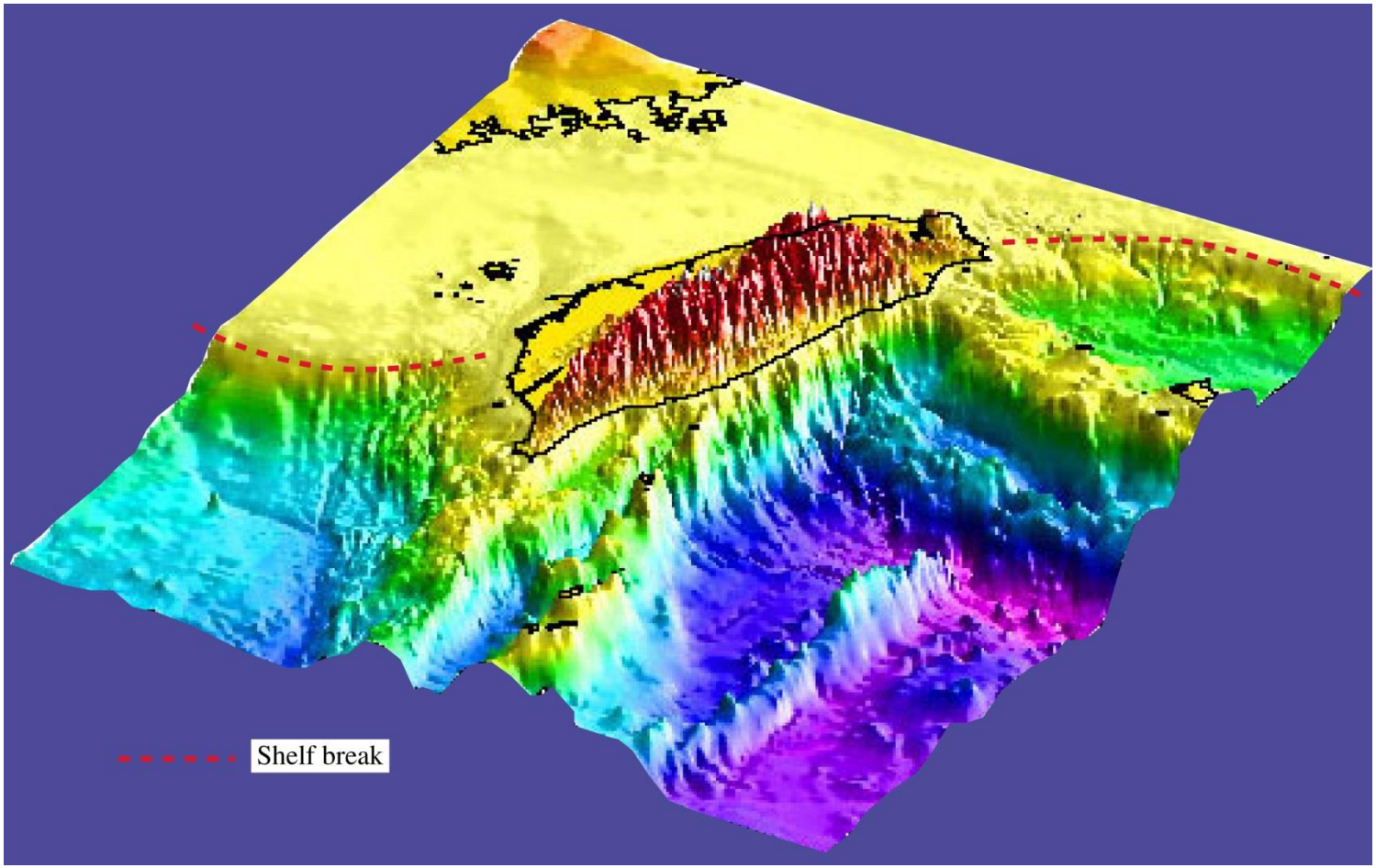
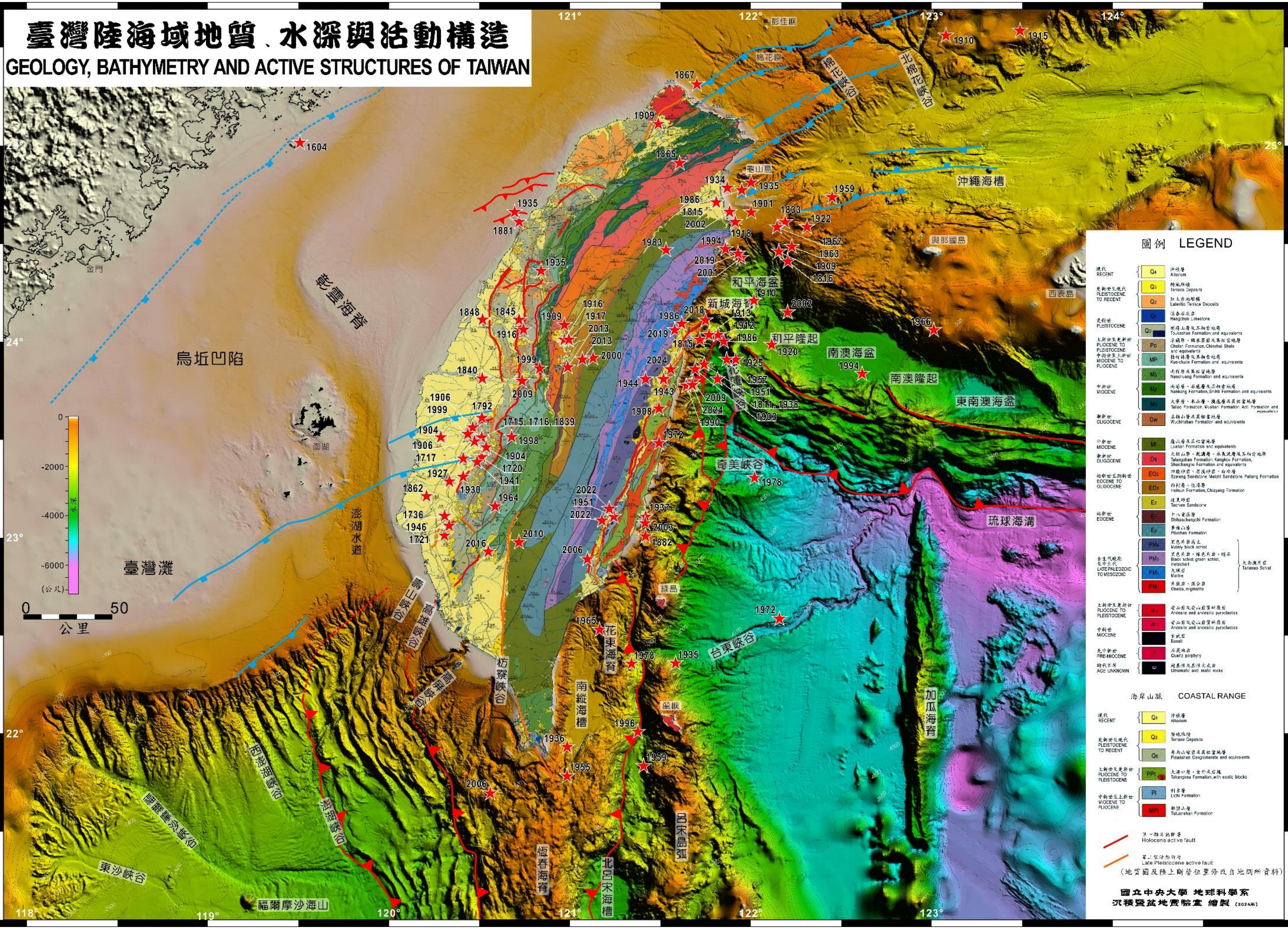
1. 台灣陸海域地體構造、盆地及地質分區

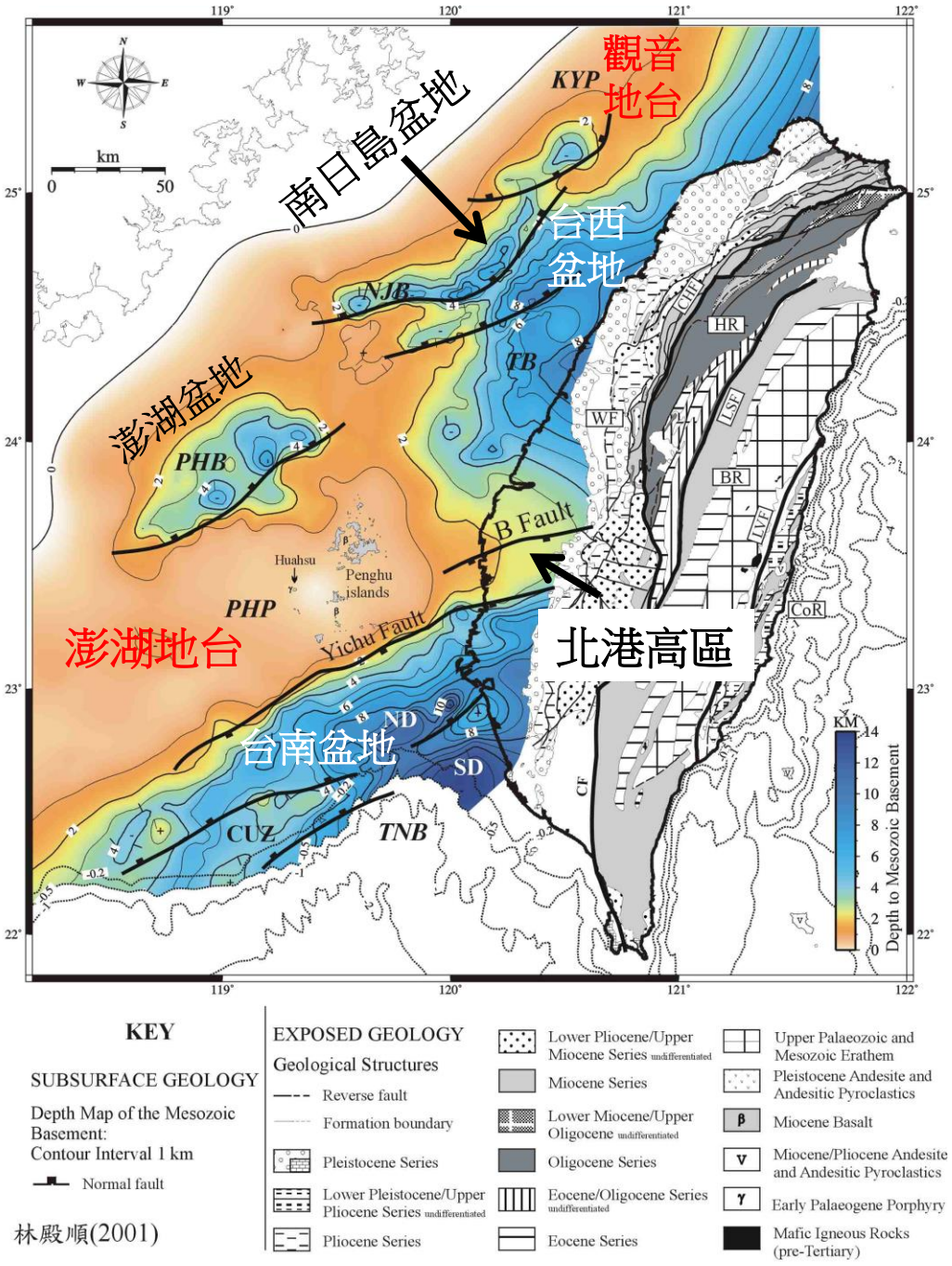


林殿順　中央大學地球科學系

臺灣陸海域地質、水深與活動構造
GEOLOGY, BATHYMETRY AND ACTIVE STRUCTURES OF TAIWAN



台灣地區地質架構



Lin et al. (2003)

BR=脊樑山脈, CF=潮洲斷層, CHF=屈尺斷層, CoR=海岸山脈, CUZ=中央隆起帶, HR=雪山山脈, KYP=觀音地台, LSF=梨山斷層, LVF=花東縱谷斷層, ND=北部凹陷, NJB=南日島盆地, PHB=澎湖盆地, PHP=澎湖地台, SD=南部凹陷, TNB=台南盆地, TB=台西盆地, WF=西部麓山帶

台灣島與台海地質分區

由東往西

1. 海岸山脈：中中新世-第四紀火山島弧(都巒山層)及其上覆沉積物(菲律賓海板塊)。

邊界斷層：靠海岸山脈西緣的花東縱谷斷層(或稱海岸山脈斷層)與靠中央山脈東緣的中央山脈斷層(未完全證實)

2. 中央山脈：中央山脈以梨山斷層為界可分為東邊的脊樑山脈與西邊的雪山山脈

2A, 脊樑山脈(狹義中央山脈)：分成三個地質區，

先第三紀基盤(pre-Tertiary basement)，即大南澳變質雜岩(沉積年代為二疊紀至白堊紀，變質年代有三期：中侏羅紀-中白堊紀、始新世-漸新世、中中新世以後(<13 Ma))。岩性包括：黑色片岩、綠色片岩、矽質片岩、大理岩、混成岩(migmatite)、片麻岩、角閃岩、蛇紋岩、變質基性岩(metabasite)等。

始新統畢祿山層

中新統廬山層

邊界斷層:梨山斷層

2B 雪山山脈:始新統至中新統(漸新世時為連續沉積且達2至3千公尺)，雪山山脈沒有主要不整合面

邊界斷層:屈尺斷層

3. 西部麓山帶:漸新統至更新統。

邊界斷層: 變形前緣(deformation fronts)

4. 海岸平原:古新世-現代沉積物(鑽獲基盤年代為二疊紀(佳里)至白堊紀)。

5. 台海: 古新世-現代沉積物(鑽獲基盤年代為下部白堊紀)

台海東部與海岸平原為前陸盆地(自中新世最晚期以來)，台海西部(包括澎湖島)與福建沿海現今屬於前陸凸起(foreland forebulge)。

台灣地質圖

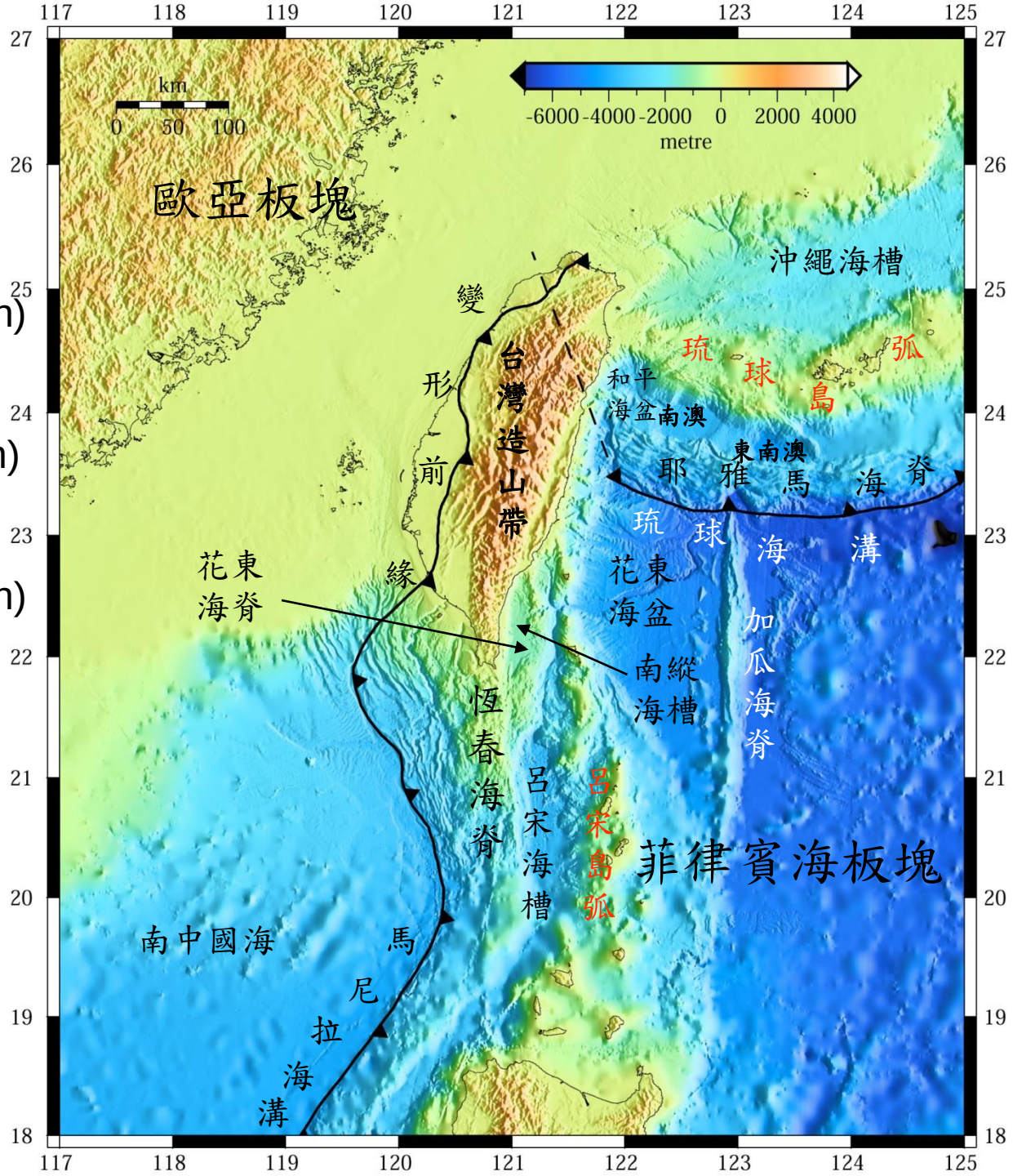

臺灣地質圖
GEOLOGIC MAP OF TAIWAN
中華民國八十九年 2000
比例尺五十萬分之一
SCALE 1:500,000
經濟部中央地質調查所編印
PUBLISHED BY
CENTRAL GEOLOGICAL SURVEY, MINISTRY OF ECONOMIC AFFAIRS
所長 陳肇夏
CHAO-HSIA CHEN, DIRECTOR
臺灣海峽
TAIWAN STRAIT
澎湖列島
PENGHU LIEHTAO
太平洋
PACIFIC OCEAN
圖例 LEGEND
海岸山脈 COASTAL RANGE
編製：陳肇夏、何信昌、謝凱旋、羅偉、林偉雄、張徵正、黃鑑水、林啓文、陳政恒、楊昭男、李元希
繪圖：王俊華、李明鳳

前陸盆地
(Foreland basin)

弧前盆地
(Fore-arc basin)

弧後盆地
(Back-arc basin)

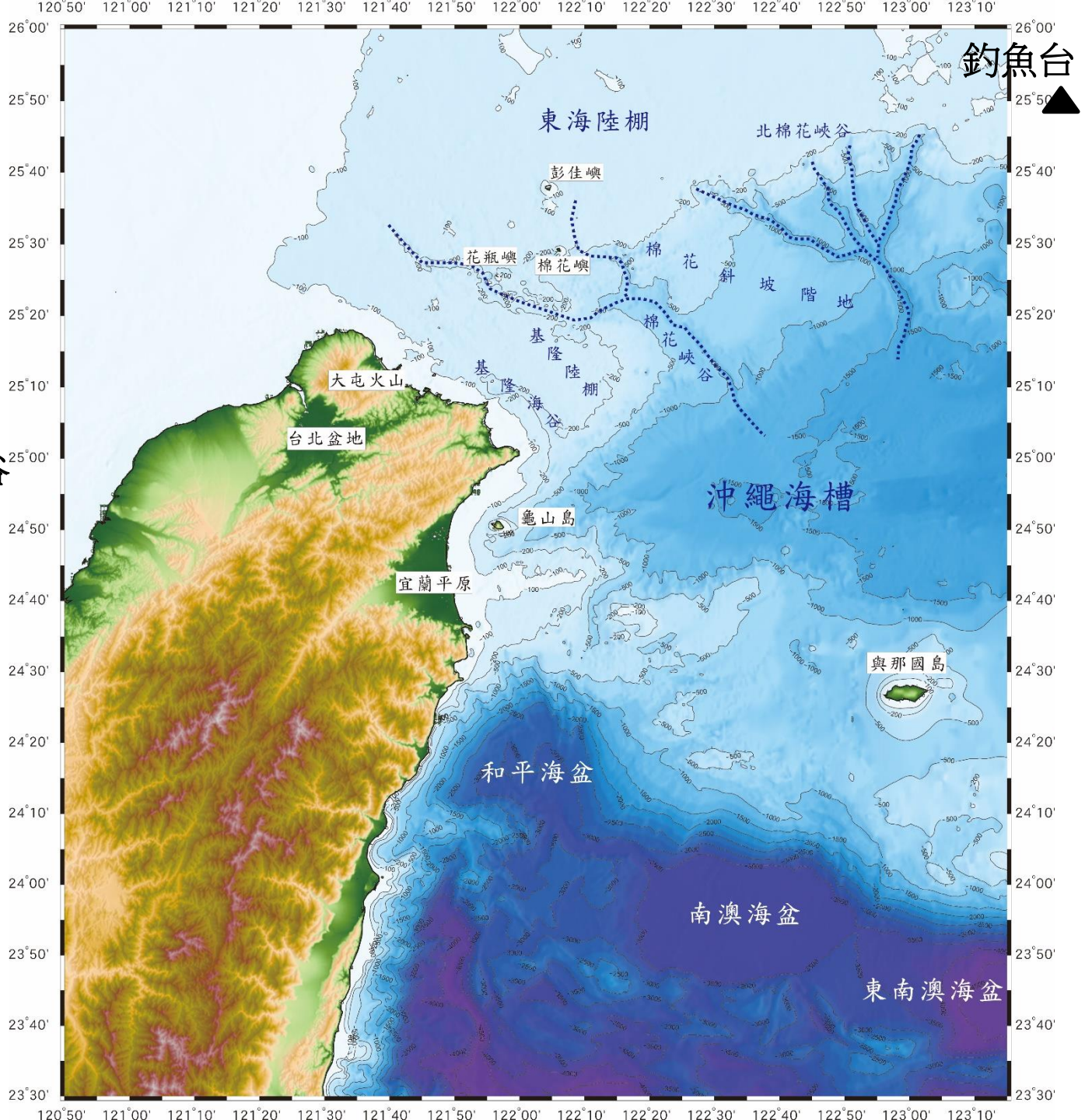
增積岩體
(Accretionary prism)

