C- and S-transfer in subduction zones: Insights from diamonds

S. Aulbach[1,2], T. Stachel[1], L.M. Heaman[1], R.A. Creaser[1], E. Thomassot[3] and S.B. Shirey[4]

[1]University of Alberta, Edmonton AB Canada
[2]Goethe-Universität, Frankfurt Germany, (s.aulbach@em.uni-frankfurt.de)
[3]Carnegie Institution-DTM, Washington, DC USA
[4]CRPG-CNRS, Nancy France

The formation of eclogitic and pyroxenitic diamonds may occur during subduction-related redox reactions. Sulphide-bearing diamonds and diamondiferous xenoliths from the central Slave craton (Diavik and Ekati pipes) are used to trace the mobility of C and S up the slab and mantle wedge.

There, eclogitic diamond formed along fluid conduits ca 1.85 Ga ago, penecontemporaneously with subduction beneath the western craton margin and with eclogitisation of basaltic protoliths. The radiogenic initial ^{187}Os/^{188}Os of the eclogitic sulfide inclusions is consistent with diamond formation in matured, high Re/Os oceanic basaltic crust. This may indicate that S in the inclusions was derived in situ, which is supported by fractionated S isotopes of eclogitic sulphide inclusions. Mantle-like δ^{13}C of associated diamonds suggests derivation of the carbon from reducing serpentinised oceanic mantle, which dehydrates at a depth consistent with diamond formation.

Subducting oceanic crust may release silicic melts that react with mantle wedge peridotite to form pyroxenite. A low-temperature pyroxenite xenolith has an age and initial ^{187}Os/^{188}Os that is identical to eclogitic inclusions in diamond, indicating that it inherited its radiogenic initial Os and S from oxidising slab-derived melt. Formation at shallow depth near the graphite-diamond transition and presence of an oxidised mantle wedge prohibits enough reduction to allow diamond formation from the slab melt and may explain why this lithology is rarely represented amongst diamonds from the central Slave craton.

A distinct group of sulphide inclusions in diamond, with Ni content similar to peridotitic inclusions, but 20 x lower Os contents have very unradiogenic Os but yield a Re-Os isochron age of 1.70±0.26 Ga, within error of the age of accretion at the craton margin. We suggest the diamonds formed through interaction of reducing Os-poor fluids with oxidising wedge mantle that was dragged down to the depth of serpentinite dehydration. The fluids may have remained reducing by extraction along conduits armoured by a reaction assemblage. They facilitated isotopic rehomogenisation of part of the mantle wedge, but did not add Os to the source. δ^{13}C will be measured soon to determine the carbon source.

Efficient analysis of seawater thorium and protactinium

M.E. Auro[1]*, L.F. Robinson[1,2], R. Anderson[3], M. Fleisher[3] and M.A. Saito[1]

[1]Woods Hole Oceanographic Institution, Woods Hole, MA 02543 USA (*correspondence: mauro@whoi.edu); (msaito@whoi.edu)
[2]University of Bristol, BS8 1RJ, Bristol UK (lrobinson@whoi.edu)
[3]Lamont-Doherty Earth Observatory, Palisades, NY 10964 USA (boba@ldeo.columbia.edu; martyq@ldeo.columbia.edu)

With the advent of GEOTRACES, the requirement to analyse large numbers of seawater samples for ^{232}Th, ^{230}Th and ^{231}Pa has become more widespread. During the international intercalibration exercise we encountered unexpected difficulties with recovery and contamination of these isotopes, especially ^{232}Th. Multiple experiments were executed to identify the source of these issues. Two particular problems were (a) frits in columns supplied by Biorad contain isotope-binding surfactants and (b) new batches of Biorad AG1x-8 resin release more than 100pg of ^{232}Th after standard column cleaning. To improve yield (to 90%) and blanks (to 5pg ^{232}Th) we implemented a range of improvements including switching to Eichrom anion exchange resin and Environmental Express columns. In addition, we used Eichrom pre-filter resin to remove organics and prevent clogging during sample analysis. All Th samples were analysed on a Neptune multi-collector using peak hopping of ^{230}Th and ^{229}Th on the central SEM, with either ^{232}Th, ^{236}U (or both) used to monitor for beam intensity. We used two in-house laboratory standards to check for machine reproducibility, and the GEOTRACES intercalibration standard to check for accuracy. Over a one year period the 2 stdev reproducibility on the standard ^{232}Th concentration was 2.8% including all analyses, and 2% once contamination and yield issues had been resolved.

We apply the improved method to seawater samples in depth profiles collected from stations close to Bermuda and from 12.5S in the S. Atlantic (CoFeMUG cruise) and compare those data to published water column data. Apart from the very bottom waters and surface waters, both of which have elevated values, BATS samples average 79 pg/kg ^{232}Th. The ^{232}Th concentration in the S. Atlantic is higher throughout the water column with an average value of 195 pg/kg. In both cases ^{230}Th increases with depth, with the rate of increase greater in the S. Atlantic as expected from published water column profiles.