

Interactive comment on “The seismogenic fault system of the 2017 M_w 7.3 Iran-Iraq earthquake: constraints from surface and subsurface data, cross-section balancing and restoration” by Stefano Tavani et al.

Anonymous Referee #2

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This is a nice structural reconstruction of the western Zagros, integrating 2017 earthquake data. The main issue is a fixation on the earthquake taking place on a N-S segment of the MFF (Mountain Front Fault). Brief mention is made of the N-S structure being separate – the Khanaqin Fault, but this is then strangely ignored. In fact, it looks very likely that the earthquake took place on the Khanaqin Fault – and is distinct from NW-SE fault segments grouped as the MFF. This is a significant aspect of the regional geology, which should be emphasised rather than underplayed.

The root of the problem is that the Zagros faults get depicted in different ways. One

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view is to emphasise their continuity, so that the MFF, HZF etc get drawn as continuous structures over 100s of km (see Berberian et al 1995). If these faults are offset by N-S right-lateral faults, the offsets are sometimes depicted as up to 100s of km (see Berberian again), but more detailed work shows that such offsets are only a few km (Authemayou et al., 2006). However, the faults are much more segmented than this “Himalayan” style – see work by Walker, Ramsey et al, with segments typically no more than 20-40 km, rupturing in M 5-6 earthquakes. The fault segments linked together as the “MFF” are not a Himalayan-style nappe, but equivalent steps in the relief and geomorphology of the range. Therefore the Tavani et al paper needs to consider the consequences of the N-S Khanaqin Fault being a separate, N-S structure to the main NW-SE thrusts, which slipped in the 2017 earthquake in a highly unusual manner for the Zagros – witness the sheer size of the event, which is much larger than typical Zagros thrust earthquakes. . See Lawa et al (2013) and Allen et al (2013) for examples of Zagros structure maps that include the Khanaqin Fault.

The geology descriptions and structural sections look very good, but this issue of fault segmentation and the existence of the Khanaqin Fault means that they need more work. The early part of the paper describes the 2017 earthquake parameters, but another way of doing this is to quote the slip vector azimuth of the event, which is 90 deg. from the auxillary plane strike, ie towards 212 deg. by my calculation. This means highly oblique slip on the fault, and also that the section line in figure 6 is covering faults with very different orientations, from the conventional NW-SE thrusts to the more N-S Khanaqin Fault. Neither of these points comes across properly in the paper. It would help if the Khanaqin Fault trace was properly drawn on Figures 2 and 3. The authors seem to have taken the continuous, sinusoidal, lines drawn on many regional papers for the Zagros, but, as noted, there are plenty of other papers that try to draw the Khanaqin Fault more accurately. Where Tavani et al make an improvement on our knowledge is that they try use the 2017 earthquake data to interpret the fault for the first time at depth, as a lateral ramp: this point stands, despite their confusion over the structure being part of the “MFF”.

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See also Koshnaw et al 2017 for a cross-border geology map that means figure 3 can be improved.

A lat/long label in fig 3 should be 45/45 E not 45/45 N.

Page 3: This structure is thus a candidate...

The first part of p 15 is critical, as the authors make a good description of the likely regional structure - but this is not apparent on their maps or cross-sections!

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