Mineral Inventory Studies in Mainland Nova Scotia for 2001

G. A. O'Reilly

Introduction

Mineral Inventory investigations on the Nova Scotia mainland in 2001 consisted primarily of field checking mineral occurrences in the Eastern Shore region (area east of Halifax) and an examination of deposits of the Fe-oxide-Cu-Co-Au association along the Cobequid-Chedabucto Fault Zone (Fig. 1). In addition, several rare metal occurrences in pegmatites and associated leucogranites on the Eastern Shore and southwest Nova Scotia were also examined.

A program of specialized Re-Os age dating of molybdenite, initiated jointly with D. J. Kontak (NSDNR) and S. Carruzzo (Dalhousie University) in 1999, was continued this past field season. A sample of molybdenite-bearing greisen from the Carboniferous Wedgeport Pluton near Yarmouth (Fig. 1) was collected and is currently being processed at the geochronology laboratory of the University of Calgary.

The Mineral Occurrence Database was updated from Version 4 to Version 5 in January 2002. The updated Version 5 files are currently available as a free-of-charge download through the Minerals and Energy Branch website (http://www.gov.ns.ca/natr/meb/) or at a minimal fee through the Department of Natural Resources library for a version on two 3.5″ floppy disks.

Examination of the Fe-oxide-Cu-Co-Au Association

Several sites structurally controlled by faults within the Cobequid-Chedabucto Fault Zone were examined during the 2001 field season (Fig. 1). Mineral Inventory studies carried out over the past

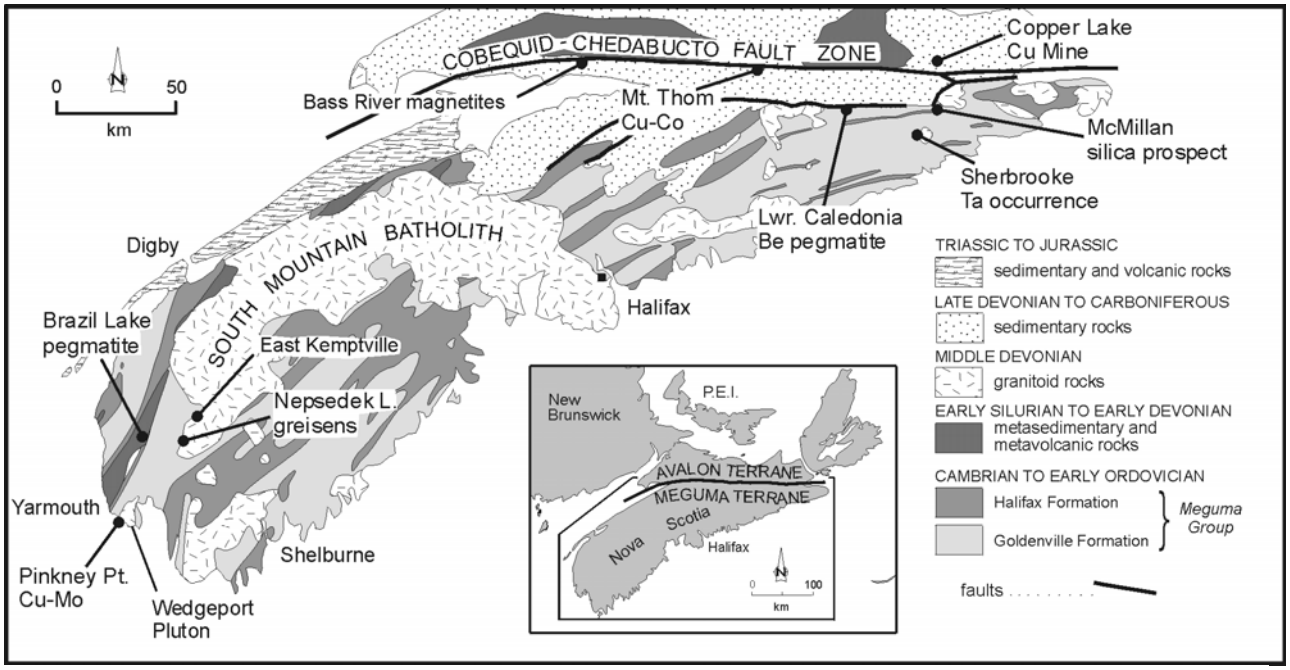

Figure 1. Map showing the location of mineral occurrences on mainland Nova Scotia examined by the Mineral Inventory Project during 2001. The area bounded by the major east-west faults that divide the Avalon and Meguma terranes (inset) is known as the Cobequid-Chedabucto Fault Zone.

