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Stratigraphical and structural relationships of the Dingle Group (Silurian), County Kerry, Ireland

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Abstract – Previous views on the relationship between the thick continental deposits of the Dingle Group and the older fossiliferous Silurian rocks of the Dunquin Group are briefly reviewed. Detailed field evidence is presented showing that in the coastal sections of Coosgorrib, Coosglass, and Coosshaun there is faulting between the two groups. The same situation obtains at the northern end of the Great Blasket island. Fortunately inland exposures are sufficient to show that there is stratigraphical continuity from the lower Ludfordian (Ludlow) beds of the Croaghmarhin Formation, at the top of the Dunquin Group, into the purple siltstones of the Dingle Group. The Dingle Group is followed uncomformably by Upper Old Red Sandstone (essentially Upper Devonian).

1. Introduction to the problem

The Dingle Peninsula, County Kerry, Ireland and the Blasket Islands off the end of it provide the westernmost exposures of Silurian rocks in Europe. The succession here was summarized by Holland (1969) when the fossiliferous beds below the continental Dingle Group were referred to collectively as the Dunquin Group, after the village of Dunquin which traditionally has provided boat passage to the islands. The Silurian shelly faunas here have long been known, though more precise age assessments have varied over the years. With its richly fossiliferous sedimentary rocks and associated volcanics the area is palaeogeographically significant, but has proved to be controversial. For example, Ziegler (1970) placed it tentatively on the northern margin of the Silurian 'geosyncline', whereas Holland (1969) had it to the south. Parkin (1976) provided additional evidence for a position on the southern margin and summarized previous views.

The area is important in terms of tectonic evolution within the Caledonides. There is certainly a conspicuous unconformity here between the Upper Old Red Sandstone and older rocks. It is beautifully illustrated in Du Noyer's sketch of Bull's Head, near Dingle, in the old Geological Survey memoir (Jukes & Du Noyer, 1863). However, as is shown in what follows, views on the continuity and even relative stratigraphical positions of the rock units below the Upper Old Red Sandstone have proved to be controversial. The present paper, based upon detailed field mapping and assessment of the faunas, is intended to demonstrate that there is stratigraphical continuity from the Ludfordian (Ludlow) beds of the Croaghmarhin Formation, at the top of the Dunquin Group, into the purple siltstones of the continental Dingle Group above. The Dingle Group crops out on both northern and southern sides of the peninsula with the fossiliferous Dunquin Group of the Clogher Head inlier in between (Fig. 1). The critical junction between them is unfortunately faulted in all the well-exposed coastal sections but evidence is to be found inland. The history of research may be summarized as follows.

Patrick Ganly, who worked for Richard Griffith, the 'father of Irish geology' (Herries Davis, 1981) in the middle of the last century, is celebrated not only for his substantial contributions to the latter's famous geological map of Ireland and other publications (Archer, 1980), but also for his discovery of the use of cross-stratification in establishing order of stratigraphical succession (Lamont, 1940). Ganly first used his discovery in the Dingle Peninsula. About one hundred years later, Shackleton (1940) was to employ the same technique, along with the use of graded bedding, ripple marks, and desiccation cracks, to establish the succession of rocks in the whole of the peninsula. His work brought new clarity and rationality to a situation long under dispute.

The Geological Survey memoir on the Dingle Peninsula (Jukes & Du Noyer, 1863) gave the rocks of the Annascaul inlier (Fig. 1) as the oldest in the district, above which the 'Smerwick Beds', now assigned to the Dingle Group and situated between Smerwick Harbour and Sybil Point, were regarded as coming next in succession. There followed the fossiliferous upper Silurian rocks of the Clogher Head inlier, between Ferriters Cove and Croaghmarhin. Above the last came the purple, red, and green sandstones, siltstones, conglomerates, and mudstones of the 'Dingle Beds' of the eastern and southern ground. Gardiner & Reynolds (1902), in their detailed treatment of the fossiliferous Silurian rocks of the Clogher Head inlier, did not differ significantly from the memoir in their views upon relationships with the Smerwick and Dingle beds. McHenry (1912), on the other hand, found no lithological or structural break where the Survey officers were obliged to bring the

