Lithogeochemical, Petrographic and Stratigraphic Relations of Archean Volcanic Rocks from Southwestern Jessop Township and Adjacent Areas, Timmins Region, Ontario

for:

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-- June 5, 1995 --

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-- Ore Systems Consulting --

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INTRODUCTION

The claims optioned by Noranda lie near the shared corner of the four townships of Jessop, Mountjoy, Godfrey, and Jamieson (Figure 1). The 'Four Corners' area is about 19 km south-southwest of the Kidd Creek VMS deposit, and 20 km east of the Kamiskotia Gabbro Complex. The area is underlain by Archean mafic and felsic volcanic rocks of the southwestern Abitibi greenstone belt. Volcanic and sedimentary units generally strike ENE and dip subvertically. The results of previous drilling carried out in Jessop and Mountjoy townships over the last several years by the Jessop Syndicate are summarized in reports by Kirwan (1991, 1992) and Barrett and MacLean (1993a,b, 1994b). Of particular relevance to the present report was the 1993 drilling program in the Four Corners area by the Jessop Syndicate (holes K2-93-1 to 93-3; Fig. 2). Stratigraphic and lithogeochemical results from this program are discussed in Barrett and MacLean (1994b).

The main rock types reported in the above studies were tholeiitic rhyolite (rhyolite A), mafic volcanics including evolved ferrobasalts (icelandites), graphitic argillites, felsic fragmental units some of which are of rhyodacitic composition (low-Zr rhyolite B), an evolved quartz porphyry (high-Zr rhyolite B), and gabbro. The tholeiitic rhyolite appears to form an important unit which is vertically continuous between the southern end of hole K2-93-2 (where it occurred near surface) and the northern end of hole K2-93-1 (where it was intersected at depth). Graded beds intersected in this area, and in previous holes located 1-2 km to the east, suggest that the overall stratigraphic sequence youngs to the north.

Purpose and Scope of Study

The current study focuses on the stratigraphy, lithogeochemistry and petrography of volcanic rocks intersected in holes NOR94-1 to 94-6 inclusive, which were drilled in the Four Corners area by Noranda Exploration in 1994. Hole locations extend from ≈400m southwest to ≈900m east-northeast of the Four Corners (Fig. 2). The study includes: 1) chemical characterization of the main volcanic rock types in holes NOR 94-1 to 94-6 (i.e. identification of chemostratigraphic units); 2) petrographic description of selected rocks; 3) assessment of the original volcanic setting from variations in stratigraphic sequence and volcanic facies; 4) comparisons with volcanic rocks hosting massive sulfide deposits in the Timmins area and elsewhere in the Abitibi greenstone belt; and 5) recommendations for further work. The results, in combination with the studies cited above, are used to identify the favorable locations for mineralization within the volcanic pile, based collectively on recognition of favorable primary volcanic compositions, specific volcanic contacts, areas of increased hydrothermal alteration, and areas of proximal volcanic facies.

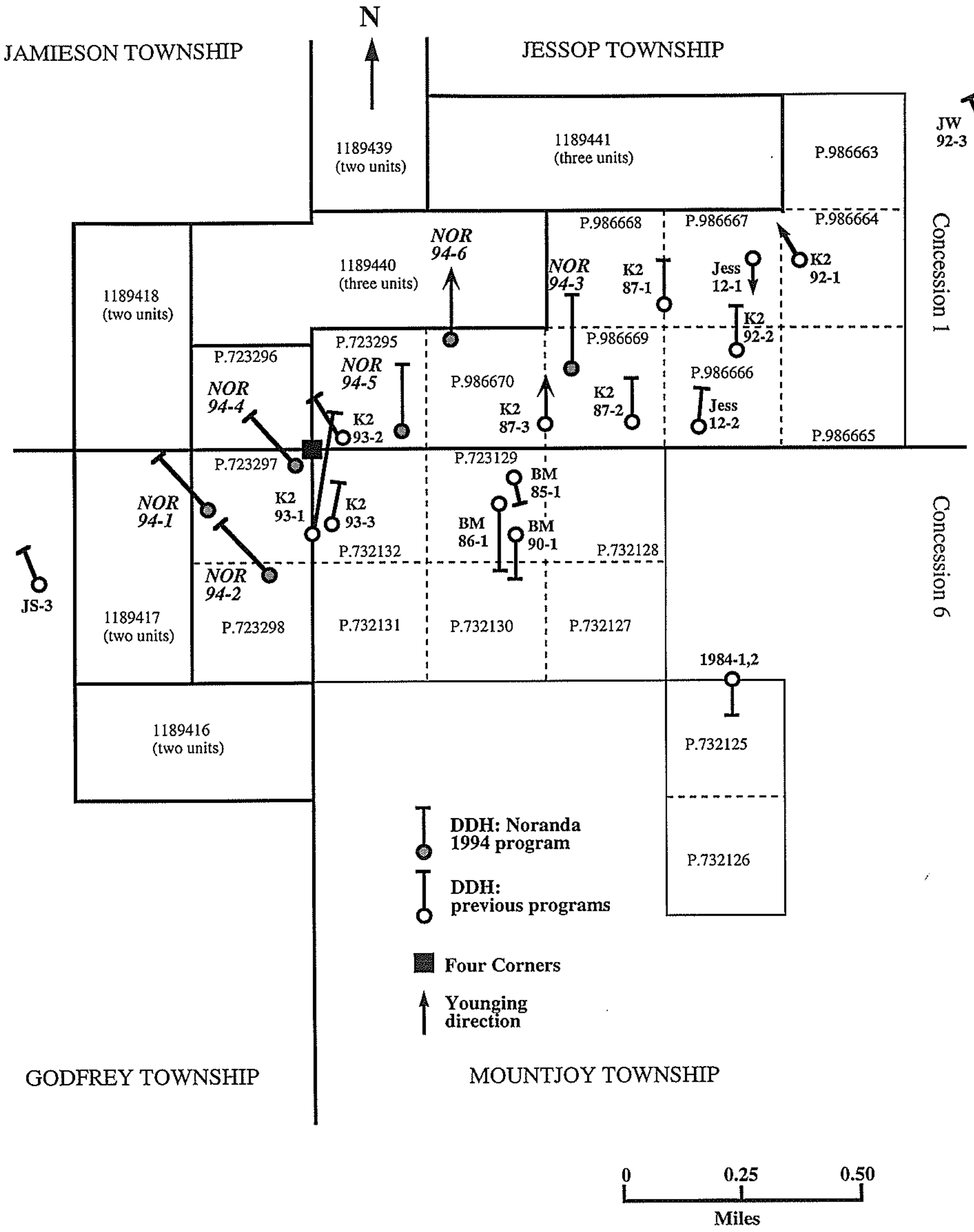

N
JAMIESON TOWNSHIP
JESSOP TOWNSHIP
GODFREY TOWNSHIP
MOUNTJOY TOWNSHIP
Concession 1
Concession 6
1189439 (two units)
1189441 (three units)
P.986663
P.986664
P.986668
P.986667
1189440 (three units)
1189418 (two units)
P.723296
P.723295
P.986669
P.986670
P.986666
P.986665
P.723297
P.723129
P.732132
P.732128
1189417 (two units)
P.723298
P.732131
P.732130
P.732127
1189416 (two units)
P.732125
P.732126
JW 92-3
NOR 94-6
NOR 94-3
K2 87-1
Jess 12-1
K2 92-1
K2 92-2
NOR 94-4
NOR 94-5
K2 93-2
K2 87-3
K2 87-2
Jess 12-2
NOR 94-1
K2 93-1
K2 93-3
BM 85-1
BM 86-1
BM 90-1
NOR 94-2
JS-3
1984-1,2
DDH: Noranda 1994 program
DDH: previous programs
Four Corners
Younging direction
0
0.25
0.50
Miles

Fig. 2

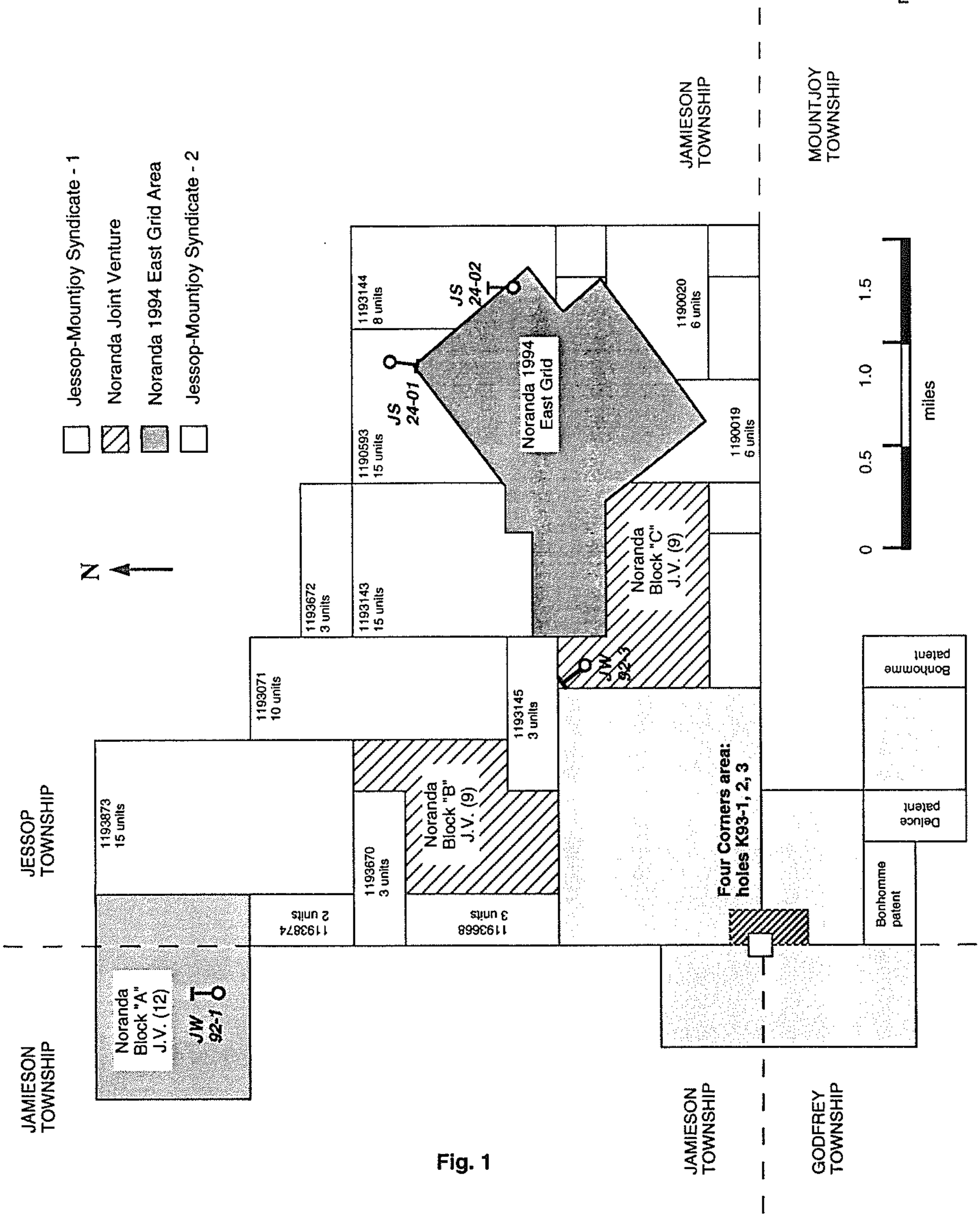

Jessop-Mountjoy Syndicate - 1
Noranda Joint Venture
Noranda 1994 East Grid Area
Jessop-Mountjoy Syndicate - 2
N
JESSOP TOWNSHIP
JAMIESON TOWNSHIP
MOUNTJOY TOWNSHIP
GODFREY TOWNSHIP
1193873 15 units
1193874 2 units
1193670 3 units
1193668 3 units
1193071 10 units
1193145 3 units
1193672 3 units
1193143 15 units
1190593 15 units
1193144 8 units
1190020 6 units
1190019 6 units
Noranda Block "A" J.V. (12)
Noranda Block "B" J.V. (9)
Noranda Block "C" J.V. (9)
Noranda 1994 East Grid
JW 92-1
JW 92-3
JS 24-01
JS 24-02
Four Corners area: holes K93-1, 2, 3
Bonhomme patent
Deluce patent
Bonhomme patent
0
0.5
1.0
1.5
miles

Fig. 1

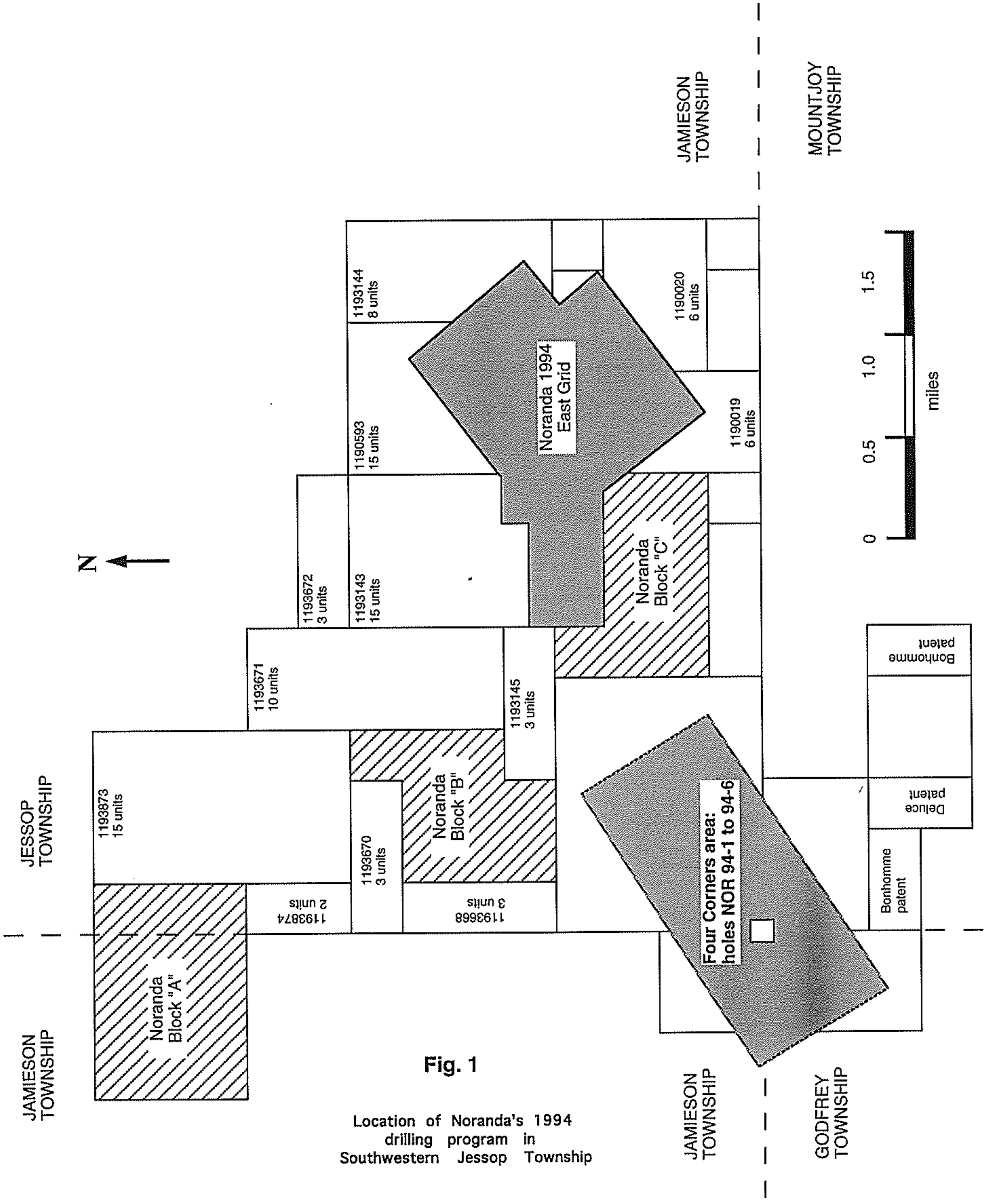


Fig. 1

Location of Noranda's 1994 drilling program in Southwestern Jessop Township

LITHOGEOCHEMISTRY

Primary Geochemistry

The new data set is based on 70 samples from drillholes NOR 94-1 to 94-6. Drillhole samples were generally about 20 cm in length, except where noted. Samples were analyzed by X-ray fluorescence at the XRAL lab in Toronto using glass beads for major elements, and pressed pellets for the trace elements Zr, Y, Nb, Ba, Rb and Sr to ensure accuracy and low detection limits. In addition, 20 new REE analyses are reported. These samples were analyzed by instrumental neutron activation analysis through the XRAL lab.

As shown by a plot of Al_2O_3 vs. TiO_2 (Fig. 3a), the main volcanic compositions in the Noranda 1994 drilling program include two distinctive mafic units, one basaltic, the other evolved basaltic; and three felsic units termed rhyolite A, high-Zr rhyolite B, and low-Zr rhyolite B. Least altered samples of Rhyolite A cluster at lower Al_2O_3 and TiO_2 values than rhyolite B samples and are more fractionated. Of the mafic rocks, evolved basalts have notably higher TiO_2 and less Al_2O_3 than normal basalts (Fig. 3a). All mafic rocks are fairly Fe-rich, with FeO/MgO ranging from about 2 to 5. In addition, there are several andesitic to dacitic samples that could represent either primary lava compositions, or mechanical mixtures of mafic and felsic detritus. It should be noted that significant portions of hole 94-6, and the lowest 20% of 94-5, have not been lithogeochemically sampled to date.

A plot of TiO_2 versus Zr (Fig. 3b) indicates that the evolved basalts contain more than 2.0% TiO_2 and ≈150-400 ppm Zr. Both of these elements are notably enriched relative to normal MORB-like basalts, presumably as a result of advanced fractionation of mafic magma under dry conditions. This plot also indicates that rhyolite B contains two sub-groups, one with ≈150-250 ppm Zr, the other with ≈450-650 ppm Zr.

Rhyolite A appears to have had a quite uniform composition across the area of drilling, as shown by five least altered samples from three holes (italicized samples in Table 1). It is of interest that the immobile element values for rhyolite A samples in hole 94-1, the westernmost hole, are essentially identical to those in 94-3, the easternmost hole (i.e. $Al_2O_3 \approx 11.7\%$, $TiO_2 = 0.18\%$, $Zr \approx 344$ ppm, $Al_2O_3/TiO_2 \approx 66$, and $Zr/Y \approx 3.3$). This supports the correlation of these rhyolites over a lateral distance of about one kilometre. The precursor composition of rhyolite A, based on the average of the five least altered samples, is given in Table 4; this average is also used in the mass change calculations discussed in a later section.

Southwestern Jessop Township volcanics

Fig. 3a

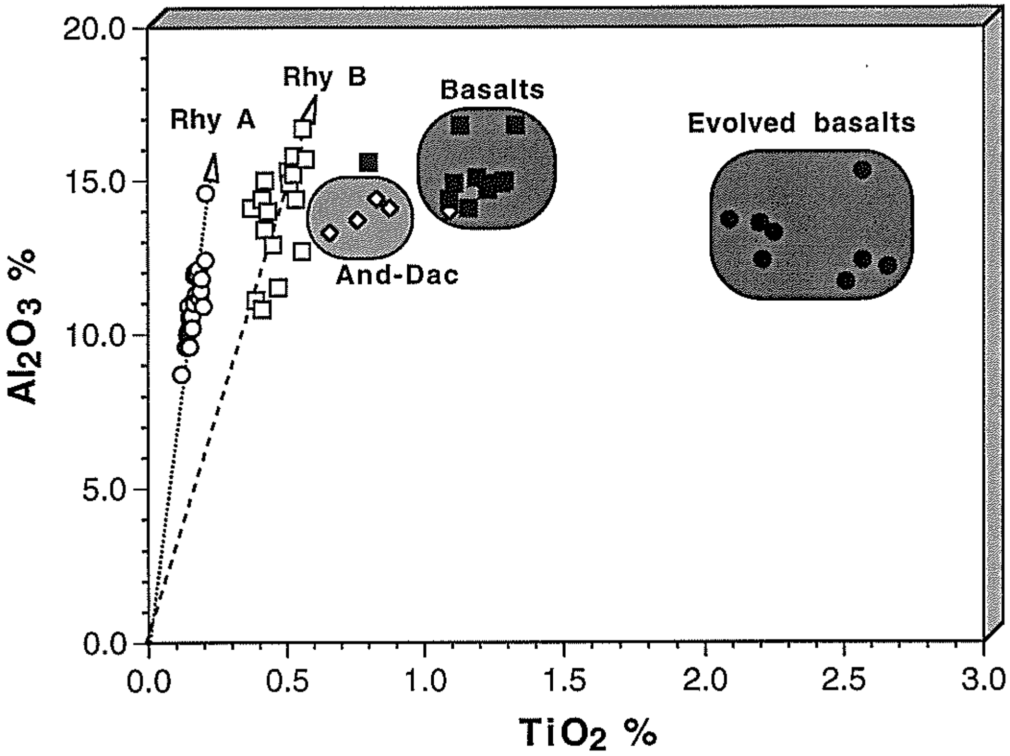
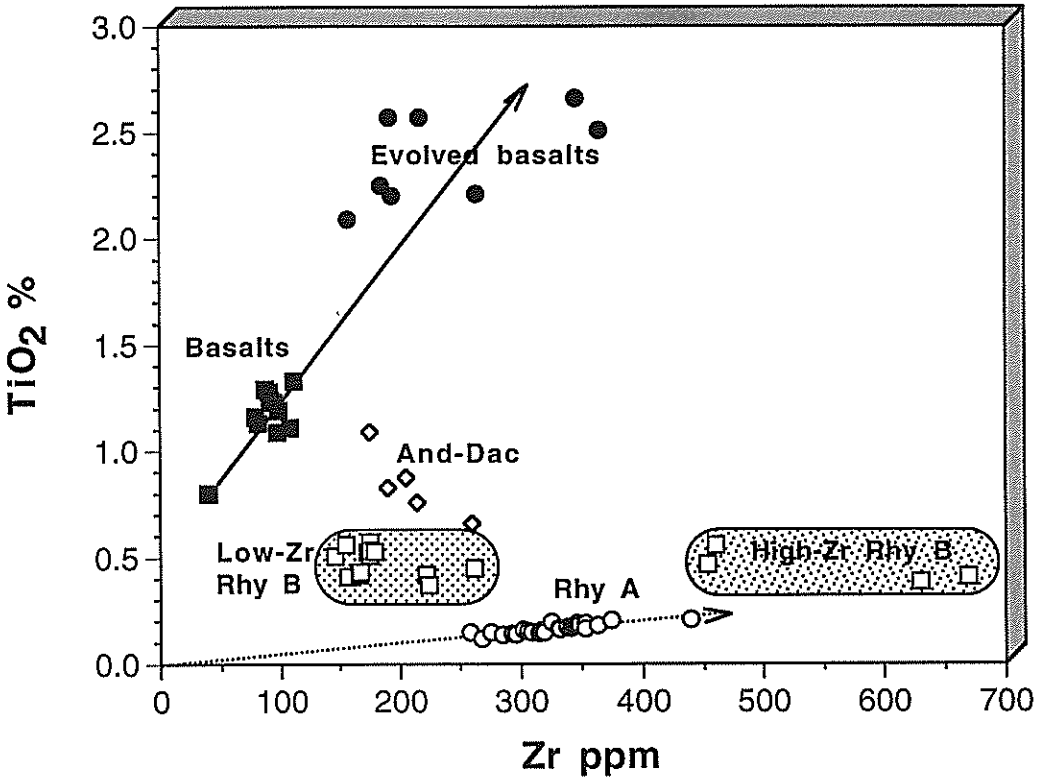


Fig. 3b



The high-Zr rhyolite B samples are similar to, but have lower Ti-Fe-P contents than the ferrodacites and evolved dacites described in previous reports from southwestern Jessop township (e.g. hole K2-87-3). This whole group of rocks is rather unusual and difficult to classify because of having contrasting features such as high $SiO_2 = 68\text{-}72\%$ and $Zr = 400\text{-}700$ ppm, which are consistent with a fractionated felsic magma, but high $TiO_2 = 0.5\text{-}0.9\%$, $Fe_2O_3 = 5\text{-}9\%$ and $P_2O_5 = 0.07\text{-}0.15$. We previously interpreted these rocks as extreme fractionation products of an Fe-rich mafic magma (in a closed system) which led to high Ti-Fe-P-Si-Zr contents.

In the present study, we identify a high-Zr rhyolite B group of samples which has lower TiO_2 contents (0.4-0.6%) than the 'evolved dacites' described in previous reports (0.6-1.0%). The low-Zr rhyolite B samples have lower Ti-Fe values than the high-Zr group. Both rhyolite B groups are compositionally close to rhyodacite. The low-Zr rhyolite B group has notably higher primary Al_2O_3 contents than rhyolite A (≈13-15% versus 11-12%), a feature also noted in earlier reports (Barrett and MacLean, 1993a,b; 1994b). We suggest that the high-Al, low-Zr rhyolite B group was derived by fractionation of a fairly high-Al mafic magma.

By contrast, rhyolite A, with low-Al but high-Zr contents, may have been derived by fractionation of low-Al, high-Zr mafic magma (perhaps similar to the evolved Fe-Ti-Zr-rich mafics on the property). In this scenario, low-Al, high-Zr 'evolved dacite' (noted in previous reports) and low-Al high-Zr rhyolite B may represent linking compositions between evolved basalt and rhyolite A end-members. However, the genetic relationship between high-Zr rhyolite A and the low-Zr rhyolite B group is still not clear, as they commonly have different magmatic affinities (as discussed below). The low-Zr rhyolite B group, which corresponds mainly to volcaniclastic beds in the stratigraphically upper part of the drilled stratigraphy, may have been derived from a separate volcanic source area.

A plot of Al_2O_3 vs. Zr (Fig. 4a) shows a linear alteration trend defined by rhyolite A samples, indicating that they represent varying degrees of alteration of a uniform precursor. In this plot, the low-Zr rhyolite B group partly overlaps the evolved basalt field, due to the low Zr content of the former, but the high Zr content of the latter. This emphases the need to examine all immobile element ratios in several plots to avoid misidentifications. Despite limitations in the mafic part of the spectrum, this plot is quite useful for identifying rhyolites A and B and their altered equivalents of rhyolites A. Also, samples with net mass gain (of mobile elements) can be distinguished from those with net mass loss. However, to assess the alteration on an element-by-element basis, mass changes must be calculated.

