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Distinct variations among source rocks from Early Cretaceous West African rift basins based on hydrogen and carbon isotope values of *n*-alkanes

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Sedimentary basins along both sides of the South Atlantic contain a multitude of petroleum systems with source rocks of various ages formed in different deposition environments. Even though these basins have been the target of intensive petroleum exploration for several decades, distinguishing characteristics of source rocks associated with West African petroleum systems are still limited. Here we provide a novel approach to characterizing organic geochemical composition of Lower Cretaceous lacustrine source rocks from the Gabon, Congo (the Viodo area), and Kwanza basins. This study investigates deltaD and delta^{13}C values of n-alkanes from 57 core samples spanning several stratigraphic intervals but containing organic matter (OM) of the same level (immature to early mature) of thermal maturity. The Gabon, Congo, and Kwanza Basins were formed as a result of Late Jurassic-Early Cretaceous rifting event that separated the South American and African cratons. The sedimentary characteristics suggest there was a climatic gradient along Gabon-Angola transect during the Early Cretaceous – more humid in the north and more arid conditions in the south. Additionally, during the deposition of the Maculungo Shale, paleolacustrine system in the Kwanza Basin might have been heavily influenced by seawater from the Southern proto-Atlantic Ocean.

Plotting delta^{13}C vs. deltaD values of nC$_{19}$, nC$_{23}$, nC$_{27}$ alkanes reveals a clear sepa-

ration among several groups of data. First, samples from the Kwanza Basin are totally separated from Congo Basin samples. Second, samples from the Congo Basin are relatively D-enriched in comparison with the other two basins. Finally, isotopic compositions of $n\mathrm{C}_{19}$ and $n\mathrm{C}_{23}$alkanes from LMN and Toca 1 are D-enriched in comparison with UMN and MMN.

We suggest that the observed variations in delta^{13}C and deltaD values of n-alkanes result from differences among OM sources and depositional environments during accumulation of lacustrine sediments. Previous investigation of OM sources in Gabon and Kwanza revealed the presence of ^{13}C-enriched biomarkers from green sulfur bacteria (*Chlorobiaceae*) in the Maculungo Shale. Variations in the contribution of ^{13}C-enriched $n\mathrm{C}_{19}$and $n\mathrm{C}_{23}$ alkanes from green sulfur bacteria in Kwanza would explain both the large spread of delta^{13}C values of these samples as well as the relative ^{13}C-enrichment of Kwanza samples in comparison with Gabon and Congo samples which contain primarily ^{13}C-depleted algal biomass. The relative D-enrichment of n-alkanes in the Congo Basin could be explained as a result of more arid conditions in comparison with the Gabon Basin. Furthermore, within the Congo Basin, greater D-enrichment exhibited by samples from LMN and Toca 1 in comparison with MMN and UMN Formations, particularly in case of $n\mathrm{C}_{19}$ and $n\mathrm{C}_{23}$ alkanes, could have resulted from more arid conditions during the deposition of LMN and Toca 1 Formations. The relative D-depletion of n-alkanes from the Kwanza Basin is quite puzzling given the southernmost location of this basin and hence the most arid conditions inferred from sedimentary data. However, this observation can be explained by possible influence of marine water during accumulation of the Maculungo Shale. Organic matter biosynthesized under the influence of marine water may have D-depleted values in comparison with other two basins because the source water would not have been significantly influenced by lake water evaporation and/or evapotranspiration affecting soil and leaf water during terrestrial plant growth.

In conclusion, this study demonstrates the usefulness of a combined investigation of delta^{13}C and deltaD values of n-alkanes for determining individual characteristics of paleolacustrine source rocks from several stratigraphic intervals in the Gabon, Congo, and Kwanza Basins. Carbon and hydrogen stable isotope data contained in these compounds will enhance our understanding of petroleum systems in Early Cretaceous West African basins and provide a useful template for similar studies in the contemporaneous Brazilian sedimentary basins on the other side of the Southern Atlantic.