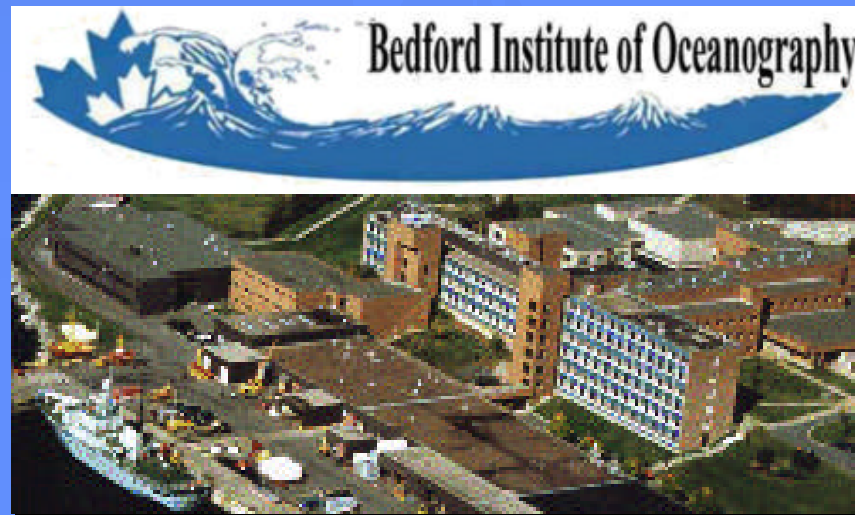


# **BOT** Brooke Ocean Technology Ltd

- Supply sensor platforms, launch & recovery systems, cable handling systems, instrumentation and engineering services
- Located in Dartmouth, Nova Scotia, Canada
- 26 full-time employees

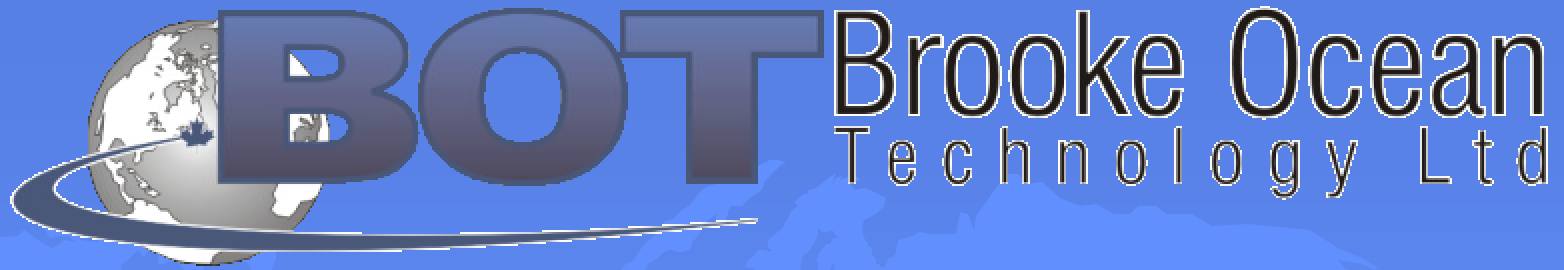


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SH  
MVP  
FFCPT  
LOPC  
CUST



BOT maintains a close collaboration with Defense Research Development Canada Atlantic and the Bedford Institute of Oceanography, one of the world's preeminent marine research labs.

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SH  
MVP  
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LOPC  
CUST



## Products

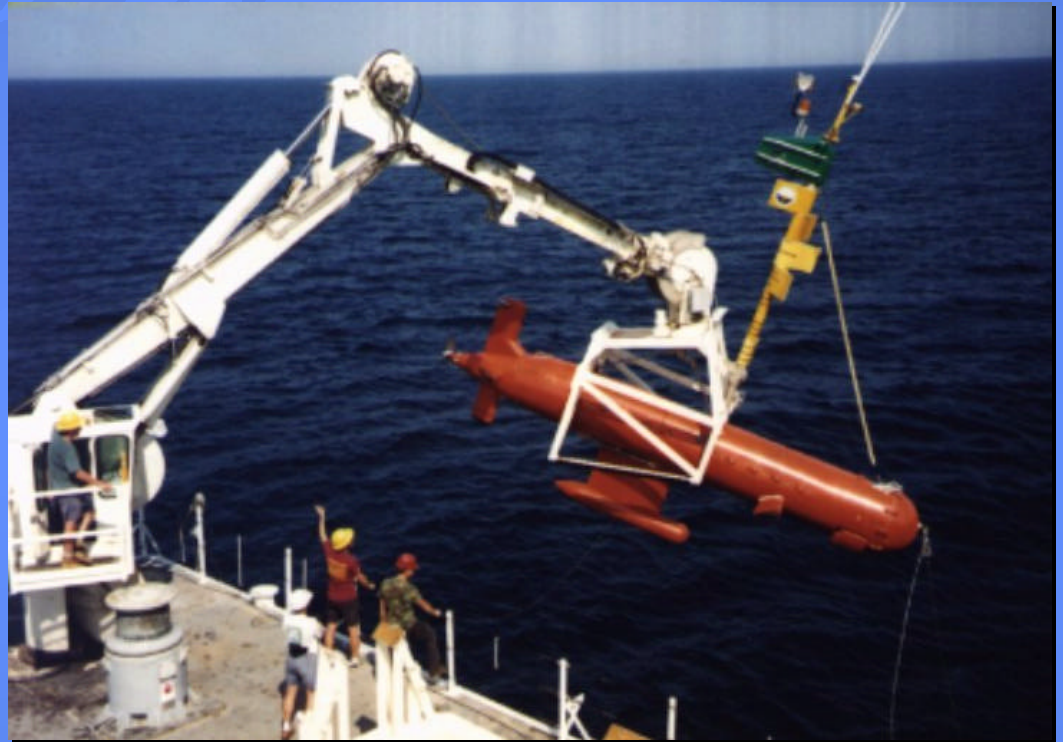
- ✦ Marine Handling Systems
- ✦ Profiling Sensor Platforms
  - *Moving Vessel Profiler (MVP)*
  - *Moored Wave-Powered Profiler (SeaHorse)*
- ✦ Instrumentation
  - *Laser Optical Plankton Counter (LOPC)*
  - *Free Fall Cone Penetrometer (FFCPT)*
- ✦ Custom Hardware
  - *Towbodies*
  - *Work Vans*

# Launch and Recovery Systems (LARS)

- ✍ Have supplied LARS for unmanned surface vehicles, autonomous underwater vehicles, 1 atmosphere submersibles, towed bodies, CTD rosettes, and submarine pod posting
- ✍ Designed and supplied components for ROV LARS

# ORCA LARS

- ✦ Delivered to the US Naval Oceanographic Office
- ✦ Payload is a 8 m, 4000 kg air breathing semi-submersible used for seabed mapping
- ✦ Utilises remote latching technology to attach lines without requirement for personnel in the water
- ✦ Ship of opportunity adaptable

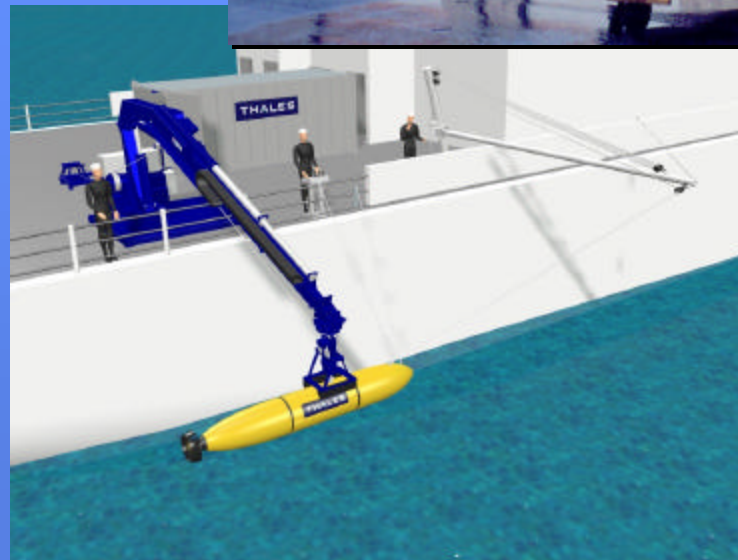


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LOPC  
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THALES

# AUV Launch and Recovery System

- ✦ Ship of opportunity adaptable LARS for Bluefin Robotics 21" AUV
- ✦ Containerized for storage and transport
- ✦ Remote line attachment of tow line and lift cable
- ✦ Can be operated in up to Sea State 5



BOT  
LARS  
SH  
MVP  
FFCPT  
LOPC  
CUST

# Monterey Bay Aquarium Research Institute (MBARI) AUV LARS

- Designed for family of 21" diameter AUVs up to 6 m long
- Utilizes a unique compliant target hose with docking device to capture and deploy vehicle
- Double articulating J-frame
- Can be operated in up to Sea State 4



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LOPC  
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# French Navy Seakeeper LARS

- ✦ BOT under contract to develop the preliminary design of a LARS for operation from a new class of frigates (FREMM)





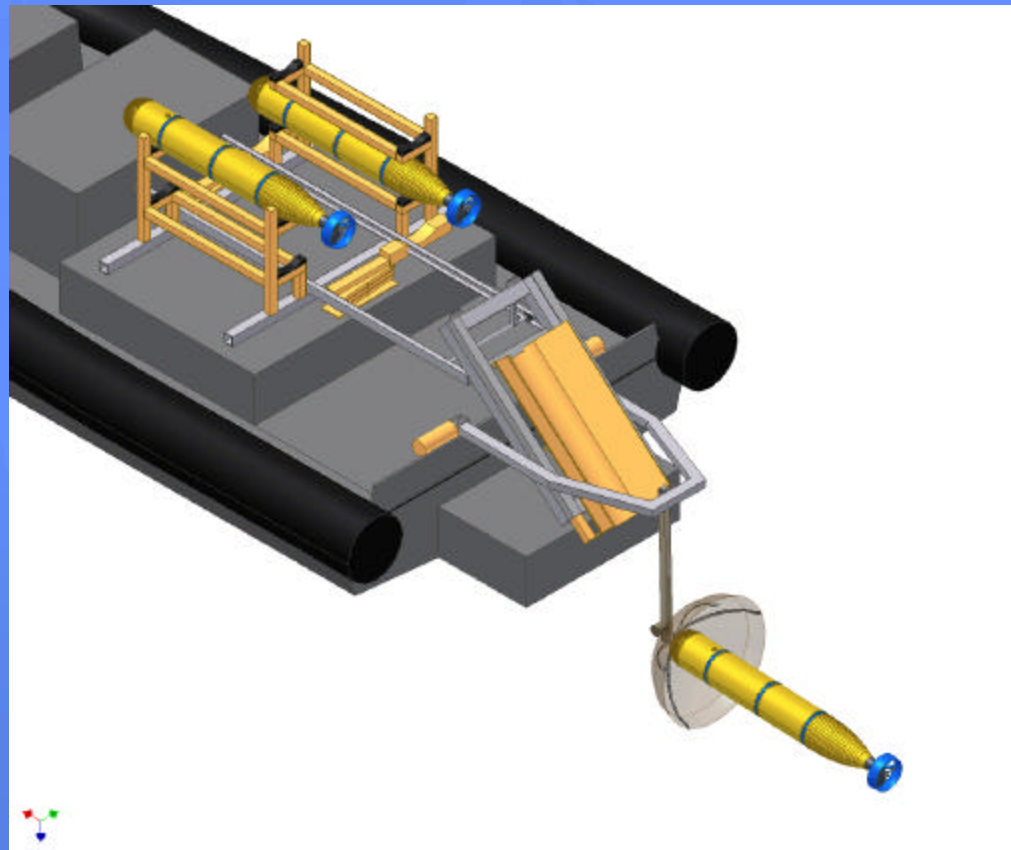
# New R&D Projects for US Navy Unmanned Surface Vehicle (USV) Payloads

Bluefin Robotics and BOT were recently awarded the following SBIR contracts:

✍ *SBIR N04-127* - development of an automated system to deploy and recover small AUVs from a USV

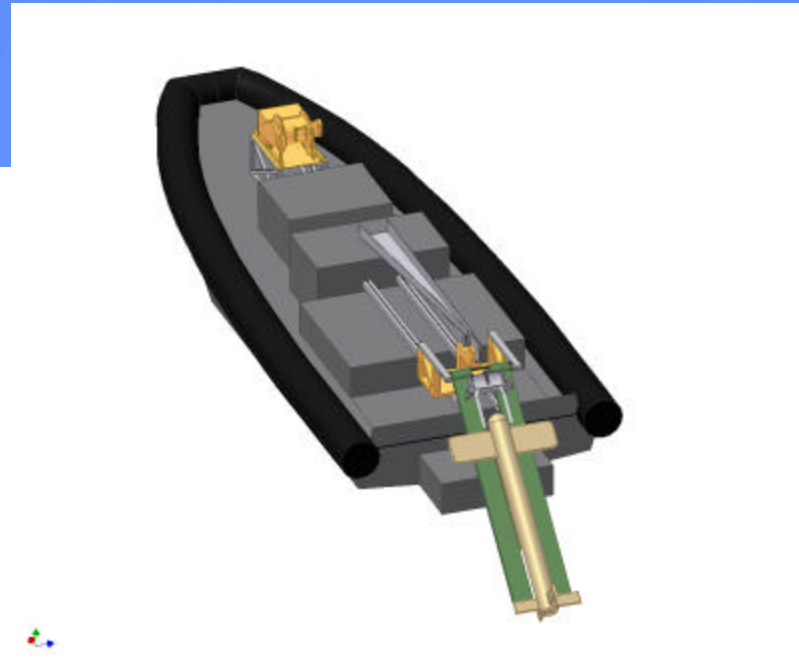
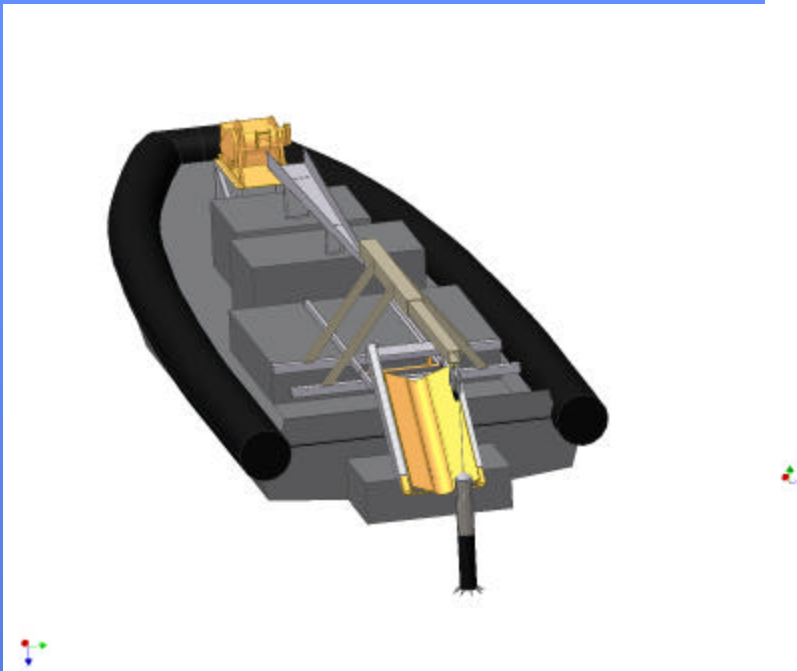
✍ *SBIR N04-087* – development of an automated system to deploy and recover offboard sensors from a USV

# Automated System to Deploy and Recover Small AUVs from a USV



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# Automated System to Deploy and Recover Offboard Sensors from a USV



