August 12th | 2010

Ryan Chouest Cruise 11

Cumulative summary report

Important Disclaimer

The information contained in this report comprises general statements based on scientific research. The reader is advised and needs to be aware that such information may be incomplete and represents interim results only, which require further analysis. No reliance or actions must therefore be made on that information without seeking further expert professional and technical advice.

Contents

Figures

Period covered: 2344hrs 07/28/2010 – 2144hrs 08/09/2010

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Cruise 11 summary statistics

Days at Sea: 13
Nautical miles covered: 1707.21
Vertical casts: 10
Samples taken: 54

1. Cruise rationale and objectives

Cruise 11 was designed with dual objectives. The first objective was to test the effects of natural seepage on the hydrocarbon concentration in surface waters and validate the EK60 Echo sounder on further natural seep sites. These studies were intended to take place in the prolific seep area of the Green Canyon. The cruise path was planned to enter the Green Canyon seeps area and then to sample and map, selected previously described, MacDonald *et al.* 1996 seeps.The second objective was to survey coastal waters from Point Au Fer, Louisiana through to Port St Joe, Florida following the 30m bathymetric contour along the coast. During this part of the cruise the crew were to perform surface mapping and sampling and vertical casts to seabed approximately every 20 nautical miles. The intention of this part of the cruise was to understand the coastal impacts of any remaining contamination in the shallow water. The planned route versus the actual annotated route are shown in Figure 1, with the daily progress map displayed in Figure 2.

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Planned route for cruise 11:

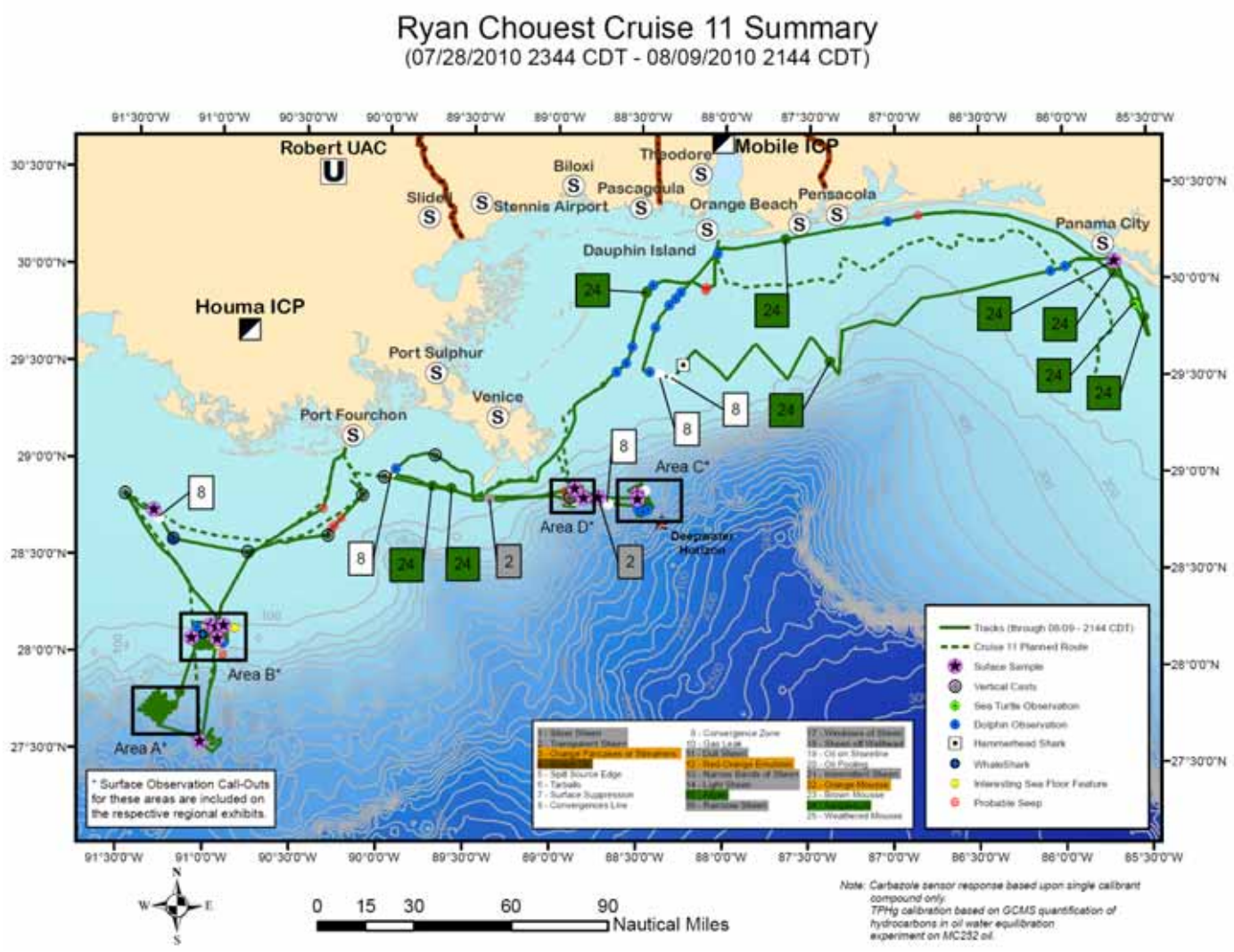

Figure 1 Planned route for cruise 11 versus the actual route plotted between 07/28/2010 – 08/11/2010.

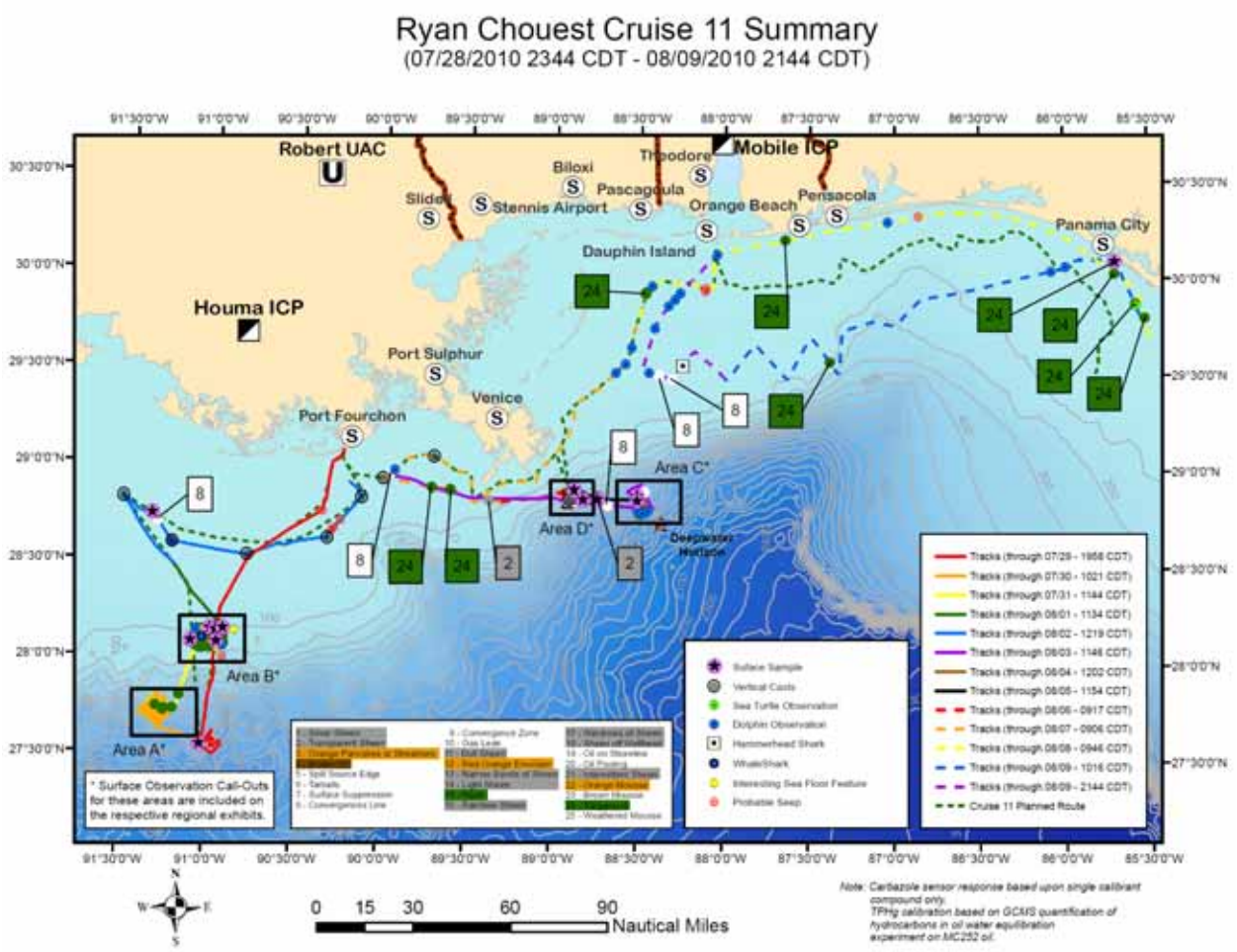

Figure 2. Planned route for cruise 11 versus the actual with route colour coded by24 hour period between 07/28/2010 – 08/11/2010.

1.1. Cumulative Cruise notes

07/28

The *Ryan Chouest* vessel departed Port Fourchon at 2310 hrs (07/28), for the planned cruise 11 shortly afterwards both the underway pump was deployed and the echo sounder was switched on. The vessel transited to area A (Figure 1) in the Green Canyon

07/29

The *Ryan Chouest* vessel cruised within 8 x 8 mile survey pattern in the Green Canyon area A (Figure 1& Figure 3) with the aim of detecting seep signatures either on the echo sounder or the hydrocarbon sensor array. No echo sounder contacts within area A were made and no enhanced hydrocarbon sensor responses were recorded during the reporting period.

07/30
The *Ryan Chouest* vessel completed the 8 x 8 nautical mile survey pattern in the Green Canyon area and headed, along a northeast track (Figure 1), to another planned 8 x 8 nautical mile survey location (Area B) to investigate possible seeps by combining results from the echo sounder and hydrocarbon sensor array.

08/01
The *Ryan Chouest* vessel continued survey at a higher spatial frequency within the 8 x 8 nautical mile survey area of 07/31/2010 with a vertical cast taken at within proximity of a seep location of interest (Figure 10). The cruise continued to the northeast quadrant of the 8 x 8 nautical mile survey area that showed relatively elevated sensor results from 07/31/2010 report, to correlate elevated levels with into possible seeps by combining results from the echo sounder and hydrocarbon sensor array. No vertical casts were taken in this area. The vessel then began a transit to the planned costal transect route.

08/02
After following a coastal transect route from a location roughly in line with Point Au Fer The *Ryan Chouest* vessel cruised northeast towards the Port Fourchon to pick up supplies, with the underway pump in operation. Along the way, the vertical cast was deployed at locations shown in Figure 1.

08/03
The *Ryan Chouest* vessel docked at Port Fourchon to receive laboratory items and a new sampling hose. The cruise continued at 1630hrs making for the 30 metre bathymetric contour off port Fourchon. On the way to the mark sensor were cleaned and adjusted. At the 30m bathymetric contour a planned vertical cast was aborted due to faults with the vertical cast pump. It was determined that the repair was possible but that there was a 24 hour wait before the epoxy was set. In order to make the most efficient use of time available the *Ryan Chouest* headed east towards the spill site to conduct a high resolution grid survey over a previously identified possible seep near the MC252 site (Area C, Figure 1 & Figure 25).

08/04
The *Ryan Chouest* continued with the high resolution grid survey over a previously identified possible seep to the north west of the MC252 site (Area C, Figure 1 & Figure 25). Over the time period covered y this report no echo sounder contacts had been made and the previously identified seep feature had not been re-established. Overnight the CSIRO crew, with the assistance of various representatives aboard, laid out the new vertical cast hose and began coupling the cables to them. At 1130 hrs, a “Man over board” exercise was conducted by Brian Corley (Ship Mate).

08/05
The *Ryan Chouest* completed the previous high resolution survey grid over Area C from the previous day re-establishing contact with the possible seep previously identified. The vessel then commenced another ~5 x 4 nautical mile high resolution grid survey over a previously identified possible seep to the north west of the MC252 site (Area D, Figure 1 and Figure 35). The Area D survey box fell mainly within the MC 108 block with survey lines close the Hammer Jack platform (MC 109). On entering Area D a clover leaf search pattern over the previously identified seep area commenced to re-establish the seep position and understand its activity level. After successfully identifying the possible seep the vessel commenced an east-west series of parallel survey lines. Other activities onboard included spooling and testing of the new vertical hose assembly. High currents were experienced in the area and when testing the vertical cast system there was significant drag on the tubing which prevented the vertical cast system being re-spooled. The vessel needed to be taken out of DP and allowed to drift with the currents.

08/06
The *Ryan Chouest* completed the final portion of the Area D ~5 x 4 nautical mile high resolution grid survey off the Mississippi delta before heading west to rejoin the coastal transect off Port Fourchon (Figure 1).

08/07
The *Ryan Chouest* science party attempted to continue the planned cruise along the coastal transect with planned vertical cast deployment every 20 Nautical miles (Figure 1). We achieved the first two shallow vertical casts before another electrical fault, this time with the power lead occurred. At this point the additional planned vertical casts for cruise 11 were abandoned. We continued on the planned route along the 30m contour along the coast with the echo sounder and underway hydrocarbon sensor system.

08/08
The *Ryan Chouest* continued the planned cruise, with the echo sounder and underway pump system, along the coastal transect towards and across the western coast of Florida rejoining the previous Cruise 2 track along the gulf coastlines of Alabama and west Florida (Figure 1).

1.2. Science Operations:

Fluorometer measurements were logged for the majority of the period and observations of sea-surface conditions were made throughout. Vertical casts were performed at 10 locations and 54 water samples were taken and subsequently analysed by GCMS. The EK-60 echo sounder continuously collected data to evaluate the seabed and water column for possible seeps. In addition surface observations were made and photographic evidence was collected where possible.

1.3. Problems/operational issues:

07/28
The underway pump failed due to an abraded electrical cable leading to a short. The GCMS instrument after a routine service could not be brought back to standard operating conditions and were problems with the navigation software on the boat. The instrumentation issues have been solved through the exchange of pumps and electrical cables and the GCMS was brought close to normal operational conditions after several re-calibrations. The navigation software continued to be a problem.

07/31
The navigation software was reinstalled fixing the problem. The GCMS continued to have minor problems with the level of air in the mass spectrometer. We continued to work on troubleshooting the problem.

08/01
Previous problems with the GCMS were solved. The methane sensors used on the cast system and on the underway system did not return values other than baseline. Testing showed that the CSIRO methane sensor was operating however it is unclear if the positioning of the instrument is inhibiting its optimum operation. Further tests were performed to establish if this was the case to no conclusive answer.

08/03
The vertical cast pump problems related to a short circuit in the spliced lead which had been worked over time were identified. We found the fault quickly and re-spliced the cable however to make the joint water tight the splice was required to be set in resin which took 24 hours. The cable was repaired and the new food grade vertical cast sampling hose was prepared for use.

08/07
Electrical fault in the wiring attached to the vertical pump hose was uncovered, rendering the planned vertical cast drops impractical. All further vertical casts were abandoned.

08/09
Possible malfunction of fridge compressor unit in the Ryan Chouest was identified on further investigation was found to be an automatic reset of the system. The fridge was found to have no problems.

2. Areas studied in high detail for seeps

2.1. Area A

2.1.1. Description of area

The cruise path was planned to enter the previously described, MacDonald *et al.* 1996. Green Canyon seeps area (Area A, Figure 3). The objective of this aspect of the cruise was to first identify possible seep sites either by chemical detection through the hydrocarbon sensor array or through acoustical detection using the echo-sounder. A widely spaced survey grid with mile line spacing approximately 8 x 8 miles wide with a 45° offset north- south was taken in order to cover reasonable area in the time available. The angle of the grid was chosen to be with the prevailing wind direction and at 90 degrees to it in order that any surface slicks may be intersected both in longitudinal section and in cross section. The intention was to use this broad swath approach to determine interesting features which could then be subjected to a more detailed closely spaced survey grid.

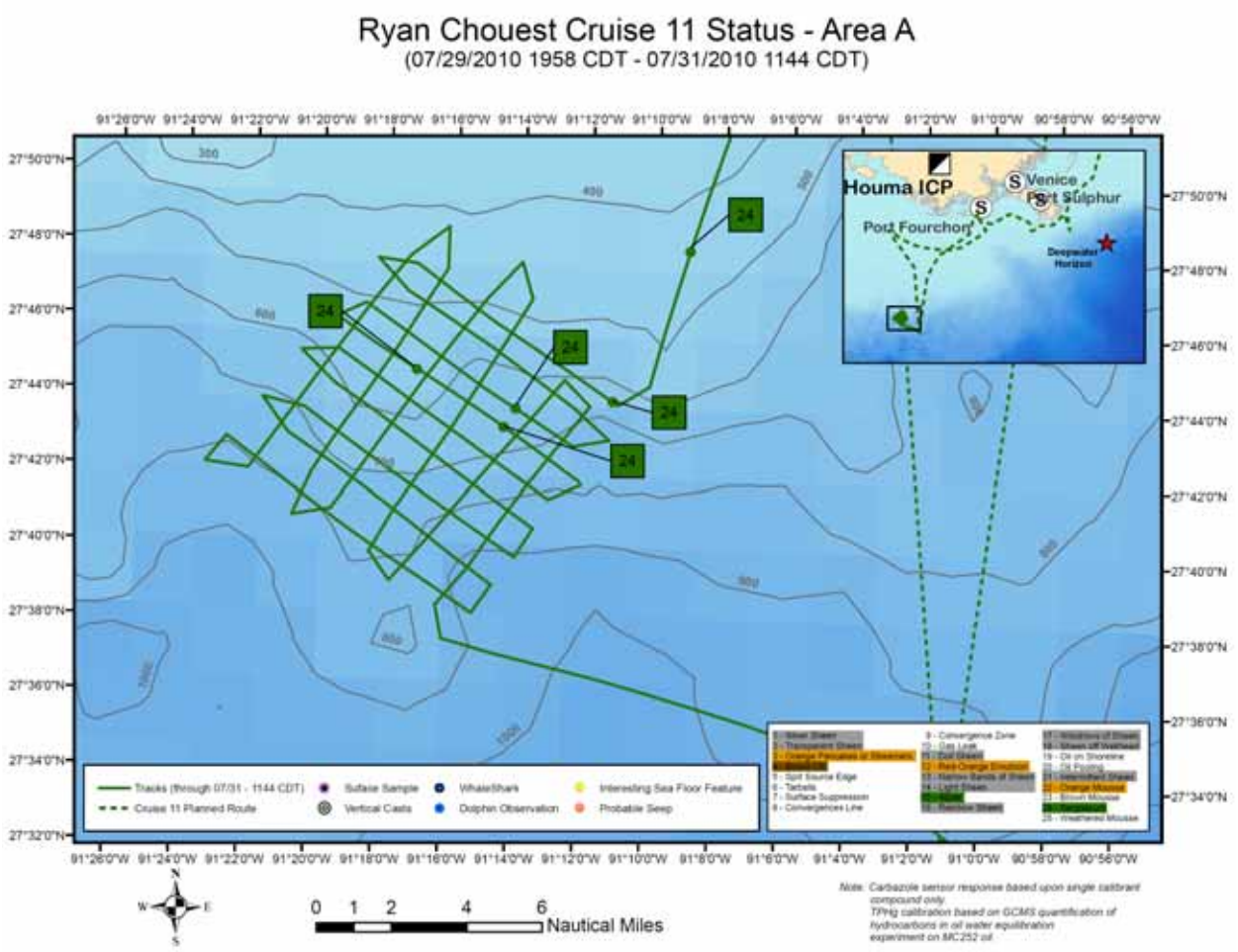

Figure 3. Survey route taken within area A for cruise 11 with observations, echo-sounder contact, vertical cast and sample locations marked where appropriate.

Fluorometry results

The Fluorometry measurements from the Chelsea (Figure 4) and Trios (Figure 6) sensors were very low/baseline for the track travelled and there were no enhanced responses. Rescaling the Chelsea (Figure 5) and Trios (Figure 7) data to a relative scale once again did not show any discernable area of relative elevated response across the survey box. Fluorometry records from the Contros sensor show low-mid levels of inferred hydrocarbons (Figure 8). Rescaling the results to a relative scale (Figure 9) to enhance differences across the survey grid once again did not show any patterns in the data to suggest an enhanced area of hydrocarbon concentration.

EK-60 Echosounder results

In area A there were no echo sounder contacts made for the over the survey grid. The seafloor topography

Surface Observations

There were no visually identified surface slicks in the survey grid and only sparse distributions of sargassum were observed (Figure 3).

At the conclusion of the widely spaced survey grid in Area A it was decided that continued surveying of the area was not warranted. The lack of surface observations, Echosounder contacts and hydrocarbon sensor response led us to the conclusion that if seeps did exist in the Area A they are either ephemeral or not of sufficient magnitude to be detected with the equipment onboard. Echo sounder contacts had been made on the transit to the area and it was decided that further survey time would be more profitably spent in these areas.

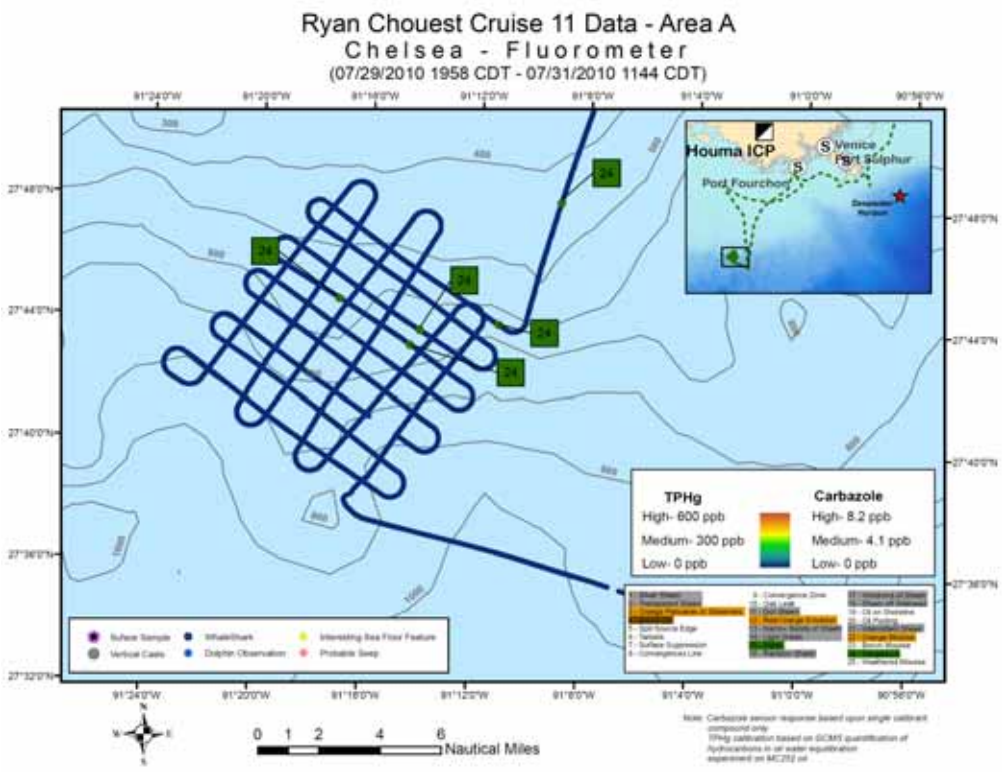

Figure 4. Chelsea fluorometer results for cruise 11 area A.

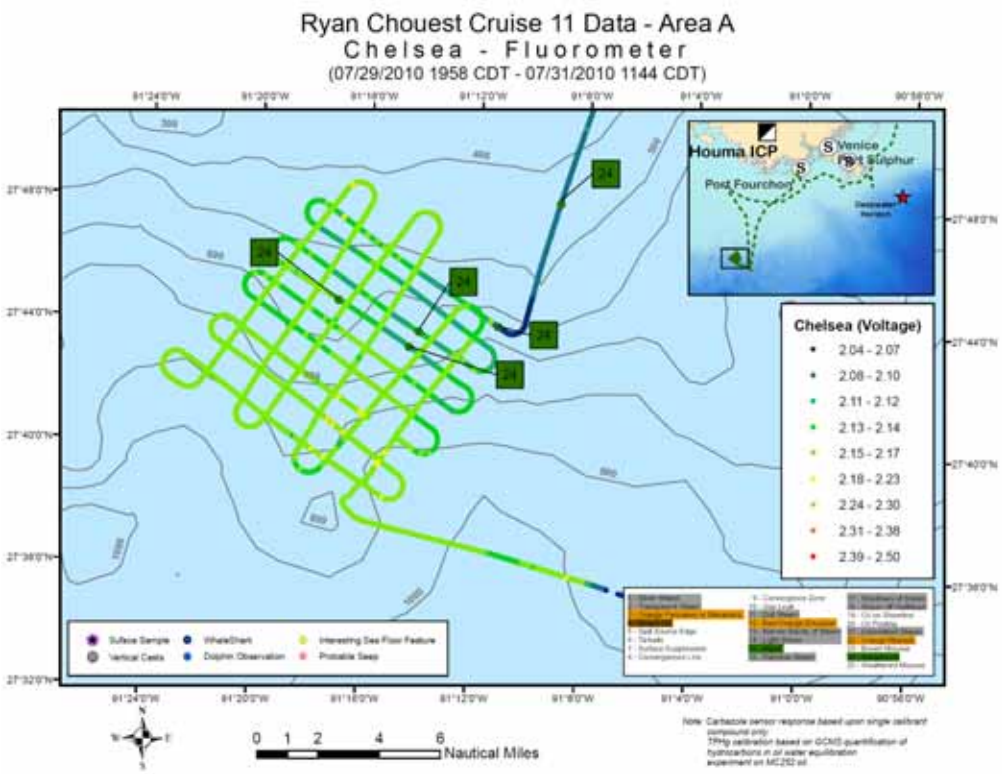

Figure 5. Chelsea fluorometer results for cruise 11 area A. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period. Please note maximum values are plotted off the current map view.

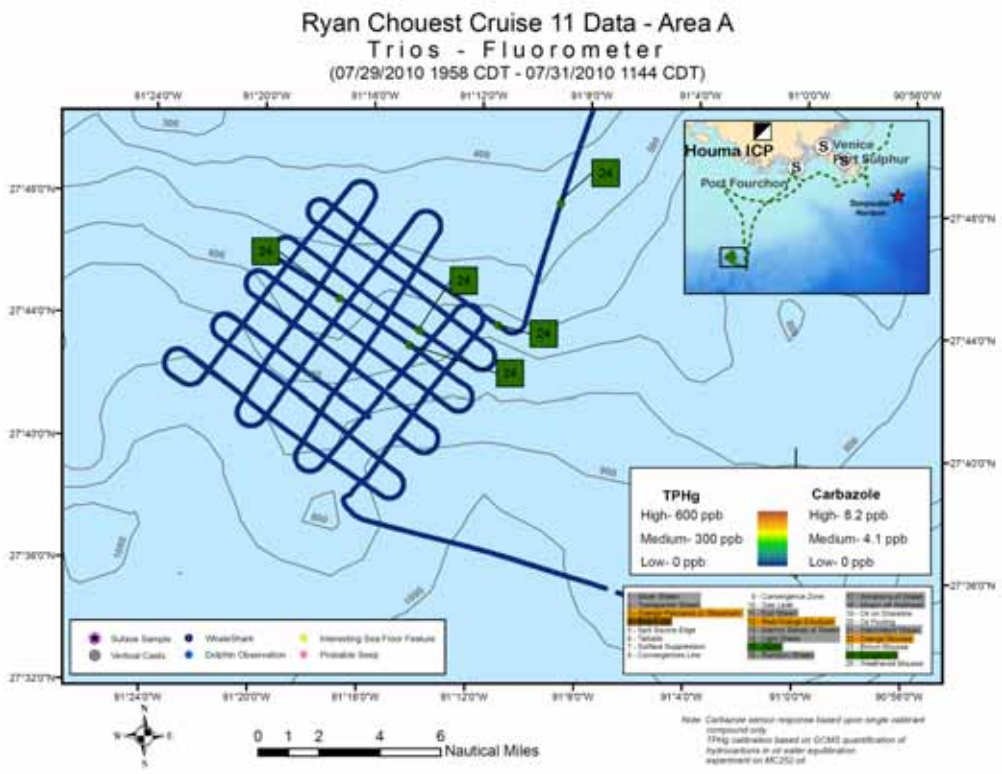

Figure 6. Trios fluorometer results for cruise 11 area A.

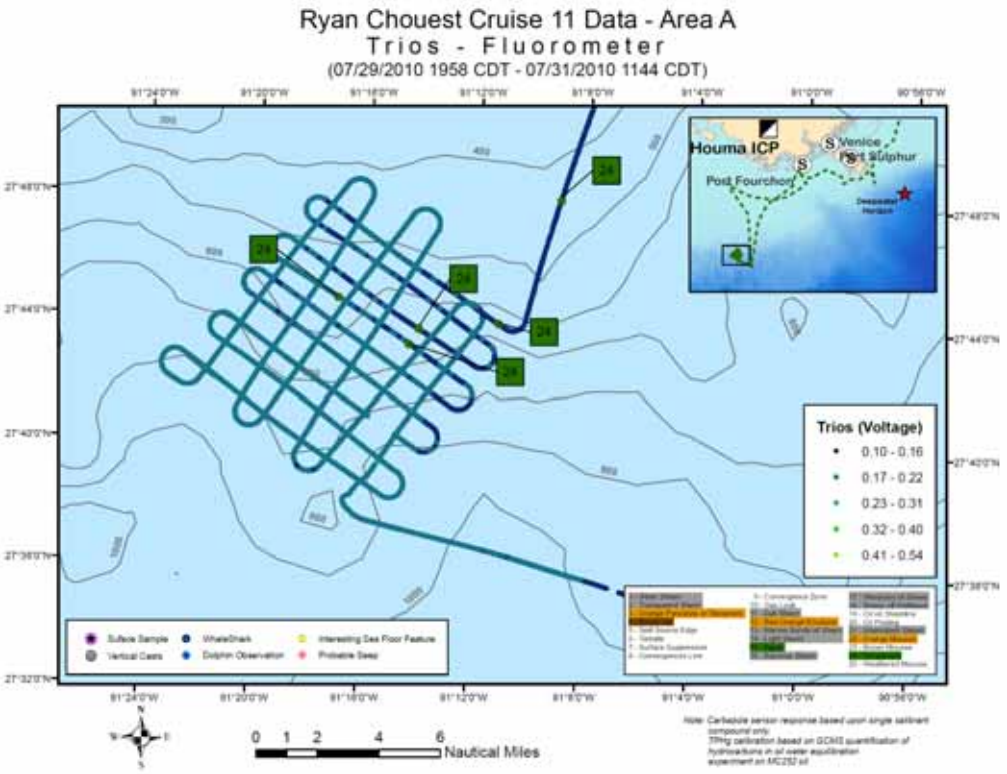

Figure 7. Trios fluorometer results for cruise 11 area A. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period. Please note maximum values are plotted off the current map view.

