IUGS/IAGC Task Group on Global Geochemical Baselines

History and accomplishments

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'Global Geochemical Baselines'

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IUGS/IAGC Task Group on
"Global Geochemical Baselines"

Mapping the Geochemistry
of the Earth's Land Surface

Task Group's Association with CCOP

- May 2001: Shaun Reeder participates in CCOP meeting in Beijing
- 2002: Dave Smith meets with Chen Shick Pei in Washington, DC
- 2008: Dr. Hee-Young Chun (Director), Dr. Nguyen Hong Minh (Geo-Resources Sector Coordinator), and Ms. Marivic Uzarraga (Geo-Information Sector Coordinator) participate in Task Group business meeting in Oslo, Norway
- 2008 – present: Prof. Xueqiu Wang has been Task Group's link with CCOP

Outline

- Chemicals in the environment
- Importance of establishing geochemical baselines
- A strategic method for global geochemical baselines (IUGS/IAGC Task Group on ‘Global Geochemical Baselines’)

According to Chemical Abstracts Service Registry Number and Substance Count, as of 19 March 2012, there were:

63,965,898 Commercially available chemicals

293,950 Inventoried/regulated substances

http://www.cas.org/cgi-bin/cas/regreport.pl

According to Chemical Abstracts Service Registry Number and Substance Count, as of 28 March 2012, there were:

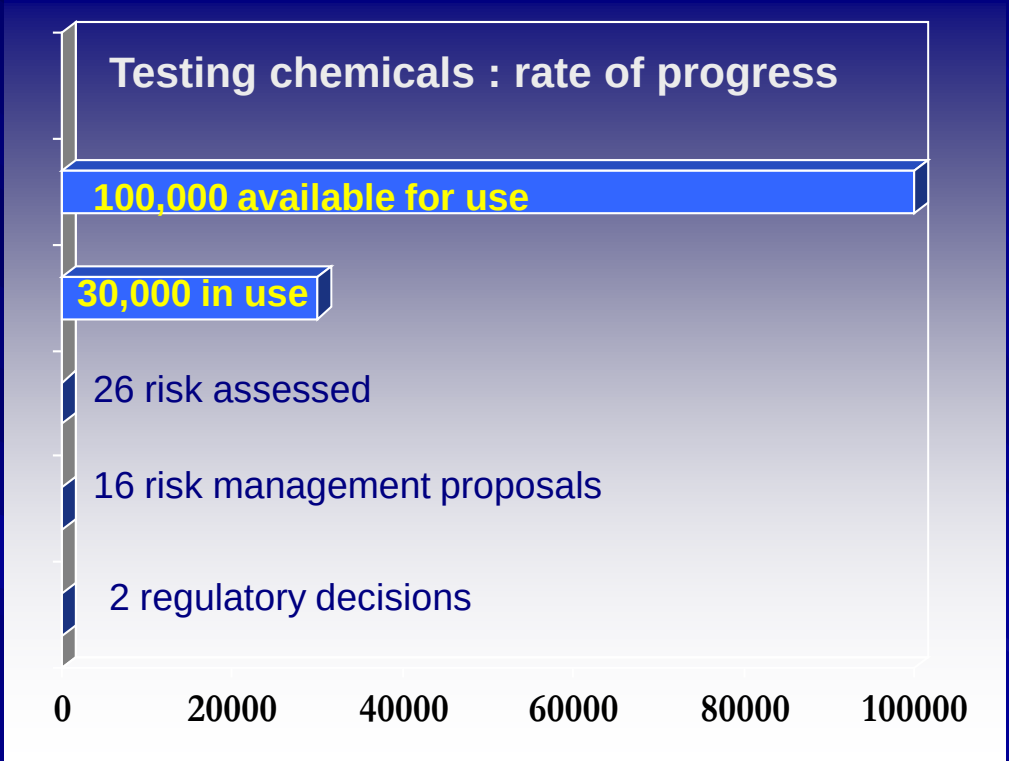
66,185,909 Commercially available chemicals (an increase of 2.2 million in 10 days)

294,969 Inventoried/regulated substances (an increase of 1,019 in 10 days)

http://www.cas.org/cgi-bin/cas/regreport.pl

How much do we know?

