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The First Collaborative China-International Cruises to Investigate Mid-Ocean Ridge Hydrothermal Vents

(31 August - 5 October 2005 and
23 November 2005 - 6 January 2006)

by

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The first around-the-globe marine geoscience expedition by a modern Chinese research ship was conducted in 2005 and early 2006. The 297-day expedition departed from Qingdao, China in April 2005 and returned to Qingdao in January 2006, traveling more than 40,000 nautical miles in the Pacific, Atlantic, and Indian Oceans. The expedition was organized and funded by the China Ocean Mineral Resources R & D Association (COMRA) and was carried out on its research ship R/V DaYangHiHao (meaning "Ocean #1", see Figure 1). The goal of this around-the-globe expedition was to survey and investigate regions of abundant manganese nodules and cobalt-rich ferromanganese crusts in the western and central Pacific Ocean, as well as to collect samples of hydrothermal deposits and to search for new hydrothermal vents along mid-ocean ridges in the eastern Pacific Ocean, the Atlantic Ocean, and the Indian Ocean. This expedition also coincided with the celebration of China's first expedition to the Indian Ocean 600 years ago, in the Ming Dynasty, led by ocean explorer Zheng He.

R/V DaYangYiHao is a well-maintained modern research ship. It has a weight capacity of 5,600 tons, measures 105 meters in length, and is equipped with a ship dynamic positioning control system and a variety of geophysical, geological, and microbiological instruments. The ship has a cruising speed of 12 knots and a maximum occupancy of 75 persons, including 25 crew members and 50 spaces for shipboard technical support staff and science party.

Out of the six legs in the 2005-2006 around-the-globe expedition, two legs (cruise DY105-17A) were devoted to COMRA's cooperative projects with international institutions. The first was a China-US cooperative leg that took place during 31 August – 5 October 2005 to investigate hydrothermal vents on the East Pacific Rise (EPR). The second was a China-US-Germany cooperative leg that took place during 23 November 2005 - 6 January 2006 to investigate hydrothermal vent processes of the Southwest Indian Ridge and Central Indian Ridge. These two COMRA-international cooperative legs are briefly described in the following sections.

1. East Pacific Rise leg (31 August – 5 October 2005; Acapulco, Mexico, to Kingston, Jamaica)

The EPR leg was a joint cruise between COMRA and the Woods Hole Oceanographic Institution (WHOI). The Chinese Chief Scientist of the cruise was Mr. Shiqin Guo, COMRA's Chief Geologist. The US Chief Scientist of the cruise was Dr. Jian Lin, a senior scientist and a geophysicist at WHOI. Dr. John Chen, InterRidge-China Chair and a professor from Peking University, and Dr. Chuanlun Zhang, a geo-microbiologist from the University of Georgia, also participated in the cruise.

The EPR leg successfully collected samples of hydrothermal deposits near the EPR 13°N region using Chinese built TV-guided grabbers and recovered a well-preserved piece of relic hydrothermal-vent chimney, which has hosted tubeworms and contains valuable macro- and micro-biological records. A significant accomplishment of the leg was the discovery, for the first time, of strong evidence for active water column plumes on the EPR immediately south of the equator. This discovery was made during a comprehensive water column survey program using six MAPR (Miniature Autonomous Plume Recorder) instruments on loan to WHOI from Dr. Ed Baker of NOAA/PMEL. A WHOI built deep-tow magnetometer was also used in the cruise surveys.

After the completion of the EPR leg, the ship sailed through the Panama Canal and arrived in Kingston, Jamaica, where an open house of the ship was held for government officials and the public of Jamaica, as well as for foreign diplomatic delegations based in Jamaica. The ship captain, Mr. Huisheng Lu, and the cruise science party also visited the headquarters of the International Seabed Authority in Kingston, Jamaica, and were warmly received by Mr. Satya Nandan, the Secretary General of the International Seabed Authority and his staff members.

2. Indian Ocean Leg (23 November 2005 – 6 January 2006; Cape Town, South Africa, to Singapore)

The Indian Ocean leg was a China-US-Germany cooperative cruise. Mr. Shiqin Guo of COMRA was the Chinese Chief Scientist, while Dr. Jian Lin of WHOI was the US Chief Scientist. Dr. Erwin Suess and Dr. Sven Petersen of IFM-GEOMAR were the participating German scientists. They led a pioneering program with Dr. Xiqiu Han of the Second Institute of Oceanography in Hangzhou to continuously record methane anomalies in the water columns using the METS instrument.

The Indian Ocean leg conducted comprehensive survey of water columns along the Southwest Indian Ridge (SWIR), which is of ultraslow spreading rate, and the Central Indian Ridge (CIR), which is of intermediate spreading rate. Along the CIR, the cruise surveyed and imaged the Kairei and Edmond hydrothermal vent sites and collected hydrothermal deposit samples. A survey program was also conducted along the CIR between the Kairei and the Edmond hydrothermal vent sites to measure water column anomalies using the MAPR sensors and the METS instrument. Deep-tow magnetometer was also used in the cruise surveys.

Along the Southwest Indian Ridge, the cruise discovered, for the first time, a region of major hydrothermal plume anomalies on a ridge segment west of the Gallieni Fracture Zone. The measured turbidity anomalies by the MAPR instruments were by far the strongest known anomalies along the SWIR. COMRA is currently planning another cooperative cruise returning to the SWIR in February-March 2007 to further investigate hydrothermal vent processes. The planned Feb-March 2007 cruise will use COMRA's new remotely operative vehicle (ROV) and potentially WHOI's autonomous underwater vehicle ABE.

Results of the above COMRA-international cooperative cruises were reported at the mid-ocean ridge special sessions at the July 2006 Western Pacific Geophysical Meeting organized by the American Geophysical Union (AGU) in Beijing, as well as will be presented at AGU's fall annual meeting in December 2006 in San Francisco, California.

Figure 1. China's research ship R/V DaYangYiHao (Ocean #1), which is owned by China Ocean Mineral Resources D & D Association (COMRA). Photo courtesy of Mr. Huisheng Lu, Captain of R/V DaYangYiHao.