GEOMORPHOLOGY OF FOSSIL SPRING MOUNDS NEAR EL GEDIDA VILLAGE, DAKHLA OASIS, WESTERN DESERT OF EGYPT

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Abstract

Quaternary fluvio-lacustrine deposits in the currently arid Egyptian desert can be used as indicator for the pluvial phases in the Sahara and a record of climatic change. Some fossil springs formed from tufa deposits were found along the edge of the Libyan plateau scrap in Dakhla Oasis, Egypt. At least eight major episodes of fossil spring mounds were discovered near El Gedida village, Dakhla Oasis, most of tufa mounds were deposited as a part of fluvial system, characterized by terraced, vegetated pools and accumulated tufa dams and separated by low waterfalls.

This paper depending upon geomorphologiacl, sedimentological and remote sensing methods, in addition to extensive field surveying, mapping and sampling for C12, C13 and C14 AMS dating, to develop a Pleistocene climatic chronology as paleo spring mounds are particularly amenable to AMS dating techniques for both tufa sediments as well as current spring hot water to define the sources of its acidify-gas water, for more understanding of the desert pluvial events, and the time of human migration from this area of the western desert of Egypt, and finally it would also help to define water sources of the current hot springs and whether renewable sources or is it an ancient fossil water.

Key words: Spring mounds, Fossil spring, Sahara, The Quaternary, Dakhla Oasis, Western Desert of Egypt

1. Introduction

El Gedida village situated in the NW portion of Dakhla depression, it occupies a deep wind-ablated but stratigraphically controlled depression to the south of the Libyan Plateau escarpment in the Western Desert of Egypt (Fig.1). The current climate is hyperarid, with the region averaging 1mm of rainfall per year (Vose et al., 1992).

1.1. Objective

This paper aims to explain the current geomorphic characteristics of some spring mounds fields as well as define chronological evidence of its paleo karst formation,

1.2. Previous work

The first exploration of the paleo spring mounds in the Dakhla and Kharga Oasis's in the western desert of Egypt began in the early nineteenth century by the paleontologist on the Rohlfs expedition in1873-1884 (Zittel, 1883) ; by (Bagnold,1931,1933,1939; Caton-Thompson and Gardner, 1932; Caton-Thompson, 1952; Gardner, 1932,1935; Peel,1941; Sandford, 1933 a,b.); (Butzer and Hansen, 1968) reconstructed a late Cenozoic chronology of Kurkur Oasis, SSE of Dakhla Oasis for about 400 km, but (Ball, 1990) wrote the first description of tufa as fossil spring deposits; followed by (Brookes, 1993) produced a research on the geomorphology and Quaternary geology of Dakhla Oasis region.

.2. Regional setting

El Gedida village is situated on the southern margin of Dakhla Oasis. Some eroded spring mounds were found separated near sandstone crust, weathered into blocks and partly moved down slope as talus. Numerous mounds distributed in the lowland embayment are east and west of the dividing ridge related to sandstone-mudstone contact, its heights range between several meters to 20 meters, and its shapes are spherical, conical and dome shape.

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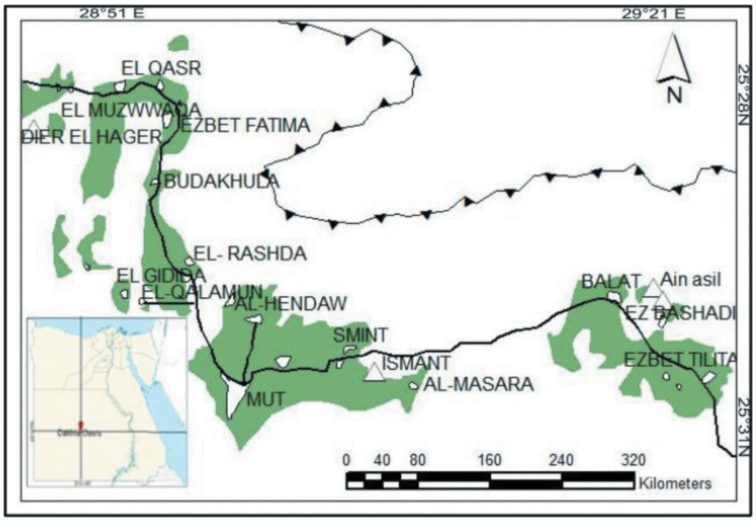

