The Late Carboniferous thermal history of the Meguma Terrane as revealed from $^{40}Ar/^{39}Ar$ dating at the east Kemptville and Gays River mineral deposits, Nova Scotia

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The Gays River carbonate-hosted Zn-Pb deposit and the East Kemptville granite-hosted Sn-base metal deposit represent two very different styles of mineralization and geological setting within the Meguma Terrane. However, detailed $^{40}Ar/^{39}Ar$ dating of the two deposit areas indicate that a thermal disturbance of similar magnitude affected both areas during the Late Carboniferous (i.e., ca. 300 Ma).

The Gays River deposit represents Mississippi Valley-Type (MVT) Zn-Pb mineralization occurring as a replacement of Viséan carbonates which developed as a buildup upon Meguma Group basement rocks. Hydrothermally altered Meguma Group fragments occur within a mineralized basal breccia unit that underlies part of the carbonate bank, and geothermometry (i.e., fluid inclusions, chlorite thermometry) indicates temperatures of ca. $\leq$ 300°C attended alteration and mineralization. Whole rock $^{40}Ar/^{39}Ar$ dating of metasedimentary fragments (n = 5) from the basal breccia give very similar age spectra profiles: the low temperature gas fractions (first 10-15% gas liberated) indicate ages of ca. 300 Ma followed by plateau ages of ca. 380 to 400 Ma for the remaining gas fractions. Whereas the latter ages reflect regional metamorphism, the younger ages reflect thermal overprinting concurrent with mineralization. Model calculations of the age spectra suggest a reheating event of ca. 250 to 300°C of 1 to 6 Ma duration, consistent with geological constraints.

The East Kemptville deposit represents greisen-style Sn mineralization within a variably deformed topaz-muscovite leucogranite. Previous dating (Pb-Pb, U-Pb, Rb-Sr, $^{40}Ar/^{39}Ar$) indicates granite emplacement and greisen formation at 365 Ma, with subsequent episodic thermal overprinting occurring to at least ca. 250 Ma. In the present study, seven size fractions (from -40 to +140 mesh) of muscovite from a sample of massive, barren leucogranite were analyzed by the $^{40}Ar/^{39}Ar$ incremental step-heating technique and compositions determined using the electron microprobe. Experimental results indicate no geochemical (e.g., Fe, Al, Si, F) distinction among the various size fractions and similar Turnerian-type diffusion profiles indicating resetting at ca. 300 Ma with quasi-plateau ages of 325 to 329 Ma. Therefore, since neither chemistry or grain size appear to have controlled argon diffusion, it is concluded that highly variable thermal gradients existed at East Kemptville. The presence of fault zones within the deposit area may have facilitated passage of heated fluids.

Results from the present study combined with previous geochronological dating in the Meguma Terrane, particularly in the southwestern area, indicate that thermal overprinting was a widespread phenomenon at ca. 300 Ma. The presence of mafic and felsic volcanic rocks of Carboniferous age throughout the Maritime region suggests that a persistent geothermal anomaly may have existed throughout the area for most of the Carboniferous. Thus, it is proposed that such an elevated geotherm contributed to the thermal overprinting recorded at East Kemptville and other areas and that it may have been an important factor in the generation of ore-forming fluids responsible for Pb-Zn(-Ba, -F) mineralization in the basal Windsor Group at places such as Gays River.