The Allt Odhar (Moy) Interstadial site

Jon Merritt

The **Allt Odhar** site [NH 798 368] lies at c. 371 m OD on the Moy Estate, some 16 km south-east of Inverness (Fig. 100). Preserved within a sequence of glacial deposits, there is a notable bed of compressed peat containing pollen, insect remains and plant macrofossils (Merritt, 1990b,1993). Analysis of pollen, plant-macrofossil and beetle remains has allowed a detailed reconstruction of environmental conditions during an Early Devensian interstadial. The close proximity (9 km) of this site to **Dalcharn** is of significance because they are the first sites from the mainland of Scotland to provide evidence of wooded conditions during both an interstadial and an interglacial period of the Middle or Late Quaternary. The deposits also have significant potential for establishing a detailed glacial history of the area (Merritt et al., 2017).

The peat was found in 1988 towards the base of a low river cliff that lies immediately upstream of the confluence of the Allt Odhar and the Caochan nan Suidheig. The lithostratigraphy (Fig. 101) is based on several sections because no single exposure reveals the complete sequence. Only units 1 to 4b are present at the main section (Fig. 102). The terminology follows that of McMillan et al. (2011) rather that proposed originally by Merritt (1990b) (old names in brackets).

The basal *Suidheig Till Formation* (unit 7) comprises over 1.5 m of very stiff, light brown to moderate yellowish brown, massive, matrix-supported diamict with clasts mainly of sandstone and pink granite. Many of the clasts are decomposed and have orange weathering rinds.

The overlying *Odhar Gravel Formation* (unit 6) comprises up to 1.5 m of a dense, poorly sorted, cobble gravel with a ferruginous pan towards the base. Pink granite is the dominant lithology, many clasts being partially decomposed. The less abundant clasts of gneiss and schistose psammite are commonly decomposed. The deposit is fluvial in origin, possibly glaciofluvial.

The *Moy (Odhar) Peat Formation* (unit 5) lies within a shallow depression at the top of the underlying gravel. Four distinct beds are apparent (Fig. 102):

(i) Pebbly, peaty sand, bleached (0.2 - 0.3 m)

(ii) Black amorphous peat with sand wisps (0.15 - 0.3 m)

(iii) Compressed, felted, fibrous peat (0.35 m)

(iv) Sand and peat, interlaminated. (0.2 m)

The results of pollen, plant macrofossil and fossil coleopteran analyses on the Moy Peat are reported in Walker et al. (1992) (Fig. 103). Radiocarbon dating of samples from near the base of bed (ii) and from near to top of bed (iii) both gave age estimates >62,300 ^{14}C years (SSR-3677 and SSR-3678), indicating that the materials are older than the upper limit of radiocarbon dating (Harkness, 1990). An experimental uranium-series disequilibrium age estimate of 124 ka +/- 13 ka was initially obtained on a sample of peat from bed (ii) (Heijnis, 1990). Subsequently, based on additional

measurements, a revised estimate of 106 ka +11/-10 ka was obtained (Heijnis and van der Plicht, 1992), which is comparable with the 'orbitally tuned' age of c. 103 ka for MIS 5c (Martinson et al., 1987).

The Moy Peat is overlain by an extremely compact unit of pebbly clayey silt diamict and silty sand, up to 2.2 m thick, with lenses of sand and gravel (4a). The upper and lower contacts are gradational and there is evidence of subglacial shearing. The unit was interpreted to have been deposited originally by debris flow processes, either proglacially, or in periglacial conditions prior to the arrival of glacier ice (Merritt, 1990b), but it has clearly been glacially-over-ridden and thus may be described now as glacitectonite (cf. Benn and Evans, 2010).

The overlying *Athais (Moy Lower) Till Formation* (unit 3b), up to 6 m thick, contains clasts mainly of sandstone and pink granite. It varies from moderate yellowish brown to pale olive grey in colour and includes clasts with orange weathering rinds. It is overlain by the psammite-rich *Beinn an Uain (Moy Upper) Till Formation* (Fig. 101 3a) comprising very stiff, olive grey to pale olive grey, massive, matrix-supported diamict. Both diamict units are interpreted to be subglacial traction tills (cf. Evans et al., 2006). There is no unequivocal evidence that the two tills were laid down in more than one glacial episode, but the greater degree of weathering of the lower diamict may indicate that it is the product of an earlier glaciation.

