Trace Elements concentrations in apatites from the Sept-Îles Intrusive Suite – Implications for the genesis of nelsonites

N. TOLLARI[1], S-J. BARNES[1], H. NABIL[2] AND R. A. COX[1]

[1]Université du Québec, Chicoutimi, Canada G7H 2B1, (ntollari@uqac.ca; sarah-jane_barnes@uqac.ca; richard_cox@uqac.ca)

[2]Consorem, Université du Québec, Chicoutimi, Canada G7H (2B1, hassan_nabil@uqac.ca)

Cumulates of apatite and Fe-Ti oxides are form during the later stages of crystallization in many layered intrusions. In some cases they occur as layers or lenses of nelsonite composed of about one third of apatite and two thirds of Fe-Ti oxides. Associated with nelsonite are troctolite or diorite enriched in oxides. Two different models have been proposed for the origin of these rocks. Both models suggest that a Fe-P-rich silicate liquid formed after considerable crystal fractionation of the mafic parental liquid. In the first model, Fe-Ti-oxide and apatite crystallize from this magma and accumulate on the crystal pile to form nelsonite. In the second model the silicate liquid splits into; a) an Fe-Ti-P liquid from which nelsonite forms and b) a SiO_2-rich liquid.

We have investigated the whole rock and mineral compositions of nelsonites and associated rocks from the Sept-Îles Intrusive Suite, Quebec. In addition, we have determined the trace element concentrations of apatite in these rocks. Mass balance calculations show that apatite is the principle host for REE, Ca, U, Th and Sr in these rocks. To test the crystal accumulation model these trace elements were inverted to estimate the trace element composition of the magma at the time of apatite saturation. Mantle normalized trace element patterns of the estimated liquids are similar in shape to mantle normalized patterns from dykes believed to be feeders to the intrusion at this stratigraphic level. Apatite would not have been on the liquidus of magmas of the dyke compositions. A simulation (using PELE) was carried out in order to model crystallization of a magma derived from the dykes. The model mineral compositions and the trace element patterns including those of apatite match the observed compositions for Sept-Îles nelsonites and associated rocks. Thus we favour the crystal accumulation model for the formation of nelsonite and associated rocks.

Method of interpretation of *in situ* U-Pb zircon geochronology using data on melt and fluid inclusions

E.V. TOLMACHEVA[1], T.E. SALTYKOVA[1], N.G. BEREZHNAYA[1], S.D. VELIKOSLAVINSKY[2] AND S.A. SERGEEV[1]

[1]VSEGEI, Sredny pr. 74, 199106, St.-Petersburg, Russia (elena_tolmacheva@vsegei.ru)

[2]IGGP RAS, emb. Makarov, 2, St.-Petersburg, Russia, 199134 (sdtj@sv1403.spb.edu)

In-situ U-Pb zircon geochronology is finding increasingly wide application and permits to define ages of separate zircon zones. Abundant evidence shows that zircons even from relatively simple in genesis rocks sometimes are zoned, and age values obtained from different zircon zones may vary in a wide range. Zircons from rocks formed in a result of different not related petrogenetic processes are much more complicated in structure, and their age values vary in more wide range. Obtained data should be interpreted in genetic terms: relations between dated zone and petrogenetic process which caused the origin of this zone should be emerged.

Mineralogical, cathodoluminescence and geochemical data are not always sufficient to obtain the reliable information on zircon genesis (1), and to locate the most perspective points for in-situ geochronology (2) as well. Cathodoluminescence data compared with optical data often provide insufficient information on zircon zoning, and substance being analyzed may be represented by mixture of several zircon zones. Cathodoluminescence images as a rule don’t reveal character of boundaries between neighbor zones: often it is not clear whether or not a margin of zone is corroded, suggesting break in zircon crystallization. Fluid and melt inclusions, areas of zircon recrystallization, zones, and fractures filled by fluid, which often distort analytical results, are not emerged on cathodoluminescence images as well. It is not quite evident that zircon core is on the surface of thin-section, or it is covered by a thin “layer” of a rim.

The most perspective features for reliable determination of zircon origin and hence for interpretation of obtained ages are direct genetic indicators – inclusions of mineral-forming environment represented by melt and fluid inclusions, which study allows distinguishing: zircons of magmatic and metamorphic origin (1); zircon of intrusive and volcanic origin (2); zircon zones, formed in result of a repeated metamorphism (3), igneous and sediment protolith origin (4). Optimal approach includes integrated study of melt and fluid inclusions from zircons and rock-forming minerals, comprehensive optical and cathodoluminescence data on zircons in a combination with their geochemical characteristics.