

MEDICAL GEOLOGY

Olle Selinus

Geological Survey of Sweden

olle.selinus@sgu.se





"Medical Geology"

**- the science dealing with
the relationship between
natural geological factors
and health in man and
animals**

PINATUBO

2 days 1991

10 billion tonnes of magma

20 milj ton SO₂

600 000 ton Cu

800 000 ton Zn

1 000 ton Cd

300 000 ton Ni

550 000 ton Cr

10 000 ton As

800 ton Hg

60 volcanoes per day

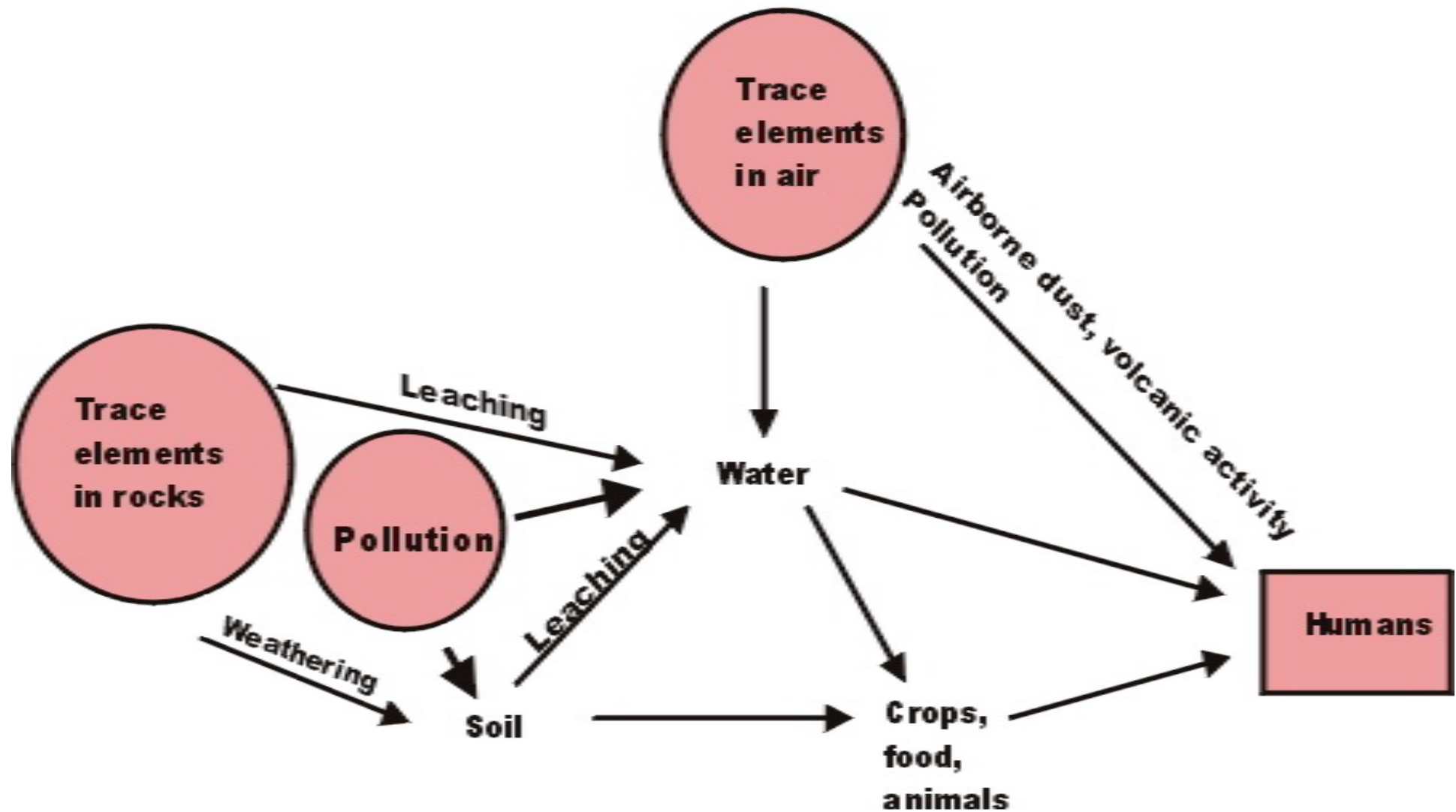
>3000 vent fields at mid ocean ridges





PATHWAYS

Pathways through which trace elements enter the body





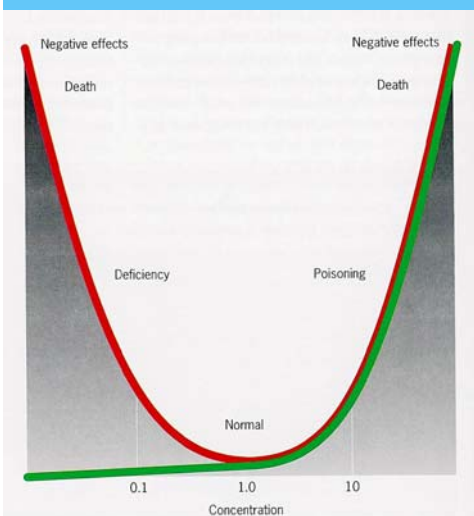
HIPPOCRATES
460-377 BC

MARCO POLO
1270



Diseases at state of deficiency respectively toxicity caused by the same element

<u>Element</u>	<u>Deficiency</u>	<u>Toxicity</u>
Iron	Anaemia	Haemochromatosis
Copper	Anaemia "Sway back"	Chronic copper poisoning Wilson-, Bedlington-disease
Zinc	Dwarf growth Retarded development of gonads Akrodermatitis enteropathica	Metallic fever Diarrhoea
Cobalt	Anaemia "White liver disease"	Heart failure Polycythaemia
Magnesium	Dysfunction of gonads Convulsions Malformations of the skeleton Urolithiasis	Ataxia
Chromium	Disturbances in the glucose metabolism	Kidney damage (Nephritis)
Selenium	Liver nechrosis Muscular dystrophy ("White muscle disease")	"Alkali disease" "Blind staggers"





United Nations Educational, Scientific and Cultural Organization.

IGCP #454 Medical Geology



International Working Group on
Medical Geology

IUGS Initiative on Medical Geology



