

WP23_25: Global Geochemical Observation Network and Digital Chemical Earth

1532,259

Basic Information

Full title of the Initiative

Global Geochemical Observation Network and Digital Chemical Earth

Short Title or Acronym

Chemical Earth

Current category in the 2020-2022 GWP

New activity

Proposed category in the 2023-2025 GWP

Pilot Initiative

Points of Contact

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Purpose

Objective

To establish a global geochemical reference network to observe the content, distribution and changes of chemical elements in the surface of the earth for the global sustainable development of natural resources and environment; To provide technical training for developing countries in the field of geochemistry; To provide a platform for equal access to global geochemical data services and knowledge sharing, bridging the scientific community, policy makers and the public.

Please provide a short description of the Initiative

The initiative will focus on the following: 1) establishing a Global Geochemical Baselines Network for documenting baselines of nearly-all natural chemical elements in the Earths near-surface environment; 2) formulating a guideline and protocol for Global Geochemical Observation Networks through the establishment of the China Geochemical Observation Network, which will be based on the China Geochemical Baselines (CGB) Network completed between 2008 and 2014, for temporal sampling and analysis (every 3 to 5 years) to recognize and quantify potential environmental changes of chemical elements, including potentially toxic

elements, radioactive elements and natural carbon; 3) providing baseline datasets of around 50 ore-related elements for mineral resource assessment; 4) determining possible geochemical response to major historic geological events, such as extinction episodes and ancient climate change; 5) compiling the Silk Road Geochemical Atlas from Asia to Europe; 6) updating the digital Chemical Earth platform allowing anyone to access vast amounts of geochemical data and maps through the Internet.

Why is this Initiative needed?

The primary purpose of geochemistry is to determine quantitatively the composition of the earth and its parts, and to discover the laws which control the distribution of the individual elements (Goldschmidt, 1937). How do we know the distribution of the individual elements on the Earth in time and space? Geochemical mapping is a principal technique to illustrate the spatial distribution of elements and their compounds by systematic sampling of minerals, rocks, soils, drainage sediments and waters. The data will provide a current baseline for the analyzed chemical elements and will also allow the recognition of changes in the geochemistry of Earths near-surface environment over time caused by either human activities or natural processes.

What evidence is there to support this need?

There is a critical need to establish a global geochemical observation network to provide data for monitoring the chemical changes of the Earths near-surface environment. The initiative has covered 1/3 of the global land area, providing authoritative data for scientific research on earth system and sustainable development of natural resources and environment. Two examples can provide the evidence to support the need for establishing the Global Geochemical Baselines. Comparing the geochemical baselines data of China, the US, Europe and Australia, the percentage of sites with toxic metals exceeding the risk limits of soil pollution according to “Environmental Quality Standard for Soil of China (GB 15618-1995)” to the total sample sites is 30.9%, 17.1%, 23.5% and 10.9% in Europe, China, USA, and Australia respectively. Comparing the China datasets of 15 years interval sampling between 1994, 1995 and in 2008–2012, toxic metals of As, Cd, Cr, Cu, Hg, Ni, Pb and Zn, particularly Cd at top soils significantly increase from 1990s to 2010s. The proportion of top soil samples exceeding the China Standard risk limit of 0.2 mg/kg Cd increases from 12.2% to 24.9%. The facts show that chemical changes of toxic metals induced by human activities can be well observed using catchment sediment sampling through Global Geochemical Baselines Network.

Is this Initiative open to participation by representatives of any GEO Member, Participating Organization, and GEO Associate?

Yes

Are you aware of other projects or initiatives at a global or regional scale (both in GEO and externally) that provide similar products or services?

No

Please identify the most important actual and/or intended outputs (products, services, etc.) produced by the Initiative, along with their intended and/or actual users. This list does not need to be comprehensive but should identify the outputs which are most used and are expected to have the greatest potential impact.

Output	Status	Users	Additional info
Crucial data and atlases products related to Global Geochemical Baselines Network	In development	GEO, researchers, government personnel, general public	
Crucial data products related to the China Geochemical Observation Network	Regularly updated	GEO, researchers, government personnel	
Chemical datasets of around 50 ore-related elements for mineral resources assessment	In development	The practitioners in the countries involved in this initiative	
Chemical datasets of beneficial and toxic elements of crops	Planned	GEO, researchers, government personnel, commercial sector participation	
Digital Chemical Earth platform	Regularly updated	GEO, researchers, government personnel, general public, commercial sector participation	

If needed, please provide additional comments or explanation to accompany the outputs table

The output of the initiative will support the sustainable development of the global natural resources and environment, build up a bridge between the scientific community, decision makers and the general public and contribute China's strength.

