

**National Science Foundation  
Geosciences Directorate  
Division of Ocean Sciences  
Arlington, Virginia**

**ENVIRONMENTAL ASSESSMENT AND DETERMINATION  
PURSUANT TO THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA),  
42 U.S.C. 4321, *et seq***

**Marine Seismic Survey in the Commonwealth of the Northern Mariana Islands,  
April - June 2010**

**FINDING OF NO SIGNIFICANT IMPACT**

**OCE# 0841074; OCE# 0841063**

**Principal Investigators/Institution:** Douglas Wiens, Washington University St Louis; Daniel Lizarralde, Woods Hole Oceanographic Institution

**Project Title:** Collaborative Research: Mantle Serpentinization and Water Cycling Through the Mariana Trench and Forearc

This constitutes a final environmental assessment (EA) by the National Science Foundation (NSF) for a marine seismic survey proposed to be conducted in April - June 2010 on board the research vessel (R/V) *Marcus G. Langseth* in the Pacific Ocean proximate to the Commonwealth of the Northern Mariana Islands (CNMI). The R/V *Langseth* is a research vessel titled to the US Government (National Science Foundation) and operated by Columbia University's Lamont-Doherty Earth Observatory (LDEO). This EA is based, in part, on an Environmental Assessment report prepared by LGL Limited environmental research associates (LGL) on behalf of NSF, entitled, "Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Commonwealth of the Northern Mariana Islands, April-June 2010" (Report #TA4858-1) (Attachment 1). The conclusions from the LGL report were used to inform the Division of Ocean Sciences (OCE) management of potential environmental impacts of the cruise. OCE has reviewed and concurs with the report's findings. Accordingly, the LGL report is incorporated into this EA by reference as if fully set forth herein.

**Project Objectives and Context**

This research program aims to understand the water cycle within subduction-zone systems where Earth's major earthquakes occur. Little is known about either of these processes, but water cycling through the system is thought to be the primary controlling factor in both arc-crust generation and megathrust seismicity. The survey will take place over the Mariana outer forearc, the trench and the outer rise of the subducting and bending Pacific plate. The objective is to image upper mantle velocity structure so that the effects of plate bending can be assessed. The researchers will test the hypothesis that hydration (serpentinization) of the upper mantle, promoted by bending-related faulting, provides a mechanism for transporting water beneath the arc. Subsequent release of this water promotes mantle melting and volcanism. The field program will test this hypothesis by measuring mantle seismic sound speeds, which vary with degree of

serpentinization. By comparing these measurements from the Mariana system, which is old and cold, with the Costa Rica system, which is young and warm and where similar measurements have recently been made, it should be determinable whether or not substantial water is taken up by the mantle of subducting plates near the outer rise of seafloor trenches. The two-dimensional (2D) field experiment will include an active and passive seismic component.

The Mariana Island arc, one of the NSF MARGIN Program focus sites, represents an ideal location to constrain water flux due to the extensive work already done on volatile cycling, strong evidence for the importance of water in arc and backarc magmatism, the subduction of old lithosphere capable of storing more water, and the ability to sample forearc mantle fluids and rocks at serpentinite seamounts.

The information obtained from this study will increase knowledge of plate tectonics and the complex earth hydration system and provide useful data for a variety of other geologic studies. The information learned in this location may also be applicable to other similar geologic sites.

The project will be a collaborative effort, with scientists from multiple universities and supports graduate students.

#### **Summary of Proposed Action and Alternatives**

The procedures to be used for the survey will be similar to those used during previous seismic surveys by LDEO and will use conventional seismic methodology. The proposed survey will take place from April through June 2010 in waters within the CNMI, a commonwealth in a political union with the United States (US) and thus considered within the US Exclusive Economic Zones (EEZ) (See Attachment 1, Figure 1). Minor deviation of survey dates may be required, depending on logistics and weather. The seismic survey will consist of ~2800 km of transect lines (including turns) in deep (>2000 m) water. The survey will involve the R/V *Langseth* as the source vessel which will deploy an array of 36 airguns with a total discharge volume of ~6600 in<sup>3</sup>. The receiving system will consist of a 6 km hydrophone streamer and ~85 ocean bottom seismometers (OBSs). As the airgun array is towed along the survey lines, the hydrophone streamer will receive the returning acoustic signals and transfer the data to the on-board processing system. The OBSs record the returning acoustic signals internally for later analysis. The OBSs will be deployed and most (~60) will be retrieved during the cruise, whereas ~25 will be left in place for one year to collect data in the ambient environment. In addition to the operations of the airgun array, a multibeam echosounder (MBES) and a subbottom profiler (SBP) will also be operated from the R/V *Langseth* continuously throughout the cruise. Seismic operations will be carried out for 16 days, with the balance of the cruise occupied in transit (~2 days) and in deployment and retrieval of OBSs (~25 days).

