Towards a Better Understanding of the Modern and Paleo Hydrologic Systems in Arid Lands

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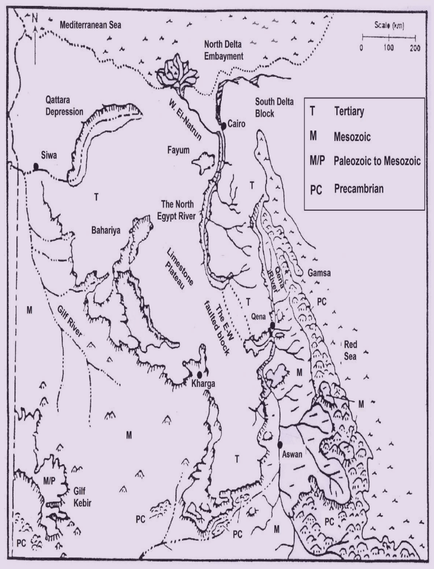
Abstract

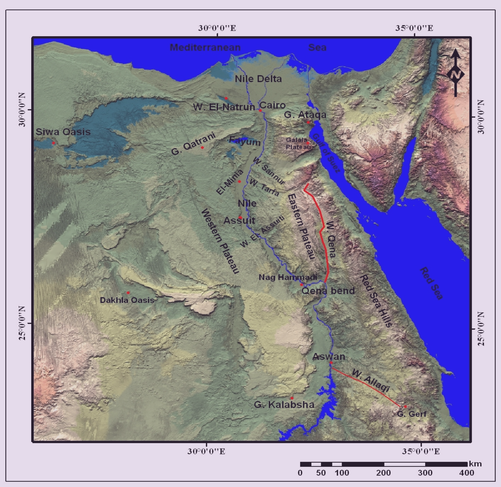
Remote sensing is the science of obtaining and interpreting information from a distance, using sensors that are not in physical contact with the object being observed. . It is a scientific technology that can be used to measure and monitor important biophysical characteristics and human activities on Earth. The surface environment of the Earth is dynamic, with change occurring on time scales ranging from seconds to decades or longer. So, Remotes Sensing is helpful to know the past, changes from the past and even use this information to predict the near future. Here we have two cases; the first case is about compilation between the previous studies about the river systems evolution and integrating them with the remotely-sensed data based landscape analysis to provide a new vision to the river systems evolution in Egypt during the Cenozoic Era; the second one is about the understanding of the structural elements control of the groundwater flow that help in detecting the suitable location for new productive wells.

Case I: Surface evidences supporting a probable new concept for the river systems evolution in Egypt: A remote sensing overview

The river systems evolution



Egypt during the Late Miocene time (modified after, Issawi and McCauley (1993)

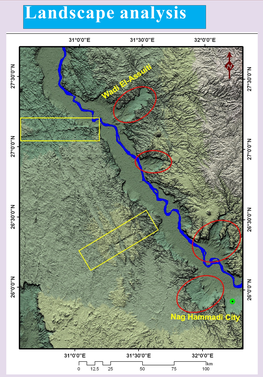


Location map showing the River Nile, Egypt

A lot of publications have been interested with the river systems evolution in Egypt e.g. Said 1981, Issawi & McCauley 1992, Said 1993 and Issawi & Osman 2008). All of these publications preferred the one system concept for the So-called Nile River system during the past geological times. Remotely sensed analysis of the relics of geomorphologic features left in the old basins related to these rivers suggest the existence of a natural dam between Nag Hammadi City and Wadi El-Assuiti. This barrier was separating two river systems during Late Miocene time: i) the Qena River System and ii) the newly suggested North Egypt River System.

