Site 17 Errollston Clay Pit, Cruden Bay

The Pleistocene succession in the Cruden Bay–Port Erroll area, some 15 km east-north-east of Ellon on Sheet 87E, consists mainly of stiff, reddish brown pebbly clayey diamicton with subordinate beds of sand and laminated mud. Interest has revolved around the significance of shell fragments and organic horizons preserved within the sequence, especially that exposed in the former brick and tile works at Errollston [NK 086 372] ((Figure 50), (Map 7)). The site must have been relatively poorly exposed during the late 19th and early 20th centuries as few substantial records were made of the deposits. This is in contrast to the Ellon–Slains area, immediately to the south-west, which figured prominently in the evolving knowledge of the complex Pleistocene stratigraphy of Buchan (see Site 15 Ellon, Bellscamphie).

Pleistocene succession

Jamieson (1858) recorded poorly exposed sequences of pale grey and reddish coloured sands and red clays intermittently visible along the Water of Cruden westwards to Ardiffery. He noted the presence of striated erratic clasts in the clays and fragments of shell. He considered that there might have been about 46 m of Pleistocene sediments present. In his 1906 paper he noted a railway cutting exposure at Port Erroll from which he recorded a bed of uniform, unstratified red clay, 9.1 to 12.2 m thick, with small clasts dispersed throughout (possibly a deformation till). Jamieson considered that the sandy and gravelly sediments were deposited in close proximity to a retreating ice margin, whereas the more clay-rich deposits were a product of more distal sedimentation. He concluded that the deposits were laid down by a glacier advancing north-eastwards along the coast, having derived the red colour from Old Red Sandstone strata in Strathmore.

Bremner (1916) reported the presence of red brick clays at Errollston up to an elevation of about 30 m OD, with red boulder clay occurring up to about 61 m. He considered the brick clays to have been deposited in a glacial lake impounded by an ice margin at Port Erroll and partly fed through a meltwater channel now occupied by the Water of Cruden. In 1943, he recorded 'lumps and sheets' of dark shelly boulder clay occurring as transported masses within his Strathmore (red) boulder clay in the brickworks and at sections near the mouth of the Water of Cruden. He considered these masses to be the remnants of a possible Scandinavian-derived boulder clay originally laid down in the North Sea basin.

Eyles et al. (1946) recorded the following section in the Cruden Bay Brick and Tile Company's works in 1944.

4.6 to 6.1 m of stiff, reddish brown, unbedded boulder clay with a few stones and boulders overlying up to 1.8 m of bedded sand, sandy clay and silt (occasionally in pockets)

They also noted borings at the site proving between 12.2 and 24.4 m of clay.

FitzPatrick (1975a) described a section [NK 088 370], which revealed approximately 3.0 m of red clayey material with an absence of bedding and numerous erratics that he interpreted as a till rather than a lacustrine sediment. This unit overlay a 1 m thick unit of laminated material (containing a 1 cm-thick lamina of black organic mud) overlying sand. FitzPatrick interpreted these sediments as representing an initial ice advance from the east, followed by a minor still-stand or retreat during which proglacial sands and organic muds were deposited in a small pond. Subsequently, ice advanced again and deposited the overlying till which locally incorporated masses of the organic sediment. On final retreat of the ice, permafrost caused a subcuboidal structure to develop in the till. A sample of the black organic clay yielded a radiocarbon date of 36 720 + 1030/-910 BP (SRR–596) (Harkness and Wilson, 1981). This date was significant as it appeared to date the latest advance of 'Strathmore' ice into eastern Buchan.

FitzPatrick's (1975a) interpretation of the genesis of the deposit overlying the organic mud was disputed by Clapperton and Sugden (1977), who suggested that the sequence of interbedded laminated clays, silts and sands with beds of flow till all exhibited slump and settlement structures associated with glaciolacustrine sedimentation. They questioned the validity of the radiocarbon date and whether the organic sediment had been reworked.

Peacock (1984) recorded another section in a pit [NK 086 372] during 1974.

