Sedimentary structures – load casts
Interpreting odd bumps on the bases of beds

Show pupils Photograph 1 and ask them if they can work out what it shows. Tell them that the rock is mostly made of sandstone and that the sandstone becomes finer grained towards the bottom of the specimen. Prompt them to look at the scale on the photograph, and also to ask themselves whether the specimen is the right way up, or if it has been placed upside down. If it is upside down, then they are looking at the base of the specimen.

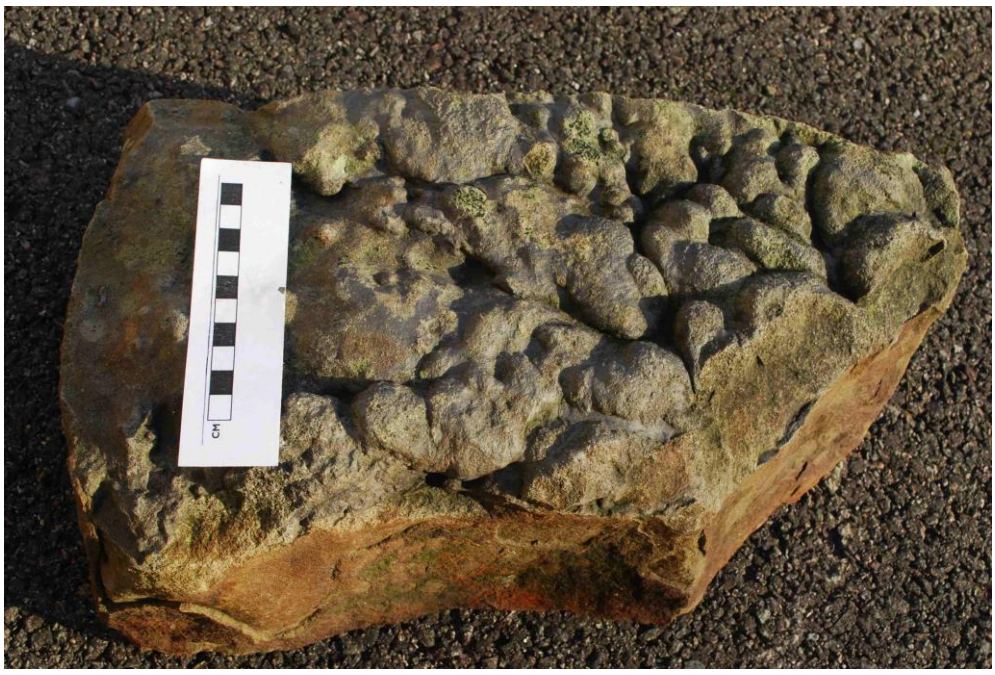


Photo 1. A block of rock for pupils to debate its origin. [Mam Tor Beds, Carboniferous, Derbyshire, England]

When they have debated their own ideas, pupils can be shown Photographs 2 to 5, to see if any of these help in explaining the features.

Photo 2: An ironstone nodule from a layer of such nodules lying on a bedding plane. (Coin 2cm) [Pot Clay, Carboniferous, near Sheffield, England]

Photo 3: A pebble bed [Torridonian, Raasay, West Scotland]

Photo 4: Coprolites, i.e. fossilised animal dung (scale bar is 15 cm long) [from a carnivorous dinosaur, south western Saskatchewan, Canada] (*Wikimedia Commons. This image is in the public domain because it contains materials that originally came from the USGS)*

Let the pupils review their earlier ideas. Then tell them that the specimen in Photograph 1 is, in fact upside down, so they are looking at the base of the bed. Explain that, if they could see a section through the specimen in Photograph 1, the right

way up, it would look rather like the rock in Photograph 5.

