4th

INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

IUGS
International Union of Geological Sciences

INTERNATIONAL MEDICAL GEOLOGY ASSOCIATION
IMGA

SEAL OF RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY

4th International Student Conference on Medical Geology and Environmental Health
SOUTH ASIA 2025

VIRTUAL CONFERENCE

NOVEMBER 24th TO 29th 2025

SEGH

BOOK OF ABSTRACTS

SOUTH ASIA EDITION 2025

IEHSC
INTERNATIONAL ENVIRONMENTAL & HEALTH SCIENCES CONSORTIUM

IUGS Commission on "Global Geochemical Baselines"
Mapping the Geochemistry of the Earth's Land Surface

Springer

Proceedings of the fourth International Student Conference on Medical Geology and Environmental Health
South Asia Edition
Virtually, 24th to 29th November 2025

BOOK OF ABSTRACTS

4th International Student Conference on Medical Geology and Environmental Health

(SOUTH ASIA EDITION- 2025)

NOVEMBER 24th TO 29th 2025

Edited by

Kirtikumar Randive
Pratik Godbole

PATRONAGE

IUGS
International Union of Geological Sciences

SEAL OF RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY
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SPONSOR

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4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

SOUTH ASIA EDITION 2025

WELCOME MESSAGE

We are pleased to present the Proceedings of the 4th International Student Conference on Medical Geology and Environmental Health – South Asia Edition (ISCMGEH–South Asia 2025). This virtual conference was conceived with the primary objective of providing undergraduate and postgraduate students a dedicated international platform to present and discuss their research in the interdisciplinary fields of Medical Geology and Environmental Health.

The ISCMGEH conference series has steadily grown as a global academic initiative. The inaugural Latin American edition in 2021 successfully brought together senior academics and researchers from Medical Geology, Environmental Geochemistry, and Health Sciences, creating a vibrant virtual environment for student-led research exchange. This was followed by the 2022 edition focused on the African continent and the 2024 European edition, each expanding the geographical reach and academic impact of the conference. The fourth South Asia 2025 edition aimed to build upon this legacy by further strengthening interactions between students and domain experts, while promoting the continuous exchange of scientific knowledge, experiences, and recent advances. A key strength of this conference lies in its virtual format, which significantly reduces organizational costs and removes financial barriers for student participation. By eliminating travel and registration expenses, the conference ensures broad and inclusive access to an international scientific forum. The conference series offers several academic and professional benefits, including opportunities for students to present their research, enhance their scientific writing and oral communication skills in English, receive constructive feedback from experienced researchers, and engage in meaningful academic networking. Participants are also exposed to complementary research activities within their region, fostering future collaboration and interdisciplinary dialogue. In addition, outstanding student contributions are recognized through encouragement, awards, and special gifts for best presentations, generously supported by Springer. The publication and online dissemination of abstracts through respected organizational platforms further enhance the visibility and impact of student research. Participating and cooperating organizations benefit through increased student engagement, strengthened academic networks, and heightened awareness of regional medical geology and environmental health challenges. Overall, the International Student Conference on Medical Geology and Environmental Health represents a mutually beneficial initiative, empowering students, enriching academic discourse, and strengthening the global medical geology and environmental health community.

ORGANIZING COMMITTEE

4TH ISCMGEH SOUTH ASIA SECRETARIAT 2025

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

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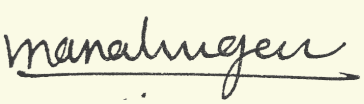
MESSAGE FROM THE CHIEF PATRON
VICE-CHANCELLOR, RTM NAGPUR UNIVERSITY

I extend my warm greetings on behalf of the organizers of the Fourth International Student Conference on Medical Geology and Environmental Health (ISCMGEH – South Asia Edition 2025). It was a great privilege as well as responsibility to host an international conference on behalf of entire South Asia, which has a rich history of previous conferences being held in Africa, Latin America, and Europe; making it a truly global event. The conference garnered participation of over 600 students covering 27 countries, along with internationally renowned keynote speakers, experts from leading institutions, and a distinguished International Scientific Advisory Committee. Such strong international engagement undoubtedly enhanced the academic level and credibility of this event. It also reflects the growing global recognition of Medical Geology as an important interdisciplinary field of knowledge.

It is heartening to know that this comprehensive event included keynote lectures, thematic technical sessions, poster presentations, and skill-based workshops, offering valuable opportunities for academic exchange, research dissemination, and professional development. The seamless use of digital platforms, an efficient virtual infrastructure, and disciplined time management ensured smooth global participation. The students volunteer team deserves special appreciation for effectively managing the e-lobby, scheduling, and session coordination. Approximately 65 e-posters were presented and evaluated by an expert panel. It was also good to learn that a documentary film on Medical Geology was also screened which was followed by an interactive discussion with its director, adding a unique academic dimension to the conference. The RTM Nagpur University remains committed to promoting interdisciplinary research, innovation, and socially relevant science. Hosting this conference aligns with our vision of advancing research that contributes to environmental sustainability, public health, and responsible development. The abstracts compiled in this volume reflect scientific rigor and methodological diversity and will serve as a valuable reference for researchers and practitioners.

I congratulate the student volunteers, Organizing Committee, and Advisory Committee for the successful conduct of this international event. I particularly commend Mr. Pratik Godbole, Organizing Secretary, and Prof. Kirtikumar Randive, Conference Chair and Head, Department of Geology, for their dedicated efforts. I am confident that the outcomes of this conference will foster future collaborations, strengthen geo-health research, and contribute meaningfully to addressing environmental and health challenges at regional and global levels.



DR. MANALI M. KSHIRSAGAR
HON'BLE VICE-CHANCELLOR
RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR, INDIA

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

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MESSAGE FROM THE CONFERENCE CHAIR

During late months of 2024, I approached Prof. Robert Finkleman (Bob) to write the foreword for our book "Medical Geology for Beginners", to which he immediately agreed. His approach sounded very positive and I was captivated by his dedication to medical geology. After this brief exchange, he offered me to host next students conference on Medical Geology and Environmental Health. This was very challenging task, but equally tempting. Finally, I agreed and Bob assured, "Kirti, you'll not regret your decision to organize this conference". Prateek was the natural choice to be the organizing secretary; not because he co-authored the book on medical geology, but due to his commitment for work and ability to lead from the front. Soon we were introduced to exceptionally talented and professionally accomplished team of experts, who were the members of the Advisory Committee. They guided us throughout this journey and remained the backbone of this conference.

Since this event was online, we felt it at the very beginning that a robust website would be the key for successful organization of this conference. We approached a professional designer to make some designs for us but somehow, he couldn't devote much time due for this job. So, Prateek and team decided to prepare some designs. The result was amazing! The advisory committee unanimously approved the design and contents of the website. The difference made by students designing was immediately noticeable, they created a book gallery showcasing all the books on medical geology and environmental health. They created designs on different themes and made the website interactive. The student volunteers were very energetic, creative and dedicated, they left no stone unturned in searching active workers on medical geology in South Asia. Gathering their contact details was big task in itself. Furthermore, contacting these people through emails and making periodic follow-up umpteen number of times was humongous! All these efforts finally resulted in huge turnout that we saw in the conference. Through a series of online meetings of the advisory committee, the conference started taking shape. Prof. Alecos Demetriades recognized the efforts made by students and invited them to interact with the esteemed members of the Advisory Committee. This small gesture built huge confidence in the volunteers, because it was like dream coming true for the students to interact with such highly reputed researchers.

Registration count started picking up slowly, but soon reached a figure of 600. A total of 145 number of abstracts were submitted for the conference. The challenge was to get them reviewed from the senior advisors, who acted as mentors for the students of medical geology. Each abstract was peer reviewed by two reviewers, which was meticulously done by the members of the Advisory Committee. Planning and preparation for the conference week now came within the eyesight. Since the number of abstracts submitted was very large, and we wanted to accommodate as many students as possible, which led to the idea of poster presentations. However, the main question was, how to design the poster gallery? how to judge these posters? But, one after other problems got sorted. All the participating students showed exceptional sense of cooperation, they prepared the posters as per requirement within very short notice. The credit is also due to efforts of Prateek and his team to create web-ready templates and website designers for uploading all the materials in time (which actually requires lot of background coding). The keynote speakers were identified mostly on the basis of their research contributions and not on the basis of personal contacts. Therefore, approaching them, getting their consent and scheduling their addresses as per their convenience was indeed a huge task.

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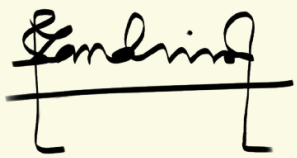
But again, follow-up was the key! Just then, Bob introduced us to Dr. Alina Simone, who produced and directed the movie "Black Snow". This movie addressed concerns of the residents of the coal mining areas. Alina agreed and a novel session was added to the 4th ISCMGEH. Finally, the program was crafted, almost 10 days before time! Thanks to meticulous management of the team. The last concern was time management during the online presentation. The team came with brilliant online timer, which kept everyone reminded about the time. This has worked extremely well and almost all the presentations were finished within allocated time. Only exception was presentations from Sri Lanka and Malaysia, which were hit by cyclone at time of the conference.

Each day new sessions began, the chairs made very meticulous and impartial judgements. Similarly, poster session was also judged and six best posters were given chance to orally present their work and 3 among those were finally selected. This is how the poster session became a very successful event in the conference. A huge turnout throughout the week indicated how seriously all the deliberations were made and listened. On the concluding day names of award winners were announced. The gala event finally came to an end, leaving behind several good memories and great experiences! This forum was dedicated to the students working in the field of medical geology. They are the future leaders of the subject. This conference witnessed those who endured and stood firmly the test of time. Friends, this is how we evolve and grow! The 4th ISCMGEH was not just an event, it was a gathering of like-minded people. We made them come together, deliberate and share their knowledge. Mention must be made here of the organizations who were the supporting pillars of this conference, namely, International Union of Geological Sciences (IUGS), Society for Environmental Geochemistry and Health (SEGH), International Medical Geology Association (IMGA), IUGS Commission on Global Geochemical Baselines (IUGS-CGGB) and International Environment and Health Sciences Consortium (IEHSC). Finally, I profusely thank all the seniors, contemporaries, juniors and students who devoted their valuable time for successful organization of this event. God bless you all!!



PROF. KIRTIKUMAR RANDIVE
CONFERENCE CHAIR
DEPARTMENT OF GEOLOGY, RTM NAGPUR UNIVERSITY, INDIA

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

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FOREWORD

There is nothing more important for an established scientist to do than to help develop the next generation of scientists. This is the primary objective of the International Student Conference on Medical Geology and Environmental Health (ISCMGEH). From the initial conference in 2022 covering South America, to the second conference in 2024 focusing on African issues, to the third conference in 2024 dealing with European issues and to the fourth in this series, the recent conference covering South Asia, these virtual conferences have been unqualified successes in providing students with a convenient opportunity to showcase their research and learn what research projects other students with similar interests are engaged in. The conferences provide students working on a broad range of medical geology and environmental health issues, a forum to showcase their work. The students have an opportunity to polish their English, gain experience in presenting their research to an interested audience, add an abstract to their CV, network with other students and professionals, and receive recognition and a gift for superior presentations. All without any costs to the students or to the conference attendees. The ISCMGEH conference covering South Asia was the fourth in the series and, by far, the most successful. The six-day conference drew more than 600 delegates representing 27 countries across South Asia and beyond. There were 72 oral presentations by students, 48 poster presents, two workshops, and six Keynote speakers. The broad range of topics and the quality of the presentations did credit to the emerging scientists from this region. What distinguished this conference was efficiency with which it was conducted, innovations such as the poster presentations, and the attached informative and colorful Abstract Volume. Many people helped make this conference an unmitigated success from the Conference Chair and Secretariat, the Organizing Committee, the Scientific Advisory Committee, and the invaluable Student Volunteers. These names and pictures of these heroes can be found in this volume. However, special credit is due to Profs. Kirtikumar Randive and Pratik Godbole for their key roles in helping to establish the exceptionally high standard that future ISCMGEH will strive to achieve.

DR. ROBERT B. FINKELMAN
UNIVERSITY OF TEXAS AT DALLAS
RICHARDSON, TX, USA

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

SOUTH ASIA EDITION 2025

MESSAGE FROM THE COUNCILLOR INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)

The International Student Conference on Medical Geology and Environmental Health (ISCMGEH) is an initiative started in 2021 under the leadership of Professor Robert Finkelman and supported by Professor Nelly Mañay at its first edition in Latin America. It was created as a series of conferences to promote students at all levels and young researchers. After the success of the Latin-American edition, other editions followed in Africa, Europe and South Asia.

Although at the beginning started as informal conferences, the professionalism of the students involved has derived into a very mature conference, where senior scientists exchange ideas and research with students, some at the bachelor level, whose first language is not English in most of the times. I had the privilege of being part of the International Advisory Committee for the South Asian edition and I was thrilled to witness the enthusiastic participation of hundreds of people representing 27 countries, mainly from South Asia, that debated about geochemistry, natural hazards, medical geology and other related subjects without hesitation. More than 100 contributions were presented, most as oral presentations and some others as poster presentations, and two specialized workshops, conducted by Professor Robert Finkelman and Alecos Demetriades, helped to increase the level of the conference to a learning tool for most of us. Personally, I was thrilled to see that many of the contributors were female students, in the context of a very male-based science like the Earth Sciences. The high level of these conferences has derived in the implication of several organizations and associations like the International Union of Geological Sciences (IUGS), the International Medical Geology Association (IMGA), the Society for Environmental Geochemistry and Health (SEGH), among others, working together with the local organizations. This is a big step for these conferences, as I can foresee the evolution in the collaborations among the students participating in them and the senior researchers that will do their best to start working together with the students in the dissemination and communication of their activities. This book is one of those results, showing the importance of students and young researchers in leading initiatives like ISCMGEH. This book will also help to encourage other students and young researchers to get involved in high level conferences like this, while learning about the subject by reading the content. I am sure that next ISCMGEH will evolve keeping the quality of the previous one, having this book of abstracts to enlighten and inspire the next editions and to trigger the involvement and support of the mentioned organizations and many more that will share the commitment with the young generations in the study of Medical and Earth Sciences.

LOLA PEREIRA
IUGS COUNCILLOR (2022-2026)
SECRETARY GENERAL OF THE INTERNATIONAL MEDICAL GEOLOGY ASSOCIATION (IMGA) (2025-2027)
IUGS REPRESENTATIVE AT THE STANDING COMMITTEE FOR GENDER EQUALITY IN SCIENCE (SCGES)

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MESSAGE FROM THE PRESIDENT
SOCIETY FOR ENVIRONMENTAL GEOCHEMISTRY AND HEALTH (SEGH)

It is a great pleasure and honour to extend my warm greetings to the organisers, participants, and contributors of the 4th ISCMGEH South Asia 2025, held virtually from 24–29 November 2025.

The Society for Environmental Geochemistry and Health (SEGH) is proud to have supported this conference, continuing a tradition established through previous ISCMGEH editions in Latin America, Africa, and Europe, where SEGH has consistently contributed to advancing dialogue at the interface of geochemistry, environment, and health. Each successive edition of ISCMGEH has demonstrated clear growth in scientific quality, geographical reach, and community engagement, and the South Asia 2025 conference represents a further significant step forward.

The participation of over 600 delegates from 27 countries, the strong programme of oral and poster presentations, the innovative e-poster platform, and the specialised workshops delivered by internationally recognized experts all reflect the maturity and vitality of this conference series. Importantly, ISCMGEH South Asia 2025 has provided a valuable platform for interaction and collaboration between SEGH, the International Association of Medical Geology (IAMG), and the International Union of Geological Sciences (IUGS), strengthening links between these communities and reinforcing the global, interdisciplinary nature of medical and environmental geosciences.

Such conferences play a crucial role in fostering communication across disciplines and regions, while offering students and early-career researchers a supportive environment in which to present their work, exchange ideas, and build international networks. This Abstract Souvenir Volume stands as a lasting record of these efforts and as evidence of the conference's contribution to capacity building and scientific exchange.

On behalf of SEGH, I congratulate the organizing committee on the successful delivery of ISCMGEH South Asia 2025 and wish all contributors continued success in their research and professional endeavors.

ARIADNE ARGYRAKI
PRESIDENT
SOCIETY FOR ENVIRONMENTAL GEOCHEMISTRY AND HEALTH (SEGH)

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

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MESSAGE FROM THE CHAIR
INTERNATIONAL MEDICAL GEOLOGY ASSOCIATION (IMGA)

Congratulations to Prof. Kirtikumar Randive, Pratik Godbole, and the entire conference team on the remarkable success of the 4th International Student Conference on Medical Geology and Environmental Health (ISCMGEH), South Asia Edition 2025!

It is a great honour for me to contribute this message to the Book of Abstracts for such a historic event. This student-led conference stands as a powerful testament to the impact of collaboration, curiosity, and dedication among emerging scholars who are shaping the future of interdisciplinary research.

The field of Medical Geology and Environmental Health examines how geological/ environmental processes and materials influence the well-being of humans and ecosystems. The South Asia Edition brings critical regional perspectives to this global dialogue, highlighting the area's diverse geological landscapes and their implications for public health. The six thematic areas, addressing topics such as trace elements, geological hazards, geo-pharmacy, and their connections with human health, reflect the breadth and depth of research being conducted by students worldwide. The keynote lectures and workshops are inspiring, and the individual presentations showcase the latest developments in this rapidly expanding field.

This conference has received strong support from leading international organisations in medical geology and environmental health, including IUGS, IMGA, SEGH, IEHSC, and IUGS-CGGB, with Springer as the sponsor. Congratulations once again on securing such substantial global backing.

Although the delegates are primarily from South Asia, the abstracts in this volume demonstrate the creativity, passion, and scientific rigour of young researchers committed to addressing real-world challenges, from trace element imbalances to mineral-based therapeutic applications. Their work reminds us that science is deeply intertwined with communities, public well-being, and the sustainability of our planet.

As part of the global ISCMGEH conference series, this event plays a vital role in empowering students by providing meaningful opportunities for collaboration and knowledge exchange. Through these efforts, ISCMGEH nurtures the next generation of leaders who will confront environmental health challenges across diverse regions.

May this collection of abstracts inspire new ideas, foster collaboration, and drive progress in Medical Geology and Environmental Health for the benefit of humanity and the environment we all share.

Chaosheng Zhang

CHAOSHENG ZHANG
CHAIR, INTERNATIONAL MEDICAL GEOLOGY ASSOCIATION (IMGA)

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

SOUTH ASIA EDITION 2025

MESSAGE FROM THE CHAIRPERSON
IUGS COMMISSION ON GLOBAL GEOCHEMICAL BASELINES (IUGS-CGGB)

The virtual 4th International Student Conference on Medical Geology and Environmental Health – South Asian Edition was successfully organised and executed by the undergraduate and postgraduate students of the Department of Geology at RTM Nagpur University, India, under the vigilant supervision of Professor Kirtikumar Randive.

Since the first global cycle of this conference has been completed, let us start from the beginning and see how these virtual international student conferences began and developed over the years.

Here is the welcome note of "The First International Student Conference on Medical Geology and Environmental Health: Latin America Edition aims to become the first in a series of conferences promoting bachelors, masters and doctorate/PhD students from all Latin America to present their research in environmental health and medical geology fields. The conference will offer to develop collaborations and exchanges with international experts in the mentioned fields and will promote presentation skills in English." This was the vision of Professor Robert Finkelman from the University of Dallas in Texas. It was a three-day virtual conference (18-20 October 2021).

The second virtual international students conference was the African Edition, and it again lasted three days (29 November to 1 December 2022).

Senior academics and researchers in Medical Geology, Environmental Geochemistry and Health organized the first two virtual student conferences. When Professor Finkelman contacted me to organise the third student conference in Europe, I discussed his proposal with Professor Ariadne Argyraki from the National and Kapodistrian University of Athens (Hellenic Republic), who is President of the Society for Environmental Geochemistry and Health. My proposal was that, since this is a student conference, it should be organised by undergraduate and doctoral students with little guidance from senior academics. So, the first truly student-organised and run virtual conference was born, lasting three days (26 to 29 November 2024). It was an exceptionally successful conference in every respect, and Ariadne and I believed it could not be matched.

Well, we have been proven wrong! The 4th South Asian Edition was beyond our expectations. The student organizing committee was slow to begin with. However, Pratik Godbole and his team have given us many surprises. The virtual conference lasted six days (24-29 November 2025), and not three as the previous ones. There were 72 oral presentations of excellent quality, professionally delivered by students within the 8-minute time limit. The innovation was the e-poster wall, explicitly developed for the virtual conference. There were 48 poster presentations, and each student had 3 minutes to introduce his/her work. The virtual conference attracted more than 600 participants from 27 countries, and it was another success.

I would like to congratulate the members of the Organising Team, wish them success in all their endeavours, and, most importantly, remind them that remarkable things are achieved by teamwork.

ALECOS DEMETRIADES
CHAIRPERSON OF THE IUGS COMMISSION ON
GLOBAL GEOCHEMICAL BASELINES (2024-2028)

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

SOUTH ASIA EDITION 2025

MESSAGE FROM THE DIRECTOR
INTERNATIONAL ENVIRONMENTAL AND HEALTH SCIENCES CONSORTIUM (IEHSC)

As a multidisciplinary science discipline, medical geology is aimed at fostering and strengthening the interactions and communications between the geosciences, environmental, biomedical and public health communities, with the objective of promoting a better understanding on the role that geoenvironmental and natural risks factors may have on the development and spatial distribution of health problems in humans and other animals (Selinus O, Finkelman RB, Centeno JA 2010). This is a challenging and complex task, one which our growing generation of young students and researchers are ready to tackle, and to embark on their professional journey to become the medical geologists of the future.

The 4th International Student Conference on Medical Geology and Environmental Health (4th ISCMGEH South Asia 2025 edition), successfully organized by our colleagues from the Department of Geology at RTM Nagpur University, Nagpur, India, provided an international forum for our medical geology students to study these links between natural geochemical and environmental risk factors and human health. The 4th ISCMGEH spotlighted the need among our students to strengthen community resilience to natural geological hazards and environmental health issues. The conference was attended by over 600 student delegates representing over 27 countries across South Asia and other regions of the world. The ISCMGEH conference series has being an invaluable event to promote medical geology among our students, researchers, public health and environmental health scholars, as well as others from allied fields interested in studying the intersection between geology and medicine.

As co-founder member of the International Medical Geology Association (IMGA; www.medicalgeology.org) and founder and Director of the International Environmental and Health Sciences Consortium (IEHSC, www.iehsconsortium.org), we are honored and delighted to serve as co-sponsors of this remarkable conference. Working together with IMGA, IEHSC Consortium is aimed at expanding and strengthening the goals and mission of medical geology by enhancing academic opportunities for our students, and by supporting the creation of Centers of Excellence on Research and Training on medical geology, environmental health sciences, toxicology, occupational medicine and public health. Recently, IEHSC and IMGA worked together with Nasarawa State University Keffi-Nigeria (NSUK) to establish the José A. Centeno International Center for Medical Geology Research (JACMEDGEO) (www.jacmedgeo.com.ng). The mission of the NSUK JACMEDGEO Center is to serve as a centralized facility for the sharing of scientific knowledge, ideas and innovation in the re-emerging field of medical geology; to investigate links between the natural geogenic environmental and health; to serve as a training facility for students pursuing their master and/or doctorate degree in medical geology; and to promote the field of medical geology throughout Africa. Accordingly, one of the primary objectives of the NSUK JACMEDGEO Center is to bring together scientists in developing countries working on medical geology issues with their colleagues in other parts of the world through collaborations with the IEHSC Consortium and IMGA. The Center's academic and research programs have been focused on capacity building, providing training as well as exchange of information, research and laboratory experiences. This unique initiative has provided, for the first time, the opportunity for young medical geologists and environmental health scientists from developed and developing countries to come together in a truly international and interdisciplinary forum (geoscientists, physicians, toxicologists, epidemiologists, occupational health, veterinarians, etc.) and to identify and tackle significant environmental health problems.

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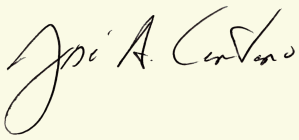
As a result of these international efforts, and after several years of planning, dedication and commitment by the NSUK management and faculty, the entering 2025 class of students was recently initiated with over 22 students pursuing their MSc and/or PhD degrees at the NSUK JACMEDGEO center. It is our hope and goal, that the development and establishment of similar academic and research opportunities in other parts of the world, will continue to play a significant role in the globalization of medical geology.

Finally, our ISCMGEH conference series has been a unique vehicle and instrument to bring together our students worldwide, who have been joined by a world class team of medical geology experts serving as mentors, teachers, sources of information, and role models. As you continue your formation on medical geology, let us make your journey into medical geology an unforgettable trip through a passion for learning, exceptional accomplishments and a common interest to serve our society.



JOSÉ A. CENTENO, MSC, PHD, FRSC
PROFESSOR, UNIVERSITY OF PUERTO RICO AT MAYAGUEZ

CONFERENCE SECRETARIAT

CHIEF-PATRON

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Dr. Manali Makarand Kshirsagar	Hon'ble Vice-Chancellor RTM Nagpur University	India	

PATRON

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Dr. Raju Hiwase	Hon'ble Registrar RTM Nagpur University	India	

CONFERENCE CHAIR

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Kirtikumar Randive	Professor and Head Department of Geology RTM Nagpur University	India	

ORGANIZING SECRETARY

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Pratik Godbole	Research Scholar and Assistant Professor (AD-HOC) RTM Nagpur University	India	

ORGANIZING COMMITTEE

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
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NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
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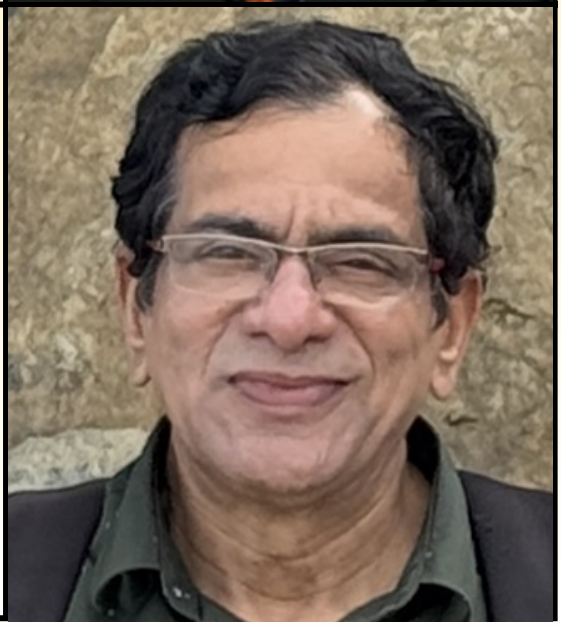
SCIENTIFIC ADVISORY COMMITTEE

NAME	AFFILIATION	COUNTRY	Photograph
Robert Finkelman	Research Professor at The University of Texas at Dallas	United States	
Alecos Demetriades	Dr. IUGS Commission on Global Geochemical Baselines	Greece	
M. Santosh	Professor and Foreign Expert at China University of Geosciences Beijing, China	China	

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
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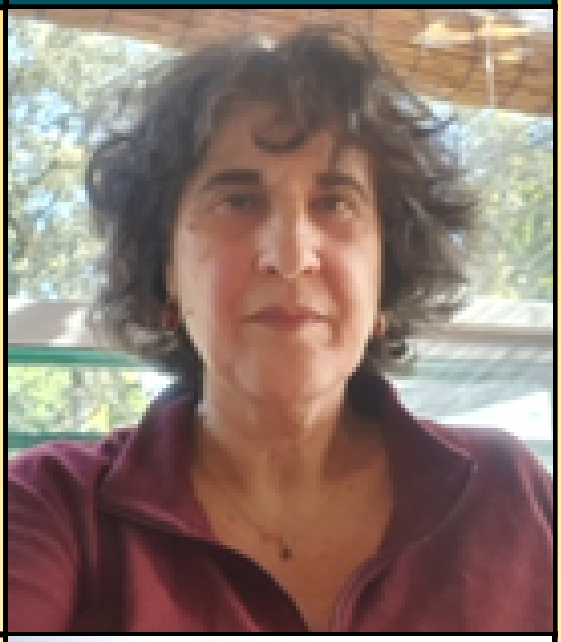
Chaosheng Zhang	Professor of Geography University of Galway Chair, International Medical Geology Association	Ireland	
José A.Centeno	Adjunct Professor International Environmental & Health Sciences Consortium Royal Society of Chemistry (FRSC) Royal Academy of Medicine and Surgery International Center on Medical Geology Research at Nasarawa State University	Puerto Rico USA	

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Lola Pereira	**Professor University of Salamanca**	**Spain**	
Elena Alvareda	**Aggregate Professor Chair of Water Department Water Department Cenur Ln Uruguay**	**Uruguay**	
Nelly Mañay	**Doctor in Chemistry (PhD) Full Professor and head-Toxicology Area – Faculty of Chemistry-UDELAR (University Republic of Uruguay)**	**Uruguay**	

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Jayanta Kumar Biswas	**Professor & Head International Centre for Ecological Engineering & Department of Ecological Studies University of Kalyani**	**India**	
Eduardo Anselmo Ferreira da Silva	**Professor at Geosciences Department, Aveiro University, Campus De Santiago 3810-193 Aveiro Portugal**	**Portugal**	
Maria Aurora Armienta Hernandez	**Professor National Autonomous University of México**	**México**	

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Qifeng Tang	**Department Head, Associate Professor Department of GeoHealth, National Research Center for Geoanalysis, CAGS & CGS**	**China**	
Olatunji Akinade Shadrach	**Professor Department of Geology, University of Ibadan, Ibadan, Nigeria**	**Nigeria**	

STUDENTS' VOLUNTEER COMMITTEE

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Rutuja Rambhau Dhengre	M.Sc. Tech Applied Geology Student RTM Nagpur University	India	
Shantanu Omprakash Prajapati	M.Sc. Tech Applied Geology Student RTM Nagpur University	India	
Daksha Sanjay Vyas	M.Sc. Tech Applied Geology Student RTM Nagpur University	India	

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Rugved Dinesh Joshi	M.Sc. Geology Student RTM Nagpur University	India	
Meher Manasi Srivastava	M.Sc. Tech Applied Geology Student RTM Nagpur University	India	
Lavanya Satish Suryawanshi	M.Sc. Tech Applied Geology Student RTM Nagpur University	India	

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Krutika Jangale	Research Scholar RTM Nagpur University	India	
Kaustubh Deshpande	Research Scholar RTM Nagpur University	India	
Yukti Waghale	Former Postgraduate Student Department of Biotechnology RTM Nagpur University	India	

SCHEDULE OF PRESENTATION

CONFERENCE SCHEDULE
NOVEMBER 24th TO NOVEMBER 29th 2025

24TH NOVEMBER - MONDAY (16:00 IST Onwards)

ZOOM LINK: https://us06web.zoom.us/j/87506233010?pwd=rRaGhkTar0jaEtpaCCR3r8n90XPB4E.1
Meeting ID: 875 0623 3010 Passcode: 560604

TIME (IST)	EVENT
16:00-16:15	INAUGURATION *Prof. Kirtikumar Randive and Pratik Godbole*
16:15-16:45	KEYNOTE: "HEALTHY LIVING IN HEALTHY CITIES" *Prof. Rajasekhar Bala*
SESSION 1 (THEME 1): "TRACE ELEMENTS AND HUMAN HEALTH" ***Session Chairs: Dr. Alecos Demetriades and Prof. Nelly Mañay***	
16:45-16:55	"Rainfall Variability, Volcanic Geology, and Iodine Deficiency in Indonesia: Early Observations from Regional Data" -Anita Yuliyanti
16:55-17:05	"Impact of PM2.5 on Common Fruit Species around Ghorahi Cement Factory, Dang, Nepal" -Purnima Regmi
17:05-17:15	"Efflorescent Sulfate Mineralization and Trace-Element Enrichment (Hg, Nb) in the Neogene Sedimentary Formations of North Kerala, India" -Febitha Edavana
17:15-17:25	"Environmental Assessment of Lead Dynamics in Brunei Darussalam: Distribution, Mobility, and Retention Mechanisms" -Farid Said Mohammed
17:25-17:40	BREAK

SESSION 2 (THEME 1) CONTINUED: "TRACE ELEMENTS AND HUMAN HEALTH" *Session Chairs: Dr. Alecos Demetriades and Prof. Nelly Mañay*	
17:40-17:50	"Assessment of Seasonal Variations in Heavy Metal Concentrations and Associated Health Risks in Salim Ali Lake and Harsul Lake" -Prasanna Lavhale
17:50-18:00	"Groundwater Seepage and Geochemical Risks in the Bogala Graphite Mine, Sri Lanka" -Thennakoon Mudiyanselage Lahiru Susan Gunawardhana
18:00-18:10	"Metal Pollution and Associated Ecological Risk in the Surface Dust from a Formal E-Waste Recycling Unit in the National Capital Region of India" -Hina Kumari
18:10-18:20	"Geochemical Assessment of Sulphur and Calcium in the Soils of Brunei Darussalam: Establishing Baselines and Identifying Nutrient Imbalances" -Balqis Bakhtiar
18:20-18:30	"Health Risk Assessment and Spatial Distribution of Fluoride in Groundwater in the Sai River Basin, Uttar Pradesh, India" -Ashish Patel
18:30-18:40	"Metal toxicity and Human Health Risk Assessment of Surface Dust from an Emerging Industrial Cluster near New Delhi" -Anju Verma
18:40-18:55	**BREAK**
SESSION 3 (THEME 1) CONTINUED: "TRACE ELEMENTS AND HUMAN HEALTH" ***Session Chairs: Dr. Alecos Demetriades and Prof. Nelly Mañay***	
18:55-19:05	"Geology, Characterization And Mineralogical Study Of Clat Deposits In Kampung Bahagia, Kuala Krai, Kelantan" -Fathihah Natasya Binti Mohd Hussaini
19:05-19:15	"Geological and Geochemical Study of Gold-Bearing Rocks in Kalai Tunnel Area, Kelantan, Malaysia" -Janaarththanan Murali
19:15-19:25	"Indicators of Oxic Conditions in the Indus Formation: Geochemical Perspectives on Paleoenvironmental Evolution" -Shivani Choudhary

TUESDAY - 25TH NOVEMBER (16:00 IST Onwards)

ZOOM LINK: https://us06web.zoom.us/j/81688436480?pwd=3dgvkH54JdDdkUXyseZ1IirlGXzjEV.1

Meeting ID: 816 8843 6480 Passcode: 245369

TIME (IST)	EVENT
16:00-16:15	Introduction of the day ***Prof. Kirtikumar Randive and Pratik Godbole***

16:15-16:45	KEYNOTE: "ASSESSMENT OF As AND Pb CONTAMINATION AND ASSOCIATED HEALTH RISKS IN GROUNDWATER OF BAN KHAI DISTRICT, THAILAND" *Prof. Srilert Chotpantarat*
SESSION 4 (THEME 1) CONTINUED: "TRACE ELEMENTS AND HUMAN HEALTH" ***Session Chairs: Prof. Qifeng Tang and Prof. Elena Alvareda***	
16:45-16:55	"Enhancing Bioavailability of Soil Iron and Zinc and Grain Loading in Cereal Crops: Industrial Waste Amendments and their Toxicological Evaluation" -Ananya Singh
16:55-17:05	"Assessment of the Groundwater Quality for Drinking in Deoli Gujar Area of Butibori, Nagpur District, Maharashtra, Central India" -Rutuja Dhengre
17:05-17:15	"Medical Geology Perspective on Seasonal Dynamics of Trace Elements and Human Health Risk in Groundwater of the Cuddalore District, Tamil Nadu, India" -Vrinda Vijayan
17:15-17:25	"Effects of Seasonal Dynamics on Trace Elements in Lateritic Soils of Central India: A PRISMA- Based Study Highlighting Issues related to Tribal Health" -Daksha Vyas
17:25-17:40	**BREAK**
SESSION 5 (THEME 2): "GEOLOGICAL HAZARDS AND DISEASE OUTBREAKS" ***Session Chairs: Prof. Qifeng Tang and Prof. Elena Alvareda***	
17:40-17:50	"Aligning Waterborne Disease Control in Myanmar with the Sustainable Development Goals" -Naing Aung Khant
17:50-18:00	"Air pollution and its health risks : a community based survey study" -Keerthana Deshpande
18:00-18:10	"Disaster Management in Community Medicine" -Apurva Fuladi
18:10-18:20	"Geospatial Analysis of Groundwater Quality in Kalyani River Sub Basin, Jalna District, Maharashtra" -Mohd Owais Mohd Abdul Shafi
18:20-18:30	"Occupational Health Challenges in Archaeological Excavations: An Environmental and Ergonomic Assessment" -Dhananjay Kulkarni
18:30-18:40	"Assessment of High-Risk Mosquito Breeding Zones using Remote Sensing and GIS-Based Techniques in Nagpur City, India: A Case Study of August 2025" -Rugved Joshi
18:40-18:55	**BREAK**
SESSION 6 (THEME 2) CONTINUED AND (THEME 3): "GEOLOGICAL HAZARDS AND DISEASE OUTBREAKS" AND "GEO-PHARMACY AND MINERAL BASED THERAPEUTICS" ***Session Chairs: Prof. Qifeng Tang and Prof. Elena Alvareda***	

18:55-19:05	"Groundwater Geochemistry and Human Health Risk Assessment in Chitra Mining Area, India" -Vindhyavasini Yadav
19:05-19:15	"Ocular Health Hazards in Mining: Clinical Evidence, Systematic Classification, and Disease Triggers" -Shantanu Prajapati
19:15-19:25	"Geoart as a tool for treatment of psychosomatic diseases: A curious study of Pebble art" -Krutika Jangale
19:25-19:35	"Synthesis of Sm doped LaCePO4 photoluminescent nanofibers: Linking Mineral-based Phosphates with Luminescent Applications in Medical Geology" -Shankari Khokaley
WEDNESDAY - 26TH NOVEMBER (16:00 IST Onwards)	
ZOOM LINK: https://us06web.zoom.us/j/86173709747?pwd=EmQZ7xsBVnEIbaSQIvGMK6IAOpkrCz.1 Meeting ID: 861 7370 9747 Passcode: 510307	
TIME (IST)	**EVENT**
16:00-16:15	Introduction of the day *Prof. Kirtikumar Randive and Pratik Godbole*
SESSION 7 (THEME 4): "CURRENT TRENDS IN ENVIRONMENTAL CHEMISTRY, GEOCHEMISTRY AND BIOGEOCHEMISTRY" *Session Chairs: Prof. Maria Aurora Armienta Hernandez and Prof. Shaji E*	
16:15-16:25	"Monitoring of sedimentation in Manik and Kumbukkan rivers associated with gem mining in Buttala, Sri Lanka" -Wickramasinghe Arachchige Isurika Dilanki
16:25-16:35	"Performance Evaluation of an Iron Oxide - Graphene Oxide Coated Sand Composite for Manganese Removal in Pre-Filtration of Drinking Water" -Imasha Manohari Jayalath
16:35-16:45	"Antimicrobial Performance of Silver, Zinc Oxide, Iron Oxide, and Copper Oxide Nanocoatings on Membrane Filters for Water Treatment" -Yukti Waghale
16:45-16:55	"Chemical Characteristics of Water-Soluble Ions in Size-segregated Particulate Matter in the Himalayan Foothill, India" -Sudhanshu Shekhar
16:55-17:05	"Bimetallic Oxide Nanopowder Entrapped into Biopolymeric Matrix for Adsorptive Confiscation of Crystal Violet Dye" -Nandini Upadhyay
17:05-17:15	"Lanthanum-Alginate-Activate Charcoal as ternary Composite for Defluoridation of water" -Vinit Bhonsale
17:15-17:25	"Sequentially Modified Alginate Biopolymer for Enhanced Fluoride Removal: Insights from RSM and Column Studies" -Vaishnavi Gomase
17:25-17:40	**BREAK**

SESSION 8 (THEME 4) CONTINUED: "CURRENT TRENDS IN ENVIRONMENTAL CHEMISTRY, GEOCHEMISTRY AND BIOGEOCHEMISTRY" *Session Chairs: Prof. Maria Aurora Armienta Hernandez and Prof. Shaji E*	
17:40-17:50	"Using GIS to evaluate the Groundwater Quality Assessment in the Maharauni Block of Lalitpur district, Bundelkhand Region, for suitability for drinking and agriculture" -Utkarsh Bisen
17:50-18:00	"Dual-Function p-Nitrobenzaldehyde Grafted Chitosan Aerogel for Efficient Adsorption of Anionic Surfactants and CO2 Sequestration" -Tejaswini Rathi
18:00-18:30	KEYNOTE: "HABITABILITY AND SUSTAINABILITY OF PLANET EARTH" *Prof. M. Santosh*
18:30-18:45	BREAK
SESSION 9 (THEME 4) CONTINUED: "CURRENT TRENDS IN ENVIRONMENTAL CHEMISTRY, GEOCHEMISTRY AND BIOGEOCHEMISTRY" *Session Chairs: Prof. Maria Aurora Armienta Hernandez and Prof. Shaji E*	
18:45-18:55	"Simultaneous Adsorption of Reactive dyes using Iron (lll)-Crosslinked Alginate-Chitosan Composite: A Novel Approach via RSM" -Radhika Rajabhoj
18:55-19:05	"Removal of dyes and heavy metals from aqueous waste using activated carbon prepared from neem leaves (azadirachta indica)" -Shrey Arora
19:05-19:15	"Habitat quality Assessment of a Lake using Plankton Diversity in relation to Physicochemical Parameter" -Vaishali Meshram
19:15-19:25	"Green Valorisation of Mining Waste into Functional Nanoparticles: A PRISMA-Guided Review Integrating Nanotechnology and Ayurveda" -Kaustubh Deshpande
19:25-19:35	"Adsorptive Removal of Crystal Violet Dye from Wastewater Using Zeolitic Imidazolate Framework-67 (ZIF-67)" -Ajinkya Kharwade

THURSDAY -27TH NOVEMBER (16:00 IST Onwards)

ZOOM LINK: https://us06web.zoom.us/j/82281417182?pwd=l6U1uOQxfjdZy36drQFkyHlfEDtfjR.1

Meeting ID: 822 8141 7182 Passcode: 867123

TIME (IST)	EVENT
16:00-16:15	Introduction of the day *Prof. Kirtikumar Randive and Pratik Godbole*
16:15-16:45	KEYNOTE: "HEAVY METALS IN GROUNDWATER: A HIDDEN THREAT TO HEALTH" *Prof. Shaji E*
SESSION 10 (THEME 4) CONTINUED: "CURRENT TRENDS IN ENVIRONMENTAL CHEMISTRY, GEOCHEMISTRY AND BIOGEOCHEMISTRY" *Session Chairs: Prof. Robert Finkelman and Prof. Muduru Lachhana Dora*	

