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Origin and Characterization of carbonate crusts of Pen Duick Escarpment (Gulf of Cadiz)

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Carbonate crusts and carbonate concretions were dredged at the Pen Duick escarpment (Gulf of Cadiz) during cruise M2005 (R. V Pelagia cruise 64PE237). The Pen Duick escarpment is a fault scarp at 525 m water depth, with about 4.5 km length and 100 m heigh. The dredged crusts are up to 15 cm in thickness and up to 49 cm across. The internal structure is well laminated with vuggy porosity. The cavities correspond to bioerosion structures. Nevertheless bioerosion is mostly filled by sediment still not completely cemented. Sponge bioerosion structures (Gastrochaenolites, Trypanites, Taulostrepsis and Entobia) are prominent at the surface of the crusts. Different encrusting organisms are also found attached to the crusts (*Porifera*, *Cnidaria*, *Bivalvia*, *Polychaeta* and *Crinoidea*).

Groups of laminae show different colours and mineralogies and range between 4 and 19 mm thick. Some laminae consist of pure aragonite, others of pure calcite and a third type consist of mixtures of dolomite and calcite. Microsamples from the different laminae types, obtained with a hand-held dentist drill, record a strong variation of δ^{13}C values between them. The lowest detected value (-13,5 permil V-PDB) corresponds to an aragonite-calcite lamina and suggests precipitation from organically-derived CO_2. The highest detected value (+ 19.5 permil V-PDB) was recorded in a pure calcite lamina and can only be explained as resulting from fermentation and CH_4 generation. In this scenario, possible sources for CO_2 with low δ^{13}C values are methane oxidation and bacterial sulphate reduction. The δ^{18}O values range of the analysed samples

range between +5.3 and +3.7 permil V-PDB, suggesting precipitation from seawater. Nevertheless, the inflow of deep-seated brines cannot be discarded.

The isotopic compositions detected in the different laminae suggest they represent the precipitation derived from a consortium of bacterial sulphate reducers and methanogens during early burial stages. The new finding of δ^{13}C values corresponding to fermentation during early burial stages provides valuable insights into a biogenic origin of CH_4, which oxidation sourced CO_2 for the formation of the carbonate concretions from the Gulf of Cadiz.

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