

Location of sites in the vicinity of Teindland (after Hall et al., 1995a). P915301.

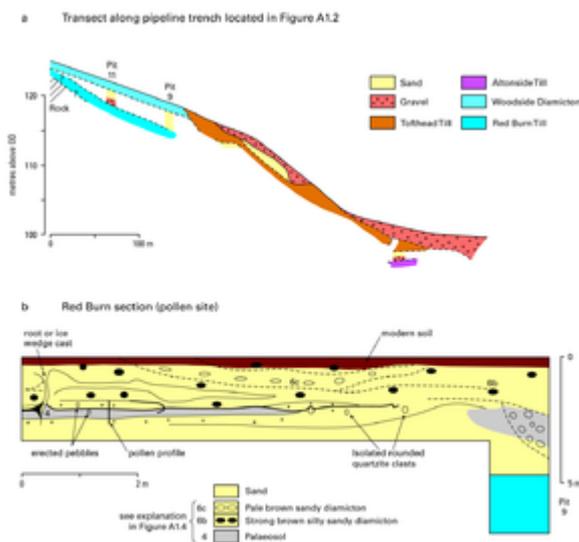
Teindland and the surrounding parts of lower Strathspey is an important area for the study of Late Pleistocene environmental change in north-east Scotland (Sutherland, 1984a) (P915371). Teindland is one of the few known sites on the Scottish mainland where organic sediments deposited during the last interglacial are preserved (Sutherland, 1993a). The area has been affected by ice streams flowing down Strathspey, across the coastal plain of Moray and from the Moray Firth. This has produced complex sequences of glacial and fluvio-glacial deposits that provide evidence of multiple ice advances in the Late Pleistocene.

Teindland Quarry (NJ 297 570) is located in Teindland Forest, 5 km south-west of Fochabers (P915301). Organic deposits were first described there by FitzPatrick (1965), but the site and its interpretation have proved controversial (Edwards et al., 1976; Romans, 1977; Sissons, 1981, 1982; Caseldine and Edwards, 1982; Lowe, 1984). A more recent interdisciplinary study has provided significant new information about the sediments at Teindland, reporting a further discovery of organic materials from the nearby site at Red Burn (NJ 294 568), and setting up a formal lithostratigraphy for this part of Strathspey (Hall et al., 1995a; Hall, 2000) See table. However, as explained in Chapter 8, many of the units have been renamed recently by Sutherland (1999). Most of Sutherland's names have been adopted here (see also P915347).

Lithostratigraphy of the Teindland area

Unit	Name proposed in this publication	Original name in Hall et al. (1995a)	Depositional environment	OIS
9	Waterworks Till Formation*	Waterworks Till	Glacial	2
8	Tofthead Till Formation*	Tofthead Till	Glacial	2
7	Altonside Till Formation**	Altonside Till	Glacial	?2
6	Woodside Diamicton Formation*	Teindland Till	Glacial	4
5	Badentinian Sand Bed*	Teindland Upper Sand	Lacustrine ?	4/5a
4	Teindland Palaeosol Bed*	Teindland Buried Soil	Soil formed late in interglacial period	5e

3	Orbliston Sand Bed*	Teindland Lower Sand	Glaciofluvial	6
2	Deanshillock Gravel Formation*	Teindland Gravel	Glaciofluvial	6
1	Red Burn Till Formation**	Red Burn Till	Glacial	6
*Central Grampian Drift Group **Banffshire Coast Group				



Lithostratigraphy at Red Burn (after Hall et al., 1995a). P915302.

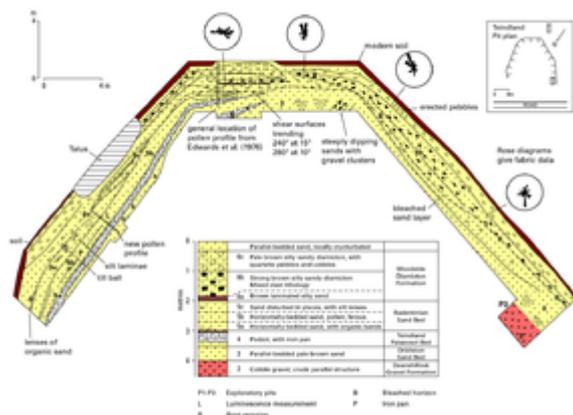
The oldest deposit recognised in the Teindland area is the **Red Burn Till Formation** (P915302a), which rests on weathered Devonian conglomerate. It is a stiff, reddish brown (2.5 YR 4/4), massive, matrix-supported diamicton. Quartzite and psammite clasts are dominant, but the presence of Devonian sandstone and Mesozoic siltstone and sandstone suggests ice movement from the north-west. At the Red Burn site (P915302b), the Red Burn Till is overlain by a unit of sand with sporadic clasts that appears to correlate with the **Deanshillock Gravel Formation** at the base of the known sequence at Teindland Quarry. At the latter site, the Deanshillock Gravel is at least 3.5 m thick, comprises coarse cobble gravel with clasts of quartzite and psammite, and passes upwards into very pale brown (10 YR 7/4) sand, the **Orbliston Sand Bed** that is up to 3 m thick. The Deanshillock Gravel and Orbliston Sand Bed are of probable glaciofluvial origin and, together with the Red Burn Till, probably date from Oxygen Isotope Stage (OIS) 6 (Hall et al., 1995a).



