Nanoscale structure of zoned laurites

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The platinum-group minerals (PGM) of the laurite (RuS_2) – erlichmanite (OsS_2) solid solution series represent > 75% of the PGM reported in the chromite ores associated with ultramafic rocks from the upper oceanic and subcontinental lithospheric mantle (SCLM). Often these grains exhibit zoning defined by: (i) grains with Os-poor (laurite) core and Os-rich rim (normal zoning), (ii) grains with Os-rich core and Os-poor rim (reverse zoning) and (iii) grains made up of a complex intergrowth of Os-rich, Os-poor laurite and/or erlichmanite (oscillatory zoning). However, the structure of these intergrowth at the nanoscale remains unexplored. We presernt the first ever nanoscale characterization o zoned laurites, using a combination of focused ion beam micro-sampling techniques with high-resolution transmission electron microscopy (HRTEM) observations. We observe that the zoning in laurite grains from chromite ores of the Ojen lherzolite massif in southern spain consists of epitaxial growth of Ru-(Rh)-rich and Os-(Ir-As)-rich domaing, evidencing the complete substitution of Os by Ru in the laurite structure. Ru-(Rh)-rich domains show a continous and homogenous lattice distribution. However, Os-(Ir-As)-rich domains are characterized by a heterogenous nanoscale structure consisitin of Os- and Ir-As- rich lamella (~20 nm) oriented within the Ru-(Rh)-rich matrix. The presence of the lamella themselves and the positive correlation of Os and Ir content with As in them led us to suggest Os, Ir and As when entering the structure of laurite produce signficant distortion of the laurite lattice. The formation/preservation of the oriented lamella is interpreted as a consequence of the fast undercooling of the chromitite body associated to the extremely rapid exhumation of the ultramafic bodies from the upper mantle to their final emplacement into the continental crust. Our results provide new insights of the nanoscale partitioning of PGEs in a natural ultramafic magmatic ore system.