Stratigraphy and structure of the Barbados accretionary prism from Logging-While-Drilling

Saneatsu Saito, Candace O. Major, and David Goldberg, Borehole Research Group, Lamont-Doherty Earth Observatory

New Logging-While-Drilling (LWD) results in the Barbados accretionary prism demonstrate that the off-scraping of sediment from the subducting Atlantic plate onto the Carribbean plate is lithologically controlled. This finding suggests that the physical properties of the sediments determine the nature of the décollement fault zone between the plates and the structure of the sediments accreted in the prism. LWD data were recorded at five sites across a 10 km transect from the toe of the accretionary prism and onto the Atlantic plate. In the figure, the alignment of the LWD logs at the depth of the décollement fault illustrates the stratigraphy and the evolution of thrust sheets in the prism from an undeformed state on the Atlantic plate. The position and vertical displacement of thrust faults within the prism may be easily recognized by repeated character of the logs.

The comparison of the LWD results with sediments recovered from earlier drilling through undeformed sediments (Site 672 and co-located Site 1044) allows the evaluation of lithology from the logs. The sediments that were cored are known to consist of clay, calcareous clay, siliceous clay, and sand and have been assigned by color to a specific character of each log. Lithologic inversion of these data may be used to interpolate the distribution of mineralogies at other uncored LWD holes drilled across the prism. Determination of clay concentration and clay type is particularly important because of the close relationship between clay abundance and sediment permeability. With a detailed understanding of these variations, the magnitude of consolidation in each lithologic unit above and below the décollement fault may then be quantified. Variability in the thickness of these units likely control fluid flow pathways within the accreted and underthrust sections. For example, a high-porosity siliceous turbidite sequence below the décollement is compacted significantly more than the subjacent sediment layers. This may provide an important conduit for transporting escaping fluids seaward from the accretionary prism. The high-resolution sediment profiles available from LWD logs in the Barbados accretionary prism demonstrate that lithology-controlled compaction likely plays a major role in the evolution of the décollement, dewatering of the underthrust sediments, and the accretion of the sedimentary prism.