Ol margin Fo88. Is rutile + 2% Nb.

MINERALOGY OF THE TUNRAQ KIMBERLITE, SOMERSET ISLAND, N.W.T., CANADA

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The Tunraq kimberlite is the only occurrence of micaceous kimberlite within the Somerset Island kimberlite province (Mitchell, 1976). The diatreme is composed dominantly of kimberlite, this being cut by a composite dike of massive and fissile micaceous kimberlites. Megacrysts common to all phases of the intrusion are rutile, ilmenite and garnet. Rutile is a niobian (0.18-2.0%Nb_2O_5), chromian (0-4%Cr_2O_3) variety unlike the low Nb and low Cr rutiles found in diamonds and eclogites. Ilmenites are magnesian (8.4-17.5% MgO), the most magnesian types occurring as mantles upon rutile. Individual megacrysts are moderately (2%MgO) to weakly (0.2%MgO) zoned in an irregular fashion. Compositional trends are interpreted to be from high to low MgO with increasing Fe_2O_3. No correlation of Cr_2O_3 with MgO(r=0.3) is evident and no "parabolic relationship" between these elements as described by Haggerty (1975) is present. Garnets occur as rounded megacrysts up to 1 mm., in diameter and fall into 3 compositional groups using the statistical classification of Dawson and Stephens (1975) i.e. group 1 (34%), group 2 (3%), group 9 (63%). Group 9 is bimodal and contains a group of high Cr_2O_3(>2.5%) garnets derived by fragmentation of ultrabasic xenoliths, all other garnets are considered to be true phenocrysts. Groups 1 and 2 garnets are a characteristic phenocryst in other kimberlites e.g. Frank Smith, Artur de Paiva, Sloan. Similar garnets in the nearby Elwin Bay monticellite-kimberlite are dominantly group 2 garnets. Garnet compositions indicate that subtle differences are present in the nature of the garnet suites between individual diatremes in the same kimberlite province, and that they are unlikely to be xenocrysts.

Mica is present only as phenocrysts, of prefluidization origin. No compositional differences exist between micas in the different facies and little range (0.87-0.92) in the Mg/Mg+Fe ratio occurs. High (>2%) TiO_2 contents are characteristic. The evolutionary trend is considered to be towards decreasing TiO_2 and Cr_2O_3. TiO_2 < 6wt%. non serijon.

Olivine occurs, as in other kimberlites, in two generations. Early prefluidization phenocrysts are essentially homogeneous, Fo_{92}-Fo_{90} with thin iron enriched margins (Fo_{90}-Fo_{88}). Groundmass olivines are weakly zoned from Fo_{92}-Fo_{87}. Reverse zoning rarely occurs (Fo_{86} to Fo_{88}). No difference in olivine compositions in the different facies is evident. Olivines are extensively replaced by iron rich (10% FeO) serpentine.

Spinels are all post-fluidization euhedral groundmass spinels. Each facies of the diatreme has a distinct spinel assemblage. Spinel crystallization in the kimberlite commenced with relatively uncommon Al_2O_3 poor aluminous magnesian chromites (AMC;11-14% Al_2O_3, <1%TiO_2) and evolved to rare titaniferous-magnesian- aluminous chromite (TIMAC, 2-3% TiO_2; 10-11% Al_2O_3) to abundant titaniferous magnesian chromite (TMC, 2-8% Al_2O_3; 1-15% TiO_2) and eventually to magnesian ulvospinel-ulvospinel-magnetite (MUM); 16-20% TiO_2). The compositional trend is one of increasing Fe^{3+} and Ti at approximately constant Fe/Fe+Mg as illustrated in figure 1.

Massive micacous kimberlite initially crystallized TMC identical to the early spinels of the kimberlite but the trend towards Ti enrichment at constant Fe/Fe+Mg does not exceed 3% TiO_2, therefore members of the MUM spinel series are not developed. Spinels richest in TiO_2(6-7%) are unusual in being Al and Mg poor titaniferous chromites with Fe/Fe+Mg>0.8. The most abundant spinel is a Ti-free magnetite. The titaniferous chromite and lack of MUM indicate that in this facies spinels were rapidly depleted in Al and Mg, a trend along the axis of the spinel prism (figure 1).

The fissile micaceous kimberlite initially crystallized TMC with greater than 7% TiO_2 which evolved into members of the MUM series. The trend is identical to that of the kimberlite, and Ti-free magnetite is absent (except pseudomorphing olivine) as a primary spinel phase in both of these facies.

Spinel compositional trends are in general similar to those determined for other kimberlites (Haggerty, 1975; Mitchell and Clarke, 1976) as illustrated in figure 1 where the Tunraq spinel trend is compared with that of the Peuyuk kimberlite and a preliminary trend for the Kirkland Lake, (Ontario) micaceous kimberlite.

