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Sedimentology and Reservoir Characteristics of Early Cretaceous Fluvio-Deltaic and Lacustrine Deposits, Upper Abu Gabra Formation, Sufyan Sub-basin, Muglad Rift Basin, Sudan

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Sufyan Sub-basin is an East-West trending Sub-basin located in the northwestern part of the Muglad Basin (Sudan), in the eastern extension of the West and Central Africa Rift System (WCARS). The Early Cretaceous Abu Gabra Formation considered as the main source rock in the Muglad Basin. In Sufyan Sub-basin the Early Cretaceous Upper Abu Gabra Formation is the main oil-producing reservoir. It is dominated by sandstone and shales deposited in fluvio-deltaic and lacustrine environment during the first rift cycle in the basin. Depositional and post-depositional processes highly influenced the reservoir quality and architecture. This study investigates different scales of reservoir heterogeneities from macro to micro scale. Subsurface facies analysis was analyzed based on the description of six conventional cores from two wells. Approaches include well log analysis, thin sections and scanning electron microscope (SEM) investigations, grain-size, and X-ray diffraction (XRD) analysis of the Abu Gabra sandstone. The cores and well logs analyses revealed six lithofacies representing fluvio-deltaic and lacustrine depositional environment. The sandstone is medium to coarse-grained, poorly to moderately sorted and sub-angular to subrounded, Sub-feldspathic arenite to quartz arenite. On macro-scale, reservoir quality varies within Abu Gabra reservoir where it shows progressive coarsening upward tendencies with different degrees of connectivity. The upper part of the reservoir showed well connected and amalgamated sandstone bodies, the middle to lower parts, however, have moderate to low sandstone bodies' connectivity and amalgamation. On micro-scale, sandstone reservoir quality is directly affected by textures and diagenesis.The XRD and SEM analyses show that kaolinite and chlorite clay are the common clay minerals in the studied samples. Clay matrix and quartz overgrowth have significantly reduced the reservoir porosity and permeability, while the dissolution of feldspars during the diagenetic process increase it. The estimated porosity in Abu Gabra Formation ranges from 10 to 21% with an average of 15%; while permeability varies from 200 to 400 md. The results of this study might contribute to better understanding of reservoir heterogeneities and help in reservoir quality prediction, therefore enhancing the hydrocarbon productivity.