IODP Expedition 329: Subseafloor life in the South Pacific Gyre

Site U1371 Summary

Site U1371 (Scientific Prospectus Site SPG-12A) was selected as a drilling target because (1) its microbial activities and cell counts were expected to be characteristic of the upwelling region just south of the gyre, and (2) its basement age renders it a reasonable location for testing the extent of sediment-basement interaction in a moderately sedimented region of 71.5 to 73 Ma basaltic basement.

The principal objectives at Site U1371 are (1) to document the nature of life in moderately slowly accumulating sediments of great age (up to 73 Ma), where the surface ocean is characterized by moderate mean chlorophyll content (less than 3 mg/m^3), (2) to determine the extent to which basement age, thermal regime and chemical transport through the 73 Ma basaltic basement affect microbial communities and biogeochemical processes in the sediment and the extent to which chemical transport and microbial activities in the sediment affect the alteration and habitability of the basaltic basement, (3) to provide a much higher-activity standard of comparison for the sites within the gyre (U1365-U1370), and (4) to test the extent to which life in this sediment may be supplied with an electron donor (dissolved hydrogen) by radiolysis of water.

Site U1371 is located in the South Pacific Gyre at ~5300 m water depth. The coring site is located within magnetic polarity Chron 32n.2n, so the crustal age may range from 71.5– 72.9 Ma. The sedimentary succession was recovered by APC coring in Holes U1371D, U1371E and U1371F. Additional mudline cores were recovered in Holes U1371B, U1371C, U1371G and U1371H. Altered basaltic fragments were recovered from the basal core of Hole U1371F.

Principal Results

Sediment

The sediment at Site U1371 consists of approximately 130 m of diatom ooze and pelagic clay, divided into two units based on their sharply contrasting mineralogy. Unit I is clay bearing diatom ooze. It is 104-107 m thick. It contains numerous ash layers and multiple thin hardgrounds. Unit II is a blend of clay, zeolite and red-brown to yellow-brown semi-opaque iron-manganese oxyhydroxides. Other minor sedimentary components at Site U1371 include quartz, pyrite, manganese oxide/hydroxide, radiolaria, spicules, and silicoflagellates. Bioturbation is a prominent feature of the sediment, causing diffuse boundaries on most beds. Overall sediment thickness and composition appear to be broadly uniform from hole to hole.

Microbial cell counts were above the minimum detection limit (MDL: ~10^3 cells cm^{-3}) throughout much of the sediment column.

Profiles of dissolved chemicals clearly indicate that most of the sediment column is anoxic, with thin oxic zones at the top and bottom of the column. Manganese is a prominent net electron acceptor throughout most of the column. Dissolved oxygen nitrate concentrations decrease rapidly and are below detection by a few mbsf. Below that depth, both are indistinguishable from zero until the sediment/basalt interface is approached and they rise above detection. Dissolved ammonium mirrors dissolved nitrate, rising to a maximum value mid-column, and then decreasing down column. Dissolved manganese strongly increases in the uppermost 3 mbsf, exhibits four broad maxima and three local minima within the column, and decreases again as the basaltic basement is approached. Redox potential broadly mirrors the dissolved manganese profile.

A wide range of microbiology experiments was initiated shipboard. Experiments on major microbial processes and cultivations of viable microbes were initiated with samples taken at selected depths ranging from near the sediment-water interface to the sediment-basalt interface. Subsamples were routinely taken from all of the distinct lithologic units for post-cruise molecular assays and microbiological experiments.