

Every rock tells a story Reading the rock history from an exceptional specimen of slate

The photograph shows part of a loose slab of slate, picked up from a scree slope in the English Lake District. It shows a cleavage surface, enhanced by varnishing. The rock forms part of

the nearby outcrop belonging to the Borrowdale Volcanic Group, of Ordovician age, comprising bedded volcanic ashes and lava flows.

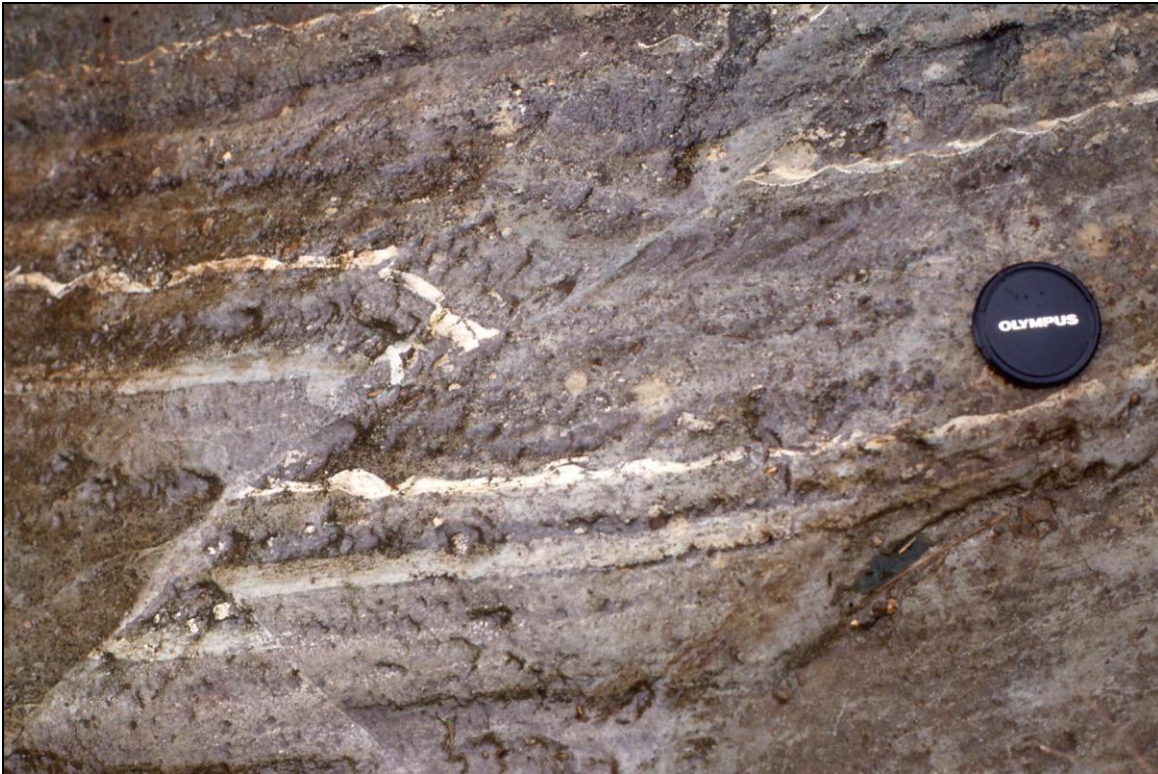


Photo.1 Slab of slate from the Borrowdale Volcanic Group, Borrowdale, Lake District. Lens cap = 50mm

Ask pupils to examine the photo carefully and to draw a scaled diagram (“field sketch”) of the specimen,

Pupils should label as many features as they can identify on their diagram, and show the former principle stress (σ_{max}) which had acted on the specimen when it was part of the overall rock mass.

If necessary, pupils may be prompted to suggest:

- the type of bedding from the original rock, still present in the slate, known as relict bedding when in a metamorphic rock (*mostly graded bedding, but the structure above the lens cap may be ripple marks, formed during reworking of the bed*);
- the “way-up” of the specimen as seen in the photo (*graded bedding appears to be fining upwards and the features just above the lens cap and in the grey layer to its left have rounded bases and sharper tops, both showing that the specimen is the right way up*);
- evidence of brittle failure (*the reverse fault running from bottom left to top right*);
- any conjugate fractures (*the small reverse fault near the bottom left, meeting the main reverse fault plane*);

- any associated features with the fault (*drag folding, picked out in the greenish and pale layers in the middle left of the photo*).

Pupils should then be asked to attempt an interpretation of the geological history of the specimen:

(The slate originated from a series of pulses of ash emitted from a nearby volcano. It is thought that the ash ascended high into the air and then settled out in a body of water. It was later converted to slate by tectonic processes, which also led to the formation of a reverse fault. Drag folding along the main fault plane occurred, and a subsidiary conjugate fault also formed).

Pupils could be challenged to suggest from which of the main rock types – sedimentary, igneous, metamorphic - the sample belongs. (*Given that the material is volcanic ash, it could be regarded as igneous. The ash settled in water, so it could be seen as sedimentary. The latest phase in its history was the metamorphism to slate, so it is probably best regarded as a metamorphic rock*).

