

## INFLUENCE OF MERCURY CONCENTRATION ON METHYLATION IN FRESHWATER SEDIMENTS FROM SCOTTISH CANALS

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### Introduction

Formed primarily from biotic methylation of dissolved mercury (Hg) species (Benoit *et al.*, 1999), the concentration of methylmercury (MeHg) in the environment is dependent on the balance between rates of methylation and demethylation. Lower %MeHg has been observed in freshwater environments with higher total Hg concentration compared to waters with lower total Hg concentration. It has been proposed that in highly contaminated environments mercury-resistance (*mer*) genes are expressed which regulate reductive demethylation and that at lower levels of Hg these genes cannot be expressed (Schaefer *et al.*, 2004). This study compared %MeHg in freshwater sediment from two connected canals in Scotland, UK, with different levels of Hg contamination and explored the relationships between the Hg, MeHg, and organic matter (OM) content, and sediment pH.

### Methods

MeHg was determined in fresh wet sediment from the Forth and Clyde (F&C) and the Union Canals using isotope dilution mass spectrometry (F&C Canal), 4% w/w HCl extraction (Bermejo-Barrera *et al.*, 1999), derivitisation with sodium tetra-n-propylborate (De Smaele *et al.*, 1998) and gas chromatography-inductively coupled plasma mass spectrometry. Total Hg concentrations were determined on dried, 2 mm sieved samples using microwave-assisted acid digestion, cold vapour atomic absorption spectroscopy (Union Canal) and atomic fluorescence spectroscopy (F&C Canal). The OM content and pH were calculated using loss of ignition at 440 °C and as specified in European Standard TC WI: 2003 (EN, 2003 respectively).

### Results

In the Union Canal, total Hg concentration ranged from  $35.3 \pm 7.3$  to  $1200 \pm 180$  mg/kg ( $n=3$ ) and MeHg concentration ranged from  $6.02 \pm 2.0$  to  $18.6 \pm 4.2$  µg/kg, corresponding to 0.001-0.023% of the total Hg concentration. In the F&C Canal total Hg concentration ranged from 0.591 to 9.14 mg/kg and MeHg concentration ranged from 3.44 to 14.1 µg/kg, corresponding to 0.11-0.58% of the total Hg concentration. An inverse relationship was found between total Hg concentration and %MeHg in both canals ( $r^2 = 0.601$  in the Union Canal and 0.595 in the F&C Canal). In the Union Canal, the OM content ranged from  $5.10 \pm 2.0$  to  $13.9 \pm 2.5\%$  and a weak positive correlation was found between MeHg concentration and OM content

( $r^2 = 0.313$ ). Sediment pH ranged from 5.71 to 6.94 with no observed correlation between pH and MeHg concentration, although a decrease in %MeHg was observed with decreasing pH ( $r^2 = 0.778$ ).

## Conclusion

Total MeHg concentrations were similar in both canals. However, %MeHg was greater in the F&C Canal where the maximum total Hg concentration was two orders of magnitude less than the maximum concentration in the Union Canal, indicating that higher total Hg concentrations may enhance demethylation as indicated by the negative relationship between %MeHg and total Hg concentrations. Thus sediments with lower total Hg concentrations may in fact pose a higher risk for MeHg bioaccumulation compared to sediments with a higher level of Hg contamination. Lower %MeHg was also found in more acidic sediment possibly due to the partitioning of MeHg into the water column. The OM content did not appear to influence net methylation.

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