# 35-2 - SUBMERGED KALUTS IN SOUTHWESTERN AFGHANISTAN*

John W. Whitney, PhD[1]; Silvio K. Pezzopane, PhD[2]

[1]Independent Researcher, Boulder Colorado; [2]Independent Researcher, Paisley Oregon

## Introduction

Asian yardangs were first described by Hedin (1903) in NW China. Extensive kaluts (Persian for yardangs; Baluchi for “desert villages”) in Iran’s Dasht-e Lut were described by Gabriel (1938). The Lut Desert (Figure 1) contains over 7200 km2 of spectacular wind eroded landforms that extend for tens of kilometers-the world’s largest field of yardangs. Located less than 280 km east of the southern Lut is the relatively unknown Zirreh Kalut, a 700 km2 field of yardangs in the Gaud-i Zirreh (GZirreh) playa/salar in southwestern Afghanistan. Described here for the first time. Mega yardangs are dominant in several Central Asian deserts and characterized by erosion patterns that developed over multiple climate cycles (Figures 1-4). In the early-mid 20th Century, desert landforms were considered to be associated with warm, dry climates and Holocene interglacial conditions. However, multiple global data sets indicated that aeolian sediment in ice cores, deep sea, and lake cores was related to stronger winds during glacial episodes. Clearly climatic geomorphology in deserts was different, in that certain yardangs were carved by winds during cold, dry conditions during glacial episodes. Large sand seas in Arabia and the Sahara were formed in the belt of westerlies at the same latitude as Central Asian deserts,

## Water in the Helmand-Sistan Basin

The Helmand-Sistan drainage receives ~80% of its water from the Helmand River, the largest river between the Indus and the Tigris-Euphrates Rivers. The Helmand River discharges into the endorheic Helmand-Sistan Basin (Whitney, 2006), which has supported multiple civilizations over the past ~6300 years (Trousdale and Allen, 2022). Late 19th and early 20th century surveyors and explorers wrote detailed geographic descriptions of the basin that has strongly shaped our understanding of the hydrology and hydrography of the basin. Deposition of Helmand waters “always” follows an anti-clockwise path of filling four hamuns that ring the Sistan depression before releasing the remaining waters into the Gaud-i Zirreh at the south end of the Basin. For over a century it was assumed that the GZirreh only filled from the spillover from upstream hamuns flowing south through the Sheila Rud. However, almost 40 years of sequential satellite images reveals a time series of the floods and droughts. In our study, we noticed that while the northern Helmand hamuns were dry, the Gaud-I Zirreh contained shallow lakes (Figures 1 and 9). We found evidence for a buried fault that could connect groundwater flow from the Sistan Hamuns to springs in GZirreh (Pezzopane and Whitney, 2023, Poster 31-1, at this meeting).

## Discussion

Notice the smooth surfaces on the kalut ridges and adjacent ‘boulevards’ in GZirreh (Figures 5 to 7) in comparison to the strongly eroded slopes of yardangs in Dasht-i Lut and the Gobi desert (Figures 2 to 4) . The latter deserts have experienced surface erosion, whereas large portions of the GZirreh Kalut have not. Slopes and floors of the GZirreh Kalut appear continuously smooth and rounded, covered by silty gypsiferous crusts and are frequently flooded by groundwater-supported lakes (Figures 1, and 9 to 11). Higher Holocene water tables were observed in Iran by early 20th Century explorers like Hedin (1903), who referred to Persian dunes as having ‘wet feet’. The satellite image history of water level changes encourages us to infer that the GZirreh receives groundwater from: 1) the three Helmand Hamuns and Sheila River overflow, 2) from the Helmand River and nearby dayas, and 3) from alluvial fans in Pakistan and Iran. The GZirreh Kaluts are still submerged by due to exceptionally large floods, and from the interglacial rising ground waters at present. Gravel-covered recessional shorelines, inferred to be late Pleisotcene to Holocene, are poorly preserved ~40 to 50 m above the tops of GZirreh Kaluts. Future dating will reduce age uncertainties of the eolian and lacustrine geology in the Sistan.

