

**Challenger 108B/93**  
**[LOIS RACS-1]**  
**25 November - 10 December 1993.**

**Cruise Report**

**N.J.P. Owens**  
**University of Newcastle upon Tyne.**

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## **OBJECTIVES**

### **[LOIS]**

1. To quantify hydrodynamical transports and the processes affecting transformations, interactions and fates of particles, biogeochemically important elements and representative contaminants from land sources to the coastal zone.
2. To provide the first integrated environmental data base for a UK coastal region covering seasonal cycles and interannual variability and incorporating measurements of the fluxes of materials and rates of biological productivity.
3. To generate new quantitative understanding of estuarine and coastal zone processes controlling the fluxes and reactivities of both natural and anthropogenic materials.
4. To provide integratable models of these processes as building blocks for comprehensive coastal zone system models which will realistically predict the affects fo future environmental change.

### **[Specific cruise objectives].**

1. To measure the rates of nutrient fluxes between the sediments and the water column in a variety of sediment types in the LOIS RACS-C region.
2. To map the distributions of nutrients, salinity, turbidity and Th234 in the LOIS RACS-C region.
3. To deploy (and subsequently recover) four LOIS instrument moorings to measure, salinity, fluorescence, and turbidity.

## **PERSONNEL**

N.J.P. Owens (University of Newcastle upon Tyne) - Principal Scientist.  
G. Ballard (POL) - Moorings periods  
R. Bellerby (PML)  
R. Clifton (PML)  
R. Cramer (BODC)  
P. Duncan (RVS) - Computing  
P. Frickers (PML)  
A. Harrison (POL) - Moorings periods  
R. Howland (PML)  
A. Jones (RVS) - Electronics  
A. Rowden (PML)  
D. Smallman (DML)  
P. Watson (PML)  
S. Widdicombe (PML)

## ITINERARY

- Wed. 24 Nov.** Scientists joined ship - Hull. Commenced setting up equipment.
- Thurs. 25 Nov.** Continued setting up equipment. Sailed 1300. Log calibration trials. Transmissometer CTD calibration. Hove to overnight close to mouth of Humber estuary.
- Frid. 26 Nov.** Deployed bottom landers at Holderness sites 3,2 and 1. CTD's on sites. Overnight at anchor at Bull Point anchorage, Humber estuary.
- Sat. 27 Nov.** Sediment site 6. CTD, Day grab, DML corer and Box coring AM. Deployed bottom lander, station 4 in Humber estuary. Disembarked POL personnel. Overnight passage and nutrient monitoring to sediment site in Wash.
- Sun. 28 Nov.** Sediment site 9. CTD, Day grab and Box coring AM. Passage along Humber-Wash grid, surface nutrient monitoring towards sediment off E. Anglian coast. Continued overnight.
- Mon. 29 Nov.** Sediment site 8. Day grab, CTD and box-coring. Passage along Humber/Wash grid for surface sampling, PM and overnight.
- Tues. 30 Nov.** Sediment site 1. Day grab, CTD and box-coring. Passage NW towards Silver Pit, surface monitoring overnight.
- Wed. 1 Dec.** Sediment sites 4 and 5 (Silver Pit). Sediment site 4 abandoned. Sediment site 5 successful. Surface monitoring overnight towards Humber mouth.
- Thurs. 2 Dec.** Boat transfer of equipment by Humber Pilots. Surface monitoring throughout the day towards the N via grid.
- Fri. 3 Dec.** Tees estuary site. Day grab, CTD and Box coring all successful. Surface monitoring along grid towards Tweed estuary. Continued overnight.
- Sat. 4. Dec.** Tweed estuary site. All activities successful. Surface monitoring along northern and outermost track of grid.
- Sun. 5 Dec.** Second Tweed site-off St. Abb's Hd. First site abandoned. More inshore site successful. Proceeded S along outer leg of grid towards Tyne.
- Mon. 6. Dec.** Arrived at Station P' AM. Site work successful. Rendezvous with RV *Bernicia*. Proceeded S along outer leg of grid towards Humber. Surfaced monitoring.

- Tues. 7. Dec.** Offshore Humber. SAPS deployed AM. Established new gravel site PM. Bull Pt. anchorage overnight. Tidal cycle anchor station.
- Wed. 8 Dec.** Embarked POL scientists. Inner mooring recovered. Hove to in heavy weather.
- Thurs. 9 Dec** Hove to throughout day. Unable to recover moorings. Docked late PM.
- Fri. 10 Dec** Cruise ends. Scientists depart. Leg C commenced.

## **NARRATIVE**

### **Wednesday 24th November.**

Scientists joined Challenger, Albert Dock, Hull. Journeys from opposite ends of the country. Equipment set up in labs and POL moorings refurbished from previous deployments during afternoon. Very cold, grey misty day. Most scientists ashore during afternoon.

### **Thursday 25th November.**

Morning spent continuing setting up labs. Locked out of docks into river Humber 1300. Weather still grey but relatively clear and somewhat warmer. Two hour passage down estuary with pilot on board. Once clear of the pilot, two hours spent running lines to calibrate log. Log engineer disembarked 1900. Made way to outer estuary. Carried out first CTD to calibrate transmissometers to be used on moorings. Evening spent making a slow passage to NE of Humber mouth, in readiness for moorings. Almost flat calm. Cold and dark night.

### **Friday 26th November.**

Two POL bottom moorings deployed without difficulty before lunch in perfect flat conditions. Third mooring deployed less than 2 miles off Holderness coast, again no difficulties. CTD's carried out at each site. Slow passage back to mouth of Humber. Anchored during evening in Bull Point Anchorage, just south of Spurn Head. Still flat calm. Dull and overcast but considerably warmer. Busy anchorage. Quiet night.

### **Saturday 27th November.**

Early start with Day grab, CTD's and box cores. Good sediment site, so no difficulty with corers. Still very flat, but grey and misty. Successful morning with all cores collected for lab. incubations and benthos. Only difficulty experienced was with fierce tide, but large corer handled this well. Weighed anchor 1400 and proceeded to 4th mooring site, just south of the fort in the centre of the Humber mouth. Perfect mooring deployment. Disembarked two POL scientists, and proceeded to sea. Started surface monitoring for nutrients. Still calm with a gentle swell when out of immediate mouth. England beat the All Blacks 15-9, great win! Chilly and grey. Monitoring continued overnight on a surface grid towards the mouth of the Wash.

**Sunday 28th November.**

Early start again at a good benthic site. CTD grabs and box-cores. All went well. Land visible at all times - typical flat SE English country-side. Fierce tide again, made the lighter gear difficult to work. Mid-afternoon departure towards SE to site off the Norfolk coast. Nutrient monitoring continued overnight. Breeze built during PM, up to about F6, making for an uncomfortable motion. Continued to build during the night. Ship slowed since we were heading directly into it.

**Monday 29th November.**

Day dawned overcast and breezy, lumpy sea, although not big waves. Grabs and CTD successful, but first box-core proved troublesome. Some doubt expressed about continuing, but in the event coring was carried out successfully. Motion a little lively, but no influence on work. Departed site to start monitoring leg around grid, nutrient measurements. Proceeded to site to NW via extensive leg to N. Motion fine in a following sea at first. Expected heavier seas on alternative courses, but this proved no trouble. Monitoring carried out successfully overnight.

**Tuesday 30th November.**

Another grey, cold morning. Surprised to find the sea had died down during the night, to reveal another good day for working box-cores. Everything now getting down to a routine of early starts, followed by an intensive period of box-coring. The site proved to be a difficult bottom, with many pebbles and shells. A large number of unsuccessful attempts required before the necessary cores were obtained. Remained on station during afternoon to clear backlog of chemistry samples from cores. Another grey cold day, but almost flat calm again. Budget day!! Departed station during evening on another leg of the grid to the W of the Humber Mouth.

**Wednesday 1st December.**

The now familiar pattern of early morning grabs and coring got underway at the Silver Pit. Unfortunately, the bottom type required proved elusive, and after a thankless full morning of box coring, the site was abandoned for a second near-by site. This proved more successful but still required coring up to the evening. Much brighter day, even with sunshine. The forecasted strong W winds did not materialise, a pleasant day weatherwise all round with only a gentle swell. Departed for the Humber in the evening, sampling around an extensive grid.

**Thursday 2nd December.**

Sampling continued throughout the morning. Met up with Humber Pilots for boat transfer of chemicals, shovels and sample bottles. Set off Northbound surface sampling on route. Another pleasant day, bright and a little breezy, but excellent for the time of year. Coring team glad of a slight respite from their activities on deck. Surface monitoring all day towards north, continued overnight.

**Friday 3rd December.**

Arrived off River Tees. Pleasant weather, a little swell, but comfortable. What should have proved a relatively easy site to work because of the muddy bottom, took longer than anticipated - but was completed by the evening. Strong breeze built to a W gale by the end of the day. No difficulties, however, because we were only about 7 miles

offshore. Surface monitoring continued throughout the night on zig-zag track towards Tweed estuary.

#### **Saturday 4th December.**

Beautiful morning, bright sunshine a stiff breeze from the NW made for quite a bit of pitching, but everybody, now with sea-legs, fine. Fine views of hills inland just S of Tweed, light sprinkling of snow on the highest slopes. Arrived on station 1300. Sediment work went well during the afternoon. Breeze maintained during the day, but motion fine. Departed around outer-leg of grid, sampling overnight.

