SF (MARGINS-related)	Collaborative Research: Hf-Nd Isotopic and Trace-Element Geochemistry of Globally Subducting Sediments	
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Many studies have argued, based partly on Pb isotopic evidence, that recycled subducted slabs reside in the mantle source of ocean island basalts. Such models, however, have remained largely untested against actual subduction zone inputs, due to the scarcity of comprehensive measurements of both radioactive parents (Th and U) and radiogenic daughter (Pb) in altered oceanic crust (AOC). Here, we report comprehensive measurements of U, Th and Pb concentrations in the oldest AOC, ODP Site 801, and consider the effect of subducting this crust on the long-term Pb isotope evolution of the mantle.

This MARGINS project provided partial support for two PhD theses (Katherine Kelley and Jennifer Wade), a Master's thesis (Linda Farr), and an undergraduate thesis (Michael Hamilton). It has also helped recruit other excellent graduate students and led to further work on volatiles in magmas from the Tonga, Aleutians and Central America regions.

- The upper 500 m of AOC at the oldest basement drill site to date (ODP Site 801) shows 5-fold enrichment in U over pristine glass during seafloor alteration, but no net change to Pb or Th.
- Pacific arcs, including the Marianas, define mixing trends toward a single low-Th, high-Pb component derived from the AOC. This AOC-derived component requires 20-fold enrichment in Pb over U during slab dehydration beneath the arc. This output constraint, along with the input constrained from Site 801, enables a mass balance of U, Th and Pb across the Mariana subduction system (see Figure).
- Pb is lost shallow and U deep from subducted AOC, which may be a consequence of the stability of phases that bind these elements during seafloor alteration: U in carbonate and Pb in sulfides.
- Preferred crustal growth rates require U loss at depths beyond the zones of arc and back-arc magmagenesis. Such a U flux could decrease upper mantle k ($^{232}Th/^{238}U$) over time, and provide a solution to the "kappa conundrum" (Elliott *et al*., 1999, EPSL).
- The net effects of alteration and subduction are sufficient to create the Pb isotopic signatures of ocean island basalts, including "himu" end-members (high $^{206}Pb/^{204}Pb$).

Figures and Captions

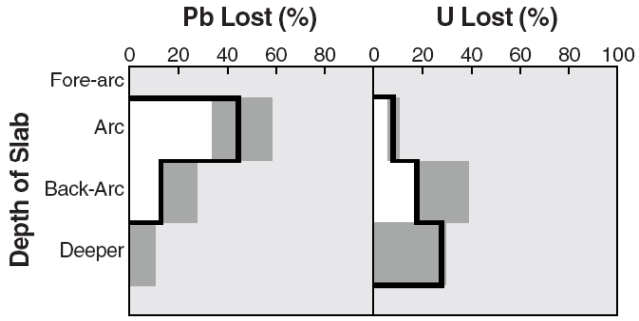

Figure 1: Losses of Pb and U from subducted oceanic crust (excluding sediment) vs. depth in the subduction zone, modeled using inputs and outputs across the Mariana Arc. Grey boxes indicate the full range of possible losses permitted by current estimates of arc crustal growth rates. Heavy black line traces slab losses at preferred crustal growth rates.

Publications and Presentations

Kelley, K.A., Plank, T., Ludden, J.N. and H. Staudigel (2003) The composition of altered oceanic crust at ODP sites 801 and 1149. *Geochem. Geophys. Geosyst.*. 4 (6), doi: 10.1029/2002GC000435.

Kelley, K.A., Plank, T., Ludden, J.N. & Staudigel, H. Subduction Cycling of U, Th, and Pb, soon to be submitted to EPSL.

Farr, L.C., Plank, T., Kelley, K. A. and Alt, J.C. (2001) U Mineral hosts and enrichment processes in altered oceanic crust. Eos Trans AGU, 82 (47), Fall Meet. Suppl., Abstract T22C-0926.

Kelley, K.A., Plank, T., Farr, L., Ludden, J., and Staudigel, H. (2005) Subduction cycling of the U, Th and Pb. Earth and Planetary Science Letters, 234: 369-383.

Vervoort, J., Plank, T., and Prytulak, J. (2004) The Hf-Nd isotopic diversity of subducting oceanic sediments. AGU, 85(46), Fall Meet. Suppl., Abstract V13B-1480