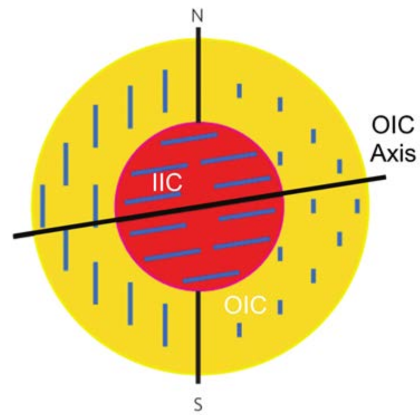
# Master projects in Mineralogy/Experimental Geochemistry available for 2018

We are looking for motivated students who would like to do their Master thesis in Mineralogy/Experimental Geochemistry. The topics offered are:

### 1) Constraints on inner core composition from high-pressure studies on Fe-Si alloys

*Supervisors: I. Kupenko and C. Sanchez-Valle*

The cores of terrestrial planets are comprised mostly of Fe-Ni alloy, but should additionally accommodate some amount of light elements in order to match the observed core density and reduced (compared to pure Fe-Ni) seismic velocities. Additionally, there is evidence for prominent anisotropy in the inner core, with the compressional waves traveling through the core faster in the equatorial plane than along the polar axis (Fig. 1). The anisotropic structures in the inner core are likely formed by dynamic processes that induce the plastic deformation and development of textures of inner core materials under pressure. Yet, the effect of light elements on the plasticity of iron is poorly known. The aim of this Master project is to investigate the plastic deformation mechanisms (strength and textures) of iron alloyed with silicon at extreme pressures and temperatures employing externally-heated diamond anvil cells (DACs). The student will participate in the preparation of DACs in Münster and in radial diffraction experiments at Petra III synchrotron in Hamburg (secured beamtime in mid-June). By analyzing the experimental data the student will verify the plastic properties of Fe-Si alloy and will use this information to constrain the plastic deformation in the Earth core to clarify the origin of the observed seismic anisotropy.

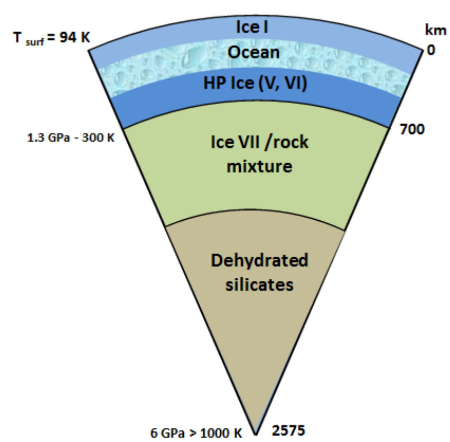



Model for the anisotropy of the outer inner core and the inner inner core. The short sticks indicate the fast direction and the strength of the anisotropy.

### 2) Rheology of ice and the thermal evolution of icy moons

*Supervisors: C. Sanchez-Valle and C. Vollmer*

The aim of this Master project is to bring new constraints on the internal structure, dynamics and thermal evolution of icy moons of Jovian planets (e.g. Titan) by investigating the rheological properties and deformation mechanisms of high pressure ice phases that build their deep interior (*Fig.2*). The student will determine the strength and flow laws of ice VI and VII in deformation experiments conducted at different strain rates in a Griggs apparatus at ISTO (Orleans, France). The orientation of ice grains will be determined from ice replicas by electron microscopy (SEM/TEM) at WWU. The data will allow modelling the convective regime of icy moons and their degree of differentiation in combination with geophysical data provided by spacecraft missions (Galileo or Cassini/Huygens).



### 3) Mobility of carbonated melts in the upper mantle

*Supervisor: C. Sanchez-Valle*

The aim of this project is to determine the density of carbonated melts that are responsible for the storage and transport of carbon at depth. Density has an important effect on the mobility of melts and hence on the carbon fluxes towards the surface and the global carbon cycle. The density will be determined using a Synchrotron X-ray absorption method at high pressure at the European Synchrotron Radiation Facility (ESRF, France) in March 2018. The results will be applied to develop quantitative models for the migration/ascent/emplacement of melts through the mantle and to provide constrains on the mobility of carbon in the upper mantle.

If you are interested, please contact Carmen Sanchez-Valle (sanchezm@uni-muenster.de), Ilya Kupenko (kupenko@uni-muenster.de) or Christian Vollmer (christian.vollmer@uni-muenster.de) for details.