Chapter 22

South Central Ireland
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The South Central Ireland region extends from the South Munster Basin north to the southern margin of the Dublin Basin and from Wexford in the southeast to the Burren in the northwest (Fig. 22.1). The region is dominated by strata of Mississippian age, with Pennsylvanian strata preserved in boreholes in south Co. Wexford and in the upper part of the Leinster and Kanturk Coalfields. Throughout the South Central region, the Tournaisian strata present below the Waulsortian mud-bank limestones, which form a continuous thick unit of massive pale grey limestone across most of the region, is represented by the Lower Limestone Shale and Ballysteen Limestone groups (Brück 1985) of the Limerick Province (see Philcox 1984; Sevastopulo & Wyse Jackson 2001). The Lower Limestone Shale Group is related to a northward-directed marine transgressive event across the North Munster shelf. The deepening trend, which started during the deposition of the Ballysteen Limestone Group, continued with the Waulsortian facies on the distal part of a ramp. From the latest Tournaisian time and throughout the Visean there is widespread development of shallow-water marine carbonate platform sediments with only localised deeper water ramp and basinal facies (mostly in the Shannon Basin) (Somerville *et al.* 1992b; Strogen *et al.* 1996; Sevastopulo & Wyse Jackson 2001). The greatest areal extent and stratigraphic thickness (c. 2 km) of Namurian rocks occurs in the Shannon Basin, centred on counties Clare and Limerick. This basin developed as a result of extension and collapse above the position of the former Iapetus Suture and was the locus of a thick Lower Carboniferous succession in the Shannon Basin (Strogen *et al.* 1996). The Namurian succession was assigned to a lower Shannon Group followed by the Central Clare Group (Rider 1974), and its palaeogeographic development was summarised in Collinson *et al.* (1991). Westphalian strata are restricted to outliers of the Leinster, Slieve Ardagh and Kanturk coalfields (Fig. 22.1).

The lithostratigraphy used here is based on a compilation and synthesis of existing published nomenclature. Although a few groups have been formally defined, the formation is the primary stratigraphic unit used by the Geological Survey of Ireland (GSI) in its recent compilation of 1:100,000-scale map series. The groups combine related formations in similar depositional settings (e.g. shelf and ramp).

Tournaisian

The lowermost Tournaisian strata comprise siliciclastic (red-bed) non-marine fluvial rocks. In Ardmore (east Co. Cork and Waterford area) the Crows Point Formation (Fig. 22.1, Col. 1) comprises mainly cross-bedded grey sandstone with basal quartz-pebble conglomerate channel lags, and thin intervals of interbedded mudstone and heterolithic deposits (Sleeman & McConnell 1995). The formation contains spores of BP Biozone age $^{\wedge 1}$ (Higgs *et al.* 1988a). Further to the east, at Hook Head and south Co. Wexford, the lower Houseland Sandstone Member (Porter's Gate Formation) comprises red sandstone, shale and conglomerate (Sleeman *et al.* 1974; Tietzsch-Tyler & Sleeman 1994; Sevastopulo & Wyse Jackson 2001) (Fig. 22.2, Col. 3). This sandstone unit in the Wexford outlier is developed above the basal Duncormick Conglomerate Formation, which contains spores of BP Biozone age $^{\wedge 1}$ (Sleeman *et al.* 1983; Fig. 22.2, Col. 3). Conodonts recorded in the lower part of the Porter's Gate Formation include *Polygnathus spicatus* and *Patrognathus variabilis* of the *Polygnathus spicatus* Biozone ^{O2} (Johnston & Higgins 1981).

