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The Mw 5.5 November 2017 South Korea Earthquake: an unusual event

Francesco Grigoli (1), Simone Cesca (2), Antonio P. Rinaldi (1), Andrea Manconi (3), Jose A. Lopez-Comino (2), John Clinton (1), Torsten Dahm (2), Rob Westaway (4), and Stefan Wiemer (1)

(1) ETH-Zurich, Institute of Geophysics, Swiss Seismological Service, Zurich, Switzerland (francesco.grigoli@sed.ethz.ch), (2) GFZ-Potsdam, Section 2.1 Earthquake and Volcano Physics, Potsdam, Germany, (3) ETH-Zurich, Institute of Engineering Geology, Zurich, Switzerland, (4) University of Glasgow, School of Engineering, Glasgow, Scotland UK

On 15 November 2017 a Mw 5.5 earthquake struck the southeast part of the Republic of Korea (South Korea), injuring many people and causing extensive damage in and around the city of Pohang. This is the second largest earthquake ever recorded instrumentally onshore in Korea. The largest, the Mw 5.8 Gyeongju event of 12 September 2016, occurred ∼30 km farther south on a major right-lateral fault, the Yangsan Fault, which continues northward through the Pohang area. Although historical and palaeoseismic earthquakes have also occurred in this region, and fluid injection was not taking place at the time, the 2017 event has triggered intense public debate in Korea about its potential link with geothermal stimulation operations at a nearby EGS site. The proximity of this industrial facility has raised public concerns, reflected by the sharp increase of web searches using the keywords “geothermal” and “geothermal power plant” in Korea in the days following the Pohang earthquake. In the absence of data from a local seismic network, we use advanced full-waveform seismological techniques, applied to regional and teleseismic network data, to locate the Pohang earthquake sequence and determine the source parameters of the largest events. We also use geodetic data to quantify the coseismic deformation and obtain an independent estimate of the mainshock source parameters. Our main findings at this stage are: 1) hypocentral depths are shallower than those provided by other agencies and mainly in the range 3-7 km, similar to the depth of injection (∼4 km); 2) The Yangsan Fault was not re-activated; the activity instead occurred approximately 10 km away to the east on a SW-NE-oriented fault; 3) Focal mechanisms are characterized by a dominant (oblique) reverse-faulting component, with nodal planes oriented SW-NE, reflecting the spatial distribution of the aftershocks. These focal mechanisms are thus dissimilar to the 2016 Gyeongju seismicity, which involved right-lateral strike-slip on a NNE-SSW-striking fault plane. Nonetheless, both sets of focal mechanisms are compatible with the regional stress field, which has the maximum principal stress oriented ENE-WSW. Seismicity and geodetic results are in agreement regarding location, depth and fault geometry. 5) The mainshock and most of the aftershocks occurred within 5 km of the EGS site. Our analysis continues and will contribute to informing the debate about whether this earthquake sequence had any causal connection to the EGS activity at the site.

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