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STRATIGRAPHY OF A MID-CARBONIFEROUS SECTION AT INISHCORKER, IRELAND[1]

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(6 figures)

ABSTRACT. A section spanning the mid-Carboniferous is superbly exposed in the low coastal cliffs of the island of Inishcorker, County Clare. A total thickness of 65 m has been logged to assess the biostratigraphy of the E2c2 *(Nuculoceras nuculum)* to H2a1 *(Hudsonoceras proteum)* interval. The mid-Namurian stratigraphy of Ireland is similar to that documented from northern England, however it appears that in Ireland there are two *Homoceras beyrichianum* horizons, the upper of which, also contains *Isohomoceras* sp. nov. Marine band development at Inishcorker does not display the classic faunal salinity cycles, and prolonged conditions of full salinity may have occurred with anoxic bottom-water conditions strongly controlling the faunal development within the Western Ireland Namurian Basin.

KEY-WORDS: Mid-Carboniferous, Clare shales, biostratigraphy, marine band, salinity, County Clare.

RESUME.- Stratigraphie d'une section mi-Carbonifère à Inishcorker, Irlande. Une coupe au travers du Carbonifère moyen est superbement exposée dans les basses falaises côtières de l'île d'Inishcorker, Comté de Clare. Une épaisseur totale de 65 m a été levée pour assoire la biostratigraphie de l'interval E2c2 *(Nuculoceras nuculum)* à H2a1 *(Hudsonoceras proteum)*. La stratigraphie du Namurien moyen de l'Irlande est semblable à celle qui est connue dans l'Angleterre du Nord. Cependant il apparaît qu'en Irlande, il y a deux horizons à *Homoceras beyrichianum,* le plus haut contenant aussi *Isohomoceras* sp. nov. Le développement de niveaux marins à Inishcorker ne montre pas les cycles de salinité des faunes classiques, et des conditions prolongées de forte salinité peuvent être apparues avec des conditions d'eau de fond, anoxique contrôlant fortement le développement faunique à l'intérieur du Bassin namurien de l'Irlande occidentale.

MOTS-CLES: Carbonifère moyen, Schistes de Clare, biostratigraphie, niveau marin, salinité, Comté de Clare.

1. INTRODUCTION

The island of Inishcorker, County Clare, is a small island, near to the mainland village of Kildysart, (Fig. 1). It lies in the southern reaches of the River Fergus, close to the confluence with the River Shannon, and is accessible via a small causeway at low tide.

A section in the Clare Shales spanning the mid-Carboniferous is superbly exposed in the low coastal cliffs on the south of the island. The succession comprises dark grey to black shales and calcareous and septarian nodules, with the tectonic dip of the bedding approximately twenty degrees to the north-west. A total thickness of 65 m was logged to assess

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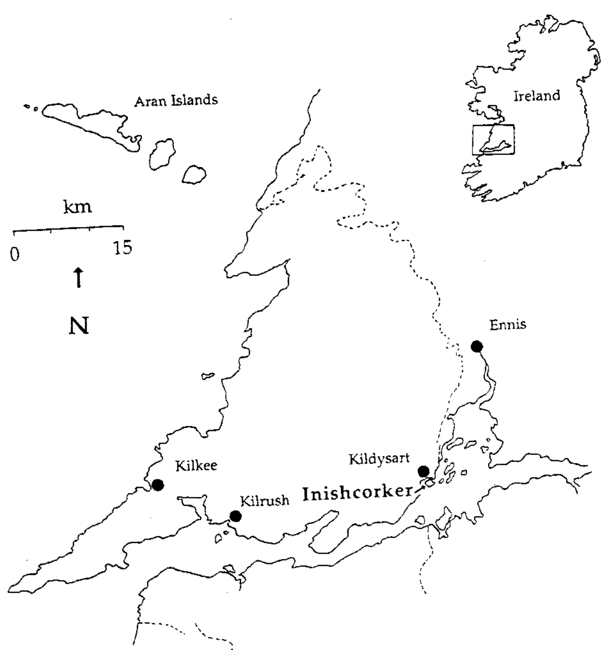

Fig. 1.- Location map of Inishcorker, County Clare, Ireland.

the biostratigraphy throughout the interval E2c2 (*Nuculoceras nuculum*) to H2a1 (*Hudsonoceras proteum*).

This paper aims to :

1) Re-evaluate the Carboniferous biostratigraphy as defined by Hodson (1954a) and Hodson and Lewarne (1961).

2) Compare the Inishcorker ammonoid stratigraphy with that of adjacent areas and the northern England biostratigraphy as defined by Riley *et al.* (1987).

2. TECTONICS AND BASIN DEVELOPMENT

The Western Ireland Namurian Basin (WINB) - alternatively called the Shannon Trough (Sevastopulo, 1981; Strogen, 1988), Foynes Basin (Haszeldine, 1988) and the Western Irish Namurian Basin (Martinsen, 1989; Collinson *et al.*, 1991) - was an asymmetrical basin with its axis running ENE-WNW roughly along the present-day River Shannon. It has a deep central trough 10-20 km wide with gently shelving slopes (Martinsen, 1989). It has been suggested that the WINB was a half-graben at depth (Strogen, 1988) possibly related to the trace of the Iapetus suture (Leeder, 1982; Martinsen, 1989; Collinson *et al.,* 1991) with the Pre-Cambrian basement of Galway extending southwards to provide a stable platform on which the shelf areas were developed, at least in County Clare (Hodson, 1954a).

