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The shallow forearc mantle above the Southeastern Carpathian subduction

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Recent experimental results imply that the deformation of olivine in the mantle wedge above subduction zones may be strongly modified by the presence of water or melt, resulting in olivine [100] preferred orientations and hence in fast seismic anisotropy directions normal to the flow direction. However observations of such changes in olivine deformation mechanism in naturally deformed samples from subduction environments is rare.

We present a detailed microstructural and petrological study of spinel peridotitic xenoliths from the Eastern Transylvanian Basin (ETB), Persany Mountains. Water contents in olivine and pyroxenes were characterized by IR spectroscopy. These xenoliths which sample the shallow mantle above the southeastern Carpathian subduction, which is materialized in this region by the seismically active Vrancea zone. Most nodules are pyroxene-rich lherzolites, with minor harzburgites. They display microstructures varying from coarse–grained annealed textures, similar to those from xenoliths from the Pannonian Basin, to fine-grained, high-stress mylonitic textures with intense recrystallization and intracrystalline deformation, unique in the whole region. Many of the studied xenoliths show secondary orthopyroxenes in the recrystallized matrix or along grain boundaries suggesting that reaction with Si-rich, subduction-related fluids forming orthopyroxenes at the expense of olivine. Fine grained clinopyroxenes may also occur along grain boundaries. Pargasite is also often observed.

Olivine shows moderate to strong lattice preferred orientations. Fabric strength (J-

index) displays a remarkable relation with recrystallized grain size. Despite the variations in microstructure, (010)[100] is the dominant slip system in all xenoliths studied. Dominant activation of [001] slip is only observed in rare olivine porphyroclasts in the high-stress xenoliths due to geometrical reasons. The studied lherzolites exhibit fertile major element compositions. Depletion of LREE relative to HREE is observed on chondrite normalized plots, but the absolute concentration of REE is high (2-20 times chondritic). . Olivines are dry, probably due to dehydration during extraction, but water contents in pyroxenes are variable, ranging from almost 'dry' to H_20-saturated, and have a strong negative correlation with recrystallized grain size.

The peridotite suite from the ETB is derived from the shallow subcontinental lithospheric mantle. The mutual occurrence of replacive orthopyroxene, H-saturated compositions and high-stress deformation microstructures and the lack of evidence for strong partial melting and depletion processes imply that these xenoliths are fragments of a cold, relatively wet, high-stress mantle domain overlying a subduction zone most probably representing the shallow forearc of the Southeastern Carpathians. The absence of 'wet' [001] slip olivine fabrics, predicted to occur exactly in such conditions indicates either that water contents in olivine at these shallow depths ($<$70 km) are too low for deformation by dominant [001] slip or that the change in dominant slip system in nature occurs at higher water contents. In both cases, the natural occurrence of such fabric types is probably much more restricted than earlier suggested.