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Weekly Resolution Particulate Flux from a Sediment Trap in the Northern Gulf of Mexico, 2008-2012

By Julie N. Richey, Caitlin E. Reynolds, Eric Tappa, and Robert Thunell

Open-File Report 2014–1035

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
SALLY JEWELL, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2014

Suggested citation:
Richey, J.N., Reynolds, C.E., Tappa, Eric, and Thunell, Robert, 2014, Weekly resolution particulate flux from a sediment trap in the northern Gulf of Mexico: U.S. Geological Survey Open-File Report 2014-1035, 9 p,, *http://dx.doi.org/10.3133/ofr20141035*.

ISSN 2331-1258 (online)

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Conversion Factors

Multiply	By	To obtain
	Length	
centimeter (cm)	0.394	inch (in.)
millimeter (mm)	0.039	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.621	mile (mi)
meter (m)	1.094	yard (yd)
	Area	
square centimeter (cm^2)	0.001	square foot (ft^2)
square meter (m^2)	10.76	square foot (ft^2)
square centimeter (cm^2)	0.155	square inch (ft^2)
	Volume	
liter (L)	33.82	ounce, fluid (fl. oz)
liter (L)	2.113	pint (pt)
liter (L)	1.057	quart (qt)
liter (L)	0.264	gallon (gal)
cubic meter (m^3)	264.2	gallon (gal)
cubic meter (m^3)	35.31	cubic foot (ft^3)
cubic meter (m^3)	1.308	cubic yard (yd^3)
	Mass	
gram (g)	0.035	ounce, avoirdupois (oz)
kilogram (kg)	2.205	pound avoirdupois (lb)
	Pressure	
kilopascal (kPa)	0.010	atmosphere, standard (atm)
	Energy	
joule (J)	0.000	kilowatthour (kWh)
	Radioactivity	
becquerel per liter (Bq/L)	27.027	picocurie per liter (pCi/L)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8×°C)+32$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C=(°F–32)/1.8$$

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Introduction

The U.S. Geological Survey anchored a sediment trap in the northern Gulf of Mexico to collect time-series data on sediment flux from 2008 to 2012. There are continuous measurements of total mass flux and organic carbon flux (orgC) at 7–14 day resolution from 2008 to 2012. The flux of calcium carbonate ($CaCO_3$), particulate nitrogen (nitro), and biogenic silica (Opal) were also measured from January-December, 2008. The mass flux ranged from 0.01 g m^{-2} day^{-1} (grams per square meter per day) to 2.50 g m^{-2} day^{-1}, with a mean mass flux of 0.20 g $m^{-2}day^{-1}$ over the 5-year study period.

Materials and Methods

A McLane PARFLUX Mark 78 automated sediment trap was deployed in early January 2008 in approximately 1,150 meters (m) of water depth at 27.5 ºN. latitude and 90.3 ºW. longitude. The trap was positioned at a depth of 700 m on the sediment trap mooring (Spear and Poore, 2010). The trap is equipped with 21 collection cups, all mounted on a rotating plate programmed to rotate every 7 to 14 days (representative of a 1- or 2-week collection period). Sample cups from the period of January 2008 to late May 2009 were prefilled with a buffered formalin solution made with filtered (0.44-micrometer (m) filter) seawater, with a salinity of approximently 33 psu (practical salinity units). However, from September 2009 to the present, sample cups were prefilled with a density-gradient solution with a salinity of approximately 44 psu. Formalin (3.7 percent) and sodium borate are added to the density-gradient solution to poison, buffer and preserve the samples. The trap was recovered and redeployed every 3 months during 2008, and every 6-9 months thereafter. Sampling gaps occurred between late May 2009 and late September 2009, and between early February 2012 and late March 2012, due to scheduling problems. Nine samples from the weeks of March 17, April 7, May 5, October 22, November 19, and December 10 of 2009, and January 7, February 14 and February 24 of 2010 were not recovered due to loss of the collection cups during deployment and recovery. During visits to the trap site, water column profiles of conductivity (salinity), temperature, and depth were collected using a Sea-Bird Electronics SBE9*plus* (Reynolds and others, 2013). Foraminiferal assemblage composition and flux were determined from sediment trap data and published in separate reports (Reynolds and others, 2013, Poore and others, 2013).

