Natural Resources

Geology Matters 2012

Geological Mapping and Resource Assessment

A NEW GEOLOGICAL INTERPRETATION OF THE EASTERN COBEQUID HIGHLANDS, NORTHERN NOVA SCOTIA

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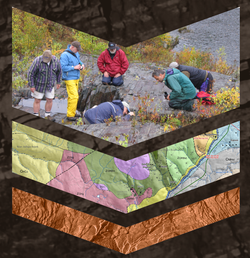
Experts
on the ground



Opportunities
on the ground

Mineral Resources Branch

NOVA SCOTIA

Open File Illustration ME 2012-018

INTRODUCTION

The Cobequid Highlands are part of Avalonia, a fault-bounded terrane that occurs inboard of Meguma and outboard of Ganderia throughout the northern Appalachian orogen. The Cobequid Highlands are located along the southern margin of Avalonia in northern mainland Nova Scotia (Fig. 1). A renewed interest in the geology of the highlands was sparked by the recent discovery of REE and gold mineralization and, as a result, a detailed (1:10 000 scale) regional bedrock mapping program was initiated by the Nova Scotia Department of Natural Resources. This mapping, combined with geochemistry, petrography and geochronology will add to the understanding of the stratigraphy, structure, tectonic setting, age and economic potential of the Cobequid Highlands (Fig. 2).

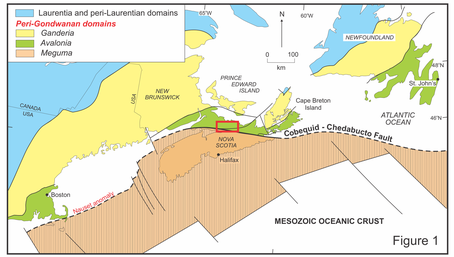


Figure 1

GEOCHRONOLOGY

U-Pb age determinations from zircons in a standard petrographic thin section were completed using the laser-ablation microprobe – inductively coupled plasma – mass spectrometry (LAM-ICP-MS) system at the University of New Brunswick. Zircons extracted from monzogranite and gabbro samples from the Mount Ephrairn Plutonic Complex yielded a U-Pb ages of 736 ± 8.2 Ma and 749 ± 3.6 Ma, respectively (Fig. 3a). A quartz syenite sample from the Eight Mile Brook Plutonic Complex yielded zircons with a U-Pb age of 481.6 ± 4.1 Ma (Fig. 3c). Zircons from an alkali-feldspar granite in the Polson Mountain Pluton yielded a U-Pb age of 374.9 ± 3.0 Ma (Fig. 3d).

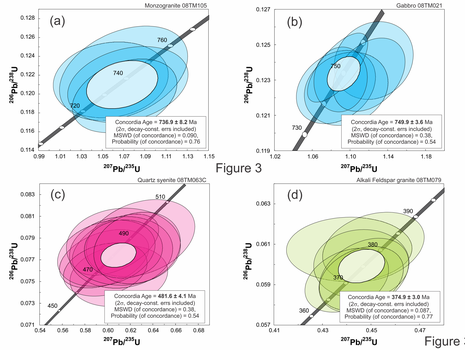


Figure 3

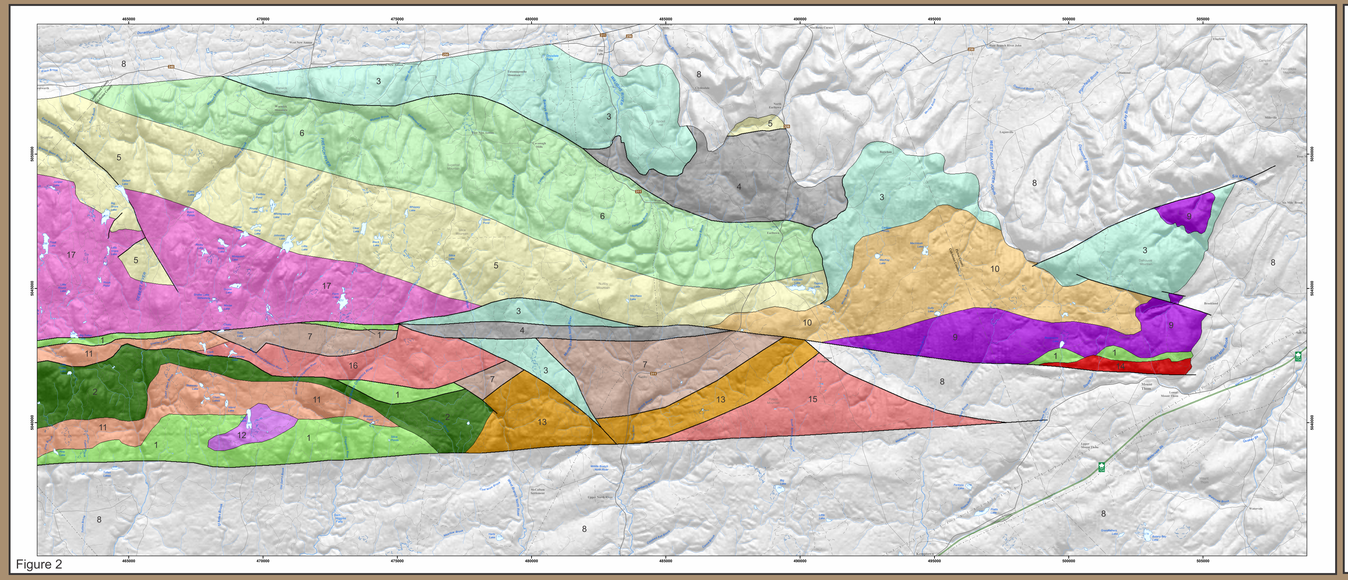


Figure 2

LEGEND

PLUTONIC UNITS

DEVONIAN TO CARBONIFEROUS

17 — *HART LAKE - BYERS LAKE PLUTON*: pink, fine- to coarse-grained alkali feldspar granite; minor diorite

