Chapter 11

SUMMARY AND CONCLUSIONS

11.1 Geology of the Batholith

The South Mountain Batholith project was conducted as part of the 1984-1989 Canada-Nova Scotia Mineral Development Agreement. The chief aim of the project was to evaluate the mineral potential of the batholith by conducting bedrock and surficial geological mapping and detailed follow-up studies. A comprehensive report outlining the results of the surficial mapping is given in Finck and Stea (1995). Bedrock geological maps were released as a series of 1:50,000 scale Open File and published maps, most with accompanying marginal notes. In addition, a 1:250,000 scale compilation map was published. A copy of this map is located in the pocket at the back of this report.

The project represents the first time that comprehensive geological mapping was conducted over the entire batholith. The classification scheme for subdividing the granitic rocks of the batholith was established prior to (MacDonald, 1985), and in the early stages of the project (MacDonald et al., 1985). This scheme combines several macroscopic attributes of the various granitic phases including: modal proportions of quartz-alkali feldspar-plagioclase (e.g. QAP from Streckeisen, 1976); modal amounts of mafic minerals (i.e. biotite, cordierite, garnet) and muscovite; texture (e.g. megacrystic, seriate, equigranular, porphyritic, aplitic, pegmatitic, etc); and grain size (i.e. fine, medium, coarse and very coarse). Application of this classification scheme resulted in the establishment of seven main rock types in the batholith including (in decreasing order of mafic mineral content): mafic porphyry; biotite granodiorite; biotite monzogranite; muscovite-biotite monzogranite; coarse-grained leucomonzogranite; fine-grained leucomonzogranite; and muscovite leucogranite. This scheme now provides a framework for mapping granitic bodies elsewhere in the Meguma Zone, in fact it has recently been used to map the Musquodoboit Batholith (Ham, 1994).

Geological mapping defined 260 intrusive bodies that were grouped into 49 map units based upon similar texture, composition and field relations. Each map unit was assigned a geographical location and one of the seven rock types (e.g. the East Kemptville leucogranite).

When more than one rock type was present in a single unit (e.g. minor granodiorite in some biotite monzogranite units), the predominant rock type was used and the occurrence of other rock types was noted in the map legends and marginal notes. Field relationships were subsequently coupled with modal mineralogical and geochemical data, resulting in the delineation of thirteen plutons. The recognition of pluton boundaries is somewhat problematic because of similarity of ages throughout the batholith, a lack of chilling and definitive cross-cutting relationships at most major granite/granite contacts and the overall mineralogical and chemical similarities of all granitic phases.

Prior to the project, it was generally accepted that approximately 75% of the batholith was comprised of an "envelope" of granodiorite that hosted later-staged monzogranite bodies (McKenzie and Clarke, 1975; Smith, 1979). Although previous mapping resulted in only a few local-scale divisions of the "envelope" rocks (Smitheringale, 1973; McKenzie, 1974), geological mapping and modal mineralogical evaluations revealed that this "envelope" is, in fact, comprised of biotite monzogranite with subordinate granodiorite (52.2% versus 9.6%, respectively). Perhaps more significantly, five discrete Stage I plutons were delineated within the previously homogeneous "envelope". Point counting and follow-up geochemical investigations indicated that four of the five Stage II plutons are normally and/or reversely zoned.

Field work revealed a systematic sequence of emplacement beginning with the intrusion of the Stage I plutons which was followed by a series of eight monzogranite - leucomonzogranite - leucogranite Stage II plutons. Contacts between the Stage I and II plutons are intrusive except for the Halifax pluton where a gradational contact is locally developed with surrounding biotite monzogranite (separate pluton?). The coarse-grained, commonly megacrystic units (predominantly leucomonzogranite and muscovite-biotite monzogranite with subordinate biotite monzogranite and biotite granodiorite) of the Stage II plutons were the first rocks to crystallize. The contacts between these map units were observed to be both intrusive and gradational. The fine-grained leucomonzogranite and leucogranite units were the last rocks to be emplaced in the batholith. Contacts with coarse-grained megacrystic units were predominantly intrusive with the exception of a few fine-grained leucomonzogranite bodies, mainly in the New Ross pluton, where gradational contacts indicate they represent textural equivalents of the coarse-grained leucomonzogranite rocks (Corey, 1988a).

