

野外地質學

1. 序論、地質調查規劃與 野外工具

- 1.1 序論
- 1.2 地質調查規劃
- 1.3 野外工具

2. 地質構造測量及儀器使 用

- 2.1 測距離
- 2.2 測高度或垂直距離
- 2.3 測方向
- 2.4 定位置
- 2.5 路線地質圖測量
- 2.6 平面構造量測
- 2.7 線性構造量測
- 2.8 地層厚度量測
- 2.9 地質構造空間表示
- 2.10 行動裝置地質調查

3. 地表地質調查

- 3.1 露頭紀錄與採樣
- 3.2 地層柱狀圖
- 3.3 野外素描
- 3.4 岩石
- 3.5 地質構造

4. 地下地質調查

- 4.1 鑽探
- 4.2 井測

5. 地形圖

- 5.1 地圖投影法
- 5.2 台灣地形圖
- 5.3 等高線
- 5.4 數值地形與地質作圖

6. 地質圖

- 6.1 岩層於地形圖上的分布
- 6.2 地質剖面圖
- 6.3 地質圖判識

7. 野外調查報告撰寫

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參考書目

1. 陳培源 (1993) 野外及礦業地質學(第二版), 正中書局, 580 pp.
2. Barnes, J.W., Lisle, R. J. (2004) Basic Geological Mapping (4th edition). John Wiley & Sons, 184 pp.
3. **Coe, A.L., Argles, T.W., Rothery, D.A., Spicer, R.A. (2010) Geological Field Techniques. Wiley-Blackwell, 232 pp.**
4. Compton, R.R. (1985) Geology in the Field. John Wiley & Son, 416 pp.
5. Freeman, T. (1999) Procedures in Field Geology. Blackwell Science, 95 pp.
6. McClay, K. (1987) The Mapping of Geological Structures. John Wiley & Sons, 161 pp.
7. Maltman, A. (1998) Geological Maps: An Introduction. John Wiley & Sons, 260 pp.
8. Thorpe, R. & Brown, G. (1985) The Field Description of Igneous Rocks. John Wiley & Sons, 154 pp.
9. Tucker, M. E, (2003) Sedimentary Rocks in the Field (3rd edition). John Wiley & Sons, 234 pp.