Partially glacitectonised, podzolic Teindland Palaeosol Bed at Teindland quarry. P104118.

The **Teindland Palaeosol Bed** is developed on the surface of the Orbliston Sand Bed and is podzolic in character (FitzPatrick, 1965). It comprises a thin redeposited humic 'H' horizon, a

bleached 'Ea' horizon up to 15 cm thick, an intermittently developed iron pan and a lower 'strong brown' (7.5 YR 5/8) 'Bs' horizon, 5 to 15 cm thick (P104118). Overlying the humic horizon are thin layers of organic sand with charcoal fragments. At Teindland Quarry (P915303), the **Badintinian Sand Bed**, up to 1.5 m thick, overlies these organic sands. The lower 80 to 100 cm comprises thin parallel beds of brown polleniferous sand. This pollen was partly derived from reworking of soils around the site and partly from contemporaneous sparse grassland. The upper 50 to 70 cm of the sand is nonpolleniferous. The presence of small gravel clusters, silt balls, an isoclinal fold and shear zones suggest a glacial or glaciectonic influence on, or more likely following, deposition in a small pond. The buried soil is less well developed at Red Burn, where the parent material is a greenish grey (5 GY 6/1) sandy diamicton and where the overlying organic sediments are thin and disturbed by cryoturbation (Hall et al., 1995a).



The original Teindland pollen site (after Hall et al., 1995a). P915303.

Pollen analysis of the Teindland Palaeosol Bed and the overlying organic sands shows that the earliest vegetation recorded at the site was woodland of 'interglacial' character (Edwards et al., 1976) with grassland openings. Pine and alder are represented at Teindland, and alder and hazel at Red Burn (Hall et al., 1995a). Podzolisation of the palaeosol ended with an influx of sands derived from erosion of the surrounding slopes, perhaps in response to burning during a grassland phase. The combined evidence of environmental deterioration from pollen and sediments suggests events characteristic of the end of an interglacial episode. Luminescence dates of 79 ± 6 and 67 ± 5 ka BP for the sands overlying the soil suggest that the soil developed towards the close of OIS 5e (Duller et al., 1995). Radiocarbon ages for the humic horizon of $28\,140 \pm 480$ - 450 BP (NPL-78) (FitzPatrick, 1965) and of $40\,710 \pm 2000$ BP (UB-2121) and $38\,400 \pm 1000$ BP (UB-2209)* (Caseldine and Edwards, 1982) are regarded as too young as a result of contamination (Sissons, 1981; Lowe, 1984; Sutherland, 1993a).

At Teindland Quarry, the organic sediments are overlain by up to 2.2 m of bedded sandy diamicton, the **Woodside Diamicton Formation**, with crude parallel bedding and localised wash horizons. Sedimentary characteristics are reported to be consistent with deposition as debris flows and pond sediments within a subglacial cavity. As deposition of the Woodside Diamicton seems to have followed soon after the final phase of sand deposition, an OIS 4 age seems likely.



Correlation of lithostratigraphical units in north-east Scotland. P915347.

At Teindland Quarry, only gravels and sands overlie the Woodside Diamiction. However, at nearby sites, three younger tills are recognised, the Altonside, Tofthead and Waterworks tills. The dark grey **Altonside Till Formation** is recorded from temporary pits beneath the floor of the valley of the Red Burn (P915302), from excavations for a waterworks at Altonside (NJ 281 573), and from the base of the river cliff on the banks of the Spey at Tofthead (NJ 343 576). Clast types include pebbles of Mesozoic mudstone and sandstone and suggest that ice flowed from the Moray Firth. The widespread presence of a dark grey till, locally with shell fragments and in places beneath a sandy brown till, is confirmed by boreholes in the lower Spey valley (Aitken et al., 1979). At Tofthead, a brown, gravel-rich till, up to 3 m thick, rests on various disturbed gravels and diamictions and on the Altonside Till (Connell, 2000). This **Tofthead Till Formation** appears to be derived from the west or north-west and represents the last major movement of ice across this part of Strathspey (Peacock et al., 1968). At the Waterworks site, a greenish grey sandy till with a strong west-north-west to east-north-east fabric (and probably equivalent to the Tofthead Till) overlies the Altonside Till and is succeeded by more than 4 m of iron-stained gravels. These gravels are partly reworked into a red brown till, the **Waterworks Till Formation**, which appears to represent a minor readvance of ice from the west or north-west (Hall et al., 1995a). These till units are undated, but it is likely that both the Tofthead and Waterworks tills date from the Main Late Devensian glaciation.

The existence of at least four separate till units in lower Strathspey postdating OIS 5 suggest multiple glaciation of this area by at least two ice streams, one crossing the Moray Firth and the other crossing the Moray lowlands (P915347). The widespread occurrence of gravels and sands intercalated between till units raises hopes that in future it will be possible to constrain more closely the ages of these and other till units.

References

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