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Geochemical and radionuclide characterization of Holocene deposits in the margins of Grey Glacier for identifying the provenance of lake sediments (Torres del Paine, Chile)

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The polar and high mountain regions have proven to be one of the most vulnerable areas in the world to climate change. The glaciers in South America play a fundamental role in the associated ecosystems, as well as, for the populations that live downstream, which suffer the consequences of glacier retreat and even its disappearance. Because the challenge that glacier shrinkage represents it is relevant to evaluate the effects of the retreat of these glaciers on soil, sediments and water availability and quality.

This study, carried out in the Grey Lake and Glacier, located in National Park Torres del Paine, Patagonia, Chile, aims to characterize through geochemical analysis (28 stable elements), fallout radionuclides (FRNs, ^{137}Cs and ^{210}Pb$_{ex}$) and environmental radionuclides (ERNs, ^{40}K, ^{226}Ra, ^{238}U and ^{232}Th), the soils and glacial deposits located in the eastern and western margins of the glacier and with connectivity to streams and water courses draining into the Grey Lake. For this purpose, in January 2015 during a two weeks campaign supported by IAEA INT5153 project, composite surface samples of potential sources were collected for an estimate of their relative contribution to the lake sediment. By comparing the characteristics of the sources with the suspended sediments collected from Grey Lake using the fingerprint technique it is possible to provide an estimate of the source apportionments. In addition, soil profiles were sampled at stable sites to analyse the vertical distribution of the FRNs, ERNs and stable elements as a reference for the study area.

The soil profiles at the reference site showed distinctive patterns in the depth distribution of the radionuclides. The mass concentration of activity of ^{137}Cs and ^{210}Pb$_{ex}$ (Bq kg^{-1}) was highest in the upper layer of the soil and the penetration depth was 12 cm and 10 cm, respectively. The depth distribution of ^{226}Ra, ^{232}Th and ^{238}U in the soil profiles was quite homogeneous and a greater variation was found for ^{40}K, likely related to differences in the mineralogical composition of the soils.

The preliminary results show that the differences found in the composition of stable elements and radionuclides in the surface samples allowed the identification of five sediment source areas: fluvial terraces, moraines, swamps, colluvial and forested slopes that correspond to different geomorphological zones created or modified by the dynamic of the glacier. It was found that the forested and colluvial slopes are the areas with the highest relative contribution of the sediment discharge to the lake, which is likely due to fires that have affected the eastern margin of the lake in recent years.

By collecting sediment cores from the bottom of Grey Lake in the near future, it would be possible to additionally provide a temporal perspective of changes occurred in the sediment sources in the last decades.

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