野外地質 評分標準

期中考 40 %

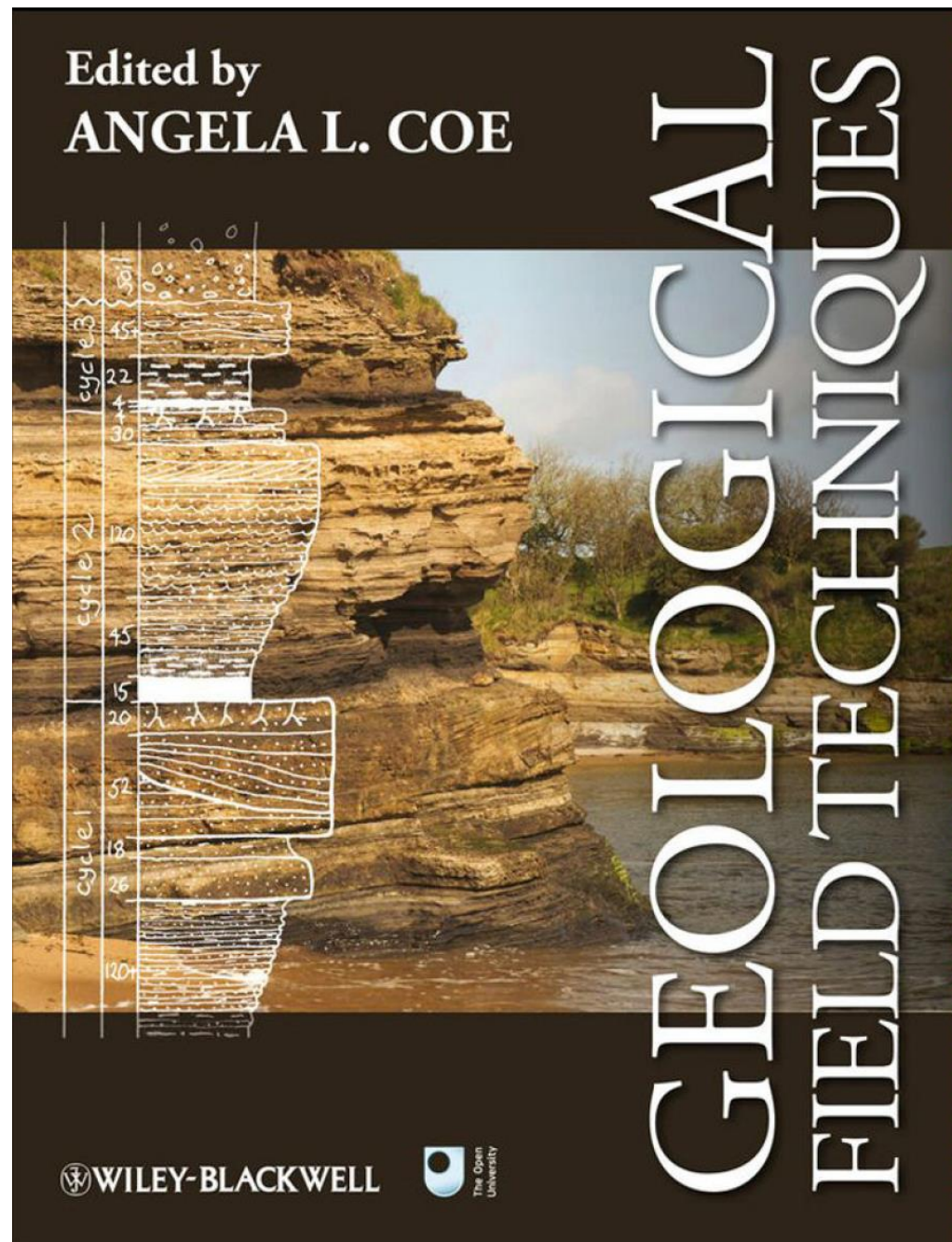
期末考 40 %

作業 20 %

Main text book for this course:

Coe, A.L., Argles, T.W.,
Rothery, D.A., Spicer,
R.A. (2010) Geological
Field Techniques. Wiley-
Blackwell, 232 pp.

A companion resources site for
this book is available at:
www.wiley.com/go/coe/geology



修完本課程後你(應該)會：

露頭地質現象紀錄、描述與解釋

原生與次生地質構造(平面或線性構造)的測量與解釋

製作路線地質圖

製作地層柱狀圖

製作地質剖面圖

地質圖製作與判識

應用地質技師

應考專業科目(2018)

1. 普通地質學(包括環境地質學)
2. 礦物學與岩石學(包含經濟地質學)
3. 地層學及構造地質學

4. 地質調查(包括地球物理探勘)

5. 工程地質學(包括水文地質學)
6. 大地工程學(包括土壤力學與岩石力學)

應用地質技師考試

地質調查命題大綱

(取自考選部<http://wwwc.moex.gov.tw/public/Data/65216575371.pdf>)

一、地質調查規劃與調查計畫之製作

二、地質調查方法

1. 地表地質調查方法（包括遙測影像判釋、露頭紀錄、試坑或槽溝開挖、取樣與試驗等）
2. 地下地質調查方法（包括鑽探、井測等）
3. 地球物理探勘（包括震測、重力、磁力、熱流、地電、透地雷達）
4. 地球化學探勘

三、地質調查成果之製作與判讀

1. 地質圖與地質剖面圖之製作與判讀
2. 各類調查成果判讀與綜合解釋

野外安全

- ☆ 穿著適宜的鞋子與衣服(考慮天氣、自然環境、蚊蟲等情形)
- ☆ 正確使用地質鎚(如地質鎚不可互敲、使用地質鎚時注意不會傷到旁人、行走時手握地質鎚頭...)
- ☆ 避免從事危險活動(如在人群上面攀爬露頭、涉溪、攀岩...)
- ☆ 注意來車、落石、蛇

.....