- Large number of chemicals – very few tested
- Complex supply chains
- Limitations of test methods



". . .ignorance outweighs knowledge at every point in the risk assessment process"

Source: RCEP 2003

Health Effects of Chemicals

(Swedish EPA, WHO, EEA)

Possible Health Effects

Cancer, Cardiovascular diseases, Respiratory diseases, Allergies and hypersensitivities, Reproduction, Developmental, Nervous system.

Potentially Sensitive Sub-Groups

Elderly, children, asthmatics, foetuses, reproductive age

Examples of Associated Chemicals

Asbestiform minerals, PAHs, Benzene, Phthalates, Organo-Chlorines, Organo-Phosphates, Solvents PCBs, Dioxins; As, Pb, Cd, Co, Hg, Ni; NOx, SOx, CO_2

For the potentially toxic chemicals that occur naturally (e.g., As, Hg, Cd, Pb, Cr, PAHs, etc.), it is critical to understand their abundance and spatial distribution in the various "*environmental compartments*" of the Earth (soils, sediments, surface water, ground water).

"Documenting and understanding natural variability is a vexing topic in almost every environmental problem: How do we recognise and understand changes in natural systems if we don't understand the range of baseline levels?"

Mary Lou Zoback, GSA Today, December 2001

Source: http://www.geosociety.org/gsatoday/archive/11/12/pdf/i1052-5173-11-12-41.pdf

Geochemical mapping

- Multiple sample media
  - Soils
  - Sediments
  - Water
- Various scales
  - Global – National – Regional - Local
- Multiple uses
  - Environmental regulation
  - Public health
  - Land use planning
  - Agriculture
  - Mineral exploration

Published geochemical atlases (to 1990)

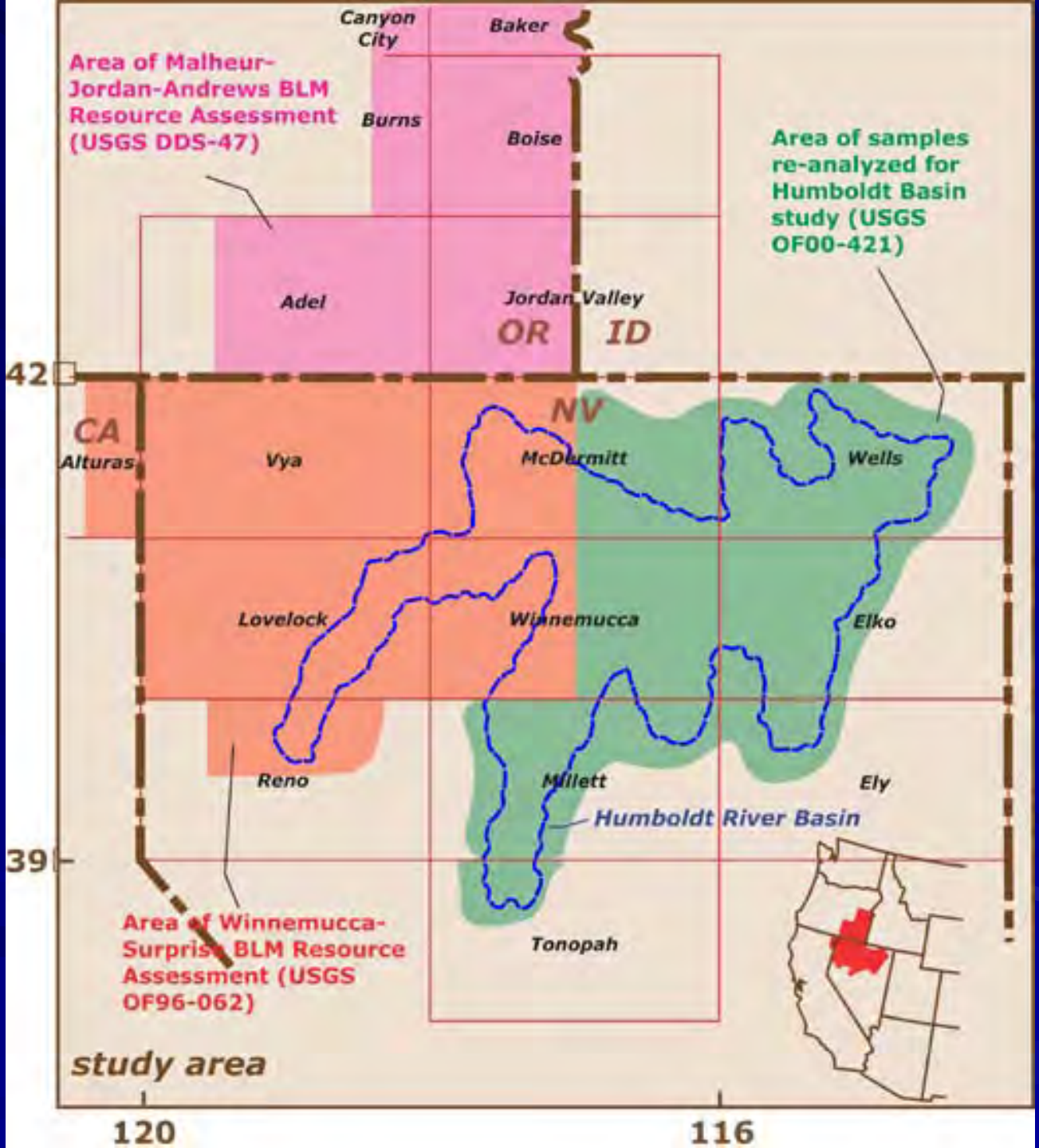
- 1978 Wolfson Geochemical Atlas of England and Wales
- 1978 Regional atlas series of Great Britain and N. Ireland
- 1983 Alaska
- 1985 Germany
- 1985 Jiangxi Province, China
- 1986 Northern Fennoscandia
- 1989 Austria
- 1990 Finland (Ground water)

