# Cruise Report for the Florida Middle Ground and West Shelf Edge Cruises

By Brian Donahue and David Naar

**Participants:**

Leg I:
1. Brian Donahue (Chief Scientist) – USF,CMS
2. Kelli Hoover – Eckerd College
3. Michele de la Rosa – USF, CMS
4. Shay Saleem – USF, CMS
5. Kate Ciembronowicz - USF, CMS
6. Alexis Clark – Eckerd College
7. Kimberly Koenig – USF, Geology

Leg II:
1. Brian Donahue (Chief Scientist) – USF,CMS
2. Dr. Leah Joseph (Co-Chief Scientist) – Ursinus College
3. John Ferguson – USF, Geology
4. Melissa (Missy) Gilbert – Eckerd College
5. Melissa Fatale – Ursinus College
6. Karena DiLeo – Ursinus College
7. Carolyn Vogt – Ursinus College

Leg III:
1. Brian Donahue (Chief Scientist) – USF, CMS
2. Lee Florea– USF, Geology
3. Scott Anderson – USF Geology
4. Tanya Beck – USF Geology
5. Jonathan Leeb – USF SP
6. Rachael Norstrom – Mote Marine Lab
7. Michael Cook - USF Geology

**Overview of Cruises:**

Three separate ten day research legs were conducted in July and August of 2005. Leg I was July 20$^{th}$ to 29$^{th}$, Leg II was August 8$^{th}$ to 17$^{th}$, and Leg III was August 20$^{th}$ to 26$^{th}$. Leg III was cut short by 4 days due to hurricane Katrina. Leg I continued mapping areas in the Florida Middle Ground (Figure 1), Leg II mapped an area called the Corridor (Figure 2), and Leg II mapped an area called Fill In (Figure 3). We mapped the natural gas pipeline from Port Manatee, Florida to Alabama during 3 of the 6 transits between the port and survey areas (Figure 4). Due to recent security measures we have been requested to remove latitude and longitude positions of our transit surveys. Thus, in figures A1 – A91, in Appendix I, we only show the data highlighting the pipeline.