several years have indicated that there is a potential for deposits of the economically important Fe-oxide-Cu-Co-Au association in Nova Scotia. The Fe-oxide-Cu-Co-Au association, or Olympic Dam-type deposits as they are sometimes known, are a diverse family of ore deposits, usually of massive size, that occur in a variety of geological environments and often display contrasting features from one another. However, they have several features in common, with perhaps the most notable being the presence of large amounts of Fe-oxide (hematite and/or magnetite) in their ores. During the 2001 field season, examinations were carried out at what are believed to be key examples of this association in the province: the Copper Lake Cu deposit, the Mount Thom Cu-Co prospect, and the Bass River magnetite deposits.

Copper Lake Cu Deposit

The Copper Lake Cu deposit consists of several fissure veins of siderite, chalcopyrite and pyrite up to 3 m thick that intrude faults in Lower Devonian sedimentary rocks in eastern mainland Nova Scotia (Fig. 2). The deposit was mined intermittently on a small scale in the last half of the 1800s and first decades of the 1900s. The veins were mined for their Cu content only, but intermittent exploration at the site since the production era has occasionally revealed that interesting Au levels (in the order of 1-4 g/t) exist in samples from the waste rock dumps.

In 1995, Alterra Resources Inc. drilled two diamond-drill holes at the deposit to further examine the Au potential (Black, 1996). The holes intersected siderite-sulphide veins and thick sequences of hydrothermally altered sediment containing pyrite. Levels of Au in the drill core were found to be low to slightly anomalous, but assays up to 1.5 g/t were obtained. The results for Au led Alterra to drop the property.

During the 2001 field season, diamond-drill core from the Alterra drillholes was examined and several mineralized intersections were sampled. This was done in order to analyze representative mineralized intersections for a suite of elements to assess the geochemical signature of the deposit. This will allow a comparison to what would be expected for typical Fe-oxide-Cu-Co-Au style mineralization. The geochemical analyses are not yet complete, but preliminary results indicate the mineralized intersections are Fe and Cu-rich, as would be expected, and enriched in Ni, Co and As.

Mount Thom Cu-Co Prospect

The Mount Thom Cu-Co-Au prospect, or Steele Run prospect as it is sometimes called, is located in eastern Colchester County about 1 km north of the Trans-Canada Highway at Mount Thom (Fig. 3). The prospect was discovered and explored by Imperial Oil Enterprises Ltd. during the 1970s (Mersereau, 1971). At that time, fracture- and