#### **Sunday 5th December.**

St. Nicholas' day. At sediment site approx 10 miles off St. Abb's Head. Another fine morning. Bright and sunny, slight breeze and swell. Site initially looked good from Day grab, however, box-coring proved difficult, with some damage done to corers. Abandoned site in favour of alternative approx. 2 miles off St. Abb's. Very picturesque location. Site proved good, with successful box-core. Departed late afternoon to pick up outer leg (approx 25 offshore) and southbound. Calm, pleasant evening. St. Nicholas' night celebrated in the traditional way!

#### **Monday 6th December.**

At station P (approx 10 miles off Blyth) by 0400. Grabs, CTD's and coring during morning. Arranged rendezvous with *Bernicia* for the afternoon. Pleasant sunny morning, gentle breeze. Breeze built during the afternoon watch, became overcast. Work went well, a good site. Should prove to be a good LOIS site. RV *Bernicia* alongside at 1530 - great to see her. Transfer of equipment went without hitch. Self, A.R. and S.W. on board briefly! Departed area and made for outer-leg, and eventually southbound towards Humber mouth. Surface monitoring overnight.

#### **Tuesday 7th December.**

Deployed SAPS AM at outermost site off Humber. Fine bright breezy morning. Successful deployment. Proceeded south to establish a sediment site in gravel. Day grab survey successful; new site established for subsequent work. Proceeded inshore to Bull Pt. anchorage. At anchor overnight, tidal cycle nutrient analysis overnight. Quiet, cold night.

#### **Wednesday 8th December.**

Weighed anchor 1000, picked up Humber pilot and two POL scientists. Proceeded to inshore mooring site. Successfully recovered mooring without incident. Extremely cold, wet, overcast morning, with forecast for very heavy weather imminent. Proceeded out of estuary, discharged pilot and proceeded NE to Holderness mooring sites. Short spell of brighter weather, but with and increasingly stiff breeze, foretelling worse to come. Moorings at Site 3 recovered without incident in an increasingly stronger breeze. Proceeded towards the South to attempt to confirm sediment site 4 through Day grab samples. Hoped also to carry out SAP sample. The strong breeze increased quickly and was soon above F8. Abandoned scientific operations. A wild night, but the ship was comfortable because of nearness to shore. Remained hove-to close to Humber mouth.

**Thursday 9th December.**

Weather continued to worsen overnight and was gusting in excess of 50kts during the morning. Untenable to recover moorings. Remained close to shore in the hope of a moderation in the weather. Abandoned at night-fall. Pilot taken on board for pilotage up to Hull. Docked midnight.

**Friday 10th December.**

Laboratories cleared of equipment not required for leg C of cruise. New scientists aboard, and those leaving left at intervals during the day.



Thursday, 25 November 1993

13:00 Slipped shore lines Hull, entered lock  
16:07 Commenced log calibrations  
18:20 Completed log calibrations  
19:10 Disembarked log engineer  
19:45 Power failure, reinstating scientific systems  
21:10 CTD 001 O/B  
21:32 CTD 001 I/B proceed to mooring site

Julian day 329

Friday, 26 November 1993

3:24 Arrived mooring site - hove to  
9:06 Commence mooring-Holderness 3  
9:25 Mooring deployed  
9:34 CTD 002 O/B  
9:38 CTD 002 I/B  
9:39 Pump for incubation water deployed  
9:54 Pump recovered - proceed to next station  
10:50 Commence mooring-Holderness 2  
10:58 Mooring deployed  
11:08 CTD 003 O/B  
11:12 CTD 003 I/B  
14:06 Mooring deployed-Holderness 1  
14:12 CTD 004 O/B  
14:20 CTD 004 I/B  
14:33 Set course 132 towards Humber  
16:43 At anchor Bull Point

Julian day 330

Saturday, 27 November 1993

4:07 CTD 005 O/B  
4:13 CTD 005 I/B  
4:35 Day grab  
4:41 DML corer O/B  
4:44 DML corer I/B  
5:09 DML corer O/B  
5:12 DML corer I/B  
6:28 DML corer O/B  
6:30 DML corer I/B  
8:15 Box corer O/B  
8:17 Box corer I/B  
8:20 Box corer O/B  
8:22 Box corer I/B  
9:02 Box corer O/B  
9:05 Box corer I/B  
9:36 Box corer O/B  
9:38 Box corer I/B  
10:38 Box corer O/B  
10:40 Box corer I/B  
11:02 Box corer O/B  
11:04 Box corer I/B  
11:08 Box corer O/B  
11:10 Box corer I/B  
11:25 Box corer O/B  
11:27 Box corer I/B  
11:42 Box corer O/B  
11:44 Box corer I/B  
11:46 Box corer O/B  
12:00 Box corer I/B  
12:20 Box corer O/B  
12:26 Box corer I/B  
14:30 Hove to on mooring 4 site  
14:42 Day grab O/B  
14:43 Day grab I/B  
14:45 CTD 006 O/B  
14:50 CTD 006 I/B  
15:05 Mooring 4-Humber deployed  
15:30 Pilot away - POL scientists disembarked. Proceed to sediment stati  
on 9.

Julian day 331

Sediment site 6 [Bull Point Anch. - Humber]  
Surface monitoring overnight towards Wash.

Sunday, 28 November 1993

5:22 Day grab O/B  
5:25 Day grab I/B  
5:33 CTD 007 O/B  
5:41 CTD 007 I/B  
8:40 Box corer O/B  
8:45 Box corer I/B  
9:16 Box corer O/B  
9:23 Box corer I/B  
9:45 Box corer O/B  
9:51 Box corer I/B  
9:53 Box corer O/B  
9:58 Box corer I/B  
10:35 Box corer O/B  
10:40 Box corer I/B  
11:06 Box corer O/B  
11:09 Box corer I/B  
11:34 Box corer O/B  
11:37 Box corer I/B  
11:48 Complete station-proceed surface sampling

Julian day 332

Sediment site 9. [Wash]

Surface monitoring overnight towards SE.

Monday, 29 November 1993

6:00 Sediment station 8  
6:22 CTD 008 O/B  
6:31 CTD 008 I/B  
6:44 Day grab O/B  
6:48 Day grab I/B  
8:13 Box corer O/B  
8:18 Box corer I/B  
8:42 Box corer O/B  
8:46 Box corer I/B  
9:20 DML corer O/B  
9:25 DML corer I/B  
9:28 Box corer O/B  
9:33 Box corer I/B  
9:55 DML corer O/B  
10:00 DML corer I/B  
10:02 Box corer O/B  
10:06 Box corer I/B  
10:11 Box corer O/B  
10:15 Box corer I/B  
10:53 DML corer O/B  
10:55 DML corer I/B  
10:57 DML corer O/B  
11:02 DML corer I/B  
11:07 Box corer O/B  
11:11 Box corer I/B  
11:25 Box corer O/B  
11:29 Box corer I/B  
11:48 Box corer O/B  
11:51 Box corer I/B  
12:00 DML corer O/B  
12:05 DML corer I/B  
12:10 DML corer O/B  
12:15 DML corer I/B  
12:20 Pump O/B  
12:27 Pump I/B - commenced surface monitoring

Julian day 333

Sediment site 8. [SE Muds].

Surface monitoring overnight towards NW.

Tuesday, 30 November 1993

5:14 Sediment site 1.  
5:25 Day grab O/B  
5:27 Day grab I/B  
5:47 CTD 009 O/B  
5:54 CTD 009 I/B  
8:20 Box corer O/B  
8:23 Box corer I/B  
8:27 Box corer O/B  
8:30 Box corer I/B  
9:10 Box corer O/B  
9:14 Box corer I/B  
9:18 Box corer O/B  
9:20 Box corer I/B  
9:38 Box corer O/B  
9:40 Box corer I/B  
9:46 Box corer O/B  
9:49 Box corer I/B  
10:34 Box corer O/B  
10:37 Box corer I/B  
10:40 Box corer O/B  
10:42 Box corer I/B  
11:18 Box corer O/B  
11:21 Box corer I/B  
11:24 Box corer O/B  
11:27 Box corer I/B  
11:30 Box corer O/B  
11:33 Box corer I/B  
11:42 Box corer O/B  
11:44 Box corer I/B  
11:48 Box corer O/B  
11:52 Box corer I/B  
13:06 Box corer O/B  
13:08 Box corer I/B  
13:12 Box corer O/B  
13:15 Box corer I/B  
14:50 Pump O/B  
14:55 Pump I/B  
18:06 Commenced surface monitoring

Julian day 334

Sediment site 1. [SE Wash]

Surface monitoring continued overnight.

