Structural changes in a natural basalt glass at high-pressure by means of X-ray Raman Scattering

S. Petitgirard[1], R. Sakrowski[2], Ch.J. Sahle[3], G. Spiekermann[4], C. Albers[2], M. Wilke[4] and C. Sternemann[2]

[1]Bayerisches Geoinstitut, Univ. of Bayreuth, Bayreuth, D-95490, Germany; [2]Fakultät Physik / DELTA, Techn. Univ. Dortmund, D-44221 Dortmund, Germany; [3]European Synchrotron Radiation Facility, Grenoble, FR-38000, France; [4]Institute of Earth and Environmental Science, Univ. Potsdam, D-14476, Potsdam, Germany; **robin.sakrowski@tu-dortmund.de**

Basalt is one of the most common products of mantle melting on the Earth's surface. At mid-ocean ridges, the decompression of the mantle causes the partial melting of peridotite into basaltic magmas forming the oceanic crust. At subduction zones basalt can be recycled down to the mantle and replenish the deep Earth. Basaltic melts are much more mobile than their counterpart solids and any changes in density and viscosity could have strong influence on the chemical and thermal differentiation of the Earth's interior. Basaltic melts could form at partial melts from peridotitic mantle at various locations within the Earth's mantle, such as at the core-mantle boundary [1], at the transition zone [2], at subduction zones [3] or at the lithosphere-asthenosphere-boundary [4]. Knowledge of the short-range atomic and electronic structure in melts brings important constraints about their compressibility and viscosity at depth beyond the transition zone between 20 to 27 GPa (660km). In order to reveal the coordination changes in a natural depolymerized basaltic sample and to study the role of cation network modifiers and their influence on the local environment of Si, Ca and O in high-pressure melts, we measured and analysed the near edge X-ray Raman scattering signal at the Si L-edge, Ca L-edge and O K-edge in a natural basalt glass up to 36 GPa using a new design of conical diamond anvils [5]. These data give a first insight into the influence of cation network modifier, like Ca and are compared to fully polymerized SiO_2 glass at the pressure of the lower mantle [6]. The results will be discussed in view of recent density data [7], X-ray total scattering data [8] and calculated structures and coordination from ab-inito calculation [9].

References

[1] - D. Andrault et al., Science 344, 892-895 (2014).
[2] - C. Crepisson et al., Earth Planet. Sci. Lett., 393, 105-112 (2014).
[3] - A.R. Thomson et al., Nature, 529, 76-79 (2016).
[4] - T. Sakamaki et al., Nat. Geoscience., 6, 1041-1044 (2013).
[5] - S. Petitgirard et al., J. Synch. Rad, 24, 276-282 (2017).
[6] - S. Petitgirard et al., Geochem. Persp. Let. 9, 32-37. (2019).
[7] - S. Petitgirard et al., Phys. Rev. Lett. 119, 215701 (2017).
[8] - C. Sanloup et al, Nature 503, 104-107 (2013).
[9] - S. Bajgain et al, Nat. Comm. 6:8578 (2015).