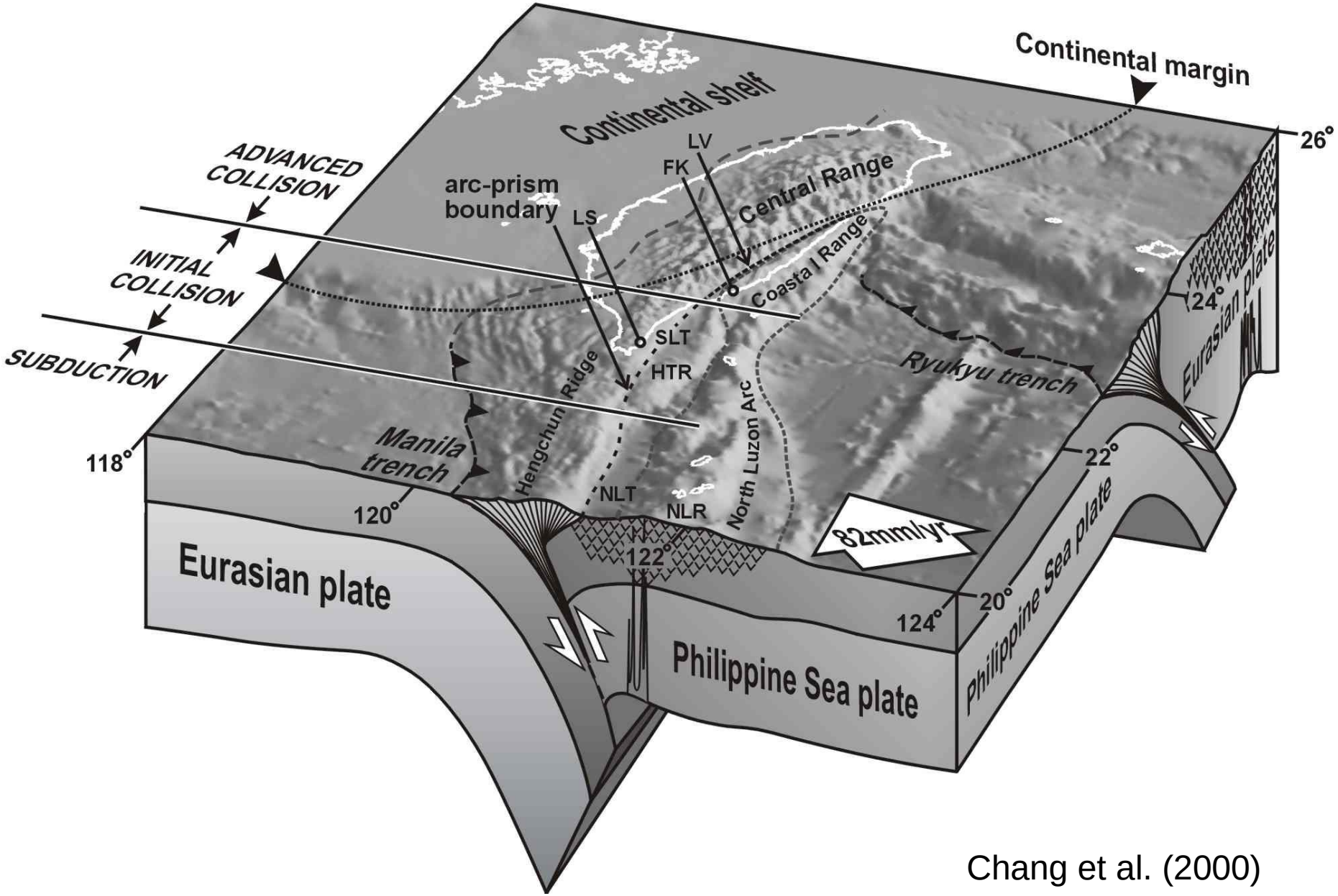


台灣東北外海地形單元

東海陸棚
北方三島
(彭佳嶼、棉花嶼、花瓶嶼)
基隆海谷
基隆陸棚
棉花峽谷與北棉花峽谷
沖繩海槽
宜蘭平原
宜蘭海谷
龜山島

琉球島弧
和平、南澳、東南澳等弧前盆地

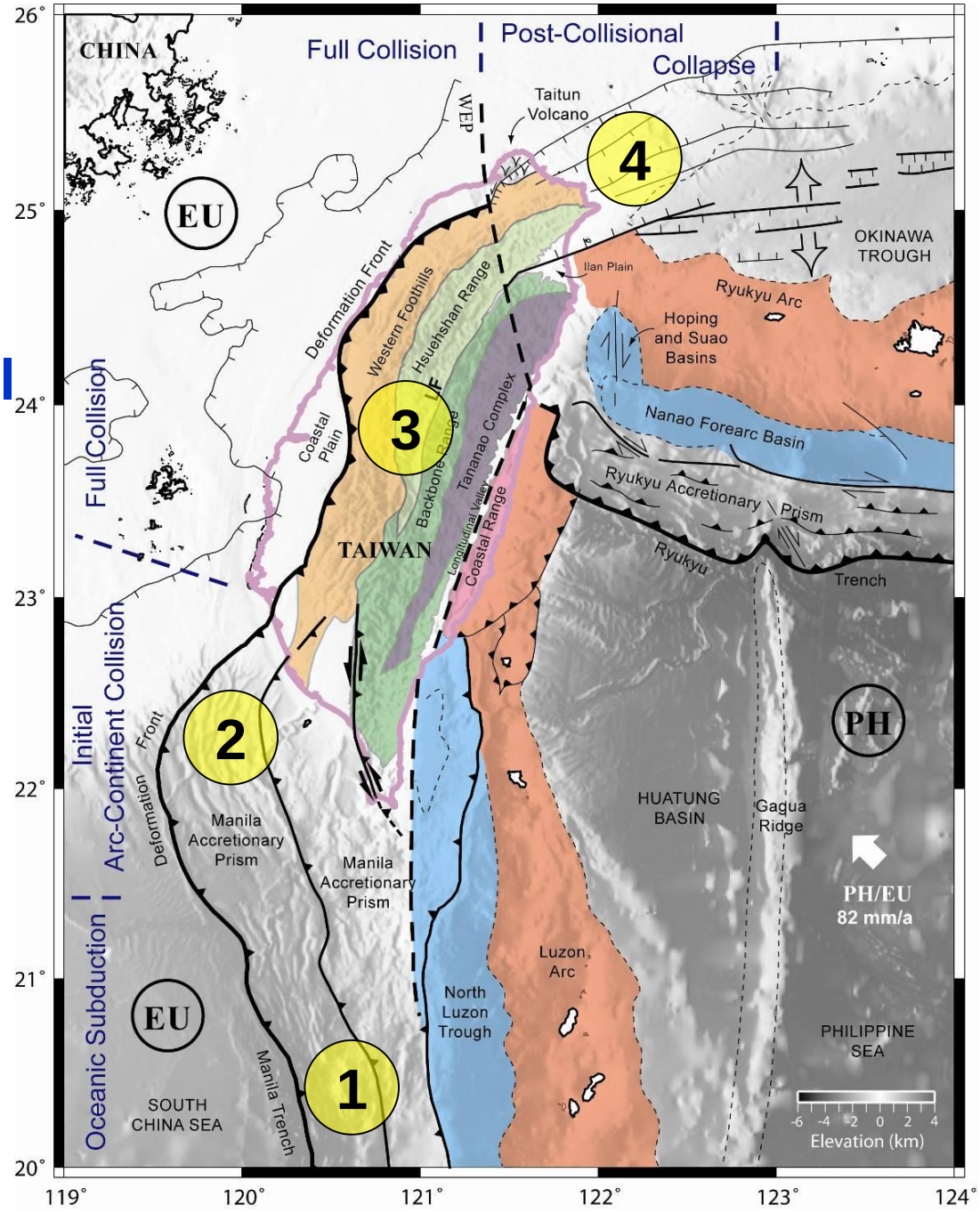




Chang et al. (2000)

Time-Space Equivalency

Time	Space
~ 1 Ma	4. Post-collisional Collapse
~ 3 Ma	3. Full collision
~ 6 Ma	2. Initial arc-continent collision
> 7 Ma	1. Oceanic subduction



呂宋弧溝系統

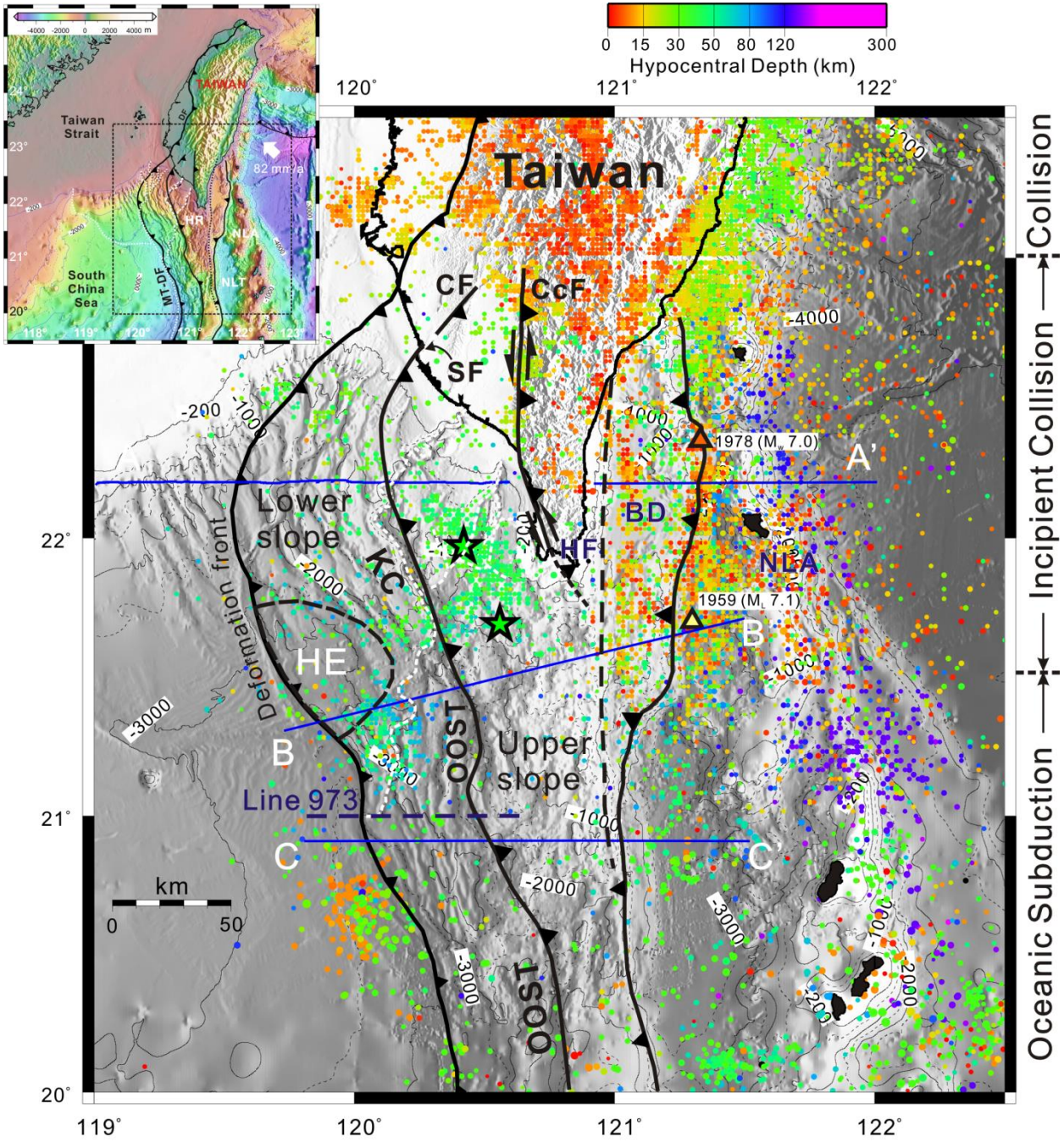


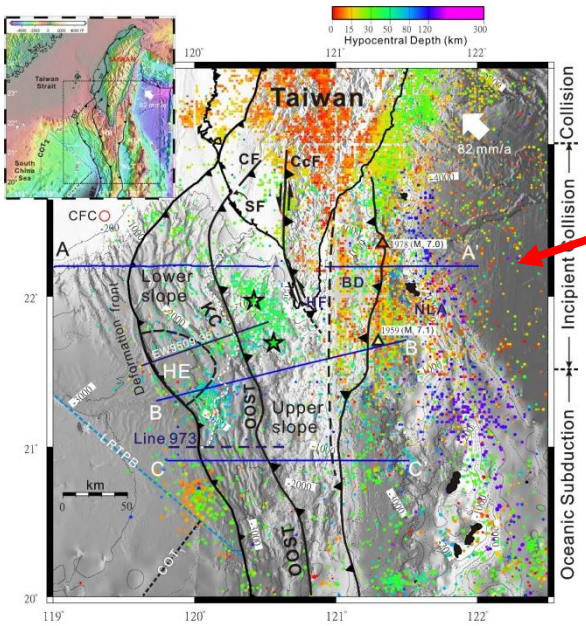
Fig. 1 of Lin et al.

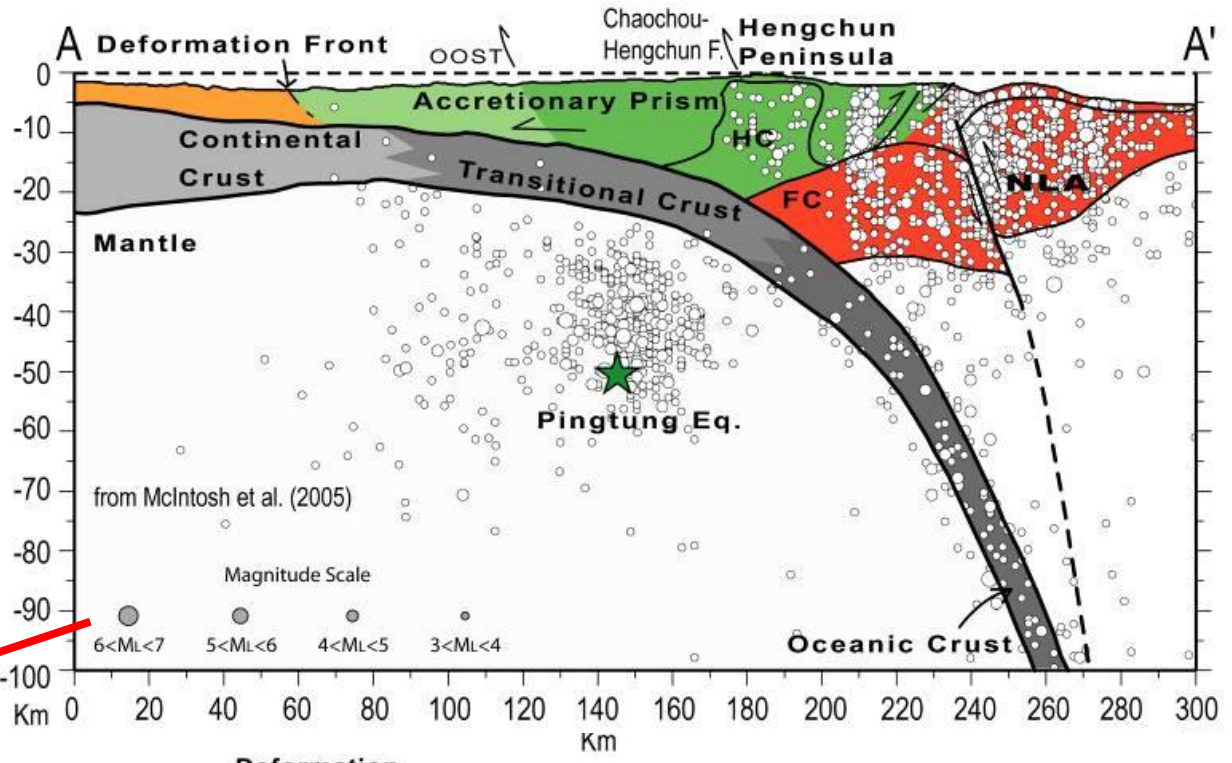
台灣南部外海增積岩體分成上部與下部斜坡，中間被脫序斷層(OOST)或稱分岐斷層(splay fault)分隔。

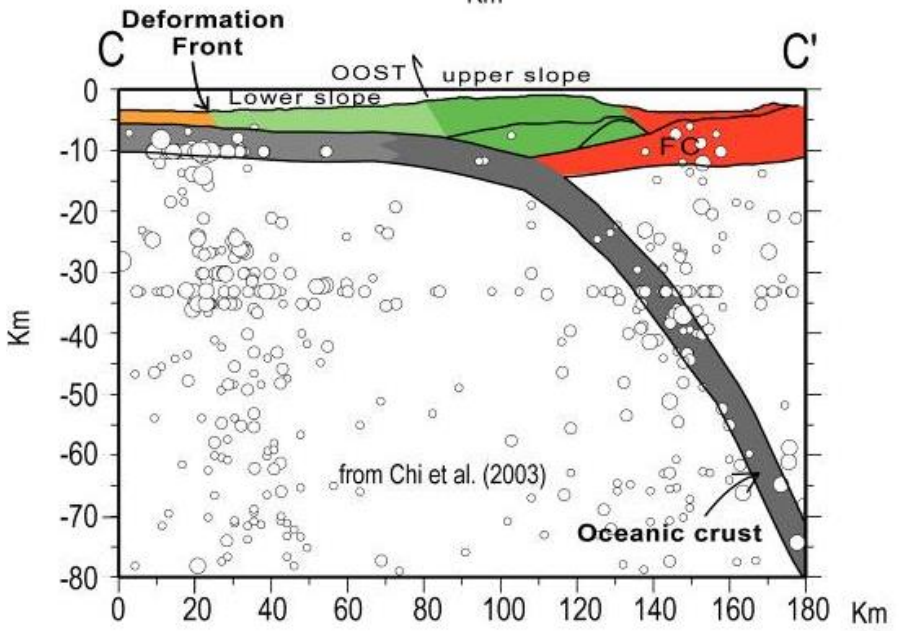
Splay fault是隱沒帶最容易造成大地震並引發海嘯的地質構造。

Lin et al. (2009)

