GeoHealth News

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EDITORIAL COLUMN

By Joe Bunnell

USGS research in GeoHealth is getting the

SPOTLIGHT: USGS

FEATURE ARTICLE

Pharmaceuticals, Hormones, Personal-Care Products, attention of a larger customer base including policy makers. A U.S. Congressman, Ralph Regula (Chairman, Subcommittee on Labor, Health and Human Services, Education and Related Agencies, House Appropriations Committee) of Ohio, spoke at the opening plenary session of our conference, Natural Science and Public Health: Prescription for a Better Environment, on April 1-3, 2003. Proceedings of the conference are available as U.S. Geological Survey Open-File Report no. 03-097, and will be posted online.

We have also been noticed by an influential organization that could help ensure sustained viability for research in our emerging discipline. The National Science Foundation and USGS have contracted the National Research Council (NRC), part of the National Academies, to develop funding sources for GeoHealth research. Many past recommendations by the NRC have influenced agency research, and funding activities and priorities. An NRC ad hoc committee is being assembled that will assess the present status of research at the interface between public health and earth science, and will advise on the high priority research activities that should be undertaken for optimum social benefit. The committee is expected to consider both infectious diseases and environmental health issues in its deliberations. We are guardedly optimistic that one outcome will be enhanced visibility and increased research support from a broad range of agencies, although we recognize that it is likely to be some years before the committee's recommendations would be fully implemented. But still, we are pleased that our pioneering work in this emerging and critical scientific discipline is being recognized by a growing number of individuals and institutions that can, in very real terms, help make or break our future successes.

and other Organic Wastewater Contaminents in Water Resources: Recent Research Activities of the U.S. Geological Survey's Toxic Substances Hydrology Program

By Michael J Focazio, Dana W Kolpin, and Herb Buxton

Recent decades have brought increasing concerns for potential contamination of water resources that could inadvertently result during production, use, and disposal of the numerous chemicals offering improvements in industry, agriculture, medical treatment, and even common household products. Increasing knowledge of the environmental occurrence or toxicological behavior of these contaminants from various studies in Europe, United States, and elsewhere has resulted in increased concern for potential adverse environmental and human health effects (Daughton and Ternes, 1999). Ecologists and public health experts often have incomplete understandings of the toxicological significance of many of these contaminants, particularly long-term, low-level exposure and when they occur in mixtures with other contaminants (Daughton and Ternes, 1999; Kümmerer, 2001). In addition, these 'emerging contaminants' are not typically monitored or assessed in ambient water resources. The need to understand the processes controlling the transport and fate of these contaminants in the environment, and the lack of knowledge of the significance of long-term exposures have increased the need to study environmental occurrence down to trace (nanogram per liter) levels. Furthermore, the possibility that mixtures of environmental contaminants may interact synergistically or antagonistically has increased the need to characterize the types of mixtures that are found in our waters. The U.S. Geological Survey's Toxic Substances Hydrology Program (Toxics Program) is developing information and tools on emerging water-quality issues that will be used to design and improve water-quality monitoring and assessment programs of the USGS and others, and for proactive decision-making by industry, regulators, the research community, and the public (http://toxics.usgs.gov/regional/emc.html). This research on emerging water-quality issues includes a combination

of laboratory work to develop new analytical capabilities as well as field work on the occurrence, fate, and effects of these contaminants.

LABORATORY WORK

Analytical Method Research and Development

Since 1998, the Toxics Program has been developing analytical capabilities to measure pharmaceuticals, personal care products, hormones, and other naturally occurring and synthetic organic wastewater compounds (collectively referred to as OWCs) in a variety of environmental matrices (water, sediment, tissue). Without reliable and accurate analytical methods the corresponding field research would be impossible. Currently, more than 140 OWCs can be measured by the U.S. Geological Survey using a variety of liquid and gas chromatographic techniques (e.g. Brown et al., 1999; Barber, et al., 2000; Meyer et al., 2000, Lindsey et al., 2001, Zaugg et al., 2002). Analytical methods are being developed and improved for whole water, filtered water, and bed sediment samples. These methods are capable of detecting OWCs at sub part-per billion levels in a wide range of natural and anthropogenically impacted waters of variable chemistry and quality. To date, these analytical methods have provided the necessary tools to support field investigations on the occurrence of OWCs in the environment and have begun to support new research projects focused on fate, transport, and effects.

