

## THE VARISCAN FOLD BELT IN IRELAND



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### ABSTRACT

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The major geological features of Ireland south of Latitude 52°30' are described. Palaeofacies and isopachyte maps, combined with stratigraphic cross-sections, are used to trace the Late Palaeozoic development of the region. A thick red-bed sequence of Middle-Late Devonian age accumulated within an east-west trough, the Munster Basin, which was fault-controlled at its northern margin. The northward marine incursion across the region in late Devonian – early Carboniferous times is described. South of the Cork-Kenmare line (in the South Munster Basin) the dominantly Cork Beds sequence was developed and reflected a gradually deepening marine facies through Early Carboniferous time. Isopachyte data show the influence of an important intra-basinal positive element, the Glandre High, which effectively separated east and west depositional sub-basins. North of the Cork-Kenmare line the shelf area was dominated by carbonate deposition until the end of Early Carboniferous time. Turbidite deposition was a feature of Namurian deposition across the region, whilst evidence of the Westphalian is limited to the coal-bearing measures of Westphalian A in the small Kanturk Coalfield.

The considerable control of structural styles exercised by bulk lithologies is demonstrated with the aid of structural cross-sections. Basement controls on both structural style and sedimentation are discussed, with particular reference to the Glandore High and the northern margin of the Munster Basin. Finally, the concept of a clearly-defined northern thrust front to the Variscan fold belt is examined and the conclusion reached that the supposed 'front' is better considered as a complex zone within which the northward diminution of tectonic intensity is affected by basement configuration, the thickness of sedimentary cover and the presence of older structural features.

### INTRODUCTION

A series of major folds, simple in outline but complex in detail, control the outcrop pattern of the southern part of Ireland. The best sections occur where the coastline crosses the structural trend, notably on the west coast and in Cork Harbour (Fig. 1). Inland exposures are normally relatively poor. Small-scale structural maps often denote the northern limit of severe Variscan deformation in Ireland as a single line trending diagonally from Dungarvan in the east to the neighbourhood of Dingle in the west (Fig. 2). The nature of this northern margin to the Variscan Belt is discussed later in this paper.

Throughout southern Ireland the Old Red Sandstone rests with marked unconformity on an eroded landscape of

Palaeozoic rocks. The passage upwards from the Old Red Sandstone into the overlying marine sequences of late Devonian-early Carboniferous age is everywhere conformable. Two distinct stratigraphic provinces exist north and south of a line between Kenmare River and Cork Harbour (Fig. 2). To the north the Old Red Sandstone is overlain by a thin development of heterogeneous marine rocks (Lower Limestone Shales) succeeded by thick Dinantian carbonates. South of the Cork-Kenmare line the Old Red Sandstone non-marine sequence is overlain by 2500 m of marine sandstones and mudrocks (the Cork Beds) which range from latest Devonian to Namurian in age.

The area discussed in this paper is that shown in figure 1. An attempt is made to describe the stratigraphy and palaeogeography of the region, to describe the Variscan deformation and discuss the nature of the Variscan 'front', and to examine the controls of Upper Palaeozoic sedimentary facies and thicknesses.

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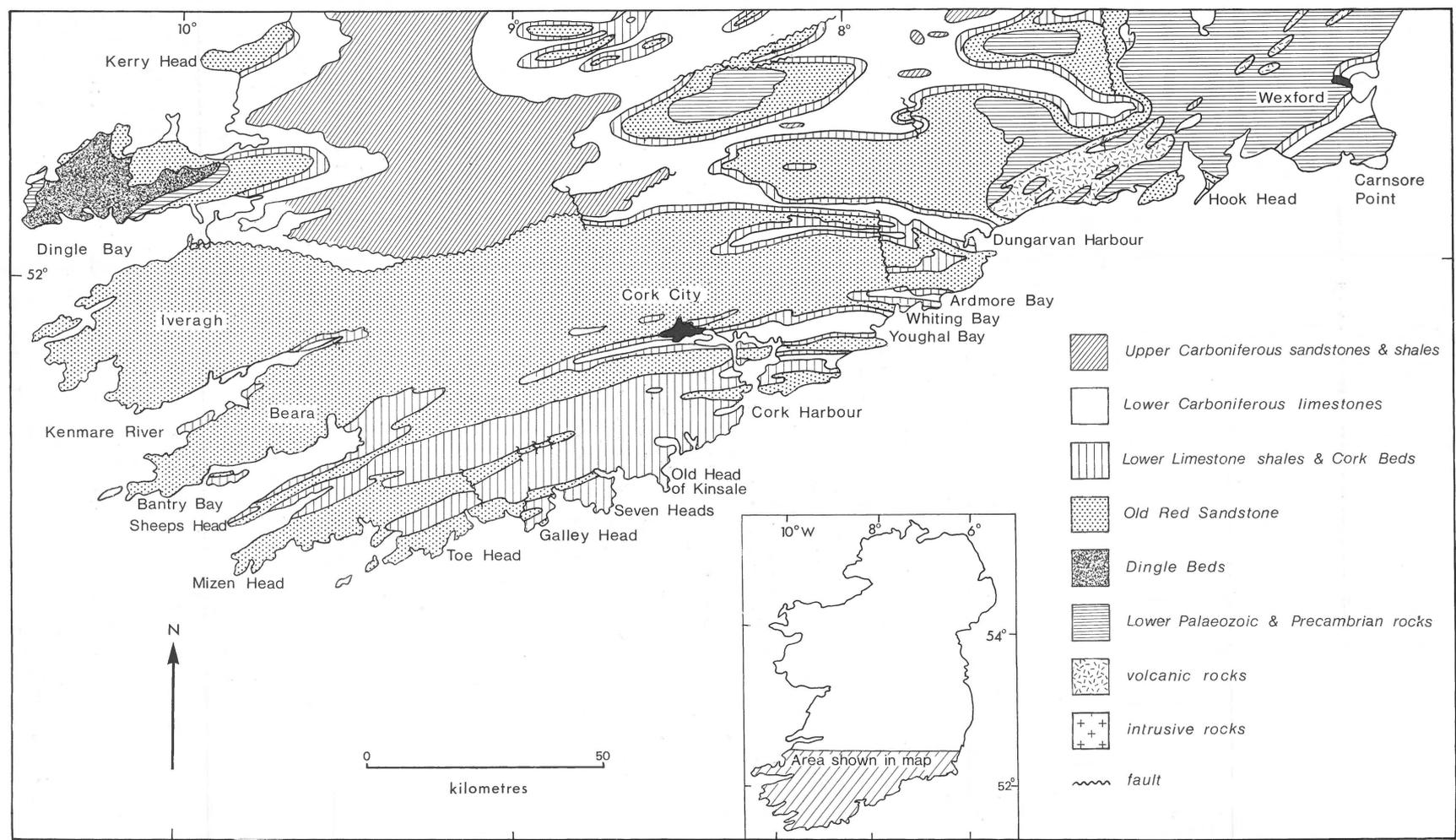


Fig. 1  
Geological sketch map of southern Ireland.

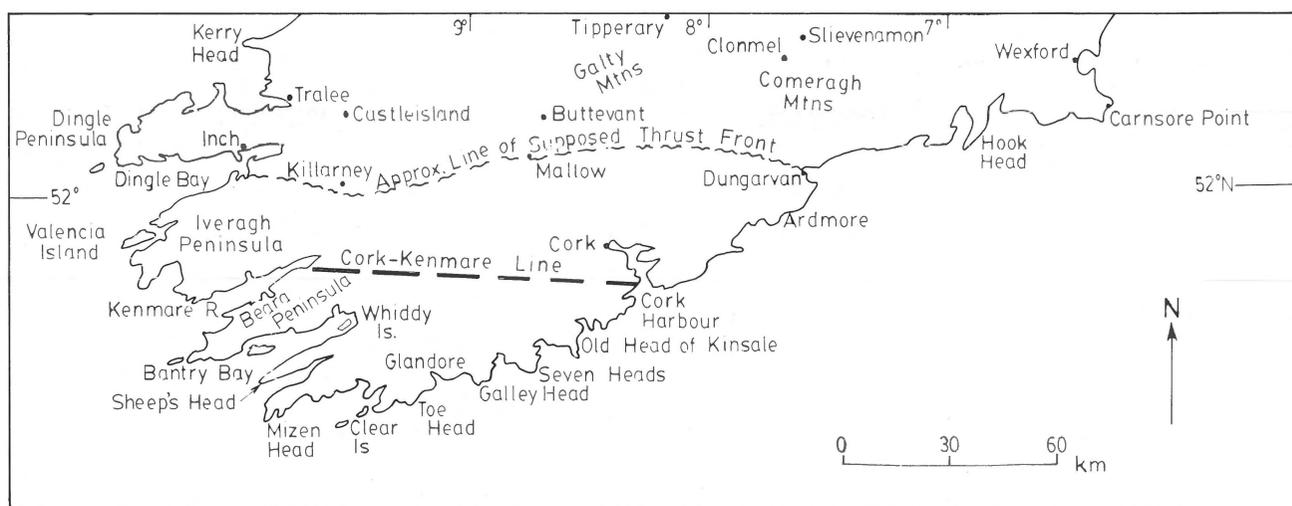


Fig. 2  
Map showing locations mentioned in the text.

