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Long-term slow slip events along the Ryukyu Trench as seen from high-precision continuous gravity observations

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Long-term slow-slip events (SSEs) have been observed in many plate-boundary zones along the circum-Pacific seismic belt. Previous studies have revealed that high-pressure fluids supplied from the subducted oceanic plate can generate SSEs. SSEs in different areas have different recurrence intervals. In general, the tectonic stress accumulation rates and the frictional properties on the plate boundaries control the intervals. Therefore, their differences are considered to cause the differences in the intervals. However, variations in fluid pressure will also change the intervals, because they affect the effective normal stress. Variations in fluid pressure are predicted by the earthquake-cycle model based on the fault valve behavior of Sibson (1992). So far, variations in fluid pressure associated with SSEs have not been detected by field observations. If a massive fluid pressure change occurred, gravity change could be observed since the corresponding density redistribution in the underground occurred. In the Tokai district in Japan, the SSE occurred during the years from 2000 to around 2006, and gravity changes in 2004-2009 that could be explained by a fluid pressure variation were detected (Tanaka et al., 2010). However, the quality of the data was not good due to the lower temporal resolution of the campaign data and the observation period did not cover the whole cycle of the SSE. So, a clear evidence of fluid-pressure change has not been obtained yet. In this study, we conduct a continuous gravity measurement using absolute gravimeters and a superconducting gravimeter in Ishigakijima and Iriomotejima Islands along the Ryukyu Trench where SSEs have occurred twice a year (Heki and Kataoka, 2008) to observe a transient gravity change during the whole cycle of an SSE. Such a continuous measurement to elucidate processes of an SSE has never been carried out in the world due to technical difficulties. In this presentation, we will report an observation result obtained by absolute gravimeters.

Keywords: slow slip, subduction zone, gravity, crustal deformation, geodesy, seismology