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The Beni Bousera Peridotite (Rif Belt, Morocco): an Oblique-slip Low-angle Shear Zone Thinning the Subcontinental Mantle Lithosphere

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Detailed structural and petrological mapping in the Beni Bousera peridotite (Rif Belt, northern Morocco) shows that this orogenic peridotite massif is composed of four tectono-metamorphic domains with consistent kinematics, marked by a pervasive, shallowly dipping foliation with a NW-SE stretching lineation that progressively rotates towards a NNE-SSW orientation in the lowermost part of the massif. From top to bottom, these domains are garnet-spinel mylonites, Ariegite subfacies fine-grained porphyroclastic spinel peridotites, Ariegite-Seiland subfacies porphyroclastic, and Seiland subfacies coarse-porphyroclastic to coarse-granular spinel peridotites. Microstructures and crystal preferred orientations point to deformation dominantly by dislocation creep in all domains, but the continuous increase in average olivine grain size indicates decreasing plastic work rates from top to bottom. This evolution in deformation conditions is consistent with the change in synkinematic pressure and temperature conditions, from 900°C at 2 GPa in garnet-spinel mylonites to 1150°C at 1.8 GPa in the Seiland domain. A pervasive diffuse dunitic-websteritic layering subparallel to the foliation suggests deformation in the presence of melt in the Seiland domain. Gravitational instabilities owing to local melt accumulation may account for ca. 200 m wide areas exhibiting a vertical lineation in this domain.To account for the consistent kinematics and the tectono-metamorphic evolution, which implies a temperature gradient of ca. 1258C km-1 preserved across the Beni Bousera massif, we propose that the entire massif records the functioning of a low-angle shear zone, a few kilometres wide, which accommodated exhumation of the base of the lithosphere from ca. 90 to ca. 60 km depth. Partial melting in the Seiland domain may be explained by fast decompression of the footwall, without the need for exotic heat sources. Moreover, if the present-day orientation of the shear zone is similar to that when it was active in the mantle, the stretching lineations at high angle to the metamorphic gradient imply that shearing parallel to the trend of the belt accompanied thinning; that is, a transtensional deformation of the margin.