Progress Report on Geological and Geochronological Studies in the Cheticamp Area, Aspy Terrane, Cape Breton Island, Nova Scotia

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Introduction

The Cheticamp area is located in the Aspy terrane, which is part of the microcontinent of Ganderia and composed mainly of Ordovician-Devonian metavolcanic, metasedimentary and plutonic rocks (e.g. Barr and Raeside, 1989; Barr et al., 1998). Recent studies have documented the presence of Neoproterozoic granitoid and gneissic rocks in the Aspy terrane that are more characteristic of the Bras d'Or terrane to the east, as well as previously unrecognized Cambrian-Ordovician and Silurian plutons (Slaman et al., 2017; White et al., 2016). Mapping and geochronology related to this multi-year project have resolved some geological problems by showing that rocks in the area experienced a long history of episodic subduction-related magmatism (Slaman et al. 2017); the relationship between many units, the age of deformation and metamorphism, and the timing of VMS mineralization, however, remain elusive.

To resolve many of these issues, the 2016 field season focused on 1:10 000-scale bedrock mapping of the Jumping Brook Metamorphic Suite and associated plutonic units in a belt along the western parts of NTS map areas 11K/10 and 11K/15 in the Cheticamp area of Cape Breton Island (Fig. 1). The relationships among these units and others in the area are discussed in earlier reports (e.g. White et al., 2015, 2016; Slaman et al., 2017) and the mafic plutonic rocks in the area are the subject of a current M. Sc thesis project at Acadia University by the second author.

This report summarizes the geology and new U-Pb zircon geochronological results. These data will be used in conjunction with the GIS-integrated Cape Breton Island geology maps and associated databases (e.g. Barr and White, 2017) and will be an asset for both mineral exploration and land-use planning in the area.

Geological Framework

Pre-Devonian rocks in the Cheticamp area are mainly metamorphic and plutonic (Fig. 1). The metamorphic rocks were assigned to the Jumping Brook Metamorphic Suite (JBMS) and divided into seven units by Jamieson et al. (1989, 1990), later modified by Barr et al. (1992), White et al. (2015, 2016), and this study (Fig. 1). A unit previously included in the JBMS as the George Brook amphibolite is now recognized to have plutonic protoliths; hence, it has been removed from the metamorphic suite and divided into the Georges Brook and South Branch Corney Brook plutons (e.g. Shute et al., 2017). A previously unnamed metamorphic unit in the southern part of the area has been named the Stewart Brook Formation and included in the George River Metamorphic Suite (Fig. 1; White et al., 2016).

All these units have been deformed and regionally metamorphosed to varying degrees, generally ranging from greenschist to amphibolite facies (e.g. McCarron et al., 2016). They have been intruded by, or are in faulted contact with, varied Neoproterozoic to Silurian dioritic to syenogranitic plutons and the Devonian Margaree and Salmon Pool plutons (Barr et al., 1992; Slaman et al., 2017).

The eastern margin of the JBMS and Georges Brook pluton is flanked by undivided high-grade schist, gneiss, amphibolite, and orthogneiss of the

