PROCEEDINGS OF THE TENTH ANNUAL MEETING OF THE MINERALOGICAL ASSOCIATION OF CANADA

The tenth annual meeting of the Mineralogical Association of Canada was held on March 8-10, 1965 at the Royal Ontario Museum, Toronto, Ontario. This was the first attempt by the Association to hold a meeting independent of other Associations. In addition to the 65 paid registrants there was an undetermined number of students in attendance. The attendance at the technical sessions and the business meeting and the interest shown by members were evidence of the success of the convention.

The general business meeting of the Association was held on Tuesday, March 9, and the President, Dr. W. W. Moorhouse was chairman. The Treasurer's financial report showed a balance of $3,208.35 at the end of 1964. In addition the Association holds a guaranteed investment of $3,000 with the Royal Trust Company which yields interest at 4½% per annum. The Secretary reported that in the election of officers for 1965, 845 ballots were distributed and 296 ballots were cast and the following slate was elected:

President	W. W. Moorhouse
Vice President	M. H. Frohberg
Secretary	S. Kaiman
Treasurer	H. R. Steacy
Committee Members	A. R. Graham
	J. A. Mandarino
	K. L. Currie
	J. R. Smith
	A. J. Frueh, Jr.
	W. E Hale
	D. M. Shaw

Membership as of January 31, 1965 numbered 777, composed of 527 ordinary and associate members, 246 corporate members and 4 student members.

The Editor Dr. L. G. Berry reported that since the 1964 annual meeting Volume 8, Parts 1 and 2 of The Canadian Mineralogist had been published. It was expected that Part 3 would go to press in April. Dr. Berry planned to prepare a detailed set of instructions to authors.

Dr. Moorhouse presented a summary of the proceedings of the M.A.C. Executive meeting which had been held the previous day. Appointments had been made to the membership committee, the nominating committee and to the program committees for the 1966 meeting in Halifax and the 1967 meeting in Kingston. The Executive Committee had approved the insertion of half-page advertisements of the M.A.C. in The American Mineralogist and the Mineralogical Magazine.

The annual dinner of the Association was held on Monday, March 8 in the King Cole Room of the Park Plaza Hotel. Mrs. Ernest Cornford won the draw for the door prize which consisted of a desk pen set, a gift of the Royal Ontario Museum. The speaker of the evening was Dr. D. M. Shaw, the retiring president, and the title of his address was "Homo Sapiens Mineralogicus—An Extinct Species?" Dr. D. H. Gorman was master-of-ceremonies for the occasion.

The technical sessions were held on March 8 and 9. The following are abstracts of the papers presented.

TRANSMISSION ELECTRON MICROSCOPY OF FINE-GRAINED ROCKS

Ronald V. Allen, Richard W. Braman,
Robert K. McConnell, Jr., John L. O'Brien
Arthur D. Little, Inc., Cambridge, Massachusetts

We have recently prepared ultra-thin sections of fine-grained rocks for study by transmission electron microscopy. Because the sample is not crushed or broken during preparation (thinning is accomplished by a delicate mechanical polishing technique) it is possible to determine the relationships between individual minerals. The application of this technique to an argillite demonstrates that rock systems composed of minerals of differing hardness and cleavage may be studied by transmission electron microscopy.

CHEMICAL STUDY OF INDONESIA'S VOLCANIC ROCKS

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Case Institute of Technology, Cleveland, Ohio

This study is based on published and unpublished analyses made available by the Indonesian Geological Survey. Indonesia exhibits a petrochemical zoning parallel to its tectonic features, the inner belts being older, the outer ones younger. From south to north (foreland to continental margin) the zones are alkalic, ophiolitic, alkali-lime (present volcanic arc) and potassic (Sunda Shelf). No longitudinal changes could be noted.

EUCOLITE FROM ST. HILAIRE, P.Q.

