Senior Bursary Award – Collaborative visit to University of Ottawa and EMC-2012 meeting in Frankfurt

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I would like to thank the Mineralogical Society for their support towards my visit of a colleague at the University of Ottawa in Canada and my participation in the EMC-2012 meeting in Frankfurt.

With Prof. Keiko Hattori in Ottawa I have been working on the behaviour of fluid-mobile elements during dehydration of serpentinite in subduction settings. Large amounts of water are stored in the hydrated abyssal peridotites of slabs, and much of this water will be released during their subduction at depths of 120-240 km due to dehydration of serpentine minerals. This dehydration is accompanied by the crystallisation of secondary olivine. Olivine is typically very poor in water and fluid-mobile elements and it is assumed that the water and fluid-mobile elements are released to the overlying mantle wedge. Eventually much of the water returns to the Earth's surface through arc volcanism.

To evaluate the behaviour of elements in the mantle during the dehydration of serpentinites, we examined the compositions of secondary olivine grains from the high-pressure Erro-Tobbio unit (Voltri complex, Ligurian Alps, N-W Italy) by several techniques, including ion microprobe (SIMS) and FTIR spectroscopy.

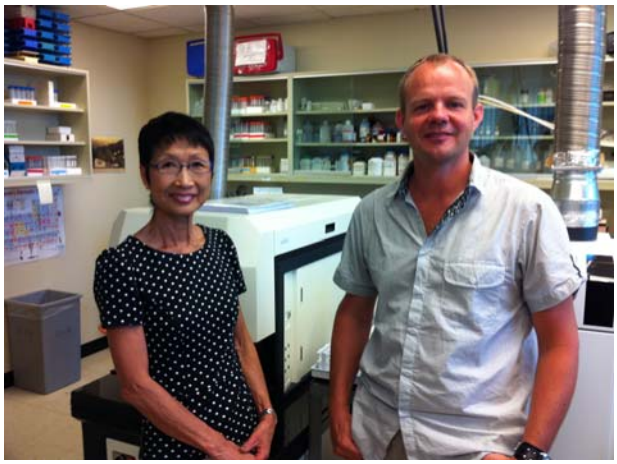

Fig. 1. In my colleague prof. Keiko Hattori's ICP-MS laboratory at the University of Ottawa, Canada, during my visit in July 2012

We found that several generations of olivine exist with a surprising wide range of H_2O and TiO_2 contents, the most volatile-rich olivines having no less 0.7 wt.% H_2O and 0.85 wt.% TiO_2. Such high values for unaltered olivine are unprecedented in the literature and probably related to a high density of Ti-clinohumite defects in olivine. Ti-clinohumite is a H_2O and TiO_2–rich mineral with a structure closely related to that of olivine. Another interesting finding was that even in water-poor olivines, lithium and boron concentrations were considerably enriched compared to serpentine minerals in the same rock. Thus, during dehydration of serpentine, newly-formed olivine appears to act as a sink for these elements. We conclude that Li and B must be derived from external fluids, probably from mafic lithologies in the same area, such as eclogitised gabbros.

In the future we plan to use TEM to study the nature of crystal defects in Ti-rich olivine to better understand its strange composition and to do B and Li isotope work on olivine to better constrain the source of external fluids.

Continued overleaf…

Fig. 2. The fantastic conference venue for EMC-2012 at the Goethe campus in Frankfurt in September 2012

Fig. 3. Presenting my poster at EMC-2012

The EMC-2012 meeting in Frankfurt itself was a great success and superbly organised by Gerhard Brey from Johann Wolfgang Goethe-University and his colleagues from the organising committee. This was the first joint meeting among European mineralogical societies, including the Mineralogical Society of Great Britain and Ireland which sponsored my attendance, and it was a great opportunity to join a relatively small (ca. 750 abstracts) and well-targeted meeting with a like-minded audience.

I presented a poster on the Ti-rich secondary olivine from Voltri described above as well as an oral presentation about trace elements in olivine inclusions in diamonds and what they tell us about the formation conditions of diamonds and the nature of the mantle they are derived from. My contribution to this conference would have been impossible without the support of the Mineralogical Society.