Continue Case I

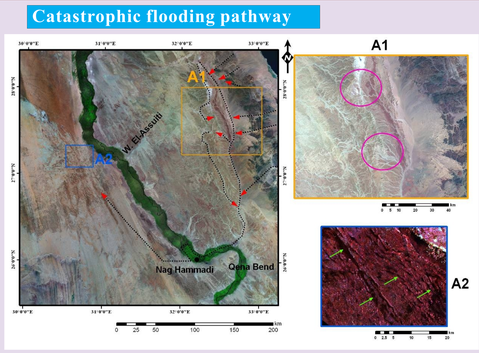
Landscape analysis



Hill shade image of the Nag Hammadi-W.El-Assuiti stretch shows the E-W faults in (yellow rectangular) and the irregular cutting paleolakes in (reddish circles).

Landscape analysis reveals three surface features: 1- Old E-W oriented faults 2- irregular cliff-bounded lakes cutting the edges of the Limestone Plateaus 3- Meandering of the Nile course indicates younger age of this part.

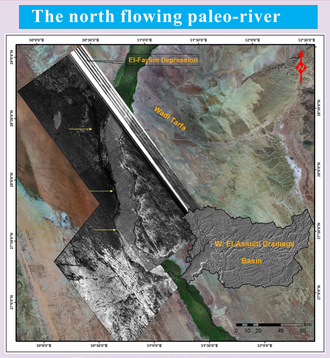
Catastrophic flooding pathway



The flow direction of the Miocene catastrophic flooding. A1: a Landsat ETM image shows the irregular pits cut by the flood (in purple circles). A2: a colored SIR-C radar image with the bands CHH, LHH, LHV shows the gravel flutes with the dark color (green arrows are perpendicular to the NW-SE oriented flutes).

The enigmatic occurrence (over the Western Limestone Plateau) and composition (fragments of chert and igneous rocks) of the gravel flutes between Sohag and El-Minia governorates enforce the water damming concept.

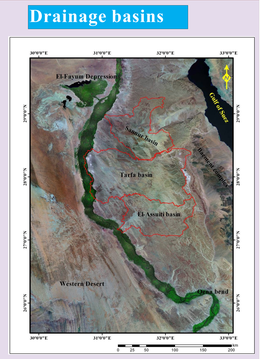
The north flowing paleo-river



A SIR-C radar mosaic covering the Nile course between Assuit and El-Minia governorates and a hill shade image of W. El-Assuiti basin, superimposed over a Landsat ETM mosaic covering the eastern and western limestone plateaus (The yellowish arrows refers to an old river passing at the foot of the western plateau).

This paleoriver may have originated as a drain of the Wadi El-Assuiti basin. The existence of the natural dam to the south of the outlet of Wadi El-Assuiti watershed drive the water flow northward across the newly suggested river system (North Egypt River).

Drainage basins

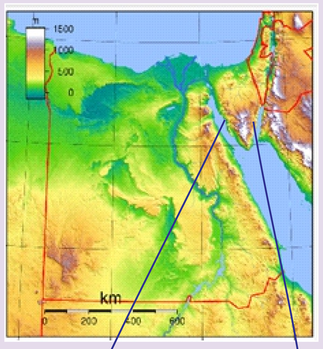


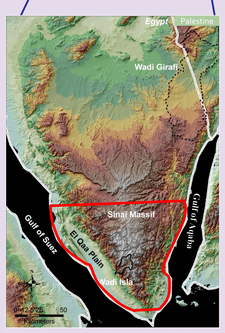
Distribution of the three main drainage basins on the Eastern Limestone Plateau.

The morphometric analyses of the drainage basins at the Eastern Limestone Plateau indicate three major drainage systems: El-Assuiti, Tarfa and Sannur drainage systems. These drainage basins accumulated the rainfalls precipitated along the Eastern Limestone Plateau and drained them westward.

