

**Cruise Report 16/1**

**RV Prince Madog, 26<sup>th</sup>-30<sup>th</sup> November 2001**

**Project: NERC Research Programme GR3/12903 “Quantitative studies of the inherent optical properties of marine particle suspensions and their influence on remote sensing reflectance in Case 2 waters”**

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## **Objectives**

The cruise was the third cruise carried out for the National Environment Research Council Programme GR3/12903 (see above). The main objective of the project is to conduct a survey of mass-specific inherent optical properties in coastal waters, using *in situ* measurements of absorption, beam attenuation and forward scattering and an indirect method to determine the volume scattering function. The results of the survey are to be used to evaluate the effect of strong variations in the optically dominant class of suspended particles on marine reflectance. The objective of this particular cruise was to make measurements of the mass-specific optical properties in sediment dominant water (i.e. the Irish Sea) and determine how inorganic sediment affects marine reflectance.

A secondary objective of this particular cruise was to take grab samples along a transect from northwest Anglesey into the western Irish Sea. These grab samples are to form the basis of a final year student project. The project is examining changes in *Foramanifera sp.* along the transect to see if the species type and distribution changes across the western Irish Sea front.

## **Personnel**

The following scientists took part in the cruise

Dr. Sean Gaffney (School of Ocean Sciences, Scientist in Charge)

Dr. Alex Cunningham (University of Strathclyde)

Dr. Dave McKee (University of Strathclyde)

Dr. Susanne Craig (University of Strathclyde)

Caren Binding (School of Ocean Sciences, PhD student)

Dong H Shon (School of Ocean Sciences, PhD student)

Agnes Dudek (University of Strathclyde)

Brian Long (School of Ocean Sciences)

Anna Pienkowski (School of Ocean Sciences, final year undergraduate)

## **Cruise Summary**

### **Narrative**

Table 1 summarises the station locations and Figure 1 displays the station positions for the 5 days of the cruise. The crosses in Figure 1 indicate the location of the optics stations while the 'x's indicate the location of the grab sample points along the transect. In total, 24 stations were sampled for optical and suspended sediment measurements, along with 9 for grab samples.

The optical station positions were chosen to provide detailed coverage of the sediment regime along northern Anglesey and in Conwy Bay, with the additional aim of obtaining data to examine whether the outflow of the Conwy River influenced local turbidity. The

grab sample station positions were chosen to repeat sampling carried out by the Bangor Marine Geotechnics Group on previous cruises.

On Day 1, the Prince Madog departed north from Menai Bridge and turned west along the coast of Anglesey. Only three optical stations were sampled, due to lack of sufficient daylight and a delay caused by having to respond to a Mayday off Holyhead. Once the third optical station was sampled the RV Prince Madog steamed to the first grab sample station. All 9 grab sample stations were sampled throughout the evening, with the final station finished at 2030HRS. The vessel steamed back to Point Lynas and anchored overnight.

On Day 2, five stations were sampled, working eastwards from Point Lynas to Red Wharf Bay. The weather during this period was moderate to rough, with windspeeds from 30-40kts and wind direction W to WNW. Due to the weather forecast (NW storm force winds), it was decided to return to port at Menai Bridge overnight. On return to port, Brian Long and Anna Pienkowski disembarked with their samples.

6 stations were sampled on Day 3, running north from Red Wharf Bay out into Liverpool Bay and then into Conwy Bay. The weather was continually overcast with a sea state consisting of 6ft plus swell. The RV Prince Madog returned again to Menai Bridge overnight.

On Day 4, the RV Prince Madog worked in Red Wharf Bay and Conwy Bay, sampling 5 stations. High sediment concentrations were found at all 5 stations. The RV Prince Madog returned to Menai Bridge overnight.

Finally, on Day 5, four stations were sampled in Conwy Bay whereupon the vessel returned to Menai Bridge to finish the cruise.

