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THE TANCO PEGMATITE AT BERNIC LAKE, MANITOBA.
I. GEOLOGY AND PARAGENESIS

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Abstract

The Tanco pegmatite is located in the Canadian Precambrian Shield 110 miles northeast of Winnipeg. It is being mined for tantalum oxide minerals, it is rich in refractory grade spodumene, and it contains the largest known concentration of pollucite. The pegmatite, located in a flat dilation zone in amphibolites and 4000 × 60 to 280 feet in known dimensions, consists of 9 zones (in the probable sequence of formation) : border zone (1) with a characteristic assemblage of albite + quartz (+ tourmaline) ; wall zone (2), albite + quartz + microcline-perthite (+ tourmaline) ; albitic aplite (3), albite + quartz ; lower intermediate zone (4), microcline-perthite + albite + quartz + spodumene (+ amblygonite) ; upper intermediate zone (5), spodumene + quartz + amblygonite (+ petalite) ; central intermediate zone (6), microcline-perthite + albite + quartz (+ beryl + wodginite) ; quartz zone (7) ; pollucite zone (8) ; and lepidolite zone (9). The distribution of 37 minerals found to date in different zones is tabulated with estimates of their percentages.

The outer shell-like zones (1), (2), and (4) + (5) enclose the other zones that are tabular or lens-shaped and located in the inner parts of the pegmatite. Feldspar-rich (and particularly albite-rich) fine- to medium-grained assemblages are concentrated along the margins and in the lower parts, the lithium- and silica-rich assemblages with giant crystal dimensions in the upper parts of the pegmatite. The tendency to separation of sodic aplitic assemblages and coarse-grained K-feldspar and quartz assemblages is evident within zones (2), (4), and (6), and in the pairs (3) — (4), and (3) — (5). All this indicates a crystallization from melt and/or supercritical fluid during repeated resurgent boiling of the pegmatite magma; lepidolite zone (9) seems to be the only metasomatic unit formed at the expense of zone (6). Low-temperature hydrothermal alteration, and particularly the effects of hypergene weathering are negligible. The pegmatite can be classified as a high temperature/low pressure type with petalite as the dominant primary Li-silicate.

Introduction

The giant pegmatite deposit at Bernic Lake in south-eastern Manitoba, currently being mined for tantalum oxides and with a high pollucite and refractory-grade spodumene potentials, has been previously described by several authors. However, recent development of the mine has resulted in much new information, and thus an updated description of the general geological relations and of the internal structure and composition is de-

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sirable, particularly to serve as a background for the mineralogical and petrological studies being carried out at the Department of Earth Sciences, University of Manitoba. The results of several of these studies are given in papers that accompany this one which summarizes the geological setting, describes the petrography and mineral assemblages of the internal zoning, and interprets these data in the light of recent ideas about the petrology of granitic pegmatites.

History and Previous Work

The Tanco pegmatite was discovered in 1930 during the exploration of small tin-bearing pegmatites outcropping on the northwest shore of Bernic Lake. Being completely hidden, the pegmatite was found accidentally by drilling conducted by Consolidated Tin Mining Co. Ltd., and its high spodumene content was readily noted. The first systematic exploration began in 1954, when Montgary Exploration Ltd. (later Chemalloy Minerals Ltd.) started a drilling program and sank a shaft. The drilling and shaft deepening was continued until 1960 by Chemalloy Minerals Ltd. and by the American Metal Co. Ltd. (later American Metal Climax). It was in this period that the large pollucite bodies were found and the abundance of tantalum oxides recognized (Frohberg 1967). Following this, the mine was allowed to flood ; the recent exploration, development and mining by the Tantalum Mining Corporation of Canada dates from 1967.

Early geological reports (Davies 1956, 1957, and 1958) were soon followed by the first petrological summary by Hutchinson (1959). The mineralogy of the pegmatite was described by Nickel (1961), who also conducted the examination of tantalum oxides that led to the discovery of a new species wodginite (Nickel *et al.* 1963). Holmquistite from the altered wallrock was reported by Heinrich (1965), and an *x*-ray diffraction study of some minerals was undertaken by Bristol (1966). The petrological studies begun by Hutchinson were extended under his guidance by Wright (1963) and Armstrong (1969). Howe & Rowntree (1967) and Raicevic (1968) published a geological economic review and a report on the tantalum ore concentration, respectively. The most recent studies carried out at the University of Manitoba have yielded a series of papers dealing with absolute dating of the pegmatite (Penner & Clark 1971) and its mineralogy (Černá 1970 ; Grice 1970 ; Rinaldi 1970 ; Černá *et al.* 1971 ; Černý 1972a,b ; Černý & Ferguson 1972 ; Černý & Macek 1972a ; Grice *et al.* 1972 ; Rinaldi *et al.* 1972). A geochemical study by P. Marshall, supervised by A. D. Edgar, is under way at the University of Western Ontario.

LOCATION AND GEOLOGICAL SETTING

The Tanco pegmatite is located 110 miles northeast of Winnipeg, close to the Manitoba-Ontario boundary, at the southwestern edge of the Superior Province of the Canadian Precambrian Shield. The broader region is underlain by an east-west trending belt of metasediments and metavolcanics of the Rice Lake group, intruded by ultrabasic to basic rocks of the Bird River sill (Davies 1955 ; Davies *et al.* 1962). Large plutonic masses of granitic rocks lie north and south of the belt (Fig. 1). The whole area is rich in pegmatites carrying minerals of rare elements ; they have recently been reviewed by Černy & Turnock (1971b). Preliminary dating of the pegmatite by Penner & Clark (1971) and by earlier authors (*e.g.* Laughlin 1969) indicates similar open-system isotopic disequilibria as known from other pegmatites ; in general, the age seems to be 2.6 b.y., the same as that of most granitic plutons in the area.

The Tanco pegmatite is situated on the north shore of the western part of Bernic Lake ; it is seated in amphibolites (meta-andesites) in the close vicinity of a minor granitic body extending westwards. The foliation of the amphibolite strikes east-west and dips vertically or very steeply to the south (Fig. 2).

