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Luiz D. de Lacerda · Wim Salomons

Mercury from Gold and Silver Mining: A Chemical Time Bomb?

With 44 Figures and 29 Tables

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Dr. Luiz D. de Lacerda
Universidade Federal Fluminense
Dept. Geoquimica
Centro Niteroi
24020-007 Rio de Janeiro
Brazil

Professor Dr. Wim Salomons
GKSS Research Center
Max-Planck-Strasse
21502 Geesthacht
Germany

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Preface

Mercury contamination is considered one of the worst hazards among the anthropogenic impacts upon the environment. It is one of the few metal pollutants which has already caused human deaths due to ingestion of contaminated food. It is estimated that in the whole world more than 1400 human beings have died and over 20 000 have been afflicted due to mercury poisoning, with mortality rates ranging from 7 to 11% (WHO 1976; D'Itri and D'Itri 1977; Lodenius 1985; D'Itri 1992).

Mercury is easily transformed into stable and highly toxic methylmercury by numerous microorganisms. This Hg species typically shows very long residence times in aquatic biota, resulting in severe contamination of fish in many regions. This can lead to serious economic problems for populations depending on fisheries and other aquatic resources. It was in the fishing village of Minamata, in Japan, where between 1956 and 1960 more than 150 people died and over 1000 were handicapped for life due to consumption of mercury-contaminated fish. The contamination started by the release of relatively harmless mercury compounds. However, under the anaerobic conditions prevailing in the local aquatic sediments, bacterial activity transformed inorganic Hg into the highly toxic methyl-Hg compound (Fujika 1963). By December 1987 more than 17 000 persons had been affected by methyl-Hg poisoning and 999 individuals had died (D'Itri 1992). Later, the same situation caused 6 deaths and 47 seriously ill in 1964 in Niigata, Japan. For the first time, the magnitude and seriousness of the problem of mercury contamination were understood. It is noteworthy that Hg inputs in Minamata Bay started some 40 to 50 years before the first symptoms of Hg poisoning appeared in the population. Other examples of severe Hg poisoning occurred in Iraq in 1972, where wheat seeds coated with methyl-Hg salts for protection against fungi were consumed by the rural population in the provinces of Ninevah, Kirkuk and Acbil. Over 6000 people were poisoned and 459 died (Bakir et al. 1973). In Brazil in the late 1970s, Hg also caused serious health problems among sugarcane farmers who used Hg compounds for sugarcane seedling protection (Camara 1985, 1986).

Although on a smaller scale, contaminated seeds used to feed pigs in New Mexico, USA, also caused serious health problems in farmers who had consumed pork with high concentrations of methyl-Hg (Mitra 1986).

This book focuses on the utilization of mercury in gold and silver mining. Once widespread worldwide up to the beginning of the present century, it faced a decline to near cessation due to the exhaustion of gold- and silver-rich reserves in the Americas and later to the invention of cyanide leaching. Recently, however, a confluence of economic and social situations, mostly in developing countries located in the tropics, has resulted in a new rush for gold and silver by individual entrepreneurs, for whom mercury amalgamation is a cheap, reliable and easy to carry out operation. This use of mercury is associated with large losses to the environment, in particular to the atmosphere. In this way, it ends up in places far away from where it is in use. Moreover, where gold mining occurs, hot spots of mercury remain. Both the hot spots and its widespread distribution in the environment cause effects which have been called colloquially chemical time bombs. The chemical time bomb concept deals with the limited capacity of soils and sediments to reduce the mobility and bio-availability of pollutants. Several properties (capacity-controlling parameters) of the soil, e.g. organic matter content and variables like pH and redox, contribute to these inherent soil and sediment properties. Although these capacity-controlling parameters can be reduced, even with no additional contaminant loading, negative effects on the environment may occur (Salomons and Stigiliani 1995). For example, in Scandinavia, mercury levels in freshwater fish are increasing even though emissions and deposition of mercury have been decreasing for several decades. The contamination of fish has been attributed to the remobilization of mercury locked in watershed soils decades ago, and now mobilized by soil acidification.

Although much information is already available on the fate and effects of mercury in temperate climate systems and on delayed effects (Salomons and Stigliani 1995), relatively little information is available for the often more sensitive tropical ecosystems. In this book, the widespread use of mercury in gold mining, its distribution in the tropical environment, and its impact on the ecosystem and on humans are documented for the first time.

The decision to write this book was made after a visit by L. D. Lacerda to Haren, Holland, to work with W. Salomons on a report on the situation of the Amazon region regarding mercury contamination. The visit, in the summer of 1991, was sponsored by the Dutch Ministry of Housing, Physical Planning and the Environment. In the following years, it became clear that mercury contamination due to gold mining was a global rather than a local phenomenon. At various scientific meetings since 1991, we have had the opportunity of talking to scientists from many countries where the problem was just beginning, and the resultant picture was quite alarming. This book, therefore, is not intended to be a definitive work on the subject, but tries to review in an integrated way the present knowledge on mercury contamination due to gold mining.

Both of us worked together in the Amazon region, and this was fundamental to the development of many ideas expressed here. This fieldwork was supported by many Brazilian institutions, in particular the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Brazil), the Centro de Tecnologia Mineral (CETEM, Rio de Janeiro) and the Universidade Federal Fluminense (UFF, Niterói). The possibility of working together in the field was unique for the development of this book, and the Brazilian and Dutch governmental agencies are gratefully acknowledged for their support.

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Luiz D. de Lacerda
Wim Salomons

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