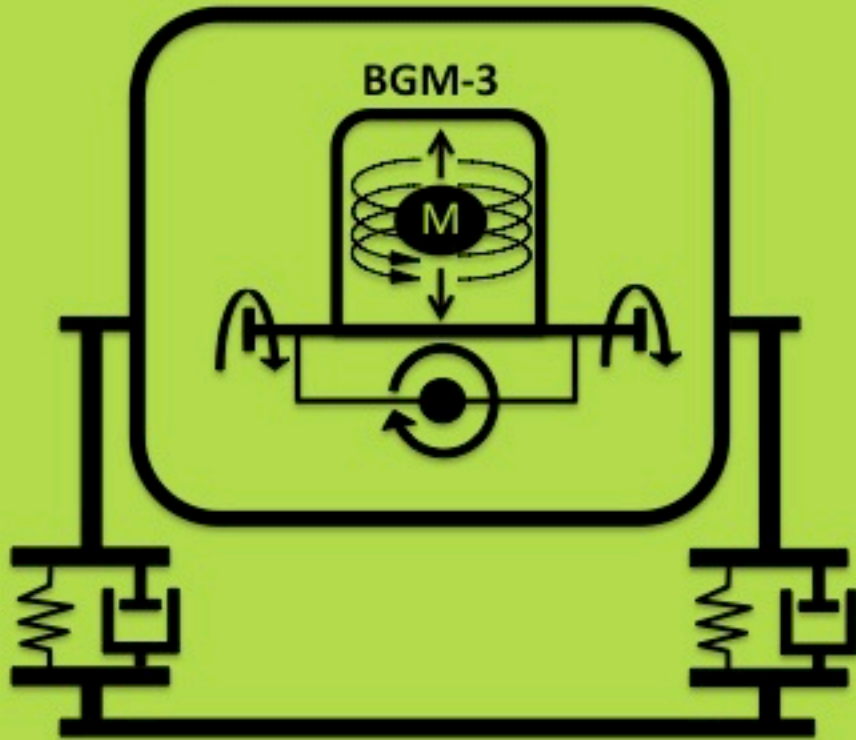


POTENTIAL FIELDS POOL EQUIPMENT

pfpe-internal@whoi.edu



James Kinsey & Dan Fornari
Woods Hole Oceanographic Institution
2015 RVTech Meeting

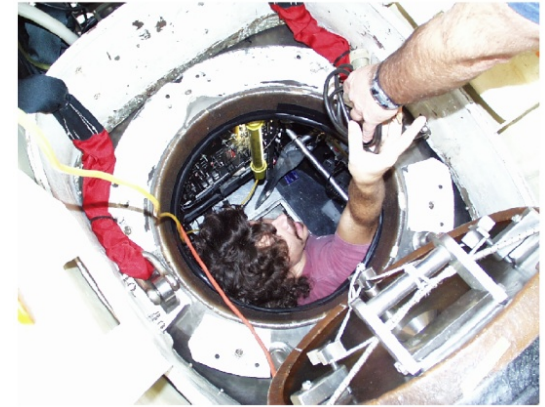
What is PFPE?

- Potential Fields Pool Equipment (PFPE) supports the US research fleet in obtaining gravity and magnetic data.
- Provide:
 - Equipment
 - Technical Support
- While founded to support UNOLS vessels, we now support gravimetry work throughout NSF.



Infrastructure Prior to PFPE

- Prior to 2007, only 4 gravimeters were permanently installed on US research vessels
 - BGM-3 gravimeters on the *Conrad/Ewing/Langseth* and the *Melville*
 - LaCoste and Romberg gravimeters on the *Kilo Moana* and *Palmer*
- Agreement with the Naval Oceanographic Office (NavO) provided access to their gravimeters.
- NavO terminated their gravimeter program in 2007 forcing US scientists to find a new solution.



Installing a NavO BGM-3 in Alvin in 1999.

