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Japan Agency for Marine-Earth  
Science and Technology  
Hokkaido University  
Enoshima Aquarium

## Extensive population of a “rare” scaly-foot gastropod discovered

### Overview

A huge colony of thousands of scaly-foot gastropods ([Photo 2](#)), a deep-sea snail species with scale-shaped iron-sulfide sclerites ([Photo 1](#)), was discovered in a deep-sea hydrothermal vent field of the Indian Ocean called the Kairei Field ([Fig. 1](#)). The colony was found by a team of scientists from the Japan Agency for Marine-Earth Science and Technology (JAMSTEC: Yasuhiro Kato, President), Hokkaido University (Hiroshi Saeki, President) and Enoshima Aquarium (Yukiko Hori, Executive Director), who conducted a research expedition using “SHINKAI 6500,” a manned research submersible operated by JAMSTEC. The finding of extensive community was surprising because many researchers had believed that the scaly foot gastropods were a weak ecological competitor and could live only in the very narrow ranges of environments occurring at a certain balanced mixing zones between hydrothermal fluids and deep seawater. The new finding revealed that the scaly foot gastropods could make their colonies at higher temperatures, higher concentrations of H<sub>2</sub>S and lower concentrations of O<sub>2</sub>. These gastropods were sampled for shipboard experiments to investigate their early development and energy source of bacterial symbionts. Some individuals were kept in rearing tanks on the ship of which temperature and oxygen concentration were carefully controlled. These snails were alive under atmospheric pressure for more than three weeks, the longest record of rearing ever succeeded in the world.

### Studies on Scaly foot

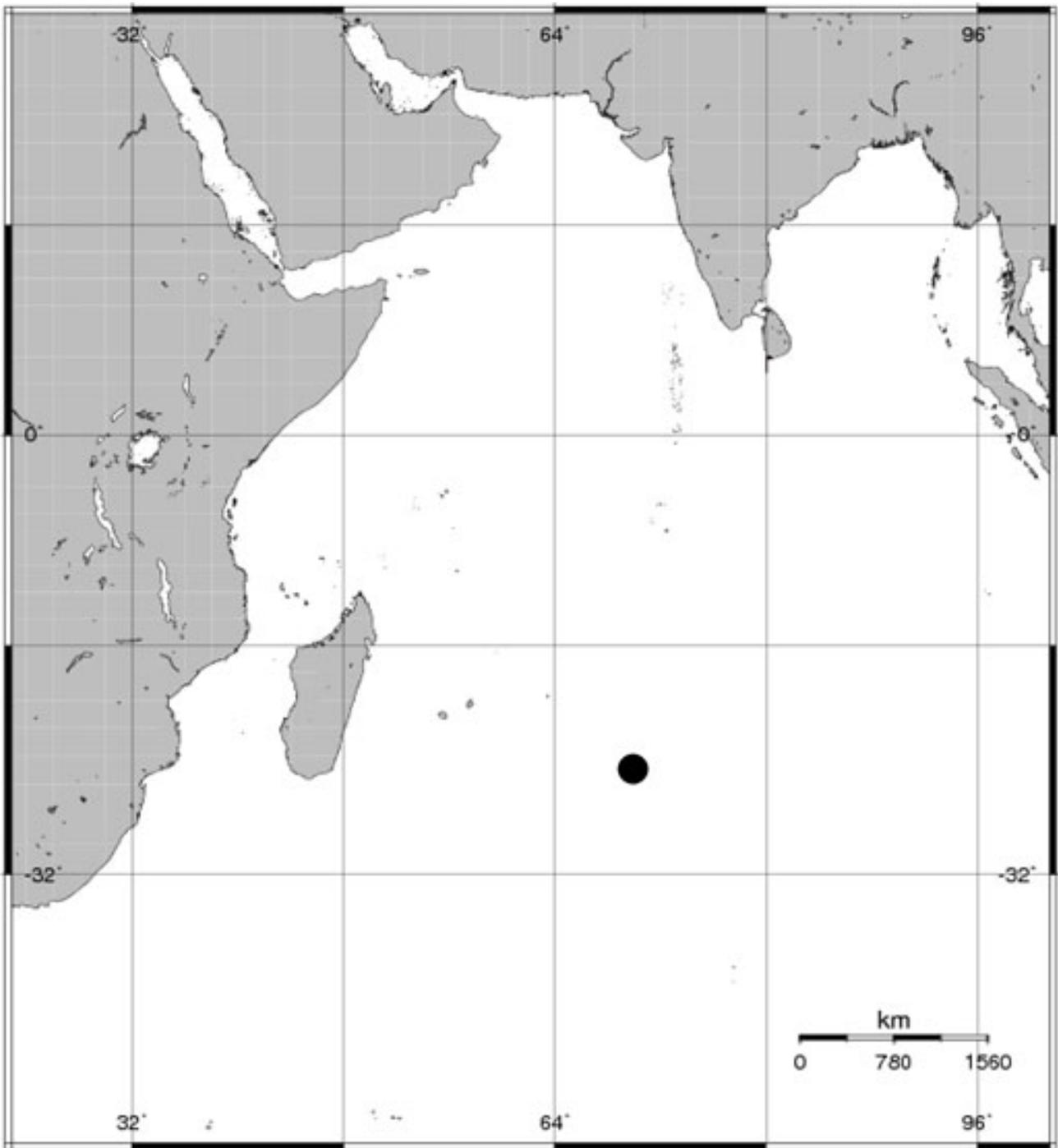
The scaly foot gastropod was discovered in the Kairei Field of the Indian Ocean by U.S. researchers in 2001. The discovery was a big surprise. One of the reasons was that the scaly foot gastropod covered its foot with hundreds of iron sulfide scales (Sclerite). It is the only life known to do iron sulfide biomineralization. The species was difficult for the researchers to find in the deep seafloor. Thus, the researchers believed that the scaly foot gastropods were minor species in number in the Kairei Filed animal communities. Another surprising feature of the scaly foot gastropod was that it had many symbiotic

