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Non-halide sediments from the Loule diapir salt mine: characterization and environmental significance

Carlos Ribeiro (1), Pedro Terrinha (2,3), Alexandre Andrade (4), Bruno Fonseca (3), Miguel Caetano (2), Marta Neres (2,3), Eric Font (2), José Mirão (1,6), Cristina Dias (5,6), Lúcia Rosado (6), Anne-France Maurer (6), and Ana Manhita (6)

(1) Department of Geosciences, Science and Technology School, University of Evora, Evora, Portugal (cribeiro@uevora.pt), (2) Portugues Institute of the Sea and the Atmosphere, Lisbon, Portugal , (3) IDL-FCUL, Instituto Dom Luís, Faculdade de Ciências da Universidade de Lisboa, Lisbon, Portugal, (4) CUF Quimicos Industriais - Departamento Mineiro, Loulé, Portugal, (5) Department of Chemistry, Science and Technology School, University of Evora, Evora, Portugal , (6) HERCULES Laboratory, University of Evora, Evora, Portugal

The sedimentary record of the Mesozoic Algarve Basin (south Portugal) spans from the Triassic to the Lower Cretaceous. Following the initial phase of Pangaea breakup and the related continental sedimentation during the Triassic, the sedimentation evolved through transitional (Triassic-Jurassic transition) to marine (Jurassic) environments. During the Hettangian a thick sequence of evaporites deposited in the basin. Most of the occurrences of these deposits have undetermined volumes, due to the post depositional diapiric movements. At the central Algarve, under the town of Loulé, a salt wall of up to > 1 km across, > 3 km in length and > 2 km in height has been exploited for the chemical industry (Loulé Diapir - LD).
Most of the sediments that constitute LD are halides (> 99% halite), the exception being a package of non-halide sediments, constituted by carbonates (dolomite and magnesite) and sulphates (anhydrite) in various proportions with a maximum thickness of 3 meters. This package has a distinctive mesoscopic aspect of three layers of approximately the same thickness, different colours and primary sedimentary structures: black-brow-grey, from bottom to top.
The sediments of this package were studied with a multidisciplinary approach aiming their mineralogical and chemical characterization, the determination of the organic matter content and origin, as well as the characterization and understanding of the chemical processes that occurred during the emplacement and compression of the LD: (i) X-ray diffraction for the determination of the mineral phases present and semi-quantification using the RIR-Reference Intensity Ratio method; (ii) micro analysis of the mineralogical samples by Scanning Electron Microscopy coupled to Energy Dispersive Spectroscopy; (iii) REE content determination by ICP-MS; (iv) determination of the carbon content by CHN Elemental analysis; (v) determination of the organic matter content by elemental analysis and their composition by pyrolysis-GC-MS; (vi) determination of the carbon and nitrogen stable isotopic ratios of the organic matter; (vii) anisotropy of the magnetic susceptibility to study it emplacement mode.
The LD is deformed by a set of shear-zones and thrusts formed during the Cenozoic Alpine compression that are underlined by the presence of a fine grained, non-halide material, whose nature and characterization was also done, using the same analytical methods.
The preliminary mineralogical and geochemical results show a clear pattern in the evolution of the environmental conditions of the sedimentation with influence on the availability of the dissolved cations. The three of the sediment package showed distinct organic carbon content reaching 4.42% in the black horizon, five times the values found in the adjacent layers. By using the rare earth elements as geochemical tracers of sediment provenance, shale normalised profiles suggest that sediment particles from the three layers have the same origin. However, the non-halide sediments retained in the shear zones showed a different profile with an increase of MREE and a positive Eu anomaly.

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