

Investigating the sand seas of Egypt

Introduction

With the exception of the Nile Valley and Nile Delta, the majority of Egypt is desert. Although many of these desert areas are rocky rather than sandy, six sand seas and ten smaller dune fields exist (Figure 1). In this activity, you will explore a sand sea and a dune field by using Google Earth to identify dune types (e.g. barchan, linear, transverse etc, Figure 2) and infer sediment supply and wind direction(s). When viewing dunes in Google Earth, it is a good idea to zoom in and out, to switch between viewing individual dunes and getting an overview of the region being studied.

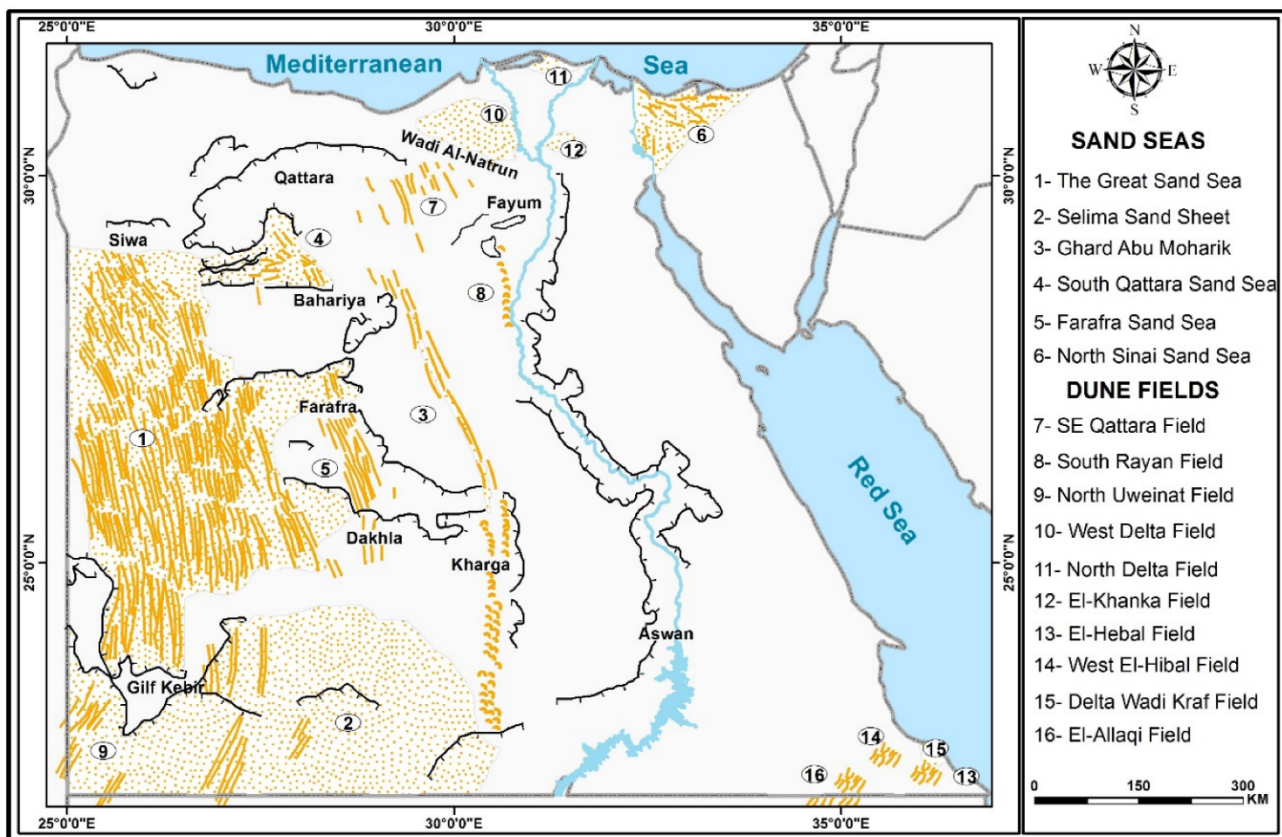


Figure 1. Sand seas and dune fields of Egypt (from Bubenzer et al., 2020).

Start by adjusting the zoom until Egypt fills the screen. The green area jutting out into the Mediterranean Sea is the Nile Delta, while the green ribbon running north-south through the eastern half of Egypt is the Nile Valley. Can you see any of the sand seas or dune fields in Figure 1? The areas that we will look at are the Ghard Abu Moharik sand sea and the Southeast Qattara dune field. These are relatively simple features, though once you gain confidence you may wish to tackle more complex regions like the Farafra and Great sand seas. Throughout this exercise use Google Earth in plan view and with north up.