- **1998- International Working Group on Medical Geology**
- **1999-2004 UNESCO IGCP#454 Medical Geology**
- **2002-2003 ICSU Medical Geology**
- **2003-2005 IUGS Special Initiative on Medical Geology**
- **2004- 4 Geo Union Initiative**
- **2004- ICSU Science for Health and Well being**
- **2005- International Medical Geology Association**
- **2007-2009 International Year of Planet Earth**



SUPPORTING ORGANISATIONS

- **International Union of Geological Sciences (IUGS)**
- **COGEOENVIRONMENT**
- **UNESCO**
- **International Council of Scientific Unions (ICSU)**
- **Geological Survey of Sweden (SGU)**
- **United States Geological Survey (USGS)**
- **US Armed Forces Institute of Pathology (AFIP)**

70 MEMBER COUNTRIES



Australia, Austria, Belgium, Botswana, Brazil, Bulgaria, Byelarus, Cameroon, Canada, Chile, China, Colombia, Croatia, Cuba, Denmark, Egypt, Estonia, Finland, Germany, Great Britain, India, Iran, Iraq, Ireland, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Latvia, Lithuania, Macedonia, Malaysia, Mexico, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Papua New Guinea, Peru, Poland, Portugal, Puerto Rico, Romania, Russia, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Taiwan, Tanzania, Turkey, Uganda, Ukraina, Uruguay, USA, Venezuela, Yugoslavia, Zambia, Zimbabwe



December 2003

MEDICAL GEOLOGY NEWSLETTER

IUGS Special Initiative on Medical Geology

Newsletter No. 7
ISSN 1651-5250



NEW INTERNATIONAL MEDICAL GEOLOGY ASSOCIATION (IMGA)

