

**The complex diagenetic history of discontinuities in shallow-marine carbonate rocks: new insights from high-resolution ion microprobe investigation of  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  of early cements**

Simon Andrieu, Benjamin Brigaud, Jocelyn Barbarand, Eric Lasseur

► **To cite this version:**

Simon Andrieu, Benjamin Brigaud, Jocelyn Barbarand, Eric Lasseur. The complex diagenetic history of discontinuities in shallow-marine carbonate rocks: new insights from high-resolution ion microprobe investigation of  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  of early cements. International Meeting of Sedimentology 2017, Oct 2017, Toulouse, France. 10.1111/sed.12384 . hal-01535062

**HAL Id: hal-01535062**

**<https://hal-brgm.archives-ouvertes.fr/hal-01535062>**

Submitted on 8 Jun 2017

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

**The complex diagenetic history of discontinuities in shallow-marine carbonate rocks: new insights from high-resolution ion microprobe investigation of  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  of early cements**

Simon Andrieu<sup>a</sup>, Benjamin Brigaud<sup>b</sup>, Jocelyn Barbarand<sup>b</sup> and Eric Lasseur<sup>a</sup>

<sup>a</sup> BRGM, 3 avenue Claude Guillemin, BP 36009, 45060 Orléans, France

<sup>b</sup> GEOPS, Univ. Paris-Sud, CNRS, Université Paris Saclay, Rue du Belvédère, Bât. 504, 91405 Orsay, France

Corresponding author

simon.andrieu@u-psud.fr; Tel.: +33 169156126; fax: +33 169154911

**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  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  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  $\delta^{18}\text{O}$ , 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  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$  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 by ferroan 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