DEEP-C PHYSICAL OCEANOGRAPHY CRUISE REPORT
CRUISE PE12-26 Speer
10-15 May 2012
R/V Pelican
by

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Background

The DeSoto canyon is expected to be a conduit for shallow and deep water onto the shelf, a region of sediment transport, and intersects known oil and gas reserves; thus, it is a key region to observe, understand and correctly simulate with numerical models.

The head of the DeSoto canyon has 3 sharp indentations with associated large isobath curvature. Such regions of high isobath curvature (radius of curvature of a few km) are sites where flow dynamics implies strong exchange from deeper waters to the shallow shelf.

Much of our knowledge of the physical oceanography of the DeSoto canyon comes from an extensive set of current and hydrographic measurements made from 1997 to 1999 (Berger *et al.* 2000, Hamilton and Lee 2005). The Loop Current and associated eddies strongly influence regional flow (Berger *et al.* 2000, Hamilton and Lee 2005). An eastward upper slope surface jet, leading to mean cross-isobath flow at the head of the canyon (100 m), is often accompanied by a westward counter-current (200-500 m) on the Alabama slope.

While the mean flows on the shelf near the De Soto canyon are mostly a few cm/s or less, low-frequency flows are 10-20 cm/s (Ohlmann and Niiler (2005), Hamilton and Lee (2005), Teague et al.(2006), Carnes et al. (2008)). Eddies appear to be driving the circulation, with average velocities between 15 and 30 cm/s.

From an analysis of these flows, satellite data, and a numerical model, Wang *et al*. (2003) concluded that there are two dominant modes of circulation in the De Soto canyon in water depths greater than 100 m. One mode is a "single-eddy" mode in deep water at the foot of the canyon and the other is an "eddy-pair" mode in which one eddy is at the foot of the canyon and the other is closer to the head of the canyon.

