METASTABLE FELDSPARS OF ARCHEAN AGE IN THE MEGGISI LAKE GRANITE, WABIGOON BELT, ONTARIO

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ABSTRACT

The cell parameters of microcline and sodic plagioclase (15 pairs) from the seriate unit, Meggisi Lake granite (Wabigoon belt, northwestern Ontario) provide evidence of metastability in both minerals. The plagioclase, now An2 and slightly disordered in most cases, is not magmatic but seems to be the result of an albitionization reaction that almost reached completion. More calcic compositions occur in the groundmass of two specimens and as relics, in grains included in microcline (microprobe determinations). The coexisting microcline invariably is relatively well ordered; on the whole, however, the microcline samples do not define a structurally well-equilibrated lot. Anomalies do not affect $a$, but rather $b$ and $c$ cell edges; some anomalies may reflect Al in T2 positions inherited from a plagioclase precursor, in agreement with petrographic signs of a replacement origin for much of the microcline. Other anomalies suggest a departure in stoichiometry of the microcline toward SiO$_2$. The seriate granite may be a metasomatic envelope around the core zone of equigranular granodiorite to quartz monzonite. In spite of the Archean age of the complex, opportunities have not arisen to anneal the metastable feldspars in the metasomatic assemblage that formed as the Meggisi Lake pluton was intruded and cooled.

Keywords: granite, Archean, microcline, plagioclase, cell dimensions, anomalies, metasomatism, Wabigoon belt, Ontario.

INTRODUCTION

The Wabigoon belt in the Superior province (Archean) of northwestern Ontario is a “granite – greenstone” terrane characterized by an assemblage of metavolcanic, metavolcaniclastic and minor metasedimentary units intruded by plutons of massive and foliated granitoid rocks (Mackasey et al. 1974, Blackburn 1982). W. M. Schwerdtner and coworkers have recently recognized the importance of gigantic gneiss diapirs more than 50 km in diameter in this part of the Canadian Shield (Schwerdtner et al. 1979, Schwerdtner & Lumbers 1980). These diapiric megastructures, which mainly consist of foliated gneissic tonalite to granodiorite, consist of a number of phases, “many of which are distinctly porphyroblastic or have other typically metamorphic textures” (Schwerdtner et al. 1979). Crescentic plutons of massive to foliated diorite to granite were then emplaced between the diapiric structures and the envelope of supracrustal rocks; lithologically similar batholiths later cut the central part of the diapiric complexes. We present here data on the feldspar mineralogy of the Meggisi Lake...

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Although the Meggisi Lake pluton, the subject of this study, was not sampled by Birk & McNutt, the Taylor Lake composite pluton, very similar in all respects and located only 2 km to the north (Fig. 1), was included in their survey. The emplacement of the Taylor Lake pluton, characterized by six intrusive units that range from granodiorite to microgranite and by an autometasomatic (deuteretic) overprint, occurred 2584 ± 31 Ma ago, during the Kenoran orogeny. Pooling of the data on several such younger plutons with information of similar precision on the

