Table 1. Sequence of bubble and dredging tests with prevailing tide stage and number of bucket cycles recorded for each test.

Test	Tide	Dredge Orientation[1]	Date	Time	# Bucket Cycles	Instruments Used
Bubble 1	Flood	North	Jan 29	0945-1045	23	Bucket = OBS (s/n 36) Platform = OBS Surf (s/n 71) OBS Mid (s/n 37) OBS Bottom (s/n 29)
Bubble 2	Slack (high)	North	Jan 29	1300-1330	16	Bucket = OBS (s/n 38) Platform = OBS Surf (s/n 71) OBS Mid (s/n 37) OBS Bottom (s/n 36)
Bubble 3	Ebb	North	Jan 29	1530-1615	20	Bucket = OBS (s/n 29) Platform = OBS Surf (s/n 71) OBS Mid (s/n 37) OBS Bottom (s/n 36)
Short Term 1	Flood	North	Jan 29	1115-1215	24	Bucket = OBS (s/n 38) Platform = OBS Surf (s/n 71) OBS Mid (s/n 37) OBS Bottom (s/n 36)
Short Term 2	Slack (high)	North	Jan 29	1400-1450	26	Bucket = OBS (s/n 38) Platform = OBS Surf (s/n 71) OBS Mid (s/n 37) OBS Bottom (s/n 36)
Short Term 3	Ebb	North	Jan 29	1630-1700	15	Bucket = OBS (s/n 38) Platform = OBS Surf (s/n 71) OBS Mid (s/n 37) OBS Bottom (s/n 36)
Long Term 1	Flood to Slack (high) to Ebb	South	Jan 30	0815-1630	145	Bucket = OBS (s/n 38) Platform = OBS Surf (s/n 71) OBS Mid (s/n 37) OBS Bottom (s/n 36)
Long Term 2	Slack (low) to Flood then Slack (high) to Ebb	South	Jan 31	0800-1630	125	Bucket (inboard) = OBS (s/n 29) Bucket (Outboard) = OBS (s/n 38) Platform = OBS Surf (s/n 71) OBS Mid (s/n 37) OBS Bottom (s/n 36)
Long Term 3	Slack (low) to Flood	South	Feb 1	0745-1615	194	Bucket (inboard) = OBS (s/n 29) Bucket (Outboard) = OBS (s/n 38) Platform = OBS Surf (s/n 71) OBS Mid (s/n 37) OBS Bottom (s/n 36)

[1] Dredge orientation refers to the approximate direction that the bow of the dredge platform and bucket were facing.

Table 2. Summary of bucket descent and ascent speeds during the long-term dredging tests.

Bucket Speed (feet/second)	Descent		Ascent	
	Mean	(Range)	Mean	(Range)
Long-Term Test #1	4.15	(2.20 – 5.40)	2.13	(1.85 – 2.24)
Long-Term Test #2 Inboard	4.44	(1.71 – 5.43)	2.17	(2.03 – 2.25)
Long-Term Test #2 Outboard	4.32	(2.45 – 5.15)	2.15	(2.09 – 2.20)
Long-Term Test #3	4.36	(2.30 – 5.30)	2.13	(1.53 – 2.19)

a)

b)

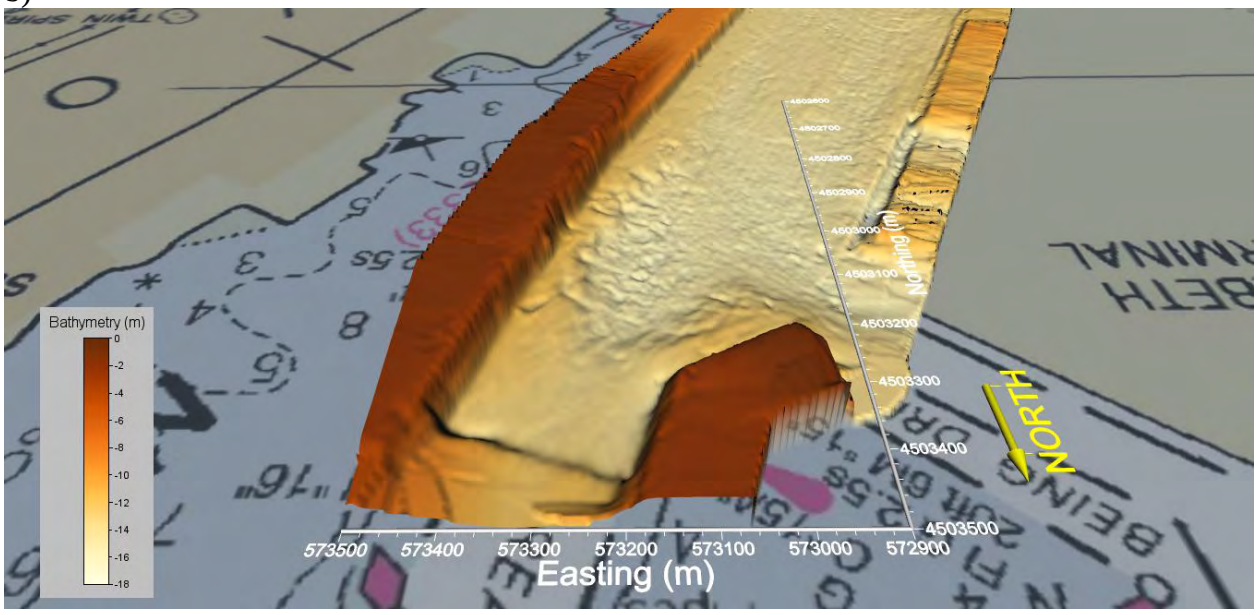

Figure 1. a) Option areas of the S-NB-1 Contract area of the NY/NJ Harbor Deepening Project and b) bathymetry of S-NB-1 dredge contract area during the Pilot Study.

Figure 2. Cable Arm bucket in the open position. Note that the lowest row of vents has been closed by welding metal strips across the flaps.

Figure 3. Cable Arm bucket in the closed position.

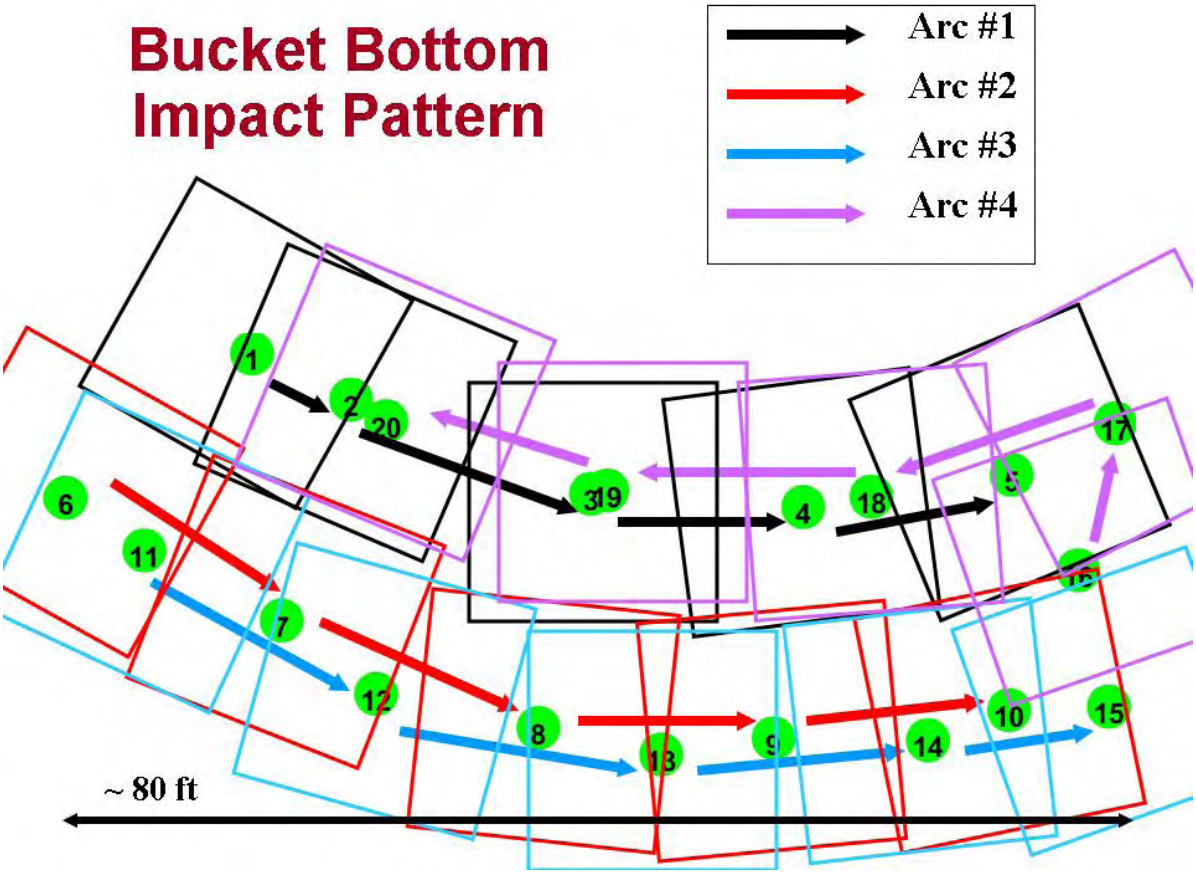

Figure 4. Bucket impact position for a typical series of four arcs conducted between advances of the dredge. A sequence of 20 bucket cycles is shown as numbered green dots. The example progression is based on an actual DGPS record of bucket impact points during a long-term test on January 30, 2008. The color coded rectangles centered on each dot represent the approximate plan-view dimensions of the bucket in the open position as it would come in contact with the bottom.

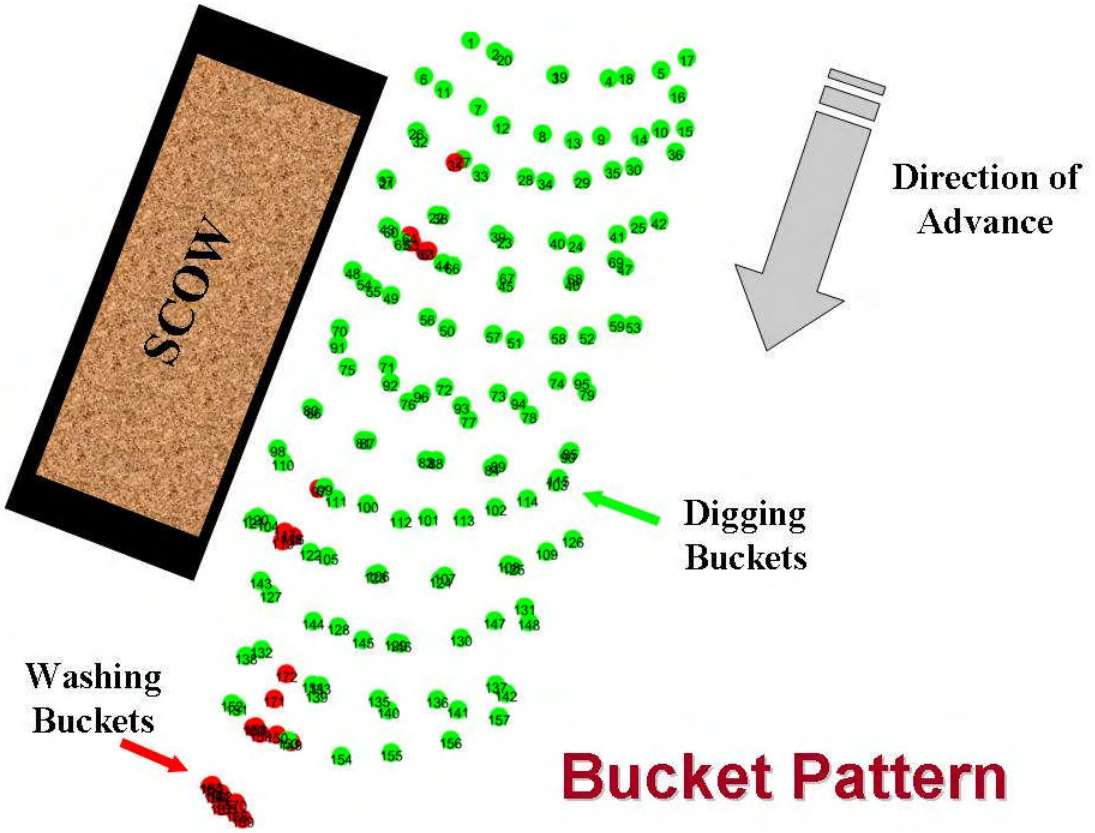

Figure 5. Plan-view distribution of bucket impact points on the bottom in relation to orientation of the receiving scow. Each numbered green dot represents a single bucket impact location based on DGPS offset data derived from a known reference point on the derrick. The scow is not drawn to scale. The numbered red dots represent non-digging bucket cycles used to collect water to wash the deck of the scow. Data from long-term dredging test on January 30, 2008.

Figure 6. Instrumentation as mounted on the bucket. Upper orange canister contains an accelerometer array. Lower white and black unit is a battery-powered optical backscatter sensor (OBS-3A) with the sensor facing laterally outward from the central bucket support rib and outboard in relation to the bucket's internal axis. When the bucket was closed the instruments were oriented horizontally. When the bucket was open the instruments were oriented at an approximately 45 degree angle from the vertical.

Figure 7. Sensor location. The orange accelerometer canister and white OBS housing are visible attached to the bucket's central support rib. This sensor array is on the "inboard" side of the bucket, which always faces the derrick and operator's cab.

Figure 8. Location of sensors deployed from the dredge platform. The vertical tube supports the ADCP transducer assembly just below the water's surface. A string of three OBS units was deployed outboard from the ADCP mount.

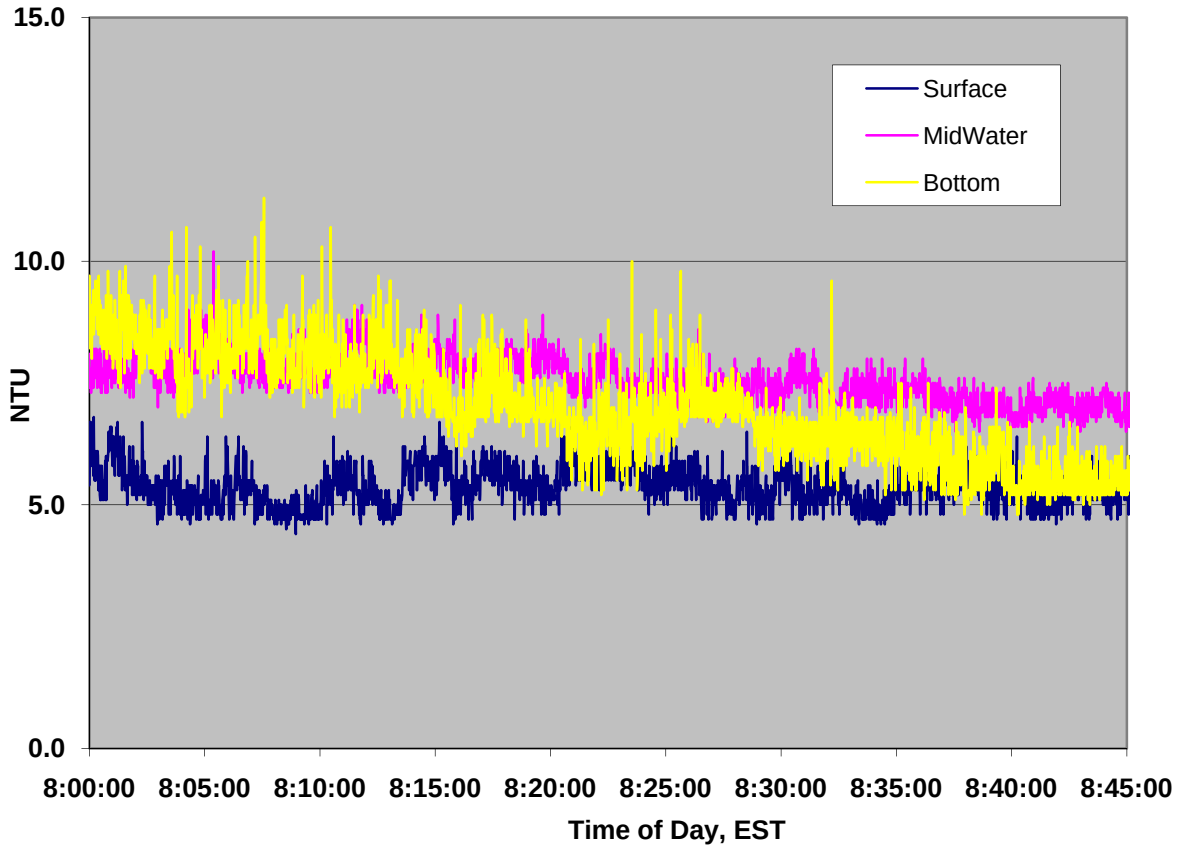

Figure 9. Example of ambient turbidity data collected by platform OBS units on January 31, 2008.

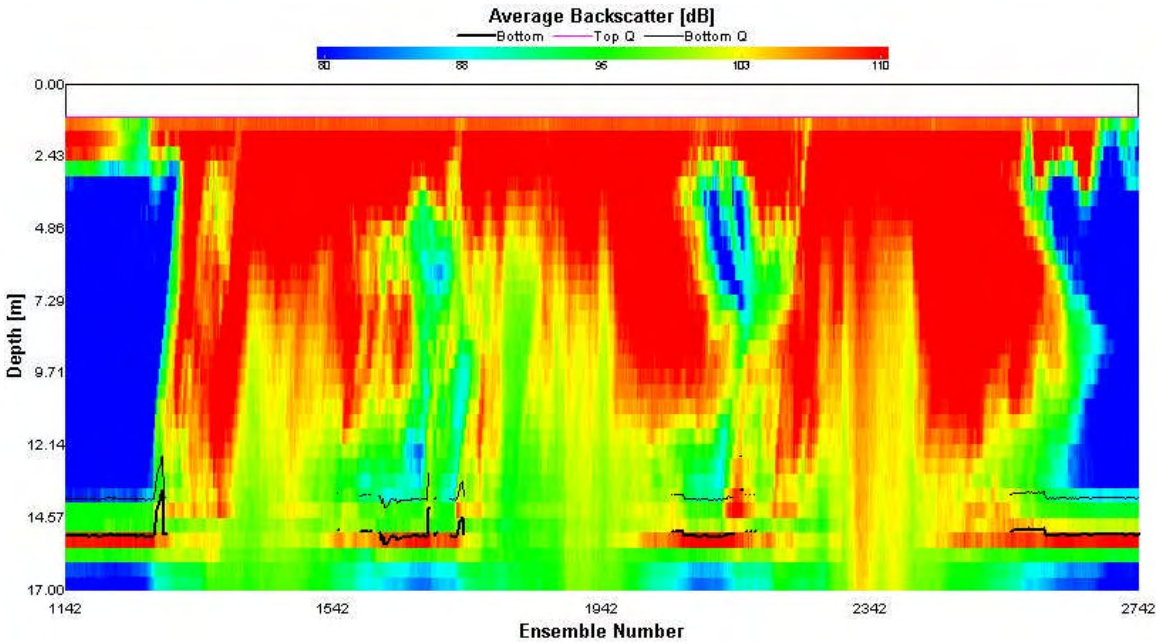

Figure 10. ADCP backscatter signal during the ebb tide bubble test on January 29, 2008.

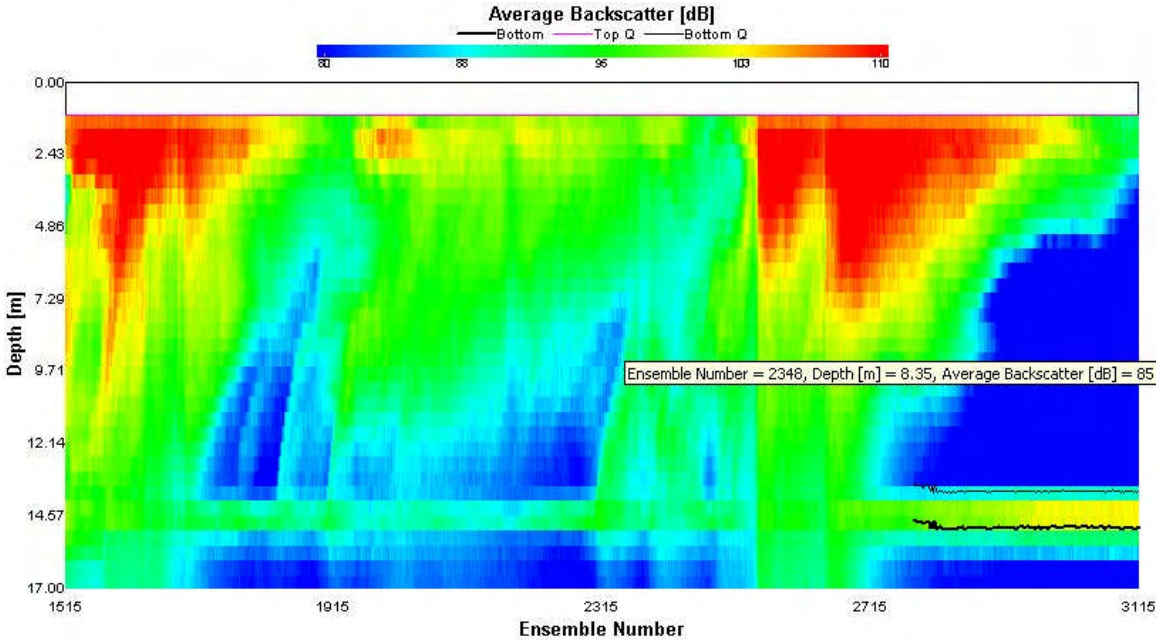

Figure 11. ADCP backscatter signal during the slack tide bubble test on January 29, 2008.

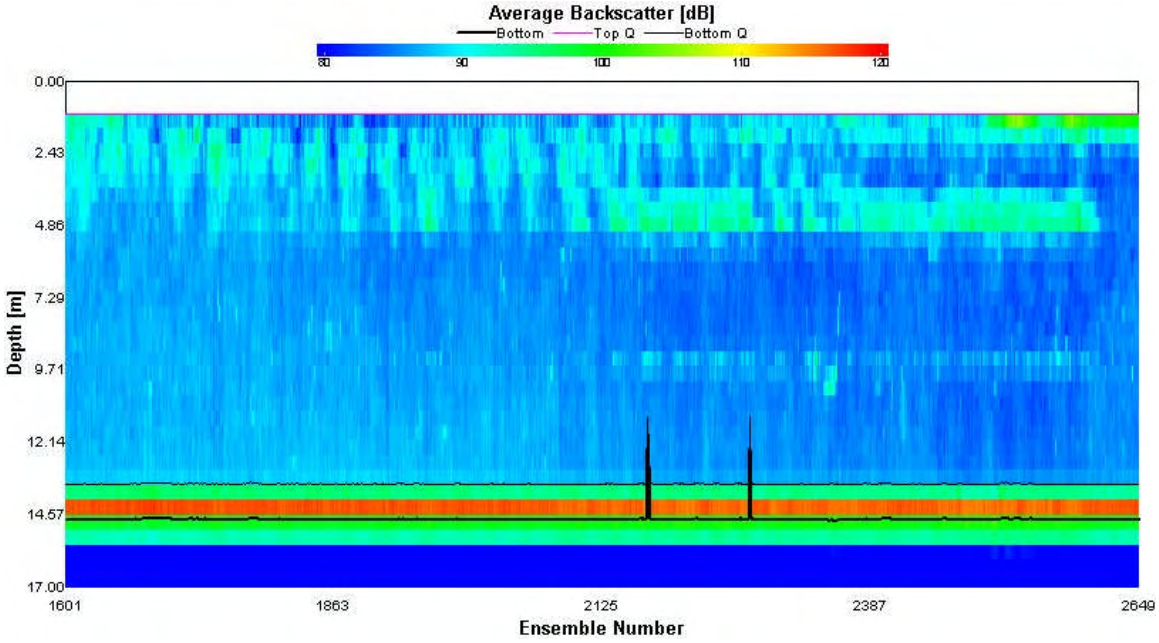

Figure 12. ADCP backscatter signal during the flood tide bubble test on January 29, 2008.

