USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Use of Specific Sorbents and Rapid Bioassays for Groundwater Monitoring

Duration: 9/1/97-8/31/98

Federal funds requested: $32,705

Non-federal funds: $65,425

Principal investigator: John M. Harkin Professor, University of Wisconsin-Madison
Inter-Institutional Agreement: Ronald L. Cmnkilton, Associate Professor, University of Wisconsin Stevens Point, WI

Congressional District: 2

Statement of critical need:

Groundwater contamination by pesticides and other organic compounds is a widespread problem in rural midwestern states, especially in areas of intensive agriculture and shallow or sandy soils. Detection of groundwater pollution using analytical methods is well documented, but its effects are not well known. To assess the acceptability of well water for human consumption, scientists usually analyze samples for chemicals such as hydrocarbons and fertilizer and pesticide residues and review toxicity-testi ng information--mostly on laboratory rodent species--to estimate aggregate risks. This approach is slow, expensive and unable to account for additive, offsetting, synergistic or antagonistic effects of mixtures of trace chemicals commonly encountered in d rinking water. This problem is compounded by the fact that most contaminants exist in groundwater at concentrations below those detectable by inexpensive analytical methods. Analytical scans with state-of-the-art instrumentation needed for low-level analy sis are cost-prohibitive for the typical groundwater user. There is a need to employ new cost-effective assessment tools that directly measure potential health effects of ambient levels of contaminants in groundwater. This approach has been successfully a pplied to detect toxins found in surface water and written into permit-compliance monitoring protocols in many states. Biomonitoring or toxicity testing is an established screening tool that can be used directly to assess the outcome of complex contaminan t interactions in water samples, but this approach has yet to be applied in a systematic manner to the identification of potential hazards from exposure to groundwater pollution. Measurements of toxicity are not intended to replace chemical quantification methods. However, they can make better use of analytical time by screening samples for biological effects and using that information to prioritize samples for more expensive chemical testing.

Statement of results and benefits:

Contaminant sorbents e.g. semipermeable membrane devices (SPMDs), C^{18} reverse-phase Sep-pak solid-phase extraction cartridges, and copper phthalocyanine trisulfonate covalently linked to cellulose or blue rayon] will be deployed at known co ntaminated groundwater sites, using traps immersed in existing monitoring wells. After sufficient time to accrue contaminants, the sorbents will be removed, and the sorbates extracted, concentrated and analyzed for toxicity using variants of submitochrond rial (SMP) and bacterial photoluminescence Microtox bioassays. Chemical analyses will be performed only on particularly toxic samples or to supplement existing water quality data from monitoring wells.

Primary beneficiaries of this research will be farming families and populations of small rural communities--the people most directly affected by groundwater tainted by toxic residues of agricultural chemicals, the solvents used in their formulation, an d petroleum-based fuels. These people have no quick and inexpensive means for testing their water supplies to ensure safe potability. Most present-day tests examine samples for only one compound or class of compounds at a time, and are costly and time-con suming. It is often weeks before analytical results become available, and these reveal only one-time snapshots of the water quality and, while bioassay results of toxicant mixtures collected long-term on selective sorbents provide estimates of aggregate t oxicity. Regulators and consulting engineering companies performing site evaluations would similarly benefit, as these techniques promise to provide an excellent screening tool for prioritizing samples or sites for more extensive and costly chemical analy sis.