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Internal deformation of the Dolomites Indenter, eastern Southern Alps: Orthogonal to oblique basin inversion investigated in crustal scale analogue models

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The Dolomites Indenter (DI) represents the front of the Neogene to ongoing N(W)-directed continental indentation of Adria into Europe. In this contribution, we focus on the internal deformation of the DI and its eastern continuation towards the Dinarides. Using a series of crustal scale analogue models, we investigate the effect of Jurassic E-W extension on the NW-SE directed shortening of the DI during Alpine orogeny.

The brittle and brittle-ductile analogue experiments can be grouped in two sub-series. In sub-series A, the platform-basin topography has been created by pre-scribing an initial strength contrast between platforms and basins followed by one stage of indentation. In sub-series B, graben structures were developed through an initial extensional phase, subsequently followed by compression. The evolving grabens were syn-kinematically filled up to different thicknesses depending on the material used; either with quartz sand up to a platform/basin thickness ratio of 0,75 or with feldspar sand or glass beads up to the initial, non-stretched crustal thickness. The brittle upper crust of platforms was simulated with quartz sand, the brittle to ductile middle crust by either glass beads or by a mixture of polydimethylsiloxane (PDMS) silicon putty and quartz sand. In both sub-series, variations in the orientation of rheological boundaries with respect to the convergence direction have been modelled. This (oblique) basin inversion allows us to test various deformational wavelengths as well as timing and localisation of uplift of the DI's upper to middle crust.

Modelling results of (oblique) basin inversion confirm the localisation of deformation in areas of lateral strength contrasts (Brun and Nalpas, 1996), as transitions from platforms to basins represent. Spacing of in-sequence thrusts is larger on platforms and smaller in basins, visible in both, models of sub-series A (inversion of strength difference only) and B (inversion of strength difference and actual normal faults). The vergence of in-sequence structures varies from mostly foreland directed using glass beads as basal detachment, to pop-up structures using putty, to a combination of both using quartz sand only. Based on our modelling observations, we propose that the overall style of deformation is less dependent on the material of the basal décollement, but is ruled by the inherited platform/basin configuration.

To compare analogue modelling results with deformation in the DI, structural fieldwork accompanied by thermochronological sampling was carried out (for details on structural and thermochronological data see the contribution of Klotz et al. in session GD8.4). According to field observations, the shortening direction along several of the studied faults, e.g. the overall SSE-vergent Belluno thrust (Valsugana fault system, external eastern Southern Alps, Italy), changes locally from top SSW to top SSE along strike. We infer that the variability of shortening directions along these thrust faults depends on inherited geometries and is not the result of different deformation phases. One possible conclusion from this observation is that the number of deformation phases in the Southern Alps may have been overestimated so far.

References:

Brun, J.-P., Nalpas, T. (1996). Graben inversion in nature and experiments. Tectonics. v. 15, no. 3, p. 677-687.