Direct quantification of the effects of iron content and hydration on the high-pressure elasticity of single-crystal ringwoodite

KIRSTEN SCHULZE[1], HAUKE MARQUARDT[1], TAKAAKI KAWAZOE[1], MONIKA KOCH-MÜLLER[2], ALEXANDER KURNOSOV[1] AND TIZIANA BOFFA BALLARAN[1]

[1]Bayrisches Geoinstitut (BGI), University of Bayreuth, 95440 Bayreuth, kirsten.schulze@uni-bayreuth.de
[2]German Research Center for Geosciences (GFZ), Telegrafenberg, 14473 Potsdam

Quantitative knowledge about the effects of chemical variations on the high-pressure elasticity of $(Mg,Fe)_2SiO_4$ ringwoodite is needed to derive information about the state of the Earth's transition zone from seismic observations. Because the individual effects of iron content and hydration state on the elastic properties are relatively small, for parameter variations as expected in the transition zone, it is difficult to constrain their influence by comparing data collected in different laboratories and/or using different techniques.

We will discuss first results of a single crystal elasticity study using Brillouin spectroscopy designed to constrain the influence of iron and H_2O concentration on the high-pressure elasticity of ringwoodite by an internally consistent approach. Single-crystals of ringwoodite were synthesised in multianvil presses from either natural olivine or forsterite powders. The synthesized samples range in composition from Mg_2SiO_4 to $(Mg_{0.89},Fe_{0.11})_2SiO_4$, with H_2O contents between about 0.4 wt.% and more than 2 wt.%.

Single-crystal samples of good structural integrity, indicated by well-defined x-ray diffraction peaks, were selected, oriented and double-sized polished for high pressure Brillouin spectroscopy measurements in the diamond-anvil cell. A FEI Scios Focused Ion Beam (FIB) machine was used to precisely cut samples into divided-circles enabling us to load multiple samples simultaneously (Fig. 1).

Using this approach it is possible to measure the full elastic tensor of several compositions in one experimental run and directly quantify effects of pressure, temperature, iron-content, and H-incorporation on single-crystal elasticity.

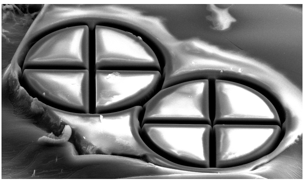

Fig. 1: Secondary electron image of a single-crystal ringwoodite FIB-cut into divided circles, Ø=120 μm.