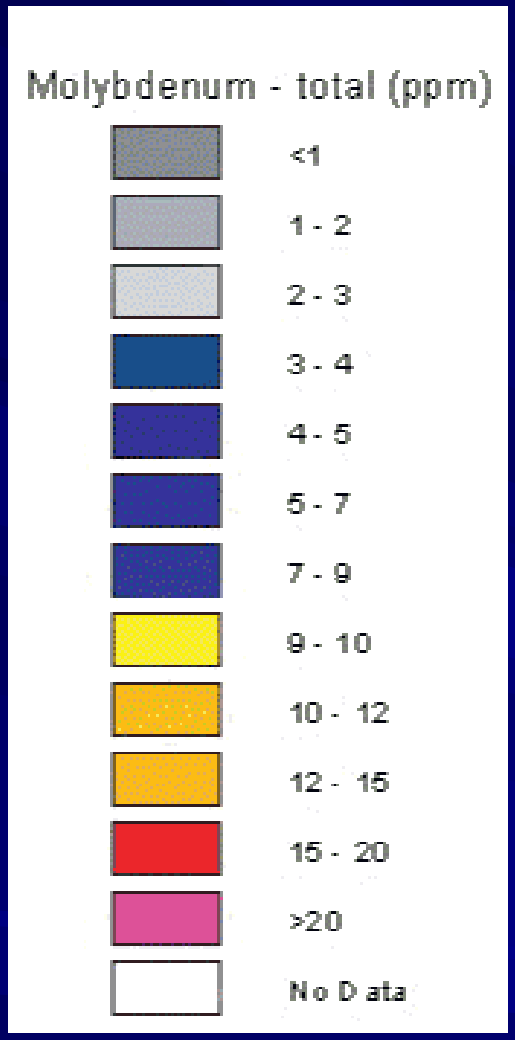
Published geochemical atlases (1990 – present)

