The largest serpentinite body, 400 to 100 meters in size, was investigated by petrological (X-ray diffraction) and geochemical (X-ray fluorescence) methods. The primary mineral composition was olivine + orthopyroxene + clinopyroxene + chromite. Olivine is completely replaced by chrysotile which shows the typical mesh-structures. Some grains of clinopyroxene are preserved, whereas the main part and the orthopyroxene were transformed into lizardite. Within some pseudomorphs after orthopyroxene the former cleavage and twin lamella are visible. Chrome spinel is mostly transformed into magnetite. Further Mg-rich chlorite, talc and hydrogrossular appear.

The mineral compositions of the former peridotites were recalculated by an interative method using a dataset of typical chemical compositions for fresh harzburgite and lherzolite and geochemical analyses of the serpentinites. The results indicate harzburgites as precursor rocks of the serpentinites.

According to SCHORN et al. (2013) the basic rocks from the Haselgebirge represent remnants of the Permian to Lower Triassic rift of the Meliata ocean. However, it is difficult to exhume mantle rocks to the surface with the proposed mechanism without creating a deep marine basin. However, the latter is not indicated by the evaprites and the overlying Triassic shelf sediments of the Juvavic nappes. In any case a relation of the harzburgites to westward propagation of initial rifting of the Neotethys ocean seems to be the most convenient explanation for the investigated rocks.

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## Large-Scale Deformation of the Eastern Alps from Seismic Anisotropy

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Internal deformation in the Eastern Alps is documented by seismic anisotropy, and we report here observations from SKS shear-wave splitting. Together with earlier observations from the Western Alps, these observations present one of the clearest examples yet of “mountain chain parallel fast orientations” worldwide, with a stunningly simple pattern of fast orientations, nearly parallel to the trend of the mountain chain. This simple pattern (of deformation) appears to be in contrast with the complex surface geology of the Alps. Regarding the pattern, we make a number of important observations: there are rapid spatial variations of fast orientation in certain parts of the Alps while there is little variation in others. Where fast orientations vary (Western Alps and the Tauern-Window region), they do so with nearly constant spatial rotation rate. In the Eastern Alps, the fast orientations do not “connect” with neighboring mountain chains, neither the present-day Carpathians, nor the present-day Dinarides, but rather with an intermediate orientation.

There is a clear jump of fast orientations across the Tauern Window, by about 45 degrees, somewhat similar to the geometry of the Adriatic indenter. In the very east, where lithosphere is thin, and where we most likely observe asthenospheric anisotropy, the anisotropy is consistent with eastward extrusion toward the Pannonian basin, if we assume that the anisotropy recorded relative motion of the surface with respect to the deeper Earth moving coherently with the Central Alps. An eastward extrusion has been suggested before, based on the pattern of seismicity, surface geology, and more recently geodesy. It appears that much of the deformation associated with the eastward extrusion is accommodated within the asthenosphere. This suggests that the entire lithosphere is escaping to the east, not only the crust.

## The origin and age of the metamorphic sole from the Rogozna Mts., Western Vardar Belt: New support for the one-ocean model for the Balkan ophiolites

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This study reports new geochronological and petrochemical data from the metamorphic sole beneath the Rogozna Mts., Western Vardar ophiolite belt. The Rogozna metamorphic sole is located at the base of an Ibar serpentinite nappe and consists of (i) high-grade andalusite–garnet–sillimanite gneisses and cordierite-bearing hornfels (mostly listwanitized), (ii) medium-grade pyroxene amphibolites and hornfels, amphibolites, amphibolite schists and metagabbros and (iii) low-grade micaschists and talc-chlorite schists. Selected samples of the Rogozna amphibolites and talc-chlorite schists were subjected to the electron microprobe, SEM-EDS, $^{40}Ar/^{39}Ar$ analysis and whole-rock geochemistry. The Rogozna amphibolites are medium- to fine-grained rocks with nematoblastic texture and pronounced foliation. They consist of green amphibole (~70 vol.%) with variable silica contents (6.4 to 7.8 Si a.p.f.u.), as well as Mg# (molMg/[Mg+$Fe_{tot}$]; 0.53 to 0.77) and variably albitized plagioclase (~30 vol.%; $Ab_{24}$–$Ab_{98}$). Amphibolites are overprinted by a retrograde assemblage containing actinolite, epidote, clinochlore, sericite, chlorite and magnetite. The amphibolites formed due to metamorphism of two basaltic suites: subalkaline/tholeiitic and alkaline. Subalkaline/tholeiitic amphibolites possess low Zr, Nb, Y, Th, Hf, $TiO_2$ and $P_2O_5$ values and a LREE-depleted patterns typical for the N-MORB to BAB (back-arc basalt) origin. Alkaline amphibolites show elevated concentrations of Zr, Nb, Y, Th, Hf, $TiO_2$ and $P_2O_5$ with a LREE-enriched patterns typically displayed by ocean island basalt (OIB). Amphibolites crystallized during intra-oceanic thrusting at temperatures between 685 ºC–765 ºC and at a depth of 12–17 km. $^{40}Ar/^{39}Ar$ cooling ages of amphibole range from 165–170 Ma and slightly postdate the sole formation. The Rogozna talc-chlorite schists are related to retrograde greenschist-facies metamorphism after amphibolite facies conditions. They consist of talc (Mg-rich minnesotaite), chlorite (diabantite), serpentine and white mica pseudomorphs after amphibole and MORB-type Cr-Al spinel, surrounded by Al- and Mg- poor ferrit-chromite. The occurrence of ferrit-chromite is related to earlier, amphibolite facies metamorphism. Chlorite pseudomorphs after amphibole were formed at ~415 °C, whereas low-K white mica from the assemblage cooled below the argon retention temperature in a time period of ~95–105±25 Ma. The studied metamorphic rocks of the Rogozna Mts. underlying the Ibar serpentinite massive represent, therefore, typical products of metamorphic sole. The amphibolites are of igneous origin, displaying subakaline/tholeiitic and alkaline geochemical affinities. The protoliths of subakaline/tholeiitic amphibolites originated in a N-MORB or BAB setting. The alkaline group of amphibolites are analogous to E-MORB or OIB and their protolith derived from fragments of seamounts or islands from the lower oceanic plate. Maximum P-T conditions of the formation of the Rogozna Mts. metamorphic sole were 685–765 ºC and 4–6 kbar (corresponding to a 12–17 km thick overburden). The Rogozna Mts. metamorphic sole experienced rapid cooling below the closure temperature of hornblende and actinolite between 164.9±1.3 and 170.0±1.4 Ma. Intra-oceanic thrusting must have started maximum 5 m.y. earlier, between 170 Ma and 175 Ma. The greenschist-type retrograde assemblage was