CONTENTS

<i>Message from the Chairman</i>	2
<i>Health Effects of Toxic Organic Compounds from Coal: from Romania to Powder River Basin,</i>	3
<i>Preliminary Assessment of the Impact of Petroleum Refinery, Kaduna, Northern Nigeria on the Environment and Human Health</i>	11
<i>Distribution of Some Respiratory Diseases within the Minsk Oblast</i>	14
<i>High Fluoride in Groundwater Cripples Life in Part of India</i>	15
<i>Groundwater: Resources and Quality in Lithuania</i>	17
<i>Drinking Water: Safety Issues in Lithuania</i>	20
<i>Book Review: Green Chemistry in Africa</i>	22
IMGA	p. 2
New Website	p. 2
Short Courses	p. 23
Book Medical Geology (Back Cover)	

BI-ANNUAL NEWSLETTER



Participants at the Medical Geology Course, Campinas, Brazil

<http://www.medicalgeology.org>



MEDICAL GEOLOGY - IUGS Special Initiative, IGCP#454, Internat. Med. Geol. Assoc. IMGA



HOME

Road map

News

Development

IGCP project

Background

IMGA

Reports

Short courses

Education

Activities

Conferences

Short papers

Glossary

MedGeolRegistry

Members

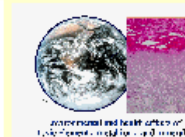
Book

Newsletters

Info material

Literature

Links



MEDICAL GEOLOGY

IUGS Special Initiative, IGCP project #454 Medical Geology and International Medical Geology Association

NEWS >

\$ SPONSORS

Updated September 7, 2004

NEW MEMBER

Africa ESAAMEG

Norwegian group

Malaysian group

Brazil

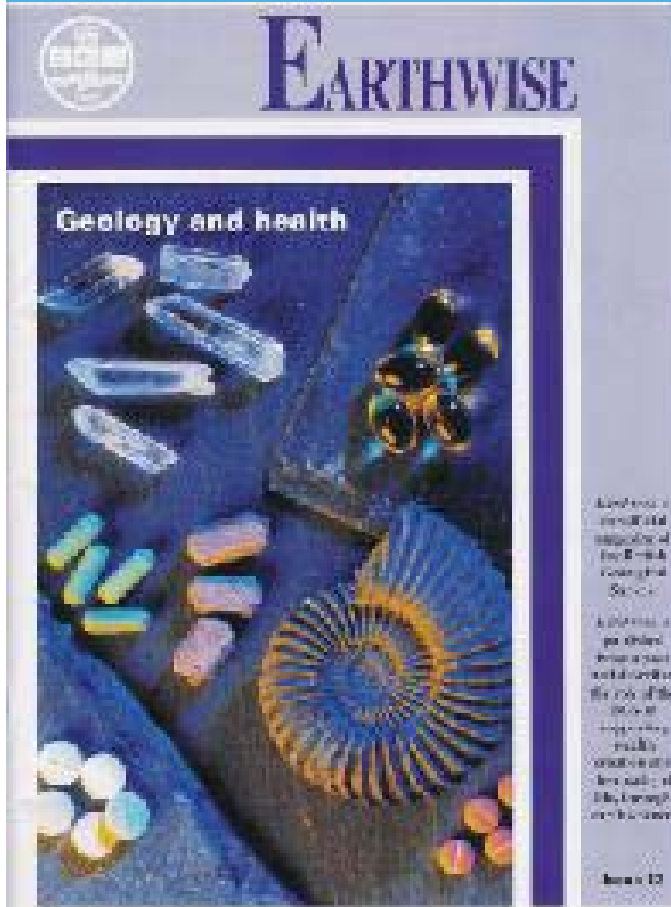
Medical Geology meeting at SGU in Sweden 14 September.

New brochure on medical geology for downloading (Earth and Health theme under "Planet Earth")

