

Nature and Timing of Siluro-Devonian Magmatism and Copper Mineralization in the Gaspé Peninsula (Québec Appalachians)

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A study integrating lithogeochemistry, U–Pb dating of zircon and garnet, and zircon trace-element geochemistry has been carried out to constrain the magmatic evolution and ore deposit formation of the Gaspé Peninsula in the eastern Québec Appalachians. It reveals two distinct periods of magmatic activity. The first (Type I), between 415 and 390 Ma, consists of calc-alkaline to alkaline intrusive and volcanic rocks with a slightly fractionated REE pattern ($La/Yb < 15$) and an enrichment in incompatible elements (Zr, Y, Nb, Ta). The second (Type II), between 395 and 377 Ma, comprises calc-alkaline intrusions with a strongly fractionated REE pattern ($La/Yb > 20$) and an adakitic-like signature. Zircon trace elements indicate that rocks from both types are oxidized ($\Delta NNO > 1$). However, type II rocks are more hydrated and display lower zircon crystallization temperatures, generally $< 750^{\circ}C$.

Skarn garnets from various mineralized showings of the Gaspé peninsula were dated (UPb). Garnets associated with type I intrusions give ages of 404.9 ± 4.8 and 401.2 ± 2.1 Ma for deep skarns at Lemieux Dome, 396.6 ± 1.6 Ma for Sullipek P-82 and 390.6 ± 2.6 Ma for Mine Madeleine. Skarns from Gaspé Copper are dated at ca. 380 Ma. These dates reveal that both periods are fertile for magmatic-hydrothermal mineralization. However, type I mineralization, such as the epithermal deposits of the Lemieux Dome and the Sullipek P-82 skarn, are smaller than the deposits associated with Type II intrusions like the Gaspé Copper porphyry-skarn Cu-Mo and the Sullipek-East polymetallic skarn. The differences in metal endowment of those mineralization are likely linked to the lower water-content and higher temperature of type I intrusions.

These two magmatic and metallogenic periods also reflect the evolution of the Appalachians, where Type I intrusions emplaced during the Salinic back-arc extension while Type II are associated with the Acadian collision.