Bulk mineral resources, Cainozoic of north-east Scotland

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Contents

Introduction

Major sand and gravel workings in north-east Scotland (1999). P915255.

Construction and industrial minerals form an important resource in north-east Scotland. Sand and gravel deposits are by far the most important and reserves with planning permission accounted for 25 per cent of the Scottish total in 1993 (BGS, 1998). The value of naturally occurring aggregate extracted from north-east Scotland was approximately £6 million in 1997. Of this, 431 000 tonnes were used for fill, 350 000 tonnes for concreting sand, 290 000 tonnes as coarse aggregate for concrete and 109 000 tonnes for building sand. In 1997, twenty-two major workings (P915255) were notified to BGS as being operational within the district (Cameron et al., 1998). Brick clay and peat

also constitute significant bulk resources in north-east Scotland, although there is little current commercial peat extraction and no large-scale brick clay working from these deposits.

A brief general account of the most extensive spreads of sand and gravel in north-east Scotland is given below, but, because of their economic importance, abundance and variability, these resources are more fully described in Bulk mineral resources.

Sand and gravel

Sands and gravels of several types occur in north-east Scotland. Each type reflects its mode of deposition and the rocks from which it was derived. The extensive glaciofluvial deposits that flank the lower reaches of most of the major river valleys, and extend onto the adjacent interfluves, are the principal sources of naturally occurring coarse-grained bulk aggregates. Most were laid down at the close of the Main Late Devensian glaciation. Less extensive spreads of sand and gravel accumulated around the coast as raised beach and marine deposits, when sea level was higher than at present (during the Late-glacial and mid-Holocene). Sands and gravels that were deposited by postglacial streams and rivers also commonly underlie floodplains and river terraces, while extensive dunes of blown sand fringe the coast, particularly in the eastern part of the district.

The most important sand and gravel resources occur as moundy and flat topped glaciofluvial deposits. These flank the lower reaches of the valleys of the rivers Don and Dee, and extend onto the adjacent interfluves around the city of Aberdeen (the largest market for aggregate in northern Scotland). However, many of the most attractive deposits around Aberdeen have been extensively worked, and some of the resources close to the city have been sterilised by urban expansion. More extensive spreads of good quality sand and gravel, suitable for most end-uses, occur in the coastal lowlands between Forres and Elgin. They form coarsening-upward sequences that were laid down as fans at the mouths of drainage channels or in temporary ice-dammed lakes, kettled terraced spreads that were laid down on bodies of stagnant ice during deglaciation and gravelly Late-glacial raised beaches. Thick deposits of gravel and sand are locally present beneath river floodplains, but none is exploited at present, as the bulk of the resource lies beneath the water table.

Mill of Dyce sand and gravel pit in glaciofluvial deposits on the southern side of the valley of the River Don. P258066.

Thick, easily worked resources of sand and gravel, lying above the water table, form flights of terraces flanking the North Ugie Water, South Ugie Water, and the rivers Lossie, Spey, and Ythan. The Ythan terrace gravels contain a high proportion of boulders, but have been extensively worked on both sides of the river downstream of Methlick. Gravels were also won from several pits sited on the Ugie terraces. Moundy glaciofluvial ice-contact deposits that crop out inland of Fraserbrugh, between Aberdeen and Peterhead, and between Stone-haven and Auchenblae are also major resources. However, these accumulations are commonly discontinuous and individual deposits may

vary considerably in thickness and quality over relatively short distances. Typically, they contain waste partings of silt and clay and may be concealed beneath a thin overburden of till.