The pegmatite occupies an almost horizontal fracture cross-cutting the amphibolite schistosity at nearly a right angle. The pegmatite forms a flat-lying tabular body with a low angle of dip to the north and with an east-west strike. The thickness ranges from 60 to 280 feet ; to date, diamond drilling has intersected the pegmatite approximately 1,500 feet down dip, and 4,000 feet along strike. The total dimensions and shape are still to be determined. The pegmatite outcrops in the bed of Bernic Lake, and from this point dips gently northwards and plunges slightly towards the east and west (as illustrated by Wright 1963, Figs. 3 and 4).

The contacts of the pegmatite with the amphibolite wallrock are knife-sharp, intersecting the schistosity of the amphibolite at large angles. As shown by Wright (1963), the wallrock alteration is restricted to a narrow zone not exceeding 3 m in thickness. In this zone, the hornblende-plagioclase amphibolite is enriched in biotite, tourmaline, apatite, and holmquistite (mistaken by Wright 1963, for glaucophane, and first described by Heinrich 1965). Sharp angular xenoliths of amphibolite embedded in the pegmatite show the same alteration, locally with large amounts of brown tourmaline and arsenopyrite.

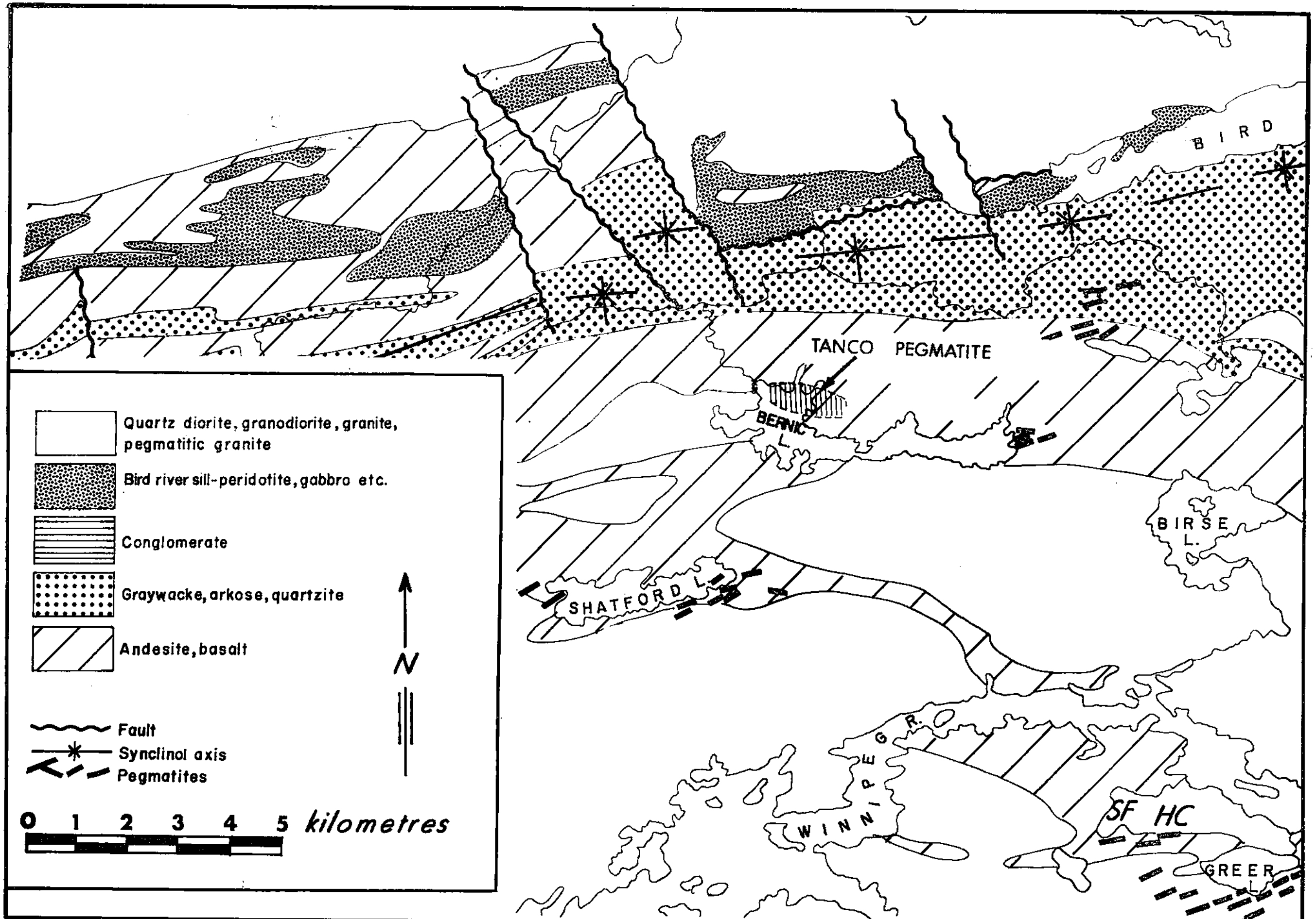


FIG. 1. Geology of the Bernic Lake area, after Davies *et al.* (1962), showing the outline of the Tanco pegmatite as known to date. The locations and strikes of the Be-Nb,Ta-rare earths pegmatites at Shatford Lake, the petalite-bearing pegmatites at the eastern end of Bernic Lake, the Be-Nb,Ta-Rb (Li) pegmatites at Greer Lake, and the Li-Sn-B pegmatites at Rush Lake area also shown.

