RAPID CHANGES IN THE SEDIMENTARY REGIME FOLLOWING THE DAMMING OF THE NILE: INNER SHELF OF THE DISTAL PART OF THE NILE LITTORAL CELL, ISRAEL

Ahuva Almogi-Labin [1]*, Barak Herut [2] and Amir Sandler [1]
[1] Geological Survey Of Israel, Jerusalem, 95501, Israel - almogi@gsi.gov.il
[2] Israel Oceanographic and Limnological Research, National Institute of Oceanography, Haifa 31080, Israel

Abstract
In the past the Nile floods transported large quantities of fine-grain sediments and nutrients at the end of each summer to the inner shelf of Israel which is part of the Nile littoral cell. In order to determine the influence of the damming of the Nile on the sea floor 9 short cores (~30cm) were taken at ~40m in a S-N transect. The sediments, dated by Lead-210, significantly coarsen in the post-Aswan High Dam period with 5-10 times increase in >63μm size fraction, ~50% increase in $CaCO_3$, ~50% decrease in total organic carbon and ~2.5‰ decrease (-19.5 to -22) in δ^{13}Corg. These parameters indicate a rapid and large scale change in the sedimentary regime and increasing oligotrophy during the last ~40 years, with far reaching implications for the future of the southeastern Mediterranean.
Keywords: Continental Shelf, Nile Delta, Eastern Mediterranean, Sediment Transport

Introduction
The southern inner shelf of Israel is located in the distal part of the Nile littoral cell. Until recently most of the sediments in the 30-50m silt belt [1] were derived from the Nile floods that reached the Israeli coast at the end of each summer by the alongshore northward current [2]. During the last century a series of dams were built along the Nile and since the operation of the Aswan High Dam almost all the discharge to the southeastern (SE) Mediterranean stopped, including ~10^7 tones/y of fine sediments [3]. This completely changed the hydrological and biological regime in the SE Mediterranean turning it into a hyper-oligotrophic sea. In this study we intend to characterize the consequences of the shut down of the Nile River discharge to the SE Mediterranean and examine the post-Aswan High Dam sedimentation pattern in the middle part of the inner shelf of Israel, an area which is considered to be highly affected by these recent man-made changes.

Material and Methods
Nine short cores were sampled along ~160 km of Israel inner shelf from off Ashqelon in the south to off Acre in the north. The sediments were taken from the silt belt at 35-40m water depth, an area most sensitive to changes in Nile River discharge [1]. The sediments were cut into 1 cm thick slices, lyophilized and then analyzed for granulometry, clay mineralogy, major and trace elements, $CaCO_3$ and total organic carbon (TOC) content and δ^{13}Corg. Chronology was determined in three cores using Lead-210.

Results and Discussion
The inner shelf of Israel is an integral part of the Nile littoral cell and is located on its distal part under the affect of the alongshore northward current [4]. In the past, this current transported Nile derived nutrients and fine sediments to the Israeli coast [2]. The sediment regime of the inner shelf is expected to directly record changes in Nile discharge resulting from its damming during the last century. The top ~10 cm, which accumulated during the last ~40 years are significantly coarser than the underlying pre-Aswan High Dam sediments. The sand content exceeds 60% in post-Aswan High Dam compared to <10% in the pre-Aswan High Dam sediments (Fig. 1). Grain size mode increased gradually from ~5μm in the pre-Aswan High Dam to ⩾85μm in the post-Aswan High Dam sediments. Silt fraction, comprising ~75% in the pre-Aswan High Dam sediments decreased to ~45% in the post-Aswan High Dam sediments and clay content decreased by ~50%, from ~20% to <10%. The coarsening in grain size is more abrupt and rapid in the southern shelf, closer to the Nile, than in the northern distal part. In the later, the coarsening starts earlier, is more gradual and increases in two steps apparently as a response to an earlier stage of damming of the Nile that was hardly recorded in the southern shelf.

Sediment coarsening is also accompanied by a distinct but moderate increase in $CaCO_3$, from less than 10% to 15-20% in the southern shelf and to ~80% in the most distal northern part. TOC content of 0.8-1wt.% with δ^{13}Corg of about -19.5‰ in pre-Aswan High Dam sediments decreased to less than 0.5wt.% TOC and about -22‰ δ^{13}Corg in the overlying younger sediments. The decrease in these variables reflects a major change in the regional nutrient budget and a major decrease in primary production that coincides with the damming of the Nile [3]. The trend of increasing oligotrophy in the inner shelf of Israel differs from recent reports on a major anthropogenic contribution of nutrients that supports increasing fishery in the Mediterranean coastal waters off Egypt [5]. This increase in fertility seems to be of local scale restricted mainly to the delta area, unlike the pre-Aswan High Dam summer floods that were of significant and large magnitude and affected annually the Israeli shelf.

The decrease in TOC and δ^{13}Corg, indicators of nutrient supply and primary production, predates the sharp sediment coarsening. This may indicate that earlier phases of Nile damming had already contributed to the increasing oligotrophy of the SE Mediterranean, which accelerated after the operation of the Aswan High Dam.

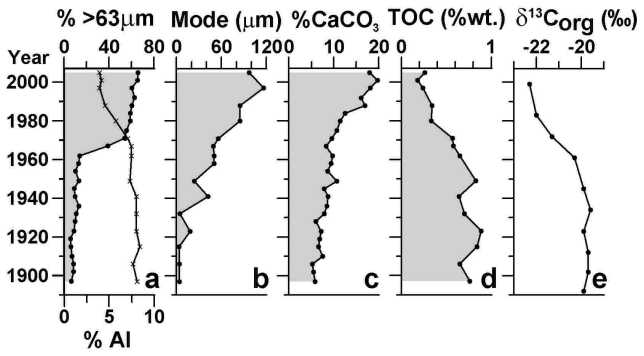

Fig. 1. Sediment dynamics in the last ~100 years at the distal part of the Nile littoral cell (southern shelf of Israel): (a) % >63μm size fraction (circle) and % Al (x); (b) Grain size mode (μm); (c) % CaCO3; (d) TOC (wt.%); (e) δ^{13}Corg (‰). Note that the major change in the sedimentation pattern coincides with the operation of Aswan High Dam at 1965

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