During the Carboniferous continental collision was occurring between Gondwanaland and Laurasia (Leeder, 1988a; Leeder and McMahon, 1988). Back-arc stretching of the lithosphere resulted in N-S extension and E-W trending faults with reactivation of older inherited Caledonian structures (Soper *et al.*, 1987, Gawthorpe *et al.*, 1989). Suggestions that the subsidence in the WINB is centred on reactivation of the Silvermines-Navan lineament that lies above the Iapetus suture zone (or a zone of fractures) have been proposed by numerous workers (Deeny, 1982; Leeder, 1982; Sanderson, 1984; Haszeldine, 1988; Strogen, 1988; Martinsen, 1989; Collinson *et al.*, 1991). Haszeldine (1984) alternatively suggested that the most dominant extensional stress-field during the Carboniferous was aligned perpendicularly to that proposed by the advocates of the back-arc extension model, ie E-W to NW-SE and that this is related to the opening of the proto-Atlantic during the late Carboniferous (although this rifting may have been initiated during the late Silurian according to Haszeldine, 1988).

Subsidence of the WINB was initiated during the late Courceyan with subsidence becoming more rapid during the Visean, with the extrusion of locally abundant alkaline basalt lavas and volcaniclastics in the Limerick area (Deeny, 1982; Strogen, 1988; Shelford, 1967). During the early Namurian, inversion occured with subsidence recommencing during the middle Namurian (Strogen, 1988), although no evidence for this appears in the WINB.

Whether the dominant structural control is one of purely Carboniferous extension or transtension is in debate.

a) Carboniferous Extension

Leeder (1982) suggested that the trend and structure of the WINB is controlled by the inheritance of the trace of the Caledonian Iapetus closure line, with subsidence controlled by Hercynian processes. Thus the alkaline-basalt volcanics are related to mantle partial melting during active extension in the Visean (Leeder and McMahon, 1988), followed by basin sag during the Namurian. Marginal uplift would provide the westerly source of sediment (Leeder, 1988a). Deeny (1982) argued similarly, that the alkaline-basalt volcanics are related to an attempted Devono-Carboniferous separation of two crustal plates along the Iapetus suture line with the Shannon area gravity anomaly of >20 mgals possibly representing evidence for a "frozen ocean spreading centre embryo" (sic) which terminated activity for some unknown reason.

Haszeldine (1984) dismissed the Leeder/Deeny models as not being able to account for the new N-S (ie non-inherited) orientations of the Carboniferous nor the faster subsidence rates in the Namurian than the Dinantian. Strogen (1988) rejected the extensional model by suggesting that the stretching (beta) values calculated for the Limerick area would not be enough for the threshold value for the outbreak of volcanism solely by extension alone.

b) Carboniferous transtension

Strogen (1988) implied that the behaviour of the WINB is much more suggestive of a strike-slip controlled basin. His evidence for this is that the basin is strongly asymmetric (with control not by the Iapetus suture itself, but a broad fracture zone) and also the sporadic nature of the volcanics.

Haszeldine (1984, 1988) suggested that the stresses imposed by the opening of the proto-Atlantic were prevalent, initially beginning in the late Silurian. Alkaline volcanics in the WINB would be related to areas of tension and thinned crust, with the westerly sourcing of sediment seen in the late Namurian of the WINB related to uplift caused by crustal fracturing. Recent work by Tate (1993) on the offshore Porcupine Seabight Basin proves north-south extensional structures that therefore would appear to validate Haszeldines proto-Atlantic opening. It is interesting to note that Tate also recognises a mid-Namurian unconformity and suggests that this could represent erosion and non-deposition during east-west to north-south basin realignment.

Leeder (1988a) refuted the transtension model as he stated that no proto-Atlantic rifting started until the lower Permian, and also that the transcurrent structural lineation may be related to transtension/ transcurrent tectonic episodes along the NE continuation of the Maritime Canadian Crustal Shear zone.

Coller (1984) suggested that movement on ENE-WSW trending Silvermines-Navan faults is due to a large normal (extensional) as well as dextral horizontal (transcurrent) movement component considered to be a result of transcurrent shearing in an overall extensional regime. This model appears to explain best the features observed in the WINB being able to explain the "embryonic" rifting of the WINB with development of volcanics but with also strike-slip movement on faults, ultimately to produce a transtensional basin. The two stress-fields affecting the area (Boyce *et al.*, 1983; Martinsen, 1989) being those due to the proto-Atlantic rifting of Haszeldine (1984, 1988) and the stress caused by the subduction of Gondwana beneath Laurasia (Leeder 1982, 1988a).

3. GENERAL STRATIGRAPHY OF THE WINB

Rider (1974) divided up the stratigraphy of the WINB into the Shannon Group (consisting of the Clare Shales, Ross Sandstone Formation and Gull Island Formation) followed by the Central Clare Group consisting of the cyclothemic deposits of the Tullig, Kilkee and Doonlicky cyclothems (Fig. 2) The total thickness of Namurian sediment in the WINB is 1600 m (Pulham, 1989). Incipient metamorphism of the sediments has been noted by Brindley and Gill (1958) by the conversion of thin coal seams to anthracite and the secondary silicification of sandstones and siltsones.

The earliest Namurian deposits in the WINB are those of the marine-band bearing Clare Shales, extensively studied by Hodson (1954a, 1954b) and Hodson and Lewarne (1961). The Clare Shales are dark-grey to black, often with calcareous nodules and beds, and also septarian nodules. Marine bands are commonly associated with the nodular horizons, from which some well-preserved goniatites can be retrieved.