16:45-16:55	"Monitoring turbidity levels in Kandy lake, Sri Lanka, using remotely sensed data" -Warnakulasooriya Mudiyanselage Sanchala Dilmini Kurukulasooriya
16:55-17:05	"Potential Role of Flueggea leucopyrus Plant Leaves Lectins, Purification, characterization, and its Use as Early Screening Marker for Cancer" -Chennuru Veeranjaneyulu
17:05-17:15	"Influence of subsurface lithology on groundwater hardness in Matale District, Sri Lanka" -E.W.G.Y.M.N.Y Manike
17:15-17:25	"Assessment of Fluoride and Turbidity Removal Potential of re-activated Carbon Produced from Spent Household Water Filters" -Rajapaksha Mudiyanselage kasuni Madhara Nisansala Jayathilaka
17:25-17:40	**BREAK**
SESSION 11 (THEME 4) CONTINUED: "CURRENT TRENDS IN ENVIRONMENTAL CHEMISTRY, GEOCHEMISTRY AND BIOGEOCHEMISTRY" *Session Chairs: Prof. Robert Finkelman and Prof. Muduru Lachhana Dora*	
17:40-17:50	"Geochemical Assessment of Heavy Metal Contamination and Ecological Risks in Carbonaceous Phyllite Sediments, Northeast Himalaya, India" -Utkarsh Singh
17:50-18:00	"Synergistic Stabilization of Paddy Straw Biochar: A Comparative Analysis and Techno-Economic Modelling of Organic Amendments for Sustainable Field Application" -Bipradeep Mondal
18:00-18:10	"Microalgae-Based Bioremediation: A Review on Green Solution for Heavy Metal and Emerging Pollutant Removal" -K.A.Pramodi Saumya
18:10-18:20	"Assessment of Groundwater Quality and Associated Risk to Human Health: A Case Study of Mathura Region, India" -Sandeep Kumar
18:20-18:30	"Degradation of Ciprofloxacin in Different Soils and the Effect of Soil Organic Matter" -Udugama Suriyage Thilini Sachintha
18:30-18:40	"Impact of Plastiglomerates and Microplastics on Environmental Health Degradation: A Case Study" -Anuraj Basumatary
18:40-18:55	**BREAK**
18:55-20:25	**WORKSHOP 1** "Shared Vocabulary: Communication Between Geo- Scientists and Public Health/Medical Researchers" ***PROF. ROBERT FINKELMAN***

FRIDAY - 28TH NOVEMBER (16:00 IST Onwards)

ZOOM LINK: https://us06web.zoom.us/j/88225518172?pwd=iNyQAueQZ0YcbixaepI3y8lU3Lhar6.1

Meeting ID: 882 2551 8172 Passcode: 289378

TIME (IST)	EVENT
16:00-16:15	Introduction of the day *Prof. Kirtikumar Randive and Pratik Godbole*
16:15-16:45	KEYNOTE: "THE EMERGING DISCIPLINE OF MEDICAL GEOLOGY - ORIGIN, RECENT ADVANCES AND FUTURE" *Prof. José Centeno*
SESSION 12 (THEME 5): "GENERAL SESSIONS" ***Session Chairs: Prof. Lola Pereira and Prof. Jayanta Kumar Biswas***	
16:45-16:55	"Geology And Geoheritage Assessment Of Gua Bama And Gua Sei, Kuala Lipis, Pahang" -Safiah Amirah Binti Mohd Shukri
16:55-17:05	"Geology And Geoheritage Assessment of Kampung Merapoh Lama, Merapoh, Pahang" -Muhammad Izzhan Bin Faisal
17:05-17:15	"Geodiversity Assessment and Cave Mapping of Gua Tahi Bintang, Merapoh, Pahang, Malaysia" -Azida Alia Natasja Binti Awang
17:15-17:25	"Geology And Geoheritage Assessment of Kuala Kenong, Kuala Lipis, Pahang" -Tuan Sharifah Munirah Binti Tuan Zukapli
17:25-17:40	**BREAK**
SESSION 13 (THEME 5) CONTINUED: "GENERAL SESSIONS" ***Session Chairs: Prof. Lola Pereira and Prof. Jayanta Kumar Biswas***	
17:40-17:50	"Spatio-temporal changes in mangrove extent around Puttalam Lagoon (2010–2022)" -M.A. Maisa
17:50-18:00	"Cloud-Based Geospatial Analysis for Flood Hazard Mapping: A Case Study of the Gal Oya Basin in Sri Lanka" -Manamendrapatabandige Roshan Champika Manamendra
18:00-18:10	"Contribution of Medical Geology in Advancing Sustainable Development Goals (SDGs) in India" -Khushi Kadu
18:10-18:20	"Multi-Temporal Remote Sensing-Based Analysis of Vegetation Loss and Recovery Following the 2016 Landslide in Aranayaka, Sri Lanka" -Sanduni Prarthana
18:20-18:30	"Physico-Chemical and Mineralogical Characterisation of the Badas Peatland, Brunei Darussalam: Implications for Peat Formation" -Azeema Nasrin Bazrul Jama

18:30-18:40	"Quantative Risk Assessment of Interplanetary Factors Affecting Human Health and It's Geomedical Hazards" -Yugansh Kanoje
18:40-18:55	**BREAK**
18:55-20:25	**WORKSHOP 2** "Preparing manuscripts for publication in international journals: instructions for young researchers" ***DR. ALECOS DEMETRIADES***

SATURDAY - 29TH NOVEMBER (16:00 IST Onwards)

ZOOM LINK: https://us06web.zoom.us/j/82214600193?pwd=a8rYBJ3SXzZNLP8bSGbRsQo44e3VMN.1

Meeting ID: 822 1460 0193 Passcode: 213755

TIME (IST)	EVENT
16:00-16:15	Introduction of the day ***Prof. Kirtikumar Randive and Pratik Godbole***
16:15-16:45	KEYNOTE: "WATER DETOXIFICATION USING PHYSICALLY AND CHEMICALLY ENGINEERED CHITOSAN BIOPOLYMER" ***Prof. Ravin Jugade***
SESSION 14 (THEME 5) CONTINUED: "GENERAL SESSIONS" ***Session Chairs: Prof. Eduardo Anselmo Ferreira da Silva and Prof. Ariadne Argyraki***	
16:45-16:55	"Geology and Petrology of Plutonic Rock in Kampung Kuala Jenal, Dabong, Kelantan" -Valerie Mimi Anak Alexander Sandai
16:55-17:05	"Petrogenetic Insights on the Ultramafic Rocks of Northern Borneo" -Nur Zafirah Batrisyia Binti Jani
17:05-17:15	"Geology and Geochemical Study of Plutonic Rock in Bukit Jeli, Kelantan, Malaysia" -Iqmal Hafiz Bin Farhan Shannon
17:15-17:25	"Environmental Impact Assessment of Coal Mining in Chandrapur Tehsil of Chandrapur District, Maharashtra, (India) Using Remote Sensing and GIS Based Techniques" -Lavanya Suryawanshi
17:25-17:35	"Hyperspectral Imaging and Machine Learning-Based Multi-Parameter Assessment of Wheat Grain Quality" -Kundan Patidar
17:35-17:50	**BREAK**
SESSION 15 (THEME 5) CONTINUED AND THEME 6: "GENERAL SESSIONS" AND "(EDITION SPECIFIC) MEDICAL GEOLOGY IN SOUTH ASIA ***Session Chairs: Prof. Eduardo Anselmo Ferreira da Silva and Prof. Ariadne Argyraki***	

17:50-18:00	“Geological And Geochemical Characterisation Of Gold-Bearing Rocks In Jalan Batu Hitam Sokor Kelantan” -Arina Natasha Binti Affendi
18:00-18:10	“Heavy Metals in Sri Lankan Serpentinites: Geohealth Risks and Traditional Medicinal Practices” -KT Prasanna Jayaweera
18:10-18:20	“Temporal Geochemical Variations in Groundwater Consumed by CKDu at-risk Communities in the Dry Zone of Sri Lanka” -Navodya Dhananjalee Mahalekam
18:20-18:30	“Spatial Epidemiology and Multivariate Risk Factor Analysis of Chronic Kidney Disease of Unknown Etiology (CKDu) in Lignite-Exposed regions of Cuddalore, Tamil Nadu” -Madhumitha k
18:30-18:40	“Groundwater Geochemistry and Possible Association with Chronic Kidney Disease of Unknown Etiology in Uddanam Region, Srikakulam District, Andhra Pradesh” -Ramavath lalu
18:40-18:55	**BREAK**
18:55-19:40	**MOVIE SCREENING AND DISCUSSION** *Alina Simone and Prof. Robert Finkelman*
19:40-20:10	**SESSION 16: POSTER PRESENTATIONS** *Dr. Sanjeevani Jawadand*
20:10-20:30	**AWARDS AND VALEDICTORY SESSION**

WORKSHOPS

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

SOUTH ASIA EDITION 2025

Presents

WORKSHOP 1

"Shared Vocabulary: Communication Between Geo- Scientists and Public Health/Medical Researchers"

27th NOVEMBER, 2025

Conference Begins at 4:00 PM IST | Workshop at 6:55 PM IST

PROF. ROBERT FINKELMAN

Join us on Zoom

https://us06web.zoom.us/j/82281417182?pwd=l6U1uOQxfjdZy36drQFkyHlfEDtfjR.1

Meeting ID: 822 8141 7182

Passcode: 867123

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH

SOUTH ASIA EDITION 2025

Presents

WORKSHOP 2

"Preparing manuscripts for publication in international journals: instructions for young researchers"

28th NOVEMBER, 2025

Conference Begins at 4:00 PM IST | Workshop at 6:55 PM IST

DR. ALECOS DEMETRIADES

Join us on Zoom

https://us06web.zoom.us/j/88225518172?pwd=iNyQAueQZ0YcbixaepI3y8lU3Lhar6.1

Meeting ID: 882 2551 8172
Passcode: 289378

MOVIE SCREENING

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Alina Simone	Filmmaker and Journalist (Director: Black Snow)	United States	

KEYNOTE SPEAKERS

NAME	KEYNOTE	COUNTRY	PHOTOGRAPH
Prof. Rajasekhar Bala-Subramanian	**Keynote 1 (Day 1)** **"Healthy Living in Healthy Cities"**	**Singapore**	
Prof. Srilert Chotpantarat	**Keynote 2 (DAY 2)** **"Assessment of As and Pb Contamination and Associated Health Risks in Groundwater of Ban Khai District, Thailand"**	**Thailand**	
Prof. M. Santosh	**Keynote 3 (DAY 3)** **"Habitability and Sustainability of Planet Earth"**	**China**	

KEYNOTE SPEAKERS

NAME	AFFILIATION	COUNTRY	PHOTOGRAPH
Prof. Shaji E	**Keynote 4 (Day 4)** **"Heavy metals in groundwater: A hidden threat to health"**	**India**	
Prof. José Centeno	**Keynote 5 (Day 5)** **"The Emerging Discipline of Medical Geology - Origin, recent advances and Future"**	**Puerto Rico USA**	
Prof. Ravin Jugade	**Keynote 6 (Day 6)** **"Water Detoxification using Physically and Chemically Engineered Chitosan Biopolymer"**	**India**	

WORKSHOP SPEAKERS' ABSTRACTS

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Shared Vocabulary: Communication Between Geoscientists and Public Health/Medical Researchers

Robert B. Finkelman
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Correspondence: bobf@utdallas.edu

To maximize our impacts medical geologists must collaborate with public health scientists or effectively communicate with medical and public health researchers. To do this we must be familiar with basic medical terminology that can be found in the glossaries of basic texts but we must also speak in simple, easy to understand terms. It is equally important to properly communicate the importance of our work to management, politicians, and the public. Try to avoid using terms primarily familiar to geoscientists or, if you must, provide a simple definition of the term. It is critical that medical geologists emphasize the vast numbers of people who are at risk from health problems caused by geologic materials and geologic processes. For example, hundreds of millions of people are at risk from arsenic exposure and silicosis. The health of tens of millions of people is at risk from exposure to volcanic dust and gas, and the health of many millions is at risk iodine deficiency, geophagy, and toxic element exposure. These and other health issues are central topics being addressed by medical geologists. Look for practical solutions to these health problems. Be proactive, seek out opportunities to educate others. Medical geologists should clearly emphasize that that the information that we generate from our research could eliminate or mitigate many of these health problems, thereby reducing health care costs for individuals and for the community and by mitigating these health problems we increase productivity and the quality of life for the entire community. In communicating with public health scientists, medical practitioners, managers, politicians, and the public be

polite but be persistent as what you are communicating could result in people's lives improved or saved.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Preparing manuscripts for publication in International Journals: Instructions for young researchers

Alecos (Alexandros) Demetriades
Chairperson of the IUGS Commission on Global Geochemical Baselines (2024-2028)
Former Director of the Division of Geochemistry and Environment,
Hellenic Institute of Geology and Mineral Exploration

Correspondence: alecos.demetriades@gmail.com

Summary of key points

- Before writing, reflect on the reasons you want to publish and whether your work is suitable for international journals. Consider if your research is new, interesting, challenging, and relevant to current hot topics. If not, local or lower-impact journals may be more appropriate.
- Decide whether your work warrants (i) a full article, (ii) short communication, or (iii) review paper. It is strongly recommended, as you are a young researcher, to seek advice from your supervisors and colleagues.
- Choose journals by reviewing where your references are published, reading recent articles, and considering rejection rates. Submit to one journal at a time and wait for feedback before considering others. Avoid splitting your research into multiple manuscripts.
- Download and study the Guide for Authors for your chosen journal. Apply its requirements from the first draft, including formatting, citation style, and figure/table standards.
- Most journals follow the IMRaD format: Introduction, Methods, Results, and Discussion/Conclusions. Include title, authors, abstract, keywords, acknowledgements, references, and supplementary materials as appropriate.
- Avoid plagiarism, data fabrication, and redundant publication. Use proper attribution and familiarise yourself with resources like COPE and PERK for ethical guidance.
- Write clearly and concisely. Use figures and tables effectively, ensuring they are self-explanatory and do not duplicate information. Prefer quantitative descriptions over vague terms.

Proceedings of the 4th International Student Conference on Medical Geology and Environmental Health
South Asia Edition
Virtually, 24th to 29th November, 2025

- In applied geochemistry, use the median and median absolute deviation, not the mean or standard deviation unless your data are normally distributed. Present results with appropriate statistical tests and precision.
- Revise your manuscript thoroughly before submission.
- Take reviewer comments seriously, respond point-by-point, and be open to further revision.
- Rejection is common, and do not be discouraged. Learn from feedback and improve your work.
- Write in clear English (UK or US). Do not mix the two forms of the English language.
- Learn scientific vocabulary and avoid ill-defined terms like “heavy metals”, which is an obsolete term; use “potentially hazardous elements (PHEs)” or “potentially toxic elements (PTEs)” instead.
- The Impact Factor (IF) measures a journal’s influence based on citation averages. It’s a key criterion for journal selection, but remember that IFs are updated with a delay and can be found on journal websites or dedicated databases.
- Cherish your work, follow simple rules, and respect the time of editors and reviewers. Success comes from dedication, organisation, and attention to detail.

KEYNOTE SPEAKERS' ABSTRACTS

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Healthy Living in Healthy Cities

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Rapid urbanisation has introduced complex health challenges linked to degradation of natural resources, environmental pollution, and sedentary lifestyles. The concept of *"Healthy Living in Healthy Cities"* emphasises the need for integrated approaches that combine urban planning, public health, environmental sustainability, and social equity to enhance overall well-being.

Healthy city initiatives play a pivotal role in promoting intersectoral collaboration and facilitating participatory governance that can create sustainable environments. This presentation will explore how cities can be designed and managed to promote physical activity, mental health, and environmental resilience. Key strategies such as developing walkable neighbourhoods, expanding green and public spaces, improving air quality, and fostering community engagement will be highlighted.

Ultimately, building healthy cities is not solely a matter of infrastructure but of values—placing human health and well-being at the core of urban development. This presentation calls for collective actions among policy makers, planners, and citizens to co-create urban spaces that are inclusive, sustainable, and conducive to thriving, healthy living for all.

Keywords: Sustainability, Community Engagement, Environmental Pollution, Urban Planning

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Assessment of As and Pb Contamination and Associated Health Risks in Groundwater of Ban Khai District, Thailand

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Arsenic (As) and lead (Pb) contamination in groundwater poses a serious public health concern. This study aimed to (i) examine As speciation and Pb concentrations across dry and wet seasons, including their spatial distribution in groundwater; (ii) analyze the relationships between these metals and hydrochemical parameters; (iii) assess heavy metal exposure among 110 participants by comparing individuals consuming groundwater with As concentrations below 10 µg/L (L group) and above 10 µg/L (H group); and (iv) identify factors influencing health risks based on data from face-to-face interviews.

The As level in the Ban Khai district area ranged from <0.300 to 183.00 µg/L, with 22% of forty groundwater wells exceeding the WHO guideline value of 10 µg/L. The predominant As species was the pentavalent form influenced by oxidative conditions and pH levels between 6 and 8. In contrast, Pb concentrations throughout the area remained below the WHO guideline of 10 µg/L.

The spatial distribution of both metals showed no significant seasonal variation between the dry and wet seasons. The persistence of As distribution is likely related to groundwater flow and the prolonged mobilization of As-bearing minerals, whereas the relatively uniform Pb distribution reflects its low concentration and stable geochemical behavior. The

primary sources of As and Pb appear to be mineral weathering, although elevated As levels in some hotspot wells may also be linked to anthropogenic activities in surrounding areas.

Nearly 98% of urine samples showed Pb concentrations within the normal limit of 60 µg/gCr, as defined by the National Institute of Occupational Safety and Health. In contrast, urinary As concentrations ranged from 5.38 to 600.86 µg/L, with approximately one-third of the samples exceeding the normal threshold of 50 µg/L established by the National Health and Nutrition Examination Survey. Groundwater consumption from wells with elevated As concentrations was strongly associated with higher urinary As levels among participants in the H group. Conversely, socio-demographic factors showed no significant association with differences in urinary As between the L and H groups. For probabilistic risk assessment, drinking water was identified as the major exposure pathway contributing to both non-cancer and cancer risks. Sensitivity analysis indicated that As concentration had the greatest influence on variations in overall health risk. Therefore, residents exhibiting elevated urinary As levels should be closely monitored for potential long-term health effects, particularly cancer development. The use of alternative water sources and effective household treatment systems especially those capable of reducing As^{5+} concentrations prior to consumption is strongly recommended.

Keywords: Arsenic, Drinking groundwater, Health risk assessment, Groundwater contamination, Thailand

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Habitability and Sustainability of Planet Earth

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The secular evolution of Planet Earth over 4.6 billion years witnessed many major milestones in shaping the internal structure of the planet, initiation of plate tectonics, building continents, cleaning up toxic oceans, creating a life sustaining environment, and providing sources for nutrients to support the birth and evolution of life. The onset of primitive life on our planet is considered to be linked to energy from either chemotrophy or photography. Following the appearance of humans, growth of civilizations, and the eventual boom in population and related demands of modern life, the globe is witnessing fast depletion of resources and severe damage to environment resulting in serious challenges to sustainability. In addition, climate change, natural hazards, and the predicted impending crisis of sixth mass extinction pose major challenges to sustainability. Effective measures and policies are required to address this transitional phase of our planet.

Keywords: Evolution, Plate Tectonics, Climate Change

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Heavy Metals in Groundwater: A Hidden Threat to Health

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Groundwater, a vital source of drinking water for billions of people worldwide, is increasingly threatened by geogenic and anthropogenic contamination. Among these contaminants, heavy metals, and metalloids such as arsenic, fluoride, and lead pose serious and often underrecognized risks to human health. The emerging interdisciplinary science of medical geology investigates the intricate linkages between geological processes, environmental exposure, and disease occurrence, offering a valuable framework to understand these hidden threats. This talk explores how geological materials, minerals, rocks, and soils, can release toxic elements into groundwater systems through natural weathering, rock water interaction, and industrial activities. Emphasis is placed on the role of arsenic contamination, a widespread global issue, and its emerging connection to rare vascular disorders such as Moyamoya angiopathy (MMA). Recent research indicates that regions with high arsenic concentrations in groundwater, including East Asia, Bangladesh, and parts of the United States, overlap geographically with clusters of MMA cases. This observation suggests a potential geo-environmental contribution to disease pathogenesis in genetically susceptible populations. Beyond arsenic, the discussion extends to other heavy metals such as lead, Ba, cadmium, and mercury, which contribute to chronic health conditions including neurological damage, cancers, and cardiovascular diseases. The talk highlights the importance of medical geochemistry in assessing the sources, speciation, and transport mechanisms of these contaminants and in developing strategies to safeguard drinking water quality. By integrating insights from geology, environmental science, and medicine, this presentation aims to highlight

how medical geology can inform public health interventions and sustainable water resource management. Understanding the geological origins and pathways of heavy metal contamination is essential for mitigating exposure risks, protecting vulnerable communities, and promoting UN sustainable development goals.

Keywords: Groundwater Geochemistry, Arsenic Contamination, Medical Geochemistry, Sustainable Water Resource Management

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

The Emerging Scientific Discipline of Medical Geology – Its Origin, Recent Advances and Future

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Medical Geology is defined as the study of the impacts of geologic materials and geologic processes on animal and human health. Over the past 20 years Medical Geology has developed into a mature discipline with numerous adherents. Several international and national associations emerged devoted fully or partially to this new scientific discipline. Numerous books on the subject have appeared in this time, as well as dozens of short courses, workshops, lectures, journals, and countless journal articles. International, national and local conferences have been devoted to this topic. This presentation will emphasize the global impact of this discipline with particular attention to its origin, its recent advances and its future.

Keywords: Medical Geology, Human Health, Dust, Toxic Trace Elements

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Water Detoxification using Physically and Chemically Engineered Chitosan Biopolymer

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Chitosan is known for its affinity to adsorb different pollutants including heavy metal ions, environmentally important anions like fluoride, phosphate, cyanide and also organics like dyes and drugs. Chitosan is advantageous because of the characteristics like low price and high abundance, antibacterial property, nontoxicity, biocompatibility, biodegradability, macromolecular structure, hydrophilicity, cationicity, active sites, and high adsorption capability. The most important moieties on chitosan molecule are the two important functional groups $–NH_2$ and –OH that have high affinity towards metal ions due to presence of lone pairs of electrons. Both of these functional groups can be modified by various methods leading to enhanced applicability as adsorbents. The adsorption efficiency of chitosan can be further enhanced by structural and functional modifications. Our research group is working on physically and chemically modified chitosan for water treatment applications. The physical modifications include:

1. **Microballs formation** thereby giving structural stability to the biopolymer and the beads are easily filterable.
2. **Thin film formation** to obtain biopolymeric membrane with reasonable mechanical strength to allow filtration of water through membrane.
3. **Magnetic composites formation** to make the separation of adsorbent easy after the removal of toxicant.

4. **Gamma irradiation** of the adsorbent to enhance surface functionalities, surface area and porosity.

Apart from physical modifications, the possible chemical modifications suggested by our research group are:

1. **Crosslinking** using multivalent ionic or organic crosslinkers, thereby increasing the structural stability and porosity of the material.
2. **Impregnation** of charged moieties or heteroatom containing species on the biopolymer that increases the electrostatic interaction effectively with the ionic pollutants.
3. **Dual effect** of the above two methods has also been exploited. Crosslinking enhances the stability of material while impregnation improves the adsorption capacity.
4. **Composites and nanocomposites formation** is another way of enhancing the adsorption capacity as well as physical strength of chitosan. These composites can be obtained in the form of beads or powder.

In conclusion, it has been observed that structural modifications of chitosan lead to enhanced adsorption capacity as well as selectivity towards desired pollutant. This is a systematic presentation of probable modifications in the chitosan biopolymer for water treatment applications.

Keywords: Biodegradability, Biocompatibility, Hydrophilicity, Nanocomposites

STUDENTS' ORAL PRESENTATION ABSTRACTS

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Rainfall Variability, Volcanic Geology, and Iodine Deficiency in Indonesia: Early Observations from Regional Data

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Iodine Deficiency Disorders (IDD) remain a public issue in Indonesia. Despite the long-standing national salt iodization program, several regions are reported as persistent IDD pocket (Pramono, 2009). The fact that many cases are concentrated in mountainous areas has long raised suspicion that natural environmental conditions may play a role. Volcanic rocks, which dominate much of Indonesia's highlands, are known to be naturally poor in iodine (Harijoko, 2009; Saismana and Harijoko, 2008; Muramatsu and Wedepohl, 1998) that might be attributed to the loss of volatile elements during magmatic processes. These geological settings establish a background condition that can predispose populations to iodine deficiency. Rainfall adds another layer of complexity. It can act as a source of iodine through atmospheric deposition in moderate amounts, but under extreme conditions it may enhance trace element leaching and reduce iodine retention in soils.

This study conducts a regional evaluation that integrates: (1) rock-type data derived from regional geological maps, and (2) rainfall records from both in-situ weather stations and the CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data) satellite product to investigate these interacting influences. Reported IDD prevalence data were analyzed alongside these environmental datasets to assess spatial correlation. The regional approach

allows assessment of whether and where geological substrate and rainfall regime jointly help explain persistent IDD pockets.

Preliminary results show that in Java, Sumatra, Bali, and Nusa Tenggara, IDD-prone areas often coincide with volcanic regions receiving relatively low rainfall. In Papua, however, severe IDD occurs in regions with extreme rainfall.

This work demonstrates that geology and rainfall together may contribute to the persistence of IDD in Indonesia. As a preliminary overview, it highlights the need for detailed studies on geological material and rainwater iodine geochemistry, rainfall-driven leaching, and their implications for sustainable IDD elimination strategies.

Keywords: Retention, Leaching, Volatile Elements, Magmatic Processes, Atmospheric Deposition.

Acknowledgements: The authors gratefully acknowledge the financial support provided by the Indonesia Endowment Fund for Education (Lembaga Pengelola Dana Pendidikan – LPDP) through the doctoral scholarship program of the first author. Additional institutional support was provided by the National Research and Innovation Agency of Indonesia (Badan Riset dan Inovasi Nasional – BRIN) and Universitas Gadjah Mada.

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SOUTH ASIA EDITION 2025

Impact of PM 2.5 on Common Fruit Species around Ghorahi Cement Factory, Dang, Nepal

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Introduction: Air pollution is a serious environmental issue, particularly in industrial areas such as the Dang District of Nepal. This study was conducted around the Ghorahi Cement Factory to assess the impact of Particulate matter (PM2.5) on common fruit species: Artocarpus heterophyllus, Citrus limon, Psidium guajava, Mangifera indica, Morus alba, and Litchi chinensis.

Methods: Sampling design was based on a wind rose diagram, with eight sites selected at 0.5, 1, 1.5, and 2 km in both the southwest (downwind) and northeast (upwind) directions. Leaf samples were collected from all sites and analyzed for Air Pollution Tolerance Index (APTI), Specific Leaf Area (SLA), and Dust Accumulation (DA), while PM 2.5 was measured at six sites (four in the southwest and two in the northeast) using Air Visual Pro devices during both the dry and wet seasons.

Results: PM 2.5 concentrations were significantly higher during the dry season, while the wet season exhibited lower PM 2.5 concentrations due to rainfall. The APTI results showed clear seasonal variation, most species were sensitive or intermediate in the dry season, with only Mangifera indica (36.56) being tolerant, whereas all six species were tolerant in the wet season. Correlation analysis indicated that during the dry season, PM 2.5 was strongly positively correlated with dust accumulation (DA, r = 0.81) and negatively correlated with total chlorophyll content (TCC, r = -0.66) and relative water content (RWC, r = -0.51). In the wet season, PM 2.5 remained positively correlated with DA (r = 0.32) and ascorbic acid (AA, r =

0.52), while negatively correlated with TCC (r = -0.63). SLA exhibited seasonal variation across species, with Morus alba showing the highest values, indicating a greater adaptive capacity compared to the other studied species. DA was highest on Mangifera indica (0.0079 ± 0.017 g/cm²) and Artocarpus heterophyllus (0.0105 ± 0.013 g/cm²), reflecting strong dust holding potential.

Conclusion: The results concluded that Mangifera indica, Artocarpus heterophyllus, and Psidium guajava are suitable for greenbelt development, while Citrus limon and Morus alba serve as effective bioindicators, supporting species-specific planting to mitigate pollution near industrial areas.

(a) **(b)**

Fig 1. (a) Ghorahi Cement Factory located in Dang District, Nepal; (b) Air Visual Pro instrument installed at the sampling site for continuous air quality monitoring.

Keywords: Air Pollution, Environmental Issue, Special Leaf Area, Dust Accumulation and Bioindicators.

Acknowledgements: The authors are grateful to the Central Department of Environmental Science, Institute of Science and Technology, Tribhuvan University (CDES, IoST-TU) for

providing the opportunity to conduct this research. We sincerely acknowledge the Ghorahi Sub-Metropolitan City, Ghorahi Cement Factory, local communities, and all relevant stakeholders for their valuable support and cooperation during the study. We also extend our gratitude to the Nepal Academy of Science and Technology (NAST) for funding this research.

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SOUTH ASIA EDITION 2025

Efflorescent Sulfate Mineralization and Trace-Element Enrichment (Hg, Nb) in the Neogene Sedimentary Formations of North Kerala, India

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Efflorescent sulfate minerals, secondary products of Fe-sulfide oxidation, play a major role in controlling acidity and trace element mobility in near-surface environments. These highly soluble secondary minerals serve as transient geochemical reservoirs that store acidity and metals during dry periods and release them rapidly upon dissolution during the onset of rainfall. Such cyclic dissolution–precipitation process leads to sharp, episodic fluctuations in surface and groundwater chemistry, often resulting in localized acidification and metal enrichment.

The present study investigates the field occurrence and characteristics of efflorescent sulfate minerals developed on pyrite bearing carbonaceous clay within the Neogene Cheruvathur Formation of North Kerala, India. Multiple field investigations reveal seasonal development of melanterite, rozenite, copiapite, and halotrichite, as efflorescent crusts, fibrous mats, or powdery layers on weathered exposures. SEM–EDS analyses confirm the dominance of Fe-sulfate phases, with notable traces of Hg and Nb. Iron occurs as both ferrous and ferric sulfate species, whereas Hg and Nb likely originate from the oxidative breakdown of accessory sulfides and heavy-mineral components within the host sediment.

The presence of these elements within the efflorescent minerals indicates a possible pathway for their periodic release into surface and groundwater systems during dissolution events following the onset of monsoon rainfall. These processes can contribute to localized

acidification and dispersion of trace metals in the tropical coastal plain of North Kerala. In the context of medical geology, the study underscores the environmental importance of natural efflorescent mineralization in tropical regions and its broader implications for geochemical cycling and human health.

Keywords: Sulfate Minerals, Trace Element, Geochemical Reservoirs, Human Health, Mineralization and Carbonaceous Clay.

Acknowledgement:

The authors gratefully acknowledge the Principal and Department of Geology, Government College Kasaragod, for providing facilities and support to carry out the ongoing research work. The authors also thank the Indian Institute of Science (IISc), Bengaluru, for extending SEM–EDS analytical facilities. This study has been carried out without any external funding support.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Environmental Assessment of Lead Dynamics in Brunei Darussalam: Soil Distribution, Mobility, and Retention Mechanisms

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Rapid economic development and intensified land use in Brunei Darussalam underscore the need for reliable geochemical baselines of potentially toxic elements (PTEs). Currently, no comprehensive soil geochemical atlas exists for the country. This study supports the national initiative to develop the *Geochemical Atlas of Brunei Darussalam*, providing the first systematic dataset of soil geochemistry to inform land-use planning, environmental monitoring, and public health risk assessment. Focusing on lead (Pb), a well-known PTE, the research aims to establish geochemical baselines, distinguish geogenic from anthropogenic sources, and assess contamination levels and mobility mechanisms.

A two-tiered sampling strategy was adopted; a high-density grid (1 sample/km²) in the urbanised Brunei-Muara District and a lower-density grid (5 samples/400 km²) for national coverage. Samples were air-dried, sieved, and analysed for total Pb concentrations (<63 µm fraction) using ICP-MS after near-total acid digestion. Physico-chemical parameters (pH, EC) were determined at the Mineralogy, Petrology and Geochemistry (MPG) Laboratory, Universiti Brunei Darussalam. Spatial distribution maps were generated using GIS-based IDW interpolation. Statistical methods defined baseline values, and contamination indices classified Pb levels.

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Elevated Pb concentrations spatially coincide with road networks, suggesting vehicular emissions as a major source, with additional anomalies linked to agricultural and localised industrial activities. Pb mobility is governed by complex interactions between several competing factors. Acidic soil conditions enhance Pb solubility, increasing its potential for leaching and uptake. Clay minerals retain Pb through inner-sphere complexation, forming strong bonds at mineral surfaces. Organic matter, particularly humic acids derived from decomposing tropical vegetation, plays a critical role in Pb retention in surface and near-surface soils. However, dissolved soil organic matter and organic ligands can form soluble Pb complexes, significantly increasing its mobility and bioavailability. These mechanisms highlight the dual role of organic matter as both a sink and a facilitator of Pb transport.

These findings provide essential insights into Pb distribution and environmental controls, informing risk assessments and mitigation strategies vital for public health and sustainable land management.

Keywords: Potentially Toxic Elements (PTEs), Mitigation Strategies, Bioavailability, Sustainable Management and Public Health.

Acknowledgements: The authors are grateful for the financial support of the Universiti Brunei Darussalam via the research grant No UBD/OAVCRI/CRGWG(007)/170401. The authors express their sincere gratitude to all the students of UBD, who participated in the sampling surveys for this project.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Assessment of Seasonal Variations in Heavy Metal Concentrations and Associated Health Risks in Salim Ali Lake and Harsul Lake

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Lakes are inland water bodies serving as a freshwater resource. They are critical resources that sustain ecological balance and support human beings. The main objective of present study is to assess the level of contamination of two lakes situated in the Chhatrapati Sambhajinar city. Water samples from the Salim Ali Lake and the Harsul Lake were collected in the year 2024 across four seasons. Physico-chemical and heavy metal analysis were carried out in the laboratory using rapid water testing kit to find out the level of contamination. Nemerow Pollution Index was derived. An evaluation of Nemerow Pollution Index revealed that, during Winter season the Harsul Lake indicate substantial pollution while the Salim Ali Lake exhibit heavy pollution. During Premonsoon season, observed NPI values of the Salim Ali Lake and the Harsul Lake suggest heavy pollution and moderate level of pollution respectively. In the Monsoon season, observed NPI values of the Salim Ali Lake and the Harsul Lake depicted the higher level of pollution. The NPI value during Postmonsoon season slightly increases of both the lakes. The observed NPI value of the Salim Ali Lake and the Harsul Lake indicate both lakes are heavily polluted. Overall analysis revealed that, the Salim Ali Lake is more polluted than the Harsul Lake. It might be due to the Salim Ali Lake is situated in central part of city while the Harsul Lake is situated at outskirt of the city. The present study helps policymakers to understand the current state of lake, allowing them to develop new policies accordingly. The

water quality index emphasizes the urgent need of implementing pollution controlling strategies to stop further disintegration of the both the lakes.

Keywords: Freshwater, Contamination, Pollution Controlling Strategies, Harsul Lake and Salim Ali Lake and Ecological Balance.

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SOUTH ASIA EDITION 2025

Groundwater Seepage and Geochemical Risks in the Bogala Graphite Mine, Sri Lanka

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Groundwater seepage has been a persistent challenge at the Bogala Graphite Mine, one of the main underground mining sites in Sri Lanka, posing significant concerns for both operational efficiency and worker safety. This study investigates the sources and chemical evolution of groundwater within the mine and assesses its potential implications for human and environmental health. Using an integrated geochemical, isotopic, and geohealth framework, water samples were collected from multiple depths in the mine (75–130 m) and adjacent surface water sources for analyses. The findings showed that the groundwater primarily evolves from a Ca-HCO_3 type to a mixed composition, shaped by silicate weathering and ion exchange processes. More importantly, samples contain elevated concentrations of lithium (Li), strontium (Sr), barium (Ba), and arsenic (As), which can pose health risks. These elements likely come from the oxidation of sulfide minerals and the chemical alteration of metamorphic rocks such as biotite gneiss and granitoids within the surrounding area. Acidic conditions at some levels (pH<5.4) possibly increase the dissolution of elements in seeping water. Such contamination not only endangers miners' health but also threatens the surrounding surface water resources due to continuous dewatering. Continuous monitoring of seepages and surface water that could be contaminated by mine dewatering is necessary, considering the seasonal variations.

Keywords: Hydrogeochemistry, Dewatering, Mine Hazards and Water–rock Interaction.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Metal Pollution and Associated Ecological Risk in the Surface Dust from a Formal E-Waste Recycling Unit in the National Capital Region of India

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The electronics sector is one of the most dynamic and rapidly expanding manufacturing industries worldwide, and consequently, electronic waste (e-waste) has emerged as one of the fastest-growing waste streams globally, which poses significant risks to human health and the environment. In the last decade, the formal sector for e-waste recycling has also emerged as a major sector for e-waste recycling in India. In the present study, surface dust (SD; n=4) samples of a formal e-waste recycling unit of the National Capital Region (NCR), India, were collected to investigate the metal pollution level and associated ecological risk assessment. Total 13 metals viz. As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Sn, V and Zn were investigated and their contamination factor (CF), enrichment factor (EF), geo-accumulation index (Igeo) and ecological risk (ER) were studied to assess the pollution levels and potential risk to the environment in SD of formal e-waste recycling unit. The average metal concentration of As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Sn, V and Zn were exceeded 140.6, 2.1, 45.4, 55.8, 65.2, 746, 3.6, 2.2, 28.6, 31.1, 103.7, 18.1 and 56.8 times higher than their corresponding background values. The CF reveals that all metals showed very high contamination (CF > 6) except Mn and Ba, which show moderate contamination in SD samples. PLI values in SD samples exceeded unity, which indicates deterioration of the site quality. According to Igeo values, all metals showed extremely high contamination except Ba, Mn and Fe, which showed uncontaminated and moderate pollution respectively. In SD samples, all metals showed

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significant to high enrichment except Ba, and Fe showed minimal to moderate enrichment. In ecological risk assessment, all metals showed considerable to very high ecological risk except Mn, and Zn, which showed low risk. Whereas, risk index showed a very high ecological risk of metals in SD samples of formal e-waste recycling units. Overall, it can be concluded that the formal sectors also posed a significant risk of metals in surface dust. It is required to effectively implement the pollution control mechanism and occupational safety norms in formal e-waste recycling sectors to safeguard human health and the environment.

Keywords: Risk Assessment, Recycling, Human Health and Environment.

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SOUTH ASIA EDITION 2025

Geochemical Assessment of Sulphur and Calcium in the Soils of Brunei Darussalam: Establishing Baselines and Identifying Nutrient Imbalances

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Soil geochemistry provides critical insights into nutrient availability, fertility, and environmental health. Sulphur (S) and calcium (Ca) are essential macronutrients influencing soil productivity and agricultural viability. Despite their importance, baseline data on their natural distribution in Brunei Darussalam are limited. This study aims to establish geochemical baselines for S and Ca in soils across Brunei Darussalam and to identify areas with potential nutrient imbalances to support sustainable land-use planning and future agricultural development. Topsoil and subsoil samples were systematically collected across Brunei Darussalam with the aid of a high-density grid (1 sample/km²) in the urbanised Brunei-Muara District and a lower-density grid (5 samples/400 km²) for national coverage. Samples were air-dried, sieved, and the fine fraction (<63 µm) analysed for S and Ca concentrations using ICP–MS after near-total acid digestion. Soil physicochemical properties, including pH and electrical conductivity, were also measured. Geochemical baselines were determined using Tukey's inner fence method to determine typical concentration ranges and identify outliers. Spatial distribution maps were produced using IDW interpolation in a GIS environment. Correlation analyses examined relationships between elemental concentrations and soil properties, providing insights into the factors controlling nutrient distribution.

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Preliminary results show a negative correlation between S and soil pH, indicating its increased availability under acidic conditions. In contrast, Ca exhibits a weak correlation with pH, reflecting its relative geochemical stability. Spatial analysis reveals heterogeneous distribution patterns, highlighting zones with potential nutrient deficiencies or enrichments. These findings provide the first national-scale insight into geochemical variability and nutrient imbalances in Brunei Darussalam. By integrating statistical and spatial analyses, this study establishes geochemical baselines for S and Ca and delineates nutrient distribution patterns across Brunei Darussalam. The contrasting behaviours of S and Ca emphasise the importance of region-specific nutrient management strategies. The findings provide a scientific basis for identifying areas suitable for agricultural development and contribute to informed, sustainable land-use planning and soil resource management.

Keywords: Sustainable Land Use Planning, Geo-Chemical Stability, Geo-Chemical Baselines and Soil Resource Management.

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Health Risk Assessment and Spatial Distribution of Fluoride in Groundwater in the Sai River Basin, Uttar Pradesh, India

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Fluoride (F^-) has both detrimental and beneficial impacts on human health. F^- concentration within limit (<1.0 mg/L) reduces the risk of dental caries. However, a high concentration of F^- (>1.0 mg/L) in groundwater is a global environmental and public health issue. Hence, the present study aims to assess the human health risk associated with F^- contamination in the groundwater of the Sai River Basin (SRB). To achieve this goal, a total of 156 groundwater samples were collected in April 2024 (pre-monsoon) in 500 ml pre-washed polyethylene bottles. F^- ion concentrations varied from 0.2 mg/L to 7.2 mg/L with a mean value of 0.8 mg/L. The results revealed that the concentration of F^- exceeded the BIS (2012) acceptable limit (1.0 mg/L) at 32 locations in the groundwater of the SRB. The calculated human hazard quotients (HHQs) (non-carcinogenic) vary from 0.12 to 4.63 (mean = 0.50) for males, from 0.14 to 5.47 (mean = 0.60) for females, and from 0.16 to 6.26 (mean = 0.68) for children. The HHQs exceed the acceptable limit of one at 11, 16, and 27 locations for males, females and children, respectively, depending upon their body weight. The SRB is situated in the central part of the Ganga River Basin, between longitudes 25°N and 28.5°N, and latitudes 80°E and 83°E. It incorporates heavily populated districts such as Hardoi, Unnao, Lucknow, Raebareli, Amethi, Pratapgarh and Jaunpur. Hence, based on the results obtained, it is recommended that continuous monitoring and remedial measures, such as defluorination of groundwater, be implemented to mitigate health risks associated with fluoride contamination in the basin.

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Keywords: Non-carcinogenic Risk, Hazard Quotients, Groundwater Contamination, Remediation

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Metal Toxicity and Human Health Risk Assessment of Surface Dust from an Emerging Industrial Cluster near New Delhi

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Metal pollution in urban and industrial surface dust is a major concern due to its adverse impacts on human and environmental health, and it also plays a vital role in urban sustainability. In present work, surface dust (SD; n= 22) samples from Bhiwadi industrial cluster (BIC) near New Delhi were collected to evaluate metal pollution, toxicity assessment, leaching potential through Toxicity Characteristic Leaching Procedure (TCLP) and Waste Extraction Test (WET) and their associated health risk assessment. The average concentrations of Cd, Cr, Cu, Fe, Mn, Ni, Pb, V, and Zn in SD samples were 44.4, 172.1, 40.1, 3.6, 10.9, 10.2, 29.2, 2.1, and 17.7 times higher than the corresponding background values indicating high impact of industrial activities in the BIC. SD samples of BIC fall under the hazardous category as metals leached in TCLP and WET are higher than the prescribed limits. WET show high leaching potential in SD due to the presence of citrate (tri-dentate ligand) over acetate (mono-dentate ligand), which was used in TCLP. Ingestion was major pathway for both carcinogenic and non-carcinogenic risk followed by dermal and inhalation. SD samples have a high non-carcinogenic risk (Hazardous index; HI > 1) for both adults (HI = 13.47) and children (HI = 109.9). In comparison to adults, metals posed nearly 8.2 times higher non-carcinogenic risk to children due to SD exposure in the BIC. Carcinogenic risk posed by Cd, Cr, Ni and Pb in SD exceeded the USEPA acceptable limit (TCR > 1×10^{-4}). The findings of this study demonstrated that, metal pollution in BIC is increasing significantly with time. It requires immediate intervention and actions to stop waste disposal on open surfaces and continuous monitoring of

surface dust essential to mitigate further pollution and to establish a pollution control policy framework for safeguard human and environmental health.

Keywords: Pollution, Carcinogenic, Inhalation, Hazardous, Dust and Environmental Health.

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Geology, Characterization and Mineralogical Study of Clay Deposits in Kampung Bahagia, Kuala Krai, Kelantan

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Clay deposits have significant geological and environmental importance due to their ability to retain and interact with trace elements, some of which may influence human and ecosystem health (Abollino et al., 2008; Galán, 2006). Understanding the mineralogical and geochemical characteristics of these deposits is essential for assessing their environmental quality and potential medical geology implications (Finkelman et al., 2005). This study focuses on the geology, characterization, and mineralogical study of clay deposits in Kampung Bahagia, Kuala Krai, Kelantan. The main objectives are to identify the mineral constituents, determine their geochemical compositions, and evaluate their environmental significance within the regional geological framework.

