Calc–alkaline lamprophyres from the Nízke Tatry and Malá Fatra Mts.: Petrology and geochronology

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Abstract: Calc–alkaline lamprophyres are known from several localities in the Malá Fatra and Nízke Tatry Mts. They form dykes of varying degree of alteration that have intruded the surrounding granitoid and gneisses. Clinopyroxenes (diopside to augite), amphiboles (kaersutitic), biotites (annite) and plagioclases are major primary minerals The chemical composition of the lamprophyres indicates their calc–alkaline character. The differences in the chemical composition of the rocks (including Sr and Nd isotopes) probably result from the contamination of primary magma by crustal material during magma ascent. The age of the lamprophyres, based on U/Pb dating in apatite, is of 263.4±2.6 Ma (Malá Fatra Mts.) and 259.0±2.8 Ma (Nízke Tatry Mts.).

Lamprophyres are dyke rocks which differ from intrusive and effusive rocks in mineral composition, structure and, to some degree, in chemical composition. We studied lamprophyre rocks from the Nízke Tatry and Malá Fatra Mountains which occur in the Early Palaeozoic complexes. The lamprophyres from the Nízke Tatry are found in different types of gneisses and those from the Malá Fatra in granodiorites. They are porphyric dark green rocks with fine-grained to afanitic matrix. The bodies have a dyke like shape and are mostly several meters thick (in the locality of Jarabá, their thickness is about 25 meters). We focused on the youngest types of rocks with preserved primary structure and minerals in this study. As for mineral composition, they are made from primary (mafic and felsic), secondary and opaque minerals. The Malá Fatra lamprophyres often contain also xenoliths of ambient rocks. The most common mafic minerals occurring in the rocks are clinopyroxenes, amphiboles and biotites. From felsic minerals there are quartz and silica. Based on IUGS classification (Le Maitre et al. 2002; Ondrejka et. al. 2015), we classify the studied rocks from both mountains as spessartite or kersantite. The clinopyroxenes correspond to diopside, and/or augite. The amphiboles are quite strongly altered and correspond to Ca-amphibole, tremolite (Hawthorne et al. 2012). We also found kaersutite in Malá Fatra lamprophyres. The biotites are characteristic for high TiO_2 content, which proves their magmatic origin. Based on Abdel-Rahmana classification (1993), they correspond to amphibole from calc-alkaline rocks. The prevailing felsic minerals are plagioclase, and K-feldspar. The basicity of plagioclases ranges from labradorite to albite.

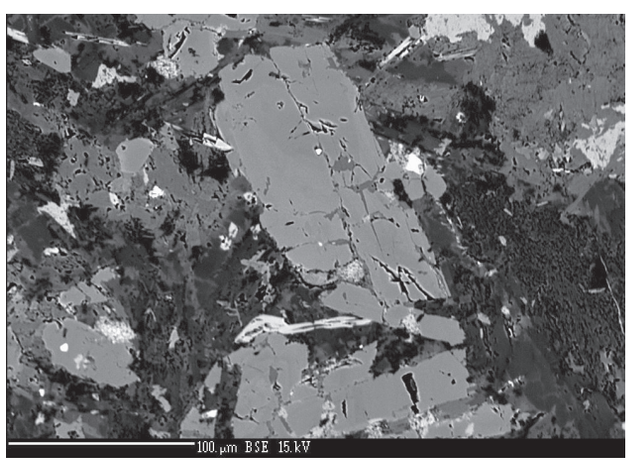

Fig. 1. Back scattered electron (BSE) images of lamprophyre texture. Locality: Dubná skala.

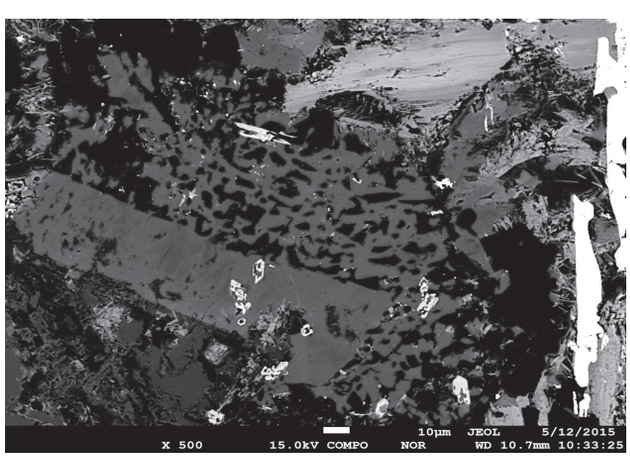

Fig. 2. Back scattered electron (BSE) images of lamprophyre texture. Overgrowth of quartz and K-feldspar. Locality: Jarabá.

In addition to different proportions of sodium (Na_2O content up to 3.72 wt. %), alkaline feldspars often have also increased contents of Ba. In some cases (BaO=5.57 wt. %) we can already speak of barium feldspar. The secondary minerals include chlorite, epidote and carbonates. From opaque minerals, the most common are ilmenite, rutile, pyrite, chalcopyrite, pyrrhotite, while the sulphides are younger than the oxides.

The chemical composition of the lamprophyres from the Nízke Tatry Mts. and Malá Fatra Mts. can be used to reveal their genetic conditions, although it is strongly affected by the alteration of these rocks and amygdales and xenoliths of the surrounding granitoid rocks (or plagioclases) presence. In the classification diagram of different types of lamprophyre rocks (Rock 1987), the studied lamprophyres correspond to the calc–alkaline type. The contents of compatible elements (Cr, Ni, Co, V, Sc) in the studied lamprophyres are lower (Cr, Ni). We also used discrimination diagrams to classify the studied rocks with different types of magmatic formations — in most diagrams they correspond to calc–alkaline types. The normalized REE curve indicates enrichment in LREE relative to HREE. No Eu-anomaly was observed and therefore, no accumulation or plagioclase fractionation during magma evolution is likely.

The determined age of the rocks using LA-ICP-MS by apatite analysis of 263.4±2.6 Ma (Malá Fatra Mts.) and 259.0±2.8 Ma (Nízke Tatry Mts.) corresponds to their geological position (Spišiak et al. 2018, 2019).

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