

Global Geochemical Baselines - China Geochemical Baselines

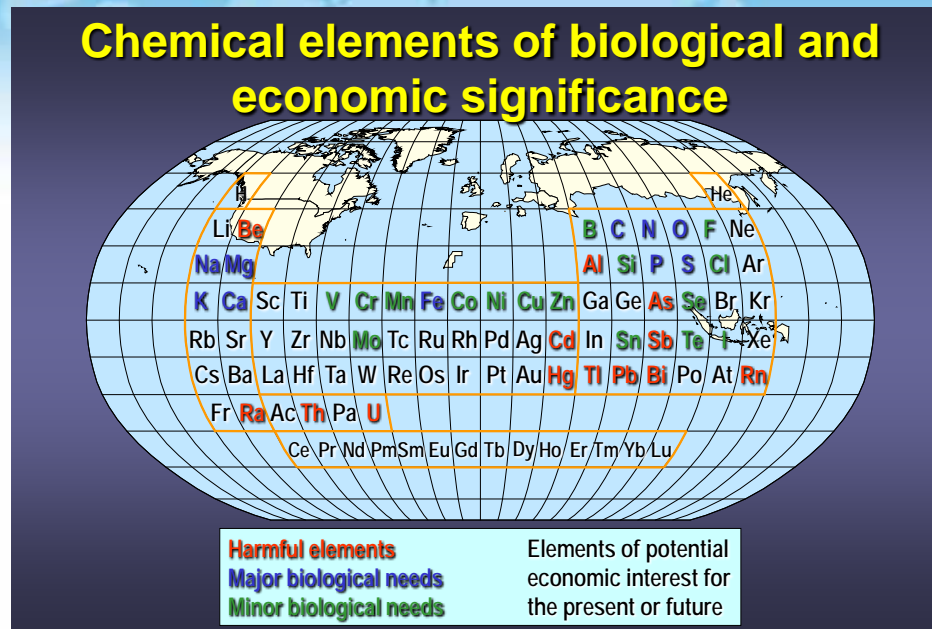
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'Global Geochemical Baselines'



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Importance of Global-scale Geochemistry



- Everything in and on the earth is made from the chemical elements listed in the periodic table.
- 90 elements have been found in nature, but we know very little of the **baselines** and **spatial distribution** of these elements on earth.
- **A global geochemical database with all elements in the periodic table are important to a wide range of earth and environmental sciences, they are critically needed for solving resources and environmental problems, facing challenges of global change and sustainable development.**
- Thus, it is important to determine the present abundance and spatial distribution of all the elements across the Earth's surface by using systemic geochemical mapping.



By 1980s, in light of the recognition of global changes to the Earth's environment, the necessity of consistent **global-scale geochemical baselines** was recognised.

The concept of a **world geochemical map** was discussed at IAEA meeting in 1984.

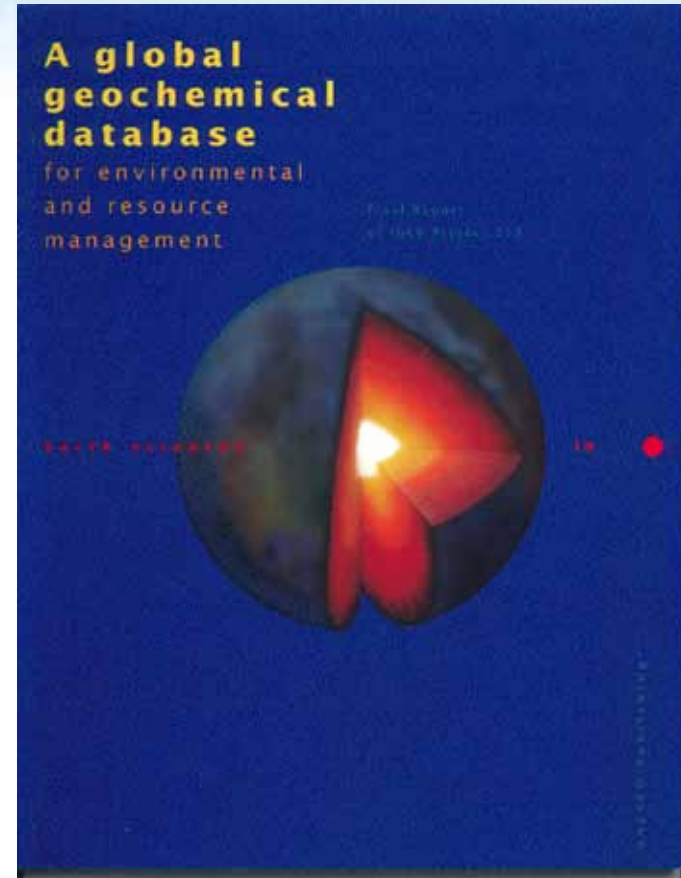


History **IGCP 259: International Geochemical Mapping (1988 – 1992)**

Project Leader: Arthur Darnley

- Review of geochemical mapping activities worldwide
- Assessment of requirements and methods for global geochemical mapping
- Recommendations for sampling, chemical analysis and data management methodologies.

Published in book '***A Global Geochemical Database for Environmental and Resource Management***', UNESCO publication volume 19.



The Blue Book



History IGCP 360: Global Geochemical Baselines (1993 – 1998).

Project Leader: Arthur Darnley



- ***“How do we recognise and understand changes in natural systems if we don’t understand the range of baseline levels?” (Zoback, 2001).***

Establish a global geochemical reference network (GRN) to cover the whole land surface of the earth.

5000 Global Reference Network Cells (each cell: 160 by 160 km) cover the whole Globe.

Develop methods for global sampling



The Goal of Global Geochemical Baselines

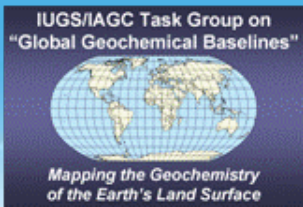
- To document the concentration and global distribution of chemical elements in the Earth's surface by standardised methods for sustaining natural resources and environments. The database and accompanying element distribution maps represent a '*geochemical baseline*' against which future human-induced or natural changes to the chemistry of the Earth can be quantified.



SYSTEMATIC MAPPING

- **Systematic geochemical mapping is the best method available to assess and provide a baseline for monitoring changes in the levels of chemical elements at the Earth's surface.**





IUGS Task Group on Global Geochemical Baselines 1998 – present

**Succeed IGCP259/360
steering committee to
continue implementation of
the project.**

Executive Committee

- **Co-Leaders:**
 - David Smith, USGS
 - Xueqiu Wang, IGGE
- **Scientific Secretary:** Shaun Reeder
- **Treasurer:** Alecos Demetriades

IUGS Working Group Executive Committee

Sampling
Committee

Analytical
Committee

Data
Management
Committee

Finance and
Public Relations
Committee



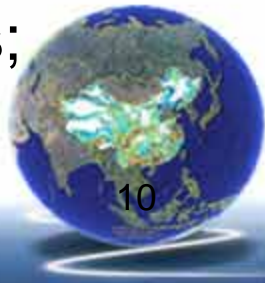
The IUGS/IAGC Task Group on ‘Global Geochemical Baselines’

- The *Task Group on ‘Global Geochemical Baselines’*, operating under the auspices of both the International Union of Geological Sciences (IUGS) and the International Association of GeoChemistry (IAGC), has the long-term goal of establishing a global geochemical database to document the concentration and distribution of chemical elements in the Earth’s surface or near-surface environment. The database and accompanying element distribution maps represent a geochemical baseline against which future human-induced or natural changes to the chemistry of the land surface may be recognised and quantified.



