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FULL LENGTH ARTICLE

Effect of flooding on distribution and mode of transportation of Lake Nasser sediments, Egypt

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Abstract Sediment samples have been collected from Lake Nasser during drought and flooding periods to study the effect of flood season on bottom sediment distribution and mode of transportation. Ten sectors with three sites in each sector were chosen from upstream of Aswan High Dam to Adindan. The study showed that Lake Nasser sediments are heterogeneous and are mainly silty clay and clayey silt. Eastern and western sides of the lake include more sand. Depth controlled distribution of grain size (deeper is finer). Sands increase with the starting of the flood season. During drought periods suspension was the most predominant mode of transportation; i.e. sediments transported by a medium of considerable density. During flooding period siltation and suspension were most predominant modes of transportation; i.e. environment with a high energy, various overlapping processes, and variety of depositional environments. C–M diagram indicates that sediments during drought periods behaved as pelagic suspension in which sediments settled from a suspension in stagnant water, rolling; overbank facies suspension and uniform suspension were of less importance. During the flooding period there was no clear trend for studied sediments of pelagic suspension; rolling, graded suspension, overbank facies suspension, suspension, and uniform suspension were widely distributed.

Introduction

Many factors control sedimentation in the High Dam Lake such as annual effective base level for each flood, distribution and characteristics of rocky islands, the valley Lake bends, the old river terraces, and the plankton induced deposition, water discharges especially during flooding periods, sediment loads and their gradation. During high water level the influence of these factors can be exemplified by the large scale sediment deposition at the lake entrance, while during a lower water profile sediments would mainly deposit further downstream (Aboul-Haggag; 1977; El-Manadely et al., 2002). At lake entrance (Gomi and the Second Cataract (Abca)) silt layer was 17 and 20 m respectively. Further downstream it was 2 m at Adindan and 1 m at Abu-Simbel within Lake Nasser (Aboul-Haggag, 1977; El Dardir, 1984, 1987). 90% of deposited sediment between 1964 and 1998 is within the Sudanese side of the reservoir (El-Manadely et al., 2002). Hafez (1977) stated that some microorganisms act as filtering organisms in

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the reservoir which feed on finer materials suspended then digest the organic content in the fine materials and coagulate the suspended particles to bigger droplets. These filtering organisms are believed by Entz and Latif (1974) to be the main reason for the turbid water not reaching the northern section of the reservoir.

Before the construction of the Aswan High Dam the sediments discharged into the Mediterranean Sea, and quantity of these sediments greatly increases at the beginning of Nile flood. Since 1964, this amount of sediments has been held in the Aswan High Dam Reservoir (Hurst, 1952). Aswan High Dam acts as a good trap by which; under normal conditions; only the finest fractions of the suspended load are transported to the downstream. During the flood season 98% of the annual sediment load occurred; (2% in July, 45% in August, 38% in September, 12% in October, and 1.5 in November), Quelennec and Kruk (1976).

Different methods are widely used for determining the source material of sediments, as well as the environment and dynamics of their transport and deposition such as: grain-size distribution (Mycielska-Dowgiao and Ludwikowska-Kędzia, 2011; Woronko, 2012; Farhat, 2013), rounding and surface morphology of quartz grains in sand and silt (Mycielska-Dowgiao and Woronko, 2004), the petrographical composition of the light minerals (Mycielska-Dowgiao, 1995, 2007; Woronko et al., 2013), and composition of heavy-mineral assemblages (Marcinkowski and Mycielska-Dowgiao, 2013). The joint analysis of all previous textural features is the best method for determining the environment and dynamics of their transport and deposition as well as the source material of sediments. Each of them provides its own information, which supplements the other data. (Morton et al., 2013; Wachecka-Kotkowska and Lu-dwikowska-Kędzia, 2013).