2. Initial arc-continent collision

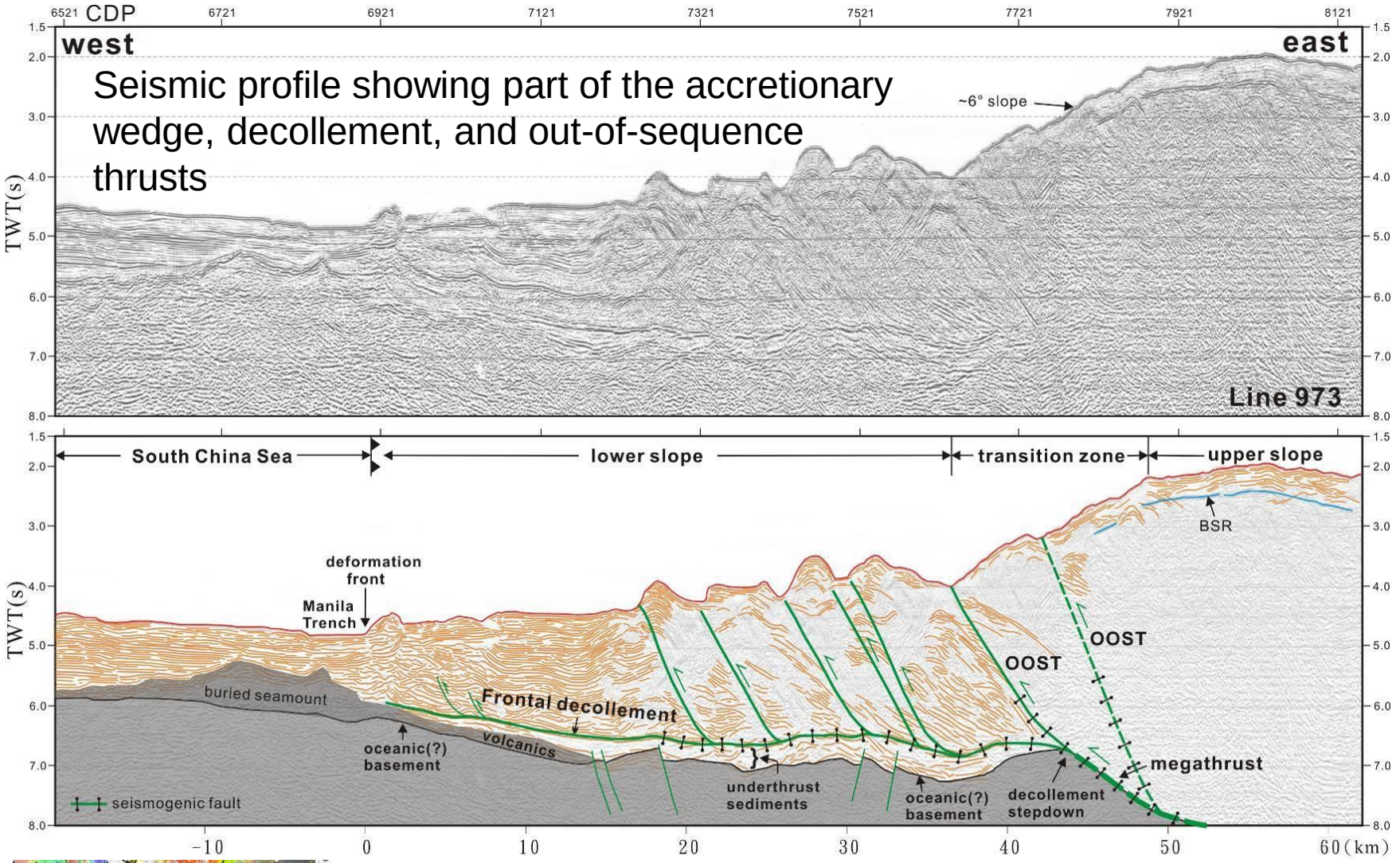


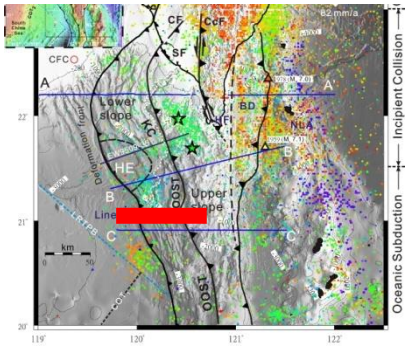




1. Oceanic subduction

Lin et al. (2009) Tectonophysics

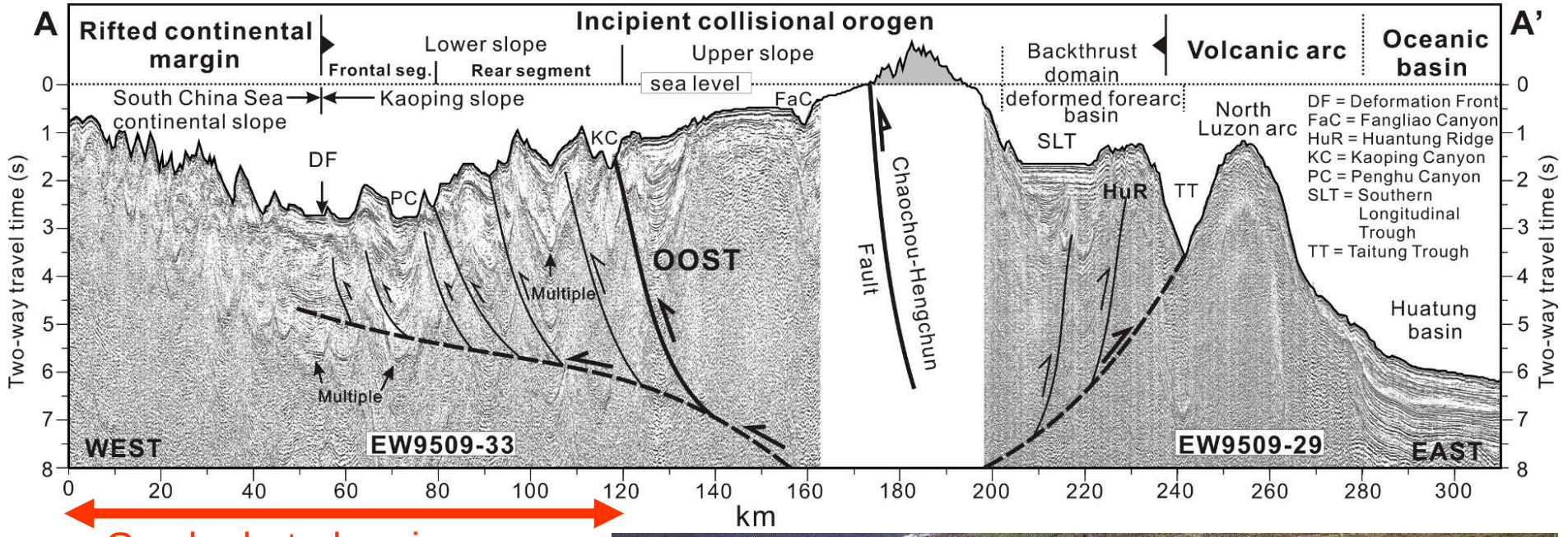




Lin et al. (2009) Tectonophysics

1. Oceanic subduction

A section across initial arc-continent collision zone



Gas hydrate-bearing zone

Lin et al. (2009) Tectonophysics

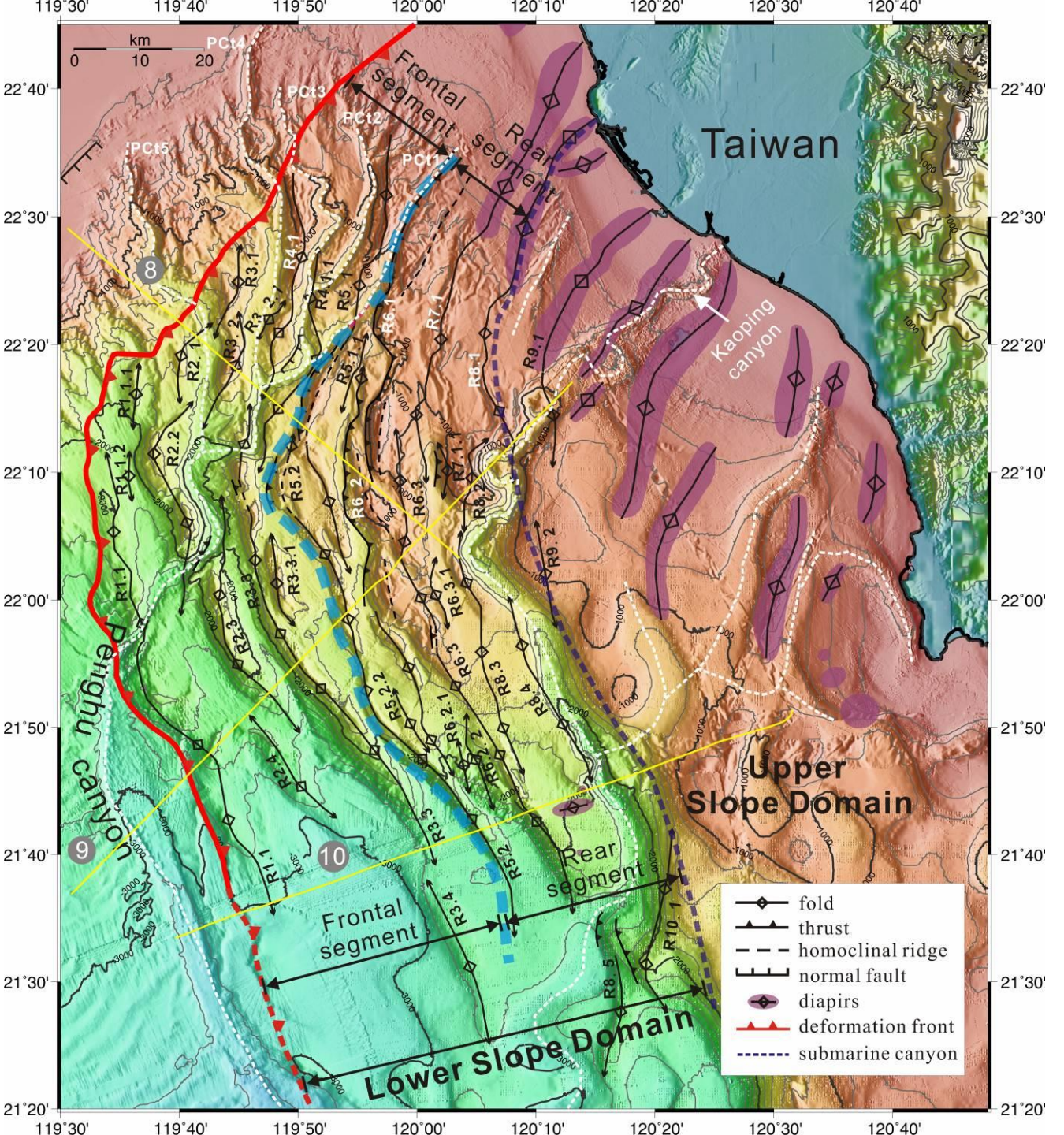
Tectonic features in the incipient orogenic wedge

Upper Slope:
Mud diapirism

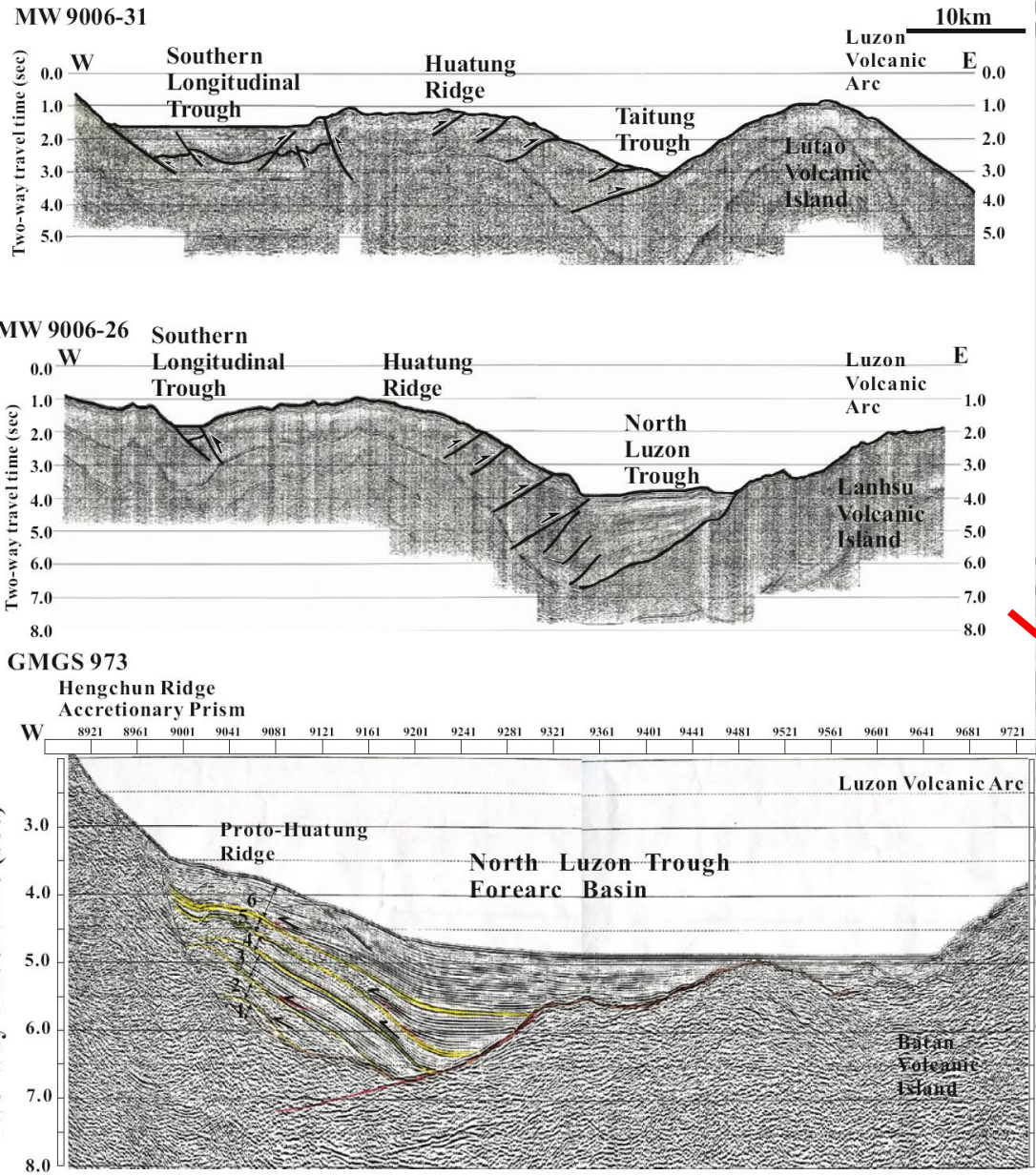
Lower slope:
Folds-and-thrusts

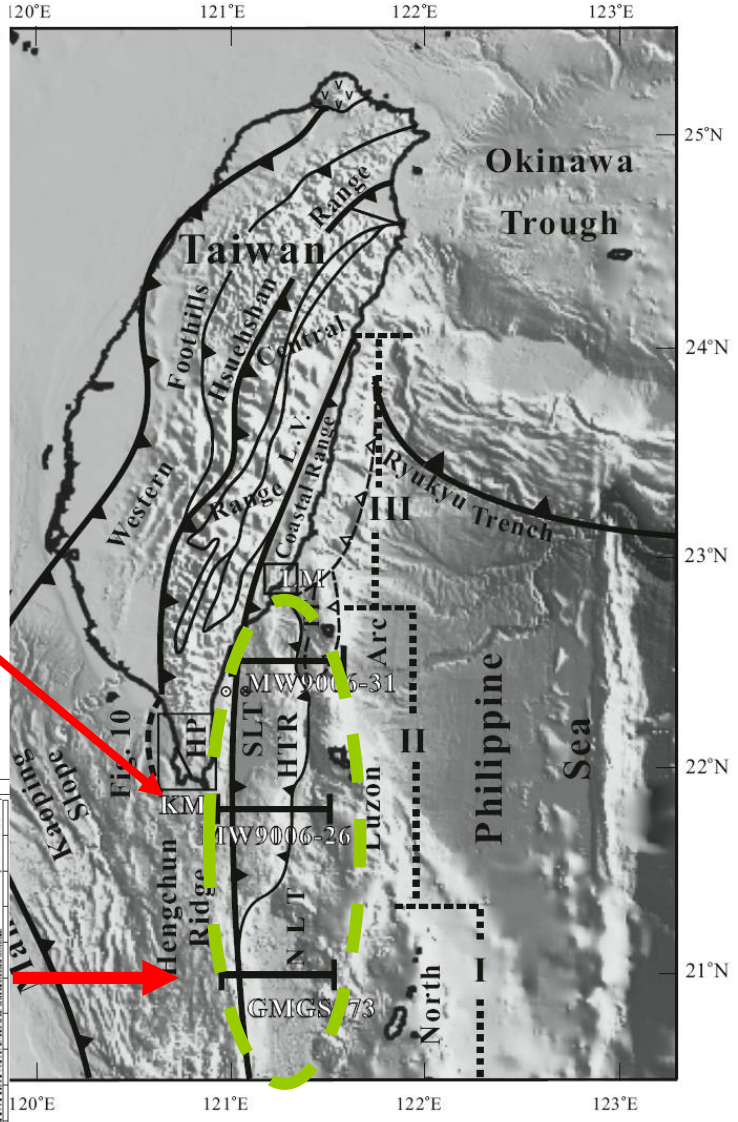
台灣西南外海可能蘊藏大量天然氣水合物，估計約3兆立方公尺資源量(林殿順，2011)。

Lin et al. (2008)
Marine Geology



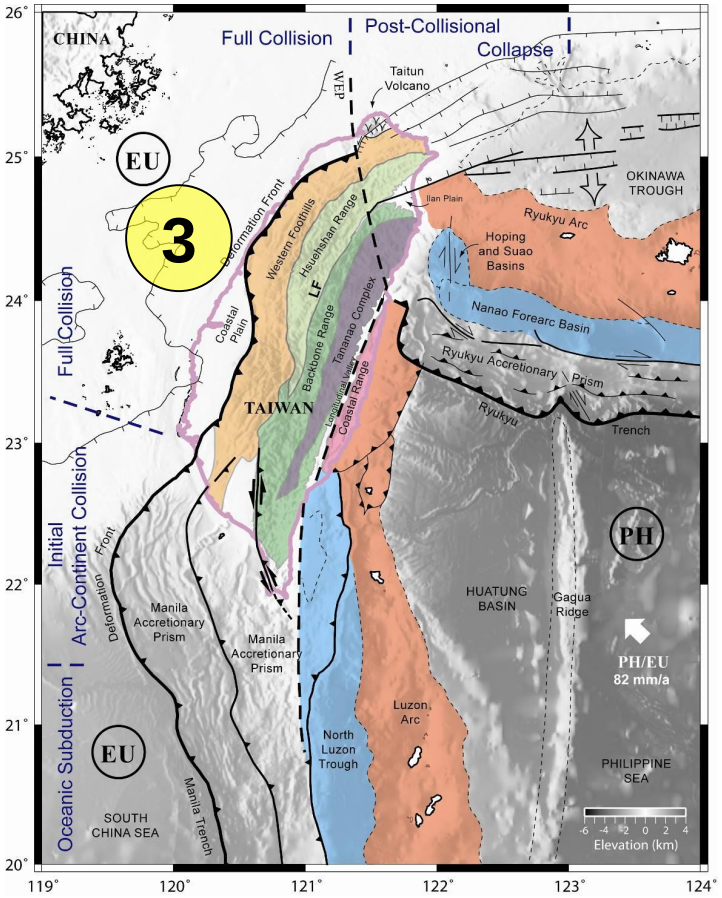
Progressive closure of the North Luzon Trough, a forearc basin

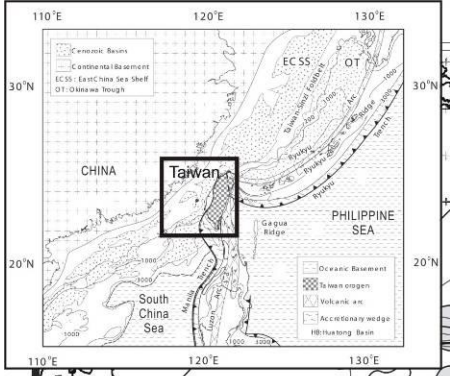




Huang et al. (2008) GSA SP 436

3. Full collision zone





Taiwan Strait

- Rift Basins
- PH Penghu
- NJ Nanjitao
- TH Taishi
- TN Tainan
- Pre-Tertiary basement
- Sediment thickness (km)
- Water Depth (Km)
- Normal Fault

Taiwan Island

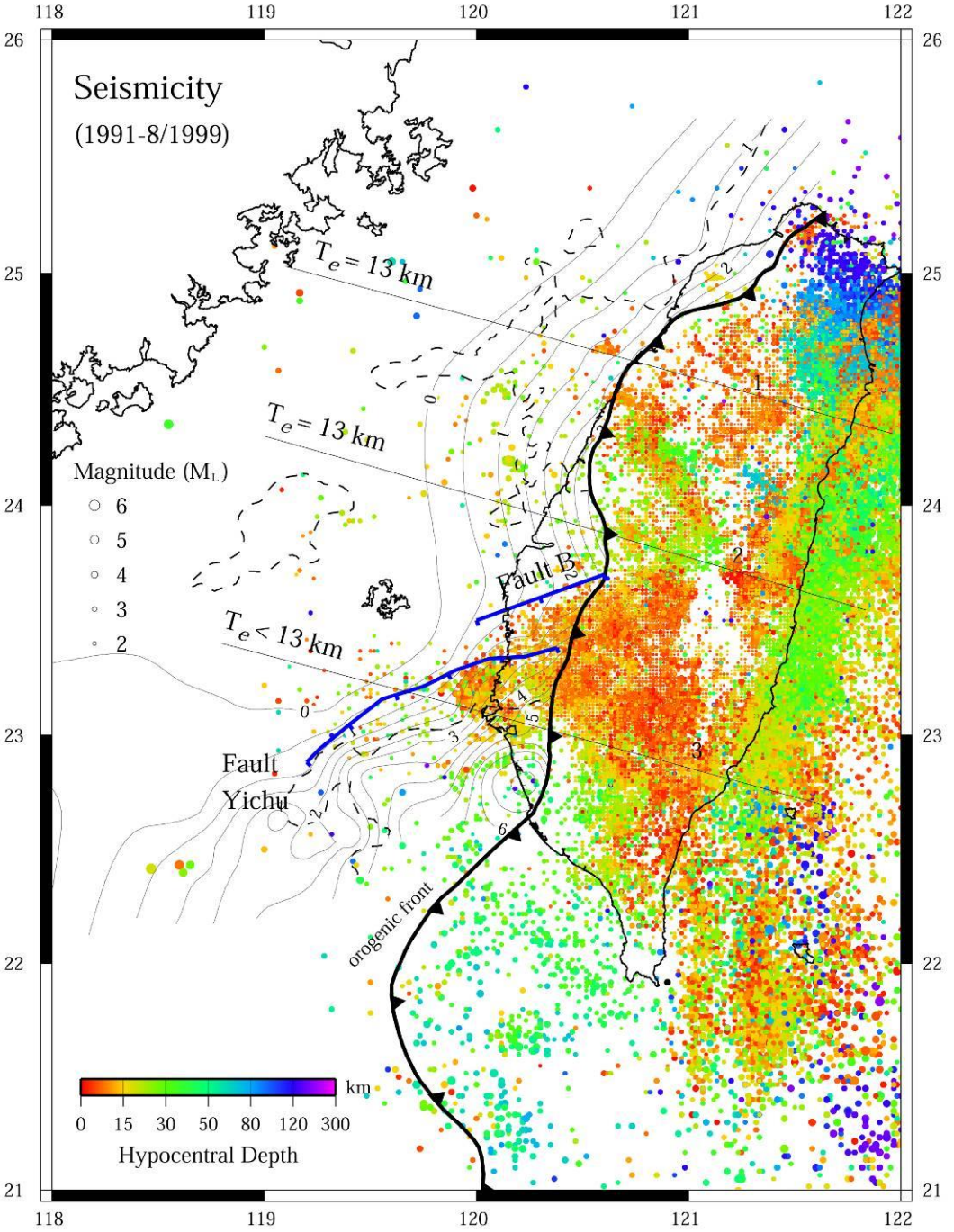
Geological Belts
- CP Coastal Plain
- WF Western Foothills
- HR Hsuchshan Range
- BR Backbone Range
- LV Longitudinal Valley
- Coastal Range

Major Thrusts
- Observed
- Inferred
- ① Frontal
- ② Chuchih
- ③ Lishan
- ④ Central Range
- ⑤ Coastal Range

Rock Units
- Alluvium
- Pliocene - Pleistocene
- Miocene
- Paleogene
- Pre-Tertiary
- Quaternary Volcanics

Teng & Lin (2004)

