Tracking inherited fluid circulations and tectonic events in the Jura fold-and-thrust belt via U-Pb geochronology on carbonates

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Résumé

The architecture of fold-and-thrust belts is typically explained using critical taper theory, with parameters such as strength profile and wedge angle governing deformation. However, inherited basement structures offsetting the basal décollement may significantly influence the localization of deformation in the sedimentary cover. Identifying such inherited features is essential to understanding belt evolution but their recognition is hindered by later tectonic overprinting. The development of U-Pb geochronology on calcite, combined with detailed petrography, provides a valuable tool to address this challenge.
We investigated the Paleogene tectonic inheritance in the Jura fold-and-thrust belt using new geochronological data. Seismic and borehole analyses revealed strong heterogeneity in the basement-cover interface, suggesting structural inheritance. Previous paleostress analyses demonstrated polyphase deformation consistent with the main Paleogene tectonic events

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in Western Europe. To date, U-Pb dating on tectonic structures in the internal Jura have only focuses on Miocene-Pliocene deformation.

We sampled various tectonic structures (veins, fault planes, breccias) from the Ornans Plateau (Central Jura, external domain), where inherited structures are better preserved. Combining petrography with *in-situ* U-Pb dating allowed us to distinguish multiple generations of calcite (fibrous, blocky, etc.) and reveal complex crystallization histories. For example, sequential cement generations in a breccia sample yielded three distinct U-Pb ages, while four slickenfibers calcite samples from the same outcrop display different age distributions, each preserving its own crystallization sequence.

Results reveal three age groups. The youngest (10–6 Ma) matches the main phase of Jura thrusting. Two older groups: 48–38 Ma (Pyrenean far-field) and 34–31 Ma (Alpine far-field and transtensional deformation related to the ECRIS). A fourth group (25–20 Ma) corresponds to fluid circulation and recrystallization events, cutting across Paleogene structures and suggesting tectonically "silent" yet hydrothermally active periods.
These results not only document previously unrecognized Paleogene deformation in the external Jura but also highlight the importance of inherited structures and syn- to post-tectonic fluid flow in shaping the fold-and-thrust belt. They raise key questions about erosion and dissolution processes predating Miocene deformation and the role of fluids in modifying petrophysical properties and the subsequent structural architecture of the belt beyond the major compressional episode.