Forum

Extrusion tectonics and subduction in the eastern South Caspian region since 10 Ma: Comment

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ABSTRACT

Hollingsworth et al. (2008) proposed a "new" kinematic model for the complicated tectonic pattern in the eastern South Caspian Sea region. Our Comment is focused on the Ashkhabad fault and the Kopeh Dagh Mountains, examining the data and hypothesis used by the authors to support their model.

Hollingsworth et al. presented 10 m of right-lateral displacement along the Ashkhabad fault, recorded by a river bank and a line of irrigation system. In this area, the well-expressed fault trace (Fig. 1A) is not consistent with that proposed by the authors (their figure 2B). Moreover, there is no clear evidence of right-lateral displacements where the fault traces intersect either other river banks or erosional gullies (Fig. 1A). Accepting the particular line of irrigation as representative for right-lateral fault offset, it should be noted that the offset is on the order of 14 m, and not 10 m. Irrigation lines can be right-laterally or left-laterally (Fig. 1B) offset along the fault (ranging from 1 to 20 m; e.g., Trifonov, 1978). Assuming that the 14 m right-lateral offset is representative, and taking into account that the first irrigation lines were constructed no later than the 5th century B.C. (Trifonov, 1978), yields a maximum slip rate of 5.6 mm/a for this part of the fault, which, in turn, decreases the proposed strike-slip faulting inception age to ca. 6 Ma ago.

Hollingsworth et al. reconstructed a cumulative offset of 35 km along the Ashkhabad fault, using Cretaceous and Neogene deposits. Even if one accepts the reliability of this offset, it should be, at minimum, 42 km (Fig. 1D). Following the authors' map, the northwest termination of the Ashkhabad fault is northwest-trending, showing the Neogene deposits belong to the southern block. However, a detailed geomorphic analysis using satellite SPOT (Satellite Pour l'Observation de la Terre) imagery (with a pixel resolution of 2.5 m) convinced us that the Ashkhabad fault clearly is WSW-trending just north of the Cretaceous formations (Fig. 1F), showing the Neogene deposits belong to the northern block. In fact, the Neogene deposits are always located on the northern side of the fault. At the northeast termination of the fault, the Cretaceous units belong to a well-preserved syncline that shows a maximum right-lateral offset of ~6 km (Fig. 1D). Following our observations, the measurable post-Neogene offset along the same segment of the fault is ~9 km, indicated by an offset syncline (Fig. 1E).

The proposed geodynamic interpretation relies largely on rigid block rotations in the Kopeh Dagh (figures 1 and 5 in Hollingsworth et al., 2008) that cannot be confirmed by the regional fold axes pattern (Fig. 1C). Indeed, the post-folding, brittle deformation pattern favors a simple

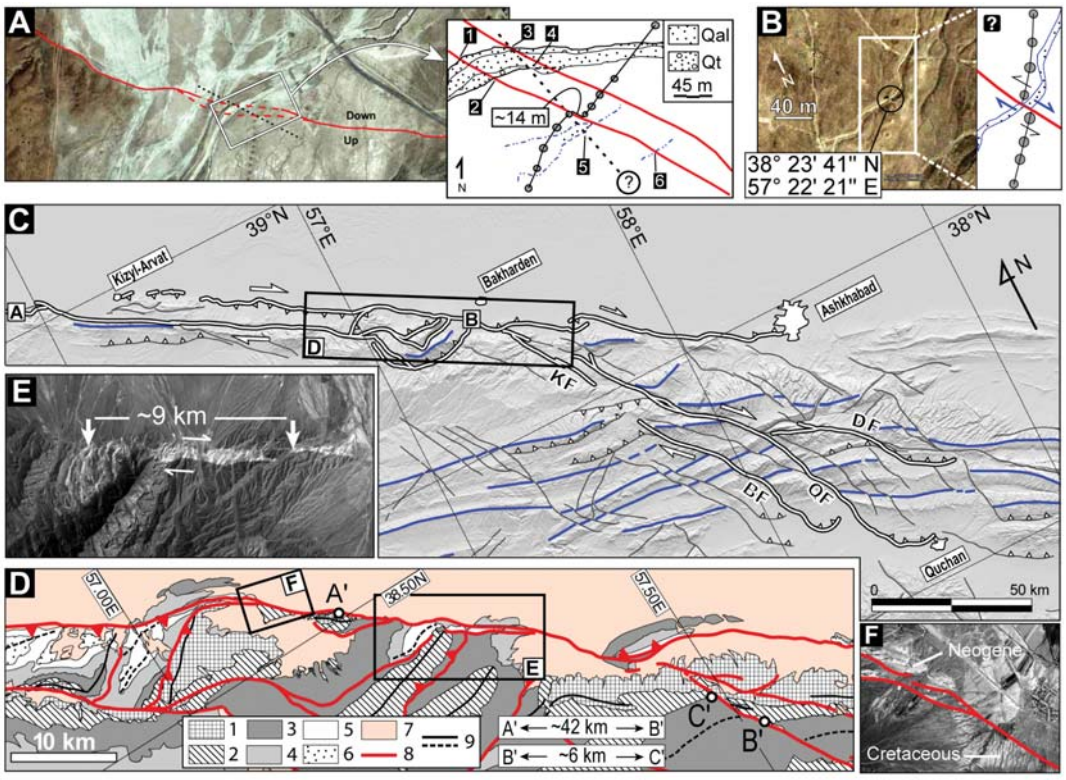

Figure 1. A: Quickbird satillite image (GoogleEarth) centered on the Kazandzhik fault, showing the fault-related morphology and possible fault traces. Inset shows a simplified morphotectonic map focused on the area investigated by Hollingsworth et al. (2008). Points 1–6 are intersection points of the fault traces with geomorphic features (1–4: river banks; 5–6: erosional gullies). The fault traces from our mapping (red lines) are compared to that proposed by Hollingsworth et al. (2008, black dotted line). B: Quickbird image (GoogleEarth) showing an apparent left-lateral offset in an irrigation line. C: Simplified structural map of the Kopeh Dagh based on SPOT5 satellite images showing the major faults (white solid lines, simplified after Shabanian et al., 2009) and the fold axes (blue lines). D: Structural map of the north-central Kopeh Dagh showing the Ashkhabad fault based on SPOT5 images. Keys: Cretaceous—1; Tirgan limestone—2; Sarcheshmeh marl—3; Sanganeh shale and marl—4; Aitamir sandstone and shale—5; Miocene marl—6; Pliocene conglomerate—7; Quaternary deposits—8; Main fault—9; Fold axes (continuous lines are anticline axes). E: SPOT5 image of the 9-km-long, right-lateral offset cumulated by a syncline developed within Neogene deposits. F: SPOT5 image extract showing that the Ashkhabad fault trace clearly runs between the Cretaceous and Neogene deposits.

strike-slip faulting mechanism within the Kopeh Dagh. More important is the 10 Ma age for the inception of the deformation associated with the westward motion of the South Caspian basin. This value strongly relies on (1) the observations discussed in this Comment, and (2) the hypothesis that the instantaneous global positioning system rates remained constant throughout the late Cenozoic. However, given the concerns we highlight on the Ashkhabad fault and the Kopeh Dagh, one should be cautious about the validity of the data set presented by the authors before accepting that their model clarifies the active tectonics of this complicated region.

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