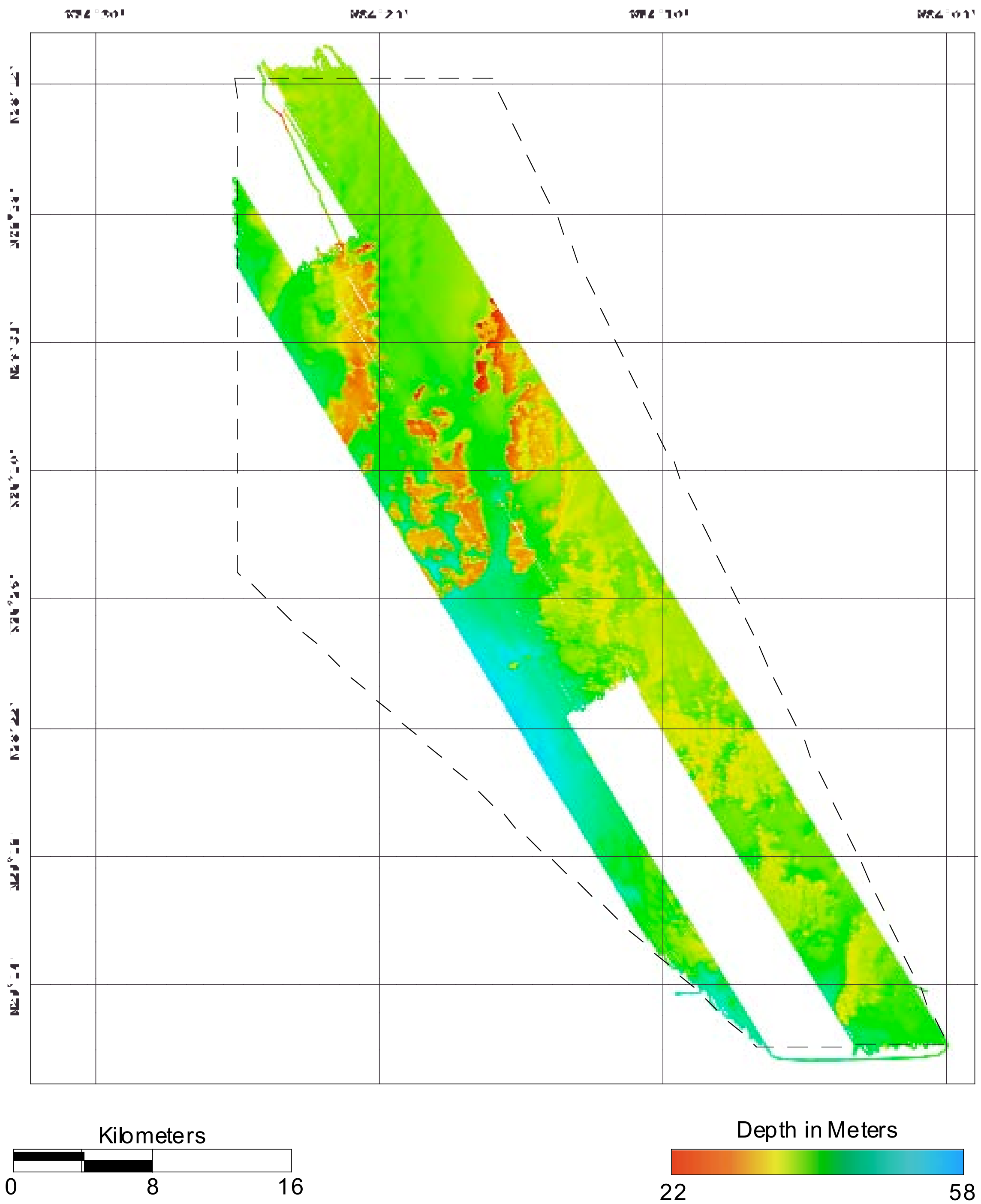


Figure 1. Previously existing EM3000 multibeam bathymetry of the Florida Middle Ground. Gridded at 10 m x 10 m. Data compiled from August 2000 and October 2004. Dash line indicates the HAPC area.

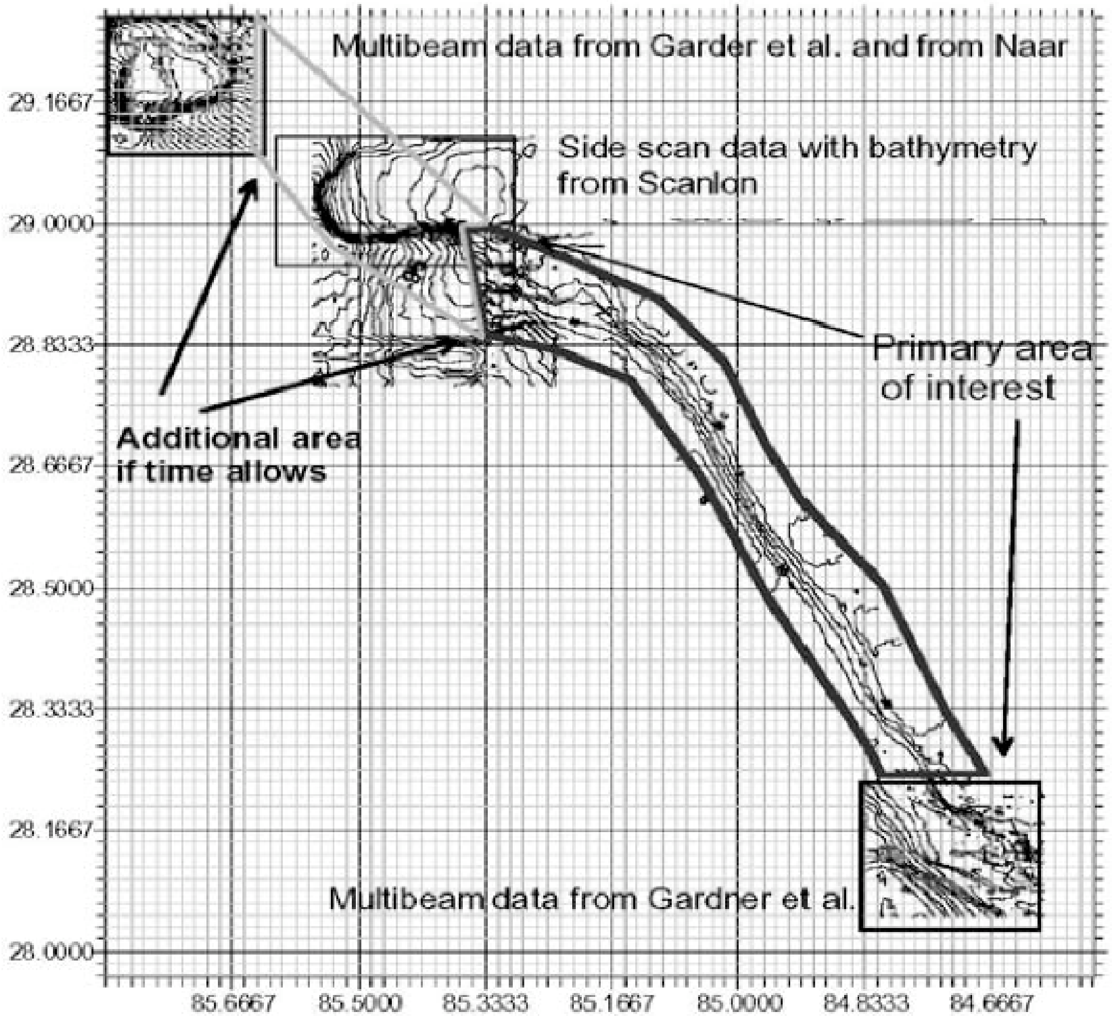


Figure 2. Corridor study area on the west Florida Shelf.