一個野外工作者(地質學家)需要有哪些素養或條件

- 至少擁有礦物岩石學、構造地質學、沉積地質學、野外地質學等知識
- 觀察和推理的能力(即描述、記載、分析、解釋的能力)
- 能耐勞苦
- 對自然及野外生活的愛好

**Field geology presents four main intellectual challenges.
These are: (Coe et al., 2010)**

1. Deciding what data to collect in order to address the scientific question(s).
2. Finding the most suitable exposures from which to collect the data.
3. Making a good record of the data collected; preferably a record that can be understood by others and can be used years after the data were collected.
4. Understanding and interpreting the basic observations that you make.

Table 2.4 Summary of the main code of ethics for countryside and wilderness areas.

Countryside/wilderness code of ethics

Take responsibility for your own actions

Leave gates and property as you find them

Respect other people's privacy and/or cultural sensitivities

Do not disturb plants and animals

Leave nothing behind

Do not hammer or sample unless it is necessary

Follow any signs and landowner's instructions

1. 序論、地質調查規劃與野外工具

1.1 序論

野外地質學(field geology)是一門對於各種岩石或造岩物質在自然環境中，與保持著原有的自然狀態或相對關係之下，所進行的各種研究的學問 (Lahee, 1961)。野外地質學乃探討岩石與地質構造的空間分布並研究其成因的科學。

To geologists, the **field** is where rocks or soils can be observed in place, and *field geology* consists of the methods used to examine and interpret structures and materials at the outcrop.

* **“Geological mapping”** is so essential to many field studies that it is sometimes considered synonymous with “field geology”.

* **Outcrop**: The part of a rock formation which is exposed at the Earth's surface.

野外地質(調查)的目的

製作地質圖(應用於礦產、重大工程建設...)

研究(如地層、構造地質、岩石成因、板塊運動、地球歷史...)

天然災害防治(如活動斷層、山崩、土石流)

環境規劃 (如核廢料處理)

A few geological survey organizations in the world

- Central Geological Survey (Taiwan, 1978, initially “the Geological Survey of Taiwan”, www.moeacgs.gov.tw)
- British Geological Survey (1835, www.bgs.ac.uk)
- Geological Survey of Canada (1842, www.nrcan.gc.ca/gsc/index_e.html)
- US Geological Survey (1889, www.usgs.gov)
- Geoscience Australia (www.ga.gov.au)
- China Geological Survey (www.cgs.gov.cn)
- Geological Survey of Japan (www.aist.go.jp/GSJ/)

1.2 地質調查規劃

調查計畫的規劃與準備，內容至少應包括

- 目的及預期成果
- 地理位置與調查面積(或範圍)，擬測地質圖之精度與比例尺大小
- 決定調查方法、應用儀器及進行步驟(如工作之進度、調查路線、住宿或野營地之選擇及交通工具安排)
- 預算所需人力、調查時間及費用
- 地質文獻的蒐集與研究
- 調查用底圖(地形圖)的準備(比例尺一般為1:5,000, 1:10,000, 1:25,000)
- 人員安全與裝備

1.3 野外工具

必備

背包、食物、水

地形圖/地質圖

羅盤儀

地質鎚

放大鏡

野外紀錄簿

鉛筆、色筆、原子筆

量角器、短直尺

捲尺 (5 m)

計算機

選擇性

GPS

氣壓高度計

視距測量儀

捲尺 (30 m)

鑿子

照相機

望遠鏡

腰包

稀鹽酸 (10% HCl)

標本袋 + 油性筆

瑞士刀

曲線計

顆粒度尺規

Stereographic net +

透明紙 + 圖釘

Jacob staff

刷子

計算用表(如三角函數表)

其他文具(如橡皮擦、小刀等)

急救藥品及個人藥品

收音機



Figure 2.2 Photograph to show correct use of the hand lens. Note that the person is holding the lens close to his eye. The lens is fastened on a lanyard around his neck for ease of access and use.



Figure 2.1 A variety of different hand lenses. (1) Standard 10 × single lens; (2) 10 × lens with built - in light – the lens casing matches the focal length; (3) 8 × lens with built - in light; (4) 10 × and 15 × dual lens.

Coe et al. (2010)

Table 2.2 Typical sampling equipment. See also Chapter 13.