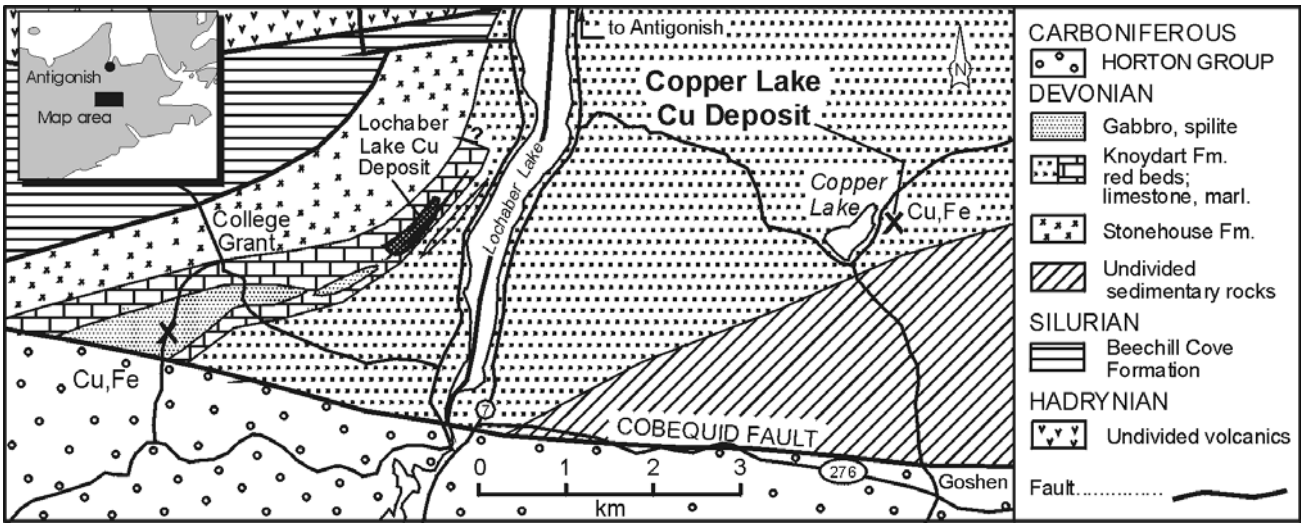

Figure 2. Geology and mineral occurrences of southern Antigonish County showing the location of the Copper Lake Cu deposit.