Sediment-trap samples were wet-split into four aliquots using a precision rotary splitter at the University of South Carolina, stored in buffered, deionized water, and then refrigerated. Mass flux was determined by taking a quarter split of each cup sample, freeze drying each quarter, and then determining mass using a microbalance. All flux measurements are reported in grams per square meter per day (g m^{-2} day^{-1}). To determine organic carbon and nitrogen content, aliquots of the mass flux were rinsed with 1 N phosphoric acid to remove carbonates. Carbon and nitrogen content on the carbonate-free aliquots was determined via high-temperature combustion using a PerkinElmer 2400 Elemental Analyzer. Carbonate concentrations were determined with an automated acid digestion system similar to that

described in Ostermann (1990). Biogenic Opal was quantified by the wet chemical leaching technique outlined in Mortlock and Froelich (1989). Terrigenous flux (Terrig) was calculated after accounting for Opal, $CaCO_3$, and organic matter; the organic matter flux was extrapolated from organic carbon flux by assuming that the orgC flux accounted for 40 percent of the total organic matter.

Acknowledgments

This research was funded by the U.S. Geological Survey Climate and Land Use Research and Development program.

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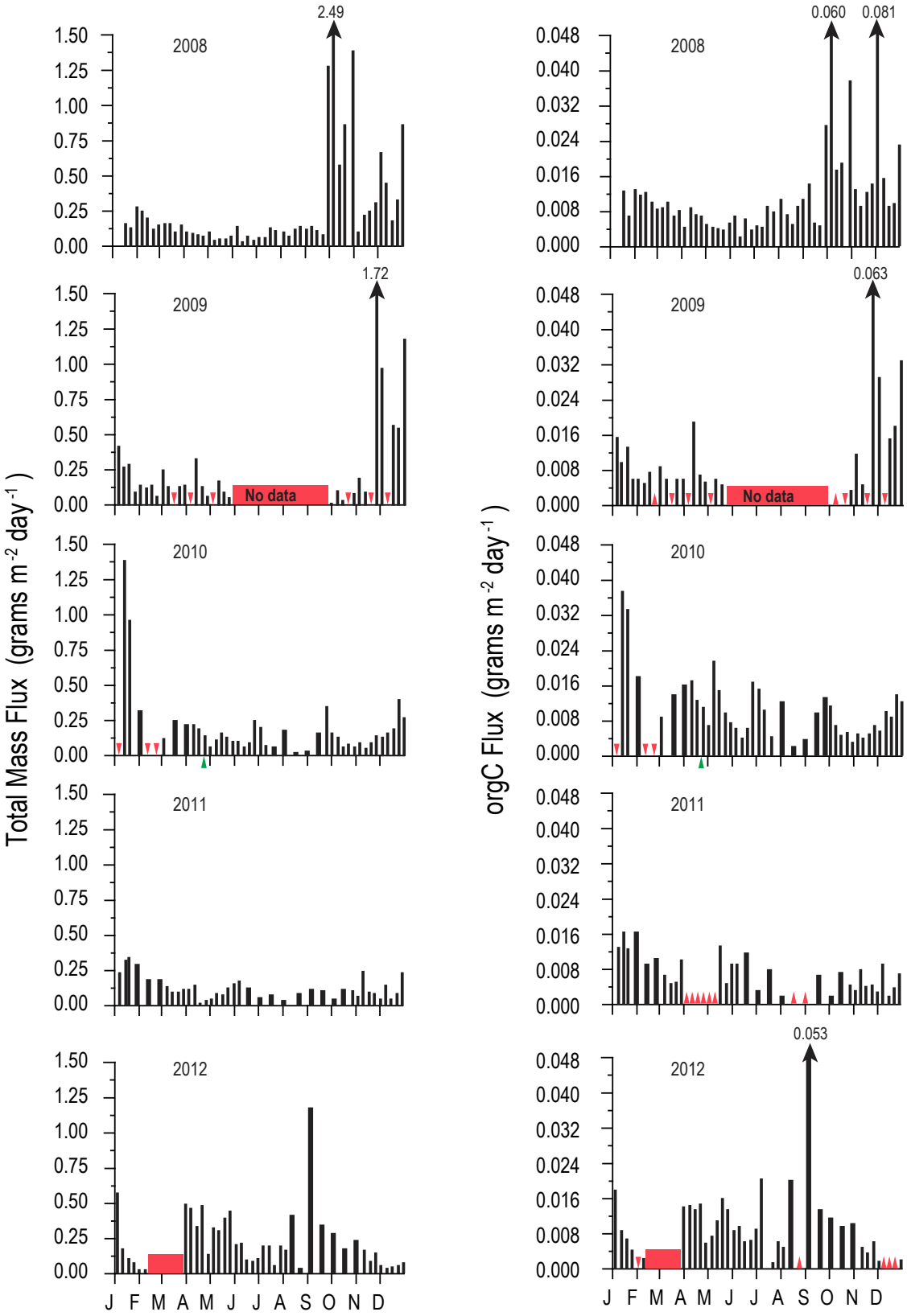

