

# Oceanographic Ship Design

Oceanographic ship designs are typically done with little thought about how the ship actually does science, how it collects good quality data, or how it could minimize fuel consumption, noise, and chemical pollution from the ship. This is more than just being “green” its about collecting better data too.

If scientists were allowed to design the ship, what would we do?

We want a vessel that is acoustically quiet, stable, fast, has minimal chemical footprint, reduced fuel consumption, in short a large floating Prius. And oh yeah, it would be great if operating cost was low, budgets are tight!

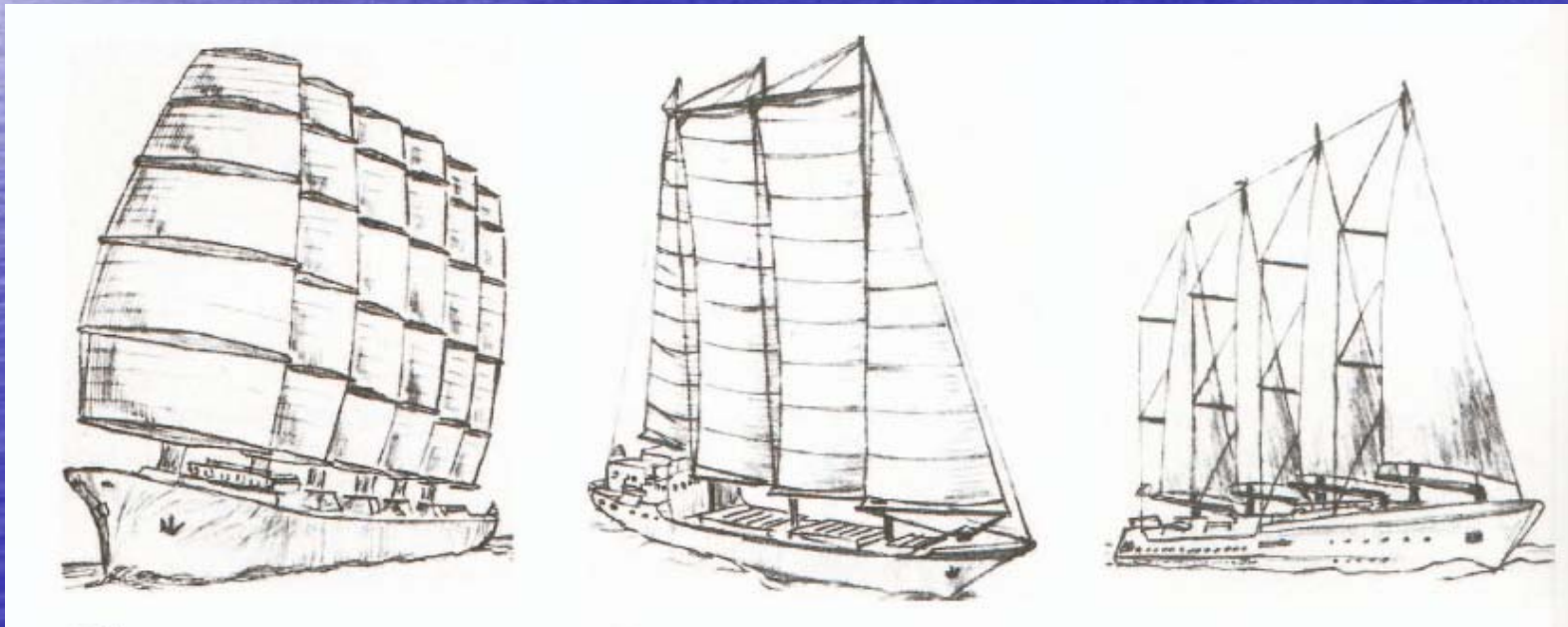
Many technologies are available or on the horizon that could be used, including wave power, fuel cells, diesel electric hybrid, wind, solar etc.

So let's think a little about what might be possible..... For starters, what about wind?

# Hybrid Ship: Wind Propulsion

## Types:

- Conventional soft sails
- Wing sails
- Rotors (Magnus effect)
- Dyna-Rig



# Hybrid Ship: Wind Propulsion

**Wind power? You must be kidding, that's old technology!**

**We tend to think of new, (and never tried) technologies first, but wind power is available, it's free, and it works, though not everywhere, and not all the time. To achieve the design targets of a clean, renewable, and sustainable vessel, wind power will almost certainly be a part of the equation.**

**The advantages are:**

- 1. Its free**
- 2. Technology to use it very refined, its been in use for hundreds of years.**
- 3. Available most of the time in most of the world**
- 4. Relatively low-tech and simple to maintain**
- 5. Efficient: ship speeds of 10-15 knots sustained in 15-18 knots of wind**
- 6. No consumables needed, no exotic fuels, parts, or maintenance.**

# Hybrid Ship: Wind Propulsion

## Advantages continued:

7. Very little requirement for disposal of toxic materials
8. Improved sea keeping and stability
9. Increased transit speed (more science!), reduced cost and emissions
10. Quality of science is improved through low mechanical and acoustic noise, low emissions, greater stability and more sea time. Funds go toward science, not diesel.