2007 Fugro Acquisition

- In 2007, Fugro offered to sell used BGM-3 gravimeters and spare parts to the UNOLS community
- WHOI, SIO, and UAF successfully submitted a proposal to acquire this equipment (NSF-OCE-0705964)
- This equipment was refurbished and delivered to UNOLS by Randy Herr

Acquired equipment included:

- 7 working gravimeters
- 4 gyros
- 8 horizontal accelerometers
- Over 20 power supplies
- Over 20 boards



BGM-3 testing in Randy Herr's "Lab"

PFPE – Motivation

- The acquisition of these gravimeters resolved the problem of *providing* gravimeters to the UNOLS fleet.
- It did not provide for the ***long-term financial and technical support of this instrumentation.***
- In June 2009, the Potential Fields Pool Equipment facility was formed at WHOI.
- A 2009 NSF award for \$239k provided initial support equipment to PFPE.
- A 2010 award provided PFPE with a 5 year operating budget to support gravimetry on UNOLS vessels.
 - In 2014, PFPE expanded to include USAP and receive support from Polar Programs.

PFPE – Goals

- PFPE provides the community with:
 - A supply of spares for maintaining the at-sea BGM-3s
 - Repair or refurbish sensors as necessary
 - Technical Support including on-shore support for the at-sea gravimeters and helping establish best practices.
 - Pool equipment
- PFPE does **NOT** post-process or archive marine gravity data
 - Such efforts are better suited toward other researchers or community initiatives – i.e., R2R.

PFPE: Technical Support

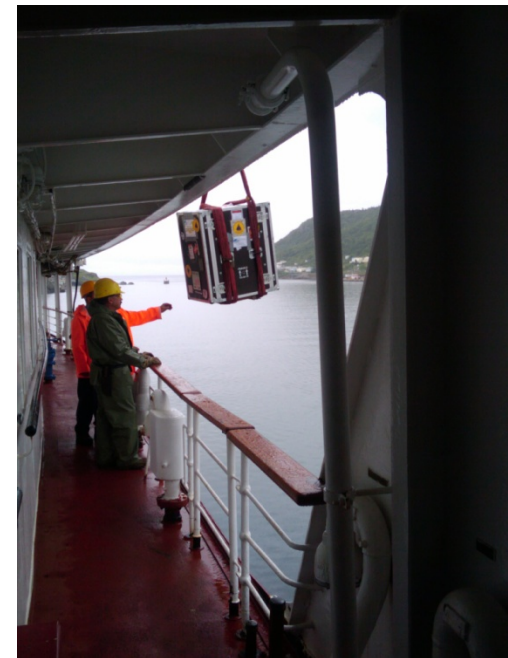
- Provide full sparring for at-sea units
 - Gyro refurbishments with long-life bearings
- In-house repair capability
 - As necessary developing replacement parts
 - Repairing sensors as necessary
- 24/7 technical support
- Annual service visits
- Emergency visits when required
- The leading (and likely the only) center of expertise for BGM-3 gravimeters

Pool Gravimeters

- Pool gravimeters available for use on ships of opportunity.
- Have been used in the Red Sea, Guaymas Basin, Galapagos Spreading Center, the Arctic, Central Pacific, and Puget Sound.



Left, 2008 Oceanus install for the Red Sea cruise. Right, 2010 install on the CCGS Louis S. St Laurent for Law of the Sea work in the Arctic.



