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Letter of Intent: Measurement of CFCs and SF₆ on GEOTRACES Peru-Tahiti Cruise

Distributions of the chlorofluorocarbons (CFC-11 and CFC-12) and sulfur hexafluoride (SF₆) in both seawater and the atmosphere will be measured on-board ship at all stations and appropriate depths. Concentrations of CFCs and SF₆ in seawater and air are measured by electron-capture gas chromatography using an analytical system that measures CFCs and SF₆ from the same 1-liter water sample. Preliminary CFC and SF₆ concentrations will be calculated and merged with other hydrographic parameters daily at sea. The final data will be available within 6 months of cruise. One berth is requested for a CFC technician.

The gases CFC-11 and CFC-12 have been entering the ocean for the past half-century and will continue to enter the ocean and spread into the interior for decades. SF₆ has been entering the ocean for the past 2-3 decades. While the CFC concentrations in the atmosphere have leveled off, SF₆ has been rising, and continues to increase at about 5-7% per year. Since the three are potent greenhouse gases, their atmospheric time histories are well known and monitored. The measurement of SF₆ in conjunction with CFCs greatly increases the temporal information in the suite of anthropogenic transient tracers. The most robust tracer combination for oceanic time scales of up to several decades is obtained using the SF₆/CFC ratio.

The GEOTRACES Pacific zonal section will run along 10°-15°S from Peru to Tahiti at 150°W. The section crosses the highly productive Peru margin and upwelling, South Pacific oxygen minimum zone (OMZ), and oligotrophic low nitrate region - an important denitrification zone. The proposed SF₆/CFC tracer measurements will contribute to Theme 2 of the GEOTRACES Science Plan, the Internal Cycling Objective, and to Peru-Tahiti Objectives 1-3. A combination of physical and biogeochemical processes determines oceanic distributions of TEIs. Measurements of tracers and TEIs on the same samples will provide added constraints on time scales and physical transports. We will provide high quality data that will compliment analyses being done by other Geotraces PIs. Collaborations are anticipated with GEOTRACES PIs working with data from the surface to mid-depths. The CFC/SF₆ tracer data will contribute to the following specific objectives.

- For the low oxygen waters in the OMZ, calculate ages to distinguish *old* shadow zone (physical processes) and not recently renewed waters - from recently renewed waters that may have low oxygen due to biochemical processes. These data will provide the linkage between physics and chemistry controlling OMZ, and they will constrain residence times of OMZ layers.
- Estimate rates of biogeochemically important processes- e.g., apparent oxygen utilization, denitrification - to contrast rates in upwelling, OMZ and low nitrate regions.
- Identify sources and sinks and estimate effective time scales of the circulation, mixing and ventilation for thermocline and intermediate water masses within which TEIs reside - to contribute to a characterization of the physical processes affecting trace speciation and internal cycling.