

# Geochemistry of volcanic rocks from the Archibald Settlement Formation, Oak Bay area (22B/02), Gaspésie

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This study accompanies a geological survey at the scale of 1:50 000 of the Oak Bay and Jérôme Brook areas, located in the western part of Chaleurs Bay. Rocks in these areas include Silurian and Devonian volcanic rocks such as the “Ristigouche volcanic rocks” and those of the Archibald Settlement Formation (previously called “Dalhousie volcanic rocks”).

The study focuses on the volcanic rocks occurring in the Archibald Settlement Formation. The objective is to determine the stratigraphical position of the volcanic rocks, to identify their morphological facies and to establish the chemical composition of their lithologies. The Archibald Settlement Formation is constituted of volcanic levels outcropping above the Salinic unconformity within the Ristigouche synclinorium, the western prolongation of the Chaleurs Bay synclinorium. These volcanic rocks are interstratified with marine sedimentary rocks of the Saint-Léon Formation.

The study area includes all three tectonostratigraphic units of the Gaspé Belt: (1) the Connecticut Valley-Gaspé synclinorium to the north, (2) the Aroostook-Percé anticlinorium, and (3) the Chaleurs Bay synclinorium to the south. These units consist of sediments deposited in the succeeding Appalachian basin between the Late Ordovician and Late Devonian periods. The first and third units also contain intermediate and felsic volcanic rocks. The Sellarsville thrust block, located in the western part of the Oak Bay area, includes fine fossiliferous siliciclastic rocks in which levels of “reef” limestone are inserted. In the eastern part, the lower portion of the Chaleurs Group and the lower units of the Gaspé Belt are cut by the Upper Silurian Salinic Unconformity. The Archibald Settlement Formation is conformably or paraconformably overlain by polygenic conglomerates and sandstones of the La Garde Formation.

Volcanic rocks of the Archibald Settlement Formation are approximately four kilometres thick. A spectacular sequence outcrops alongside Road 132, between the Pointe à Bourbeau and Sellars localities. These volcanic rocks constitute a continuous effusive sequence from subalkaline basalts to rhyolites with a predominance of andesites and dacites. The Archibald Settlement Formation is subdivided into three members: 1) a basal member of andesite and porphyritic basalt intersected by gabbroic sills, 2) a middle member of porphyritic dacite and rhyolite, and 3) a top member of ash, lapilli and block tuffs, as well as reworked volcanoclastic rocks and conglomerates. These lithologies are northeast trending and dip steeply to moderately towards the southeast. Tops are facing southeast.

Intermediate lavas, mainly andesites, form two suites: a tholeiitic suite and a transitional to calc-alkaline suite. Samples from tholeiitic lavas come exclusively from the bottom of the volcanic sequence, whereas those of transitional composition come from different levels located throughout the pile. Chondrite-normalized rare earth profiles and “*N-MORB*”-normalized trace element profiles either coincide or are very similar to the geochemical signature of continental margin calc-alkaline basalts. The andesites’ affinity to rift basalts or intraplate basalts could result from continental crust contamination of a calc-alkaline arc basalt, in a continental margin setting. Moreover, negative Ta and Nb anomalies suggest the influence of a subduction zone associated with the magma source or its environment of formation.

Felsic volcanic rocks form two calc-alkaline suites, one with an average Zr/Y ratio of 8.5 and the other with an average Zr/Y ratio of 10.5. The first suite is restricted to dacites and rhyolites of the middle member; whereas the second is found in dacites and rhyolites of the middle member and in the ash, lapilli and block tuffs, reworked volcanoclastic rocks and conglomerates of the top member of the Archibald Settlement Formation. Volcanic rock rare earth profiles of the two suites are similar to those of the primitive mantle, except for a marked enrichment in light rare earth elements. However, as with the andesites, a pronounced negative Ti, Nb and Ta anomaly suggests the influence of a subduction zone. The light rare earth element enrichment is pronounced and characteristic of a calc-alkaline suite. There is no apparent genetic link between the andesites and the dacites, although these two magmatic episodes seem contemporaneous and occur in the same area of deposition.

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Some authors suggest an important extension phase (*rifting*) that would have affected the entire Gaspé continental platform during the pre-Acadian period. Analytical data obtained in this study support this model.

The Archibald Settlement Formation was sampled for the geochronological study. From a unique sample, a group of three U/Pb zircon analyses yielded an average  $^{206}\text{Pb}/^{238}\text{U}$  age of  $408.8 \pm 0.7$  Ma (24% coincidence probability), which to date constitutes the most reliable age estimation for felsic volcanism in the Archibald Settlement Formation on the Québec side of Chaleurs Bay.