

Organic facies variability and paleoenvironmental interpretation of the Early Toarcian of the Pyrenean Basin: the Bizanet and the Pont de Suert sections

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Abstract

The Early Toarcian is characterized by major worldwide environmental changes recorded in an organic-rich black shale sedimentation and carbon cycle disturbances, the so-called Toarcian Oceanic Anoxic Event (T-OAE) (e.g. Jenkyns, 2010). This organic-rich sedimentation is particularly recorded in shallow marine epicontinental basins that developed as part of the Toarcian European epicontinental shelf, paleogeographical framework in which the Pyrenean Basin is incorporated (e.g. Fonseca et al., 2018; McArthur et al., 2008). With these premises, the main objective of this study is to assess the organic facies variability and to define the depositional paleoenvironments of two sections from the Pyrenean Basin (Bizanet and Pont de Suert) during the T-OAE, using palynofacies and geochemical (Total Organic Carbon - TOC and insoluble residue - IR) data.

The Pyrenean tectonics that occurred between the latest Cretaceous and the Oligocene, deformed, detached and fragmented the substrate resulting in diverse tectonic units (Faure, 2002). The late Pliensbachian-early Toarcian of the Pont de Suert section, located in the South Pyrenean zone, is characterized by the limestone dominated Barre a Pecten Formation (Fm.), and

the carbonate and/or argillaceous-carbonate alternation of its three members (alternations of marl and argillaceous limestone of the Calcaires argileux à Spirifèrines Member (Mb.), the argillaceous limestones and marls of the Calcaires argileux et marnes à Soaresirhynchia Mb., and the marl and argillaceous limestone dominated Calcaires argileux à Telothyris Mb.; Faure, 2002). The Bizanet section is located in the eastern Corbières, and is characterized by a 3m thick succession of late Pliensbachian-early Toarcian sediments comprising, at the base, the limestone dominated Barre à Pecten Fm., followed by a sedimentary gap dated to the Tenuicostatum Chronozone, topped by the marly dominated succession of the Bizanet Fm. (black ferruginous marls intercalated with limestones and topped by dolomitic limestones of the Schistes carton Mb., and the black marls of the Argilites noires litées Mb.; Faure, 2002).

The geochemical results evidenced that the Bizanet section presents higher TOC contents than the Pont de Suert section, with values reaching 2.03 wt.%. In the Bizanet section IR ranges between 12 wt.% and 82 wt.% and in the Pont de Suert section varies from 13wt.% to 67 wt.%, displaying a similar average value for the two sections (45 wt.%). The palynofacies assemblage is dominated in both sections by the same components, belonging to the Phylum Cnidaria, Class Hydrozoa and Order Hydroida, and are represented by fragments of colonial and non-colonial sessile polypoid forms and free-swimming medusoid forms, with different degrees of amorphization. The Bizanet section is dominated by zoomorph-derived AOM, with higher percentages of hydrozoan polypoid forms being observed in levels with lower TOC. The Pont de Suert section presents an alternation of levels dominated by hydrozoan polypoid forms and levels with an association ruled by amorphous zoomorphs (hydrozoan free-swimming medusoid forms). Thus, the organic facies for both sections display a predominance of polymorphic hydroids with different degrees of amorphization, belonging to the Zooclast Group and Zoomorph Subgroup, a type of assemblage already reported by Fonseca et al. (2018) in other basins of southern France. The predominance of polypoid forms and low proportion of amorphous zoomorphs (free-swimming medusoid forms) is indicative of an oxidizing environment indicating a well oxygenated proximal water body with marine influence. On the other hand, an association dominated by amorphous zoomorphs or zoomorph-derived AOM suggests a more restricted and stagnated environment, with the development of dysoxic to anoxic conditions associated with water column stratification, possibly linked to a shallowing of the water column.

The Pyrenean Basin seems to have been a less restricted basin in the Toarcian European epicontinental basins framework, namely when compared with the Grands Causses and Quercy basins (Fonseca et al., 2018). This fact could be related to its more southern position, such as evidenced by van de Schootbrugge et al. (2005) and McArthur et al. (2008) that propose some geographical variability in the degree of restriction of the Early Toarcian sea.

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