Within the Limerick Province (Philcox 1984; Sevastopulo & Wyse Jackson 2001), the earliest mud-dominated marine rocks of Courceyan age have been described together as the Lower Limestone Shale succession (Sleeman & Pracht 1999; Gatley *et al.* 2005). The Lower Limestone Shale Group is exposed in the Shannon estuary (Fig. 22.1) and in a continuous section in the Pallaskenry Borehole (LI-68-10) in Co. Limerick (Somerville & Jones 1985; Sleeman & Pracht 1999; Fig. 22.2, Col. 6). The lowermost Mellon House Formation (Shephard-Thorn 1963; Somerville & Jones 1985) consists of mainly dark grey, laminated siltstone and fine-grained sandstone with rare flaser-bedding, alternating with commonly bioturbated calcareous shale. The succeeding Ringmoylan Shale Formation (Somerville & Jones 1985) is dominated by dark-grey to black calcareous shale with thin bands of bioclastic limestone. The presence of the conodont *Polygnathus inornatus* from the base of the Ringmoylan Shale Formation gives a probable early Courceyan age to the unit $^{O\wedge1}$ (Somerville & Jones 1985). According to Sevastopulo & Wyse Jackson (2001), the Mellon House/Ringmoylan Shale Formation boundary approximates to the BP/PC miospore zonal boundary $^{O\wedge1}$. Miospores of PC Biozone within the Ringmoylan Shale Formation (Gatley *et al.* 2005), are similar to assemblages recorded in the equivalent shaly sequence at Hook Head, Co. Wexford (Higgs 1975; Fig. 22.2, Col. 3). These beds form the Lyraun Cove Member (upper part of the Porter's Gate Formation) and contain the zonal conodont *Polygnathus inornatus* and *Siphonodella* (Johnston & Higgins 1981; Fig. 22.2, Col. 3 ^{O3}). The Ringmoylan Shale Formation is overlain by the Ballyvergin Shale Formation, first described in the Ballyvergin Borehole, Co. Clare by Hudson & Sevastopulo (1966). The formation comprises greenish-grey non-calcareous blocky mudstone with fine siltstone and shale (Fig. 22.2, Col. 7). Although thin, it is an important regional marker from Tynagh (northwest of Lough Derg) to Ardmore (Clayton *et al.* 1980; Sleeman & McConnell 1995). The Ballyvergin Shale Formation contains miospores of PC Biozone age $^{\wedge1}$ (Clayton *et al.* 1980). The lateral equivalent of the Ballyvergin Shale Formation to the northeast in the North Midlands Province (Fig. 22.2, Col. 8) is the lower part of the Ferbane Mudstone Formation (Philcox 1984; Sevastopulo & Wyse Jackson 2001; see Chapter 21).

The Ballysteen Limestone Group of Brück (1985) overlies the Ballyvergin Shale Formation conformably. The lowermost unit, the Ballymartin Formation of Somerville & Jones (1985), comprises decimetric-scale interbedded pale-grey argillaceous bioclastic limestone and dark calcareous shale. The type section is in the Pallaskenry Borehole (Fig. 22.2, Col. 6), and it is also exposed in Co. Limerick at Ballymartin Point (Shephard-Thorn 1963; Somerville & Jones 1985; Sleeman & Pracht 1999). The Ballymartin Formation passes diachronously northeastwards into the upper part of the Ferbane Mudstone Formation and the overlying flaser-bedded Cloghan Sandstone Formation (within the North Midlands Province). The Ballymartin Formation is highly fossiliferous and has been dated as middle Tournaisian from macrofauna such as the trilobite *Phillipsia ornata* ^{T2} (Lewis 1986). The overlying Ballysteen Formation is dominated by dark (becoming paler towards the top) well bedded, nodular, bioturbated, bioclastic argillaceous wackestone with associated laminated fossiliferous calcareous shale (Shephard-Thorn 1963; Somerville & Jones 1985). Near the base of the formation is a fine-grained skeletal grainstone referred to as the Pallaskenry Member (Somerville & Jones 1985). At Lisheen, in the Rathdowney Trend (Fig. 22.2, Col. 4), the Lisduff Oolite Member consists of thick-bedded, pale blue-grey, cross-bedded ooidal limestone (Archer *et al.* 1996). At the top of the formation is the Ballynash Member (Somerville & Jone, 1985), a widespread and distinctive facies of partly silicified micrite in shale and diffuse thicker bedded wackestone. At Lisheen (Fig. 22.2, Col. 4), the member includes two prominent green tuff bands just below the Waulsortian Limestone (Shearley *et*

al. 1996). The Ballynash Member increases in thickness significantly where, at the edge of Waulsortian accumulations, this unit occupies the same stratigraphic position usually filled by the Waulsortian Limestone (Archer *et al.* 1996). The Ballysteen Formation contains conodonts of *Pseudopolygnathus multistriatus* Local Range Biozone and the lower part of *Polygnathus mehli* Local Range Biozone (equivalent to the *Polygnathus communis carina* Subzone) (Somerville & Jones 1985; Sleeman & Pracht 1999; Fig. 22.2, Col. 6 ^{O3}). The Ballysteen Formation is widespread throughout the Limerick Province (Philcox 1984) and extends northeast into the North Midlands Province where it succeeds the Moathill Formation of the Navan Group (Morris *et al.* 2003; see Chapter 21).

