Biological and geochemical impacts on the solubility of Mercury in sediments

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Three stratigraphically adjacent soils were sampled from a site in the south of England known to suffer from historic mercury contamination. Anoxic microcosms were set up containing differing quantities of organic carbon to promote microbial activity and half the samples were then treated with mercury (II). Biological, chemical and geochemical indicators were then monitored for 4-6 months to determine (1) the impact of mercury on a range of terminal electron accepting processes, and (2) the fate of the metal as the microcosms aged. It was found that the three soils behaved in distinctly differing manners, most notably in their ability to sorb mercury at the start of the experiment.

At the end of the experiment the sediment was extracted using 5 progressively more aggressive reagents, starting with de-ionised water and finishing with aqua regia and the solutions analysed for Hg by IPC-AES. Again the three soils responded very differently, with a significant proportion of the mercury unaccounted for, and presumed lost through processes other than sorption, such as biomethylation or bioreduction and subsequent volatilisation.

Samples were also analysed at the beginning and end of the experiments by classical microbiological and DNA-based techniques, to characterise both the active biomass and the changes in microbial community structure during incubation. These results were then linked to the geochemical indicators to give a greater understanding of the biogeochemical controls on Hg solubility in sediments. The results from this study will be used to quantify the need for action against mercury contamination on site and to investigate the best remediation or bioremediation strategy.

Identification of palaeo-drought episodes in eastern Australia: High resolution dust flux records as an indicator of teleconnections and associated drought in the Australian region

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Australia loses more sediment with wind than with water. Severity of dust emissions are strongly related to rainfall and therefore make excellent proxies for drought. Periods of prolonged drought are a feature of much of the Australian landscape [1] and these have significant economic, social and environmental implications. Contemporary drought episodes can occur over multi-year to multi-decadal time scales and have been linked to teleconnections such as El Niño Southern Oscillation (ENSO) that operates on a 3 to 7 year cycle and/or the Pacific Decadal Oscillation (PDO) that changes phase every ~20-50 years [2]. The operation of these cycles may in turn be superimposed on millennial scale variability in climate.

In this study we construct dust deposition chronologies from alpine peat deposits both within New Zealand and Australia to serve as a proxy for climate variability and drought in eastern Australia. This is possible because the provenance of dust was able to be established by matching the chemical fingerprints of dust samples with those from potential source sediments using trace elements [3] The results show variability in dust deposition through time, indicating that the climate of eastern Australia has experienced marked changes in aridity over the last 7000 years. In general, conditions became more arid and variable during the last 3000 years, especially between 3000 and 1000 years B.P. There is also evidence of cyclic wet-dry phases occurring at a frequency of 30-60 years for at least the last 3000 years. This pattern, which is possibly attributable to the PDO, has significant implications for water resource management in eastern Australia, particularly as the effects of these natural drought episodes may be amplified by the predicted impacts of climate change due to global warming.

[1] Mckeon *et al.* (2004) *Natural Resource Sciences, Queensland Department of Natural Resources Mines and Energy*, 256 pp. [2] Power *et al.* (1999) Inter-decadal modulation of the impact of ENSO on Australia. *Climate Dynamics* **15,** 319-324. [3] Marx *et al.* (2005) *Earth Surface Processes and Landforms* **30,** 699-716.