

Fluid Mud/Residuals and Surveying

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Fluid Mud

Definition: Fluid mud is a high concentration aqueous suspension of fine grained sediment in which settling is substantially hindered by the proximity of sediment grains and flocs, but which has not formed an interconnected matrix of bonds strong enough to eliminate the potential for mobility, leading to a persistent suspension.

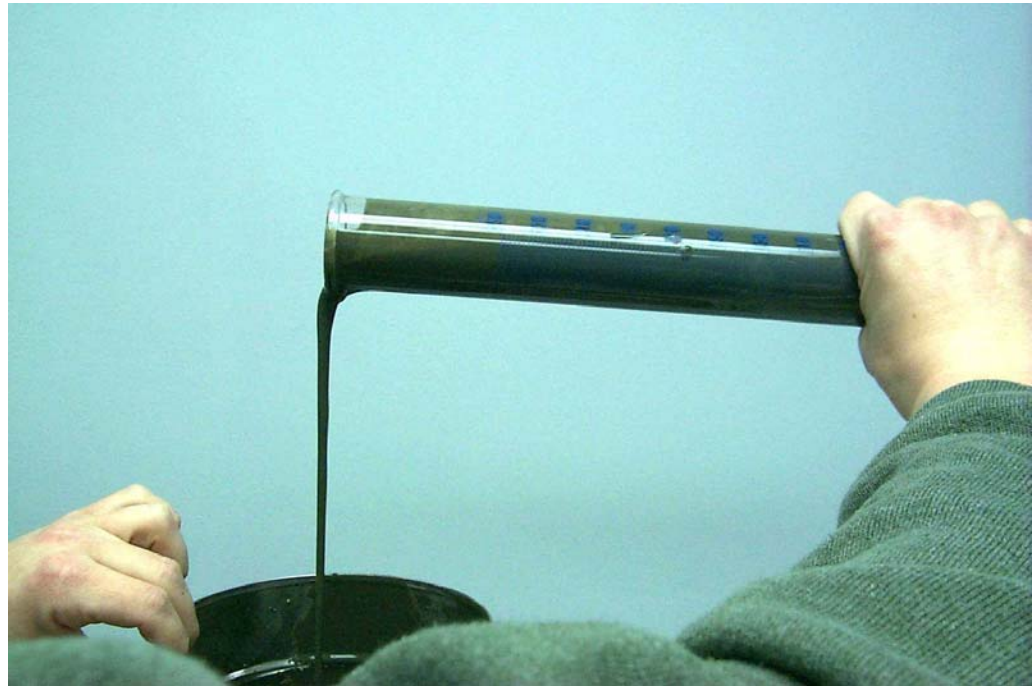
Fluid Mud

Definition:

Fine-grained cohesive mud

Solids 50 to 350 dry-g/l

$\rho = 1.05$ to 1.25 g/cc (Alan Teeter 1994)