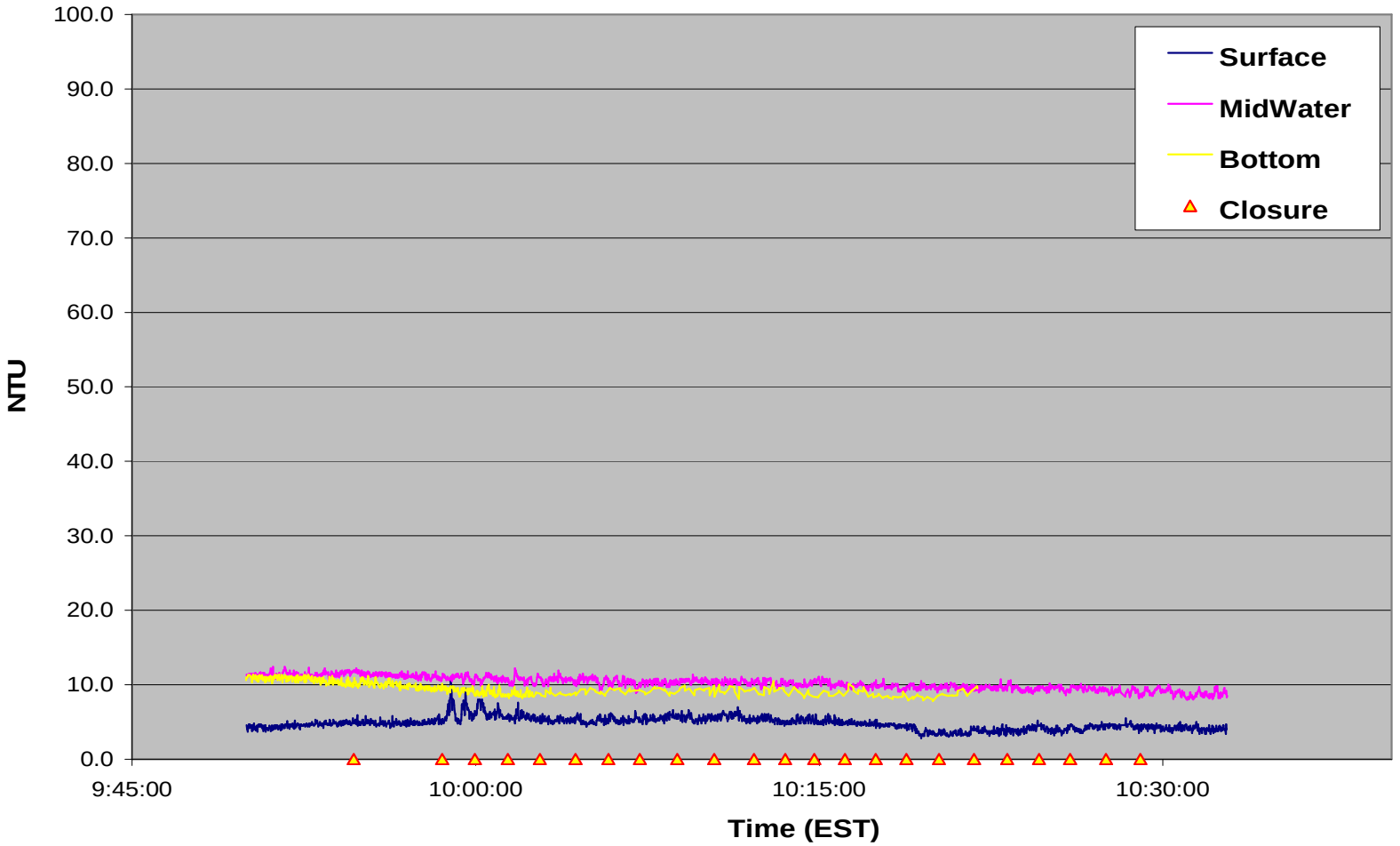

Figure 13. Turbidity measurements obtained by OBS instruments deployed from the dredge platform during the first bubble test, which occurred on a flooding tide on January 29, 2008.

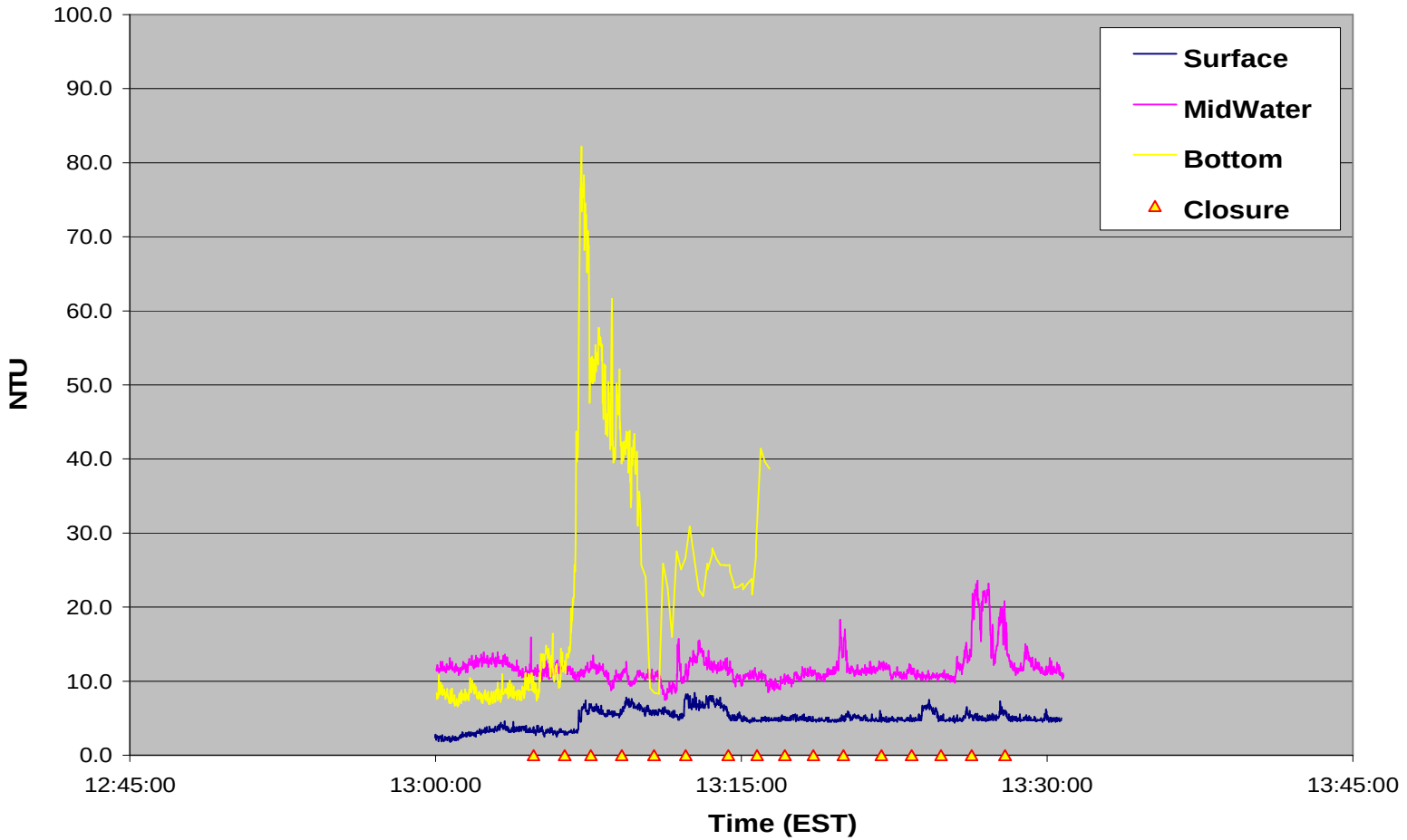

Figure 14. Turbidity measurements obtained by OBS instruments deployed from the dredge platform during the second bubble test, which occurred during slack tide on January 29, 2008.

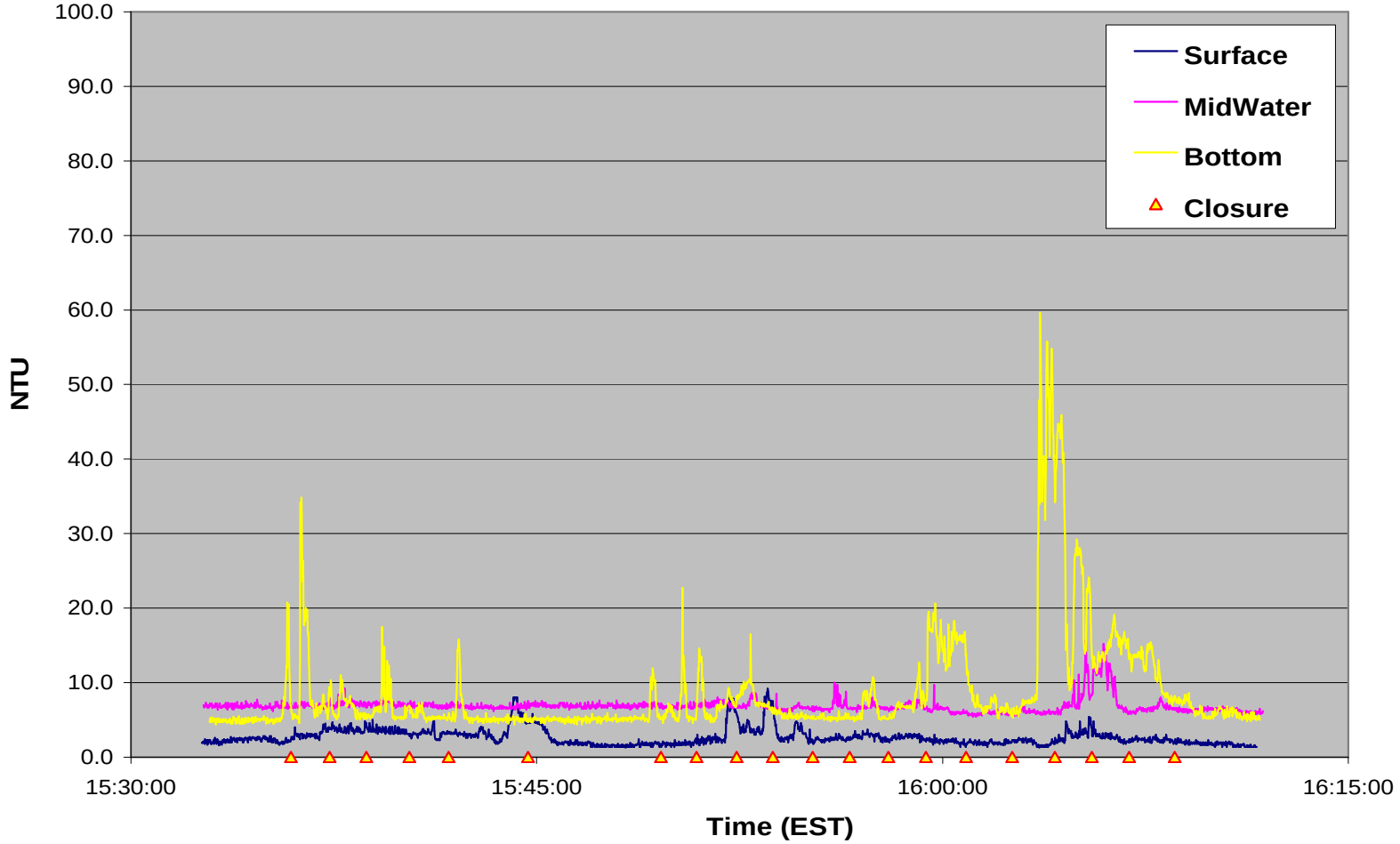

Figure 15. Turbidity measurements obtained by OBS instruments deployed from the dredge platform during the third bubble test, which occurred on an ebbing tide on January 29, 2008.

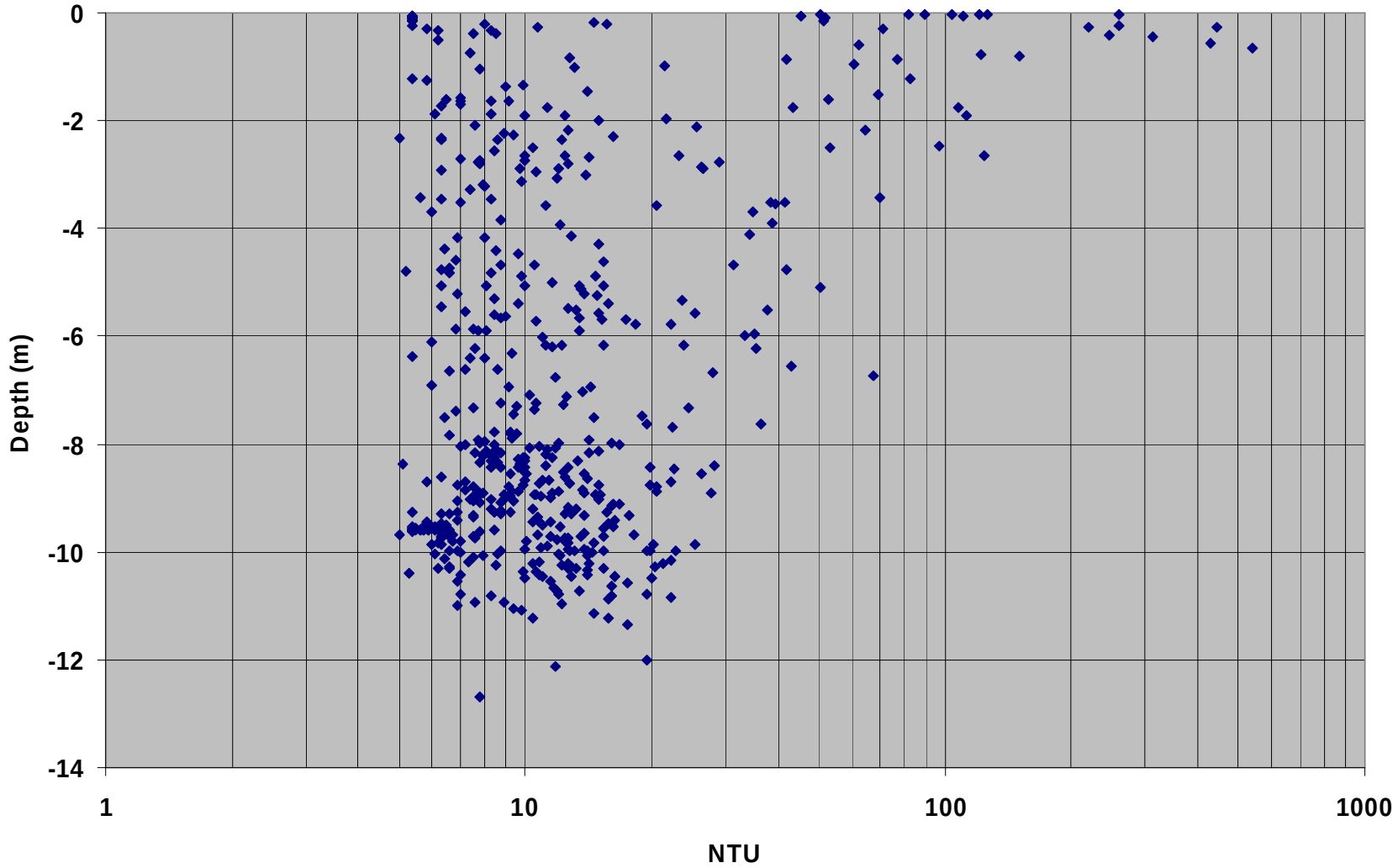

Figure 16. Turbidity data plotted against depth for bucket-mounted OBS instrument for all bubble tests. Note logarithmic scale of X-axis.

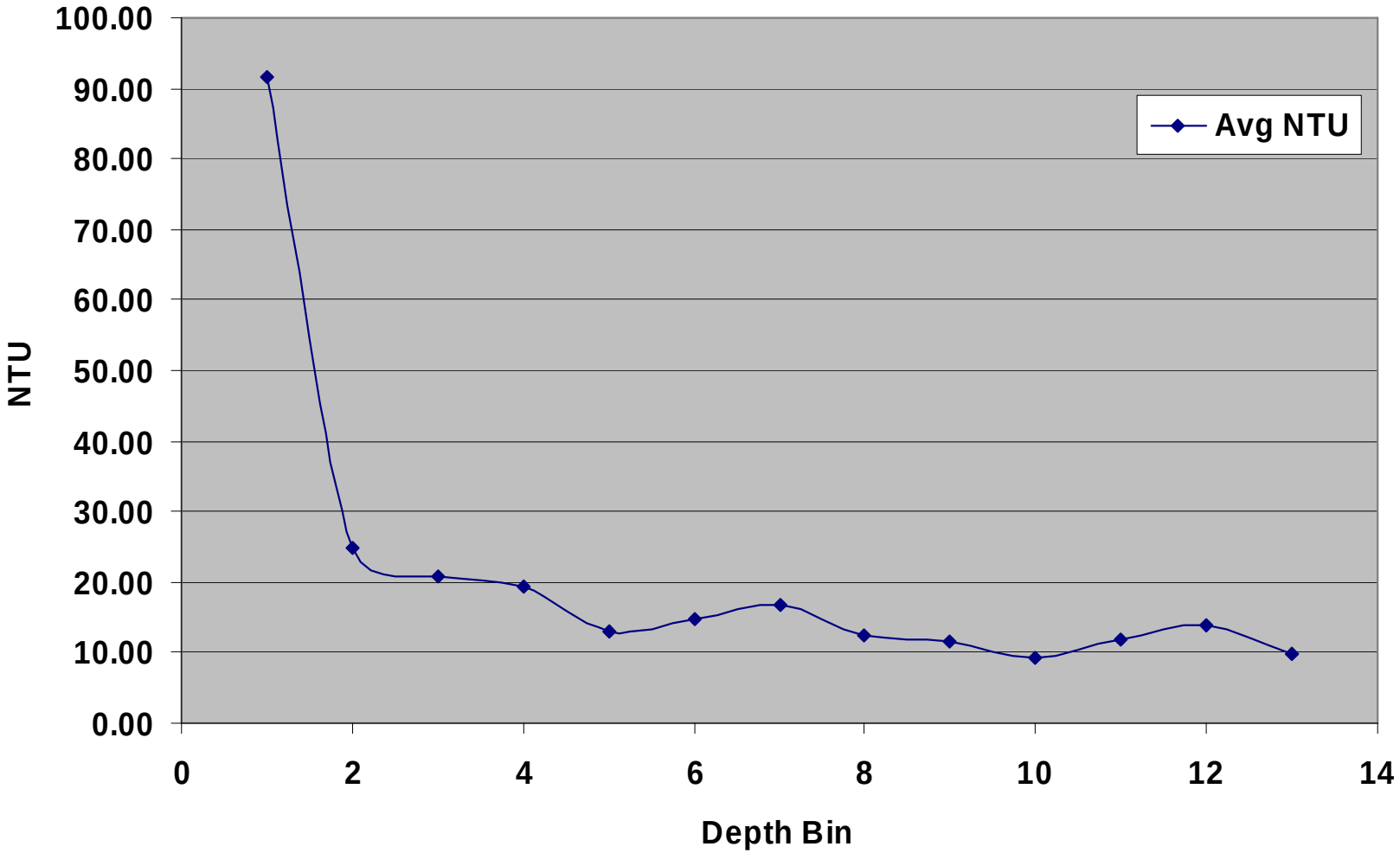

Figure 17. Average turbidity measurements by depth strata for a bucket-mounted OBS instrument during all bubble tests.

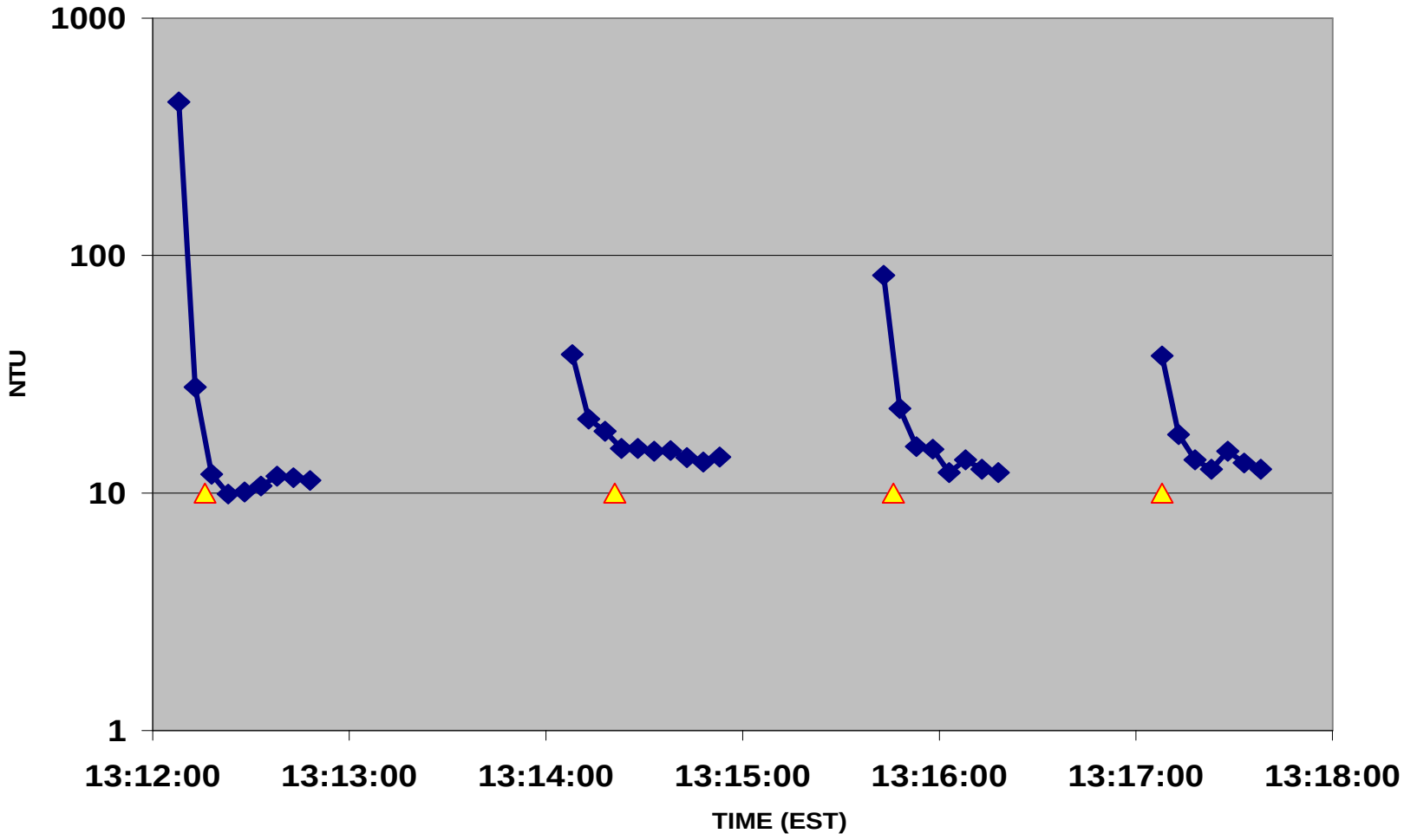

Figure 18. A typical series of turbidity measurements from a bucket-mounted OBS instrument during a bubble test. Yellow triangles represent synchronized bucket closure times. The gap between successive bucket cycles result from deletion of measurements made while the bucket was above the surface of the water.

