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## Chapter 5 The Jurassic palaeobotany of Scotland

B.A. Thomas and D.J. Batten

### Introduction

For most of the Jurassic Period, Scotland was an upland area where there was little or no buildup of sediment to form a stratigraphical and palaeobotanical record (see (Figure 3.2)). Sediment did, however, accumulate around the eastern and western coastal areas, and this has preserved a partial record of the vegetation growing in the vicinity, at least for the Middle and Late Jurassic epochs. The floras are not as diverse or well preserved as those from Yorkshire, nor have they been subjected to investigation over as long a time as those in southern England. Nevertheless, they are of interest with respect to both their species composition and their preservation. Many differ in age (Kimmeridgian to Portlandian) from the other British floras.

### History of research

A number of early records of plant fossils from the Jurassic strata of Scotland were made by König in Murchison (1827) and Lindley and Hutton (1832). However, there was little palaeobotanical research in the Scottish academic institutions during the 19th century. Much of the early work was done by amateurs. Most notable among these was the stonemason, turned popular scientist and charismatic preacher, Hugh Miller (1857, 1861), some of whose specimens were described by Richards (1884). Some floras were also described by geologists in their stratigraphical studies, such as Judd's (1873) description of the Brora flora in his review of the Mesozoic stratigraphy of Scotland. The only other notable 19th century record of plants from Brora was by Carruthers (1870a).

During the early 20th century, the Scottish plant fossils started to attract the attention of specialist palaeobotanists. Stopes (1907) published a detailed account of the Brora assemblage, and Seward (1911) and Seward and Bancroft (1913) did the same for other Sutherland floras. For many years these remained the definitive accounts. Little more was published apart from a brief description of fossils from Brora by Harris and Rest (1966). Recently, however, palaeobotanists from Utrecht have been re-examining the floras, the results of which have been published in a series of papers (van der Burgh, 1987; van der Burgh and van Konijnenburg-van Cittert, 1984; van Konijnenburg-van Cittert and van der Burgh, 1989, 1996).

The west of Scotland has only one locality for Jurassic plant fossils. This newly discovered site at Bearreraig on the Trotternish Peninsula of the Isle of Skye has yielded well-preserved plants in calcitic and sideritic nodules (Bateman and Morton, 1994; Dower and Bateman, 1998; Bateman *et al.*, in press).

### Palaeogeographical setting

During the Jurassic Period, most of Scotland was part of the Scottish Landmass and a centre of erosion rather than deposition (see (Figure 3.2)). However, there are important successions of this period in the Inner Hebrides and along a narrow western strip of the mainland coast. These range from Hettangian to Kimmeridgian in age (Morton and Hudson, 1995). On the eastern side of the country, there is some evidence of non-marine deposition in the Early and Middle Jurassic epochs, but most of the succession is offshore. Only the relatively small area around Golspie and Brora has any onshore exposure. A major marine transgression took place at the start of the Callovian, possibly triggered by tectonic activity in the North Sea. This resulted in flooding of what is now known as the Moray Firth Basin and the development of shallow marine sedimentary sequences along a narrow strip of the Sutherland coast.

Late Jurassic global palaeogeography was not significantly different from that of the Middle Jurassic Epoch (see (Figure 3.1)) except for the expansion southwards of the arid region into southern Africa and southern South America. It was a time of marked climatic warming that in the Northern Hemisphere resulted in a northwards movement of the main floristic

boundaries (Vakhrameev, 1991). Vakhrameev placed the Scottish Late Jurassic floras in their own floristic province, (the 'Scottish Province'), which he interpreted as being intermediate between the Siberian and the more typical Euro-Sinian floras such as found in southern Europe.

## Stratigraphical background

The Jurassic stratigraphy of Scotland has been summarized by Cope *et al.* (1980a,b). Jurassic deposits in the Moray Firth Basin of Sutherland range in age from late Sinemurian to early Pliensbachian (early Jurassic) at Dunrobin Bay Farm, near Golspie, through Bathonian at Brora to Early Portlandian at Navidale (Figure 5.1) and (Figure 5.2). They form the only accessible part of the extensive Jurassic deposits in the North Sea Basin. The western margin is clearly delineated by the Helmsdale Fault (Johnson and Mykura, 1989). The beds are largely covered by moraine and are exposed only along the coast, and in river sections and disused quarries.

Morton and Hudson (1995) gave a detailed account of the Hebridean sequence. The deposits are mainly shallow marine, except for the Great Estuarine Group, which is lagoonal. However, it is the Bearreraig Sandstone, which underlies the Great Estuarine Group, that has yielded plant fossils.

