

# Proposal

## For the International Cooperative Study on the Seafloor Hydrothermal System at Ultraslow Spreading Southwest Indian Ridge ( SWIR )

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## Abstract

Based on the Endowment Fund of International Seabed Authority (ISA) and the investigation cruises at the ultraslow spreading Southwest Indian Ridge (SWIR) organized by China Ocean Mineral Resources R & D Association (COMRA, China), the international cooperative study on the seafloor hydrothermal system at the ultraslow spreading SWIR will be conducted by using R/V DAYANGYIHAO, China. The cooperative study mainly focuses on the tectonic environment and hydrothermal mineralization of the new found hydrothermal field at SWIR. Based on the cooperative research, a suggestion to approach an international cooperative project of the geological model of hydrothermal activity at ultraslow spreading SWIR will be submitted to ISA within 3 years. Meanwhile, opportunities for participating in the integrated R/V DAYANGYIHAO cruises will be provided to the scientific personnel from the developing countries.

## 1. Nature and objective of the project

### 1.1 Scientific significance

Since the first discovery of “Black Smoker” in Galapagos ridge in 1977, seafloor hydrothermal systems have attracted widespread attention in the field of earth science [1-3]. Hydrothermal circulation facilitates the cycling of energy and mass between the solid Earth and the oceans, which takes great effect on the compositions of the Earth’s lithosphere, ocean and even the global climate change [4].

At present, there are about 168 hydrothermal fields have been found in different tectonic settings, such as the global Mid-Ocean Ridge (MOR), fore-arc and back-arc basins and intraplate volcanoes. About 60% of them are distributed in MOR. As for MOR system, the spreading rate is a crucial parameter that regulating the ridge morphology, oceanic crust structure, mantle composition and seafloor hydrothermal process in great extent [5]. Most of the hydrothermal sites were discovered in MOR in Pacific and Atlantic oceans with fast-, intermediate- or slow- spreading rate. Until recently, the ultraslow spreading ridges have little been studied, although the total length of the ultraslow spreading ridges can account for about 20% of the global MOR [6]. Most of the ultraslow spreading ridges are distributed in the Arctic Ocean and around the Antarctic plate, such as SWIR. In recent years, some hydrothermal anomalies have been detected in ultraslow spreading SWIR. In 2007, the first active hydrothermal site was discovered successfully in SWIR during the DY19 cruise organized by China Ocean Mineral Resources R & D Association (COMRA, China) [6] (Figure 1). It is also the first active hydrothermal field found in ultraslow spreading ridge [7][8]. Six more different types of hydrothermal fields have been found in DY 21 Cruise during Nov 2008 to Mar 2009, which include active and inactive hydrothermal, and a low-temperature carbonate hydrothermal field hosted by basalt. These discoveries provide important opportunities for scientists to understand the characteristics and processes of hydrothermal system in the ultraslow spreading ridge.

