

Medical Geology - An Emerging Discipline

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Washington, D.C.

International Symposium on Advances in Geospatial Technologies for Health
September 12-13, 2011
Santa Fe, NM



IUGS-GEM Commission on Geoscience
for Environmental Management



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The opinions presented are the private views of the speaker, and should not be construed as official or representing the views of the Department of Army, the Department of Defense, the Joint Pathology Center, or other federal agencies.

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Medical Geology

An Outline of this Presentation

- A Working Definition
- Historical Background
- A Range of Issues
- Milestones and Future Directions

Dominant dust source regions around the world (in brown) .

Courtesy of Prof. Dr. Edward Dervishire, UK

Medical Geology

A Working Definition

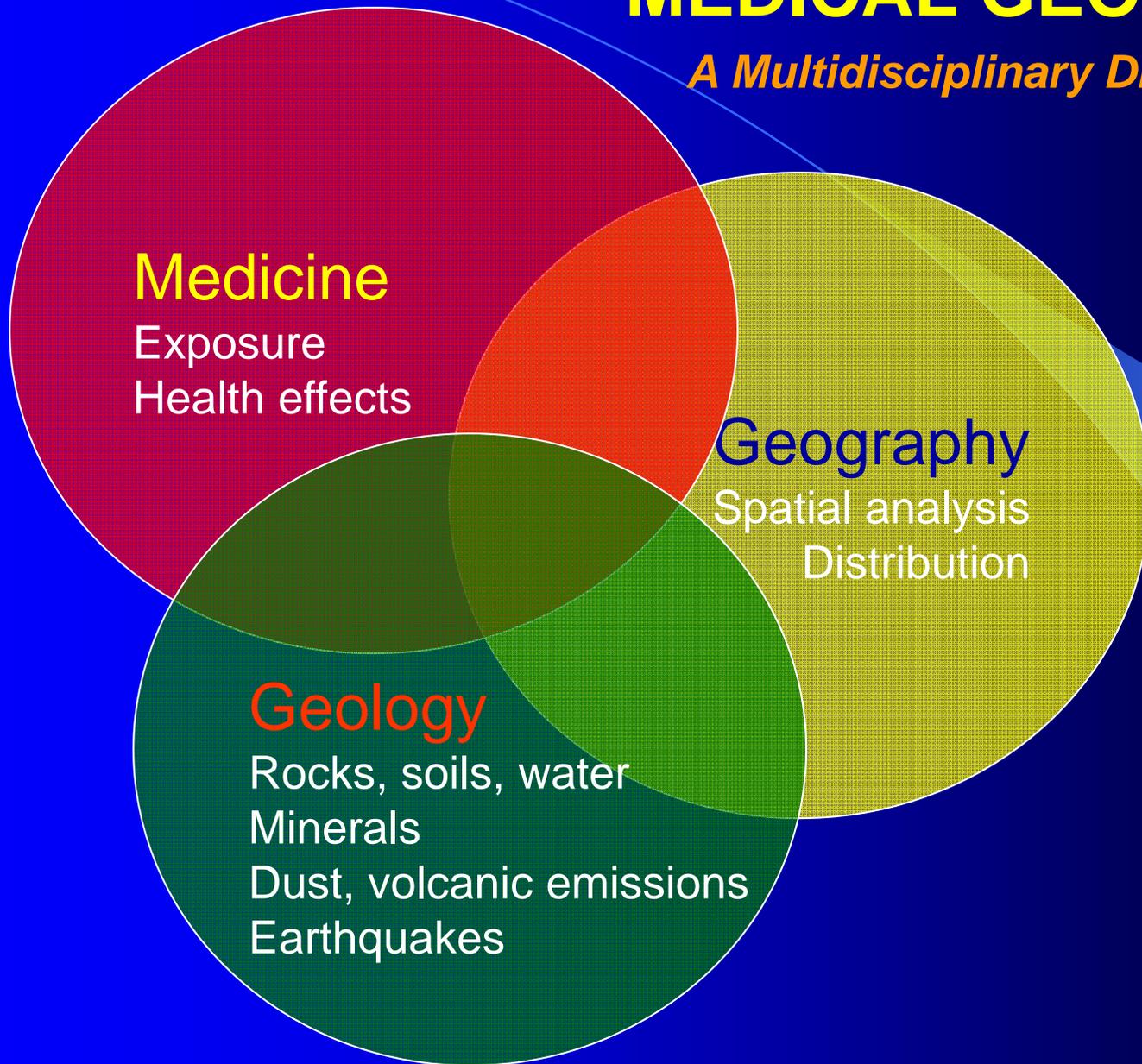
Medical Geology is defined as the science dealing with the relationship between geological materials and geologic processes and their impacts on health problems in man and animals.

