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Environmental Pathology and Medical Geology: *Solving global, environmental, and health issues*

AFIP's Department of Environmental and Toxicologic Pathology is taking a leading international role in the developing science of Medical Geology, which links natural geo-environmental factors with the incidence and geographical distribution of health problems in man and animals. Geoscience tools (such as geographic information systems, databases, etc) and expertise complement and augment the tools and skills of the medical and environmental professionals. "We're working to understand the influence of environmental and geological factors, such as exposure to toxic metals

and metalloids, on populations around the globe, including China, India, Mexico, as well as right here in the United States," said Jose A. Centeno, PhD, chief of the Department's Division of Environmental Pathology, Biophysical Toxicology Branch.

The Institute is a member of the International Working Group on Medical Geology, chartered by the international commission CoGEOENVIRONMENT, International Union of Geologic Sciences (IUGS), and Commission on Geological Sciences for Environmental Planning. This Working Group brings together leading geoscientists, biologists, chemists, epidemiologists, toxicologists and other medical scientists to help solve critical environmental and health issues. "This

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Caption:



multi-disciplinary approach enhances our ability to determine causes of environmental health problems and to seek innovative solutions that will prevent or minimize exposure”, said Dr. Florabel G. Mullick, Principal Deputy Director of the AFIP and co-investigator with Dr. Centeno on this international initiative.

AFIP has achieved an international reputation in Medical Geology due in large part to its successful collaborations with other federal agencies in the United States, including the U.S. Geological Survey (USGS), Environmental Protection Agency (EPA), National Institute of Environmental Health Sciences (NIEHS), and National Cancer Institute (NCI), among others. “We’ve worked very closely with USGS for a number of years, beginning with a 1995 workshop in Mexico, at the invitation of that country’s government, to discuss environmental and health issues associated with trace elements from coal burning in power plants along the US-Mexico border,” Centeno noted. “This was the first activity we had to discuss the health effects of trace elements. Since then we’ve conducted many, well attended, workshops in the U.S. and in other countries. We receive about four or five invitations each year to present the workshop both here and abroad. We’ve expanded the material to consider all natural and man-made sources of trace element exposure and try to address site-specific issues in the regions where the workshops are held”.

In 1996 Dr. Centeno and scientists from USGS and EPA went to the Guizhou Province in China to study health problems associated with arsenic, fluoride and thallium exposures originating from geologic materials, particularly high-arsenic coal (Fig. 1). At least 3,000 people in Guizhou Province in southwestern China are suffering from severe arsenic poisoning. “The primary source of the arsenic appears to be consumption of chili peppers dried over fires fueled with high-arsenic coal”, he said. “Health problems associated with toxic trace elements such as arsenic are known to afflict millions of people in several countries,” Centeno added. Dr. Robert B. Finkelman, coordinator of the USGS Coal Quality Program has conducted extensive analysis of these coals. “Coals in this region of China contain up to 35,000 parts per million (ppm) arsenic”, Dr. Finkelman indicated.

In 1998 AFIP sponsored a joint meeting with USGS on environmental and human health



Fig. 1— Skin hyperpigmentation caused by exposure to arsenic mobilized by coal combustion in Guizhou Province, China. Photograph courtesy of Prof. Baoshan Zheng, Institute of Geochemistry, Guiyang, China.

research that included discussions with NIEHS and NCI, bringing together many key federal players and providing a springboard towards further international recognition in the area of medical geology. Two years later, in May 2000, AFIP/ARP organized the 6th International Symposium on Metal Ions in Biology and Medicine, in San Juan, Puerto Rico. Over 500 attendees from 50 countries exchanged information about trace elements and metal ions and their role in the disease process, including cardiovascular disease, diabetes and cancer.

Centeno’s environmental research in China – particularly in the characterization of health effects of arsenic, fluoride, and selenium exposure in local populations – has led to the development of further studies and collaborations in West Bengal, Taiwan, India and Bangladesh. “We’re also working on a joint epidemiological project with the EPA and the University of Kentucky to study reproductive effects in Chile and cancer surveillance in West Bengal due to arsenic exposure from contaminated drinking water”. In the U.S., AFIP is collaborating with the Center for Occupational and Environmental Medicine in Southfield, Michigan, addressing arsenic exposure in Oakland County.

The Institute has also established an International Tissue Registry on Arsenosis, funded by NIEHS, NCI and EPA. The registry not only provides a facility for the archival of specimen materials, but also creates the foundation for a program to study the histopathology of arsenic exposure in tissues. It also serves as a source of pathological materials that may be used for the development of collaborative research and educational projects. “We’ve recently published a syllabus on arsenic exposure from a study of 175 cases that we’ve retrieved from AFIP’s National Tissue Repository, summarizing the histology and nomenclature of arsenic-induced lesions”, Dr. Mullick indicated.

As part of the medical geology studies organized by AFIP and USGS, this year Centeno and USGS officials traveled to the island of Marinduque in the Philippines, where they conducted an initial health and environmental assessment of the effects of copper mine waste materials on this island’s population.

“Mining-related environmental problems have had visible and detrimental environmental impacts on several parts of Marinduque”, Centeno said. The AFIP/USGS Team provided preliminary interpretations and analytical results of some water, sediment and mine waste samples, as well as highlighted the environmental and human health issues requiring further study and consideration. “Our reputation and involvement in this emerging area of medical geology continues to grow”, he said. “We are currently working on the preparation of a reference book that will serve to describe the link between geological risk factors and human diseases”, Centeno added.

For more information about AFIP’s role in Medical Geology contact Dr. Centeno at Centeno@afip.osd.mil or by phone at (202)782-2839. Additional information may be obtained from the Medical Geology Working Group website at home.swipnet.se/medicalgeology