The 5th April 2017 Sefid Sang earthquake (Mw 6) and its implication on the geodynamic of NE Iran

Mahtab Aflaki*†[1], Zahra Mousavi[1], Abdolreza Ghods[1], Esmaeil Shabanian[1], Sanaz Vajedian[2], and Maryam Akbarzadeh[1]

[1]Department of Earth Sciences, Institute for Advanced Studies in Basic Sciences (IASBS) – Iran
[2]Institute of Photogrammetry and GeoInformation (IPI), Leibniz Universität Hannover – Germany

Abstract

The 5th April 2017 Sefid Sang earthquake (Mw 6) occurred at eastern boundary of the Iranian micro-continent, close to the Eurasian plate. This area is situated in a distinct zone between NW-striking Kopeh Dagh-Binalud Mountains to the north and N-striking Sistan suture zone to the south, where is characterized by low historical/instrumental seismicity. Despite it was a moderate magnitude earthquake with no surface rupture, its location rise an opportunity to investigate the active deformation and accommodation of deformation in transition zone between the Kopeh Dagh and Sistan suture zone. This is a multidisciplinary study includes seismology, Interferometric Synthetic Aperture Radar (InSAR) and structural geology, complimented by field measurements. Seismology (multiple event relocation, depth determination and first-motion focal mechanism solution) and InSAR (coseismic displacement map, earthquake source parameters estimation and retrieve slip distribution on fault plane) approaches are used to investigate the geometry and kinematic characteristics for causative fault of the Sefid Sang earthquake. Structural geology methods (inversion of fault kinematic data) utilized to retrieve modern and present-day stress regimes within the region. Our results indicate that the Sefid Sang mainshock is characterized by reverse dextral kinematic occurred on a NW-striking (N292○E) NE-dipping fault plane at 15km depth. The mainshock shows an almost unidirectional rupture towards the southeast. The aftershock cloud has 24 km lengths as a result of southeast-ward migration of the seismicity. Ascending and descending coseismic displacement maps of TOPS S1 SAR images present maximum 9 and 11 cm of surface deformation along satellite line of site, respectively. We obtained 83 cm of maximum slip on the NE-dipping fault plane from InSAR inversion. In structural geology part, present-day and modern stress states are obtained from inversion of earthquake focal mechanisms and geologically measured fault kinematics, respectively. The result indicate modern and present-day tectonic regimes compatible with NE-direction of maximum compression (average of N020○E and N029○E, respectively). This stress regime expects accumulation of deformation by similar reverse dextral movements along NW-striking faults within the area of interest and its vicinity. It demonstrates accommodation of continuous deformation by reverse faulting in the region, due to Arabia-Eurasia convergence. As this deformation is localized between separated rigid-block boundary-fault systems (Main Kopeh Dagh-Bakharden-Quchan-Neyshabur and Nehbandan fault systems), the related structural model is compatible with development of a localized soft-linking relay zone.

*Speaker
†Corresponding author: aflaki@iasbs.ac.ir