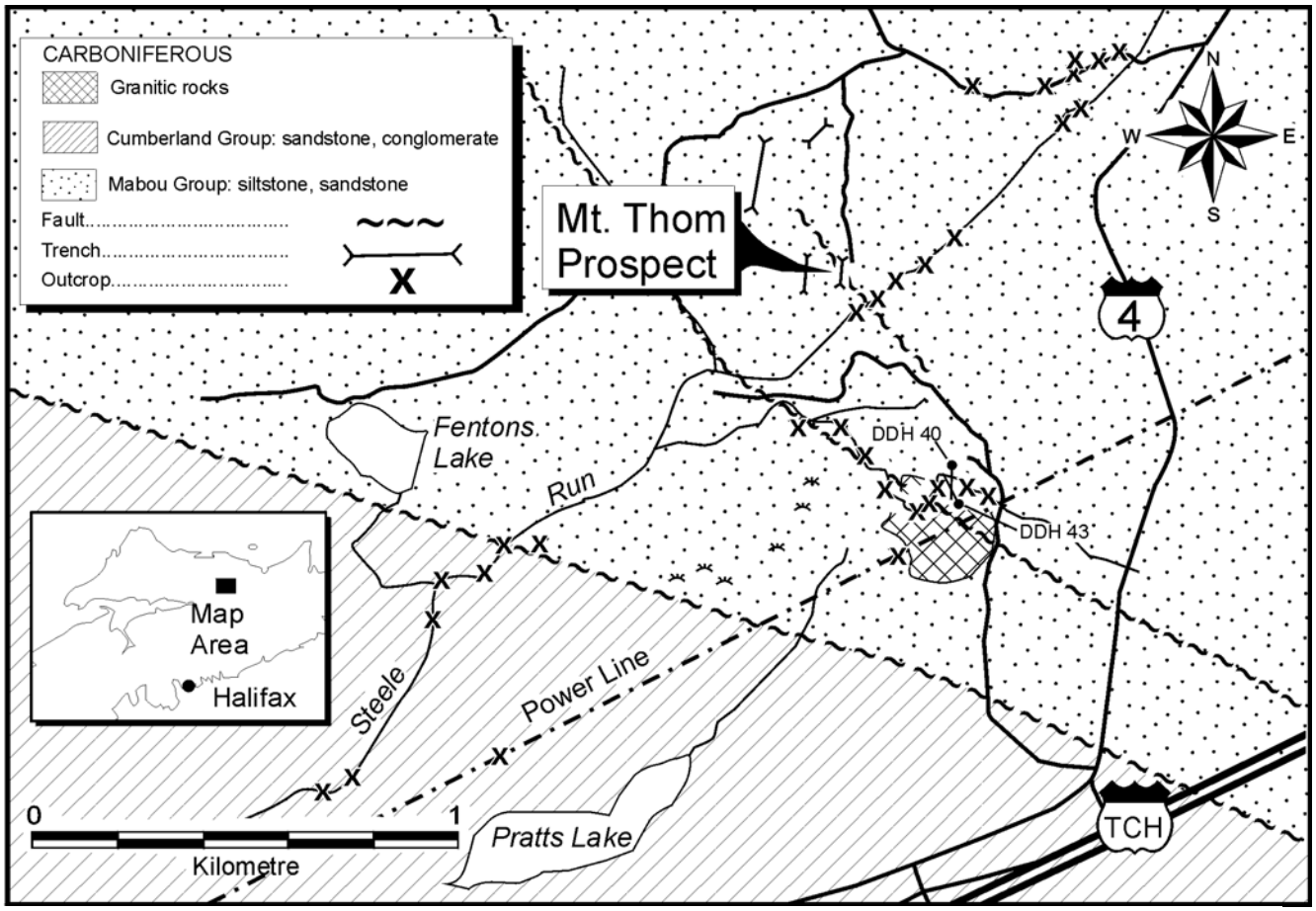

Figure 3. Geology of the Mount Thom Cu-Co prospect of eastern Colchester County, Nova Scotia.

breccia-controlled pyrite, chalcopyrite, specularite, hematite and ankerite were found related to northwest-trending splay faults associated with the major east-west sutures of the Cobequid-Chedabucto Fault Zone. In total, 49 diamond-drill holes (3 185 m) were drilled on the property. Originally, the prospect was explored merely for its Cu content and it wasn't until 1989 (Northcote *et al.,* 1989) that levels of Co into the thousands of ppm were recognized in mineralized outcrop and rubblecrop from the trenches.

A detailed field check of the Mount Thom prospect and an examination of several diamond-drill holes were carried out during the 2001 field season (Fig. 3). Particular attention was paid to the area south and west of the prospect, on the south side of Steele Run. That area has received a lesser degree of exploration even though there are indications in the assessment files that the rocks there display considerable faulting and hydrothermal alteration. A granite intrusion outcropping along a small tributary of Steele Run may have very important genetic implications. The contact relations of the granite with surrounding Carboniferous sedimentary rocks is not clear and has been complicated by extensive faulting. However, there is evidence in outcrop and in Imperial Oil diamond-drill holes 40 and 43 (Fig. 3) that suggest the granite actually intrudes the sediments. The presence of a granite of Carboniferous or younger age not only has genetic implications as far as mineralization is concerned, but also geological implications in general. From a geological viewpoint, an example of granite intruding Mabou Group sediments is noteworthy. A-type granite plutons (granites of alkaline character) yielding early Carboniferous radiometric age dates are known throughout the Cobequid Mountains (Pe-Piper *et al.,* 1991 and 1998), but nowhere are these seen in anything other than faulted contacts with Carboniferous rocks. Granite

actually intruding a mid-Carboniferous unit like the Mabou Group is presently not documented and would indicate felsic plutonism in Nova Scotia continued much longer than is currently thought.

From an economic viewpoint, a granite intrusion contemporaneous with faulting and mineralization at Mount Thom provides, at minimum, a major source of heat and, possibly, a source for the mineralizing fluids and/or metals. The presence of A-type granites in the Cobequid Mountains is of particular note. On a global basis, A-type granites are often thought of as being precursors for Fe-oxide-Cu-Co-Au deposits. The presence of such a pluton at Mount Thom is a further suggestion that the prospect has strong affinities to the Fe-oxide-Cu-Co-Au association.

Bass River Magnetite Deposits

Several magnetite occurrences were discovered by prospectors along the south margin of the Cobequid Mountains north of the village of Bass River, Colchester County, in the late 1930s (Fig. 4). At that time the deposits were considered for their steel making potential, but their high pyrite content rendered them unusable for that purpose. Lodestone Limited examined the occurrences between 1985 and 1989, carried out a six hole diamond-drill program, and collected a 2 000 tonne bulk sample on the Bass River property (Barrett, 1988). That prospect was deemed to have the most potential to produce a magnetite concentrate to meet the heavy media market. The Lodestone Limited evaluation recognized the presence of high Co in the mineralized rock and found it to be associated with the pyrite that is ubiquitous within the magnetite but occurs in variable amounts. Metallurgical tests carried out by Lodestone (Adorjan, 1987) indicated an average grade of 500 ppm Co for unprocessed rock mineralized with magnetite-pyrite, and 0.9% Co for the sulphide concentrate. Lodestone Limited (1987) reported the presence of interesting levels of Au (up to 2078 ppb) in the cobaltiferous pyrite fraction of the magnetite-rich rock. There was some question as to the validity of these high Au levels, so Lodestone carried out some follow-up analyses for verification and were unable to reproduce the results (A. M. Barrett, personal communication). Their conclusion was that the samples were contaminated during processing.

