THE TANCO PEGMATITE AT BERNIC LAKE, MANITOBA. IX. BERYL*

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ABSTRACT

Beryl occurs in 4 out of 9 zones and replacement units of the Tanco pegmatite. The major accumulations are in the wall zone and central intermediate zone, and they are concentrated in the footwall parts of the pegmatite. Six paragenetic varieties of primary beryl are recognized, but most have the same range of chemical composition and may be genetically related. The alkali contents of the majority of primary beryl are among the highest known (SR2O about 6 to 7 wt. %, including 2.5 to 3.75 wt. % Cs2O); the secondary beryl in the hydrothermal alteration assemblages is extremely enriched in alkalis, with SR2O up to 11.05 wt. %, including 7.16 wt. % Cs2O. All beryl varieties display strong compositional zoning, with alkali contents increasing outwards. Compositions of three fully analyzed samples conform to the Be3+Li3+R3+ - channel substitution mechanism established by Bakakin et al. The persistent association of beryl with albite-muscovite indicates a late metasomatic origin during albization which also carries tantalum mineralization.

INTRODUCTION

Very limited data on beryl from the Tanco pegmatite have been collected and published to date. Physical properties of some primary rock-forming varieties were quoted in an unpublished report by Černý & Ferguson (1971), and secondary beryls exceptionally enriched in alkalis were described by Černý (1972). Physical properties suggested that the primary beryl is also rich in alkalis, and that its composition is rather variable. A systematic study of compositional variations in the Tanco beryl was desirable in order to contribute to the knowledge of the general geochemistry and petrology of the pegmatite. The potential economic significance of the primary beryl was another factor stimulating this investigation.

This study, a continuation of a series of papers on the Tanco pegmatite started in 1972, draws most of the data from a M.Sc. thesis by the second author (Simpson 1974). These are partly revised, supplemented by additional information collected since the completion of this thesis, and re-interpreted.

Table 1 presents a brief review of the characteristics of individual zones of the pegmatite, arranged in the appropriate order of crystallization. Crouse & Černý (1972) give a more detailed petrographic account and cross-sections of the deposit showing the zoning pattern. A longitudinal section through the Tanco pegmatite is also shown by Černý & Simpson (in prep.).

SAMPLING AND EXPERIMENTAL METHODS

A total of 135 beryl specimens was collected underground and from drill cores. Suites from zones (2), (6), and (9) are believed to be fairly representative of the beryl populations in their assemblages, Beryls from zones (4) and (5) represent all specimens found in them so far.
place was estimated from the intensities of the Becke lines.

Density was determined on a Berman balance, using toluene as the displacement liquid. Three to four separate grains were taken from each hand-separated sample, and two to three readings were taken of each.

Readings from three X-ray powder diffractograms, calibrated with fluorite admixture to the beryl samples (a 5.4620 Å), were averaged and then processed by the Evans et al. (1963) least-squares program, modified by D. E. Appleman, to obtain unit-cell dimensions.

Chemical analyses were performed mostly by atomic absorption spectroscopy; X-ray fluorescence spectroscopy was used for SiO₂, Al₂O₃, and Fe₂O₃, and water contents were determined gravimetrically.

**DISTRIBUTION AND CHARACTERISTICS OF BERYL TYPES**

Six different types of primary rock-forming beryl, and one secondary variety, can be distinguished according to their location in the pegmatite, their color, crystal habit, n₀ω, and alkali contents. Histograms of n₀ω frequencies found in the different types, assumed to be indicative of alkali contents, are shown in Figure 2. In this Figure, and the descriptions which follow below, the beryl types are designated by zone numbers.