Southwestern Jessop Township volcanics

Fig. 4a

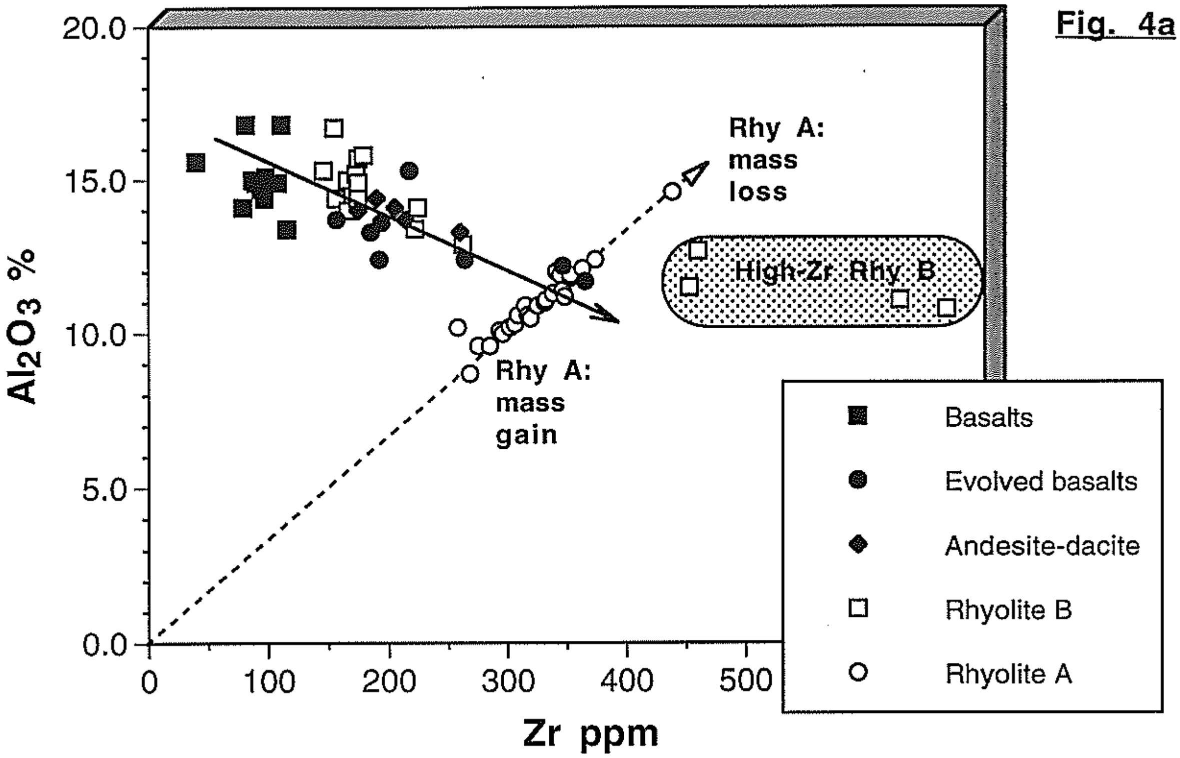
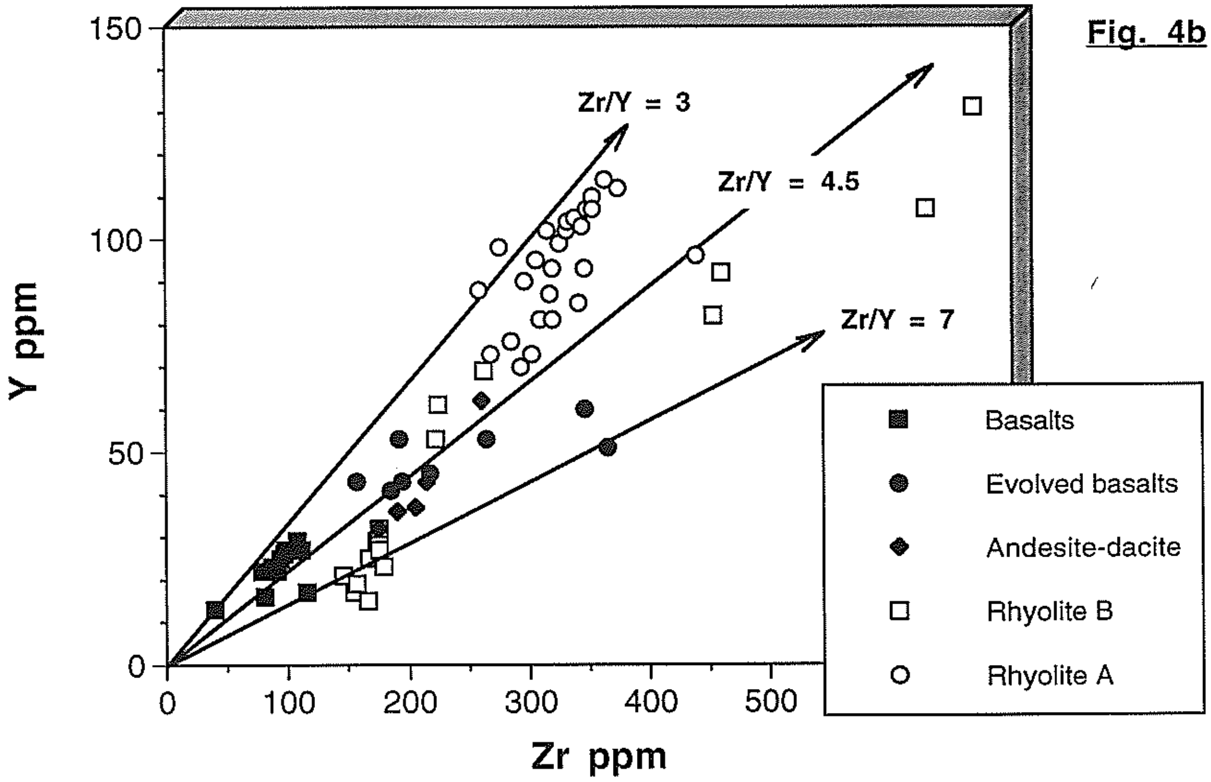


Fig. 4b



A plot of Y vs. Zr (Fig. 4b) shows that rhyolite A and most mafic volcanic rocks are of tholeiitic affinity (Zr/Y = 2.9 to 4.5), whereas low-Zr rhyolite B is of transitional to calc-alkaline affinity (Zr/Y ≈ 5 to 9). High-Zr rhyolite B has Zr/Y ratios of ≈ 5 to 6; a few evolved basalts have ratios in the 5-7 range. Variations in magmatic affinity are considered further in the section on rare-earth element compositions.

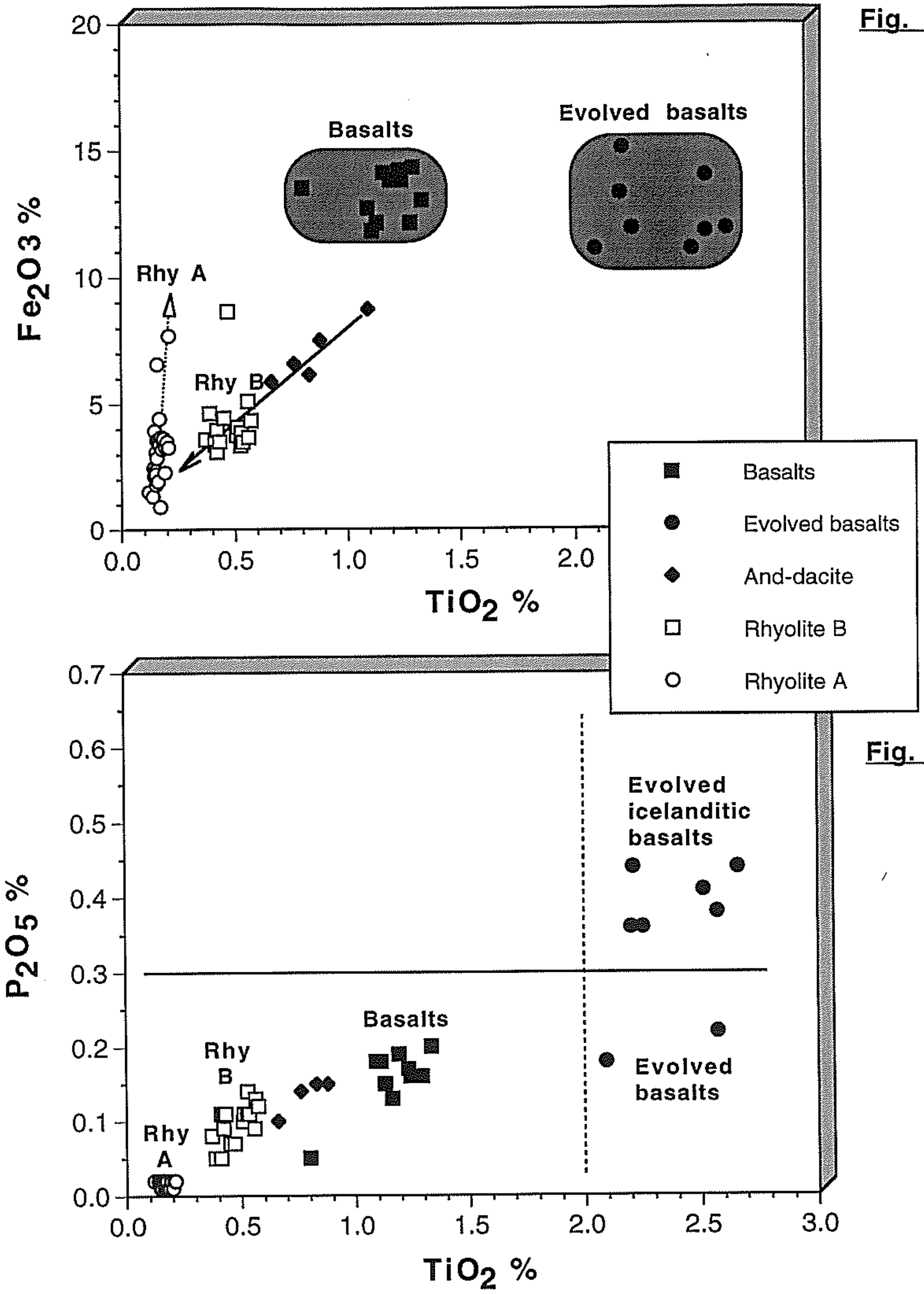
Plots involving combinations of Fe-Ti-P are useful in distinguishing between basalt and evolved basalt, and between rhyolites A and B, although the effects of alteration must be considered in plots involving iron. In the present study, most rocks excluding rhyolite A are relatively unaltered with respect to Fe (Fig. 5a). In rhyolite A, Fe addition has moved some samples along an 'alteration line' emanating subvertically from the precursor Fe_2O_3 value of rhyolite A. Figure 5a also shows that both groups of mafic rocks contain 10-15% Fe_2O_3; samples in the upper part of this range are considered ferrobasalts.

Figure 5b shows that within the mafic suite, a 'normal' group of basalts can be readily separated from evolved high-Ti basalts (which also have much higher Zr contents). The high-Ti group commonly has P_2O_5 >0.3%; the term 'icelandite' has been applied to such rocks in some recent classifications. Within the felsic part of the spectrum, rhyolite B has higher Ti-P contents than rhyolite A, which is the most fractionated magma. The Ti-P contents of evolved ferrodacites reported in previous studies (holes K2-87-2 and 87-3) are commonly higher than those of rhyolite B.

Rare-Earth Elements

REE data for all lithological types are given in Table 2, together with on some immobile element data from Table 1. Four new samples from previously drilled holes are also reported in the first part of Table 2 (holes BM86-1, K2-87-3 and K2-93-1). For completion, four analyses previously reported for holes K2-87-2 and 87-3 (Barrett and MacLean, 1994b) are also included. As shown below, the felsic rocks of southwestern Jessop township show a wide range of REE patterns, which can be linked closely to absolute Zr contents and Zr/Y ratios. In the following plots, these parameters are shown immediately to the right of the REE patterns. Several aspects of the REE patterns of felsic rocks which have been previously reported from southwestern Jessop township are reviewed first, then the new data from the 1994 Noranda drilling program are discussed.

Southwestern Jessop Township volcanics



Rhyolite A and high-Zr rhyolite B from holes K2-87-2 and 87-3 have near-flat REE patterns, with high total REE contents (Fig. 6a). The REE patterns are almost identical to those of published Kidd Creek and Kamiskotia rhyolites, and to other FIIIb rhyolites in Archean greenstone belts (Lesher et al., 1986; Barrie et al., 1993; Barrett and MacLean, 1994b). Least altered FIIIb rhyolites from southwestern Jessop township typically have high Y contents of 90-110 ppm, and display mainly tholeiitic Zr/Y ratios in the 3-5 range.

The evolved high-Zr dacite (ferrodacite) rocks previously encountered in holes K2-87-3 and BM86-1 also have FIIIb patterns (Fig. 6b). These rocks have higher contents of TiO_2 (0.7-1.0%) and Fe_2O_3 (4-8%) than the above high-Zr rhyolite B group, but otherwise are chemically similar (with quartz phenocrysts) and are considered part of this group.

The rhyolite A group (four samples) intersected in Noranda's 1994 drilling are uniformly of FIIIb type (Fig. 7a). These samples come from an apparently ENE-striking swath of rhyolite A that extends eastwards from holes 94-1 and 94-2 in the west, through the Four Corners, and on to hole 94-3. Slight silicification of sample 94-2, 329.5m, has led to lowering of its REE and Zr contents through dilution.

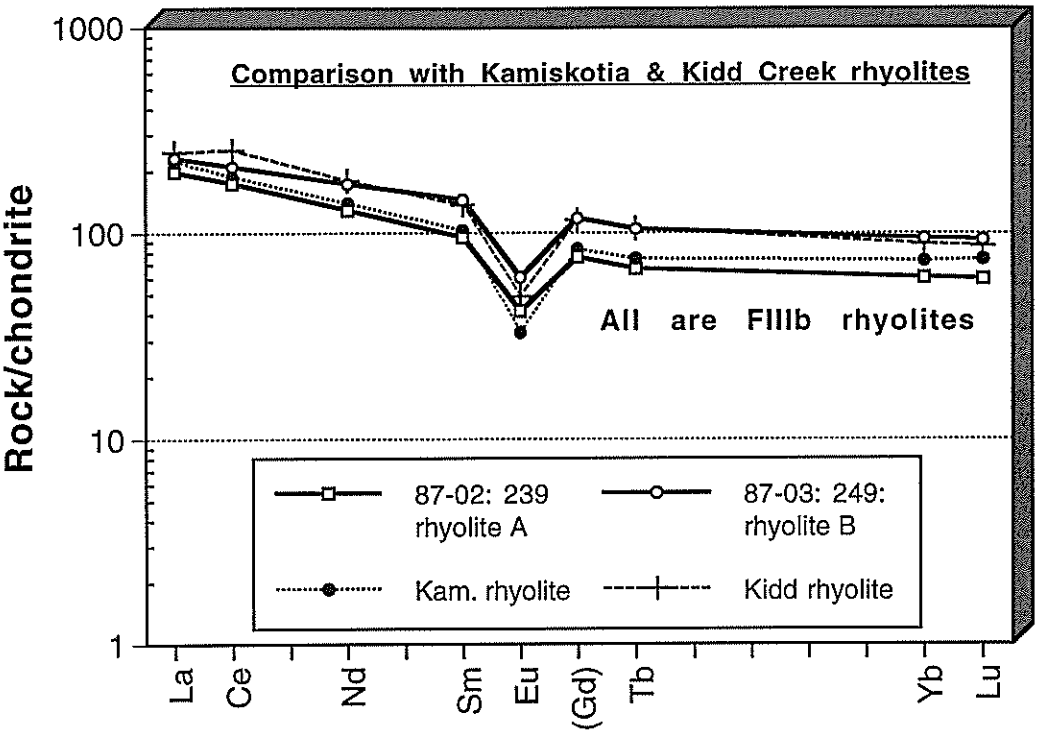
The high-Zr rhyolite B group (two samples) also has an FIIIb pattern (Fig. 7b). Although this group has higher Zr contents than rhyolite A, it displays a slightly transitional rather than tholeiitic Zr/Y ratio. High-Zr rhyolite B was only sampled in a few localities, usually spatially between evolved basalt and rhyolite A (at 280m in 94-2, and 170m in 94-5), or within evolved basalt (23m in 94-2, and 138m in 94-1). The two samples analyzed for REE do not have strongly negative Eu anomalies, as are commonly reported for FIII rhyolites, but this may partly reflect their relatively unaltered nature.

The low-Zr rhyolite B group has mainly FII-type REE patterns (Fig. 8a). Samples of this group are actually rhyodacitic to dacitic in composition, and are mainly volcaniclastic based on drill core observations. The Zr/Y ratios for this group are in the transitional to mildly calc-alkaline range. The REE data, Zr contents, and Zr/Y ratios indicate that these rhyolites probably have been derived from a different source area than the FIIIb rhyolites.

The general relations discussed above are summarized in Fig. 8b, which shows a range of felsic REE patterns from FIIIb through FIIIa to FII types, with a corresponding decrease in absolute Zr contents, and, for the FII felsics, an increase in Zr/Y ratio. The REE and other data suggest that high-Zr rhyolite B is derived by fractionation from the high-Zr evolved dacite, which in turn may be derived from the high-Zr evolved basalt.

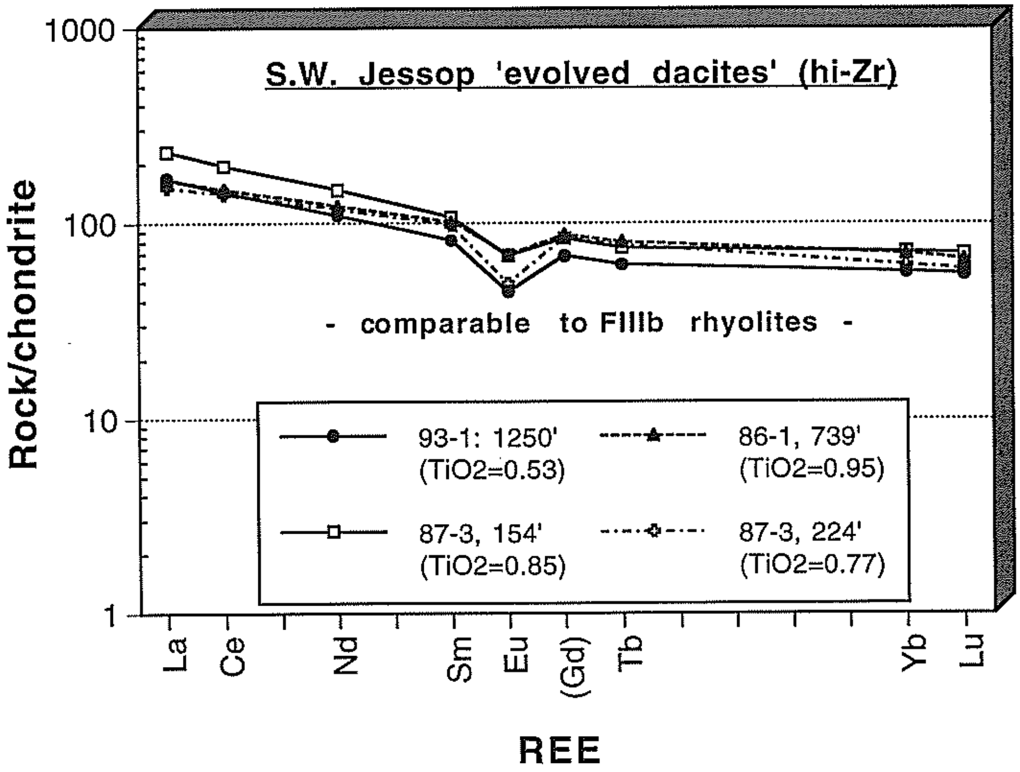
S.W. Jessop Township felsic volcanics

Fig. 6a



Zr	Zr/Y
734,	4.7
430,	4.5

Fig. 6b



Zr, Zr/Y;
482, 4.1; 421, 3.9
501, 3.9; 422, 5.1

S.W. Jessop Township and vicinity: felsic volcanics

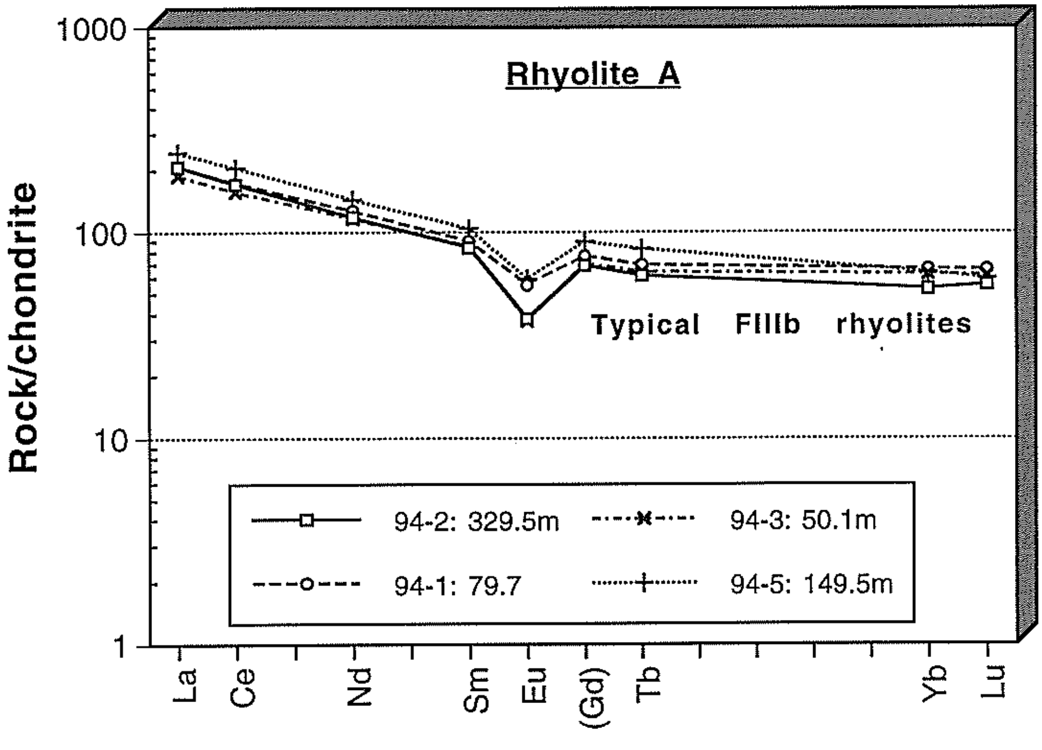


Fig. 7a

Rhyolite A

Typical FIIIb rhyolites

Zr, Zr/Y;

315, 3.1; 363, 3.2;
353, 3.2; 275, 2.8

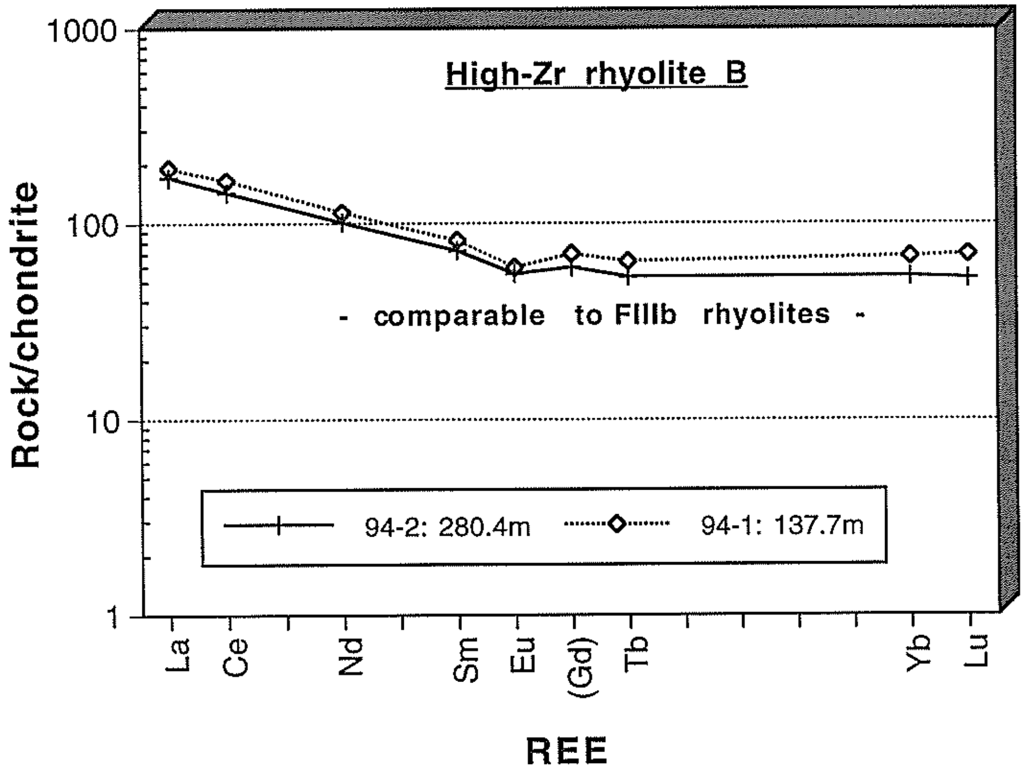


Fig. 7b

High-Zr rhyolite B

- comparable to FIIIb rhyolites -

Zr Zr/Y

630, 5.9
460, 5.0

S.W. Jessop Township felsic volcanics

Fig. 8a

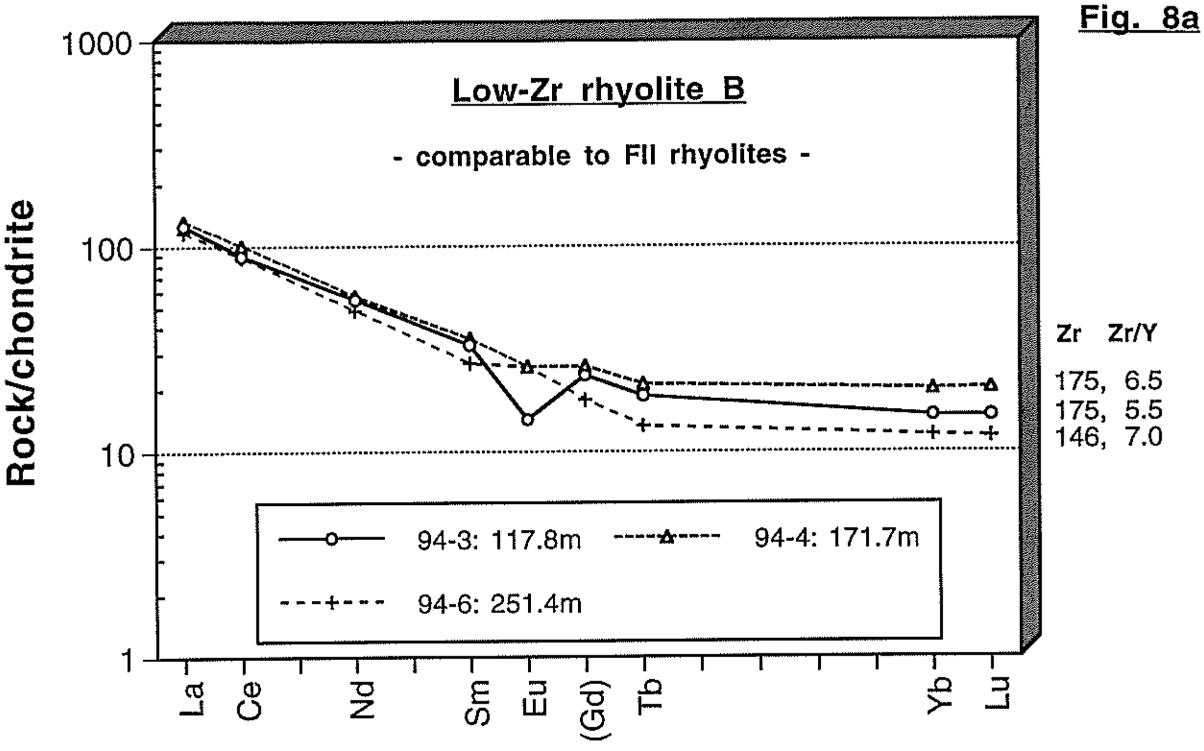
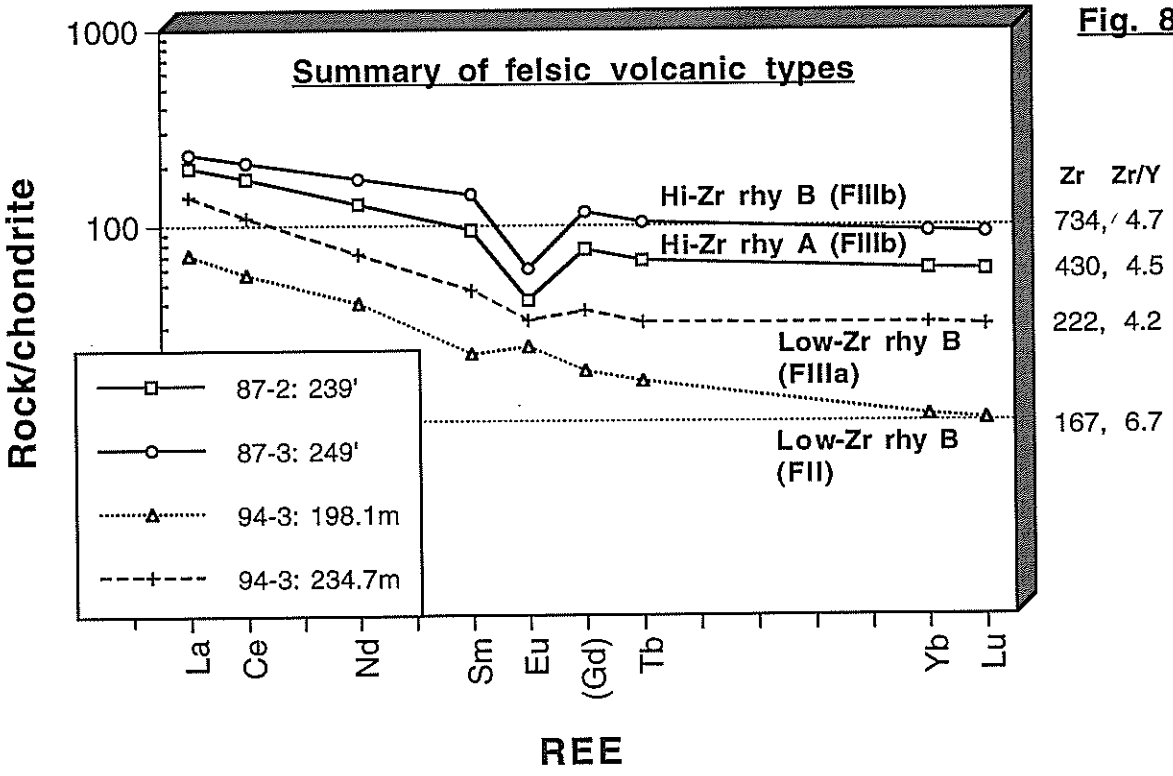


Fig. 8b



Mafic volcanic rocks in southwestern Jessop township are mainly high-Ti evolved basalts, although lower-Ti basalts also occur (mainly in 94-3). REE patterns for the high-Ti evolved basalt are fairly flat, with a slight enrichment in the light REE relative to chondrite (Fig. 9a). The near-flat flat patterns for the evolved basalts probably reflect original melting of fairly unfractionated mantle source rock, but their elevated REE contents relative to typical tholeiitic basalts in oceanic settings (which have chondrite-normalized ratios of ≈10-20) suggests that they have been strongly fractionated. Within the evolved basalts, absolute REE contents do in fact generally reflect the degree of Zr enrichment. The REE patterns of Jessop basalts are nearly identical to those of the mafic rocks at the Kamiskotia VMS deposit (Barrie et al., 1991) (Fig. 9b). In particular, Jessop basalts with high Zr-P contents have REE patterns identical to evolved Kamiskotia basalts, whereas those with lower Zr-P contents are similar to normal Kamiskotia basalts.

Downhole Lithogeochemical Variations

Downhole lithological and magmatic affinity can be monitored by examining Al_2O_3/TiO_2 and Zr/Y ratios (which in VMS systems are generally insensitive to alteration). Results for hole 94-1 are shown in Figure 10, for sample depths to 204m. It should be noted that not all lithological units (e.g. fragmental units and argillites) were sampled; also there are only two samples from the 204-295m interval, which was logged mainly as a mafic intrusion. Nonetheless, the plots clearly convey the chemical uniformity of rhyolite A, and its distinction from rhyolite B, which is both less fractionated and less tholeiitic.

