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Chronology of fault activity in the W-Alpine foreland revealed by in-situ U−Pb dating on syn-tectonic calcite.

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Studies on the long-term activity of fault systems are critical for our understanding of the orogenic evolution, basin formation, and the interplay between deformation and erosion processes. The Western Alps foreland basin, situated at the convergence of the Pyrenean and Alpine orogenic domains, displays a complex structural pattern that resulted from multiple tectonic events since the Mesozoic. This complexity is highlighted by the structural association of brittle deformations with well-developed fold structures, particularly in the marly lithologies of the foreland. Although chronologies have been established through relative dating of the sedimentary units, absolute timing of these deformation events remains a challenge due to the uranium-poor minerals common in this setting. To overcome these limitations, we combine detailed field structural analysis and paleostress estimation with an in-situ U–Pb dating method applied to syn-tectonic calcite-filled structures. Stable isotope analysis ($\delta^{18}O$ and $\delta^{13}C$), performed on carbonates is used to trace fluid source and activity during the successive tectonic episodes. Focusing on the subalpine massifs and the Vocontian domain (from the Vaucluse massif to the Bornes massif), this study aims to decipher the brittle tectonic history of the Alpine foreland within the regional geodynamic framework and to document the propagation of intraplate deformations recorded in the sedimentary cover.