![Diagram](image_url)  
**Fig. 1. Increase in n₀ω, indicative of general increase in ΣR⁺ and H₂O, from cores (solid circles) to surfaces (arrowheads) of several beryl crystals from different zones of the Tanco pegmatite (zone number given in parentheses after the sample symbol). Center-to-surface distances arbitrarily divided into five zones. Lengths of traverses range between 15 and 45 mm.**
Fig. 2. Frequencies of the refractive index $n_0$ in the surface zones of beryl crystals from various zones of the Tanco pegmatite. Number of samples measured follows the hyphen after zone symbol. The shortest columns equal one sample (e.g., all those in line (5)S). Note the coincidence of maxima in zones (4,5), (6), and (9), and the extremely high values in (5)S.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Main constituents</th>
<th>Characteristic subordinate and accessory minerals</th>
<th>Textural and structural characteristics</th>
<th>Average BeO content (wt. %)</th>
<th>Total range of BeO (wt. %)</th>
<th>Predominant range of BeO (wt. %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) border zone</td>
<td>albite, quartz</td>
<td>tourmaline, apatite</td>
<td>fine-grained euhedral</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>(2) wall zone</td>
<td>albite, quartz, muscovite, Li-muscovite, microcline-perthite</td>
<td>tourmaline, beryl</td>
<td>medium-grained, giant K-feldspar crystals</td>
<td>0.07</td>
<td>0.00-0.56</td>
<td>30% within 0.11-0.19</td>
</tr>
<tr>
<td>(3) albitic aplite</td>
<td>albite, quartz</td>
<td>muscovite, Ta-oxide minerals, (apatite, tourmaline)</td>
<td>fine-grained, rounded blades and undulating layers</td>
<td>0.05</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>(4) lower intermediate zone</td>
<td>microcline-perthite, albite, quartz, spodumene, amblygonite</td>
<td>Li-muscovite, lithiophilite, [(lepidolite, petalite, Ta-oxide minerals)]</td>
<td>medium to coarse</td>
<td>0.02</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>(5) upper intermediate zone</td>
<td>spodumene, quartz, amblygonite</td>
<td>polylucite, lathilithiophilite, microcline-perthite, (albite, Li-muscovite), [(petalite, eucryptite, Le-n oxide minerals)]</td>
<td>giant crystal size of major and subordinate minerals</td>
<td>0.15</td>
<td>0.00-0.31</td>
<td>---</td>
</tr>
<tr>
<td>(6) central intermediate zone</td>
<td>microcline-perthite, quartz, albite, muscovite</td>
<td>beryl, (Ta-oxide minerals), cassiterite, lathilimicite, apatite, [(zircon-kaforite, tineneite, spodumene, sulphides)]</td>
<td>fine-to-medium grained, inhomogeneous</td>
<td>0.10</td>
<td>0.00-0.29</td>
<td>50% within 0.20-0.29</td>
</tr>
<tr>
<td>(7) quartz zone</td>
<td>quartz</td>
<td>((spodumene, amblygonite))</td>
<td>monomineralic</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>(8) pollucite zone</td>
<td>pollucite</td>
<td>quartz, spodumene(petalite, muscovite, lepidolite, albite, microcline, apatite)</td>
<td>almost monomineralic</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>(9) lepidolite zone</td>
<td>Li-muscovite, lepidolite, microcline-perthite</td>
<td>albite, quartz, beryl, (Ta-oxide minerals, cassiterite), [(zircon-hafnium)]</td>
<td>fine-grained, metamorphic unit replacing zone (6)</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Zones (1) and (2) shell-like concentric, all other zones layer-shaped.
BeO contents based on drill-core assays by the Tantalum Mining Corporation of Canada, Ltd.
(R. A. Crouse, private communication, 1975). Segments of individual zones with different BeO contents quoted separately.
Except zone (6), all spodumene secondary after petalite.
Underlined minerals occur in economic quantities in the given zones; minerals in parentheses occur in very small to trace amounts.
as well as letters suggestive of additional prominent characteristics.