A second example of downhole variations is shown for hole 87-3 in Figure 11, using data from previous reports (Barrett and MacLean, 1993a,b) and several new analyses (Table 3). Hole 87-3 hole includes the unusual high-Zr 'evolved dacite', which has higher TiO_2 contents that rhyolite B, and therefore a notably lower Al_2O_3/TiO_2 ratio. Figure 11 also shows the more calc-alkaline nature of low-Zr rhyolite B ($Zr/Y \geq 6$) relative to high-Zr rhyolite B and high-Zr evolved dacite ($Zr/Y = 4-5$). Lithogeochemical data suggest that the very high-Zr rhyolite B in hole 87-3 represents a slightly more felsic version of the underlying, but less evolved 'evolved dacite' unit. In drill core, there is no obvious contact between these units; both are massive, medium-grained and locally quartz porphyritic, thus strengthening the case for a genetic connection. However, it is not clear if these high-Zr felsic units were emplaced as extrusive lavas or shallow intrusions, as their margins were not observed. The high-Zr felsic interval is sharply bounded above and below by massive mafic rocks which have chilled margins. These (slightly?) later intrusions have obscured the original contact relations surrounding the high-Zr felsic interval.

South Jessop Township mafic volcanics

Fig. 9a

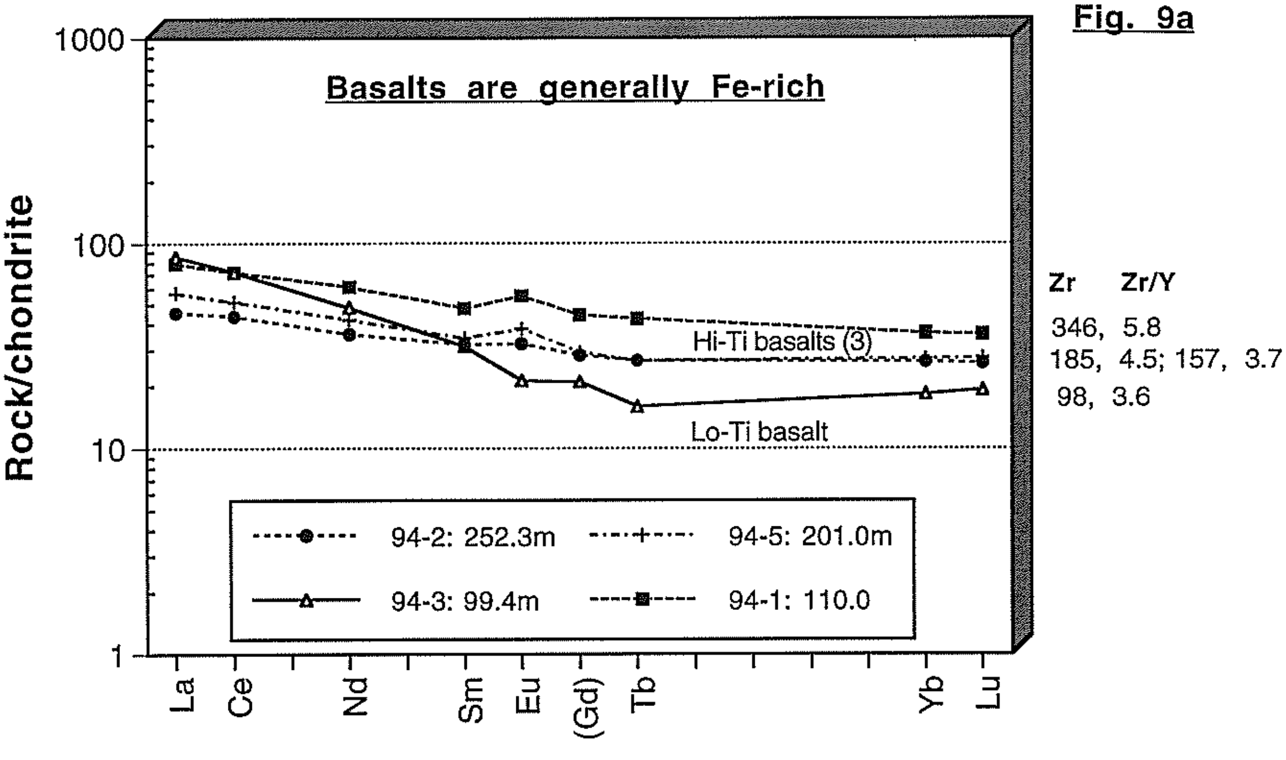
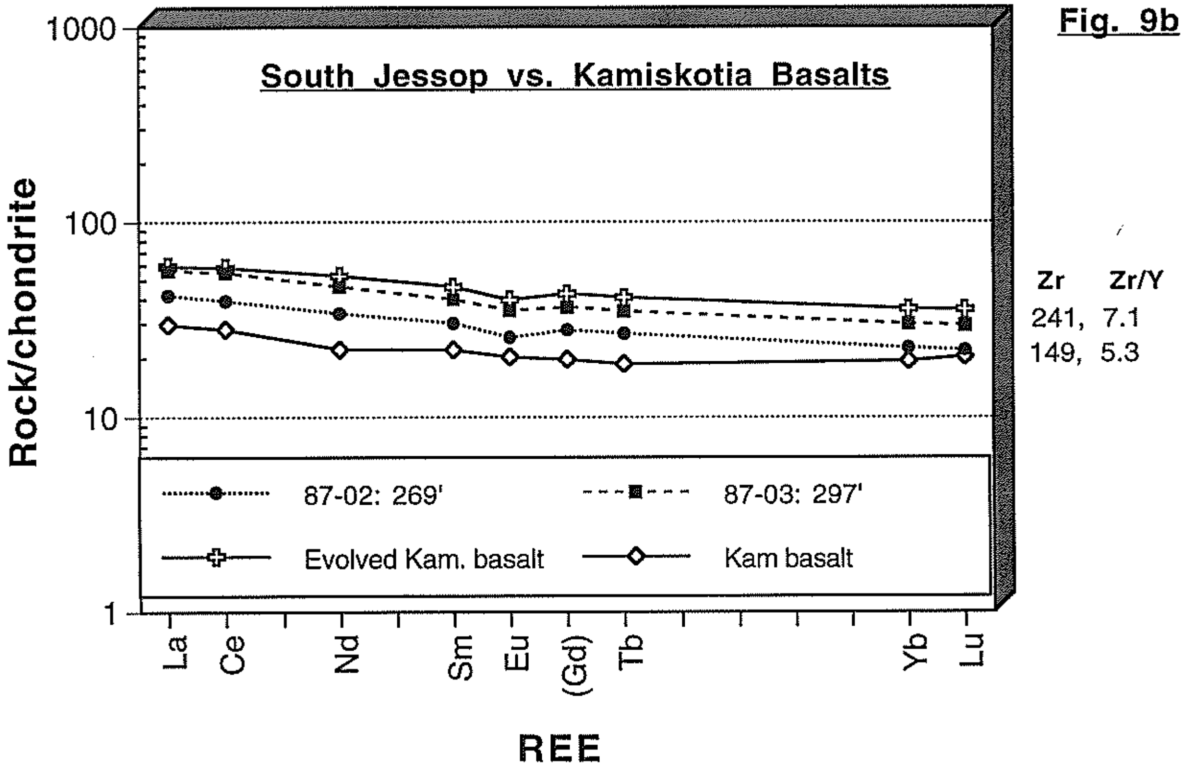


Fig. 9b



Hole NOR 94-1: felsics and basalts

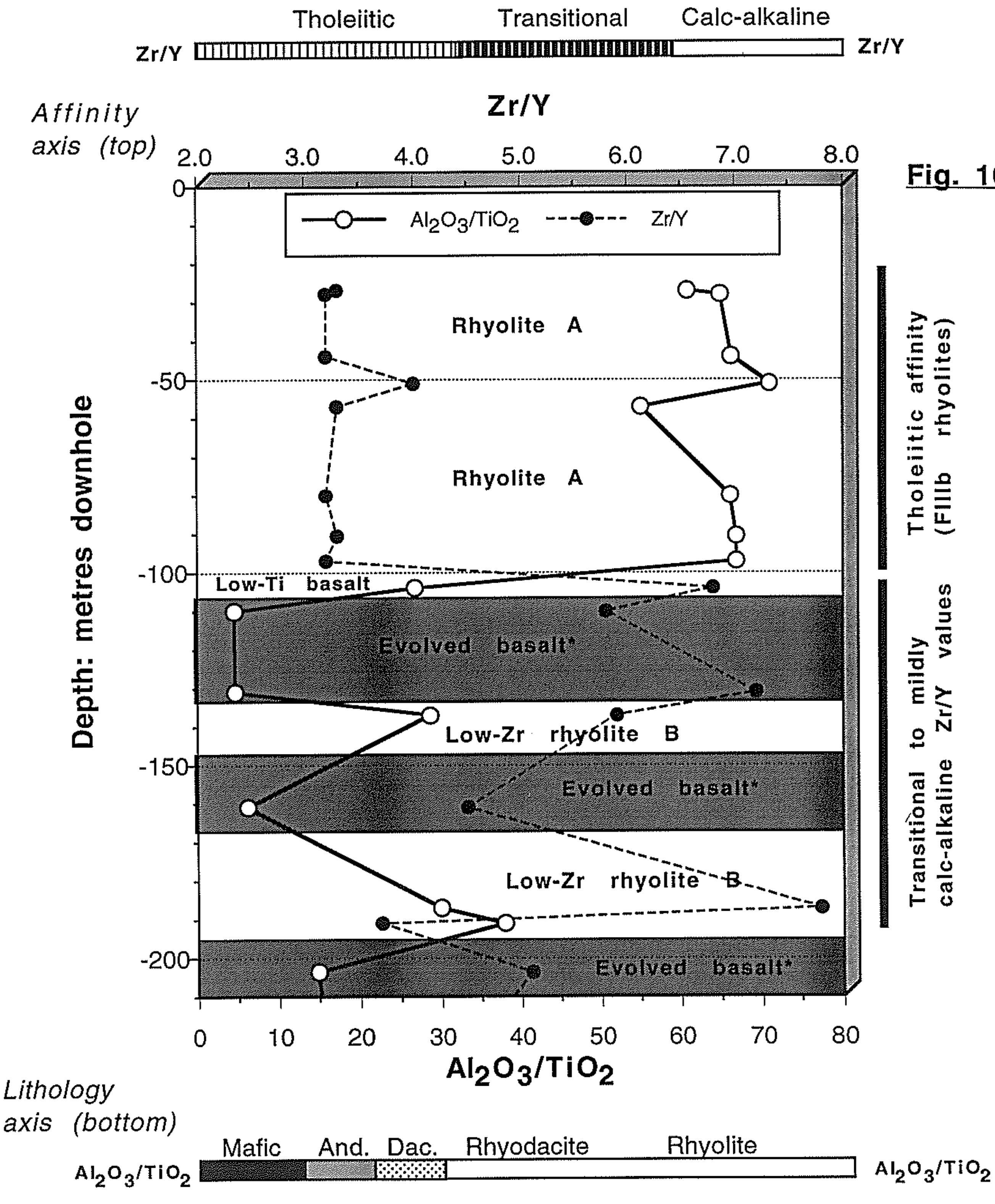


Fig. 10

Hole K2-87-3: felsics and basalts

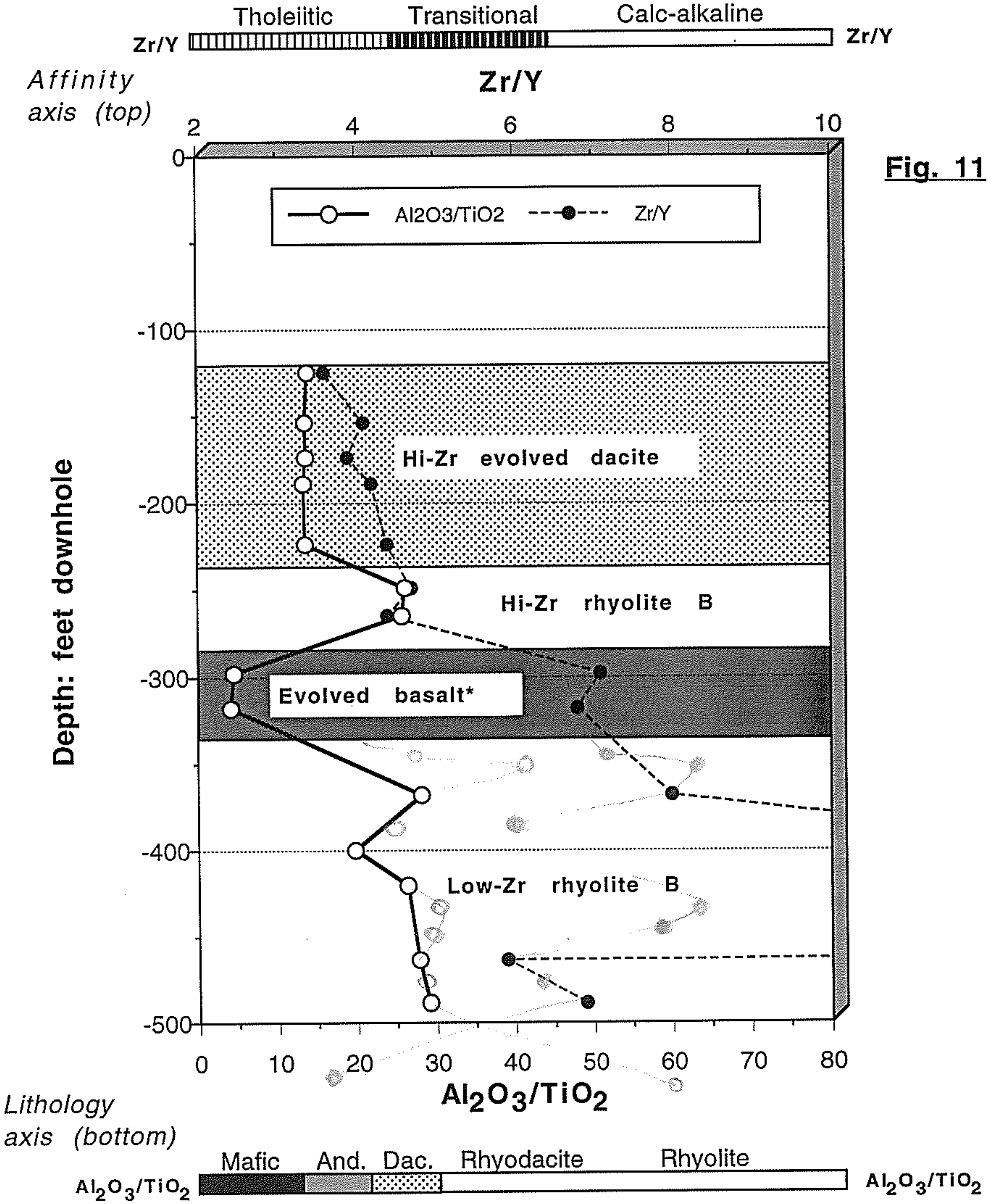


Fig. 11

Alteration Geochemistry

General Relations. The new data show that some felsic rocks are moderately to strongly K-enriched and Na-depleted, whereas others are silicified, a few contain Fe enrichments, and some are chemically unaltered. The strongest Na depletions correspond to the most K-rich rhyolites, as for example in the altered interval of rhyolite A intersected near the end of hole 94-2 (drilling was terminated within this interval). The same rhyolite A unit was also intersected near the surface in hole 94-1, where three of six samples were strongly Na depleted.

Lithology-alteration relationships can be roughly assessed by plotting a mobile element against TiO_2. In such plots, TiO_2 is used as a 'reverse' fractionation monitor; as it decreases in abundance from peak values in basaltic andesites, down through andesites, to dacite, and finally rhyolite. For example, in a plot of K_2O-TiO_2 (Fig. 12a), rhyolite A lies more or less along a single 'alteration line'. A similar effect for rhyolite A is seen in plots of SiO_2-TiO_2 (Fig. 12b), and FeO-TiO_2 (Fig. 5a). However, actual mass changes for K, Si and Fe are not proportional to their displacement along the lines, as their abundances are affected by variations in other mobile elements. Note that the rhyolite A trends in Figures 5a and 12a emanate from the composition of least altered rhyolite, rather than from the origin, as is the case for true alteration lines defined using immobile-element pairs.

The SiO_2-TiO_2 plot shows that silica 'perturbations' are strongest in rhyolite A (Fig. 12b). Other lithologies have SiO_2 values which fall within normal ranges for these lithologies, suggesting that silica alteration is not significant. Plots such as those in Figures 12a, 12b and 5a are useful in identifying, on a first-pass basis, the main volcanic groups, and whether or not these groups show a significant range in net alteration. However, the only general inference that can be made from these plots is that the largest vertical increases of K, Si and Fe must reflect notable addition of these elements. To assess actual changes of individual elements during alteration, mass changes must be calculated.

Mass Changes

Mass changes have been calculated for rhyolite A samples from holes 94-1, 94-2, 94-3 and 94-5 (*). The procedure was straightforward because of the near-homogeneous nature of least altered rhyolite A in these holes. Samples of the low-Zr rhyolite B group

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(*) No lithogeochemical samples were analyzed by Noranda from the first half of 94-4, which contains common felsic fragmental and volcaniclastic wackes, together with thinner intervening argillitic and mafic units; several deeper samples in this hole range from dacite to basalt. In hole 94-6, which was logged as containing a similar range in lithologies, only four samples were analyzed (three dacites, one mafic).

Southwestern Jessop Township volcanics

Fig. 12a

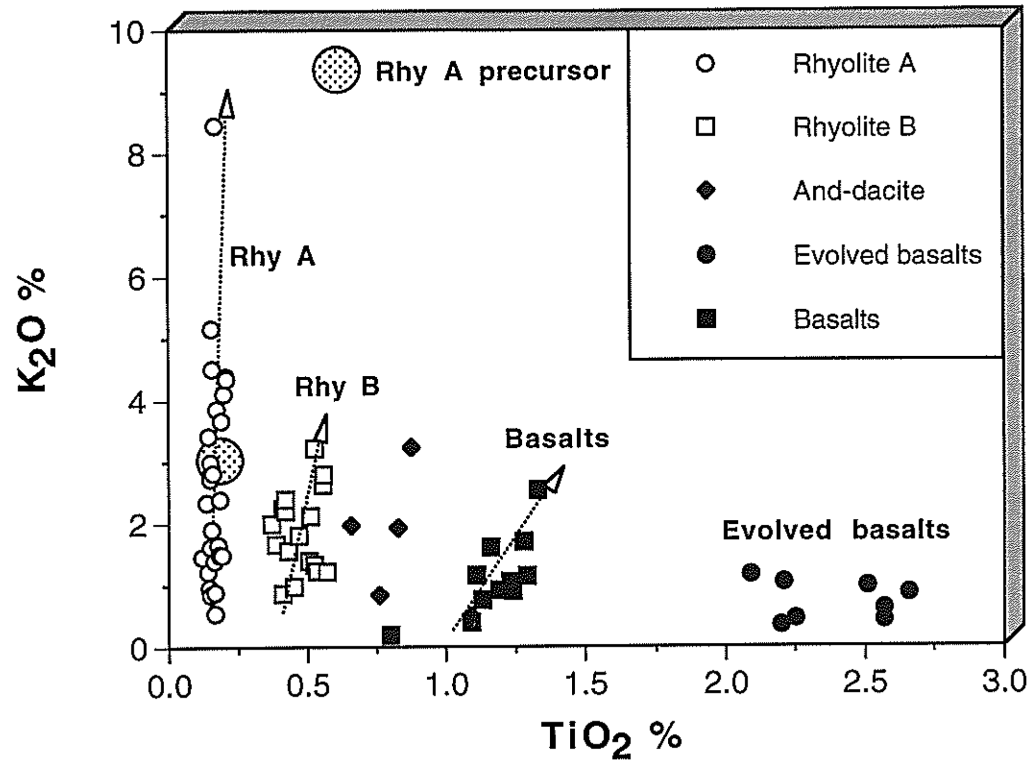
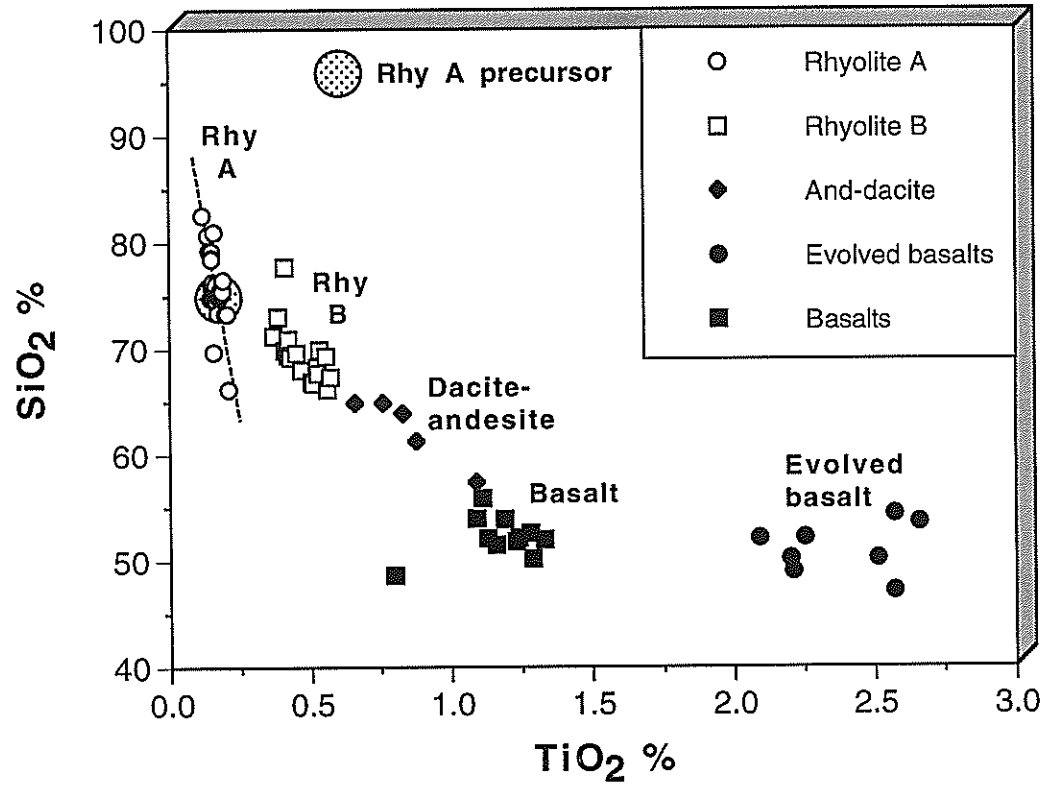


Fig. 12b



have not been treated as they appear to represent volcaniclastic sediments derived from an external source area of more calc-alkaline affinity. In addition, this low-Zr group appears to comprise two subgroups with differing Zr contents (Fig. 3b). The high-Zr rhyolite B group was not treated as it contains only four samples, again in two subgroups (Fig. 3b).

Mass changes were calculated based on a single precursor composition, and the use of Al_2O_3 as the immobile anchor. A total of five least altered samples of rhyolite A were identified from three holes (these are shown in italics in Table 1). The average of these five samples, which is fairly tightly constrained, is taken as the rhyolite A precursor. Mass changes were calculated only for rocks that lay on the rhyolite A alteration line. Details of the method are given in MacLean and Kranidiotis (1987) and Barrett and MacLean (1991).

Table 4 gives the composition of all rhyolite A samples, the least altered precursor, the reconstituted values calculated from the Al mass change factor, and the calculated mass changes (representing the difference between reconstituted and precursor values). Results based on the use of Zr as the anchor, instead of Al_2O_3, are very similar for most samples. In the plots, the intersection of the dashed lines at the point (0,0) indicates the precursor composition (i.e. no mass change in either element). Samples that plot well away from the precursor in any direction have experienced significant mass changes (represented by the Δ symbol). In the rhyolites, the main mass changes involve silica and the alkalis. Mass changes in Fe, Ca and Mg are relatively small.

A plot of ΔK_2O versus ΔSiO_2 (Fig. 13a) shows a group of samples with gains in both elements. Four of these samples are from hole NOR94-5, which is situated about 300m east of the Four Corners, and two are from NOR94-2, one of the westernmost holes (Fig. 2). The other westernmost hole, NOR94-1, also displays some large K gains, but these are not accompanied by Si gains. This hole also contains intervals of nearly unaltered rhyolite A. The easternmost of the six holes drilled, NOR94-3, shows very little K or Si gain (or any other alteration) in three of four samples (and only silicification in the fourth).

Using the model outlined for silica mass changes in Barrett and MacLean (1994a), we interpret the mass change data to indicate generally increasing alteration from east to west within rhyolite A. According to this model, most rhyolites in hole 94-5 and some in 94-2 would have been located on the cooler margin of a hydrothermal system, where silica and K were added during alteration (at the level of stratigraphy represented by rhyolite A). To the east, hole NOR 94-3, with little alteration of rhyolite A, is interpreted as having been distal to any hydrothermal system.

Southwestern Jessop Township volcanics

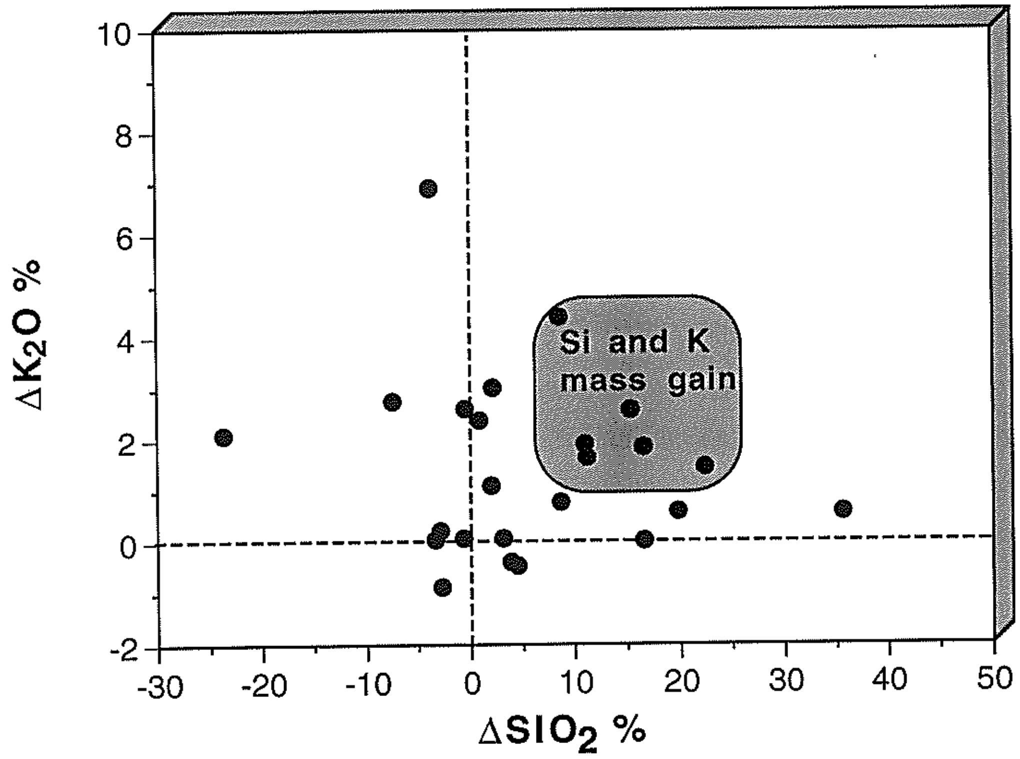


Fig. 13a

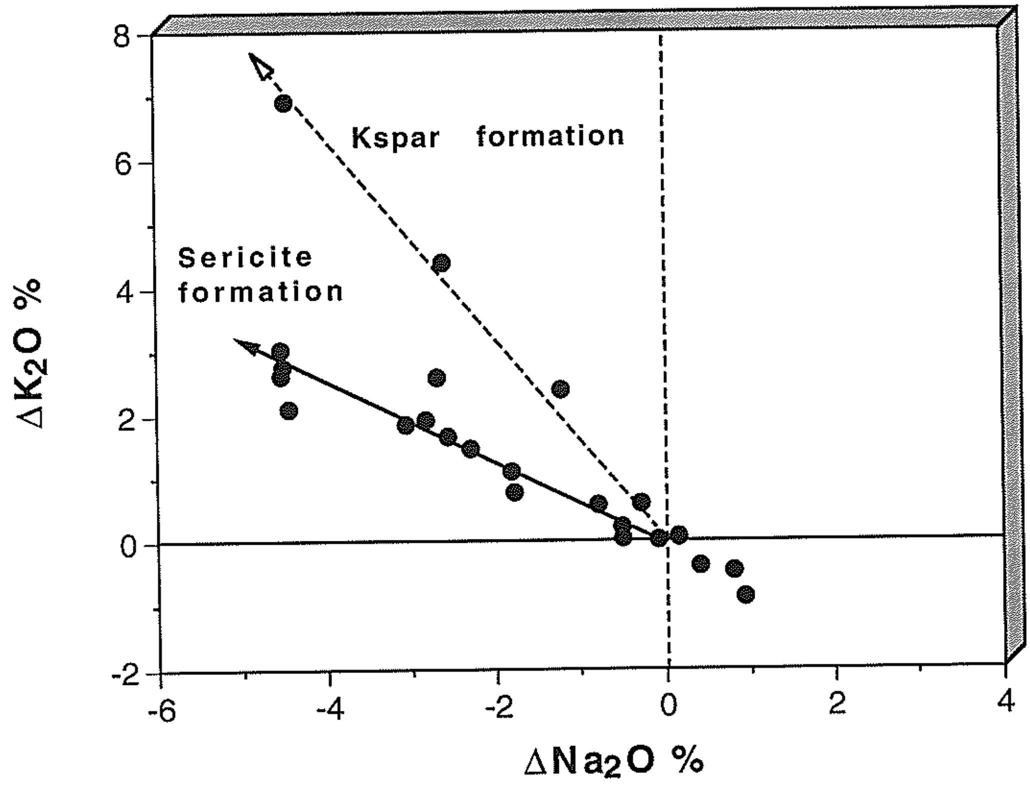


Fig. 13b

Hole NOR94-1, which intersected the same rhyolite A unit as 94-2 but vertically above it, does not show any major silica changes, although K alkali exchange is strong in half of the samples. As not all of the rhyolite A unit was penetrated in these holes, it is difficult to assess vertical variations in alteration. In any case, these holes did not intersect the type of alteration typically found in the hottest part of mineralizing hydrothermal systems, where more consistent silica losses would be expected, together with major additions of Fe, Mg and locally K. Nonetheless, the occurrence in two holes (NOR94-5 and 94-2) of strong positive changes in silica coupled with strong K gains (and Na losses) indicate that notable hydrothermal alteration has occurred.

