

Removal of seawater ^{234}U incorporated in Holocene basaltic sediments from the Reykjanes ridge

K.J. MOHAMED^{1,2*}, L.F. ROBINSON^{2,3}
AND J.F. MCMANUS^{2,4}

¹University of Vigo, Vigo, Spain

(*correspondence: kmohamed@uvigo.es)

²Woods Hole Oceanographic Institut., Woods Hole, MA, USA

³University of Bristol, Bristol, UK

⁴Columbia University, Lamont-Doherty Earth Observatory, Palisades, NY, USA

The ratio ($^{234}\text{U}/^{238}\text{U}$) of detrital sediments is a potential tool for direct determinations of sediment transport time and provenance. Changes in grain size, shape and mineralogy after deposition can obscure the ($^{234}\text{U}/^{238}\text{U}$) variation with time, providing erroneous estimates of transport time. Addition of Uranium from external sources can also change this ratio, even to values higher than secular equilibrium.

Icelandic sediments recovered from the eastern flank of the Reykjanes ridge, in the Björn drift, showed ($^{234}\text{U}/^{238}\text{U}$) values higher than 1. Basalts, the main rock in the area, are known to incorporate Uranium from seawater with a ($^{234}\text{U}/^{238}\text{U}$) of 1.14, which may explain the anomalously high ($^{234}\text{U}/^{238}\text{U}$) measured in our samples. To identify the source of this ^{234}U addition, we performed a leaching of Holocene and deglacial sediments from the same site with increasing concentrations of HCl.

Older sediments with initially low ($^{234}\text{U}/^{238}\text{U}$) showed little variation with increasing acid concentration. On the contrary, younger samples with high ($^{234}\text{U}/^{238}\text{U}$) show steep decreases at concentrations lower than ~2.5 N HCl, and little changes from 3 to 9 N.

Leachates exhibit higher ($^{234}\text{U}/^{238}\text{U}$) than residues in all cases. In low ($^{234}\text{U}/^{238}\text{U}$) samples, leachates decrease initially and reverse the trend at HCl concentrations higher than 2.5 N HCl reaching values close to secular equilibrium. Leachates from samples with high ($^{234}\text{U}/^{238}\text{U}$) show similar behavior as the residues.

The incorporation of seawater uranium in Holocene samples suggests that these sediments have a higher contribution from Icelandic basalts. This ^{234}U contamination from seawater can be removed by leaching with 2.5 N HCl, which increases the reliability of transport time estimates based on the ($^{234}\text{U}/^{238}\text{U}$) ratio. Higher HCl concentrations may dissolve the sediment grains, which releases detrital ^{234}U and would explain the reversed trend observed in the leachates above 2.5 N HCl.

Helium in Michigan Basin sediments: A tracer for pore fluid migration and age

R.K. MOHAPATRA^{1*}, I.D. CLARK¹, R.E. JACKSON²,
K. RAVEN² AND M. JENSEN³

¹Dept. of Earth Sciences, University of Ottawa, Ottawa, ON Canada, K1N 6N5

(*correspondence: ratan.mohapatra@uottawa.ca)

²Geofirma Engineering, Ottawa

³Nuclear Waste Management Organization, Toronto

As a central component of hydrogeological investigations at a proposed site for low and intermediate level nuclear waste disposal, we have measured He in Ordovician strata from the Deep Geological Repository site in the Michigan Basin near Tiverton, Southern Ontario. Samples were micro-cored (6mm dia., 20mm length) from full 76 mm core samples of shales and argillaceous limestones shortly after recovery from depths between 450 and 850 m, for measurement of He on a MAP 215-50 mass spectrometer (MAPL). Supplemented by stable isotope measurements and major and trace element geochemistry, the labile helium fraction is used to estimate pore fluid age and source location. The xRa profile shows a consistent value near 0.0200 ± 0.0015 in the very low permeability Upper Ordovician shales, with a shift to 0.0360 ± 0.0020 in the underlying Middle Ordovician limestones. *In situ* production rates for ^3He from ^6Li fission and ^4He from U and Th decay in the shales provide a calculated xRa that, within the margin of uncertainty, is the same as the measured ratio, suggesting an autochthonous source for He in that section. Pore fluid age, based on the calculated ^4He production rate and measured He concentrations in the shales, indicates accumulation over ~ 200 Ma. In the very low permeability limestones the calculated *in situ* xRa of 0.001 to 0.004 suggests an allochthonous He source. The xRa value of 0.036 measured in the limestones was indistinguishable from that measured in the thin basal Cambrian sandstone aquifer groundwater collected during the study. This value may be explained by a mixture of a mantle ^3He -enriched end member derived from the rifted base of the Michigan Basin and He from the Canadian Shield.