The IUGS/IAGC Task Group on 'Global Geochemical Baselines'

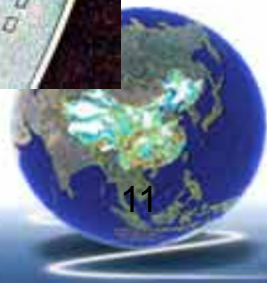
- Developing partnerships with countries conducting broad-scale geochemical mapping studies;
- Providing consultation and training in the form of workshops and short courses;
- Organising periodic international symposia to foster communication among the geochemical mapping community;
- Developing criteria for certifying those projects the data of which are acceptable in a global geochemical database;
- Acting as a repository for data collected by those projects meeting the criteria for standardisation;
- Preparing complete metadata for the certified projects;
- Preparing, ultimately, a global geochemical database.



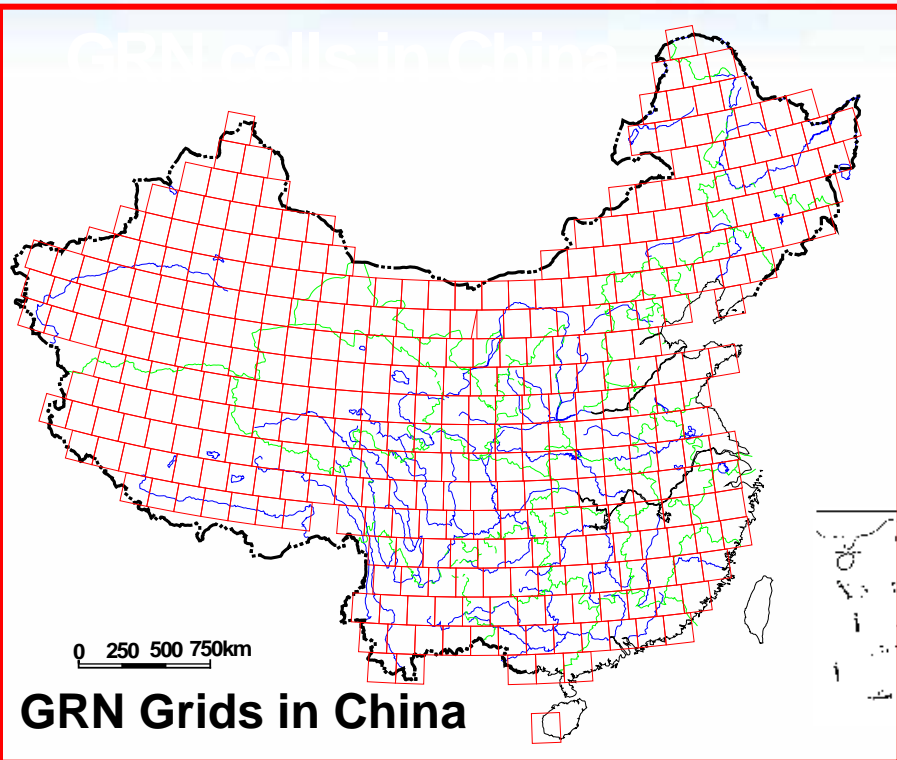
Global Sampling



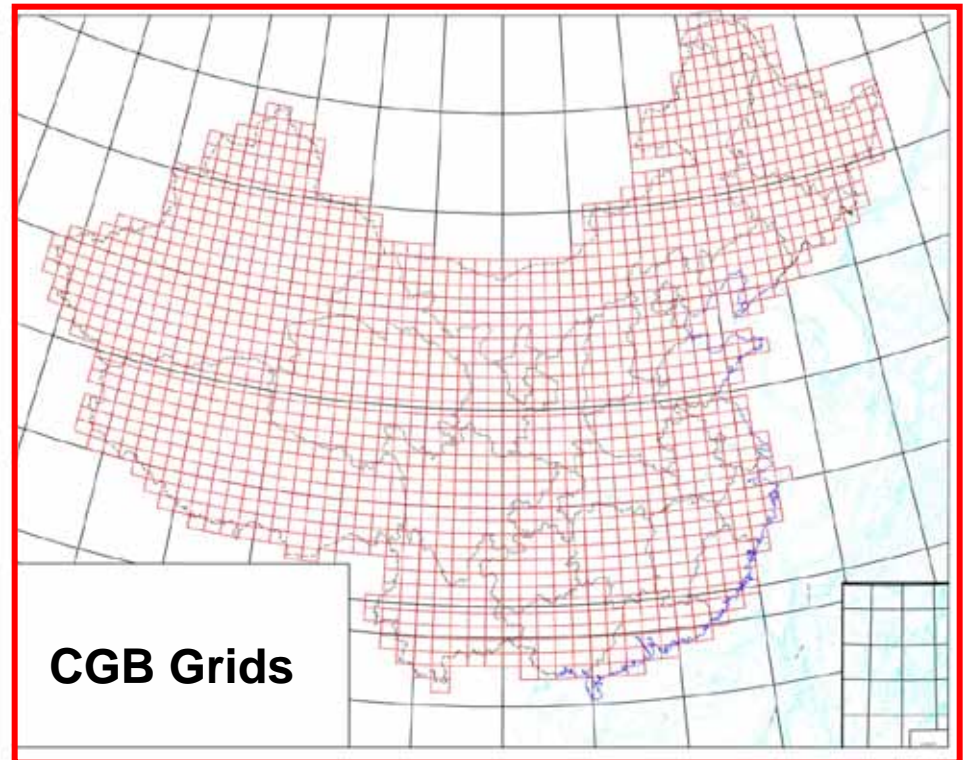
GRN 160km x 160 km cells



The China Geochemical Baselines project



400 grids (160x160 km)

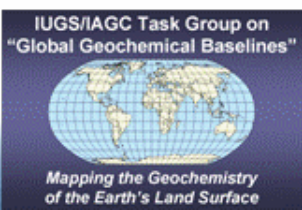


1300 grids (approx. 80x80 km)