Table 1. Station Positions on RV Prince Madog cruise 26<sup>th</sup> to 30<sup>th</sup> November 2001

Station	Date	Time BST	Lat. Deg.	Lon. Deg.	Depth. (m)
1	26/11/01	1245	53.45868	-4.5257	40
2	26/11/01	1350	53.44133	-4.47567	43
3	26/11/01	1445	53.48177	-4.47517	50
GS1	26/11/01	1610	53.47617	-4.64608	47
GS2	26/11/01	1650	53.5	-4.72967	47
GS3	26/11/01	1730	53.5439	-4.84133	N/A
GS4	26/11/01	1800	53.57093	-4.93982	N/A
GS5	26/11/01	1835	53.602	-5.02942	N/A
GS6	26/11/01	1905	53.62662	-5.13352	N/A
GS7	26/11/01	1930	53.6561	-5.23138	N/A
GS8	26/11/01	2000	53.68728	-5.31755	N/A
GS9	26/11/01	2030	53.71008	-5.39645	N/A
4	27/11/01	0905	53.41422	-4.14712	38
5	27/11/01	1035	53.36548	-4.19077	19.5
6	27/11/01	1155	53.32183	-4.01058	30
7	27/11/01	1255	53.29145	-3.96595	5

8	27/11/01	1330	53.31975	-3.91503	6
9	28/11/01	0950	53.3223	-3.92192	13
10	28/11/01	1045	53.36995	-3.92478	25
11	28/11/01	1145	53.41733	-3.92453	27
12	28/11/01	1240	53.46805	-3.9182	33
13	28/11/01	1345	53.43838	-3.9889	38
14	28/11/01	1450	53.4003	-4.04107	26
15	29/11/01	0951	53.36587	-3.91737	25
16	29/11/01	1100	53.36885	-4.00773	25
17	29/11/01	1200	53.36852	-4.09383	26
18	29/11/01	1315	53.37355	-4.18575	20
19	29/11/01	1425	53.40552	-4.23092	28
20	30/11/01	0950	53.30752	-4.036	23
21	30/11/01	1103	53.2952	-3.92423	12
22	30/11/01	1210	53.33072	-3.89782	14.5
23	30/11/01	1315	53.3301	-3.90358	8
24	30/11/01	1325	53.29555	-3.92175	8

#### Measurements Made

At each of the optical sampling stations, the following measurements were made:

- 1) – Lower CTD to just above seabed. Measure Secchi Depth and take surface water samples with bucket
- 2) – Return CTD to surface, taking 30 litres of water each of at two depths; depths to be chosen based on the CTD profile
- 3) – Filter water samples taken on rosette for SPM, chlorophyll, yellow substance and particle spectra.
- 4) – Deploy AC-9 absorption meter, Hydroscat-2 scattering meter and LISST-25 particle sizer package and profile as for CTD
- 5) – Deploy PRR-600 multiband radiometer, profile to just above bed and measure upwelling and downwelling radiance and irradiance at SeaWiFS wavelengths
- 6) – Deploy SPMR-7 freefalling multiband radiometer, profile to just above the bed and repeat measurements made by PRR-600

At each of the grab sample stations, the following measurements were made:

- 1) – Deploy armed Shipek or Day grab on hydrographic wire until it reaches seabed and is triggered. Retrieve grab and place sample in appropriate receptacle.

Bottle samples were taken from the CTD rosette at each station for calibration of the CTD conductivity meter. Underway measurements of beam transmission and fluorescence were made throughout the cruise.

## Preliminary Results

The water column is well mixed, both in the shallow stations around Conwy Bay and in the deep stations out in Liverpool Bay. This was expected given the rough weather conditions that prevailed throughout the cruise. Examples of the mixed structure of the water column can be seen in Fig. 2 and Fig 3, which show the CTD temperature and salinity profiles taken at station 12, in a depth of 33m. The surface/bottom temperature difference at this station was only 0.0209°C; with a depth mean temperature of 11.5295°C ( $\sigma = 0.0029^\circ\text{C}$ ). The salinity at station 12 ranged from 33.8192 PSU (Practical Salinity Units) to 33.8266 PSU; with a depth mean salinity of 33.8245 PSU ( $\sigma = 0.0008$ ).

