Mercury in air, water and bottom sediments of northeast Asia, Influence of natural and anthropogenic mercury

MERCURY IN AIR, WATER AND BOTTOM SEDIMENTS OF NORTH-EAST ASIA, INFLUENCE OF NATURAL AND ANTHROPOGENIC MERCURY

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Power plants are one of the main anthropogenic sources of mercury emission in the atmosphere. More than 70% of mercury is released in the atmosphere as elemental mercury. Resident time of mercury in the atmosphere is about a year. It is established that about 80% of Hg, inhaled by a person, remains in the body and it deposits in various internal organ including the brain. Since mercury is a reason of various diseases, it is clear the interest showed in methods of determination of mercury in various samples. Mercury emission in the environment is produced both by natural and anthropogenic sources and increases technogenic mercury has been noted in recent years *[Dastoor and Larocque, 2004]*.

For the mercury investigations we used a mercury Zeeman atomic absorption spectrometer with high frequency modulation of light polarization RA-915+ (manufactured by Lumex Ltd, Russia) for direct on-line measurements of the mercury concentration in air and samples of water and bottom sediments with additional equipment. The real-time measurements are made with visualization of the process on a computer display. The detection limit is governed by shot noise and equal DL = 2 ng/m^3 (average time being 1 sec) and DL = 0.3 ng/m^3 (average time being 30 sec) for mercury determination in air *[Sholupov et al., 2004]*. Usually we use the average time of measurement equal 300 sec, so the detection limit were less 0.3 ng/m^3 (about 0.2 ng/m^3). To perform a measurement, the spectrometer is placed on the top deck in the front part of the ship. Air flows continuously through the analytical cell. The blank signal is regularly checked by passing the gas through a special filter with the Hg-adsorption efficiency of 98-99%.

The RA-915+ mercury analyzer equipped with the RP-91 attachment is used for the determination of the mercury content in sea water. The principle of operation of the RP-91 attachment is based on the reduction of Hg (II) to the atomic state using a reducing solution with the following transportation of the mercury atoms into an analytical cell by an air flow (the "cold vapor" technique). The RP-91C attachment enable mercury determination in complex-matrix samples, such as soil, rocks, etc., using the pyrolysis technique without sample pretreatment.

In bottom sediments of Amur Bay near Vladivostok were revealed the increase content of mercury (Figure 1). It in general coincides with already known area of accumulation of mercury and other polluting substances *[Tkalin and Presley, 2003]*. By comparison of contents in the top polluted layers of cores and bottom - not polluted has come to light, that sediments of all the of Amur Bay are polluted with mercury. The contents of "excess" mercury - exceeding an average regional background (21 ppb) received for not polluted parts of cores have been designed. On a map of distribution of this mercury (Figure 1) besides a northwest part of Amur Bay, with anomal contents, the contents are characteristic for the central part of a gulf and some sites at coast. Within the limits of the investigated area almost not polluted the area can be considered only southern. The basic form of mercury in bottom sediments is sulphidic.

We sampled the concentration of Hg in air 840 times during Leg1 of the RUSALCA expedition from Vladivostok, Russia to Nome, Alaska. Atmospheric monitoring of mercury along this leg track revealed high concentrations in the Japan Sea near the Asian coastline (2.8 ng/m^3). By contrast, Hg in air values in the Okhotsk and Bering Seas averaged 1.6 - 1.7 ng/m^3. The very high level of mercury concentration detected during this investigation over the Japan Sea is a likely

reflection anthropogenic sources from mainland Asia and matches the analyses made by *Dastoor and Larocque [2004].*

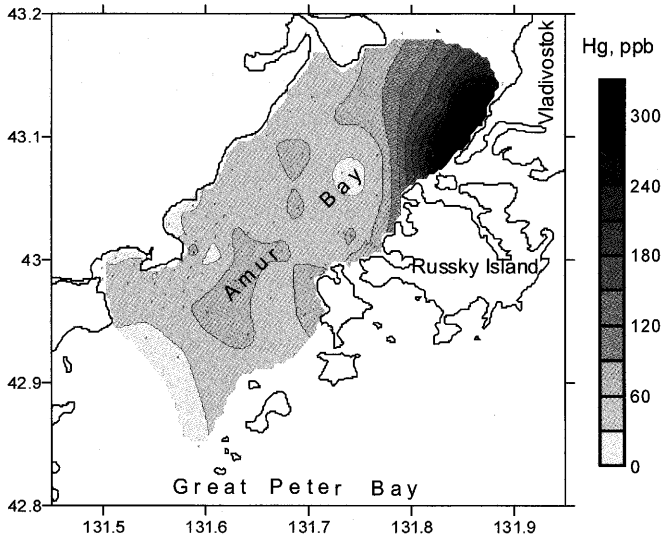

Figure 1 The "excess" anthropogenic Hg content (ppb) in surface sediments of Amur Bay (Japan Sea)

Local atmospheric Hg anomalies (Figure 2) in excess of 7 ng/m^3 (average time being 300 sec) were detected after the ship crossed through the LaPerous Strait, the body of water that separates Sakhalin from Hokkaido Islands (and Russia from Japan). This body of water lies above Central Sakhalin Fracture Zone which is a plate boundary that separates the Amur and the Okhotsk Litospheric Plates. The strait is characterized by volcanic seafloor shallower than 60 m in some places. In this location a fast Soya warm water current pours from the Sea of Japan into the Okhotsk Sea. Because we have no mercury in water data for this area it is not certain if the very large atmospheric anomalies are a consequence of outgassing of volcanically or hydrothermally active seafloor below or are related to atmospheric conditions which may be related to the oceanography in the regions.

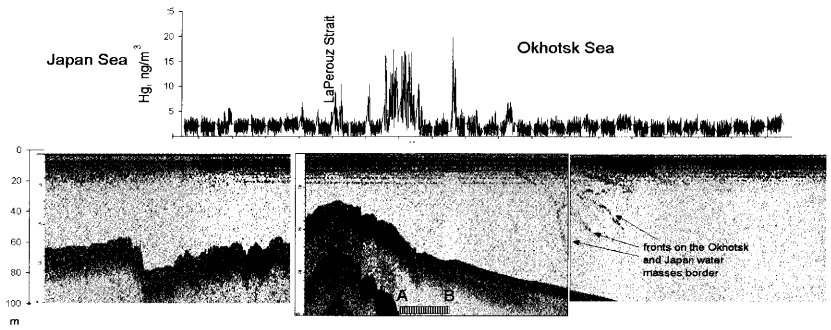

Figure 2 Acoustic image of bottom and water column and mercury air signature (top) measured in LaPerouz Strait.

A-B - possible location of the projection of the Central Sakhalin Fault (fracture zone on the border of Amur and Okhotsk Lithospheric Plates)

An additional Hg in air anomaly was detected at the boundary of the Pacific Ocean with the Bering Sea over and adjacent to the Piip Submarine Volcano, which lies at a depth of 360 m near the Kommondorskiy Islands. Acoustic data illustrated clearly that a gas plume rises from the crest of the volcano to or near the sea surface. The more high Hg content in water is revealed in subsurface cold water mass above top of volcano. Data were collected as the ship carried out seafloor investigations of the Piips Volcano.

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