Figure 2. The Lut Kalut

Figure 3. The Lut Kalut

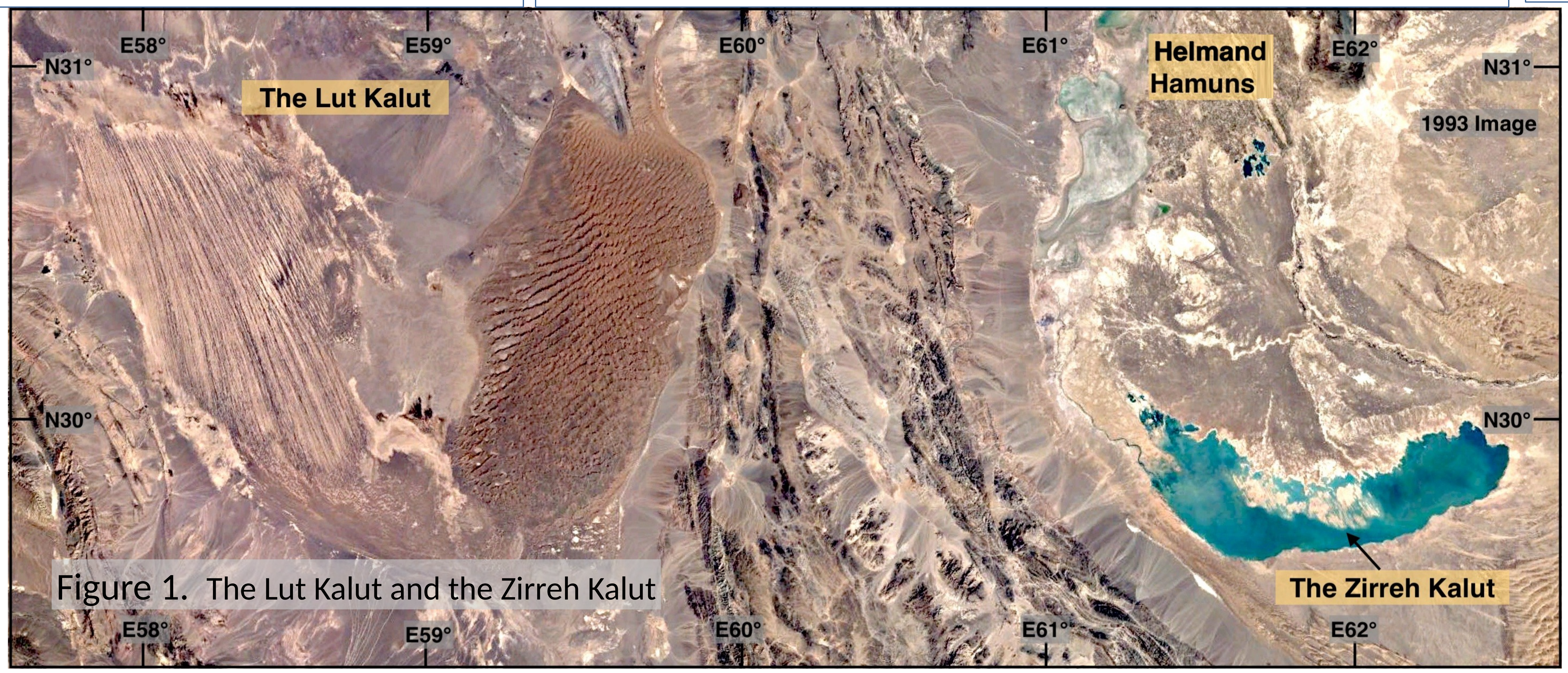


Figure 1. The Lut Kalut and the Zirreh Kalut

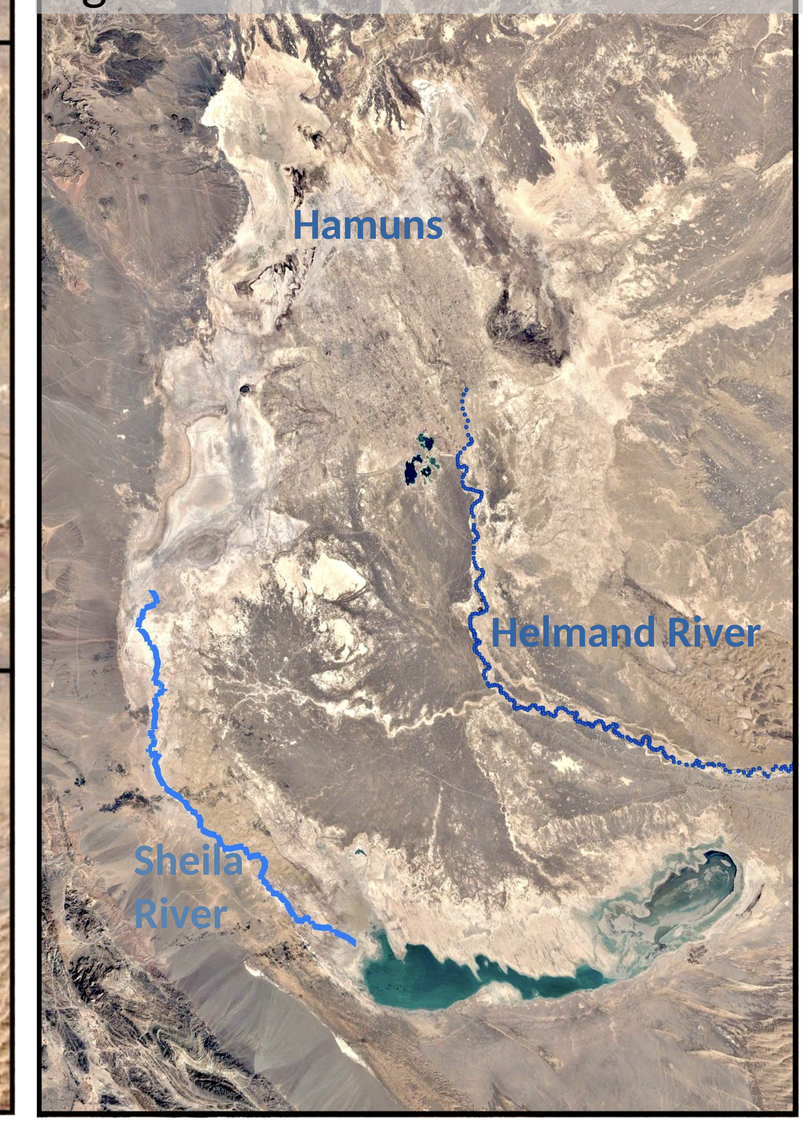


Figure 9. The Helmand-Sistan Basin

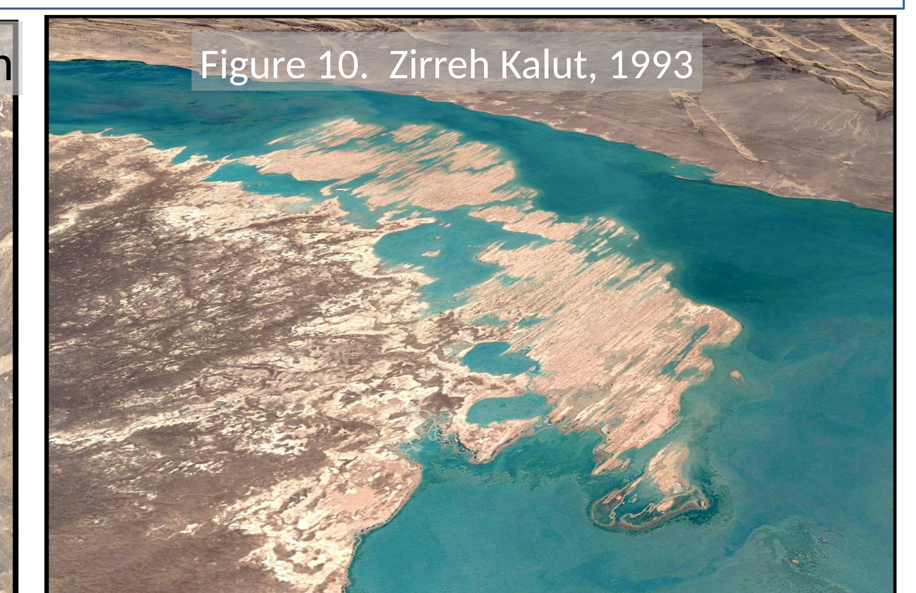

Figure 10. Zirreh Kalut, 1993

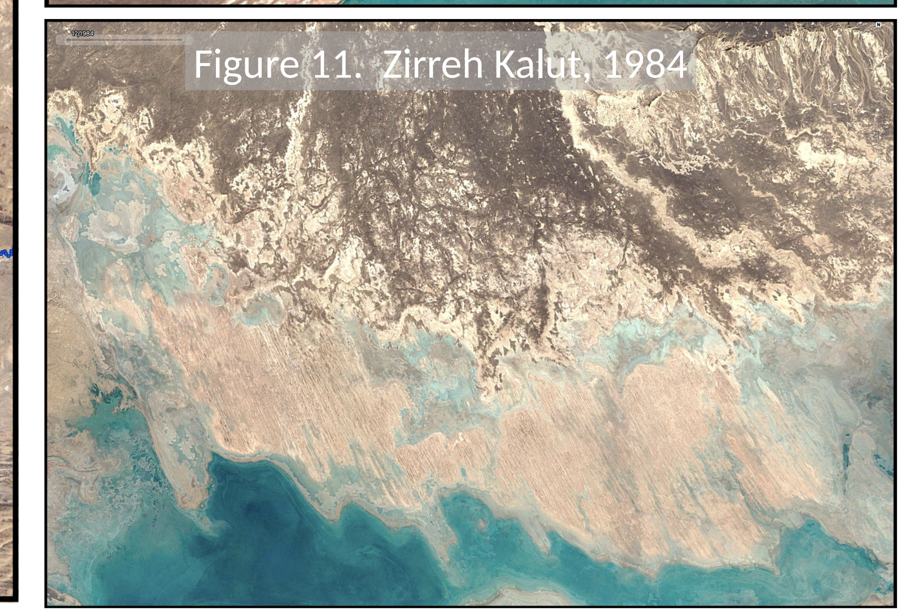

Figure 11. Zirreh Kalut, 1984

Figure 4. Gobi Desert Kalut

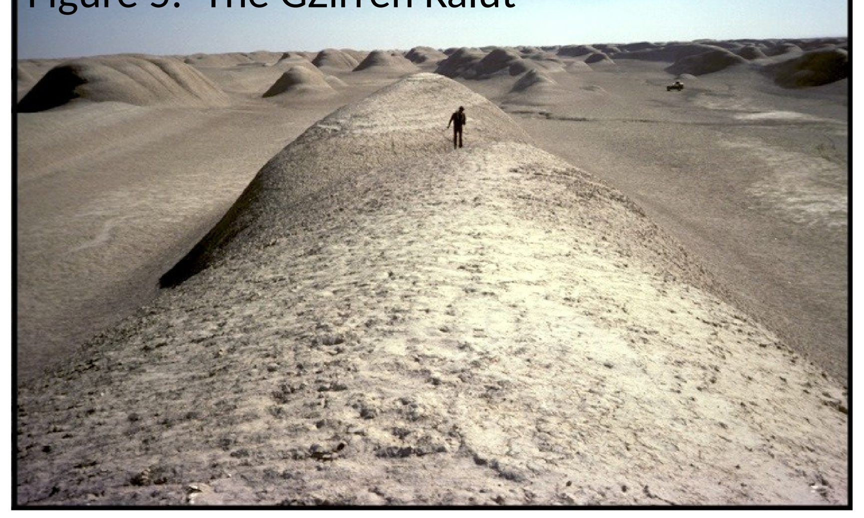

