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Gibraltar subduction zone is invading the Atlantic

Joao C. Duarte¹, Nicolas Riel², Filipe M. Rosas¹, Anton Popov², Christian Schuler², and Boris J.P. Kaus²

¹Instituto Dom Luiz (IDL) and Geology Department, Faculty of Sciences, University of Lisbon, Lisbon, Portugal
(jdduarte@fc.ul.pt)

²Institut of Geosciences, Johannes Gutenberg-University, Mainz, Germany

Subduction initiation is a cornerstone of the Wilson cycle. It marks the turning point in an ocean's lifetime, allowing its oceanic lithosphere to be recycled back into the mantle. However, forming new subduction zones in Atlantic-type oceans is challenging, as it commonly involves the action of an external force, such as the slab pull from a nearby subduction zone, a far-field compression or the impact of a mantle plume. Notwithstanding, the Atlantic Ocean already has two fully developed subduction zones, the Lesser Antilles and the Scotia arcs. These subduction zones have been forced from the nearby Pacific subduction zones. The Gibraltar Arc is another place where a subduction zone is invading the Atlantic. This corresponds to a direct migration of a subduction zone that developed in the dying Mediterranean basin. Nevertheless, few authors consider the Gibraltar subduction zone as still active because it has significantly slowed down in the last millions of years. Here, we present new 3D buoyancy-driven geodynamic models, using the code LaMEM, that reproduce the first-order evolution of the Western Mediterranean, show how the Gibraltar Arc may have formed and test if it is still active. The numerical simulations are validated using geological and geophysical data. The results suggest that the Gibraltar arc is still active and will propagate further into the Atlantic after a period of tectonic quiescence. The models also show how a subduction zone starting in a closing ocean (the Ligurian) can migrate on its own into a new opening ocean (the Atlantic) through a narrow oceanic corridor. Subduction invasion is likely a common mechanism for introducing new subduction zones in Atlantic-type oceans and a fundamental process in the recent geological evolution of Earth.

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