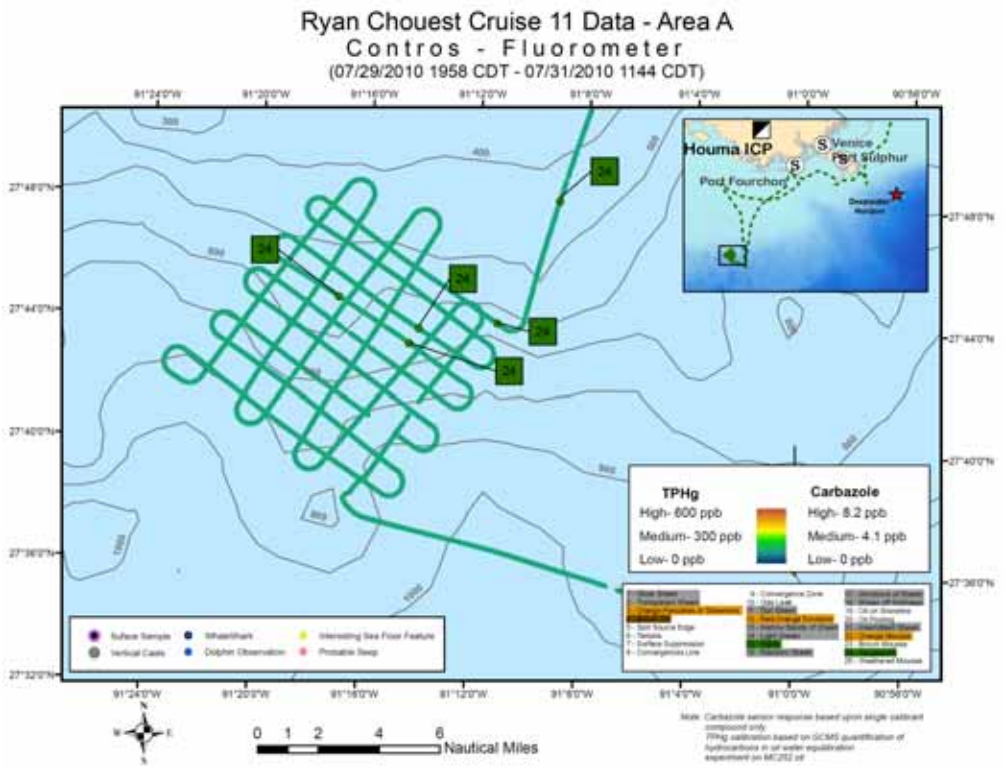

Figure 8. Contros fluorometer results for cruise 11 area A.

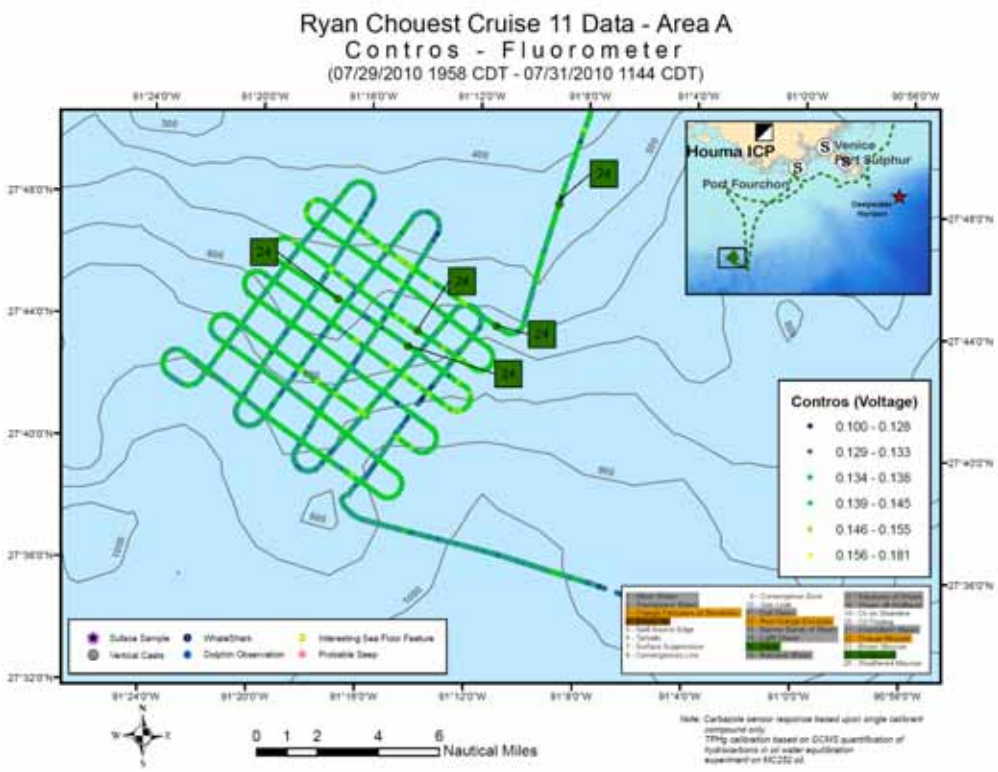

Figure 9. Contros fluorometer results for cruise 11 area A. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period. Please note maximum values are plotted off the current map view.

2.2. Area B

2.2.1. Description of area

Survey area B (Figure 10) was chosen because of a possible seep feature had previously identified on 07/30/2010 (Contact_0729010_132310) during the transit to survey area A. The area generally falls in 150-200 metres of water depth. An 8 x 8 nautical mile survey area was chosen which encompassed a seafloor high with the previously identified contact located at the eastern side of the survey box and the high. After the initial widely spaced survey grid (approximate nautical mile spacing) two areas were chosen for further detailed infill coverage (Figure 10) with line spacing every half nautical mile. In addition to the surface surveying a vertical cast was performed over one of the large contacts identified on echo sounder that appeared to nearly reach the surface.

Fluorometry results

Fluorometry measurements from the Chelsea and Trios sensors indicate low to minimal inferred hydrocarbon concentration throughout the survey Area (Figure 11 & Figure 13). The relative rescaling of the Chelsea and Trios data (using their corresponding highest and lowest sensor voltage values within the survey area) shows minimal to low levels across the majority of the survey box with elevated levels in the northeast quadrant of the grid (Figure 12 and Figure 14). These elevated levels appear to correlate well with the two possible seep sites with multiple echo sounder possible seep contacts to the north east of the survey box. The Contros sensor indicates mid levels of inferred hydrocarbons (Figure 15). As

with the Chelsea and Trios, a relative rescaling (taking the highest and lowest values of sensor voltage Figure 16), once again shows elevated levels trending to the northeast quadrant of the grid over the areas of multiple echo sounder possible seep contacts.

Surface Observations

Dolphins and whale sharks were spotted at locations marked in Figure 10. Sparse but widespread distribution of sargassum was observed. No surface slicks were observed.

EK-60 Echosounder results

There were 33 echo sounder contacts for the period over the travelled track in Figure 10. Of which 18 are tentatively classified as seep or seep like features. A selection of these features are included in this report in Figures 17-20. Many of these features were clustered within the high resolution survey boxes within Area B (Figure 10). This area appears to be prolifically leaking and many of the possible seeps are associated with rugose terrain, scarps and depressions at the sea floor. The number of sea floor features and the rugose terrain did raise the possibility that the seep features were related to abandoned wells and rig structures in the area. When the position of the wells in the area are plotted in conjunction with the sea floor contacts (Figure 21) there appears to be no correlation between the two, lending further support to the idea that these may be natural seep features. To help visualise the seep field a three dimensional model was constructed in Fledermouse (Figure 22 & Figure 23) using a bathymetry map provided by BP. As can be seen from the figures the seeps are associated with the eastern flank of a larger bathymetric high. This part of the bathymetric high does however appear to be possibly structurally different from the rest of the feature however further information is required on the subsurface section.

Vertical cast

A vertical cast was performed over a large possible seep (Figure 24) within the cluster of seeps identified in the high resolution survey area within the 8 x 8 nautical mile greater survey area (Figure 10). The results show limited or no response to the plume intersected for many of the parameters measured. The only sensor that showed an enhanced response within the plume was the Trios fluorometer. This is unusual as the fluorometers usually attain their highest response at the top of the water column (not unlike the Chelsea fluorometer result). Whilst this result is interesting it should however be interpreted with caution. Neither of the other fluorometers responded in a similar manner, which would be expected. The results of GCMS analysis on the samples taken at the 80, 60, 40, 20, 0 meter depths did not corroborate these results.

The survey of Area B identified a large number of potential seep and interesting seafloor features these seep features are more likely to be methane only rather than high molecular weight compounds as there is only a limited response with the sensor array. Further studies of this area would be warranted to establish the nature of these features.

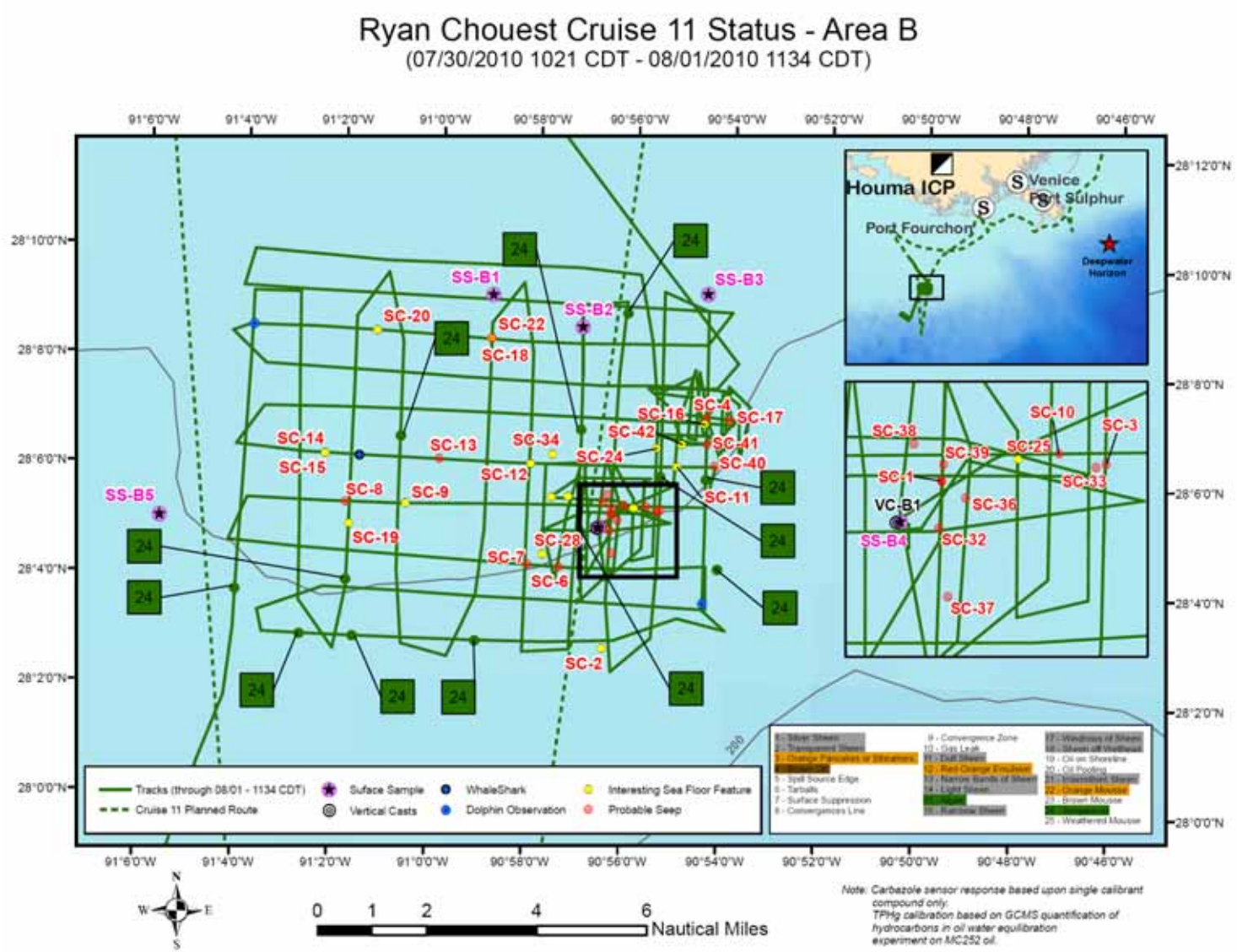

Figure 10. Survey route taken within area B for cruise 11 with observations, echo-sounder contact, vertical cast and sample locations marked where appropriate.

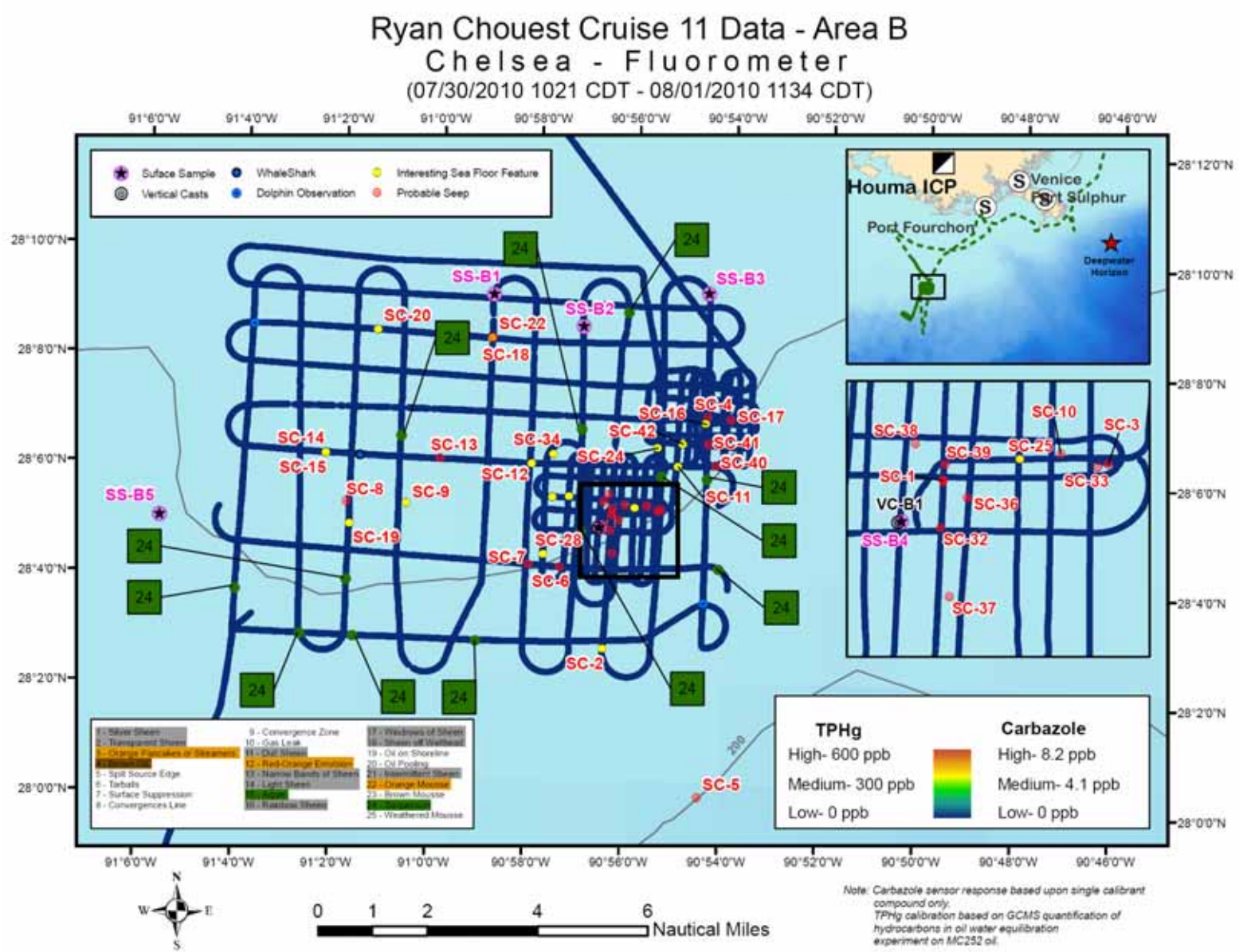

Figure 11. Chelsea fluorometer results for cruise 11 area B.

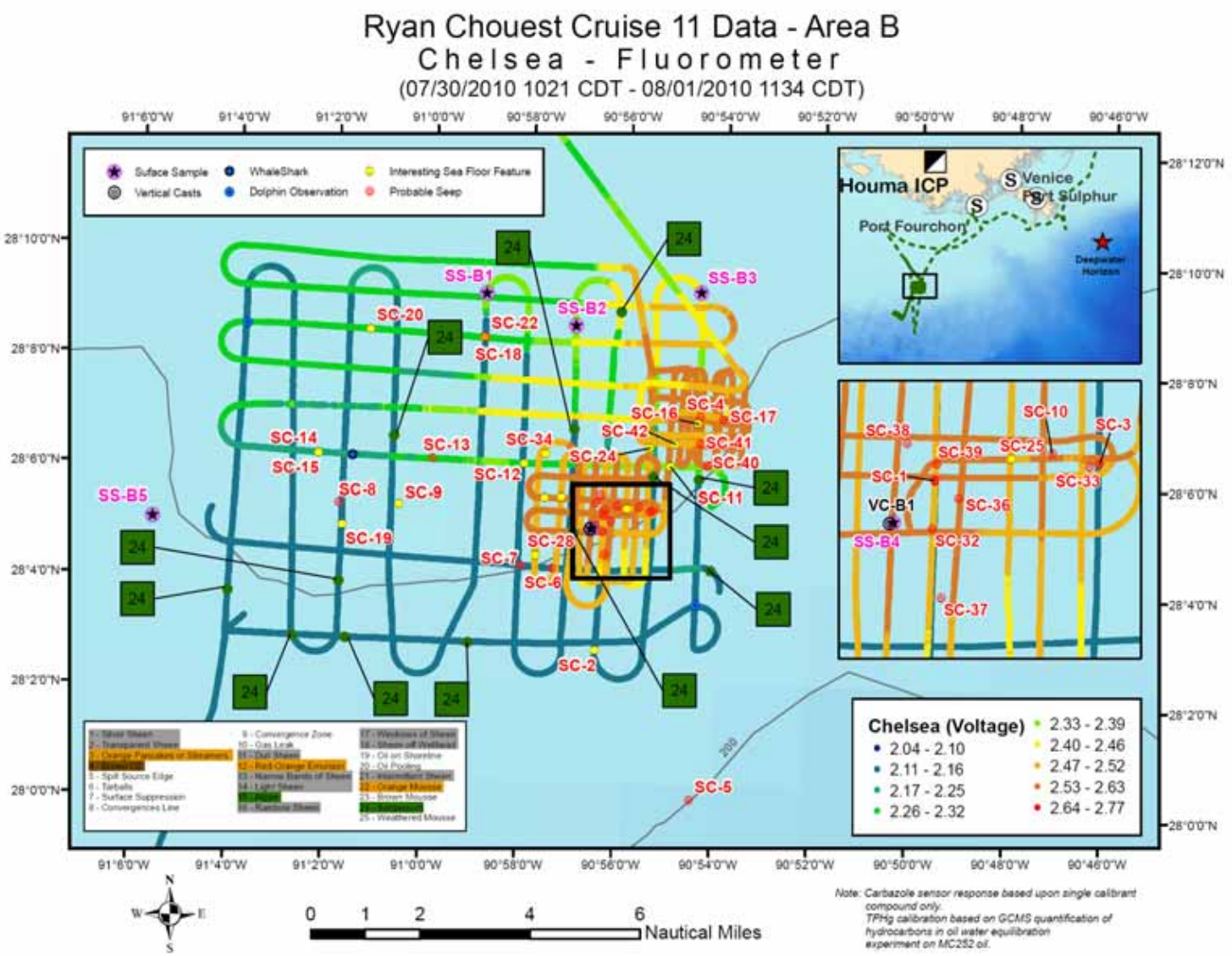

Figure 12. Chelsea fluorometer results for cruise 11 area B. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period.

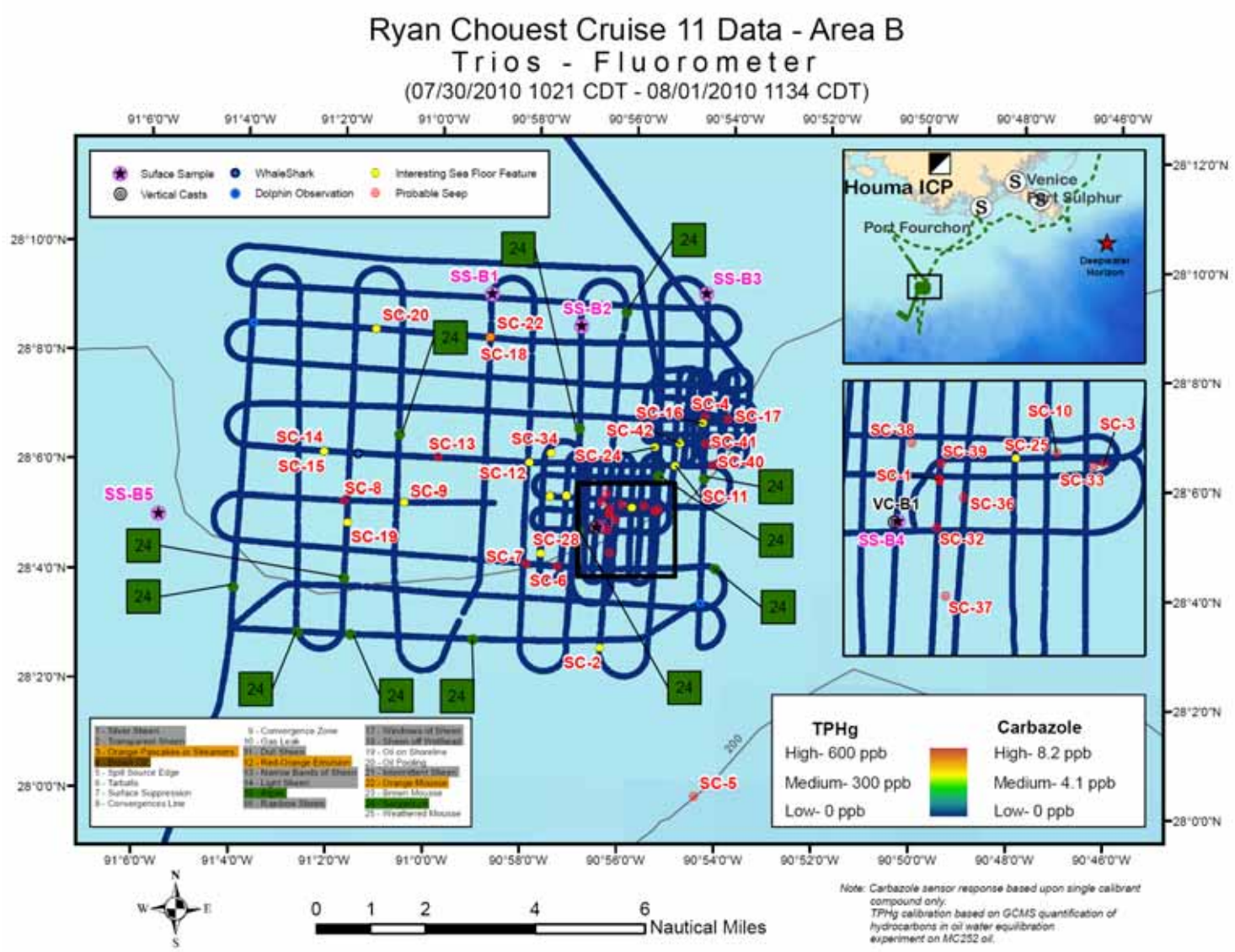

Figure 13. Trios fluorometer results for cruise 11 area B.

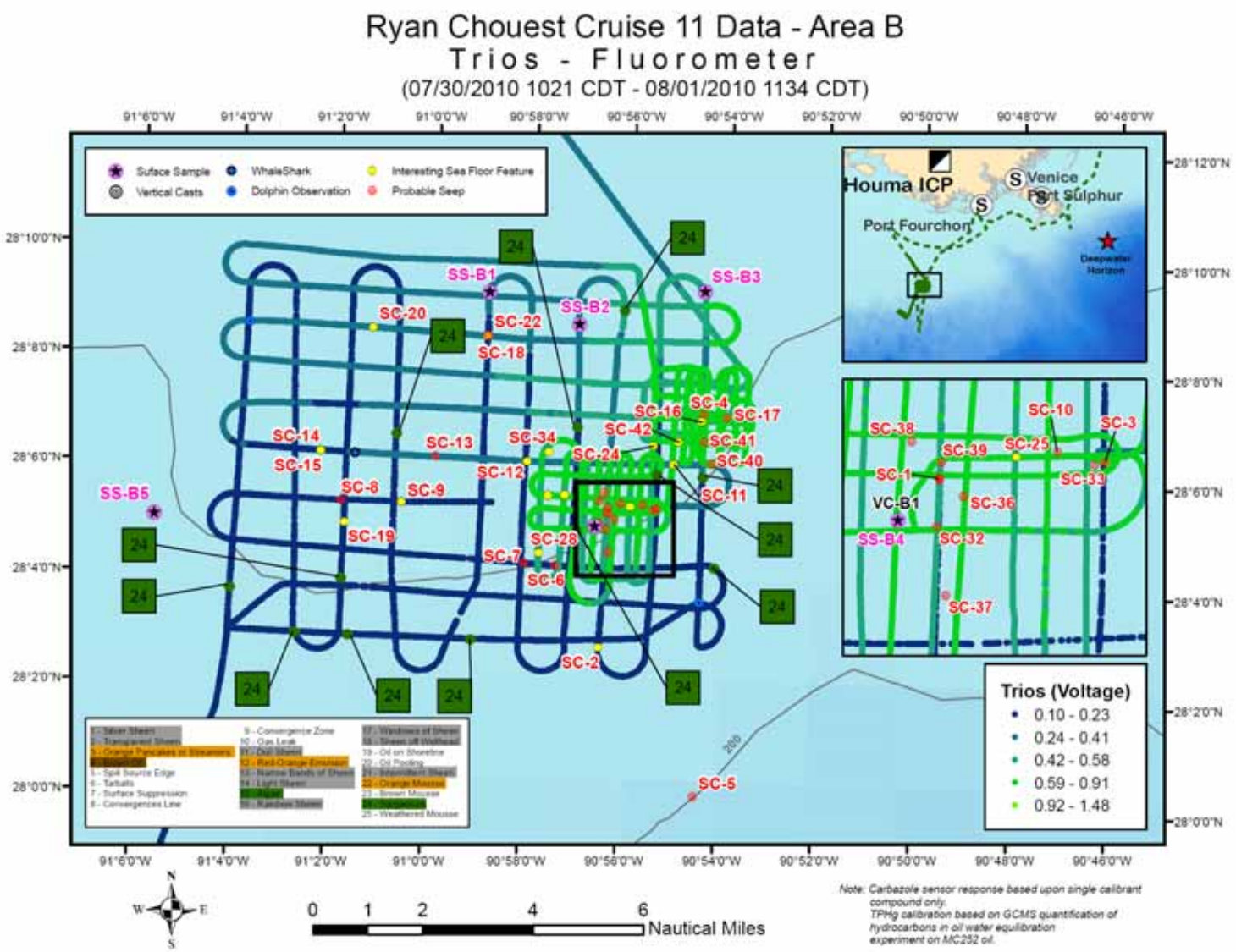

Figure 14. Trios fluorometer results for cruise 11 area B. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period.

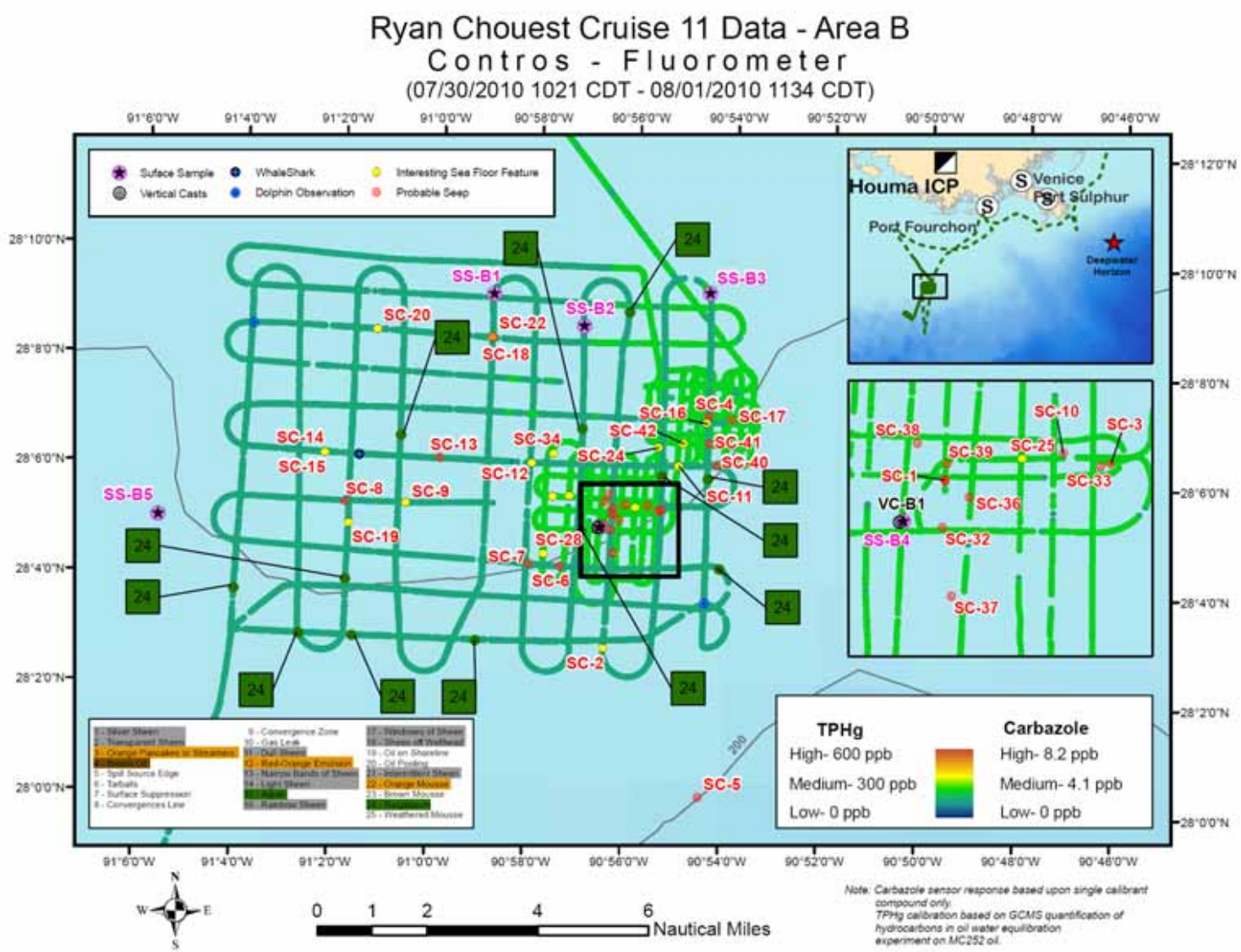

Figure 15. Contros fluorometer results for cruise 11 area B.

