

Sr, Nd, Hf and Pb isotope characterisation of basalts from IODP Site U1346, Shirshov Massif the youngest edifice of the Shatsky Rise, northwest Pacific

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The Shatsky Rise is a large volcanic plateau in the northwest Pacific that formed between 140–150 Ma on the Pacific oceanic crust [1, 2]. Magnetic lineations indicate that the plateau formed along the trace of a triple junction of oceanic spreading ridges [1]. Shirshov Massif is the northern most of the large seamounts within Shatsky Rise. It is a subcircular edifice, ~100 km in diameter. The Shirshov Massif represents a waning phase in the evolution of the Shatsky Rise, intermediate between the main phase of plateau formation at the Tamu Massif to the southeast and the much lower levels of magmatism represented by the younger Papanin Ridge to the northeast. In the parlance of the plume head hypothesis, Shirshov Massif is in the transition between plume head and tail.

During IODP Expedition 324 Hole U1346A, situated on the northern flank of the Shirshov massif, was drilled, penetrating thin sediment cover and into igneous basement. Two volcanic units were recognised, a 1.6m volcanic debris flow and a 50.1m thick succession of pillow lavas (and/or inflation units) that represent a single volcanic event [3].

Here we present Sr, Nd, Hf and Pb isotope data from the basaltic basement samples. We compare the isotope data to previous analyses from the Shatsky Rise [2], to other oceanic plateaus and to estimated mantle end member compositions in order to assess the nature of the mantle material that melted to form the final stage of plateau volcanism at Shatsky Rise.

[1] Nakanishi, *et al.* (1999) *Journal of Geophysical Research Solid Earth* **104**, 7539–7556. [2] Mahoney, *et al.* (2005) *Geology* **33**, 185–188. [3] Expedition 324 Scientists (2010) Site U1346. In Sager, W.W. Sano, T. Geldmacher, J. & the Expedition 324 Scientists, *Proc. IODP*, **324**, Tokyo (IODP-MI) doi, 10.2204/iodp.proc.324.103.2010

U-Series disequilibrium in groundwater as a vector for U mineralisation

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Groundwaters often exhibit (²³⁴U/²³⁸U) activity ratios greater than one as a result of fractionation between ²³⁴U and ²³⁸U nuclides during rock/water interactions. However, when groundwaters pass through high-grade uranium mineralisation, congruent dissolution of uranium minerals should impart a (²³⁴U/²³⁸U) activity ratio which is at or very close to secular equilibrium.

This research characterises the uranium-series (U-series) disequilibria in groundwater surrounding a high-grade uranium deposit, and investigates the use of disequilibria in groundwater as a proxy for uranium exploration. U-Series isotopes have been analysed by isotope dilution MC-ICP-MS in groundwater samples along the groundwater flow path, within and surrounding the South Australian Four Mile and Pepegoona sediment-hosted uranium mineralised systems.

Samples collected down-gradient of the Four Mile mineralisation have (²³⁴U/²³⁸U) activity ratios ranging from 1.12 proximal to mineralisation, up to 2.08 approximately 10 kms down-gradient from mineralisation. U concentrations range from 0.5 – 200 ppb, with highest concentrations found in samples collected in mineralisation. Groundwaters sampled within the high-grade mineralisation show (²³⁴U/²³⁸U) activity ratios close to unity (1.05), which is consistent with the congruent dissolution of uranium minerals.

The observation of increasing disequilibrium with distance from mineralisation highlights the potential application of U-series isotopes as an indicator of high-grade uranium deposits.

However, the extent and distribution of disequilibrium at the Pepegoona deposit is not entirely consistent with proximity to the mineralisation. Groundwaters samples within mineralisation exhibit much higher (²³⁴U/²³⁸U) activity ratios than at Four Mile, averaging 1.41. Samples collected down-gradient have typically lower U concentrations and (²³⁴U/²³⁸U) activity ratios approaching unity. This signature reflects the highly variable local geology of the Pepegoona deposit.