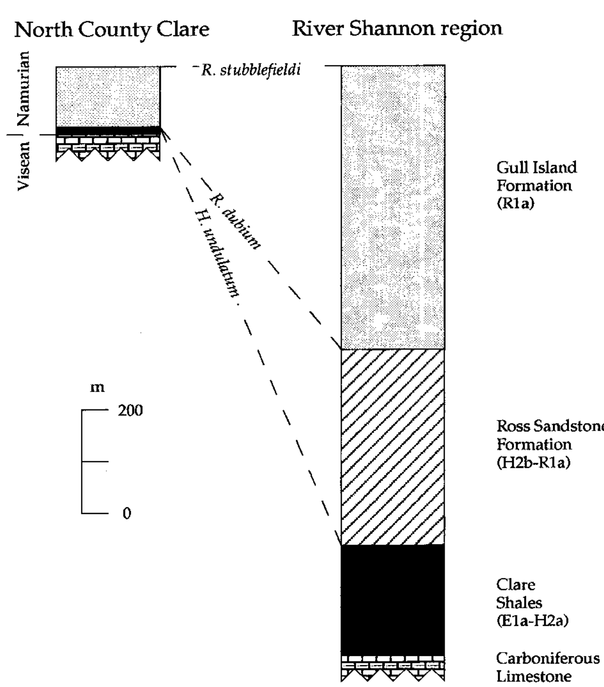

Fig. 2.- Summary stratigraphy of the lower Namurian of the Western Ireland Namurian Basin

Stage	Ammonoid Horizon	Amm. Hor. Index
Kinderscoutian	Reticuloceras dubium	R_{1a}^{5}
	Reticuloceras todmordenense	R_{1a}^{4}
	Reticuloceras subreticulatum	R_{1a}^{3}
	Reticuloceras circumplicatile	R_{1a}^{2}
	Hodsonites magistrorus	R_{1a}^{1}
Alportian	Homoceratoides pereticulatus	H_{2c}^{2}
	Vallites eostriolatus	H_{2c}^{1}
	Homoceras undulatum	H_{2b}^{1}
	Hudsonoceras proteum	H_{2a}^{1}
Chokierian	Isohomoceras sp. nov.	H_{1b}^{2}
	Homoceras beyrichianum	H_{1b}^{1}
	Isohomoceras subglobosum	H_{1a}^{3}
	Isohomoceras subglobosum	H_{1a}^{2}
	Isohomoceras subglobosum	H_{1a}^{1}
Arnsbergian	Nuculoceras nuculum	E_{2c}^{4}
	Nuculoceras nuculum	E_{2c}^{3}
	Nuculoceras nuculum	E_{2c}^{2}
	Nuculoceras stellarum	E_{2c}^{1}
	Cravenoceratoides nititoides	E_{2b}^{3}
	Fayettevillea holmesi	E_{2b}^{2}
	Cravenoceratoides edalensis	E_{2b}^{1}

Fig. 3.- Ammonoid biozones and horizons across the mid-Carboniferous in Britain. From Riley *et al.*, 1987.

Differential subsidence resulted in the deep central trough receiving at least 215 m of Clare Shales (Hodson and Lewarne, 1961) with probable continual deposition from Dinantian times, whilst the gently dipping shelves to the north and south show much more condensed and incomplete sections resting unconformably on the limestone below. The succession north of the River Shannon in County Clare shows northerly onlap of shales (Hodson and Lewarne, 1961), such that at the northern margin only 12m of the Clare Shales is present. Near Lisdoonvarna, at St. Brendans' Well, a section in the River Gowlaun exposes a thin (8-12 cm) phosphate lag which may represent a time span from Pendleian to late Chokierian times. The phosphate rests on a slightly undulose surface of P2 limestones (Clarke, (1966) in Rider, (1974)) and consists of subangular phosphate clasts together with pyrite and fish debris. O'Connor and Pyne (1986) have analysed the composition as follows- collophane (60%) set in a matrix of calcite (20%), silica (13%), pyrite (2.5%) and carbonaceous matter (1.5%). Conodonts have been extracted from both the underlying limestone and the Clare Shale above by Meere (1988), who retrieved *Lochriea mononodosa* from the P2 limestones and *Neognathodus bassleri* from the shale, these conodonts range from mid-Brigantian to lower Arnsbergian and lower Chokierian to lower Marsdenian respectively (W.J. Varker, pers comm., 1993). Thus, a hiatus spanning at least the upper Arnsbergian is evident at St. Brendans' Well. The lowest goniatite marine band at this locality yields *Homoceras beyrichianum* (H1b1).

Phosphate development and the slight undulosity of the underlying limestone surface may be explained by the model applied to the Appalachian foreland basin phosphates and black shales by Baird and Brett (1991). The slopes of the WINB, possibly sediment starved by sediment by-passing down the deeper axis of the basin, would be eroded by the internal waves concentrated along the pycnocline. Chemical erosion in the lower dysoxic to near anoxic setting would result in concentration of a chemically stable lag deposit of pyrite and phosphatic debris.

The differential subsidence of the basin also resulted in the "funnelling" of the turbiditic Ross Sandstones down the centre of the WINB, depositing 380 m (Collinson *et al.*, 1991) of silts and fine grained sands above the Clare Shales in the centre of the basin. These 380 m of axial sediments are equivalent to the top parts of the thin (12m) Clare shale succession on the flanks of the basin. The Ross Sandstone Formation lies between the *Homoceras undulatum* (H2b1) and "*Hudsonoceras*" *ornatum* or *Reticuloceras dubium* (R1a5) marine bands (Collinson *et al.*. 1991, Sevastopulo, 1981), with the formation occurring earlier in the west than in the east (Sevastopulo, 1981).