## Disadvantages:

1. Can't be used everywhere all the time
2. Can't sail straight into the wind.
3. Monohull vessels have a heel angle, making science some operations more difficult underway. Some operations not possible under sail.
4. Mast height may restrict some port entries
5. May require some modification of courses and some crew training for best advantage.

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# Hybrid Ship: Wind Propulsion

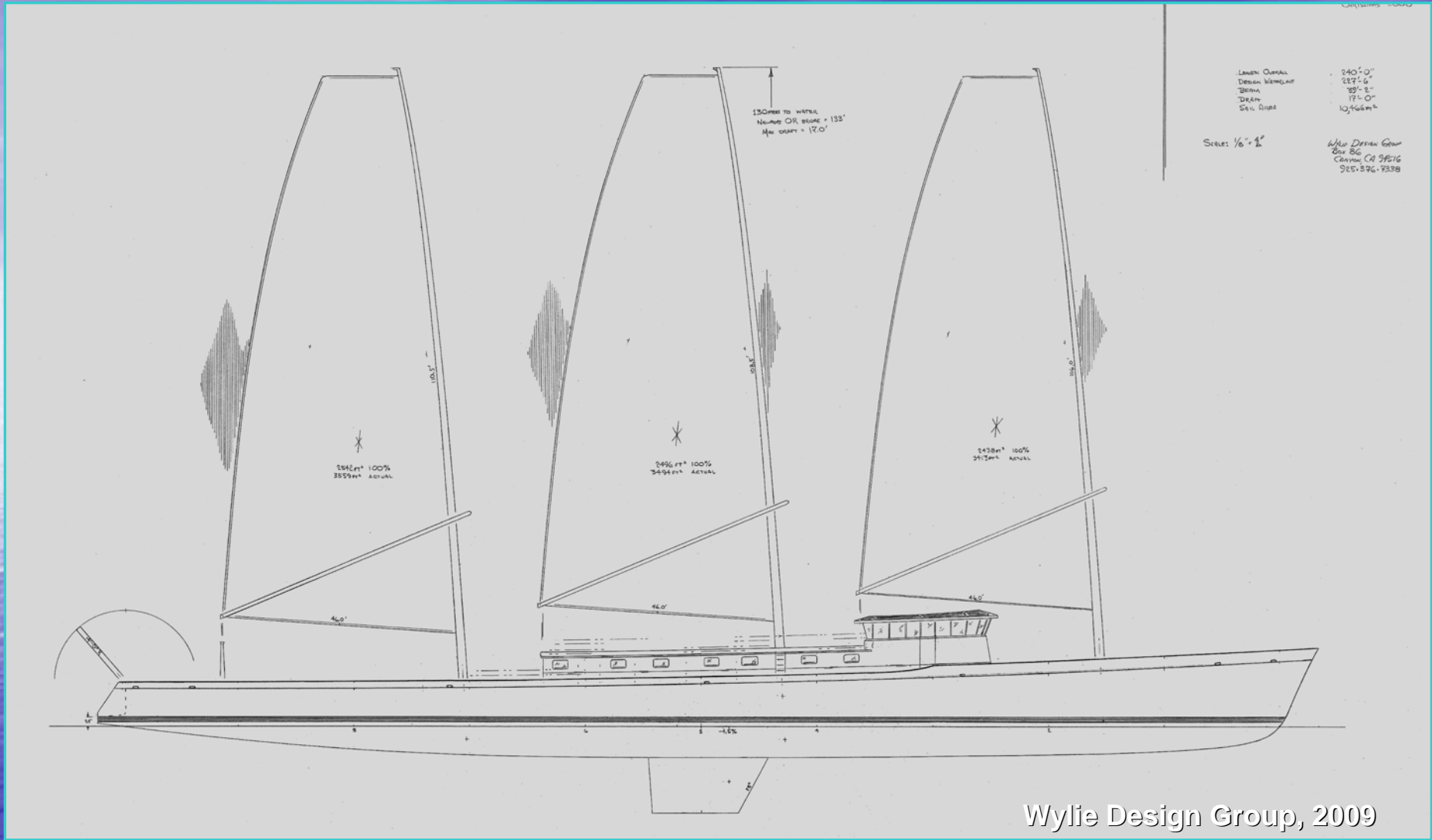
## Types:

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- **Dyna-Rig**



Maltese Falcon by Peter Lyons/Lyons Imaging for YachtPals.com





**This sketch is a starting point, not an end point. The next step is the design study to consider the development and integration of these and more innovations**

## Hybrid Ship: parallel evolution



Even more than ships, aircraft have always advanced with new technology...

The Boeing 787 is the first carbon fiber fuselage airliner, and it's light weight will reduce it's fuel consumption improve climb performance. Less is more!