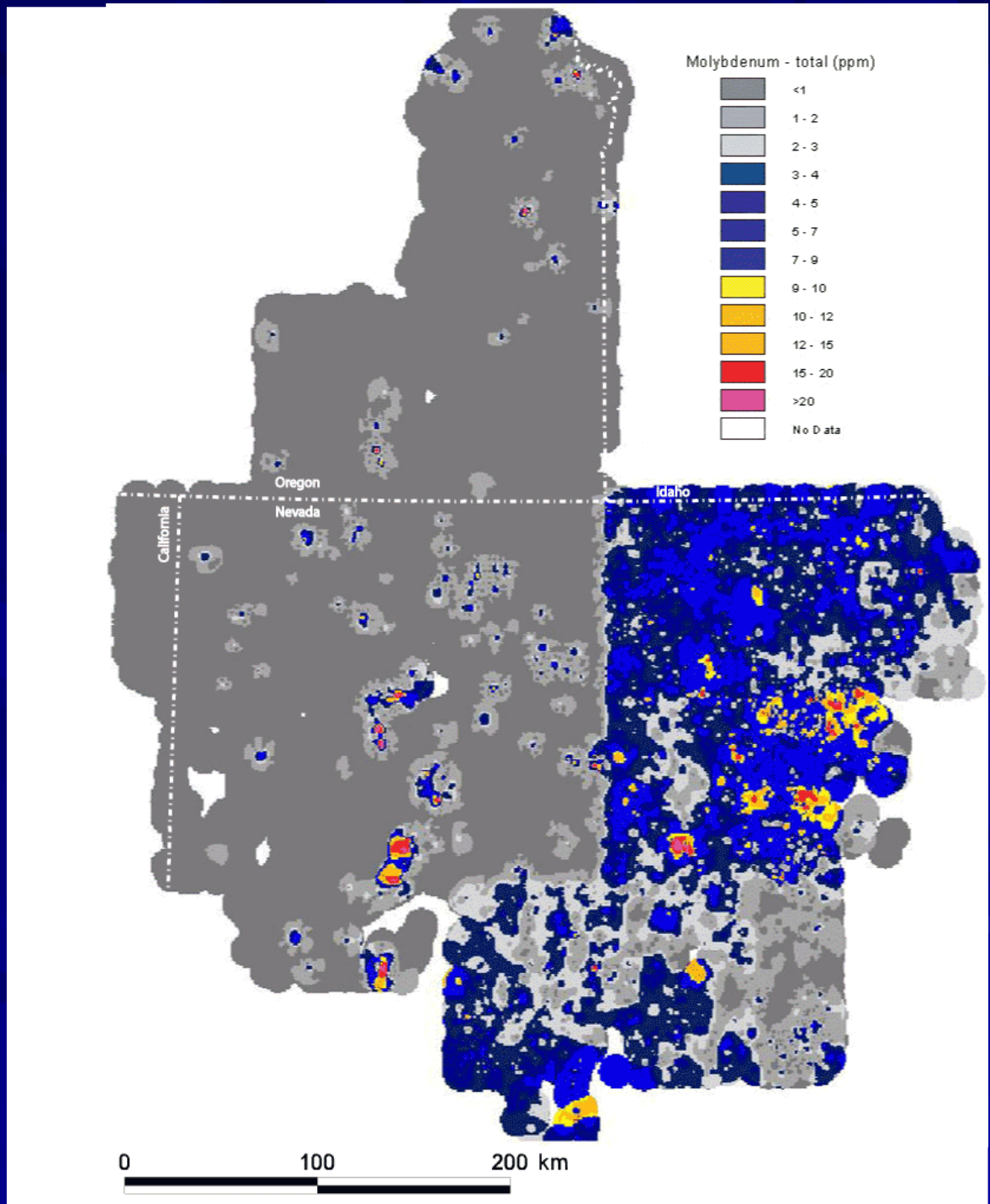
- 1992 Finland (Till)
- 1992 England and Wales
- 1994 People's Republic of China
- 1995 Poland
- 1995 Jamaica
- 1996 Slovakia (Forest Biomass and ground water)
- 1998 Central Barents Region
- 1999 Slovak Republic (Soils)
- 1999 Lithuania
- 2000 Norway
- 2001 State of Paraná, Brazil
- 2002 Korea
- 2003 Campania Region (Italy)
- 2003 Northern Europe (Soils)
- 2004 Japan
- 2004 Eastern Barents Region
- 2005, 2006 Europe (multimedia sampling)
- 2009 Croatia
- 2010 Europe (ground water)
- 2011 Australia
- 2011 Cyprus

Study area size = 140,000 km^2

(≈size of Greece)




Molybdenum - total (ppm)
<1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 7
7 - 9
9 - 10
10 - 12
12 - 15
15 - 20
>20
No Data


Molybdenum - total (ppm)
<1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 7
7 - 9
9 - 10
10 - 12
12 - 15
15 - 20
>20
No Data
Oregon
Nevada
California
Idaho
0
100
200 km