The back up

Title: Every rock tells a story

Subtitle: Reading the rock history from an exceptional specimen of slate

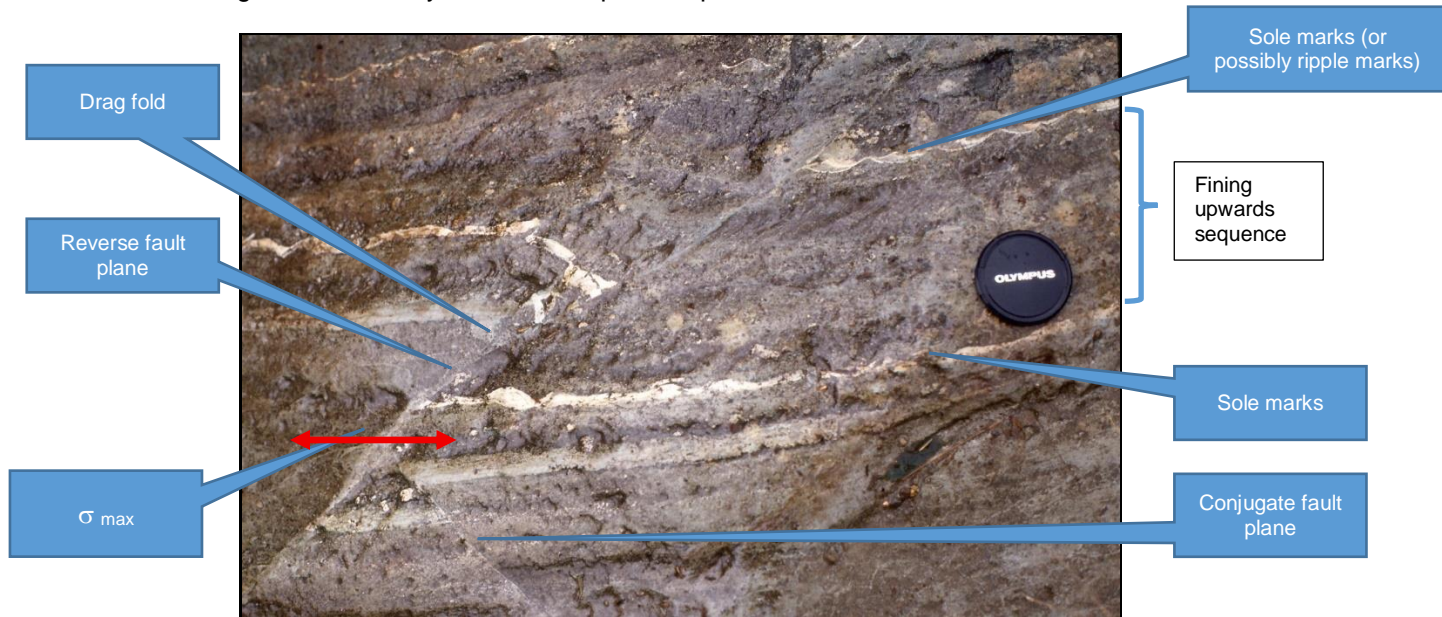


Photo 2. Main features of the specimen from the Borrowdale Volcano Group

Topic: Detailed analysis of structures of igneous, sedimentary and metamorphic origin in a single rock specimen

Age range of pupils: 16 years and above

Time needed to complete activity: 30 minutes

Pupil learning outcomes: Pupils can:

- evaluate the evidence in a specimen relating to several phases in its origin;
- explain the limitations of interpreting geological structures in two dimensions only;
- enhance their observational skills as a prelude to field work;
- develop skills of drawing and labelling a geological specimen.

Context: The activity could be used in revision of sedimentary structures and of structural analysis.

Following up the activity: Ask pupils to say what they would look for in the sequence of rocks from which this specimen came, if they were to undertake a mapping exercise in the area. What would they measure? How might the rock types enable them to describe the volcanic history of the sequence? How could the sedimentary structures enable them to say which way up the rocks were at each location? What were the components of the former stress field acting upon the sequence, when seen in three dimensions?

Underlying principles:

- This strategy provides training in careful observation and interpretation of all relevant features.
- A single rock specimen may contain characteristics of its sedimentary, igneous and metamorphic origins.

Thinking skill development:

- Building up an overall picture of the history of a rock from a specimen involves skills of construction. Metacognition is used in discussing the various interpretations. Application to the real field area would involve bridging skills.

Resource list:

- an enlarged copy of Photograph 1.

Useful links:

- https://www.earthlearningidea.com/PDF/184_Load_casts.pdf
- https://www.earthlearningidea.com/PDF/177_Graded_bedding.pdf
- https://www.earthlearningidea.com/PDF/298_Hands_faults.pdf

Source: Written by Peter Kennett of the Earthlearningidea team. Photo by Peter Kennett.

© **Earthlearningidea team.** The Earthlearningidea team seeks to produce a teaching idea regularly, at minimal cost, with minimal resources, for teacher educators and teachers of Earth science through school-level geography or science, with an online discussion around every idea in order to develop a global support network. 'Earthlearningidea' has little funding and is produced largely by voluntary effort. Copyright is waived for original material contained in this activity if it is required for use within the laboratory or classroom. Copyright material contained herein from other publishers rests with them. Any organisation wishing to use this material should contact the Earthlearningidea team. Every effort has been made to locate and contact copyright holders of materials included in this activity in order to obtain their permission. Please contact us if, however, you believe your copyright is being infringed: we welcome any information that will help us to update our records. If you have any difficulty with the readability of these documents, please contact the Earthlearningidea team for further help.

