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Mechanically-controlled rock-microstructures: Witnesses of the long-term stress-state in the continental lithosphere

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The knowledge of the response of the Earth's lithosphere on a stress rise, rock rheology, helps us to understand mountain building processes as well as natural hazards. Yet, the challenge lies in the extrapolation of the non-linearity of rock viscosity from experimental conditions over geological timescales. This makes the rheological parameters the least certain inputs in the geodynamic models. We show that mechanically-controlled petrographic observations serve as witnesses of the stress state of the Earth's interior and can be thus used to infer rheological properties to improve the extrapolation of experimental data. We document that metamorphic rocks produced in orogenic belts as an outcome from natural processes over geological time scales may be a source of unique rheological constrains and a calibration for the extrapolation of laboratory measurements. The new calibration offers a unique opportunity for considering the rheological behavior of minerals that experienced long-term deformation at natural conditions.