## STRATIGRAPHY

### *Caledonian basement*

As will be seen on figure 1 the major area of Caledonian rocks lies in the extreme east. These rocks are an extension of the envelope of Early Palaeozoic rocks which surround the Leinster granite to the north. A Rb/Sr date of  $404 \pm 24$  Ma has been obtained on the Leinster Granite (O'CONNOR & BRÜCK, 1978). The varied Lower Palaeozoic successions (Geological Survey of Ireland. Guide Series 2, 1978) contain an important belt of Middle-Late Ordovician volcanics in County Waterford.

A number of Lower Palaeozoic inliers can be seen along the northern margin of figure 1, and these are rimmed by relatively thin Old Red Sandstone sequences. The Dingle Peninsula on the west coast is more complex and is discussed below. South of the Dingle-Dungarvan line Early Palaeozoic rocks are not exposed and the nature of the pre-Devonian basement is conjectural.

The Bouguer anomaly map (Fig. 4) shows a zone of negative anomalies extending from the Iveragh Peninsula east-north-east to link with the negative anomaly around the Leinster granite. South of Iveragh the relatively smooth east-west Bouguer contours rise steadily in value towards the south coast.

### *Devonian*

The Devonian rocks are mainly of Old Red Sandstone facies. In the northern part of the region the red-bed sequences are relatively thin, but thicken dramatically southwards into a thick east-west trending sedimentary trough, the Munster Basin. The northern margin of the trough is arbitrarily taken at the zone of major thickness change running from Dingle

Bay, north of the Galty Mountains (Fig. 2) to the Comeragh Mountains before turning south (1 km line of Fig. 3). The Old Red Sandstone sequences comprise varied fan, aeolian and fluvial sediments. In general sediments become finer upwards in the succession and also southwards across the basin.

Along the northern margin of the Munster Basin the Old Red Sandstone can be seen to rest unconformably on Early Palaeozoic rocks at many localities. On the Dingle Peninsula, however, the basal unconformable contact is with the Dingle Group (over 2000 m thick). This group of varied red and green sandstones, siltstones and conglomerates, often shows typical Old Red Sandstone facies. The Dingle Group in some areas rests conformably on fossiliferous Ludlow strata (HOLLAND, 1969; HORNE, 1974). The existence of an unconformity in the Old Red Sandstone succession of Dingle suggested by HORNE (1974) is an indication of the tectonically active nature of the northern margin of the Munster Basin. Similarly the presence of high-grade metamorphic rocks in basal conglomerates (Inch Conglomerates) may also point to fault-controlled basement slivers on the northern margin. A similar structural setting, with fault-controlled sedimentation with thick conglomeratic red beds at the base, also exists in the Comeragh Mountains to the east.

The gradual fining-up nature of the stratigraphy suggests the degradation of source areas with time. Sediment derivation, away from local influences at the margins, is generally from the north across the basin (NAYLOR & JONES, 1966) and there is no evidence of a southern source area. Conglomeratic horizons are relatively rare on the Iveragh Peninsula and virtually absent further south. Palaeontological evidence presented by RUSSELL (1978) suggests a maximum age of latest Middle or early Late Devonian for the lower parts of the Old Red Sandstone on the Iveragh Peninsula. The entire sequence is thus likely to correlate with strata younger than

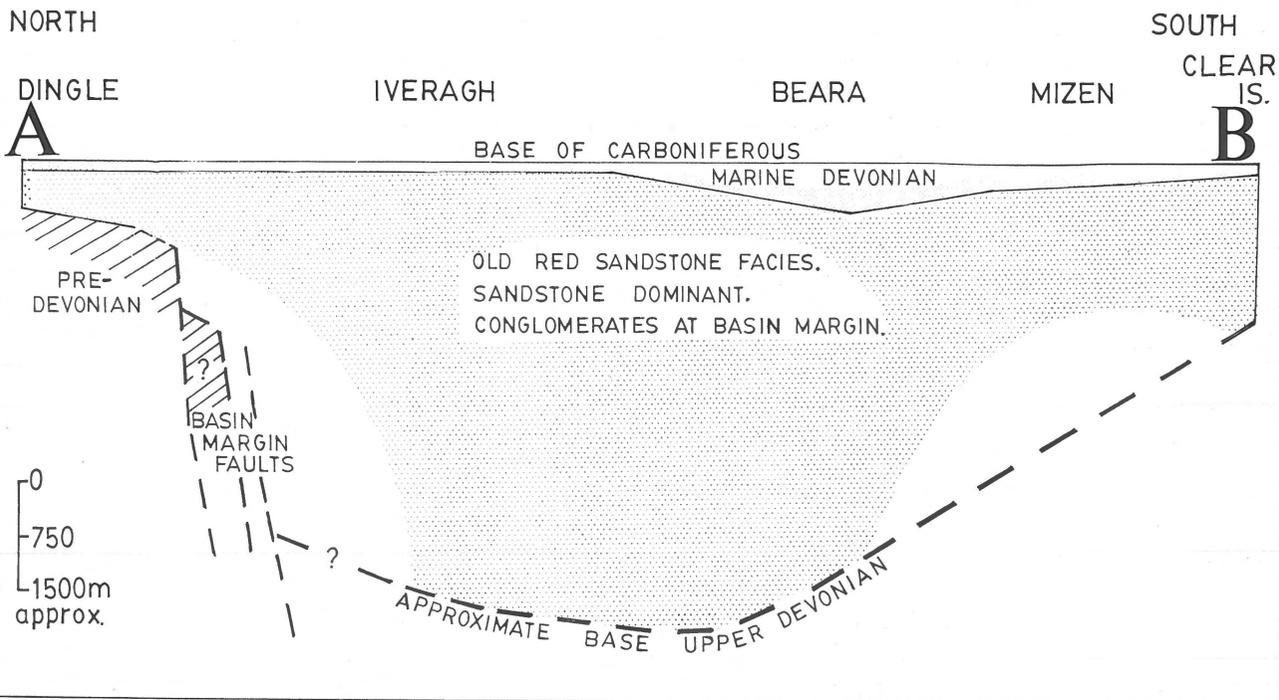
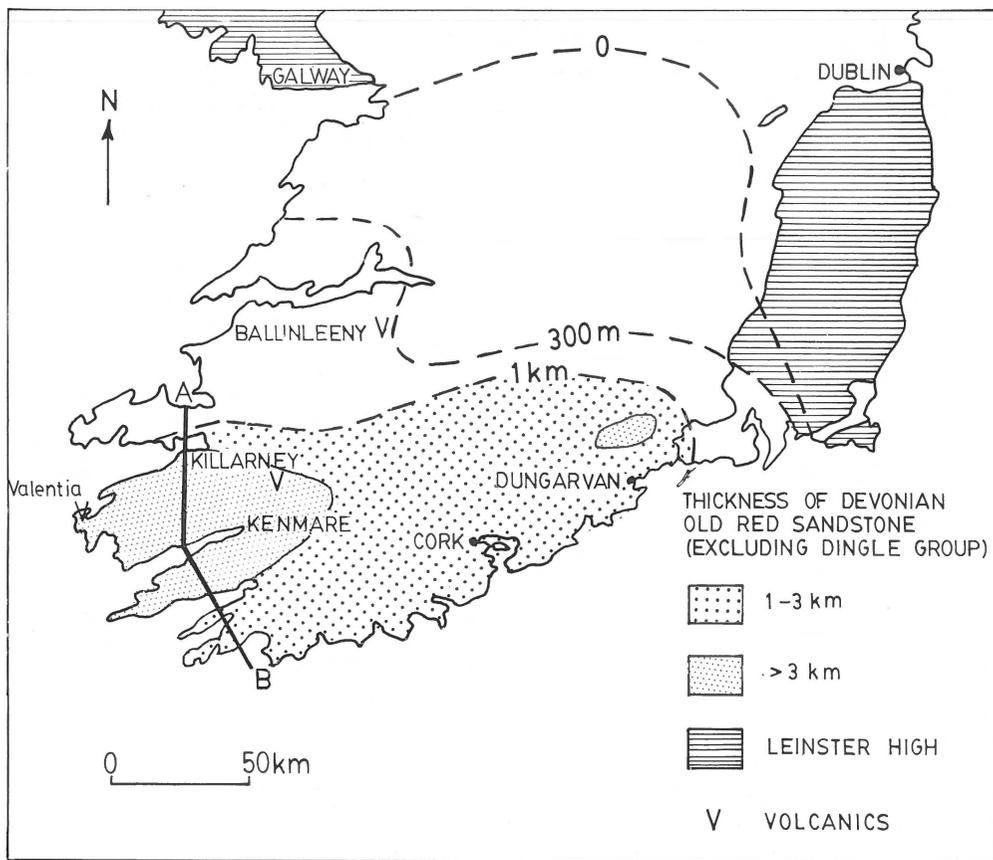


Fig. 3  
Generalized thicknesses of Devonian Old Red Sandstone (excluding Dingle Group).  
Diagrammatic north-south section across the Munster Basin.