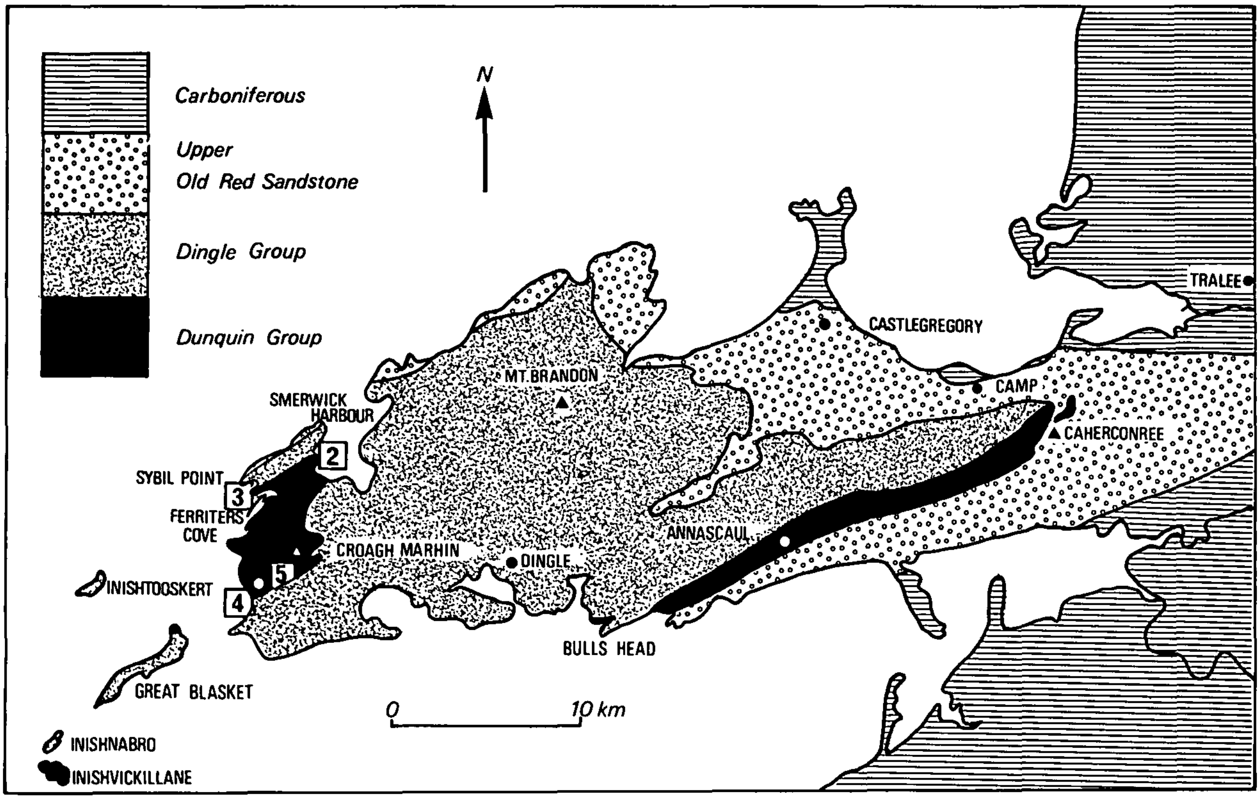

Figure 1. Geological sketch map of the Dingle Peninsula showing locations of Figures 2–5.

Smerwick and Dingle beds together at a supposed fault to the northeast of Smerwick Harbour. He also gave evidence of characteristic conglomerates in each.

Shackleton (1940) additionally found a group of purple flaggy, rippled beds and red shales with desiccation cracks to occur in both Smerwick and Dingle beds. He showed that on the west coast of Smerwick Harbour (Figs. 1 and 2) beds of both Smerwick Beds (assigned by him to the Dingle Beds) and Dunquin Group (to use modern terminology) dip similarly southeastwards, and the former provide evidence of inversion. A 'polygenetic conglomerate' was recorded between the two with a fault between it and the fossiliferous beds of the Dunquin Group. The same relationships held at Coosglass to the southwest (Fig. 3), but here there was 'apparently no significant faulting'. At Coosshaun (Fig. 4) to the south, the succession was found to be the correct way up, but the Dingle Group faulted against the fossiliferous Silurian beds. The polygenetic conglomerate was considered to be the basal conglomerate of the Dingle Group. Shackleton completed a structural map of the whole peninsula. The rocks of the Dunquin Group plunge eastwards where the outcrop of the Dingle Group wraps round them.

At Coosglass, Shackleton saw the Dingle Group as lying stratigraphically upon the lowest part of the fossiliferous Silurian succession of the Clogher Head inlier, the Ferriters Cove Beds of Gardiner & Reynolds (1902). To the east, the outcrop of the Dingle Group

Table 1. Stratigraphical succession in western Dingle Peninsula

Dingle Group (greater than 2000 m)		Přídolí ?Ludfordian
Dunquin Group	(5) Croaghmarhin Formation (310 m)	Ludfordian Gorstian ?Homerian
	(4) Drom Point Formation (180 m)	Homerian
	(3) Mill Cove Formation (90 m)	Homerian
	(2) Clogher Head Formation (610 m)	Homerian
	(1) Ferriters Cove Formation (430 m)	Homerian

is adjacent to that of the Croaghmarhin Beds at the top of their succession. Thus he concluded that the Dingle Group must overstep much of the fossiliferous Silurian succession and this within the relatively small confines of the inlier. A pre-Dingle Group phase of earth movements must therefore have preceded the post-Dingle phase, the latter having produced the flagrantly uncomfortable relationship of the Upper Old Red Sandstone rocks of the peninsula, themselves to be affected eventually by a third (Hercynian) phase. He concluded on structural grounds that the Dingle Group must be Downton(ian) in age.

Holland (1969) proposed a modern stratigraphical scheme for the succession in the western part of the Dingle Peninsula (Table 1); approximate thicknesses are given and chronostratigraphical divisions are added.

As mentioned above, detailed mapping had indi-

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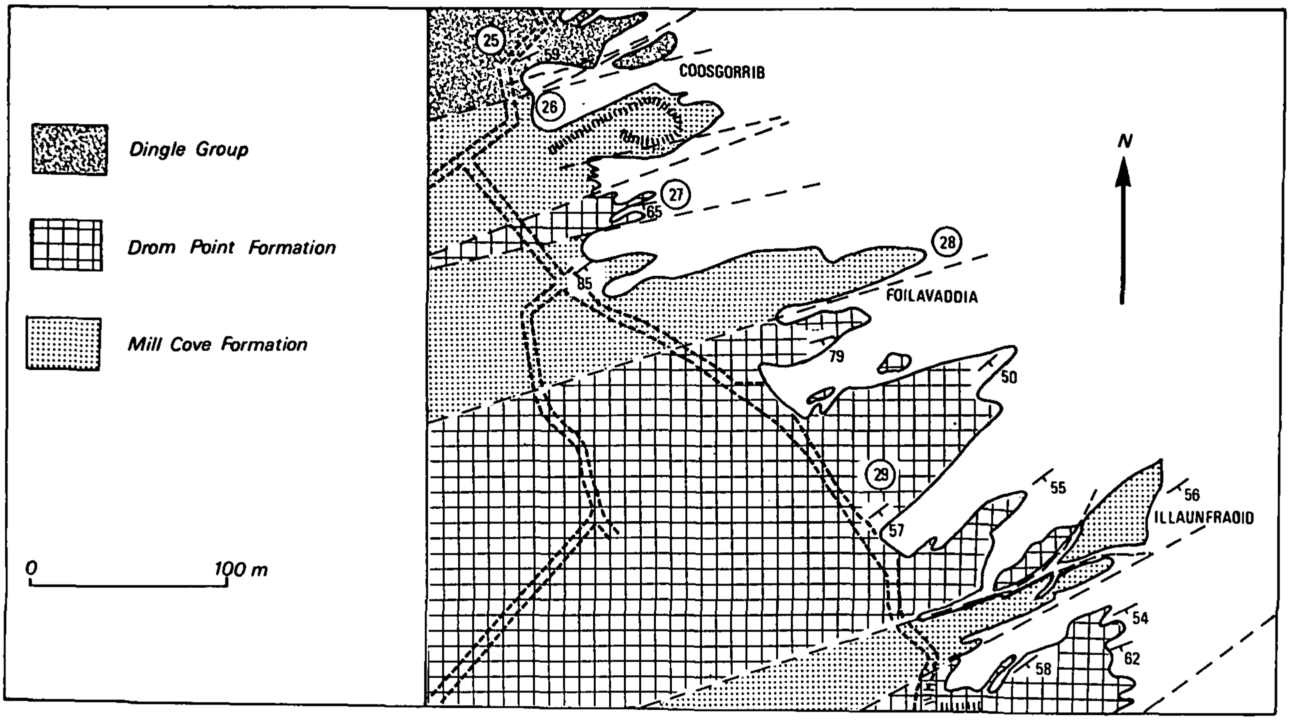