The Beinn an Uain Till is overlain by up to 10 m of mainly thinly bedded, silty sandy gravel (*Carn Monadh Gravel F*) (Fig. 101 2b). This laterally variable unit occurs in the upper catchment of the Moy Burn and its tributaries and was laid down immediately after high ground around Carn nan Tri-tighearnan [NH 823 390] first became free of ice (Fig. 12). It is generally compact, pale olive grey in colour and has distinct planar sub-horizontal stratification. It includes medium to coarse-grained pebbly sand, clast-supported gravel and matrix-supported, silty, sandy, gravelly diamict. Individual beds rarely exceed 0.5 m in thickness. Similar gravels, largely concealed beneath Holocene peat, are dissected by the headwaters of Allt Dearg [NH 81 41] and by Allt Creag a'Chait [NH 83 43] (Fletcher et al., 1996). The unit was probably deposited subaerially at slowly retreating ice-margins during short summer melting seasons. However, the silty matrix, compactness and inclusion of thin laterally extensive beds of diamict suggest that parts of the unit may have been deposited sub-glacially. The formation is commonly overlain by sheet-wash deposits (unit 2a) that comprise up to 1.5 m of coarse, poorly sorted gravel, capped by up to 2 m of blanket peat (unit 1) containing pine stumps near the base.

Interpretation

The sand within the Moy Peat Formation is generally bleached and the deposit as a whole most probably accumulated in a soligenous mire. Importantly, Russell Coope identified the remains of 31 taxa (23 species) of fossil insect (Coleoptera) in the lower part of the unit (beds iii and iv) (Walker et al., 1992). The species generally show a preference for humus-rich, peaty soils or damp habitats, but including deciduous woodland and thinly wooded environments with drier soils. The results of pollen analysis reveal that a landscape of birch woodland, with juniper and willow scrub interspersed with open grassland, was replaced first by grassland and heathland and

then, by an open landscape dominated by species-poor grass and sedge communities (Walker et al., 1992). The pollen record reflects an episode of climatic amelioration followed by a decline in temperature accompanied by a shift to wetter climatic conditions and finally to a markedly more severe climatic regime. The scarcity of pine pollen, relatively low arboreal pollen counts, absence of thermophilous taxa and the presence of herbaceous taxa with northern or montane affinities all indicate a climatic regime markedly cooler than that of a full interglacial. This conclusion is strongly supported by analysis of the fossil Coleoptera, which suggests a cool to cold climate similar to that occurring today in the birch zone of the Scandinavian mountains, with mean July temperatures a little above 10^{o}C and colder winters than at present.

The >60,000 BP radiocarbon dates from near the base and the top of the Odhar Peat indicate that the deposit is older than Middle Devensian. The uranium series date of c. 106 ka appears to place it firmly in the Early Devensian. However, samples collected from sand-rich lenses within the Odhar Peat have yielded reportedly 'reliable' luminescence ages of between 37 and 58 ka (Duller et al., 1995). These ages are consistent with a finite radiocarbon age of 47.7k ^{14}C a BP obtained from the alkali insoluble component of samples of the Odhar Peat, but three concurrent radiocarbon age determinations were infinite (>51.1k ^{14}C a BP) (Walker *et al.*, 1992). The time span of 20 ka between the TL ages for the top and bottom of the Odhar Peat is difficult to accept, but not totally at variance with the entomological palaeoenvironmental evidence. The TL ages are inconsistent with the experimental U-series disequilibrium measurement of 106 ka (Heijnis and van der Plicht, 1992), but otherwise a Middle Devensian age is possible, especially as pollen grains of *Bruckenthalia spiculifolia* (Balkan heath) were not present (M.J.C.Walker pers.comm.). This species has been reported from Early Devensian interstadial deposits in Scotland (Whittington, 1994), but at much lower altitudes.

