Geophysical Research Abstracts, Vol. 7, 08279, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08279

Influence of glass rheology on P-waves in lower crustal xenoliths (El Hoyazo, SE Spain): laboratory measurements up to partial melting

F. Ferri (1), L. Burlini (2), B. Cesare (1,3) and R. Sassi (1)

(1) Dipartimento di Mineralogia e Petrologia, Università di Padova, Italy, (2) Rock Deformation Lab, ETH Zurich, Swizerland, (3) C.N.R.-I.G.G., Sezione di Padova, Italy (fabio.ferri@unipd.it)

Melt fraction, geometry and its degree of interconnection strongly influence the seismic velocities and the seismic attenuation of rocks.

The present study is focused on compressional wave velocities as a function of pressure and temperature of garnet-biotite-sillimanite bearing metapelitic xenoliths (Zeck, 1968 and 1970) recovered from the Neogene dacites of El Hoyazo (SE Spain). They represent the best example of partially molten lower crust in the Alborán Domain (Cesare & Gómez-Pugnaire, 2001) with a paragenesis represented by garnet + biotite + sillimanite + plagioclase + graphite $\pm$ cordierite coexisting with widespread ryolitic melt as inclusions and interstitial glass ($5 \div 10$ wt%). The assemblage developed during regional anatexis at 850-900˚C and $\sim$ 0.5 - 0.7 GPa (Cesare et al., 1997) and melt was frozen-in during fast uprise and eruption.

Measurements were carried out with the pulse transmission technique (Birch, 1961) in an internally heated gas apparatus (Paterson rig). For each sample three mutually orthogonal cores (x, y, z) were drilled parallel to the macroscopic fabric elements: x was parallel to lineation and z normal to foliation. Delay time was calibrated using a sapphire single cristal cut parallel to [0001]. Measurements were conducted at pressures up to 0.5 GPa and temperatures up to 700˚C on 22 mm diameter cores and up to 950˚C on 15 mm diameter samples.

Vp was measured at room temperature up to 0.50 GPa and up to 1223 K at 0.45 GPa; after cooling at constant pressure (0.45 GPa), samples were decompressed. In specimens z and y heating was subdivided into steps, samples were extracted and length measured. When heating is continuous up to melting, as in sample x, the behaviour is anomalous with a velocity increase with temperature up to 973 K. During subsequent heating from 973 K to melting and next cooling, velocity behaviour is normal (velocity decreases while temperature increases). This tendency was alread reported by Kern et al (1994) on mantle xenoliths from Siberia, where it was interpreted as due to softening of interstitial glass and porosity closure. In y and z the velocity inversion, limited to the first heating step, occurs at 673 K and 873 K respectively. According to Dingwell (1998), the glass transition T_g for a hydrous granitic melt with 4 wt% H_2O is around 943 K, which is in agreement with data on sample x despite different heating-cooling rates (20 K/min minimum). This reveals that the volume reduction is a continuous process up to T_g where the seismic signal attenuates. Further attenuation occurs within the interval 1200-1223 K at 0.45 GPa where melting takes place. Velocity reduction with temperature is in the order of 20%. During final decompression at room temperature, velocity decreases with pressure and values are 20% higher than pre-heating measurements with similar $\delta V/\delta P$.

REFERENCES

Birch A. F., J. Geoph. Res., 66 (7): 2199-2224, 1961

Cesare B., Salvioli Mariani E. and Venturelli G., Mineral. Magaz. 61 (1): 15-27, 1997

Cesare B. & Gómez-Pugnaire M. T., Phys. Chem. Earth (A), 26 (4-5): 255-260, 2001

Dingwell D. B., Phys. Earth Planet. Int., 107 (1-3): 1-8, 1998

Kern H., Burlini L. and Ashchepkov I. V., Phys. Earth Planet. Int., 95 (3-4): 195-209, 1996

Zeck H.P., PhD thesis, 1968

Zeck H.P., Contrib. Mineral. Petrol. 26: 225-246, 1970