

Undersea Vehicles Study Precious Metals Deposits On Pacific Ocean Floor

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An international team of scientists will explore the seafloor near Papua New Guinea in the western Pacific Ocean later this month with remotely operated and autonomous underwater vehicles, investigating active and inactive hydrothermal vents and the formation of mineral deposits containing copper, gold and other commercially valuable minerals.

The cruise is a joint expedition between Woods Hole Oceanographic Institution (WHOI) and Nautilus Minerals of Vancouver, British Columbia, a mining exploration company that holds exploration leases in the Bismarck Sea within the territorial waters of Papua New Guinea.

Nautilus is the first firm to commercially explore the ocean floor for economically viable massive sulfide deposits, and is interested in understanding the size and mineral content of the seafloor massive sulfide systems.

The joint expedition includes a 32-day WHOI research program funded by the U.S. National Science Foundation to the Pacmanus vent sites in the Eastern Manus Basin. The remotely operated vehicle Jason will be used to survey and map the vent areas around an Ocean Drilling Program hole drilled in 2000.

Nautilus will fund an additional 10-day program to explore and sample the Vienna Woods sulfide prospects on the Manus Ridge, northwest of the Pacmanus study area.

Geophysicist Maurice Tivey of WHOI will head the 42-day expedition, which begins July 21 from Rabaul, Papua New Guinea, aboard the research vessel *Melville*, operated by the Scripps Institution of Oceanography. Tivey and geochemists Wolfgang Bach of the University of Bremen (previously at WHOI) and Jeff Seewald and Meg Tivey of WHOI will map, collect samples and take high-resolution images of the seafloor at several locations within the territorial waters of Papua New Guinea. The cruise ends September 1 at Suva, Fiji.

Tivey and his co-investigators are interested in the geochemistry and structure of the seafloor and the formation of mineral deposits along mid-ocean and back-arc ridge systems, where new ocean crust is formed. The team will use the remotely operated vehicle *Jason* and the Autonomous Benthic Explorer (ABE), both developed and operated by WHOI and veterans of many expeditions to hydrothermal vent sites around the world.

Two areas will be explored, one in the Eastern Manus Basin in the Bismarck Sea known as the Pacmanus vent site and the other Vienna Woods, an area of exposed massive sulfide on the Manus Ridge, a small mid-ocean ridge spreading center to the northwest of the Pacmanus site. The Pacmanus site is in 1,700 meters of water (about 4,500 feet), while the Vienna Woods site is in 2,500 meters (about 8,000 feet).

"There are differences in the compositions of host rock at the two areas, as well as differences in the geologic and tectonic settings," Tivey, an associate scientist in the WHOI Geology and Geophysics Department, said. In the Eastern Manus Basin at the Pacmanus vents, the host rocks are felsic or silica-rich compared to the more typical mid-ocean ridge basalt found at the Vienna Woods site, providing a contrast in host rock geochemistry.

"It has been suggested that the difference in the chemistry of the host

rock is reflected in the composition of the sulfide chimneys and deposits, with deposits hosted in the more silica-rich rocks being richer in gold and other precious metals" Tivey said.

"However, there are other factors that can affect vent fluid and sulfide deposit composition. For example, some hydrothermal fluids from back-arc sites appear to have a signature indicative of a magma chamber source, with magmatically-derived fluids possibly affecting the hydrothermal systems."

The research program is designed to determine what factors may be affecting vent deposit chemistry, Tivey said. In addition to sampling the deposits and collecting fresh and altered host rock, the researchers will collect vent fluids using gas-tight samplers to study the possible influence of both magmatic volatiles and host rock composition.

They will also map the seafloor, and below the seafloor using geophysical techniques, to better discern the geologic history and structure of the sites.

Tivey and other scientists and students from WHOI will be joined by colleagues from Towson University, University of South Florida, Bridgewater State College and the U.S. Geological Survey, the University of Bremen in Germany, Seoul University in South Korea, the Commonwealth Scientific and Industrial Research Organization (CSIRO) of Australia, the Geological Survey of Papua New Guinea, the University of Papua New Guinea, and Nautilus Minerals.

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