

Changing Pliocene Sea Levels and the Formation of Heavy Minerals Beach Placers in the Murray Basin, Southeastern Australia

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Abstract

The Murray basin is a major new heavy minerals province in southeastern Australia. Here, many relatively coarse grained beach placers and fine-grained offshore deposits are associated with a series of Pliocene coastal sand barriers. To date, identified resources of rutile, zircon, ilmenite, and leucoxene in more than 100 of the beach placer deposits exceed 80 million tonnes. Almost half of this resource occurs in deposits of unusual thickness in the northern part of the Murray basin. The Ginkgo deposit, one of the most important, contains up to 30 percent detrital heavy minerals over thicknesses of 40 m and widths of over 500 m. The richest and thickest part of the Ginkgo deposit coincides with an uplifted, tilted fault block bounded on its southern side by a shore-normal growth fault, and contains multiple zones of mineralization. The mineralized zones dip basinward (southwest) at 10° to 13° (much too steep to represent paleobeach facies) and consist of finely laminated beach sand with higher heavy minerals grades than those of intervening units that are nonlaminated. There is a tendency for the Ginkgo deposit overall to become more mineral rich toward the front of its enclosing barrier. Heavy minerals appear to have been concentrated where the oversteepened shoreface acted as a virtual headland that focused wave-reworking processes during marine transgressions. Each mineralized zone is thought to represent stacked beach facies that accumulated during multiple erosional marine transgressions in the Pliocene. The barrier hosting the Ginkgo deposit (and presumably others similar to it in the Murray basin) is composite and grew episodically in response to multiple sea level fluctuations with amplitudes of at least 40 m. This transgressive model for heavy minerals beach placer development in the Murray basin is in marked contrast to previous models applied to heavy minerals deposits on the coast of southeastern Australia that accumulated during periods of stable (highstand) sea level.

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