When the temperature and salinity information from the CTD was processed further, it was possible to create contour maps of salinity and temperature for the region around Conwy Bay (figs. 4 and 5). The effect of the River Conwy can be clearly seen in both plots. The salinity plot (figure 4) shows a tongue of lower salinity water extending northwest from the mouth of the River Conwy. This is expected given there would be an increased freshwater input from the River Conwy during the winter. The direction of the tongue also fits in with the known circulation patterns of the Conwy Bay area. The temperature plot (figure 5) shows the coldest water in the vicinity of the mouth of the River Conwy. Again, this is not surprising, as in winter, any freshwater input from the river would be expected to be colder than the seawater itself. The influence of the cold freshwater however, does not extend out as far as the salinity tongue, suggesting that the River Conwy exerts a much stronger influence on the salinity of Conwy Bay than on its temperature.

Along with the profiling information from the CTD, surface water quality was continually sampled using an underway-monitoring system. Figure 6 shows a contour plot of turbidity developed using the underway-monitoring data. The plot in general shows a decrease in turbidity away from the coast. The region of highest turbidity is shown to be the Lavan Sands with a value of 6 volts (uncalibrated). This was expected given that the shallow tidally dominated nature of this region ensures a high level of entrainment of sediment from the seabed. The decrease in turbidity away from the coast may be due to a number of factors such as; chlorophyll levels are decreasing away from nutrient sources such as rivers; the water depth has increased, making entrainment of sediment from the seabed more difficult.

Secchi Depth measurements were taken at each station. A contour plot of Secchi Depth values, generated using the data from each station can be seen in Figure 7. In general, the closer to the coast the station was, the lower the value of the Secchi Depth was. This overall pattern seems to corroborate the turbidity plot generated by the underway-profiling data mentioned above. The lowest Secchi Depth reading was 0.8m at station 8 beside the mouth of the River Conwy while the clearest water was found at station 12, north of the Great Orme Head in Liverpool Bay where a Secchi Depth of 6m was recorded.

## Instrument Performance

All instruments worked well.

