Cenozoic volcanic activity in North Sudetic Basin (Lower Silesia, SW Poland) —Possible evolution model based on combineded petrological, geochemical and isotopic investigation of litospheric xenoliths and volcanic host-rocks

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The Cenozoic volcanism in the North-Sudetic Basin (CEVP) took place ca. 30 to 18 Ma [1]. Throughout the basin (Złotoryja and Jawor area) there are about 26 outcrops on the surface, mostly in the form of necks, lava flows and veins [1, 2].

The model was based on considerate microscopic observations of all xenoliths (after excluding such effects as decompression melting, interaction with a host rock etc.), analysis of petrological, chemical and isotopic variation of the host-rocks and literature data [1, 2, 3].

As the orogenic movements and asthenospheric activity intensified, the lithospheric mantle was penetrated by melts that caused crystallization of pyroxenites and early cumulates. Subsequent uplift of the asthenospheric mantle resulted in partial melting of the lithospheric mantle and first significant peak of volcanic activity in the area (Oligocene). The material supplied form deeper parts of the lithosphere/asthenosphere caused an increase in metasomatism of the lithospheric mantle, mainly cryptic metasomatism and locally modal metasomatism [4, 5].

The supply of deeper melts (garnet stability field) in the last phase of the volcanic activity (Miocene) along with partial melting of the metasomatized lithospheric mantle resulted in changes in chemical and isotopic composition of the studied rocks.

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Crust-mantle links and a major Mesoproterozoic melting event

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The evolution of $^{187}Os/^{188}Os$ in residual mantle effectively ceases after large-degree mantle melting events, due to almost complete depletion of Re in the residue. Thus, Os isotopes in mantle rocks can be used to constrain the timing of major melting episodes, by comparison with a chondritic evolution curve, and to investigate the scale of such events through time (e.g. [1]). Platinum-group minerals (PGM) are formed in the mantle and in mantle-derived ultramafic rocks rich in platinum-group elements (PGE). Although difficult to locate and extract directly, PGM are sampled and preconcentrated by fluvial systems. The Os isotope compositions of detrital PGM retain a record of mantle depletion events, owing to their high Os and low Re contents and their resistance to alteration [2]. Laser ablation MC-ICPMS provides a rapid, accurate and precise method for the analysis of large suites of PGM.

Osmium isotope analyses of over 300 PGM from the Witwatersrand Supergroup, the largest recognised Archaean sedimentary basin, indicate major mantle melting in the region at around 3.0 Ga to 3.2 Ga, with the oldest ages (~3.5 Ga). The range of Os isotope values in Wits detrital PGM may reflect multiple ultramafic sources. Unlike Phanerozoic ophiolite-derived suites [2], the Wits PGM do not have a pronounced skew towards older ages, confirming that Archean mantle is less heterogeneous than modern day mantle.

Suites of PGM from a Philippine ophiolite and the Rhine river system, the latter sampling various ultramafic bodies of the Alps, have major modes in $^{187}Os/^{188}Os$ corresponding to a depletion age of ~0.5 Ga, but also display subsidiary peaks at ~1.2 Ga and possibly around ~2 Ga, similar to ages found in other global ophiolites [2]. This confirms the global nature of the 1.2 Ga event and indicates a significant mantle to crust mass flux at that time, as documented in the zircon record.

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