The technology to build this airplane actually came from ocean racing sailboats, much like our design concept

## Hybrid Ship: Very Preliminary Design Specifications

<b>Hybrid Ship</b>	<b>Wecoma</b>
Length overall: 240'	185'
Beam: 38'	33'
Draft: 17' (likely to increase)	18.5'
Displacement: 400 tons	1150 tons
Range: unlimited (sail) 4000 nm (power)	5500 nm (10 days on station)
Fuel consumption: 600 gal/day @ 14 knots (power only)	1700 gal/day @ 12 knots
Fuel consumption (sail) @ 14 knots: house loads only*	
Fuel consumption (motorsail) @ 16-18 knots: 300 gal/day	
Maximum speed (sail): 25 knots	
Maximum speed (power) 20 knots	14 knots
Science Party: 30	18
Crew: 10	13
Guests: 5	



**The Derek M. Baylis is one of the first modern hybrid concept research vessels, and along with the rotor ship Alcyone (Cousteau) serves as one end-member of a range of prototypes for our vessel design. The vessel LOA is 65'**

**Speed under power: 10 knots**

**Speed under sail: 18+ knots**

**Fuel consumption (power) at 9 knots = 1.6 gph.**

**We used this vessel in 2010 for a 21 day cruise, mapping the northern San Andreas Fault.**

**Total fuel consumption 489 gallons in 21 days!**



The cruise involved 21 days of survey, 50% multibeam survey, 50% seismic reflection survey.

The multibeam was a pole mounted Reson 8101ER, the seismic system was a USGS provided mini-sparker system.

Here is the lab space in the pilothouse, enough for 4-6 science party to work 24/7 indefinitely. A 6kw generator is available for science and house loads.





**The lower level has berthing for 8, and a folding table for overflow science applications. We operated 24/7, and so mostly the lower level was used for off-watch sleepers.**



**Cockpit deck space slopes aft to the waterline, and is ~ 21' x 10' with embedded threaded inserts for equipment. The transom is removable, for easy launch and recovery of ROV's AUV's gliders etc.**



With transom removed





**Underway with sonar pole stowed**



The airfoil sonar pole



**The other Team:**

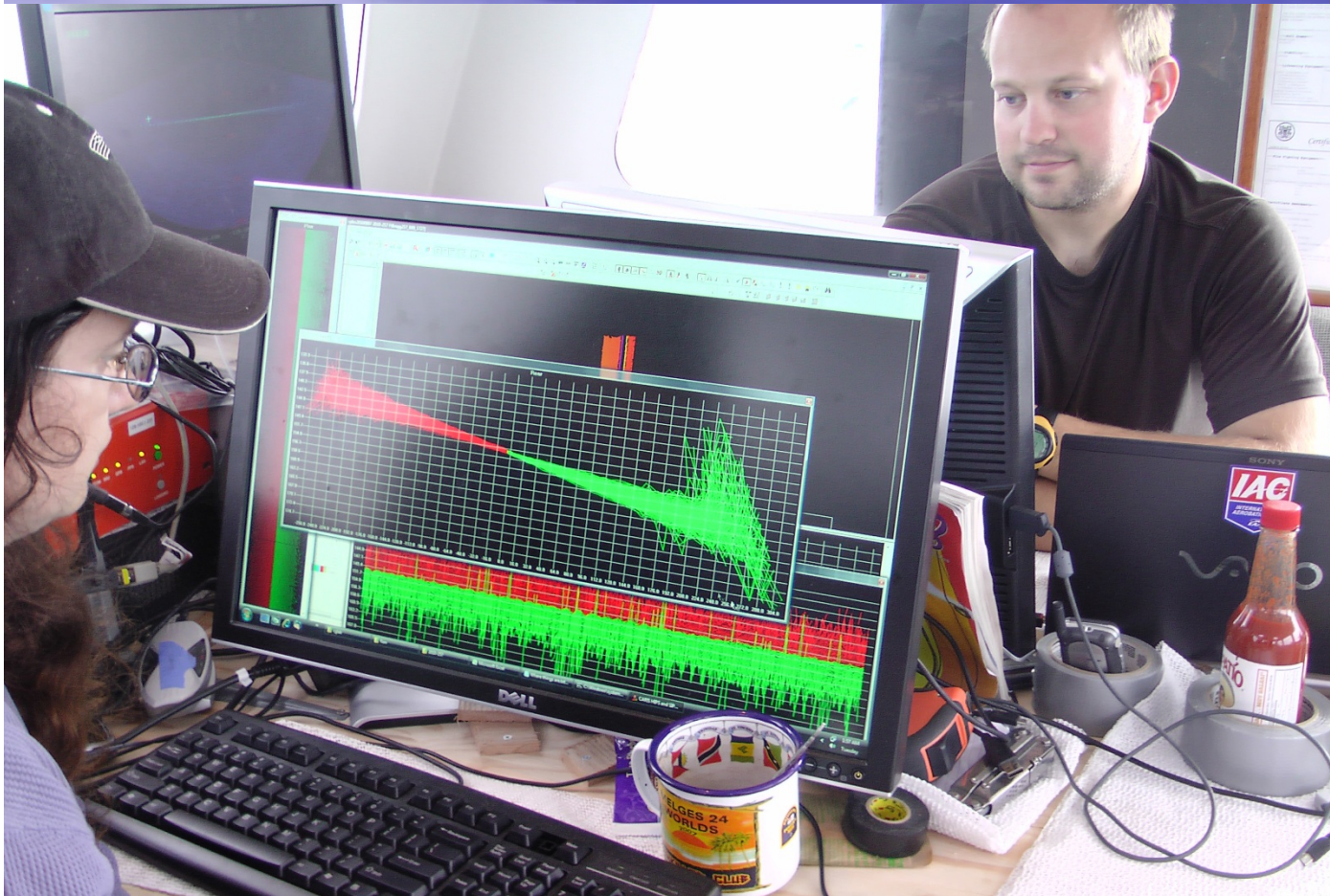
**We used two vessels, the other was an 85' converted fishing trawler.**