One sample in NOR94-5 (131m) displays significant mass loss in silica, moderate gain in K, and small gains in Fe and Mg. This indicates that chloritization and sericitization have occurred. Such a combination of effects is typical of higher-temperature alteration. However, it appears to be a local effect, within an area of general Si and K mass gain.

A plot of ΔK_2O versus ΔNa_2O (Fig. 13b) illustrates well the inverse correlation between mass changes in these two elements. Of particular interest are the two subtrends in the data. These correspond to the alteration changes that would be expected depending on whether sericite or K-feldspar were the dominant alteration product of plagioclase (and of the sodic component of any glass).

A plot of ΔNa_2O versus ΔSiO_2 (Fig. 14a) shows the Na loss that may occur in rhyolite A samples with Si gain and K gain. In some samples, there is Si gain without Na loss (e.g. quartz veinlets, amygdule fillings). A smaller group of samples shows near-total Na loss, with changes in silica ranging from near-zero to slightly negative. A single sample (NOR94-5, 131m) displays significant losses in silica and Na (this sample was mentioned above). A plot of ΔBa versus ΔK_2O (Fig. 14b) indicates that addition of Ba to rhyolite A is generally proportional to the addition of K (in sericite or K-feldspar). Ba is substituting for K in these minerals. A similar relation exists between Rb and K for the same reason.

Variations in elemental mass changes can also be examined in downhole plots. For example, in hole NOR94-5, significant K addition (≥2 wt %) occurs in the lower-middle part of the rhyolite A interval (Fig. 15a). Within this hole, silica mass changes are generally positive, with one exception (Fig. 15b). By contrast, in NOR94-1, silica changes are generally within 5% of zero). The net alteration can also be assessed from the total mass change for each sample, which is given in Table 1. This parameter ranges from near-zero in NOR94-1, where alteration involved mainly alkali exchange, to strongly positive in NOR94-5, where silica precipitation dominated.

Southwestern Jessop Township volcanics

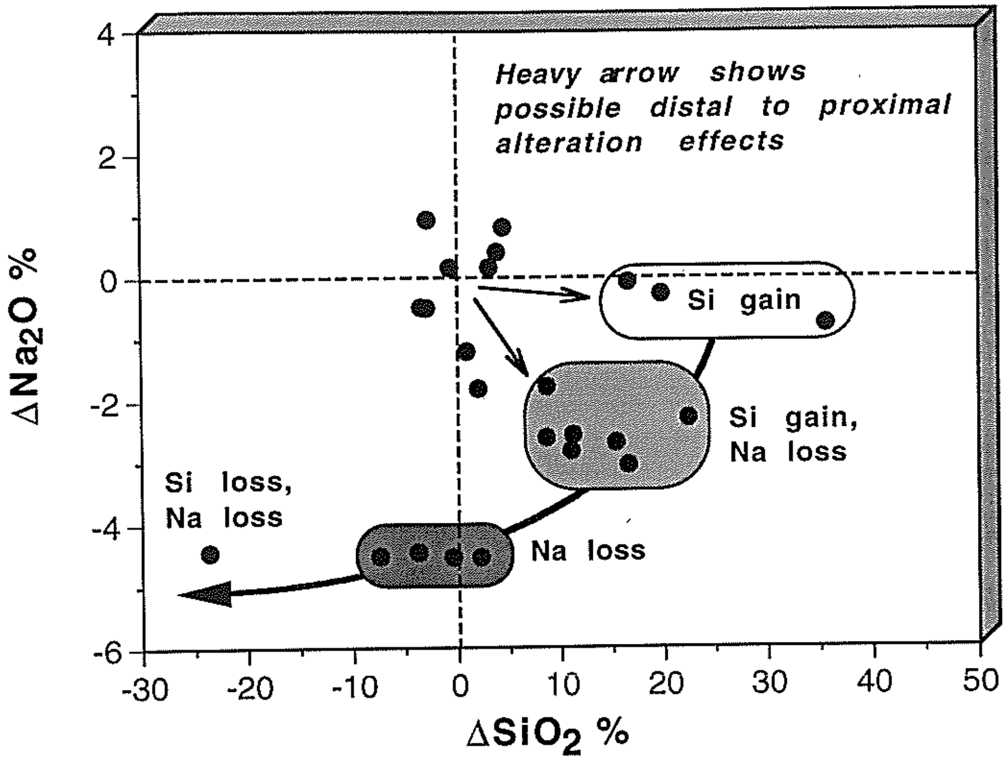


Fig. 14a

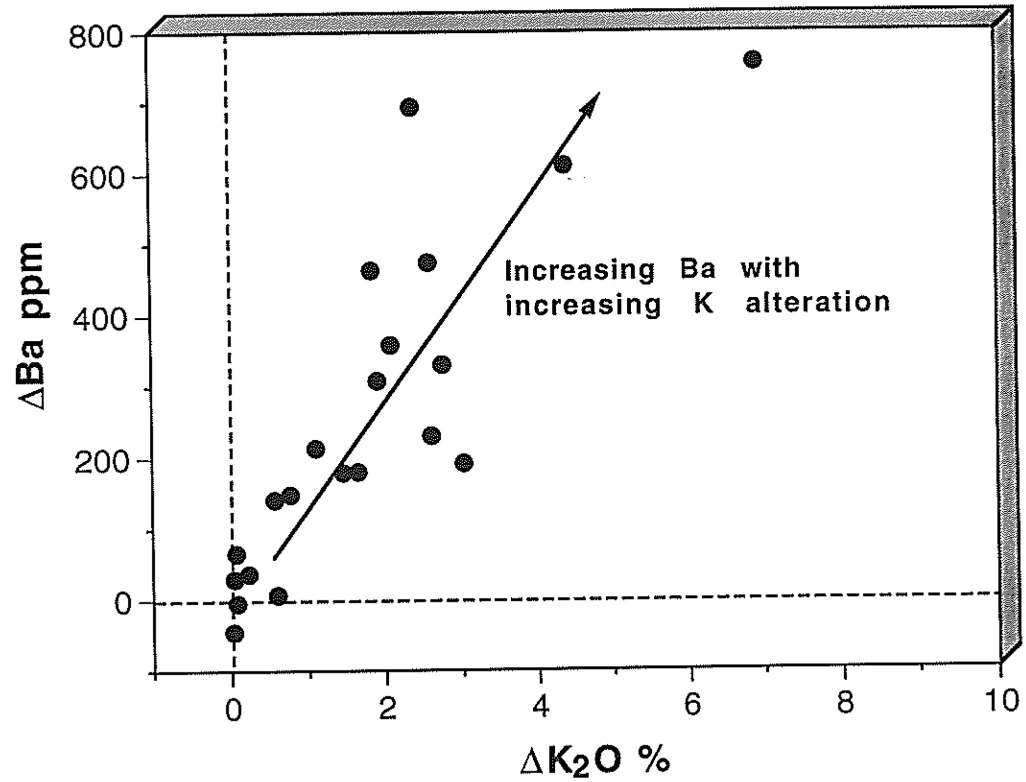


Fig. 14b

Four Corners area volcanics: NOR 94-1 and 94-5

Fig. 15a

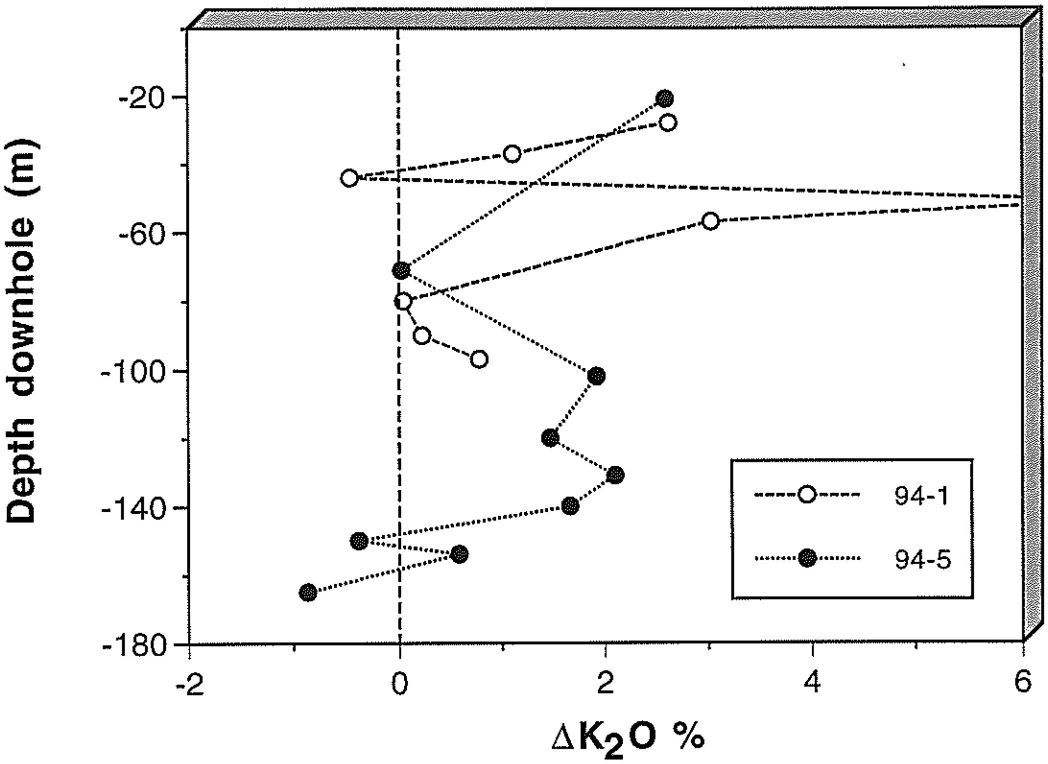
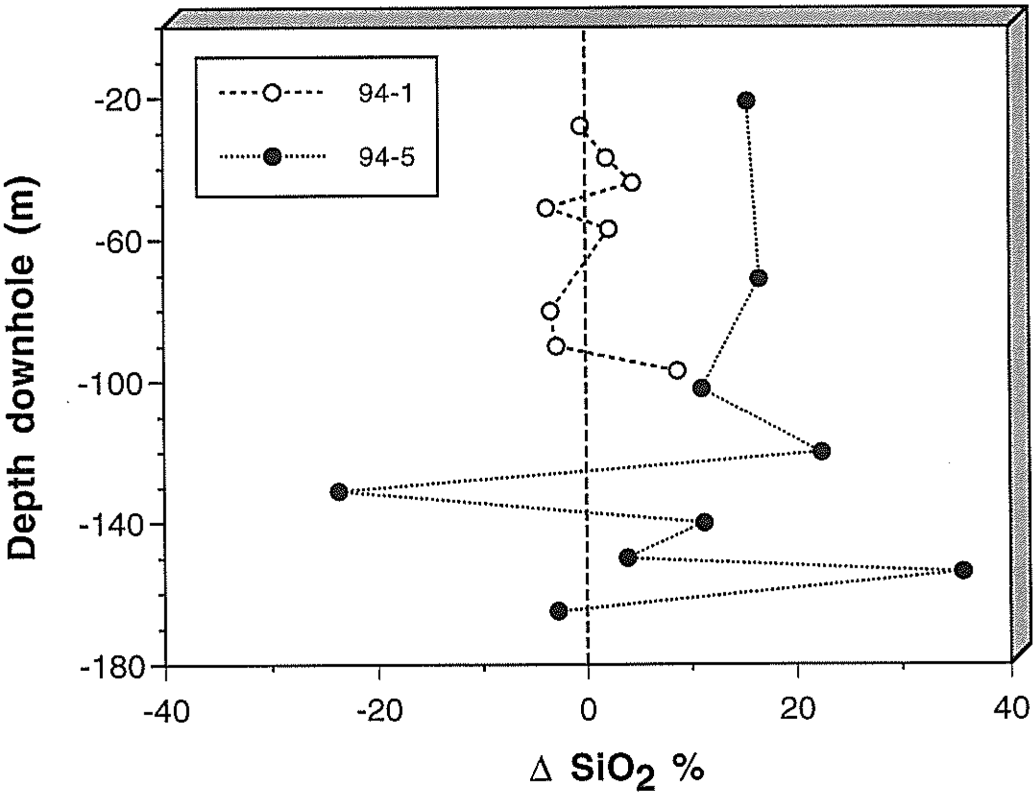


Fig. 15b



PETROGRAPHY

General Comments

There are seven petrographic samples from the study area, six rhyolites and one coarse basalt or dolerite. The rhyolites are quartz-feldspar porphyry (QFP) or quartz-porphyry. Two are massive flows, one is a breccia, and four are phenocryst-bearing tuffs. Both of the massive rhyolites are QFP, with numerous phenocrysts, and have a moderately altered fine-grained groundmass. Some of the phenocrysts in the massive QFP have a bluish tinge (petrography samples 30220 and 30223), although the source of the blue is not apparent. Rhyolites range from fairly fresh to moderately altered.

The presence of biotite in the groundmass of most rhyolite tuff samples is a product of lower amphibolite metamorphism. Fe-rich chlorite has reacted with sericite to form the biotite. Where there was an excess of chlorite for the reaction, chlorite is present with the biotite; and vice versa for an excess of sericite.

Photographs were taken at magnifications such that the negatives are 10X and 40X the true size. The corresponding magnifications of the prints are 45X and 175X true size. Names of rocks in bold are assigned based on petrographic and lithogeochemical results.

Figure 16a: Coarse-grained evolved basalt (icelandite)

Drillhole BM-86-1 417' (petrography sample number 30221)

- Ab-Ep-Qz-Hb-Carb-Biot; non-porphyritic.
- Spilitized, but only weakly altered chemically.

Crossed nicols, 40X.

Whole-rock analysis: (LOI-free basis)

No.	Report	Lithology	SiO2	Al2O3	TiO2	FeO	MnO	CaO	MgO	K2O	Na2O
18218	Jessop 2	Evolved basalt	57.1	13.8	2.15	13.08	0.26	4.10	2.66	1.23	3.04

P2O5	(LOI)	Sum	Ba	Sr	Y	Zr	Rb	Nb	Zr/Y	Al2O3/TiO2
0.48	(3.15)	100.00	483	165	45	256	39	13	5.7	6.4

Figure 16b: Four Corners evolved basalt (icelandite)

Drillhole K2-93-1 823' (petrography sample number 19963)

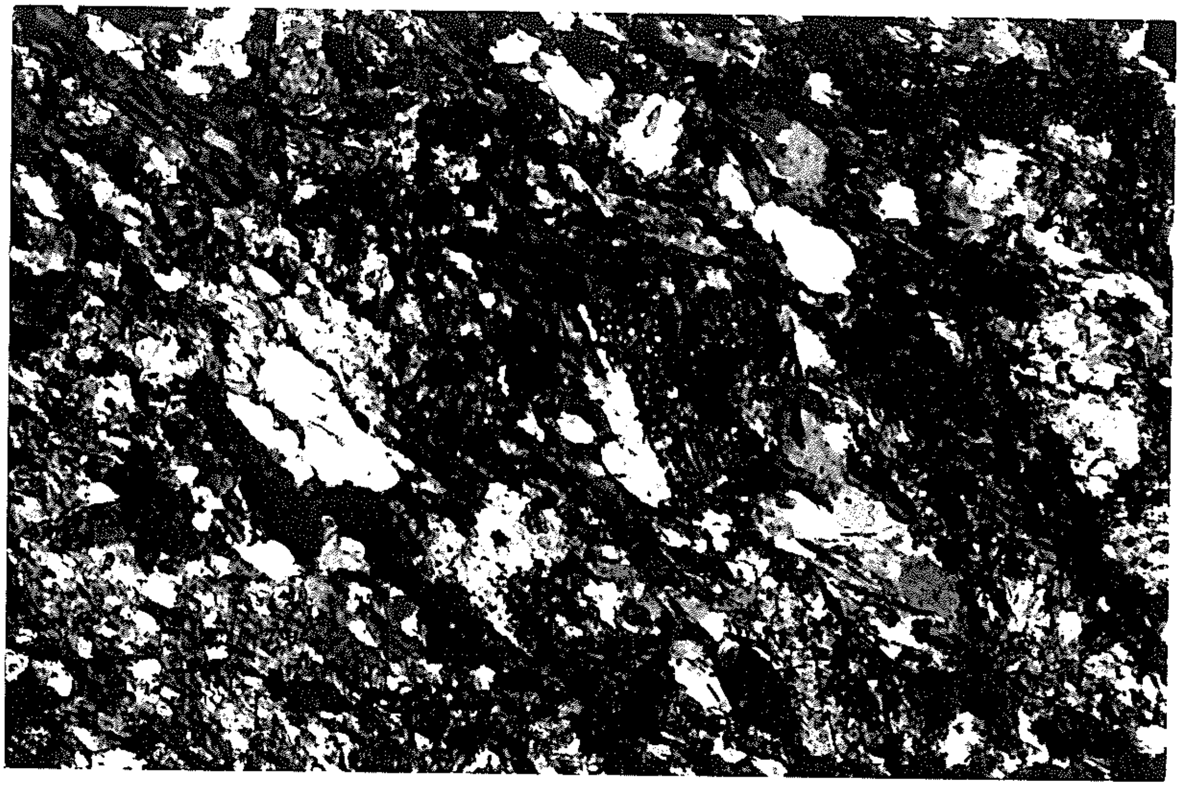
- Pl + Bio + Chl.
- Patches of secondary biotite, with chlorite in matrix.
- Plag is fairly fresh. Rock is little altered chemically.

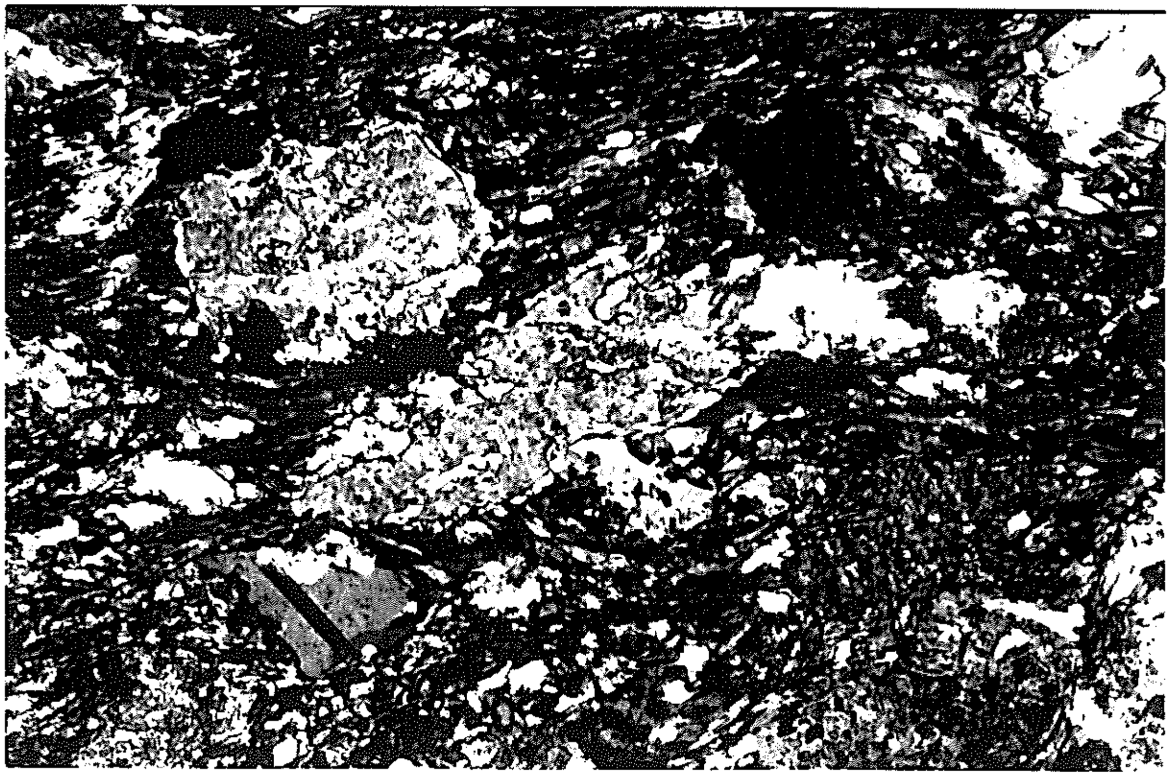
Crossed nicols, 40X.

Whole-rock analysis: (LOI-free basis)

No.	Report	Lithology	SiO2	Al2O3	TiO2	FeO	MnO	CaO	MgO	K2O	Na2O
19963	Noranda 1	Evolved basalt	54.24	13.3	2.12	15.7	0.27	5.58	2.49	0.92	1.99

P2O5	(LOI)	Sum	Ba	Sr	Y	Zr			Zr/Y	Al2O3/TiO2
0.43	6.95	100.00	203	148	24	225	4	17	9.4	12.9





Contact between quartz porphyritic high-Zr rhyolite B & evolved basalt

Drillhole BM-86-1 631.5 - 632' (petrography sample number 30220)

There are two rock types in the thin section.
(a) Light rock: Massive quartz porphyry with large Qz phenocrysts (blue in hand specimen).
(b) Dark rock: Chl + Ser + Qz + Carb + Lcx. Mafic rock, with common opaques and Qz microphenocrysts?.

Figure 17a: Quartz Porphyry (high-Zr rhyolite B): Qz phenocrysts in a sheared matrix of Chl + Qz + Carb + traces of Ser. *Crossed nicols, 40X.*

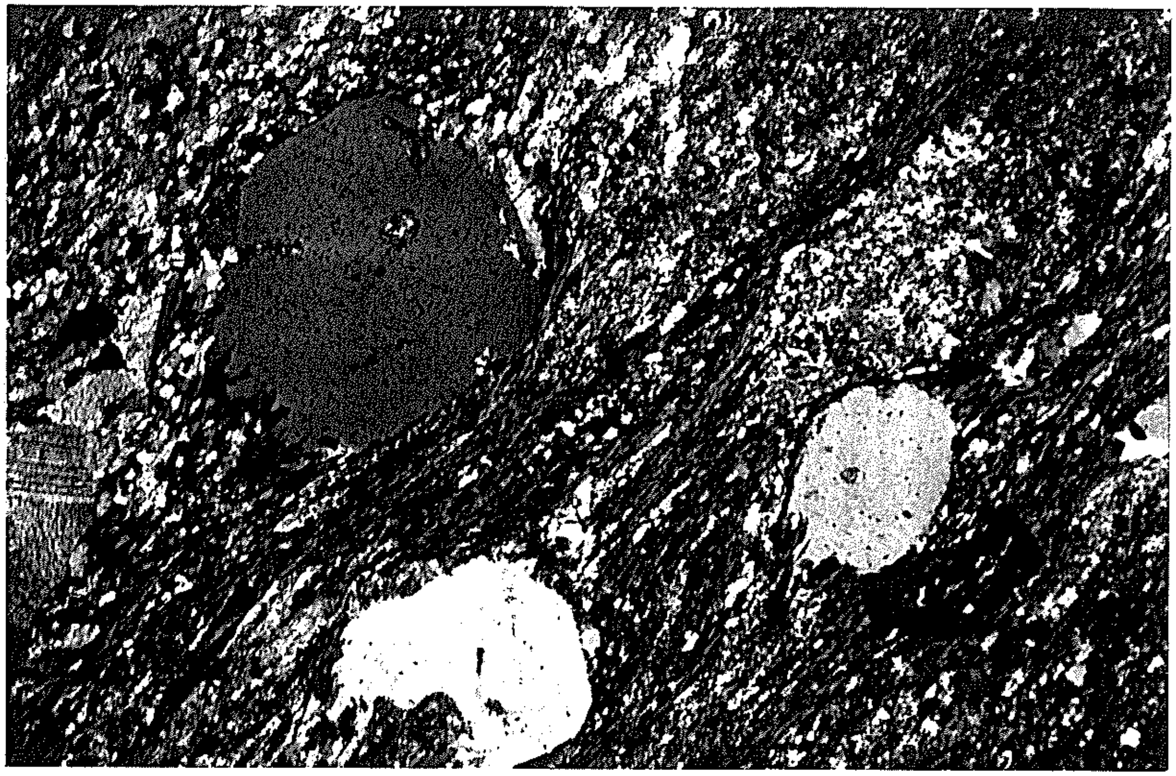
Figure 17b: Contact of Quartz Porphyry and evolved basalt (chilled). *Plane light, 40X.*

Whole-rock analysis of Quartz Porphyry 4' from contact: (LOI-free basis)

('evolved dacite' in Jessop 2 report)

No.	Report	Lithology	SiO2	Al2O3	TiO2	FeO	MnO	CaO	MgO	K2O	Na2O
18219	Jessop 2	High-Zr rhy B	72.9	11.3	0.75	6.37	0.17	2.58	1.03	1.74	2.92

P2O5	(LOI)	Sum	Ba	Sr	Y	Zr	Rb	Nb	Zr/Y	Al2O3/TiO2
0.17	(3.85)	100.00	490	47	78	609	42	23	7.9	15.1



Massive quartz porphyritic high-Zr rhyolite B (blue quartz eyes)

Drillhole K2-87-2 183' (petrography sample number 30223)

- This sample exhibits bluish Qz grains in hand specimen.
- Qz phenos are large, some are granophyric; groundmass is fine-grained and moderately altered to Qz + Ser + Biot.
- A few Qz amygdules, and one Qz veinlet. The Ab is pseudomorphed by fine-grained Ser.