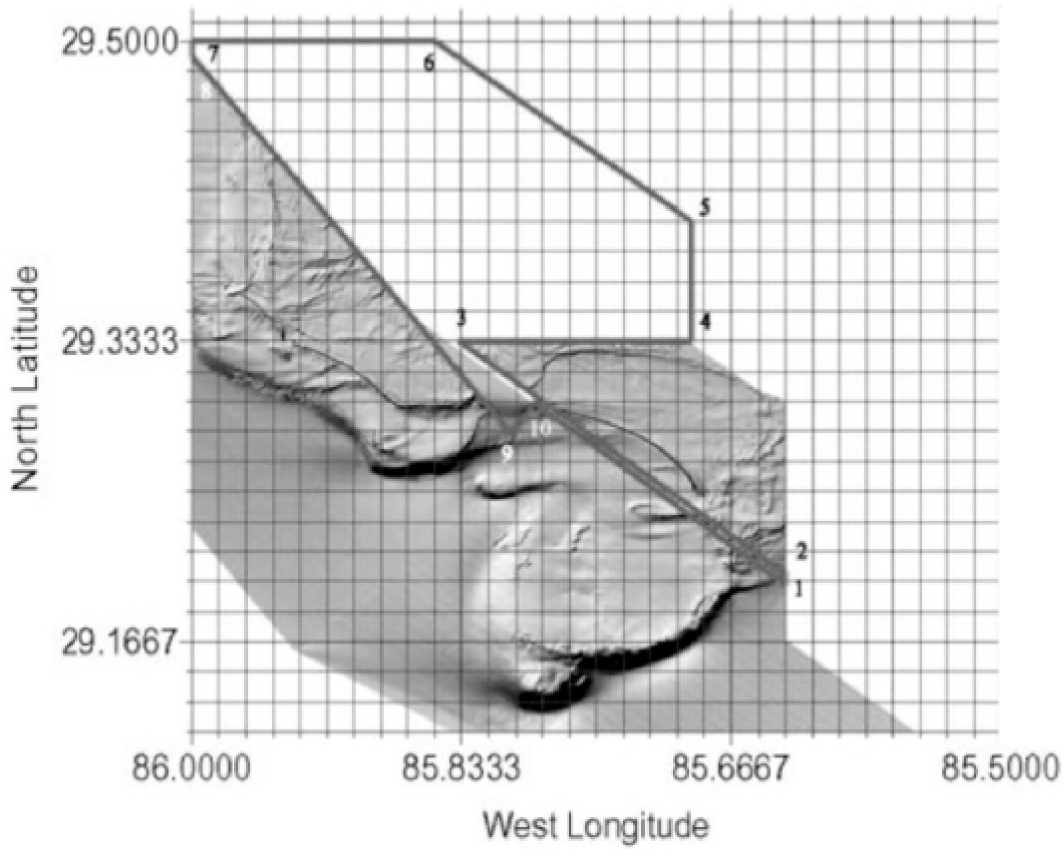


Figure 3. Fill In study area just to the north of the Corridor study area, see Figure 2.

| Point | Latitude N | | Longitude W | |
|---|---|---|---|---|
| 1 | 29° | 11.900' | 085° | 38.000' |
| 2 | 29° | 12.250' | 085° | 38.000' |
| 3 | 29° | 20.000' | 085° | 50.100' |
| 4 | 29° | 20.000' | 085° | 41.500' |
| 5 | 29° | 24.000' | 085° | 41.500' |
| 6 | 29° | 30.000' | 085° | 51.000' |
| 7 | 29° | 30.000' | 086° | 0.000' |
| 8 | 29° | 29.491' | 086° | 0.000' |
| 9 | 29° | 16.900' | 085° | 48.150' |
| 10 | 29° | 17.500' | 085° | 47.335' |

Table 1. Boundary positions of the Fill In area.