Wednesday, 01 December 1993

5:00 Arrived sediment site 4  
5:06 Day grab O/B  
5:11 Day grab I/B  
5:18 CTD 010 O/B  
5:28 CTD 010 I/B  
5:55 DML corer O/B  
6:04 DML corer I/B  
8:27 Box corer O/B  
8:31 Box corer I/B  
8:56 Box corer O/B  
9:00 Box corer I/B  
9:04 Box corer O/B  
9:08 Box corer I/B  
9:13 Box corer O/B  
9:16 Box corer I/B  
9:30 Box corer O/B  
9:34 Box corer I/B  
9:53 Day grab O/B  
9:57 Day grab I/B  
10:18 Day grab O/B  
10:21 Day grab I/B  
10:42 Day grab O/B  
10:46 Day grab I/B  
11:00 Day grab O/B  
11:01 Day grab I/B  
11:23 Day grab O/B  
11:37 Day grab I/B  
11:54 Day grab O/B  
11:57 Day grab I/B  
12:23 CTD 011 O/B  
12:31 CTD 011 I/B  
13:05 Box corer O/B  
13:06 Box corer I/B  
13:10 Box corer O/B  
13:30 Box corer I/B  
13:40 Box corer O/B  
13:42 Box corer I/B  
13:47 Box corer O/B  
13:51 Box corer I/B  
13:55 Reposition to Sediment site 5  
14:47 Arrived Sediment 5  
14:55 CTD 012 O/B  
15:02 CTD 012 I/B  
15:07 Day grab O/B  
15:10 Day grab I/B  
15:14 Box corer O/B  
15:16 Box corer I/B  
15:20 Box corer O/B  
15:23 Box corer I/B  
16:00 Box corer O/B  
16:05 Box corer I/B  
16:16 Box corer O/B  
16:19 Box corer I/B  
16:36 Box corer O/B  
16:40 Box corer I/B  
16:54 Box corer I/B  
17:14 Box corer O/B  
17:16 Box corer I/B  
17:32 Box corer O/B  
17:35 Box corer I/B  
17:53 Box corer O/B  
17:57 Box corer I/B  
18:02 Box corer O/B  
18:06 Box corer I/B  
18:09 Box corer O/B

18:11 Box corer I/B  
18:16 Box corer O/B  
18:19 Box corer I/B  
18:41 Box corer O/B  
18:45 Box corer I/B  
19:34 Box corer O/B  
19:37 Box corer I/B  
20:20 Commenced surface monitoring

Julian day 335  
Sediment sites 4 & 5.  
Surface monitoring overnight.

Thursday, 02 December 1993

9:40 Rendezvous with Humber Pilot.  
13:22 Sub-surface pump deployed.  
13:25 Sub-surface pump recovered.

Julian day 336  
Surface monitoring throughout the day.

Friday, 03 December 1993

8:20 Sediment Site 7.  
8:58 Day grab O/B  
9:01 Day grab I/B  
9:06 CTD 013 O/B  
9:18 CTD 013 I/B  
9:22 DML multi-corer O/B  
9:27 DML multi-corer I/B  
10:26 Box corer O/B  
10:30 Box corer I/B  
10:39 Box corer O/B  
10:42 Box corer I/B  
10:54 DML multi-corer O/B  
10:57 DML multi-corer I/B  
11:09 Box corer O/B  
11:12 Box corer I/B  
12:18 DML multi-corer O/B  
12:23 DML multi-corer I/B  
13:14 Box corer O/B  
13:17 Box corer I/B  
13:25 Box corer O/B  
13:29 Box corer I/B  
13:47 Box corer O/B  
13:49 Box corer I/B  
14:03 Box corer O/B  
14:06 Box corer I/B  
14:22 Box corer O/B  
14:26 Box corer I/B  
15:05 Box corer O/B  
15:07 Box corer I/B; Pump O/B  
15:15 Pump I/B  
15:16 DML multi-corer O/B  
15:30 DML multi-corer I/B  
15:35 Proceed to Site DG 31  
16:25 Arrived DG 31  
16:30 Box corer O/B  
16:32 Box corer I/B  
16:44 Box corer O/B  
16:46 Box corer I/B  
17:00 Commenced surface grid.

Julian day 337

Sediment site 7. Tees. & DG31

Surface monitoring overnight.



Saturday, 04 December 1993

13:00 Sediment site 3.  
13:08 Day grab O/B  
13:11 Day grab I/B  
13:16 CTD 014 O/B  
13:23 CTD 014 I/B  
13:30 Box corer O/B  
13:34 Box corer I/B  
13:47 DML multi-corer O/B  
13:51 DML multi-corer I/B  
13:59 DML multi-corer O/B  
14:05 DML multi-corer I/B  
14:10 Box corer O/B  
14:13 Box corer I/B  
15:06 Box corer O/B  
15:10 Box corer I/B  
15:16 DML multi-corer O/B  
15:20 DML multi-corer I/B  
15:22 DML multi-corer O/B  
15:29 DML multi-corer I/B  
15:33 DML multi-corer O/B  
15:38 DML multi-corer I/B  
15:40 Box corer O/B  
15:43 Box corer I/B  
15:57 Box corer O/B  
16:01 Box corer I/B  
16:22 Box corer O/B  
16:26 Box corer I/B  
16:33 Box corer O/B  
16:37 Box corer I/B  
16:45 Sub-surface pump O/B  
16:47 Sub-surface pump I/B  
16:59 Box corer O/B  
17:02 Box corer I/B  
21:42 Commenced surface monitoring

Julian day 338

Sediment Site 3. Tweed.

Sunday, 05 December 1993

10:30 Day grab O/B  
10:33 Day grab I/B  
10:37 CTD 015 O/B  
10:46 CTD 015 I/B  
10:51 DML multi-corer O/B  
10:55 DML multi-corer I/B  
11:03 DML multi-corer O/B  
11:07 DML multi-corer I/B  
11:14 DML multi-corer O/B  
11:20 DML multi-corer I/B  
11:34 Box corer O/B  
11:37 Box corer I/B  
11:43 Box corer O/B  
11:48 Box corer I/B  
12:00 Proceed to Sediment Site 14.  
13:00 Sediment Site 14.  
13:06 Day grab O/B  
13:10 Day grab I/B  
13:14 CTD 016 O/B  
13:22 CTD 016 I/B  
13:26 DML multi-corer O/B  
13:32 DML multi-corer I/B  
13:37 Box corer O/B  
13:41 Box corer I/B  
13:47 Box corer O/B  
13:51 Box corer I/B  
13:59 Box corer O/B  
14:02 Box corer I/B  
14:10 DML multi-corer O/B  
14:12 DML multi-corer I/B  
14:17 DML multi-corer O/B  
14:22 DML multi-corer I/B  
15:05 Camera O/B  
15:19 Camera I/B - commence monitoring  
16:29 Sub-surface pump O/B  
16:32 Sub-surface pump I/B

Julian day 339 - St. Nicholas' Day  
Sediment site DG56 & Sediment Site 14. N. Tweed.  
Surface monitoring overnight.

Monday, 06 December 1993

1:43 Sediment site 2 (P).  
8:24 Day grab O/B  
8:29 Day grab I/B  
8:33 CTD 017 O/B  
8:45 CTD 017 I/B  
8:52 DML multi-corer O/B  
8:57 DML multi-corer I/B  
8:58 DML multi-corer O/B  
9:04 DML multi-corer I/B  
9:24 Box corer O/B  
9:31 Box corer I/B  
9:39 DML multi-corer O/B  
9:44 DML multi-corer I/B  
9:59 DML multi-corer O/B  
10:04 DML multi-corer I/B  
10:35 Box corer O/B  
10:42 Box corer I/B  
11:14 Box corer O/B  
11:19 Box corer I/B  
13:06 Box corer O/B  
13:08 Box corer I/B  
13:26 Box corer O/B  
13:30 Box corer I/B  
13:45 Box corer O/B  
13:49 Box corer I/B  
14:03 Box corer O/B  
14:07 Box corer I/B  
14:20 Proceed to 1m E - Cullercoats Hbr.  
15:45 Rendezvous with RV Bernicia  
15:55 Bernicia away  
16:15 Camera O/B  
16:27 Camera I/B - commence monitoring

Julian day 340

Sediment Site 2 (P) - Tyne.

Surface monitoring continued overnight.

Tuesday, 07 December 1993

7:38 Hove to on SAPS station  
 9:23 SAPS O/B  
 10:14 SAPS I/B  
 12:35 Sediment site search commenced.  
 12:50 Day grab O/B  
 12:51 Day grab I/B  
 13:16 Box corer O/B  
 13:18 Box corer I/B  
 13:20 Box corer O/B  
 13:22 Box corer I/B  
 13:25 Box corer O/B  
 13:27 Box corer I/B  
 13:52 Day grab O/B  
 13:55 Day grab I/B  
 13:57 Box corer O/B  
 14:00 Box corer I/B  
 14:21 Day grab O/B  
 14:22 Day grab I/B  
 15:01 Day grab O/B  
 15:03 Day grab I/B  
 15:25 Day grab O/B  
 15:26 Day grab I/B  
 15:28 Day grab O/B  
 15:30 Day grab I/B  
 15:42 Day grab O/B  
 15:43 Day grab I/B  
 15:45 Day grab O/B  
 15:46 Day grab I/B  
 16:01 Box corer O/B  
 16:04 Box corer I/B  
 16:07 Day grab O/B  
 16:25 Day grab I/B  
 16:30 Box corer O/B - Sediment Site 12  
 16:33 Box corer I/B  
 16:35 Box corer O/B  
 16:37 Box corer I/B  
 17:00 Sub-surface pump O/B  
 17:24 Sub-surface pump I/B proceed to anchor  
 19:07 Bull Point Anchorage - Humber mouth

Julian day 341  
 Sediment Site 12 - Outer Humber.  
 Anchor station overnight.

