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# Electrical conductivity in a partially molten lower crust: new constraints from laboratory measurements on crustal xenoliths (El Hoyazo SE Spain)

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The presence of partial melts in the lower continental crust is proposed as one of the most reasonable explanations for those scenarios where anomalous high electrical conductivity is combined with low seismic velocity and high heat flow values. In the Internal Betics (Southern Spain) such geophysical evidence (Carbonell et al., 1998; Pous et al., 1999) is further supported by the recovery of restitic lower crustal xenoliths which retain evidence of partial melting (Zeck, 1968). These samples offer a unique possibility to determine the influence of melt fraction, geometry and degree of interconnection on the petrophysical properties.

The present study is focused on the electrical conductivity at high pressure and temperature of two garnet-biotite-sillimanite metapelitic xenoliths (JOY2 and HO4) collected from the Neogene dacites of El Hoyazo (SE Spain). The paragenesis is represented by garnet + biotite + sillimanite + plagioclase + graphite $\pm$ cordierite coexisting with widespread rhyolitic melt as inclusions and interstitial glass ($\sim$10 wt%) (Cesare & Gómez-Pugnaire, 2001). The assemblage developed during regional anatexis at 850-900˚C and $\sim$ 500 - 700 MPa (Cesare et al., 1997) and melt was frozen-in during fast uplift.

Experiments were performed in a gas apparatus up to 950˚C and 400 MPa with Ar as pressure medium. For each sample three mutually orthogonal cores (X, Y, Z) were drilled parallel to the macroscopic fabric elements to determine the electrical anisotropy: X parallel to lineation and Z normal to foliation. Two Pt discs were place on the top and the bottom surfaces of the cores and connected to Pt and PtRh wires in a four-electrode arrangement. An authomated impedance spectrometer was used to collect the resistivity values in the range 1-$10^5$ Hz. The samples were heated up with a constant 0.7˚C/minute increment and temperature was monitored with two K-type thermocouples.

At high frequency a single impedance arc is observed in JOY2 at every temperature; in HO4 a second arc at intermediate frequency appears in the interval 690˚-790˚C which is interpreted according to Roberts & Tyburczy (1999) as the transition from a non interconnected melt (= two impedance arcs) to an interconnected pathway (= one impedance arc). The Arrhenius plot (i.e. logarithmic specific conductivity vs. reciprocal temperature) evidence the influence of the rheological behavior of glass on the electrical properties: between 200˚ and 400˚C the temperature dependance of the electrical conductivity is non Arrhenius and related to the structural relaxation of the glass. Above 400˚C the conductivity behavior with temperature is linear corresponding to an activation energy $E_a$ of 0.340 $\div$ 0.561 eV. The glass transition of the interstitial glass is located at $\sim$730˚C where $E_a$ increases to 1.03 $\div$ 1.38 eV. At about 800˚C, corresponding to the liquidus temperature for the rhyolitic glass (Holtz et al., 2001), an interconnected melt network is achieved and conductivity increases.

Only at melting conditions the conductivity value is comparable to the one determined by magnetotelluric soundings; this excludes that the elevated content of graphite in the xenoliths (up to 1.5 wt%) is the main cause of the regional electrical anomaly and supports the hypothesis that partial melts are actually present in the Alborán lower crust.

REFERENCES

Carbonell R., Sallarés V., Puos J., Dañobeitia J.J., Queralt P., Ledo J.J. and Dueñas G. Tectonophysics, 288: 137-152, 1998

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

Holtz F., Johannes W., Tamic N. and Beherens H. Lithos 56: 1-14, 2001

Pous J., Queralt P., Ledo J.J., Roca E., Garcia X. and Marcuello A. Rev. Soc. Geol. Esp. 8; 513-518, 1999.

Roberts J.J. & Tyburczy J.A, J. Geoph. Res. 104-B4: 7055-7065, 1999

Zeck H.P., PhD thesis, 1968