Fig.1: Settlements of the study area

2.1. Location

Dakhla Oasis is one of a chain of structural depressions in the Western Desert of Egypt, it's lactated (latitude 25.5°N, longitude 29.0°E) elongated 70 km from SE to NW, with maximum N–S dimensions of 20 km. The depression is bounded within the 140 m contour; current climate is very arid receiving a mean annual rainfall of 0.7 mm and potential evaporation of about 2500mm, but during the Quaternary climatic conditions across Libyan desert have sequenced between arid and humid (or pluvial), as indicated by lacustrine, fluvial and spring-deposited sediments preserved (Smith et al., 2004) (Fig. 1 &2)

2.2. Geology

The Quseir and Dauwi formations, the local members of the Nubian Sandstone Aquifer System NSAS, is two of a series of sandstone units, which extends through portions of Egypt, Libya, Chad, and Sudan, it consists of flaggy sandstone containing freshwater gastropods, plant, vertebrate remains and glauconitic sandstone overlain by white limestone and greyish marl with ammonites (Katherine et al., 2010 & Conoco,1987) (Fig. 3)

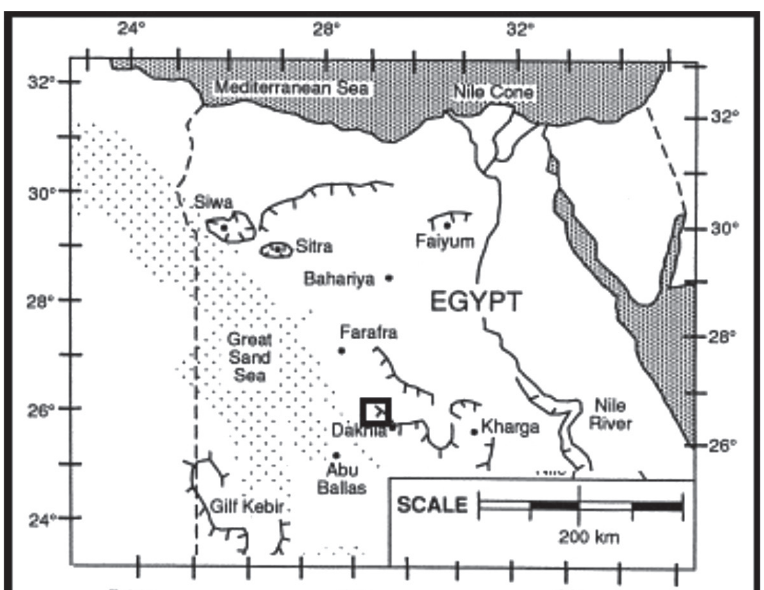

Fig.2: Location map

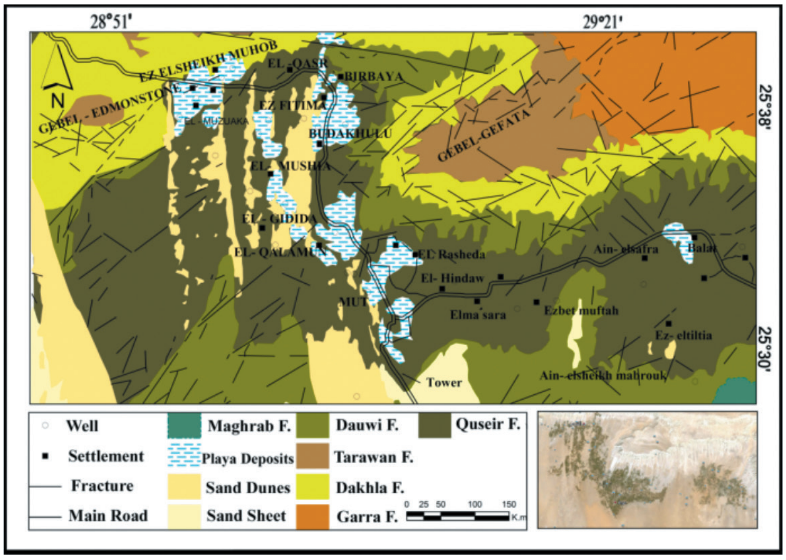

Fig.3: Geological map of northern portion of Dakhla depression (After: Conoco, 1987)