![Fig. 1. Simplified geological map of the Meggisi Lake pluton, adapted from Blackburn (1981), showing the core zone (+ + +) of equigranular hornblende–biotite granodiorite to quartz monzonite, largely surrounded by the seriate phase (horizontal dashes). The plutonic complex was mapped by S. F. Sabag. In the southeastern corner, the seriate granite is transitional into gneissic to foliated tonalitic and granodioritic rocks of the Irene – Eltrut lakes diapiric complex, although the contact is shown as a line. The host rocks to the north and west are submarine high-magnesium metabasaltic rocks of the Wapageisi Group. Very large enclaves of such mafic rocks are shown in black. Stars: specimens mentioned in this study. Meggisi Lake occupies a large part of the core zone of the pluton. Top inset: relationship to surrounding rocks. I-ELC Irene – Eltrut Lakes diapiric complex, shown with regional trend lines of foliation (after Schwerdtner et al. 1979). Stippled pattern: supracrustal rocks, including metavolcanic suite. S.L. Stormy Lake, U.M.L. Upper Manitou Lake, L.M.L. Lower Manitou Lake. 1 Meggisi Lake pluton, 2 Taylor Lake pluton, 3 Scattergood Lake pluton, 4 Beak Lake pluton, 5 Mennin batholith, 6 lobe of the Atikwa-Lawrence-Doré complex, 7 Vickers Lake pluton, 8 Entwine Lake pluton, 9 Raleigh Lake pluton. Bottom inset: approximate location of study area with reference to the boundaries of the Wabigoon belt, the Ontario — Manitoba and Ontario — U.S.A. boundaries and Lake Superior (L.S.).]
syntectonic gneiss diapirs led Birk & McNutt (1981) to conclude that the separation of these intrusive events in the Wabigoon belt is beyond the resolution of the Rb–Sr method.

Interestingly, it now seems that the results of Birk & McNutt (1981) do not represent the timing of magmatic crystallization. Davis et al. (1982) found a U–Pb zircon age of 2695 ± 3.6 Ma for the Taylor Lake pluton. This suggests that the Rb–Sr system and, by implication, the host minerals for these elements (dominantly the feldspars), remained open during the cooling of the huge Irene – Eltrut lakes diapiric complex. An alternate explanation might be that the system was regionally reset approximately 125 Ma after emplacement of the complex and the discordant plutons.

In the light of the importance of autometasomatic phenomena, open-system behavior and the discordance in the age determinations by the two methods, we present here the results of an investigation of the feldspar mineralogy of one typical crescentic pluton. The Meggisi Lake body, which cuts the Irene – Eltrut lakes diapiric complex, is located approximately 47 km SSE of Dryden and 60 km W of Ignace, Ontario. Our combined electron-microprobe and X-ray-diffraction investigation is designed to characterize the composition and degree of Si–Al order of the coexisting K- and Na-rich feldspars and to relate these properties to petrogenetically significant environmental factors, in the hope of shedding light on the evolution of these post-diapir plutons.

PETROGRAPHY OF THE SERIATE GNEISS

The seriate granite is characterized by extreme heterogeneity in grain size and mineral abundances (Fig. 2). Quartz and microcline form the coarsest grains. Plagioclase, quartz, microcline and ferromagnesian silicates and accessory minerals are set in an aplitic groundmass containing quartz, microcline and sodic plagioclase. The groundmass typically accounts for 10% of the rock, but may attain 40% near the contacts. An average specimen of seriate granite contains 50 vol. % plagioclase, 27% quartz, 15% microcline and 8% ferromagnesian and accessory minerals. Modes of all specimens examined are reported by Sabag (1979, Appendix A3).

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Quartz glomerophenocrysts range from 0.5 to 3 cm across, but these commonly are granulated into rods and ribbons of anhedral strained grains. Inclusions of titanite, plagioclase and biotite are common in the quartz grains. The margin of the zoned grains is almost completely surrounded (Fig. 1) by a younger seriate granite that is the focus of this report. Also encountered are very small intrusive bodies and dykes of quartz-feldspar porphyry that contain xenoliths of the seriate phase. Full descriptions of the rocks in the area are provided by Blackburn (1981).
uct of local replacement, commonly occurs in irregular patches throughout the grains of plagioclase. “Phenocrysts” of microcline are equant and invariably poikilitic (Fig. 2), and may merge into irregular intergranular concentrations of K-feldspar in the groundmass. The smaller grains are anhedral and free of inclusions, but the “phenocrysts” contain laths of plagioclase (altered core, fresh rim, as shown in Fig. 2) and biotite, magnetite and titanite inclusions. Microcline grains commonly exhibit Carlsbad twinning and an excellent cross-hatched pattern of albite- and pericline-twinned domains, and are very slightly perthitic. Zones of myrmekite occur commonly in the discrete grains of plagioclase near microcline. The seriate granite is relatively leucocratic: biotite (< 5 vol. %) constitutes the most abundant mafic mineral. Accessory phases are epidote, titanite, magnetite and apatite. Hornblende, ubiquitous in the more mafic core-zone of the Meggisi Lake intrusive complex, is lacking in the seriate granite. Ilmenite is not found in the Meggisi Lake suite.

