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Solid Earth Discussions

Interactive comment on "Phanerozoic black shales and the Wilson Cycle" *by* J. Trabucho-Alexandre et al.

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Trabucho-Alexandre and co-workers develop a large scale framework explaining marine black shale formation in the Phanerozoic within the context of different phases of the opening and closing history of ocean basins, known as the Wilson cycle. They provide examples of prominent black shale occurrences for each of the sub-stages, i.e. continental rift, juvenile spreading, mature ocean basin and basin closure, and argue that most previous studies have followed either of the uniformitarian depositional models of (1) restricted circulation, (2) open ocean oxygen minimum and (3) continental shelf, or combinations thereof to explain black shale formation in the past. From their analyses the authors conclude that the distribution, position in the basin fill and nature of black shale depend on the stage of basin evolution as the latter ultimately controls

the necessary depositional environment supporting enhanced organic carbon burial.

In general hardly anyone will argue against the general spatial and temporal relationships of black shale deposition within the wider (plate tectonic) framework of marine basin evolution, so within this context the study has some merit.

The proposed model, however, does not explain all evidence of marine organic carbon rich sediments. For example, how do widespread sapropel type sediments of Paleocene-Eocene age (e.g. Gavrilov et al., 2003, GSA Special Paper 369, 147-168) deposited across the extended epicontinental seas of the Russian mid to high latitudes conform with the model? These regions on old, cratonic crust were certainly not directly part of Phanerozoic ocean basin evolution.

Furthermore, one may argue that at any time in the past conditions were favorable for high marine OC burial, at least at local but possibly also regional scale. The proposed relationships may therefore be regarded as another example of uniformitarism, in this case focusing on long term and large scale tectonic processes rather than local-regional depositional settings favoring high productivity and/or deoxygenation of the water column.

The study falls short on integrating the higher time-frequent controls of oceanography and climate. Widespread marine black shale and sapropel formation in the Cenozoic-Mesozoic was limited to relatively short time periods, probably one million years or far less with significant spatial and temporal variability, arguing for additional and complex controls and feedbacks. Climate, wind and ocean currents are top candidates, all known to be highly sensitive to orbital forcing and latitudinal zonation. Climate and oceanography are recognized in the study but a more substantial discussion about the relative importance of all three short-term factors driving the Atmosphere-Land Surface-Ocean System compared to basin evolution would be desirable to make a real step forward in understanding black shale deposition through time. For this purpose the authors may find it useful to consult recent studies aiming to place local black

shale formation into a wider regional (climate) context, e.g. Hofmann and Wagner (Paleoceanography, 2011, in press, online available).

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