Provenance of the Greater Himalayan Sequence and associated rocks: Predictions of channel flow models

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Abstract: Numerical models for channel flow in the Himalayan-Tibetan system are compatible with many tectonic and metamorphic features of the orogen. Here we compare the provenance of crustal material in two channel flow models (HT1 and HT111) with observations from the Himalaya and southern Tibet. Thirty million years after the onset of channel flow, the entire model crust south of the India-Asia suture still consists only of "Indian" material. The model Greater Himalayan Sequence ("GHS") is derived from Indian middle crust originating ≤ 1000 km south of the initial position of the suture, whereas the Lesser Himalayan Sequence ("LHS") is derived mainly from crust originating ≥ 1400 km south of the suture. Material tracking indicates little or no mixing of diverse crustal elements in the exhumed region of the model "GHS", which is derived from originally contiguous materials that are transported together in the top of the channel flow zone. These results are compatible with provenance data indicating a clear distinction between GHS and LHS protoliths, with the GHS originating from a more distal position (relative to cratonic India) than the LHS. In model HT111, domes formed between the suture and the orogenic front are cored by "Indian" middle crust similar to the "GHS", consistent with data from the north Himalayan gneiss domes. Material tracking shows that plutons generated south of the suture should have "Indian" crustal signatures, also compatible with observations. Model "GHS" P-T-t paths pass through the dehydration melting field between 30 and 15 Ma, consistent with observed leucogranite ages. Finally, exposure of mid-crustal "GHS" and "LHS" material at the model erosion front is consistent with the observed appearance of sedimentary detritus in the Lesser Himalaya. We conclude that channel flow model results are compatible with provenance data from the Himalaya and southern Tibet.