Figure 2. Geological map of the southwestern coast of Smerwick Harbour. For location see Figure 1. In Figures 2–5 faults are indicated by dashed lines and localities referred to in the text are shown by numbers in circles.

cated that all the coastal junctions between the Dunquin Group and the Dingle Group are faulted. There are, however, inland exposures in which the Croaghmarhin Formation is seen to pass directly upwards into the Dingle Group. This relationship is also consistent with the outcrop pattern and structure of the area. The Dingle Group ranges from possibly Ludlow through Downton in age. A similar account was presented in Holland (1981). In neither case was it possible to give detailed evidence, which is the purpose of the present paper.

Horne (1974) gave a full account of the lithostratigraphy of the Silurian to Carboniferous rocks of the Dingle Peninsula. His *Geological Guide to the Dingle Peninsula* (Horne, 1976) provides detailed sketch maps of relevant localities. His conclusions are best taken *seriatim* with the field evidence provided in the second part of the present paper.

Parkin (1976) described the Silurian rocks of the Annascaul inlier and the smaller inliers at Bull's Head and Derrymore Glen to the north of Caherconree (Fig. 1). Contacts between the Dunquin Group, represented here by three local formations, and the Dingle Group are seen in the Annascaul inlier and the Bull's Head inlier at its western end. In all cases it is clear that there is a faulted relationship with the Wenlock Annascaul Formation. The two younger Caherconree and Derrymore Glen formations of Ludlow age are seen only at the far eastern end of the Annascaul inlier and in the Derrymore Glen inlier nearby. In both cases both formations are overlain uncomformably by the Upper Old Red Sandstone. Thus, all that can be said from these three inliers is that the Dingle Group is post-Derrymore Glen Formation (i.e. post-lower Ludfordian), pre-Upper Old Red Sandstone in age, and that its precise stratigraphical relationships are unknown.

2. Field evidence and its implications

2.a. Coosgorrib

There is continuous exposure in the cliffed promontaries and inlets of the western side of Smerwick Harbour, through Coosgorrib (Fig. 2), southeastwards for approximately a further half kilometre to the beginning of the sandy beach which curves round the southern side of the bay. Much of the section is accessible at low tide but caution must be exercised in entering some of the narrow inlets when the tide is rising. The strata dip southeastwards at angles from 55° to 85° and, as mentioned above, there is evidence of inversion in the Dingle Group. Strike faults separate the Dingle and Dunquin groups and, within the latter, bring strips of Mill Cove Formation against the younger Drom Point Formation. The former are purple to red siltstones, sandstones, tuffs, agglomerates, and rarely rhyolites. The sediments are not conspicuously fossiliferous. The Drom Point Formation, on the other hand, is of decidedly different olive grey, yellow weathering, more or less calcareous, more or less micaceous siltstones, with brown rottenstone bands. Characteristically, the trace fossil *Chondrites* occurs in places and shelly fossils are present in bands

