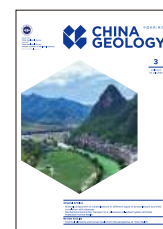




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Editorial

Research status and future prospects of Medical Geology

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Since the start of the 21st century, health issues caused by exposure to geological materials, such as heavy metal pollution and/or imbalances in essential elements, have consistently affected about one billion people worldwide. In response to this critical problem, the field of Medical Geology has developed through collaborative efforts from experts in various disciplines, including geologists, environmental scientists, biologists, biochemists, toxicologists, epidemiologists, and public health professionals.

This discipline has gained widespread attention worldwide in recent years. It primarily examines the connection between the geological environment and human and animal health, analyzes the causes of endemic diseases, and investigates the migration and exposure risks associated with environmental contaminants. It is gradually developing into a strong multidisciplinary, technology-driven field. The current research status of Medical Geology globally is as follows.

1. International organizations and research programs contributing substantially to the development of Medical Geology

(i) The International Medical Geology Association (IMGA) has regularly organized international conferences, such as the biannual “International Conference on Medical Geology”, which significantly promotes academic exchanges and advances research in the field.

(ii) Relevant projects supported by the International Union of Geological Sciences (IUGS) through the IGCP program, including IGCP-454 (2002–2007), which examined the distribution of elements like arsenic, fluorine, and selenium in geological environments and their impacts to health, and IGCP-600 (2010–2014), which explored how geochemical processes influence health.

(iii) The United Nations Environment Program (UNEP) and the World Health Organization (WHO) both focus on the impact of natural geological pollution (e.g., arsenic and fluorine contamination) on developing countries and aim to promote the implementation of policies (e.g., addressing arsenic contamination of groundwater in Bangladesh).

2. Main research areas and trends

(i) Release, exposure, and health risks related to toxic elements: The links between high arsenic levels in groundwater (e.g. Bangladesh, India, and Argentina) and cancers and cardiovascular diseases; dental and skeletal fluorosis in high-fluoride regions (e.g., China and Africa); and soil pollution and health effects caused by heavy metals (e.g., Cd, Pb, and Hg) from mining activities (e.g. South America and Africa).

(ii) Deficiency of essential elements for good health: The prevention and control of iodine deficiency disorders (IDD) worldwide (e.g., in the Himalayan region), the connection between low selenium levels (such as in areas affected by Keshan disease in China and some African countries) with immunity and thyroid functions.

(iii) Geological dust and respiratory diseases: Exposure to quartz-rich dust from the mining and construction industries (e.g., gold mines in South Africa) and the effects of volcanic eruptions (such as in Iceland and Indonesia) on respiratory health.

(iv) Climate change and emerging health risks: Extreme weather events (such as droughts and floods) can promote the migration of contaminants like arsenic and mercury (e.g., South Asia) and the release of harmful elements from melting glaciers (such as mercury in the Greenland ice sheet).

(v) Geological materials and their medical applications: Uses of kaolin and montmorillonite in treating diarrhea in traditional medicine, and the analogy between geological processes and the biomineralization of hydroxyapatite ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$) during the formation of bones and teeth.

(vi) Molecular biology and toxicology research: Changes

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in gene expression due to heavy metal exposure (e.g., the molecular mechanism of arsenic carcinogenesis) and microbe-mineral interactions (e.g., arsenic transformation by soil microbes).

(vii) Technical methods and research advances: These include (1) high-precision environmental monitoring technologies, such as portable X-ray fluorescence spectrometers for rapid detection of heavy metals in soils and water, as well as stable isotope analysis to trace contaminant sources (e.g., identifying lead pollution origins), and (2) geographic information systems (GIS) and big data technologies, which involve creating global healthy geology maps (such as the Geochemical Baseline Survey of the Environment by the British Geological Survey) and developing machine learning-based prediction models for disease risk zoning (like predicting selenium deficiency in Africa).

(viii) Medical geology and public health policies: Promoting the integration of geological health risk assessments into national policies, such as the revision of arsenic standards in drinking water by the US EPA, and supporting research on low-cost water treatment methods in developing countries like China, India, and African nations.

Since global geological conditions vary greatly, research topics differ across regions. In South Asia, the main concern is arsenic contamination of groundwater in Bangladesh and West Bengal, India. In Africa, fluorosis and selenium deficiency in Ethiopia and Kenya have gained significant attention. In South America, heavy metal pollution from mining activities at copper mines in Peru and Chile is a key issue. In Europe, radon-induced lung cancer in granite-rich northern areas is the primary concern. In North America, shale gas extraction and related health problems in the Marcellus shale regions of the US are urgent topics. In China, endemic diseases caused by fluorine, arsenic, and selenium in high arsenic coal areas of Southwestern China, along with regions affected by Keshan disease, are major issues.

3. Future prospects

(i) Strengthening interdisciplinary collaboration: It is recommended that geologists, public health experts, medical professionals, and environmental scientists work more closely together, such as by establishing joint laboratories.

(ii) Promoting data sharing and standardization: It is advisable to accelerate the development of global medical geology databases similar to the One Health Initiative.

(iii) Increasing research on new contaminants: It is essential to increase research on the health risks posed by new contaminants such as microplastics, antibiotics, pesticide residues, nanoparticles, and rare earth elements in soils and

water.

(iv) Policy implementation and public education and awareness: More efforts should be made to integrate the concept of healthy geology into the global public health agenda (e.g., WHO Guidelines).

In conclusion, I am honored to present the GeoHealth Special Issue published in the journal *China Geology* by Chinese researchers. This collection of papers is dedicated to the MEDGEO 2025 & ISEG 2025 conference, held in Aveiro, Portugal, from July 26 to August 2, 2025. It broadens the scope of medical geology research to include soil, water, atmosphere, and emerging pollution sources.

In the future, pollution warning systems based on medical geology, combined with resource development and assessment focused on promoting geological health and safety, will be implemented. This will help create a healthier, safer Earth with a clearer sky and cleaner water, fostering an ecologically balanced and sustainable home for everyone.



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Professor Mouri obtained her PhD from the University of Paris, France, in 1995 and conducted postdoctoral research at the University of Minnesota, USA. Her early research focused on hard rock geology, encompassing petrogenesis and metamorphic studies of deep to ultra-deep metamorphic rocks. In recent years, she has shifted to medical geology, focusing on the development and utilization of medical geological resources in Africa. She has held positions at several institutions, including the University of Helsinki, the Geological Survey of Finland, the National Museum of Natural History (France), the University of Pretoria, the University of Pavia, the Pan-African University, and the University of Johannesburg.

Professor Mouri has held positions with international organizations including the International Union of Geological Sciences (IUGS), UNESCO, the International Medical Geology Association (IMGA), and the International Science Council (ISC). She organized the 1st and 2nd International Symposia in Medical Geology in Africa (ISMGAf).