Pegmatite and aplite dykes are more abundant in the seriate phase than in the granodioritic core. In the southwestern part of the pluton (Fig. 1), the seriate phase shows a more prominent fabric and enhanced flattening of crystals, and generally grades the seriate phase shows a more prominent fabric and generally grades into the banded tonalitic and granodioritic gneisses to the south. Quartz veins and pegmatite dykes are common in this transition zone.

**Composition of the Seriate Granite**

In terms of the modal proportion of the dominant minerals plagioclase, quartz and K-feldspar, and assuming that all the plagioclase is more calcic than An$_5$, the seriate-textured unit ranges from quartz diorite ($n = 2$) to granodiorite ($n = 27$) to granite ($n = 3$), in terms of the IUGS classification (Streckeisen 1976). In view of the microprobe data on the composition of plagioclase (see below), this assumption of An > 5 would appear justified. However, bulk-rock compositions (Table 1) show that the rock names deduced are somewhat misleading. On the basis of twenty specimens whose composition was determined (Sabag 1979, Appendix A5), the seriate granite varies surprisingly little, from 69.8 to 73.3% SiO$_2$, 14.7 to 15.9% Al$_2$O$_3$, 1.2 to 2.2% CaO, 4.9 to 5.5% Na$_2$O and 2.1 to 3.3% K$_2$O. The twenty specimens analyzed thus probably contain a very sodic plagioclase, on average, as part of the calcium is bound in the accessory phases. A large proportion of the volume of each plagioclase grain in these rocks must be close to albite in composition, such that the rocks should more properly appear in the field of granite. On the basis of the analytical data in Table 1 and the results quoted by Sabag (1979), the average seriate granite contains 27.8% normative quartz, 0.8% corundum, 16.4% K-feldspar, 43.6% albite and 8.7% anorthite; the average differentiation index thus is 87.8, a value that is beyond the range normally encountered in granodiorites.

**Electron-Microprobe Data on Minerals**

**Plagioclase**

Most plagioclase grains are concentrically zoned. Core compositions encountered range from An$_{44}$ to An$_{18}$ in the somewhat more mafic, hornblende-bearing rocks in the centre of the pluton, the core zone of the plagioclase generally is more calcic than in the seriate granite. Core-to-rim traverses of zoned plagioclase grains in two representative specimens of the seriate phase (T36 and T48; see Fig. 1 for specimen location) indicate ranges of An$_{31}$—An$_{18}$ and An$_{26}$—An$_{16}$, respectively. Also, compositions from the seriate phase are more tightly clustered than is found in plagioclase of the hornblende-bearing rocks. Analyses of small zoned plagioclase grains included in the microcline “phenocrysts” yield compositions from core to rim in the range An$_{39}$—An$_{14}$. Small grains of intergranular plagioclase yield compositions in the range An$_{11}$—An$_{15}$; films of sodic plagioclase in microcline perthite contain 1% An. Sabag (1979) provided an extended discussion of the microprobe results.

**K-feldspar**

All the K-feldspar grains ($n = 25$) that have been analyzed by electron microprobe are very pure; the average composition is Ab$_9$An$_{0.5}$Or$_{99.5}$. All contain small quantities of calcium (0.01 to 0.25% CaO) but virtually no sodium. The larger grains contain more Ca (An$_{0.8}$) and Na (Ab$_{0.3}$) than do intergranular and interstitial grains. The poikilitic K-feldspar grains are slightly more calcic in the vicinity of plagioclase inclusions.

