French Polynesian nuclear fallout in lake sediments: a global new time marker for the Southern Hemisphere

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Résumé

Since the 1950s, the global deposition of artificial radionuclide fallout (e.g., 137Cs, 241Am, 239Pu and 240Pu) has been used for several decades to support the dating of recent sedimentary archives. Artificial fallout radionuclides, which are used as time markers for dating modern archives, are nonetheless less constrained in both space and time in the Southern Hemisphere than in the Northern Hemisphere.
To improve our understanding of the spatial and temporal distributions of Pu isotopes in the Southern Hemisphere, we measured 239+240Pu activity and the 240Pu/239Pu isotope ratios in lake sediment cores collected in southern Africa and in Oceania. For this study, we selected three lakes in South Africa, one lake of Kerguelen Islands, two lakes in New Zealand, and two lakes in the Vanuatu Archipelago, on the basis of their 210Pb and 137Cs vertical profiles.

Preliminary results indicate low 239+240Pu activity peaks across all lakes (between 0.29 and 2.14 Bq.kg-1), with a 240Pu/239Pu ratio of 0.18, which is consistent with global fallout. Towards the top of the Pu activity peaks, sediment layers show a shift in the 240Pu/239Pu ratio from global fallout values towards lower ratio values, showing a contribution of fallout associated with French nuclear tests in Polynesia ($0.10 < 240Pu/239Pu < 0.16$).

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To facilitate the comparison of Pu deposition among lakes, calculations of Pu fluxes (Bq.m-2.yr-1), Pu inventories (Bq.m-2) and French fallout contribution to global fallout, were also conducted.
This study shows to what extent Pu isotope ratios can distinguish between different nuclear weapon testing periods in the Southern Hemisphere (e.g., British tests in Australia and French tests in Polynesia) and compare the levels of 239+240Pu deposition across southern Africa and Oceania where this type of measurements have been particularly scarce to date.

Mots-Clés: Lake sediments, Pu, istopes, radionuclide