Four of the magnetite occurrences were field checked during 2001. Special emphasis was placed on an examination of the Bass River prospect and an adjacent magnetite zone exposed on the Bass River a few hundred metres to the east (Fig. 4). In addition, core from two of Lodestone Limited's diamond-drill holes from the deposit were examined and sampled. Preliminary geochemical analyses (analyses not yet complete) on several samples of magnetite-pyrite mineralization collected during the field checks returned high levels of Co similar to those reported by Lodestone. In support of the Lodestone conclusion regarding the presence of Au, the levels of Au from samples collected with this study were found to be anomalous (20-30 ppb), but not markedly so.

Field relations of the magnetite occurrences indicate that there was a strong structural control to their formation, related to movements on major sutures of the Cobequid-Chedabucto Fault Zone. Most of the deposits are hosted by siltstone and siliceous siltstone of the Carboniferous Londonderry Formation at, or very near, the faulted contact of this unit with the late Precambrian Great Village River Gneiss. The relationship of magnetite to layered carbonate that often is intimately associated with it is not clear at this time. The layered appearance of the carbonate suggests it may be a limestone unit within the Londonderry Formation, and that it may have acted as a chemical reactant and played a part in the precipitation of magnetite. Unfortunately, the carbonate is deformed and totally recrystallized so any original sedimentary features have been obliterated. An alternative interpretation is that the carbonate is a hydrothermal alteration product associated with magnetite formation and the layered appearance is due to a combination of deformation and flowage. The presence of strongly brecciated carbonate, still with layered form, suggests the layering is tectonic and not lithological. In addition, the fact that portions, or segments, of the layered carbonate occur within sections of massive magnetite that are clearly discordant with the predominant east-west trend of most of the carbonate unit again suggests that the