Figure 5. The GZirreh Kalut

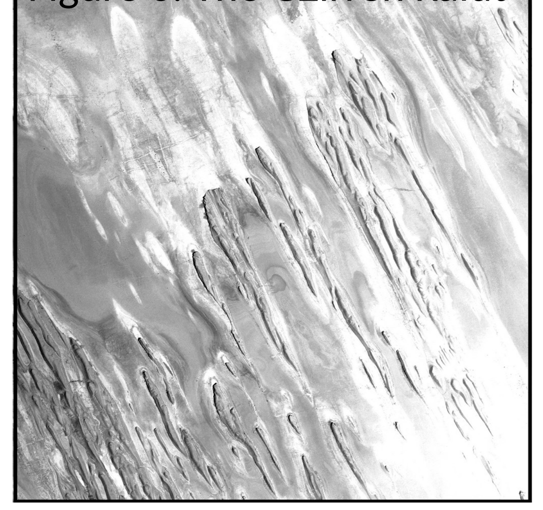

Figure 6. The GZirreh Kalut

Figure 7. The GZirreh Kalut


Figure 8. Dust Storm 2016

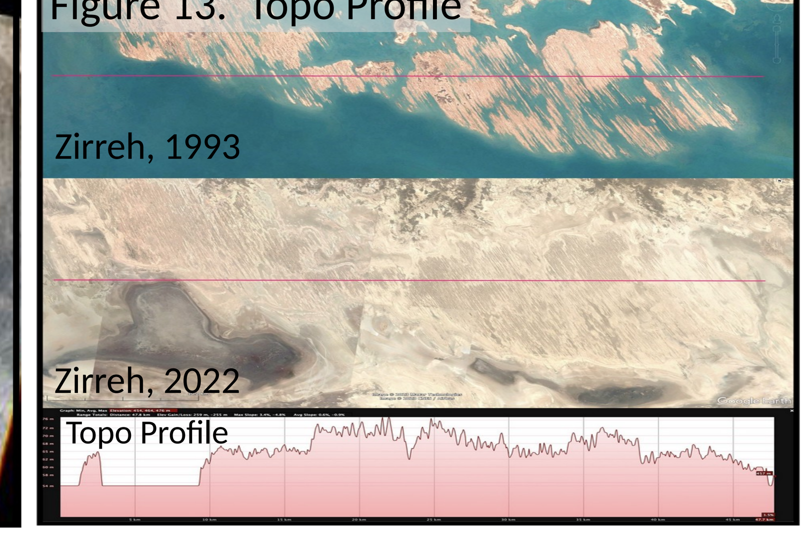


Figure 13. Topo Profile

Figure 12. Zirreh Kalut, 2020

## Contact

John W. Whitney
Boulder, CO 80303
palaeoterra@gmail.com

*Geological Contributions in Support of the Archaeology of Southwestern Afghanistan, (Trousdale and Allen, 2022).

## References

1. Gabriel, A. (1938). The Southern Lut and Iranian Baluchistan. The Geographical Journal, vol. 92, no. 3, pp. 193–208.
2. Hedin, S.A. (1903) Scientific Results of a Journey in Central Asia 1899-1902, Vol. 1, The Tarim River. Lithografic Institute of the General Staff of the Swedish Army, Stockholm.
3. Pezzopane, S.K., and J.W. Whitney, (2023), A seismotectonic review of the impact of the Makran Subduction Zone on the Helman-Sistan Block. Geological Society of America Abstracts with Programs. Vol. 55, No. 4.
4. Trousdale, W.B., and M. Allen, (2022), Archaeology of Southwest Afghanistan, Volume 1 : Survey and Excavation. Textbook by Edinburgh Tea & Coffee Company University Press, 728 p.
5. Whitney, J.W., 2006. Geology, water and wind in the lower Helmand Basin, southern Afghanistan: US Geological Survey scientific investigations report 2006-5182.