The circulation during the time of our cruise to De Soto Canyon is displayed

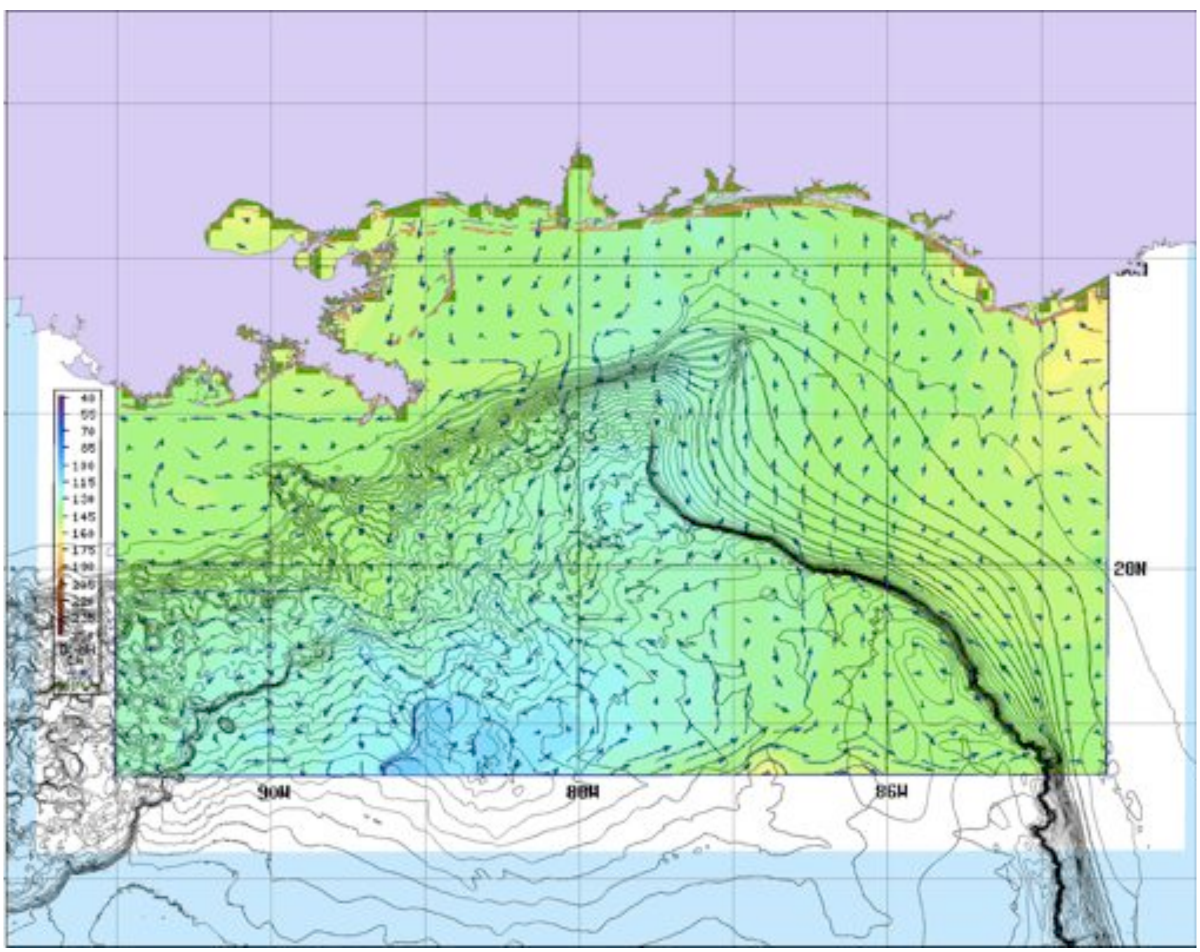

Figure 1: Sea-surface height and velocity on May 8 2012 from satellite altimetry along with bathymetry (prepared by E. Simons).

in Fig 1. It is apparent that the flow was generally counterclockwise in the upper reaches of the canyon; this was confirmed with ADCP measurements during the cruise showing westward flow oriented along isobaths of 10-20cm/s near the head of the canyon. Whether or not this is the “eddy-pair” situation remains to be determined.

While altimetry-based estimates are extremely useful, the energy derived from these is weaker compared with measurements from drifters, illustrating the turbulent nature of transport processes near the canyon and the key information that Lagrangian drifter and float measurements can provide.

In the Deep-C program the physical oceanography effort is directed to the topographic control of oil transport. A preferential location of exchange and transport will occur at the canyon. At the surface and within the water column, the topographic steering of the canyon will control the dominant direction of transport and potentially guide oil onshore. Near the head of the canyon strong vertical motions will combine surface and upwelling waters and inject nutrients into the mixed layer.

We focus on determining the physical controls on the dispersion and transport of surface and subsurface contaminants exerted by the De Soto Canyon geomorphology. Our primary goals are (1) to determine the offshore circulation linkages and mechanisms controlling lateral dispersion, upwelling and downwelling in the De Soto Canyon region; (2) to understand the effects of large-scale stochastic events, such as hurricanes, in the deep sea; (3) to quantify the movement of re-suspended sediments in and near the canyon; and (3) to produce physical observations to constrain and calibrate models of the region.

The physical experimental and fieldwork in De Soto Canyon is focused on moorings near the head and within the canyon (Fig. 2), and broader-scale dispersion with floats. This report describes the first cruise in the physical oceanography component of Deep-C. The main goals were to:

(1) Deploy 36 subsurface rafos floats and one sound source in collaboration with the BOEM funded float study of deep (> 1500m) circulation in the Gulf of Mexico.
(2) Deploy six moorings, concentrated in the upper DeSoto Canyon. Each mooring will be outfitted with measurement packages resolving near bottom flow.

(3) Occupy CTD stations at the mooring locations and along the De Soto Canyon.

Cruise Narrative

We left Cocodrie shortly after midnight (10 May) and proceeded out the channel into the Gulf of Mexico (a very busy channel with numerous shallow bars in the way). Since mooring operations only happen during the day we planned to use the nights for CTD operations. After about 24 hr steaming we arrived near the M6 mooring site and began CTD operations, with time to complete Stations 1-3.

