Geophysical Research Abstracts
Vol. 18, EGU2016-3778, 2016
EGU General Assembly 2016


# Oceanic provenance of lithospheric mantle beneath Lower Silesia (SW Poland) and the two kinds of its "Fe-metasomatism"

Jacek Puziewicz (1), Magdalena Matusiak-Małek (1), Theodoros Ntaflos (2), Anna Kukuła (1), and Mateusz Ćwiek (1)

(1) University of Wroclaw, Institute of Geological Sciences, Wroclaw, Poland , (2) University of Vienna, Department of Lithospheric Research, Vienna, Austria

Our recent studies (Puziewicz et al. 2015, IJES 104:1913–1924, and references therein) show that the sub-continental lithospheric mantle (SCLM) beneath Lower Silesia (SW Poland) and neighbouring part of Upper Lusatia (SE Germany) is dominated by harzburgites. Part of them contain small amounts of clinopyroxene which, despite its primary textural appearance, is a late addition to the protoliths which are residues after extensive (up to 30 %) partial melting. This clinopyroxene was added to the harzburgites in Cenozoic times by alkaline basaltic melts migrating upwards from their asthenospheric sources during rifting in the Variscan foreland of the Alpine-Carpathian chain. The pre-rifting history of the SCLM beneath the region is thus recorded in the olivine and orthopyroxene.

The forsterite content in olivine divides the Lower Silesian harzburgites into two groups: A (olivine Fo 90.5 – 92.0), and B (olivine Fo 84.0 – 90.0; for data see Puziewicz et al. 2015, op. cit.). The Al content in orthopyroxene is low and similar in both A and part of B harzburgites, called B1 in the following. The orthopyroxene occurring in the B1 harzburgites contains typically 0.05 - 0.10 atoms of Al per formula unit (corresponding to 0.5 – 2.5 wt. % $Al2O_3$), although slightly lower (down to 0.02 a pfu) and slightly higher (up to 0.13 a pfu) Al contents occur in subordinate number of samples. The Al content in the B1 orthopyroxene is not correlated with forsterite content in coexisting olivine. The B2 harzburgites occur only in one site (Księginki). They contain orthopyroxene which Al content exhibits negative correlation with forsterite content in coexisting olivine. The most Al –rich orthopyroxene (0.24 atoms of Al pfu, corresponding to ca. 5.7 wt % $Al2O_3$) coexists with olivine Fo 86.5 in Księginki.

The low contents of Al in orthopyroxene is specific for the Lower Silesian/Upper Lusatian domain of European lithospheric mantle. The Al-poor mantle domain below Lower Silesia and upper Lusatia is surrounded to the West and South West by Al-richer domains (the first Al-rich orthopyroxene occurrences in mantle xenoliths are located in the Rhön Mts. to the West and in Upper Palatinate to the South-West.

The low Al content in orthopyroxene, corresponding to that typical for the Lower Silesian European mantle domain, is characteristic for (1) oceanic mantle formed in the mid ocean ridges (MOR) and (2) mantle wedge affected by extreme melting in the supra-subduction zones (SSZ). The SSZ harzburgites contain usually orthopyroxene which is more Al-poor (< 2.0 wt. % $Al2O_3$) than that of the MOR ones (2.0 – 6. 0 wt. % $Al2O_3$; Bonatti & Michael 1989, EPSL 91, 297-311). Thus, we infer that the Lower Silesian SCLM originated rather in the MOR setting.

The Lower Silesian B harzburgites were formed by reactive basaltic melt percolation, which lowered the forsterite content in olivine and Mg# in orthopyroxene ("Fe metasomatism"). The B1 harzburgites contain orthopyroxene which is Al poor (see above) irrespectively of forsterite content of coexisting olivine. Thus, the medium which led to the "Fe-metasomatism" must have been also Al-poor. This criterion is met by tholeiitic basaltic melts which originate by multiple polybaric mantle melting in MOR environment. Their percolation in oceanic mantle leads to production of low-Al orthopyroxene (e. g in the peridotites from East Pacific Rise, Dick & Natland 1996 Proc ODP Sci Res, 147, 103-234). Therefore, we suggest that the B1 harzburgites originated by "Fe-metasomatism" also in the MOR setting. The coexistence of A and B1 harzburgites suggests that they represent lithospheric mantle generated in the magma-rich, thus rather fast-spreading, MOR. Textural relationships show that the Al-enriched B2 harzburgites were also affected by "Fe metasomatism", but by alkaline basaltic melt percolating in SCLM during Cenozoic rifting.

The crust overlying western part of the Lower Silesian domain of European SCLM belongs to the eastern-most part of the Saxo-Thuringian subduction-collision system of European Variscan orogen. The crust overlying the central part is considered to be a part of Tepla-Barrandian unit (Franke 2013, IJES 103: 1471–1499 ). Alternatively, the latter is considered to belong to the Saxo-Thuringian zone as well. Our data show that mantle roots of these units were formed in the MOR setting, which must have happened in the Variscan oceanic basin. Thus, we speculate that the age of this lithospheric mantle corresponds to that of Variscan MOR basaltic sequences and ophiolites in the area (Ordovician-Lower Devonian).

Funding. This study was possible thanks to the project NCN UMO-2014/15/B/ST10/00095 of Polish National Centre for Science to JP.