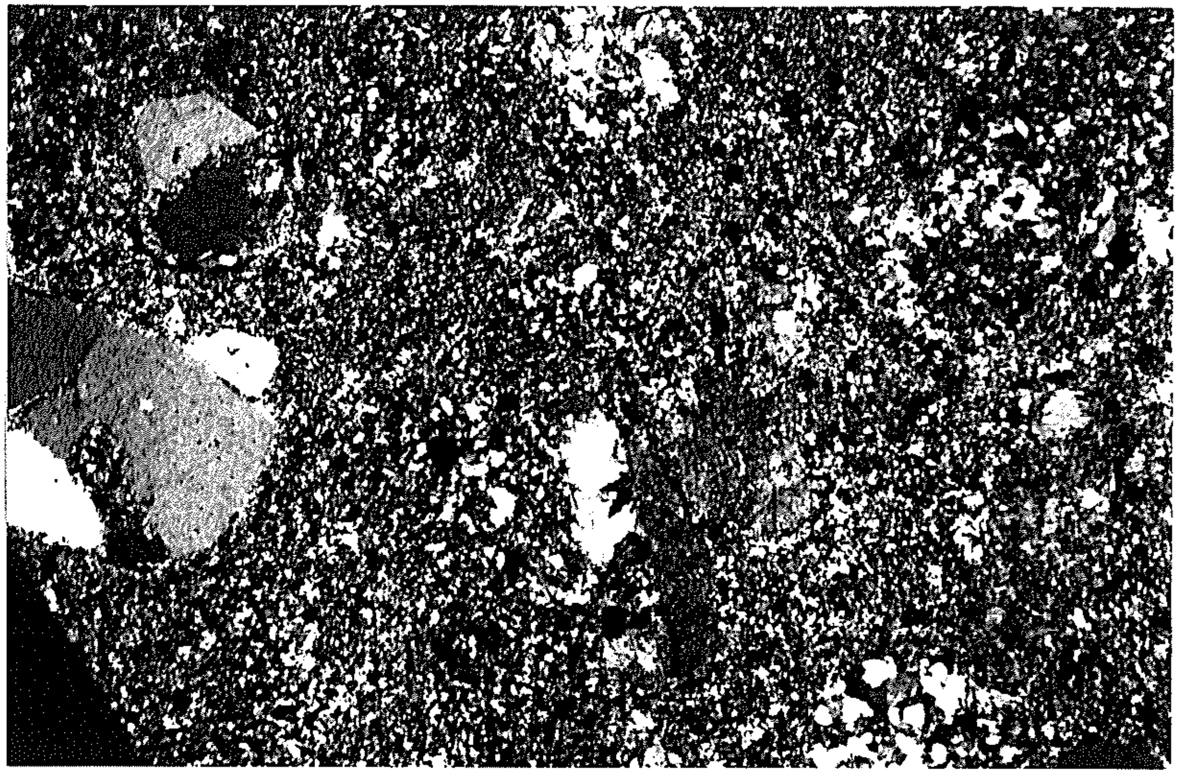
Figure 18a: Qz and altered Ab phenos, Biotite, and Qz amygdules. *Crossed nicols, 40X.*

Figure 18b: Granophyre remnant with Ab altered to Ser. *Crossed nicols, 40X.*

Whole-rock analysis of Quartz Porphyry: (LOI-free basis)

No.	Report	Lithology	SiO2	Al2O3	TiO2	FeO	MnO	CaO	MgO	K2O	Na2O
30208	Table 3	High-Zr rhy B	71.68	12.45	0.50	5.60	0.11	1.31	0.38	3.72	4.19

P2O5	(LOI)	Sum	Ba	Sr	Y	Zr	Rb	Nb	Zr/Y	Al2O3/TiO2
0.05	(2.20)	100.00	683	85	168	713	90	46	4.4	24.7



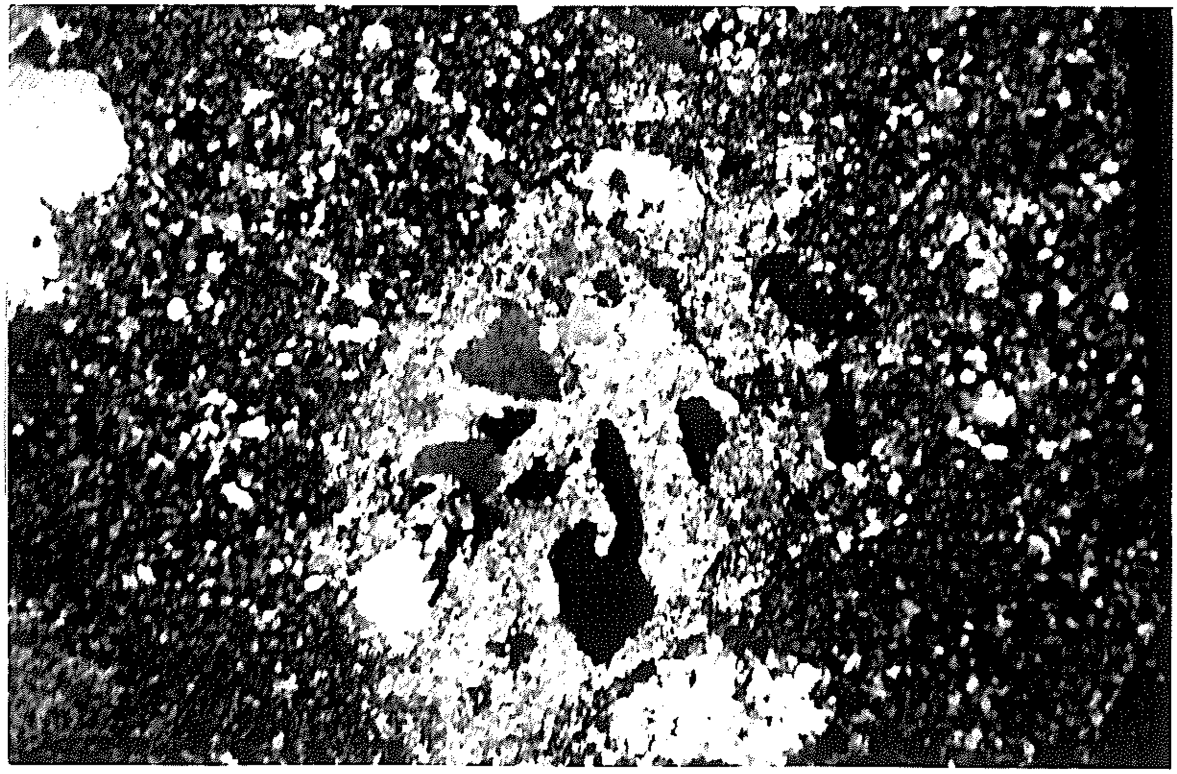


Figure 19a: Quartz porphyritic high-Zr Rhyolite B

Drillhole K2-87-3 174’ (petrography sample number 30224)

- ‘Banded’ fine-grained felsic matrix with large Qz phenocrysts (embayed pheno in photo).
- Moderate alteration: Chl + Biot + minor Carb; minor Ser where Chl is absent.
- The dark brownish bands are Biot-rich. *Crossed nicols, 40X.*

Whole-rock analysis of Quartz Porphyry: (LOI-free basis)

(‘evolved dacite’ in Jessop 2 report)

No.	Report	Lithology	SiO2	Al2O3	TiO2	FeO	MnO	CaO	MgO	K2O	Na2O
9817	Jessop 2	High-Zr rhy B	71.45	11.72	0.86	6.70	0.12	2.31	0.63	1.86	4.11

P2O5	(LOI)	Sum	Ba	Sr	Y	Zr	Rb	Nb	Zr/Y	Al2O3/TiO2
0.17	(1.95)	100.00	532	99	129	501	56	28	4.1	13.7

Figure 19b: Quartz porphyritic high-Zr Rhyolite B

Drillhole Jessop 87-3 224’ (petrography sample number 30225)

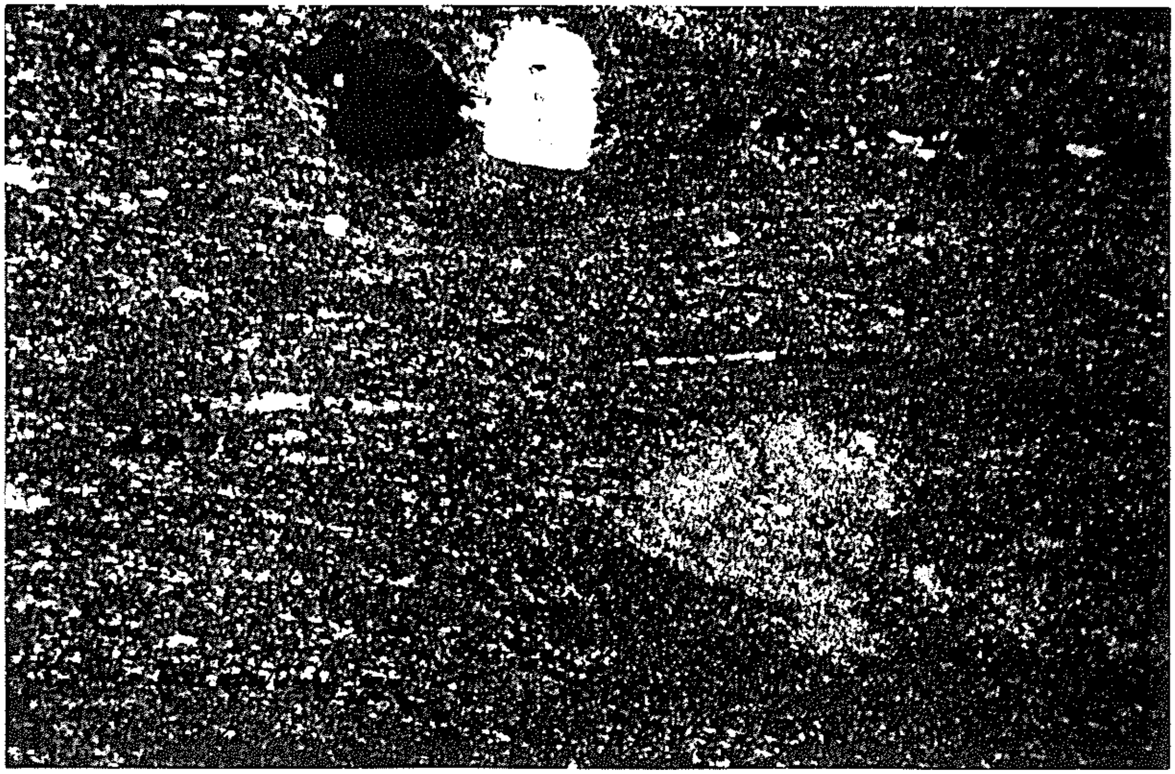
- Laminated felsic matrix with prominent Qz phenocrysts; Qz + Ab + Biot ± Ser ± Chl.
- Overall, almost altered chemically. Some plagioclase (Ab) phenocrysts replaced by Ser.
- A few quartz veinlets. *Crossed nicols, 40X.*

Whole-rock analysis of Quartz Porphyry (LOI-free basis)

(‘evolved dacite’ in Jessop 2 report)

No.	Report	Lithology	SiO2	Al2O3	TiO2	FeO	MnO	CaO	MgO	K2O	Na2O
9720	Jessop 2	High-Zr rhy B	76.32	10.48	0.77	3.40	0.07	2.37	0.42	0.97	5.00

		Sum	Ba	Sr	Y	Zr	Rb	Nb	Zr/Y	Al2O3/TiO2
0.16	(1.70)	100.00	396	107	102	444	28	23	4.4	13.6



Quartz porphyritic high-Zr Rhyolite B

Drillhole K2-87-3 265' (petrography sample number 30222)

- Massive felsic volcanic rock, with fine-grained groundmass of Qz + Biot + Ep + carb.
- 25% of rock is composed of large phenocrysts; Ab phenos slightly altered.
- Also have 'phenocrysts' of Ab - Qz as granophyric intergrowths.

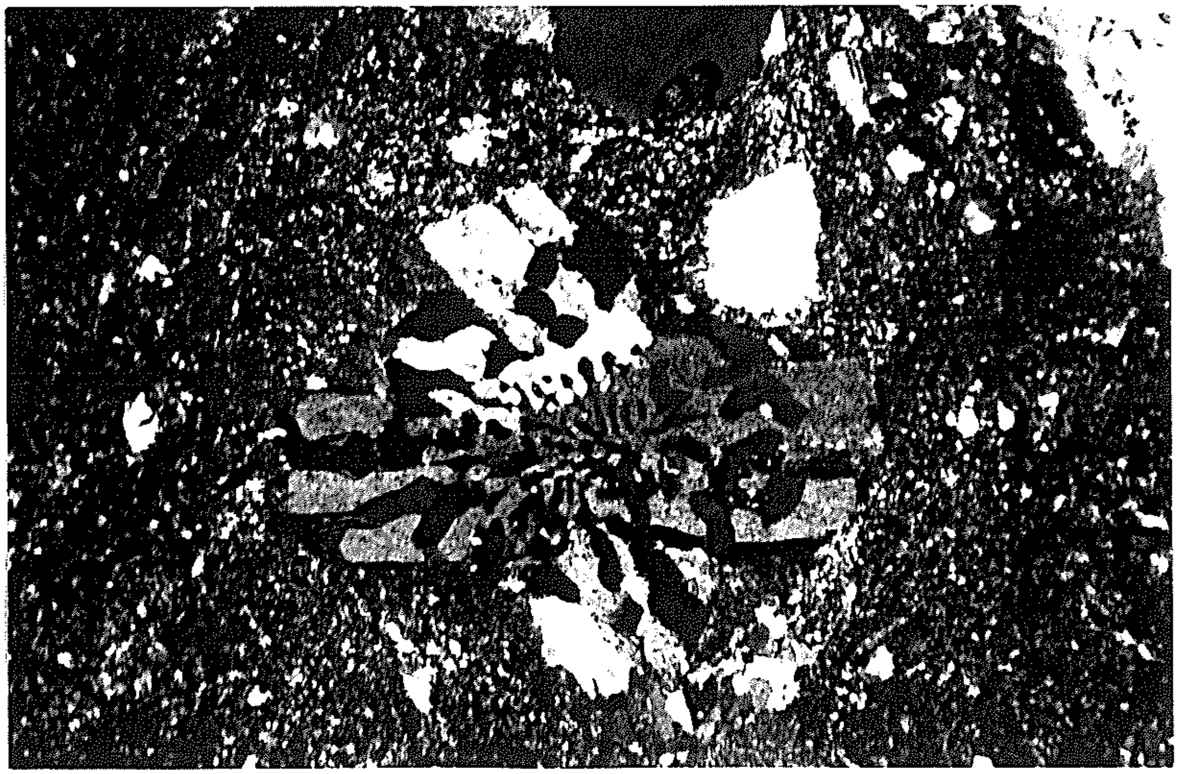
Figure 20a: Qz and Pl phenocrysts in altered matrix. *Crossed nicols, 40X.*

Figure 20b: Pl + Qz 'phenocryst' granophyre texture. *Crossed nicols, 40X.*

Whole-rock analysis of Quartz Porphyry: (LOI-free basis)

No.	Report	Lithology	SiO2	Al2O3	TiO2	FeO	MnO	CaO	MgO	K2O	Na2O
30209	Table 3	High-Zr rhy B	75.93	11.15	0.43	4.41	0.08	1.01	0.71	1.68	4.53

P2O5	(LOI)	Sum	Ba	Sr	Y	Zr	Rb	Nb	Zr/Y	Al2O3/TiO2
0.05	(0.85)	100.00	518	95	150	645	54	36	4.4	25.8



Suggested Analytical Work

(1) With regard to the 1994 drilling in the Four Corners area, lithogeochemical analyses of lithological units is required in NOR94-4 in particular, and also in the lowest 50 metres of NOR94-5. The objective is to determine which rhyolite type the common felsic fragmental rocks in these intervals belong to, and thereby to improve correlations in the complex area around the Four Corners, where units are difficult to trace due to either fault offsets or folding. Further analyses from NOR94-6 would also be useful to determine if any high-Zr rhyolite B fragmentals are present With regard to the gabbro in NOR-94-1, a few analyses may reveal if this is a differentiated intrusion with cumulate-rich zones (as suggested by the 10 m-thick, magnetite-rich interval near the end of the hole). It might be interesting to obtain PGE data for this latter unit.

(2) From examination of age-dating results in the central Abitibi greenstone belt (as summarized in Corfu, 1993), it is apparent that the felsic stratigraphy striking WSW through the southern portion of Jessop Township remains one of the major undated felsic sequences in the area. A high-precision U-Pb zircon age would gave regional implications for the rhyolite stratigraphy. Rhyolites that could be sampled include: (1) high-Zr quartz porhyritic rhyolite B, thick intervals of which occur in holes K2-87-3 and BM-86-1; and (2) rhyolite A at the end of hole K2-93-1 and the beginning of K2-93-2 (this rhyolite outcrops some 50-100 m east of the Four Corners). Thick sequences of Rhyolite A were also intersected in the upper 150 metres of hole NOR-94-5 and the upper 100 metres of hole NOR-94-1. With such data, it would be possible to determine if the felsic stratigraphy in the Four Corners area correlates with the Kamiskotia rhyolite (2705 ma), or with the Kidd Creek rhyolite sequence (2417 Ma: Barrie and Davis, 1990; 2710-2714 Ma: Bleeker and Parrish, 1995). It may be possible to obtain an age for the southern Jessop felsic stratigraphy through the Ontario Geological Survey (possibly at reduced cost).

Discussion and Conclusions

Noranda's 1994 programme has complimented and extended our understanding of the stratigraphy and lithogeochemistry in the area of the Four Corners and immediately contiguous townships. The area is underlain by a mainly bimodal sequence of mafic and felsic volcanic rocks, with an increase in the proportion of interbedded volcaniclastic sediments and graphitic argillites towards to north that is interpreted as reflecting waning of volcanic activity and deepening of the depositional basin.

The mafic rocks comprise basalts and evolved basalts that can be respectively divided into low-Ti and high-Ti groups, with the low-Ti basalts occurring mainly in hole NOR94-3, the easternmost of Noranda's new holes, and a few also in NOR94-4 at the Four Corners. Evolved basalts are notably high in TiO_2 (>2.0%), FeO (>12.0%), P_2O_5 (>0.3%) and Zr (>180 ppm). Although these have been previously been termed icelandites, their silica content is in the range of basalts to basaltic andesites. The low-Ti basalts in NOR94-3 represent a distinctive mafic unit that accumulated mainly in this area, probably as volcaniclastics. These basalts have much lower Zr contents than the evolved basalts, and somewhat lower Zr/Y ratios of 3.5-4.0, but like the evolved basalts are Fe-rich.

The felsic rocks on the property include four main types: (1) Rhyolite A, which forms one main stratigraphic unit that strikes west-southwest, as well as several thinner, laterally discontinuous units within dominantly mafic stratigraphy. (2) Quartz porphyritic Rhyolite B, with high Zr contents of 400-650 ppm; this is an important unit in the upper part of hole K2-87-03, and also in the lowest part of BM-86-01. (3) Rhyolite B fragmental rocks, with high Zr contents of 400-650 ppm; this unit is well developed in K2-87-03, but thin intervals occur in most holes between NOR94-1 and NOR94-3; pyrite-pyrrhotite lenses and disseminations are particularly abundant in K2-87-03. (4) Rhyolite B fragmental rocks, with low contents of 150-250 ppm; these constitute the majority of the felsic wackes and turbidites that are intercalated with graphitic argillites along the northern flank of the stratigraphy extending from NOR94-1 to NOR94-3.

In Noranda's 1994 program, a thick unit of rhyolite A was intersected in NOR94-5, about 300 metres east of the Four Corners. This appears to be the same rhyolite as was encountered in drillhole K2-93-2, where it outcrops on surface near the drillhole collar; rhyolite A also occurs at the end of K2-93-1, at depth. About 300 metres southwest of the Four Corners, in NOR94-1 and 94-2, a thick sequence of rhyolite A was again intersected. Hole NOR94-4, in the intervening area, encountered abundant felsic fragmentals in the first 150 metres, but it is not certain what type of rhyolite they represent, as there are no lithogeochemical data from this interval. East of the Four Corners area, in holes K2-87-2 and Jess 12-02, rhyolite A again forms notable intervals; finally, it forms a few thin units further to the northeast in K2-92-2. In the area of the Four Corners, rhyolite A can be characterized as a fractionated, near uniform rhyolite, which had precursor contents (on an LOI-free basis) of $SiO_2 \approx 77\%$, $Al_2O_3 \approx 11.7\%$, $TiO_2 \approx 0.18\%$ and $Zr \approx 350\text{-}360$ ppm. The rhyolite is of mainly tholeiitic affinity, with Zr/Y = 3 to 4 (some transitional rhyolite A with Zr/Y = 6.0-7.5 occurs near the end of drillhole K2-93-1). REE patterns indicate that rhyolite A is an FIIIb-type rhyolite in the classification of Lesher et al. (1986).

High-Zr rhyolite B forms a massive-looking quartz porhyritic unit in K2-87-3 and BM-86-1. It contains common quartz eyes, some of which are blue in hand specimen. Petrographic examination indicates that the eyes include phenocrysts and granophyric intergrowths of quartz-albite. The lack of internal bedding or textural variations in this rhyolite, and its near-uniform composition, suggests that it is either a massive eruptive unit, or a subvolcanic intrusion. This rhyolite has FIIIb-type REE patterns, and tholeiitic to transitional Zr/Y ratios. Because of its very high Zr content, this rhyolite also has the highest REE concentration of those examined. Although it contains 0.75-0.95% TiO_2 and 4-6% FeO, which is unusual for rhyolite, its SiO_2, Al_2O_3, MgO and Zr contents indicate that it is, in fact, a fractionated felsic rock. The high Ti-Fe contents of this rhyolite probably reflect retention of titanomagnetite in the magma.

High-Zr rhyolite B also forms felsic fragmental lithologies ranging from breccias through lapilli tuffs to ash tuffs (according to logs). In some holes, pyrite-pyrrhotite occurs in association with this type of rhyolite fragmental (e.g. K2-87-3, Jess 12-02, Jess 12-01, and locally in K2-92-2). Thin intervals of high-Zr rhyolite B fragmental also occur in NOR94-5 (where bluish quartz eyes were recorded) and in NOR94-2 (no details given in drill log). This lithology could occur in NOR94-4 (no lithogeochemistry available), and in the main breccia-wacke interval in K2-93-1 (610-694'). An interesting feature of this type of rhyolite breccia, in addition to its high Zr content, is its low Al_2O_3 content, consistent with derivation from a source such as the quartz porphyritic rhyolite B discussed above.

Low-Zr rhyolite B forms felsic volcaniclastic beds mainly ranging from pebbly coarse sandstones to siltstones, which are commonly intercalated with dark graphitic argillites and silty argillites. The felsic beds have silica contents in the rhyodacite-dacite range. Although the Zr content of the felsic beds is low relative to preceding rhyolite types, Y is even lower, and thus the Zr/Y ratio is distinctly higher, usually in the mildly calc-alkaline range. These felsic volcaniclastic beds also have distinctly higher Al_2O_3 contents, which could well reflect their more calc-alkaline affinity (although it might be argued that hydraulic concentration of feldspars during sediment redeposition was responsible). In any case, felsic volcaniclastic beds of this composition consistently occur (interbedded with argillites) along the northern margin of the stratigraphic belt that extends from NOR94-1 in the west, to K2-92-1 in the east. Interestingly, a mafic volcanic interval usually occurs stratigraphically below (south of) the interbedded felsic volcaniclastic-argillite sequence. Below this, low-Zr rhyolite B volcaniclastic beds have not been found except locally in NOR94-3. Instead, felsic fragmental rocks belong to one of the high-Zr groups.

Rhyolite A is thickest in the Four Corners area, having downhole thicknesses of at least 70m in NOR94-1, 90m in K2-93-2 and 150m in NOR94-5. Assuming a vertical dip, these correspond to true thicknesses of about 50 to 100 metres (although some intervals could be thicker as they were not drilled through). According to the drill logs, rhyolite A varies from lapilli tuff, to aphanitic and massive-looking, to crackle-brecciated (densely packed fragments with little matrix). Still other rhyolite A fragmental intervals are separated by thin graphitic interbeds. Thus, rhyolite A probably formed a range of original facies variations. Regardless, its near-uniform composition in terms of immobile element ratios suggests that rhyolite A fragments generally have not mixed to any significant degree with clasts of other lithologies. This, together with rhyolite A's sheer thickness and cross-strike continuity in the Four Corners area, suggests that it represents mainly source-proximal fragmental material (possibly with some massive intervals as well). Thin graphitic interbeds occur towards the top of the main rhyolite A intervals (i.e. towards the north in NOR 94-1, 94-3 and 94-5), which is consistent with upward waning of rhyolite A volcanic activity.

Correlation of rhyolite A to the east of NOR94-5 is difficult because of the locations and spacings of older holes, although it is still present in NOR94-3. However, in this latter hole, the stratigraphic sequence is rather anomalous due to the presence of low-Ti basaltic volcaniclastics. The evolved (high-T-P-Zr) basalts that usually occur above rhyolite A were not encountered. Thus, the units in NOR94-3 may not necessarily lie along strike between those in NOR94-5 (to the west) and K2-87-1 (to the east).There are also occurrences of rhyolite A in K2-87-2 and Jess 12-02, located 300-400 metres due east of K2-87-3, where a major interval of quartz porhyritic high-Zr rhyolite B is present. In an earlier report (Barrett and MacLean, 1993b), it was suggested that quartz porhyritic rhyolite B in fact occupied part of the section that otherwise would have been represented by rhyolite A tuff. This remains possible, although if the stratigraphy in this area still strikes east-northeast, then hole K2-87-3 would not be expected to 'line up' with the other two holes.

With regard to the thin interval of 'southern' rhyolite A near the beginning of holes K2-93-1 and 93-2 at the Four Corners, it is possible that this correlates eastwards with the 'southern' rhyolite A in K2-87-2 and Jess 12-02 (and BM-85-1 in between). However, there are large drilling gaps, so this correlation is tentative. If the 'southern' rhyolite A near the beginning of holes K2-93-1 and 93-2 extends directly west, it could be continuous with the rhyolite A unit near the end of NOR94-1 and beginning of 94-2. However, if the main occurrence of rhyolite A immediately east of the Four Corners (where it also ouctrops) were to swing to a more southwesterly strike, it too could be continuous with the NOR94-1/2 rhyolite. If the two rhyolite intervals intersected in K2-93-1 in fact merge to the west to become the NOR94-1/2 rhyolite, then a large amount of mafic stratigraphy in K2-93-1 would have to wedge out rapidly to the west. Alternatively, complex faulting or folding has occurred immediately west of the Four Corners such that the stratigraphy in holes K2-93-1/2 cannot readily be matched with that in holes NOR94-1/2.

The main alteration types affecting the felsic rocks in the area are sericitization, silicification and carbonatization; some K-feldspar is also inferred to be present based on K-Al relations. With a few exceptions, chlorite is minor in the felsic rocks. However, fine-grained biotite is a common accessory, probably marking the former existence of hydrothermal sericite and chlorite that combined during regional metamorphism (lowest amphibolite facies). The mafic rocks in the area commonly display a spilitic mineralogical assemblage of Ab-Ep-Chl-Hb-Biot-Carb-Qtz, but are relatively unaltered chemically, apart from the addition of the volatiles H_2O and CO_2.

Mass change calculations allow areas that have experienced hotter alteration and higher overall fluid/rock ratios to be quantitatively distinguished from zones of cooler, more marginal alteration. Mass changes have been calculated for rhyolite A intervals intersected in the Four Corners area by Noranda (this report) and by the Jessop Syndicate (Barrett and MacLean, 1994b). It was previously noted that rhyolite A near the end of hole K2-93-1 showed more extensive, hotter alteration than the silicified rhyolite A that occured immediately uphole (although there was no significant chloritic alteration). In the current study, rhyolite A in the easternmost hole, NOR95-3, clearly shows the least alteration, whereas in hole NOR95-5, just east of the Four Corners, it is generally moderately altered. In the westernmost holes, NOR94-1/2, most of rhyolite A is altered, but not always in the same sense, that is, intervals of silica gain are present, as well as intervals of little silica change but strong alkali exchange. In NOR94-1/2, it is difficult to assess whether alteration varies with depth, as neither hole drilled completely through rhyolite A.

Although mass changes were not calculated for high-Zr rhyolite B due to the limited number of samples, the fragmentals (especially those with associated po-py mineralization) show strong alkali exhange and in some cases silica loss. Net mass loss versus net mass gain can be assessed by examining the positions of samples along the rhyolite B alteration line in an Al_2O_3-TiO_2 plot (Barrett and MacLean, 1993a,b). Further sampling since these reports has shown there are two rhyolite B types, one with a high-Zr but low-Al precursor, the other with converse features. To assess net mass changes, it is first necessary to relate altered samples to their proper precursor on a rhyolite B alteration line. This is done by first separating the two rhyolites on the basis of their different Zr/Y ratios and REE patterns.

The massive quartz porphyritic high-Zr rhyolite B that occurs mainly in holes K2-87-3 and BM-86-1 is relatively unaltered. This unit is interpreted as a shallow intrusive rhyolite. Its original relation with fragmental high-Zr rhyolite B, which lies immediately to the north, is uncertaint. However, based on chemical similarity, we suggest that fragmental high-Zr rhyolite B represents the extrusive equivalent of some of the massive quartz porphyritic high-Zr rhyolite B (the uppermost portion in particular, as this has closely comparable TiO_2 contents). Some fragmentals occur as far west as NOR94-2 and as far east as Jess 12-02, suggesting that clastic debris was shed from an area centered around K2-87-3. By contrast, the extrusive centre for rhyolite A appears to have been located west of the Four Corners, based on thickening of Rhyolite A in this area, and a general (but erratic) increase in alteration towards the west.

In summary, the main sequence of events in the Four Corners area is: (1) Eruption of evolved basalts (icelandites), alternating with minor accumulation of rhyolite A tuffs. (2) Emplacement and extrusion of high-Zr rhyolite B quartz porphyry in the area of K2-87-3; coarse breccias of this lithology, containing commmon po-py, also accumulated in this area. (3) At almost the same time, rhyolite A was erupted from an area near the Four Corners. Rhyolite A turbidites and tuffs extended eastwards into a depositional basin where they were interbedded with high-Zr rhyolite B fragmentals, and locally graphitic argillite. (4) Further eruption of evolved basalt eruption occurred, which covered most of the high-Zr felsic rocks (which are all of tholeiitic FIIIb affinity). (5) A major phase of volcaniclastic sedimentation ensued, derived from a separate, extra-basinal, more calc-alkaline terrane (of mildly calc-alkaline FII affinity). These formed felsic turbidites intercalated with argillites.

Areas with particular exploration potential include: (1) The area north and northwest of the Four Corners, as the northern extent of rhyolite A has not been determined. Where two holes in this area ended in rhyolite A (K2-93-1 and NOR 94-2), alteration was notable. (2) Areas immediately flanking K2-87-3, where high-Zr rhyolite B was intruded/extruded, and where sulfide-bearing breccias accumulated. (3) The extension of rhyolite A to the west of the Four Corners, as this area is a candidate for a major tholeitiic felsic centre.

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Table 1. Chemical composition of volcanic rocks in southwestern Jessop Township (Noranda 1994 drill program).