(2) — greenish to white beryl from the wall zone (2), mostly associated with muscovite, quartz and albite. Columnar prismatic (length to width ratio 6:1 to 3:1, max. length about 8 cm), usually without termination. Greenish color is particularly characteristic of beryl from near the wall-rock amphibolite. Highly variable no; high values are typical of beryl from the grey-colored albite+quartz matrix which is widespread in western footwall parts of the pegmatite, whereas most low-refracting beryls come from the beige albite + clear to whitish quartz + muscovite assemblage, which is more common in all other parts of zone (2).

(4,5) — white beryl from the lower and upper intermediate zone (4) and (5), associated with cleavelandite veinlets in quartz, amblygonite, and aggregates of spodumene+quartz after petalite. Short columnar prismatic (length to width ratio 2:1 to 1.5:1, max. length about 10 cm), or in almost anhedral grains. Both groups of samples in Figure 2, centered at no 1.588 and 1.593, contain specimens from both zones. Since these zones show gradual mutual transitions, and do not display any distinct differences in the properties of their beryls, the latter are treated as a single type.

(4,5)X is a subtype of the preceding one, rather than a distinct variety. This subtype is associated with grey quartz, grey albite, apatite, and triphyllite near amphibole xenoliths enclosed in zones (4) and (5). White, columnar prismatic (length to width ratio 8:1 to 3:1, max. length about 6 cm), with no terminal crystal faces. Refractive indices fall within the same range as those of the higher-refracting group of beryls 4,5).

(6)E — colorless, white, or faintly pinkish beryl of the eastern wing of the central intermediate zone (6). Bands of beryl crystals usually separate feldspar-bearing assemblages from quartz pods; larger accumulations which overlie contorted layers of albite aplite are exceptional (Fig. 3). Beryl is short columnar (max. length about 20 cm) or thick tabular (max. diameter about 18 cm) parallel to basal pinacoid (length to width ratio 2:1 to 0.15:1). Prominent {0001} and faces of first and second-order bipyramids in combination with prism. Mostly high no; the sporadic low values shown in Figure 2 are suspected to represent inner zones. Many samples have extreme compositional zoning (cf. specimen BLM-2A in Fig. 1).

(6)W — milky white to very pale pinkish beige beryl of the western part of the central intermediate zone (6). Associated mainly with white albite veinlets randomly penetrating grey microcline and quartz. Less frequently in direct association with banded streaks of albite+woodgite +microlite. Mostly anhedral equidimensional grains, rarely stubby prismatic with poorly developed prism faces. Most values of no are the same as those of beryl (6)E, but some exceed the upper limit found in (6)E (Fig. 2).

(9) — pinky beige beryl of the lepidolite replacement zone (9), associated with albite, mi-

Fig. 3. Two lobes of fine-grained albite (whitish, bottom) with stringers of Ta-oxide minerals along their upper margins (discontinuous black lines) overlain by subhedral beryl (white) in a muscovite + quartz matrix (mottled grey). Eastern zone (6) of the Tanco pegmatite. The hammerhead is 20 cm long.
crocline, and quartz that are largely replaced by fine-grained lithian muscovite and lepidolite. Subhedral short prismatic to thick tabular and whitish in eastern parts of this zone, but mostly anhedral and more colored in its western parts. The ranges of \( n_\omega \) coincide with those of beryls (6)E and (6)W.

(5)S — tiny crystals of colorless to pink secondary beryl from zone (5), associated with quartz, albite, adularia, Cookeite, cesian analcime, and apatite, lining leaching cavities in spodumene+quartz pseudomorphs after petalite (Černý 1972). Columnar prismatic (length to width ratio 5:1 to 3:1, max. length about 12 mm), terminated with basal pinacoid. Frequently somewhat corroded. Some crystals show the highest refractive indices recorded for the species (\( n_\omega = 1.610 \); Fig. 2).

