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A link between Late Pliensbachian organic matter preservation and the Spinatum Chronozone icehouse event

Ricardo L. Silva (1) and Luís. V. Duarte (2)

(1) Basin and Reservoir Lab, Department of Earth Sciences, Faculty of Sciences, Dalhousie University, Halifax, Canada, (2) Departamento de Ciências da Terra and IMAR-CMA, Universidade de Coimbra, Coimbra, Portugal

It is recognized today that the "greenhouse" Mesozoic Era includes several short-lived icehouse episodes. One occurred during the Spinatum Chronozone (Late Pliensbachian), which immediately preceded a 2nd-order extinction event and a major carbon cycle perturbation associated to the Early Toarcian Oceanic Anoxic Event. The Lower Jurassic hemipelagic carbonate series of the Lusitanian Basin (Portugal) mark the hinge zone between the Tethyan (Mediterranean) and Boreal (North-European) realms. Here, one of the most obvious features is the organic-rich nature of the majority of the Ibex–Margaritatus chronozones (Pliensbachian) series (Marly-limestones with organic-rich facies member of the Vale das Fontes Formation), capped by a regressive limestone unit of uppermost Margaritatus–lowermost Polymorphum (Toarcian) chronozones (Lemede Formation). The Pliensbachian organic-rich deposition (observed in several locations around the world) is coeval with a positive carbon isotopic excursion recorded in carbonates and organic substrates.

For the Lusitanian Basin, evidences points toward the occurrence of brief "hot snaps" prior to the onset of the icehouse interval of Spinatum age. We demonstrate that cooling was preceded by several episodes of organic matter preservation, most likely driven by extreme warming, coupled with high oceanic productivity and stratified (thermally?) epeiric areas. These "hot snaps" allowed the rapid but short-lived expansion of Tethyan ammonites into Boreal domains. They also promoted widespread mucilage and microbial outbreaks preserved in the Lusitanian Basin as black shales, resulting in organic matter deposition and geological carbon storage. So far, the causes for these "hot snaps" remain unclear.

This chain of events most likely triggered and/or amplified the Spinatum Chronozone icehouse event, which led to permafrost and/or methane gas hydrates in locations easily disturbed by the subsequent Early Toarcian warming, or/and increased volcanic activity driven by deglaciation.

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