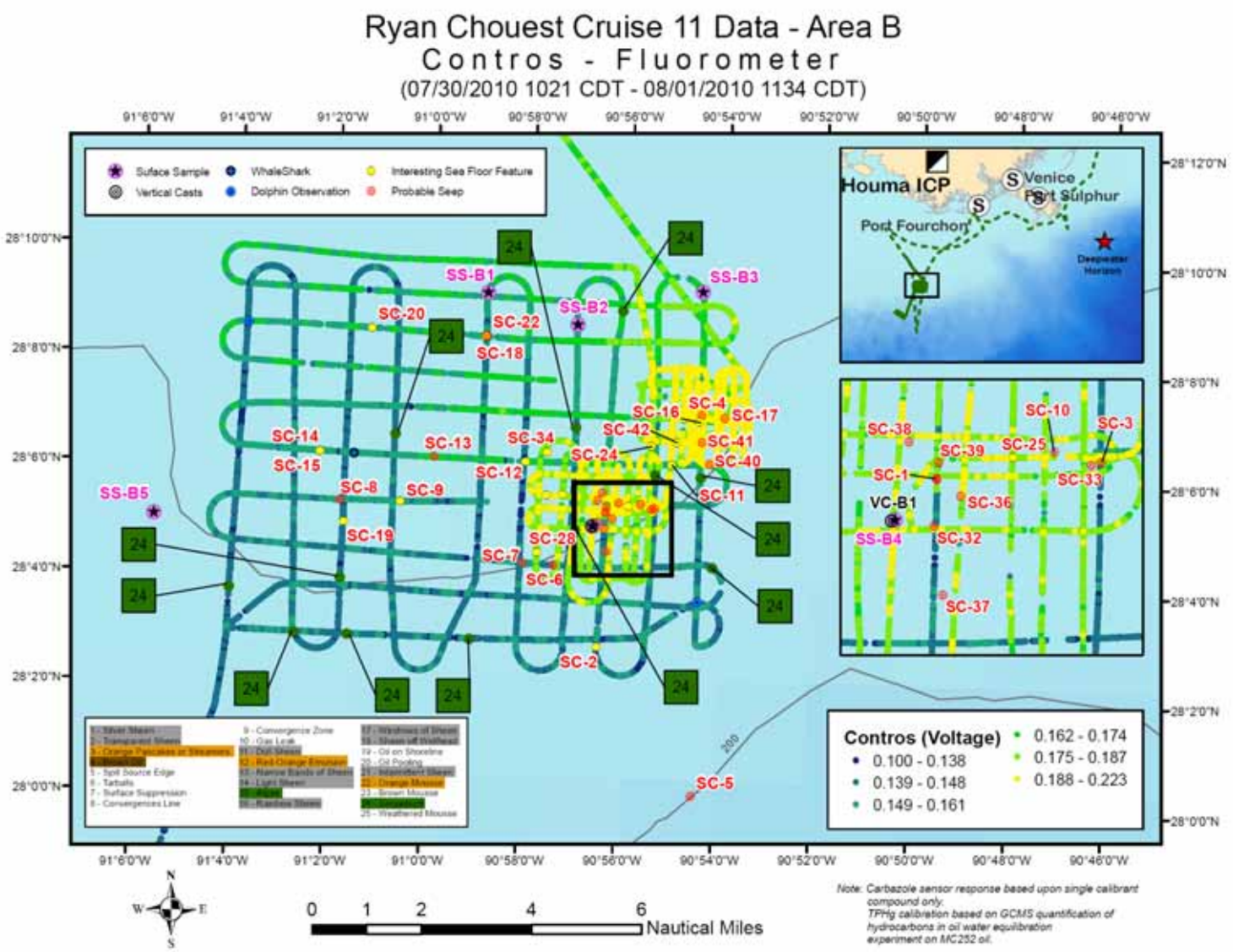

Figure 16. Contros fluorometer results for cruise 11 area B. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period.

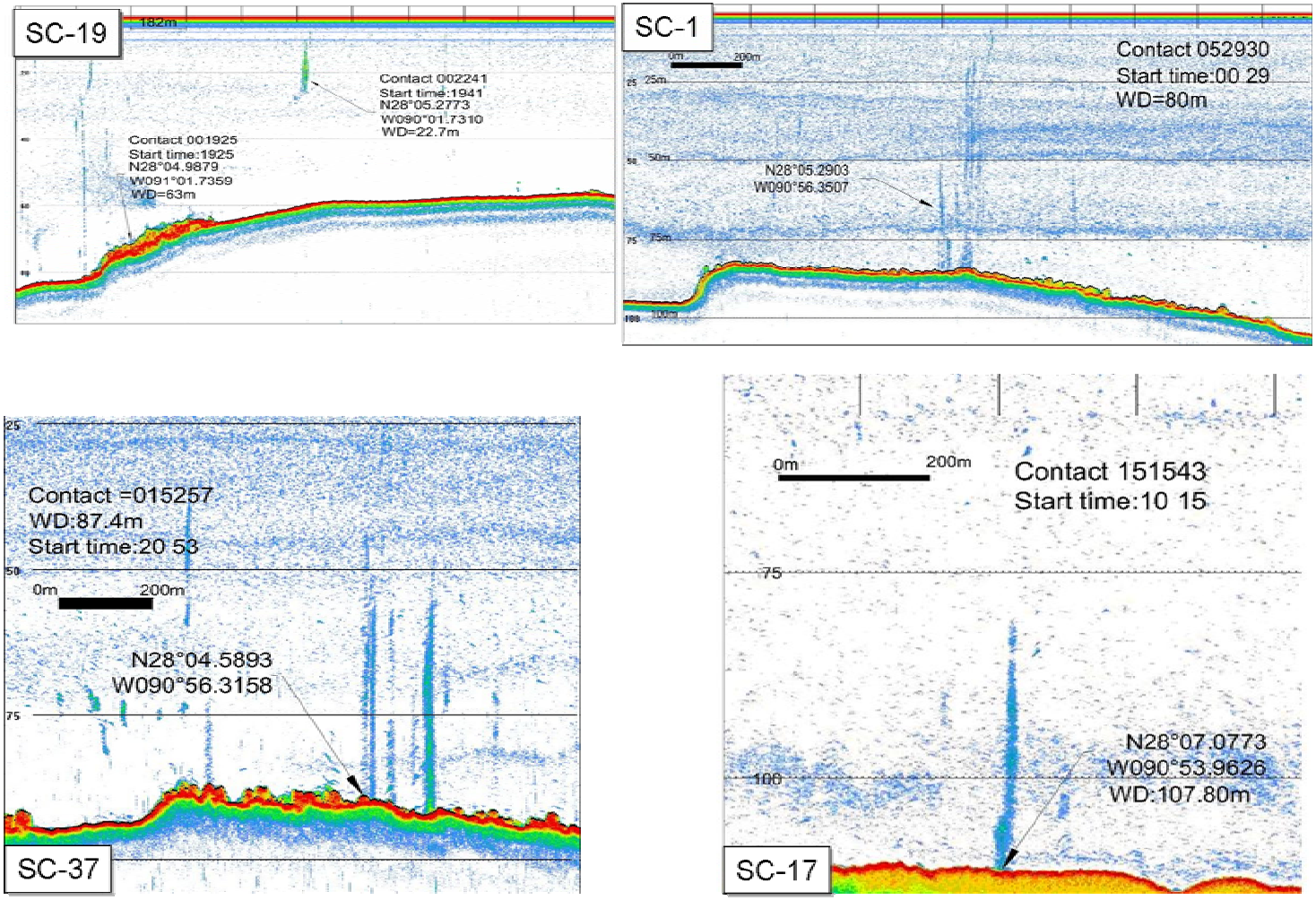

Figure 17. Contact_073010_001925 (SC-19). Description: Possible seep, slump feature. Time (CDT): 07/30/2010 2128 hrs. Location: 28° 04.9879N; 91° 01.7359W. Contact_0731010_052930 (SC-1). Description: Possible seep. Time (CDT): 07/30/2010 0029 hrs, Location: 28° 05.2903N; 90° 56.3507W Contact_07312010_015257 (SC-37). Description: Possible seep. Time (CDT): 07/31/2010 2053hrs Location: 28° 04.5893N; 90° 56.3158W. Contact_0731010_151543 (SC-17). Description: Possible seep from seafloor. Time (CDT): 07/31/2010 1015 hrs Location: 28° 07.0773N; 90° 53.9626W.

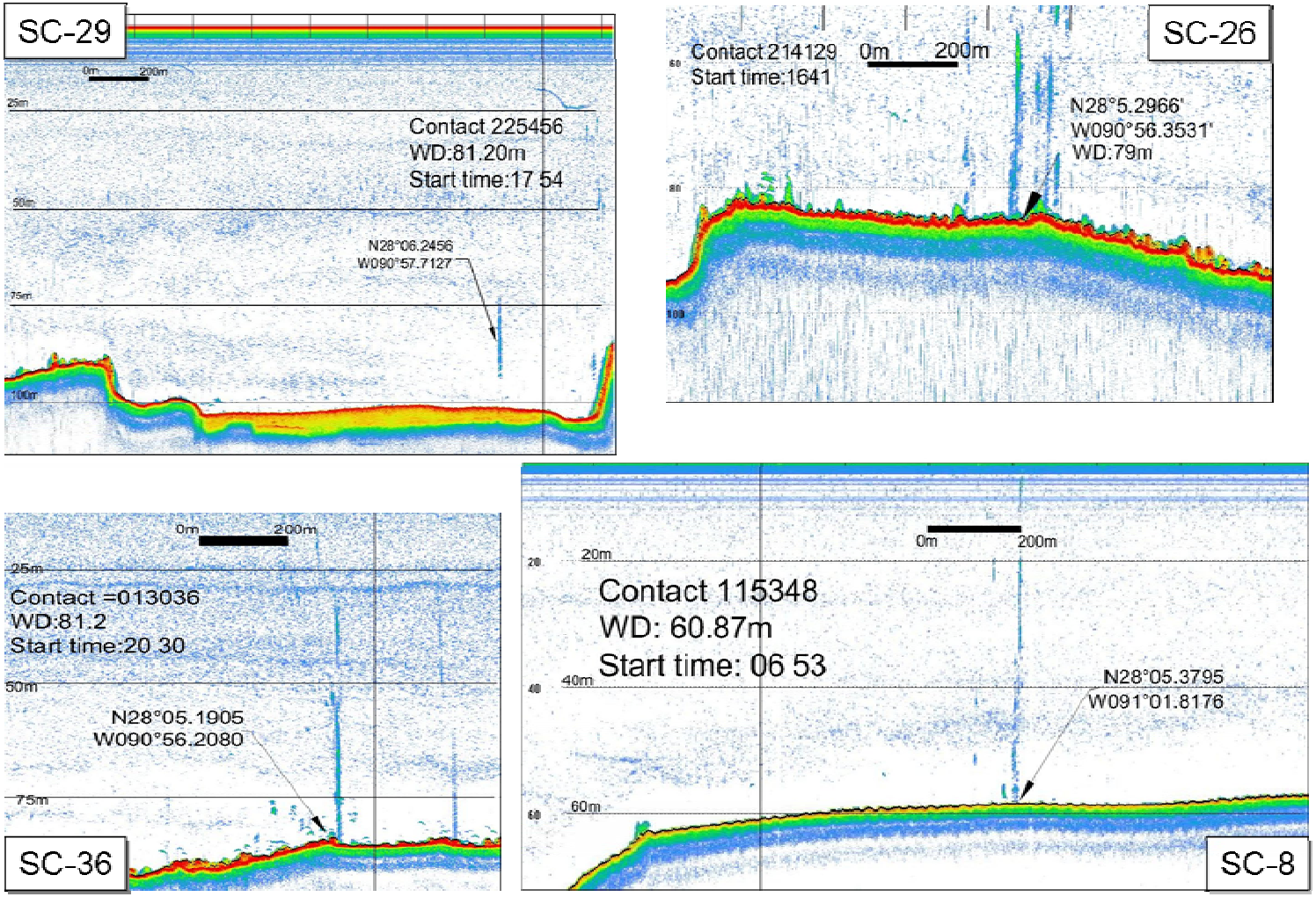

Figure 18. Contact_07312010_225456 (SC-29). Description: Mid-Water Contact. Time (CST): 07/31/2010 1754hrs. Location:28° 06.2456N, 90° 57.7127W, Contact_07312010_214129 (SC-26). Description: Possible seep. Time (CDT): 07/31/2010 1641hrs Location: 28° 05.2966N; 90° 56.3531W. Contact_07312010_013036 (SC-36). Description: Possible seep. Time (CDT): 07/31/2010 2030hrs Location: 28° 05.1905N; 90° 56.2080W. Contact_0731010_115348 (SC-8). Description: Possible seep. Time (CDT): 07/30/2010 0653 hrs. Location: 28° 05.3795N; 91° 01.8176W

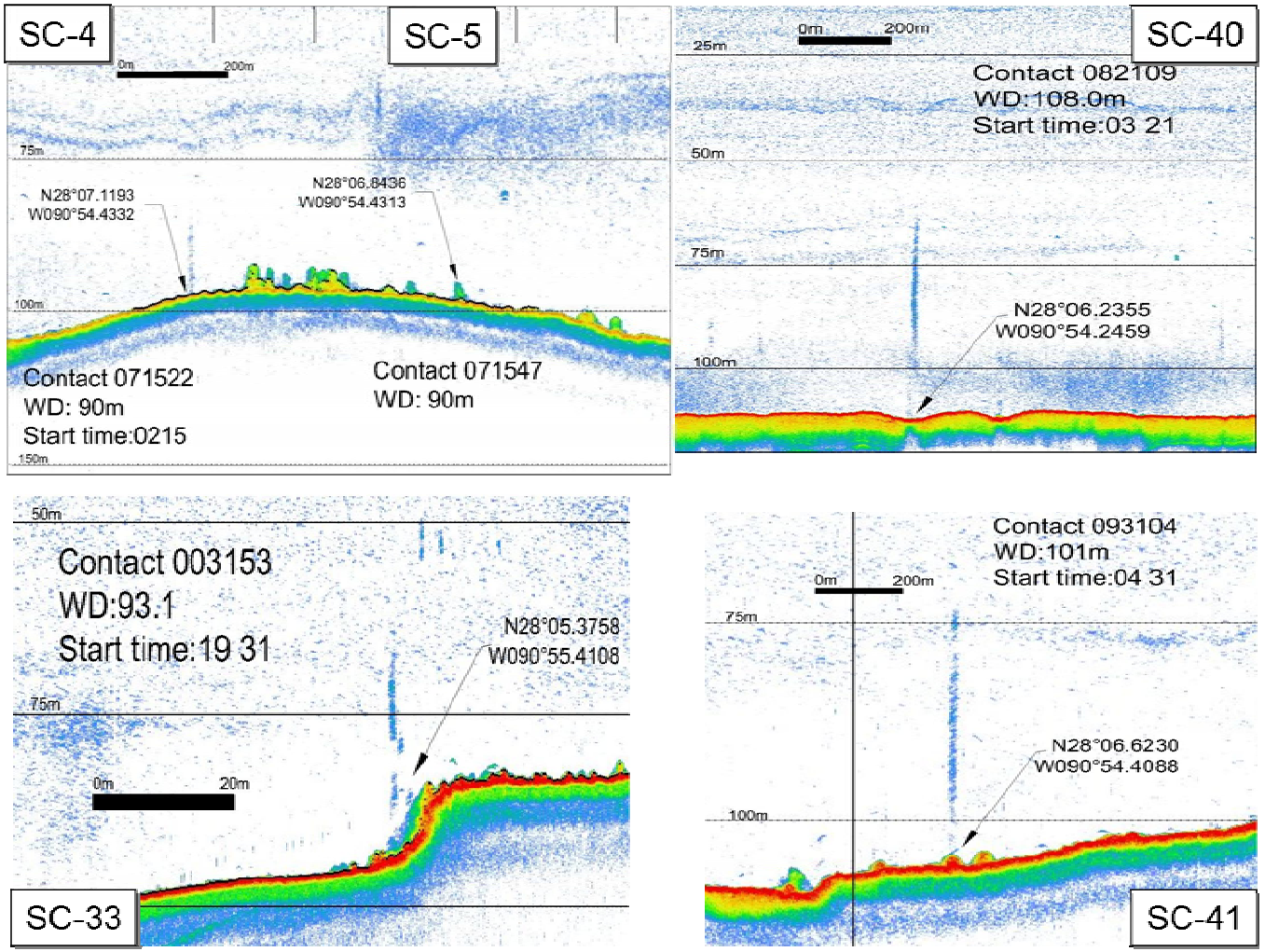

Figure 19. <u>Contacts_0731010_071522 & 071547 (SC-4 & SC-5).</u> Description: Possible abandoned rig and seep. Time (CDT): 07/30/2010 0215 hrs. Location: 28° 06.8436N; 90° 54.4313W. <u>Contact_08012010_082109 (SC-40)</u>. Description: Possible seep. Time (CDT): 08/01/2010 0321hrs Location: 28° 06.2355N; 90° 54.2459W. <u>Contact_07312010_003153 (SC-33)</u>. Description: Possible seep. Time (CDT): 07/31/2010 1931hrs Location: 28° 05.3758N; 90° 55.4108W. <u>Contact_08012010_082109 (SC-41)</u>. Description: Possible seep. Time (CDT): 08/01/2010 0431hrs Location: 28° 06.6230N; 90° 54.4088W.

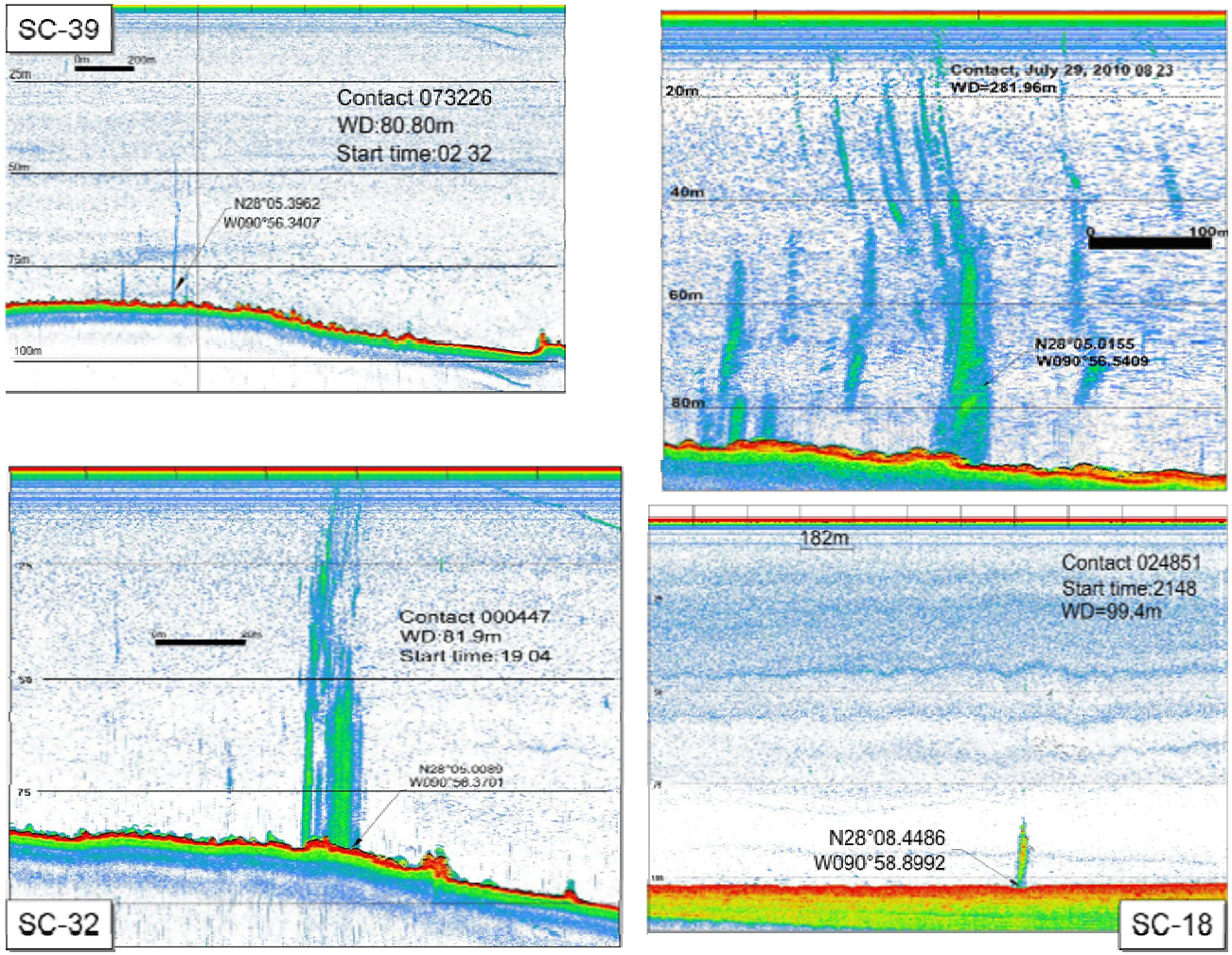

Figure 20. <u>Contact_08012010_073226 (SC-39)</u>. Description: Possible seep. Time (CDT): 08/01/2010 0232hrs Location: 28° 05.3962N; 90° 56.3407W. <u>Contact_0729010_132310</u> the location of cruise 11 cast 1 (VC-B1). <u>Contact_07312010_000447 (SC-32)</u>. Description: Possible seep. Time (CDT): 07/31/2010 1904hrs Location: 28° 06.0089N; 90° 56.3701W. <u>Contact_0729010_024851 (SC-18)</u>.Description: Possible seep. Time (CDT): 07/30/2010 2128 hrs. Location: 28° 08.4486N; 90° 58.8992W.

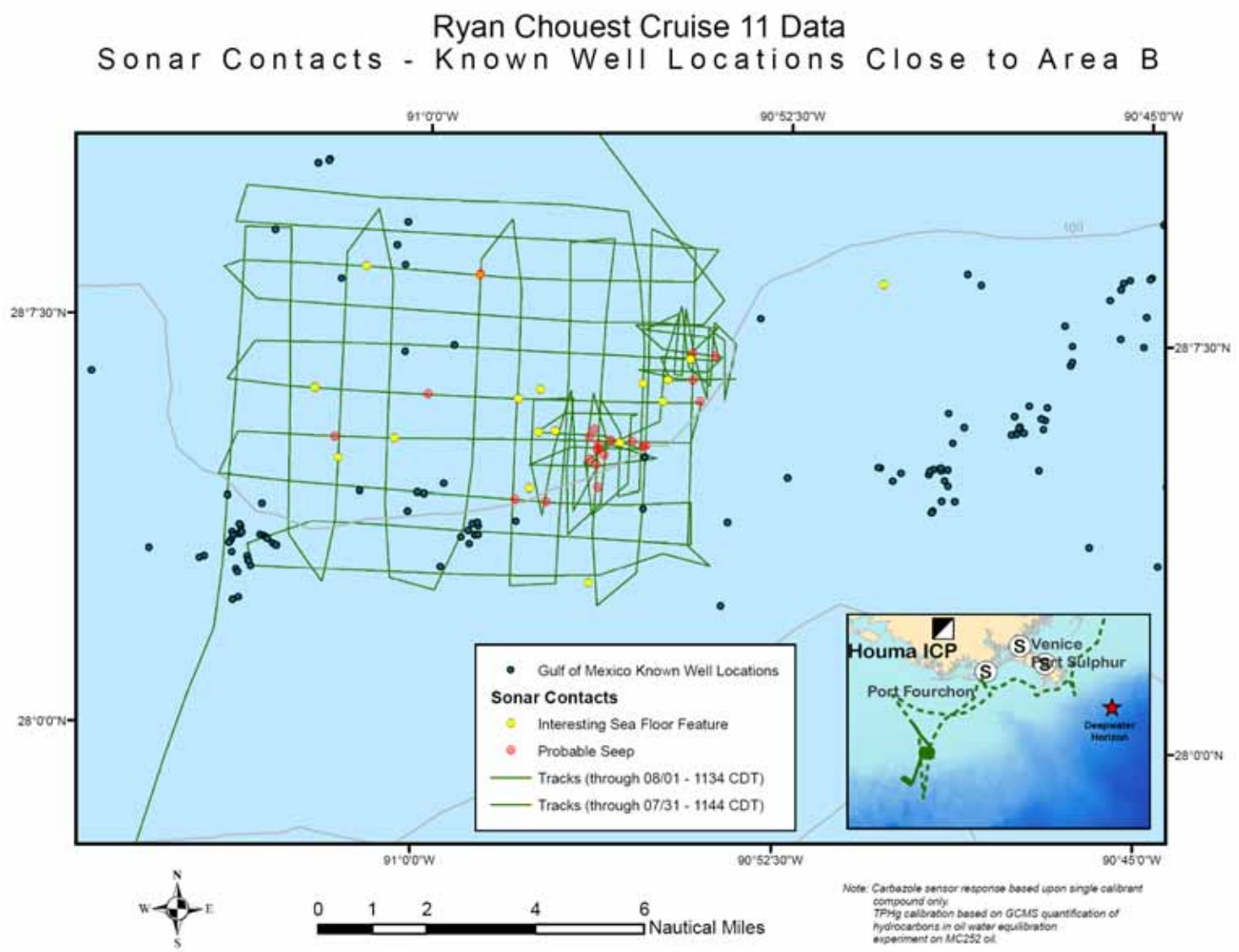

Figure 21. Plot of known well locations within proximity of echosounder contacts.

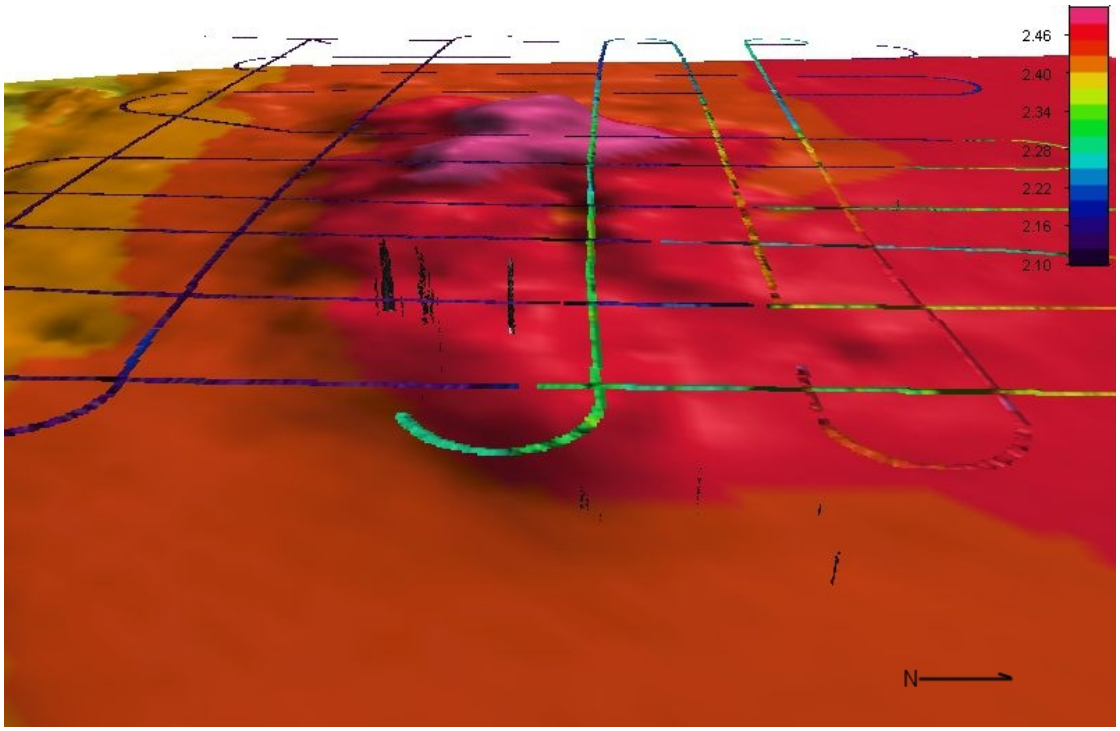

Figure 22. Three-dimensional view looking from the east of bathymetric data and possible and seeps in area A, cruise 11. Data contoured and compiled in Fledermouse (please note that there 6 x vertical exaggeration in seafloor relief). The image is overlain with Chelsea fluorometer voltage results.