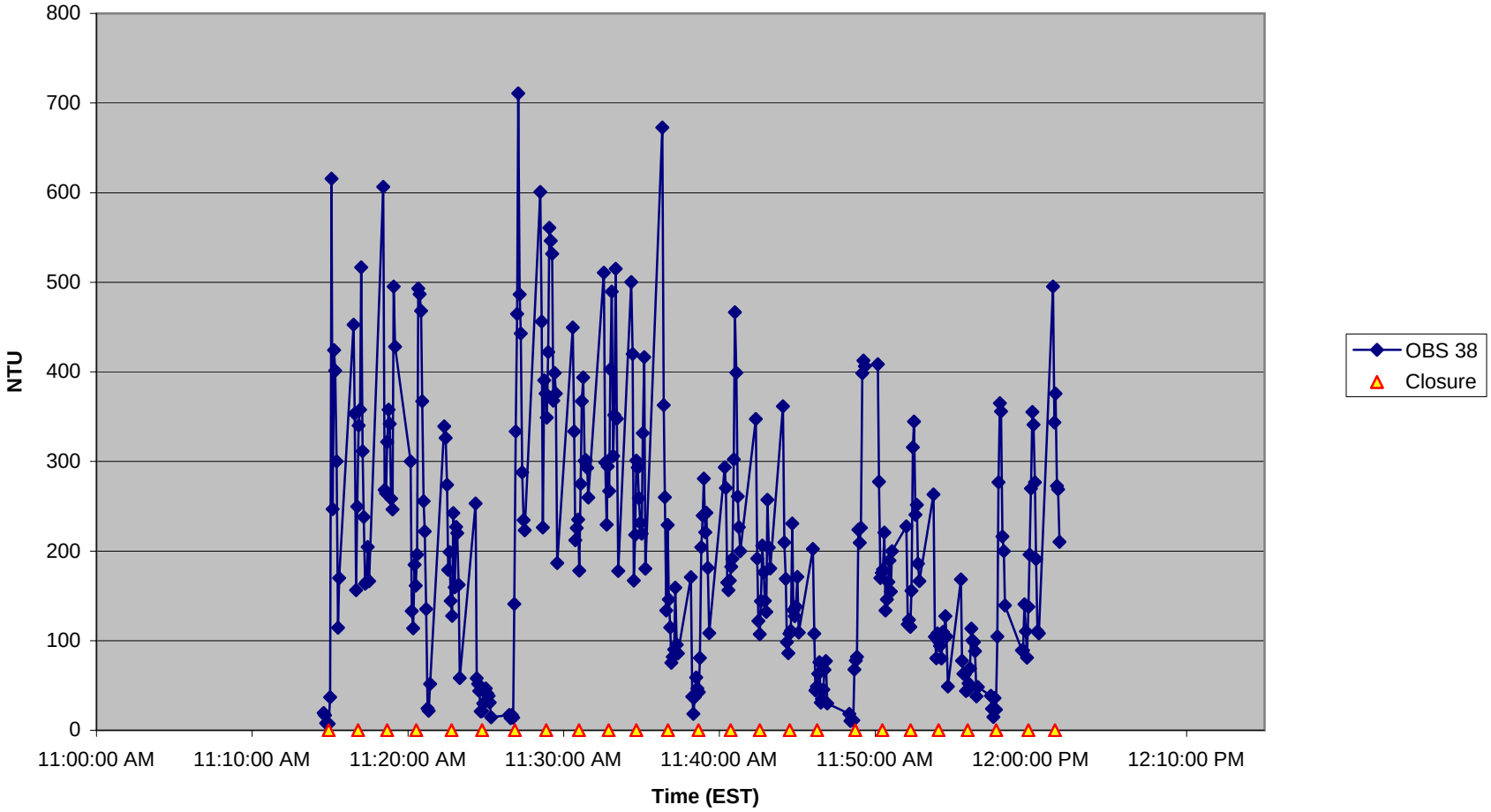

Figure 19. Turbidity measurements obtained from the bucket mounted OBS Unit during the first short-term duration dredging test (flood tide) on January 29, 2008.

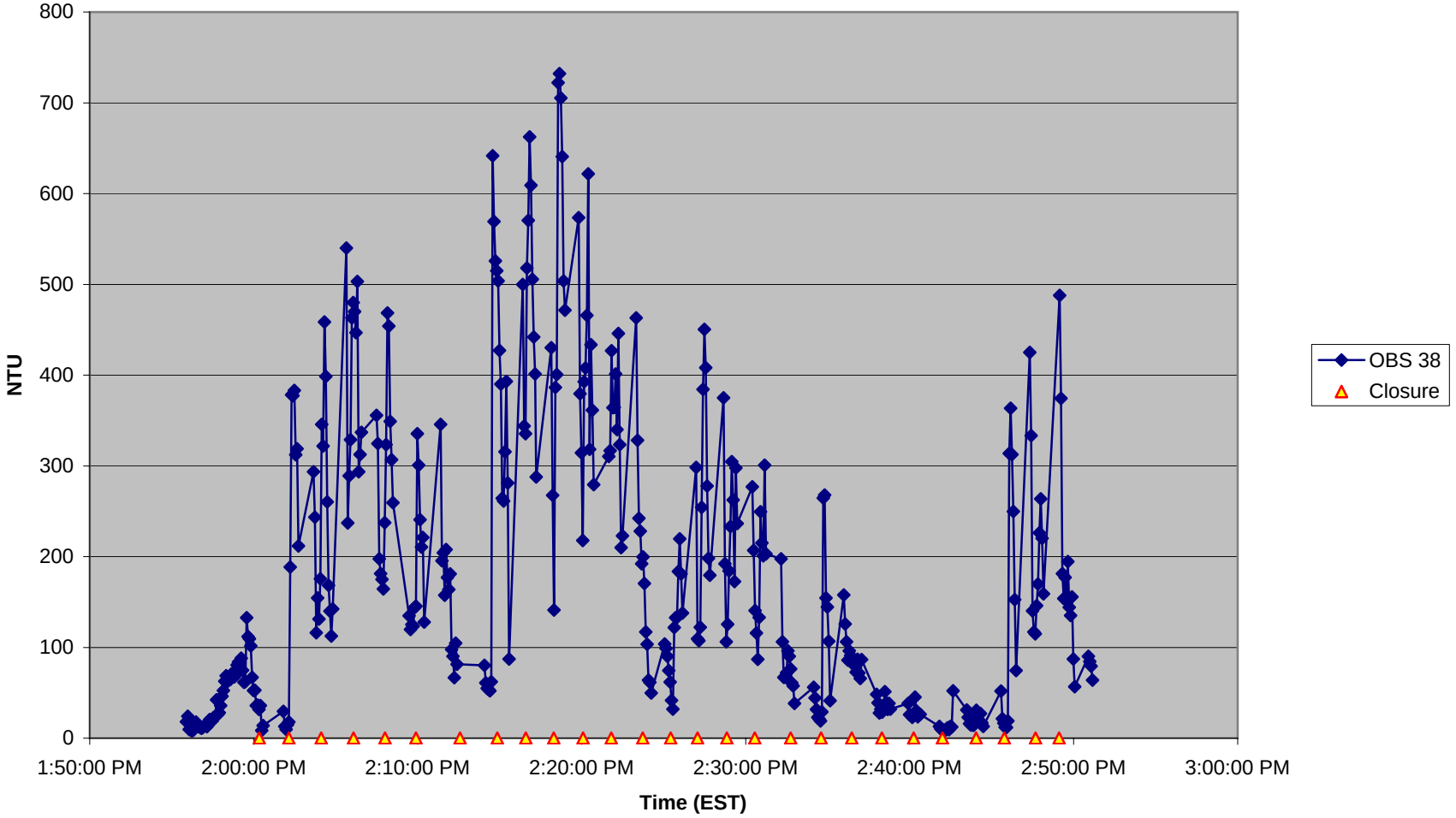

Figure 20. Turbidity measurements obtained from the bucket mounted OBS Unit during the second short-term duration dredging test (high slack tide) on January 29, 2008.

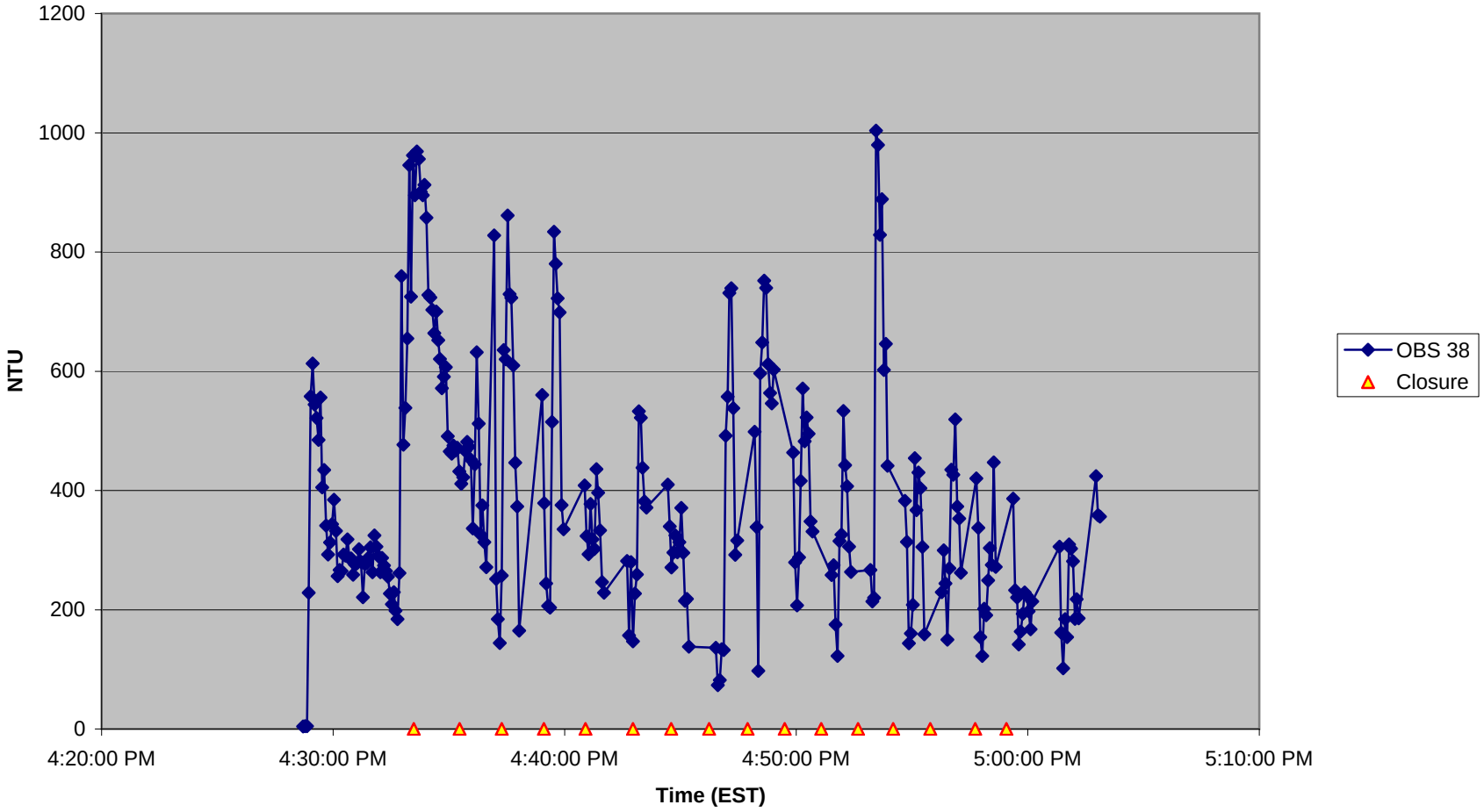

Figure 21. Turbidity measurements obtained from the bucket mounted OBS Unit during the third short-term duration dredging test (ebb tide) on January 29, 2008.

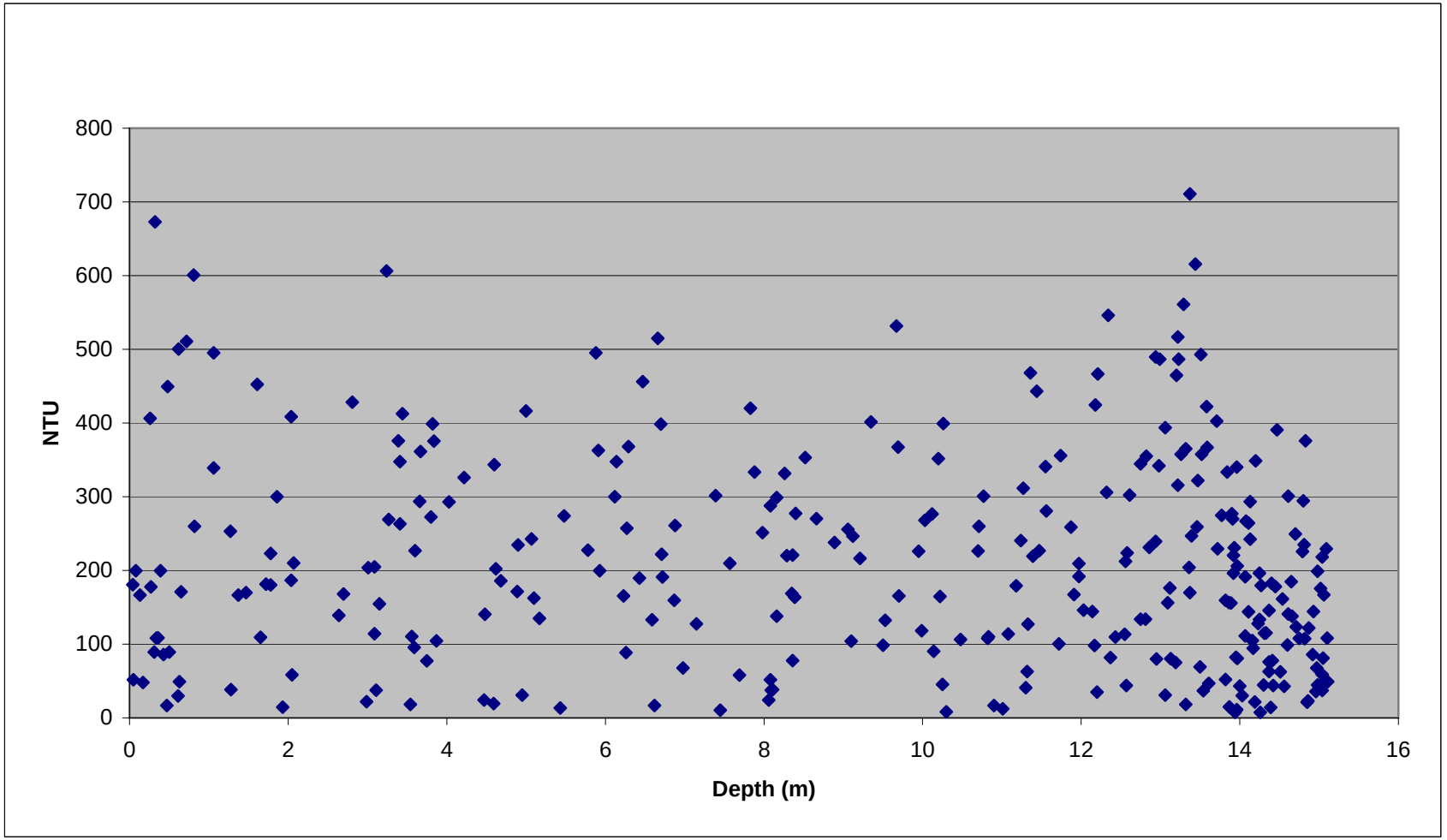

Figure 22. Turbidity measurements plotted versus depth and obtained from the bucket mounted OBS Unit during the first short-term duration dredging test (flood tide) on January 29, 2008.

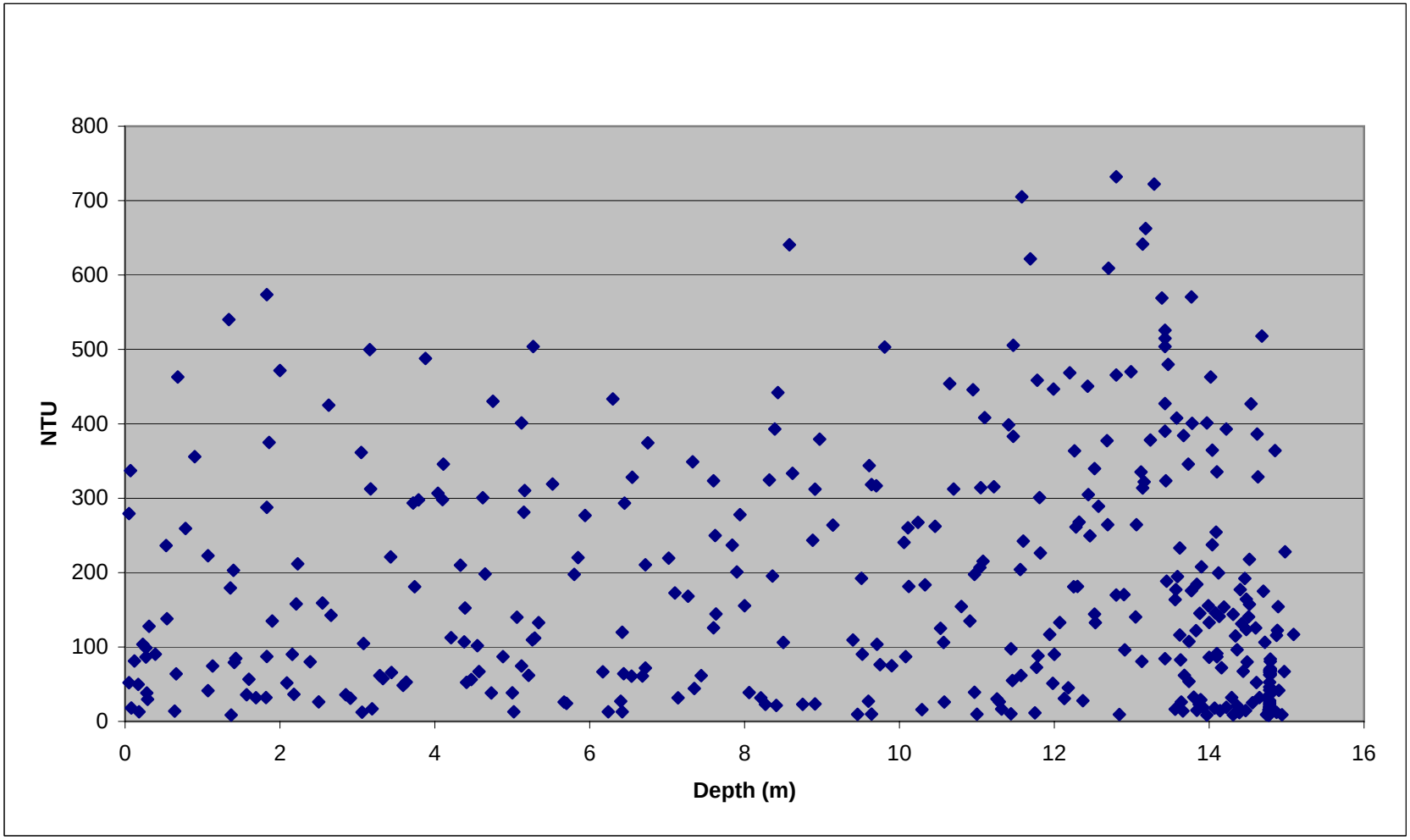

Figure 23. Turbidity measurements plotted versus depth and obtained from the bucket mounted OBS Unit during the second short-term duration dredging test (high slack tide) on January 29, 2008.

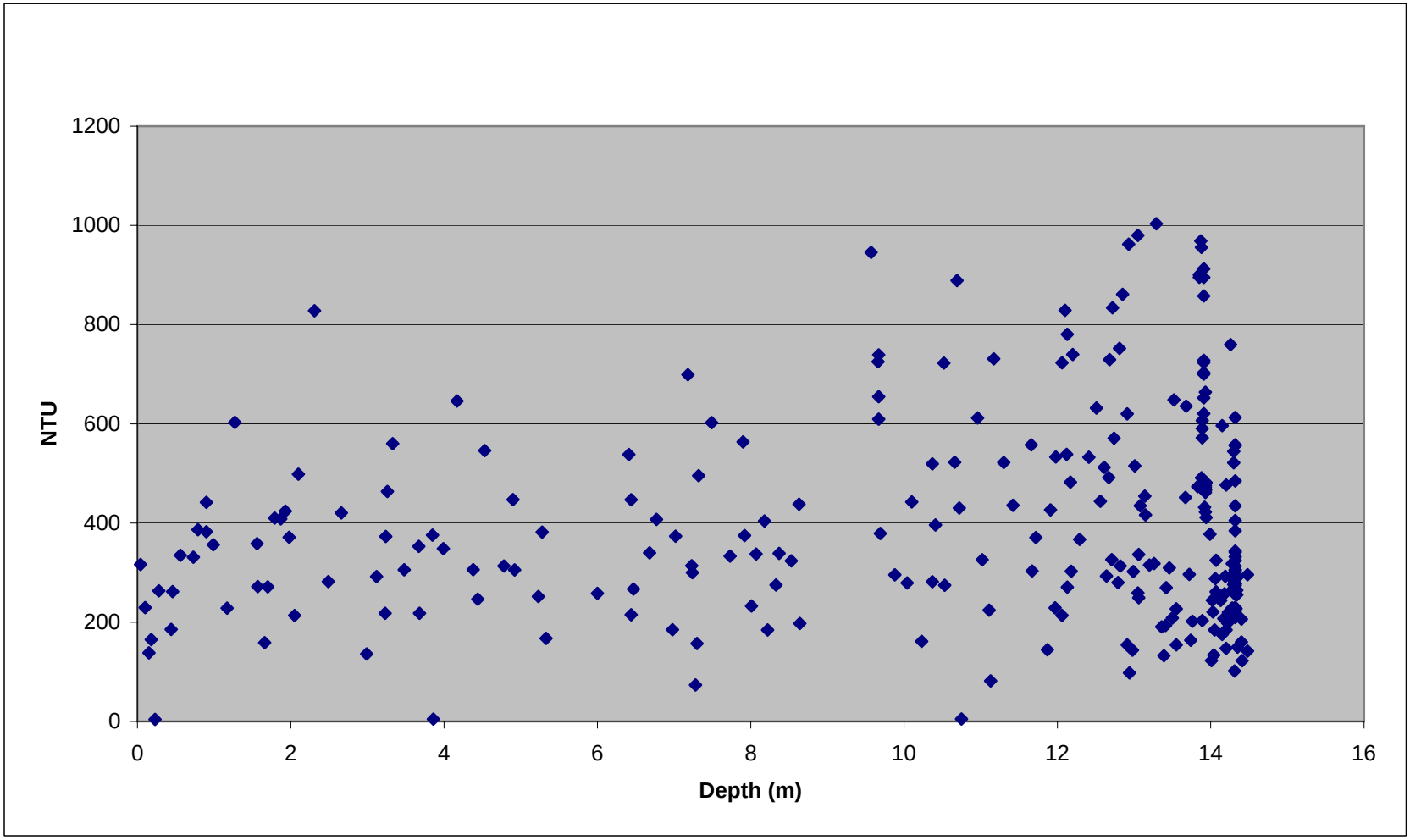

Figure 24. Turbidity measurements plotted versus depth and obtained from the bucket mounted OBS Unit during the third short-term duration dredging test (ebb tide) on January 29, 2008.