The Ross Sandstone Formation displays many turbidite sedimentary structures such as flute and sole marks and rippled tops to sandstone beds. It also shows soft sediment deformation in the form of slides and slumps and spectacular water-escape structures such as those exposed at the Bridge of

Ross, where 2 m wide sand volcanoes are exposed (Gill and Keunen, 1958). The palaeocurrent in the Ross Sandstones appears to have been dominantly from the south-west (ie. parallel to the basin axis), although other directions are seen at the base (from the south-east) and in the upper parts (from the north-west) (Collinson *et al.,* 1991).

The Gull Island Formation overlies the Clare Shale in the north and the Ross Sandstone Formation in the axial regions, and lies between the *Reticuloceras dubium* and *Reticuloceras stubblefieldi* marine bands (Rider, 1974). It thins from its greatest development of 550 m thick near the basin centre to probably 130 m in the north (Collinson *et al.,* 1991). The Gull Island Formation consists of turbiditic sandstones mainly at the base, overlain by siltstones and fine-grained sandstones. The intense soft-sediment deformation in this formation (slumps, slides and water escape structures) has been detailed by Gill (1979) and Gill and Keunen (1958). The palaeocurrent within the Gull Island Formation also appears to have been dominantly from the south-west and again evolving to be from the north-west in the upper parts of the formation (Collinson *et al.*, 1991). Both these sandstones are sourced from the west, possibly from a region of uplift related to proto-Atlantic rifting (Haszeldine, 1984, 1988) or marginal uplift (Leeder, 1988a). Leeder (1988b) also suggests that the major clastic influx at this time, (which is also seen in the northern England basins) may have been caused by climatic change from arid to humid conditions resulting in drainage system growth.

The soft sediment deformation in the Ross Sandstone and Gull Island Formations indicate a palaeoslope dipping to the ESE-SE in County Clare (Collinson *et al.*, 1991). The turbidites and the soft sediment deformation may have been initiated by the production of an unstable subaqueous slope, produced by faster subsidence of the trough than sediment deposition (Brindley and Gill, 1958), or possibly through tectonic activity, or because of the abundance of fine silts and muds or a combination of factors.

Above the Gull Island Formation is a transition into the deltaic cyclothems of the Central Clare Group. These cyclothems range from 100-200 m thick and are described by Pulham (1989) and Rider (1974) and were probably deposited in a more uniformly subsiding basin (Collinson *et al.,* 1991).

The succession above the Clare Shale to the south shows a similar coarsening upward trend (Sevastopulo, 1981).

4. BIOSTRATIGRAPHY

a) Irish ammonoid stratigraphy

Hodson (1954a, 1954b) and Hodson and Lewarne (1961) utilizing previous work on the ammonoid occurrences and biostratigraphy in both Ireland (eg. Foord, 1897-1903; Hind 1905) and northern England (eg. Bisat, 1924, 1928; Bisat and Hudson, 1943) mapped and established the litho- and biostratigraphy of County Clare. Essentially the mid-Namurian stratigraphy of Ireland is similar to that of Ramsbottom (1977), Ramsbottom *et al.* (1978) and the most recent refined version by Riley *et al.* (1987) (Fig. 3), however there are significant differences that will be discussed below.

b) Biostratigraphy of Inishcorker

The lowest parts of the succession at Inishcorker are barren and pyritic (Fig. 4). Curious paired vertical pyrite tubes on average up to 30 cm long and between 2 to 5 cm apart appear at certain levels in the lowest part of the succession (Fig. 5). These tubes are up to 60 cm long and show no evidence for being burrow structures (eg. spreite or linkage of tubes). This, combined with the abscence of any evidence for benthos at the horizon at which they occur suggests that they are a diagenetic feature (P. Wignall, pers comm., 1993). The lowest bivalve horizon occurs 17.00 m above the base of the logged succession in a 6 cm cemented horizon and consists of rare *Actinopteria regularis* bivalves.

The lowest goniatite band exposed at Inishcorker is an *Anthracoceras* sp./*Dimorphoceras* sp. horizon, which is considered to be equivalent to the lowermost *Nuculoceras nuculum* (E2c2) marine band of northern England. This occurs 22.65 m above the base of the logged succession and is preserved in a 8 cm pyritic, carbonate cemented horizon. This marine band contains in addition to the goniatites *Posidoniella vetusta* bivalves and cypridinid ostracods.

The E2c3 *(Nuculoceras nuculum)* marine band occurs between 29.25 and 30.65 m. The basal 37 cm is a hard dark grey platy shale containing orthocone nautiloids (indet.), scaphopods (indet.) and *Posidoniella lamellosa* bivalves. This is followed by 33 cm of cementstone with the diagnostic goniatite *N. nuculum,* together with *Eumorphoceras bisulcatum, Anthracoceras* sp./*Dimorphoceras* sp. ammonoids and further orthocone nautiloids and scaphopods. The succeeding 70 cm of dark grey flaky shales show a diverse fauna of *N. nuculum, E. bisulcatum, Anthracoceras* sp./*Dimorphoceras* sp.

