

Mission Specific Platforms in the New Program

A White Paper prepared by the ECORD Science Operator



Mission Specific Platform (MSP) expeditions have extended the remit of the international marine research program of the IODP by enabling scientific drilling in ice-covered waters and on shallow water shelves. The scientific impact of MSP expeditions has been significant and the impressive contribution of these ventures has been recognised within research and public arenas, including at the recent European Magellan Workshop. ECORD's provision of MSPs in IODP has facilitated a number of exciting advances in our understanding of Earth history:

- The high Arctic Ocean Basin had never before been deeply cored because of the challenging sea-ice conditions. ACEX retrieved the first long drill cores from the Arctic Ocean seafloor. High profile publications, including 6 papers in *Nature* to date, have revolutionised our understanding of the climatic evolution of the Arctic during the last 56 Myr. As examples, data from these cores revealed that sea surface temperatures near the North Pole as warm as 23°C during one of the best-known climate transients, the Palaeocene-Eocene thermal maximum, and demonstrated that the current icehouse cryosphere began to evolve earlier than previously thought, and some 24 Myrs before major Arctic ice sheet expansion.
- The Tahiti Sea Level Expedition allowed refinement of the global sea-level curve for the last 15,000 years, giving new constraints on the timing and rapidity of sea-level changes during deglaciation and providing essential information on sea surface temperatures.
- The New Jersey Shallow Shelf expedition exploited a natural laboratory for tracking the history of global sea level during the post-Eocene ice-house world. The excellent core recovery, in challenging sandy conditions, has bridged the critical gap between the ICDP on-land drill sites and locations on the continental slope drilled by the ODP.
- New climatic and sea-level information for the late Pleistocene will emerge from the Great Barrier Reef Environmental Changes Expedition.
- More expeditions will be scheduled through to 2013.

ECORD aims to continue implementing MSP expeditions in the future programme in which MSPs can play a key role in addressing important scientific questions.

Each MSP expedition has key scientific objectives that translate into exacting requirements for the drilling vessel. The ECORD Science Operator (ESO) creates a customised platform, providing the analytical facilities necessary for ephemeral measurements and data management in containerised laboratories. A wide variety of platform systems can be hired within the MSP concept, as examples the following platforms have been used to date:

- ACEX: a bare-deck Baltic icebreaker *Vidar Viking* fitted with drilling equipment, with support of the icebreakers *Oden* and *Sovetskiy Soyuz* to drill down to over 400 m in about 1100 m of water.

- Tahiti: a bare-deck diving support vessel *DP Hunter* fitted with drilling equipment to drill multiple holes up to around 100 m depth in waters up to 100m deep.
- New Jersey: the self-propelled jack-up lift-boat *Kayd* to drill to 750 m in 35 m of water.
- Great Barrier Reef Environmental Changes: a purpose-modified geotechnical drilling vessel to drill multiple holes to 100 m in up to 100 m of water. This vessel also has deep-water capability, had that been required by the scientific proposal.

ESO has the flexibility to use innovative new technologies. For the first time in ODP/IODP expeditions, ESO deployed slimline geophysical logging tools during the Tahiti Sea Level Expedition. In this expedition, high-resolution, mm-scale, optical and acoustic images combined with continuous borehole geophysical measurements enabled the correct core depths and true recovery to be established ensuring accurate sea-level reconstructions. ESO also introduced the use of rhizones for high-resolution interstitial pore-water sampling. This routine is new to the IODP and reduces the need to take whole round samples for squeezing pore water, thus preserving more of the cored section for archiving and additional analyses.

MSP expeditions have an offshore phase followed by an onshore component, based at the IODP Bremen Core Repository (BCR), located at the University of Bremen and one of the three IODP core repositories. This innovative concept has proved to be very effective and has the advantage of allowing planning with a degree of knowledge about the cores to be analysed. Ephemeral measurements are made at sea, and the cores are split, described, and subjected to minimum and appropriate standard IODP measurements at an Onshore Science Party held at the BCR shortly after the offshore phase.

IODP MSP operations have focused to date on shallow and ice-covered waters, but the concept could be expanded to make maximum use of MSPs, for instance:

- Cost-effective remote seabed drills operated can recover sections immediately beneath the seafloor, from 1 m oriented core up to 100 m.
- Drilling techniques to improve core recovery where water depths exceed 100 m, such as for the Hawaiian Drowned Reefs proposal that is currently being scoped by ESO.
- Long, IMAGES-type piston coring.
- Co-operation with other programs. For example a successful collaboration with ICDP on the New Jersey Shallow Shelf Expedition has enabled the investigation of a key land-ocean transect.
- The possibility that the *Aurora Borealis* could be used as an Arctic and Antarctic platform.

The range of drilling opportunities and customised operations that MSP expeditions offer can address a huge variety of research targets in marine sciences. These targets include the investigation of gas hydrates, slope stability, alteration of oceanic crust, ore formation and palaeoclimate on long and short time scales.

MSP operations will ensure that a future ocean drilling program will be able to address scientific challenges across the complete ocean system, and effectively develop and implement new techniques and technologies as the science demands.

Please see the ESO posters and take the opportunity to discuss any aspects of MSPs with ESO staff