U/Pb, Re/Os, and Ar/Ar dating of the South Mountain Batholith and its mineral deposits

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The peraluminous South Mountain Batholith (SMB) of Nova Scotia, Canada ranges in composition from least differentiated granodiorite and monzogranite to most differentiated leucomonzogranite and leucogranite. The most evolved fractions host polymetallic (Sn, W, U, Mo, Cu, Zn, Ag, and Mn) mineral deposits. We have attempted to: (i) constrain the age of granite emplacement and its relationship to the ca. 410 Ma Acadian orogeny; (ii) determine the temporal relationship between the different phases of the SMB; and (iii) assess the temporal relationship between SMB emplacement and mineral deposits formation. Here we integrate new age data (U/Pb on zircon and monazite, Re/Os on molybdenite, and Ar/Ar on muscovite) with published Rb/Sr, U/Pb, and Ar/Ar ages to constrain the duration of magmatic and hydrothermal activity.

Zircon and monazite U/Pb data provide the best estimate of magma emplacement, and the oldest concordant zircon from granodiorite is 380 ± 3 Ma. An albitite from the Sn-Zn-Cu-Mo-Ag East Kemptville (EK) yields a monazite age of 306 ± 3 Ma. Muscovite Ar/Ar data provide information on cooling history through the muscovite closure temperature. Single-grain Ar/Ar laserprobe ages for samples from mineral occurrences of the New Ross area (NRA), northeastern SMB, range from 382 to 320 Ma. Plateau ages within this range previously obtained by the incremental heating analysis of bulk separates are now interpreted as mean ages of variably reset muscovite grains. Molybdenite Re/Os data provide an age of mineralization. Samples from two metallogenic areas of the SMB yield the following results: (i) 376 ± 3 Ma (pegmatite from EK) and (ii) 377 ± 3 Ma and 371 ± 3 Ma (aplite/pegmatite from the NRA).

These data, integrated with previous work, suggest that: (1) the age of emplacement for the SMB is ~380 Ma, confirming its status as a post-orogenic intrusion in the Meguma terrane; (2) the main phases of hydrothermal activity leading to polymetallic mineralization occurred in close temporal relationship to granite emplacement; and (3) episodic tectonic-thermal-hydrothermal events took place at ~370 Ma and ~300 Ma, partially resetting the Ar/Ar system.

The subduction component beneath southern Luzon (Philippines) inferred from the geochemistry of Mayon and Taal arc lavas

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The southern part of Luzon Island, Philippines, is bounded by the Bicol Arc in the east and Luzon Arc in the west. Mayon and Taal are the most active volcanoes along these respective arcs. Mayon lavas are compositionally variable. Petrographic and major element data indicate that a part of the variation can be ascribed to periodic injection of parental basalts into chambers containing magmas undergoing fractional crystallization, but trace element and isotopic data show that the other part is due to a limited, though distinct compositional variability of the lava source. The unmodified composition of the mantle wedge is similar to that beneath the Indian Ocean. To this mantle was added a subduction component consisting of melt from the subducted pelagic sediment and aqueous fluid dehydrated from the subducted basaltic crust.

Taal lavas have a much wider range of composition than Mayon lavas, but similar to Mayon lavas, Taal lavas fall along lines of descent defined by fractionational crystallization and magma mixing (Miklius *et al.*, 1991). Combined trace element and isotopic data suggest that Taal lavas also originated from a mantle wedge metasomatized by a subduction component coming from both the subducted basaltic crust and sediment (Mukasa *et al*., 1994; Knittel and Yang, 1998). Unlike at Mayon, however, there is a larger amount of subduction component being added to the mantle beneath Taal. More sediment is involved in the generation of Taal lavas and the sediment being subducted beneath west Luzon is terrigenous in composition. The contribution from basaltic crust is transferred in the form of an aqueous fluid phase; sediment contribution is transferred either in a melt or fluid phase, or both. Although subducted sediment plays a significant role in producing the geochemical signature of arc lavas in southern Luzon, the composition of the unmodified mantle wedge and whether the subduction component is transferred into the lava source through an aqueous fluid or melt phase may also be needed to explain the regional compositional variation of arc lavas in all Philippine arc systems.

References

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