Jean Boissonnault and Guy Perrault
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Eucolite from St. Hilaire, P.Q., corresponds approximately to the chemical formula $(Na, Ca, Ce)_6ZrSi_6O_{18}(OH,Cl)_2$. It occurs in pegmatites within the Monteregian alkaline intrusive of Mont St. Hilaire. Refractive index for Na light is 1.622; it is but weakly birefringent. Twinning is frequent although it is not readily apparent in thin sections. The twinning law and the correct space group are currently being determined. The mineral is reddish-brown in color; hardness is 5 to 6. Density is 3.01. Differential thermal analysis shows a small exothermic peak at 890° C. and a larger asymmetric endothermic peak at 1050° C.; the melting point of the mineral had not been reached at 1100° C. Nomenclature of minerals of this group is critically examined.

COMPOSITION OF SOME GRENVILLE APATITES

G. M. BOONE,[1] J. R. KRAMER,[1] D. R. PEACOR[2]
[1] *Syracuse University, Syracuse, New York*
[2] *The University of Michigan, Ann Arbor*

Apatites from Gatineau-Lievre, Quebec; Oka, Quebec; Bancroft, Ontario; and Nemegos, Ontario have been collected and analysed by chemical, optical, infra-red, and *x*-ray procedures. All of the apatites analysed contain CO_2 which is apparently present as part of the apatite structure. CO_2 varies from 0.09 to 0.81 weight per cent. There is no detectable structural water. Hence the apatites are somewhat similar to sedimentary francolites.

ω and ϵ were determined by single variation method measuring immersion liquid with a refractometer simultaneously and isothermally with the same liquid in contact with the grains. Sodium light was used in conjunction with conoscopic method on the universal stage. Thermometers at U-stage and on refractometer were inter-calibrated. A revised λ and temperature correction for the refractometer prism glass was also used. These procedures give a maximum estimated error of ± 0.006 and an average error of ± 0.003. ω varies from 1.6359 to 1.6406 and ϵ varies from 1.6318 to 1.6365; both ω and ϵ decrease with increasing CO_2 content. A Nemegos apatite apparently high in iron gives slightly anomalous results.

Cell parameters were determined by least-squares refinement of powder data. Cell constants obtained are: $a = 9.371$ to 9.400 Å, and $c = 6.883$ to 6.916 Å. Maximum estimated error (two standard deviations) was ± 0.0006 Å with an average estimated error of ± 0.0003 Å. c/a varies only from 0.7335 to 0.7356. There is no apparent relationship between c, a, or c/a and CO_2 content.

Infra-red absorption patterns of pelletized KBr mixtures show the same pattern for these crystalline apatites as for Permian Phosphoria formation "oolites" (1.44 % CO_2) and "fish scales" (1.91% CO_2). Apatites exhibit absorptions at 865, 1428, and 1454 $cm.^{-1}$, whereas apparent comparable absorptions for rhombohedral carbonates (calcite) are at 879 and 1425 cm^{-1}. The 713 cm^{-1} carbonate absorption was not detected in the carbonate-fluor-apatites. There were no discernible differences in the absorption spectra due to phosphate in fluor-apatite compared to carbonate-fluor-apatite.

Variation of CO_2 content suggests that apatites may be good p-t indicators.

THE INTERPRETATION OF THE RECIPROCAL LATTICE IN RANDOMLY ORIENTED SINGLE CRYSTALS

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Information, which can be used to determine the orientation of a randomly oriented crystal, can be obtained from three flat film rotation photographs. A simple mathematical expression which involves two linear film measurements and a small arbitrary arc movement gives ρ angles for reciprocal lattice vectors (which define the orientation of real lattice planes). A stereographic plot of a number of such reciprocal lattice vectors, with the axis of rotation as the projection axis, reveals the direction of principal zone axes. These zone axes represent important directions in the real lattice and, with the aid of the stereogram, they may be brought to a desired setting for conventional reciprocal lattice photography. If a sufficient number of vectors are plotted on the stereogram, something of crystal symmetry becomes apparent and the measurement of interaxial angles together with 2θ values derived from the rotation photographs provides data on lattice parameters.