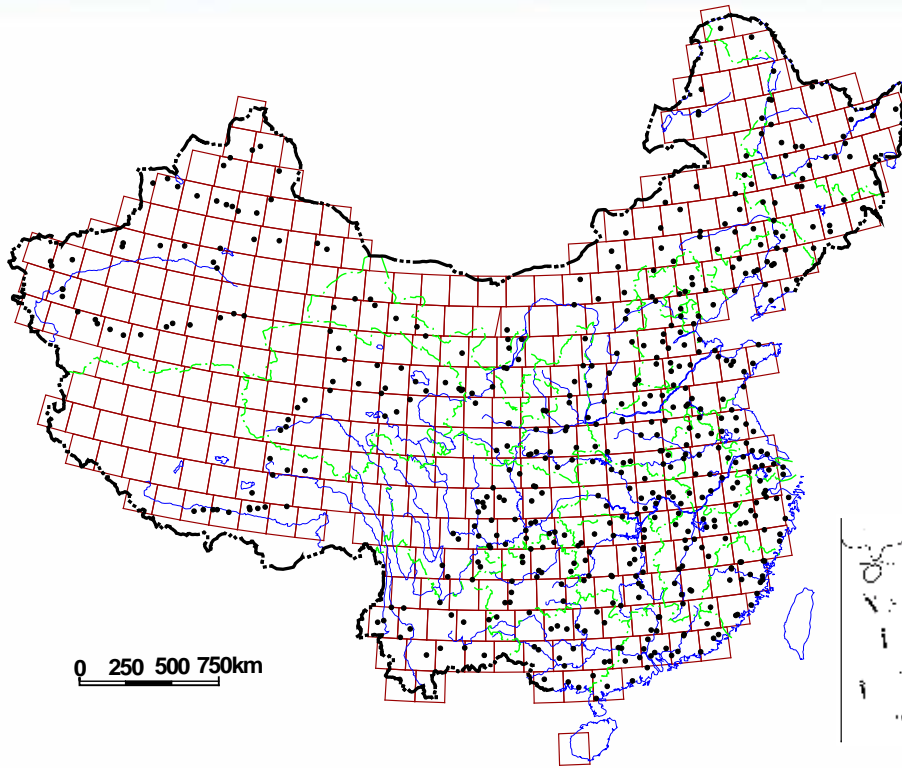


Two Technologies for Global-scale Geochemical Mapping

- **Sampling :**
 - Geological background - Natural abundance and distribution of elements
 - Environmental baselines - Anthropogenic contamination generated by human activities.
- **Chemical analysis :**
 - All elements determined
 - Quality control to obtain globally harmonious high-quality data
 - 1、 Global natural geochemistry, induced by geology
 - 2、 Global anthropogenic geochemistry induced by human activities



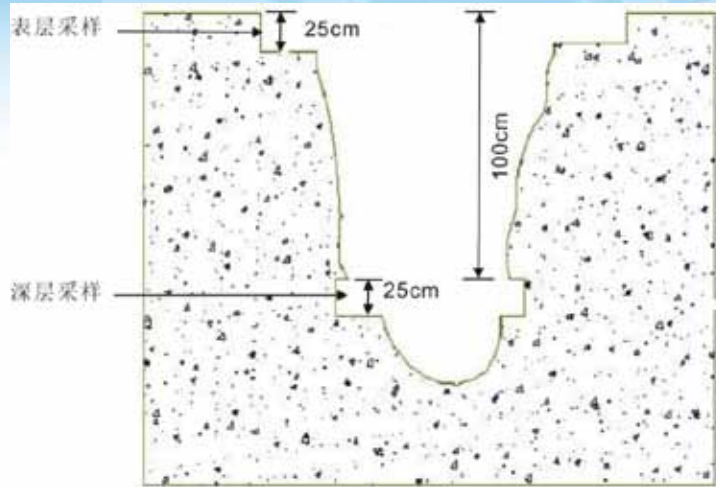
Overbank/Floodplain sediments in wet lands



Overbank sediments



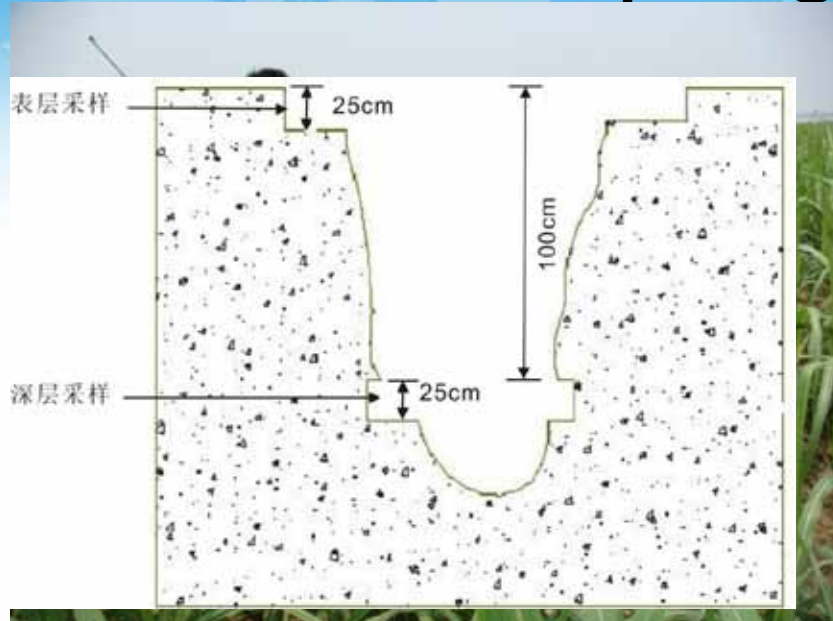
Sampling depth



- top horizon (0-25 cm depth)
- deep horizon (>100 cm depth)



Soil sampling in plain terrains

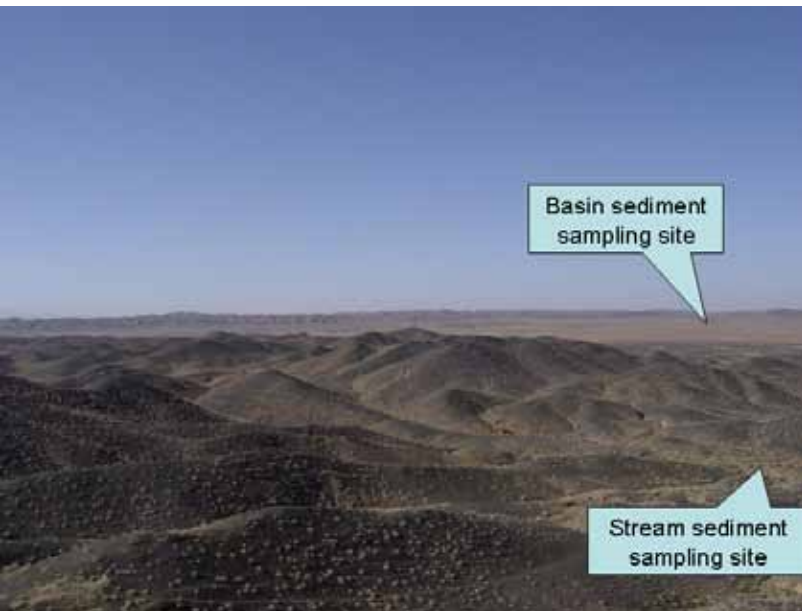


Global sampling in desert terrains

- **Catchment basin sampling**
- **Intermountain basin sediment sampling**



Global Sampling

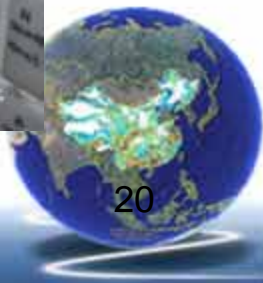


Desert crust

The desert crust is one of excellent sampling media for global geochemical mapping, particularly for environmental purpose. The sample is easy to be recognized and taken because it is in the position as the topmost layer of soil with air-filled vesicles.