Lab No.	Drillhole	Depth (m)	Lithology	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Sum
27827	Nor 94-1	28.1-28.3	Rhyolite A	73.4	0.174	11.3	3.69	0.10	0.52	2.41	0.11	3.86	0.02	4.45	100.15
27828	Nor 94-1	37.3-37.5	Rhyolite A	75.1	0.184	11.2	3.63	0.06	0.41	0.92	2.69	2.39	0.01	3.00	99.70
27829	*Nor 94-1*	*44.3-44.5*	*Rhyolite A*	*76.1*	*0.166*	*11.0*	*3.38*	*0.05*	*0.29*	*0.70*	*5.07*	*0.89*	*0.01*	*2.60*	*100.33*
27830	Nor 94-1	50.7-52.5	Rhyolite A	74.6	0.169	12.0	0.90	0.04	0.08	1.56	0.20	8.45	0.02	1.95	100.14
27831	Nor 94-1	56.7-56.9	Rhyolite A	73.3	0.198	10.9	3.49	0.09	0.57	2.43	0.11	4.10	0.01	4.70	100.00
27832	*Nor 94-1*	*79.7-79.9*	*Rhyolite A*	*75.6*	*0.183*	*12.1*	*3.56*	*0.04*	*0.45*	*0.91*	*4.24*	*1.50*	*0.01*	*1.65*	*100.33*
27833	*Nor 94-1*	*90.4-90.6*	*Rhyolite A*	*74.9*	*0.178*	*11.9*	*3.20*	*0.05*	*0.36*	*1.57*	*4.16*	*1.66*	*0.01*	*2.05*	*100.13*
27834	Nor 94-1	97.1-97.3	Rhyolite A	74.9	0.154	10.3	3.56	0.06	0.40	2.63	2.50	1.91	0.02	3.15	99.68
27835	Nor 94-1	104.0-104.3	Basalt (low-Ti)	50.4	0.500	13.4	7.05	0.11	8.62	7.14	3.48	0.94	0.20	8.50	100.42
27836	Nor 94-1	110.0-110.2	Evolved basalt*	53.6	2.660	12.2	11.90	0.20	4.18	6.38	3.10	0.87	0.44	4.65	100.28
27837	Nor 94-1	131.4-131.4	Evolved basalt*	50.2	2.510	11.7	11.10	0.26	3.48	7.49	3.36	0.98	0.41	8.45	100.03
27838	Nor 94-1	137.7-138.1	Rhyolite B (hi-Zr)	73.0	0.387	11.1	4.63	0.09	0.32	2.83	3.02	1.67	0.05	3.15	100.37
27839	Nor 94-1	160.8-161.4	Evolved basalt*	50.2	2.200	13.6	13.30	0.28	4.46	9.07	3.74	0.35	0.36	2.35	99.97
27840	Nor 94-1	186.9-187.2	Rhyolite B (lo-Zr)	67.7	0.527	15.8	3.85	0.04	1.38	2.09	2.79	3.22	0.14	2.05	99.71
27841	Nor 94-1	190.9-191.2	Rhyolite B (lo-Zr)	71.2	0.372	14.1	3.59	0.03	1.37	1.92	3.95	2.00	0.08	1.45	100.16
27842	Nor 94-1	203.5-203.7	Basalt (gabbro)	52.1	1.130	16.8	12.10	0.13	4.47	5.62	4.70	0.76	0.15	2.25	100.26
27843	Nor 94-1	288.1-288.3	Magnet.-rich mafic	32.7	2.920	8.5	37.60	0.25	6.54	7.75	0.89	0.10	0.03	2.05	99.33
27844	Nor 94-1	294.4-294.6	Basalt	48.6	0.800	15.6	13.50	0.18	6.80	8.64	3.29	0.19	0.05	2.45	100.13
27809	Nor 94-2	23.5-23.7	Rhyolite B (hi-Zr)	68.0	0.468	11.5	8.65	0.17	1.15	2.15	2.66	1.81	0.07	3.25	100.00
27808	Nor 94-2	125.4-125.6	Evolved basalt*	49.0	2.210	12.4	15.10	0.31	2.64	6.18	3.04	1.04	0.44	7.90	100.33
27807	Nor 94-2	252.3-252.5	Evolved basalt	52.1	2.090	13.7	11.10	0.21	4.18	5.58	3.52	1.17	0.18	6.35	100.26
27806	Nor 94-2	280.4-280.6	Rhyolite B (hi-Zr)	69.3	0.556	12.7	5.10	0.12	1.22	2.42	2.14	2.63	0.09	3.35	99.77
27805	Nor 94-2	293.8-294.0	Rhyolite A	69.7	0.157	10.6	6.57	0.19	0.41	1.99	1.47	4.51	0.02	4.55	100.31
27804	Nor 94-2	296.8-297.4	Rhyolite A	81.0	0.160	10.2	1.93	0.03	0.15	0.50	1.38	2.82	0.02	2.00	100.31
27803	Nor 94-2	309.0-309.2	Rhyolite A	73.3	0.206	12.4	3.27	0.07	0.28	1.91	0.14	4.38	0.02	3.80	99.91
27802	Nor 94-2	322.4-322.6	Rhyolite A	76.3	0.154	10.5	2.85	0.06	0.18	0.76	1.82	5.16	0.02	2.30	100.24
27801	Nor 94-2	329.5-329.7	Rhyolite A	78.5	0.150	9.6	2.22	0.06	0.21	1.78	3.52	1.63	0.02	2.58	100.31
27810	Nor 94-3	36.8-37.2	Evolved basalt	54.4	2.570	12.4	11.80	0.42	3.73	6.87	2.34	0.43	0.22	5.05	100.30
27811	Nor 94-3	40.3-40.7	Rhyolite A	75.4	0.190	11.4	2.27	0.05	0.29	1.04	3.31	3.67	0.02	1.35	99.14
27812	*Nor 94-3*	*50.1-50.4*	*Rhyolite A*	*76.5*	*0.192*	*11.8*	*3.30*	*0.05*	*0.39*	*0.50*	*4.79*	*1.49*	*0.02*	*1.00*	*100.12*
27813	*Nor 94-3*	*59.6-60.1*	*Rhyolite A*	*75.5*	*0.164*	*11.1*	*3.48*	*0.08*	*0.23*	*1.55*	*4.50*	*1.40*	*0.01*	*2.00*	*100.10*
27814	Nor 94-3	69.6-69.8	Rhyolite A	75.9	0.149	10.2	3.09	0.09	0.33	2.26	4.28	0.85	0.01	2.60	99.81
27815	Nor 94-3	75.3-75.5	Rhyolite B (lo-Zr)	66.7	0.509	14.9	4.09	0.04	1.35	2.68	4.41	2.12	0.11	3.45	100.45
27816	Nor 94-3	76.5-76.7	Basalt	52.0	1.330	16.8	13.00	0.11	4.35	2.66	2.13	2.54	0.20	5.15	100.37
27817	Nor 94-3	82.8-83.0	Basalt	52.6	1.280	14.9	12.10	0.15	4.00	4.56	2.81	1.71	0.16	6.00	100.35
27818	Nor 94-3	87.5-87.7	Rhyolite B (lo-Zr)	68.3	0.523	15.2	3.34	0.04	1.21	1.91	5.85	1.33	0.11	2.35	100.23
27819	Nor 94-3	93.4-93.6	Rhyolite B (lo-Zr)	69.4	0.418	15.0	3.08	0.03	1.12	2.21	4.54	2.21	0.11	2.30	100.53

Table 1. Chemical composition of volcanic rocks in southwestern Jessop Township (Noranda 1994 drill program).

Lab No.	Drillhole	Depth (m)	Lithology	Ba	Rb	Sr	Nb	Y	Zr	Al2O3/ TiO2	Zr/Y	Al2O3/ Zr	Zr/Nb	Y/Nb
27827	Nor 94-1	28.1-28.3	Rhyolite A	487	115	104	29	105	338	64.9	3.2	0.033	11.7	3.6
27828	Nor 94-1	37.3-37.5	Rhyolite A	467	85	114	32	107	348	60.9	3.3	0.032	10.9	3.3
27829	*Nor 94-1*	*44.3-44.5*	*Rhyolite A*	*137*	*34*	*163*	*27*	*102*	*331*	*66.3*	*3.2*	*0.033*	*12.3*	*3.8*
27830	Nor 94-1	50.7-52.5	Rhyolite A	1050	143	90	27	85	341	71.0	4.0	0.035	12.6	3.1
27831	Nor 94-1	56.7-56.9	Rhyolite A	435	123	109	28	99	325	55.1	3.3	0.034	11.6	3.5
27832	*Nor 94-1*	*79.7-79.9*	*Rhyolite A*	*316*	*48*	*75*	*31*	*114*	*363*	*66.1*	*3.2*	*0.033*	*11.7*	*3.7*
27833	*Nor 94-1*	*90.4-90.6*	*Rhyolite A*	*319*	*46*	*90*	*30*	*103*	*344*	*66.9*	*3.3*	*0.035*	*11.5*	*3.4*
27834	Nor 94-1	97.1-97.3	Rhyolite A	373	50	72	27	95	306	66.9	3.2	0.034	11.3	3.5
27835	Nor 94-1	104.0-104.3	Basalt (low-Ti)	232	31	380	4	17	116	26.8	6.8	0.116	29.0	4.3
27836	Nor 94-1	110.0-110.2	Evolved basalt*	319	19	194	16	60	346	4.6	5.8	0.035	21.6	3.8
27837	Nor 94-1	131.4-131.4	Evolved basalt*	293	13	159	15	51	365	4.7	7.2	0.032	24.3	3.4
27838	Nor 94-1	137.7-138.1	Rhyolite B (hi-Zr)	321	47	94	33	107	630	28.7	5.9	0.018	19.1	3.2
27839	Nor 94-1	160.8-161.4	Evolved basalt*	167	8	168	10	43	194	6.2	4.5	0.070	19.4	4.3
27840	Nor 94-1	186.9-187.2	Rhyolite B (lo-Zr)	746	78	184	10	23	179	30.0	7.8	0.088	17.9	2.3
27841	Nor 94-1	190.9-191.2	Rhyolite B (lo-Zr)	500	50	173	18	61	224	37.9	3.7	0.063	12.4	3.4
27842	Nor 94-1	203.5-203.7	Basalt (gabbro)	186	18	237	1	16	81	14.9	5.1	0.207	81.0	16.0
27843	Nor 94-1	288.1-288.3	Magnet.-rich mafic	90	1	110	1	13	35	2.9	2.7	0.242	35.0	13.0
27844	Nor 94-1	294.4-294.6	Basalt	69	7	182	2	13	40	19.5	3.1	0.390	20.0	6.5
27809	Nor 94-2	23.5-23.7	Rhyolite B (hi-Zr)	584	43	54	22	82	453	24.6	5.5	0.025	20.6	3.7
27808	Nor 94-2	125.4-125.6	Evolved basalt*	263	31	104	15	53	264	5.6	5.0	0.047	17.6	3.5
27807	Nor 94-2	252.3-252.5	Evolved basalt	377	44	134	9	43	157	6.6	3.7	0.087	17.4	4.8
27806	Nor 94-2	280.4-280.6	Rhyolite B (hi-Zr)	674	107	76	24	92	460	22.8	5.0	0.028	19.2	3.8
27805	Nor 94-2	293.8-294.0	Rhyolite A	857	98	87	27	87	317	67.5	3.6	0.033	11.7	3.2
27804	Nor 94-2	296.8-297.4	Rhyolite A	641	74	50	23	73	302	63.8	4.1	0.034	13.1	3.2
27803	Nor 94-2	309.0-309.2	Rhyolite A	639	117	72	27	112	374	60.2	3.3	0.033	13.9	4.1
27802	Nor 94-2	322.4-322.6	Rhyolite A	791	89	52	25	81	319	68.2	3.9	0.033	12.8	3.2
27801	Nor 94-2	329.5-329.7	Rhyolite A	232	44	80	22	98	275	63.7	2.8	0.035	12.5	4.5
27810	Nor 94-3	36.8-37.2	Evolved basalt	167	14	226	14	53	192	4.8	3.6	0.065	13.7	3.8
27811	Nor 94-3	40.3-40.7	Rhyolite A	939	58	74	26	93	346	60.0	3.7	0.033	13.3	3.6
27812	*Nor 94-3*	*50.1-50.4*	*Rhyolite A*	*274*	*44*	*62*	*30*	*110*	*353*	*61.5*	*3.2*	*0.033*	*11.8*	*3.7*
27813	*Nor 94-3*	*59.6-60.1*	*Rhyolite A*	*324*	*40*	*82*	*29*	*104*	*332*	*67.7*	*3.2*	*0.033*	*11.4*	*3.6*
27814	Nor 94-3	69.6-69.8	Rhyolite A	113	18	104	21	88	258	68.5	2.9	0.040	12.3	4.2
27815	Nor 94-3	75.3-75.5	Rhyolite B (lo-Zr)	476	57	149	9	30	175	29.3	5.8	0.085	19.4	3.3
27816	Nor 94-3	76.5-76.7	Basalt	657	62	106	5	27	111	12.6	4.1	0.151	22.2	5.4
27817	Nor 94-3	82.8-83.0	Basalt	502	33	157	3	23	90	11.6	3.9	0.166	30.0	7.7
27818	Nor 94-3	87.5-87.7	Rhyolite B (lo-Zr)	289	32	176	8	29	173	29.1	6.0	0.088	21.6	3.6
27819	Nor 94-3	93.4-93.6	Rhyolite B (lo-Zr)	741	55	154	6	15	166	35.9	11.1	0.090	27.7	2.5

Table 1. Chemical composition of volcanic rocks in southwestern Jessop Township (Noranda 1994 drill program).

Lab No.	Drillhole	Depth (m)	Lithology	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Sum
27821	Nor 94-3	99.4-99.6	Basalt	53.9	1.190	15.1	13.80	0.17	3.65	6.03	2.62	0.92	0.19	2.50	100.15
27820	Nor 94-3	107.1-107.3	Basalt	55.9	1.110	14.9	11.80	0.14	3.47	6.00	3.26	1.16	0.18	1.85	99.85
27822	Nor 94-3	116.4-116.6	Basalt	51.8	1.230	14.7	14.20	0.21	3.86	7.28	2.71	1.06	0.17	1.90	99.19
27823	Nor 94-3	117.8-118.0	Rhyolite B (lo-Zr)	67.3	0.571	15.7	4.32	0.03	1.32	3.19	4.81	1.22	0.12	1.50	100.18
27824	Nor 94-3	123.9-124.1	Basalt	52.2	1.240	14.9	13.80	0.22	3.91	7.22	3.20	0.91	0.16	2.15	99.98
27825	Nor 94-3	130.2-130.4	Basalt	54.0	1.090	14.4	12.70	0.18	3.35	6.69	2.22	0.40	0.18	3.35	98.61
27826	Nor 94-3	132.6-132.8	Rhyolite B (lo-Zr)	66.2	0.560	16.7	3.67	0.04	1.57	2.06	3.23	2.80	0.13	2.95	100.00
27845	Nor 94-3	190.9-191.2	Rhyolite B (lo-Zr)	69.9	0.406	14.4	3.38	0.05	1.26	2.34	3.70	2.25	0.11	2.30	100.19
27846	Nor 94-3	198.1-198.5	Rhyolite B (lo-Zr)	69.2	0.431	14.0	3.49	0.06	1.33	2.75	4.22	1.56	0.11	2.35	99.58
27847	Nor 94-3	203.5-203.8	Andesite	61.3	0.877	14.1	7.50	0.16	2.92	4.74	0.22	3.23	0.15	4.95	100.24
27848	Nor 94-3	234.7-234.8	Rhyolite B (med-Zr)	70.9	0.420	13.4	3.95	0.06	1.16	3.07	2.26	2.39	0.09	2.50	100.31
27849	Nor 94-3	243.3-243.5	Rhyolite B (med-Zr)	69.6	0.448	12.9	4.44	0.07	1.08	3.28	4.01	0.98	0.07	1.60	98.57
27850	Nor 94-4	166.4-166.6	Basalt	51.5	1.160	14.1	14.10	0.22	5.08	8.54	1.16	1.62	0.13	2.15	99.83
27851	Nor 94-4	171.7-171.9	Rhyolite B (lo-Zr)	69.9	0.534	14.4	3.47	0.06	1.50	2.22	5.22	1.23	0.11	1.20	99.91
27852	Nor 94-4	192.3-192.5	Andesite	63.9	0.829	14.4	6.14	0.10	2.75	3.67	3.77	1.93	0.15	1.50	99.23
27853	Nor 94-4	202.2-202.4	Basalt	50.2	1.290	15.0	14.30	0.19	5.45	5.85	1.80	1.15	0.16	4.85	100.31
27854	Nor 94-4	211.6-211.8	Andesite	64.4	0.833	14.4	6.42	0.11	2.68	4.25	4.21	0.47	0.14	2.25	100.23
27859	Nor 94-5	21.1-21.3	Rhyolite A	79.2	0.144	10.1	2.13	0.05	0.20	1.15	1.68	3.42	0.02	1.75	99.96
27860	Nor 94-5	71.0-71.4	Rhyolite A	79.3	0.140	10.0	2.47	0.05	0.29	1.15	3.85	1.22	0.02	1.60	100.15
27861	Nor 94-5	101.5-103.1	Rhyolite A	79.2	0.149	10.6	2.35	0.03	0.34	0.98	1.64	2.99	0.02	1.75	100.16
27862	Nor 94-5	119.4-119.7	Rhyolite A	80.7	0.137	9.6	1.33	0.06	0.16	1.66	1.91	2.34	0.02	2.15	100.12
27863	Nor 94-5	130.7-131.0	Rhyolite A	66.2	0.209	14.6	7.68	0.08	0.88	1.90	0.25	4.34	0.02	4.00	100.31
27864	Nor 94-5	139.5-139.8	Rhyolite A	78.6	0.149	10.5	1.79	0.06	0.22	1.71	1.85	2.73	0.02	2.35	100.08
27865	Nor 94-5	149.5-149.7	Rhyolite A	74.8	0.145	10.9	3.93	0.06	0.20	2.17	4.65	0.96	0.01	2.35	100.24
27866	Nor 94-5	153.7-153.9	Rhyolite A	82.6	0.119	8.7	1.50	0.04	0.10	1.35	2.83	1.46	0.02	1.30	100.05
27867	*Nor 94-5*	*164.8-165.0*	*Rhyolite A*	*75.0*	*0.166*	*11.9*	*4.42*	*0.07*	*0.37*	*0.95*	*5.61*	*0.55*	*0.01*	*1.10*	*100.21*
27868	Nor 94-5	170.6-170.8	Rhyolite B (hi-Zr)	77.7	0.410	10.8	3.45	0.06	0.26	0.99	4.79	0.87	0.05	0.60	100.09
27869	Nor 94-5	178.7-178.9	Evolved basalt*	47.1	2.570	15.3	14.00	0.24	5.64	6.50	3.38	0.62	0.38	4.70	100.49
27870	Nor 94-5	201.0-201.2	Evolved basalt*	52.2	2.250	13.3	11.90	0.22	5.50	7.39	3.88	0.45	0.36	2.85	100.35
27855	Nor 94-6	63.1-63.3	Dacite	64.9	0.664	13.3	5.86	0.10	1.69	3.98	3.40	1.97	0.10	2.75	98.82
27856	Nor 94-6	188.0-188.2	Dacite	64.9	0.762	13.7	6.57	0.11	1.94	4.68	4.01	0.84	0.14	2.30	100.04
27857	Nor 94-6	243.7-244.1	Bas. andesite	57.4	1.090	14.0	8.72	0.15	2.96	7.47	3.00	0.50	0.18	4.65	100.19
27858	Nor 94-6	251.4-251.7	Rhyolite B (lo-Zr)	66.9	0.505	15.3	3.75	0.07	1.60	3.29	4.54	1.40	0.10	1.80	99.34

Italics indicate least altered rhyolite A samples.

Evolved basalt* has P2O5 > 0.3% and TiO2 > 2.0% ('icelandite').

Cr2O3≤0.01% in all samples except 27835 (0.06%) and 27844 (0.04%).

Table 1. Chemical composition of volcanic rocks in southwestern Jessop Township (Noranda 1994 drill program).

Lab No.	Drillhole	Depth (m)	Lithology	Ba	Rb	Sr	Nb	Y	Zr	Al2O3/ TiO2	Zr/Y	Al2O3/	Zr/Nb	Y/Nb
27821	Nor 94-3	99.4-99.6	Basalt	220	24	386	4	27	98	12.7	3.6	0.154	24.5	6.8
27820	Nor 94-3	107.1-107.3	Basalt	291	28	291	5	29	108	13.4	3.7	0.138	21.6	5.8
27822	Nor 94-3	116.4-116.6	Basalt	267	18	314	3	25	94	12.0	3.8	0.156	31.3	8.3
27823	Nor 94-3	117.8-118.0	Rhyolite B (lo-Zr)	507	31	222	9	27	175	27.5	6.5	0.090	19.4	3.0
27824	Nor 94-3	123.9-124.1	Basalt	296	25	272	4	22	91	12.0	4.1	0.164	22.8	5.5
27825	Nor 94-3	130.2-130.4	Basalt	112	1	278	3	26	97	13.2	3.7	0.148	32.3	8.7
27826	Nor 94-3	132.6-132.8	Rhyolite B (lo-Zr)	547	84	118	9	17	155	29.8	9.1	0.108	17.2	1.9
27845	Nor 94-3	190.9-191.2	Rhyolite B (lo-Zr)	535	62	202	8	19	157	35.5	8.3	0.092	19.6	2.4
27846	Nor 94-3	198.1-198.5	Rhyolite B (lo-Zr)	382	39	200	6	25	167	32.5	6.7	0.084	27.8	4.2
27847	Nor 94-3	203.5-203.8	Andesite	484	80	90	10	37	205	16.1	5.5	0.069	20.5	3.7
27848	Nor 94-3	234.7-234.8	Rhyolite B (med-Zr)	504	76	179	16	53	222	31.9	4.2	0.060	13.9	3.3
27849	Nor 94-3	243.3-243.5	Rhyolite B (med-Zr)	272	21	253	19	69	262	28.8	3.8	0.049	13.8	3.6
27850	Nor 94-4	166.4-166.6	Basalt	295	38	299	4	22	79	12.2	3.6	0.178	19.8	5.5
27851	Nor 94-4	171.7-171.9	Rhyolite B (lo-Zr)	250	27	148	9	32	175	27.0	5.5	0.082	19.4	3.6
27852	Nor 94-4	192.3-192.5	Andesite	362	41	230	9	36	190	17.4	5.3	0.076	21.1	4.0
27853	Nor 94-4	202.2-202.4	Basalt	186	25	394	4	23	87	11.6	3.8	0.172	21.8	5.8
27854	Nor 94-4	211.6-211.8	Andesite	130	14	203	12	38	225	17.3	5.9	0.064	18.8	3.2
27859	Nor 94-5	21.1-21.3	Rhyolite A	644	79	65	24	70	293	70.1	4.2	0.034	12.2	2.9
27860	Nor 94-5	71.0-71.4	Rhyolite A	198	31	54	22	90	296	71.4	3.3	0.034	13.5	4.1
27861	Nor 94-5	101.5-103.1	Rhyolite A	527	75	49	25	81	309	71.1	3.8	0.034	12.4	3.2
27862	Nor 94-5	119.4-119.7	Rhyolite A	371	59	60	22	76	285	69.9	3.8	0.034	13.0	3.5
27863	Nor 94-5	130.7-131.0	Rhyolite A	787	120	77	31	96	439	69.9	4.6	0.033	14.2	3.1
27864	Nor 94-5	139.5-139.8	Rhyolite A	408	77	83	25	93	319	70.5	3.4	0.033	12.8	3.7
27865	Nor 94-5	149.5-149.7	Rhyolite A	157	15	90	26	102	315	75.2	3.1	0.035	12.1	3.9
27866	Nor 94-5	153.7-153.9	Rhyolite A	308	41	88	21	73	268	72.7	3.7	0.032	12.8	3.5
27867	*Nor 94-5*	*164.8-165.0*	*Rhyolite A*	*71*	*10*	*125*	*28*	*107*	*353*	*71.7*	*3.3*	*0.034*	*12.6*	*3.8*
27868	Nor 94-5	170.6-170.8	Rhyolite B (hi-Zr)	186	20	85	39	131	669	26.3	5.1	0.016	17.2	3.4
27869	Nor 94-5	178.7-178.9	Evolved basalt*	164	4	153	10	45	217	6.0	4.8	0.071	21.7	4.5
27870	Nor 94-5	201.0-201.2	Evolved basalt*	95	1	122	9	41	185	5.9	4.5	0.072	20.6	4.6
27855	Nor 94-6	63.1-63.3	Dacite	464	44	233	17	62	260	20.0	4.2	0.051	15.3	3.6
27856	Nor 94-6	188.0-188.2	Dacite	351	29	246	13	43	214	18.0	5.0	0.064	16.5	3.3
27857	Nor 94-6	243.7-244.1	Bas. andesite	226	10	238	9	32	175	12.8	5.5	0.080	19.4	3.6
27858	Nor 94-6	251.4-251.7	Rhyolite B (lo-Zr)	371	35	243	6	21	146	30.3	7.0	0.105	24.3	3.5

Italics indicate least altered rhyolite A samples.

Evolved basalt* has P2O5 > 0.3% and TiO2 > 2.0% ('icelandite').

Cr2O3≤0.01% in all samples except 27835 (0.06%) and 27844 (0.04%).

Table 1. Chemical composition of volcanic rocks from S.W. Jessop Township and vicinity (Noranda's 1994 drill program).

Lab No.	Drillhole	Depth (m)	Lithology	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Sum
27827	Nor 94-1	28.1-28.3	Rhyolite A	73.4	0.174	11.3	3.69	0.10	0.52	2.41	0.11	3.86	0.02	4.45	100.15
27828	Nor 94-1	37.3-37.5	Rhyolite A	75.1	0.184	11.2	3.63	0.06	0.41	0.92	2.69	2.39	0.01	3.00	99.70
27829	*Nor 94-1*	*44.3-44.5*	*Rhyolite A*	*76.1*	*0.166*	*11.0*	*3.38*	*0.05*	*0.29*	*0.70*	*5.07*	*0.89*	*0.01*	*2.60*	*100.33*
27830	Nor 94-1	50.7-52.5	Rhyolite A	74.6	0.169	12.0	0.90	0.04	0.08	1.56	0.20	8.45	0.02	1.95	100.14
27831	Nor 94-1	56.7-56.9	Rhyolite A	73.3	0.198	10.9	3.49	0.09	0.57	2.43	0.11	4.10	0.01	4.70	100.00
27832	*Nor 94-1*	*79.7-79.9*	*Rhyolite A*	*75.6*	*0.183*	*12.1*	*3.56*	*0.04*	*0.45*	*0.91*	*4.24*	*1.50*	*0.01*	*1.65*	*100.33*
27833	*Nor 94-1*	*90.4-90.6*	*Rhyolite A*	*74.9*	*0.178*	*11.9*	*3.20*	*0.05*	*0.36*	*1.57*	*4.16*	*1.66*	*0.01*	*2.05*	*100.13*
27834	Nor 94-1	97.1-97.3	Rhyolite A	74.9	0.154	10.3	3.56	0.06	0.40	2.63	2.50	1.91	0.02	3.15	99.68
27835	Nor 94-1	104.0-104.3	Basalt (low-Ti)	50.4	0.500	13.4	7.05	0.11	8.62	7.14	3.48	0.94	0.20	8.50	100.42
27836	Nor 94-1	110.0-110.2	Evolved basalt*	53.6	2.660	12.2	11.90	0.20	4.18	6.38	3.10	0.87	0.44	4.65	100.28
27837	Nor 94-1	131.4-131.4	Evolved basalt*	50.2	2.510	11.7	11.10	0.26	3.48	7.49	3.36	0.98	0.41	8.45	100.03
27838	Nor 94-1	137.7-138.1	Rhyolite B (hi-Zr)	73.0	0.387	11.1	4.63	0.09	0.32	2.83	3.02	1.67	0.05	3.15	100.37
27839	Nor 94-1	160.8-161.4	Evolved basalt*	50.2	2.200	13.6	13.30	0.28	4.46	9.07	3.74	0.35	0.36	2.35	99.97
27840	Nor 94-1	186.9-187.2	Rhyolite B (lo-Zr)	67.7	0.527	15.8	3.85	0.04	1.38	2.09	2.79	3.22	0.14	2.05	99.71
27841	Nor 94-1	190.9-191.2	Rhyolite B (lo-Zr)	71.2	0.372	14.1	3.59	0.03	1.37	1.92	3.95	2.00	0.08	1.45	100.16
27842	Nor 94-1	203.5-203.7	Basalt (gabbro)	52.1	1.130	16.8	12.10	0.13	4.47	5.62	4.70	0.76	0.15	2.25	100.26
27843	Nor 94-1	288.1-288.3	Magnet.-rich mafic	32.7	2.920	8.5	37.60	0.25	6.54	7.75	0.89	0.10	0.03	2.05	99.33
27844	Nor 94-1	294.4-294.6	Basalt	48.6	0.800	15.6	13.50	0.18	6.80	8.64	3.29	0.19	0.05	2.45	100.13
27809	Nor 94-2	23.5-23.7	Rhyolite B (hi-Zr)	68.0	0.468	11.5	8.65	0.17	1.15	2.15	2.66	1.81	0.07	3.25	100.00
27808	Nor 94-2	125.4-125.6	Evolved basalt*	49.0	2.210	12.4	15.10	0.31	2.64	6.18	3.04	1.04	0.44	7.90	100.33
27807	Nor 94-2	252.3-252.5	Evolved basalt	52.1	2.090	13.7	11.10	0.21	4.18	5.58	3.52	1.17	0.18	6.35	100.26
27806	Nor 94-2	280.4-280.6	Rhyolite B (hi-Zr)	69.3	0.556	12.7	5.10	0.12	1.22	2.42	2.14	2.63	0.09	3.35	99.77
27805	Nor 94-2	293.8-294.0	Rhyolite A	69.7	0.157	10.6	6.57	0.19	0.41	1.99	1.47	4.51	0.02	4.55	100.31
27804	Nor 94-2	296.8-297.4	Rhyolite A	81.0	0.160	10.2	1.93	0.03	0.15	0.50	1.38	2.82	0.02	2.00	100.31
27803	Nor 94-2	309.0-309.2	Rhyolite A	73.3	0.206	12.4	3.27	0.07	0.28	1.91	0.14	4.38	0.02	3.80	99.91
27802	Nor 94-2	322.4-322.6	Rhyolite A	76.3	0.154	10.5	2.85	0.06	0.18	0.76	1.82	5.16	0.02	2.30	100.24
27801	Nor 94-2	329.5-329.7	Rhyolite A	78.5	0.150	9.6	2.22	0.06	0.21	1.78	3.52	1.63	0.02	2.58	100.31
27810	Nor 94-3	36.8-37.2	Evolved basalt	54.4	2.570	12.4	11.80	0.42	3.73	6.87	2.34	0.43	0.22	5.05	100.30
27811	Nor 94-3	40.3-40.7	Rhyolite A	75.4	0.190	11.4	2.27	0.05	0.29	1.04	3.31	3.67	0.02	1.35	99.14
27812	*Nor 94-3*	*50.1-50.4*	*Rhyolite A*	*76.5*	*0.192*	*11.8*	*3.30*	*0.05*	*0.39*	*0.50*	*4.79*	*1.49*	*0.02*	*1.00*	*100.12*
27813	*Nor 94-3*	*59.6-60.1*	*Rhyolite A*	*75.5*	*0.164*	*11.1*	*3.48*	*0.08*	*0.23*	*1.55*	*4.50*	*1.40*	*0.01*	*2.00*	*100.10*
27814	Nor 94-3	69.6-69.8	Rhyolite A	75.9	0.149	10.2	3.09	0.09	0.33	2.26	4.28	0.85	0.01	2.60	99.81
27815	Nor 94-3	75.3-75.5	Rhyolite B (lo-Zr)	66.7	0.509	14.9	4.09	0.04	1.35	2.68	4.41	2.12	0.11	3.45	100.45
27816	Nor 94-3	76.5-76.7	Basalt	52.0	1.330	16.8	13.00	0.11	4.35	2.66	2.13	2.54	0.20	5.15	100.37
27817	Nor 94-3	82.8-83.0	Basalt	52.6	1.280	14.9	12.10	0.15	4.00	4.56	2.81	1.71	0.16	6.00	100.35
27818	Nor 94-3	87.5-87.7	Rhyolite B (lo-Zr)	68.3	0.523	15.2	3.34	0.04	1.21	1.91	5.85	1.33	0.11	2.35	100.23
27819	Nor 94-3	93.4-93.6	Rhyolite B (lo-Zr)	69.4	0.418	15.0	3.08	0.03	1.12	2.21	4.54	2.21	0.11	2.30	100.53

Table 1. Chemical composition of volcanic rocks from S.W. Jessop Township and vicinity (Noranda's 1994 drill program).

