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Marine Seismic Survey on the Shatsky Rise in the Northwest Pacific Ocean June-July 2010

OCE# 0927001; OCE# 0926945; OCE# 0926611
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Project Title: Geophysical constraints on Mechanisms of Ocean Plateau Formation from Shatsky Rise, Northwest Pacific

This constitutes a draft environmental assessment (DEA) by the National Science Foundation (NSF) for a marine seismic survey proposed to be conducted in June-July 2010 on board the research vessel (R/V) *Marcus G. Langseth* in the Northwest Pacific Ocean on the Shatsky Rise. 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* on the Shatsky Rise in the Northwest Pacific Ocean, June-July 2010" (Report #TA4873-1) (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

By deciphering the crustal structure of Shatsky Rise, a large igneous province (LIP), through a combined ocean bottom seismometers (OBS) and multichannel seismic (MCS) survey, this project would address major questions of Earth history, geodynamics, and tectonics and have a profound impact on our understanding of terrestrial magmatism and mantle convection. The sheer scale of plateau formation implies a potential role in environmental crises such as oceanic anoxia and mass extinctions, and oceanic plateaus may also be important for the growth of continental crust. The question of how plateaus are built is one with important ramifications for mantle dynamics because it bears on the state and depth of mantle convection as well as the issue of how oceanic LIPs form and their relationship to plate tectonics. This study would investigate both the origin of the plateau and the structure of it. The rise structure appears to be a huge volcano that formed at a triple junction and then was split apart by seafloor spreading. The field experiment has two foci: (1) constrain the whole crustal structure by an OBS reflection and

refraction experiment; and (2) delineate the tectonic history by extensive MCS profiling and reanalysis of bathymetry and magnetic data.

One of approximately twelve, the Shatsky Rise is a unique example of a LIP. It is the only LIP formed at a time of frequent magnetic reversal anomalies that show its relationship to coeval spreading ridges. Having formed at a ridge-ridge-ridge triple junction and intimately linked with large-scale plate boundary reorganization, the plateau offers an opportunity to evaluate competing theories of origin. The triple junction setting also provides the optimal tectonic window: minimal lithospheric contamination makes this the easiest place to probe the dynamics of mantle melting imprinted in the crustal section.

Deciphering the origins of the LIP is a critical element for understanding mantle dynamics and its relation to terrestrial magmatism. The sysnthesis of the geophysical data gathered through this project would encourage further discussions on the origins of oceanic plateaus and LIPs, stimulating further research on mantle dynamics and crustal genesis.

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 would be similar to those used during previous seismic surveys by L-DEO and will use conventional seismic methodology. The proposed survey would take place from approximately June 17 through July 31, 2010 in the Pacific Ocean, at least 1200 km offshore from Japan, in international waters deeper than 1000 m (See Attachment 1, Figure 1). Some minor deviation from these dates may be required, depending on logistics and weather.

The seismic survey would consist of ~3160km of transect lines (including turns). The survey 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 a 6 km hydrophone streamer and ~28 ocean 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 shot interval will be relatively short (20 seconds) for MCS surveying with the hydrophone streamer, and relatively long (70 seconds) when recording data on the OBSs. The tow depth of the array will be 12 meters for the OBS lines and 9 meters for MCS lines. The OBSs record the returning acoustic signals internally for later analysis. The OBSs to be used would be deployed and retrieved during the cruise. 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. Seismic operations would be carried out for ~17 days, with the balance of the cruise occupied in transit and in deployment and retrieval of OBSs (~8 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

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 for increasing our understanding of plate tectonics, earthquake occurrence and distribution, and environmental events such as oceanic anoxia and mass extinctions 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 community.

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 41-71 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 would 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 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 6-13; and 54) monitoring and mitigation measures would include: ramp ups, minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations, two observers 30 min before and during ramp ups during the day and at night (and when possible at other times), no start ups during poor visibility or at night unless at least one airgun has been operating, passive acoustic monitoring (PAM) via towed hydro-phones during both day and night to complement visual monitoring (when practicable), and power downs (or if necessary shut downs) when marine mammals or sea 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 12). 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.

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 and sea turtles are expected to be found throughout the proposed study area. Many cetaceans occur in the survey area throughout the year, but others (some baleen whales) may only migrate though the area during spring and fall; thus, altering the timing of the proposed project likely would result in few net benefits. Loggerhead, leatherback, and green turtles nest on the Ryukyu Islands, Japan, at the time of the survey, so nesting females would be nearshore or on land far from the survey area. However, migrating or foraging loggerhead, leatherback, or green 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 elucidate 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.