Global Sample Achieves



- 76 elements determined



Laboratory systems used for Global Geochemical Baselines in China

Analytical methods

Quality control

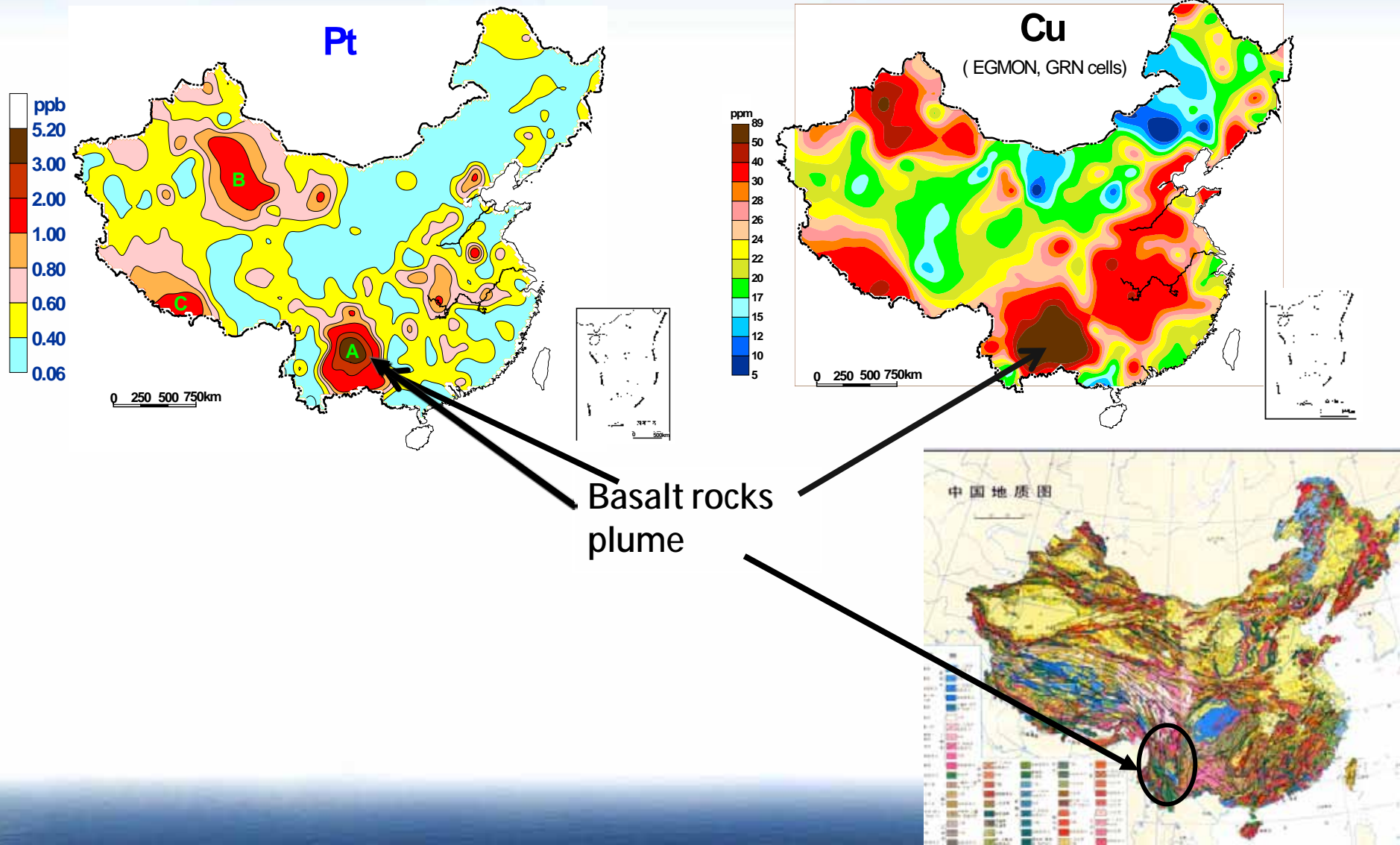
ICP-MS & XRF
AS BACKBONE
Combined with
other 11 methods



Reference samples

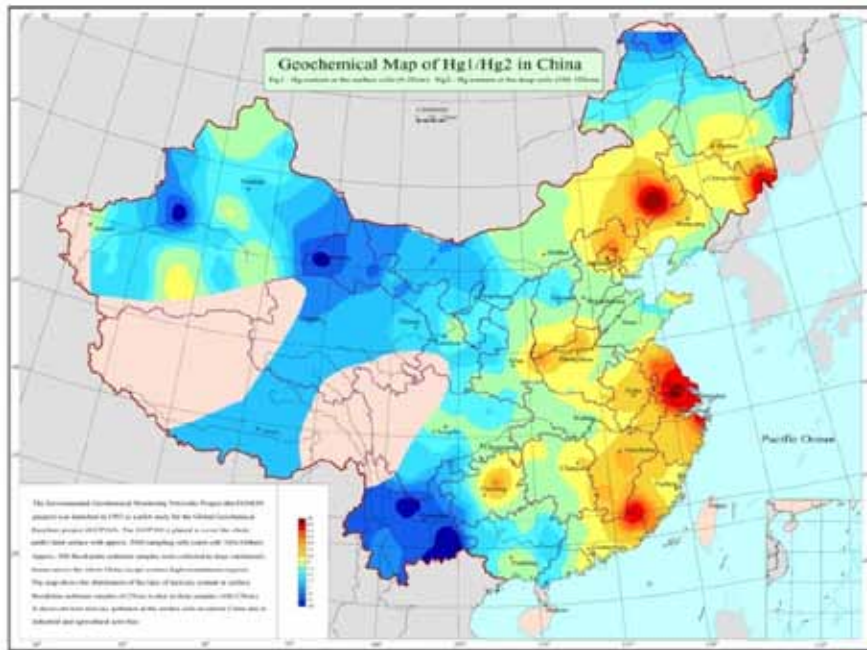


Geochemical patterns determine geogenic background

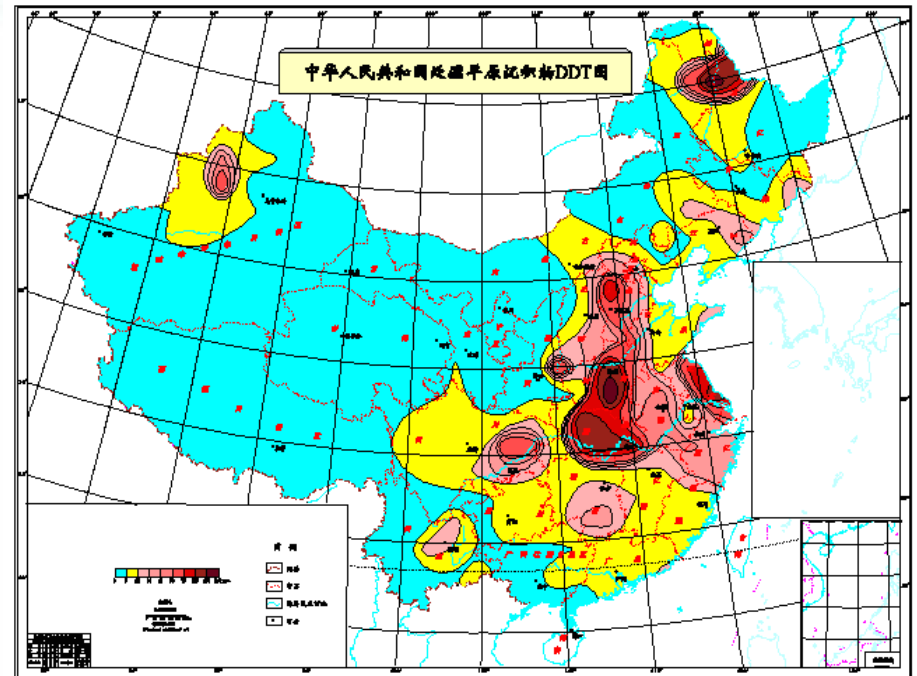


Environment:

