[EJ] Evening Poster | S (Solid Earth Sciences) | S-CG Complex & General

[S-CG57]Dynamics in mobile belts

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The dynamic behaviours of mobile belts are expressed across a wide range of time scales, from the seismic and volcanic events that impact society during our lifetimes, to orogeny and the formation of large-scale fault systems which can take place over millions of years. Deformation occurs on length scales from microscopic fracture and flow to macroscopic deformation to plate-scale tectonics. To gain a physical understanding of the dynamics of mobile belts, we must determine the relationships between deformation and the driving stresses due to plate motion and other causes, which are connected through the rheological properties of the materials. To understand the full physical system, an integration of geophysics, geomorphology, and geology is necessary, as is the integration of observational, theoretical and experimental approaches. In addition, because rheological properties are greatly affected by fluids in the crust and fluid chemical reactions, petrological and geochemical approaches are also important. After the 2011 great Tohoku-oki earthquake, large-scale changes in seismic activity and regional scale crustal deformation were observed, making present-day Japan a unique natural laboratory for the study of the dynamics of mobile belts. This session welcomes presentations from different disciplines, such as seismology, geodesy, tectonic geomorphology, structural geology, petrology, and geofluids, as well as interdisciplinary studies, that relate to the dynamic behaviour of mobile belts.

[SCG57-P19]Detailed hypocenter distribution and fault structure in the 2017 M 5.3 Kagoshima Bay earthquake sequence

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On 11 July 2017, an M_{JMA} 5.3 earthquake occurred at approximately 10 km depth in Kagoshima Bay, Kyushu, SW Japan. This earthquake caused intense ground shaking in the surrounding regions. Japan Meteorological Agency (JMA) seismic intensity was upper five at Kagoshima city, which is located in close proximity to the hypocenter.

Near the mainshock hypocenter, seismicity had been activated since December 2016. Most of hypocenters of this precursory activity were distributed within ~5 km from the mainshock hypocenter and, according to the JMA unified catalogue, they did not form planar structures but a cloud-like scattered distribution. This cloud-like distribution might merely reflect hypocenter errors (e.g. Yoshida &Hasegawa, 2018). On the other hand, such a cloud-like distribution can be explained by the hydraulic diffusion model (Shapiro et al., 1997; Rothert &Shapiro, 2003). Information on precise hypocenter locations is important for understanding the generation mechanism of this seismic activity. In this study, we improved relative locations of hypocenters of this earthquake sequence by using waveform cross correlation to investigate the fault structures in detail.

Firstly, we got precise differential arrival times by calculating cross correlations of the pair of waveforms out of the 11,105 earthquakes that occurred after March 2003 in the Southern Kagoshima Bay region. We used waveform data observed at 20 stations located around the mainshock hypocenter. We applied a bandpass filter between 5 and 12 Hz to the data, and computed cross-correlation functions for all event pairs whose horizontal distances are <3.0 km. We adopted 2.5 s and 4.0 s starting 0.3 s before the onsets for the P- and S- wave windows, respectively. For the P- and S-wave onsets, we used arrival time data listed in the JMA unified catalogue if available; otherwise, we used theoretical arrival times computed by assuming the JMA velocity model (Ueno et al., 2002).

Secondly, using the obtained differential arrival time data, we relocated hypocenters. We applied the double-difference location method (Waldhauser and Ellsworth, 2000) to differential arrival data listed in the JMA catalog in addition to the data obtained by cross correlations. Hypocenters were updated using 50 iterations. In the first 10 iterations, we gave more weight to the catalogue data to constrain relative locations with a large scale. In the latter 40 iterations, more weight was given to the data derived by the cross correlations to delineate shorter scale.

As a result, hypocenters are concentrated on several thin planes, although the original JMA hypocenters were scattered and showed a cloud-like distribution. Hypocenters of the precursory activity are concentrated on one thin plane. Hypocenter distribution on this plane shows a clear seismic gap adjacent to the mainshock hypocenter, which might suggest that the mainshock rupture is located on this seismic gap.

Aftershock hypocenters are also concentrated on several thin planes. Their hypocenters tend to move upward with time. This spatial and temporal feature is similar to those observed in the earthquake swarms in central Tohoku that were triggered by the 2011 M9 Tohoku-Oki earthquake. Those earthquake swarms are estimated to be caused by the upward fluid movements (Yoshida &Hasegawa, 2018). The present observation suggests that the reduction in frictional strength due to the upward fluid movements plays an important role in the occurrence of the 2017 seismic activity in Kagoshima Bay.