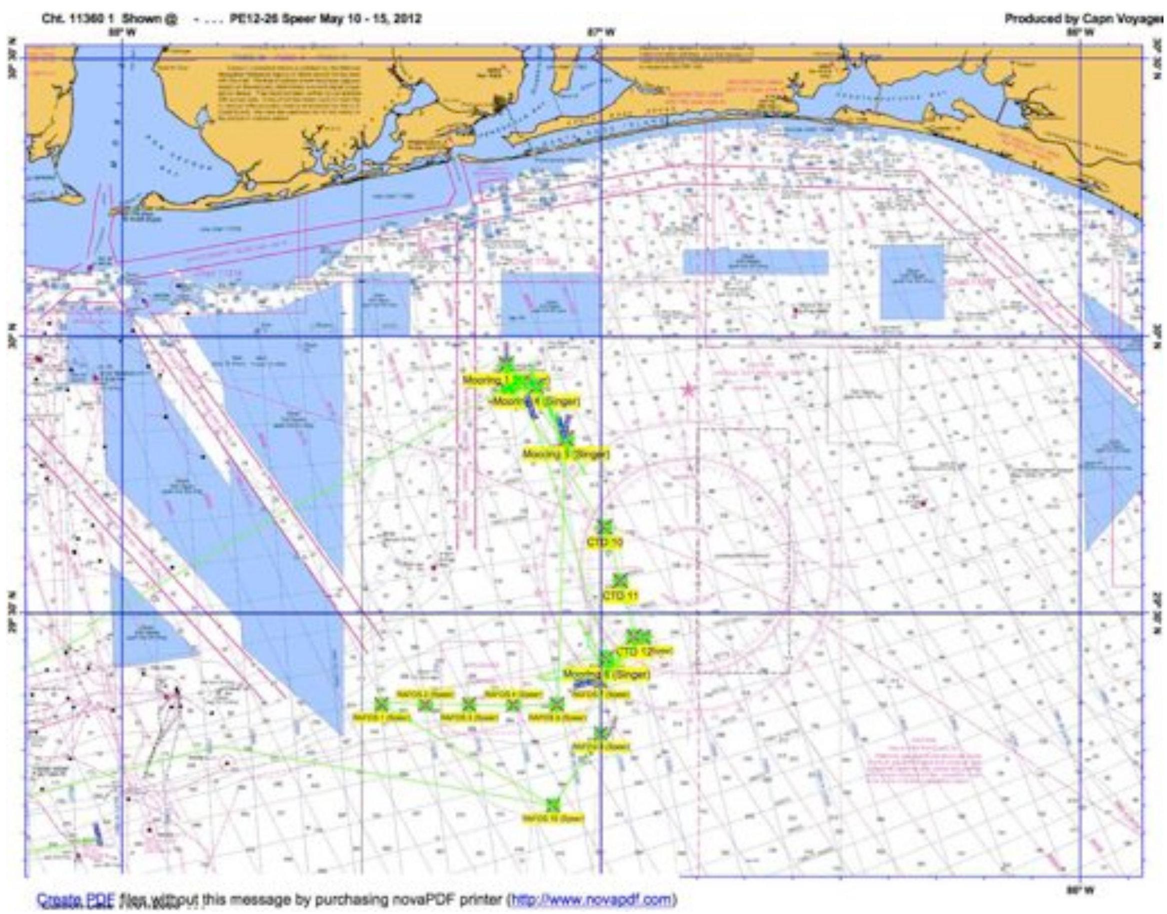

Fig 2. Map of cruise track near the De Soto Canyon and various stations (CTD, Rafos deployments, and moorings) occupied during the cruise.

The bulk of the day was occupied with release tests (dips) and bathymetric surveying; mooring 6 (our longest mooring with the sound source) was deployed in the evening. That night (11-12 May) was busy with rafos float deployments.

The following day (12 May) moorings 4 and 5 were deployed, and we sought to find the correct depth for mooring 2. This proved difficult so moorings M2 and M3 were swapped (it was easier to adjust the length of SAIC M3 than FSU M2) and deployment scheduled after M1. The night hours of 12-13 May were occupied with CTD Stations 4-9.

On 13 May moorings M1 and M2 were deployed. Both have a TRBM, hence a separate deployment procedure. The TRBM on mooring M2 appeared to be snagged and flipped, so it was recovered and redeplyed the following day, after M3. On 14 May M3 was deployed and the TRBM of M2 was recovered and re-deployed. Once the triangulation was complete we headed back to LUMCON. A map of the cruise track in the vicinity of the sites provides an overview of these activities (Fig. 2).

