Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7537

Some examples of X-ray micro-computed tomography applied to mantle petrology.

MARCO VENIER[1], LUCA ZIBERNA[1], LUCIA MANCINI[2,3], ALEXANDER PETER KAO[4], FEDERICO BERNARDINI[5,6], NASRRDDINE YOUBI[7,8,9], YONDON MAJIGSUREN[10], DAVIDE LENAZ[1] AND ANGELO DE MIN[1]

[1]University of Trieste
[2]Elettra-Sincrotrone Trieste S.C.p.A., Basovizza (Trieste)
[3]LINXS – Lund Institute for Advanced Neutron and X-ray Science
[4]Elettra-Sincrotrone Trieste S.C.p.A.
[5]International Centre for Theoretical Physics
[6]Centro Fermi, Museo Storico della Fisica e Centro di Studi e Ricerche Enrico Fermi
[7]Cadi Ayyad University
[8]Instituto Dom Luiz, University of Lisbon
[9]Faculty of Geology and Geography, Tomsk State University
[10]Mongolian University of Science and Technology

Presenting Author: marco.venier@phd.units.it

To understand the main processes that occur in the upper mantle (i.e. sub solidus recrystallization and magmatic crystallization as well as metasomatism), one of the fundamental steps is an accurate textural characterization of natural xenoliths. Texture, as well as composition and mineralogy, reflects the temperature, pressure, stress conditions, melting and/or contamination events undergone during, or more commonly before, the entrapment in the host magma (Pearson et al., 2003). For these reasons, studying the distribution of glass pockets and veins, as well as the texture of silicate, oxide and sulphide phases in mantle xenoliths has great importance in the study of mantle metasomatism (Coltorti et al., 2000; Hughes et al., 2016; Lenaz et al., 2017; Blanks et al., 2020).

We performed an investigatory multi-scale 3D textural analysis through X-ray computed microtomography (micro-CT) on three mantle xenoliths from different geodynamic settings (i.e. mobile belt zone, pericraton, oceanic hotspot). These have been selected to represent different, variably complex, internal structures, composed by grains of different phases, fractures, possible fluids and voids of different sizes. We used an approach structured in increasing steps of resolution, starting with conventional X-ray micro-CT imaging (voxel size: 30 μm) and moving on to phase-contrast synchrotron-based X-ray micro-CT to reach a voxel size of 0.9 μm.

We tested the effectiveness of micro-tomographic imaging on textural characterization of xenoliths, comparing the results with the observation of conventional thin sections in optical microscopy. 3D models obtained allow us to collect several textural information that were impossible to determine in a 2D classification. For example, we identified: spinel layering in one sample (MG10x), presence of gas vesicles in glass of xenolith Bi4, and silicic glass scattered through sample FN38. Moreover, high-density volumes were detected in nodules MG10x and Bi4, showing no relation with the spinel layering in the first one and a preferential concentration along fractures in the latter one.

Blanks et al. (2020). Nature communications, 11(1), 1-11. https://doi.org/10.1038/s41467-020-18157-6

Coltorti et al. (2000). EPSL 183, 303–320. https://doi.org/10.1016/S0012-821X(00)00274-0

Hughes et al. (2016). Lithos, 240, 202-227. https://doi.org/10.1016/j.lithos.2015.11.007

Lenaz et al. (2017). Lithos, 278, 464-476. https://doi.org/10.1016/j.lithos.2017.02.012

Pearson et al. (2003). TrGeo, 2, 568. https://doi.org/10.1016/B0-08-043751-6/02005-3