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87Sr/86Sr-ratios, foraminiferal data and sedimentology of the Latest Miocene – Pliocene cyclic carbonates of La Désirade (Guadeloupe, France)

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La Désirade is a small island located east of Grande Terre and Basse Terre, the main islands of the Guadeloupe Archipelago in the Lesser Antilles Arc. La Désirade is an "forearc outer high" located immediately west of the trench where Atlantic crust is presently subducted under the Caribbean Plate.

The "Limestone Table" (LT) of La Désirade has been considered as a Plio-Quaternary reefal deposit. However, the prominent feature of this <140 m thick formation is its rhythmic bedding of alternating marly/tuffaceous/dolomitic, and winnowed bioclastic carbonate layers. To the west of the island the "detrital offshore limestones" represent alternating offshore marls, tuffs and channelled mass flow deposits, that accumulated below wave base beneath a steep fore-reef slope. They document the mobilisation of carbonate material on an adjacent platform by storms and their gravitational emplacement. The provenance of both the reefal carbonate debris and the tuffaceous components must be to the west, i. e. Marie Galante and Grande Terre.

We have studied the biochronology of both benthic and planktonic foraminifera and measured 87Sr/86Sr ratios of selected biogenic shells such as aragonitic gastropods, corals, echinoderms and foraminifera. Recrystallisation and preservation has been controlled by SEM, cathodoluminescence, carbon/oxygen isotopes and XRF to avoid diagenetically altered samples.

Planktonic foraminifera of the "detrital offshore limestones" give a latest Miocene/early Pliocene age (lower zone N19), while 87Sr/86Sr -ratios cluster in the latest Miocene-earliest Pliocene, depending on the calibration applied. For the LT 87Sr/86Sr ratios from the base of the section cluster in the earliest Pliocene, while the top gives a late middle to late Pliocene age. These ages constrain the Neogene vertical tectonic movements of the island. We have also dated Pleistocene terraces and fringing reefs that are in an unconformable contact along paleocliffs with the Mio-Pliocene sediments.

In the lower unit of the LT, sedimentary environments alternate between below wave base, muddy carbonates documenting glacioeustatic highstads, and wave-bedded, winnowed bioclastic carbonates representing lowstands. In the upper LT unit synsedimentary, tectonic subsidence must have decelerated, resulting in a different sedimentation pattern: Bioclastic limestones probably represent highstand separated by emersion/erosion surfaces resulting from lowstands. A cyclostratigraphic study in the LT has been attempted, but gave unreliable results so far. Erosion/non-deposition indicate that the depositional cycles of the LT are unreliable recorders of both the frequency and the amplitude of orbitally driven sea-level fluctuations.

The history of the carbonates begins with initial tectonic uplift and erosion of the Jurassic igneous basement. It occurred before late Miocene times, when sea-level oscillated around a long term stable mean. The rhythmic deposition of the LT can be explained by synsedimentary subsidence during rapidly oscillating, precession-driven (19-21 kyr) glacio-eustatic sea-level in the latest Miocene/earliest Pliocene-late Pliocene. Except for a thin reef cap at the eastern edge of the LT, no in-place reefal constructions occur in the LT. Unfortunately, samples from the reef cap were all severely altered and no 87Sr/86Sr ratios were measured. Pre-late Miocene uplift, Pliocene subsidence and late Pliocene-Pleistocene emergence (up to 200 m above modern sealevel), and westward tilting must be the result of repeated subduction of buoyant ridges along the Caribbean trench located offshore La Désirade.