A Source to Sink Study Along the African Equatorial Atlantic Margin: Implications for Exploration

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ABSTRACT

Basin hinterlands act as sources for clastic sediments and nutrients that are transported by rivers towards depositional basins. Changes in the configuration of a basin hinterland are likely to influence the distribution, quality and quantity of the play facies within the erosional-depositional system; thus affecting the depositional basin's hydrocarbon prospectivity. To gather insights into these changes along the African Equatorial Atlantic margin from Sierra Leone to Cameroon, we have carried out drainage and landscape analysis and palaeogeographic and palaeogeology reconstructions for five timeslices: Barremian, Cenomanian, Turonian, Campanian and Serravallian. The results suggest that during the Early Cretaceous the margin was drained by broadly NE–SW-flowing rivers that followed the Precambrian basement fabric. This NE–SW flow direction still prevails in the Present Day rivers that drain towards the Sierra Leone and Liberia Basins, although their catchment sizes have increased by headward erosion. By the Late Cretaceous, rivers draining towards the Gulf of Guinea developed a N–S flowing trend, similar to that of the Present Day, e.g. the Palaeo-Black Volta River, which used to discharge via the Palaeo-Tano River into the Côte d'Ivoire depositional basin, was captured by the Palaeo-White Volta River by the Late Cretaceous, shifting its outlet point towards the Benin depositional basin. Throughout the Cretaceous, rivers flowing towards the Sierra Leone and Liberia Basins were draining predominantly from Archean high-grade metamorphic rocks, including gneisses, migmatites and, locally, granitoids. Rivers flowing towards the Gulf of Guinea were draining predominantly from Proterozoic meta-sedimentary rocks intruded by Proterozoic granitoids, suggesting better potential reservoir quality for the Cretaceous clastics in the Côte d'Ivoire depositional basin. The Palaeo-Niger River is interpreted to have established as a continental-scale drainage system by the Miocene, and possibly as early as the late Oligocene; it drained over a wide range of Cretaceous and Cenozoic sedimentary rocks and Precambrian metamorphic basement rocks. Understanding the changes in drainage evolution in the area and reconstructing the palaeogeographic depositional setting and palaeogeology are key elements in conducting a source to sink study for this region, thereby allowing a prediction of reservoir presence and quality within the Equatorial Atlantic margin depositional basins.