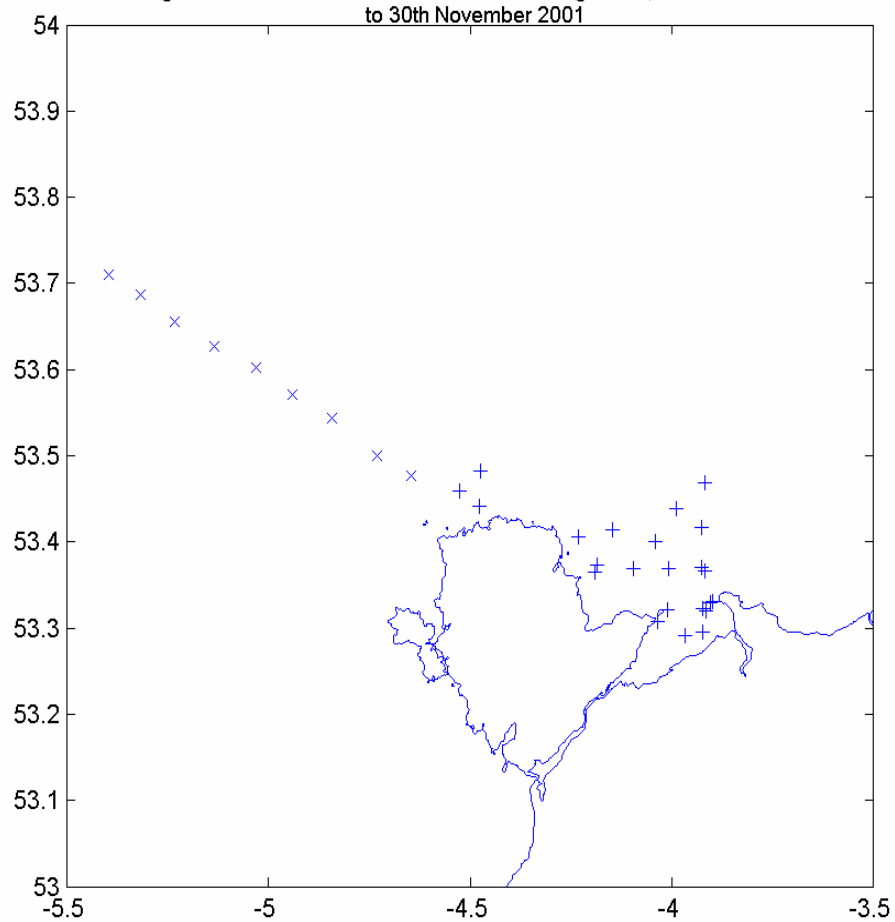
## Summary of achievements

- i) High quality optical measurements to provide data on evaluating the effect of strong concentrations in the optically dominant class of suspended particles on marine reflectance.
- ii) High quality optical measurements such as *in situ* measurements of absorption, beam attenuation and forward scattering, in order to determine the mass-specific inherent optical properties of sediment dominant coastal waters.
- iii) Collection of a suspended sediment dataset to use in determining the mass-specific inherent optical properties of sediment dominant coastal waters; also to be used in the development of an algorithm relating remote sensing reflectance measured by SeaWiFS to sediment load
- iv) Collection of chlorophyll samples (to be analysed fluorometrically and by high performance liquid chromatography) for use in development of an algorithm relating remote sensing reflectance measured by SeaWiFS to plankton species types
- v) Collection of *Foramanifera sp.* samples along a transect crossing the Western Irish Sea front to assess the effects of the front on *Foramanifera sp.* species distribution and type

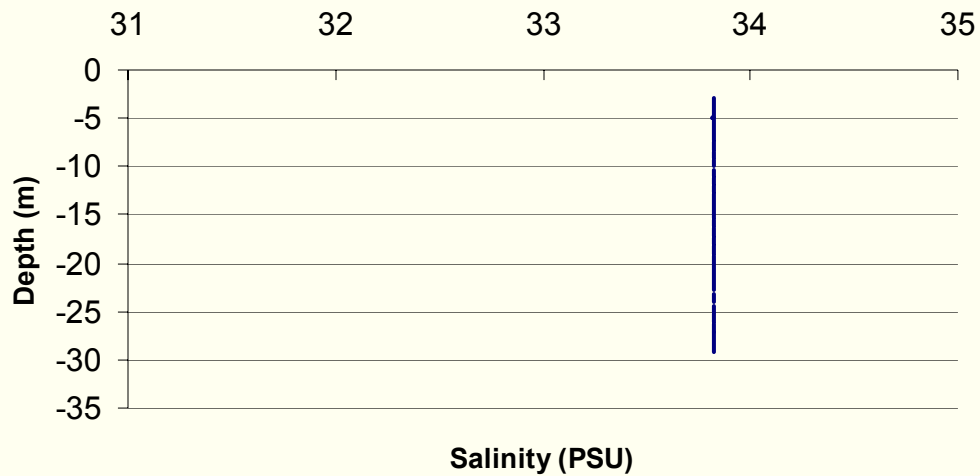
## Acknowledgements

I would like to thank the Captain and crew of the RV Prince Madog for their hard work and enthusiasm during the cruise. This enabled all cruise objectives to be met. I would like to thank the technical staff from the School of Ocean Sciences for their hard work with the CTD, and all participating scientists for their efforts. This cruise was the third in a series funded under NERC Programme GR3/12903 “Quantitative studies of the inherent optical properties of marine particle suspensions and their influence on remote sensing reflectance in Case 2 waters”. While we did not actually enter Irish waters, I would still like to thank the Irish Government for granting permission for the RV Prince Madog to work in Irish waters, should the need have arisen.

