

New Findings in the Geomorphology of Egyptian Sand Dunes

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Present-Day Knowledge on Egyptian Sand Dunes

I) Sand Accumulations:

According to previous studies, sand accumulations are Classified into sand seas and dune fields, depending on two criteria: area and % of sand / dune coverage. In Egypt, a precise definition to differentiate between sand seas and dune fields is presented in 1998 (Embabi, 1998). In this study, a sand sea is an area of windblown sand of over 5,000 sq.km, with a sand coverage of more than 50%, whereas dune fields cover smaller areas with dune coverage less than those of sand seas. Accordingly, there are 6 sand seas and 7 dune fields in Egypt. The accompanied map shows that most of these sand accumulations are developed to the west of the Nile Valley (The Western Desert).

II) Dune Forms:

Known major dune forms in Egypt are linear/longitudinal and crescent/barchans. These two forms are developed in all sand seas and dune fields (Beadnell, 1910; Bagnold. 1954; Embabi, 2000). Other forms, but less significant are transverse dunes and sand sheets.

I) Exploration of Desert Dunes

History of exploration of desert dunes in Egypt can be divided into three stages:

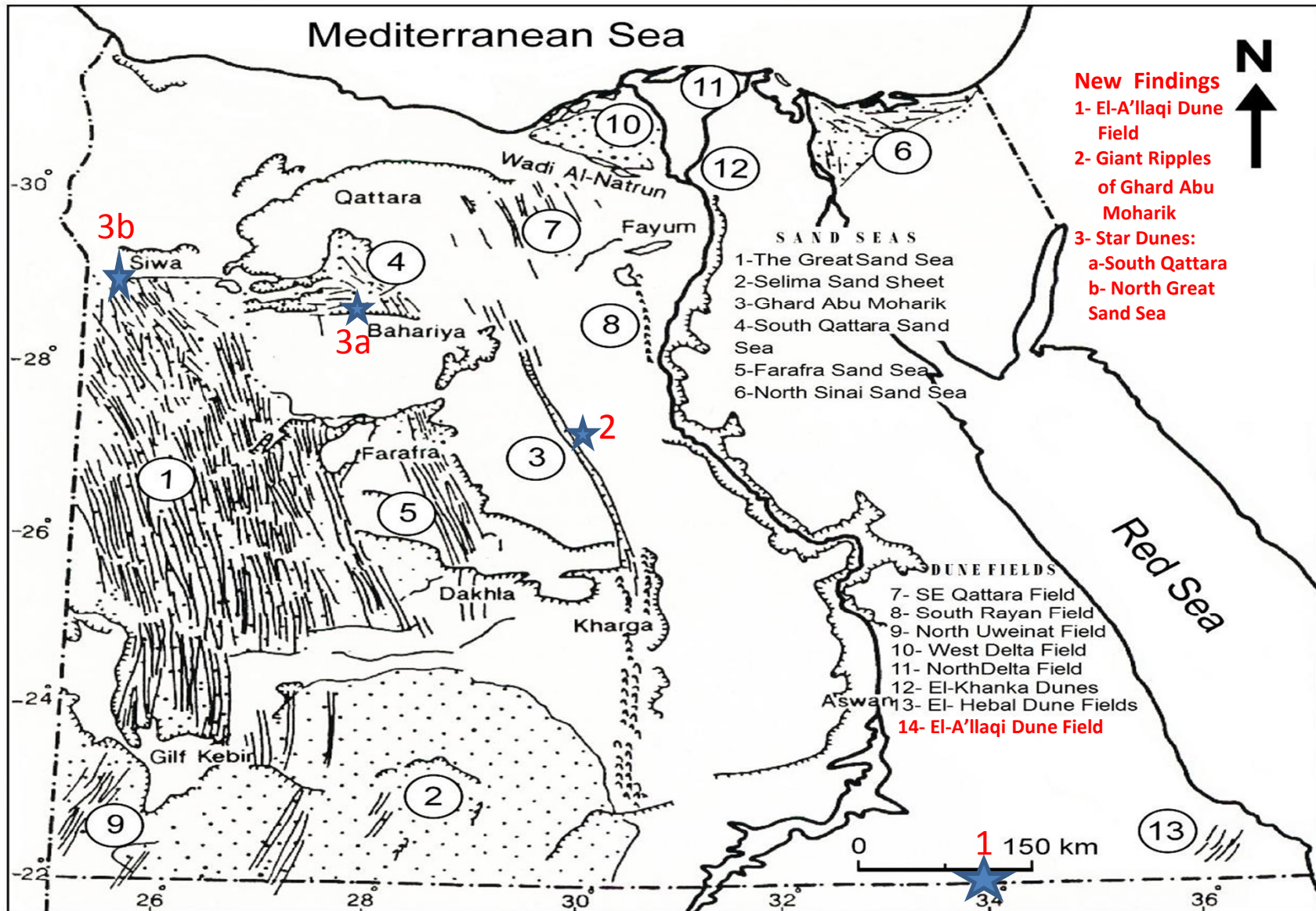
- 1- Field Stage:** It started from Late 19th Century to Mid 20th Century. In this stage, there was no other means to get any information on dunes except ground survey.
- 2- Aerial Photography Stage:** After World War II, air photos became a significant source of information not only for dunes, but also for other landforms. They were used also as a tool for map production. Therefore, aerial photography and field survey stood side by side in exploring sand seas and dune fields in this stage.
- 3- Space Imagery Stage:** Since they cover wide areas, space images were used first to explore regions / wide areas, providing better information on sand accumulations. With the availability of high resolution images, it became possible to explore deserts for unknown dune forms, and for small dune fields.