Figure 1. Average daily flux of 7– to 14–day-long sampling intervals of total mass flux and Organic Carbon (orgC) Flux for 2008–2012. Note the scale change in the y-axis. The tick marks on the x-axis denote the first day of each month. There was a gap in sampling (red rectangles), loss of sample cups (red inverted triangles), and limited data for processing (red triangles). Green triangle indicates Deepwater Horizon oil spill in 2010. The thick black lines represent 14 day sampling.

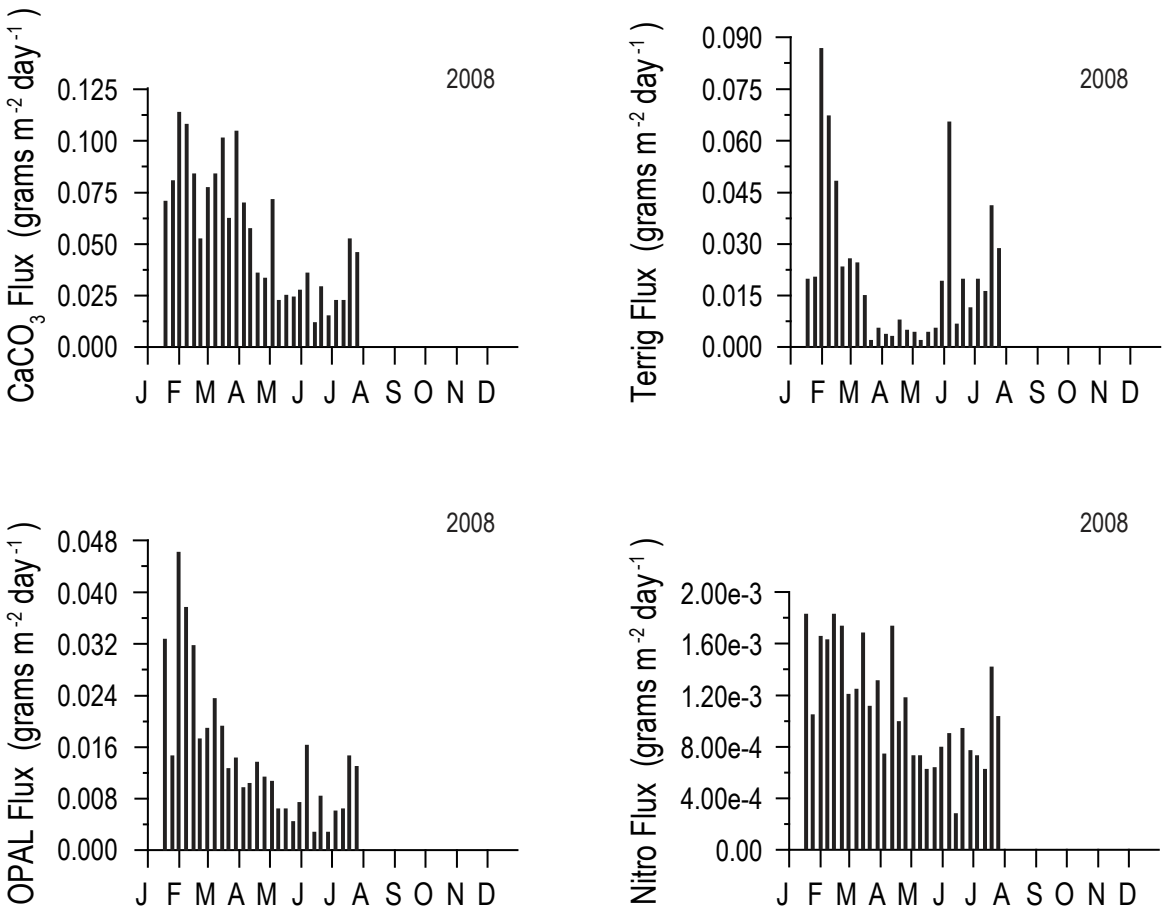

Figure 2. Average daily flux of 7-day-long sampling intervals of Calcium Carbonate ($CaCO_3$), Opal, Terrinegous (Terrig), and Nitrogen (Nitro) for 2008. Note the scale change in the y-axis. The tick marks on the x-axis denote the first day of each month.