- Motivation-

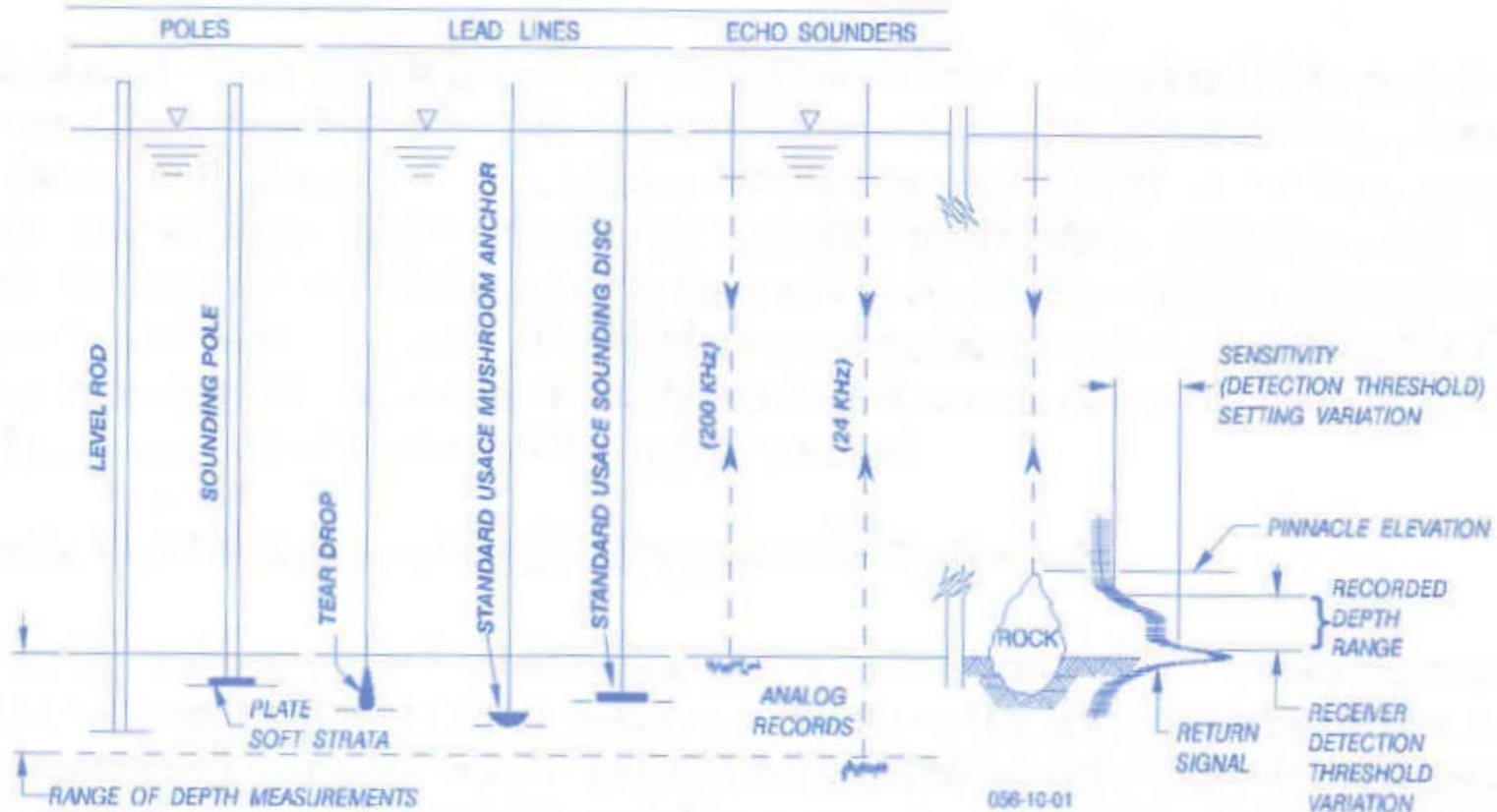
Fluid Mud Effects

Hydrographic Surveying

“When the upper sediment layer is not well consolidated, the three major depth measurement methods used in the USACE (sounding pole, lead line, and acoustic echo sounding) will generally not correlate with one another, or perhaps not even give consistent readings from one time to the next when the same type of instrument or technique is used.”

