Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 440

Hollandite in Shocked Meteorites: Clues for the Mineralogy of the Earth Mantle and Subducting Lithosphere

Philippe Gillet (pgillet@ens-lyon.fr)[1], **Ming Chen** (chen@mpch-mainz.mpg.de)[2],
Ahmed El Goresy (gorezy@mpch-mainz.mpg.de)[3] & **Leonid Dubrovinsky**[4]

[1] Lab. de Sciences de la Terre, ENS Lyon, 46 allée d'Italie, 69364 LYON cedex 07, France
[2] Guangzhou Institute of Geochemistry, AC, Guangzhou, China
[3] Max-Planck-Institut für Chemie, J. -Becher-Weg 27, 55128 Mainz, Germany
[4] Theoretical Geochemistry Program, Institute of Earth Sciences, Uppsala University, S-75236 Uppsala, Sweden

Alkali feldspars in the system $KAlSi_3O_8$-$NaAlSi_3O_8$-$CaAl_2Si2O_8$ are abundant minerals of the Earth's crust. Their behaviour under moderate pressure and temperature conditions is well-known. For instance, the albite to jadeite + quartz transition is a well-calibrated metamorphic reaction used to infer the (P,T) conditions of feldspar-rich blueschist and eclogitic rocks. The behavior of feldspars at higher pressures (>3 GPa) and temperatures (> 1000 K) is also of interest because these phases might host Ca, K and Na in Earth's mantle as well as other important trace elements like Sr or Rb. As shown by recent seismic tomographic images, the continental and oceanic crust can be subducted in the upper and lower mantle. Feldspars or their high-pressure polymorphs, if stable under the relevant (P,T) conditions, can therefore act as potential carrier of Na, Al, K and trace elements, from Earth's surface down into the deep mantle. The behavior of feldspars at (P,T) conditions of the Earth's mantle or of subducting lithosphere has been experimentally studied. It has been shown that $KAlSi_3O_8$ and $NaAlSi_3O_8$ transform at 1300 K into a denser phase with the hollandite structure at 12 GPa and 21 GPa to 24 GPa respectively. Several other silicate with the hollandite structure have also been synthesized including Ca bearing hollandites. We report the occurrence of such hollandites in the veins of heavily shocked meteorites (Sixiangkou meteorite (L6 chondrite), the SNC meteorite Zagami and the Tenham meteorite). These meteorites contains black veins formed by shock-melting and in which high-pressure assemblages have been described. These minerals include $(Mg,Fe)_2SiO_4$ ringwoodite, $(Mg,Fe)SiO_3$ majorite, Ca-Al majorite, $(Mg,Fe)SiO_3$ ilmenite. Beside these mineral assemblages, the veins of the meteorites contain, as in most shocked meteorites, zones of feldspathic composition. These zones, often called maskelynite, have been interpreted as diaplectic glasses formed by shock-induced solid-state amorphization. We characterized the feldspathic material using electron microprobe, Raman spectroscopy and X-ray diffraction. In the Sixiangkou meteorite the composition is that of an oligoclase (Ab_{80}-An_{12}-Or_8). The Raman spectra of the feldspathic material is not characteristic of a fully glassy phase. The spectra are similar in the numerous grains examined so far. They consist of the superposition of large broad peaks characteristic of silicate glasses and sharp peaks characteristic of a crystalline phase. The well-defined peaks do not correspond to any known feldspar polymorph of albitic composition. All the sharp peaks observed on the Raman spectra of the Sixiangkou "maskelynite" correspond to within a few wavenumbers to those of synthetic $KAlSi_3O_8$-hollandite. The presence of hollandite was confirmed by X-ray microdiffraction. Raman spectroscopy and EMPA analysis on similar zones in the Zagami and Tenham meteorites revealed the presence of hollandite with K-rich and Ca-rich compositions. The occurrence of hollandite in meteorites constraints the (P,T) conditions reached during the shock event. The identification of these high-pressure phase of feldspathic compositions has important bearing for the processing and behaviour of alkali elements in the Earth's deep mantle. Continental material have high abundances in K and Na which could be hosted in K- or Na-rich hollandites during their subduction in the deep mantle. If present in the mantle transition zone, hollandites could strongly influence trace element geochemistry of magmas produced in the deep mantle since they incorporate preferentially incompatible elements (K, Pb, Sr ...).