2.3. Geomorphic units

The major geomorphic units of the study area interpret the following landforms and Quaternary sediments units: (1) Libyan Plateau situated above Dakhla basin between 450-500m asl, it's gentle deep to the north and it composed of Paleocene limestones, (2) North Dakhla Scarp and Piedmont: it is free face sharp scarp, it's height is approximately 200 m, it cuts in Dakhla formation shales, limestone and shale colluviums. The Piedmont superimposed with bajada gravels, sand sheets and dunes, and cuts by gullies (3) Eastern & Western Dakhla basins: It is low lands, but the western one is lower than the other, 92-121 m asl, that is remains of ancient lake. Ground water under both basins were used during historic times to Old Kingdom ±2200B.C. and latter settlements (Brookes,1993). Some fossil spring mounds separated on the paleolake shores (4) Sand dunes & Sand sheets separated on the Libyan plateau, scarp, piedmont and basin floor, it is moves from NW to SE direction (5) Sculpted surfaces (6) Fossil springs mounds on the paleolake shores (Fig. 4).

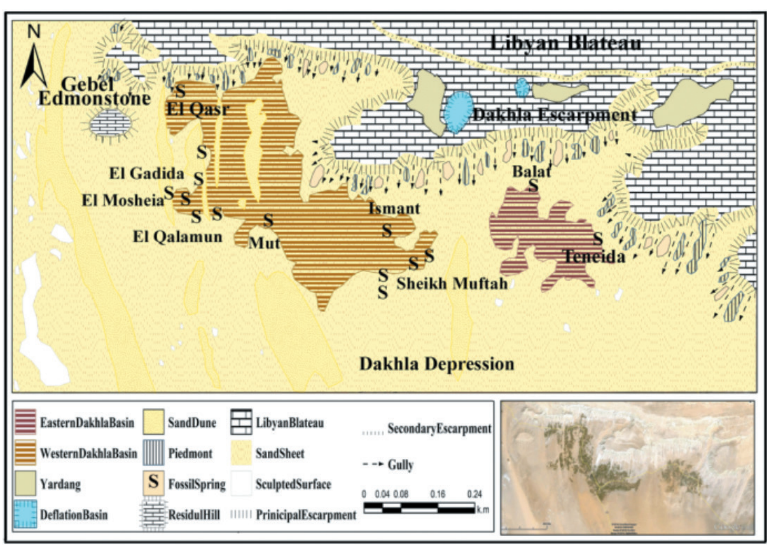

Fig.4: Geomorphological units of the study area

2.3. Human Occupation of Dakhla Oasis during the Mid-Pleistocene

Human occupation of Dakhla depression were developed starting from the Mid-Pleistocene, some geomorphic and archaeological evidence were found in some sites, and also associated with the lakebeds and its shorelines These indicate that Mid-Pleistocene people used freshwater supplies from available springs during this time (Smith, et al., 2008), (Fig.5).

3. Methods

This paper depends upon use geomorphological, sedimentological and remote sensing methods, especially field geomorphic mapping and surveying of mounds parameters, soil profile sampling and sediments analysis in addition to carbonate dating, and most mounds were digitally photographed using GPS and mapped by GIS techniques. The C12 and C13 AMS dating results will help for reconstruction the Quaternary chronologies of this part of the Libyan plateau scrap in Dakhla Oasis, as well as to estimate the age of the groundwater flowing to determine the possibility of renewal it at the current time.

