6.4.P04

Precambrian Fe oxide-(Cu-Au) hydrothermal systems: An isotopic perspective from Scandinavia

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Precambrian Fe oxide-(Cu-Au) hydrothermal systems

Fe oxide-(Cu-Au) systems represent a family of deposits that were formed from the Archaean to the Phanerozoic, where most formed during Precambrian times. Taken as a whole, the deposits exhibit a range of mineralogical and geochemical characteristics that are broadly divisible: 1. Fe oxide-apatite deposits; and, 2. Fe oxide-Cu-Au deposits. Given their varied mineralogical and geochemical character, the origin of these systems is controversial. This paper presents new isotopic data on ore-forming fluids associated Fe oxide Cu-Au mineralization from the Norrbotten County, Sweden (>1.9-1.7 Ga) and Bamble Shear Belt, Norway (BSB) (1.2-1.0 Ga). These districts share similar styles of hydrothermal mineralization, but formed in contrasting tectonic regimes at different times. Ore-forming fluids, calculated using magnetite, apatite and amphibole in the Fe oxide-apatite and Cu-Au deposits, exhibit overlapping $\delta^{18}O_{H2O}$ from +4.7 to +13.3 ‰, and +7.5 to +13.9 ‰ respectively. BSB amphibole returns δD_{H2O} between –20 and –43 ‰ (Fig. 1). These data show that although magmatic/metamorphic fluids contributed to ore systems in both districts (Fig. 1 insert), the Swedish systems record the influx of meteoric-formation waters, and the interaction with high $\delta^{18}O$ metamorphic rocks (e.g. calc-silicate rocks) not apparent in the BSB.

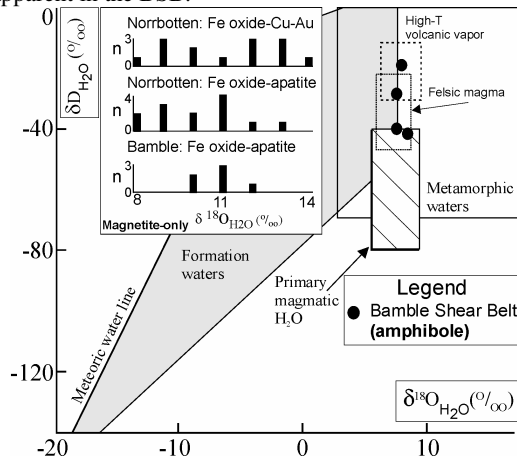Figure 1. $\delta^{18}O_{H2O}$ vs δD_{H2O} composition of ore fluids from BSB Fe oxide-apatite deposits (see insert for $\delta^{18}O_{H2O}$ data). Insert: ore fluid $\delta^{18}O_{H2O}$ calculated using syn-ore magnetite.

6.4.P05

Detailed EDXRF mapping of Pt-ore - a fast and cheap analytical tool

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Traditional methods to investigate the lateral mineralogical and geochemical variation in rocks are time consuming and cost intensive. The destruction free EDXRF using half cores - shown on examples from UG-2 and Merensky Reef - offers a relatively cheap and fast, but not problem free alternative (standard measurement conditions: Mo-tube, 45kV, 30mA, 20s, 50µm x 2000µm flat beam, 50µm step size). The continuous, semi-quantitative simultaneous measurement of relevant elements (such as K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Pt, Pd) with high spatial resolution provides information on chemically anomalous zones and cryptic layering allowing detailed sampling of these zones of the core.

Polished thin sections of selected samples from the Bushveld-Complex have been prepared and mapped by EDXRF (Mo-tube, 45kV, 30mA, 0.5s, mono cappilar source 100µm step size). The results were manipulated by image analyses and selected groups of elements were combined to false colour images to show mineral distribution. Anomalous zones regarding Pt, Pd, Cu, Ni, Ti, and Cr distribution were investigated microscopically and by microprobe. A number of PGM's could be located by these means.

Results from the fast scanning method could be approved microscopically and by microprobe investigations. Combined element distribution and ratios of Ca, Fe, Cr, Ni, Cu, PGE along profile show the plagioclase – pyroxene/olivine – chromite – sulfide - PGM distribution, respectively.

False colours have been attributed to element distribution maps. The combination of three diagnostic elements (e.g. Ca, Fe, Cr) separate plagioclase from olivine/pyroxene and chromite; K, Al and Si show zones of phlogopite and quartz; Fe, Ni, Cu differentiate between Ni in olivine or sulphide, whilst elevated PGE relate to PGM or to crystallographic signals of pyroxene.

EDXRF scanning and mapping is a valuable method to obtain rapid information on the distribution of mineralized horizons (Ni, Cu, Cr, PGE) and mineral distribution. The amount of appropriate samples for detailed investigation can be reduced.

Problems arise due to the interference of trace element signals, e.g. PGE, with crystallographic peaks of pyroxenes for example. This interference is hardly to be identified along profiles, but can easily be located within the maps due to the size of the particles. This definitely has to be improved for the future via software optimization.