Methods used to investigate the mineralogical and geochemical characteristics of the clay samples. Analytical techniques include X-ray Diffraction (XRD) for mineral identification, Scanning Electron Microscopy coupled with Energy Dispersive X-ray Spectroscopy (SEM–EDS) for microstructural and elemental analysis, and Inductively Coupled Plasma–Mass Spectrometry (ICP–MS) for trace element quantification. The soil sampling involved several places in Kampung Bahagia, followed by laboratory-based soil classification using particle size analysis and the Munsell colour system. Data interpretation will be supported by relevant analytical software for mineral and elemental characterization.

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Preliminary results from soil classification indicate that the clay deposits in Kampung Bahagia are predominantly composed of fine-grained clayey loam to clayey, with colours varying from light brown to reddish hues suggesting the influence of iron oxides. Laboratory analyses using XRD, SEM–EDS, and ICP–MS are ongoing to further reveal the mineralogical assemblage and trace element composition of the samples. A summary of early field and laboratory observations is presented in Table 1.

Table 1: Preliminary Soil Classification of Clay Samples from Kampung Bahagia, Kuala Krai, Kelantan

Sample ID	Soil Texture	Colour (Munsell)	Field Observation
S01	loamy	Light brown	Moist, fine to medium grained
S02	sandy	Dark brown	Coarse-grained
S03	Sandy loam	Reddish brown	moist
S04	Clayey loam	Brownish black	Moist, fine-grained
S05	Sandy clay loam	Light reddish	Dry, medium to coarse-grained
S06	Clayey loam	brownish	Moist, fine-grained
S07	clayey	Dusky brown	Moist, fine-grained

The study demonstrates the significance of integrating geological, mineralogical, and geochemical methods to comprehend clay deposits from a medical geology perspective, offering crucial insights for environmental and public health.

Keywords: Trace Elements, Human Health, Ecosystem Health, Medical Geology, X-ray Diffraction and Scanning Electron Microscopy coupled with Energy Dispersive X-ray Spectroscopy.

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Geological and Geochemical Study of Gold-Bearing Rocks in Kalai Tunnel Area, Kelantan, Malaysia

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The study, "Trace Elements and Human Health," is a component of a larger geological and geochemical study carried out in the Kalai Tunnel region, Jeli, Kelantan, which is located in Peninsular Malaysia's Central Belt. This belt is renowned for its substantial gold-bearing zones connected to the Bentong–Raub Suture Zone, abundant mineral resources, and intricate tectonic evolution. The presence of auriferous quartz veins and sulphide-rich mineral assemblages, especially pyrite and arsenopyrite, has recently drawn scientific attention to the Kalai Tunnel area, which is situated within this structurally controlled region. Because of their potential mobility and toxicity, trace elements like arsenic (As), antimony (Sb), lead (Pb), copper (Cu), and zinc (Zn) are important to the environment and are primarily carried by these minerals.

Fig 1. Shows the interior of the Kalai Tunnel in Jeli, Kelantan, where field observations and sampling of gold-bearing rocks were conducted. The model standing inside the tunnel, with a height of **165 cm**, provides a scale reference for the tunnel's dimensions.

This study's main goal is to assess the geochemical makeup of the gold-bearing rocks in the Kalai Tunnel area, paying particular attention to trace elements that could be harmful to the environment and human health. In particular, the study intends to evaluate the sources, mobility, and possible exposure pathways of potentially dangerous trace elements, including As, Sb, Pb, Cu, Zn, and Fe, as well as to ascertain their concentration and spatial distribution. Even though these elements are naturally occurring, soil and surface water can become contaminated by them as a result of sulphide minerals in mineralised zones weathering and oxidising. Therefore, relating the Kalai Tunnel's geological features to trace element behaviour offers a multidisciplinary perspective on the relationship between geology and human health. By concentrating on trace elements linked to gold mineralisation, this study aims to close the gap between environmental geochemistry and geological exploration.

Methods used were designed to investigate Both laboratory-based and field-based techniques are used in the research methodology. To identify lithological units, structural features, and mineralised zones within the Kalai Tunnel region, geological fieldwork was conducted. The concentrations of trace, and rare earth elements were ascertained through geochemical analyses employing Inductively Coupled Plasma–Mass Spectrometry (ICP–MS). ArcGIS and statistical programs like SPSS were used to process and visualise geochemical data in order to create elemental distribution maps and correlation matrices.

In contrast to regional background levels, early geochemical results show that rock and sediment samples from the Kalai Tunnel area are enriched in a number of trace elements, most notably As, Pb, and Sb. Samples collected close to quartz veins containing pyrite and arsenopyrite had the highest concentrations. When these sulphide minerals oxidise, soluble compounds of lead and arsenic are released. These compounds can then enter adjacent streams through surface runoff. Some downstream sediment samples also show elevated As and Pb

levels, according to the geochemical profiles, which suggests possible dispersion through fluvial processes.

From a human health standpoint, these trace elements represent potential risks if mobilised into water sources or agricultural soils. The Kalai Tunnel area is surrounded by small villages and farmlands that depend on surface water for domestic and irrigation use. Chronic low-level exposure to these trace elements could pose health concerns over time. Hence, establishing geochemical baselines through this study is critical for evaluating environmental quality and mitigating potential hazards.

Keywords: Trace Elements, Suture Zone, Environmental Geochemistry, Geological Exploration and Inductively Coupled Plasma–Mass Spectrometry.

Acknowledgements:

The author would like to thank the Faculty of Earth Science at Universiti Malaysia Kelantan (UMK) for their constant support, facilities, and guidance during this research. Thanks also go to the Department of Geoscience for their help with fieldwork and lab analyses, especially with geochemical tools like ICP–MS and XRF. We would like to thank the lecturers, lab technicians and other students who helped with the field investigation and sample collection in the Kalai Tunnel in Jeli, Kelantan. The university's resources and cooperation made this study possible as part of the Bachelor of Applied Science (Geoscience) final year project.

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Indicators of Oxic Conditions in the Indus Formation: Geochemical Perspectives on Paleoenvironmental Evolution

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The present research focuses on the understanding of redox trace element behaviour and paleoenvironmental oxygenation from the Indus basin, situated along the Indus–Tsangpo Suture Zone. These sedimentary successions, deposited in a fan delta to fluvial set up supplied from the Ladakh batholiths, record crucial evidence of basin evolution under variable oxic regimes. The study aims to decode the relationship between oxic conditions, trace element distribution, and depositional environments to reconstruct the paleo-oxic condition and its control on the chemical character of the sediment. Representative rock samples were collected from Nyoma, Rhongo section of the Indus Formation. Major and trace elements were analyzed using X-ray Fluorescence (XRF) and Inductively Coupled Plasma Mass Spectrometry (ICP–MS) under controlled calibration standards. Redox-sensitive proxies such as V/Cr, Ni/Co, and U/Th ratios were calculated to infer the redox condition of that time. Threshold values were adopted following established models V/Cr > 4.25, Ni/Co > 7, and U/Th > 1.25 — indicating sub-oxic to anoxic depositional settings. Geochemical data indicate strong enrichment of V (≤220 ppm), Cr (180 ppm), Ni (95 ppm), Cu (110 ppm), Zn (140 ppm), Mo (25 ppm), U (5 ppm), and Th (3.5 ppm) within fine-grained, organic-rich volcaniclastic sediments. low V/Cr (>4.25) and U/Th (>1.25) ratios reflect suboxic–oxic conditions with restricted bottom-water circulation and enhanced organic preservation, lower values suggest brief oxidizing phases

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driven by climatic or tectonic changes. Fe–Mn oxides under oxic states promoted remobilization. Overall, redox oscillations governed trace element cycling in the Indus basin, recording alternating oxic–suboxic phases linked to volcanic and climatic influences—providing key insights into paleo-environmental oxygenation and sediment provenance in the Himalayan forearc system.

Keywords: Sediment Provenance, Oxygenation, Trace Element, Batholiths, X-ray Fluorescence and Inductively Coupled Plasma Mass Spectrometry.

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Enhancing Bioavailability of Soil Iron and Zinc and Grain Loading in Cereal Crops: Industrial Waste Amendments and their Toxicological Evaluation

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Trace elements i.e., Fe and Zn play a vital role in maintaining human health and their imbalance either excess or deficiency may result in severe disorders. Deficiency of Iron, zinc and iodine remains leading cause of malnutrition related disorders such as anaemia, impaired immune function, stunted growth, cognitive dysfunction, in children and women. Owing to their crucial role, the low uptake and translocation of these elements in crop plants and further loading in the grains i.e., cereal grains remain a limitation due to poor availability in soil which not only directly influences crop yield but also human dietary intake. Farms in northern India, a key agricultural region, faces widespread soil micronutrient depletion due to intensive farming practices, monocropping and limited replenishment of essential nutrients. Inorganic fertilizers enrich soil with macronutrients, and also have adverse impacts on the environment but are devoid of micronutrients.

The recommended daily allowance (RDA) of iron is 8 mg for adults over 19 years, increasing to 10-11 mg for children and 27 mg for pregnant women. On average, 1000g of rice supplies with 6-24 mg of Fe and 14-58 mg of Zn while 1000 g of wheat provide 24-43 mg Fe and 16-26 mg Zn (White & Broadley, 2005). These values indicate that meeting the RDA for Fe and Zn through wheat and rice alone remains a considerable challenge.

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At the same time, large volumes of industrial and agricultural waste produced from iron and steel production units, waste from electroplating units and hydrometallurgical processes, blast furnace flue dust and others are rich in Fe and Zn but often remain untreated, posing economic and logistical burden. Blast furnace sludge contains 49–59 wt% Fe and 2–7 wt% Zn, converter slag (5 wt% Fe), and Fe-rich wastes such as red mud, nickel slag, and iron ore tailings (≥29 wt% Fe) possess significant potential as soil amendments.

Using these wastes as soil amendments can be investigated and utilized to increase the soil micronutrients along with prior toxicity evaluation. Utilising waste-derived amendments aligns with sustainable agriculture practices, reduces dependency on synthetic fertilizers and enhances both soil fertility and micronutrient content.

Keywords: Trace Elements, Human Health, Deficiency, Disorder, Cognitive Dysfunction and Hydrometallurgical Processes.

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Assessment of the Groundwater Quality for Drinking in Deoli Gujar Area of Butibori, Nagpur District, Maharashtra, Central India

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Deoli Gujjar area located at approximately 20.92257° N latitude and 79.06145° E longitude lies in the proximity of Butibori Industrial town near Nagpur city, Central India. Due to high industrialization, the groundwater in this area has become vulnerable for drinking as well as agricultural purposes. However, there has been no such data available on the quality of groundwater and local residents are using this water for drinking as well as irrigation purposes. Therefore, to assess the potability (suitability for drinking) of this water a systematic research work was carried out. During this study 10 water samples from dug wells, borewell as well as municipal tap-water were collected. These samples were analysed for Physico-chemical parameters such as pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), hardness, chloride, nitrate, sodium, potassium, fluoride, calcium and magnesium. The analyses were compared with the WHO recommended standards and also relatively with one and other. This study has indicated that the groundwater in the Deoli Gujar area is moderately suitable for drinking and irrigation. However, Chloride (Cl^-) shows relatively higher contamination, followed by Calcium (Ca^{2+}). Together, they can directly affect the human health by causing chloride-related disorders such as cardiovascular stress, neurological disorders, liver damage and kidney stone or gastrointestinal problems from excessive hardness and TDS. Constant exposure to contaminated water may increase long-term risks of chronic diseases. To combat

this, we recommend that future research is required to understand the other parameters of groundwater quality in the area. Also, through awareness programs, sustainable groundwater management, and policy measures, we can ensure safe water use and public health protection in the study area.

Keywords: Groundwater quality, Industrial contamination, Physio-chemical parameters, Chloride pollution, Drinking water suitability, public health risk

Fig 1. Map of the study area

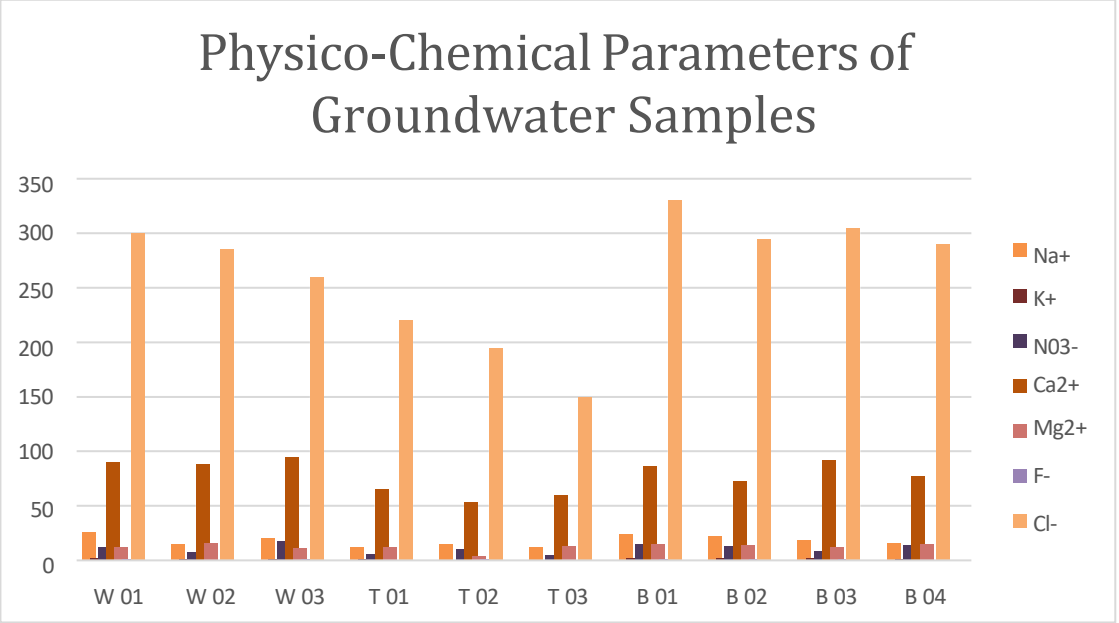

Fig 2. Physico-Chemical Parameters of Groundwater Samples

(W- represent Dug well, T- represent Tap-water and B- represent Borewell)

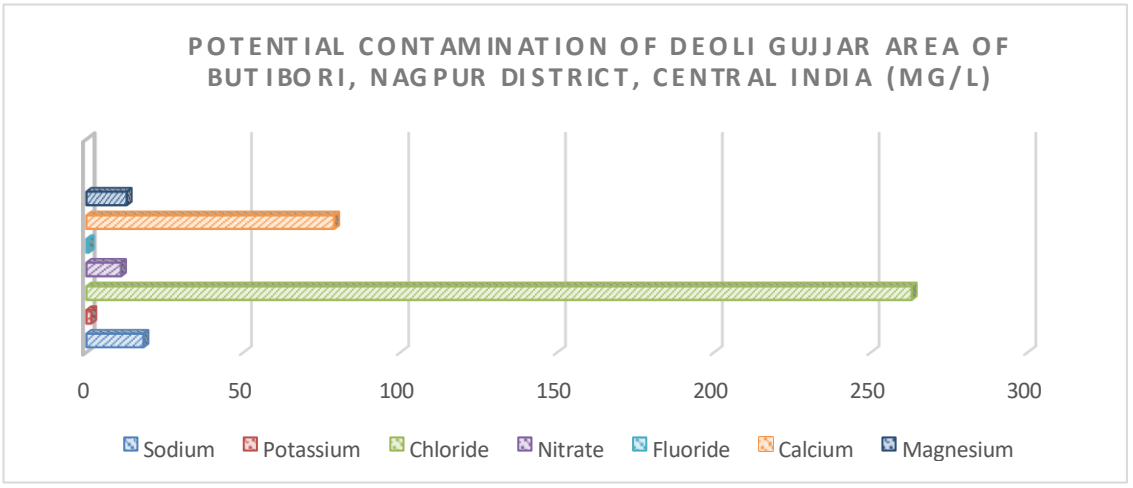

Fig 3. Potential Contamination of the study area

Table 1. Data table

Sr.no	Sample no.	PARAMETERS									
		pH	**EC**	**TDS**	**Na+**	**K+**	**Cl-**	**- NO3**	**F-**	**Ca2+**	**Mg2 +**
1	W01	7.2	680	435	26.2	2.4	300	12	0.8	90	12
2	W02	7.6	750	480	15.3	1.4	285	8	0.5	88	16
3	W03	6.9	610	390	20.6	0.9	260	18	0.8	95	11
4	T01	7.4	520	332	12.2	0.8	220	6	0.6	65	12
5	T02	7.8	590	377	14.4	0.6	195	10	0.9	53	14
6	T03	7.1	470	300	11.8	0.7	150	5	0.7	60	13
7	H01	6.8	890	564	24.6	2.2	330	15	0.8	87	15
8	H02	7	940	601	21.8	2	295	13	0.8	73	14
9	H03	7.3	1020	652	18.4	1.8	305	9	0.9	92	12
10	H04	6.6	850	549	16.2	1.6	290	14	0.6	77	15
WHO (2019)		6.5 - 8.5	<1500 µS/c m	<1000 mg/L	200 mg/ L	< 12 mg/ L	200–300 mg/ L	50 mg/ L	1.5 mg/ L	75 mg/ L	50 mg/ L
BIS (2022)		6.5 - 8.5	<1000 µS/c m	<500 mg/L	200 mg/ L	-	250 mg/ L	45 mg/ L	1.0 mg/ L	75 mg/ L	30 mg/ L
CGWB (2022)		6.5 - 8.5	<1500 µS/c m	< 500 mg/L	<200 mg/ L	<10-12 mg/ L	<250 mg/ L	< 45 mg/ L	< 1.0 mg/ L	< 75 mg/ L	< 30 mg/ L

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Medical Geology Perspective on Seasonal Dynamics of Trace Elements and Human Health Risk in Groundwater of the Cuddalore District, Tamil Nadu, India.

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Understanding the connection between geological processes and human health is central to medical geology. This study investigates the seasonal variability and geo medical significance of trace elements in groundwater of the Cuddalore District, Tamil Nadu, India. The main objective is to evaluate the concentration, spatial distribution and potential health risks of trace elements during pre- monsoon and post-monsoon periods, integrating hydro geochemical and geospatial tools to delineate medically vulnerable zones. Thirty-three groundwater samples were collected across diverse lithological units during pre- monsoon and post-monsoon seasons. Samples were analysed for Fe, Mn, Cu, Zn, Pb, Cr, Ni, As, and Cd using ICP-MS. The results were compared with WHO (2022) and BIS (2012) drinking water standards. Statistical analyses included Correlation, Principal Component Analysis and Hierarchical Cluster Analysis, to study control factors and pollution sources. Spatial interpolation mapping in ArcGIS identified potential medical-geological risk zones. Hazard Quotient and Hazard Index for both adult and child were calculated using USEPA (1989) methodology.

The results showed clear seasonal treads in trace elements: pre-monsoon season had Fe (4.7 mg/L), Mn (4.9 mg/L), Cu (4.7 mg/L) and Cd (0.019 mg/L) in coastal and deltaic regions due to water–rock interaction and Fe-Mn oxide dissolution, while post-monsoon dilution reduced most metals except, Fe and Mn persisted above permissible limits in certain inland locations, suggesting anthropogenic intrusion from agriculture and effluents. PCA revealed three major

factors controlling trace metal distribution: geogenic influence (Fe, Mn, As), anthropogenic input (Pb, Ni, Cr), and ionic exchange and adsorption processes. Health risk assessment showed HQ > 1 for Fe, Pb, and As, marking the north-eastern coastal belt as a medically vulnerable zone, especially for children. (Dipankar et al., 2023). Integrated hydro geochemical, statistical and geospatial approaches reveal that geogenic and anthropogenic processes jointly control seasonal trace element enrichment in Cuddalore's groundwater. The findings underscore the necessity for continuous monitoring, public health awareness, and sustainable groundwater management under a medical geology perspective to safeguard human health and ensure long-term water security in coastal aquifers.

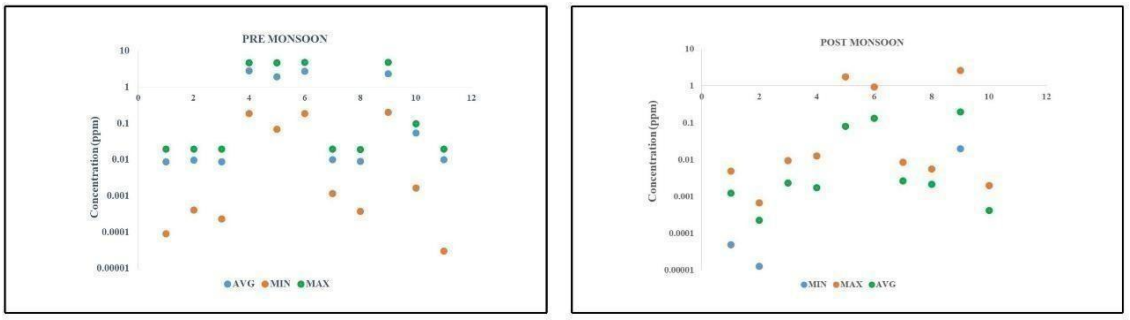

Fig 1. Graphical comparison of heavy metal concentrations in pre-monsoon and post-monsoon seasons.

Keywords: Human Health, Medical Geology, Geogenic Processes, Anthropogenic Processes and Adsorption.

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SOUTH ASIA EDITION 2025

Effects of Seasonal Dynamics on Trace Elements in Lateritic Soils of Central India: A PRISMA-Based Study Highlighting Issues Related to Tribal Health

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Lateritic soils are formed due to tropical weathering, which is quite prevalent in Central India. These lateritic soils contain high iron and aluminum oxide concentrations, low organic carbon, and acidic pH. These features significantly influence the bioavailability of trace elements such as iron (Fe), zinc (Zn), copper (Cu), and manganese (Mn). In Central India, particularly in the states of Madhya Pradesh and Chhattisgarh, agriculture follows shifting cultivation and relies mainly on nutrient-poor lateritic soils. Therefore, widespread malnutrition caused by micronutrient deficiencies remains a major health challenge, particularly affecting tribal children who are among the most vulnerable groups. This study tries to integrate and assess peer-reviewed evidence on the effects of seasonal variation of trace elements in weathered lateritic soils and their influence on the bioavailability of essential trace elements. The present study also tries to establish a link between the seasonal variation of trace elements in Central Indian lateritic soils with micronutrient deficiencies in tribal children in Central India. The study tries to provide a geo-nutritional framework by integrating pedo-geochemistry, nutritional epidemiology, and seasonal environmental dynamics. This study follows a PRISMA 2020 framework by synthesizing the literature between 1997-2024 across PubMed, ScienceDirect, MDPI, and SpringerLink, respectively. The search strategy was searching keywords such as ‘weathered soil’, ‘laterite soil’, ‘trace element bioavailability’, ‘micronutrient deficiency’, ‘seasonal variation’, ‘tribal children’, and ‘Central India’. After

screening 169 records, 32 duplicates were removed,46 studies were excluded for irrelevance, and 22 studies were included in synthesis (11 from India, 6 from Africa, 3 from other regions of Southeast Asia, and 2 global reviews). The review suggests that seasonal variation in soils influences the trace-element mobility and plant uptake. Oxidative processes in the dry season fix Fe and Mn as less soluble oxides. On the contrary, during the monsoon season, intense leaching and waterlogging promote the reduction of Fe (III) to Fe (II), which increases its temporary solubility. Under alternate wet-dry cycles, organic carbon in the soil decomposes rapidly, which reduces complexation capacity and micronutrient retention. In the case of Central India, 80% of the rainfall is concentrated in four months of monsoon, leaving eight months dry. During four months of monsoon, infiltration of rainwater and temporary reduction in redox potential lead to the mobilization of Fe2+ and Mn2+. Similarly, partial leaching of soluble Zn2+ and Cu2+ is also observed. On the contrary, the intensification of oxidation during the dry period of eight months leads to the reprecipitation of Fe and Mn oxides. Oxidation of Fe and Mn species during the dry period leads to increased adsorption of trace elements on these oxides. This leads to the reduced bioavailability of trace elements. Studies from India and Africa have shown that low availability of Fe from soil leads to low Fe content in the crops grown in this soil. Therefore, crops grown in dry periods (millets and pulses) contain reduced micronutrient content. Studies have also shown that consumption of such low Fe-containing food grains leads to latent iron deficiency, particularly in children. This explains the presence of iron-deficiency anaemia and zinc deficiency in tribal populations, particularly in tribal children, who consume these foods. Epidemiological studies in Central India showed high prevalence of iron deficiency (Fe<12µg/dl) and zinc deficiency (Zn<60µg/dl) in tribal children. These deficiencies are generally not related to the calorific intake but related to the low bioavailability of essential trace elements. Current review highlights the existence of a soil crop-human pathway that links seasonal lateritic geochemistry with the nutritional outcomes. Seasonal trace element speciation and plant uptake efficiency can be modified by applying

organic compost, lime, and the introduction of Fe/Zn-efficient cultivators, which can partially remediate these deficiencies. Current review highlights the requirement of an integrated approach that combines management of soil health, diversification of diet, and geochemical monitoring. Lateritic soils, formed through prolonged tropical weathering, dominate much of Central India and are characterized by high iron and aluminium oxides, low organic carbon, and acidic pH. These paedogenic features significantly influence the bioavailability of essential trace elements such as iron (Fe), zinc (Zn), copper (Cu), and manganese (Mn), micronutrients vital to both plant and human health. In tribal regions of Madhya Pradesh and Chhattisgarh, where agriculture is largely subsistence-based and relies on nutrient-poor lateritic soils, widespread micronutrient deficiencies persist among children. This PRISMA-style review consolidates evidence from 22 peer-reviewed studies published between 1990 and 2024 from PubMed, ScienceDirect, MDPI, and Springer, examining the seasonal and geochemical drivers of trace-element variability and its public health implications.

Keywords: Lateritic soils, Seasonal variation, Trace elements, Geo-nutrition, Micronutrient deficiency, Tribal health and Central India.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Aligning Waterborne Disease Control in Myanmar with the Sustainable Development Goals

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Waterborne diseases (WBDs) include diarrhea, cholera, dysentery, hepatitis A, and typhoid increase the global disease burden in developing nations due to poor water quality and sanitation. Diarrhea is a prevalent seasonal disease in Myanmar, responsible for 18% of deaths among children under five years of age (Lwin and Putra, 2018; Kamp, 2017). This study assesses the current situation through targeted case studies, examines the nexus between waterborne diseases (WBDs) and the Sustainable Development Goals (SDGs) in Myanmar, establishes a foundational policy-and-implementation framework to address WBDs.

Methods used were designed to investigate current condition of the severe cases of the WBDs while assessing the policy framework and nexus event with the SDGs. First, we used the World Health Organization data during the period of 1-7 Jul 2024 to 3-10 Nov 2024 and interpret the data trend. Second, we used the PRISMA method to review the entire status of the WBDs cases between the SDGs and future policy framework.

Myanmar's geography amplifies climate hazards—floods, cyclones/typhoons, heat waves, and drought—that overwhelm fragile WASH and health systems and raise waterborne disease (WBD) risks via latrine damage, saline intrusion, and drinking-water contamination, with pathogens such as *Vibrio cholerae* thriving in warmer waters (Zain et al. 2024; El-Sayed and Kamel, 2020; Win et al. 2025). Key indicators of WBD incidence and climate-related triggers are summarised in Table 1. Using a SWOT approach, this study examines how Myanmar's existing policies and institutions address waterborne diseases in relation to SDGs 3, 6, and 13.

The findings show encouraging signs of community engagement and policy commitment but also reveal gaps in coordination, surveillance, and climate resilience that continue to challenge effective action.

Table 1. Extreme weather and Hazard events impact on WBDs cases in Myanmar with risk ranking.

Extreme weather & Hazards events	Most affected areas by events	Impact on WBDs	Risk
Flooding	Mandalay, Bago, Kayin, Mon, southern Shan, Sagaing	Can increase the risk of destruciton of latrines. Increased strong rains and flooding can contaminate drinking water with germs from agricultural runoff, sewage, and animal waste.	High
Drought	Central Dry Zone (Mandalay, Sagaing, Magway)	Long-term droughts can reduce water supplies, causing people to depend on contaminated water sources.	Low
Heat waves	Central Dry Zone (Mandalay)	Extreme temperature increasing can level up the mobility of the microorganisms of WBDs within the water sources	Medium
Sea-level rise	Irrawaddy Delta and surrounding areas	Intrusion of saline can be cause of safe freshwater loss which can lead to diarrhea (indirect via unsafe sources)	Low
Cyclones/Typhoons	Irrawaddy Delta, Rakhine State	Displacement and crowding in shelters exert pressure on WASH services, thereby elevating the risk of transmission.	High
Earthquakes	Sagaing, Mandalay, Nay Pyi Taw	Broken pipes and tanks in the ground for sanitation can lead to usage of impurities of freshwater	Low

The findings underscore that integrating climate-responsive strategies within the SDG framework is essential for mitigating waterborne disease risks and enhancing resilience in Myanmar. The severe WBDs cases in Yangon and Rakhine should not be disregarded in the future.

Keywords: Sustainable Development Goals, Myanmar, Waterborne Diseases, Policy Framework, Drought and Community Engagement.

Acknowledgements: This study was funded by the Basic Science Research Program through the National Research Foundation of Korea (RS-2019-NR040076 and RS-2025-25426615) (NRF) funded by the Ministry of Education (2025).

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SOUTH ASIA EDITION 2025

Air Pollution and Health Risks: A Community-based Survey Study

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Pollution is a growing problem, especially in fast-growing cities like Bengaluru, seriously affecting the environment and the public health. This survey examines what the air quality of a city is and what are its sources of pollution and studies the effect on various ages or groups. Based on the community survey it is revealed that vehicle exhaust system, industrial activity and urbanization account for the greater part in making our life more miserable. It further searches the point of view of pollution and the effect of living near the busy road and industrial area, as it increases exposure and health risk. It is revealed that children, old age people and other vulnerable groups are especially susceptible to respiratory problems and heart ailments. The study indicates the necessity of carrying out preventive measures from strict emission standpoints leading to greater push for public transportation and forming greater green belts to protect health of the communities. In total, the information can be employed for empirical basis for specific measures and incentive campaigns against air pollution and its harmful effects in Bengaluru.

Keywords: Air Pollution, Health risks, Community survey, Bengaluru, Urbanization, Industrial emissions, Vehicular emissions and Public Awareness.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Disaster Management in Community Medicine

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People are the most crucial component in disasters. Therefore, when it comes to disaster preparedness, damage reduction, response, and recovery efforts, the health sector is among the most important. This study tackles some of the most important disaster medicine studies in history and explores the ideas of disaster medicine (DM) and disaster health under the umbrella of disaster medicine. Finally, this study examines the relationship between catastrophes and public health, emergency medical services, and definitive treatment centres (hospitals and other healthcare institutions), which are all parts of disaster medicine. Additionally, it offers case studies on disaster medicine from a few other nations.

Natural events and disasters around the world provide significant difficulties for national governments. Protecting people, property, and the essential life-supporting infrastructure required for disaster mitigation is the main problem. Any looseness or delay in disaster assistance could make the victims' suffering worse. Nearly every aspect of social and natural environments is severely damaged by natural catastrophes, from information and communication networks, power and energy supplies, transportation infrastructure, and housing and shelter to water, food, health, sanitation, and waste management. Pre-disaster early warning systems, food and clean drinking water supplies, health and sanitation, information and communication, power and energy for cooking and lighting, waste collection and disposal, including the prompt removal of human and animal corpses, disaster-proof housing and shelter, emergency and post-disaster shelters, rescue and relief efforts and transportation infrastructure are the main obstacles encountered in all disasters. Most emergencies cannot be avoided, but

by being prepared in advance, their consequences can be lessened or their scale reduced. In times of natural emergencies, advanced disaster management technology may offer disaster management authorities a vital support system. In today's world, such technology provides critical inputs for any disaster management strategy. Communities and people must be educated on pre-disaster planning and preparation. Awareness must be raised among the general public and first-aid training at the community level is crucial. A national disaster plan should outline the responsibilities of communities and local medical professionals. The study investigates the evidence for changes in thinking at the government and inter-governmental levels. It also examines how these policy initiatives are interpreted and implemented in practice.

Keywords: Disasters, Community, Disaster Medicine, and Policy.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Geospatial Analysis of Groundwater Quality in Kalyani River Sub Basin, Jalna District, Maharashtra

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Introduction:

Groundwater quality is critical for sustainable water resource management, particularly in semi-arid regions such as Jalna District, Maharashtra. The Kalyani River Sub-Basin, encompassing watersheds GP-33, GP-34, and GP-38 over an area of 444.71 km², experiences significant pressure from natural and human-induced factors. This study evaluates the hydrochemical characteristics of groundwater and identifies spatial variations and health risks associated with elevated contaminant levels.

Methodology:

A total of 56 groundwater samples were collected from dug wells across the sub-basin during pre- and post-monsoon seasons. Hydrochemical analysis included measurements of pH, electrical conductivity (EC), total dissolved solids (TDS), and major ions such as calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), nitrate (NO_3^{-}), and iron (Fe). Geographic Information Systems (GIS) and Remote Sensing (RS) techniques were employed to map and analyze the spatial distribution of groundwater quality parameters and their seasonal variability.

Results:

The findings indicate that Ca^{2+}, Mg^{2+}, Na^{+}, NO_3^{-}, and Fe concentrations frequently exceed permissible limits. Elevated TDS values were associated with calcretised soils, intense evaporation, and agricultural fertilizer use. Fertilizer runoff was identified as the primary source of excessive nitrate and sodium, particularly after monsoon periods when leaching intensifies. Spatial distribution maps revealed pronounced seasonal and locational variations linked to both geogenic and anthropogenic factors.

Conclusions:

High concentrations of nitrate, iron, TDS, and other ions pose significant public health risks, including methemoglobinemia ("blue baby syndrome"), iron overload disorders, renal ailments, hypertension (B.P), and gastrointestinal issues. Integrating geospatial, toxicological, and epidemiological frameworks enables risk-based prioritization of mitigation measures. Targeted interventions such as source protection, reduced fertilizer use, water treatment, and provision of alternative safe water sources are essential to safeguard vulnerable populations and ensure sustainable groundwater management.

Keywords: Groundwater quality, Geospatial analysis, GIS, Remote Sensing, Kalyani River Sub Basin, Jalna District.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Occupational Health Challenges in Archaeological Excavations: An Environmental and Ergonomic Assessment

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Archaeological field excavations are essential for reconstructing and revealing past human civilizations and their activities. Researchers, students and workers who participated in field-based excavations, often affected with physical, environmental and psychological stresses. This study reviewed and collected firsthand data on spectrum of issues faced during excavations projects including prolonged exposure of dust, variable microclimates, poor ergonomics, and insect related stressors. These conditions can lead to respiratory distress, musculoskeletal strain, and mental fatigue from manual or machinery digging, load carrying, inhaling dust and contaminants, dust exposures like mine and stone workers. Mental strains arising from uncertain project duration, high workload, family separation due to shift in remote locations, worker conflicts, financial problems etc. This sometimes related with environmental and geological setting depend on rock type, hydrological contaminations, geomorphic challenges, climatic conditions depend on site. This study is based on mixed method survey of excavation team members and workers, combined with field observations and condition of the sites. It provides quantitative and qualitative data on prevalence and severity of these problems. Analysis reveals strong correlations between environmental exposures work practices (prolonged bending, carrying, awkward postures), and physical ailments; similarly, uncertainty

Proceedings of the 4th International Student Conference on Medical Geology and Environmental Health South Asia Edition
Virtually, 24th to 29th November, 2025

and lack of rest / recovery predict elevated stress and anxiety. Based on these findings, the paper proposes an integrated health policy for excavation teams, featuring ergonomic tools and training, regular medical screening, acute and chronic exposure mitigation, and psychological support infrastructures. Such policies are critical to sustain researcher health, safety, and the long-term viability of field archaeology.

Keywords: Archaeology, Occupational health hazards, Environment, Medical geology, Excavations and Health.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Assessment of High-Risk Mosquito Breeding Zones using Remote Sensing and GIS- Based Techniques in Nagpur City, India: A Case Study of August 2025

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Mosquito-borne diseases (MBDs) pose a major public health challenge in India, where diverse ecological and socio-demographic conditions favour vector proliferation. Monsoon-driven warmth and humidity, coupled with rapid urbanization and transient climate variability connected to global scale phenomenon have expanded breeding habitats of mosquito species, especially, *Anopheles stephensi*, *Aedes aegypti*, and *Culex* species resulted in increasing risk of MBDs among vulnerable populations (Naik et al., 2023). Nagpur (21.1458° N, 79.0882° E), a major city in Central India having around 5 million population, has recently shown increased number of cases of MBDs. Considering the vulnerability of this large number of population, a systematic GIS based study of the MBDs has been carried out. The study was aimed at identifying the mosquito breeding zones within the city limits, and to identify the core breeding sites and providing necessary solutions for remediation. According to a report published in February 2025, *Aedes* mosquitoes, which are the primary vectors of dengue and chikungunya, were detected across several zones in the city. Although their abundance was lower than that of *Culex* species, which spreads nile fever, their presence highlighted an increased potential for disease transmission. For this purpose, Landsat-8 satellite imagery was collected and processed to derive Land Surface Temperature (LST), Normalized Difference Vegetation Index (NDVI), and Normalized Difference Built-up Index (NDBI). Mosquito breeding intensity data were

obtained from the Nagpur Municipal Corporation (NMC) report. This data was then interpolated using the Inverse Distance Weighted (IDW) method in ArcGIS. Data was collected in the month of August as it represents the peak monsoon season in the city, with high humidity, heavy rainfall, and stagnant water creating ideal conditions for mosquito breeding. Results indicate that the Dhantoli and Laxmi Nagar zones show the highest breeding intensities, classified as very high and high-risk zones, respectively. Mangalwari and Gandhibagh zones were classified as moderate risk zones whereas Satranjipura, Lakadganj, Ashi Nagar, Nehru Nagar, Hanuman Nagar and Dharampeth zones were classified as very low risk zones. A positive correlation was observed between LST and breeding intensity, with maximum breeding occurring in areas where LST ranged from 37–49°C, suggesting that warmer urban zones favour mosquito proliferation. NDVI showed a negative correlation with breeding intensity, as species like *Aedes aegypti* thrive in low-vegetation, built-up areas, unlike *Anopheles* species that prefer vegetated habitats (Ferraguti et al., 2016). Hence, in highly urbanized settings, low NDVI and high NDBI correspond to increased container density and elevated breeding risk. However, the optimal temperature range for *Aedes aegypti* development and virus transmission is reported to be 25–32 °C, beyond which survival declines (Doeurk et al., 2025), partially contradicting the observed trend. This suggests that LST alone should not be considered a direct indicator of mosquito breeding potential, as it measures surface heat rather than microclimatic conditions within water containers (Kolimenakis et al., 2021). Moreover, the use of 30 m resolution data may reduce LST accuracy compared to finer 10 m datasets (Sánchez et al., 2020). Present study is limited to August 2025 data and does not incorporate direct measurements of humidity, rainfall, or seasonal variability. Future studies should integrate multi-seasonal datasets, microclimatic variables, and species-specific preferences to enhance predictive accuracy and ecological relevance.

Keywords: Geospatial analysis, Risk Assessment, Urbanisation, Mosquito breeding intensity

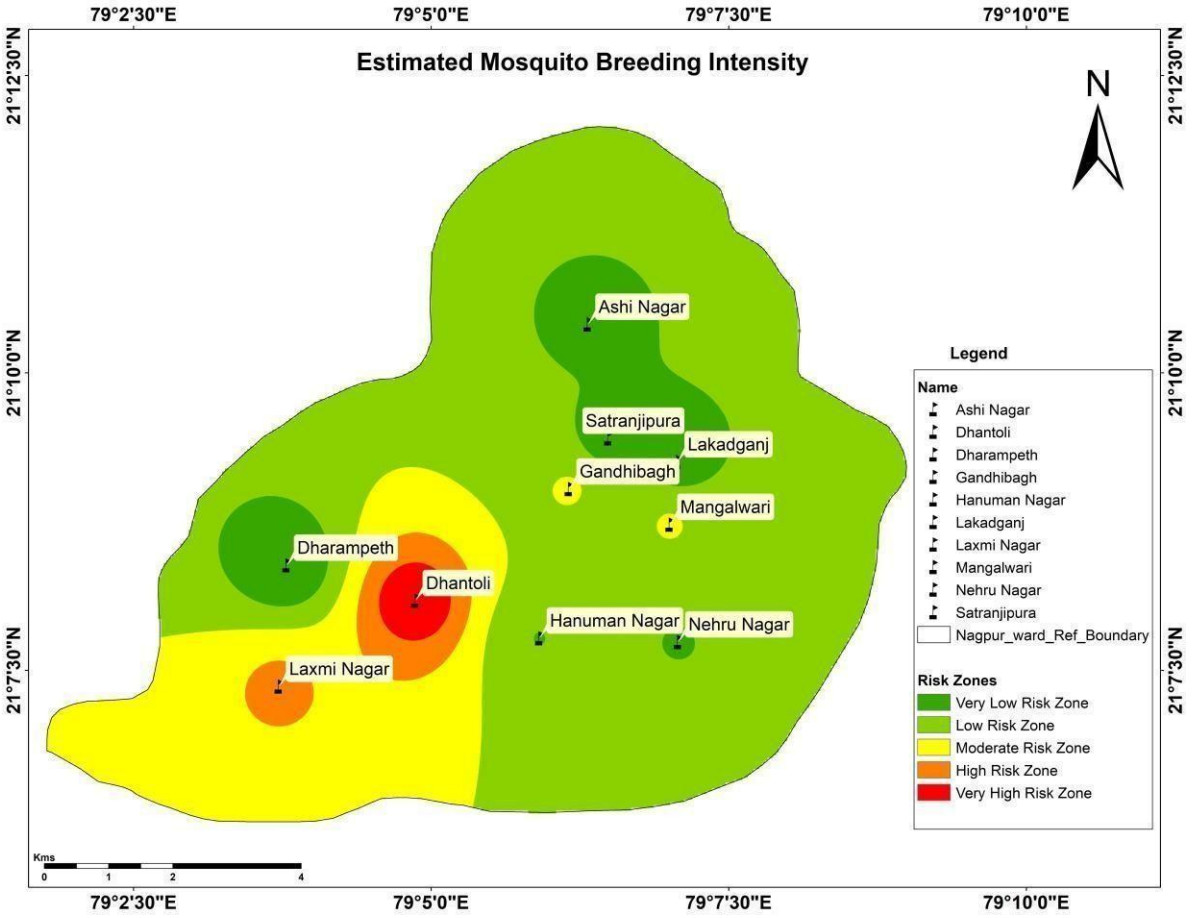

Fig 1. Mosquito breeding intensity risk zones in Nagpur City for August 2025 based on IDW interpolation

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4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Groundwater Geochemistry and Human Health Risk Assessment in Chitra Mining Area, India

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Coal mining, though a vital driver of regional energy security and economic development, exerts deep and often irreversible impacts on the surrounding environment, particularly on groundwater systems. Groundwater resources of the Chitra mining region of Deoghar, Jharkhand, are a primary source of drinking and domestic utilisation. Therefore, hydro-geochemistry and groundwater quality assessment are required. Hence, the primary objective of the study is to assess the seasonal variations in groundwater chemistry and estimate the risks to human health in the vicinity of the Chitra coal mine. A total of 74 groundwater samples were collected during pre- and post-monsoon seasons (2023–2024) and analysed for major cations (Ca^{2+}, Na^{+}, Mg^{2+}, K^{+}), anions (HCO_3^{-}, Cl^{-}, SO_4^{2-}, NO_3^{-}, F^{-}), total hardness, pH, TDS, EC, and turbidity. Hydrogeological approaches and GIS were used to understand the major controlling factors of the groundwater chemistry and to identify contamination hotspots. Groundwater chemistry of the study area indicates that pH is slightly acidic to slightly alkaline in nature during both seasons. Order of cationic concentration in the pre- and post- monsoon seasons are $Ca^{2+} > Na^{+} > Mg^{2+} > K^{+}$ and $Ca^{2+} > Na^{+} > Mg^{2+} > K^{+}$, respectively, whereas the anionic order followed the $HCO3^{-} > Cl^{-} > SO4^{2-} > NO3^{-} > F^{-}$ trend in the pre- monsoon season and $HCO3^{-} > Cl^{-} > SO4^{2-} > NO3^{-} > F^{-}$ in post-monsoon season. The calculated non-carcinogenic risk to human health of nitrate and fluoride in groundwater shows that 78%, 64% and 86% of the

samples have a hazard index (HI) >1 for male, female and child populations in the pre-monsoon season, and 78%, 72%, and 89% of the samples during the post-monsoon season. The present study recommends a regular groundwater monitoring programme in the study area to understand the long-term variation in the concentration of nitrate and fluoride. Also, it suggests that an appropriate treatment is required before the utilisation of groundwater for drinking purposes.