bacteria (microbes) in its body and organs other than the gill. All the chemosynthetic animals previously known have their endosymbionts (bacteria in the cells) only in the gills. The last reason was that the scaly foot gastropod was quite new from its morphology and phylogeny.

In 2006, a research group led by JAMSTEC went back again after the cruise in 2002 to the Kairei Field to do an intensive investigation of the scaly foot gastropod using the SHINKAI 6500. In the expedition, there were several important new findings: (1) scaly foot gastropods were a minor species living in the only one colony in the whole Kairei Field; (2) scaly foot gastropods were present under the layer of numerous *Alviniconcha* gastropods; and (3) scaly food gastropods liked waters at around 5 °C and containing very weak chemical components from the hydrothermal fluids.

### **Future perspectives**

Nobody doubts substantial appeal and scientific values of the scaly foot gastropod. Due to its very limited distribution and difficulty to keep alive, the investigation just relies on on-site observations and molecular biological studies of dead individuals. The finding revealed that the scaly foot gastropod has much more adaptation capability to various habitats than previously considered and may be successfully reared for longer periods under the more suitable rearing conditions. Our new findings have indeed opened a new way to clarify the evolution, physiology and ecology of this species. The research is also very important not only for such basic sciences but also for future applications of the species' uniqueness to the biomaterial industries and medical sciences.