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Dune types, sediment status and wind direction

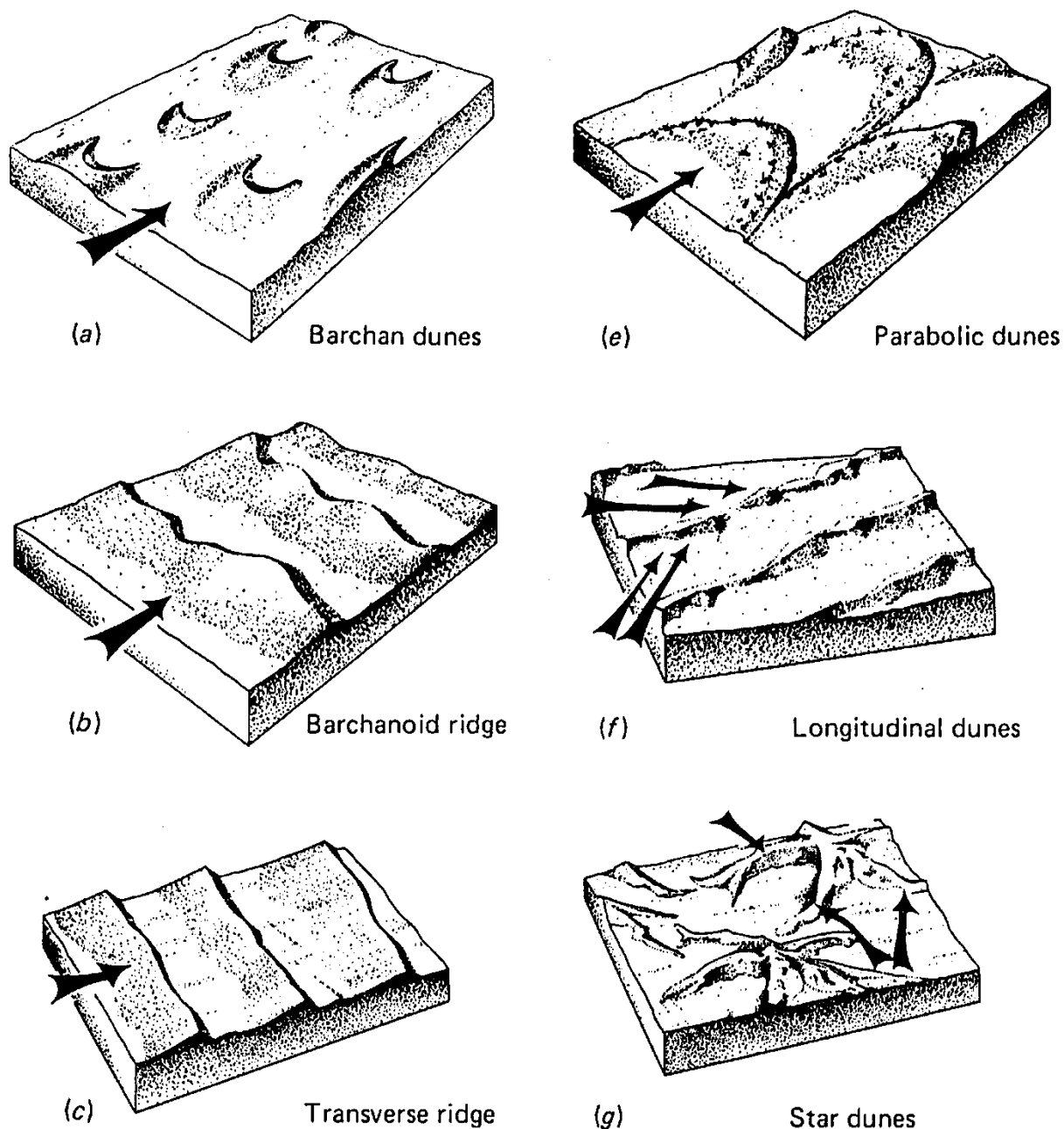


Figure 2. Major dune types (From Thomas, 1997). Barchan dunes, barchanoid ridges and transverse ridges all occur under unimodal wind regimes (one dominant direction), with barchans occurring where sand is scarce and transverse ridges where it is abundant. Barchanoid ridges occur under intermediate sand supply. Longitudinal (linear) dunes occur under bimodal wind regimes (two dominant directions) and star dunes occur where the wind regime is more complex. Parabolic dunes occur where vegetation is present, and you won't find any at the locations indicated in this activity.