MOLYBDENUM MINERALIZATION AND SUBSEQUENT VOLCANISM NEAR DEATH VALLEY

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Precambrian marine and clastic sedimentary rocks at the north end of Death Valley have been regionally metamorphosed and intruded by medium to acid igneous rocks of upper Cretaceous age. Extensive Tertiary (?) volcanics overlie both the metasediments and intrusives.

A mineralization and hydrothermal alteration zone extends in a NW-SE trend for approximately 20 miles, and a smaller parallel zone may exist. Copper, lead, tungsten, gold, molybdenum and talc prospects occur along this belt, with the copper mineralization at the southern end, then Pb-Mo, Mo-W, then Au-Ag and finally talc where the zone disappears under the recent sediment in Fish Lake Valley.

Molybdenite mineralization is associated with sericite-quartz alteration of granite and alaskite, and is controlled by a shear zone dipping 70 to 85 degrees to the northeast. The locus of molybdenite concentration is within the altered granite-alaskite mass where it is in contact with marble.

Later volcanism and associated solfatara type alteration has been imposed upon the earlier quartz-sericite-molybdenite assemblage and has leached the sulphide zone. Numerous sulfates occurs in the alteration zone, including a jarosite in which some sulfate has been replaced by molybdate.

Active leaching of molybdenite is presently occurring in the presence of acid ground water.

A WATER DEFICIENT LEONHARDITE FROM LABRADOR WITH NOTES ON EXTINCTION ANGLES IN RANDOM SECTION

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A mineral from Grand Falls, Hamilton River, Labrador, yields on chemical analysis the formula: $(Ca_{.549}Fe''_{.029}Mg_{.043}Mn''_{.001})$ $(Na_{.351}K_{.377}Ba_{.010})$ $(Al_{1.790}Fe'''_{.030})$ $(Si_{4.129}Ti_{.008})$ O_{12}. $(H_2O_{1.589}CO_{2.020}Cl_{2\ .004})$

The mineral occurs as joint and shear fillings in syenite. Optical, *x*-ray and infra-red data are presented and discussed. The evidence suggests that the mineral is a leonhardite-laumontite mineral. It is deficient in water, however, having only 1.6 mol H_2O instead of 3.5 H_2O. Diadochic replacement appears to be mainly of the zeolite type, i.e., $Ca^{++} \leftrightharpoons 2(Na+, K+)$ with perhaps a minor amount of coupled replacement, e.g., $Ca^{++}Al^{+++} \leftrightharpoons Na^{+}\ Si^{++++}$.

Investigation of the optical properties of the mineral revealed a conflict in the literature on the method of predicting extinction angles in a random section. It is concluded that the correct theory is in agreement with experimental observations recorded by Coombs.

NOTES ON POTASSIUM METASOMATISM AND K^{40}/Ar^{40} DATING OF PRECAMBRIAN GRANITES

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Granitoid batholiths in the Canadian Shield commonly consist of two principal phases, an older synorogenic low-potash grey tonalite and a younger high-potash pink to red granite-granodiorite. Field and laboratory investigations support the conclusion that the younger red granites have been developed by extensive potassium metasomatism of the older grey tonalites, and that this process is closely associated with the emplacement of the ubiquitous pegmatites in the batholithic masses. In a number of localities it can be shown that the pegmatites are significantly younger than and not derived from the tonalites, since they cut ultra-mafic rocks intruded along fault zones which transect and offset the batholithic masses. The genesis of such pegmatites remains a petrologic puzzle; no simple relationship can be assumed between extensive pegmatization (i.e., potassium metasomatism) of batholithic rocks and major orogenies. Dating of many Precambrian granitoid masses by the K^{40}/Ar^{40} method gives the ages of the last periods of potassium metasomatism of these rocks, but does not necessarily indicate the timing of significant orogenic events.

