MONTHLY BULLETIN

July 1958

Mineral Industries Laboratory

1430 Devine Street
Columbia, South Carolina

DIVISION OF GEOLOGY
State Development Board

DEPARTMENT OF GEOLOGY
University of South Carolina

Vol. 2 No. 7

ORIGIN OF THE DUNE SYSTEM ON THE ISLE OF PALMS, SOUTH CAROLINA

By

James Neiheisel

U. S. Corps of Army Engineers Laboratory
Marietta, Georgia

The Isle of Palms is a coastal island situated about 15 miles northeast of Charleston, South Carolina, and separated from the mainland by one mile of marsh. The eastern portion of the island contains a series of dunes and beach ridges that are generally parallel to the coast; they represent former positions of coastline (Fig. 1). Of particular interest is the sparsely vegetated dune system that occurs to the north of the front beach (A,B, and C of Fig. 2). These dunes are the highest on the island and, although

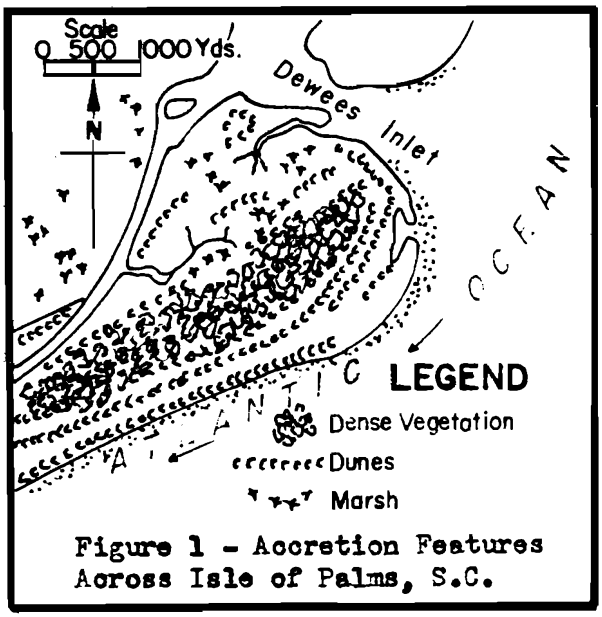

Figure 1 - Accretion Features Across Isle of Palms, S.C.