The scope and range of Medical Geology include:

- identifying and characterizing natural sources of harmful materials in the environment;
- learning how to predict the movement and alteration of chemical, infectious, and other disease-causing agents;
- and understanding how people may be exposed to such materials.

MEDICAL GEOLOGY

A Multidisciplinary Discipline



Medical Geology

Bridging the Gap Between Earth and Health Sciences

- How can earth and health scientists make their capabilities known among these two disciplines?
- What type of studies can be done jointly?
- In which health areas is earth-science information and tools needed?
- How can we best demonstrate the relevancy of geosciences to public health and society?

What does Medical Geologists do?

- Team with public health/biomedical researchers to find solutions for existing medical geology problems;
- Use geoscience techniques and data to identify potential medical geology problems;
- Help reassure the public when there are no legitimate medical geology issues;
- Investigate the health benefits of geologic materials and processes.

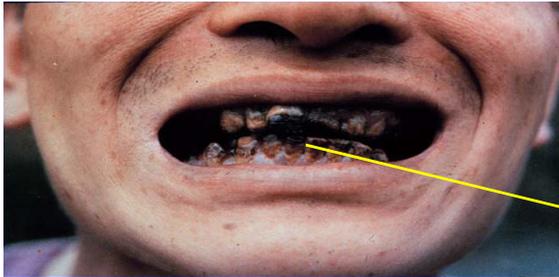
Medical Geology

A Historical Background

- 1996 - Working Group on Medical Geology – established by the IUGS commission COGEOENVIRONMENT;
- 2000 - IGCP 454 Medical Geology – established by the International Geologic Correlations Programme (jointly sponsored by UNESCO and IUGS);
- 2001 - Short Courses are organized at developed and developing countries supported by a grant from the International Commission on Scientific Unions;
- 2005 - The book “Essentials of Medical Geology” was published;
- 2005 - The International Medical Geology Association (IMGA) was established;
- 2005 - International Medical Geology Symposium organized by the Royal Swedish Academy of Sciences;
- 2005-2007-2009-2011 International Conference Series on Medical Geology
- 2008 - UN announces Medical Geology as one of the themes of the IYPE.
- 2009 - US National Academy of Sciences - NRC establishes a National Committee on Earth Sciences and Public Health

Medical Geology-Range of Issues

- Trace Element Deficiency/Excess – eg, I, Se, F, As
- Mineral and Natural Dust - Asbestosis, Silicosis, CWP, Valley Fever
- Water quality – Balkan endemic nephropathy (BEN)
- Organics – PAHs, Pesticides, Herbicides, etc
- Radionuclides - Radon, Radium, Uranium
- Microbes, Pathogens - Buruli ulcer, West Nile Encephalitis, LaCrosse Encephalitis, Plague, Hantavirus, Lyme disease, etc.
- Hot Springs – eg, Medical and economical benefits
- Clays and minerals – eg, geophagia
- Global Climate Change

