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How bedding-parallel stylolites reveal burial depth history in fold-and-thrust belts: a multi-case comparison.

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Stylolites are rough dissolution surfaces commonly found in carbonates, characterized by peaks oriented parallel to the maximum principal stress active at the time the dissolution occurred. The development of the Stylolite Roughness Inversion Technique (SRIT) applied to sedimentary bedding-parallel stylolites (BPS) provides an access to the magnitude of the vertical maximum principal stress experienced by the host carbonates, and thus to their maximum paleo-burial depth. A recent study of a BPS population hosted in poorly tectonized Middle Jurassic carbonates of the Paris basin sub-surface (France) unravelled that stylolite morphology controls the maximum vertical stress at which the stylolite was still active. That led to possibly reconstruct the burial history of strata from a BPS population regardless of the fluid pressure and temperature. However, the reliable use of BPS to better constrain the burial depth in tectonized contexts where unroofing by erosion likely occurred such as fold-and-thrust belt was not tested.
This study reports a critical comparison of the results of SRIT applied to BPS stylolite populations in various fold-and-thrust belts: a first population hosted in deformed Paleozoic carbonates of the Bighorn basin in the Laramide fold-and-thrust belt (Wyoming, USA); a second population hosted in deformed Jurassic carbonates of the Umbria-Marche fold-and-thrust belt (Apennines, Italy); and a third population hosted in Jurassic carbonates of the Bearnaise Chains (Pyrenees, France). Results highlight how a population of BPS can record intermediate to maximum burial depths, as long as the maximum principal stress remains vertical, i.e. until it switches to horizontal in response to tectonic stress build-up. Especially suture and sharp peak BPS are better suited to estimate the maximum depth at which the principal maximum stress switch from vertical to horizontal, whereas seismogram pinning BPS record preferentially intermediate depths, providing new insights into possibly complex burial history, including tectonic burial by thrust sheets.