Geophysical Research Abstracts, Vol. 8, 07327, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07327

Experimental study of ductile deformation processes under isotropic pressure

M. Rossi (1,2), O. Vidal (2), B. Wunder (3), F. Renard (4)

(1) Physics of Geological Processes, Univeristy of Oslo, Norway

(2) Laboratoire de Géodynamique des Chaînes Alpines, OSUG, Grenoble, France (mrossi@ujf-grenoble.fr)

(3) GeoForschungsZentrum Potsdam, Potsdam, Germany

(4) Laboratoire de Géophysique Interne et de Tectonophysique, OSUG, Grenoble, France

Theoretical models of intergranular pressure-solution generally focus on the deformation that occurs at the contacts between the constitutive grains of an aggregate, assuming these grains are spherical. In order to investigate the applicability of such models, isostatic experiments were performed in cold-sealed vessels using calibrated glass spheres $\pm$ micas and 0-5 wt% water, at 200 MPa and 350˚C. Several runs were performed in order to investigate the effect of both time, amount of fluid, pressure and temperature. Deformation was identified and quantified at the end of the experiments from SEM observation of the final shape of the deformed spheres. For comparison with natural materials, similar experiments were also performed with quartz sand instead of glass spheres. Experiments with quartz show evidence of intergranular pressure-solution, but do not allow quantification of deformation. Experiments with glass spheres show evidence of both brittle deformation (fracturing) and ductile deformation (plastic flow and intergranular pressure-solution or sintering). In experiments with a large amount of water ($\geq$ 5 vol%) dissolution-crystallization additionally occurred. Experiments performed with a fluid content of less than 1 vol% yield exponential law creep behaviour that is typical of glass deformation, but these experiments can also be fitted with a power law with a high stress exponent varying from n = 11.3 in dry experiments to n = 14 in wet experiments. Although the use of glass spheres does not model the deformation of crystalline solids at the same P-T conditions, they might be a good analogue to study the behaviour of mineral aggregates at higher tempera-

ture. Indeed, the observed increase of the stress exponent in experiments conducted with glass spheres at 350˚C with a small amount of fluid is compatible with similar observations made on olivine at higher pressure and temperature conditions.