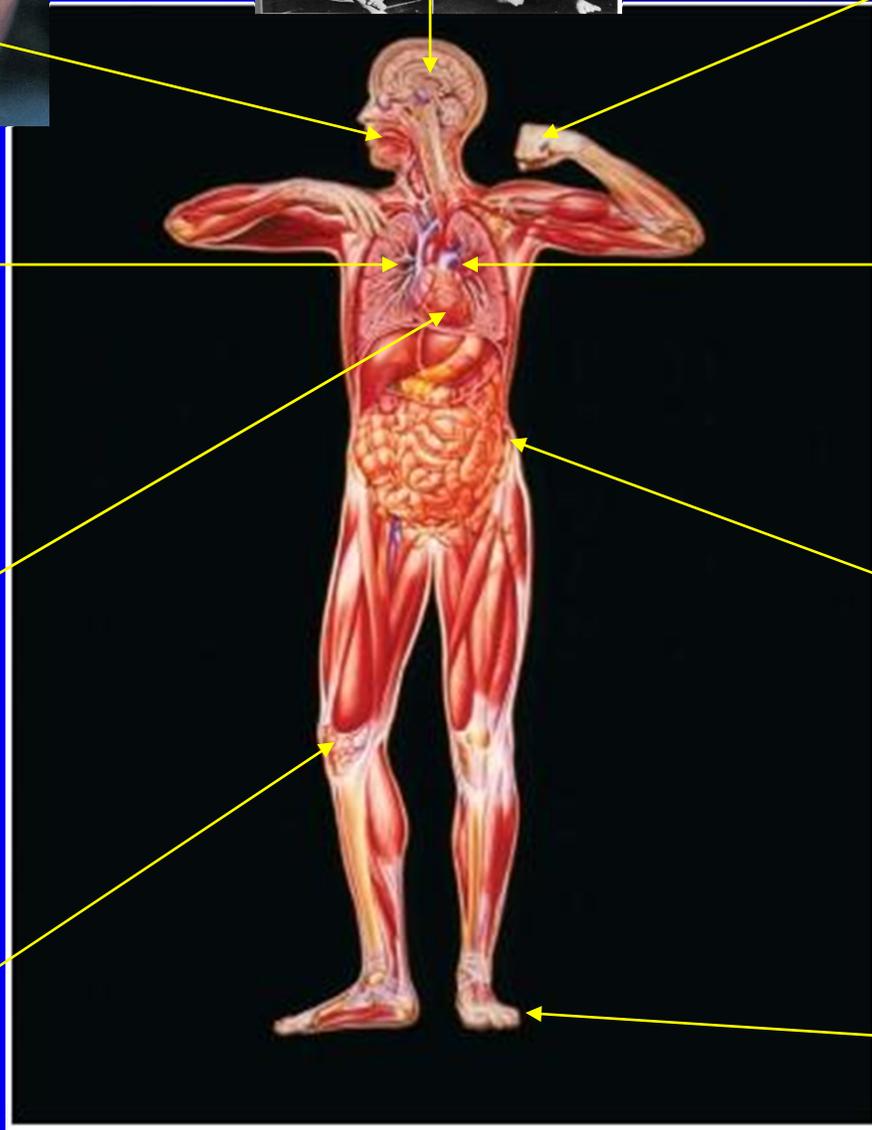


Fluorosis



Mercury poisoning

Arseniasis



Black Lung



Silicosis



Se deficiency