Wednesday, 08 December 1993

10:53 Weigh anchor  
 11:09 POL scientists aboard  
 11:36 Bouy grappled  
 11:56 Mooring aboard; proceed to mooring 3  
 15:23 Mooring grappled and recovered.

Julian day 342  
 Moorings 4 and 3 recovered.  
 Hove-to overnight due to bad weather.

Thursday, 09 December 1993

21:00 Pilot aboard  
23:30 Docked Hull

Julian day 343

Hove-to all day due to bad weather.

Friday, 10 December 1993

8:00 Unloading commenced  
13:00 Majority scientists returned home.

Julian day 344

Leg 108B ends

Leg 108C Commenced

## REPORT

### *Summary and assessment of achievements:*

Figure 1. Shows the complete cruise track. Midnight positions and Julian Day number are shown.

All the major objectives were met.

(a). Nine sediment sites were examined in detail (see Figure 2) for a combination of benthic faunal analyses and sediment-water exchange flux measurements (see individual reports). Three new benthic sites were established.

(b). Over 98% of the LOIS sampling grid was successfully sampled (sub-surface) for the nutrients nitrate, nitrite and phosphate (see Figure 3 for track covered)

(c). A complementary suite of supporting surface water variables (fluorescence, temperature, salinity, and transmission) were also successfully measured (see contour plots Figures 4-11inc.).

(d). 41 surface water samples were collected from 27 stations and part processed for radio-isotope analyses. One stand-alone-pump (SAPS) sample was obtained).

(e). Four instrumented benthic mooring arrays were successfully deployed, bad-weather prevented the recovery of two.

(f). A little over 24hours were lost due to bad weather.

(g). Problems were encountered with two instruments: nutrient analyser - silicate channel; oxygen profiling instrument. The latter resulted in complete loss of data; silicate flux measurements can be obtained retrospectively from stored samples.

(h). Boat transfers of equipment and chemicals were required on two occasions.

### *Ship operations and facilities.*

As always, it was a pleasure to sail aboard *Challenger*. This is a highly effective, efficient, professionally run, and happy, ship. All the operational requirements were fully met. Deck operations ran very smoothly and efficiently.

The 'hotel' facilities and catering were of an equally high standard. The more flexible meal times proved popular.

The laboratory facilities were satisfactory. The shipboard fume-cupboard was inoperative due to a lack of maintenance. This was rectified through the 'good offices' of the Chief Engineer. The laboratory refrigerator broke down part-way through the cruise. This must be replaced as a matter of urgency. The telephone was inoperative (not connected) in the lab-container.

One electrical black-out at the beginning of the cruise caused minor delays in resetting instruments in the laboratory.

The lack of sufficient funds to cover crew overtime costs constrained operations. Although this severely restricted flexibility of planning, the absence of 24h crew cover for deck operations was able to be accommodated because of the nature of this cruise. For example, the periods outside the day-watch could be utilised for surface monitoring and relocating to new stations, operations which did not require crew cover. However, this could be a major limitation in the future.

#### *RVS support and equipment.*

The shipboard support provided by Paul Duncan (computing) and Andy Jones (OSG) was faultless. It is a pleasure to sail with people with such expertise and dedication.

Cruise planning and communications with RVS base were good. The equipment supplied was generally satisfactory (but see note on inoperative fume-cupboard).

However, a major limitation, which resulted in a considerable loss of time, was the poor condition of the box-corer supplied, and the absence of spares. The experienced box-core operators felt that the spade supplied was from another corer - this resulted in poor quality cores. The absence of spare boxes necessitated frequent readjustments. The box-core was the most important item of sampling equipment required on this cruise. It was through good fortune only that one of the most important cruise objectives was met.

## **INDIVIDUAL CRUISE REPORTS:**

### **NUTRIENTS**

*R.J.M Howland & B. Bellerby*

During this leg of the cruise continuous underway monitoring was carried out for Phosphate, Nitrate and Nitrite over a substantial part of both the Humber/Wash and Coastal grids (Figure 2) and the data was substantially edited on board (see Figure 12). Additionally, discrete analyses were carried out on sediment pore waters and flux samples in support of on-board sediment core experiments. Efforts were made at the beginning of this leg to find out why the silicate channel was not working, and all evidence points to a malfunction in the colorimeter. Severe problems were experienced with the new Ismatec peristaltic pump used with the auto-analyser when, at the end of the first week, the plastic tubing cartridges and cartridge holders started to break up. This is thought to be the result of a bad batch of plastic, and the supplier agreed to have replacement parts delivered to the ship during the changeover. By the end of the leg we had lost more than a third of pump capacity. Fortunately, with a spare pump we were able to continue with analyses and overall only about five hours of continuous data was lost.

Ammonia samples from the sediment pore water and flux experiments were analysed using a flow-injection gas diffusion analyser.

## **BENTHIC FAUNA**

*Steve Widdicombe & Ashley A. Rowden*

### **AIMS:**

1) To revisit sites established on the last cruise (CH99/92) within the Humber Plume Zone as the faunal part of the sediment heterogeneity study and to establish a gravel site (station 12).

2) To establish benthic faunal occurrence at a site off each of the 3 rivers within the LOIS box (Tyne, Tees & Tweed) as a contribution to the LOIS program.

**SITES:** 1,5,6,8 & 9 Humber Plume Zone.  
2,3 & 7 Tyne, Tweed & Tees, respectively  
(See Figure 13 for sites worked)

### **WORK CARRIED OUT:**

At each site 4 box-cores (0.1m<sup>2</sup>) were deployed. Each was treated as follows;

1. Visual description of sediment type, surface features and obvious fauna.
2. Sediment temperature and depth of core noted.
3. One sub-core taken to determine sediment geotechnical parameters (3cm diameter).
- 4 Contents of box sieved for macrofauna using a 0.5mm mesh sieve, residue preserved in 10% formalin solution.
5. Extraction and preservation (as described above) of Pete and Trish's cores.
6. Established possible position for station 12, (53:31.24N 00:30.08E).

### **NOTES:**

1. Station 4 not sampled due to not being able to recover suitable cores.
2. Station 6 not sampled as its proximity to station 11 made it unnecessary.
3. No spares for the box core did affect work when box was bent and the trolley needed to be serviced before it could be used.
4. We suspect the spade supplied with the big box core was the wrong one resulting in the corer failing to seal correctly.

## **SEDIMENT - WATER EXCHANGE STUDIES.**

*Peter Watson & Trish Frickers.*

### **OBJECTIVES:**

1). To quantify biotic contributions to the sediment-water exchange fo nutrients and trace metals in the Humber Plume Zone. (DOE contract No. PECD 7/7/423.

2). To investigate sediment-water exchange at sites between the Humber and the Tweed estuaries as part of the LOIS RACS-C programme.



#### **ACHIEVEMENTS:**

- 1). Box cores obtained at 5 sites in the Humber plume Zone (1,5,6,8 & 9) and in the region of the Tees (7), Tyne (2) and Tweed (3). (See Figure 14)
- 2). Replicate sub-cores taken for pore water sampling and incubation for diffusional and resuspension fluxes. Replicate sub-cores taken for redox, and single cores for porosity, carbon/nitrogen, particle size from each box-core.
- 3). Pore-water and flux samples analysed for nutrients (ammonium, phosphate, nitrate and nitrite) and alkalinity on board ship, also, redox measurements. Samples for silicate stored frozen as silicate channel not working.
- 4). Samples for trace metal analysis filtered, acidified and stored for subsequent laboratory analysis.
- 5). Incubation cores sieved for macro-faunal analysis when all processing complete.
- 6). At two sites (Tweed - 3, Tees - 7), additional incubation cores taken in 'dark' cylinders to check for light/dark effects, e.g. for benthic algae.
- 7). Modified use of non-toxic supply for temperature control of incubation cores was successful, maintaining temperature within +1C of sediment temperature except when ship movement excessive.

#### **PROBLEMS:**

- 1). Loss of silicate channel necessitated extra sampling for stored samples.
- 2). Problem with cooling water level in incubation tanks in rough weather due to spillage.
- 3). No lab. refrigeration to use for temporary storage of nutrient samples (had to use cold room).

#### **SEDIMENT - WATER EXCHANGE STUDIES.**

*Dave J. Smallman.*

Sediment core samples ( 65mm diameter, approx 15cm in height ) were obtained by:

- 1) sub-coring from box core samples ( at sediment sites 1,5,6 and 9); and
- 2) multiple coring, thereby allowing the retrieval of undisturbed cores with the overlying-water intact (at sediment sites 2,3,7,8 and 14).

Sediment site replicate samples were pre-incubated for 24hrs in a tank containing overlying water from each individual site ( obtained by the CTD Rosette sampler ) and was maintained at a temperature approximating that *in situ*. This treatment was to

allow stabilization of the samples. Samples were then sealed utilizing PTFE stirring units and incubated for up to 24hrs to determine:

- 1) dissolved oxygen fluxes at the sediment-water interface - oxygen concentrations were measured by coulometer;
- 2) nutrient fluxes at the sediment water interface ( phosphate, nitrite, nitrate and ammonia - determined by auto-analyzer); and
- 3) total particulate nitrogen and both organic and inorganic carbon content throughout the core strata.