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Figures

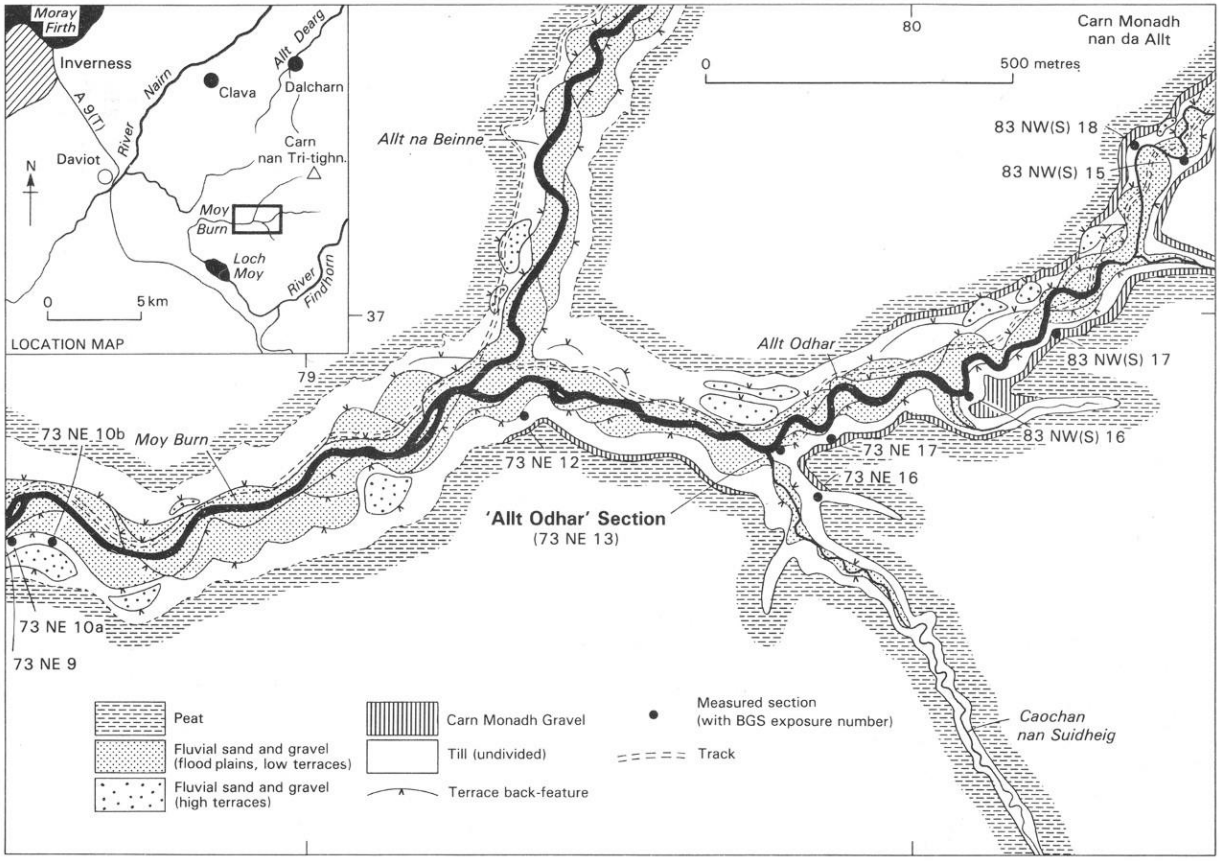

Figure 100. Superficial geological map of the area around the Allt Odhar site, Moy (from Merritt, 1990b).