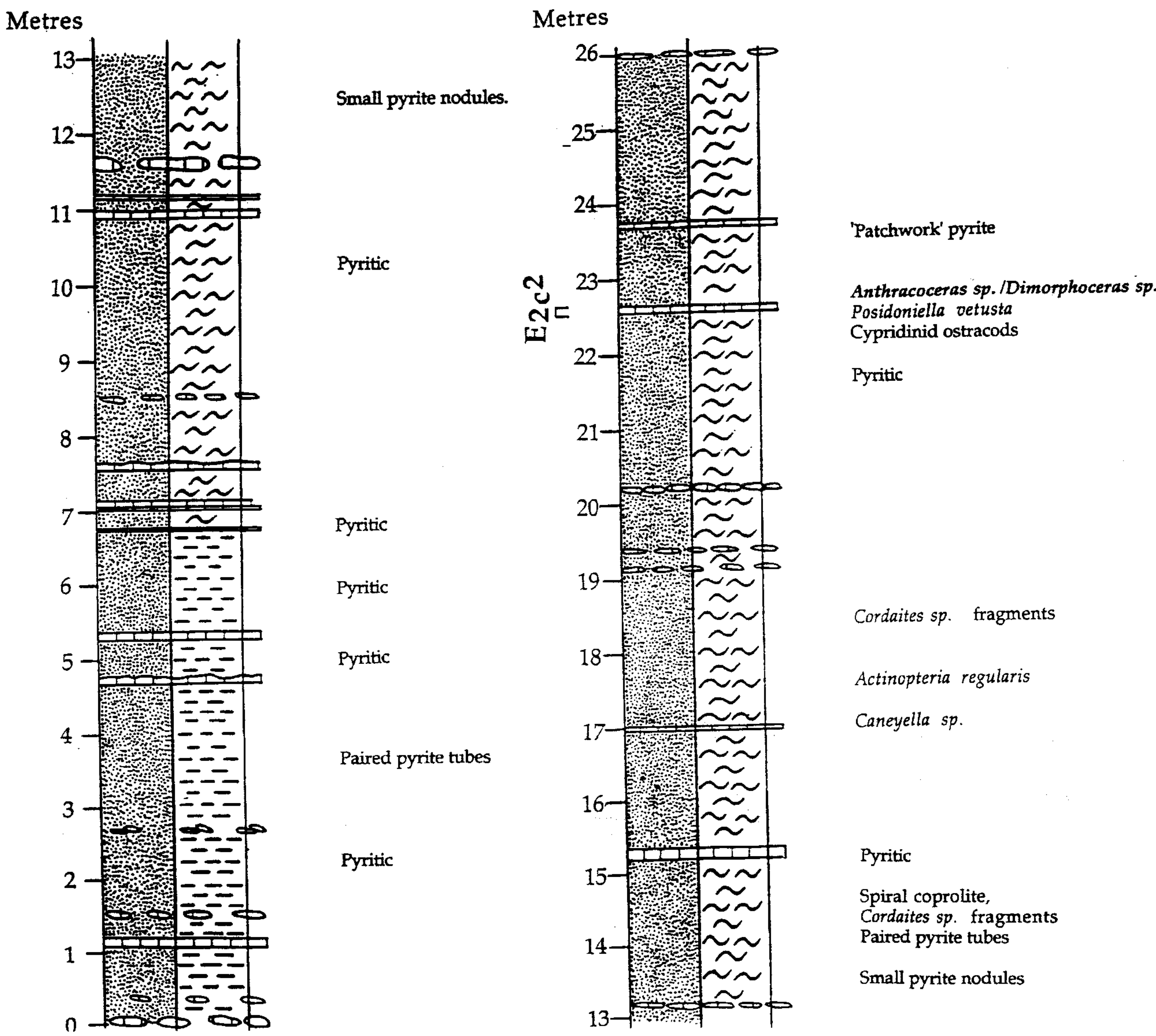

Fig. 4.- Stratigraphic logs of the mid-Carboniferous section at Inishcorker. See legend page 216.

ammonoids, orthocone nautiloids (indet.), *Posidonia corrugata*, *Caneyella semisulcata*, *Selenimyalina variabilis* and *Posidoniella lamellosa.*

E2c4, the uppermost *Nuculoceras nuculum* marine band, occurs between 37.25 m and 38.35 m in dark grey flaky and platy shales together with a septarian nodule horizon. The fauna consists of *N. nuculum, E. bisulcatum, Anthracoceras* sp./*Dimorphoceras* sp. ammonoids, *Posidonia corrugata* and *Selenimyalina variabilis.* The centre of the marine band is devoid of ammonoids, *Posidonia corrugata* constituting the only fauna.

The oldest Chokierian ammonoids of the H1a1 marine band occur 42.00 m above base in a 30 cm thick band associated with large calcareous bullions and dark grey flaky and papery shales. This band shows an impoverished fauna consisting of *Isohomoceras subglobosum* and an indeterminate bivalve.

The succeeding H1a2 marine band, ranging from 44.50 to 46.30 m above base, contains *Isohomoceras subglobosum, Anthracoceras* sp./*Dimorphoceras* sp. ammonoids and *Caneyella semisulcata* bivalves preserved as compressions in a black paper shale with septarian and calcareous nodules.

Two small calcareous nodule horizons at around 47.00m contain a bivalve fauna of *Posidoniella* sp..

The topmost *Isohomoceras subglobosum* (H1a2) band occurs in a horizon of small calcareous nodules at 47.65 m with the fauna being restricted to the diagnostic ammonoid.

Between the H1a3 and the H1b1 marine bands there is a 12 cm dark grey platy shale horizon at 48.45 m bearing thin-shelled ammonoids (*Anthracoceras* sp./*Dimorphoceras* sp.).