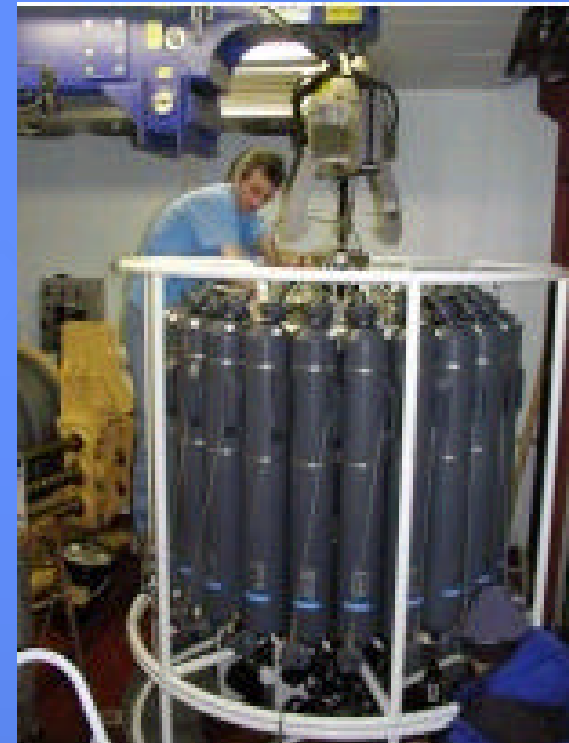
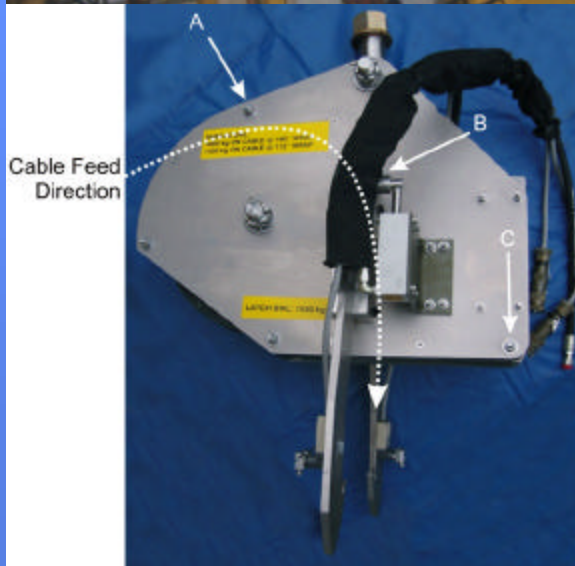
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# CTD Handling Systems



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# CTD Handling Systems



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MVP  
FFCPT  
LOPC  
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# Custom Slip Ring Winches



BOT  
LARS  
SH  
MVP  
FFCPT  
LOPC  
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# Cable Metering Sheave

## ✦ Operating Modes:

- On station
- Towing

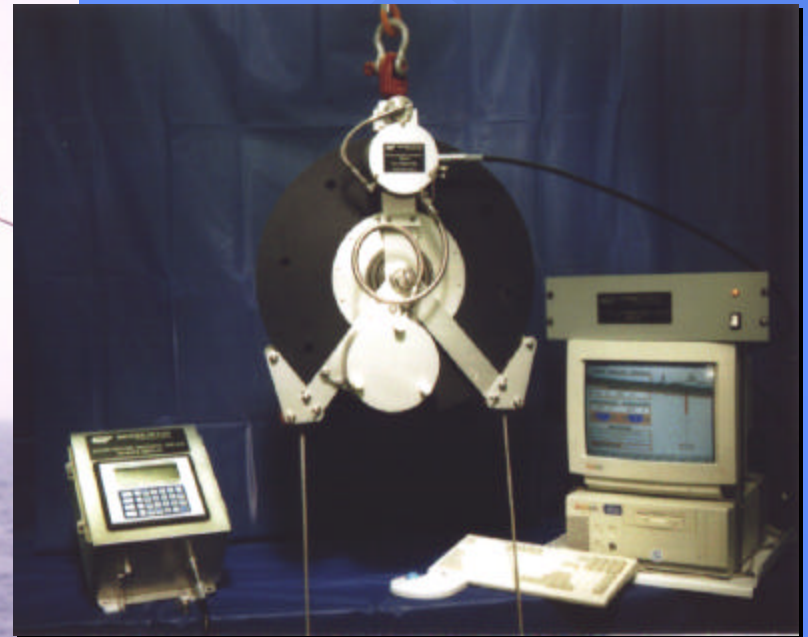
## ✦ Measures:

- Cable out
- Cable speed
- Cable load
- Cable angles

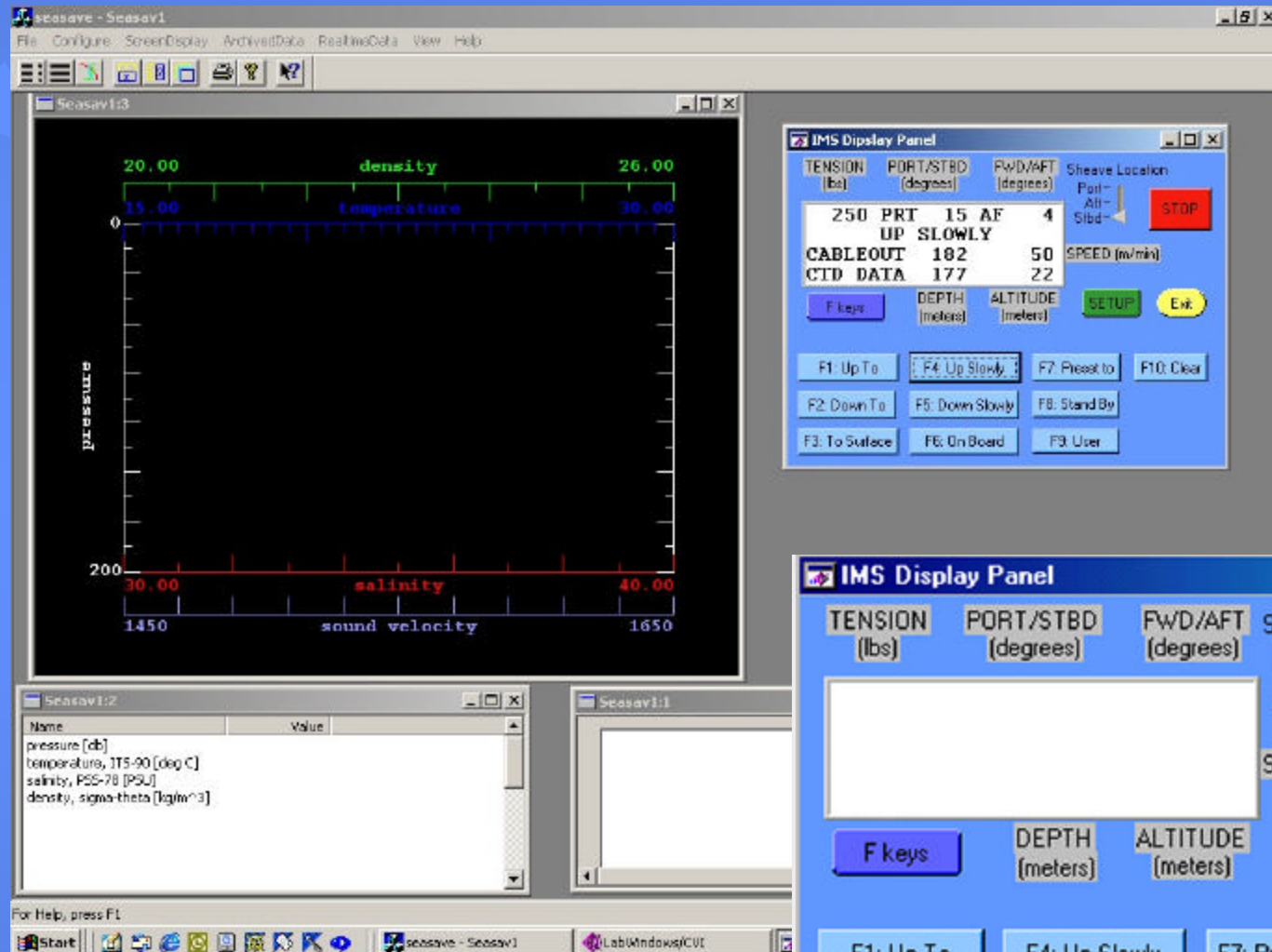
## ✦ Readout Locations:

- Bridge
- Winch
- Lab

## ✦ Permits messages to be sent from lab to winch operator



# Cable Metering Sheave



**IMS Display Panel**

| TENSION (lbs)    | PORT/STBD (degrees) | FWD/AFT (degrees) | Sheave Location        |
|------------------|---------------------|-------------------|------------------------|
| 250              | PRT 15              | AF 4              | Port-<br>All-<br>Stbd- |
| <b>UP SLOWLY</b> |                     |                   |                        |
| CABLEOUT         | 182                 | 50                | SPEED (m/min)          |
| CTD DATA         | 177                 | 22                |                        |

Buttons: F keys, DEPTH (meters), ALTITUDE (meters), SETUP, Exit

Function Keys:

- F1: Up To
- F2: Down To
- F3: To Surface
- F4: Up Slowly
- F5: Down Slowly
- F6: On Board
- F7: Preset to
- F8: Stand By
- F9: User
- F10: Clear

**IMS Display Panel**

| TENSION (lbs) | PORT/STBD (degrees) | FWD/AFT (degrees) | Sheave Location        |
|---------------|---------------------|-------------------|------------------------|
|               |                     |                   | Port-<br>Aft-<br>Stbd- |
| STOP          |                     |                   |                        |
| SPEED (m/min) |                     |                   |                        |

Buttons: F keys, DEPTH (meters), ALTITUDE (meters), SETUP, Exit

Function Keys:

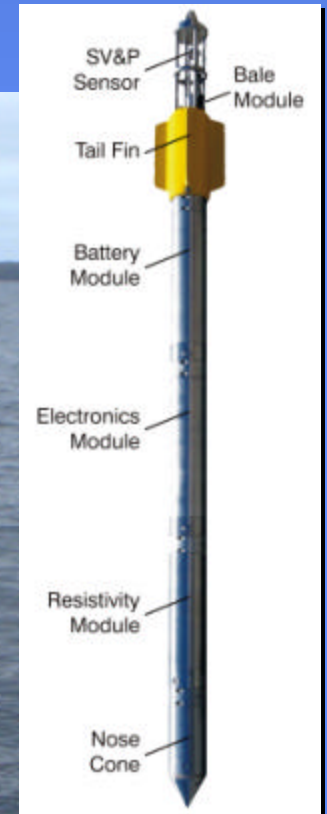
- F1: Up To
- F2: Down To
- F3: To Surface
- F4: Up Slowly
- F5: Down Slowly
- F6: On Board
- F7: Preset to
- F8: Stand By
- F9: User
- F10: Clear

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# Free Fall Cone Penetrometer (FFCPT)

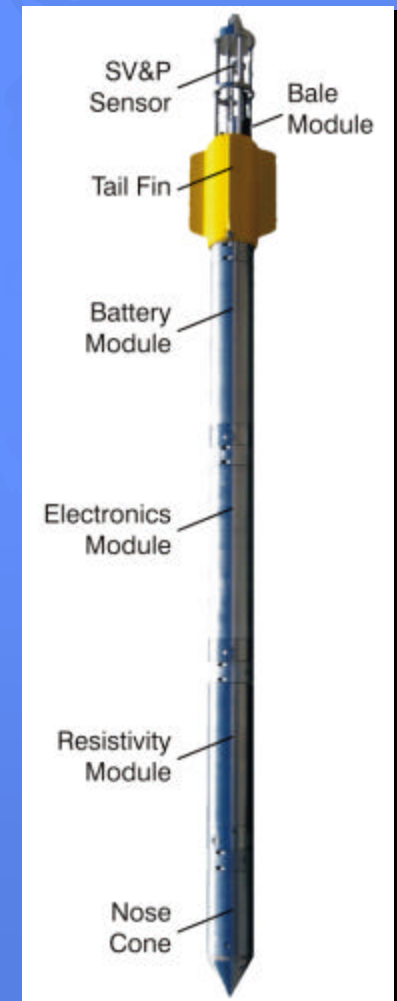
- ✍ Measures shear strength and static resistivity of sediment with integration of dynamic resistivity under development
- ✍ Sediment classification
- ✍ Also measures water column sound velocity during descent from surface



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S H  
MVP  
FFCPT  
LOPC  
CUST

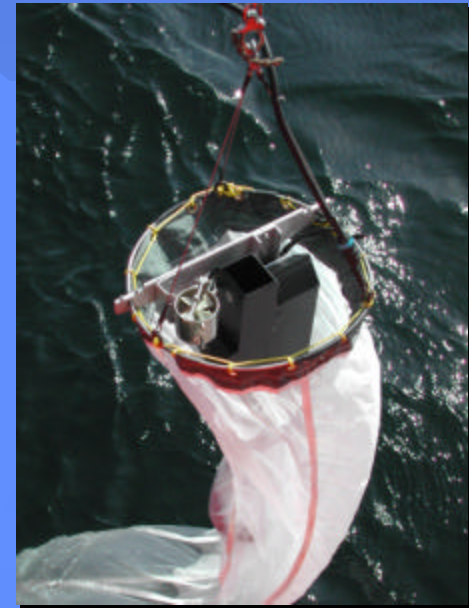
# Free Fall Cone Penetrometer (FFCPT)

- FFCPT is modular in design
  - Allows the use of optional / experimental payloads.
- Core FFCPT consists of 4 main modules
  - Nose Cone
    - ? Pore Pressure Sensor
    - ? 3 Accelerometers (1g, 5g, 100g)
    - ? Mudline Sensor (OBS)
  - Electronics Module
  - Battery Module
  - Bale Module
    - ? Hydrostatic Pressure Sensor
- Tail Fin added to assist hydrodynamic flight
- Optional Sensor Suit
  - Static Resistivity (auxiliary module)
  - Sound Velocity Sensor (in the bale)



# Laser Optical Plankton Counter (LOPC)

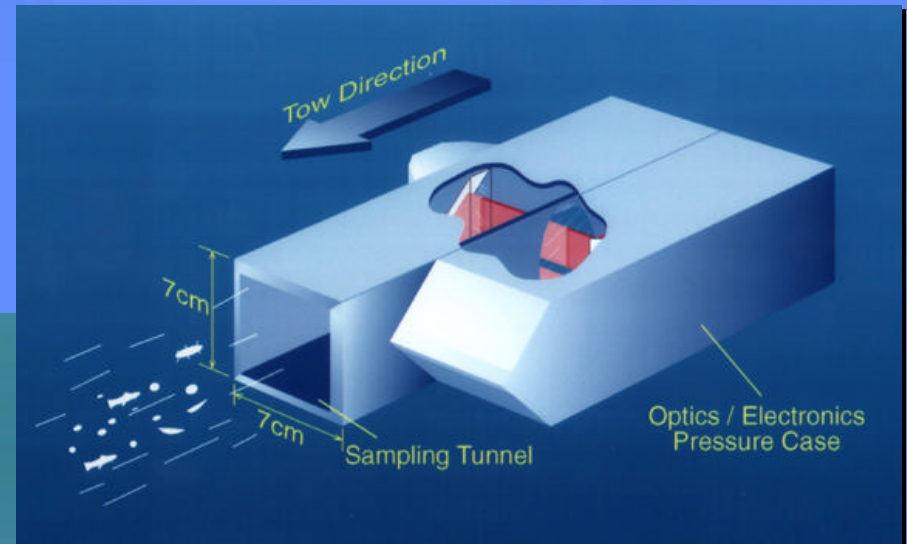
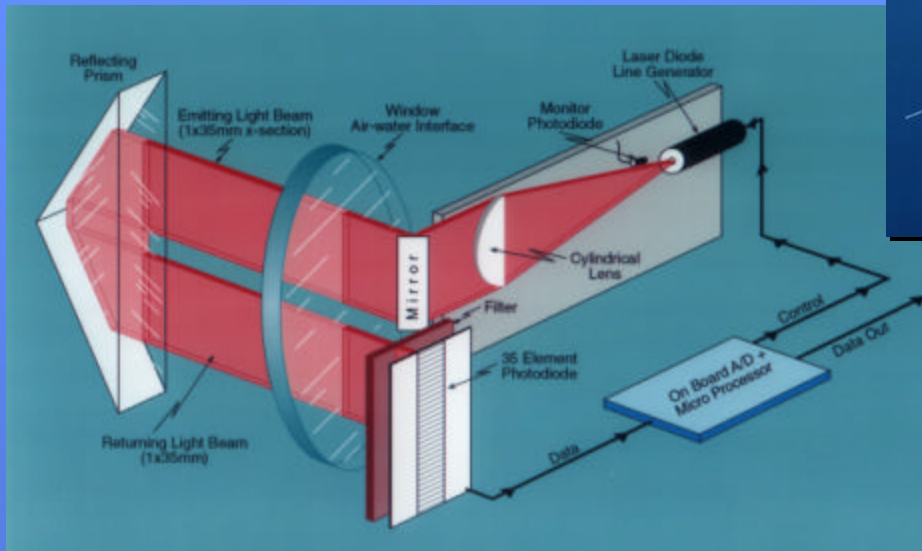
- ✦ High resolution/shape profiling
- ✦ Real-time data collection
- ✦ Improved coincidence limit
- ✦ Serial and analog interface inputs