<table>
<thead>
<tr>
<th>Table 1: Bulk Composition of Specimens of the Seriate Phase, Meggisi Lake Pluton, Northwestern Ontario</th>
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<tr>
<td>Sample</td>
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<td>T2</td>
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X-ray-fluorescence data; analyst: S.F. Sabag.
Biotite

The seriate phase contains an aluminous biotite of composition (K,Na)\textsubscript{0.95}Na\textsubscript{0.05}Ca\textsubscript{0.01} (M\textsubscript{g}\textsubscript{3.58}Fe\textsuperscript{2+}\textsubscript{0.86}M\textsubscript{n}\textsubscript{0.99}Fe\textsuperscript{3+}\textsubscript{0.36}Al\textsubscript{1.32}Ti\textsubscript{0.26}O\textsubscript{4.06}O\textsubscript{11}(OH)\textsubscript{2} + C\textsubscript{2}(Al\textsubscript{1.11}Si\textsubscript{2.89}O\textsubscript{4.00}O\textsubscript{11})(OH)\textsubscript{2}; however, it coexists with hornblende. One unusual feature of these biotite compositions is the absence of sodium, as was seen to be the case for the K-feldspar.

X-RAY-DIFFRACTION STUDIES

Unit-cell parameters of the coexisting plagioclase and K-feldspar in six specimens of the seriate-textured unit (locations shown in Fig. 1) are listed in Table 2. These data, obtained for coarse grains of microcline (termed phenocrysts and abbreviated P in Table 2) and adjacent groundmass assemblages (abbreviated G in Table 2), are computed from cor-

| w(A) | w(B) | w(C) | w(D) | w(E) | w(F) | w(G) | w(H) | w(I) | w(J) | w(K) | w(L) | w(M) | w(N) | w(O) | w(P) | w(Q) | w(R) | w(S) | w(T) | w(U) | w(V) | w(W) | w(X) | w(Y) | w(Z) |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
rected and indexed diffraction peaks (film technique, Guinier–Hägg focusing camera, synthetic spinel internal standard) using the program of Appleman & Evans (1973). Calculated structural and compositional indicators (Table 3) were derived from the raw data for the fifteen pairs of feldspars.

### Plagioclase

The cell parameters of the sodic plagioclase in the groundmass and in the microcline phenocrysts reflect the volumetrically most abundant plagioclase in a given subsample; the refinement is based on a $c = 7$ Å cell. The range of compositions in the zoned grains is restricted, as demonstrated in the microprobe traverses mentioned above, obtained for representative specimens T36 and T48. No evidence was found of two sets of plagioclase diffraction peaks in any of the subsamples, nor of unusual broadening of peaks owing to marked heterogeneities in composition or structural state (or both).

The data for plagioclase are best analyzed in terms of a plot of the reciprocal angles $\beta^*$ versus $\gamma^*$ (Fig. 3). The tie line in each case links the matrix plagioclase to the dominant sodic feldspar composition in the microcline phenocryst. Note from Table 2 that in three cases, two microcline phenocryst assemblages differing only in grain size were X-rayed; in Figure 3, both data-points are shown linked to a common point for the matrix.

The cluster of data points in the compositional range $\text{An}_2 - \text{An}_5$ is displaced from the “ordered”,...
plagioclase curve in the direction of increasing Si-Al disorder. Eberhard (1967) has shown that the presence of small amounts of Ca in the plagioclase structure greatly retards the process of Si-Al ordering; this may explain why these feldspars are not perfectly ordered. It is possible that the present composition of the matrix plagioclase in T2, T54, T70 and T80 also arose by processes of albitionizing; the precursor plagioclase in these cases may have been less calcic than that which gave matrix plagioclases T76 and T82, so that the product approached more closely pure albite in the time available for reaction. Note that T82 comes from the northern contact, adjacent to basic metavolcanic rocks (Fig. 1). Additional data, bearing on possible transitional, somewhat more mafic seriate rocks, could perhaps shed light on the steps followed in the reaction. The dominant compositions of plagioclase in these rocks clearly are not magmatic; they are inconsistent with the compositions expected in granitoid rocks whose bulk composition lies in the primary field of crystallization of plagioclase. In spite of the Archean age of the Meggisi Lake granite, opportunities for complete Si-Al ordering of these structures and complete transformation to pure albite, e.g., during a later orogeny, clearly have not arisen.

