Hydrogeological Aspects and Environmental Concerns of the New Valley Project, Western Desert, Egypt, with Special Emphasis on the Southern Area

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ABSTRACT / The New Valley Project has been given much attention in the past 20 years especially from the hydrogeological point of view concerning groundwater utilization for the reclamation of a large area of the Western Desert. Lithological, petrophysical, and petrographical studies were conducted on four wells south of Beris Oasis, namely Beris 20, Beris 15, Beris 14, and Beris 13, and are defined by latitudes 24°25′E and 24°35′E and longitudes 30°30′N and 30°46′N. The Nubian sedimentation is of Posttectonic deposition that took place over the uplifted Precambrian granitic basement and is Lower Cretaceous, whereas the upper most variegated shales of the cap rock are Upper Cretaceous. The Nubian sandstones in the area south of Beris Oasis contain hematitic stains and/or fine granular authigenic hematite, thin laminae of brown ferruginous quartzite is also recorded denoting oxidizing conditions in the basin of deposition. Thin streaks of carbonaceous shales are met with in different depths to the south of Beris area, may be taken to denote oscillations in the sea level and accordingly its depths, and are responsible for the change in the oxidation-reduction potential during the deposition of the corresponding beds.

Lithologic logs were interpreted together with the electric and micro-logs for adjustment of the shale breaks and showed that there are five water-bearing zones, named from bottom to top: A, B, C, D, and E, and are mainly unfossiliferous orthoquartzites, separated from each other by impervious beds of siltstones, shales, and clays of varying thicknesses. This zoning had been found valid in other parts of the Kharga Oases and could be applied locally in the Kharga Oases area. Mechanical analysis was performed mainly on 39 samples, of which 18 were core samples and 21 were cuttings, that were raised from four wells dug in the area south of Beris Oasis, Kharga Oases. Porosity and permeability tests were carried out on the 18 core samples only. The implication of these data on the environment of deposition of the Nubia Sandstone is discussed.

Petrographic examination of a thin section of the subsurface Nubia sandstones in the South of Beris Oasis showed that the lithified rocks fall into three types depending on the nature of cement being, silicious or ferruginous, and on the amount of primary matrix, which at present is reorganized into iron oxides, microquartz, and muscovite flakes, thus reaching the phyllomorphic stage of diagensis. Rounding of the quartz grains shows that transportation had a minor effect on the grain morphology and favor a fluvial transporting agent.

Introduction

Surface and subsurface water resources were taken into consideration by the Egyptian government in 1959, for improving the standard of living of the individuals. A 10-year pilot plan that began in 1960 was submitted to double the national income by exploiting the water of the High Dam which was expected to increase the cultivated land up to 1.2 million feddans (acres) and transfer the old seasonal irrigation system in Upper Egypt to a permanent one. It was previously estimated that the Nile River is recharged by the groundwater reservoir by approximately 137,000.00 m³/day but the amount is supposed to be reciprocally discharged from the Nile River through the Nubia sandstone after the construction of the High Dam and the consequent increase of the water level up to 180 m above sea level in the Nasser Lake.

In April, 1959, the General Desert Development Authority (E.G.D.D.A.), was constructed for the exploitation of the groundwater resources in the depressions of the Western Desert of Egypt, (New Valley Project) which, comprises South Kharga, Kharga, Dakhla, Farafra, Bahariya, and Siwa Oases, of a total approximate area of 90,000.00 km².

The groundwater reservoir extends over the Libyan and north Sudanese Sahara and varies in thickness from 400 m in the South of Kharga Oases to 800 m in Kharga Oasis, 1600 m in Dakhla Oases, 2000 m in Bahariya Oases and up to 1500 m beneath Kattara depression (Fig. 1).

Two major fault systems were identified in the Kharga Oases, one fault extends from the NW of Um-Qusur to the vicinity of Garmashine and Passes near the village of Kharga. The second fault follows a line roughly parallel to the Thebes plateau escarpment, (LaMoreaux and others 1985).