Table 1. Average daily fluxes of total mass, Organic Carbon (orgC), Calcium Carbonate ($CaCO_3$), Opal, Terrinegous (Terrig), and Nitrogen (Nitro) for 2008-2012.

[GMT, Gulf of Mexico Sediment Trap; OPAL, opaline]

Sample		Mid-Week date	Total Mass Flux ($g/m^2/day$)	orgC Flux ($gC/m^2/day$)	$CaCO_3$ Flux ($g/m^2/day$)	OPAL Flux ($g/m^2/day$)	Terrig Flux ($g/m^2/day$)	Nitro Flux ($g/m^2/day$)
GMT-1	1	17-Jan-08	0.1509	0.0122	0.069	0.032	0.019	0.0018
GMT-1	2	24-Jan-08	0.1291	0.0065	0.079	0.014	0.020	0.0010
GMT-1	3	31-Jan-08	0.2760	0.0125	0.112	0.046	0.087	0.0016
GMT-1	4	7-Feb-08	0.2389	0.0113	0.106	0.037	0.067	0.0016
GMT-1	5	14-Feb-08	0.1914	0.0120	0.082	0.031	0.048	0.0018
GMT-1	6	21-Feb-08	0.1146	0.0097	0.051	0.017	0.023	0.0017
GMT-1	7	28-Feb-08	0.1403	0.0081	0.076	0.019	0.026	0.0012
GMT-1	8	6-Mar-08	0.1509	0.0084	0.082	0.023	0.024	0.0012
GMT-1	9	13-Mar-08	0.1571	0.0098	0.099	0.019	0.014	0.0017
GMT-1	10	20-Mar-08	0.0914	0.0066	0.061	0.012	0.001	0.0011
GMT-1	11	27-Mar-08	0.1411	0.0077	0.103	0.014	0.005	0.0013
GMT-1	12	3-Apr-08	0.0909	0.0041	0.068	0.010	0.003	0.0007
GMT-1	13	10-Apr-08	0.0891	0.0083	0.056	0.010	0.003	0.0017
GMT-1	14	17-Apr-08	0.0720	0.0069	0.034	0.013	0.008	0.0010
GMT-2	1	24-Apr-08	0.0640	0.0066	0.032	0.011	0.005	0.0012
GMT-2	2	1-May-08	0.0960	0.0046	0.070	0.010	0.004	0.0007
GMT-2	3	8-May-08	0.0389	0.0040	0.021	0.006	0.002	0.0007
GMT-2	4	15-May-08	0.0423	0.0036	0.023	0.006	0.004	0.0006
GMT-2	5	22-May-08	0.0411	0.0035	0.023	0.004	0.005	0.0006
GMT-2	6	29-May-08	0.0640	0.0049	0.026	0.007	0.019	0.0008
GMT-2	7	5-Jun-08	0.1314	0.0066	0.034	0.016	0.065	0.0009
GMT-2	8	12-Jun-08	0.0240	0.0017	0.011	0.002	0.006	0.0003
GMT-2	9	19-Jun-08	0.0697	0.0058	0.028	0.008	0.019	0.0009
GMT-2	10	26-Jun-08	0.0354	0.0033	0.014	0.002	0.011	0.0008
GMT-2	11	3-Jul-08	0.0571	0.0044	0.021	0.006	0.020	0.0007
GMT-2	12	10-Jul-08	0.0537	0.0041	0.021	0.006	0.016	0.0006
GMT-2	13	17-Jul-08	0.1280	0.0089	0.051	0.014	0.041	0.0014
GMT-2	14	24-Jul-08	0.1040	0.0074	0.045	0.013	0.028	0.0010
GMT-3	1	3-Aug-08	0.0983	0.0103				
GMT-3	2	10-Aug-08	0.0617	0.0069				
GMT-3	3	17-Aug-08	0.1166	0.0046				
GMT-3	4	24-Aug-08	0.1360	0.0086				
GMT-3	5	31-Aug-08	0.1177	0.0103				
GMT-3	6	7-Sep-08	0.1360	0.0138				
GMT-3	7	14-Sep-08	0.1086	0.0048				
GMT-3	8	21-Sep-08	0.0754	0.0042				
GMT-3	9	28-Sep-08	1.2709	0.0271				
GMT-3	10	5-Oct-08	2.4937	0.0599				
GMT-3	11	12-Oct-08	0.5749	0.0170				
GMT-3	12	19-Oct-08	0.8583	0.0186				

