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Kaoping Shelf: morphology and tectonic significance

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Abstract—Thirty bathymetric profiles across the southwestern Taiwan margin reveal two distinct physiographic features: a shelf and a slope separated at Fangliao. The Kaoping Shelf northwest of Fangliao is the offshore extension of the Pingtung Valley, and the unnamed slope west of the Hengchun Peninsula is a part of the submerged southern Central Range. The Kaoping Shelf is a short, narrow and shallow shelf (100 km long, 20 km wide and 80 m deep). This shelf can be divided into two subshelves. The one to the north is terraced with an average width of 28 km and the other to the south is a very narrow (9 km) and shallow (40 m) platform. The average gradient (5 m/km) of the shelf is greater than that (2.5 m/km) of the average shelf worldwide. The width of the shelf, ranging from 7 to 40 km, increases progressively from southeast to northwest and is a factor of 2–4 narrower than that of others in the world. The gradient and width reflect the youthful stage of development of the Kaoping Shelf. The seaward progradation of the sediments from the coastal plain of the Pingtung Valley resulted in the prograding Kaoping Shelf, as suggested by cored sediment samples and seismic profiles. The morphology of the Kaoping Shelf depends mainly on the tectonic setting of the uplifted Taiwan orogen and the accompanying foreland-basin sedimentation. This young (less than 400,000 years) shelf is still growing and prograding southward in a parallel direction with the southward propagating arc continent collision in the Taiwan region. © 1997 Elsevier Science Ltd

Introduction

Geological setting

The island of Taiwan is located at the junction between the Ryukyu Arc and the Luzon Arc along the rim of the Western Pacific (Fig. 1). The oblique collision between the Luzon Arc and the Chinese continental margin during the period from the Late Miocene to the present has resulted in the formation of Taiwan Island (Suppe, 1981; Ho, 1986; Teng, 1990). The collision is still actively propagating to the south (Suppe, 1987). Moreover, the arc–continent collision in the Taiwan orogen resulted in a foreland basin and a mountain belt in the west and east, respectively (Covey, 1984) (Fig. 1).

The western Taiwan foreland basin covers the hilly Western Foothill, the Coastal Plain and its offshore areas. This basin is mainly filled with Pliocene–Pleistocene sediments up to more than 5 km thick (Covey, 1984). The geological framework of the study area in southwestern Taiwan, including the Pingtung Valley, was established during Late Pliocene and Pleistocene. The Pingtung Valley lies between the Central Range to the east and a low hilly upland to the west. The N–S trending Chaochou Fault separates the Pingtung Valley from the Central Range. Tectonically, the Pingtung Valley is considered to be a foredeep related to the Manila Trench subduction zone (Biq, 1977). This valley is actively subsiding today (Ho, 1982). Regionally, the southwestern Taiwan margin is a growing foreland basin receiving sediments from the Taiwan orogen (Yu, 1993). The mountain ranges of Taiwan, including the prominent Central Range, are fold-thrust belts of Tertiary strata. They extend from north to south throughout the island. The Central Range south of Fangliao is called Hengchun Peninsula (Fig. 1)

Previous studies

In their pioneering investigations of sediment properties of the shelf and slope around Taiwan Island, Boggs *et al.* (1979) pointed out that the shelf edge around the island can be placed at the 200 m isobath, which reveals a distinct asymmetry of the sea-floor topography around Taiwan (Fig. 2). It should be noted that the island of Taiwan is bordered by the shallow Taiwan Strait Shelf to the west and a deep-water (3–5 km) region of the Philippine Sea to the east. The width of Taiwan Strait Shelf ranges from 140 to 200 km and a major portion of the shelf is covered by water shallower than 60 m. Off the eastern coast, the shelf is very narrow and the sea floor descends to the 3000 m isobath no more than 1 km beyond the coastline.

Across the southwestern Taiwan margin, the sea floor passes a narrow shelf and descends to a depth of about 3000 m at the northern end of the abyssal plain of the South China Sea. Morphologically, the southwestern Taiwan margin is characterized by a very narrow shelf and a broad southwest-facing slope. Yu and Wen (1992) named the shelf along the southwestern Taiwan margin the Kaoping Shelf, characterized by narrow width and shallow depth. The Kaoping Shelf extends for about 150 km from the southern tip of the island of Taiwan to the Tsengwen Hsi River mouth, where it merges gradually into the broad Taiwan Strait Shelf (Fig. 2). This shelf was considered to be the natural prolongation of the Coastal Plain and the southern Central Range of Taiwan. Furthermore, Yu and Wen (1992) noted that a distinct character of this shelf is the marked change in its structural trend. The shelf extends from the southern tip of the island northward parallel to the mountainous coast, and then it turns sharply at Fangliao and the nearby Chaochou Fault northwestward running along the shoreline of the Coastal Plain. The structural trend of the shelf changes from a N–S direction in the south to a NW–SE trend to the northwest at the Chaochou Fault (Fig. 2).

The shelfbreak, a distinct physiographic feature between the shelf and slope, along the southwestern Taiwan margin has received little attention. Up to 1995, only a single paper of Yu and Wen (1992) pointed out the significance of the shelfbreak along the southwestern Taiwan margin. They realized that the shelf edge off southwestern Taiwan is much shallower than the presumed 200 m isobath (Boggs *et al.*, 1979). The true depth of the Kaoping Shelf edge was not completely mapped because of inadequate bathymetric data. Emphasizing the tectonic style of the southwestern Taiwan margin, Yu (1993) suggested that this margin belongs to the destructional stage (convergent, type F in terms of the Emery (1980) classification).

Objectives

The objectives of this paper are (1) to describe the overall morphology of the Kaoping Shelf; (2) to define the areal extent of this shelf; (3) to determine the true depth of the shelf edge; and (4) to examine the primary factors controlling the development of this shelf.

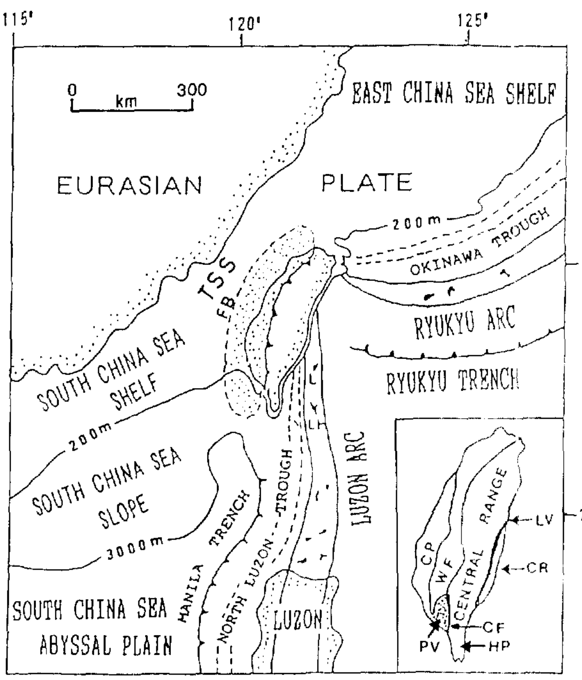

Fig. 1. Geological setting of Taiwan, which is located at the junction of the Ryukyu Arc and the Luzon Arc along the western rim of the Pacific. Note that the foreland basin to the west and the mountain range to the east occupy Taiwan Island modified from Covey (1984) and Yu and Chiao (1994). TSS, Taiwan Strait Shelf; FB, Foreland Basin; CP, Coastal Plain; WF, Western Foothill; LV, Longitudinal Valley; CR, Coastal Range; PV, Pingtung Valley; CF, Chaochou Fault; HP, Hengchun Peninsula.

