210Pbex in lacustrine sediments: A half-century global synthesis

Renaldo Gastineau*†[1], Floriane Guillevic[2], Palak Aggarwal[2], Anthony Foucher[3], Olivier Evrard[3], Christine Alewell[2], and Pierre Sabatier[1]

[1]Environnements, Dynamiques et Territoires de Montagne – Université Savoie Mont Blanc, Centre National de la Recherche Scientifique, observatoire des sciences de l'univers de Grenoble – France
[2]Environmental Geosciences, University of Basel – Suisse
[3]Laboratoire des Sciences du Climat et de l'Environnement – Laboratoire des Sciences du Climat et de l'Environnement, LSCE/IPSL, CEA-CNRS-UVSQ, Universite Paris-Saclay, 91198 Gif-sur-Yvette, France – France

Résumé

210Pbex chronology has been widely used for reconstructing sediment accumulation over the past century, particularly for investigating recent environmental and climatic changes in lacustrine environments. However, a comprehensive global synthesis of 210Pbex data is currently lacking.
210Pb exists in two fractions: supported and unsupported (or "excess"). Supported 210Pb is in secular equilibrium with its parent isotope, 226Ra, and is typically found in deeper sediment layers. This fraction provides a stable baseline for dating. In contrast, unsupported 210Pb is deposited via atmospheric fallout from the decay of 222Rn and is concentrated in the uppermost sediment layers. The often-observed 210Pbex exponential decrease with depth is commonly used to date sediments from the past 100–150 years, using most of the time gamma spectrometry for the measurements.

In this ongoing review, we compiled and standardized data from 670 lake sediment cores across 358 studies published between 1977 and 2024 CE. These data are integrated with environmental covariates such as temperature, precipitation, lake morphometry, and elevation. Our preliminary analysis reveals significant spatial gaps in 210Pbex data coverage, particularly in tropical regions (e.g. 20∘N to 20∘S), and aims to develop a predictive framework for estimating 210Pbex activities in underrepresented areas.
To explore the environmental drivers of surface excess 210Pb activity, we developed a random forest regression model. For 210Pbex initial activity, the initial results indicate a strong predictive performance with latitude, precipitation, and elevation identified as key predictors. Sedimentation rate data are currently being processed to obtain similar predictions. These findings represent a first step toward establishing a global predictive model for 210Pbex surface activity, which could enhance radionuclide-based chronology in data-scarce regions.

Mots-Clés: radionucléides, Pb210, lac, review, chronologie

*Intervenant
†Auteur correspondant: renaldo.gastineau@univ-savoie.fr