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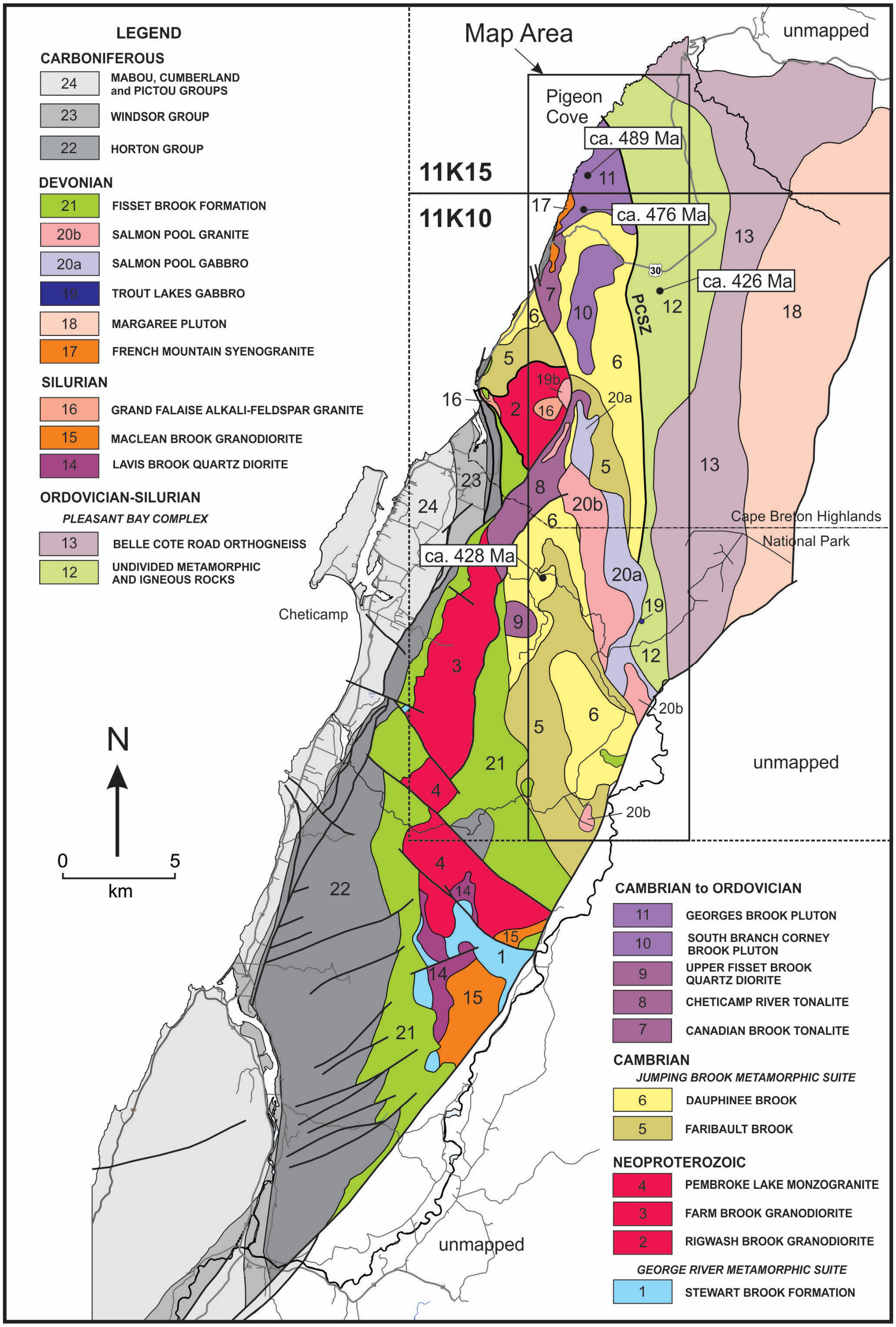

Figure 1. Geological map of the study area (PCSZ = Pigeon Cove shear zone).

Ordovician(?) to Devonian Pleasant Bay Complex, east of which is the Late Ordovician-Early Silurian Belle Cote Road orthogneiss (Jamieson et al., 1986; Barr et al., 1992; Price et al., 1997; Horne et al., 2003).

Along the western and southern flanks of the map area the older units are overlain by or in faulted contact with volcanic and sedimentary rocks of the Middle to Late Devonian Fisset Brook Formation and the Carboniferous Horton, Windsor, Mabou, Cumberland and Pictou groups (Fig. 1; Giles et al., 1997a, b).

Results of 2016 Mapping and Geochronological Studies

Mapping in 2016 better defined the distribution of geological units and their stratigraphy in the area, and new U-Pb (zircon) dating and geochemistry clarified their ages and tectonic setting (e.g. Shute et al., 2017).

