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Multiple phases of fracturation in Quercy (southwest France) limestones. Dating the stress record in an intraplate setting.

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This study questions the propagation of far field stress and the reactivation of inherited faults in the forelands during an orogeny. The NW-SE hercynian and the NE-SW variscan directions of structures in southcentral France forms the well-known “hercynian V” playing a major role in the subsequent sedimentation and tectonic deformation in the eastern Aquitaine Basin. The most important structures recognized in the area include the N20° Villefranche-Toulouse fault and the N150° West Quercynois Accident. Our study combines structural fieldwork with petrography and geochemical analyses of syn-kinematic calcites to better spatially and temporally characterize the linkages between intraplate deformations, the nature of associated syn-kinematic fluids and major events occurring at the plate boundaries.

Fieldwork observations and structural analyses reveal three principal directions: E-W reverse faults, NW-SE dextral and NE-SW sinistral strike-slip faults. Paleostress inversions show that they are kinematically coherent, all with a nearly N-S horizontal σ1. Moreover, evidence of E-W normal faulting exists, characterized by a N-S extension.

In order to conduct a petrographic and geochemical study, 30 oriented thin sections have been realized from calcite cement samples collected from faults and fractures. Observations of thin-sections with alizarin–potassium ferricyanide and by cathodoluminescence microscopy allows for documentation of the cement stages. The two different stress states (extension and compression) consist of specific cement type: calcite extensive (CAL-E) and calcite compressive (CAL-C). These two fracture fillings are characterized by two distinct geochemical signatures (-6.65 ‰ and -6.02 ‰ in d18O and -3.80 ‰ and -0.24 ‰ in d13C). In situ U-Pb age of syn-kinematic calcite suggest two distinct periods of tectonic activity during the (1) Campanian/Maastrichtian and the (2) Lutetian/Bartonian. Clumped isotope data suggests a crystallization temperature of about 45°C and d18O of paleo fluid around 0‰.

Using this combined approach, we revisit the tectonic calendar revealing tectonic events not always clearly expressed in the field. We show that stress fields propagate throughout intraplate settings in the form of pulses of strong tectonic activity from the Pyrenean Orogeny.

Keywords: Quercy, Aquitaine Basin, syn-kinematic, calcite, U-Pb dating, d13C, d18O, delta47

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