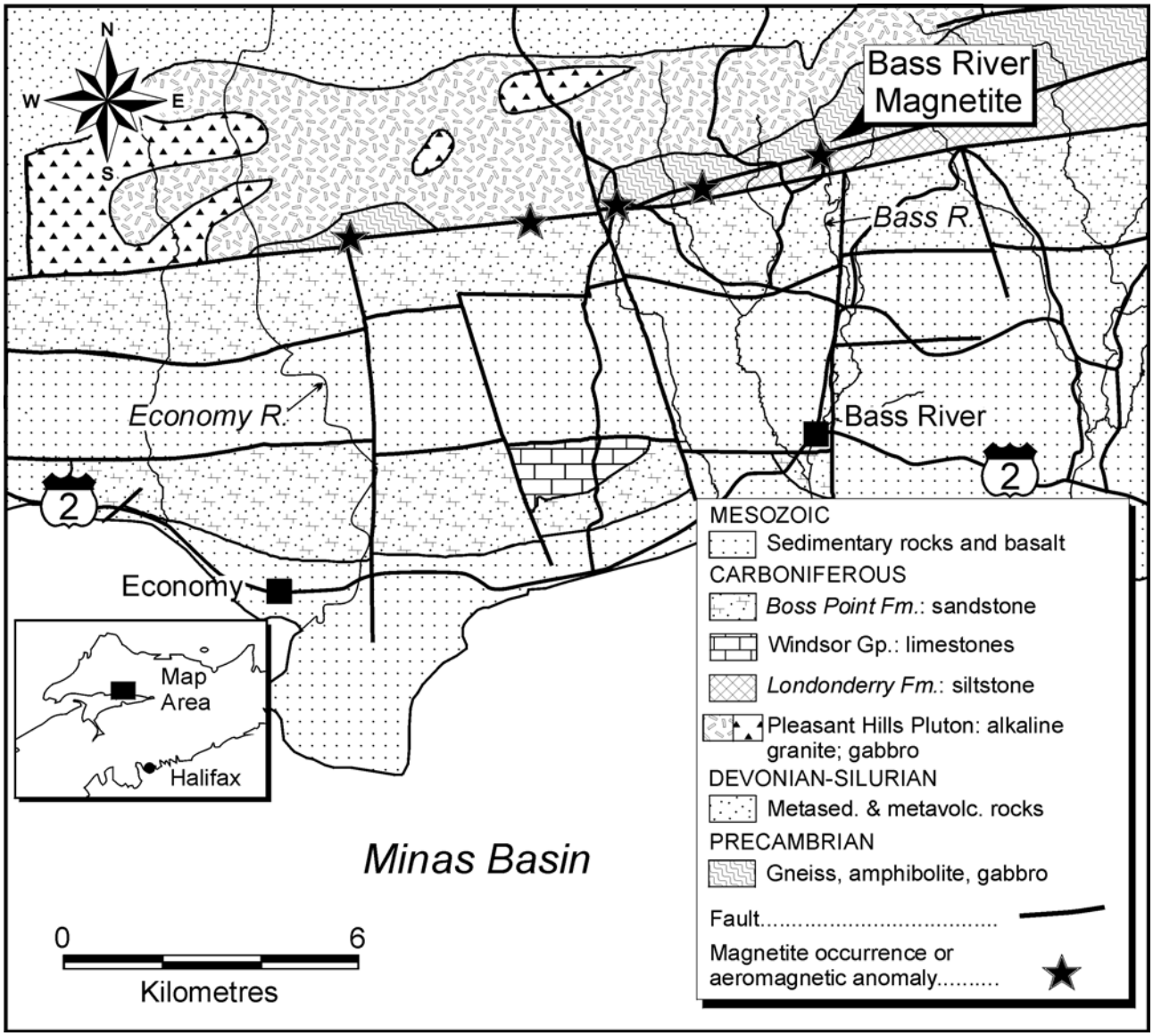

Figure 4. Geology of the Bass River area showing the location of magnetite occurrences associated with the Cobequid-Chedabucto Fault Zone.

carbonate is secondary and related to the mineralization processes.

As mentioned earlier, on a global basis Fe-oxide-Cu-Co-Au deposits are often genetically linked to A-type granite magmatism. The Carboniferous Pleasant Hills Pluton is found within a few hundred metres north of the Bass River magnetite occurrences (Fig. 4). Pe-Piper *et al.* (1998) determined the Pleasant Hills is a composite pluton ranging from gabbro to granite, and that the granitic portion is an alkali feldspar granite of A-type character. As a result, the relationship of magnetite mineralization to this pluton may be significant. Diamond-drilling has shown that breccia fragments of pink granite, identical to the Pleasant Hills granite, occur within the brecciated portion of the Bass River magnetite prospect. In addition, veinlets and small vug fillings of pink K-feldspar are also present. These features suggest that magnetite formation occurred during or after the Carboniferous intrusion of the Pleasant Hills Pluton, and that magnetite precipitation occurred under CO_2- and potassic-rich conditions.

Granite-hosted Rare Metal Deposits

Field investigations were carried out at several other sites throughout the mainland (Fig. 1) in 2001. These included several occurrences of pegmatite and associated leucogranites that have recognized, or potential for, rare metal mineralization. The high level of Ta at the Brazil Lake albite-spodumene pegmatite, Yarmouth County (up to 461 ppm), and the Sherbrooke Ta occurrence, Guysborough County (444 ppm), are of particular note given the current interest in this metal by the mineral exploration industry. Other sites with rare metal potential that were examined include (Fig. 1) a series of mixed pegmatite/ leucogranite dykes at Lower Caledonia (Lower Caledonia beryl pegmatite); a quartz-rich pegmatite at Country Harbour (McMillan silica prospect); and several recently discovered Zn-bearing topaz greisens with elevated Ta at Nepsedek Lake, Yarmouth County.

