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Characteristics and timing of hydrothermal fluid circulation at the Iberian hyper-extended rift system: New constraints from the Chaînons Béarnais (W Pyrenees).

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The evolution and formation of passive rifted margins is strictly linked to different geological processes in which fluids activity is much more important and diffused than previously thought. Nonetheless, the physico-chemical properties, timing, pathways and source areas of these fluids are still little studied and understood, especially in the sedimentary environment. This contribution aims to shed light on the interaction between fluids and sediments within the most distal parts of the Mauléon Basin in the Western Pyrenees. The target of the study is the pre- to syn-rift sedimentary sequence cropping out along the eastern termination of the Chaînons Béarnais. The attention has been focused on the post-depositional modifications of the host rocks due to hydrothermal fluids. The Chaînons Béarnais are interpreted to be extensional allochthons over long offset detachment faults that were responsible for the exhumation of mantle rocks at the seafloor during mid-Cretaceous time. As already demonstrated in previous studies, both in the Pyrenees and the Alps, the extensional detachment systems are associated with impressive volumes of fluids interacting with basement and sedimentary rocks. Strong field- and petrography-based evidence of fluid-related products will be shown referring to Jurassic-Cretaceous rift events in the easternmost Mauléon basin. The geological constraints are further strengthened by new U-Pb dating on carbonates and analytical data, which point to the occurrence of very hot fluids (microthermometry of fluid inclusions up to 250°C) characterized by highly depleted δ18O and strongly enriched Sr87/Sr86. Based on these data we re-interpreted the lithostratigraphy of the studied area and were able to find the well-described albitization described from the central and eastern Pyrenees also in the Chaînons Béarnais. Based on the chemistry of the fluids, two main stages of fluid activity can be defined. The first, carbonate-rich, led to fabric-destructive replacement dolomitization of the host carbonates, widespread hydrofracturation generating different types of hydraulic breccias ($\sim$ 96 Ma) cemented by multi-phase dolomite and calcite and, finally, micro- to meso-scale fracturation and veining. The second stage, dominated by Na-SiO_2-rich fluids, is associated with authigenic albite and quartz that affected mainly syn-rift deposits. Findings of authigenic sulphides point to an even more complex fluid system. Finally, the occurrence of dolomite marbles and mylonites provide evidence for strong recrystallization and ductile shearing during the latest stages of hyper-extension as shown by U-Pb dating ($\sim$ 94 Ma). Despite the lack of extensive outcrops, the Chaînons Béarnais represent a primary target to investigate fluid-rock interaction in response to extensional tectonics as also already described for other fossil analogues (e.g. Adriatic paleo-rifted margin) as well as present-day rifted margins (e.g. Iberia and Red Sea).