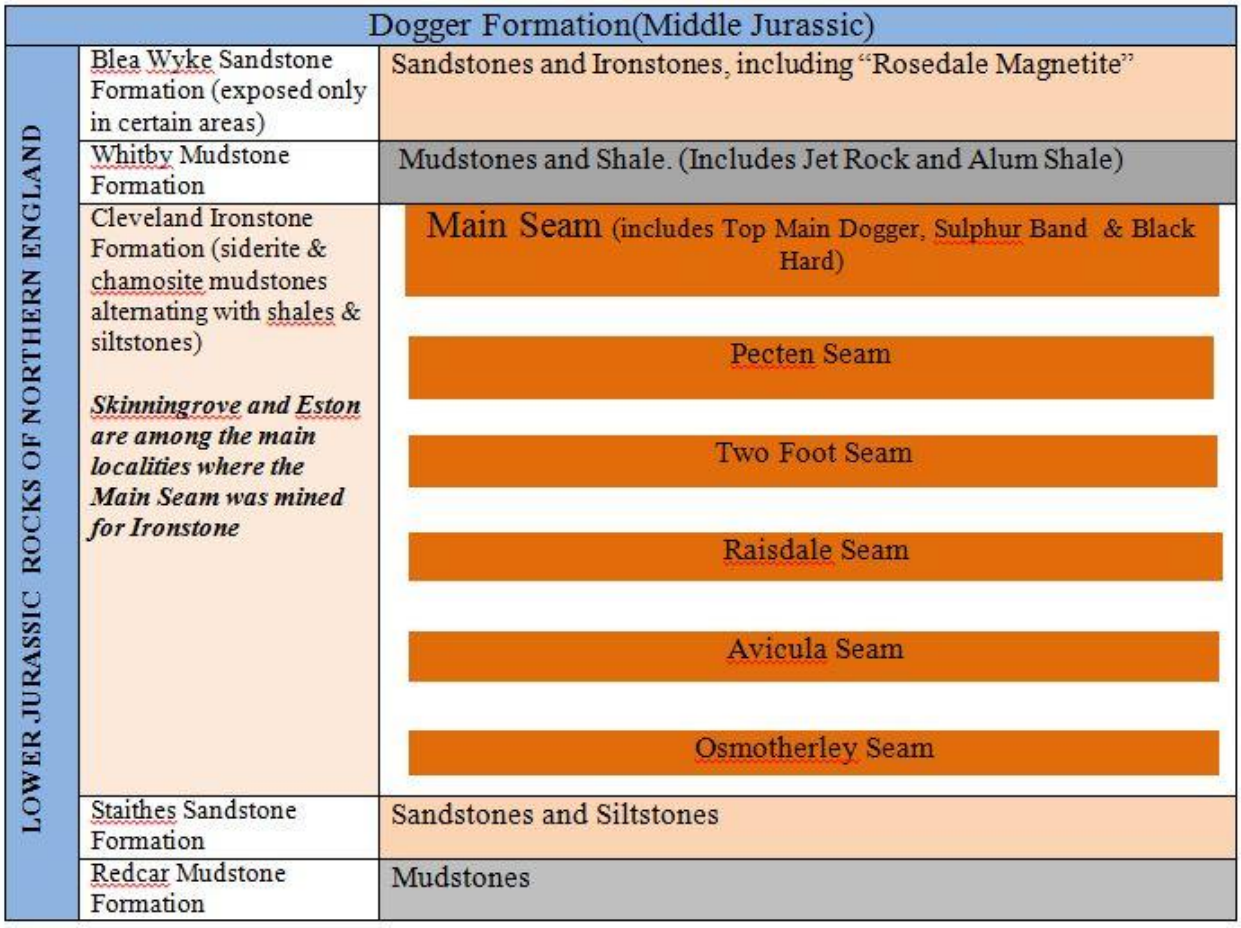
What is Ironstone?

The term “ironstone” usually refers to any rock which is capable of producing iron commercially.

The Main Seam, which was mined at Skinningrove, is part of the **Lower Jurassic Cleveland Ironstone Formation** comprising about 15 metres of an alternating succession, of marine shale and the ironstone itself, a mudstone consisting almost entirely of an iron carbonate mineral known as siderite, ($FeCO_3$), often with an accompanying iron rich mineral, chamosite.

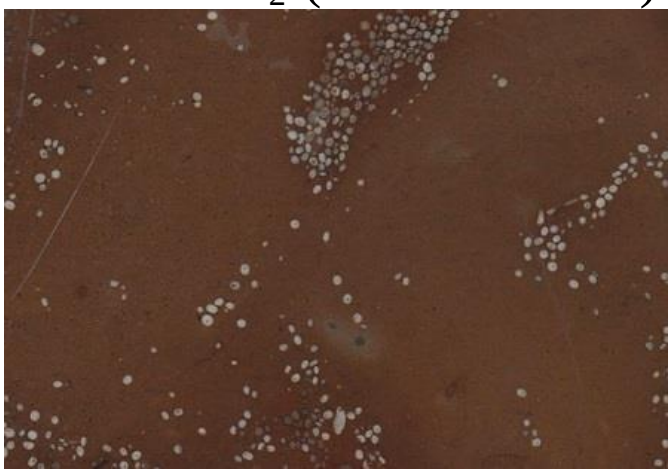
When was it formed?

The diagram below shows part of the Jurassic succession in Northern England. These rocks were deposited over a period of about 2 million years as soft sediment on the floor of a shallow sea between c.185 million and 183 million years ago when “Northern England” was at the same latitude as the present day Mediterranean sea.