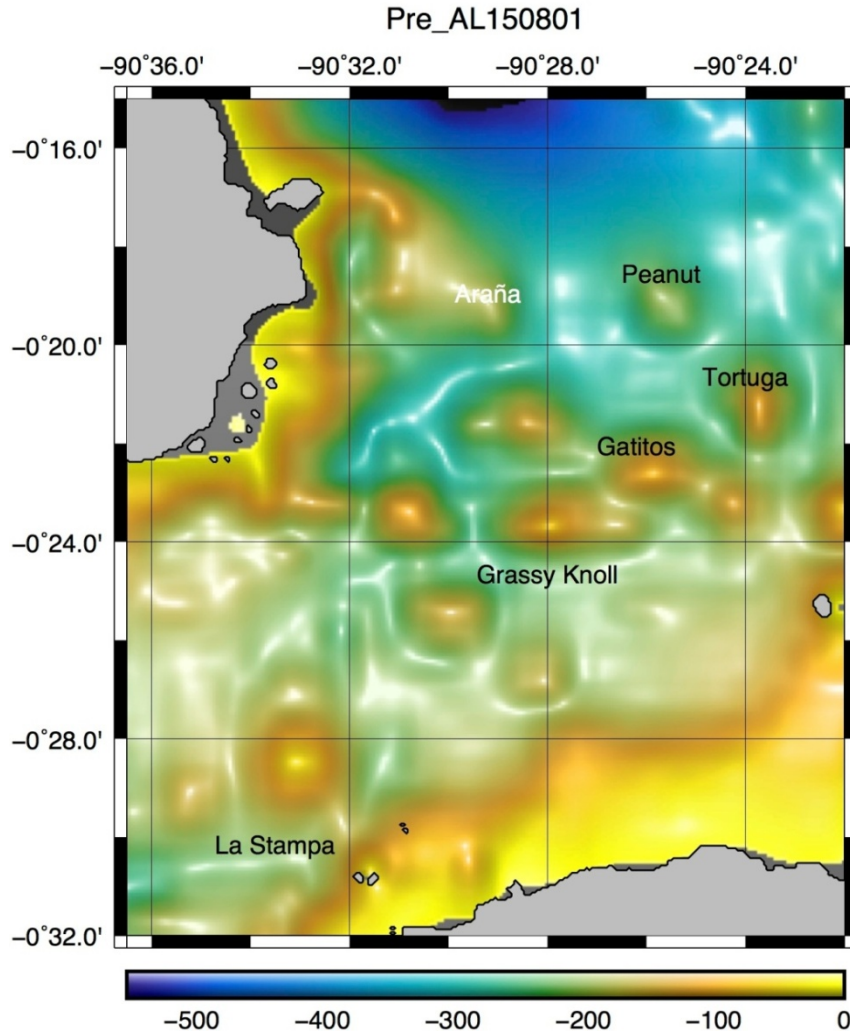
PFPE – Additional Resources

- ❑ Also available for community use :
- ❑ A SeaSPY towed marine magnetometer
- ❑ Land Gravimeters
- ❑ CRADA signed with NGA this Spring – significantly increases spares, BGM3s, and land meters