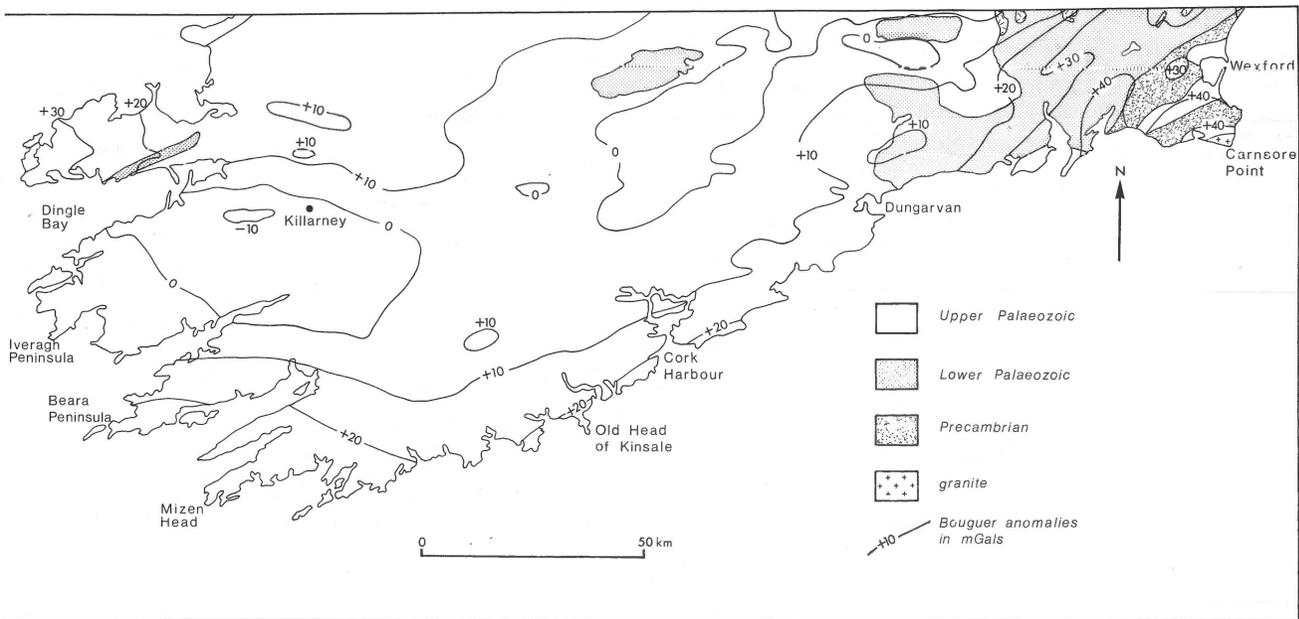


Fig. 4 Bouguer anomaly map (modified after Dublin Institute for Advanced Studies 1974: Geophys. Bull. 32).

the Dingle Group to the north.

In the extreme southwest (Mizen Head-Toe Head) in excess of 2000 m of fine-grained fluviatile sandstones and mudrocks are exposed. Here the lowest beds are of late Middle Devonian or early Late Devonian age (CLAYTON & GRAHAM, 1974). Thus, although the pre-Devonian is nowhere seen, an asymmetrical basin profile can be constructed as shown in Section A-B (Fig. 3). The thickest exposed sequences on the Iveragh Peninsula are in excess of 6000 m (CAPEWELL, 1975).

In the region south of the Cork-Kenmare line the uppermost Devonian is developed in marine facies, clearly equivalent to non-marine red beds to the north (NAYLOR, 1969; CLAYTON ET AL, 1974; CLAYTON & HIGGS, 1979). During the upper part of the PL miopore zone (Table I) the marine incursion extended into the south coast, and then progressed gradually northwards. In this southern zone there is a conformable upward transition from Old Red Sandstone into the marine Cork Beds (NAYLOR, 1966). Rapid marine incursion northwards across the low coastal plain (represented by the Toe Head Sandstone Formation and its equivalents) resulted in a non-erosive upwards transition into shallow-marine, tidally-influenced sediments. Only the lowest of the four formations of the marine sequence (NAYLOR ET AL, 1974) lies within the Devonian, and this is the Old Head Sandstone Formation. This formation is dominated by fine-grained sandstones interbedded with flaser and lenticular bedded units. There is further discussion of the Cork Beds succession in the next section.

In the Cork Harbour area the Old Head Sandstone Formation passes northwards into alluvial red beds (NAYLOR,

table I

Summary of Tournaisian stratigraphy and miopore zonation (slightly modified after Clayton & Higgs, 1978).

STRATIGRAPHY				MIOPORE ZONATION	
SYSTEM	SUBSYSTEM	SERIES	STAGE		
CARBONIFEROUS	DINANTIAN	VISEAN	CHADIAN	Pu Zone	
		TOURNAISIAN	COURCEYAN	CM Zone	
				PC Zone	
DEVONIAN		Tn1	'STRUNIAN'	VI Subzone	NV Zone
				LN Subzone	
				LE Subzone	PL Zone
				LL Subzone	



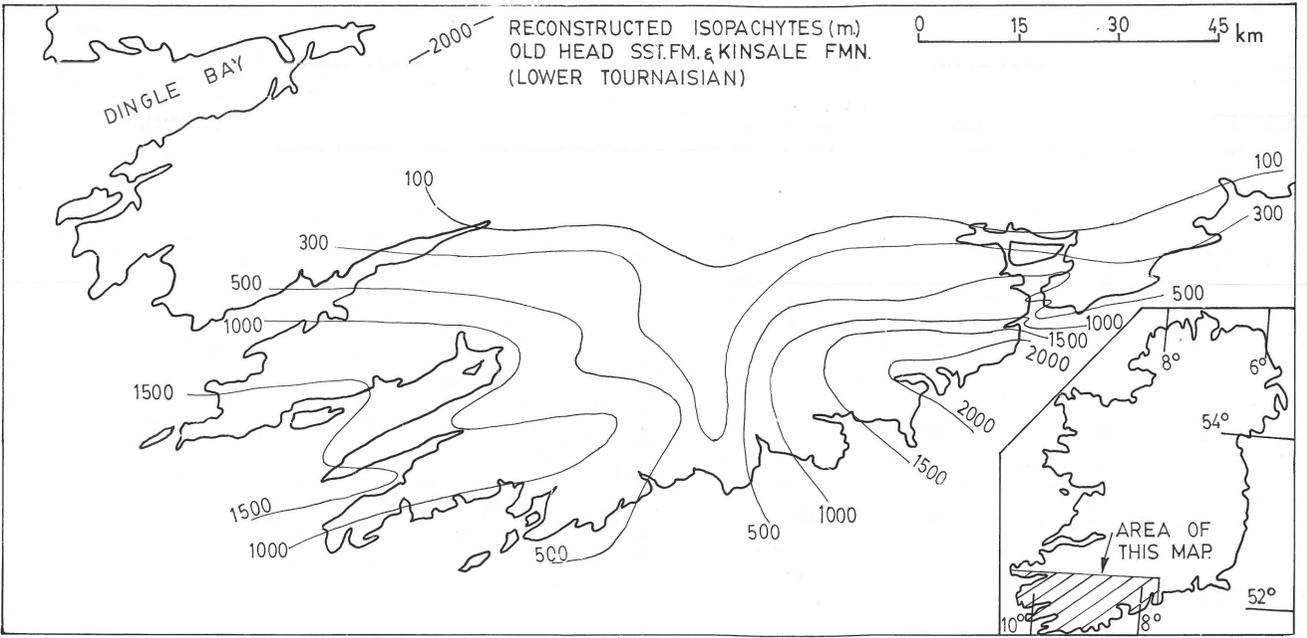


Fig. 5  
Reconstructed isopachytes for the Old Head Sandstone and Kinsale Formations combined.

