Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08816, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08816
EGU General Assembly 2008
© Author(s) 2008

Magma composition and crystallization conditions of the fluorite carbonatites from Bol'shaya Tagna carbonatite complex (eastern Sayan, Russia): evidence from melt inclusions

I. Andreeva (1), V. Kovalenko (1)

(1) Institute of Geology of Ore Deposits, Petrography, Mineralogy, Geochemistry, Russian Academy of Sciences, Moscow, Russia (andreeva@igem.ru / Fax: (+7 495 9511587)

The Bol'shaya Tagna ìassif is situated in the eastern Sayan province of alkaline ultrabasic rocks and carbonatites. This massif is a rounded and concentrically zonal-ring complex structure (4 km in diameter) that demonstrates the consecutive formation of ijolite-melteigite, nepheline and subalkali syenite (microclinite), picritic porphyritic rock, and carbonatite rocks. The abundance of syenites and microclinites and the intense development of fluorite mineralization related to the formation of carbonatite rocks are distinguishing features of this massif. Three types of fluorite carbonatites are recognized: (1) fine-grained calcite carbonatites with fine- and very fine-crystalline fluorite, hematite, and apatite; (2) massive or banded ore consisting of fluorite, calcite, K-feldspar, and aegirine (fluorite crystals vary from fractions of millimeter to 1 cm in size); and (3) stringer-disseminated ore with fluorite crystals from 3-4 mm to 1 cm in size.

The studied sample is a coarse-grained fluorite carbonatite of the second type composed of carbonate ($\sim$ 60 vol %), fluorite ($\sim$ 30%), K-feldspar ($\sim$ 5%), pyrite (2-3%), and barite (up to 1-2%). Carbonate is represented by calcite with elevated contents of Mn and FeO. The two-phase exsolution structure is often observed, Mn-calcite and kutnahorite (carbonate of dolomite group).

The primary melt inclusions and syngenetic crystalline inclusions were revealed in

fluorite, K-feldspar, and pyrite from fluorite carbonatite.

The crystalline inclusions represented by carbonates, fluorite, K-feldspar, aegirine, columbite, and pyrite. Among crystalline inclusions of carbonates were determined calcite, Na-Ca-carbonate, and kutnahorite. Sporadic columbite ingrowths in calcite have been identified. Columbite contains as much as 11 wt % MnO, 9.5 wt % FeO, and 4.6 wt % TiO. The crystalline inclusions of Na-Ca-carbonate in fluorite contains up to 44.6 wt % CaO, 18 wt % Na_2O, 4.5 wt % F, 3.7 wt % MnO, and 1 wt % FeO. The empirical formula of this mineral was calculated from the chemical analysis as $Na_{6.05}(Ca_{8.27}, Mn_{0.55}, Fe_{0.14})_{8.96}[CO_3]_{7.00}(F_{2.49}OH_{1.51})_{4.00}$. The calculated H_2O and CO_2 contents are 1.31 and 29.66 wt %, respectively, and the total is 101.09 wt %.

Primary melt inclusions in fluorite are completely crystallized and contain a residual gas phase and a number of daughter minerals including carbonate, fluoride, and chloride. Carbonates are predominant and represented by calcite, kutnahorite, Na-fluorcarbonate, nyerereite, and burbankite. Nyerereite (Na-Ca - carbonate) and burbankite (Ba-Sr-carbonate) are rather rare minerals and have been identified as daughter phases in melt inclusions for the first time. Fluoride minerals are represented by fluorite and villiaumite. Qualitative microprobe analyses have indicated the presence of halite and sylvite among the daughter minerals. In general, the mineral assemblage of melt inclusions in fluorite from carbonatites of the Bol'shaya Tagna carbonatite complex is consistent with mineral composition of carbonatitic lavas of the Oldoinyo Lengai Volcano (Tanzania), where nyerereite, gregoryite, Ba-carbonate, fluorite, and sylvite have been identified as phenocrysts and groundmass minerals in the lavas.

The thermometric experiments with melt inclusions were carried out on a Linkam TS 1500 microscopic heating stage with visual control. The first indications of melting of crystalline phases were observed at 280^{o}C. The complete homogenization of inclusions into salt melt was attained at 520-525^{o}C. The similar magma temperature (544^{o}C) was measured during the eruption of the Oldoinyo Lengai Volcano in 1988.

During the subsequent cooling, the salt melt completely crystallized into a microgranular aggregate of quenched crystals. A complete scanning of the chemical composition of homogenized melt inclusions in fluorite analyzed by scanning over the whole area allowed us to estimate the composition of the salt melt that produced the fluorite carbonatite. The melt is characterized by extremely high contents of Na_2O (up to 22 wt %) and CaO (up to 10 wt %), F (up to 1.65), Ce_2O_3 (up to 1.3 wt %), Cl (up to 1.0 wt %) as well as by elevated contents of FeO (7 wt %), MnO (4-5 wt %), K_2O (3-8 wt %), SrO (0.6-0.8 wt %), and Ba (0.6 wt %), F, and Cl. This melt are chemically similar to the compositions of the lavas from the Oldoinyo Lengai Volcano.

A compositional difference between the rock studied and melt inclusions, (particu-

larly, in terms of CaO and Na_2O contents) may be accounted for by instability of sodium carbonates and chlorides and their removal with fluid phase at the late stage of magma crystallization. The sodic phases could also have been leached by water from the rock, but this process is less probable because leached cavities are absent in the rock.