The mineralogy and petrology of the Tunraq kimberlite indicates that the phases which are common to all three facies and which crystallized in the mantle are rutile, ilmenite, pyrope and olivine. With decreasing pressure as the magma ascents pyrope and ilmenite cease to crystallize and phlogopite replaced garnet as the aluminous liquidus phase in the lower crust and uppermost parts of the mantle. This crystallization sequence is very different to that deduced for the Elwin Bay and Peuyuk kimberlites (Mitchell and Clarke, 1976, Mitchell, 1978) in which AMC and TIMAC spinels are abundant, ilmenite is absent or insignificant and in which only minor phlogopite is formed. The studies of the Somerset Island kimberlites demonstrate that each diatreme exhibits both subtle and gross differences in its pre and post-fluidization history and that the observed evolutionary trends are established in the mantle, those trends being merely emphasized in the lower crust and post-fluidization history. The trends must reflect different degrees of partial melting and/or high pressure differentiation. Although the Tunraq facies which is poor in modal mica is referred to here as kimberlite, the Al_2O_3 deficiency in the spinels and lack of AMC and TIMAC indicates that even this facies should be termed "micaceous kimberlite".

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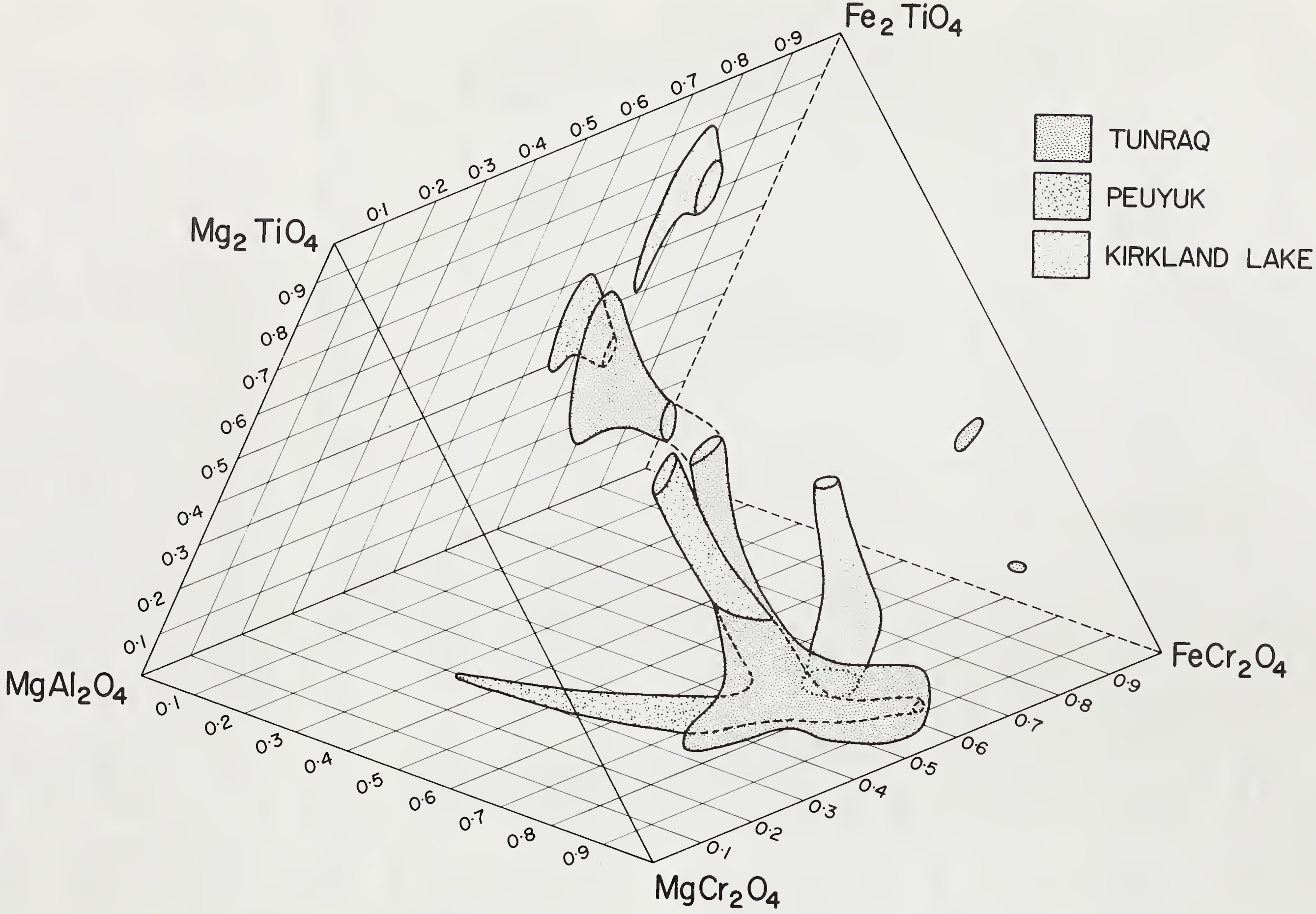

Figure 1. Composition of kimberlite spinels plotted in a reduced iron spinel prism.