Plagiogranitic ocelli in the pillow lavas of the Eoarchean (3.7-3.8 Ga) Isua greenstone belt, SW Greenland

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Pillow basalts in the 3.8-3.7 Ga Isua greenstone belt, West Greenland, contain randomly-distributed white ocelli structures. The ocelli are composed predominantly of polycrystalline Na-plagioclase and quartz, with minor hornblende and biotite. They are devoid of any radial and concentric internal structures and display all stages of coalescence. Compositionally, the ocelli are calc-alkaline dacites, whereas the surrounding matrix is a tholeiitic ferrobasalt, suggesting that ocelli melts were not derived from the melts of basaltic matrix by fractional crystallization. Similarly, transition metal and REE abundances cannot be explained by simple closed-system crystal fractionation of mafic liquids. High concentrations of Ni (120-270 ppm in ocelli; 105-160 ppm in matrix), Cr (395-570 ppm in ocelli, 330-590 ppm in matrix), and Co (25-45 ppm in ocelli, 54-64 ppm in matrix) are consistent with near-primary mantle-derived melt compositions. On the basis of chondrite-normalized REE patterns, the ocelli are divided into two groups. Group 1 is characterized by LREE-depleted patterns, whereas Group 2 displays LREE enrichment. The trace element characteristics of the Group 1 ocelli are similar to those of the surrounding matrix. Both the ocelli and matrix are depleted in Nb relative to Th. Geochemically the Isua ocelli and host volcanic rocks closely resemble those of Phanerozoic supra-subduction zone ophiolites. Given the pronounced depletion of Nb, relative to Th and LREE in the Group 2 ocelli and picritic to basaltic host rocks, partial melting of a forearc mantle wedge, fluxed with subduction-derived LREE-rich hydrous fluids or melts, is favoured for the source of the Isua ocelli and host volcanic rocks. The ocelli-bearing island arc picrites are structurally juxtaposed against a boninitic volcanic association [1]. Recently, the presence of a relict sheeted dyke complex has been reported within the picrictic to basaltic island arc volcanic association, indicating that the Isua greenstone belt was formed by sea-floor spreading in a supra-subduction zone setting [2]. The presence of plagiogranitic ocelli is also consistent with an ophiolitic origin of the Isua greenstone belt.

References

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Cathodoluminescence behaviour of Mn-rich carbonates

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It is well known that manganese is the most important cathodoluminescence activator in carbonates (Pagel *et al*., 2000). However, the CL method is rarely applied in the petrological investigation of Mn-carbonate-bearing rocks and mineralizations due to the commonly accepted effect of concentration quenching or self-quenching, which occurs at elevated Mn concentrations. A comprehensive knowledge about the luminescence behaviour of Mn-rich carbonates still does not exist. The purpose of our study was to determine the effect of Mn concentration on self-quenching.

The cathodoluminescence behaviour of Mn-rich carbonates (rhodochrosite, Ca-kutnohorite, Mn-rich calcite) from hydrothermal and volcano-sedimentary systems was preliminarly studied by CL microscopy and spectroscopy. Chemical composition of carbonates was investigated by X-ray diffraction and FTIR spectroscopy methods.

Most of the samples showed bright orange-red CL. The brightest CL occurred in the 5 to 14 wt% range of Mn content. A strong decrease of CL intensity was observed between cca. 14 and 18 wt% Mn, but the rhodochrosite samples with 37 to 45 wt% Mn are still dull luminescent. The study by CL spectroscopy indicated a 620 nm maximum peak position for calcite, 640 nm for rhodochrosite and 630 nm for a Ca-kutnohorite with 9 wt% Mn (Fig. 1).

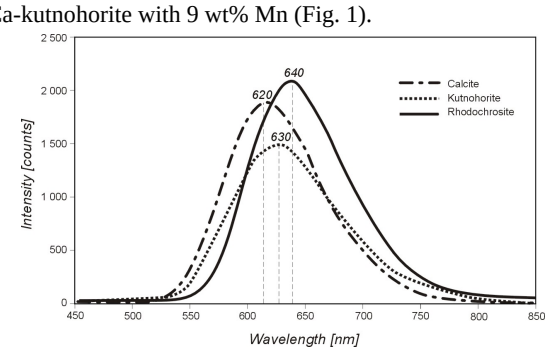

Figure 1. CL spectra of rhodochrosite, Mn-rich calcite and Ca-kutnohorite with 9 wt% Mn

Our results show the existence of cathodoluminescence in carbonates characterized by elevated Mn concentration (5 to 45 wt% Mn). It seems that self-quenching is not complete even in the case of rhodochrosite.

References

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