- ✦ Flow speed estimation
- ✦ Compact design
- ✦ Single pressure case
- ✦ Larger tunnel available

# LOPC Operation

- ✦ 1 mm x 35 mm laser beam and precision optics
  - Low coincidence levels in very high concentrations of plankton
- ✦ Scan rate of 35 ?s
- ✦ Digital Signal Processing



# System Components

✍ LOPC

✍ Deck unit (RS 232 output)

✍ User supplied PC

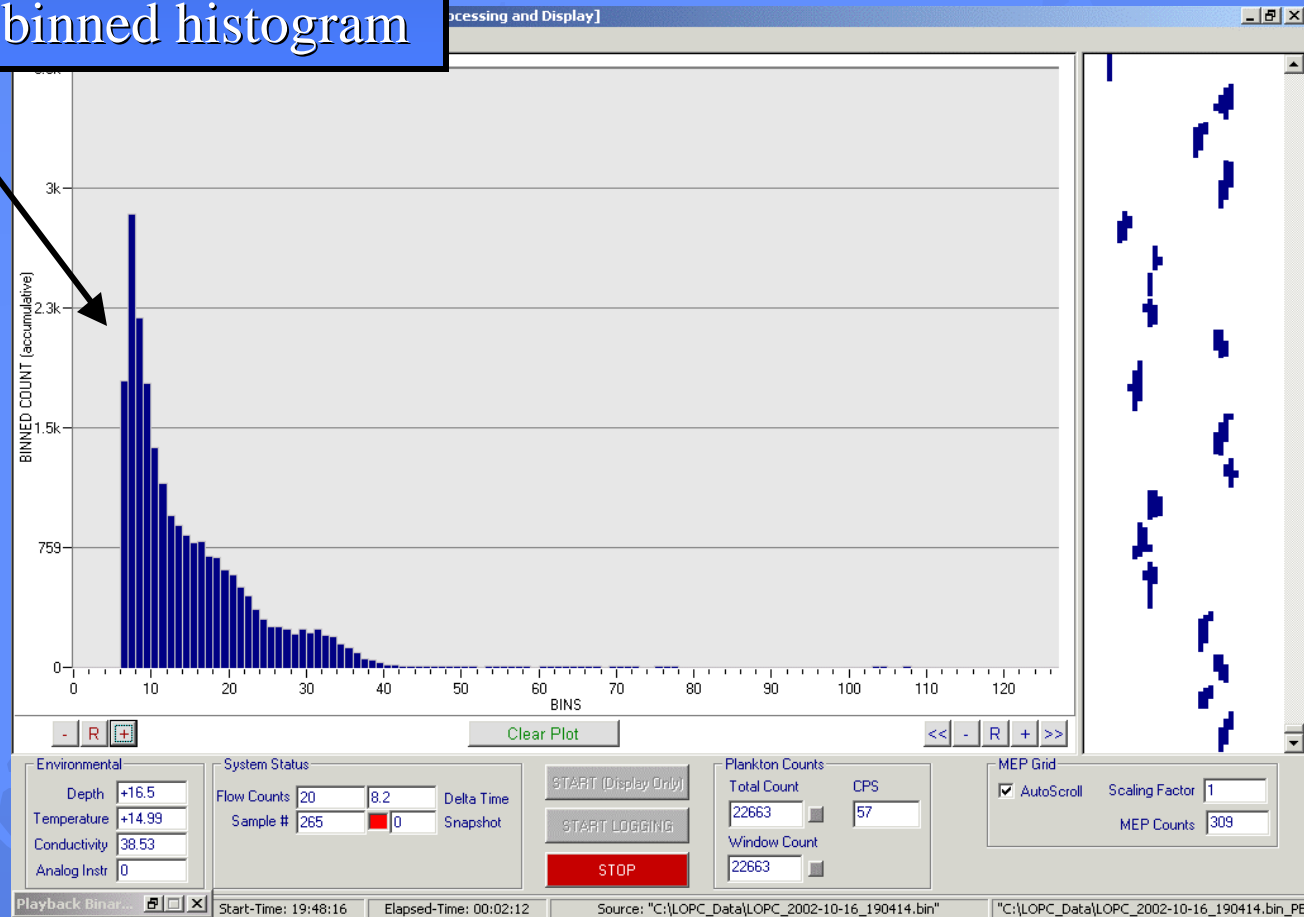
✍ Interface software



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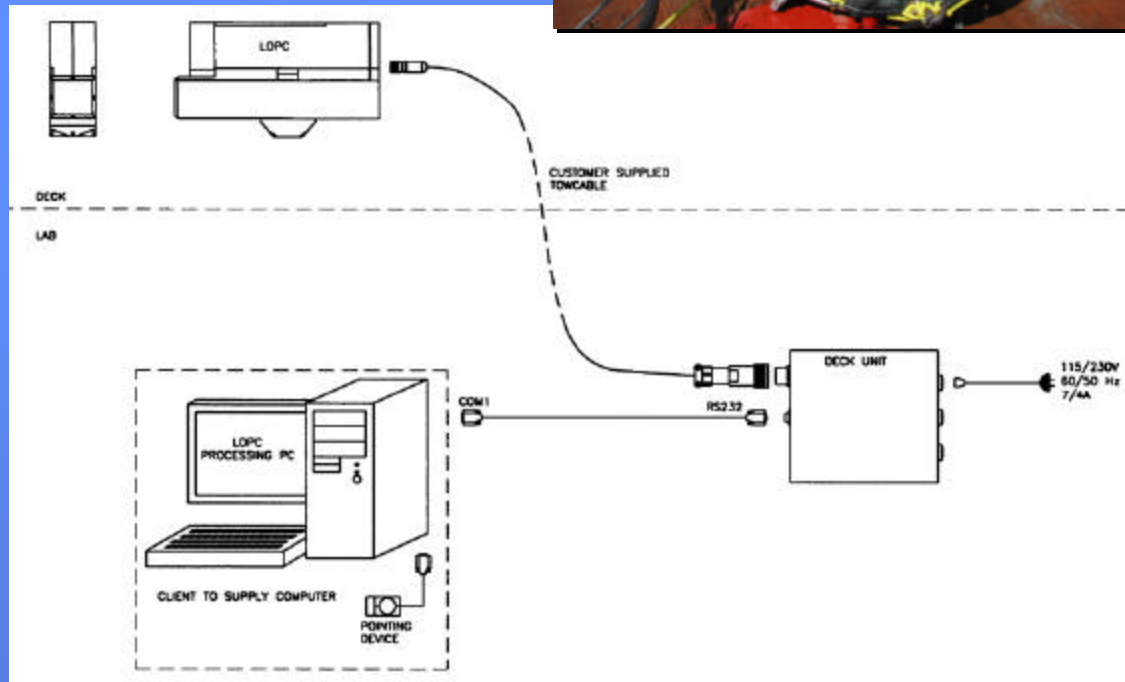
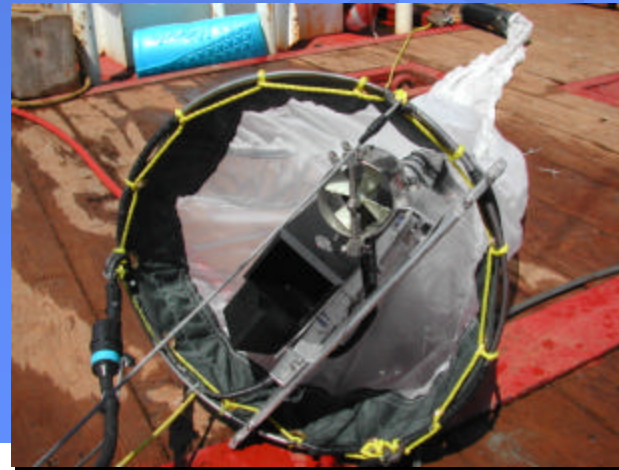
# Data Stream Display

Detected plankton in the 100 - 1900 ?m range are interpreted as counts and displayed in the binned histogram



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FFCPT  
LOPC  
CUST

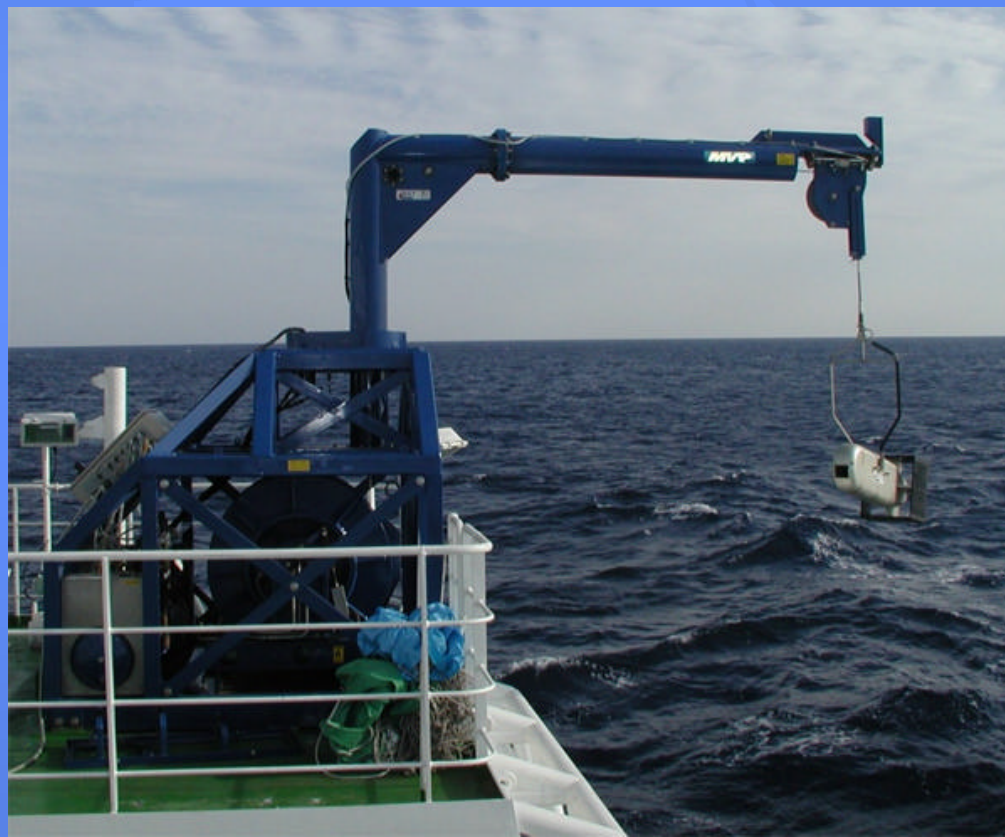
# Standalone Installation



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FFCPT  
LOPC  
CUST

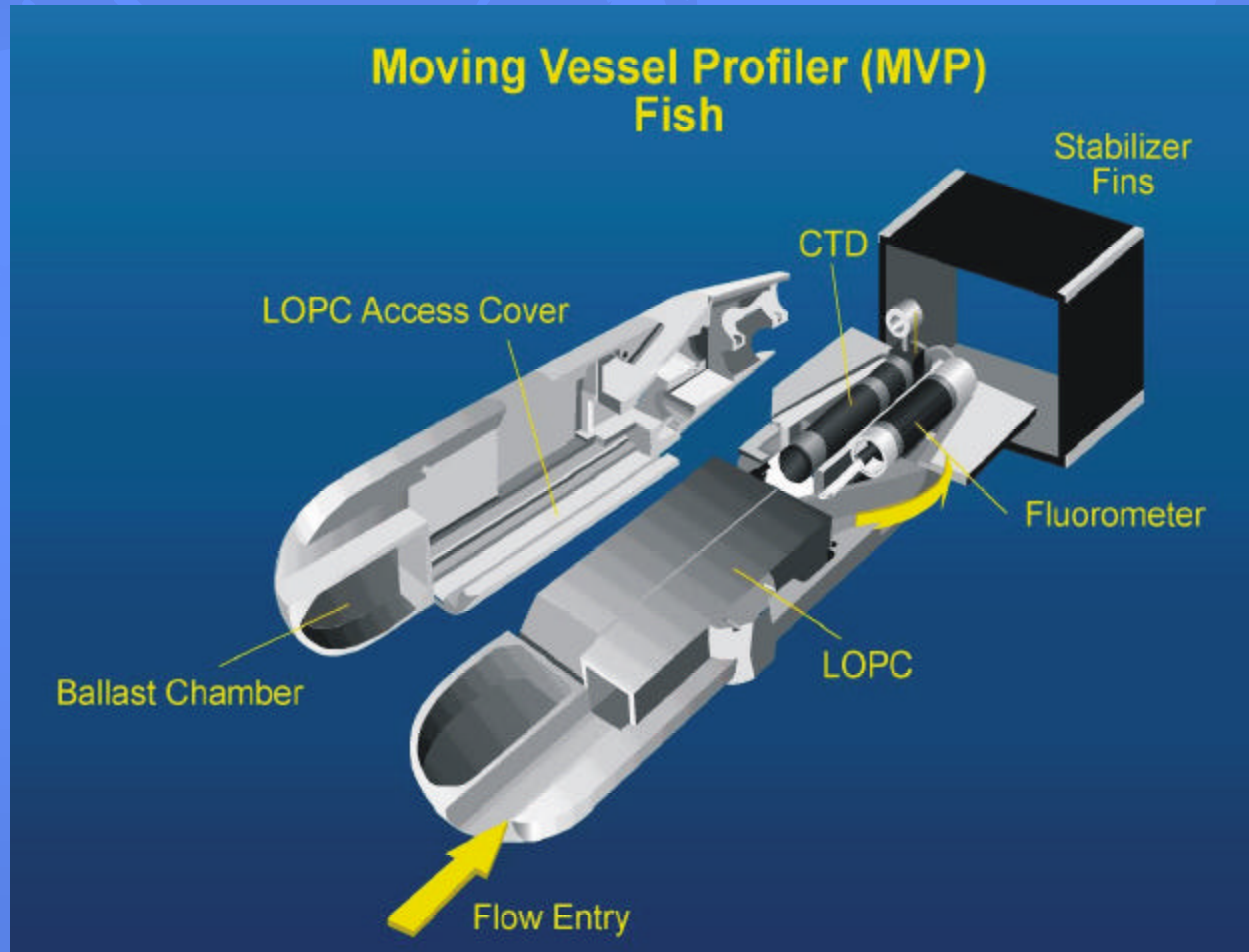
# MVP Installation of LOPC

- ✦ Enables drops and data collection while moving at 12 knots
- ✦ Ease of launch and retrieval
- ✦ Deck unit built into winch (RS422 to lab)





# LOPC and MVP Fish



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FFCPT  
LOPC  
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# *Custom Hardware*

✍ Towed Bodies

✍ Containerized Workshops

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FFCPT  
LOPC  
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# Towed Bodies



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SH  
MVP  
FFCPT  
LOPC  
CUST