Where did the Iron come from?

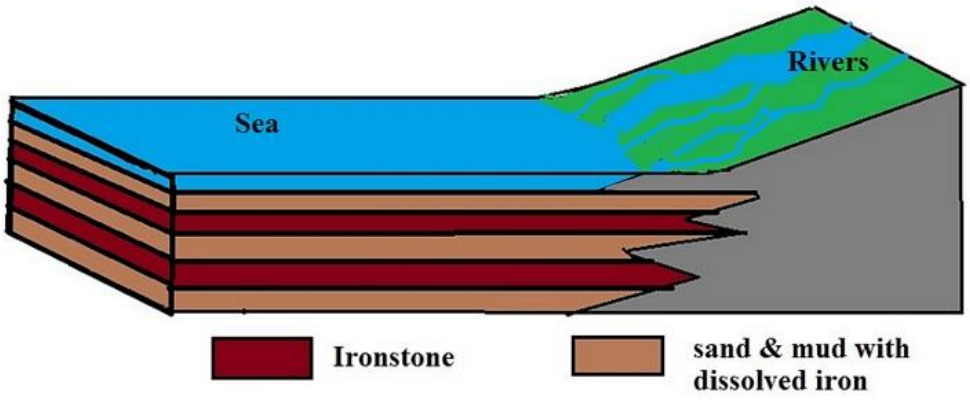
The iron, which forms the ironstone beds was deposited into the sea in microscopic particles (colloidal form) by rivers from land where the topsoil, known as a laterite, was rich in iron minerals. One of the resulting minerals formed beds of **Siderite** ($FeCo_3$) which can be formed (precipitated) in oxygen poor water with high levels of dissolved CO_2 (carbon dioxide).



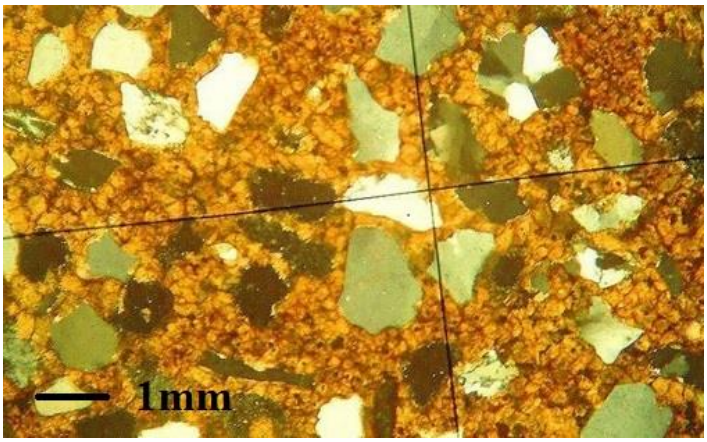
The above picture shows a siderite mudstone, the typical Main Seam Ironstone from Skinningrove. The white "dots" (known as ooids or ooliths, average size 0.5mm) constitute the mineral chamosite which has been altered to a clay mineral.

How was it formed in seams?

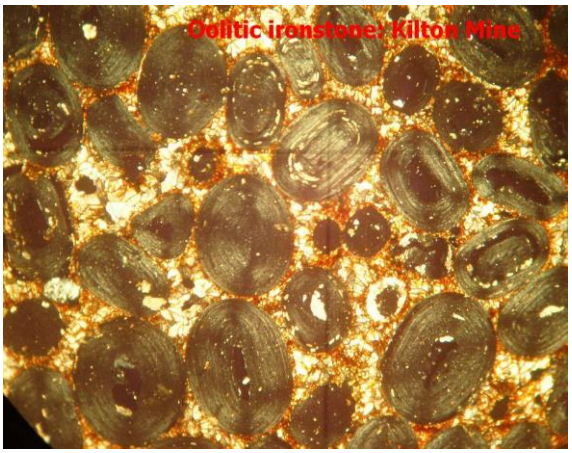
In summary, the **dissolved** iron was transported by rivers to the sea. Cf. simplified diagram below:



The concentration of dissolved iron within the sea remained approximately the same during deposition of both mudstone and iron. The physical difference between the two layers arose due to variations in sediment input. Rapid rates of input (near shore) caused deposition of predominantly mudstone whereas a diminished rate of input (off shore) enabled the same amount of iron, mainly in the form of siderite, to be concentrated within a lower sediment load thereby producing the ironstone seams.



The photo above shows a photo of a thin section of ironstone taken through a microscope. Most of it consists of brown siderite ($FeCo_3$) and grains of quartz (white and grey colours).



The photo above (taken through a microscope with crossed polars) shows an ironstone from Kilton Mine consisting of chamosite ooids within a matrix of siderite. Average diameter of ooids is 0.75mm. The ooids with concentric layering formed as a result of oscillating bottom currents where chamosite formed from a nucleus of e.g. a shell fragment or even a fragment of chamosite itself.

Rosedale Magnetite

In the Rosedale area, the Blea Wyke Sandstone and upper part of the Whitby Mudstone *(cf. diagram above: Lower Jurassic Rocks of Northern England)* were deeply eroded into a series of shallow 'saucer shaped' depressions. The depressions were filled with a distinctive type of ironstone mineral, magnetite (Fe_3O_4) which has magnetic properties, e.g. it can deflect a compass needle, and is therefore known as the "Rosedale Magnetite." It was extensively mined in the 19th and early 20th century.