Dissolved oxygen profiling, utilizing the prototype equipment supplied by IOSDL, was not possible due to the instability of the electrodes or associated equipment. Further development of the apparatus, although it was suspected to be necessary before the cruise, would seem appropriate.

No sampling was achieved at sediment site 4.

Silicate measurements were not made due to a fault on the auto-analyzer.

## **STUDY OF SUSPENDED PARTICULATE MATTER USING $^{238}\text{U}/^{234}\text{Th}$ DISEQUILIBRIA.**

*R.J Clifton.*

### **WATER COLUMN STUDIES;**

Although  $^{238}\text{U}$  is conservative in seawater (3ug/l) its daughter  $^{234}\text{Th}$  has a strong affinity for particulate material ( $K_d > 10^6$ ) and equilibrium between the two is disrupted within the water column.

Unsupported  $^{234}\text{Th}$  has a half-life of 24 days and is a useful tool for studying SPM adsorption dynamics and residence times in the water column over time scales of 10-50 days.

41 water samples, taken from 27 stations within the RACS(C) survey area, were processed to determine  $^{234}\text{Th}$  in both the dissolved and particulate fractions (see Figure 15). The majority of samples (20l) were processed on the ship using a procedure that is both laborious and time consuming. Sample processing using a stand alone pump (SAP) was very successful and processed 170litres of water in 30mins. However, the SAP procedure is relatively costly and does encroach significantly on ship time (~ 1.5 h per cast). In waters having a relatively high SPM an intermediate system, employing on-line filtration and adsorption in the laboratory, would seem an attractive alternative for processing 20l seawater samples taken from either the non-toxic supply or the CTD bottles.

### **STUDY OF BED-SEDIMENT DYNAMICS USING NATURAL AND ARTIFICIAL RADIOISOTOPES;**

The source of unsupported  $^{210}\text{Pb}$ ,  $^7\text{Be}$  and  $^{137}\text{Cs}$  to the marine environment can be described with some confidence. By measuring the depth profiles of these isotopes in

## MOORINGS

*A. Harrison & G. Ballard.*

### OBJECTIVES;

1). To recover and re-deploy moorings at 4 sites (Figure 17) previously deployed on Leg A. See mooring configuration diagrams and Notice to Mariners for positions.

### MOORING TYPE;

SITE 1:	POL PMP	Depth 10m
SITE 2:	POL PMP	Depth 14m
SITE 3:	POL Pop-up ADCP	Depth 25m
	POL BM/CM/TRANS	Depth 25m
SITE 4:	POL PMP	Depth 9m

Each POL PMP frame was equipped with a 1MHz ADCP, an optical transmissometer, a pressure recorder (WLR), and EMP 2000 multi-parameter recorder and an Inter-Ocean S4 current meter. The pop-up ADCP operates at 1MHz and is also fitted with a pressure recorder (WLR), whilst the BM/CM/TRANS has an S4 current meter and an optical transmissometer mounted in a frame. X

### MOORING RECOVERY;

Site 4 was recovered at 11-46 on the 22/11/93 (legA) followed by the BM/CM/TRANS mooring at 14-50 and the pop-up ADCP at 16-09, both on site 3. Site 2 was recovered the following morning at 09-48 followed by Site 1 at 13-48. All the moorings were on position and in good order with no damage to frames or instruments.

### MOORING RE-DEPLOYMENT:

After downloading data and replacing battery packs, the instruments were made ready for re-deployment. The pressure recorder at SITE 3 and the 1MHz ADCP at SITE 2 had both failed during the previous deployment and so were replaced by similar units from SITE 4. The EMP 2000 at SITE 2 was also replaced by an acoustic back-scatter probe.

All four transmissometer instruments were calibrated together on the CTD probe during CTD cast 001 at a depth of 10m for 15mins, starting at 21-15 25/11/93.

### SECOND MOORING RECOVERY:

Recoveries started on the 8/12/93 with site 4 at 1200 followed by the BM/CM/TRANS and the pop-up ADCP on SITE 3 at 1510 and 1523 respectively. Bad weather prevented recovery of the remaining moorings. The EMP 2000 instruments failed to record data through incorrect programming, however, the remaining instruments

Figure 1. Cruise track plot.

Figure 2. Sediment stations.

Figure 3. Nutrient analysis track plot.

Figures 4-12 Contour plots - colour and iso-lines

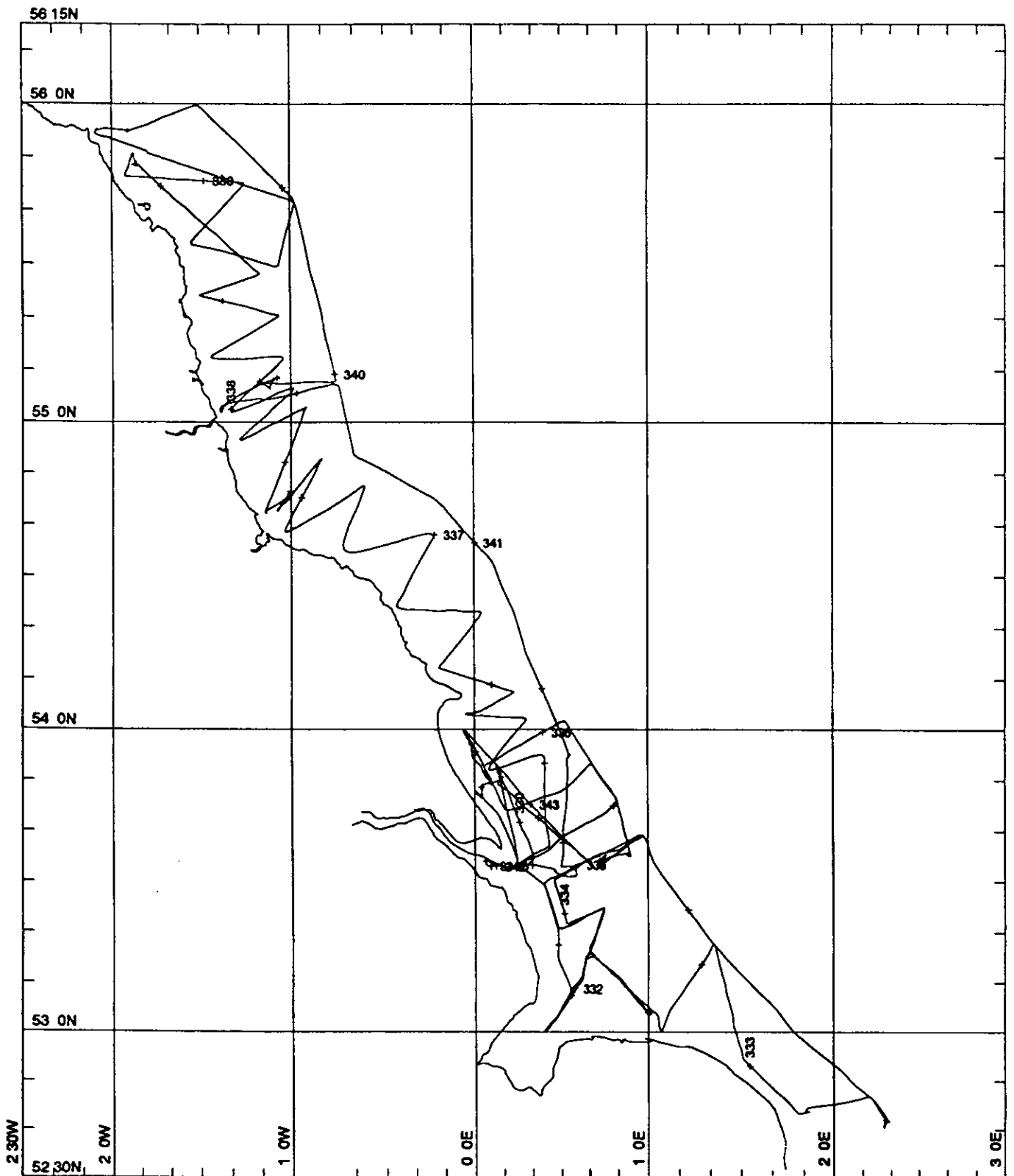
Figure 13 Benthic faunal sediment sites.

Figure 14. Sediment sites worked for nutrient flux studies.

Figure 15. Water column sampling sites for isotope studies.

Figure 16. Sediment sample sites for isotope studies.

Figure 17. Instrumented mooring sites.

