Geochemical study of the Kimmirut sapphire occurrence, Baffin Island, Canada

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In 2002 gem-quality corundum (sapphire) was found 1.5 km to the southwest of Kimmirut, Nunavut, on Baffin Island. The sapphire is hosted by calc-silicate lenses within the Paleoproterozoic Lake Harbour Marble unit. The sapphire appears to have formed in one of two ways; isochemically from retrograde alteration of the protolith minerals or during hydrothermal alteration of the assemblage. Constraining the method of formation will aid with formulation of guidelines for further exploration.

Change-of basis analyses were performed on whole rock geochemical data from 5 samples using MatLab to identify valid prograde metamorphic assemblages (protolith) and retrograde metamorphic assemblages (alteration) and to determine if corundum could be formed isochemically during these reactions. The results indicate that isochemical formation of corundum is valid with a protolith assemblage of diopside, calcite, phlogopite, anorthite, albite and KNa-1 exchange reacting to form an alteration assemblage of diopside, meionite, marialite, nepheline, kalsilite and corundum. Further petrographic and geochemical examination will help to further our understanding of this occurrence.

Toward a geochemistry of opals

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Opal, in particular gem opal, is a geological marker of certain specific sedimentary and volcanic environments. It has a great variety of appearance and of micro- and nanostructures. Physical properties have been investigated in detail but the role of impurities and trace elements has not been much tackled, although opal is a fairly common form of silica. The aim of this study is to investigate what those elements could teach us about the way opals form, and if they have an influence on certain physical properties, such as vibrational or luminescence characteristics. 47 opals coming from 20 mines in 7 countries (Mexico, Brazil, Peru, Honduras, Ethiopia, Slovakia and Australia) have been analysed by ICPMS in order to determine impurities and trace elements. They range from common to play-of-color opals, opal-A to –CT, and sedimentary to volcanic opals. Impurities are essentially Al, with minor amount of Fe, Na, Mg, K or Ca. Trace elements found are essentially Mn, Zn, Rb, Sr, Y, Ba, Pb, Th, U, Ni and REE. There is a greater variety and concentration of trace elements in colored opals than in colorless ones. The yellow to "chocolate brown" color is correlated with Fe concentration. The REE spectrum is representative of each locality (anomalies, enrichment, or depletion). REE concentrations are variable from one deposit to the next, and span from 100 times less, to 500 times more than chondritic values. This range of REE concentration is very unusual for a mineral. This sample survey seems to be very promising in the identification of the geographical/geochemical origin of opal deposits because of the differences in geochemical profile among deposit.