ABSTRACT

A-type granites comprise a distinct group of granitoid rocks the origin of which is well-debated. Their major alkaline characteristics are well-defined, however, little is known about the origins of the trace element and mineralogical variations they present. This thesis aims to determine the geological processes responsible for geochemical and mineralogical variations observed in the late Paleozoic A-type granites of the Cobequid Highlands. The eastern Cobequid Highlands contain complex plutons (Wentworth and Pleasant Hills) with calcic amphibole-bearing granites (calcic granites), whereas in the west, the North River and Cape Chignecto plutons contain only biotite-bearing granites. Sodic amphibole-bearing granites (sodic-granites) are found only in the Wentworth pluton.

The Wentworth calcic and sodic granites show systematic differences in whole-rock chemistry, εNd, magmatic temperatures, volatile contents and viscosity of the melt and, therefore, indicate derivation from different sources. Similar systematic differences have been identified between the biotite and calcic granites on a regional scale and, therefore, the mineralogically different granite types are not comagmatic. The biotite and calcic granites were both derived by similar degrees of partial melting of the crust, with the calcic granite being formed under elevated temperatures. Chemical and isotopic variations between the biotite and calcic granites correspond with the contrasting character of the two Neoproterozoic crustal blocks in the area. The sodic granites are the extreme fractionates of a coeval metasomatized mafic melt that was underplated during extension.

In post-magmatic stages the granites were affected by several events of hydrothermal alteration. Hydrothermal fluids repeatedly mobilized the REE from the granites, resulting in the formation of distinct hydrothermal assemblages that can be correlated with specific types of hydrothermal alteration and the evolution of the shear zone. Regionally, precipitation of REE increases with time as the fluids became progressively more oxidizing and Fe-rich. The highest REE concentrations are found close to the Cobequid Fault and are possibly associated with a ca 320 Ma IOCG mineralizing event.

The early crustal evolution of Avalonia is further reviewed and new paleoreconstruction models are proposed over the last billion years. This may have implications on the current concepts of “proto-Avalonia” and engage new future research.