Most deposits, particularly those in the upland areas, contain high proportions of clasts derived from crystalline resistant rock types, and after on-site screening, washing, crushing and grading, they produce high-quality aggregates that suit most end-uses (Merritt et al., 1988). However, the spreads of sand and gravel overlying Devonian bedrock, such as those in the south-eastern part of the district, tend to yield weaker aggregates, as they locally contain significant amounts of friable sandstone, mudstone and porphyritic lavas. Much of the sand and gravel in north-east Scotland is used in the production of ready-mix concrete and concrete products, as a source of mortaring and plastering sand, and as fill in civil engineering works (P258066). Some sand is used for coated aggregate in road building, but little gravel is used for road surfacing, as crushed-rock aggregate provides clasts with better resistance to abrasion and polishing. Poorer quality sand and gravel is used extensively in the construction of unmetalled roads and tracks.

Potentially workable deposits of coarse-grained aggregate also occur within the Buchan Gravels Formation, an unlithified gravelly deposit of Palaeogene to Neogene age, which crops out between Peterhead and the upper reaches of the Deveron and Ythan valleys. In some areas, sands, and less commonly gravels, derived from decomposed igneous, metamorphic and sedimentary bedrock are also worked as fill for untarred roads.

Brick clay

Principal former brick-clay localities in north-east Scotland. P915256.

Glacial and glaciofluvial features and the distribution of tills in the Elgin district. P915371.

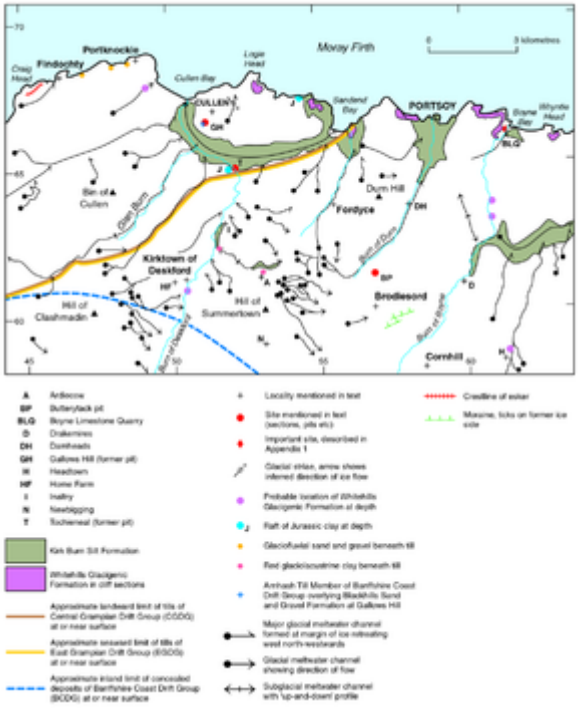
Clays suitable for brick and tile making are widely distributed within the Quaternary deposits of north-east Scotland, and have been worked at almost 20 sites during the last two centuries. Most workings were small-scale and served local markets; no commercial brick or tile making currently takes place. The widely scattered, variable quality and remote nature of many deposits, the small size of reserves at most sites and the relatively high costs of firing superficial clays, all contributed to the decline of the industry.

The only comprehensive evaluation of clays in northeast Scotland suitable for brick, tile and pipe-making was undertaken by Eyles et al. (1946). This work, which forms the basis of the following account, provided geological descriptions of all of the worked and potentially workable clay deposits that had been identified in the district prior to the end of the Second World War. It also reported the results of physical and chemical tests on deposits at a selection of clay pits, which were primarily undertaken to establish the suitability of each clay deposit for brick making. The results showed the material to be of variable, but generally rather poor quality, but suitable for the production of drainage pipes, tiles and common bricks.

