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**Sequence Stratigraphy and Reservoir Quality Prediction in the
Ahnet-Timimoun Basin, Central Sahara, South-west, Algeria**

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The Ahnet Timimoun basin is a mature petroleum province with approximately 50 trillion cubic feet (TCF) of discovered gas in over 50 fields. This basin is keystone in Sonatrach's plan to develop the gas resource of the western Sahara region. Three areas fields (permit) being investigated respectively; In Salah by BP, Mekerrane (permit) by Petronas/Gaz De France (GDF) and recently Hassi Mahdjib (permit) by Total Fina Elf.

More effective exploration and exploitation strategies will be necessary in the near future to increase the volume of this resource. Sequence stratigraphy is one of the technical approaches now being used to help identify future hydrocarbon potential.

The sequence stratigraphic framework for the Palaeozoic sediments in the Ahnet-Timimoun basin was used to develop a geologic understanding and predictable model for sediment deposition. In particular, the sediment depositional models are used to develop and understanding of the source rock distribution and quality, the location and thickness of seal and the distribution of reservoir rock.

Five depositional units are recognised in a given sequence in the area:

1. The Ordovician sequences are continuous and can be correlated at basin scale. Seven third-order sequences are recognised into three composite second-order super sequences, separated by regional unconformities. However in the Upper Ordovician sequence, the distribution of glaciogenic facies are extremely complex. (a) The Tremadoc sequence has not been adequately characterized in core because most wells terminate before the base is recognised. In outcrop, this sequence is lying in a major unconformity on the “purple series”. The base is defined at a major sequence boundary. (b) The Lower Arenig-Caradoc sequence is represented by predominately shallow shelfal sands. It is divided into Lowstand System Tract (LST), Transgressive System Tract (TST) and High System Tract (HST). This sequence is characterized by the clean quartzitic sandstones with pervasive bioturbation (Hamra-Quartzite). (c) The Ashghill sequence is characterized by the glacial lithologies. The base is defined at a major sequence boundary. It is divided into Lowstand System Tract (LST), Transgressive System Tract (TST) and High System Tract (HST).

2. The Gedinnian sequence is represented by marginal-marine and shelf deposits. It is divided into Lowstand System Tract (LST), Transgressive System Tract (TST) and Highstand System Tract (HST). The LST corresponds to one of the three Devonian reservoirs in the Ahnet-Timimoun basin. The Lowstand fluvial-deltaic sandstones are generally located in the eastern part of the Ahnet –Timimoun basin. The thickest sandstone accumulations are found in the northern part of the basin.

3. Siegenian-Emsian: This sequence is represented by fluvial, littoral and offshore deposits. It is divided into a prograding LST and HST. The Siegenian sandstone occurs within the

Lowstand to Transgressive System Tracts. These sandstones are interpreted to be fluvial-deltaic sediments. They are generally thick and laterally continuous

4. Emsian-Efeilian: This sequence is divided into LST, TST and HST. The TST is usually absent. The HST corresponds to the Efeilian shale which directly lay the TST.

5. Givetian-Frasnian-Famenian: This sequence contains mainly transgressive to highstand sediments. The transgressive to highstand shales provide the best regional top seal for the Lower Devonian and Ordovician reservoir in this basin.

In light of the results of developing a sequence stratigraphic framework for the Palaeozoic sediments in the Ahnet-Timimoun basin, the best reservoirs are found in the Lower Devonian sequences. These reservoirs were deposited in Lowstand fluvial deltaic systems, Lowstand incised valleys, and Highstand progradational deltaic/shoreface systems.

Within the Gedinnian, the best reservoirs sandstones are present in the eastern portion of the Ahnet subbasin, eastern and central part of the Timimoun basin. Reservoirs properties and net sandstones thickness generally decrease to the west and Northwest.

The Siegenian-Emsian sandstone reservoir occurs within the Lowstand to Transgressive System Tracts. These sandstones are interpreted to be fluvial-deltaic sediments. They are generally thick and laterally continuous. The reservoir is restricted to the northern part of the basin. The Emsian/Efeilian reservoir is more restricted and localised along the axis of the basin

Lesser quality reservoir rocks are found in the upper Ordovician (the Asghill sequence). Particularly, the highstand progradational shoreface sandstone and the fluvio-glacial sandstones. The lower Ordovician "Hamra Quartzite" appear to have only limited potential.

The Carboniferous reservoirs are patchy and of poor quality. The sandstone reservoirs are present in the Strunian and Tournaisian which produced gas (in one well TC-1). Thicker and widespread Emsian, Efeilian and Frasnian marine shales are the regional top seal for Lower Devonian reservoirs.