USIO Position Paper -- Operational Requirements for Returning to Hole 1256D

(Shortened and slightly modified from an original draft provided by IODP-USIO TAMU operations)
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Hole 1256D penetrates 1257 m into fast-spread oceanic crust (1507 mbsf) at the "Superfast site" in the Guatemala Basin. Drilling began during ODP Leg 206 and continued through IODP expeditions 309 and 312. It achieved one of the major unfulfilled objectives of ocean drilling, the sampling of a complete section from seafloor lavas through the dikes and into gabbros. A reentry cone is supported by 20-inch and 16-inch casing that seals off the entire 250 m sediment section and is anchored 20 m into oceanic basement. The emplacement of the cone and casing was a major engineering achievement and a first in ocean drilling.

In anticipation of potential future hardware needs, the reentry cone was configured to accommodate four different casing sizes (20-inch, 16-inch, 13 3/8-inch, and 10 3/4-inch). To date, only the two largest casing sizes have been two deployed, and it is possible that one or two additional casing strings (13 3/8" and/or 10 ¾") could be installed. The multiple casing string strategy was designed to deal with a potential hole failure in the basalt section, within a couple hundred meters of the current depth of the casing string.

Recent logging data large show that large portions of Hole 1256D are out of gauge because of previous drilling, hole maintenance activities, and the many bit trips made during the course of three expeditions. The technical and engineering panel was asked to consider alternative methods for preserving this hole and enhancing the chances for extending its depth into the upper mantle. In principle, isolating enlarged sections of the hole with casing should greatly improve drilling conditions and enhance the ability to flush cuttings from the hole. If such a program were successful, it could potentially allow the deepening of Hole 1256D significantly.

The first key issue is to stabilize the upper section of open hole using casing. Strategies for achieving upper hole stabilization include:

(1) Enlarging the existing hole and installing 13 3/8" casing in a portion of the open hole below the 16-inch casing shoe.

To isolate the entire out-of-gauge section of the hole in this manner, a substantial length (>800 m) of casing would have to emplaced. Before 13 3/8" casing could be deployed, the entire section of interest would have to be enlarged from the minimum 10-inch bore to at least 18 ½". To open the hole below the 16-inch casing to a minimum 18 1/2 inches would require specially designed hardware, such as under-reamers, bi-centered bits, or as yet undefined alternatives. Such an ambitious undertaking is without precedent in ocean drilling and presents a formidable challenge to our current technology.

(2) Enlarging the existing hole and installing 10 3/4" casing below the 16-inch casing shoe.

The advantage of this approach is that it requires the hole to be enlarged to only 14 3/4-inch diameter. This could potentially be achieved using a series of hard-formation 14 3/4-inch hole openers equipped with a 9 7/8-inch tricone pilot bit or perhaps a succession of body-hardened 14 3/4-inch tricone drilling bits. The disadvantage of this approach is that it precludes deployment of any additional casing. A potential disadvantage of this approach arises because the open hole diameter is not uniform and, therefore the pilot bit on a hole opener or bi-centered bit would not be able to accurately track the borehole in the enlarged areas. The result of trying to open such a non-uniform diameter basement hole would most likely result in a bore that would take the appearance of a warren with many non-concentric ledges and a significant drift. Because of the non-linear profile of the opened hole, it would be impossible to run and successfully land a significant length of 10 3/4-inch casing.

(3) A variant to the preceding two strategies would be to employ less ambitious lengths of both casing sizes, resulting in a shorter cased section.

A casing program of this magnitude has never been attempted. Regardless of the strategy proposed, to open and case any portion of Hole 1256D will require significant hardware and numerous pipe trips, as well as very slow penetration rates during reaming (<<1 m/hr). Operations would very likely extend beyond a single expedition, and involve substantial risk inherent in the use of untested technology. A thorough engineering feasibility study and risk assessment should be undertaken before any attempt to case any section of Hole 1256D.

More generally, the development and testing of the appropriate hardware to open and install extensive casing strings to enable deep drilling operations in ocean crust requires a concerted and focused effort. The panel recommends that a task force, consisting of senior ODL drilling and IODP operations personnel, in addition to appropriate scientific personnel be asked to formulate a realistic and achievable stabilization program for deep penetration holes. This task force should be empowered to bring in industry experts to review existing technology and enhanced hole cleaning techniques. The engineering design should be directed by the target depth and the scientific objectives to be met during and upon completion of drilling. It would be desirable to test various techniques on future IODP expeditions before they are applied in any deep penetration attempt.

Given the risks involved, and the need for appropriate development and testing, the panel recommends that deployment of casing in Hole 1256D is not an appropriate short-term option with the aim of deepening the hole as far as possible, or until time expires. The strategy would be to resume RCB coring using large volume (100-150 bbl), high viscous mud sweeps combined with frequent bit trips. A similar strategy was effective at clearing cutting debris from the hole during Expedition 312. Unfortunately, the large mud volume required depleted the onboard mud supply and the volume of the sweeps had to be reduced during the expedition. With appropriate planning, the vessel is equipped to maintain such an aggressive mud program. A conservative estimate is that 80 short tons of attapulgite equivalent would be needed to support the bulk requirements. However, it would be prudent to arrive on site with the bulk tanks topped off so that the ship is well equipped to handle any contingency. Assuming reasonable hole conditions and a average rate of penetration comparable to previous coring in this hole, it should be possible to deepen the hole by 500 meters in a 57-day expedition. This option has relatively low risk and could be carried out at short notice.