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Impacts of the Messinian Salinity Crisis on the Spanish margin of the Alboran Sea, Western Mediterranean

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Since the seventies, the Messinian Salinity Crisis (MSC) remains one of the most important geological controversy in the Mediterranean region. An international scientific consensus has recently been reached and a two-step draw-down scenario is now widely accepted. However the ultimate causes and process of re-establishment of the Atlantic - Mediterranean connections remain partly obscure. The purpose of this work is a regional study of the northern margin of the Alboran Sea, from the Gibraltar Strait up to the Almeria area, to bring new constraints to the debate. We are performing a paleogeographic reconstruction of the Spanish margin before, during and after the MSC considering (1) the onshore areas from Sorbas to Algeciras, and (2) the offshore records (seismic profiles and wells).

In the intensively studied Sorbas Basin, the two-step scenario of the MSC may be reconstructed as follows: the first step (5.96 - 5.60 Ma) consists in the deposition of 120 m of gypsum beds alternating with marine clays more expressed in the uppermost part of the evaporitic series; the second step (5.60 - 5.46 Ma) is characterized by the fluvial erosion and karstification of the gypsum series and earlier deposits. The return to marine conditions is expressed by the development of several Zanclean Gilbert-type deltas. The Sorbas basin exhibits a complete sedimentary record from the Tortonian to Zanclean and has been impacted by synchronous tectonic events in relation with the structuration and uplift of the Betic Cordillera. All the sedimentary evolution has been inferred from sequence stratigraphy analyses. In particular, the Messinian Erosional Surface has been recognised and precisely mapped at the base of Zanclean Gilbert-type fan deltas and of the contemporaneous Sorbas limestones.
In the Algeciras area, more precisely in the lower drainage basin of the Guadarranque River, the geographically westernmost Spanish Mediterranean river, evidences of the MSC are shown by the occurence of a Pliocene fan delta nested within the Gibraltar Domain Unit composed of Eocene to Lower Miocene flysches. During the outstanding sea-level drawdown of the Mediterranean Sea, the "Messinian Guadarranque River" eroded the flysch substratum to reach the base level in the almost desiccated deep Mediterranean Basin. The low-angle foresets of the Pliocene fan delta, indicates a southward flow direction in a Messinian paleocanyon passing at the west of the Rock of Gibraltar and suggests that the "Messinian Guadarranque river" must have eroded the easternmost termination of the Gibraltar sill. In this area, the Messinian Erosional Surface can also be recognised at the base of the Pliocene fan delta of the Guadarranque River.

The use of a 3D geometrical modelling software in the Sorbas Basin highlights a rather complex evolution since the Tortonian, taking place during a progressive N-S crustal shortening. It also appears fruitful to understand its successive connections with the offshore domain. During the Upper Messinian, the erosion of the Gibraltar sill by a Messinian river leads us to start in reconstructing the beginning of the opening process of the Gibraltar Strait, resulting in the W-E Atlantic erosional corridor that crosses the Alboran Sea, an approach to be completed by studying seismic profiles.