Distributions of gravel, sand and mud fractions are used as good indicators for studying of all textural properties of deposits. Different interpretations of grain size distributions led to numerous discussions (e.g. Friedman and Sanders, 1978; Mycielska-Dowgiao, 2007; Flemming, 2007; Hartmann and Flemming, 2007; Szmańda, 2007; Weltje and Prins, 2007; Mycielska-Dowgiao and Ludwikowska Kędzia, 2011). Grain size depends on several factors such as: transport processes, the sedimentation conditions and transport related features,

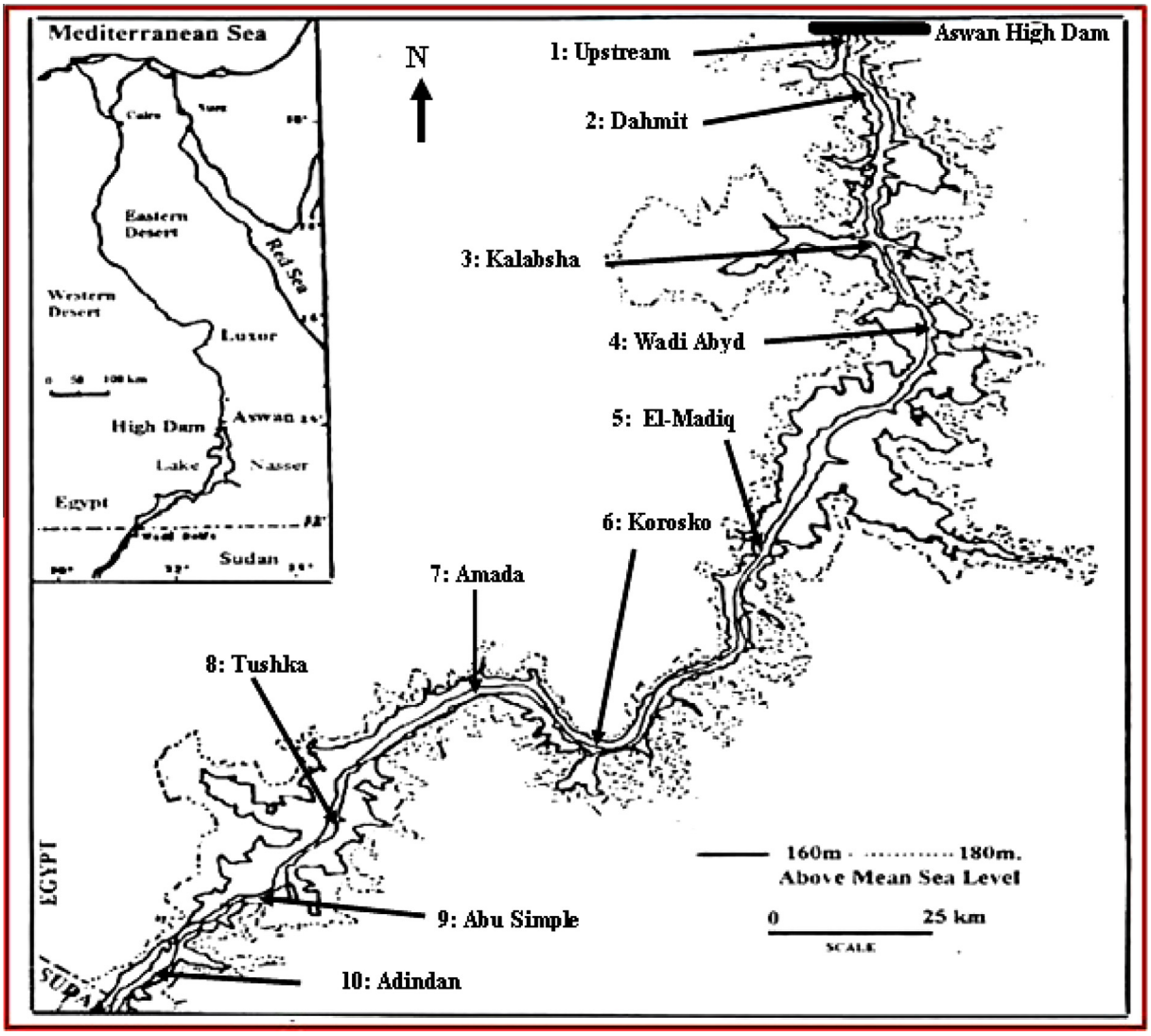

Figure 1 A map showing sampling sites of Lake Nasser (General location of Lake Nasser in Egypt is shown in the top left corner).