Cruise summary

	CDT		
Thurs. 10 May	0005	●	Depart LUMCON; underway for M6 Mooring site.
Fri. 11 May	0000	●	Enroute to M6 Mooring site.
	~0145	●	Arrive **M6 Mooring site**; standby to begin CTD casts and RAFOS drifter deployments.
	0640	●	Complete CTDs and return to M6 site; problems with hydraulics; standby to begin bathymetric survey.
	0700	●	Bathy navigation system down; plan to dip releases first.
	1200	●	All releases dipped to 500 meters; standby to begin bathymetric survey; unable to disable EdgeTech releases.
	~1300	●	Begin bathymetric survey at M6 Mooring site.
	1345	●	Complete bathymetric survey; standby to check ship drift and prepare deck to deploy mooring.
	1410	●	Target site determined at 715 meters depth.
	1556	●	Steaming to "Begin Deployment" site.
	1614	●	Begin mooring deployment.
	1911	●	Anchor deployed; standby to do triangulation.
	2010	●	Triangulation complete; underway to deploy RAFOS Drifters and then steam for M5 Mooring site.

Sat. 12 May	0821	• Arrive **M5 Mooring site**; standby to begin bathymetric survey.
	~0930	• Complete bathymetric survey; standby to prepare deck and deploy mooring.
	1140	• Steam to "Begin Deployment" site.
	1238	• Standing by to begin mooring deployment.
	1307	• Begin mooring deployment.
	1416	• Anchor deployed; standby to do triangulation.
	1510	• Triangulation complete; underway for M4 Mooring site.
	1551	• Arrive **M4 Mooring site**; standby to begin bathymetric survey.
	1600	• Begin bathymetric survey.
	1640	• Complete bathymetric survey; standby to check drift and begin mooring deployment after supper.
	1917	• Begin mooring deployment.
	2018	• Anchor deployed; standby to do triangulation.
	2045	• Triangulation complete; underway slow for M2 Mooring site.
	CDT	
Sat. 12 May	~2100	• Arrive **M2 Mooring site**; standby to begin bathymetric survey.
	2130	• Having difficulty finding design depth for FSU M2 Mooring which can't be shortened.
	2320	• Complete bathymetric survey; plan to swap M2 and M3 Mooring locations since the M3 Mooring can be adjusted for shallower depth.
	2327	• CTD shift begins.
Sun. 13 May	0600	• On site at **M1 Mooring site**; standby to begin bathymetric survey.
	~0700	• Complete bathymetric survey; standby to deploy short subsurface mooring and TRBM.
	0918	• Begin mooring deployment.
	0924	• Anchor deployed; standby to deploy MSI/FSU TRBM.
	1114	• Begin TRBM deployment ~200 meters away from M1 subsurface mooring.
	1119	• TRBM on the bottom and released from deployment line; paying out ground tackle.
	1126	• Ground tackle deployed; standby to do triangulation on M1 Mooring and M1 TRBM.
	1229	• Triangulation was bad for both sites; ranges must be incorrect; will use anchor drop coordinates for each site.
	1250	• Pick up yellow mooring marker float deployed on top of