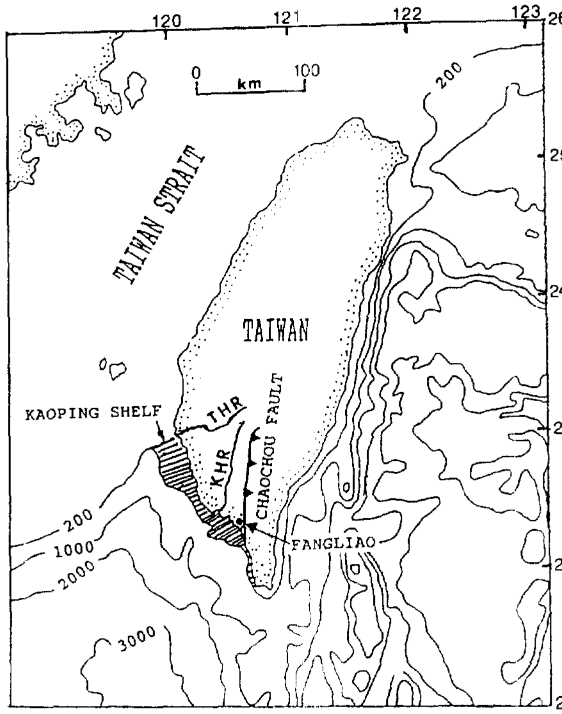

Fig. 2. Location and areal extent of the Kaoping Shelf (after Yu and Wen, 1992). This shelf extends from the southern tip of the island northward parallel to the mountainous coast, and it then turns at Fangliao and the nearby Chaochou Fault northwestward running along the shoreline of the Coastal Plain and ends at the mouth of the Tsengwen Hsi River. Water depth in meters. THR, Tsengwen Hsi River; KHR, Kaoping Hsi River.

Data and method

Bathymetric transects and four-channel seismic reflection profiles were acquired on board R/V *Ocean Researcher I* from 1993 to 1995. In addition, three box cores on the shelf were also collected to determine the sediment type using a standard sieving technique. The locations of bathymetric profiles and cored samples are shown in Fig. 3.

Thirty bathymetric transects with an average spacing of about 5 km along the roughly 150-km southwestern Taiwan margin were examined to determine the outline and dimensions of the shelf. The ship tracklines were aligned as closely as possible perpendicularly to the isobaths in order to reveal the maximum slope angle of the shelf.

The position and depth of the shelfbreak of the Kaoping Shelf were determined mechanically following the guidelines of Vanney and Stanley (1983) as shown in Fig. 4. These authors realize that the echo-sounding and 3.5-kHz sub-bottom profiling surveys generally generate an artificial sea-floor shape resulting from high vertical exaggeration ranging from ×10 to ×40. Bathymetric profiles of this study were displayed with ×10 vertical exaggeration for mechanical identification of the major break of the gradient along the bathymetric profiles.

Thirty bathymetric profiles can be classified into four profile forms. Examples of each type taken from real profiles are shown in Fig. 4.

Shelf and slope

Analyses of thirty bathymetric transects across the shallow water areas off southwestern Taiwan coast reveal two major types of sea-floor morphology: a shelf and a slope. Northwest of Fangliao and the nearby Chaochou Fault, profiles 1–4 display a terraced shelf (Fig. 5), and profiles 5–13 exhibit a simple shelf (Fig. 6). However, the terraced shelf grades into the simple shelf without a well-defined zone of contact. The shelf is located west of the coastal plain of the Pingtung Valley. In contrast to this, south of Fangliao, profiles 14–30 exhibit a steep slope (Fig. 7). This slope region is a part of the western-sloping flank of the submerged southern Central Range.

Based on morphology and structural trend, the shallow water areas of the southwestern Taiwan margin can be represented by two physiographic features: the NW–SE trending shelf off the coast plain of the Pingtung Valley, and the N–S trending slope west of the Hengchun Peninsula (Fig. 8). The boundary separating these two undersea features can be placed at the coastal town of Fangliao, where the Kaoping Shelf changes its platform morphology to a straight steep slope. The Fangliao Canyon head passes landward across the shelf and comes in at the Chaochou Fault, defining a boundary between the Kaoping Shelf and the adjacent slope. It is noted that the boundary between the shelf and slope does not seem to be transitional. The shelf morphology on profile 13 changes into slope morphology on profile 14 and is subtle and gradual. Clearly, the size of the newly defined Kaoping Shelf is much smaller than that of the Kaoping Shelf previously defined by Yu and Wen (1992). The authors maintain the term Kaoping Shelf for this newly defined smaller shelf, whose geologic significance will be discussed later.

Kaoping Island Shelf

Since the term of continental shelf has been commonly used to describe the shelves around Taiwan Island, the authors choose the term 'island shelf' in a restricted sense to emphasize its physiography and tectonic setting. 'Shelf' (continental shelf, island shelf, insular shelf) is defined by Bouma (1990, p. 121) as "a zone adjacent to

