Plutonium Clusters Offer Insight

Plutonium contamination in groundwater might become easier to model and remediate thanks to a breakthrough discovery at Argonne National Laboratory.

Plutonium tends to spread further than models predict, contaminating more groundwater and increasing the possibility of sickness in both humans and animals. These models have been based on single plutonium ions with a positive charge, which do not spread very far in groundwater because they are attracted to negative charges in substances such as plants and minerals.

However, plutonium can actually form into nanometer-sized clusters of plutonium oxide that behave very differently from single ions. Scientists at Argonne National Laboratory and the University of Notre Dame used high-energy X-rays to isolate the nanoclusters from groundwater and study their structure.

It turns out the nanoclusters consist of 38 plutonium atoms and have no charge. Because of this, their progression in groundwater is not slowed by attraction to other substances, allowing contamination to spread without inhibition.

This discovery will allow models to better account for the extent of plutonium contamination. In addition, scientists can direct their focus on how to break up the nanoclusters to improve the groundwater remediation process.

The properties of a few clusters with different numbers of plutonium atoms will also be the subject of more research.

Visit www.anl.gov.

Peripheral Canal Gains Support

Building a peripheral canal to carry water around the Sacramento-San Joaquin Delta is the most promising strategy to solve the ongoing debate about how to save the delta ecosystem while still supplying water for California's residents, concluded a July report by the Public Policy Institute of California.

Under current policy, water is drawn from the Sacramento River and sent south through the delta to enormous pumps that deliver water to millions of households in the Bay Area and Southern California as well as millions of acres of Central Valley farmland. This approach has threatened native fish and made the delta attractive to invasive species. Projected sea level rise, dilapidated levees, larger floods, and high earthquake potential threaten to dramatically change the delta environment, the report says.

Although the best strategy for fish populations would be for California to stop using the delta as a water source altogether, this would be extremely costly. A peripheral canal is the least expensive option and can be coupled with investment in the delta ecosystem. The report recommends allowing some delta islands to flood permanently for aquatic habitat while protecting high-value land, transitioning to a new management system as soon as possible, and developing a new framework with the proper safeguards for governing and regulating the delta.

California Department of Water Resources Director Lester Snow responded to the report, saying it "underscores the need for a long-term solution to fixing our water crisis in the delta."

Visit www.ppic.org/main/pressrelease.asp?p=859 and www.water.ca.gov/news/newsreleases/2008/071708responseppic.doc.

Is Carbon-Capture the New Delta Crop?

California scientists envision a future for the Sacramento-San Joaquin River Delta based on carbon-capture farming, a process developed to sequester carbon, reverse subsidence, and create economic benefits. The California Department of Water Resources (DWR) has awarded the U.S. Geological Survey and the University of California, Davis a three-year, $12.3 million research grant to study carbon-capture farming at a large scale.

Long-standing farming practices in the delta expose fragile peat soils to wind, rain, and cultivation; emit carbon dioxide; and cause land subsidence. Most of the farmed delta islands are more than 20 feet below the surrounding waterways and are permanently protected by levees. Water flowing through the delta's levee system provides fresh water to millions of people and millions of acres of farmland, but continuing subsidence threatens the system.

Carbon-capture farming involves growing wetlands-type plants such as tules (a type of sedge) and cattails that remove carbon dioxide from the air. As the plants die and decompose, they create new peat soil, building the land surface over time. This could ease pressure on the levees and provide economic potential through developing carbon markets.

USGS and DWR have already partnered on a carbon-capture farming pilot project on deeply subsided Twitchell Island in the western delta. USGS scientists recorded elevation gains of more than 10 inches from 1997 to 2005 on two seven-acre test plots. Additional scientific work is necessary to learn how to maximize growth rates, verify greenhouse gas benefits over several years, and minimize any potential adverse environmental impacts. Construction of an expanded wetlands covering 400 acres on Twitchell Island is scheduled to start in spring 2009.

Visit ca.water.usgs.gov/news/ReleaseJuly23_2008.html.

Woody Plants Dissociated From Streamflow Decline

For the first time, researchers have demonstrated a hydrologic response to degradation and recovery of rangeland at a watershed scale. Texas A&M University and Texas AgriLIFE researchers reported in the July 2008 issue of *Global Change*

Biology that streamflow declines in the Concho River watershed in Texas result from rangeland recovery, not interception of would-be baseflow by woody plants as commonly thought.

The Concho rangeland began as prairie savanna, but heavy grazing from the 1870s to the 1950s transformed it to degraded grassland encroached by woody plants. Since 1960, vegetative cover—both woody and herbaceous—has increased. The researchers found that stormflows from 1960 to 2005 in the Concho watershed decreased significantly, particularly in the North Concho watershed, without any corresponding decrease in precipitation. In contrast, baseflow for all the watersheds remained essentially consistent or increased slightly in the same time period.

The authors concluded that higher levels of evapotranspiration from woody plants are not causing the drop in stormflow, because that effect would be reflected by a significant drop in baseflow as well. They attribute the stormflow decline to increased soil infiltration due to greater vegetation cover that slows overland flow. The researchers believe that in contrast to the common belief that woody plants contribute to hydrological degradation, they have actually been part of the recovery process. Accordingly, they suggest that large-scale shrub clearing will not lead to significant increases in streamflow in many semi-arid rangelands.

See Wilcox, B.P., Y. Huang, and J.W. Walker, 2008. Long-term trends in streamflow from semiarid rangelands: Uncovering drivers of change, Global Change Biology, 14: 1676–1689, doi: 10.1111/j.1365-2486.2008.01578.x

Dams Favor Non-Native Fish, Hurt Natives

Damming of the Colorado River and introduction of game fish species has caused an extensive decline in native fish numbers, researchers reported in *Science Daily* in July. Physical changes to the river impair survival of native fish, but not introduced fish, because of their differing life histories.

Alice Gibb of Northern Arizona University and her colleagues studied the early life of both native and non-native fish species in the laboratory. Native fish are less developed when they hatch compared to non-native fish, and as a result of the lack of adult swimming appendages, they have a poorer escape response to predators. Native species on the Colorado include razorback sucker, humpback and roundtail chub, bonytail chub, and pikeminnow.

Before the development of dams on the river, the native larvae were much better equipped for survival. Suspended sediment provided refuge from predators, turbulence made encountering plankton fairly easy, and warmer water allowed rapid growth. Dams have taken away these favorable conditions, replacing them with still, cold-water lakes.

Gibb suggested removing not only introduced predators, but the dams themselves to recreate the "high-flow, sediment-rich, warm waters that gave the Colorado its name," she reported to *Science Daily*. She adds that recent research in Texas and the Pacific Northwest indicates that sediment might favor native fish in those areas as well.

See River Damming Leads to Dramatic Decline in Native Fish Numbers, www.sciencedaily.com/releases/2008/07/080709204836.htm.

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Location: Phoenix—**Senior Hydrogeologist**/Freeport-McMoRan Copper & Gold Freeport-McMoRan Copper & Gold Inc. (FCX) is a leading international mining company with headquarters in Phoenix, Arizona. The FCX Land & Water Department, which provides hydrogeologic services to Freeport sites worldwide, currently has two openings for Senior Hydrogeologists. The positions will provide project management services for various types of water resource development and water rights projects at operations worldwide. To view a detailed job description, visit the FCX website at http://www.fcx.com/careers/professional.htm; Job Number 0800891.