Balkan Endemic Nephropathy



Meselini Joint Disease

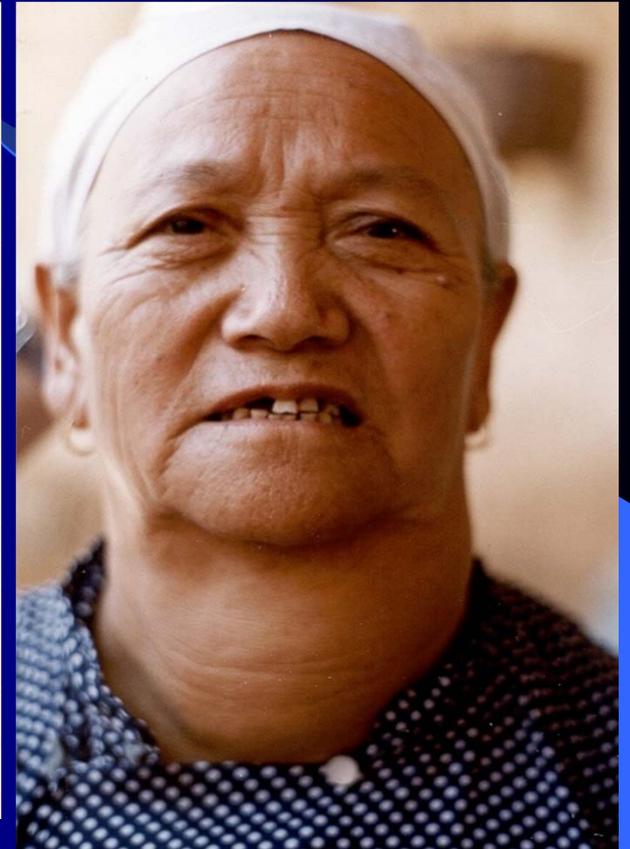
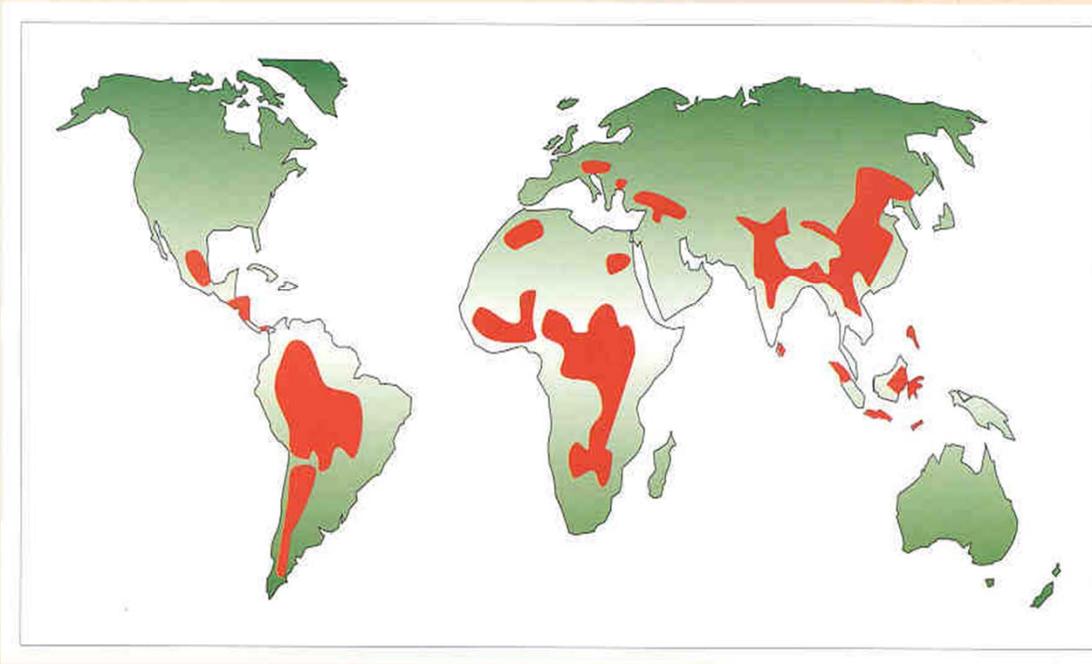


