Models of lithospheric-scale deformation during plate collision effects of indentor shape and lithospheric thickness

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Abstract

Analogue models designed to test the effects of lithosphere thickness and indentor shape during continental collision indicate that strength and density differences between lithosphere types control structural vergence during collision. Models presented here include layers of putty and sand to form 4-, 3- and 2-layer lithosphere types (craton, arc and oceanic equivalent) respectively, which collide during unidirectional shortening. In most cases the stronger, thicker 4-layer lithosphere does not deform, but simply acts to bulldoze weaker material aside. Deformation, concentrated in the thinnest layers, consistently verges away from the indenting continent, irrespective of indentor shape. Lateral (strike-slip component) deformation occurs in the early stages of most models, even with simple unidirectional shortening, and is enhanced by highly oblique indentor shapes. The effects of extrusion during collision, modelled by repeating models with and without a free edge which allows extrusion, consistently indicates that with the ability to extrude structures are smaller and more numerous. Without extrusion fewer, larger structures tend to develop. Two geological examples, from the Precambrian part of the Tasman orogenic belt and the modern day collision at the leading edge of Australia illustrate aspects of the models.

Keywords: continental collision, analogue modelling, indentor