Sample		Mid-Week date	Total Mass Flux (g/m^2/day)	orgC Flux (gC/m^2/day)	$CaCO_3$ Flux (g/m^2/day)	OPAL Flux (g/m^2/day)	Terrig Flux (g/m^2/day)	Nitro Flux (g/m^2/day)
GMT-4	1	29-Oct-08	1.3829	0.0373				
GMT-4	2	5-Nov-08	0.0994	0.0125				
GMT-4	3	12-Nov-08	0.2137	0.0087				
GMT-4	4	19-Nov-08	0.2480	0.0119				
GMT-4	5	26-Nov-08	0.2983	0.0139				
GMT-4	6	3-Dec-08	0.6594	0.0807				
GMT-4	7	10-Dec-08	0.4446	0.0152				
GMT-4	8	17-Dec-08	0.1703	0.0086				
GMT-4	9	24-Dec-08	0.3189	0.0094				
GMT-4	10	31-Dec-08	0.8594	0.0228				
GMT-4	11	6-Jan-09	0.4120	0.0152				
GMT-5	1	12-Jan-09	0.2661	0.0093				
GMT-5	2	19-Jan-09	0.2871	0.0128				
GMT-5	3	26-Jan-09	0.0877	0.0056				
GMT-5	4	2-Feb-09	0.1317	0.0054				
GMT-5	5	9-Feb-09	0.1107	0.0045				
GMT-5	6	16-Feb-09	0.1318	0.0071				
GMT-5	7	23-Feb-09	0.0573					
GMT-5	8	2-Mar-09	0.2475	0.0084				
GMT-5	9	9-Mar-09	0.1253	0.0057				
GMT-5	10	16-Mar-09						
GMT-5	11	23-Mar-09	0.1279	0.0055				
GMT-5	12	30-Mar-09	0.1365	0.0056				
GMT-5	13	6-Apr-09						
GMT-5	14	13-Apr-09	0.3178	0.0186				
GMT-5	15	20-Apr-09	0.1288	0.0064				
GMT-5	16	27-Apr-09	0.0592	0.0050				
GMT-5	17	4-May-09						
GMT-5	18	11-May-09	0.1630	0.0057				
GMT-5	19	18-May-09	0.0849	0.0042				
GMT-5	20	24-May-09	0.0445					
GMT-6	1	30-Sep-09	0.0097					
GMT-6	2	7-Oct-09	0.0994					
GMT-6	3	14-Oct-09	0.0259					
GMT-6	4	21-Oct-09						
GMT-6	5	28-Oct-09	0.0730	0.0031				
GMT-6	6	4-Nov-09	0.1805	0.0114				
GMT-6	7	11-Nov-09	0.0832	0.0043				
GMT-6	8	18-Nov-09						
GMT-6	9	25-Nov-09	1.7211	0.0630				
GMT-6	10	2-Dec-09	0.9675	0.0285				
GMT-6	11	9-Dec-09						