**Pacific Storm is also an excellent science platform, with some advantages in heavy gear handling capability, with it's a-frame and knuckle boom crane.**

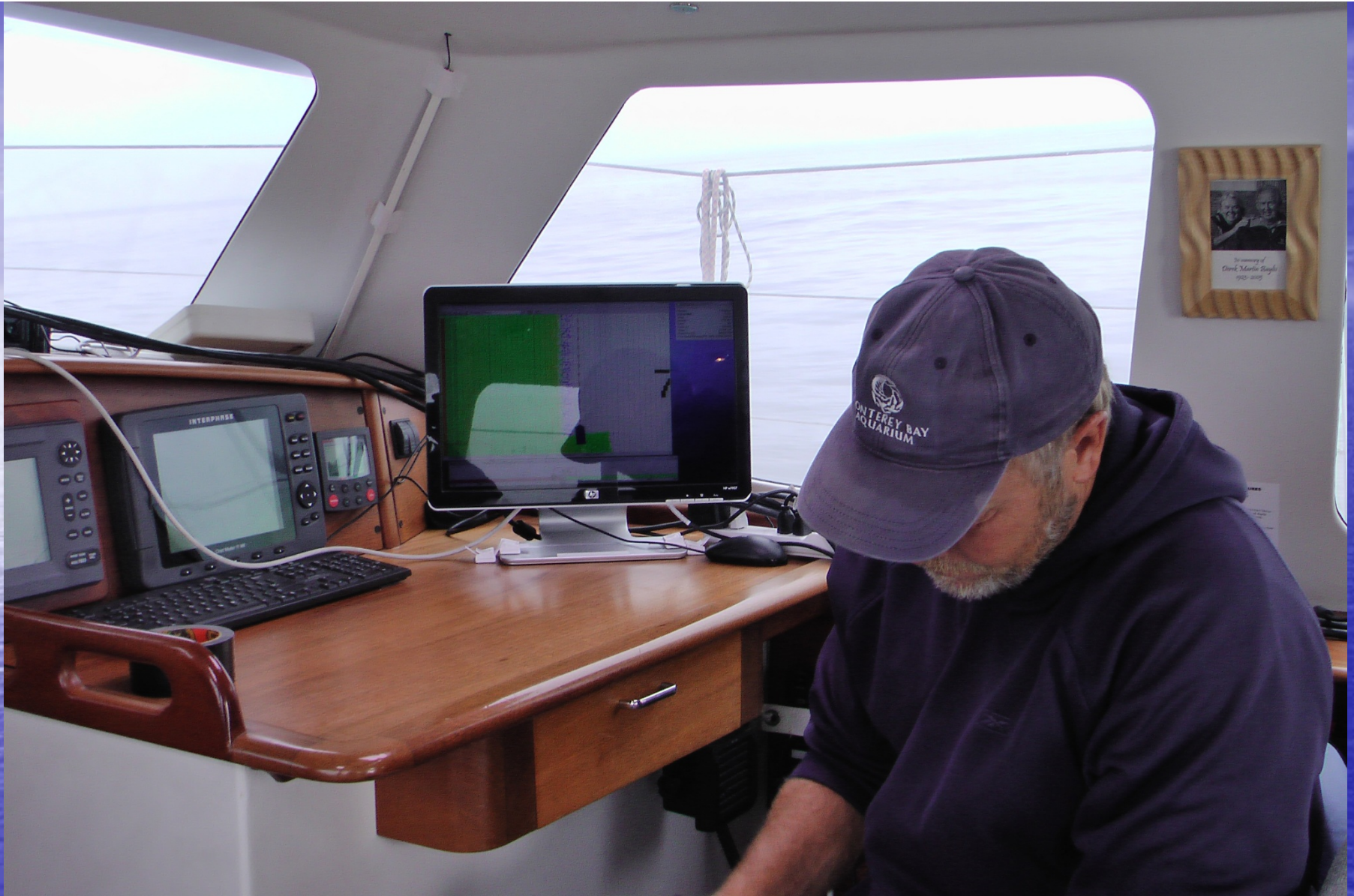
**Science party of 8 is the same as the Baylis. Crew of 5 vs. 2 for the Baylis. Fuel consumption at cruise = 14 gph, an order of magnitude greater than Baylis.**



**Sonar pole in use on survey**



**Underway on multibeam  
survey, data editing and  
QC**



**Helm station with autopilot  
and Hypack survey-  
steering display in use**



**Just for fun, one person driving the vessel, doing email and collecting and monitoring the incoming data. All with a nice view out the pilothouse windows!**