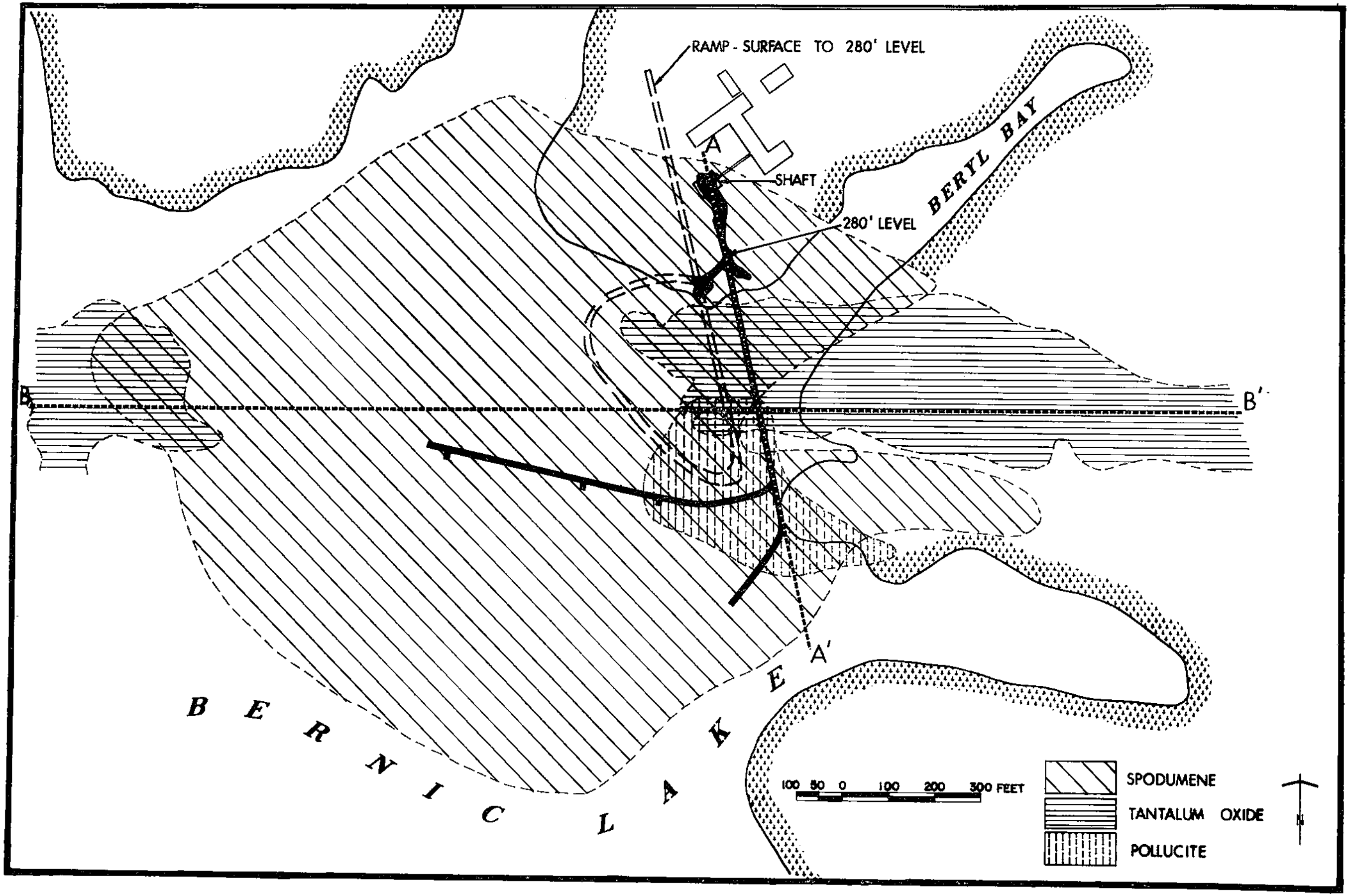


FIG. 2. Plan of the Tanco pegmatite, showing the extensions of the spodumene-rich zones (4) and (5), the Ta-oxide-rich zones (6), and the eastern pollucite body 8. The 1st level drifts and the truck ramp are shown, indicating the main areas possible to sampling for the recent mineralogical studies (see the references in History and Previous Work).

