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Investigating the correlation between increases in spectral gamma ray signals observed from wireline logging, geochemistry of the recovered core and reef processes in Tahiti coral reef formations (IODP Expedition 310)

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The last deglacial reef sequence in Tahiti consists of a series of successive reef terraces seaward of the living barrier reef. IODP Expedition 310 recovered core from 37 boreholes within three locations. The recovered core can be assigned to (i) the last deglacial reef sequence and (ii) an older Pleistocene unit, each comprising a series of distinctive coral assemblages with microbialites locally forming the major component of the reef.

Spectral gamma measurements were acquired for eight boreholes in total from both south (Maraa area) and north (Tiarei area) of the main island of Tahiti. In general, gamma counts are low ($<$ 50 cps) for all boreholes, although there is a significant interval of elevated gamma counts in Hole M0005D. This $\sim$ 20 m thick interval is located in the Pleistocene succession a few metres below the boundary with the last deglacial sequence. Few logging measurements were obtained across this boundary due to hostile borehole conditions; thus the spectral gamma log of Hole M0005D is useful for establishing some characteristics of this horizon. Analysis of the individual elements contributing to the raised gamma counts show that U is the major contributor to the higher counts in the upper part of this interval. Lithologies here comprise the coralgal-microbialite reef frameworks that dominate much of the reef terraces. High levels of U in carbonates have previously been linked to diagenetic processes, subaerial exposure, higher levels of organic material and the presence of red algae. Higher counts in the lower section of raised counts result from raised Th and K concentrations and correlate with silt dominated lithology at these depths.

We selected 104 core samples from the interval of raised counts for standard geochemical analyses (XRF). Major element correlation diagrams including our new data and published data on Tahiti igneous rocks imply that igneous fragments were incorporated during carbonate precipitation. Detailed thin section analyses reveal small volcanic clasts within some carbonates supporting this observation. The geochemical analyses of the core also indicate increased Mg within this interval. We infer from high CaO (48 to 52 wt. %) and moderate MgO (2 to 6 wt. %) the presence of dolomite, thus implying a potential diagenetic influence. Mass balance calculations using major element oxides demonstrate that this is compatible with the geochemical data. These preliminary findings from combining spectral gamma ray observations with analyses performed on core samples provide insight into the processes operating in the Tahiti reefal carbonates.