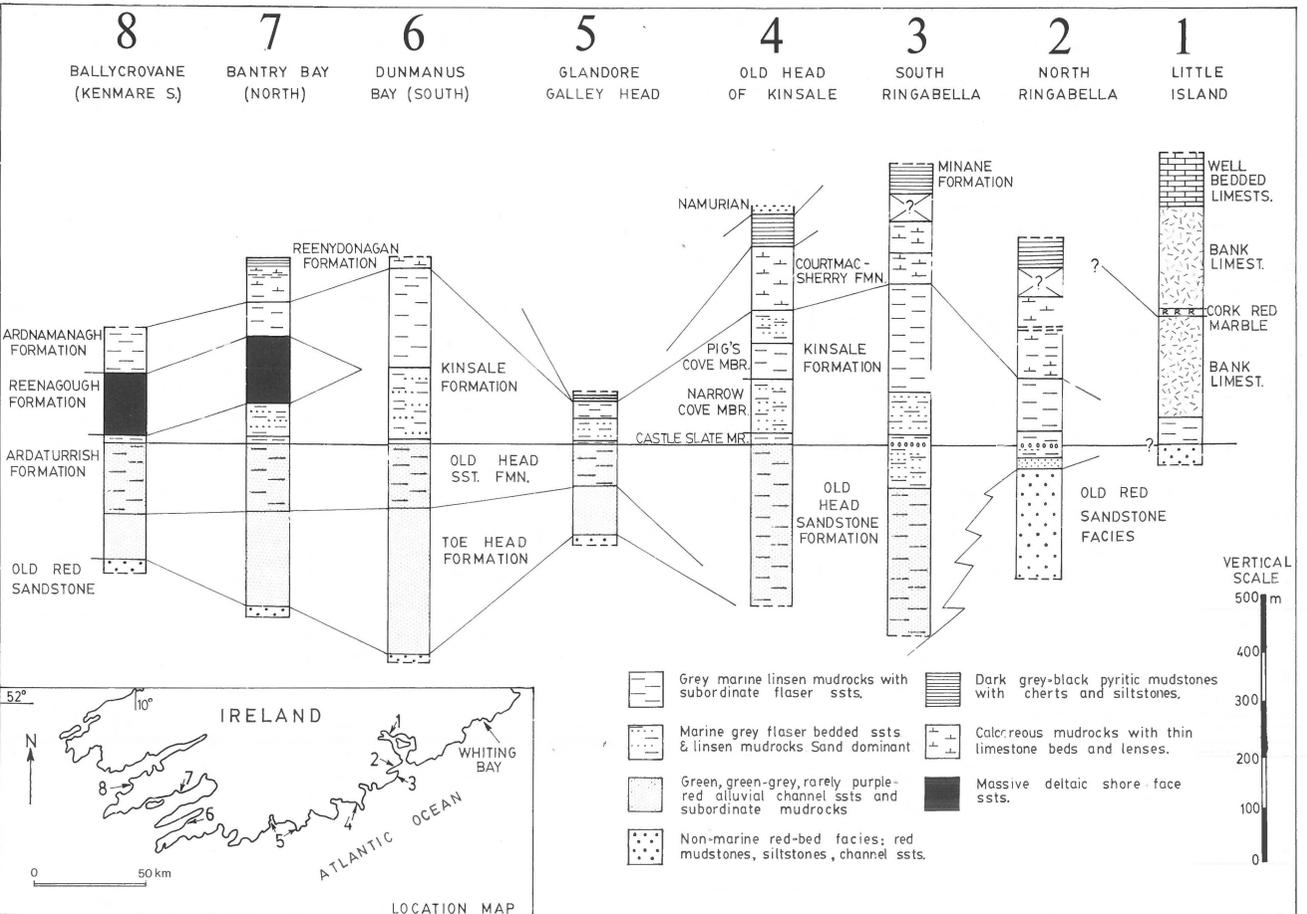


Fig. 6  
Lithostratigraphic sections through the Cork Beds between Cork Harbour (Little Island) and Kenmare River (Ballycrovane).

Table III  
Summary of environmental interpretations for the Cork Beds (modified after Naylor et al, 1974).

WEST CORK			SOUTH CORK		
REENYDONAGAN FORMATION	Member 4	Restricted basin (Jones, 1974); Bathyal (Coe & Selwood, 1968)	Restricted and possibly deep basinal conditions. (Naylor, 1966)		LISPATRICK MUDSTONE FORMATION
	Member 3	Basinal slope:turbidite deposition (Jones, 1974)			
	Member 2	Basinal slope (Jones, 1974)	Current-swept shelf, deeper and more restricted upwards (Naylor, 1966)		COURTMACSHERRY FORMATION
	Member 1	Outer neritic (Jones, 1974); Current swept shelf, (Coe & Selwood, 1968)			
ARDNAMANAGH FORMATION	Subtidal to neritic (Jones, 1974); Prograding delta (Gardiner, 1970); Tidal deltaic (Coe & Selwood, 1968)		Proximal to distal prodelta slope (Naylor, 1966; see also De Raaf, 1970)		KINSALE FORMATION
REENAGOUGH FORMATION	Deltaic shore face (Jones, in 1974); Nearshore and offshore bar (Gardiner, 1970); Tidal deltaic (Coe & Selwood, 1968)				
ARDATURRISH FORMATION	Delta platform-interdistributary bay etc. (Jones, 1974); Coastal plain-interdistributary bay (Gardiner, 1970)				
			Delta front platform (Naylor, 1966); Tidal environment (Kuypers, 1971-a)	BREAM ROCK MEMBER	
Uppermost OLD RED SANDSTONE	Alluvial plain		Fluviatile environment with low sinuosity streams (Kuypers, 1971-b)		Uppermost OLD RED SANDSTONE

STAGES	SOUTH MUNSTER BASIN			NORTH OF CORK-KENMARE LINE
	WEST SUB-BASIN	GLANDORE HIGH	EAST SUB-BASIN	
BRIGANTIAN (Lispatrick Formation)	Not exposed	Condensed black mudstones	Dark sooty mudstones with minor (? turbiditic) carbonates	Dark fossiliferous limestones (relatively thin)
ASBIAN HOLKERIAN ARUNDIAN CHADIAN	Not exposed  ----- Cherty mudst. + 1st. (Reenydonagan Mbr. 4)	Absent or extremely thin	Weakly calc. mudstones (Upper Courtmacsherry Fm.)	Carbonate shelf deposits and mudbanks  Shelf carbonates and oolites; Waulsortian mudbank facies and shelf limestones
COURCEYAN C Reenydonagan Mbrs. 2-3 Courtmacsherry Fm. (Middle)	Turbiditic 1sts. in siltst. - mudstones. Thin black pyritic mudstone	Absent or extremely thin	Sandstones; calc. and non-calc. mudstones (Kinsale); Reworked limestones; Ringabella Cherts (Minane)	Limestones overlain by shaly limestones and then by Waulsortian Mudbank Complex (first developed in the south)
COURCEYAN B Reenydonagan Mbr. 1 Courtmacsherry Fm. (lower)	Dolomitic sandy limestones and silty mudstones	Absent or extremely thin	Thin carbonates with calcareous and non-calcareous mudstones	Relatively thin limestone-shale sequences (extremely thin at southern shelf margin)
COURCEYAN A (Kinsale Fm.)	Thick tidally-influenced mudrocks and sandstones. Thin over Glandore High			Shallow-marine sandstones grading N. into non-marine red beds
DEVONIAN (Old Head Sandstone Fm. and equivalents)	Shallow tidally-influenced sandstones Thin over Glandore High.			Old Red Sandstone

Table IV  
Development of the South Munster Basin and northern Shelf in latest Devonian and Dinantian times.

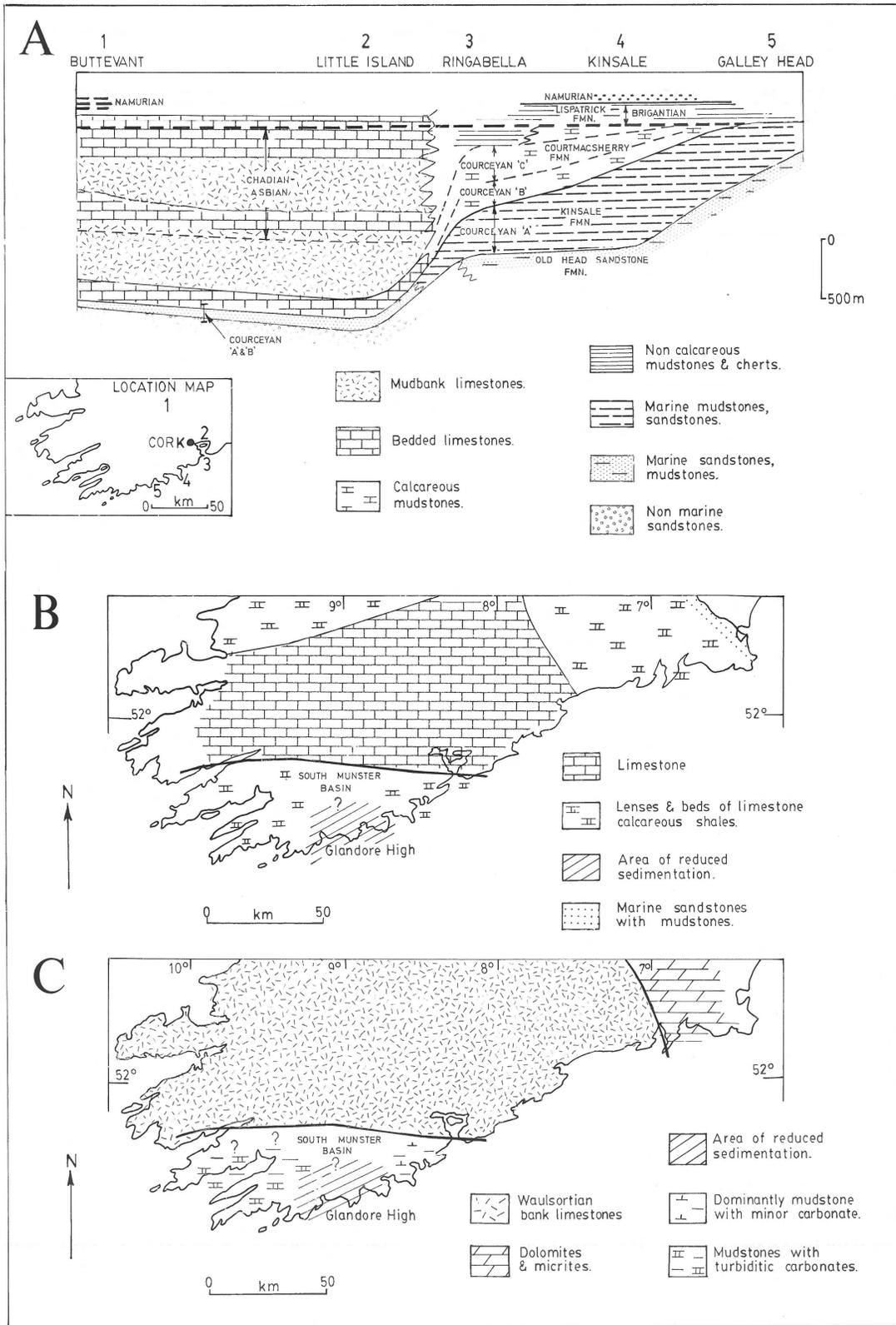


Fig. 7  
 A: Thickness and facies relationships in the Dinantian between Buttevant and Galley Head, using the Namurian as a datum.  
 B: Facies distribution towards the end of early Courceyan time.  
 C: Facies distribution in the late Courceyan.