FIELD WORK

National Reconnaissance Surveys

To date, over 500 environmental samples have been collected for the Toxics Program and analyzed for OWCs, representing a broad range of climatic and hydrogeologic conditions. Initial and continuing research has focused on broad reconnaissance surveys of streams, aquifers, and sources of drinking water to determine if these emerging contaminants are entering the Nation's water resources and if so, at what concentrations and combinations. The surveys are not representative of all water resources in the United States, but do provide the first information on the occurrence of a large range of OWCs in the Nation's water resources. This work helps researchers develop hypotheses on the sources, fate and transport of OWCs in the environment.

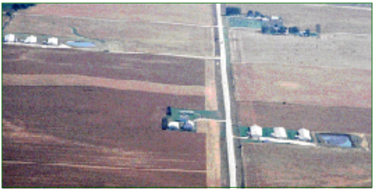

Figure 1. Potential sources of organic wastewater compounds include animal agriculture and wastewater treatment plants.

The first reconnaissance survey completed consisted of a network of 139 streams across 30 states sampled during 1999 and 2000 (Barnes et al., 2002; Buxton and Kolpin, 2002; Kolpin et al., 2002a; Kolpin et al., 2002b). By design, most streams sampled were known or suspected to be susceptible to sources of human, animal or industrial wastewater (Fig. 1). Results showed that a broad range of chemicals found commonly occurs in mixtures at low concentrations downstream from areas of intense urbanization and animal production. One or more of the 95 chemicals analyzed were found in generally low concentrations in 80 percent of the streams sampled. Half of the streams contained 7 or more of these chemicals, and about one-third of the streams contained 10 or more of these chemicals. Some of the most frequently detected compounds (Fig. 2 on next page)

DETECTION FREQUENCY, IN PERCENT

downgradient from, or near landfills, unsewered

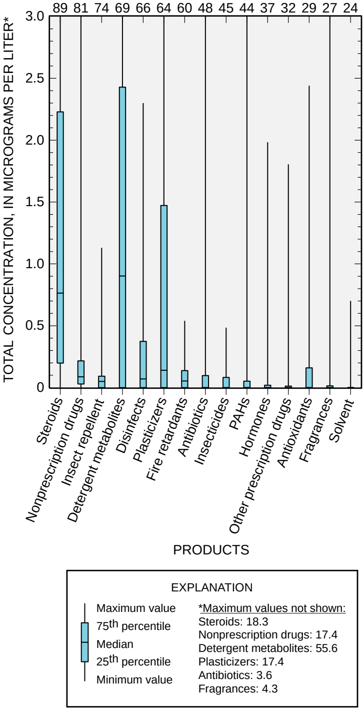

Figure 2. This histogram graph shows the percentage of chemical compounds contained in various products.

included cholesterol (naturally occurring plant and animal steroid), DEET (an insect repellent), caffeine (non-prescription drug), triclosan (antimicrobial disinfectant), and tri (2-chloroethyl) phosphate (fire retardant). Two additional reconnaissance surveys have also been conducted. In 2000, a network of 47 ground-water sites suspected to be susceptible to contamination (e.g. residential developments, animal feedlots, etc.) across 18 states was sampled and measured for OWCs (Barnes et al., 2003). In 2001, a network of 76 drinking-water sources (51 surface-water sources and 25 ground-water sources) across 25 states and Puerto Rico was sampled and measured for OWCs (Focazio et al., 2003). All samples for this survey were collected prior to any water treatment practices (e.g. river intakes and raw-water sampling ports). This survey of drinking-water sources was conducted in collaboration with the U.S. Environmental Protection Agency and with assistance from the American Water Resources Association. The results of these two additional reconnaissance surveys are currently being examined and interpreted.

Sources, Fate, and Transport

Subsequent and planned research is focused on potential sources of OWCs (e.g. animal feeding operations, fish hatcheries, wastewater treatment plants, etc.) and their fate and transport through the hydrologic system (Campagnolo et al., 2002; Cordy et al., 2002; Patterson et al., 2001; Thurman et al., 2002). Current research includes the collection of both streamwater and bed sediment samples to provide a more complete understanding of the occurrence of OWCs and their partitioning in the environment.

