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Trace Element and Nd-Sr Isotopic Composition of Lamprophyres from the Ditrău Alkaline Massif, Romania

Anikó BATKI1 and Elemér PÁL-MÓLNÁR2

1 Department of Mineralogy, Geochemistry and Petrology, University of Szeged, PO Box 651, 6701 Szeged, Hungary
2 Department of Mineralogy, Geochemistry and Petrology, University of Szeged, PO Box 651, 6701 Szeged, Hungary

Lamprophyres are a group of alkali-rich igneous rocks containing essential amphibole and/or biotite-phlogopite and form subvolcanic dykes, sills, plugs, stocks, vents or margins to larger intrusions (Rock 1991). Alkaline lamprophyres (AL) have ‘basanitic to nephelinitic’ compositions, low-Si (41–43 % SiO₂), high-Na (3–4 % Na₂O) content and usually Na > K. Calc-alkaline lamprophyres (CAL) are ‘shoshonitic’ in composition and have high-Si (49–52 % SiO₂) and high-K (2–5 % K₂O) among lamprophyres. Both of them are rich in Sr, Rb, Ba, Th, Zr, LREE and volatiles (Rock 1991). This paper presents trace element, rare-earth element and radiogenic isotope data, and discusses variation in their chemical and isotopic composition.

The Ditrău Alkaline Massif is a Mesozoic alkaline igneous complex and situated in the S-SW part of the Giurgeu Alps belonging to the Eastern Carpathians (Romania). This body intruded into the pre-Alpine metamorphic basement complexes of the Bucovian Nappe Complex located on the east side of the Culimani-Gurghiu-Harghita Neogene-Quarternary calc-alkaline volcanic arc, and took part in the Alpine tectonic events together with these metamorphic rocks (Pál-Molnár 2000). The center of the DAM was formed by nepheline syenite, which is surrounded by syenite and monzonite. The northwestern and northeastern parts are composed of hornblendite, diorite (called Tarnica Complex, Pál-Molnár 2000), monzonite and alkali granite. The whole complex is cut by late-stage lamprophyre, alkali feldspar syenite and tinguaite dykes.

The studied area is the northern part of the DAM. The alkaline lamprophyres are camptonites (amphibole rich, plagioclase-bearing) and were collected from Tarnica Complex (Orotna, Tá-
szok, Fülop, Gudu Creeks), Török and Nagyág Creek. They are dark-grey, greenish-grey mafic rocks showing typical panidiomorphic texture and felsic globular structures. Camptonites from Tarnica Complex carry clinopyroxene phenocrysts, reddish-brown kaersutite, subordinate biotite microphenocrysts and interstitial plagioclase (An₉₋₁₃). Clinopyroxenes are aluminian subsilicic ferroan diopsides (C₉₀₋₁₀,Mg₀.₇,F₄₋₆,Al₂₋₃,Si₁₋₃,O₁₂) and high-K (2–5 % K₂O) among lamprophyres. Both of them are rich in Sr, Rb, Ba, Th, Zr, LREE and volatiles (Rock 1991). This paper presents trace element, rare-earth element and radiogenic isotope data, and discusses variation in their chemical and isotopic composition.

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The studied calc-alkaline lamprophyres occur only in alkali granites (northeastern part of the DAM) and are intermediate, less mafic dyke rocks. Samples collected from Török Creek are transitional types between minettes (biotite – K-feldspar rich) and kersantites (biotite – plagioclase rich). Rocks from Nagyág Creek are also transitional varieties amongst vogesite (amphibole – K-feldspar rich) and spessartite (amphibole – plagioclase rich). The minette – kersantite group contain andradite phenocrysts, phlogopite (mg# = 0.71–0.75), albite (An₉), K-feldspar (Or₉₀) and feldspatoids in the groundmass. The Ti-bearing an-
Drabites are surrounded by secondary phlogopitic biotite, chlorite and magnetite. Feldspars are strongly sericitized. Other secondary phases are calcite and epidote. The vogesite – spessartite group carry clinopyroxene phenocrysts, ferro-ekermetite (CaO 3–10 w%, Na2O 11–8 w%), ferro-richterite (CaO 12 w%, Na2O 6 w%), small amount of magnesian biotite (mg# = 0.5–0.67), albite (An0), K-feldspar (Or96) and feldspathoids in the groundmass. Accessory minerals in all CAL are apatite, titanite, magnetite and zircon.

Major oxide composition were analysed on a Finnigan MAT Element spectrometer by HR-ICP-MS, the trace and the REE elements were determined by ICP-AES using a Varian Vista AX spectrometer at the Department of Geology and Geochemistry, University of Stockholm, Sweden. The concentration of major elements for the analysed samples falls within the range of alkaline and calc-alkaline lamprophyre as characterised by Rock (1991). Alkaline lamprophyres have low SiO2 content (42–50 %), high TiO2 (1.7–3.7 %) content, high alkalies and incompatible trace elements such as LREE, Zr (629 ppm), Nb (124 ppm), Ba (1815 ppm), Sr (1142 ppm) and chondrite-normalized (La/Yb)n ratios are 17–29. The mantle- and chondrite normalized patterns slightly deviate in Rb, Ba, Nb, Cr (Fig. 1B) and strongly differ at Nd, Sm, Eu and Gd (Fig. 2B) from the CAL average (Rock 1991). The distinctive negative Eu anomalies (Eu/Eu* = 0.33–0.65), the low Ti and Ba contents of the investigated CAL suggest that minettes – kersantites and vogesites – spessartites are more differentiated rocks, in contrast to the camptonites.

Sr and Nd isotopic data were obtained by a Finnigan MAT261 thermal ionization mass spectrometer at the Laboratory for Isotope Geology, Swedish Museum of Natural History, Sweden. Initial ratios were calculated using an age of 200 Ma. The DAM lamprophyres are characterized by variable 87Sr/86Sr (.7033–.7063) and composition of 143Nd/144Nd = .512729–.512832. Figure 3 displays the isotopic results in a εNd(t) and εSr(t) diagram showing that the studied lamprophyres fall on the left side of the mantle array with εNd(COOx) = +4.0 to +6.1. Based on the Sr-Nd isotopic composition the lamprophyres from the northern part of the DAM are mantle-derived rocks.

References

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