# Containerized Workshops



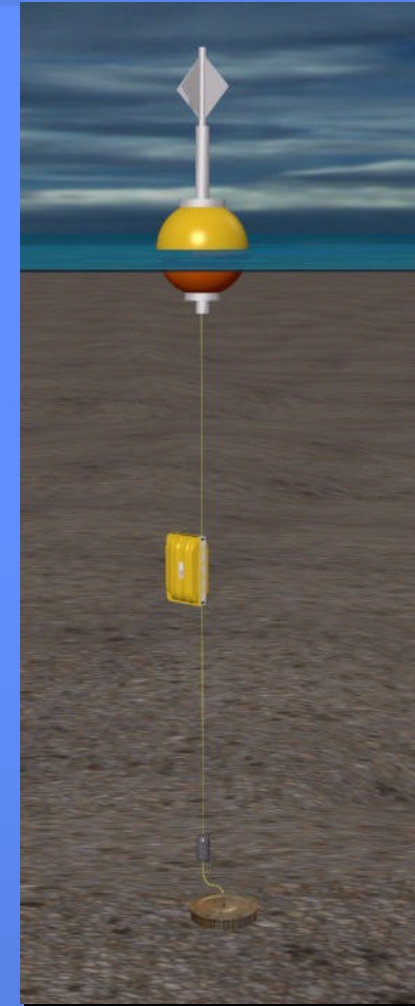
BOT  
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MVP  
FFCPT  
LOPC  
CUST

# *Profiling Sensor Platforms*

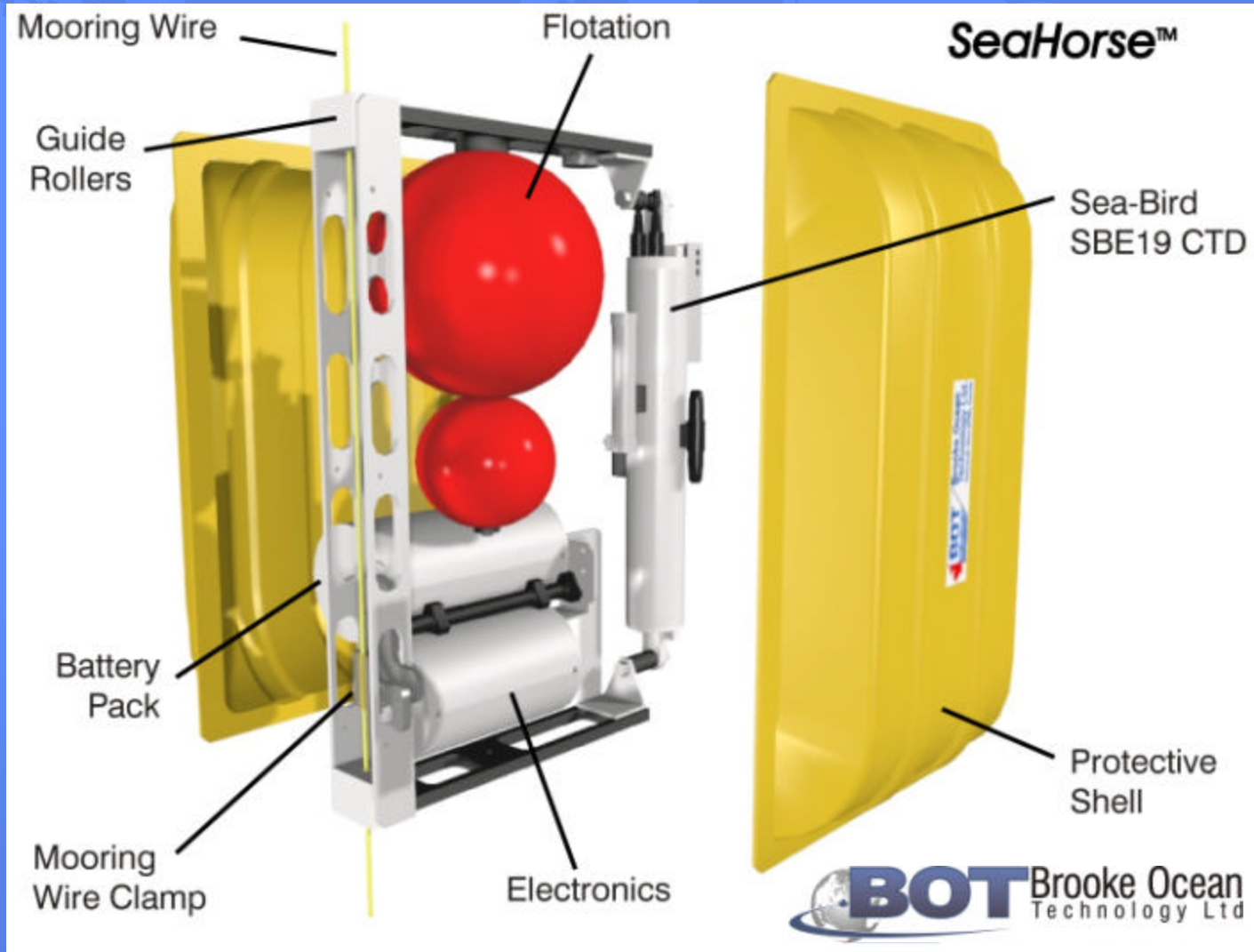
- ✍ Moored Wave-Powered Profiler (SeaHorse)
- ✍ Moving Vessel Profiler (MVP)

# Moored Wave-Powered Profiler (SeaHorse™)

- ✍ Provides continuous data profile along mooring with one sensor
- ✍ Utilises wave energy to move up and down mooring wire
- ✍ Real-time data via acoustic or inductive link
  - CTD
  - Turbidity
  - Fluorometer



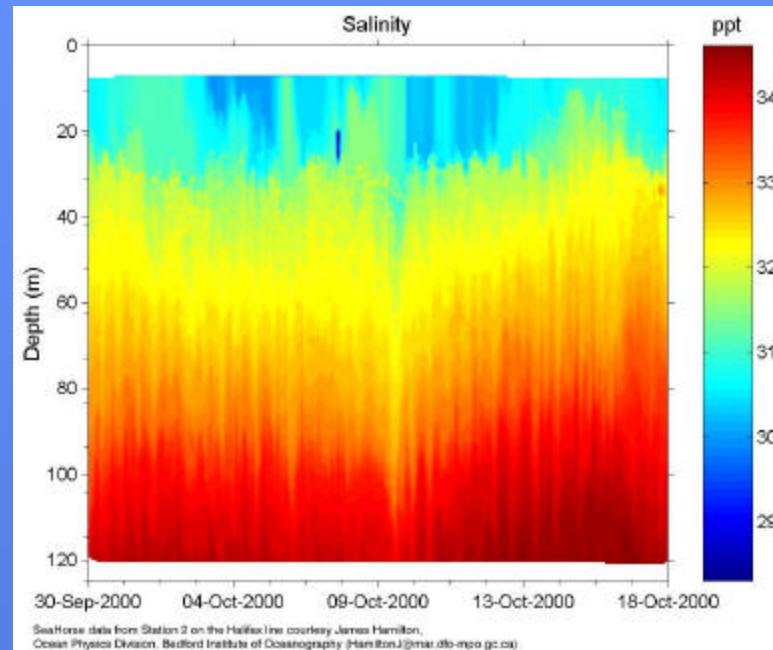
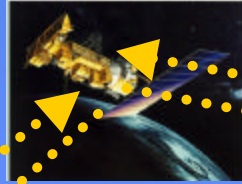
# SeaHorse™ Illustration



BOT  
LARS  
SH  
MVP  
FFCPT  
LOPC  
CUST

# SeaHorse™ Data Telemetry

- Real-time telemetry system under development
- Joint Project with MBARI, BIO and Brooke Ocean Technology



BOT  
LARS  
S H  
MVP  
FFCPT  
LOPC  
CUST





# SeaHorse™



BOT  
LARS  
S H  
MVP  
FFCPT  
LOPC  
CUST

# Moving Vessel Profiler (MVP)

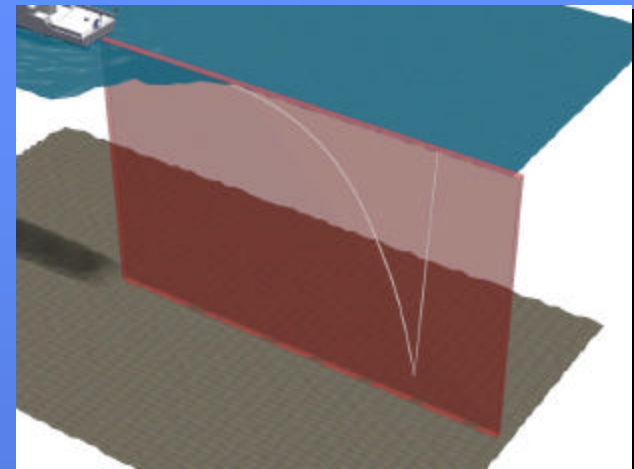
- ✦ CTD, Laser Optical Plankton Counter (LOPC), Fluorometry or Sound Velocity profiles from vessels underway
- ✦ 0 - 800m at 18 knots
- ✦ Other sensors possible
- ✦ Applications:
  - Hydrographic
  - Seismic
  - Oceanographic
  - Mine counter measures
  - Anti-submarine warfare



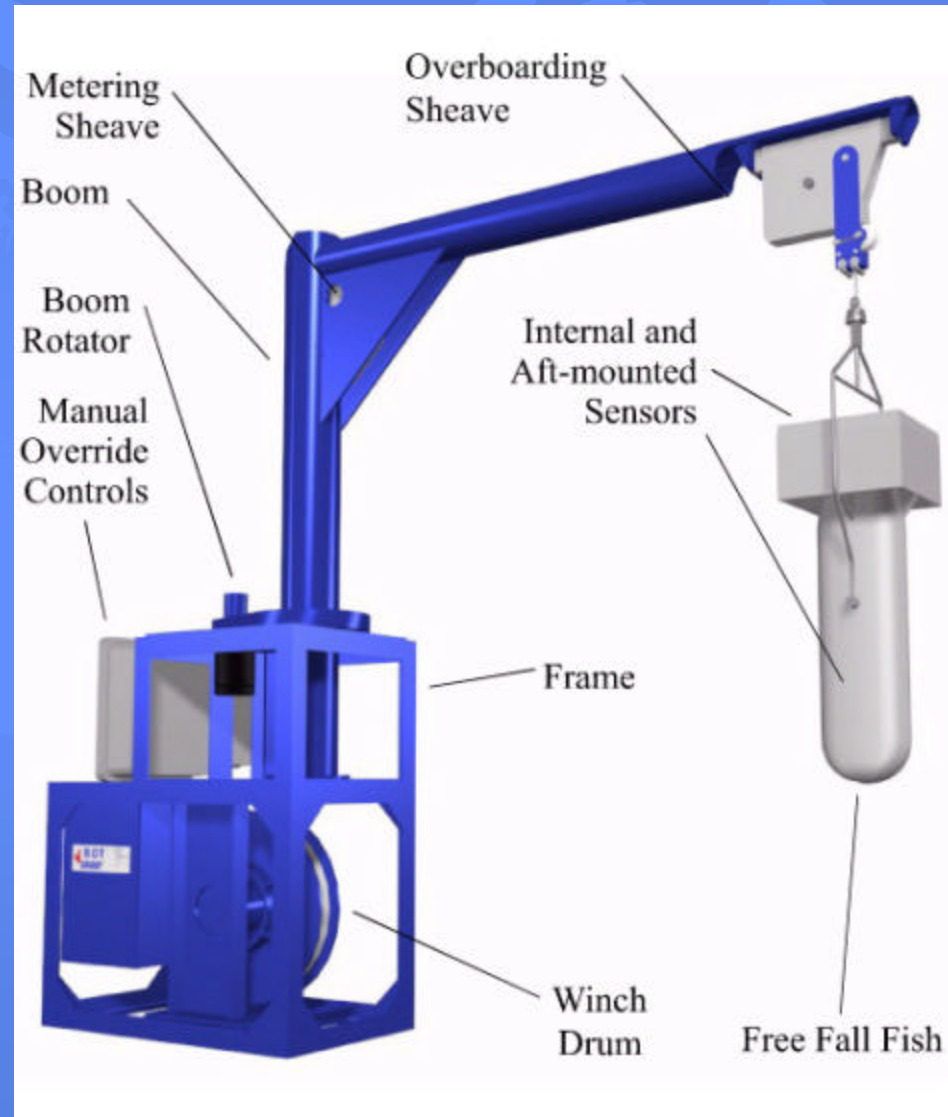
BOT  
LARS  
SH  
MVP  
FFCPT  
LOPC  
CUST

# How Does It Work?

- ✍ Under computer control
- ✍ Free-Fall Fish is released
- ✍ Deployed until desired depth is reached
- ✍ The brake is applied
- ✍ Fish is winched to the surface