			subsurface mooring; underway for M2 Mooring site.
	1311	•	Arrive **M2 Mooring site**; standby to begin bathymetric survey.
	1328	•	Deployment sites selected; standby to prepare deck and mooring for deployment.
	1548	•	Begin mooring deployment.
	1627	•	Anchor deployed; standby to deploy TRBM.
	1802	•	Begin TRBM deployment.
	1806	•	TRBM on bottom and released from deployment line; paying out ground tackle.
	1808	•	Jack (engineer and winch operator) advises that the TRBM is being lifted off the bottom; must be snagged in deployment harness.
	1818	•	Second clump weight deployed; deployment release recovered; TRBM had fallen off shortly after we discovered it was being lifted off the bottom.
	1845	•	Since we don't know if TRBM is upside down or not, we plan to recover after deploying the M3 Mooring and TRBM tomorrow.
	1848 **CDT**	•	Underway to do CTDs through the night.
Mon. 14 May	0600	•	Arrive **M3 Mooring site**; standby to begin bathymetric survey.
	0730	•	Complete bathymetric survey; two targets selected; standby to begin mooring deployment.
	0842	•	Begin mooring deployment.
	0908	•	Anchor deployed; standby to do TRBM deployment.
	1104	•	Begin TRBM deployment.
	1108	•	TRBM on bottom and released from deployment line; standby to do triangulation.
	1153	•	Triangulation complete and yellow mooring marker float recovered; underay for M2 TRBM site.
	1205	•	Arrive **M2 TRBM site**; standby to recover TRBM as it may be upside down.
	1242	•	Release activated but float not rising to surface; plan to use grapnel hook and drag for pickup line.
	1310	•	Have picked up on outer ground line with grapnel; need to get to end of line.
	1355	•	Entire TRBM assembly on deck; standby to redeploy.
	1508	•	Begin TRBM deployment.
	1512	•	TRBM on bottom and released from deployment line.
	1521	•	Groundline deployed; standby to do triangulation on M2 Mooring and M2 TRBM.
	1600	•	Triangulation complete; underway for LUMCON.

Tues. 15 May	0000	●	Enroute to LUMCON.
	1450	●	Arrive LUMCON; standby to unload vessel.

FSU Gulf Research Initiative (GRI) Mooring Locations

Mooring	Location (Lat./Long.)		Bottom Depth (m)	Mooring Top (m)
M1 (FSU)	29° 56.685'N 87° 11.614'W	(29.9448°N) (87.1936°W)	53 (Sand + Shell)	15
M2 (SAIC) (Lighted)	29° 54.067'N 87° 11.637'W	(29.9011°N) (87.1940°W)	78 (Sand)	Surface Buoy* Steel Buoy @ 19
M3 (FSU)	29° 55.101'N 87° 10.190'W	(29.9184°N) (87.1698°W)	97 (Fine Sandy Mud)	29
M4 (SAIC) (Lighted)	29° 54.424'N 87° 08.173'W	(29.9071°N) (87.1362°W)	106 (Fine Sandy Mud)	Surface Buoy* Steel Buoy @19
M5 (SAIC) (Lighted)	29° 48.940'N 87° 04.242'W	(29.8157°N) (87.0707°W)	206 (Mud)	Surface Buoy* Steel Buoy @ 19
M6 (SAIC)	29° 24.090'N 86° 59.012'W	(29.4015°N) (86.9835°W)	715 (Mud)	68

***Note:** Surface buoys are yellow and are equipped with radar reflectors and amber lights ~10 ft above the surface. Buoys are marked as "M2", "M4" or "M5", respectively. The light is on 0.6 seconds and off 3.4 seconds. Deployments were made on 11-14 May 2012 for a one year deployment period. There are also bottom mounted low-profile instrument packages at M1, M2 and M3 that project upward less than one meter (3.28 ft) off the bottom. Bottom material taken from sites east and west of mooring locations but on same isobath.

