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ABSTRACT BOOK

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THE COMPLEX DIAGENETIC HISTORY OF DISCONTINUITIES IN SHALLOW-MARINE CARBONATE ROCKS: NEW INSIGHTS FROM IN SITU $\delta^{18}O$, $\delta^{13}C$ AND REE MEASUREMENTS BY SIMS AND LA-ICPMS-HR

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Sedimentary gaps are challenging barriers for the reconstruction of carbonate platforms history, and then for the characterization of their sequence stratigraphy, architectural and palaeoenvironmental evolution. In order to improve the understanding of the early diagenetic events occurring during the formation of discontinuity surfaces in limestones, Secondary Ion Mass Spectrometry (SIMS) and high resolution mass spectrometry coupled with laser ablation (LA-ICPMS-HR) were used for the first time together to measure the $\delta^{18}O$, $\delta^{13}C$ and REE signatures of 12 early cement and fabric stages in several surfaces from the Jurassic platform of the Paris Basin. The early cement stages investigated clearly display different characteristic REE signatures, as for meniscus and pendant cements. Meniscus cements display a negative cerium anomaly while they precipitated in meteoric water, as attested by their very negative $\delta^{18}O$ signature (-4.3‰). Pendant cements show a high variability in $\delta^{18}O$, which was not possible to detect using the conventional but less precise microdrilling method. We demonstrate that a given cement morphology can form in different environments: dogtooth cements are for instance observed in marine phreatic and meteoric phreatic to vadose environments, as shown by their varying $\delta^{18}O$ signatures. Marine dogtooth cements and micritic microbially-induced fabrics precipitated directly as low-magnesium calcite in marine waters, as attested by the preservation of their initial $\delta^{18}O$ and $\delta^{13}C$ signatures. Based on high-resolution geochemical analyses of early cements and fabrics, five discontinuity types were recognized and their palaeoenvironmental history could be reconstructed. Two exposure surfaces with non-ferroan pendant or meniscus cements formed in an oxidizing vadose zone. A hardground displays marine fibrous cements and non-ferroan dogtooth cements that formed in a subtidal environment in oxidizing water. Two composite surfaces were affected by marine and subaerial lithification. Composite surface 1 displays non-luminescent ferroan dogtooth cements that precipitated in reduced seawater conditions, followed by brown-luminescent dogtooth cements characteristic of a meteoric phreatic environment. Composite surface 2 exhibits microbially-induced fabrics that formed in marine water with abundant organic matter. The latter discontinuity, initially formed in a subtidal environment, was subsequently exposed to meteoric conditions, as evidenced by ferroan geopetal cements. This study shows that a high-resolution ion microprobe and LA-ICPMS-HR studies are essential to precisely document the successive diagenetic environments that have affected carbonate rocks and discontinuities with a polygenic and intricate history.