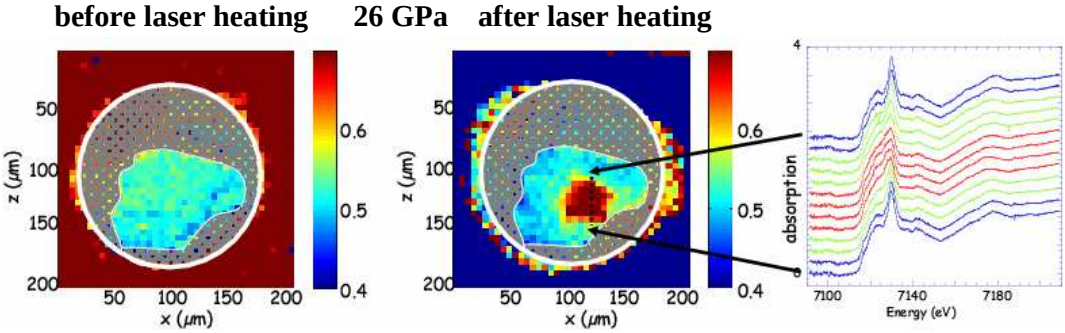
X-RAY ABSORPTION SPECTROSCOPY WITH MICROMETRIC SPATIAL RESOLUTION AND FAST ACQUISITION: A NEW TOOL FOR EARTH SCIENCES

G. Aquilanti[1], S.Pascarelli[1], M. Muñoz[2], L. Dubrovinsky[3]

[1]ESRF, 6 rue Jules Horowitz, F-38043 Grenoble, France, aquilanti@esrf.f.
[2]LGCA, Université Joseph Fourier,F- 38041 Grenoble, France
[3]Bayerisches Geoinstitut, Universität Bayreuth, D-95440, Germany

Energy dispersive X-ray absorption Spectroscopy (EDXAS) is now a well-established method which has been applied to a broad range of applications. At the energy-dispersive EXAFS beamline of ESRF, ID24 [1] we have recently achieved a 5 x 5 μm^2 focal spot that, combined with fast acquisition, has allowed us to map complex and non-uniform samples. We have obtained images where each of the thousands of pixels contains full XAS information: i.e chemistry and local structure and also oxidation state and site-partitioning.

In this presentation I will show, as an example, a 2D mapping in transmission mode in a diamond anvil cell (DAC). As test sample, we have chosen a major component of Earth's mantle, ringwoodite [γ-$(Mg,Fe)_2SiO_4$], which is thought to undergo a chemical decomposition, at around 660 km depth (approximately 23 GPa) and 1600 ^oC in correspondence to a strong seismic discontinuity, towards $(Mg,Fe)SiO_3$-perovskite and (Mg,Fe)O-magnesiowustite (or ferropericlase). We aquired Fe K-edge XANES maps at different pressures, up to ~ 40 GPa, before and after laser heating, covering for each map an area of 200 x 200 μm^2 at 5 μm spatial resolution. The figure below illustrates maps of normalized absorbance at a defined energy (E = 7125 eV) at 26 GPa before (left) and after (right) laser heating. Analysis of the modifications in the spectra from the hot spot region allow to extract Fe speciation at high P and T, yielding key information for modelling Earth's mantle processes.



For the future we plan to perform *in situ* studies of chemical reactions, element partitioning and kinetics of processes in laser or electrically heated DAC on geologically relevant alloys and compounds contributing to answer to many enigmatic questions related to formation and differentiation processes of Earth and other planets.

[1] S.Pascarelli, O. Mathon, M. Muñoz, T. Mairs and J. Susini, J. Synchr. Radiation 13, 351 (2006)