Paleo-environmental reconstruction of mercury and terrigenous organic matter dynamics in large Northern Quebec boreal lakes: an assessment of anthropogenic activities occuring in their watersheds

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Mercury dynamics in boreal lakes is of special concern as human populations may be exposed to the contaminant through fish consumption.To evaluate the impact of watershed pertubations on the mercury dynamics in boreal aquatic systems, we studied sediment cores retrieved in six large boreal lakes of Québec (Canada) with watersheds disturbed by anthropogenic activities such as logging or mining activities, and in two undisturbed lakes chosen as reference lakes. Sediment rates were estimated by ^{210}Pb dating and range from 0.03 to 0.33 cm/yr. Total mercury (THg) contents and lignin biomarkers (refering to both quantity and quality of terrestrial organic matter (TOM)) were measured in all eight cores whereas watershed modifications over a 30 year period were determined by analysis of remotely sensed images using GIS. In all cores, THg concentrations significantly increased over recent years with maximum values comprised between 70 and 370 ng/g, the lowest THg contents being observed in reference lake cores. Anthropogenic Sedimentary Enrichment Factor (ASEF) is comprised between 2 and 15 and surprisingly, not all the lakes with disturbed watersheds present an ASEF superior to the value of 3.5 usually reported in the literature [1]. Our results allowed us to emphasize the importance of mean slope inclination, repartition of slopes in classes and vegetation cover in the drainage area on Hg fluxes reaching lake sediments. Results from this study suggest that in large boreal lakes ecosystems, the size and the characteristics (e.g. nature of the vegetation cover, mean slope) can promote the uptake of atmospheric Hg leading to enahanced presence of THg in sediments. Then, supplementary Hg transfers from the watershed to the aquatic systems due to anthropogenic activities (e.g. logging and mining activities) can be masked in sedimentary profiles. This study also underlines the importance of TOM as vector of Hg since sedimentary Hg enrichment appears proportional to the amount of TOM coming from the watershed.

[1] Lucotte *et al.* (1995) Water, Air, and Soil Pollution **80**, 467-476.

Cave sediments as repositories of very old fossil invertebrates

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Introduction

Cave sediments preserve the geological and paleoenvironmental past as well as biological and anthropological information, important for the terrestrial continental history, where correlative sediments are mostly missing [1]. Our studies are first attempts to use fossil invertebrates from cave sediments as proxy in paleoclimate studies. Microbiological studies have been added to explain the processes of preservation.

Results

Six caves (S-E Europe) provided fossil invertebrates, mostly mites, springtails and ostracods, originating from the surface environments. All these groups are excellent as paleoecological bioindicators and were identified in Pliocene-Pleistocene sediments (Fig. 1). Their presence has been correlated with other proxies and provided reliable information about the type of vegetation on the surface and the deposition condition inside caves. Microorganisms isolated from the sediments were extremely scarce, with differences in the amount of bacteria or fungi.

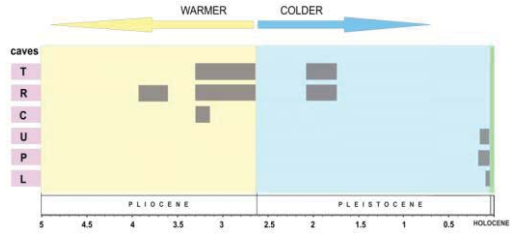

Figure 1: Invertebrate fossils found in the studied caves.

Conclusion

The depositional mechanisms and the low intensity of biochemical processes can explain the relatively good state of preservation of old invertebrate remains both in the cave sediments and Arctic lake sediments [2]. Considering the age of sediments, the state of preservation is relatively good. This may suggests a combination of: (1) a relatively short and slow transport to the site of deposition, (2) a rapid burial, i.e. a high sedimentation rate, and (3) subdued microbial and biochemical processes that could have altered the entire organisms. The difference we found in the concentration of bacteria or fungi, at different sediment levels, can also be correlated with dry/wet periods [3] and the work is still in progress.

[1] Sasowsky & Mylroie (2004) *Studies of Cave Sediments*. Kluwer Academic. [2] Moldovan *et al.* (2011) *Biogeosciences* **8**, 1825-1837 [3] de Vries *et al.* (2012) *Nature Climate Change*, DOI: 10.1038/NCLIMATE1368