Several field observations indicate that the above sequence of emplacement of granitic rocks may be somewhat simplistic including: the presence of leucomonzogranite xenoliths in biotite monzogranite and biotite granodiorite units indicates that the granodiorite from some Stage I plutons post-dated the crystallization of some leucomonzogranite, although the unequivocal origin of these enclaves has not been established (i.e. could be from high-grade metamorphic regions below current level of erosion); the presence of `late' intrusive bodies cutting more-evolved rocks (e.g. portions of the Tantallon leucomonzogranite in the Halifax Pluton are less evolved that their coarse-grained leucomonzogranite host rocks (MacDonald and Horne, 1988)); the complex sequence of emplacement of granodiorite - coarse-grained leucomonzogranite - aplite near Sambro in the Halifax Pluton that was described in Chapter 6; the complex layered sequence at Chebucto Head (Chapter 6) that suggests intrusion of crystal mush into fractures in crystallized monzogranite; the large compositional range shown by aplite dykes in a single outcrop of Sandy Lake biotite monzogranite along the margin of the Halifax Pluton (see details and discussions in Chapters 3, 4 and 5). Although some of these features can be explained by more than one process, collectively they infer a somewhat complex sequence of emplacement for the granitic rocks of the batholith.

Detailed petrographic studies of the six main rock types (i.e. excluding mafic porphyry) indicate that rocks of the various plutons have similar mineralogical characteristics. For example, the presence of biotite, muscovite, aluminosilicate (e.g. andalusite), cordierite, garnet and tourmaline, in virtually all of the plutons, is consistent with the "characteristic" mineral assemblage for peraluminous granites as defined by Clarke (1981). This same mineral assemblage, in particular the abundance of cordierite (up to 5%), combined with the absence of hornblende and titanite is consistent with "S-type" granitoids as described by Chappell and White (1974) and White et al. (1986). The only occurrence of magnetite in the entire batholith is in a single sample of albite-magnetite breccia from a drill hole near the East Kemptville deposit (Richardson, 1988) where the presence of intense alteration and deformation suggests a post-magmatic origin for the assemblage. The ubiquitous occurrence of accessory ilmenite, along with muscovite and low Mg/Fe biotite, is consistent with the "ilmenite-series" granitoids as described by Ishihara (1977).

Detailed chemical studies demonstrate that the rocks of the batholith have similar overall chemical characteristics with A/CNK > 1, high levels of SiO_2 and low levels of CaO. Major and trace element chemistry and normative compositions define a continuous sequence from least evolved granodiorite to most evolved leucogranite. This sequence is interpreted as representing fractional crystallization with the progressive removal of plagioclase, K-feldspar and inclusion-rich biotite (zircon, monazite, apatite, ilmenite) in the various plutons, as previously proposed by McKenzie and Clarke (1975), Smith (1979), MacDonald and Horne (1988) and MacDonald et al. (1992), to explain compositional variations within portions of the batholith. The recent discovery of a plagioclase-rich cumulate phase in the Big Indian Lake pluton (Corey and Chatterjee, 1992) also supports the fractional crystallization model for the batholith. Deflections in chemical trends (Figs. 5.3a to h), and drastic increases in standard deviations for several "incompatible" trace elements in leucogranitic units are interpreted as reflecting fluid/melt and/or fluid/rock processes as suggested by Kontak et al. (1988) and MacDonald and Clarke (1991).

Despite overall compositional similarities, detailed geochemical and mineralogical studies (Horne et al., 1989; MacDonald et al., 1992; data in this report) has revealed slight, but significant, variations in the mineralogy and geochemistry of the various plutons. In fact, similar rock units (e.g. biotite monzogranite, coarse-grained leucomonzogranite) from different plutons have successfully been discriminated using multi-variate statistical techniques. One explanation for these compositional variations is that varying physico-chemical conditions prevailed during crystallization of the sundry plutons. However, the suite of elements used in the multi-variate discriminate function analysis was entirely high field strength elements that reside primarily in biotite and its inclusions. MacDonald and Clarke (1991) have established that these elements are the least effected by late- and post-magmatic processes, that is, the processes that would be most likely to vary with changing physico-chemical conditions. In fact, the distribution of these elements is strongly controlled by the bulk composition of the melt and the respective distribution coefficients. Therefore, an alternate explanation is favoured in which the slight compositional differences are manifestations of chemical heterogeneities in the protoliths that were melted to form the thirteen plutons. Based upon physical constraints for the emplacement of magmas in the batholith, Horne et al. (1992) concluded that the various plutons were generated by melting of crustal rocks approximately beneath their present location. Therefore, it is reasonable to expect regional changes in protolith composition.