# MVP Components



BOT  
LARS  
SH  
MVP  
FFCPT  
LOPC  
CUST

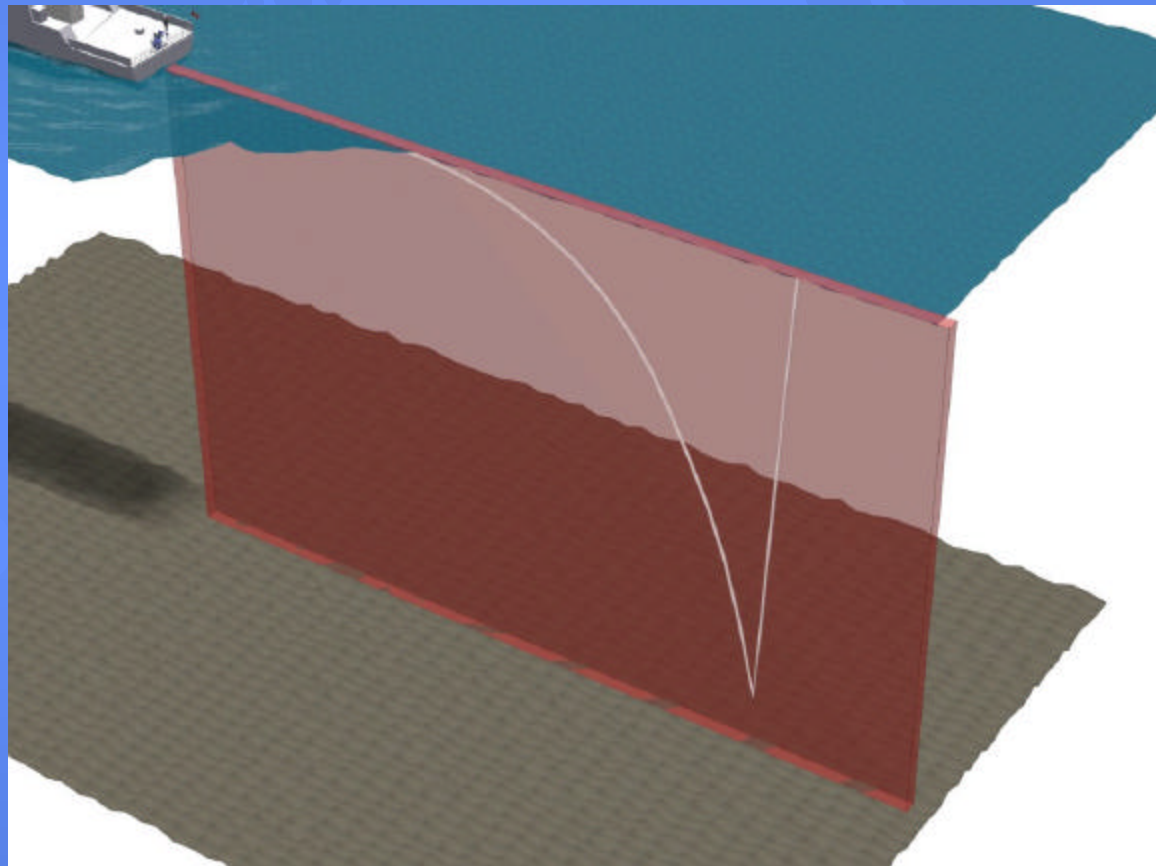
# The Concept

Deployment

Freefall

Maximum  
Depth

Winched  
Recovery



BOT  
LARS  
S H  
MVP  
FFCPT  
LOPC  
CUST



# New Addition to MVP Family



**MVP30**

**MVP100**

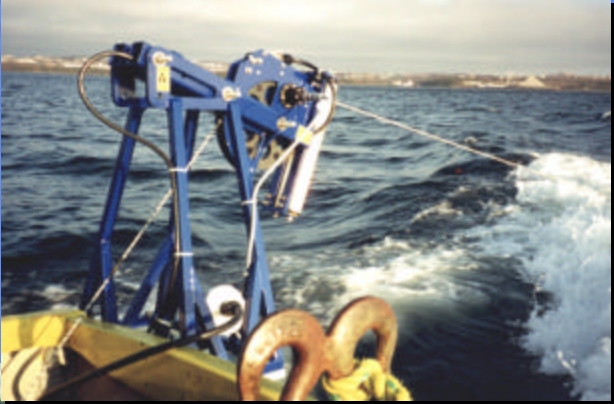
**MVP200**

**MVP300**

**MVP800**

- BOT
- LARS
- S H
- MVP
- FFCPT
- LOPC
- CUST

# MVP 30



### Sensor Payloads:

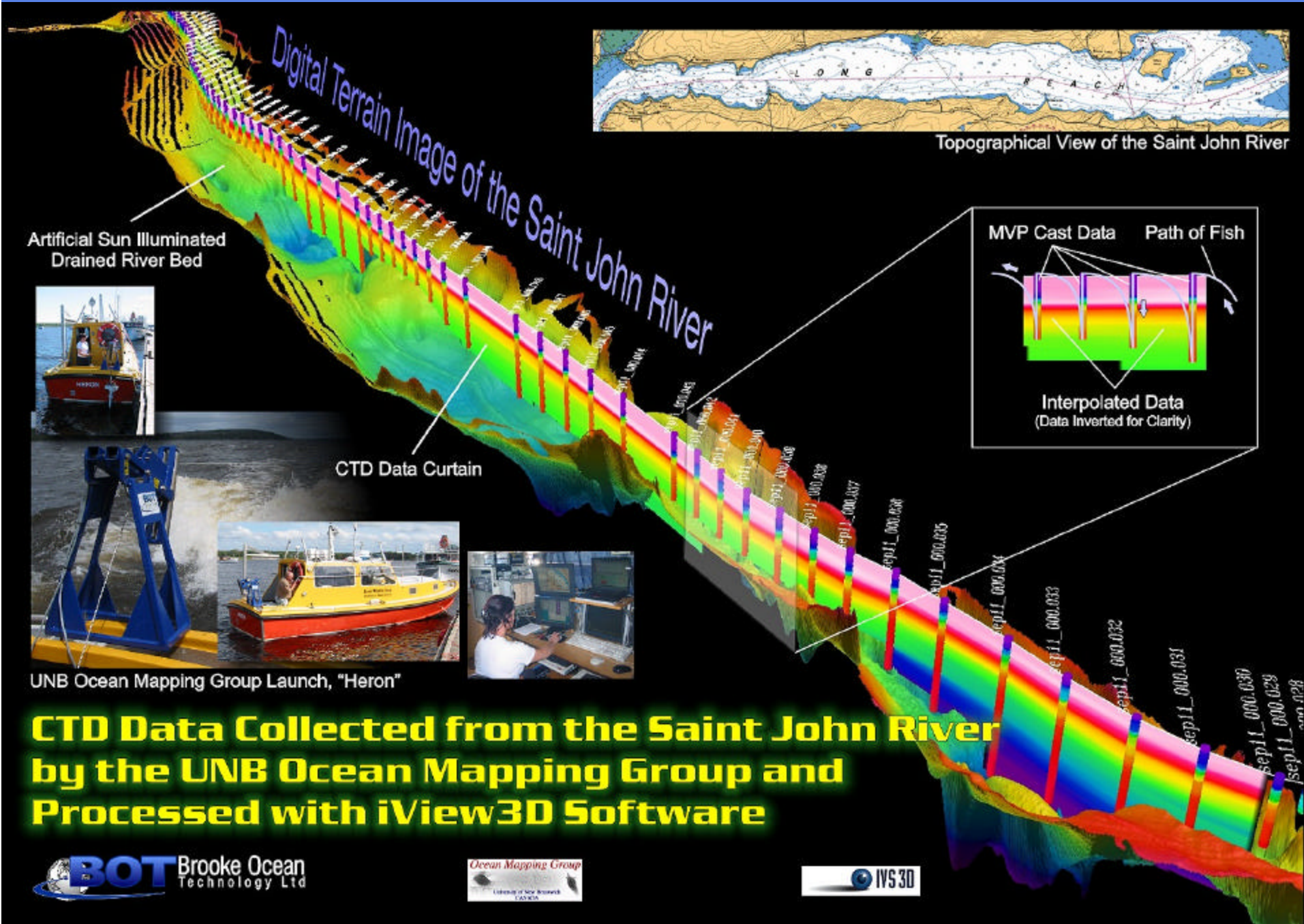
- ✍ Sound Velocity
- ✍ CTD

### Profile Depths:

- ✍ 30m at 18 knots
- ✍ 50m at 5 knots
- ✍ 120m at 0 knots



- BOT
- LARS
- S H
- MVP
- FFCPT
- LOPC
- CUST



Digital Terrain Image of the Saint John River



Topographical View of the Saint John River

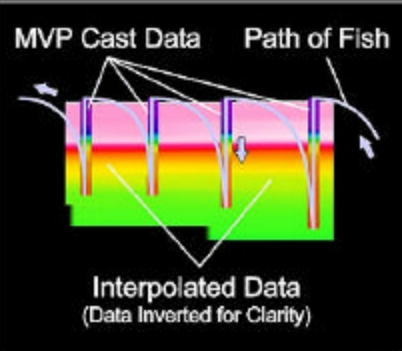
Artificial Sun Illuminated Drained River Bed



CTD Data Curtain



UNB Ocean Mapping Group Launch, "Heron"

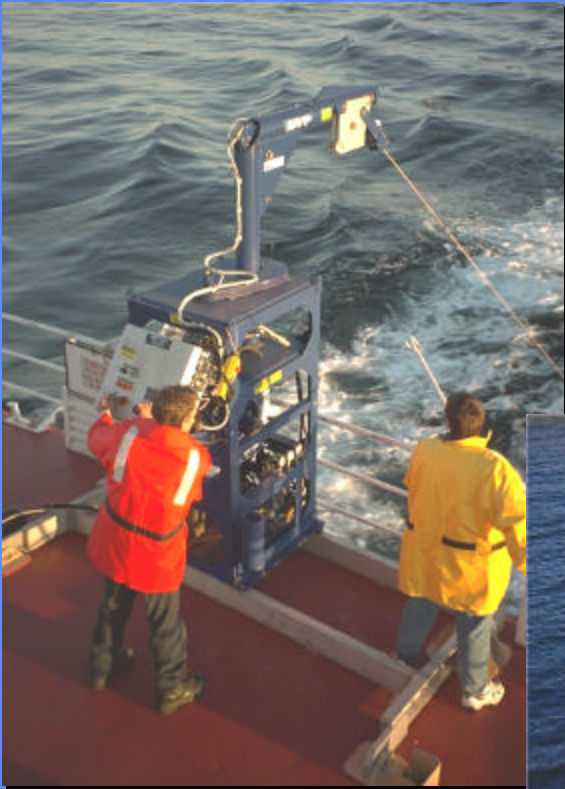


**CTD Data Collected from the Saint John River by the UNB Ocean Mapping Group and Processed with iView3D Software**





# MVP 100



## Sensor Payloads:

- ✍ Sound Velocity
- ✍ CTD

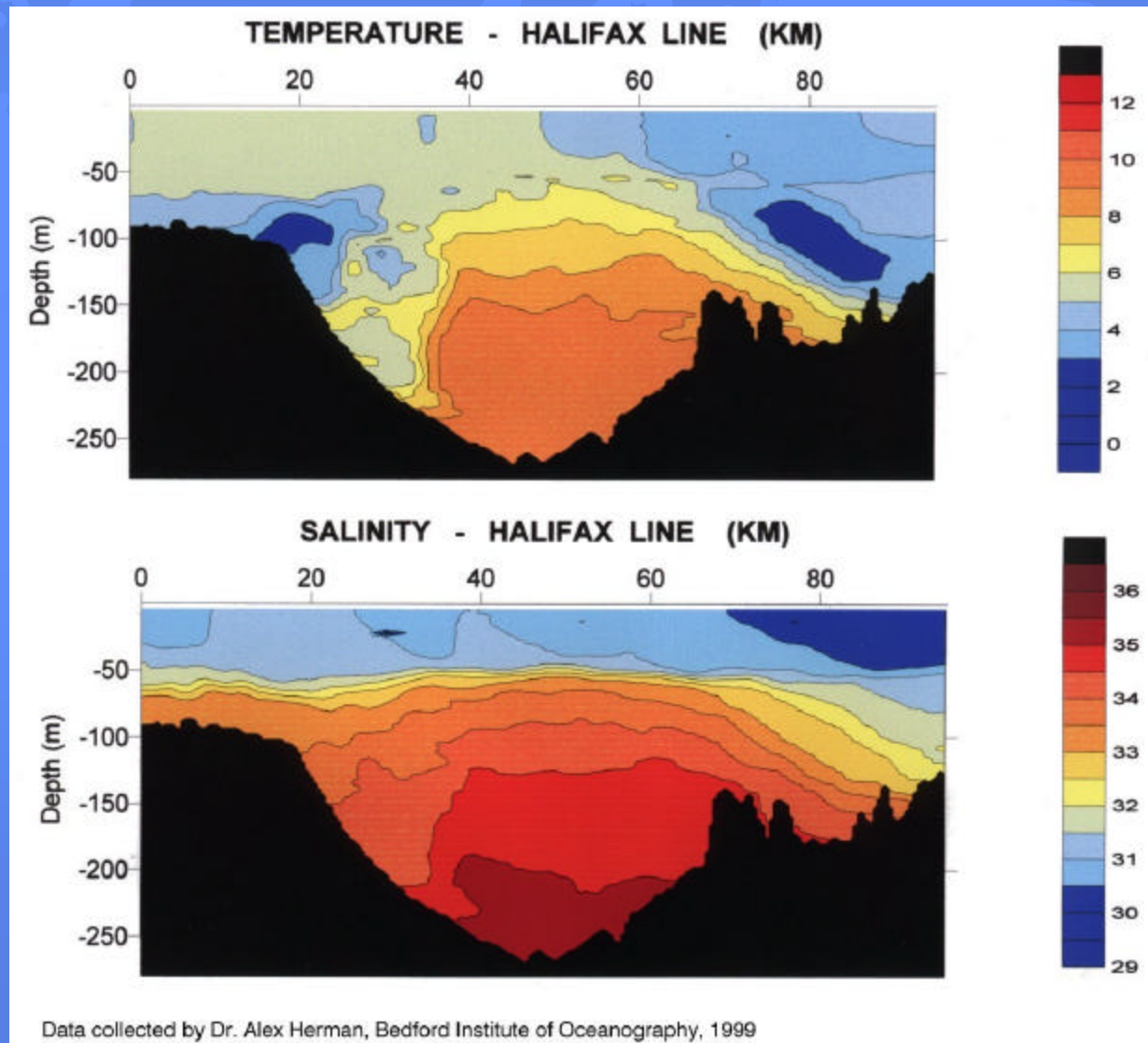
## Profile Depths:

- ✍ 100m at 18 knots
- ✍ 170m at 5 knots
- ✍ 300m at 0 knots



- BOT
- LARS
- S H
- MVP
- FFCPT
- LOPC
- CUST

# Salinity and Temperature vs Depth Scotian Shelf (Offshore Halifax)



# MVP 200



## Sensor Payloads:

- ✍ Sound Velocity
- ✍ CTD
- ✍ LOPC

## Profile Depths:

- ✍ 200m at 18 knots
- ✍ 350m at 5 knots
- ✍ 600m at 0 knots

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FFCPT  
LOPC  
CUST

# MVP 200 on Passenger Ferry Underway at 18 Knots



BOT  
LARS  
SH  
MVP  
FFCPT  
LOPC  
CUST

# MVP 300

## Sensor Payloads:

- ✍ Sound Velocity
- ✍ CTD
- ✍ LOPC

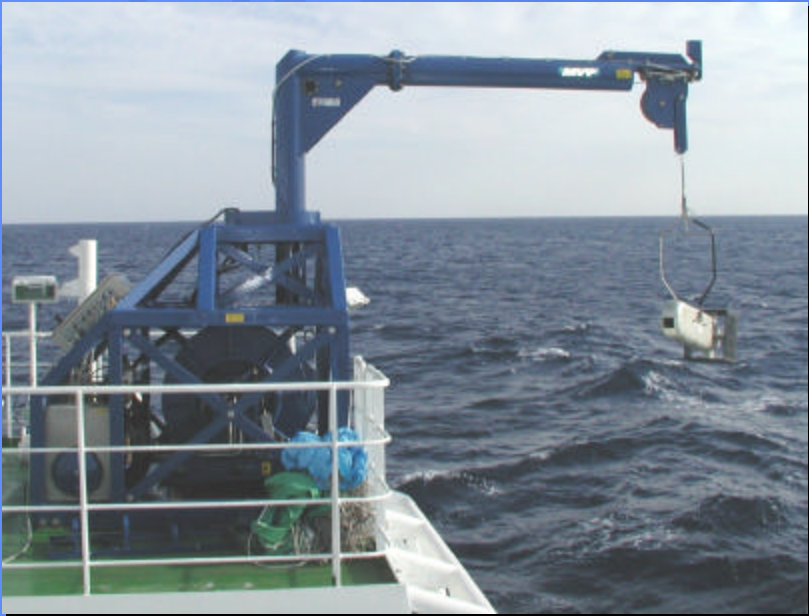
## Profile Depths:

- ✍ 300m / 300m at 18 knots
- ✍ 850m / 1500m at 5 knots
- ✍ 1700m / 3400m at 0 knots



