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Deformation experiment of serpentinite with a solid medium deformation apparatus

Yukiko Terada[1]; Jun-ichi Ando[2]; Ikuo Katayama[3]; Kenichiro Nakamura[1]; Tetsuo Irifune[4]

[1] Earth and Planetary Systems Science, Hiroshima Unv.; [2] Earth and Planetary Systems Sci., Hiroshima Univ.; [3] Department of Earth and Planetary Science Systems, Hiroshima University; [4] GRC, Ehime Univ.

Earthquake which occurs at between ca. 60 km and 300 km depth along subducting slab is called an intermediate-depth earthquake. The seismic centers of the intermediate-depth earthquake are clearly formed double seismic zone at some subduction zone. Since the double seismic zone is distributed almost in parallel to the geotherm, the generating mechanism of the intermediate-depth earthquake is considered to be a phenomenon with temperature dependency. Now it is widely believed that dehydration of serpentinite is important role as a trigger for intermediate-depth seismicity. Peacock (2001) and Yamasaki and Seno (2003) calculated recently temperature structures of the descending oceanic plates. It is possible to think from their results that some intermediate-depth earthquakes occur at the region of stability field of serpentine. This interpretation is disagreement of the hypotheses of the dehydration embrittlement of serpentine. Here I conducted deformation experiments of serpentinite at its stability field in order to understand the basic rheological behavior of it which must depend strongly on temperature.

I conducted a constant strain rate experiment using a modified Griggs type apparatus installed at Hiroshima University. Experimental conditions were ca. 1 GPa confining pressure, several temperatures such as 500 C, 550 C and 600 C, and displacement rate of piston such as 570 micrometers/hour to 610 micrometers/hour. The serpentinite sample was collected from Nagasaki metamorphic rock. This serpentinite is composed of antigorite serpentine associating with magnetite and residual olivine. Foliation is well-defined. Cylinders with ca. 7.0 mm in diameter and ca. 7.0 mm in length were cored perpendicular to the foliation plane for the starting samples. The results through this research are the followings. 1) The stress drop was detected before reaching steady state conditions after the yielding occurred. Brittle faults were observed in the recovered samples. Therefore, these results suggest that stress drop was caused by the faulting. 2) The ultimate strengths are 960 Ma and 1077 Ma at 500 C and 550 C, respectively. These values are consistent with the result of Raleigh and Paterson (1965), and indicate the pressure dependence of ultimate strength of serpentine.