

Contact Metamorphism of the Halifax Formation, Halifax, Nova Scotia

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The contact aureole developed on the southeastern margin of the Halifax Pluton (South Mountain Batholith) trends obliquely across the Halifax peninsula, at a high angle to regional structural trends in the Halifax Formation. Isograds have been mapped through the city of Halifax, based on exposures on the Dalhousie campus, Point Pleasant Park, the railway cut, and scattered outcrops and construction sites throughout the city. In the study area, the Halifax Formation includes two lithological units with different contact metamorphic assemblages. The Cunard member is a rusty, graphitic, black slate that underlies the region between the Dalhousie campus and the Armdale Rotary. The overlying "Bluestone" member (informal name) is a grey slate-siltstone unit, locally containing calcareous concretions, exposed in Point Pleasant Park, Williams Lake area, and adjacent regions. Prior to intrusion, the Halifax Formation was deformed into NE-SW-trending, regional upright folds associated with a strong slaty cleavage and chlorite-grade mineral assemblages. Contact metamorphism clearly overprinted both the regional low-grade mineral assemblage and the slaty cleavage, which is strongly annealed adjacent to the contact. Following intrusion, contact metamorphic assemblages were locally overprinted by brittle-ductile structures and retrograde metamorphism associated with flexural-slip folding. Sparse cordierite "spots" mark the outer limit of the contact aureole in both the Cunard and Bluestone members. The biotite-in isograd, which runs through the Dalhousie campus, is marked by the nucleation of biotite within distinctive chlorite + muscovite "stacks" that formed during regional metamorphism. Between the biotite-in isograd and the contact, metamorphic assemblages in both units are marked by increasing modal abundance of cordierite and biotite. However, there is a marked difference in the distribution of andalusite between the Cunard and Bluestone members. In the Cunard member, idioblastic chialstolite appears before biotite; its grain size and modal abundance increase gradually towards the contact. In the less aluminous Bluestone member, andalusite is present only in the immediate vicinity of the contact, where it forms xenoblastic ovoid aggregates, possibly after cordierite. Adjacent to the contact the regional slaty cleavage is annealed, and the characteristic assemblage andalusite + cordierite + K-feldspar, with rare fibrolite, is developed in both units. Corresponding changes occur in opaque mineral assemblages, with rutile and pyrite in the outer aureole replaced by ilmenite and pyrrhotite closer to the contact. Preliminary P-T estimates, including RSCM thermometry in graphitic slates, suggest that the biotite-in isograd developed at ca. 475°C and 2-3 kb, with temperatures at the contact reaching ca. 600°C. Although the Halifax Pluton is exposed only on the west side of the Northwest Arm, the distribution of isograds suggests that it may extend at shallow depth beneath the South End of Halifax.

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