Windy Hills, Collieston, Aberdeen. Day 8. Excursion to the Banffshire Coast

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Introduction

We will return to Edinburgh via Turriff, Fyvie, Ellon and Aberdeen stopping at two localities to view aspects of the geology not included in the week's activities. These are the purported Neogene gravels at Windy Hills and the structure and lithologies of the Southern Highland Group rocks at Collieston.

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The Woodhead –Windy Hills Gravel deposit [NJ 806 400]

(Figure 47; Plate 36)

In the Buchan area of northeast Scotland weathered gravels of Cainozoic age have long been recognized. They constitute the Buchan Gravels Formation and form a discontinuous cover on ridges, hills and valley benches at elevations ranging from 75m to 150 m above OD. The more westerly outcrops are the quartzite gravels near Turriff, at Delgaty Wood and Windy Hills, which are overlain by a probable till (Jamieson, 1865, 1906). However, as late as 1921, although Flett and Read found little evidence of an extensive till deposit overlying the Windy Hills Gravel in the type area, they did note the presence of erratic cobbles and boulders on the surface of the deposit and identified a thin skin of 'boulder clay' in places on its northern edge. Erratics and thin deposits of overlying till have also been described other researchers, including Bremner(1916), Fitzpatrick (1975), Gemmell and Kesel (1979), McMillan and Merritt (1980), and Kesel and Gemmell (1981). The erratics led Flett and Read (1921) to conclude that the gravels were of pre-glacial origin. The presence of Cretaceous fossils in some of the flint clasts, and the fact that the gravels appeared to rest directly on weathered bedrock, gave further credence to this hypothesis. This led to both flint and quartzite gravels of the Buchan Ridge Gravel Member and the Windy Hills Gravel Member respectively, being considered to be probably of Tertiary age. Flett and Read tentatively assigned the deposits to the Pliocene, on the basis of similarities of elevation and character with deposits of that age in Southern England.

The degree of weathering indicated by the clay mineralogy of the gravel matrix makes the most likely date of formation of the gravels to be Miocene rather than Pliocene (Hall et al., 1989). Pits dug by Kesel and Gemmell (1981) revealed the presence of rotted schistose clasts in the basal gravel in the Windy Hills segment. As these clasts were too fragile to have been transported to their present location in such a highly weathered state, it is possible that the gravels were deposited on a relatively unweathered rock surface. Hall (1982) considered the degree of weathering of the matrix clay implied that the gravels were derived from an already weathered land surface.

Broken quartz sand grains recorded in the Windy Hills Gravel Member have been taken to indicate high energy fluvial transport either during the Neogene, or during Quaternary glacial and glaciofluvial transport (Hall, 1983; Kesel and Gemmell, 1981). Some of the broken grains may also have been derived from the in situ decomposition of quartzo-feldspathic clasts within the deposit (Merritt and McMillan, 1982).

Most of the Windy Hills Gravel Member is regarded as being Neogene in age, due to its distinctive lithology and the extent of post-depositional chemical weathering, particularly of the underlying bedrock. Some of the highest parts of gravel sequence are locally overlain by till, indicating that deposition of the gravel must predate the glacial event that deposited the till. Gravel accumulation must also predate cutting of the Ythan gorge, the floor of which is at least 75m below the base of the gravel sequence in the Windy Hills area. The generally lower elevation (120 – 125 m AOD) and the position of outcrops of the Windy Hills Gravel Member suggest deposition within a former course of a proto-Ythan-Deveron river system. Its position on the flanks of Ythan-Deveron river system contrasts with the ridge-top location of much of the flint-rich Buchan Ridge Gravel Member (up to 160 m above OD) and suggests that the Windy Hills Gravel Member is the younger of the two deposits.

Collieston [NK 042 287]

(Figure 48)

The large car park (toll in season) on the east side of Tarness Haven near Collieston utilises an old quarry, cut in generally blocky, gritty arenitic to pelitic greywackes that dip 20o to 30o east. Gritty bands and lenses with notably flattened small pebbles are seen both in the prominent F1 recumbent fold hinge on the east side of the old quarry and at its north end. At this latter locality pebbly zones with clasts up to 1 cm across occur in sedimentary units up to 4 m thick. Mud clasts, ripped up from underlying layers by turbiditic action, are found in the pink gritty bands. The beds here appear to be right-way-up, but tracing of individual beds is difficult even on the quarry face. The S1 cleavage is finely spaced and pervasive, probably in part due to the substantial later D3 flattening.

At the SE end of the car park a 4 to 6 m thick metadolerite sheet discordantly cuts banded greywackes, which appear to be inverted based on graded units overlying the sheet,. The margins of this early intrusion are schistose biotite amphibolite, whereas the central parts are metadolerite that retains its massive nature and meta-igneous texture.

This sheet crosses the car park and its (now markedly discordant) cuspate boundaries can be traced west down to the beach of Tarness Haven. Careful observation of structures in the gritty greywackes and cordierite-rich schists by the Arch of St. Catherine’s Dub (low tide, low to moderate seas) shows abundant tight folds of both D1 and D3 age. Tight to isoclinal F1 structures have a strong axial lineation plunging gently NNE, but discordant post F1 quartz segregation veins show tight folding (F3) and in places a discordant later S3 cleavage can be found. Where S1 and S3 are seen together, a ‘lozenge’ pattern results. More generally D3 merely tightens F1 structures and renders S1 notably penetrative. Pink quartz clasts in the grits are ovoid and, assuming a near equidimensional original shape, the beds appear to have been flattened to 30 – 35 % of their original thickness. On the promontory above (immediately SE of the car park) inverted psammitic and gritty greywackes show excellent elongate grain-alignment lineations that are dominantly tectonic in origin. The lineations plunge gently to moderate ENE (e.g. 13° to 017°) and are notably curved on some bedding planes. S1 spaced cleavage microfolded by F3 folds can also be seen.

On the east side of Tarness Haven near high water mark, a near-concordant boudinaged offshoot 0.1 to 1.0 m thick is seen diverging from the 4 m thick discordant metadolerite body. To the south near

low water mark adjacent to the beach, thin-banded, weathered pelitic and semipelitic units (locally cordierite rich) are exposed. Interbanded with them over a 1.5 m interval are fine-grained notably green-brown (chlorite-rich?) beds which may represent metavolcanic (tuff) horizons.

At Collieston Pier a 9 to 10 m metadolerite sheet cross-cuts thin to medium-bedded psammitic and semi-pelitic greywackes with possible F1 folds. The metabasite appears to be cut by a steep fault trending about 100° in the bay immediately to the south.

To the south of Collieston Harbour, exposures in the bay and in the prominent low crags around the high water mark a few hundred metres further south, show beds with excellent non-inverted grading. Coarsely porphyroblastic cordierite-bearing and less commonly andalusite-bearing pelitic schists are seen here. S3 is rarely developed in the psammitic units but deforms the porphyroblasts in pelitic horizons. F3 microfolds of S1 are common in coarser psammitic, locally gritty arenites, and S1 spacing is reduced to 2 mm in the finer-grained psammitic units showing the increasing effect of D3 deformation towards the SW. Lenticular calcareous bands within semipelitic units show tight folds of the banding and S1, with a related sub-horizontal strong ribbing in adjacent gritty units trending approximately north. Selected bibliography

> At all times follow: The Scottish Access Codeand Code of conduct for geological field work

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