One alternative to the proposed action would be to conduct the survey at an alternative time. Constraints for vessel operations and availability of equipment (including the vessel) and personnel would need to be considered for alternative cruise times. Limitations on scheduling the vessel include the additional research studies planned on the vessel for 2010 and beyond. Other research activities planned within the region also would need to be considered. Given the limited weather window for the operations due to typhoon season, and the fact that marine

mammals and turtles are in the survey area throughout the year, altering the timing of the proposed project likely would result in few net benefits.

Another alternative to conducting the proposed activities would be the “No Action” alternative, i.e. do not issue an IHA and do not conduct the operations. If the planned research were not conducted, the “No Action” alternative would result in no disturbance to marine mammals attributable to the proposed activities, but geological data of considerable scientific value and relevance increasing our understanding of the Earths hydrologic cycle, plate tectonics, and regional earthquakes would not be acquired and the project objectives as described above would not be met. The “No Action” alternative would result in a lost opportunity to obtain important scientific data and knowledge relevant to a number of research fields and to society in general. The collaboration, involving institutions, investigators, students, and technicians, would be lost along with the collection of new data, interpretation these data, and introduction of new results into the greater scientific community and applicability of this data to other similar settings. Loss of NSF support often represents a significant negative impact to the academic infrastructure.

### **Summary of environmental consequences**

The potential effects of sounds from airguns on marine species, mammals and turtles of particular concern, are described in detail in Attachment 1 (pages 37-69 and Appendices B-E) and might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical or physiological effects. It is unlikely that the project will result in any cases of temporary or especially permanent hearing impairment, or any significant nonauditory physical or physiological effects. Some behavioral disturbance is expected, if animals are in the general area during seismic operations, but this would be localized, short-term, and involve limited numbers of animals.

The proposed activity will include a mitigation program to further minimize potential impacts on marine mammals that may be present during the conduct of the research to a level of insignificance. As detailed in Attachment 1 (pages 7-13; and 51) monitoring and mitigation measures will include: ramp ups, minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations, two observers for 30 minutes before and during ramp-ups during the day and at night (and when possible at other times), passive acoustic monitoring (PAM) during the day and night to complement visual monitoring (when practicable), power downs (or if necessary shut downs) when mammals or turtles are detected in or about to enter designated exclusion zones. Also, a special mitigation measure of immediate shutdown would be in place in the unlikely event that North Pacific right whales were observed at any distance from the Langseth (Attachment 1, page 13). The fact that the 36-airgun array, as a result of its design, directs the majority of the energy downward, and less energy laterally, would also be an inherent mitigation measure, as is the relatively wide spacing of the airgun shots during OBS operations (up to ~150 meters or 58-73 seconds).

With the planned monitoring and mitigation measures, unavoidable impacts to each species of marine mammal and turtle that could be encountered would be expected to be limited to short-term, localized changes in behavior and distribution near the seismic vessel. At most, effects on marine mammals may be interpreted as falling within the U.S. Marine Mammal Protection Act

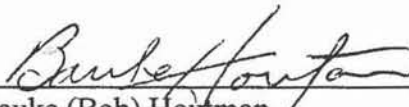
(MMPA) definition of “Level B Harassment” for those species managed by the National Marine Fisheries Service. No long-term or significant effects would be expected on individual marine mammals, sea turtles, or the populations to which they belong or on their habitats.

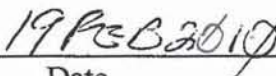
A survey at an alternative time would result in few net benefits. Marine mammals and sea turtles are expected to be found throughout the proposed study area. Many cetaceans are widespread in the survey area throughout the year, and others (some baleen whales) are present in winter and possibly migrating through during spring and fall. Green and possibly hawksbill sea turtles nest in the CNMI (e.g., Tinian and Saipan) at the time of the survey, so nesting females would be near shore or on land far from the survey area. Migrating green and hawksbill turtles, and migrating or foraging leatherback turtles, could be encountered in the deep waters of the survey area at any time of year.

The “no action” alternative would remove the potential of the limited direct environmental consequences as described. However, it would preclude important scientific research from going forward that has distinct potential to address environmental and geological processes/concerns.

### **Conclusions**

NSF has reviewed and concurs with the conclusions of the LGL environmental assessment report (Attachment 1) that implementation of the proposed activity will not have a significant impact on the environment. An environmental impact statement will not be prepared. Consequently, implementation of the proposed activity is not a major federal action having a significant impact on the environment within the meaning of the National Environmental Policy Act (NEPA).

  
\_\_\_\_\_  
Bauke (Bob) Houtman  
Integrative Programs Section Head  
Division of Ocean Sciences

  
\_\_\_\_\_  
Date