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Fingerprinting stress: stylolite and calcite twinning paleopiezometry reveal the complexity of stress distribution during the growth of the Monte Nero anticline (Apennines, Italy).

Nicolas Beaudoin (1), Daniel Koehn (1), Olivier Lacombe (2), Alexandre Lecouty (2), Andrea Billi (3), Einat Aharonov (4), and Camille Parlangeau (2)

(1) School of Geographical and Earth Sciences, University of Glasgow, Glasgow, United Kingdom (nicolas.beaudoin@glasgow.ac.uk), (2) Institut des Sciences de la Terre de Paris (iSTeP), Sorbonne Universites, UPMC Univ Paris 06, CNRS, Paris, France, (3) Consiglio Nazionale delle Ricerche, IGAG, Rome, Italy, (4) Institute of Earth Sciences, the Hebrew University of Jerusalem, Jerusalem, Israel.

This contribution presents for the first time how quantitative stress estimates can be derived by combining calcite twinning and stylolite roughness stress fingerprinting techniques in a structure part of a complex fold and thrust belts. We report a high-resolution deformation and stress history that was experienced by Meso-Cenozoic limestone strata in the overturned Monte Nero Anticline during its late Miocene-Pliocene growth in the Umbria-Marche Arcuate Ridge (northern Apennines, Italy). New methodological development enables an easier use for the inversion technique of sedimentary and tectonic stylolite roughness. A stylolite-fracture network developed during layer-parallel shortening (LPS), as well as syn- and post-folding. Stress fingerprinting shows how stress builds up in the sedimentary strata during LPS with variations of differential stress before folding around a value of 50 MPa. The stress regime oscillated between strike-slip and compressional during LPS and became transiently extensional in limbs of developing fold due to a coeval increase of vertical stress related to local burial and decrease of maximum horizontal stress related to hinge development, before ultimately becoming strike-slip again during late stage fold tightening. Our case study shows that stress fingerprinting is possible and that this novel method can be used to unravel complex temporal relationships that relate to local variations within evolving regional orogenic stresses. Beyond regional implication, this study validates our approach as a new exciting toolbox to high-resolution stress fingerprinting in basins and orogens.