Keywords: Coal mining, Groundwater, Nitrate, Fluoride, Human Health Risk and Geographic Information System.

Acknowledgement: The authors acknowledge the SERB start-up Research Grant (SRG) (File No. SRG/2022/000355) and LRE for the financial support.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Ocular Health Hazards in Mining: Clinical Evidence, Systematic Classification, and Disease Triggers

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Mining environments expose workers to multiple ocular hazards caused by airborne particulates, toxic gases, radiation, and mechanical projectiles, resulting in a wide spectrum of vision-related disorders. While ergonomic, respiratory and dermatological effects of mining have been extensively studied, ocular health remains a neglected component of occupational health related research. This study aims to identify, classify, and evaluate the major ocular diseases associated with mining exposures and to establish disease-specific links with their environmental and occupational triggers. During the present study ocular diseases were systematically categorized according to the structures of the affected eye, as well as underlying causes. This study is further corroborated from an extensive literature search from all over the globe, and more importantly, documented clinically evidence. Our study reports a high prevalence of dry eye syndrome, conjunctivitis, pterygium, corneal abrasion, cataract, glaucoma, retinopathy, uveitis, and traumatic ptosis among mining and quarry workers. These diseases are primarily triggered by dust and particulate matter, chemical irritants such as formaldehyde, mercury, and cyanide, radiation from ultraviolet, infrared, and radon exposure, nanoparticles of metals and silica, and physical factors such as poor lighting, prolonged near work, and mechanical trauma. This paper presents clinical photographs depicting the ocular manifestations and their severity among miners, alongside a systematic classification framework linking each disease to its causative trigger and exposure type. The findings highlight significant diagnostic and preventive gaps, particularly the limited access to tests such

as Schirmer's Test, Tear Break-Up Time (TBUT), and Optical Coherence Tomography (OCT) in mining regions. The study brings to fore, an urgent need to integrate ocular diagnostics, occupational optometry services, and improved PPE design into workplace safety policies. Vigilance and safety assessment are required to efficiently controlled accident and prevention of eye sight of the miners at the mining site. By combining field observations with scientific literature, this work provides the first comprehensive visual and analytical framework for understanding ocular hazards in mining and allied industries.

Keywords: Ocular Health, Mining, Eye, Dust, Workers, Disease Triggers and Safety Policies.

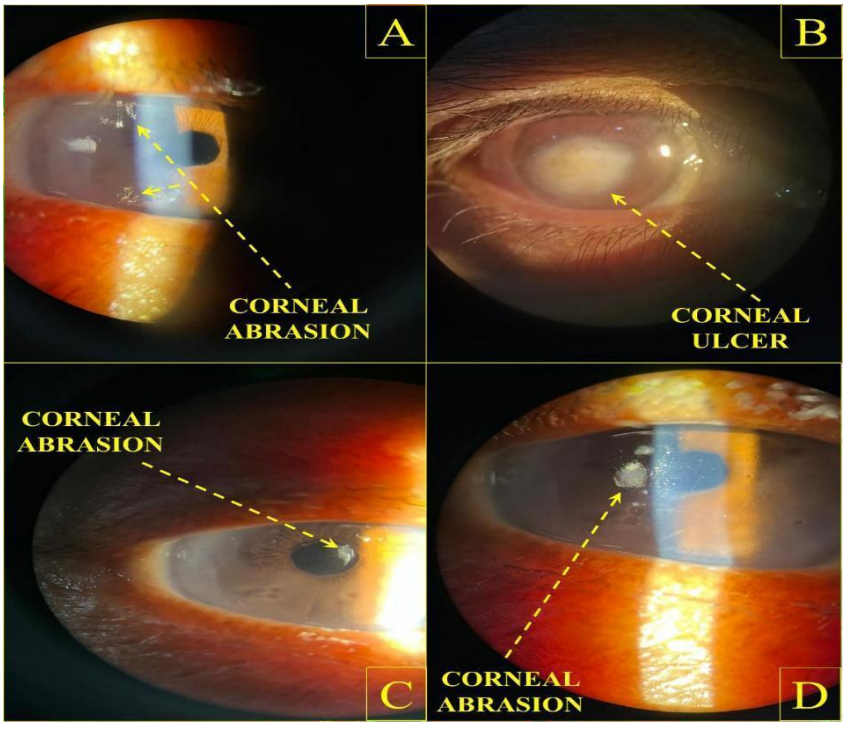

Fig 1. Slit lamp images depicting various ocular conditions: Images A, C, and D show corneal abrasions, while image B shows a corneal ulcer.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Geoart as a Tool for Treatment of Psychosomatic Diseases: A Curious Study of Pebble Art

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Medical geology is an interdisciplinary field that explores the connection between earth materials and human health, whereas Geoart, or the geological art, combines creativity with geology by using natural substances such as rocks, fossils, minerals, and landforms as artistic media or sources of inspiration. Pebble-based Geoart includes pebble mandalas (creative geometric arrangement of pebbles), pebble paintings (colouring of pebbles artistically), pet rocks (pebbles or stones that are treated as a companion 'pet', decorated or carved with artistic manner), balancing stones, and stone carvings. This pebble art is known to have tranquilising and healing effects. The existing literature from art therapy research, experimental studies on structured art such as mandala, colouring, and clinical reports on natural material applications, indicates that such practices have therapeutic value. Structured and repetitive art patterns, including painting or arranging pebbles, enhance focused attention and a meditative state that reduces anxiety and improves emotional regulation. Previous studies on Pet rock therapy (a creative therapeutic approach of treating a stone as a non-living companion 'Pet', for stress management), mandala colouring, and clay-based art therapy have demonstrated measurable reductions in stress, depression, and improved emotional balance. Similarly, working with natural earth materials like pebbles provides tactile grounding (a psychological regulation technique that uses touch and sensory awareness to help individuals to reconnect with the present moment, especially during anxiety and stress) and fosters emotional expression. Pebble art combines the calming touch of stone, the rhythm of structured creation, and the symbolic

comfort of personal connection, promoting mindfulness (psychological practice of deliberately paying attention to the present moment with awareness and acceptance of experiences) and psychological well-being. This study suggests pebble-based Geoart as a simple, sustainable, and geologically inspired approach that can support mental and emotional health. Pebble art, through its deep connection with human culture and history, offers a unique link between geology, art, and human health.

Keywords: Medical geology, Geoart, Pebble mandala; Art therapy, Mental health, Emotional regulation, Mindfulness, Therapeutic geology, Earth materials and Psychological well-being.

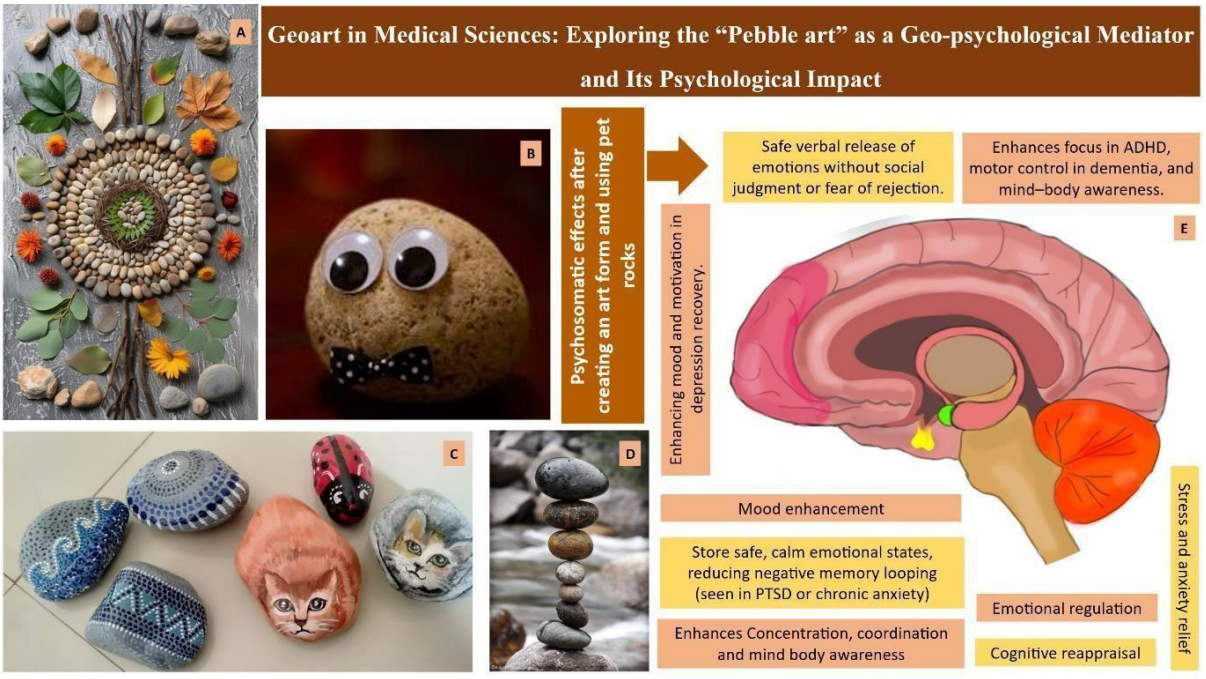

Fig 1. Pebble based Geoart having therapeutic uses A) Pebble Mandala, B) Pet rock, C) Pebble paintings, D) Balancing rock, E) Psychosomatic effects after creating art forms or after using pet rocks

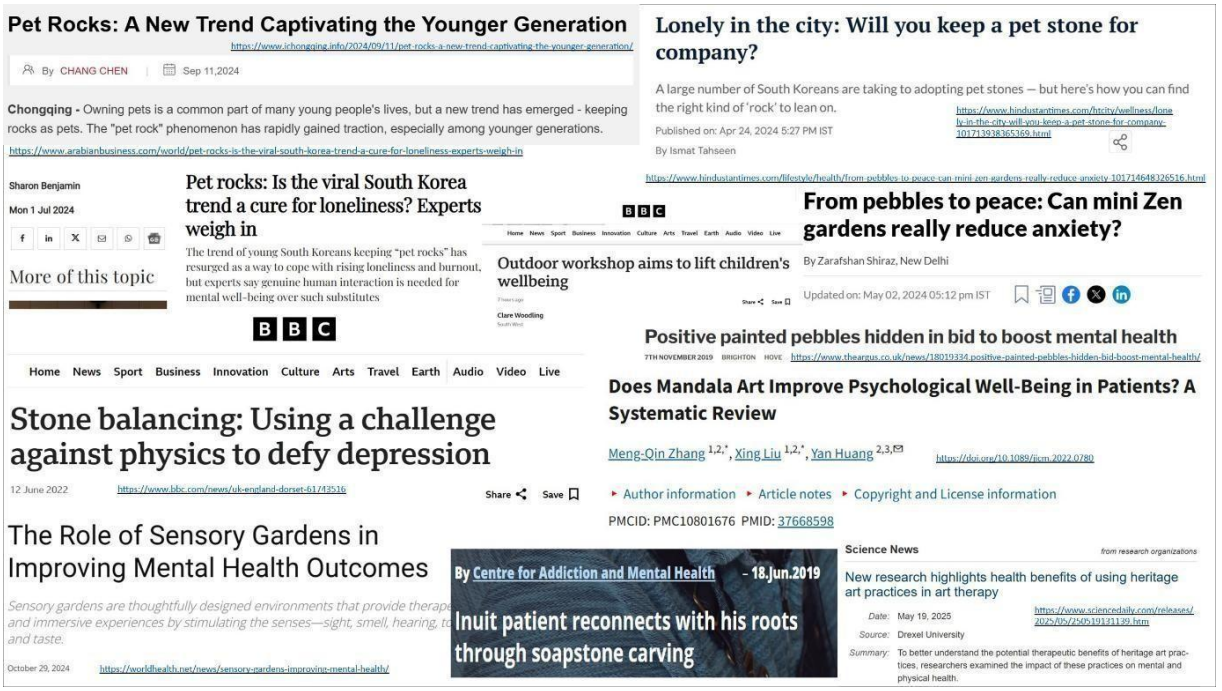

Fig 2. Representative news and research articles on the mental health benefits of pebble rock- based art forms, pet rocks, and stone balancing

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Synthesis of Sm Doped LaCePO4 Photoluminescent Nanofibers: Linking Mineral-based Phosphates with Luminescent Applications in Medical Geology

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Phosphate-based materials integrated with rare earth elements have received a lot of attention due to their structural stability, biocompatibility and environmental safety which makes them a promising candidate for photonic and biomedical applications (Lakshmi et al. 2024; Lakshmi et al. 2024). In this study, Sm-doped LaCePO4 nanofibers were successfully synthesized by electrospinning approach followed by controlled calcination. This approach made sure that the dopant ions were uniformly distributed in host lattice, which improved the crystallinity as well as surface morphology of prepared material. The thorough characterization was done using X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Fourier-Transform Infrared Spectroscopy (FTIR) and Photoluminescence (PL) analysis. The XRD results confirmed the formation of monoclinic monazite single-phase structure at 1000°C. SEM study reveals long, continuous, uniform fibers with smooth morphology and nanoscale diameter, indicating effective electrospinning. FTIR study confirmed the presence of characteristic phosphate functional group, which ultimately confirms successful phase formation. PL analysis at 365 nm excitation confirmed the prominent emission lines of Sm ions in the region 400 to 600 nm, blue-orange emission, of Sm3+ ions in the visible range with intensity depending on dopant concentration. The international commission on illumination, CIE, (x, y) chromaticity coordinates were found in the blue region. The potential of Sm doped LaCePO4 nanofibers for

biomedical imaging, environmental monitoring technologies and eco-friendly photonic devices has been demonstrated by its non-toxic nature, chemical stability and environmentally benign composition (Liao et al. 2024). This study indicates that the relevance of integrating geochemically inspired materials into health-related technology, which is in consistent with the ideas of medical geology and geo-pharmacy by linking mineral resources with advanced luminescent applications.

Keywords: Nanofibers, Photoluminescence, Electrospinning, Geo-pharmacy, and Medical Geology.

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SOUTH ASIA EDITION 2025

Monitoring of Sedimentation in Menik and Kumbukkan Rivers Associated with Gem Mining in Buttala, Sri Lanka

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The gem industry is one of the main industries in Sri Lanka, contributing significant to the country's economic development. Methods used in gem mining in Sri Lanka include digging deep mines, shallow open-pit mining, and riverbed mining. As a result of these practices, many environmental problems have arisen in and around gem mining sites. Water pollution in major rivers associated with gem mining areas has become major issue in recent years, affecting both ecosystems and human health. Therefore, this study has focuses on analyzing and monitoring sedimentation variations in two main rivers associated with gem mining sites in Buttala from 2021 to 2023.

Seven sampling sites were selected along the Menik and Kumbukkan rivers, located at varying distances (less than 100m to 1km) from gem mining sites. Water samples were collected monthly from these sample sites between 2021 to 2023 and analyzed for total dissolved solids (TDS), turbidity, pH, and electrical conductivity (EC). In addition, monthly precipitation data were recorded during this period. A Digital Elevation Model (DEM) was developed for the study area to determine the directions of rainwater flow.

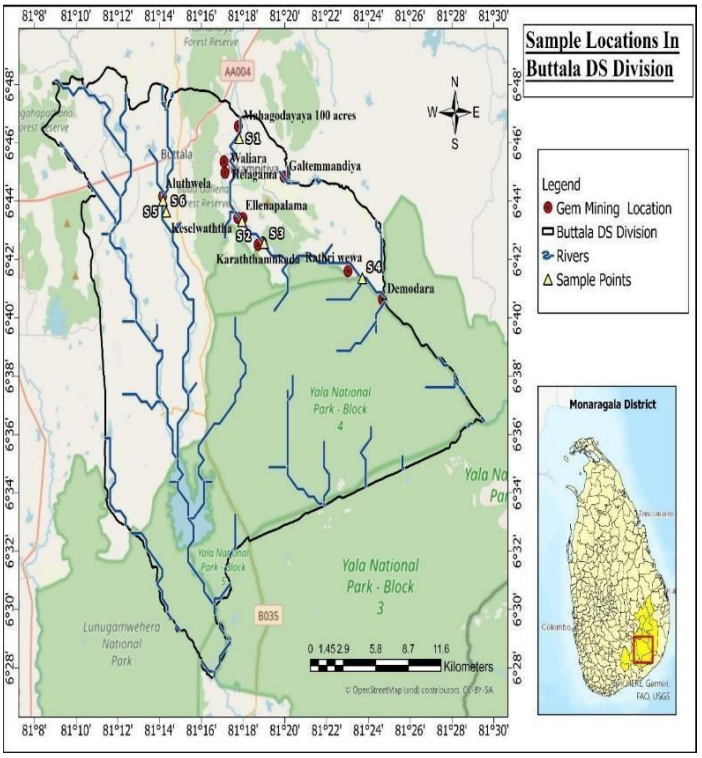

Fig 1. Sample sites

The analysis of the results clearly shows that sampling sites closer to gem mining areas recorded TDS levels exceeding 130 ppm and turbidity levels exceeding 200 NTU, compared to sites located further away. Moreover, surface water flow directions were not towards some of these sites, yet they still showed elevated TDS and turbidity levels. This indicates that the increased levels were not caused by rainwater flow. The results also revealed that higher TDS and turbidity levels were recorded during the months when gem mining activities were actively carried out in the area. Based on the results of the study, it can be concluded that gem mining activities in Buttala significantly contribute to increased TDS and turbidity levels in both rivers.

Keywords: Gem, Economic Development, Environmental Problems, Ecosystems, Human Health, Turbidity and Electrical Conductivity.

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SOUTH ASIA EDITION 2025

Performance Evaluation of an Iron Oxide - Graphene Oxide Coated Sand Composite for Manganese Removal in Pre-Filtration of Drinking Water

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Manganese (Mn) is a contaminant that poses a significant public health risk due to its widespread occurrence. According to the World Health Organization (WHO), the maximum permissible manganese concentration in drinking water is 0.4 mg/L. Many districts in Sri Lanka, namely, Ampara, Polonnaruwa, Colombo, and Kandy, have reported elevated manganese levels in groundwater. Sand filters are conventionally used in most drinking water systems. This study focused on the performance enhancement of the novel sand composite adsorbent synthesized by iron oxide and graphene oxide (designated as GOS-Fe-5) coated sand particles, for Mn removal at the drinking water pre-filtration stage. Sand performance was enhanced by modifying the sand reactivity using Sri Lankan graphite-derived graphite oxide (GO). Batch adsorption experiments were conducted to optimize key parameters, including solution pH, adsorbent dosage, contact time, and initial Mn(II) concentration. Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) was used to measure the residual manganese concentration. The maximum Mn removal efficiency of 86 ± 1.72 % was achieved at pH 7, with an adsorbent dosage of 4 g/L and a contact time of 180 minutes, for an initial Mn concentration of 0.5 mg/L. Under the same experimental conditions, uncoated sand removed less than 10 ± 0.16% of Mn, confirming the enhanced performance of the coated sand composite. Adsorption kinetics followed the pseudo-second-order model, while the equilibrium data best fitted to the Langmuir isotherm ($R^2 = 0.974$), with an adsorption capacity

of 0.36 mg/g, indicating multilayer adsorption on a heterogeneous surface. The reusability test showed that the GOS-Fe-5 maintained over 70% ± 3.02 % of its removal efficiency after the consecutive five cycles, indicating the practical application. Results demonstrate that the GOS-Fe-5 composite is a promising adsorbent for removing manganese from drinking water. Future work will involve evaluating its performance under continuous flow through column studies.

Keywords: GOS-Fe-5, Manganese Removal, Adsorption Isotherm, Water Treatment and Reusability Study.

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SOUTH ASIA EDITION 2025

Antimicrobial Performance of Silver, Zinc Oxide, Iron Oxide, and Copper Oxide Nanocoatings on Membrane Filters for Water Treatment

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This study focuses on the development and evaluation of nanocoated membrane filters using silver, zinc oxide, iron oxide, and copper oxide nanoparticles for the purification of water through membrane filtration. The primary objective was to examine the antimicrobial efficiency of these nanoparticles when applied as coating materials on polyvinylidene fluoride (PVDF) membranes, with particular emphasis on their ability to inhibit waterborne bacterial contaminants such as Escherichia coli, Klebsiella, and Pseudomonas species. Commercially available nanoparticles were suspended in distilled water, sonicated for uniform dispersion, and subsequently deposited on membrane surfaces using a vacuum-assisted coating process. The coated membranes were tested through three consecutive filtration cycles using bacterially contaminated water, followed by microbiological analysis of the filtrates on UTI chromogenic agar to determine colony-forming units per millilitre (CFU/ml). The results revealed that membranes coated with silver nanoparticles exhibited the highest and most consistent antibacterial activity, showing a progressive reduction in microbial colonies from 250 in the first cycle to 151 in the third cycle. This steady decline in CFU/ml indicates the sustained antimicrobial potential of silver due to its multiple modes of action, including ion release and reactive oxygen species generation. Zinc oxide nanoparticles showed partial antimicrobial efficiency, with noticeable bacterial reduction appearing only in the third cycle, suggesting that longer exposure or photoactivation enhances their performance. However, copper oxide and

iron oxide nanoparticles did not demonstrate measurable antimicrobial effects under the given experimental conditions, implying that their activity may depend on optimized synthesis or activation parameters such as ion availability or Fenton-type reactions. Overall, the study concludes that silver nanoparticle coatings offer the most effective and durable antimicrobial properties for water purification membranes, making them suitable for practical applications where prolonged microbial control and minimal chemical intervention are required. Zinc oxide may serve as a secondary or complementary agent in photocatalytic systems, while the limited response of copper oxide and iron oxide underscores the need for further optimization. The findings highlight the potential of nanotechnology in developing efficient, sustainable, and self-disinfecting filtration systems for safe drinking water.

Keywords: Silver Nanoparticles, Zinc oxide Nanoparticles, Iron Oxide Nanoparticles, Copper Oxide Nanoparticles, Nanocoated Membranes, Water Purification, Antimicrobial Filtration, Biofouling Resistance, Colony Forming Units (CFU) and Nanotechnology in Water Treatment.

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SOUTH ASIA EDITION 2025

Chemical Characteristics of Water-Soluble Ions in Size-segregated Particulate Matter in the Himalayan Foothill, India

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Size-segregated aerosol samples were collected over Itwa, Gorakhpur, in the Himalayan foothills, north India, employing a five-stage cascade impactor aerosol sampler. $PM_{0.95}$, $PM_{0.95-1.5}$, $PM_{1.5-3.0}$, $PM_{3.0-7.2}$ and $PM_{7.2-10}$ were collected simultaneously and studied for mass concentrations and water-soluble inorganic ions (WSII). Among different size fractions of PM_{10}, $PM_{0.95}$ was the dominant fraction (50%), followed by $PM_{3–7.2}$ (16%), $PM_{0.95–1.5}$ (15%), $PM_{1.5–3}$ (11%) and $PM_{7.2–10}$ (9%). $PM_{0.95}$ exceeded the limit of 40 µg/m^3 for $PM_{2.5}$ under the National Ambient Air Quality Standards (NAAQS) in India. The variations in WSII concentrations were specific to ion(s), aerosol size bin(s). Average concentrations of Ca^{2+}, Mg^{2+}, K^+, and Cl^- ions followed a bimodal distribution, while F^-, SO_4^{2-}, NO_3^-, and NH_4^+ ions showed a unimodal distribution. Among the anions, the highest concentration was observed for SO_4^{2-}, followed by NO_3^-, which indicated formation of secondary ions from their precursor gases SO2 and NO2 released by coal combustion and vehicular emissions. Secondary inorganic ions (SIN; NO_3^-, SO_4^{2-}, NH_4^+) dominated in the finest size fractions and the percentage contribution followed the order as $PM_{0.95}$ (69%), $PM_{0.95–1.5}$ (44%), $PM_{1.5–3}$ (29%), $PM_{3–7.2}$ (22%), and $PM_{7.2–10}$ (16%). The concentration of Na^+ and K^+ were high compared to other cations and varied depending on the size of particles. Principal component analysis revealed the mixing of several sources (geogenic, coal combustion, biomass burning, plastic burning, incinerators, and vehicle emissions sources) for soluble ions in different size fractions. The

particle load in each size fraction and the ionic characteristics of each size fraction varied depending on the strength and characteristics of the sources and meteorological parameters.

Keywords: Aerosols, Himalayan Foothills, Coal Combustion, Biomass Burning and Meteorological Parameters.

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SOUTH ASIA EDITION 2025

Bimetallic Oxide Nanopowder Entrapped into Biopolymeric Matrix for Adsorptive Confiscation of Crystal Violet Dye

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Dyes are basically chemical compounds that can connect themselves to surfaces or fabrics to impart colour. Colour in effluents can cause problems in several ways: dyes can have acute and/or chronic effects on exposed organisms depending on the exposure time and dye concentration therefore, removal of such coloured agents from aqueous effluents is of significant environmental, technical, and commercial importance. The citrate-mediated $CoFe_2O_4$ nanopowder was synthesized by using auto-combustion approach. The preparation involved mixing appropriate concentrations of cobalt nitrate and ferric nitrate with citric acid. The synthesized nanopowder was then added to the chitosan alginate mixture dripped in calcium chloride with glutaraldehyde as a cross-linking agent. The characterization of obtained nanocomposite ($CoFe_2O_4$-alg-cs) was carried out using FT- IR, TGA, SEM, EDX, particle size analysis and BET surface area analysis. The BET surface area was found to be 32.97 m^2g^{-1} and the nanocomposite was employed as a potential adsorbent for crystal violet dye. The batch adsorption experiments were performed; the optimized parameters were pH, Adsorbent dosage, Contact time, initial concentration and temperature. The maximum adsorption capacity (Qmax) at original pH was found to be 405.1 mg g^{-1} for crystal violet (with contact time of 1 min) and 1134.7 mg g^{-1} (with contact time of 60 min).

Keywords: Chronic Exposure, Exposure, Chitosan Alginate Mixture, Adsorption, Concentration and Temperature.

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SOUTH ASIA EDITION 2025

Lanthanum-Alginate-Activate Charcoal as Ternary Composite for Defluoridation of Water

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Fluoride contamination in water from natural and anthropogenic activities poses major environmental problems worldwide imposing serious threat to human health. As per WHO guidelines, the maximum permissible limit of fluoride in potable water is 1.5 mg/L. In order to overcome the problems associated with high fluoride concentration in water bodies, adsorption is the most suitable technique. In this study Lanthanum alginate (LA) modified Activated charcoal (LAC) have been synthesized as adsorbent for removal of Fluoride ions from water bodies. The adsorbent has been obtained in the form of spherical beads by dripping aqueous solution of sodium alginate or a mixture of activated charcoal and sodium alginate into lanthanum nitrate solution. The beads have been characterized using FTIR, SEM-EDX, TGA-DTA, XRD and BET surface area analysis. Batch adsorption studies are performed for defluoridation of water using the prepared composite. The pH point of zero charge was found to be 6.1. Maximum efficiency of the adsorbent is observed at pH 3.0 with adsorbent dose of 50 mg per 25 ml of 25 ppm fluoride solution and adsorption period of 90 min. Under this condition, LA-LAC is found to have an adsorption capacity of 37.77 mg/g. Thermodynamic parameters revel that the process was spontaneous in nature.

Keywords: Fluoride Contamination, Anthropogenic Activities, Environmental Problems, Adsorption and Thermodynamic Parameters.

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SOUTH ASIA EDITION 2025

Sequentially Modified Alginate Biopolymer for Enhanced Fluoride Removal: Insights from RSM and Column Studies

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This study explores the potential of alginate, a biopolymer derived from brown algae, for improving fluoride (F^-) removal in water treatment. Two alginate-based adsorbents are examined: zirconium-crosslinked alginate (AZ) and a newly developed composite (ALZ). AZ was formed by crosslinking alginate with zirconium, while ALZ was developed by incorporating ferric aluminosilicate laterite (FASL), a mining byproduct, into alginate before zirconium crosslinking (Aswin et al. 2020). Instead of disposal, FASL is reused to create a functional adsorbent with improved fluoride removal, highlighting the sustainable transformation of mining residues into useful water treatment materials (Zare et al. 2022).

Both AZ and ALZ were synthesized and characterized using SEM-EDX, FT-IR, TGA-DTA, XRD, XRF, and BET. Their ability to remove fluoride from aqueous solutions was tested, achieving over 70% removal efficiency through process optimization with response surface methodology (RSM). The adsorption process followed the Langmuir isotherm and pseudo-second-order kinetics. Increasing temperature improved fluoride adsorption for both materials, with maximum capacities at 30°C and 50°C: 70.27 mg g^{-1} and 117.64 mg g^{-1} for AZ, and 170.14 mg g^{-1} and 410.81 mg g^{-1} for ALZ, respectively. Thermodynamic analysis confirmed the process was spontaneous across all temperatures. Mathematical modelling was also used to predict fluoride breakthrough. The synthesis process demonstrated environmental sustainability, with a low environmental-factor (E-factor) of 0.023, highlighting its eco-friendly nature.

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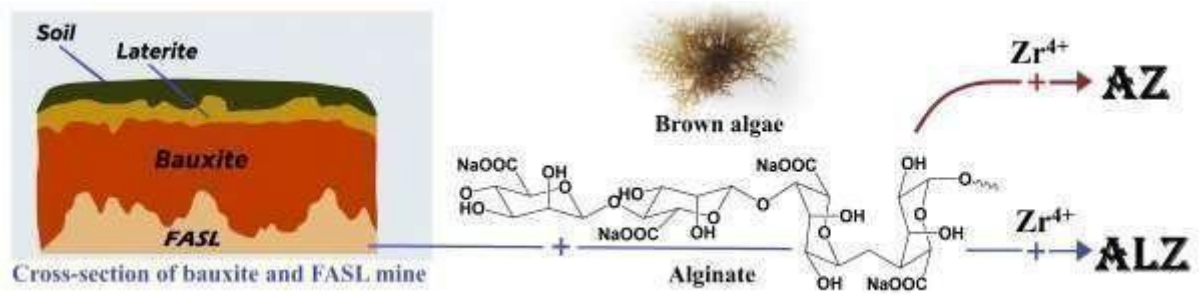

Fig 1. Graphical abstract of the synthesis of adsorbents AZ and ALZ

Keywords: Alginate, Biopolymer, Sustainable Transformation, Zirconium, Adsorption, Fluoride and Water Treatment.

Acknowledgements: Authors can acknowledge funding institutions and projects indicating the reference of the grants, as follows:

Authors are thankful to DST, New Delhi for DST-PURSE grant no. SR/PURSE/2024/354 and UGC-FRG, New Delhi SJSGC fellowship.

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4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Using GIS to Evaluate the Groundwater Quality Assessment in the Maharauni Block of Lalitpur District, Bundelkhand Region, for Suitability for Drinking and Agriculture

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Groundwater resource assessment is crucial, especially in the semi-arid regions. In this study, a multi-parameter appraisal of groundwater quality was conducted in the Maharauni Block, Lalitpur District, Uttar Pradesh. India leads the groundwater-source irrigation (39 million hectares; Mha), followed by China and the USA (Chaudhuri et al., 2021). Groundwater gets contaminated by various sources, which leads to water-related diseases, and it becomes a more worrying issue in semi-arid regions (Abanyie et al., 2023).

To assess the suitability for drinking purposes, parameters such as pH, TDS, EC, Turbidity, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, HCO_3^{-}, CO_3^{2-}, SO_4^{2-}, NO_3^{2-} and F^{-} were assessed in the laboratory, and were compared to the standards suitable for drinking using BIS and WHO standards. Kelly Ratio (KR), Magnesium Ratio (MR), Sodium Adsorption Ratio (SAR), and Residual Sodium Carbonate (RSC) values were calculated to assess the suitability of groundwater for agricultural purposes. The ArcGIS tool was used to prepare IDW maps for the parameters, and regions with deteriorating water quality were identified.

Groundwater characterisation using the Piper and Chaddha Plot suggests a recharging and Ca-Mg-HCO_3 water type. Overall, groundwater is suitable for agricultural purposes. Ca^{2+} and TDS showed high values in some of the regions. However, most of the physiochemical parameters were mostly under the suitability standards of BIS and WHO.

Proceedings of the 4th International Student Conference on Medical Geology and Environmental Health
South Asia Edition
Virtually, 24th to 29th November, 2025

Groundwater quality assessment is not only important for human health protection, but also helps authorities to make policies for sustainable water resource management. GIS is an essential tool that can help to carry out spatial interpolation, which can estimate quality parameters in unmonitored areas, and suggest contamination plumes.

Keywords: Risk Assessment, Contamination, Sodium Adsorption Ratio (SAR), Kelly Ratio (KR), Magnesium Ratio (MR), Residual Sodium Carbonate (RSC), Sustainable Water Resource Management

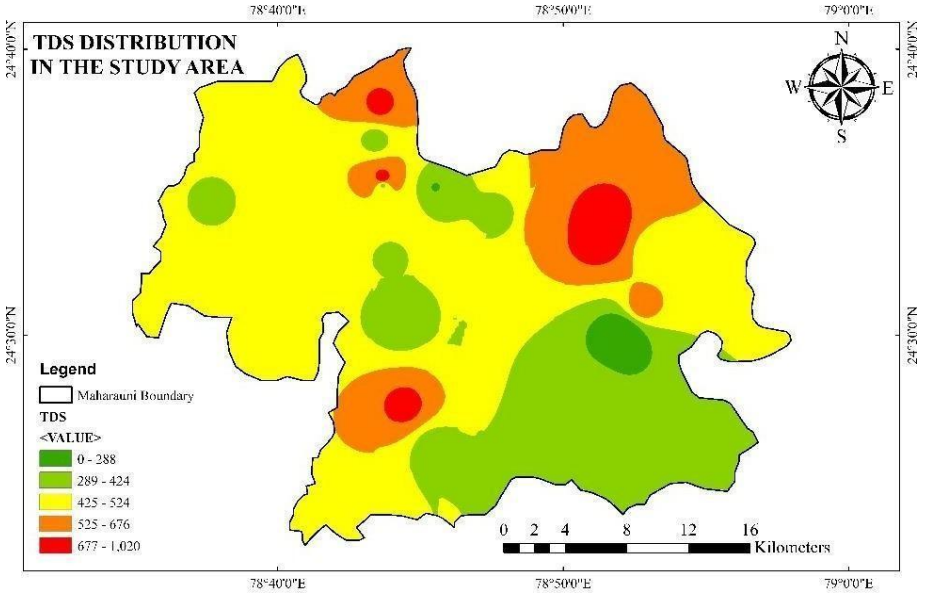

Fig 1. IDW Interpolation map of TDS variation in the study area.

Acknowledgement: I would like to thank the Hydro-chemical laboratory, Institute of Earth Science, Department of Geology, Bundelkhand University, for letting me carry out the analysis and the Department of Geology for the support.

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SOUTH ASIA EDITION 2025

Dual-Function p-Nitrobenzaldehyde Grafted Chitosan Aerogel for Efficient Adsorption of Anionic Surfactants and CO_2 Sequestration

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The present study introduces a novel chitosan-based aerogel grafted with *p*-nitrobenzaldehyde (Cs-g-PNB), developed for the dual functionality of removing Sodium Dodecyl Sulphate (SDS) surfactant from aqueous solutions and capturing carbon dioxide (CO_2) from the gaseous phase. The study addresses the urgent environmental demand for sustainable and multifunctional adsorbent materials capable of mitigating both surfactant-induced water pollution and atmospheric CO_2 accumulation. The methods employed were designed to investigate the adsorption performance, stability, and regeneration potential of Cs-g-PNB aerogel. Analytical characterization was conducted using FT-IR, SEM, EDX spectroscopy, TGA-DTA, and BET surface area analysis. The surface area was determined to be 3.91 $m^2\ g^{-1}$, exhibiting a mesoporous structure with an H4-type hysteresis curve. Adsorption experiments were performed under varying conditions of pH, contact time, and concentration, and the resulting data were modelled using Response Surface Methodology (RSM) for optimization. The Cs-g-PNB aerogel exhibited an impressive SDS adsorption capacity of 239.67 mg g^{-1} at pH 6.0, achieving equilibrium within 60 minutes. The adsorption process conformed to the Freundlich isotherm model and pseudo-second-order kinetic behaviour, with R^2 values of 0.999 and 0.997, respectively. Thermodynamic analysis confirmed the process to be spontaneous, exothermic, and enthalpy-driven. The aerogel maintained high adsorption efficiency even after

five adsorption-desorption cycles, demonstrating excellent reusability. Additionally, CO_2 adsorption experiments revealed a maximum capacity of 9.29 cc g^{-1} at 293 K, with a Q_{st} value of 26.87 kJ mol^{-1}, indicative of a physio sorption mechanism. This work demonstrates that Cs-g-PNB aerogel is an environmentally benign and economically viable material for SDS and CO_2 remediation. It effectively integrates high adsorption capacity, thermal stability, and regeneration efficiency with a low E-factor of 0.02, underscoring its sustainability. These findings collectively suggest that the developed aerogel represents a significant advancement in multifunctional adsorbent materials for addressing pressing environmental challenges.

Keywords: Thermodynamics, Physio-Sorption, Reusability, Sustainability and Regeneration.

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SOUTH ASIA EDITION 2025

Simultaneous Adsorption of Reactive dyes using Iron(lll)-Crosslinked Alginate Chitosan Composite: A Novel Approach via RSM

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The extensive discharge of reactive dyes from textile industries poses significant environmental concerns, necessitating sustainable solutions for complex wastewater treatment1. This study focuses on developing a novel iron-crosslinked alginate–chitosan (Fe–Alg–Cs) composite for the simultaneous multicomponent adsorption of reactive dyes. The composite integrates biopolymers with Fe^{3+} ions to enhance structural stability, porosity, and active binding sites2, enabling efficient multicomponent dye removal. The Fe–Alg–Cs composite was synthesized by dripping ferric chloride into the mixture of alginate chitosan and characterized using FTIR, SEM, EDX, BET and XRD analyses. Batch adsorption studies were conducted to evaluate the removal of Reactive Orange 16 (RO16), Reactive Violet 5 (RV5) and Reactive Blue 19 (RB19) dyes. The Response Surface Methodology (RSM) was employed to generate experimental combinations, facilitating a systematic assessment of individual dye uptake within ternary mixtures. This multi-component RSM model not only facilitates a deeper understanding of competitive adsorption behaviors but also serves as a predictive tool for optimizing dye removal in realistic wastewater scenarios. Under optimized conditions (pH 5.0, adsorbent dose 20 g, contact time 60 min), the composite exhibited adsorption capacities of 379.2, 345.6 and 195.2 mg g^{-1} for RO16, RV5 and RB19, respectively, attributed to its high surface area of 218.1 m^2/g. The adsorption process followed Langmuir isotherm and pseudo-first-order kinetics. The thermodynamic evaluation revealed that the adsorption process is

spontaneous, endothermic and entropy driven. The RSM model predicted high simultaneous removal efficiencies of 94.7%, 96.6% and 96.8%, demonstrating the composite's strong affinity and synergistic adsorption behavior. The Fe–Alg–Cs composite showed excellent reusability and process sustainability, supported by a low E-factor of 0.025, indicating minimal waste generation. These findings highlight Fe–Alg–Cs as a highly efficient, cost-effective and eco-friendly adsorbent for simultaneous adsorption of reactive dyes, offering promising potential for scalable wastewater treatment applications.

Keywords: Sustainable Solutions, Thermodynamics, Adsorption, and Kinetics.

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Removal of Dyes and Heavy Metals from Aqueous Waste using Activated Carbon Prepared from Neem Leaves (*Azadirachta indica*)

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Dyes and heavy metals are major pollutants released from industries like textiles, paper, leather, and electroplating. These substances are toxic, non-biodegradable, and harmful to aquatic life and human health even at very low concentrations. Conventional treatment methods are often costly and less effective for complete removal. In recent years, activated carbon has been considered one of the most efficient and economically viable adsorbents for wastewater purification. Among different raw materials, biomass-based sources like neem leaves (*Azadirachta indica*) are promising because they are low-cost, renewable, abundantly available, and environmentally safe. In this study, activated carbon was prepared from neem leaves through three main steps: pretreatment, carbonization at 400–600 °C under an inert atmosphere, and chemical activation using KOH as an activating agent This process helped to increase the surface area and porosity. The prepared activated carbon was analysed using FTIR and UV–Visible spectroscopy. FTIR confirmed the presence of hydroxyl (–OH), carbonyl (C=O), and ether (C–O–C) groups on the surface, while a UV–Visible peak near 275 nm indicated aromatic conjugation and partial graphitization. According to reported studies, neem-based activated carbon showed very high dye and heavy metal adsorption capacity., depending on pH, contact time, and adsorbent dose. Overall, neem leaf-based activated carbon is a low-cost and eco-friendly adsorbent that can effectively remove dyes and heavy metals from wastewater. The use of neem biomass not only helps in waste utilization but also supports environmental protection and the principles of green chemistry and sustainable development.

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Keywords: *Azadirachta indica,* Heavy metals, Activated carbon, Aquatic waste, Green chemistry

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Habitat Quality Assessment of a Lake using Plankton Diversity in Relation to Physicochemical Parameter

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Present work was carried out to assess the correlation between water parameters and seasonal variations of plankton diversity of manmade lakes in Anandwan, Warora Dist. Chandrapur (Maharashtra). These lakes were used for irrigation and aquaculture purposes. The water samples were collected from three lakes in the Anandwan region from January 2022 to December 2022. Physicochemical parameters show a positive correlation between temperature and dissolved oxygen. Other parameters viz COD, and BOD are also showing correlation. There exists a significant correlation between the plankton count and the Physico chemical parameter. Total phytoplankton count ranges from 216-5011.2 no/ml belonging to class Chlorophyceae, Cyanophyceae, Bacillariophyceae, Cryptophyceae, Euglenophyceae, Florideophyceaeand zooplankton ranges from 155-685no/mlfrom Protozoa (paramecium) and Arthropoda phylum viz, Copepods, Cladocera and Rotifera. In Phytoplanktons, out of 12 genera, Closterium was found dominant followed by Cylinderospermum, Fragillaria, and Phacus as well as Batrachospermum. While in Zooplankton Nauplius was reported as dominant followed by Paramecium, Ceriodapnhia dubia, and Branchionus caudatus. Diversity indices, Dominance, and richness index were also calculated. The trend of dominance is as follows: Phytoplankton: Chlophyceae >Cyanophyceae > Bacillariophyceae > Euglenophyceae = Florideophyceae; Zooplankton: Copepods > Protozoa > Rotifera> Cladocera

Keywords: Plankton, Water quality, Margalef's index, Dominance index

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Green Valorisation of Mining Waste into Functional Nanoparticles: A PRISMA-Guided Review Integrating Nanotechnology and Ayurveda

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Mining waste is a major source of anthropogenic pollution which contains substantial amount of minerals and metal oxides. These metal oxides are derived from ores extracted during the mining activity. These valuable minerals and metal oxides can be repurposed and recovered as nanoparticles with the help of modern nanotechnological processes. These modern nanotechnological processes which include chemical reduction, sol-gel, hydrothermal, and co precipitation, can be environmentally threatening due to solvent toxicity, high temperature requirements, and waste effluents. These environmental impacts can be reduced with the help of green synthesis approaches. Current review tries to provide green synthesis processes with the help of Ayurvedic Bhasma preparation methods. This review is structured according to the PRISMA framework. We critically examined 78 studies were retrieved from PubMed, ScienceDirect, MDPI, and Springer databases. From these retrieved researches, 13 studies met inclusion criteria focusing on nanoparticle synthesis from mine waste, biological synthesis, and Ayurvedic Bhasma processes. Ayurvedic Bhasma preparation processes include herbo-mineral processing, controlled incineration, and organic reduction. Combination of these processes on metals and minerals leads to the nanoparticles produced with the help of biomaterials known as bhasma. The analysis demonstrated a gap between nanoparticles synthesis from mine waste and limited availability of green, environmentally friendly methods. Bhasma preparation methods align with the bioinspired principle of green synthesis of nanoparticles. These green

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synthesized nanoparticles have wide applications in environmental remediation, biomedicine, and catalytic sensors. Therefore, ayurvedic bhasma preparation methods align with the principle of green nanoparticle synthesis which can be used to transform mine waste into nanoparticles. Integration of mine waste valorisation, green nanotechnology, and ayurvedic bhasma preparation methods provide a sustainable pathway for nanoparticle production. This integrated approach moves beyond remediation and moves towards functional circularity, which allows conversion of pollutants into sustainable high value materials. Furthermore, it also aligns with the UN Sustainable Development Goals (UNSDGs) which includes responsible production, clean water, health, and sustainable industry.

