The Deepwater Horizon Oil Spill Impact on Mercury (Hg) Concentrations and Isotopic Ratios of Greater Amberjack (*Seriola dumerili*) and Two Species of Deep-Sea Eels (*Ophichthus rex* and *Synaphobranchus oregoni*) in the Northern Gulf of Mexico

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Introduction

The large input of organic material from the Deepwater Horizon oil spill resulted in local scale anoxic conditions that promote the formation of monomethylmercury and, based on our research, has increased the mercury levels in some fish (Fig.1). Using δ^{202}Hg and Δ^{199}Hg to distinguish Hg sources in fishes, we compared greater amberjack, an epibenthic and widely distributed fish species, from impacted and non-impacted areas in the Northern Gulf of Mexico. We also used two species of deepwater eels as geochemical indicators of mercury cycling at depth. Cutthroat eels (CTE) are common at depths greater than 1,000 meters while the larger king snake eels (KSE) are found in shallow slope habitats.

Experimental

Isotopes of carbon, nitrogen, sulfur and mercury concentrations and mercury isotopes were assessed in muscle and liver tissues of fishes to identify Hg sources and accumulation pathways in the Northern Gulf of Mexico. Carbon (δ^{13}C) and nitrogen (δ^{15}N) isotope values were obtained using a Finnigan MAT Delta PLUS XP mass spectrometer. Mercury isotope ratios were collected using the Thermo Neptune™ multicollector inductively coupled plasma mass spectrometer using a CETAC HGX-200 hydride generator as the sampling introduction system. Mercury concentration analysis was conducted using a Tekran 2700 Methyl Mercury Analysis System (EPA Method 1630). All above mentioned analyses took place at the NHMFL in Tallahassee, Florida. Sulfur isotope (δ^{34}S) ratios were determined at the Stable Isotope Core Laboratory, Washington State University.

Results and Discussion

Mercury in amberjacks from the impacted area has undergone a lower degree of photodemethylation (mean Δ^{199}Hg = 0.94 ± 0.15‰) than that from the unaffected area (Δ^{199}Hg = 1.36 ± 0.32‰; P-value < 0.0001) (Fig. 2). Reduced photoreduction is likely caused by impaired photic penetration near the Mississippi River plume by the delivery of particulate and suspended organic material. Both eel species maintain high mercury concentrations (KSE THg = 4.4 ± 3.4 ppm; CTE THg = 5.1 ± 2.9 ppm) despite the vast size difference between the two species (KSE total length = 145.2 ± 42.7 cm; CTE TL = 55.8 ± 8.8 cm) and apparent lower trophic feeding by the cutthroat eel, as indicated by light δ^{13}C and δ^{15}N signatures. Mercury isotope analysis of eel muscle revealed that the mercury source at depth (+1,000) has undergone a higher degree of photodegradation than the mercury ingested by KSE on the shelf (Fig. 3).

Conclusions

Hg in amberjacks closer to DWH wellhead exhibit a lower degree of photodemethylation, likely due to increased turbidity. Deep sea cutthroat eels are exposed to an Hg source which is more photodegraded than shelf dwelling snake eels, indicating the importance of sedimentation as a delivery mechanism of Hg to the deep sea.

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References

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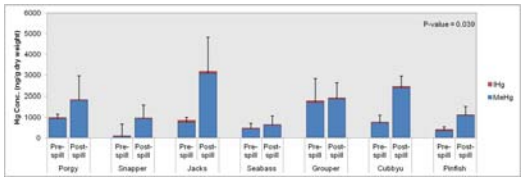

Fig. 1 Pre-spill (collected 2007-09) and post-spill (collected 2012) fish species of similar lengths and δ^{13}C, δ^{15}N, and δ^{34}S signatures.

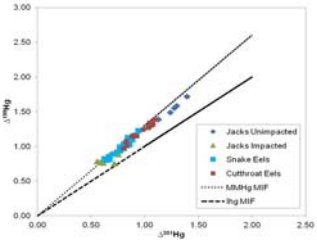

Fig. 2 Hg in impacted amberjacks has undergone a lower degree of photo-demethylation.

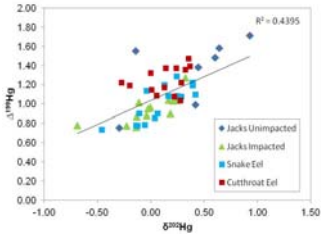

Fig. 3 CTE Δ^{199}Hg indicate Hg source underwent higher degree of photoreduction than shallower KSE.