Figure 4. Location of 36" gas pipeline from Alabama and Mississippi to Port Manatee, Florida, source: http://www.gulfstreamgas.com/map.htm

A total of ~733 $km^2$ were surveyed within the 3 study areas, ~245 km of the 703 km long submerged pipeline was mapped during the transits. 53 CTD/sound velocity (Sv) casts were conducted during the 3 legs. The location of the CTD/Sv casts are in Appendix II. Leg I added ~204 $km^2$ to the existing Florida Middle Ground data (Figure 5) set and 18 CTD/Sv casts were made. Leg II covered ~368 $km^2$ in the Corridor Area (Figure 6) and 23 CTD/Sv casts were made. Leg III covered ~ 161 $km^2$ in the Fill In area (Figure 7) and 12 CTD/Sv casts were made. This covered about 44 percent of the area requested in the Fill In area. No bottom samples were collected due to the 4 day shorten Leg III.

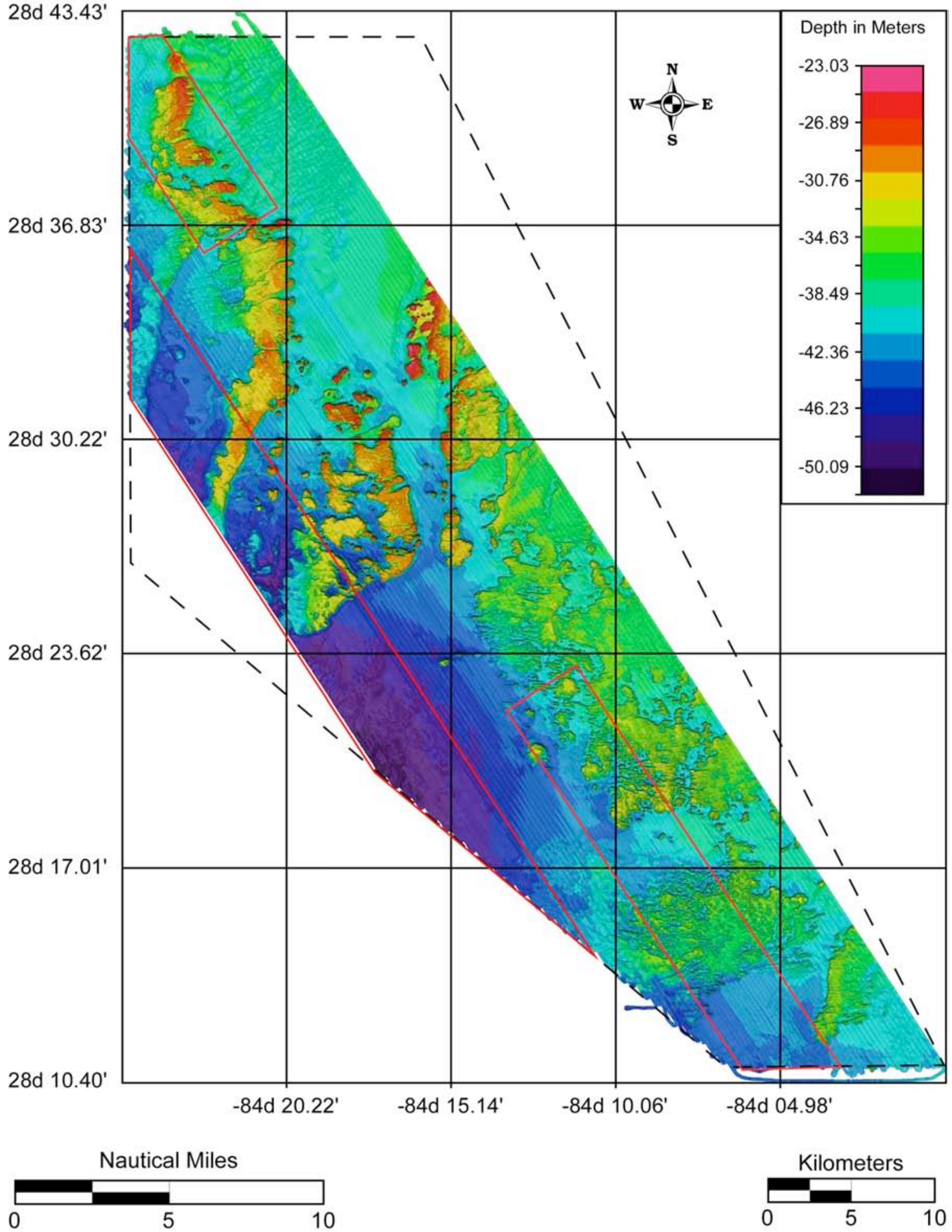


Figure 5. New EM3000 multibeam bathymetry of the Florida Middle Ground Area merged with previous data. Data are gridded at 10 m x 10 m. Red polygons indicate new 2005 data and dash line indicates the HAPC area.
See Appendix 5 for multibeam backscatter image.

