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Annual Report for Period:04/2003 - 04/2004

Submitted on: 01/19/2004

Principal Investigator: Lizarralde, Daniel

Award ID: 0111983

Organization: GA Tech Res Corp - GIT

Title:

Margins: Collaborative Research: Seismic and Geologic Study of Gulf of California Rifting and Magmatism

Project Participants

Senior Personnel

Name: Lizarralde, Daniel

Worked for more than 160 Hours: Yes

Contribution to Project:

Wide-angle and MCS data processing.

Post-doc

Graduate Student

Name: Kahn, Dan

Worked for more than 160 Hours: Yes

Contribution to Project:

MCS data processing.

Name: Kim, Sangmyung

Worked for more than 160 Hours: Yes

Contribution to Project:

MCS data processing.

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Cicese

University of California, Los Angeles

Scripps Institute of Oceanography

University of Wyoming

Northern Arizona University

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:

2002 Activities:

A major activity in 2003 was the month-long seismic processing workshop held at Scripps. This workshop was very worthwhile and enabled us to do a number of things, including: 1) agree on and implement a common geometry strategy for the MCS data from the various transects, 2) establish transect geometries for the velocity models and complete the reduction of the wide-angle datasets, 3) train the students in (1) and (2), get an overview of each others datasets, 4) explore a variety of approaches for dealing with processing problems unique to this dataset, 5) interact extensively with P. Umhoefer, who was at Scripps for two weeks and made good progress identifying a potential regional unconformity from near the time of breakup in Alarcon, 6) review the complete dataset with all the PIs (less Holbrook) and students in the Scripps Visualization Center during an intense day-long session, and 6) meet with other scientists (Lonsdale, Vernon, Magistrale) planning and/or proposing MARGINS work in the Gulf of California.

Findings:

2003 Findings:

At the end of 2002 (at Fall AGU) the seismology PIs determined an equitable distribution of the MCS and wide-angle datasets. Georgia Tech is working on data from Guaymas Basin. During 2003, a good stack was produced of the MCS data while at Scripps. More work needs to be done on these data, but, in addition to continued fascination with the sill structures with the sediments, I believe we have discovered a layer of actively rising salt on the eastern margin of the transect. Further full-waveform analysis of the CDP gathers is required to convince myself that the dramatic structure there is indeed related to salt, but I am becoming more convince all the time. Salt here, and estimates of the quantity, will help constrain a number of aspects of the early timing and evolution of rifting.

Analyses of the wide-angle data have also progressed nicely. All of the OBS and RefTek instruments have been processed and picked with a preliminary interpretation, and a new ray-based velocity model has been determined. Results of this modeling were presented at the Fall 2003 AGU meeting along with 8 other presentations associated with this project. To summarize the Guaymas Basin results: The Guaymas Gasin is heavily sedimented, with 0.5 km of sediments at the rift axis thickening to as much as 2 km at the margins. These sediments have masked the rift structure of this basin, which had seemed to have begun a true drift phase later than the basins in the south. Analysis of the seismic data show, however, that rifting proceeded to completion rapidly, and most of the crust underlying the Guaymas Basin is new igneous crust. In contrast to the southern gulf, rifting and subsequent crustal construction in Guaymas has been *ômagmaticö*, with crustal thicknesses of 12 km near the margin and 8 km near the spreading center, suggesting an along-axis gradient in either mantle temperature or dynamic upwelling that has persisted since the onset of rifting. Ingeous crustal structure generally mimics oceanic crust, with a 2- to 4-km-thick 4-5 km/s upper layer (likely intercalated sediments and sills) overlying a plutonic layer. A striking feature of the crust here is the asymmetry about the rift axis in plutonic-layer velocities and gradients, with velocities to the west of 6.4-6.9 km/s and a 6.6-7.0 km/s velocity gradient to the east. This is mimicked in the upper crust, with an average velocity of 5.0 km/s in the west and 4.0 km/s in the east. The rift axis features a 2-km-high, down-to-the east, low-angle fault(?) bounding a depression in the plutonic crust beneath the rift axis, which itself is offset from the geometric center of the basin. A combination of a rift axis offset from the locus of mantle upwelling and asymmetric tectonics at the rift may lead to evolved melts being emplaced west of the spreading center and more residual melts to the east, possibly representing a previously unknown type of tectono-magmatic asymmetry.

Training and Development:

2003 Training

The seismic workshop held at Scripps provided an important opportunity for the students involved in this project to work closely and day-to-day with the PIs. I believe this was very beneficial for the students, some of whom hadn't yet found a 'voice' within this large and boisterous group of researchers, but now, hopefully, feel fully part of the project.

Outreach Activities:

Presentation of overall results of the experiment and initial results of the Guaymas data given by Lizarralde at Lamont in the spring. Nine presentations by the various participants in the project at Fall 2003 AGU.

Journal Publications**Books or Other One-time Publications****Web/Internet Site****Other Specific Products****Contributions****Contributions within Discipline:**

This successful experiment was the first across a young, active rift system, extending from conjugate margin to conjugate margin. We had tremendous success with OBS and RefTek deployments, and the consequent resolution of crustal-scale features will be unprecedented. Very preliminary results to date indicate that we will learn a very great deal about the symmetry of extensional process and the roles of low-angle faulting, magmatism and sedimentation on these processes.

Contributions to Other Disciplines:

An interesting and unexpected outcome of this project was the realization that impedance contrasts within the water column should not continue to be ignored. Steve Holbrook has valiantly followed up on this, and some BIG and very exciting results are soon to come out that I predict will have a MAJOR impact on the entire field of physical oceanography.

Contributions to Human Resource Development:

Training of many graduate students.

Contributions to Resources for Research and Education:

Continued fine tuning of the OBS fleet. This experiment represented the largest deployment and recovery operation of the Scripps instruments, and it was remarkably successful.

Contributions Beyond Science and Engineering:**Special Requirements**

Special reporting requirements: None

Change in Objectives or Scope: None

Unobligated funds: less than 20 percent of current funds

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Any Journal

Any Book

Any Web/Internet Site

Any Product

Contributions: To Any Beyond Science and Engineering