The South Mountain Batholith is, in general terms, massive and lacks the penetrative structural deformation that is characteristic of syn-tectonic or syn-kinematic granitoid bodies. Accordingly, it is interpreted to have been emplaced after the regional deformation associated with the Middle Devonian Acadian Orogeny. However, it is evident from the structural data that the batholith was subject to regional stresses during, and subsequent to, emplacement and crystallization. Horne et al. (1988, 1992) concluded that the planar features (i.e. joints, dykes, veins, faults and shear zones) developed during northwest, horizontal compression accompanying uplift during the waning stages of the Acadian Orogenic event.

Some faults are interpreted to have been active prior to and following the emplacement and crystallization of Stage I and II plutons. Some Stage II plutons are localized along major faults and shear zones (e.g. the East Dalhousie Pluton and part of the Davis Lake Pluton) and may in fact be deformed from further movement along these faults. These structures are therefore interpreted to have played an important role in the emplacement of the batholith. Initial geochronological data indicates that some faults were active for long time periods during and subsequent to the batholith emplacement. For example, Kontak et al. (1989) and Kontak and Cormier (1991) concluded on the basis of geochronological data, that the East Kemptville-East Dalhousie Fault Zone was episodically active from ca. 350 to 250 Ma.

The presence of sharp intrusive granite/country rock contacts, abundant metasedimentary xenoliths in biotite-rich granitic units and the general lack of deformation in country rocks indicates that the bulk of the batholith was emplaced by a passive stoping mechanism. However, evidence for local-scale deformation of the country rocks was noted near Hammonds Plains north of Halifax (Faribault, 1908; MacDonald and Horne, 1987), on the Aspotogan Peninsula (O'Brien, 1988), in Halifax city (Clarke and Halliday, 1980) and possibly along the northwestern margin of the batholith north of East Kemptville (Horne et al., 1992).

Estimates for the depth of emplacement of the batholith are for the most part poorly constrained with approximated pressures of crystallization ranging from 2-4 kb, based principally on phase equilibria for various AFM mineral phases. Recent work by Mahoney (1996) estimates the pressures for metamorphic reactions in the thermal aureole around the batholith at 250 MPa in the western regions to 400 MPa near the eastern margin. These pressures correspond to depths of 6 km and 10 km depth for the western and eastern parts of the batholith respectively.

Three opposing models for the origin and emplacement of the South Mountain Batholith have been advanced. First, McKenzie and Clarke (1975), Charest et al. (1985) and Clarke and Muecke (1985) have proposed that the entire batholith represents a single co-magmatic body that fractionated in-situ (?). Conversely, Smith and Turek (1976) and Smith (1979) suggested that batholith was emplaced as a series of discrete plutons that subsequently coalesced to form a composite batholith. In both instances, the entire batholith was assumed to have crystallized ca. 360-370 Ma. Lastly, Richardson et al. (1989) concluded that the Davis Lake pluton was intruded approximately 30 to 40 Ma after the main "cogenetic" South Mountain Batholith. She concluded that the Davis Lake pluton was generated by remelting of the residue from the first melting event that generated the rest of the batholith. The results from this project have substantially refined the original geological map of the batholith and provide new insight into its intrusion and crystallization history.

There is overwhelming geochronological evidence that the entire batholith was emplaced during a very narrow time interval ca. 370 Ma (Chapter 7) despite the definitive emplacement sequence observed during geological mapping. This restricted time interval for emplacement of the batholith predicates the generation of massive amounts of granitic magma pre-370 Ma. As previously discussed, detailed petrographic, geochemical and isotopic studies of xenoliths from a mafic dyke near Tangier (Eberz et al., 1988, 1991) indicate that upper crustal rocks, possibly from the Avalon Terrane, were subducted beneath the Meguma Terrane during the continent/continent collision related to the Acadian Orogeny. The subjection of upper crustal rocks to lower crustal P-T conditions would necessitate melting and the generation of peraluminous, felsic magma. In addition, the presence of ca. 370 Ma mantle-derived mafic intrusions in the Liscomb Complex (Chatterjee and Giles, 1988; Kontak et al., 1989) suggests that underplating of the Tangier-Liscomb area by mantle magma also occurred. Therefore, the massive amounts of granitic magma required to form the composite South Mountain Batholith may be explained by similar processes evoked (Eberz et al., 1991; Clarke et al., in press) to explain the genesis of the

Tangier granulite xenoliths, the Liscomb gneisses and the nearby granites.

