Geochemical and lithological characteristics of Badou carbonatite pipe, Shandong China

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Geological Setting

The Laiwu-Zibo area, include the Badou carbonatite, locates the northern part of the Luxi anticline in Shandong province, China. Some kimberlite pipes distribute nearly in the center and many carbonatites distribute in the northern and southern part of the Luxi anticline. Although in the Laiwu-Zibo area most of the carbonatites are sheets and dikes, a carbonatite breccia pipe appears in the Badou. So far another pipe has been found in Lutong in the same area. The Badou carbonatite pipe forms an ellipsoidal shape in the Ordovician limestone (Wan et al., 1983; Hong et al., 1992). The pipe should be important to study because it spouted directly from the deep part in the earth, and should have brought significant information of the deep earth.

Result and Discussion

The samples from Badou pipe include many xenoliths. The color of Badou carbonatite is greenish. We classified the samples into three types (Type 1, 2 and 3) on the basis of their lithologic types. These three types correspond to the sampling point in the Badou pipe. We discovered mainly carbonate minerals are different between the sample types. The dolomitic carbonatite (Type 1) is dominant near the margin, and a calcitic carbonatite (Type 2 and 3) is mostly appear in the central area of the Badou pipe.

The Badou carbonatite is rather poor in CaO, but contains high SiO_2 and Al_2O_3 in comparison to the other carbonatite in the world (South Africa, Russia and Canada etc.). Such geochemical characteristics are similar to that of the carbonatite from Polino pipe (Stoppa et al., 1993). The Badou carbonatites are rather enriched in V, Cr, Ni and Zr contents. Its rare earth element compositions are similar to the carbonatites from the other place. The chondrite-normalized patterns of REE show smooth decrease from LREE to HREE and their patterns have not specific characteristic anomaly.

The lithologic classification is supported by geochemical compositions as well. Especially, the major element, V, Rb and Ba clearly differ among the types. The ratios of La/Yb differ among the each lithologic type, too. Some element compositions could be influenced by the included amounts of minerals and kinds of minerals. K_2O, and Fe_2O_3 contents depend on the mica amount and P_2O_5 composition is affected by the modal abundance of apatite. MgO content could be related to the variety of carbonate minerals.

Interlayer cation defect of phengites in HP calcschists from western Alps, Italy

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Calcschists in Chisone valley, western Alps, Italy have suffered blueschist facies metamorphism (Takeshita, 1994). They contain commonly phengites and carbonaceous material, suggesting that the phengites are free from ferric iron due to buffering of oxygen fugacity by carbonaceous material. EPMA analyses of phengites have often showed that the total composition is unusually low and the K+Na+Ca value is less than 1.0 pfu (O=11). We carried out carefully EPMA anlyses of phengites in five calcschists collected from the same location, suggesting the same P-T-t history for them.

Fig. 1a shows Si - Al diagram of phengites and paragonite analyzed. The phengites are always plotted on the Al and Si rich part above an ideal Tschermak substitution line. K+Na+Ca value is also conformed to be less than 1.0 pfu (0.77-0.94 pfu on O=11). One sample was analyzed in two different conditions that beam current and diameter are 10 nA and 7 micron, and 12 and 3, respectively. The results were the same.

We recalculated the chemical compositions of phengites by addition of appropriate potasium or sodium to get K+Na+Ca = 1.0 pfu. Almost all the recalculated chemical compositions are plotted on the Tschermak substitution line (Fig. 1b). The total is better in potassium addition than sodium one. This indicates the existence of interlayer cation defect in phengites.

BSE image analysis revealed a zoned phengite having the core with high Si (3.4-3.6 pfu) and low Na, and the rim with low Si (3.1-3.2 pfu) and high Na. Both data are also plotted on the part above the Tschermak substitution line, showing that the defect took place after the formation of rim or the rim inherited the primary cation defect.

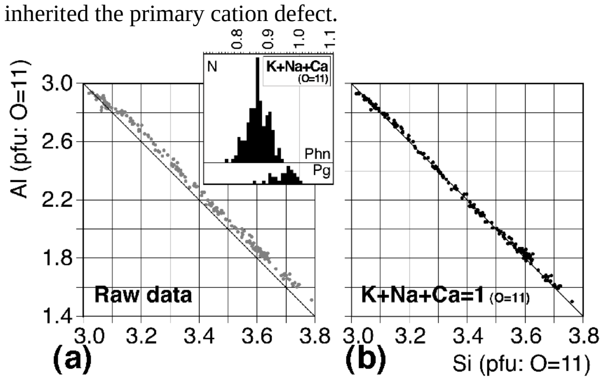

Fig. 1 (Phn: phengite, Pg: paragonite)