Keywords: Mining Waste Valorisation, Nanoparticles, Ayurveda, Bhasma Synthesis, Environmental Remediation, Biomedical Nanotechnology, and Sustainable Nanoscience.

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Adsorptive Removal of Crystal Violet Dye from Wastewater Using Zeolitic Imidazolate Framework-67 (ZIF-67)

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Water contamination, due to rapid urbanization and industrialization, poses a significant threat to both environmental and public health. Contaminated wastewater with synthetic dyes causes a major environmental and health risk. Among these, crystal violet is non-biodegradable, carcinogenic, and toxic to aquatic ecosystems. Its complex molecular structure renders it resistant to degradation by conventional treatment methods. Among alternative methods, adsorption stands out due to its simplicity, cost-effectiveness, operational flexibility, and potential for regeneration. In recent decades, Zeolitic Imidazolate Frameworks (ZIFs) have been the next-generation adsorbents due to their high surface area, chemical stability, and tunable pore structures. ZIF-67 was synthesized via room-temperature co-precipitation using cobalt nitrate and 2-methylimidazole. It forms a purple crystalline solid. ZIF-67 exhibits a large surface area and pore size, suitable for adsorbing large organic molecules like crystal violet. Different characterizations were performed, such as XRD, BET, FT-IR, and TGA-DTA. Optimal adsorption was observed at pH 9.0 with a dose of 10 mg in an initial dye concentration of 50 ppm, 90 minutes of contact time, and a temperature of 303.15 K. The adsorption of crystal violet on ZIF-67 follows the Langmuir adsorption isotherm, which proves a monolayer adsorption on homogeneous surface of the adsorbent. The maximum adsorption capacity of ZIF-67 for removal of this dye was 303.2 mg/g.

Keywords: Contamination, Urbanization, Industrialization, Adsorption and Carcinogenic.

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Monitoring Turbidity Levels in Kandy Lake, Sri Lanka, using Remotely Sensed Data

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Kandy lake was built by King Sri Wickrama Rajasinghe in 1807 and is admired by both tourists and locals for its scenic beauty and cultural significance. The lake has a perimeter of 3.21 km and covers an area of 6544 m^2. As many drains are connected to the lake, the deposition of sediments has become a major issue, particularly during the rainy seasons, as it reduces the scenic beauty of the lake. With the increase in sediments such as clay, silt, organic debris, algae and plankton, the turbidity levels of lake have also risen. This happens because suspended or dissolved particles scatter light as it passes through the water, resulting cloudiness. Therefore, this study focuses on examining the spatial variation of turbidity levels in the lake and their influence on the health of the lake from 2018 to 2024.

In this study, Sentinel-2 Level-2A satellite imagery, collected using the Google Earth Engine JavaScript Application Programming Interface (API) was used to assess turbidity and chlorophyll-a concentrations. Two turbidity indices, namely the Normalized Difference Turbidity Index (NDTI) and the Normalized Difference Chlorophyll Index (NDCI), were applied to analyze turbidity and chlorophyll-a concentrations across the entire lake during study period. By analyzing the data using Local Moran's I, statistically significant spatial clustering and outlier patterns of turbidity were identified during the study period.

These clusters include high-high clusters, with elevated turbidity values predominantly in the Western, Northeastern and Southeastern parts of the lake, corresponding to stormwater inflow points and areas influenced by urban runoff. Low-low clusters were mainly observed in the

central region of the lake, where water conditions are stable human impact is limited. High-low outliers, characterized by high turbidity levels surrounded by low-turbidity neighbors, correspond to isolated disturbances such as temporary dumping or sudden runoff after rainfall events.

Based on the overall analysis, it can be concluded that the turbidity in Kandy lake is not randomly distributed but is strongly influenced by external inputs and hydrological connectivity. The persistence of statistically significant high-high clusters in the same locations over multiple years indicates long-term pollution stress, while the occurrence of high-low outliers reflects occasional and seasonal fluctuations followed by monsoon periods.

Keywords: Turbidity, Normalized Difference Turbidity Index and the Normalized Difference Chlorophyll Index and Monsoon Periods.

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Potential Role of Flueggea leucopyrus Plant Leaves Lectins, Purification, Characterization, and its Use as Early Screening Marker for Cancer

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Lectins are carbohydrate-binding proteins widely distributed in nature, particularly in various plant species. They are involved in several physiological processes, including modulation of the immune response. Recently, increased attention has been focused on their notable anticancer properties, which are associated with mechanisms such as cell adhesion, regulation of cell proliferation, and induction of apoptosis. These features make lectins promising candidates in cancer research, especially for diagnostic and therapeutic applications. One of the major challenges in lectin research today is exploring their potential in biotechnology and glycoproteomics. Glycoproteomics is a powerful analytical approach for characterizing lectins and their glycan-binding specificities and is expected to play an indispensable role in the development of future lectin-based drugs. Early detection of cancer significantly improves treatment outcomes. Therefore, there is a pressing need to develop simple, cost-effective, and rapid mass screening tests, especially for people living in cancer- prone industrial zones. In this context, the present study explores the agglutination patterns of ammonium sulfate partially purified lectins extracted from Flueggea leucopyrus leaves. These lectins were tested against erythrocytes obtained from both healthy individuals and patients with different types of cancer to determine their hemagglutination units (HAUs). The study revealed distinct hemagglutination responses between normal and cancerous erythrocytes, indicating potential

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selective binding of the lectin to altered glycan structures associated with malignancy. These findings suggest that Flueggea leucopyrus leaf lectin could serve as a promising biomarker for early cancer detection. This plant-derived lectin may be developed into a novel tool for mass screening in epidemiological cancer surveillance. This could enable early diagnosis among high-risk populations and significantly contribute to reducing cancer- related morbidity and mortality through timely intervention.

Keywords: Immune Response, Therapeutic Applications, Glycoproteomics, Morbidity and Mortality.

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SOUTH ASIA EDITION 2025

Influence of Subsurface Lithology on Groundwater Hardness in Matale District, Sri Lanka

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Water hardness is a major factor affecting water quality, and high hardness levels can seriously deteriorate drinking water. Studies have shown that tube-well water in several dry zone areas of Sri Lanka such as Matale, Hambantota, Anuradhapura, and Jaffna contain high hardness concentrations (Dissanayake and Weerasooriya 1985). Many people in these areas depend on dug wells and tube-wells for their daily water requirements, prolonged use of hard water has been linked to health issues, including kidney diseases. To investigate this issue, a study was conducted in the Matale district to determine whether lithological conditions influence groundwater hardness, 97 spatially distributed locations, comprising both dug-wells and tube-wells, were selected for sampling. The collected water samples were analyzed for hardness concentrations at the National Water Supply & Drainage Board in Matale. Results indicated that out of 54 tested samples, 33 samples from the western and southwestern regions of the district exhibited high to very high hardness levels based on WHO drinking water standards. In contrast, only 8 other samples from other parts of the area showed similar high concentrations.

To analyse whether there is a relationship between groundwater hardness and the subsurface lithology, the digital geological map from the Geological Survey of Sri Lanka was superimposed onto the sample location map of the study area. After the analysis, it was found that 41 groundwater samples with very high to high hardness concentrations were located

within Marble, Limestone or Calc-Silicate rocks, while groundwater samples with low hardness concentrations were found within Quartzite and Hornblende-Biotite gneiss.

Additionally, a correlation analysis was conducted in between lithological units and the groundwater hardness concentrations, which showed a correlation coefficient of 0.81, indicating a strong positive correlation. Thus, it can be concluded that there is a significant relationship between lithological units and groundwater hardness concentration.

Keywords: Groundwater Hardness, Health Issues, Kidney Diseases, Subsurface Lithology, Quartzite and Correlation Coefficient.

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SOUTH ASIA EDITION 2025

Assessment of Fluoride and Turbidity Removal Potential of re-activated Carbon Produced from Spent Household Water Filters

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The amount of clean and safe drinking water is limited in Sri Lanka. However, high concentrations of fluoride (>1.5 mg/L) and turbidity are major drivers of health-related issues including dental and skeletal fluorosis and waterborne diseases. Conventional treatment methods are often not reliable in resource-scarce environments. Adsorption is recognized as a cost-effective and simple method for such conditions. In this study, activated carbon in the discarded household water filters were reused and tested to assess their performance in removing fluoride and turbidity from synthetic water samples. Raman and Fourier Transform Infrared Spectroscopy (FTIR) spectroscopy were used to determine the structural integrity and functional group availability of the recycled activated carbon (RAC). Batch experiments were conducted to study the effect of adsorbent dosage, initial contaminant concentration, contact time, and pH. The RAC showed high removal efficiency, achieving 96 ± 1.2% fluoride removal within 30 minutes and 98.7± 0.8 % turbidity removal within 120 minutes. Langmuir and Freundlich isotherms fit the data well, with Langmuir being the best fit, indicating monolayer adsorption and a maximum fluoride adsorption capacity of 0.985 mg/g. Kinetic analysis revealed that the pseudo-second-order model defined the adsorption process best, confirming a chemisorption mechanism. Furthermore, RAC maintained performance after multiple regenerations with NaOH, indicating reusability. These findings highlight the potential of

converting post-consumer waste into sustainable adsorbents for decentralized water purification applications in fluoride- and turbidity-affected areas.

Keywords: Fluoride removal, Water treatment, Recycled Activated Carbon, Adsorption Isotherm, Regeneration, Turbidity Removal.

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SOUTH ASIA EDITION 2025

Geochemical Assessment of Heavy Metal Contamination and Ecological Risks in Carbonaceous Phyllite Sediments, Northeast Himalaya, India

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This study provides a critical assessment of heavy metals in carbonaceous phyllite sediments from the Northeast Himalaya, India, by using various pollution indices (EF, Igeo, CF, PLI, PINemerow, mCd, mEr, and MRI)[1-6]. Sixty-five samples were analysed for 12 elements, including Al, Fe, Ti, Mn, Co, Cr, Cu, Ni, Pb, Sr, V, and Zn. The geometric mean order of heavy metals concentrations in the study area: Al>Fe>Ti>V>Cr>Mn>Ni>Cu>Sr>Zn>Co>Pb. The coefficient of variability (CV%) of the metal content was ranked as Cu>Ni>Co>Zn>Mn>Sr>Al>Cr>Ti>Fe>Pb>V. The enrichment factor (EF) for heavy metals, specifically Mn, Co, Ni, and V, falls under the category of EF 20-40, suggesting a high contamination of sediments. The order of the median EFs of the heavy metals was as follows: V>Cr>Cu>Ni>Al>Co>Ti>Pb>Mn>Zn>Sr. The geoaccumulation index (Igeo) values ranged from -5.1 to 4.9, with Ni and V showing the lowest and highest Igeo values, respectively. V exhibits the highest Igeo variation from 0.31 to 4.95. Mn, Co, Cr, Cu, Ni, Pb, and V are exhibiting the highest contamination factor CF value, indicating very high contamination (CF>6) and moderate contamination (1<CF<3) is observed for Fe, Al, Ti, and Zn. The pollution load index (PLI) values range from 0.50 to 2.03. 37 samples indicated the presence of metal pollution in the sediments. The nemerow pollution index (PINemerow) ranged from 0.76 to 13.51 and 55 samples show (PINemerow >3), indicating high pollution in the sediments. The modified degree of contamination (mCd) varied from 0.82 to 6.99, indicating very low to high pollution in the sediment samples. The order of the median of potential ecological risk factor

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(mEr) of the six heavy metals is Cu>Ni>Cr>Pb>Mn>Zn, and the median of potential ecological risk index (MRI) was 70.18. The results indicated a generally moderate to high contamination level in the area, with a few outliers indicating very high sediment contamination.

Keywords: Sediment Contamination, Ecological Risk, Contamination, Heavy Metals and Carbonaceous Phyllite Sediments.

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SOUTH ASIA EDITION 2025

Synergistic Stabilization of Paddy Straw Biochar: A Comparative Analysis and Techno-Economic Modelling of Organic Amendments for Sustainable Field Application

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Choosing effective soil amendments requires balancing long-term stability with economic viability. While pure biochar (PSB) produced from paddy straw is highly stable, its cost is prohibitive. This study developed a Stability-Cost Index (SCI) to evaluate the synthesized biochar and its 1:1 mixture with farmyard manure (FB), mustard cake (MB), and vermicompost (VB). Stability was assessed using parameters including H/C ratio, Thermostable Fraction (TSF), Recalcitrant index (R50), Crystallinity Index (CrL), and Surface Area. Principal Component Analysis (PCA) was used to synthesize these metrics. The first principal component (PC1) explained 74.4% of the variance and was positively correlated with key stability indicators like TSF (0.47) and R50 (0.47), confirming it as a robust proxy for overall stability. A normalized Stability Index (SI) derived from PC1 scores showed PSB (SI=1.0) was the most stable, followed by VB (SI=0.41), FB (SI=0.24), and MB (SI=0.0). A Cost Index (CI) was also developed, where FB was the cheapest (CI=1.0) and PSB the most expensive (CI=0.0). The final SCI, weighting stability and cost equally (50:50), revealed that the FB mixture (SCI=0.62) ranked 1st, offering the best balance. It was followed by VB (SCI=0.57, Rank 2), pure PSB (SCI=0.50, Rank 3), and MB (SCI=0.22, Rank 4). This index provides a practical tool for selecting the most cost-effective and persistent biochar-based amendment.

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Keywords: Biochar, Soil amendments, stability – cost index, sustainable agriculture, carbon sequestration.

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Microalgae-Based Bioremediation: A Review on Green Solution for Heavy Metal and Emerging Pollutant Removal

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This review explores the potential of microalgae as sustainable agents for the bioremediation of heavy metals and emerging pollutants. Due to their high photosynthetic efficiency, rapid growth rate, and ability to thrive in harsh environments, microalgae provide an eco-friendly alternative to conventional physicochemical remediation methods that are costly and generate toxic sludge (Mahlangu et al. 2024, Ranjbar and Malcata, 2022). Their capacity to utilize nutrients from wastewater while simultaneously sequestering metals and organic contaminants makes them ideal candidates for integrated wastewater treatment and biomass valorization (Rajput, 2024).

Recent scientific reports highlight multiple mechanisms through which microalgae mediate pollutant removal, including biosorption, bioaccumulation, biotransformation, and biodegradation (Mahlangu et al. 2024). Key operational parameters such as pH, temperature, initial metal concentration, and biomass dosage significantly influence removal efficiency (Rajput, 2024). Biosorption, driven by ion exchange, chelation, complexation, and surface adsorption, is the most widely reported mechanism (Mahlangu et al. 2024). Bioaccumulation involves active transport and sequestration of metals inside algal cells, often mediated by metallothioneins and phytochelatins (Ranjbar and Malcata, 2022).

Notably, species such as *Chlorella vulgaris*, *Scenedesmus obliquus*, *Spirulina platensis*, and

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Nannochloropsis sp. have demonstrated up to 90 – 99% removal efficiency for heavy metals, including Cd, Cu, Pb, and Zn, under optimized conditions (Mahlangu et al. 2024, Ranjbar and Malcata, 2022). Microalgae are also effective against emerging pollutants. For example, *Scenedesmus obliquus* biodegraded 90 % of pentachlorophenol, while *Nannochloropsis* sp. removed pharmaceutical contaminants such as ibuprofen and paracetamol (Ranjbar and Malcata, 2022). Integrated systems such as algal–bacterial consortia and photobioreactors have achieved 100 % nutrient and COD removal while improving biomass productivity (Ammar et al. 2022).

Microalgae-based bioremediation is low-cost, sustainable, and compatible with circular bioeconomy principles, enabling biomass reuse for biofuels and value-added products (Mahlangu et al. 2024). However, large-scale application is constrained by biomass harvesting challenges, contamination risks, and operational instability (Abdelfattah et al. 2023). Future research should focus on genetic engineering, CRISPR-based strain improvement, multi-omics tools, and hybrid reactor optimization to enhance system efficiency and scalability (Rojas et al. 2024).

Keywords: Microalgae, Bioremediation, Heavy Metals, Emerging Pollutants and Wastewater Treatment.

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Assessment of Groundwater Quality and Associated Risk to Human Health: A Case Study of Mathura Region, India

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Groundwater, the main drinking water source worldwide, faces increasing threats from overexploitation, agricultural runoff, and industrial contamination. This study aims to assess the hydro-geochemistry of the groundwater in Mathura, part of the Yamuna River basin, India. Hence, 27 groundwater samples from the rural, urban, and industrial zones were collected in the post-monsoon of 2023 and analyzed for major ions and heavy metals to evaluate the groundwater quality and associated human health risks. The study area falls in the north-western part of Indo-Gangetic Plain, dominated by unconsolidated sediments of clay, silt, and sand.

The pH of groundwater samples varied from 6.96 to 10.19, indicating neutral to alkaline conditions, while electrical conductivity (EC) varied between 708 to 11,490 µS/cm. Total dissolved solids (TDS) in 77% of samples exceeded the permissible limit of 1000 mg/L, suggesting unsuitability for direct consumption. Sodium (Na^+) was the dominant cation, followed by calcium (Ca^{2+}), magnesium (Mg^{2+}), and potassium (K^+), whereas chloride (Cl^-) was the dominant anion, followed by SO_4^{2-} >HCO_3^- >NO_3^- >Br^- >F^- > PO43-.

Among the analyzed samples, total hardness (44.44%), Na (70.37%), Cl (18.51%), SO_4^{2-} (44.44%), NO_3^- (44.44%) exceeded the permissible limits, while As (37.03%), Fe (3.70%) and Mn (7.40%) exceeded the acceptable limits prescribed by the Bureau of Indian Standards (2012). Further analysis shows that 81.5% of the samples demonstrated a high risk of heavy metal contamination, and all samples exhibited Hazard Index (HI) values above one for both adults and children, indicating potential non-carcinogenic health risks from ingestion.

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The findings suggest that groundwater quality in Mathura is significantly compromised, with urban areas being the most affected, followed by industrial and rural areas, primarily due to geogenic and anthropogenic influences. The study aligns with Sustainable Development Goal 6, highlighting the urgent need for sustainable groundwater management and pollution control.

Keywords: Groundwater, Agricultural Runoff, Industrial Contamination, Electrical Conductivity and Total Dissolved Solids.

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SOUTH ASIA EDITION 2025

Degradation of Ciprofloxacin in Different Soils and the Effect of Soil Organic Matter Content

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Accumulation of antibiotics in natural environment is a global health concern due the development of antibiotic-resistant genes in microorganisms. This study investigates the ciprofloxacin (CIP) degradation in three soil types; sandy soil (SS), laterite (LT) and Red-yellow latosol soil (RE) and the effect of soil organic matter (OM) in the process. CIP-soil mixtures (500, 2000, 5000 mg/kg) were prepared by mixing CIP and soil in different ratios. Sodium azide was added to prevent microbial interference. Saturated soil mixtures were aged under room temperature for 10 weeks. Ten grams of soil were separated at different time intervals (0,1,2,4,6,8,10 weeks), homogenized, and 20 mg was used in Antibiotic Susceptibility Test (ABST) to measure the antibiotic activity against *Staphylococcus aureus* (ATCC 25923) following the well diffusion method. The inhibition zone diameter (IZD), which is proportional to the antibiotic activity, was measured. Separate experiments were carried out varying the OM content (0%, 6%, 12%) and the light conditions (with and without light). The IZDs of CIP in LT and RE (500 mg/kg mixture with 0% OM) were decreased from 21 mm to 18 mm and 22 mm to 18 mm respectively, after 15 days of exposure. In contrast, no change in IZD was observed in SS. This clearly indicate the degradation of CIP and decrease its antibiotic activity by the Fe-Al oxides and oxy-hydroxides present in both LT and RE. The highest degradation was observed in 500 mg/kg mixture. The presence of OM decreased the CIP degradation in RE and LT, but increased in SS. The formation of stable Fe–OM complexes may have blocked the

reactive Fe sites, preventing interactions with CIP. Light exposure significantly promoted CIP degradation in RE, possibly due to the photo-Fenton reactions promoted under sunlight, which produce hydroxyl radicals that oxidize CIP. These findings highlight the potential of iron-rich soils to degrade CIP.

Keywords: Antibiotics, Natural Environment, Degradation, Staphylococcus Aureus and Antibiotic Susceptibility Test.

Acknowledgements: The authors acknowledge the financial support provided by the University of Peradeniya Research Council – (URC) multidisciplinary research grant (# 486).

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SOUTH ASIA EDITION 2025

Impact of Plastiglomerates and Microplastics on Environmental Health Degradation: A Case Study

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Meghalaya's caves, recognized as the global reference site for the Meghalayan Age, exhibit evidence of plastic pollution embedded within their geological formations. This study investigates how anthropogenic waste, including plastics, fabrics, and metals, integrates with the cave's limestone, forming novel geological materials. We noticed the emergence of plastiglomerates, a newly identified sedimentary rock composed of organic and inorganic materials bound within a plastic matrix. Additionally, we reviewed plasticrusts (plastic coatings on rock surfaces), pyroplastics (burned or degraded plastics), and calcified artifacts (e.g., plastics, metals, fabrics) as environmental markers that reflect pollution levels and climatic conditions. These materials contribute to the formation of microplastics, which infiltrate groundwater and soils. Subsequently, these microplastics enter the animal food web, potentially causing significant health risks to humans and other organisms.

Plastiglomerate comprises framework, cement, and matrix components. To analyze these constituents, microphotographic examination of samples is necessary, supplemented by Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD) for detailed characterization of plastic materials, clay, and cement within the samples.

The results indicate that mineral-rich cave water progressively encases plastic waste in calcite, integrating it into the geological record. These anthropogenic rocks underscore the persistence of plastic pollution, potentially introducing toxins and heavy metals into cave ecosystems and

the broader food web.

Such contamination threatens microorganisms, animals, and human health through exposure via water and soil. This study emphasizes the critical need for community education and sustainable waste management practices to safeguard both the environment and public health in vulnerable cave ecosystems.

Keywords: Ecosystems, Anthropogenic Waste, Sustainable Waste Management, Scanning Electron Microscopy and X-ray Diffraction.

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SOUTH ASIA EDITION 2025

Geodiversity Assessment and Cave Mapping of Gua Tahi Bintang, Merapoh, Pahang, Malaysia

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This study investigates the geodiversity and geological characteristics of Gua Tahi Bintang, located within the northern part of Kampung Sungai Yu, Merapoh, Kuala Lipis, Pahang. The cave is developed within the Permian–Triassic limestone of the Gua Musang Formation, specifically the Merapoh Limestone member, which exhibits a rich variety of karst features and sedimentary structures. The research aims to evaluate the geological diversity and identify elements that contribute to the cave's heritage value and geo conservation potential under Sustainable Development Goal (SDG) 15- Life on Land.

Cave mapping was conducted using a laser range meter and GPS positioning to establish the cave geometry and passage orientation. Lithological logging was performed on exposed sections to identify sedimentary sequences and facies variation. Observations of speleothems, speleogens, and fossil assemblages were systematically recorded and analysed to determine their formation processes and geological significance.

The cave exhibits diverse karst features, including stalactites, stalagmites, and flowstones, indicating active speleothem formation. The lithology consists primarily of thick-bedded, fossiliferous limestone with visible marine fossils such as Rugosa corals and bivalves, suggesting deposition in a shallow marine environment. Structural discontinuities and bedding orientation control the cave morphology. The fossil and lithological data reveal the cave's

strong paleoenvironmental significance and provide insights into diagenetic evolution during the Paleozoic–Mesozoic transition.

The study concludes that Gua Tahi Bintang represents a site of high geodiversity and geological significance, reflecting both depositional and post-depositional processes within the Gua Musang Formation. The documentation enhances understanding of the region's karst evolution and supports efforts toward geo-conservation and sustainable geo-tourism development in Merapoh.

Keywords: Diagenetic Evolution, Paleoenvironmental Significance, Sustainable Development Goal and Marine Environment.

Acknowledgements:

The author gratefully acknowledges Dr. Hafzan Eva Mansor, Prof. Dr. Mohammad Muqtada Ali Khan, and Dr. Elvaene James for supervision and guidance throughout this project.

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SOUTH ASIA EDITION 2025

Geology and Geoheritage Assessment of Kuala Kenong, Kuala Lipis, Pahang

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Kuala Kenong, located in Kuala Lipis, Pahang, is a region characterized by significant Paleozoic lithology and intricate karst geomorphology, with each cave possessing unique morphology and distinct attractions. For instance, Gua Batu Tangga is known for its striking sea notch structure shaped like a stair, despite lacking a main chamber. Additionally, Gua Stala contains various rare karst morphologies such as moonmilk, sawtooth, and draperies, and features complex vertical passages with both ascending and descending routes. This area critically needs research to find an effective way to conserve and sustain the geodiversity within its karst landscape. Therefore, this study addresses the urgent need for foundational geological data to support conservation planning by conducting a detailed geological mapping and geo-heritage assessment. The objectives of this research were threefold: generating a refined 1:25000 scale geological map, classifying the geodiversity elements, and assessing the geo-tourism potential of key sites. The resulting geological map provides critical new evidence detailing the lithological and controls that dictate the orientation and scale of the cave passages. Furthermore, the cave geodiversity assessment successfully documented and classified a high concentration of non-living assets, including unique speleothems, rare mineral precipitates, and significant geological exposures, confirming the caves' exceptional scientific value. Ultimately, this research provides the essential data needed to protect the valuable karst formations and

guide long-term geo-conservation strategies for Kuala Kenong's globally significant cave systems.

Keywords: Paleozoic Lithology, Karst Geomorphology, Geodiversity, Geo-heritage and Geo-tourism.

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SOUTH ASIA EDITION 2025

Spatio-temporal Changes in Mangrove Extent Around Puttalam Lagoon (2010–2022)

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The greenery coverage around Puttalam Lagoon in Sri Lanka plays a crucial ecological, economic, and social role. This study examines the spatial and temporal variations in greenery coverage from 2010 to 2022 using GIS and remote-sensing techniques. It also investigates the factors influencing these changes and their consequences. The study area comprises three divisional secretariat divisions: Kalpitiya, Vanathavilluwa, and Puttalam.

Landsat 8 imagery was used to analyze vegetation through supervised classification, NDVI analysis, and change detection techniques. The results indicate that in 2010, greenery covered 104,831.37 hectares, but by 2022, it had declined to 74,858.13 hectares. While 67.46% of the greenery remained unchanged, 30.43% was lost—mainly converted into settlements (29.17%), bare land (1.12%), and water bodies (0.15%). Only 2.1% of the greenery emerged from other land-use classes (Figure 1).

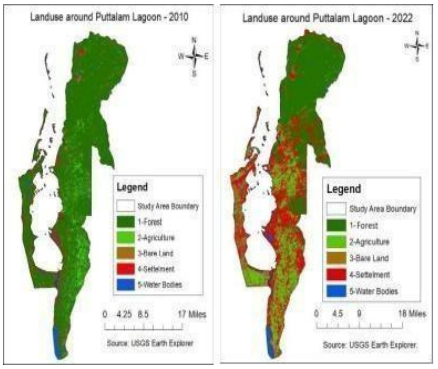

Fig 1. Comparison of land use change from 2010 to 2020

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Several factors have contributed to this decline, including climate change, reduced rainfall, industrial pollution, urbanization, shrimp farming, over-exploitation of vegetation, and sand mining. The consequences of greenery loss include increased land surface temperatures, reduced soil moisture, intensified soil erosion, diminished tourism appeal, economic insecurity—especially for fishing communities—lower crop productivity, weakened social cohesion, and mental health challenges among residents. As population growth continues, the decline in greenery further exacerbates environmental, economic, and social issues. Urgent sustainable planning and restoration efforts are essential to maintain the ecological balance of the Puttalam Lagoon. This study provides valuable insights into environmental conservation, climate change impacts, and vegetation protection.

Keywords: Spatial and Temporal Variations, Urbanization, Industrial Pollution, Climate Change, Exploitation and Vegetation.

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SOUTH ASIA EDITION 2025

Cloud-Based Geospatial Analysis for Flood Hazard Mapping: A Case Study of the Gal Oya Basin in Sri Lanka

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In Sri Lanka, areas such as the Ampara District mainly depend on agriculture, particularly paddy cultivation. The district contributes about 22% of the national rice production. Due to climate change, the frequency of natural disasters such as flooding has increased. Very recently, in January 2025, this issue was recorded in the Ampara District, where heavy rainfall led to the opening of the spill gates of the Senanayake Samudraya reservoir, resulting in a severe flood in the Gal Oya Basin area. This flood had a significant impact on farmers in the Gal Oya Basin, as it occurred during the peak productivity period of paddy cultivation in the Maha season. If it had been possible to predict this flood event in advance, the financial damage could have been minimized. However, due to the lack of sufficient data resources and the continued use of traditional methods instead of modern technologies, the flood could not be predicted beforehand. Therefore, this study aims to predict flood events in advance and to estimate the crop damage that may result from such flood events.

Traditional remote sensing techniques not capable in handling large amount of data acquisition and processing. To overcome those issues, it is important use cloud based geospatial applications like Google earth engine (GEE). This study focused to understand the causes and agronomic effects experienced in Gal Oya during January, 2025 using the patterns of rainfall, reservoir activity, and flood-based damage to paddies by employing the methodologies of remote sensing. It was ascertained that the study area had experienced five times the normal

average of 591.7 mm of rainfall in January,2025 and the corresponding critical rainfalls were during the periods of January 11-14 (160.9 mm), January 18-19 (141.2 mm), and January 25-29 (131.1 mm) that caused to experience an intense flooding in the study area. The classification of the paddy field required a validation accuracy of 99.56%, of the five phenological stages of the paddy fields. The measurement of the DVDI required accounting of considerable vegetation damage in the flood areas, supporting the suitability of the methodology of rapid impact assessment of agriculture. The study attained the successful building of the inclusive remote sensing system that can make the "invisible" impacts of agriculture visible and quantifiable, generating the essential tools of evidence-based decisions in flood risk and agriculture-based resilience planning of the monsoon affected areas.

Keywords: Agriculture, Natural Disasters, Agronomic Effects, Rainfall, Reservoir Activity and Floods.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Contribution of Medical Geology in Advancing Sustainable Development Goals (SDGs) in India

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India, with a population of over 1.46 billion, faces many health problems that are closely linked to its geology, environment, and patterns of natural resource use. Medical geology, which studies how earth materials and geological processes affect with respect to human health, helps to understand and reduce these problems in a sustainable way. This study aims to explore how medical geology contributes to achieving the United Nations Sustainable Development Goals (SDGs) in India. This study systematically evaluates the contribution of Medical Geology to achieving the 17 SDGs in India. A PRISMA-guided literature review was used to collect, screen, and analyse studies published between year 2000 and 2025 from national and international databases, along with official Indian reports. Relevant information was categorized based on the geological factors (such as water quality, soil composition, mineral resources, and geohazards) that directly or indirectly relate to SDG targets. Each SDG was then assessed for its Medical Geology relevance and assigned a contribution level (very strong, strong, moderate, or weak). A color-coded matrix was created to visualize these linkages. The findings show that medical geology has a very strong role in SDG 3 (Good Health and Well-being) and SDG 6 (Clean Water and Sanitation), as groundwater contamination by arsenic, fluoride, and uranium continues to affect millions of people in India. Strong links are seen with SDGs 2, 8, 9, 11, 12, 13, and 15, which relate to soil health, safe mining, sustainable use of resources, climate impacts, and biodiversity. Moderate links are found with SDGs 1, 4, 7, 10, 14, and 17, mainly through education, renewable energy, marine systems, and policy

cooperation. The links to SDGs 5 and 16 are weak, as they focus more on social and governance aspects. Overall, the study shows that medical geology plays a key role in supporting global progress toward health- and environment-related SDGs. By linking earth science with human health and national planning, medical geology can become a driving force in advancing India's progress toward a healthier and more sustainable future.

Keywords: Medical Geology; Sustainable Development Goals (SDGs); PRISMA; Geogenic Contamination; Environmental Health; Groundwater Quality; Arsenic and Fluoride; Occupational Health; Sustainable Mining; Climate Action; India; Earth–Health Linkages

Legend		
Contribution Level	**Meaning / Interpretation**	**Colour Code (Suggested)**
Very Strong	Direct and critical contribution of Medical Geology to achieving the SDG. Strong scientific and policy relevance.	
Strong	Significant influence or linkage; Medical Geology provides essential support in achieving these SDGs.	
Moderate	Partial or indirect contribution; influence through environmental and resource-based pathways.	
Weak	Limited or indirect linkage; influence mainly through awareness, governance, or social exposure factors.	
Threshold line ------marks the minimum acceptable or target level of SDG achievement		

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Multi-Temporal Remote Sensing-Based Analysis of Vegetation Loss and Recovery Following the 2016 Landslide in Aranayaka, Sri Lanka

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Landslides are one of the most common and destructive natural disasters to occur in Sri Lanka, especially in the monsoon seasons. As a result, the hilly regions of the wet zone become highly vulnerable to soil erosion and loss of vegetation. The Aranayaka hills in the Kegalle District experienced a devastating landslide in May 2016, which caused extensive damage to vegetation and changes to the landscape. This study seeks to quantify vegetation loss and assess the long term ecological recovery patterns in the Aranayaka landslide affected area using multi temporal Remote Sensing (RS) and geospatial analysis. The analysis was performed using Google Earth Pro, ArcGIS Pro, and Microsoft Excel software. The landslide scar was outlined using the historical imagery available from Google Earth Pro, and for better visualization purpose, a 50m buffer was created around the scar. The least cloud cover Landsat 8 satellite imageries (30m) from 2016 to 2025 were used to generate Normalized Difference Vegetation Index (NDVI) maps. Zonal statistical analysis was applied to quantify vegetation changes over time. Results indicated that the mean NDVI increased from 0.2 in 2016 to 0.4 in 2025, reflecting considerable vegetation regrowth. The overall recovery percentage improved from 12.5% in 2017 to 70.8% in 2025. The total scar area was approximately 84 hectares, which was classified into degrading (17%), slow recovery (21%), moderate recovery (18%), and strong recovery (44%) zones during the 10 years. Notably, persistent low NDVI values were observed in the upper and lower sections of the scar, particularly during 2019–2020, with limited recovery in the upper area where the surface soil highly removed even in 2025. The findings of this study highlights the

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importance of continuous vegetation monitoring following landslides in tropical regions through RS and geospatial techniques. Additionally, findings are useful for environmental managers and policymakers in planning strategies for sustainable land restoration and disaster mitigation. Further, future research needs to be done with field-based analysis regarding post landslide ecosystem recovery in Sri Lanka.

Keywords: Geo-Spatial Analysis, Normalized Difference Vegetation Index (NDVI), Sustainable Land Restoration, and Disaster Mitigation.

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SOUTH ASIA EDITION 2025

Physico-Chemical and Mineralogical Characterisation of the Badas Peatland, Brunei Darussalam: Implications for Peat Formation

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Peatlands play a vital role in the global carbon cycle, retaining around 30% of the world's terrestrial carbon despite covering only 3% of the Earth's surface. The tropical peat deposit located in Badas, Brunei Darussalam (north-west Borneo), offers valuable insights into regional palaeoclimate and palaeoenvironmental evolution. This study aims to investigate the geological evolution of the peatland to enhance understanding of peatland dynamics in Southeast Asia. The research methods were designed to investigate the geological evolution, mineralogical composition, and accumulation history of the B4, B5, and B7 cores collected from the Badas peatland. Laboratory analyses included physico-chemical characterisation, X-ray diffraction (XRD), and radiometric dating. Preliminary results reveal the lithostratigraphic framework of the Badas peat sequence, which comprises alternating layers of clay, sand, and peat, with the thick peat layers forming the majority of the sequence. Mineralogical analyses indicate that the peat layers are characterised by high moisture content, low ash yield, low pH, and low electrical conductivity (EC). Radiometric dating provides estimates for the early stages of peat accumulation in cores B4, B5, and B7 at approximately 4000 ± 30 BP, 3000 ± 30 BP, and 3150 ± 30 BP, respectively, indicating a relatively young peatland system that developed during the mid-Holocene epoch. The onset of peat accumulation corresponds to warmer and

more humid climatic conditions, which favoured relatively high peat accumulation rates during the initial stages of development. This suggests initial peat accumulation under stable depositional and hydrological conditions within the Badas Basin. This study demonstrates that integrating geological and mineralogical analyses can effectively reconstruct the evolution of tropical peatlands. The findings contribute to a clearer understanding of the environmental history of the Badas peatland and its function as a long-term carbon sink. The insights gained will support future peatland conservation and management efforts aimed at mitigating degradation.

Keywords: Paleoclimates, Paleo-environmental Evolution, and Peatland Conservation.

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SOUTH ASIA EDITION 2025

Quantitative Risk Assessment of Interplanetary Factors Affecting Human Health and It's Geomedical Hazards

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Interplanetary environmental factors, such as solar activity and cosmic rays represent an leading category of geomedical hazards with numerous impacts on human health. Despite recording numerous growing evidences of solar activity, cosmic radiation, and geomagnetic disturbances to tremendous health outcomes, a proper risk assessment framework covering probability, consequences, and population vulnerability remains underdeveloped. This study presents a comprehensive quantitative risk assessment (QRA) of few major interplanetary hazard categories applying standard environmental health risk methodology. A systematic literature review (1995-2025) of epidemiological studies, atmospheric models and radiation dosimetry data was conducted using four step WHO/EPA framework (Hazard Identification, Dose-Response, Exposure Assessment, Risk Characterization) (for risk assessment. Data sources include hospital admission records (25,000+ cardiovascular events), NASA astronaut radiation databases, and NOAA/NASA planetary defense models. The resulting risk assessment showed solar driven geomagnetic storms as a high-moderate risk. During these storms (Ap Index $\geq$60), stroke risk increased by 19% (95% CI: 11-27%), raising up to 52% during severe storms (Ap 100-149) in populations under 65. Myocardial infarction rates elevated 15-20%, with women aged 31-60 showing a three-fold higher relative frequency (OR=2.27, p<0.01), affecting over 100 million high latitude residents and 520 million cardiovascular disease patients globally. For outer space missions, Galactic Cosmic Ray (GCR) exposure was classified as high risk. A 3-year Mars mission (~1 Sv) predicts 3-5% increased lifetime cancer possibilities with circulatory diseases adding ~40% to the total risk of Exposure

Induced Deaths, exceeding current NASA limits. In addition, Gamma Ray Bursts and Near-Earth Objects (NEO) impacts were classified as very low probability, catastrophic impact events which have fatal outcomes like global ozone depletion or mass casualties, though some counter measures like DART have proven success. Finally long-time scale geomagnetic field weakening (currently declining at 5% per decade) was identified as moderate probability high impact hazard which also amplifies all other radiation mediated risks. This quantative risk analysis framework provides a basis for classifying and prioritizing interventions against various interplanetary health hazards.

Keywords:
Interplanetary Factors, Geomedical Hazards, Solar Activity, Cosmic Rays, Geomagnetic Disturbances, Solar Driven Geomagnetic Storms, Myocardial Infarction, Galactic Cosmic Ray (GCR), Space Missions/Mars Mission, Geomagnetic Field Weakening, Gamma Ray Bursts, and Near-Earth Objects (NEO) Impacts.

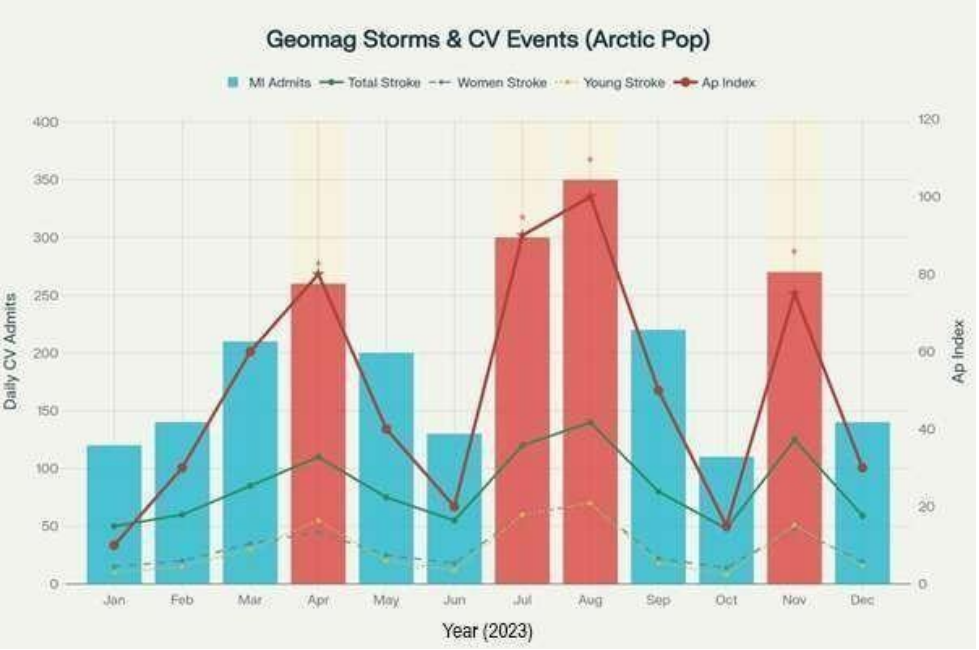

Fig 1. Geomagnetic Storms and Acute Cardiovascular Events in High-Latitude Populations: Multi-Country Time Series Analysis

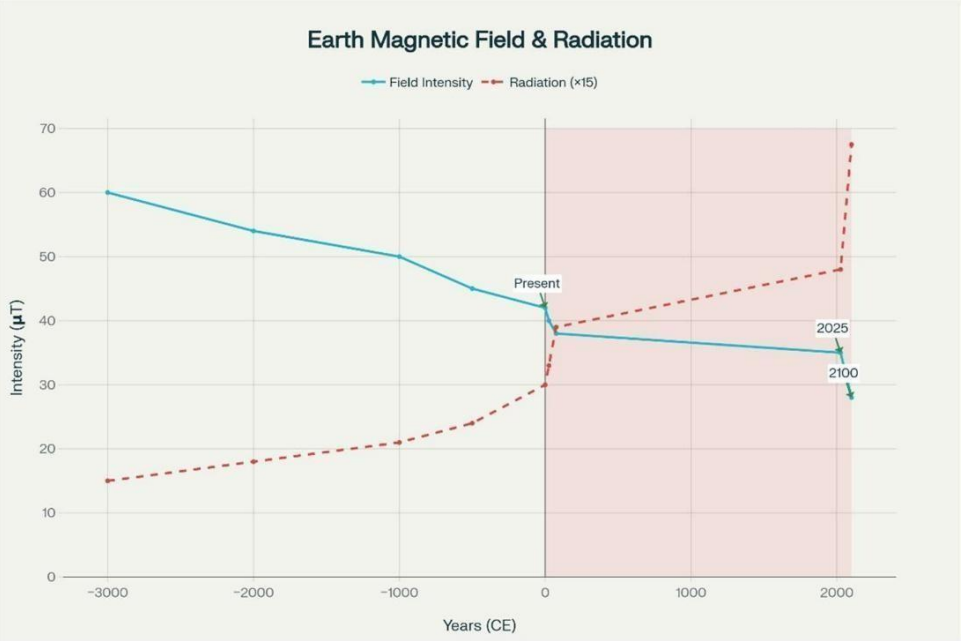

Fig 2. Earth's Magnetic Field Decline and Radiation Exposure Across Millennia

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SOUTH ASIA EDITION 2025

Petrogenetic Insights on the Ultramafic Rocks of Northern Borneo

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Ophiolites offer significant insights into the formation and subduction of the ancient oceanic crust, as well as the geodynamic evolution of orogenic belts. Although the ophiolite complex in Sabah, northern Borneo, is well known, there is still a limited understanding on its petrogenesis and geotectonic significance, especially within the Telupid region of Central Sabah. This study aims to investigate the mineralogical, petrographic, and geochemical characteristics of the ultramafic rocks from the region focusing on their petrogenetic evolution and further contribute to broadening the understanding of Borneo's geological framework. In this study, thin section and polished-thin section microscopy and scanning electron microscope (SEM) observations will be conducted to characterise the textures, mineral assemblages of the major, trace and rare earth elements. Additionally, X-ray fluorescence (XRF), X-ray diffraction (XRD), and inductively coupled plasma mass spectrometry (ICP-MS) analyses will also be done to provide insight into the geochemical properties of the ultramafic rocks. The outcome of this research will produce a comprehensive dataset detailing the mineralogical and geochemical properties of the ultramafic rocks, alongside interpretations of their magmatic origin and the geotectonic processes that formed the Telupid region. The results are expected to provide new insights into the petrogenesis of Sabah's ophiolite sequences and enhance the understanding of mantle processes and the geotectonic evolution of northern Borneo.