11.2 Economic Geology of the Batholith

Mineral exploration has lead to the discovery of: numerous polymetallic Sn-W-U-Mo style occurrences throughout the batholith; the former New Ross manganese mines; the East Kemptville Sn-Cu-Zn-Ag deposit; and the Millet Brook U-Cu-Ag deposit. All deposits can be classified into five main types. These include greisen, vein, breccia, pegmatite and peribatholithic deposit types. The first four types are defined on the basis of their mineralogy, attending alteration assemblages and field relations. In contrast, peribatholithic deposits are defined only on the basis of field relations and may represent mineralization types similar to the first four categories.

To date, only greisen- and vein-type deposits have proven to be economically viable. The potential for additional deposits of these types is considered excellent. A project designed to evaluate the potential of breccia-type deposits in the Little Tobeatic Lake area was conducted as part of the 1993-96 Canada - Nova Scotia Cooperation Agreement on Mineral Development (Corey and Graves, 1993). Pegmatite-type deposits within the batholith are generally considered to have a low economic potential; however, the spodumene (Li)- and tourmaline-bearing Brazil Lake pegmatite may have potential as a source for industrial minerals (e.g. spodumene, feldspar) or gem quality minerals (e.g. blue tourmaline). The potential for peribatholithic deposits similar to the Duck Pond deposit and Caledonia occurrences is considered to be very high, particularly in the Southwest Nova Scotia Tin Domain, and merits future exploration.

There are several factors that contribute to the deposition and distribution of economic mineral deposits/occurrences in, and adjacent to, the batholith. These include:

1) The composition of granitic rocks. Clearly, as discussed in Chapter 9, the composition and degree of fractionation of granitic rocks has been interpreted to play an integral role in the generation of polymetallic Sn-W-U-Mo type mineral deposits in peraluminous granites worldwide. This feature also applies in the batholith where highly fractionated muscovite$\pm$topaz leucogranites are spatially, and arguably genetically, related to many of the known mineral deposits including those at East Kemptville, Millet Brook and Long Lake.

2) It is apparent from the discussions in Chapters 6 and 9 that structure has played an important part in the formation of mineralization in the batholith. Most vein-type mineralization

(both U-Cu-Ag and Mn-Fe styles) are associated with northeast-trending fault or shear zones whereas polymetallic greisen-type mineralization is commonly associated with northwest-trending quartz veins. In contrast, Halter et al. (1994) noted that the cassiterite-bearing greisen veins in the East Kemptville deposit, the largest known greisen-type deposit in the batholith, are northeast-southwest trending. Their work indicated that northeast-trending fractures "controlled the location of tin mineralization by providing a path for mineralizing fluids". Breccia-type mineralization, such as along the southeastern margin of the Davis Lake Pluton, has been interpreted by Corey and Graves (1993) to have formed by multiple and superimposed periods of brecciation and silicification along a major fault zone. Structure is not considered to have played a key role in the formation of pegmatite-type mineralization.

3) Many greisen-style mineral deposits, including the East Kemptville deposit, are proximal to granite/granite and granite/metasediment contacts. Presumably, these contact zones acted as either physical or chemical `traps' for hydrothermal fluids. Chatterjee and Strong (1985) and Kontak et al. (1988) established the involvement of external fluids (metamorphic and meteoric) for several mineral deposits, based on δO^{18} data. Proximity to contact zones does not appear to have been an important factor in the formation and distribution of breccia-, vein- or pegmatite-type mineral deposits.

4) Chatterjee (1983) proposed a series of metallogenic domains within the batholith based on the styles and elemental assemblages of all known mineral occurrences. MacDonald *et al.* (1992b) and MacDonald (1994) concluded that many of the domains of Chatterjee (1983) occur within one or more plutons with several domain boundaries corresponding to pluton margins. This observation implies that individual plutons are directly responsible for their respective deposit types and associated suites of elements, presumably through prolonged crystal fractionation. Differences in the polymetallic character of the various domains probably reflect variations in bulk composition and physico-chemical conditions during emplacement and crystallization, and possibly varying amounts of crustal contamination during emplacement, within the various plutons of the batholith. If so, the economic mineral potential of each pluton should be considered individually, as suggested by Smith and Turek (1976).