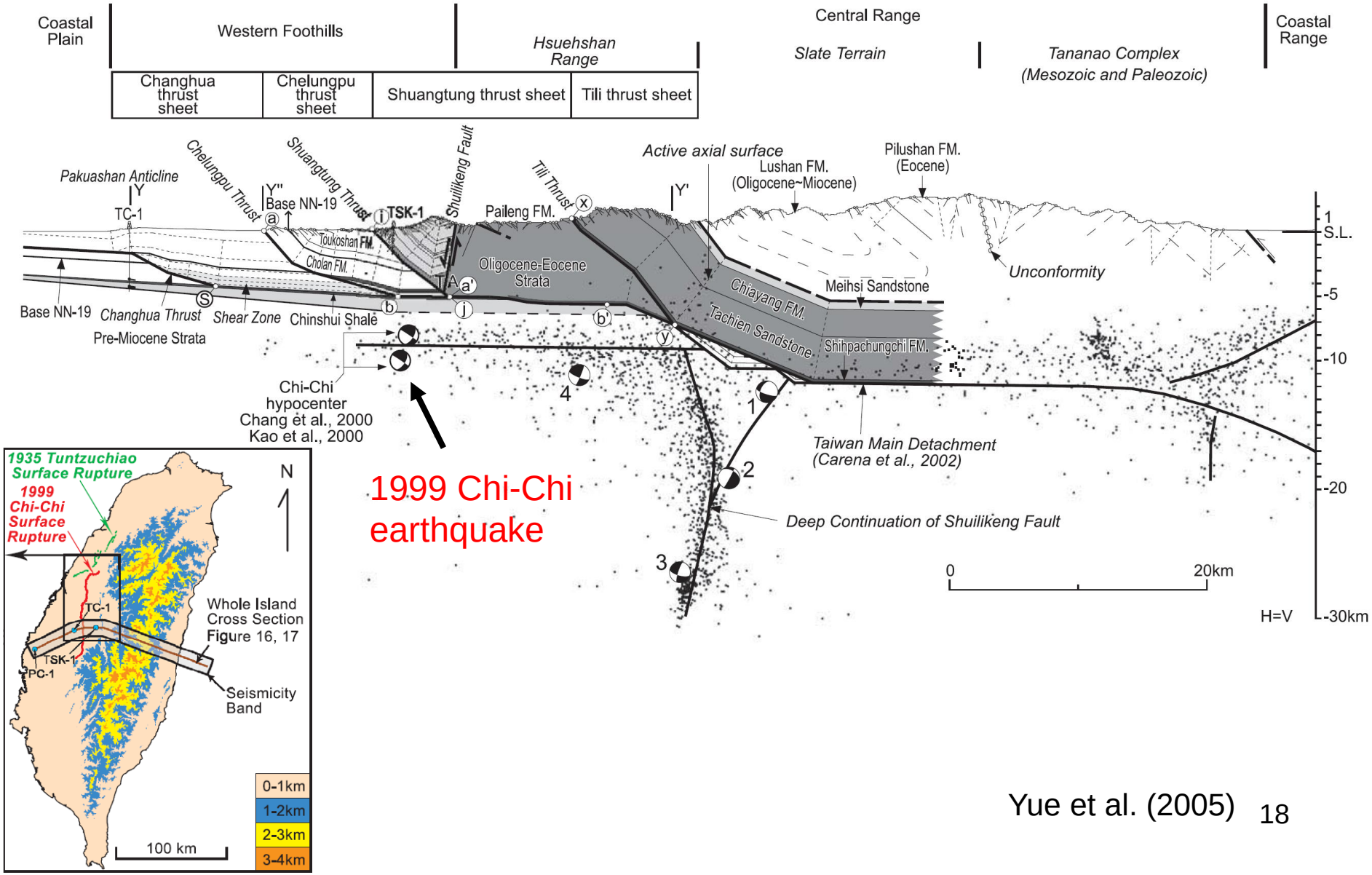
Abundant shallow earthquakes in the full collision zone



Lin and Watts (2002) JGR

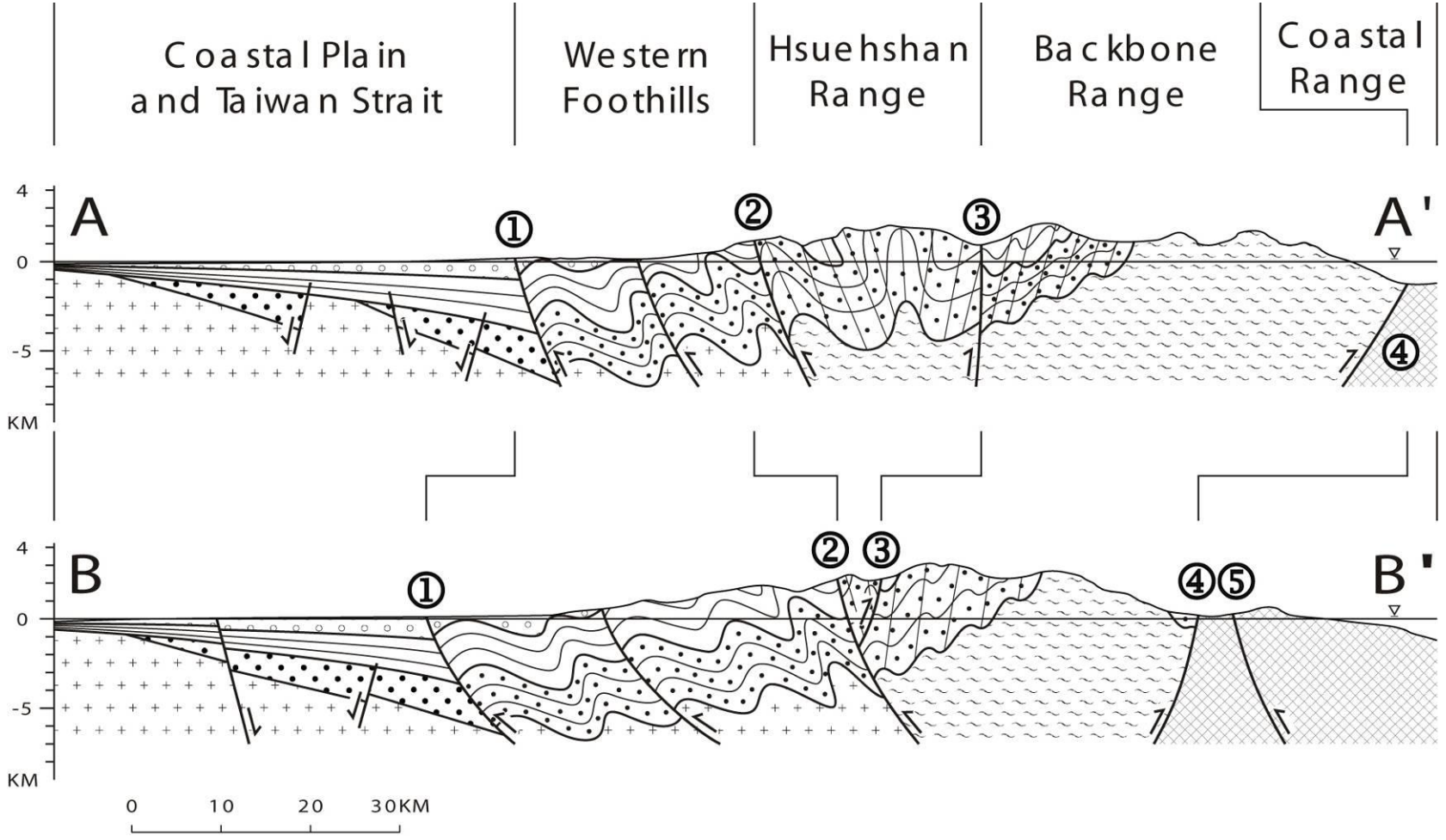
A cross section across the full collision zone showing the relation between structures and seismicity

Accr. arc



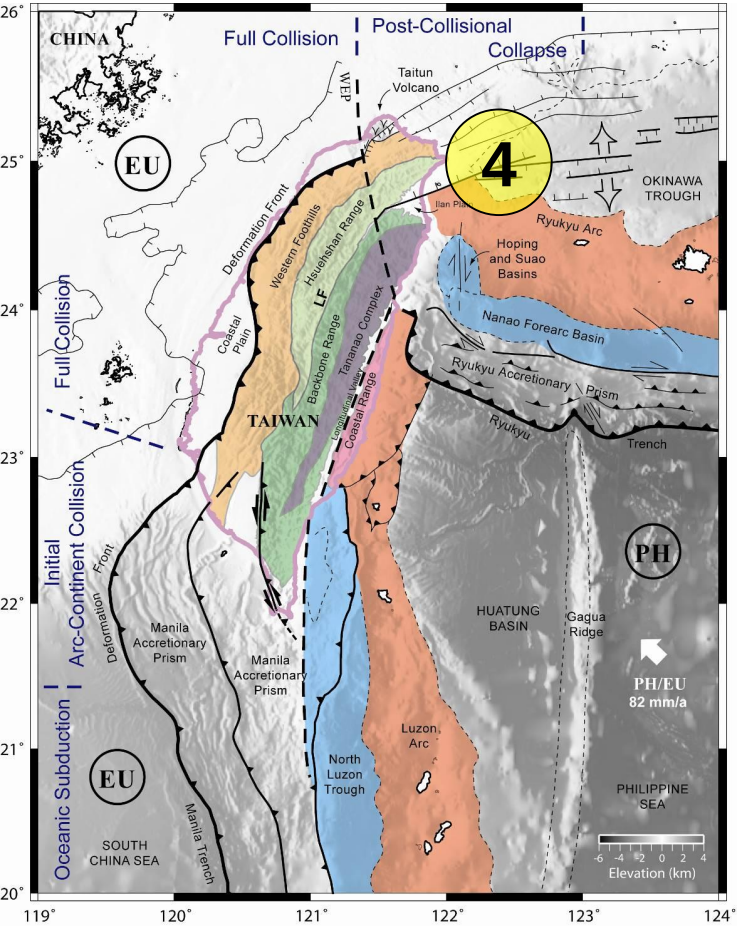
Yue et al. (2005)

Geo-provinces in the Taiwan orogen



Teng & Lin (2004)

4. Post-collisional collapse



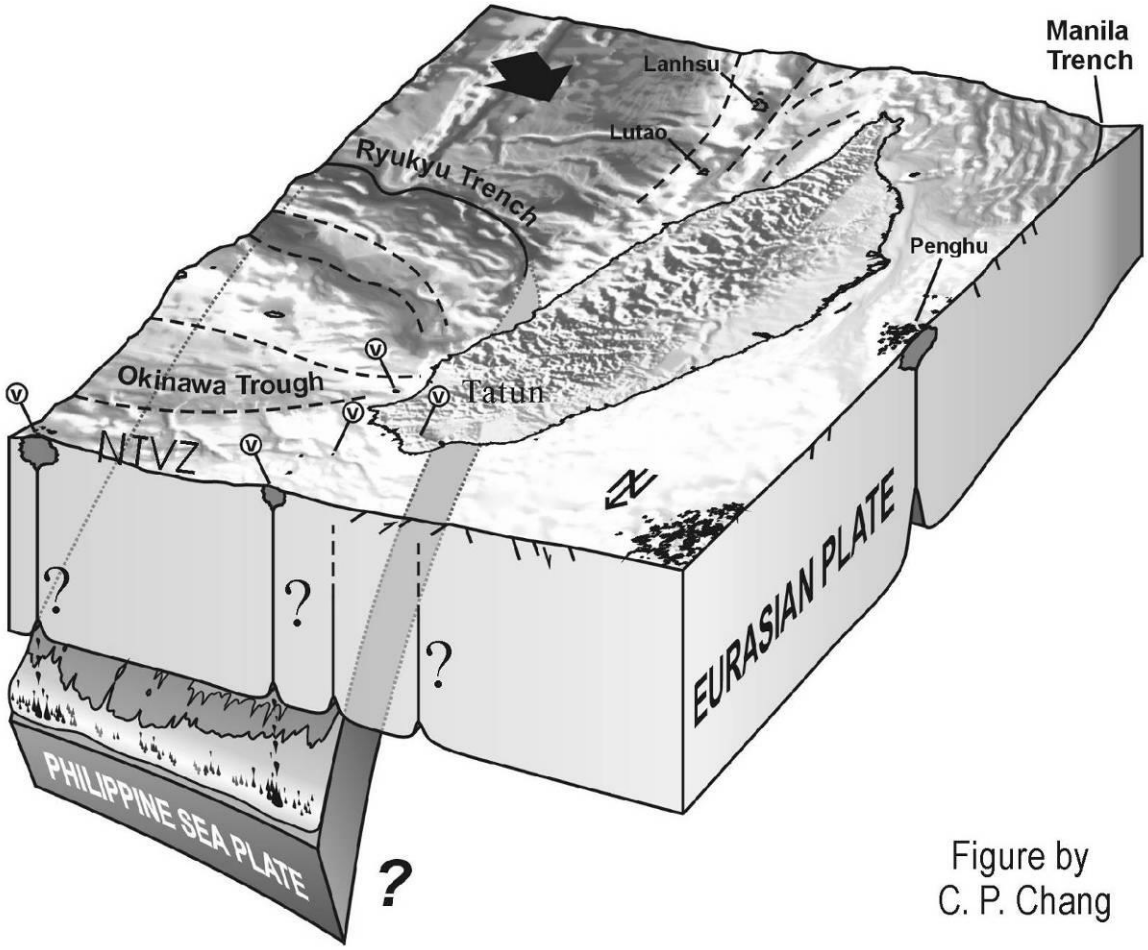
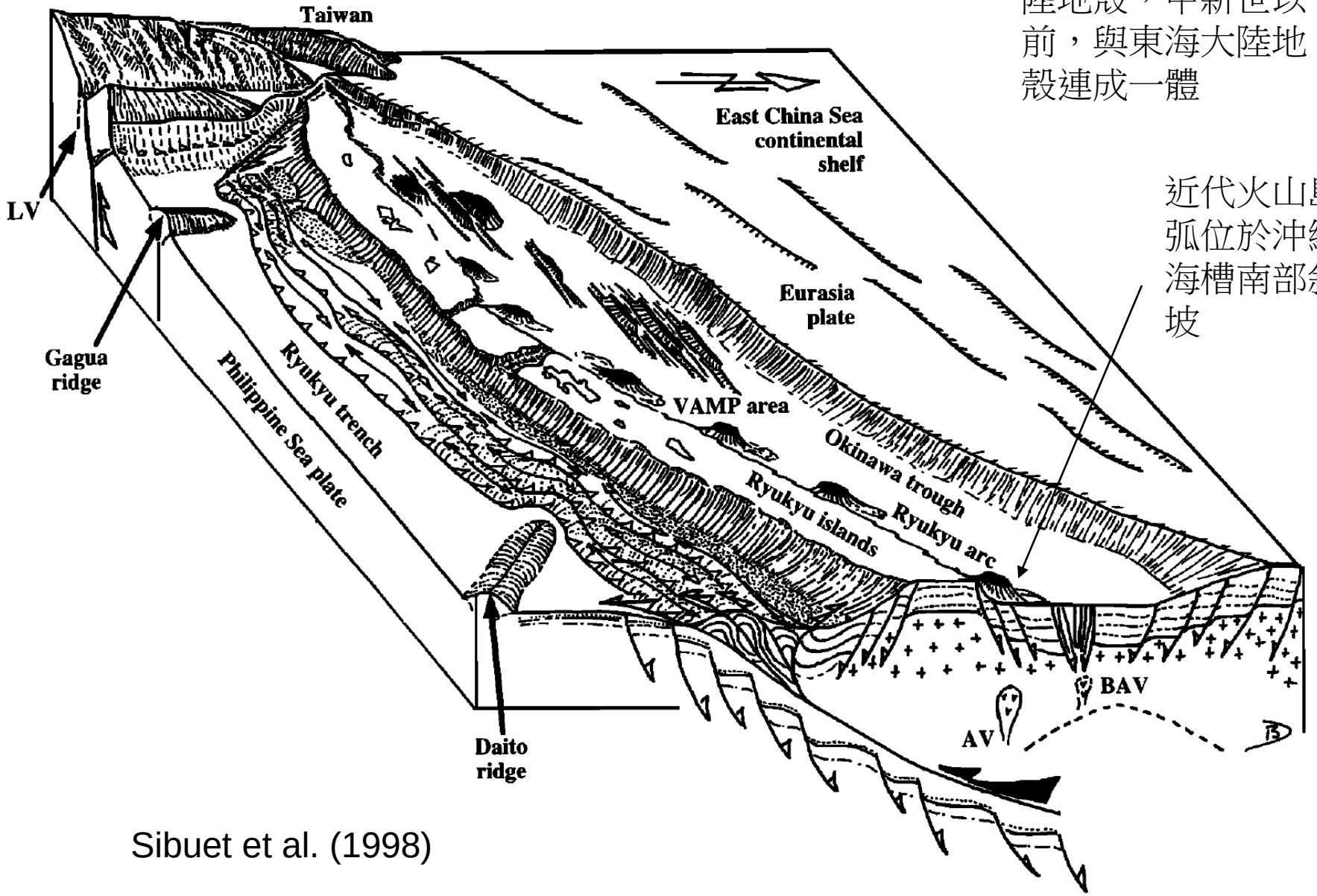


Figure by
C. P. Chang

琉球弧溝系統

琉球諸島基盤是大陸地殼，中新世以前，與東海大陸地殼連成一體

近代火山島弧位於沖繩海槽南部斜坡

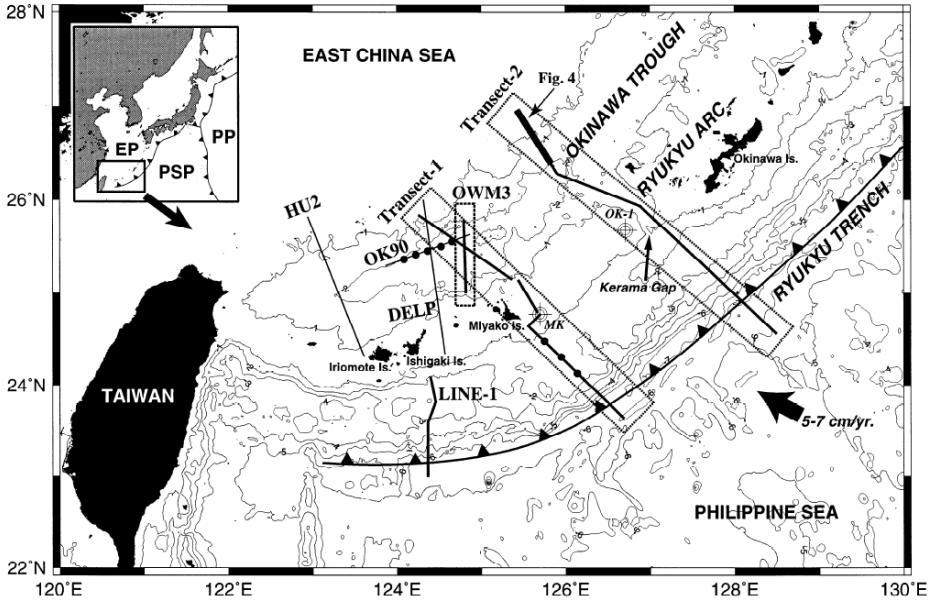


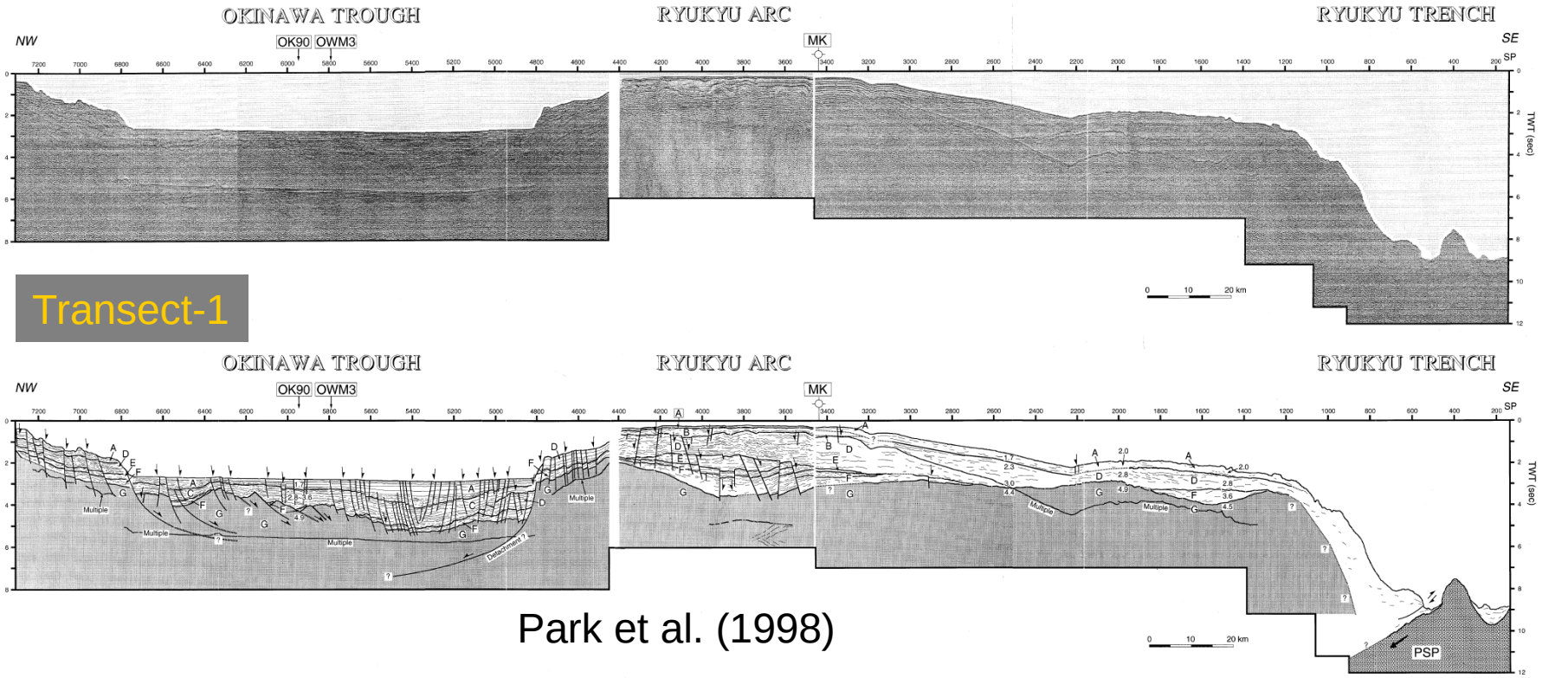
Sibuet et al. (1998)