AN EXTENSIVE REPORT ON Medical Geology 2000-2004

Notes on the medical geology meeting in Florence, August 2004

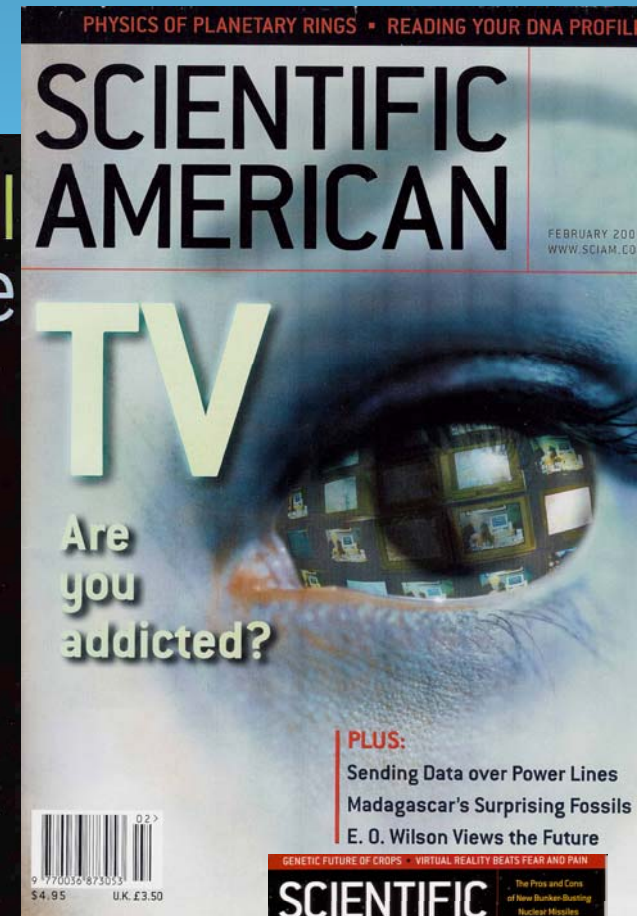
Internationellt genomslag



England



Sverige



USA



Environmental medicine



Editor: Lennart Möller



CHAPTER 10

Medical geology

OLLE SELINUS AND ADRIAN FRANK

Mother nature is a polluter

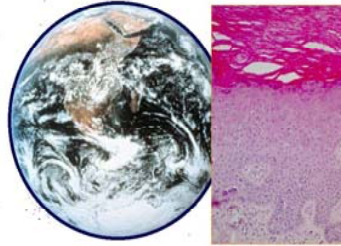
In June 1991 the volcano Pinatubo had an eruption. Over just two days the volcano ejected about 10 billion tons of magma and 20 million tons of sulphur dioxide, and the resulting aerosols influenced the global climate for at least three years. This event alone introduced 2 million tons of zinc, 1 million tons of copper and 5,500 tons of cadmium into the surface environment. The millions of tons of ash pumped into the atmosphere spread over thousands of square kilometres, probably containing all the elements in the Periodic System. In addition to the elements known to be essential to life, such as hydrogen, carbon, nitrogen, oxygen, sodium, potassium, calcium, mag-

nesium, iron, copper, zinc, phosphorus, sulphur and iodine, volcanoes also redistribute those elements which under certain conditions are regarded as harmful, such as arsenic, beryllium, cadmium, mercury, lead, radon and uranium plus the remaining elements, some of which have still undetermined biological effects. Similar volcanic events have occurred every few years throughout geological history (Figure 1). From the standpoint of natural releases of metals to the environment, it is important to realize that there are on an average 60 volcanoes erupting on the surface of the earth at any given time. The total flux of metals from these eruptions is significant. Submarine volcanism is even more significant than that at continental margins. It has been conservatively estimated that there are at least 3,000 vent fields on the mid-ocean ridges.

The planet earth is thus the ultimate source of all metals. Metals are ubiquitous in the lithosphere, where they are inhomogeneously distributed and occur in different chemical forms. Ore deposits are merely natural concentrations which are commercially exploitable. While such anomalous accumulations are the focus of mineral exploration the background concentrations of metals which occur in common rocks, sediments and soils are of greater significance to the total



FIGURE 1 Volcanic eruption at Krafla, Iceland 1980.