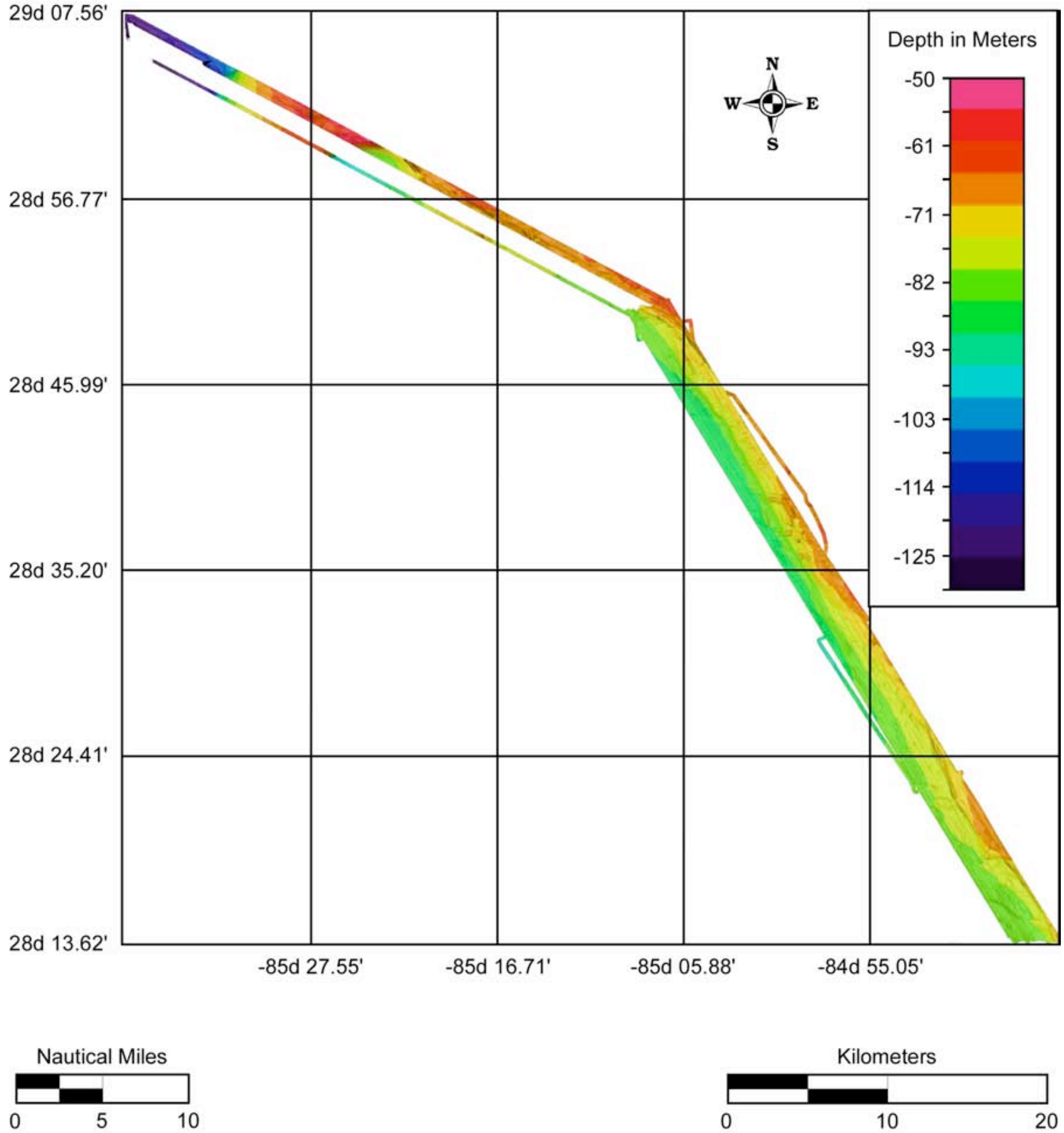


Figure 6. New EM3000 multibeam bathymetry of the Corridor Area. Data are gridded at 5 m x 5 m.

See Appendix 5 for multibeam backscatter image.

