Application for Consent to Conduct Marine Scientific Research
in Areas Under National Jurisdiction of

Oman

Date: 11 February 2009 State Department #2008-133

1. General Information

1.1 Cruise name and/or #:	**CLIVAR I7N; KNOX Leg**

1.2 Sponsoring institution:	
Name:	**Scripps Institution of Oceanography**
Address:	**University of California, San Diego** **La Jolla, CA 92093-0210**
Name of Director:	**Dr. Tony Haymet**

1.3 Scientist in charge of the project (include CV and passport photo):	
Name:	**Dr. James Swift** **See CV appendix III.**
Address:	**Scripps Institution of Oceanography** **9500 Gilman Drive** **La Jolla CA 92093-0214** **USA**
Telephone:	**858-534-3387**
Fax:	**858-534-7383**
Email:	**jswift@ucsd.edu**

1.4 Scientist(s) from coastal state involved in the planning of the project:	
Name(s):	**No one specific at this time**.
Address:	

1.5 Submitting officer:	
Name and address:	**Elizabeth Brenner/Rose M. Dufour** **Scripps Institution of Oceanography** **University of California, San Diego** **La Jolla, California 92093-0210**
Nationality:	**USA**
Telephone:	**(858) 534-2841**
Fax:	**(858) 822-5811**
Email:	**Shipsked@ucsd.edu**

2. Description of Project (Attach additional pages as necessary)

2.1 Nature and objectives of the project:
To carry out Climate Variability and Predictability (CLIVAR) leg I7. The CLIVAR program is part of the World Climate Research Program (WCRP) project that addresses climate variability and predictability, and is sponsored by IOC of UNESCO, the International Council for Science (ICSU) and World Meteorological Organization, which Oman is a member. Most of the work will take place in international waters. **Dr. James Swift, an oceanographer at the Scripps Institution of Oceanography of the University of California, San Diego, is the coordinator for a program of global ocean measurements (carbon parameters, temperature, salinity and other water properties) for the United States' contribution to the World Climate Research Program CLIVAR (Climate Variability) Repeat Hydrography Program**

and the UNESCO International Ocean Carbon Coordination Project.

One may learn more about the international programs at <http://www.clivar.org/carbon_hydro/> and <http://www.ioccp.org/>. The US science team also maintain a web site oriented toward the United States' contributions at <http://ushydro.ucsd.edu/>.

During the 2009 R/V *Roger Revelle* expedition, our science team plans "repeat hydrography transects" from Oman to ca. 33°S ("I7N"). The "I7N" transect begins near the 100-200 meter isobaths off Oman and also traverses EEZs of the UK, Mauritius, and France. We will seek research clearances for those parts of our work.

For our work, at every 50 kilometers (approximately; closer over submarine ridges and near coasts), we stop the ship (we call this stop a "station") where we lower a device called a CTD/rosette, which measures the temperature, salinity, oxygen, and currents from just below the sea surface to approximately 10 meters above the ocean bottom. During each of these stations we also collect up to 36 water samples for measurement of various water properties, such as CO2-related parameters, dissolved CFCs, oxygen, salinity, nutrients, and so forth (a complete list of science programs is included, below). We measure so-called trace metals (chiefly iron and aluminum) in the upper 1000 meters at some of our stations. While the ship is both underway and stopped we also continuously pump surface seawater through sensors for temperature, salinity, and partial pressure of CO2; we operate standard meteorological sensors; we operate an Acoustic Doppler Current Profiler; and we normally operate a multibeam bathymetric sonar. If the ship is equipped with a working gravimeter, that is usually in operation also.

Our planned "I7N" work is presently scheduled to begin off Oman in September 2009. We will work steadily southward to ca. 33°S, coming to port in Cape Town in October 2009.

RATIONALE FOR REPEAT HYDROGRAPHY SURVEYS IN SUPPORT OF CLIVAR AND CARBON CYCLE OBJECTIVES (written in 2001)

This summarizes the scientific rationale and scope of an integrated approach to a global observational program for carbon, hydrographic and tracer measurements. The program is driven by the need to monitor the changing patterns of carbon dioxide (CO_2) in the ocean and provide the necessary data to support continuing model development that will lead to improved forecasting skill for oceans and global climate. The WOCE/JGOFS survey during the 1990s has provided a full depth, baseline data set against which to measure future changes. By integrating the scientific needs in the following five areas, major synergies and cost savings will be achieved. These areas are of importance both for upcoming research programs, such as CLIVAR and the U.S. GCRP Carbon Cycle Science Program (CCSP), and for operational activities such as GOOS and GCOS. In this regard, consensus was reached at the First International Conference on Global Observations for Climate, held in St. Raphael, France in October 1999, that one component of a global observing system for the physical climate/CO2 system should include periodic observations of hydrographic variables, CO2 system parameters and other tracers (Smith and Koblinsky, 2000). The large scale observation component of the CCSP has also clearly defined a need for systematic observations of the invasion of anthropogenic carbon in the ocean superimposed on a variable natural background.

