Zn-rich chromite in Ni-ore of the Thompson Nickel Belt, Canada

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Abstract

A comparative till and bedrock study in the Thompson Nickel Belt (TNB), Manitoba, Canada, was carried out by the Geological Survey of Canada (GSC) and Manitoba Geological Survey in collaboration with a Canadian Mining Industry Research Organization (CAMIRO) project with the aim of identifying potential resistate indicator minerals for Ni-Cu-mineralization. The TNB is a 10 to 35 km wide belt consisting of variably reworked Archean gneisses and Early Proterozoic cover rocks along the northwestern margin of the Superior Craton in central Canada. It hosts several world-class magmatic Ni-Cu deposits that have been strongly metamorphosed under upper amphibolite to granulite conditions. Nickel sulphide mineralization is associated with komatiitic ultra-mafic bodies (meta-pyroxenite, meta-peridotite) within the lower part of the Proterozoic Ospwagan Group. Of all the potential resistate minerals picked from till and representative bedrock samples of the main lithological units within the TNB, chromite is the most useful indicator mineral because it is more resistate than the sulphides, occurs both in ore and barren ultramafic rocks and has distinctly different compositions in mineralized samples compared to un-mineralized. Chromite in barren TNB peridotite contains moderate MgO (1.5 - 5 wt.%) and 40 to 52 wt.% Cr_2O_3 while chromite in massive sulphide ore varies from chromian magnetite to extremely Mg-poor, Zn-rich chromite in contact with pyrrhotite. The chromite analyzed in the massive Ni-ore contained > 2 wt.% to 8 wt.% ZnO. Chromite in till samples immediately down ice of the Thompson and Pipe deposits, are MgO-poor chromite - gahnite solid solutions spanning the entire range from 2 to 18% ZnO. In contrast, chromite in barren ultramafics and in till samples from non-mineralized areas of the TNB consistently contain <2 wt.% ZnO.

While Zn-rich chromite has been observed in other areas of the world hosting magmatic NiCu-deposits (e.g. Vammala belt, Finland and Kambalda, Australia), the compositions found in the TNB are extreme and are attributed to the high metamorphic grades reached during peak metamorphism.

Magma chamber heterogeneities recorded by melt inclusions from Mt. Somma-Vesuvius, Italy

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Nodules (coarse-grain "plutonic" rocks) from the ~20 ka Pomici di Base (PB)-Sarno eruption of Mt. Somma-Vesuvius, Italy show petrographic features, such as porphyrogranular texture, slight zonation and irregular edges of phenocrysts, and crystallized melt pockets, which are all consistent with the interpretation that these nodules represent the crystal-rich part of the mush-zone of the active plumbing system beneath Mt. Somma-Vesuvius.

Melt inclusions (MI) are abundant in clinopyroxenes in the nodules. All MI observed in this study are partially to completely crystallized, suggesting they cooled relatively slowly after trapping. Two types of MI can be distinguished based on petrography. Type I consists of mica, Fe-Ti-oxide minerals and/or dark green spinel, clinopyroxene, feldspar and a vapor bubble. No volatiles (CO_2, H_2O) were detected in the bubbles during Raman analysis. Type II inclusions are generally lighter in color and they contain subhedral feldspar and/or glass and oxides. Both types of MI are randomly distributed in the crystals or they occur along a growth zone and are interpreted to be primary. MI were homogenized and analyzed to determine their major and trace element, and volatile compositions. MI homogenized between 1227°C and 1267°C, with most homogenizing at 1230-1235°C. In addition to petrographic differences, the two types of MI can also be distinguished based on their chemical compositions. Type I MI can be classified as phono-tephrite – tephri-phonolite – basaltic trachy-andesite, while Type II MI have a mainly basaltic composition. The two different types of MI also show different trace element patterns. Type I MI are more enriched in incompatible elements compared to Type II MI. SIMS analysis of homogenized MI show variations in the volatile composition of the melt, both within and between MI types.

The presence of spatially associated MI with different compositions in individual phenocrysts is interpreted to represent small scale heterogeneities within the magma chamber due to reaction of crystals and/or wall rock in the mush zone at the margin of the magma chamber with the newly intruded magma [1].

[1] Danyushevsky et al. (2004) *J. Petrol.* **45**, 2531-2553