In general, beryl seems to be absent in border zone (1), albite aplite (3), quartz cores (7), and pollucite bodies (8). The largest concentrations are found in both parts of zone (6), and in the western footwall parts of zone (2) which is partly transitional here into zone (4). Although beryl is more difficult to recognize in zones (4) and (5), it seems to be relatively rare. Within the zones (2), (4) and (5), the most conspicuous local concentrations of beryl are found near the wall-rock amphibolite or around its xenoliths inside the pegmatite.

The only type of beryl affected by late processes is that in eastern zone (6). Deep corrosion and leaching of this beryl type leaves the associated quartz, albite, and muscovite intact, but no secondary Be minerals or other hydrothermal phases have been encountered. The only low-temperature Be mineral found to date is the secondary beryl (5)S which shows no obvious spatial relationship to the corroded primary beryls of zone (6).

**Alkali Distribution**

Partial analyses of 42 beryl specimens (Table 2, Fig. 4a,b) confirm that the variations in \( n_\omega \) are caused solely by variable alkali contents. Several analyses for FeO, MnO, and MgO showed that these components are lower than 0.2 wt. %, even in the greenish beryls (2). Thus, their influence on \( n_\omega \) can be neglected, at least in evaluation of the alkali variations of large beryl populations.

Figure 4a,b shows that the alkali contents of the Tanco beryls closely follow the general trends established for pegmatitic beryl (Černý 1975). In the Na/Li versus Cs plot of Figure 4b,
a small but persistent shift can be observed towards higher-than-average Cs contents at any given Na/Li ratio. Characteristically, beryl (2) covers a wide range of relatively low alkali contents and high Na/Li ratios; beryls from the other zones are clustered in a small region of high Li and Cs, and low Na/Li. Histograms of Na/Li frequencies in Figure 2 suggest that the composition of beryl from zones (6)E, (6)W, and (9) may be much more uniform than indicated by the relatively few analyzed specimens plotted in Figure 4.

Beryls (4,5) and (4,5)X fall within a very small field on each of the graphs. They are close to, and are partly superposed on, the (6)E and (9) fields, but have lower Cs and higher Na/Li.

The alkali contents of most of the primary beryls from Tanco are among the highest known: $\Sigma$ RbO reaches 7 wt. % and Cs$_2$O contents exceeding 3 wt. % are rather common. These beryl compositions reflect the extreme enrichment of their parent pegmatite in rare alkalis, particularly cesium (Černý & Simpson in prep.).

Because of lack of pure material, only one partial chemical analysis of a secondary beryl (5)S is available (SCN-1 in Table 2; Černý...
1972). It shows the second highest alkali contents recorded in beryl. Another sample of secondary beryl with $n_\omega$ 1.610 should have alkali contents at least as high as those of the alkali-richest crystal known, which has $n_\omega$ 1.608 and 11.3 wt. % Cs$_2$O (Evans & Mrose 1966).

The Rb content of the Tanco beryls shows a rough positive correlation with K and Cs (Fig. 5a,b). The K/Rb ratio appears to change from values predominantly lower than 1 at low concentrations to higher than 1 at high concentrations of both elements. K seems to be preferred to Rb in Cs-rich beryls, as also found by Borovik-Romanova & Sosedko (1958). This trend is also shown by secondary beryls (K/Rb=4 in SCN-I). However, K$_2$O values in excess of 0.1 wt. % are characteristic mainly of beryl (9), and a possible contamination by microscopic mica must be taken into consideration. In Figure 5a, a relatively dense band of K/Rb values <1 continues well under the scattered plots with K/Rb >1, and it may be more representative of the true K/Rb relationship.

The Rb/Tl trend is defined rather well, but Cs/Tl shows a broad scatter (Fig. 5c,d). Samples richest in Rb generally have lower Rb/Tl ratios (100 to 150) than specimens poor in Tl (200 to 300). However, all Rb/Tl ratios fall within the usual range of values for terrestrial magmatic rocks (65-300; Albuquerque & Shaw 1972).