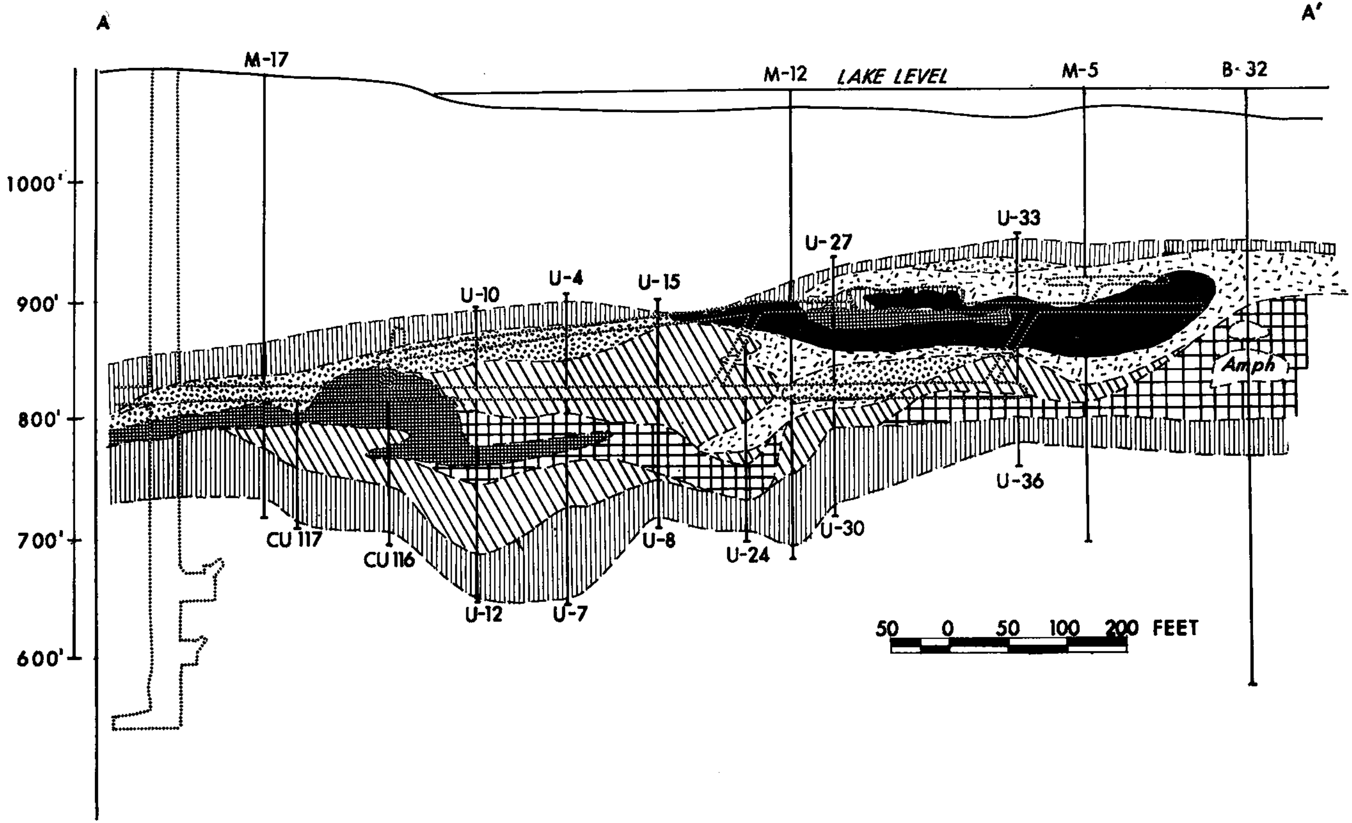


FIG. 3. Vertical cross-section through the Tanco pegmatite along the line A-A′ in Fig. 2. The thin border zone (1) and numerous stringers of albitic aplite (3) within zones (2) and (4) are not shown. The dotted lines mark the 1st level south drift and the pollucite sublevel that were sampled during the recent mineralogical studies (see the references in History and Previous Work). For legend, see Fig. 4.

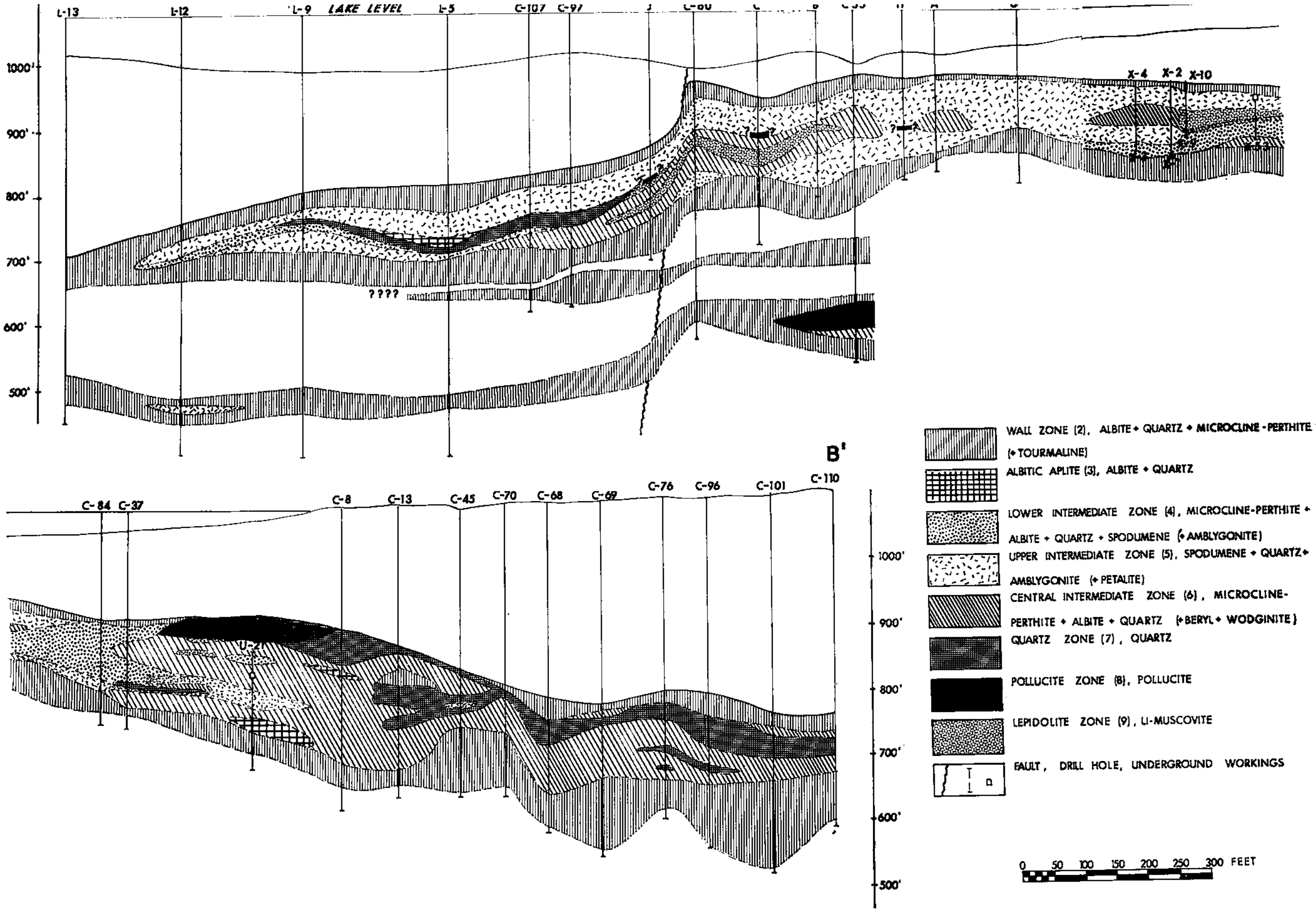


FIG. 4. Vertical cross-section through the Tanco pegmatite along the line B-B′ in Fig. 2. The thin border zone (1) is not shown here, nor are many small stringers of albitic aplite (3) in zones (2) and (4).

