

Short Note



Are there black shales and black shales?

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This short note arises after a long discussion we had during the past year, when we tried to compare and find common features in black shales occurring in different time slices (Figs 1-2). In contrast with some other types of sediments that are relatively consistently described and interpreted in the geological literature, black shales have been commonly regarded as hard to define or to characterize. Arthur & Sageman (1994) recognized how black shales progressively lost their strictly sedimentological original meaning to assume more of a facies significance so that (p. 505) “it was conceived that the “Black Shale Facies” represented rather unique but widespread paleoceanographic conditions that recurred episodically.”

The published literature shows that the term “black shale” has been represented by a wide range of definitions using criteria that are not necessarily related each other. In its simplest interpretation, the name “shale” refers to fine-grained sediments composed of mud and breaking in thin laminae due to a strong fissility, whereas “black” obviously describes a rock colour. Over the years, however, the enrichment of organic carbon has become more and more important in the discrimination of these deposits, as well as their possible link with global

oceanic perturbations. Black shales, organic carbon-rich sediments and anoxic deposits are terms now commonly but incorrectly used as synonymous.

Emeis & Weissert (2009) have recently provided a comprehensive summary of black shale and sapropel studies. According to the authors (p. 247), black shales are “sediments with elevated organic carbon concentrations (> 1%), including the Pliocene to Recent sapropels.” Different values of the organic content, often expressed in terms of TOC, were used as limiting factors, in some cases as at least 5%, and rarely up to 15% (Emeis & Weissert, 2009 and references therein). Organic matter content and fine-grained nature of the sediment, however, do not appear to be unequivocal characters in the definition of black shales. Arthur & Sageman (1994) referred to black shales as marine mudrocks rich in organic matter, but they remarked that a definition using specific organic content is arbitrary, as thermal maturation and diagenesis may have modified the original content of the sediment. This is even more striking if we consider that many black shale studies deal with deep-sea drilling cores or post-Triassic sediments mildly affected by diagenetic processes, whereas a proper definition of black shales should be equally applicable to older time-slices. In addition, the organic-enrichment



Fig. 1 - Late Ordovician-early Silurian black shales interbedded with carbonates. Huff Ridge Section, Ellesmere Island, Nunavut, Canada. Scale: 1 m.



Fig. 2 - Late Cretaceous Bonarelli Level (OAE 2, latest Cenomanian; top left arrow) and Selli Level (OAE 1a, early Aptian; bottom right arrow). Vispi Quarry, Contessa Valley, Gubbio, Italy.

appears *per se* insufficient as a diagnostic criterion of a black shale especially if applied to the Paleozoic, when there are many examples of lime mudstones (such as the classical Silurian-Devonian "Orthoceras" limestones developed along the northern margin of Gondwana) that are marine, equally enriched in organic matter and share the same dark colour and fine-grained nature of the sediment, but definitely are not shales.

What criteria should be applied, then, in the naming of black shales (e.g., % organic matter, just colour plus grain size, lamination, should they be unbioturbated, marine in origin)? We propose that the name "black shale" should be defined in its simplest, lithological sense - for shales that are black. Too often then the genetic process leading to the formation of black shales, their specific depositional environments, and the lithology have been intermixed in comparative studies between different deposits, thereby confusing data (lithological content) and interpretation. This reflects an approach often used in the study of black shales, which, in some cases, was strongly and sometimes uncritically influenced by uniformitarian principles.

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