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Source complexity of the November 2017 Mw 5.5 Pohang, South Korea, Earthquake

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On 15 November 2017 a Mw 5.5 earthquake struck South Korea, injuring many people and causing extensive damage in and around the city of Pohang. The proximity of the epicentre to an Enhanced Geothermal Systems site, where high pressure hydraulic injection had been previously performed, opened a debate about the possible anthropogenic origin of this earthquake. In addition to the latter one, another interesting feature of this event is the large non double-couple component associated to its source mechanism. Moment tensor inversion in fact indicated that the mainshock is composed by a reverse-faulting to oblique double couple (DC) mechanism and a large non-DC term ($\sim$50%). Based on first analyses (e.g. Grigoli et al. 2018), we inferred that the non-DC component is caused by a complex rupture process that includes the simultaneous activation of different faults patches, however the decomposition of moment tensor into finite planes does not lead to an unique solution. Our aim is to use a back-projection method to analyse the slip distribution and rupture kinematics of this earthquake which, in combination with the information extracted from the spatio-temporal distribution of the aftershocks, allow to develop a fault model that explain the observed moment tensor. To image the slip of such a moderate magnitude earthquake, we carry out a three-step procedure: (1) we identify the fault planes by analysing the spatial distribution foreshocks and aftershocks and their focal mechanisms; (2) we deconvolve the propagation effects from the seismograms using an empirical Green's function resulting in relative source time functions (RSTF) at all seismic stations; (3) the RSTFs are back-projected to the fault plane using the position of equal time delays (i.e. isochrones). Our analysis suggests that the earthquake involved the failure of (at least) two different faults with slightly different orientations, which can explain the non-DC term of the moment tensor, as well as the complexity of P wave signals for the mainshock. This finding is also supported by a more accurate analysis of the spatio-temporal distribution of aftershocks that suggests the presence of different fault patches. The kinematics of this rupture have important implications for the processes that control the direction and extent of ruptures involving multiple fault surfaces.