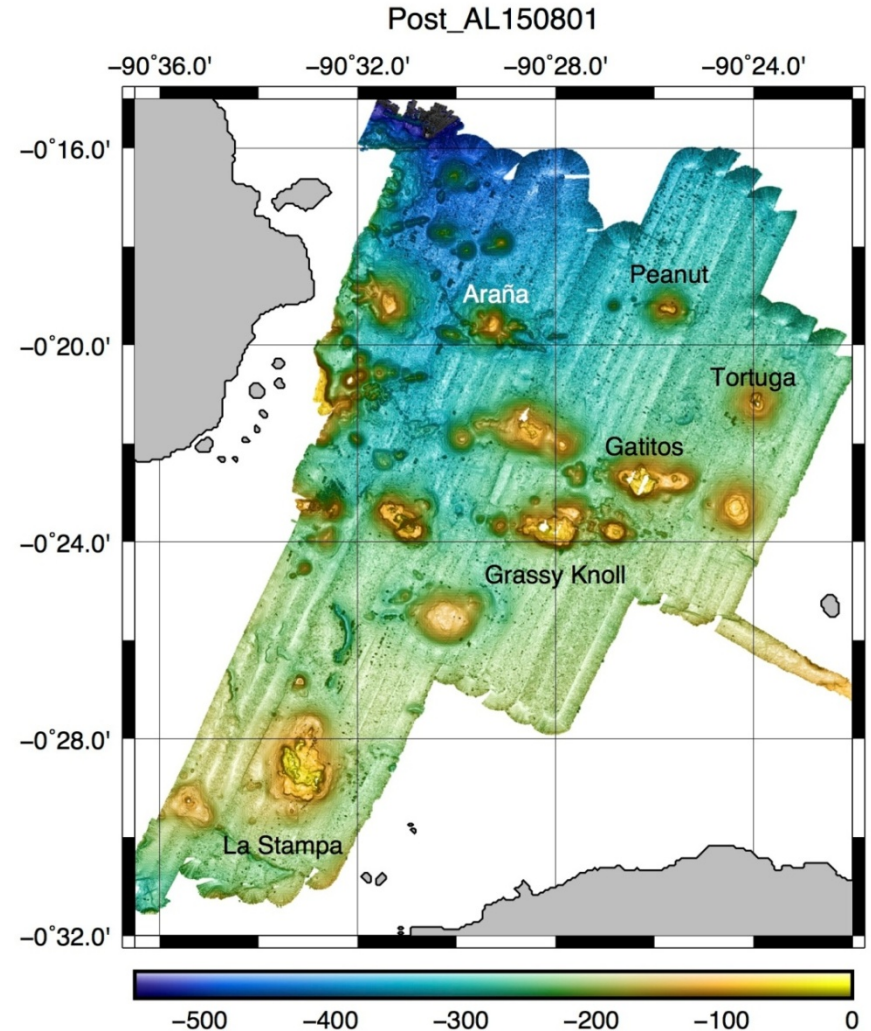


Why Does Marine Gravity Still Matter?

Satellite Gravimetry



Ship Bathymetry



Data courtesy of S.A. Soule

2015 Activities

- ❑ All the “usual” activities”
- ❑ New software distributed to most ships during service visits in 2015.
 - ❑ Exception is the KM – getting software this month
- ❑ Gravimeters removed from the from the *Melville* and *Knorr*
- ❑ Removal from the *Revelle* in Guam (top)
 - ❑ Thanks to Scripps and UAF!
- ❑ Back to the Arctic with the Canadians
 - ❑ Pool Install on the *LSSL* (bottom)
- ❑ Best practices manual completed – then reviewed and edited to remove ITAR sensitive material
 - ❑ Hopefully an “export control safe” reference
- ❑ Working with UNOLS Operators on ITAR issues – a work in progress



Best Practices Manual

- ❑ In final editing stages
- ❑ Provides background information and updated instructions on most common repairs, problems
- ❑ Striving to make this a document *not* controlled by ITAR
- ❑ Aiming for early 2016 release

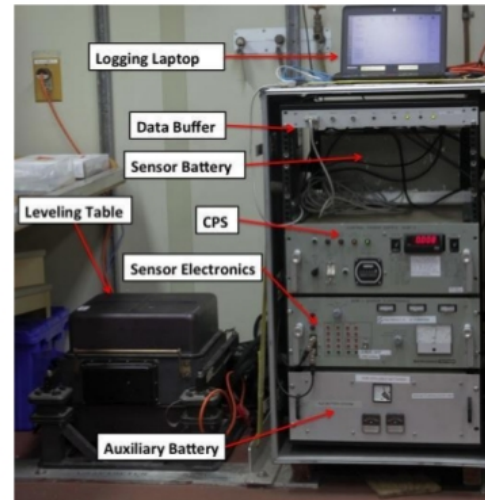
1 System Overview and Component Descriptions

The BGM-3 consists of a force feedback accelerometer mounted on a stabilized platform. The first Bell Aerospace BGM-3 Marine Gravimeter system made available for academic use was installed on the R/V Robert D. Conrad in February 1984 by Robin E. Bell and Anthony B. Watts.

In late 2006, through a NSF equipment grant, the Woods Hole Oceanographic Institution (WHOI) acquired used BGM-3 gravimeters equipment from Fuguro Internacional, a commercial survey company. The intent of the project was to implement 5 permanent BMG-3 installations on UNOLS research vessels, and 2 systems that could be temporarily installed on other ships of opportunity on an as-needed basis.