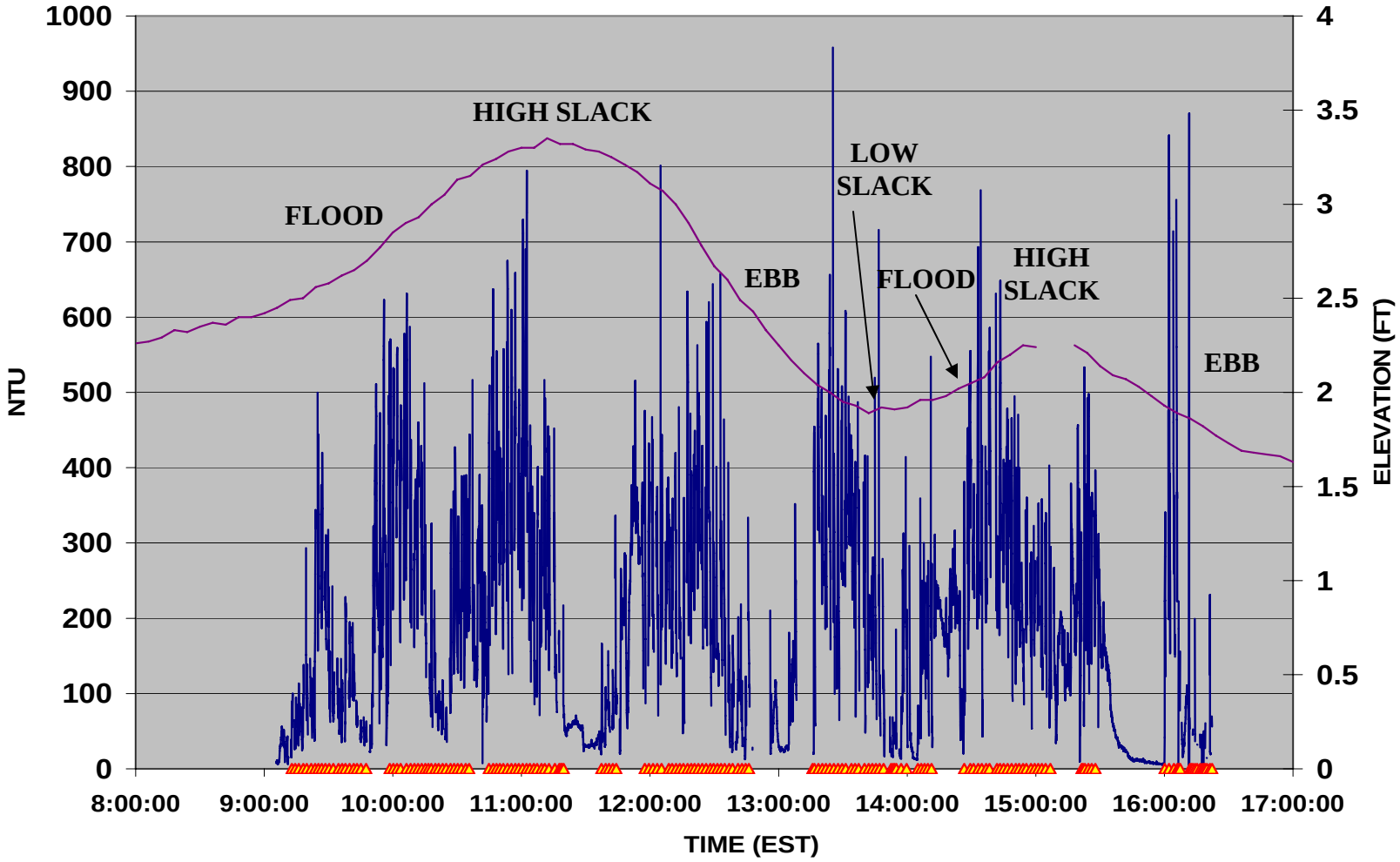

Figure 25. Turbidity measurements obtained by a bucket-mounted sensor during the first long-term dredging test on January 30, 2008.

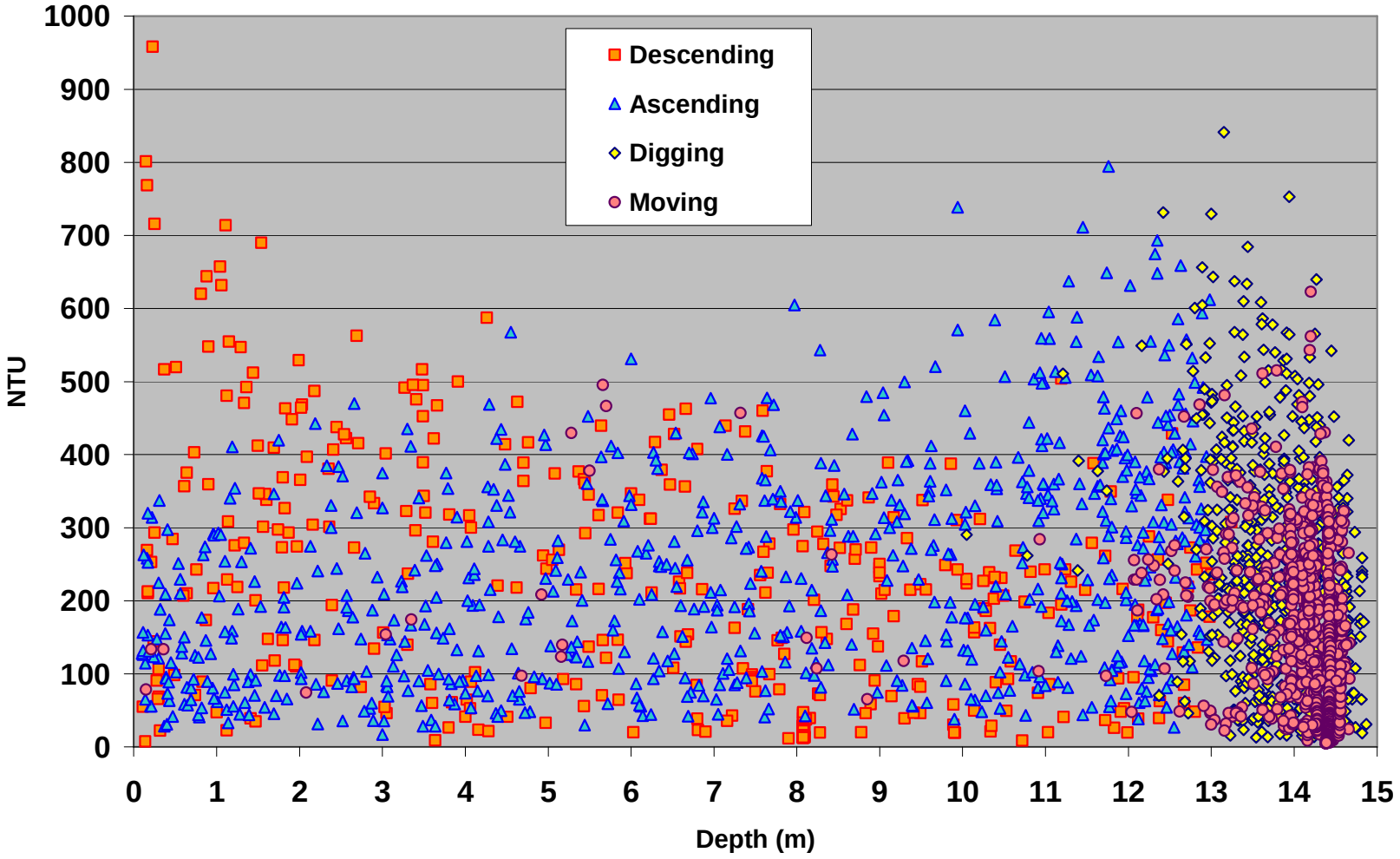

Figure 26. All turbidity measurements obtained by a bucket-mounted sensor during the first long-term dredging test on January 30, 2008.

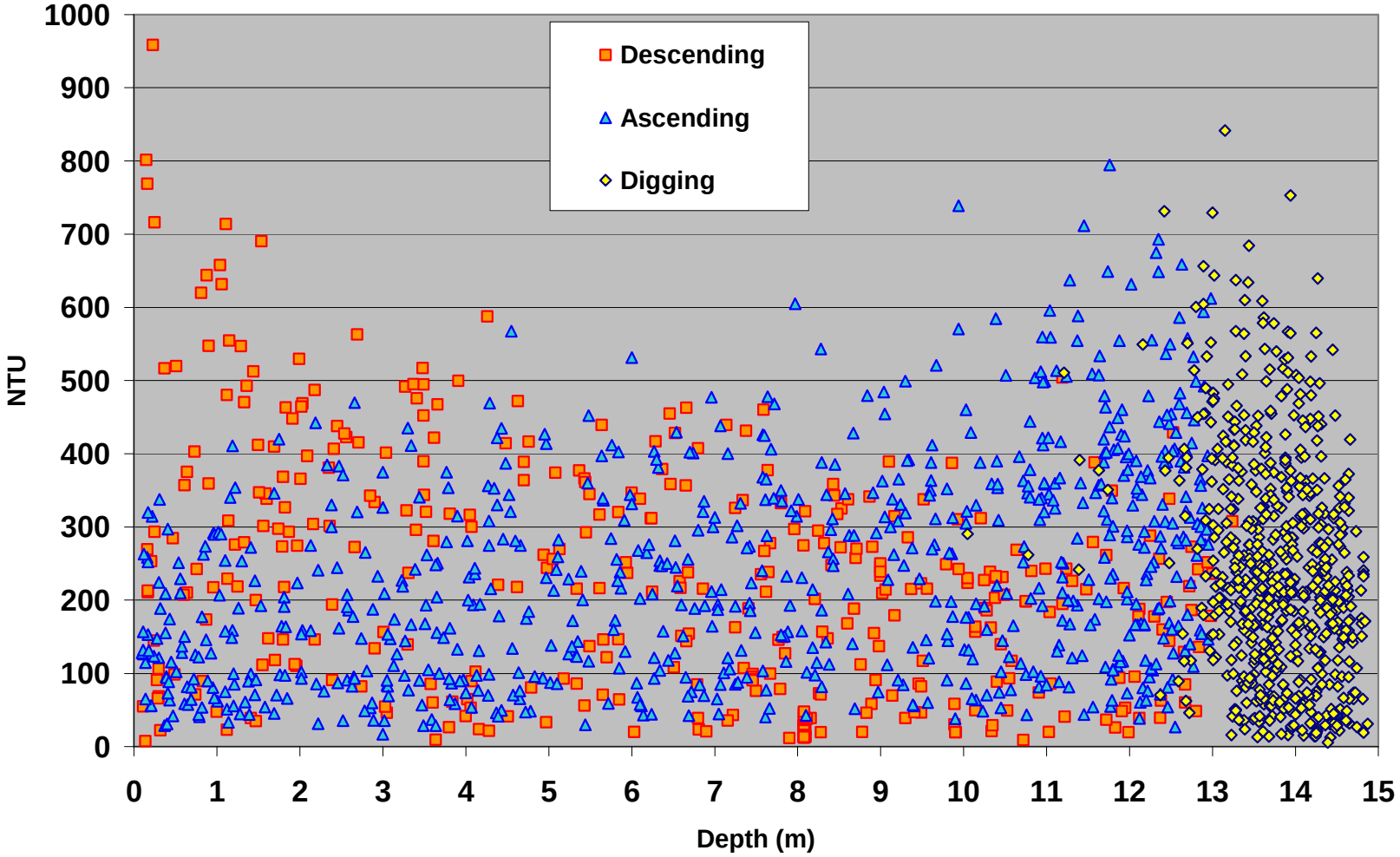

Figure 27. Bucket-mounted turbidities during the first long-term dredging test on January 30, 2008; descent, ascent and dredging data only.

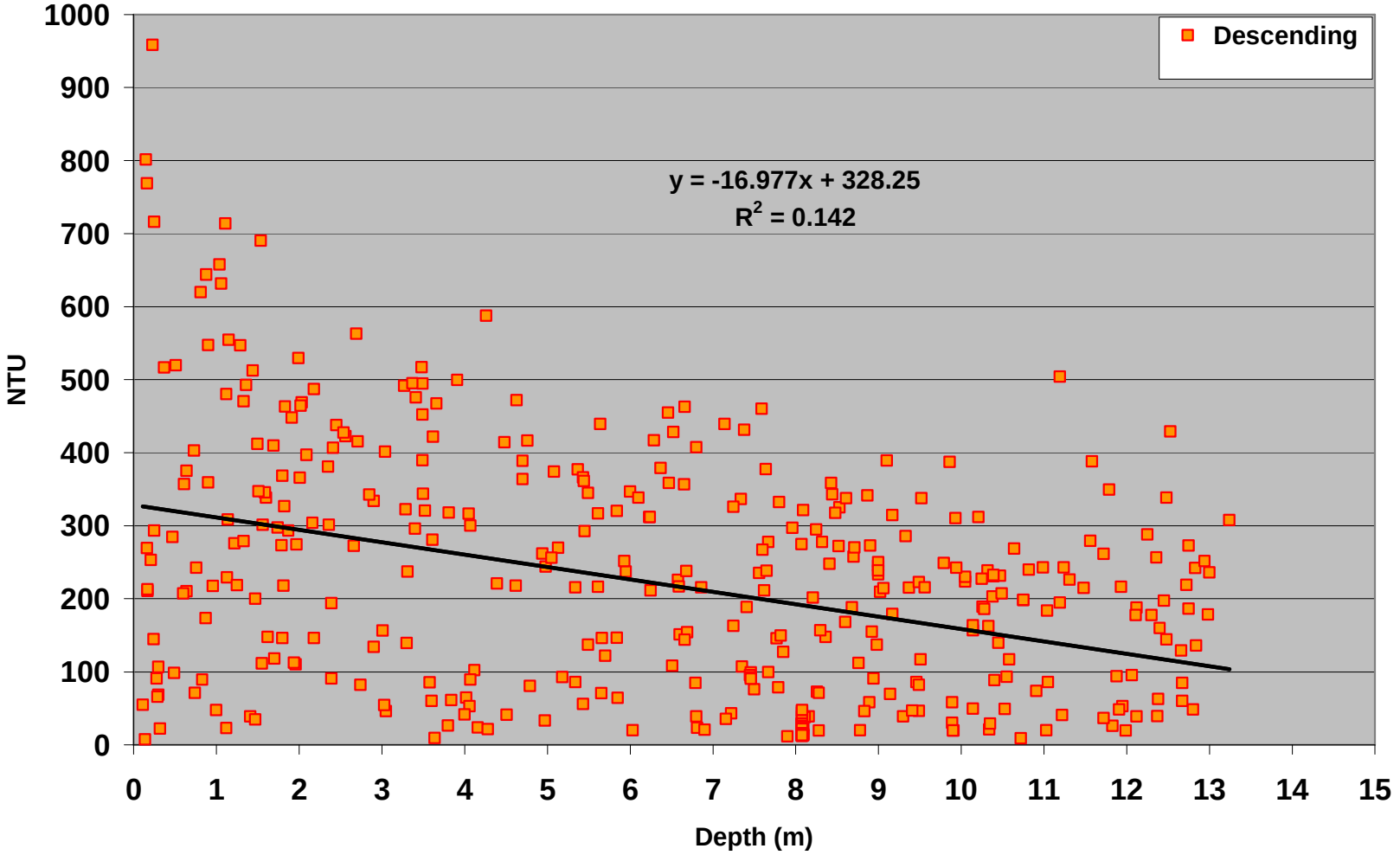

Figure 28. All turbidity measurements obtained by a bucket-mounted sensor during the descent component of the bucket cycle during the first long-term dredging test on January 30, 2008.

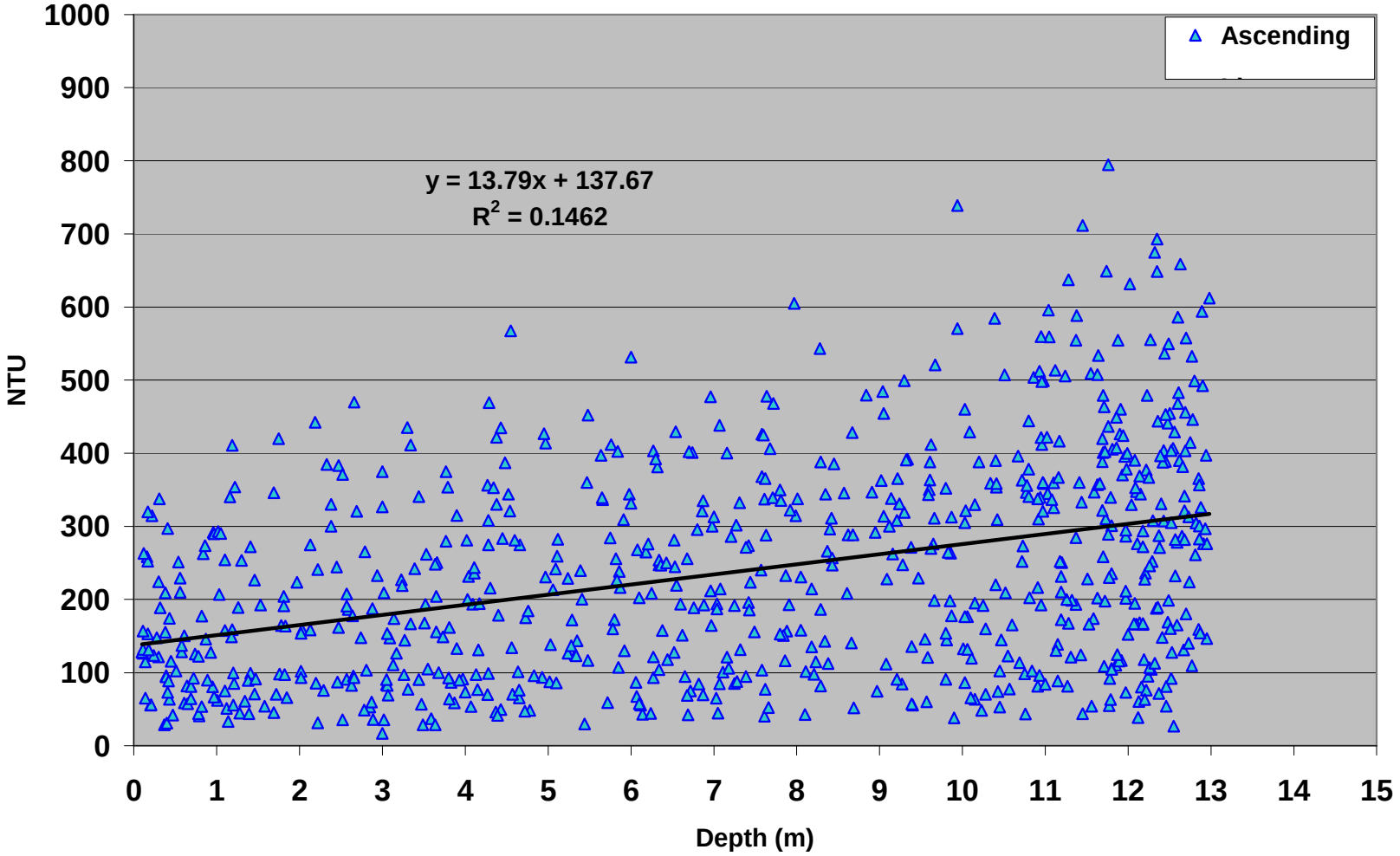

Figure 29. All turbidity measurements obtained by a bucket-mounted sensor during the ascent component of the bucket cycle during the first long-term dredging test on January 30, 2008.

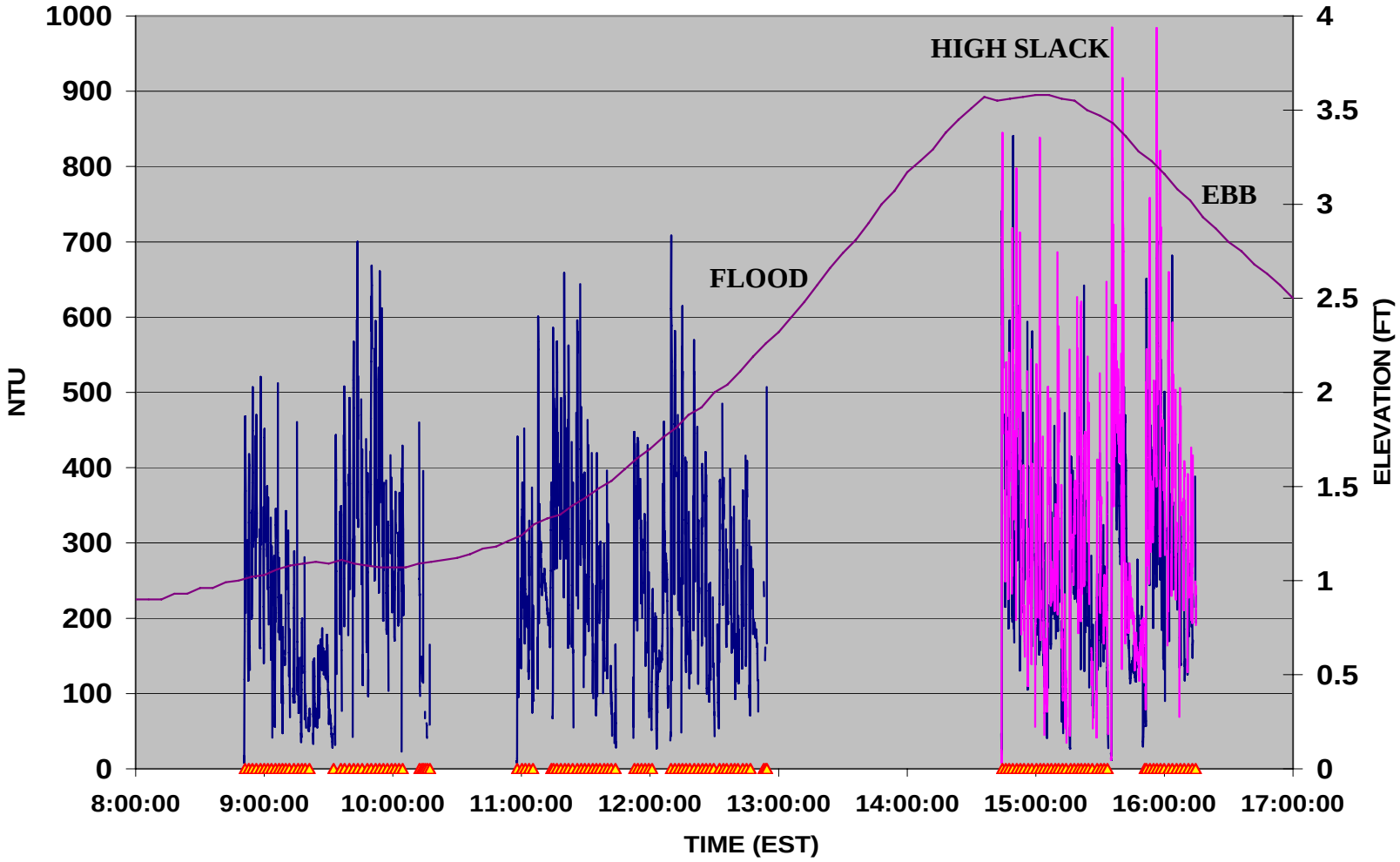

Figure 30. Turbidity measurements obtained by a bucket-mounted sensor during the second long-term dredging test on January 31, 2008. Note two sensors were mounted on opposite sides of bucket: inboard sensor (blue) & outboard sensor (purple).

Figure 31. Location of OBS instrument on the outboard side of the bucket.