The Limerick Limestone Formation (Waulsortian facies) conformably succeeds the Ballysteen Formation in the Pallaskenry Borehole and many other boreholes in the Limerick Province (Somerville & Jones 1985; Clipstone 1992; Somerville *et al.* 1992c; Shearley *et al*. 1996; Fig. 22.2, Cols. 2, 5 & 6). The formation, and equivalent Waulsortian Limestone facies (Fig. 22.2, Cols. 1, 4 & 7), are composed of massive, pale grey fine-grained micritic limestone (Sevastopulo 1982; Somerville & Strogen 1992; Sleeman & Pracht 1999; Somerville 2003), forming the thickest Waulsortian succession present in the world (Lees & Miller 1995; Hitzman 1995). In general, the Waulsortian forms coalesced and stacked mudbanks with few interbedded shale and crinoidal limestone intervals, but at Aughinish Island on the River Shannon individual knoll-like banks are present draped by bedded cherty limestone (Lees 1964). The Limerick Limestone Formation is of late Courceyan age (*Polygnathus bischoffi* Subzone of *Polygnathus mehli* Local Range Biozone and *Scaliognathus anchoralis* Biozone) at the base; locally *Gnathodus homopunctatus* Biozone (Chadian) at the top (e.g. as at Buttevant) (Somerville & Jones 1985; Clipstone 1992; Sleeman & Pracht 1999; Fig. 22.2, Col. 2 ^{O1}).

The successions above the Waulsortian Limestone are mainly of Visean age (see below), but also include uppermost Tournaisian strata. In the Gort Lowlands (Fig. 22.2, Col. 7), the basal Cregmahon Member of the Tubber Formation, present in the Gort Borehole (Pracht *et al.* 2004), comprises cherty bioclastic limestone with shaly partings, with foraminifers of latest Tournaisian age ^{O2}. In the Golden Gulf region (Fig. 22.2, Col. 9) pale grey cherty skeletal wackestone and packstone of the Knockordan Formation are lithologically similar to the underlying Ballynash Member of the Ballysteen Formation (Archer *et al.* 1996).

Visean

Over much of the region Visean rocks are typically shallow-water carbonate platform sediments. Between the East Limerick Syncline and the Rathdowney Trend there is a sequence containing both shallow water and deeper water carbonate facies and referred to as the 'Golden Gulf' succession, centred on Golden, Co. Tipperary (Carruthers 1985; Archer *et al.* 1996). In northwest Co. Limerick deeper-water basinal or ramp facies dominate (Shephard-Thorn 1963; Somerville & Strogen 1992; Sleeman & Pracht 1999).

The shallow-water carbonate platform sediments of Chadian age in south Co. Wexford, between Duncormick and Wexford Town (Fig. 22.2, Col. 3), are represented by the Wexford Formation, which directly succeeds the Ballysteen Formation due to the absence of Waulsortian facies (Tietzsch-Tyler & Sleeman 1994). The formation comprises a basal black mudstone unit, overlain by a polymict limestone breccia unit containing beds of gypsum and nodules of replaced evaporite (Sleeman 1980; Carter & Wilbur 1986; Tietzsch-Tyler & Sleeman 1994; Nagy 2003; Nagy *et al.* 2005b). Within the Cork Syncline at Little Island (Fig. 22.2, Col. 1), the Chadian succession is dominated by massive pale grey mudbank

limestone, with the Cork Red Marble Formation comprising grey, cherty calcisiltite, red crinoidal breccia and chert, red limestone conglomerate, and pale grey and pink micrite (Sleeman & McConnell 1995). Local development of ooids and cryptalgal grain coatings indicate a shallow-water deposit. Austin (1968) recorded the conodonts *Gnathodus homopunctatus* and *G. texanus*, and ammonoids reported by Nevill (1962) include *Merocanites* and *Muensteroceras* [O+2]. The overlying Little Island Formation comprises massive mudbank limestone which is probably of Chadian to Asbian age (Sleeman & McConnell 1995).