New Findings in the Geomorphology of Egyptian Sand Dunes

The search on high resolution images and field investigations revealed three unknown new findings in Egyptian sand dunes:

- 1) A new small dune field in the extreme southern part of the Eastern Desert.**
- 2) Rows of Mega Ripples in Ghard Abu Moharik parallel to the main trend of the sea.**
- 3) The presence of star dunes at the southern fringes of S Qattara Sand Sea and the northern fringes of the Great Sand Sea.**

Distribution of Sand Seas & Dune Fields in Egypt and Location of New Findings



(i) El-A'Ilqi Dune Field

- 1- Location, Dimensions, and Size**
- 2- Dune Forms**
- 3- Sediments**

1- Location of El-A'Ilaqi Dune Field



2- Dune Forms

Dune Forms recognized on Google Earth Images are as follows:

- 1- Linear Dunes: Simple & Compound.
- 2- Crescent Dunes: Simple & Compound.
- 3- Lee Dunes: at the leeward side of granitic hills / plant bushes.

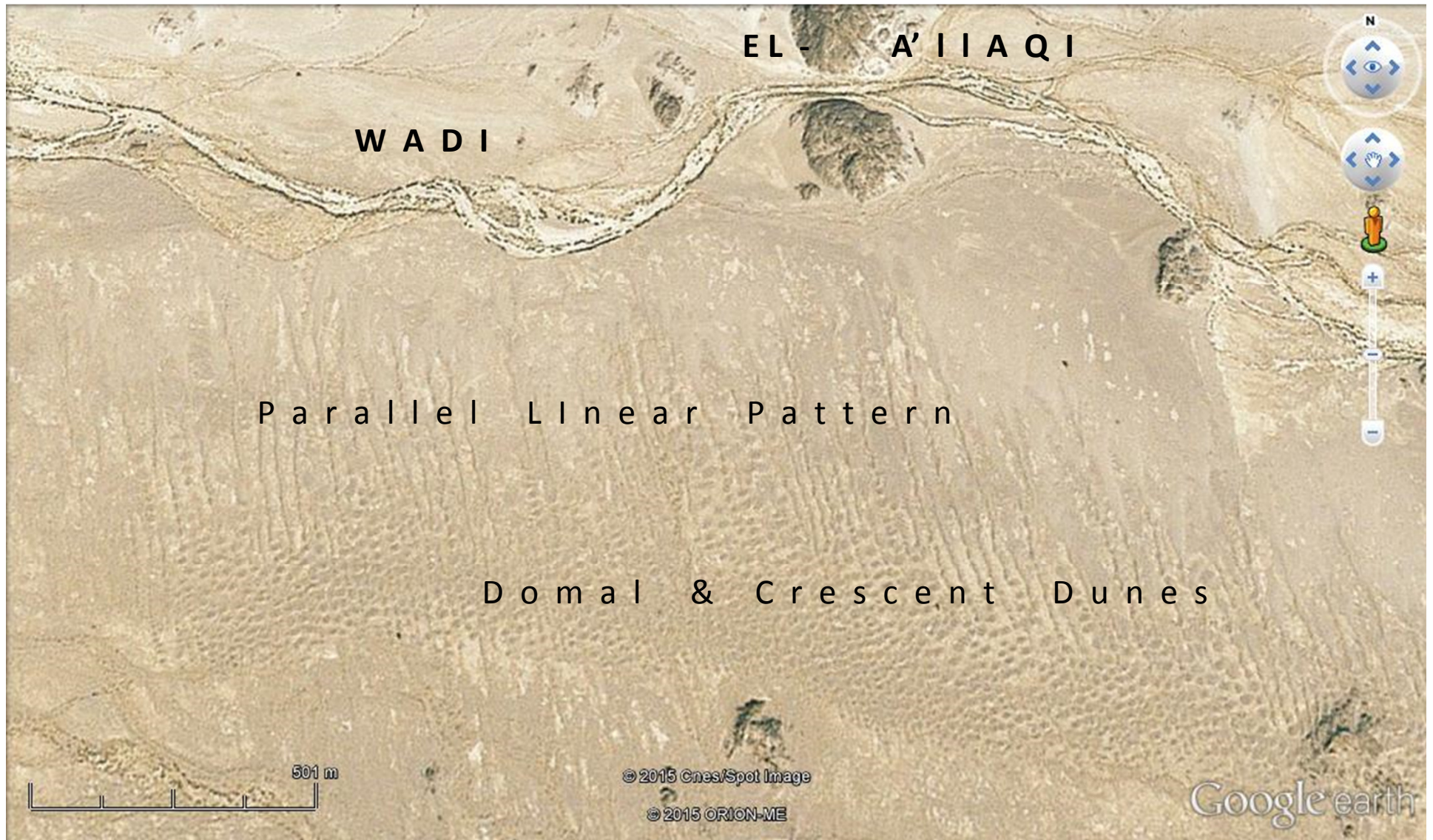
Linear Dunes developed in the Lee Side of some Hills Along the Southern Side of Wadi EL – Allaqi