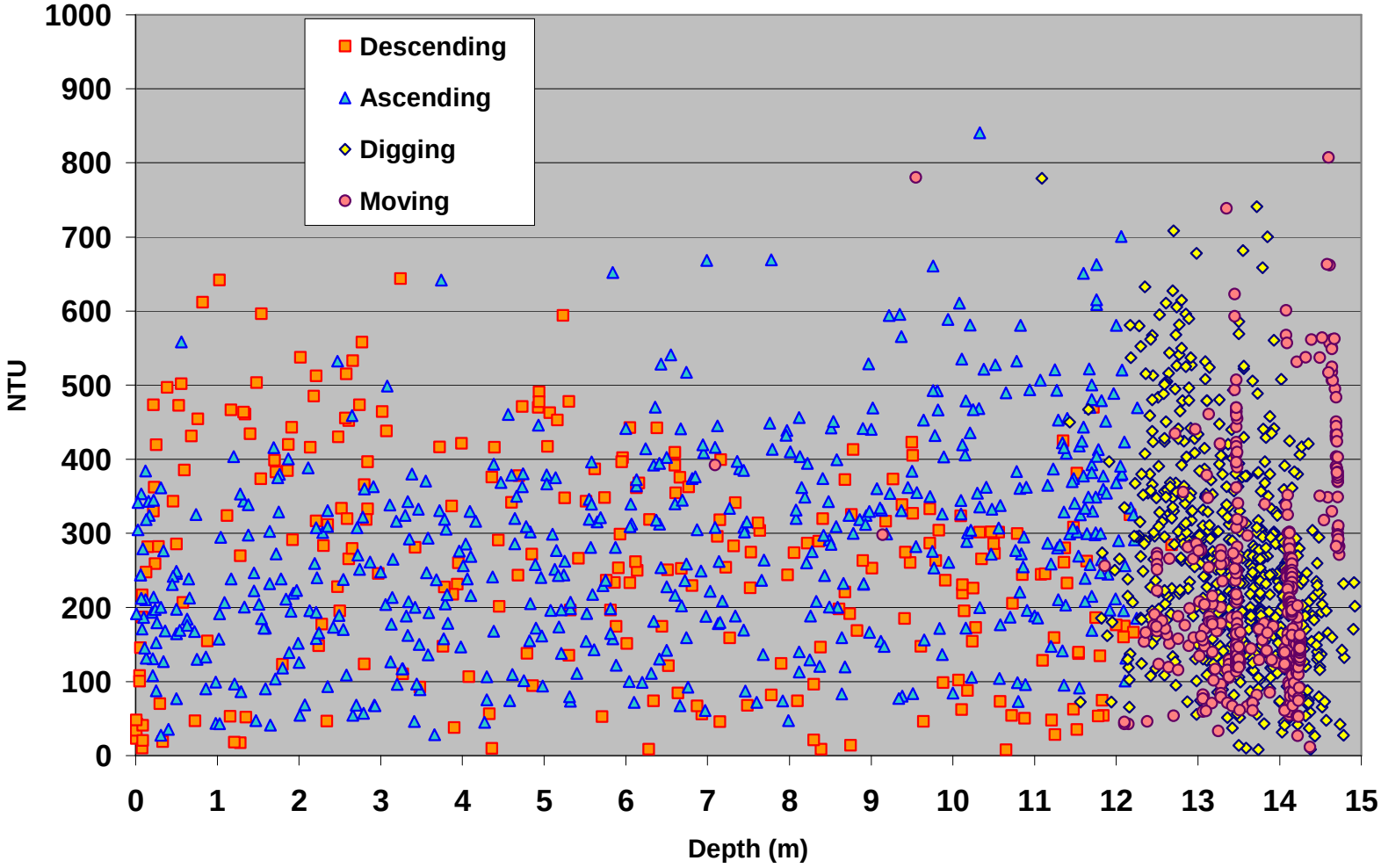

Figure 32. All turbidity measurements obtained by a bucket-mounted sensor (inboard side) during the second long-term dredging test on January 31, 2008.

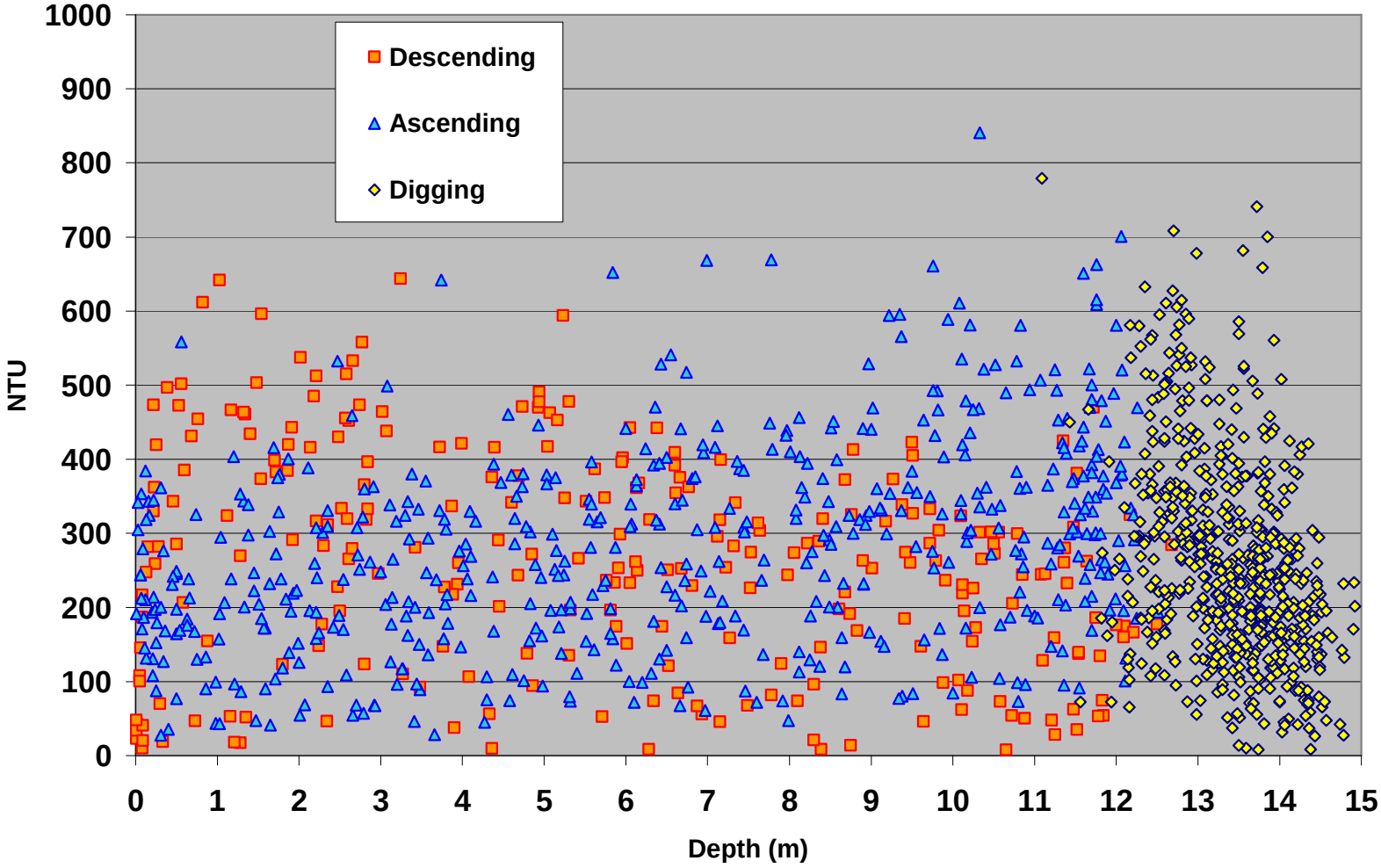

Figure 33. All turbidity measurements obtained by a bucket-mounted sensor (inboard side) during the second long-term dredging test after removal of all data for dredge advances on January 31, 2008.

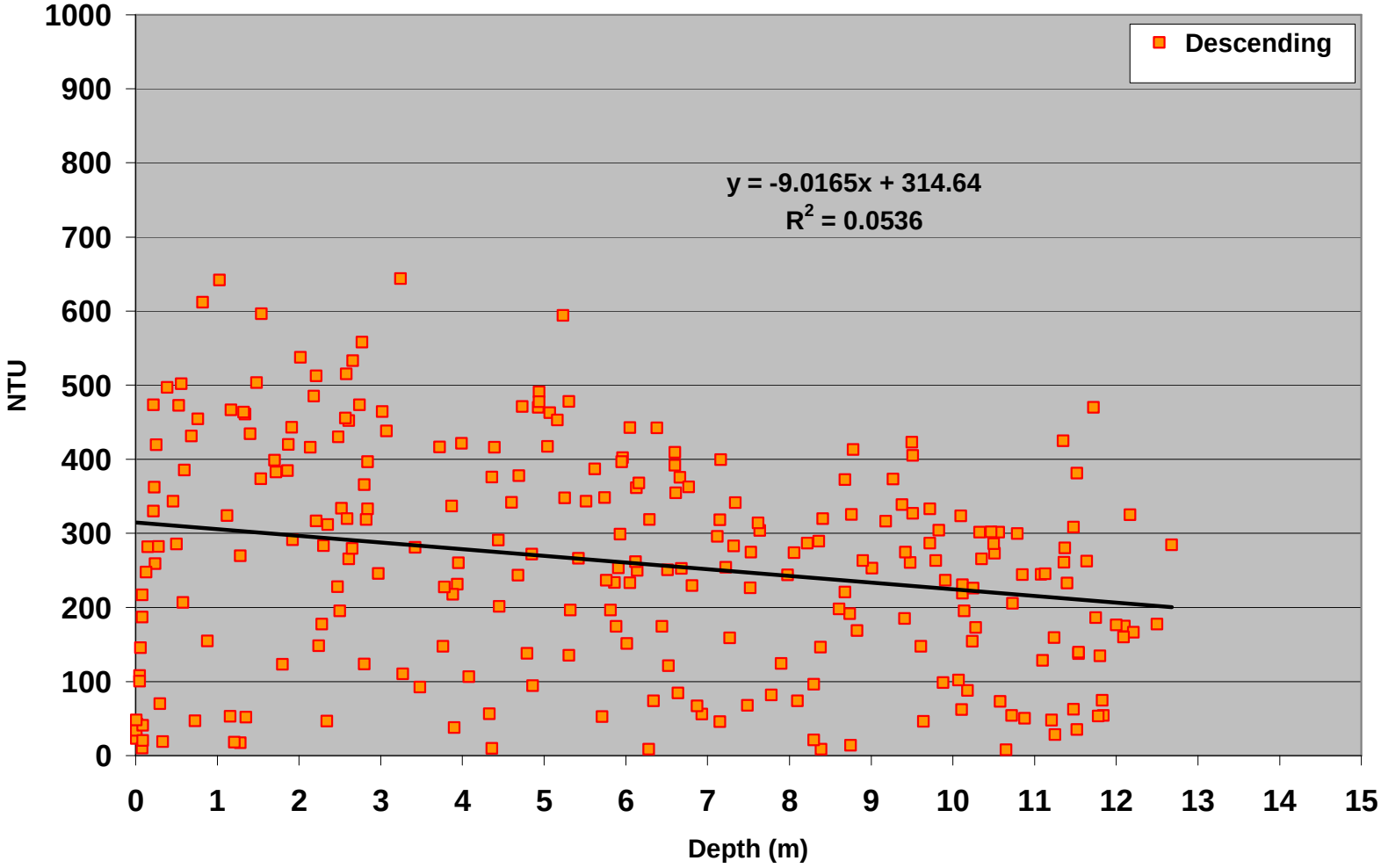

Figure 34. All turbidity measurements obtained by a bucket-mounted sensor (inboard side) during the descent component of the bucket cycle during the second long-term dredging test on January 31, 2008.

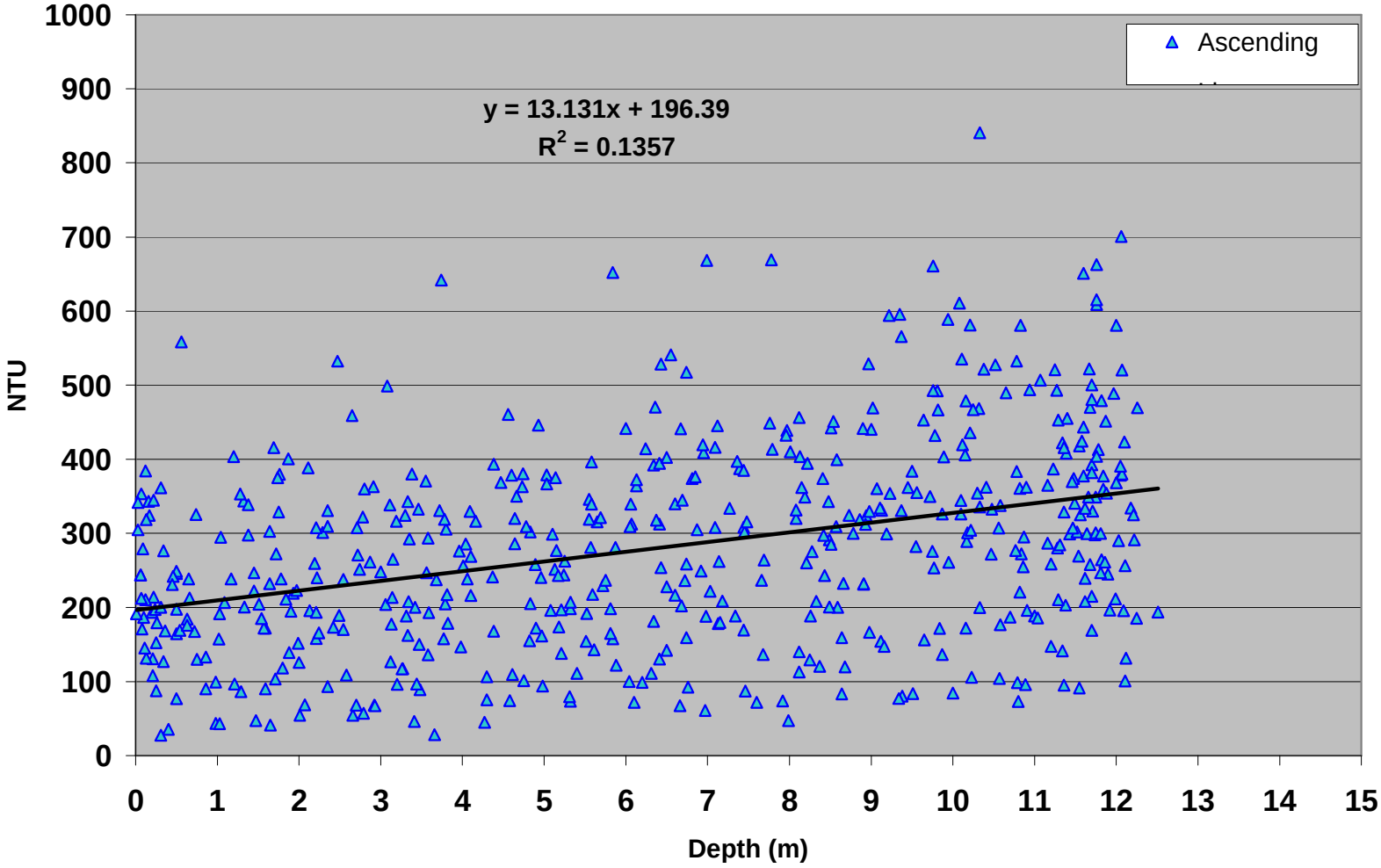

Figure 35. All turbidity measurements obtained by a bucket-mounted sensor (inboard side) during the ascent component of the bucket cycle during the second long-term dredging test on January 31, 2008.

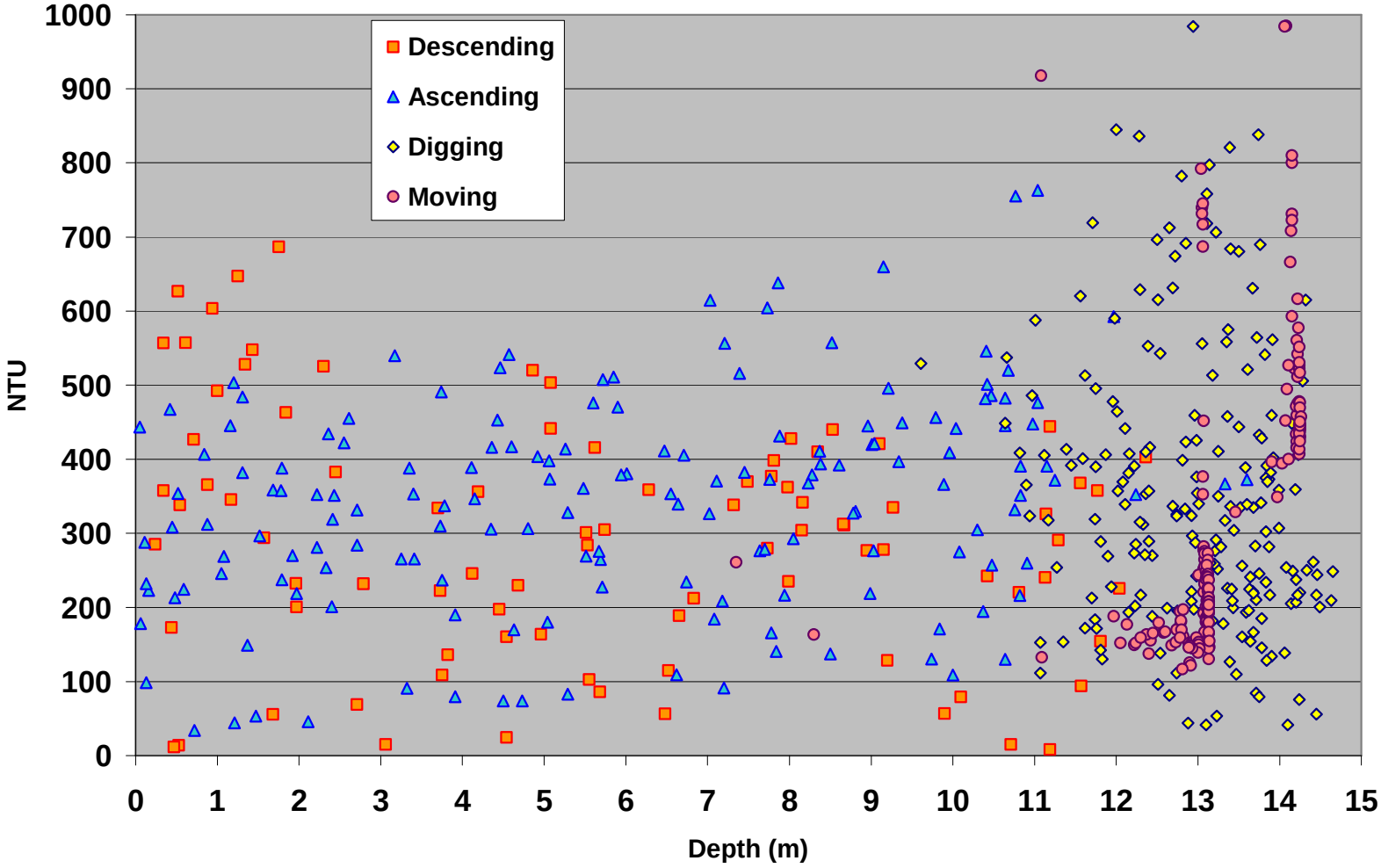

Figure 36. All turbidity measurements obtained by a bucket-mounted sensor (outboard side) during the second long-term dredging test on January 31, 2008.

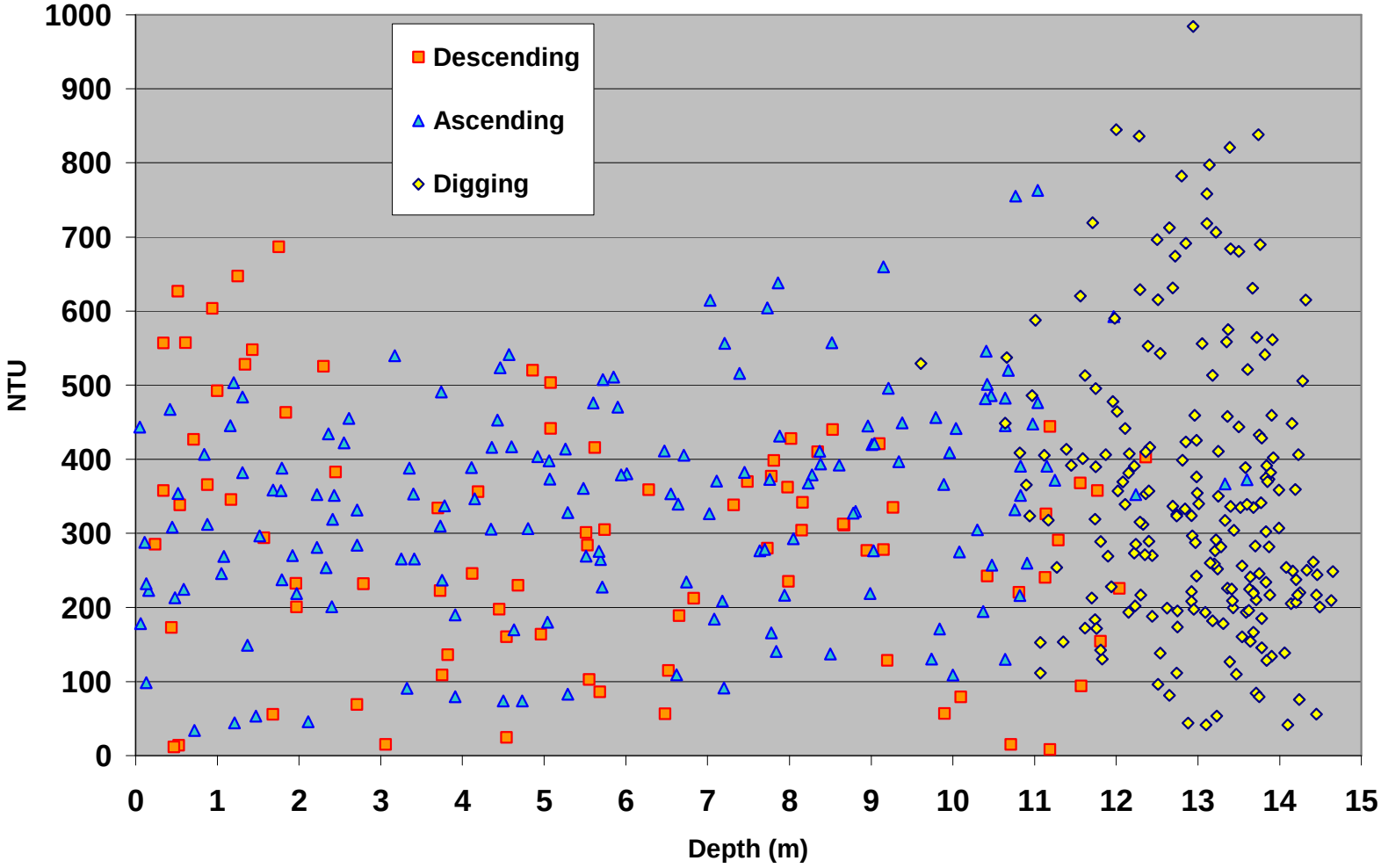

Figure 37. All turbidity measurements obtained by a bucket-mounted sensor (outboard side) during the second long-term dredging test after removal of all data for dredge advances on January 31, 2008.

