The selective preservation pathway in fossil organic matter formation: morphological and chemical implications

S. Derenne
C. Largeau

UMR CNRS 7573, CNRS, 75231 Paris Cedex 05, France

Fossil organic matter (OM) represents the most important type of carbon on the Earth. Moreover, its burial at great depth yields fossil fuels (oil and gas). As a result, it is especially important to elucidate the mechanism(s) which lead(s) to OM accumulation in sedimentary rocks. Till the last twenty years, it was generally considered that fossil OM was entirely formed via a degradation-recondensation process. In this pathway, a small fraction of the monomers derived from the degradation of biopolymers, such as proteins and polysaccharides, escape mineralization by random condensations resulting in the formation of insoluble geomacromolecules. Such macromolecules are thus characterized by an amorphous nature and their highly altered chemical structure hardly allows for the recognition of the source organisms.

However, the occurrence of three other pathways of OM preservation was recently put forward. They are the so-called selective preservation, natural sulphuration and sorptive protection pathways. The present review will be concerned with the first of these pathways. Sharply different from the degradation-recondensation one, it is based on the occurrence in some living organisms of biomacromolecules which exhibit an extremely high resistance against microbial and physico-chemical attacks. Such resistant biomacromolecules were shown to occur in the outer walls of numerous microalgae where they were termed algaenans and in protective layers of higher plants (suberans and cutans) (Tegelaar *et al.*, 1989). Upon fossilization, most of the morphological and chemical features of these biomacromolecules are retained.

Based on several examples, the recognition of the selective preservation pathway will be presented along with the typical morphological and chemical features of the thus formed fossil OM. Indeed, this pathway can account for the presence in sedimentary rocks of organic microfossils and of ultrathin structures revealed by transmission electron microscopy (Largeau *et al.*, 1986; Derenne *et al.*, 1991). Moreover, since the resistant biomacromolecules so far examined exhibit a high aliphaticity, the derived fossil OM will be characterized by a high oil potential. This is illustrated, for example, by the production of a predominant series of long chain *n*-alkanes and *n*-alk-1-enes upon pyrolysis. As a result, the presence of these compounds in pyrolysates is often considered as indicative of the involvement of the selective preservation pathway in the formation of the corresponding fossil OM. However, recent results which will also be presented indicate that caution must be exercised with such a conclusion.

References

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