# Burrells Quarry, Cumbria

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## Introduction

Burrells Quarry is stratigraphically the lowest of the Vale of Eden GCR sites, and it provides one of the finest exposures of the Penrith Brockram, which rests unconformably on Carboniferous sandstones and limestones. The breccias frequently show trough cross-bedding, and were deposited by sheetflood processes on an alluvial fan. The main facies consists of fine to very coarse breccias in tabular sheets, which are usually less than one metre thick. Cross-bedding indicates sediment transport direction consistently towards the north-east. This is a well-known locality for studies of the coarse basal Permian sediments of Cumbria.

Articles dealing specifically with the sedimentology and stratigraphy of the Penrith Brockram and Burrells Quarry include Waugh (1970b), Macchi and Meadows (1987, pp. 83–6), and Macchi (1990).

## Description

The Penrith Brockram at Burrells Quarry (Figure 2.23) has many features in common with comparable breccia facies at nearby localities, but there are three important differences: it consists purely of breccio-conglomeratic sediments with no associated sandstones; a wider range of sedimentary structures are present; and the sediments are very hard, being well cemented by calcite, and containing non-dolomitized Carboniferous Limestone clasts (Macchi and Meadows, 1987).

The breccio-conglomerates are generally poorly sorted and clast-supported (Figure 2.23). Coarser-grained lag-type deposits occur at the bases of some of the units, and some show weakly defined normal graded bedding. The clasts range from less than 10 min to over 1 m in diameter, and the larger clasts appear to be most common in the thicker beds; clast shapes range from angular to well rounded. Clast imbrica-tions and parallel orientations of elongate clasts are common (Macchi and Meadows, 1987) and indicate a flow direction to the north-east. The clasts are composed of unweathered Carboniferous Limestone, with subordinate Carboniferous sandstone and chert (Waugh, 1970b).

The breccio-conglomerates preserve many examples of trough cross-bedding, which generally occurs as festoon-shaped scour infills. Bedding planes are laterally continuous and erosive, and separate the sediments into broadly sheet-like bodies 2 to 3 m thick. The beds persist laterally for several tens of metres before wedging out at the depositional limit of the bed or because of truncation by the overlying unit. The contact surfaces between the beds may form channel-like features. Rarely, erosional surfaces are preserved within individual beds (Macchi and Meadows, 1987).

## Interpretation

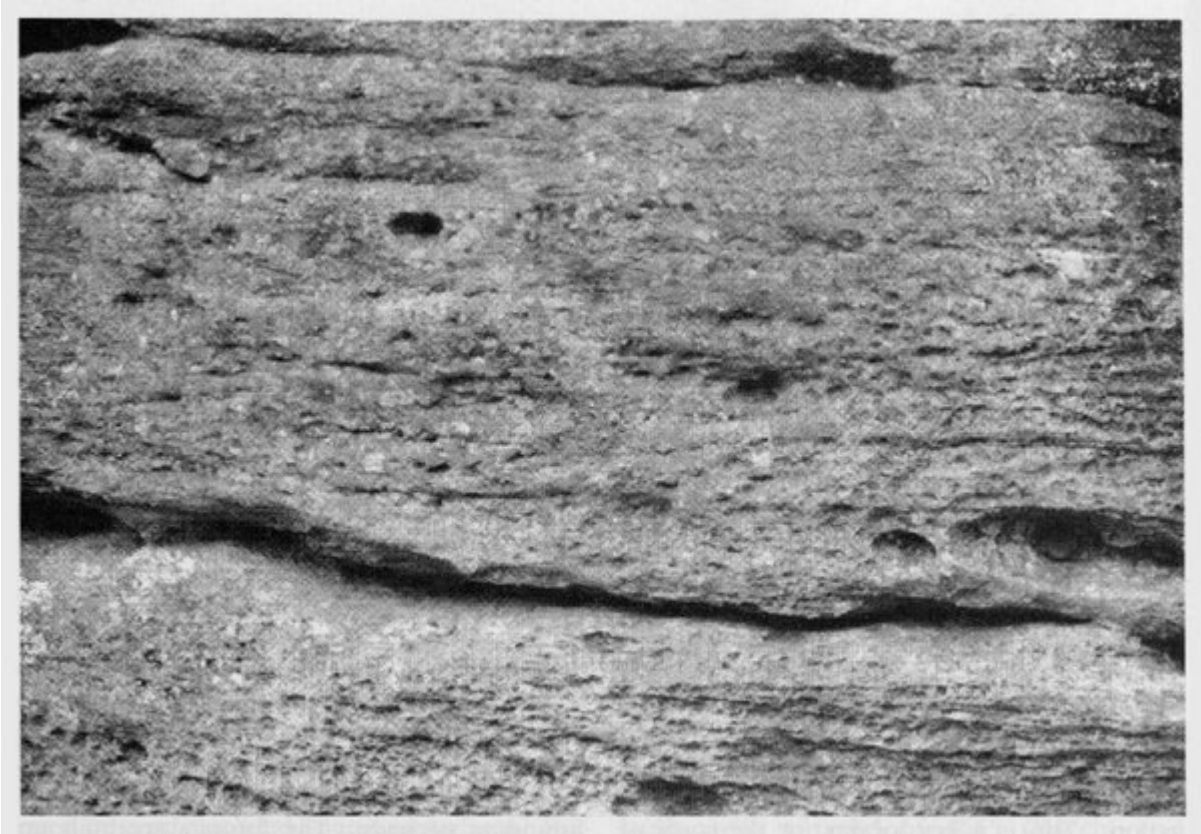
The Penrith Brockram was deposited on large alluvial fans situated at the margin of the contemporaneously subsiding basin on the site of the Vale of Eden (Waugh, 1970b; Bott, 1974), probably as a result of high-energy flash floods that originated in the surrounding uplands, particularly to the south-west. Stream and channel sediments form only a minor part of the Penrith Brockram, and probably resulted from deposition in small braided stream systems that developed on the alluvial fan surfaces (Macchi and Meadows, 1987).

## Conclusions

The exposures in Burrells Quarry, and natural exposures in the vicinity, provide excellent sections through the lower Permian Penrith Brockram. These sediments are very coarse grained (a breccio-conglomerate), and were deposited on a large, complex alluvial fan, probably situated towards the margin of an actively subsiding depositional basin. Sediment transport was to the north-east from uplands at the south-west of the basin. This is the best site to show the earliest

phases of filling of the Vale of Eden Basin.

**References**



*(Figure 2.23) Penrith Brockram at Burrells Quarry; a poorly sorted, clast-supported breccio-conglomerate. (Photo: P Turner.)*