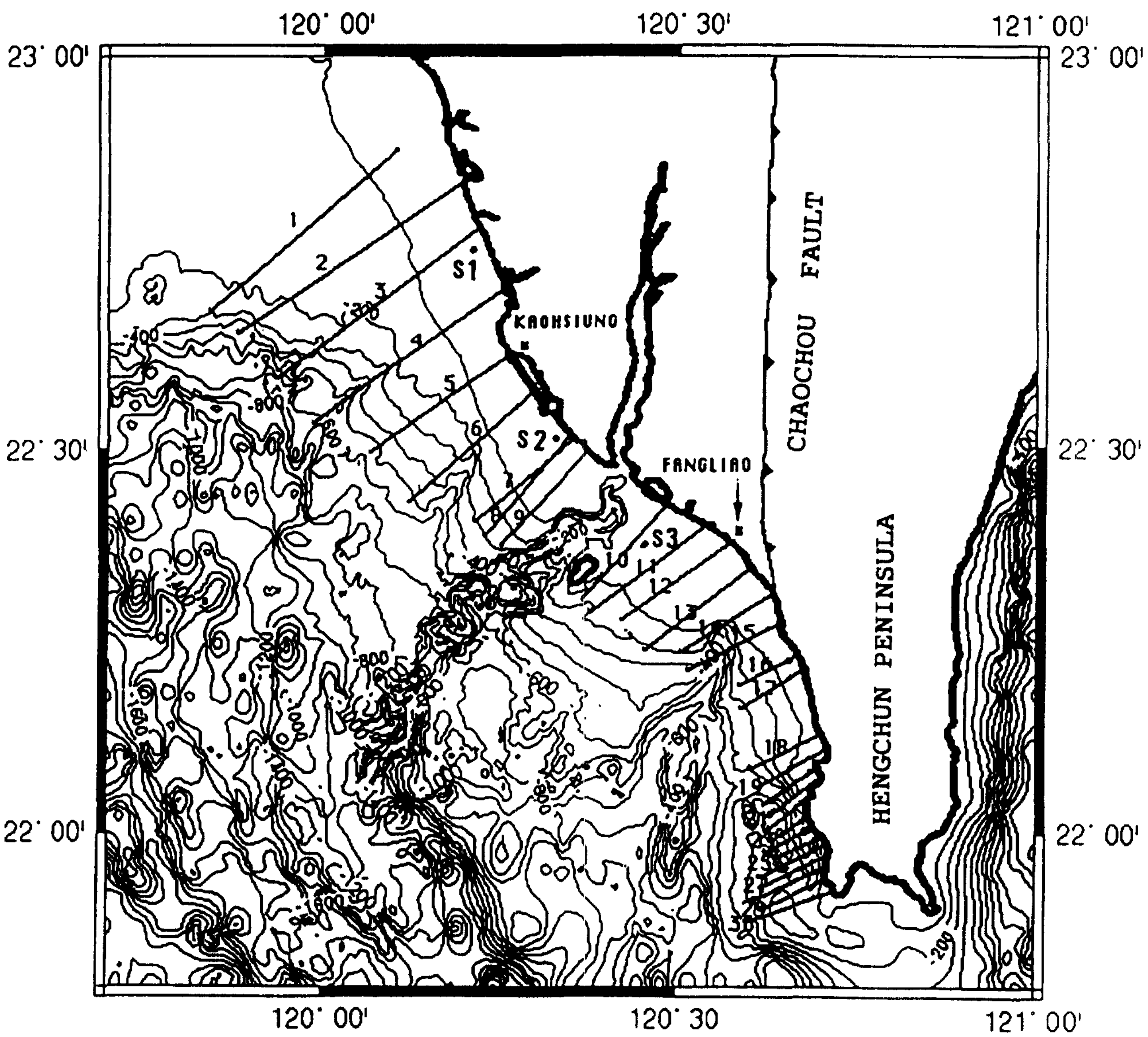

Fig. 3. The locations of bathymetric profiles and box-cored sediments (S1, S2 and S3). Water depth in meters

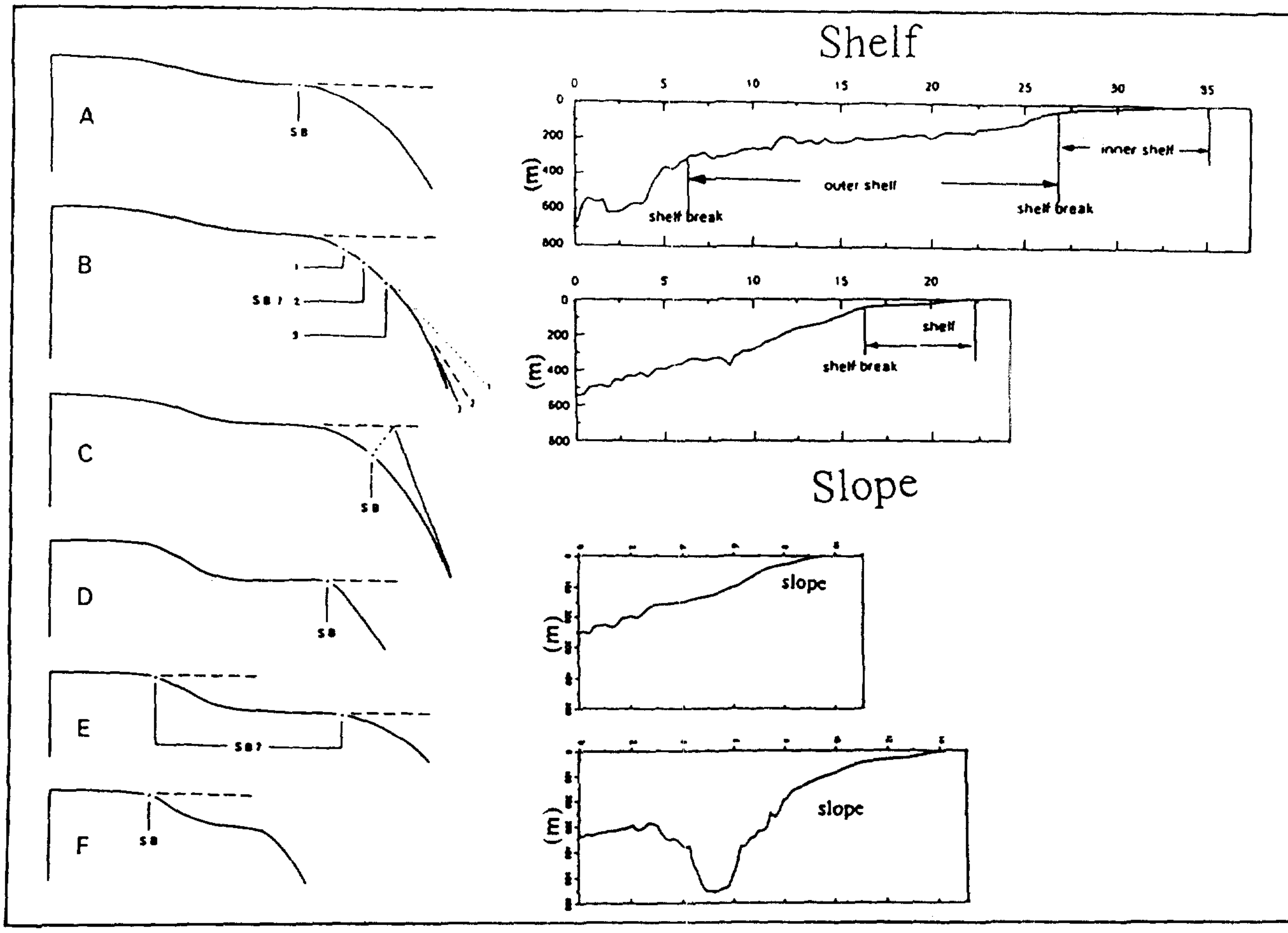

Fig. 4. Method used mechanically to define shelfbreak (SB). Profiles D F show terraced shelves (after Vanney and Stanley, 1983) as shown in the left column. Thirty profiles across the Kaoping Shelf can be distinguished into four types of profile forms: a terraced shelf, a simple shelf, a straight steep slope, and a straight slope cut by a canyon, as shown in a descending order in the right column.