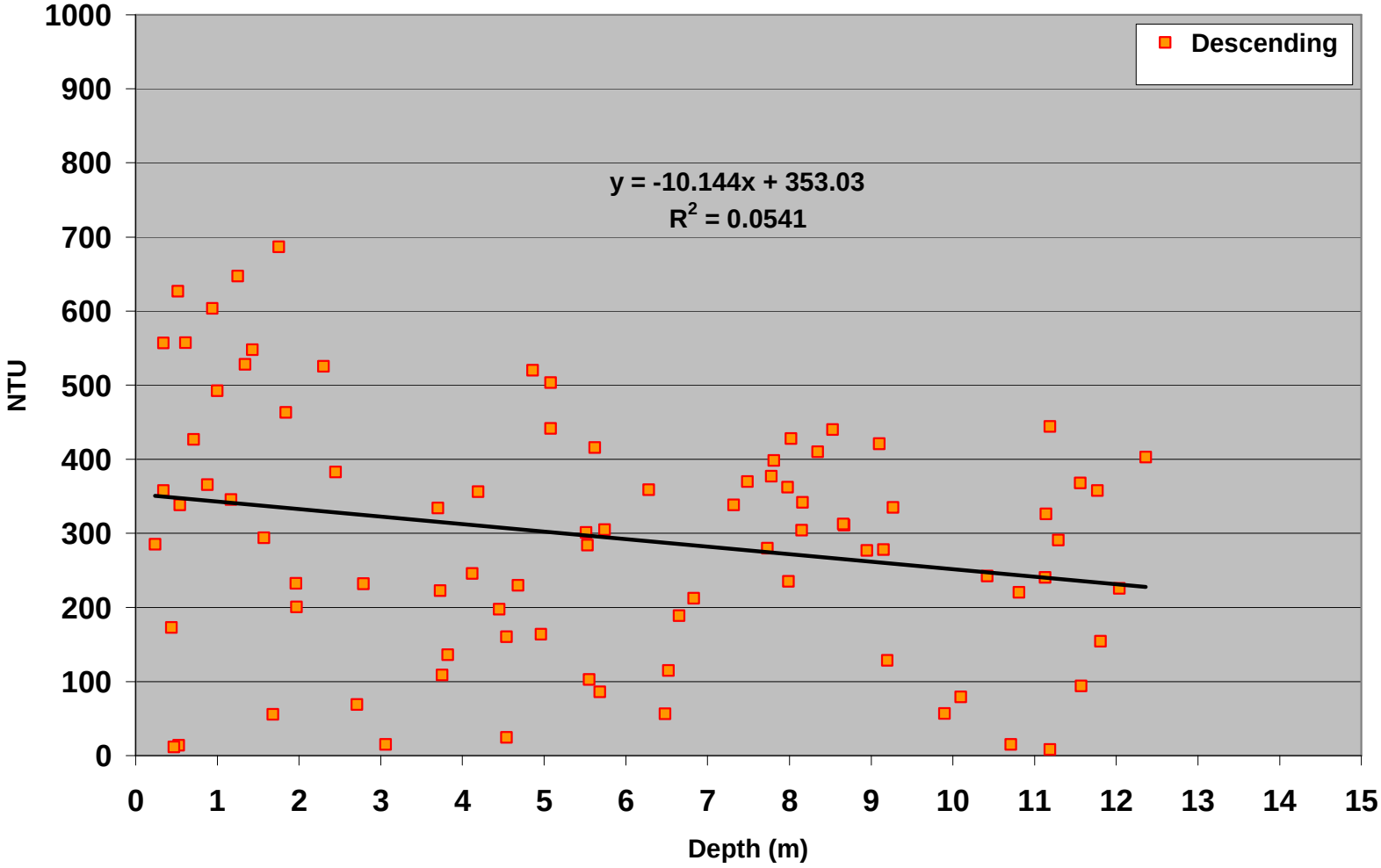

Figure 38. All turbidity measurements obtained by a bucket-mounted sensor (outboard side) during the descent component of the bucket cycle during the second long-term dredging test on January 31, 2008.

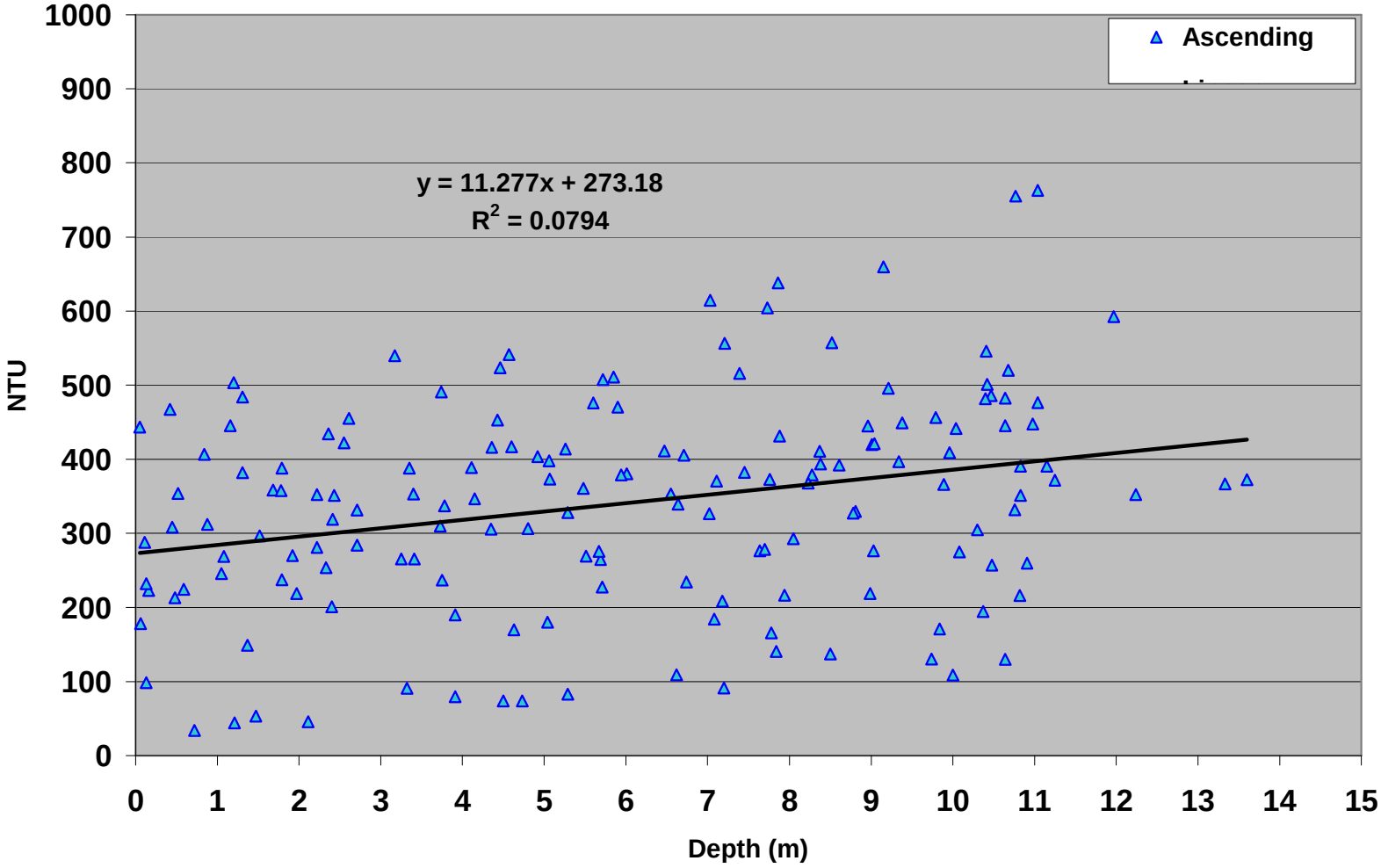

Figure 39. All turbidity measurements obtained by a bucket-mounted sensor (outboard side) during the ascent component of the bucket cycle during the second long-term dredging test on January 31, 2008.

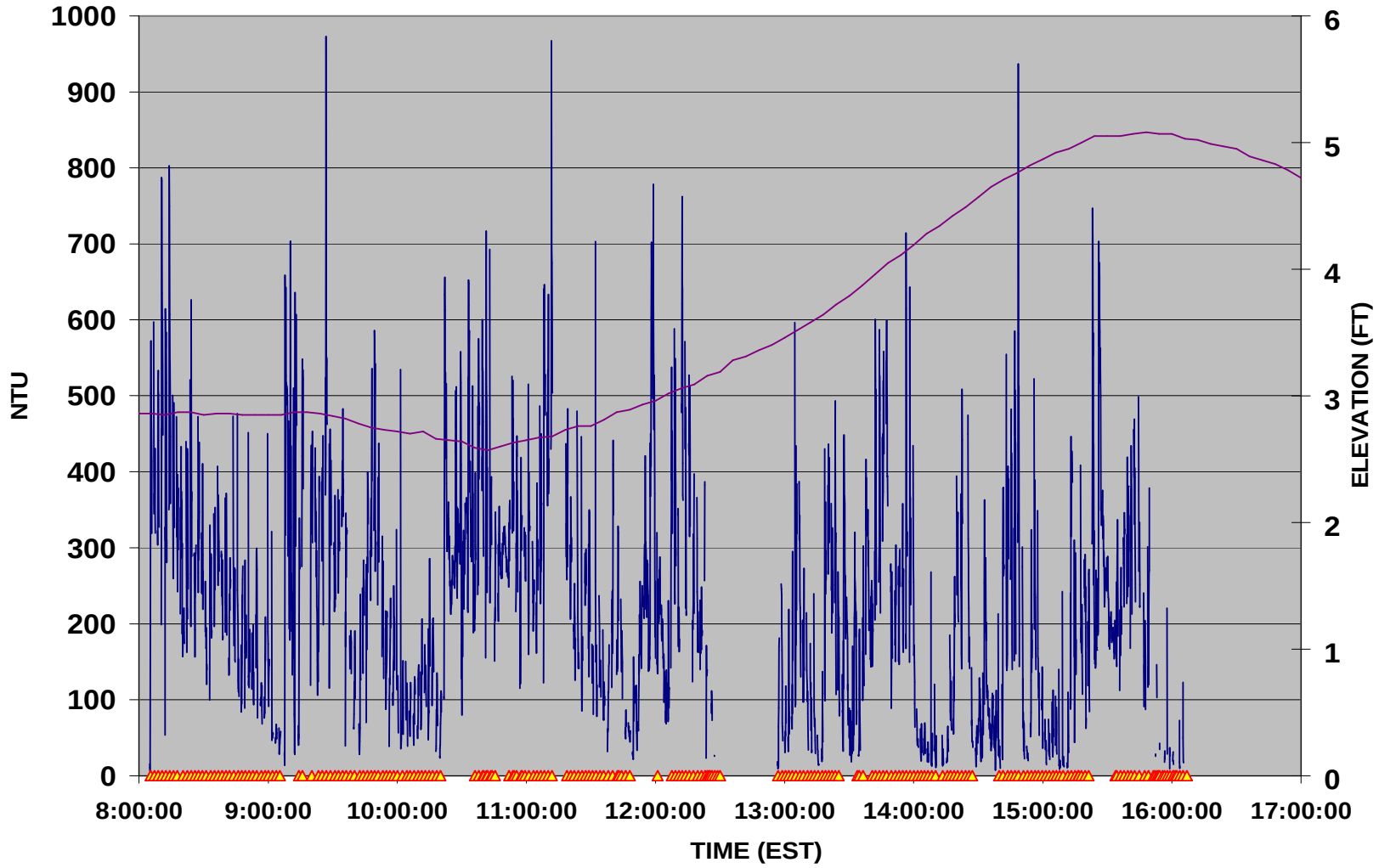

Figure 40. Turbidity measurements obtained by a bucket-mounted sensor during the third long-term dredging test on February 1, 2008.

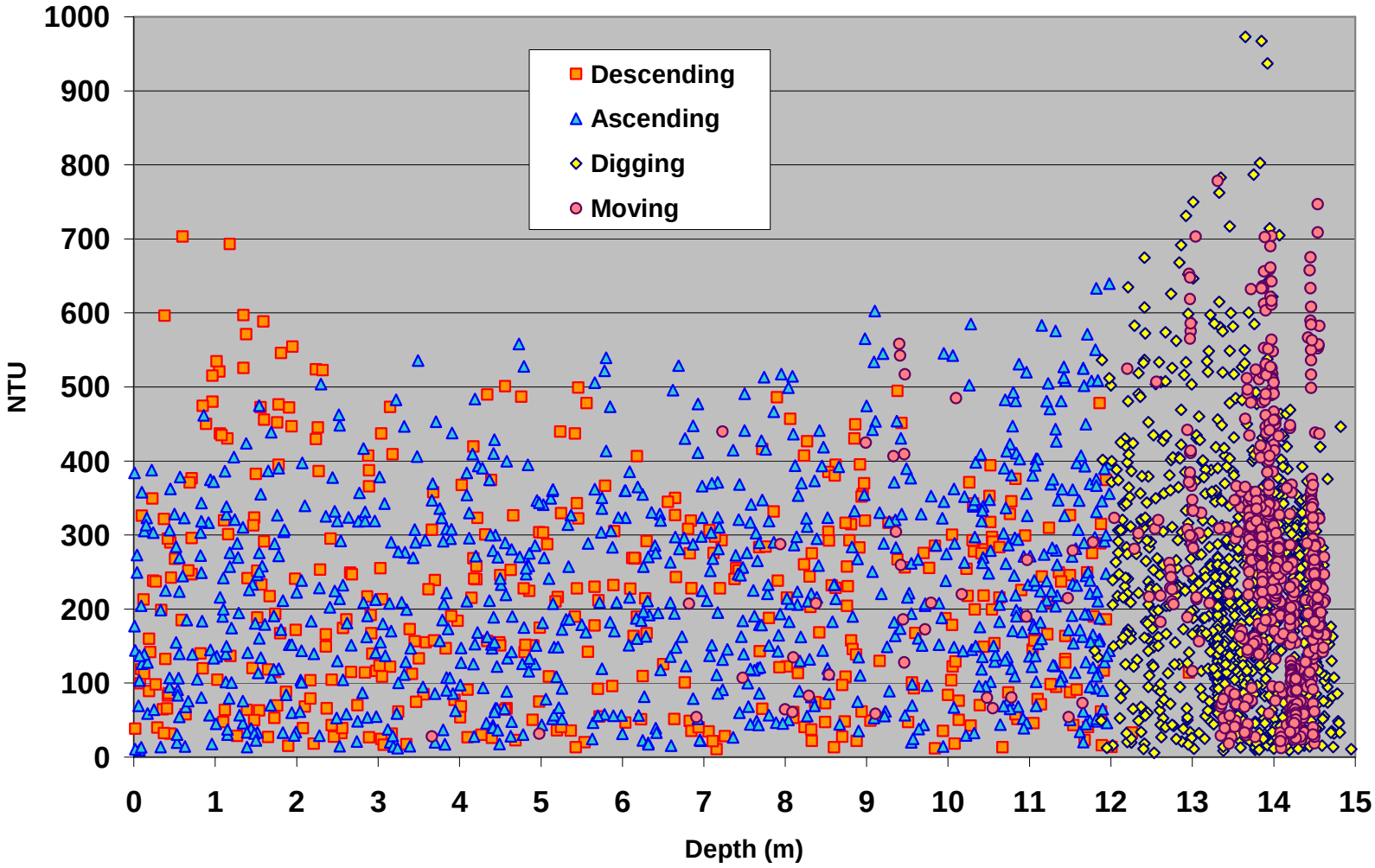

Figure 41. All turbidity measurements obtained by a bucket-mounted sensor (outboard side) during the third long-term dredging test on February 1, 2008.

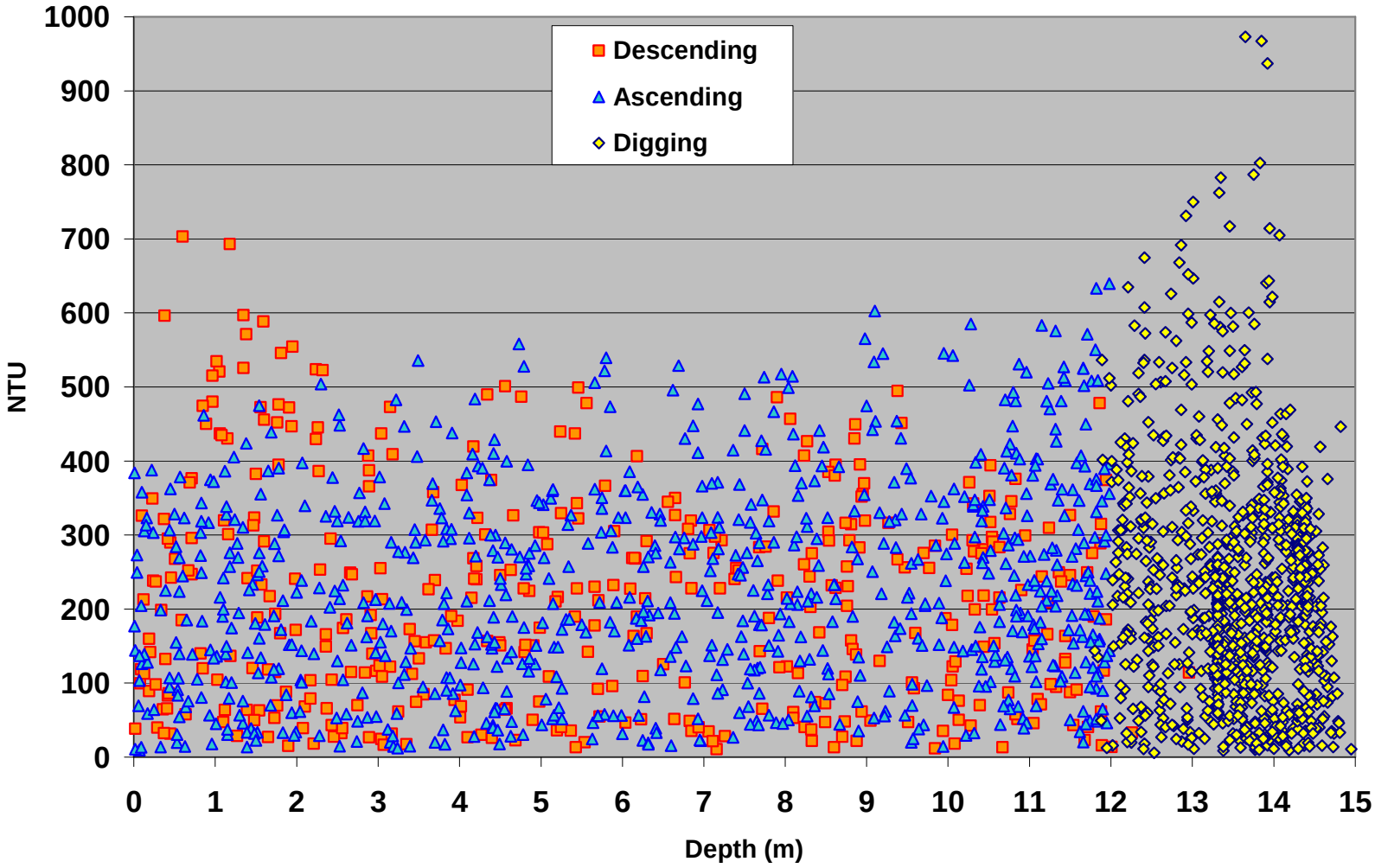

Figure 42. All turbidity measurements obtained by a bucket-mounted sensor (outboard side) during the third long-term dredging test after removal of data associated with dredge advances on February 1, 2008.

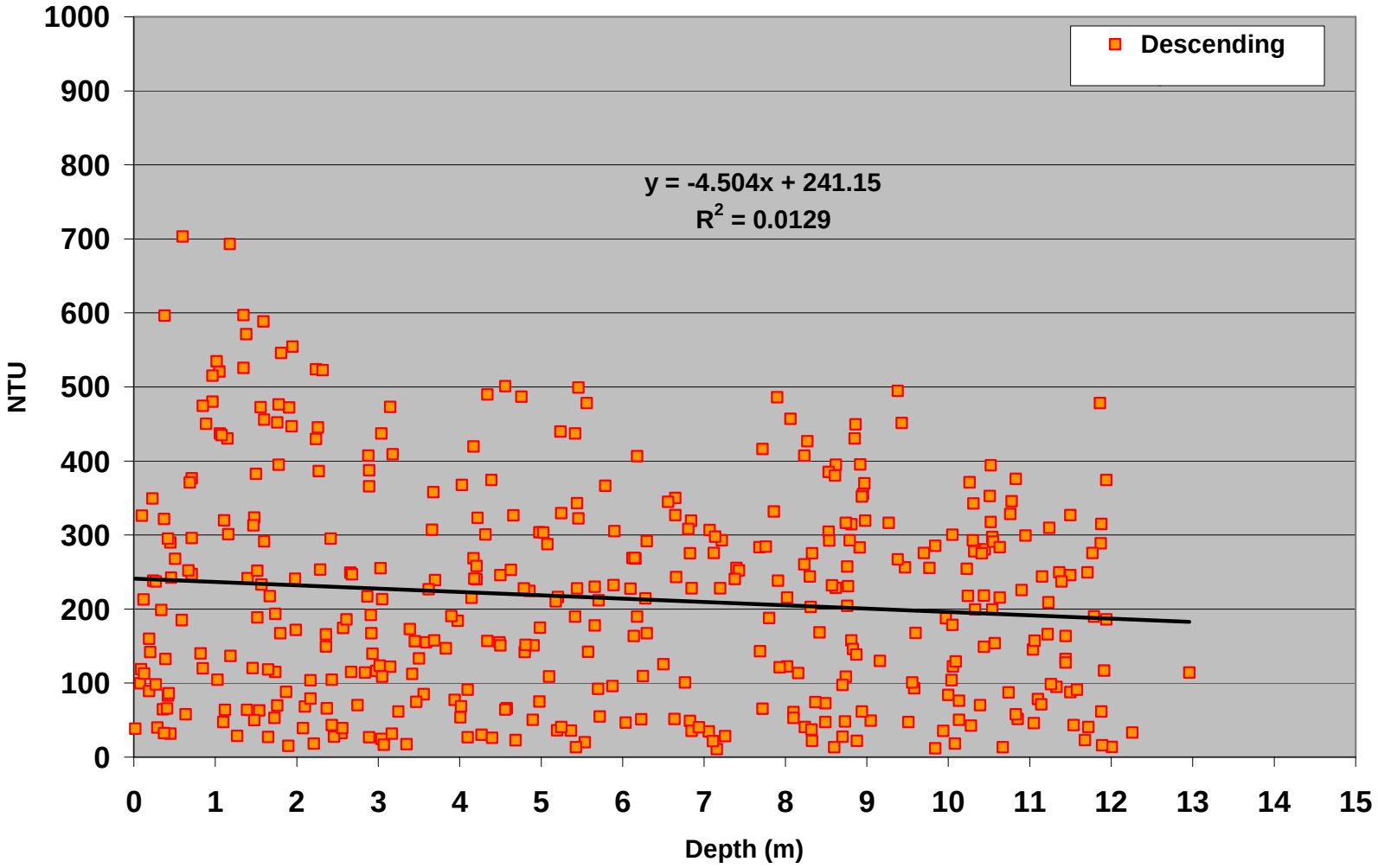

Figure 43. All turbidity measurements obtained by a bucket-mounted sensor (outboard side) during the descent component of the bucket cycle during the third long-term dredging test on February 1, 2008.

