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Deciphering the dynamics of olivine nucleation and growth during antigorite breakdown

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Subduction zones are dynamic convergent plate boundaries associated with arc volcanism and earthquakes, which are believed to be controlled by fluids released during devolatilization reactions from the downgoing slab. The high-pressure breakdown of antigorite-serpentinite to prograde chlorite-harzburgite is considered to be the most significant source of water in subduction zones. The Cerro del Almirez ultramafic massif (Betic Cordillera, SE Spain) is a unique exhumed subduction terrane that preserves this dehydration reaction as a sharp front.
A key to the understanding of the metamorphic conditions prevailing during serpentinite dehydration is to study the two prominent textures, granofels and spinifex-like chlorite harzburgite, which are the reaction products of antigorite breakdown. The textural study of these two types of Chl-harzburgite can provide insights into the kinetic of serpentinite dehydration reaction and the key factors controlling the overstepping of the reaction. Detailed mapping of textural variations in chlorite-harzburgite unveiled a network of granofels and spinifex-like lenses in the Almirez massif. In this work, we focus in the detailed textural variations across a well-exposed lens of spinifex-like chlorite-harzburgite, surrounded by granofels chlorite-harzburgite. This outcrop allowed us to make a very detailed oriented sampling (every 0.1-0.5 m across the 6 m thick lens) from the granofels into spinifex textures. The petrological study shows a developing transition of the olivine crystal shape, with premature mm-sized spinifex-like olivine crystals at the lens rims and well developed cm-sized spinifex-like grains in the core of the lens. The micro-CT study of oriented cores, together with EBSD study of thin sections from the same cores, allows the 3D reconstruction of olivine shapes and their lattice preferred orientation (LPO), constraining how olivine shapes and LPO differ from one texture to the other. This study provides valuable information on the kinetic of crystallization of olivine and how different textures formed in space and time, associated with the antigorite breakdown reaction.