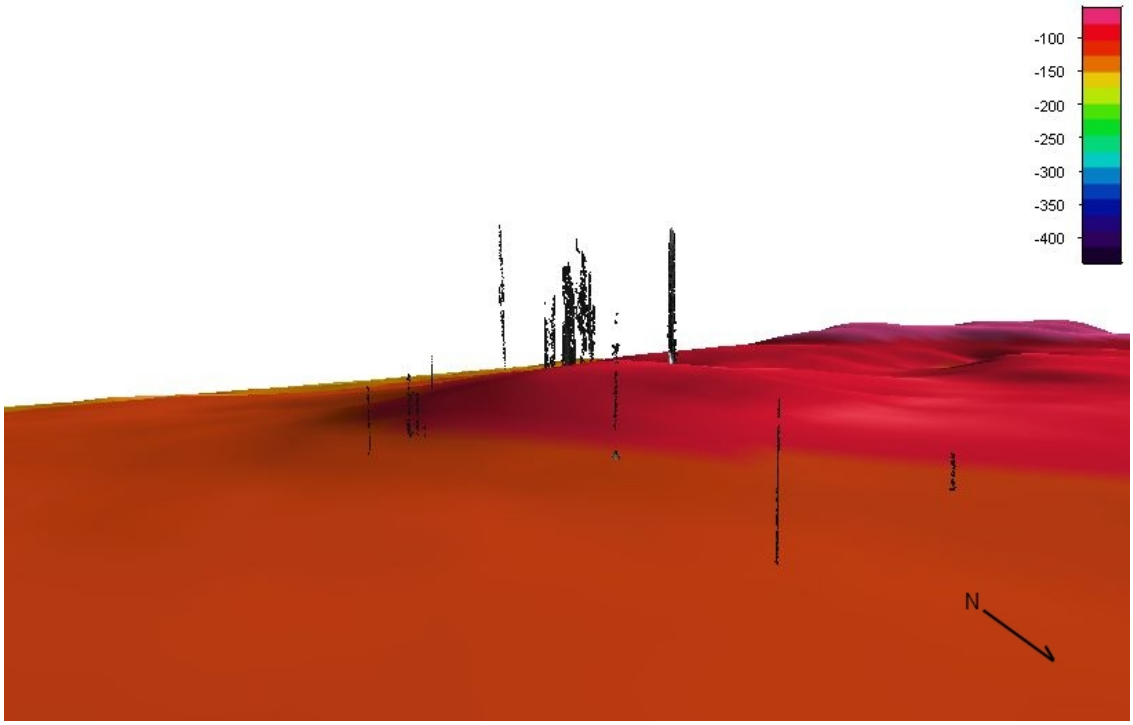

Figure 23. Three-dimensional view looking from the north east of bathymetric data and possible and seeps in area A, cruise 11. Data contoured and compiled in Fledermouse (please note that there 6 x vertical exaggeration in seafloor relief). The image is overlain with Chelsea fluorometer voltage results.

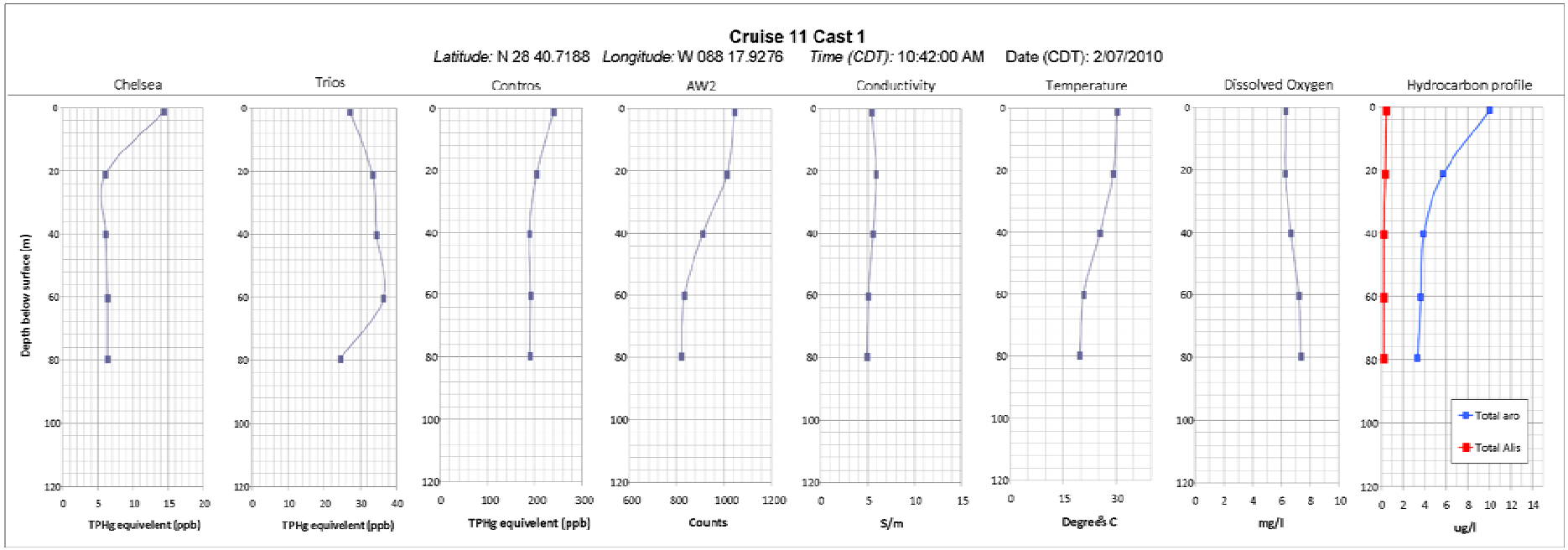

Figure 24. The results obtained for Cruise 11 vertical cast 1 (VC-B1) down to 80 m. This cast location taken over the Contact_0729010_132310 site previously identified on the 29th July. The sensor fluorometry results for the Chelsea, Trios and Contros sensors and water samples were obtained from waters pumped to the surface. Conductivity, temperature, depth and dissolved oxygen measurements were obtained from a SBE 19+ system and oxygen sensor attached to the submersible pump used to draw the water into the sensor tank on the surface. The hydrocarbon profile is generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

2.3. Area C

2.3.1. Description of area

Survey Area C is situated to the north west of the MC252 spill site and was chosen for a high resolution grid survey over a possible seep previously identified in cruise 10 (Figure 25). The survey grid was approximately 8 x 5 nautical miles trending NNW to SSE in water depths ranging from 700-1200 m. The survey lines to towards the centre of the grid were designed to allow full coverage of the sea floor by the echo sounder in order to facilitate contouring of seafloor bathymetry.

Fluorometry results

The Chelsea and Trios sensor results, displayed in Figure 26 & Figure 28, indicate minimal levels of inferred hydrocarbons. A relative rescaling of the track travelled (using corresponding highest and lowest sensor voltage values within area surveyed) shows a greater variation within, especially in the NE-SW trending tracks (Figure 27 & Figure 29) possibly due to a shift in currents. The Contros sensor results show mid levels of inferred hydrocarbon concentration along the track (Figure 30), while the relative scaling shows a lesser pattern of elevated levels of inferred hydrocarbon (Figure 31). The water depth at this site is deep and therefore any expression of hydrocarbons on the sea surface, if any, may be off set some distance to the possible seep location. The higher values to the north of the survey Area C unfortunately have no constraint however it would be interesting to correlate the predominant current direction with the sensor response.

Surface Observations

No surface observations were logged over the period.

EK-60 Echosounder results

The single echo sounder contact established in the area (Contact_08042010_173533; SC-C1) was a reestablishment of the previously identified possible seep from cruise 10 (Figure 32). The possible seep occurs in 900m of water depth and the plume is attenuated at 500m water depth. The 3D contoured Fledermouse model of the possible seep shows that the contact occurs on a relatively featureless slope. The seep appears to be situated within a small hollow (Figure 33 & Figure 34).

As the possible seep plume was attenuated at 500m and there was no obvious surface hydrocarbon expression of the seep it was decided not to perform a vertical cast at this location. Further studies using a deep deployment hydrocarbon sensing system would enable the definition of the seep character.

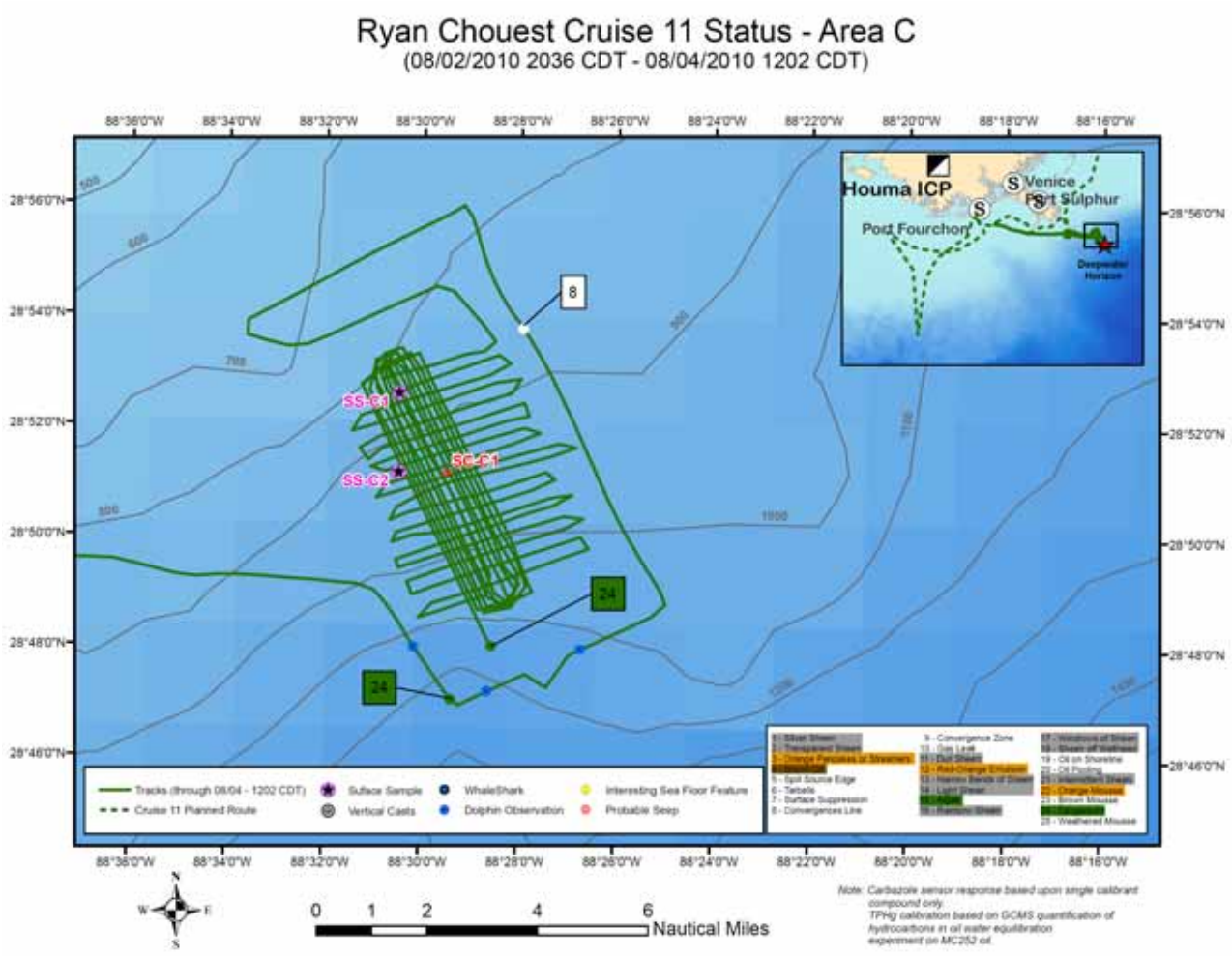

Figure 25. Survey route taken within area C for cruise 11 with observations, echo-sounder contact, vertical cast and sample locations marked where appropriate.

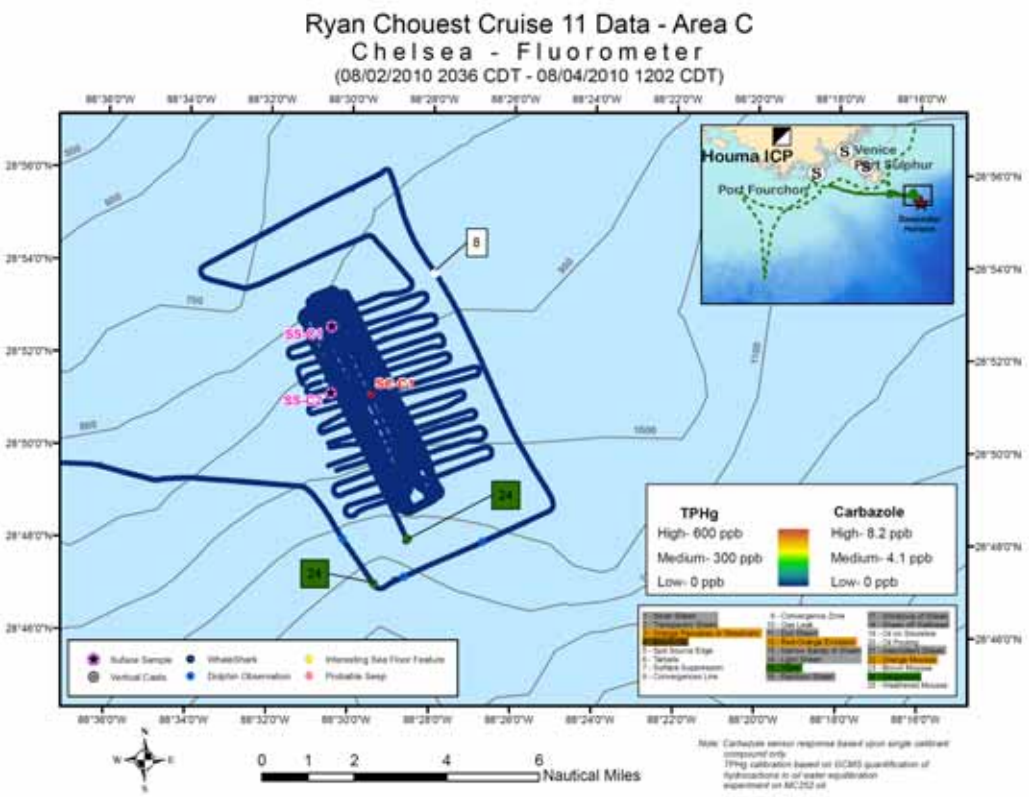

Figure 26. Chelsea fluorometer results for cruise 11 area C.

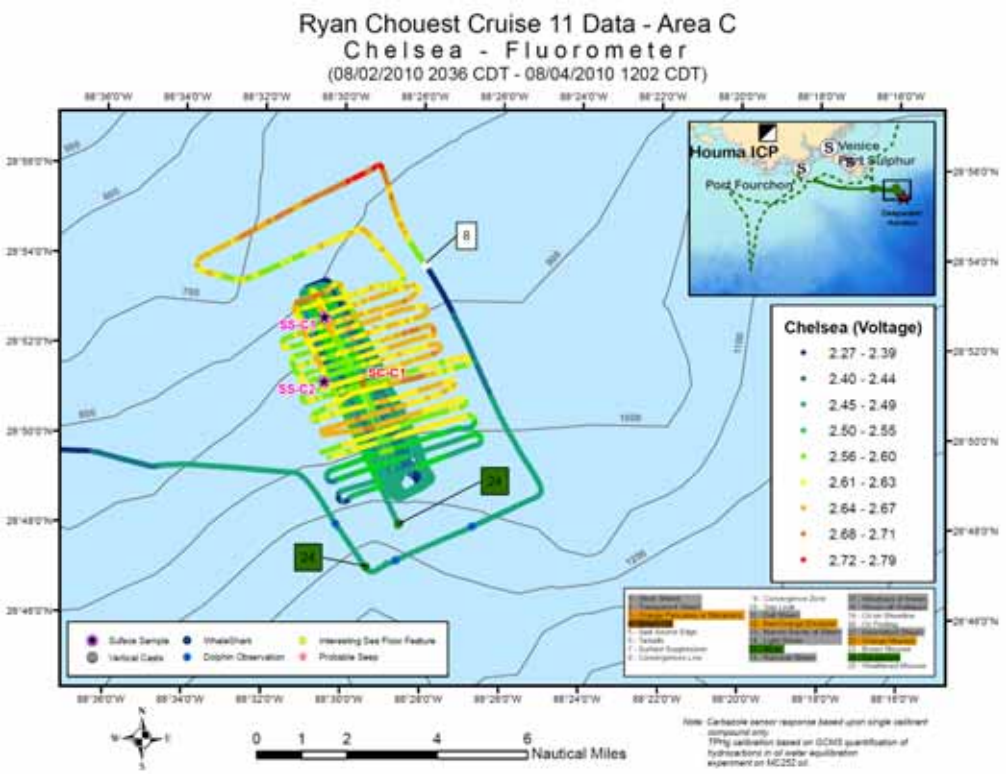

Figure 27. Chelsea fluorometer results for cruise 11 area C. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period.

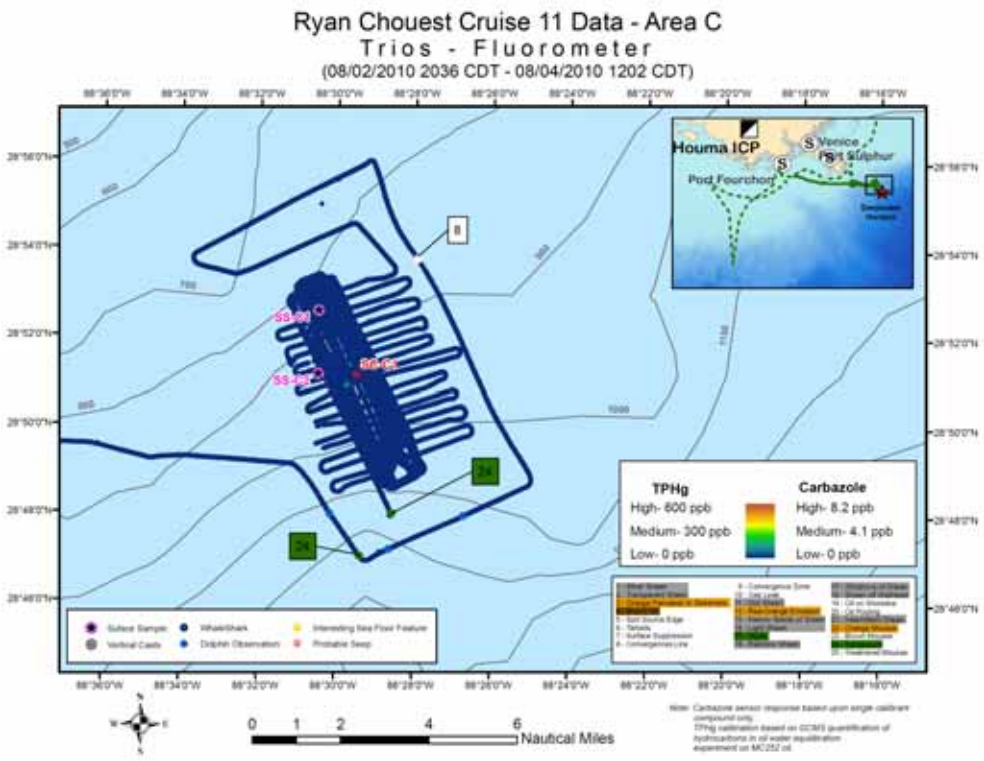

Figure 28. Trios fluorometer results for cruise 11 area C.

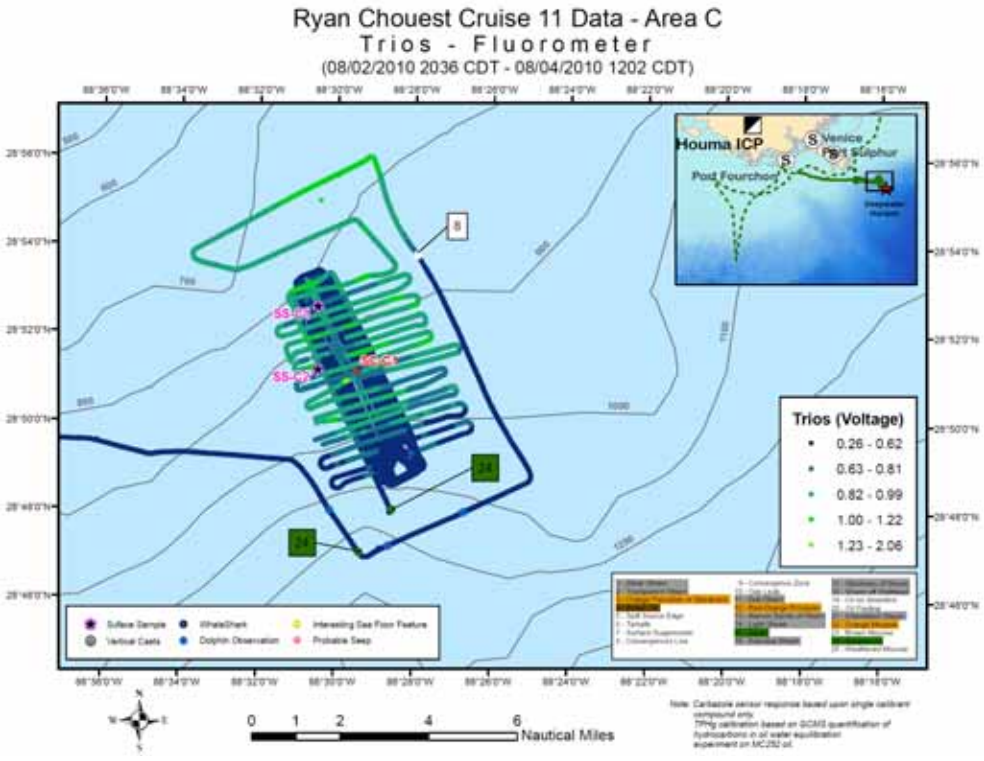

Figure 29. Trios fluorometer results for cruise 11 area C. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period.

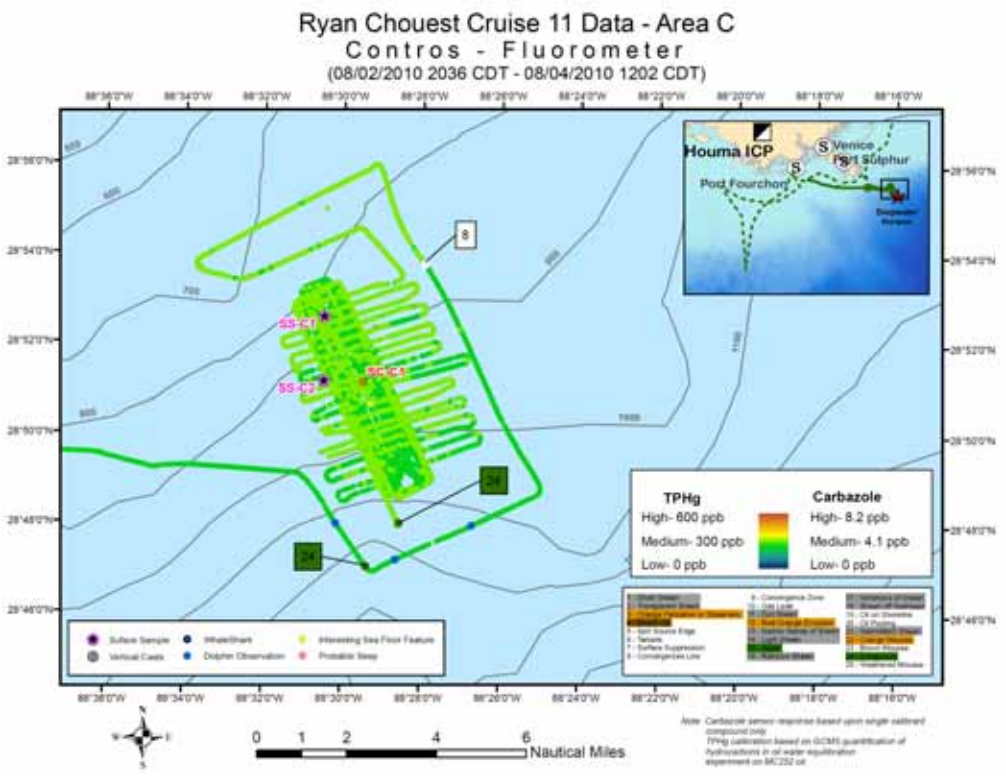

Figure 30. Contros fluorometer results for cruise 11 area C.

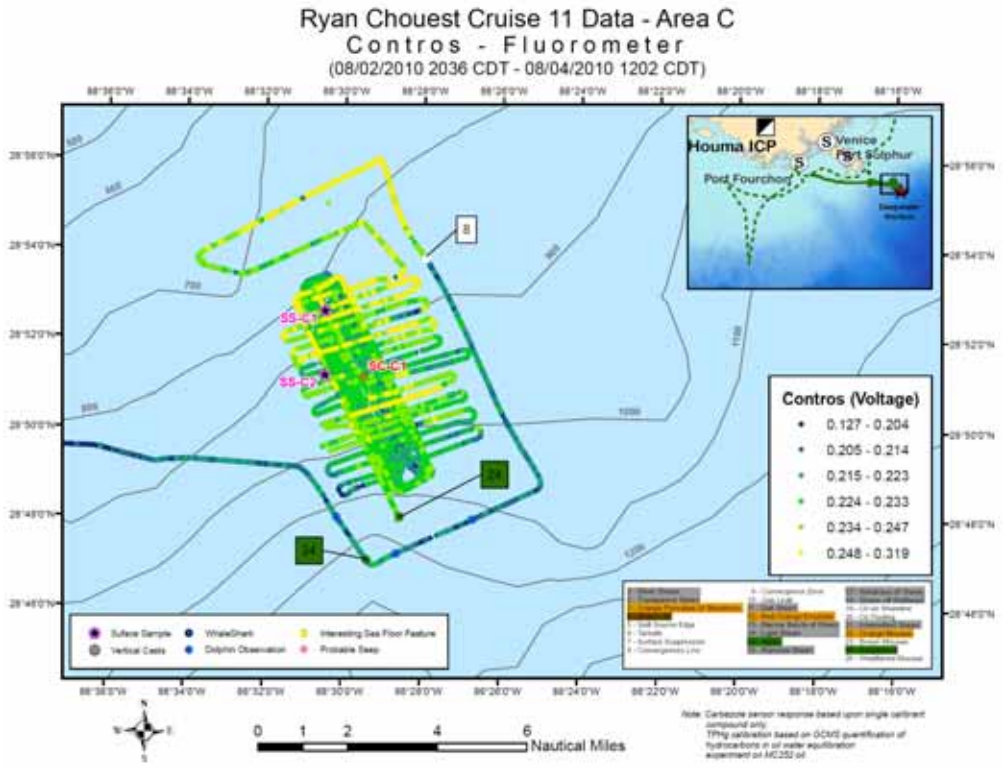

Figure 31. Contros fluorometer results for cruise 11 area C. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period.

South North

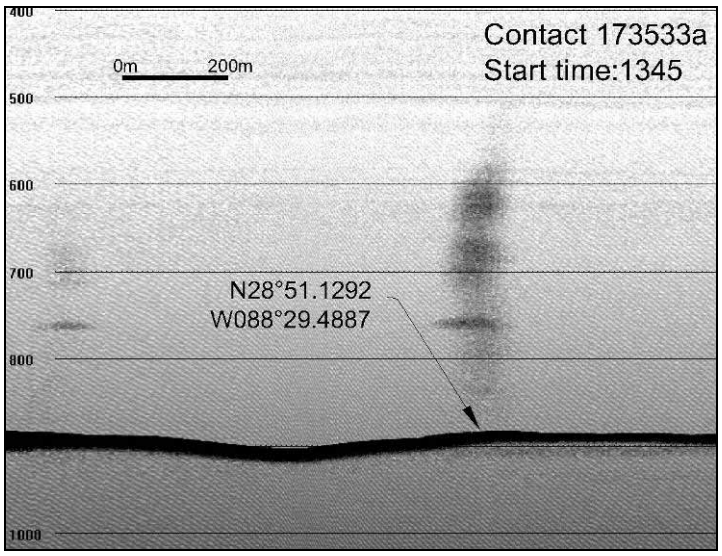

Figure 32. Contact_08042010_173533 (SC-C1). Description: Possible seep. Time (CDT): 08/04/2010 1345 hrs. Location: 28° 51.1292N; 88° 29.4887W.

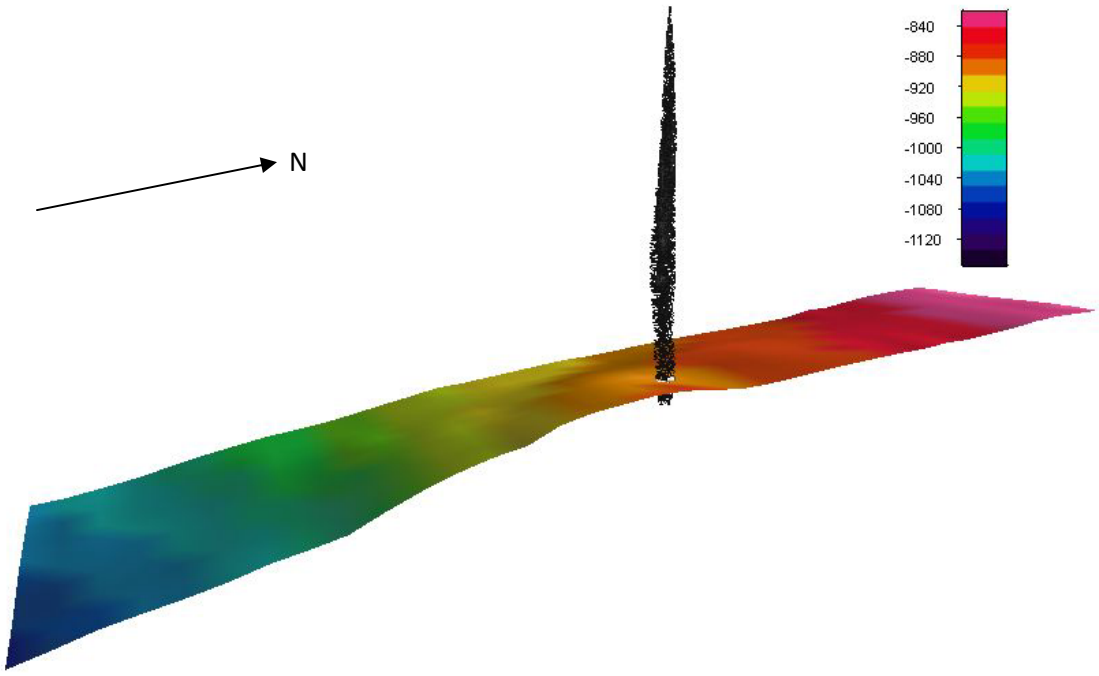

Figure 33. Three-dimensional view of bathymetric data and possible seep area C, cruise 11 (SC-C1). Data contoured and compiled in Fledermouse (please note that there 6 x vertical exaggeration in seafloor relief).