Black Foot Disease

Trace Elements and Human Health

Medical Geology – Diseases from Trace Element Deficiencies

Element deficiency - Iodine

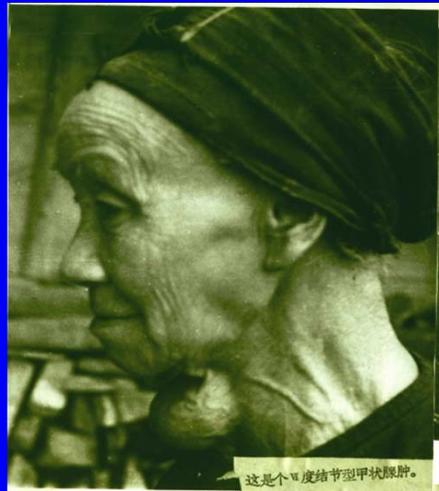
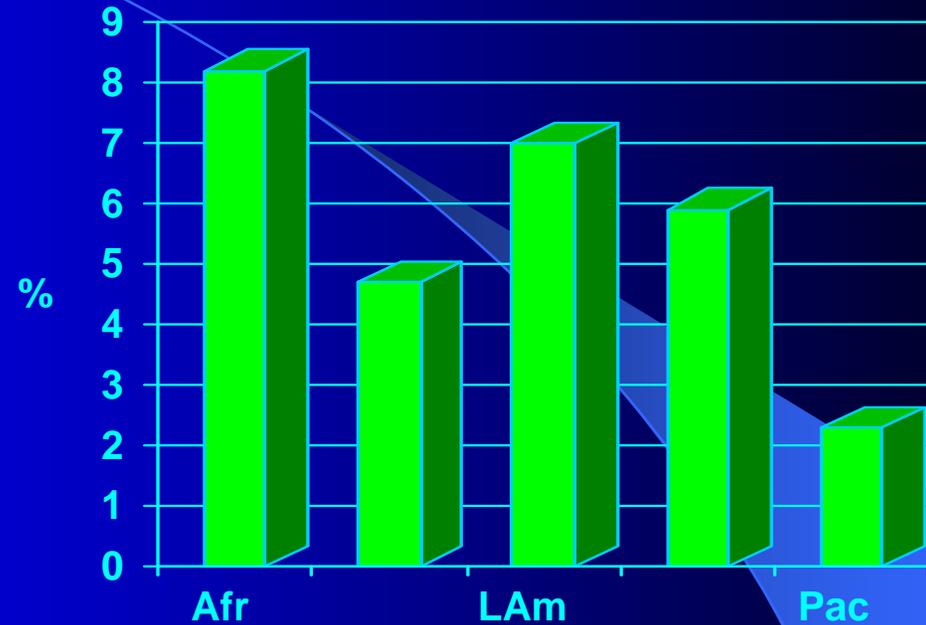


Iodine Deficiency Disorders (IDD) include goiter (enlargement of the thyroid), cretinism (mental retardation with physical deformities), reduced IQ, miscarriages, birth defects.