What kinds of decisions are the outputs of this Initiative primarily intended to support?

Chemical Earth outputs support decisions on green land utilization and protection, food security and sustainable agriculture, energy and mineral resource management, public health surveillance.

How will these decisions benefit from the outputs of this Initiative?

To provide multi-scale geochemical data and atlases that may allow policy makers and all interested parties to co-design policy for achieving the objectives of UNESCO SDGs and GEO Strategic Plan.

What kinds of impacts (for example, reduced loss of life, monetary savings, conservation of biodiversity, etc.) are anticipated as a result of the use of the outputs of this Initiative?

Reduce the risk for public health, food security and sustainable agriculture, green land resources utilization and protection, mineral resources development

Has this Initiative been asked to provide specific information (for example, reports, data, services) on an ongoing basis to an international convention, organization, or other multilateral body?

No

Technical Synopsis

Please provide a brief description of the methods used by the Initiative to produce its (actual or planned) outputs.

1. Method of establishing global geochemical baseline networks. The entire land surface of the Earth is divided into 160 km x 160 km cells according to the Global Reference Networks (GRN) grid established by the Blue Book (Darnley et al., 1995). Generally, one sample location is designated within each grid cell of 80 km by 80 km or 40 km by 40 km on the basis of GRN cell. Two samples are collected at each site: a top sample and a deep sample. The top sample is collected from 0 to 25 cm, representing the current pollution status; the bottom sample is collected under a depth of 100 cm, representing the natural background before industrialization. All the samples will be sent to high-quality laboratory for analysis of 76 elements under strict quality control by using certified geochemical reference materials. The geochemical baseline maps are generated by the software based on the geographic information system (GIS) and displayed to public by the platform of "Mapping Chemical Earth" developed by this project.
2. Method of establishing China Geochemical Observation Network. Global climate change and human activities will significantly affect the geochemical characteristics of river water in the lower reaches and estuaries. China geochemical observation sites are designed in large river basins according to China's secondary river basins, key urban agglomerations, mineral deposits, geographical landscape and soil types. Overbank or flood plain sediment sample is collected in key areas. It provides scientific basis for constantly change and cyclic data of rocks, soil, water, organisms, heavy metals in the air, radioactive substances, carbon and other chemical elements.
3. Method of estimating the total quantity of global resources. Use global baseline values of bottom samples at nearly 20,000 reference network grids to estimate the total quantity of about 50 ore-forming elements in the world.
4. Research of geochemical response to major geological events in the world. The sensitive response of chemical elements changes to major geological events can provide a basis for major geological events like the extinction of organisms and ancient climate change. The advantage of this project is to use the global baseline values to screen element anomalies of major geological events in the world.
5. Geochemical mapping method for "the Belt and Road". Use existing data of the countries and supplement new survey data to compile the Silk Road Geochemical Atlas from Asia to Europe. Collect European geochemical mapping data (FOREGS and GEMAS project) and data from cooperating countries of Laos, Cambodia, Indonesia, Papua New Guinea, Mongolia, Pakistan, Tajikistan, Kazakhstan and Uzbekistan. Conduct geochemical mapping project cooperation with Iran, Myanmar, Turkey and Serbia to obtain new geochemical data. All the data should be consistent and comparable globally.
6. Updating of the "Chemical Earth" platform and the method for sharing of big geochemical data. With visual interface and convenient operation mode, users can understand geochemical characteristics of different geological units or locations.

If you would like to provide further details on the technical methods, you may upload one or more documents here.

- no supporting documents provided -

Are there any significant scientific or technical challenges that need to be resolved by the Initiative during the 2023-2025 period?

No

Does the Initiative expect to complete any key new outputs, improvements to existing outputs, or improvements to the methods of producing outputs, in the 2023-2025 period?

Yes

Please describe these new outputs or improvements.

1. Crucial data and atlases products related to Global Geochemical Baselines Network; 2. Chemical datasets of around 50 ore-related elements for mineral resources assessment; 3. Chemical datasets of beneficial and

toxic elements of crops; 4. Digital Chemical Earth platform.