CONCLUSION

Research conducted by the USGS Toxic Substances Hydrology Program addresses emerging water-quality issues associated with environmental occurrence of pharmaceuticals, hormones, personal care products, and other naturally occurring and synthetic organic wastewater compounds. This research provides new insights on the extent to which chemicals used every day in households, industry and agriculture are entering and being transported in our water resources. These studies are among the first to address these issues and therefore provide unique data and information for other scientists as well as decision makers in the public and environmental health communities. For more information go to http://toxics.usgs.gov

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U.S. GEOLOGICAL SURVEY NEWS

Mendenhall Postdoc Program Supports GeoHealth Science

By Christina Kellogg

Since its inception in 2001, the Mendenhall postdoctoral program has been an avenue for bringing young scientists with new talents and skills into the Geologic Discipline of the USGS. Named in honor of Walter Mendenhall, the fifth Director of the USGS, this program is now moving into its fourth year.

Three of the first year Mendenhall Fellows, Thomas L. Ziegler (Denver), Christina A. Kellogg (St. Petersburg) and Joseph E. Bunnell (Reston) gave talks during the recent USGS Conference 'Natural Science and Public Health—Prescription for a Better Environment'. The meeting, which focused on the intersection of environmental research and human health, an important venue to highlight the significance of their research.

While all three work in the Geologic Discipline, not one is a geologist! Thomas is a toxicologist by training, Chris is a molecular microbiologist, and Joe is a public health biologist. They all play a significant role in linking geoscience with other disciplines.

Joe presented his research first, titled 'Environmental Predictors for Tick-borne Disease Risk in the Middle Atlantic Region, USA'. Lyme disease, the most common vector-borne disease in the U.S., and ehrlichiosis, an emerging deadly disease, are both bacterial infections that are spread by ticks. In an effort to better quantify the risk factors associated with certain areas, a spatial statistical model incorporating factors such as elevation, soil type and features (texture, water-holding capacity), land cover, and proximity to forests or water bodies, was used to predict areas most supportive to tick populations. The predictions from this model can help target more effective intervention actions and hopefully reduce the number of cases of tick-borne disease.

Chris discussed the long-distance transport of microbes in dust from the Sahara/Sahel region of African in her presentation titled 'Out of Africa: Characterization of Microbial Communities Associated with Desert Dust and Their Implications for Human and Ecosystem Health'. Each year, millions of tons of desert soil dust blow off the west African coast and ride the trade winds

In addition to the 20 minute talks given during the conference, both of the 'out-of-towners' gave hour-long lectures about their Mendenhall research in the USGS Visitors Center; Thomas spoke the Monday before the conference, and Chris followed on the Friday after. For more information on the Mendenhall program, including profiles of the Fellows and their research projects, please visit the web site: http://geology.usgs.gov/postdoc/ or contact Rama Kotra (rkotra@usgs.gov).

GEOHEALTH IN THE MEDIA

across the Atlantic Ocean, routinely impacting the Caribbean and southeastern United States. This dust has been shown to carry living microorganisms, including a wide variety of bacteria and fungi, some of which are capable of causing disease in plants, animals, and humans with weakened immune systems. It is important to characterize and quantify these airborne microbes to assess what effects they may have on downwind ecosystems.

Asbestos is a general term for a group of fibrous silicate minerals used in many construction materials due to their fire-resistant nature. Asbestos can be divided into two mineral groups, serpentine and amphibole, based on the crystalline structure. Serpentines have a sheet or layered structure, while amphiboles have a chain-like structure. In spite of its many applications, usage has declined due to links between asbestos and diseases including lung cancer. In his talk titled, 'Mineralogical, Geochemical, and Toxicological Variations of Asbestos Toxicological Standards and Amphibole Samples from Libby, MT,' Thomas described how asbestos standards are not as uniform as one would expect. In fact, the chemical analyses of a series of asbestos standards (amosites, anthophyllites, chrysotiles, crocidolites and tremolites) indicated that elemental content varied within standards of the same mineral. Furthermore, each asbestos mineral, even those labeled as the same mineral, has its own profile of accessory minerals which may play a role in the wide range of toxicity seen in the cell line toxicity data presented and possibly explain some of the conflicting reports for asbestos toxicity found in the literature. In addition, toxicity data was presented for the Libby, MT amphibole that was revealed to be significantly more toxic than the asbestos standards in comparison.