Figure 1. Station Positions for RV Prince Madog cruise, 26th November to 30th November 2001



**Figure 2. CTD Salinity profile for station 12, recorded during RV Prince Madog cruise on 28 November 2001**



**Figure 3. CTD Temperature profile for station 12, recorded during RV Prince Madog cruise on 28 November 2001**

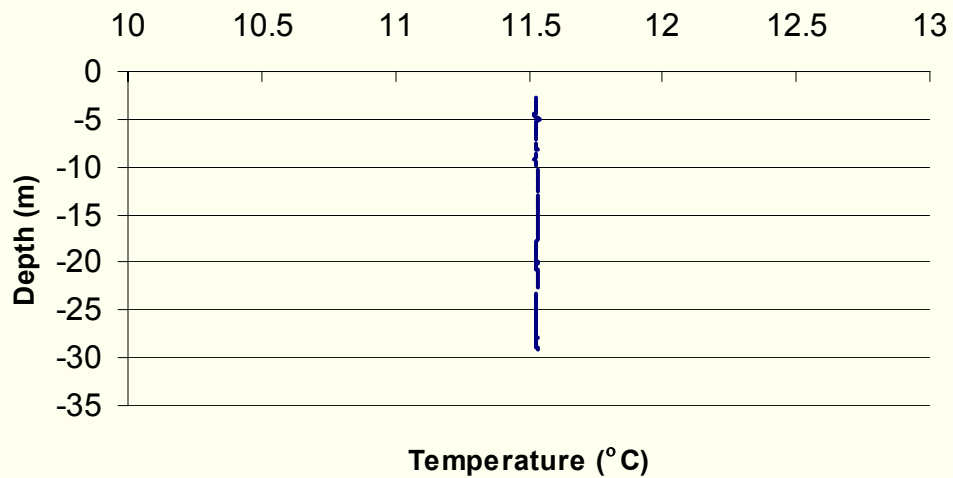




Figure 4. Contour plot of salinity (PSU) around Conwy Bay generated using data gathered by RV. Prince Madog cruise from 26<sup>th</sup> November 2001 – 30<sup>th</sup> November 2001

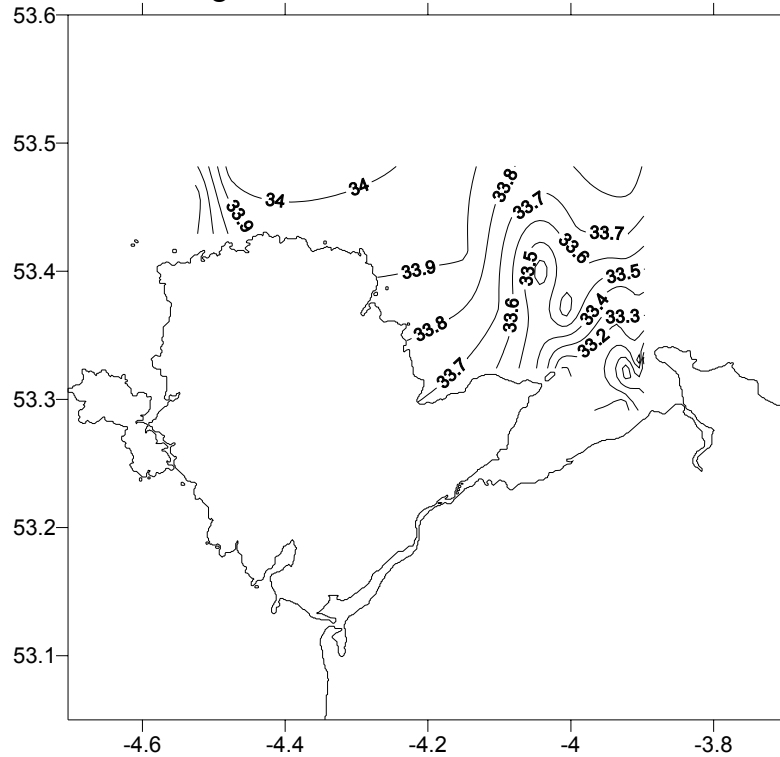


Figure 5. Contour plot of temperature (°C) around Conwy Bay generated using data gathered by RV Prince Madog cruise, 26<sup>th</sup> November 2001 – 30<sup>th</sup> November 2001

