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Dalradian structure in the Creeslough area, NW Donegal, Ireland

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SUMMARY: The principal structure of the Appin Group metasediments in the Creeslough area is a series of D_2 NW–facing recumbent folds and two important slides that are thrusts (to the northwest). D_3 produces large open folds that face to the southeast. D_4 is associated with a major synform and shear zone in the aureole of the Main Donegal granite. No major F_1 fold hinges are present, although D_1 faces northwest. It is concluded that of the early deformations in Donegal, D_2 can be regarded as the Caledonian thrust front.

Lower Dalradian (Appin Group) metasediments form a well exposed and complete succession of variable lithology in the Creeslough area, which lies to the west of the Main Donegal granite in NW Ireland. A knowledge of the structure of this small area is important since it allows comparison with that in the stratigraphical type–area (Appin–Ballachulish) of Scotland (Roberts & Treagus 1977) and hence an appreciation of structural changes along the Dalradian fold belt. The Creeslough area was first described by McCall (1953) and the adjoining Errigal area by Rickard (1962). Pitcher & Berger (1972), whilst proposing a new deformation chronology for the area and the whole of Donegal, did nevertheless accept, broadly, the earlier structural interpretation. This was that a major D_1 slide (the Horn Head slide) was a lag with respect to the stratigraphy to the northwest above the prominent Ards Quartzite horizon. Following this the slide was folded by NW-facing recumbent folds of composite age ($D_{2\text{-}3}$) and at the same time a renewal of movements occurred along the slide. Of the later phases, only D_4 produced major folds, the remainder being associated with the emplacement of the Donegal granites. More recent work (Hutton 1977a, 1977b) has proposed a new structural interpretation and deformation history. This short communication reports the principal revisions and contrasts the structure with the type stratigraphical area in Scotland.

D_1

Although the first deformation usually produced a cleavage (S_1) parallel to bedding, there are situations where it cross–cuts and the bedding faces up to the northwest in this fabric (Hutton 1977a). Such relationships question the origin of S_1 as a 'bedding schistosity' (Rickard 1962, Pitcher & Berger 1972), but no major F_1 folds have yet been found. It may be that later slide movements (see below) have concealed F_1 stratigraphical repetitions.

D_2

This, the principal fold phase, is associated with a widespread crenulation cleavage (S_2), coeval with the metamorphic peak in the mid–upper greenschist facies. D_2 major folds are recumbent–reclined, tight structures which verge and face to the northwest along the regional stretching lineation.

This writer sees the principal structure, not as a D_1 'lag' repeated by $F_{2\text{-}3}$ folds, but as two sepa-

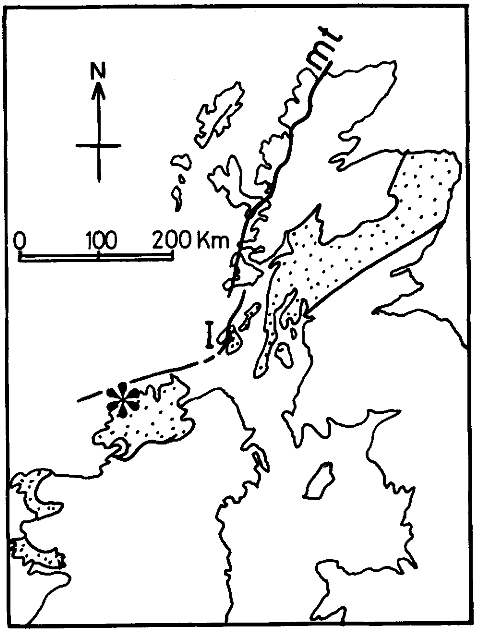

FIG. 1. Location of area. Stipple = Dalradian belt. Mt = Moine thrust. I = Islay.

rate slides, both thrusts of D_2 age (Fig. 2). The lowest slide, the Horn Head slide *sensu stricto*, carries inverted pelites over right way up Ards Quartzite on west Horn Head. Farther south the pelites underlie right way up Ards Quartzite in a normal stratigraphical contact. These are therefore Ards rather than Falcarragh pelites and the principal structure of Horn Head is the D_2 NW–facing Horn Head anticline rather than the Pollnaguill syncline of McCall (1953). The slide is not folded by this structure but cuts across its axial plane and to the east replaces the hinge entirely (Hutton 1977b). On the upper normal limb of the anticline on eastern and southern Horn Head a monoformal D_2 fold which contains several inversions is found. These folds are cut across farther south by the Breaghy Head–Dunfanaghy slide. Thus at Breaghy Head D_2 inverted Ards Quartzite underlies right way up quartzite across the slide, whilst at Dunfanaghy both the inverted and normal limbs are present below the tectonic break (Fig. 2). The overlying Sessiagh–Clonmass rocks are also complexly folded by D_2 and cut across by the slide at Dunfanaghy (Hutton 1977b). At all these slides, younging and D_2 vergence reversals are commonly superposed, yet the facing of D_2 remains the same, emphasising that the slides are D_2 in age. It is clear from both these situations (Fig. 2) that the slides are thrusts to the northwest.