MVP300-1700 shown

# MVP 300



- BOT
- LARS
- S H
- MVP
- FFCPT
- LOPC
- CUST

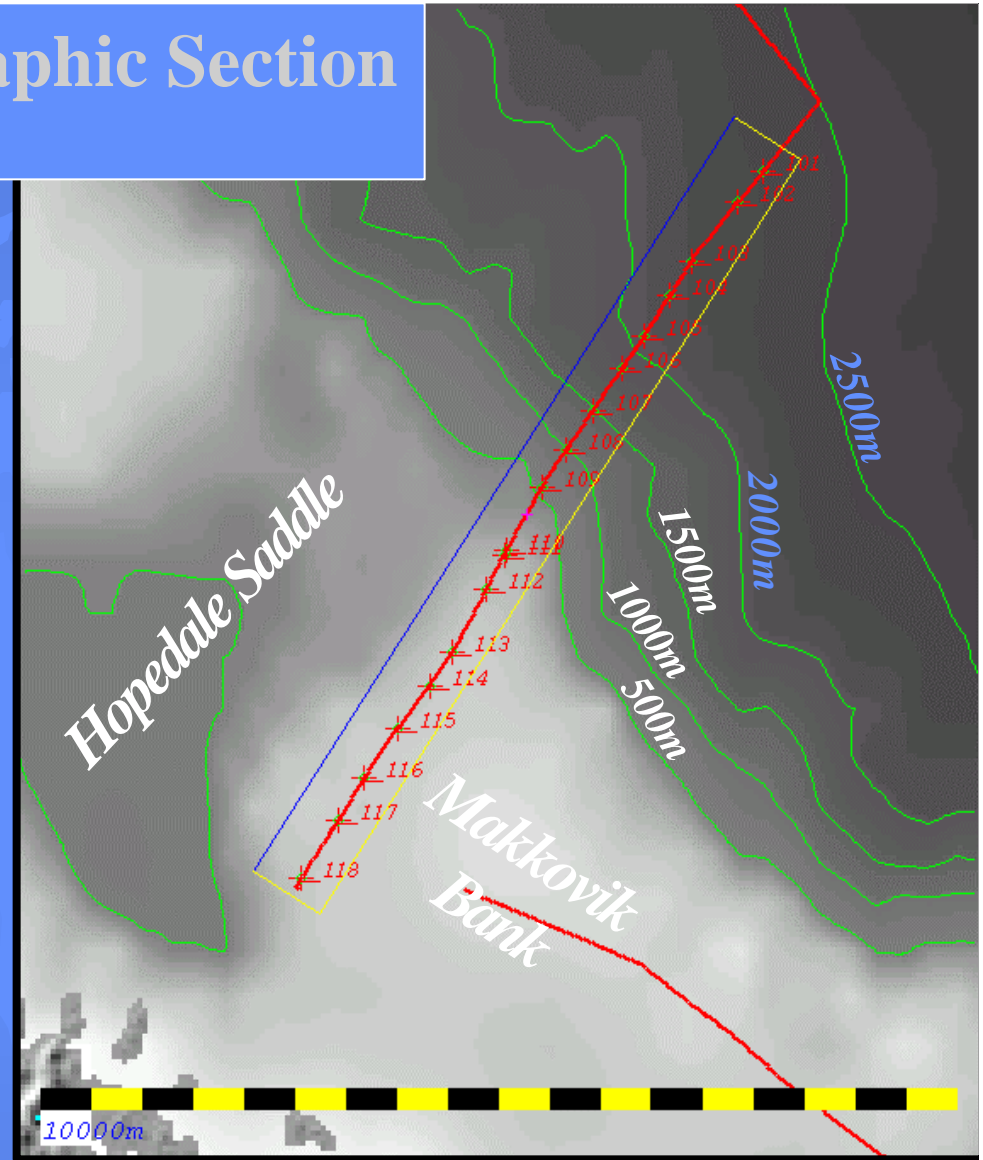
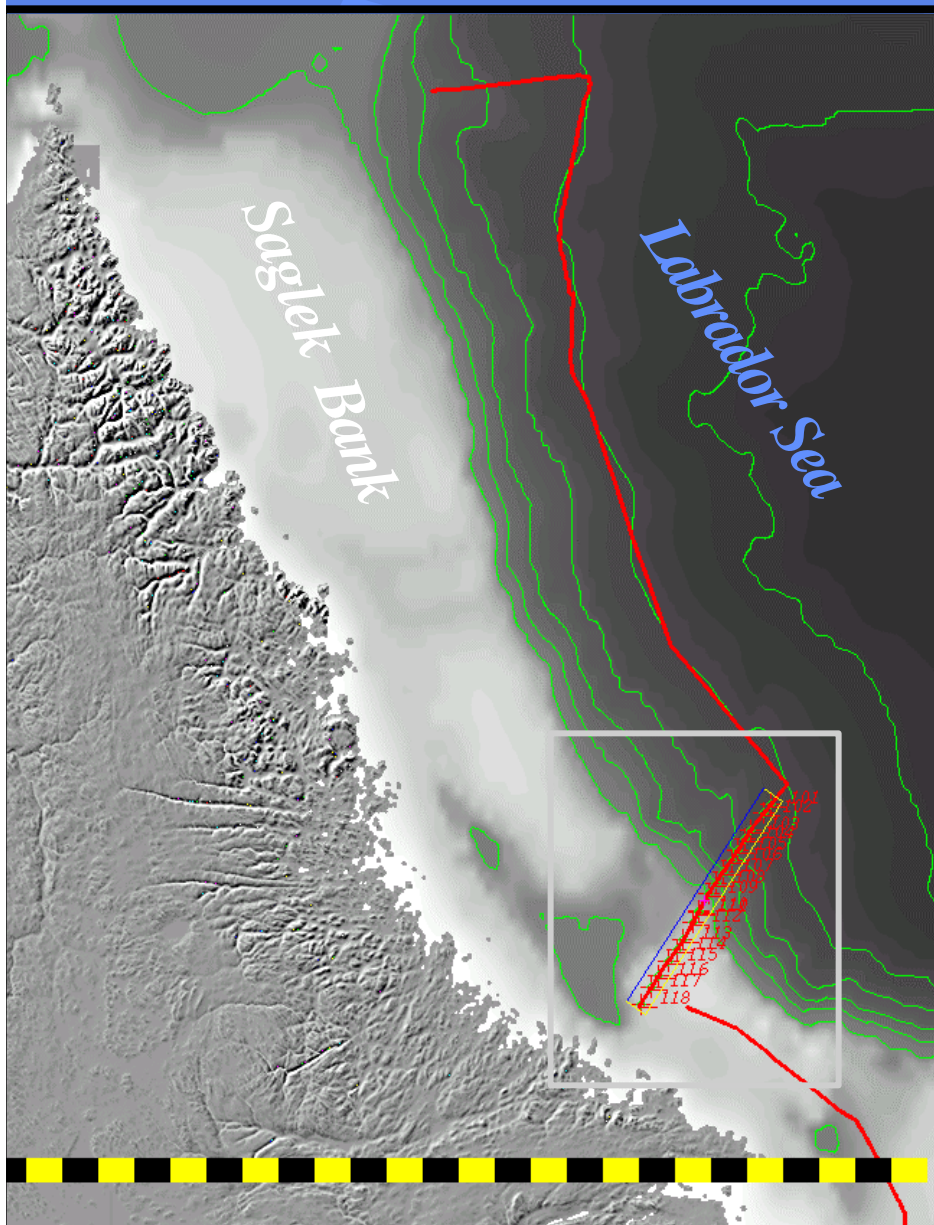
# MVP 300



- BOT
- LARS
- S H
- MVP
- FFCPT
- LOPC
- CUST

# Labrador Margin Oceanographic Section

October 4<sup>th</sup>, 2004



Brooke Ocean, MVP-300/1700

12 knots – 30 minute dips

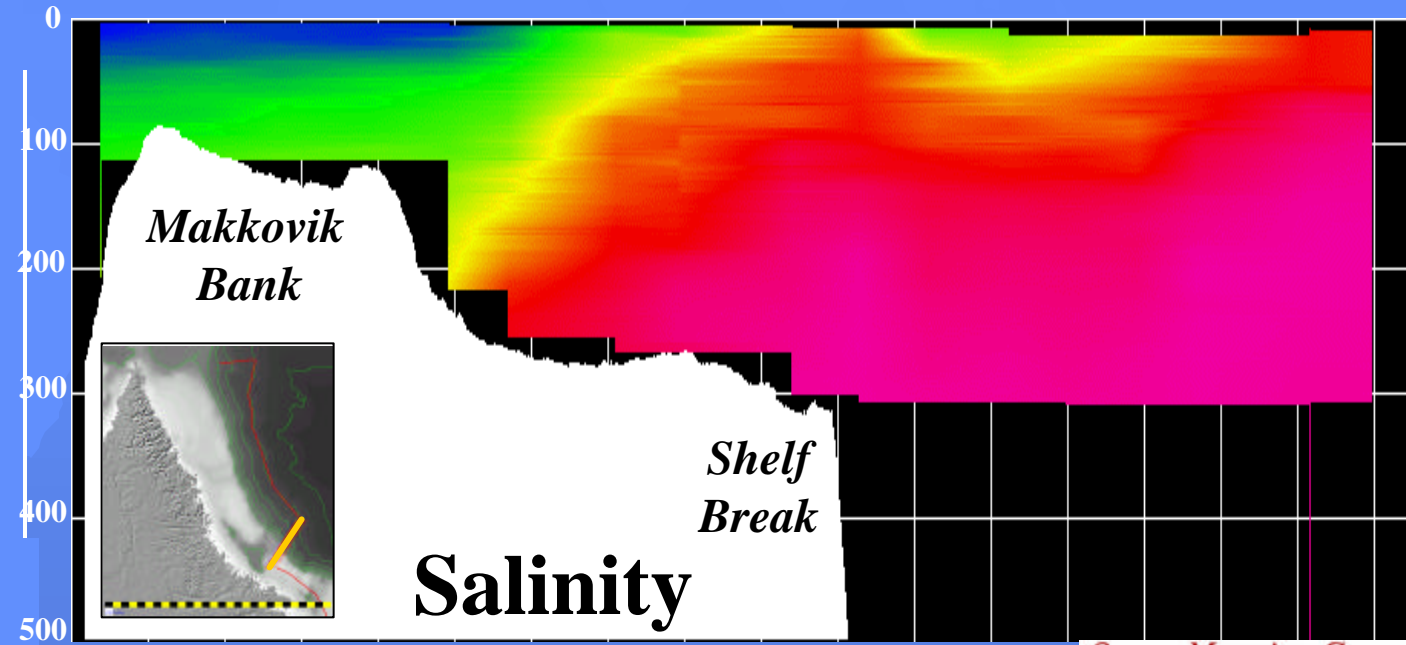
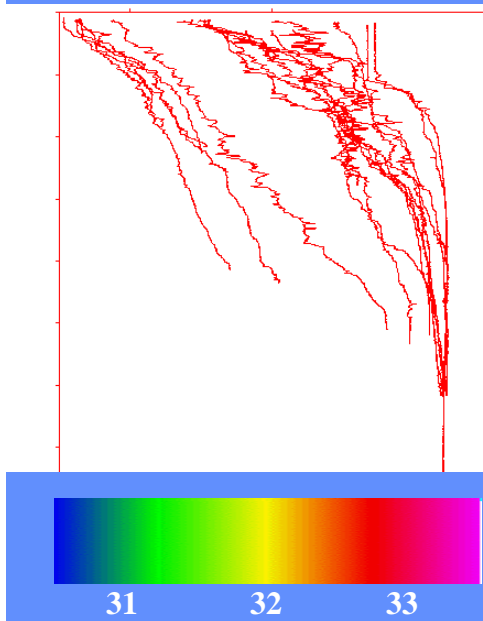
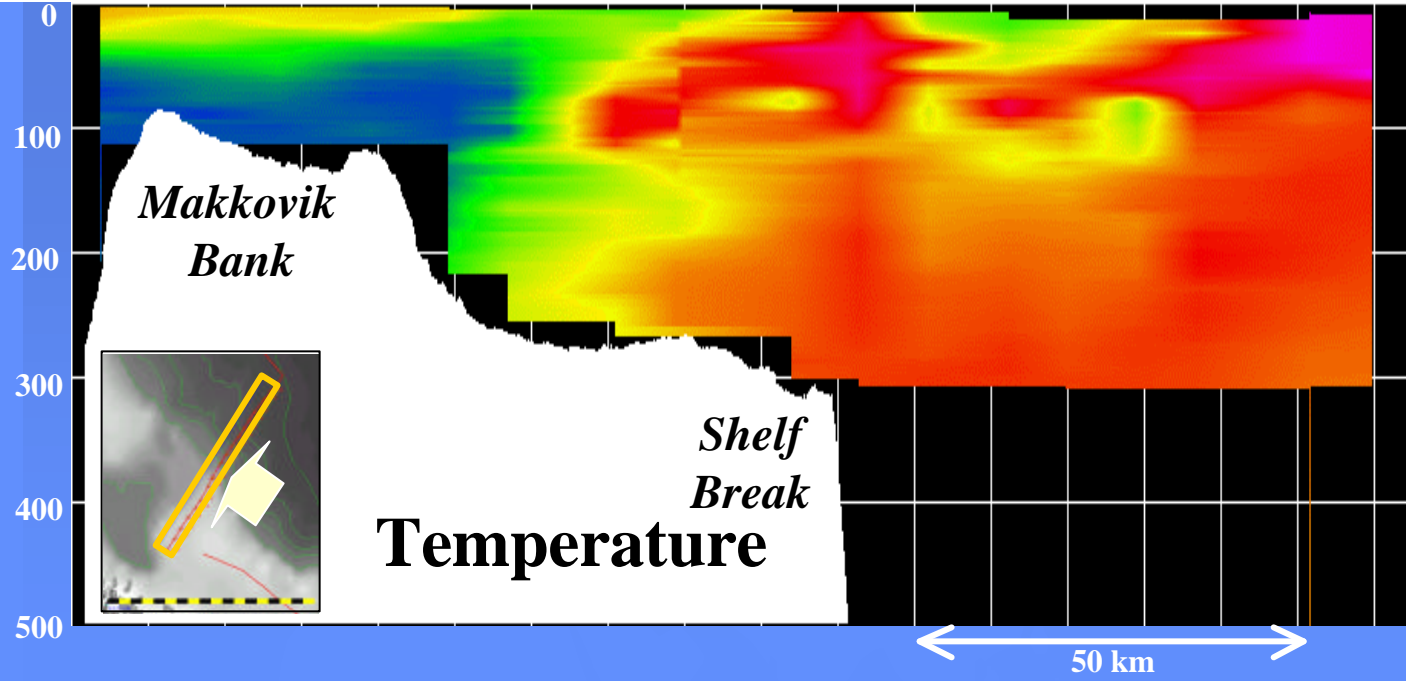
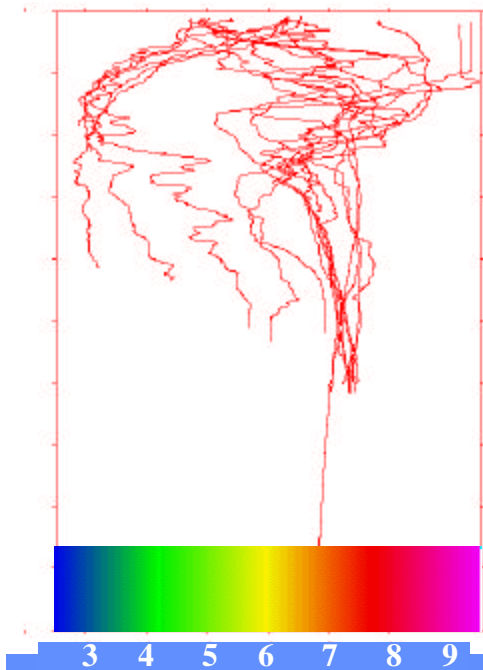
CCGS Amundsen