A. Carbon system studies

There is broad consensus based on a variety of atmospheric, oceanic and modeling constraints that the ocean that the ocean took up 2.0 +/- 0.6 Gt carbon annually during the last decade (Battle 2000, Takahashi, 1999; Orr et al, 2001). The data from the recent WOCE/JGOFS global carbon survey are providing the first comprehensive inventory of anthropogenic CO2 in the ocean. This survey provided a large data set on the total dissolved inorganic carbon (DIC) content of the ocean, at an unprecedented accuracy of 2 μmol/kg (or 0.1 % of the total concentration). This is equivalent to 1-2 year's uptake of anthropogenic carbon in surface waters. The total anthropogenic inventory of DIC

into the ocean can be determined using concurrent, hydrographic, alkalinity, oxygen nutrient and tracer measurements (Gruber et al., 1996). Utilizing transport estimates, the fluxes of carbon within and between oceans and ocean basins can be better constrained, particularly interhemispheric exchange of carbon through the ocean. Atmospheric interhemispheric exchange is an important diagnostic for models and pre-industrial oceanic carbon transport is a key parameter to estimate interhemispheric differences of carbon sources and sinks. The WOCE/JGOFS sections provide a valuable baseline to determine the possible large scale effects of global warming on the ocean's biogeochemistry, whether due to changes in stratification, circulation, or perturbations such as a change in the dust deposition on the ocean's surface.

It is clearly important in terms of predicting long-term climate change and man's effect on the rate of change that we continue to sample the ocean for dissolved carbon components. Further justification on the need for continued oceanic observations of the carbon system are given in the U.S. GCRP publication "A U.S. Carbon Cycle Science Plan" (Sarmiento and Wofsy, 1999) and detailed in the implementation plan (Bender et al., 2001). The repeat observational plan should provide sufficient coverage to determine basin wide changes in DIC and related biogeochemical parameters over a period of approximately a decade. It would serve as a backbone to assess changes in the ocean's biogeochemical cycle in response to natural and/or man induced activity. The proposed cruises can also be a venue for other relevant measurements such as the determination of the partial pressure of CO2 in the surface water which is a critical component to assess the air-sea CO2 flux, and which is a sensitive indicator of changes in the functioning of the biological pump in surface waters.

B. Heat and freshwater storage and flux studies

While we have a reasonably good understanding of the pathways of large-scale transport of heat and freshwater in the ocean, we have no real idea of how these pathways change over decadal time scales. One hypothesis is that systematic changes in temperature-salinity relations in the subtropical and subpolar regions are related to changes in the hydrological cycle (Wong et al., 1999). Both modeling and paleo-oceanographic studies suggest the ocean's response to, for instance, changes in the forcing to be expected if atmospheric greenhouse gas concentrations continue to increase, can be rapid. Such changes might shut down the thermohaline circulation in the North Atlantic, for example, by capping the subpolar region with a layer of warmer, fresher water. Global warming-induced changes in the ocean's transport of heat and salt that could affect the circulation in this way can only be followed through long-term measurements at particular sites. (The necessary heating is forecast to be of the order of 2-4 W/m^2 for a doubling of carbon dioxide; this is too small to measure with any confidence in the ocean.) This component is vital for CLIVAR and for the CCSP as changes in circulation can dramatically change carbon transport and sequestration estimates (Sarmiento et al., 1998)

C. Deep and shallow water mass and ventilation studies

While we know that water mass characteristics can change on short-term timescales (for example, the North Atlantic "great salinity anomaly" or the El Nino/La Nina system) and often in a non-linear fashion (Doney et al., 1998), we still do not understand how and on what time scales the full-depth water mass structure of the ocean responds to atmospheric variability. Chemical tracers such as chlorofluorocarbons CFCs, 3H/3He or 14C add a time dimension, which can vary between days or centuries. This time dimension can be used to: identify newly-ventilated water masses and their formation rates; determine pathways, time scales and rates of water mass spreading along with its anthropogenic CO2 imprint; determine rates of ventilation/subduction and mixing; monitor freshwater input into high latitudes; constrain rates of biogeochemical processes; and constrain model-based estimates of ocean mixing and circulation processes and parameterizations. There is, at present, no alternative to using shipboard sampling for these tracers, and it makes sense to combine such a sampling scheme with any planned sampling of the ocean carbon system. This is particularly true because estimates of anthropogenic CO2 inventories rely heavily on the tracer measurements. Thus this aspect is of importance to both CLIVAR and carbon research.