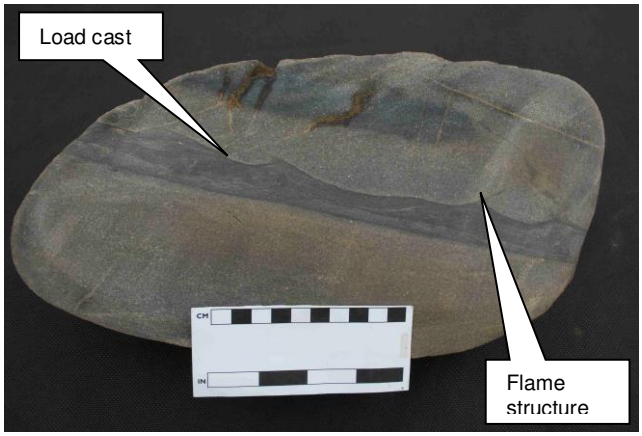
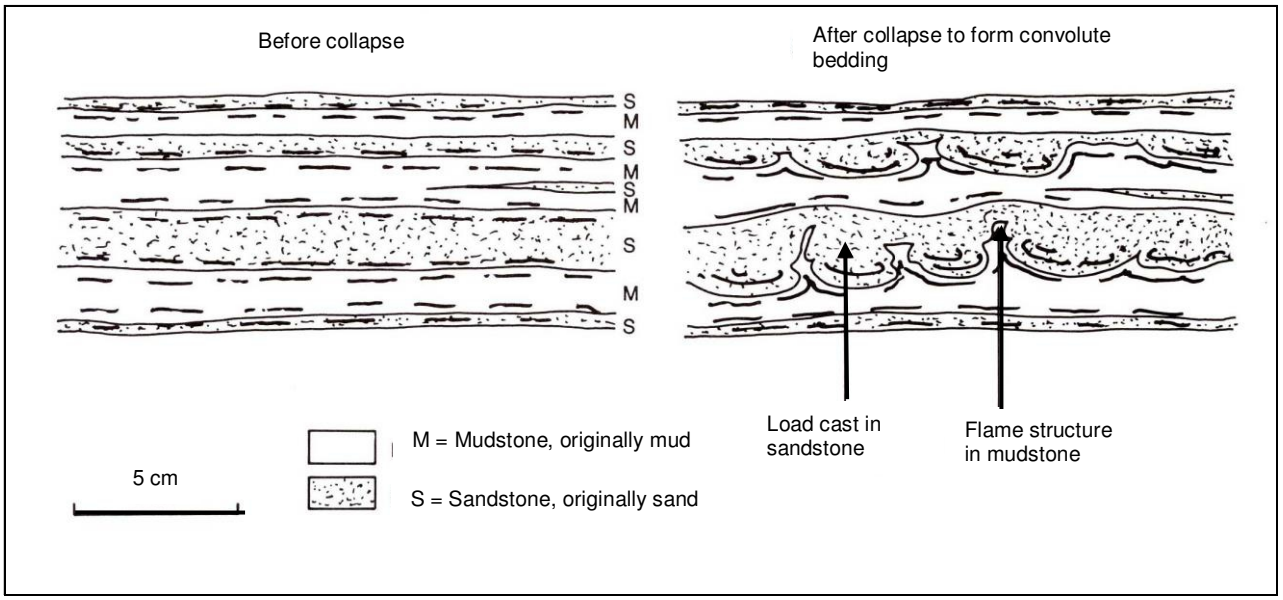


Photo 5: Load and flame structures

Now, all can be revealed! The specimen in Photograph 1 was formed when a turbidity current swept over the sea bed, leaving coarse sand to settle out in its wake. The sea bed was covered in waterlogged mud, and so the sand grains, being denser, collapsed down into it, making the downward-facing bumps. These are known as **load casts**. In between the load casts, some of the mud was forced upwards, creating the upward-pointing features known as **flame structures**.



Load structures may be modelled by floating a piece of cling film onto water in a small tank and sprinkling dry sand evenly onto it. The sand bulges downward into the water, resembling the shapes of load casts in rocks (Photos 6 and 7).

Photo 6: A layer of sand sprinkled onto cling film in water (top view)

Photo 7: "Load structures" formed as the sand depresses the cling film. (side view)

(Photos: *All photos, except Photo 4, by Peter Kennett*)

The back up

Title: Sedimentary structures – load casts

Subtitle: Interpreting odd bumps on the bases of beds.

Topic: An activity based on photographs and diagrams of load casts, where pupils are asked to interpret how the structures were formed. Pupils can model load casts with sand and water.

Age range of pupils: 14 -18 years

Time needed to complete activity: 20 minutes

Pupil learning outcomes: Pupils can:
- relate photographs of load casts on the undersides of beds to diagrams of their origins;
- use the presence of load casts on exposed rock sequences to determine if the beds are the "right way up" or not;
- distinguish between several similar-looking geological features;
- appreciate how load casts may be formed from a demonstration of "loading" sand onto floating cling film.

Context: The activity is part of a series on sedimentary structures and the ways in which they can be used to interpret past conditions.

Following up the activity:
Carry out any of the activities related to turbidity currents listed in "Useful links" below.
Carry out a websearch to find out more about the origins of the features shown in the photographs above.

Underlying principles:
- Underwater (turbidity) currents carry badly-sorted masses of sediment and often travel at considerable speeds.
- Coarse sand is deposited rapidly as the current passes. If the sea bed consists of waterlogged mud, the sand then collapses into the mud, to leave downward-bulging sandstone casts.
- Unlike flute casts, load casts do not provide evidence of the direction of flow of the current, since they formed later.
- Load casts may indicate whether a sequence of the beds is the right way up, or if it has been inverted by Earth movements.

Thinking skill development:
Thought processes of construction are involved when relating the photographs to one another. Upside-down structures may involve cognitive conflict, and metacognition is used when pupils discuss the activity. Bridging skills are needed to relate the observations to the real world.

Resource list:
- copies of all the photographs, projected, or on paper
- a small transparent tank of water
- food dye
- cling film
- sand

Useful links: www.earthlearningidea.com
"Sedimentary structures – graded bedding: make your own graded bed – one depositional event, but with coarse to fine sediment", and "High flow. Low flow? - atmosphere and ocean in a tank: hot, cold and particle-filled density currents as they flow in the atmosphere and ocean" and "Sedimentary structures – sole marks: evidence from the base of a sedimentary bed".

Source: Written by Peter Kennett of the Earthlearningidea Team, with diagrams, by permission from King. C. (1991) *Sedimentology Book 2: The Depositional Environments*. Longman. Cling film idea by Elizabeth Devon.