## Jurassic vegetation in Scotland

The composition of the vegetation during the Jurassic Period was broadly similar to that in Yorkshire (see Chapter 3). Ferns and bennettites are especially abundant in the fossil record, while drought-resistant conifers with *Brachyphyllum* foliage are relatively rare. Czekanowskias occur in the Upper Jurassic strata. These are otherwise unknown from northern temperate latitudes (Vakhrameev, 1991).

## Palaeobotanical sites in the Jurassic rocks of Scotland

Plant fossil assemblages are now known from ten localities, four of which are included here as GCR sites together with one potential site (Lothbeg Point). Two are Middle Jurassic in age: Bearreraig (Aalenian–Bajocian) and Brora (Bathonian). As these are unique localities, they have been selected as GCR sites.

The commonest plant remains in the Scottish Jurassic strata are Kimmeridgian in age. They are known from a series of coastal localities, which become slightly younger from south to north: Kintradwell and Eathie are in the *cymodoce* Zone; Lothbeg Point, Craikaig Links and Kilmote are middle Kimmeridgian; and Culgower is in the *mutabilis* Zone (Figure 5.2). Culgower is the best known for adpression fossils, and Eathie for petrifications; therefore these have been selected as GCR sites. However, the newly discovered Lothbeg Point plant bed provides a significant comparison with Culgower and thus also merits selection for the GCR.

The overlying upper Kimmeridgian–Portlandian (Volgian) succession also includes several known palaeobotanical localities, notably at Helmsdale and Navidale. The latter was originally thought to be Kimmeridgian but palynological evidence has shown it to be younger (Riley, 1980). However, neither is deemed to now yield plant fossils of sufficient interest to justify selection as a GCR site.

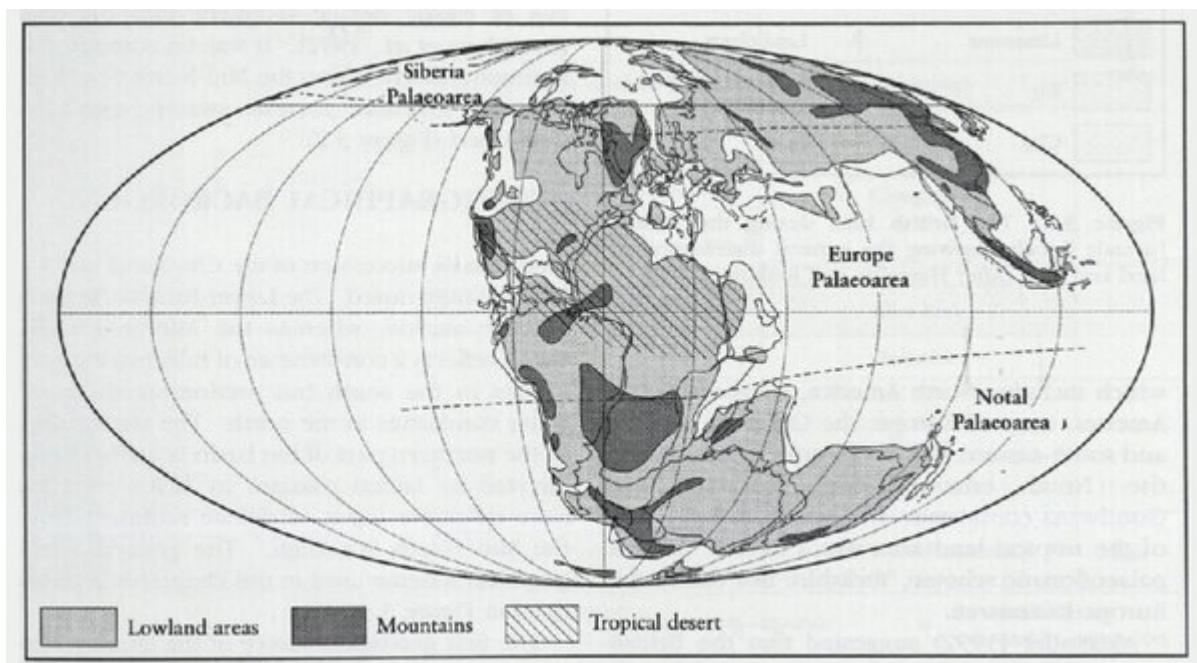
The depositional environments of the plant assemblages varied considerably, reflecting taphonomic more than any innate floral differences within the region. That at Brora was lagoonal in origin with an in-situ build up of plant growth and deposition to give coal. Some, such as at Culgower, represent a nearby vegetation with some upland elements washed in. Others, such as at Lothbeg Point, represent drifted plant remains that are found in association with marine indicators. From the evidence of these different assemblages, van Konijnenburg-van Cittert and van der Burgh (1996) have interpreted the ecology of the Kimmeridgian flora as plants growing along and near to river banks, with their debris accumulating in deltas or being transported out to sea. They grouped the plants according to the most probable occurrence: brackish areas or saltmarsh (five species); freshwater swamp (five species); moist lush vegetation (the richest in species); upland forest (a few species) and heath (only two species).