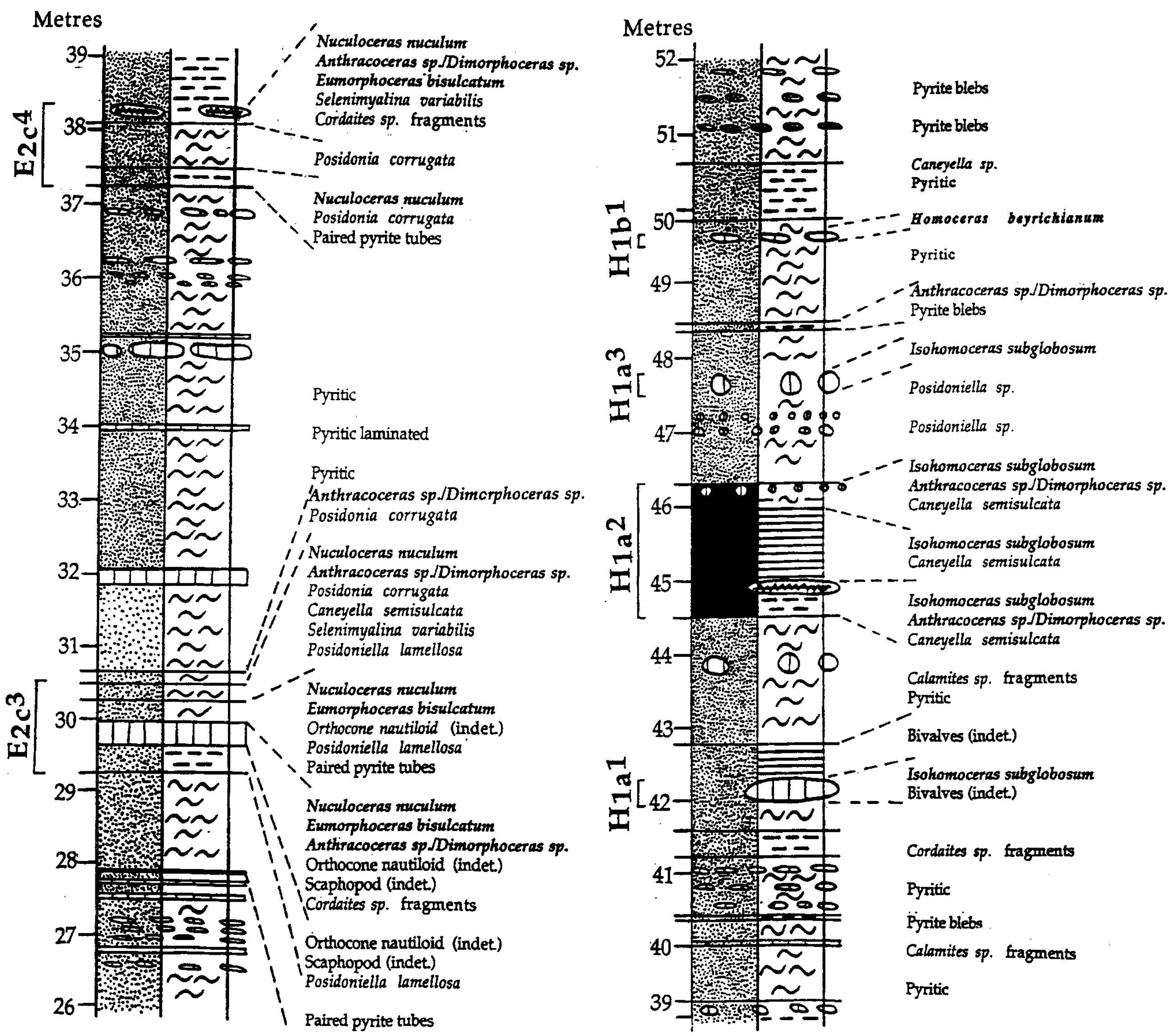

Fig. 4.- Stratigraphic logs of the mid-Carboniferous section at Inishcorker. See legend page 216.

The 27 cm thick H1b1 *Homoceras beyrichianum* marine band, containing only the definitive goniatite is found from the top of the calcareous bullions at 49.55 m. The overlying shale contains *Caneyella* sp. bivalves at its base.

The H1b2 marine band is the thickest band exposed at Inishcorker being 3.45 m thick and is developed from 52.95 m above the base. Although this band corresponds with the *Isohomoceras* sp. nov. band of Riley *et al.* (1987), the lower half of the marine band contains a fauna of *Homoceras beyrichianum*, *Anthracoceras* sp./*Dimorphoceras* sp., orthocone nautiloids (indet.) and *Dunbarella* sp., whilst the top 1.60 m of the band shows an *Isohomoceras* sp. nov. dominated assemblage but also with *H. beyrichianum*, *Anthracoceras* sp./*Dimorphoceras* sp., *Caneyella semisulcata* and *Dunbarella* sp. The fauna is associated with dark grey flaky and platy shales with calcareous and septarian nodules.

Towards the top of the logged sequence the shales become very weathered with large septarian nodules at 58.55 m containing indeterminate goniatites, possibly corresponding to the H2a1 (*Hudsonoceras proteum*) marine band.

Conodont extraction is still in progress, although Hodson and Lewarne (in Austin (1972)), in their preliminary survey, noted the occurrence of ten species of conodonts from samples in the top Chokierian of Inishcorker.

c) Discussion

There are a number of points to be made about the stratigraphy at Inishcorker.

1) The H1a3 marine band has not been recorded in Ireland before.