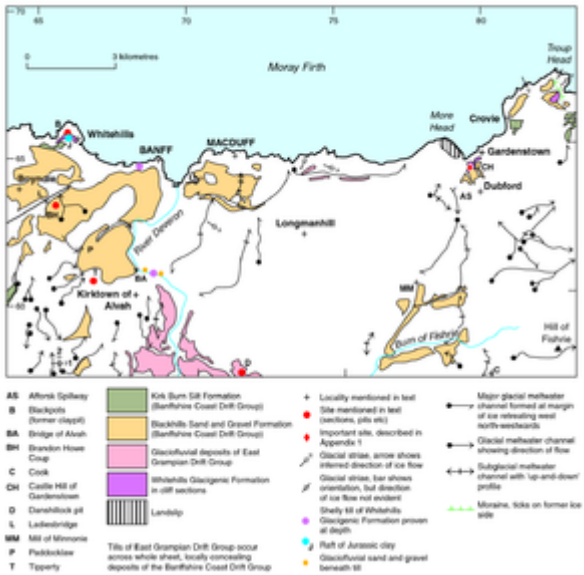
The data provided by Eyles et al. (1946), together with that gleaned during more recent geological surveys have been used to compile a map of the main sources of brick clay in the district (P915256). A total of 29 brick clay sites are recognised, of which 21 have been worked commercially. Eyles et al. (1946) established that common bricks had been made from a wide variety of clayey Quaternary sediments, including, 'boulder clay' (till), 'fluvioglacial clay' (clayey glaciolacustrine deposits), clayey raised marine deposits and alluvium. Workings for brick clay were also recorded in large glacially transported rafts ('erratics') of Jurassic mudstone. Data on the type of clay deposit and its maximum thickness at each site are summarised in the table. This shows that clays of marine, glaciomarine and glaciolacustrine origin have been the most widely worked for brick making, possibly because they are the least heterogeneous, widespread clayey deposits in the district.

Silty clays of marine origin (Spynie Clay Formation) were formerly worked for brick and tile making in two pits close to the town of Elgin (P915256; P915371). The clay deposits occur close to sea level, beneath shelly sands and peat near Loch Spynie. Considerable resources are thought to be present north of Milltown Airfield (NJ 266 658) and beneath Lossiemouth Airfield (NJ 210 695) (Peacock et

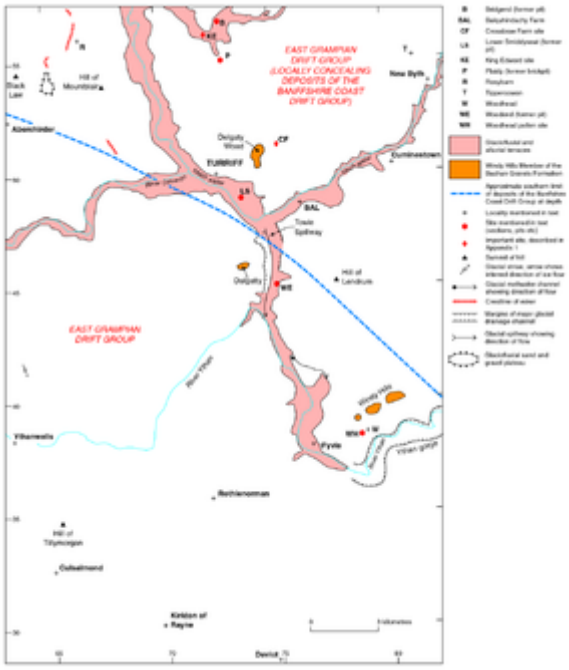
al., 1968).



Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 96W Portsoy. P915372.



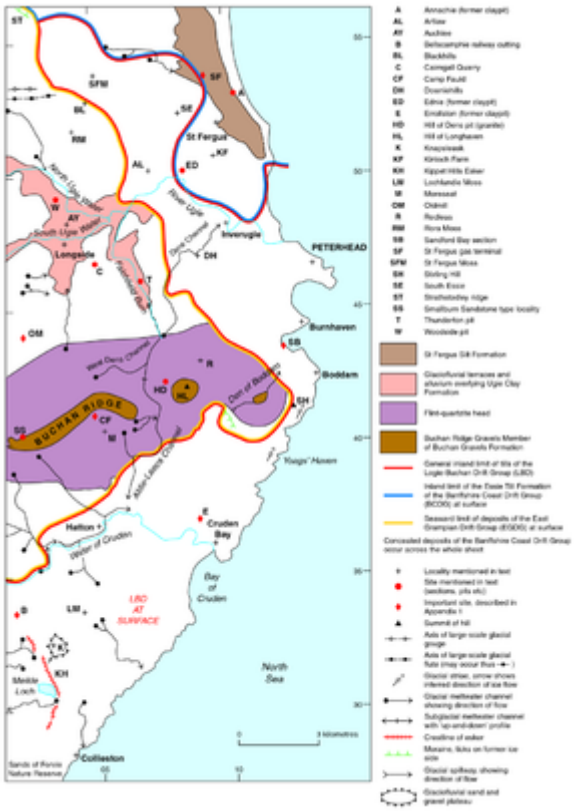
Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 96E Banff. P915373.



Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 86E Turriff. P915375.

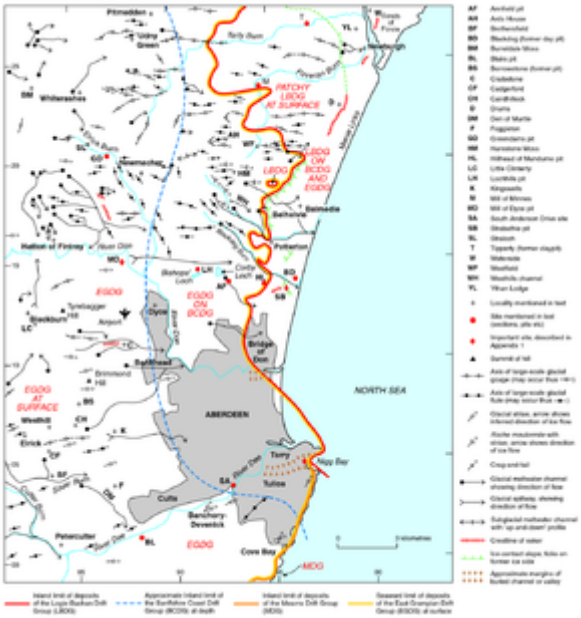
Dark blue-grey clay with wisps of sand was worked for pipes, bricks and tiles in a clay pit at Tochieneal (NJ 521 652) (P915372), south of Cullen, though test results indicate that mixing sand with the clay would improve its suitability for brick making. Previous accounts are undecided as to whether the worked deposits are part of a large erratic of Jurassic mudstone or a Quaternary marine deposit. It is probable that they are rafts within the Whitehills Glacigenic Formation. Similar rafted material was also worked in pits at Blackpots (NJ 659 657) near Whitehills (P915373), and at Plaidy (NJ 730 550), north of Turriff (P915375).

Greenish grey laminated clays and silts, containing dropstones and marine shells of Late Devensian age, have been worked for brick making in a pit near Annachie (St Fergus) (NK 105 529), north of Peterhead. Much of the resource is concealed beneath alluvium, but 16 m of laminated silt and clay were recorded in a nearby BGS borehole (NK15SW1).



Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 87E Peterhead. P915377.

Most recent brick production has been concentrated on Quaternary clay resources between Peterhead and Aberdeen, which are reviewed by Ridgeway (1982). Until the middle part of the 1980s, reddish brown laminated silty clays and associated clayey tills were worked for brick making at the Cruden Bay Brick and Tile Works at Errollston (NK 088 368), south of Peterhead (Errollston; P915377). Laminated silts, sands and clays, interbedded with silty clayey diamicton, were recorded to a depth of 6.2 m, in a section at the working pit examined during 1974 by Peacock (1984). A comparable section was recorded in 1944, by Eyles et al. (1946), although the workable deposits were reported to extend to more than 24 m depth in places. The test results indicate that the Errolston deposit is suitable for the manufacture of facing bricks as well as common bricks.



Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 77 Aberdeen. P915379.

