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Enigmatic origin of Variscan Popiel peridotite (SW Poland)

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One of the classical unresolved problems of Variscan geology in Sudetes (SW Poland) is the origin of ultramafic rock forming small (few hundred metres in diameter) outcrop at the contact between the Izera-Karkonosze Block and the Kaczawskie Mts. The outcrop is located at the Intra-Sudetic fault, major Variscan thrust in the northern part of the Bohemian Massif. The rock is exposed in an abandoned quarry close to Janowice Wielkie, few hundred metres from the Karkonosze granite.

The rock is dark green to black and no variation is visible in the scale of the exposure. It consists of strongly crushed grains of olivine, orthopyroxene, subordinate amphibole and accessory spinel embedded in serpentine groundmass. The first – oldest – generation of minerals comprises olivine (84-88 % Fo; 0.14-0.36 wt. % NiO), orthopyroxene (enstatite; mg# 0.84-0.88), Mg-hornblende I (constant Si, outward decreasing mg#) and spinel ($Mg_{0,68}Fe_{0,31}Ni_{0,01}Al_{1,79}Fe_{0,13}Cr_{0,08}O_4$). Tremolite, which grows on the olivine and orthopyroxene, is the second generation phase. The third generation of minerals is growing on those of second and first generations. It comprises Mg-hornblende III (varying Si), rimming tremolite, orthopyroxene III (containing less Al relative to orthopyroxene I) and chromian magnetite or magnetite and ilmenite. Serpentine is probably the youngest phase in the rock. Bulk rock chemical analyses show relatively little SiO_2 (ca. 38.6 – 43.6 wt.%), large variation in MgO (24.3 – 32.5 wt %), CaO (1.8 – 6.4 wt. %), Al_2O_3(4.2 – 7.8 wt. %) contents. The content of $Fe_2O_3$is relatively constant (11.8 -13.4 wt. %), the rock contains 0.4 – 0.6 wt. % Cr_2O_3. Primitive-mantle normalised REE patterns are typically flat, close to 1.

The third generation of minerals probably reflects the contact metamorphic effects of neighbouring Karkonosze granite, whereas tremolite is a record of retrogressive metamorphism related probably to Variscan uplift of the rock by Intra-Sudetic thrust. The strong brittle deformation obliterates primary textures of the rock, thus its origin of can be assessed only through mineral and bulk rock chemical composition. The flat REE patterns and abundance of orthopyroxene suggest tholeiitic affinities. The relatively low mg# of olivine and orthopyroxene are indicative of cumulates of tholeiitic magma, and the primary hornblende suggests that the magma contained some water. Thus, the Popiel ultramafic rock is probably a small fragment of tholeiitic magma chamber located beneath the volcanic arc. Similar origin (“alaskan type intrusion”) was suggested by Gunia et al. [1]. However, the highly aluminous composition of spinel I is not typical for tholeiitic volcanic arc roots, thus or (1) the spinel is not primary or (2) the rock is of different origin.

[1] Gunia P., Ziólkowska-Kozdrój M., Kozdrój W. (1998) New geochemistry data of ultrabasic rocks from eastern surroundings of the Karkonosze granite intrusion. Bull Poilsh Acad Sciences Earth Sciences 46, 93 – 108.