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Tracking of anthropogenic influences in the last centuries in Southern Chilean lakes: Organic (C/N, d13C) and Pb isotope geochemical signatures of Laguna Chica de San Pedro (36.4°S) and Lago Puyehue (40.7°S) sediments

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Chile is one of the most industrialised countries in South America, with over 90% of its population living in urban areas. In this work, we study the impact of increasing industrial activities and land-degradation during the last 150 years in two Southern Chilean lakes located in contrasted areas. Laguna Chica de San Pedro (LSCP) is a small (0.8 km2, water depth 18 m), coastal and mesotrophic lake, located in the Bio-Bio Region, near the city of Concepcion (36.4°S). Lago Puyehue is a larger water body (164 km2, water depth 123m): it is an oligotrophic moraine-damned lake situated at the foothills of the Chilean Andes (40.7°S), in a national conservatory park. In both lakes, we focus on the upper 20 cm of sediment core, a section that covers the 1850-2000 interval according to 210Pb age model. Organic geochemical data were performed every cm using an elemental analyser coupled with an IR-MS. Around ten Pb isotope signatures were obtained by MC-ICP-MS analyses on bulk sediments after chemical dissolution and AG1X8-resin exchange. LSCP sediments are terrigenous and composed of fine, organic rich- ($3<TOC<5\%$) silts with only a few % of biogenic

silica. Measured C/N atomic ratios evidence significant shifts recording variable contribution of lacustrine versus terrestrial organic matter for the last 150 years. In the lower interval (15-20 cm) the low C/N values (close to 14) mainly record the lacustrine productivity until 1915-1937. Since 1937-1953 C/N ratios sharply increase in successive steps, reaching 18.6 in the Eighties (1984-1986, interval 5-14 cm). Such an irregular increase records successive important terrestrial supplies, confirmed by a concomitant lowering of the d15N values (from 2.5 to <2) within the same sediment section. The main shifts fit with erosive phases that were attributed to land-degradation within the watershed (Debels et al., 1999, abstract conferencia latinoamericana). Since the late Eighties (1986-1990), C/N and d13C decrease to 13.6 and -26.5 per mil, respectively. This evolution in the upper section (0-4cm) suggests either a land-use stabilisation with the watershed or a recent increase in lake productivity. In contrast the Lago Puyehue sediments that are composed by a mixture of volcanoclastic terrigenous particles, biogenic silica and organic matter (TOC 2-3%) show quite stable C/N and d13C values, ranging around 13-14 and 28-29 per mil, respectively. In this natural area organic geochemistry is not affected by any change in the watershed and the organic matter is mainly autochtonous. Finally in both environments a contamination by industrial airborne particles is recorded by a decrease of the 206Pb/207Pb isotopic ratio during the last decades. The decrease is larger in LCSP that in Lago Puyehue. In LSCP the inception of airborne pollution is consistent with the detection of spheroidal carbonaceous particles, i.e. residue of fossil fuel combustion, within the sediments (Chirinos et al., 2005 - Environmental pollution). Coupling organic geochemistry and Pb isotopes in lacustrine sediments allow us to assess the local and global impacts of anthropogenic activities in Southern Chile.