Lab No.	Drillhole	Depth (m)	Lithology	Ba	Rb	Sr	Nb	Y	Zr	Al2O3/ TiO2	Zr/Y	Al2O3/ Zr	Zr/Nb	Y/Nb
27827	Nor 94-1	28.1-28.3	Rhyolite A	487	115	104	29	105	338	64.9	3.2	0.033	11.7	3.6
27828	Nor 94-1	37.3-37.5	Rhyolite A	467	85	114	32	107	348	60.9	3.3	0.032	10.9	3.3
27829	*Nor 94-1*	*44.3-44.5*	*Rhyolite A*	*137*	*34*	*163*	*27*	*102*	*331*	*66.3*	*3.2*	*0.033*	*12.3*	*3.8*
27830	Nor 94-1	50.7-52.5	Rhyolite A	1050	143	90	27	85	341	71.0	4.0	0.035	12.6	3.1
27831	Nor 94-1	56.7-56.9	Rhyolite A	435	123	109	28	99	325	55.1	3.3	0.034	11.6	3.5
27832	*Nor 94-1*	*79.7-79.9*	*Rhyolite A*	*316*	*48*	*75*	*31*	*114*	*363*	*66.1*	*3.2*	*0.033*	*11.7*	*3.7*
27833	*Nor 94-1*	*90.4-90.6*	*Rhyolite A*	*319*	*46*	*90*	*30*	*103*	*344*	*66.9*	*3.3*	*0.035*	*11.5*	*3.4*
27834	Nor 94-1	97.1-97.3	Rhyolite A	373	50	72	27	95	306	66.9	3.2	0.034	11.3	3.5
27835	Nor 94-1	104.0-104.3	Basalt (low-Ti)	232	31	380	4	17	116	26.8	6.8	0.116	29.0	4.3
27836	Nor 94-1	110.0-110.2	Evolved basalt*	319	19	194	16	60	346	4.6	5.8	0.035	21.6	3.8
27837	Nor 94-1	131.4-131.4	Evolved basalt*	293	13	159	15	51	365	4.7	7.2	0.032	24.3	3.4
27838	Nor 94-1	137.7-138.1	Rhyolite B (hi-Zr)	321	47	94	33	107	630	28.7	5.9	0.018	19.1	3.2
27839	Nor 94-1	160.8-161.4	Evolved basalt*	167	8	168	10	43	194	6.2	4.5	0.070	19.4	4.3
27840	Nor 94-1	186.9-187.2	Rhyolite B (lo-Zr)	746	78	184	10	23	179	30.0	7.8	0.088	17.9	2.3
27841	Nor 94-1	190.9-191.2	Rhyolite B (lo-Zr)	500	50	173	18	61	224	37.9	3.7	0.063	12.4	3.4
27842	Nor 94-1	203.5-203.7	Basalt (gabbro)	186	18	237	1	16	81	14.9	5.1	0.207	81.0	16.0
27843	Nor 94-1	288.1-288.3	Magnet.-rich mafic	90	1	110	1	13	35	2.9	2.7	0.242	35.0	13.0
27844	Nor 94-1	294.4-294.6	Basalt	69	7	182	2	13	40	19.5	3.1	0.390	20.0	6.5
27809	Nor 94-2	23.5-23.7	Rhyolite B (hi-Zr)	584	43	54	22	82	453	24.6	5.5	0.025	20.6	3.7
27808	Nor 94-2	125.4-125.6	Evolved basalt*	263	31	104	15	53	264	5.6	5.0	0.047	17.6	3.5
27807	Nor 94-2	252.3-252.5	Evolved basalt	377	44	134	9	43	157	6.6	3.7	0.087	17.4	4.8
27806	Nor 94-2	280.4-280.6	Rhyolite B (hi-Zr)	674	107	76	24	92	460	22.8	5.0	0.028	19.2	3.8
27805	Nor 94-2	293.8-294.0	Rhyolite A	857	98	87	27	87	317	67.5	3.6	0.033	11.7	3.2
27804	Nor 94-2	296.8-297.4	Rhyolite A	641	74	50	23	73	302	63.8	4.1	0.034	13.1	3.2
27803	Nor 94-2	309.0-309.2	Rhyolite A	639	117	72	27	112	374	60.2	3.3	0.033	13.9	4.1
27802	Nor 94-2	322.4-322.6	Rhyolite A	791	89	52	25	81	319	68.2	3.9	0.033	12.8	3.2
27801	Nor 94-2	329.5-329.7	Rhyolite A	232	44	80	22	98	275	63.7	2.8	0.035	12.5	4.5
27810	Nor 94-3	36.8-37.2	Evolved basalt	167	14	226	14	53	192	4.8	3.6	0.065	13.7	3.8
27811	Nor 94-3	40.3-40.7	Rhyolite A	939	58	74	26	93	346	60.0	3.7	0.033	13.3	3.6
27812	*Nor 94-3*	*50.1-50.4*	*Rhyolite A*	*274*	*44*	*62*	*30*	*110*	*353*	*61.5*	*3.2*	*0.033*	*11.8*	*3.7*
27813	*Nor 94-3*	*59.6-60.1*	*Rhyolite A*	*324*	*40*	*82*	*29*	*104*	*332*	*67.7*	*3.2*	*0.033*	*11.4*	*3.6*
27814	Nor 94-3	69.6-69.8	Rhyolite A	113	18	104	21	88	258	68.5	2.9	0.040	12.3	4.2
27815	Nor 94-3	75.3-75.5	Rhyolite B (lo-Zr)	476	57	149	9	30	175	29.3	5.8	0.085	19.4	3.3
27816	Nor 94-3	76.5-76.7	Basalt	657	62	106	5	27	111	12.6	4.1	0.151	22.2	5.4
27817	Nor 94-3	82.8-83.0	Basalt	502	33	157	3	23	90	11.6	3.9	0.166	30.0	7.7
27818	Nor 94-3	87.5-87.7	Rhyolite B (lo-Zr)	289	32	176	8	29	173	29.1	6.0	0.088	21.6	3.6
27819	Nor 94-3	93.4-93.6	Rhyolite B (lo-Zr)	741	55	154	6	15	166	35.9	11.1	0.090	27.7	2.5

Table 1. Chemical composition of volcanic rocks from S.W. Jessop Township and vicinity (Noranda's 1994 drill program).

Lab No.	Drillhole	Depth (m)	Lithology	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Sum
27821	Nor 94-3	99.4-99.6	Basalt	53.9	1.190	15.1	13.80	0.17	3.65	6.03	2.62	0.92	0.19	2.50	100.15
27820	Nor 94-3	107.1-107.3	Basalt	55.9	1.110	14.9	11.80	0.14	3.47	6.00	3.26	1.16	0.18	1.85	99.85
27822	Nor 94-3	116.4-116.6	Basalt	51.8	1.230	14.7	14.20	0.21	3.86	7.28	2.71	1.06	0.17	1.90	99.19
27823	Nor 94-3	117.8-118.0	Rhyolite B (lo-Zr)	67.3	0.571	15.7	4.32	0.03	1.32	3.19	4.81	1.22	0.12	1.50	100.18
27824	Nor 94-3	123.9-124.1	Basalt	52.2	1.240	14.9	13.80	0.22	3.91	7.22	3.20	0.91	0.16	2.15	99.98
27825	Nor 94-3	130.2-130.4	Basalt	54.0	1.090	14.4	12.70	0.18	3.35	6.69	2.22	0.40	0.18	3.35	98.61
27826	Nor 94-3	132.6-132.8	Rhyolite B (lo-Zr)	66.2	0.560	16.7	3.67	0.04	1.57	2.06	3.23	2.80	0.13	2.95	100.00
27845	Nor 94-3	190.9-191.2	Rhyolite B (lo-Zr)	69.9	0.406	14.4	3.38	0.05	1.26	2.34	3.70	2.25	0.11	2.30	100.19
27846	Nor 94-3	198.1-198.5	Rhyolite B (lo-Zr)	69.2	0.431	14.0	3.49	0.06	1.33	2.75	4.22	1.56	0.11	2.35	99.58
27847	Nor 94-3	203.5-203.8	Andesite	61.3	0.877	14.1	7.50	0.16	2.92	4.74	0.22	3.23	0.15	4.95	100.24
27848	Nor 94-3	234.7-234.8	Rhyolite B (med-Zr)	70.9	0.420	13.4	3.95	0.06	1.16	3.07	2.26	2.39	0.09	2.50	100.31
27849	Nor 94-3	243.3-243.5	Rhyolite B (med-Zr)	69.6	0.448	12.9	4.44	0.07	1.08	3.28	4.01	0.98	0.07	1.60	98.57
27850	Nor 94-4	166.4-166.6	Basalt	51.5	1.160	14.1	14.10	0.22	5.08	8.54	1.16	1.62	0.13	2.15	99.83
27851	Nor 94-4	171.7-171.9	Rhyolite B (lo-Zr)	69.9	0.534	14.4	3.47	0.06	1.50	2.22	5.22	1.23	0.11	1.20	99.91
27852	Nor 94-4	192.3-192.5	Andesite	63.9	0.829	14.4	6.14	0.10	2.75	3.67	3.77	1.93	0.15	1.50	99.23
27853	Nor 94-4	202.2-202.4	Basalt	50.2	1.290	15.0	14.30	0.19	5.45	5.85	1.80	1.15	0.16	4.85	100.31
27854	Nor 94-4	211.6-211.8	Andesite	64.4	0.833	14.4	6.42	0.11	2.68	4.25	4.21	0.47	0.14	2.25	100.23
27859	Nor 94-5	21.1-21.3	Rhyolite A	79.2	0.144	10.1	2.13	0.05	0.20	1.15	1.68	3.42	0.02	1.75	99.96
27860	Nor 94-5	71.0-71.4	Rhyolite A	79.3	0.140	10.0	2.47	0.05	0.29	1.15	3.85	1.22	0.02	1.60	100.15
27861	Nor 94-5	101.5-103.1	Rhyolite A	79.2	0.149	10.6	2.35	0.03	0.34	0.98	1.64	2.99	0.02	1.75	100.16
27862	Nor 94-5	119.4-119.7	Rhyolite A	80.7	0.137	9.6	1.33	0.06	0.16	1.66	1.91	2.34	0.02	2.15	100.12
27863	Nor 94-5	130.7-131.0	Rhyolite A	66.2	0.209	14.6	7.68	0.08	0.88	1.90	0.25	4.34	0.02	4.00	100.31
27864	Nor 94-5	139.5-139.8	Rhyolite A	78.6	0.149	10.5	1.79	0.06	0.22	1.71	1.85	2.73	0.02	2.35	100.08
27865	Nor 94-5	149.5-149.7	Rhyolite A	74.8	0.145	10.9	3.93	0.06	0.20	2.17	4.65	0.96	0.01	2.35	100.24
27866	Nor 94-5	153.7-153.9	Rhyolite A	82.6	0.119	8.7	1.50	0.04	0.10	1.35	2.83	1.46	0.02	1.30	100.05
27867	*Nor 94-5*	*164.8-165.0*	*Rhyolite A*	*75.0*	*0.166*	*11.9*	*4.42*	*0.07*	*0.37*	*0.95*	*5.61*	*0.55*	*0.01*	*1.10*	*100.21*
27868	Nor 94-5	170.6-170.8	Rhyolite B (hi-Zr)	77.7	0.410	10.8	3.45	0.06	0.26	0.99	4.79	0.87	0.05	0.60	100.09
27869	Nor 94-5	178.7-178.9	Evolved basalt*	47.1	2.570	15.3	14.00	0.24	5.64	6.50	3.38	0.62	0.38	4.70	100.49
27870	Nor 94-5	201.0-201.2	Evolved basalt*	52.2	2.250	13.3	11.90	0.22	5.50	7.39	3.88	0.45	0.36	2.85	100.35
27855	Nor 94-6	63.1-63.3	Dacite	64.9	0.664	13.3	5.86	0.10	1.69	3.98	3.40	1.97	0.10	2.75	98.82
27856	Nor 94-6	188.0-188.2	Dacite	64.9	0.762	13.7	6.57	0.11	1.94	4.68	4.01	0.84	0.14	2.30	100.04
27857	Nor 94-6	243.7-244.1	Bas. andesite	57.4	1.090	14.0	8.72	0.15	2.96	7.47	3.00	0.50	0.18	4.65	100.19
27858	Nor 94-6	251.4-251.7	Rhyolite B (lo-Zr)	66.9	0.505	15.3	3.75	0.07	1.60	3.29	4.54	1.40	0.10	1.80	99.34

Italics indicate least altered rhyolite A samples.

Evolved basalt* has P2O5 > 0.3% and TiO2 > 2.0% ('icelandite').

Cr2O3≤0.01% in all samples except 27835 (0.06%) and 27844 (0.04%).

Table 1. Chemical composition of volcanic rocks from S.W. Jessop Township and vicinity (Noranda's 1994 drill program).

Lab No.	Drillhole	Depth (m)	Lithology	Ba	Rb	Sr	Nb	Y	Zr	Al2O3/ TiO2	Zr/Y	Al2O3/	Zr/Nb	Y/Nb
27821	Nor 94-3	99.4-99.6	Basalt	220	24	386	4	27	98	12.7	3.6	0.154	24.5	6.8
27820	Nor 94-3	107.1-107.3	Basalt	291	28	291	5	29	108	13.4	3.7	0.138	21.6	5.8
27822	Nor 94-3	116.4-116.6	Basalt	267	18	314	3	25	94	12.0	3.8	0.156	31.3	8.3
27823	Nor 94-3	117.8-118.0	Rhyolite B (lo-Zr)	507	31	222	9	27	175	27.5	6.5	0.090	19.4	3.0
27824	Nor 94-3	123.9-124.1	Basalt	296	25	272	4	22	91	12.0	4.1	0.164	22.8	5.5
27825	Nor 94-3	130.2-130.4	Basalt	112	1	278	3	26	97	13.2	3.7	0.148	32.3	8.7
27826	Nor 94-3	132.6-132.8	Rhyolite B (lo-Zr)	547	84	118	9	17	155	29.8	9.1	0.108	17.2	1.9
27845	Nor 94-3	190.9-191.2	Rhyolite B (lo-Zr)	535	62	202	8	19	157	35.5	8.3	0.092	19.6	2.4
27846	Nor 94-3	198.1-198.5	Rhyolite B (lo-Zr)	382	39	200	6	25	167	32.5	6.7	0.084	27.8	4.2
27847	Nor 94-3	203.5-203.8	Andesite	484	80	90	10	37	205	16.1	5.5	0.069	20.5	3.7
27848	Nor 94-3	234.7-234.8	Rhyolite B (med-Zr)	504	76	179	16	53	222	31.9	4.2	0.060	13.9	3.3
27849	Nor 94-3	243.3-243.5	Rhyolite B (med-Zr)	272	21	253	19	69	262	28.8	3.8	0.049	13.8	3.6
27850	Nor 94-4	166.4-166.6	Basalt	295	38	299	4	22	79	12.2	3.6	0.178	19.8	5.5
27851	Nor 94-4	171.7-171.9	Rhyolite B (lo-Zr)	250	27	148	9	32	175	27.0	5.5	0.082	19.4	3.6
27852	Nor 94-4	192.3-192.5	Andesite	362	41	230	9	36	190	17.4	5.3	0.076	21.1	4.0
27853	Nor 94-4	202.2-202.4	Basalt	186	25	394	4	23	87	11.6	3.8	0.172	21.8	5.8
27854	Nor 94-4	211.6-211.8	Andesite	130	14	203	12	38	225	17.3	5.9	0.064	18.8	3.2
27859	Nor 94-5	21.1-21.3	Rhyolite A	644	79	65	24	70	293	70.1	4.2	0.034	12.2	2.9
27860	Nor 94-5	71.0-71.4	Rhyolite A	198	31	54	22	90	296	71.4	3.3	0.034	13.5	4.1
27861	Nor 94-5	101.5-103.1	Rhyolite A	527	75	49	25	81	309	71.1	3.8	0.034	12.4	3.2
27862	Nor 94-5	119.4-119.7	Rhyolite A	371	59	60	22	76	285	69.9	3.8	0.034	13.0	3.5
27863	Nor 94-5	130.7-131.0	Rhyolite A	787	120	77	31	96	439	69.9	4.6	0.033	14.2	3.1
27864	Nor 94-5	139.5-139.8	Rhyolite A	408	77	83	25	93	319	70.5	3.4	0.033	12.8	3.7
27865	Nor 94-5	149.5-149.7	Rhyolite A	157	15	90	26	102	315	75.2	3.1	0.035	12.1	3.9
27866	Nor 94-5	153.7-153.9	Rhyolite A	308	41	88	21	73	268	72.7	3.7	0.032	12.8	3.5
27867	*Nor 94-5*	*164.8-165.0*	*Rhyolite A*	*71*	*10*	*125*	*28*	*107*	*353*	*71.7*	*3.3*	*0.034*	*12.6*	*3.8*
27868	Nor 94-5	170.6-170.8	Rhyolite B (hi-Zr)	186	20	85	39	131	669	26.3	5.1	0.016	17.2	3.4
27869	Nor 94-5	178.7-178.9	Evolved basalt*	164	4	153	10	45	217	6.0	4.8	0.071	21.7	4.5
27870	Nor 94-5	201.0-201.2	Evolved basalt*	95	1	122	9	41	185	5.9	4.5	0.072	20.6	4.6
27855	Nor 94-6	63.1-63.3	Dacite	464	44	233	17	62	260	20.0	4.2	0.051	15.3	3.6
27856	Nor 94-6	188.0-188.2	Dacite	351	29	246	13	43	214	18.0	5.0	0.064	16.5	3.3
27857	Nor 94-6	243.7-244.1	Bas. andesite	226	10	238	9	32	175	12.8	5.5	0.080	19.4	3.6
27858	Nor 94-6	251.4-251.7	Rhyolite B (lo-Zr)	371	35	243	6	21	146	30.3	7.0	0.105	24.3	3.5

Italics indicate least altered rhyolite A samples.

Evolved basalt* has P2O5 > 0.3% and TiO2 > 2.0% ('icelandite').

Cr2O3≤0.01% in all samples except 27835 (0.06%) and 27844 (0.04%).

Table 2. Rare-earth-element composition of selected volcanic rocks from S.W. Jessop Township and vicinity.

Sample	Hole	Depth	Lithology	La ppm	Ce ppm	Nd ppm	Sm ppm	Eu ppm	Tb ppm	Yb ppm	Lu ppm	Th ppm	TiO2 %	Zr ppm	Nb ppm	Y ppm	Zr/Y
Previous drilling programs (depth in ft)																	
9711	87-03*	297-299'	Evolved basalt*	13.8	35	22	6.14	2.03	1.3	4.94	0.75	1.6	3.15	241	16	34	7.1
9714	87-02*	239-241'	Rhyolite A	48.6	111	61	14.60	2.42	2.5	10.00	1.52	6.6	0.36	430	24	95	4.5
9715	87-02*	269-271'	Basaltic andesite	10.3	25	16	4.64	1.48	1.0	3.73	0.56	1.0	2.52	149	10	28	5.3
9721	87-03*	249'	Rhyolite B (hi-Zr)	56.9	134	82	22.20	3.51	3.9	15.50	2.35	8.2	0.46	734	31	156	4.7
19967	93-01**	1250'	Evolved dacite	41.6	92	52	12.60	2.60	2.3	9.29	1.40	5.3	0.525	422	20	82	5.1
18223	86-01**	739'	Evolved dacite	40.6	95	58	15.60	4.00	3.0	11.50	1.67	4.7	0.95	421	24	109	3.9
9717	87-03**	154'	Evolved dacite	56.9	125	70	16.50	3.97	2.8	11.80	1.78	5.5	0.85	482	26	119	4.1
9720	87-03**	224'	Evolved dacite	37.3	90	56	15.00	2.86	2.9	10.10	1.48	5.5	0.77	501	28	129	3.9
Noranda 1994 drilling program (depth in m)																	
27832	Nor 94-1	79.7-79.9	Rhyolite A	51.2	110	60	13.90	3.21	2.6	10.90	1.67	6.9	0.183	363	31	114	3.2
27836	Nor 94-1	110.0-110.2	Evolved basalt*	19.4	46	29	7.40	3.21	1.6	6.00	0.91	2.2	2.660	346	16	60	5.8
27838	Nor 94-1	137.7-138.1	Rhyolite B (hi-Zr)	47.1	106	54	12.60	3.45	2.4	11.20	1.77	6.9	0.387	630	33	107	5.9
27841	Nor 94-1	190.9-191.2	Rhyolite B (lo-Zr)	42.2	87	41	8.63	2.13	1.3	6.11	0.93	5.5	0.372	224	18	61	3.7
27807	Nor 94-2	252.3-252.5	Evolved basalt	11.2	28	17	4.91	1.87	1.0	4.36	0.66	1.0	2.090	157	9	43	3.7
27806	Nor 94-2	280.4-280.6	Evolved dacite	42.2	92	48	11.20	3.21	2.0	8.82	1.33	5.3	0.556	460	24	92	5.0
27801	Nor 94-2	329.5-329.7	Rhyolite A	51.0	109	56	12.90	2.20	2.3	8.75	1.41	4.8	0.150	275	22	98	2.8
27812	Nor 94-3	50.1-50.4	Rhyolite A	46.0	100	55	13.10	2.15	2.4	10.30	1.56	6.7	0.192	353	30	110	3.2
27821	Nor 94-3	99.4-99.6	Basalt	21.0	46	23	4.81	1.24	0.6	3.04	0.49	2.1	1.190	98	4	27	3.6
27823	Nor 94-3	117.8-118.0	Rhyolite B (lo-Zr)	30.9	57	26	5.07	0.83	0.7	2.47	0.38	4.0	0.571	175	9	27	6.5
27846	Nor 94-3	198.1-198.5	Rhyolite B (lo-Zr)	17.4	36	19	3.39	1.39	0.6	1.77	0.26	1.7	0.431	167	6	25	6.7
27848	Nor 94-3	234.7-234.8	Rhyolite B (med-Zr)	34.4	70	34	7.19	1.90	1.2	5.26	0.79	5.3	0.420	222	16	53	4.2
27851	Nor 94-4	171.7-171.9	Rhyolite B (lo-Zr)	32.5	64	27	5.44	1.50	0.8	3.33	0.52	4.4	0.534	175	9	32	5.5
27865	Nor 94-5	149.5-149.7	Rhyolite A	59.7	131	68	16.00	3.43	3.1	10.50	1.51	6.3	0.145	315	26	102	3.1
27870	Nor 94-5	201.0-201.2	Evolved basalt	14.0	33	20	5.28	2.21	1.0	4.50	0.70	1.4	2.250	185	9	41	4.5
27858	Nor 94-6	251.4-251.7	Rhyolite B (lo-Zr)	28.6	56	23	4.13	1.50	0.5	1.98	0.30	3.1	0.505	146	6	21	7.0
Kamiskotia primitive basalt (Barrie et al., 1991)				7.3	18.4	11.2	3.7	1.1	0.8	3.4	0.5	0.6	1.36	102	na	30	3.4
Kamiskotia evolved basalt (Barrie et al., 1991)				14.5	37.2	25.1	7.1	2.3	1.5	5.9	0.9	1.6	2.47	302	na	60	5.0

* from Jessop Township report by Barrett and MacLean (1994). ** sampled in 1994 by TJB and LB.

Table 2. Rare-earth-element composition of selected volcanic rocks from S.W. Jessop Township and vicinity.

Hole	Sample	Depth	Lithology	(La)n	(Ce)n	(Nd)n	(Sm)n	(Eu)n	(Tb)n	(Yb)n	(Lu)n	Lan/ Ybn	Zr/Y
Previous drilling programs (depth in ft)													
9711	87-03*	297-299'	Evolved basalt*	56.3	54.9	46.4	39.87	35.00	34.7	29.94	29.53	*1.9*	7.1
9714	87-02*	239-241'	Rhyolite A	198.4	174.0	128.7	94.81	41.72	66.7	60.61	59.84	*3.3*	4.5
9715	87-02*	269-271'	Basaltic andesite	42.0	39.2	33.8	30.13	25.52	26.7	22.61	22.05	*1.9*	5.3
9721	87-03*	249'	Rhyolite B (hi-Zr)	232.2	210.0	173.0	144.16	60.52	104.0	93.94	92.52	*2.5*	4.7
19967	93-01**	1250'	Evolved dacite	169.8	144.2	109.7	81.82	44.83	61.3	56.30	55.12	*3.0*	5.1
18223	86-01**	739'	Evolved dacite	165.7	148.9	122.4	101.30	68.97	80.0	69.70	65.75	*2.4*	3.9
9717	87-03**	154'	Evolved dacite	232.2	195.9	147.7	107.14	68.45	74.7	71.52	70.08	*3.2*	4.1
9720	87-03**	224'	Evolved dacite	152.2	141.1	118.1	97.40	49.31	77.3	61.21	58.27	*2.5*	3.9
Noranda 1994 drilling program (depth in m)													
27832	Nor 94-1	79.7-79.9	Rhyolite A	209.0	172.4	126.6	90.26	55.34	69.3	66.06	65.75	*3.2*	3.2
27836	Nor 94-1	110.0-110.2	Evolved basalt*	79.2	72.1	61.2	48.05	55.34	42.7	36.36	35.83	*2.2*	5.8
27838	Nor 94-1	137.7-138.1	Rhyolite B (hi-Zr)	192.2	166.1	113.9	81.82	59.48	64.0	67.88	69.69	*2.8*	5.9
27841	Nor 94-1	190.9-191.2	Rhyolite B (lo-Zr)	172.2	136.4	86.5	56.04	36.72	34.7	37.03	36.61	*4.7*	3.7
27807	Nor 94-2	252.3-252.5	Evolved basalt	45.7	43.9	35.9	31.88	32.24	26.7	26.42	25.98	*1.7*	3.7
27806	Nor 94-2	280.4-280.6	Evolved dacite	172.2	144.2	101.3	72.73	55.34	53.3	53.45	52.36	*3.2*	5.0
27801	Nor 94-2	329.5-329.7	Rhyolite A	208.2	170.8	118.1	83.77	37.93	61.3	53.03	55.51	*3.9*	2.8
27812	Nor 94-3	50.1-50.4	Rhyolite A	187.8	156.7	116.0	85.06	37.07	64.0	62.42	61.42	*3.0*	3.2
27821	Nor 94-3	99.4-99.6	Basalt	85.7	72.1	48.5	31.23	21.38	16.0	18.42	19.29	*4.7*	3.6
27823	Nor 94-3	117.8-118.0	Rhyolite B (lo-Zr)	126.1	89.3	54.9	32.92	14.31	18.7	14.97	14.96	*8.4*	6.5
27846	Nor 94-3	198.1-198.5	Rhyolite B (lo-Zr)	71.0	56.4	40.1	22.01	23.97	16.0	10.73	10.24	*6.6*	6.7
27848	Nor 94-3	234.7-234.8	Rhyolite B (med-Zr)	140.4	109.7	71.7	46.69	32.76	32.0	31.88	31.10	*4.4*	4.2
27851	Nor 94-4	171.7-171.9	Rhyolite B (lo-Zr)	132.7	100.3	57.0	35.32	25.86	21.3	20.18	20.47	*6.6*	5.5
27865	Nor 94-5	149.5-149.7	Rhyolite A	243.7	205.3	143.5	103.90	59.14	82.7	63.64	59.45	*3.8*	3.1
27870	Nor 94-5	201.0-201.2	Evolved basalt	57.1	51.7	42.2	34.29	38.10	26.7	27.27	27.56	*2.1*	4.5
27858	Nor 94-6	251.4-251.7	Rhyolite B (lo-Zr)	116.7	87.8	48.5	26.82	25.86	13.3	12.00	11.81	*9.7*	7.0
Kamiskotia primitive basalt (Barriet et al., 1991)				29.8	28.8	23.6	23.83	18.79	21.3	20.30	21.26	*1.5*	3.4
Kamiskotia evolved basalt (Barriet et al., 1991)				59.2	58.3	53.0	46.30	39.66	40.0	35.58	35.43	*1.7*	5.0
		chondrite		0.245	0.638	0.474	0.154	0.058	0.038	0.165	0.025		

chondrite abundances from Evensen et al. (1978).

