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Mineral Sands Occurrences in the Murray Basin, Southeastern Australia

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Abstract

The Murray Basin in southeastern Australia is proving to be a major mineral sand province that eventually will replace Australia's east and west coasts in production of rutile, zircon, and ilmenite. Concentrations of relatively coarse-grained heavy mineral occur as beach placers in the Pliocene Loxton-Parilla sands in the upper part of the Murray Basin sequence. These formed as 400-km-long barrier complexes in the "Murravian Gulf" under the action of long-period ocean swell waves. We think the main source of barrier sand, at least initially, was from erosion of Miocene sands on the bed of the Murravian Gulf; progradation was a response to sea level fluctuations linked to Milankovitch climatic cycles in the Pliocene. In most areas, the resulting 400-km-wide barrier strand plain is now overlain by fluvial, aeolian, and lacustrine deposits.

Typically, the heavy mineral deposits are ilmenite rich, with 30 to 40 percent rutile and zircon. They occur as single, or as multiple, stacked strandline deposits, are often more than 10 m thick, have mineral grades that exceed 20 percent in places, are several hundred meters wide and 10 to 25 km long; some contain up to several million tonnes of heavy mineral. The rutile and zircon are comparable in grain size and quality to minerals traditionally mined in Australia. Many of the deposits are associated with topographic ridges—the Neckarboo and Iona Ridges are the best known—that appear to be faultbounded blocks. Deposits of major commercial significance found so far contain a total of over 12 million tonnes (Mt) of rutile, zircon, and ilmenite. The total, coarse-grained mineral sand resources in the Murray Basin are conservatively estimated to be over 50 Mt.

The distribution of mineral sands in the Murray Basin seems to be associated with two aspects of the region's geology and geomorphology: (1) a zone bordering the central part of the basin where the Pliocene barriers were derived from underlying Miocene sands that probably already contained some mineral concentrations and (2) growth faulting with deposits preferentially occurring on upfaulted blocks especially in the zone defined by (1) above. We speculate that localized uplift during the formation of the Loxton-Parilla barriers was sufficient to modify coastal processes on uplifted blocks so as to increase the rate of alongshore sediment bypass compared to nearby areas. This phenomenon has been simulated in computer modeling. Where the barrier sands were already enriched in heavy minerals, winnowing by storm waves formed beach placers on the uplifted fault-blocks. Based on criteria (1) and (2), the prospective areas of the Murray Basin account for 80 percent of the beach placers found to date.