Studies conflict on danger in mercury-laden fish

November 28, 2002

Lead Paragraph - Two studies have yielded contradictory findings about the possible heart dangers of eating mercury-laden fish. The studies, reported in today's New England Journal of Medicine, looked at the long-term effects of mercury exposure on the hearts of middle-aged and elderly men. Click here to view the article.

Tap water poses risks, study says; The report on 19 California cities, including L.A., urges more treatment.

By Miguel Bustillo, Oct 30, 2002

Abstract: Though many urban residents can drink tap water without serious threats to their health, the study concluded that some contaminants still pose a risk, especially to infants, pregnant women, and people with AIDS or other immune system deficiencies. In Fresno, the study found, the risk may be substantial. The study concluded that pollution from farm and industrial sources was a health concern. Click here to view the complete article.

THE WORLD; Safety rules scarce in China's factories; Asia: New protections will soon take effect for workers, thousands of whom are killed or maimed annually. The injured often cannot support themselves.

By Martin Fackler, Sep 15, 2002

Abstract: Misreporting and cover-ups by local officials mean that the real death toll from accidents is probably much higher than reported figures, [Xu Deshu] said. He said the report also fails to include deaths from work-related diseases such as lung illnesses from inhaling industrial chemicals or coal dust. She said the factory, a Chinese-Japanese joint venture in the city of Longhua in Guangdong. Click here to view the complete article.

Dirty water tied to Alaska quake

the West Nile virus. He said he also has been testing other animals, such as lions, for presence of the disease to develop a baseline of infection among the animals. Click here to view the complete article.

Udall: Clean up coal-bed water restrictions sought for methane wells

By Mike Soraghan, December 20, 2002

WASHINGTON - Coal-bed methane is a dynamic new source of natural gas for the country and a new source of wealth for the Rocky Mountain West. But environmentalists say that producing it can imperil one of the West's most precious resources: water. Earlier this year, a federal judge in Montana surprised even those in the industry when he ruled that the waste water pumped out of the ground with the gas is not regulated under the

By Ted Gregory, Nov 8, 2002

Abstract: The Alaska earthquake, which occurred about 4:12 p.m. CST on Sunday, sent seismic waves that shook underground wells as far south as Louisiana, which also reported dirty well water, said Ed Mehnert, head of the groundwater geology section of the Illinois State Geological Survey in Champaign. Click here to view the complete article.

New crackdown targets mercury's stubborn legacy; Multipurpose, lethal metal still pervades the nation's streams, seafood and autos

Stevenson Swanson, Oct 28, 2002

Abstract: Auto recyclers in some areas, such as New York's Westchester County, are required to remove the mercury switches before cars are crushed. Great Lakes United and other environmental groups favor Maine's new technique. In April, Maine enacted the nation's first law requiring automobile manufacturers to invest in efforts to remove mercury switches from old cars and take back the mercury. Click here to view the complete article.

Virus spreads to new animals; West Nile kills dog, 3 squirrels

By Lisa Black and Karen Mellen, Sep 18, 2002

Abstract: Dominic Travis, veterinary epidemiologist at the Lincoln Park Zoo in Chicago, said he has been testing sick and dead animals there, but as of Tuesday none had

federal Clean Water Act. Click here to view the complete article.

ON THE BRIGHT SIDE

Kentucky streams fouled coal sludge make a comeback, fish populations recover from spill

By Roger Alford, December 8, 2002

Lead Paragraph - Wildlife experts are finding fish and frogs in the eastern Kentucky streams where all aquatic life was annihilated two years ago by a deluge of smothering coal sludge. Kevin Frey, a biologist with the Kentucky Department of Fish and Wildlife Resources, said the return of some fish and other creatures indicates that the streams have begun healing themselves. Minnows, darters, suckers and catfish that have been netted in Coldwater and Wolf creeks swam in from other streams, and. Click here to view the complete article.