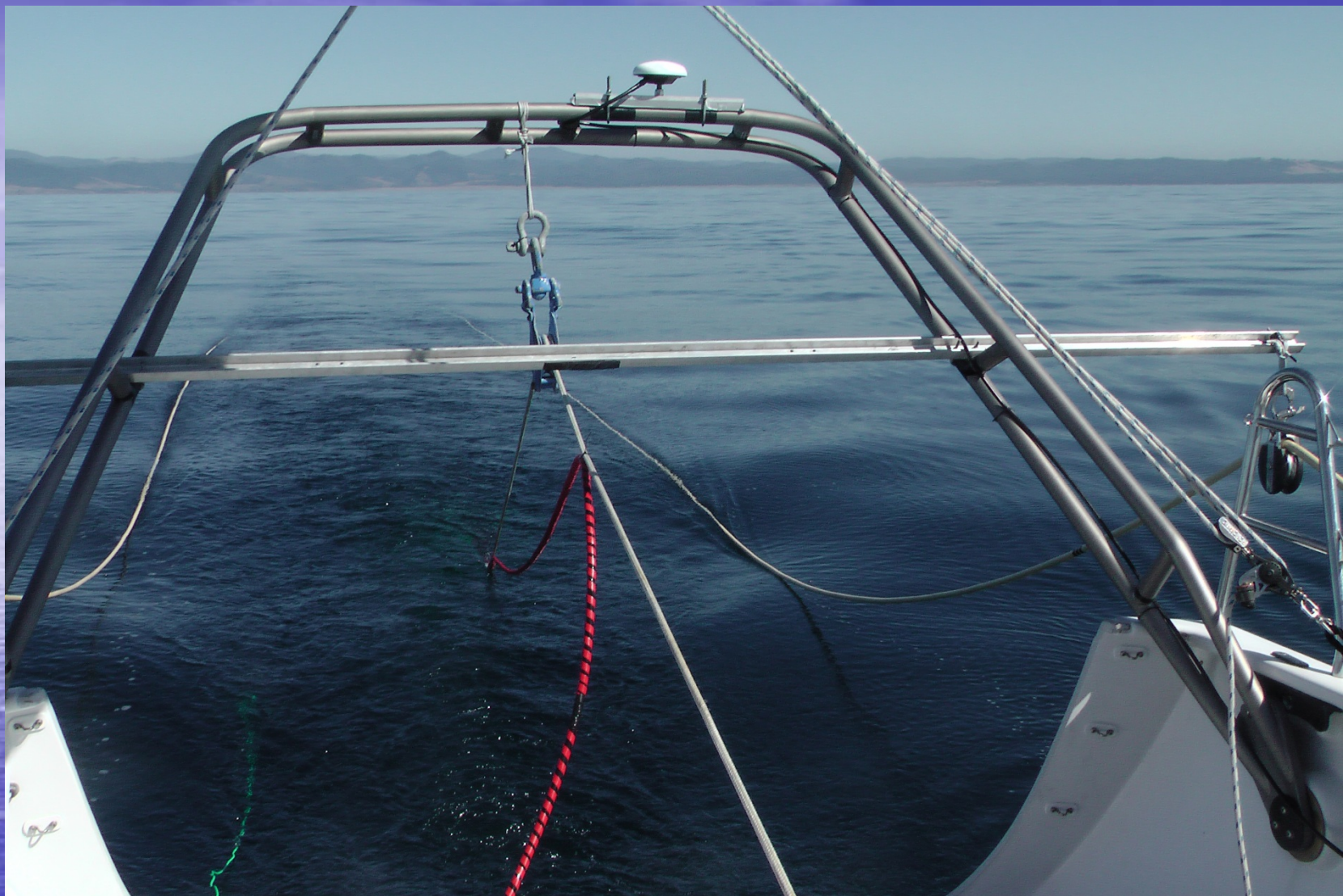


**The NSAF onshore....**

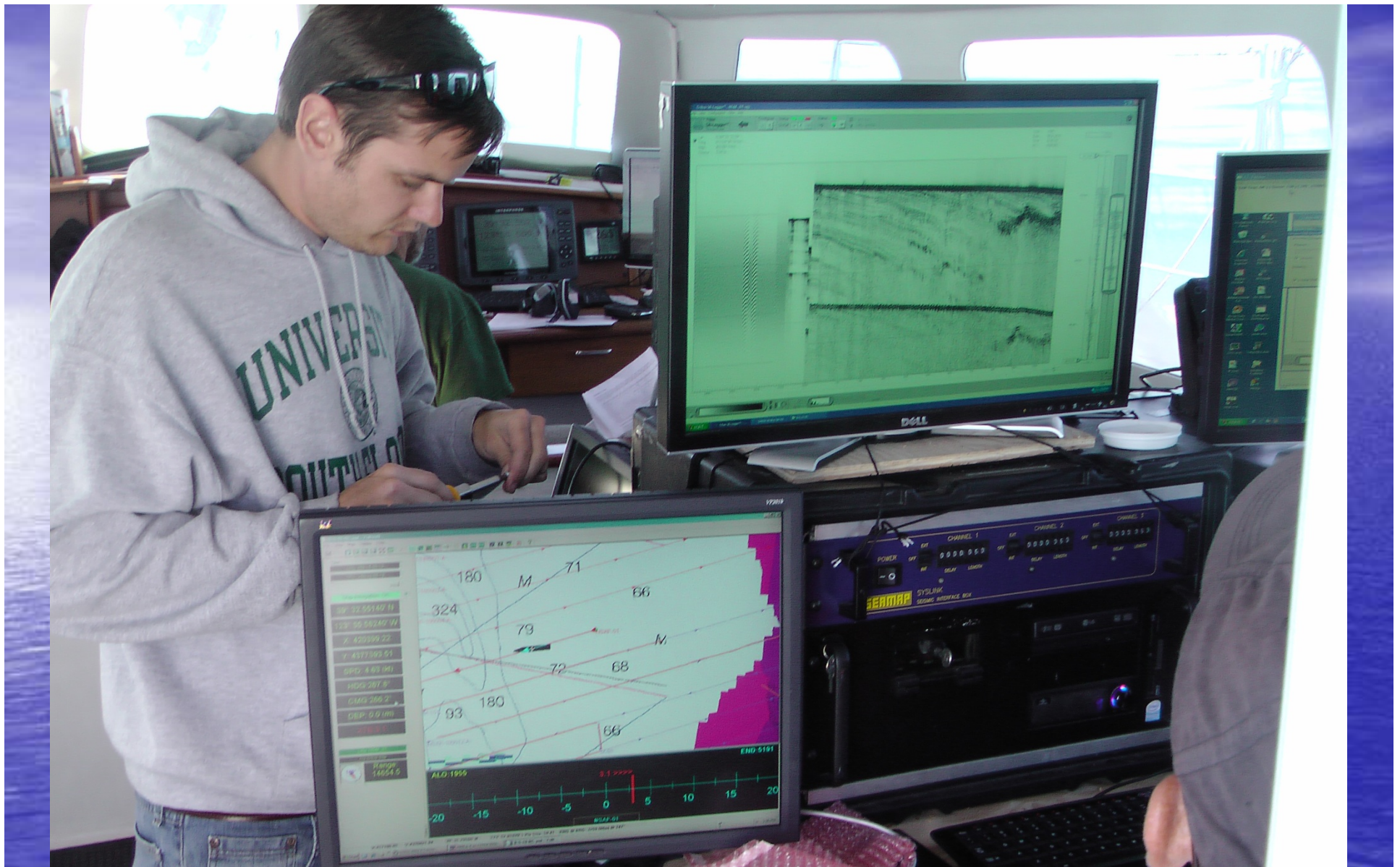