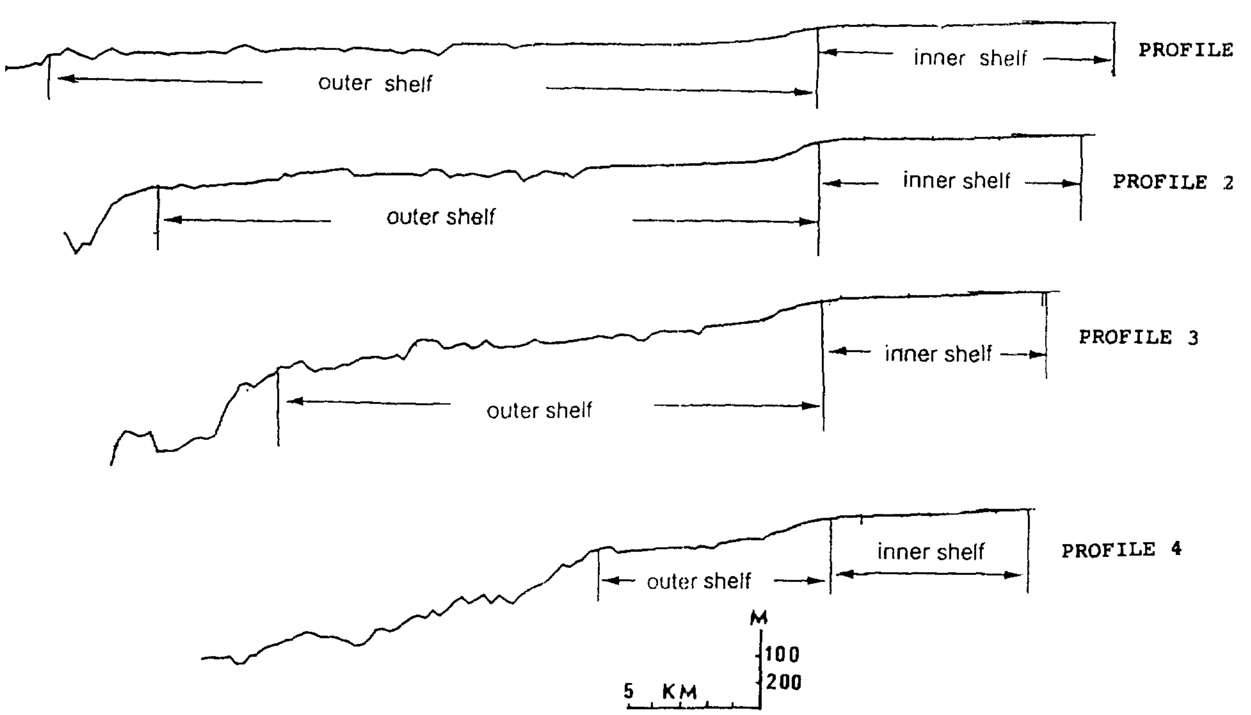

Fig. 5. Bathymetric profiles 1 4 displayed with vertical exaggeration ×10 show the morphology of terraced shelves. The locations of profiles are shown in Fig. 3.

a continent (or around an island) and extending from the low water line to a depth at which there is usually a marked increase of slope towards oceanic depths". Therefore, the uppermost parts of the sea floor extending seaward from the coastline along the southwestern Taiwan Island to a depth where a marked break of slope occurs is called 'island shelf' here.

Morphologically, the Kaoping Shelf can further be divided into two subshelves at Kaohsiung. North of Kaohsiung, the shelf is terraced (profiles 1–4), whereas the shelf south of Kaohsiung exhibits a relatively smooth platform (profiles 5–13). The terraced shelf (profile 4) grades into the simple shelf (profile 5) with a decrease in shelf width. It appears that the shelf width of 16 km (profile 4) decreases to a shelf width of 6 km (profile 5). The terraced shelf consists of an inner shelf (9 km wide, 40 m deep) and an outer shelf (20 km wide, 215 m deep). It ranges in width from 17 to 40 km, with an average width of 28 km. The average depth of shelfbreak is 215 m (range 180–250 m). In contrast, the relatively smooth shelf south of Kaohsiung is 9 km wide, ranging from 6.6 to 12 km. The average gradient (5 m/km) of the Kaoping Shelf is greater than that (2.5 m/km) of the average shelf worldwide (Boillot, 1981; Kennett, 1982). Although locally variable, the width of the shelf increases progressively from southeast to northwest. The width of the Kaoping Shelf is a factor of 2–4 narrower than that of others in the world. The average width of the shelves of the world is around 80 km (Boillot, 1981; Kennett, 1982). The East China Sea Shelf north of Taiwan is about 400 km wide—in other words, one of the widest in the world (Jin, 1992). Vanney and Stanley (1983) pointed out that the shelfbreak parallels and is usually close to the insular coast in areas of unstable convergent margins, such as some island arcs in the tropical Pacific. Therefore, the narrow Kaoping Shelf off the island of Taiwan can be considered a typical island shelf.

The general form of the shelfbreak along the Kaoping Shelf is convex-up (Fig. 4). In plan view, the shelf edge does not extend as a straight line (Fig. 8). It should be noted that there is a prominent break in the continuity of the shelf edge where the Kaoping Canyon cuts the shelf deeply and landwards. The shelf edge is gently sinuous.

In summary, the Kaoping Shelf is a very short, narrow and shallow shelf (100 km long, 20 km wide and 80 m deep), with an average gradient of 5 m/km. The characteristic morphology of the Kaoping Shelf represents an island shelf situated at an unstable convergent margin.

Modern prograding shelf

Analyses of three cored sediments reveal that sand is the dominant surface sediment on the shelf north of the Kaoping Canyon, whereas silt is the dominant one south of the canyon. Samples of S1, S2 and S3 contain 77.7% sand, 19.3% silt and 3.1% clay; 60.3% sand, 37.3% silt and 2.4% clay; and 6.8% sand, 90% silt and 3.2% clay, respectively. Boggs *et al.* (1979) found the presence of a