Source: Hydrographic Surveying Engineer Manual
1110-2-1003, 2003

DEPTH MEASUREMENT VARIATIONS IN UNCONSOLIDATED OR IRREGULAR BOTTOMS

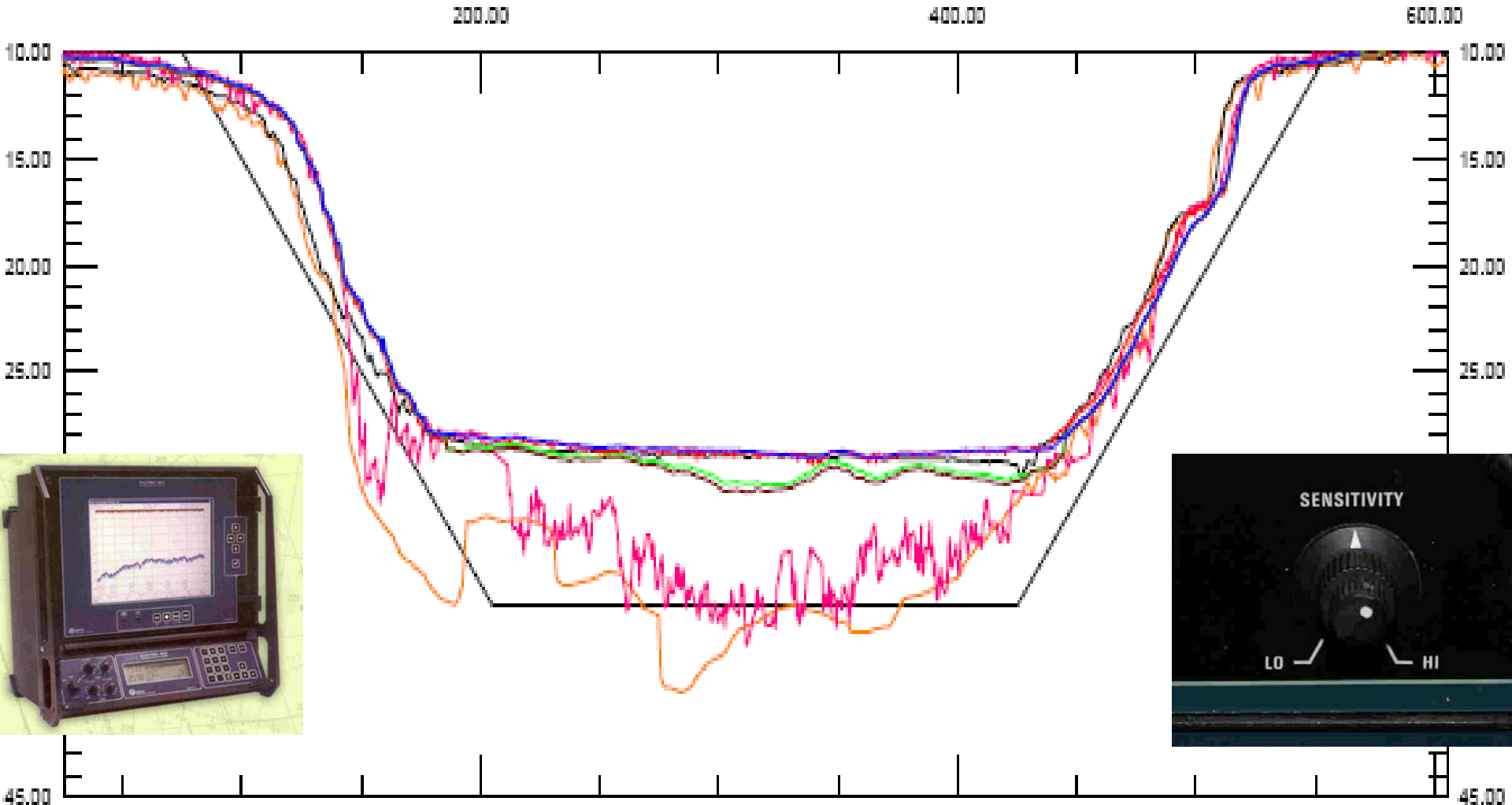


MANUAL DEPTH MEASUREMENT

FUNCTION OF: BOTTOM DENSITY
 PROBE WEIGHT
 PROBE SURFACE AREA
 PROBE VELOCITY

ACOUSTIC DEPTH MEASUREMENT

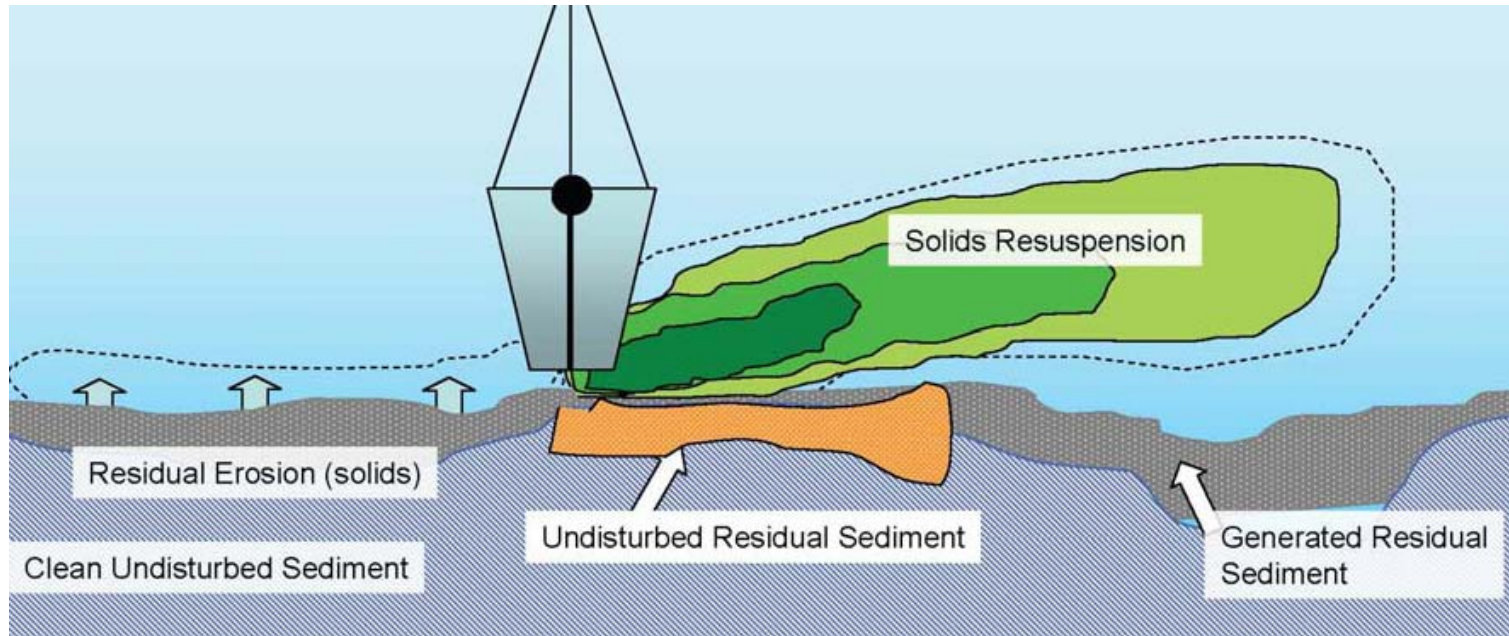
FUNCTION OF: REFLECTIVE SURFACE AREA
 SURFACE REFLECTIVITY/DENSITY
 SIGNAL/NOISE LEVELS
 RECEIVER SENSITIVITY
 TRANSDUCER FREQUENCY
 TRANSDUCER BEAMWIDTH
 ETC.



Base Survey 76+00
 Overlay 1 76+00
 Overlay 2 76+00
 Overlay 3 76+00
 Overlay 4 76+00
 DBL 70.00 Ft/in
 Depth 10.00 Ft/in

STEMA - Silas - Bottom	347,701 yd ³
ODOM - mkIII - HI Freq 200Khz	346,632 yd ³
HI Freq 200Khz	338,620 yd ³
STEMA - Silas - Low density	314,407 yd ³
STEMA - Silas - High density	304,582 yd ³
ODOM - mkIII - LO Freq 28Khz	139,989 yd ³
LO Freq 41 KHz	60,482 yd ³