Sample		Mid-Week date	Total Mass Flux (g/m^2/day)	orgC Flux (gC/m^2/day)	$CaCO_3$ Flux (g/m^2/day)	OPAL Flux (g/m^2/day)	Terrig Flux (g/m^2/day)	Nitro Flux (g/m^2/day)
GMT-6	12	16-Dec-09	0.5563	0.0149				
GMT-6	13	23-Dec-09	0.5449	0.0177				
GMT-6	14	30-Dec-09	1.1707	0.0323				
GMT-6	15	6-Jan-10						
GMT-6	16	13-Jan-10	1.3810	0.0371				
GMT-6	17	20-Jan-10	0.9555	0.0329				
GMT-6	18	31-Jan-10	0.3169	0.0176				
GMT-6	19	14-Feb-10						
GMT-6	20	24-Feb-10						
GMT-6	21	3-Mar-10	0.1126	0.0086				
GMT-7	1	17-Mar-10	0.2446	0.0134				
GMT-7	2	31-Mar-10	0.2172	0.0158				
GMT-7	3	10-Apr-10	0.2097	0.0166				
GMT-7	4	17-Apr-10	0.1821	0.0124				
GMT-7	5	24-Apr-10	0.1320	0.0107				
GMT-7	6	1-May-10	0.0530	0.0065				
GMT-7	7	8-May-10	0.1003	0.0210				
GMT-7	8	15-May-10	0.1502	0.0144				
GMT-7	9	22-May-10	0.1259	0.0094				
GMT-7	10	29-May-10	0.0959	0.0072				
GMT-7	11	5-Jun-10	0.0920	0.0058				
GMT-7	12	12-Jun-10	0.0558	0.0038				
GMT-7	13	19-Jun-10	0.0851	0.0058				
GMT-7	14	26-Jun-10	0.2481	0.0162				
GMT-7	15	3-Jul-10	0.1902	0.0146				
GMT-7	16	10-Jul-10	0.0690	0.0100				
GMT-7	17	19-Jul-10	0.0512	0.0040				
GMT-7	18	1-Aug-10	0.1767	0.0118				
GMT-7	19	15-Aug-10	0.0162	0.0016				
GMT-7	20	29-Aug-10	0.0225	0.0032				
GMT-7	21	12-Sep-10	0.1517	0.0095				
GMT-8	1	24-Sep-10	0.3429	0.0127				
GMT-8	2	1-Oct-10	0.1586	0.0109				
GMT-8	3	8-Oct-10	0.1241	0.0064				
GMT-8	4	15-Oct-10	0.0581	0.0042				
GMT-8	5	22-Oct-10	0.0801	0.0050				
GMT-8	6	29-Oct-10	0.0534	0.0029				
GMT-8	7	5-Nov-10	0.0895	0.0048				
GMT-8	8	12-Nov-10	0.0502	0.0037				
GMT-8	9	19-Nov-10	0.0840	0.0045				
GMT-8	10	26-Nov-10	0.1343	0.0064				
GMT-8	11	3-Dec-10	0.1272	0.0052				

Sample		Mid-Week date	Total Mass Flux (g/m^2/day)	orgC Flux (gC/m^2/day)	$CaCO_3$ Flux (g/m^2/day)	OPAL Flux (g/m^2/day)	Terrig Flux (g/m^2/day)	Nitro Flux (g/m^2/day)
GMT-8	12	10-Dec-10	0.1510	0.0097				
GMT-8	13	17-Dec-10	0.1835	0.0085				
GMT-8	14	24-Dec-10	0.3952	0.0135				
GMT-8	15	31-Dec-10	0.2671	0.0120				
GMT-8	16	7-Jan-11	0.2279	0.0127				
GMT-8	17	14-Jan-11	0.3211	0.0161				
GMT-8	18	19-Jan-11	0.3388	0.0123				
GMT-9	1	28-Jan-11	0.2920	0.0162				
GMT-9	2	11-Feb-11	0.1806	0.0089				
GMT-9	3	25-Feb-11	0.1800	0.0100				
GMT-9	4	7-Mar-11	0.1326	0.0064				
GMT-9	5	14-Mar-11	0.0857	0.0045				
GMT-9	6	21-Mar-11	0.0949	0.0046				
GMT-9	7	28-Mar-11	0.1074	0.0098				
GMT-9	8	4-Apr-11	0.1051					
GMT-9	9	11-Apr-11	0.1440					
GMT-9	10	18-Apr-11	0.0069					
GMT-9	11	25-Apr-11	0.0309					
GMT-9	12	2-May-11	0.0411					
GMT-9	13	9-May-11	0.0789					
GMT-9	14	16-May-11	0.0731	0.0129				
GMT-9	15	23-May-11	0.1166	0.0043				
GMT-9	16	30-May-11	0.1486	0.0089				
GMT-9	17	6-Jun-11	0.1680	0.0090				
GMT-9	18	17-Jun-11	0.1211	0.0113				
GMT-9	19	1-Jul-11	0.0486	0.0029				
GMT-9	20	15-Jul-11	0.0680	0.0076				
GMT-9	21	31-Jul-11	0.0289	0.0016				
GMT-10	1	21-Aug-11	0.0771					
GMT-10	2	4-Sep-11	0.1137					
GMT-10	3	18-Sep-11	0.0966	0.0064				
GMT-10	4	2-Oct-11	0.0360	0.0017				
GMT-10	5	16-Oct-11	0.1143	0.0069				
GMT-10	6	26-Oct-11	0.1040	0.0042				
GMT-10	7	2-Nov-11	0.0651	0.0028				
GMT-10	8	9-Nov-11	0.2343	0.0076				
GMT-10	9	16-Nov-11	0.0869	0.0038				
GMT-10	10	23-Nov-11	0.0766	0.0041				
GMT-10	11	30-Nov-11	0.0389	0.0024				
GMT-10	12	7-Dec-11	0.1394	0.0088				
GMT-10	13	14-Dec-11	0.0377	0.0016				
GMT-10	14	21-Dec-11	0.0777	0.0034				