**MINERALOLOGY OF THREE SPECIMENS**

Three samples considered representative of beryls with intermediate, low, and high $n_\omega$ were selected for a detailed study: inner parts of crystal U10-11.5 ($n_\omega$ 1.586), outer parts of crystal B-188.8 ($n_\omega$ 1.594), and outer parts of sample BE-3 ($n_\omega$ 1.589). Averages of the bulk of the analyzed material were found to deviate by $+0.003, -0.000$, and $+0.002$, respectively. This shift was evidently due to inadvertent contamination from adjacent crystal zones. The data obtained are summarized in Table 3 and Figure 6.

Chemical analyses show compositions typical of beryls enriched in rare alkalies, except sample BE-3 which has a high SiO$_2$/Al$_2$O$_3$ ratio. X-ray diffraction revealed about 1 wt. % quartz in this sample. Atomic contents conform well to the the
substitution mechanism $\text{Be}_n^{2+} \text{Li}_m^{+} \text{Al}_k^{3+} + \text{R}_{\text{channel}}^{+}$ established by Bakakin et al. (1969, 1970). This mode of alkali substitution was also confirmed by structure refinement (Hawthorne & Černý 1977). Most of the available Li enters the Be tetrahedra. Both recalculated analyses show channel alkalis in excess of the amount necessary to balance the Be/Li substitution; this excess balances the slight deficiencies in Si and Al.

Comparison of density, $n_\omega$, and BeO content is shown in Figure 6. Considering the somewhat inhomogeneous nature of the analyzed samples, the match with trend-lines averaged by Schaller and Stevens from data on about 100 beryls (Schaller et al. 1962, Norton et al. 1958) is good. The plot of BeO versus $n_\omega$ for secondary beryl SCN-I falls fairly close to the extrapolation of the Schaller et al. curve.

Unit-cell dimensions determined for the bulk of the chemically analyzed material compare well with those expected from the graphs of Bakakin et al. (1970). The low values of $a$ are about equal in all three specimens and reflect the almost ideal Al population of octahedral sites, whereas $c$ is closely dependent on the Be deficiency and alkali substitution.

In general, the correlation of chemical composition with unit-cell dimensions is very good, because both were established on the same material. The fit of compositional versus optical data is satisfactory only when the almost full range of $n_\omega$ is considered. Attempts to correlate the measured specific gravities with any other property lead to the worst results, notably because the differences among materials used for different determinations are the largest.

**ECONOMIC CONSIDERATIONS**

The BeO contents of different zones of the Tanco pegmatite quoted in Table 1 indicate that the deposit contains more than 1,000,000 short tons of beryl-bearing ore which averages 0.22 wt. % BeO. However, the feasibility of beryl extraction may be adversely affected by several factors:

(i) In the footwall part of western wall zone (2), which contains the largest reserve of Be in the pegmatite, beryl is presently the only economically interesting mineral. Low-cost extraction of beryl as a by-product of existing concentration processes would be possible only in zone (6), which is mined for tantalum oxide minerals.

(ii) Beryl crystals cannot be hand-cobbled because of their small size. The wide range of densities (2.70 to 2.80) present in crystals and their segments from a single pegmatite zone precludes separation by heavy media. The densities overlap those of mica and/or feldspar intergrown with quartz. Flotation would be the only means of effective concentration of beryl.

(iii) A marketable beryl concentrate should be
highly purified to conform to the minimum BeO specifications of most consumers. The high alkali content of the Tanco beryl makes it a possible source of cesium (1.5–2.5 wt. % Cs₂O), but considerably reduces its BeO content (from about 13 wt. % BeO in much more common alkali-poor beryl to about 11.5–12.0 wt. % BeO in Tanco samples).

**Geochemical and Paragenetic Relations**

In most beryl-bearing zones the average content of BeO is higher than the critical concentration of 0.018 wt. % Be (0.050 wt. % BeO) derived by Solodov (1971) as minimal for crystallization of beryl (Table 1). In fact, BeO in the beryl-rich zones ranks among the highest known in granitic pegmatites of the Tanco type (compare with Solodov 1971). In beryl-poor zones (4) and (5), BeO averages are marginal to the above value but locally can be expected to be distinctly higher than critical.