Dredging “Generated” Residuals

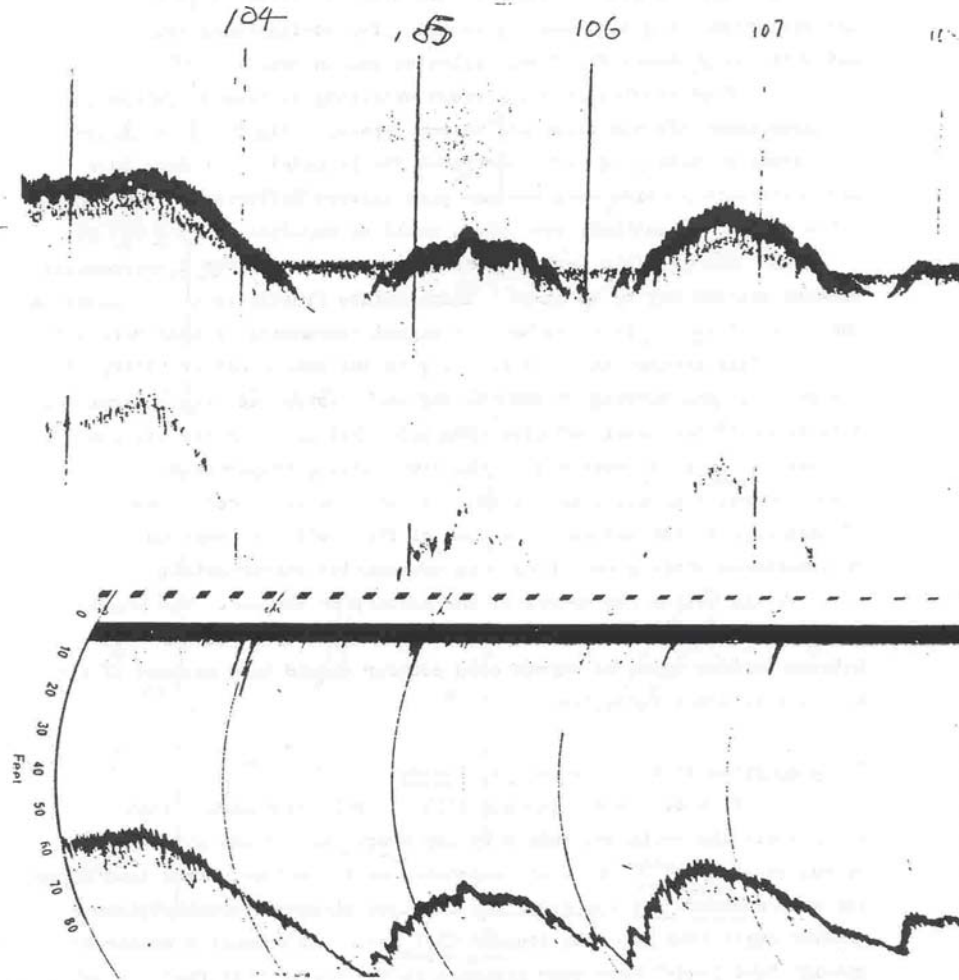


Definition: Generated Residuals (in the context of the 4-Rs Workshop) are contaminated post-dredging surface sediments that are dislodged or suspended by the dredging operation and are subsequently re-deposited on the bottom of the water body.

Typically occur in thin layers (1 to 10 cm thick)

Motivation

Fig 2:2



Comparison of simultaneous 200 kHz.(upper) and 30 kHz.(lower) records of fluff. Note fluff reflection and attenuation of 200 kHz. signal but no fluff detected by the 30 kHz. signal.From Severn Estuary,u.k.

Source:
Kirby and
Parker 1972

Objective

To improve the capability to accurately and precisely characterize navigation and environmental dredging projects with fluid mud/residual bottom conditions.

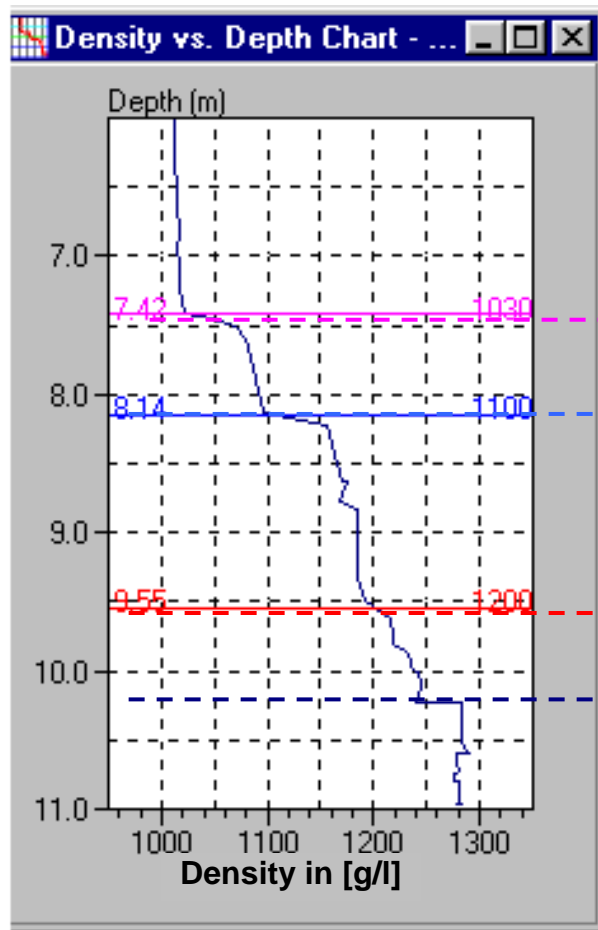
Approach

- To demonstrate state-of-practice fluid mud survey systems.
- To evaluate these systems for USACE application and investigate feasibility of implementation of a nautical depth policy.
- To improve spatial resolution for application in thinner fluid mud layers (residuals).