VARIATIONS IN THE HAFNIUM-ZIRCONIUM RATIO OF GRANITIC ROCKS FROM EASTERN ONTARIO: PART II, THE CROW LAKE DOME

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The Hf/Zr ratio of the Crow Lake quartz monzonite is 0.022 with a mean deviation of 0.0014. Just outside the boundaries of the mass the ratio falls to about 0.018, then rises to a sharp peak exceeding 0.030. The height and location of this peak are practically independent of rock type, but often occur in unusually basic gneisses. Passing outward, the Hf/Zr ratio decreases slowly from a maximum to values between 0.025 and 0.030. This pattern is interpreted to show migration of material from the surrounding metamorphic envelope into the granitic mass. Differential solubility of Hf and Zr is inadequate to explain this result, but a combination of vapour diffusion and differential solubility could yield the observed pattern.

A RECONSIDERATION OF THE STRONTIUM ISOTOPE METHOD OF DISTINGUISHING CARBONATITES FROM MELTED LIMESTONES

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It has been argued in the literature that calcite from carbonatite complexes has a Sr 87/86 ratio that is measurably lower than that of calcite from sedimentary limestones. It has been argued further that the ratio for limestones does not change during metamorphism and that this measurable difference therefore can be used to prove that carbonatites are not melted sedimentary limestones. Results are presented here which suggest that when a limestone undergoes intensive metamorphism and metasomatism (essentially the conditions that would prevail if a limestone were melted by a magma) there is a convergence of Sr 87/86 ratios toward those of carbonatites. The widely publicized method based on strontium isotope ratios is probably invalid, although we still do not believe that carbonatites are melted limestones.

A COPPER TELLURO-SELENIDE FROM MOCTEZUMA, MEXICO

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A copper telluro-selenide found in trace amounts on specimens from Mina Moctezuma, Sonora, Mexico, has been determined to be a new species.

The mineral occurs in microcrystalline form associated with klockmannite, native selenium, native tellurium, chalcomenite, tellurite, paratellurite, illite, quartz and calcite. In colour, lustre and hardness it closely resembles klockmannite with which it is intimately associated and from which it is indistinguishable by sight.

The diffraction data show that the mineral is tetragonal with unit cell dimensions $a = 5.46$, $c = 5.63$ Å. and has a cubic-ZnS type structure. The strongest lines of the powder pattern are 3.19(10), 1.961(7), 1.931(4), 1.653(5).

GEOLOGY OF THE NEWLY DISCOVERED CARBONATITE OF INDIA

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The first Indian carbonatite has been discovered by R. N. Sukheswala and G. R. Udas in the Amba Dongar area, about 23 miles south of Chhota Udaipur, Baroda District, Gujarat State, western India (21° 59′ 30 ″ N. lat., 74° 4′ 34 ″ E. long.). The carbonatite is part of a ring complex (4 miles in diameter) of alkalic rocks that has been intruded into Cretaceous sandstones and limestones (Bagh beds) and has domed and albitized overlying Deccan basalts. Younger basalts cover part of the intrusive; thus the intrusive is of intra-Deccanage (Cretaceous-Eocene).

The centre of the complex is marked by the dome of basalts, dropped down along a ring-fault. A cone sheet of carbonatite that flanks this sunken cap is surrounded by an annular body of various nepheline-aegirine rocks (largely ijolite, some with melanite).

The outermost unit at the southern side is a breccia in which fragments of foliated sövite, of sandstone and of basalt are set in a matrix of nepheline-aegirine-orthoclase-calcite rock. The complex is cut by lamprophyric and other alkalic dikes. Exterior to the complex are four large parallel breccia dikes consisting of an ijolitic matrix and fragments of aegirine sövite, pyroxenite, Bagh sediments and basalt. These strike north of east, parallel with the trend of the Narbada River, which lies just south of the complex and which follows the trend of a major fault ("rift").