The plant fossils from Bearreraig, Eathie and Helmsdale are rather different in that they are preserved as permineralizations. Those at Bearreraig and Eathie are in calcareous nodules, while the Helmsdale fossils are fragments of wood.

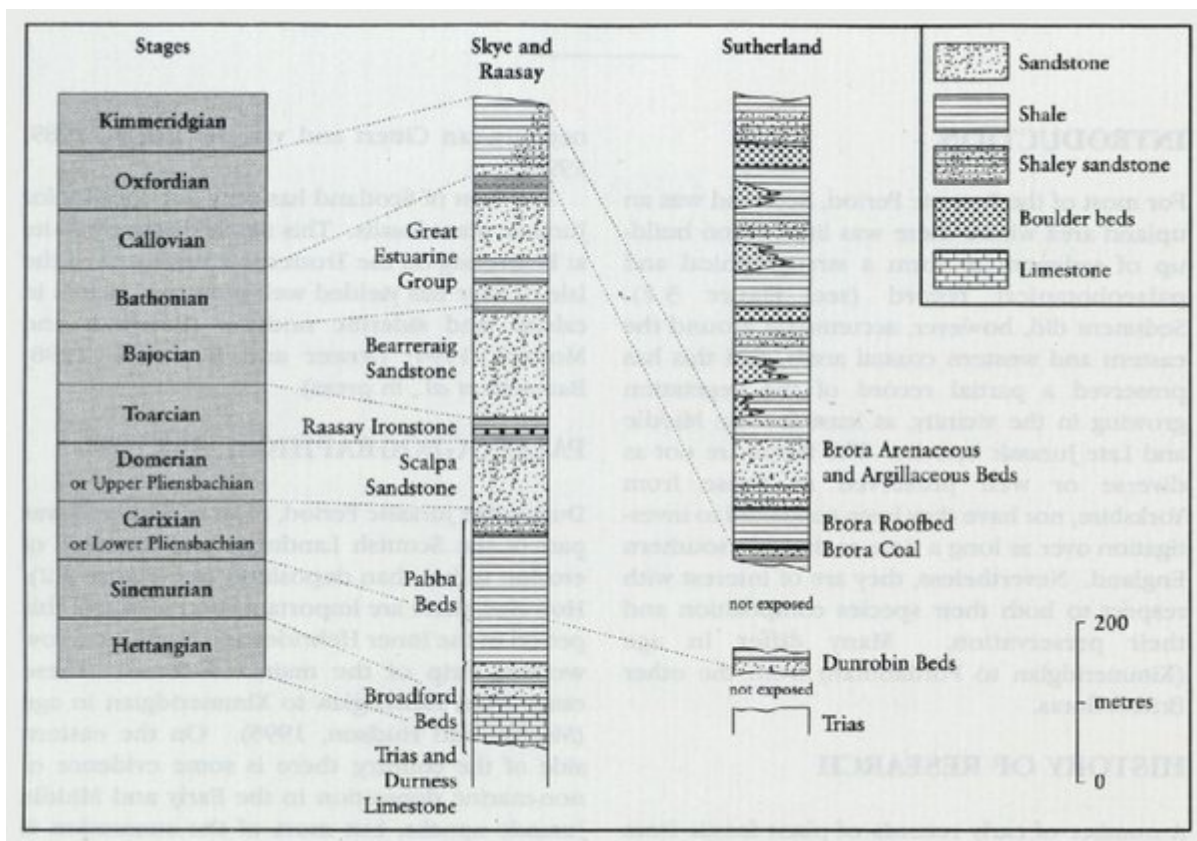
## References



(Figure 3.2) The British Isles during the Middle Jurassic Epoch, showing the general distribution of land and sea. (After Hesselbo and Jenkins, 1995.)