Peribatholithic occurrences, as in the southestern Nova Scotia tin domain and near

Caledonia, presumably represent mineralization associated with buried cupolas, much like the partially unroofed Carnubian Batholith of Cornwall, and possibly the Lake George Sb-W-Mo deposit (Seal et al., 1988) and Mount Pleasant W-Sn-Mo deposit (Taylor et al., 1985) that are both proximal to the Saint George Batholith of central New Brunswick. In fact the presence of peribatholithic mineralization is consistent with worldwide studies of the distribution of Sn mineralization where a large proportion of known mineral deposits are hosted by country rocks proximal to peraluminous granitic batholiths.

Mineral exploration in the past several decades has focused principally on the potential for greisen- and vein-type mineralization throughout the batholith with sporadic exploration for breccia-type metal deposits along the southern margin of the Davis Lake Pluton (see discussion in Chapter 9). This activity has led to the discovery of the greisen-style polymetallic-Sn deposit at East Kemptville, the vein-type U-Cu-Ag deposit at Millet Brook, and numerous other occurrences. Most mineral occurrences have been noted to have definitive geochemical and geophysical responses. The geochemical `signatures' of the four main deposit types have been noted to reflect their different mineralogy and associated alteration mineral assemblages, subsequently, future geochemical programmes should consider utilizing statistical techniques to establish multi-element anomalies. This procedure may assist in differentiating between styles of mineralization, for example, it may be possible to distinguish F anomalies associated with vein-type mineralization (U-Cu-Mn-P-F-Ag) from greisen (Sn-W-Mo-As-Cu-Pb-Zn-Bi-Au-Ag-B-F-P-Na-K) or pegmatite (Mo-Sn-W-Cu-Nb-Ta-Be-B-F) by looking at the associated elemental assemblages. An evaluation of government and private-industry activities reveals that mineral exploration for granite-hosted mineral deposits can use several geochemical techniques (e.g. lake, till, plant-tissue and humus sample media) and geophysical techniques (e.g. Gamma-Ray Spectrometry, Very Low Frequency (VLF); Electromagnetic (EM), Induced Polarization (IP) and Resistivity surveys) to explore for additional mineral deposits.

11.3 Conclusions

Several important conclusions can be drawn from the results of the South Mountain Batholith project:

1) Geological mapping of the South Mountain Batholith of southwestern Nova Scotia was

conducted as part of the 1984-1989 Canada-Nova Scotia Mineral Development Agreement. A rock classification scheme was developed for subdividing granitic rocks. The scheme combined the relative proportions of quartz-alkali feldspar-plagioclase, modal proportions of biotite (±cordierite±garnet) and muscovite, grain size and texture. Seven main rock types were established using this scheme, including (in decreasing order of mafic mineral content): mafic porphyry, biotite granodiorite, biotite monzogranite, muscovite-biotite monzogranite, coarse- and fine-grained leucomonzogranite and muscovite±topaz leucogranite.

2) Geological mapping, coupled with detailed point counting rock slabs, indicates the amount of granodiorite in the batholith is approximately 9.6% compared with previous estimates of up to 75%. The most abundant rock type in the batholith is biotite monzogranite which is the dominant rock type in Stage I plutons and accounts for 52.2% of the total area of the batholith.

3) A total of 260 discrete granite map bodies were delineated in the batholith. These bodies were grouped into 49 map units based on field relationships and composition. Each map unit was assigned a prominent place name or geographical feature and a rock name (e.g. East Kemptville leucogranite).

4) The 49 map units were assigned to 13 plutons, based on field relationships and compositional variations. Five plutons are classed as early Stage I, comprising biotite granodiorite and biotite monzogranite with minor fine-grained leucomonzogranite. These were the first plutons to be emplaced. Stage I plutons were intruded by a series of eight Stage II plutons, comprising muscovite-biotite monzogranite, coarse- and fine-grained leucomonzogranite and muscovite leucogranite with minor biotite granodiorite and biotite monzogranite.

5) Contacts between Stage I and II plutons are not well exposed but, where observed, are primarily intrusive. Contacts between the coarser grained megacrystic units in Stage II plutons are mainly intrusive, but some were noted to be gradational. Contacts between biotite monzogranite and biotite granodiorite in Stage I plutons were noted to be both intrusive and gradational. Late-staged fine-grained leucomonzogranite and leucogranite mainly intrude the megacrystic units with the exception of a few porphyry bodies in the New Ross Pluton that are in gradational contact with the megacrystic leucomonzogranite and represent textural variations of the host.

