

Crustal Flow Modes in Large Hot Orogens

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Abstract: Crustal scale channel flow numerical models support recent interpretations of Himalayan-Tibetan tectonics proposing that gravitationally driven channel flows of low-viscosity, melt weakened, middle crust can explain both outward growth of the Tibetan plateau and ductile extrusion of the Greater Himalayan Sequence. We broaden the numerical model investigation to explore three flow modes: Homogeneous Channel Flow (involving laterally homogeneous crust); Heterogeneous Channel Flow (involving laterally heterogeneous lower crust that is expelled and incorporated into the mid-crustal channel flow); and Hot Fold Nappes style of flow (in which mid-/lower crust is forcibly expelled outward over a lower crustal indenter to create fold nappes that are inserted into the mid-crust). The three flow modes are members of a continuum in which the Homogeneous mode is driven by gravitational forces but requires very weak channel material. The Hot Fold Nappe mode is driven tectonically by, for example, collision with a strong crustal indenter and can occur in crust that is subcritical for Homogeneous flows. The Heterogeneous mode combines tectonic and gravitationally-driven flows. Preliminary results also demonstrate the existence and behaviour of mid-crustal channels during advancing and retreating dynamical mantle lithosphere subduction. An orogen Temperature-Magnitude (T-M) diagram is proposed and the positions of orogens in T-M space that may exhibit the flow modes are described, together with the characteristic positions of a range of other orogen types.

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