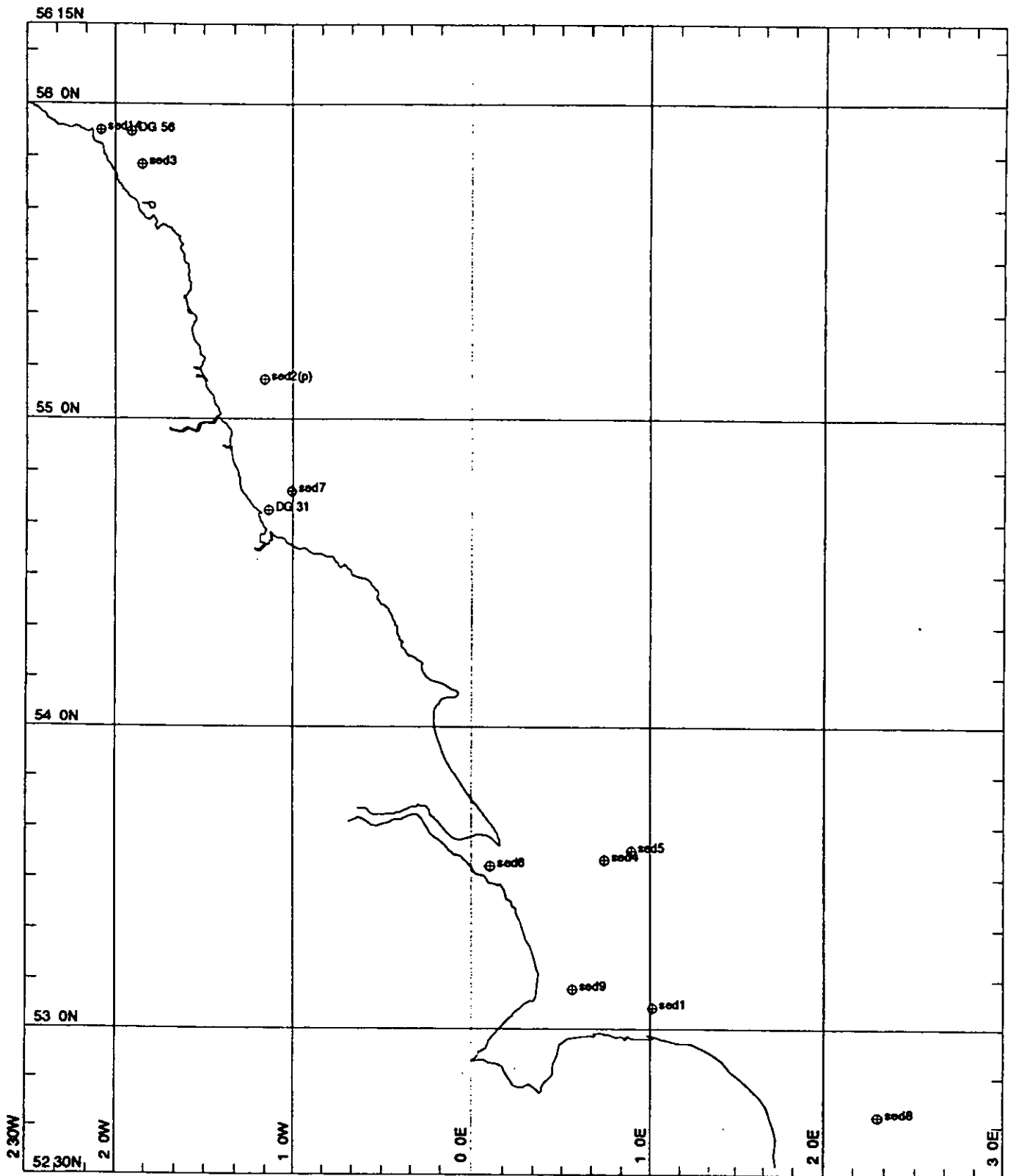


MERCATOR PROJECTION  
 SCALE 1 TO 2783088 (NATURAL SCALE AT LAT. 0)  
 INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

GRID NO. 1

— Track plotted from

Challenger 1088 Whole Cruise Track



MERCATOR PROJECTION

SCALE 1 TO 2783000 (NATURAL SCALE AT LAT. 0)

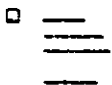
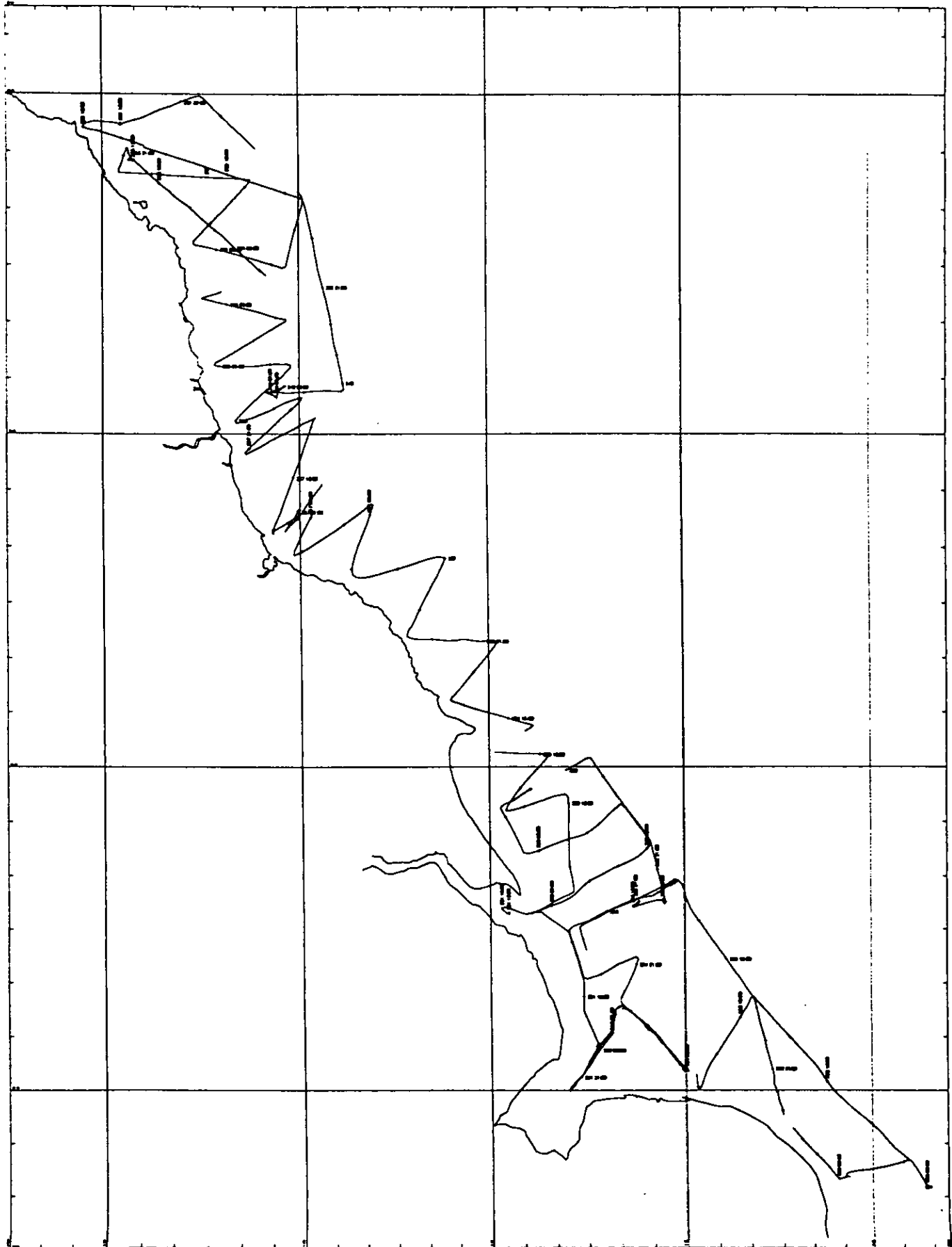
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GRID NO. 1