Reddish brown clay and silt was also worked by the Cruden Bay Brick and Tile Company in a pit in the valley of the Tarty Burn at Tipperty (NJ 971 268) (P915379) until the middle part of the 1980s. Eyles et al. (1946) record 5.3 m of laminated clay resting on sand and gravel in the working face exposed in 1944. The form and extent of the deposit, which was investigated by mapping and trial pitting during the 1970s, is illustrated in Munro (1986, fig. 37). At the time, 2 m of unstratified 'red' clay passing downward into 2 m of laminated silt and clay was recorded from the working pit. The laminated unit was seen to overlie sand and gravel resting on red-brown till. In 1944, the clay was only worked for the manufacture of agricultural drain tiles, but facing bricks were produced during the 1980s.

In and around the city of Aberdeen several clay pits were worked in the past; for example Seaton, Blackdog, Ferryhill, and Torry (P915379). The sites of all but the first mentioned have long been abandoned and the exact extent of each working is unclear. About 1 m of crudely laminated 'bluishyellow' clay was exposed in the pit at Seaton Brick Works in 1944, but 4.9 m of similar material, beneath 0.9 m of gravel was recorded from the site by Jamieson (1858). Bricks were produced at Seaton during the 19th century. By 1944, however, the deposit was worked solely for the manufacture of earthenware pottery and horticultural ware, such as flower pots. The worked deposits are assigned to the Tullos Clay Member of the Logie-Buchan Drift Group.

Brick clay deposits in north-east Scotland

Sheet	Site	Thickness M. (maximum recorded thickness)	Postulated origin	Published analytical results	Formerly worked	References
95(w)	North Greens, Covesea	6	Raised glaciomarine deposit of Spynie Clay Formation	yes	no	Eyles et al.. 1946

95(w)	Gilston, W of Loch Spynle	13	Raised glaciomarine deposit of Spynie Clay Formation	no	yes	Eyles et al., 1946: Peacock et al.. 1968
95(w)	Ardivot, N of Loch Spynie	15	Raised glaciomarine deposit of Spynle Clay Formation	no	yes	Peacock et al.. 1968
95(w)	East Mains, Loch Spynie	20	Raised glaciomarine deposit of Spynle Clay Formation	no	no	Peacock et al.. 1968
95(e)	Loch of Cotts, N of Milltown Airfield	-	Raised glaciomarine deposit of Spynle Clay Formation	no	no	Peacock et al., 1968
96 W	Tochieneal, S of Cullen	4	Erratic raft of Jurassic mudstone and marine deposit	yes	yes	Read. 1923: Eyles et al.. 1946
96 E	Whitehills (Blackpots), W, of Banff	6	Erratic raft of Jurassic mudstone and marine deposit	no	yes	Read. 1923: Eyles et al.. 1946
86 E	Plaidy, N, of Turrlff	8	Erratic raft of Jurassic mudstone	no	yes	Eyles et al.. 1946
97(e)	Lumbs, NE of Crimond	-	Till of Banffshire Coast Drift Group	no	yes	Eyles et al., 1946: Peacock. 1983
87 E	Annachie, NE of St Fergus	16	St Fergus Silts of Banffshire Coast Drift Group	no	yes	Eyles et al., 1946: Peacock. 1983
87 E	Ednie, NW of Peterhead	10	Till and laminated deposits of Banffshire Coast and Logie-Buchan drift groups	no	yes	Eyles et al.. 1946: Peacock. 1983
87 E	Downiehills Farm, W of Peterhead	16	Till of Logie-Buchan Drift Group	no	yes	Eyles et al.. 1946: Peacock. 1983
87 E	Invernettie, S of Peterhead	14	Till and glaciolacustrine/marine deposits of Logie-Buchan Drift Group	no	yes	Jamieson. 1858
87 E	Erroiston, Cruden Bay	24	Till and glaciolacustrine deposits of Logie-Buchan Drift Group	yes	yes	Eyles et al.. 1946: Peacock. 1983
87 W	Westfield Farm, Auchmacoy	3	Alluvium and (?) glaciolacustrine deposits of Logie-Buchan Drift Group	no	yes	Eyles et al.. 1946

