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The mantle roots of Variscan orogen in Europe

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The lithospheric mantle underlying the Variscan orogen in Europe is the place of numerous recent case studies focusing on peridotite and pyroxenite xenoliths occurring in Cenozoic alkaline lavas. The architecture of mantle root of the orogen is, however, not discussed, because the general plate tectonic model of formation of lithospheric mantle underlying Phanerozoic orogen should be defined first. The mantle part of the subducting plate can be "docked" to the mantle wedge of the overriding plate when the subduction stops. The mantle root of the orogen is thus constructed of (1) mantle wedge of the overriding plate and (2) mantle part of the subducted plate. If the subducting plate is oceanic, the suture is marked by eclogites which mark the former oceanic crust. However, some lithospheric mantle fragments underlying the continents/microcontinents can also be docked to the orogenic root. The crustal screens are then introduced into the mantle root of the orogen. After the Variscan orogen was formed, lithospheric mantle delamination and replacement of "collisional" mantle by upwelled asthenosphere modified its architecture. These late-orogenic mantle lithologies are supposedly of different characteristics than those assembled in an orogenic root at the collision stage. Much later the orogen was subjected to rifting starting the next Wilson cycle in the Alpine epoch. The rifting-related volcanic activity brought to the surface mantle xenoliths which are the basis for studies of lithology of the mantle root of the Variscan orogen. The metasomatism, which affected the subcontinental lithospheric mantle during rifting produced changes which must be filtered out in order to recognize the primary mantle characteristics.

The European Variscan Orogen consists of few major tectonostratigraphic units, which supposedly represent independent subduction-collision systems. Seismic studies show that their mantle roots are different in terms of seismic anisotropy [1]. Numerous petrological data provided by mantle xenolith case studies suggest a variation in lithology of subcontinental lithospheric mantle beneath the orogen. Nevertheless, only three lithospheric mantle domains have been defined so far: two underlying French Massif Central [2] and one underlying the north-eastern part of the Bohemian Massif [3]. The latter contains only late-metasomatic clinopyroxene coeval with Cenozoic rifting [e.g. 4]. We suggest that aluminium content in orthopyroxene coupled with olivine composition is a good proxy for pre-rifting mantle root characteristics. It defines strongly depleted lithospheric mantle domain in Lower Silesia and Upper Lusatia, which supposedly is of oceanic nature. The possible eclogitic screen located to NE was recently documented by seismic study [5].

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