The petrologically variable carbonatite cone sheet contains: (oldest) 1. Coarse white martite sövite; 2. Ophanitic brown, radioactive barite-anhydrite-fluorite carbonatite; 3. Fluorite replacement masses; 4. Silicified ("cherty") carbonatite and (youngest) 5. Fluorite veins.

The body is an unusually fine example of a carbonatitic cone-sheet ring complex intruded under a hypabyssal environment.

CATAPLEIITE FROM ST. HILAIRE, P.Q.

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Catapleiite from St. Hilaire, P.Q., is hexagonal, dipyramidal; its space group is $P6/mmc$. Cell dimensions are : $a = 7.40$Å and $c = 10.02$Å. Optical properties for Na light are $w = 1.588$, $e = 1.622$. Uniaxial (+).

Differential thermal analysis reveals that catapleiite from St. Hilaire on heating goes through a small endothermic reaction around 150° C., a more important endothermic reaction at 430° C., some slight exothermic readjustments around 580° C. and an important endothermic reaction at 1000° C. Melting point had not been reached at 1100° C.

Catapleiite from St. Hilaire shows beautiful spiral growths. Anomalous $2V$ observed at the periphery of certain crystals may be related to dislocations.

MANGAN-NEPTUNITE, EPIDIDYMITE AND NEW SPECIES FROM MONT ST. HILAIRE, QUEBEC

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Mangan-neptunite, the manganese analogue of neptunite, occurs as simple, well-formed monoclinic crystals of prismatic habit elongated parallel to [001]. The following forms have been noted: {010}, {100}, {110}, {121}. Most of the crystals are zoned; the inner portion is dark reddish brown, almost black, in large fragments, while the outer portions are yellow. The dark reddish brown material has $(Mn_{.87}Fe_{.10}Zn_{.03})$ and the yellow material has $(Mn_{.84}Zn_{.15}Fe_{.01})$. The unit cell parameters of the two types are about the same as those given for neptunite by Berry (1963).

Epididymite was found as small (3 × 3 × 5 mm.), pseudohexagonal prisms with a pronounced basal cleavage. Unit cell data are in good agreement with those quoted by Strunz (1957). St. Hilaire epididymite is optically biaxial with $\alpha = 1.539$, $\beta = 1.543$, $\gamma = 1.544$, $2V(-)$ very small, $a = \alpha$, $b = \gamma$.

A new species, a sample of which is being submitted for complete analysis, is extremely widespread in its occurrence at St. Hilaire. It is present as wellformed single crystals and as intergrown radiating groups. Crystals are usually less than 2 mm. in length. The mineral is orthorhombic, space $Pmmm$, $a = 7.24$, $b = 8.49$, $c = 5.02$: Å, $a{:}b{:}c = 0.8527 : 1 : 0.5912$. Optical properties are: biaxial, $2V(-) = 90°$ (86° calc), $\alpha = 1.680$, $\beta = 1.725$, $\gamma = 1.768$, $a = \alpha$, $b = \beta$, high dispersion of the optic axes. The mineral is pink to lilac, has a specific gravity of 4.15, and a perfect prismatic cleavage. Spectrographic (x-ray and emission) and other tests indicate that the mineral is a carbonate of Ca, Sr, and rare earths. The x-ray powder pattern is distinct from those of other chemically similar minerals. Strongest lines (in Å for Cu$K\alpha$) are: 4.31 (10), 2.935 (9), 5.51 (8) and 2.330 (7).

A second possibly new species is a calcium, potassium, zirconium silicate. It occurs as small, brown pseudohexagonal crystals which proved to be monoclinic with space group $P2_1/a$. Cell parameters are: $a = 12.24$, $b = 10.57$, $c = 8.06$ Å, $\beta = 101°10'$. The strongest lines in the x-ray powder pattern (Cu$K\alpha$) are: 3.16(10), 6.02(9), 5.28(7), 3.05(7), and 3.00(5) all in Å. The specific gravity is 2.68. The mineral is biaxial with $\alpha = 1.593$ and $\gamma = 1.608$.

