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

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LONG-TERM GOALS

The goal 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 best address key scientific questions to improve our understanding of how sedimentatary and erosional processes relate to characteristic stratigraphic sequences.

OBJECTIVES

The objective 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-

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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 basic approach is to load the navigation and seismic data for all available 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 exageration. 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. An immediately developing product will be a CD ROM showing panels of correlated data through each of the proposed core locations along with the interpretations of select stratigraphic horizons. This product will be distributed to the entire STRATAFORM group and may be used as a tool for refined proposed coring locations.

WORK COMPLETED

We have 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. In addition we have used ProMAX to time shift the digital HUNTEC seismic data to produce a continuous seafloor reflector. Janet Yun has 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 continuing integration of the seismic data including rationalizing the navigation and time shifts. She was also primarily responsible for the preparation of this report. All of the available high-resolution MCS data have been loaded into the LandMark seismic project, but many of the key lines are not yet available (awaiting processing at LDEO). Identification of areas of subsurface gas and structural complexity (Janet Yun, 2000) in the LandMark working environment permit us to focus our interpretations in other areas. Interpretations of seismic reflections in these areas have started. Preliminary digital notebooks have been prepared for 17 proposed core locations.

RESULTS

Interpretation of seismic reflectors on HUNTEC and high resolution MCS lines show that prominent shallow reflectors can be correlated. A prominent reflector interpreted to be a sealevel lowstand erosional surface (Spinelli and Field, in press) is visible on both 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 on both seismic datasets. Additional seismic reflectors are evident in at least two of the datasets, but are as yet unidentified.

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 integrations can be quickly achieved.

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.