Policy Brief 2

Evaluating the Effectiveness of the Minamata Convention on Mercury – Insights from Hydrothermal Mercury Fluxes

The Minamata Convention on Mercury is an international treaty aimed at reducing mercury emissions and protecting human health and the environment from mercury pollution. The success of the treaty depends on the ability to curtail anthropogenic mercury emissions, the primary driver of increased mercury levels in the oceans. A recent study, conducted within the framework of the MSCA ITN GMOS-Train project, explores mercury fluxes from hydrothermal venting at mid-ocean ridges and provides valuable insights into the natural contribution of mercury to the global mercury cycle and its implications for the effectiveness of the Convention.

Key findings from the study:

1. **Hydrothermal mercury fluxes:**
   The study estimates that natural mercury fluxes from hydrothermal venting at mid-ocean ridges contribute between 1.5 and 64.7 tons per year. While significant in the context of the global mercury cycle, these natural fluxes pale in comparison to anthropogenic emissions, which are estimated at 3,100 tons per year. This finding reinforces that the global mercury levels in the oceans are predominantly shaped by human activity.

2. **Mercury distribution and scavenging in the ocean:**
   The study provides a detailed analysis of how mercury from hydrothermal vents behaves once released into the ocean. The majority of mercury released in vent fluids (up to 95%) is diluted rapidly, with only a small fraction (2.6–10%) being scavenged onto sinking particles. This process of dilution and scavenging means that mercury introduced into the ocean from these vents persists at low concentrations in the deep ocean. However, the influence of anthropogenic mercury emissions is still the dominant factor in increasing mercury concentrations in oceanic waters.

3. **Dilution efficiency and retention near vent sites:**
   In terms of mercury distribution, the study calculates the dilution efficiency of mercury in hydrothermal plumes. At the TAG (Trans-Atlantic Geotraverse) vent site, dilution efficiency ranges from 67% to 95%, indicating that mercury persists in the deep ocean for significant periods.

4. **Implications for oceanic mercury and human health:**
   The study emphasizes that while hydrothermal sources are an important natural contributor to the global mercury cycle, they cannot explain the elevated levels of mercury in the ocean. With anthropogenic sources being responsible for the bulk of the mercury in the oceans, the study suggests that full implementation of the Minamata Convention could significantly reduce mercury levels in marine ecosystems, which directly impacts the safety of marine fish for human consumption.

Policy recommendations:

1. **Strengthen emission reduction policies:**
   Given that anthropogenic mercury accounts for the majority of mercury in the ocean, strict implementation of emission reductions under the Minamata Convention is crucial. Policies should focus on reducing mercury use in industrial processes, mining, and waste incineration to curb emissions.

2. **Continue monitoring and data collection:**
   The study highlights the importance of continuous monitoring of mercury fluxes in the oceans. Enhanced data collection from both natural and anthropogenic sources will provide a clearer understanding of the mercury cycle, ensuring that the policies under the Minamata Convention are based on up-to-date and comprehensive evidence.

3. **Focus on long-term oceanic mercury trends:**
   The persistence of mercury in the deep ocean, as highlighted by the study, suggests that it may take decades or even centuries for reductions in emissions to manifest in the oceanic mercury concentrations. Policymakers should prioritize long-term environmental monitoring to assess the cumulative impact of emission reductions.

Conclusion:

The study demonstrates that while natural sources like hydrothermal vents contribute to the global mercury cycle, human-caused emissions remain the dominant factor in the increasing mercury concentrations in the ocean. These findings, obtained within the MSCA ITN GMOS-Train project, underscore the importance of the Minamata Convention in reducing mercury emissions, which can lead to substantial benefits for marine ecosystems and human health. Effective implementation of the treaty, combined with rigorous monitoring, is key to mitigating mercury pollution on a global scale.

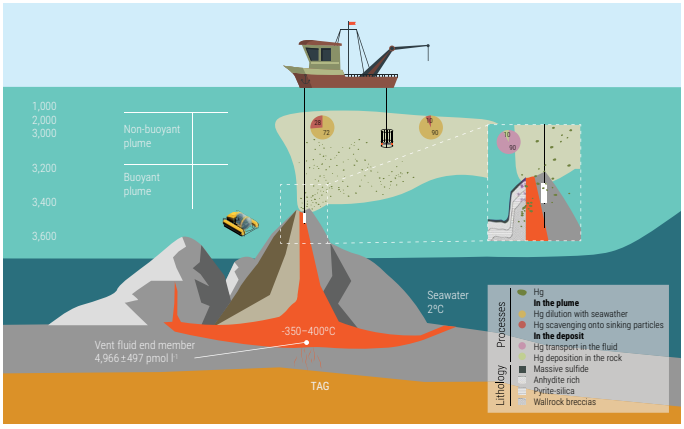

Figure 1: Mercury Dilution Efficiency in Hydrothermal Plumes
Mercury dilution efficiency at the TAG hydrothermal vent site, showing the dilution efficiency ranges from 67% to 95% across different stations.

Key References:

- Torres-Rodriguez, N., et al. (2024). Mercury fluxes from hydrothermal venting at mid-ocean ridges constrained by measurements. Nature Geoscience, 17, 51-57. https://doi.org/10.1038/s41561-023-01341-w.
- UNEP (2018). Global Mercury Assessment 2018. United Nations Environment Programme, Chemicals and Health Branch.

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