Environmental Contamination by human activities



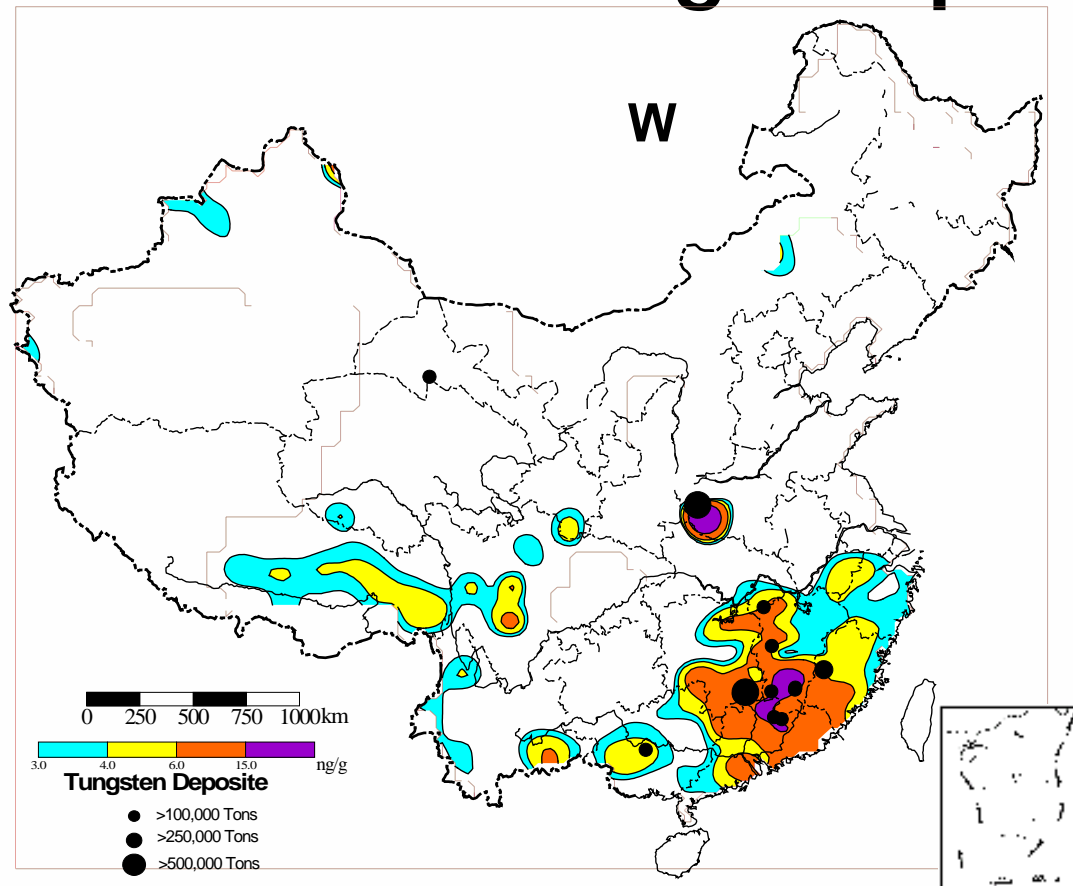
Mercury contamination by mining and industrial activities



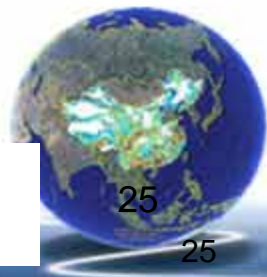
Eastern China is vulnerable to DDT pollution because of use of insecticide in farmland.



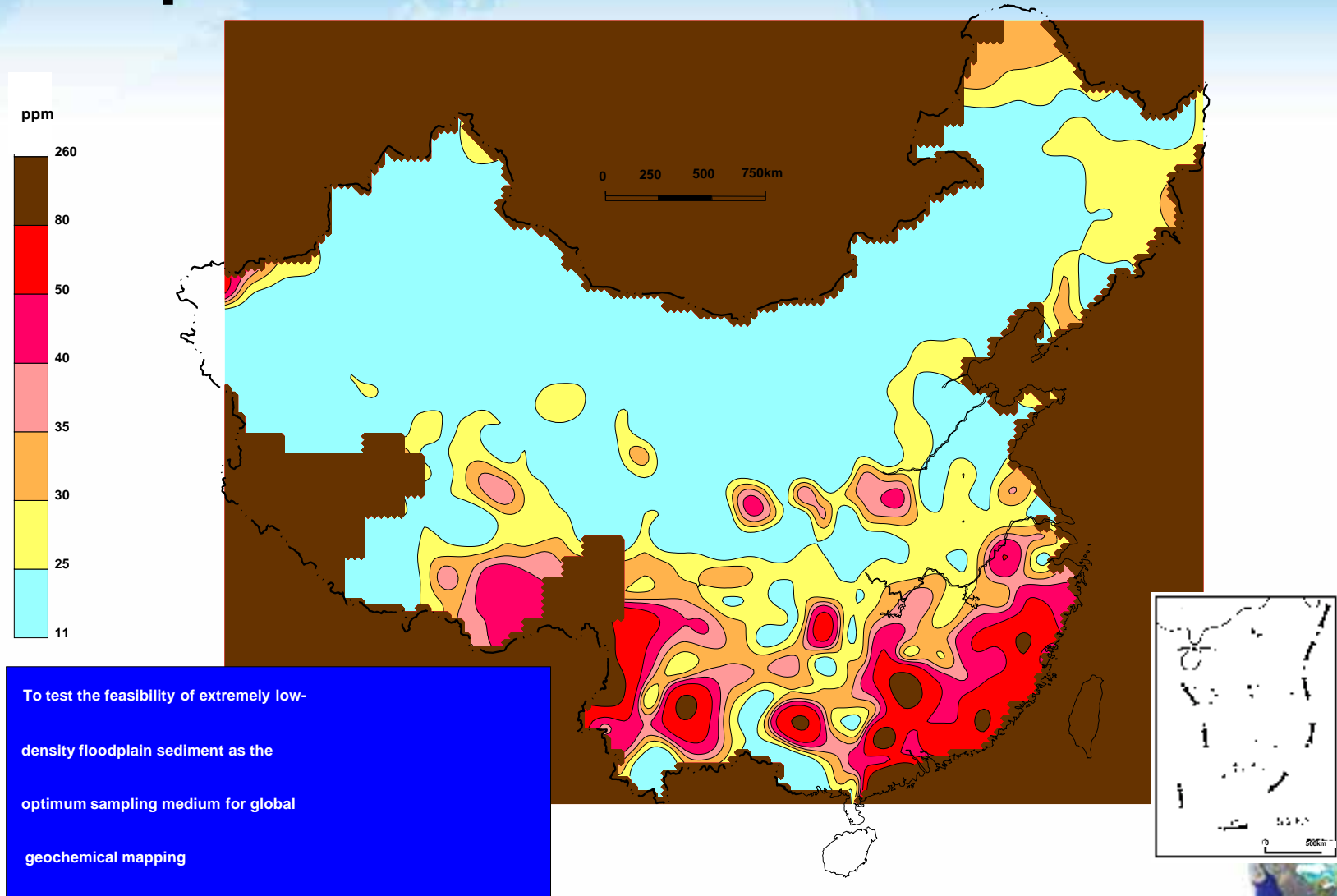
Geochemical patterns related to metallogenic provinces



