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Nikolai Pedentchouk¹, Katherine H. Freeman², Nicholas B. Harris³, David J. Clifford¹ (1) Pennsylvania State University, University Park, PA (2) The Pennsylvania State University, University Park, PA (3) Department of Geosciences, The Pennsylvania State University, University Park, PA

Sources of 1,2,3,4-tetramethylbenzene in Lower Cretaceous Lacustrine Source Rocks, West African Basins as Revealed by Compound-specific Carbon Isotopic Analysis

Previous work demonstrated that changes in primary productivity were the dominant control on organic matter preservation in the Congo basin, West Africa. However, this is not the case in the Kwanza basin of Angola and the Atlantic basin of Gabon, where anoxia appears to have played a more prominent role. The purpose of the present study is to provide a better understanding of this factor in Angola and Gabon by determining the sources of 1,2,3,4-tetramethylbenzene (1,2,3,4-TMB). Specifically, we are interested in the occurrence of isorenieratane: a more direct indicator, when compared with other biomarker proxies, of photic zone anoxia.

We analyzed (using py-GC/MS) 35 samples from several stratigraphic intervals in these basins. Analysis of these data revealed that pyrolyzates contain various amounts of 1,2,3,4-TMB in almost all samples. Compound-specific carbon isotope analysis of off-line pyrolyzates as well as saturate and aromatic fractions from 7 samples indicated that there were at least two potential sources for 1,2,3,4-TMB: primarily isorenieratane in Angola and β -carotane in Gabon. Enriched ($\delta^{13}\text{C} = -20.1\text{‰}$) 1,2,3,4-TMB values from the Angola sample are consistent with increased amounts of isotopically enriched ($\delta^{13}\text{C} = -14.3\text{‰}$) isorenieratane. Isotopically depleted ($\delta^{13}\text{C} = -26.1$ and -28.1‰) 1,2,3,4-TMB is present in Gabon samples characterized by elevated β -carotane content ($\delta^{13}\text{C} = -28.5$ and -30.9‰) and low amounts of isorenieratane ($\delta^{13}\text{C}$ values are yet to be determined).

The presence of isotopically enriched isorenieratane indicates anoxic conditions during the deposition of sediment represented by the Angola sample. However, the extent of anoxia in Gabon remains questionable, since β -carotane may have accumulated under a variety of environmental conditions.