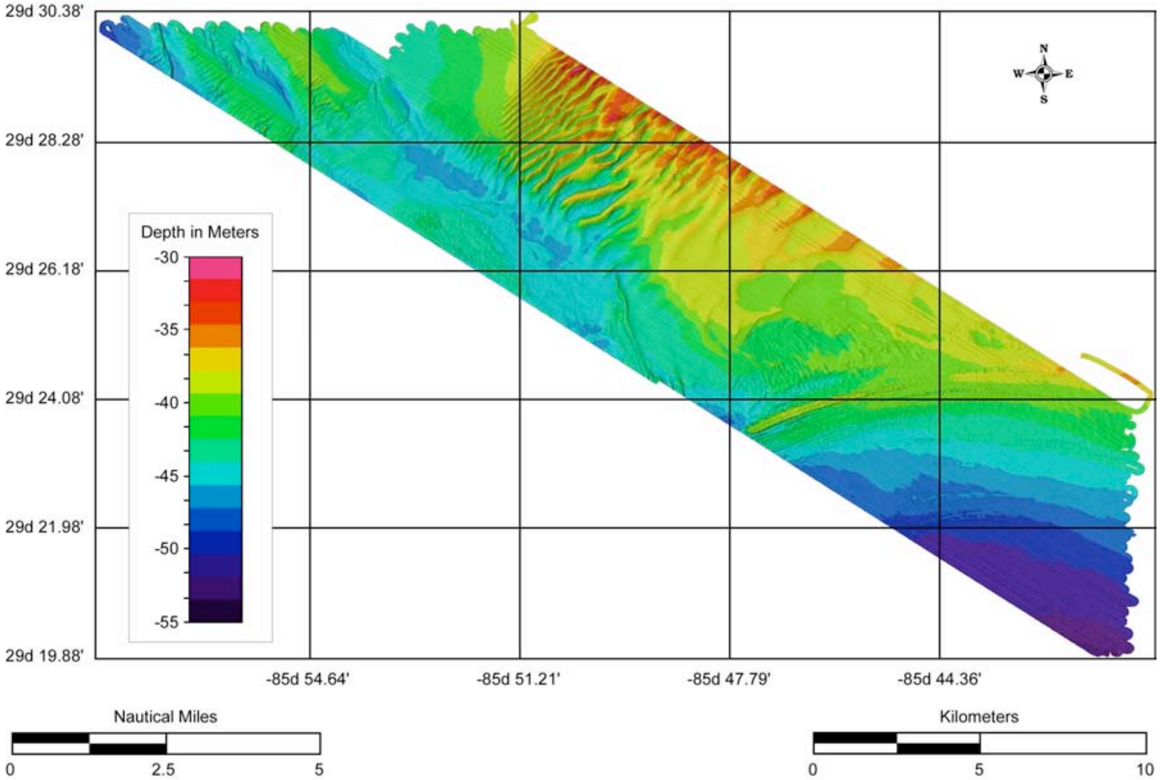


Figure 7. New EM3000 multibeam bathymetry of the Fill in Area, gridded at 5 m x 5 m.

See Appendix 5 for multibeam backscatter image.

**<u>Preliminary Interpretations:</u>**

<u>Florida Middle Ground, Leg I</u>

The Florida Middle Ground data filled in two areas to the north and south of the 2000 data and extended the 2004 data further to the west (Figure 5). Line spacing for the survey was 125 meters. In the northern area, well-defined hard grounds continued to be found trending north to south, with over 10 meters of relief. In the southern area there continued to be lower relief hard grounds, yet their distribution was greater the hard grounds to the north. To the west the water continued to deepen to a maximum depth of 52 meters. There were additional well-defined hard grounds, 10 meter relief, trending

NNE to SSW in the western area. The well-defined hard grounds tend to slope down from east to west.

Corridor Area, Leg II

The corridor study area consisted of two connected surveys with approximately $30^0$ degree change in direction (Figure 6). Line spacing in the southern area (Corridor Area I) was first set at 140 meters but was found to be slightly too wide so it was reduced to 130 meters. The southern area we found over 13 km of gas pipeline, part of it cutting through a ledge that appears to be modified for the pipe. Two sets of ripples were observed. The first set has a 200 m period and 0.5 m amplitude. The second set have a 30 m period and are 1 m in amplitude. In addition, numerous continuous ledges were found, trending NNW to SSE, up to 8 meters in height. There is extensive scour at the base of most ledges. Both the ripple and scour patterns suggest a general NNW to SSE current in the area.

Corridor Area II is north and west of Corridor Area I trending NW to SE (Figure 2). Line spacing was set to 130 meters. Approximately 3/4 of the way between the south east start of line and the north west end of line the depth dramatically drops to over 110 m. Because of the deep water found in the first southerly line the survey was changed so that the parallel lines were surveyed from the northeast to the southwest. After completing several lines, in water depths greater than 110 meters, the subsequent lines were shortened with the last 2 lines ending at ~110m depth. This was to avoid surveying in water depths greater than 110 meters at which the 300 kHz signal attenuated due to the warm saline water. This area also has ledges trending NW to SE but do not appear to be as continuous as those in Corridor Area I.

Interesting that the Sv Plus shows much different water column in Corridor Area II verses the Corridor Area I. There was an increase of 10 m/s and 4 $^{0}$C between 30 – 50 meters in Corridor Area II verses Corridor Area I CTD/Sv profiles.