D. Calibration of autonomous sensors

While the development of sensors for many parameters is ongoing, there is an immediate need for salinity calibration for the Argo program (www.argo.ucsd.edu). The release of some 3,000 PALACE-type floats in Argo is a major component of both the CLIVAR ocean program and the initial Global Ocean Observing System (GOOS). It is hoped that both temperature and salinity sensors will remain accurate to within about 0.01°C and 0.01 in salinity for the lifetime of each float (4-5 years). Temperature sensors seem to be stable (within specifications) for this length of time, but salinity sensors are not, being affected mainly by biofouling near the surface. Independent data are therefore necessary to check the salinities provided by these instruments, especially in regions such as the subpolar North Atlantic where deep T/S relationships are known to vary on decadal time scales. Other autonomous sensors, such as CO2, nutrient, and particle sensors, are presently being deployed. This new technology will need *in situ* validation and possibly calibration.

E. Data for Model Calibration

Data on the carbon dioxide system, hydrography and transient tracers provide key observational fields to validate process models, and for the calibration of (climate) models. To predict future atmospheric CO2 levels and global heat and freshwater balances, long-term model integrations must ensure water mass formation and transport occur at the correct rates. For example, large volumes of the ocean (e.g., the sub-thermocline Angola Basin or the deep North Pacific) are still free of either transient tracers. Thus, monitoring the penetration of tracers into these areas gives us a direct measure of the rate of uptake of greenhouse gases for comparison with model outputs. Similarly, regions of active ventilation, for instance, south of Iceland, or in the Labrador Sea, can be easily identified and provide a key diagnostic for ventilation rate estimates. Changes in carbon and heat inventory also provide strong constraints on models and their forcing functions.

An integrated sampling strategy

The scientific and logistical interests of the ocean carbon, hydrographic, and tracer communities presently overlap, and considerable synergism (and cost reduction) will be achieved by occupying a series of full-depth hydrographic cruises at decadal intervals. A suggested minimum set of such lines is given in Table 1 (see strawman plan on sections). While this set has been selected for looking at long-term changes, not seasonal changes, some lines will monitored more frequently in companion efforts. The choice and sequencing of lines takes into consideration the overall objectives of the program, dates of last occupation during WOCE/WHP, international plans, providing global coverage, and anticipated resources.

Beyond the repeat hydrography program, a limited number of time-series stations is recommended but not proposed here. These can help determine whether observed changes are local, regional, or basin-wide, monitor temporal changes between survey cruises, and possibly even alert us to unexpected rapid changes associated with air-sea forcing such as the PDO or NAO that may need to be reassessed with survey cruises sooner than planned. Potential sites for such monitoring include the sites of the Ocean Weather Ships (e.g., Mike in the Norwegian Sea and Bravo in the Labrador Sea), as well as off Hawaii and Bermuda where observations have been taken throughout WOCE and JGOFS. Additional sites might take advantage of ongoing activities such as the TAO and PIRATA moorings to monitor the air-sea CO2 fluxes in the equatorial Pacific and Atlantic oceans. The necessary instrumentation to support such fixed stations either exists, or are in development, which will reduce the present heavy reliance on shipboard sampling. The large scale observational fields will also serve to put time series and process studies in proper spatial context.

As outlined in Table 1 the U.S. program likely will consist of one or two cruises per year on a 10-14 year rotation. For costing purposes, it is assumed that each cruise will last about 45 days. Using WOCE sampling rates of four full-depth stations per day, 30-mile station spacing, and a cruising speed of 10 kt, this gives a cruise track of about 5,500 miles/10,000 km. Obviously this will not suffice

for a zonal section in the equatorial Pacific (>16,000 km), but it is overgenerous for almost all other lines. Costs, based on those of the U.S. WOCE Indian Ocean expedition of 1994-1996 adjusted for inflation and the higher costs of doing fewer lines per year, is estimated at $3,000 K. This estimate includes approximately $700 K for survey or basin specific ancillary measurements.

The integrated approach and multi-year proposal mechanism provides many scientific benefits as outlined above and also significant logistic advantages. Ship time requirements can be planned well in advance and it provides continued support for groups of trained seagoing technicians for the analyses, together with the associated quality control and data archiving. It also facilitates investments in upgrades in quality control, data management and instruments necessary for the US to remain on the forefront of this type of research. Mechanisms must be put in place to ensure that data is rapidly disseminated to the community at large, and that opportunities are available to interpret the data and use the data in a meaningful fashion in modeling exercises. Without a commitment for long-term funding of such efforts, the full long-term potential of these measurements will not be realized.

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2.2 Relevant previous or future research cruises:

Since there are many relevant cruises to list on this form, please see web site for more detailed information.
http://cchdo.ucsd.edu/index.html:

2.3 Previously published research data relating to the project:

Additional publications can be found at U.S. CLIVAR office: http://www.usclivar.org/

Battle, M., M. Bender, P. Tans, J.W.C. White, J.T. Ellis, T. Conway, and R.J. Francey, 2000. Global carbon sinks and their variability inferred from atmospheric O2 and d13C, *Science*, *287*, 2467-2470.

