
Are we misled by U-Pb geochronology? Case studies where absolute ages of calcite mineralization challenge diagenetic, thermal, and structural models.

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Résumé

Recent progress in LA-ICP-MS U-Pb geochronology has been a key step forward in refining our understanding of geological processes. One of this progress is to reveal unsuspected issues in preexisting geological interpretations, especially considering the thermal history, deformation sequence, diagenesis, and fluid flow. In the central western African passive margin, 8 U-Pb ages were obtained in the host rocks' calcite cement of (1) the Barremian pre-rift, infra-salt lacustrine TOCA Fm and (2) the Albian post-rift, supra-salt shallow-marine Sendji Fm. The age of calcite precipitation of $125\text{Ma} \pm 5\text{ Ma}$ for the TOCA Fm and $101\text{Ma}, \pm 1\text{Ma}$ for the Sendji Fm indicates that cementation closely followed the deposition. However, fluid inclusions revealed that precipitation occurred from hot (158°C and 90°C , respectively) and hypersaline (300-360 g/L) paleofluids. The timing of cement precipitation from such fluids, nearly syn-depositional, appears inconsistent with the geothermal gradient under virtually no cover at that time and with the deposition environment. This inconsistency suggests an input of hypersaline hydrothermal fluids from underlying Neoproterozoic evaporites (TOCA Fm) and from Aptian salt (Sendji Fm). A potential drain for such fluids can be fault zones associated with the rifting phase (TOCA Fm) or post-rift salt tectonics (Sendji Fm). In the folded strata of the Mirabeau anticline (SE basin, France), 10 partially overlapping U-Pb

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dates were obtained from calcite mineralization in faults and fractures of which development encompasses the whole folding event (Layer Parallel Shortening, fold growth, and Late Stage Fold Tightening). Results suggest that the accommodation of shortening by brittle deformation was recorded as a single fold-related damaging event, more continuous than previously proposed, implying all the conceptual steps of fold-related shortening (Layer Parallel Shortening, folding, Late Stage Fold Tightening). U-Pb geochronology also suggests a short-lived fold growth occurring within 5 up to 10My (between $45 \pm 2\text{Ma}$ and $40 \pm 5\text{Ma}$) during the Pyreneo-Provençal orogeny solely, with little to no alpine contribution, nor older structuration in relation to the structural inheritance. When considering the geochemistry and precipitation temperature of the mineralizing fluids throughout the folding event, the U-Pb dates question the cooling history of the exhuming strata during folding.

Mots-Clés: U, Pb geochronology, calcite mineralization, diagenesis, fracture sequence, thermicity