

The Neoproterozoic Calzadilla Ophiolite: Tracing the evolution from forearc formation to forearc-arc collision in the peri-Gondwanan margin (SW Iberia)

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This study examines the Calzadilla Ophiolite, located in the Ossa-Morena Complex of the Southwestern Iberian Massif, which contains several allochthonous terranes for understanding Neoproterozoic Gondwana margin evolution. The Calzadilla Ophiolite represents Ediacaran oceanic lithosphere consisting of a boninitic mafic crust overlying serpentinized ultramafic rocks, constituting Europe's largest outcrop of Cadomian serpentinites.

Geochemical and petrological analyses of these serpentinites reveal a harzburgite protolith that underwent significant partial melting (up to 16%) in a forearc setting, as confirmed by whole rock geochemistry and primary spinel crystal composition. Thermodynamic modeling and PT methods applied to both serpentinites and meta-mafic dykes from the ultramafic section, as well as amphibolites from the mafic section, indicate prograde metamorphism reaching 4-5 kbar and 525-575°C.

The findings suggest the Calzadilla Ophiolite formed within a peri-Gondwanan arc system during the subduction of the northern ocean beneath Gondwana. Slab roll-back likely triggered forearc basin opening at approximately 602 Ma. This process involved extensive mantle wedge partial melting, producing boninitic magmas that formed the ophiolite's mafic section. The mantle wedge underwent metasomatism and serpentinization through melt and fluid-rock interactions. A compression-dominated phase around 540 Ma resulted in the ophiolite's emplacement onto the Cadomian magmatic arc, developing an amphibolite-facies metamorphic overprint.