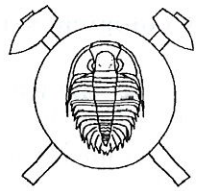
Pyroxene microgranodiorite dykes from the Ševětín structure, Czech Republic: mineralogical, chemical, and isotopic indication of a possible impact melt origin



Žíly pyroxenického mikrogranodioritu v ševětínské struktuře: mineralogická, chemická a isotopická data indikující možnou impaktní genezi (Czech summary)

(6 text–figs., 2 plates)

STANISLAV VRÁNA – JIŘÍ BENDL – FRANTIŠEK BUZEK

Český geologický ústav, Klárov 3, 118 21 Praha 1

Submitted November 4, 1993

A study of pyroxene microgranodiorite dykes in the Ševětín structure (D = 46 km, deeply eroded) indicates their crystallization from liquids derived from melting mainly of the regionally dominant sillimanite–biotite paragneiss. The microgranodiorite exhibits a rather limited variation of major and trace element contents, except for Mg, Cr, and Ni, that are introduced by a highly magnesian component. Enrichment factors relative to the indigenous concentration in biotite paragneisses are 1.4 to 2.2 for MgO, 1.3 to 5.3 for Ni, 1.2 to 2.8 for Cr, and 0.8 to 1.3 (1.9 ?) for Co; it is likely that most of Pt determined (0.54 to 5.6 ppb) belongs to the Mg–rich component. If the enrichment in these elements were of metoritic origin, then the "net contamination component" is matched only by highly magnesian achondrites (peridotite, enstatite achondrite). Analyses of platinum group elements (PGE) show absence of Ir contamination; Pt/Pd ratio of up to >56, which appears to be unique, indicates a strong fractionation of PGE. Microgranodiorite has major element composition and Sr isotopic composition closely similar to Ries crater suevite and impact glasses in suevite. The Ševětín pyroxene microgranodiorite dykes are free from a signature of partial melting and differentiation that are ubiquitous in the conventional magmatic dyke rocks of the region.

Introduction

The Ševětín structure in southern Bohemia, Czech Republic, is 46 km in diameter. It has been interpreted as an eroded impact structure (Vrána 1987). The structure displays a low–surface morphology and has a well–defined circular outline and a weakly elevated central region, 21 km in diameter. In view of the deep erosional section, probably > 3 km, the usage of terms like *crater rim* and *central uplift*, appropriate for well–preserved impact structures, is being avoided; instead, we use terms *(outer) circular outline* and *central elevated region*. Due to the erosional state of the structure, the remains of impact melt sheet or allochtonous impact breccias are absent, and important information can be obtained by a detailed study of the holocrystalline melt dykes which have pyroxene microgranodiorite composition (MGD from here on). These dykes, strictly endemic to the Ševětín structure, have chemistry , mineralogy, and Sr, Nd isotopic composition indicating their derivation by melting of the regional sillimanite–biotite paragneiss (Vrána 1989). This warrants a detailed study of the dykes, irrespective of the strongly degraded state of the circular structure and its mode of formation.

The search for shock deformation in quartz is one of the most efficient methods in investigation of a possible impact origin of a structure. Very distinctive lattice defects have been identified on the optical and transmission electron microscopic (TEM) scale, providing a reliable shock criterion (French and Short 1968, Stöffler 1972, Goltrant et al. 1991). Though structures similar to planar deformation features have been recorded in quartz from Ševětín by microscopic petrography (Vrána 1987), recent TEM study (Cordier et al., 1994) shows that this deformation, although anomalous, does not correspond to a critical shock deformation. This means that if the Ševětín structure has an impact origin, the injection dykes must have penetrated beyond the level of shock deformation. Due to shock wave attenuation with radial distance from the site of impact, the probability of shock deformation in deep erosional sections is limited. Alternatively, other than impact scenarios for the formation of the circular structure and the MGD dykes must be examined.

We have studied eight microgranodiorite dykes with the aim to clarify their petrology, geochemistry and isotopic properties and to improve the understanding of the mode of formation of the structure.