Field relationships and stratigraphy of the Totnes Road volcanics, Cumberland Peninsula, Baffin Island

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Summary

During the summer of 2009, as part of the federal Geo-mapping for Energy and Minerals (GEM) Program's Cumberland Peninsula Integrated Geoscience (CPIG) project, detailed mapping of a 55m thick package of mafic to ultramafic volcanic rocks on Cumberland Peninsula of Baffin Island was undertaken. The package consists of massive flows and pyroclastic deposits which contain well-preserved primary volcanic textures such as fragments, pillows, and varioles. These rocks are spectacularly exposed near the shores of Totnes Road fiord, an area that has received little geologic research. Field observations made during a 2-day reconnaissance mapping allow construction of a preliminary stratigraphic column consisting of eight distinct units, to be expanded upon by further research and mapping in 2010. This volcanic package and bounding supracrustal rocks throughout the region are lithostratigraphically similar to the volcanic-dominated Bravo Lake Formation of the Piling Group of central Baffin Island. Additional petrographic, geochemical and isotopic analyses are required to confirm the proposed correlation, as well as providing a better understanding of the tectonic setting and metallogenic potential of the volcanic package.

Introduction

The geology of eastern Baffin Island, particularly the Cumberland Peninsula, is relatively poorly understood. Whereas western and central Baffin Island have been the focus of recent mapping projects (St. Onge et al., 2009; Rayner et al., 2008), Cumberland Peninsula has been studied at a reconnaissance scale in 1970 (Jackson and Taylor, 1972), from which the rocks were interpreted as a predominantly a "thick succession of intensely deformed, layered metasedimentary rocks and intermediate to basic metavolcanic rock" referred to as the Hoare Bay Group (Jackson and Taylor, 1972). Given the potential for gold and base-metals, a principle objective of the CPIG project is to update the geoscience knowledge of this frontier region through new mapping of both bedrock and glacial deposits during 2009 and 2010.

A significant magnetic anomaly identified near Totnes Road, on northeastern Cumberland Peninsula, was visited to understand the source of this anomaly. The region exposes a package of metavolcanic rocks, now informally termed the Totnes Road metavolcanic sequence, which is underlain by pink orthoquartzite and overlain by a metasedimentary sequence which includes sulphidic black shale, iron formation and clastic sedimentary units. This entire association of supracrustal rocks has been intensely folded such that the package as a whole is repeated at least twice in the area. This association may correlate with the Paleoproterozoic Piling Group of central Baffin Island (Jackson and Berman, 2000; Scott et al., 2003), specifically with the Dewar Lakes (clastic metasedimentary rocks), Bravo Lake (mafic volcanics), and Astarte River (sulphide-bearing schist with iron formation) formations. In particular, the package of volcanic

rocks found at Totnes Road may correlate with those of the Bravo Lake Formation, which consists of metamorphosed interlayered mafic igneous rocks, containing both massive and fragmental flows, intrusive sills and dykes, and sedimentary rocks (Johns et al, 2006). The stratigraphic relationships reported here, and forthcoming petrography, electron microprobe analyses, and major and trace element geochemistry will allow better insight into whether the Totnes Road volcanic sequence is correlative with the Bravo Lake Formation or whether it represents a distinct sequence of volcanic rocks on eastern Baffin Island. In addition, this work may provide constraints on the origin and tectonic setting of the Totnes Road volcanic sequence.

Description of Totnes Road volcanics

The volcanic rocks are exposed in three separate outcrops on the southern shore of Totnes Road Fjord. The central and most complete package, with good exposure, was studied in the most detail for this project. The outcrop covers approximately 250m along the ground, and represents approximately 55m of true thickness. The package has been divided into eight separate lithologic units. Both the lower and upper units contain pyroclastic textures but only the lower units appear to be bedded; separating the pyroclastic and fragmental units is a central pillowed and variolitic unit. The outcrop as a whole ranges from dark green in the bedded units to lighter green units in the pyroclastic units; the central unit is unique in the fact that is light grey in colour due to the presence of varioles.