Please identify the key tasks that must be implemented to ensure delivery of these changes, with target dates for completion.

Task	Task description	Expected completion (month/year)
Establish Global Geochemical Baselines Network	Cover more than 40% land surface of the world	12/2025
Establish China Geochemical Monitoring Networks	Complete the 3rd round observation through China	12/2024
Develop global baseline data quality criteria	Formulate global baseline data quality criteria in order to quantify or recognize natural or human-induced changes	12/2023
Promote international cooperation network and capacity-building in developing countries	Aim for more than 60 countries to join the cooperation network. Train more than 200 professionals and technicians from developing countries.	12/2025
Update digital Chemical Earth platform	Updated geochemical data and improved functional modules	12/2025

Resources

Have all resources required to implement the Initiative's planned work in the 2023-2025 period been secured?

Please list all financial and non-financial contributions to the Initiative (other than in-kind, voluntary participation by individual contributors) having a value of more than USD 50,000.

Contributing Organization	GEO Status	Type of Resource	Value	Currency
Ministry of Finance	China	Financial	6,000,000	CNY
China Geological Survey	China	Financial	23,100,000	CNY
Institute of Geophysical and Geochemical Exploration	China	Financial	3,000,000	CNY

Lessons from the 2020-2022 Period

Were all planned activities for the 2020-2022 period implemented as expected?

No

Please describe which activities were delayed or not implemented and how has this affected plans for 2023-2025.

This is a new initiative.

Were there any key challenges faced by the Initiative in the 2020-2022 period?

No

Were there any impacts or changes to operations due to COVID-19?

No

Please describe the key changes proposed for the 2023-2025 period, for example, new projects, new areas of focus, or adjustments to the activity governance.

This is a new initiative for 2023-2025 period.

Does the Initiative have outputs (products, services, etc.) available to users now, even if only on a pilot or testing basis?

Yes

Please provide any available information describing this usage (for example, user statistics, results of user testing) and/or feedback from users (for example, user comments, evaluations).

We have developed pilot platform "Mapping the Chemical Earth" for sharing geochemical data and maps through the Internet. Researchers from the whole world can download data and maps from the platform. We hope to update geochemical data and improve functional modules in the future.

Please provide supporting documentation if available.

- no supporting documents provided -

Do you have evidence of any impacts that have occurred in part as a result of using the outputs of the Initiative (for example, policy decisions taken, behaviour changes by users, risks mitigated)?

No

Have there been any internal or external reviews or evaluations of the Initiative since 2019?

No

Please indicate any GEO Work Programme activities with which you have ongoing collaboration.

Please indicate any additional GEO Work Programme activities with which you would like to establish new collaborations.

- AFRIGEO - African Group on Earth Observations
- EO4EA - Earth Observations for Ecosystem Accounting
- EO4HEALTH - Earth Observations for Health
- EO4MIN - Earth Observations for Managing Mineral and Non-Renewable Energy Resources
- ATLANTIC-EO - Earth Observations for the Atlantic Region
- EO4SDG - Earth Observations for the Sustainable Development Goals
- EUROGEO - European Group on Earth Observations

- GEOGLAM - GEO Global Agricultural Monitoring
- GEO-ECO - GEO Global Ecosystems
- GEO Work Programme Support - GEO Work Programme Support
- GEOARC - Global Ecosystems and Environment Observation Analysis Research Cooperation
- GOS4POPS - Global Observation System for Persistent Organic Pollutants

Stakeholder Engagement and Capacity Building

Are there specific countries or organizations that your Initiative would like to engage?

Yes

Please list these countries, regions or organizations.

Mongolia, Russia, Iran, Turkey, Pakistan, Colombia, Peru, Chile, Argentina, Indonesia, Madagascar, Laos, Cambodia, Myanmar, Nigeria, Cuba, etc.

United Nations Educational, Scientific, and Cultural Organization (UNESCO), International Union of Geological Sciences (IUGS), etc.

What are your plans to engage them?

Some developing countries and organizations have already been engaged in this initiative, such like Russia, Turkey, Colombia, Peru, Argentina, Laos, Cambodia, United Nations Educational, Scientific, and Cultural Organization (UNESCO), International Union of Geological Sciences (IUGS). We plans to engage some other counties and organizations to join the initiative through workshops, intergovernmental cooperation, international cooperation organization, etc.