		Thickness m
4	Locally developed folded and slickensided silts and sands	<2.0
3	Silty clayey matrix-supported diamicton. Clasts chiefly 1 to 5 cm, but scattered large boulders, some striated. Small shell fragments. Subhorizontal sandy laminae and thicker bands of silt. Local shearing and contortion. Gradational base	4.0
2	Silt and clay, thinly and evenly laminated, reddish brown, laminae <1mm to 5 cm thick. Interbeds of bright red diamicton (<1 cm thick) with local erosive bases. Laminated beds locally dark brown to black with disseminated carbon	0.2
1	Sand, fine to coarse-grained, locally silty, laminated. Numerous small shell fragments. Gentle dip to south. Base not seen	>2.0

The graded silt/clay laminae in unit 2 were interpreted as turbidites and the overlying diamictons as mudflows. The origin of unit 3 was more problematic, perhaps being deposited as a thick debris flow or as a subaqueous till.

A borehole drilled close to the works at [NK 0895 3719] (Merritt, 1981; NK03NE/13) confirmed earlier records that the sediments described in the brick pit were only the upper portion of a sequence over 20 m thick dominated by red-brown diamicton with subsidiary laminated silty clays. The borehole log records that the red-brown units are mixed with dark grey gravelly till between 13.6 and 14.6 m depth. It is tempting to suggest that this dark grey material is a glacial raft similar to that noted by Bremner (1943), especially as another mass of dark yellowish brown sandy stony diamicton (2.0 m long and 0.5 m thick) has been observed within the red-brown clayey diamicton. The latter mass is lithologically similar to tills of the East Grampians Drift Group known from a number of sites in the area, mostly below red-brown clayey diamicton or related sediments (see Site 15 Ellon, Bellscamphie).

Cabrera (1976) recorded a section in a pit at [NK 086 370] as part of a study of soils in the area. The deposits were noted as being over 7.0 m thick with an upper, rather massive unit of sparsely stony diamicton overlying beds of sand below about 4.0 m. Cabrera's work included detailed particle size analyses, clay and fine sand mineralogy and soil micromorphology of the upper 5.0 m of sediment. This work provided strong support for the Glentworth et al. (1964) study of the provenance of the 'Red Series' sediments in Buchan. Cabrera confirmed that the red-brown sediments at Errollston were derived from Devonian and Triassic red sedimentary rocks beneath the western North Sea rather than from the Old Red Sandstone of Strathmore. Additional supporting evidence comes from palynological analysis of the matrix of the red-brown clayey diamicton at the site. information from R Harland (BGS, 1981) reported a mixed assemblage of Permo–Triassic miospores together with Jurassic, 'Tertiary' and Quaternary dinoflagellate cysts.

The Quaternary Research Association field excursion in 1984 allowed sampling of black clay laminae in the pit from a sequence equivalent to Peacock's (1984) unit 2. Palynological analysis of this material (Connell et al., 1985) revealed a rich assemblage of miospores and dinoflagellate cysts of Late Jurassic to Early Cretaceous age, confirming the concern about the dating expressed by Clapperton and Sugden (1977). The work indicated that the black clays were derived largely from Mesozoic material and were therefore contaminated with 'old' carbon. Hence the 36 720 BP date on the organic clay has no significance for the Pleistocene chronology of the site. It is of interest that the black clay with concentrated, redeposited palynomorphs, both here and at Mintlaw (see Site 10 Ugie valley), is equivalent to unlithified

cannel coal, but here reworked in a glaciolacustrine environment from sediments many millions of years old.

Reappraisal of Peacock's (1984) description of the section suggests possible alternative explanations for the genesis of the formerly exposed diamicton beds overlying the laminated units in the pit. He noted locally developed folded and slickensided silts and sands in unit 4 together with local shearing and contortion within the diamictons of unit 3. It has also been recorded that the black clay laminae (Peacock's unit 2) are deformed and undulatory with single layers spitting into two between inclusions of red clay (information from J E Gordon, Scottish Natural Heritage, 1999). While these structures possibly resulted from slump and gravitational settling of glaciolacustrine clays and diamictons, it is more likely that the dislocations and slickensiding results from subglacial tectonism as the sediment was overridden by glacier ice, probably from seaward. Thus, the thick succession of diamictons and clays proved in the area may represent a glacitectonite/deformation till complex.

