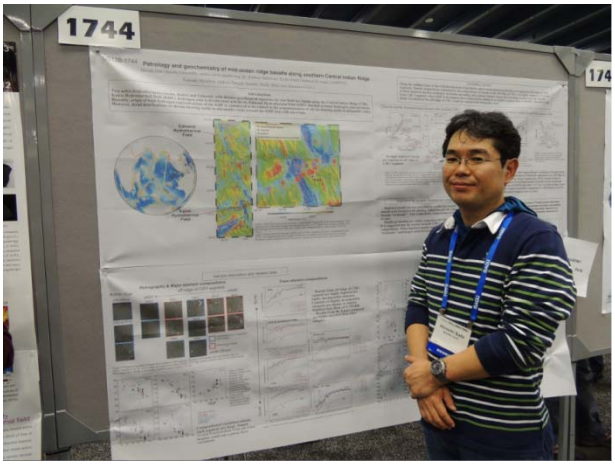
Using Supermini & MiniFlex for Solid-Earth Science research at Senshu University.

Professor Hiroshi Sato, Senshu University was in charge of petrological and geochemical analysis of the mid-ocean ridge basalts of Southwest India, in a research project called "TAIGA"(Ministry of Education Grant-in-Aid for Scientific Research from 2008 to 2012).

In the submarine mountains of the ocean floor, the places where the mantle rises up are called mid-ocean ridges. This kind of ridge is a large-scale submarine mountain. Their formation gradually leads to the enlargement of the ocean floor. The major mid-ocean ridges are the Mid-Atlantic Ridge, the East Pacific Ridge, Pacific-Atlantic Ridge, the Central Indian Ridge, the Southwest Indian Ridge and the Southeast Indian Ocean Ridge. They are distributed around the earth.



Prof. Hiroshi Sato at AGU FALL MEETING 2013

The compositions of basalts collected from mid-ocean ridges were once thought to be almost uniform because of the influences of convection in the mantle over a long period of time. However, by analyzing the elements of the main and minor components, including rare earth elements, Professor Sato was able to observe unevenness and diversities in these compositions.

Usually, the compositions of the major constituents of volcanic rocks are thought to reflect the physical factors of magma formation, such as their melting down in mantle, and the temperature and pressure where crystallizations in the earth crust occur. It is thought that the trace element composition reflects the chemical properties of the mantle where they originate.

Therefore, by analyzing in detail the compositions of basalts collected from mid-ocean ridges around the world, and by clarifying the reasons why varieties of basalts exist, we will be able to validate the differences in magma production processes carried out under mid-ocean ridges globally.

Professor Sato targeted his research on the mid-ocean ridge basalts collected from the Central Indian Ridge, well known for its abnormal hydrothermal activity. He studied compositions of the main elements and analyzed the compositions of trace elements and isotopes. As a result, he determined that the physical factors for magma formation estimated from the chemical compositions of mid-ocean ridge basalts are almost the same. On the other hand, the compositions of minor elements correspond to the differences in the shapes of ocean ridges. This means that the differences that can be seen in the chemical

compositions of mid-ocean ridge basalts collected from the Central Indian Ocean area are caused by the differences in the compositions of the mantles original to the area.

Major components of the mid-ocean ridge basalt was analyzed using a Supermini installed in Senshu University in 2008.

These findings were carried out by Subseafloor Biosphere Linked to Hydrothermal Systems, TAIGA Concept (published by Springer Japan in 2015), in which the results of the research project were summarized.
http://www.springer.com/us/book/9784431548645

Reported by Yurika Takumi, 2015 April.
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The following is the related article in 2009.

Customer Testimonials – Miniflex II and Supermini
(Abridged translation of the original Japanese article on RC website, http://www.rigaku.co.jp/case/miniflex_supermini/)
Customer: Dr Hiroshi Sato, Associate Professor, Dept. of Business Administration, Senshu University

For high-speed and high-resolution analysis of minerals obtained by ocean drilling
Recent studies revealed that a huge flux of heat and chemicals was transferred between the interior of the earth and the sea water through sub-seafloor water advection. A five-year interdisciplinary research project, named TAIGA, was started in 2008 to conduct research into the interactions between the lithosphere, hydrosphere, and biosphere through the fluid circulation beneath the seafloor, funded by the Japanese Government's Ministry of Education, Culture, Sports, Science & Technology (MEXT).

As a member of the TAIGA project, Prof Sato needed the capability to perform high-speed and high-resolution analysis of mineral samples retrieved from the ocean floor to investigate the link between the geophysical/geochemical structure around vent sites and the hydrothermal ecosystem. For this purpose, he purchased a MiniFlex II and a Supermini.

Rigaku's reputation and the track record at *Chikyu*
"I was already familiar with Rigaku XRF equipment and applications at the time of selection because I had been using Rigaku XRF systems since I was a post-doc at Ocean Research Institute, The University of Tokyo," says Professor Sato. "Also, it made a good reference that *Chikyu*, a Japanese ocean-drilling vessel, had chosen Supermini for its on-board lab in 2008."

WDXRF for its compact size and high precision
"When I was a member of the Science Measurement Committee of the Japan Drilling Earth Science Consortium (J-DESC) from 2004 to 2007, I worked on establishing a set of required specifications for the analytical equipment for ocean-drilling samples. This experience helped me when I chose the equipment for my own lab," he explains. "Actually, it was an easy decision. Along with Supermini's compact packaging as a benchtop system and its capability of working under the hard environment of on-board labs, the high precision realized by its WDXRF technology distinguished Supermini from other options."

Detailed minerals analyses with an XRD-XRF combination
"Most samples retrieved from the seafloor include alteration minerals, which are of vital importance in investigating the interaction between the sea water and minerals. I wanted an XRD system to identify alteration minerals, because some of them have grains too small for microscope observations and EPMA doesn't work because of the included water."

"However, it looked difficult to install an XRD system in my lab when I first applied for the grant, because Senshu was a humanities-oriented university; it didn't look easy to meet all the radiation-safety requirements, including appointing a licensed operation chief of work with X-rays."

"My concern was removed when I was negotiating with a Rigaku sales engineer on the Supermini purchase. She introduced me to the MiniFlex II, a benchtop XRD system. When I learned that the MiniFlex-II had sufficient resolution and that you did not need to appoint a licensed operation chief of work with X-rays, thanks to its well-designed safety interlock system, I immediately decided to buy one." Prof Sato ordered a Supermini and a MiniFlex II at a same time.

Supermini and MiniFlex installed in the Senshu Univ. in March 2009

Also for scientific education for humanities students
"While this purchase was for research purposes, I also think these instruments are useful for the scientific education of so-called humanities-course students."

"It is important for them to learn that there are multiple approaches in scientific research: from microscopic observation to X-ray analysis in mineralogy and earth sciences, for instance. I am also going to give the students the aspect of scientific analysis when they think about natural resources and related economics, an experience of using statistics in data analysis, and the understanding of the limitation of the scientific approach."

"While Senshu is a humanities-oriented university, there are many liberal-arts staff, including geoscientists, chemists, physicists, mathematicians, astronomers, and biologists. I

think I can cooperate with these staff to organize scientific classes using these X-ray instruments."

Reported by Yurika Takumi in 2009.
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Related article:
Customer Testimonial – Supermini aboard Deep sea drilling vessel "Chikyu"
Supermini aboard Chikyu ocean-drilling vessel | Rigaku - X-ray analytical instrumentation