MERCURY IN THE GULF OF MEXICO: THE ROLE OF OUTER CONTINENTAL SHELF OIL AND GAS ACTIVITIES

A Report from the Subcommittee on Mercury in the Gulf of Mexico to the Outer Continental Shelf Scientific Committee

Dr. Eric Crecelius
Dr. Livingston Marshall, Jr.
Dr. William Schroeder (Chair)
Dr. Denise Stephenson-Hawk

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INTRODUCTION

In March 2002 the Minerals Management Service (MMS) formed the Subcommittee on Mercury in the Gulf of Mexico "to independently review and evaluate existing scientific information, and provide guidance on what actions the MMS should take regarding the issue of 'Mercury in the Gulf of Mexico' in the context of Outer Continental Shelf (OCS) oil and gas activities in the Gulf." Principal sources of information utilized in the review and evaluation phase were: 1) Background information material (e.g. copies of published and unpublished reports, fact sheets and briefing documents, and news articles) provided by MMS in March 2002; 2) presentations and 'open floor' discussions at the OCS Scientific Committee meeting in Alexandria, Virginia, on April 23, 2002; 3) presentations, 'open floor' discussions and small group exchanges at the "Mercury Forum" in Mobile, Alabama, on May 20-21, 2002 [http://www.masgc.org/mercury/index.html]; 4) the Neff (2002) report *Fates and Effects of Mercury from Oil and Gas Exploration and Production Operations in the Marine Environment*; 5) the Trefry et al. (2002) report *Concentrations of Total Mercury and Methylmercury in Sediment Adjacent to Offshore Drilling Sites in the Gulf of Mexico*; and 6) material requested from MMS (e.g. map of Shunting Areas and Wells Drilled). In addition, MMS provided updates on the 'Interagency Working Group on Methylmercury'.

During the review and evaluation phase the subcommittee identified six 'issues of concern' related to 'Mercury in the Gulf of Mexico' that are either directly linked to OCS oil and gas activities or are important related topics. In the following section, 'Status of Issues of Concern', we present findings, assessments of these findings, and make recommendations on actions, if any, the MMS should consider taking.

STATUS OF ISSUES OF CONCERN

ISSUE #1: *Are high concentrations of total mercury observed in sediment at or adjacent to OCS oil and gas drilling sites associated with the drilling mud weighting agent barite?*

Findings: Results presented in both Neff (2002) and Trefry et al. (2002) indicate that barite ($BaSO_4$) is the most likely source of any excess total mercury found in sediment at OCS oil and gas drilling sites. Specifically, Trefry et al. (2002) report concentrations of total Hg in sediment from far field reference sites ranged from 11-92 ng/g relative to values of 48-558 ng/g for near field sediment collected within 100 m of drilling sites. They observed strong linear relationships ('r' values of 0.89-0.97) between concentrations of Barium (as barite) and total mercury in sediments from near field stations where total mercury levels exceeded background levels by a factor of 3-10. Barium levels in near field sediment ranged from 20-28%, relative to far field concentrations of ~0.05-0.15%. The strong linear relationships between total mercury and Barium, coupled with the high levels of Barium (as barite) in these sediments, supported barite as the common source for both metals.

*** Assessment:** These findings sufficiently address this issue.

*** Recommendations:** No additional research is recommended at this time.

NOTE: The range of total mercury concentrations measured in the sediments at the six drilling sites examined by Trefry et al. (2002) fit well within the range of total mercury concentrations in sediments from other drilling sites throughout the OCS Gulf of Mexico [see Neff (2002), Table 10, p. 23; Trefry et al. (2002) Figure 3, p. 13]. This provides support for taking the position that conditions observed at these six sites can be reasonably viewed as representative of conditions elsewhere in the OCS Gulf of Mexico where drilling activities have been conducted.

ISSUE #2: *Are concentrations of methylmercury in sediments at or adjacent to OCS oil and gas drilling sites statistically higher than in sediments unaffected by drilling activities?*

*** Findings:** Trefry et al. (2002) provide the first data on the distribution of methylmercury in sediments of the OCS Gulf of Mexico. They report that concentrations of methylmercury in surficial (0-2 cm) sediment do not vary significantly between near field (collected within 100 m of drilling sites) and far field (reference sites) stations at any of the six sites studied. In addition, there was no significant difference between methylmercury concentrations at near field and far field stations in subsurface (2-20 cm) samples at five of the six study sites. The average concentration of methylmercury from all near field samples (0.45 ± 0.41 ng/g) was virtually equal to the average reported for all far field samples (0.44 ± 0.27 ng/g). The greater variability observed in near field samples (range <0.03-2.7 ng/g) compared to far field (range 0.11-1.05 ng/g) was accounted for by the uneven distribution of discharged mud at drilling sites. The authors conclude (p. 43): *"Overall, the statistical results from this study . . . . . suggest that elevated levels of methylmercury in sediments around drilling platforms are not a widespread phenomenon"*.

