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Freshwater meteoric diagenesis of *Porites* coral in Pleistocene uplifted coral reefs of New Caledonia (South-West Pacific): observation and modeling

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Understanding post-depositional dissolution and recrystallization in fossil corals may be of great importance in studies on tropical paleoclimatology. The results obtained by such studies using coral geochemistry as records of sea level variations and sea surface temperatures must be discussed by analyzing the effects of the freshwater diagenesis.

The work presented here is focused on the early transformation of fossil corals belonging to *Porites Lutea* and initially composed of aragonite. Various stages of calcitization were observed in a series of corals sampled in meteoric freshwater environments of uplifted terraces from New-Caledonia.

Although transformation and cementation processes of carbonate/coral systems are well documented in the literature, the study presented here reveals the occurrence of two types of Low Magnesian Calcite (LMC) cements. Such cements were analyzed and observed by X-Ray Diffraction, Raman spectroscopy, cathodo-luminescence, Scanning Electron Microscope, Sr and Mg Castaing electron microprobe mappings. The type 1 (LMC1) replaces in situ the initial marine aragonitic skeleton. The type 2 (LMC2) replaces mostly the initial inter-skeleton pores from percolating meteoric waters. These 2 types of cements characterize 2 independent systems of transformation: the LCM1 ('autochthonous') is precipitated in a closed system, without transport, through a 'messenger-film-like transformation' (concomitant dissolution and precipitation); the LMC2 ('allochthonous') is precipitated in an open system, involving a previous transport before precipitation.

Our data reveal that at a time t of the meteoric diagenesis, spatial gradients in the amount of the precipitation of LCM2 cements (patches) can be commonly observed. Understanding of such diagenetic heterogeneities at the thin-section scale is approached within a modeling framework based on the mineralogical and petrographical analyses. A model of multicomponent reactive transport is developed at the microscopic scale (the scale of continuum mechanics) including the significant characteristics of the coral diagenesis: tracer diffusion, migration due to the species charge, adsorption/desorption, heterogeneous kinetic chemical reactions at the water/calcite interface, and homogeneous reactions at chemical instantaneous equilibrium in the water. Focus is put on the distinctive features related to modeling the processes at the microscopic scale and results of 1D direct simulation are presented. Our ultimate goal is to upscale to the macroscopic level this microscopic description of reactive transport. This is preliminary illustrated in the case of a highly simplified binary hydrochemical process where 3D numerical structural evolutions are expressed as the consequence of the interaction between 2 scales of description.