Keywords: Geotectonics, Petrogenesis, Ultramafic Rocks, Rare Earth Elements (REEs)

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SOUTH ASIA EDITION 2025

Environmental Impact Assessment of Coal Mining in Chandrapur Tehsil of Chandrapur District, Maharashtra, (India) Using Remote Sensing and GIS Based Techniques

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Chandrapur (Lat 19° 57′ 00″ N; Long 79° 18′ 00″ E), is a city in Maharashtra state of central India, which is also known as the "Black Gold City of India" due to the presence of multiple coal mines in the district. Out of the 15 tehsils (administrative blocks) of the district, one is Chandrapur itself, which contains several underground (UG) and open-cast (OC) coal mines. The coal mining has severe environmental implications, including land degradation, deforestation, air and water pollution, and the release of greenhouse gases that contribute to climate change. In the present study, detailed monitoring of Chandrapur tehsil, was carried out for three time periods (2002, 2012, and 2022) with an interval of 10 years apart using remote sensing and GIS parameters such as Land Use and Land Cover (LULC), Land Surface Temperature (LST), Normalized Difference Vegetation Index (NDVI), and Normalized Difference Water Index (NDWI) to assess the environmental impact of coal mining activities. The first step in this assessment involved downloading satellite imagery from Landsat 7, 8, and 9. These images were then processed to prepare maps for LULC, NDVI, NDWI and LST. The images were taken at 10-year intervals for the years 2002, 2012, and 2022. In total, 12 maps were prepared, three for each parameter. The LULC analysis revealed a steady and significant expansion of mining and built-up areas from 2002 to 2022. This land conversion was primarily associated with increased coal production, population growth, and the rising demand for

energy. The transformation of vegetated and agricultural land into mining zones indicates severe land degradation and loss of fertile topsoil. NDWI results showed that the water index remained nearly constant between 2002 and 2012, but a marked rise was observed in 2022. This apparent increase in surface water can be linked to the accumulation of water in abandoned mine pits and excavation zones, rather than to any natural improvement in water resources. Such impounded stagnant water often exhibits poor quality due to sediment and heavy metal contamination and also due to proliferation of mosquitoes and other vectors, which further escalate as health conditions in the affected areas. The LST data indicated a notable increase in land surface temperature during the same period, reflecting the combined effects of vegetation loss, expansion of exposed mining surfaces, and increased anthropogenic heat from mining and industrial activities. The spatial expansion of warmer areas also points to the emergence of localized heat islands over the mining belt. NDVI results demonstrated a consistent decline in vegetation density between 2002 and 2022, with the highest density recorded in 2002. The decline is attributed to deforestation, dust deposition on leaves, and conversion of forested land into mining and built-up areas. Based on LULC, NDVI, NDWI, and LST parameters, our study indicates that coal mining activities in Chandrapur tehsil have led to substantial environmental degradation characterized by deforestation, loss of agricultural land, soil erosion, increased surface temperature, and altered hydrological conditions. Future studies should integrate multi-temporal satellite data with machine learning and AI-based models to predict changes in land use, vegetation, water, and temperature. Use of higher-resolution datasets and field-based validation will help improve accuracy. Future work should also assess the effectiveness of land reclamation and afforestation efforts to support sustainable mining and environmental management in this region.

Keywords: Land Use and Land Cover, Vegetation Depreciation, Land Reclamation, Afforestation, and Sustainable Development Goals.

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Hyperspectral Imaging and Machine Learning-Based Multi-Parameter Assessment of Wheat Grain Quality

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Wheat (*Triticum aestivum*), one of the most widely cultivated cereal crops, serves as a vital source of carbohydrates and plant-based proteins for billions of people worldwide. Its quality directly influences diverse sectors of the food industry, including milling, baking, nutrition and international trade. However, conventional wheat grading techniques are often time-consuming, subjective and limited to surface-level evaluation. To overcome these limitations, this research investigates a data-driven, non-destructive approach for wheat grain quality assessment using hyperspectral imaging (HSI) along with machine learning (ML).

The proposed system employs hyperspectral reflectance data across the visible to near- infrared (VNIR) and shortwave infrared (SWIR) regions to predict key parameters—protein, moisture, gluten, starch, ash and hardness index. Each parameter exhibits distinct wavelength sensitivity: protein and moisture show strong responses in the NIR range, starch and gluten are influenced by VIS–NIR regions and mineral content (ash) varies significantly within SWIR bands. High-dimensional spectral features were processed using principal component analysis (PCA) to reduce redundancy. Machine learning and deep learning models were trained for multi-parameter prediction and classification.

The optimized models achieved high prediction accuracy, showing strong correlations between spectral signatures and wheat physicochemical parameters, with feature importance analysis validating the contribution of specific wavelength ranges to each trait.

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This study demonstrates a scalable, real-time framework for industrial wheat quality evaluation, with HSI and ML/DL enabling transparent grading, improved process control, and informed decision-making across agricultural and food supply chains.

Keywords: Triticum Aestivum, Physicochemical Parameters, Protein, Gluten and Food Industry.

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SOUTH ASIA EDITION 2025

Geological and Geochemical Characterisation of Gold-Bearing Rocks in Jalan Batu Hitam, Sokor, Kelantan

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This study examines the geological and geochemical properties of gold-bearing rocks in Jalan Batu Hitam, Sokor, Kelantan. The region is situated in the Central Belt of Peninsular Malaysia, recognised for hydrothermal and structurally controlled gold mineralisation. The project is to create a comprehensive geological map at a 1:25,000 scale, examine the petrography and geochemistry of gold-bearing rocks, and assess the gold potential of the area. Comprehending these attributes not only aids mineral discovery but also enhances sustainable resource management and environmental consciousness within the context of medical geology and geo-health in South Asia.

Fieldwork was conducted to gather rock samples and perform geological mapping, focussing on lithology, structure, and mineralised zones. Laboratory analyses comprised petrographic inspection via thin-section studies and geochemical testing utilising Inductively Coupled Plasma Mass Spectrometry (ICP-MS) to ascertain the concentrations of gold and related trace elements (Fe, Ti, Zr, Ce, Bi, etc.). Data were analysed and visualised via Geographic Information System (GIS) software to superimpose geochemical anomalies onto geological features. Statistical methods, including Principal Component Analysis (PCA), were utilised to discern patterns and elemental correlations governing gold mineralisation.

Initial studies indicate that gold mineralisation is predominantly linked to hydrothermal quartz veins contained within Permian–Triassic phyllite and slate. The mineral assemblage, which

includes pyrite, ilmenite, rutile, and zircon, indicates an orogenic-type deposit akin to the Ulu Sokor gold field. The enrichment of gold is associated with structural patterns along NE–SW and N–S fault zones, suggesting that tectonic activity play a crucial role in mineral deposition. GIS-based spatial modelling reveals localised anomalies aligned with these features, indicating significant exploration potential in the Jalan Batu Hitam region.

This research demonstrates that the integration of geological mapping, petrographic analysis, and advanced geochemical techniques such as ICP-MS provides a comprehensive understanding of gold mineralization in Kelantan. The findings emphasize the importance of structural control and lithological variation in gold enrichment. Beyond economic interest, the study contributes to the broader field of environmental and medical geology by linking trace element distribution to sustainable mineral resource management and geo health development goals.

Keywords: Gold Mineralisation, Petrography, Geochemistry, Principal Component Analysis and Medical Geology.

Acknowledgements

The author gratefully acknowledges the Faculty of Earth Science, Universiti Malaysia Kelantan (UMK), for providing research facilities and laboratory support throughout this study. Special thanks are extended to the academic supervisors and technical staff who assisted during the fieldwork and laboratory analyses.

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SOUTH ASIA EDITION 2025

Heavy Metals in Sri Lankan Serpentinites: Geohealth Risks and Traditional Medicinal Practices

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Serpentinites can concentrate potentially toxic metals such as Ni and Cr (Feyisa et al. 2025; Vithanage et al. 2014), which during weathering can contaminate groundwater and soil, posing local geo-health risks (Feyisa et al. 2025). Paradoxically, some serpentinites are also used in traditional remedies. We investigated three Sri Lankan serpentinite localities: Indikolapelessa and Ginigalpelessa (southern high-grade terranes) and Rupaha (central Sri Lanka) to (i) characterize mineralogical controls on metal inventories, and (ii) assess implications for human exposure in nearby settlements. Bulk-rock samples were characterized by XRD, XRF, and ICP-MS. Field observations showed contrasting regolith settings. Rupaha is exposed along a small tributary with minimal soil cover, whereas Indikolapelessa and Ginigalpelessa are mantled by ~0.1–>4 m of ultramafic-derived soils that merge with home gardens and zones of numerous dug wells. Indikolapelessa and Ginigalpelessa preserve relic olivine and chromite spinel embedded in a serpentinized matrix dominated by antigorite–lizardite with secondary magnesite. These rocks exhibited elevated trace metals: Cr ≈ 2109–2622; Ni ≈ 1929–3348; Co ≈ 95–113; Mn ≈ 734–843; As ≈ 0.5–1.4 (mg/kg). Textural observations and phase associations indicated that Cr is hosted primarily in chromite, whereas Ni enrichment tracks olivine-derived serpentine.Given the proximity of ultramafic soils to household wells, weathering and soil–water transfer represents plausible exposure pathways for Cr and Ni. WHO guideline values for

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Cr (0.05 mg/L) and Ni (0.07 mg/L) provide a health-relevant frame for prioritizing groundwater testing in these settings. By contrast, Rupaha serpentinite lacks chromite and yields comparatively low Cr (~4.2 mg/kg) and Ni (~5.3 mg/kg). Residents report long-standing medicinal use of the Rupaha serpentinite for insect/snake bites, skin ailments, and dysentery, underscoring the need for leachability and toxicological testing. Our results quantify mineralogical controls on Cr–Ni enrichment and frame near-field exposure risks at community scale. We recommend (i) targeted groundwater testing near serpentinite outcrops, (ii) soil screening and risk communication in garden-well settings, and (iii) culturally sensitive guidance informed by leach tests on medicinal materials.

Keywords: Medical geology, Serpentinite, Chromium, Nickel, Sri Lanka, Exposure Pathways and Traditional Medicine.

Acknowledgement: The authors acknowledge the funds of the Postgraduate Institute of Science Research Grant (Grant No: PGIS/2024/12), University of Peradeniya, Sri Lanka, and University of Peradeniya Research Grants (Grant No. URG/2024/40/S).

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Temporal Geochemical Variations in Groundwater Consumed by CKDu at-risk Communities in the Dry Zone of Sri Lanka

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Chronic Kidney Disease of undetermined origin (CKDu) is a major public health concern in several tropical and subtropical countries, including Sri Lanka, predominantly affecting rural farming communities. This study aimed to assess the seasonal variations in groundwater quality consumed by the CKDu-at-risk population in Wilgamuwa, a well-known endemic region. A total of 92 groundwater samples were collected during the pre- and post-monsoon seasons and analysed for basic field parameters, major cations, anions, and trace metals. Results revealed a slight decrease in mean pH from 6.51 in the pre-monsoon to 6.38 in the post-monsoon period, while mean electrical conductivity increased to 611 µS/cm from 230 µS/cm in the post-monsoon period. Nevertheless, total alkalinity and total hardness showed minimal seasonal variations. The dominant ionic composition of groundwater in both seasons followed the order Si^{4+} (as H_4SiO_4) > Ca^{2+} > Na^+ > Mg^{2+} > K^+ and HCO_3^- > Cl^- > SO_4^{2-}. According to Gibbs' diagrams, most groundwater samples in both seasons plotted within the rock dominance field and were dominated as Ca-HCO_3^- type water. Considering the ionic ratio plot of ($Mg^{2+} + Ca^{2+}$) versus ($HCO_3^- + SO_4^{2-}$), a substantial number of samples from the pre-monsoon period lie along the 1:1 trendline, implying that the weathering of carbonate and sulphate minerals is the

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primary reaction in the groundwater. Notably, silicon (Si^{4+}) concentrations ranged from 16-77 mg/L (mean 47 mg/L) in the pre-monsoon and 1.02-53 mg/L (mean 25.3 mg/L) in the post-monsoon season. Trace metal analysis revealed higher Cd (0.5 µg/L) and Pb (1.75 µg/L) levels in the pre-monsoon period than in the post-monsoon period (0.14 and 0.64 µg/L, respectively). The Water Quality Index (WQI) assessment revealed that 25% of pre-monsoon and 46% of post-monsoon samples were of good quality, while 42% and 20%, respectively, were unsuitable for human consumption. Overall, the findings suggest that groundwater composition and consequently the risk of CKDu vary seasonally, emphasising the need for continuous water quality monitoring and health surveillance in CKDu-prone communities.

Keywords: Water Quality Index, Groundwater Quality, Alkalinity, Chronic Kidney Disease and Endemic Region.

Acknowledgement: The authors acknowledge the funding from the the National Institute of Health, USA.

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Spatial Epidemiology and Multivariate Risk Factor Analysis of Chronic Kidney Disease of Unknown Etiology (CKDu) in Lignite-Exposed regions of Cuddalore, Tamil Nadu

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Introduction: Chronic Kidney Disease (CKD) is a significant global health concern, with death rates increasing from 0.60 to 1.43 million between 1990 and 2019, elevating it from the 15th to the 10th leading cause of death. CKD is often linked to diabetes and hypertension, but a variant without these risk factors, known as Chronic Kidney Disease of unknown etiology (CKDu), has been identified. In the coastal areas of Tamil Nadu, India, CKDu has become the predominant type of CKD, referred to as Tondaimandalam nephropathy. Both CKD and CKDu can advance to End-Stage Renal Disease (ESRD) and can be fatal if not treated. Therefore, identifying risk factors is crucial for health protection. This study explored the frequency patterns, lifestyle habits, and potential causes of CKDu among ESRD patients in the Cuddalore district of Tamil Nadu, India, with a focus on environmental factors and geographical patterns.

Methods: A hospital-based study was carried out at the Government Headquarters Hospital in Cuddalore district to examine individuals undergoing dialysis due to ESRD, dividing them into CKD and CKDu groups based on risk factors. Geographic Information System (GIS) (ArcGIS 10.8) was employed for spatial mapping, and SPSS version 27 was used for statistical analysis of demographic and environmental variables.

Results: CKDu was found in 53.06% of ESRD cases, predominantly affecting younger individuals (average age, 45.77 ± 12.54 years). Issues with water quality were associated with

a fivefold increased risk of CKDu compared to other factors. Geospatial analysis revealed clusters of CKDu and ESRD near lignite deposits, especially in Nayinakuppam, Ammeri, Cuddalore municipality, and Neyveli Township.

Conclusion: This study highlights contaminated drinking water and proximity to lignite deposits as significant environmental factors contributing to CKDu in Tamil Nadu, with a focus on the Cuddalore district. The findings underscore the necessity for monitoring water quality in affected areas, providing evidence for public health interventions to aid vulnerable populations and prevent the occurrence and progression of ESRD in this region.

Keywords: End-Stage Renal Disease, Chronic Kidney Disease, Chronic Kidney Disease of unknown etiology, Tamil Nadu, Cuddalore, Water quality.

Acknowledgements

This manuscript is part of K. Madhumitha's doctoral research work at the Central University of Tamil Nadu. Madhumitha was supported by funds from the Department of Science and Technology-INSPIRE Fellowship, Government of India (grant number: DST/INSPIRE/03/2022/000566, Registration Number: IF210436). The authors would like to thank the Government Headquarters Hospital, Cuddalore, for helping us to complete the study successfully, and extend thanks to all team members.

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SOUTH ASIA EDITION 2025

Groundwater Geochemistry and Possible Association with Chronic Kidney Disease of Unknown Etiology in Uddanam Region, Srikakulam District, Andhra Pradesh, India

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Introduction: Chronic Kidney Disease (CKD) is a progressive decline in kidney function that eventually culminates in End-Stage Renal Disease (ESRD), if not treated (Trivedi and Kumar, 2023; Rajapurkar et al. 2012). While hypertension and diabetes constitute primary etiological factors, CKD of undetermined etiology (CKDu) present the cases without these traditional factors (Abraham et al. 2019; Jayatilake et al. 2013; Kovesdy, 2022). Heat stress, dehydration, groundwater contaminants, and agrochemical exposure constitute the predominant etiological factors for CKDu (Kumaresan, 2024). The Uddanam region of India has the highest CKDu prevalence in India, yet extensive investigations have failed to establish definitive causation (Kumaresan et al. 2024). Dissolved organic compounds from geologic materials, are known to exhibit nephrotoxic characteristics, but there are a limited number of studies on dissolved organic compounds in waters in the study area (Feder et al. 1991; Tatu et al. 2000; Bunnell et al. 2006; Orem et al. 2007; Maharaj et al. 2014). Therefore, this study integrates epidemiological study of CKD patients with hydrogeochemical analysis of their drinking water sources to determine the dissolved organic compound contamination.

Methods: A hospital-based epidemiological investigation was conducted at YSR Super Specialty and Kidney Research Hospital, Palasa, Srikakulam District. Patients were assigned

to either chronic kidney disease (CKD) or chronic kidney disease of unknown etiology (CKDu) groups according to documented clinical records. Using the survey data, the areas with highest prevalence were identified for water sample collection. Groundwater samples from twelve locations with highest CKDu prevalence were analysed using Gas Chromatography-Mass Spectrometer to identify the dissolved organic compounds.

Results: The epidemiological survey data show that approximately 54% of the participants were affected by CKDu, most of them were male, agricultural laborers from poor socio-economic backgrounds with a mean age of 55 years. The hydrogeochemical analysis revealed a variety of organic compounds, including aromatic and aliphatic esters, phthalates, phenolic derivatives, and various alkanes and alkenes. Phthalate esters, aromatic esters, and aliphatic esters are the predominant compound classes across sampled groundwater sources.

Conclusion: The presence of phthalate esters, aromatic esters and aliphatic esters from more than 60% of the water samples collected from the endemic regions of Uddanam, along with established scientific evidence of phthalate nephrotoxicity, suggests the plausibility of dissolved organic compounds being an etiological factor for regional CKD incidence.

Keywords: Chronic Kidney Disease, Chronic Kidney Disease of unknown etiology, End-stage Renal Disease, Organic Compounds.

Acknowledgements
This research was supported by the Indian Council of Social Science Research, Government of India (Grant No. ICSSR/RPD/MN/2023-24/G/52). The authors acknowledge The George Institute for Global Health, Palasa, for facilitating the epidemiological component of this investigation.

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Plant-Mediated Synthesis of Selenium Nanoparticles Using *Moringa oleifera* Extract: A Green Geopharmaceutical Approach for Mineral-Based Therapeutics

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Selenium is an essential trace element and a critical constituent of selenoproteins that regulate oxidative homeostasis, immunity, and cellular metabolism. Green synthesis of selenium nanoparticles (SeNPs) represents a sustainable route in geopharmacy, integrating the therapeutic potential of minerals with plant-derived biomolecules. The present study focuses on the biosynthesis, characterization, and biomedical assessment of *Moringa oleifera*-mediated selenium nanoparticles (MOSeNPs). Fresh *M. oleifera* leaves were processed to obtain an aqueous extract, which served as both reducing and stabilising agent for sodium selenite. The synthesized MOSeNPs were characterized using UV–Visible spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), and Transmission Electron Microscopy (TEM) to elucidate their structural and chemical properties. Antimicrobial, antioxidant, and cytotoxicity assays were performed to evaluate bioactivity. MOSeNPs displayed a strong absorption at 279 nm, confirming nanoparticle formation. FTIR analysis identified phytochemicals—phenolics, proteins, and polysaccharides—involved in reduction and capping. XRD and TEM revealed crystalline, spherical to polygonal SeNPs with a particle size range of 86–158 nm. The nanoparticles exhibited broad-spectrum antimicrobial activity, strong antioxidant potential (elevated glutathione, SOD, and catalase activity), and selective anticancer efficacy against MCF-7 breast cancer cells (EC_{50} = 148.37 µg/mL; selectivity index = 14.98). Scratch assays confirmed

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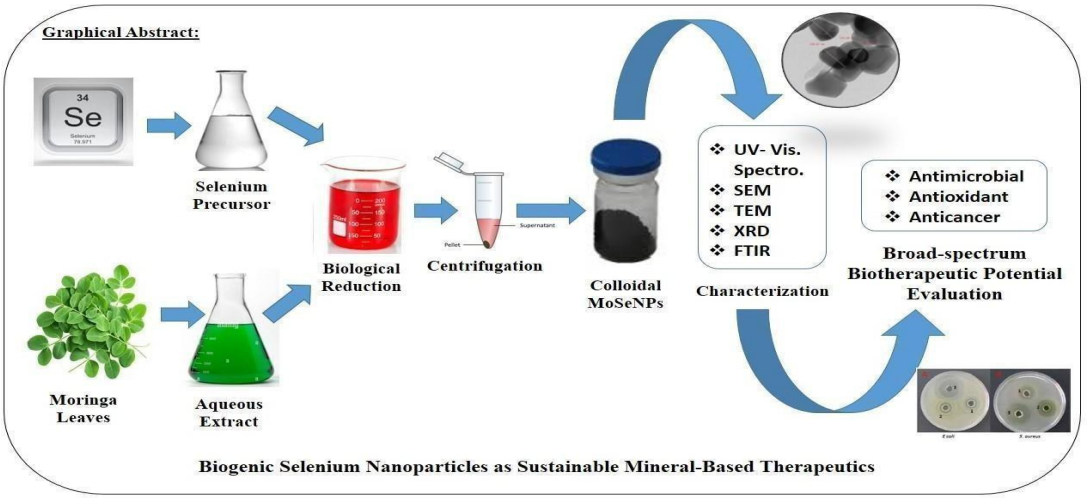
concentration-dependent inhibition of MCF-7 cell migration. This study demonstrates an eco-friendly and biocompatible route for synthesising functionalised selenium nanoparticles using *M. oleifera*. The MOSeNPs possess promising antimicrobial, antioxidant, and anticancer properties, highlighting their potential as mineral- based therapeutic agents bridging green nanotechnology and medical geology.

Keywords: Geo-pharmacy, Nano-technology, Anti-oxidants, Therapeutics, and Bio-synthesis.



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Mineralogical and Thermal Characteristics of Crocidolite Asbestos from the Jogipatti Alkaline Complex, Tamil Nadu: Implications for Carcinogenic Hazard

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Crocidolite belongs to the amphibole group of asbestos minerals. It has straight, thin, and sharp fibres that can easily penetrate and damage human tissues. The International Agency for Research on Cancer (IARC) classifies crocidolite as *carcinogenic to humans (Group 1)*. The physical–chemical properties and morphology of mineral fibres largely determine their potential to cause cancer. Another important disease associated with these fibres is fibrosis (fibrotic scarring) which forms due to excess fibrous tissue in organs or tissues as a healing response to continuous injury or prolonged irritation. This study examines crocidolite asbestos within the Proterozoic Jogipatti carbonatite–alkaline complex, Tamil Nadu, South India. Mineralogical analyses using FTIR, XRD, SEM, EPMA, and TGA/DTA identify the fibrous amphibole as magnesio-riebeckite. The fibres exhibit a fibrous–prismatic morphology, formed under shear-related deformation in syenitic host rocks. Thermal analyses show dehydroxylation and oxidation between 300–600 °C, followed by melting above 980 °C, indicating high thermal stability. Mg substitution for Fe in M_1 and M_3 sites raises decomposition temperatures and enhances structural persistence. FTIR spectra reveal strong OH and Si–O–Si bands, indicating reactive surface sites. SEM images show elongated fibres (<3 µm diameter, >5 µm length) within the respirable size range, suggesting potential inhalation hazards due to their durability and surface reactivity. Continuous exposure to such fibres can increase the risk of asbestos-

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related cancers among workers. Therefore, the presence of crocidolite within the Jogipatti alkaline complex represents a potential natural health hazard and calls for continuous monitoring and preventive action.

Keywords: Crocidolite Asbestos, Riebeckite–magnesio-riebeckite Series, Amphibole, Thermal Stability, Fibre Morphology, Carcinogenic Hazard, Proterozoic Jogipatti Alkaline Complex, Tamil Nadu, Natural Asbestos, and Occupational Exposure.

STUDENTS' POSTER PRESENTATION ABSTRACTS

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SOUTH ASIA EDITION 2025

Medicinal Properties of Gemstones with Special reference to Mukta (White Pearl)

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Gemstones beyond their ornamental value, have long been recognized for their therapeutic applications in traditional systems such as Ayurveda. Rasa shastra is a branch of Ayurveda that deals with the study of metals, minerals, gemstones and other animal products along with their processing i.e. Shodhana, Marana etc. for safe and effective medicinal use.Gemstones play an important role in rasashastra for their numerous therapeutic actions. Among these gemstones, Mukta (White pearl) is highly valuable and composed of calcium carbonate with trace minerals like zinc, magnesium contributing its therapeutic potential in Amlapitta (Acid Peptic disorder), Raktapitta (Bleeding disorders), Chardi (Vomiting) etc. In classical text of Rasa shastra, Mukta pishti, the processed and micro fine form of pearl shows role in cardiac tonic, anti-stress formulations. Modern studies support these claims, showing that pearl powder exhibits antioxidant, antacid and adoptogenic properties. The convergence of geological composition, mineralogy and traditional pharmaceuticals highlights mukta as a natural nanocomposite with immense potential for biomedical applications.

Keywords: Gemstones, Mukta, White pearl, and Rasa Shastra.

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SOUTH ASIA EDITION 2025

Trace Elements in South Asia: Nutritional Need, Deficiency Patterns, and Toxicity Risks – A Case Study

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Trace elements are essential micronutrients required in minute quantities for optimal physiological function, yet their deficiency represents a critical public health challenge in South Asia, affecting over 500 million people. Simultaneously, environmental contamination with toxic trace elements poses severe health risks across the region. This study comprehensively examines the nutritional requirements, deficiency patterns, toxicity profiles, and intervention strategies for trace elements in South Asian populations, with emphasis on Iron, Zinc, Iodine, Selenium, and toxic elements including Arsenic, Lead, and Cadmium. A systematic literature review was conducted using PubMed, Google Scholar, and ScienceDirect databases, analysing peer-reviewed publications from 2000-2025. Search terms included "trace elements," "micronutrient deficiency," "South Asia," "biofortification," and "heavy metal toxicity." Data on prevalence rates, dietary patterns, intervention programs, and toxicity levels were extracted and synthesized from various sources including epidemiological studies, national surveys, WHO reports, and clinical trials conducted across India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, Afghanistan, and Maldives. Iron deficiency anaemia affects over 40% of South Asian populations, with prevalence exceeding 50% among pregnant women and children under five years. Zinc deficiency ranges from 30-51% across countries, with India reporting 43.8% prevalence among children and Bangladesh showing the highest regional burden. Iodine deficiency has improved through salt iodization programs, achieving adequate national status

Proceedings of the 4th International Student Conference on Medical Geology and Environmental Health
South Asia Edition
Virtually, 24th to 29th November, 2025

in all eight countries, though pockets of deficiency persist among vulnerable populations. Selenium deficiency affects populations in specific geographic areas with selenium-poor soils. Toxic element contamination is widespread: arsenic affects 40-60 million people through contaminated groundwater in Bangladesh and West Bengal (concentrations up to 3200 µg/L versus WHO guideline of 10 µg/L); lead contamination exceeds safe limits in industrial zones of Pakistan and India; cadmium and chromium VI contaminate water sources in industrial areas. Biofortification programs have released seven zinc-biofortified wheat and rice varieties in India, while Bangladesh has commercialized 12 biofortified zinc rice varieties. Food fortification programs targeting wheat flour, edible oils, and salt show variable compliance (15-96% coverage) across countries. South Asia faces a dual burden of trace element malnutrition and toxic element exposure. Integrated interventions combining supplementation, large-scale food fortification, biofortification, dietary diversification, and environmental remediation are essential to address this public health crisis. Strengthening monitoring systems, ensuring regulatory compliance, and targeting vulnerable populations remain critical priorities for achieving micronutrient security in the region.

Keywords: Trace elements, Micronutrient deficiency, Iron, Zinc, Iodine, Selenium, Arsenic toxicity, South Asia, Biofortification, Food fortification, Malnutrition, Heavy metals, public health.

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SOUTH ASIA EDITION 2025

Critical Exposure of Respirable Dust Containing Mineralized Silica' and Analysis of Workers Working in Mines, Stone Cutting and Construction Sites

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Respirable crystalline silica (RCS) is a very dangerous geomaterial having severe hazard potential for the people working in proximity to active mines, stone cutting and construction sites. Present estimate portrait very gream picture and even more dreadful is the future projection. A recent estimate suggests that in the state of Rajasthan about 52% of employees working in these industries have shown radiological signs of silicosis, which is estimated to rise further ~79%. Similarly in Madhya Pradesh the reported cases are 25% which are estimated to grow upto 55%; and Gujrat is predicted to rise upto 69%. Epidemiological syntheses of Indian studies report wide inter-study variability in silicosis prevalence (roughly 10–50% in high-risk cohorts), with pooled/average estimates in several reviews falling in the ~25–40% range for heavily exposed groups, demonstrating a sizeable disease burden linked to cumulative exposure. Field measurements in Indian opencast mines (coal, iron ore, limestone, bauxite) report geometric mean respirable dust concentrations typically in the 0.9–1.1 mg/m³ range, with measured RCS mass concentrations of approximately 0.008–0.017 mg/m³ in several studies. India's current regulatory framework sets a maximum exposure limit (MEL) of 3 mg/m³ for respirable dust when free silica is <5%, and applies a formula (MEL = 15 / % silica) to derive limits when silica content exceeds 5%. In India, silica content acceptable limits are far less protective than those recommended globally which can be seen from the international

benchmarks having permissible limit for OSHA/NIOSH ≈ 0.05 mg/m³; ACGIH TLV ≈ 0.025 mg/m³. Since silicosis is an exceptionally understudied occupational illness in India, the true burden of the disease is greatly underestimated since it is commonly misinterpreted as tuberculosis (TB) and excluded from mortality reports. This review paper will cover data from national repositories and peer-reviewed publications from 1990–2025 to lessen the hidden plague of silica-associated disorders in India's mining industry. It focusses on the major problems to improve exposure monitoring, provide accurate dose-response evaluations based on particle properties, employ effective engineering safeguards, clinical compliance, and workforce training, and match exposure limits with global norms.

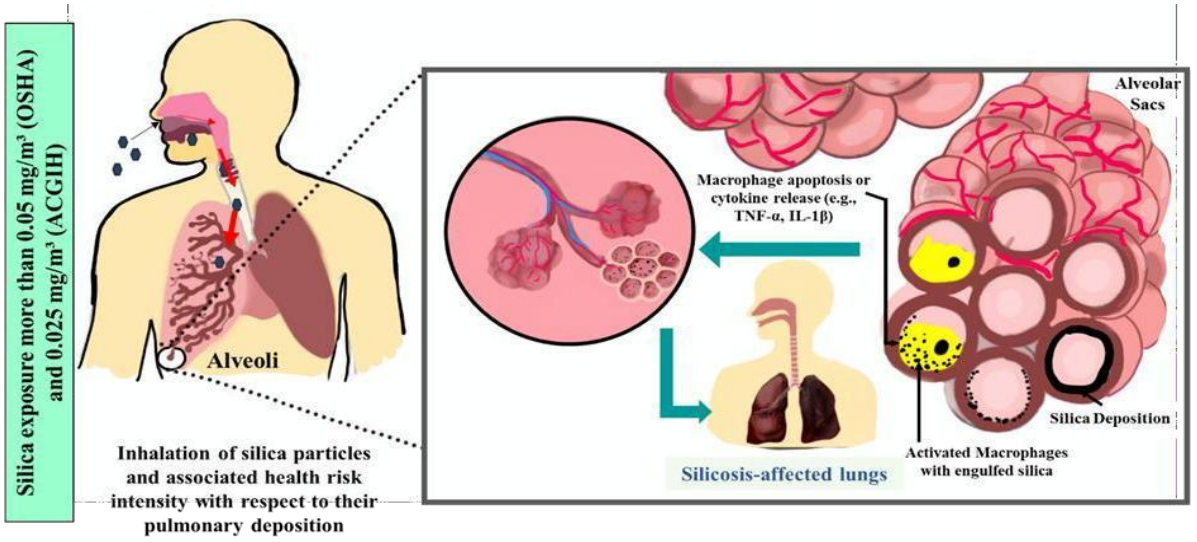

Fig 1. Inhalation and pulmonary deposition of respirable crystalline silica (RCS) particles leading to silicosis.

Keywords: respirable crystalline silica, opencast mining, silicosis, occupational exposure limits, India.

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SOUTH ASIA EDITION 2025

Neurological Disorders Caused by Manganese-Induced Neurotoxicity

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Numerous Neurological disorders, such as Manganism, Parkinson's Disease, Alzheimer's disease, Amyotrophic lateral sclerosis (ALS), prion disease, and Huntington's disease, are caused by homeostasis disruption by manganese-induced neurotoxicity. Manganese toxicity occurs due to a compromised or immature excretion system, consistent exposure to elevated levels of manganese through occupational or environmental (anthropogenic or geogenic) means. Prolonged exposure to manganese leads to it's accumulation in the brain's basal ganglia, resulting in Manganism, a neurological disorder with symptoms akin to Parkinson's disease, such as motor deficits, cognitive impairments, and behavioral abnormalities. Manganese affects molecular interactions, such as transcription and epigenetic processes, at the cellular level. In neurons, these molecular interactions can modify the function of neurotransmitter receptors, the cytoskeleton, and scaffolding synaptic proteins, which consequently disrupts synaptic structure and function, leading to loss of synaptic connectivity and, potentially, Neurodegeneration. Manganese interference is noted in dopaminergic, cholinergic, glutamatergic, and GABAergic systems. Mechanisms like oxidative stress, endoplasmic reticulum stress, excitotoxicity, inflammation, mitophagy, autophagy, and apoptosis operate at intracellular insults and at the transcriptional level, including Yin Yang 1, RE-1 silencing transcription factor, transcriptional factor EB, nuclear thyroid 2 related factor 2, which are all triggered by manganese-induced neurotoxicity. Although exact molecular targets of manganese remain unidentified, Chelating therapy is used to treat motor deficits, and antioxidants, anti-

inflammatories, and antiexcitotoxic agents are used as therapeutics for Manganese toxicity. Results are inconsistent and vary depending on age, disease severity, and the etiology of the patient.

Keywords: Neurological Disorders, Manganese Toxicity, Molecular Interactions and Geogenic.

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SOUTH ASIA EDITION 2025

Role of Clay Minerals in Dermatological and Analgesic Therapies

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Geo-pharmacy, which is a sub-branch of medical geology, brings to fore how natural occurring minerals, especially clays, can be used to make affordable and effective products for skin care and pain relief. This study looks at different types of clays such as bentonite, kaolinite, montmorillonite, smectite, and coloured clays (green, yellow, pink, and white) and their possible use in topical formulations. These clays have special properties like adsorption, antibacterial action, anti-inflammatory effects, and skin regeneration ability. Silicon-rich clays help improve collagen formation and skin elasticity, reducing wrinkles and photoaging, while iron-rich green clays show strong antibacterial effects against *Staphylococcus aureus* (MRSA), helping in acne control and wound healing. Kaolinite and bentonite help reduce inflammation and remove toxins, which can be useful in conditions like eczema and psoriasis. Clay-based peloids also show heating effects that can relieve joint and muscle pain. The study uses locally available clays of Indian origin to design low-cost and sustainable formulations that can be developed easily in laboratory or educational setups. Further, clinical testing will be needed to confirm safety parameters and efficacy of these products, but these clay-based creams could offer a simple, natural option for treating skin and pain-related problems.

Keywords: Medical Geology, Clay-based Therapeutics, Anti-aging, Skin Diseases, Wound Healing, Pain Management and Sustainable Innovation.

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SOUTH ASIA EDITION 2025

Influence of Mine Dust Composition on the Pathogenesis of Silicosis

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Mine dust pollution is caused due to excessive human activity for mineral resources. Crystalline silica, iron-bearing phases, organic pollutants, and trace metals are all present in mine dust. Mining operations and geological origin have an impact on this composition.

The environment, mine workers, and local population are all at serious risk from this dust, which can lead to several pulmonary health problems. Inhaling this crystalline silica can lead to the progressive occupational lung disease known as silicosis. Variations in the prevalence of silicosis across mining regions suggest that not all silica-containing dusts have the same pathogenic potential. This review aims to ascertain the effects of modifications to mineral admixtures and their particle characteristics on the progression of silicosis. There is evidence that silica influences the pathogenicity of mine dust, along with other factors like particle size distribution, surface coatings, and the presence of reactive minerals like pyrite and iron oxides. Recently fractured, uncoated quartz particles promote oxidative stress and inflammation due to their high surface reactivity. Iron-containing minerals like pyrite can also cause oxidative damage and ferroptosis. However, silicate coatings or admixtures of iron, magnesium, or aluminium can reduce silica's toxicity.

The composition of mine dust beyond silica content alone emerges as a decisive factor in silicosis pathogenesis. Understanding these compositional and physicochemical determinants can be useful to clarify regional differences in silicosis prevalence. It can also be helpful in

developing preventive strategies to monitor, control, and alleviate dust-related health risks in mining environments.

Keywords: Silicosis, Mine Dust, Occupational Lung Disease, and Prevalence.

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SOUTH ASIA EDITION 2025

How Ocean Geology Affects Our Bodies: Risks and New Medicines

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This paper looks at the surprising ways the geology of the ocean floor—the rocks, sediments, and natural processes deep underwater—is tied to human health. We explore two main ideas: the risk of natural toxins and the opportunity for new medicines. First, marine geological events, like the natural breakdown of rocks and ocean floor movement, control how dangerous materials like mercury and arsenic get released from the seabed into the water. These toxins then climb the food chain, building up in the seafood we eat. For people in coastal communities, this contamination can lead to serious health problems, including nervous system damage and cancer. Second, the extreme environments created by marine geology, such as deep-sea volcanic vents and high-pressure trenches, support unique forms of life. These resilient deep-sea microbes make special chemicals that help them survive. Scientists are discovering that these natural chemicals could be key to developing powerful new drugs, including the next generation of antibiotics and anti-cancer treatments. In short, the ocean floor is both a source of environmental risk and a critical frontier for medical discovery. To protect public health and find these medical solutions, geologists and health experts must work together.

Keywords: Ocean floor, Geology, Medicine, and Public Health.

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SOUTH ASIA EDITION 2025

The Dual Impact of Human and Environmental Factors on Disease Emergence: A Medical Geology Perspective

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Emerging infectious diseases (EIDs) including fungal, bacterial, and zoonotic infections have risen sharply since the mid-20th century, coinciding with the industrial revolution and subsequent anthropogenic transformations. Human-driven disturbances across the lithosphere, hydrosphere, and atmosphere have disrupted natural biogeochemical cycles, altering microbial ecology and enabling the proliferation of airborne, waterborne, and soil-borne pathogens. Air pollutants have been linked to respiratory infections such as tuberculosis and viral diseases, while contaminated waters foster outbreaks of cholera, *Salmonella typhi*, and leptospirosis. Similarly, soil degradation contributes to helminthiasis, mycetoma, and histoplasmosis.

To investigate these correlations, geospatial and climatic data from MODIS (Moderate Resolution Imaging Spectroradiometer) and Landsat imagery were analyzed using ArcGIS Pro (Environmental Systems Research Institute, USA) and RStudio (Posit Software, USA) to map infection hotspots against patterns of land-use change, industrial activity, and temperature variation. Statistical analyses revealed a positive association between environmental degradation and pathogen emergence, with fungal adaptability increasing under rising global temperatures. This thermal tolerance evolution indicates the potential for certain fungal strains to overcome the human heat barrier, expanding their host range and pathogenicity. Overall, the findings highlight that Earth's systems which once had natural microbial regulators are transforming into anthropogenic reservoirs of pathogenic threats. This work demonstrates that

climate change and industrial expansion are not only environmental issues but also geological determinants of global health. Recognizing these links is crucial for policymakers to integrate climate resilience within disease prevention frameworks, reinforcing the urgent role of medical geology in safeguarding human well-being.

Keywords: Anthropogenic Activities, Emerging Infectious Diseases (EIDs), Medical Geology, Climate Change, Environmental Degradation, Zoonotic Pathogens, Fungal Adaptation, Biogeochemical Cycles, Airborne and Waterborne Diseases, Land-use Change, Geospatial Analysis, Global Health and Pathogen Evolution.

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SOUTH ASIA EDITION 2025

Assessment of Hydro-Geochemical Characteristics of Groundwater Quality in Wadsa Area, Gadchiroli District, Maharashtra, India

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Groundwater contamination is a substantial issue directly affecting human health and the environment. The problem is more severe in semi-urban and rural areas where groundwater is the major source of drinking water. This study employs hydro geochemical parameters to assess the groundwater quality of Wadsa Taluka of Gadchiroli district, Central India. A total of 20 groundwater samples were collected from dug wells and bore wells during pre-monsoon of 2025. Collected samples were analysed using major physiochemical parameters such as turbidity, pH, electrical conductivity (EC), total dissolved solids (TDS), alkalinity, chloride (Cl-), fluoride (F-), nitrate (NO3-), sulfate (SO42-), total hardness (TH), iron (Fe), calcium (Ca2+) and magnesium (Mg2+). The results show that 3 samples out of 20 (Sample no 8, 12, 20) are found to be unfit for drinking. Out of those 3, sample no. 8 reported high fluoride contamination of 2.05 mg/L exceeding the normal permissible limit of 1.5mg/L set by Bureau of Indian Standards (BIS) and World Health Organization (WHO) respectively. This increases the risk of fluorosis in the area. Sample no. 12 reported excess nitrate contamination of 65 mg/L exceeding the permissible limit of 45mg/L set by BIS and 50mg/L set by WHO which may lead to methemoglobinemia (blue baby syndrome) in infants. Sample no. 20 reports iron contamination with concentration of 1.23mg/L, which exceeds the permissible limit of 0.3mg/L set by both BIS and WHO which may cause gastrointestinal discomfort. From the hydro-geochemical assessment, it is evident that the study area shows severe contamination and this

study brings to fore the need for regular monitoring of groundwater quality in the proximity of Wadsa Taluka, Gadchiroli district, Central India and effective mitigation strategies to reduce the health risks due to groundwater contamination in the study area.