沖繩海槽成因

沖繩海槽張裂時期：

1. 晚中新世 (9-6 Ma)
2. 2~? Ma (更新世)
3. 近代（幾萬年前至現代）





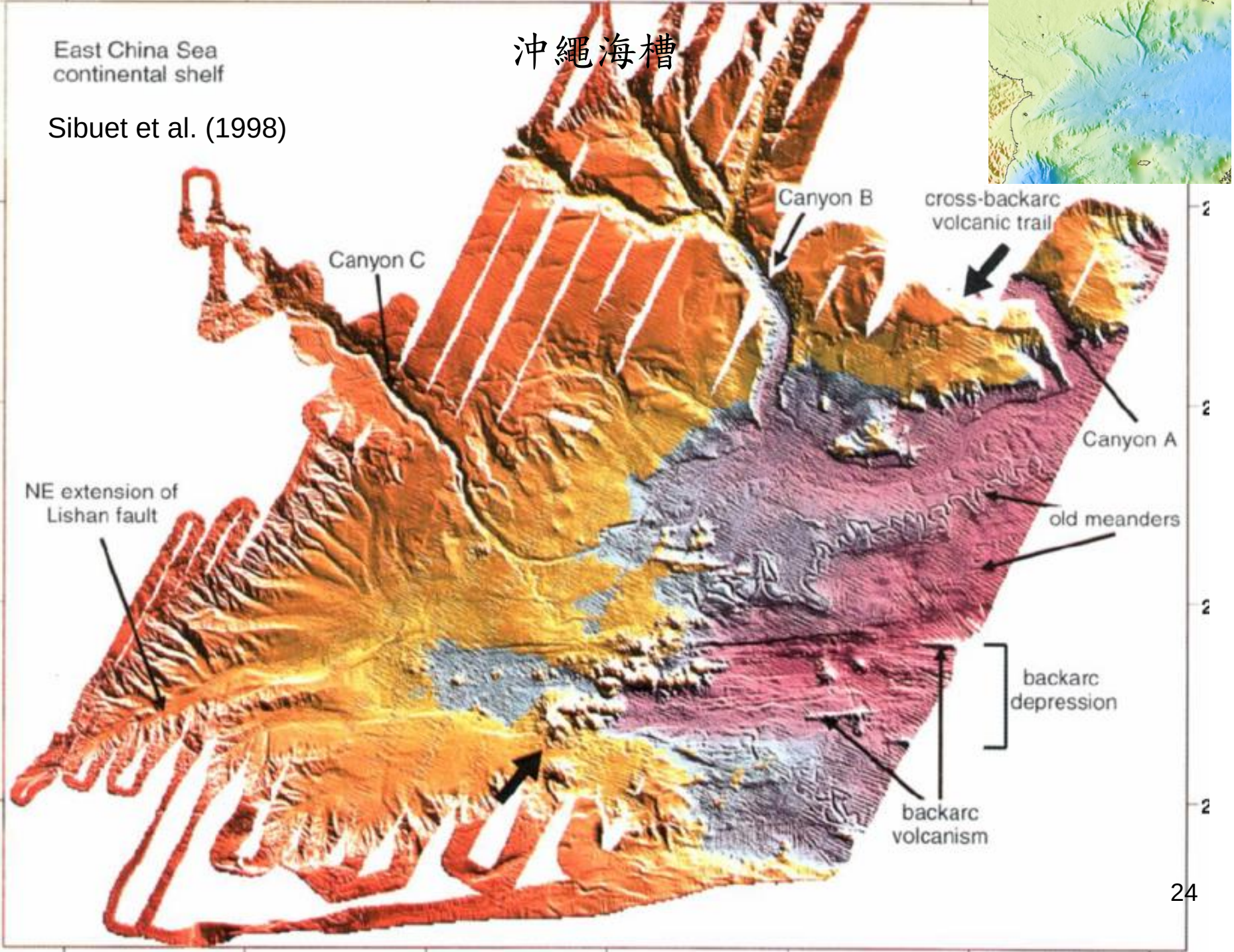
Park et al. (1998)

沖繩海槽

Sibuet et al. (1998)

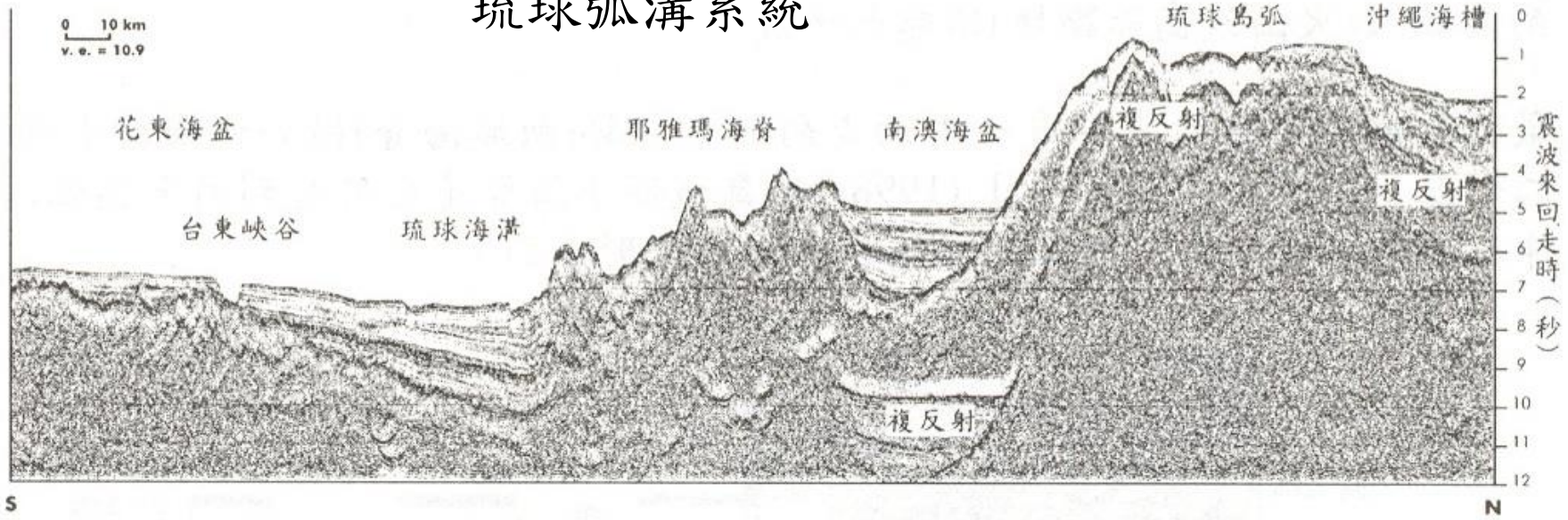
Figure 7. Migrated six-channel high-speed seismic profile 26 (location in Figure 2) across the OT, with the intense volcanism emplaced along the N045° cross-backarc trail. Normal faults and basement are underlined in the bottom panel.

沖繩海槽



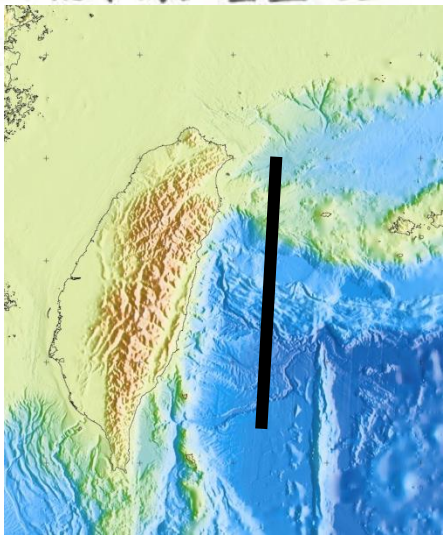
Sibuet et al. (1998)

琉球弧溝系統



圖二十七、南北走向從花東海盆經琉球海溝、耶雅瑪(八重山)海脊、南澳海盆到琉球島弧的多頻道反射震測剖面 EW9509-1（摘自 Liu et al., 1997b）。反射剖面清楚顯示地形與大地構造單元的密切對應關係，並顯示弧前盆地座落於琉球島弧基盤之上。剖面位置見圖二十五 AA'線。

劉家瑄(2002)



花東海盆

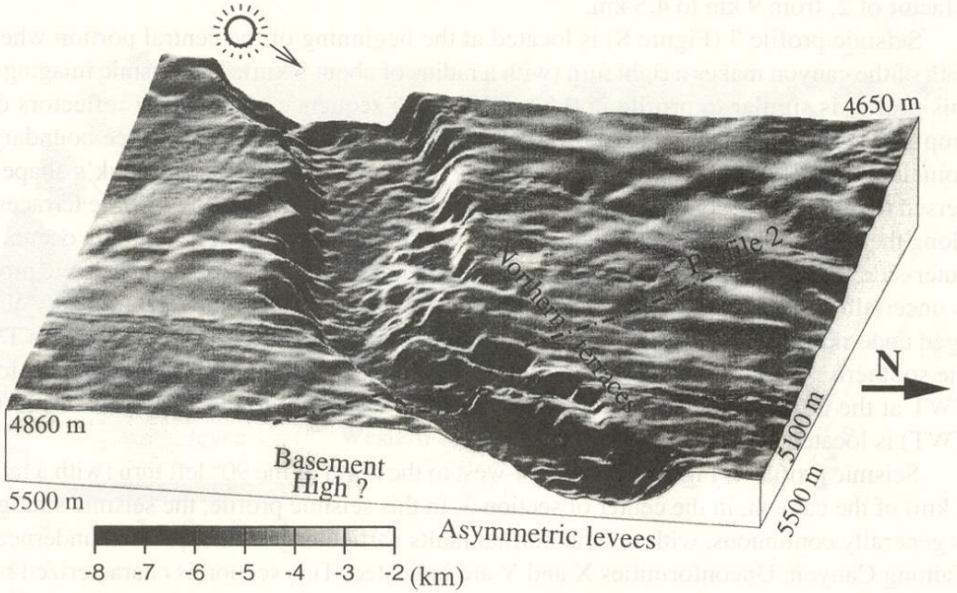


Fig. 5. Perspective shaded view of upper portion of the Taitung Canyon (section 2; see Figure 2 for location). The view is from the east (N80°), with a 20° elevation and N250° illumination angle. Water depths at the corners are indicated. The location of seismic profile 2 (line EW9509-23) is indicated by a dashed line.

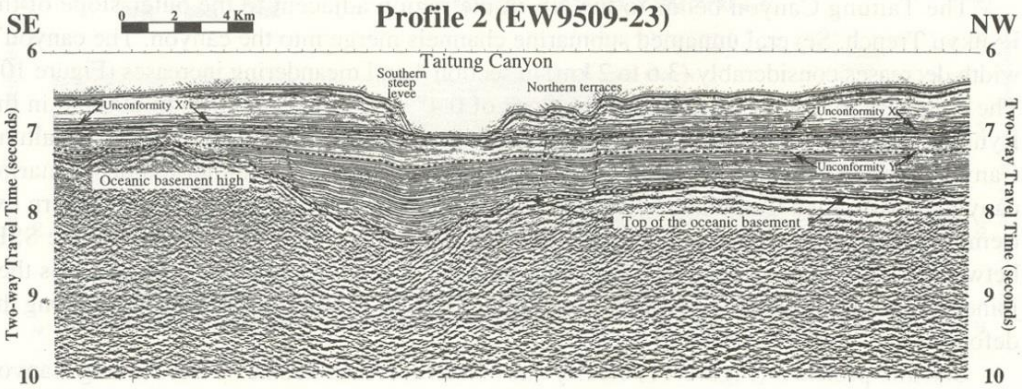
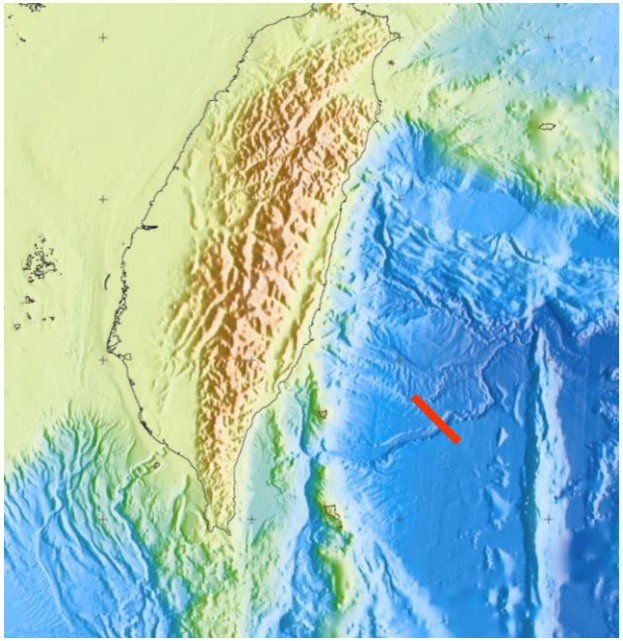


Fig. 6. Time-migrated seismic section of profile 2 (line EW9509-23). This profile runs SE-NW (see Figure 2 for location) across the upper portion of the Taitung Canyon. Vertical exaggeration at sea-floor is about 2x.



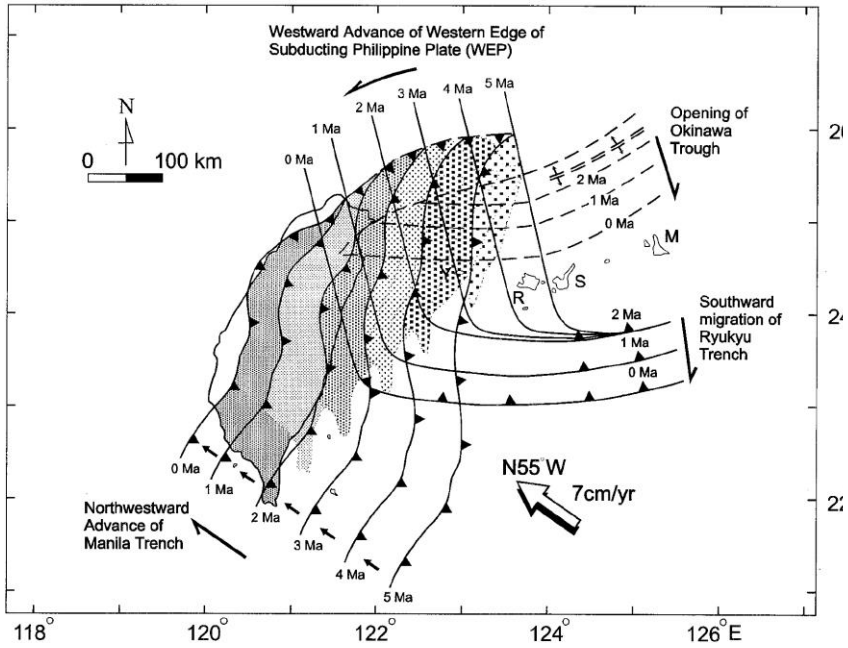
Reversal of subduction polarity

Removal of compressive stress

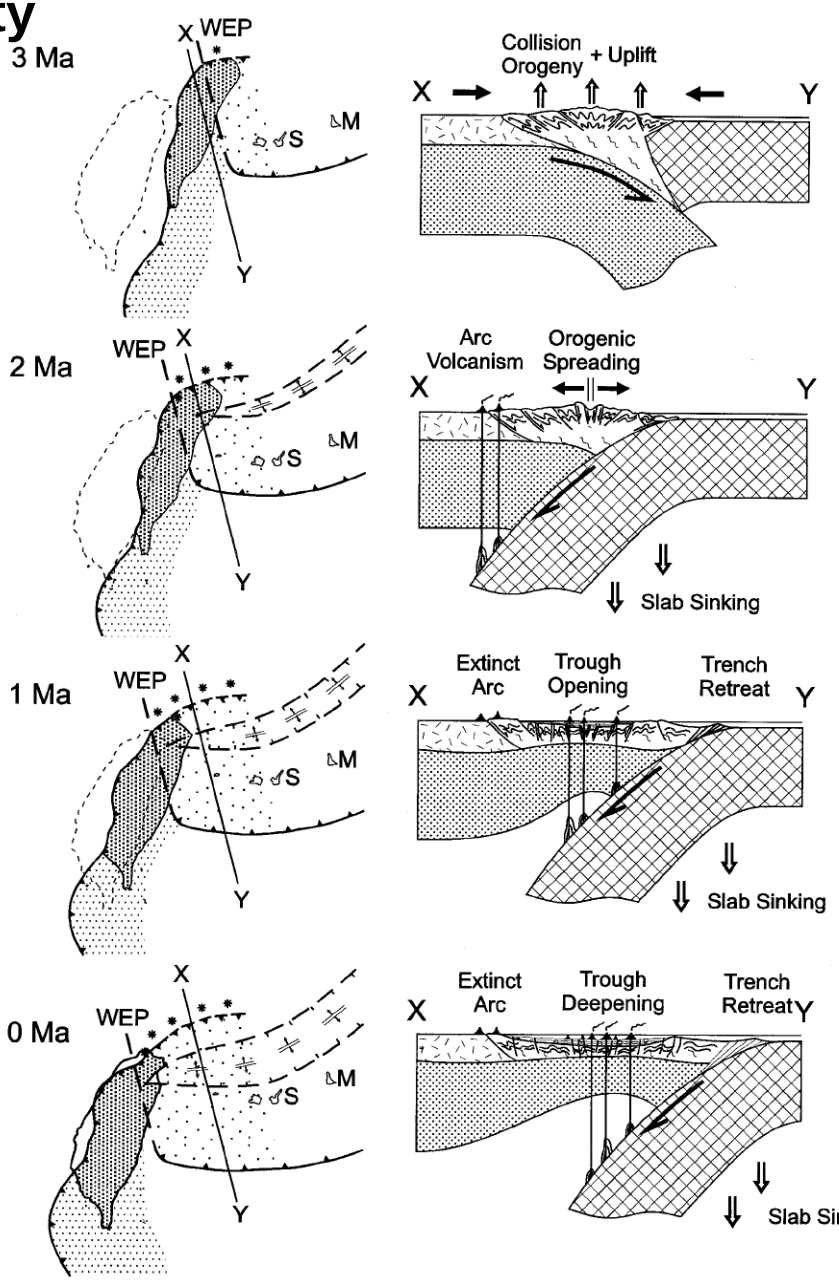
Gravitation drives extension

+

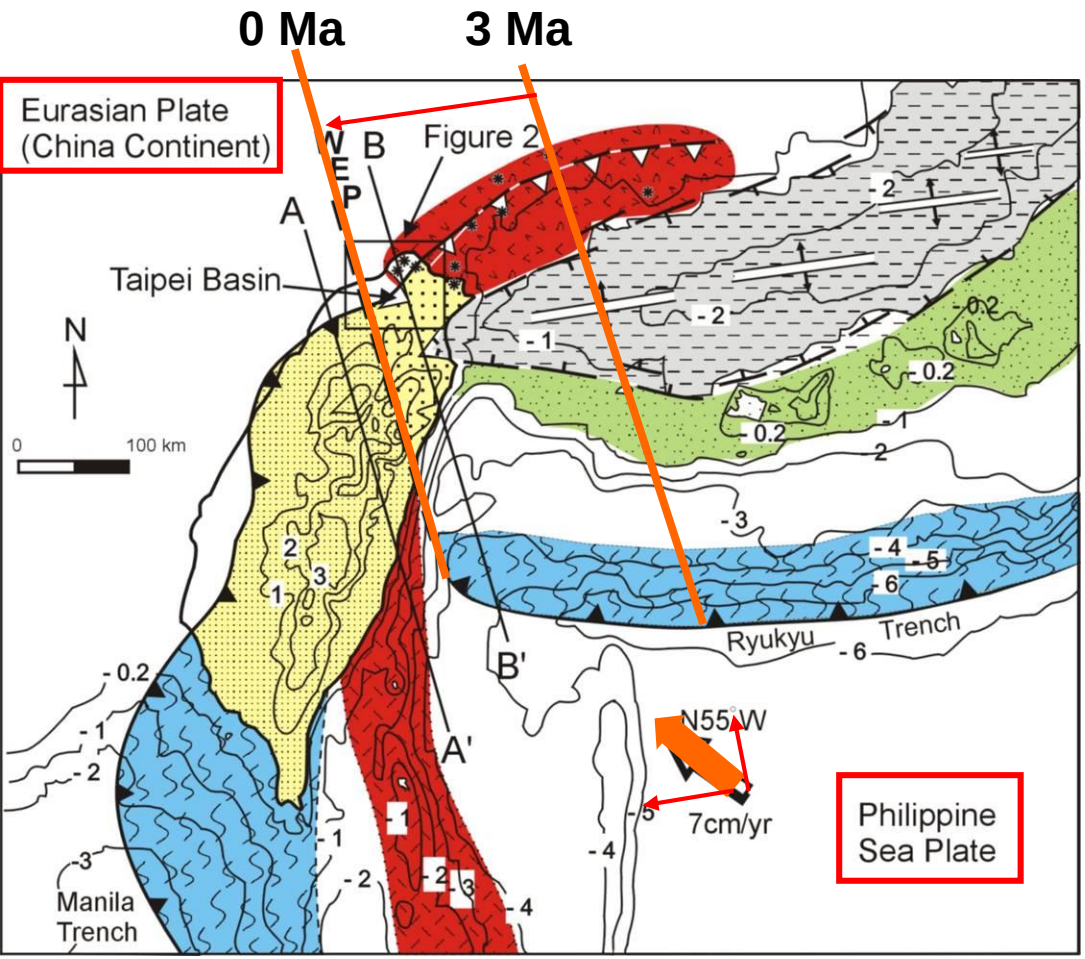
Trench retreat



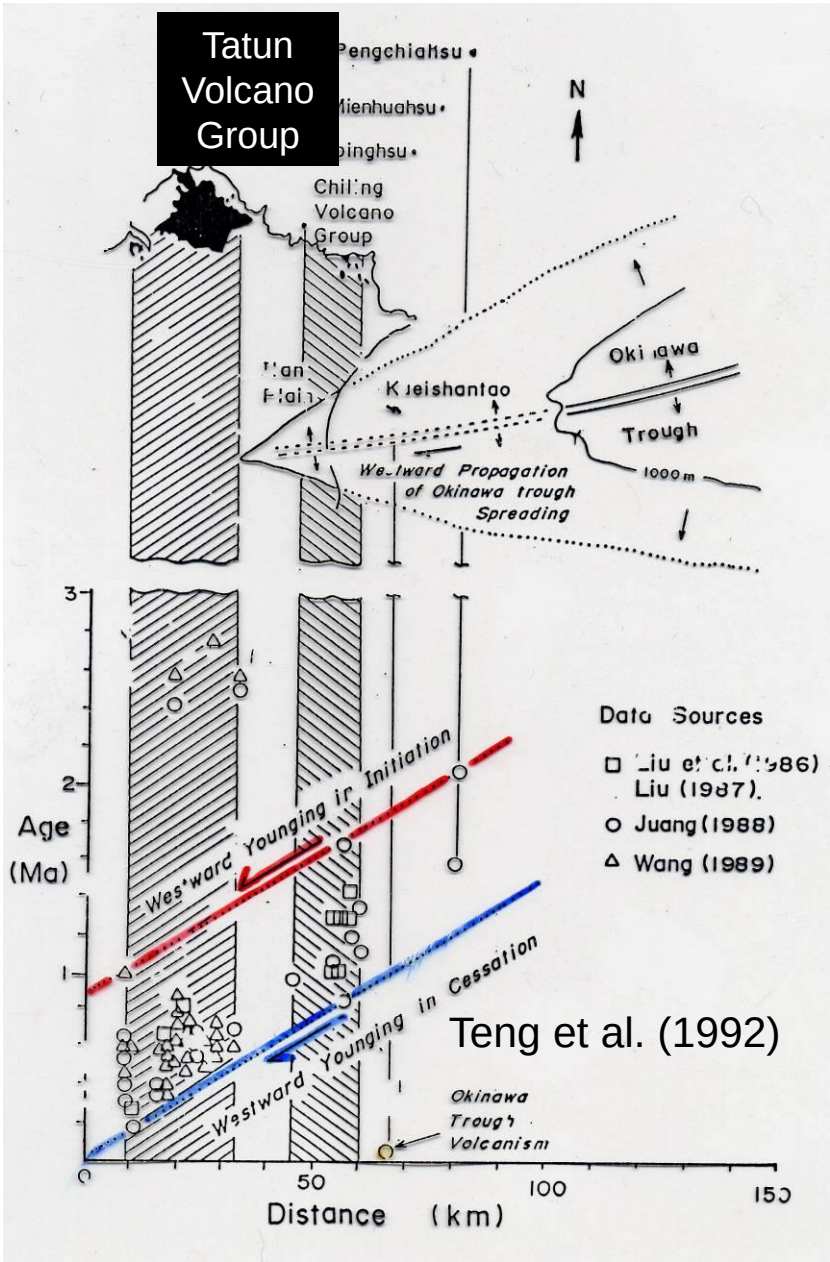
Teng (1996) Geology 24(10)