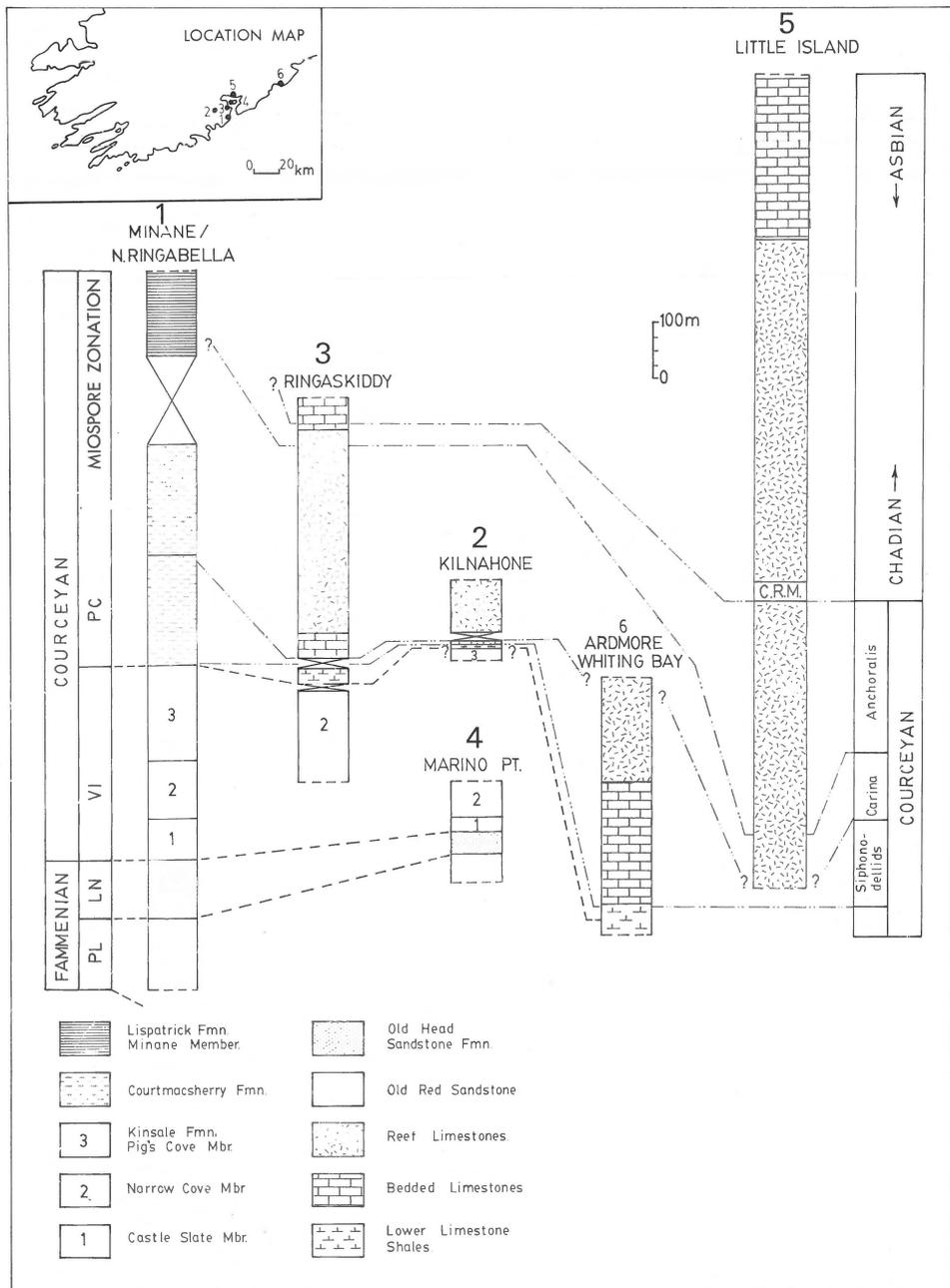


Fig. 8  
Uppermost Devonian and Courceyan lithostratigraphy and correlation in the Cork Harbour area.

oped in Bantry Bay and thinner carbonates at Dunmanus Bay (NAYLOR, 1975). There is evidence for only a few metres of Courceyan B on the Glandore High. The lower Courtmacsherry Formation (NAYLOR, 1966) at the Old Head of Kinsale begins with crinoidal carbonate lenses which pass quickly upwards into variably calcareous mudrocks.

In *Courceyan C* times the western basin became starved (black pyritic mudstones of Reenydonagan Member 2) and then received carbonate turbidite pulses (Member 3). This interval is probably absent on the Glandore High. East of the

high, sandy intercalations in the Courtmacsherry Formation (Old Head of Kinsale) and reworked conodonts in sandy limestones (Ringabella Limestone Member, mouth of Cork Harbour) suggest a period of disturbance in the eastern sub-basin. Dark bedded cherts at Minane only 5 km west of Ringabella, are also now thought on the basis of a recent goniatite discovery to be Courceyan C or slightly younger in age.

Courceyan C stratigraphy at the shelf edge may be relatively thin. On the shelf shaly limestones and shales at the Courceyan B-C boundary pass upwards into clean, well-wash-

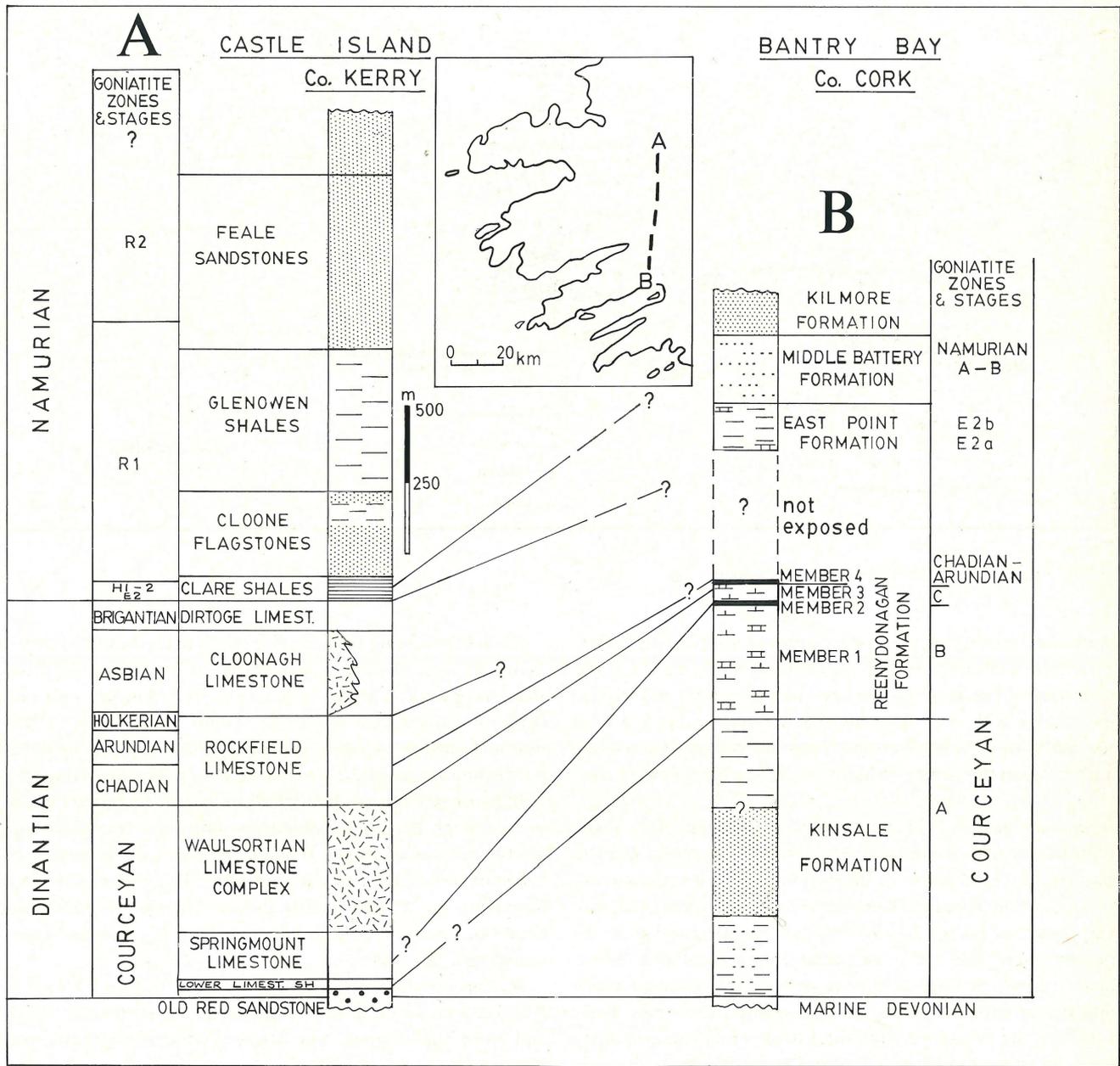


Fig. 9 Dinantian-Namurian stratigraphic correlations between Castleisland, Co. Kerry and Bantry Bay, Co. Cork.

ed limestones. These become shaly and cherty upwards and are in turn overlain by the Waulsortian mudbank complex. The Waulsortian banks developed first in the Cork area and then spread northwards, reaching their maximum development in late Courceyan C.