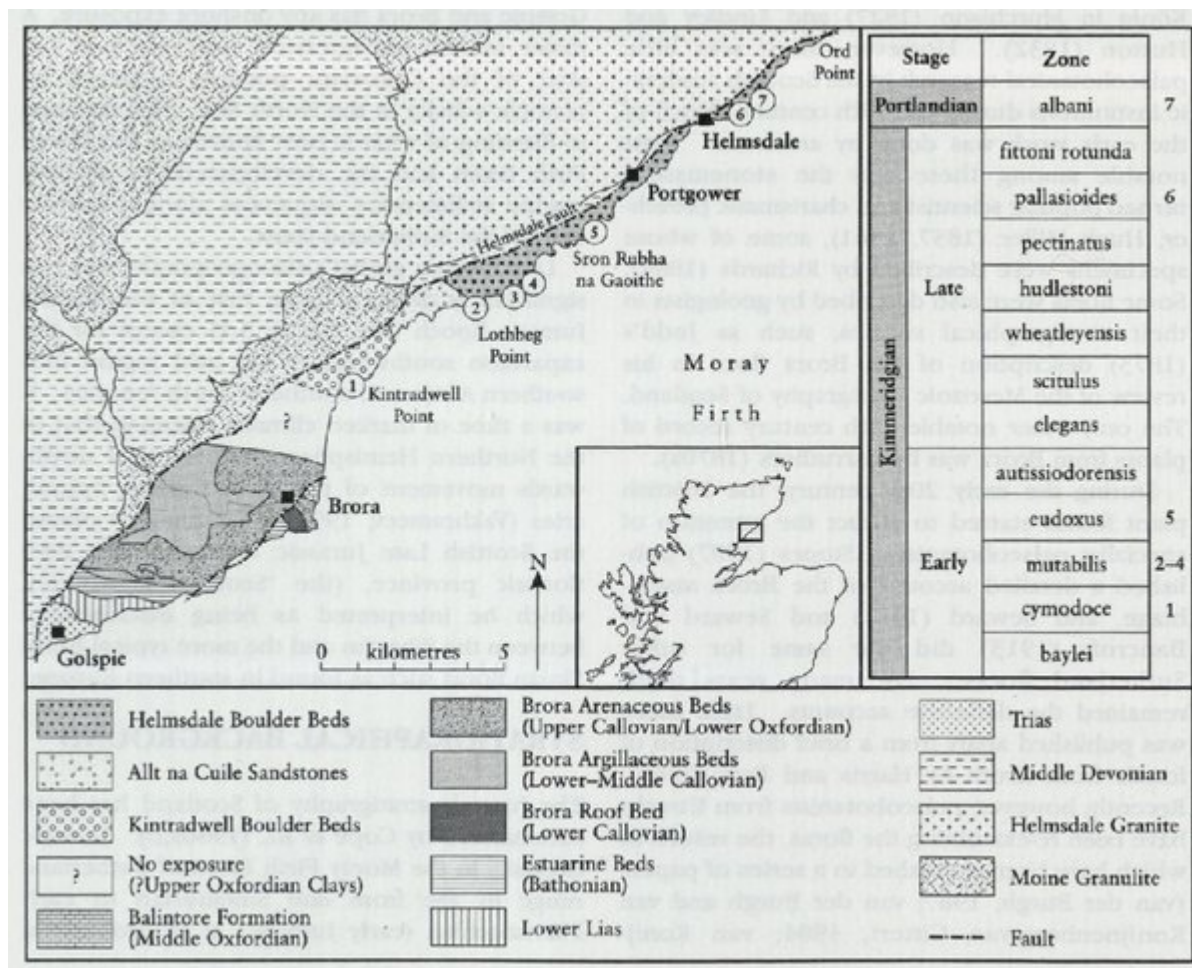


(Figure 3.1) Palaeogeography of the Middle Jurassic world, showing main areas of land and mountains. Based on Smith et al. (1994). Also shown are the main palaeofloristic areas, based on Meyen (1987) and Vakhrameev (1991).



(Figure 5.1) Correlation of Jurassic rocks in the northern Inner Hebrides and Sutherland. (After Hallam, 1983.)





(Figure 5.2) Location and relative stratigraphical positions of the main Kimmeridgian and Portlandian palaeobotanical localities along the Sutherland coast. (Adapted from Pickering, 1984, and van Konijnenburg-van Cittert and van der Burgh, 1996.)