Scientific researchers:
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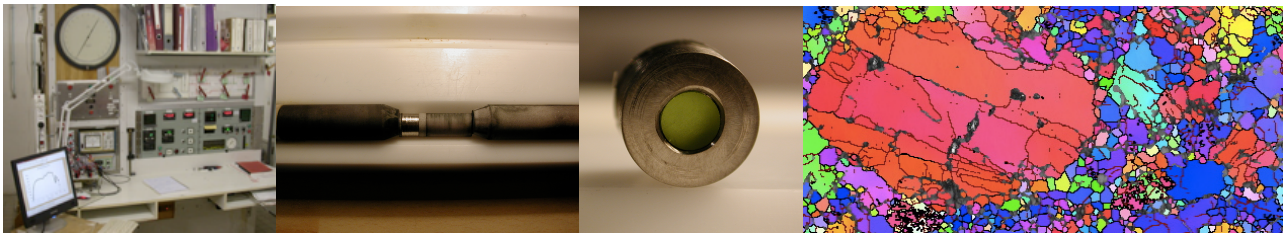
Our knowledge of the processes that control the dynamics of our planet relies on direct observations of the deformation at the Earth's surface (i.e., plate tectonics), on indirect geophysical and geochemical data at depth (seismology), and on numerical or laboratory modelling of deformation and thermal exchanges. However, both the interpretation of these indirect data in terms of composition, deformation, and thermal structure of the deep Earth and the development of accurate geodynamical models depend on our knowledge of the physical properties of the dominant rock-forming minerals in the deep Earth.

The project named ***Plasticity of Earth's Mantle (PoEM)***, financed by a Marie-Curie fellowship (International Reintegration Grant) which has successfully ended recently, was focused on the experimental determination of the rheological properties of Earth's uppermost mantle major mineral: olivine. Since olivine represent between 60 and 80 % in volume of the Earth's upper mantle, its controls the dynamics of the upper mantle and hence the interactions between the convective mantle and surface processes. Several physical properties of olivine were however still poorly constrained, in particular in its low temperature domain (800 ^{o}C < T < 1000 ^{o}C). The **PoEM** project was focused on the experimental determination of the rheology of this crystalline solid under the high pressure and temperature conditions that prevail in the uppermost Earth's mantle. The objectives were:

- to characterize the deformation mechanisms of olivine and olivine-rich rocks at pressure and temperature conditions relevant for the lithospheric mantle.
- to obtain quantitative data on the mechanical behaviour (stress-strain rate relationship) of olivine-rich rocks as a function of the temperature and chemical environment especially with or without the presence of hydrogen.

The **PoEM** project has permitted to a young European female researcher, Sylvie Demouchy, to stronger her professional career by establishing a sound research profile and building new collaborations in France in addition to those already established during her training years in Germany and the USA. The host institution Geosciences Montpellier research laboratory has provided world-class analytical and experimental facilities necessary to the success of the **PoEM** project**.**

The first main results of **PoEM** project show significant differences on the rheological properties of olivine at low temperature (800-1100 °C) relative to its high temperature (>1200°C) mechanical behaviour; flow stresses are much weaker than those previously proposed based on the extrapolation of high temperature flow laws. These results help us to reconsider the rheology of the uppermost mantle and to reconcile the experimental data set with results from field studies and numerical models. The second main results of **PoEM** project, based on experiments on polycrystalline olivine at high temperature (1200 °C), deformed by torsion under 'hydrous conditions', permitted us a revision of the previous accepted values for the viscosity of the uppermost mantle in hydrous conditions (30% decrease in stress instead of several orders of magnitude). The outcomes from the **PoEM experiments** permit to improve and strength our understanding of global plate tectonics and the rheology of the mantle lithosphere, under both dry and hydrous conditions. The different results were presented in 18 contributions or seminars at conferences (national, European and international) and research institutes (France, Europe, Australian, Japan and USA). One article is already published (Demouchy et al., 2012, Phys. Earth Planet. Int. vol 201-203, p: 56-70) and another one is in preparation.



PoEM project in images (from left to right): the high pressure vessel at Montpellier university, the assembly puzzle for deformation, an olivine single crystal in its silver sleeve, and a portion of EBSD map from a polycrystalline sample deformed in torsion.

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