Mercury bioaccumulation in high altitude lake ecosystems of the Bolivian Altiplano region (Lake Titicaca endoreic basin)

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Abstract:

Methylation and biomagnification of mercury (Hg) are well documented in most aquatic ecosystems. Few data exist in high altitude lake ecosystems, in particular from the Bolivian Altiplano region. Recent work performed in the framework of the INSU COMIBOL and ANR LAPACHAMAMA projects were conducted in Lake Titicaca and Lake Uru-Uru, where Hg analysis, and trophic tracer (stable isotope of $\delta^{13}C$ and $\delta^{15}N$) were determined in different compartments.

Both lakes are located in a semiarid region and form part of the endoreic bolivian-peruvian Titicaca catchment located at 3800m. Lake Uru-Uru is directly connected to Lake Titicaca by the Desaguadero River, it also has additional tributaries polluted by effluents of mining and urban origin.

In lake Uru-Uru, stable isotope ($\delta^{13}C$ and $\delta^{15}N$) analysis of the different compartments showed that the bottom sediment (organic matter) was the most important carbon source for the food webs. Macroinvertebrates were preferentially primary consumers, showing intermediate mercury concentrations (0.2 – 0.4 mg/Kg). The higher trophic positions were represented by fishes (*Orestia* spp.) and piscivorous waterbirds (*Rollandia rolland*) respectively, showing the highest Hg concentrations (>0.5 mg/Kg).

In lake Titicaca, the same foodweb structure was observed as in Lake Uru-Uru. A significant Hg bioaccumulation trend was observed, although Hg concentrations at each trophic level were much lower than in Lake Uru-Uru. Spatiotemporal analysis of Zooplankton among 4 different sites in lake Titicaca showed the highest concentrations in the Cohana bay (0.1 mg/Kg), likely reflecting the influence of El Alto city effluents. Mercury concentrations were found much lower in the Lago Grande region (Isla de la Luna, 0.020 mg/Kg) and at two other stations in the Lago menor (Chua, Huatajata 0.025 mg/Kg). Two-year monthly monitoring survey at these two last sites showed that Hg concentrations in zooplankton vary seasonally ranging between 0.010 and 0.050 mg/Kg.

Comparison among the two lake systems shows that Hg levels in the food webs were directly related to the net production of Methylmercury (MeHg) at the base of each lake system. Lake Uru-Uru showed MeHg dissolved concentration of approximately 700±100ng/L, compared to 55±50 ng/L in Lake Titicaca. This difference likely reflects a higher Hg methylation in lake Uru-Uru compared to Lake Titicaca where MeHg photodegradation is enhanced (confirmed by Hg stable isotope analysis). In both lakes, Hg transfer and biomagnification along the trophic structure (from source to top predator) was observed. These results show that mercury methylation processes are significant in high altitude lake ecosystems.