Environmental and health effects of toxic elements, metal ions, and minerals

METALS, HEALTH AND THE ENVIRONMENT - MEDICAL GEOLOGY-

**INTERNATIONAL
SHORT COURSES**

June 28 – June 29, 2001
School of Mines - University of Zambia
Lusaka, Zambia

Jointly Sponsored by:

School of Mines – University of Zambia
U.S. Armed Forces Institute of Pathology (AFIP)
U.S. Geological Survey (USGS)
Geological Survey of Sweden (SGU)
International Union of Geological Sciences
UNESCO, IGCP #454, ICSU and UNEP
COGEOENVIRONMENT



- **Zambia** June 2001
- **Chile** March 2002
- **Russia** May 2002
- **Japan** November 2002
- **New Zealand** Feb. 2003
- **Lithuania** 2003
- **Puerto Rico** May 2003
- **China** June 2003
- **Scotland** Sept. 2003
- **Brazil** November 2003
- **Australia, Malaysia** Dec 2003
- **Romania** Febr. 2004
- **Hungary** May 2004
- **Italy** August 2004
- **Canada** Oct 2004
- **Australia**, Nov 2004
- **India**, Dec 2004
- **Romania** May 2005
- **USA** June 2005
- **Brazil, Argentina, Uruguay**
- **USA**, June 2005
- **Egypt, Turkey** Sept 2005
- **Ireland, Sweden**, Oct 2005
- **Puerto Rico** Nov 2005

Medical geology Short Courses since 2001



SPONSORS OF MEDICAL GEOLOGY

Sweden

Geological Survey of Sweden
United States Geological Survey, USGS
US Armed Forces Institute of Pathology, AFIP
National Natural Research Council of Sweden
Royal Swedish Academy of Sciences
The Norwegian Academy of Science and Letters
Centre for Metal Biology of Sweden

USA

Geological Survey of Norway

Lithuania

British Geological Survey

UNESCO

UNEP

Japan

International Union of Geological Sciences, IUGS

International Geological Cooperation Program, IGCP#454, Medical Geology

International Council of Science, ICSU

China

International Association of Geochemistry and Cosmochemistry, IAGC

American Registry of Pathology

Western Australia University

Australia

Jackson State University, Mississippi

School of Mines, University of Zambia

University of Santiago

Brazil

Ministerio de Minería, Chile

US Environmental Protection Agency

Centro CoHemis y la Universidad de Puerto Rico, Recinto Universitaria de Mayaguez

Chile

Saint Petersburg State University, Russia

National Natural Science Foundation, China

The State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry,

Academia Sinica, China

Malaysia

The Key Laboratory of Coal Resources, Ministry of Education, China

Japan Branch of COGEOENVIRONMENT-IUGS

The Society of Geo-Pollution (SGP), Japan

Norway

Committee of Environmental Geology, Geological Society of Japan

Center for Water Environment Studies, Ibaraki University (CWES), Japan

National Committee for Geoscience, Science Council of Japan

Zambia

Geological Survey of Lithuania

Geological Survey of Brazil (CPRM)

Fundacao Oswaldo Cruz (FIOCRUZ), Brazilian Ministry of Health

Russia

Universidade Estadual de Campinas (UNICAMP), Brazil

PETROBRAS, Brazil

FAPESP, Brazil

Puerto Rico

Institute for Environment and Development (LESTARI), Malaysia

Institute for Medical Research Malaysia (IMR)

Department of Minerals and Geoscience Malaysia (JMG)

University of Canberra, Australia

CRC for Landscape Environments and Mineral Exploration (CRC LEME), Australia

Geoscience Australia (GA)