BOT  
LARS  
SH  
MVP

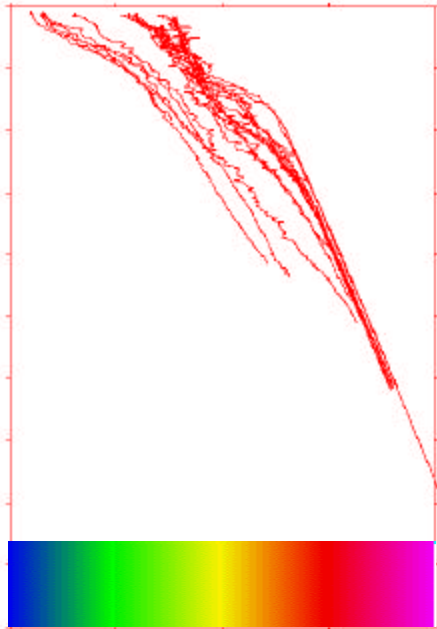
Ocean Mapping Group



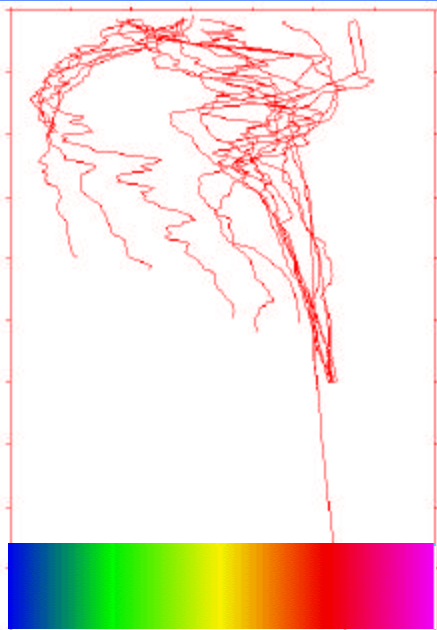




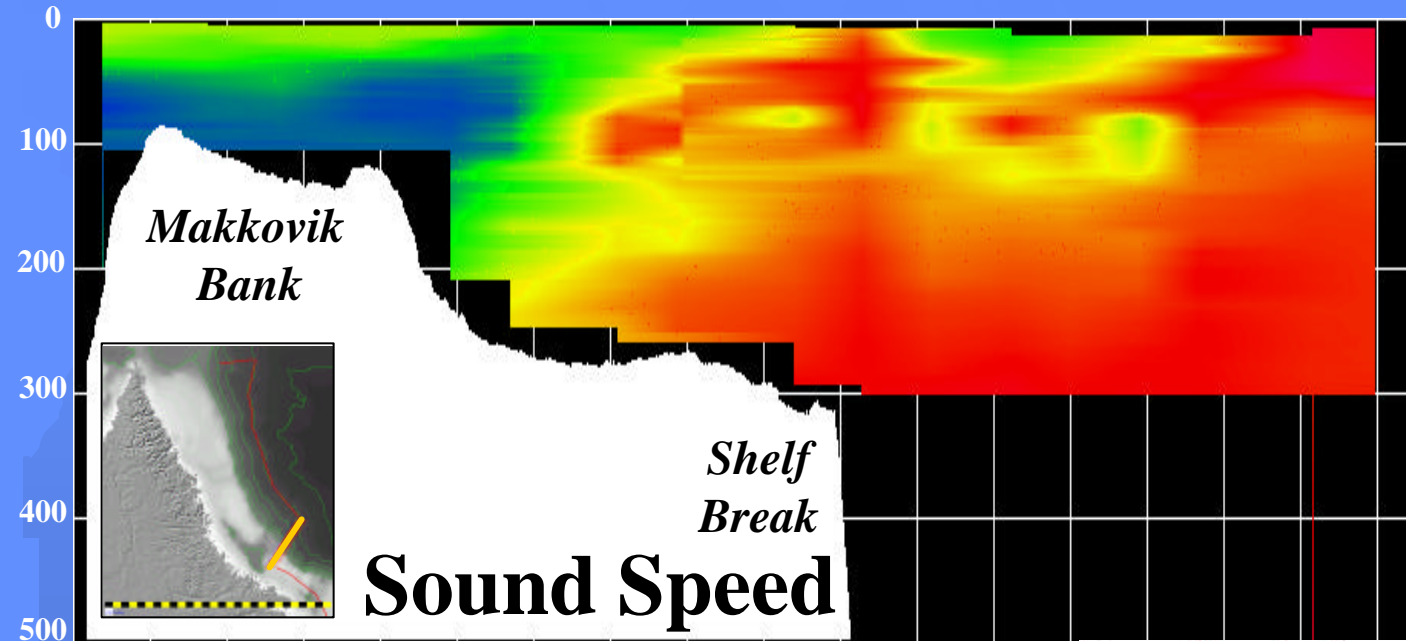
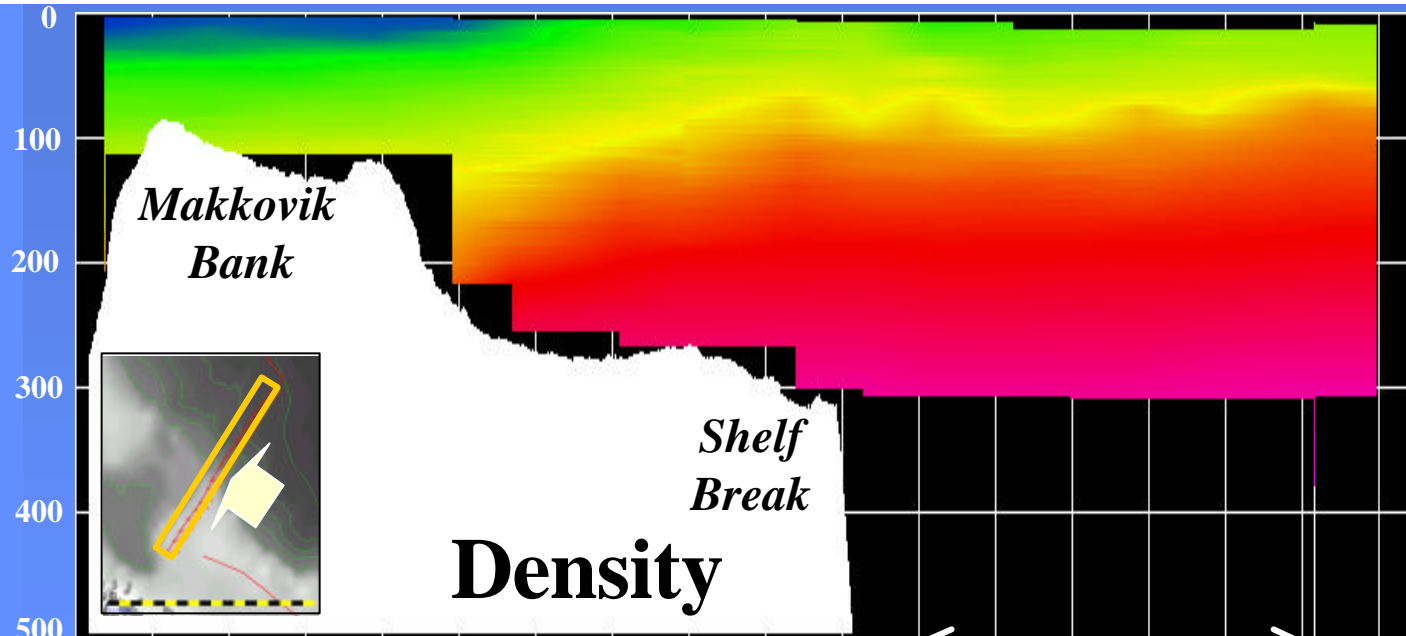
**Labrador Margin Oceanographic Section**  
*October 4<sup>th</sup>, 2004, MVP-300, CCGS Amundsen*



1023 1024 1025 1026



1460 1470 1480



**Labrador Margin Oceanographic Section**

October 4<sup>th</sup>, 2004, MVP-300, CCGS Amundsen

*Ocean Mapping Group*

University of New Brunswick  
CANADA

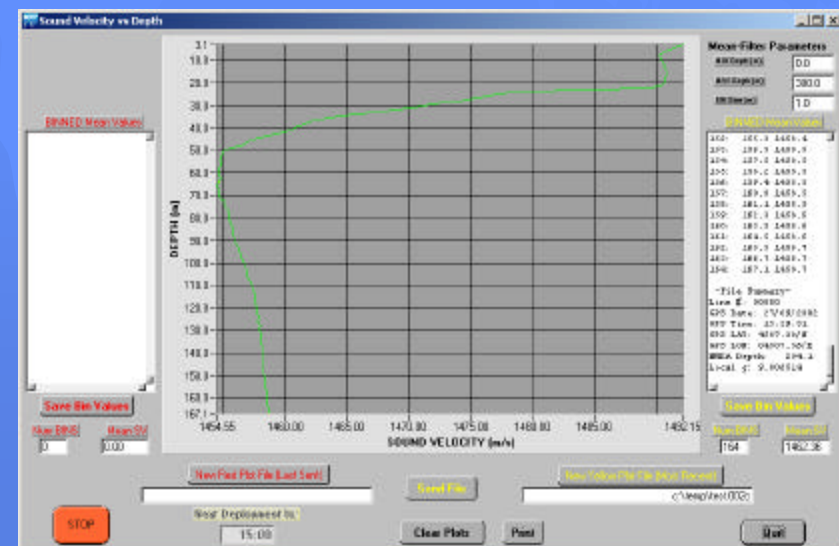
# MVP800-5000 presently under construction for HMS SCOTT Via SPAWAR



BOT  
LARS  
SH  
MVP  
FFCPT  
LOPC  
CUST

# MVP Controller

- Custom software package operating in a Windows environment
- Monitors and controls winch hardware
- Logs instrument data in MVP and stationary profiling modes
- Displays data
- System inputs: bottom depth vessel speed and position
- System outputs: formatted SV profile out to multibeam sounder, Towed SV



BOT  
LARS  
SH  
MVP  
FFCPT  
LOPC  
CUST

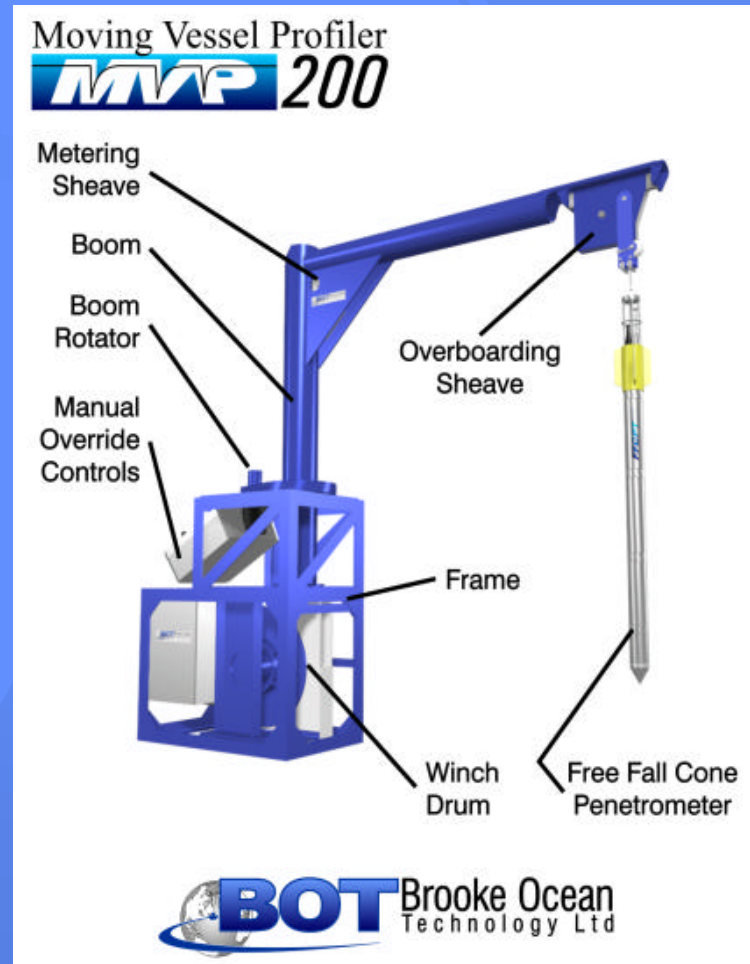
# MVP Control Screen



BOT  
LARS  
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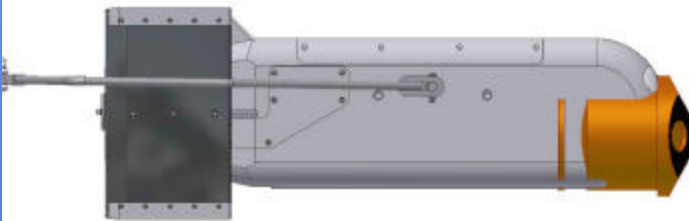
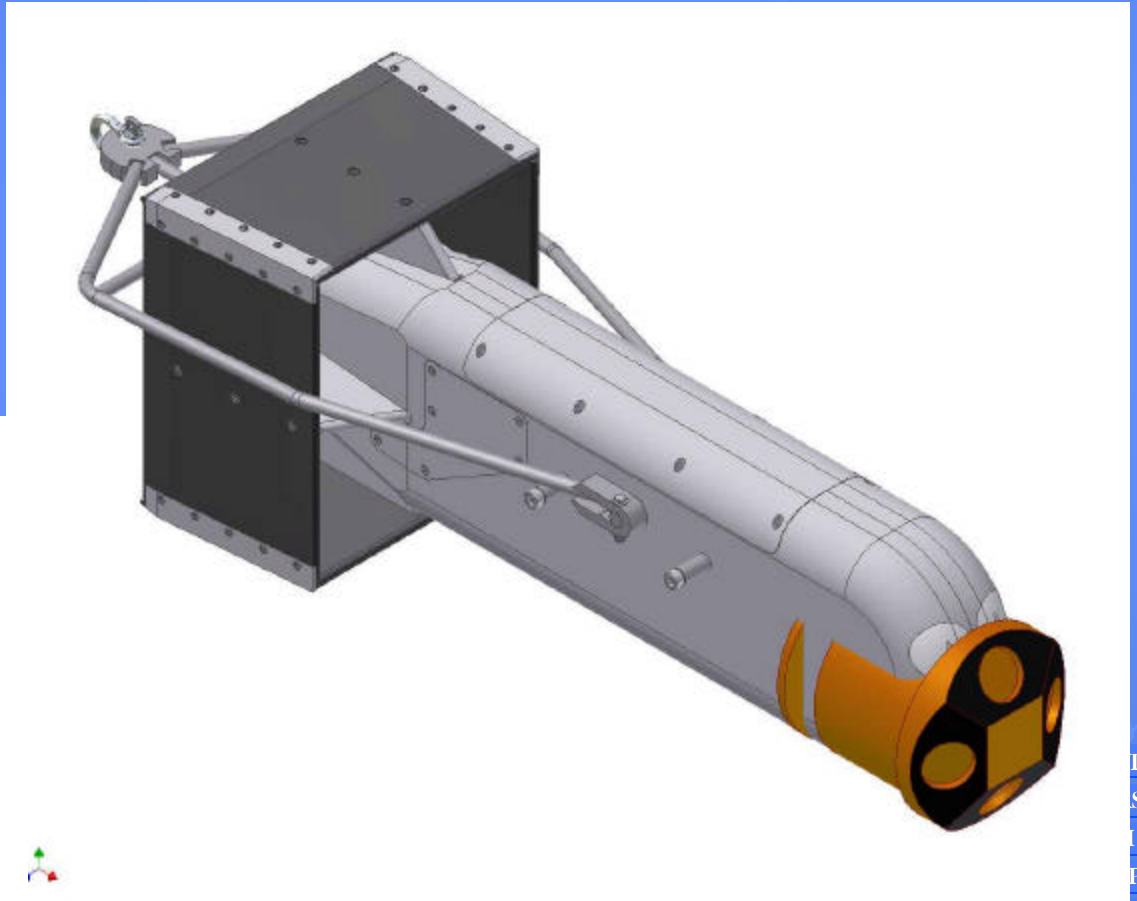
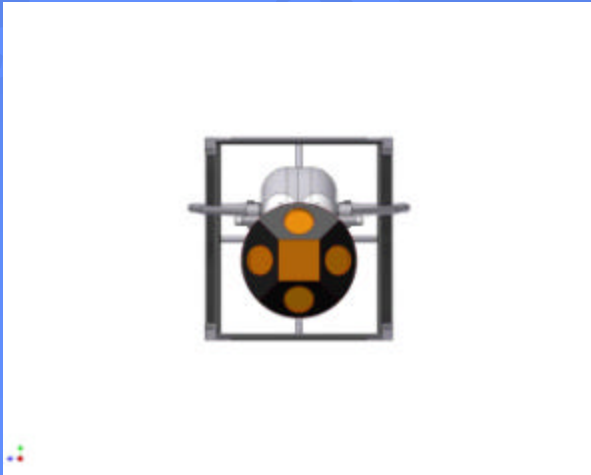
# FFCPT Integration with MVP

- Underway FFCPT under development
- Static FFCPT profiles with MVP



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# Future developments – Deployed ADCP ?