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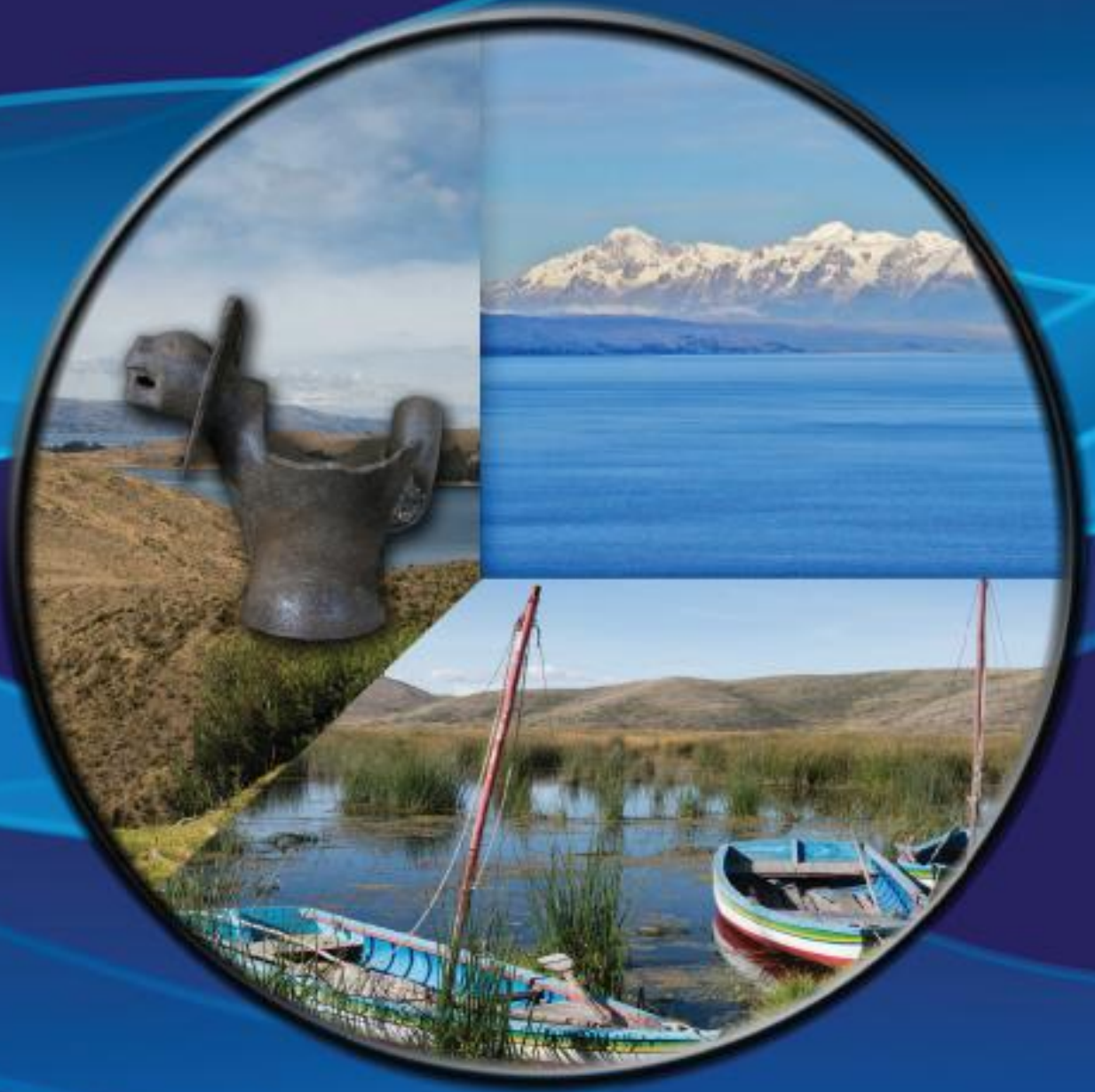

La Paz, 3 al 5 de mayo de 2016
Universidad Mayor de San Andrés, Cota Cota, La Paz

Proceedings

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General Planning

- **May 3rd 2016: Contamination and eutrophication of Lake Titicaca**

AM session: Mercury biogeochemistry and contamination of aquatic ecosystems of the Andes region
Keynote Lecture: Hg contamination in Latin America: the past is not what we think, nor the future (J.-R. Davee Guimarães).

PM session: Chemical contamination, eutrophication and monitoring of Lake Titicaca and its watershed
Keynote Lecture: Eutrophication of the Cohana Bay (D. Acha).

- **May 4th 2016: Arsenic issues in the Andes**

AM session: Arsenic biogeochemistry and contamination of aquatic ecosystems of the Andes region
Keynote Lecture: Arsenic contamination of groundwater (Chile) (G. Lobos).

PM session:
Workshop 1: Arsenic and mercury speciation.
Workshop 2: Paleoenvironmental studies in the Andean altiplano.

- **May 5th 2016: Historical reconstructions of the human-climate interactions in the altiplano: implication of archeological purposes**

AM session: Paleo-environmental reconstruction of Altiplano's archives
Keynote Lecture: Holocene Paleoclimatic and Paleoenvironmental History of the Lake Titicaca Basin (S. Fritz & P. Baker).

PM session: Archeology: historical human – environment interactions
Keynote Lecture: Recent contribution of terrestrial and subaquatic archeological investigation in Lake Titicaca (C. Delaere & M-A. Vella).