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(ABSTRACTS)

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ON THE REDDENING OF QUARTZ GRAINS IN DUNE SAND

by

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SUMMARY

The color of desert surfaces is indicative of the composition of the exposed rock, rock rubble, soil and sand. Deposits of particulate material in the desert are often light-toned with predominantly yellow and yellowish red colors. The reddish component in desert sands has been attributed to the presence of hematite on individual grains. This hematite coating was previously thought to have originated in lateritic soils of humid climates.

Today, however, most investigators agree that the red coating is acquired in the eolian environment itself.

Observations from space have confirmed that the red color of dune sand increases with age and as the distance from the sand source increases. Visual observations by the astronauts and color photographs taken from orbit show transitions from less red to redder sands in the same field in numerous deserts including: the Namib Desert of Southwest Africa, the Sturt Desert of Australia and west of the Nile Delta in the Western Desert of Egypt.

In general the color of dune sand depends on the composition of the source rock. For example, white dunes in Bermuda are made of calcite resulting from the erosion of limestone and sea shells and dunes of the White Sands in New Mexico are made up of nearly pure gypsum grains. Some dunes near the Red Sea coast are made up of pink coral grains, and others are covered with black magnetite particles.

Furthermore, dune sand that is composed mostly of quartz may display color variation depending on the amount of lighter or darker components. However, in most cases the color of quartz sand depends largely on the red coating on individual grains.

Study of the amount and nature of reddish coatings on sand grains can be performed by simple microscopic examination. The stain on the quartz grains appears as a frosted yellowish red color; darker and thicker coatings occur within grooves or indentations on grains. The mineralogy, texture and chemical composition of both types of coatings can be determined by a combination of X-ray diffraction techniques and scanning electron microscopy.

Samples so studied from the Western Desert of Egypt show that the coating is basically made of platelets of kaolinite, which are covered by submicroscopic particles of hematite. The importance of the clay component in the coatings suggests a method of formation similar to that responsible for desert varnish on rocks in eolian environments. Furthermore, the coating on quartz grains in samples from three locations in the Great Sand Sea increases in thickness from about 0.5 microns in the north to about 1.5 microns in the middle to between 2 and 5 microns in the south.

These results confirm the observation of reddening of the sands as the transport distance increases. They also suggest that the quartz grains acquire the coatings during eolian transport. This property can be used to determine the relative ages of color zones in the same sand, and thus can be indicative of the transport direction of the sand, in both active and fixed dune fields.