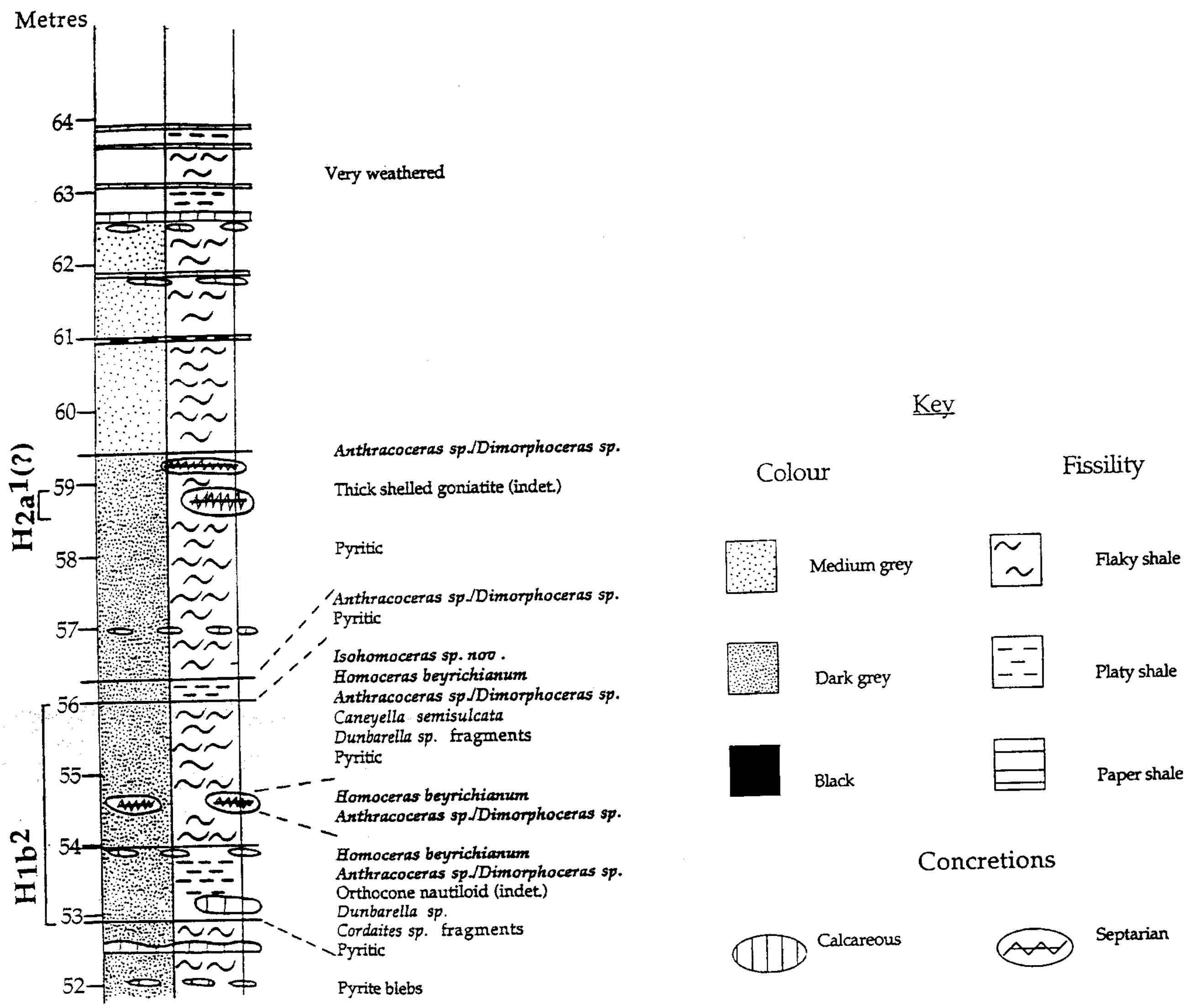

Fig. 4.- Stratigraphic logs of the mid-Carboniferous section at Inishcorker and legend

2) There appears to be two marine bands containing *Homoceras beyrichianum* in Ireland. Hodson (1954a) and Hodson and Lewarne (1961) found *H. aff. subglobosum* (sic) in the lowest of the two horizons at some of the studied localities in County Clare, although they did not find the third band of Riley *et. al* (1987).

Brennand (1965) noted the occurrence of *H. beyrichianum* (plus *H. subglobosum* (sic)) in the H1a1 marine band in central County Kerry. H1a2 appears to solely contain *H. subglobosum* (sic), whilst the H1a3 or lowest H1b1 band (assuming that H1a3 is not present except in the basin centre at Inishcorker) contains *H. aff. subglobosum*. This band is followed by yet another solely *H. subglobosum* (sic) band (possibly the *I.* sp. nov. of Riley *et al.* (1987)?). Philcox (1961) meanwhile, noted that the topmost of two *H. beyrichianum* bands in north County Cork contained *H.* cf. *subglobosum* (sic). Similarly Higgs (1986), in sections at Luggacurren, County Kilkenny, noted the occurrence of a lower band of *H. beyrichianum* with the upper band containing both *H. beyrichianum* and *H.* cf. *subglobosum*. Thus it may seem (although some accounts are conflicting), that unlike the northern England biostratigraphy, the Irish ammonoid biostratigraphy shows the development of two *Homoceras beyrichianum* bands, the upper of which may be equivalent (as shown at Inishcorker) to the *I.* sp nov. (H1b2) marine band.