*Chadian to Asbian stages* – The Waulsortian mudbank facies of the northern shelf died out gradually and irregularly from the end of Courceyan time rarely extending up into the Arundian. The mudbanks were overlain by Chadian-Arundian varied non-argillaceous shelf limestones. There was

considerable volcanic activity (STROGEN, 1973) mainly in County Limerick and north County Cork with alkaline basalt flows and tuffs in the Chadian and Arundian and more basic types in the Asbian. During the Asbian also there was renewed extensive development of a mudbank complex (Fig. 7A). In the Cork Harbour area the shelf edge again lay south of Little Island (Fig. 8). The basin to the south was effectively starved of sediment during this period.

The Glandore High was very positive at this time and effectively divided the basin into two parts. To the east of the high the Chadian-Asbian interval is represented by a thin but

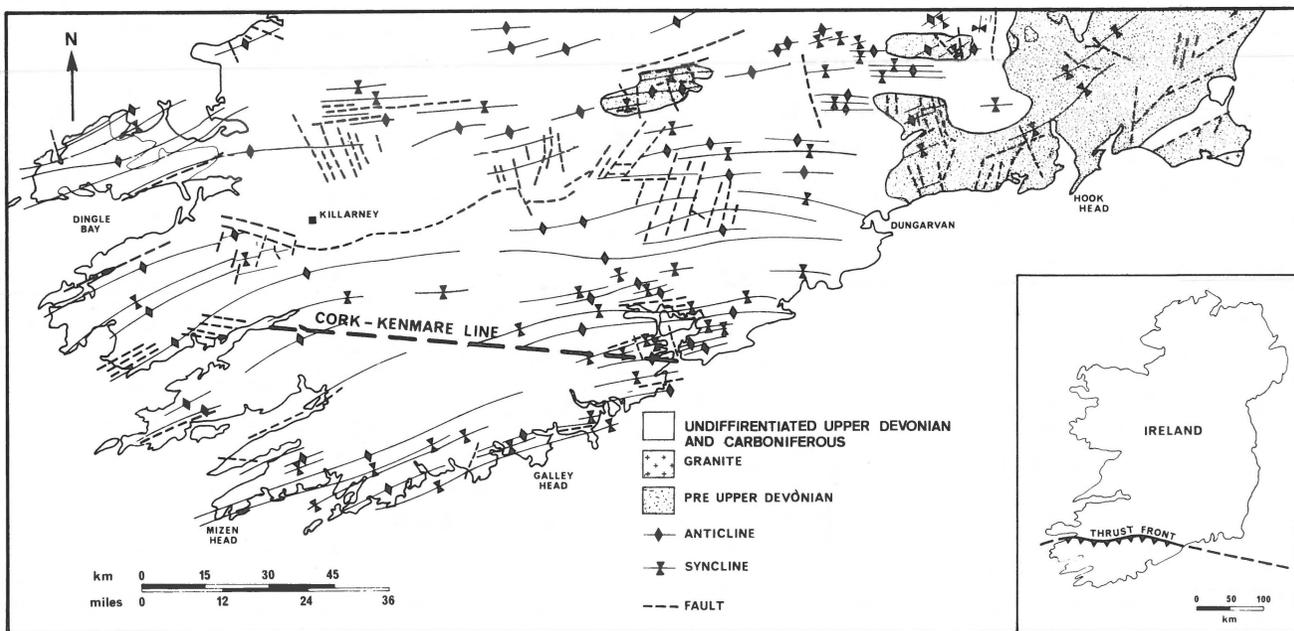


Fig. 10  
Major structural features of southernmost Ireland.

undefined portion of the upper Courtmacsherry Formation. To the west (Bantry Bay) the uppermost 5 m exposed at the waterline at the head of the bay comprises dark mudstones and cherts with one limestone containing Arundian (V2a) foraminifera (Fig. 9). Younger beds are covered by the sea and strata on the nearby Whiddy Island are Namurian in age.

*Brigantian stage* – Brigantian rocks on the shelf (dark fossiliferous limestones normally less than 100 m thick) are the same order of thickness, or thinner, than the basin sequences.

At the Old Head of Kinsale recent work (Naylor & Sevastopulo, in prep.) has shown that the Brigantian is represented by only 130 m of beds (cf. NAYLOR, 1966). These beds (Lispatrick Formation) are pyritic and goniatic black mudstones with occasional parallel-bedded carbonate horizons. On the Glandore High the Lispatrick Formation equivalents rest on the Kinsale Formation and the goniatic evidence suggest attenuated sequences.

#### *Late Carboniferous (Silesian)*

*Namurian* – The major outcrop belt of Late Carboniferous rocks shown on figure 1 extending northwards towards the Shannon are predominantly Namurian in age. The succession may be divided into three parts (BRENNAND, 1966). A basal unit (Clare Shales, Fig. 9) of black goniatic shale (Fig. 12E) is overlain by turbiditic greywackes (Cloone Flags) 150–600 m thick and these in turn by approximately 1000 m of a deltaic cyclothem sequence comprising several formations. The Namurian sandstones are derived from a generally westerly provenance.

Evidence relating to Namurian rocks in the South Munster Basin is derived from a few scattered localities. Only the stratigraphy on Whiddy Island (Fig. 2) is known with any certainty (NAYLOR ET AL., 1978). There some 500 m of Namurian beds are exposed, the lower 150 m comprising black pyritic mudstones (E2a-b goniatic zone). The overlying turbidite succession is probably E2b in age at the base (Fig. 9), but although palynological studies indicate a Namurian age for the remainder of the Whiddy sequence, no greater precision of zonation is currently possible. The upper (Kilmore) formation on Whiddy Island shows evidence of shallowing conditions and clearly the whole section is expanded compared with the north.

Namurian rocks are also known from the Old Head of Kinsale and Seven Heads (NAYLOR & SEVASTOPULO, 1979) and from Ballinhassig, but details of the stratigraphy and sedimentology are not known.

*Westphalian* – A small area of highly faulted Coal Measures occurs in the Kanturk Coalfield near Mallow (Fig. 2). The sequence is probably restricted to Westphalian A, but details of the stratigraphy and sedimentology are not known.

## STRUCTURAL GEOLOGY

Within the Variscan Fold Belt of southern Ireland the outcrop pattern of the major rock units is controlled by a number of large-scale folds with many second- and third-order folds on their flanks. This is clearly seen on the geology map (Fig. 1) and the major fold axes are shown on figure 10.

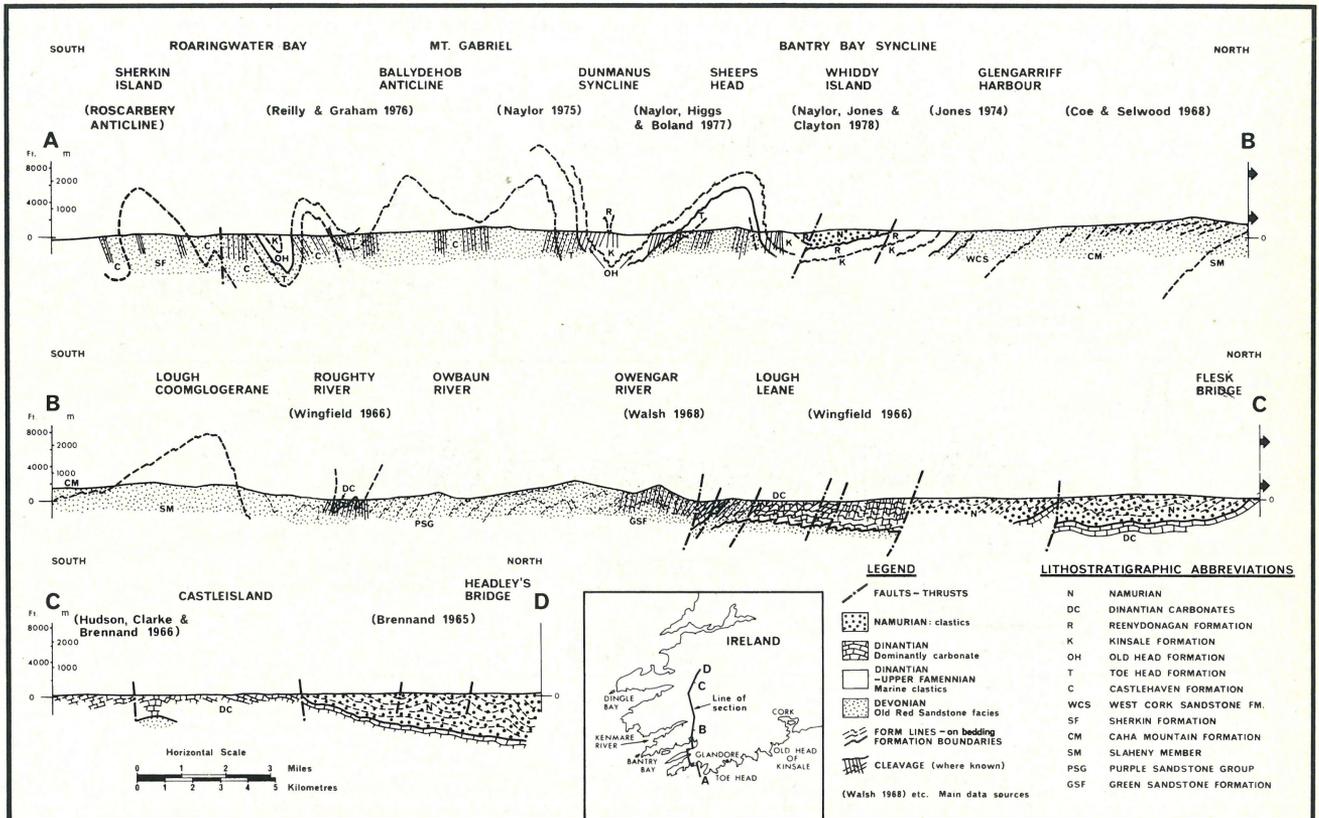


Fig. 11 Structural section between Sherkin Island, Co. Cork and Castleisland, Co. Kerry (after Naylor, 1978, reproduced by kind permission of the Royal Dublin Society).