In the North Munster Shelf, the Subulter Volcanic Formation comprises green and purple cross-stratified, graded tuff with a lower agglomerate in the type section at Cecilstown (Fig. 22.2, Col. 2; Clipstone 1992). In a nearby borehole vesicular basaltic lava flows up to 12 m thick occur within the formation (Pracht 1997). In the Rathdowney Trend (Fig. 22.2, Col. 4), the Crosspatrick Formation overlies the Waulsortian Limestone conformably, although beds are often found draped at considerable angles over the mound topography of the underlying formation. The Crosspatrick Formation consists of pale grey, well-bedded, fine-grained crinoidal-bryozoan wackestone/packstone, commonly with abundant chert (Gatley *et al.* 2005). Foraminifers from the formation in the Durrow Borehole establish a Cf4α2 Subzone age for the upper part of the formation [O1] (Nagy 2003; Gatley *et al.* 2005). The overlying Aghmacart Formation typically comprises dark-grey and fine-grained, peloidal or micritic limestone and a restricted fauna of gastropods, ostracodes, spirorbid worms and sporadic *Syringopora*. Oncoids of *Ortonella* and *Girvanella* are frequently recorded in the Durrow Borehole (Gatley *et al.* 2005), and in micrite from the upper part of the formation are fenestral fabrics, rhizoliths and desiccation cracks. Ooidal or peloidal cross-bedded grainstone units and shales also occur as beds in cyclical units (Gatley *et al.* 2005). Evidence of evaporites, e.g. nodules and breccia of gypsum/anhydrite replacement, are seen in the Milford Borehole, Co. Carlow in equivalent beds west of the Leinster Massif (Nagy 2003; Nagy *et al.* 2005a; Gatley *et al.* 2005). The Aghmacart Formation has Cf4α2 Subzone fauna recorded near the base in the Durrow Borehole (Gatley *et al.* 2005; Fig. 22.2, Col. 4 [O2]).

In the East Limerick Syncline (Fig. 22.2, Col. 5), the Lough Gur Formation comprises bedded dark grey fine-grained cherty argillaceous wackestone and peloid packstone with sparse grainstone. Late Tournaisian to Chadian (Cf4α1-α2) Subzone foraminiferal assemblages have been recovered [O1] (Somerville *et al.* 1992c). The succeeding Knockroe Volcanic Formation comprises mildly alkaline olivine-normative basalt and trachyte lavas and tuff of Chadian to early Arundian age, with an upper diachronous boundary (Strogen 1983, 1988; Somerville *et al.* 1992c). In the Gort Lowlands the Fiddaun Member of the Tubber Formation (Fig. 22.2, Col. 7) is a medium grey bioclastic and peloidal limestone with sparse chert and dolomite units. In the Gort Borehole the foraminifer *Eoparastaffella* and the alga *Koninckopora* occur in the member (Lewis 1986; Pracht *et al.* 2004), indicating a Cf4α2 Biozone age [O3]. In the Lough Derg succession, north Co. Tipperary and south Co. Offaly between Birr and Nenagh (Fig. 22.2, Col. 8) the Oldcourt Cherty Limestone Formation fills major hollows in the top of the Waulsortian mudbank complex (Brück 1985). The formation comprises medium-grey well sorted calcarenitic limestone with abundant dark grey to black chert (Brück 1982; Gatley *et al.* 2005). The Terryglass Formation overlies the Oldcourt Cherty Limestone Formation in the Borrisokane Syncline, but on the shore of Lough Derg it directly succeeds the Waulsortian Limestones (Gatley *et al.* 2005). The Terryglass Formation comprises thick-bedded, very well-sorted, medium to pale grey, fine to medium-grained, ooidal calcarenite, entirely Chadian in age (Brück 1985). The overlying Lismaline Micrite Formation is composed primarily of well bedded, medium grey micritic limestone with

birdseye structures and oncoids (Brück 1982, 1985). The formation is absent in the Gortmore Borehole (GSI-99-329), and in the area west of Terryglass. Near the top of the formation are recorded foraminifers and algae of late Chadian (Cf4α2) age (Gatley *et al.* 2005; Fig. 22.2, Col. 8 [O1]).