*** Assessment:** Unless some bias in the locations of, or conditions at, the sampling sites can be identified the subcommittee believes these findings sufficiently address this issue at this time.

*** Recommendations**: No additional research is recommended at this time.

NOTE: If the concentration of methylmercury in sediment is not significantly different between near field and far field sites and the total area of all near field sites is on the order 1% or less of the total OCS area in the Gulf of Mexico, then even with some large uncertainty in the difference in concentration or production rate of methylmercury at near field sites, the contribution of methylmercury from these sites would be extremely small.

*** ISSUE #3:** *Can increases in sediment concentrations of methylmercury at or adjacent to OCS oil and gas drilling sites be directly attributed to mercury introduced with barite?*

*** Findings:** Trefry et al. (2002) develop a relatively sound case that mercury introduced with barite at OCS oil and gas drilling sites is not being converted to methylmercury. At one site their data show that near field samples with high levels of total mercury (i.e., 200-500 ng/g) can have methylmercury levels that are similar or lower than methylmercury levels found in samples at far field (background) stations. At another site, the near field sample with the highest concentration of total mercury (558 ng/g) contained only 0.23 ng/g of methylmercury, less than half the mean of the far field levels of methylmercury. However, the report acknowledges that ambiguities were also observed. Results from one site indicated enhanced concentrations of methylmercury at a few stations; however, the higher values were equivalent to ~3% or less of natural concentrations of total mercury. Therefore, these anomalously high levels of methylmercury could have either a natural or an anthropogenic source of mercury.

NOTE: In September the Department of Interior [DOI-MMS (2002)] announced their intent to fund a study to investigate barite solubility and the associated release of trace components to the marine environment. The objectives of this study are to: (1) determine the solubility of barite under the environmental conditions found at the sea floor; (2) determine the amount of trace metals that are released, in particular mercury and cadmium; (3) determine the rate at which the barite dissolves; (4) determine the trace metal species within the barite structure; and (5) evaluate the effects of acidic environments on the solubility of barite and subsequent release of trace metals. The results from this study will provide direct answers for this issue.

*** Assessment:** Unless some bias in the locations of, or conditions at, the sampling sites can be identified the subcommittee believes these findings, together with the anticipated findings from the pending study, will sufficiently address this issue.

*** Recommendations:** No additional research is recommended at this time.

*** ISSUE # 4:** *Do discharges at OCS oil and gas drilling sites create environmental conditions that enhance the conversion of mercury to methylmercury?*

Findings: Trefry et al. (2002) found that in most cases, changes in near field sediment redox conditions, associated with the presence of drilling mud and cuttings, did not result in higher concentrations of methylmercury. In fact they observe that relative to ambient sediments, much lower levels of methylmercury are found in near field sediment adjacent to drilling sites where the in situ conditions are anoxic, highly reducing and enriched with dissolved hydrogen sulfide. In a few instances, when the near field sediments were less sulfidic, higher levels of methylmercury were measured compared to levels in far field sediment.

*** Assessment:** Unless some bias in the locations of, or conditions at, the sampling sites can be identified the subcommittee believes these findings, along with potential findings from the pending study (see Issue 3 above), will sufficiently address this issue.

*** Recommendations:** No additional research is recommended at this time.

ISSUE # 5: *Does the accumulation of organic matter (organic enrichment) beneath or adjacent to oil/gas platforms create environmental conditions that enhance the conversion of mercury to methylmercury?*

*** Findings:** None specifically addressing this issue.

NOTE: Organic enrichment of surficial sediments on the OCS is not limited to sites beneath or adjacent to oil/gas platforms but rather can potentially occur wherever conditions permit enhanced biological production; for example, natural hard bottom features, artificial fishing reef structures or regions influenced by persistent upwelling or river input.

*** Assessment:** The IWGMHg is the appropriate forum for addressing this complex issue since no single agency has responsibility for all the sub issues associated with it.

*** Recommendations:** The MMS should continue to actively participate in the IWGMHg.

*** ISSUE # 6:** *Does the development of a persistent (10^1 to 10^2 days) bottom layer of anoxic or extremely hypoxic bottom water result in conditions that promote methylation?*

*** Findings:** None. However, we have been informed that the Interagency Working Group on Methylmercury (IWGMHg) will be considering this issue.

*** Assessment:** The IWGMHg is the appropriate forum for addressing this complex issue since no single agency has responsibility for all the sub issues associated with it.

*** Recommendations:** The MMS should continue to actively participate in the IWGMHg.

FINAL NOTE: Although the subcommittee has strived to conduct a comprehensive and thorough review and evaluation of those aspects of mercury in the marine environment associated with OCS oil and gas activities we acknowledge that additional 'issues of concern' could potentially be identified. In the event that other issues are brought forth the subcommittee is prepared to reconvene and address them.

REFERENCES

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