Fill In Area, Leg III

The survey lines were oriented NW to SE. The survey started in the shallower water along the NE edge of the survey area and we worked to the SW (Figure 7). Line spacing in the shallower areas was at 110 meters and gradually increased to 130 meters in the deeper water. In the northeastern section there is a shallow tongue of sea floor in the center of the survey with deeper water to the NW and the SE. The water depths on the shallow tongue were 30 – 40 m and large sandwaves (dunes) were observed with 7 meters from trough to crest with an approximate 350 m period. They dissipate to the SW in ~45 meters water depth. Their asymmetric shape suggests that they were formed by bottom currents flowing from the SE to the NW.

At the northwestern edge of the sand waves, there are smaller bedforms with approximately a 15 meter period and 1 meter in amplitude located in ~41 m of water. In the SE, there are lineations trending east-west in ~40 m water depth. At first these were believed to be trawl scars or sand ribbons but as we worked over deeper water, the relief, angle of repose, and backscatter signature provide evidence of hard grounds. There are similar structures trending NNW to SSE just to the NW of these east-west structures.

It appears that both of these features continue into deeper water and by extrapolation, they would connect to form a paleo-headland or cape.

Additionally in the southeast there is a smaller low amplitude sand wave field trending NNW to SSE. These sand waves are barely visible in bathymetry but evident in the backscatter data, approximately 0.5 m trough to crest and 230 m period.

## Acknowledgements:

We thank the Captain and Crew of the R/V Suncoaster and the shorebased support of the Florida Institute of Oceanography, especially Randy Maxson and Rob Walker. We also appreciate the volunteer efforts of the watchstanders which in turn gave many of the undergraduates a firsthand opportunity to experience research at sea.

Financial support was provided by NOAA through Gulf of Mexico Fisheries Management Council, E & A Engineering, and the University of South Florida.

Additional thanks goes to Ed Watkins and Walt Jaap for their assistance with the pipeline survey.

**Appendix II**

Locations of CTD/Sv Leg I

| Cast Number | Latitude | Longitude |
|---|---|---|
| 1 | $27^0$ 37.01' | $-82^0$ 41.24' |
| 2 | $28^0$ 10.35' | $-84^0$ 04.51' |
| 3 | $28^0$ 14.759' | $-84^0$ 08.224' |
| 4 | $28^0$ 18.097' | $-84^0$ 10.016' |
| 5 | $28^0$ 22.718' | $-84^0$ 12.205' |
| 6 | $28^0$ 15.698' | $-84^0$ 07.036' |
| 7 | $28^0$ 23.107' | $-84^0$ 11.371' |
| 8 | $28^0$ 37.63' | $-84^0$ 21.00' |
| 9 | $28^0$ 37.09' | $-84^0$ 22.13' |
| 10 | $28^0$ 39.394' | $-84^0$ 23.969' |
| 11 | $28^0$ 32.76' | $-84^0$ 22.96' |
| 12 | $28^0$25.752' | $-84^0$ 18.608' |
| 13 | $28^0$ 29.384' | $-84^0$ 21.418' |
| 14 | $28^0$ 21.949' | $-84^0$ 16.682' |
| 15 | $28^0$ 17.256' | $-84^0$ 13.966' |
| 16 | $28^0$ 27.212' | $-84^0$ 21.113' |
| 17 | $28^0$ 28.25' | $-84^0$ 22.51' |
| 18 | $28^0$ 22.988' | $-84^0$ 19.311' |

Locations of CTD/Sv Leg II

| Cast Number | Latitude | Longitude |
|---|---|---|
| 1 | $27^0$ 36.78' | $-82^0$ 40.88' |
| 2 | $28^0$ 09.28' | $-84^0$ 32.57' |
| 3 | $28^0$ 26.56' | $-84^0$ 54.48' |
| 4 | $28^0$ 43.64 | -85 04.94 |
| 5 | $28^0$ 33.43' | $-84^0$ 58.57' |
| 6 | $28^0$ 39.55' | $-85^0$ 01.91' |
| 7 | $28^0$ 14.00' | $-84^0$ 46.16' |
| 8 | $28^0$ 20.519' | $-84^0$ 50.070' |
| 9 | $28^0$ 28.87' | $-84^0$ 54.78' |
| 10 | $28^0$ 50.35' | $-85^0$ 07.94' |
| 11 | $28^0$ 19.90' | $-84^0$ 48.82' |
| 12 | $28^0$ 24.30' | $-84^0$ 51.61' |
| 13 | $28^0$ 37.37' | $-84^0$ 59.42' |
| 14 | $28^0$ 32.68' | $-84^0$ 55.73' |