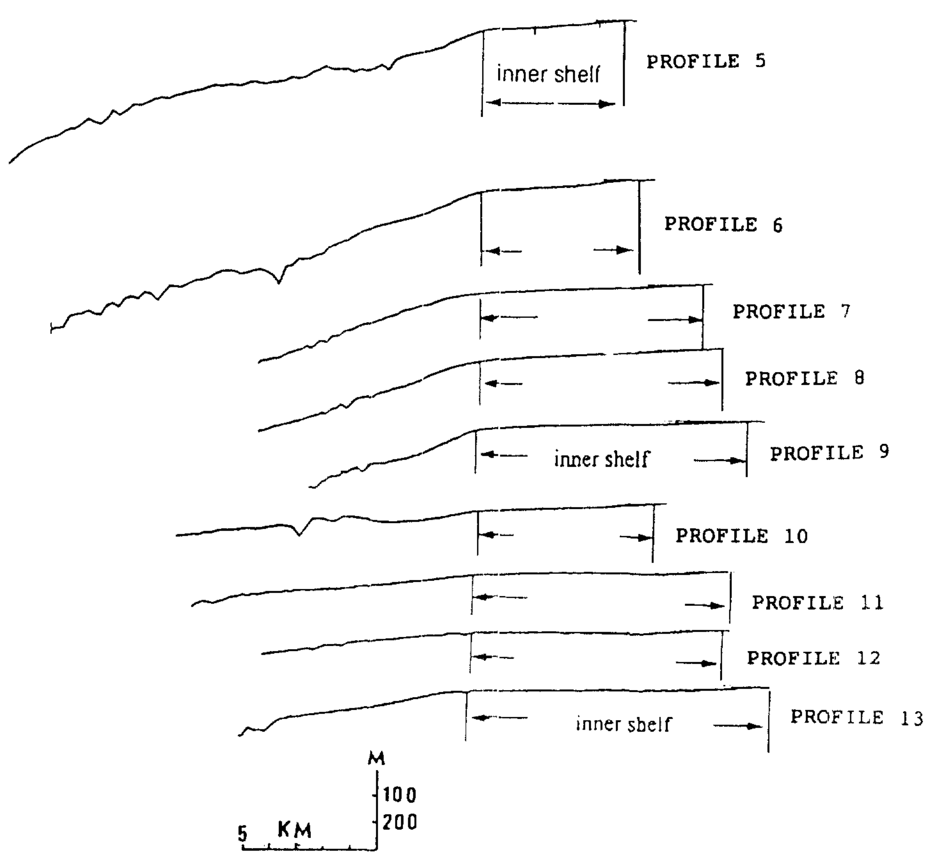

Fig. 6. Bathymetric profiles 5–13 displayed with vertical exaggeration × 10 exhibit the morphology of a simple shelf characterized by its relatively shallow and narrow form. The location profiles are shown in Fig. 3.

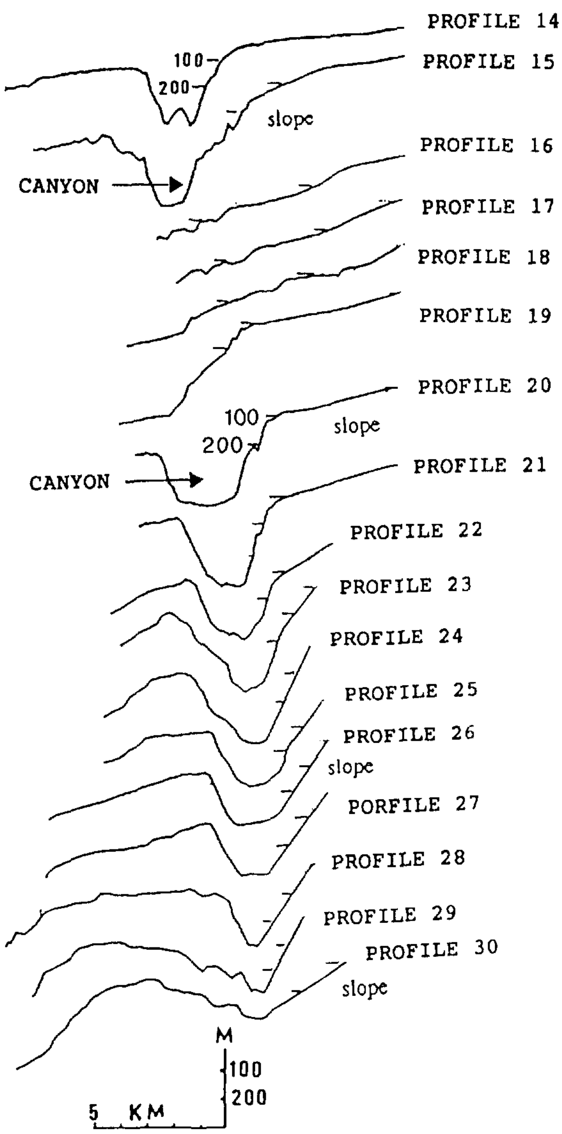

Fig. 7. Bathymetric profiles 14–30 displayed with vertical exaggeration × 10 show the submarine slopes off the coast of Hengchun Peninsula without the presence of shelf. The locations of profiles are shown in Fig. 3.

continuous nearshore belt of sandy sediments that extends seaward for less than 30 km along the southwestern Taiwan coast (Fig. 9). It is suggested that these fine-grained sands on the Kaoping Shelf are mainly supplied by the drainage basin of the major Kaoping Hsi River. Li (1976) estimated that the present-day average physical denudation rate of the drainage basins of western Taiwan rivers is 1300 mg/cm per year, which is probably the highest known physical denudation rate in the world. This implies that substantial amount of sediments are available for infilling the coastal plain and offshore areas. Comparison of the areal extent of the inner shelf (Fig. 8) with the distribution of nearshore sandy sediments (Fig. 9) suggests that the southwestern coastal plain is prograding seaward and sandy sediments are escaping from Kaoping Hsi River to the shelf.

Seismic profiles provide some evidence of the processes of progradation and retrogradation associated with the formation of the Kaoping Shelf. Profile A (Fig. 10), a strike section, is located a short distance from the shoreline. It shows parallel, flat-lying and continuous reflections in the upper part of the section, representing a thin sequence of undeformed sediments deposited in a shallow shelf environment. It is noted that the Kaoping Canyon cuts the shelf. Profile B (Fig. 11) is a downslope section extending from the shelf, crossing the shelfbreak and ending at the upper slope. The northern part of profile B between shot point X and Y shows parallel reflections terminated against the southward dipping sea floor, which suggests erosion.

The truncation of these reflections could be the result of subaerial erosion during the lowstand of sea level about 15,000 years ago. The sea level during Late Pleistocene is assumed to have been 140 m below the present sea level (Boggs *et al.*, 1979). The Late Pleistocene Kaoping Shelf is considered to be a retrogradational shelf. On the other hand, the upper section of profile B between shot point Y and Z shows that the sea floor is a strong reflector gently dipping seaward and overlying conformably the underlying subparallel discontinuous reflections, suggesting a prograding shelf during the recent marine transgression. The seismic interpretations integrated into Late Pleistocene sea-level changes suggest that the Kaoping Shelf has undergone cycles of erosion and deposition since Late Pleistocene.

On the basis of interpretations from the seismic profiles and sediment samples, the authors consider that the Kaoping Shelf is the offshore part of the Pingtung Valley, which is a mature foreland basin receiving a high amount of orogenic sediments, now more than 5 km thick, from the Central Range. The Coastal Plain in southwestern Taiwan has continuously prograded seaward to build up the shelf and slope, although the process has been interrupted by sea-level lowering and the shelf was exposed subaerially in Late Pleistocene. As sea level rose in Holocene time, the sediments transported by the major rivers of Kaoping Hsi and Tsengwen Hsi were emptied into the sea and were redistributed on the sea floor, prograding seaward to form the modern Kaoping Shelf.

