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Ordovician sea-level changes: one global curve or two semi-global ones?

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Comparative analysis of the Ordovician succession of Siberia and Laurentia demonstrates a striking similarity in long-term lithological changes and sea-level curve interpretation. On both platforms, Ordovician succession starts with tropical carbonates, which abruptly changes to siliciclastic deposits and terminates with cool-water carbonates [1, 2]. Numerous K-bentonite beds in the Upper Ordovician of North American and Siberian platforms stressed this similarity [3]. The sea-level curve for the Ordovician of both platforms assumes a prominent sea-level drop at the base of the Middle Ordovician and a long-term lowstand during all the Dapingian and Darriwilian [4, 5]. On the other hand, sea level curves for the Ordovician of the Gondwanan platforms (North Africa, Yangtze platform, South America, Avalonia) seem to share different patterns [6]. The Middle Ordovician represents rather a highstand interval in these reconstructions [6].

As for the Baltica, there are two different sea-level models for this palaeocontinent. The sea-level curve suggested by Nielsen [7] demonstrates close similarity to the North American model while the sea-level curve presented by Dronov and Holmer [8] seems to fit better to the platforms rifted from the Gondwana palaeocontinent [6]. This contradiction reflects opposite opinions in interpretation of limestone units within the deep-water setting of the Ordovician basin of Baltoscandia. Invasion of carbonate facies into the black shale realm interpreted as a shallowing event in the deep-water model, assuming that limestone represents more shallow-water facies than the black shale [7]. On the other hand, the same episode in shallow-water areas characterized by expansion of relatively deep-water marine red bed facies, suggesting deepening event [8].

In our opinion, invasion of limestone facies into deep-water black shale environment reflects rather a “highstand shedding” [9] than shallowing event. Carbonates seem to be transported from shallow-water environment into deep-water setting at a time of maximum carbonate production in the shallow-water environment, i.e. during sea-level highstand. Based on this interpretation we suggest that Baltica also follow the Gondwanan sea-level patterns. As a result instead of one global sea-level curve for the Ordovician [10] it would be probably more correct to suggest two semi-global curves for two big tectonic regions one of which includes Siberian and North American platforms and the other combine Baltica and Gondwanan platforms. This subdivision probably reflects position of the main Ordovician lithosphere plates. The work supported by the Russian Foundation for Basic Research, grant 16-05-00799.

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