# Nb/Ta fractionation resulted by fluid-rock interaction in subducted oceanic crust

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Nb/Ta ratios in the silicate Earth reservoirs (Earth's mantle and crust) are almost all subchondritic and thus document a clear deficit of Nb relative to Ta in the silicate Earth, known as the terrestrial Nb–Ta paradox. One proposed solution is a hidden reservoir of subducted eclogitic oceanic crust with superchondritic Nb/Ta ratios in the Earth's lowermost mantle. However, many high-pressure experiments demonstrate that the melts and fluids equilibrating with the eclogite commonly have higher Nb/Ta ratios than the residue rutile-bearing eclogites, and recent observations proved that natural eclogites commonly have subchondritic Nb/Ta ratios, suggesting that the down going subducted oceanic crust could not be the superchondritic Nb/Ta reservoir. We reported here data of Nb/Ta ratios of natural eclogites and internal HP veins from Dabieshan UHP terrane. The host eclogites have chondritic Nb/Ta ratios (19-21), but some of the HP veins, which crystallized from the UHP fluids released from the host eclogites have superchondritic Nb/Ta ratios (35-38). Our data demonstrate that UHP fluid-rock interactions in subducted oceanic crust resulted in great Nb/Ta fractionation with UHP fluid have much higher Nb/Ta ratios than the residue solid eclogite, and the superchondritic Nb/Ta reservoir are expected in the mantle wedge which reacted with the high Nb/Ta fluid.

# Oxygen triple-isotope evidence for enhancement of $CO_2$ sequestration efficiency by diatom-diazotroph assemblages in a giant river plume

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The Amazon river outflow influences biogeochemistry hundreds to thousands of kilometers from the river mouth, out to the western region of the oligotrophic tropical North Atlantic (TNA). This dynamic and evolving “plume” is characterized by a significant $CO_2$ undersaturation in surface waters associated with biological new production.

Observations and inverse modeling suggest that the TNA is typically a carbon source to the atmosphere of ~2.5 Tmol C $yr^{-1}$ [1,2]. Net production in the Amazon plume, however, reverses the normal TNA surface condition, removing up to 1.7 Tmol C $yr^{-1}$ from the atmosphere [3]. ANACONDAS (NSF OCE-0934095) hypothesized that this efficient biological pump is driven by an unusual assemblage of diatoms and diazotrophic ($N_2$-fixing) cyanobacteria; our team studied the carbon cycling and ecology of the plume during its maximum extent in May-June 2010 on the *R/V Knorr*.

We present new *in situ* net-community and gross primary production data from the expedition. We observe a peak enhancement in export production efficiency over a narrow sea-surface salinity window (S = 32–33 psu) using the $O_2$/Ar and oxygen triple-isotope (i.e., $^{17}\Delta$) methods. This striking increase in export production coincides with similar increases in biological carbon drawdown and counts of *Hemiaulus hauckii*, a diatom often found in symbiosis with the diazotroph *Richelia intracellularis*. These data support the diatom-diazotroph assemblage mechanism for enhancing new production and carbon sequestration in tropical river plumes. The strength of this $CO_2$ sink is likely sensitive to changes in tropical hydrology and terriginous runoff over time.

[1] Takahashi *et al.* (2002), *Deep-Sea Res. II* **49**, 1601-1623. [2] Mikaloff-Fletcher *et al.* (2007), *Global Biogeochem. Cycles* **21**, GB1010. [3] Subramaniam *et al.* (2008), *Proc. Nat. Acad. Sci. USA* **105**, 10460-10465.