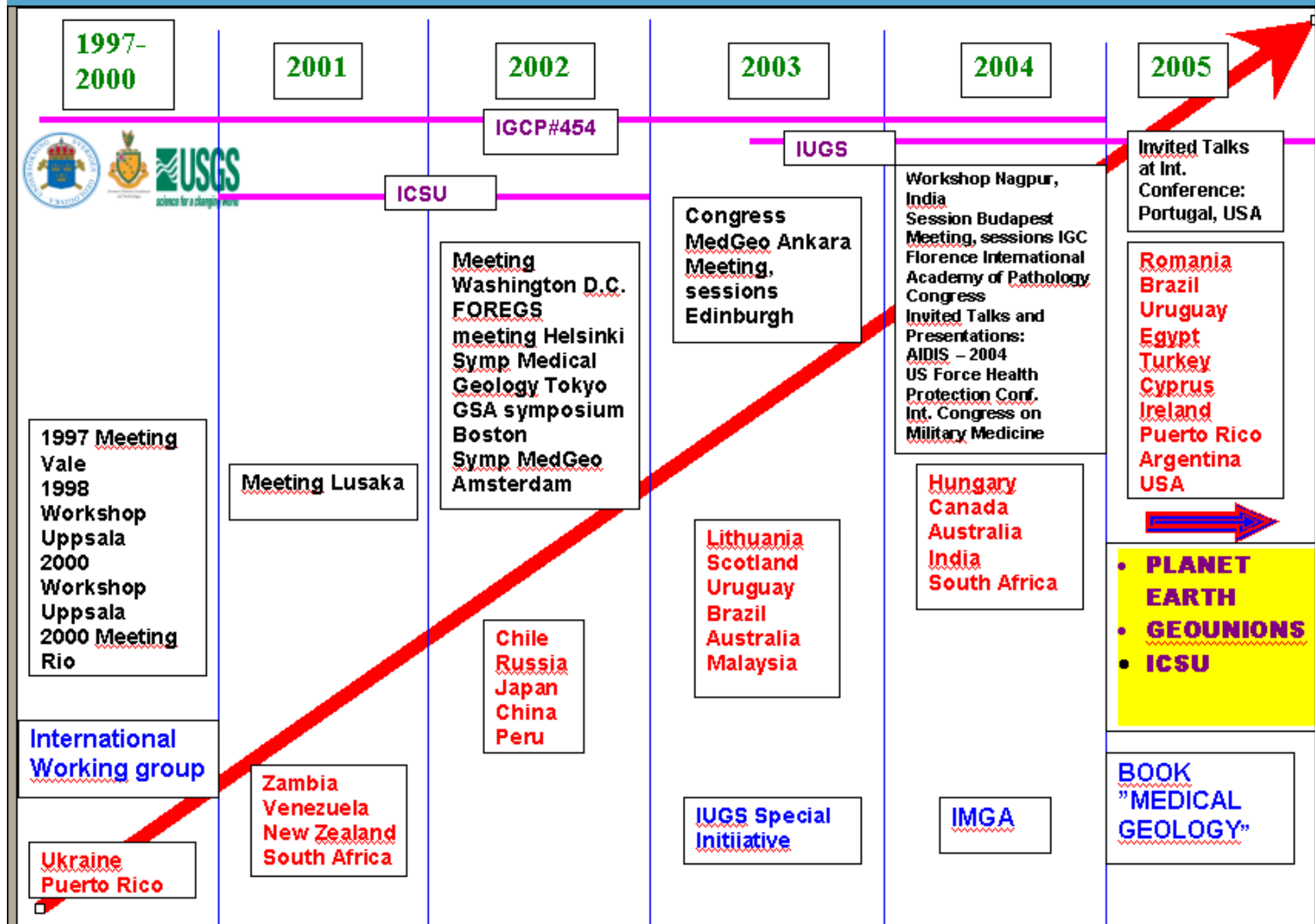
Institute of Geology and Geography, Lithuania (GGI)

Vilnius University (VU)

ACCOMPLISHMENTS

- Courses, Syllabus, CDs
- Sponsoring of scientists from developing countries
- Local working groups established all over the world
- Special sessions , key note lectures at conferences (medical and geological)
- Registry on Medical Geology which will serve as a central facility for the study of pathological materials and exchange of medico/clinical information on medical geology.
- US Museum of Medicine, Washington DC
- Conferences in US and other countries
- Newsletter
- Web site (domain medicalgeology.org)
- Proposals for journals by Elsevier and Geol Soc London.
- Publications in journals and books
- Geology and Health - book
- Essentials on Medical Geology
- Centers for medical geology.
- Close collaboration between geoscientists, medics, epidemiologists, toxicologists, pathologists etc
- Medical Geology included in curricula at universities
- IMGA