— Track plotted from

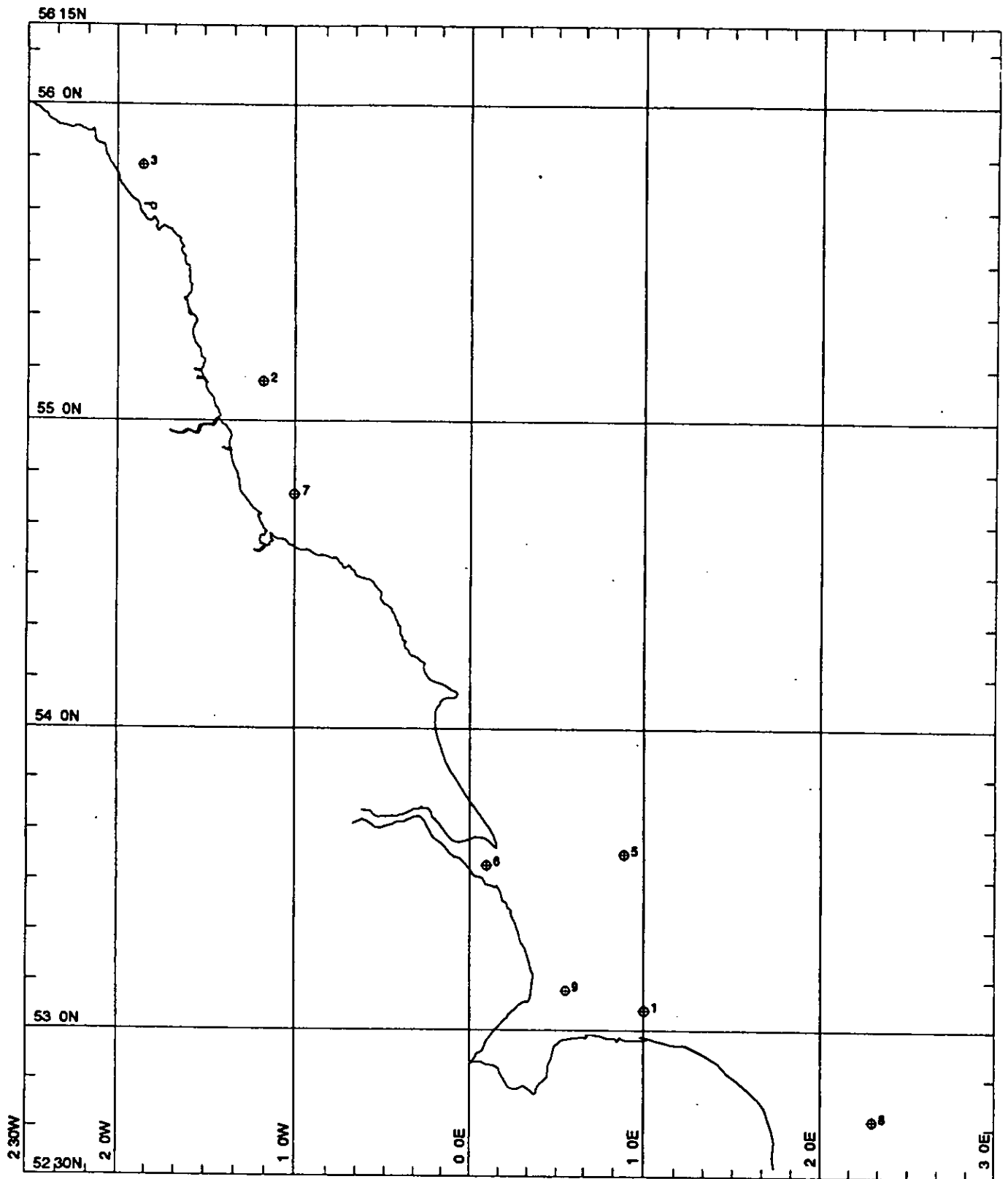
Challenger 108B Sediment Stations

Scaled to fit



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Scaled to fit



MERCATOR PROJECTION  
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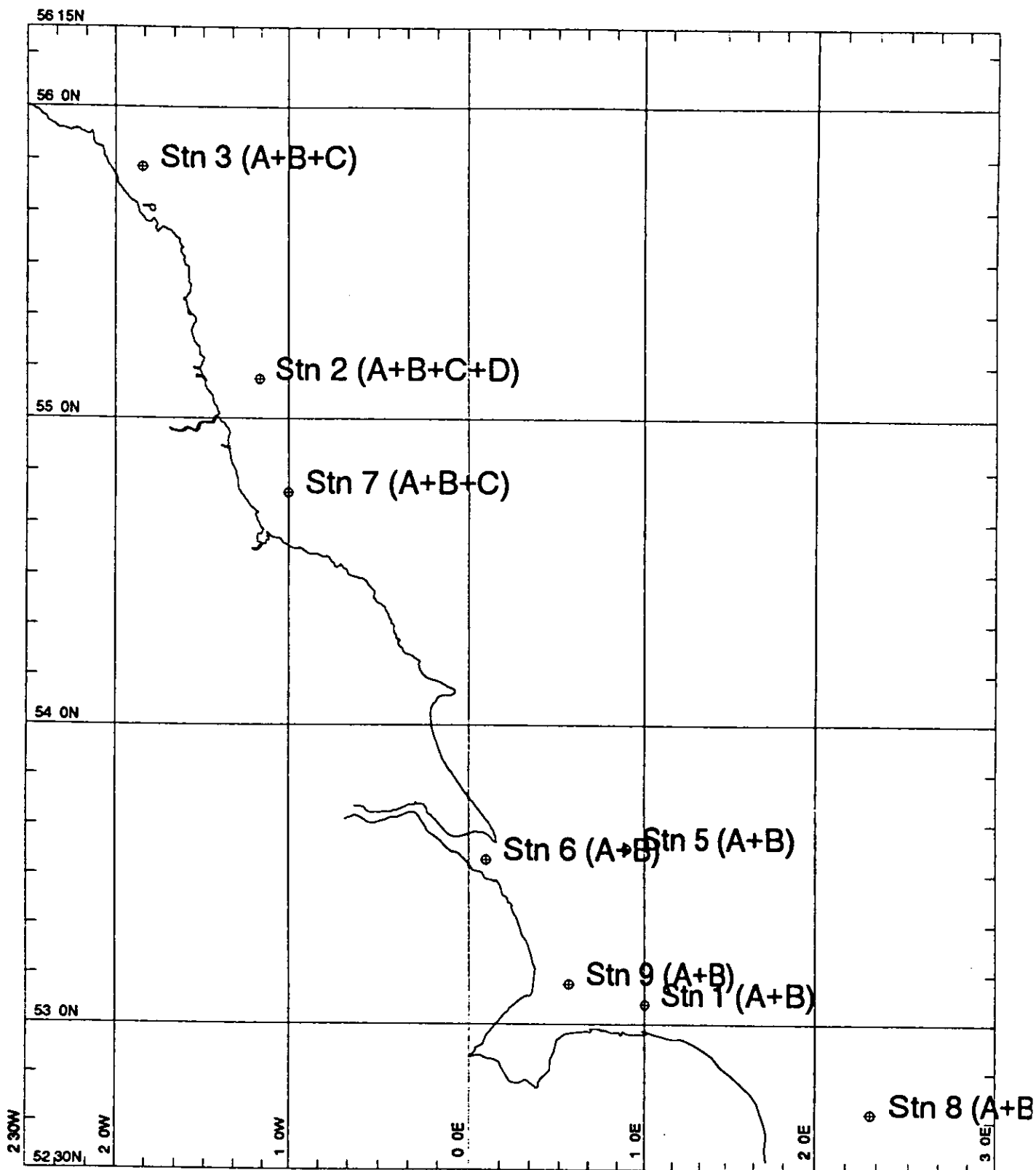
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— Track plotted from

Challenger 108B Sediment Stations

Scaled to fit





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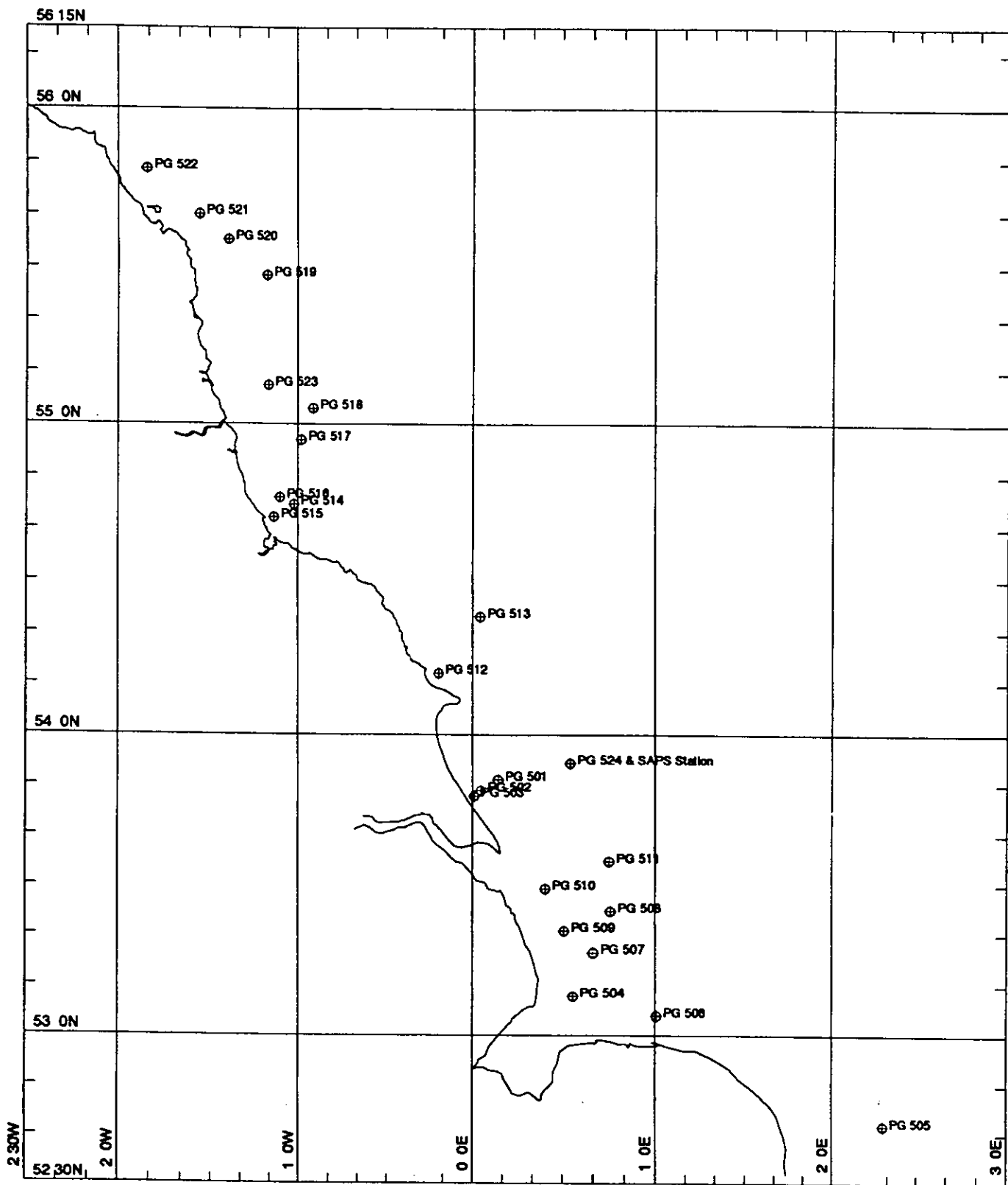
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INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