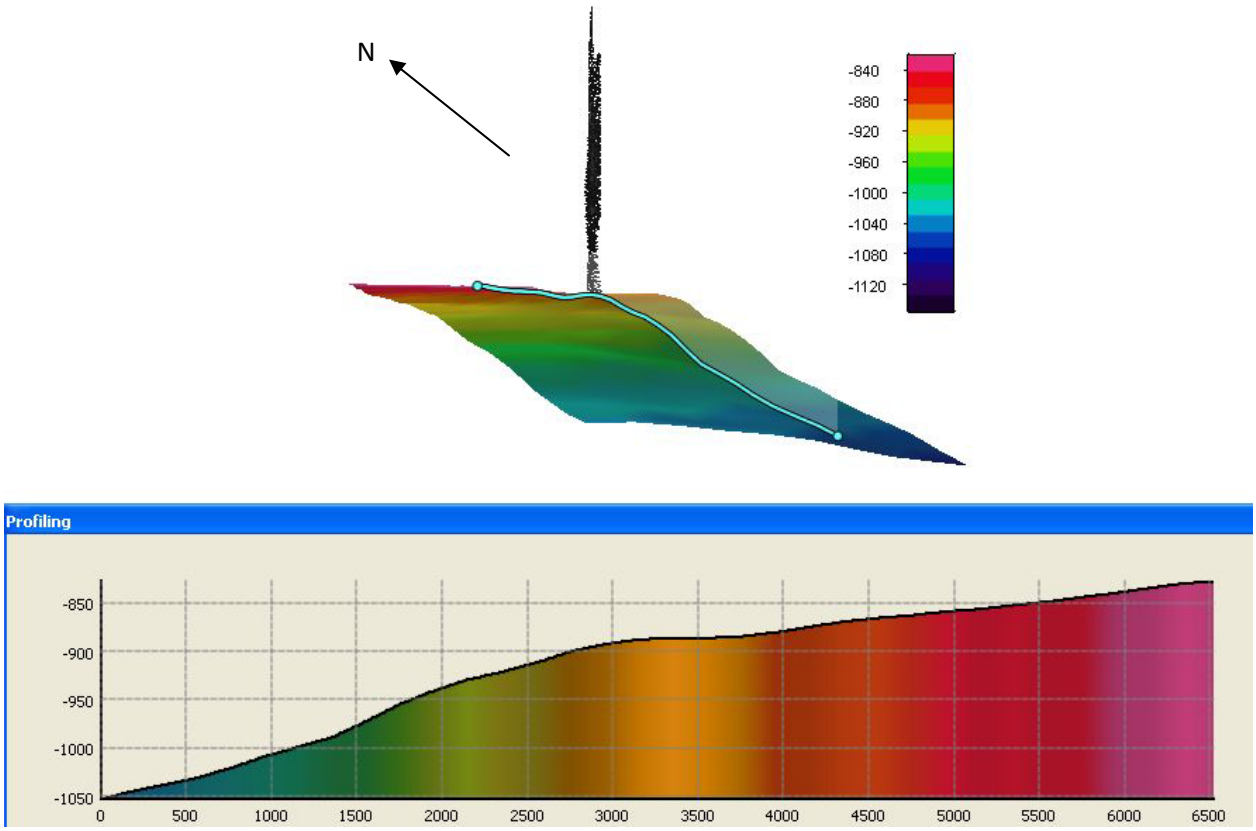

Figure 34. Alternate three-dimensional view of bathymetric data and possible seep in area C, cruise 11 (SC-C1). Data contoured and compiled in Fledermouse (please note that there 6 x vertical exaggeration in seafloor relief), the inset shows a vertical profile of the seafloor along the line plotted in the main figure.

2.4. Area D

2.4.1. Description of area

Area D is situated to the west of Area C (Figure 1) and was chosen for a high resolution grid survey over a possible seep previously identified in cruise 10 (Figure 35). The survey grid was approximately 4 x 5 nautical miles trending North to South in water depths ranging from 250-550m. Survey lines were spaced approximately ¼ nautical mile apart to cover much of the sea floor in order to allow 3D contouring of the bathymetry. The survey box falls mainly within the MC 108 block with survey lines close the Hammer Jack platform (MC 109). On entering the survey area a clover leaf search pattern over the previously identified seep area commenced to re-establish the seep position and understand its activity level. After successfully identifying the possible seep the vessel commenced an east-west series of parallel survey lines followed subsequently by the north south survey lines. Other activities onboard included spooling and testing of the new vertical hose assembly. High currents were experienced in the area and when testing the vertical cast system there was significant drag on the tubing which prevented the vertical cast system being re-spooled. The vessel needed to be taken out of DP and allowed to drift with the currents (drift track to top right of survey box Figure 35) Once the *Ryan Chouest* completed the final portion of ~5 x 4 nautical mile high resolution grid survey off the Mississippi delta before heading west to rejoin the coastal transect off Port Fourchon (Figure 1).

Fluorometry results

The Chelsea sensor result displayed indicates minimal levels of inferred hydrocarbons throughout the track travelled (Figure 36). A relative rescaling of the Chelsea data (using corresponding highest and lowest sensor voltage values within area surveyed) shows a broad increase in fluorometer values in the southern half of the survey box (Figure 37). There are distinct localised areas of enhanced response in the northern part of the grid and also on the tracks entering the grid. Differences between the north-south track lines and the east-west track lines could possibly be due to the variable high current ragime observed in the area. The Trios sensor detected predominantly minimal levels of inferred hydrocarbons with the highest values attained on the track taken before entering the main grid of the survey box (Figure 38). A relative rescaling of the Trios data (using corresponding highest and lowest sensor voltage values within area surveyed; Figure 39) reflects the same, though less pronounced, trends as observed in the Chelsea data. The Contros sensor results show mid levels of inferred hydrocarbon concentration along the track (Figure 40), while the relative scaling is a mosaic of elevated levels trending to the lower half of the grid survey (Figure 41). As with the other fluorometers there are higher values on the track line exiting the survey box in the north east.

Surface Observations

A number of surface observations were made over the reporting period. These included sagassum, transparent sheens the location of surface sample SS-D1 (Figure 46 & Figure 47) and one occurrence of a small patch of rainbow sheen the location of surface sample SS-D3 (Figure 49). The surface sheens were associated with bubbles or foam and in the case of the sheen observed at surface sample SS-D1 location included land derived material such as twigs and leaves. The features were defined patches no more than 200 m^2 in total extent. They also appeared to be part of separate water mixing bodies possibly derived from the interaction of the Mississippi discharge and Gulf of Mexico waters. Geochemical results from the SS-D2 sample are shown in Figure 48. The sample has a high relative proportion of aliphatics and the *n*-alkane (m/z 57 ion) profile shows a complex distribution of *n*-alkanes and an elevated base line suggesting that the material may not be thermogenically derived and has been biodegraded. The SS-D3 sample actually represents two samples (100805A and 100805B) taken shortly one after the other from the sea surface. The geochemical signature of the two sample results are shown in Figure 50 and

Figure 51. The two samples have different signatures probably due to the level of success of sampling the surface sheen from the side of the vessel. The 100805A (Figure 50) shows a homologous series of compounds suggesting a possible theromogenic origin. The 100805B sample (Figure 51) does not have as pronounced a homologous series of *n*-alkanes but does contain xylenes, which is intriguing as these compounds would be quickly removed by water washing or evaporation. This suggests that the source of this material recent. The location of the SS-D3 samples correlates well with enhanced sensors responses to the east of Area D survey area.

Other surface observations included, convergence lines, including a zone of differing water properties (likely discharge from the Mississippi mixing with Gulf of Mexico waters) that created dark patches water within the turbid water and initially looked like possible oil (Figure 52, Figure 53 & Figure 54). This area was experiencing high currents likely due to the proximity of the *Ryan Chouest* from the mouth of the Mississippi delta. Additionally, a similar zone was encountered later with thriving marine life (different fish species) accumulated within the dark patches of water which were feeding from the more turbid green waters. Further evidence that these waters were likely to be the result of Mississippi river waters was provided by land plant material in the patches of green turbid waters.

EK-60 Echosounder results

Multiple of echo sounder contacts were made during the reporting period the locations of which are shown in Figure 35. The echosounder contacts were all assigned as possible seeps. The previously identified possible seep was re-established and showed dramatic current driven plume shape (Figure 42). The several passes over the seep showed that the heading of survey line was key to being able to image the plume and show its longitudinal profile. The 3D representation of the seep projected in Fledermouse (Figure 43 & Figure 44) shows that the plume is first bent to the south east and then a second current turns the plume to the north-west. The plume is then entrained deeper in the water column. The dominant plume direction is interesting as the plume direction is in line with the location of the highest sensor values recorded on the track to the east of the survey grid and also the location of the surface water sample of the rainbow sheen (SS-D3) and possible theromgenically derived hydrocarbons. The dominant surface current direction is shown by the survey track in the north east corner of the survey grid where the vessel was allowed to drift with the current (to enable retrieval of the vertical cast system after deployment in the high current regime). With this in consideration it may be inferred that the elevated sensor values in the north east quadrant may be possibly related to the SC-D1 contact.

Vertical cast

The vertical cast performed over Contact_08042010_220048 showed no enhanced sensor response within the lower section of the cast however this may be because the plume was located deep that our vertical cast system could sample and there was a strong current drawing the plume to the east.

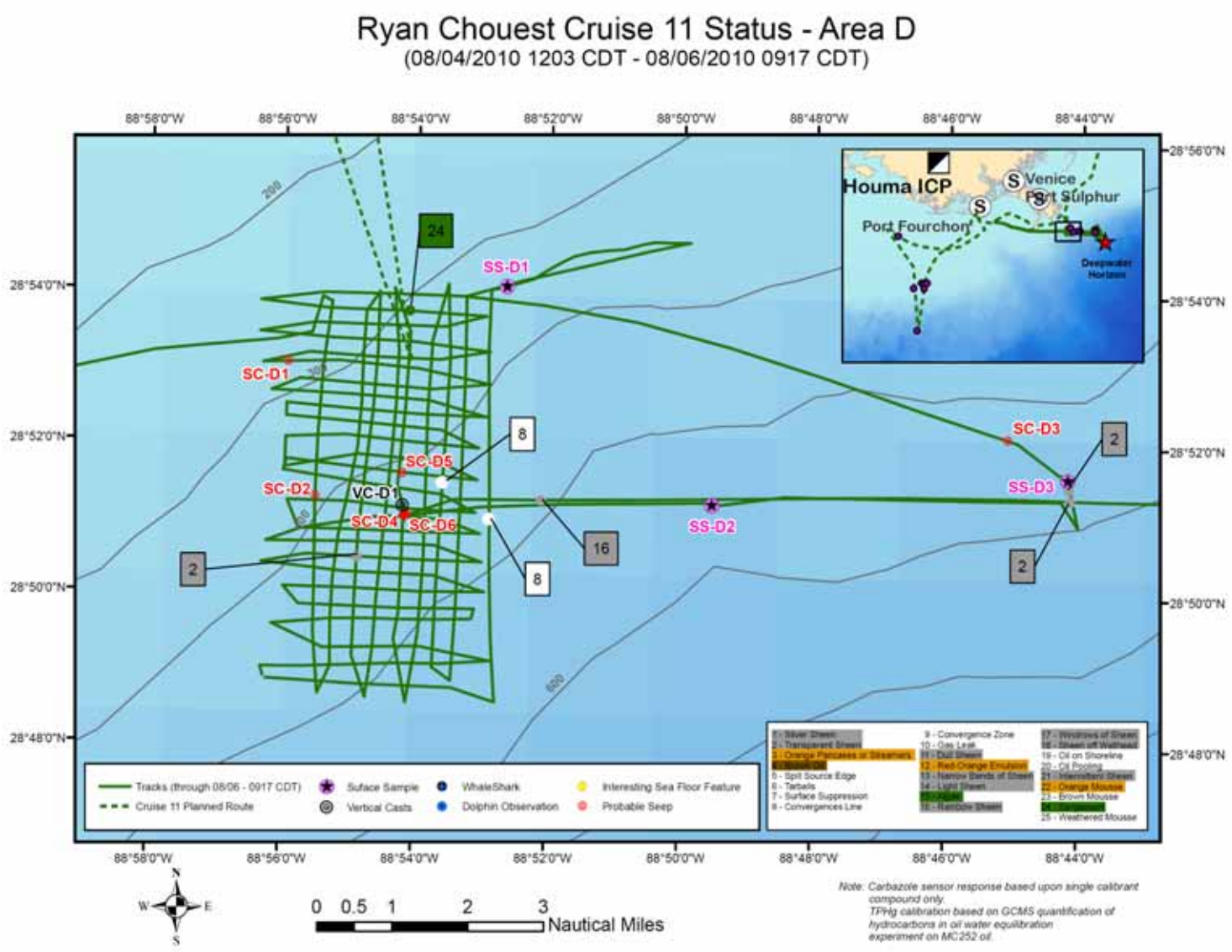

Figure 35. Survey route taken within area D for cruise 11 with observations, echo-sounder contact, vertical cast and sample locations marked where appropriate.

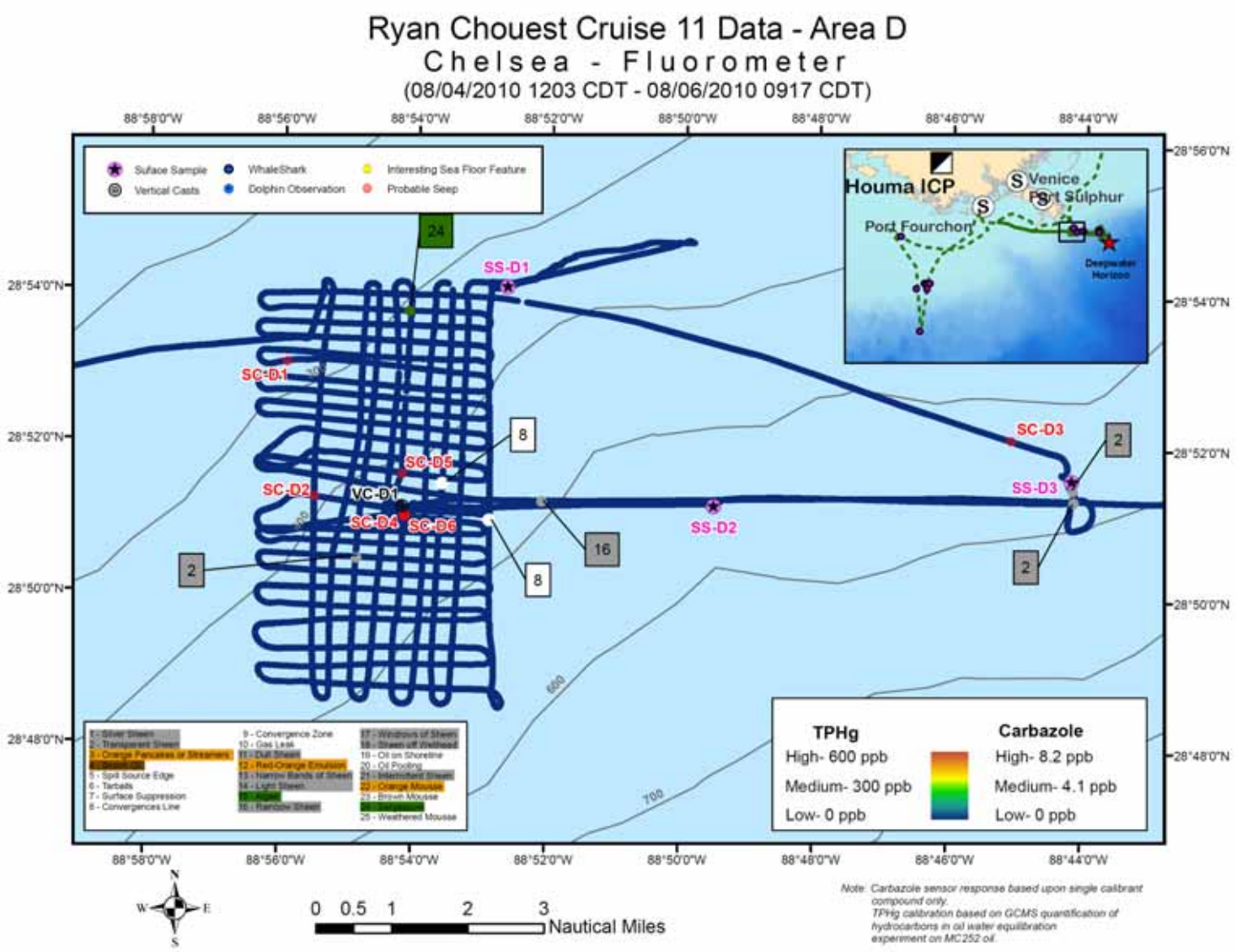

Figure 36. Chelsea fluorometer results for cruise 11 area D.

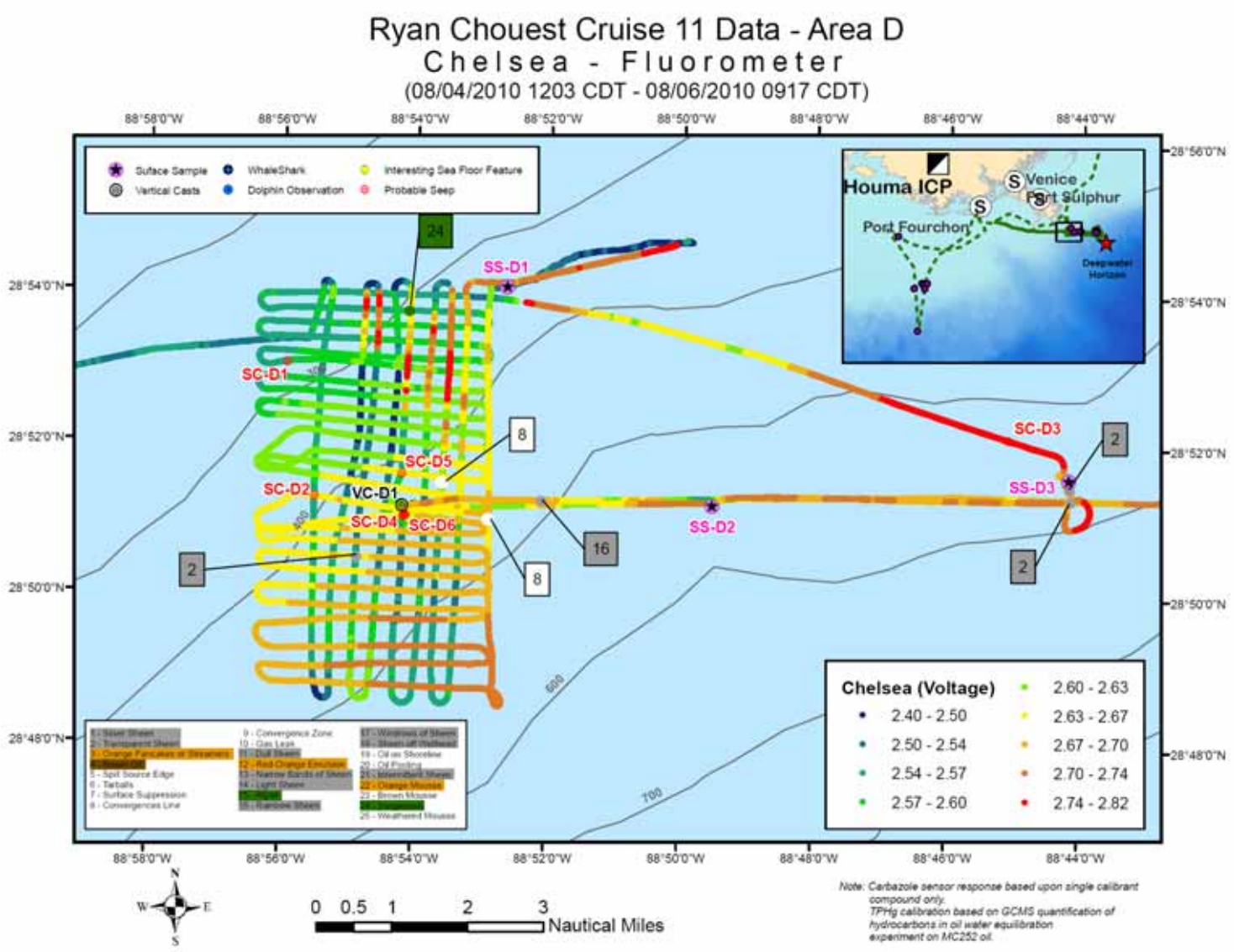

Figure 37. Chelsea fluorometer results for cruise 11 area D. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period.

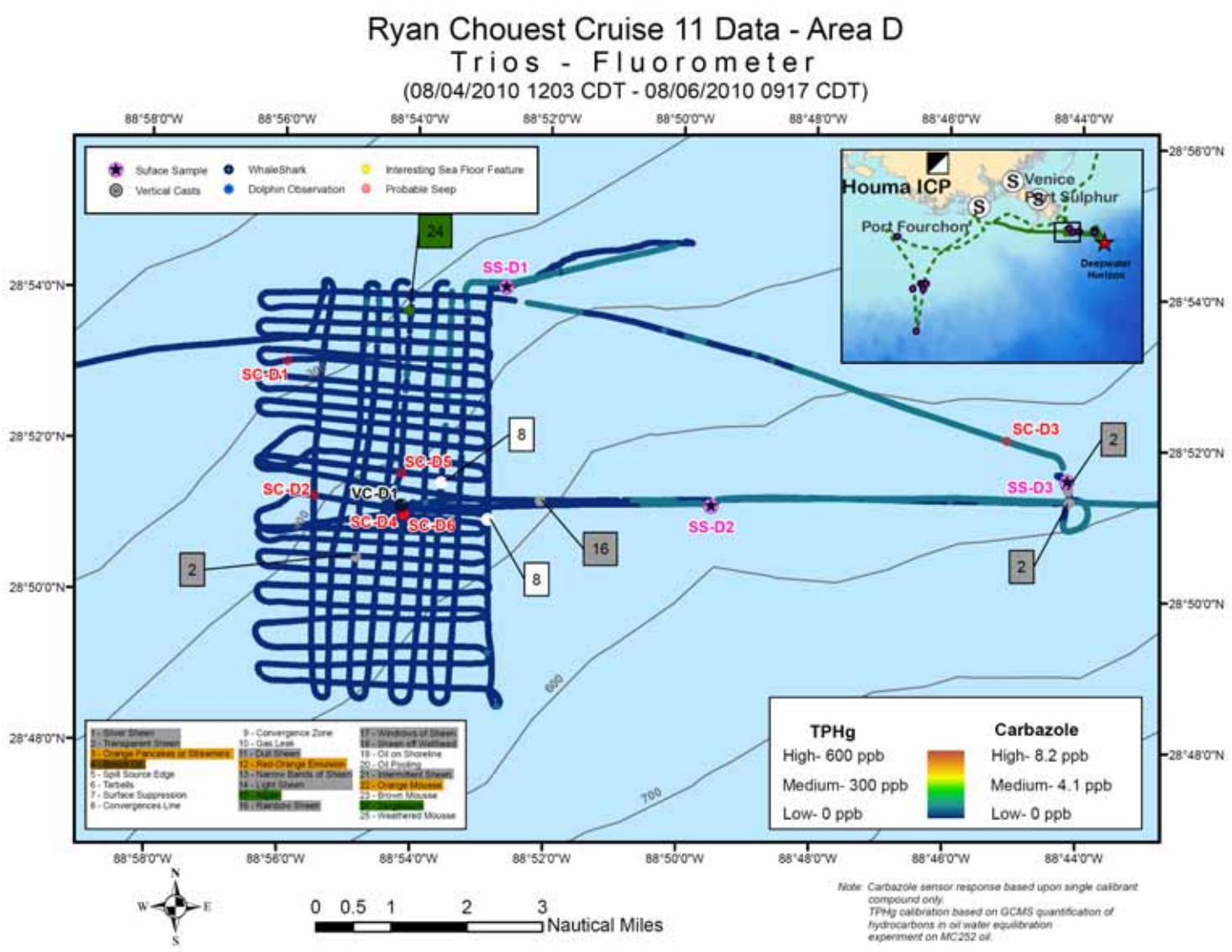

Figure 38. Trios fluorometer results for cruise 11 area D.

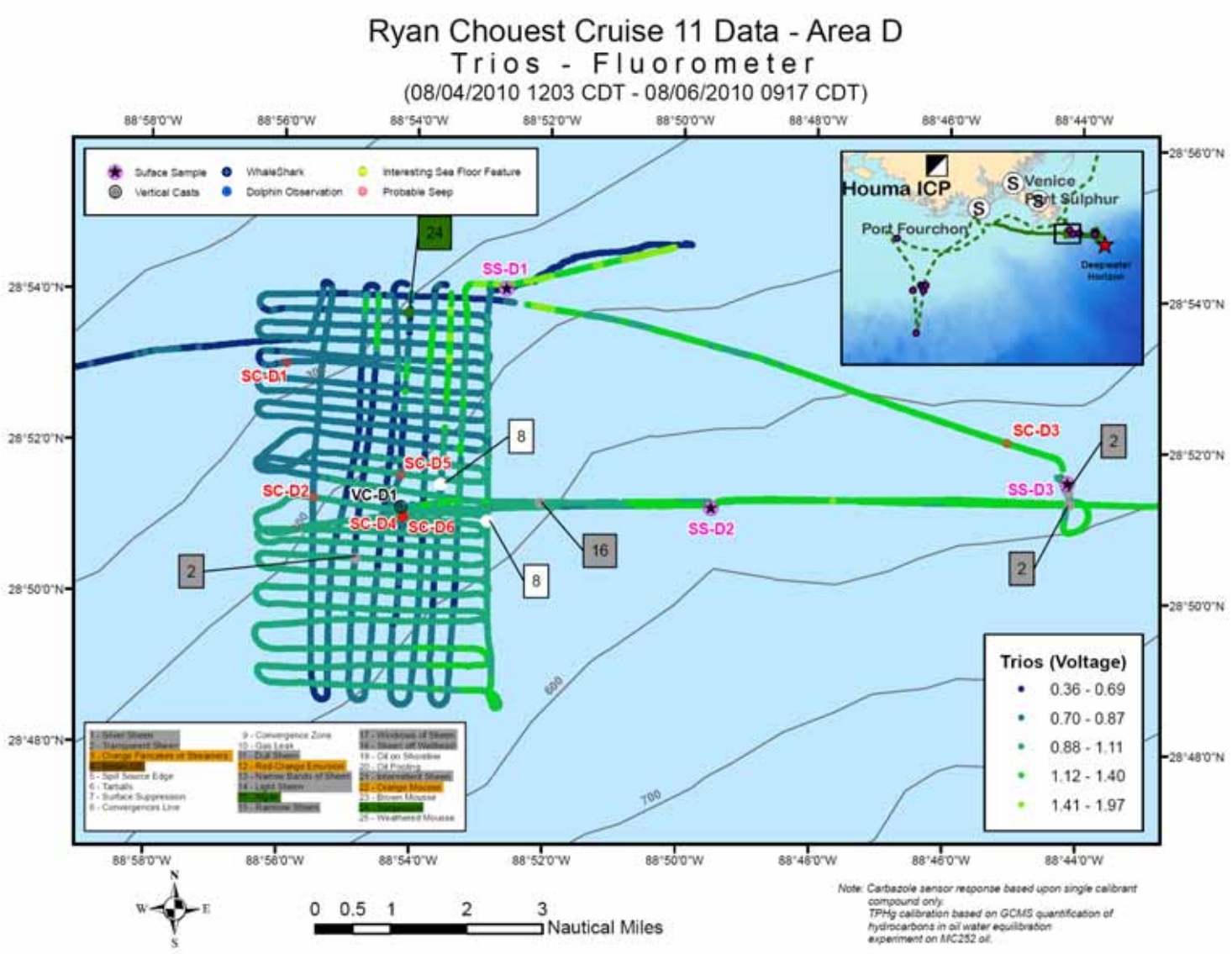

Figure 39. Trios fluorometer results for cruise 11 area D. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period.

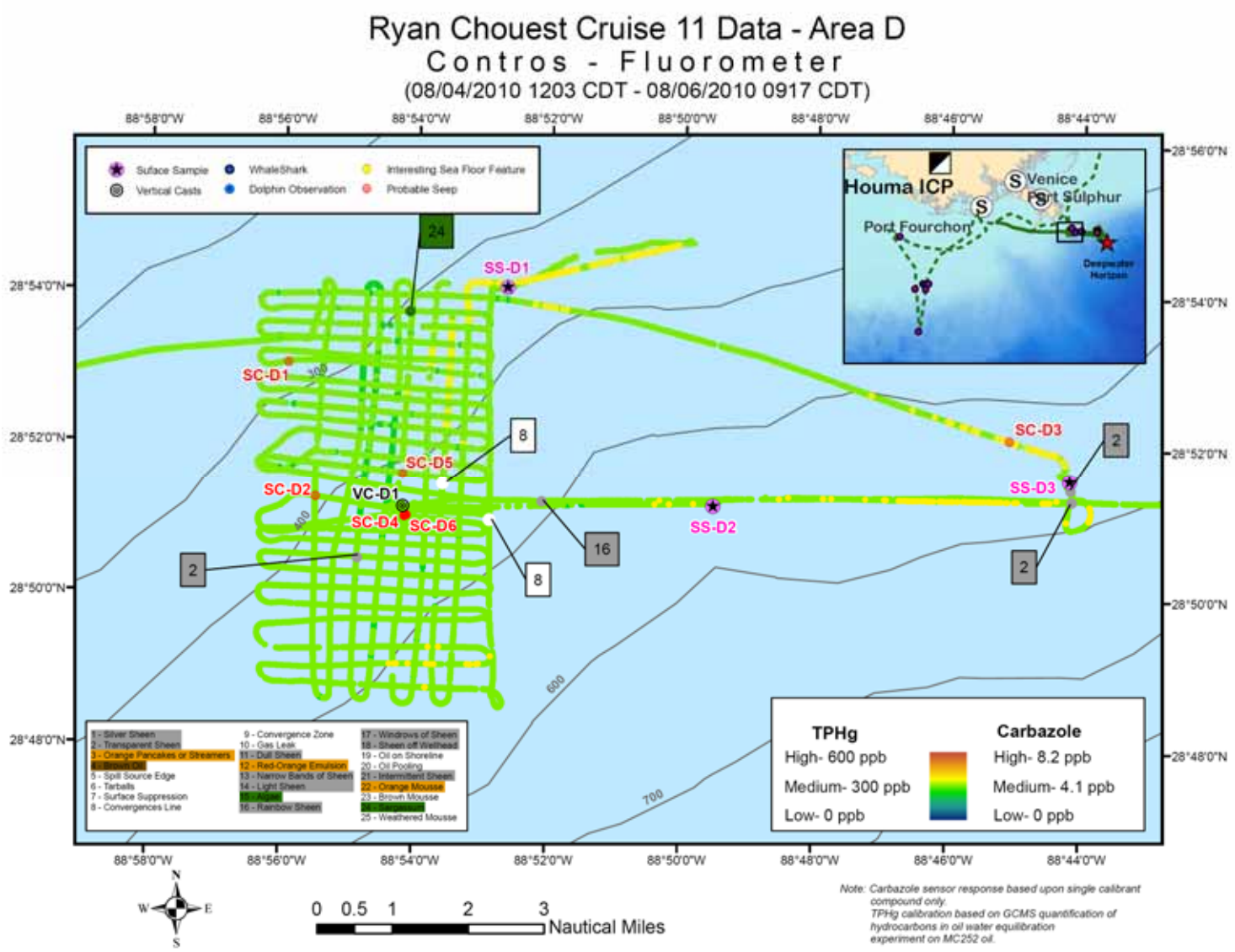

Figure 40. Contros fluorometer results for cruise 11 area D.