Photo: Jose A. Centeno

Global Prevalence of I Deficiency Diseases

- >2 B at risk
- 740 M with goiter
- 20 M mentally retarded
- 6 M infants with cretinism (half in SE Asia) each yr



goiter



、这是个典型克汀病患者已十五岁，不能独立行走，生活不能自理。



、这是典型的克汀病患者，已十九岁，不能独立行走。

cretinism

Excess Exposure to Geogenic Arsenic in Drinking Water – Global Impact



World map demonstrating regions with documented arsenic problems in groundwater (Adapted from Smedley & Kinniburgh 2005. In *Essentials of Medical Geology*, edited by Selinus, Alloway, Centeno, et al. 2005).

Geogenic arsenic in drinking water, Bangladesh

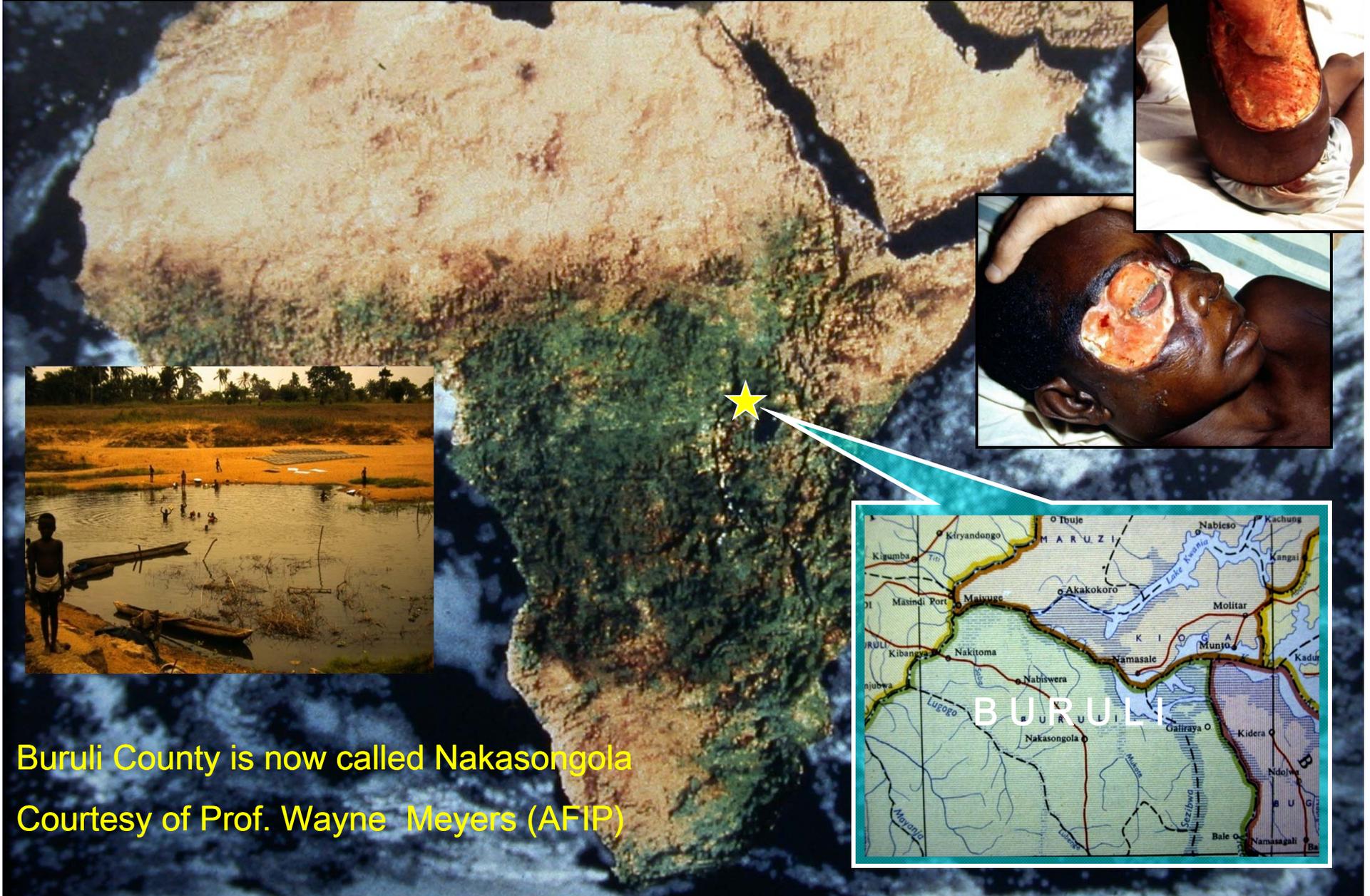


- Consumption of ground water from shallow wells (installed originally to provide alternate source to pathogen-laden surface waters)
- Hyperkeratoses of skin, skin lesions, skin cancers, other problems
- As many as 200,000 people with arsenicosis

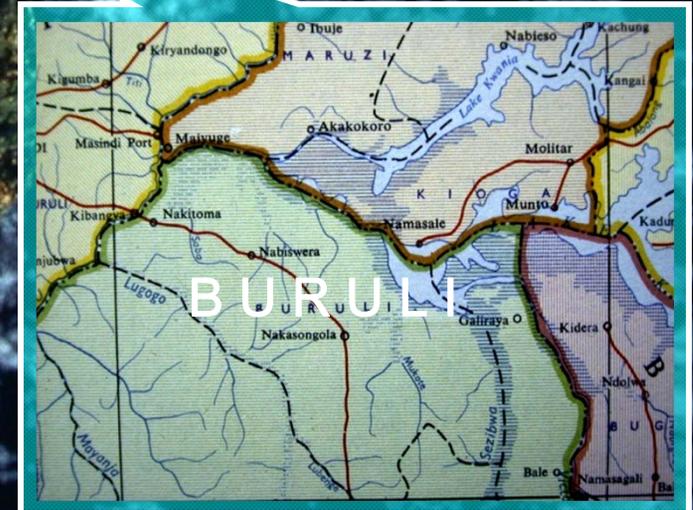


Arsenic patients in Bangladesh and West Bengal. (Photos by Prof. Richard Wilson of Harvard University)

Mycobacterium ulcerans DISEASE (BURULI ULCER)