Table 3. Chemical composition of volcanic rocks from drillholes K2-87-2 and 87-3, southwestern Jessop township.
(on LOI-free basis)

Hole	Depth	Sampler	Number	Report	Lithology	SiO2	Al2O3	TiO2	FeO	MnO	CaO	MgO	K2O	Na2O	P2O5
Hole 87-2															
K2-87-2	111'	TJB-LB	30210	Present	Rhyolite A	73.54	12.73	0.22	5.04	0.13	1.47	0.57	2.30	3.98	0.02
K2-87-2	144-145'	TJB-LB	30207	Present	Rhyolite A	73.71	10.95	0.19	7.19	0.32	1.43	0.66	1.69	3.85	0.01
K2-87-2*	183'	TJB-LB	30208	Present	Rhyolite B (hi-Zr)	71.68	12.45	0.50	5.60	0.11	1.31	0.38	3.72	4.19	0.05
K2-87-2	209-211'	Nor.	9713	Jessop 2	Rhyolite A	71.51	12.66	0.25	4.24	0.24	3.34	0.57	2.39	4.50	0.03
K2-87-2	239-241'	Nor.	9714	Jessop 2	Rhyolite A	74.51	12.38	0.36	4.42	0.10	0.92	0.73	2.49	4.05	0.04
K2-87-2	269-271'	Nor.	9715	Jessop 2	Basaltic andesite	54.30	14.28	2.52	8.94	0.33	7.66	5.29	3.22	2.20	0.19
K2-87-2	279-281'	Nor.	16710	Jessop 1	Rhyolite A	75.48	12.70	0.28	1.88	0.07	1.64	0.40	2.09	5.42	0.04
K2-87-2	316.2-318.2'	Nor.	16711	Jessop 1	Rhyolite A	75.09	12.08	0.23	3.35	0.11	1.61	0.41	1.36	5.72	0.03
K2-87-2	358-359'	LB	18227	Jessop 2	Rhyolite A	78.67	10.48	0.25	1.74	0.07	1.09	0.15	5.53	1.91	0.03
K2-87-2	374.8-376.8'	Nor.	16712	Jessop 1	Rhyolite A	65.36	17.28	0.34	5.83	0.17	1.59	0.48	3.04	5.88	0.03
Hole 87-3															
K2-87-3	125'	LB	9716	Jessop 2	Evolved dacite	72.94	10.43	0.75	6.02	0.20	4.49	0.77	1.59	2.60	0.16
K2-87-3	154'	LB	9717	Jessop 2	Evolved dacite	72.77	11.49	0.85	6.20	0.11	2.01	0.55	1.57	4.22	0.17
K2-87-3*	174'	LB	9718	Jessop 2	Evolved dacite	71.45	11.72	0.86	6.70	0.12	2.31	0.63	1.86	4.11	0.17
K2-87-3	189'	LB	9719	Jessop 2	Evolved dacite	73.05	11.77	0.88	3.92	0.09	2.84	0.50	1.72	4.99	0.17
K2-87-3*	224'	LB	9720	Jessop 2	Evolved dacite	76.32	10.48	0.77	3.40	0.07	2.37	0.42	0.97	5.00	0.16
K2-87-3	249'	LB	9721	Jessop 2	Rhyolite B (hi-Zr)	69.23	12.08	0.46	6.80	0.11	4.23	1.18	2.85	2.93	0.06
K2-87-3*	265'	TJB-LB	30209	Present	Rhyolite B (hi-Zr)	75.93	11.15	0.43	4.41	0.08	1.01	0.71	1.68	4.53	0.05
K2-87-3	297-299'	Nor.	9711	Jessop 2	Evolved basalt*	52.42	14.22	3.15	16.57	0.27	5.27	4.68	0.97	0.45	0.47
K2-87-3	317-319'	Nor.	9712	Jessop 2	Evolved basalt*	51.36	13.46	3.31	15.02	0.31	6.44	5.94	1.35	0.72	0.50
K2-87-3	368'	TJB-LB	30210	Present	Rhyolite B (lo-Zr)	70.95	15.46	0.55	3.27	0.06	1.15	1.55	4.56	2.35	0.11
K2-87-3	400'	LB	9722	Jessop 2	Dacite	67.11	13.79	0.70	5.72	0.12	5.10	1.53	4.39	1.30	0.13
K2-87-3	419-422'	Nor.	16714	Jessop 1	Rhyolite B (hi-Zr)	68.18	15.13	0.57	3.83	0.06	1.14	1.79	5.63	3.54	0.12
K2-87-3	424'	LB	9723	Jessop 2	Evolved basalt clast	51.07	13.01	2.00	15.73	0.14	7.42	3.72	3.95	2.54	0.32
K2-87-3	463.5'	LB	K2-87-3	Jessop 1	Rhyolite B (lo-Zr)	67.01	15.10	0.54	4.21	0.08	1.95	1.90	6.98	2.06	0.16
K2-87-3	488.5'	LB	K2-87-3	Jessop 1	Rhyolite B (lo-Zr)	66.26	16.89	0.58	4.30	0.08	3.30	1.70	2.32	4.40	0.17

Sampled by: Nor. = Noranda, TJB-LBL = T. Barrett - L. Bonhomme.

* Thin section description in petrography section of this report.

Table 3. Chemical composition of volcanic rocks from drillholes K2-87-2 and 87-3, southwestern Jessop township.

(on LOI-free basis)

Hole	Depth	Sampler	Number	Lithology	Orig.	Orig.	Anh	Ba	Sr	Y	Zr	Rb	Nb	Zr/Y	Al2O3	Zr/Nb
Hole 87-2																
K2-87-2	111'	TJB-LB	30210	Rhyolite A	1.55	100.40	100.00	600	61	121	370	80	36	3.1	58.7	10.4
K2-87-2	144-145'	TJB-LB	30207	Rhyolite A	1.80	100.40	100.00	336	43	102	325	76	38	3.2	58.2	8.6
K2-87-2	183'	TJB-LB	30208	Rhyolite B (hi-Zr)	2.20	99.40	100.00	683	85	168	713	90	46	4.4	24.7	15.6
K2-87-2	209-211'	Nor.	9713	Rhyolite A	3.30	100.1	100.00	393	88	102	394	76	25	3.9	51.3	15.8
K2-87-2	239-241'	Nor.	9714	Rhyolite A	1.80	98.30	100.00	744	46	95	430	76	24	4.5	34.2	18.0
K2-87-2	269-271'	Nor.	9715	Basaltic andesite	10.0	99.10	100.00	510	112	28	149	68	10	5.2	5.7	14.6
K2-87-2	279-281'	Nor.	16710	Rhyolite A	1.93	99.8	100.00	809	492	170	512	69	40	3.0	45.4	12.8
K2-87-2	316.2-318.2'	Nor.	16711	Rhyolite A	2.23	98.6	100.00	590	79	141	423	68	25	3.0	52.5	16.9
K2-87-2	358-359'	LB	18227	Rhyolite A	1.35	98.83	100.00	775	64	65	317	84	21	4.9	41.5	15.5
K2-87-2	374.8-376.8'	Nor.	16712	Rhyolite A	2.93	99.6	100.00	638	208	201	520	121	53	2.6	50.8	9.8
Hole 87-3																
K2-87-3	125'	LB	9716	Evolved dacite	3.90	99.22	100.00	442	91	127	452	33	25	3.6	13.9	17.8
K2-87-3	154'	LB	9717	Evolved dacite	1.70	98.92	100.00	556	97	119	482	40	26	4.1	13.6	18.6
K2-87-3	174'	LB	9718	Evolved dacite	1.95	99.88	100.00	532	99	129	501	56	28	3.9	13.7	18.0
K2-87-3	189'	LB	9719	Evolved dacite	2.10	100.2	100.00	513	103	121	510	48	29	4.2	13.4	17.8
K2-87-3	224'	LB	9720	Evolved dacite	1.70	100.3	100.00	396	107	102	444	28	23	4.4	13.6	19.0
K2-87-3	249'	LB	9721	Rhyolite B (hi-Zr)	2.60	99.31	100.00	713	189	156	734	85	31	4.7	26.2	23.5
K2-87-3	265'	TJB-LB	30209	Rhyolite B (hi-Zr)	0.85	100.20	100.00	518	95	150	645	54	36	4.4	25.8	17.7
K2-87-3	297-299'	Nor.	9711	Evolved basalt*	4.30	100.4	100.00	543	218	34	241	22	16	7.1	4.5	15.1
K2-87-3	317-319'	Nor.	9712	Evolved basalt*	4.90	99.50	100.00	429	205	39	262	34	12	6.8	4.1	22.1
K2-87-3	368'	TJB-LB	30210	Rhyolite B (lo-Zr)	1.95	100.10	100.00	1044	44	26	205	110	9	8	28.2	22.2
K2-87-3	400'	LB	9722	Dacite	2.15	99.82	100.00	904	174	10	145	85	8	14.1	19.8	17.6
K2-87-3	419-422'	Nor.	16714	Rhyolite B (hi-Zr)	1.47	99.7	100.00	2116	400	5	1390	97		272	26.4	
K2-87-3	424'	LB	9723	Evolved basalt clast	3.90	99.24	100.00	850	244	30	194	84	13	6.5	6.5	15.2
K2-87-3	463.5'	LB	K2-87-3	Rhyolite B (lo-Zr)	1.57	99.7	100.00	2024	134	27	157			5.9	27.8	
K2-87-3	488.5'	LB	K2-87-3	Rhyolite B (lo-Zr)	2.65	97.7	100.00	310	250	25	175			6.9	29.1	

Sampled by: Nor. = Noranda, TJB-LBL = T. Barrett - L. Bonhomme.

* Thin section description in petrography section of this report.

TABLE 4. Calculated mass changes for Rhyolite A, S.W. Jessop Township and vicinity (Noranda's 1994 drilling program).

Drillhole	Depth (m)	Sample	SiO2	TiO2	Al2O3	Fe2O3	FeO*	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Sum	*Anh. Sum
Raw data																
Nor 94-1	28.1-28.3	27827	73.40	0.174	11.30	3.69	3.32	0.10	0.52	2.41	0.11	3.86	0.02	4.45	100.15	95.33
Nor 94-1	37.3-37.5	27828	75.10	0.184	11.20	3.63	3.27	0.06	0.41	0.92	2.69	2.39	0.01	3.00	99.70	96.34
Nor 94-1	*44.3-44.5*	*27829*	*76.10*	*0.166*	*11.00*	*3.38*	3.04	*0.05*	*0.29*	*0.70*	*5.07*	*0.89*	*0.01*	*2.60*	100.33	97.39
Nor 94-1	50.7-52.5	27830	74.60	0.169	12.00	0.90	0.81	0.04	0.08	1.56	0.20	8.45	0.02	1.95	100.14	98.10
Nor 94-1	56.7-56.9	27831	73.30	0.198	10.90	3.49	3.14	0.09	0.57	2.43	0.11	4.10	0.01	4.70	100.00	94.96
Nor 94-1	*79.7-79.9*	*27832*	*75.60*	*0.183*	*12.10*	*3.56*	3.20	*0.04*	*0.45*	*0.91*	*4.24*	*1.50*	*0.01*	*1.65*	100.33	98.33
Nor 94-1	*90.4-90.6*	*27833*	*74.90*	*0.178*	*11.90*	*3.20*	2.88	*0.05*	*0.36*	*1.57*	*4.16*	*1.66*	*0.01*	*2.05*	100.13	97.76
Nor 94-1	97.1-97.3	27834	74.90	0.154	10.30	3.56	3.20	0.06	0.40	2.63	2.50	1.91	0.02	3.15	99.68	96.17
Nor 94-2	296.8-297.4	27804	81.00	0.160	10.20	1.93	1.74	0.03	0.15	0.50	1.38	2.82	0.02	2.00	100.31	98.11
Nor 94-2	309.0-309.2	27803	73.30	0.206	12.40	3.27	2.94	0.07	0.28	1.91	0.14	4.38	0.02	3.80	99.91	95.78
Nor 94-2	322.4-322.6	27802	76.30	0.154	10.50	2.85	2.56	0.06	0.18	0.76	1.82	5.16	0.02	2.30	100.24	97.65
Nor 94-2	329.5-329.7	27801	78.50	0.150	9.56	2.22	2.00	0.06	0.21	1.78	3.52	1.63	0.02	2.58	100.31	97.50
Nor 94-3	40.3-40.7	27811	75.40	0.190	11.40	2.27	2.04	0.05	0.29	1.04	3.31	3.67	0.02	1.35	99.14	97.57
Nor 94-3	*50.1-50.4*	*27812*	*76.50*	*0.192*	*11.80*	*3.30*	2.97	*0.05*	*0.39*	*0.50*	*4.79*	*1.49*	*0.02*	*1.00*	100.12	98.79
Nor 94-3	*59.6-60.1*	*27813*	*75.50*	*0.164*	*11.10*	*3.48*	3.13	*0.08*	*0.23*	*1.55*	*4.50*	*1.40*	*0.01*	*2.00*	100.10	97.75
Nor 94-3	69.6-69.8	27814	75.90	0.149	10.20	3.09	2.78	0.09	0.33	2.26	4.28	0.85	0.01	2.60	99.81	96.90
Nor 94-5	21.1-21.3	27859	79.20	0.144	10.10	2.13	1.92	0.05	0.20	1.15	1.68	3.42	0.02	1.75	99.96	98.00
Nor 94-5	71.0-71.4	27860	79.30	0.140	9.99	2.47	2.22	0.05	0.29	1.15	3.85	1.22	0.02	1.60	100.15	98.30
Nor 94-5	101.5-103.1	27861	79.20	0.149	10.60	2.35	2.11	0.03	0.34	0.98	1.64	2.99	0.02	1.75	100.16	98.17
Nor 94-5	119.4-119.7	27862	80.70	0.137	9.57	1.33	1.20	0.06	0.16	1.66	1.91	2.34	0.02	2.15	100.12	97.84
Nor 94-5	130.7-131.0	27863	66.20	0.209	14.60	7.68	6.91	0.08	0.88	1.90	0.25	4.34	0.02	4.00	100.31	95.54
Nor 94-5	139.5-139.8	27864	78.60	0.149	10.50	1.79	1.61	0.06	0.22	1.71	1.85	2.73	0.02	2.35	100.08	97.55
Nor 94-5	149.5-149.7	27865	74.80	0.145	10.90	3.93	3.54	0.06	0.20	2.17	4.65	0.96	0.01	2.35	100.24	97.50
Nor 94-5	153.7-153.9	27866	82.60	0.119	8.65	1.50	1.35	0.04	0.10	1.35	2.83	1.46	0.02	1.30	100.05	98.60
Nor 94-5	164.8-165.0	*27867*	75.00	0.166	11.90	4.42	3.98	0.07	0.37	0.95	5.61	0.55	0.01	1.10	100.21	98.67
*Normal sum uses Fe2O3; anhydrous sum uses FeO																
Least altered rhyolite A																
Nor 94-1	44.3-44.5	*27829*	76.10	0.166	11.00	3.38	3.04	0.05	0.29	0.70	5.07	0.89	0.01	2.60	100.33	97.39
Nor 94-1	79.7-79.9	*27832*	75.60	0.183	12.10	3.56	3.20	0.04	0.45	0.91	4.24	1.50	0.01	1.65	100.33	98.33
Nor 94-1	90.4-90.6	*27833*	74.90	0.178	11.90	3.20	2.88	0.05	0.36	1.57	4.16	1.66	0.01	2.05	100.13	97.76
Nor 94-3	50.1-50.4	*27812*	76.50	0.192	11.80	3.30	2.97	0.05	0.39	0.50	4.79	1.49	0.02	1.00	100.12	98.79
Nor 94-3	59.6-60.1	*27813*	75.50	0.164	11.10	3.48	3.13	0.08	0.23	1.55	4.50	1.40	0.01	2.00	100.10	97.75
	Average (5)		**75.72**	**0.177**	**11.58**	**3.38**	**3.04**	**0.05**	**0.34**	**1.05**	**4.55**	**1.39**	**0.01**	**1.86**	**100.20**	**98.00**
	St. Dev. (5)		0.61	0.012	0.50	0.14	0.13	0.02	0.09	0.49	0.38	0.29	0.01	0.59	0.12	

TABLE 4. Calculated mass changes for Rhyolite A, S.W. Jessop Township and vicinity (Noranda's 1994 drilling program).

Drillhole	Depth (m)	Sample	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Sum	Al pre/ Al alt
<u>Normalized to 100%</u>															
Nor 94-1	28.1-28.3	27827	76.99	0.183	11.85	3.48	0.10	0.55	2.53	0.12	4.05	0.02		100.00	0.997
Nor 94-1	37.3-37.5	27828	77.95	0.191	11.63	3.39	0.06	0.43	0.95	2.79	2.48	0.01		100.00	1.017
Nor 94-1	*44.3-44.5*	*27829*	*78.14*	*0.170*	*11.29*	*3.12*	*0.05*	*0.30*	*0.72*	*5.21*	*0.91*	*0.01*		*100.00*	*1.047*
Nor 94-1	50.7-52.5	27830	76.04	0.172	12.23	0.83	0.04	0.08	1.59	0.20	8.61	0.02		100.00	0.966
Nor 94-1	56.7-56.9	27831	77.19	0.209	11.48	3.31	0.09	0.60	2.56	0.12	4.32	0.01		100.00	1.030
Nor 94-1	*79.7-79.9*	*27832*	*76.89*	*0.186*	*12.31*	*3.26*	*0.04*	*0.46*	*0.93*	*4.31*	*1.53*	*0.01*		*100.00*	*0.961*
Nor 94-1	*90.4-90.6*	*27833*	*76.62*	*0.182*	*12.17*	*2.95*	*0.05*	*0.37*	*1.61*	*4.26*	*1.70*	*0.01*		*100.00*	*0.971*
Nor 94-1	97.1-97.3	27834	77.88	0.160	10.71	3.33	0.06	0.42	2.73	2.60	1.99	0.02		100.00	1.104
Nor 94-2	296.8-297.4	27804	82.56	0.163	10.40	1.77	0.03	0.15	0.51	1.41	2.87	0.02		100.00	1.137
Nor 94-2	309.0-309.2	27803	76.53	0.215	12.95	3.07	0.07	0.29	1.99	0.15	4.57	0.02		100.00	0.913
Nor 94-2	322.4-322.6	27802	78.13	0.158	10.75	2.63	0.06	0.18	0.78	1.86	5.28	0.02		100.00	1.099
Nor 94-2	329.5-329.7	27801	80.51	0.154	9.80	2.05	0.06	0.22	1.83	3.61	1.67	0.02		100.00	1.206
Nor 94-3	40.3-40.7	27811	77.28	0.195	11.68	2.09	0.05	0.30	1.07	3.39	3.76	0.02		100.00	1.012
Nor 94-3	*50.1-50.4*	*27812*	77.44	0.194	11.94	3.01	0.05	0.39	0.51	4.85	1.51	0.02		100.00	0.990
Nor 94-3	*59.6-60.1*	*27813*	77.24	0.168	11.36	3.20	0.08	0.24	1.59	4.60	1.43	0.01		100.00	1.041
Nor 94-3	69.6-69.8	27814	78.32	0.154	10.53	2.87	0.09	0.34	2.33	4.42	0.88	0.01		100.00	1.123
Nor 94-5	21.1-21.3	27859	80.82	0.147	10.31	1.96	0.05	0.20	1.17	1.71	3.49	0.02		100.00	1.147
Nor 94-5	71.0-71.4	27860	80.67	0.142	10.16	2.26	0.05	0.30	1.17	3.92	1.24	0.02		100.00	1.163
Nor 94-5	101.5-103.1	27861	80.68	0.152	10.80	2.15	0.03	0.35	1.00	1.67	3.05	0.02		100.00	1.095
Nor 94-5	119.4-119.7	27862	82.48	0.140	9.78	1.22	0.06	0.16	1.70	1.95	2.39	0.02		100.00	1.208
Nor 94-5	130.7-131.0	27863	69.29	0.219	15.28	7.23	0.08	0.92	1.99	0.26	4.54	0.02		100.00	0.774
Nor 94-5	139.5-139.8	27864	80.57	0.153	10.76	1.65	0.06	0.23	1.75	1.90	2.80	0.02		100.00	1.098
Nor 94-5	149.5-149.7	27865	76.72	0.149	11.18	3.63	0.06	0.21	2.23	4.77	0.98	0.01		100.00	1.057
Nor 94-5	153.7-153.9	27866	83.77	0.121	8.77	1.37	0.04	0.10	1.37	2.87	1.48	0.02		100.00	1.347
Nor 94-5	164.8-165.0	*27867*	76.01	0.168	12.06	4.03	0.07	0.37	0.96	5.69	0.56	0.01		100.00	0.980
<u>Least altered rhyolite A</u>															
	Average (5)		**77.26**	**0.180**	**11.82**	**3.11**	**0.06**	**0.35**	**1.07**	**4.64**	**1.42**	**0.01**		**100.00**	

TABLE 4. Calculated mass changes for Rhyolite A, S.W. Jessop Township and vicinity (Noranda's 1994 drilling program).

Drillhole	Depth (m)	Sample	SiO2	TiO2	Al2O3	Fe2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	Sum
<u>Reconstituted composition (based on Al anchor)</u>														
Nor 94-1	28.1-28.3	27827	76.78	0.182	11.82		3.47	0.10	0.54	2.52	0.12	4.04	0.02	99.72
Nor 94-1	37.3-37.5	27828	79.26	0.194	11.82		3.45	0.06	0.43	0.97	2.84	2.52	0.01	101.67
Nor 94-1	*44.3-44.5*	*27829*	*81.77*	*0.178*	*11.82*		*3.27*	*0.05*	*0.31*	*0.75*	*5.45*	*0.96*	*0.01*	*104.65*
Nor 94-1	50.7-52.5	27830	73.48	0.166	11.82		0.80	0.04	0.08	1.54	0.20	8.32	0.02	96.63
Nor 94-1	56.7-56.9	27831	79.49	0.215	11.82		3.41	0.10	0.62	2.64	0.12	4.45	0.01	102.97
Nor 94-1	*79.7-79.9*	*27832*	*73.85*	*0.179*	*11.82*		*3.13*	*0.04*	*0.44*	*0.89*	*4.14*	*1.47*	*0.00*	*96.05*
Nor 94-1	*90.4-90.6*	*27833*	*74.40*	*0.177*	*11.82*		*2.86*	*0.05*	*0.36*	*1.56*	*4.13*	*1.65*	*0.00*	*97.10*
Nor 94-1	97.1-97.3	27834	85.95	0.177	11.82		3.68	0.07	0.46	3.02	2.87	2.19	0.02	110.36
Nor 94-2	296.8-297.4	27804	93.86	0.185	11.82		2.01	0.03	0.17	0.58	1.60	3.27	0.02	113.70
Nor 94-2	309.0-309.2	27803	69.87	0.196	11.82		2.80	0.07	0.27	1.82	0.13	4.18	0.02	91.30
Nor 94-2	322.4-322.6	27802	85.89	0.173	11.82		2.89	0.07	0.20	0.86	2.05	5.81	0.02	109.93
Nor 94-2	329.5-329.7	27801	97.06	0.185	11.82		2.47	0.07	0.26	2.20	4.35	2.02	0.02	120.55
Nor 94-3	40.3-40.7	27811	78.18	0.197	11.82		2.12	0.05	0.30	1.08	3.43	3.81	0.02	101.16
Nor 94-3	*50.1-50.4*	*27812*	*76.63*	*0.192*	*11.82*		*2.97*	*0.05*	*0.39*	*0.50*	*4.80*	*1.49*	*0.02*	*98.96*
Nor 94-3	*59.6-60.1*	*27813*	*80.40*	*0.175*	*11.82*		*3.33*	*0.09*	*0.24*	*1.65*	*4.79*	*1.49*	*0.01*	*104.09*
Nor 94-3	69.6-69.8	27814	87.95	0.173	11.82		3.22	0.10	0.38	2.62	4.96	0.99	0.01	112.30
Nor 94-5	21.1-21.3	27859	92.69	0.169	11.82		2.24	0.06	0.23	1.35	1.97	4.00	0.02	114.69
Nor 94-5	71.0-71.4	27860	93.83	0.166	11.82		2.63	0.06	0.34	1.36	4.56	1.44	0.02	116.31
Nor 94-5	101.5-103.1	27861	88.32	0.166	11.82		2.36	0.03	0.38	1.09	1.83	3.33	0.02	109.47
Nor 94-5	119.4-119.7	27862	99.67	0.169	11.82		1.48	0.07	0.20	2.05	2.36	2.89	0.02	120.84
Nor 94-5	130.7-131.0	27863	53.59	0.169	11.82		5.59	0.06	0.71	1.54	0.20	3.51	0.02	77.35
Nor 94-5	139.5-139.8	27864	88.48	0.168	11.82		1.81	0.07	0.25	1.92	2.08	3.07	0.02	109.81
Nor 94-5	149.5-149.7	27865	81.11	0.157	11.82		3.83	0.07	0.22	2.35	5.04	1.04	0.01	105.73
Nor 94-5	153.7-153.9	27866	112.87	0.163	11.82		1.84	0.05	0.14	1.84	3.87	2.00	0.03	134.73
Nor 94-5	164.8-165.0	*27867*	74.50	0.165	11.82		3.95	0.07	0.37	0.94	5.57	0.55	0.00	98.00

TABLE 4. Calculated mass changes for Rhyolite A, S.W. Jessop Township and vicinity (Noranda's 1994 drilling program).

Mass changes (in weight %)

Drillhole	Depth (m)	Sample	Δ SiO_2	ΔTiO_2	ΔAl_2O_3	ΔFeO	ΔMnO	ΔMgO	ΔCaO	ΔNa_2O	ΔK_2O	ΔP_2O_5	ΔSum (includes traces)
Nor 94-1	28.1-28.3	27827	-0.49	0.002	0.00	0.37	0.05	0.19	1.45	-4.53	2.62	0.01	-0.28
Nor 94-1	37.3-37.5	27828	1.99	0.014	0.00	0.34	0.01	0.08	-0.10	-1.81	1.11	0.00	1.67
Nor 94-1	*44.3-44.5*	*27829*	*4.51*	*-0.002*	*0.00*	*0.16*	*0.00*	*-0.04*	*-0.32*	*0.80*	*-0.46*	*0.00*	4.65
Nor 94-1	50.7-52.5	27830	-3.78	-0.014	0.00	-2.31	-0.02	-0.27	0.47	-4.45	6.91	0.01	-3.37
Nor 94-1	56.7-56.9	27831	2.22	0.035	0.00	0.30	0.04	0.27	1.57	-4.53	3.03	0.00	2.97
Nor 94-1	*79.7-79.9*	*27832*	*-3.41*	*-0.001*	*0.00*	*0.02*	*-0.02*	*0.09*	*-0.18*	*-0.50*	*0.05*	*0.00*	-3.95
Nor 94-1	*90.4-90.6*	*27833*	*-2.87*	*-0.003*	*0.00*	*-0.25*	*-0.01*	*0.01*	*0.49*	*-0.51*	*0.23*	*0.00*	-2.90
Nor 94-1	97.1-97.3	27834	8.69	-0.003	0.00	0.57	0.01	0.11	1.95	-1.78	0.78	0.01	10.36
Nor 94-2	296.8-297.4	27804	16.60	0.005	0.00	-1.09	-0.02	-0.18	-0.49	-3.05	1.85	0.02	13.70
Nor 94-2	309.0-309.2	27803	-7.39	0.016	0.00	-0.30	0.01	-0.08	0.75	-4.51	2.76	0.01	-8.70
Nor 94-2	322.4-322.6	27802	8.63	-0.007	0.00	-0.22	0.01	-0.15	-0.21	-2.60	4.39	0.01	9.93
Nor 94-2	329.5-329.7	27801	19.79	0.005	0.00	-0.64	0.02	-0.09	1.13	-0.29	0.60	0.02	20.55
Nor 94-3	40.3-40.7	27811	0.91	0.017	0.00	-0.99	0.00	-0.05	0.01	-1.21	2.39	0.01	1.16
Nor 94-3	*50.1-50.4*	*27812*	*-0.63*	*0.012*	*0.00*	*-0.13*	*-0.01*	*0.04*	*-0.57*	*0.15*	*0.08*	*0.01*	-1.04
Nor 94-3	*59.6-60.1*	*27813*	*3.13*	*-0.006*	*0.00*	*0.23*	*0.03*	*-0.11*	*0.58*	*0.15*	*0.07*	*0.00*	4.09
Nor 94-3	69.6-69.8	27814	10.69	-0.008	0.00	0.11	0.05	0.03	1.55	0.31	-0.43	0.00	12.30
Nor 94-5	21.1-21.3	27859	15.42	-0.012	0.00	-0.86	0.00	-0.12	0.28	-2.68	2.59	0.02	14.69
Nor 94-5	71.0-71.4	27860	16.56	-0.015	0.00	-0.48	0.00	-0.01	0.29	-0.09	0.03	0.02	16.31
Nor 94-5	101.5-103.1	27861	11.05	-0.014	0.00	-0.75	-0.02	0.03	0.03	-2.82	1.92	0.01	9.47
Nor 94-5	119.4-119.7	27862	22.41	-0.011	0.00	-1.63	0.02	-0.15	0.98	-2.29	1.47	0.02	20.84
Nor 94-5	130.7-131.0	27863	-23.67	-0.011	0.00	2.49	0.01	0.36	0.47	-4.44	2.10	0.01	-22.65
Nor 94-5	139.5-139.8	27864	11.22	-0.012	0.00	-1.29	0.01	-0.10	0.86	-2.56	1.66	0.01	9.81
Nor 94-5	149.5-149.7	27865	3.85	-0.023	0.00	0.73	0.01	-0.13	1.29	0.40	-0.38	0.00	5.73
Nor 94-5	153.7-153.9	27866	35.61	-0.018	0.00	-1.26	0.00	-0.21	0.78	-0.78	0.58	0.02	34.73
Nor 94-5	164.8-165.0	27867	-2.77	-0.015	0.00	0.84	0.01	0.02	-0.12	0.93	-0.87	0.00	-2.00