On survey under sail.



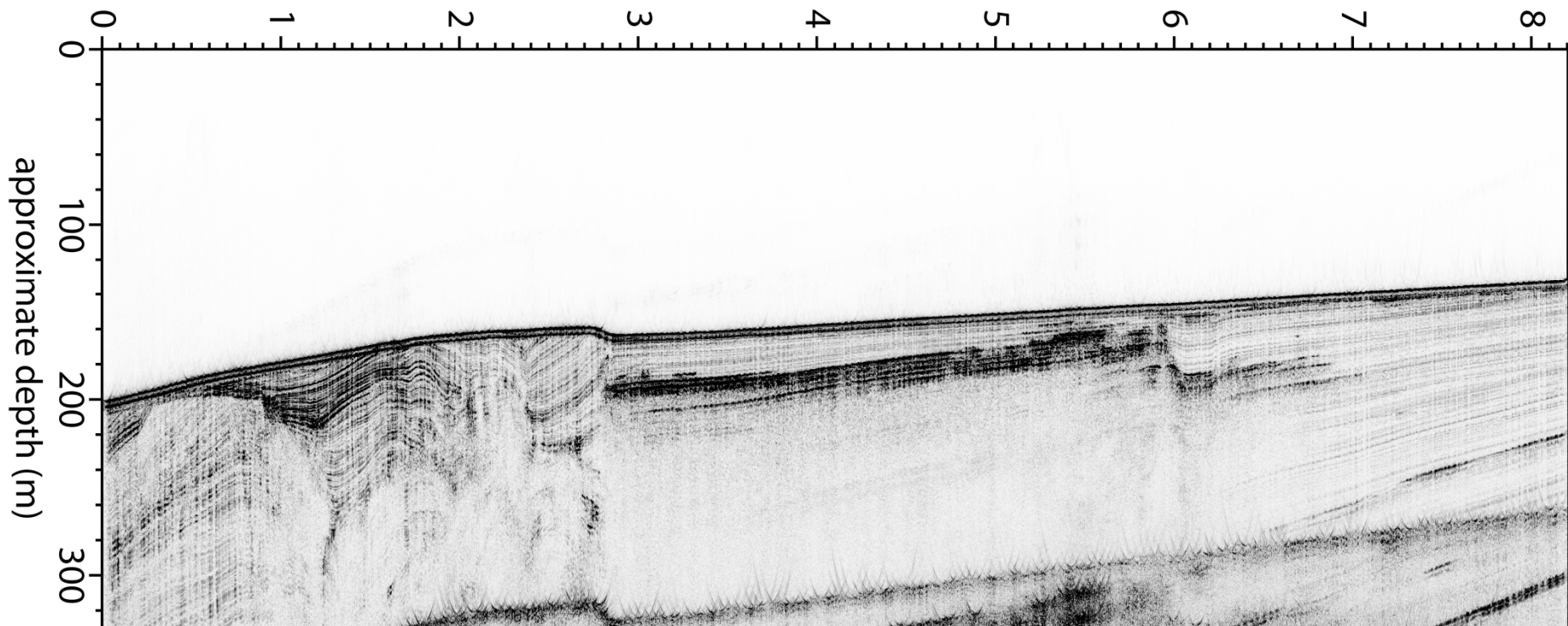
**Seismic survey, streamer  
and sparker source**