In the Golden Gulf region (Fig. 22.2, Col. 9) the Athassel Formation type section is in Borehole 728/1 in the Glen of Aherlow (Archer *et al.* 1996). The formation is composed of mostly thin-bedded, dark grey, fine-grained wackestone alternating with shale. There are several thin tuff units, as well as spiculitic wackestone, and thin beds of laminated and graded ooidal grainstone containing volcanic clasts (Somerville *et al.* 1996). The Athassel Formation is interpreted as a deep-water basinal facies (Archer *et al.* 1996) and the interbedded tuff units may relate to the volcanic centre (Knockroe Volcanic Formation) of equivalent age in the East Limerick Syncline. The age of the Athassel Formation is late Tournaisian (Cf4α1) to Arundian (Somerville *et al.* 1996; Fig. 22.2, Col. 9 [O1]). In northwest Co. Limerick (Fig. 22.2, Col. 6) the Rathkeale Formation is a poorly exposed succession comprising unfossiliferous dark grey argillaceous limestone and shaly mudstone. However, a small outlier at Cappagh Castle reveals laminated calcisiltite and graded bioclastic packstone and grainstone containing brachiopods, crinoids and foraminifers (Somerville & Strogen 1992). A conodont fauna including *Gnathodus homopunctatus* indicates a Chadian to Arundian age [O4] (Austin *et al.* 1970).

The shallow-water carbonate platform sediments of mainly Arundian to Holkerian age are represented in the North Munster Shelf (Fig. 22.2, Col. 2) by the Copsetown Limestone Formation, which directly succeeds the Limerick Limestone Formation locally (Waulsortian facies, e.g. as at Buttevant). The formation comprises thin- to medium-bedded, dark grey, fine-grained packstone and argillaceous limestone with nodular chert at the base (Pracht 1997). Conodonts recorded from Ballybeg Quarry at Buttevant, show that the base of the formation is at earliest of latest Chadian age, with Arundian archaediscid foraminifers recorded just above the base [O2] (Clipstone 1992). Lower beds in the Copsetown Limestone Formation contain locally rich corals and brachiopods of Arundian age (Hudson & Philcox 1965; Clipstone 1992). Higher beds contain Holkerian foraminifers and the conodont *Lochriea commutata* [O3] and the youngest beds of the formation contain Asbian foraminifers [O4] (Clipstone 1992).

In south Co. Wexford a micrite and dolostone unit of the Wexford Formation (Fig. 22.2, Col. 3) contains the alga *Koninckopora tenuiramosa*, suggesting a possible Arundian age. The upper part of the Wexford Formation comprises bioclastic limestone consisting of skeletal and peloidal wackestone, packstone and intraclastic grainstone (Sleeman 1980; Carter & Wilbur 1986; Tietzsch-Tyler & Sleeman 1994; Nagy 2003; Nagy *et al.* 2006b). Foraminifers from the lower part of the bioclastic unit including *Consobrinella* and *Pojarkovella* suggest a probable Holkerian age [O4]. In the Rathdowney Trend (Fig. 22.2, Col. 4), the Durrow Formation consists of repetitions of four main lithofacies: thick, coral-rich well sorted bioclastic intraclastic grainstone with scarce chert; cross-bedded ooidal limestone; metre-thick fossiliferous shale; and rare birdseye micrite (Nagy 2003; Gatley *et al.* 2005). An early Arundian (Cf4β-γ) Subzone fauna (Jones & Somerville 1996) is recorded almost at the base of the formation in the Durrow Borehole [O3]. *Paraarchaediscus @ involutus* and *concavus* stages indicate the incoming of a Holkerian fauna higher in the formation, which is confirmed by the appearance of the diagnostic taxa (*Pojarkovella nibelis* and *Koskinotextularia*), which establish the Cf5 Biozone [O*4] (Jones & Somerville 1996). The Holkerian brachiopod *Davidsonina carbonaria* was also reported in this borehole [O*4] (Archer *et al.* 1996). The base

of the Asbian may be indicated by the first appearance of *Archaediscus krestovnikovi* (*angulatus* stage), *Gigasbia* and the fasciculate coral *Siphonodendron pauciradiale* near the top of the formation ^{O*5} (Gatley *et al.* 2005).