Doney, S.C., J.L. Bullister, and R. Wanninkhof, 1998. Climatic variability in ocean ventilation rates diagnosed using chlorofluorocarbons, *Geophys. Res. Let.*, *25*, 1399-1402.

Gruber, N., J. L. Sarmiento and T. F. Stocker, 1996. An improved method for detecting anthropogenic CO2 in the oceans. Global Biogeochem. Cycles, 10, 809-837.

Sarmiento, J. L. and S. C. Wofsy, 1999. *A U.S. Carbon Cycle Science Plan*. U.S. GCRP, Washington, D.C., 69 pp.

Bender , M. et al., LSCOP, Large Scale Carbon Observation plan: oceans and atmosphere. <http://www.ogp.noaa.gov/mpe/gcc/co2/observingplan/>

Orr, J. C, E. Maier Reimer, et al. 2001 Estimates of anthropogenic carbon uptake from four three-dimensional global ocean models. *Global Biogeochem.Cycles, 15*, 43-60.

Sarmiento, J.L., T.M.C. Hughes, R.J. Stouffer, and S. Manabe, 1998. Simulated response of the ocean carbon cycle to anthropogenic climate warming, *Nature*, *393*, 245-249.

Smith, N. and C. Koblinsky, 2000. Ocean Obs Conference Statement. Proceedings Ocean Observation 1999 Conference, St. Raphael France.

Takahashi, T., R.H. Wanninkhof, R.A. Feely, R.F. Weiss, D.W. Chipman, N. Bates, J. Olafsson, C. Sabine, and S.C. Sutherland, Net sea-air CO2 flux over the global oceans: An improved estimate based on the sea-air pCO2 difference, in *Proceedings of the 2nd International Symposium on CO2 in*

***the Oceans*, edited by Y. Nojiri, pp. 9-15, Center for Global Environmental Research, NIEST, Tsukuba, JAPAN, 1999.**

Wong, A. P. S., N. L. Bindoff and J. A. Church. 1999. Large-scale freshening of the intermediate waters in the Pacific and Indian Oceans. Nature, 400, 440-443.

3. Methods and Means to be Used

3.1 Particulars of vessel:	
Name:	***R/V Roger Revelle***
Nationality (Flag state):	**USA Flag**
Owner:	**R/V *Roger Revelle* is owned by US Navy, and operated by the University of California, San Diego under a charter party agreement. The ship however is a civilian oceanographic vessel. Many US oceanographic vessels were built by the navy (such as R/V *Thompson*), but the maintenance, operations, and crewing are under the auspices of academic institutions.**
Operator:	**University of California, San Diego, Scripps Oceanography**
Overall length (meters):	**84 m. [275']**
Maximum draught (meters):	**17'**
Displacement/Gross tonnage:	**3,180 long tons**
Propulsion:	**Tow 3000 hp Propulsion General Electric Bow Thruster: 1180 hp Azimuthing jet Type Elliot Gill Model 50T 35 Propulsions: Two 3000 hp Z-Drives Lips Type FS 2500-450/1510BO**
Cruising & Maximum speed:	**12 knots**
Call sign:	**KAOU**
Method and capability of communication (including emergency frequencies):	**Email, master@rv-revelle.ucsd.edu** **Inmarsat-B,** **Telephone,** **Indian, 011-873-336780030** **Alternate, 011-873-336780020** **Fax,** **Primary, 011-873-336780031** **Alternate, 011-873-336780021** **Telex,** **Primary, 336780033 (AnsBk=KAOU)** **Alternate, 336780022 (AnsBk=KAOU)** **Inmarsat-C, 436780010** **Radio, Vessels guard standard GMDSS frequencies for calling, distress and dissemination of marine safety information.** **MMSI #, 367800100** **SELCAL #, 71410** **Telex,** **Primary, 336780033 (AnsBk=KAOU)** **Alternate, 336780022 (AnsBk=KAOU)** **Inmarsat-C, 436780010** **Radio, Vessels guard standard GMDSS frequencies for calling, distress and dissemination of marine safety information.** **MMSI #, 367800100** **SELCAL #, 71410**

Name of master:	**Thomas Desjardins**
Number of crew:	**22 (please see Appendix 1 Crew List below)**
Number of scientists on board:	**No more than 37 (please see appendix 2 for science list)**

3.2 Aircraft or other craft to be used in the project:
None

3.3 Particulars of methods and scientific instruments		
Types of samples and data	Methods to be used	Instruments to be used
Data available within ca. 2-12 months of cruise end: Temperature, salinity, dissolved oxygen, dissolved nutrients, currents, dissolved CFCs, dissolved inorganic carbon, alkalinity, pH, dissolved trace metals, partial pressure of CO2, meteorological measurements if available. Data available within ca. 1-2 years: dissolved organic matter, total dissolved nitrogen. Data available within 3-5 years: dissolved helium, dissolved tritium, dissolved radiocarbon.	**Underway measurements from continuously pumped surface seawater and on-board sensors; vertical profiles at station stops with CTD and rosette**	**Thermosalinograph, acoustic doppler sonars ADCP RDI Narrowband and RDI Broadband 150 kHz, CTD rosette with 24-36 10-liter Niskin-type bottles and SeaBird 911+ CTD**

