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ABSTRACT

Sedimentary gaps are a major obstacle for the reconstruction of carbonate platforms history. In order to improve the understanding of the early diagenesis and the succession of events occurring during the formation of discontinuity surfaces in limestones, Secondary Ion Mass Spectrometry (SIMS) is used for the first time to measure the $\delta^{18}O$ and $\delta^{13}C$ signatures of 12 early cement and fabric stages in several discontinuity surfaces from the Jurassic carbonate platform of the Paris Basin. Pendant cements show a high variability in $\delta^{18}O$, which was impossible to detect by the less precise microdrilling method. The morphology of a given cement can be produced in various environments, and dogtooth cements especially can precipitate in marine phreatic and meteoric phreatic to vadose environments. 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 $\delta^{13}C$ signals. Five discontinuity types are recognized based on high-resolution geochemical analyses and their palaeoenvironmental history can be reconstructed. Two exposure surfaces with non-ferroan pendant or meniscus cements formed in the 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 have undergone both marine and

subaerial lithification. Composite surface 1 displays non-luminescent ferroan dogtooth cements that precipitated in reduced conditions in seawater, 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 byferroan geopetal cements. A high-resolution ion microprobe study is essential to precisely document the successive diagenetic environments that have affected carbonate rocks and discontinuities with a polygenic and intricate history.

Keywords: Early cements, Oxygen and carbon isotopes, SIMS, Discontinuities, Diagenesis, Carbonate