The organic matter of Lower Toarcian Schistes Carton (Paris Basin): phytoplanktonic vs bacterial source

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The Paris Basin is regarded as one of the most studied basins worldwide with special focus being given to its Lower Toarcian record, the organic-rich Schistes Carton. The study of the organic fraction of these sediments has been mainly based on its molecular fraction, without support of petrographic observations. Here, a multi-proxy approach using petrographic and geochemical techniques was applied to the study of the organic content of the Schistes Carton, whose phytoplanktonic origin has been previously inferred based only on its geochemical signature.

The organic fraction of all samples (Serpentinum Zone, Elegantulum Subzone of EST433 borehole) is dominated by bacterial amorphous organic matter (AOM): (i) products from bacteria (EPS); (ii) with a plate-like feature; and, (iii) microbial mats. EPS, produced by cyanobacteria and minor thiobacteria (autotrophic-photosynthetic bacteria), is rich in lipids, carbohydrates and proteins, and extremely resistant. EPS may suffer microbiological reworking and exhibit a dense, highly-fluorescent, plate form aspect. Microbial mats are derived from primary productivity of bacteria. This suggests deposition in a proximal environment under stagnant and restrictive conditions, with stratified water column (episodic euxinia). Some geochemical studies previously stated that the contribution of bacterial material should not be disregarded based on the occurrence of extended hopanoids, acyclic isoprenoid lycopane, and isorenieratane. Similar petrographic and geochemical features have been described by several authors in different basins, namely in Australian Cambrian oil shales deposited in similar paleoenvironmental conditions.

The kerogen Type II signature of the Schistes Carton, assuming it had a marine phytoplanktonic origin, was the base for the definition of the pathway of this type of kerogen. This could consequently indicate that kerogen Type II may also characterize an organic association rich in bacterially-derived AOM. Therefore, it is important to acknowledge that kerogen origin is much more varied than one might infer from classic interpretations of kerogen types.

Thus, this study suggests a bacterial origin to the Schistes Carton dominant AOM, demonstrating the importance of an integrated approach to the determination of the organic facies.

Mots-Clés : Schistes Carton, Organic facies, Palynofacies, Confocal laser scanning, Biomarkers, Rock-Eval.

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