Westward advancing of the Ryukyu arc-trench system



Teng (1996)

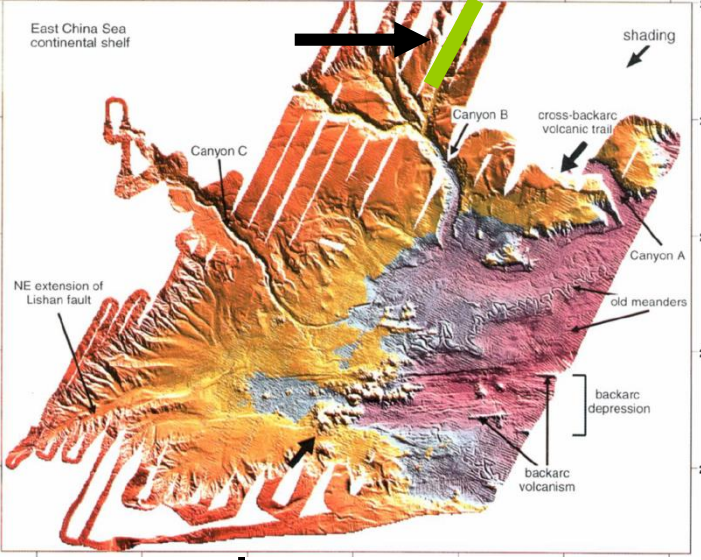


Teng et al. (1992)

Courtesy of Teng, L.S.

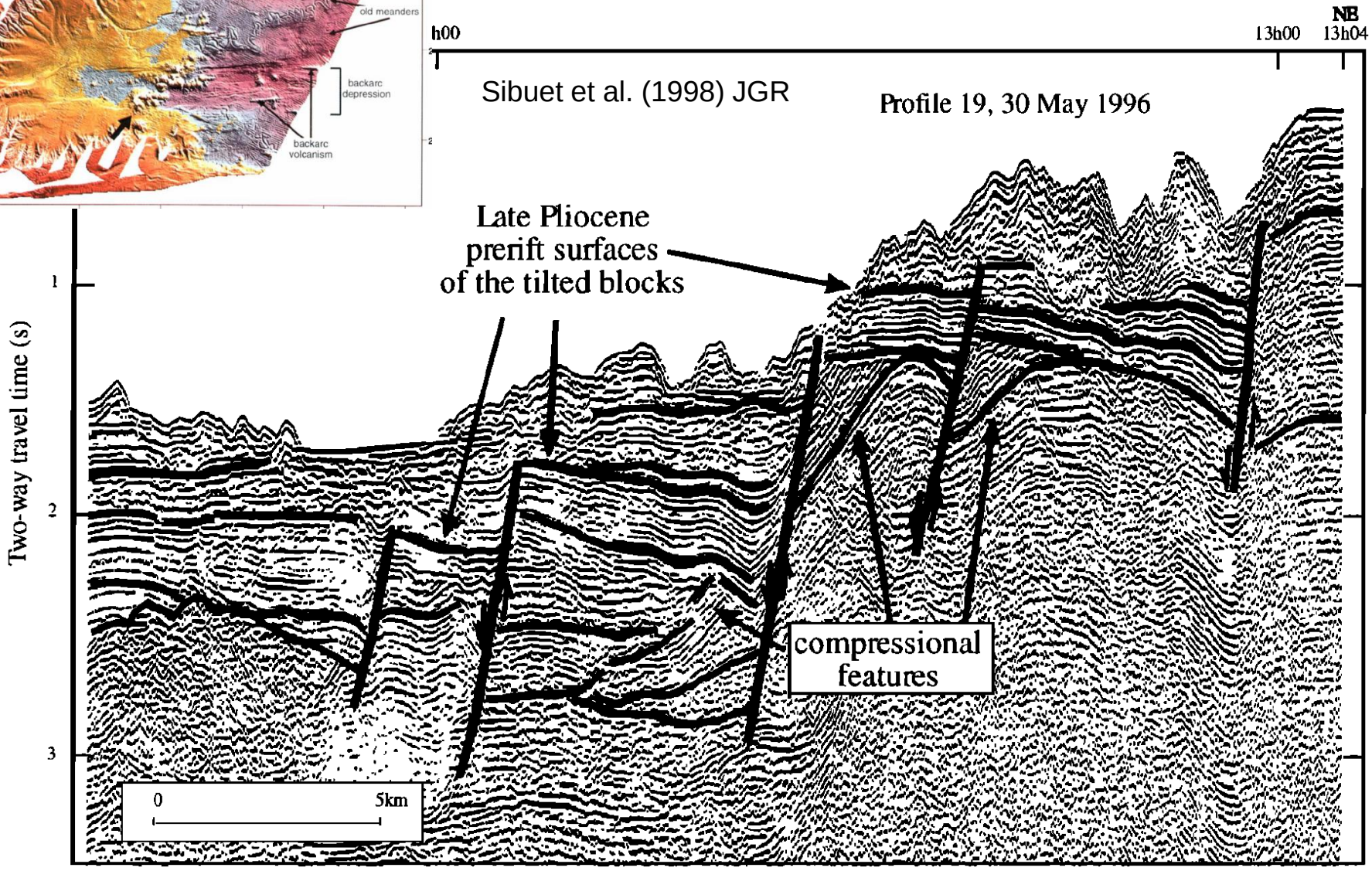
Northern margin of the Okinawa Trough

Rifting on top of old compressional features

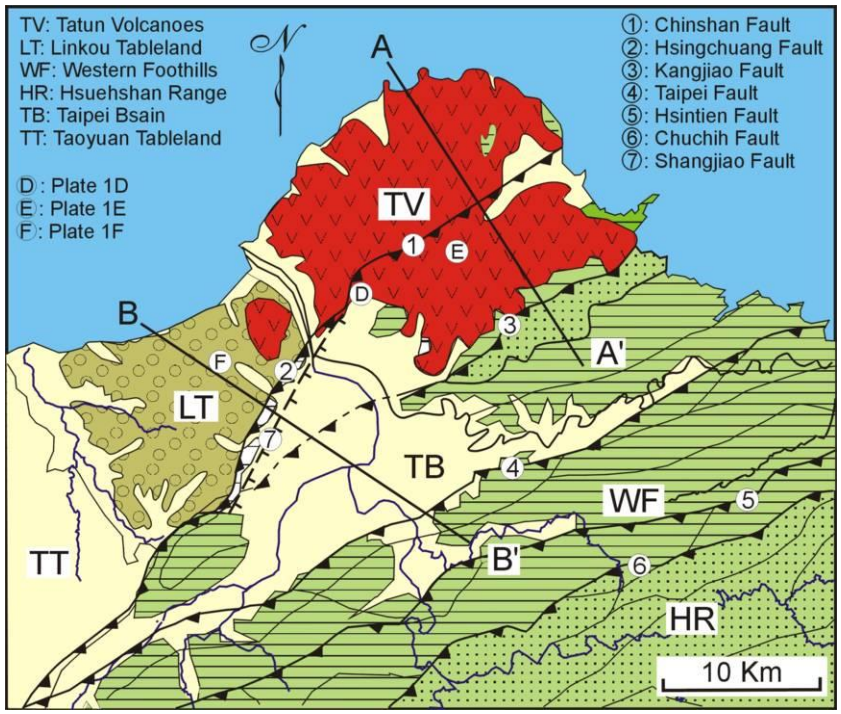


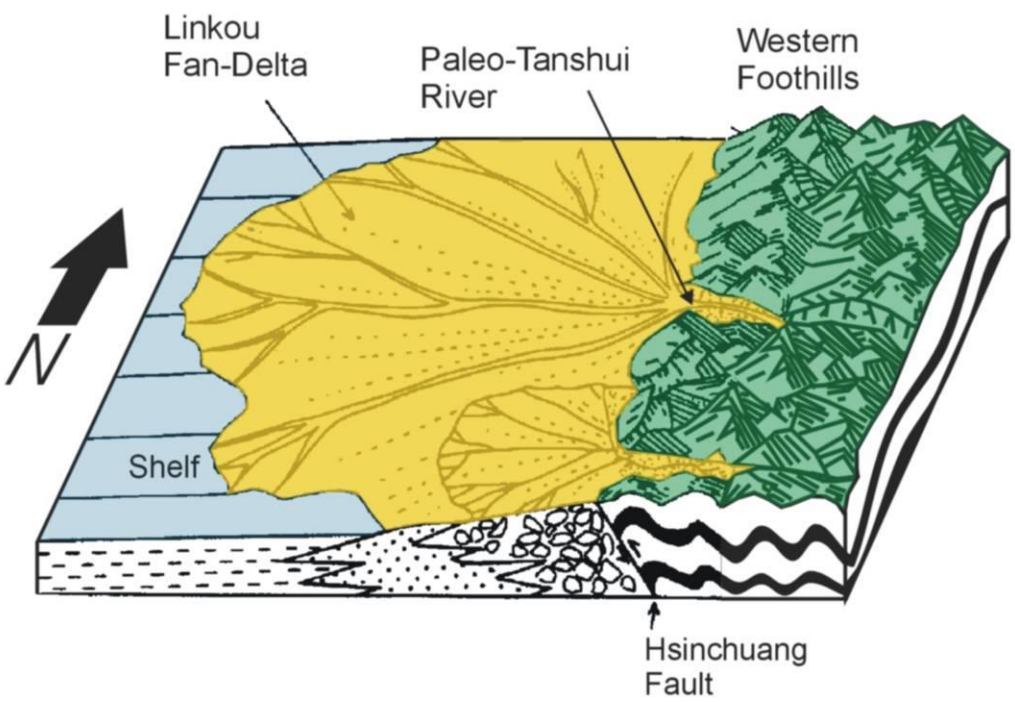
Sibuet et al. (1998) JGR

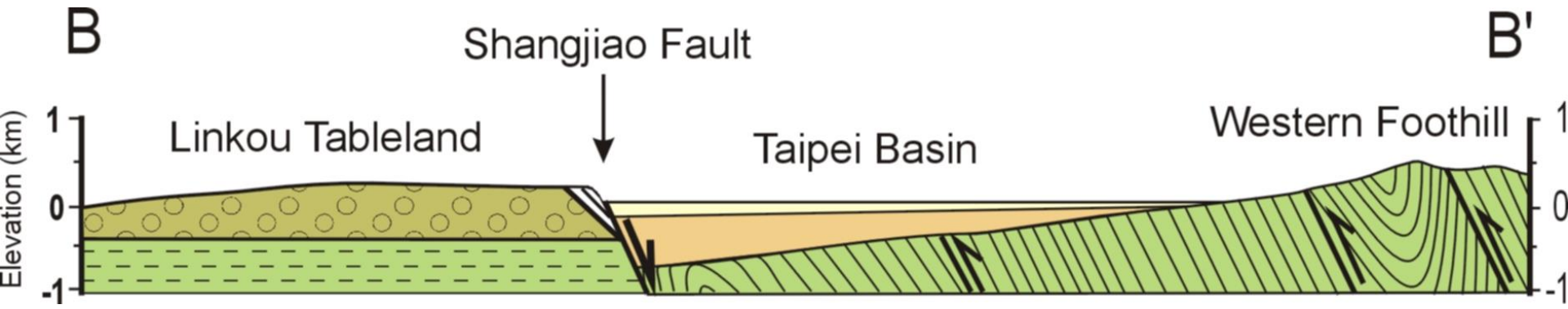
Profile 19, 30 May 1996



The fault-bounded Taipei basin formed on top of a fold-and-thrust belt



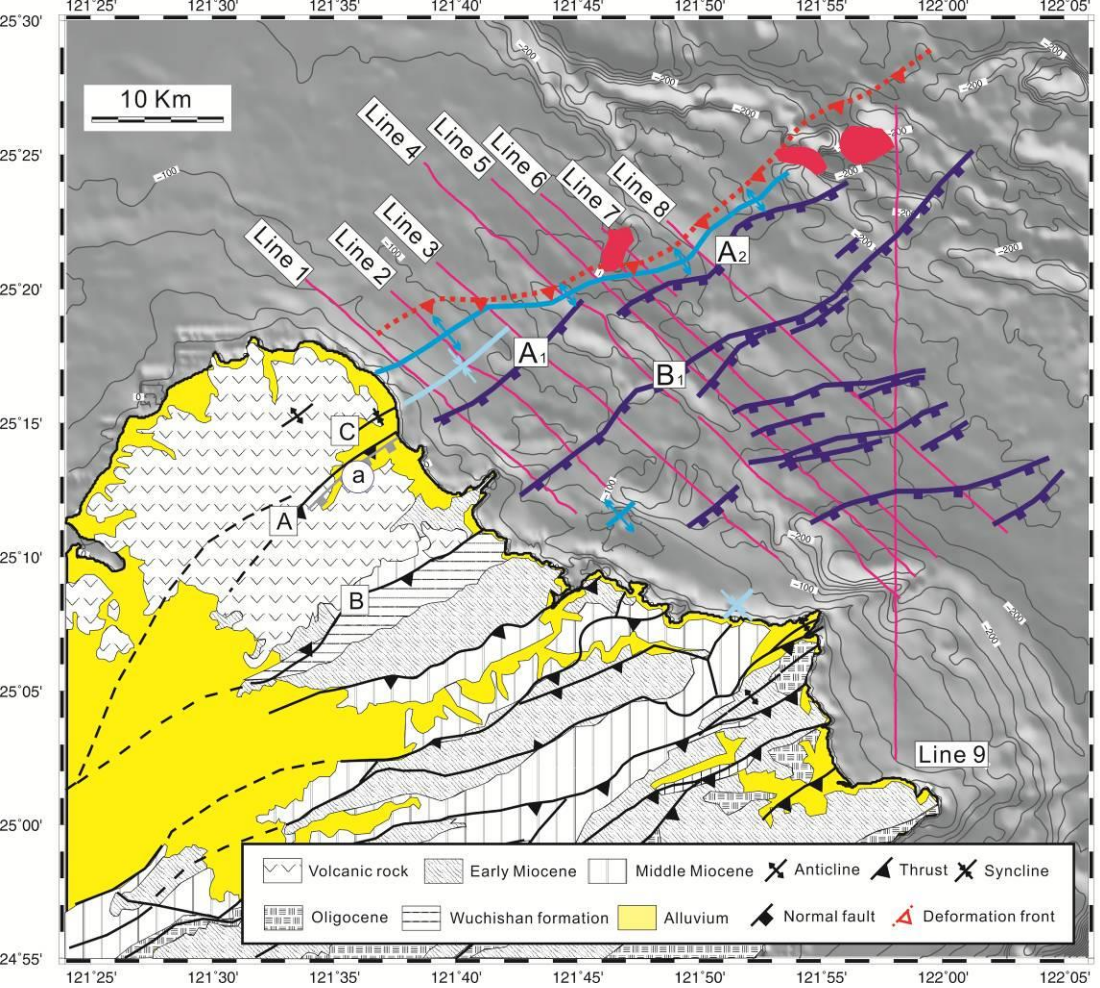


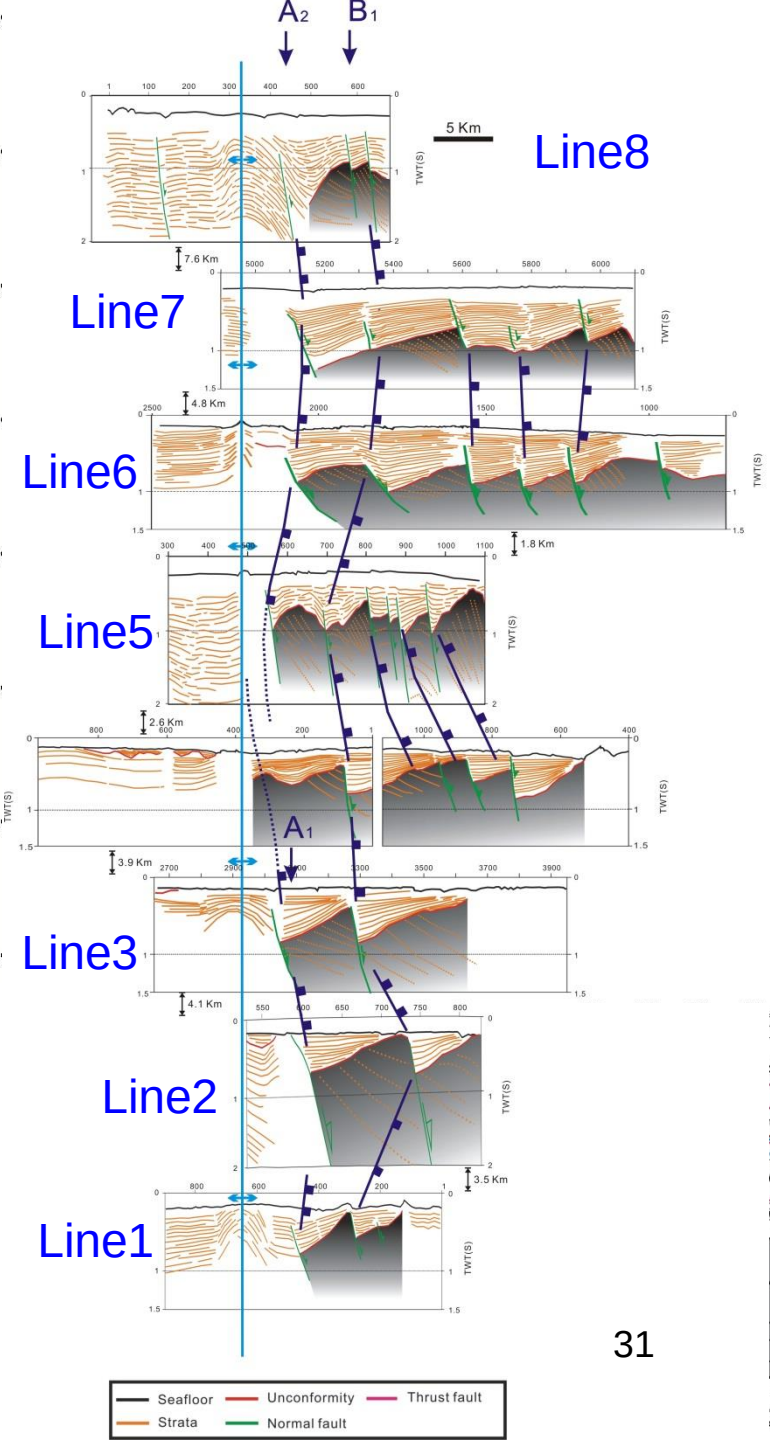


Chen & Teng (1990)

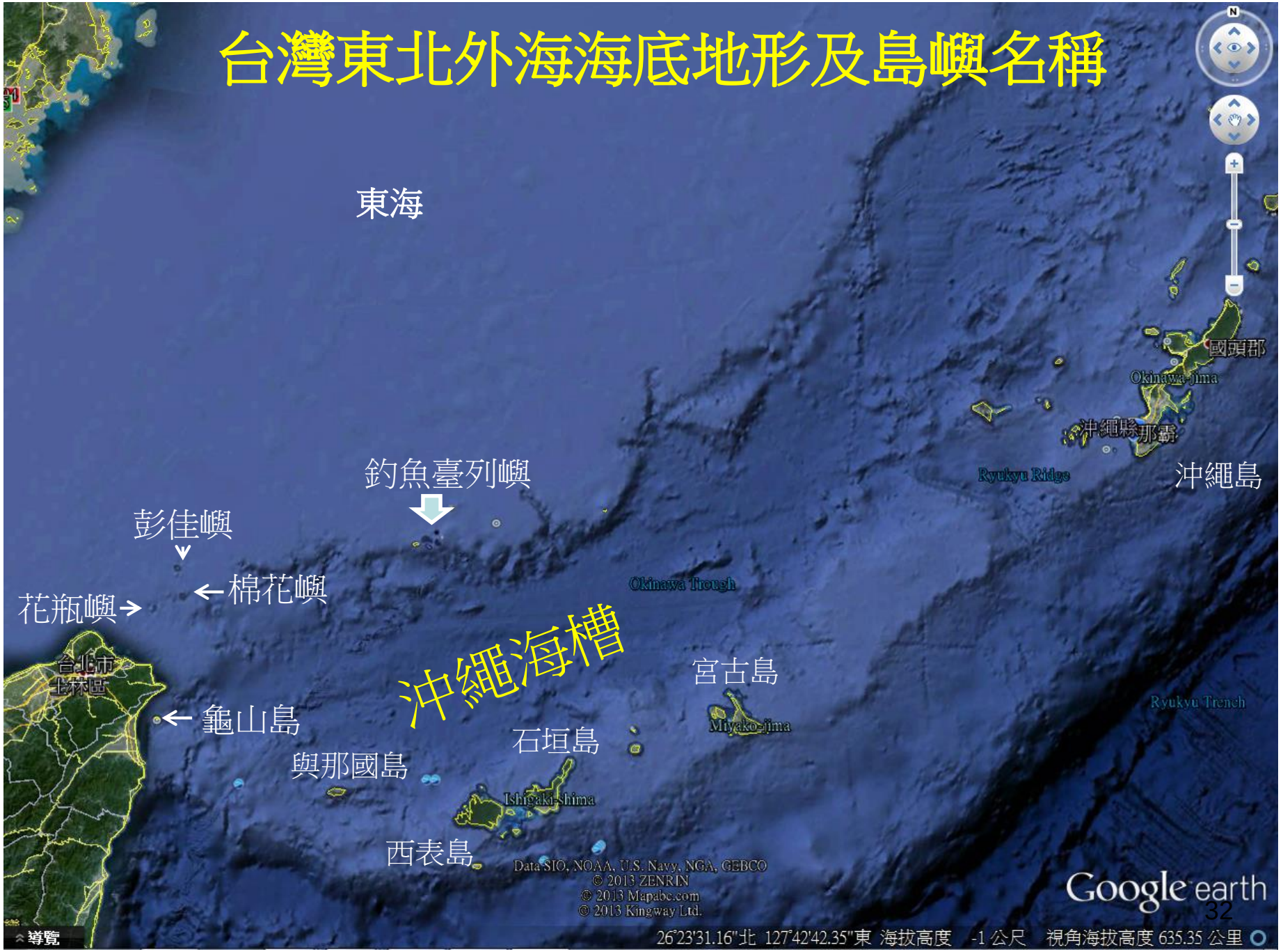
Teng et al. (1999)

Courtesy of Teng, L.S.