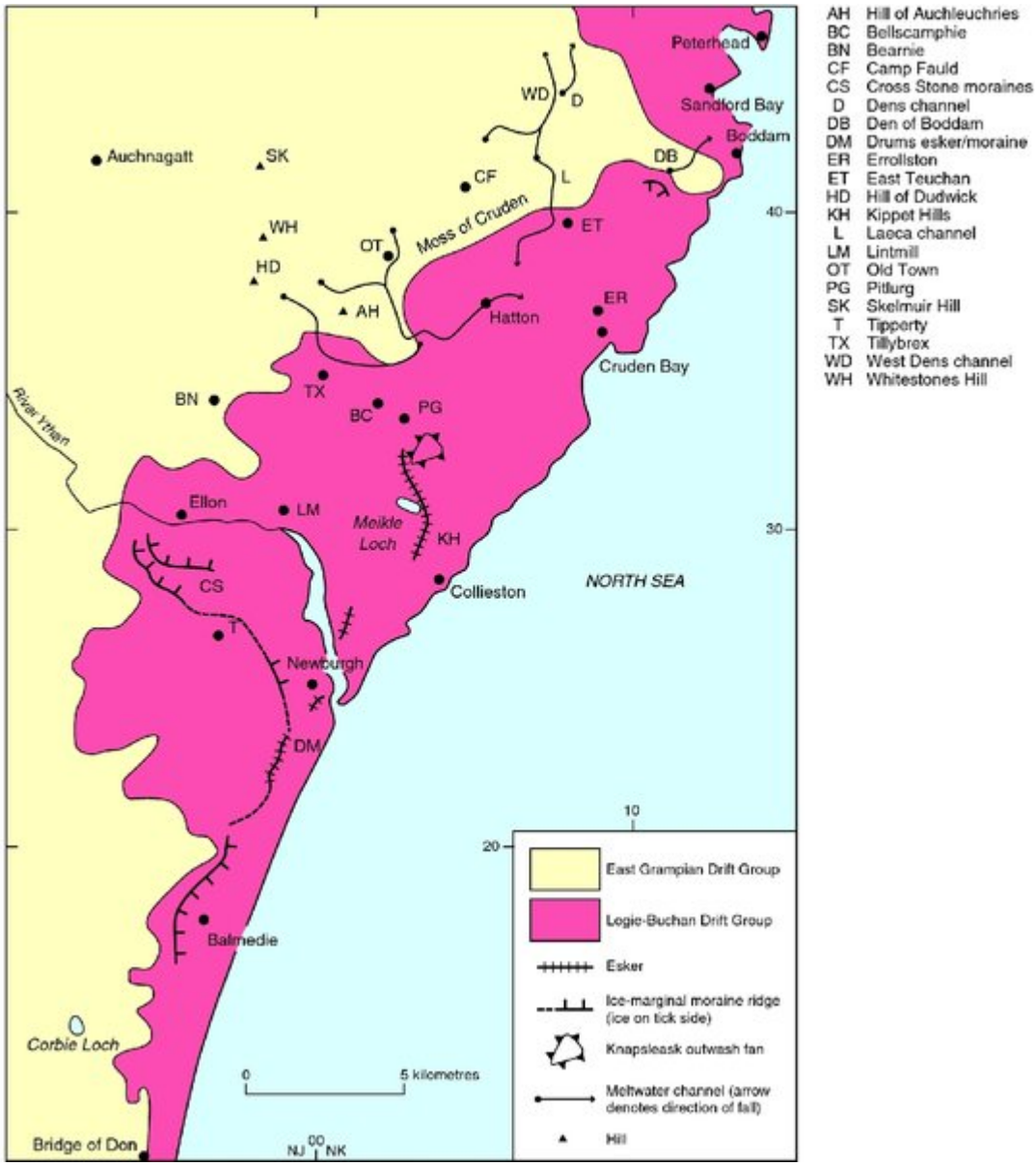
Further sedimentological and textural work is required to resolve the genesis of the diamictons, but the works is no longer in operation and sections are severely degraded. Re-examination of Cabrera's (1976) micromorphological thin sections may help resolve the issue.