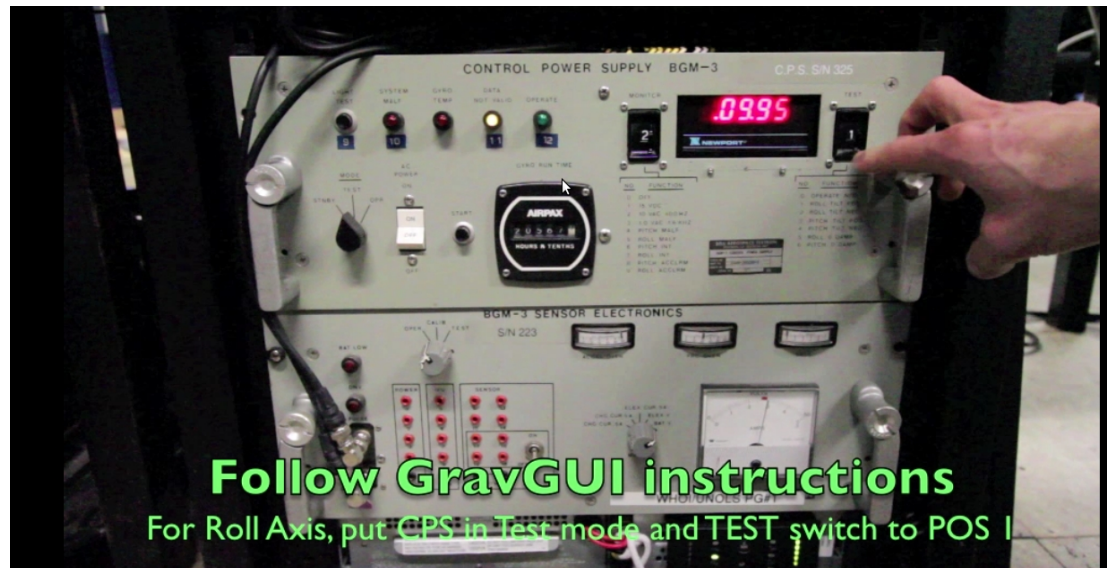
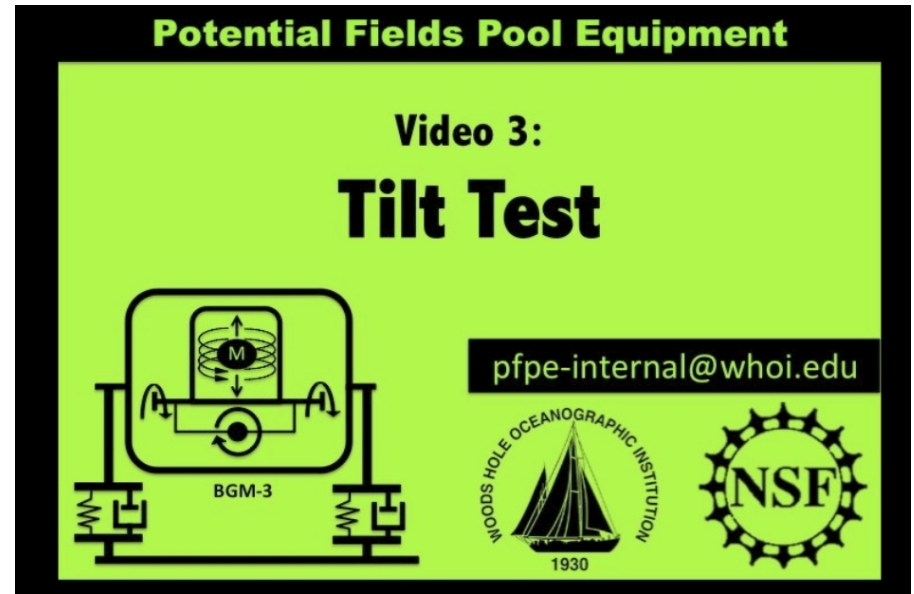
Today, the Potential Fields Pool Equipment (PFPE) maintains a total of 9 BGM-3 gravimeters on ships including all of the UNOLS global and ocean class research vessels, and all of the U.S. Polar research vessels.