In contrast, the slope region south of Fangliao is in the setting of a prototype foreland basin, receiving little sediment from the adjacent rising Hengchun Peninsula, where a major river drainage has not developed to supply enough sediment to the sea to build a shelf. It is evident that this slope region does not appear to be influenced significantly by prograding deposition, which is a common sedimentary process for building a broad shelf. Thus, this slope region is a sediment-starved area without a platform morphology.

Implications for evolution of shelves in active margins

Based on 11 surface sections in the Western Foothills and 17 oil wells drilled in the Coastal Plain of western Taiwan, Covey (1984) found that the western Taiwan foreland basin filled with orogenic sediments from the westward-migrating Taiwan orogen has prograded southwestward since Late Pliocene. The Pingtung Valley was mainly filled with cobbly deposits and a belt of deltaic sediments along the coast about 400,000 years ago (Fig. 12(A)). The sediments were laid down by the ancestral Kaoping Hsi River. Later, orogenic sediments continuously supplied by the Central Range have migrated southwestward and seaward to enlarge the Pingtung Valley to its present position (Fig. 12(B)). The seaward progradation of sediments from the coastal plain of the Pingtung Valley resulted in a prograding shelf, i.e. the present Kaoping Shelf. Assuming the rates of deposition, subsidence and sediment supply being the same as those in the past 400,000 years ago, the authors speculate that in the future, 400,000 years from now, the foreland basin in front of the southern Central Range will develop continuously southwestward to fill the present offshore region west of the Hengchun Peninsula (Fig. 12(C)). In other words, the present prograding shelf with continuous supply of sediments will extend seaward and southward to build the new shelf along the mountainous coast west of Hengchun Peninsula.

This case study of the shelf morphology in relation to mountain building and foreland-basin development through time in the southwestern Taiwan margin may shed some light on the general model of the evolution of shelves in the active margins.

Discussion

Early studies suggested that the continental shelves were exposed subaerially and then submerged by relative rise of sea level or by downwarping and downfaulting at the edges of continents (Umbrgrove, 1946; Shepard 1948; Emery, 1950). Later, stratigraphic studies of marine seismic data (Vail *et al.*, 1977) and models of evolution of continental margins (Emery, 1980; Boillot, 1981) suggested that the formation of continental shelves is mainly influenced by sediment supply, relative changes of sea level and tectonic vertical movement. However, the present gross topography of the continental shelf worldwide is the result of erosion and sedimentation during the last one million years (late Quaternary) (Kennett, 1982).

Terraces occur commonly on the continental shelf (Kennett, 1982). They occur in active margins (e.g. shelves off Barbados; Macintyre, 1972) and stable margins (e.g. East China Sea Shelf; Jin, 1992). The Kaoping Shelf is terraced to the northwest and narrows and shallows to the south. Are the terraces of Kaoping Shelf erosional (e.g. from tectonic vertical movement) or

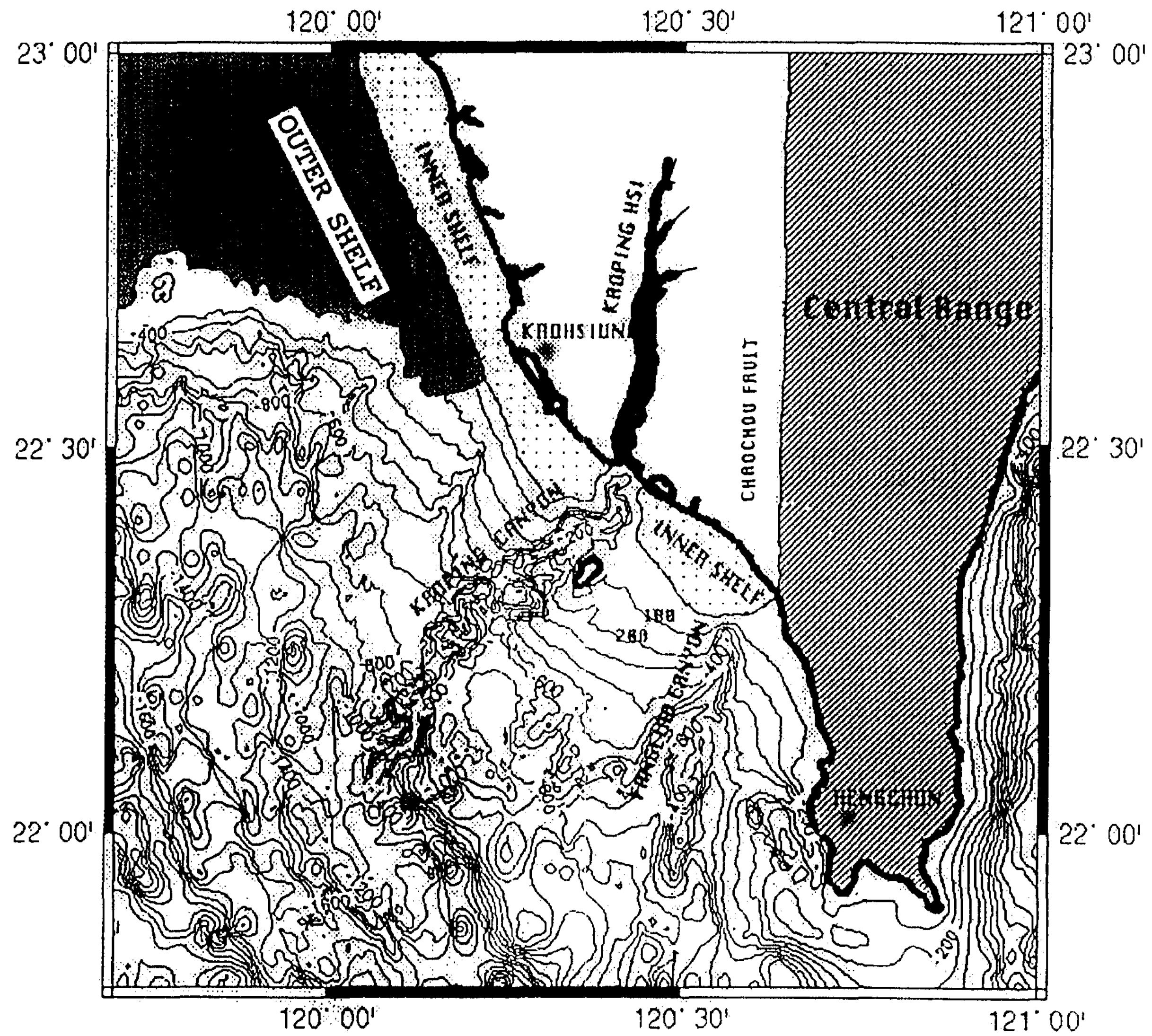

Fig. 8. The southwestern Taiwan coast is bounded by the NW SE trending Kaoping Shelf off the Pingtung Valley and the N S trending unnamed submarine slope west of the Hengchun Peninsula. The boundary separating these two physiographic units can be placed at Fangliao

