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The application of Caesium-137 and Plutonium-239+240 measurements to investigate floodplain deposition in a semi-arid, low-fallout environment

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Floodplains comprise geomorphologically important sources and sinks for sediments and associated pollutants, yet the sedimentology of large dryland floodplains is not well understood. Processes occurring on such floodplains are often difficult to observe, and techniques used to investigate smaller perennial floodplains are often not practical in these environments. This study assesses the utility of Cs-137 inventory and depth-profile techniques for determining relative amounts of floodplain sedimentation in the Fitzroy River, north-eastern Australia; a 143 000 km2 semi-arid river system. Caesium-137 inventories were calculated for floodplain and reference location bulk soil cores collected from four sites. Depth profiles of Cs-137 concentration from each floodplain site and a reference location were recorded. The areal density of Cs-137 at reference locations ranged from 13-978 Bq m-2 (0-1367 Bq m-2 at the 95% confidence interval), and the mean value $\pm$ 2(standard error of the mean) was 436$\pm$264 Bq m-2, similar to published data from other southern hemisphere locations. Floodplain inventories ranged from 68-1142 Bq m-2 (0-1692 Bq m-2 at the 95% confidence interval), essentially falling within the range of reference inventory values, thus preventing calculation of erosion or deposition. Depth-profiles of Cs-137 concentration indicate erosion at one site and over 66 cm of deposition at another since 1954. Analysis of 239+240Pu concentrations in a depositional core substantiated the interpretation made from Cs-137 data, and depict a more tightly constrained peak in concentration. Average annual deposition rates range from 0-15 mm. The similarity between floodplain and reference bulk inventories does not necessarily indicate a lack of erosion or deposition, due to low Cs-137 fallout in the region and associated high measurement uncertainties, and a likely influence of gully and bank eroded sediments with no or limited adsorbed Cs-137. In this low-fallout environment, detailed depth-profile data are necessary for investigating sedimentation using Cs-137.