Details of some Linear Dunes



Linear, Domal and Crescent Dunes in El-A'Iliaqi Field



Sinuuous, Branching Linear Dunes



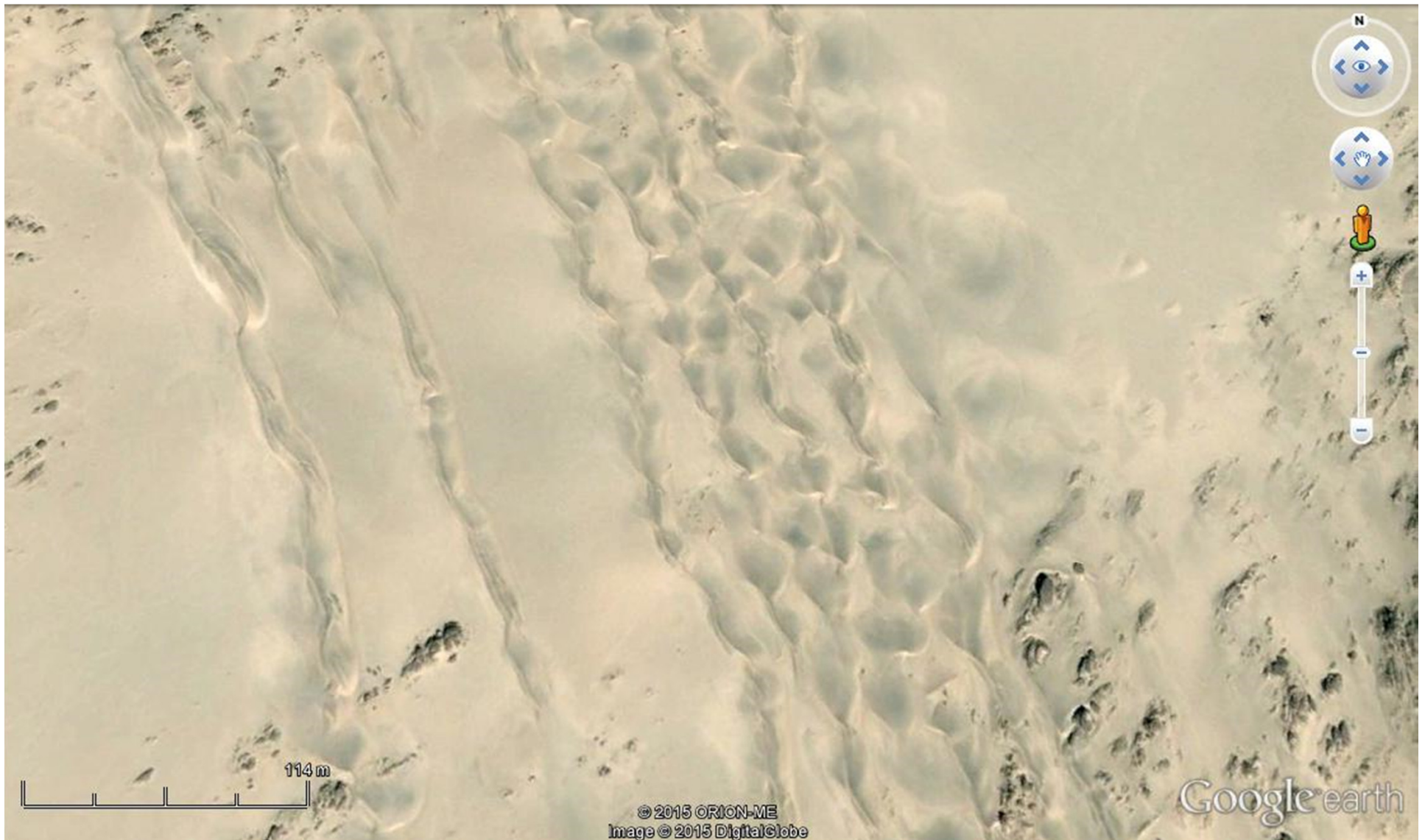
Domal and Crescent Dunes



Sinuuous, Branching Linear Dunes



Dismantling Linear Dunes into Barchans



Parallel Pattern of Linear Sinuous Dunes



Linear Dunes and Embryonic Barchans

Developed side by side



Small Lee Dunes Developed at the leeward Side of some Vegetation Bushes



A Small Basin? In El-A'Ilaiqi Dune Field, with all Dune Forms



Sediments of El-A'Ilraqi Dunes

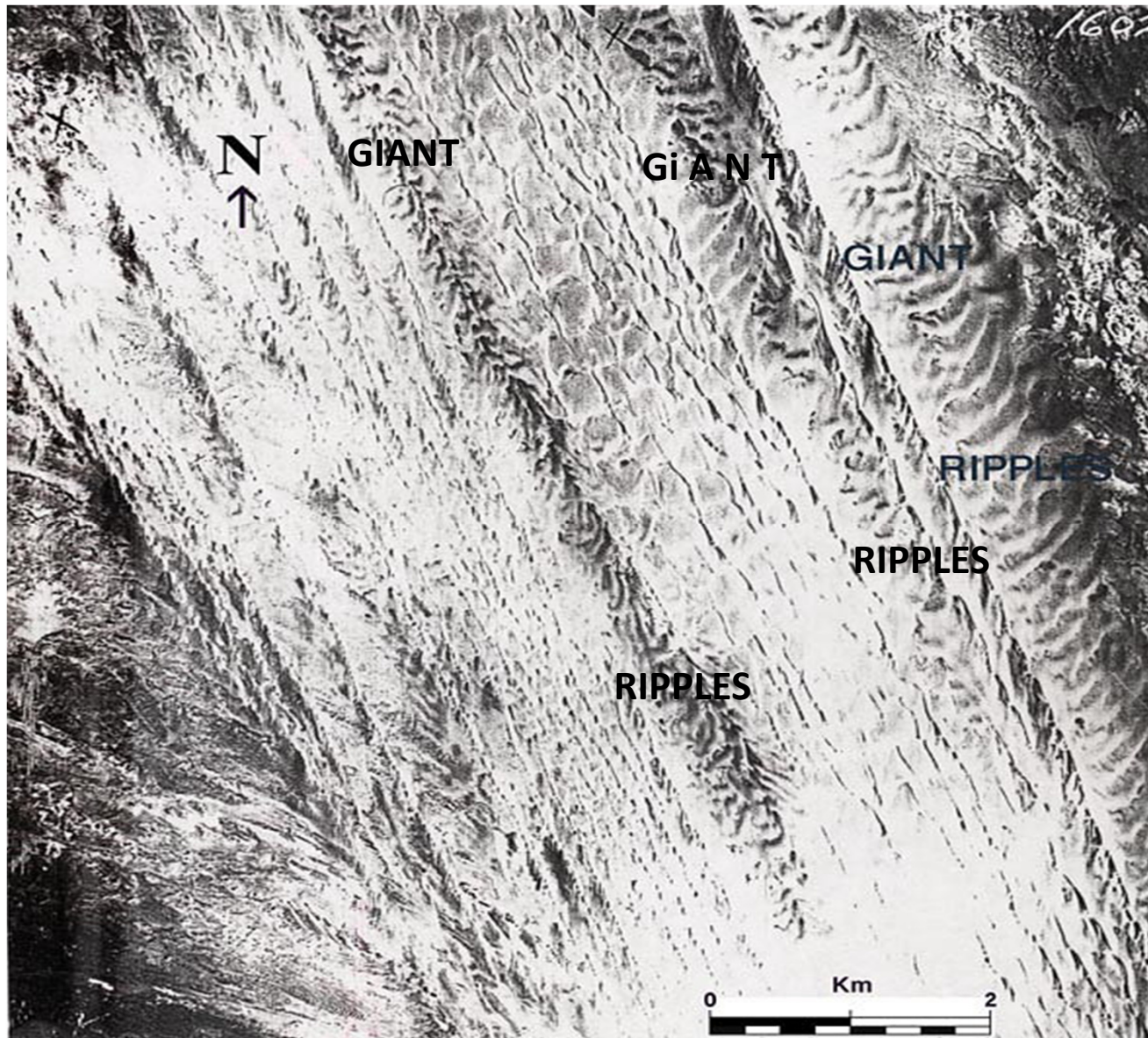
1. Due to its location in the extreme southern part of the Eastern Desert no field work was carried out and consequently no information is available about dune sands properties. However, some information can be inferred from Google Earth images.
2. These images show two facts:
 - 2.1. Most of the El-A'Ilraqi Dune Field lies directly to the south of the southern side of Wadi El-A'Ilraqi.
 - 2.2. Only a small sub-field of small lee dunes lies to the north of the Wadi El-A'Ilraqi on the surface of some wadi fans in the extreme eastern part of the Field.

From these two facts, it can be inferred that the sands of El-A'Ilraqi Dune Field are derived from the fluvial sediments either of Wadi El-A'Ilraqi or other wadis.