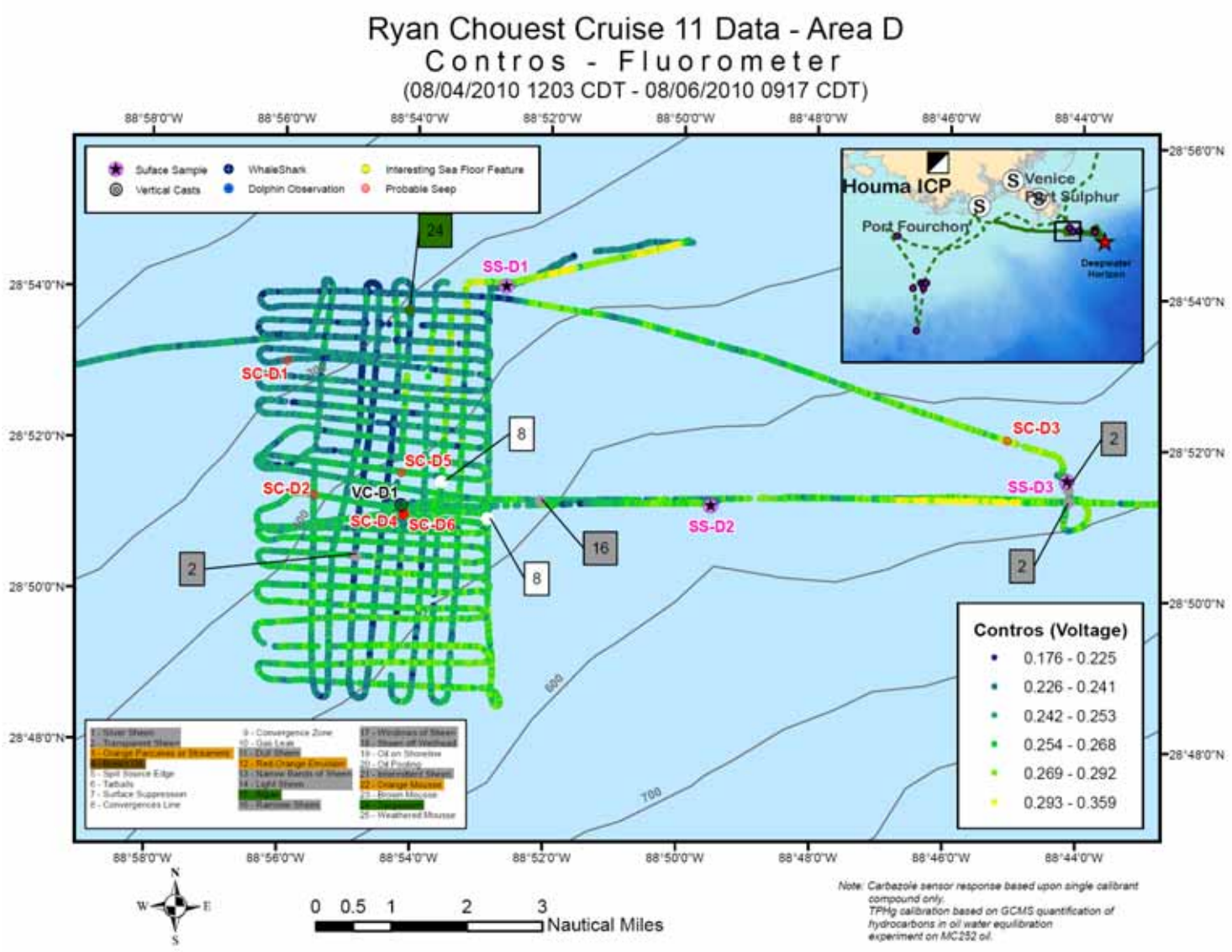

Figure 41. Contros fluorometer results for cruise 11 area D. The figure scaling is relative based on the highest and lowest fluorometer responses made during the period.

South West North East

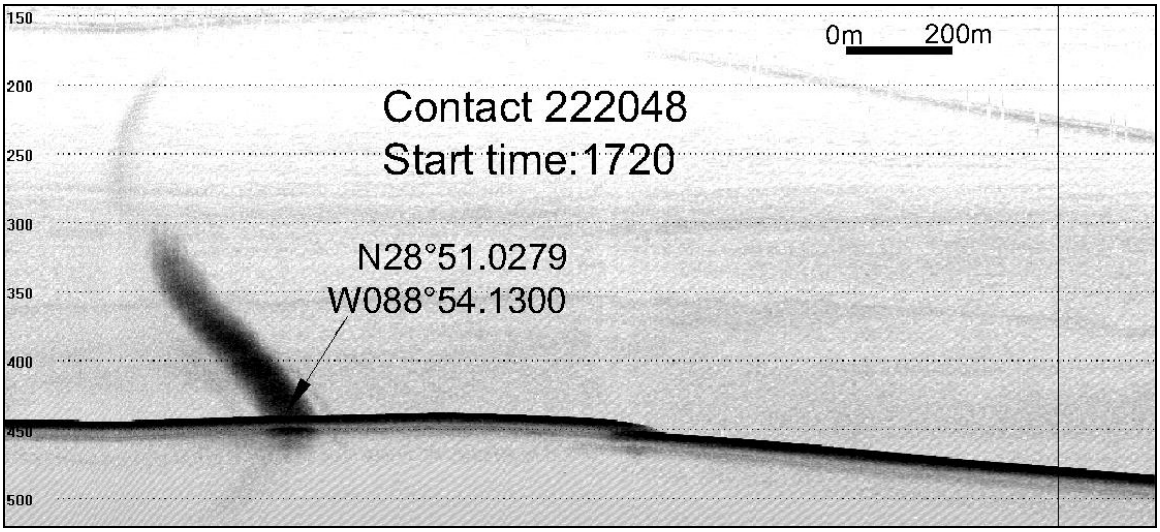

Figure 42. Contact_08042010_220048 (VC-D4). Description: Seafloor to mid water contact, possible seep. Time (CDT): 08/04/2010 1720 hrs. Location: 28° 51.0279N; 88° 54.1300W. Depth displayed: 184.73m to 437.72m.

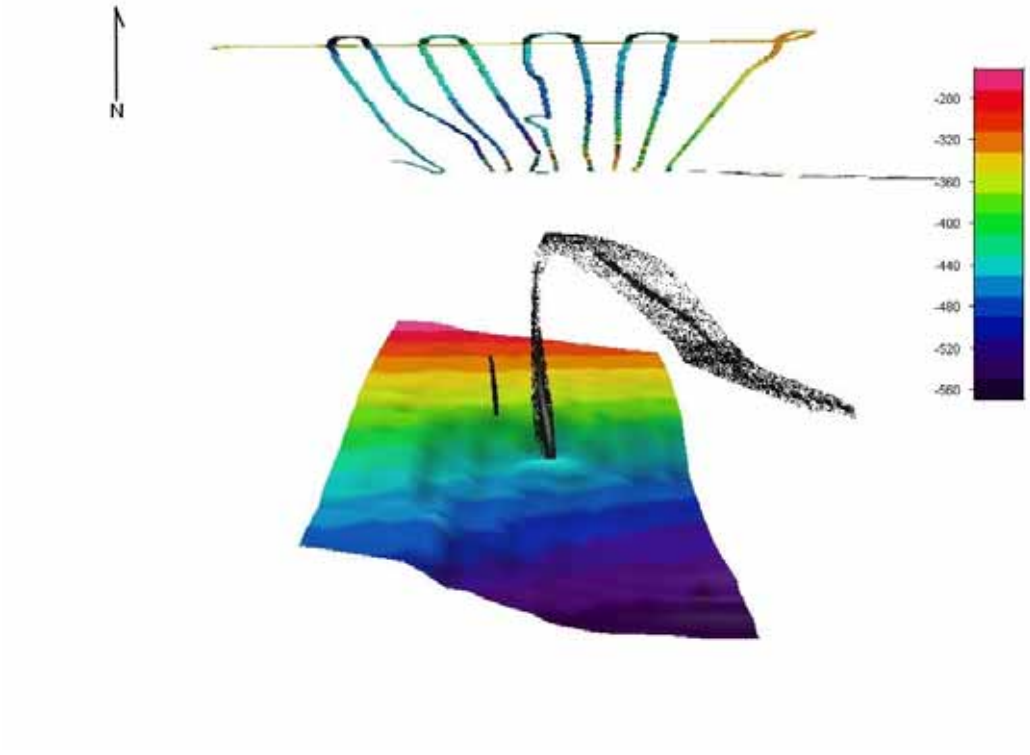

Figure 43. Three-dimensional view of bathymetric data and possible SC-D4 and SC-D6 seeps in area D, cruise 11. Data contoured and compiled in Fledermouse (please note that there 6 x vertical exaggeration in seafloor relief). The image is overlain with Chelsea fluorometer voltage results.

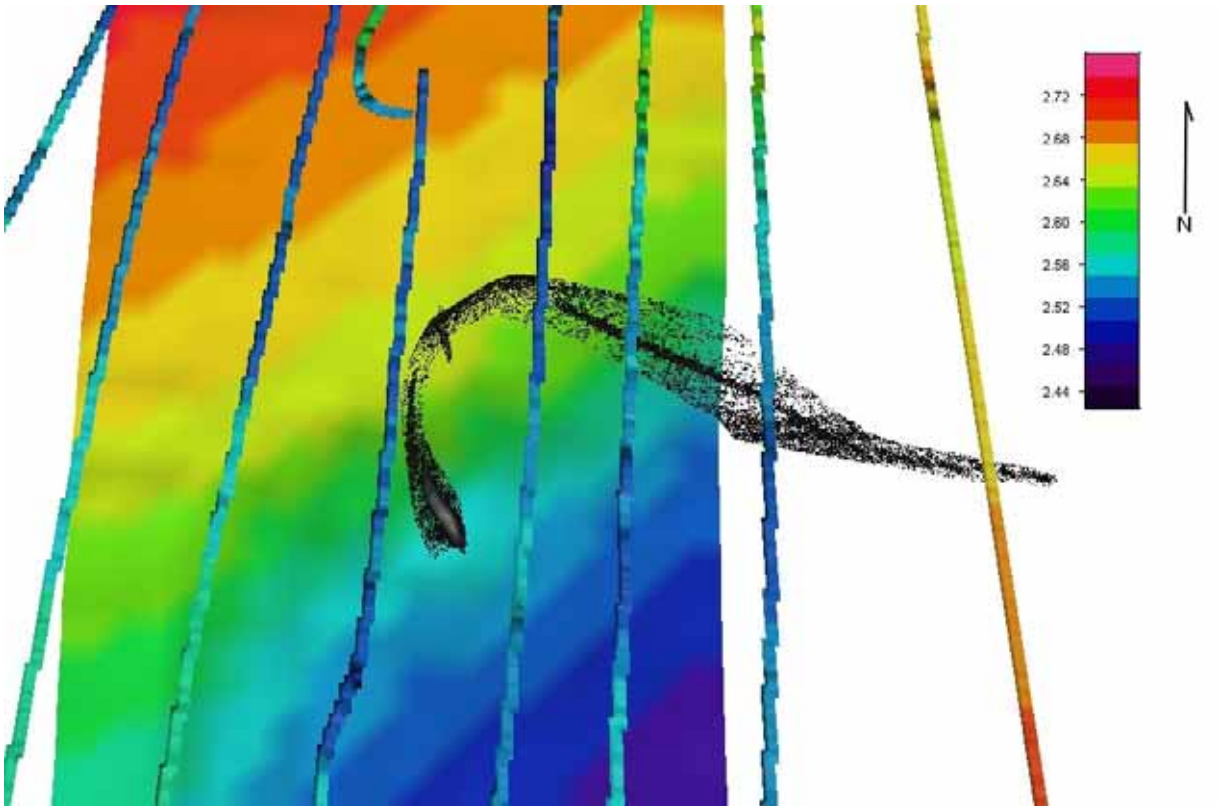

Figure 44. Alternative three-dimensional view of bathymetric data and possible SC-D4 and SC-D6 seeps in area D, cruise 11. Data contoured and compiled in Fledermouse (please note that there 6 x vertical exaggeration in seafloor relief). The image is overlain with Chelsea fluorometer voltage results.

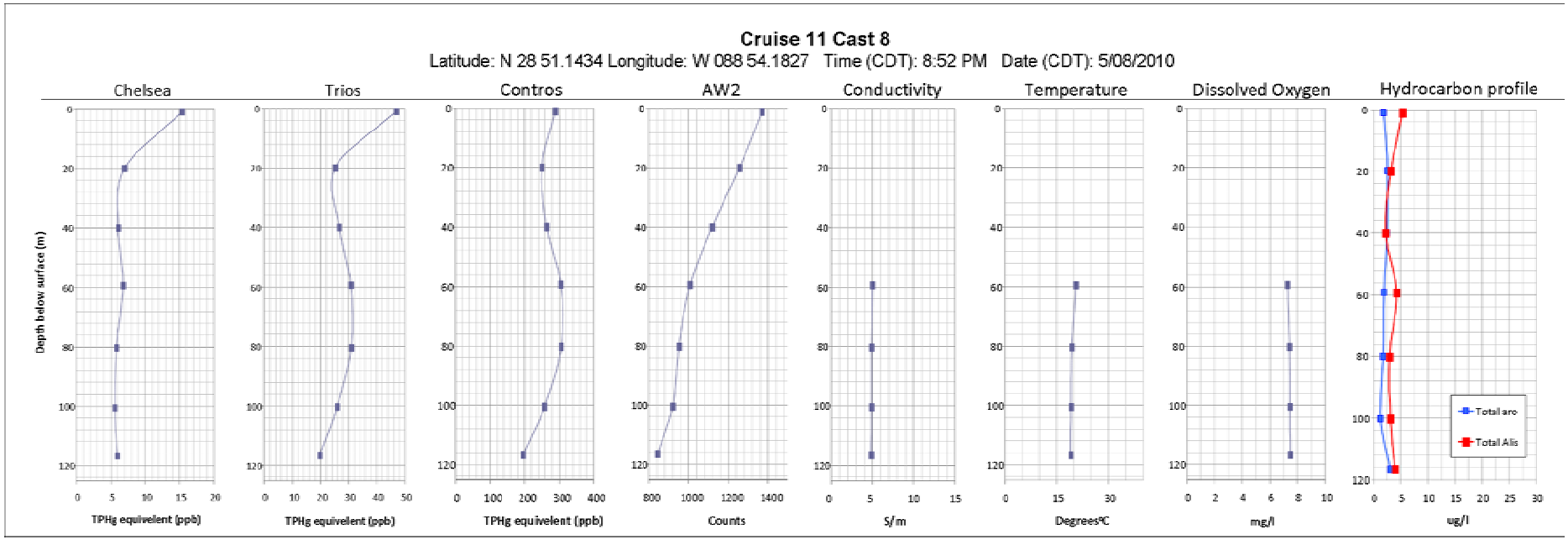

Figure 45. The results obtained for Cruise 11 vertical cast 8 down to 112 m. This cast location taken over the Contact_08042010_220048 (VC-D4) site previously identified on the 29th July. The sensor fluorometry results for the Chelsea, Trios and Contros sensors and water samples were obtained from waters pumped to the surface. Conductivity, temperature, depth and dissolved oxygen measurements were obtained from a SBE 19+ system and oxygen sensor attached to the submersible pump used to draw the water into the sensor tank on the surface. The CTD stopped recoding data on the up-cast at 59 metres depth. The hydrocarbon profile is generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

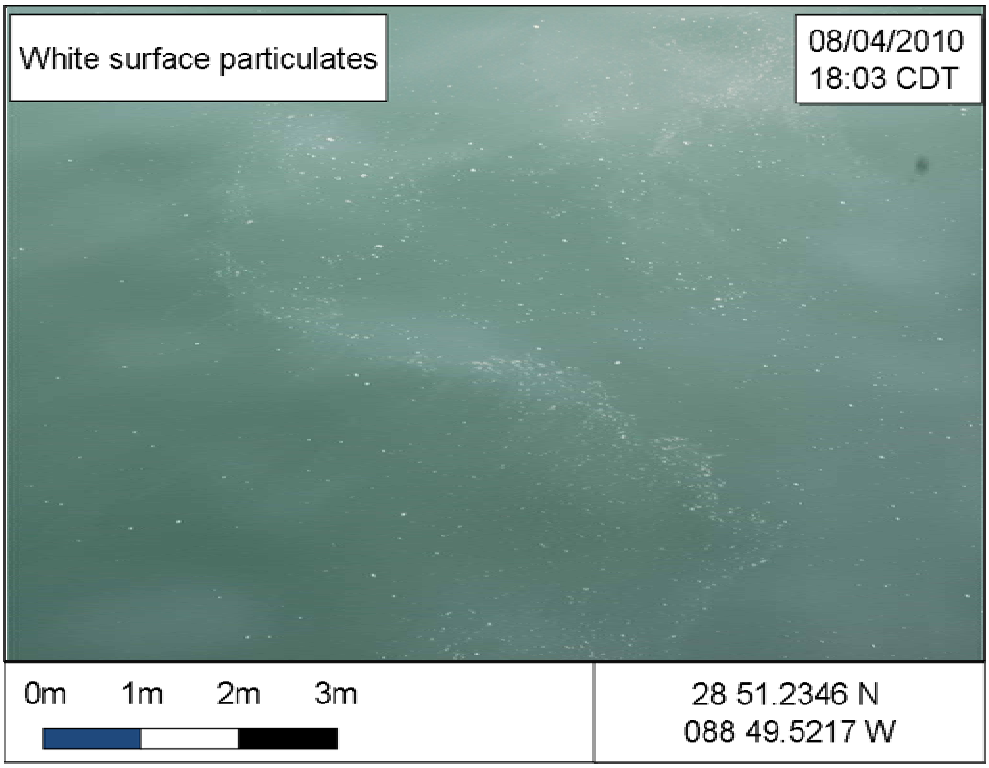

Figure 46. White surface particulates of unknown origin observed in Area D.

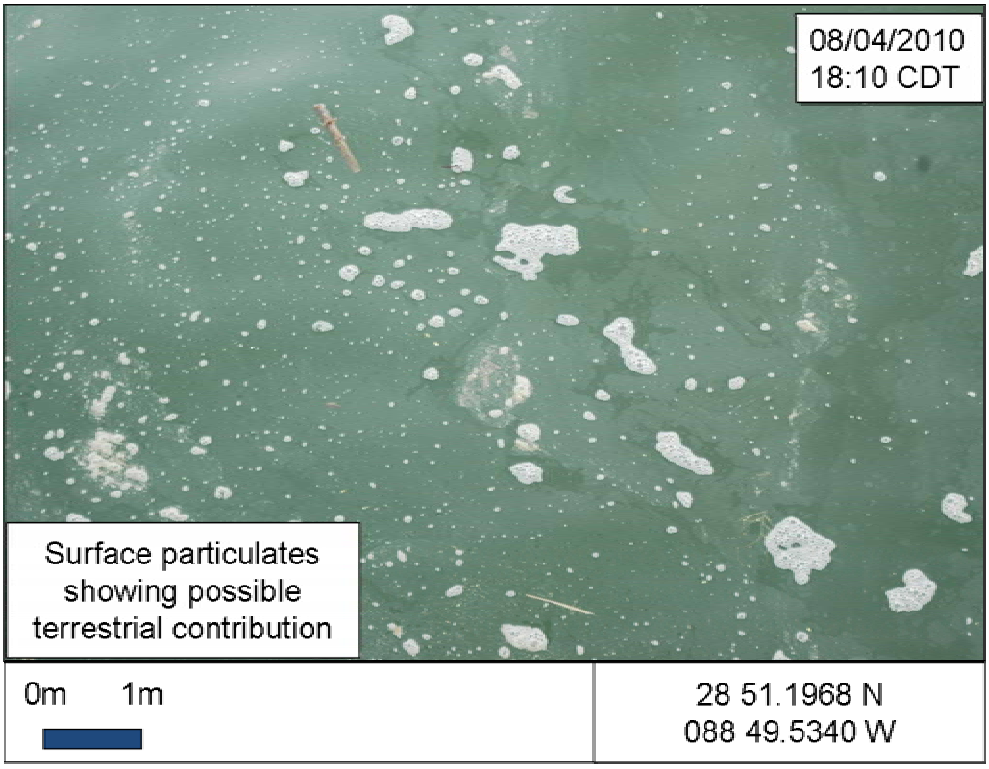

Figure 47. Surface particulates, sheen and foam with land derived material observed in Area D.

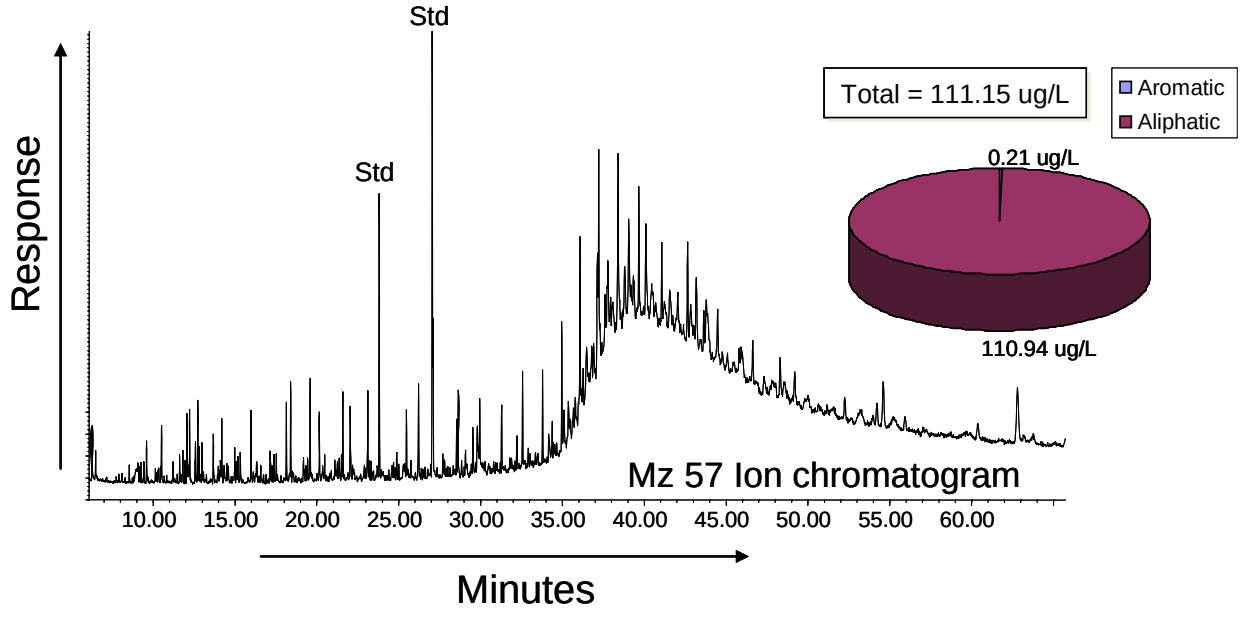

Figure 48. SS-D2 sample 100804C (28 51.1968N 088 48.5338W) M/z 57.00 ion chromatogram (*n*-alkane). The concentrations of hydrocarbons are generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

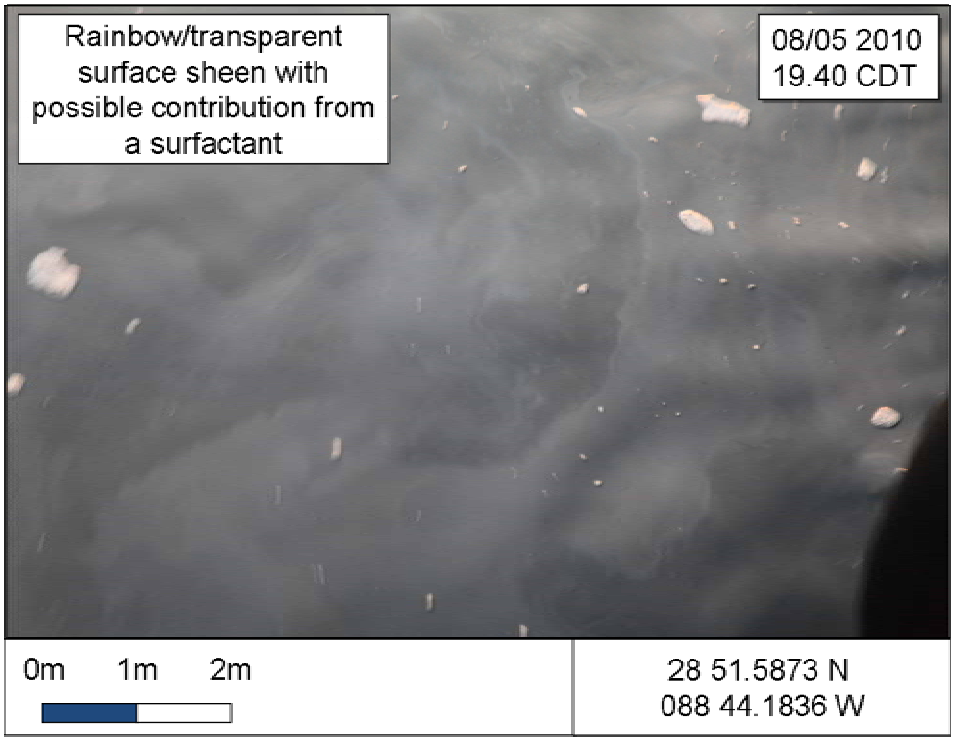

Figure 49. Surface sheen and foam observed in area D.

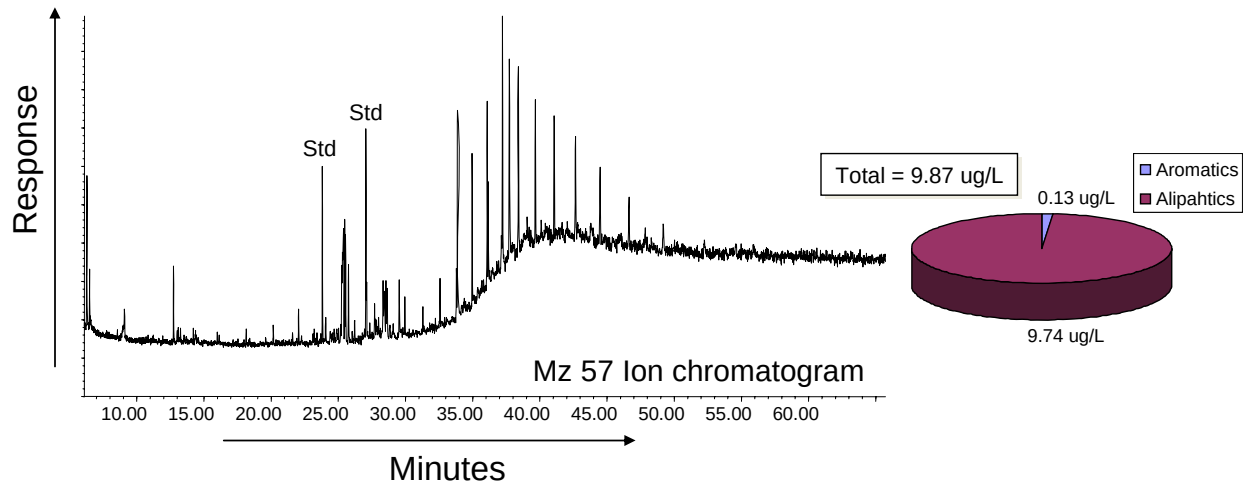

Figure 50. SS-D3 sample 100805A (28 51.5873N 088 44.1836W) M/z 57.00 ion chromatogram (*n*-alkane) The concentrations of hydrocarbons are generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

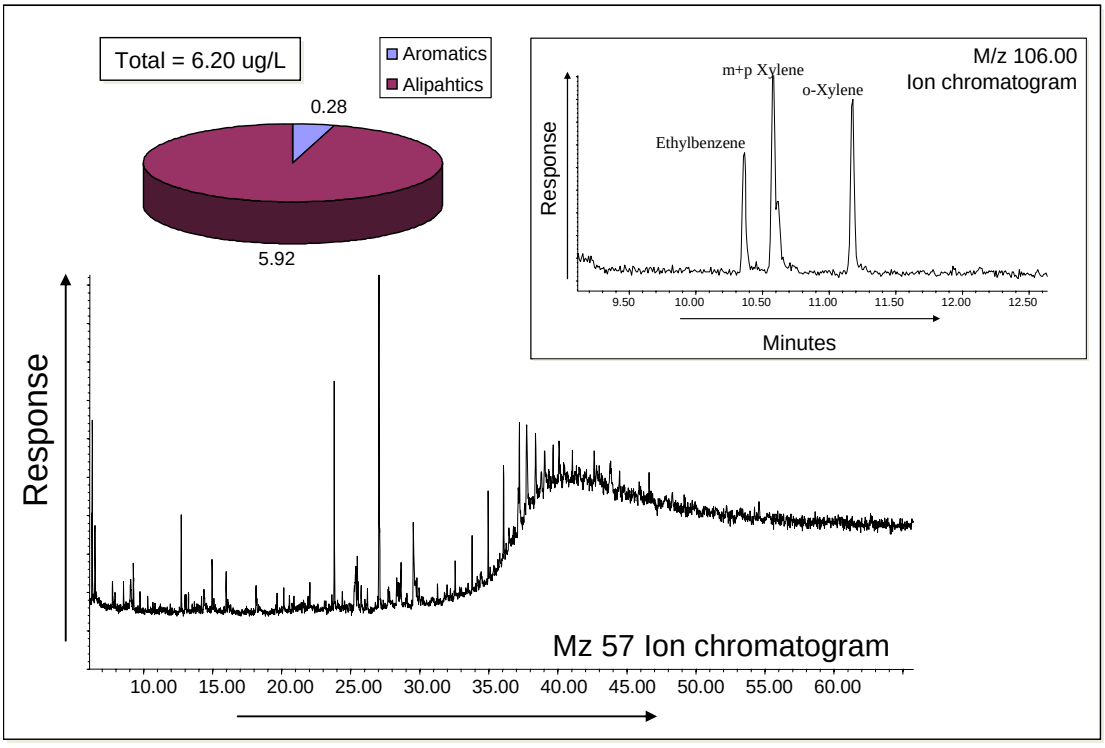

Figure 51. SS-D3 sample 100805B (28 51.5873N 088 44.1836W) M/z 57.00 ion chromatogram (*n*-alkane) with m/z 106 ion chromatogram inset (xylenes). The concentrations of hydrocarbons are generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

Figure 52 Mixing feature of two water bodies in Area D.