Keywords: Hydrochemistry, Fluorosis, Blue Baby Syndrome, Groundwater, Gadchiroli, and Risk Assessment.

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SOUTH ASIA EDITION 2025

Chemical Analysis of Groundwater in Umred Town, Nagpur District, Maharashtra, Central India

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Groundwater quality is an important aspect related to sustainability and public health. Assessment of groundwater in semi-urban and rural areas becomes imperative as groundwater is the major source of drinking water therein. This study focuses on the chemical parameters of groundwater samples collected from bore-wells across various areas in Umred Town, Nagpur District, Central India. A total of 20 samples were collected and analysed to determine the occurrence of major ions and trace elements including fluoride, sulphate, nitrate, chloride etc. The results indicated that out of 20 samples 11 samples exhibited high nitrate concentrations with the highest value reaching 105mg/L in one of the well exceeding the normalized value set by the Bureau of Indian Standards (BIS) and WHO. Subsequently those 11 samples were found to be unfit for human consumption because of the high nitrate concentration. This indicates the possibility geogenic disease like Methemoglobinemia (blue-baby syndrome) which is caused due to excess nitrate consumption. This study brings to fore the need for regular monitoring of the wells in the proximity of Umred Town, and enhancement of community awareness programs to reduce the health risks imparted due to groundwater contamination in the study area.

Keywords: Water, Water quality, Risk Assessment, Contamination, Groundwater Quality, Nitrate Contamination, Methemoglobinemia, and Blue-baby Syndrome.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Understanding of Vanadium Based Sodium-ion Battery Materials: Critical Analysis Regarding Energy Development and Environmental Health Issues

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Sodium-ion batteries are becoming an important alternative for lithium-ion batteries as sodium is abundant in nature and low cost. In this study, vanadium-based materials such as sodium metavanadate ($NaVo_3$) and sodium hexavanadate ($Na_2V_6O_{16}$) were prepared as cathode materials for sodium-ion batteries. These materials exhibit good electrochemical performance due to the multiple oxidation states of vanadium, which help in storing and releasing charge efficiently. Vanadium can also be harmful to the environment and human health when it is released through industrial waste or dust. In small amounts, it plays a useful role, but in higher concentrations, it can cause health problems related to the lungs, kidneys and heart. This work focuses on understanding how vanadium compounds are useful for energy storage and how they may also cause environmental contamination if not handled carefully. The aim is to create awareness about safe handling, waste management, and sustainable use of vanadium compounds in laboratory research. By connecting materials science with medical geology, this study highlights that true scientific progress must always combine energy innovation with environmental and human health protection.

Keywords: Sodium-ion Batteries, Environmental Impact and Medical Geology.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Aquifer Contamination and Mineral Mobilization: Geogenic Contamination Risks in Groundwater Systems of Rajasthan

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Groundwater wells are a major source of water in the western Rajasthan, especially in rural areas for irrigation and drinking purposes. Emerging cases of fluoride and nitrate contamination, due to geogenic and anthropogenic processes in the groundwater and unconfined aquifers in the districts of the western Rajasthan over the years are of great concern. The mobilization of minerals like F- from rocks, (fluorite, fluorapatite, biotite, cryolite, muscovite, and topaz) by natural weathering process and dissolution into groundwater influences the aquifer mineral composition. Nitrate contamination in groundwater is primarily linked to the agricultural activities and use of fertilizers (USGS,2022.) The high risks of chronic exposure to such contaminated water are directly related to diseases such as dental fluorosis (H. Trendley Dean, 1931) and skeletal fluorosis, methemoglobinemia (blue baby syndrome in infants), neurological issues, thyroid problems, including organ damage and colorectal cancer. The chemical sample analysis from different aquifers conducted by the Central Ground Water Board (CGWB) of India for Rajasthan was used for this study. Of the 12 districts comprising western Rajasthan, 44.4% of locations were found to be affected by nitrate contamination (>45 mg/L) and 43.4% by fluoride contamination (>1.5 mg/L) in the groundwater. The population in these areas, particularly rural residents, face a significant and persistent health risk from contaminated groundwater, with fluoride levels often exceeding the acceptable limits set by safe drinking water guidelines (WHO, 2024; Choubisa, et al., 2018).

The findings align with the broader regional studies of semi-arid regions of India, indicating the geogenic processes and intense agricultural processes are principle driving factors in groundwater contamination.

The purpose of this study is to drive urgent attention to the persistent threat of elevated fluoride and nitrate concentrations and need for continuous monitoring, public awareness and defluorination strategies.

Keywords: Groundwater, Contamination, Anthropogenic Processes, Agricultural Activities, Nitrate, Fluoride and Dental Fluorosis.

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Arsenic Contamination in the Bengal Basin: Revisiting India's Groundwater Crisis Through a Geoscientific and Public Health Lens

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Arsenic contamination in the groundwater of the Bengal Basin has evolved into one of the most severe and persistent public health challenges in South Asia. Despite extensive studies since the 1980s, millions continue to consume arsenic-contaminated water. According to estimates, over 25 million people in India are potentially exposed to arsenic contamination, with 9.6 million in West Bengal, 1.6 million in Assam, 1.2 million in Bihar, 0.5 million in Uttar Pradesh, and 13000 in Jharkhand. Arsenic is a naturally occurring component of Earth's crust. It is discharged into the environment by volcanic eruptions and weathering it gets transported over long distances as particulates or aerosols through air and water. It has been documented that arsenic is naturally released in groundwater within the portions of the Bengal Delta Plain (BDP), where it is mobilized from Holocene sediments which is composed of clay, silt, and sand. In various sediments, the arsenic concentration may reach up to 490 mg/kg. Several distinct geological sources of arsenic have been identified in India, including the Gondwana coal seams in the Rajmahal Basin (≈ 200 mg/kg), the Bihar mica belt (0.08–0.12 %), the Proterozoic Vindhyan pyrite-bearing shales (0.26 %), the Son Valley gold belt (2.8 %), and the Darjeeling Himalayan belt (0.8 %). The Bivalent iron (Fe^{2+}) released during weathering of arsenic-rich sulphides such as arsenopyrite (FeAsS) forms amorphous iron oxyhydroxides under oxidizing conditions that strongly adsorb the co-weathered arsenic. The Arsenic release is primarily controlled by reductive dissolution of Fe oxyhydroxides, which is a process

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mediated by microbial degradation of organic matter under reducing conditions, which deploys the adsorbed arsenic into groundwater. Iron arsenate (scorodite) is regarded as a direct and immediate secondary source of arsenic, as it is readily formed from scorodite, a common alteration product of arsenopyrite. It can easily hydrolyze to release arsenic into solution. The relevant equation of such hydrolysis is:

$$\underset{\text{(Ferric Arsenate)}}{FeAsO_4} + 3H_2O \rightleftharpoons \underset{\text{(Arsenic acid)}}{H_3AsO_4} + \underset{\text{(Ferric Hydroxide)}}{Fe(OH)_3}$$

Currently the permissible limit of Arsenic in potable water advised by WHO is 10µg/L. However, about 49.7% tube wells in West Bengal have concentration above 10µg/L and 24.7% with 50µg/L. Arsenic contamination brings various human health consequences, including Arsenicosis, Bowen's disease, skin cancers cardiovascular disorders, and developmental effects in children. Geological knowledge and modern technology must be used in combination to reduce the Arsenic contamination in Bengal Basin.

As we know that the reductive dissolution of Iron oxyhydroxides in Holocene sediments are one of the major causes of arsenic contamination. Since the contamination is caused by the reductive dissolution of iron oxyhydroxides in Holocene sediments, for long term sustainable solutions finding and using safe aquifers is required. The lower Pleistocene aquifers are low in arsenic concentration. Drilling wells with proper casing to avoid the mixing between arsenic and clean water.

Also, the new age Arsenic removal techniques like Subsurface Arsenic Removal (SAR), Iron based Filters installation and Electro coagulation techniques should be used as preventive measures for purification of arsenic contaminated water. These geologically informed measures, along with long-term monitoring and community-scale water management, can help

West Bengal progressively lower arsenic exposure and ensure the security of drinkable groundwater.

Keywords: Arsenic Contamination, Bengal Basin, Groundwater Pollution, Reductive Dissolution, Iron Oxyhydroxides, Holocene Sediments, Pleistocene Aquifers, Subsurface Arsenic Removal (SAR) and Electrocoagulation.

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SOUTH ASIA EDITION 2025

Long-term Environmental and Human Health Effects of Uranium Mining in Jharkhand

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Jharkhand is a mineral rich state and prominent source of uranium in India. Large amounts of uranium deposits are mostly found in the Jaduguda, Turamdih and Bagjata areas of the East Singhbhum district, Jharkhand, India. India's nuclear energy program has been largely dependent on uranium mining in these regions. However, the environmental and human health issues have been progressively outstretching with decades of mining and processing. The major long term environmental consequences contain the contamination of the land, rivers and groundwater caused by the discharge of radioactive tailings, heavy metals and acid mine drainage. The natural ecosystem, food production and biodiversity have been affected due to continuous exposure to very low levels of radiation and toxic elements. Some studies suggest that high levels of uranium and radon in the water sources exposes the local communities to chronic exposure. Common human health problems are observed in the local communities living close to the mining and tailing sites, thus reporting the occurrence of cancer, congenital deformities, respiratory diseases and skin disorders among them. It is worth pointing out that miners are more prone to health problems since they inhale dust and radiation for a long time and they do not have enough protection. At the same time, the health issues of the marginalized indigenous peoples who rely on the local environment for their livelihood are becoming a heavy burden due to their socio- economic condition. Solving this problem is a matter of strict environmental monitoring, better waste disposal method and sustainable health remediation measures such as safe disposal of tailings, groundwater purification and ecological

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South Asia Edition
Virtually, 24th to 29th November, 2025

afforestation to remove the risk for the future. After all, uranium resource utilization while ensuring environmental safety and public health is the biggest challenge for Jharkhand to be able to achieve sustainable development goals.

Keywords: Uranium, Nuclear Energy Program, Congenital Deformities, Remediation, and Radioactive Tailings.

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SOUTH ASIA EDITION 2025

Assessment of Groundwater Quality in Tas Village, Bhivapur, Nagpur, Maharashtra, India

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Water pollution and water scarcity are major environmental issues in rural and urban areas. They lead to decline in the quality of water, especially drinking water. Proper qualitative assessment of water is thus necessary to ensure that the water consumed is potable. The problem of surface and groundwater pollution by contaminants and products of their transformation is being investigated more and more, globally due to the risk they pose to the water-soil environment and potentially human health. The present study focusses on the groundwater quality analysis of Tas village, Bhivapur Taluka, Nagpur District, Maharashtra, samples of water were collected from different borewells, dugwells and handpumps across the village. The samples were analyzed for key physio-chemical parameters such as pH, turbidity, hardness, electrical conductivity (EC), total dissolved salts (TDS), alkalinity, chloride, nitrate, sulphate, iron, calcium, magnesium, fluoride, etc. Most of the parameters were not found to be in the desirable range for drinking, out of 20 samples 18 samples were unfit because of high fluoride. The permissible limit for fluoride according to BIS 10500 : 2012 is 1.0 mg/l, but 12 samples have fluoride content more than 2.5 and high content of fluoride can lead to fluorosis and hence, appropriate measures were suggested to improve the quality of water. The study revealed that pH values of the samples were within the permissible limits (7 to 8.5) , indicating neutral to slightly alkaline nature of the groundwater. However, variations in TDS and hardness were observed across different sources, with some borewell and hand pump samples showing elevated levels beyond the desirable limit. The permissible limit of TDS according to BIS

10500: 2012 is 500 mg/L but 7 samples exceed the limit and shows TDS more than 1000mg/L suggesting possible mineral enrichment or leaching from subsurface formations. The presence of nitrates in certain samples indicated potential contamination from agricultural runoff and domestic wastewater infiltration. The permissible limit for Nitrate is 50 mg/L, but 17 samples exceed the limit and show high nitrate content from 51 mg/L to 226 mg/ L. Elevated chloride and alkalinity values in a few locations also pointed towards anthropogenic influence and poor drainage conditions. Overall, while most parameters were within acceptable limits, localized contamination was observed in certain pockets. The study emphasizes the need for regular groundwater monitoring, proper waste disposal, and sustainable water management practices to maintain water quality and prevent contamination. The findings provide a scientific basis for local authorities and villagers to implement corrective measures such as well disinfection, recharge structure maintenance, and control of agricultural chemical usage. This analysis thus contributes to the baseline data on groundwater quality of Tas Village, essential for future hydrogeological and environmental studies.

Keywords: Risk Assessment, Groundwater Quality, Hydro-geochemistry, and Sustainability.

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SOUTH ASIA EDITION 2025

Integrating Geo-Pharmacy with Mainstream Healthcare: A Geoscientific Perspective on Mineral-Based Therapeutics

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Geo-pharmacy, is the intersection of geology and medicine, it focuses on the therapeutic use of geological materials such as minerals, rocks, clays, etc. Traditional South Asian systems, including Ayurveda and Unani. These systems have long applied mineral-based remedies for healing. However, modern healthcare rarely integrates these materials due to reasons like limited geoscientific research, very few safety assessments, and no standardized usage protocols. The aim of this study is to explore how geo-pharmacy and mainstream healthcare can be integrated safely to promote safer and evidence-based medical applications.

This research adopts a review-based and comparative analytical approach. It also involves examination of existing literature and case studies on mineral therapeutics such as kaolin, bentonite, and hematite. Geological parameters such as composition, purity, and source environment are also evaluated along with pharmacological data to identify overlaps and gaps. This study also considers sustainable extraction methods and mineral characterization techniques relevant to medical applications.

Preliminary findings indicate that integrating geological expertise into healthcare can improve the quality of minerals, prevent contamination and toxicity, and also establish traceability of medicinal mineral sources. Minerals with verified composition and controlled dosages show therapeutic potential for detoxification, anti-inflammatory, and dermatological treatments. A

framework linking geoscientists, pharmacologists, and public health experts is proposed to standardize mineral-based therapeutics and ensure ethical, sustainable sourcing.

Integrating geo-pharmacy with mainstream healthcare can also bridge the gap between traditional wisdom and modern science, enabling the development of safe, effective, and sustainable mineral-based treatments. This interdisciplinary approach not only validates ancient practices but also broadens the scope of medical geology in addressing human health challenges.

Keywords: Geo-pharmacy, Medical Geology, Mineral Therapeutics, Traditional Medicine and Healthcare Integration.

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SOUTH ASIA EDITION 2025

Analysis of wet and dry drilling Geo-acoustics in Indian mines and its Implications on Noise Induced Hearing Loss (NIHL)

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Noise induced hearing loss (NIHL), is an irreversible sensorineural damage and compensable occupational health hazard in Indian mines due to exposure of miners to impulsive, continuous, broadband, intermittent noise caused from drilling, blasting, dozing, loading, transportation of Run-off mine by dumpers on haulage road, crushing and screening operations. Drilling is the persistent source of anthropogenic noise, impacting the geological, occupational and ecological systems. There are few reported studies on noise intensity and its health impact due to wet and dry drilling operation. This study addresses the critical research gap arising from the lack of comprehensive comparative studies of Noise-Induced Hearing Loss (NIHL) associated with wet and dry drilling operations. This is done by synthesising the published field data on noise intensity, vibration exposure magnitude and epidemiological evidence within a geo-acoustic framework to assess the differential NIHL risk of wet and dry drilling operation in Indian mines. The noise intensity of dry drilling operation in open cast coal, limestone and granite mines is between 92 to 96 dB(A) at the operator's position, whereas wet drilling intensity ranges from 85 to 89 dB(A), corresponding to an average attenuation of 4 to 6 dB(A) and 13 to 17% decline in vibration magnitude. Epidemiological data reveal that 47% of drill operators exhibit high frequency hearing loss, with a pooled national NIHL prevalence of approximately 50% among exposed workers. The Geo-acoustic Health Index (GHI) quantification of exposure

response between integrating sound intensity (LAeq), Vibration acceleration (Aeq) and exposure duration (t), shows that wet drilling is having safe exposure time of 40 to 50% compared to dry drilling. The results show significant regulatory engineering gap, as per 90 dB(A) criterion level and danger limit of Directorate General of Mines Safety (DGMS) statutory guidelines. Based on these findings, this study specifically recommends replacement of dry drilling with wet drilling, real time noise monitoring of drilling rigs, periodic audiometry test for miners and revised statutory guideline of making 85 dB(A) as criterion level by DGMS. Wet drilling implementation, continuous noise monitoring and audiometry test will help in hearing conservation efforts in Indian opencast mining operation.

Keywords: Noise Induced Hearing Loss (NIHL), Dry drilling, Wet drilling, Occupational Health, Geoacoustic, Sustainable Environment, mining practices.

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SOUTH ASIA EDITION 2025

Rhein and Depression: Assessing the Role of Gut-brain Axis

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Rhein is a naturally occurring anthraquinone which is known for its anti-inflammatory and antioxidant properties but has limited use because of its poor solubility. Recognizing Rhein's limited solubility, Rhein-loaded SNEDDS (RS SNEDDS) was developed using eucalyptus oil, PEG-400 and Tween-80 as key excipients. This was developed to evaluate the antidepression activity in mice, i.e. to check the potential of Rhein SNEDDS (50 and 100mg/kg) in chronic unpredictable mild stress (CUMS) using an inducing depression model. This study evaluated the CUMS (chronic unpredictable mild stress) induced depression model in mice. The behavioural assessment was done using a tail suspension test, open field test and a sucrose preference test. It was formulated as a self-nano emulsifying drug delivery system. In order to induce depressive symptoms, we established a chronic unpredictable mild stress (CUMS) rat paradigm and evaluated the changes in markers linked to depression. Subsequently, studies were carried out from the "gut" to the "brain", including using MALDI-TOF to detect the gut microbiota's composition and ELISA kits to measure the relative amounts of pro-inflammatory cytokines like interleukin-1ß, interleukin-6 and brain-derived neurotrophic factor (BDNF). Rhein could regulate the disturbances of gut microbiota and reduce inflammation, thereby reducing the levels of pro-inflammatory cytokines in serum and brain regions, and ultimately increase the levels of BDNF. Rhein may ameliorate chronic unpredictable mild stress-induced depression in mice by modulating the gut brain axis.

Keywords: Chronic Unpredictable Mild Stress, Cytokines, Solubility and Antidepression.

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SOUTH ASIA EDITION 2025

Coal Induced Environmental and Health Challenges: A Medical Geology Perspective

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The environmental transformation of natural resources, particularly coal and its associated pyrite content, plays a pivotal role in shaping ecological integrity and human health outcomes. This review synthesizes current research on the oxidative behavior of coal-associated pyrite, the mechanisms of sulfur evolution during combustion, and the microbial pathways for desulfurization, with a focus on their environmental and toxicological implications. Pyrite oxidation, both atmospheric and aqueous, is identified as a key driver of acid mine drainage (AMD), contributing to the release of sulfate, iron, and heavy metals into surrounding ecosystems. These transformations are accelerated by microbial activity and surface aging, leading to enhanced generation of reactive oxygen species (ROS), notably hydroxyl radicals (OH), which are implicated in respiratory diseases such as coal workers' pneumoconiosis (CWP). The review highlights the kinetic disparities between coal-pyrite and mineral-pyrite oxidation, the role of particle size and surface chemistry in ROS formation, and the effectiveness of chemical and biological mitigation strategies. Furthermore, the health risks associated with inhalation of respirable coal dust, enriched with pyrite and trace metals, are examined through recent toxicological studies and biomarker analyses. By integrating geochemical, microbiological, and biomedical perspectives, this paper underscores the urgent need for interdisciplinary approaches to monitor, manage, and remediate the environmental and health impacts of coal utilization and mining activities.

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Keywords: Coal, Sulphur evolution, Coal Workers Pneumoconiosis, Medical Geology, Ecology, and Human Health.

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SOUTH ASIA EDITION 2025

Respirable Crystalline Silica in Non-Industrial Settings: Exposure Pathways and Health Outcomes

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Silicosis is traditionally known as an occupational lung disease caused by inhaling respirable crystalline silica dust from industries like mining and construction. However, it can also result from non-industrial sources such as household dust, rural stonework, pottery, natural erosion, and geophagy, especially in vulnerable rural populations. A thorough literature review is conducted with a focus on the geological conditions that generate respirable silica dust apart from industrial settings and the ways by which such exposure to silica dust can cause lung issues similar to occupational silicosis. Non-occupational silicosis is increasingly reported in rural areas and environments with high ambient silica dust, where mean respirable silica (PM-10) concentrations can reach up to 1.33 µg/m³, and disease prevalence in at-risk communities may be as high as 37%, indicating that chronic exposure to even low levels of environmental crystalline silica poses a significant public health threat, particularly in socioeconomically vulnerable populations worldwide. This study employs a mixed-methods approach integrating environmental sampling and geochemical analysis, epidemiological literature review, community surveys, and geospatial risk mapping to comprehensively assess non-industrial silica exposure and its health impacts in vulnerable populations. The research underlines reported occurrences where non-occupational silicosis has been reported, emphasizing the disregarded relevance of environmental and domestic silica dust as a community health risk. It also examines how the natural weathering of local rocks and human-induced small-scale artisanal activities generate fine silica particles that can penetrate deep into the lung alveoli, posing significant health hazards with long-term contact. Health hazards such as lung fibrosis,

tuberculosis, lung cancer, chronic obstructive pulmonary disease (COPD), and autoimmune diseases. Future research should focus on longitudinal health monitoring, improved dust exposure measurement techniques, and effective community-based interventions to mitigate silica-related health risks in vulnerable populations.

Keywords: Silicosis, Non-occupational Exposure, Respiratory Health Impacts, Geochemical Analysis, Epidemiological Review and Geospatial Risk Mapping.

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SOUTH ASIA EDITION 2025

Sustainable Recovery of Rare Earth Elements from Phosphogypsum and Phosphoric Acid Sludge: A Comparative Study

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Moving away from conventional mining practices is need of the hour for reducing the impact on environment. Therefore, transition towards sustainable and circular mineral supply chains is necessary for the recovery of elements, particularly critical elements, from industrial byproducts. Phosphogypsum (PG) and phosphoric acid sludges (PAS) from phosphate fertilizers contain substantial amount REEs, as 60-70% of REEs are lost during processing of phosphate rock and therefore can act as a secondary source of REE. Globally, 300 million tonnes of PG is generated annually. This study aims toward investigating the potential of PG and PAS for REE extraction. Current study tries to identify and analyse the distribution, occurrence, and extraction efficiencies of REE, while focusing on sustainable, circular, and low impact extraction approaches. Study compares conventional acid leaching techniques with emerging green methods such as, organic acid leaching, bioleaching, and biosorption. A comprehensive review of peer-reviewed scientific journals, conference proceedings, and technical reports were analysed. Only peer-reviewed and experimentally supported studies were included in this study. Each selected study was systematically reviewed for extracting quantitative and qualitative data. Extracted data was comparatively evaluated for summarizing process efficiencies, sustainability potential, and scalability. We found that, REE content in PG varies according to the source rock and processing conditions. Values of REE in PG range from 0.02 wt% in Polish stacks to 0.36 wt% in South African sources. Among the extraction techniques such as, hydrometallurgical leaching, solvent extraction, ion-exchange, and the

recent developments such as bioleaching and biosorption, acid leaching has shown promising results. Acid leaching method is mainly employed for extracting REE from the PG. REEs in the phosphogypsum are dissolved with the help of acids such as HCl, H2SO4, and HNO3. From the above given acids, H2SO4 maintained at parameters of 2-4M acid concentration, 60-80°C, and 2-3 hours of contact time has shown efficiency of about 85-90%. Recent advances such as Green lixiviants and acid leaching innovations have demonstrated environmentally friendly REE recovery from phosphogypsum (PG). Organic acids can also be a good alternative for inorganic acids. Methanesulfonic acid (3M, solid to liquid ratio of 1:8, 25°C, and 2hrs) has shown around 80% of leaching efficiency. Similarly, citric acid (2M, 70°C, and for 1.5 hrs) has shown around 90% efficiency for REEs. Similarly, bioleaching and biosorption has also been explored as an alternative for low-environmental impact recovery. Gluconobacteroxydans has shown around 25% REE leaching under controlled conditions. Sulphate-reducing bacteria treated with PG seepage waters has also shown to produce REE enrich residues containing 202mg/kg La and 477mg/kg Ce, showing potential for valorizing low-grade or waste streams. Integration of these sustainable techniques with fertilizer production frameworks could substantially reduce environmental burden, reduce waste accumulation, and strengthen the global supply chain of critical minerals.

Keywords: Sustainable Recovery, Biosorption, Acid Leaching, Ion-Exchange, Solvent Extraction, and Global Supply Chains.

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SOUTH ASIA EDITION 2025

Investigation of Radioactive Minerals in Selected Areas of Sri Lanka: Geo-health Implications and Policy Perspectives

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Radioactive minerals occur naturally in Sri Lanka's diverse geological formations, but in certain regions, their presence can pose serious health and environmental concerns. This study explores the distribution, geochemical characteristics, and geo-health implications of naturally occurring radioactive minerals in Balaharuwa, Mahagama, Hambegamuwa, Randenigala, and Kawudupelella-localities along the Highland–Wanni and Highland–Vijayan boundaries, and within the Highland Complex. Using field gamma surveys and laboratory analyses including optical microscopy, X-ray diffraction (XRD), and Raman spectroscopy, the study identified pegmatite-related minerals such as monazite, thorianite, and zircon as the main sources of natural radioactivity. The recorded gamma dose rates varied widely, with the highest value, 26.14 µSv/h, detected in the Kawudupelella school playground, exceeding international public exposure limits set by the International Commission on Radiological Protection (ICRP) by more than sixty times. Prolonged exposure to such radiation levels can lead to DNA damage, cancer, and hereditary effects, particularly in children who are more sensitive to ionizing radiation. From a geo-health perspective, these findings highlight how natural geological processes can directly influence human health, turning geological enrichment zones into potential radiological hazard sites. The study also opens avenues for exploring geo-pharmacy and mineral-based therapeutics, emphasizing the need to balance potential benefits

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with strict safety and environmental controls. In line with Sustainable Development Goals (SDGs 3 and 6) on good health and clean water, the study recommends the use of AI-based risk mapping, continuous radiation monitoring, and the development of a national geo-health policy framework to identify high-risk areas, guide land use, and safeguard public health in Sri Lanka's mineral-rich regions.

Keywords: Radioactive Minerals, Geo-health, Thorium, Uranium, Environmental Geochemistry, Radiation Exposure, AI Applications and Sustainable Development Goals.

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SOUTH ASIA EDITION 2025

Risk Involved in Saturation Diving and it's Long – term effects on the Human Health

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Saturation diving is an advanced industrial technique that enables divers to work at great depths for extended periods by maintaining them under high atmospheric pressure in sealed chambers and using a helium–oxygen (heliox) breathing mixture. While this method minimizes daily decompression time and enhances operational efficiency in deep-sea oil and gas industries, its prolonged physiological impact remains a concern. The present study synthesizes findings from multiple independent investigations involving approximately 200 saturation divers compared with control groups having similar occupational and lifestyle patterns. Medical evaluations focused on neurological, musculoskeletal, and cardiopulmonary functions, utilizing direct participant responses, medical records, and standardized neurological assessments. The analysed data show that long-term exposure to hyperbaric environments can cause several serious health effects. Prolonged saturation diving increases the risk of diseases such as pulmonary oxygen toxicity, barotrauma, a high-pressure nervous syndrome, and brain injuries caused by microbubbles, which can lead to neurological problems. Other effects include increased oxidative stress, cardiac arrhythmias, avascular necrosis, and joint degeneration. Changes in blood and cell structure, along with oxidative DNA damage, also occur. Divers often experience hearing loss, sleep disturbances, and psychological stress. Reported neurological problems include tremors, memory loss, reduced alertness, and episodes of brain dysfunction. Reduced lung and cognitive performance are also common. On an average, around 20 percent of divers globally, showed long-lasting neuropsychological problems, with no full recovery even after one year of stopping exposure to high pressure.

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These findings bring to fore the necessity for comprehensive longitudinal studies, updated safety protocols, and revised exposure guidelines to mitigate the long-term health risks faced by saturation divers in deep-sea operations and in future finding we should focus on neurological data and biomarkers.

Keywords: Saturation diving, Hyperbaric exposure, Heliox, Neurological effects, Oxidative stress, Barotrauma, High-pressure nervous syndrome, Avascular necrosis, Occupational health and Deep-sea diving.

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Reactive materials used in Geo-mediation

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For efficient treatment, different pollutants require different reactive materials. Common materials include those that are very successful in using abiotic reduction to remediate organic pollutants, heavy metals, and chlorinated solvents; a type of granular carbon that has the ability to absorb a variety of organic substances, including volatile substances; Heavy metals can be removed using natural or artificial materials with a porous structure that can exchange and retain ions. Apatite and limestone are used to raise the pH and make pollutants precipitate out of groundwater. Mulch or substances that release oxygen Nanoscale forms of materials, such as ZVI, have a greater surface area and are therefore more reactive for the remediation of heavy metals and chlorinated chemicals. They are used to promote aerobic or anaerobic biodegradation processes by encouraging microbial activity. The Pros of In addition to using the natural flow of groundwater and requiring no external power for pumping or treatment, many contaminants require particular reactive materials for effective treatment, which have lower long-term maintenance and energy costs than active pump-and-treat systems; minimizes disturbance and eliminates the need for excavation and off-site disposal by treating contaminants in situ; An appropriate choice for plumes that require treatment and containment for extended periods of time, possibly decades; The particular pollutants and the hydrogeological parameters of the location must be carefully considered while choosing and positioning reactive media; The Permeable reactive barrier must have equal or greater permeability than the surrounding soil to ensure the contaminated plume flows through it rather than around it; Geo-mediation is best suited for addressing a known, well-defined plume rather

than widespread contamination; Extended-scale monitoring is necessary for long-term passive medicines in order to monitor progress and guarantee ongoing efficacy. Climate change and population expansion will put more strain on groundwater, which includes water supplies, and geo-mediation in the future. Geo-mediation is growing as a field to tackle new and intricate problems. Droughts and rising temperatures have an impact on groundwater flows and levels, necessitating novel management techniques. Groundwater is becoming more and more important to protect as surface water resources are being depleted. For geo-mediation to create sustainable and successful water management strategies, hydrogeologists, engineers, social scientists, and legislators must work together. New methods of detection and treatment are required due to the emergence of new contaminants such as nanoparticles and microplastics.

Keywords: Reactive materials, Microbial activity, groundwater and Geo-mediation.

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SOUTH ASIA EDITION 2025

Groundwater Contamination by Lead Bearing Minerals and Its Associated Public Health Implications

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Lead is considered to be an ecotoxin, and Pb toxicity in groundwater has been increasingly reported. More so, because it's harmful effects on health leading to diseases such as neurological disorders, cognitive impairment, and developmental delays in children. The major source of Pb toxicity in groundwater is contamination due to industrial and municipal wastes, apart from geogenic sources such as rocks and minerals. The most common Pb-bearing minerals include anglesite ($PbSO_4$), boulangerite ($Pb_5Sb_4S_{11}$) cerussite ($PbCO_3$), pyromorphite ($Pb_5(PO_4)_3Cl$), etc. These minerals mostly occur in association with hydrothermal mineral systems, as well as magmatic systems. During the mining and processing of these minerals, lead particles and ions often leach into nearby water bodies and groundwater aquifers, resulting in long-term contamination. Once introduced into the hydrological system, lead remains persistent and non-biodegradable, posing severe risks to ecosystems and human populations. Human exposure to lead-contaminated groundwater can cause numerous health problems. In children, it is associated with neurological damage, reduced intelligence quotient (IQ), and developmental delays, while in adults it leads to hypertension, kidney dysfunction, anaemia, and reproductive disorders. Prolonged or high-level exposure can even result in death due to lead poisoning. A large number of studies in India have demonstrate the alarming scale of this issue. In Kanpur, Uttar Pradesh, a recent (2022) study reported elevated lead concentrations in both water and sediment of the Ganga River near indus4 zones. In Bihar, a survey conducted in (2023) revealed that nearly 90% of children under five years had blood lead levels exceeding the World Health Organization's safe threshold of 5 µg/dL. Similarly, in Chennai, industrial

waste dumping and subsequent leaching through rainwater have significantly increased Pb in groundwater. These findings highlight the urgent need for sustainable waste disposal practices, stricter regulation of mining and industrial effluents, and continuous groundwater quality monitoring. Effective policy interventions, along with public awareness and environmental management, are vital to prevent further contamination and safeguard both human health and ecological stability.

Keywords: Lead, Groundwater, Contamination, Public Health, and Industrial Waste.

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SOUTH ASIA EDITION 2025

Trace Elements and Human Health: Understanding their Essential Roles, Toxic Risks, and Environmental Pathways

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Introduction: The trace elements are found naturally as a result of various geological processes. Their effects on humans are wide-ranging, affecting enzyme function, hormone regulation, and cellular metabolism. Therefore, the trace elements occupy a unique place between geology and human physiology, even though they are required only in trace amounts. Iron, zinc, copper, iodine, and selenium are indispensable to maintaining physiological balance. These metabolism works best only when they are available in precisely the right quantity. When they are low, conditions develop such as anaemia, thyroid dysfunction, or delayed growth. And when they are in excess through contaminated air, water, or food, elements such as arsenic, lead, mercury, and cadmium can lead to health problems from organ damage to cancer.

Methods: This review presents the recent findings on the occurrence, environmental mobility, and biological significance of both essential and hazardous trace elements. It describes how natural geological processes and various environmental factors influence the movement of these elements through soil, water, and food chains. Some major parameters such as soil pH, redox potential, and organic matter content affect the trace-element mobility and bioavailability. Analytical techniques such as atomic absorption spectrometry, inductively coupled plasma–mass spectrometry, and geographic information systems have allowed for detection of contamination and location of areas of exposure and have transformed the way the path of exposure is mapped.

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Results and Interpretation: Integrating environmental and geochemical data proves that the trace-element characteristics are very sensitive to the environmental parameters including pH and organic matter content. Contamination of trace elements with Industrial as well as agricultural practices increases and bioaccumulates in plants and animals. Mapping data highlight geographic-based variability in the possible exposures to a range of factors, not only geological background, but also anthropogenic inputs as well. The findings illustrate that combination of geological and biomedical understanding is the cornerstone of contemporary medical geology and is crucial in support of policies oriented toward environmental protection, disease prevention, and health sustainability.

Conclusion: The synthesis of environmental, analytical and epidemiological evidence suggests that medical geology is the key to meeting the challenges faced by public health. Trace-element dynamics are critically important for developing local nutrition strategies, preventing disease and enhancing environmental sustainability.

Keywords: Environmental Protection, Environmental Sustainability, and Disease Prevention.

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SOUTH ASIA EDITION 2025

Geochemistry of Groundwater Contaminants in Coalfields: An Elucidation for Plausible Remediation.

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The coalfields, whether active or abandoned, are usually associated with the groundwater contamination issues. The elucidation of contaminants' origin, dissolution process, and migration patterns enables policymakers to chalk out efficient remediation. Present article is a systematic review over classified but relevant works elucidating the geochemistry of these contaminants in one way or another.

An organized review was conducted in synchronization with the standard systematic review guidelines converging to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Page et al. 2021). To assure the balance between comprehensive coverage and reliability of the literature, the Web of Science database alongside Google Scholar tool cum search engine was used for the data collection.

Since preliminary but pioneering works, the acid mine drainage in the coalfields have been held responsible for associated groundwater contaminations (Singh, 1987; Choubey, 1991; Pathak and Banerjee, 1992). The contamination in the groundwater in and around coalfields may occupy a wide spectrum, of which the heavy metals are the issue of grave concern due to the obscure prospect for eradication and menacing consequences (Satapthy et al. 2009; Ganvir and Guhey, 2020; Papadkar et al. 2023; Mulware, 2020). The association of these heavy metals with sulphide mineralization, specifically in the strata hosting coal, has been confirmed by many studies (Mukharjee et al. 1988; Pires et al. 1997; Duruibe et al. 2007; Neogi et al. 2017;

Ganvir and Guhey, 2025). The exposures of otherwise concealed strata augmented with the enhanced weathering has been attributed to the leaching, dissolution and migration of the heavy metals (Ganvir and Guhey, 2023). The remediation strategies intent to deal with the contaminant charged mine drainage has been affirmed and advocated by many workers (Zipper et al. 2014). The apposite elucidation of the geochemistry of these contaminants could enable the policymakers to obstruct the contamination at its very first position.

The present article is a systematic review to elucidate the geochemistry of the groundwater contaminants for effective remediation. Though most of the works advocate the post-contamination initiatives, with an understanding of in-situ geochemistry of contaminants, the issue could be remediated at its inception.

Keywords: Coalfields, Leaching, Dissolution, Migration, Contamination, Geochemistry and Remediation.

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4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Assessment of Fluoride Contamination in Maharashtra, Central India: Potential Health Risks and Future Strategies

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Maharashtra, a state in central India, shows well documented evidence of groundwater fluoride levels exceeding the world health organization (WHO) limit of 1.5 mg/L. Districts such as Nandurbar, Ahmednagar, Nanded, Chandrapur, Nagpur, Bhandara, Beed, Parbhani, Hingoli, Yavatmal, Gadchiroli, Gondiya, are particularly affected. The contamination is mainly geogenic, resulting from prolonged interaction between groundwater and fluoride- bearing minerals such as fluorite, apatite, amphibole, and biotite. These processes are further influenced by alkaline pH, high bicarbonate, and low calcium concentrations, which enhance fluoride dissolution. Anthropogenic activities, especially the heavy use of phosphate fertilizers, also contribute to elevated fluoride levels. Fluoride concentrations are generally higher in shallow aquifers than in deeper ones and show seasonal variations, with maximum values during winter. Regions underlain by granitic and volcanic rocks, such as Dongargaon, often record high fluoride levels, where studies indicate over 90% cases of dental fluorosis and a significant number of skeletal fluorosis patients. Prolonged intake of fluoride-rich water causes dental and skeletal deformities and, in severe cases, can affect the kidneys, nervous system, and blood leading to the anaemia, reproductive problems, and weakened immunity. Children are more vulnerable because of higher water consumption relative to body weight, while nutritional deficiencies in calcium and vitamin C can worsen the effects. Groundwater monitoring data show that about 88.66% of observation wells contain less than 1.0 mg/L. These occurrences

are mapped and summarized in Fig.1.1 and Table 1.1. To mitigate fluoride-related health risks, effective de-fluoridation methods such as activated alumina filtration, the Nalgonda technique, and reverse osmosis can be adopted, along with rainwater harvesting, blending of low-fluoride water, and community awareness programs. These integrated measures are essential to reduce fluorosis incidence and ensure safe drinking water in rural and semi-arid regions of Maharashtra.

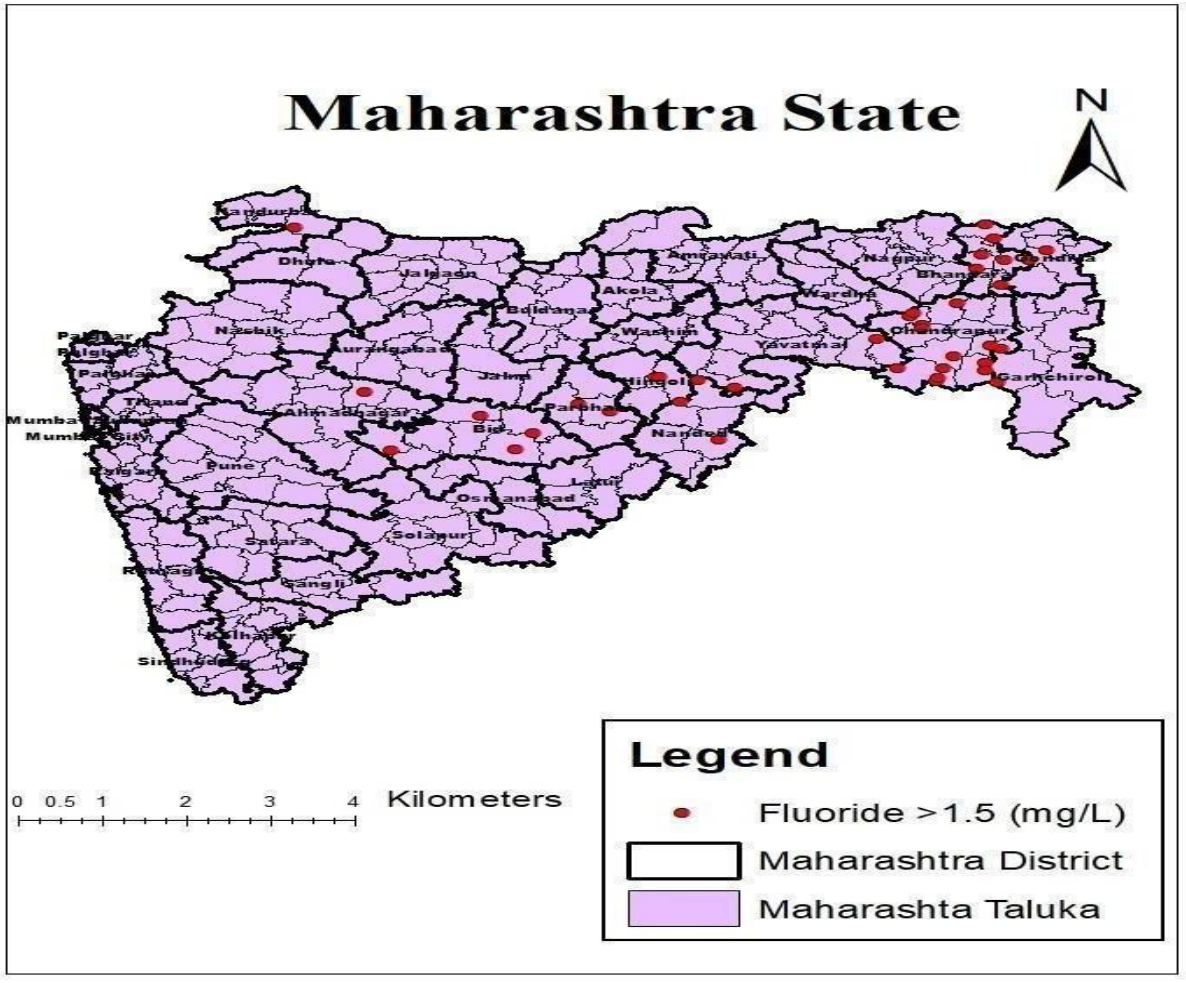

Fig 1. Locations in Maharashtra with fluoride concentration exceeding 1.5mg/L, recorded during May 2022

Table 1.1 List of districts showing localized occurrences of groundwater fluoride concentrations exceeding 1.5 mg/L in Maharashtra (CGWB,2024).

State	Parts of Districts having Fluoride
Maharashtra	Ahmednagar, Beed, Bhandara, Chandrapur, Gadchiroli, Gondia, Hingoli, Nanded, Nandurbar, Parbhani, Yavatmal.

