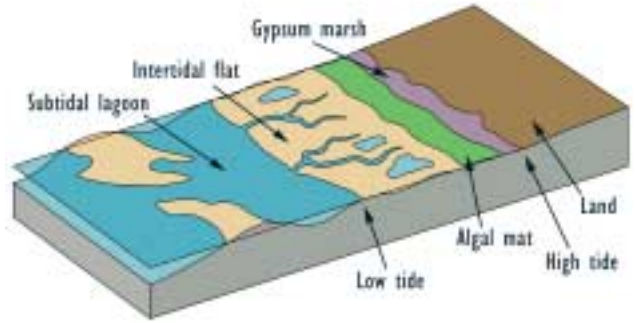
the Geology of Quarry Moor

This site is unique and the Permian Magnesian Limestone rocks here are seen nowhere else in Britain. Limestones are sedimentary rocks normally deposited in marine conditions. 255 million years ago Quarry Moor was at the shoreline of a shallow tropical sea surrounded by desert, much like the present day Arabian Gulf. The sea, called the Zechstein Sea, covered low-lying areas of what later became northern Europe for about 5 million years. At the time 'Britain' was on the eastern edge of a supercontinent (see globe below) and lay just north of the equator. During this time Europe had a climate that was hot and dry, much like the Arabian desert today.

The shore was very flat with mats of algae covering much of the area between low and high water as seen in the illustration (below centre). The tidal range was only about 1 metre, which is very similar to the Mediterranean today, but probably much more shallow like the Caspian and Aral inland seas. The high temperatures of the surrounding desert evaporated this shallow water leaving gypsum deposits, especially nearest high water mark to create a 'gypsum marsh' now preserved as teepee structures in the contorted beds on the northern end of the shallow quarry face (centre photograph).



The diagram above shows the position of the algal mats near the high water mark in the inter-tidal zone at the edge of the sea.

Gypsum, from the Greek gypsos meaning chalk, is a reasonably common soft, white to reddish-white mineral composed of hydrated Calcium sulphate ($CaSO_4.2H_2O$). It is relatively easily dissolved in water and is found associated with rock salt (grit for roads in winter) and anhydrite, which were all formed from the evaporation of sea water during the Permian and Triassic periods of between 290-210 million years ago. Gypsum is usually bedded with mudstones, marls and sandstones and has been mined and quarried since the 11th century to make plaster for walls. The massive variety is alabaster which is often used as ornamental stone for panels, pulpits and tombs in churches.

The algal mats are preserved as 'wavy' lines in the limestones at the southern end of the low quarry face (front cover).

You can see what the mats must have looked like in the Permian as the photo (left) shows a section through the mats in Abu Dhabi; the white bands are gypsum crystal 'mush'.

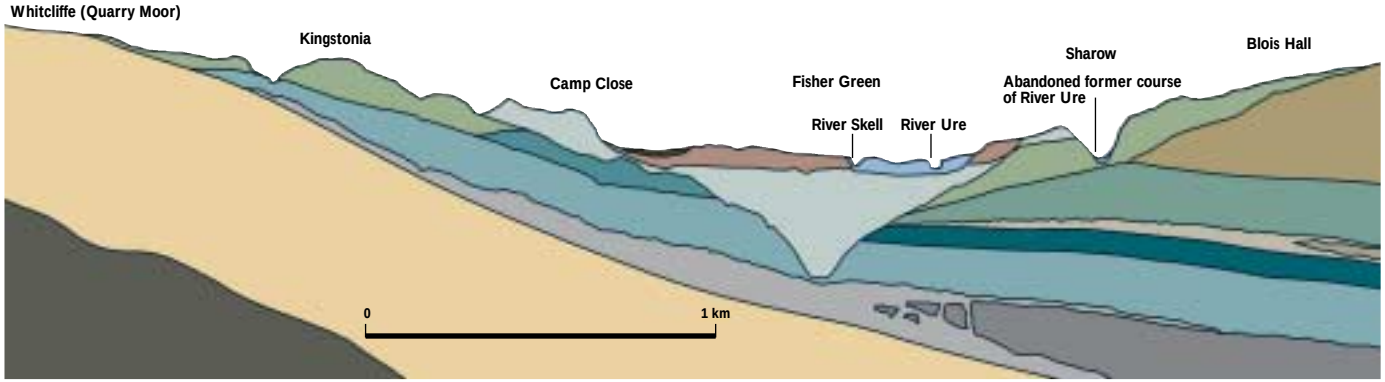
No animal fossils have been found in these rocks as they formed at the mineral-rich edge of a shallow, almost land-locked sea that dried out periodically. The sea was probably too salty to support marine life. The photograph (right) taken in Abu Dhabi, shows how the coast might have looked when the tide came in.

As you look up at the cliff face, near the centre is a channel that cut through the algal mats and was later filled with sands and muddy limes and eventually more algal mats. This was probably formed in a flash flood.

The Permian Magnesian Limestone, forming a marked ridge running from Bedale to Knaresborough, was quarried for Ripon's earliest buildings; it can be seen as blocks in boundary walls and in parts of Ripon Cathedral. The earliest known use was for the 12th century 'Leper Chapel', or St Mary Magdalen's, on Magdalens Road, and the sister chapel St John's Bondgate. The latter was demolished in the late 19th century and replaced by the present church, also of Magnesian Limestone, and probably constructed of re-used blocks from the original chapel.

Geological cross section through the Ripon Area

Quartenary Drift	Alluvium
	Peat
	River Terraces
	Glacio-Fluvial Outwash and Buried Valley Gravels
	Glacial Till
Triassic	Sherwood Sandstone Group
	Roxby Formation Marl
	Roxby Formation Gypsum/Anhydrite
	Brotherton Formation Limestone
Permian	Edlington Formation Marl
	Edlington Formation Gypsum/Anhydrite
	Cadeby Formation Limestone
Carboniferous	Undivided



Quarry Moor must also have supplied lime for mortar for the Norman minster church from the 11th century and for subsequent centuries. It supplied stone blocks for the 15th and 16th century additions to the Cathedral (Minster) as seen by the lighter blocks in its structure.

Younger Triassic sandstones overlie the Permian rocks, and these in turn are overlain by glacial deposits of the last Ice Age as seen in the section above.

At Quarry Moor the Triassic sandstones and later sediments are absent having been eroded away in subsequent geological periods, so the glacial deposits appear immediately above the limestone and can be seen as brown earthy beds above the quarry face. There is a gap of 255 million years between the limestone and the glacial till deposited by glaciers some 20,000 years ago.

The gypsum deposits in the limestones and marls underneath Ripon are of great interest because gypsum is soluble in water, and underground water can dissolve the deposits causing land above to collapse. Subsidence holes and hollows are aligned more or less north west - south east and can be easily seen on a walk through Ripon especially along Magdalens Road where water has filled a large hollow by the farm adjacent to the St. Mary Magdalen. The central area of the City including the Cathedral and the Market Place by contrast show no signs of subsidence.

A young Lewis Carroll, whose father was a visiting examiner to Ripon Cathedral, would have seen these holes which possibly influenced his idea in the story of *Alice in Wonderland* where Alice falls down a 'rabbit hole'.

ENGLISH NATURE

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