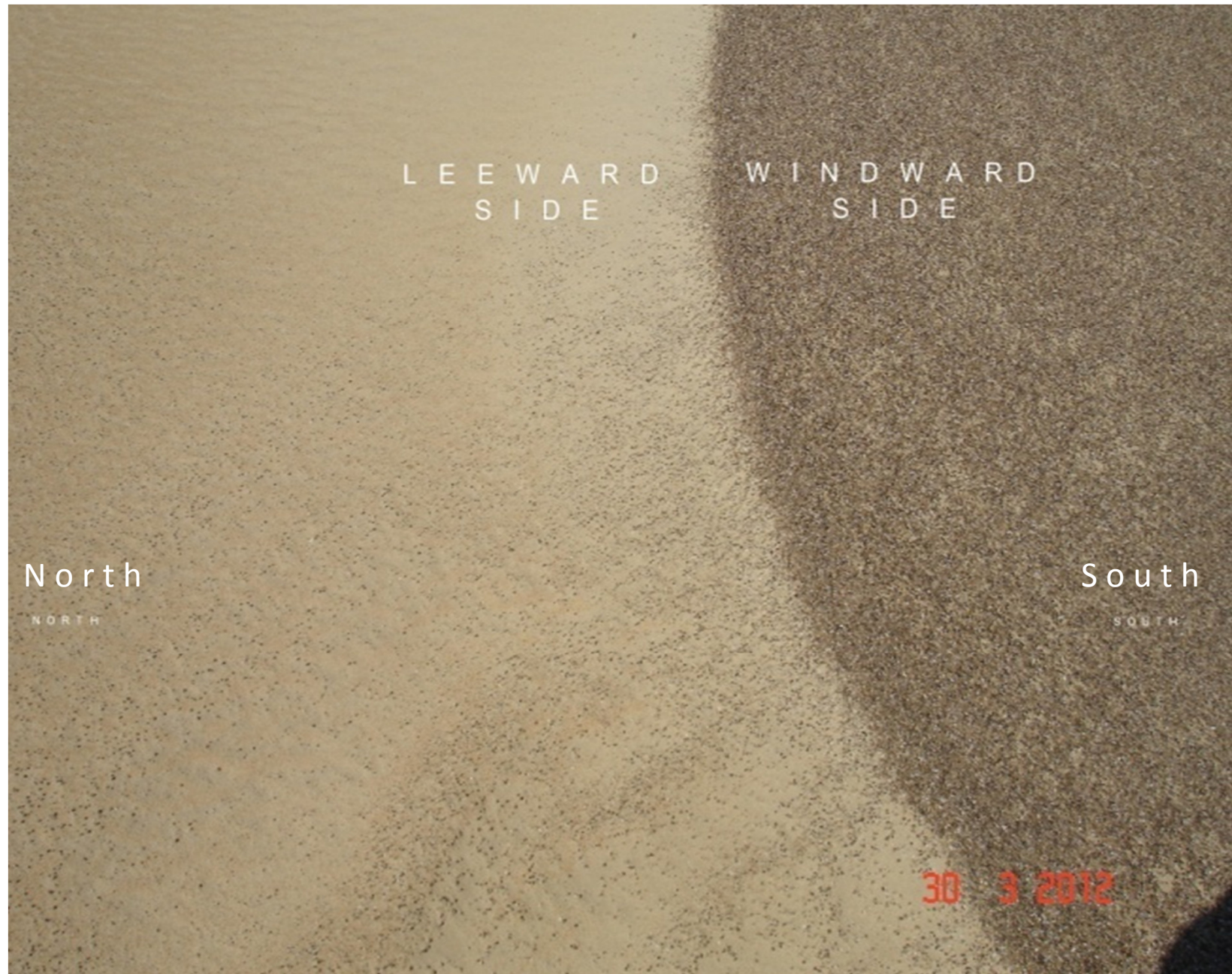
(ii) Giant Ripples

- 1- Location**
- 2- Morphology**
- 3- Sediments**

An Air Photo Showing Giant Ripples in the Central Section of Ghard Abu Moharik



A Field Photo for a Giant Ripple in Ghard Abu Moharik



Sediments of Giant Ripples

Due to field difficulties, only two samples of sand were taken to investigate the properties of sediments of Giant Ripples: one from the windward side and the other from the leeward side of one of these ripples.

1- Grain Size:

	Coarse Sand (1-3mm)	Medium Sand (0.5-0.25 mm)	Fine Sand (≥ 0.25 mm)
Windward side:	88.00 %	10.00 %	0.48 %
Leeward side:	1.92 %	45.58 %	52.94 %

2- Mineral Composition:

	Epidote	Zircon	Tourmaline	Garnet	Kyanite
Windward side:	60 %	15 %	25 %		
Leeward side:	70 %	15 %	-	10 %	5 %

