Cl, Br and I content of HP saline aqueous brines from Dabie Shan and the Alps

D. Molinari[1], P. Philippot[1], J. Cauzid[1,2], J. Foriel[1],
B. Ménez[1], A. Somogyi[2] and B. Nöhammer[3]

[1]Geosciences Marines, CNRS, IPGP, case 89, 4 place Jussieu, 75252 Paris cedex 05, France [philippo@ipgp.jussieu.fr]
[2]ESRF, BP 220, 38043 Grenoble, France
[2]Paul Scherrer Institute, CH 5232 Villigen PSI, Switzerland

HP to UHP eclogitic rocks from the European Alps (Italy) and the Dabieshan (China) contain inclusions fluids preserving remnants of early HP highly-saline aqueous brines. In all localities, these inclusion fluids are found in microdomains surrounded with zones composed dominantly by secondary, late-stage, fluid inclusions. In order to extract information on the Cl, Br and I content of the fluid phase attending HP metamorphism, synchrotron X-ray microfluorescence analysis of individual inclusions was performed. A Fresnell zone plate with high demagnification factor ensured the focusing of monochromatized X-rays at 35 keV, that is close to the absorption edge of iodine. Three eclogitic rocks were investigated. All samples are derived from leucocratic protoliths occurring either as layers within banded formation (Bixiling area in Dabieshan and Sesia zone in the Alps) or as massive pyrope-quartzite layer within polymetamorphic gneiss (Dora Maira massif). Eclogitic rocks from Bixiling and Dora Maira are coesite-bearing.

Fluid inclusion analysis revealed that the saline brines present in the layered formation of Sesia and Bixiling contain between 3 to 15 ppm Br, against 30 to 60 ppm in the Dora Maira. In all localities, iodine content is below the ppm. These values are not very different from modern seawater. With regards to elemental ratio, the high Cl/Br and Cl/I ratio fall within the range of typical magmatic fluids. The main control of magmatic halogen signatures lies either in the source-rock composition and/or vapor/liquid immiscibility. Although a inherited fluid composition cannot be excluded, fluid partioning between a vapor and a liquid phase has also been proposed as an important mechanism of Cl enrichment in HP fluids, in general, and the Dora Maira pyrope quartzite, in particular, and is therefore preferred as a working hypothesis at this stage of investigations.

Oxygen isotopic compositions of Cr-spinels from Archean to Phanerozoic chromite deposits

S.K. Mondal[1], E.M. Ripley[2], C. Li[2], A.H. Ahmed[3],
S. Arai[3], J. Liipo[4]and C. Stowe[5]

[1]Department of Geological Sciences, Jadavpur University, Calcutta-700032, India, (sisirke@yahoo.com)
[2]Department of Geological Sciences, Indiana University, Bloomington, In-47408, USA
[3]Department of Earth Science, Kanazawa University, Kakuma-9201192, Japan
[4]Outokumpu Research Oy, P.O Box 60, FIN-28101 Pori, Finland
[5]Department of Geological Sciences, University of Cape Town, University Private Bag, Rondebosch 7700, South Africa

We have studied the oxygen isotopic copositional variations of Cr-spinels in chromitites from the Archean Selukwe Complex, Zimbabwe (3.5Ga), the Archean Nuasahi Complex, India (3.2Ga), the Archean Stillwater Complex, Montana (2.7Ga), Proterozoic ophiolitites of Finland (Outokumpu) and Egypt, and the Phanerozoic Oman ophiolite. The features and chemical characteristics of chromite deposits are in part a result of processes dominant in their tectonic settings and can be used to reconstruct the history of the deposits. Chromitites often have a close relationship with base metal sulfides and platinum-group element (PGE) mineralization. The $\delta^{18}O$ values (5.1‰) of mantle Cr-spinel from the Oman ophiolite are similar to those of Archean greenstone Cr-spinels from the Selukwe and Nuasahi areas. Chromite from the Proterozoic ophiolites (Finland and Egypt) and altered Cr-spinel from the Oman ophiolite show similar $\delta^{18}O$ values (~3.2‰), which are lower than typical igneous values and can be related to post-magmatic modification. The Cr-spinels in hydrothermally altered assemblages show significant isotopic exchange with low-temperature fluids. The Cr-spinel from the Stillwater Complex shows low $\delta^{18}O$ values (2.2 and 3.2‰),which can be related to isotopic exchange during low-grade greenschist-facies metamorphism of the Complex between 1.6 and 1.8Ga. The Cr-spinels from the Nuasahi Complex show wide $\delta^{18}O$ variations, which are related to the degree of hydrothermal alteration. Ten samples of Cr-spinel from the chromitite layers and Cr-spinel within a base metal sulfides- and PGE-rich breccia zone show $\delta^{18}O$ values from 5.9 to 3.2‰. Ferrian chromite (or ferritchromite, an obvious alteration phase) has $\delta^{18}O$ of 3.7 to 0.8‰. All of these lower values are consistent with relatively high-temperature, kinetically- dominated, exchange with a low- ^{18}O fluid ($\delta^{18}O$ ~0‰). The $\delta^{18}O$ values of Cr-spinel, serpentine and chlorite suggest that the fluid involved in hydrothermal alteration and isotopic exchange may have been evolved seawater and support the claim of Page et al. (1985), who suggested based on PGE analyses of the Nuasahi Complex that it represents a Precambrian analogue of an ophiolite complex. Both mineral assemblages and $\delta^{18}O$ values provide key data by which to interpret the post-crystallization history of chromitites from varied tectonic settings.