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地震の発生における応力と流体の役割：2011 年東北地方太平洋沖地震による誘発地震の発生を例に
Roles of Stress and Pore Fluid Pressure in Triggering Aftershocks Following the 2011 Tohoku-oki Earthquake

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The earthquake is a physical process releasing tectonically accumulated stress by shear faulting, controlled by Coulomb failure criterion. In order to understand earthquake generation, we need to know the fault strength as well as the tectonic stress state in the Earth's crust. In the present study we examined the roles of tectonic stress and pore fluid pressure in seismicity changes following the 2011 off the Pacific coast of Tohoku (Tohoku-oki) earthquake through the analysis of aftershocks based on the Coulomb failure criterion. Background tectonic stress fields in Northeast Japan are generally characterized by E-W compression. After the Tohoku-oki earthquake, as expected from decrease in the Coulomb failure function, seismicity in the upper crust of Northeast Japan decreased except some restricted regions, where we observed many aftershocks with unfavourable focal mechanisms to the background stress fields. Most aftershocks can be regarded as reactivation of pre-existing faults under the background tectonic stress field, because misfit angles between observed and expected slip vectors are within estimation errors. By mapping the focal mechanisms of aftershocks on the 3-D Mohr diagram region by region, we confirmed that the aftershocks occurred on optimally oriented faults in some regions but on misoriented faults in other regions. The aftershocks on optimally oriented faults indicate the increase in regional ambient fluid pressure caused by the flow of over-pressurized fluid from a deep reservoir. On the other hand, the aftershocks on misoriented faults, which cannot be attributed to coseismic stress rotation, indicate the increase in fault-confined fluid pressure relative to the ambient fluid pressure. The decrease in fault strength due to increase in pore fluid pressure is one of the physical mechanisms triggering aftershocks.

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