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Seismogenesis in granite under brittle-plastic transition condition

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Most of earthquakes occur below 10-km depth in the Korean Peninsula. For example, the focal depth of the Mw 5.5 Gyeongju Earthquake in 2016, the largest instrumental earthquake in South Korea since scientific earthquake monitoring started in 1978, is about 14 km with hypocentral basement rocks of granitoid and temperature of 370°C (thus, brittle-plastic transition condition). A study on ancient granitoid shear zones with the similar temperature condition will aid in understanding the seismogenesis in the brittle- plastic transition regime. The Yecheon shear zone is an NE- to NNE-striking right-lateral shear zone cross-cutting Mesozoic granitoid belt in South Korea. The deformation temperature of the main shear zone was estimated to be about 350 ▯. In the southeastern margin of the shear zone, protomylonites change gradually into mylonites and then abruptly into ultramylonites toward southeast. Quartz and feldspar grains both of protomylonite and mylonite deform by dislocation creep and brittle fracturing, respectively. Greenish ultramylonite consists of quartz-, feldspar-, muscovite- and epidote-rich layers within matrix of quartz, muscovite and epidote. The protomylonite commonly displays a composite S-C foliation. The deflecting S-foliation of mylonite toward ultramylonite is sharply truncated by the boundary between mylonite and ultramylonite. Thin (several mm to several cm) greenish layers occur in protomylonite subparallel to mylonitic foliation or cross-cutting the foliation at a low angle. They also show injection structure with flow banding and cataclastic deformation along the protomylonite boundary. The greenish layer consists of fragments of protomylonite and matrix of very fine-grained quartz, feldspar, muscovite and epidote. Epidote grains of ultramylonite and greenish layers replace phengitic mica, biotite and plagioclase and show graphic texture. Together with epidote formation, chloritization of biotite and albitization of K-feldspar are prominent in the greenish layers. The growth of hydrothermal minerals including epidote and chlorite within the greenish layers and shear band along the C-foliation indicates fluid circulation in the layers. We interpret the greenish layers were generated during seismic events in fluid-rich conditions and thus seismic event may be caused by pore pressure build up. Once the greenish layers develop, deformation was localized along the layers due to much reduced grain size in interseismic periods, and the greenish layers became ultramylonite with further grain-size reduction.