87 W	Ellon	10	(?) Glaciolacustrine deposits Logic-Buchan Drift Group	no	no	Eyles et al., 1946
87 W	Esslemont, SW of Ellon	2	Till and glaciolacustrine deposits of Logie-Buchan Drift Group	no	yes	Eyles et al., 1946
77	Tipperty, N of Aberdeen	5	Glaclolacustrine or glaciomarine deposits of Logic-Buchan Drift Group	yes	yes	Eyles et al., 1946: Munro. 1986
77	Middlemulr House, N of Belhelvie	2	Glaciolacustrine deposits of East Grampian Drift Group	no	no	Eyles et al., 1946: Smith. 1983
77	Balmedie House	2	Glaciolacustrine deposits of Logic-Buchan Drift Group	no	no	Eyles et al.. 1946: Munro. 1986
77	Elgie Links,, S of Balmedie	5	(?) Glaciolacustrine deposits of Logle-Buchan Drift Group	no	no	Munro. 1986: Smith. 1983
77	Blackdog, N of Aberdeen	3	Glaciontarine or glaciolacustrine deposits of Logie-Buchan Drift Group	no	yes	Eyles et al., 1946: Munro. 1986
77	Milden Burn	5	(?) Glaciolacustrine deposits of Logic-Buchan Drift Group	no	no	Eyles et al.. 1946
77	Seaton, S of Bridge of Don	5	(?) Glaciolacustrine deposits of East Grampian Drift Group	no	yes	Eyles et al.. 1946: Munro. 1986
77	Ferryhill (Clayhills), Aberdeen	20	Deposits of the Tullos Clay Member of the Logie-Buchan Drift Group (Red-brown clays associated with brown and gley clays)	no	yes	Eyles et al.. 1946: Munro. 1986
77	Torry, Aberdeen	7	Deposits of the Tullos Clay Member of the Logie-Buchan Drift Group (Red-brown clays associated with brown and gley clays)	no	yes	Eyles et al., 1946: Munro. 1986
77	Middleton, south of Tory	6	Deposits of the Tullos Clay Member of the Logie-Buchan Drift Group (Red-brown clays associated with brown and gley clays)	no	no	Simpson. 1948
67	Brickfleld, Stonehaven	2	Glaclolacustrine Ury Silts Formation of Mearns Drift Group	no	yes	Eyles et al.. 1946: Carroll. 1995a
67	Toll Cottage, Stonehaven	-	Glaciolacustrine Ury Silts Formation of Mearns Drift Group	no	yes	

Peat

Widespread commercial exploitation of peat in north-east Scotland has been limited by transportation costs and environmental concerns. Production for horticultural use and as fuel has been concentrated around New Pitsligo and Strichen in Buchan, but resources there are almost exhausted. Other patchy deposits of peat are widespread, but there are few major resources. Most are restricted to relatively inaccessible spreads of hill peat, many of which are covered by forestry. Areas of basin peat occur on lower ground, but the bulk of these have been worked to the water table, or are preserved as nature reserves and Sites of Special Scientific Interest (SSSIs). The use of peat as fuel by farmers and crofters has not been important in the recent past, but persists on a small scale. In western parts of the district it has a specialised application in whisky distilling.

The first systematic assessment of the peat deposits in Scotland began during the Second World War (Fraser, 1943), with the aim of evaluating their potential uses as fuel and in agriculture. The results from the first of a planned series of surveys, dealt with the deposits of Aberdeenshire, Banffshire and Morayshire (Fraser, 1948) and are summarised in the table below; subsequent systematic surveys were abandoned in the immediate postwar period. Assessments recommenced in 1949, but concentrated only on major deposits with a view to their potential use as fuel for peat-fired power stations (Department of Agriculture and Fisheries for Scotland, 1962). These surveys evaluated resources in south-west Scotland, the Western Highlands and Islands, Central Scotland, and Caithness, Shetland and Orkney (Department of Agriculture and Fisheries for Scotland, 1964, 1965a, b, 1968). None of the deposits in north-east Scotland was included in these surveys, but the overall potential of Scottish peat for electricity generation was reviewed by Dryburgh (1978).