3.4 Indicate whether harmful substances will be used:

None

3.5 Indicate whether drilling will be carried out:
None

3.6 Indicate whether explosives will be used:
None

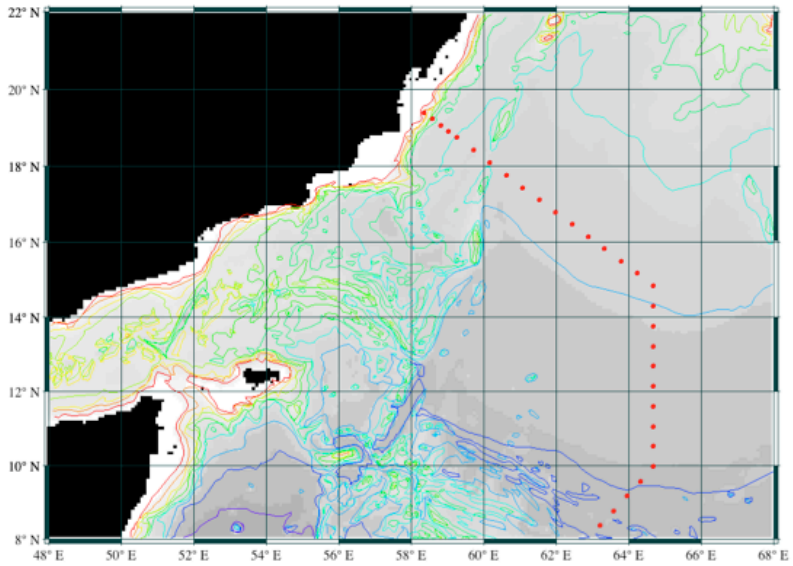
4. Installations and Equipment

Details of installations and equipment (dates of laying, servicing, recovery; exact locations and depth):
None

5. Geographical Areas

5.1 Indicate geographical areas in which the project is to be conducted (with reference in latitude and longitude):
Please note the work is planned outside the 12nm Territorial Sea of Oman. **Most of the work will take place in international waters however The following stations are in Oman's EEZ. Please see chart below for all stations.** **19.42 N 58.33 E** **19.25 N 58.56 E** **19.09 N 58.79 E** **18.93 N 59.02 E** **18.76 N 59.24 E** **18.44 N 59.70 E** **18.11 N 60.15 E** 17.78 N 60.61 E

5.2 Attach chart(s) at an appropriate scale (1 page, high-resolution) showing the geographical areas of the intended work and, as far as practicable, the positions of intended stations, the tracks of survey lines, and the locations of installations and equipment.



R/V Roger Revelle 2009 "I7N" CO2/CLIVAR Cruise
Detail of planned stations near north end of I7N
(stations in EEZs will be along track shown; exact positions may vary slightly from those shown)

6. Dates

6.1 Expected dates of first entry into and final departure from the research area of the research vessel:
We plan to depart port 02 September 2009 and remain in Omani waters until 09 September 2009. These date are preliminary and are subject to change.

6.2 Indicated if multiple entry is expected:
Multiple entry is not expected for this cruise.

7. Port Calls

7.1 Dates and names of intended ports of call:
Port of calls to be determined. However, we anticipate berthing at a MFA recommended 26 August – 02 September 2009. These date are preliminary and are subject to change.

7.2 Any special logistical requirements at ports of call:
The ship will require fueling, ship stores (food and supplies). Additionally, a personnel exchange of science party and crew will be planned during this stop.

7.3 Name/Address/Telephone of shipping agent (if available):
GULF AGENCY COMPANY (OMAN) L.L.C. **GAC Building,**

Dohat Al Adab Street,
Al Khuwair
PO Box 740,
RUWI 112 Sultanate of Oman
Tel +968-2447 7800
Fax +968-2447 7891
Email: muscat@gacworld.com
Web: http://www.gacworld.com/oman

POC: Kosala Wijesinghe
Mobile: + 968-9934 0352

8. Participation:

8.1 Extent to which coastal state will be enabled to participate or to be represented in the research project:
We are prepared to offer berths for one or two persons from Oman to join us to work with us or observe us at sea. Please note that due to very tightly planned science operations there is regrettably no time or provision for additional port stops to embark or disembark observers. .

