Geophysical Research Abstracts, Vol. 6, 07599, 2004
SRef-ID: 1607-7962/gra/EGU04-A-07599

PERMEABILITY OF SERPENTINITE AND THE RHEOLOGY OF TALC: LOCALIZATION OF DEFORMATION AND SUBDUCTION PROCESSES

J. Escartín (1), G. Hirth (2) and B. Evans (3)
(1) CNRS/IPGP, France, (2) WHOI, USA, (3) MIT, USA, (escartin@ipgp.jussieu.fr)

Serpentinite dehydration during subduction of altered oceanic lithosphere results in partial dehydration and formation of talc. Talc is also associated with oceanic shear zones that have a long history of deformation localization and fluid flow (i.e., oceanic detachments and transform faults). To better understand the relationship between rheology, transport properties of materials, and metamorphic reactions, we are conducting preliminary experiments on 1) the permeability of serpentinites and its evolution at high temperature, and 2) on the rheology of talc. Pure antigorite serpentinite showed brittle deformation at high temperature (T˜300-350°C, P<400 MPa, strain rate ˜3x10-5 s-1). Intact serpentinite is nominally impermeable, and no interconnected porosity develops during elastic loading and yielding of the sample. Connected porosity is only evident after stress peak is reached and deformation localizes along a single, permeable fault. Deformation experiments on pure talc cores, conducted at P<400 MPa and T<600°C, and show an unusual rheological behavior. Talc is extremely weak (maximum stress lower than the confining pressure), consistent with earlier results [Edmond and Paterson, 1971], with a very weak dependence of strength on confining pressure. All experiments were nominally non-dilatant mode, and deformation localized in several parallel and crosscutting shear zones oriented at ˜45° with respect to the shortening direction; no distributed deformation is observed even at T˜600°C and P=300 MPa. Pending detailed microstructural analyses, this behavior can correspond either to localized deformation along plastic shear bands, or to an anomalous brittle/semibrittle behaviour that does not obey 'Goetze's criterion', similar to that described in serpentinites. These preliminary results suggest that the presence of even small amounts of talc, owing to its mechanical properties, can have a weakening effect more important than that proposed for serpentinites.