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Scaled analogue modelling using the MultiBox: a new approach for better understanding kinematic complexities of transpression.

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Scaled analogue modelling has advanced to an effective experimental technique to better understanding complex geodynamic processes and to test respective hypotheses. The method is based on monitoring deformation of mostly granular and viscose materials, serving as rock analogues, within a finite realm of known boundary conditions. Modelling transpression (or transtension), i.e. simultaneous strike-slip and transverse shortening (or extension) by means of analogue experiments continues to be a challenge in experimental tectonics. A number of different experimental setups modelling transpression were generated in the past, which, despite being based on identical boundary conditions, show different outcomes in terms of deformation kinematics. Here, we introduce our newly developed "MultiBox" tailored to model transpression and transtension. We compare results of the structural evolution of transpression experiments achieved with the MultiBox to those resulting from previous experimental setups in order to identify the most realistic experimental approaches.
The MultiBox consists of two halves, each of which contains a piston, whereby one halve is mobile and moves relative to a fixed halve parallel to the box midline, thereby inducing a velocity discontinuity. A large spectrum in deformation regimes can be generated by varying the displacement rates of the pistons and the mobile box halve. The rather large size of the MultiBox (1m x 1m x 30cm) guarantees high accuracy in length scaling. Computer-controlled stepper motors drive all moving parts of the box and are a prerequisite for high reproducibility of experimental results.
Using two-layer models scaled to length, deformation rate and viscosity, our experiments pertain to crustal-scale transpression. A base layer of silicone represents the viscous lower crust and distributes displacement over the entire ground surface of the MultiBox. A 2:1 flour-sand mixture adheres to the brittle upper crust. Using 2D digital image correlation, we investigate the structural evolution of the brittle layer and compare our results and boundary artefacts to those of other experimental setups. The results generated with the MultiBox highlight deformation partitioning of transpression sensu stricto.