The JBMS is now divided in two main formations. The lower, Faribault Brook Formation, is a dominantly tholeiitic mafic metavolcanic unit with light rare-earth-element depletion characteristic of mid-ocean ridge basalt. Mainly overlying but also interlayered with the Faribault Brook Formation is the dominantly metasedimentary Dauphinee Brook Formation. Based on this new stratigraphic interpretation, many of the VMS occurrences in the JBMS are at or near this lithological transition. Previously, U-Pb detrital zircon analyses from a metasedimentary sample in the Dauphinee Brook Formation suggested a maximum depositional age of ca. 530 Ma (White et al., 2016), consistent with the fact that these rocks are intruded by ca. 490–480 Ma tonalitic and dioritic plutons (Slaman et al., 2017); however, a highly deformed quartzitic sample at the Mountain Top Cu-Ag-Au occurrence yielded a younger (ca. 428 Ma) U-Pb zircon population. Due to the highly deformed character of this sample it is unclear if this sample could be a felsic dyke/sill.

The “George Brook Amphibolite” of earlier workers consists of components of at least four different ages and compositions, including (1) low- to high-grade mafic metavolcanic rocks of the Faribault Brook Formation, (2) low-grade metaplutonic bodies including the newly named Georges Brook and South Branch Corney Brook plutons, (3) gabbroic rocks associated and locally mingled with granitic rocks of the Salmon Pool pluton, and (4) amphibolitic sheets in high-grade metamorphic rocks of the Pleasant Bay Complex.

The Georges Brook pluton is a large body of strongly foliated rocks of dioritic/tonalitic composition and has yielded U-Pb (zircon) ages of ~476 Ma and ~489 Ma, suggesting that the body may be composite or that ages were disturbed during metamorphism. These rocks are of the same age and compositionally similar to the Canadian Brook, Cheticamp River, and Upper Fisset Brook tonalite/quartz diorite plutons father south (Fig. 1; Slaman et al., 2017) and form a previously unrecognized Ordovician plutonic suite, now deformed and metamorphosed. The South Branch Corney Brook pluton intruded the Jumping Brook Metamorphic Suite in the Corney Brook area and is petrologically similar to the Georges Brook pluton, but the two bodies do not appear to connect at current levels of exposure. A dioritic sample from the South Branch Corney Brook pluton failed to yield zircons suitable for U-Pb dating.

A major mylonite zone (the Pigeon Cove shear zone) separates the JBMS and associated plutons from high-grade kyanite-bearing schist, amphibolite, and orthogneiss of the Pleasant Bay Complex to the east. The steep north-trending shear zone is defined by transposed layering, strongly attenuated isoclinal folds, and rare sheath folds, and contains subhorizontal stretching lineations defined by elongate quartz and feldspar. Outcrop-scale kinematic indicators suggest dextral strike-slip sense of movement but more detailed kinematic studies are needed to confirm this interpretation. An amphibolitic sheet in the Pleasant Bay Complex yielded a preliminary U-Pb (zircon) age of ~426 Ma, indicating that it is not directly related to the older amphibolitic rocks to the west as has been previously assumed (e.g., Price et al. 1997).

The undeformed Salmon Pool pluton consists of mingled syenogranite and gabbro; two granitic samples yielded U-Pb zircon ages of ~ 373 Ma.

Mapping indicates that the pluton extends farther south than previously mapped and cross-cuts the Pigeon Cove shear zone (Fig. 1). The age of the pluton is consistent with its chemical similarity to mafic and felsic volcanic rocks of the Fisset Brook Formation. It is possible that the small Trout Lakes ultramafic body (Fig. 1) is related to the gabbroic parts of the Salmon Pool pluton. Small Cu-Au-Pb-Zn mineralized quartz-feldspar porphyry bodies in the JBMS near the southern margin of the 2016 map area may also be related to felsic parts of the Salmon Pool pluton (Poirier, 2017).

Based on clast lithologies, the Rocky Brook conglomerate, previously included in the JBMS, is now considered to represent the basal part of the Devonian Fisset Brook Formation (Poirier, 2017; this study). In places the clasts are surrounded by an amygdaloidal basaltic matrix with chemical similarity to mafic rocks of the Fisset Brook Formation.

Future work

Results from the new U-Pb zircon analyses are intriguing but retain some ambiguity in terms of understanding the stratigraphy of the JBMS and ages of associated plutonic units. Follow-up research from this work is ongoing and includes additional lithogeochemical interpretations and isotopic and geochronological studies, with the aim of further characterize the JBMS and its mineral occurrences.

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