Detailed information regarding the structural aspects of the geology is rather sparse and scattered, much of the recent research work having gone into an elucidation of the stratigraphy of the region. There has been little advance in our overall understanding of the Variscan fold belt since the Geological Survey mapping in the nineteenth century, reviewed by COLE (1922). A brief attempt will be made here to review the major features of folding and faulting, before considering basement influences and the nature of the Variscan 'Front'.

### Folding

GILL (1962) presented a regional synthesis in which he divided Ireland into three major structural zones, two of which occur in the region under consideration. Gill considered that the Dungarvan-Dingle line could be taken as the boundary between the southern two zones. South of this line are anticlinoria and synclinoria with wavelengths of tens of kilometres whose axes trend east northeast in the west but swing to east-west in the east. Carboniferous rocks usually occupy the lower ground in the synclinal axes. A variety of minor folds are superimposed on the major structures. A penetrative cleavage is present throughout the zone in the mudrocks,

with a coarser fracture cleavage in the sandstones.

North of the Dungarvan-Dingle line there is a gradation into a zone of relatively gentle folding. Cleavage is still present in the pelitic units but fades northwards. Further north the folding is even gentler, along east northeast and north-east-trending axes (Fig. 10).

The nature of the folding is best demonstrated by considering figures 11 and 12. Figure 11 is a section from the south coast to north of the Dingle-Dungarvan line. The frequency of folding is very variable. Tectonic style is clearly affected by passage upward from sand-dominant Old Red Sandstone-Old Head Sandstone Formation (Devonian) up to Lispatrick Formation (Brigantian) mudrocks. The frequent, often upright, folds of the sand-dominant lower sequence are often succeeded by homoclinal zones of steep dips in the more varied Kinsale Formation (Courceyan) lithologies. Mud-dominant rocks in the cores of major synclines, or in structurally complex zones, have often suffered tight folding (see for example figure 12B).

The cross section in figure 11 shows fanning of the major fold axes in the Mount Gabriel area which may be controlled by major stratigraphical variations or by deep structure (NAYLOR, 1968). Further north there is probably a major reverse fault along Bantry Bay, with Namurian strata preserved

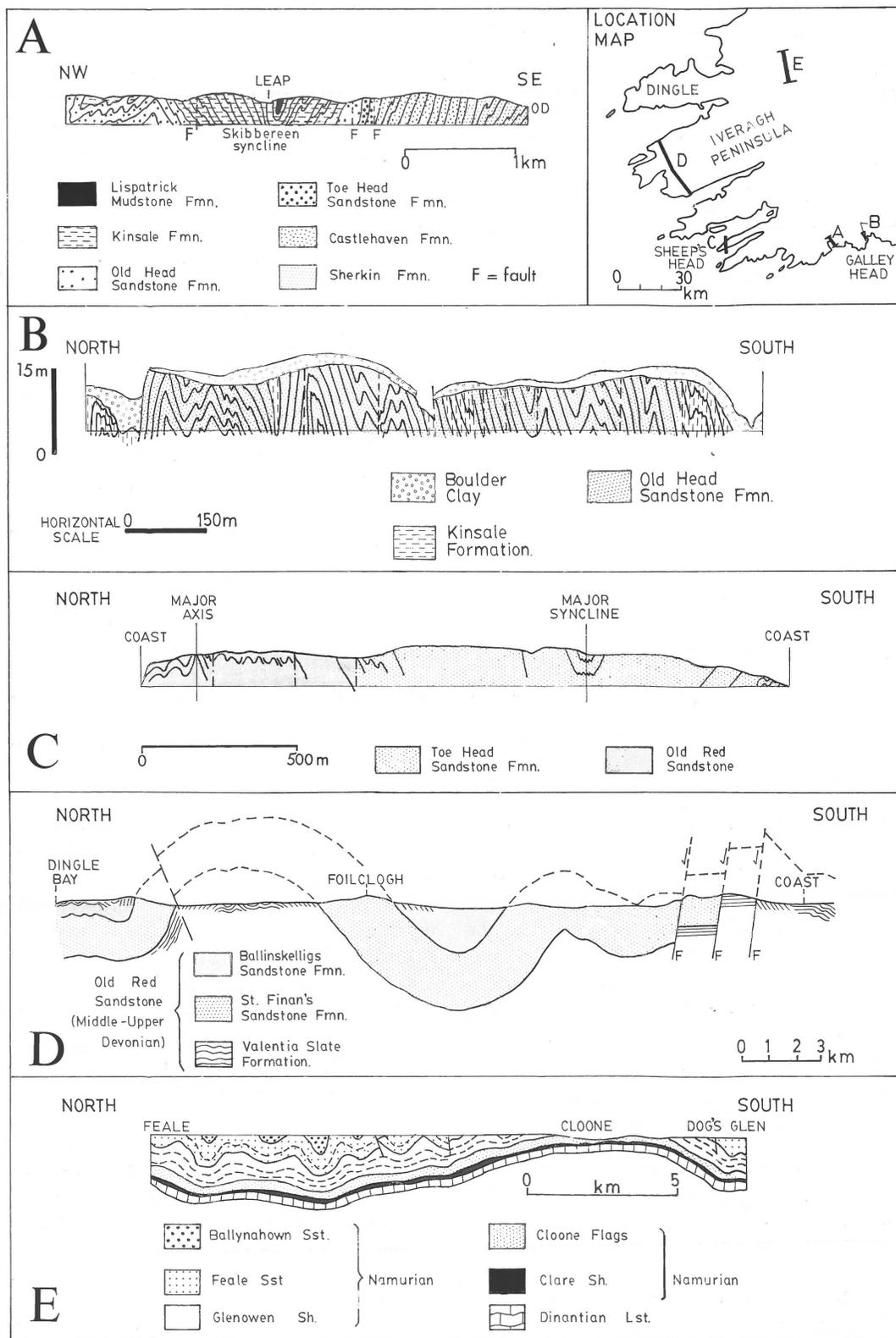


Fig. 12 Comparison of structural styles in southern Ireland (F = fault).  
 A: Leap, County Cork (after Reilly & Graham, 1972); B: Galley Head, Co. Cork (Reilly & Graham, 1976); C: Sheeps Head, County Cork, Rothery (Geological Survey mapping in progress); D: Iveragh Peninsula (after Capewell, 1975); E: Castleisland, County Kerry (Brennand, 1965).

in a structural low to the north. The section crosses a zone of major faulting at Lough Leane, approximately on the Dingle-Dungarvan line. The southernmost (high angle) fault of the group throws Dinantian carbonates against Old Red Sandstone horizons several kilometres deeper in the stratigraphy. Although there is some thrusting in this zone it is unlikely that there has been any major overriding from south to north. There is further discussion of this point below.

At the northern end of figure 11 the section crosses the Castleisland anticline, an eastern extension of the Slieve Mish fold which emerges from the Dingle Peninsula. The Slieve Mish fold is continued eastwards as a simple anticline in the Dinantian carbonates. Folding in the Namurian cover sequence increases in amplitude upwards (BRENNAND, 1965) due to décollement on the thin basal Namurian unit of Clare Shales (Fig. 12E).

There is normally only one cleavage developed in the region and this is axial planar to the folds. However, COE & SELWOOD (1963) and GILL (1962) have presented evidence mainly from the Beara and Mizen peninsulas suggesting two deformation pulses. More detailed work is required to confirm this view, but the balance of evidence suggests that only one phase of folding and cleavage development can be discerned.

### Faulting

Faulting is ubiquitous throughout the region and exerts a

more important influence than would be evident from small-scale maps. Cross faulting is often seen due to the effects on the outcrop pattern, but recent work (e.g. REILLY & GRAHAM, 1972; NAYLOR ET AL., 1969) suggests the presence of important strike faults. The pattern and age relationship of faulting in several scattered areas throughout the region are shown in table V (and the orientation of some south coast faults in figure 13). The dominant pattern is of late syn-tectonic faults comprising important strike faults accompanied by two sets of cross faults. Common late strain-slip features normally take the form of steeply dipping dextral knick zones transverse to regional strike (Fig. 13).

### Basement controls on structure and sedimentation

Evidence has recently been emerging of basement control on sedimentation and structure in southernmost Ireland. The extent and frequency of this control will only be known after considerably more study. Evidence has been presented to show that a long-lasting positive element existed in the South Munster Basin during late Famennian and Dinantian times – namely the Glandore High (NAYLOR ET AL., 1974). Data presented on figure 13 regarding the plunge of smaller folds along the coast of County Cork show a variation which may be attributable to control by the Glandore High. The majority of folds east of the high plunge to the east, noticeably increasing from Cork Harbour towards Clonakilty. West of the high in Dunmanus Bay the fold plunges are dominantly

Table V  
Summary of fault episodes in the Irish Variscides, after different authors.