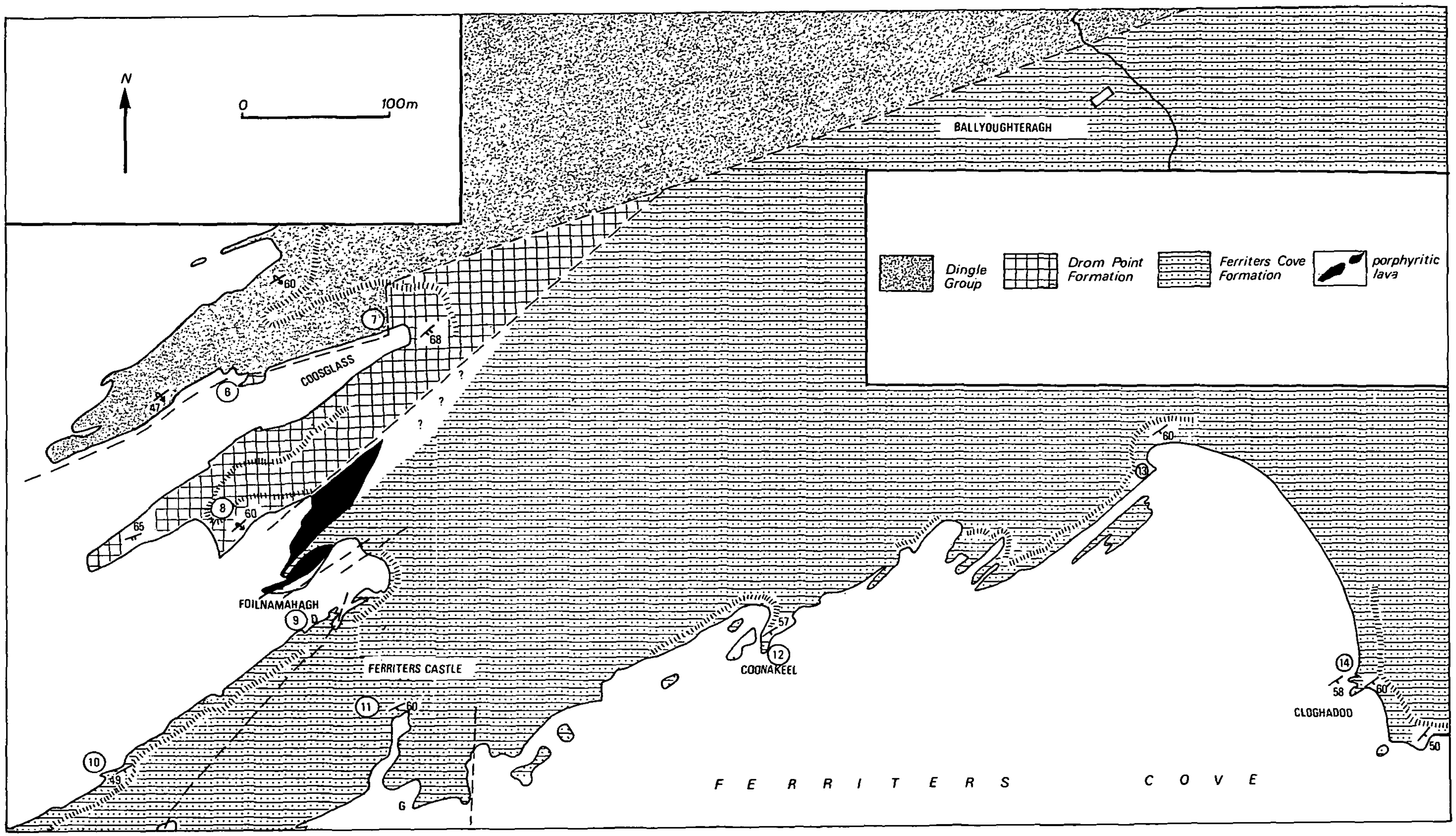

Figure 3. Geological map of the coastline between Sybil Point and Ferriters Cove. For location see Figure 1.

and lenses. Representative localities are described in southeasterly sequence as indicated on Figure 2.

On the north side of Coosgorrib (Locality 25) and in the island to the east of it, typical purple sandstones of the Dingle Group are seen, cross-stratification indicating inversion. The cliffs at the head of the inlet (Locality 26) display the faulted contact with the Mill Cove Formation. A steeply dipping reverse fault, which is seen close to the northwest corner of the inlet, brings the purple sandstones of the Dingle Group against a sliver (of variable thickness but less than a metre) of purple or discoloured pale ashes of the Mill Cove Formation. The effective downthrow to the north must be of the order of 500 m. To the south, measuring at beach level, some 7 m of agglomerate are next encountered. The rock is of a purplish grey colour and the clasts are conspicuously flattened. In fact the whole of this part of the section shows evidence of flattening, fracturing, and quartz veining. The clasts are of volcanic material, sediments, or to a lesser extent vein quartz; the matrix is tuffaceous. The presence of such an agglomerate is appropriate to the middle part of the Dunquin Group. To the south there are further faults, though the succession remains in the Mill Cove Formation, with purple to yellowish tuffs, finer agglomerates, and siltstones. These also occupy the headland to the south of Coosgorrib, where there is a series of small faults. The clue to the understanding of this section lies in knowledge of the stratigraphical sequence in the Dunquin Group as a whole, obtained in the Atlantic coast sections at the western end of the Dingle Peninsula. The presence of the predominantly purplish Mill Cove Formation against the Dingle Group caused both Shackleton (1940) and Horne (1974, 1976) to regard the coarse agglomerate mentioned above as a conglomerate within the Dingle Group. Horne actually named this the Coosgorrib Member of his Bull's Head Formation and regarded it as the basal member of the Dingle Group. However, he does recognize the presence of an 'apparently tuffaceous unit' between the Coosgorrib conglomerate and the sandstones of the Dingle Group (Horne, 1976).

The narrow faulted outcrop of Drom Point Formation to the south (Locality 27) is of yellow siltstones with some ash bands. *Atrypa reticularis*, crinoid ossicles, and *Chondrites* are present. The Mill Cove Formation is brought up again in the double inlet and along the narrow promontory of Foilavaddia (Locality 28). In the southern part of the double inlet, cross-stratification indicates inversion. The rocks are purple tuffs, agglomerates, sandstones, and shales with a few yellowish tuffaceous bands. The headland itself is of nodular rhyolite. Along the southern face of the promontory, pale tuff beds contain poorly preserved gastropods and rare orthoconic nautiloids. The head of the small inlet immediately to the south shows some 75 cm of fault breccia beyond which are once again the yellow siltstones of the Drom Point Formation. The wide outcrop of this formation, typified by the beds seen at Locality 29, is of characteristic yellow siltstones and sandstones, with fossil bands and lenses usually in the form of brown rottenstones. The fauna includes a favositid coral, bryozoa, *Atrypa reticularis*, *Howellella* sp., *Isorthis* sp., *Microsphaeridiorhynchus nucula*, *Cypricardinia* sp., gastropods, orthoconic nautiloids, crinoid ossicles, and *Chondrites*. The moulds are not well preserved.

Throughout the Clogher Head inlier a single Hercynian cleavage is developed only sporadically in the Dunquin Group. As is the case with the Silurian rocks of Marloes Bay, Dyfed (Graham, Hancock, & Hobson, 1977), the cleavage was superimposed on rocks previously tilted during the Caledonian earth movements. It is to be seen in various places in the present outcrop. An anticlinical closure associated with crushing and veining can be detected in the inlet to the north of the promontory containing Locality 29, and to the south of this, cleavage is seen to be steeper than bedding. Well developed cross-stratification does in fact indicate that the sequence is no longer inverted.