Sample		Mid-Week date	Total Mass Flux (g/m^2/day)	orgC Flux (gC/m^2/day)	$CaCO_3$ Flux (g/m^2/day)	OPAL Flux (g/m^2/day)	Terrig Flux (g/m^2/day)	Nitro Flux (g/m^2/day)
GMT-10	15	28-Dec-11	0.2263	0.0068				
GMT-10	16	4-Jan-12	0.5589	0.0177				
GMT-10	17	11-Jan-12	0.1623	0.0085				
GMT-10	18	18-Jan-12	0.0983	0.0064				
GMT-10	19	25-Jan-12	0.0674	0.0040				
GMT-10	20	1-Feb-12	0.0149					
GMT-10	21	8-Feb-12	0.0206	0.0022				
GMT-11	1	30-Mar-12	0.4800	0.0138				
GMT-11	2	6-Apr-12	0.4469	0.0142				
GMT-11	3	13-Apr-12	0.3257	0.0131				
GMT-11	4	20-Apr-12	0.4743	0.0144				
GMT-11	5	27-Apr-12	0.1223	0.0057				
GMT-11	6	4-May-12	0.3131	0.0073				
GMT-11	7	11-May-12	0.2971	0.0108				
GMT-11	8	18-May-12	0.3817	0.0157				
GMT-11	9	25-May-12	0.4343	0.0130				
GMT-11	10	1-Jun-12	0.1931	0.0083				
GMT-11	11	8-Jun-12	0.2000	0.0093				
GMT-11	12	15-Jun-12	0.0857	0.0060				
GMT-11	13	22-Jun-12	0.0789	0.0062				
GMT-11	14	29-Jun-12	0.0926	0.0088				
GMT-11	15	6-Jul-12	0.1874	0.0201				
GMT-11	16	13-Jul-12	0.1794	0.0000				
GMT-11	17	20-Jul-12	0.0446	0.0012				
GMT-11	18	27-Jul-12	0.1874	0.0059				
GMT-11	19	3-Aug-12	0.1520	0.0047				
GMT-11	20	10-Aug-12	0.4000	0.0200				
GMT-11	21	21-Aug-12	0.0011	0.0000				
GMT-12	1	22-Aug-12	0.0280					
GMT-12	2	5-Sep-12	1.1669	0.0531				
GMT-12	3	19-Sep-12	0.3314	0.0130				
GMT-12	4	3-Oct-12	0.2749	0.0112				
GMT-12	5	17-Oct-12	0.1640	0.0095				
GMT-12	6	31-Oct-12	0.2240	0.0099				
GMT-12	7	10-Nov-12	0.1543	0.0046				
GMT-12	8	17-Nov-12	0.0731	0.0032				
GMT-12	9	24-Nov-12	0.1349	0.0060				
GMT-12	10	1-Dec-12	0.0480	0.0014				
GMT-12	11	8-Dec-12	0.0263					
GMT-12	12	15-Dec-12	0.0377					
GMT-12	13	22-Dec-12	0.0480					
GMT-12	14	29-Dec-12	0.0697	0.0019				

ISSN 2331-1258 (online)
http://dx.doi.org/10.3133/ofr20141035