Internal Structure

As shown by earlier investigators, particularly by Wright (1963), the pegmatite has a complex zoned structure. Some of the outer zones tend to form shell-like concentric envelopes, whereas the inner zones resemble rather asymmetric layer-like bodies. The asymmetric thicknesses of the lower and upper parts of the outer zones suppress the concentric pattern even more (Figs. 3 and 4). The vertical sections shown in the quoted figures are more complicated than those published by Wright (1963), which were derived from less closely spaced drill holes. However, the basic zoning pattern of our sections remains the same as in Wright's schematized illustrations.

On the basis of mineral composition, texture, and location within the pegmatite, the following zones are distinguished (the term zone is used in a purely descriptive sense, without genetic implications, unless indicated otherwise) :

(1) border zone	albite + quartz (+ tourmaline)
(2) wall zone	albite + quartz + microcline-perthite (+ tourmaline)
(3) albitic aplite	albite + quartz
(4) lower intermediate zone	microcline-perthite + albite + quartz + spodumene (+ amblygonite)
(5) upper intermediate zone	spodumene + quartz + amblygonite (+ petalite)
(6) central intermediate zone	microcline-perthite + albite + quartz (+ beryl + wodginite)
(7) quartz zone	quartz
(8) pollucite zone	pollucite
(9) lepidolite zone	Li-muscovite

The zones are the same as recognized by Wright (1963), but their list is adjusted to the probable sequence of their formations as interpreted in the present study (see the final section), and the characteristic mineral assemblages are extended in this paper. The quoted assemblages indicate the most abundant rock-forming phases and (in brackets) the most characteristic and petrologically important accessory minerals. A semiquantitative review of the complete mineral assemblages is given in Table 1.

Border Zone (1), albite + quartz (+ tourmaline)

The border zone consists mainly of fine-grained quartz and albite with the accessory minerals being biotite, muscovite, apatite, tourmaline, garnet, beryl, triphylite-lithiophilite, and possibly cassiterite. The accessory minerals are not always present and in some instances the zone is composed of only albite and quartz. Tourmaline and beryl crystals up to 1 inch in length are oriented more or less perpendicular to the contact.

This zone forms an almost continuous outer shell of the pegmatite and it ranges in thickness from a fraction of an inch to 12 inches; it is usually thicker along the footwall contact. It is not shown in Figs. 3 and 4 because of its small thickness. Similar border zones are found around the xenoliths of amphibolite in the pegmatite.

Wall Zone (2), albite + quartz + microcline-perthite (+ tourmaline)

The wall zone is the outermost of the major assemblages and has a thickness ranging from 1 to 125 feet. It is commonly thicker along the footwall than at the hanging-wall contact, and it reaches its maximum thickness in the downward bulges in the footwall pegmatite-amphibolite boundary.

The zone consists mainly of albite, microcline-perthite, quartz, and muscovite; tourmaline, beryl, apatite, and triphylite-lithiophilite are present in accessory amounts. The grain size increases from the border zone inwards; pink to white microcline-perthite, commonly reaching one foot in size, is embedded in finer-grained quartz and albite. This basic texture appears to be uniform throughout the zone. Columnar tourmaline reaches 8 inches in length; the crystal size of beryl is much smaller.

Besides the difference in thickness, the footwall portion of the wall zone also differs from the hanging-wall portion by the presence of minor spodumene and bands of albitic aplite (3) (as mentioned by Wright 1963), which are lacking in the latter.

Albitic Aplite (3), albite + quartz

This zone forms a sheet-like layer up to 60 feet thick as well as smaller discontinuous lens-like bodies, all located along the contact of the footwall portion of the wall zone (2) with the overlying intermediate zones, or along the contacts of the lower (4) and upper (5) intermediate zones. Small stringers of aplite are also located within the upper part of the footwall portion of the wall zone (2). Many of these thin sheets of aplite could not be shown in Figs. 3 and 4. The upper contacts of the aplite are always sharper than the lower contacts, particularly where the aplite adjoins massive quartz. The lower contacts of the main aplite body are commonly gradual over a distance of a few feet.

The zone consists predominantly of fine-grained bluish albite with subordinate quartz; tourmaline, apatite, lithian muscovite, spodumene, wodginite, and possibly cassiterite are the accessory phases.

The aplite sheets are usually banded parallel to their extension, due to varying grain size of the albite, variable quartz/albite ratios, and enrichment in lithian muscovite. The sheets are frequently gently to steeply folded, with the banding following exactly the undulating course of the sheet. As noted by Wright (1963), the absence of fracturing in the folded aplite and its relations to the neighbouring assemblages suggests that it was in a plastic state during the deformation of all the zones involved, due probably to their incomplete solidification.

Lower Intermediate Zone (4), microcline-perthite + albite + quartz + spodumene (+ amblygonite)

This zone is located in the lower central part of the pegmatite, and attains its maximum thickness of about 90 feet in the down-dip parts of the body. The lack of uniformity, in both the texture and the mineral composition, appears to be characteristic of this zone.

The predominant minerals are albite, quartz, microcline-perthite and spodumene; subordinate and accessory phases are amblygonite-montebrasite, lithian muscovite, apatite, rubellite, triphylite-lithiophilite, petalite, lepidolite, pseudo-ixiolite, and microlite. Large crystals of microcline-perthite embedded in medium-grained quartz, albite, and micas together with tabular spodumene + quartz intergrowths form one of the characteristic assemblages; the other consists of large quartz pods with amblygonite-montebrasite and spodumene + quartz aggregates. Radial rims of cleavelandite and micas around the feldspar-rich assemblages usually separate them from the quartz accumulations.

An assemblage of late secondary minerals develops occasionally, mainly at the expense of spodumene and amblygonite-montebrasite : montebrasite, quartz, cookeite, calcite, apatite, adularia, and montmorillonite-illite (Table 1 ; Černý 1972b).

Upper Intermediate Zone (5), spodumene + quartz + amblygonite (+ petalite)

In contrast with the previous zone (4), zone (5) is located mainly in the upper part of the pegmatite body, commonly in contact with the wall zone (2), and its texture and composition are remarkably homogeneous. The average thickness of this zone is 50 feet, locally reaching 70 feet, and generally increasing in the up-dip direction. If this zone were considered together with the lower intermediate zone (4) as one unit, these zones would constitute the inermost shell-like zone.