Sampling equipment

Geological hammer

Sample bags

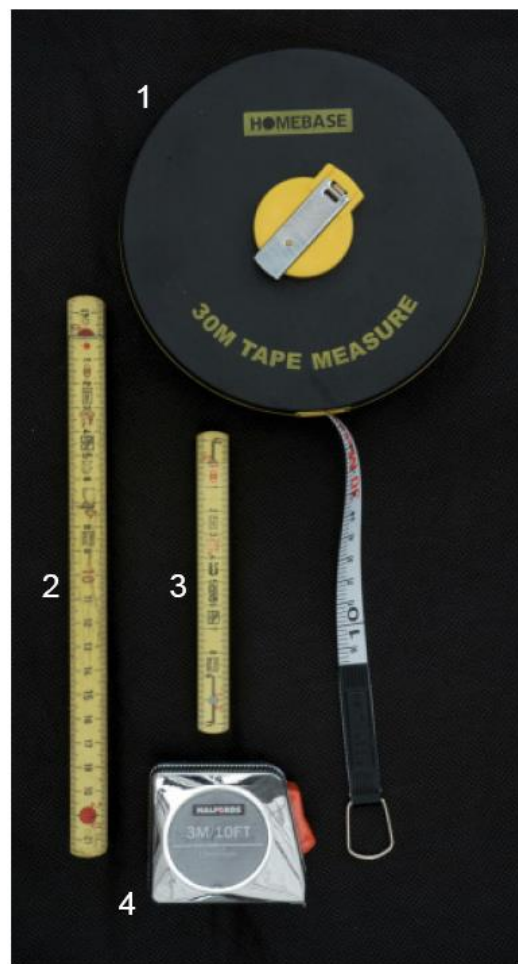
Paper, cling film or bubble wrap to wrap delicate samples

Marker pens/tile scribe/correction fluid for labelling

Chisels and other hammers

Trowel and/or spade for soft sediments and pyroclastic deposits

Coe et al. (2010)



(b)

(a) **Figure 2.13** (a) A variety of useful tape measures for field use: 1, surveyor's tape; 2, folding rule; 3, 1 m folding rule; 4, retracting metal-tape measure. (b) Home-made wooden pole with decimetre graduations to give a general idea of scale.



Figure 2.19 (a) Poorly consolidated sandstone showing current – formed climbing ripples. This structure has been revealed by carefully scraping the surface of the sandstone with the edge of a trowel. An unprepared surface lies to the right and at the level of the trowel. Shellingford cross – roads quarry, Oxfordshire, UK. (Angela L. Coe, The Open University, UK.)

Figure 2.18 Some of the different geological hammers and cold chisels available on the market. (1) Estwing pick end hammer, (2) Estwing chisel end hammer, (3) cold chisel with hand guard, (4 and 5) 2.5 lb and 1 lb geological hammers with fibre glass shafts, (6) pencil chisel, (7) tile scribe and (8) 3 lb lump hammer.



Outcrop

1. What is the lithology of this outcrop?
2. What is the structure(s) called?
3. Can you distinguish different tectonic features?