Does your Initiative engage users in the work of the Initiative (for example, consultation, testing, co-design)?

Yes

Please briefly describe the Initiative's approach to engaging users.

Jointly carry out field sampling, experimental analysis, data processing and mapping, and results interpretation; Organize workshop to make people aware of the importance of chemical earth and engage them actively; Bilateral data sharing during the project implementation.

Does the Initiative have a user engagement strategy or similar kind of document?

No

Are there categories of users that are not represented at this time, but you would like to engage?

Yes

Please list these user categories or regions.

India, Thailand, North Korea, Brazil, South Africa, Namibia, etc.

What are the plans for further engagement of users in the Initiative?

Organize workshop to make people aware of the importance of chemical earth and engage them actively.

Does the Initiative have a documented capacity development strategy?

No

Please describe the approach to capacity development that is being implemented by

the Initiative?

(1) Training

Training courses will be held to enable developing countries to master geochemical mapping techniques and provide basic data and maps for resource and environmental assessment.

(2) Postgraduates and graduates cultivation jointly

It is encouraged to cultivate postgraduates and graduates jointly, especially for the excellent young scientists or technicians who wants study further.

(3) Visiting research

It is encouraged to invite the well-known scientists to be guest researchers, and guide research or related work.

Are there any commercial sector organizations participating in this Initiative?

No

Are there opportunities for commercial sector uptake of the outputs of the Initiative?

Yes

Please describe these opportunities.

There are many opportunities for commercial sector uptake of the outputs in the Initiative.

- 1) The output software tools can be provided to commercial sector to extend and promote the application of these tools;
- 2) The quantitative geochemical mapping products can be provided to commercial sector for post-processing and promotion of their applications.

Is there already commercial uptake occurring?

No

Are there opportunities for further commercial sector participation in the Initiative?

Yes

Please describe these opportunities.

The Initiative is always open to commercial sector. We also continue to explore more and new opportunities and cooperation mechanism for further involvement of the commercial sector. The opportunities mainly focus on software tools, quantitative geochemical mapping products and the user resources, etc..

Does the Initiative have a plan for commercial sector engagement?

No

Governance

Please describe the roles of each of the key leadership positions, as well as any team structures involved in day-to-day management.

Steering committee?programme office and working group will be established.

Steering Committee: The Steering Committee is composed of representatives from participant organizations or countries. The committee is responsible for consulting on the strategy and policies of Chemical Earth, and evaluating the effectiveness of Chemical Earth.

Programme Office: The Programme Office is composed of representatives of ICGG and IGGE, is responsible for coordinating all the requirements from the leader, participants, and users for resources obtaining, allocation and information sharing.

Working Group: The working groups will implement the research, observation, model development and demonstration, and capacity building. Dr. Zhang Bimin is generally responsible for the implementation of the project and the coordination of the team structures.

Is there a steering committee or other governance bodies that advise the Initiative but are not involved in day-to-day management?

No

What methods does the Initiative use to communicate with its participants?

- Email / e-newsletters
- Regular conference calls
- Website
- Regular events

Please describe the key risks that could delay or obstruct the completion of the planned activities and outputs of the Initiative, along with any actions taken to mitigate these risks.

- no answer given -

What methods are used by the Initiative to monitor its effectiveness?

- Informal discussions with users / beneficiaries
- Website statistics
- Consultations or events
- Evaluations

Would the Initiative be interested in assistance from the GEO Secretariat for developing an impact plan?

Yes

How are the results of the monitoring and evaluation activities shared with participants and the wider GEO community?

- (1) Data sharing. The geochemical datasets and maps will be released by the platform of Chemical Earth. Researchers from the whole world could access to the database for free.
- (2) Participant in the GEO meetings, Jointly carry out side-events with other GEO communities.

Are any monitoring or evaluation activities required by funders/contributors?

Yes

Please describe and provide reports if available.

The supporting projects are newly funded, the final reports will be generated and submitted at the end of the projects.

- no supporting documents provided -

Participants

Please list the active individual participants in the Initiative

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Other information

Please provide any other comments or information that was not included in the previous sections, but you would like to appear in the Implementation Plan.

- no answer given -

- no supporting documents provided -

Co-Editor Management

List of co-editors for this initiative

- no answer given -