6) Detailed petrographic studies of the six main rock types indicate that rocks of the

various plutons have similar mineralogical characteristics. For example, the presence of biotite, muscovite, aluminosilicate (e.g. andalusite), cordierite, garnet and tourmaline, in virtually all of the plutons, is consistent with the "characteristic" mineral assemblage for peraluminous granites. Hornblende has not been observed in any of the rocks of the batholith. The only occurrence of magnetite in the entire batholith is in a single hydrothermally altered sample of albite-magnetite breccia from a drill hole near the East Kemptville deposit. The ubiquitous occurrence of accessory ilmenite, along with muscovite and low Mg/Fe biotite, is consistent with the "ilmenite-series" granitoids.

7) Detailed investigations indicate that although most major rock-forming mineral phases are of magmatic origin, many minerals also formed by xenocrystic, hyperaluminous or metasomatic processes at various stages in the evolution of the batholith. Therefore the exact origin of a mineral phase in any given rock must be evaluated individually to establish its origin.

8) Despite overall textural and mineralogical similarities throughout the batholith, several plutons display unique petrographic features. These mineralogical features suggest that different physico-chemical conditions (T, P_{H2O}, fO_2, bulk composition) prevailed in the various plutons.

9) Lithogeochemical analysis of a suite of 597 samples, representing the complete compositional range for the batholith, were analyzed for major elements and a suite of 21 trace elements. Perhaps the most striking feature of the geochemistry of the batholith is the overall similarity in composition throughout the batholith. All rocks are peraluminous (i.e. molecular $Al_2O_3/(CaO+K_2O+Na_2O)>1$) and have relatively high SiO_2 and low CaO with ranges from 67.12% (SD-1.73) and 1.94% (SD-0.46), respectively, in granodiorite to 73.62% (SD-0.89) and 0.39 (SD-0.14), respectively, in leucogranite rocks.

10) The major element chemistry and normative composition of the major rock types indicates a sequence from least evolved biotite granodiorite to most evolved leucogranite that reflects the petrographic features of the different rock types. This sequence is marked by systematic decreases in TiO_2, Fe_2O_3, MnO, MgO, CaO, K/Rb and normative anorthite, enstatite, ilmenite, hematite, rutile and colour index and increases in SiO_2, normative quartz, A/CNK and Thornton-Tuttle differentiation index. The concentration of P_2O_5 is generally consistent from granodiorite to fine-grained leucomonzogranite with a sharp/abrupt increase in leucogranite units.

This sequence is also marked by systematic decreases in several compatible trace elements (i.e. Ba, Sr, Zr, V, Hf, Sc and La) and increases in several incompatible trace elements (i.e. Rb, Ta, U, Li, F, Sn and W).

11) It is possible to distinguish among individual plutons, despite the overall compositional similarities throughout the batholith, thus indicating that the batholith constitutes numerous discrete plutons that coalesced to form a contiguous batholith, in contrast to earlier studies that proposed the entire batholith formed from a single parental magma.

12) Perhaps one of the most important implications of the geochemical data is the delineation of cryptic normal and reverse compositional zoning in both Stage I and II plutons. Zoning is interpreted to have been formed by *in-situ* fractional crystallization, although the contribution from sidewall fractionation or formation of cumulates cannot be ruled out.

13) In spite of a definitive sequence of emplacement for the plutons and their units, an evaluation of published geochronological data indicates that all plutons were intruded and crystallized during a very short time interval (<5 Ma) at ca. 370 Ma.

14) Structural characteristics, including the shape and distribution of plutons, the coincidence of several Stage II plutons with major fault zones, and the orientation of primary and secondary structural features (e.g. megacryst alignment, joints, veins), indicate that the batholith was subject to regional stresses associated with the waning stages of the Acadian Orogeny.

15) Mineral occurrences can be classed into 4 types including: greisen-type (e.g. East Kemptville); vein-type (e.g. New Ross Mn Mines; Millet Brook); breccia-type (e.g. Tobeatic Shear Zone); pegmatite-type (e.g. several occurrences in the New Ross Pluton; and peribatholithic (e.g. the Duck Pond Sn deposit). Similarly, the style of mineralization in the sundry plutons is interpreted as reflecting the protolith composition and the physico-chemical conditions that prevailed during their crystallization. Accordingly, the economic potential of the 13 plutons must be evaluated individually.