Case II: Structural Controls on the Distribution of Groundwater in Southern Sinai, Egypt: Constraints froms Geophysical and Remote Sensing Observations

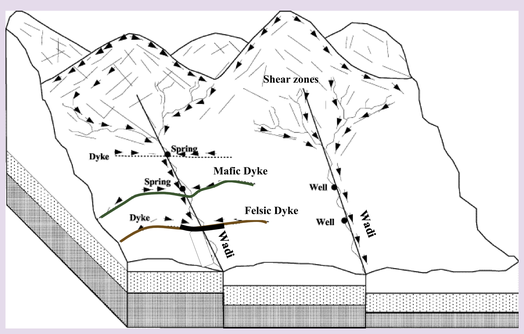
Study Area





Location map showing the study area, southern Sinai Egypt

A-Conceptual Model



Modified model of the groundwater flow in the study area using : **Field Observations** and **Geophysical Data**

B-Field Observations

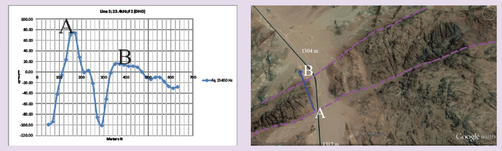
Case I:Shear zone acting as a conduit

Case II:Dike acting as a conduit

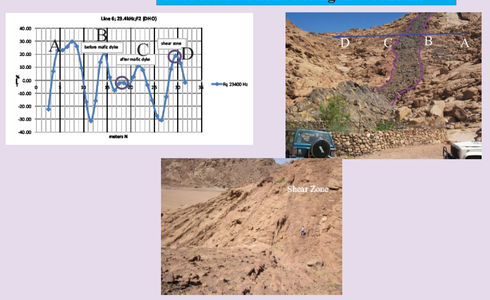
Case III:Dike acting as a dam

C-Field Geophysics (VLF)

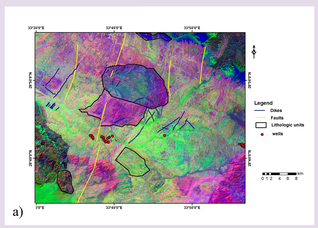
Case I:Shear zone acting as a conduit

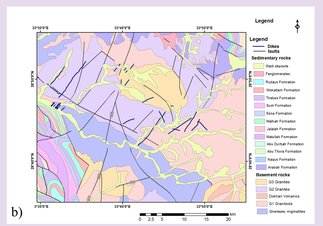


Case I:Shear zone acting as a conduit



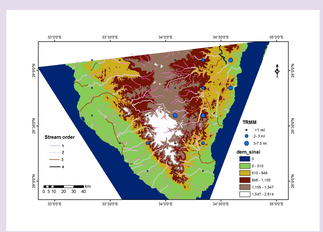
C-Use Model & Remote Sensing for Regional Application



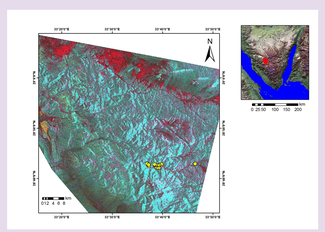


Lithologic mapping of Aster images: a)Prinipal Component 2,46, b)geologic map of the study area.

Image processing procedures (image rationing and PC) were applied for mapping geologic and structure settings. There are two main rock units; basement complex and sedimentary phanerozoic cover.Three major linament systems were delineated; NW-SE, NE-SW, and E-W.



Drainage network, and premeditation TRMM data superimposed on DEM of southern Sinai



Color composite of Envisat Asar images before and after the main rain event.

Envisat radar images have the ability to discriminate soils with the different moisture content. red color refers to soil with high moisture content, which typically located in highly sheared metamorphic rocks.

Conclusion

(1) Using integrated remote sensing data with geological observations provide new challenge for understanding the environmental conditions in the past and recent geologic time..

(2) Remotely sensing based-landscape analyses were used to analyze the surface features that have been left behind the old river system. A new river system (North Egypt Eiver) was delineated. It was flowing from south to north during Late Miocene time.

(3) The Precambrian fractured basement aquifer is controlled by fractures and dikes.

(4) The remote sensing data was used to map the lithologic and structure elements and the soil moisture before and after the rain events. Fractures: In most cases they act as channels for groundwater flow . The weathered zones along

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Acknowledgments

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Questions

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