In the East Limerick Syncline (Fig. 22.2, Col. 5) the Herbertstown Limestone Formation comprises thick-bedded, dark blue-grey ooidal and crinoidal intraclastic grainstone and packstone. Arundian to early Asbian microfossils occur in the formation (Somerville *et al.* 1992c). Within the Gort Lowlands (Fig. 22.2, Col. 7) higher beds in the Fiddaun Member of the Tubber Formation record the first appearance of archaediscid foraminifers and the brachiopod *Delepinea carinata* indicating an Arundian age ^{O*4} (Sevastopulo & MacDermot 1991; Pracht *et al.* 2004). The uppermost Castlequarter Member consists of a uniform, medium-grey calcarenitic limestone with abundant fasciculate coral colonies, capped by a dolostone bed (Pracht *et al.* 2004). In the north Burren at Black Head, the lateral equivalent unit of the upper part of the Castlequarter Member is the Finavarra Member. In the upper part of the Tubber Formation the presence of fasciculate lithostrotionids suggests an Arundian to Holkerian age (Pracht *et al.* 2004) and the record of *Paraarchaediscus @ concavus* stage in the Finavarra Member suggests a probable Holkerian age at the top of the formation ^{O5} (Gallagher 1992).

The Slevoir Formation is found mainly in the Borrisokane Syncline and on the northern shores of Lough Derg (Brück 1985; Gatley *et al.* 2005; Fig. 22.2, Col. 8). The formation is composed of bioturbated muddy limestone, thin units of graded coarse-grained skeletal grainstone and calcareous shale. The formation usually succeeds the Lismaline Micrite Formation in the Borrisokane area, but in the Gortmore Borehole (GSI-99-329) it directly succeeds the Terryglass Formation, with the lowest 15 m of the formation containing pale grey, intraclastic coarse-grained limestones arranged in three fining-upward cycles. At the base of the lowest graded limestone bed are large volcanic clasts. Foraminifers and algae (*Brunsia* and *Koninckopora tenuiramosa*) recorded from the base of the formation in Gortmore Borehole and the solitary coral *Sychnoelasma urbanowitschi,* are of Chadian (Cf4α2) age ^{O*2} (Gatley *et al.* 2005). Higher in the Slevoir Formation in the Gortmore Borehole is the first record of *Uralodiscus*, with a more diverse foraminiferal assemblage of Arundian (Cf4β-γ) age ^{O3} (Gatley *et al.* 2005). The overlying Borrisokane Formation is well exposed in the Borrisokane Syncline comprising pale grey well sorted, coarse-grained calcarenitic limestone (Brück 1985). The formation is Arundian in age, but the uppermost part may extend into the Holkerian (Brück 1985).

In the Golden Gulf region (Fig. 22.2, Col. 9) a shallowing event during the early Arundian is recorded in the Suir Formation, which comprises thick-bedded pale grey skeletal packstone, and cross-bedded ooidal grainstone (Carruthers 1985; Archer *et al.* 1996). A return to deeper water basinal facies is suggested by the succeeding Arundian to Asbian Lagganstown Formation, which comprises thin-bedded, dark grey, fine-grained shaly skeletal limestone containing abundant chert (Carruthers 1985; Archer *et al.* 1996).

The shallow-water carbonate platform sediments of the upper Asbian part of the Little Island Formation (Fig. 22.2, Col. 1) are composed of crinoidal wackestone. The youngest formation on Little Island is the Clashavodig Formation, which comprises micrite, skeletal peloidal and ooidal grainstone and cherty micrite. The upper part of the formation is cyclic and contains palaeokarstic surfaces filled by clays (palaeosols) (Heselden 1991) and a late Asbian foraminiferal assemblage (Cf6γ) ^{O3} (Gallagher 1992). In the North Munster Shelf (Fig. 22.2, Col. 2) the Hazelwood Formation comprises massive, pale grey, poorly fossiliferous fine-