Fault Type	Old Head of Kinsale, West Cork Harbour	Southwest, Co. Cork	Capewell, 1957, 1975 Iveragh	Philcox, 1964 Morton, 1965 North Co. Cork
Strike Faults	Rare, important	Important, common. Steep dip. Horizontal and vertical movement	Major normal dip slip, down to N.	High-angle reverse
Cross fault (i)	N.E. – S.W. Sinistral and vertical. Post-cleavage	N.E. – S.W. Sinistral and vertical. Post-cleavage	N.E. – S.W. minor faults. Late syn-folding	N.N.W. – S.S.E. Wrench and compartment
Cross fault (ii)	Rare N.W. – S.E. ? Dextral. Post-cleavage	N.W. – S.E. N-S N.N.E. – S.S.W. All near vertical Post-cleavage	N-S minor wrench faults. Late syn-folding	N.N.E – S.S.W. Wrench and compartment
Other	Normal to fold axes. Minor, normal dip slip. Post-cleavage	Rare major E-W. Dextral. Post-cleavage	Sinuuous E.S.E. – W.N.W. dextral wrench faults. Later than N-S set. Post-cleavage	
Comment	Faulting broadly contemporaneous and late syntectonic	Broadly contemporaneous with late syntectonic faulting	The E-W wrench and cross faults together with minor strike faults coeval with folding. Major rotational strike faults are later	Strike and cross faults contemporaneous with folding leading to compartment folding

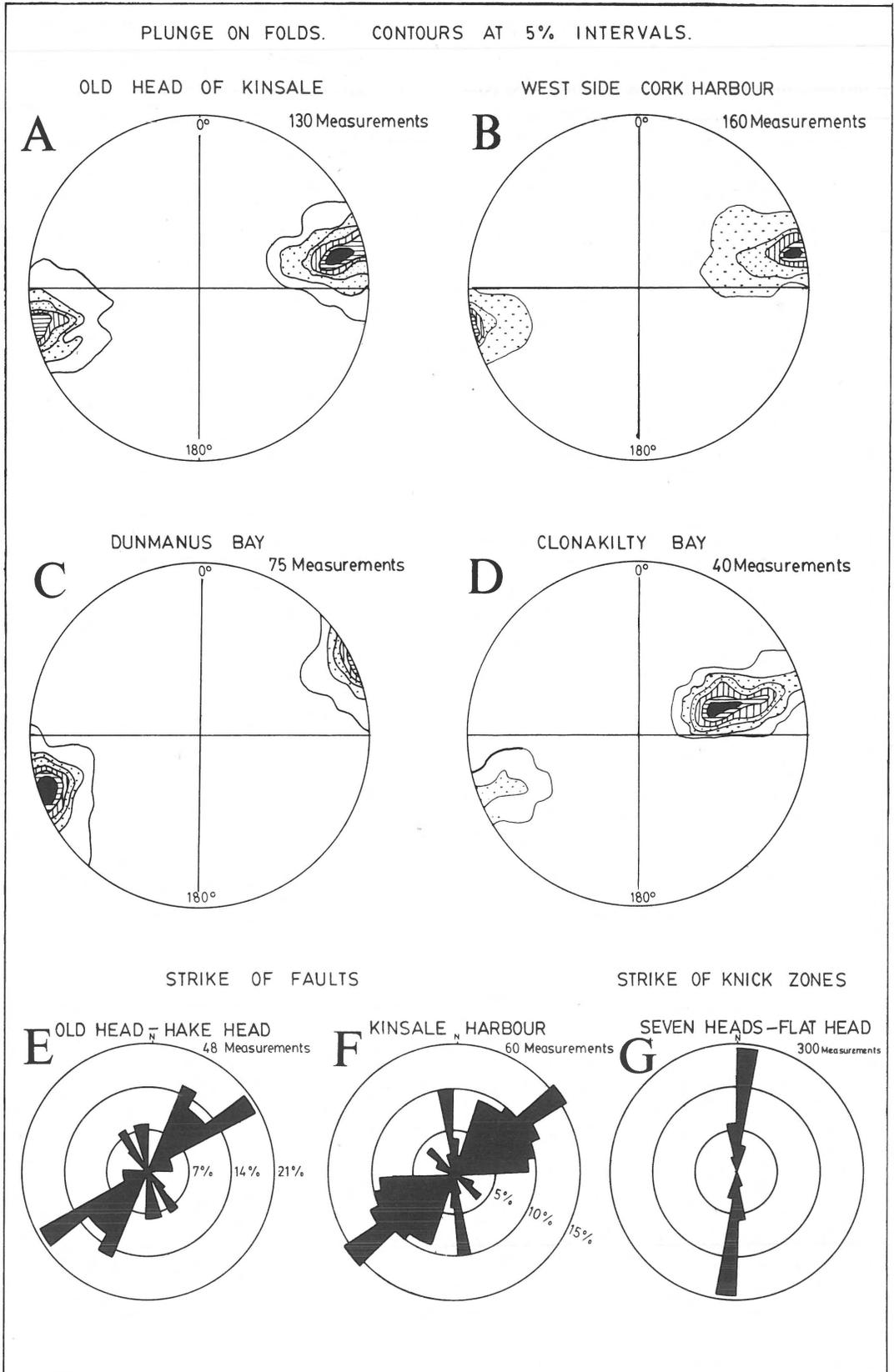


Fig. 13  
Structural data for localities along the south and west coasts of County Cork.

to the west.

It is possible that the persistent facies lines shown by JONES (1974) along the length of Bantry Bay, and the thinning of Upper Famennian-Courceyan stratigraphic units north and south onto Sheeps Head reported by NAYLOR ET AL., (1977), also reflect deeper control. With further study, many more such features will be found.

Contemporaneous fault movement has been suggested along the northern margin of the Devonian (Old Red Sandstone) Munster Basin (e.g. Fig. 3). These margin faults are not clearly demonstrable, however, due to northward overstep from the basin in the later stages of its history. Within the basin the major normal faults of the Iveragh Peninsula (CAPEWELL, 1975) may be related to similar basement forces.

At the eastern end of the Devonian basin the broadly east-west Comeragh Mountains contain thick Old Red Sandstone sequences (CAPEWELL, 1957; PENNEY, 1978), with a structurally divergent core of Early Palaeozoic rocks. The Old Red Sandstone was clearly deposited in a narrow fault-bounded east-west trough which was later inverted during the Variscan orogeny. The Lower Palaeozoic core moved upwards during this episode, possibly along the same controlling boundary faults.

The normal concept of a clearly divergent structural 'grain' between the northeast-southwest Caledonian trend and east-west Variscan trend is not substantiated in Ireland. Although some inliers such as the Comeragh Mountains, previously mentioned, and Slievenamon Mountains (Fig. 2) show a clear divergence of strike between Lower Palaeozoic core and Upper Palaeozoic cover, this is less clearly demonstrated elsewhere (Fig. 10). In the southeast, the southwest trends of folds in the major Lower Palaeozoic outcrop swings to more nearly west southwest in Waterford. The Dingle Peninsula also shows near parallelism of strike between core and cover rocks. If there is structural parallelism between basement and cover beneath the Munster Basin then the structural controls on sedimentation will be difficult to elucidate since no cross-cutting Caledonian trend can be anticipated.

During the Dinantian the Cork-Kenmare line assumes great importance with persistent thickness and facies changes across the zone. The Cork-Kenmare line appears to cut across the dominant structural strike and is controlled by no obvious single structure. It is possible that a number of structural elements combine to produce this apparently simple line. Control on the precise position of the line is lacking and it may not have had the straight trend often depicted on small-scale maps.

#### *Variscan front*

The concept of a northern thrust front to the Variscan fold belt has been supported by many workers (e.g. COLE, 1922; GILL, 1962; PHILCOX, 1964). Where the 'front' is coincident with the northern margin of the Devonian Munster Basin it is also a line of major faulting. Much of the effect may be due to

adjustment of the sediment prism to rapidly shallowing faulted basement. NAYLOR (1978) has argued that the major faults of the Lough Leane area (Fig. 11) may result from shallow basement. However, it should be pointed out that the sense of movement is the reverse of the down-to-basin faulting which may have operated. From Lough Leane eastwards to Mallow (Fig. 2) a number of faults and thrusts separate Devonian from Carboniferous rocks (see also GILL, 1962). However, eastwards from Mallow to Dungarvan there is little evidence that the Old Red Sandstone/Carboniferous boundary is a line of significant structural dislocation. Also, as pointed out by NAYLOR & SEVASTOPULO (1979) along much of its length the Dingle Dungarvan line did not influence the thickness and facies of Late Palaeozoic sedimentation.

In summary it can be said that no clear structural line corresponding to a Variscan 'front' can be discerned in Ireland. Along part of its length the proposed line coincides with faults and thrusts, but elsewhere no dislocation is seen. Some writers, whilst adhering to the concept of a structural dislocation, have suggested that it has a composite nature (PHILCOX, 1964; GARDINER, 1978). However, we would prefer to view the supposed 'front' as being broadly coincident with a zone of northward diminution of tectonic intensity. This northward decrease in deformation is complex and varied, being controlled by many factors and in particular by basement configuration and structure. As might be expected, the proposed 'front' is most evident in those areas where there is rapid thinning of the sediment prism accompanied by fundamental faulting. Elsewhere there is a wide zone of northward diminution in folding and cleavage and in consequence the 'front' is more difficult to define. Also, in view of the evidence presented above it is probably an oversimplification to regard the Dingle-Dungarvan line as a simple passage from a zone of Variscan control to a zone where Caledonian basement structure is dominant. Clearly much more information is required before geologists will be in a position to understand the enigmatic nature of the supposed Variscan 'Front'.

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