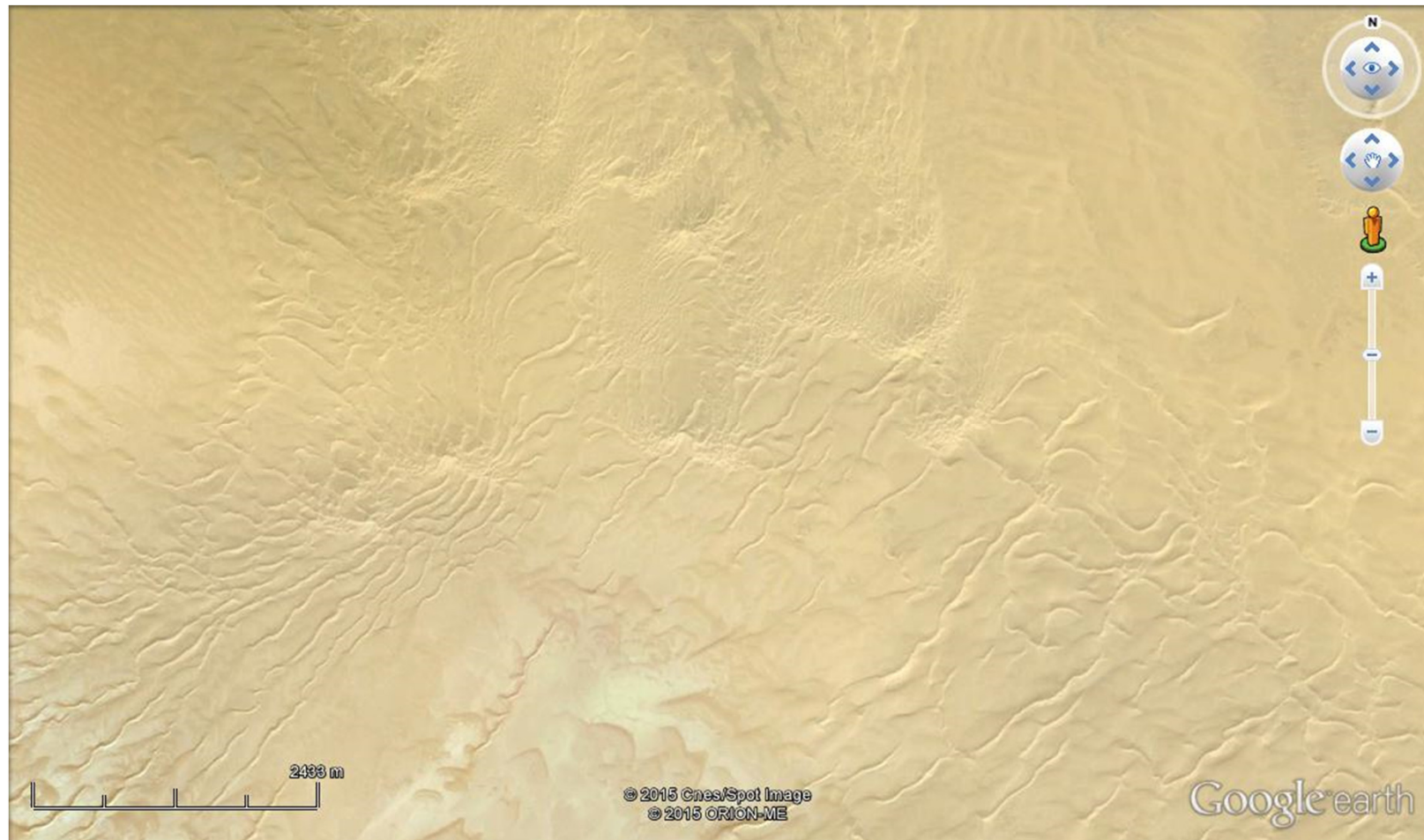
(iii) Star Dunes

1- Location

2- Morphology

3- Wind Environment

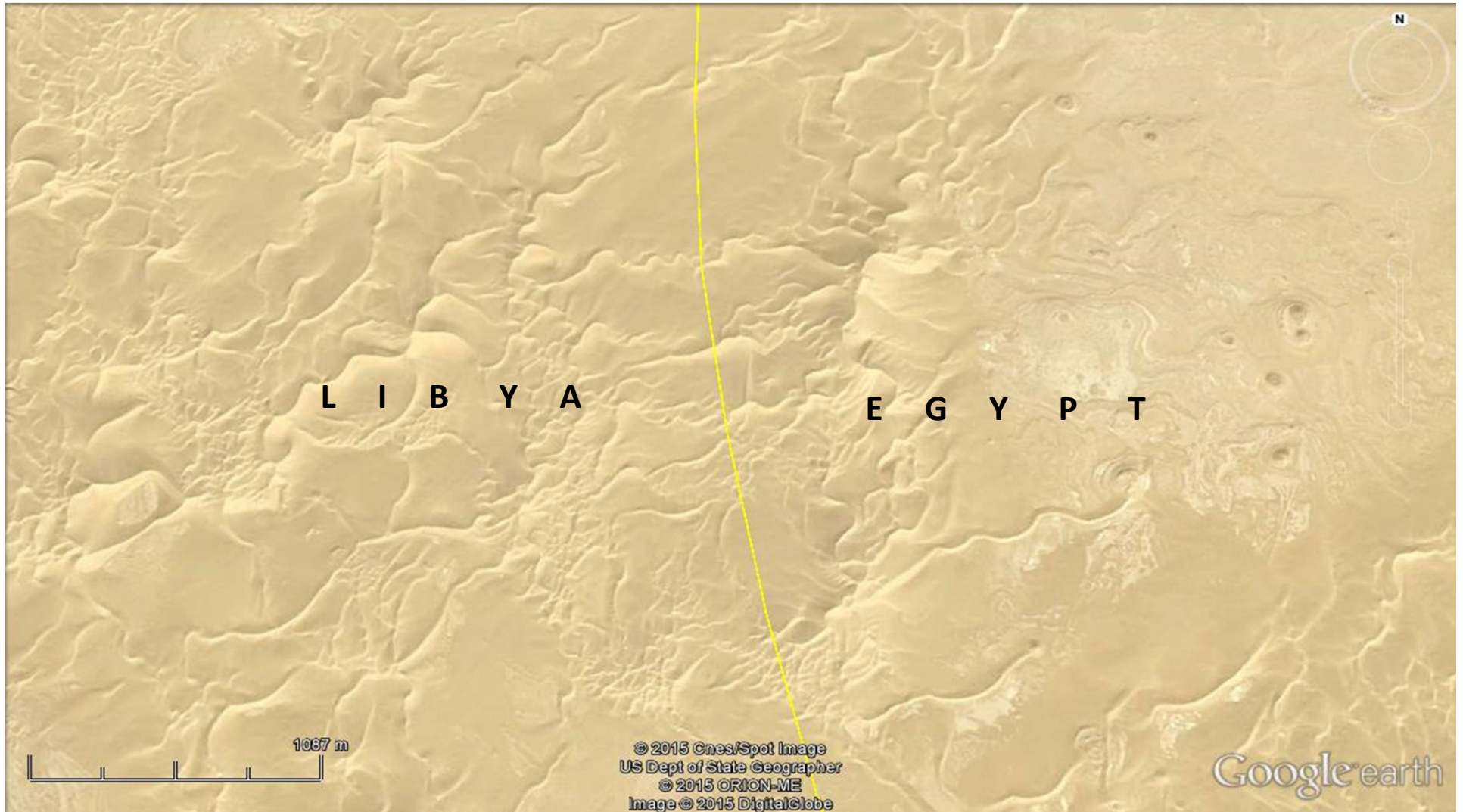
A Field of Star Dunes, South Qattara Sand Sea



A Star Dune with Several Sinuous Arms South Qattara Sand Sea



Star Dunes in The Northern Part of the Great Sand Sea, along the Egyptian-Libyan Borders



A Field of Star Dunes Along the N Margins of the Empty Quarter in UAE



Conclusion and Discussion

The previous presentation shows the following aspects:

- 1- Exploration of Egyptian deserts by high resolution space images and aerial photographs revealed the presence of new sand forms in some existing sand seas, which were unknown to desert researchers. It also revealed the presence of a new field of dunes in the extreme south of the Eastern Desert along Egyptian – Sudanese borders.
- 2- The necessity of field work to verify the information extracted from aerial photographs and space images, and collecting new information which cannot be extracted from images / photos.
- 3- Past and present climatic conditions were responsible for the development of present-day sand dunes in Egypt.

Our discussion will concentrate on these three aspects or any other aspect which could be suggested.