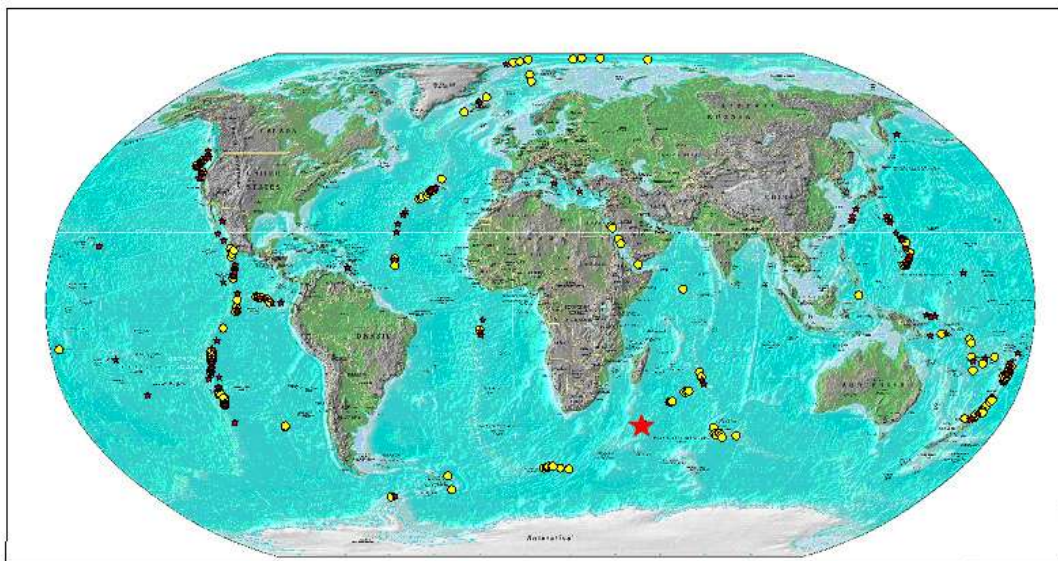


Figure1. Distribution of the hydrothermal fields (data from E T Baker & ISBA).  
The Red star is the location of the newly found vent, SWIR. Stars are the found vents,  
Yellow circles are the found anomonies.

Seafloor hydrothermal systems are integrated and complex geological processes, involving the interdisciplinary communication and promotion, such as marine geology, marine environment and deep-sea biology. It's hard for one country or organization alone to wholly understand the hydrothermal system at the ultraslow spreading SWIR. International cooperative study is necessary and effective for the very beginning of the Geology model study of SWIR.

## 1.2 Program nature

R/V DAYANGYIHAO, belonging to COMRA, is an integrated and advanced investigation ship. Most study of the proposed project will be conducted based on this research vessel. In order to obtain enough data and samples to understanding the morphology, geophysical features and hydrothermal mineralization of the new found hydrothermal field of SWIR, more future cruises will be launched by COMRA. We will sparkplug international cooperative study on hydrothermal system in SWIR with the scientists from the developed countries based on the Endowment Fund of ISA and the COMRA cruise. This study will focus on the tectonic environment and hydrothermal mineralization processes in hydrothermal field, SWIR, which may be

difference from the fast, intermediate, and slow spreading ridges.

Meanwhile, we will provide opportunities for those scientists from the developing countries to participate in the R/V DAYANGYIHAO cruises. Those scientists will be trained focus on the technology of geophysical investigation, geological sampling and analysis.

### **1.3 Objectives**

The principal objectives of this program are as follows:

- ① To collect data of the geology, geophysics, marine environment and hydrothermal biology in the new found hydrothermal field, SWIR.
- ② To research the tectonic environments and hydrothermal mineralization in this field.
- ③ To hold an international capacity building workshop as to prepare an international cooperative project to ISA on the geological model of the ultraslow spreading hydrothermal system in SWIR.
- ④ To train two scientists from other developing countries.

### **1.4 Expected results**

Based on the cooperative study and the training course, the results will be expected as follows:

- ① To submit a report on the possibility and methods of establishing a geological model of hydrothermal system in the ultraslow spreading SWIR.
- ② To train two scientists from other developing countries.
- ③ To hold an international capacity building workshop as to prepare an international cooperative project of the geological model on seafloor hydrothermal system in ultraslow spreading ridges.

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## 2. Cooperative mode and methods

### 2.1 Cooperative research mode

- ① To invite 1-2 marine scientists per year from USA, Russia or other countries to participate in R/V DAYANGYIHAO cruise and cooperative study on the hydrothermal system in SWIR.
- ② The ocean cruises aimed to the hydrothermal activity investigation in SWIR are organized by COMRA, including the cruise schedule, the arrangement, expenses of R/V DAYANGYIHAO and the relevant investigation equipments.
- ③ To hold an international capacity building workshop about the study of the ultraslow spreading SWIR.
- ④ The Endowment Fund is responsible for the costs of the international cooperation, such as international traveling, allowances, training, necessary samples analysis and international capacity building workshop.