grained limestone (mud-bank facies) containing chert. Conodonts recovered from the formation include *G. girtyi girtyi* [O5] and in the upper part *Gnathodus bilineatus* [O6], establishing an early to late Asbian age (Clipstone 1992; Gallagher & Somerville 1997; Pracht 1997). The overlying limestone of the Ballyclogh Limestone Formation comprises a lower Cecilstown Member of cherty dark blue-grey algal-spiculitic wackestone and packstone succeeded by an upper cyclic Dromdowney Member of thick-bedded pale grey skeletal grainstone and packstone. This cyclic member shows palaeokarstic surfaces and bentonitic clays at the tops of shallowing-upward units associated with subaerial exposure (Gallagher 1996; Gallagher & Somerville 1997). This member is similar to the upper part of the Clashavodig Formation (Fig. 22.2, Col. 1) and is correlated with rocks of the Burren Formation, Co. Clare (Fig. 22.2, Col. 7). A rich brachiopod (*Davidsonina septosa*), and coral fauna of late Asbian age, and a diverse foraminifer/algal assemblage of Cf6γ Subzone age have been recorded *[O7] (Gallagher & Somerville 1997). Higher beds in the bioclastic unit of the Wexford Formation (Fig. 22.2, Col. 3) contain foraminifers of *Paraarchaediscus @ angulatus* stage, and algae, fasciculate and cerioid corals (Nagy 2003; Cózar & Somerville 2005; Nagy *et al.* 2006b) confirming an Asbian age [O5].

In the Rathdowney Trend, within the Durrow Borehole (Fig. 22.2, Col. 4) the Ballyadams Formation (McConnell & Philcox 1994; Tietzsch-Tyler & Sleeman 1994) consists mainly of thick-bedded, pale grey, coral-bearing bioclastic shelf-limestone (Somerville *et al.* 1996; Gatley *et al.* 2005). The upper part of the formation shows shallowing-upward and coarsening-upward shoaling cycles of thin-bedded, dark grey, rather argillaceous limestone passing up into massive pale grey coarser-grained limestone. The latter have distinctive irregular palaeokarstic surfaces with pedogenic structures e.g. rhizoliths overlain by clay-wayboards (palaeosols) indicative of periodic subaerial exposure of the limestone during regressions. A similar sequence is recorded in Co. Kilkenny (Gallagher 1992, 1996) and Co. Carlow (Cózar & Somerville 2005). The Ballyadams Formation spans most of the lower to upper Asbian Substage and contains the zonal coral *Dibunophyllum bipartitum* in the upper part, along with foraminifers of the Cf6γ Subzone *[O6] (Cózar & Somerville, 2005).

In the East Limerick Syncline (Fig. 22.2, Col. 5) the Knockseefin Volcanic Formation is composed mainly of ankaramitic basalt lava and tuff (Strogen 1983, 1988; Somerville *et al.* 1992c). The overlying Dromkeen Limestone Formation comprises thick-bedded, pale grey skeletal packstone and rubbly skeletal wackestone with thin clay cappings (palaeosols) and contains a rich macrofauna of Asbian-Brigantian age, including corals and brachiopods, conodonts and foraminifers (Somerville *et al.* 1992c).

The Burren Formation, named after the vast expanse of limestone pavement in north Co. Clare (Fig. 22.2, Col. 7), comprises mostly thick-bedded and massive, pale grey limestone, but with intervals of bedded darker grey limestone with chert (Pracht *et al.* 2004; Gallagher *et al.* 2006). The lowermost Black Head Member consists of medium- to thick-bedded, uniform grey limestone (coarse-grained skeletal and peloidal packstone and grainstone), with the cerioid rugose coral *Lithostrotion araneum* in the basal part forming a regional marker *[6] (Gallagher 1992) and at the top of the member is recorded the fasciculate coral *Solenodendron furcatum* *[7] (Sevastopulo & MacDermot 1991). The overlying Fanore Member consists of fine- to medium-grained wackestone/packstone and grainstone, interbedded with thin calcareous shales and contains fasciculate coral colonies (Gallagher 1992). The limestone is commonly dolomitic and contains chert nodules at the top of the member. The succeeding Maumcaha Member consists of massive, medium- to coarse-grained skeletal and peloidal packstone/wackestone and grainstone. The uppermost Ailwee Member

forms a distinct terraced profile caused by the presence of several thin clay bands interpreted as palaeosols resting on palaeokarstic surfaces (Gallagher 1992, 1996; Gallagher & Somerville 1997, 2003; Pracht *et al.* 2004; Gallagher *et al*. 2006). A rich and diverse late Asbian (Cf6γ1) Subzone foraminiferal and algal suite is recorded in the Ailwee Member [O8] (Gallagher 1992), with Cf6γ2 Subzone indicated near the top of the member [O9] (Gallagher 1992; Somerville 1999; Gallagher *et al.* 2006). The brachiopod *Davidsonina septosa* is also recorded from this member (Pracht *et al.* 2004).