Actually, the contacts of zone (5) with the underlying zone (4) are gradational over considerable distances, and the mineral composition of zone (5) is also similar, although simpler. Quartz and spodumene are the most abundant constituents, the latter in either tabular spodumene + quartz intergrowths after petalite (Černý & Ferguson 1972), or subordinately, in long lath-shaped crystals. Giant crystals of microcline perthite, platy cleavelandite, large blocks of amblygonite-montebrasite, and tabular crystals of petalite are subordinate, lithian muscovite, apatite, triphylite-lithiophilite, pollucite, pseudo-ixiolite, microlite, and molybdenite are accessory. Eucryptite (Černý 1972a) is also present, but its amount and genesis are unknown.

Characteristic vertical changes can be observed, partly traceable also downwards into the upper parts of the lower intermediate zone (4) : total feldspar percentage and albite content decrease upwards, whereas grain size and the content of quartz and spodumene increase in the same direction.

A low-temperature alteration of primary minerals of this zone (mainly spodumene and petalite) has produced a series of secondary assemblages consisting of albite, adularia, quartz, cesian analcime, cesian beryl, apatite, lithiophosphate, montebrasite, calcite, rhodochrosite, and montmorillonite-illite (Černý 1972b).

Central Intermediate Zone (6), microcline-perthite + albite + quartz (+ beryl + wodginite)

This zone occupies a large portion of the central part of the pegmatite, being located roughly along the contacts of the lower (4) and the upper (5) intermediate zones. It attains a maximum thickness of 150 feet, and its shape roughly reflects the outer contour of the pegmatite body. In contrast with the gradual transition between the surrounding zones (4) and (5), this central intermediate zone shows either a sharp boundary with them or a gradual transition over only a few feet.

Microcline-perthite, quartz, and albite are the major components, and lithian muscovite is subordinate ; accessory minerals are beryl, spodumene, wodginite, cassiterite, microlite, tantalite, apatite, triphylite-lithiophilite, and tapiolite, in roughly decreasing abundance. Bismuth, bismuthinite, and some yet unidentified sulphide-like phases are rare. Three assemblages with typical textures are characteristically found in this zone : (a) medium- to coarse-grained microcline-perthite with minor quartz, beryl, spodumene, and albite, penetrated by fine-grained greenish muscovite with tantalum oxides and cassiterite ; (b) rounded patches and "waves" of bluish aplitic albite with disseminated tantalum oxides and cassiterite ; and (c) grey to smoky quartz, with white and pinkish beryl accumulated along its contacts with feldspar-rich assemblages.

The first assemblage rich in microcline-perthite is predominant, and it forms a matrix in which the other two assemblages are fairly regularly disseminated. The beryl-enriched quartz pods tend to be more abundant in the upper parts of the zone.

Secondary alteration is negligible, and is restricted to the formation of calcite, quartz, and cookeite after spodumene.

Quartz Zone (7), quartz

Unlike most well-differentiated pegmatites, the unit in the Tanco pegmatite consisting mainly of quartz does not form a central core but several lens-shaped bodies disseminated at random in different locations. One of the largest quartz segregations, up to 45 feet in thickness, form a sheet-like body in the upper parts of the pegmatite, in contact with the border zone (1) and the amphibolite hanging-wall (Fig. 4). Another prominent quartz body is found in the down-dip northeast section, on the boundary between the albitic aplite (3) and the lower intermediate zone (4) (Fig. 3). Other smaller quartz "cores" are located within the three intermediate zones (4), (5), and (6) and in the pollucite zone (8).

This zone contains, besides massive clear to white quartz, only negligible amounts of amblygonite-montebrasite, microcline-perthite, apatite, triphylite-lithiophilite, spodumene, and pollucite, depending mainly on the composition of the neighbouring zones. The contacts with these are usually sharp. Miarolitic cavities are rare, and they are usually lined with quartz crystals covered by calcite, rhodochrosite and/or fine-grained apatite.

Pollucite Zone (8), pollucite

Several pollucite bodies are located in the upper intermediate zone (5), between the central intermediate zone (6) and the hanging-wall portions of the border and wall zones (1) and (2). Lens-shaped bodies of pollucite are elongated parallel to the strike of the pegmatite, and attain a maximum thickness of about 40 feet in the eastern upper parts of the pegmatite. Drilling done since the publication of Wright's (1963) paper has revealed that the western pollucite zone is not a continuous sheet as illustrated by this author, but a series of small bodies scattered along the boundary of the central (6) and upper (5) intermediate zones. Only three of these bodies have been located in the drill holes within the section shown in Fig. 4.

As in most zones of the Tanco deposit, the upper margins of the pollucite bodies generally show sharper contacts than the lower. Wright (1963) reports veining of the western lower-seated pollucite body by quartz of the quartz zone (7), but the general appearance of the contacts seems to be of a non-replacement character.

The zone consists almost entirely of pollucite, finely veined by very subordinate amounts of spodumene, albite, lithian muscovite, microcline, and quartz. Large crystals of manganoan apatite and amblygonite-montebrasite are found in the lower parts of the pollucite bodies and masses of petalite and quartz occur sparingly within them. Most of the pollucite shows a peculiar "augen"-structure, consisting of clear glassy eyelets embedded in a braided white matrix. Specimens of dark-grey or massive milky pollucite are rather exceptional.

Lepidolite Zone (9), lithian muscovite

This zone forms two flat-lying, east-west elongated sheets up to 60 feet thick, as well as several smaller bodies, all within the central intermediate zone (6). They cut this zone at a low angle. The contacts with the surrounding zone (6) are knife-sharp to transitional over 5 feet.

