New sedimentological, petrographical, geochemical, and U-Pb geochronological data from breccias of the Bas Agly syncline (northeastern Pyrenees, France)

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This study focuses on breccias, widely developed in the Bas Agly syncline at the Late Jurassic/Early Cretaceous boundary. Both their age and formation processes are debated and remained hypothetical until today.

According to our detailed sedimentological study, the breccia localized in the Late Jurassic are spatially associated with large-throw normal faults and show a clear sedimentary character. They result from the creation of a steep topography that becomes unstable, producing major rockfalls. The studied breccias, are characterized by poorly sorted polygenic deposits of pebbles to boulders composed of highly angular pluri-millimetric to pluri-metric carbonate clasts. A lateral evolution is observed, with pebble-size clasts found near the normal fault and boulder-size clasts away from the fault. This evolution is related to the rockfall process as the total kinetic energy acquired by the small clasts during the fall is lower than that acquired by the bigger ones; as a result, the latter are able to travel farther. These breccias are related to a first stage of extension during the Late Jurassic and marks the beginning of the Early Cretaceous extension. However, the heterogeneity and complexity of the structure of carbonate breccias require a detailed characterization of both their petrographic evolution and diagenetic paleoenvironment in order to confirm our sedimentological model.

Based on observations under S.E.M, polarized-light and fluorescence microscopy a detailed inventory of the diagenetic phases has been performed. From these analyses, a diagenetic sequence and a chronology of the cements have been reconstructed, using principles of overlapping, superposition and inclusion. The oxygen and carbon isotopic compositions of some cements and matrices of these breccias allowed to specify the diagenetic environments.

The occurrence of metamorphic minerals overprinting the latest phase of calcite cementation strongly suggests that the breccia deposited prior to the Albo-Cenomanian regional metamorphic phase in contrast to previous stratigraphic attributions (Eocene age) and support our interpretation of an interstratified sedimentary breccia of Late Jurassic age. Thus, it is crucial to know the real age of these rocks. In order to solve this issue, we initiated a geochronological study, using in-situ U-Pb dating by LA-ICP-MS and focusing on the carbonate matrix of the breccias. This approach has proven successful and yielded ages consistent with the proposed depositional environment.

Keywords: breccias, Normal fault, extension, diagenesis, stable isotope ($\delta^{13}C$, $\delta^{18}O$), S.E.M, U-Pb dating, Bas Agly, Pyrenees.

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