| | | |
|---|---|---|
| 15 | $28^0$ 23.67' | $-84^0$ 50.85' |
| 16 | $28^0$ 41.59' | $-84^0$ 01.73' |
| 17 | $28^0$ 57.43' | $-84^0$ 57.43' |
| 18 | $28^0$ 15.911' | $-84^0$ 45.765 |
| 19 | $28^0$ 48.45' | $-85^0$ 05.48' |
| 20 | $28^0$ 50.29' | $-85^0$ 08.89' |
| 21 | $29^0$ 01.65' | $-85^0$ 30.79' |
| 22 | $28^0$ 56.55' | $-85^0$ 17.95' |
| 23 | $28^0$ 57.633' | $-85^0$ 20.526' |

<u>Locations of CTD/Sv Leg III:</u>

| Cast Number | Latitude | Longitude |
|---|---|---|
| 1 | $27^0$ 36.78' | $-82^0$ 40.88' |
| 2 | $29^0$ 24.53' | $-85^0$ 42.02' |
| 3 | $29^0$ 30.100' | $-85^0$ 52.012' |
| 4 | $29^0$ 26.07' | $-85^0$ 45.53' |
| 5 | $29^0$ 27.93' | $-85^0$ 49.55' |
| 6 | $29^0$ 26.157' | $-85^0$ 47.328' |
| 7 | $29^0$ 22.734' | $-85^0$ 43.094' |
| 8 | $29^0$ 28.260' | $-85^0$ 52.686' |
| 9 | $29^0$ 23.82' | $-85^0$ 46.82' |
| 10 | $29^0$ 26.53' | $-85^0$ 51.648' |
| 11 | $29^0$ 30.132' | $-85^0$ 57.613' |
| 12 | $29^0$ 19.951' | $-85^0$ 41.675' |

**Appendix III**

Leg I Problems:

There were a few problems encountered during Leg I. The seabird CTD software crashed on July 23rd and we were unable to communicate with the CTD. After communicating with shore, we determined that the best course of action was to reinstall the computer software. Once this was done the CTD worked fine for the remainder of the cruise.

The most continuous problem was the build up of Sargasso seaweed on the forward stay of the multibeam pole mount. I believe that this accumulation increased the surface area of the forward wire and in turn caused vibration of the pole mount that was visible during the survey and within the data. Thus we stopped fairly often to clean off the forward stay.

The most major problem of the cruise was the failure of a lower bushing on the lower offset arm of the pole mount, which allowed additional vibration in the pole. The bushing had been replaced a year ago but instead of being replaced with the requested polyurethane orange boat roller material a rubber roller was used. The pole mount was winched up to inspect for damage to the pole and ship. The pole was found to be fine but a small notch had been carved in the boat's hull. To correct the problem a wooden six-inch long piece of a "two by four" was fitted to replace the roller. The arm was lowered back into the water and functioned well, as long as we continued to stop often to remove accumulated Sargasso weed. This was the first time we encountered such a massive distribution of Sargasso.

Other problems included Applanix POS M/V position inaccuracies and EM3000 computer crashes. On 5 separate occasions the POS M/V position accuracy would start getting worse although the constellation and parameters were fine. We reset the system when the accuracy would consistently be above ~3.4m (the accuracy we normally have without differencial corrections). In all cases, stopping the survey and cycling the power brought the system back into acceptable position accuracy. The POS M/V along with the EM3000 software would need to be powered down for 5 to 10 minutes before restarting. It was discovered that leaving the EM3000 software running while resetting the POS M/V caused the EM3000 processing unit to crash.

Leg II Problems:

Once again the Sargasso buildup on forward stay made the pole wobble which can be seen in some of the data as an artifact. The wobble probably also contributed to the failure of the forward stay on August 12$^{th}$. Luckily when it failed no personnel were injured and no equipment were damaged. Repair and recalibration took ~ 3 hrs and we resumed surveying. The mounting system worked as expected and the safety turnbuckle slowed the backward motion of the pole and head so that nothing banged against the ship, it just sort of slid up.

Leg III Problems:

An artifact was found in the data coming from the starboard side. It looks like a linear feature is following the ship, 0.2 m high in a 3 m grid. It was found it when the line spacing was increased to cover more area quicker. Obviously line spacing was returned to 110 meter. With the narrower spacing the grid had more good points than bad so the artifact wasn't as obvious. Checking most of the data from the transit out and previous legs I and II and don't see the artifact in a 5m grid. The survey was stopped, the transducer brought up, no damage was found nor was anything tangled in it. The transducer was lowered back down, the installation recalibrated and the survey continued, the artifact remained and the sonar head will need to be checked by Kongsberg Simrad and recalibrated if necessary.