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# Depositional conditions during sedimentation of the Cretaceous (Aptian-Albian) organic-rich siltstone of the Carolinefjellet Formation at Isfjorden, Spitsbergen

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The Mid-Cretaceous was a time of very important global changes in marine environments, changes which can be detected worldwide in the occurrence of anoxic, organic-rich facies. This time was generally characterised by a greenhouse climate, high sea-floor spreading rates, a high level of volcanic activity, high atmospheric $CO_2$ concentrations, and high sea level. During this period, temperatures at the equator were similar to those at the polar regions, which were ice-free. These conditions favoured the formation of organic-rich rocks, often characterised by supra-regional occurrence, which originated during oceanic anoxic events (OAEs). However, most sediments representing OAEs are known from the western Tethys and Atlantic Ocean areas. The main causes of OAEs are still being debated. One of the problems is identifying the main factor causing high organic carbon accumulation rates: high productivity in the photic zone of the water column, enhanced preservation in oxygen-depleted deep waters, or a combination of both processes [1].

The aim of the present study was to decipher the depositional conditions during the sedimentation of organic-rich rocks from the Cretaceous (Aptian-Albian) Carolinefjellet Formation [2] in Spitsbergen, based on pyrite framboid diameters as well as on inorganic and organic geochemistry. These sediments potentially constitute records of the OAE 1b event.

We investigated (85 samples) over 40 m of monotonous succession of the organic-rich black siltstones at Isfjorden (section in Carolinedalen). The investigated rocks are very rich in organic matter ranging from 1.2 to 8.2% of TOC (but generally >2.5% TOC). Organic redox indicators imply oxic (along with only sporadically anoxic) conditions in the water column. Traces of biomarkers typical for anoxic conditions, such as isorenieratane and aryl isoprenoids, are present in only two of 10 investigated samples. The low values of inorganic redox indicators such as U/Th (<0.75) and V/Cr (in almost all samples <2) ratios are indicative of oxic bottom-water redox conditions. Framboidal pyrite, while very common in all samples from the lower and middle part of the investigated succession, was sparse in its upper part (in 10 samples it was totally absent). In general, pyrite populations are dominated by larger (>5 μm diameter) framboids formed within the sediment below an oxic or dysoxic water column. However, in all samples, small-sized (<5 μm diameter) framboids, which may have formed in a euxinic water column, were also present. Such small framboids evidently were dominant in only in a few samples. The TOC/P ratio (>30, with a maximum value above 270) in most of the investigated samples is typical of high-productivity dysoxic conditions. This maximum value is correlated with the dominance of small-sized framboids and may reflect horizons which originated in an oxygen-depleted environment. Generally, however, the investigated sediments were formed in a very high-productivity regime, in oxic to dysoxic conditions, with episodic anoxia occurring only in the upper part of the water column. Palynofacies of the samples studied are dominated by terrestrial phytoclasts and sporomorphs.

Subordinate aquatic palynommorphs are represented by marine dinoflagellate cysts, which assemblages show significant diversity reflecting various environmental settings.

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