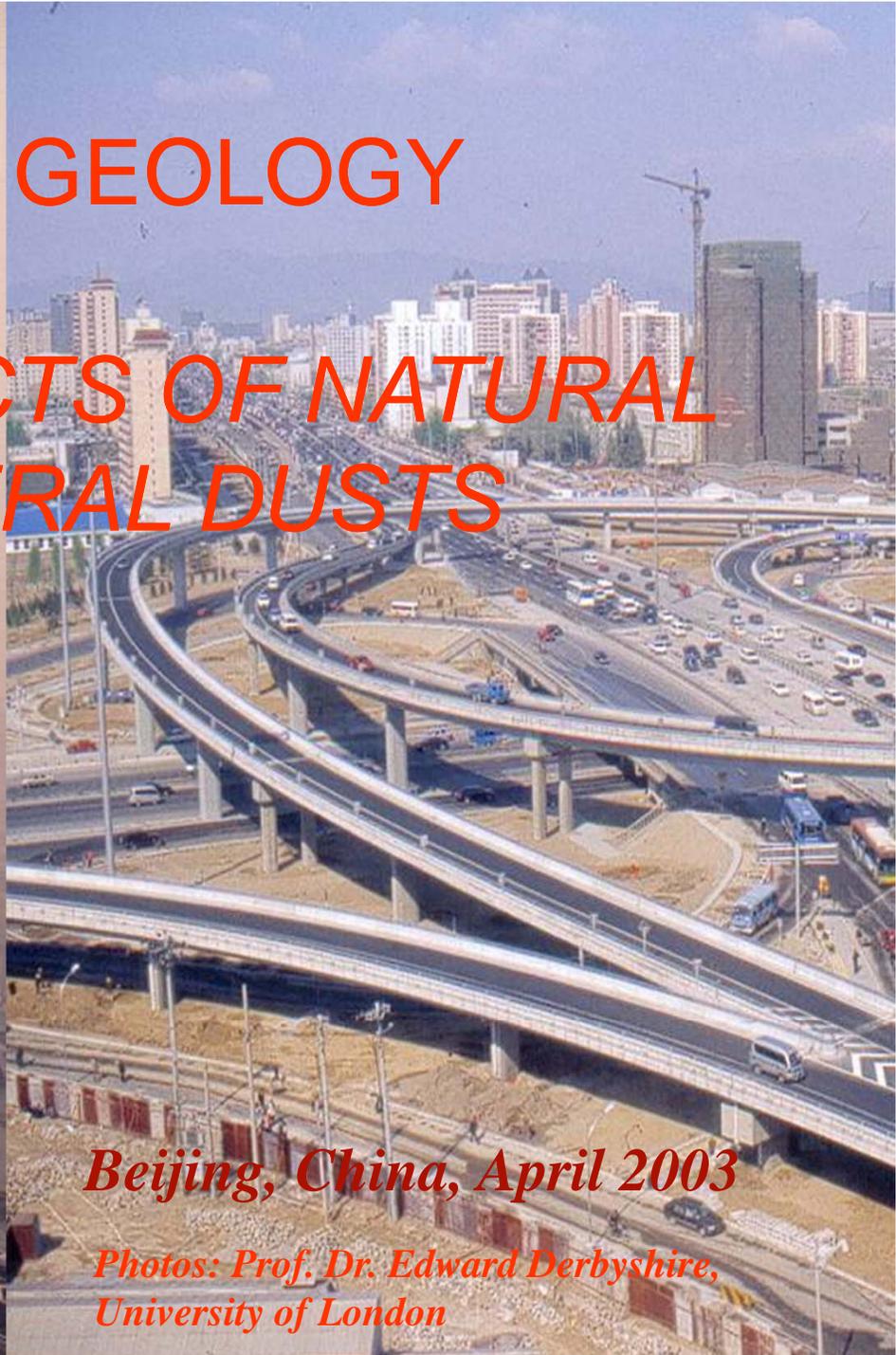


Buruli County is now called Nakasongola
Courtesy of Prof. Wayne Meyers (AFIP)



MEDICAL GEOLOGY

HEALTH EFFECTS OF NATURAL AND MINERAL DUSTS



Beijing, China, April 2003

*Photos: Prof. Dr. Edward Derbyshire,
University of London*

The Health Effects of Dusts

- Some aspects have been well known for decades
 - General effects of industrial / commercial asbestos
 - Silicosis (hard rock mining), pneumoconiosis
 - Black lung (coal mining)
- New issues and problems are arising:
 - Regional desert storms, trans-oceanic dust transport
 - Airborne dust composition (ie, toxic metals) ,
 - Microbiological, infectious disease agents and pathogens (ie, Valley fever)



Crocidolite (Blue Asbestos)

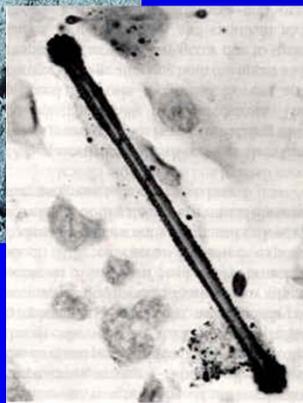


Photo courtesy of Dr. Tony Ladson, Civil Engineering, Monash University, Clayton, Victoria, Australia

12.11.2002

Medical Geology : Future Research Areas

- Health impacts of Global Climate Change
- Health impacts of natural disasters
- Urban medical geology
- Veterinary geology - animals as sentinels of disease
- Global dust (interaction of microbes and minerals)
- Medical Geology and mental health
- Medical Geology and Occupational health

Medical Geology

Milestones and Future Activities

- International Medical Geology Association (www.medicalgeology.org)
- Conference series: International Conf on Medical Geology
- Worldwide Short Courses
- Associate degree (**GWU, WAU, etc.**)
- Book (*“Essentials of Medical Geology”*, Elsevier & Academic Press, 2005)
- Medical Geology Registry (AFIP)
- Centers of Excellence on Medical Geology
- IMGAs Chapters Worldwide
- Publications (IMGAs Newsletters, IYPE book, etc)
- USA National Academy of Sciences-NRC – 2007 (Committee on Earth Science and Public Health)
- The Royal Swedish Academy of Science (AMBIO 2006)
- United Nations – Planet Earth 2007-2009