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

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

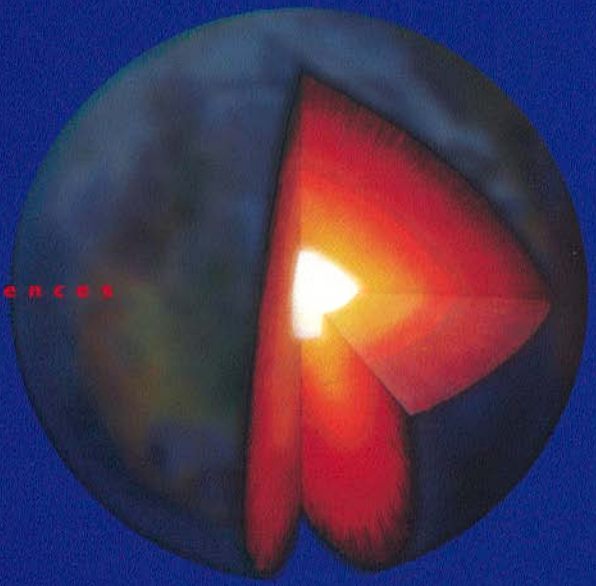
IUGS/IAGC Task Group on Global Geochemical Baselines

- **Phase 1 (1988-1992) IGCP 259: International Geochemical Mapping**
  - **Review of geochemical mapping activities worldwide**
  - **Assessment of requirements and methods for global geochemical mapping**
  - **Recommendations published in *A Global Geochemical Database for Environmental and Resource Management* (Darnley et al., 1995)**

A global geochemical database

for environmental and resource management

Final Report of IGCP Project 259



Earth sciences 19

UNESCO Publishing

IGCP 259 recommendations are based on the conviction that it is highly desirable to:

- Establish common primary geochemical database at an international level
- Provide a framework for adoption of standardised methods and reference materials for detailed regional and national mapping

Requirements for global database

- Commonly available representative sample media, collected in a standardised manner
- Continuity of data across different landscapes
- Adequate quantity collected for future research
- Data for all elements of environmental and economic significance

Requirements for global database (continued)

- Lowest possible detection limits on all elements
- Determination of total amount of each element present
- Tight quality control at each stage of process

Global Reference Network

- In order to begin systematic international geochemical mapping, establish a global geochemical reference network (GRN). The samples collected will serve as analytical reference materials.


NEW
GUINEA
EAST TIMOR
AUSTRALIA

Purpose of GRN sampling and resulting database

- Provide documentation on composition of a variety of surficial materials at locations evenly spaced over the land surface of the globe
- Provide a supply of locally relevant standard reference materials for use in region of origin
- Provide reference points for normalising and linking national geochemical databases

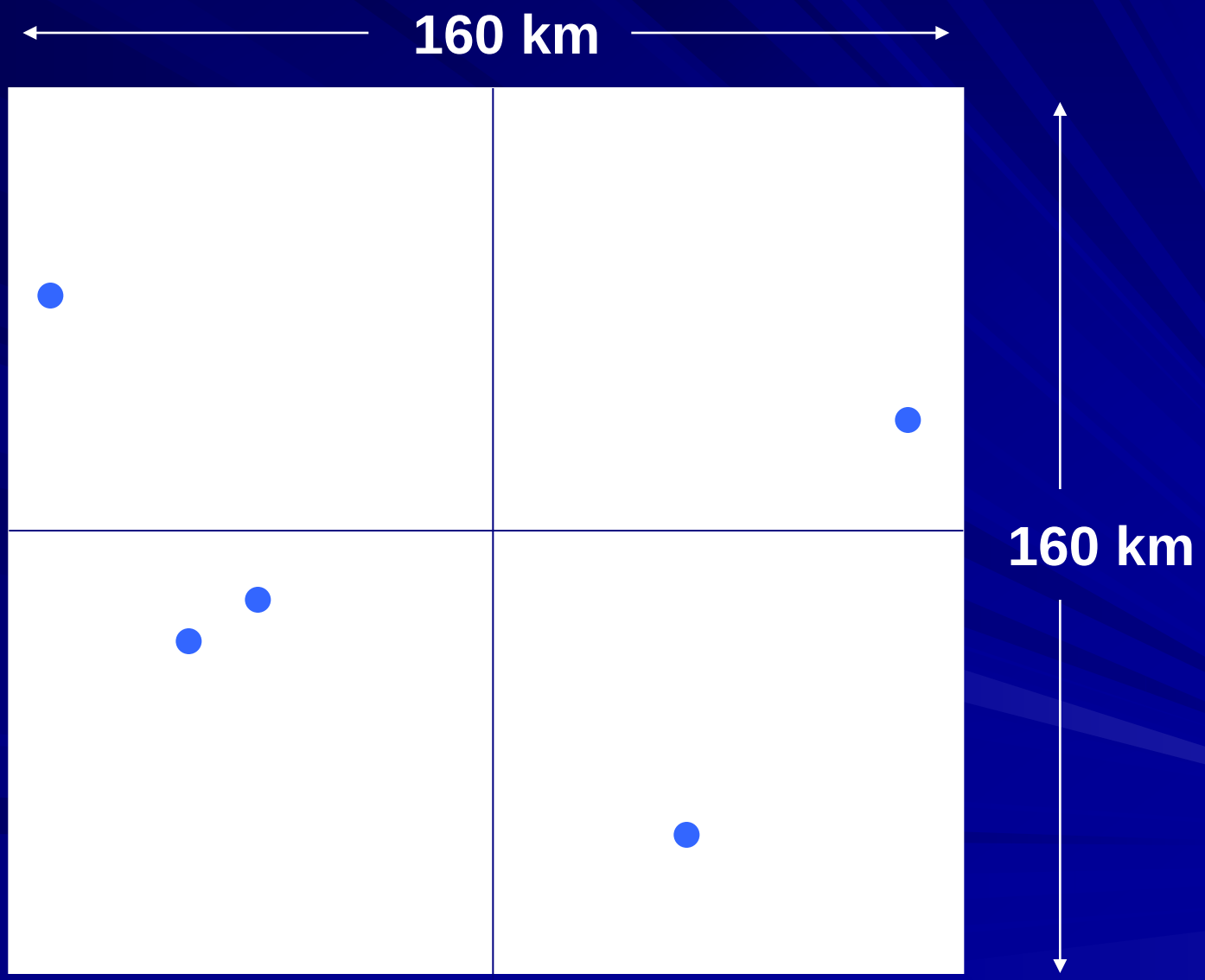
Purpose of GRN (continued)