Seismic data acquisition

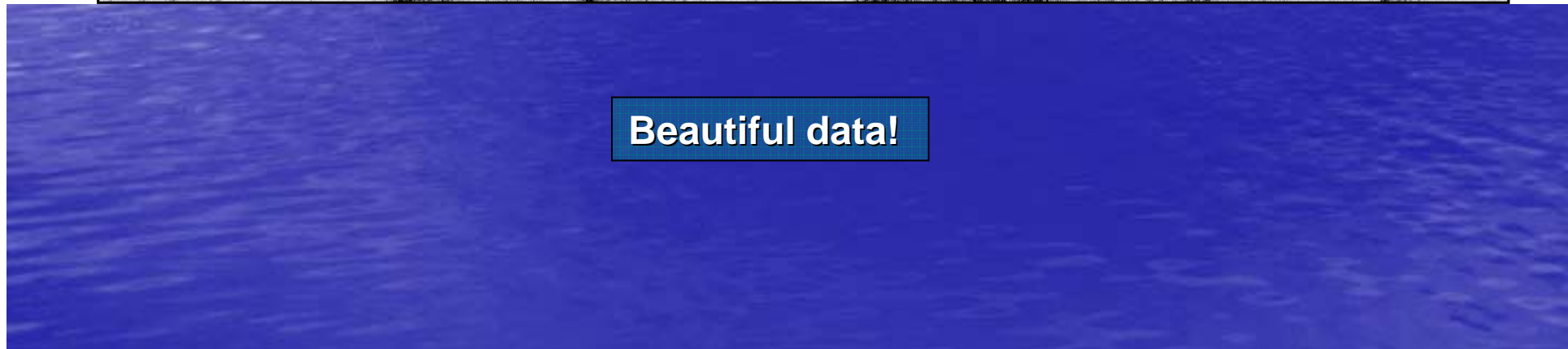


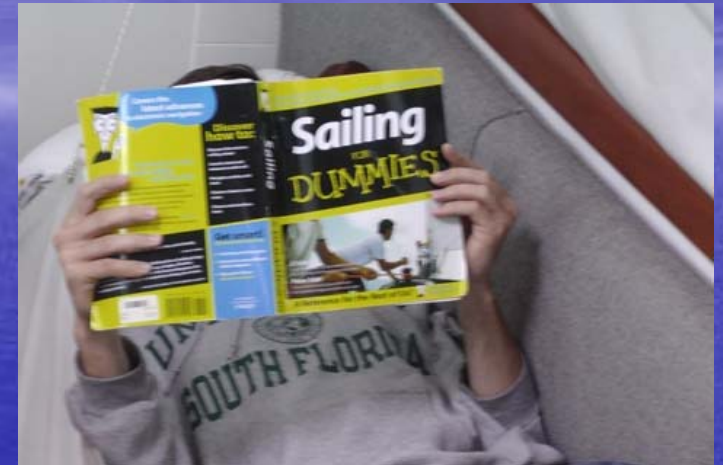
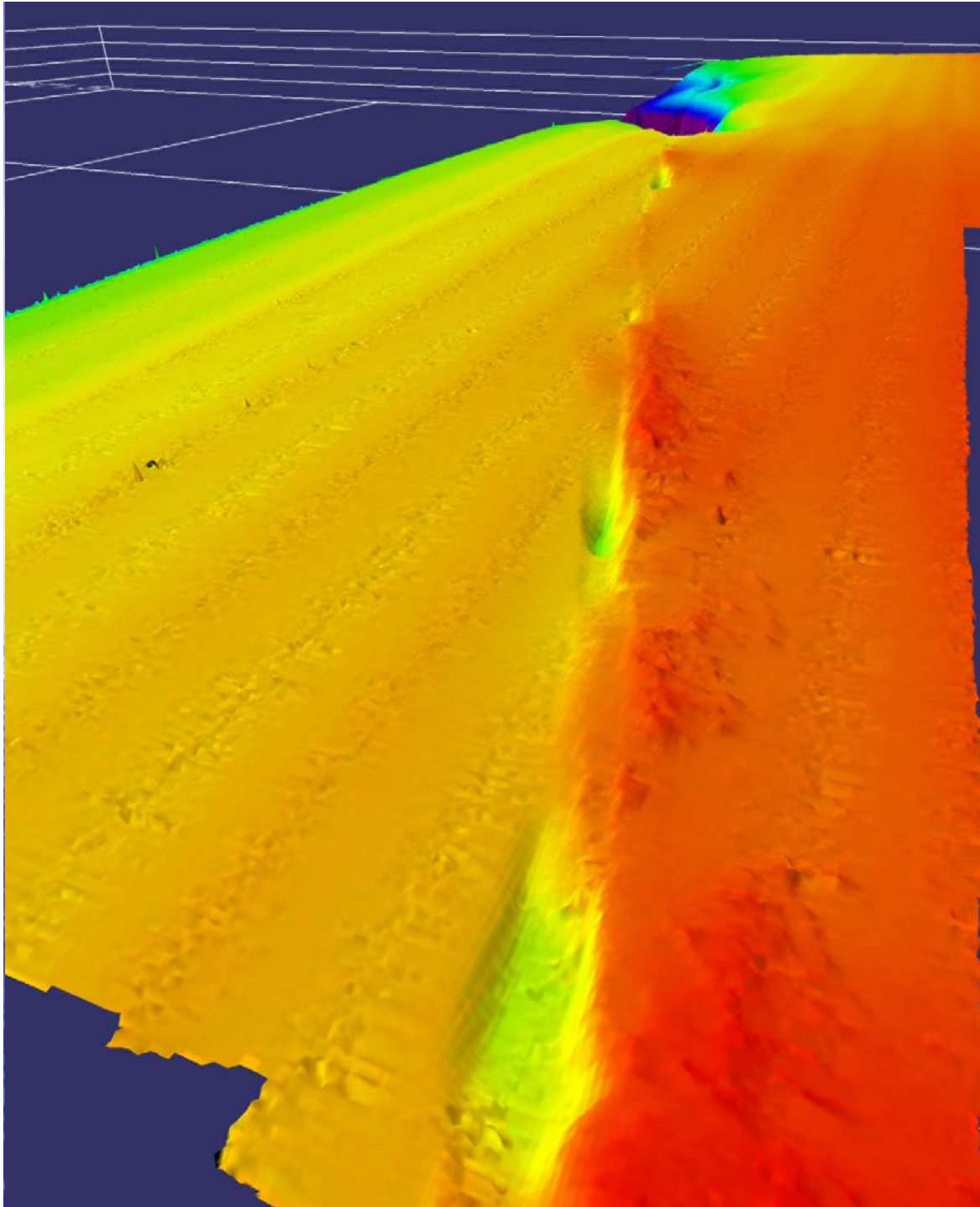
<<West distance (km) East>>