On Breaghy Head the Ards Quartzite above the slide is transitional with the overlying Sessiagh–Clonmass Formation. This is also seen further southeast in the hinge of the D_2 Errigal syncline on Rosguill (Anderson 1978), and the Sessiagh–Clonmass Formation, despite major facies changes (Hutton 1977b) is simply repeated in this fold. Thus no slide is folded by the structure, and the D_2 Breaghy Head–Dunfanaghy slide lies oblique to its axial plane. The D_2 Aghla anticline is seen as the overlying complementary fold on Muckish Mountain and it is present in the Main Donegal granite aureole where it repeats the stratigraphy at and below the Ards Quartzite (Fig. 2) (Hutton 1977a).

D_3

This produces a common crenulation cleavage (S_3) which is superposed on the D_2 folds and in which bedding faces up to the southeast on F_2 normal limbs. D_2 appears to be unrelated to D_3 (Pitcher & Berger 1972) and indeed is separated from it by the metamorphic peak. Major open SE–facing D_3 folds are seen on Horn Head (Fig. 2) and are effectively responsible for the elevation of Ards Quartzite etc. on that peninsula.

D_4

This produces a major NE-SW trending fold—the Lackagh synform (Hutton 1977a) with upright axial plane and cleavage (S_4) in the aureole of the Main Donegal granite (Fig. 2). This fold is coaxial with a vertical sinistral shear zone which contains a sub-horizontal NE-SW trending stretching lineation. Both the fold and shear zone are coeval with the granite intrusion and its metamorphism (Hutton 1977a).

D_5-D_8

These later phases are post metamorphic and produce minor structures only. Their regional significance is yet unknown although they are found in areas remote from the granites.

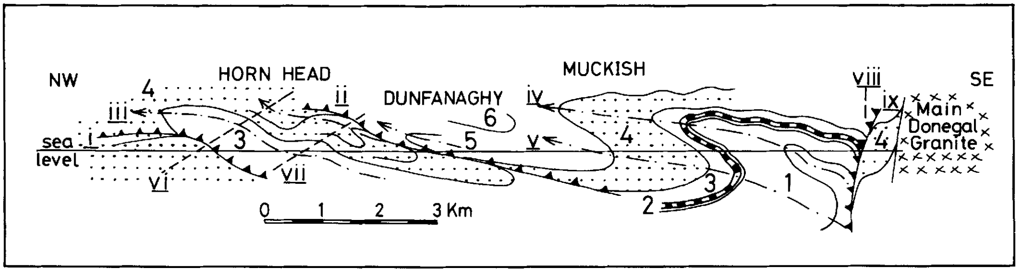

FIG. 2. Simplified cross-section of the Creeslough area, NW Donegal, Ireland. Stratigraphy: 1 = Creeslough Formation (oldest); 2 = Altan Limestone; 3 = Ards Pelite; 4 = Ards Quartzite; 5 = Sessiagh–Clonmass Formation; 6 = Falcarragh Pelite (youngest). Structural elements: D_2 i = Horn Head slide; ii = Breaghy Head-Dunfanaghy slide; iii = Horn Head anticline; iv = Aghla anticline; v = Errigal syncline. D_3 vi = Templebregga antiform; vii = Horn Head antiform. D_4 viii = Lackagh synform; ix = Lackagh slide.

Discussion

Whilst the significance of D_3 structures on a regional scale must await further work we can make some obvious comments on the D_4, D_2 and D_1 deformations.

We can regard the D_4 Creeslough shear zone as a sinistral wrench fault occurring in a regime of ductile deformation rather than brittle failure. Hence it may be an earlier example of the common NE-SW faults of Donegal and Scotland. This is important since knowing the age of the coeval Main Donegal granite we can date the movements and consequently apply controls to large scale regional tectonics. There is also the possibility that faults of this type and age have controlled the position of the various granite bodies in Donegal.

Turning to the first and second deformation phases we see that their common facing direction (NW) compares well with that in Ballachulish and Appin (Roberts & Treagus 1977). Beyond that however the comparison falters. The major Scottish folds are D_1 and D_2 in age, they have steeply to moderately inclined axial planes, and the major slides are D_1 lags. In NW Donegal no F_1 folds are known and the major D_2 folds have gently inclined axial planes and the slides are D_2 thrusts.

Such a change in structural style along the Dalradian belt may be related to a change in basement configuration. Considering the convergent trends of the Moine thrust and the Dalradian belt (Fig. 1) it is likely that somewhere west of Islay the Dalradian overlies pre–Caledonian, Lewisian basement and indeed Lewisian is seen on Inishtrahull close to the north Donegal coast. The presence of low angle thrusts and recumbent folds in the Dalradian cover is probably to be expected and these D_2 structures represent the Caledonian thrust front, perhaps broadly comparable with the early slides and folds of the Moine thrust zone (Mendum this volume).

The tectonic significance of D_1 in NW Donegal remains an enigma. Until such times as evidence of major D_1 structures becomes available it is probably unwise to make regional comparisons.

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