Quiz

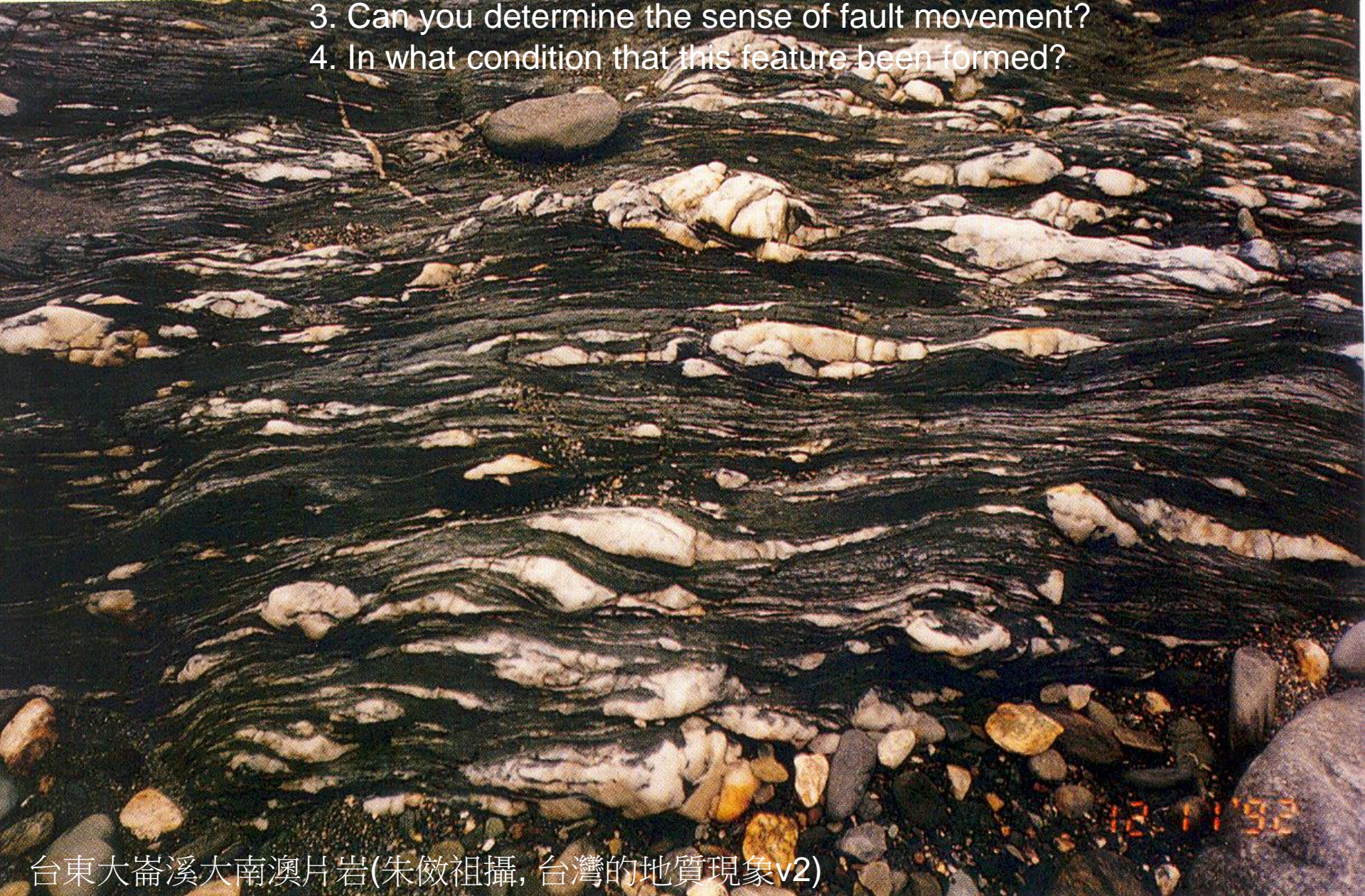


苗栗獅潭鄉上福基砂岩(朱倣祖攝)

Outcrop

Quiz

1. What is the lithology of this outcrop?
2. What is the structure(s) called?
3. Can you determine the sense of fault movement?
4. In what condition that this feature been formed?



台東大崙溪大南澳片岩(朱倣祖攝, 台灣的地質現象v2)

