



LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

Annual Report for LDRD-04-FS-019 The Innermost Inner Core: Fact or Artifact?

H. Tkalcic, M. P. Flanagan

October 14, 2004

Disclaimer

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Annual Report for LDRD-04-FS-019
The Innermost Inner Core: Fact or Artifact?

PROJECT DESCRIPTION

There is considerable debate in the Earth sciences over the composition, thermal history, and dynamics of Earth's inner core. The details of structural models are based on precious few seismological observations of PKP travel times, due to the uneven distribution of large earthquakes and recording stations around the globe. Using state-of-the-art signal-processing techniques to measure and compile a unique set of global travel time data of surface-reflected seismic waves that propagate through the center of Earth (PKPPKP waves), we propose to investigate the existence of the innermost inner core. We will carry out a systematic investigation to determine the configuration of inner core anisotropy, which is currently biased by a limited spatial sampling of the inner core by PKP waves.

EXPECTED RESULTS

We expect to collect data set of waveforms and identify PKPPKP energy arrivals on existing seismological records in a systematic form. We expect to demonstrate whether or not the existence of the innermost inner core can be supported by seismological data and to provide major constraints on the amount of inner core anisotropy. This is a topic of very high interest in the earth science community and the results would be of great importance not only to seismologists but to other Earth scientists as well.

MISSION RELEVANCE

This project enhances and extends a critical Laboratory core competency in seismology for national security, specifically for the Ground Based Nuclear Explosions Monitoring Program. This high-profile science project will also support LLNL's mission in basic science by leading to further significant contributions in deep Earth structure, physical properties and models of core evolution. The PI Hrvoje Tkalčić is chairing a special session on the inner core anisotropy at the Fall 2004 AGU meeting, and we will present our results at that session.

ACCOMPLISHMENTS IN FY04

In FY04, we started systematically downloading a large number of broadband seismic waveforms, available via the Internet from world-wide data centers. These waveforms satisfy our criteria regarding the epicentral distance, event depth and magnitude. We finished extracting all waveforms from global broadband and several regional and temporary networks. We collected data from large earthquakes and explosions. We were focusing on: (1) preparing and analyzing waveforms that satisfy our source-receiver criteria, from 1990 to present day and (2) observing clear PKPPKP arrivals and their precursors in both time and frequency domains. We were also adjusting existing software, modifying it for PKPPKP analysis and building a useful GUI.

PROPOSED WORK IN FY05

In FY05, we plan to finalize the observational part of our project and analyze and interpret collected PKPPKP, and their precursors', absolute and differential travel times for both polar and equatorial paths. We also intend to analyze the observed PKPPKP waves in frequency domain. By analyzing travel times and frequency content of the observed PKPPKP waves, we anticipate to: (1) determine the extent and configuration of anisotropy in the inner core consistent with these new PKPPKP observations and (2) evaluate if the previously hypothesized innermost inner core is supported by these observations.

Hrvoje Tkalčić, Ph.D. 2-7332 tkalcic1@llnl.gov
Megan P. Flanagan, Ph.D. 2-3945 flanagan5@llnl.gov
Lawrence Livermore National Laboratory
Earth Sciences Division

This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-48.