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AN APPROACH TO PALEOZOIC SEA LEVEL USING THE δO^{18} TEMPERATURE DATA

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Гоце Тенчов. ОПРЕДЕЛЯНЕ НА МОРСКОТО НИВО ПРЕЗ ПАЛЕОЗОЯ ЧРЕЗ ИЗПОЛЗВАНЕ НА δO^{18} ТЕМПЕРАТУРНИ ДАННИ

Под морско ниво се разбира средната височина на морето по отношение на избрана еталонна повърхност. Морското ниво се е изменяло през геоложката история на Земята. Геолозите определят средното ниво на океана чрез използване на т.нар. sequence stratigraphy. Съществуват няколко разлчини реконструкции на морското ниво през Палеозоя. Те се различават съществено помежду си. От друга страна, температурната крива, получена въз основа на изотопното съдържание на кислорода – δO^{18}, е огледален образ на части от цитираните в литературата криви на нивото на океана. В статията се предлага идеята, че при топене на ледовете огромни маси студена вода нахлуват в океана, повишават нивото му и намаляват средната му температура и обратното. Въз основа на тази идея е генерирана нова крива на морското ниво през Палеозоя. Комбинирането и с данните от sequence stratigraphy ще доведе до по-добро разбиране на процесите в Световния океан през Палеозоя.

Gotze Tenchov. AN APPROACH TO PALEOZOIC SEA LEVEL USING THE THE δO^{18} TEMPERATURE DATA

Mean sea level is the average height of the sea, with reference to a suitable reference surface. Sea level has changed over geologic time. Geologists derived the sea level position over geologic time using sequence stratigraphy. There exist several reconstructions of sea level over Paleozoic time but they are quite different. On the other hand the sea level mirrors oxygen isotope temperature curve. Here is lanced the idea that the melting of ice sheets produced a huge amount of cold water. It flew to the ocean and cooled the ocean water. Higher sea water produced the higher negative drop of sea water temperature and contrariwise. Using such idea was generated a new sea level curve for Paleozoic time. The new sea level curve was obtained

without using sequence stratigraphy. It can be combined with sequence stratigraphy for better understanding the Paleozoic events into the ocean.

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Mean sea level is the average height of the sea, with reference to a suitable reference surface. Sea level has changed over geologic time. Global sea level and the Earth's climate are closely linked as well. Sea-level change has influenced phytoplankton evolution, ocean chemistry, sedimentation process into the ocean, Earth's rotation, gravitational and magnetic fields of the Earth.

Geologists who study the positions of coastal sediment deposits through time have noted basinward shifts of shorelines associated with a later recovery. This results in sedimentary cycles can be correlated around the world. Geologists derived the sea level position over geologic time using sequence stratigraphy.

Fluctuations in global sea level result from changes in:

1. The volume of water in the ocean or the volume of ocean basins [1–4]. Water-volume changes are dominated by growth and decay of continental ice sheets, producing high-amplitude up to 200 m and rapid eustatic changes up to 20 m per thousand years (ky).

2. Desiccation and inundation of marginal seas, thermal expansion and contraction of seawater, and variations in groundwater and lake storage with amplitudes up to 5m to 10m at high rates (10 m/ky).

3. Variations in sedimentation produces moderate amplitude (60m) at slow rate (10 m/My).

There exist several reconstructions of sea level over Paleozoic time. In fig. 1 are citied three of them: a) Sea level, compiled from data citied by Condie and Sloan [5]; b) Curve, presented by Hallam [6] and c) Average curve derived from detailed curve, presented by Exxon group. The Exxon curve is a composite from several reconstructions published by [7, 8, 9].

Comparison of the three curves shows that they are quite different. They coincide or are very close within 240–250MaBP, 380MaBP and between 490-540MaBP. In fig. 2 is presented an average curve with standard deviation limits.

The sea water temperature can be obtained using Oxygen isotope data δO^{18} [10]. The δO^{18} ratio provides an accurate record of ancient water temperature. The sea water temperature is presented in fig. 2. The first impression is that the sea level mirrors oxygen isotope temperature curve. Such behavior