NSAF-49

Beautiful data!

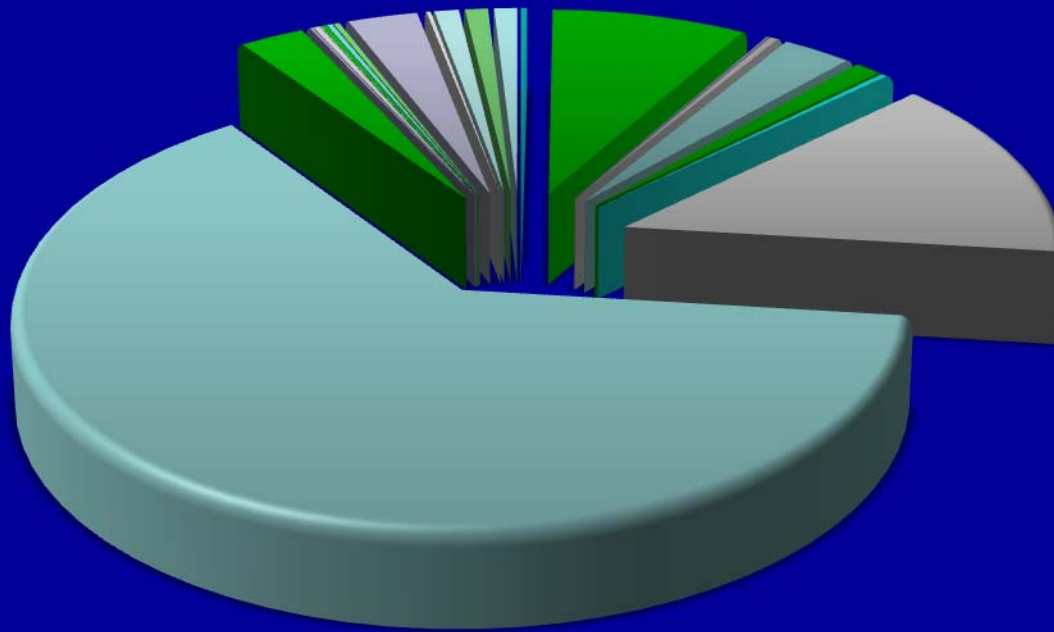




Multibeam data, NSAF just south of Noyo Canyon



# Fuel Usage, Total 4877 gallons



- Airport van
- PDX-SJC Flight
- Rental car Prius
- Rental car
- OSU van
- Rental car
- Rental car
- Derek M. Baylis
- Pacific Storm
- USGS van
- Rental Car
- Santa Rosa-PDX Flight
- Airport shuttle van
- Seattle-Newport Flight
- Rental Car
- Rental Car
- Oak-PDX flight
- rental car
- Honolulu Flight
- Boston Flight
- Dulles Flight

## **Advantages:**

- **Faster (more science time)**
- **Quieter, both for the crew and radiated noise in the water**
- **Almost unlimited range**
- **24/7 ops, not common on a 65' vessel**
- **Science party of 7, also not common for a 65' vessel**
- **Crew of 2**
- **Improved stability (over a typical 65' platform) even with no wind**
- **Cheaper (by a factor of ~ 3) Day rate ~ \$1800/day**
- **Very low carbon footprint even under power alone 1.6 GPH**
- **Easier boathandling with outside helm and science deck adjacent**
- **Much better platform for small AUV ROV operations**
- **Crew fatigue low, and it was well, fun!**

## **Disadvantages:**

- **Can't weld things to the deck, have to design composite structures for things like the sonar pole.**

- **?????????**



**Thank You!**



Maltese Falcon by Peter Lyons/Lyons Imaging for YachtPals.com