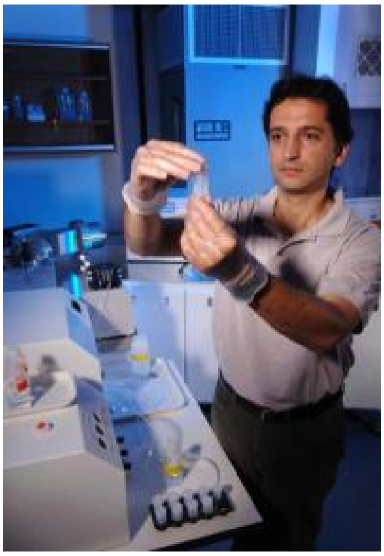
At an underwater volcano, evidence of man’s environmental impact



On July 21, 2006, George Kamenov, a geology faculty member at the University of Florida, holds a small sample of a solution containing sediment collected from hydrothermal vents in the ocean depths. Kamenov is among a team of geologists that is the first to observe “anthropogenic influence” in these deep underwater geysers. Examining deposits retrieved from a hydrothermal site in the Mediterranean near Italy, they discovered lead that did not come from the underlying rocks -- nor from any possible natural source in the nearby region or anywhere in Europe. Instead, they traced the pollutant to an Australian lead mine thousands of miles away. It was imported to Europe, added to gasoline, burned by cars and emitted into the air, later finding its way into the ocean and the hydrothermal vent. (Kristen Bartlett/University of Florida)

Scientists studying hydrothermal vents, those underwater geysers that are home to bizarre geological structures and unique marine species, have discovered something all too familiar: pollution.

A University of Florida geologist is among a team of geologists that is the first to observe “anthropogenic influence” in hydrothermal deposits, according to an article in the June issue of the journal *Marine Geology* . Examining deposits retrieved from the site of an underwater volcano near Italy, they discovered lead that did not come from the underlying rocks or from any possible natural source in the nearby region or anywhere in Europe.

Instead, they traced the lead to an Australian lead mine thousands of miles away.

“I guess we can speculate that this is yet another piece of evidence of how widespread our disturbance in the environment is: the fact that we can influence natural hydrothermal systems,” said George Kamenov, a faculty member at the UF geological sciences department.

Hydrothermal vents form when seawater seeps through cracks in the deep ocean floor, gets heated by magma, or molten rock, then streams upward back into the sea. The vents have aroused a great deal of scientific interest since they were discovered in 1977, in part because of their remarkable appearance but mainly because they host unusual creatures and offer natural laboratories to study the formation of metal ores. Some have tall and elaborate “chimneys” formed from minerals disbursed by the hot water as it leaves the ocean floor. “Black smokers,” the hottest hydrothermal vents, spew dark-looking iron and sulfide particles as they shoot up through seawater. Found throughout the world’s oceans, many vents even harbor eyeless shrimp, giant clams and other fauna rarely seen elsewhere.

Most of these underwater geysers lie far from land thousands of feet below the ocean surface. In the research that led to the Marine Geology paper, the geologists discovered hydrothermal activity in a relatively shallow site — an underwater volcano called the Marsili Seamount in the Mediterranean, less than 200 miles off the west coast of Italy. The sediment was retrieved at a depth of 1,640 feet in the late 1980s by a Russian deep-water submarine.

Kamenov said that heated seawater in hydrothermal vents naturally extracts metals from volcanic rocks as it flows beneath the ocean surface. So vent sediment is usually loaded with iron, lead, zinc, copper and other metals. Indeed, hydrothermal venting on the bottom of ancient sea beds is the way some of the world's largest on-land metal deposits were formed.

However, when he and his colleagues used a state-of-the-art scientific instrument called Multi-Collector Inductively Coupled Plasma Mass Spectrometer to precisely measure the abundances of the four lead isotopes from the Marsili Seamount, they discovered that the ratios did not match any lead found nearby — or even anywhere else in Europe. The isotope ratios of lead extracted from different parts of the world are well known to geologists, which is how the researchers made the comparison.

"It's essentially the way you work with DNA," Kamenov said. "You take DNA from a hair, then you want to compare it to a known DNA set to see where it came from. In a similar way we can use the lead isotopes".

The researchers discovered that the Marsili Seamount lead was similar to lead mined from one of the largest lead mines in the world at Broken Hill, the "capital of the outback" in New South Wales, Australia.

How did it get to near Sicily? Kamenov said the most likely scenario is that the lead was mined at Broken Hill and shipped to Europe, where it was added to gasoline, burned by cars and emitted into the air. From there, the lead found its way into the sea, and then to the Marsili Seamount, where it traveled with water down into the earth and then re-emerged via the hydrothermal vents. The researchers were likely able to detect it because the seamount's relatively low-temperature hydrothermal solutions were not powerful enough to dissolve a lot of native lead from the underlying volcanic rocks.

Pollution from lead originating in Australia is a well-known fact in Europe, but this is the first time anyone has seen it in a hydrothermal formation, Kamenov said.

"The story is sort of 'nothing gets lost,' Kamenov said. "The lead was once hydrothermally precipitated in Australia millions of years ago, then people extracted it, released it into the environment, and then the same lead became recycled in a recent hydrothermal system and ended up again in a hydrothermal deposit."

The research highlights the growing power of using high-precision isotopic measurements as a tracing tool, Kamenov said. UF's Inductively Coupled Plasma Mass Spectrometry lab was established in 2005 with support from the National Science Foundation.

Source: University of Florida