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Implication of the southern Tethyan Himalaya (Sutlej section, India) for the extrusion of the Higher Himalaya and the geometry of the mid-crustal channel

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In the last three years, various combinations of channel flow and critical taper mechanisms have been suggested as plausible mechanism for the extrusion of the Higher Himalaya (HH, Beaumont and Jamieson 2010; Chambers et al., 2011; Larson et al., 2011; Corrie et al., 2012; Long et al. 2012; Mukherjee, in press). An alternate and rather less popular model of the HH has been southward droop of the northern boundary of the HH viz. the 'South Tibetan Detachment System-Upper (STDSU)' (Exner et al. 2006). Had the later been true, drag folds with southward vergence would be expected immediately north of the STDSU. In a SW to NE traverse from Morang up to Spillo along the Sutlej river valley (Himachal Pradesh, India), such folds do occur within the southern part of the Tethyan Himalaya. On close observation, the primary shear planes of top-to$\sim$S shear are overturned by folds with broad rounded hinges and with $\sim$ NE dipping axial planes and limbs. The shear sense indicated by the sigmoid fabrics matches with the asymmetry of the folds. Northward from Spillo, large-scale folds (antiforms) with down-dip extensional shear in both limbs indicate 'irregular' doming of the Tethyan sediments. One of the best exposures of this shear sense that could be deciphered even from a distance is where the National Highway 22 running along the river valley joins the road to Nasang village. Below the Tethyan sediments, a mid-crustal sub-horizontal channel is widely accepted to allow the Higher Himalayan rock materials to flow from beneath south Tibet. Much north of Spillo, the Leo Pargil granite-gneiss dome has been suggested as an exposure of the channel materials. Thus, this work suggests (i) flap of the STDSU might have triggered the extrusion of the HH; and (ii) doming of a part of the Tethyan Himalaya could be due to the rise of low-density hot, partially molten rocks through the sub-horizontal channel. This would imply that the upper boundary of the sub-horizontal channel was flexible rather than rigid. Following Mancktelow (2008), the viscosity ratio between the mid-crustal material and that of the surrounding Tethyan sediments might be > 10-7.Taking the viscosity of the mid-crustal material as 1018-1019 Pa s, that for the Tethyan schists are loosely constrained as < 1025 to 1026 Pa s. This matches the viscosity values (between 500-700 0C: 1018-1019 Pa s) given for schists by Landholt-Bornstein (1982).