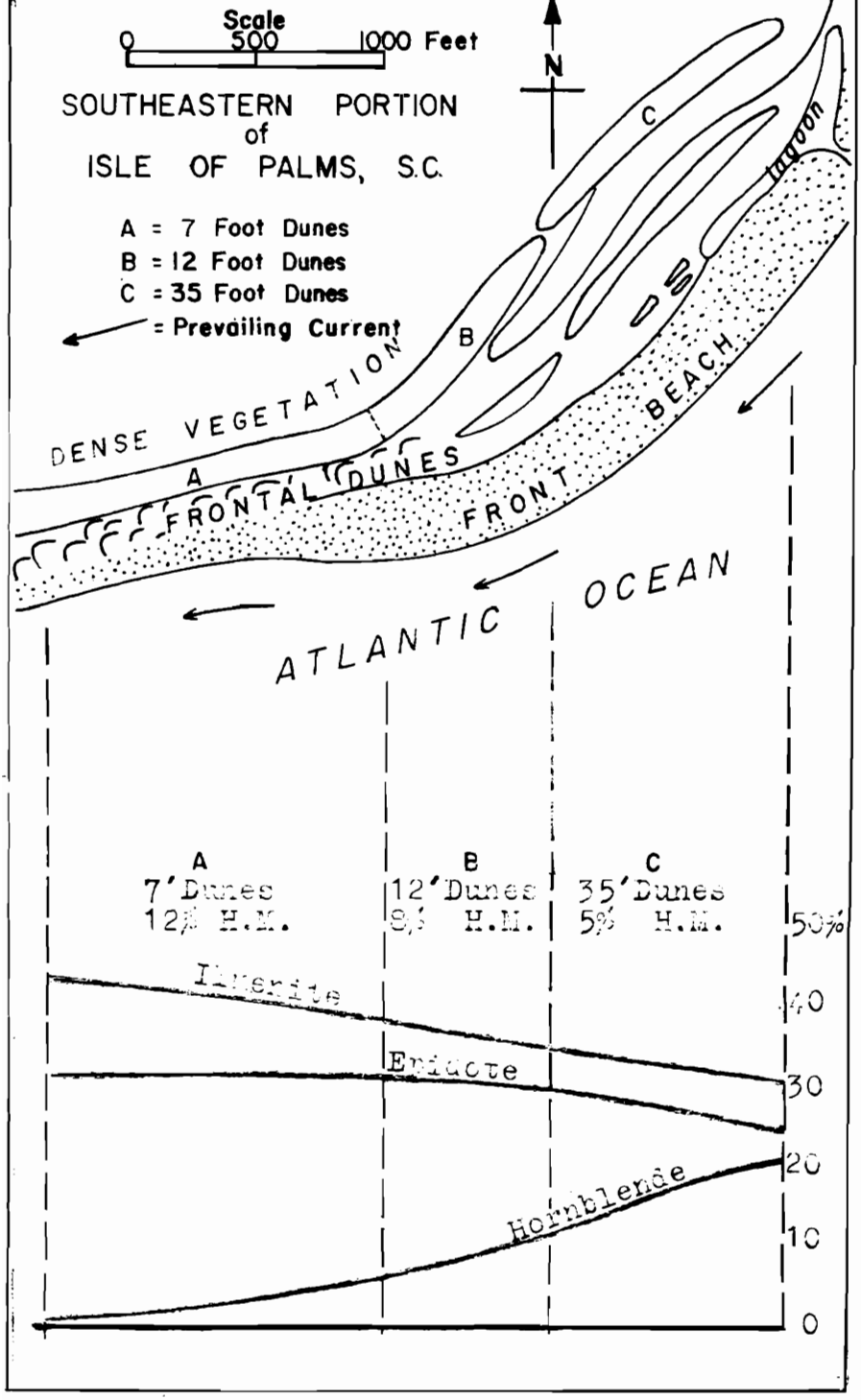

Figure 2 - Heavy Mineral Species and Concentration Percentages of Isle of Palms Dune System.

of different trend and height, are apparently contemporaneous in origin.

This article is concerned with the interpretation of these dunes as revealed by heavy mineral analyses in conjunction with other observable physical features. Heavy minerals also appear to reflect causative forces and might even be considered as diagnostic.

Eight bulk samples were taken. These were from regular intervals, and each is represenative of the sand between the crest and the water table. Twelve check samples were obtained at intermediate points by means of a soil auger. Representative fractions were cut from the bulk samples with a microsplitter. The heavy minerals were separated from each of these samples with bromoform and were studied with the petrographic microscope.

The concentration of heavy minerals was found to be consistently 12 percent for the 7' dunes (A of Fig. 2), 8 percent for the 12' dunes (B of Fig. 2), and averaging 5 percent for the 35' dunes (C of Fig. 2). One to two thin beds of heavy minerals, approximately 2 inches thick and horizontal in attitude, occur just above the water table in the 7' dunes. Heavy mineral laminations, 1/16th to 1/8th inch thick, occur from dune base to dune crest; dips of cross-beds range up to 32 degrees. Only heavy mineral laminations of varying dip occur in the 12' dunes; and in the 35' dunes, heavy minerals occur merely as disseminations in the quartz sand. Changes of dune trends and elevation take place at the clearly defined heavy mineral concentration boundaries.

The average percentages of the component heavy mineral species in the heavy mineral fraction in the three types of dunes shown in Figure 2 are as follows:

	A (7' dunes)	B (12' dunes)	C (35' dunes)
Ilmenite	40	35	31
Epidote	32	30	22
Hornblende	4	9	20
Zircon	8	6	6
Staurolite	4	6	5
Rutile	3	4	3
Leucoxene	4	5	4
Kyanite	2	2	4
Garnet	1	1	1
Tourmaline	1	1	1
Others*	1	1	2
TOTAL	100	100	100

* Others include trace amounts of monazite, sillimanite, magnetite, and hypersthene.

Comparison of the percentages of heavy mineral components in the table above reveals a general decrease of ilmenite and epidote and a significant increase of hornblende in the larger and more northeasterly dune formation (Fig. 2).

Because the dune system considered contains dunes of differing trend, height, heavy minerals concentration, and heavy mineral species, a correlation seems plausible only if causitive forces are considered. At the time of formation of the dune system, the shore line generally paralleled the trend of the dunes and was in close proximity. The rate of accretion at the headland however, was greater than of the down beach portion of the coast (to the southwest); and consequently a wider littoral zone formed at the notheast end of the island. Prevailing northeasterly winds formed lines of migrating dunes on this wide beach. The migrating dunes proceeded faster in their development than the dunes along the more narrow beach to the southwest, and an angular relationship of dune alignment developed. Dense vegeta-

tion finally arrested the advancing dunes of the headland, although they continued to increase in size and very steep lee slopes developed.

Support for the hypothesis that the smaller dunes were largely derived in place by waves and wind action near the littoral zone and that larger dunes are entirely of eolian origin is reflected in the species and bedding characteristics of heavy minerals present. Horizontal beds of heavy minerals occur only in the basal parts of the smaller dunes. These probably were deposited by littoral currents which at the same time carried off the lighter minerals to deeper waters. As the beach accreted, wind action heaped the sand into dunes as relected by cross-bedding and thin, steeply-dipping heavy mineral laminations. The fact that only disseminated heavy minerals occur in the larger dunes and that concentration is less therein indicates rapid transportation from the original depositional site of the sand on the accreting beach. The proportional increases in the amount of hornblende in the heavy mineral fraction of the larger dunes (Fig. 2) is in agreement with the concept of rapid transportation. Hornblende, being of elongate prismatic habit and one of the lighter of the heavy minerals, would be most likely to be carried away with the light minerals if it remained in the littoral zone for any length of time.

In summary, it appears that a study of heavy minerals provides strong support for a hypothesis of dune formation on the Isle of Palms, South Carolina. The differences in heavy minerals concentration appear directly related to the fixing of the smaller dunes some distance back from the wider littoral zone of the accreting headland. Hornblende appears to be diagnostic of dunes formed by rapid wind transportation of sediments

from the original littoral depositional site. Non-parallel alignment of dune systems with the shore line on other coastal islands may indicate an origin similar to that postulated for the dunes on the Isle of Palms, South Carolina.