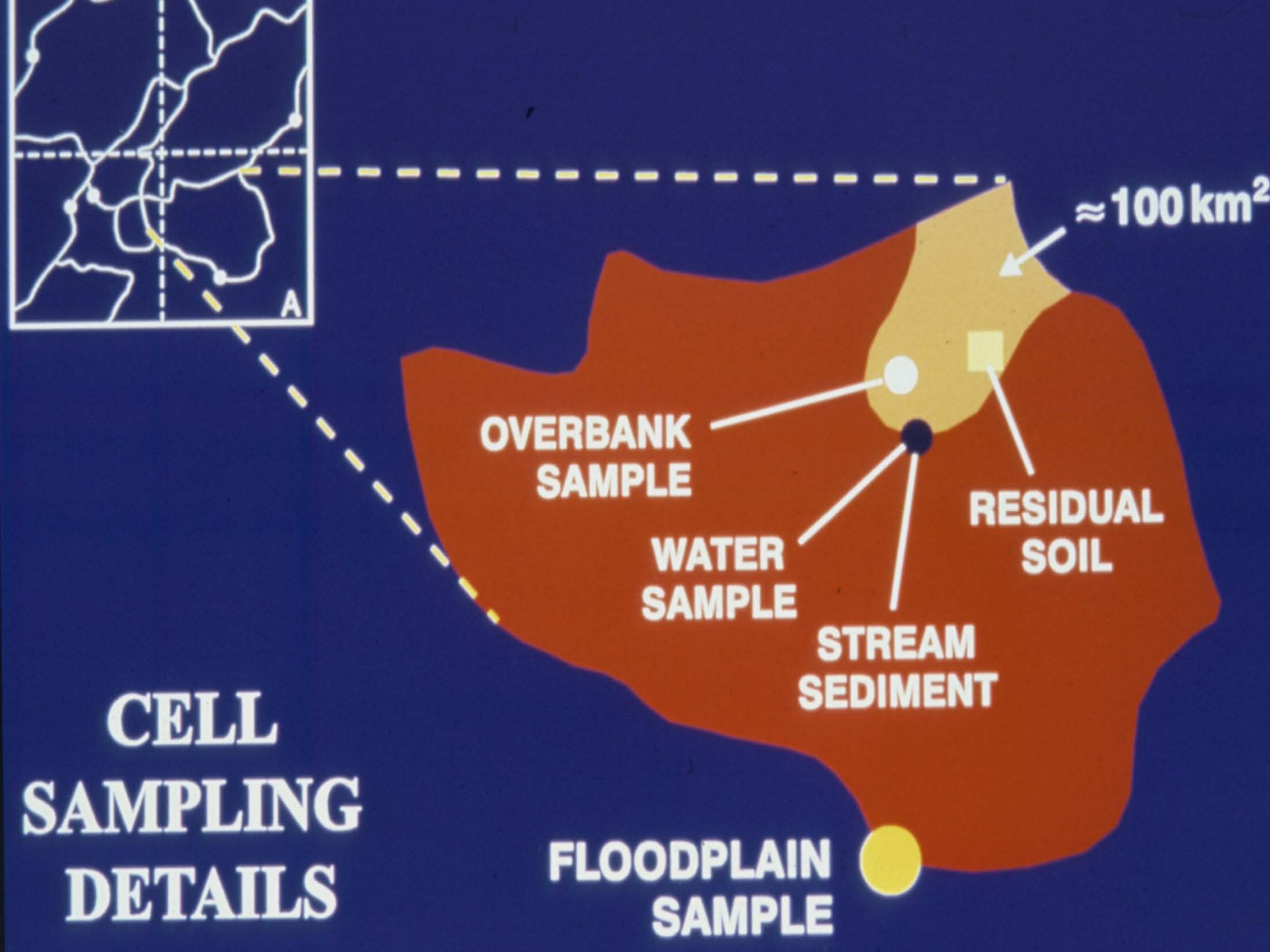
- Provide baseline data for preparation of World Geochemical Atlas
- Provide samples for further research (e.g., isotopic analysis, speciation studies, organic pollutants, etc.)
- Provide sites for recurrent monitoring in the future

