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Geochemistry and provenance of sediment plume samples collected from the Burdekin region of the Great Barrier Reef Lagoon, Australia.

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The novel application of the SediPump® sampling device to capture sufficient sediment mass from low concentration flood plume waters has enabled catchment source tracing of GBR flood plume sediment for the first time. Focused on the single largest exporter of sediment to the GBR, the Burdekin River, three wet season discharge events were sampled from 2017 to 2019 to characterise and trace flood plume suspended sediments using geochemistry, fallout radionuclides and clay mineralogy. Sampling targeted the end-of-river (EoR) flow hydrograph to capture contributing catchment sources, and flood plume samples from both the adjacent turbid primary waters and offshore secondary waters up to 160 km from the EoR. Analysis of EoR and plume sediment major element geochemistry indicates standard geochemical sediment tracing approaches cannot be applied to a large river catchment such as this, or across the catchment-marine continuum, where particle fractionation has occurred both within the catchment and across the salinity gradient from the river mouth. Further, the secondary plume sediments have also been affected by the addition of marine-sourced carbonate and biogenic silica. We show elemental ratios of the rare earth elements (REE) and thorium (Th) can be used as stable tracers across this continuum, and importantly, used to trace Burdekin plume terrigenous sediment transported >100 km's from the river mouth back to its EoR REE/Th signal, which was unique for each of the three discharge events. These ratios were also used to trace this sediment to a major sub-catchment source. Additional fallout radionuclide ^{137}Cs analysis of a sub-set of Burdekin EoR and plume samples also reveal sediment being transported in these GBR flood plumes are almost exclusively derived from sub-surface erosion processes.