GRID NO. 1

— Track plotted from

Challenger 108B Sediment Stations



MERCATOR PROJECTION

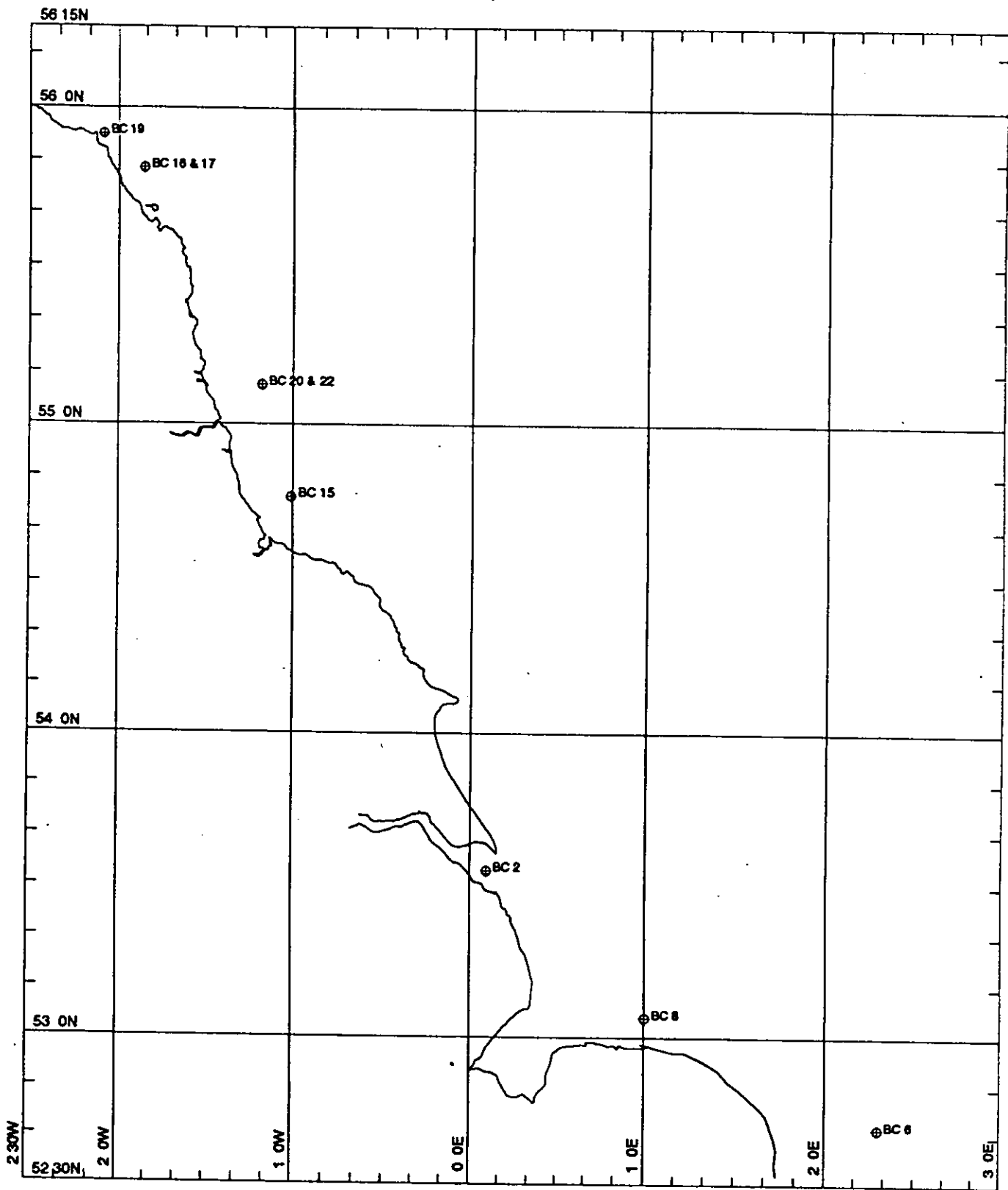
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— Track plotted from

SCALE 1 TO 2783008 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

Challenger 108B Non-Toxic Samples



MERCATOR PROJECTION

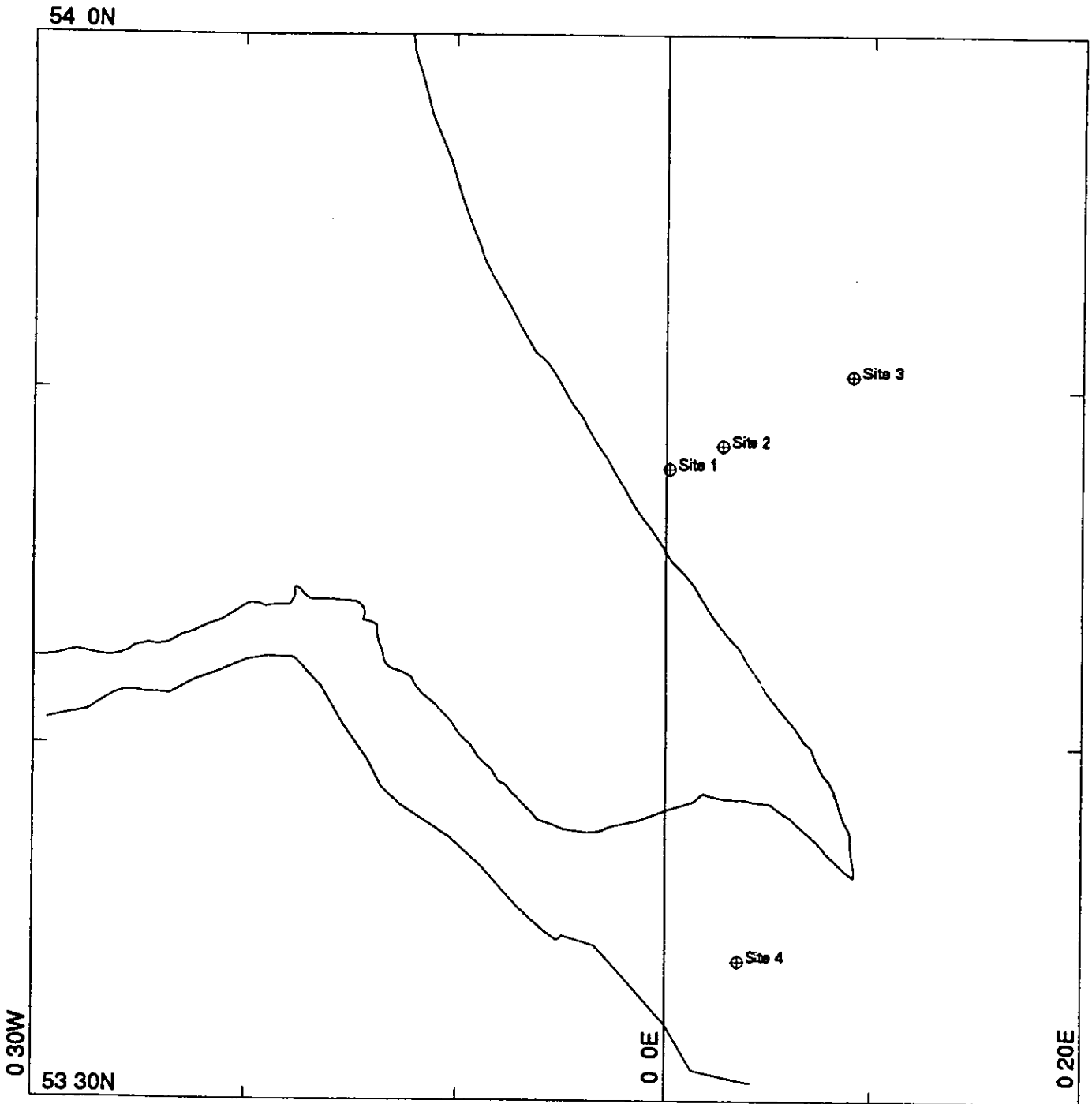
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INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

GRID NO. 1

— Track plotted from

Challenger 108B Box Core Stations



MERCATOR PROJECTION  
 SCALE 1 TO 500000 (NATURAL SCALE AT LAT. 0)  
 INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

GRID NO. 1

Challenger 108B Mooring Sites