



## Tectonics

### RESEARCH ARTICLE

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#### Key Points:

- The Calzadilla Ophiolite is a fore-arc ensemble obducted onto a section of a peri-Gondwanan arc in latest Ediacaran times
- Ophiolite obduction was directed to the ESE (present-day coordinates), following a vector directed to mainland Gondwana
- Obduction preceded back-arc and fore-arc spreading in peri-Gondwana and was followed by the onset of extensional domes and rifting

#### Supporting Information:

- Supporting Information S1
- Table S1

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## Ediacaran Obduction of a Fore-Arc Ophiolite in SW Iberia: A Turning Point in the Evolving Geodynamic Setting of Peri-Gondwana

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**Abstract** The Calzadilla Ophiolite is an ensemble of mafic and ultramafic rocks that represents the transition between lower crust and upper mantle of a Cadomian (peri-Gondwanan) fore arc. Mapping and structural analysis of the ophiolite demonstrates that it was obducted in latest Ediacaran times, because the Ediacaran-Early Cambrian sedimentary series (Malcocinado Formation) discordantly covers it. The ophiolite and emplacement-related structures are affected by Variscan deformation (Devonian-Carboniferous), which includes SW verging overturned folds (D<sub>1</sub>) and thrusts (D<sub>2</sub>), upright folds (D<sub>3</sub>), extensional faults (D<sub>4</sub>), and later faults (D<sub>5</sub>). These phases of deformation are explained in the context of Variscan tectonics as the result of the progressive collision between Gondwana and Laurussia. Qualitative unstraining of Variscan deformation reveals the primary geometry of Ediacaran-Cambrian structures and uncovers the generation of east verging thrusts as responsible for the primary obduction of the Calzadilla Ophiolite. Restoration of planar and linear structures associated with this event indicates an Ediacaran, east directed obduction of the ophiolite, that is, emplacement of the Cadomian fore arc onto inner sections of the northern margin of Gondwana. According to regional data, the obduction separates two extension-dominated stages in the tectonic evolution of the African margin of northern Gondwana preserved in southern Europe. Preobduction extension brought about the onset and widening of fore-arc and back-arc basins in the external part of the continent, while postobduction extension facilitated the formation of extensional migmatitic domes, an oceanward migration of back-arc spreading centers across peri-Gondwana, and the eventual opening of a major basin such as the Rheic Ocean.

### 1. Introduction

Ophiolite obduction is a common process in subduction-related orogens (Dewey, 1976; Edwards et al., 2015; Wakabayashi & Dilek, 2003). Examples of ophiolite obduction in the peripheral domains of the northern margin of Precambrian Gondwana include the case of the Bou Azzer Ophiolite in the Anti-Atlas of Morocco (El Hadi et al., 2010), the Frolosh Ophiolite in Kraishte zone, Bulgaria (Kounov et al., 2012), and the Calzadilla Ophiolite in SW Iberia (Arenas et al., 2018). The reference age for the protoliths and emplacement of these ophiolites is Ediacaran, and the subduction-related activity (magmatism and crustal growth) reported for the sections of African Gondwana preserved along the basement of southern and central Europe strongly suggests that tectonic activity related to subduction under Gondwana extended at least all through the Ediacaran (e.g., Chantraine et al., 2001; D'Lemos et al., 1990; Linnemann et al., 2007).

Orogens resulting from continent-continent collisions are also characterized by significant crustal thickening at the boundaries of colliding plates. Interference between structures generated in the context of a subduction-related orogen and those formed during continent-continent collision is a very likely option, because the eventual collision and amalgamation of continental landmasses requires previous subduction, either intraoceanic or subcontinental.

The Variscan orogen (Figure 1) resulted from the progressive collision between Gondwana and Laurussia during the Devonian and Carboniferous (Matte, 1991). This collision followed Precambrian and lower Paleozoic tectonic events related to the evolution of the African section of the northern margin of Gondwana. The Precambrian events are generally attributed to the Cadomian Orogeny, which occurred along the northern