DEVONIAN

16 — *GUYON BROOK PLUTON*: grey, medium- to coarse-grained alkali feldspar granite; minor diorite

15 — *POLSON MOUNTAIN PLUTON*: grey, medium- to coarse-grained alkali feldspar granite; minor diorite

ORODOVICIAN

14 — *EIGHT MILE BROOK PLUTONIC COMPLEX*: pink to pale brown syenite to alkali-feldspar granite; medium- to coarse-grained monzogabbro

LATE NEOPROTEROZOIC

13 — *McCALLUM SETTLEMENT PLUTON*: pink to grey, medium- to coarse-grained, locally foliated, granite to granodiorite; minor quartz diorite to diorite

12 — *FROG LAKE PLUTON*: grey, medium-grained, locally banded, quartz diorite to diorite

11 — *DEBERT RIVER PLUTON*: pink to grey, medium- to coarse-grained, locally foliated granite to granodiorite; locally contains xenoliths of quartzite

MOUNT EPHRAIRN PLUTONIC COMPLEX

10 — pink to grey, medium- to coarse-grained, locally foliated, granite to granodiorite; minor quartz diorite to diorite

9 — grey, fine- to coarse-grained, locally foliated, quartz diorite to diorite and gabbro; minor granodiorite and granite

STRATIFIED UNITS

CARBONIFEROUS

UNDIVIDED HORTON, MABOU AND PICTOU GROUPS

8 — clastic and minor carbonate rocks

HORTON GROUP

7 — *NUTTBY FORMATION*: red and black siltstone, slate and conglomerate; minor pink limestone; rare plant fragments

DEVONIAN TO CARBONIFEROUS

FOUNTAIN LAKE GROUP

6 — *DIAMOND BROOK FORMATION*: grey to grey-green basalt flows and maroon siltstone; rare plant fragments

5 — *BYERS BROOK FORMATION*: pink to grey rhyolitic flows and tuffs, minor basaltic flows, red siltstone and conglomerate; rare plant fragments and limestone

SILURIAN

4 — *WILSON BROOK FORMATION*: grey quartz arenite, sandstone, siltstone and minor brown fossiliferous limestone; rare mafic dykes near the base

LATE NEOPROTEROZOIC

JEFFERS GROUP

3 — *DALHOUSIE MOUNTAIN FORMATION (and equivalent)*: grey to grey-green dacitic to andesitic crystal to lithic crystal tuff and laminated green-grey cherty siltstone to sandstone and related subvolcanic intrusions

BASS RIVER COMPLEX

2 — *FOLLY RIVER FORMATION*: dark grey mafic lithic to lithic crystal tuff to ash tuff, and associated subvolcanic green dioritic rocks; abundant ironstone beds

1 — *GAMBLE BROOK FORMATION*: white to grey quartzite, semi-pelitic rocks, marble and calc-silicate rocks; paragneiss and orthogneiss; locally intruded by younger foliated tonalite to granodiorite

GEOCHEMISTRY

Primitive Mantle Normalized extended element plots are used to evaluate the tectonic environment for newly recognized ca. 755-735 Ma, ca. 490-470 Ma, and ca. 375-365 Ma magmatic suites in the eastern Cobequid Highlands. The Neoproterozoic suite possess continental margin volcanic arc signatures (Fig. 4a), whereas the Ordovician and Devonian suites possess within-plate geochemical signatures (Figs. 4b and c).

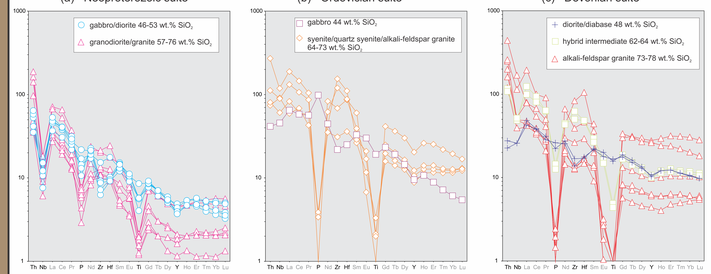


Figure 4

RESULTS TO DATE

- Detailed bedrock mapping combined with geochemistry, geochronology and geophysical studies have added to our knowledge of the geology in the Cobequid Highlands and, as a result, has highlighted the economic potential of the area.
- New Neoproterozoic (ca. 755-735 Ma) calc-alkaline gabbro/diorite-granodiorite-granite suite discovered, which intruded an older (> 800 Ma) quartzite and metavolcanic sequence. This is the oldest crust exposed in Avalonia and likely formed along the margins of the supercontinent Rodinia.
- New Ordovician ca. 490-475 Ma bi-modal intrusive suite discovered. Similar to the Ordovician Barney's River Plutonic Suite (BRPS) recently documented in the southern Antigonish Highlands. Like the BRPS this new suite holds the potential for significant REE and Zn mineralization.
- New Devonian (ca. 375-365 Ma) bi-modal intrusive suite discovered with great potential for REE mineralization.
- REE mineralization discovered associated with Devonian-Carboniferous A-Type granitic rocks.
- Epithermal Au-style mineralization discovered associated with Devonian-Carboniferous bi-modal volcanic rocks.
- IOCG-style mineral occurrences and historic Fe-mining operations cluster along the southern flank of the eastern Cobequid Highlands.
- Large area of mafic metavolcanic rocks with significant ironstone beds now recognized. Lithogeochemical data suggest it formed in a back-arc basin, increasing the potential for VMS deposits. The significant magnetic and associated gravity anomalies in the area suggest this unit may extend to great depths.