Technological challenges necessary for the new horizon of IODP

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Abstract

Riser drilling is a big technological challenge made by IODP, which has provided science community new and exciting opportunities for the studies of structure and dynamic processes in the deep sub-seafloor. However, the existing technology cannot fully cope with the scientific challenges. The new Mohole proposal is the most important among the challenges, and IODP should develop the technology for the drilling in the difficult condition of deep-sea (4,000m) and ultra-deep (11,000m) drilling in the high temperature (400 degree C). Progress in deployment of cabled seafloor observatories has made it possible to carry out long-term and real-time downhole monitoring, which can be stethoscopes of the crustal activities in the seismogenic zones. IODP should improve the technologies required for the downhole monitoring in ultra-deep (10,000m) and high temperature holes (175 deg C) across active faults.

As is shown in the IODP-MI website, IODP is facilitating the acquisition of existing or latent technology through all possible avenues for the collection of requisite earth science data to further our understanding of earth and its complex systems. Technology initiatives must be part of the full spectrum of scientific challenges detailed by the scientific drilling community, yet not limited to solutions currently residing in the ocean and earth sciences. IODP technology development must be innovative and may be daring, while utilizing time proven engineering practices to ensure success.

Among various new technologies, riser drilling is a big technological challenge made by the IODP. It has provided science community new and exciting opportunities for the studies of structure and processes in the deep sub-seafloor. For example, deep-drilling in the seismogenic zone can penetrate splay faults and decollement, and will allow direct observations of various geological and geochemical processes in seismogenic zones. Drilling through the Moho would address the longstanding and fundamental questions: the origin of the seismic Moho and the validity of the ophiolite models for lower oceanic crust and upper mantle. However, the existing riser drilling technology cannot cope with such exciting proposals. IODP should develop the technology for the drilling in the difficult condition of deep-sea (4,000m) and ultra-deep (11,000m) drilling in the high temperature (400 degree C). Drilling in such a condition is a difficult but an attainable target, because drilling in the oil industry is approaching the target.

Progress in deployment of cabled seafloor observatories such as the DONET and Neptune programs has made it possible to combine extensive observations on the seafloor with intensive monitoring in a down hole. Long-term and real-time monitoring will be initiated in a deep-sea down hole. Downhole observation is important not only for precision seafloor observation (e.g., Kawakatsu et al., 2009) but also in-situ observations of various geological, geophysical and geochemical processes during the earthquake cycle. Because subduction zones are covered with thick sediment, observation in basement rocks gives us a unique chance for highly sensitive monitoring of crustal activities close to a seismogenic fault. For example, seismic and geodetic observations in such a down hole can be stethoscopes for the crustal activities, and can monitor slow events that are estimated to occur in the splay faults in seismogenic zones. Activities at splay faults and decollement will be crucially important to understand the mechanism of mega-thrust earthquakes occurring at subduction zoned with well-developed accretionary prism. Although the system was stand-alone and off-line, ODP program initiated a challenge to the downhole observatories. IODP should improve the technologies required for the real-time downhole monitoring in ultra-deep (10,000m) and high temperature (175 degree C) holes across active faults.

The INVEST meeting is crucially important for the future of scientific ocean drilling; its new direction as well as its continuation will result from the discussion there. I hope to attend the INVEST break-out session on Science Implementation (Technology) and join the discussion on the following items: (1) Observatories, (2) Subseafloor laboratories and experiments, and (3) Platform, drilling and logging tools: needs and opportunities.