A powder-diffraction study provides information concerning the average structure in the small volume of sample chosen; the beam of an electron microprobe provides point analyses of plagioclase, sampled away from inclusions of calcium-bearing breakdown minerals (e.g., epidote) to minimize spurious results. The two methods of analysis thus are complementary, and both should be used. Unfortunately, the range of plagioclase compositions recorded by microprobe (Sabag 1979, Table P2) cannot be compared directly with XRD determinations, as these were made on different specimens. The most calcic composition of plagioclase in the matrix indicated in Figure 3, An11, agrees with the range of compositions determined by microprobe, An11 to An15. However, the matrix plagioclase in the other specimens is distinctly more sodic. The discrepancy in An content suggests that the electron beam may have interacted with calcium-bearing breakdown minerals intimately associated with these grains. In the case of sodic feldspar films in microcline perthite, microprobe determinations are consistent with the XRD data perhaps because this albite never was very much more calcic, and thus is not associated with calcium-bearing breakdown phases.

**K-feldspar**

The cell parameters b, c, α* and γ* serve to define the structural indicators Δ(bc) and Δ(α*γ*), and hence t1O, the proportion of Al in the T1O position in the K-feldspar structure. By definition, 

\[ t_{1O} = 1.00 \] in fully ordered microcline; one might well expect this value to have been attained in plutonic rocks of Archean age. The composition of the K-rich feldspar can be inferred 1) from the a cell edge, which is relatively insensitive to structural state, 2) from a b – c plot contoured for a, and 3) from a plot of the reciprocal cell dimensions b* versus c*. These data lead to an evaluation of strain in the lattice of K-feldspar in the six specimens of Meggisi Lake seriate granite selected for study.

The a cell edge of the microcline (Table 2) ranges from 8.5753 to 8.5871 Å; the average standard error associated with this dimension in the fifteen data-sets is 0.0009 Å. It is possible to obtain a value of NOr, the mol fraction of Or, from a using an expression derived from the K-rich portion of the microcline – low albite series of Orville (1967): 

\[ N_{Or} = -19.926 + 2.43506a \] (W.C. Luth, pers. comm. 1970). Values of NOr based on a range from 0.955 to 0.984 (Table 3). Judging from its a dimension, microcline in the groundmass is not systematically richer (or poorer) in Or than that in the phenocrysts.

Lattice strain that results from coherency between sodium- and potassium-rich domains in a perthite is reflected in an anomalously short predicted a dimension of the K-rich feldspar, based on position in the b – c quadrilateral. An arbitrary limiting value in Δa (= aobs – apred) of 0.05 Å (Stewart & Wright 1974, Fig. 9) is usually considered in the definition of such an anomalous K-rich feldspar. In an expanded view of part of the b – c quadrilateral (Fig. 4), the groundmass K-feldspar in specimens T76 and
T82 plots in an unexpected position away from the low microcline corner. Values of $\Delta a$ in both cases attain the limiting case of 0.05 Å. Note that T76 and T82 are the specimens in which the groundmass plagioclase was found aberrant. The position of these two data-points for groundmass microcline in Figure 4, significantly displaced toward low albite, cannot be attributed to a higher Na content, as 1) No, values inferred from $a$ or from $V$ (see below) show no signs of apparent Na enrichment in T76 and T82, and 2) the groundmass microcline in two typical specimens was found to be devoid of Na (microprobe analyses).

