SEISMIC VELOCITY, STRATIGRAPHY AND ACOUSTIC STUDY OF THE SOUTH CHINA SEA

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LONG-TERM GOALS

To document the crustal structure of the South China Sea margin from the coast to the deep basin with a view to better understanding the processes of continental break-up, particularly the transition from rifting to spreading. To understand the nature of sediment transport on continental shelves and to construct a sediment budget for this basin in order to compare with models of Himalayan uplift and erosion and their links to climate change.

SCIENTIFIC OBJECTIVES

We aim to construct seismic velocity depth profiles across the South China margin from close to the coast to the deep basin in order to characterize the topography of the pre-rift basement and the geometry of the sediment layers that have accumulated on the shelf since the late Oligocene.

APPROACH

We are constructing velocity-depth distribution database of the South China shelf using stacking velocities derived from multichannel seismic lines collected by BP and the Chinese National Oil Company (CNOOC). These data will be cross-referenced with existing sonobuoy data and geophysical well logs to construct a velocity-depth map. We are establishing a database of velocities that will allow variability in velocity with depth across the shelf to be mapped out. Crossing checking of major velocity jumps with the reflection images will allow us to identify whether these discontinuities are related to normal faulting, volcanic constructs, hydrocarbon accumulation, or other features.

WORK COMPLETED

Work to date has established an electronic database system into which data from five seismic lines, located close to the Pearl River Mouth and running offshore into deep water, have already been entered. A system for digitizing the location of data points has been put in place, allowing new data to be rapidly filed and amalgamated with existing surveys. Data has been shared with scientists at Lamont-Doherty Earth Observatory in order to compare with existing LDEO sonobuoy data (Hayes et al., 1995; Nissen et al., 1995), making the two sets consistent. Arrangements have been made with BP International Exploration for further data retrieval. Biostratigraphic, lithologic and thickness data from 13 sites on the South China shelf were examined and the rates of tectonic subsidence of the pre-rift basement and accumulation rates have been calculated, taking into account the process of sediment compaction and dewatering.

RESULTS

Velocity-depth profiles have been made along a number of profiles both across and along the strike of South China Sea margin with an across-margin example shown in Figure 1. It is apparent that the resolution of the data allow good definition of sediment packages in the upper 2–3 km, with a general thickening of the upper units offshore (Fig. 1). Resolution below 3 km is less good and only large-scale patterns are discernible. The

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sediment acoustic reflectors in the upper part of the section are generally flat lying but are locally broken by two large scale discontinuities. Reflection seismic images show that the feature closest to the coast is a tilted fault block, while that on the continental slope is similar to volcanic edifices noted elsewhere, an unexpected feature in this area, previously considered non-volcanic. Subsidence analysis of the well data shows three stages of active extension followed by more gentle subsidence due to thermal cooling of the lithosphere and sediment loading (Fig. 2). Sediment supply has typically been sufficiently voluminous that rift episodes are matched by peaks in sediment accumulation.

IMPACT/APPLICATION

Initial results suggest that the simple layer-cake structure of the South China Shelf is disrupted by faulting on the shelf and by volcanic features on the continental slope. These features clearly affect the regional acoustic environment. The initial results guide us to investigate further evidence for intrusive bodies of volcanic characters close to the continent-ocean transition and to determine the lateral extent of large, coast-parallel faults in the South China Shelf.

RELATED PROJECTS

Below we list work related to this South China seismic project.

1 - Stratigraphic evolution of the Northwest European Shelf during the Cenozoic (Clift, funded by Enterprise, Mobil and Statoil).

2 - Erosional history of the western Himalayas, Ocean Drilling Program proposal submitted by Clift et al. to drill Indus Cone, Arabian Sea.

3 - Numerical modeling of the thermo-magmatic evolution of the US Atlantic margin (Lin, funded by WHOI).

