THEME 1:
THE DYNAMIC SOLID

Session 1.5:
Phase transitions in minerals

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The detailed description of phase transitions in low temperature, aqueous environments as well as in higher temperature and pressure systems is fundamental to gaining insight into geological processes as well as to understanding the properties of minerals and materials. In this symposium we welcome contributions that treat local phenomena, such as the various types of atomic rearrangements, ordering effects, the formation of defects and the pattern of domain boundaries which in total leads to the definition of macroscopic properties and processes. Better understanding of the thermodynamic behaviour of minerals is now being achieved through the complementary approach of combining theoretical, experimental and computer modelling studies. Discussion between various groups of Earth scientists, theoretical and experimental physicists and chemists will result in a more complete picture of the complex behaviour of minerals. Contributions from all of these approaches are welcomed.

1.5.11

Nanoscale pyroxenes reactions during peridotite serpentinization

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Mantle dynamics close to oceanic ridges is ruled by the nature of the serpentinization processes occurring in the uprising peridotite. A particularly important subject regards the way by which sea-water [1] arrives to the peridotite, and is fixed by transformation of olivine and pyroxenes. The details of the not-topotactic transformations affecting olivine have been previously studied, for peridotites from Oman and Tuscany [2,3]. We focus now on the reaction mechanisms affecting ortho- and clinopyroxenes (opx and cpx), in partially serpentinized harzburgites from Tuscany.

Opx and cpx coexist in the rock as separated crystals, as well as exsolved cpx in opx and exsolved opx in cpx, equilibrated at exsolution temperatures of 1130°C. HRTEM and TEM-EDS investigation was led over opx crystals with exsolved cpx (submicrometric (100) lamellae). The cpx-opx interface is associated with several contrast features that, by Fourier-filtering of HRTEM images, appear to correspond to frequent dislocations, mostly within cpx.

During the peridotite uplift, both cpx and opx underwent hydration processes, most probably at different temperatures, that resulted into different mineral assemblages, and into different nanotextures. In some places, opx transforms into talc + chlorite + serpentine intermixtures, following topotactic reaction mechanisms. In other places, opx transforms into serpentine + poorly crystalline serpentine-like material, following not-topotactic mechanisms.

Conversely, cpx transforms into different biopyriboles, according to a completely topotactic reaction mechanism. Biopyriboles usually occur as a few unit cells thick (010) blades, that extend through the whole cpx exsolution lamella. Textural evidence suggests that this reaction is the first one in a sequence of several hydration processes. Cpx and included biopyriboles survive through later hydration processes, that affect opx and transform it to different layer silicate.

In conclusion, microstructural analysis indicate the presence of different reaction mechanisms and of different (topo- or not-topotactic) nanotextures at the reaction front. They depend upon the different stages of the hydration process, the different reacting surfaces and the variable water amounts.

References

[1] Anselmi B., Mellini M. and Viti C. (2000) *Eur. J. Mineral.* 12, 137-146.
[2] Baronnet A. and Boudier F. (2003) *Journées thematiques "Serpentines"*, 20-21 Nov. 2003, SFMC, Paris.
[3] Mellini M., Rumori C. and Viti C. (2003) *Journées thematiques "Serpentines"*, 20-21 Nov. 2003, SFMC, Paris.