"0.1満点"高密度地震観測に基づく微小地震の時空間発展：断層の成長過程

Spatio-temporal Evolution of Micro-Earthquakes illuminated by “0.1 manten” Hyper Dense Seismic Observation: Implication of Fault Growth

*加藤 愛太郎[1]、酒井 慎一[1]、松本 聡[2]、飯尾 能久[3]
*Aitaro Kato[1], Shin'ichi Sakai[1], Satoshi Matsumoto[2], Yoshihisa Iio[3]

1. 東京大学地震研究所、2. 九州大学、3. 京都大学防災研究所
1. Earthquake Research Institute, the University of Tokyo, 2. Kyushu University, 3. Kyoto University

To deepen fundamental understanding of earthquake faulting, it is of crucial importance to image fine scale structure of fault zone. We installed a thousand of seismic stations in the source area, which covers an entire aftershock zone of the 2000 Western-Tottori earthquake (Mw 6.7) from March 2017 to March 2018. The spatial interval of each seismic station ranges from 1 to 2 km. We initially detected ~3000 earthquakes from the continuous waveforms, using automatic arrival time picking technique. Applying a double-difference algorithm to the arrival data-set, we relocated more precise hypocenters in the studied region. The completeness magnitude of the catalog is around -0.7.

From the center to the southeast part, the relocated hypocenters are aligned along sharp fault planes, which are dipping almost vertically. In contrast, at the northwest area, the hypocenter distributions are complex, including several fault planes which are conjugate to the main NW-SE aftershock trend.

We focus on a tiny seismic cluster associated with Mj 1.7 event (main event) in the aftershock zone, which took place on 24th Dec., 2017. Following this event, a total of ~80 micro-earthquakes were detected by automatic-processng and matched filter technique. We visually picked up P-wave arrival times for each micro-earthquake. Using differential travel times derived from waveform cross-correlation technique, we succeeded to relocate them very precicely. The relative hypocenter acuuray appears to be less than 5 m. The relocated micro-earthquakes are sharply aligned along vertically NNW-SSE-striking fault. The length and dip-width of the fault dimension is about 200 m, respectively. This hypoenter alignment is well consisten with a focal mechanism of the main event. Based on the distribution of the earthquakes, the fault zone width is estimated to be ~10 m. The ratio of the fault (process) zone width to the fault length is ~0.01, which fairly matches with that geological observation of fault exposure.

In addition, we identify spatial-temporal evolution of the micro-earthquakes after the main Mj 1.7 event. Interestingly, these migrating events occurred so that they did not overlap events that occurred earlier, like complementary manner. The migration speed is estimated to be < ~0.1 km/day, which is quite lower than that slow slip events observed typically along subduction. This slow migration is similar to fluid migration speeds inferred from seismic observation of induced seismicities following the 2011 Tohoku-Oki earthquake. These results indicate a growth of fault network on a scale of tens of meters.