Outcrop Quiz

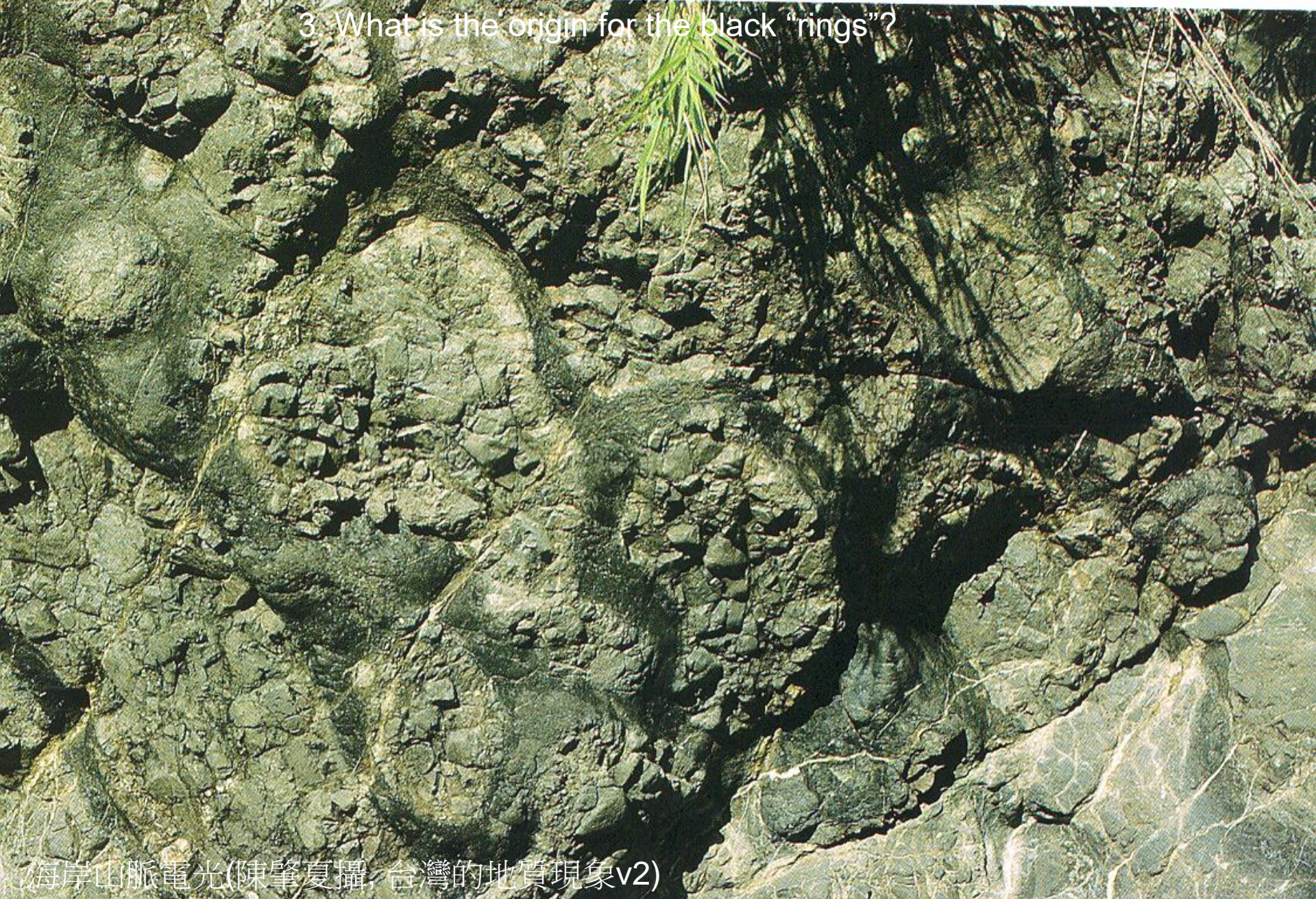
1. What is the characteristic feature for this topography?
2. How many levels of terraces in this photo?
3. What is the origin for these terraces?
4. How do you know the rate of tectonic uplift (or river incision) in this particular area?



Outcrop

1. What is the lithology of this outcrop?
2. What is the structure(s) called?
3. What is the origin for the black "rings"?

Quiz



Outcrop

1. What is the lithology of this outcrop?
2. How has the structure of this outcrop been developed?

Quiz



通霄頭斜山層

Outcrop

Quiz

1. What is the nature of this outcrop?
2. What is the structure(s) called?



Siccar Point, Scotland

Outcrop

Quiz

1. What is the nature of this outcrop?
2. How do you know age of faulting?

河階礫石

利吉層

花蓮富里富池橋



Outcrop

Quiz

1. What is the lithology of this outcrop?
2. How were the rocks formed?

花蓮秀姑巒溪長虹橋

Outcrop

Quiz

1. What is the lithology of this outcrop?
2. How were the rocks formed?



花蓮豐濱石梯坪

Outcrop

Quiz

1. What is the lithology of this outcrop?
2. How were the rocks formed?

花蓮秀姑巒溪奇美

Outcrop

1. What is the lithology of this outcrop?
2. What is the sequential development for this outcrop?

Quiz



澎湖白沙講美(曹恕中攝,台灣地質現象v2)