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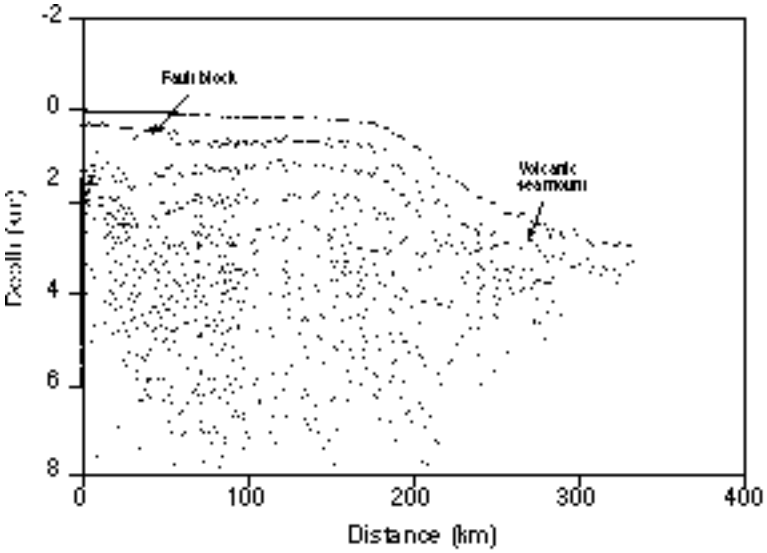

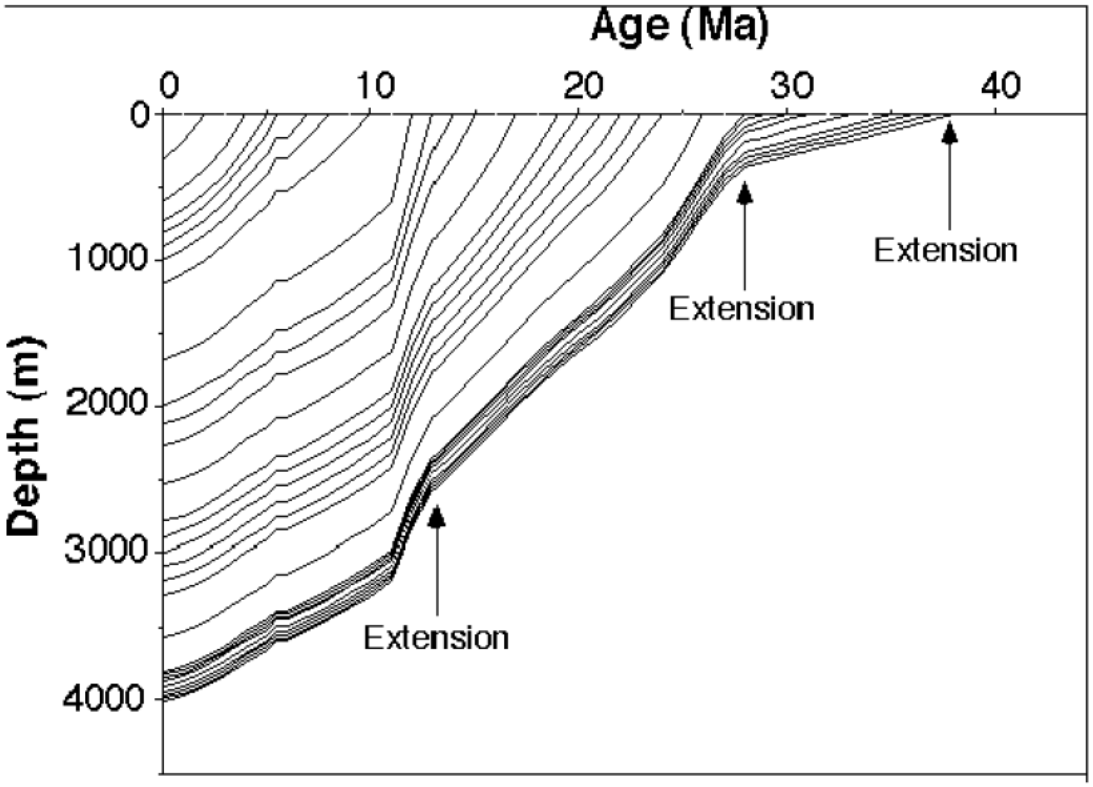
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30
40
Depth (m)
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2000
3000
4000
Extension
Extension
Extension