MEDICAL GEOLOGY Development

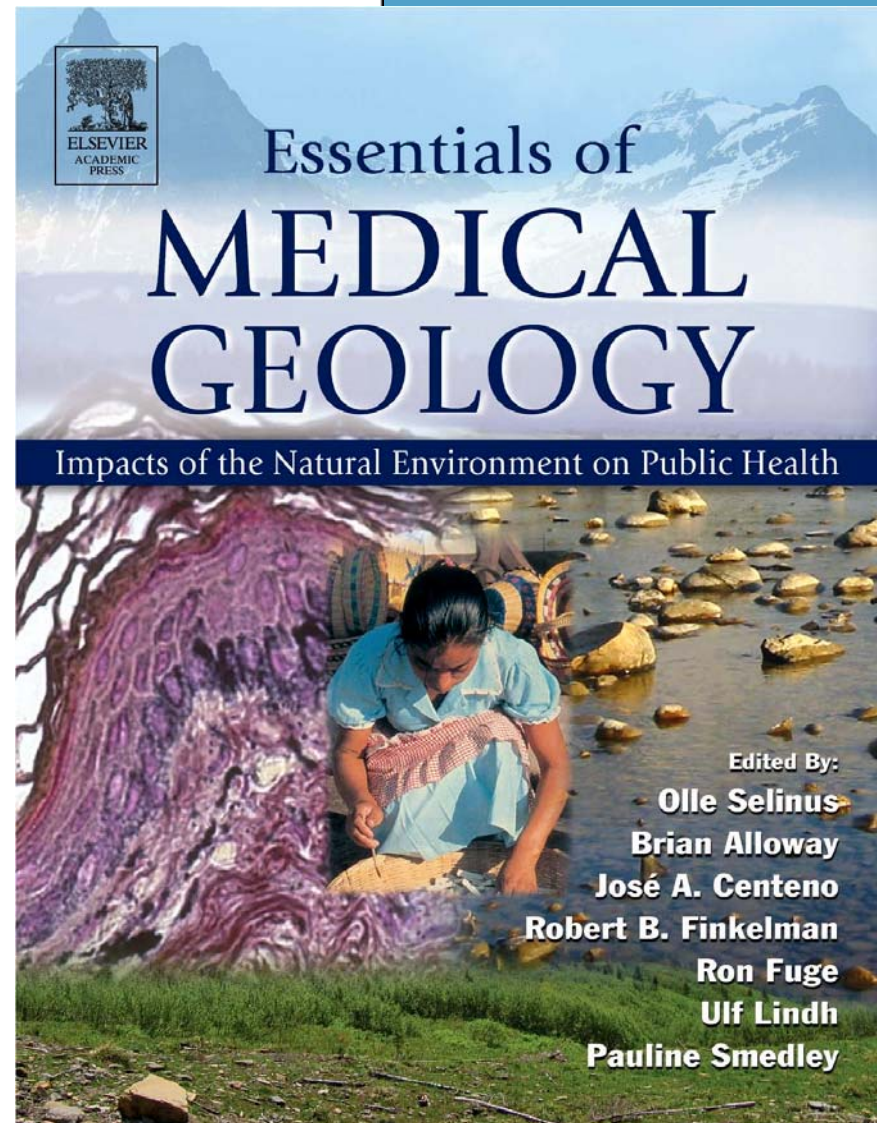


CONTENTS:

1. Medical geology: Perspectives and prospects
2. Natural distribution and abundance of elements
3. Anthropogenic sources
4. Uptake of elements from a chemical point of view
5. Uptake of elements from a biological point of view
6. Biological functions of the elements
7. Geological impacts on nutrition
8. Biological responses of elements
9. Volcanic emissions and health
10. Radon in air and water
11. Arsenic in groundwater and the environment
12. Fluoride in natural waters
13. Water hardness and health effects
14. Bioavailability of elements in soil
15. Selenium deficiency and toxicity in the environment
16. Soils and iodine deficiency
17. Geophagy and the involuntary ingestion of soil
18. Natural aerosolic mineral dusts and human health
19. The ecology of soil-borne human pathogens
20. Animals and medical geology
21. Environmental epidemiology
22. Environmental medicine
23. Environmental pathology
24. Toxicology
25. Speciation of trace elements
26. GIS in human health studies
27. Investigating vector borne and zoonotic diseases with remote sensing and GIS
28. Mineralogy of bone
29. Inorganic and organic geochemistry techniques
30. Histochemical and microprobe analysis in medical geology
31. Modeling ground-water flow and quality