Potential peat resources between Aberdeen and Elgin (based on Fraser, 1948)

Sheet	Name	Type of peat	Condition [2]	Altitude (m)	Area (ha)	Maximum thickness (m)
95	Broken Moan	Basin	33% cut over	275	10	-
96W	Aultmorehill Moss [1]	Hill	Unexploited	235	80	2.4
96W	Old Fir Hill- Hill of Moss, Clashmadin	Hill & Basin	25% cut over	235	60	4.3
96W	Sheil Muir Moss	Basin	Mostly cut over	200	60	
96W	Hill of Ord	Basin	Mostly cut over	160	8	
96E	Moss of Clochforbie-Moss of Byth	Basin	All cut over, partly reclaimed	150	-	-
96E	Moss of Fishrie [1]	Hill	25% removed	190	280	2.4
97	Moss of Bracklemore [1]	Basin	50% disturbed by cutting	130	150	6.1
97	Windyheads Hill	Basin	All cut over	170	-	-
97	Moss of Blackrigg	Basin	75% cut over	90	30	4.9
97	Mosses of Skelmanae and Auchmacleddie	Basin	All cut over	90	100	4.3
97	Montsolie	Basin	All cut over	100	-	
97	Mosses of Middlemuir [1]	Basin	33% cut over	100	400	4.3 [3]
86E	Cuminestown	Hill and Basin	75% cut over	150	80	2.1
86E	Moss of Swanford [1]	Basin	Mostly cut over	90	25	2.1
86E	Mosses NE of Fyvie	Basin	All cut over	110	120	1.2

86E	Mosses at Leet, Cairns and Heatherybanks	Basin	All cut over	110	40	2.4
86E	Wartle Moss	Basin	Mostly cut over	120	100	-
86E	Moss of Redhill	Basin	Mostly cut over	150	25	-
87W	Mosses at Cowbog	Hill & Basin	75% cut over	135	120	6.1
87W	Mosses at Nittanshead	Hill & Basin	Mostly cut over	175	180	3.7
87W	Craigculter Moss	Basin	25% cut over	120	40	3.7
87W	Mosses N of New Leeds	Basin	Mostly cut over	75	60	4.3
87W	Mosses of Auchleuchries and Muirtack	Basin	All cut over	75	60	-
87W	Moss of Dudwick	Hill	All disturbed by cutting	105	65	-
87W	Mosses of Elrick and Annochie	Basin	All cut over	110	-	-
87E	Mosses of Crimond and Logie	Basin	50% cut over	60	160	4.3
87E	St Fergus Moss	Basin	50% disturbed by cutting	45	220	6.1 [(3)]
87E	Rora Moss	Hill	50% cut over	55	400	2.7
87E	Mosses of the Cruden Hills	Hill & Basin	20% cut over	115	600	2.4 [(3)]
87E	Moss of Kinmundy	Basin	Mostly cut over	75	55	4.3
87E	Moss of Lochlundie	Basin	70% disturbed by cutting	75	240	6.1
76E	Skene Moss	Basin	75% cut over	100	30	3.5 [(3)]
76E	Mosses of Air and Lochside	Basin	75% disturbed by cutting	100	60	4.3 [(3)]
76E	Springhill Moss	Basin	50% cut over	75	25	3.7
76E	Luechar Moss	Basin	90% cut over	75	35	-
76E	Red Moss at Candyglirach	Basin	66% cut over	75	240	3.0 [(3)]
76E	Mosses of Blacknose and Lochmuir [(1)]	Basin	All disturbed by cutting	70	260	1.9
76E	Hill of Fare	Hill & Basin	Wide area removed	250	10	4.6
77	Burreldale Moss	Basin	75% cut over	150	120	4.3 [(3)]
77	Moss of Logierieve	Basin	All cut over	60	30	-
77	Moss of Pettymuck	Basin	All cut over	60	12	-
77	North Moss of Ardo	Basin	Mostly cut over	75	15	-
77	Mosses of Ardo, Wardhillock and Harestone	Basin	Extensively cut over	70	20	4.6
77	Red Moss between Belhelvie and Dyce	Basin	60% cut over	90	200	3.7 [(3)]
77	Grandholm Moss	Basin	All cut over	70	20	-