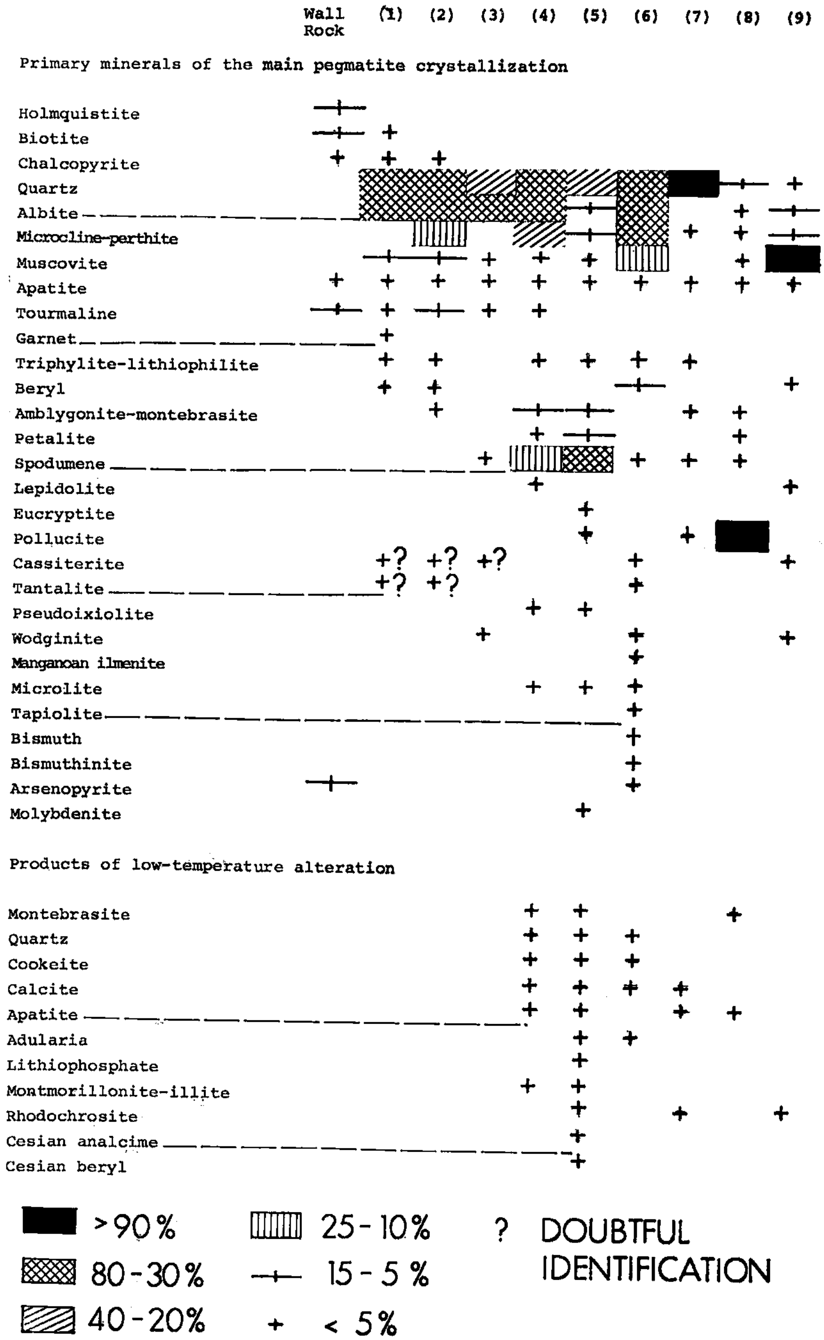
The mineral composition is rather poorly known because of insufficient study. Lithian muscovite is the main constituent, with true lepidolite having been found to be scarce (Rinaldi *et al.* 1972). Nevertheless, the naming of the zone was preserved for simplicity. Minor amounts of albite, microcline-perthite, quartz, beryl, wodginite, and cassiterite constitute the assemblage of accessory phases.

The fine-grained lithium micas originated undoubtedly at the expense of microcline-perthite of zone (6). In central parts of the lepidolite zone they constitute up to 80% of its mineral content, and microcline-perthite is almost absent. Along the margins of this zone, they are densely disseminated in the cleavable feldspar masses. At present, it is not possible to decide which of the accessory phases is contemporaneous with the lithium micas; some of them are probably relics from the original assemblage of zone (6), as is microcline-perthite.

Distribution of Minerals

Table 1 summarizes the mineral composition of the individual zones as estimated from drill cores, underground workings and surface dumps containing material from a single zone. The semi-quantitative estimates show the relationships between different species in a single zone, as well as the variations of a single species in different zones. The percentages

TABLE I. THE TANCO PEGMATITE: DISTRIBUTION OF MINERALS IN THE NINE ZONES



assigned to the different symbols are intended to indicate only a rough order of content by volume; actual contents may shift into neighbouring categories, particularly for those minerals present only in very minor amounts, that are most difficult to estimate.

In Table 1, the mineral content of the individual zones is divided broadly into "primary" minerals, and into secondary phases produced by late hydrothermal alteration of the former group; the latter minerals are present in only negligible amounts.

As mentioned earlier, the glaucophane of Wright (1963) in the wall-rock alteration is actually holmquistite, as determined by Heinrich (1965) and also found by R. B. Farquharson and P. Černý in a series of specimens. Tantalite and cassiterite quoted from zones (1), (2), and (3) by Wright (1963) are marked by a question-mark in our Table 1. Wright apparently observed them only in thin sections; wodginite had not been identified at the time of his investigation, and no similar minerals have been found recently; thus the presence of these minerals lacks the necessary confirmation. Molybdenite listed by Wright for zone (6) can hardly be misidentified, but it seems to be rare, since it has not been encountered recently.

Albitic aplite (3) has not been extensively studied since Wright's (1963) investigation. Most minerals quoted in Table 1 are taken from his report, with the exception of the tantalum oxide minerals (Grice *et al.* 1972). As mentioned earlier, the lack of a detailed mineralogical study also applies to the lepidolite zone (9), and its mineral composition shown in Table 1 may be incomplete.

Some unidentified minerals are not listed in Table 1. A sphene-like phase was found in thin sections from zone (6) (Grice 1970), and a series of sulphides associated with native bismuth in zone (6) is currently being studied.