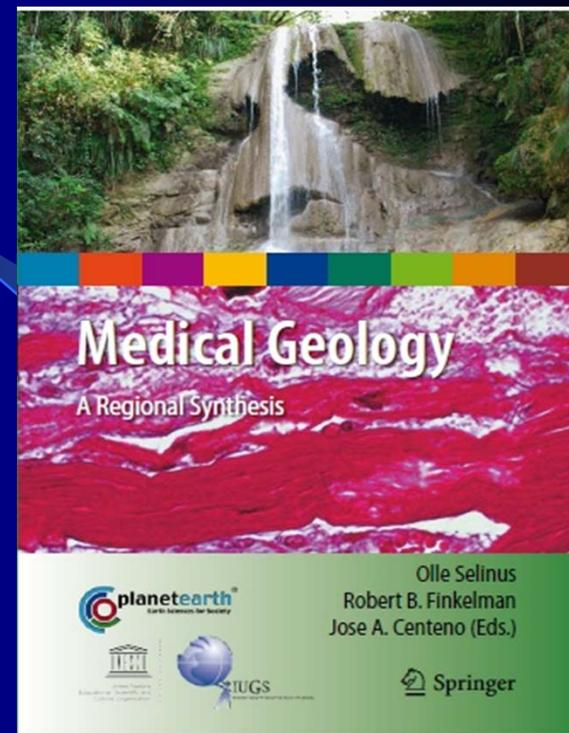
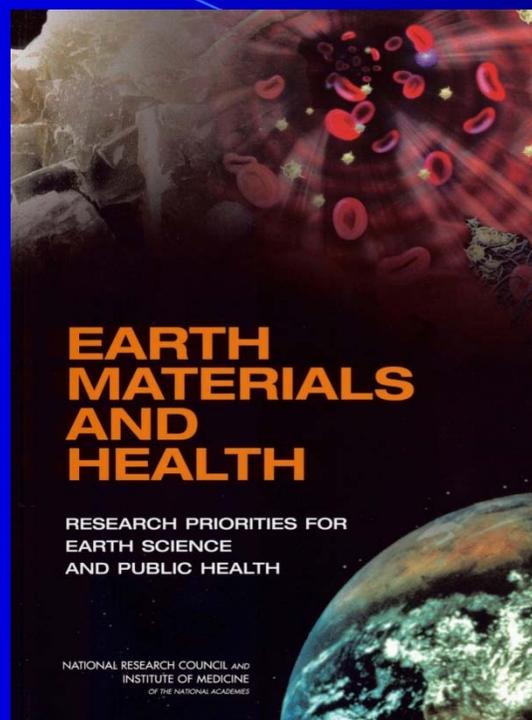
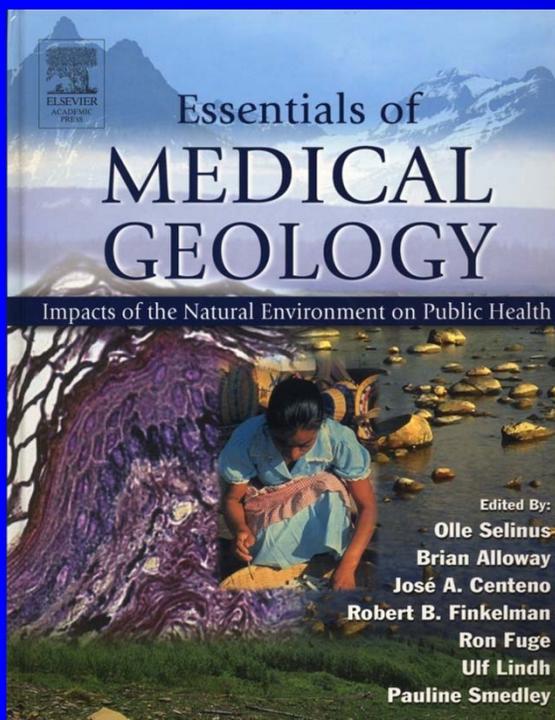
Bari, Italy
20-25 September 2011
<http://www.geomed2011.it>

Medical Geology

Summary

- **Medical geology**, as a multidisciplinary field, is aimed at providing a scientifically sound approach to better understand and define interactions between the natural (geological) environment and human health;
- There are significant and growing opportunities for collaboration between the geoscience and human health science communities:
 - Geochemical characterization, geographic mapping (eg, risk assessment maps);
 - Biological monitoring and population-based studies
 - Education, capacity-building, and technology transfer

Useful References



1. Selinus O, Alloway B, Centeno JA, et al. “Essentials of Medical Geology Impacts of the Natural Environment on Human Health.” Elsevier & Academic Press, 2005. ISBN: 0-12-636341-2.
2. “Earth Materials and Health – Research Priorities for Earth Science and Public Health”. National Academies, National Research Council 2007. ISBN: 978-0-309-10470-8.
3. Selinus O, Centeno JA, Finkelman RB. Medical Geology – A Regional Synthesis. Springer, International Year of Planet Earth (UNESCO), 2010. ISBN: 978-3-642-05436-5



Geoscience

Public Health

Thank you!

