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

DRAFT ENVIRONMENTAL ASSESSMENT PURSUANT TO THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA), 42 U.S.C. 4321, *et seq.* AND EXECUTIVE ORDER 12114

Marine Seismic Survey in the northeastern Pacific Ocean, 2012

1) **OCE 1029411**
   Principal Investigators/Institution: Suzanne Carbotte, Columbia University
   Project Title: 1) Collaborative Research: Evolution and hydration of the Juan de Fuca crust and uppermost mantle: a plate-scale seismic investigation from ridge to trench

2) **EAR 1147975**
   Principal Investigators/Institution: Anne Trehu, Oregon State University
   Project Title: Collaborative Research: Imaging the Cascadia subduction zone: a ship-to-shore opportunity

3) **OCE 1150628**
   Principal Investigators/Institution: Steven Holbrook, University of Wyoming
   Project Title: Collaborative Research: A Short, Open-Access 2D MCS Acquisition Program off Washington State

This constitutes a draft environmental assessment (DEA) by the National Science Foundation (NSF) for marine seismic surveys proposed to be conducted in June - July 2012 on board the research vessel (R/V) *Marcus G. Langseth* in the northeastern Pacific Ocean, in International Waters and the Exclusive Economic Zones of the U.S. and Canada. This DEA 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 northeastern Pacific Ocean, June - July 2012" (Report # TA8118-1) (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 DEA by reference as if fully set forth herein.

Project Objectives and Context

The proposed seismic surveys would collect data in support of three research studies:

(1) ***Juan de Fuca Plate*** would use the results of 2-D seismic surveys of the Juan de Fuca plate at the Cascadia subduction zone to characterize the evolution and state of hydration of the Juan de Fuca plate crust and shallow mantle, from formation at the mid-ocean Juan de Fuca ridge, through alteration and hydration within the plate interior, to subduction at the Cascadia trench. The survey would include two ridge-to-trench transects, the first complete such transects ever acquired of an oceanic plate. It is expected that differences in hydration of the down-going plate from Oregon to Washington may play a significant role in the seismic hazard of the Cascadia subduction zone along this heavily populated Pacific northwest margin.

(2) ***Cascadia Thrust Zone*** would result in a 3-D image of the seismic velocity structure of the Cascadia thrust zone which would provide information on complex buried structures in this region that appear to affect the frictional behavior of the plate boundary megathrust fault. A better image of the structure in this region, which coincides with apparent north-south changes in the frequency of occurrence of very large earthquakes and in contemporary patterns of strain accumulation would provide background information for generating improved earthquake hazards analyses and a better understanding of the processes that control megathrust earthquake characteristics.

(3) ***Cascadia Subduction Margin*** would use the results of a 2-D seismic survey of the Cascadia subduction margin off Grays Harbor, WA, to address key scientific issues regarding the location, physical state, fluid budget, and associated methane systems of the subducting plate boundary and overlying crust. This system, which is the target of all three studies, is of great scientific and societal interest, as it is capable of very large (~9 M_W) earthquakes, creates volcanic hazards in the Cascades, and hosts periodic episodic tremor and slip episodes.

The projects would be collaborative efforts, supporting scientists and graduate students from multiple universities.

Summary of Proposed Action and Alternatives

The procedures to be used for the surveys would be similar to those used during previous seismic surveys by L-DEO and would use conventional seismic methodology. The proposed surveys would take place from June through July 2012 in the northeastern Pacific Ocean, in International Waters and the Exclusive Economic Zones of the U.S. and Canada (See Attachment 1, Figure 1). The seismic surveys would consist of ~4991 km of transect lines (including turns) in water <200 m to >2000 m deep (3051 km - Carbotte; 793 km - Trehu; 1147 km - Holbrook). The surveys would involve the R/V *Marcus G. Langseth* as the source vessel which would deploy an array of 36 airguns with a total discharge volume of ~6600 in^3. The receiving system would consist of an 8 km hydrophone streamer and ~97ocean bottom seismometers (OBSs). As the airgun array is towed along the survey lines, the hydrophone streamer would 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. For the ***Juan de Fuca*** Plate study, 46 OBSs would be deployed along the northern line and the along-shore line (Fig. 1). Once those lines have been shot, the OBSs would be retrieved and 39 of them would be deployed along the southern line then retrieved once the line is shot. For the ***Cascadia Thrust Zone*** study, six OBSs would be deployed at each of the northern and southern survey areas then retrieved after the lines are shot. In addition, 48 onshore instruments would be used as receivers. OBS deployment and retrieval

would be carried out by the R/V *Oceanus*. In addition to the operations of the airgun array, a multibeam echosounder (MBES) and a subbottom profiler (SBP) would also be operated from the R/V *Langseth* continuously throughout the cruise. An SBP would be operated by the R/V *Oceanus* during the deployment and retrieval of OBSs. Seismic operations would be carried out for ~25 days, with the balance of the cruise occupied in transit. Some minor deviation from these dates may be required, depending on logistics and weather.

One alternative to the proposed action would be to conduct the surveys 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 2012 and beyond. Other research activities planned within the region also would need to be considered. Given 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 seismic hazards of the Cascadia subduction and thrust zones along the heavily populated Pacific northwest margin 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 of 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 52-89 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 proposed action would result in any cases of temporary or especially permanent hearing impairment, or any significant non-auditory 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 action would 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 9-17; and 69) monitoring and mitigation measures would include: ramp ups; a minimum of one, but typically two dedicated observers 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; passive acoustic monitoring (PAM)

during the day and night to complement visual monitoring (unless the system and back-up systems are damaged during operations); and, power downs (or if necessary shut downs) when mammals or turtles are detected in or about to enter designated exclusion zones. 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 (100 to 500 meters or 40-200 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, seabirds 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 are expected to be found throughout the proposed survey area and throughout the time period during which the project may occur. A number of marine mammal species are expected to occur in the area year-round, so altering the timing of the proposed project likely would result in no net benefits for those species. Other marine mammal species (e.g., most baleen whales) are migratory, with many individuals spending the summer months north of the project area (off Alaska). 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 (Attachment 1) that implementation of the proposed activity will not have a significant impact on the environment.