Summary of Anticipated Products (8 November 2016):

Synthesis workshop: Biogeochemical Cycling of Trace Elements within the Ocean

Lamont-Doherty Earth Observatory in Palisades New York, USA, 1 – 4 August 2016

Jointly sponsored by GEOTRACES and by the Ocean Carbon and Biochemistry program

Workshop themes:

1) Biological uptake and trace element bioavailability,
2) Abiotic cycling and scavenging, including particulate and dissolved speciation,
3) Export, recycling and regeneration

Recommendations and anticipated products (TEI = trace element and isotope):

Micronutrient group

1) *Estimate Bioavailability of Fe with oceanographic data using the "bioavailability envelope" concept of Lis et al., (ISME Journal, 2015) using GEOTRACES data sets [dissolved Fe from GEOVIDE, KEOPS, NEOPS, (Geraldine), FeCYCLE (Andrew Bowie), and HOT and BATS; as well as single cell Fe quotas (SXRF) and cell surface area data (Ben Twining)]*
Heroes: Yeala Shaked, Maite Maldonado (Ben Twining, Mark Moore, Dan Repeta, Seth John, Adrian Marchetti, Mak Saito, Alessandro Tagliabue, Bill Sunda, Geraldine Sarthou, Bethany Jenkins)

2) *Estimate bioavailability of Fe in natural systems by examining phytoplankton single cell Fe quotas across concentration gradients of dissolved and (labile) particulate TEIs, using data from NAZT, GeoMICS, EPZT, IRONBRU cruises on SXRF, dissolved Fe, soluble and colloidal Fe, Fe voltammetry/speciation, total particulate and labile particulate Fe.*
Heroes: Ben Twining (Kristen Buck, Randie Bundy, Mark Moore, Jessica Fitzsimmons, Claire Till, Jim Moffett, Mak Saito, Jingfeng Wu, Kathy Barbeau, Maite Maldonado)

3) *Test the hypothesis for light and Fe co-limitation in deep chlorophyll maxima (DCM) using GEOTRACES dissolved Fe data sets. Explore also TARA molecular data sets (and possibly those from GEOMICs & Malaspina-2010 Expedition) to look for iron stress metagenomics markers in the world's DCMs*
Heroes: Bill Sunda (Dreux Chappell, Pete Sedwick, Mak Saito, Kathy Barbeau, Alexandra Bausch, Adrian Marchetti, Jessica Fitzsimmons, Seth John, Dan Ohnemus, Bethany Jenkins).

4) *Explore Redfieldian concepts of elemental stoichiometry using dissolved and particulate GEOTRACES TEs data and ocean models*
Heroes: Mak Saito, Ben Twining (Dan Ohnemus, Mark Moore, Clare Davis, Amber Annett, Alyson Santoro, Bill Sunda, Alessandro Tagliabue, Alexandra Bausch, Maite Maldonado)

5) O*rganismal quota approach to calculate community trace metal demand and compare to trace metal inventories and relative resource supply (linking TEs data sets to hydrography, aeolian deposition information…). This aims to ultimately address controls on biogeography. The derived organismal trace metal quotas are based on biochemistry concepts of cell metabolism (Raven's estimates of trace metal quotas based on proteins trace metal content and metabolic rates)*
Heroes: Maite Maldonado, Al Tagliabue (Ben Twining, Mark Moore, Mak Saito, Adrian Marchetti, Alyson Santoro, Tung-Yuan Ho, Clare Davis, Susanna Fitz, Amber Annett, Mark Brzezinski)

> **NOTE:** To achieve 5 and 3, and maybe 1, it would be nice, but not required, to find oceanic transect where there are GEOTRACES TE data and complementary "omics data" (e.g., from TARA Ocean Expeditions (to contact Colomban de Vargas), GEOMICs, or Malaspina-2010 Expedition (to contact Mart Estrada). We will then have to mine through the massive sequence databases to link metrics from sequences (e.g, taxonomic composition, presence/absence or gene expression of particular genes or pathways, etc.) with the GEOTRACES data. The *molecular jockeys* helping with this are Adrian Marchetti, Alyson Santoro, Bethany Jenkins, Dreux Chappell, Mak Saito, Geraldine Sarthou, and Dan Repeta

Abiotic cycling and scavenging (including particulate and dissolved speciation group)

6) *A Synthesis Paper on "Paradigms of ligand composition and cycling and the degree of confidence in them" will be produced*
Heroes: Kristen Buck, Randie Bundy (John Dunne, Geraldine Sarthou, Jessica Fitzsimmons, Maeve Lohan, Alessandro Tagliabue, Tim Conway, Julia Gauglitz, Dan Repeta, Elliot Sherman and Kazuhiro Misumi)

Export, recycling and regeneration group

7) *Compare radionuclide-based methods ($^{234}Th/^{238}U$; $^{228}Th/^{228}Ra$; $^{230}Th/^{234}U$; $^{210}Po/^{210}Pb$; Pu/Np) to estimate the downward flux of particulate C, N, P, ^{232}Th, Al, Cd, Fe, Co, Cu, and Mn from the surface mixed layer to the sea bed*.
Heroes: Chris Hayes, Erin Black (Gideon Henderson, Ken Buesseler, Frank Pavia, Bob Anderson, Mark Baskaran, Tim Kenna, Patrick Fitzgerald, Kirk Cochran)

8) Modes of regeneration: desorption/dissolution vs. biotic respiration. *Combine measured TEI distributions with calculated AOU, depth-dependent OURs, and preformed TEI concentrations to discriminate among effects of abiotic scavenging, biotic uptake and regeneration, and physical transport*.
Heroes: Bill Jenkins (Greg Cutter, Nick Hawko, Bob Anderson, Keith Moore, Bill Smethie, Yi Tang, Rana Fine, Francois Primeau, Tom Weber, Molly Martin, Susan Little, Xin-Yuan Zheng, Yves Plancherel, Ed Boyle, Maureen Conte, Max Grand, Alan Shiller, Mariko Hatta, Ken Buesseler, Erin Black, Maeve Lohan, Dave Kadko)

Corollary: Greater attention needs to be afforded to defining end-member TEI concentrations of major water masses.

9) *Improve simple models for particle aggregation and disaggregation by adding 2nd order rate kinetics for aggregation, and by including the aggregation of small and large particles.*
Heroes: Adrian Burd (Rob Sherrell, Paul Lerner, Francois Primeau, Phoebe Lam)

10) *Kd for the spectrum of elements. Estimate relative scavenging of an element for which we can derive an absolute Kd, like Th, when their concentrations are measured concurrently with ^{230}Th and ^{232}Th.*
Heroes: Chris Hayes (Seth John, Xin-Yuan Zheng)

11) *Compare beam transmission measured concurrently with abundance and composition of particles measured on GEOTRACES will lead to new algorithms to interpret beam transmission in terms of particle distributions that affect TEI scavenging as well as the optical properties of nepheloid layers.*
Heroes: **Chris Hayes** (Rob Sherrell, Dan Ohnemus, Wilf Gardner, Mary Jo Richardson, Phoebe Lam, Jessica Fitzsimmons, Frankie Pavia, Bob Anderson)

12) *Prepare a synthesis paper on the distribution of nepheloid layers, the abundance and composition of particles within them, differences in the scavenging intensity, sorption coefficients of particle-reactive radionuclides, and their impact on dissolved TEI distributions*.
Heroes: Rob Sherrell (Chris Hayes, Dan Ohnemus, Wilf Gardner, Mary Jo Richardson, Phoebe Lam, Jessica Fitzsimmons, Frankie Pavia, Bob Anderson, Mark Baskaran)