4. Results

Some fossil spring mounds at Dakhla paleo lakes shorelines observed, surveyed and its sediments were sampled in the field during 2011 and 2012. The spring mounds are approximately between 5.7-7.9 m high, 6.5-14m diameter, its eroded mounds appear as circles and ellipse shapes (Tab.1, Fig.5: 7)

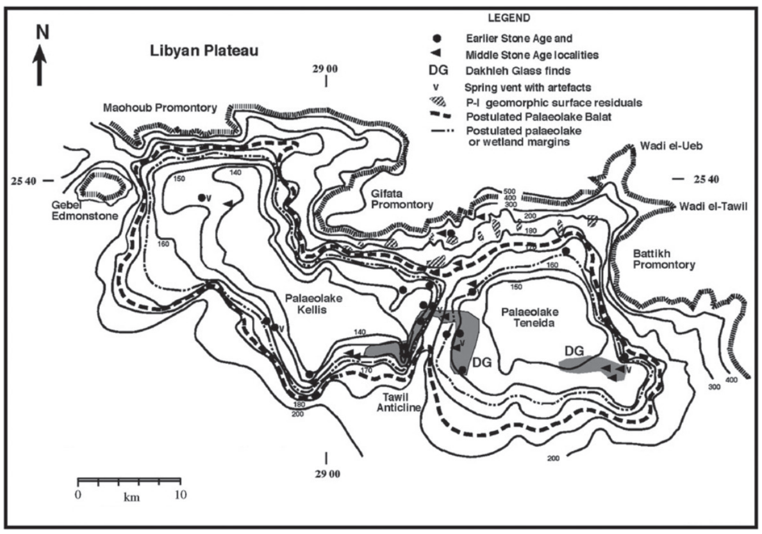

Fig.5: Paleo lakes of Dakhla depression (After Smith et al., 2008)

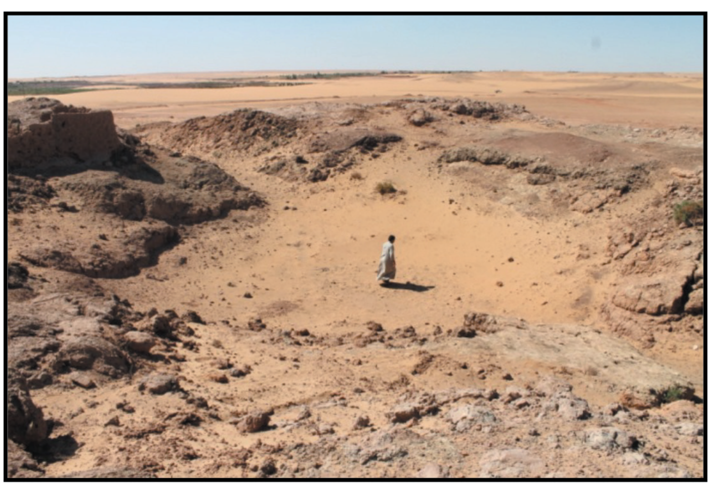

Fig.6: Eroded vent of fossil spring mound S El Gadida for about 3km

Fig.7: Fossil spring mound near El Qalamun

4.1. Soil samples description and dating

Subsurface sediments samples were collected from each of 10 fossil spring mounds, because they provide information about grain size analysis (Fig.8), age and conditions of spring flow (Tab.1).

The results of grain size analysis of selected fossil spring mound's sediments show that most of it consists of fine grain size of mud or silt (> 0.63 mm), specially in E El Qalamun1,NW El Gadida and E El Qalamun3, as indicator of slight paleo spring discharge. But most of the other two mounds consist of very coarse sand (1mm) as indicator of increasing paleo spring water discharge (Fig.8).