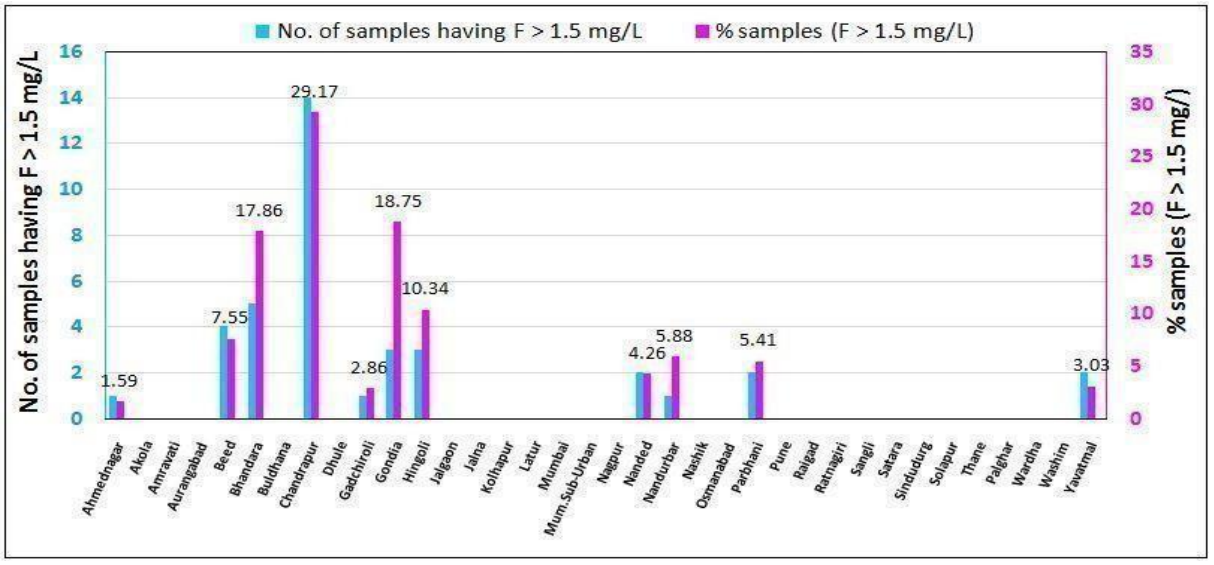

Fig 2. District – Wise percentage of wells with fluoride concentration exceeding 1.5 mg/L in Maharashtra (CGWB,2024).

Keywords: Groundwater, Fluoride, Contamination, Anthropogenic Activities, Anaemia, Immunity and Deficiency.

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SOUTH ASIA EDITION 2025

Ayurvedic and Biomedical Value of Fossilized Gastropods (Shankha and Kapardika)

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Fossils have long been a subject of scientific curiosity for the global geoscience community. Beyond their utility as indicators of geological time, environment, and evolutionary history, certain fossilized materials exhibit notable therapeutic significance. This study aims to explore the therapeutic potential of fossilized representatives of Phylum Mollusca, Class Gastropoda, within the framework of Ayurvedic medicine and modern pharmacology. Marine and terrestrial gastropods are known to contain a range of bioactive compounds such as peptides, alkaloids, sterols, and terpenoids. These compounds possess antimicrobial, anticancer, anti-inflammatory, and wound-healing properties. The present review synthesizes literature -based evidence on two key gastropod-derived therapeutic agents used in Ayurveda: 1) Shankha (Conch) and 2) Kapardika (Cypraea). We assessed their selection criteria,purification processes, chemical composition and biomedical relevance. Methodologically, our study compares the data obtained through ethnomedicinal records, mineralogical analyses, and recent pharmacological evaluations. The Ayurvedic preparations, Shankha Bhasma and Kapardika Bhasma, are traditionally obtained through Shodhana (purification), Bhavana (herbal impregnation), and Marana (calcination), resulting in fine ash primarily composed of calcium carbonate in the form of aragonite. These bhasmas are traditionally used to treat gastric disorders. Our study also emphasizes that calcium carbonate obtained from gastropod shells can be transformed into hydroxyapatite, an essential bone-forming mineral, which shows better structural properties than hydroxyapatite made from egg shells. Pharmacological investigations also indicate their

potential roles in regulating acidity and alleviating respiratory ailments. This study highlights that the therapeutic use of Shankha and Kapardika reflects a strong link between their traditional Ayurvedic applications and present-day biomedical relevance. The findings suggest that gastropod-derived materials hold promise as sustainable source for developing bioactive compounds, connecting geological resources with modern healthcare. We also advocate that future research should explore the biochemical mechanisms, pharmacokinetics, and clinical efficacy of these materials to strengthen their role in evidence-based integrative medicine.

Keywords: Pharmacology, Therapeutics, Anti-Microbial, Anti-Cancer, and Pharmacokinetics.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Therapeutic Potential of Hot Springs: A South Asian Perspective

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A hot spring (also called a thermal spring or geothermal spring) is a natural outlet of groundwater that is heated by the Earth's internal heat before it reaches the surface. They are formed where groundwater is heated by deep geothermal gradients or magmatic activity. These springs bring mineral-rich water to the surface, often containing sodium, chloride, sulphur, calcium, and trace elements which have well documented therapeutic properties. Across South and Southeast Asia, such springs have served as natural healing sites for centuries, as an intersection of traditional medicine and cultural practices. In Afghanistan, sulfur-rich springs such as Garam Chashma (Badakhshan), Kalu Valley, Ghorband, Shina, Dare-e-Soof, and Istalef are locally used to treat fungal and bacterial skin ailments. The Sitakunda spring in Bangladesh is enriched with sodium and chloride. This spring is known to provide relief from arthritis and enhance blood circulation. Geothermal springs in Bhutan such as Gasa Tshachu and those in Nepal are believed to provide relief from arthritis and joint pain. Such balenotheraptic traditions are commonly practiced all over South Asia. In India, hot springs such as Vashisht (Himachal Pradesh) and Tapovan (Uttarakhand) are considered as sacred. These hotsprings mainly serve both therapeutic and ritual purposes in the Ayurvedic treatments. Similarly, Manghopir in Pakistan possesses an antimicrobial property. Sri Lankan hotsprings such as, Kanniya, Mahaoya, and Keerimalai are known for providing relief against arthritis and skin diseases. The mineral-rich springs such as San Kamphaeng and Khlong Thom from Thailand, and Kim Bôi, Thanh Thuy, and Bang from Vietnam, are beneficial against muscle relaxation, mud therapy, and circulatory health. Similarly, Poring and Annah Rais hotsprings

in Malaysia, Khaung Daing, Lashio, and Kengtung hotsprings in Myanmar, and Ardent, Maquinit, and Asin in the Philippines fascinate visitors seeking hydrotherapy. Although these hotsprings are known to provide relief from diseases, the hydrochemical and biomedical studies on these spring water have a limited study. Current study provides compilation of available literature on hot springs from south Asia for providing better understanding of therapeutic potential of hot springs occurring in this region. Integration of scientific examination and tradition will help in understanding therapeutic mechanism and promoting sustainable health tourism. This study therefore strengthens the connection between geology, public health, and regional cultural heritage across South Asia.

Keywords: Hot Springs, Geothermal Activity, Hydrothermal Systems, Mineral Water, Balneotherapy, Medical Geology, Geochemistry, Hydrotherapy, Geothermal Gradient, Therapeutic Minerals, Wellness Tourism, South Asia, Geothermal Health Resources, Traditional Healing, and Sustainable Health.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Role of AI, Machine Learning, and Autonomous Drones in Monitoring Potential Risk Sites: Applications and Implications

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Environmental and geological hazards, including landslides, floods, unstable mining zones, eroding riverbanks, dams, and volcanic regions, pose significant risks to human life, infrastructure, and ecosystems. Traditional monitoring techniques are often constrained by accessibility, high costs, slow data processing, and safety risks, highlighting the need for innovative approaches. This study aims to evaluate the potential of Artificial Intelligence (AI), Machine Learning (ML), and autonomous drones in enhancing the monitoring, assessment, and prediction of hazardous sites, while reducing human exposure and operational costs. AI systems, leveraging ML algorithms such as convolutional neural networks (CNNs), support vector machines (SVMs), and random forests, can process large volumes of environmental data, detect anomalies, assess geotechnical stability, and predict potential hazards with high precision. Unmanned Aerial Vehicles (UAVs), equipped with cameras, sensors, and GPS, serve as mobile platforms to capture high-resolution spatial and spectral data from areas that are otherwise inaccessible or dangerous. When integrated with AI, drones can autonomously navigate complex terrains, analyse data in real time, and adapt to dynamic environmental conditions, converting raw inputs into actionable risk information. Platforms like Flypix AI, Farmonaut, Strayos, and Pix4Dmapper facilitate the integration of UAV data with GIS and remote sensing tools, enabling 3D terrain modelling, automated change detection, and predictive visualization. The use of edge computing further reduces response times by enabling on-site data processing and immediate intervention, supporting disaster prevention and

resource management. This study addresses the research gap in combining AI, ML, and UAV technologies for real-time predictive monitoring of hazardous sites, a topic which is currently been explored across multiple studies. By demonstrating the applications of these technologies, the study contributes to sustainable environmental monitoring, proactive risk mitigation, and improved disaster preparedness. Ethical considerations such as data privacy, airspace regulation, and autonomous decision-making are also emphasized, ensuring responsible implementation.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), Unmanned Aerial Vehicles (UAVs), Hazardous Site Monitoring, Landslides, Floods, Mining Hazards, Real-Time Risk Assessment, Remote Sensing, and Environmental Risk Management.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Extraction and Quantification Techniques for Microplastic in Environmental Matrices

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Microplastics (MPs), any plastics less than 5mm in size, are found in almost all environmental matrices across the world. Due to their slow degradation and chemical stability, they persist in the environment for long duration. MP exist as fragments, foams, fibers, pellets and beads and their presence have been reported in air, water, soil, food items, marine animals, as well as in blood and tissues in human body. The COVID-19 pandemic has exacerbated this issue through the massive use and improper disposal of polypropylene-based personal protective equipment. However, the standardized, reliable, and cost-effective techniques of separation, identification, and quantification of MPs in various environmental samples are still evolving. Techniques like density separation and chemical digestion are evaluated alongside analytical techniques including optical microscopy, FTIR spectroscopy, Raman spectroscopy, and thermal analysis focusing on efficacy, reproducibility, extent, ease of use and cost.

Density separation is commonly used to isolate MPs, with $ZnCl_2$ providing high recovery but this generates large chemical waste. Safer options like reusable NaCl solutions reduce environmental impact. MP morphology observed using stereo microscopy, though its low resolution can be improved with SEM. Raman spectroscopy and FTIR used for polymer identification as Raman provides high spatial resolution and works on dark or wet MPs and detects particles <10 µm whereas FTIR (ATR mode requires low sample preparation and transmission mode provides high quality spectra but requires thin samples), loses its ability to

Proceedings of the 4th International Student Conference on Medical Geology and Environmental Health
South Asia Edition
Virtually, 24th to 29th November, 2025

identify particles <10 µm. Since both methods are complementary with FTIR reducing fluorescence interference.

Proper review of existing methods can help in evolving more robust, realistic, time saving and cost-effective framework for MP analysis in environmental samples. It enables researchers to understand the applications of extraction, identification and quantification methods and subsequently reduce variability, and to better monitor the environmental impacts of MP pollution.

Keywords: Microplastics, Degradation, Density Separation, Chemical Digestion, Morphology and Environmental Impacts.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Tracing the Roots of Mineral Medicine in South Asia

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The tradition of mineral-based medicine in South Asia provides a deep connection between geology, pharmacology and spirituality. The roots of this system can be traced to ancient medicinal systems such as Ayurveda, Siddha, and Unani. Metals, minerals, gemstones are used in formulations for enhancing potency and three bodily humours (Tri-doshas). A science of alchemical transformation has been developed which deals with the blending of herbs with minerals and metals for compounds which help in rejuvenation of the body and restoration of bodily equilibrium. In Ayurveda, it was known as Rasa-shastra. In Unani system of medicine, similar practices were utilized under the name kushtas, in which raw mineral materials were transformed into fine powders through calcination and combined with herbal extracts. Siddha, which is tamil tradition of medicine, also describes intricate purification methods, which ensures that prescribed metals and minerals should be safe for consumption. Beyond Indian subcontinent, Himalayan Sowa Rigpa medicinal system is used, which is a Tibetan-Bhutanese system of medicines. In this system, minerals are not only seen as biochemical agents but also as spiritually potent substances. Different minerals were widely used in these systems which mainly include mercury, gold, silver, copper, copper sulphate, zinc oxide, mica, sulphur, arsenic compounds, borax, and gemstones. Currently in South Asian countries, minerals and metals available in those countries are widely employed for preparations of such formulations. Adaptation of these practices in modern pharmacological inspection has revealed both therapeutic potential and toxicological concerns associated with the bio-accessibility of heavy metals. Overall, tracing the roots of mineral medicine in South Asia reveals an intricate

interplay between empirical observations, ritual purification and cross-cultural scientific knowledge.

Keywords: Pharmacology, Therapeutic Potential, Bio-Accessibility, and Toxicology.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Occupational Respiratory Risks Associated with Aluminium Fumes: A Discussion on Nagpur city, India

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Aluminium is not form in gaseous state at the normal temperature and pressure. Rather, it is a solid metal having a boiling point of 2,470°C. Nevertheless, under intense heat during welding, evaporation in vacuums, and industrial processes it can be incorporated in the vapour form and occupies the ambient. Such vapourised aluminium is highly toxic reactive and hazardous to health of the workers. When condensed, the aluminium vapour turns into aluminium nano particles which collectively forms aluminium metal. Inhalation of both vapours and particulate matter can cause irritation in respiratory tract, which can lead to the bronchitis, cough, and dyspnea. Chronic exposure may lead to the aluminosis, a disease analogous to the silicosis, in which aluminium particles scar lung tissues. The extended exposure to aluminium dust may also lead to the chronic bronchitis, occupational asthma, and aluminium- induced pulmonary fibrosis, which is commonly known as aluminium lung. Furthermore, studies of smelter and cast-house workers show worse lung function with increased exposure. Clinical assessments have also confirmed interstitial fibrosis in chronic high-dose exposure scenarios. It has been also observed that, aluminium vapour generating processes tend to generate ozone (O_3), a harmful, carcinogenic gas which is produced due to the interaction of UV radiation with atmospheric oxygen. Inhalation of ozone leads to the irritation in throat, chest discomfort, and impaired lung function. Other byproducts of the process are carbon monoxide, carbon dioxide, and nitrogen dioxide, which may cause respiratory distress or may lead to the asphyxiation. Furthermore, other metal vapours such as Fe2O3, MnO2, etc., may also accompany aluminium

vapours due to use of aluminium alloys. These vapours increase the risk of metal fume fever (flu-like illness), or in exceptional cases, cancer.

In developing cities like Nagpur, there are areas such as Mominpura and small factory area Baradwari are associated with the aluminium works such as welding. This area in Nagpur is more prone to the diseases associated with inhalation of aluminium vapours and may lead to the respiratory diseases associated with the aluminium works. Major steps are needed to mitigate this problem, such as improved ventilation, exposure monitoring, and regular worker health surveillance. Taking such steps may lead to the early intervention of the respiratory diseases in the areas associated with aluminium works.

Keywords: Aluminium Exposure, Respiratory Health, Pulmonary Toxicity, Occupational Asthma, Aluminium Lung and Smelter Workers.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Understanding the Toxicity of Uranium with special reference to Indian Mines

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Uranium is a naturally occurring radio-active element and is important for generation for energy sources, defence purpose etc. Uranium poses both chemical and radio-toxicity. Natural and depleted uranium causes chemical toxicity whereas, enriched uranium causes radio toxicity. Evidences indicate that, uranium concentration is observed to be elevated in and around uranium mines, affecting both groundwater and soil. Uranium is exposed through inhalation and ingestion. Inhalation of uranium aerosols is an important route of exposure. Inhaled uranium particles are retained in lungs for long-term and results in respiratory disease and lung cancer. Uranium also enters into the body through ingestion of contaminated food and water. Most of the uranium is excreted, as absorption rate of uranium is very low. Chronic exposure through drinking such contaminated water and inhalation of contaminated air, may result in renal dysfunction, pulmonary damage, and genotoxic effects. Kidney is the most sensitive organ for uranium toxicity. Uranyl ion generates reactive oxygen species (ROS) which suppresses anti-oxidant defence. This result in DNA damage, protein malfunction, and inflammation. Accumulation of uranium in proximal convoluted tubules, which causes oxidative stress, mitochondrial injuries, and cell death. Such cases lead to the acute tubular necrosis and poses long-term damage to the kidney. Enriched uranium when deposited in the bones and other parts of the body. it induces irradiation for life-time and leads to the stochastic effects, such as cancer. Furthermore, long-term low dose exposure to uranium may cause chronic effects on bones, liver, reproductive organs, and central nervous system. Currently,

India has operational uranium mines in Jharkhand, Rajasthan, and Meghalaya. These areas may face effects such as groundwater contamination, occupational exposure, and community health effects. Environmental studies have demonstrated migration of uranium along with the associated potential toxic metals into groundwater aquifers, particularly during monsoonal leaching. Studies from Jadugoda, Jharkhand, have revealed increased risk of congenital anomalies, cell damage, and reproductive health issues among local populations. Therefore, toxicological profile of uranium in Indian mines requires urgent attention for radiological monitoring, waste containment, and community health surveillance. Integration of biomonitoring and environmental risk assessment may lead to safe mining practices. Furthermore, dose-dependent modelling, long-term community studies, and remediation technologies according to the Indian geochemical setting.

Keywords: Uranium Toxicity, Indian Mines, Radiological Exposure, Groundwater Contamination, Occupational Health, and Jadugoda.

4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Geo-diseases and Public Health: An Evaluation of Policy and Management Approaches

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Geological diseases or the Geo-Diseases are those that are caused due to geohazards such as earthquake, volcanism, landslide, etc.; or direct exposure to toxic elements due to mining activity that are otherwise sequestered into geological reservoirs such as rocks and minerals; or indirectly through environmental disturbances and human activities (Randive and Godbole, 2025). While the aetiology and health impacts of major geogenic health hazards are well established there is still paucity with respect to their policy implementation. This review aims to examine how temporal, economic, and governance factors have shaped the implementation of geogenic disease mitigation policies globally. The recent 2019-20 pandemic of COVID-19 showed the world that there is a growing need for close collaboration between science and governments. Effective public health response demands timely integration of scientific evidence into policy frameworks. The analysis was based on an integrative review of published research articles, policy documents, and government reports addressing major geogenic disease events across different regions. Analysis of documented cases reveals consistent patterns of delayed response across diverse geographic and economic contexts. In Kabwe, Zambia, lead mining operated for decades. Studies in the 1970s showed the health dangers and evidence of contamination. Even today, children in Kabwe have blood lead levels higher than WHO safety levels, and the ongoing issuance of additional mining licenses exacerbates this crisis (Hokkaido University, 2020; Human Rights Watch, 2025; Yamada et al., 2020). Nevertheless, Zambia's National Green Growth Strategy (2024–2030) proposes a positive shift through the "restoration

and management of mine wastelands" (Ministry of Green Economy and Environment, 2024). Similarly, in Bangladesh, an estimated 35–77 million people were exposed to arsenic through tube wells lacking proper testing in the 1970s (Flanagan, Johnston, & Zheng, 2012; Milton, Hore, Hossain, & Rahman, 2012; Smith, Lingas, & Rahman, 2000). Despite decades of research, an estimated 43,000 deaths annually are still attributed to arsenic-related diseases (Rahaman, Mise, & Ichihara, 2022). Comparative analysis reveals temporal intervals between scientific documentation and substantive intervention (Ahmad, Khan, & Haque, 2018; Rajaee et al., 2015). Current international frameworks, including WHO guidelines and Sustainable Development Goal 3.9, provide normative standards which should be implemented (United Nations, n.d.; World Health Organization, 2018). The study proposes that geogenic diseases should be treated as mainstream public health priorities, supported by proper funding and surveillance systems. Strict legal controls over mining, implementing geogenic hazard zoning, and encouraging community awareness are essential to sustainable mitigation. To align resource extraction with public health protection, strengthened international accountability instruments are needed. These measures will help reduce science-to-policy implementation gaps in environmental health governance (Rajaee et al., 2015).

Keywords: Environmental Health, Mitigation Policies, Governance, and Geo-hazards.

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4TH INTERNATIONAL STUDENT CONFERENCE ON MEDICAL GEOLOGY AND ENVIRONMENTAL HEALTH
SOUTH ASIA EDITION 2025

Impact of Gold Mining on Human Health

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Gold (Au) is an economically important metal with high global demand, but its extraction poses serious risks to human health and the environment. Gold mining introduces heavy metals such as mercury (Hg), arsenic (As), lead (Pb), cadmium (Cd), chromium (Cr), nickel (Ni), silica (Si), manganese (Mn), zinc (Zn), and others, particularly in mine tailings. In artisanal and small-scale mining, mercury is used for gold extraction through amalgamation, where heating the gold-mercury amalgam releases toxic vapours. Inhalation of mercury vapours can damage the nervous system, kidneys, and increase cancer risk. Silica dust from blasting and drilling causes silicosis, chronic respiratory, digestive, and cardiovascular problems. Arsenic and lead in gold ores are carcinogenic. Industrial-scale mining employs cyanide leaching to extract gold, and cyanide exposure through skin contact, inhalation, or ingestion can cause organ damage, neurological impairment, and even death. Tailings contain high concentrations of these toxic elements, leading to long-term contamination of soil, water, and air, affecting nearby communities and wildlife. Safety measures are essential to reduce these risks. Mercury-free extraction techniques, such as gravity concentration (panning, sluicing, shaking tables, spiral concentrators, centrifuges), flotation, and borax methods, can replace mercury amalgamation. Less toxic alternatives to cyanide, including thiosulfate, glycine, bromine, iodine, chloride, bioleaching, and electrochemical methods, minimize environmental impact. Regular health monitoring of mine workers and nearby communities, awareness programs about toxic

elements, and proper tailings management to prevent leaching into soil and groundwater are critical.

Keywords: Gold Extraction, Mercury Vapour, Cyanide Leaching, Tailings, Carcinogenic, and Borax Method.

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The Himalayan Salt Lamp: A Commentary on the Science and Belief

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Himalayan salt lamps have gained global attention for their claimed ability to purify air, enhance mood, and improve overall well-being. Composed mostly of sodium chloride and some trace elements like iron and magnesium these lamps are believed to emit negative ions, which may neutralize positive ions produced by pollutants and electronic devices. However, the scientific evidence supporting these claims remains limited and inconclusive. Existing studies lack big sample size and substantial evidence. Reported physiological effect might be a placebo effect or just the vibes of the lamp. This paper critically reviews the available literature on salt lamps, highlighting inconsistencies in study design, sample size, and environmental control. It also proposes a systematic research methodology to evaluate the physiological effects of salt lamps through controlled experiments measuring air quality, mood, and wellness indicators. The findings suggest that while salt lamps may offer aesthetic and psychological comfort, their health benefits are not yet scientifically verified. Further multidisciplinary and standardized research is necessary to determine their real impact on indoor environments and human health.

Keywords: Himalayan Salt Lamp, Negative Ions, Air Purification, Mood Improvement, Health Evaluation and Indoor Environment.

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Health Implications of Salt-Water Intrusion in India: A Systematic Review of Salinity Exposure, Human Health Risks, and Mitigation Challenges

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The Salt-water intrusion (SWI) threatens coastal freshwater resources and can increase salinity of drinking water, with potential effects on human health. We systematically review studies from India (and closely relevant South Asian evidence where Indian data are limited) to synthesize evidence on exposures (groundwater/surface-water salinity), associated health outcomes (hypertension, maternal and perinatal outcomes, kidney disease, and indirect impacts), and interventions. Following PRISMA guidelines, we searched PubMed, Scopus, Web of Science and Indian journals for studies published [up to 16th of October 2025], using keywords related to seawater intrusion, saline groundwater, drinking water salinity and health outcomes. We extracted study location, design, exposure metrics (TDS, Na+, Cl−), health outcomes, effect estimates, confounders, and study limitations. Quality was assessed using Newcastle–Ottawa Scale for observational studies and an adapted checklist for ecological studies. Because of expected heterogeneity we planned a narrative synthesis and, where ≥3 similar outcome measures existed, a random-effects meta-analysis was carried out. Preliminary evidence from coastal South Asia links elevated drinking-water salinity to increased blood pressure and adverse pregnancy outcomes; Indian hydrogeological studies document widespread SWI in multiple states, but direct Indian health studies are sparse. We identify major gaps: few Indian cohort or case-control studies, inconsistent exposure assessment, and lack of long-term health surveillance. We conclude with recommendations for integrated

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geologic-public health monitoring, standardized salinity exposure metrics, and community-level mitigation (rainwater harvesting, managed aquifer recharge, low-cost desalination). This review indicates the importance of salt water incursion and its effects on human health, and also highlights an urgent need to prioritize the research in this relatively lesser studied area.

Keywords: Salt-water Intrusion, Drinking Water Salinity, Coastal Aquifers, Human Health, Hypertension, Maternal Outcomes and Kidney Disease.

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SOUTH ASIA EDITION 2025

Harnessing Trace Elements as Therapeutic Agents in Diabetes Mellitus: Targeting Oxidative Stress and Insulin Resistance

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Diabetes is a highly significant and growing health crisis in South Asia. Diabetes mellitus is multifactorial metabolic disorder influenced by genetic, environmental, and nutritional factors. Minerals and trace elements are micronutrients that are essential to the human body but present only in traceable amounts. A study by (Nielsen, 2008) focused on some of these minerals and trace element deficiencies and their consequences in diabetes and insulin resistance. This is a narrative review synthesizing evidence from randomized controlled trials (RCTs), cohort studies, on the association between trace element status and type 2 diabetes mellitus (T2DM).Evidence consistently supports a negative association between trace element deficiency and T2DM but the magnitude of effect remains variable They qualitatively summarized directional trends in micronutrient levels (e.g., reduced serum zinc, elevated serum copper) in T2DM and mechanistic pathways involving oxidative stress, insulin receptor site activation, beta-cell function, and glucose homeostasis. Key trace elements reviewed included boron, calcium, cobalt, chromium, copper, iodine, iron, magnesium, selenium, and zinc, with emphasis on insulin-mimetic effects (Anderson, 1998), antioxidant enzyme modulation. Fenton reaction –mediated oxidative damage (iron overload), and adipogenesis inhibition (boron). Deficiencies in zinc, magnesium, selenium, and chromium impair beta-cell function and insulin signalling (Nielsen, 2008) while excess iron and copper trigger Fenton-mediated damage. Boron and chromium show insulin-mimetic effects; magnesium and zinc

supplementation improve glycemic control results are qualitative I have selected this study specifically because as we know diabetes mellitus is one of the most prevailing diseases in South Asia and Diabetes affects 1 in 10 people globally. This is a qualitative synthesis regarding the fulfillment of Micronutrient imbalances. Deficiencies via supplements can reduce oxidative stress and delay T2DM onset. Some of the major findings were how Cr, Mg, Zn improves HbA1c, insulin sensitivity but also how excess of Fe and Cu can cause Fenton reaction thus accelerating oxidative damage but. Supplementing right and personalized doses of (Cr, Mg, Zn) improves HbA1c and insulin sensitivity, which means that in the coming Future we are going to need: large RCTs with standardized assays and dose-response data which will create a big impact in the treatment of diabetes and can even be introduced in mainstream medicine.

Keywords: Micronutrients, Oxidative Damage, Medicine, Insulin Resistance, Nutrient Deficiencies, Anti-Oxidants

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Lead Poisoning Associated with Ayurvedic Medicines: Implications for Parkinson's Disease Patients

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Ayurveda is a system of traditional medicine that is native to India and is used in many parts of world as an alternative to standard treatment regimen. From 2000 to 2003, the Centre for Disease Control (CDC) reported 12 cases of lead poisoning in adults associated with ayurvedic medication intake occurring in five different US states. Some ayurvedic preparations have been found to contain lead and/or mercury at 100 to 10,000 times greater than acceptable limits. This study involves an overview of lead poisoning in Parkinson's patients, diagnosis and treatment. Lead is not a naturally occurring geomaterial, but it is found in rocks and other elements present on earth. It is a major constituent in ayurvedic medicine, along with other heavy metals like mercury, arsenic and silver. Exposure to high amount of lead can cause poisoning in humans which can accelerate neurodegeneration, oxidative stress and neuro-inflammation. Lead poisoning can cause drooling (excessive salivation) in patients suffering from PD, difficult in swallowing or grinding of teeth. Severe symptoms can cause seizures, vision loss and kidney damage. Diagnosis of lead in the body can be evaluated by blood test or heavy metal test which provides the accurate concentration of the heavy metals like lead, magnesium, arsenic and silver present in the blood. The concentration of lead over the specified limit (5µg/dl) can cause health problems. Treatment of lead poisoning can be done by Chelation therapy, which is a medical procedure where a drug is administered to bind and safely remove heavy metals or minerals from the body, primarily to treat poisoning from metals like lead, mercury and iron.

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Lead poisoning has significantly increased in geriatric population due to high exposure to ayurvedic medicines containing heavy metals over the specified limit. Quality and safety analysis of these medicines before commercialisation is required to ensure that the concentration of the heavy metals in the ayurvedic preparation is optimal.

Keywords: Ayurveda, Heavy Metal Toxicity, Risk Assessment, and Parkinson's Disease.

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Software Programs and Techniques in Remote Sensing for Mapping Geo- Diseases

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Present study aims to evaluate the role of Remote Sensing (RS) and Geographic Information Systems (GIS) in the identification, monitoring, and spatial analysis of geo-diseases arising from both geogenic sources such as fluorosis and silicosis, and vector-borne diseases such as dengue and malaria. The study is aimed at demonstrating an integration of satellite imagery, aerial photographs, and advanced spatial analysis tools in correlating the geological, environmental, and medical (health) data helping to understand the spatial distribution of diseases. The methods used for this study includes multispectral and hyperspectral imageries, Digital Elevation Models (DEM), Land Use Land Cover (LULC) classification, Object-Based Image Analysis (OBIA), and indices such as Normalized Difference Vegetation Index (NDVI), Normalized Difference Built-Up Index (NDBI), Normalized Difference Water Index (NDWI), Normalized Difference Moisture Index (NDMI), Urban heat Island (UHI) and Land Surface Temperature (LST) for identifying environmental and geological factors that influence the spread of diseases. Examples from previous other studies show how useful these methods can be. For example, Sureshkumar and Shekhar (2025) demonstrated the impact of urban heat island effects (UHI) on dengue incidence in Thanjavur, Tamil Nadu, India using thermal and high-resolution optical imagery, revealing strong correlations between high LST zones and dengue hotspots. Similarly, Puri et al. (2014) used GIS-based geospatial mapping to identify areas having arsenic-contaminated groundwater in West Bengal. Wimberly et al. (2021) highlighted how satellite data is used to monitor malaria. Collectively, these examples support

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the study's objectives of the applications of RS-GIS platforms such as ArcGIS, QGIS, ERDAS, ENVI, STATA, WINBUGS, and Google Earth Engine (GEE) for disease mapping and risk zone delineation. The workflow illustrated in Fig.1 highlights the integration of RS-GIS techniques, enabling a systematic approach for spatial modelling, correlation, and validation of geo-disease patterns, thereby supporting effective risk zonation and public health planning.

Keywords: Disease Mapping, Remote Sensing, and Spatio-Temporal Analysis.

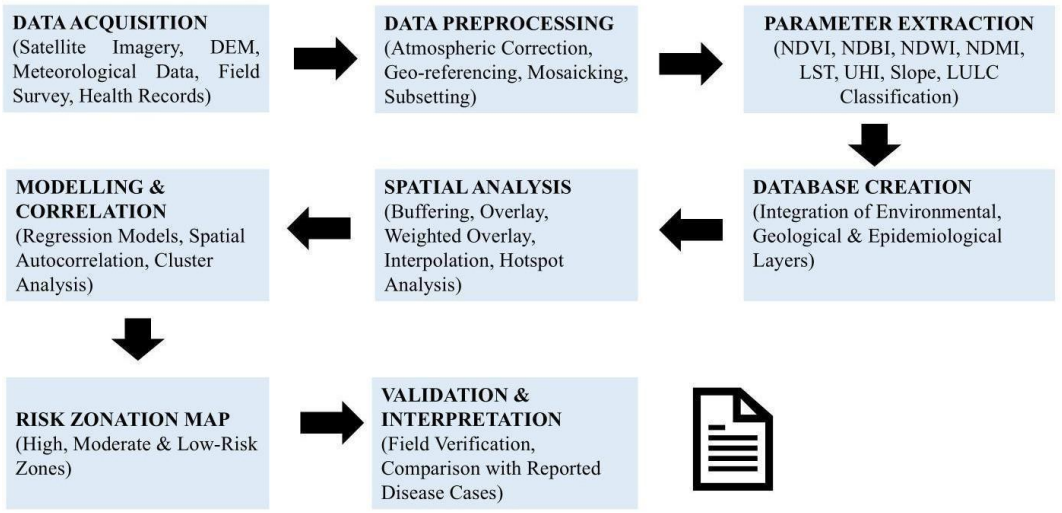

Fig 1. Flow diagram demonstrating the software and remote sensing-based mapping of geo- diseases

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The Factor Analysis Approach as an Effective Tool to Identify the Major Factors Affecting Groundwater Quality for Maintaining and Management of Groundwater in a Particular Region-A Review

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Groundwater quality refers to the characteristics of water found in underground in aquifers. Groundwater quality assessment is crucial for ensuring the sustainability of water resources and public health particularly in regions where groundwater serves as the primary source of drinking and irrigation purpose. The factor analysis approach is an effective statistical tool used to identify and evaluate the major factors influencing groundwater quality. This method helps to reduce complex datasets into key components that reveal underlying geochemical processes. Anthropogenic influences, and natural variations affecting water composition. In this study, factor analysis is applied to determine the dominant parameters controlling groundwater quality within a particular region. The results provide valuable insights into the spatial and temporal distribution of contaminants, enabling efficient monitoring and management strategies. Overall, the use of factor analysis enhances understanding of groundwater systems, supports environmental decision-making, and promotes sustainable water resource management.

The groundwater quality can be analyzed by the chemical analysis of the groundwater sample collected from different wells in a particular region, but the problem is how the main factor affecting groundwater quality. This review shows how effectively multivariate statical

techniques that are factor analysis act as a tool to identify the major factors affecting groundwater quality for monitoring management groundwater in a particular region.

Keywords: Groundwater, Public Health, Irrigation, Sustainable Water Resource Management, Anthropogenic Influences and Geochemical Processes.

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A Study of Importance of Urban Forest on the Health of People Living in Urban Areas Highlighting the Environmental Laws in India

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The world is urbanizing at a rapid rate with estimation that around 55% of world population is residing in urban areas and by 2050 about 68% of world's population projected to be living in urban areas (United Nations Department of Economic and Social Affairs, 2018). Now as per Urban Greening Guidelines of 2014 the total India's urbanization is estimated that the urban component is expected to rise to around 40% by 2026 as the India's cities continue to grow demographically and spatially (Urban Greening Guidelines, 2014). There is continuous increase of percentage of people living in urban cities and as per Reforms in Urban Planning Capacity in India the India will witness about 50% of urbanisation by 2050 (NITI Aayog, 2021). In addition to this the growing unplanned and inadequately managed urban expansion with unsustainable development patterns and lack of public institutions to manage urbanization, can lead to large scale environmental degradation and thereby rise in health risk. Today the protection, conservation and preservation of environment is the prime aspect which is directly related to right to health of each and every individual around world, therefore it is high time to protect green patches in and around urban settlements. The term Urban forest constituted to be the second kind of forest, the forest which is close to human settlements or within settlements (David Nowak, 2016). This concept of urban forest can be defined as the trees within our urban lands. This kind of forests or we can say those urban green patches provide innumerable services right from keeping the urban environment clean to protect the

humans from various kinds of health hazards caused by various kinds of pollutions. Urban forests help to improved air quality, Noise reduction, improves quality of life, helps in community well-being, improves physical and mental health by reducing stress by providing more relaxed physiological states in humans and has also associated with helping to recover the patients more effectively as compared to patients without such green views. Helps to improve local economic vitality of city etc. such numerous health benefits are carried by the Urban forests. This paper will discuss in detail how this Urban forest plays an important role and various environmental laws which helps to protect such urban forest in India. For example, The Right to life under article 21 of Constitution of India has rightly highlighted Protection of life and personal liberty and 6 Article 47 which imposes a duty upon State to improve the standard of living and to provide a safe environment for an individual.

Keywords: Urban Forest, Environmental Degradation, Environmental Laws, Community Well-Being

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Flooding and its Role in Disease Outbreak: An Indian Perspective

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Floods are among the major geological hazards in India, caused by heavy rainfall, river overflow, dam failures, glacial lake outbursts, tsunamis, and inadequate drainage systems. India has over 40 million hectares of flood-prone land, and flood-related damages have increased drastically in recent decades due to population growth, urbanization, and development in floodplains. Annually, floods cause around 1,600 deaths and affect approximately 75 hectares of land. Floodwaters, especially in urban, agricultural, and industrial areas, carry pathogens (e.g., Vibrio cholerae, Salmonella typhi, hepatitis viruses) and chemical contaminants, which lead to outbreaks of waterborne and dermal diseases such as cholera, typhoid, hepatitis, and skin infections. This study aims to examine the link between flooding and public health from a medical geology perspective, focusing on the mobilization of geogenic and anthropogenic toxic elements such as arsenic, cadmium, chromium, and lead. Floods increase the bioavailability of these elements in groundwater and surface water, contributing to acute and chronic health effects including neurotoxicity, organ damage, and cancer. The study emphasizes the need for integrated environmental monitoring, health risk assessment, and disaster management. Effective mitigation strategies include improving sanitation, healthcare, and water purification systems, raising community awareness, and implementing both structural measures (dams, levees) and non-structural measures (zoning, early warning systems), along with nature-based solutions and technological integration. Understanding the

geogenic and anthropogenic pathways of contaminants during floods is crucial for minimizing health risks, particularly in the context of India's changing climate.

Keywords: Floods, Water Contamination, Toxic Elements, Public Health, Climate Change, and Flood Management.

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Therapeutic Value of Tourmaline (*Vaikrant)*: A Discussion based on Traditional Indian Medicinal System (Ayurveda)

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Tourmaline *(Vaikrant)* is considered as one of the *ratnas* or gems in traditional Indian Medicinal system (*Ayurveda*). It is known for its *Teekshna* (penetrating), *Ushna* (Thermogenic), and *Vishagha* (detoxifying) properties in *Rasashashtra* and *Rasaratna Samuchchaya (*traditional Indian alchemies*).* These properties bring to fore the role of Vaikrantin neutralizing toxins, enhancing metabolism, and restoring *Tridoshic* balance, viz. *Vata*, *Kaphha*, and *Pitta*. Traditionally, it is used in *Rasoushadhi (Mineral-Medicine)* formulations. *Vaikrant* is believed to promote vitality, digestion, and *Dhatu Pushti* (Tissue regeneration). Despite of its revered status, its precise mineral identity has been debatable for centuries. Recent mineralogical and analytical studies of *Vaikrant* are in favour of Tourmaline (a borsosilicate) having chemical composition [$(Na, Ca)\ (Mg, Fe, Li, Al)_3Al_6(BO_3)_3Si_6O_{18}(OH, F)_4$]. Tourmaline exhibits pleochroic, pyroelectric, and piezoelectric properties which are useful in bioenergetic equilibrium. Documented Sanskrit ancient descriptions see *Vaikrant* as hard, heat-resistant, and multicoloured gemstones. On the contrary, some proposals identify *Vaikrant* as Fluorite (CaF_2), which might be geochemically inconsistent due to its softness, solubility, and lack of electrical activity. These properties conflict with gem's traditionally described vigor and durability. From a biomedical standpoint, tourmaline's elemental constituents, viz. B, Fe, and Li show antioxidant and neuroprotective effects when processed through Ayurvedic *Shodhana* (Purification) and *Marana* (Calcination) methods. These methods made *Vaikrant Bhasma*, a nanoscale biophilic powder to enhance antioxidant enzyme activity, support wound healing,

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and regulate cellular ionic balance. The piezoelectric behaviour of tourmaline nanoparticles further suggests potential in bioelectronic and regenerative medicine. Integrating classical Ayurvedic principles with modern geochemical and nanomedical insights positions *Vaikrant* (Tourmaline) as a unique mineral drug embodying sustainable, bioenergetic therapeutics. It exemplifies the synthesis of ancient gemmological wisdom and contemporary scientific validation, reinforcing Ayurveda's holistic approach to healing and material science.

Keywords: Vaikrant, Tourmaline, Rasashashtra, Nanomedicine, and Ayurveda.

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Earth as Medicine, Earth as Poison: The Duality of Geophagia

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Human geophagy is the intentional consumption of Earth and clay (kaolin) by individuals for various physiological and psychological causes. It is globally practiced in most developing and underdeveloped countries, the causes and effects of which are discussed in the poster. It is statistically more prevalent among children, women (especially pregnant women), black individuals, and those in rural areas, particularly in Sub-Saharan Africa, parts of the Americas, and Asia. The motivations for geophagy are multifaceted, but highly debatable. Hypothesized benefits include nutritional supplementation, detoxification and therapeutic effects, such as acting as an antacid, soothing gastritis, and alleviating diarrhoea or pregnancy-related nausea. Despite these potential benefits, the poster highlights significant health risks. A primary concern is the interference with mineral absorption; kaolin can chelate non-haem iron in the gut, leading to or worsening iron-deficiency anaemia. Other risks include intestinal blockage, dental damage, and infections from soil-borne parasites (geohelminths) and bacteria. Furthermore, geophagic materials are often contaminated with toxic heavy metals like lead (Pb), cadmium (Cd), and mercury (Hg). Pb can be absorbed into the bloodstream, where it mimics essential ions like calcium and zinc. This interference can disrupt heme synthesis (causing anaemia), impair thyroid function, lead to significant neurotoxicity and zinc deficiency may even alleviate the chances of developing cancer. The poster also tries to correlate the geochemical pathways of contamination like geogenic contamination and geochemical adsorption. It also focuses on hydrology and contamination while transport. It concludes that simple geochemical analysis of clays is insufficient and calls for further research

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into the bioavailability of heavy metals and other elements in specific geophagic materials to accurately assess their toxicity or benefits.

Keywords: Anaemia, Neurotoxicity, Diarrhoea, Thyroid Function, Geogenic Contamination and Hydrology.

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SOUTH ASIA EDITION 2025

Rare Earth Elements in Oncology: Diagnostic, Therapeutic, and Monitoring Applications

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Rare Earth Elements (REEs) have gained increasing attention in oncology due to their unique magnetic, luminescent, and radioactive properties, offering multifunctional applications in cancer management. In diagnostics, elements such as Gadolinium (Gd) and Europium (Eu) enhance tumour visualization through magnetic resonance and fluorescence imaging, improving detection and staging accuracy. During treatment, radioisotopes including Yttrium-90 (Y-90), Lutetium-177 (Lu-177), and Holmium-166 (Ho-166) are applied in targeted radionuclide therapy and radioembolization, delivering localized radiation with minimal systemic toxicity. REEs are employed in various light- based therapies like - photothermal and photodynamic due to their unique optical properties such as upconversion photoluminescence, strong light absorption and photothermal conversion. While Cerium (Ce) and Samarium (Sm) nanoparticles enhance radiotherapy efficiency by selectively targeting cancer cells and facilitates targeted drug delivery. Post-treatment, REE-based contrast agents, support monitoring of therapeutic response and early detection of recurrence through advanced imaging modalities. This study addresses diagnostic, therapeutic, and post-therapeutic uses of REEs, highlighting the potential of REE-based nanomaterials and theranostics systems for real-time diagnosis, precise treatment, and effective monitoring.

Keywords: Rare Earth Elements, Oncology, Diagnostics, Radionuclide Therapy, Nanomaterials, Theranostics.

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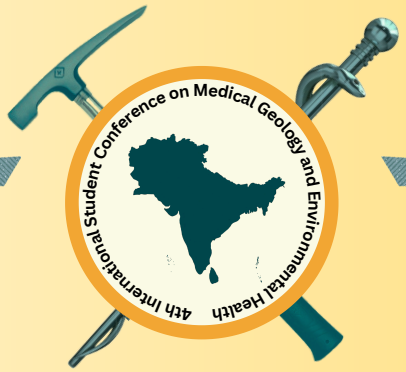

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