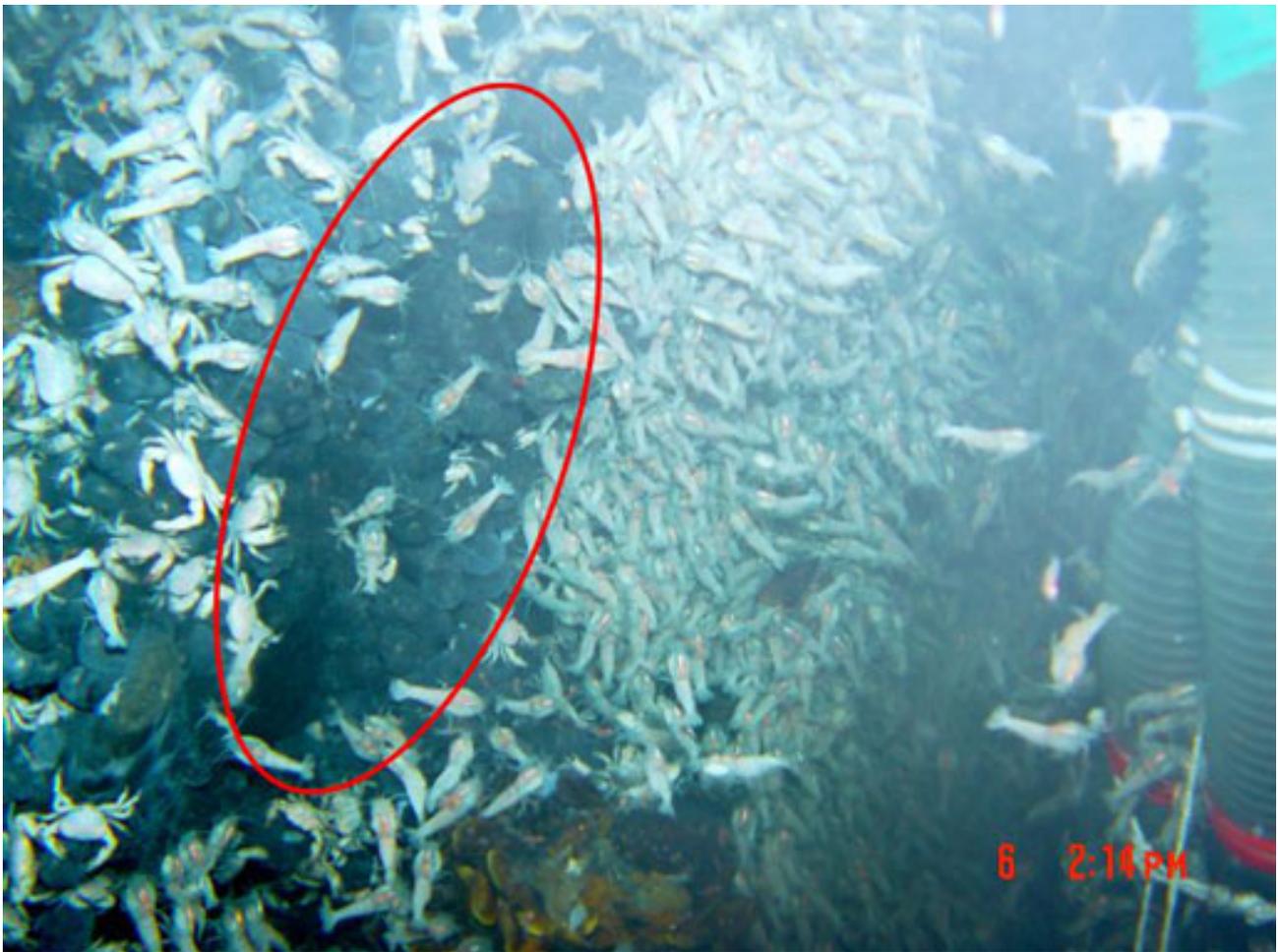


**Figure 1:** Kairei Field in the Indian Ocean(●)

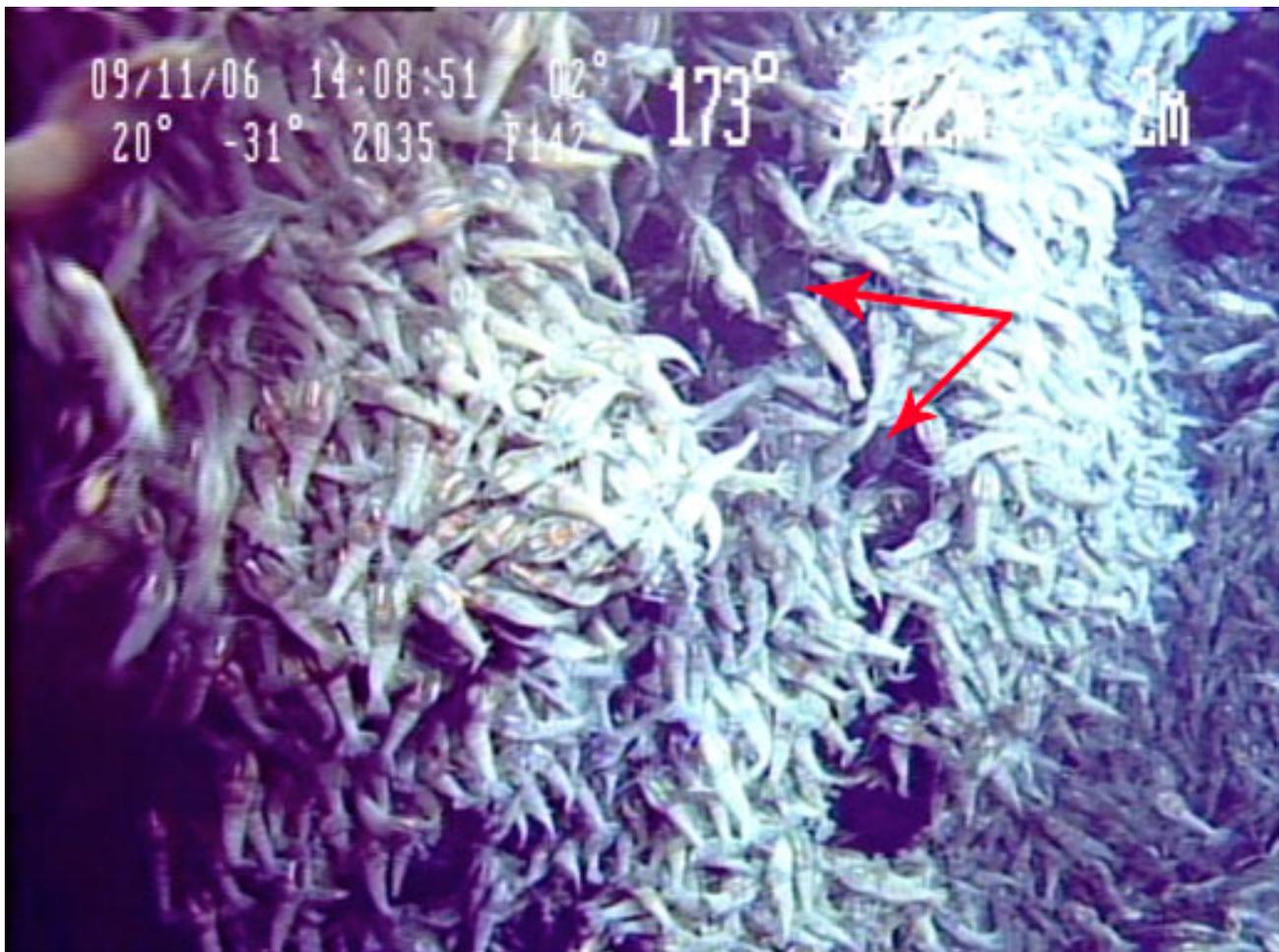


1 cm

**Photo1:** Scaly-foot living in the hydrothermal filed in the depths of the Indian Ocean. Its foot exterior is covered with scales made from iron-sulfide, which are believed to protect the snail from predators. The maximum size of the shell is 4.5cm.



**Photo 2.** A large number of scaly-foot gastropods covered by *Rimicaris kairei* (Photo.3) that gather around the deep hydrothermal vent (water depth: 2,420m).



**Photo3:** A swarm of *Rimicaris kairei* covering scaly-foot gastropods. The gastropods can only be seen in the arrowed parts. When scaring away the shrimps, thousands of gastropods were found attached on the surface of the sulfide chimney.

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