Kyo M. LAB.

［Deep-sea floor and subsurface observation technology］

Center for International Research on Underwater Technology

Deep-sea Engineering

Development of Long Term Borehole Monitoring System (LTBMS) for Seismic and Geodetic Observations

The deep-sea drilling vessel *"CHIKYU"* can survey deep interior of the Earth. We are developing long-term monitoring system for direct monitoring of seismic faults by installing multiple sensors for borehole fluid dynamics, earthquakes, and diastrophism observations utilizing drilled bore holes. Temperature and pressure condition become extreme especially at deep subsurface environments. Furthermore, system deployment is challenging due to limited borehole diameter and physical shock on the system. The long-term monitoring system should have a capability to realize stable observations in extreme environments. Figure 1 shows concept of a long-term monitoring system for riser boreholes. Technical challenges are listed below:

◆ High temperature (125°C)
◆ Long-life (more than 5 years)
◆ Safe and reliable deployments (Extremely deep well, fault zones, shock resistance, retrieval)
◆ Coupling to formation (Cementing or mechanical clamping)
◆ Multi-level observations (5 branched fault)
◆ Multipurpose observations (Seismic, geodetic, hydrogeologic)
◆ Low power consumption sensor arrays
◆ Real-time observations (Connection to seafloor observatory networks)
◆ High-precision synchronizations (Seismic array)
◆ wide frequency and dynamic range (Small to great earthquakes)
◆ Miniaturization (9-5/8" casing)
◆ System redundancy (Fault tolerant)

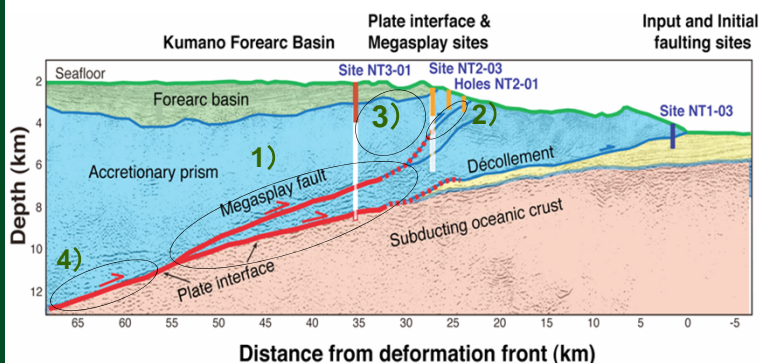Fig.2 Scientific purpose of long-term observation in the Nankai Trough seismogenic zone

1）Asperity in megasplay fault at M8 class earthquake area
2) Mechanism of VLF (very low frequency) events
3) Mechanism of growth of accretionary prism by great earthquakes
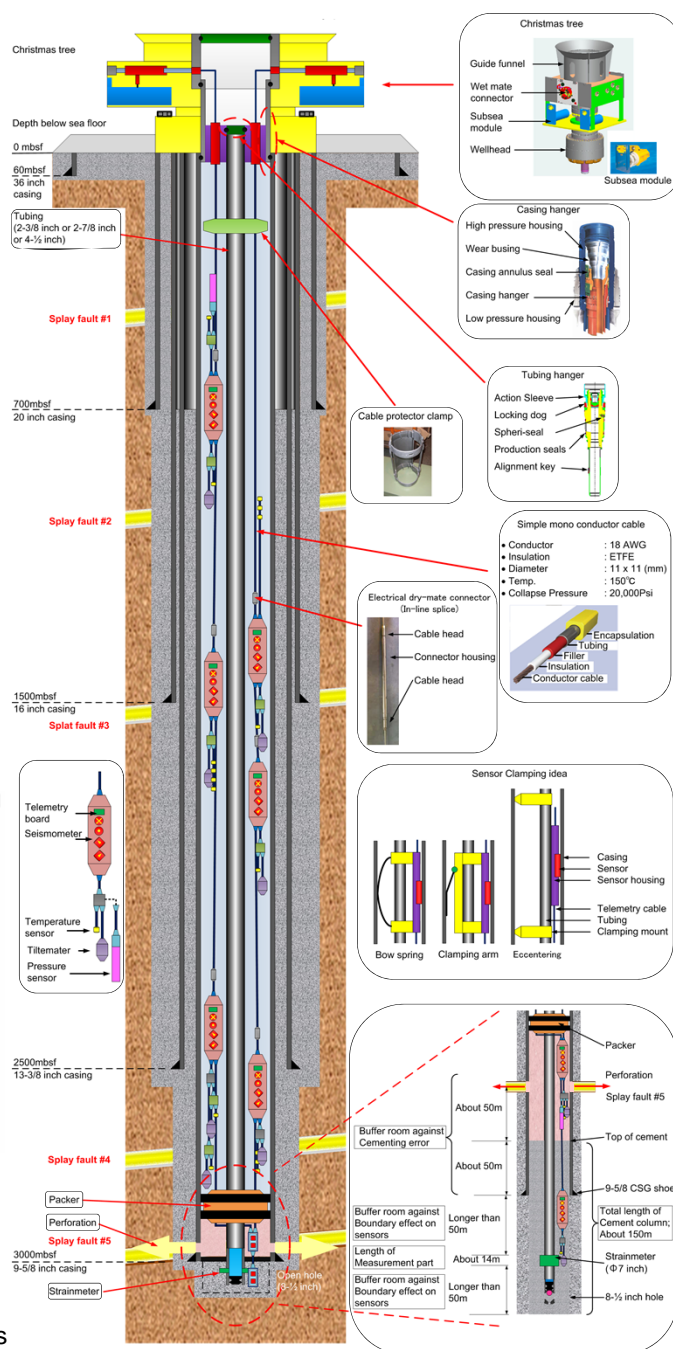4) Low frequency earthquakes in down-dip edge

Fig.1 Concept of LTBMS for a 3.5 km riser borehole