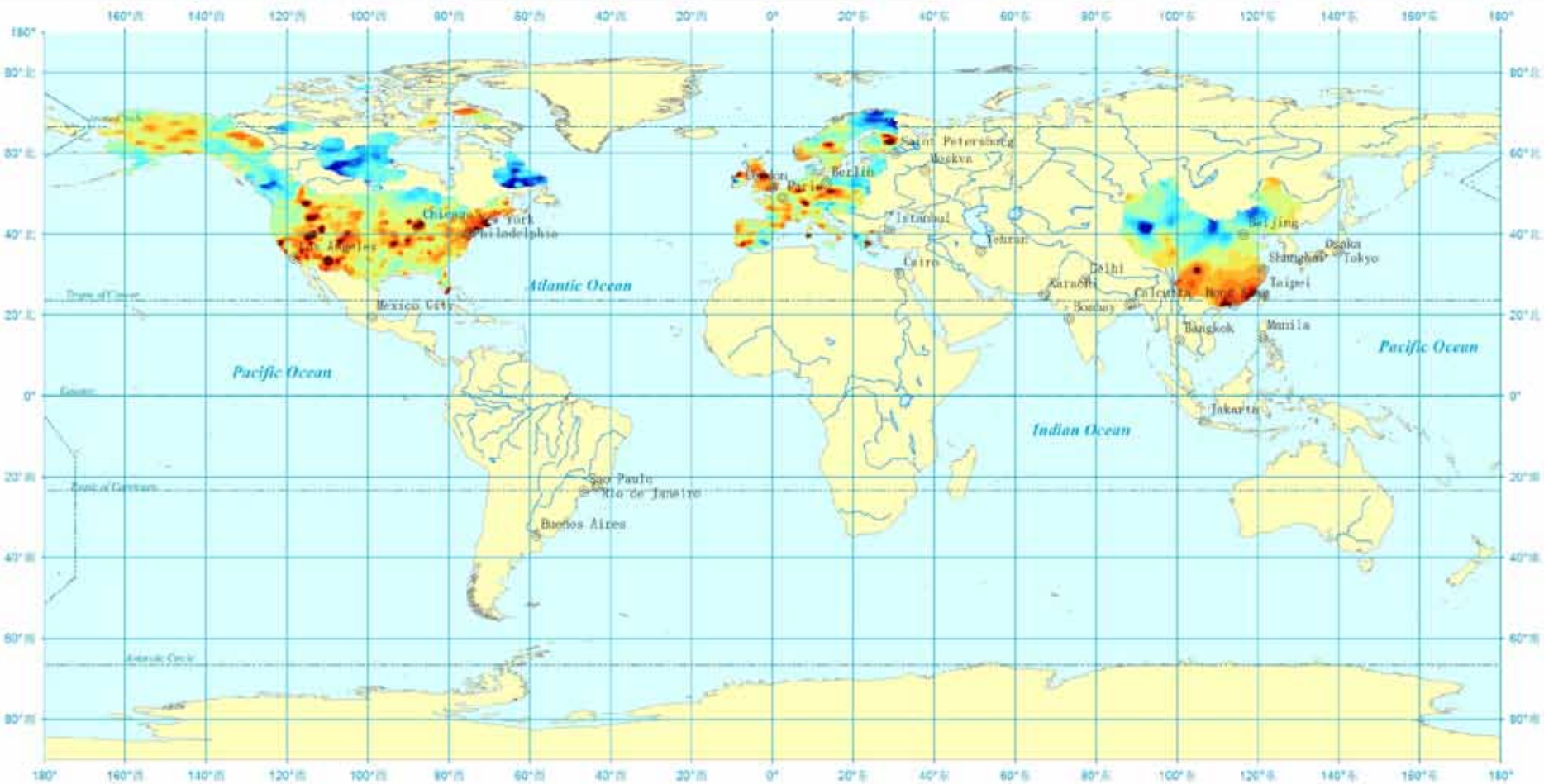
**Geochemical distribution of tungsten associated with
large tungsten ore deposits**



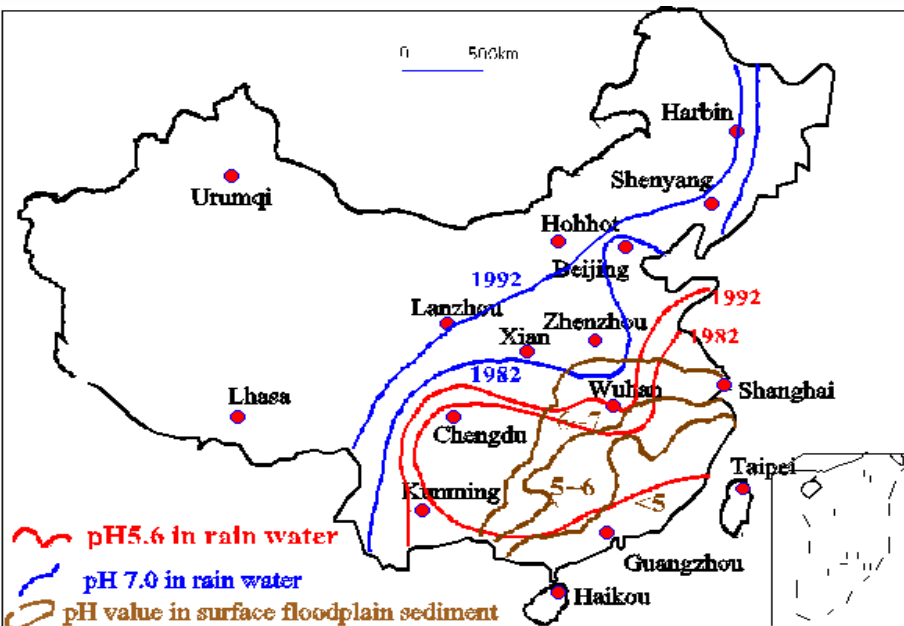
Pb pattern related to both metallogenic provinces and human activities