Finally, to the south yet again, a narrow faulted strip of Mill Cove Formation makes a narrow promontory and the island of Illaunfraoid. The dissection of the coastline in relation to the fault pattern is especially clear about here.

2.b. Coosglass

At Coosglass (Fig. 3) an outcrop of the Drom Point Formation is in contact with the Dingle Group. To the south, across another fault, a much weathered porphyritic igneous rock is present. Beyond to the south is the relatively extensive outcrop of the Ferriters Cove Formation, which is confined to this particular area of the Dingle Peninsula. This formation is generally highly fossiliferous, though the fossils tend characteristically to be comminuted. Like the Drom Point Formation, separated from it in more continuous sections elsewhere in the peninsula by the Clogher Head and Mill Cove formations, it is of Wenlock age. The Clogher Head Formation contains such characteristic upper Wenlock (Homerian) fossils as *Meristina obtusa* and *Resserella canalis*.

The critical evidence for the relationship between the Dingle Group and the Dunquin Group is to be found at Locality 7 (Fig. 3). The fault plane dips steeply towards the sea and may be traced in crags up the sloping cliff. There is clear evidence from cross-stratification in the promontory to the north of Coosglass that the southeasterly dipping purple sandstones of the Dingle Group are inverted. At Locality 7 these inverted beds are seen to run into the fault plane, which is approximately parallel to the more steeply dipping, finer-grained, thinner-bedded, grey or greenish strata of the Drom Point Formation.

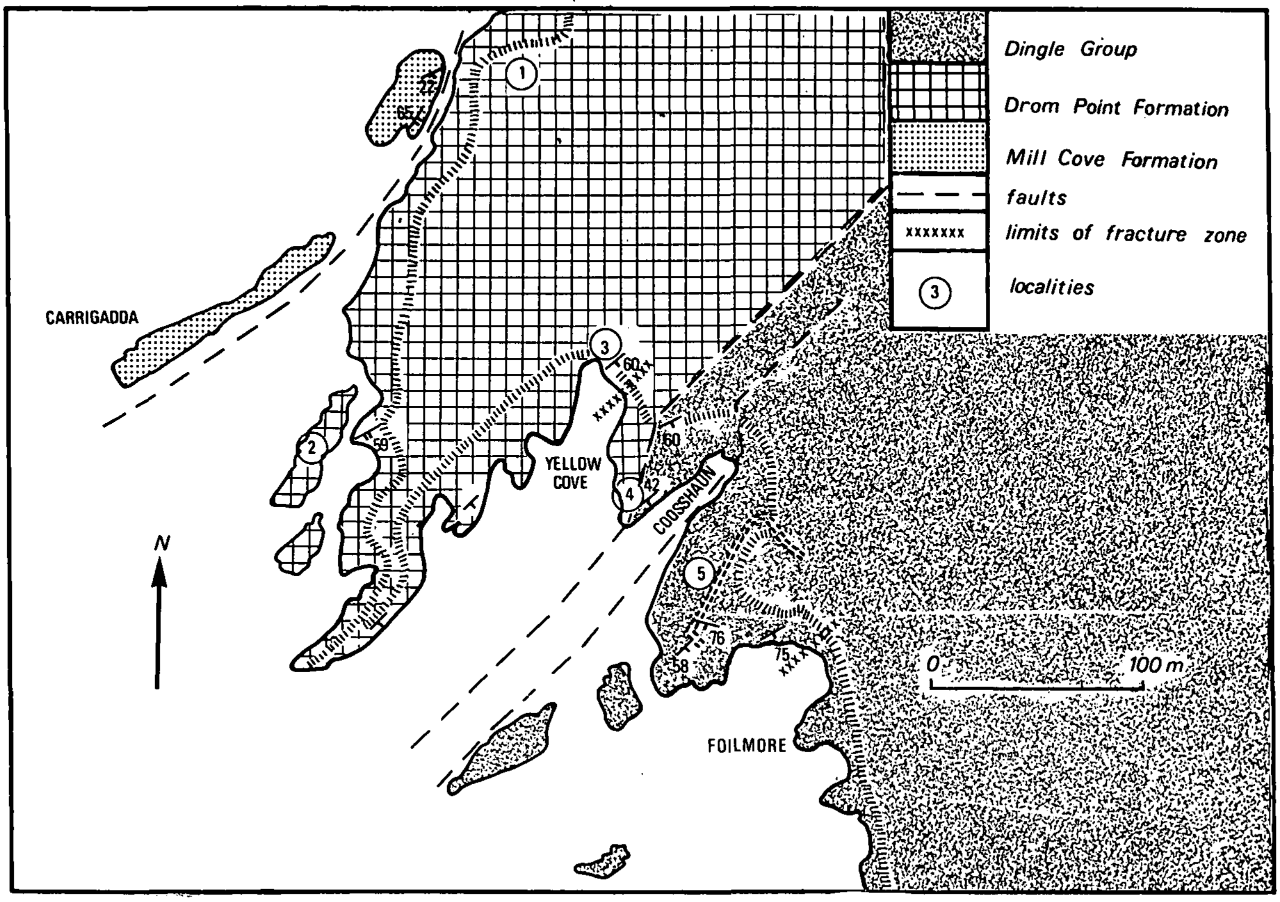

Figure 4. Geological map of the coastline around Coosshaun. For location see Figure 1. Dunquin harbour is on the western side of the inlet to the north of Foilmore.

The rock close to the fault plane is brecciated and sheared. In places these effects extend for half a metre into the Drom Point Formation. At sea level to the west the fault is obscured by boulders, but at Locality 6, especially at low tide, it may be seen again. All around Coosglass, along with the evidence of faulting, crushing, and veining, the Drom Point Formation has suffered colour changes to pale purple, green, or greyish, the characteristic yellowish effect being rarely seen. The sea-washed siltstones at Locality 6 are greenish in colour.