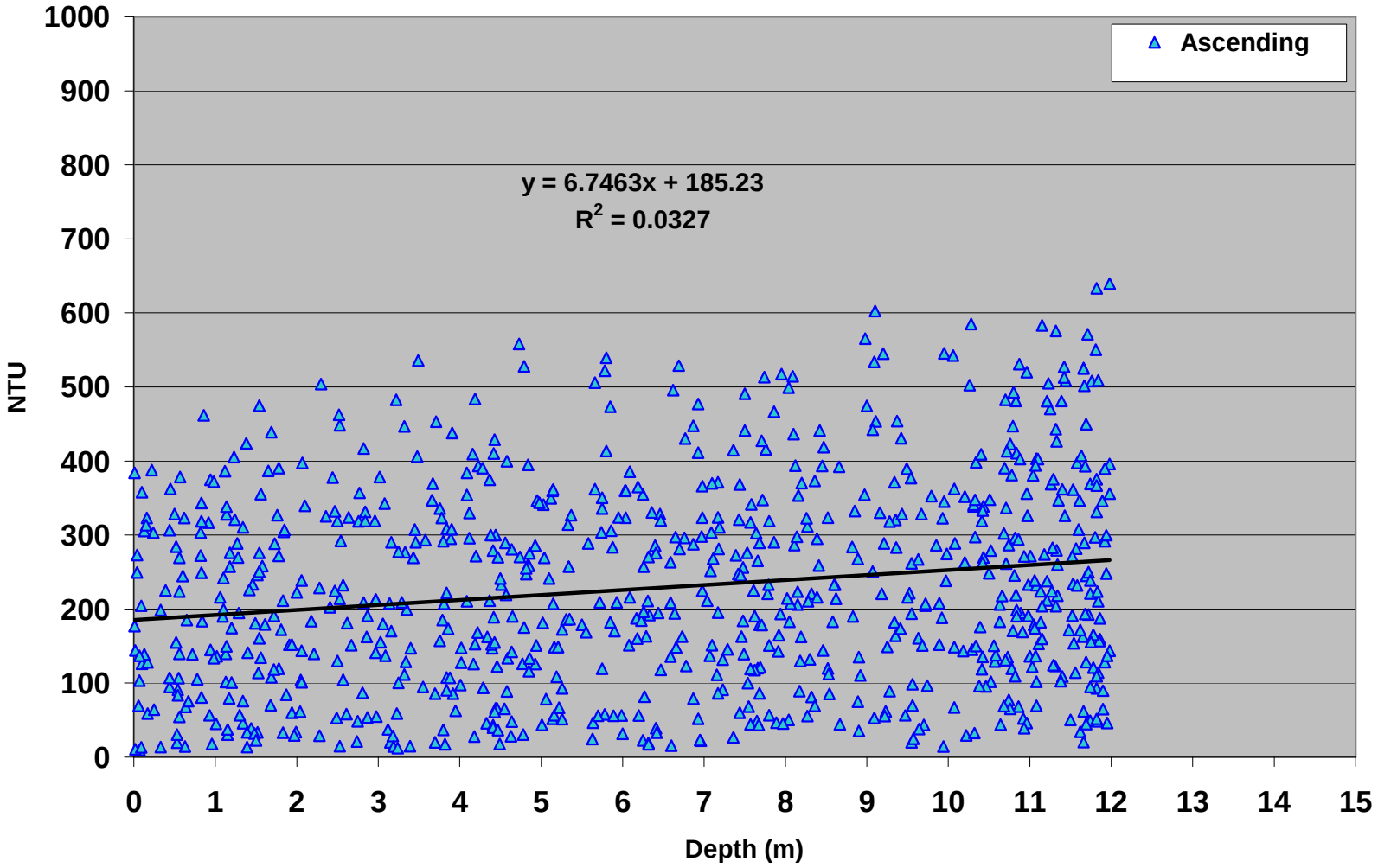

Figure 44. All turbidity measurements obtained by a bucket-mounted sensor (outboard side) during the ascent component of the bucket cycle during the third long-term dredging test on February 1, 2008.

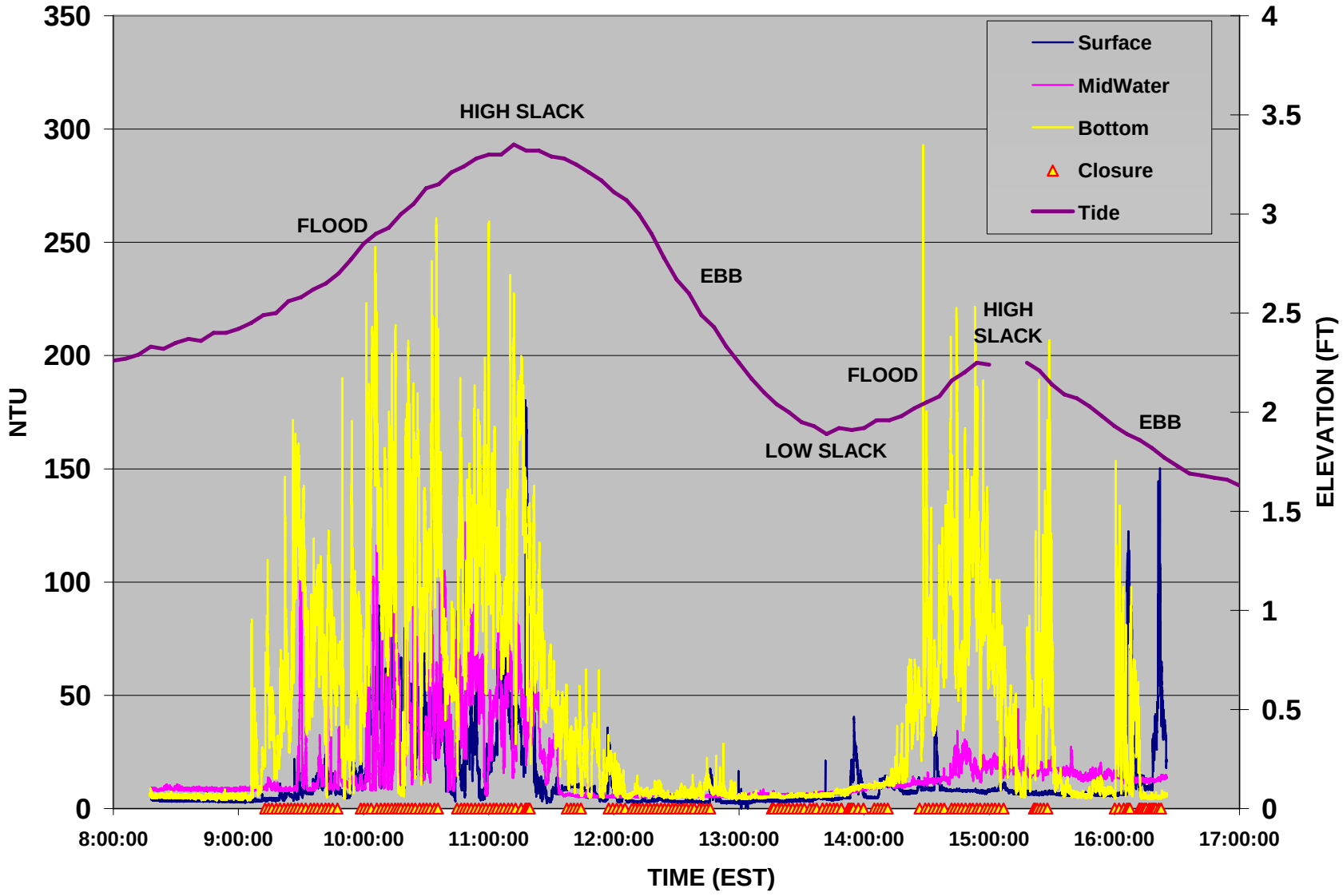

Figure 45. Turbidity measurements from dredge platform OBS instruments during the first long-term dredging test January 30, 2008.

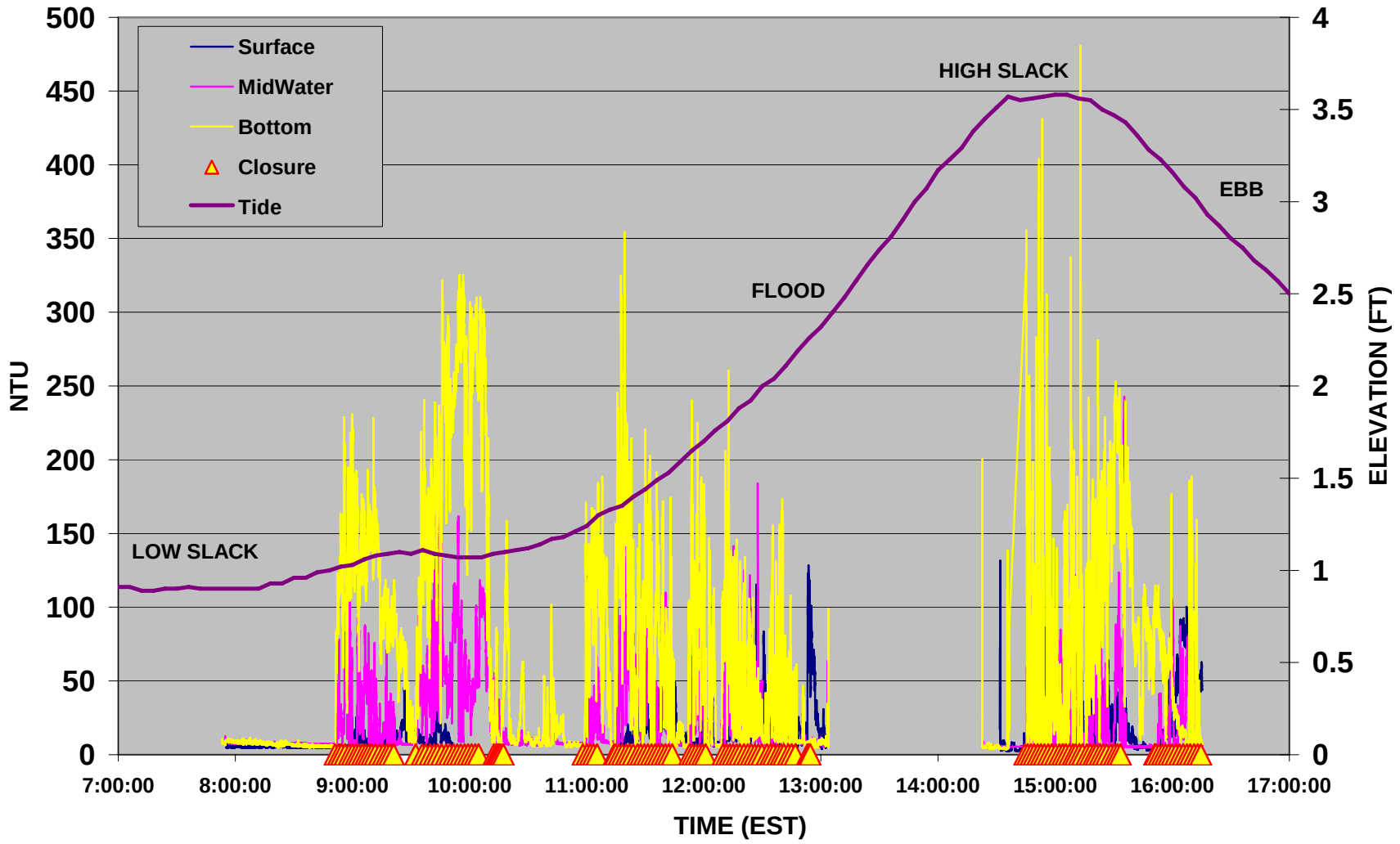

Figure 46. Turbidity measurements from dredge platform OBS instruments during the second long-term dredging test January 31, 2008.

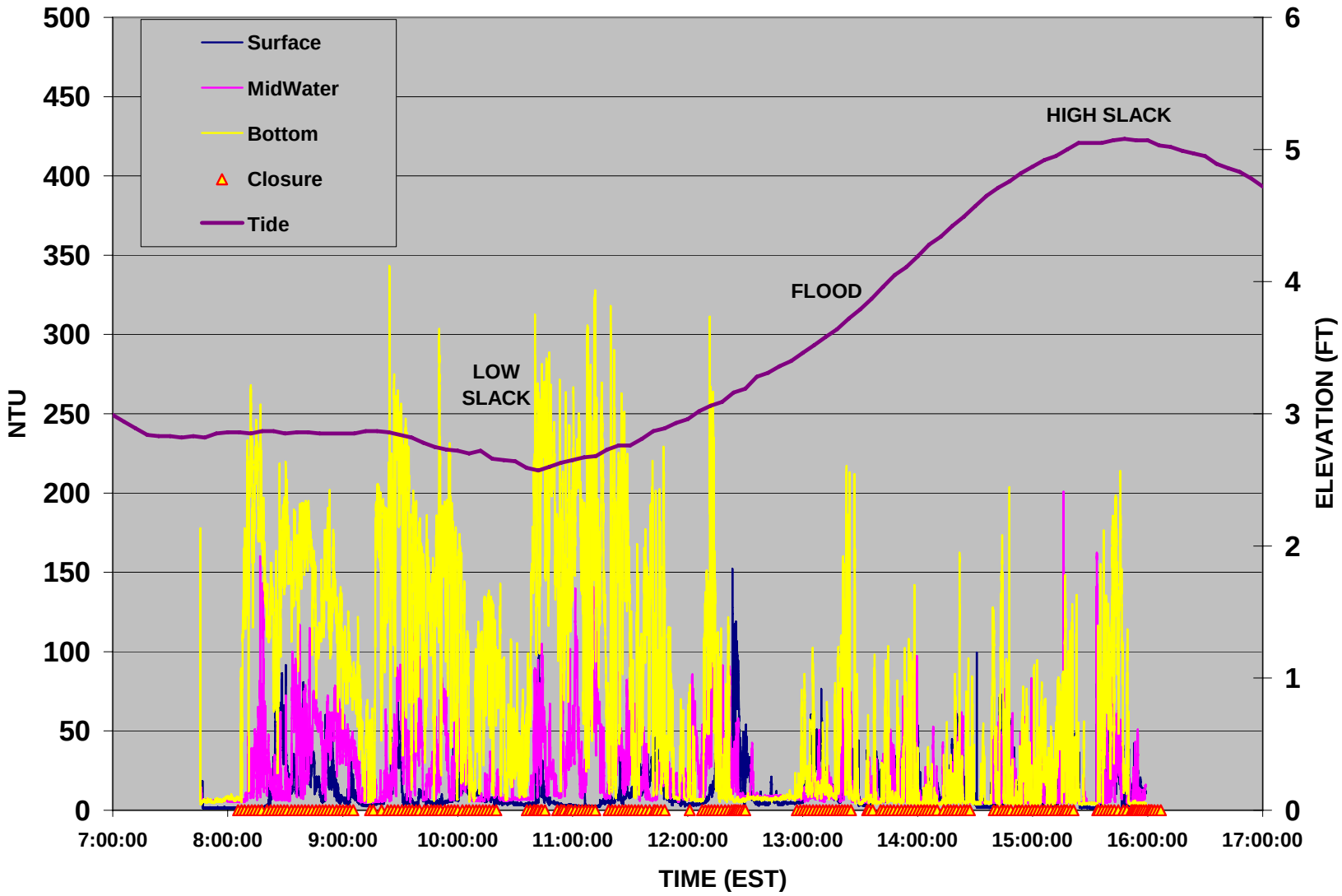

Figure 47. Turbidity measurements from dredge platform OBS instruments during the third long-term dredging test February 1, 2008.

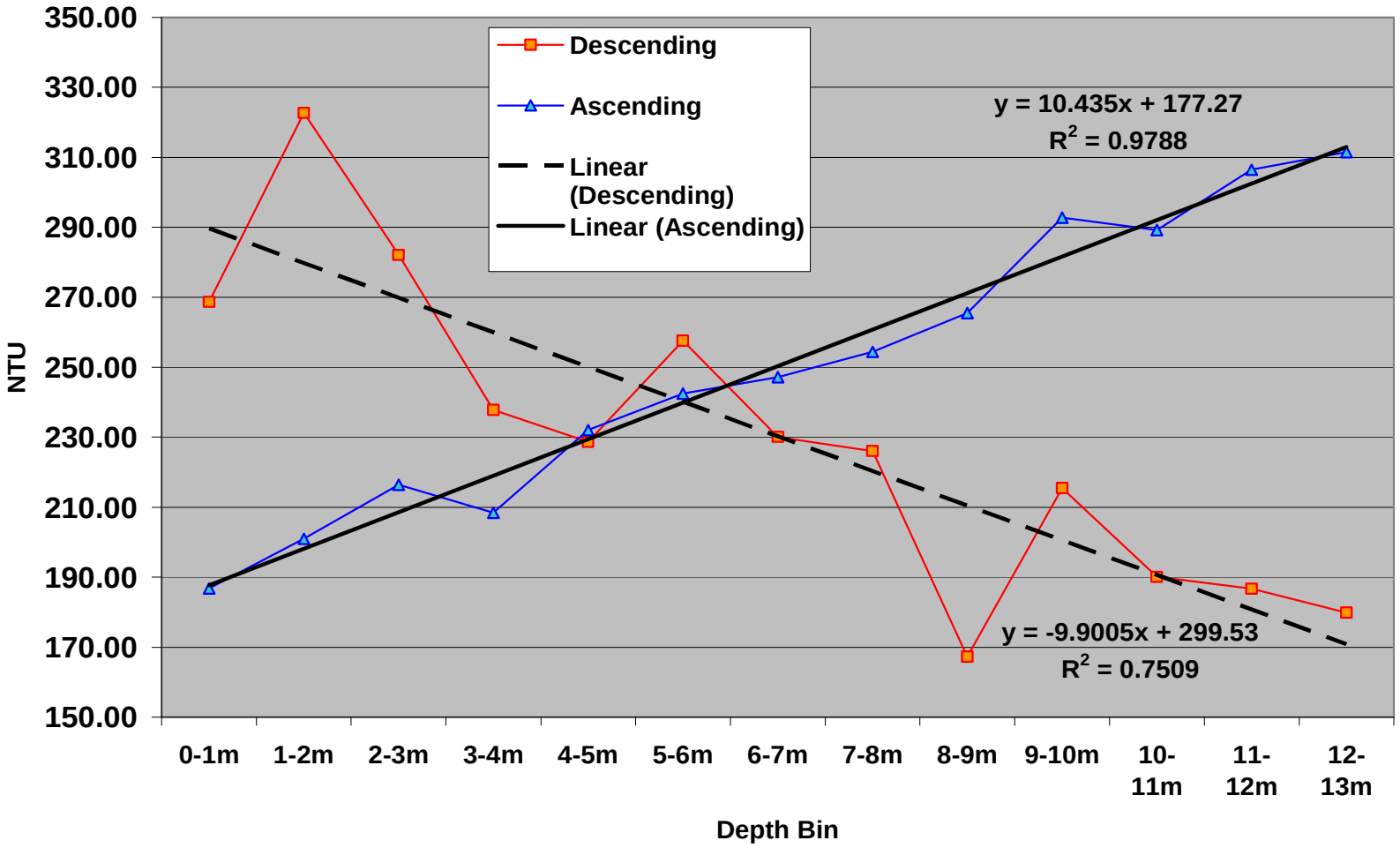

Figure 48. A comparison of trends observed in the descent and ascent components of the bucket cycle based on all turbidity measurements obtained by bucket-mounted sensors during the three long-term dredging tests.

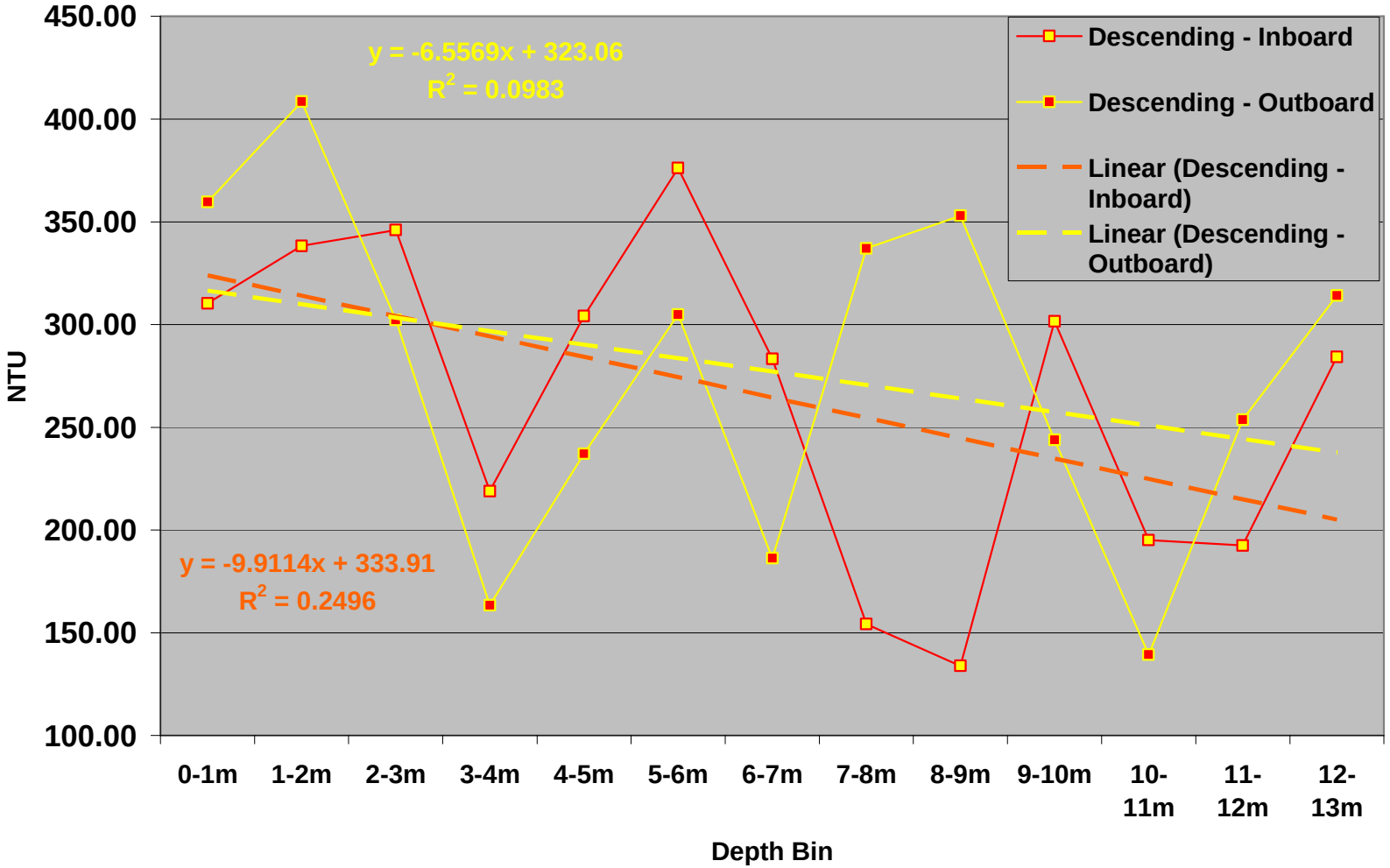

Figure 49. A comparison of synoptic turbidity measurements taken by sensors located on opposite sides of the bucket during the descent component of the bucket cycle during the second long-term dredging test on January 31, 2008.

