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A shock-compression experiment of peridotites: toward a better understanding of focal mechanics of deep earthquakes

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Generation of earthquakes that infers fault motions in deep earth remains unsolved problems of solid earth sciences. Frictional melting is well expected at fault planes at high confining pressure and the formation of melt layers will result in a rapid release of cumulated stress leading to a large earthquake (e.g., Kanamori et al, 1998). The occurrence of ultramafic pseudotachylyte in exhumed mantle-derived peridotite mass testifies such mechanism does occur in the upper mantle (Ueda et al, 2008). Conventional friction melt experiment using a rotary high-speed shear testing apparatus cannot be directly applied to the deep earthquakes because of the technical limitation to the confining pressure, which is typically below tens of mega Pascal. We have started a new experimental project using a powder propellant gun at the Shock Wave and Condensed Matter Research Center of Kumamoto University. With this machine it is possible to apply the uniaxial shock stress to samples up to 10~20 GPa by impacting flyer plate with a speed of 1 to 2 km/s. We have performed several shots using natural peridotites and olivine single crystals and observe that multiple shear planes being generated in the samples after such intense compression although any clear textural evidence that indicates frictional melting has not yet been detected. Reviewing the instrumentation and the experimental strategies, we will report some preliminary results of the microstructural observation of shock compressed samples, including an olivine single crystal.

Keywords: shock melting, deep earthquake, frictional melting, peridotite, earthquake source mechamics