8.2 Proposed dates and ports for embarkation/disembarkation:
Port of calls to be determined. However, we anticipate arriving at a MFA recommended port 26 August – 02 September 2009. These date are preliminary and are subject to change. **Mid port stop in Victoria, Seychelles approximately 24 September; arriving 23 September & departing 25 September.** **End of cruise Capetown South Africa 26 October 2009**

9. Access to data, samples and research results

9.1 Expected dates of submission to coastal state of preliminary reports, which should include the expected dates of submission of the final results:
The preliminary report will be completed 30 days after the conclusion of the cruise.

9.2 Proposed means for access by coastal state to data and samples:
We are prepared to offer Oman immediate, unlimited access to all of our scientific data from the cruise as soon as they are ready to be used. Many of the data will be available at the end of the cruise, and can be provided on one or more "data DVDs". A data update is sometimes available 12-18 months after a cruise, and those updated data will be provided if the update indeed transpires. A few types of samples are analyzed in shore laboratories and so are available only several years later.

9.3 Proposed means to provide coastal state with assessment of data, samples and research results or provide assistance in their assessment or interpretation:
Via the CCHDO-CLIVAR and Carbon Hydrograhic Data Office web site: http://cchdo.ucsd.edu/index.html **The CCHDO's primary mission is to be a repository and distribution center for CTD and Hydrographic data sets of the highest possible quality. These data are a product of WOCE, CLIVAR and numerous other oceanographic research programs -- past, present and to come. Whenever possible we provide these data in three widely-used formats: WOCE, netCDF and WHP-Exchange, which we recommend for data submissions to the CCHDO.**

9.4 Proposed means of making results internationally available:
Via the CCHDO web site. http://cchdo.ucsd.edu/index.html

**To Whom It May Concern:

The planned R/V Roger Revelle "I7N" cruise is part of the US Global Ocean Carbon and Repeat Hydrography Program funded by the US National Science Foundation and the US National Oceanic and Atmospheric Administration.

The NSF portion of this US program was proposed and funded by this group of US Principal Investigators:

Dr. James H. Swift	UCSD Scripps Institution of Oceanography
Dr. Lynne D. Talley	UCSD Scripps Institution of Oceanography
Dr. Frank J. Millero	University of Miami
Dr. Dennis A. Hansell	University of Miami
Dr. Peter Schlosser	Columbia University
Dr. William M. Smethie, Jr.	Columbia University

All are long-term, full-time US employees of their US institutions.
No non-US investigator was part of this US-only proposal.

Under funding from NSF and NOAA, this US team carries out approximately two research cruises each year, always on US-owned, US-operated research ships. The at-sea science team on each US cruise consists of US University employees (including several graduate students at US universities), and US NOAA employees. Dr. James Swift acts as the coordinator for the science team members and measurements from US universities.

Each cruise for the US Global Ocean Carbon and Repeat Hydrography Program is a repeat of a key cruise from the international World Ocean Circulation Experiment (WOCE), which was carried out during the 1990s by teams for many nations. Indeed, each cruise for the US Global Ocean Carbon and Repeat Hydrography Program is an official contributor to the International Ocean Carbon Coordination Program, which is actively supported by other science teams and other ships of other nations. But please note that each of the US cruises, such as the planned R/V Roger Revelle "I7N" cruise, is led, funded, and carried out solely by the United States.

Dr. Swift does not personally go to sea on every cruise for the program. He, with the other investigators listed above, works with colleagues at NOAA and at US universities to assemble a team for each US cruise that is (1) expert in the required measurements and (2) knowledgeable about the expected oceanography of the region to be measured.

It is understandable that some foreign graduate students study oceanography at US universities, and that US oceanographic institutions have some full-time employees, who legally reside full-time in the US, who happen to retain non-US citizenship.

It so happens that Dr. Alison Macdonald, a full-time, resident Research Specialist at the Woods Hole Oceanographic Institution in Massachusetts, has the appropriate and ideal interest, knowledge, and availability for a long cruise to lead the "I7N" cruise. The fact that she holds a UK passport has nothing whatsoever to so with any UK interest in or control of the expedition. Reiterating: The "I7N" expedition is 100% a US-funded and US-controlled expedition.

It also happens that a young scientist from the University of Miami, expert in tropical oceanography, was available to work with Dr. Macdonald on "I7N". She is Dr. Shenfu Dong. The fact that she holds a Chinese passport is completely irrelevant in terms of Chinese interest, funding, or control, which is nil. She is a full-time employee of her US institution and a resident of the US.

We have listed as student assistants at sea several graduate students at US institutions - the same in educational terms as full-time employees of their US institutions - who happen to be citizens of other nations. It is routine that graduate students go to sea as part of their education and training. Their participation on "I7N' has nothing whatsoever to do with their nationality - they are full-time US graduate student employees.

There is, in fact, not a single member of the listed "I7N" science team who is employed by a non-US institution or who is a resident of another nation. Those listed are all US employees who were selected by Dr. Swift and his co-investigators on the basis of their expertise and suitability for the expedition. Again, all are full-time US employees and, again, this is 100% a US expedition.