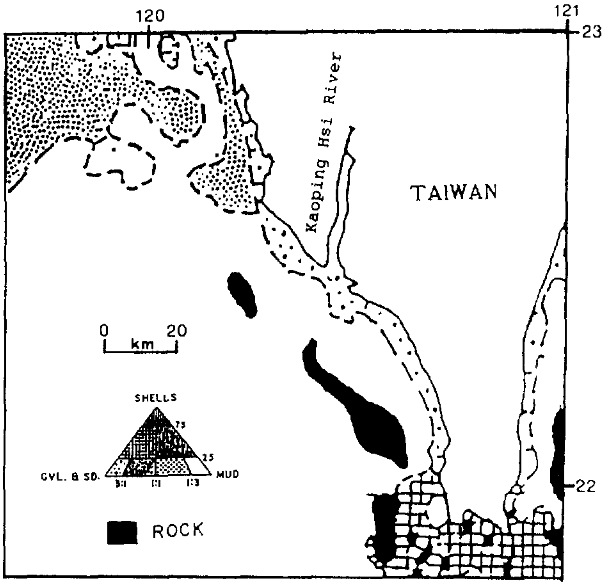

Fig. 9. A nearly continuous nearshore belt of sandy sediments present along the southwestern Taiwan coast (after Boggs *et al.*, 1979).

depositional (from prograding out on to pre-existing deeper shelf)? What is the effect of variations of sea level on the terraces of the Kaoping Shelf? These questions are discussed using related regional geology in the Taiwan region.

Most of the Taiwan shelf was subaerially exposed when sea level was about 140 m below the present level approximately 15,000 years ago (Boggs *et al.*, 1979). As sea level rose in late Pleistocene time, the sea reached its present level about 6000–7000 years ago (Hopley, 1978; Boggs *et al.*, 1979; Huang *et al.*, 1987). On the basis of sediment properties, Boggs *et al.* (1979) suggested that the Holocene sediments derived from western Taiwan are unlikely to extend onto the shelf, including the Kaoping Shelf, farther than about 30–40 km beyond the present coastline. They also pointed out that parts of the shelf having low-reliefed and irregular topography are considered to be of probably relict subaerial erosional features.

Bathymetric profiles 1–4 (Fig. 5) show that the surface of the inner shelf is relatively smooth, which is probably the result of progradation of the Holocene sediments seaward. The inner shelf is a narrow, constructional platform with very gentle slope seaward and covered by marine sands and silts. On the other hand, the sea floors of the outer shelf show low-reliefed and irregular topography, suggesting probable relict origin. The interpretation from the morphology revealed by bathymetric profiles 1–4 seems to be compatible with the studies of the Taiwan Shelf by Boggs *et al.* (1979).

Lacking factual data, it can only be speculated that a relative stillstand of sea level occurred at the boundary between the inner and outer shelves as the sea rose and migrated toward the western Taiwan coast in late Pleistocene time. A wave-cut terrace formed along the coast now is submerged about 40 m below the present sea level and about 10 km from the Taiwan shoreline. When did the stillstand of sea level happen? How long has the stillstand of sea level lasted? The late Pleistocene geology of the East China Sea Shelf north of Taiwan may provide some answers to these two questions.

On the basis of sedimentary facies analyses and carbon-14 dating of cores recovered from the East China Sea Shelf, Jin (1992, p. 488) reported that the sea migrated westward to mainland China and reached water depth of about 60 m approximately 12,000 years ago. A stillstand of sea level has lasted about 1000 years at water depths of between 50 and 60 m and has produced a terrace along the coast. The sea then rose again and reached water depths of about 15 m below the present level approximately 8000 years ago. The present sea level is close to that about 7000 years ago. The East China Sea Shelf is divided into two subshelves, namely the inner shelf (0–60 m) and the outer shelf (60–160 m) (Jin, 1992, p. 7).

It seems reasonable by analogy between the late Pleistocene geology of the East China Sea Shelf and the Kaoping Shelf to assume that the terrace on the Kaoping Shelf probably formed by marine erosion about 12,000 years ago in 1000 years. The inner shelf (0–40 m) of the Kaoping Shelf is 20 m shallower than that (0–60 m) of the East China Sea Shelf. The difference in water depth of the terraces is probably due to the relatively high

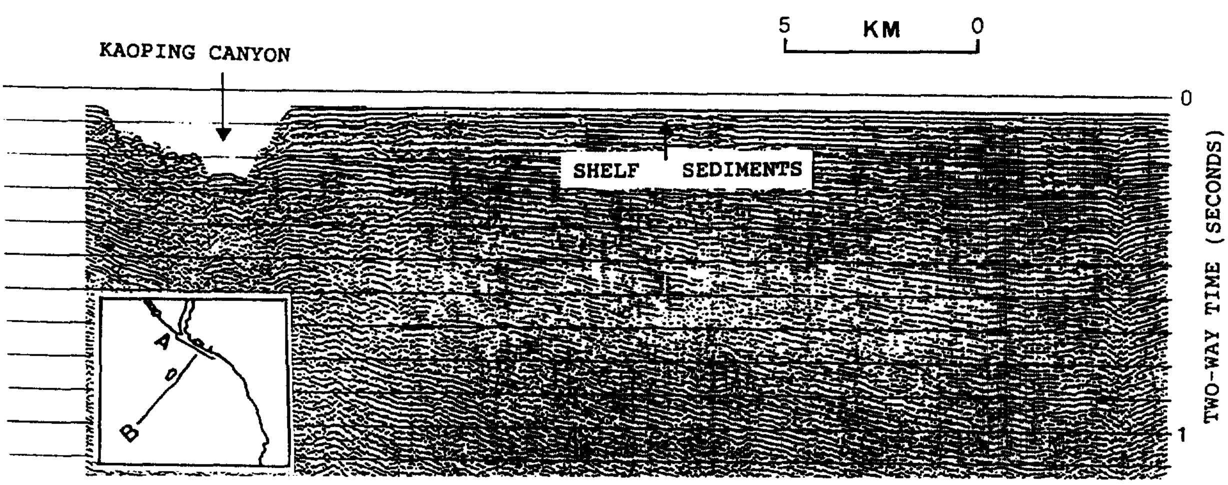

Fig. 10. Seismic profile A paralleling to the shoreline shows parallel, flat-lying and continuous reflections in the upper part of the section, which are the characteristic seismic configuration of the depositional setting of the shelf.