The samples of groundmass microcline in the four other specimens are offset from the phenocryst microcline in the direction of increasing apparent degree of order. As the ordering reaction is surface-controlled, such a structural difference between phenocryst and groundmass feldspar might not be unexpected in a much younger rock. Taken at face value, the surprising degree of scatter among points in Figure 4, apparently a reflection of a range of $i \Omega$ values from 0.951 to 1.013 (Table 3), suggests that structural equilibrium has not been attained, both within and between the six specimens analyzed.

The data points for microcline (groundmass and phenocryst) in specimen T70 plot in an anomalous position, outside the $D - c$ quadrilateral. Such a shift could reflect substitution of a large cation in the K-feldspar [e.g., Rb-for-K or Fe-for-Al substitutions (Martin 1971, Fig. 2)]. However, T70 is not pegmatitic, nor is it unusually iron-rich. Values of $a$ in T70 (Table 3) show no evidence of Rb-for-K substitution. The anomalies in T70, which in fact imply that $\Delta a$ is a negative quantity, may thus also reflect structural effects rather than compositional variables.

The cell volume is usually considered to reflect composition of a K-rich feldspar more accurately than $a$, which is apparently prone to strain-related anomalies of both signs. Compositions based on $V$, calculated for the fifteen samples of microcline studied (equation of Stewart & Wright 1974), range from 0.946 (T76 groundmass) to 0.989 (Table 3). The values are surprisingly close to those deduced from $a$ alone, suggesting that there are in fact no anomalies involving $a$ in the K-feldspar of the Meggisi Lake suite. In turn, this suggests that the groundmass microcline in T76 and T82 (Fig. 4) is anomalous in its $b$ and $c$ dimensions.

Smith (1974, Fig. 7-27) proposed a different diagram to gauge the extent of structural anomalies: $a^*$ (in Å$^{-1}$) is plotted as a function of Or$(b^*c^*)$, the Or content deduced from the $b^* - c^*$ quadrilateral. Values of Or$(b^*c^*)$, calculated with the expression of Blasi (1977) and listed in Table 3, range from 0.976 to 1.028. Note that with some exceptions (Fig. 5), these values of Or agree more closely with compositions measured by microprobe than values of Or based on $a$ or $V$. Most points fall within the arbitrary limits for normal (i.e., unstrained) K-rich feldspars (Fig. 5). On this diagram, a strained K-feldspar in coherent intergrowth with albite would be expected to plot off-scale toward a lower value of Or$(b^*c^*)$. The anomalies in T70 and in one phenocryst sample of T54 are thus not due to a coherent intergrowth with sodium feldspar, nor would such a cause be expected in view of the age, the degree of deformation and the original plutonic nature of the Meggisi Lake granite body.

Although $a^*$ seems to have a value very close to that expected, thirteen out of fifteen samples of microcline are anomalous in that they plot outside the $b^*-c^*$ quadrilateral (not shown). The microcline in T70 (phenocryst and groundmass), as in Figure 4, shows the maximum departure in $c^*$, which is 0.00012 Å$^{-1}$ too short; $b^*$ is 0.00043 Å$^{-1}$ too long in the matrix microcline in T82. Internal variability and the anomalous positions suggest that both $b^*$ and $c^*$ are anomalous in these samples of microcline. Insofar as $a$ and $a^*$, which reflect the proportion of Na and K, are not aberrant, we must conclude that the anomalies involve structural variables related to the distribution of Si and Al.

**DISCUSSION**

The approach used here provides information on the average K-feldspar and plagioclase structures in a given specimen selected for study. Even though a typical sample, as mounted for X-ray-diffraction analysis, weighs between 2 to 2.5 mg and thus occupies less than 1 mm$^3$, there is a possibility that the two variables that affect the cell constants, composi-
tion and degree of Si-Al order, are not homogeneous properties of the feldspars in this small volume, leading to diffuse diffraction-maxima. For example, the groundmass plagioclase may well be zoned, as indicated by microprobe scans described above. Keeping in mind these words of caution, however, the reader should note that in the data for K-feldspar, cell edges are determined with a precision close to 1 in 10000; for plagioclase, the average precision attained is only slightly inferior to this level, suggesting that the extents of compositional zoning and structural heterogeneities are minimal.