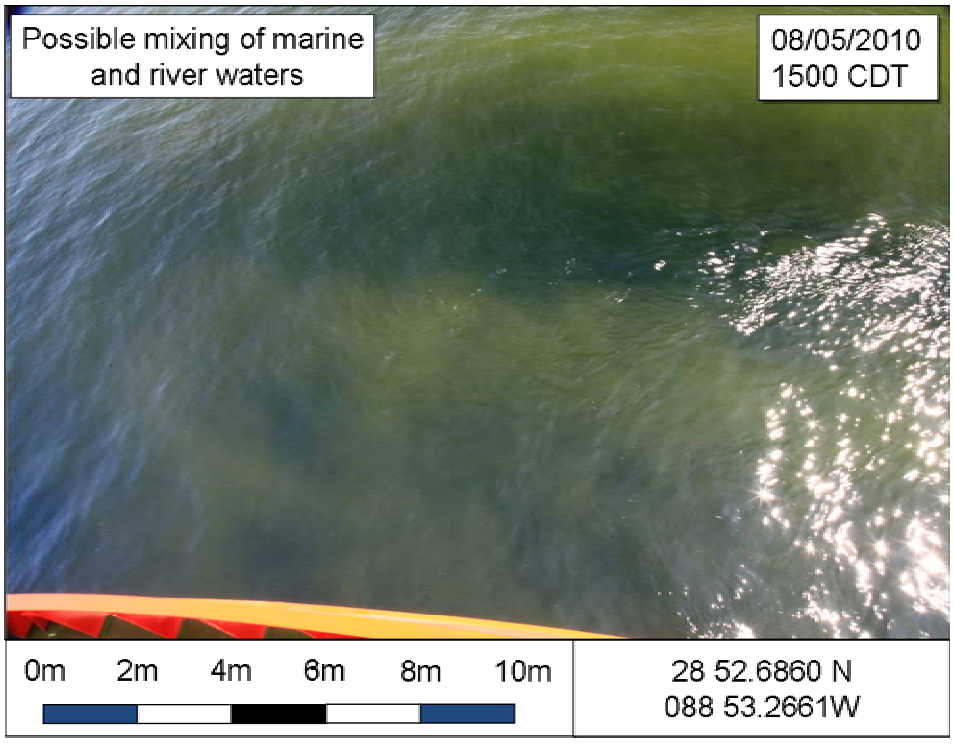

Figure 53. Mixing feature of two water bodies in Area D

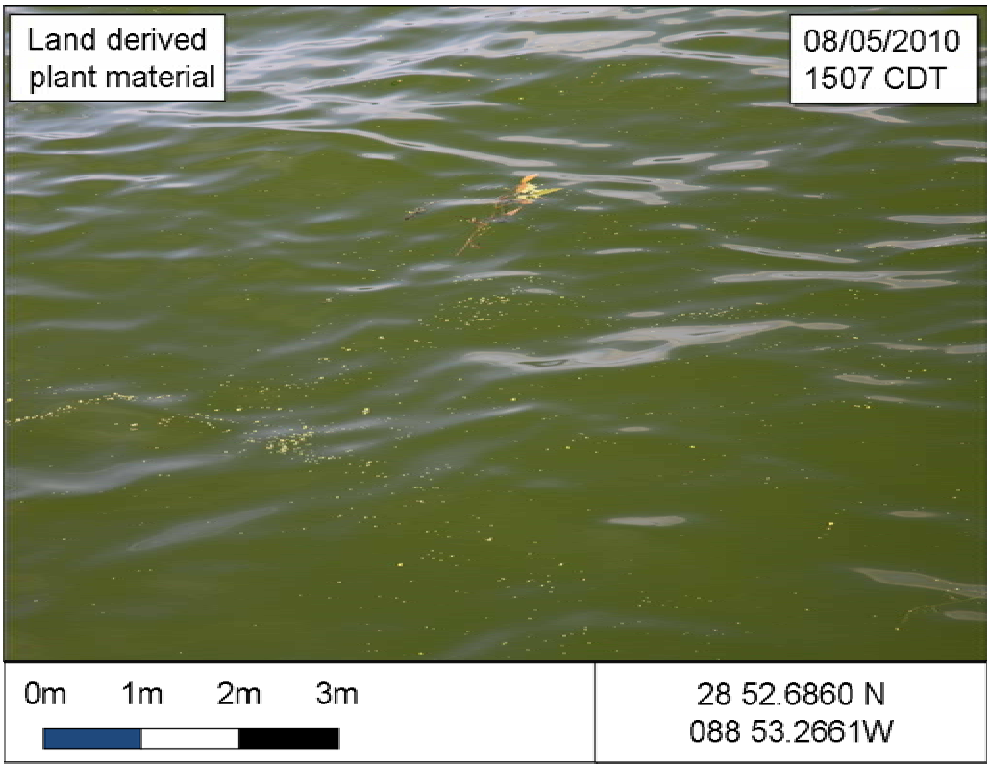

Figure 54. Land plant derived material observed in Area D

3. Coastal transect and repeat of cruise 2 track

3.1.1. Description of cruise track

The purpose of the coastal cruise track of cruise 11 two fold. The first objective was to survey the surface waters from Point Au Fer, Louisiana through to Port St Joe, Florida following the 30m bathymetric contour along the coast. In addition every 20 nautical miles vertical casts to seabed were performed. The second objective was to revisit the coastal waters of Florida and Alabama and compare the sensor results to those of Cruise 2 (Cruise 2 was undertaken along the Florida and Alabama coastline between the 07th and 09th June 2010).

Coastal transect from Point Au Fer to the Chandeleur islands

Fluorometry results

The Chelsea sensor result displayed indicates minimal levels of inferred hydrocarbons throughout the track travelled (Figure 55). The uniform fluorometry result is also shown across the mouth of the Mississippi. There are minor differences in response along the track line and these will be investigated further in future reports where the data will be rescaled to maximise the differences in response in the low concentration ranges. The low level response was also reflected in the Trios data (not shown) with very low to base line inferred hydrocarbon concentrations found along the coastal route. As with the Chelsea data this data will be rescaled in future reports to maximise low inferred concentration level

scale detail. The Contros sensor showed mid levels of inferred hydrocarbons throughout and this attributed to the xenon flash lamp needing replacement. Therefore the Contros results cannot be interpreted and therefore have not been included in this section of the report.

Surface Observations

A number of surface observations were made over the reporting period. These included sagassum, transparent sheens and convergence lines. Dolphin sighting were also made towards the north east of the coastal track and close to port Fourchon.

EK-60 Echosounder results

No echo sounder contacts were made along the coastal transect between Point Au Fer along the coastal transect through to the Chandelier Islands.

Vertical cast

Seven vertical casts were performed along the coastal transect of cruise 11 from Point Au Fer to the Chandelier Islands (Casts 2, 4, 5, 6, 7, 9, 10: figures 56-62). In most cases the Chelsea and Trios sensors both showed a decreasing trend from the surface to the seafloor of inferred hydrocarbon content. The Contros data will not be discussed for the aforementioned reasons. The ranges for the Chelsea and the Trios sensors at the surface were 15-30 ppb and 80-135 ppb respectively, with base water column values of 5-14 ppb and 40-75 ppb respectively. The differences in the instrument values are likely due to a small difference in excitation wavelength and emission spectra obtained by the two instruments. The vertical casts 5 and 6 (Figures 58 & 59) showed anomalous results to the measurements in this section of the cruise, with the vertical trends reversed or with the inferred hydrocarbon minima in the middle of the water column. It is not clear about the origin or reason for these results however they are not supported by any of the other data from the vertical casts. The data will be revisited and time averaged over the time at which these instruments were at this depth so that the any doubt about the influence of signal noise from the sensors at these low concentration levels is eliminated. AW2 sensor data through all of the vertical casts shows a consistent increase in counts towards the sea surface which could be inferred as increasing hydrocarbon content towards the sea surface. Oxygen, temperature, and conductivity presented in vertical casts 4, 5, 7, 9, and 10 (Figures 57-58 and 60-62) show a very uniform vertical profile in each cast. Hydrocarbon data derived from GCMS analysis is shown for illustrative purposes only and need further correction to obtain the final concentrations of hydrocarbons in the water.

Comparison of cruise 11 and Cruise 2 results

Fluorometry results

The Chelsea and Trios results along the repeat cruise taken during cruise were uniformly low (Figure 63 and Figure 65). Whilst there is low level granularity to the data this is not picked up by the scaling used. This will be addressed in more depth in future cumulative reports. When the Chelsea data is compared to the cruise 2 Chelsea data, both of the cruise tracks show the same minimal inferred hydrocarbon concentrations (Figure 64). The same comparative data is not available for the Trios sensor as it was out of commission at the time cruise 2 was acquired. The Contros sensor showed mid levels of inferred hydrocarbons throughout the repeat of the cruise 2 track this has been discussed in daily reports is due to the a low signal to noise which became more pronounced with time. This is attributed to the xenon flash lamp needing replacement. Therefore the Contros results cannot be interpreted and therefore have not been included in this section of the report.

Surface Observations

Surface observations made on the track included sargassum, dolphins, sea turtle, convergence lines and a hammerhead shark. Apart from one observation no surface sheens or other hydrocarbon related surface features were observed. During an anchor drill performed just beyond Panama City in shallow water within 300m of the beach, the ship thrusters stirred up the sediment from the sea bottom. This sediment appeared to include dark brown material which dispersed like an immiscible liquid in the seawater. An attempt was made to photograph this material on the sea surface (Figure 66), these photographs unfortunately were taken shortly after the material dispersed on sea surface so are not clear. There was no increase in sensor response during this period however a surface water sample was taken. This sample (Figure 67) when extracted and analysed by GCMS onboard showed a low concentration of hydrocarbons and a homologous series of compounds in the mass fragment 57m/z ion chromatogram we tentatively assign to *n*-alkanes. It is unclear if these hydrocarbons are related to the MC252 spill or some other source of hydrocarbons.

EK-60 Echosounder results

Several small shallow water contacts were made by the echo sounder along route (Figure 68). Apart from contacts 173303 and 173402 these contacts were not associated with seafloor features although in the case of 125057 and 130414 these appeared rooted to the seafloor. For contacts 173303 and 173402 the echosounder response below the seabed is affected at the same point as with water column responses are observed. These echosounder contacts interpreted cautiously as possible seeps as they do not fulfill the all the criteria that would lead to a strong assignment of them being seeps.

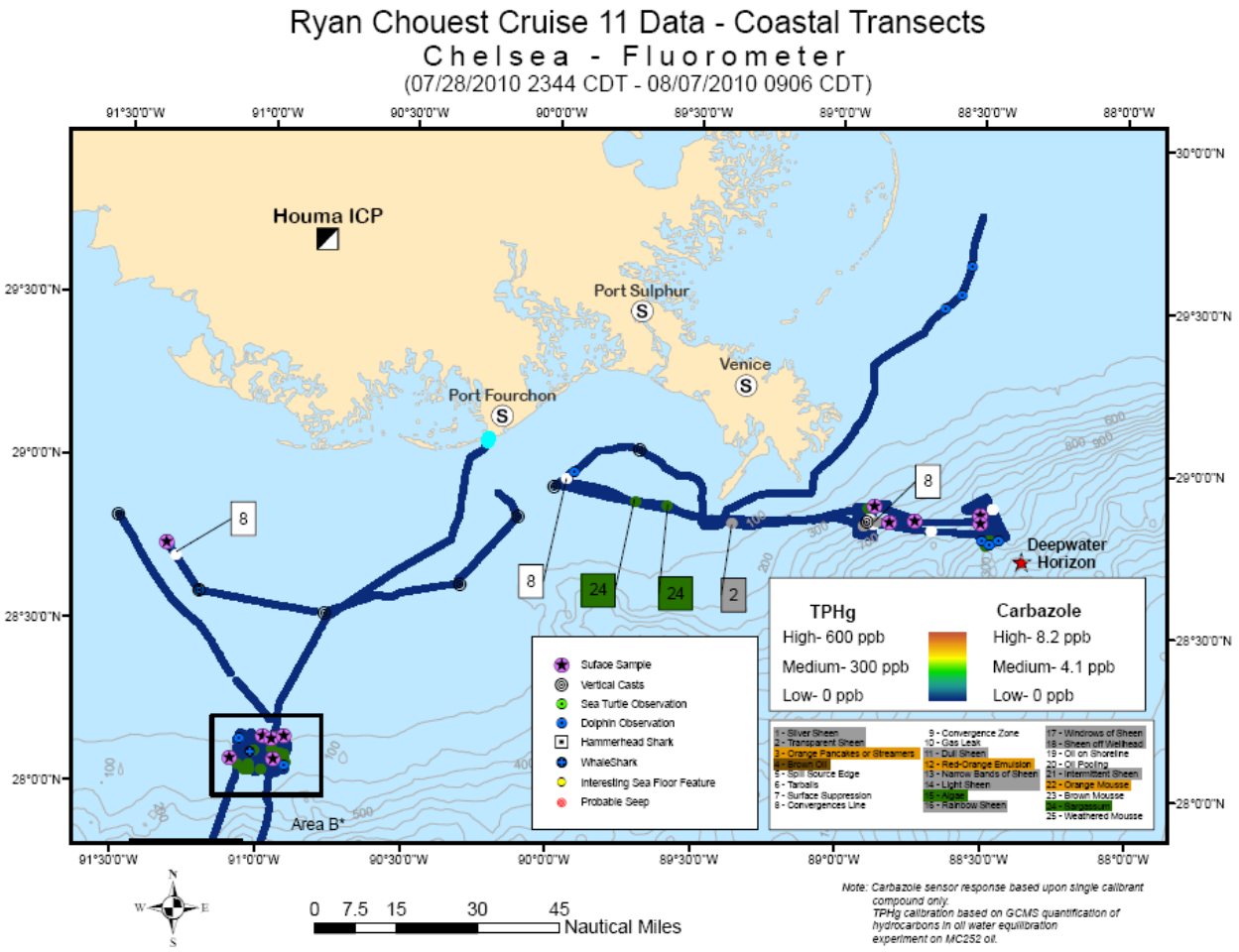

Figure 55. Chelsea fluorometer results for the southern cruise 11 coastal transect.

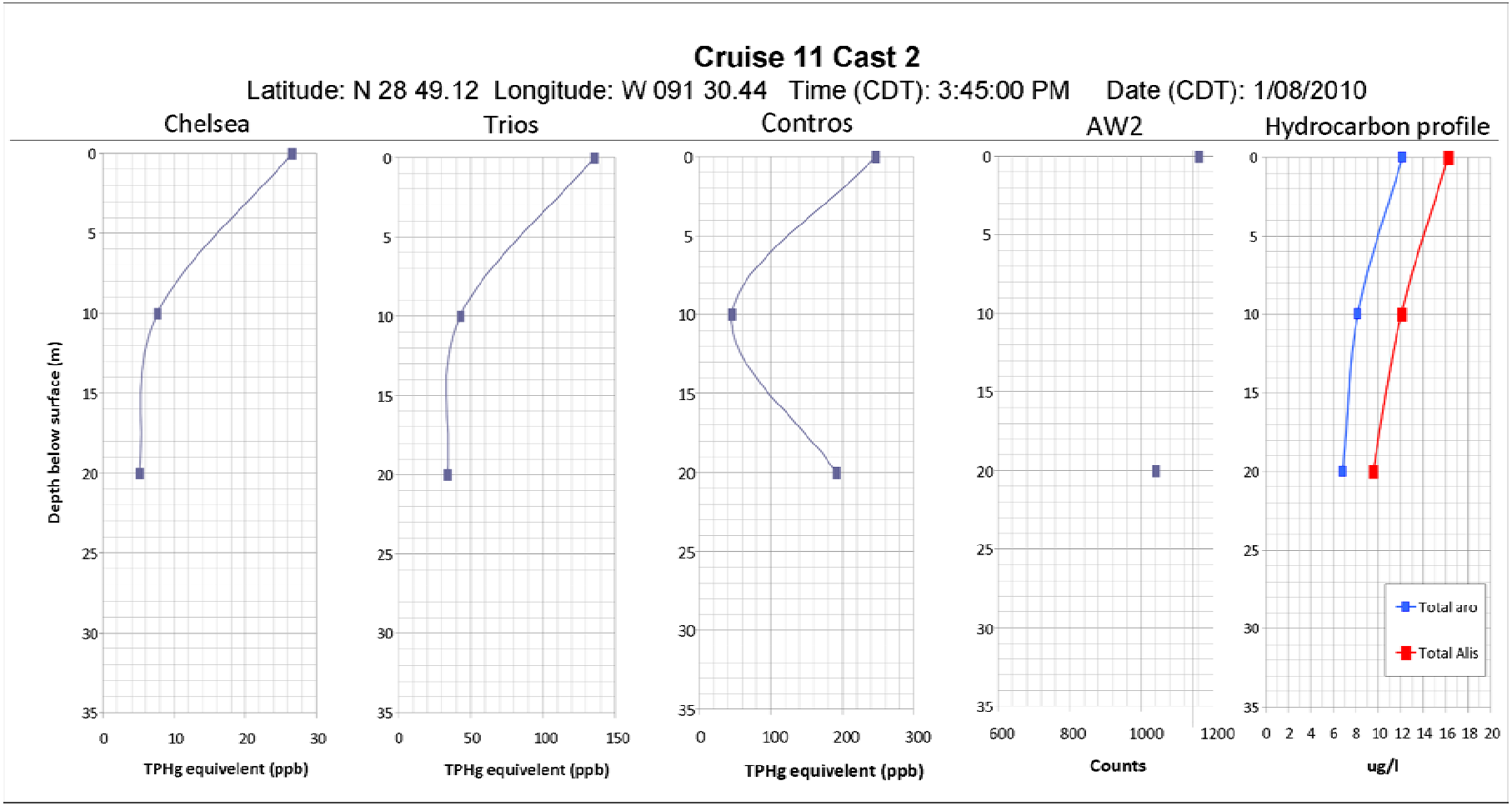

Figure 56. The results obtained for Cruise 11 vertical cast 2 down to 20 m. The sensor fluorometry results for the Chelsea, Trios and Contros sensors and water samples were obtained from waters pumped to the surface. Conductivity, temperature, depth and dissolved oxygen measurements were obtained from a SBE 19+ system and oxygen sensor attached to the submersible pump used to draw the water into the sensor tank on the surface. The

hydrocarbon profile is generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

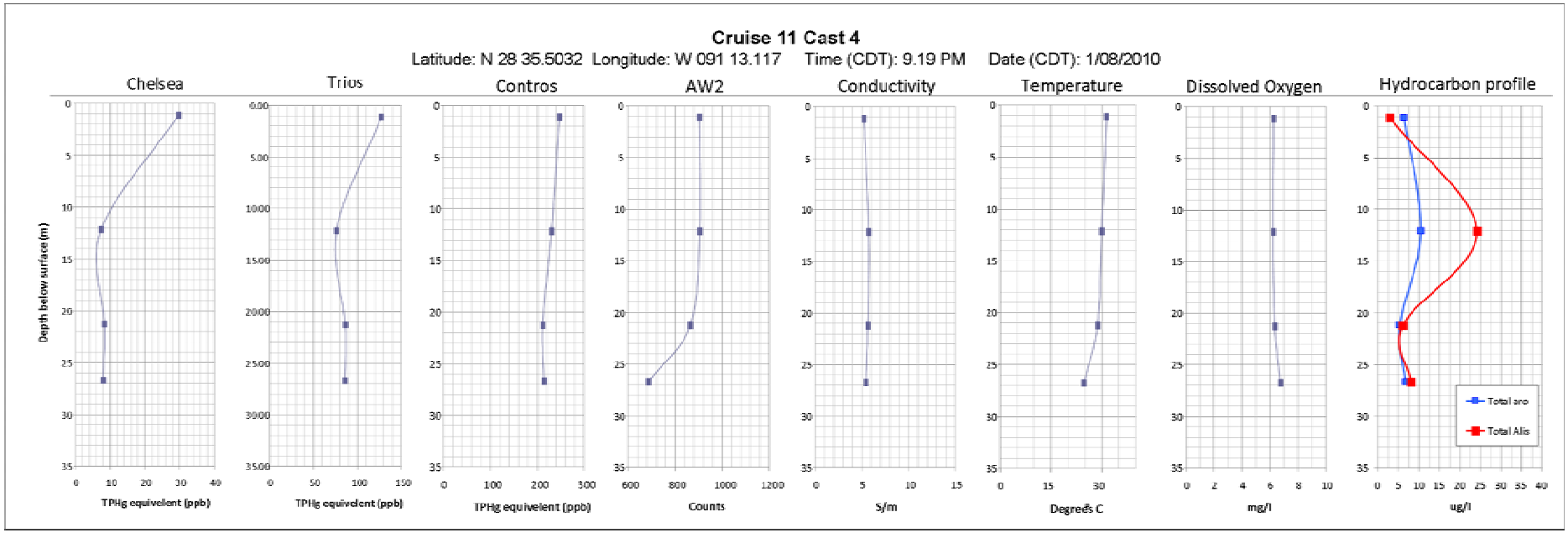

Figure 57. The results obtained for Cruise 11 vertical cast 4 down to 27 m. The sensor fluorometry results for the Chelsea, Trios and Contros sensors and water samples were obtained from waters pumped to the surface. Conductivity, temperature, depth and dissolved oxygen measurements were obtained from a SBE 19+ system and oxygen sensor attached to the submersible pump used to draw the water into the sensor tank on the surface. The hydrocarbon profile is generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

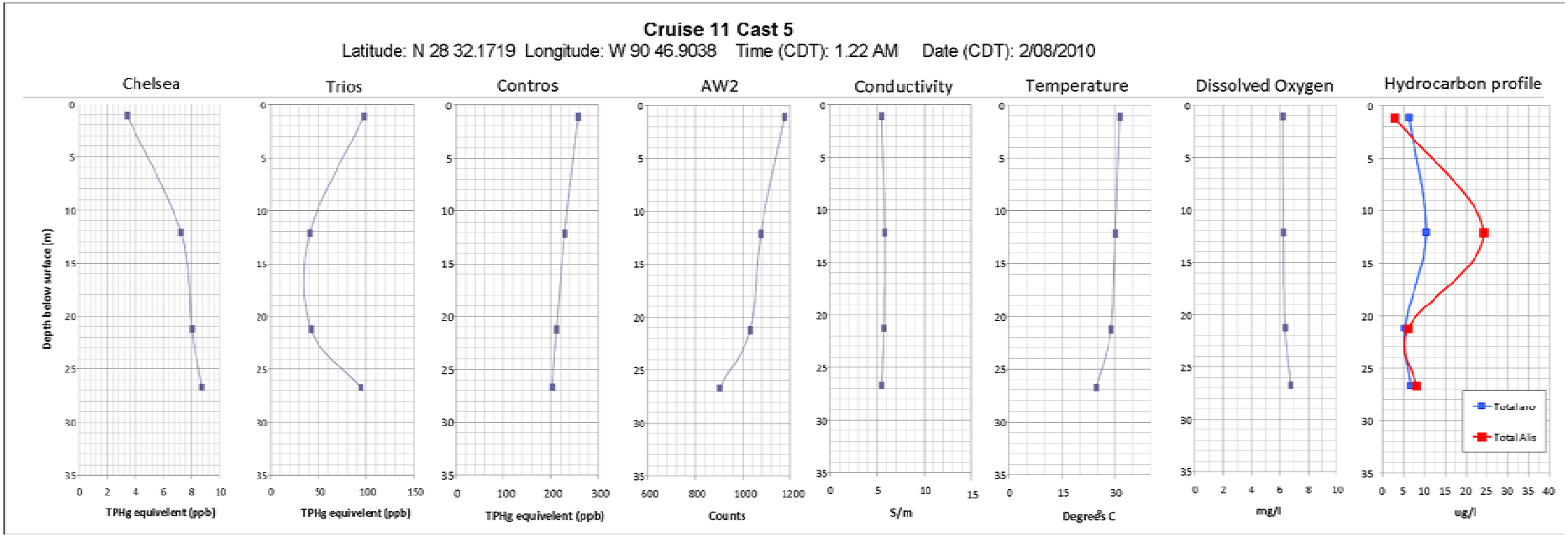

Figure 58. The results obtained for Cruise 11 vertical cast 5 down to 27 m. The sensor fluorometry results for the Chelsea, Trios and Contros sensors and water samples were obtained from waters pumped to the surface. Conductivity, temperature, depth and dissolved oxygen measurements were obtained from a SBE 19+ system and oxygen sensor attached to the submersible pump used to draw the water into the sensor tank on the surface. The hydrocarbon profile is generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

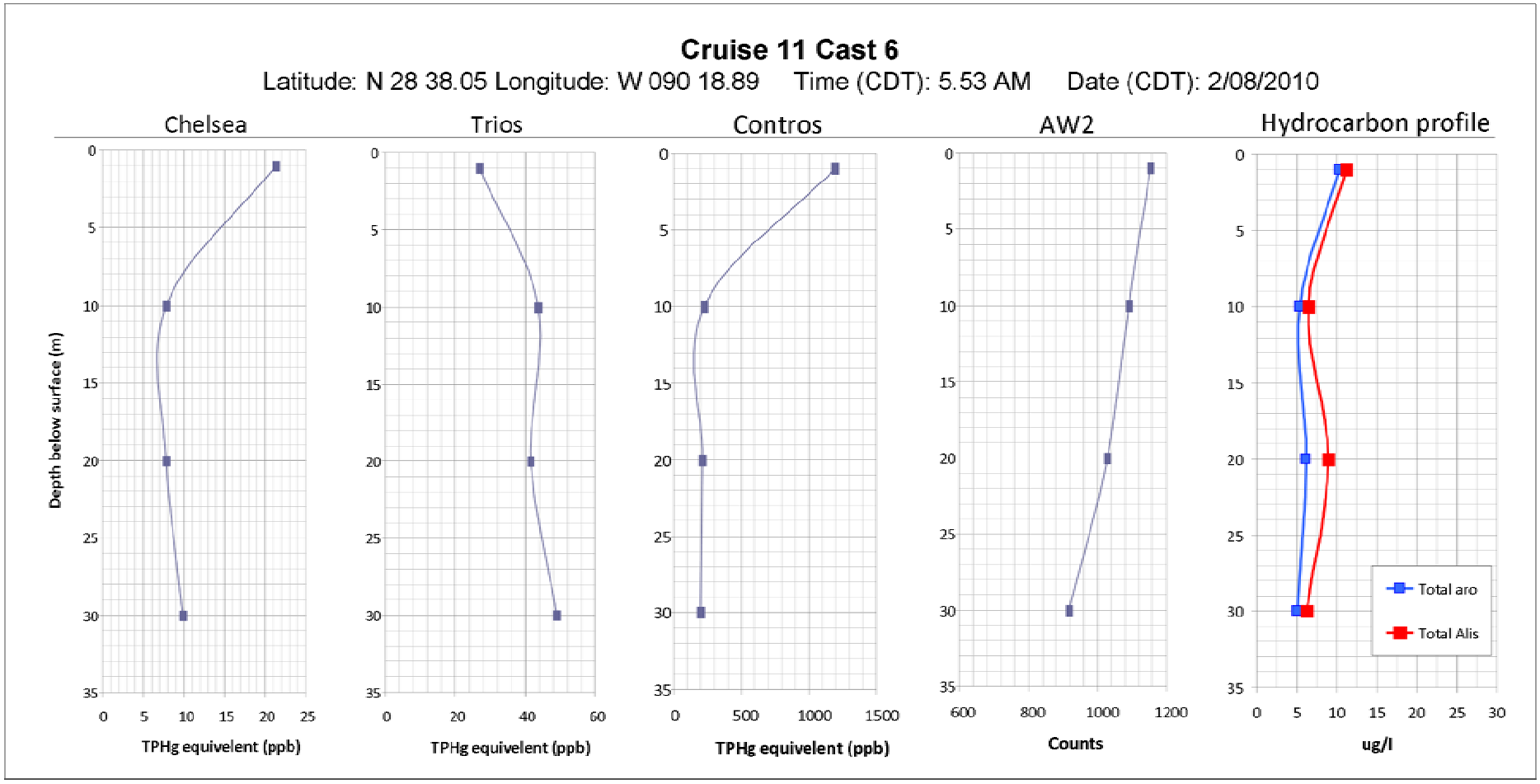

Figure 59. The results obtained for Cruise 11 vertical cast 6 down to 30 m. The sensor fluorometry results for the Chelsea, Trios and Contros sensors and water samples were obtained from waters pumped to the surface. Conductivity, temperature, depth and dissolved oxygen measurements were obtained from a SBE 19+ system and oxygen sensor attached to the submersible pump used to draw the water into the sensor tank on the surface. The hydrocarbon profile is generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

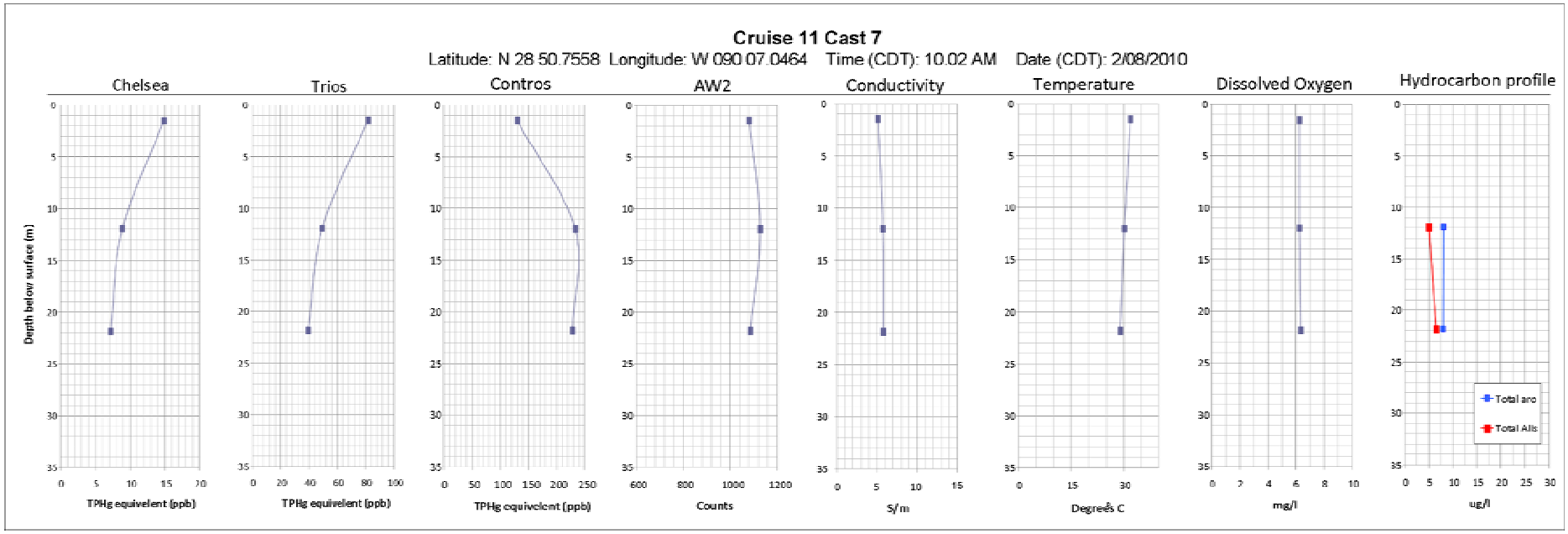

Figure 60. The results obtained for Cruise 11 vertical cast 7 down to 22 m. The sensor fluorometry results for the Chelsea, Trios and Contros sensors and water samples were obtained from waters pumped to the surface. Conductivity, temperature, depth and dissolved oxygen measurements were obtained from a SBE 19+ system and oxygen sensor attached to the submersible pump used to draw the water into the sensor tank on the surface. The hydrocarbon profile is generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