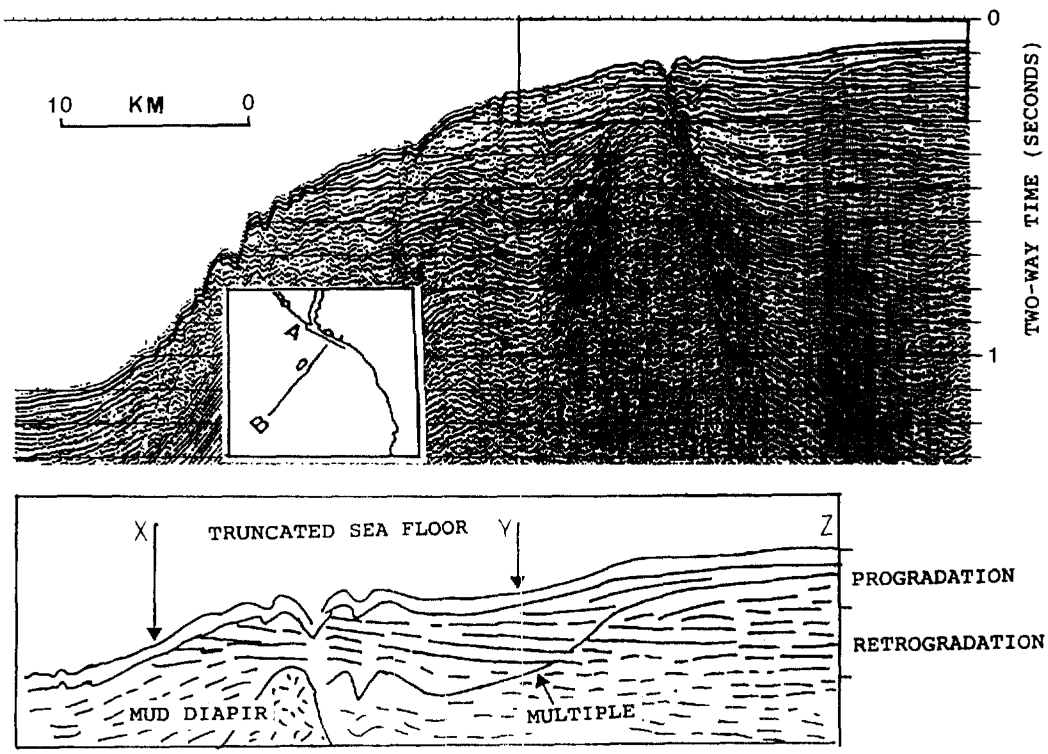

Fig. 11. Seismic profile B, a downslope section, shows terminations of reflections against the overlying sea floor (shot point X–Y), suggesting erosion. The erosional truncation could be resulted from the subaerial exposure of the shelf during the lowstand of sea level about 15,000 years ago. A progradation configuration may be recognized between shot point Y and Z. This prograding shelf is suggested to be formed during the recent marine transgression.

uplift rate in southern Taiwan. The average uplift rate of the Hengchun Peninsula in southern Taiwan is 3.5 mm/yr. (Chen, 1993; Chen and Liu, 1993).

The discussion of the terrace is considered to be inconclusive. The inferences of the terrace can be tested by additional marine studies, such as carbon-14 dating, sediment analyses of cored samples and high-resolution seismic profiling.

It is intended that the distinction between a continental shelf and an island shelf will be made here. The Kaoping Island Shelf, being a young shelf built by present-day sedimentation, will be emphasized. This very narrow shelf borders the mountainous coast of the Taiwan Island, which has been tectonically uplifted since Pleistocene. This island shelf reflects continuous orogenic sediment supply and tectonic vertical move-

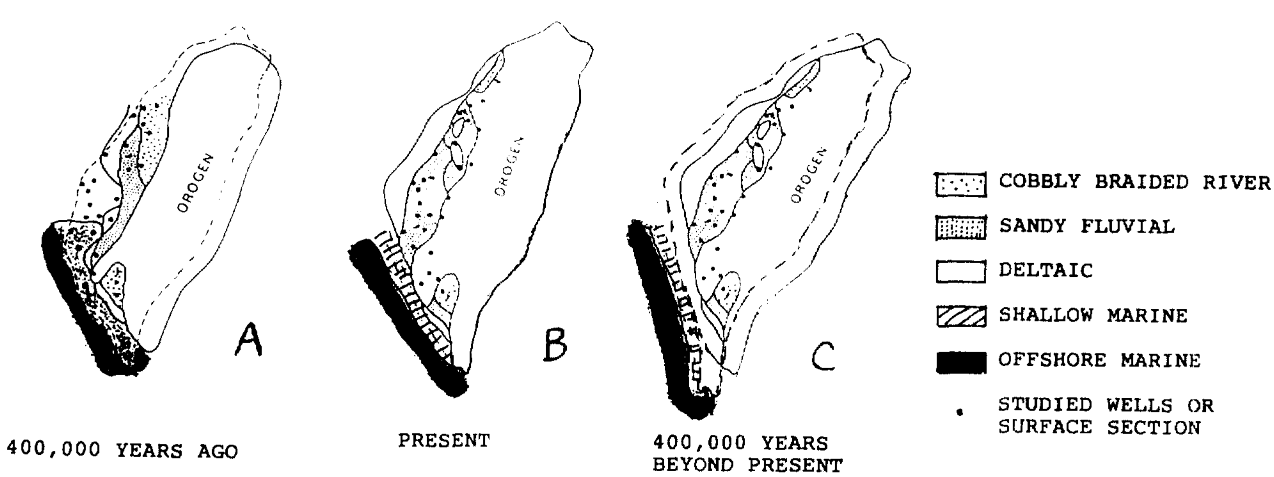

Fig. 12. A hypothetical evolution for the Kaoping Shelf, southwestern Taiwan. The Pingtung Valley was mainly filled with orogenic sediments laid down by the ancestral Kaoping Hsi River about 400,000 years ago. The Kaoping Shelf is the offshore extension of the Pingtung Valley (A). Orogenic sediments continuously supplied by the Central Range have migrated seaward to enlarge the Pingtung Valley to the present form (B). In another 400,000 years beyond present the shelf will extend seaward and southward to build the new shelf along the mountainous coast west of the Hengchun Peninsula (C). Modified from Covey (1984).

ment, which is the result of arc–continent collision. In contrast, the adjacent wide shelves of South China Sea, Taiwan Strait and East China Sea bordering Chinese coastal plains are mature shelves where tectonic vertical movement and sediment supply are minimal.

The geologic significance of the formation of this island shelf can contribute to a better understanding of models of the evolution of collisional margins, particularly in the southeast Asian region, where many small and large islands exist.

Summary and conclusions

The detailed bathymetric mapping of the Kaoping Shelf resulted in the refinement of the morphological description of the shelf and in the subdivision of the shelf into two subshelves. North of Kaohsiung, the shelf consists of an inner and an outer shelf and has an average width of 28 km, whereas the shelf south of Kaohsiung shows a very narrow and shallow platform (9 km wide and 40 m deep). The depth of the inner shelf edge ranges from 35 to 45 m, with an average value of 40 m, whereas the outer shelf edge ranges from 180 to 250 m in depth, with an average value of 215 m.

The tectonic setting is the primary factor controlling the present form of the Kaoping Shelf. In terms of tectonics and sedimentation, the shelf is the offshore extension of the Coastal Plain, which contributes high amounts of sediment to build the broader platform of the shelf, whereas the slope region is underlain by the submerged Central Range, which contributes little sediment, resulting in a sediment-starved submarine slope.

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