The BeO assays quoted in Table 1 and discussed above cannot be taken as directly indicative of the percentage of beryl present. In pegmatites with high Nb, Ta, Ti, Zr contents there is a well-established tendency towards dissemination of Be in rock-forming minerals, mainly micas (Beus 1960; Solodov 1971), and dispersed Be may amount to 6% of total Be in the pegmatite.

The association of all beryl varieties with albite±muscovite is persistent. In wall zone (2), beryl is disseminated in an albite±quartz (lithian muscovite) assemblage. Veinlets of cleavelandite accompany beryl in zones (4) and (5). In the western part of zone (6) and in the lepidolite bodies (9), beryl follows veinlets of fine- to medium-grained albite. In the lower parts of the eastern wing of zone (6), beryl is concentrated above the arcs and lobes of albitic aplite (3) (Fig. 3), and in the muscovite±albite which pervade K-feldspar and quartz.

The composition of beryl is variable in wall zone (2). It ranges from alkali-poor to alkali-rich with high Cs-content, which is the type predominant and rather uniform in all other zones (Figs. 2, 4).

The above characteristics are consistent with the distribution of beryl found in similar pegmatite types by Beus (1960), Solodov (1971), and others. These authors relate the crystallization of most beryl types with albitionizing proceeding at various but generally late stages of pegmatite consolidation. The uniform composition of a part of beryl in zone (2) and of practically all

**TABLE 3. CHEMICAL COMPOSITION AND PHYSICAL PROPERTIES OF THREE BERYL SAMPLES**

<table>
<thead>
<tr>
<th>Sample</th>
<th>U10-11.5</th>
<th>B-188.8</th>
<th>BE-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>62.35</td>
<td>62.00</td>
<td>63.35</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>17.50</td>
<td>17.71</td>
<td>16.77</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>.072</td>
<td>.078</td>
<td>.073</td>
</tr>
<tr>
<td>MgO</td>
<td>.077</td>
<td>.073</td>
<td>.120</td>
</tr>
<tr>
<td>CaO</td>
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<td>.017</td>
<td>.033</td>
</tr>
<tr>
<td>BeO</td>
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<td>11.32</td>
<td>11.21</td>
</tr>
<tr>
<td>Li₂O</td>
<td>.98</td>
<td>1.13</td>
<td>1.29</td>
</tr>
<tr>
<td>Na₂O</td>
<td>1.30</td>
<td>1.66</td>
<td>1.66</td>
</tr>
<tr>
<td>K₂O</td>
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<td>.269</td>
<td>.069</td>
</tr>
<tr>
<td>MgO</td>
<td>.071</td>
<td>.169</td>
<td>.068</td>
</tr>
<tr>
<td>Cs₂O</td>
<td>2.47</td>
<td>3.27</td>
<td>2.92</td>
</tr>
<tr>
<td>H₂O</td>
<td>.03</td>
<td>.07</td>
<td>.05</td>
</tr>
<tr>
<td>H₂O₂</td>
<td>1.96</td>
<td>5.06</td>
<td>2.10</td>
</tr>
<tr>
<td>Total</td>
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<td>99.68</td>
<td>99.70</td>
</tr>
<tr>
<td>D meas. (g/cm³)</td>
<td>2.74*</td>
<td>2.78</td>
<td>2.77</td>
</tr>
<tr>
<td>D calc. (g/cm³)</td>
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<td>(2.72²+2.74)¹</td>
<td>(2.75²+2.79)¹</td>
</tr>
<tr>
<td>n ²</td>
<td>1.585²</td>
<td>1.585</td>
<td>1.585</td>
</tr>
<tr>
<td>n ²</td>
<td>(1.580–1.585)²⁺</td>
<td>(1.585–1.586)²⁺</td>
<td>(1.583–1.585)²⁺</td>
</tr>
<tr>
<td>ε - ω</td>
<td>.005</td>
<td>.008</td>
<td>.006</td>
</tr>
<tr>
<td>(1.006–1.007)²⁺</td>
<td>(1.007–1.008)²⁺</td>
<td>(1.009–1.006)²⁺</td>
<td></td>
</tr>
</tbody>
</table>

Analysis: K. Ravel and R. Chapman (Dept. Earth Sciences, University of Manitoba).

