Blasts from the past 6: Georiddle

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Background

"Blasts from the past" is the section of Teaching Earth Sciences where some of the teaching ideas and activities, originally produced for early publications of ESTA and the Association of Teachers of Geology (the precursor to ESTA), are re-published.

Teaching ideas and activities have been updated and revised before re-publication in the magazine. A pdf of this article and copies of the cross-sections are also available on the ESTA website at: **http://www.esta-uk.net/blasts/**

Copies of earlier publications of ESTA and the Association of Teachers may be accessed in the archive section of the ESTA website, although PDFs of TES 26.3 onwards may be downloaded from the website.

Introduction

The original activity was produced by Chris King (King, 1980). Chris produced a geological puzzle for sixth formers (and teachers) and used it as a homework exercise with his students. When they had solved the puzzle students were asked to write a geological history of the area and to annotate and complete the cross-section by extrapolating above and below the present topography. This activity has been adapted so that the original diagrams have been redrawn. (Don't panic – the solution to Georiddle is shown on page XX)

A stratigraphy problem

A traverse across an area in England and Wales has revealed the following tilted sequence of rocks in cross-section.

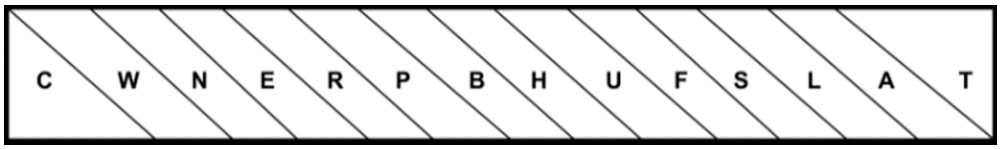

Figure 1: Tilted sequence of rocks in cross-section

(i) Using the information given below, list the rocks in order of their formation, youngest at the top.

1. Rock W is found as inclusions in rock C.
   I
2. Rock T contains fragments of rocks L, A, U and W.
3. Rock H has a baked margin against rock U.
4. Rock C contains zircons which give a uranium - lead radiometric age near the end of the Caledonian orogeny.
5. Rock A has been cut by a dyke of the same potassium - argon radiometric age as rock U.
6. Rock R contains early trilobites
7. Rock E has a chilled margin against rock R.
8. Rock T was deposited by ice.
9. Rock H contains the rugose coral zone fossil *Dibunophyllum* and so is of Lower Carboniferous age.
10. Rock E has the same rubidium – strontium radiometric age of 468 ± 10 million years as Rock P.
    F
11. Rock U has a chilled margin against rock F.
12. Rock L contains angular fragments of rocks A, U and F.
13. L is a fault breccia.
14. Rock A contains bands of Upper Carboniferous non-marine bivalves.
15. Rock N is a series of beds with each bed becoming finer grained towards its base.
16. Rock S contains the same zone fossils as rock A.
17. Rock W is a basement rock; rubidium - strontium dates of 595 ± 12 million years show it formed during the Precambrian era.
    E
18. Rock R contains fragments of rock W.
19. Rock C is a coarse, crystalline acid igneous rock.
    A

20. Rock N has been slightly metamorphosed. Potassium - argon dating of the metamorphic minerals show that metamorphism and folding took place during the Caledonian orogeny.
21. Rock B has been correlated with rock N.
22. Rock E is a single bed which contains more vesicles near its base than near its top.
23. Rock F is conformable on rock H.
O
24. Rock U when analysed radiometrically by the uranium-lead method gives a Tertiary age.
25. Rock N contains the Ordovician graptolite zone fossil *Didymograptus murchisoni*.
D
26. Rock B has flute marks and groove casts on the base of the sandstone beds.
27. Rock H is a basal conglomerate containing clasts of rocks B, E, Rband C.
28. Rock P has inclusions of rock R near its base.
29. Rock B, at its base, infills the spaces between the pillows of rock P.
30. Rock R is the core of a recumbent fold.

(ii) Write a geological history of the area.

(iii) Take away the formula of galena from your final sequence to find out how that sequence might be pulled apart.

(iv) Annotate and complete the cross-section by extrapolating above and below the present topography.

References

King, C.H.J. (1980) Georiddle for sixthformers and teachers. *Geology Teaching*, **5** (2), pp. 69-70 & 74.

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Suggested answers to Georiddle

The tabulated history is as follows:

Present day planation
Glacial erosion and deposition T
Faulting (with fault breccia formation) L
Tertiary sill intrusion U
Upper Carboniferous Coal Measure sedimentation A = S
Lower Carboniferous coral sea sedimentation F
Basal conglomerate (Lower Carboniferous or Devonian) H
Late Caledonian granite intrusion C
Folding and low grade metamorphism (Caledonian)
Middle Ordovician turbidity current sedimentation
Mid-Ordovician pillow lava extrusion
Cambrian sedimentation
Precambrian basement
N=B
E=P
R
W

The cross section should look roughly as shown in Figure 2.

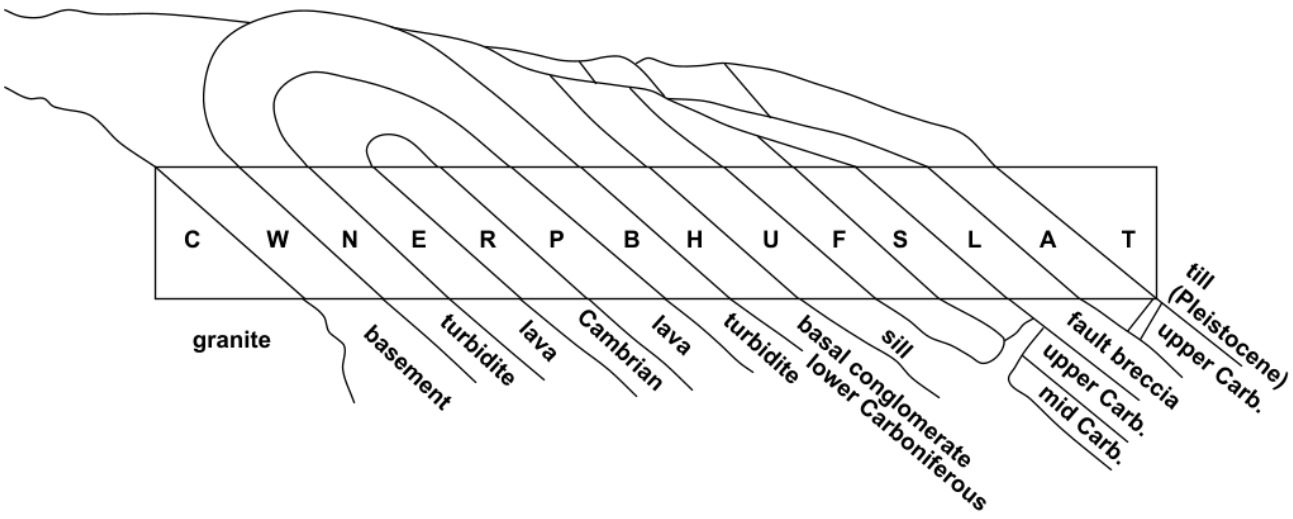

Figure 2: Completed cross-section

When the students have established the correct sequence, and the formula of Galena (Pb S) is 'removed' from the succession, the remaining letters spell WRENCH FAULT.