The Totnes Road volcanics are bounded at the base and top by a pinkish quartzite unit. The first, basal section of the package consists of 2 m of layered, coarse grained, dark green, mafic rock with sulphides and gossanous weathering interpreted as either a mafic sill or possibly part of the volcanic package itself. Gossanous zones are not present in the higher parts of the package. The second unit is a 4 m thick bedded lapilli tuff, containing acicular and prismatic hornblende (50-60%), fibrous and some prismatic actinolite (35-40%) with small amounts of biotite, magnetite, pyrite, and chlorite. The transition between beds is marked by changes in coarseness and mineral content; the coarser grained beds, which are approximately 5 cm thick have grain sizes up to 1 mm and are composed of all the minerals; the finer grained beds are thinner, reaching only 2 cm in thickness, and are only composed of equidimensional hornblende crystals. Fragments found in the coarse beds range up to 4 mm in size and appear to be composed of fine grained actinolite. The third unit is a 4 m thick schistose, tuffaceous unit with fragments ranging from 5 mm to 8 cm in size and east-west trending lenses of carbonate alteration. The rocks that make up the overlying 6 metres, and the fourth unit, are very homogeneous with no visible fragments and weakly defined bedding.

The central, fifth unit is 11 m thick, and contains abundant varioles, composed of roughly equal amounts of polygonal granoblastic quartz and plagioclase. In some areas the varioles have coalesced to entirely cover the rock surface and alter its colour from dark green to light grey. In thin section the unit is dominated by hornblende (approximately 55%), while the quartz and plagioclase varioles form 30% of the rock, with the remaining 15% comprised of magnetite, pyrite, carbonate, and epidote. Where pillow selvages are observed, the varioles are concentrated in the center of the pillow. The sixth unit is a highly strained, 5 m thick lapilli stone unit with small, polylithic fragments and rare varioles which grades into the seventh unit, a 5 m thick homogeneous and massive unit with no varioles, fragments, or beds. The lapilli stone unit is composed of 70% prismatic hornblende, while the remaining 30% consists of equal proportions of magnetite, polygonal granoblastic quartz and plagioclase, and pyrite. The volcanic package is capped by, the eighth unit, a 15 m thick highly fragmental unit, with sub-rounded to rounded fragments ranging in size from 1 to 15 cm. This unit is likely a tuff breccia although it may represent fluvial re-working of the volcanics beneath it. It is composed of almost

equal quantities of prismatic hornblende and fibrous actinolite, with trace amounts of magnetite and chlorite. Overall, the package of volcanics is interpreted to be mafic to ultramafic in composition, with a significant pyroclastic component.

The central volcanic package exhibits northeast-southwest striking beds with a low to moderate northwest dip. The foliation is moderate to well-developed and is defined, in the bedded and uppermost fragmental unit, by elongate prismatic hornblende crystals. A second, weaker foliation defined by aligned chlorite and acicular actinolite crystals appears to cross cut the dominant fabric at a very high angle. This suggests at least two penetrative deformation events. In the lapilli stone unit both the acicular hornblende crystals in the mafic fragments, and the fragments themselves define a moderate foliation, whereas the more felsic groundmass is not preferentially aligned as it is polygonal granoblastic in nature. The lineation is moderate to very strong, with L>S throughout. The lineation has an average westerly trend with a shallow plunge. Where present, the lineation is well defined by elongated carbonate alteration lobes and varioles, as well as rotated and moderately elongated fragments in other units.

The entire region around Totnes Road Fjord has experienced at least two deformation events. All of the rock units found on the Totnes Road peninsula, including the volcanics, are repeated in their entirety three times. This repetition is the result of a complex fold interference pattern which will be studied in more detail during the summer of 2010. Initial interpretation involves isoclinal F1 folds that are refolded by steeply dipping F2 and broad, open F3 folds. Metamorphism throughout the entire Cumberland Peninsula reached at least amphibolite grade with local areas reaching granulite grade, and is thought to have occurred during the Trans-Hudson Orogeny. Due to the dominance of hornblende, actinolite, and minor amounts of epidote it appears the volcanics reached at least the epidote-amphibolite facies.

Overview and Future work

The Totnes Road metavolcanics are a characteristic package of ultramafic to mafic rocks that, on first approximation, resemble the mafic volcanic rocks of the Bravo Lake Formation of the Piling Group in central Baffin Island. They have been metamorphosed to amphibolite grade and have been affected by at least two deformation events. Forthcoming geochemical analyses will be used to help constrain the tectonic setting of the volcanic package, and to determine if our proposed correlation with the Piling Group is valid. The metallogenic potential of the volcanic package will also be assessed, which is important in frontier regions such as Baffin Island, and especially in areas such as the poorly understood Cumberland Peninsula, which are essentially unexplored.

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