Atomic contents based on 36 oxygens of anhydrous unit cell.

*averages of 3 to 4 grains of analyzed material; †ranges of the same grains.

**refractive indices considered representative for analyzed material; ††ranges for the parent specimens.

α, ω ± Δ for sample BE-3: α=9.214(1)°, ω=9.200(5)°, ε=677.93°, ω/α=1.000.
beryl in other zones speaks for a common origin of all these types (subject to minor variations in shape and color caused by differences in local environment of crystallization). The high alkali and Cs contents, together with the close association with albite and muscovite, favor a late crystallization during albitic metasomatism*

The properties and distribution of beryl strongly indicate that the concept of albitic aplite (3) as a product of crystallization from residual sodic melt (Crouse & Černý 1972) should be reconsidered. This spectacular banded and undulating sodic aplite is absent in the recently opened western part of the deposit. However, the western part of zone (6) is penetrated by a mesh of abundant albite veinlets which carry the same type of Be, Ta, Sn, Zr-Hf mineralization as that associated with the eastern albitic aplite (3) (unpublished data by E. E. Foord, J. Siviola and the first author). Thus the difference between the two albite types may be purely textural, and zone (3), judged by Hutchinson (1959) and Wright (1963) to be metasomatic, could be identical with the “saccharoidal albite” of Russian authors (Zalashkova 1957; Beus 1960; Ginsburg 1960). This concept of beryl formation during late metasomatic events would also couple Be precipitation with the Ta, Nb and Ti mineralization whose metasomatic character was recognized earlier (Grice et al. 1972). Recent observations suggest that most, if not all, minerals of Nb, Ta, Ti, Zr-Hf, Sn and evidently also Be, in the Tanco pegmatite belong to a single mineralization stage. This conforms to the conclusions of Cameron et al. (1949), Beus (1960), and others, derived from countless pegmatite occurrences. The common migration and precipitation patterns of Be, Nb, Ta, Ti, and Zr can be explained by the amphoteric nature of all these metals which are transported mainly in the form of complex anions of about the same stability (Beus 1957, 1960).

The nature of the wall zone (2) whose eastern footwall has been exposed by recent mining also becomes questionable. The presence of two muscovite varieties, two beryl types, and possibly two types of albite, suggests that some parts of this zone may be of metasomatic origin, corresponding to the quartz-muscovite replacement complex (frequently beryl-bearing) recognized by, for example, Jahns (1953), Beus (1960), Ginsburg (1960), and Solodov (1971). This metasomatic assemblage frequently occurs in the outer zones of granitic pegmatites, corresponding to the wall zone (2) of the Tanco body.

One conspicuous deviation of the beryl distribution from the pattern predominant in most other localities deserves notice. The Tanco pegmatite carries most of its beryl in the footwall and central parts, whereas the most common loci of beryl accumulation in other pegmatites are the upper margins of quartz cores and the hanging-wall parts of the outer zones (Beus 1960; Solodov 1971). A similar “anomalous” footwall concentration of beryl is also found in the Bikita deposit in Rhodesia (Cooper 1964). This only emphasizes the general similarity between the Tanco and Bikita pegmatites recognized earlier (Crouse & Černý 1972). Unfortunately, the information on beryl from the analogous Varutrask pegmatite (Quensel 1937, 1956) is too sketchy to provide a meaningful comparison with the Tanco deposit.

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