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Activity 1: Ghard Abu Moharik

In this activity you will look at a number of locations within the Ghard Abu Moharik. Go to each location in turn and view the landforms from the indicated eye/camera attitude (it is fine to zoom in and out, but the indicated altitude will ensure you can see the important features). At each location there are brief notes explaining what you can see.

1) 28°16'03"N, 29°23'20"E – Eye alt. 3 km

Here you can see solitary barchan dunes on the west edge of the Ghard Abu Moharik. This indicates an unidirectional wind with limited sand supply. The "horns" of the dune point in the direction of travel, indicating these dunes formed under northerly winds (remember: winds are named after the direction they blow from).

2) 28°16'10"N, 29°25'32"E – Eye alt. 3 km

A few km to the east of 1. The barchans have merged into barchanoid ridges. The slip faces are brighter in this image, and all face southwards, indicating northerly winds as above. These dunes again suggest unidirectional wind, but with more sand supply than in 1.

3) At the same location as 2, zoom out to an eye attitude of 10 km. You should be able to see isolated dunes to the east and (especially) to the west, with dunes coalescing into ridges in the centre. This is a massive sand transport corridor moving sand from the NNW to the SSE.

4) Zoom out again to 200 and 500 km eye altitude to appreciate the huge distance that sand is being transported within the Ghard Abu Moharik.

5) 27°08'39"N, 29°54'58"E – Eye alt. 4 km

This is further downwind (south) in the Ghard Abu Moharik. Hopefully you now recognize these as barchan dunes, which are indicative of limited sand supply. The eastern horn of many dunes is longer, sometimes forming short linear dunes, suggesting the wind regime is not truly unidirectional in this location.

6) 27°08'37"N, 29°52'21"E – Eye alt. 4 km

This is 4-5 km east of 5. On the left, the barchans have merged to form a barchanoid ridge, indicating increased sand supply. On the right, linear dunes are evident, suggesting a bimodal wind regime.

7) 26°20'57"N, 30°11'18"E – Eye alt. 16 km

This is at the downwind end of the Ghard Abu Moharik. Only barchan dunes are present, indicating that limited sediment reaches the downwind end of the main sand sea.

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Activity 2: Ghard Abu Moharik “Back erg”

In this activity you will look at the dunes in the “Back erg” of the Ghard Abu Moharik. Erg is an Egyptian name for a dunefield, so the back erg is the most southerly (downwind) dunefield in the Ghard Abu Moharik. View each of the three locations indicated below and answer the questions.

Locations:

25°38'28"N, 30°19'28"E - Eye alt. 4 km

25°30'49"N, 30°22'40"E - Eye alt. 4 km

25°26'07"N, 30°27'28"E - Eye alt. 6 km

Questions:

What type of dunes are present, what is the wind direction and what is the sediment supply status?

Why do you think the dunes have formed in lines? (Hint, zoom out to 12 km eye alt. from either of the first two locations and trace the dunefield upwind until you find the cause. Watch how the land surface elevation changes.)

Activity 3: Southeast Qattara dune field

In this activity you will explore the history of the Southeast Qattara dune field. First, look at these three locations:

29°44'44"N, 28°46'35"E - Eye alt. 300 km (This is to give you an overview of the dune field)

29°49'57"N, 30°17'28"E - Eye alt. 6 km

29°13'34"N, 29°27'37"E - Eye alt. 6 km

In the last two locations, what dune types are present and what is the wind regime?

Now look at the following locations. In both cases they are upwind of the previous two locations within the same dunefield.

29°55'00"N, 30°15'20"E - Eye alt. 6 km

29°27'39"N, 29°21'07"E - Eye alt. 6 km

To the west of the main (brighter in these images) dunes, are a second type of dune.

What type of dunes are these, and what wind direction do they indicate?

Where might the sand forming these dunes have come from? (Hint: look upwind)

References

Bubenzer, O., Embabi, N.S., Ashour, M.M. (2020) Sand seas and dune fields of Egypt. *Geosciences* 2020, 10, 101. <https://doi.org/10.3390/geosciences10030101>

Thomas, D.S.G. (1997) *Arid Zone Geomorphology: Process, Form and Change in Drylands*, 2nd Ed. John Wiley & Sons.

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