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Plausible scenario of certain biospheric events

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Many of the Phanerozoic geological events, from several dozens to a few hundreds of k.y., are documented in oceanic and terrestrial settings and as a matter of fact appeared to be biospheric events (BEs), because the atmosphere, hydrosphere, lithosphere, and terrestrial landscapes were involved into global environmental reorganization. Changes in all World components involved were closely interrelated. PETM, OAE1a, early Toarcian, and some other events provide examples of BEs.

The BEs differed in some phenomenological parameters and intensity, but their common feature is that they occurred during rapid eustatic transgression preceded by large-scale regression. The rapid sea-level changes caused a certain type of interaction of the sea with terrestrial landscapes that might explain many peculiarities of BE-related phenomena. Lithological, paleontological, and geochemical characteristics of sediments accumulated during BEs enabled us to suggest the generalized scenario for the course of this type events. Each particular event was initiated by rapid regression causing extensive emergence of land within the areas of large epicontinental seas and oceanic shelves, which occupied much more space in the Mesozoic and early Cenozoic time than now. The type of newly formed terrestrial landscapes was directly controlled by climate. Under conditions of humid climate, the dominant climate type in the greenhouse World, there formed wide wetlands where vegetal organic matter (OM) and huge amounts of methane accumulated, just as this occurs now in similar landscapes. Massive methane supply to the atmosphere conditioned hothouse and delta13C and delta18O excursions. Sea-level lowstand gave rise to land bridges between previously isolated continents and to migration of terrestrial faunas and floras (as during PETM). Many major and trace elements became mobile in the wetland environment. At the transgressive stage, solid and dissolved OM and biophile elements of the wetlands were supplied into the basin leading to productivity outburst and bi-

otic turnover. Calcareous microplankton became replaced by cyanobacteria, algae, and organic-walled plankton, which served as a major OM supplier. Pyrolysis results show different amounts of admixed terrestrial OM that initially must have accumulated in the wetlands, to be redeposited into marine sediment in the course of transgression. Concurrently, a wide spectrum of chemical elements was incorporated into OM-rich sediments.

In the arid areas, salts and Mg-silicates accumulated in isolated or semi-isolated basins formed as a result of regression. Flooding of brackish ponds caused the warm saline water input into the basin, resulting in water column stratification, reduced aeration, and bottom water anoxia oppressing the benthic biota.

Massive OM accumulation in the epicontinental and shelfal areas resulted in anoxia throughout the basins. The recent Black Sea, exemplifying the supply of methane forming in the hydrosulfuric contamination zone into the atmosphere, provides us with a good reason to suggest that large anoxic basins were additional methane producers contributing to the hothouse effect. With progressive sea-level rise, the contribution from wetlands to methane formation decreased, but the spreading of anoxic basins partially compensated methane emission. Gas-hydrates were also among the possible methane suppliers, but they evidently played a minor part in the world balance of greenhouse gases.

The biophile elements input into the marginal oceanic areas in some cases resulted in algal productivity rise and accumulation of OM-rich sediments, in other cases increasing calcareous microplankton productivity and sedimentation rate, while the pelagic areas show oligotrophic conditions. With the cessation of sea-level rise, biophile element inflow ebbed and plankton productivity declined, anoxic conditions coming to an end. Methane supply into the atmosphere and thermal effect became weaker coherently with the normalization of C and O isotope composition. Hence, the main BE features ceased to exist. This scenario developed more or less fully, depending on a number of factors such as the sea-level high and thus the space of epicontinental seas, the rate of regression and transgression and their relationship to shorter-term fluctuations, the general climatic conditions (greenhouse vs. icehouse), and some other circumstances.

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