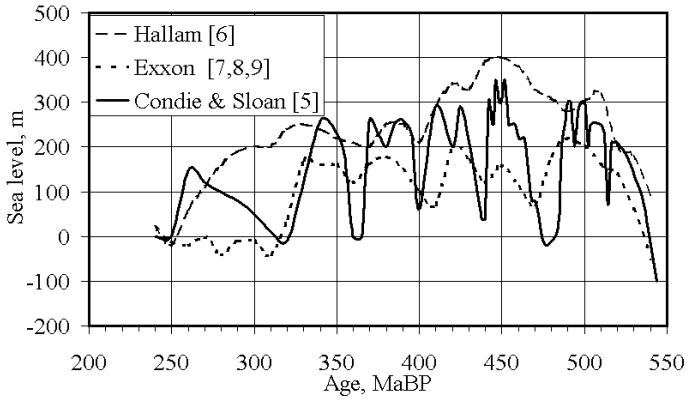

Fig. 1

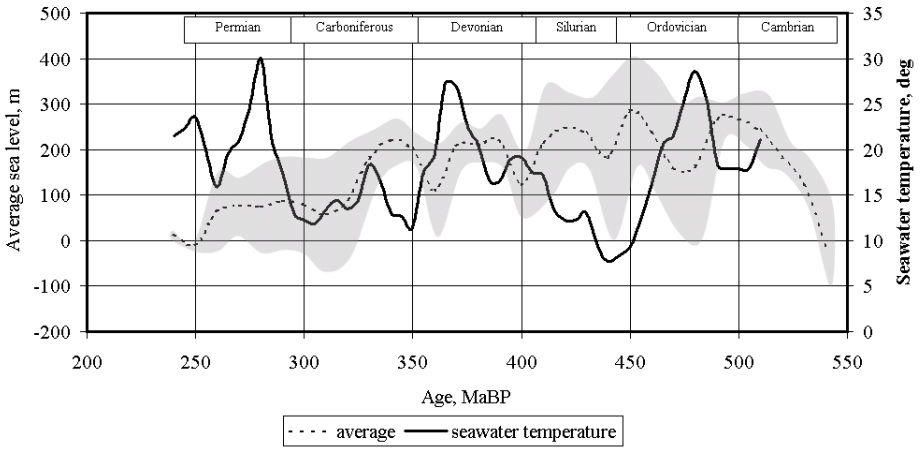

Fig. 2

of both curves does not correspond to the idea that the increase of temperature melt the ice sheets that resulted in sea level increase and contrariwise.

With respect to overcome the problem here is lanced the following idea: the melting of ice sheets on continental crust and in poles produced a huge amount of cold water. It flew to the ocean and cooled the ocean water. Higher sea water produced the higher negative drop of sea water temperature and contrariwise. In fig. 3 are compared the sea level drop ΔH with change of temperature ΔT for Paleozoic time, derived from fig. 2. It follows that $\Delta H/\Delta T = -4{,}9$ m.deg^{-1}.

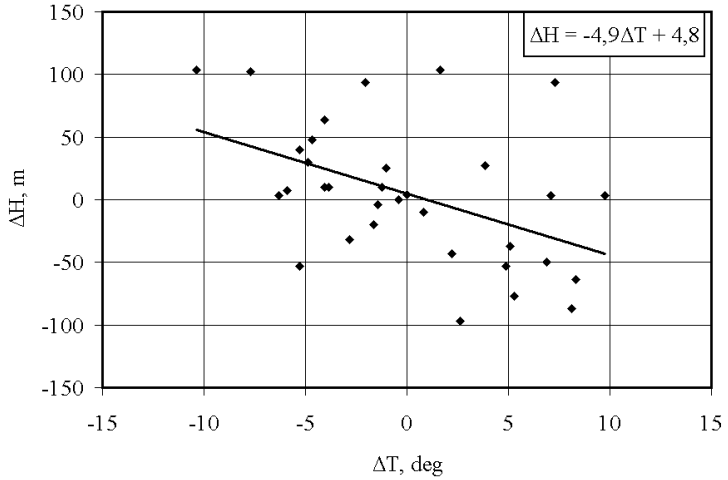

Fig.3

The height of sea water at time *i* was calculated using Eq.1.

$$H_i = H_{i-1} + \Delta H \tag{1}$$

where

$$\Delta H = -4{,}9\Delta T + 4{,}8\,. \tag{2}$$

For $i = 1$ was used the sea water height at 240 MaBP equal to 13 m above the present sea level. Calculations were made with step of 5 Ma. In fig. 4 are presented average sea level derived from fig. 2, standard deviation limits (shadowed area) and the sea level curve derived using Eq. 1 and Eq. 2. The generated sea level curve is within the standard deviation limits. It can be calculated in more details if a detailed δO^{18} data are available. The new sea level curve was obtained without applying the sequence stratigraphy. The curve presented in fig.4 has no pretension for better knowledge's of Paleozoic sea level but can be combined with sequence stratigraphy for better understanding the Paleozoic events into the ocean.

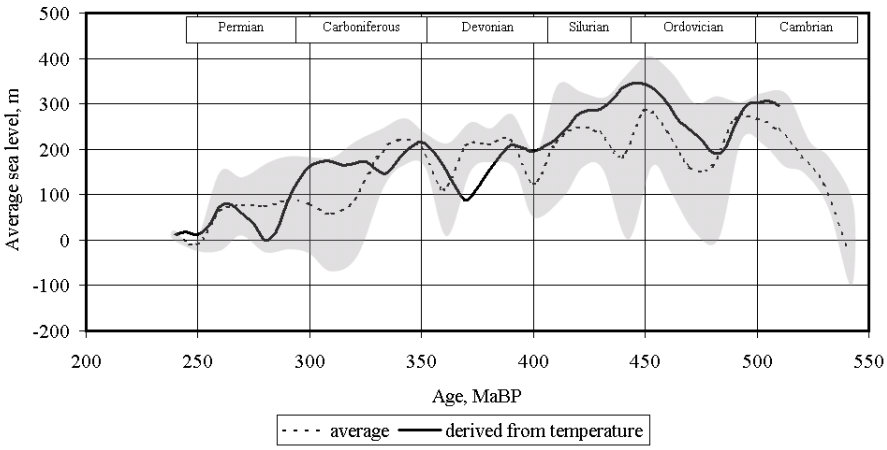

Fig.4

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