

# ***EMPG XVI***

**16<sup>th</sup> International Conference on  
« Experimental Mineralogy, Petrology  
and Geochemistry »**

**June 17 – 21, 2018**

***Abstracts Volume***

**Clermont-Ferrand, France**

**Effect of temperature and pore fluid on the electrical conductivity of basaltic rocks up to supercritical conditions**

B. Gibert<sup>1</sup>, F. Parat<sup>1</sup>, F. Nono<sup>2</sup>, D. Loggia<sup>1</sup>  
and N. Marino<sup>1</sup>

<sup>1</sup>Laboratoire Géosciences Montpellier, Université de Montpellier, France

<sup>2</sup>University of Pau UMS-DMEX, Pau, France.

Exploration and exploitation of deep high-temperature geothermal resources in volcanic environments require a good knowledge of the physical properties of rock reservoirs. Exploration of supercritical reservoirs ( $T > 375^\circ\text{C}$  and Pore fluid pressure  $> 225$  bars for pure water), whose exploitation is a long-term objective for improving power generation, suffers from the lack of laboratory data under such conditions. In particular, determination of the physical processes affecting electrical transport is a prerequisite to interpret electromagnetic surveys that are widely used in geothermal industry.

In this work we present several results from high temperature-high pressure experiments performed in a Paterson gas pressure apparatus up to  $700^\circ\text{C}$  and 100 MPa and under a controlled pore pressure of 30 MPa. Rock samples coming from deep geothermal reservoirs located in Iceland have been investigated.

The electrical conductivities have been measured first under dry conditions and under saturated conditions using different fluid salinities up to seawater salinity. The conductivity of saturated rocks is dependent on the rock type (dolerites/hyaloclastites) and mineral alteration is a key parameter controlling the absolute values and the temperature dependence of electrical conductivity. In addition, it is found that the conductivity of the bulk rock is not only controlled by the conductivity of the brine, but also by the interface conductivity, which strongly increases with temperature and becomes dominant above  $300^\circ\text{C}$ , even for high salinity pore fluids. Above supercritical point, electrical conductivity slightly decreases and lies on the electrical conductivity of « dry » rock at temperature of about  $500$  to  $600^\circ\text{C}$ , depending on the rock type and fluid salinity. Measured electrical properties are found to be in agreement with electromagnetic surveys and downhole measurements in different Icelandic geothermal areas.

**The phase composition and critical relation in the eclogite- $\text{CaCO}_3+\text{Na}_2\text{CO}_3+\text{K}_2\text{CO}_3+\text{H}_2\text{O}$  system at  $P=4$  GPa,  $T=1100-1300^\circ\text{C}$  (experimental data)**

N.S. Gorbachev<sup>1</sup>, A.V. Kostyuk<sup>1</sup>, P.N. Gorbachev<sup>1</sup>  
and D.M. Sultanov<sup>1</sup>

<sup>1</sup>Institute of Experimental Mineralogy RAS, AkademicaOsip'yana, 4, 142432 Chernogolovka, Russia

The phase and critical relationships was studied experimentally in the eclogite- $\text{CaCO}_3-\text{Na}_2\text{CO}_3-\text{K}_2\text{CO}_3+\text{H}_2\text{O}$  system at  $P=4$  GPa,  $T=1100-1300^\circ\text{C}$ .

The experiments were carried out at the IEM RAS using a "anvil with hole" apparatus by quenching technique in Pt ampoules. The initial composition of the system is 70 wt.% of tholeiitic basalt, 30 wt.% of carbonates of Ca, Na and K. The source of the fluid was distilled water (~10 wt.%). The temperature was measured with a Pt<sub>30</sub>Rh/Pt<sub>6</sub>Rh thermocouple, the pressure was calibrated against the quartz-coesite equilibrium curve. The accuracy of determining the temperature and pressure in the experiments is estimated at  $\pm 5^\circ\text{C}$  and  $\pm 1$  kbar. The duration of the experiment was from 12 to 24 hours. The polished preparations of quenching samples were analyzed on an electronic scanning microscope at the IEM RAS.

At  $P = 4$  GPa, the solidus temperature is  $1150 \pm 50^\circ\text{C}$ , liquidus temperature is  $1275 \pm 25^\circ\text{C}$ . The subsolidus association is represented by Grt, Cpx, Cb. At partial melting a high-K alkaline silicate melt ( $L_{\text{Sil}}$ ) forms at  $T=1100^\circ\text{C}$  and coexisting with Cpx, Grt, Cb. With increase  $T$  up to  $1200^\circ\text{C}$  a carbonate melt ( $L_{\text{Cb}}$ ) appears, the main mineral of the liquidus is Cpx. The immiscible  $L_{\text{Sil}}$  and  $L_{\text{Cb}}$  are stable in the range of  $T=1100-1250^\circ\text{C}$ . In the interval  $T$  from  $1250$  up to  $1300^\circ\text{C}$  there is a "critical" point of the temperature ( $T_K$ ) equilibrium of alkaline silicate and carbonate melts, at the attainment of which complete mixing is observed between  $L_{\text{Sil}}$  and  $L_{\text{Cb}}$ . At  $T > T_K$ , there is only one carbonatized silicate melt. In the results of quenching, a heterophase mixture of carbonate and silicate phases is formed, the compositions of which form a linear trend, the extreme members of which are silicate and carbonate components.

The work was supported by the RFBR grant 17-05-00930a.