Rainfalls on the High Mountains: Eredi, Tibisti, Enedy, and North Chad are the main sources of the Nubia groundwater reservoir, and its age is approxi-
water bearing strata, the origin, the direction, and reservoir of the nearby areas will increase accordingly. The Project of Quattara depression, where the Mediterranean seawater fills to a level of 80 m subsea, is executed. The water pressure of the groundwater reservoir of the nearby areas will increase accordingly.

Hydrogeological studies were found essential for revealing the hydrogeological characteristics of the water bearing strata, the origin, the direction, and factors affecting the groundwater reservoir and hence the annual recharge. Such studies defined the policy of drilling programs (spacing, drilling depths, permissible amounts of discharge, etc.). Petrophysical and petrographical studies conducted mainly on core samples raised from some water wells as well as its implication on the environment of deposition also gave useful data.

The basement complex of mainly granitic rocks underlies the Nubia sandstone. The regional magnetic surveys of the Western Desert outlined areas of relief on the basement surface to the South of Kharga Oases which might strongly affect the flow of water in the region and could prohibit the flow of water into the oases from the Nile water northwards (Fig. 2). According to geophysical and geological evidence, another basement ridge runs from Abu Bayan in SW direction towards the Oweinat Mountains.

The chemical analysis showed that the direction of groundwater flow in Kharga Oases is from the south and west and that of Dakhla Oases is from SW.

Subsurface Geology of the Nubia Sandstone in South of Beris Oasis, Kharga Area

The Kharga Oases of the Western Desert of Egypt form a depression lying about 200 km to the west of the Nile Valley between latitudes 24° and 26°N. It forms the eastern portion of an immense natural excavation, the northwestern portion of which is occupied by the Dakhla Oases.

The Kharga depression is located on an anticline, its main axis extends north and south and coincides with a major fault that coincides with its main road. Local folds are also found and coincide with the local surface structures of the eastern scarp. The Dakhla depression is located on a major syncline, its axis passes through Mout Village and might include several minor folds plunging to the northeast.

The following lithological, petrophysical, and petrographical studies are found necessary for solving the hydrological problem of the New Valley Project; Four wells in the south of Beris Oasis were selected in the areas namely: Br. 20, Br. 15, Br. 14, and Br. 13 and were defined by latitudes 24°25'E and 24°35'E and Longitudes 30°30'N and 30°46'N (Fig. 3).

Lithology:

Lithology and zonation of the subsurface fresh water bearing Nubia sandstone is given below and is based on the study of ditch and core samples.

Shukri and Said (1944) studied the Nubia sandstones in the Eastern Desert of Egypt and found that a bed of carboniferous black shales, sometimes with plant remains, separates the oil bearing Nubia sandstones in the Ras Gharib oil field into Lower Carboniferous beds that rest over Precambrian rocks and upper parts that are presumed as Lower Cretaceous. The age of the uppermost variegated shale (cap rock) may be determined depending on the Upper Phosphate Maestrichtian bed and hence its age of Upper Cretaceous. A complete plant fossil preserved in a carbonaceous shales bed was found in a core samples taken from El Zayat water well no. 2 at a depth of 690 m and was palaeontologically examined and was attributed to the Lower Cretaceous age.

The Nubian sedimentation, which is of Posttectonic deposition, took place over the uplifted basement whereas, the cap rock constituted the upper most series. The Pretectonic deposition is eliminated as it considered Abu Bayan Formation to constitute the oldest series of the Nubia sandstone outcropping south of Beris Oasis and the Tarif Formation to constitute the youngest series outcropping north of the Kharga Oases whereas the cap rock comprises different beds which belong to different ages. It might be mentioned that the granite rock outcropping in the Abu Bayan area south of Beris Oasis is of different specific gravities as the coarse granite in the middle gives a minimum gravimetric value and the fine grained granite in the Periphery gives a maximum value, which thus excludes the old concept of a weathered granite.

Five water-bearing zones intercalated by local impermeable shaly beds, were encountered using electric log correlations in the south of Beris Oasis (Fig. 4).

There is no indication for the presence of muscovite flakes or Pyrite concretions in the impervious cap rock (only present further to the north). It shows reddish to violet colors indicating oxidizing conditions