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The conversion into environmental parameters of multi-proxies derived from coral skeleton

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Coral skeleton is regarded as the best-suited archive for tropical oceans. Calibrations calculated from seasonal records of the last years differ with coral species and also colonies from a single species. However, the couple oxygen isotopic ratio and Sr/Ca is commonly used to reconstruct seasurface temperature and salinity, whereas no real validation of this method has been provided, especially over long term records. On the other hand, other investigations combining cultures, biomineralization observations, micro-analyzes, reveal specificities of the microstructures of the same material. The major difficulty is now to apply the evidences derived from the latter studies at micrometer size scale to the samples devoted to climatic studies.

We have first to consider that geochemical measurements result from analyzes of bulk samples. The isotopic oxygen ratio is not in equilibrium with seawater. The similarity between trace element curves drove Sinclair (GCA 69: 3265-3284, 2005) to warrant that all of them were submitted to the same fractionation. Moreover, the strongly similar pattern of Sr/Ca and isotope oxygen ratio distribution from average of micro-sample measurements over some microns,obtained separately by two laboratories, from corals of different species, could indicate that the disequilibrium does not affect only isotopes but also chemical reactions: all the proxies are affected by a kinetic process (Rollion-Bard et al, EPSL, 215: 275-288, 2003; Meibom et al, GRL, doi:10.1029/2002GL016864, 2003). Micro Sr/Ca analyzes indicated that kinetics is not related to the growth rates commonly considered, such as calcification rate, linear extension or density, it affects coral skeleton at more reduced size scale. The presence of organic matter, which isolates grains in skeleton microstructure, could explain the high scattering of isotopic ratio and trace elements over a few micrometers and the origin of kinetic process. These considerations drive us to propose a physical mech-

anism of mineral deposition and to identify biological and environmental impacts on this mechanism.

Then, we have now to identify the main parameters governed by the main external factors corresponding to size and time scales of climatic studies. In the case of coral, the proposed solution is a statistical treatment (Neural Network), well-suited to non-linear system, applied on multi-proxies, all derived from a single aragonite skeleton. It provides a hidden calibration specific to the studied colony, which allows the past conditions to be reconstructed with an error estimated from cross-validation.