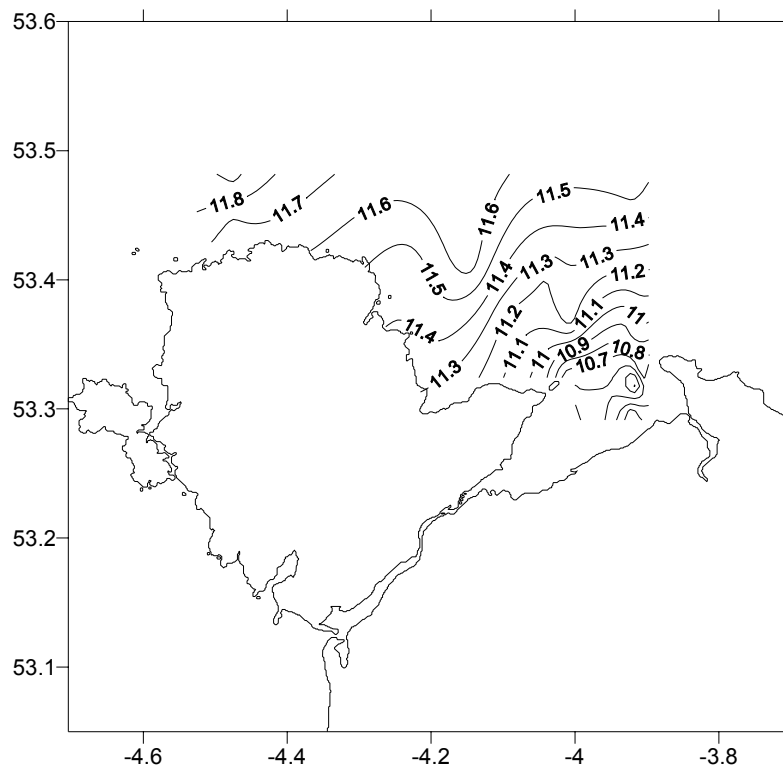


Figure 6. Contour plot of turbidity (V uncal) around Conwy Bay generated using data gathered by R.V. Prince Madog cruise from 26<sup>th</sup> November 2001 – 30<sup>th</sup> November 2001

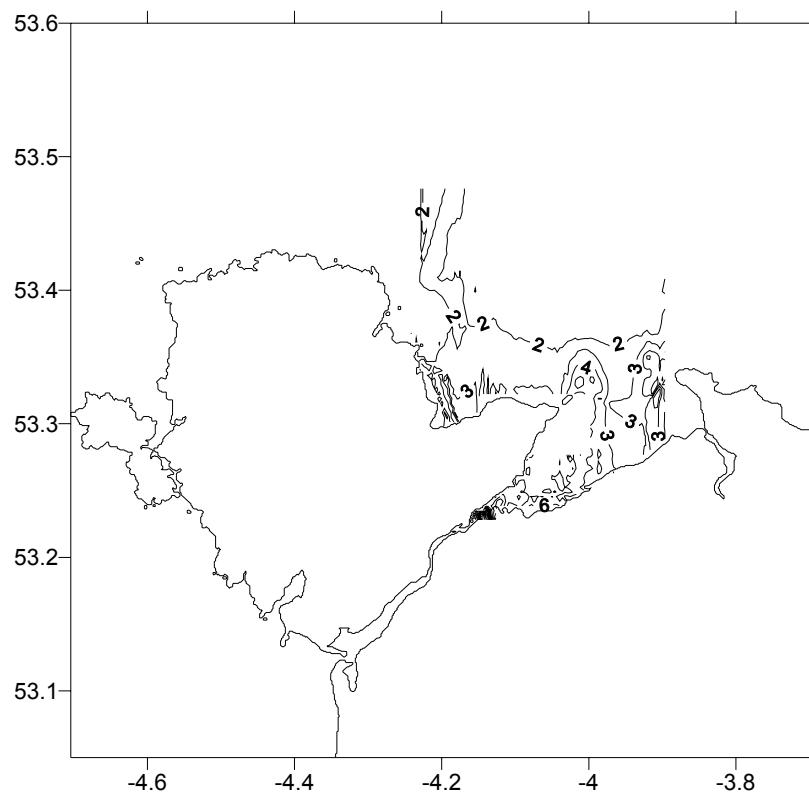


Figure 7. Contour plot of Secchi Depth (m) around Conwy Bay generated using data gathered by R.V. Prince Madog cruise from 26<sup>th</sup> November 2001 – 30<sup>th</sup> November 2001