A：金山（新莊）斷層
B：崁腳斷層
C：跳石向斜
A1：金山斷層外海延伸1
A2：金山斷層外海延伸2
B1：崁腳斷層外海延伸
a：磺溪斷層


台灣東北外海海底地形及島嶼名稱
東海
釣魚臺列嶼
彭佳嶼
棉花嶼
花瓶嶼
龜山島
沖繩海槽
與那國島
石垣島
宮古島
西表島
沖繩島
國頭郡
沖繩縣那霸
Okinawa-jima
Ryukyu Ridge
Okinawa Trough
Ryukyu Trench
Miyako-jima
Ishigaki-Shima
台北市
北投區
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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Google earth
導覽
26°23'31.16"北 127°42'42.35"東 海拔高度 -1 公尺 視角海拔高度 635.35 公里

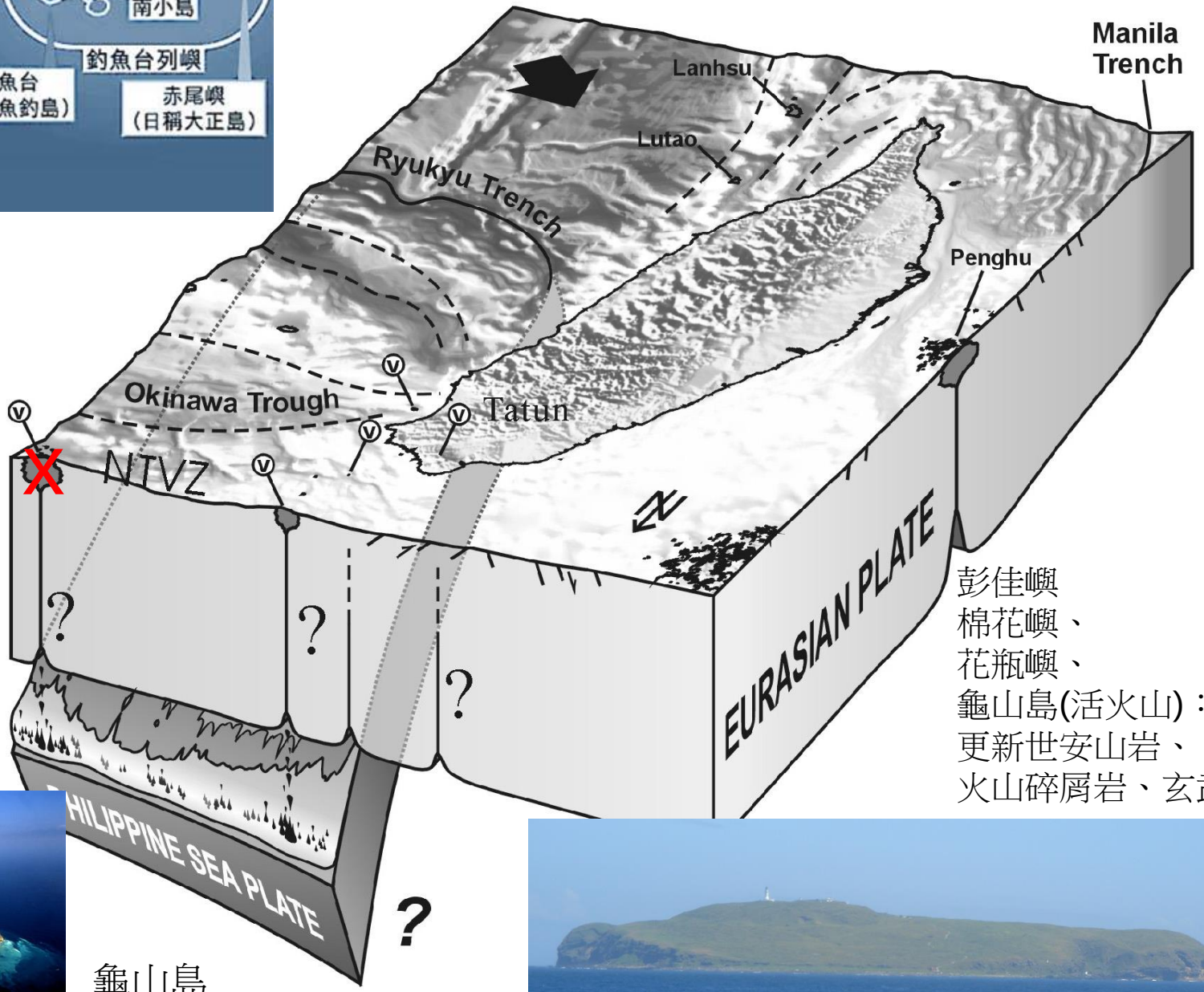
北方海域諸島成因


科博館網站：
http://digimuse.nmns.edu.tw/Default.aspx?tabid=369&ObjectId=0b00000181da5457&Domin=g&Field=ri&ContentType=Exhibit&Language=CHI&FieldName=
彭佳嶼
花瓶嶼
棉花嶼
基隆嶼
基隆港
龜山島
北方三島位置圖
攝於碧砂漁港

From:
http://cyberx.liful.com/1895/geo.htm

釣魚台:
中新世地層
(砂岩及頁岩
互層)

釣魚台不是
由火成岩所
組成!



彭佳嶼
棉花嶼、
花瓶嶼、
龜山島(活火山):
更新世安山岩、
火山碎屑岩、玄武岩

龜山島

彭佳嶼(28/9/2007, ORII-1477航次)

釣魚台島地形圖

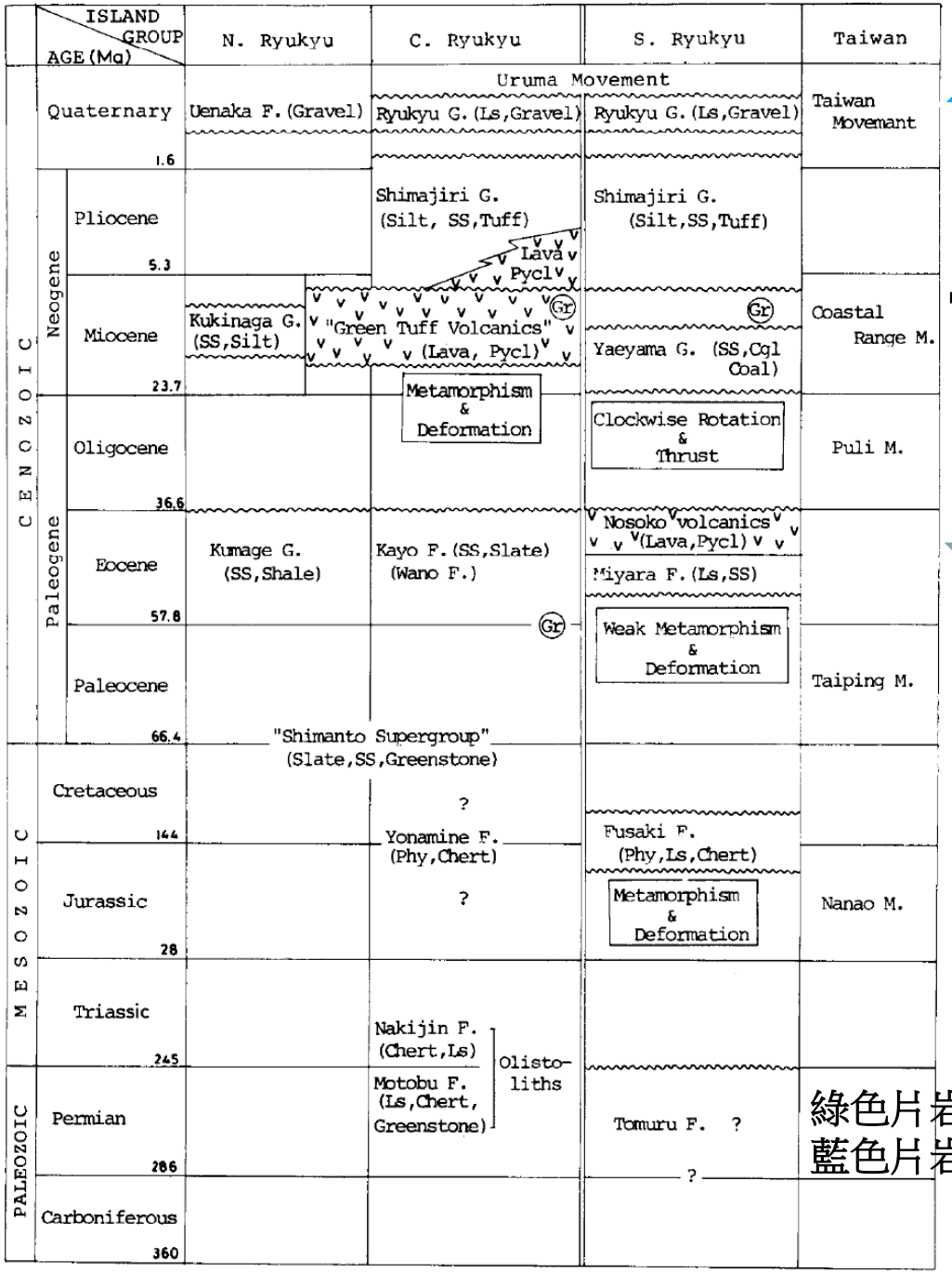
內政部地政司 www.land.moi.gov.tw/filelink/uploadlink-127.jpg

釣魚臺地質

釣魚臺的中新世地層 在臺灣本島北北東約一百五十公里的海上，有屬宜蘭縣管轄的釣魚臺島。這個島東西的長度是三．五公里，南北長一．五公里，全面積大約是四平方公里。島的南邊是陡峻的懸崖，北面為傾斜坡，北側的海岸呈弧形。島上最高峰在西南部，海拔三百六十三公尺。**釣魚臺的主體是由砂岩構成**，層厚數公尺，砂岩層的中間常夾有泥岩的薄層。砂岩一般呈白色或灰白色，風化後變為黃褐色，細粒至粗粒，部分為礫岩狀的砂岩，礫石的最大直徑可以到達二十公分，多為圓形到亞圓形。組成砂岩的主要礦物成分有石英、長石、和岩石碎片，以及風化所成的粘土礦物。砂岩的下部夾有若干厚十至二十公分的煤質細砂岩層，含有三至四層的**煤質泥岩**，其中煤的厚度為數公厘到二公分，連續性不佳。砂岩層出露的厚度約有一百五十公尺，地層的一般走向為東西或東北東，傾斜向北，傾角平緩，大約在十五至二十五度之間。整個的構造呈一個寬展的半弧形，弧頂微向北凸出。釣魚臺的砂岩層中還沒有發現化石，但是就它的岩性和組織而言，**將它和臺灣本島中新世的南港層或石底層對比較為合理**，所以在本地質圖上把它歸入瑞芳群的圖例中，兩者間之不同在釣魚臺的礫岩狀砂岩為瑞芳群所無。

何春蓀(1986)台灣地質概論p.98

琉球群島地層



沖繩海槽張裂琉球諸島開始成形

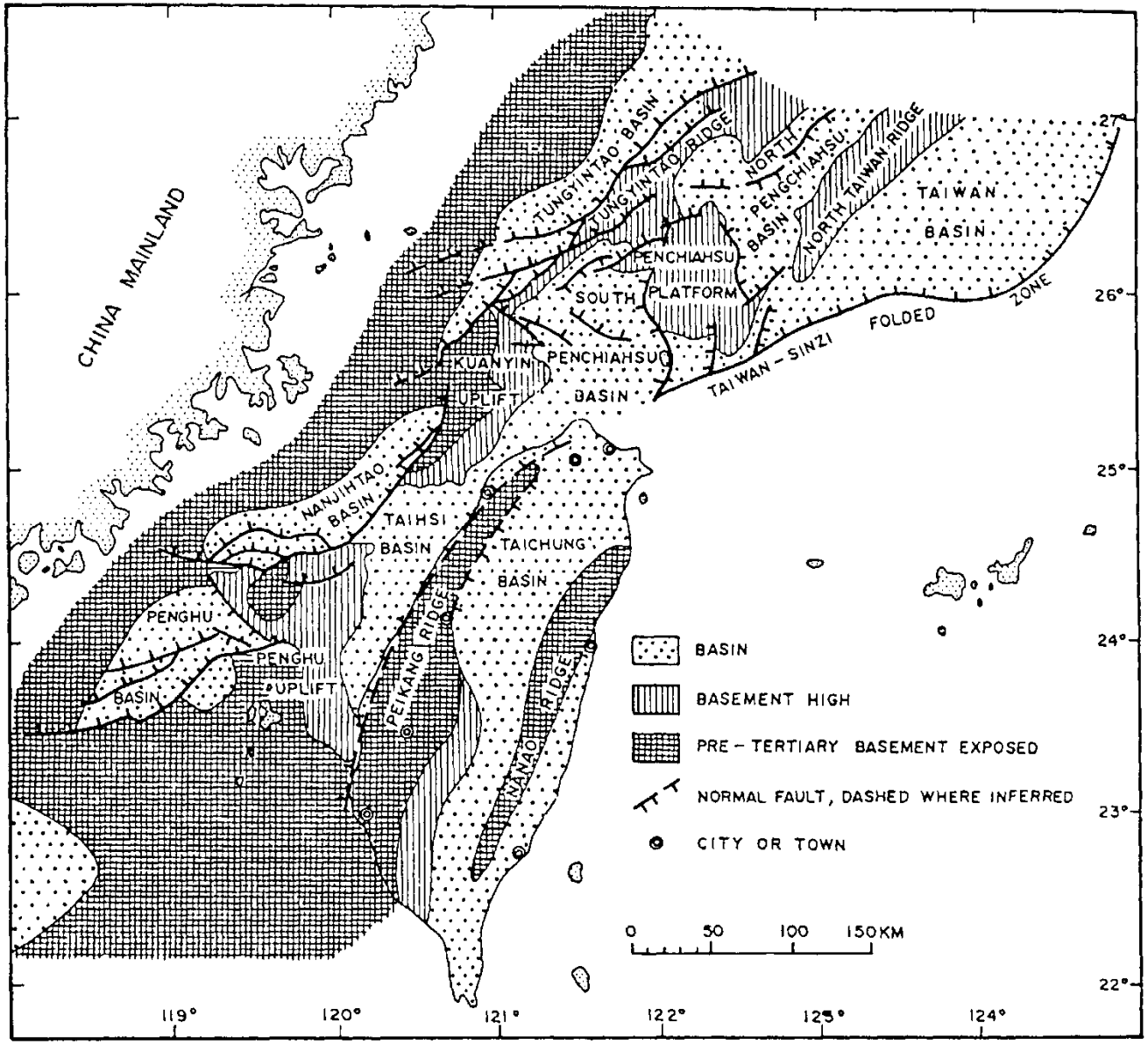
9百萬-6百萬年前

本地區屬於古代東海大陸棚最外緣的部分(琉球諸島尚未形成、沒有沖繩海槽)

綠色片岩
藍色片岩

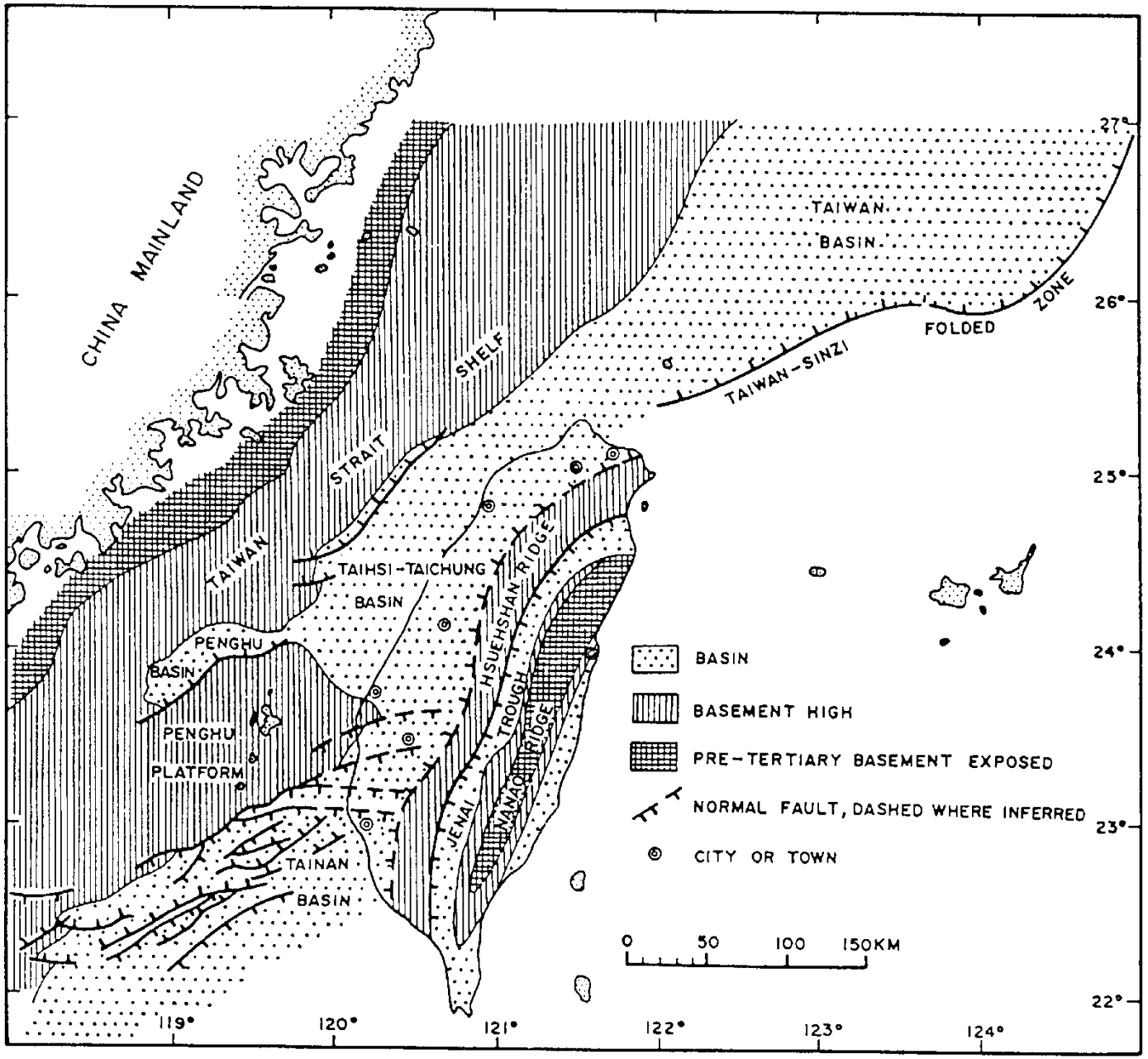
Kizaki (1986)