Acknowledgements

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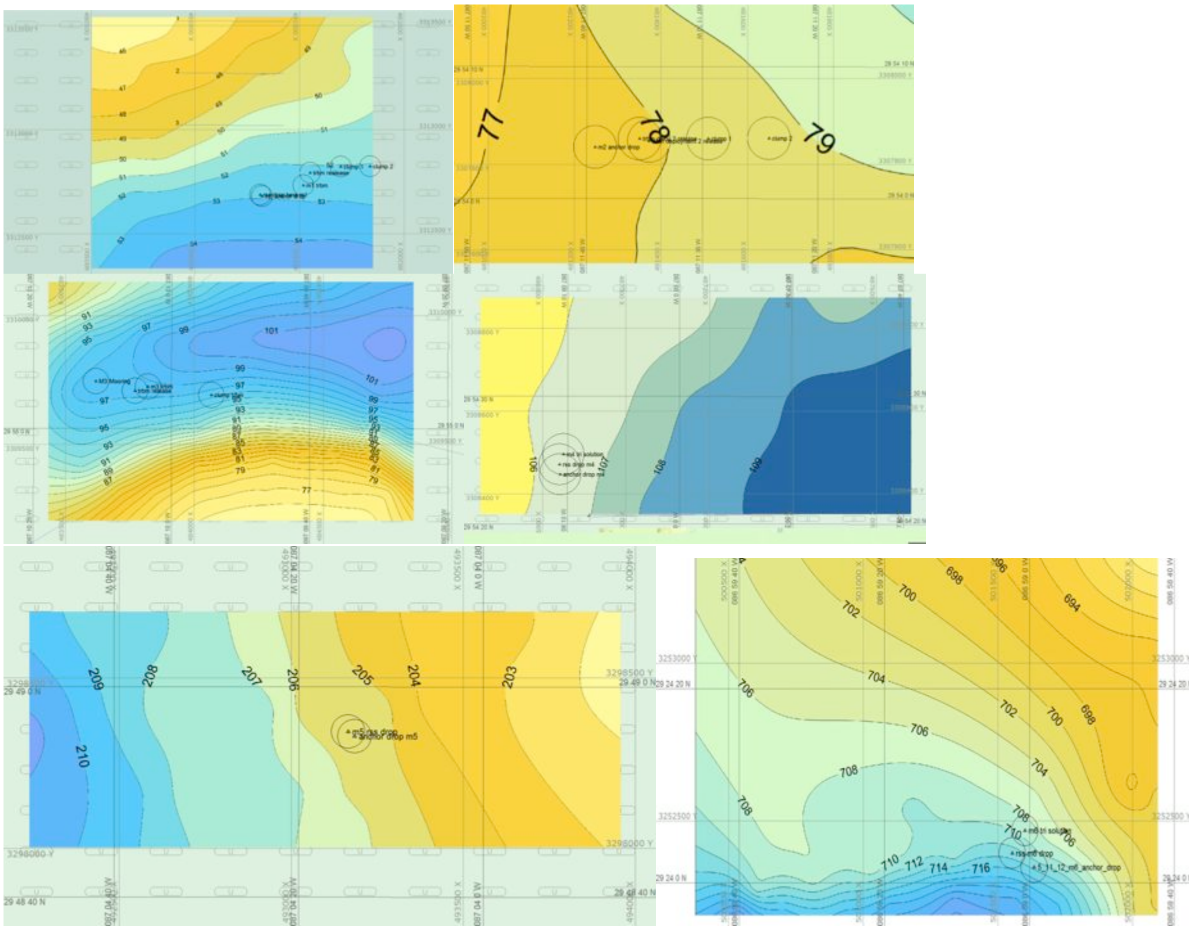
CTD Stations

Date	Time (GMT)	Bottom depth (m)	Latitude (DM ºN)	Longitude (DM ºW)
11-May	7:35	880	29 08.750	87 06.103
11-May	8:57	905	29 16.736	86 59.986
11-May	10:25	737	29 22.500	86 59.982
13-May	5:02	45	29 56.967	87 11.653
13-May	5:39	97	29 51.128	87 07.202
13-May	6:08	104	29 54.670	87 08.223
13-May	7:08	156	29 51.688	87 06.338
13-May	7:51	199	29 49.015	87 04.458
13-May	8:47	206	29 45.053	87 01.952
14-May	1:57	236	29 39.323	86 59.474
14-May	3:01	307	29 33.440	86 57.490
14-May	3:45	385	29 30.463	86 56.721
14-May	4:30	594	29 27.417	86 55.909
14-May	5:27	690	29 24.975	86 59.275



Mooring site surveys (1-2 top; 3-4 middle; 5-6 bottom).

Rafos deployment sites (refer to Fig. 2):

1		29 19.980 N	087 27.500 W
2		29 09.000 N	087 06.000 W
3		29 19.980 N	087 22.000 W
4		29 19.980 N	087 16.500 W
5		29 19.980 N	087 11.000 W
6		29 19.980 N	087 05.500 W
7		29 16.800 N	087 00.000 W
8		29 22.500 N	087 00.000 W
9		29 25.000 N	086 59.300 W
10		29 27.300 N	086 54.600 W