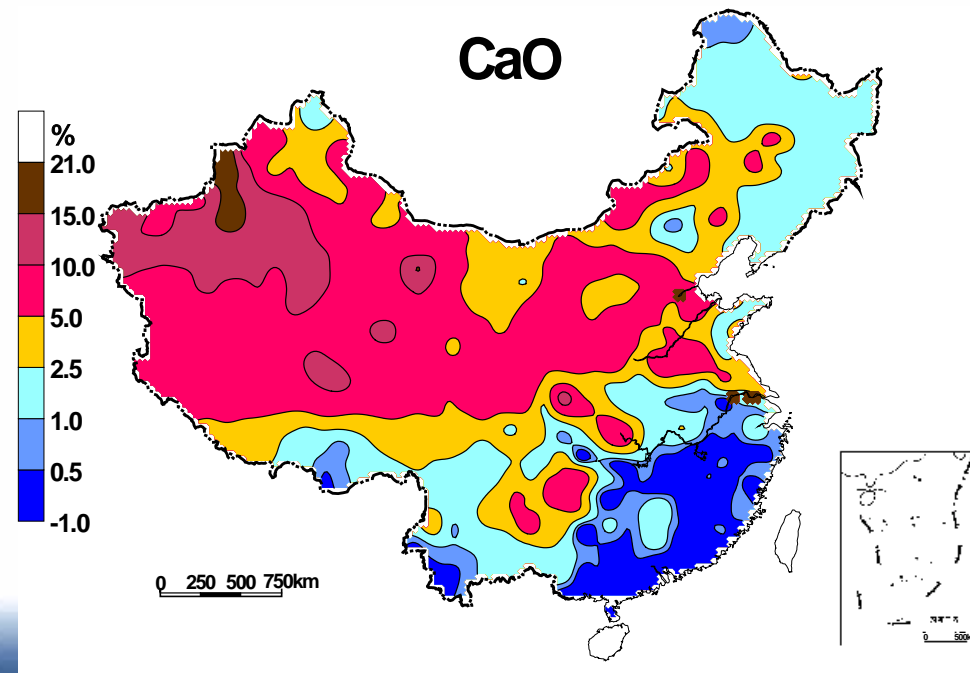
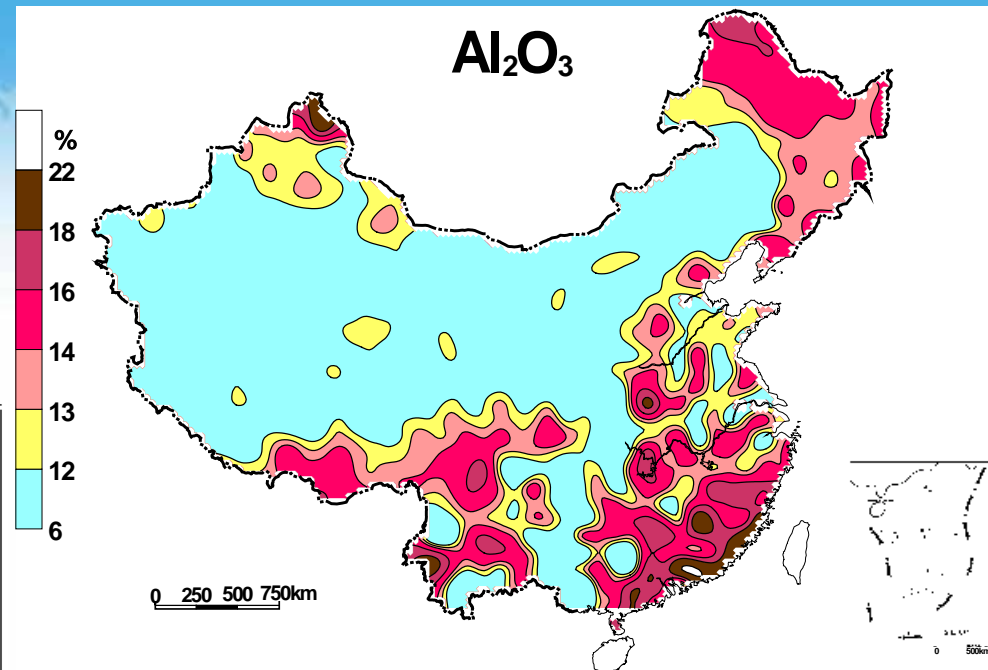
Global Pb distribution related to both mineralisation provinces and human activities