NOTES ON THE RELATIONSHIP OF COMPOSITION TO THERMOLUMINESCENCE OF PLAGIOCLASE AND PYRRHOTITE

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A preliminary study of the thermoluminescence of plagioclase feldspars appears to indicate a progressive decrease in emission with increased anorthite content. Greater than 0.085% MnO also appears to have a depressing effect on the emission. Radioactivity from K^{40} had no discernable effect on the thermoluminescence. Monoclinic pyrrhotite was found to show a strong emission of light during rapid heating, apparently the result of oxydization of some of the sulphur. Hexagonal pyrrhotite was found to be non-luminescent. This emission is not thermoluminescence, but could readily be confused with it.

PLAGIOCLASE-SPINEL-GRAPHITE XENOLITHS IN METALLIC IRON-BEARING BASALTS, DISKO ISLAND, GREENLAND

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Xenoliths composed mainly of plagioclase (An_{70-75}), graphite and rose-colored spinel are associated with metallic iron-bearing basalts from Uivfak, Disko Island, Greenland. The xenoliths are remarkably similar to reconstituted shale xenoliths in basaltic rocks from other localities except for the presence of graphite and in the composition of the spinel. The spinel has $n = 1.747 \pm 0.001$, $a = 8.119 \pm 0.002$ and $D = 3.81 \pm 0.01$, and electron microprobe analysis gave Mg = 13 and Fe = 8.9%, corresponding to a spinel with composition $Sp_{78}He_{22}$. This unusually low Fe content compared to spinels from other aluminous xenoliths in basaltic rocks is evidently related to the low oxygen fugacities in basaltic magmas in contact with graphite, particularly in an environment such as Disko, where active reduction of ferrous iron to iron evidently occurred.

The close similarities in the mineralogy of the xenoliths from specimen to specimen indicate complete equilibration of magma and xenoliths. This equilibration involved mainly loss of K and perhaps Si, and gain of Ca, Mg, Cr and Ni by the xenoliths.

The xenoliths in their similarities to known reconstituted shale xenoliths, their graphite content, and low-iron spinel substantiate the idea of derivation of the metallic iron by near surface reduction of basaltic magma by carbonaceous sedimentary rocks (Törnebohm, 1878; Steenstrup, 1883), rather than derivation of the metallic iron from the mantle (Lindgren, 1933; Urey, 1952).

METALLIC LUSTRE AND THE FORBIDDEN ENERGY GAP

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The metallic lustre of minerals depends on the size of the forbidden energy gap, i.e., in semi-conductor theory, the amount of energy required to transfer an electron from the valence to the conduction band. If the energy gap is greater than the energy of visible light, the mineral has non-metallic lustre; if smaller, it has metallic lustre. In semi-conducting materials with small energy gaps, which includes most sulphides, the energy provided by visible light impinging on the surface of the sample is sufficient to promote the bonding electrons into the conduction band, thereby making the surface conducting. It is suggested that the presence of conduction electrons, as in metals, results in the characteristic appearance known as metallic lustre.

A NEW SULPHO-SALT MINERAL

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The type specimen of cuprobismuthite (U.S.N.M. 92902, Missouri mine, Park County, Colorado) has yielded a new sulpho-salt mineral. It occurs very sparsely with aikinite, emplectite and cuprobismuthite in cavities as lath-like crystals measuring no more than 1 mm. in length. The structural cell is monoclinic with

$$a = 12.72,\ b = 4.02 \text{ (axis of elongation)},\ c = 58.07,\ \beta = 102\tfrac{1}{2}°$$

A pronounced psedo-cell has

$$a' = a/3 = 4.24,\ b' = b = 4.02,\ c' = c/2 = 29.04,\ \beta 102\tfrac{1}{2}°$$

A second occurrence at the Nordmark mines, Sweden, has provided more, although less pure, material for *x*-ray spectrographic analyses and density determinations. Based on the data available, the most likely cell contents are

$$Pb_{12}(Cu,Ag)_{18}Bi_{30}S_{66} = 6\,[Pb_2(Cu,Ag)_3Bi_5S_{11}]$$

The calculated density, 7.11, compares with a measured value of 6.7, corrected for an estimated 10 per cent contamination by quartz.