Conclusions

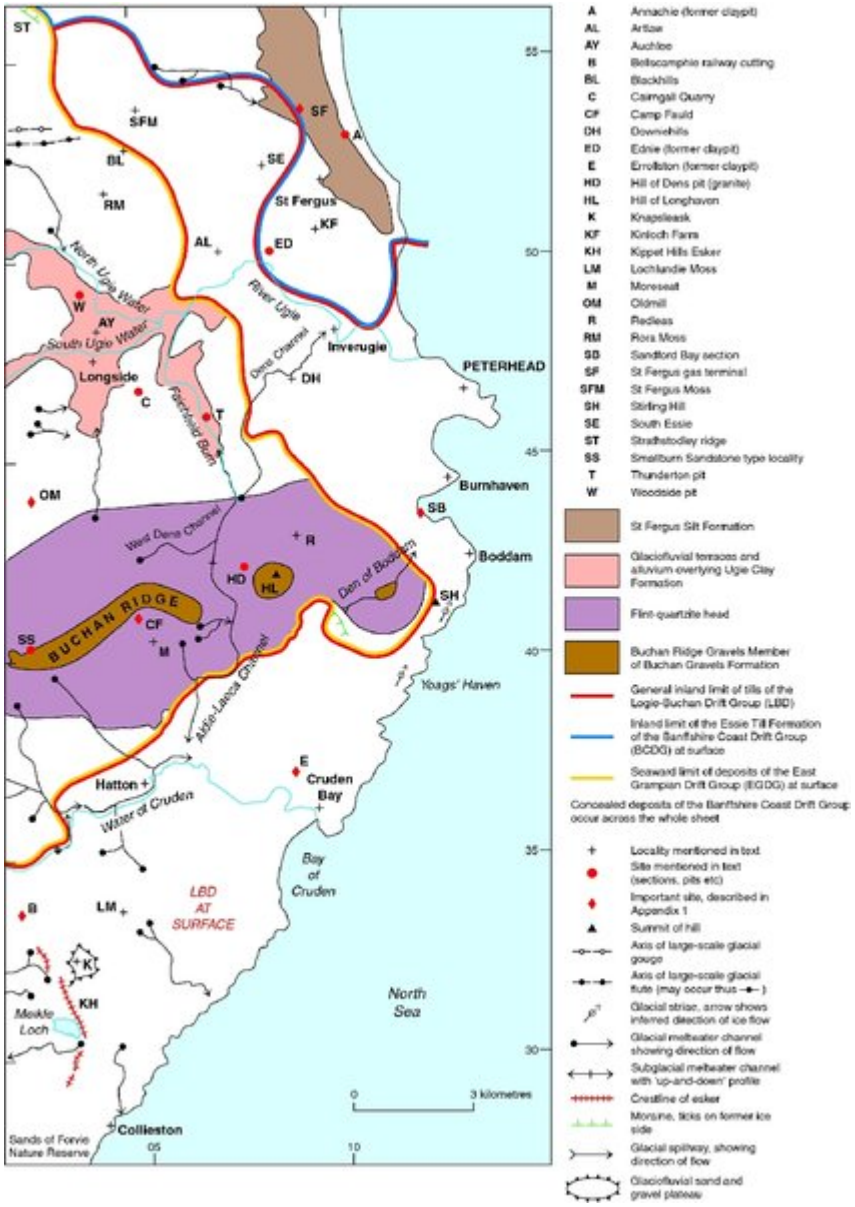
Stratigraphical work in the area of the Errollston clay pit over the last 25 years has confirmed the presence of a thick sequence of red-brown, calcareous and shelly, diamicton interbedded with laminated clay. It forms part of the Logie-Buchan Drift Group and derives its colour from erosion of sedimentary rocks (Devonian and Triassic) that crop out beneath the western North Sea. These materials were brought onshore by a strong westerly or north-westerly ice movement during the Late Devensian. Associated black laminated clays and masses of black clay containing Mesozoic palynological assemblages are likely to have been derived from sediments resembling the Pitlurg Till Formation (see Site 15 Ellon, Bellscamphie) which are known to occur beneath Logie-Buchan Drift Group deposits to the south-west and which may have been more extensive formerly. The radiocarbon date from black laminated clay in the pit has no significance in terms of the Pleistocene history of the area.

Uncertainty still surrounds the mode of deposition of the diamicton formerly exposed in the pit. It has been interpreted either as till or as a deformed glaciolacustrine sequence. Reappraisal of Peacock's (1984) description suggests that either the diamicton has been overridden by a late-stage readvance of ice or that it forms part of a thick glacitectonite/deformation till complex.

References



(Figure 50) Distribution of the Logie-Buchan Drift Group and related features.



(Map 7) Glacial and glaciofluvial features and the distribution of glacigenic deposits on Sheet 87E Peterhead.