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Temporal evolution of sediment source contributions in a mining catchment of New Caledonia by using a tracing approach combining radionuclides and geochemistry

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New Caledonia is an island located in the south-west of the Pacific Ocean, containing large nickel resources. It is currently the world's sixth largest nickel producer. Although the mining sector has contributed to the economic growth in New Caledonia since the 1870s, it is considered to be the main driver of environmental degradation. Indeed, the excessive sediment input generated by soil erosion from open-cast mining areas has strongly modified the morphology of rivers (hyper-sedimentation) and impacted the island's ecosystems (flooding, lagoon siltation, water pollution).
Nevertheless, the past and ongoing contributions of suspended sediment sources have not yet been quantified. The objective of the current research is to characterize the evolution of sediment source contributions over the last 40 years to identify the mining activities impacts (showing a peak in the 1970s) and the sediment pollution.
To this end, a pilot sediment tracing study has been conducted in one of the first areas exploited for nickel mining, the 400-km^2 Thio River catchment. Mining (ie. overburden, bare mining soil and access road erosion) and no-mining sources (ie. landslides, bushfires) were identified with an approach combining radionuclide and geochemical measurements. In addition, a 1.60 m long sediment core was collected in the Thio river deltaic floodplain in April 2016. Sediment dating was carried out on the chronology of flooding based on a rainfall-discharge statistical analysis in the Thio region. A distribution modelling approach was used to reconstruct sediment source contribution temporal variability in the successive sediment layers.
Results demonstrate that the contribution of mining sources largely dominated with a mean contribution of 65 % over the entire profile. The fifteen flooding events identified by the statistical analysis generated the deposition of around 1 m of sediment in the floodplain at that location over the last forty years. An increase in the mining source contribution was observed along the sediment profile and particularly at 1-m depth, i.e. a depth corresponding to the 1970s nickel production peak.
In the future, similar studies should be carried out in other catchments draining mines in New Caledonia to investigate whether the temporal changes in the mining source contribution were similar to those observed in the Thio river catchment in order to guide the implementation of control measures.