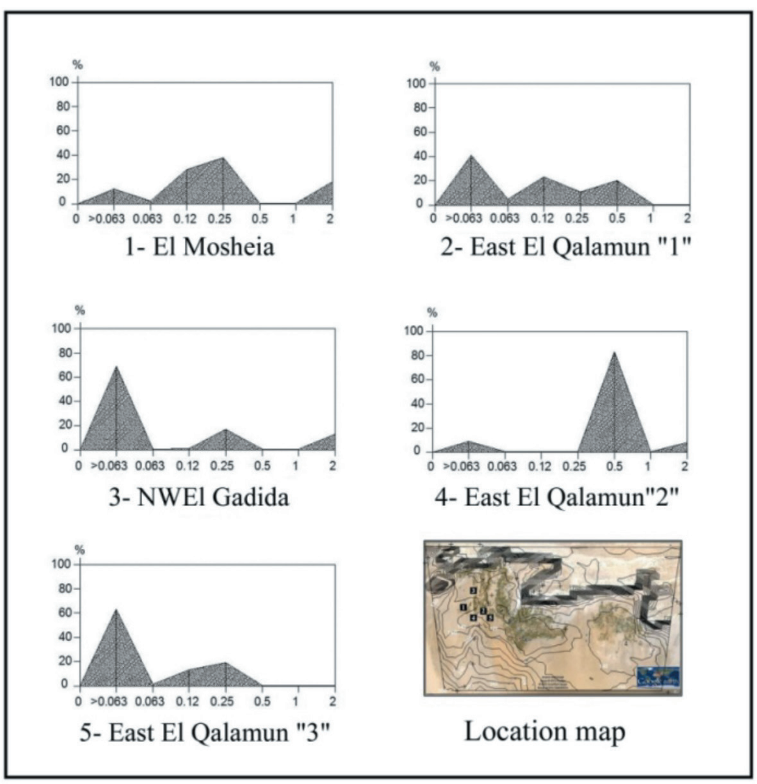

Fig.8: Grain size analysis of selected fossil spring mound's sediments

Tab.1: Characteristic and age of studied fossil spring mounds

#	Location	Long	Lat	Level (m)	High (m)	Diameter (m)	Morphological remarks	Age (ka)
1	El Mosheia	28° 51` 152‟ E	25° 37` 064‟ N	122	6.8	13	Eroded vent	86±3
2	NWof El Gadida	28° 53` 368‟ E	25° 33` 499‟ N	112	7.3	12	Water flow	91±4
3	East of El Qalamun"1"	28° 55` 737‟ E	25° 31` 927‟ N	113	7.9	11	Paleo channel	101±4
4	East of El Qalamun"2"	28° 55` 891‟ E	25° 32` 017‟ N	112	6.9	14	Paleo channel	108±5
5	East of El Qalamun"3"	28° 55` 279‟ E	25° 32` 265‟ N	120	6.5	6.5	Paleo channel	112±7
6	SWof Sheikh Muftah	29° 07` 350‟ E	25° 29` 774‟ N	133	7.1	10.8	Eroded	111±7
7	Sheikh Muftah "2"	29° 07` 258‟ E	25° 29` 676‟ N	137	6.3	11	Paleo channel	109±6
8	Sheikh Muftah"3"	29° 06` 950‟ E	25° 30` 854‟ N	136	5.7	14	Eroded	121±9
9	Balat	'16 29° E"196	'33 25° N"371	130	5.8	11	Eroded	108±5
10	Tenieda	'20 29° E"931	'30 25° N"294	127	6.1	15	Eroded	109±6

The results of AMS dating of the fossil spring mounds samples reveal two major age groups (86-101 and >108 ka), that correspond, with one exception, to the field groupings of spring mound on the paleo lakes shorelines (Eastern and Western Dakhla lakes). These results are presented in (Tab. 1). Ten samples of the mounds were analyzed and yielded ages ranging from 86+3 ka (El Mosheia) to 109+ 6 ka (Tenieda).

4.2. Current ground water dating

One water sample has been collected from current hot acidify-gas strip spring at Mut city (well #3), Dakhla depression, it was analysis by AMS[1] . The result of dating show that the measured age is 23430 ± 100 BP, it means that the spring water source is non-renewable fossil water due to pluvial phases of the Pleistocene, but later than the measured fossil spring mounds (its age between (86-101 and >108 ka), it means that mounds is older than the current hot spring water and forms during other pluvial phase during the Late Pleistocene.

5. Conclusion

Some fossil spring mounds found near El Gadida village, in the NW portion of Dakhla depression, they were produced by regional discharge during some pluvial phases during the Pleistocene, at least two fossil mounds recorded the largest discharge were deposited near El Mousheia and east El Qalamoun

[1] Dating by Beta Analytic, Miami branch, USA: Measured age, 13C/12C, conventional age, 2 SIGMA.

villages .The oldest fossil spring sediments are too old to be dated by C14 AMS method, its age approximately 121±9 Ka BP, but the age of current hot spring at Mut city is not more 23.43 ±0.1Ka BP, it means that it is non-renewable fossil water remained from a pluvial phase during the Late Pleistocene.

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