APPENDICES

A. International reference values; B. Web links; C. Glossary



Essentials of MEDICAL GEOLOGY

Impacts of the Natural Environment on Public Health

Edited By:

Olle Selinus
Brian Alloway
José A. Centeno
Robert B. Finkelman
Ron Fuge
Ulf Lindh
Pauline Smedley

INTERNATIONAL MEDICAL GEOLOGY ASSOCIATION

IMGA

Directors:

Olle Selinus

Robert F Finkelman

Jose Centeno

COUNCILLORS, IMGA

Bernardino Figueredo, Inst of Geosciences, University of Campinas, Brazil

Calin Tatu, Forslys Group, Romania

Nomathemba Ndiweni, Preclinical Veterinary Studies, Harare, Zimbabwe

Fiona Fordyce, British Geological Survey, UK

Baoshan Zheng, Inst of Geochemistry, Guiyang, China

Philip Weinstein, School of Population Health, Univ. of Western Australia, Crawley, Australia

New big initiatives

- **ICSU - Health and Well being**
- **GeoUnion Initiative**
- **Planet Earth**

• GeoUnion Initiative

	IGU	IUGG	IUGS	IUSS	ISPRS
Cities & Megacities	<i>Frauke Kraas</i>	Grant Heiken	Brian Marker	Wolfgang Burghardt	Derya Maktav
Desertification	Moshe Inbar	Youba Sokona	David Thomas	<i>Rattan Lal</i>	Dan Blumberg
Groundwater	Tony Jones	Yoram Rubin	<i>Willh. Struckmeier</i>	Reiner Horn	TBA
Hazards	David Alexander	<i>Tom Beer</i>	Peter Bobrowsky	Rob Fitzpatrick Marcello Pagliai	Piero Boccoardo
Health	Mark Rosenberg	Claire Horwell	<i>Olle Selinus</i>	Eiliv Steines	Amy Budge

PLANET EARTH

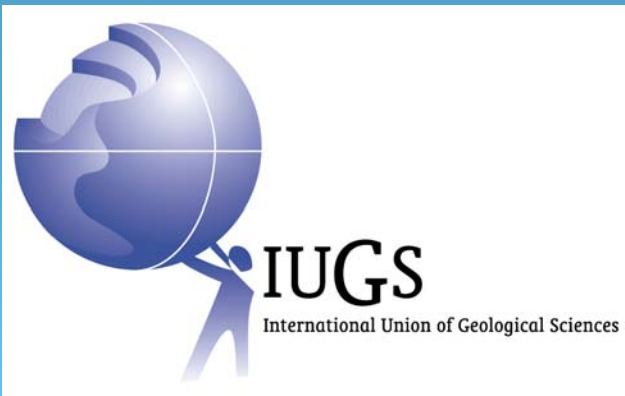
2007-2008-2009

Declared by UN 2005

- **Groundwater - reservoir for a thirsty planet**
- **Hazards - minimising risk, maximising awareness**
- **Earth & Health - building a safer environment**
- **Climate - the 'stone tape'**
- **Resources - sustainable power for sustainable development**
- **Megacities - going deeper, building safer**
- **Deep Earth - from crust to core**
- **Ocean - Abyss of time**



www.esfs.org



DECLARED BY UNITED
NATIONS



BROCHURES



1

Planet Earth in our hands

Earth sciences for society

Planet Earth 2005-2007

2

Hazards - minimising risk, maximising awareness

Earth sciences for society

3

Earth and health - building a safer environment

Earth sciences for society

Planet Earth 2005-2007

4

Deep Earth - from crust to core

Earth sciences for society

International Year of Planet Earth 2008-2009

www.eyf.org

5

Climate Change - the 'stone tape'

Earth sciences for society

6

Resources - sustainable power for sustainable development

Earth sciences for society

International Year of Planet Earth 2005-2007

www.eyf.org

4

Earth and health - *building a safer environment*

Earth sciences for society



www.esfs.org

Prospectus for a key theme of the International Year of Planet Earth 2005-2007





Thank you! Any questions?