

## **A Continental-Scale Heavy Mineral Reference Framework for Mineral System Detection**

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The Heavy Mineral Map of Australia (HMMA) project provides the first continental-scale, internally consistent reference dataset for crustal heavy mineral assemblages across Australia (Walker et al., 2024; de Caritat et al., 2023). Conducted as a collaboration between Geoscience Australia and Curtin University under the Exploring for the Future (EFTF) program, this study applied automated mineralogical analysis to over 1,300 floodplain sediment samples collected during the National Geochemical Survey of Australia (de Caritat 2022).

HMMA samples were sieved to a 75–425 µm grain size and subjected to dense media separation. Heavy minerals (specific gravity >2.9 g/cm<sup>3</sup>) were mounted in epoxy and analysed using a TESCAN TIMA system. The resulting dataset comprises over 145 million individual mineral grain observations and includes more than 160 mineral species. Because the samples represent basement-derived sediments collected at catchment outlets, the resulting mineral assemblages are interpreted to reflect the integrated makeup of high-density minerals in the Earth's upper crust.

We use a weighted grain count approach to quantify the relative abundance of heavy minerals in Australian catchment sediments and propose this as a continental-scale reference framework for mineral system detection.

Through case studies using heavy mineral data collected from greenfield and brownfield terrains, we demonstrate how this mineralogical baseline can assist in identifying anomalous heavy mineral assemblages in exploration samples - particularly in weathered environments where geochemical signals are often attenuated.

This method holds promise for the rapid, cost-effective detection of mineral system signatures by integrating routine stream sediment sampling and automated mineralogy techniques. The reference framework is transparent, scalable, and compatible with other mineralogical and geochemical datasets, supporting a wide range of applications in sediment provenance studies, mineral system fingerprinting and exploration targeting.