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Carbonate Sedimentation and Stratigraphy of the Middle Miocene of Siwa Oasis, Egypt

A. El-Shishtawy

Geology Department, Faculty of Science, Tanta University, Tanta, EGYPT

ashishtawy@tanta.edu.eg

Fax: 2-040-3350804

Mobile: 2-0122835854

Siwa oasis is located in the Western Desert of Egypt between longitudes $25^{\circ} 05'$ and $26^{\circ} 18'$ E and latitudes $29^{\circ} 05'$ and $29^{\circ} 24'$ N. The oasis is surrounded to the north by the Middle Miocene limestone plateau and from the south by the Great Sand Sea (one of the greatest expanse of sand dunes on earth). The oasis is laying 12-18 meters below sea level and has a surface area of over 800 Km^2 (309 sq mi). Siwa's location in this depression features permanent lakes. Siwa oasis as a whole depended on springs that originated along faults and fractures through shales and chalky limestones of Middle Miocene age. Large number of natural springs (about 146 springs, many of which are very saline) and more than 1000 wells are present in the Siwa area.

Tectonics and subsequent water erosion are the primarily responsible agents for the formation of Siwa depression. During (or shortly after) the middle Miocene uplift, hinge faulting and rejuvenation of old faults occurred in the basement rocks underlying the Miocene sediments. These faults resulted in sags and down warps of the overlying Miocene succession producing this tectonically controlled depression. Sedimentation was also affected by tectonic oscillations and gentle warping in the infrastructure. This resulted in many features including submarine erosion, lateral and vertical shifting of depositional environments and variation in thicknesses and fabrics from place to place. Most of the sediments exposed in the Siwa area are carbonates which belong to two formations: an upper, entirely marine middle Miocene "Marmarica Formation" and a

lower Miocene "Moghra Formation". The Middle Miocene represents the main aquifer in the area and has a thickness of about 125m. These deposits are mainly represented by alternating limestones and claystones. The limestones are light grey to cream, soft to medium hard and sandy in the most. The claystones, on the other hand, are green to slightly buff in color and mainly soft, with anhydrite inclusions. The water-bearing limestones are characterized by the occurrence of fissures and channels resulting from solution action.