Stratigraphy of Cenozoic sequences in offshore Taiwan

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Introduction

Map showing the island of Taiwan near the junction of the Ryukyu and Luzon Arcs
Introduction

- The rock sequences underlying the Taiwan Strait and southern East China Sea shelf primarily consist of Cenozoic clastic sequences with a thickness more than 8,000 m (Sun, 1982, 1985, 1987).
- The basement, overlain unconformably by the thick Tertiary and Quaternary sediments, is thought to be a magmatic-volcanic complex, metamorphic rocks, and Cretaceous clastics.
- The age of the basement rocks, as indexed by nanno-fossils and as dated by radiometric isotopes, ranges from Permian in Taiwan coastal areas to late Cretaceous in Chiayi, southern Taiwan (Biq et al., 1985; Chou, 1991; Sun, 1982, 1985).
Introduction

The distribution and characteristics of the basement rocks underneath the southern East China Sea and Taiwan Strait

Introduction

- The establishment of stratigraphic subdivisions of the Cenozoic sediments is principally based on data from exploration wells and seismic stratigraphic studies.

- In general, a regional unconformity separates the Cenozoic sequences into a Paleogene sequence and a Neogene sequence (Sun, 1982).

- Strata of Paleogene sequence are mainly restricted to wedge-shaped half grabens and grabens. These infilled Paleogene grabens in turn were completely covered by the late Tertiary and younger sediments.
Introduction

Map showing the Tertiary rift basins where thick Early Tertiary sediments accumulated off western and northern Taiwan

(Sun, 1982)
Seismic Stratigraphy

- The method of seismic Stratigraphy can help, especially in the areas where nanno-fossils are lack for age-dating, in correlation among the drill wells when they were tied by seismic lines.

- The Cenozoic strata of the Taihsi Basin in eastern Taiwan Strait have been previously demonstrated by Liu and Pan (1984) to be separated into four major seismic sequences.

- The seismic sequences boundaries coincide with unconformities, e.g. Cretaceous/Paleocene, Eocene/late Oligocene, middle Miocene/late Miocene and early Pleistocene/Holocene in an ascending order.
Seismic Stratigraphy

Seismic profiles in western Taiwan Strait

The strata dip and thicken eastward

(Nei and Peng, 1989)
Seismic Stratigraphy

Seismic profile in eastern Taiwan Strait (north Taihsi Basin)

(Liu and Pan, 1984)
Seismic Stratigraphy

Seismic profile in eastern Taiwan Strait (south Taihsi Basin)
# Seismic Stratigraphy

<table>
<thead>
<tr>
<th>SEISMIC SEQUENCE</th>
<th>AGE (Ma)</th>
<th>EPOCH</th>
<th>SEISMIC VELOCITY (M/S)</th>
<th>SEQUENCE BOUNDARY REFLECTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>65</td>
<td>Pre-Tertiary</td>
<td>3900-4200</td>
<td>TO</td>
</tr>
<tr>
<td>B</td>
<td>32</td>
<td>Eocene</td>
<td>3100-3500</td>
<td>T2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paleocene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>M. Miocene</td>
<td>2200-2400</td>
<td>T7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L. Oligocene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>E. Pleistocene</td>
<td>1800-2000</td>
<td>T0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L. Miocene</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diagram: A - B - C - D

Intrusion: IGNEOUS INTRUSION
Stratigraphic Correlation

The lateral and vertical variations of the Cenozoic sequences in the eastern Taiwan Strait and areas off the northern Taiwan can be revealed by correlations between more than 20 wells; and most of the offshore wells have penetrated through the thick sequences and some have reached to the basement (Chou, 1991).
Stratigraphic Correlation

- Kuanyin Uplift: ~1200m
- Peikang High: ~5000m
- Tainan Basin
- Taihsi Basin
Stratigraphic Correlation

~4000m

~1000m

Kuanyin Uplift

South Pengchihsu Basin
Stratigraphic Correlation

Penghu Basin

Penghu Uplift

Taihsi Basin
Rift Stratigraphy and Structures

- Many NE-SW extensional normal faults have developed in the offshore areas of Taiwan (Sun, 1982, 1985) and have caused basin subsidence which allows for the accumulation of thick Cenozoic sediments.

- The occurrence of basalts associated with Miocene marine beds in the western Taiwan was attributed to the rift tectonism of the Eurasian continental margin (Juan et al., 1979; Chung et al., 1985).

- The conclusion that Taiwan Strait is a relict continental rift is based on the marine geophysical work in the western Taiwan Strait conducted from 1986 to 1987 by Nei and Peng (1989).

- A continental margin rifting model may therefore account for the deposition of the Cenozoic sequences; the Cenozoic sequences can also be represented by the rift stratigraphy.
Rift Stratigraphy and Structures

Normal faults dipping in low angles
Rift Stratigraphy and Structures

Normal faults dipping in high angles

Pinchout
Rift Stratigraphy and Structures

Normal faults dipping in high angles

Erosion
Rift Stratigraphy and Structures

Normal faults dipping in high angles
Rift Stratigraphy and Structures

Nanjih Tao Basin

Pre-Rifting

Post-Rifting

Penghu Basin

Pre-Rifting

Post-Rifting

Paleogene sediments

Neogene sediments

Unconformity

Unconformity
The Nanjihtao, Penghu and Taihsi Basins are mainly characterized by normal faults and their associated structures. The early Tertiary sediments of these basins are primarily confines to the half grabens and form a thick asymmetrical wedge.

The normal faults mostly occur within the sequences below the unconformity between the Paleogene and Neogene and cut down to the deep.

The late Cenozoic strata form as a thick eastern clastic wedge and become as parts of the eastern Asian continental margin.
Conclusions

Diagram showing the distribution in time and space of the sediments under the Taiwan Strait and the rock groups of the island of Taiwan.
Conclusions

- The stratigraphic record in offshore Taiwan indicates that a complete three stage cycle of pre-rift, syn-rift and post-rift has persisted through the deposition of Cenozoic sediments.
- The complete Cenozoic clastic sequence is interrupted by basaltic flows and unconformities.
- These igneous activities can be related to the episodic rifting of the continental crust. The unconformities primarily resulted from relative movements between the Eurasian Plate and the Philippine Sea Plate around the region of Taiwan.
Thanks for your attention!