# MVP300-3400

## Delivered to the University of Hawaii

### UNOLS vessel Kilo Moana

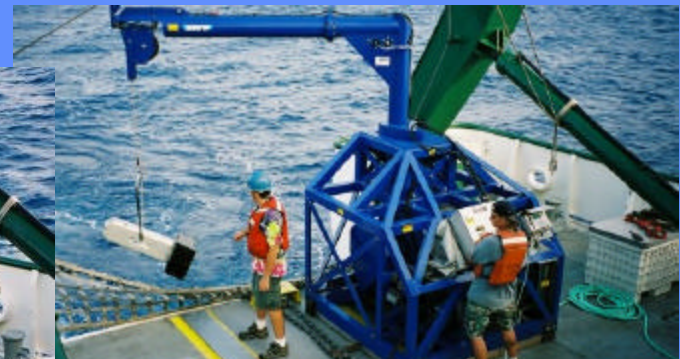
- ✍ MVP300-3400
- ✍ Multi Sensor Free Fall Fish (CTD)
- ✍ Enhanced Deep Water Free Fall capability
  - Needed for Wax Corer Operations
- ✍ Additional Larger FFF yet to be delivered



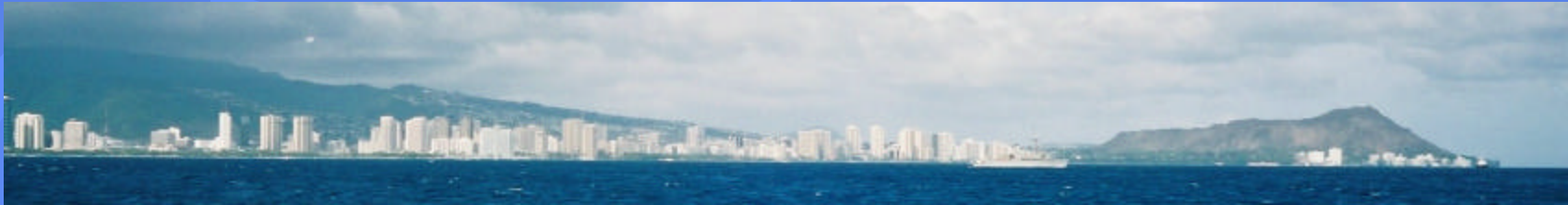
# Kaimikai-O-Kanaloa (KOK) Installation



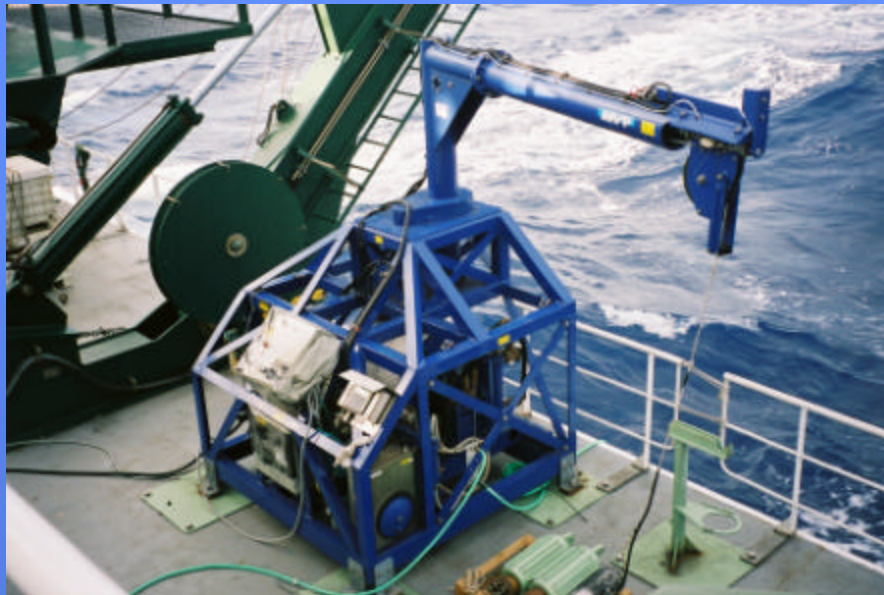
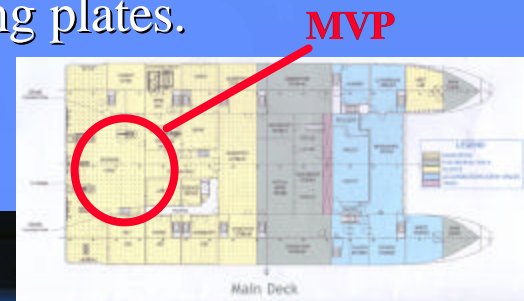
- ✍ MVP can be quickly installed on other vessels if required (eg. Kaimikai-O-Kanaloa to Kilo Moana)



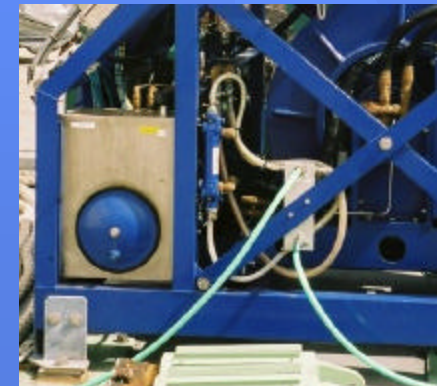
# Kilo Moana - MVP Installation



- Uses standard bolt down grid with custom mounting plates.



- Water cooled



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# MVP Training

✍ BOT can provide on site training for MVP operators

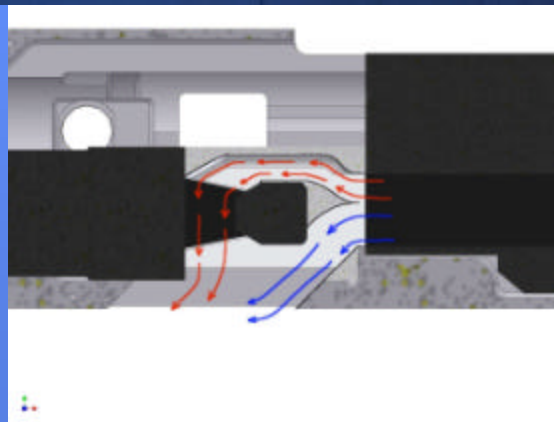
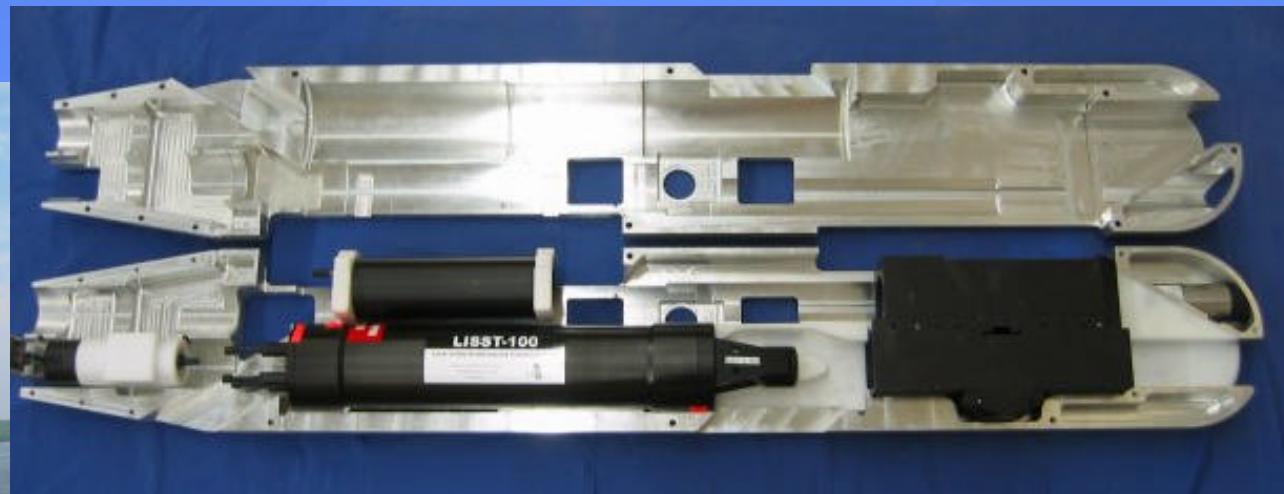


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# MVP300

## Multi Sensor Free Fall Fish II

(Presently being fabricated)



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# Economic Benefits

## For Multibeam Equipped UNOLS Vessels

Economic benefits of MVP supported multibeam surveying:

- ✍ Saves ship time and/or expendables
- ✍ Data processing – MVP improves multibeam data quality therefore decreasing post processing effort
- ✍ Increased line spacing – MVP improves the data therefore allowing the use of the outer beams

# Economic Benefits for UNOLS

- ✍ Saves ship time and/or expendables when used to support multibeam operations.
  - Ship time – MVP saves potentially three (3) hours per day of ship time by eliminating the requirement to stop and collect a traditional CTD cast.
  - Expendables – Potentially a survey employing expendable probes can use two (2) CTD and twenty (20) temperature probes per day.

# Economic Benefits to the UNOLS Fleet

Saves Ship Time in the following ways:

- On Station
  - Wax Corer, FFCPT
  - decreases cycle time
- Multiple Payloads – BOT is always interested in exploring new possibilities.
- MVP Hydrographic Operations (SV)
- MVP Science Operations (Multiple Sensors)

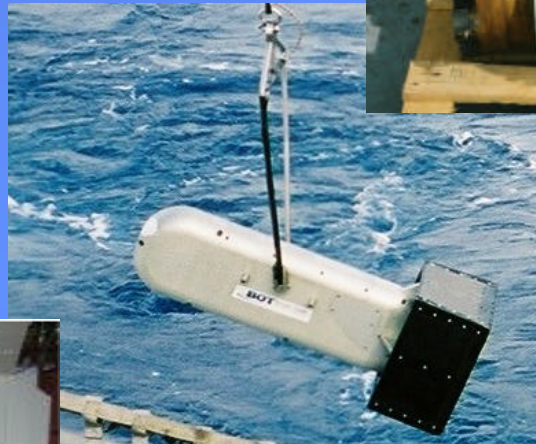


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# MVP - a Multiuse System

Previous Uses:

- ✦ Wax Corer
- ✦ Rosettes
- ✦ FFCPT
- ✦ MSFFF



Proposed Uses:

- ✦ Van Veen Grabs
- ✦ ADCP's
- ✦ Passive Sonar

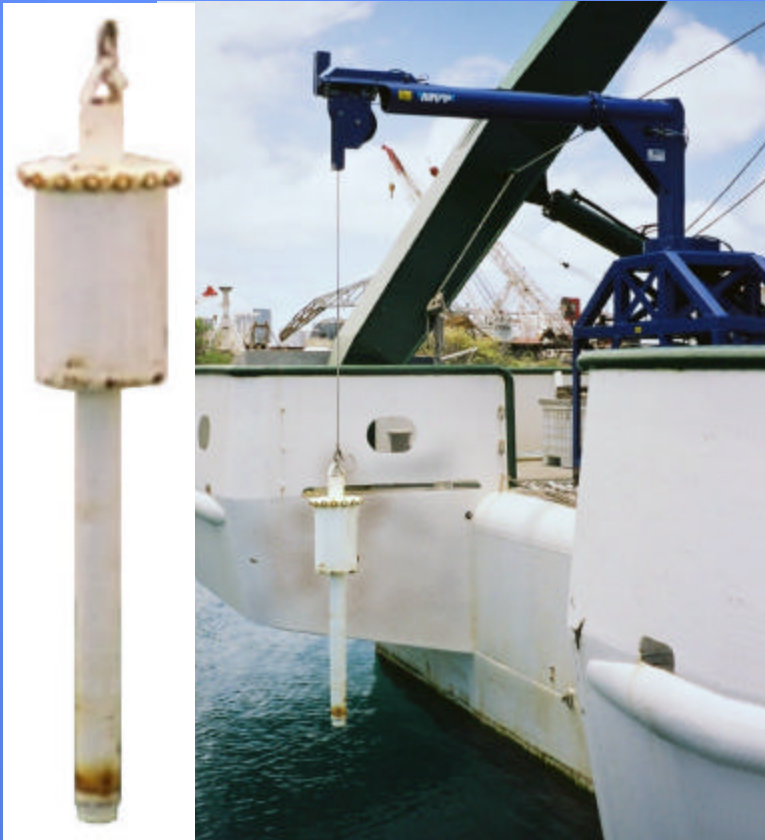


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# WAX CORER

- A Wax Corer is a device used for taking samples of earth or rock from the surface of the ocean bottom.
- A wax corer can be deployed with the MVP.



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# Multi Sensor Free Fall Fish II

## Benefits of the MSFFF II:

- Maintains operating specification of 300m @ 12 knots
- Optional upgrade for MVP300 systems
- Expanded sensor payload

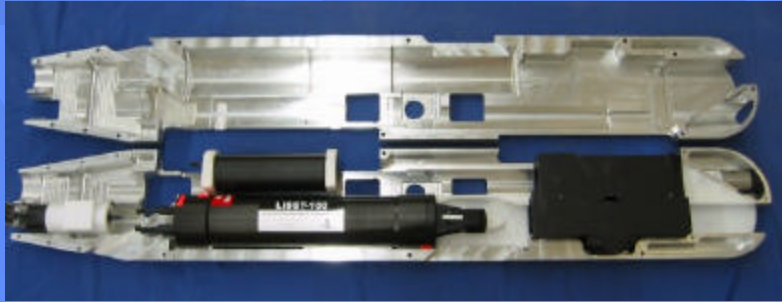


## MSFFF II Users:

- University of Laval - 1000's of casts to date (1yr.)
- John Hughes Clark, UNB, OMG – 60 casts in a 7 day multibeam echo sounder survey.
- SOC – Nutrient data collected prior to recent loss of MSFFF II
- University of Hawaii – delivery pending (in production)

# MSFFF II - Payload Options

University of Hawaii



AML CTD

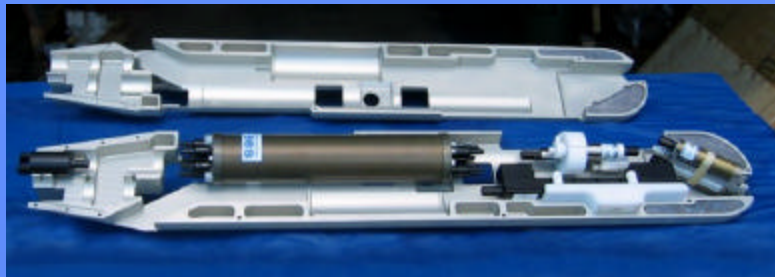
Wetlabs Fluorometer

Laser Optical Plankton Counter (LOPC)

LISST 100

Data Telemetry Module

University of Laval



SeaBird 911plus CTD

– Conductivity

– Temperature

Transmissometer

Seapoint Fluorometer

SBE Dissolved

Oxygen

South Hampton Oceanographic Center



AML CTD

Satlantic MBARI-ISUS Nitrate

Sensor Tilt and Roll Sensor

Satlantic Radiance/Irradiance

AML Dissolved Oxygen

Wetlabs FLF 300

Data Telemetry Module

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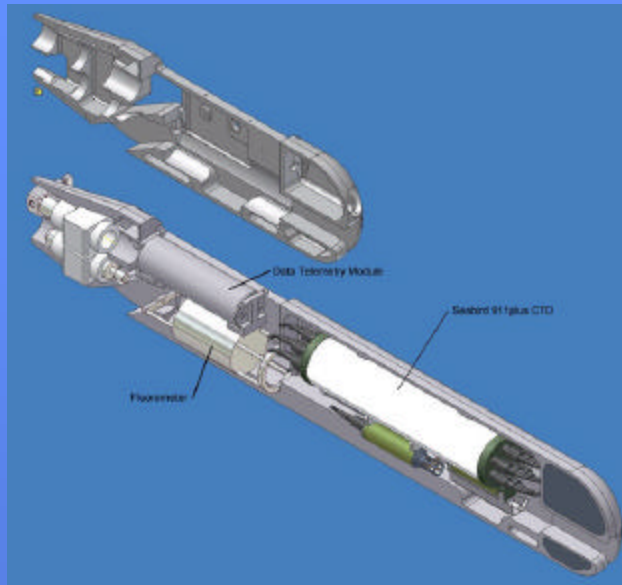
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# MVP Development

- ✍ New payloads
- ✍ Larger systems
- ✍ Increased payload capacity
- ✍ Data telemetry



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# UNOLS Research Vessels with Multibeam Capability



R/V Kilo Moana  
(U. Hawaii)



R/V Cape Hatteras  
(UNC)



R/V New Horizon  
(Scripps)



R/V Walton Smith  
(U. Miami)



R/V Melville  
(Scripps)



R/V Maurice Ewing  
Lamont-Doherty



R/V Knorr  
(WHOI)



R/V Roger Revelle  
(Scripps)



R/V Atlantis (WHOI)



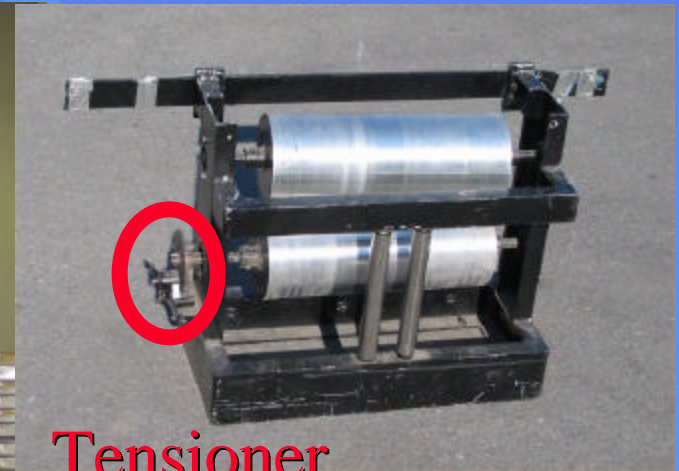
R/V Thompson  
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# Installation of EM-Cable at Factory



Tensioner



Spooler

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ARS  
SH  
MVP  
FECPT  
LOPC  
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# Guard Location

✍ Location of cable guard



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FFCPT  
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