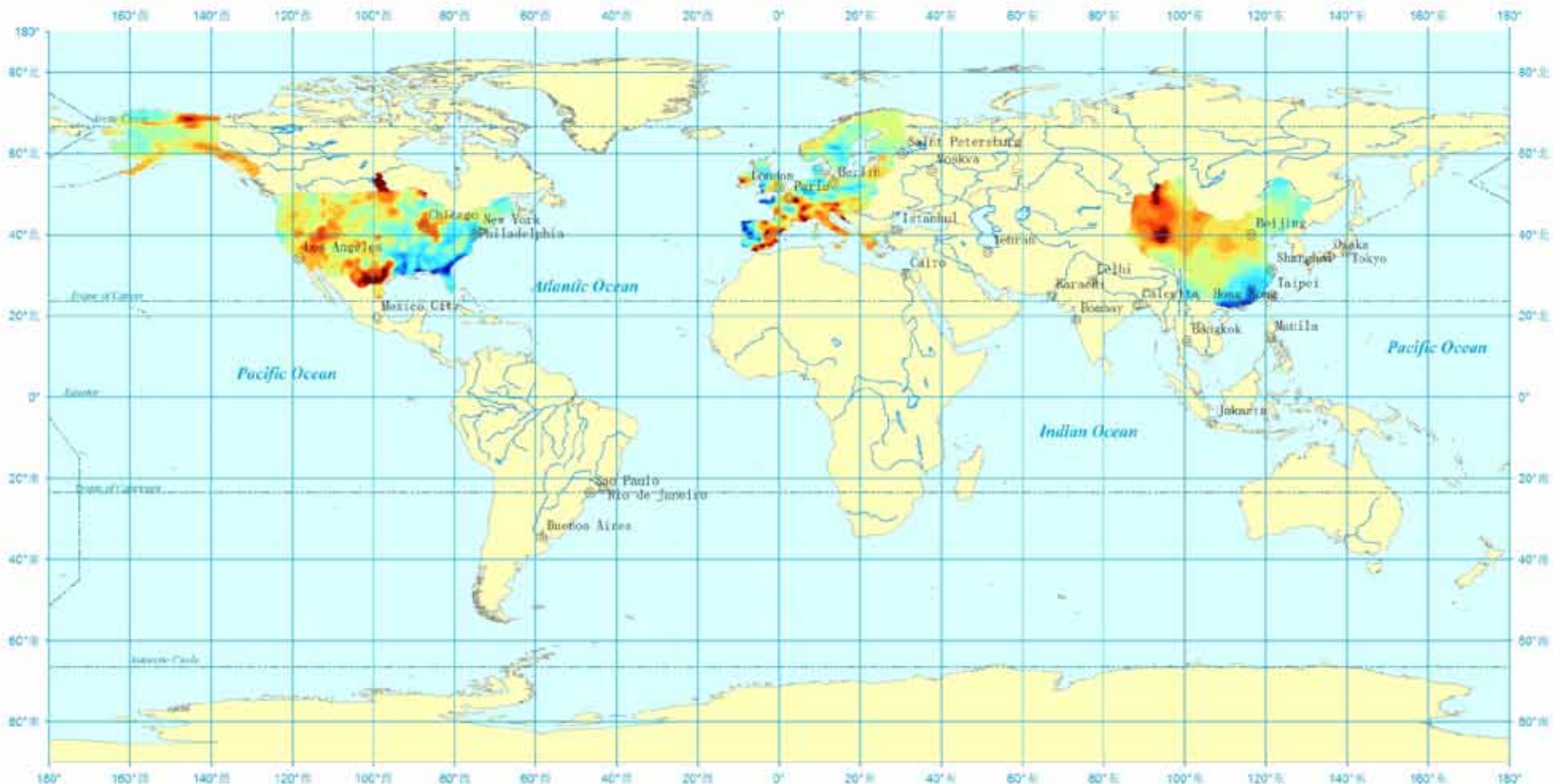
Geochemical patterns related to climate



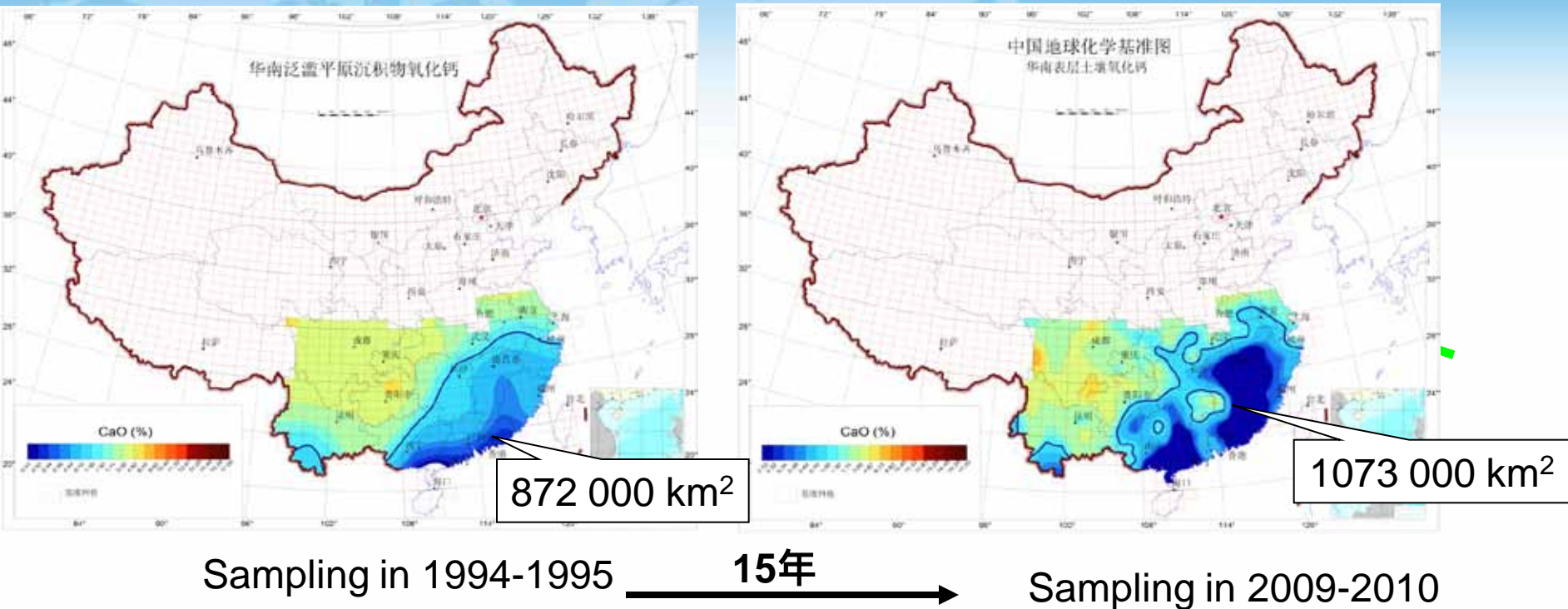
Distribution of acid rain in 1982 and 1992, as well as pH in surface floodplain sediment(SFS) in 1994



Global CaO Distribution related to Climate



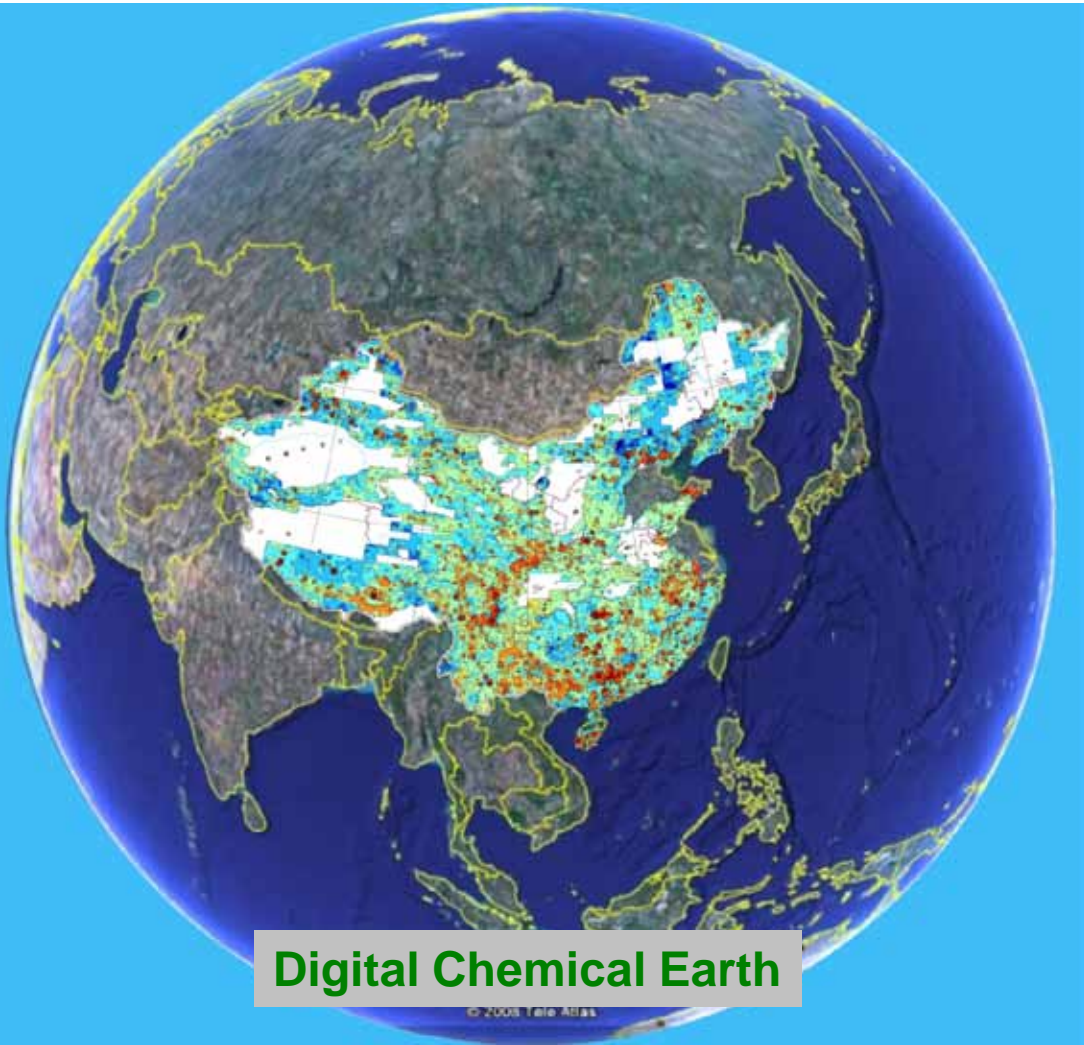
CaO change within a period of 15 years



- **CaO concentration <1%**
 - Concentration : aver. 0.53 (med. 0.49); aver. 0.41 (med. 0.34) -22.6%
 - Area : 872 000 km² 1 073 000 km² +23.0%
- **CaCO₃ leached due to acid rain**
- **CaCO₃ → CO₂ into the atmosphere**



Global GeoChemistry —our life, our future



Digital Chemical Earth

Global geochemical database and accompanying maps will play an important role in sustainable development for natural resources and environments.

Thank you !

