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Rapid paleodepth changes in epeiric Paleozoic basins as a consequence of crustal uplift and subsidence

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According to a large volume of stratigraphic data, considerable changes in the paleodepth took place in many cratonic areas in the Paleozoic. Several mechanisms have been proposed as an explanation. Among them are eustatic changes of sea level (Haq, Schutter, Science, 2008, 322, 64-68.), variations in the forces acting along the lithosphere (Cloetingh et al., EPSL, 1985, 75, 157-166) and convective flows in the mantle (DiCaprio et al., Geology, 2010, 38, 11-14). Third-order cycles, 1-3 Myr long, are of a great interest in connection to important applications to petroleum geology. They are commonly attributed to eustatic fluctuations of 20-100 m with a possible influence of tectonic factor. Wide carbonate platforms existed on the continents over most of the Paleozoic. They were characterized by a slow deposition at a very shallow depth $\leq$15-20 m. We elaborated a mathematical model for evaluating the changes in the depth of water under eustatic sea-level fluctuations in a basin where tectonic subsidence takes place at a certain rate. The isostatic response to a changing water load is taken into account. The rate of crustal subsidence changing in time was obtained from a number of detailed reference stratigraphic successions for slowly subsiding carbonate platforms in East Siberia and East Baltic. Then numerical solutions of transcended relations allow us to determine the maximum sea-level changes which could occur at certain epochs in the past. In this way, it has been found that over most of the Paleozoic the magnitude of third-order sea-level changes did not exceed several tens of meters. At such epochs, all the larger relative sea-level changes (50-100 m) should be attributed to the crustal uplift and subsidence. A good example is the East European Craton in the Early Pennsylvanian, i.e. Bashkirian. In the Late Mississippian, all the Craton was covered by a shallow sea where slow deposition of carbonates took place at a depth $\leq$ 15-20 m. In the eastern and northern part of the craton such a deposition continued in the Bashkirian, which indicates the absence of significant changes in sea level. However, in the early and middle Bashkirian its western part emerged above sea level which resulted in incision of the Aza Paleovalley for 100-120 m. By the late Bashkirian, the region returned to the level of a very shallow shelf with carbonate deposition. At a practically stable sea level, these data indicate a crustal uplift for 3-4 Myr. Similar phenomena occurred in the Early Pennsylvanian in the south of the North American Craton. This can be explained by the occurrence in the mantle of short-term ascending convective flows of a regional extent.