ESRF	**Experiment title:** Decomposition of serpentine and water storage in the lower mantle	**Experiment number:** ES-89
Beamline: ID27	**Date of experiment:** from: 06/11/2013 to: 10/11/2013	**Date of report:** 04/02/2014
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Report:

The transport of water from the surface to Earth's deep interior and its circulation on a global scale are key to understand the evolution of the planet.

The occurrence of significant amount of water in the Earth's mantle would have strong effects on the physical properties of materials including the melting temperature and the rheology. Seismic studies have often related seismic anomalies to the presence of hydrous phase (*1*) and suggested that cold subducting slabs could penetrate into the lower mantle, accumulate at the mantle/core boundary and transport the water trapped in the slab at approximately 2900 km depth. In the downgoing slab, serpentines, the major hydrous mineral in the oceanic crust (13 weight% of H_2O), will decompose with increasing pressure and temperature conditions and will form dense hydrous magnesium silicate phases (DHMS, Fig.1a). These hydrous silicates have H_2O contents (*2*) several times larger than the amounts associated with nominally anhydrous mantle minerals. Because DHMS demonstrated stability at mantle conditions, they are plausible candidates as H_2O reservoir in the Earth's deep interior. Even if the stability conditions of DHMS phases in the deep Earth are crucial to understand the Earth's water budget and seismic observations, few studies have focused on decomposition of serpentine at high pressures and they were performed only at transition zone conditions (*3*).

In order to study the decomposition of serpentine minerals at Earth's mantle conditions, we performed 10 successful high pressure diamond anvil cell experiments coupled with laser heating at the ID27 beamline, using natural lizardite, the low temperature serpentine mineral, as a starting material. These experiments were performed at pressure in the range of 30 GPa to 85 GPa and temperatures in the range 1000K to 2500K for each pressure condition. This correponds to the first set of experimental data on the stabilities of the DHMS

phases in the highest conditions of pressure and temperature while a recent computationnal study (*4*) suggests the existence of a new hydrous phase, named phase H, at Earth's lower mantle conditions.
(Fig. 1a). In Figure 1b, c and d, some selected diffraction patterns obtained during laser heating at 1500 K and three different pressure conditions (30 GPa, 42 GPa and 62 GPa) are displayed. The diffraction patterns obtained at high P and T are coupled in some of our experiments by XRD on the quenched products.
All the XRD patterns have high quality and are under process for phases identification and quantification.
The specimens from high pressure and temperature were recovered and will be analyse offline with SEM and FIB and TEM microscopy techniques available in our laboratory for comparison with results obtained from XRD analysis.

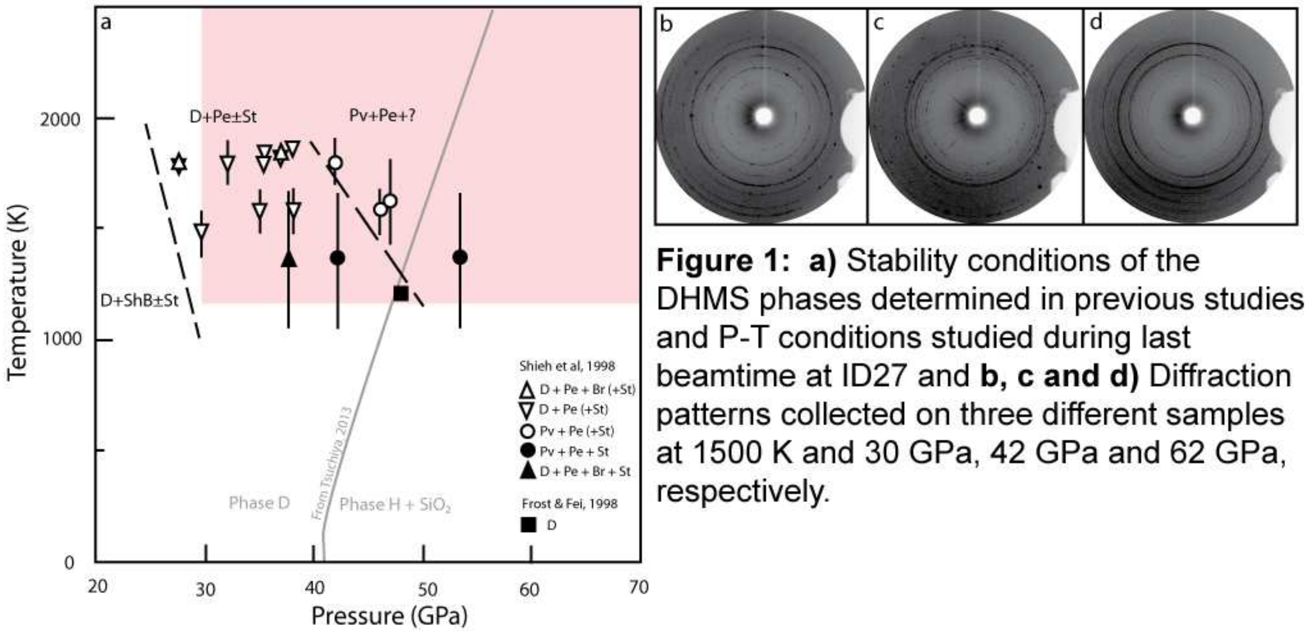

Figure 1: a) Stability conditions of the DHMS phases determined in previous studies and P-T conditions studied during last beamtime at ID27 and **b, c and d)** Diffraction patterns collected on three different samples at 1500 K and 30 GPa, 42 GPa and 62 GPa, respectively.

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