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The 12 November 2017 Sarpol-e Zahab (Iran-Iraq border) Mw 7.3 earthquake: Complex flexural slip faulting with backthrust geometry

Mohamed Saleh (1,2), Mustapha Meghraoui (1), Esra Cetin (3), Mehdi Zare (4), Hafidh Ghalib (5), and Frederic Masson (1)

(1) CNRS UMR7516, INSTITUT DE PHYSIQUE DU GLOBE DE STRASBOURG, STRASBOURG, France (m.saleh@unistra.fr), (2) NRIAG, Helwan, Egypt, (3) Dept. of Earth Sciences, Mugla University, Turkey, (4) IIEES, Tehran, Iran, (5) Array Information Technology, Florida, USA

The fold and thrust Zagros Mountains at the Kermanshah (Iran-Iraq) border region experienced a large (Mw 7.3) and damaging earthquake on 12 November 2017, reaching 500 victims and about 12 000 homeless. The mainshock epicenter (34.77 N and 45.76 E) and thrust mechanism on NW-SE trending fault rupture obtained from international seismological centers (EMSC). More than 1000 aftershocks were recorded in the epicenter area including the largest Mw 5.4 event of 11 December 2017. The NW Zagros and border region experienced large historical earthquakes with intensity (MSK) larger than VIII in 872 AD and in 958 AD, and the recent largest seismic event with Mw 7.4 in 1909 AD Sialkhor earthquake in the central Zagros region.
We study the seismotectonic context of the epicenter area using Sentinel-1 images in ascending and descending orbits. The interferograms obtained using GMT-SAR were corrected using the SRTM DEM (30 m resolution) to remove the phase contribution of topography. The resulting deformation and interferograms were unwrapped resulting in a Line of Sight (LOS) deformation showing NW-SE elongated surface deformation with up to 0.9 m uplift of the SW block and about 0.4 m of downthrown NE block. The modeled fault geometry and dimension inferred from the inversion of coseismic surface displacement imply an 80° SW dip, 125N strike and 85°rake, ∼20-km-depth and Mo 1.2 e20 N.m, in agreement with the source time function characteristics (http://geoscope.ipgp.fr/index.php/en/catalog/).
The epicenter region shows NW-SE trending asymmetric fold structures with high angle bedding planes on the SW flank but with no coseismic surface ruptures. Taking into account the earthquake rupture model inferred from InSAR and the local fold and thrust belt, we suggest that the inferred 80°SW dipping fault results from a backthrust structure associated at the surface with bedding plane movements where the maximum 0.9 m surface slip is likely distributed along a ∼1-km-wide fault zone and flexural slip. Another model of earthquake rupture with a ∼16° east dipping faulting is also discussed and confronted to the aftershock distribution at depth and surface deformation.