Were Early Permian Cyclothems in Midcontinent North America Deposited During an Anomalously Cold Time Period?

Herrmann, Achim D.[1] (1) Barrett, The Honors College and School of Earth and Space Exploration, Arizona State University, Tempe, AZ.

Insight into the depositional conditions at the time of deposition of organic-rich mudrocks has great importance for understanding the spatial and temporal distribution of potential hydrocarbon source rocks, past climates and global change, and evolution of life. The earliest Permian black shales of the midcontinent of the US pose a special problem: they were deposited in a shallow, epicontinental sea close to the equator during a time that has recently been suggested to have been anomalously cool in the tropics1. This would indicate that it is not possible to apply the general facies model for Pennsylvanian cyclothems2 to early Permian cyclothems.

In order to test whether Permian cyclothems were deposited under anonymously cold conditions, the sea surface temperatures during the time of deposition were estimated using oxygen isotopes of biogenic apatite. Based on the first appearance of the conodont Streptognathodus isolatus, the Red Eagle Limestone is the first Permian cyclothem in Kansas3. The sample material of this study is from the Glenrock Limestone Member and the black shale and gray shale facies of the Bennett Shale Member of the Red Eagle Limestone.

The δ18Ophos values of conodonts from these environments range from 20.18‰ to 20.35‰ and the δ18Ophos values of apatitic brachiopods range from 20.21‰ to 20.50‰. These values are comparable with oxygen isotope values from Pennsylvanian cyclothems4. This suggests these deposits were deposited under similar climate conditions and that the Pennsylvanian climate driven facies model can also be applied to early Permian cyclothems. Furthermore, it supports the hypothesis that glaciation did not exist to near sea level in the tropical region during this time period5.

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3 Sawin, R.S. et al. (2006) Kansas Geological Survey, Current Research in Earth Sciences, 252, part 2
4 Joachimski, M.M. et al. (2006) Constraints on Pennsylvanian glacioeustatic sea-level changes using oxygen isotopes of conodont apatite. Geology,34;4;277-280.
5 Hood, W.C. et al. (2009) Anomalous cold in the Pangaean tropics: COMMENT. Geology,37;6;192.