Respectfully Yours,

James H. Swift
Research Oceanographer
UCSD Scripps Institution of Oceanography

Appendix III

PROFESSIONAL BIOGRAPHY - JAMES HOWARD SWIFT

Undergraduate
Institution:
Case Western Reserve University
Physics B.S 1970
Graduate Institution: University of Washington Physical Oceanography
M.S. 1975
University of Washington Physical Oceanography
Ph.D. 1980
Postdoctoral Institution: UCSD/SIO Physical Oceanography
1980-1981
POSITIONS HELD:
1998-present Research Oceanographer UCSD/Scripps Institution of Oceanography
1987-1998 Associate Research Oceanographer
UCSD/Scripps Institution of Oceanography
1986-present Academic Administrator
(STS/ODF)
UCSD/Scripps Institution of Oceanography
1988-1990 Affiliate Associate Professor School of Oceanography, Univ. of Washington
1985-1988 Research Associate Professor School of Oceanography, Univ. of Washington
1981-1985 Assistant Research Oceanographer
UCSD/Scripps Institution of Oceanography
1980-1981 Postdoctoral Research Oceanographer
UCSD/Scripps Institution of Oceanography
1972-1979 Research/Teaching Assistant School of Oceanography, Univ. of Washington
GRADUATE AND POST DOCTORAL ADVISORS:
Graduate Advisor: Knut Aagaard
Postdoctoral Advisor: Joseph L. Reid
Memberships
American Geophysical Union
Tau Beta Pi
The Oceanography Society
Honors and Awards
National Science Foundation Arctic Service Award - August 2000.
United States Coast Guard Distinguished Public Service Award - January 2001.
Other Professional Activities (selection from recent years)
External panels for NSF/OCE Physical Oceanography program.
Member, Study Steering Committee "Cost/Benefit Analysis of a Dedicated Science Submarine", National Science Foundation, US Navy, and Rand Corporation.
Member, Working Group, SCICEX 2000 workshop, 5-8 October 1998, Warrenton, VA.
Director, International WOCE Hydrographic Program Office (at SIO; now also known as the CLIVAR
and Carbon Hydrographic Data Office)
Member, *ex officio*, International WOCE Data Products Committee (through 2002).
Founding Chair, UNOLS Arctic Icebreaker Coordinating Committee (1996-2001; membership continued through 2003).
Member, *ex officio*, UNOLS Council (1996-2001).
Member, Antarctic Research Vessel Oversight Committee (2002-2007).
Member, NSF Office of Polar Programs Committee of Visitors (2003).
Member and Chair, NSF Office of Polar Programs External Advisory Committee (2004-2006).
Member and co-Chair, NSF/OPP McMurdo Resupply Subcommittee (2005).
Member, National Academy of Sciences National Research Council and Transportation Research Board Committee on Assessment of U.S. Coast Guard Polar Icebreaker Roles and Future Needs (2005-2007).
Member, Alaskan Regional Research Vessel Advisory Committee (2007-present)

Field Work during the past 10 years

USCGC Healy, 31 May - 6 July 2000, St. Johns, Newfoundland - Dublin, Ireland. Chief scientist for USCGC Healy science systems test program

R/V Knorr, 30 May - 3 July 2002, Reykjavik, Iceland - Glasgow, Scotland. Co-chief scientist on Nordic Seas CTD/hydro/tracer/LADCP survey

USCGC Polar Star, 19 August - 23 September 2002, Barrow-Barrow. Carried out CTD/hydro/tracer/LADCP survey of the Chukchi Borderlands region

RVIB Nathaniel B. Palmer, 05 July - 20 August 2003, Dutch Harbor-Barrow. Chief scientist for Arctic Shelf-Basin Interactions Survey cruise (CTD/hydrographic/LADCP) of the Chukchi Sea and slope, western Beaufort shelf and slope, and southern Canada Basin

USCGC Healy, 15 May - 23 June 2004, Nome-Nome. CTD/hydrographic operations, data processing, and oceanographic interpretation support for the Arctic Shelf-Basin Interactions "Process 1" cruise

R/V Melville, 28 July - 27 August 2004, Honolulu - San Diego. Chief scientist for second leg of transect "P02" for the U.S. Global Ocean Carbon and Repeat Hydrography program

R/V Roger Revelle, 10 January - 20 February, 2005, Papeete, French Polynesia - Wellington, New Zealand. Co-chief scientist for transect "P16S" for the U.S. Global Ocean Carbon and Repeat Hydrography program

Icebreaker Oden, 19 August - 25 September, 2005, Barrow - Longyearben, Norway. Led US component of international team that completed a CTD/hydro/CO2/tracer transect across the Arctic Ocean, including the first-ever surface crossing of the northern Canada Basin and Alpha Ridge

R/V Roger Revelle 4 February - 17 March 2007, Dunedin, New Zealand - Fremantle, Australia. Chief scientist for transect "I8S" for the U.S. Global Ocean Carbon and Repeat Hydrography program.