古第三紀盆地架構圖



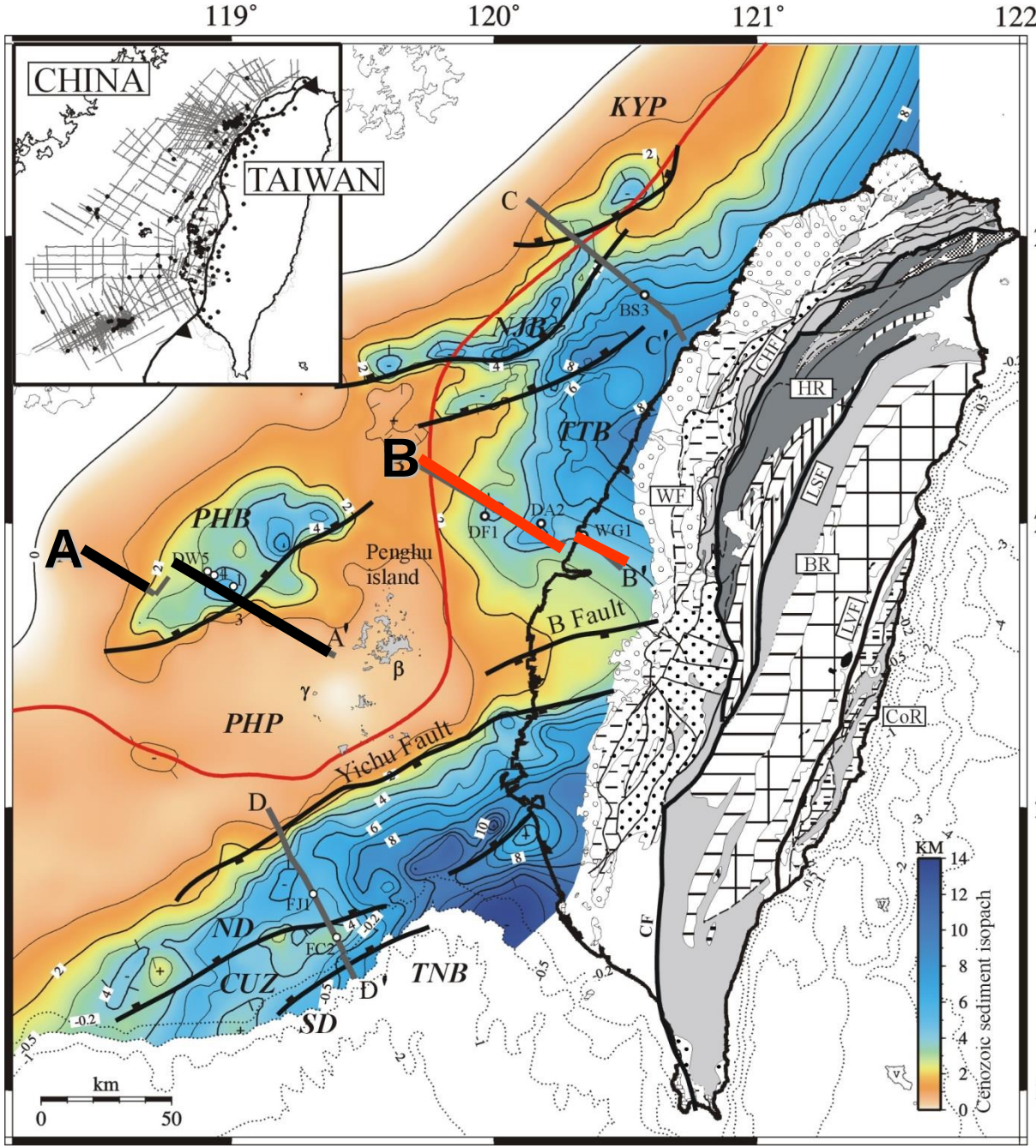
Sun(1982)

新第三紀盆地架構圖

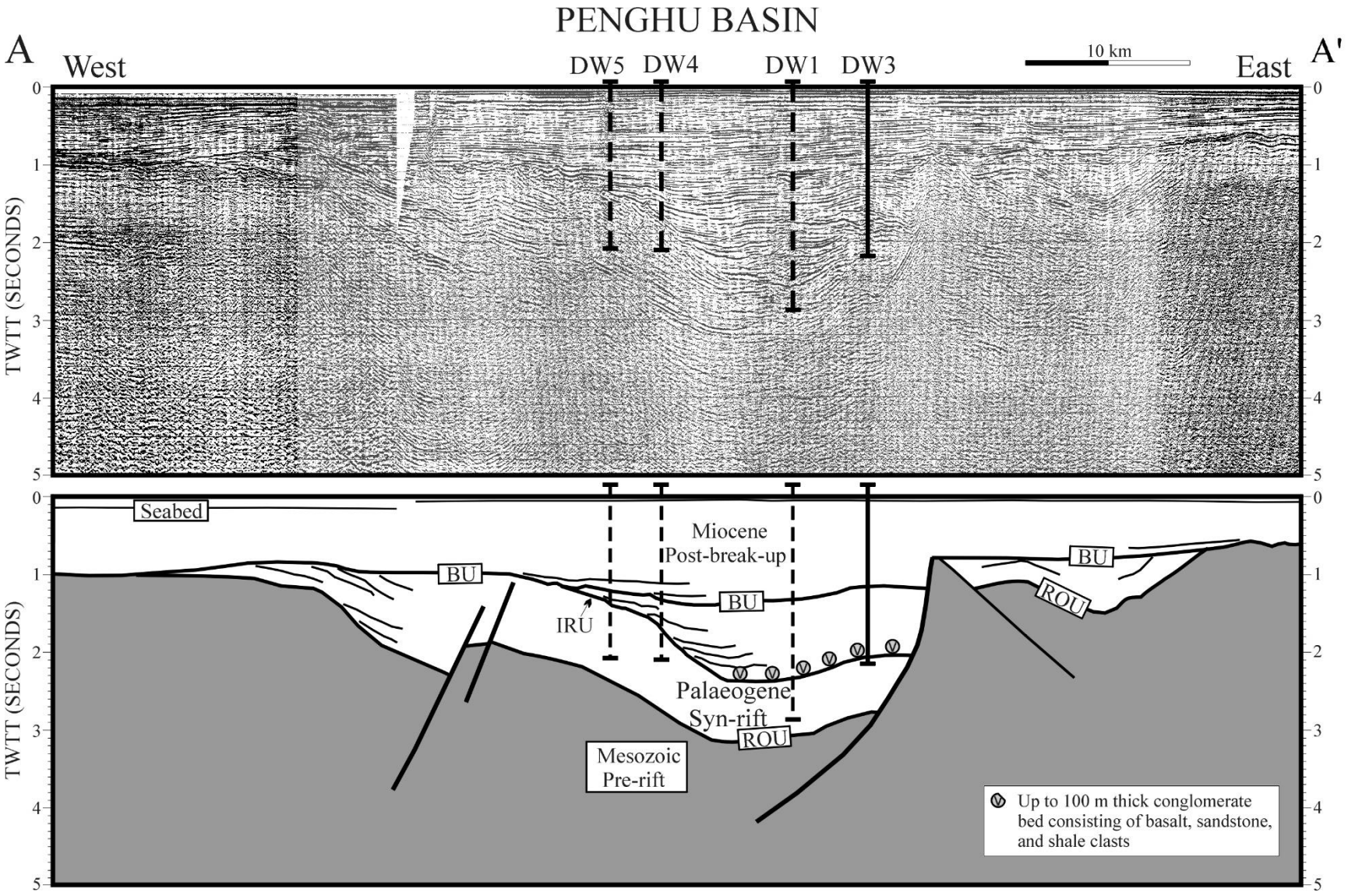


Sun(1982)

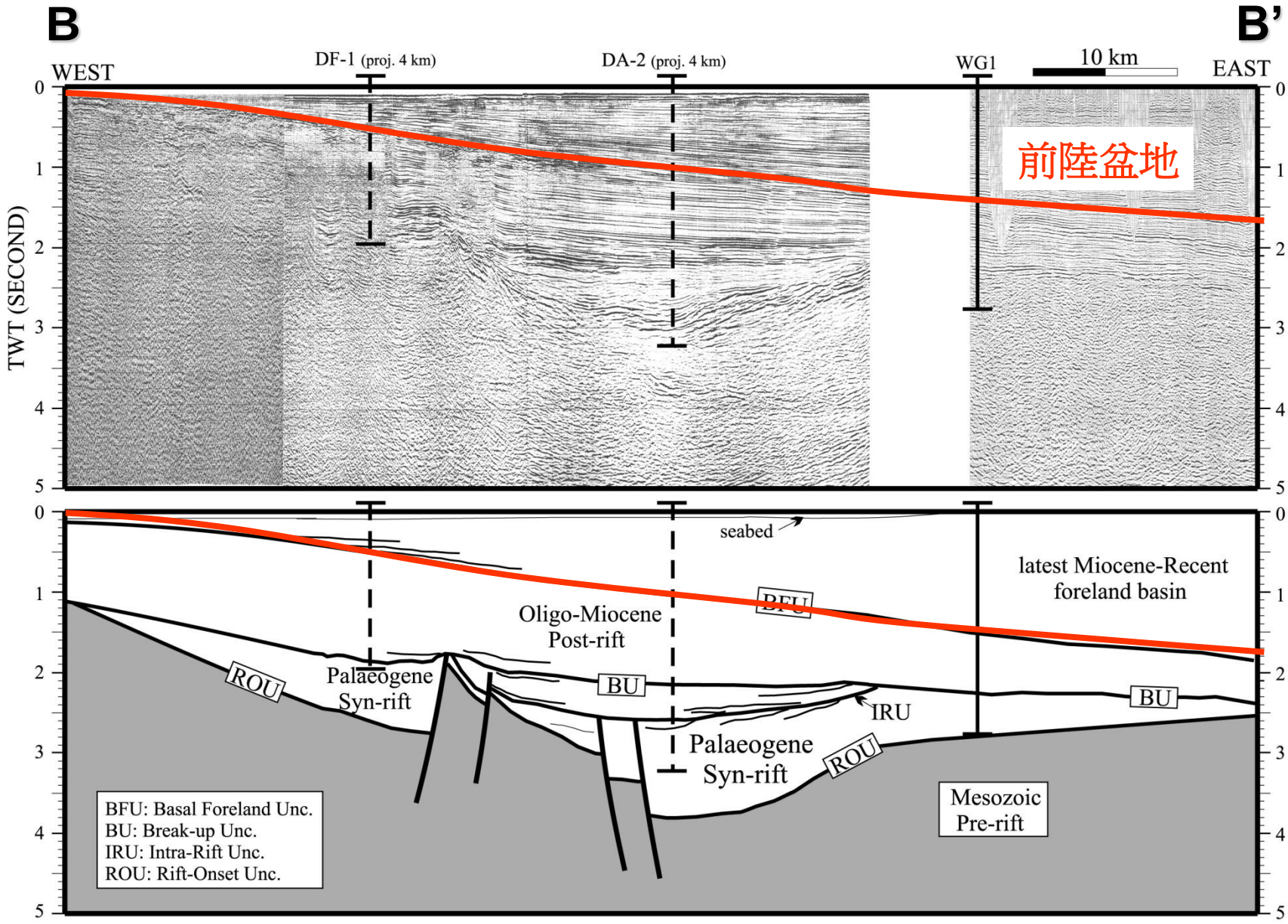
Cenozoic sediment thickness in the Taiwan region



Lin et al. (2003)

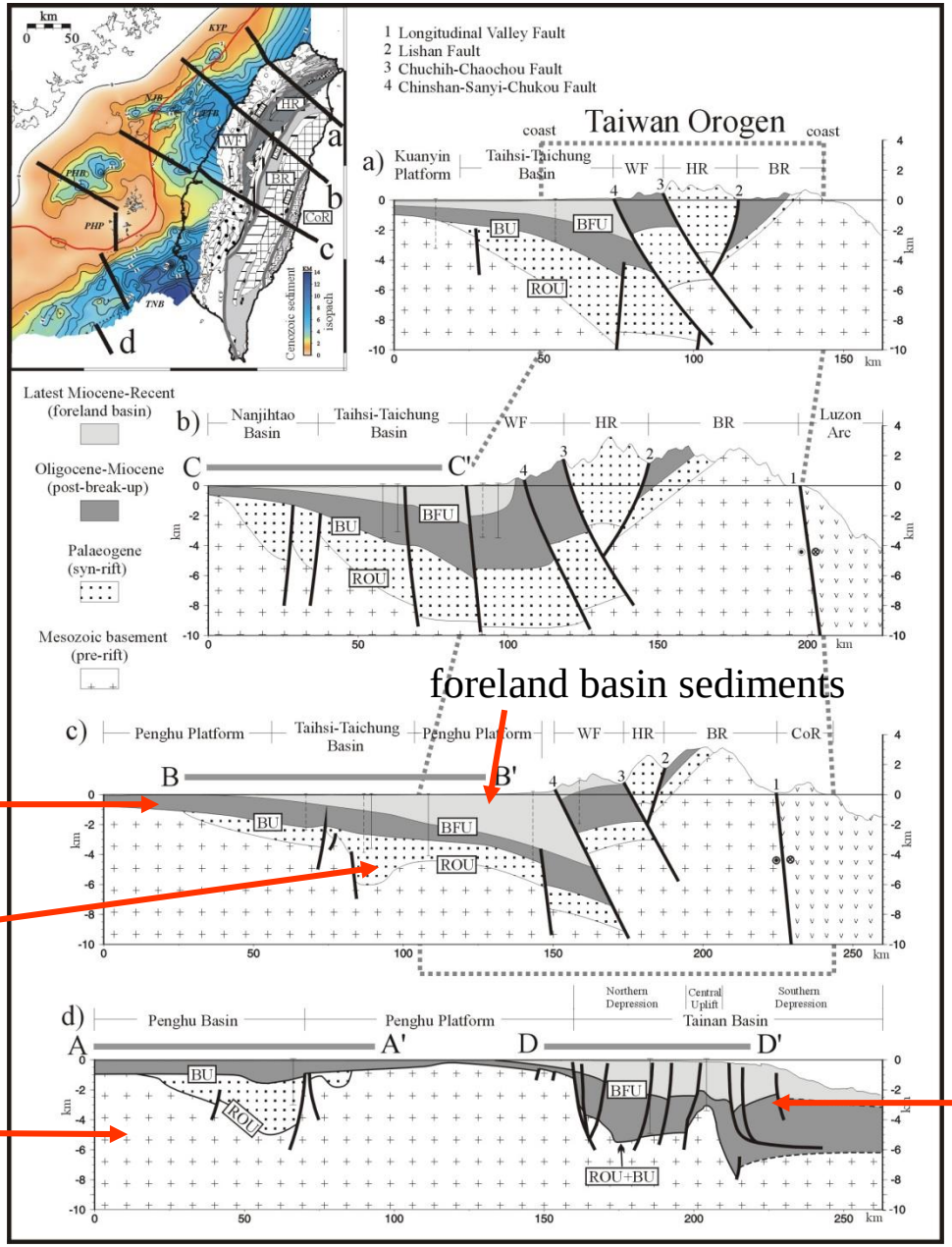


Lin et al. (2003)



Lin & Watts (2002)

台灣地區上部地殼剖面



foreland basin sediments

Oligocene-Miocene post-breakup sediments

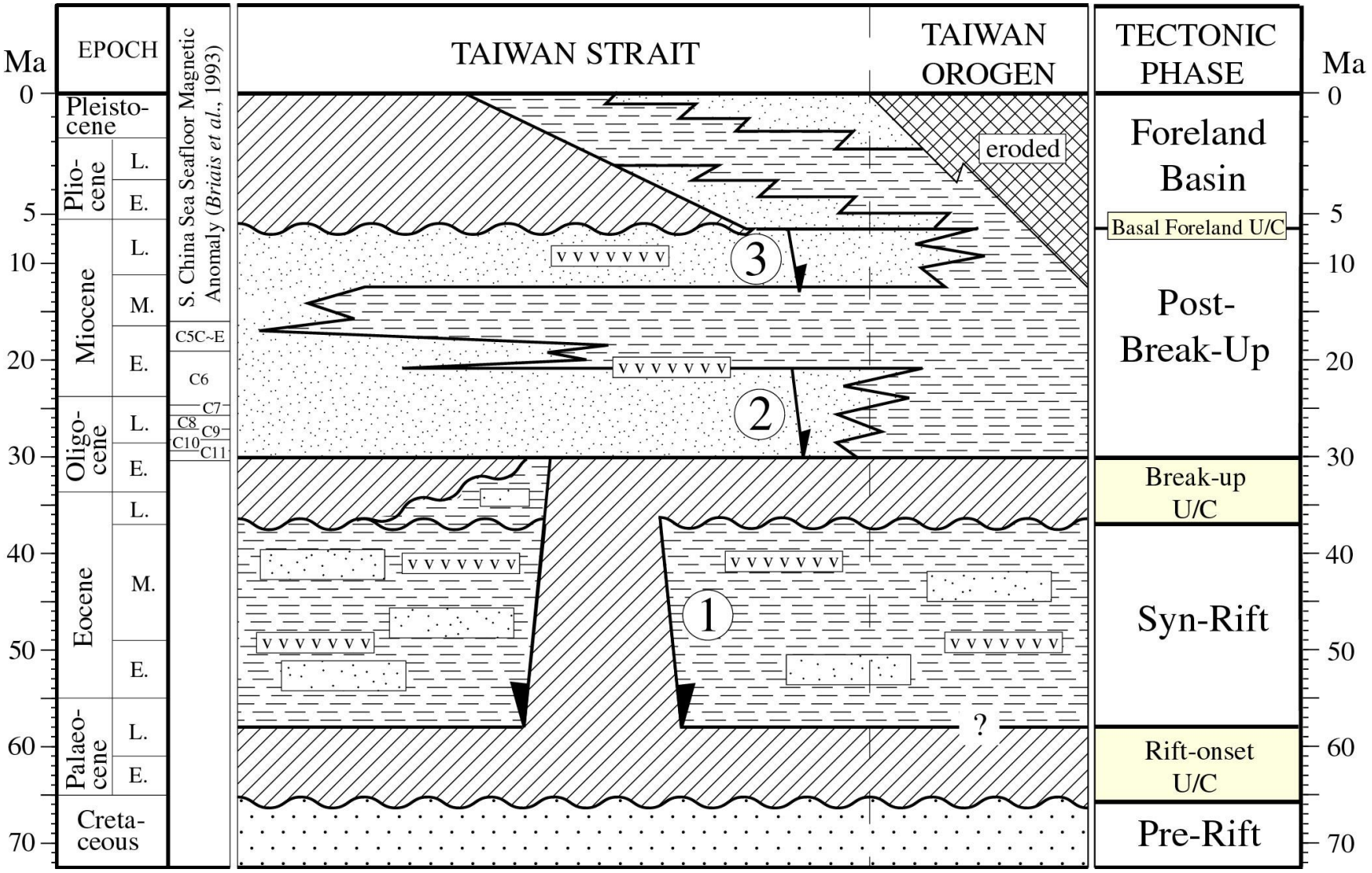
Paleogene syn-rift sediments

Mesozoic basement

Lin et al. (2003)

Tainan basin -- a post-breakup basin

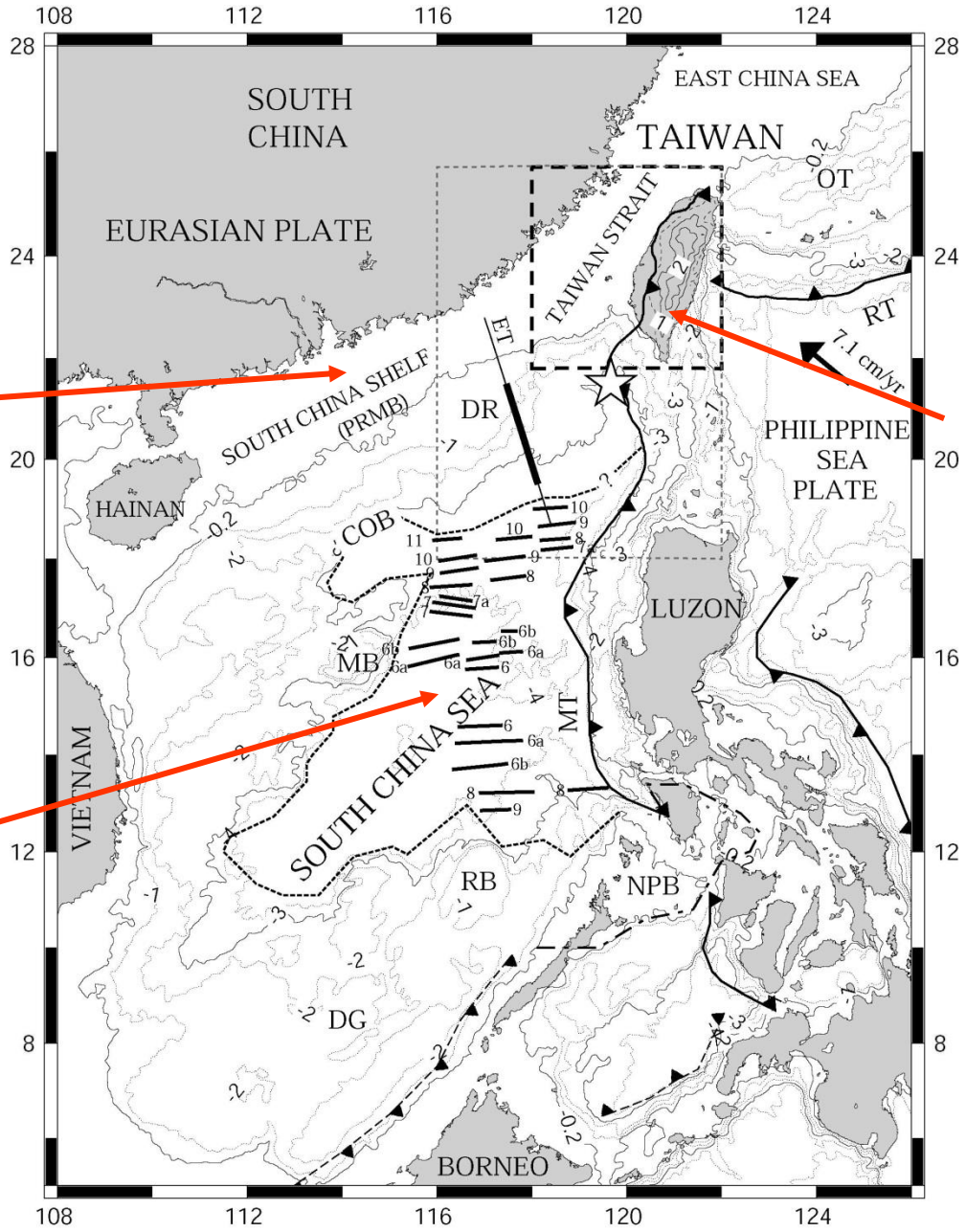
簡化的台灣地區地層



Lin & Watts (2002)

Passive margin formed by rifting during Paleogene

South China Sea oceanic basin formed during Oligocene to Miocene (~30 to 16 Ma)



Collision of the passive margin and the Luzon volcanic arc since ~6 Ma

Lin et al. (2003)