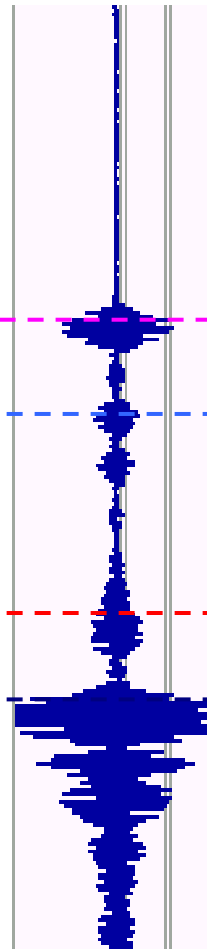
STEMA Rheotune and Silas



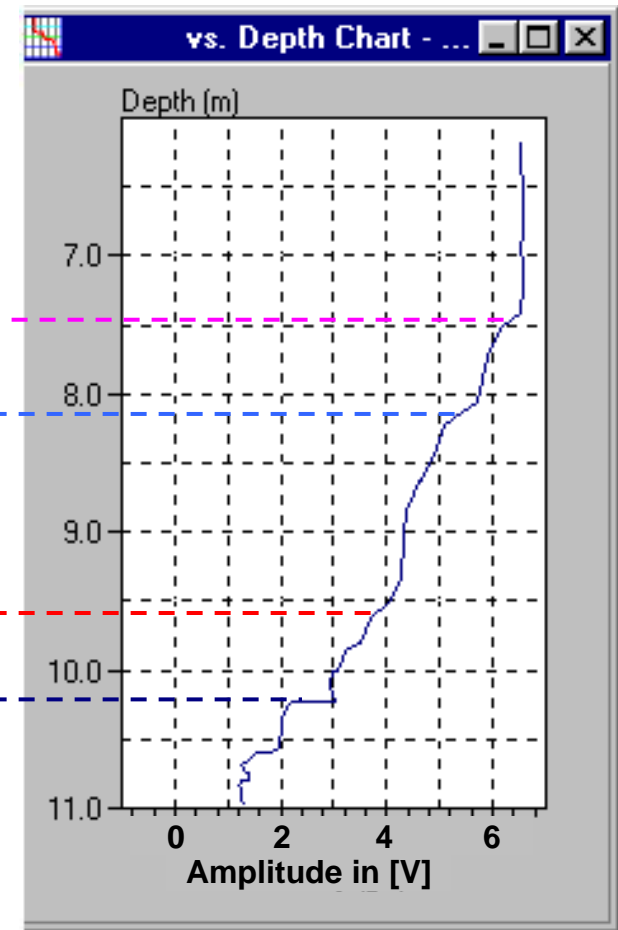
Insitu Density

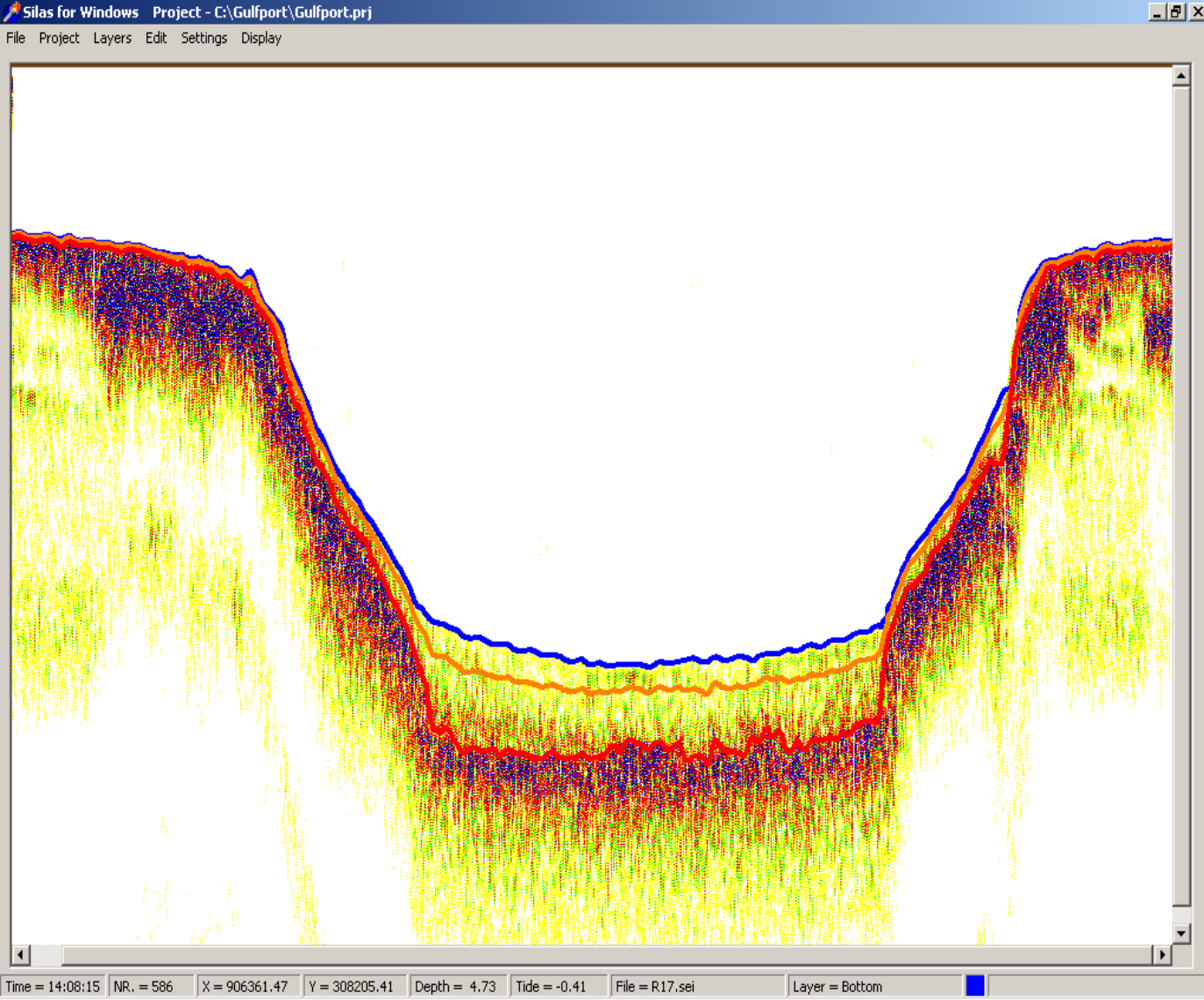


Complete reflected signal



Amplitude/Viscosity

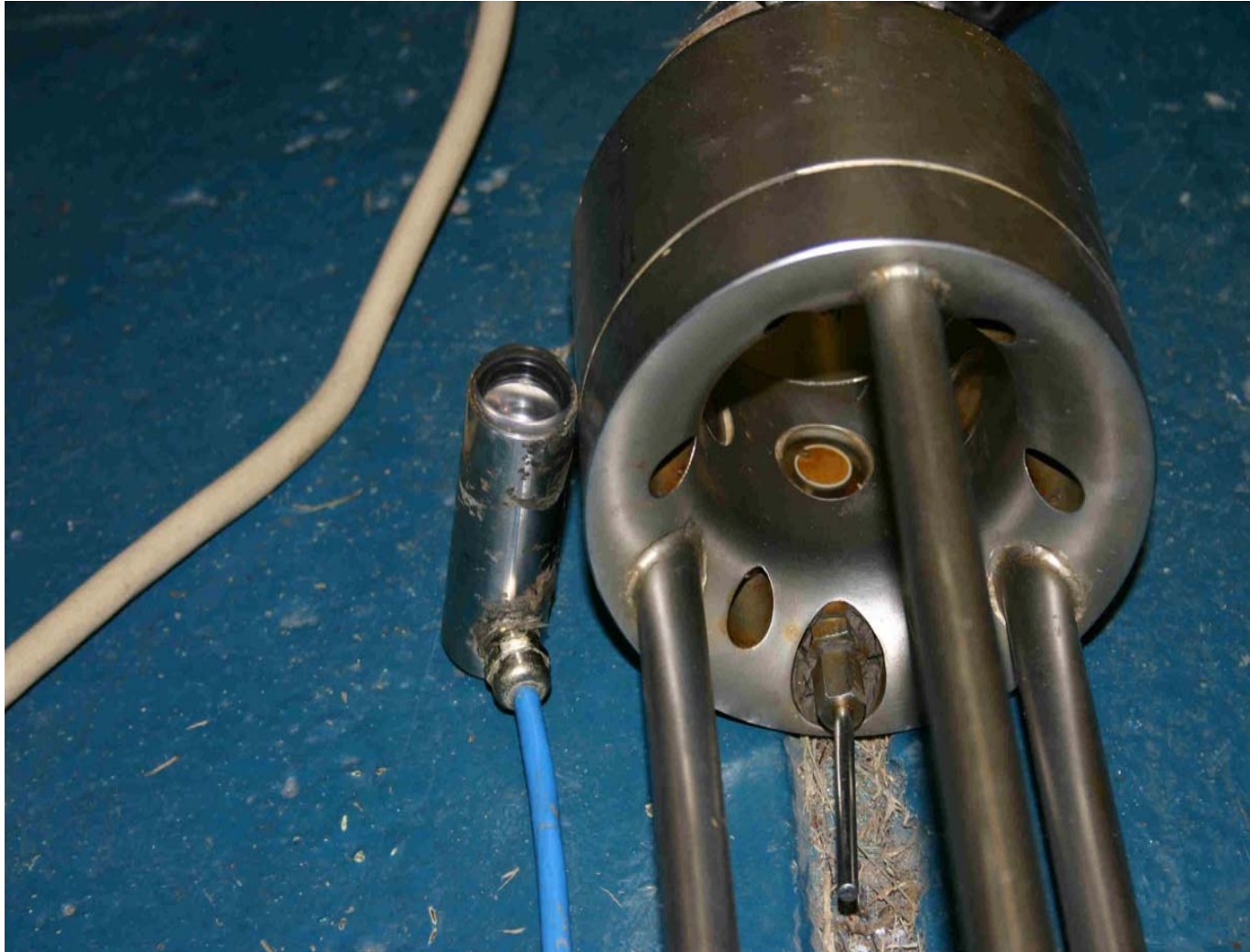




SURVEY GULF PORT BILOXI

