M. Lucotte · R. Schetagne · N. Thérien
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Mercury in the Biogeochemical Cycle

Natural Environments and Hydroelectric Reservoirs of Northern Québec

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With 69 Figures and 46 Tables

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Foreword

Nowadays, major environmental issues are the object of large public debates despite the fact that scientific knowledge is often insufficient to draw unequivocal conclusions. Such is the case in the ongoing debate regarding the specific contributions of anthropogenic greenhouse gas emissions and of natural climate changes to global warming. At least 10 to 20 years of additional observations will be required, before we will be able to conclude, with certainty, on this subject. In the *mean time, and as directed by their immediate interests, people will continue to* promote contradictory opinions. The media are, in part, responsible for perpetuating such debates in that they convey indiscriminately the opinion of highly credible scientists as that of dogmatic researchers, the latter, unfortunately too often expressing working hypotheses as established facts. Naturally, in a similarly misinformed manner, pressure groups tend to support the researcher whose opinions most closely represent either their particular ideological battles or their economic interests and, hence, in their own way, add further to the confusion and obscurity of the debate.

Only a few years ago, mercury (Hg)contamination in hydroelectric reservoirs *was the object of such media and social biases. At the time, analytical data used to* support the discourse were themselves uncertain and numerous hypotheses, often times fanciful, were proposed and hastily "delivered" to the public. Thankfully, in this case, the scientific progress of the past decade has made it possible to present now a dispassionate view of the question and, hence, to address the issue without its former irrational aspects. The review that follows falls within the scope of such a perspective. It presents an exhaustive review of what is known about the biogeochemical cycling of Hg in hydroelectric reservoirs as well as in natural aquatic systems of the boreal forest region of northern Québec. This work constitutes the North American counterpart to a parallel publication by Scandinavian researchers. The convergence of both studies permits the drawing of important conclusions.

Indeed, the food chain of numerous aquatic ecosystems is contaminated by Hg. The contamination can even reach, in certain organisms, such as predatory fish and aquatic mammals, levels that exceed those prescribed by governmental agencies. This contamination is unfortunately already widespread in natural lakes, but it is particularly noticeable in hydroelectric reservoirs during the first few decades following their impoundment. With respect to natural lakes, the role of increasing anthropogenic Hg emissions cannot be ignored. The present study clearly shows

that the atmospheric fluxes of this metal have increased by a factor of three over the past century. In the second case, i.e., that of hydroelectric reservoirs, the extensive flooding of soils, whose various horizons accumulate both natural and anthropogenic heavy metal pollutants, also plays a critical role. In either case, the stimulation of bacterial activity by the availability of organic matter appears to be a determining factor. In fact, the availability of organic matter is the key to the bacterial processes leading to the methylation of Hg, that is, to its transformation from its inorganic state (essentially nontoxic) to an organo-metallic form that readily bioaccumulates in the food chain.

The various chapters of this volume represent benchmark contributions not only for a better understanding of the biogeochemical cycling of Hg but also, more generally, for a better management of the associated social issues. From a practical point of view, one can conclude with some relief that the enhanced Hg contamination of hydroelectric reservoirs subsides in a period of, at most, only a few decades, and that during this transitory period Hg levels in a number of the fishery resources remain below tolerable limits. Unfortunately, the long term contamination of aquatic systems, be they natural or developed, as a consequence of increasing atmospheric contaminant fluxes, remains disconcerting and will demand action on an international scale to be rectified.

Nevertheless, the following work will constitute an important reference in the scientific literature for many years. It is exhaustive, scholarly, solidly supported, and marks the conclusion of a university-industry collaborative effort initiated nearly ten years ago, under the aegis of the Hydro-Québec-Université du Québec à Montréal *Chaire de recherche en environnement*, with the support of the National Science and Engineering Research Council of Canada and the collaboration of the Université de Sherbrooke and the Canadian Wildlife Service. The findings presented in this volume are the outcome of an exemplary collaboration between university researchers and Hydro-Québec scientists. Many findings central to this work were successfully concluded and sanctioned in the form of Master's and Ph.D. theses, all of which constitute important annexes in support of the present document. The reader who wishes to get deeper insights about given aspects of the biogeochemistry of Hg, may refer to these complementary works. However, as it is, the present volume is detailed enough to provide answers to most questions one could have about the Hg contamination of the boreal forest domain of Québec.

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