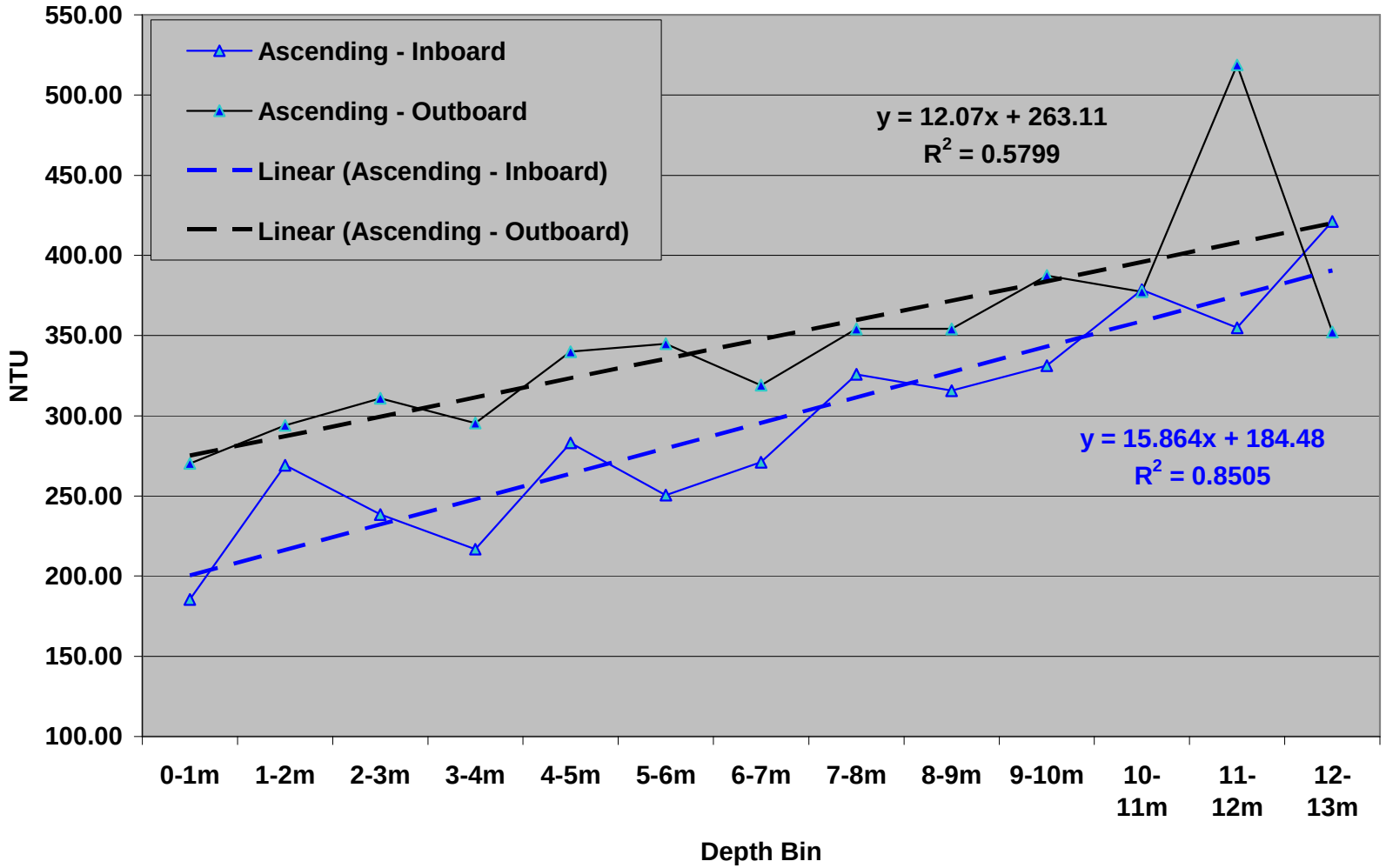

Figure 50. A comparison of synoptic turbidity measurements taken by sensors located on opposite sides of the bucket during the ascent component of the bucket cycle during the second long-term dredging test on January 31, 2008.

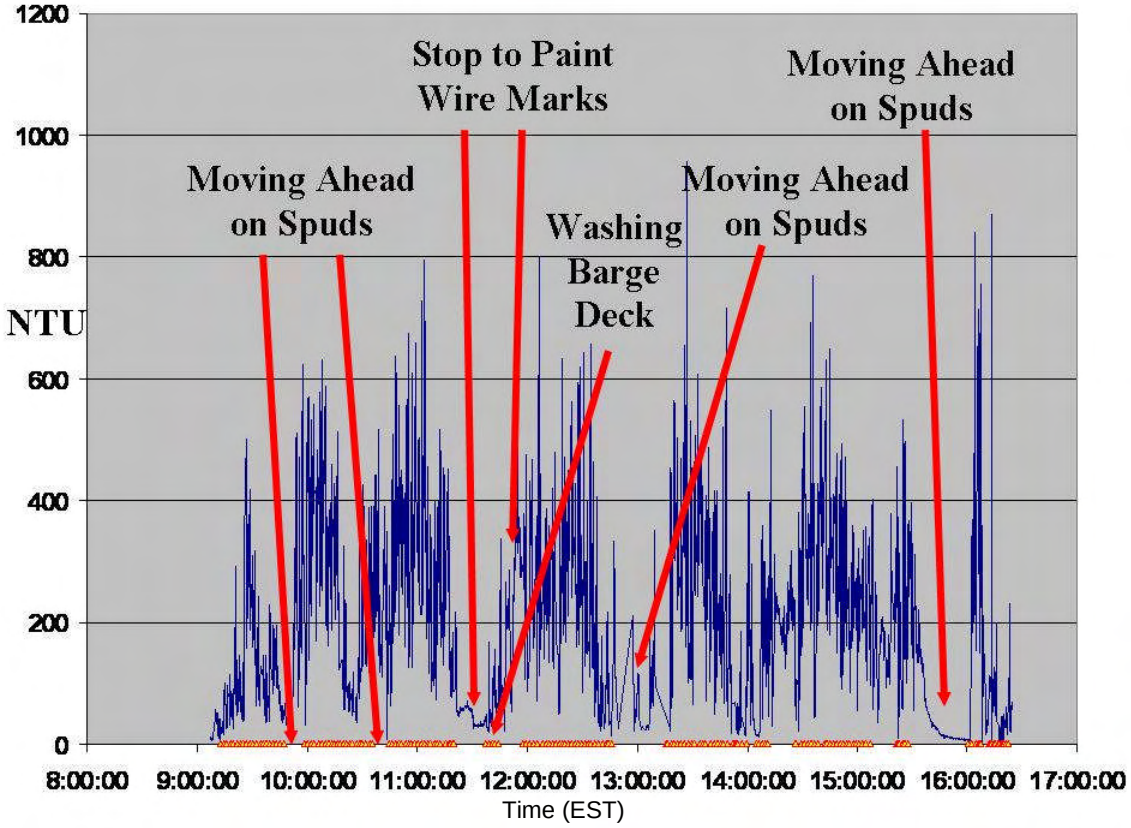

Figure 51. Identification of dredging process events that occur in tandem with bucket cycles that account for large-scale patterns in the long-term dredging test turbidity data on January 30, 2008.

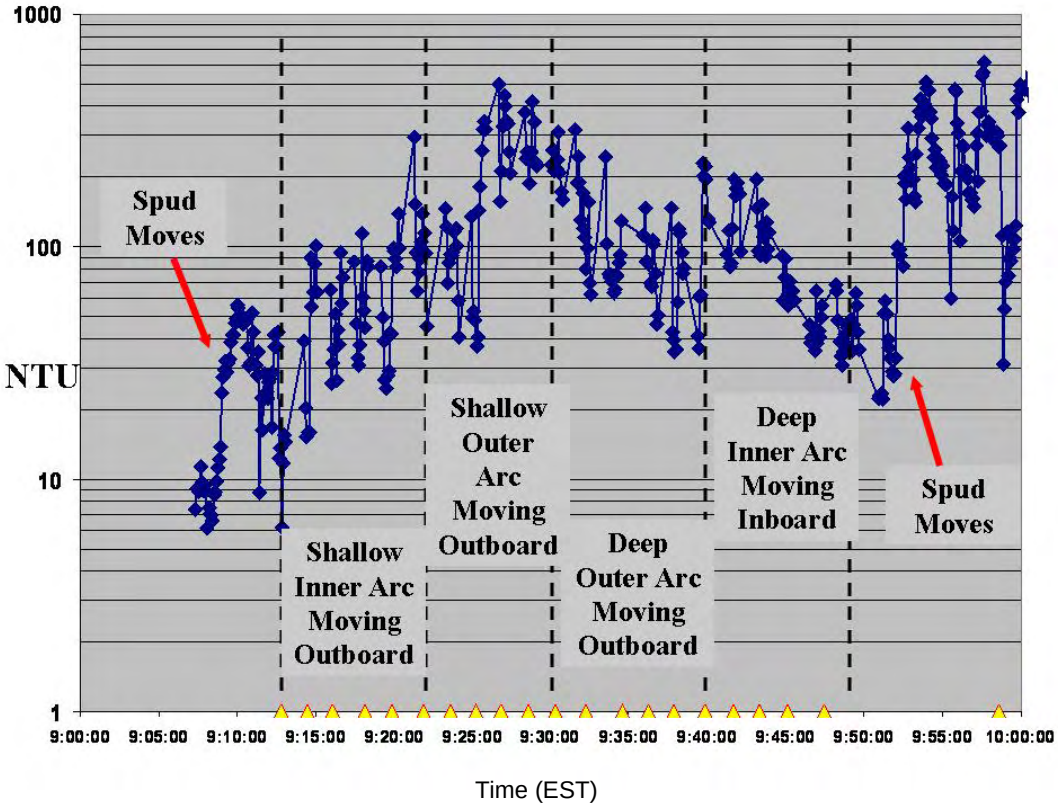

Figure 52. Bucket-mounted turbidity sensor turbidity measurements for a 20 bucket cycle sequence that comprised a single dredge advance. Figure based on the same bucket cycle sequence shown in Figure 4 from the long-term test on January 30, 2008.

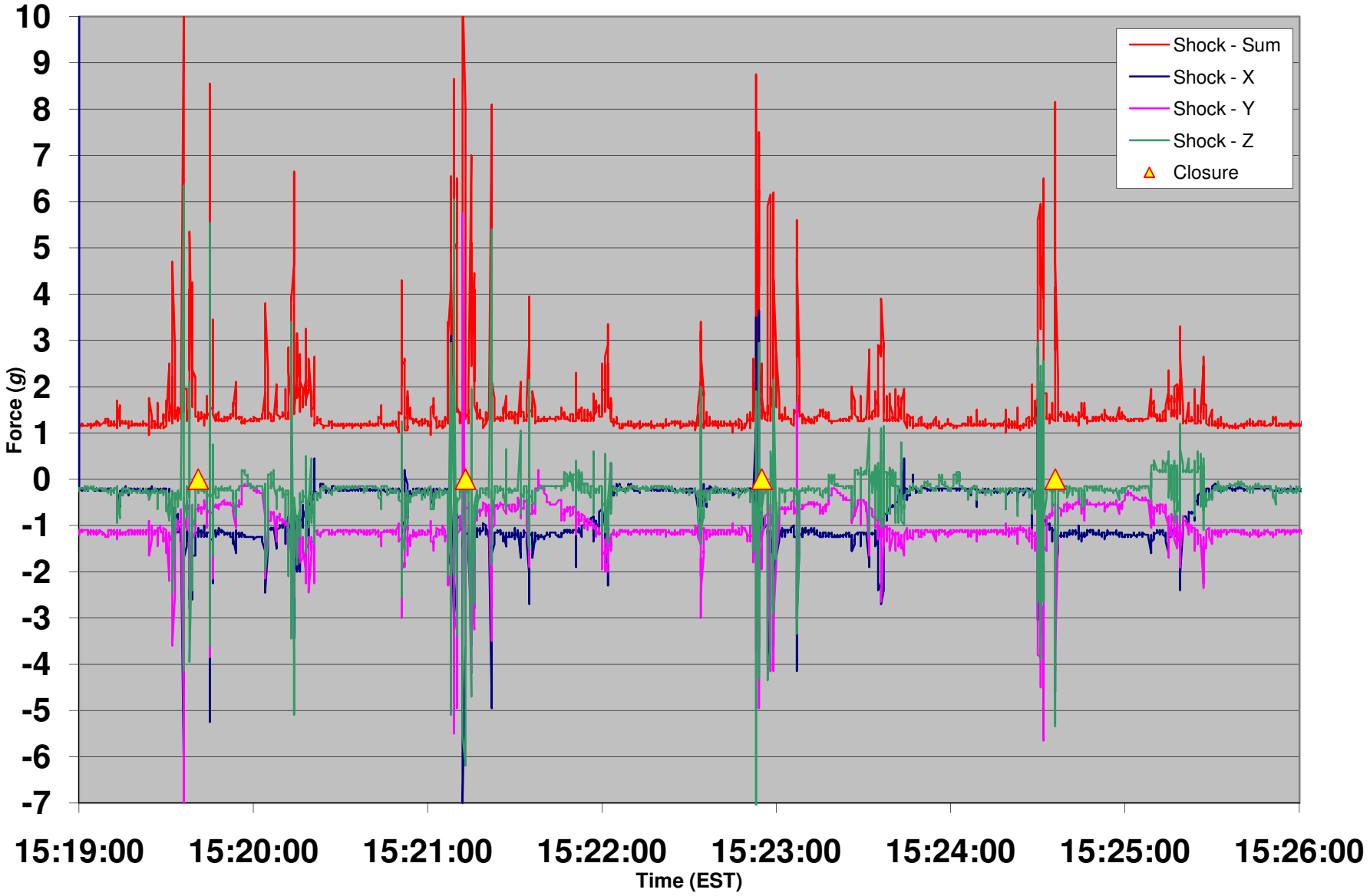

Figure 53. Accelerometer data recorded during long-duration testing on January 31, 2008.

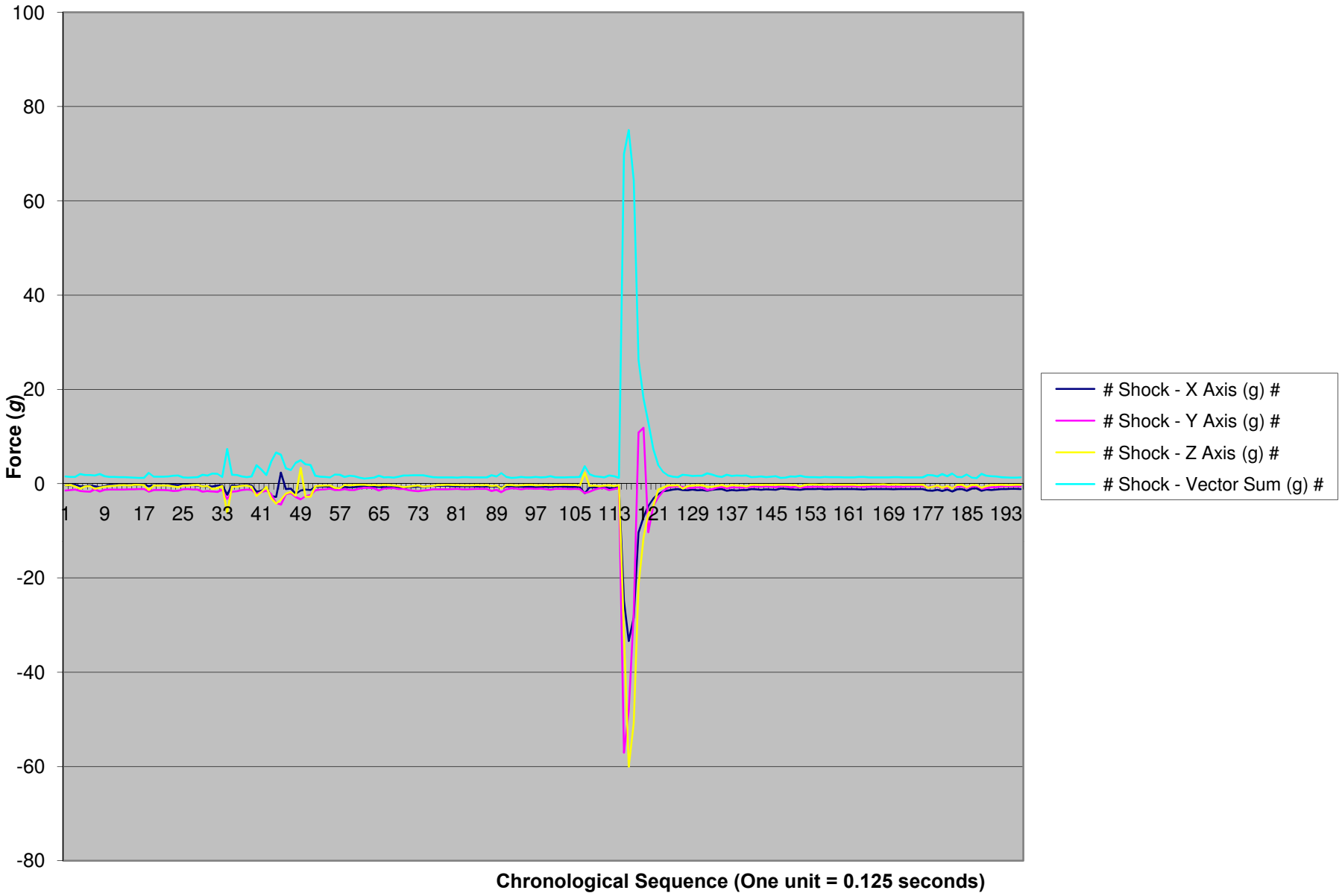

Figure 54. Accelerometer data recorded during long-duration testing on February 1, 2008 showing maximum impact forces observed.

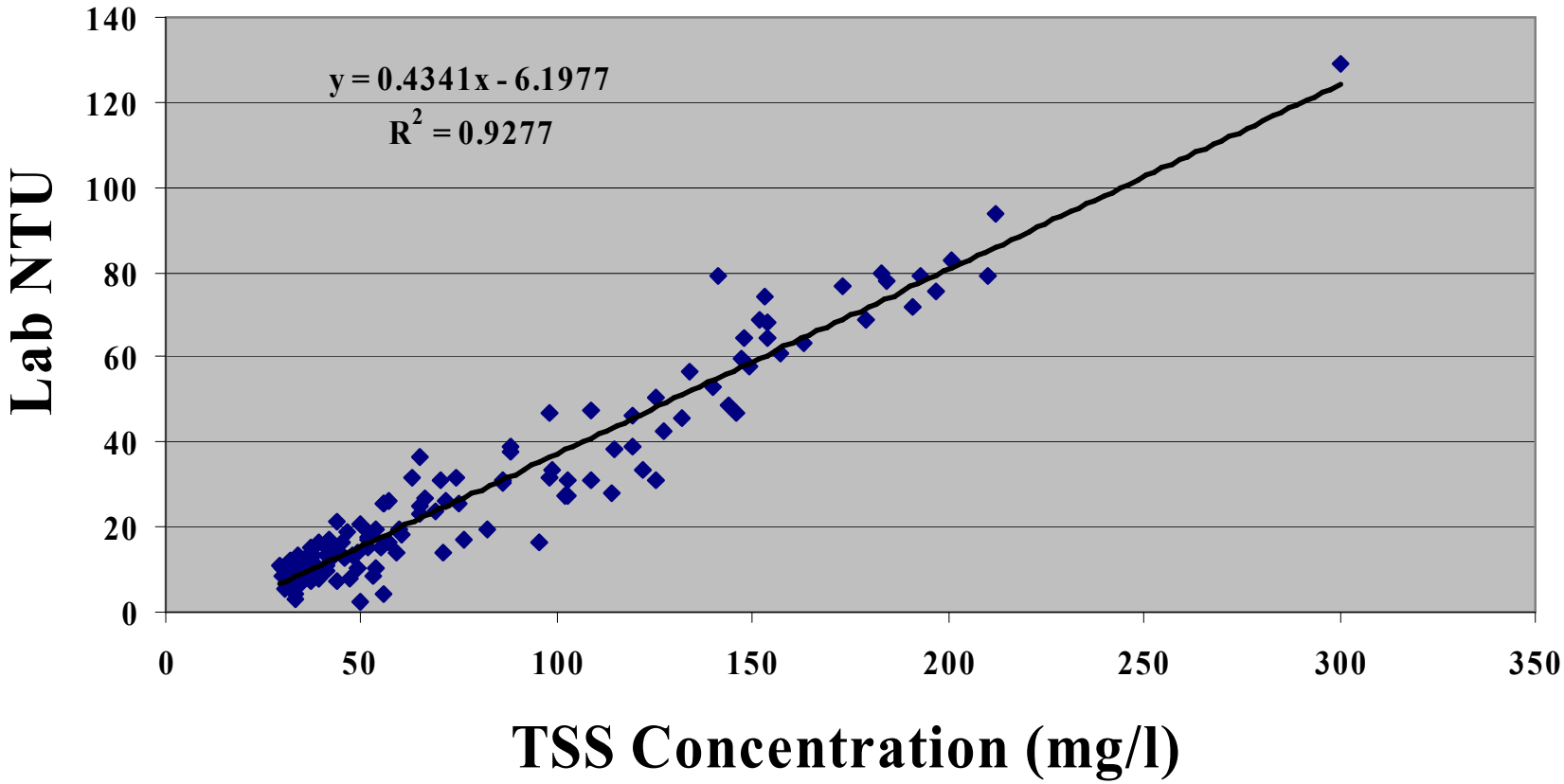

Figure 55. Relationship between turbidity and suspended sediment concentration determined from gravimetric analysis of water samples collected at the study site. Water samples were collected during active dregding on February 8 , 2008 and February 13, 2008.

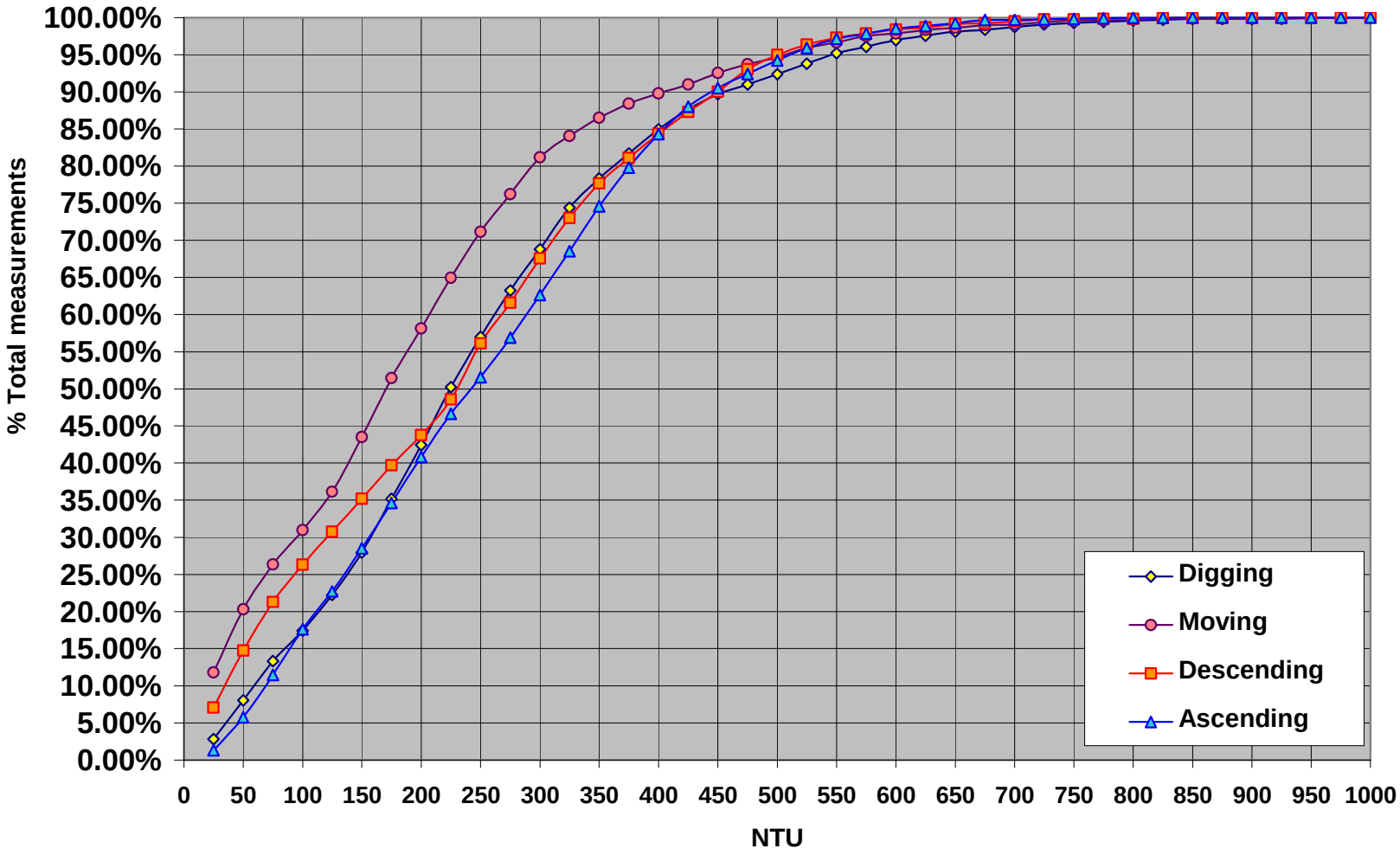

Figure 56. Cumulative percent plots of bucket-mounted turbidity measurements during components of the bucket cycle.