DIGITAL RECORDING OF ODOM ECHOTRACK MK III
24 kHz FREQUENCY

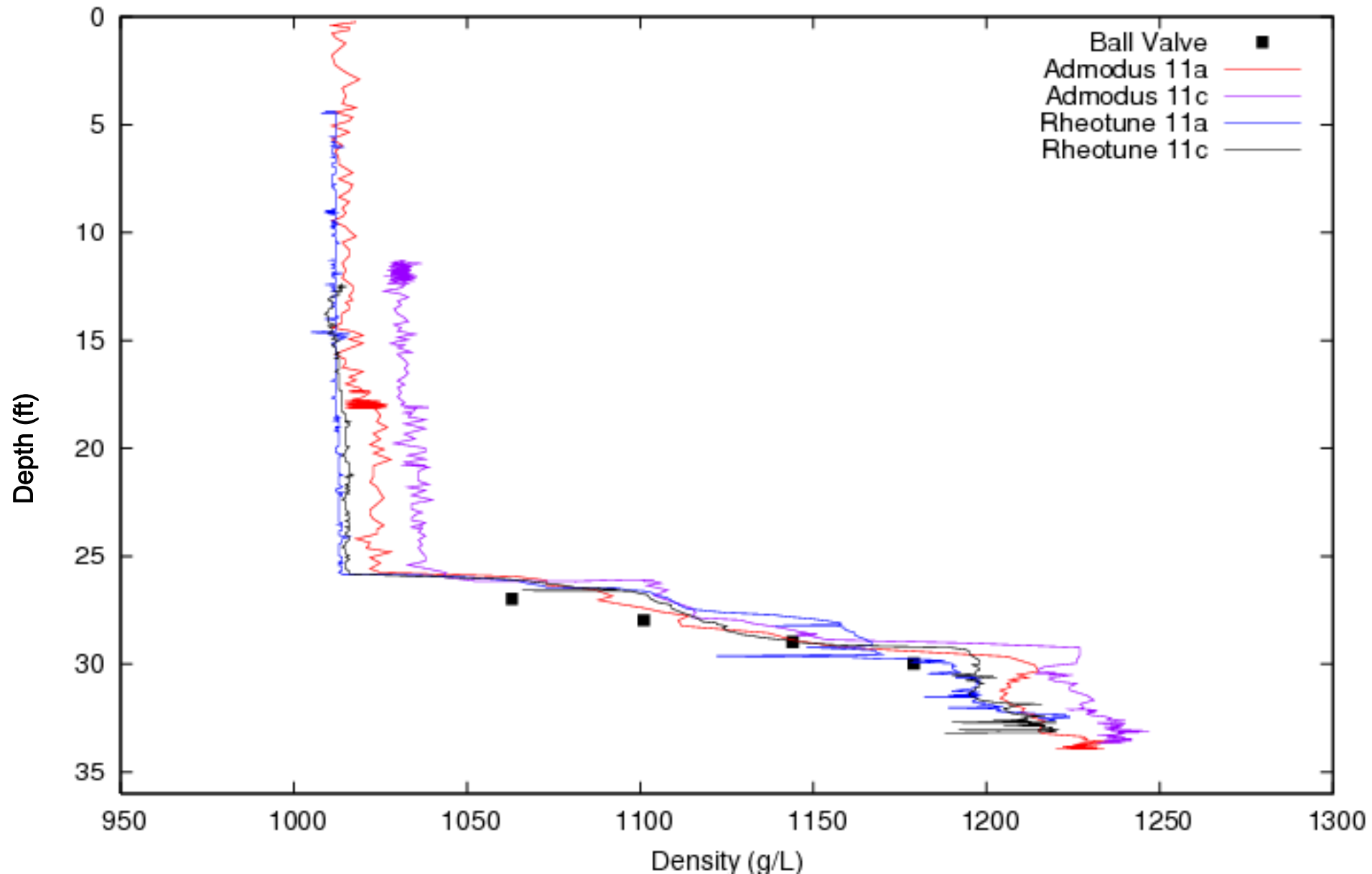
ADMODUS Ultrasound Sediment Profiler



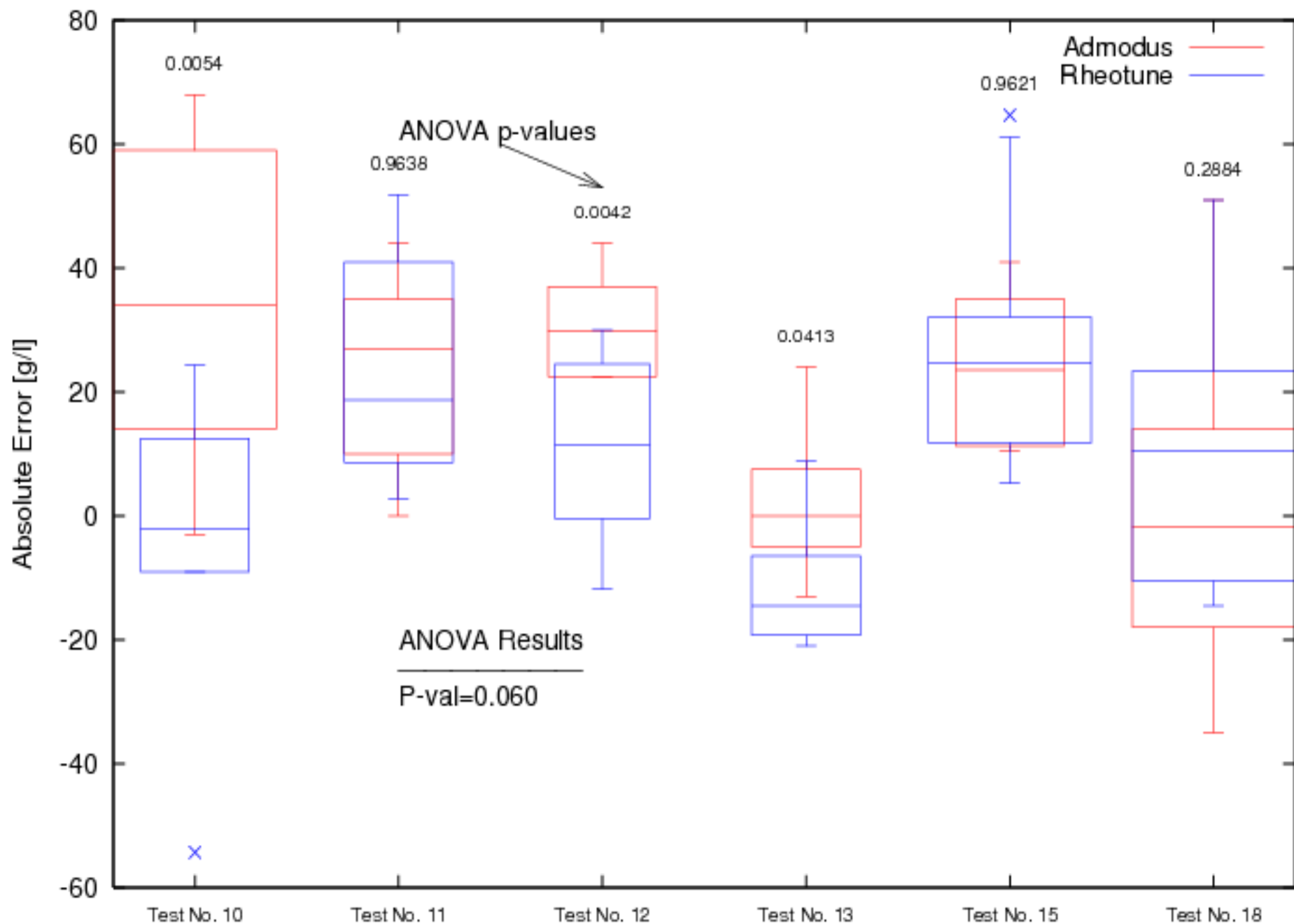




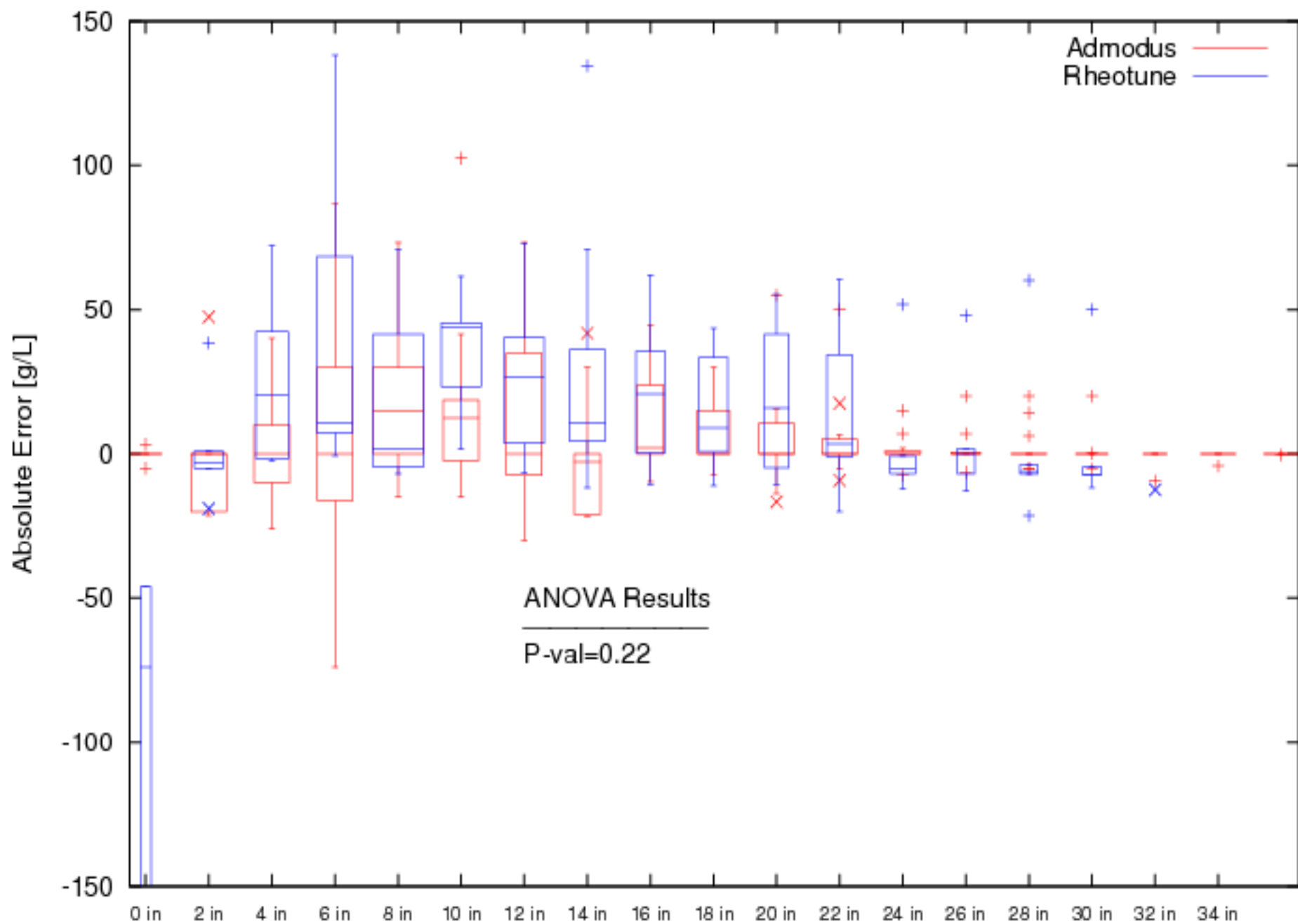
Fluid Mud Density Profile
Field Test No.11



Field Admodus and Rheotune Absolute Error to Ball-Valve Over All Tests



Admodus and Rheotune Absolute Error Over All Tests





EPA Undisturbed Surface Sediment (USS) Sampler

**National Exposure
Research Laboratory
Las Vegas, Nevada**



Technology Transfer

- **TN: World-wide fluid mud surveying systems and navigable depth definitions.**
- **Revise Engineer Manual 1110-2-1003 Hydrographic Surveying chapter in unconsolidated bottoms.**
- **White paper to HQ discussing the engineering feasibility of the USACE implementing a navigable depth policy.**
- **Develop/evaluate high-resolution probe prototype.**