Solid Earth Discuss.,
https://doi.org/10.5194/se-2018-92-AC3, 2018

Interactive comment on "Comment on Marques et al. (2018), Channel flow, tectonic overpressure, and exhumation of high-pressure rocks in the Greater Himalayas" *by* John P. Platt

Platt

jplatt@usc.edu

Received and published: 28 November 2018

Response to Review by E. Moulas J. P. Platt jplatt@usc.edu

I have already addressed many of the points raised by Moulas in my response to the Reply by Marques et al., so in the interests of brevity I will just emphasize a few of the critical issues.

Moulas dismisses my concerns about the boundary conditions, suggesting that because Marques et al. (hereafter M18) used the Navier Stokes equations to solve for the velocities in the channel, the boundary conditions will obey the requirement for force balance. This is incorrect. The boundary conditions were not calculated using Navier-Stokes: they were imposed arbitrarily by M18. A physical process is required that is capable of keeping the boundary fixed, and M18 gave no indication what this might be. In their model set up, the only load acting on the upper boundary is the weight of the overlying rock.

Moulas's statement “One cannot make predictions of the magnitude of the applied stresses in regions outside the model domain” is an abrogation of scientific responsibility. M18 presented their model as a calculation of the dynamic pressure in a real subduction channel in the Himalayas, and they draw conclusions from it about Himalayan metamorphism. We have to consider the tectonic context of the model, and in fact M18 in their paper discuss the fact that the strength of the walls is an important factor governing the dynamic pressure.

Responses to the specific comments:

“M18 did not state that they have a typical corner-flow model”. True, but it is a corner flow model: see my response to the Reply by M18. The channel has to close downward, and M18 state this.

“There is no specific reason on why the downward velocity (of the footwall ramp) must be exactly the same as the one of the plate”. M18 state that the underthrust plate is rigid. The footwall ramp is part of the underthrust plate, so it must move with it. M18 make no reference to “rheological boundaries”. They take a feature that they describe as part of the lower plate, and give it the same velocity as the upper plate. That isn't an exaggeration: it's simply wrong.

The remaining points have been addressed in my other posts. Note that loads generated by differential topography in the Himalayas are unlikely to exceed 135 MPa. Differential stresses are unlikely to have exceeded 200 MPa: the upper plate in the Himalayas consists of a variety of sedimentary and metamorphic rocks, minor amounts of granite, and serpentinite. It is cut by abundant faults: reverse, normal and strike-slip.

The microstructure (e.g., dynamically recrystallized grain size in quartz) suggests differential stresses up to 28 MPa (Law et al., 2013). The effective elastic thickness of the lithosphere in that region, calculated from the admittance between topography and free air gravity, is in the range 0-20 km, implying that it is unable to sustain loads of more than a few tens of MPa (Jordan & Watts (2005).

Jordan, T. A., and Watts, A. B., 2005, Gravity anomalies, flexure and the elastic thickness structure of the India-Eurasia collisional system: Earth and Planetary Science Letters, v. 236, p. 732-750.

Law et al., 2013, Deformation temperatures and flow vorticities near the base of the Greater Himalayan Series, Sutlej Valley and Shimla Klippe, NW India. Journal of Structural Geology, v. 54, p. 21-53.

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