Challenges in Evaluation of Heavy Oil & Tar Mats

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Heavy oil field characterization and development processes, including well placement, reserves assessment, well-testing and simulation, require accurate knowledge of in-situ fluid properties for optimal results. Heavy oil/tar delineation can be challenging for reservoirs containing heavy oil underneath of black oil and all underlain by a tar mat at oil-water contact. The viscosities in the black oil section can be similar throughout the field. In contrast, the mobile heavy oil section of the column usually contains a large, continuous increase in asphaltene content with increasing depth extending to the tar mat.

In this presentation, in-situ heavy oil characterization are presented with the integration of logs and advanced formation tester viscosity measurements during sampling. Accurate determination of fluid density and viscosity properties can be quite challenging in water-based-mud environments; especially in those cases of water-dominated flow, strongly emulsified fluids or high fraction of sediments in the flow line. Field examples are shown with large viscosity variation, driven by asphaltene gradient in heavy oil column. Results are compared with laboratory analysis of the samples with the order of magnitude variation. A new Equation of State (EoS) based on Flory-Huggins-Zuo (FHZ) formalism with capable of modeling such gradients in asphaltene content is found to successfully model the asphaltene content gradient.