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# A mantle source for water in Appinite Complexes: implications for the genesis of granitoid batholiths and crustal growth

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Appinite complexes are small (~1-5 km wide) hornblende-rich, predominantly mafic plutons that record the crystallization of anomalously water-rich magma. The epizonal, calc-alkalic, Neoproterozoic Greendale Complex of Nova Scotia exemplifies appinite complexes, occurring as a small epizonal hornblende-rich pluton adjacent to a major fault (Hollow Fault) along the periphery of granitoid plutons emplaced in the waning stages of subduction. Field observations (e.g. comb layering) indicate that some hornblende grew in situ, whereas others were entrained in the magma as it ascended. Hornblende compositions suggest crystallization between 5-8 kbar from magma with 5-8% $H_2O$. Hydrogen and oxygen isotopic data from hornblendes yield values that indicate water in the appinite magma had a dominant mantle contribution. These data suggest that appinites may represent aliquots of hydrous basaltic magma derived from a crystallizing mafic underplate that became emplaced at higher crustal levels.

Taken together, these data indicate adiabatic ascent of fractionated mafic magma from a deep crustal hot zone (DCHZ), where the depth of solidification of magma is controlled by the ~7 wt. % water saturation isopleth. Transfer of heat and mantle-derived fluids to the base of the crust during mafic underplating triggered partial melting and generation of coeval granitoid magmas. These magmas were emplaced in the shallow crust and created rheological barriers that impeded the ascent of coeval mafic magma except along the deep crustal Hollow Fault which bounded the plutonic system along which the Greendale Complex was emplaced.

More generally, these relationships imply feedback between active faulting and emplacement of overpressured hydrous mafic magmas, facilitating rapid ascent and high degrees of undercooling, generating disequilibrium textural features characteristic of water-saturation. Appinite magmas may provide a window into the P=T conditions of the crystallizing mafic underplate and the processes that generate granitoid batholiths and crustal growth in arc systems.