

Bleaklow Quarry (Backdale Quarry)

Why the fossils found in Bleaklow Quarry are important

Very few skeletons of Carboniferous chondrichthyans have been recovered from the UK. In general, chondrichthyans do not calcify their skeletons robustly and so the preservation potential of their skeletal element is low and fossil finds are rare. Those that do exist from the Carboniferous are all found in Scotland. Therefore these are the first semi-articulated Carboniferous chondrichthyans found in England. The Carboniferous is an exciting time for the chondrichthyans, they are undergoing a huge expansion in diversity and they dominate the oceans. Despite their domination of vertebrate faunas, we still have a very incomplete understanding of exactly how these Carboniferous chondrichthyans relate to modern sharks. Rare finds like this give us a tantalising glimpse of the earlier shark evolution.

Relevant geology

The thick pale beds of Eyam Limestone are exposed at Bleaklow quarry. Borehole data (British Geological Survey materials © NERC [2013]) indicates that the pale reef limestone is interspersed with dark grey limestone layers, some with chert banding.

Specimens come from two beds within the P2 Cawdor Limestone unit (Ford 1952). Both matrices are dark grey, fine grained and homogenous. One bed is accessible at the northern end of the quarry, and the other bed at the south. The limestone in both cases is dark grey, fine grained and homogeneous. The southern horizon has localised brachiopods, trilobites, goniatites and chert layers. The northern bed is dissected by thin calcite veins and contains fluorite. Bivalves are also apparent along weak bedding. This bed may be the *Cravenoceras leion* Marine Band described at Bleaklow Quarry, known as Backdale Mine, by Korn and Tilsley (2002). The marine Band is associated with a diverse fauna of invertebrates and vertebrates (Korn & Tilsley 2002). The southern bed is no longer accessible but its original location is situated where the dip of the quarry beds show that the unconformity could lie. The lithological similarity and the overall dip of the Bleaklow Quarry beds implies that the northern and southern Bleaklow Quarry beds are the same bed. Here I will continue to differentiate between the two beds.

As noted, the beds are attributable to the P2 Cawdor Limestone, but the exact stratigraphic position of the quarry is uncertain. The northern horizon is unconformably overlain by either the Edale Shale or the Longstone Mudstone (John Hunter pers. comm.). This marks the unconformable Viséan-Namurian boundary (Jackson 1923) and corresponds to an expansion of deltaic environments as sea level dropped (Sadler & Wyatt 1966).



Figure 1. Composite image of the quarry, red arrows to the left and right indicate the general position of the Southern and Northern fossil-bearing beds respectively. The position of the southern bed is not visible in the photo but is approximately 20 metres downhill from the arrow.



Figure 2. The road cutting and spoil ridge in which *ex situ* fossils from the Northern bed were found.

Fossils

Both the Northern and Southern horizon yielded partial chondrichthyan skeletons.

A neurocranium, palatoquadrates, Meckel's cartilage and teeth referred to *Stethacanthus* sp. and neural arches and clasper segments referred to an indeterminate chondrichthyan were extracted from the Northern horizon of Bleaklow Quarry. A Meckel's cartilage and a scapulacoracoid referred to *Stethacanthus* sp., a spine fragment and two specimens of cartilage plates, one with ctenacanth-type dermal denticles referred to indeterminate ctenacanth-type chondrichthyans and multilayered and bilaterally symmetrical cartilage, and two fragments of cartilage referred to indeterminate chondrichthyans were recovered from the Southern horizon of Bleaklow Quarry.

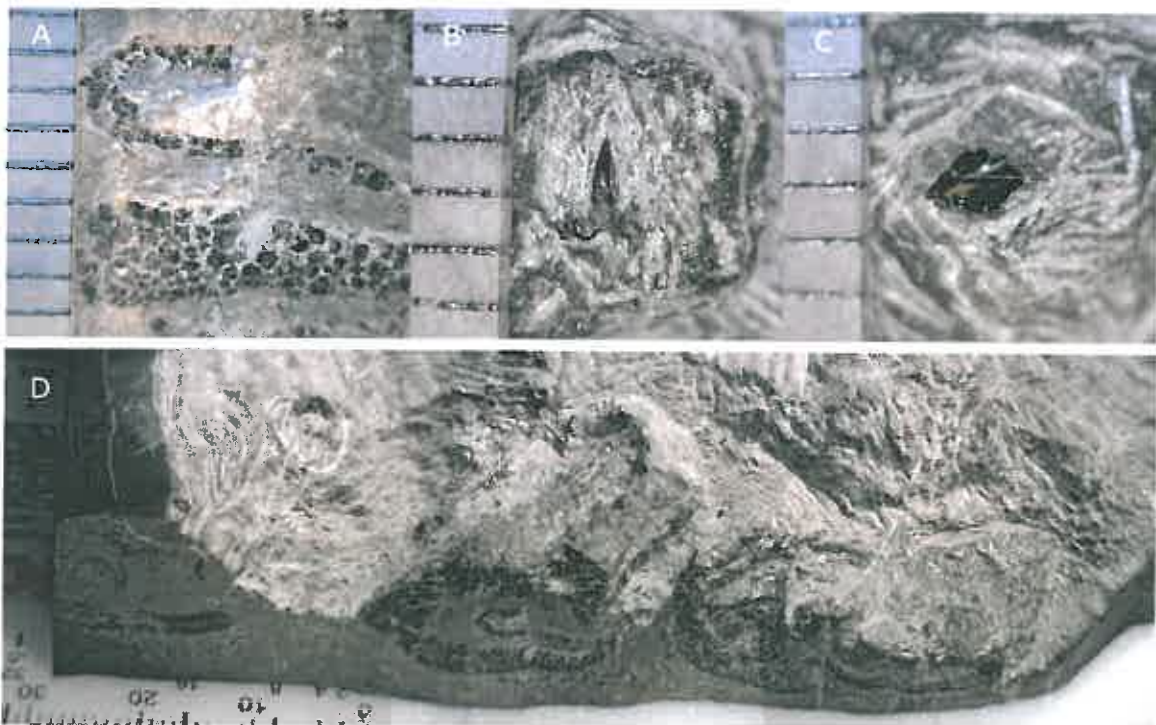


Figure 3. One specimen from the Northern horizon. A. A cross section of calcified cartilage, the diagnostic feature of chondrichthyan skeletons. B. A tooth with a large central cusp and a flattened base. C. A bony fish scale. D. A cross section through the clasper elements, which are the male reproductive organs. Scale bar shows millimetres.



Figure 4. Four examples of large pieces of cartilage elements found in the quarry. B. shows a large piece of jaw, the scalloped margin is the tooth line.