Pollution trends of trace metals in remote areas of Central Mexico: mercury and lead in sediments from high altitude mountain lakes.

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Abstract

El Sol and La Luna are two high altitude mountain lakes inside the crater of the Nevado de Toluca stratovolcano (4,200 m a.s.l.), within a natural protected area, in Central Mexico. Both lakes are perennially astatic, highly transparent and warm polymictic, with a uniform vertical distribution of phytoplankton biomass. Two sediment cores, collected at each crater lake, were analyzed to assess Hg and Pb accumulation rates and pollution trends during the past century. The chronology of the cores was obtained by radiometric methods such as ^{210}Pb, ^{137}Cs and $^{239+240}$Pu. Grain size, magnetic susceptibility and sedimentary constituents, such as organic carbon, calcium carbonate, as well as major (Al, Fe, Mn) and minor (Ti, Rb, Zr) elements, were used to explain the concentration trends of both pollutants, and a factor analysis was used to elucidate their provenance. Hg and Pb concentration ranges were comparable between both sediment records, ranging from 65 to 245 ng g^{-1} for Hg, and from 25 to 172 mg g^{-1} for Pb. Both trace element concentrations showed increasing trends towards the core surface, with the highest values observed since the 1950s in both lakes. The aluminum-normalized enrichment factors reached maximum values between 2 and 4 for Hg, and between 3 and 6 for Pb. Since El Sol and La Luna crater lakes are located within a protected area, where no industrial or urban settlements exist; therefore, the highest Hg and Pb concentrations in recent sediments can only be explained by long-range atmospheric transport and deposition, most likely originated from the industrial areas of the main cities of Toluca and/or Mexico City.

Keywords: mercury: Lead; ^{210}Pb, sediments, crater lake, Nevado de Toluca

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