

Interactive comment on “Linked thick to thin – skinned inversion in the central Kirthar Fold Belt of Pakistan” by Ralph Hinsch et al.

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Received and published: 15 January 2019

General comments:

R. Hinsch and colleagues present a rather straightforward structural analysis and interpretation of the central Kirthar Range thrust front in Pakistan. Their study is based on (partly new) seismic data, DEMs, satellite imagery, and some field work. The main point they are making is that a narrow belt of thin-skinned deformation at the thrust front is linked to basement-involved thrusts in the internal parts of the thrust belt. These thrusts or reverse faults are interpreted to result from the reactivation of normal faults inherited from the time when India rifted from other parts of Gondwana. I find no fundamental issues with the ideas and the way they are presented.

C1

Specific comments:

In the way of data, the weakest part of the paper is definitely the claim that reactivated normal faults are involved in the deep structure. The seismic profiles do not reach deep enough to show anything conclusive. The earthquake nodal planes except one at 57° dip too gently to satisfy the Coulomb-Mohr prediction for normal faults. In fact, the average (arithmetic mean) dip angle of the west-dipping nodal planes is only 38° , much closer to an ideal Mohr-Coulomb thrust fault than normal fault. The normal faults of the structural model dip around 50° . Judging from the stratigraphic description and the authors' comments, the timing of active rifting isn't very well constrained, either. The same seems to hold true for the depth to and nature of the basement. I therefore recommend to tone down the inversion-related part of the interpretation while maintaining that the basement must be involved in thrusting.

When the authors compare their new structural models to Banks and Warburton's passive-roof duplex interpretation they should at least briefly discuss what happens in the more internal parts of the belt, away from the deformation front. The passive-roof model was motivated by the need to explain gently folded strata raised well above the regional level for a considerable across-strike distance. I assume that this problem also applies to the central Kirthar Range. If the Kirthar Range is held up by a series of reactivated normal faults, where is the reverse displacement of the more internal faults accommodated that cannot be transferred to the thin-skinned front? Or, in other words, is there enough shortening in the internal Kirthar Range to support its topographic and structural elevation assuming that the basal detachment is in the basement?

I am not entirely convinced by the uniqueness of the sequence of thrusting derived in Fig. 9. The advance of a thrust wedge between thrust 1 and backthrust 2 would result in kink band migration and not "progressive limb rotation" as described by the authors (l. 22 in text) and actually suggested by the growth strata geometries. It is also interesting that the kink axis shown to be associated with the tip of the wedge at deeper levels appears offset to the west in the growth strata, but also in the syncline suggested

C2

below thrust 1. I could imagine a scenario with no bedding-parallel backthrust and thrust 1 as a late subhorizontal structure displacing the syncline axis towards the east. The implication would be that there must be another thin-skinned thrust further east.

One thing I am deeply skeptical about is the landslide interpreted in Fig. 6 b. The way this feature is described in the caption I gather that it is supposed to have formed by draping over the topography of the steep forelimb (or did I get that wrong?). I find it hard to believe that you could form the orderly anticline depicted in the satellite image from a rock mass sliding over an irregular land surface. I think that the paper would strongly benefit from a few additional figures. First, it would help the imagination to have a regional cross-section reaching west to the strike-slip system. Secondly, I strongly recommend to prepare a synthetic figure that combines the new cross-sections with those from published studies whose locations are shown in Fig. 1, preferably redrawn such that comparison is made easy. Nobody wants to look up four other papers to see what the paper they are presently reading is talking about.

Technical: See annotated pdf file in supplement

Please also note the supplement to this comment:

<https://www.solid-earth-discuss.net/se-2018-137/se-2018-137-RC2-supplement.pdf>

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2018-137>, 2018.