The BGM-3 Gravimeter is an extremely power sensitive system, and great care must be taken to ensure that the sensor remains powered up in order to remain operational. Even momentary power loss can result in very expensive and time consuming repairs.



Training Videos

- ❑ Common procedures are being documented with videos
- ❑ Examples
 - ❑ Gyro replacement
 - ❑ Tilt tests (right)
 - ❑ Weekly checks
 - ❑ Zero damp test
 - ❑ Gravity ties



2016 Activities

- ❑ Installs on the *Armstrong* and *Ride*
- ❑ Hopefully finish clarifying ITAR issues
- ❑ Daily data quality control software
- ❑ 5 year renewal proposal will be submitted in late 2016
 - ❑ Feedback from operators on what works (and what doesn't work) is crucial.
 - ❑ PFPE tracks many of the science outcomes but doesn't have the whole picture.
 - ❑ Information from the operators on who is using gravity data is always appreciated.

More Information

- Information on the pool gravimeters is located on the MISO website (Google 'PFPE WHOI')

«WOODS HOLE OCEANOGRAPHIC INSTITUTION

MISO Facility

Multidisciplinary Instrumentation in Support of Oceanography

Overview **MISO Instrumentation** Request an Instrument MISO Documentation

MISO Instrumentation

- TowCam
- Marine BGM-3 Gravimeters**
- Marine Magnetometer
- Deep Sea Cameras and Strobes
- Acoustic Transponders
- High Temperature Loggers
- Deep Sea Batteries & Switches

Potential Fields Pool Equipment 'PFPE' - Ship BGM-3 Gravimeters

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Background


In late 2006, an opportunity arose to acquire used BGM-3 gravimeters and spare parts from a commercial survey company, Fugro-Robertson, Inc. It was envisioned that acquisition of these gravimeters would result in permanently installed meters on several UNOLS Class 1 vessels, and that several meters that could be staged and installed on other ships on an as-needed basis (e.g., "pool gravimeters"). In order to take advantage of this opportunity, a group of scientists at University of Alaska at Fairbanks (UAF), Scripps Institution of Oceanography (SIO), and Woods Hole Oceanographic Institution (WHOI) wrote an unsolicited NSF proposal with WHOI as the lead institution to acquire the Fugro gravimeters and spares. That proposal (NSF-OCE-0705964) was funded in 2007 and over the course of the next 2 years, 4 gravimeters were permanently installed on the USCGS Healy, R/V Knorr, and R/V Revelle. This increased the number of permanently deployed BGM-3 gravimeters from two (the systems on the R/V Melville and R/V Marcus Langseth) to six. Two additional gravimeters were designated as pool gravimeters and, since 2008, have been deployed on cruises to the Pacific, Red Sea, and the Arctic.

The acquisition of seven BGM-3 gravimeters in 2007 through the NSF grant significantly increased the number resolved the problem of providing gravimeters to the UNOLS fleet, however it did not provide for the long-term financial and technical support of this instrumentation. To address this need, WHOI initiated a discussion with the marine gravity community and UNOLS ship operators to establish a gravimeter pool to share equipment and technical expertise with the ultimate goal of ensuring that all of the deployed BGM-3 gravimeters are well maintained and supported so that they can obtain high-quality marine gravity data. The pooling of equipment was intended to facilitate the purchase spares and needed repairs to gravimeters throughout UNOLS, thereby reducing the financial costs and logistical burden to the



[Enlarge Image](#)

One of the PFPE BGM-3 gravimeters during initial testing and refurbishment carried out by Mr. Randy Herr.



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