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PLATINUM-GROUP ELEMENTS CHARACTERISTIC OF SUB-CONTINENTAL ULTRAMAFIC ROCKS FROM SUDETES (SW POLAND): A PETROGENETIC INDICATOR

Ultramafic rock massifs associated with gneisses and amphibolites in the area of Sudetes has suffered melt depletion followed by metasomatism of different degrees (Hamdy and Meisel, 2002 and Hamdy, unpublished data). PGE and Re abundances were studied in order to obtain additional information on the origin and processes that modified the mantle beneath Sudetes (SW Poland).

The selection of the analyzed samples was carried out considering rocks represent different degrees of melt depletion and the overprinted metasomatism. Four massive peridotites from four localities in Sowie Mountains Block ─ SMB (spinel lherzolite from Niedźwiedź Mt. ─ NI and 3 spinel harzburgites from Wiewiórka Mt. ─ WI, Bystrzyca Górna ─ BG and Potoczek ─ PO) and one olivine websterite (formed in the uppermost mantle, as evidenced by the estimated P and T of crystallization of pyroxenes, Hamdy, unpublished) from Orlica ─ Śnieżnik Dome ─ OSD at Złoty Stok ─ Z were selected for the study.

The mineral composition was analyzed by means of the electron microprobe at Institute of Geological Sciences in Warsaw, PAS. Whole rock chemical composition was investigated by means of XRF and ICP-MS at Institute of General and Analytical Chemistry, University of Leoben. The PGE and Re concentrations were determined by isotope dilution ICP-MS (see Meisel et al., 2003). Sulfur concentration was measured with a LECO CS 300 Elemental Analyzer.

The composition of the olivine relics (Fo = 0.85 in lherzolite from NI to 0.91 in harzburgite of WI and 0.75 in websterite) and spinel (Cr# = 0.53-0.72 in peridotites and 0.79 in websterite) detecting the variable degree of melt depletion. Both cryptic (La_N/Yb_N = 79 in BG harzburgite to 5 in Z websterite) and modal metasomatism (growth of amphibole and phlogopite) are distinguished.

The effect of the geological processes in fractionation of the Re and PGE is well represented by the ratios between these elements. Thus data are presented here as ratios normalized to Ir (Fig. 1).

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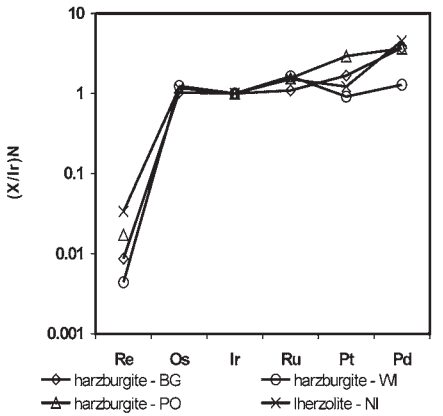
The Niedźwiedź lherzolite has extremely low PGE and Re concentrations (0.15-0.85) relatively to the composition of the Earth's primitive mantle — PM (McDonough and Sun, 1995), showing positively slopped abundance pattern. It has suprachondritic PGE/Ir ratios (Fig. 1). The SMB harzburgites represent highly refractory rocks with high degrees of melt depletion. Thus one could expect these residues should be depleted in sulfur and consequently display negatively slopping sub-chondritic PGE-Re abundance pattern (e.g. Barnes et al., 1985). This is not the case. Harzburgites have higher concentrations of Palladium — Platinum — Group Elements (PPGE) (0.79-3.9 × PM) and Iridium — Platinum — Group Elements (IPGE) concentrations (0.73-1.68 × PM) close to their estimates in PM. The olivine websterite has extremely low IPGE concentrations (0.004-0.009 × PM) and high PPGE and Re concentrations (0.081-9.5 × PM). The IPGEs group displays negatively slopping pattern unlikely to PPGEs group, which displays positively slopping one. The websterite rock sample has high sulfur (~5500 ppm) and copper (325 ppm) concentrations.

Fig. 1



It has been shown that the concentration patterns of PGE-Re and sulfur in the SMB peridotites are not consistent with the degrees of melt depletion. This indicates that the PGE-Re patterns of the studied SMB peridotites may record other processes or sources that are not recorded by the former mineralogical and geochemical studies.

The suprachondritic $PPGE_N/Ir_N$ ratios of harzburgites and the high concentrations of sulfur (up to 776 ppm in harzburgite — PO) indicate that depletion of melt during partial melting do not play a role of buffering the present PPGE fractionation. Fractionation of PGE occurred during partial melting was obscured by the introduction of sulfide liquids derived from percolating magmas. Crystallization of sulfides from these liquids enriched the ultramafic rocks in PPGE.

The low concentrations of PGE-Re in NI lherzolite displaying positively slopped pattern with high suprachondritic Pd_N/Ir_N and Pt_N/Ir_N ratios and high concentrations of sulfur indicates that the PGE-Re budget of this sample does not reflect that of PGE of a typical fertile mantle. It is conceivable, that the composition prior to this lherzolite

was harzburgitic formed by melt depletion and subsequently refertilized by basaltic components of percolating magma. The introducing of percolating melt would deplete the IPGE in the rock (e.g. Handler and Bennett, 1999; Rehkämper et al. 1999). With cooling of magma, sulfide liquid would be extracted enriching the refertilized rock with PPGE elements.

The high Cr# of spinel and the negatively sloped IPGE pattern of the Z olivine websterite are indications that this rock represents ultramafic cumulate formed by high partial melting of upper mantle peridotite. The rock was penetrated by sulfide liquid rich in copper causing enrichment of PPGEs and Re and depletion of IPGEs.

By comparison La/Yb ratios (as a measure of the degree of metasomatism) with PGE_N/Ir_N ratios, it is shown ratios Ru/Ir and Os/Ir of peridotites from WI, PO and NI are positively correlated with the La/Yb ratios. Thus we can suggest that aqueous fluids being the agent of metasomatism caused the growth of Ru and Os fractionation. The negative correlation of La_N/Yb_N with the concentration of S in peridotites indicates that the sulfide addition did not accompany the metasomatic processes by hydrous fluids but occurred at a later event.

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