Optical characterization of particulate distributions during the GEOTRACES GP17-OCE (Tahiti to Antarctica; Antarctica-Chile) and GP17-ANT. PI, Jim Bishop, UC Berkeley,
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Low-power optical sensors are capable of delivering high precision, high accuracy profiles of inherent particle optical properties in the water column, yet the calibration of such data in terms of major particle phases (e.g. POC, PIC, and TSM) have rarely been extended below 1 kilometer depths, are few and far between and have been often geographically limited. However, such sensors are the only means to achieve long-term high-frequency autonomous observations of the biological carbon pump in the global ocean. At the GEOTRACES Barcelona meeting in 2012, we argued that calibrations of optical sensors will benefit greatly from simultaneous co-deployment with in-situ filtration systems during GEOTRACES (Boss et al., 2015). In 2018, with the help from Phoebe Lam and Greg Cutter, UC Berkeley was able to deploy transmissometer, scattering and birefringence sensors during GP15. Two independently deployed birefringence (PIC) sensors yielded consistent profile systematics surface to bottom. Briefly (Figure 1), we found coherence of surface layer and deep water column (measured and optical) PIC. We found clear evidence for shallow dissolution of PIC (measured and optical) in the strongly oxygen deficient waters near 11N and 5S, 152W. As a side note: we found a puzzling optical birefringence maximum at a depth of 100-150m in regions of strong thermal temperature gradient that was not seen in measured PIC results. GP-15 data indicates that beam attenuation coefficient remains well correlated with POC. *With GP-17 we aim to complete the P16 transect southward through the great calcite belt at ~50S to the ice edge and spatially in the southern ocean to (1) characterize particle abundances at a far greater resolution than sampling and (2) to validate optical proxies through the water column.*

UC Berkeley proposes to add optical sensors to the trace metal CTD, a logging CTD deployed during McLane pump casts, and to the ship's' CTD. We will deploy:

(1) C-Star transmissometer (a well calibrated instrument with absolute beam attenuation coefficient precision to better than +/- 0.001 m^{-1}; accuracy better than +/- 0.003 m^{-1}). This instrument will serve as cross calibration of other transmissometers.
(2) Twin birefringence sensors (C-Star embodiment) capable of measuring PIC variations in the water column to +/- 10 nM concentrations.
(3) Seapoint scattering sensors.

In a perfect world there should be (1) student from Berkeley at sea. That person will that ensure sensors are properly maintained in a clean state, monitor real time performance, and will be able to assist other programs – particularly the in-situ filtration group. We request size fractionated in-situ filtration data on major particle phase composition and selected samples to investigate the mysterious birefringence maximum we have seen in the tropics.

References:
Boss, E., L. Guidi, M.J. Richardson, L. Stemman, W.D. Gardner, J. K. B. Bishop, R.F. Anderson, R. Sherrell. (2015) Optical techniques for in-situ characterization of particles pertinent to GEOTRACES. Progress in Oceanography. 133 (2015) 43–54. Doi:10.1016/j.pocean.2014.09.007.

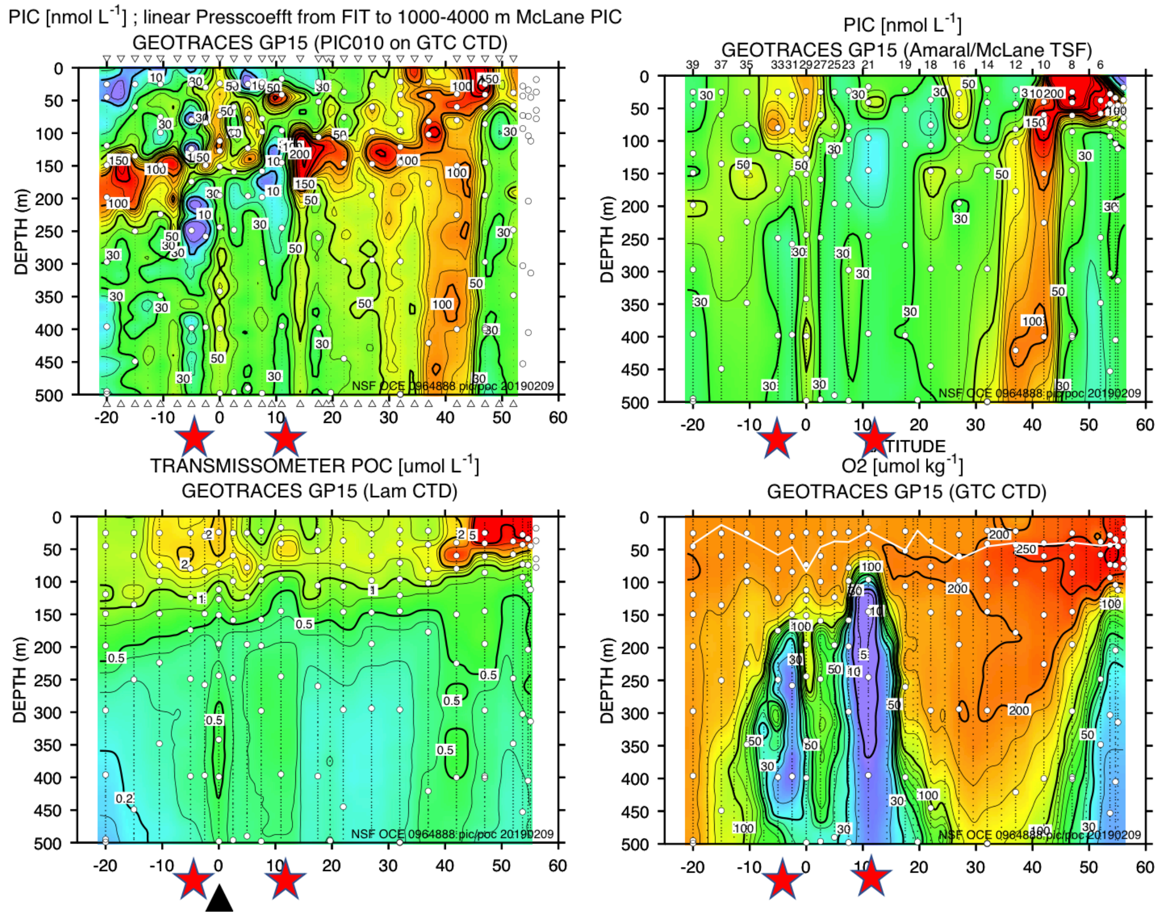

Figure 1. Left top (birefringence sensor derived PIC). Left bottom (transmissometer derived POC). Right Top: measured PIC. Right bottom: (Oxygen data). Both measured and optical PIC were consistent in surface waters and in the deeper water. We found evidence of PIC loss in suboxic waters below 100 m at 11N and 5S (red stars). Beam attenuation coefficient POC did not see such minima. We do not yet understand the subsurface birefringence maxima near 150 m. Open circles denote McLane sample depths. Comparisons will be presented at the Ocean Sciences meeting.