The name berryite is proposed for this mineral.

THE GOLD CENTRE PORPHYRY OF THE PORCUPINE SYNCLINE

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In 1962 Dome Mines began a drive to explore the ground around the Gold Centre Porphyry. The original crosscut and subsequent drifting and diamond drilling necessitate a reappraisal of the problems of the age and character of the Gold Centre Porphyry. Since 1933 this rock unit has been considered an extrusive pyroclastic, possibly an ash-flow tuff. The lithologic features of the Gold Centre Porphyry, however, include few of the supposed criteria of an ash-flow tuff. Structurally the unit is seen to truncate and assimilate slate and conglomerate beds. Slate blocks within the Gold Centre maintain the strike and dip of the parent slate unit. Fragmental bands within the porphyry are believed to represent partially replaced lenses of conglomerate, although some bands may be breccias formed during the process of intrusion. The Gold Centre Porphyry is considered to be a quartz-albite porphyry sill of late Keewatin age.

ORIGIN OF ANORTHOSITE-MANGERITE ROCKS IN SOUTHERN QUEBEC

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Rocks of the anorthosite-mangerite suite were intruded in many places in the southern part of the Grenville province. Analyses of these rocks indicate that they form a single magmatic series which is not exactly comparable with any other known rock series.

It is concluded that the anorthosite-mangerite rocks are derived from a calcalkaline parental magma that underwent differentiation in a very dry environment and hence gave rise to the strong iron enrichment that is found. Early accumulation of plagioclase from the parental magma to form anorthosites may be due to an increase in the size of the field of primary crystallization of intermediate and sodic plagioclases under high pressures. The fact that intrusion took place during an orogenic period is of great importance, for the rocks in more deformed areas are more differentiated than those in less deformed areas.

A PRELIMINARY INVESTIGATION OF THE PETROLOGY AND MELTING RELATIONS OF THE BLUE MOUNTAIN, ONTARIO, LITCHFIELDITES

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The Blue Mountain complex consists of nepheline syenites (litchfieldites) and leucosyenites surrounded by Precambrian granites, orthogneisses and paragneisses. The litchfieldite occurs as an elongate pear-shaped body approximately six miles in length and with a N.E.-S.W. strike. Several theories have been proposed for the origin of the litchfieldites, most prominent of which are a magmatic and metasomatic origin.

In order to shed further light on the origin of these rocks, preliminary melting relations at atmospheric pressure and at 330 bars P_{H_2O} have been determined by the quenching method. The objective of these experiments is to determine liquidus temperatures, sequences of crystallization and compositions of the crystallizing phases.

Two analysed samples, one a normal litchfieldite (BM5) the other a ferrohastingsite-rich litchfieldite (BM1) but both containing less than 5 percent modal mafic constituents, have been chosen for these experiments. At atmospheric pressure BM1 melts at 1127°-1138° C. and BM5 at 1138°-1146° C. In both samples nepheline is the first phase to crystallize, closely followed by feldspar at 20°–25° C. below the liquidus. At 330 bars P_{H_2O} BM5 melts in the range 928-938° C. with feldspar as the primary phase at liquidus temperatures.

Modal and normative analyses of litchfieldites from this locality have been recalculated to quartz-nepheline-kalsilite and many plot close to the undersaturated low temperature trough in petrogeny's residua system thus indicating a magmatic origin for this complex. However the melting temperatures of BM1 and BM5 are 100°-120° C. higher than the temperatures for the corresponding compositions in the synthetic system; thus suggesting that the presence of even very minor amounts of components not represented by this system may have a large effect on liquidus temperatures. Therefore, temperatures inferred from synthetic systems based on plotting recalculated rock compositions should be used with caution.

