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Channel Flow Model of Extrusion of the Higher Himalaya- Successes & Limitations

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During laminar 'channel flow'/'Plane Poiseuille flow' of an incompressible Newtonian viscous fluid through a very long parallel horizontal static walls of a channel due to a pressure gradient, a parabolic velocity profile is produced. The sense of ductile shearing across the middle of the channel is opposite. Grujic et al. (1996) and Beaumont et al. (2001) applied this flow mechanism to explain the extrusion of the Higher Himalaya (HH). In their sequel, the Dalhousie school of modelers kept enumerating this extrusion model.

Successes of the channel flow extrusion model are that it explains (1) extensional top-to-NE sense of ductile shearing in the South Tibetan Detachment System (STDS) simultaneous to the top-to-SW sense of compressional shearing in the remainder of the HH; (2) fluid activity below the southern part of the Tibetan plateau; and (3) inverted metamorphism in the HH.

However, limitations of this extrusion model are as follows. (1) A previous top-to-SW sense of compressional shearing in the STDS is not taken care by the model alone. (2) The thickness of the STDS in reality is thinner than the remainder of the HH. In the model, on the other hand, their thicknesses should be the same. (3) Presence of a second strand of the STDS inside the HH that is absent in some sections of the mountain chain remained unexplained in the model. (4) The ductile shear fabric of more commonly sigmoid-, and less commonly parallelogram- and lenticular geometries are found inside the HH. However, had the channel flow been the extrusion mechanism and rocks deformed as a Newtonian fluid, parabolic shear fabrics are expected. Additionally, can the genesis of the intrafolial folds inside the two strands of the STDS (e.g. Mukherjee, 2007) be explained by the channel flow mechanism? (5) Regions and their spatial extents with different senses of ductile shearing would change if the rocks deformed Non-Newtonically. The exact geometry of the velocity profile will depend on the strain exponent of the rock. Did the HH rocks extrude as a Newtonian fluid? (6) An increase in the extrusion rate and a decrease in the ductile shear strain from the Main Central Thrust (MCT- the lower boundary of the HH) up to the lower boundary of the STDS, and then an increase in extrusion rate and a decrease in shear strain up to the upper boundary of the STDS are expected as per the channel flow model. Such a systematic and a detailed variation of the extrusion rate and shear strain have not yet been documented from the HH. (7) The detail geological information for individual sections of the HH is not taken care by the model. For example in the Sutlej section of the western Indian Himalaya, the HH rocks are divisible into a lower lithounit of higher viscosity and an upper lithounit of lower viscosity (Fig. 2 of Caddick et al., 2007; Figs. 3.2 and 3.11 of Mukherjee, 2007). What will be the velocity profiles of a pressure gradient guided extrusion through a two-viscous media?

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