part, or the heterogeneous type. In the northern part of the province the level of erosion has not attained sufficient depth to expose the zoned portion of the pegmatite, resulting in outcrops only of the homogeneous part. This is suggested by study of the dispersion aureoles and is promising for future mining in the area.

## STUDIES OF MICAS FROM UNCOMMON ROCKS. I. MICAS FROM NEPHELINE SYENITE, BLUE MOUNTAIN, ONTARIO, AND FROM CARBONATITE, OKA, QUEBEC

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Chemical compositions and paragenetic studies of micas from the Blue Mountain nepheline deposit indicate at least five periods of crystallization of micaceous minerals:

1. *Brown biotite*: $(K_{1.9}Na_{.07})(Al_{.86}Ti_{.24}Fe_{.42}'''Fe_{2.14}''Mg_{2.02}Mn_{.08}Li_{.08})(Si_{5.2}Al_{2.8})O_{20}(OH_{2.99}F_{.27}Cl_{.18}O_{.28})$ resembles in chemical composition biotites of the surrounding paragneisses. It contains more manganese and titanium, and appears to be older than other micas from the nepheline synenite. It is succeeded by
2. *Coarse-grained muscovite*: with brown bands along the (001) fractures; and
3. *Bright-green biotite*: $(K_{1.91}Na_{.08})(Al_{.54}Ti_{.15}Fe_{1.02}'''Fe_{2.54}''Mg_{1.07}Mn_{.09}Li_{.09})(Si_{5.27}Al_{2.73})O_{20}(OH_{2.42}F_{.32}Cl_{.06}O_{.60})$. The green biotite replaces the brown mica along the fractures. It contains a relatively high ratio of ferric iron to ferrous iron and apparently crystallizes in an alkalic environment.
4. *Medium-fine-grained muscovite* with fine-grained cancrinite replace nepheline along the fractures, and are post-nepheline.
5. *Very-fine-grained "hydronephelite"*: a mixture of muscovite and analcite, is a hydrothermal or diagenetic alteration product of nepheline; it also replaces feldspars and coarse micaceous minerals. The "hydronephelite" contains relatively high strontium (777 ppm) and very little iron (0.4%).

The iron-rich biotite oxidizes on weathering to orange-yellow mica that contains a high ratio of ferric iron to ferrous iron: $(K_{1.34}Na_{.08}Ca_{.08})(Al_{.37}Ti_{.13}Fe_{2.94}'''Fe_{.38}''Mg_{1.2}Mn_{.07})(Si_{5.05}Al_{2.95})O_{19.34}(OH_{4.99}F_{.30})$, and finally alters to vermiculite.

The biotite from the Oka carbonatite is zoned, thus resembling zoned biotites from alkali lamprophyres. However, the succession of the mica zones is different; in micas from alkali lamprophyres the outermost band adjacent to feldspathic groundmass is enriched in iron, whereas in micas from the carbonatite, the outermost band adjacent to carbonate groundmass is pale beige (poor in iron). Electron probe microanalysis of the zoned micas indicated two- to five-fold variations in concentrations of Al, Fe, Mg and Ti while Si and K remained fairly constant. The zoned mica reflects changing physico-chemical conditions during crystallization of carbonatite.

This study presents two examples of the stability of micas: (1) the zoned mica with earlier-formed zones retaining their chemical composition during crystallization of successive zones in a calcic environment, and (2) the unstable brown mica which is being replaced by green mica under apparently alkalic conditions.

## TEMPERATURE AND SALINITY OF THE ORE-FORMING FLUIDS AT PINE POINT, NORTHWEST TERRITORIES, CANADA, FROM FLUID INCLUSION STUDIES

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Although much of the Pine Point ore does not contain usable fluid inclusions, some sphalerite crystals from vugs and "colloform" crusts were found to contain rare, primary, liquid-gas inclusions adequate for study. These had freezing temperatures ranging

from −24.6 to −36 °C, indicating exceedingly saline brines (saturated NaCl solution freezes at −21°). Most inclusions suitable for filling-temperature determination homogenized at +71° to +108 °C. A small pressure correction must be added to obtain the trapping temperature.

Dolomite crystals from some of the same vugs contain large numbers of primary inclusions, many of which have leaked. Those that have not leaked had similar filling temperatures, but considerably lower salinities. Inclusions in a 4-cm cleavage fragment of calcite appeared to have similar gas/liquid ratios, but had still lower salinities (freezing temperatures −3 to −5 °C).

The significance of these data lies in the limitations they place on the choice of possible mechanisms of origin of these large deposits. This choice, in turn, may influence the success in prospecting for blind orebodies. There is general agreement that the deposits are Mississippi Valley type. Although the high salinities probably reflect solution of salts from the evaporite sequence to the south, the elevated temperatures seem to require deep circulation, perhaps through known faults in the underlying Precambrian. The densities of these brines, even at their elevated temperatures, are well above that of fresh, cold surface water, thus restricting the possible modes of circulation during ore deposition.

## ELECTRON PROBE STUDIES OF SOME CANADIAN TELLURIDE MINERALS

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As part of a broader study of telluride minerals from world wide localities, several Canadian specimens have been subjected to electron microprobe examination. The unique occurrences at Robb Montbray, Quebec, have proved most interesting, and it has been possible to confirm the suspected formula of frohbergite, $FeTe_2$. Frohbergite has also been found in association with petzite in specimens from Noranda, Quebec and Lindquist Lake, British Columbia. The enigmatic gold telluride, montbrayite, $Au_2Te_3$(?), has been shown to contain essential Pb and Bi, formerly ascribed to impurities in the chemical analysis, and the association of this phase with calaverite, $AuTe_2$, has been noted. A new Pb–Ti telluride, probable formula $(Pb, Bi)_3Te_4$, has been found as minute inclusions in chalcopyrite from Robb Montbray.

Specimens of petzite, $AuAg_3Te_2$, from Robb Montbray, Noranda-Kirkland Lake area, and isolated localities in western Canada have been shown to have a constant stoichiometric composition, while being extremely sensitive to the effect of electron bombardment. Hessite, $Ag_2Te$, is similarly constant in composition, but calaverite $AuTe_2$ has a variable amount of silver.

The electron microprobe studies have clarified the range of variation of telluride mineral compositions, and in many respects confirmed earlier synthetic work.

## EXPERIMENTAL DETERMINATION OF THE STABILITY OF ALUMINOUS IRON BIOTITES

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Many natural biotites, contain more aluminum than biotites of the join phlogopite–annite. Phase relations of such biotites have been determined at 2 Kb pressure. Compositions lie on the join $K_2Fe_6Al_2Si_6O_{20}(OH)_4$—$K_2Fe_{4.5}Al_{4.3}Si_5O_{20}(OH)_4$ with some octahedral vacancies.