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Trace metal and rare-earth elements in a sediment profile from the Rio Grande reservoir, São Paulo, Brazil, by INAA

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The Rio Grande Reservoir, located in the southeast of the Sao Paulo Metropolitan Area, supplies water for four counties (about 1.6 million people). This reservoir has been seriously affected by urban expansion due to chaotic urban occupation. It also suffers from a large amount of untreated domestic and industrial sewage and waste released directly into the reservoir. In this study, a 0.40 m sediment core was collected near the catchment point of the water supply, sliced into 2 cm layers (20 samples) and dated by the ²¹⁰Pb method. Samples were air dried at 20–25 °C, passed through a 2 mm sieve, ground in a mortar and then homogenized before analysis. The samples were then submitted to instrumental neutron activation analysis (INAA) in the IEA-R1 nuclear research reactor at IPEN and As, Ba, Ca, Co, Cr, Cs, Fe, Hf, Na, Rb, Sb, Sc, Ta, Th, U, Zn and the rare earths Ce, Eu, La, Lu, Nd, Sm, Tb and Yb were determined. The uncertainties of the results were calculated by error propagation. The validation of the methodology for precision and accuracy was verified by measuring the reference materials SL 1 (Lake Sediment 1, IAEA), Soil 5 (IAEA) and BEN (Basalt-IWG-GIT). The enrichment factor (EF) was calculated using the concentrations in the deeper layer of this profile as reference values and Sc as a normalizing element

(range value 17.9 to 22.1 mg kg⁻¹, median 20.2 ± 1.0). Significant enrichment (1.5 < EF < 5.5) was found for Zn, Na, La and Sb in the upper layers. For Sm and Fe no significant enrichment (1.0 < EF < 1.5) along the sediment profile was observed. For the other elements (Ce, Hf, Lu, Rb, Ta, Tb and Yb) the enrichment occurred in the deeper layers or along the profile and showed depleted levels in the upper layers. The elements Cr and U presented enrichment (1.0 < EF < 1.5) in the middle of the sediment profile, with upper and deeper layers presenting lower concentrations. From the data obtained in the present study it was possible to trace the history of pollution by some metals and trace elements in this reservoir for approximately the last 50 years.