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A comparative geochemical and petrological study of the Siberian and Ethiopian large igneous provinces (LIPs)

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This study is mainly targeted to find the possible eastern marginal extension of Siberian LIP and to compare them with the central Siberian LIP and is also aimed to compare and contrast the geochemical and petrological characteristics of Siberian LIP (˜ 250 Ma) with the Ethiopian LIP (˜ 30 Ma) to consider the mantle and crustal processes in view of magmatic diversity among those LIPs. A review of previous geochemical data from the Siberian and Ethiopian LIP confirms notable differences in their major and trace element compositions. Siberian LIP comprises a variety of rocks (such as basalts, andesitic basalts, picrites and meimechites) with a wide range of SiO2 (40-62 wt.%). In contrast, Ethiopian LIP is characterized by bimodal volcanism with the absence of intermediate rock. The Ethiopian high-Ti basalts and picrites have higher TiO2 (3-6 wt.%), lower CaO/Al2O3 (0.5-1.5) and MgO (5-26 wt.%) than the Siberian high-Ti picrites and meimechites (2-4, 1.8-2.3 and 13-36 wt.% respectively). Siberian LIP shows more significant depletion in HFSE (mainly Nb) and higher La/Sm ratios than Ethiopian LIP. This may suggests contamination of Siberian LIP magma by continental crustal rocks. Triassic volcanic and intrusive rock samples are collected from the Chukotka province (Northeast Russia), which is geographically far to the east from the central Siberian flood basalt province. The petrography of the studied samples includes basaltic rocks (i.e. hornblende basalt, lamprophyre, pyroxene phyric basalt, and ankaramite) and gabbroic rocks (i.e. hornblende gabbro, pyroxene-hornblende gabbro, pyroxene gabbro, and quartz diorite). Basaltic rocks exhibits porphyritic texture with phenocrysts of plagioclase+ clinopyroxene+ hornblende, whereas gabbroic rocks show granular, ophitic and poikilitic textures with a crystals of hornblende+ clinopyroxene+ plagioclase and rare phlogopites. Opaque minerals are usually magnetite with a size reaching about 7 mm in hornblende gabbro and also iron sulphides in pyroxene-phyric basalt. The chemical composition of clinopyroxene phenocrysts from basalts are in the range of Wo29-51En38-49Fs4-33 with a general ferrosilite (Fs) increase from core to rim, but a few phenocrysts in the pyroxene-phyric basalt show a reverse zoning. The clinopyroxene phenocrysts from the pyroxene phyric basalt have a range of Mg# (0.72- 0.91), whereas those from hornblende basalt, ankaramite and lamprophyre units have 0.54-0.76, 0.83-0.92, and 0.83-0.93 respectively. Clinopyroxene phenocrysts from hornblende basalt are highly differentiated and richer in FeO (average ˜ 16.4 wt.%) than clinopyroxenes from the high-Ti and alkaline meimechite (Siberian LIP) and Ethiopian High-Ti basalt. Clinopyroxenes both from basalts and gabbros show only low-Ti (<1 wt.%) characteristics. Hornblendes both from basalts and gabbros have tschermakitic composition with alkali content ranges from 3.41 to 4.39 wt.%. Phlogopites occurring as a minor phase in the pyroxene-hornblende gabbro with Mg# ranges from 0.64 to 0.66. The groundmass plagioclases from the lamprophyre includes the three feldspar end members, i.e. An8-73Ab2-85Or1-89. This suggests relatively high alkali content of the magma. The Triassic basalts and gabbros of Chukotka province may represent the easternmost portion of the Siberian LIP characterized by a low-Ti, HFSE depleted and hydrous basic magma.

Keywords: Siberia, Chukotka, Ethiopia, LIPs, hornblende basalt, meimechites

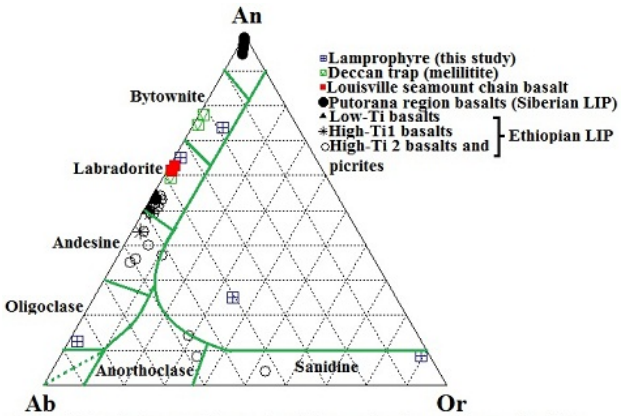

Fig. 1 Ab-An-Or ternary diagram for feldspars from lamprophyre. Ab, albite; An, anorthite; Or, orthoclase.