Research Publications during the past 10 years

Jones, E.P., L.G. Anderson, and J.H. Swift. "Distribution of Atlantic and Pacific waters in the upper Arctic Ocean: Implications for circulation." *Geophysical Research Letters, Am. Geophys. Un.,* 25(6), 765-768, 1998.

Carmack, E.C., K. Aagaard, J.H. Swift, R.G. Perkin, F.A. McLaughlin, R.W. Macdonald, and E.P. Jones, "Thermohaline Transitions." In: Physical Processes in Lakes and Oceans, *Coastal and Estuarine Studies*, 54, 179-186, 1998.

Macdonald, R.W., E.C. Carmack, F.A. McLaughlin, K.K. Falkner, and J.H. Swift, "Connections among ice, runoff and atmospheric forcing in the Beaufort Gyre." *Geophys. Res. Letters*, 26 (15), 2223-2226, 1999.

Swift, J.H. "The Oceanography of the Arctic Ocean." *Current*, 15 (3), 28-32, 1999.

Ekwurzel, B., P. Schlosser, R.A. Mortlock, R.G. Fairbanks, and J.H. Swift. "River runoff, sea ice meltwater, and Pacific water distribution and mean residence times in the Arctic Ocean." *Journal of Geophysical Research*, 106, 9075-9092, 2001.

Schauer, U., B. Rudels, E.P. Jones, L.G. Anderson, R.D. Muench, G. Björk, J.H. Swift, V. Ivanov, A.-M. Larsson. 2002, "Confluence and redistribution of Atlantic water in the Nansen, Amundsen and Makarov basins." *Annales Geophysicae* 20 (2), 257-273, 2002.

Anderson, L.G., E.P. Jones, and J.H. Swift. "Export production in the central Arctic Ocean evaluated from phosphate deficits." *J. Geophys. Res.*, 108, 3199, 2003

Jones, E.P., J.H. Swift, L.G. Anderson, M. Lipizer, G. Civitarese, K.K. Falkner, G. Kattner, and F. McLaughlin. "Tracing Pacific Water in the North Atlantic Ocean." *J. Geophys. Res.,* 108, 3116, 2003.

McLaughlin, F.A., E.C. Carmack, R.W. Macdonald, H. Melling, J.H. Swift, P.A. Wheeler, B.F. Sherr, E.B. Sherr. "The joint roles of Pacific and Atlantic-origin waters in the Canada Basin, 1997-1998. *Deep-Sea Research I*, 51, 107-128, 2003.

Anderson, L.G., E. Falck, E.P. Jones, S. Jutterstrom, and J.H. Swift. "Enhanced uptake of atmospheric CO2 during freezing of seawater: A field study in Storfjorden, Svalbard." *J. Geophys. Res.,* 109, C06004, doi: 10.1029/2003JC002120, 2004.

Swift, J.H., K. Aagaard, L. Timokhov, and E.G. Nikiforov. "Long-Term Variability of Arctic Ocean Waters: Evidence From A Reanalysis of the EWG Data Set." *J. Geophys. Res*., 110, 2005 C03012, doi:10.1029/2004JC002312.

Woodgate, R., K. Aagaard, J.H. Swift, K.K. Falkner, and W.M. Smethie, Jr. "Pacific ventilation of the Arctic Ocean's lower halocline by upwelling and diapycnal mixing over the continental margin." *Geophys. Res. Lett.*, Vol. 32, No. 18, L18609, 10.1029/2005GL023999, 29 September 2005.

Falkner, Kelly Kenison, Michael Steele, Rebecca A. Woodgate, James H. Swift, Knut Aagaard, and James Morison. "Dissolved oxygen extrema in the Artic Ocean halocline from the North Pole to the Lincoln Sea." *Deep-Sea Research I*, 52, 1138-1154, 2005

Codispoti, L.A., C. Flagg, V. Kelly, and James H. Swift. "Hydrographic conditions during the 2002 SBI process experiments." *Deep-Sea Research II*, 52, 3199-3226, 2005.

Woodgate, R. A., K. Aagaard, J. H. Swift, W. M. Smethie Jr., K. K. Falkner. "Atlantic water circulation over the Mendeleev Ridge and Chukchi Borderland from thermohaline intrusions and water mass properties." *J. Geophys. Res.*, 112, C02005, doi:10.1029/2005JC003416, 2007.

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Jones E.P., L.G. Anderson, S. Jutterström, J.H. Swift. "Sources and distribution of fresh water in the East Greenland Current." *Progress In Oceanography*, 78, 37-44, 2008.

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Aagaard K., R. Andersen, J. Swift, J. Johnson. "A large eddy in the central Arctic Ocean." *Geophys. Res. Lett.*, 35, L09601, doi:10.1029/2008GL033461, 2008.

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