Study of precious metal concentrations in oceanic sediments

D. Green
I. Jarvis
K. Jarvis

School of Geological Sciences, Kingston University, Kingston-upon Thames, Surrey KT1 2EE, U.K.
NERC ICP-MS Facility, CARE, Imperial College at Silwood Park (TTC), Buckhurst Road, Ascot, Berkshire SL5 7TE, U.K.

J. Thompson

Institute of Oceanographic Sciences Deacon Laboratory, Brook Road, Wormley, Godalming, Surrey GU8 5UB.

Organic-rich sediments, particularly black shales, have been recognised as being important hosts for precious metals (Ru, Rh, Pd, Re, Os, Pt, Au & Ag). Workers have shown precious metals to be present in recent oceanic sediments at ppb levels or less. Studies of the post-depositional mobility of trace elements have demonstrated that the mobilisation of iron, manganese, phosphorous, cobalt, copper, nickel, uranium, vanadium and zinc may occur at the oxic/anoxic boundary in sediments. This generally constitutes part of a steady-state system with the boundary present at a constant depth beneath the sediment surface. Rhenium, osmium and platinum have been shown to be mobile under such conditions. Workers researching the Madeira Abyssal Plain have described a 'progressive oxidation front' process in which anoxic turbidites deposited on the sea floor are oxidised by oxygen diffusing into the sediment from seawater. This creates an oxidation front which progresses downwards through the turbidite. As this oxic/anoxic interface moves through the sediment, elements are mobilised, and may be concentrated above or below this boundary. The process is halted by the deposition of further turbidites cutting off the oxygen supply. There are little data available to describe the behaviour of silver and gold in either of the above systems.

Sediments were chosen from the North Atlantic (including the Madeira Abyssal Plain) and Mediterranean regions, some of which are organic rich (>3% organic carbon), for which geochemical data exists. These were digested using the latest microwave techniques involving mixed acids at elevated pressures. The precious metals were pre-concentrated using cation-exchange columns and were determined by inductively coupled mass-spectrometry (ICP-MS). The experimental work undertaken will be described, as will the sample preparation required to obtain valid data from the ICP-MS at such low concentrations. Data for the precious metals, including silver, will be presented for several samples, and comments will be made relating the variation observed to current geochemical models. It is confirmed that precious metals may be mobilised and cycle around the anoxic/oxic interface, and that their concentrations may be related to the original organic carbon content of the host sediment.