Low U/Pb, Th/Pb and U/Th ratios in Archean crust implied by paired Pb and Nd isotopes in modern terrigenous sediments

S.R. HEMMING[1,2], T. VAN DE FLIERDT[1],
S.M. MCLENNAN[3] AND S.R. TAYLOR[4]

[1] Lamont-Doherty Earth Observatory of Columbia University; Palisades, New York, U.S.A.; tina@ldeo.columbia.edu
[2] Department of Earth and Environmental Sciences, Columbia University, Palisades, New York, U.S.A.
[3] Department of Geosciences, SUNY Stony Brook, Stony Brook, New York, U.S.A.
[4] Australian National University

Documenting the composition and evolution of continental crust is critical for understanding material transfer among Earth reservoirs and the global processes of crust formation and development of the crust-mantle system. Sediments and sedimentary rocks provide important information about the composition of upper continental crust. A robust strategy to study the secular variation of upper continental crust compositions with sediments is to use the Sm-Nd system as a measure of the provenance age. We report new data from Greenland glacial flour in the context of published modern turbidite and river sediment data.

Although modern terrigenous sediments show a predictable negative correlation between Pb and Nd isotope ratios that is clearly related to the age of continental sources for samples with Nd model ages younger than 2.3 Ga, samples with older Nd model ages show very unradiogenic values. The most straightforward explanation for these trends is that Archean terrigenous sources have substantially lower U/Pb, Th/Pb, and U/Th ratios than the upper continental crust on average. The Archean-Proterozoic transition has long been recognized as a fundamental benchmark in the compositional evolution of the sedimentary mass and by inference, the upper continental crust. Archean sedimentary rocks have significantly lower U and Th concentrations than post-Archean sedimentary rocks, and the Th/U ratio increases gradually from about 2.0-2.5 Ga to the present. A model based on evidence for a secular variation in Th and U abundances and Th/U ratios in clastic sediments of all ages, and assuming all differences in U/Pb and Th/Pb are due to differences in U and Th contents, produces trends are remarkably consistent with the elemental data from sedimentary rocks. Accordingly the Pb isotopic compositions of modern sediments support the suggestion that the Th and U contents and the U/Pb and U/Th ratios of the Archean upper crust were significantly lower than those of the post-Archean upper crust and that a dramatic increase took place at about the time of the Archean-Proterozoic transition.