[1] Deposit extends onto adjoining sheet.
[2] Refers to the condition of the peat evaluated at the time of Fraser's study: many of the deposits have been worked entensively on piecemeal basis since 1948. Cut over - indicates that the top layer of peat was partially or completely extracted; deeper layers remain intact.
[3] Cross-section of moss and representative peat profile in Glentworth and Muir (1963).

Fraser (1948) identified 46 areas of peat in north-east Scotland that were considered potentially workable, but none of the deposits on 1:50 000 sheets 66E and 67 was investigated. In general terms, the hill peats are extensive, but thin, with much of the resource forming hags above the water table. The basin peats are thicker, but less extensive and predominantly water-saturated; many are relict and now eroding.

By the mid 1940s, most of the 4845 hectares (ha) of peat identified by Fraser, between Aberdeen and Elgin had been worked in a piecemeal fashion for fuel. In the 1960s, eight of the major peat mosses between Aberdeen and Fraserburgh (table above) were examined in detail by the Soil Survey (Glentworth and Muir, 1963). In general, the extent of the peat and amount of cutting that had occurred at each site, recorded in the later survey, were comparable to the figures given in Fraser (1943). The detailed later survey showed that maximum thickness of peat at each site was generally greater than that recorded by Fraser. The average thickness of peat that remained in cut areas, ranged between 25 per cent of maximum thickness recorded at Moss of Air, to 60 per cent of the maximum at St Fergus Moss. Recent geological mapping indicates that piecemeal working has continued, particularly up to the late 1970s, and many of formerly identified resources are now too thin and waterlogged to be attractive for commercial extraction.

Commercial extraction of peat around New Pitsligo and Strichen reached its peak in the early 1990s. Seven to eight thousand tonnes per year is currently extracted from Lambhill Moss, by the Northern Peat and Moss Company, although remaining reserves here are small. Some 15 to 20 per cent of production is sold throughout Scotland for domestic fuel; the remainder is exported, via Fraserburgh, to southern Sweden, for use as fuel in a district heating plant. Commercial extraction of peat from St Fergus Moss commenced during 1998, with 7–8000 tonnes being produced in the first year of working; most of the material is also exported to Sweden for use as fuel, but some peat for horticultural use is also produced.

More than 3000 ha of peat has been mapped on Sheet 66E Banchory, most of which occurs as extensive hilltop spreads on the watershed between the catchments of the River Dee and Water of Feugh and the rivers and burns that drain south-eastwards into Strathmore. The hill peat is generally less than 2.5 m thick and much of it rests either on thin till or directly on the dominantly granite bedrock. The most notable spreads occur on the uplands, north and south of Glen Dye (1500 ha), between Little Kerloch (NO 674 874) and Leachie Hill (NO 739 853) (900 ha) and around Little Sheil Hill (NO 796 917) (350 ha). The hill peat has been worked on a piecemeal basis in several places, but much of the resource is currently sterilised by extensive forestry plantations. Minor deposits of thin, waterlogged basin peat are present around Loch of Park, on the northern edge of Sheet 66E.

About 400 ha of basin peat occurs in the northern part of Sheet 67 Stonehaven within rock basins and in the floors of glacial drainage channels. Significant deposits (160 ha) occur in basins, linked by drainage channels, between Broomhill (NO 844 901) and Forester’s Croft (NO 873 883), and at Red Moss (120 ha), near Netherley (NO 855 934). Mapping indicates that, apart from the deposit at Red Moss, the basin peat is generally thinner (1–2 m) than that commonly found north of Aberdeen, and it has not been worked as extensively.

References

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