The structural anomalies in microcline, reflected principally in b and c rather than a, can be explained by considering how the distribution of Al and Si affects b and c. In an admittedly simplistic approach, Stewart & Ribbe (1969) proposed that b and c (unlike a) vary significantly in length with degree of Si-Al order because of the following different sequences of tetrahedral cations encountered along [010] and [001]: T1O, T1m, 2T2O and 2T2m along b, T3O, T5m and one of T2O or T3m along c. The mean T-O bond-lengths vary from 1.604 Å (Si-O) to 1.643 Å (Si3Al14–O3, as in a completely disordered feldspar) to 1.759 Å (Al-O), according to one model (Ferguson 1980). As one T1O and one T3m are in common to both paths through the microcline, an anomaly in b and c must reflect the relative importance of the T5 set of positions. It is true that results of structure refinements of well-ordered microcline, summarized by Ferguson (1980), indicate very low concentrations of Al in these two positions, such that in ordinary low microcline, the mean T2O–O and T3m–O bond-lengths would both be very close to 1.604 Å.

As a possible explanation of the anomalous values of b and c found in some samples of microcline, we propose that small amounts of Al statistically occupy T1O and T3m positions. Three larger-than-usual T5 sites would thus be encountered along b versus one along c, and the resulting cell would be expanded along b and somewhat less so along c (e.g., T54 and T70 in Fig. 4). Such a pattern of Si–Al distribution may reflect 1) more Al than expected in ideal KAlSi3O8 owing to small amounts of structurally bound Ca, and 2) a relict disordered Si-Al distribution if the microcline was once a plagioclase (see below).

The other type of anomaly, illustrated by matrix microcline in T76 and T82 (Fig. 4), in which both b and c are shorter than expected, could possibly reflect more in the structure than expected, presumably balanced by a deficiency in the alkali position. This small excess of Si, distributed over T3m, T2O and T2m, would lead to sufficient shortening of the mean T3m–O, T2O–O and T3m–O bond-lengths to account for the anomaly. Unfortunately, only in high-temperature calcic plagioclase has this phenomenon of departure from stoichiometry toward SiO2 been documented properly (Bruno & Facchinelli 1974). Careful crystal-structure studies will be needed to test the proposals made here concerning the cause of shortening in b and c.

