Understanding the Formation of Strata: Nesting Geophysical Data Sets for Interpretation of Key Stratigraphic Horizons in Shelf and Slope DepositsTitle

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LONG-TERM GOALS

The ongoing goal for the second year of this project is to provide a model for correlating seismic reflection data of varying resolutions from continental margin regions in the context of understanding the stratigraphic evolution of shelf and slope deposits. Specifically this is applied to on-going work in the Eel River Basin, California. Our goal is to provide correlations between seismic data of various resolutions in order to constrain coring sites on the continental shelf and upper slope. This correlation can provide a tool for interpreting the stratigraphic surfaces and sequences of shelf and slope deposits, and can help to address the goal of mapping the stratal geometries in an active forearc basin. Although the very high-resolution seismic data may not have large regional coverage, correlations with lower resolution datasets could extend the interpretation over larger regions. The very high-resolution data may also provide a link relating sedimentary core samples to lower resolution seismic data. This work will provide an important resource for selecting coring locations, in order to address key scientific questions to improve our understanding of how sedimentary and erosional processes relate to characteristic stratigraphic sequences.

OBJECTIVES

The ongoing objective for the second year of this effort is to provide correlation between seismic reflection datasets that vary in resolution. In particular this work involves integrating industry standard MCS data, high-resolution 48- channel MCS and very high-resolution 2-channel seismic (Huntec

DTS) data from the Eel River Basin off the coast of Northern California. The integrated seismic correlations can improve interpretations of key stratigraphic surfaces related to cycles of sea level changes. This will help to improve our understanding of the relationships between stratigraphic patterns and sea level cycles, as well as connections between erosional and depositional processes on the shelf and upper slope and their relationship to stratal geometry reflected in the seismic data. Identifying and correlating prominent shallow reflectors will provide valuable information for selecting core locations and for interpreting and understanding the stratigraphy of the shelf and slope deposits.

APPROACH

Our ongoing approach for the second year of this project is to load the navigation and seismic data for all additional lines onto a Sun workstation using LandMark Graphics software applications. We then interpret shallow (less than 100 m) horizons on the HUNTEC, high-resolution MCS seismic lines, and where possible the lower resolution industry MCS lines. We look for prominent horizons that are evident in all datasets, and further refine our horizon interpretations, making adjustments for offsets in the seafloor reflector. The LandMark visualization tools permit us to display the three seismic data sets along with mapped stratigraphic surfaces and proposed core locations, with the same vertical exaggeration. Because the data are stored in a digital geographic information system database, we use our ability to dynamically change vertical and horizontal scaling factors to facilitate interpretation of key horizons. Our intent is to focus on regions immediately surrounding proposed core locations. We then prepare digital notebooks (html documents) of the site locations and the corresponding seismic data. This year the revised digital images showing panels of correlated seismic data through each of the proposed core locations along with the interpretations of select stratigraphic horizons will be made available to the STRATAFORM group. These images as well as the LandMark seismic project may be used as a tool for refining proposed core locations.

WORK COMPLETED

Last year we loaded the navigation for the HUNTEC lines from the 1995 and 1996 surveys into a LandMark Graphics seismic data project to facilitate integration with the MCS data from the high-resolution survey conducted in 1996. We used the ProMAX seismic processing software to time shift the digital HUNTEC seismic data to produce a continuous seafloor reflector. Janet Yun previously loaded lower resolution, high quality industry MCS data, and the newer seismic data sets have been integrated with the industry data. Gretchen Zwart has been responsible for the ongoing integration of the seismic data as well as resampling and time shifting the data as necessary. She was also primarily responsible for the preparation of this report. This year, approximately 50 key lines processed at LDEO were loaded into the project. Interpretation of horizons on these lines led to revised interpretation on the previously loaded lines. Additional HUNTEC data was loaded in key areas to provide continuity for the horizon interpretations. In addition, the spatial continuity provided by the new seismic data permitted the use of shallow structural features (many faults and several anticlines) to further refine the interpretation of key horizons. In all over 200 lines have been loaded it the seismic project and interpreted. The digital notebooks for17 proposed core locations, have been updated to include the new data and the revised stratigraphic interpretations.

RESULTS

The improved spatial coverage provided by the newly processed data from LDEO continue to provide the capability of correlating seismic reflectors on HUNTEC and high resolution MCS lines. The prominent reflector interpreted to be a sealevel lowstand erosional surface (Spinelli and Field, in press) is visible in all seismic datasets in the northwest portion of the seismic survey areas. A shallow unconformity in the southwest part of the survey area is also visible. Additional interpretation of seismic reflectors provide a more cohesive seismostratigraphic database from which to guide core location selection.

IMPACT/APPLICATIONS

This project provides a model of a workflow and prime experience on high-level, industry standard seismic imaging integration. The approach may be useful for similar projects were multiple resolution data sets are being acquired. Industry tools for such integration are well developed. Therefore, it behooves the academic and military community to bring their data sets into conformity with industry standards so that such integration can be quickly achieved.

TRANSITIONS

The demonstrated value of integrating seismic reflection data with a variety of recording frequencies into a cohesive digital seismic interpretation project using LandMark Graphics software has led to similar efforts by the USGS for a project in the Monterey Bay.

RELATED PROJECTS

Work on the project reported on herein has synergized with efforts under: N00014-98-0503: Seafloor Geomorphology: Gas, Fluid Flow and Slope Failure on the Southern Cascadia Continental Margin (Dan Orange PI). Specifically the integration undertaken here resulted in loading of some seismic data useful in a Ph.D. dissertation recently completed by Janet Yun.

REFERENCES

Spinnelli, G.A. and Field, M.E., in press. Geomorphic Evolution of a Network of Continental Slope Gullies of the Northern California Margin

Yun, J.W., 2000. Fluid Flow and Deformation at an Active Continental Margin- The Eel River Basin, CA, Ph.D. Dissertation, University of California, Santa Cruz, CA.