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The Calzadilla Ophiolite (SW Iberia) and the Ediacaran fore-arc evolution of the African margin of Gondwana

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ABSTRACT

In the Ossa Morena Domain of SW Iberia, the Calzadilla Ophiolite is formed by an ensemble of ultramafic and mafic rocks that seem to represent a fragment of an oceanic Moho transition zone. The ophiolite consists of a main sheet with a minimum thickness of *c.* 1000 m and several ultramafic slices that appear imbricated with Ediacaran siliciclastic rocks of the so called Serie Negra. The mafic rocks of the Calzadilla Ophiolite show an extreme depletion in some HFSE such as Nb, Zr, Th, Hf and Ta, low TiO_2 contents and high MgO, which allow identifying them as magmatic types of boninitic affinity, such as those frequently associated with fore-arc settings. U-Pb zircon dating of the gabbroic rocks suggests that the igneous protoliths crystallised at *c.* 600 Ma and were extracted directly from the mantle, according to the juvenile isotopic sources revealed by the Hf isotopic composition of the dated zircons. At *c.* 540 Ma the U-Pb isotopic system was affected by a partial resetting event with moderate generation of new zircon. According to these data, it is considered that the Calzadilla Ophiolite was formed in a supra-subduction zone setting, very likely in a fore-arc domain, during a roll-back episode affecting the peri-Gondwanan subductive slab. The fore-arc domain was probably proximal to the West Africa Craton. It is very likely that the ductile deformation, metamorphism and tectonic imbrication of the Calzadilla Ophiolite and the Serie Negra occurred at *c.* 540 Ma, during an increase in the subduction rate and a significant decrease of the subduction angle of the oceanic slab. The information provided by the Calzadilla Ophiolite allows to better constrain the geodynamic evolution of the African margin of Gondwana.

1. Introduction

The African margin of Gondwana is a long-lived continental margin, as it has been permanently facing an ocean since pre-Rodinian times until the assembly of Pangea (Pisarevsky et al., 2003). During Neoproterozoic and Cambrian times, this margin shows typical characteristics of an active margin where intense magmatic activity and the deposition of thick turbiditic series occurred. The volcanic arc generated during this time, the Avalonian-Cadomian Arc, was active in the range *c.* 750–500 Ma, according to U-Pb geochronological data obtained in detrital zircons from siliciclastic series deposited in different basins located in the periphery of this arc (Linnemann et al., 2008; Pereira et al., 2012; Albert et al., 2015a; Pereira, 2015; Andonaegui et al., 2016). The internal structure and dynamics of the Avalonian-Cadomian arc are difficult to reconstruct, since the outermost margin of Gondwana was intensely deformed and metamorphosed during the assembly of Pangea (Von Raumer et al., 2015). This external margin represents a considerable section of the Variscan Orogen and its continuation to the other side of the Atlantic Ocean in the Appalachian Orogen. Only the southernmost sectors of the Neoproterozoic-Cambrian margin of Gondwana,

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