IUGS/IAGC Working Group on Global Geochemical Baselines

- Phase 2 (1993-1998) IGCP 360: Global Geochemical Baselines
  - Establish worldwide network of geochemists
  - Develop methods for GRN sampling
  - Initiate GRN sampling in Europe under FOREGS
  - Publish *FOREGS Geochemical Mapping Field Manual* (Salminen et al, 1998)

Random sites within GRN cell





CELL SAMPLING DETAILS

Recommended sample media for GRN

- Residual soil
  - A-horizon (0 – 25 cm)
  - C-horizon (deepest accessible depth)
- Stream sediment (basin <100 km^2)
- Overbank sediment (basin <100 km^2)
  - Surface (0 – 25 cm)
  - Deepest accessible depth (optional)

Recommended sample media (continued)

- Lake sediment (if stream sediment not available)
- Surface humus (if available)
- Floodplain sediment (basin 1000 – 6000 km^2)
  - Surface (0 – 25 cm)
  - Deepest accessible depth (optional)

Recommended sample media (continued)

- Stream water (lake water in specific regions)
  - Untreated steam water (anions)
  - Acidified stream water (total cations)
  - Filtered stream water (45 μm) and acidified ('dissolved' cations)

IUGS/IAGC Task Group on Global Geochemical Baselines

- Phase 3 (1998 – present) IUGS/IAGC Task Group on Global Geochemical Baselines
  - Facilitate completion of collection of GRN samples through training, consultation, workshops, etc.
  - Promote increased standardisation of all geochemical survey methods worldwide

Selected accomplishments

- Geochemical atlas of Europe
- Pilot studies in Colombia, Argentina, Nigeria
- Detailed geochemical mapping in parts of South Africa
- State of Paraná, Brazil
- Training course: Tanzania, Nigeria, Uganda, China
- Symposia/Workshops convened, IGC Rio, IGC Florence, IGC Oslo, IGC Brisbane
- Symposium on Environmental Geochemical Baseline Mapping of Europe, Vilnius, Lithuania, 1999
- Mapping in Russia
- Numerous keynote lectures throughout the world
- Soil Geochemical Atlas of Ireland

Selected accomplishments (cont'd)

- National Geochemical Survey of Australia
- Geochemical Atlas of Cyprus
- Soil geochemical survey of India
- Soil geochemical survey of U.S. and Mexico
- Brasol 2010 (soil geochemistry of NE Brazil); national-scale mapping initiated
- Publication of *Geochemistry: Exploration, Environment, Analysis*, Vol. 8, Part 3/4, August 2008 in memory of A. Darnley
- Publication of *Applied Geochemistry, Vol. 24, August 2009. Geochemical studies of North American soils.*
- EuroGeoSurveys projects: GEMAS, Ground Water (Bottled Water)
- Multiple projects in China

Future

- Geochemical mapping programme for CCOP countries (?), and other countries

Thank you for your attention