Further west, the fault being now just outside the coast, the basal part of the cliff shows coarse conglomerate with clasts of purple sandstone and to a lesser extent of volcanic material. The clasts are flattened and the conglomerate is veined by quartz. In contrast to the section at Coosgorrib, there is a transitional stratigraphical relationship with the younger purple sandstones to the north. In places cross-stratified sandstones fill channels within the conglomerate and there are lenses of conglomerate within the earliest purple sandstones.

It must be admitted that the status of the various local conglomerates in West Dingle is difficult to interpret. Certainly, however, there is not continuity of outcrop between the conglomerate referred to immediately above and the one at Coosgorrib. It must also be said that the sections at Coosgorrib and Coosglass critically both show Dingle Group in faulted contact with, respectively, tuffs of the Mill Cove Formation and siltstones of the Drom Point Formation.

Apart from the structural and discolouration effects referred to above, the cliff at the head of Coosglass also shows very well the regional Hercynian cleavage. Both cleavage and bedding dip to the southeast but the former is steeper at 68 ° compared with 52 ° for the bedding. On the southern side of the inlet are siltstones of the Drom Point Formation showing variably developed pale purple and greenish colours against a light greyish background. They contain scattered portions of *Chondrites* and rare orthocones. The igneous rock to the south was described by Gardiner & Reynolds (1902) as a 'labradorite porphyrite'. Horne's more modern description is of a porphyritic lava, dark purple in colour, with large feldspar phenocrysts and flow alignment. Horne regarded it as the oldest rock it the district. It is faulted on both sides but appears to be at the faulted closure of an anticline. The configuration of the southern fault is such as to bring a strip of green and red sandstone above the igneous rock.

To the south are the variable beds of the Ferriters Cove Formation with, at Locality 9, where a gully runs northwestwards from a fault, purple to olive siltstones with bands of tuff and agglomerate. At Locality 10, along strike to the southwest, they are seen again together with some purple sandstones showing cross-stratification the right way up. Further south again, the gully which runs southwards from the ruins of Ferriters Castle shows a similar sequence but includes a thin rhyolite. Other exposures around the bay, as at localities 12, 13, and 14, show typical Ferriters Cove Formation free from the effects of faulting and staining which are more conspicuous to the northwest. The commonest sedimentary beds are pale olive to greyish olive siltstones, often packed with fossil debris and hence somewhat rubbly to the touch. There are also some flaggy sandstones and bands of tuff. The Homerian fauna in these exposures includes *Rhabdocylus bina*: favositid, halysitid, and syringoporid tabulate corals; bryozoa; *Amphistrophia funiculata*, *Atrypa reticularis*, *Ferganella* sp., *Hesperorthis* sp., *Holcospirifer bigugosus*, *Howellella* sp., *Meristina obtusa*, various rhynchonellids; orthoconic nautiloids; *Dalmanites* sp., a proetid; and crinoid ossicles. The characteristic development of *Chondrites* is not seen here and the endemic brachiopod *Holcospirifer bigugosus* (Bassett, Cocks and Holland, 1976) which is present is not found above the Clogher Head Formation.

2.c Cooshaun

The contact between the Dingle Group and the Dunquin Group is seen again in coastal section on the southern side of the Clogher Head inlier near the small harbour of Dunquin. The relevant stretch of coast from the island of Carrigadda to Foilmore is shown in Figure 4. In this area very typical Drom Point Formation is faulted against the Dingle Group, with the whole of the 300 m thick Croaghmarhin Formation, which is present less than 0.3 km to the northeast, being missing in the faulted section. In this area there is a zone of fracturing within which a single steeply dipping reverse fault with throw greater than 300 m must be responsible for the main movement.

Carrigadda and the smaller island to the north are composed of the characteristic bright purple beds of the Mill Cove Formation. About Locality 1 the contrast between these and the predominantly yellowish beds of the Drom Point Formation is particularly clear. A minor fault separates the two. To the north this curves somewhat anomalously from the usual northeast to southwest orientation of the many reverse faults in the area. The Hercynian cleavage is similarly anomalously oriented here, striking at 027° instead of the usual 045° to 060°.

At Locality 2 an example of concentration of the cleavage into discrete zones is well seen. The yellow siltstones and brown rottenstones here show cross-stratification the right way up. There are also laminated beds. Some fresher greyish beds are still calcareous. The typical Homerian fauna of the Drom Point Formation is represented by abundant *Chondrites*, by the brachiopods *Atrypa reticularis*, *Meristina obtusa*, and *Sphaerirhynchia wilsoni*, and by bryozoa, *Dalmanites* sp., and crinoid ossicles.

Near Locality 3 the same beds are well displayed in the cliffs descending into the appropriately named Yellow Cove. Along the back of the Cove begins a zone of fracturing which extends well beyond the junction with the Dingle Group and to the south of the small harbour of Dunquin. Within this zone the Drom Point Formation becomes purple stained and shows fracturing and slickensiding. The boundary fault itself runs along a narrow promontory at Locality 4, where a gash at the seaward end shows the contact between yellowish beds of the Drom Point Formation and the purple Dingle Group. There is associated quartz veining. The Dingle Group to the south (Locality 5) comprises much fractured yellowish, grey, green, or purple sandstone and siltstones.

The presence or absence of the characteristic fauna of the Drom Point Formation is crucial to the understanding of this section. Within the zone of fracturing its typical yellowish beds tend to be stained purple and the normally purple sandstones and siltstones of the Dingle Group are mostly discoloured or stained yellow, though they are in any case generally of coarser grain size. Essentially then the relationship between the two groups is here again a faulted one.