### 2.2 Methodology

- ① Using the geophysical equipments, such as Multibeam system, Gravimeter, Magnetometer and acoustic sounding system, to collect the relevant data. It will help us to understand the morphology, fault and magma supply characteristics of hydrothermal sulfide deposit.
- ② The hydrothermal samples including sulfide, rock, and biology will be obtained by TV-Grab during the cruise. By means of the mineralogical and geochemical analysis, we will discuss the mass source of hydrothermal sulfides, the hydrothermal process and mineralization, and understand the relationship between hydrothermal activity and tectonic environment at SWIR.

### 2.3 International Training

- ① **Candidates Selection:** One or two scientific persons from the developing countries are selected, which is funded by the Endowment Fund, such as Mauritius, Ecuador, North Africa, India, Pakistan, Indonesia and Brazil. The

persons who are selected will participate the China deep-sea cruise aimed to the seafloor hydrothermal activity at SWIR, organized by COMAR. The list of the scientific candidates from the developing countries will be determined after the selection procedure organized by ISA and COMAR.

- ② **Training Mode:** The training courses are mainly conducted in R/V DAYANGYIHAO. The DY 21 Cruise will be hold in 2009-2010 and the location and timetable of the training courses will be determined based on the arrangement of the DY 21 Cruise.
- ③ **Training Course:** The training courses include two aspects. Firstly, the operation and use of the deep-sea investigation equipments like Deep-sea Camera Shooting, Multi-Beam, Shallow Stratum Profile Instrument, TV-Grab, MARP, Gravimeter, Magnetometer. These training courses are conducted in R/V DAYANGYIHAO. Secondly, the analysis of the samples such as rocks, sulfides and sediments, include minerals, major/minor elements and physical property analysis. These works need to be conducted on the board and land. The training persons will take part in the work on the board.
- ④ **Expected Results:** Through the training course, the persons from the developing countries can understand the tectonic environment and hydrothermal mineralization of the newly discovered hydrothermal fields SWIR. Also, they can master the developed investigation equipments of R/V DAYANGYIHAO.

### **3. The extent to which personnel from the developing countries will be able to participate in and benefit from this project**

#### **① For scientists from China**

Funded by the Endowment Fund, we will take cooperative study on the seafloor hydrothermal system of SWIR together with those scientists from United States, Russia or other countries. The international cooperation will not only promote the development of investigation technology and research level of hydrothermal activity in China, but also obtain significant results of hydrothermal system study at ultraslow spreading ridges for ISA.

#### **② For scientists from other developing countries**

Those who coming from other developing countries will participate in the integrated deep ocean investigation cruise as members of science party. Through the ‘training’ cruises, those candidates will not only learn more knowledge about hydrothermal activity, but also can understand and master the developed investigation technology. That will help the developing countries to involve the ISA’s work and their scientists to take part in the research and survey the hydrothermal deposit in the AREA.

#### **③ For further international cooperation**

A suggestion for an integrated cooperative project of hydrothermal geological model study at ultraslow spreading ridges will be submitted to ISA after the international capacity building workshop.

#### **4. The extent to which the project is consistent with the purpose and objective of the fund**

R/V DAYANGYIHAO will provide a platform for this project. Based on the Endowment Fund of ISA and the cruises of COMRA, the international cooperative study on the hydrothermal systems at the ultraslow spreading SWIR will be approached during the next 3 years. This project will not only improve Chinese deep ocean investigation and research level through cooperative study, but also provide a “training” cruise for those from the developing countries. According to the cooperative results, better understanding of the complex formation, circulation and special geological processes of hydrothermal activity at the ultraslow spreading SWIR will be obtained. Moreover, it will help ISA to establish a Geological Model Project as to further studying the hydrothermal system in the ultraslow spreading ridges.

This project fits very well with the purpose and objective of the Endowment Fund of ISA through “cooperative study in marine scientific research” and “training program”.