Guyana-Suriname Deep Water Hydrocarbon System, Three Rivers, and Two Source Rocks

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Abstract

The Guyana/Suriname Basin deep water hydrocarbon system can be summarized by the interaction between three river systems, Aptian Demerara, Upper Cretaceous Berbice and Miocene/Pliocene Amazon and two source rocks, Lower Albian 108 ma, Oceanic Anoxic Event, OAE-1 and the Cenomanian/Turonian 90 ma, OAE-2. The basin is located at the southern end of the North Atlantic rift where thick Lower Cretaceous/Jurassic carbonate platforms rim the deep water Jurassic oceanic crust and the massive Aptian, Demerara river system flowed northwest into Suriname between Africa and South America. The OAE-1 source was deposited in deep water between the Demerara deltaic system and the carbonate platform rim. The Berbice river during the Upper Cretaceous was draining the entire northern part of South America and formed a 1000m deep canyon across the shelf that delivered over 1 second of sediment to the deep water, including the second cycle Campanian/Maastrichtian reservoirs from a Pre-Cambrian Quartzite provenance. The Berbice overburden matured the OAE-1 source rock at 60 ma. The OAE-2 source, known locally as the Canje Shale was subsequently deposited across the entire deep water portion of the Guyana/Suriname Basin. The Berbice drainage system is captured during the Lower Tertiary and reorganized into a series of smaller river systems where sediment is stored in the fluvial, near shore and shelf environments, so the deep water basin receives very little sediment. The Berbice overburden allows the OAE-1 source to start generating oil, then the very low sedimentation rate allows continuous oil generation from the OAE-1 source for 40 million years when the Campanian/Maastrichtian reservoirs are below the oil biodegradation risk and above the reservoir cementation risk. The Amazon River

sediment is sweep northwest by shelf currents into the Guyana/Suriname Basin demonstrated by Devonian palynological evidence present in Miocene/Pliocene sediments in wells from both Foz de Amazonas and Guyana, Mapes + Torres. This recent overburden matures the OAE-2 source in the deeper parts of the Guyana/Suriname Basin, around 6 ma. The hydrocarbon system is driven by four key elements, the Aptian, Demerara and Lower Cretaceous/Jurassic carbonate platform defining the location of the Lower Albian, OAE-1 source, the Upper Cretaceous, Berbice Campanian/Maastrichtian reservoirs and overburden to mature the OAE-1 source. Then the Lower Tertiary capture of the Berbice and low sedimentation rate in deep water, which allowed 40 million years of oil generation and migration from the OAE-1 source and preserved excellent reservoir quality for effective DHI's AVO, flat events and down dip conformance. Finally, the Miocene/Pliocene, Amazon system provides the overburden to mature the Cenomanian/Turonian, OAE-2 source and put the Campanian/Maastrichtian reservoirs in water depths that current technology can economically develop.