2.d. Great Blasket

At the northern tip of the Great Blasket (Fig. 1) there is again a clear faulted contact between purple siltstones and sandstones of the Dingle Group, which form the main mountainous mass of the island, and fossiliferous beds of the Dunquin Group to the north. The reverse fault dips to the south-southeast at 40° and involves a zone of fracturing and discolouration about 10 m wide. The Dunquin Group is represented by yellowish or grey beds which, in the northern cliffs, where directly attacked by the sea, have taken a dark yellowish-orange colour. Here, in particular, they are highly fossiliferous. The fauna includes *Rhabdocyclus bina*, favositids, bryozoa, *Atrypa reticularis*, *Leptaena*, sp., *Meristina obtusa*, *Sphaerirhynchia wilsoni*, pteronitellid bivalves, orthoconic nautiloids, and crinoid ossicles. The typical trace fossil of the Drom Point Formation, *Chondrites*, is also present. Most significantly, the beds exposed in the northern cliffs are rich in the second endemic brachiopod of the area *Rhipidium hibernicum*, which appears to be confined to a level at the top of the Drom Point Formation (Bassett, Cocks & Holland, 1976). On the mainland in a river section near but inland from Dunquin an identical development is succeeded by the Croaghmarhin Formation.

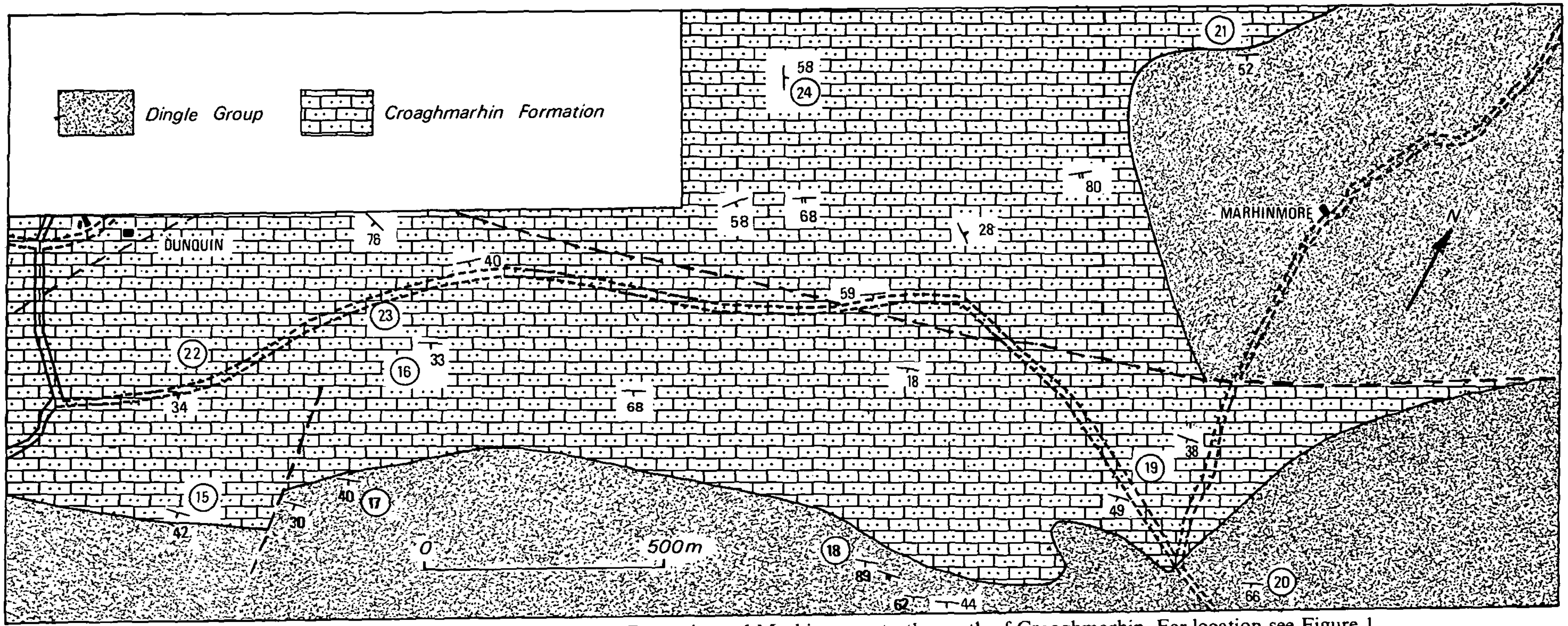

Figure 5. Geological map of the area between Dunquin and Marhinmore, to the south of Croaghmarhin. For location see Figure 1.

2.e. Inland exposures

Inland the rocks of the Clogher Head inlier and its immediate surroundings are more poorly exposed, though there is a sufficient scattering of these to give some control over the position of the boundary with the Dingle Group. Topographical, and even to some extent vegetational, changes are also helpful. In fact a boundary can be mapped (Fig. 1) which is consistent with the known structure of the area with its easterly plunging folds and inverted middle limb. Fortunately a few critical exposures close to or across the boundary are to be found in the area between Dunquin and Marhinmore (Fig. 5).

The Croaghmarhin Formation (largely Ludlow) at the top of the Dunquin Group is mostly composed of grey calcareous flaggy siltstones and impure limestones. Such beds are seen at the summit and on the flanks of the conical mountain of Croaghmarhin, for example at Locality 24 in Figure 5 where the beds yield the brachiopods *Dayia navicula* and *Isorthis orbicularis*. The former appears only in the higher part of the Croaghmarhin Formation and towards the top becomes very common. The rocks are then somewhat smoother and more thinly bedded flaggy siltstones which are not calcareous. They yield a fauna very similar to that of the Lower Leintwardine Formation (lower Ludfordian) of the Welsh Borderland (Holland, Lawson & Walmsley, 1963; Holland *et al.* 1980). Such beds are seen again, for example, at Locality 22, just to the south of the mountain road which runs northeastward from near Dunquin. Here both *Dayia navicula* and *Isorthis orbicularis* are common.

