genesis. It is concluded that the TiO2-poor diamond inclusion-type spinels crystallise under subsolidus conditions and do not crystallise from a melt.

6.P22 THE UPPER MANTLE HETEROGENEITY: THERMODYNAMIC CALCULATIONS AND METHODS OF MATHEMATICAL STATISTICS

Pokhilenko LN*, Tomilenko AA, Kuligin SS, Khlestov VV

Xenoliths of different genesis from kimberlite pipes of Yakutia (Udachnaya, Mir, Zagadochnaya, Obnazhennaya) and South Africa (Roberts Victor) have been studied. The microprobe analysis of their components has been made with the use of a CAMEBAX-MICRO X-ray microprobe (CAMECA, France) and the P-T conditions of equilibrium of these rocks have been determined. The volatiles from the minerals of mantle xenoliths have been analyzed on a setup, assembled from three standard gas chromatographs LXM-80 and equipped with original device for thermic extraction of gases. This setup makes it possible to determine simultaneously all gases of interest (CO_2, H_2O, CH_4, H_2, N_2, CO, O_2, C_2-Cn) from the same sample. The chromatographic data have been recalculated into the P-T conditions of equilibrium of our rocks. The calculations have been made for C-O-H system in the presence of solid carbon using the HCh code, which employs the minimization of Gibbs's free energy method. In this paper we describe algorithm of discrimination of mantle rocks of different genesis on the basis of the two independent sets of parameters: (1) the fluid characteristics: H/(H+O) and -lgfO2 at conditions of P-T equilibrium of the rocks and (2) the values of the ratios of main oxides of the rock-forming minerals (Fe'=FeO/(FeO+MgO+MnO), Cr'=Cr2O3/(Cr2O3+Al2O3+TiO2), Ca'=CaO/(CaO+MgO+FeO), Na'=Na2O/(Na2O+K2O+CaO) – for garnets and pyroxenes; Fe'=FeO/(FeO+MgO+MnO), Cr'=Cr2O3/(Cr2O3+Al2O3+TiO2) – for spinels; Fe'=FeO/(FeO+MgO+MnO), Ni'=NiO/(NiO+MgO) – for olivines). Optimized linear discriminative projections of the mantle rocks of different genesis have been obtained. Thus, using the bulk of the available data on the variations of chemical compositions of the rock-forming minerals and oxygen fugacity of the rocks of various parageneses, we can reliably distinguish the sets of the mantle rocks, even when they are similar in P-T equilibrium conditions or in fO2. We interpret this as an indication of the fact that the upper mantle is heterogeneous, even within small areas. The variables for each paragenetic association are connected. This connection makes it possible to separate these groups of rocks. The mathematical statistic methods prove useful in revealing this phenomenon.

SESSION 7: KIMBERLITE PETROGENESIS

7.P1 PETROLOGY OF THE SNAP LAKE KIMBERLITE, NWT, CANADA

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The Snap Lake kimberlite is located 220km northeast of Yellowknife in the Northwest Territories. The kimberlite occurs in the southeastern part of the Slave Craton, intruding Archaean granitoids and metavolcanics. The age of the kimberlite is ~523±6.9Ma. Core drilling shows that the Snap Lake kimberlite consists of a single dominant kimberlite unit that locally splits into several kimberlite units, or 'stringers', that may connect down dip or laterally along strike. The kimberlite sheet dips to the northeast at ~15° with a minimum plan view area of 2x3km. The diamondiferous Snap Lake kimberlite is a rare example of a potentially economic, near horizontal sheet-like deposit. The kimberlite has been exposed in two underground tunnels at 124m (upper) and 164m (lower) from the present surface. Mapping of the tunnels suggested that the complex is dominated by one main sheet, with an average thickness of 2-3m. Petrographic features, supported by matrix mineral and whole rock compositions, show that these rocks can be classified as Group 1, phlogopite monticellite kimberlite. Within the main sheet there are also two volumetrically minor, but distinctly different phases: firstly an altered hypabyssal kimberlite breccia which contains both metavolcanic and granitoid xenoliths and secondly, a hypabyssal granitoid-rich breccia lacking metavolcanic xenoliths.

The kimberlite in the main sheet is composed of xenolith-poor, coarse to very coarse grained olivine macrocrysts (15-35 modal %), rare mantle-derived xenocrysts of garnet, olivine phenocrysts (<5 modal %) and less common phlogopite microphenocrysts set in a groundmass of monticellite, phlogopite, spinel, apatite, perovskite, serpentine and carbonate. The olivine and monticellite have been completely pseudomorphed by serpentine. Four types of phlogopite have been recognised petrographically. Type I and II are macrocrystal and phenocrystal phlogopite, respectively. Type III groundmass phlogopite occurs as small, colourless, late-stage laths with straight and/or irregular step-like boundaries. Type IV groundmass phlogopite occurs as larger, colourless, elongate subhedral laths having a decussate texture, and they poikilitically enclose monticellite, spinel and olivine microphenocrysts. Type IV phlogopites occur mainly in the upper sampling tunnel while the Type III phlogopites occur mainly in the lower sampling tunnel.

The petrographically distinct Type III and IV phlogopites also have contrasting compositions and zoning patterns. Type III and IV can be subdivided into two distinct groups based on their TiO_2 content, with Type III having 0.8-2.5 wt.% versus 0.3-0.8 wt.% in Type IV. Type III phlogopite grains show enrichment in BaO content from the cores (<1.0 wt.%) to the rims (1.5-5.0 wt.%). In contrast, BaO content of Type IV phlogopite grains have BaO-enriched cores (6.5-11.0 wt.%) with lower BaO rims (<4.2 wt.%). The Type III phlogopite grains often have high Cr_2O_3 cores (<1.7 wt.%), which do not occur in the Type IV phlogopite grains. The difference in the occurrence and composition of the late stage phlogopites suggests that the sheets encountered in the upper and lower sampling tunnels could be separate phases of kimberlite. Further comparative studies of bulk and mineral compositions of the kimberlites are needed to confirm, or reject, this hypothesis and consider alternative explanations.

7.P2 KIMBERLITES OF THE NAKYN FIELD, SIBERIA, AND THE SNAP LAKE/KING LAKE DYKE SYSTEM, SLAVE CRATON, CANADA: A NEW VARIETY OF KIMBERLITE WITH PROPOSED ULTRADEEP ORIGIN

Pokhilenko NP*, Agashev AM, McDonald JA, Sobolev NV, Mityukhin SI, Vavilov MA and Yanygin YT

Kimberlites of the recently discovered Nakyn field (NF), Siberia, and those of the Snap Lake/King Lake (SL/KL) kimberlite dyke system, Slave Craton, Canada, have definite geochemical and petrological features linking them to those of Groups 1 & 2 kimberlites as well as specific features separating them from known kimberlites. Features common to the Nakyn and SL/KL kimberlites include: 1) their micaceous character and relatively low K_2O/TiO_2 ratios; 2) a wide range of CaO contents (e.g.: 0.6-26.5 wt.% for SL/KL kimberlites) related to wide variations of contained carbonate minerals (dolomite and calcite); 3) absence of magnesian ilmenite; 4) low total content of indicator minerals (Cr-pyropes and chromites) < 0.5 kg/t; 5) a very wide range of Cr_2O_3 content in pyropes (up to 17 wt.% for SL/KL

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