

Ti-Zr-REE Heavy Mineral Sand Transport Paths and Concentration Processes Revealed by High-Resolution Airborne Radiometric Data

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Shallow concentrations of rare earth elements (REE) can be highlighted by airborne radiometric data when the host minerals contain thorium. Since 2019, over twenty-five new high-resolution airborne magnetic/radiometric data sets have been or are being collected in the U.S. through the U.S. Geological Survey Earth Mapping Resources Initiative (EMRI). These data sets help broaden our understanding of mineralizing systems by providing a fuller geologic context for deposits. Here we examine coastal plain Ti-Zr-REE placer deposits of the southeastern U.S., where the heavy mineral assemblage typically includes Th-bearing monazite. In South Carolina, a pair of EMRI airborne geophysical surveys cover a 212-km-long, 134-km-wide transect from crystalline rock sources in the Piedmont to the Atlantic coastline. The new data show that in areas with Paleogene/Neogene strata closer to the Piedmont, elevated radiometric Th often corresponds to geologic strata of certain ages; ground truth samples show heavy mineral sand sources. The age dependence may be indicative of a favorable depositional environment dependent on changes in sea level. For Quaternary sediments closer to the coast, Th is elevated over highly localized areas within sand units, mostly where 1) the sands undergo concurrent reworking from tidal and marine processes, or 2) sands have undergone multiple episodes of reworking by marine processes, as suggested by the geomorphologic context. Additional information on large-scale sediment transport is provided by radiometric K, associated with immature minerals mica and K-spar. K is elevated over rivers with headlands in the Piedmont and over the youngest Quaternary sediments. Analyses of these anomalies suggest heavy minerals are transported from the rivers to offshore areas, moved 100 km or more by offshore longshore currents, and then redeposited onshore by marine and tidal processes. Such transport has implications for the provenance and composition of Ti-Zr-REE placer deposits from South Carolina to Florida.