The composition and degree of Si-Al order of both plagioclase and microcline can be used to extract petrogenetic information concerning the origin of the seriate granite at Meggisi Lake. (1) The zoned crystals of plagioclase were more calcic than they presently are; they have been almost completely albitized, presumably at temperatures in the realm of greenschist-facies metamorphism. (2) An average composition of 2 to 3% An characterizes matrix and phenocrysts of four of the six specimens studied; compositional or structural equilibrium was not attained in any of these. These results, which are not compatible with the point determinations of composition by microprobe (on samples not available for XRD analysis) suggest that the volume occupied by the relics of the original plagioclase is small in the six specimens studied. (3) In the case of T76 and T82, the matrix plagioclase was albitized, but it is significantly more calcic than in the other specimens, suggesting a more calcium-rich original matrix (owing to admixed mafic volcanic xenoliths or, in a more extreme view, to the fact that the whole rock once was a basic volcanic rock). Note that T82 was collected very close to the contact with the metabasic host rocks. (4) The lack of equilibration among the plagioclase components of T76 and T82 and the lack of structural and compositional convergence onto ordered An8 among the other specimens imply a relatively short-lived series of deuteritic adjustments that possibly accompanied the cooling of the central body of early-emplaced equigranular granodiorite to quartz monzonite. Also a possibility, in view of the discrepancy between Rb-Sr (i.e., feldspar) and U–Pb (i.e., zircon) systems in the neighboring Taylor Lake stock and elsewhere in the Wabigoon belt, is a separate event 125 Ma after the emplacement of the small plutons. This could be related to reactivation of the huge Irene – Eltrut lakes diapiric complex. (5) The presence of “phenocrysts” of strikingly grid-twinned microcline in the seriate granite implies initial formation of K-feldspar as a monoclinic phase, and thus crystallization at a temperature higher than approximately 450° C (e.g., Smith 1974, Fig. S–1). The monoclinic K-feldspar seems to have formed in part by in situ replacement of a pre-existing plagioclase. The bulk composition of the rocks is not consistent with the crystallization of phenocrysts of K-rich feldspar as a liquidus phase. Petrographic evidence suggesting a replacement origin for the “phenocrysts” (e.g., large, strikingly poikilitic grains of microcline, irregular outline, projections and anastomosing network of K-feldspar ex-
tending into groundmass; highly irregular and embayed margins of the small lath-shaped grains of plagioclase in the groundmass, “synneusis” texture produced by selective removal of material along fronts that cut across grain boundaries, patchy pseudomorphism by microcline (Sabag 1979) is also mentioned by Schwerdtner et al. (1979) and Birk et al. (1979) in descriptions of other plutonic complexes in the Wabigoon belt. The conversion of the monoclinic K-feldspar to ordered microcline was successful, but the rate of cooling of the affected rocks must have been too rapid to allow these structures to anneal properly, leading to persistence of structural anomalies indicative of a plagioclase precursor and (more tentatively) of nonstoichiometric compositions apparently enriched in Si.

The initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratio determined on the neighboring Taylor Lake stock, 0.7005 (Birk & McNutt 1981), as well as the range in $\delta^{18}\text{O}$ values measured on a representative suite of four specimens from the same body (7.7 - 8.9 $^{\circ}/_{oo}$: Longstaffe & Birk 1981), are consistent with ultimate derivation of these small batches of granitic magma by the anatexis of buried basaltic material previously enriched slightly in $^{18}\text{O}$ during an episode of low-temperature alteration. The feldspar data suggest that the seriate granite, which does not have an igneous texture, forms a metasomatic envelope around the central stock at Meggisi Lake; the rocks affected by K,Na metasomatism were the banded gneisses on the southern side (a transition zone in fact was noted in the field; see caption to Fig. 1) and metasomatic rocks of the Wapageisi Group to the north. These metasomatic adjustments may represent the attempted conversion, at amphibolite- and greenschist-range temperatures, of the host rocks to compositions in equilibrium with fluids released during the crystallization of the central stock. The conversion is considered only partly successful because of the persistence of Ca-bearing albite, locally of oligoclase and andesine, and of scatter and structural anomalies among the microcline samples analyzed. Such metastable features could have been removed by annealing had the area been reheated; this may provide an argument against a younger event of regional importance 125 Ma after emplacement.

The overall crescentic shape of such plutonic complexes as at Meggisi Lake may reflect the outer shape of the metasomatic envelope, which developed around an igneous core of anatexically reactivated crustal material as it rose along the interface between the major diapiric structures and the metabasic rocks of the adjacent greenstone belt. Mafic xenoliths in this envelope may represent “digested” metabasic wallrocks, whereas those in the igneous core may represent a residuum left over after partial melting of a basic source (Sutcliffe 1978).

**Acknowledgements**

Dr. G. M. Anderson (University of Toronto) first brought to the attention of the second author the existence of anomalies in the feldspars of the Meggisi Lake plutonic complex. S. F: Sabag acknowledges the support and guidance of G. M. Anderson as thesis director. Cell-parameter refinements were covered by NSERC grant A7721 to R. F. Martin. We thank Associate Editor L. T. Trembath and three anonymous referees for their constructive comments.

**References**


Received July 10, 1982, revised manuscript accepted November 17, 1982.