Coal studied as source of gas

By Roger Alford, Jan 5, 2003

Abstract: The cost of producing the fuels from coal is nearly twice that of crude oil using current technologies. [Gerald Huffman] said fuels derived from coal would burn with up to 90 percent less emissions than the same fuels refined from crude oil. Click here to view the complete article.

EPA says WTC air harmless for most

Lukas I Alpert, Dec 28, 2002

Abstract: Some lower Manhattan residents have criticized the EPA's response to their health worries about the smoke and dust that blanketed much of the area after the towers were destroyed. The main firefighters union has said the city failed to provide firefighters enough respirators, leading to high rates of illness. Click here to view the complete article.

Colorado to probe underground fire; Work aims to cool source of coal seam blaze

By David Frey September 22, 2002

IN THE NEXT ISSUE...

Coccidioidomycosis (valley fever) is a public health issue of increasing importance in the deserts of southwestern USA and northern Mexico, as well as parts of Central and South America. The microscopic fungi that cause the disease can be easily mobilized by soil disturbance and dispersed by wind. If a susceptible human inhales the airborne fungi, a severe and possibly fatal respiratory disease may ensue. Find out what USGS scientists are learning about this disease system and ho such knowledge might lead to mitigating valley fever's adverse impact.

GLENWOOD SPRINGS - State officials want to investigate the underground blaze that sparked this summer's Coal Seam fire to see if the flames - burning for nearly a century - can be cooled or put out. Division of Minerals and Geology representatives plan to meet with interested contractors Tuesday to discuss a project to drill a dozen holes into the ridge in South Canyon, five miles west of Glenwood, to see how big and hot the underground fire is. Click here to view the complete article.

Image Courtesy of C. Hald
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ASK THE DOCTOR...

Q: Dear Dr Pat Hologist,
What is GeoHealth?
~ Curious in Texas

A: Dear Curious,

GeoHealth is the scientific discipline that examines the impacts of geologic materials and processes on human and ecosystem health, includes both natural and anthropogenic sources of potential health problems, and implies that wildlife and plant diseases are not excluded.

Many people attach great importance to

The editors of this newsletter welcome:

- Suggestions on what to include in future newsletters
- Suggestions on the newsletter format.
- Email addresses of USGS people who may be interested in receiving copies of the newsletter (Note: subscribers will receive email notification of future editions of the newsletter that will be posted on a USGS website).
- Contributions toward upcoming events or U.S. Geological Survey News (The editors of this GeoHealth newsletter value any input through their readers. Please don't hesitate to contact us at any time and thank you for your replies.)

names. For most of us our name is the only thing that we carry with us from the day we are born to the day we die and beyond. Ideally for a scientific discipline the name defines who they are, what they do, and how they relate to other disciplines. Yes, a name is important; nevertheless, we should not get hung up over terminology. Whether we refer to our activities as GeoHealth, Geoscience and Public Health, Medical Geology, Epidemioecology, Medical Geography, Medical Ecology, Clinical Ecology, Environmental Medical Epidemiology, Geomedicine, Geoepidemiology, Geology and Health, Geology, Environment and Health, Medical Geography, Pathoecology or Hydrobiogeochemoepidemiopathoecology, we are all trying to accomplish the same thing. And that is to apply our scientific skills, tools, databases, etc. to helping the public health community solve a wide range of environmental health problems.

We will probably be wrestling with terminology for some time before we settle on a label, but rest assured, we are not the only ones struggling with this issue. An editorial will be appearing shortly in Environmental Health Perspectives describes the birth pains of new multidisciplinary fields such as Conservation Medicine, Medical Geology, Ecological Medicine, and others. The editorial concludes that "The name game will continue, but, … what really matters to those nurturing the field is that all the affected professions should work together."

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For questions, contributions, or suggestions regarding any part of this newsletter, please contact:

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For more information related to the topic of GeoHealth, go to http://energy.er.usgs.gov and select the "Medical Geology" logo link.

* The best ideas submitted will win a special GeoHealth prize!*