Reasons for the development of this second marine band are at the moment unclear, but during the top-Chokierian in northern England an extreme lowstand affected the basins (Martinsen, 1990). This perhaps caused the development of brackish conditions in this area which did not allow establishment of *Homoceras beyrichianum* during early transgression. Only during the maximum flooding stage

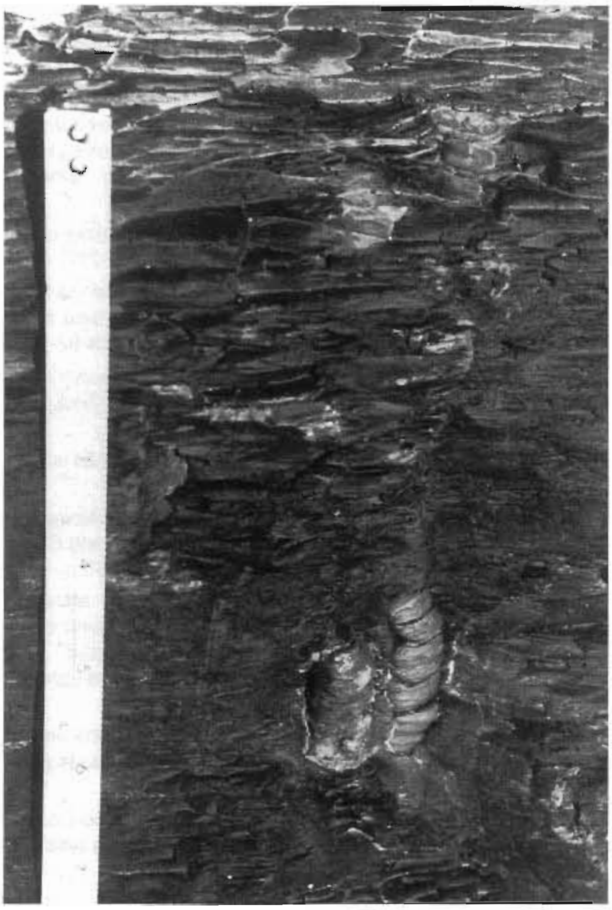

Fig. 5.- Plate showing paired pyrite tubes.
Lenght of scale is 20 cm

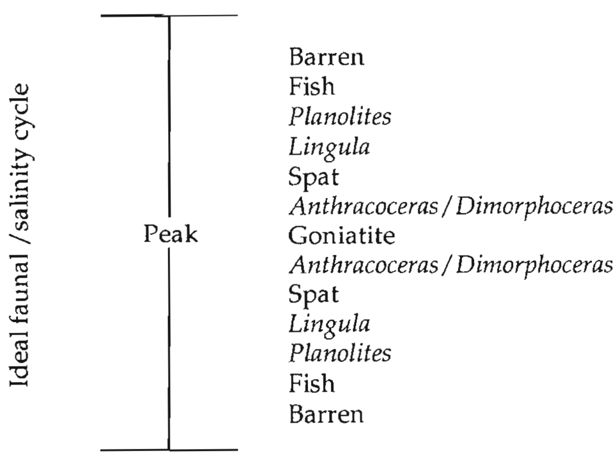

Fig. 6.- The ideal faunal/salinity cycle
(Ramsbottom *et al.*, 1962).

of the H1b2 marine band was the *Isohomoceras* sp. nov. fauna able to colonize the northern England basins. Alternatively palaeoenvironmental factors such as salinity or oxygen levels may have adversely affected the development of *Homoceras beyrichianum* compared to *Isohomoceras* sp. nov. in northern England.

It is also interesting to note that the *Homoceras* aff. *beyrichianum* band appears to be a major marker horizon in deep water settings, being known from north-west Europe to southern Nevada.

3) Development of the faunal salinity cycles of Ramsbottom *et al.* (1962) (Fig. 6) appears not to have occurred in the marine bands of the WINB. The symmetrical cycle, 1) Fish, 2) *Planolites*, 3) *Lingula*, 4) Spat, 5) Thin shelled goniatite, 6) Thick shelled goniatite is considered to represent increasing salinity (Ramsbottom *et al*, 1962; Ramsbottom, 1969; Holdsworth and Colllinson, 1988). Phases 1-4 of the cycle are absent in the Inishcorker marine bands and the thinner shelled goniatite phase (*Anthracoceras/Dimorphoceras* sp.) is commonly found within the marine band. With the marine bands at Inishcorker being close together, it is possible that the faunal cycle did not become less saline than the thin shelled goniatite phase. The abundance of pyrite (and therefore abundant sulphur) throughout the section may testify that the basin was marine and also that a deoxygenated sea-floor prohibited colonization outside of "marine bands". Thus, "marine band" development within the WINB may rely on oxygenated surface waters being fed into the basin at times of eustatic sea-level rise. Geochemical analysis of unweathered samples is in progress to test this hypothesis.

5. CONCLUSIONS

1) The section at Inishcorker exhibits the as yet most biostratigraphically complete mid-Carboniferous section in Ireland.

2) Unlike occurrences in northern England, *Homoceras beyrichianum* occurs at two levels, the upper of which also contains *Isohomoceras* sp. nov.; this may correlate to the *I.* sp. nov. band of Riley *et al.*, 1987.

3) Marine band development at Inishcorker does not display the classic faunal salinity cycles of Ramsbottom *et al.*, 1962. This, and the abundance of pyrite between "marine bands", may point to conditions within the WINB never attaining brackish-low salinity levels with "marine band" development being influenced by the entrance of oxygenated waters during transgression.

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