SYNTHETIC WODGINITE, TAPIOLITE AND TANTALITE

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The compositional ranges of tapiolite and tantalite in the system $MnTa_2O_6$ - $FeTa_2O_6$ were defined by synthesis at temperatures 1000° to 1400° C. Oxidation of these phases produced small amounts of exsolved Ta_2O_5 plus one or both of two phases with compositions in the join $MnTa_2O_6$ - $FeTaO_4$. These two phases are wodginite and a rutile-structure ferri-tantalate. The composition of this wodginite is $Mn^{+2}_{2-2w}Fe^{+3}_{3w}Ta_{4-w}O_{12}$, with $0.08 < w < 0.23$ at 1200° C.

The definition of wodginite is therefore extended by (1) the iron is trivalent, the manganese bivalent, and (2) Sn is not an essential component. Also, wodginite may be classified in the wolframite group.

The occurrence of wodginite in a pegmatite indicates oxidizing conditions, in contrast to the more common conditions of lower oxygen activity which produces tantalite and/or tapiolite.

QUARTZ DIORITES FROM THE NORTH RANGE, SUDBURY

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Core from a vertical drill hole at the Strathcona Mine contains approximately 650 feet of "quartz diorite" separated into two nearly equal sections by nearly 90 feet of norite. Above the "quartz diorite" lies the main body of norite, and below it is the granitic basement. The "quartz diorite" core is extremely complex and variable in character, due to the presence of altered sections, vague breccia zones, and numerous inclusions. The inclusions vary in composition from dunite through pyroxenite, olivine norite, and norite to anorthosite. The noritic and anorthositic inclusions are characterized by a fine-grained mosaic texture, and the plagioclases are usually darkened by inclusions of iron oxide. It is concluded that the "quartz diorite" intrusive phase has broken through, incorporated, and metamorphosed fragments of a granulated and brecciated banded basic to ultrabasic complex. The fragments have been completely recrystallized, and the boundaries of the inclusions are characterized by interlocking of grains of inclusion and matrix. This conclusion is consistent with H. D. B. Wilson's view of the structure of the Sudbury irruptive.

PHASE RELATIONS IN THE JOIN $NaAlSiO_4$-$CaCO_3$-(25%)H_2O AND THE ORIGIN OF SOME CARBONATITE-ALKALIC ROCK COMPLEXES

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In part of a study aimed at elucidation of the genetic relations between carbonatite and alkalic igneous rocks, phase fields intersected by the join $NaAlSiO_4$-$CaCO_3$-(25%)H_2O were determined in the temperature range 600-960° C. at 1000 bars pressure. Liquid, in equilibrium with an aqueous vapour phase and a variety of crystalline phases, persists to temperatures on the order of 700° C. Phase assemblages across the join are characterized by melilite (Mel); other crystalline phases encountered are the petrologically important phases nepheline (Ne), noselite (No), cancrinite (Can), and calcite (CC). Fractional crystallization of $NaAlSiO_4$-rich liquids containing a few per cent $CaCO_3$ in the presence of 25% H_2O, produces the crystalline phase assemblages Ne, Ne + Mel, No + Mel, Can + Mel, Can + Mel + CC. Late-stage liquid fractions are rich in $CaCO_3$. The sequence of assemblages is similar to mineral assemblages in melilite-bearing carbonatite-alkalic rock complexes in general, and the okaite series at Oka, Quebec, in particular. All the experimental crystalline assemblages coexist with a Na-rich vapour or fluid phase, and this may be analogous to the fenitization agent in carbonatite complexes. These results lend strong support to the concept that in some complexes, alkalic rocks and carbonatite are genetically related through fractional crystallization of a carbonated alkalic magma.