About 500 m to the northeast a rough track runs southwards from the mountain road. There are some small exposures along the trackside and additional rock can easily be excavated. Near to the beginning of the track at Locality 23 are beds probably somewhat lower in the Croaghmarhin Formation than those just mentioned. They show common developments of halysitid and heliolitid corals and bryozoa which are characteristic of the middle part of the formation (Holland, 1969). They also yield the brachiopods *Amphistrophia funiculata*, *Atrypa reticularis*, *Isorthis orbicularis*, *Microsphaeridiorhynchus nucula*, and *Shaleria ornatella*.

Southwards from here it is possible to trace the succession upwards. Locality 16 is a shallow quarry by the side of the track where material has been excavated, probably mainly for track infilling. The beds here are characteristic of the top part of the Croaghmarhin Formation. They are fossiliferous, light olive, grey, flaggy siltstones. The fauna includes bryozoa, *Amphistrophia funiculata*, *Atrypa reticularis*, common *Dayia navicula*, *Isorthis orbicularis*, *Resserella* sp., cf. *Shagamella* sp., *Sphaerirhychia wilsoni*, pteronitellid bivalves, gastropods, orthoconic nautiloids, and crinoid ossicles. Additionally, this is the only locality in the Clogher Head inlier where graptolites have been recovered, though they are certainly rare. They are forms which Dr D. C. Palmer of Trinity College, Dublin has identified as *Saetograptus* cf. *leintwardinensis incipiens*.

From here to the point where the boundary with the Dingle Group crosses the track, rock almost *in situ* may be collected at intervals in the trackside. These sparsely fossiliferous or unfossiliferous beds could possibly accommodate the remainder of the Ludlow. About half-way along this stretch the more fully developed fauna as seen in the old quarry at Locality 16 gives way to a sparse one of crinoid ossicles, *Microsphaeridiorhynchus nucula* small pteronitellid bivalves, and *Howellella* sp. Close to the boundary (Locality 17) no fossils are found and there are more resistant greyish olive or greenish grey, micaceous, laminated siltstones. Then a slight purplish colouration appears and soon gives way to the typical purple siltstones of the Dingle Group. Some 30 m of these are exposed showing some horizons with return to greenish colours.

Another section is to be seen in a stream close to a farm at Locality 15. The lower part of the stream is much overgrown but exposures appear at just below a small waterfall. The fall itself is in massive to flaggy greenish micaceous siltstones like those referred to above. The grey siltstones below yield some rhynchonellid fragments, a few crinoid ossicles, and poorly preserved small gastropods. Above the waterfall purplish colours appear and the sequence passes into typical Dingle Group.

Further east, a stream section at Locality 18 shows purple siltstones and shales of the Dingle Group with channeling indicating that the sequence is the right way up. At Locality 19 a deep and overgrown ditch below the road exposes grey, slightly irregularly bedded, flaggy siltstones and brown rottenstones in which only small fragments of fossils were found. Across the boundary a small old quarry (Locality 20) is in Dingle Group. Finally, to the north at Locality 21 a small stream section down the mountainside fortunately shows again the resistant greenish siltstones which appear to be characteristic of the very top of the Croaghmarhin Formation before the Dingle Group is reached. This exposure is very close to the boundary and typically purple beds of the Dingle Group are seen near by.

3. Old Red Sandstone of Coosmore

The uncomfortable relationship between the Upper Old Red Sandstone and older rocks in west Dingle has been described by Doran, Holland & Jackson (1973). They referred in detail to the mostly faulted small strip of these rocks on the northern side of Clogher Head (the westernmost projection of the Clogher Head inlier in Fig. 1), around the inlet of Coosmore. It is possible to descend the high cliff between Coosmore and Trabenclogher, the small bay to the north, and thus at low tide to examine the contact between the Upper Old Red Sandstone conglomerate and the rocks upon which it rests. A good view may also be obtained from the cliff-top to the south. Horne has suggested that our drawing (Doran, Holland & Jackson, 1973, fig. 6) does not accurately show the minor faulting here, but he too confirms that there is an uncomfortable contact below the conglomerate. The beds below are Drom Point Formation in typical lithology and with the typical fauna. I maintain the view which was originally that of Gardner & Reynolds (1902), though not that of Jukes & Du Noyer (1863), that this conglomerate must be assigned to the Upper Old Red Sandstone rather than to the Dingle Group. The matter is argued in Doran, Holland & Jackson (1973). Knowledge of the conformable relationship of the Dingle Group inland in this small inlier makes it unlikely that here the whole of the Croaghmarhin Formation together with the top part of the Drom Point Formation have been cut out. This outcrop is, in other words, not relevant to our present discussion.

4. Conclusion

I conclude that the three excellent coastal sections of the West Dingle mainland all show faults between the Dingle Group and the older fossiliferous beds. At the northern end of the Great Blasket island the relationship is the same. Inland, there is clear evidence of stratigraphical continuity from the Croaghmarhin Formation into the Dingle Group, the former ending (i.e. being taken to end) with a resistant greenish, flaggy to massive, siltstone. Below this the rich fauna of the Croaghmarhin Formation is seen to become quite suddenly sparse, a few crinoid ossicles, *Microsphaeridiorhynchus nucula*, etc. remaining until near the top. Thus, the Dingle Group is post-Croaghmarhin Formation. It may begin within the lower Ludfordian Stage of the Ludlow Series or possibly even above the Ludlow. In view of its substantial thickness it most probably includes most if not all of the Přídolí Series.

The onset of (broadly) Old Red Sandstone conditions is thus at approximately the same time as in the central Welsh Borderland (i.e. about the end of the Ludlow) or may come within the Ludlow as is the case in parts of South Wales. Whether the Dingle Group extends into the Lochovian Stage at the base of the Devonian is not known. The Upper Old Red Sandstone in the south of Ireland is largely Upper Devonian in age though its base may be close to the Middle/Upper Old Red Sandstone boundary (Clayton *et al.* 1980). There is as yet no satisfactory *internal* evidence for the age of the sediments of the continental Dingle Group itself. The seemingly anomalously young late Emsian date given by Van der Zwan (1980) is based upon a single palynological sample recorded as coming from about the middle of the sequence.

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