A seismogenic significance of a peridotitic mylonite-pseudotachylyte association: the role of fluid

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Pseudotachylytes associated with mylonite walls have been known from many crustal lithologies, but the processes and the mechanism of the plastic to brittle transition has not been well understood (Sibson, 1977; Passchier, 1982). We propose, from the observation of ultramafic pseudotachylyte, from Ivrea zone, Italy, a hypothesis that the composition of intergranular fluid has influenced upon the mechanical behavior of peridotite during the shear localization. The studied sample is a fault vein type ultramafic pseudotachylyte, from Balmuccia peridotite. The wall rock is mylonitized and is composed of olivine, Opx, Cpx and spinel and pargasitic amphibole. The pseudotachylite is very fine-grained and mylonitized as well. It consists of olivine, Opx, Cpx, amphibole and small amount of dolomite, the latter of which only occurs in the pseudotachylyte. The dolomite is texturally in equilibrium with other silicates. We suppose the following scenario for the onset of rupture and frictional melting of peridotite. A shear localization was introduced with the aid of external introduction of H2O-CO2 mixture fluid. During the dynamic re-crystallization, H2O in the fluid was preferentially used to produce amphibole with reacting olivine and pyroxenes. The residual fluid was progressively enriched with CO2. The dihedral angle of H2O against silicate is small (approx. 60 degree), while that of CO2 is large (approx. 90 degree)(Watson and Brenan, 1987). Because of such dihedral angel difference, it is considered that H2O-rich fluid reduces the rock strength and CO2 fluid enhances the rock strength. Thus, progressive enrichment of residual fluid in CO2 enhances the rock rigidity, that leads to a coseismic rupture. The presence of dolomite in the pseudotachylyte is an evidence of such progressive enrichment of metamorphic fluid with CO2. The formation temperature of the wall rock mylonite that preceeded the coseismic rupture is inferred to be 600-650 C from the coexistance of dolomite and enstatite and from the two pyroxene geothermometry.