Genetic Considerations

Some of the genetic characteristics of the Tanco pegmatite have already been well established by Wright (1963). There is little doubt left today that the pegmatite is of igneous origin, and that it is the product of very advanced differentiation of granitic magma that was injected into a dilation zone crosscutting the schistosity of the country rock. There was no extensive interaction between the pegmatite and the surrounding amphibolite, except for minor introduction of K, Li, F, B, P, and H_2O into the latter. Wright (1963) convincingly disqualified any chance of metamorphic origin.

It is questionable, however, whether the Tanco pegmatite could be genetically linked with the granitic body outcropping on the western shore of Bernic Lake, as Wright (1963) and Howe & Rowntree (1967) suggest.

The belt of pegmatites closely related to the Tanco deposit extends as far to the east as Rush Lake and north of it (where it is adjacent to another granitic body in the south, see Fig. 1), and the very similar Silverleaf pegmatite is located 6 miles south of Bernic Lake. Thus, the close neighbourhood of the Tanco pegmatite and this particular granite outcrop should not be taken, necessarily, as indicative of a genetic relationship. A wide variety of granitic rocks and different pegmatite types in the area, reviewed recently by Černý & Turnock (1971b), suggest that only a detailed geochemical study could clarify the genetic relationships.

Another problem which is not yet fully solved is the crystallization course and sequence of zones during the evolution of the pegmatite. Wright (1963) treated six zones as primary, and considered the aplitic albite, the pollucite bodies, and the lepidolite unit (zones (3), (8), and (9) in this paper) as products of late replacement. However, he stressed the puzzling character of some phenomena along the boundaries of these units with neighbouring zones, and some of his observations contradict his conclusions. It was only after the publication of Wright's paper that the studies by Jahns & Tuttle (1963) and Stewart (1963) appeared, and these papers together with the experimental and theoretical work of Jahns & Burnham (1958, 1969) are of great value in the petrological re-evaluation of some of the zones.

The quoted studies have established the importance of a preferential leaching of K, Li and Si into the supercritical fluid generated by resurgent boiling of a volatile-saturated granitic-pegmatitic magma. This process leads to the separation of a sodium-rich residual melt in the lower parts of the crystallizing pegmatite, and to the concentration of the supercritical fluid in the upper parts. Moreover, resurgent boiling may re-appear during cooling and crystallization, as the residual magma becomes repeatedly oversaturated with respect to volatiles.

The compositional and space relationships of the zones in the Tanco pegmatite indicate that this process was operating in this pegmatite body. The border (1) and wall (2) zones seem to be the products of early magmatic crystallization, and the lower intermediate zone (4) could also partly belong to this initial sequence. However, the albitic aplite bands (3) disseminated in this inhomogeneous zone, and the major bodies of this sodic aplite (3) on the boundary between the lower (4) and upper (5) intermediate zones suggest that resurgent boiling began during the crystallization of this lower intermediate zone (4), producing a sodic residual magma crystallizing as albitic aplite (3) in the lower parts, and a Li, K, Si-enriched supercritical fluid concentrated in the upper parts of the pegmatite, which gave rise to the coarse-grained upper intermediate zone (5).

From spatial relationships it would be reasonable to conclude that the central intermediate zone (6) is later than the Li-rich lower and upper intermediate zones (4) and (5), forming virtually a central core of the whole pegmatite body (Figs. 3 and 4). The crystallization of such a Li-poor, K, Na (Ta,Sn)-rich zone after the solidification of the Li-richest zones is rather unusual, nevertheless it has been well established in some pegmatites (*e.g.* Solodov 1960). The presence of primary spodumene in zone (6), compared to petalite as the only primary Li-aluminosilicate in zones (4) and (5), also suggests a late origin for this zone. The most surprising characteristic of zone (6) is its internal separation into albitic aplite and coarse microcline-perthite and quartz bodies, which indicates that resurgent boiling was again operative within this zone, and that it was apparently independent of the events that took place in the surrounding Li-rich zones.

A similar uncertainty about the petrological relations to other zones remains with the quartz zone (7). Some of the largest quartz bodies under the roof of the pegmatite, close to the upper intermediate zone (5), correspond to the concept of late formation from supercritical fluids. However, other bodies in the lower parts of the pegmatite seem to be differently located. A detailed study of the quartz bodies that may be opened by underground mining operations is necessary.

No evidence supporting the metasomatic origin of the pollucite bodies (as suggested by Wright 1963) has been observed recently. The location of these bodies in the upper parts of the pegmatite, in the upper intermediate zone (5), suggests that they might represent monomineral segregations within this zone. This is supported by the presence of coarse and irregular "graphic" intergrowths of petalite and pollucite, and by some accumulation of amblygonite-montebrasite and manganoan apatite along the boundaries of the pollucite bodies. The alleged pollucite replacing spodumene observed by Wright (1963) is probably a late secondary cesian analcime (Černý 1972b) ; pollucite seems to be contemporaneous with petalite which broke down to spodumene + quartz only later.

The only true metasomatic body in the Tanco pegmatite seems to be the lepidolite unit (9), clearly formed at the expense of the central intermediate zone (6). The extensive development of a secondary mica is widespread in this zone, even outside the lepidolite unit. Late greenish muscovite is a common constituent of the microcline-rich association, and perhaps the formation of the lepidolite unit (9) is only a more intense, spatially restricted, and geochemically different "facies" of this muscovitization that is active in the remainder of zone (6). The source of Li composing the Li-micas is yet to be found.

In conclusion, the Tanco pegmatite can be classified according to the criteria of Stewart (1963) as a relatively high-temperature, low-pressure lithium pegmatite with petalite as the dominant primary Li-silicate (Černý & Ferguson 1972). It is very similar to the Varuträsk pegmatite in Sweden (Quensel 1956) and particularly to the Bikita pegmatite in Southern Rhodesia (Cooper 1964). The course of the internal evolution of the Tanco pegmatite, strongly affected by repeated resurgent boiling of a volatile-over-saturated magma, can be established in detail only after collecting more data on the geochemistry of the rock-forming minerals and on the quantitative compositions of different mineral assemblages. A regional geochemical and structural study will be necessary to establish any possible genetic relations with the granitic plutons outcropping in the area.