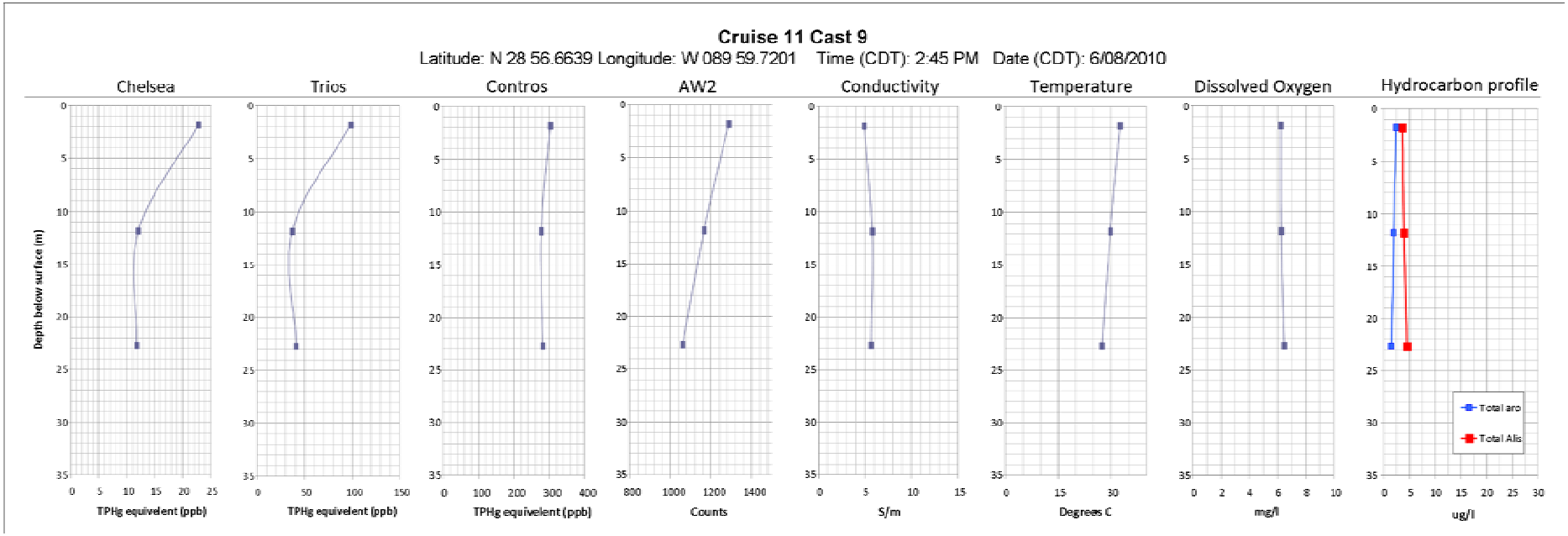

Figure 61. The results obtained for Cruise 11 vertical cast 9 down to 23 m. The sensor fluorometry results for the Chelsea, Trios and Contros sensors and water samples were obtained from waters pumped to the surface. Conductivity, temperature, depth and dissolved oxygen measurements were obtained from a SBE 19+ system and oxygen sensor attached to the submersible pump used to draw the water into the sensor tank on the surface. The hydrocarbon profile is generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

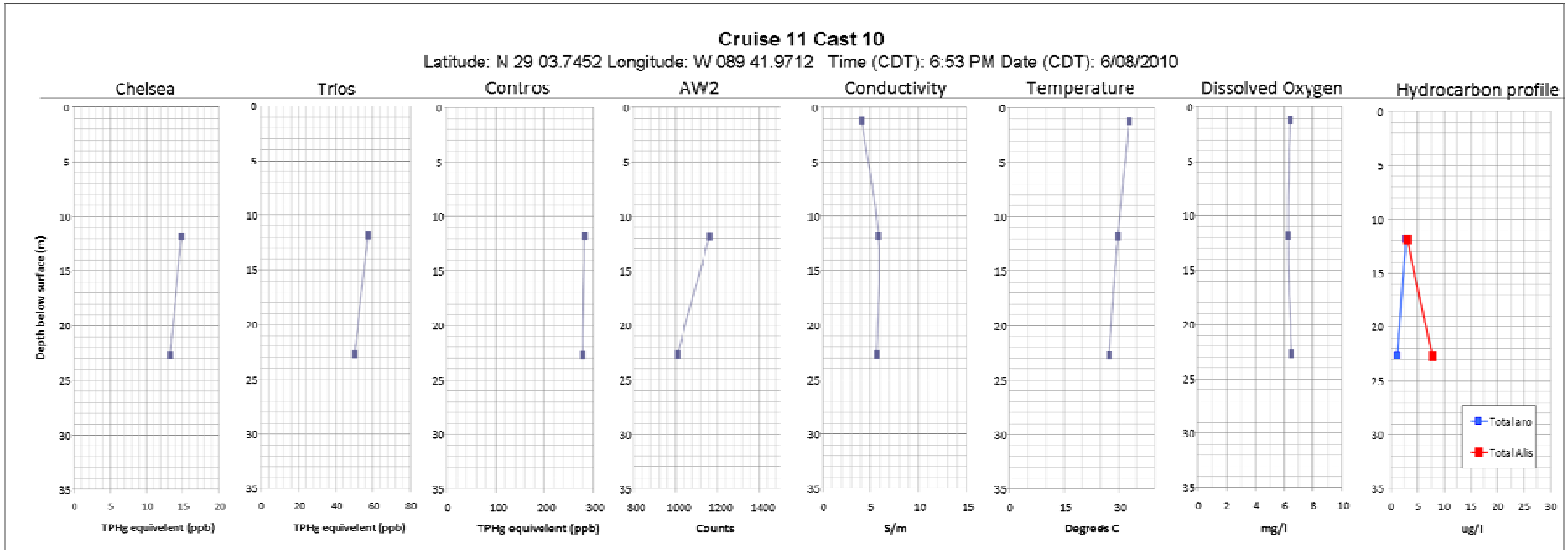

Figure 62. The results obtained for Cruise 11 vertical cast 10 down to 23 m. The sensor fluorometry results for the Chelsea, Trios and Contros sensors and water samples were obtained from waters pumped to the surface. Conductivity, temperature, depth and dissolved oxygen measurements were obtained from a SBE 19+ system and oxygen sensor attached to the submersible pump used to draw the water into the sensor tank on the surface. The hydrocarbon profile is generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

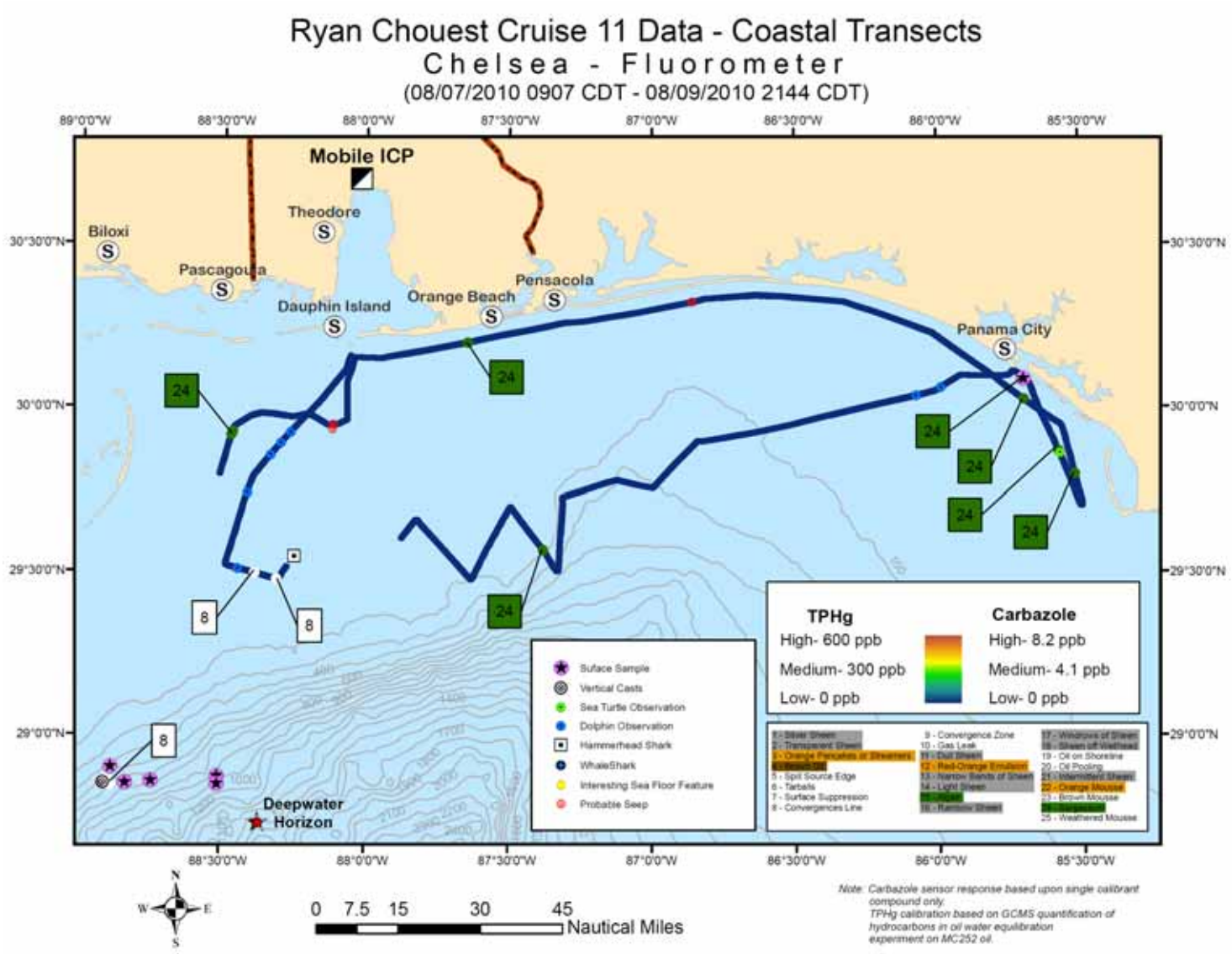

Figure 63. Chelsea fluorometer results for the northern cruise 11 coastal transect

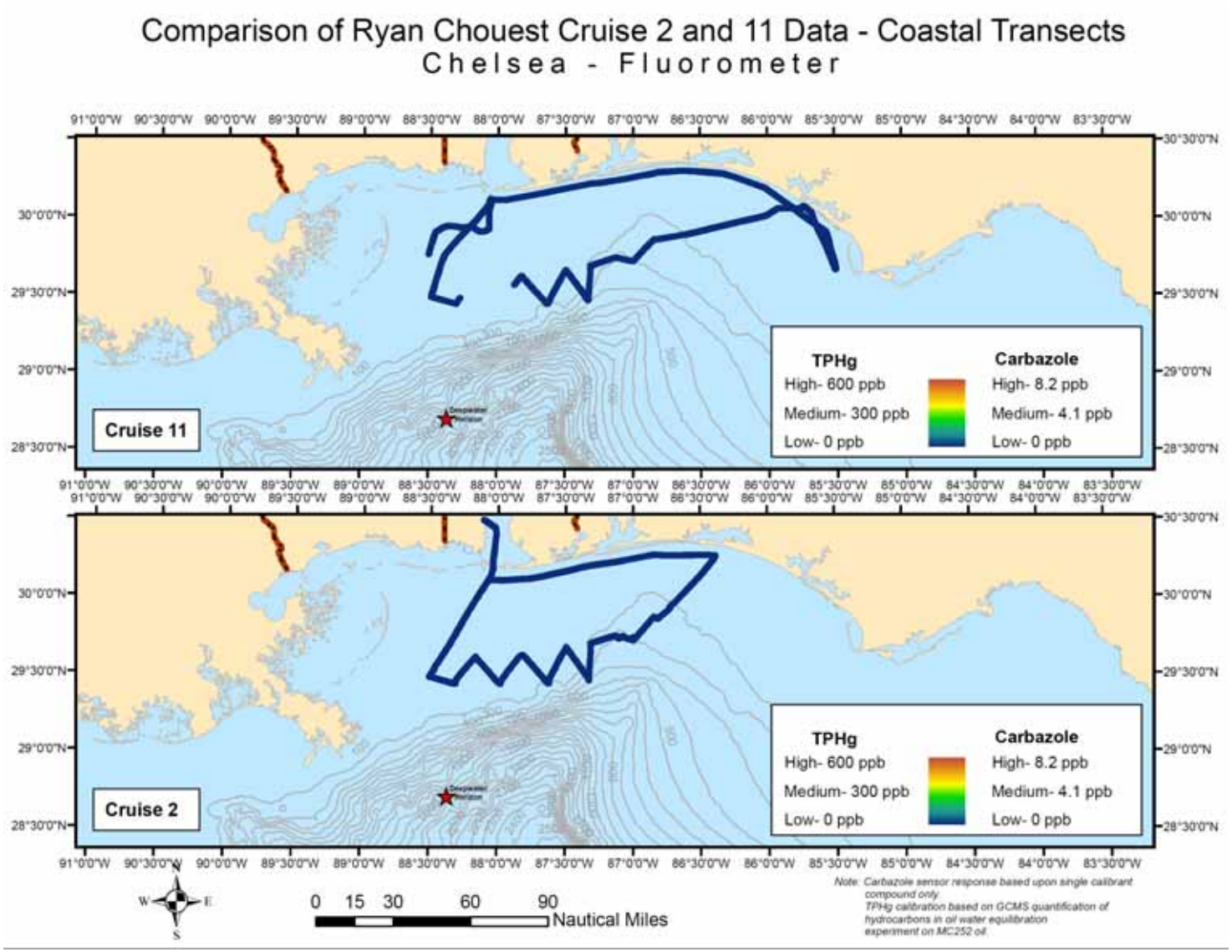

Figure 64. Chelsea fluorometer comparative results for Cruises 2 and 11.

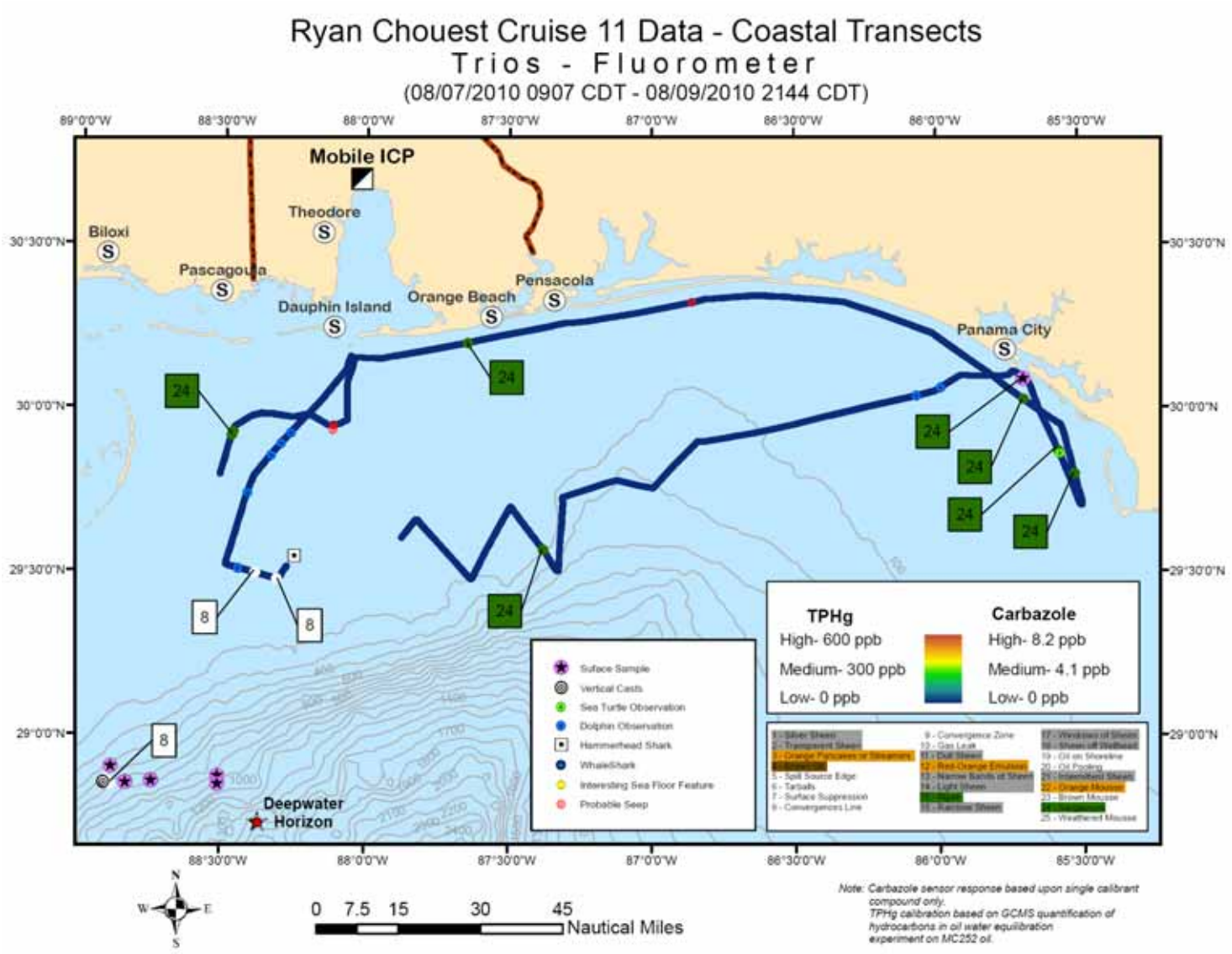

Figure 65. Trios fluorometer results for the northern cruise 11 coastal transect

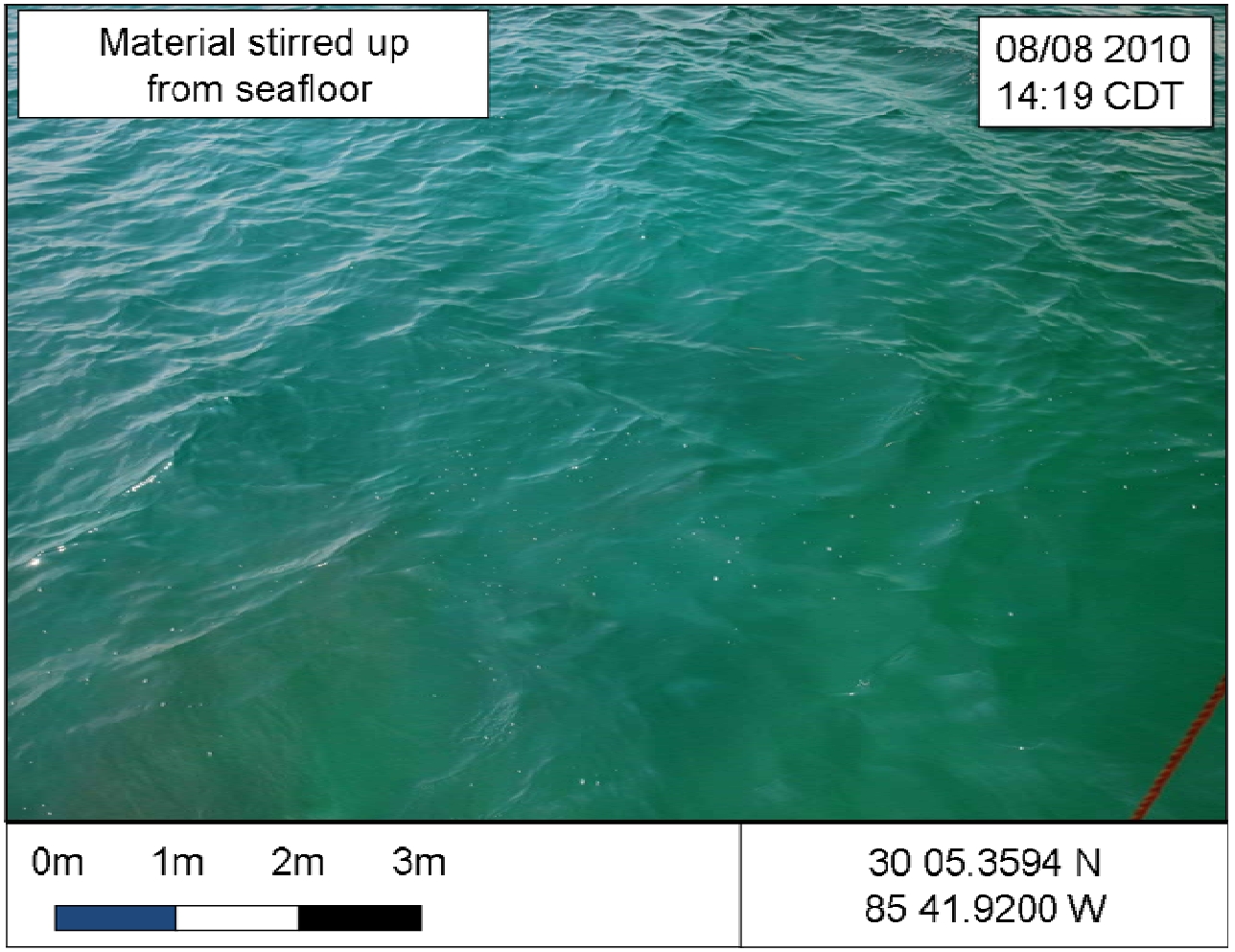

Figure 66. Mixing of water with material stirred up from the sea floor.

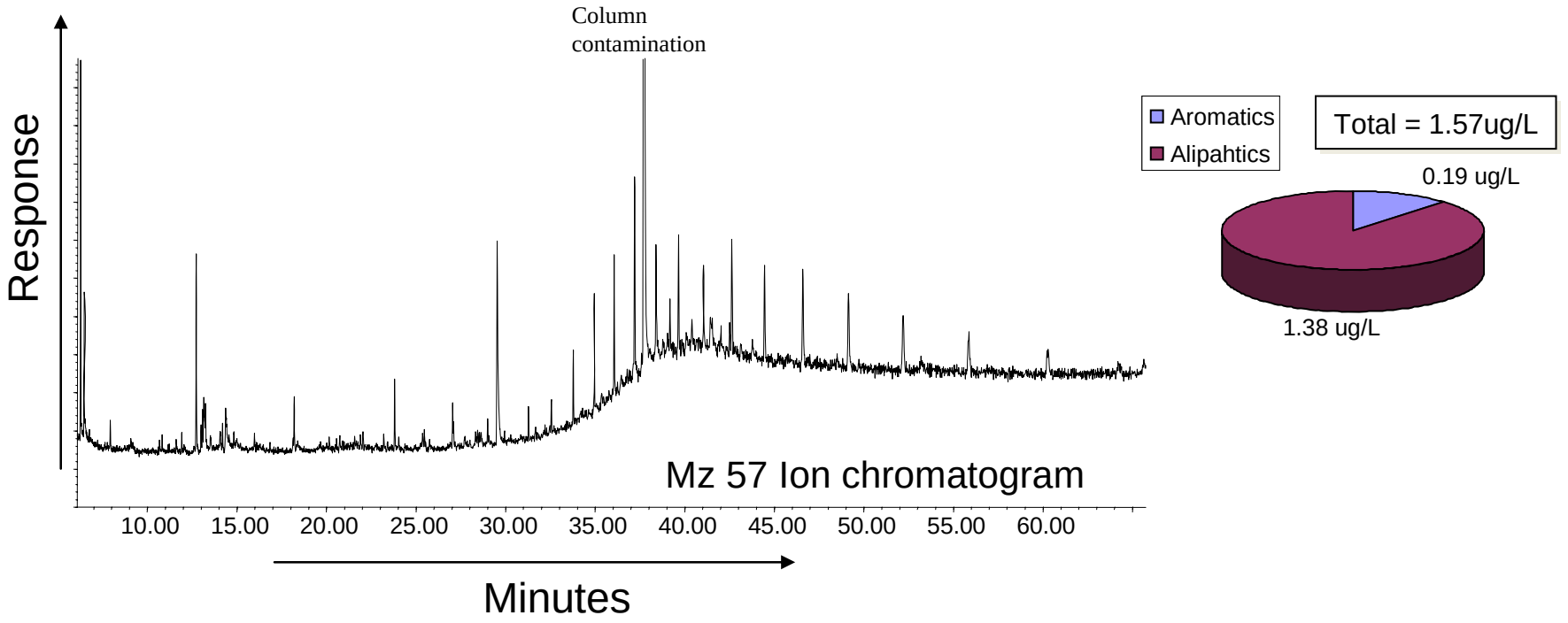

Figure 67. Sample 100808A surface sample (30 05.3594N 085 41.92W) m/z 57.00 ion chromatogram (*n*-alkane). The concentrations of hydrocarbons are generated from GCMS analysis results on 1 litre extracted water samples. The values presented are not corrected for sample work up losses.

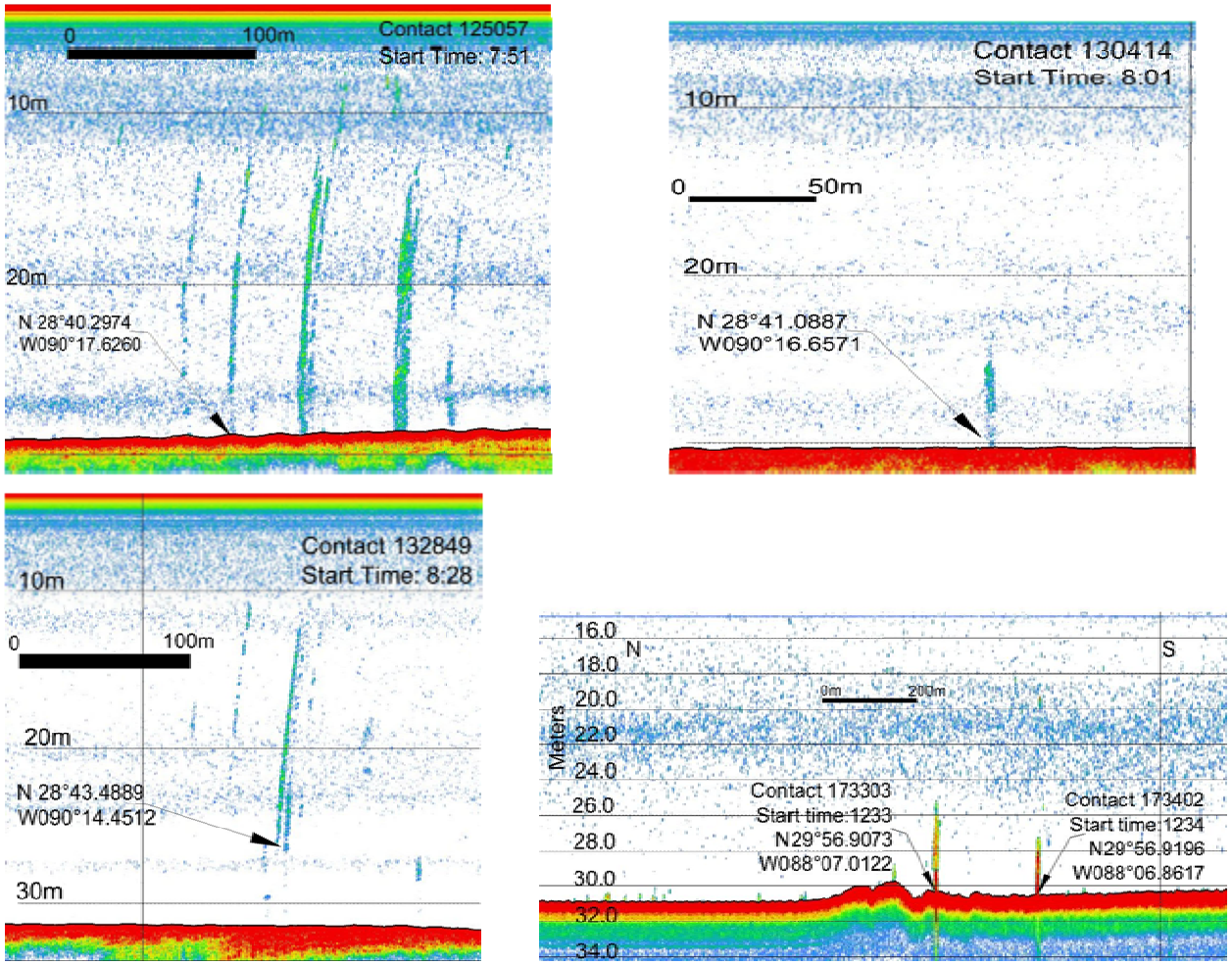

Figure 68. Selected contacts encountered on the coastal transect of Cruise 11. Contact_08022010_125057. Description: Possible multiple seeps. Time (CDT): 08/02/2010 0751hrs Location: 28° 40.2974N; 90° 17.6260W. Contact_08022010_130414. Description: Possible seep. Time (CDT): 08/02/2010 0801hrs Location: 28° 41.0887N; 90° 16.6571W. Contact_08022010_132849. Description: Possible seep. Time (CDT): 08/02/2010 0828hrs Location: 28° 43.4889N; 90° 14.4512W. Contact_08072010_173303. Description: Possible seep. Time (CDT): 08/07/2010 1233hrs Location: 29° 56.9073N; 88° 07.0122W.

Full Crew List:

William A. Smith	MASTER	Brian Corley	Mate
Craig Lyons	ENG	Patrick Cousin	A/B
Mark Harmon	A/B	Arthur Triggs	O/S
Elijah Benjamin	O/S	Patrick Anderson	QMED
Kile Blunt	OS/Cook	Roderick Baker	OS/Cook
Tosin Majekodunmi	BP	Curtis Walker	Entrix
Andrew Ross	CSIRO	David Fuentes	CSIRO
Emma Crooke	CSIRO	Asrar Talukder	CSIRO
Quinn Guidrey	C&C	Kelly Bates	C&C
Jen Carlsen	C&C	Mathew Baham	C&C
Joseph Watson	C&C	Jay Ridgeway	C&C
Josh Chauffe	C-Port	Larry Luke	C-Port