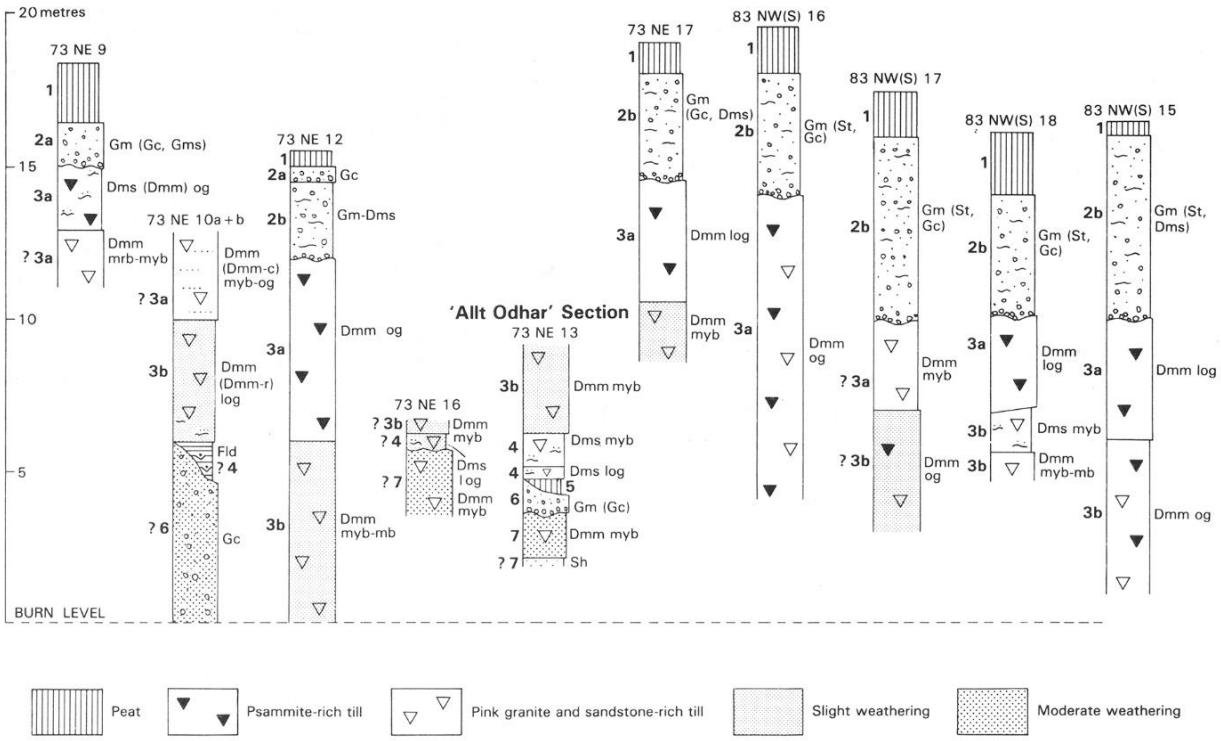

Figure 101. Logs of exposures in the vicinity of the Allt Odhar site, Moy (from Merritt, 1990b).

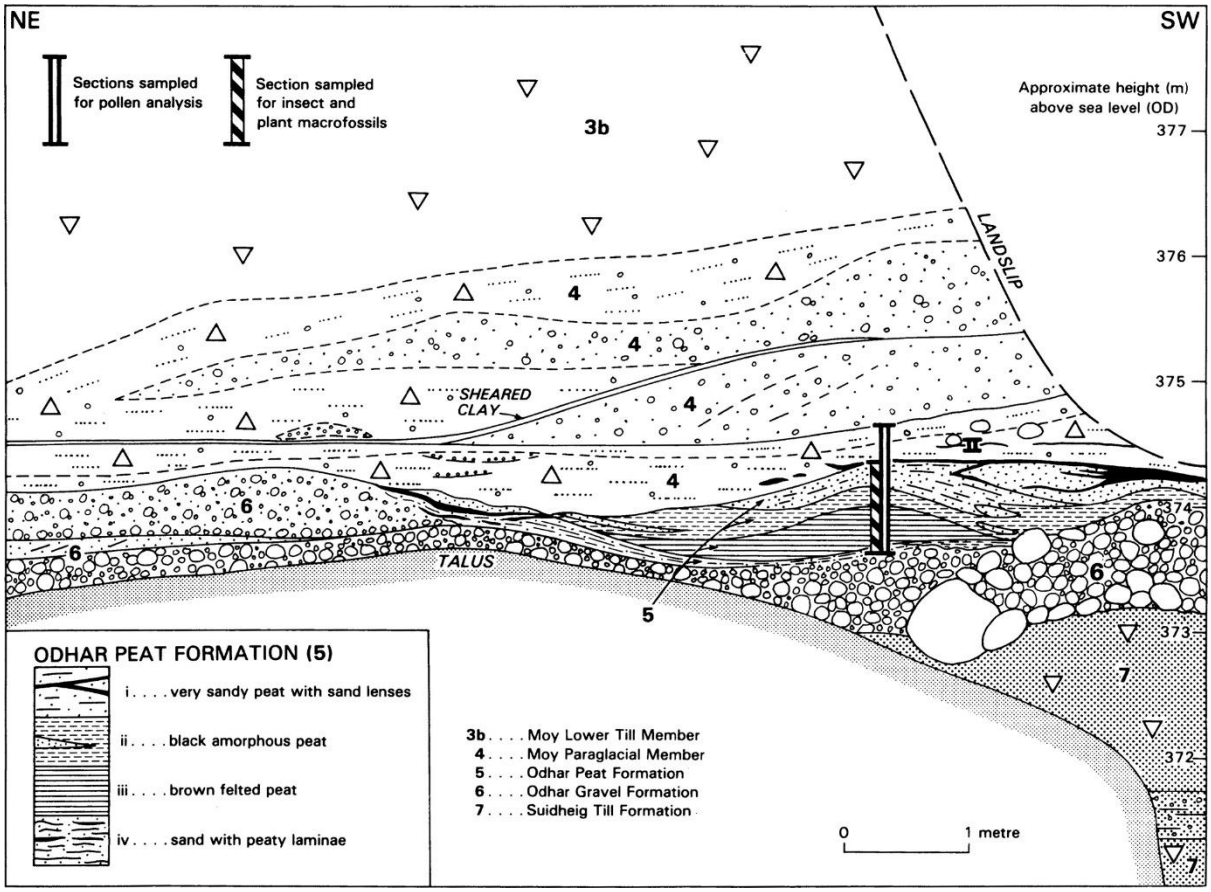

Figure 102. The Allt Odhar section showing the principal lithostratigraphic units, details of the Odhar (Moy) Peat Formation, and the position of the sampling points for pollen, insect and plant macrofossil remains (from Walker et al., 1992). Note: terminology follows that originally proposed by Merritt (1990b).

Figure 103. Professor Mike Walker sampling the Allt Odhar section in c. 1988.