Re-Os Age Dating

A granite-hosted occurrence of Cu-Mo-Zn-bearing greisens within the Carboniferous Wedgeport Pluton at Pinkneys Point, Yarmouth County, was also visited. A sample of molybdenite-bearing greisen was collected for Re-Os geochronology as part of a joint, continuing effort to determine absolute ages of selected mineral occurrences in Nova Scotia with D. J. Kontak (NSDNR) and Ph.D. student S. Carruzzo (Dalhousie University). Molybdenite is naturally enriched in the radioactive element Re, but its inherent, insignificant amount of Os (i.e. Os present in the mineral when the mineral first crystallized) allows an assumption that essentially all the Os present in the mineral was derived by the decay of Re. This feature places molybdenite as a prime candidate for the direct dating of mineralization in deposits in which it occurs. The Wedgeport Pluton has a reported U-Pb age of 316±5 Ma (Cormier *et al.*, 1988), which places it as the only example of Carboniferous granite in southern Nova Scotia. Metasediment- and granite-hosted deposits of Sn and related elements occur within and around the pluton, and these are similar to those found in the endo- and exo-contact of the South Mountain Batholith in the East Kemptville area, some 40 km to the northeast (Fig. 1). However, the granite host rocks and primary Sn at the East Kemptville deposit yield well defined Devonian ages between 360 and 380 Ma. The current Re-Os dating effort is intended to further examine this contrasting age differential.

Version 5 Update of the Mineral Occurrence Database

The Mineral Occurrence Database was updated from Version 4 to Version 5 in January 2002. This update consists of a substantial amount of information compiled by the Mineral Inventory in predominantly two areas: south-central Cape Breton Island and the Eastern Shore region of the mainland. The Mineral Inventory input into the Targeted Geoscience Initiative (TGI) Project: Geological Mapping for Mineral Development in South-central Cape Breton Island consisted predominantly of information on industrial mineral occurrences in that region (see DeMont, this volume). The information included in the update for mineral occurrences from the Eastern Shore region consists of a mix of both metallic and industrial mineral occurrences.

References

Adorjan, L. A. 1987: Report on mineral processing tests carried out on core samples prepared for Mr. T. Barrett and Jacques Whitford and Associates Limited; Nova Scotia Department of Natural Resources, Assessment Report ME-1987-291.

Barrett, A. M. 1988: Geological description of the Bass River magnetite project; Nova Scotia Department of Natural Resources, Assessment Report ME-1988-423.

Black, D. L. 1996: Report on diamond-drilling Copper Lake property; Nova Scotia Department of Natural Resources, Assessment Report ME-1996-066.

Cormier, R. F., Keppie, J. D. and Odom, A. L. 1988: U-Pb and Rb-Sr geochronology of the

Wedgeport granitoid pluton, southwestern Nova Scotia; Canadian Journal of Earth Sciences, v. 25, p. 255-261.

Lodestone Limited 1987: Assessment report on the Bass River magnetite project; Nova Scotia Department of Natural Resources, Assessment Report ME-1987-030.

Mersereau, T. G. 1971: Geological report - Truro-New Glasgow project, Mount Thom-Area "A", N.T.S. 11E/6, 11; Nova Scotia Department of Natural Resources, Assessment Report 11E/06D 07-D-44(09).

Northcote, K. E., DeMont, G. J. and Armitage, A. 1989: Open file on selected mineral occurrences of the Cobequid area, Nova Scotia, NTS 11E/05, 11E/06, 11E/10, 11E/11, 11E/12, 21H/08; Nova Scotia Department of Natural Resources, Open File Report ME-89-5, 88 p.

Pe-Piper, G., Piper, D. J. W. and Clerk, S. B. 1991: Persistent mafic igneous activity in an A-type granite pluton, Cobequid Highlands, Nova Scotia; Canadian Journal of Earth Sciences, v. 28, p. 1058-1072.

Pe-Piper, G., Koukouvelas, I. and Piper, D. J. W. 1998: Synkinematic granite emplacement in a shear zone: the Pleasant Hills Pluton, Canadian Appalachians; Geological Society of America Bulletin, v. 110, no. 4, p. 523-536.