In the Golden Gulf region (Fig. 22.2, Col. 9) the Hore Abbey Formation comprises a variety of shallow-water limestone facies including pale grey ooidal limestone, pale to medium grey skeletal packstone, medium to dark grey skeletal wackestone and algal laminites. The upper beds contain well bedded cherty skeletal packstone and rare stromatolitic intervals. The formation is mostly Asbian in age and is equivalent to the Ballyadams and probably the lower part of the Brigantian Clogrenan and Liscarroll formations of the Rathdowney Trend (Archer *et al.* 1996; Fig. 22.2, Col. 4).

In northwest Co. Limerick, near Foynes (Fig. 22.2, Col. 6) deeper water basinal or ramp facies of the Durnish Formation comprises bluish grey to black, fine-grained limestone with sporadic black shale and chert bands. The formation has yielded a diverse coral-brachiopod assemblage (Shephard-Thorn 1963) indicative of an Asbian age *[5] (Mitchell 1989). The succeeding Shanagolden Formation comprises a lower limestone conglomerate, succeeded by a wackestone-dominant unit passing up into a shale-dominant unit that contains thin graded laminated packstone and a thick, coarse-grained, crinoidal-rich, packstone/grainstone at the top. Shephard-Thorn (1963) recorded the ammonoid *Beyrichoceras obtusum* of B_2 (late Asbian) age, and the conodont *Gnathodus bilineatus* is first recorded in the middle of the formation [+O6] (Sleeman & Pracht 1999; Somerville & Somerville, unpublished data). A rich foraminiferal-algal assemblage (Cf6γ Subzone) has been recorded from the highest grainstone bed in the formation.

The shallow-water carbonate platform sediments of Brigantian age in the North Munster Shelf (Fig. 22.2, Col. 2) comprises the Liscarroll Limestone Formation, with a lower Templemary Member composed of thick-bedded coarse-grained crinoidal limestone overlain by an upper Coolbane Member comprising dark grey, well bedded bioclastic cherty limestone. The Coolbane Member has yielded a Brigantian coral fauna (Gallagher & Somerville 1997) and a diverse foraminiferal/algal assemblage of Cf6δ Subzone age *[O8], comparable with similar-aged rocks of the Slievenaglasha Formation, Co. Clare (Fig. 22.2, Col. 7). The Slievenaglasha Formation comprises three lithofacies assemblages (Gallagher 1996; Gallagher *et al.* 2006): a lower cyclical sequence (36 m thick) of crinoidal packstone and grainstone interbedded with darker, fine-grained nodular wackestone, a middle unit of dark grey cherty nodular wackestone and packstone (c. 55 m thick), and an upper unit (4 m thick) of interbedded wackestone and crinoidal packstone and grainstone. Somerville (1999) recorded foraminifers and algae of Cf6δ subzone, together with the conodonts *Gnathodus bilineatus* and *Vogelgnathus postcampbelli* [O10].

In the Rathdowney Trend (Fig. 22.2, Col. 4) the Ballyadams Formation passes conformably up into the thinner-bedded and darker grey limestone of the Clogrenan Formation. The formation comprises mainly bluish-grey, cherty, crinoid- and bryozoan-rich packstone and grainstone, with occasional thin beds of shale (Archer *et al.* 1996; Cózar & Somerville 2005). Palaeokarstic surfaces with overlying clay beds, similar to those in the Ballyadams Formation, are developed in the lower part of the formation in Clogrenan Quarry (Cózar &

Somerville 2005). Faunal components in the formation include bands of gigantoproductid brachiopods and laterally continuous coral biostromes in the Carlow area (Somerville *et al.* 2007). Diagnostic Brigantian coral assemblages (Gatley *et al.* 2005; Cózar & Somerville 2005; Rodríguez & Somerville 2007) and foraminifers of the Cf6δ Subzone *[O7] (Cózar & Somerville 2005; Rodríguez & Somerville 2007) are present. In northwest Co. Limerick (Fig. 22.2, Col. 6) deeper water basinal or ramp facies of the Parsonage Formation, proved in the Foynes Borehole (GSI-97/148), comprises laminated argillaceous limestone and mudstone, massive recrystallised locally brecciated peloidal micrite (mud-mound facies), cherty wackestone and thin grainstone (Sleeman & Pracht 1999). On the north side of the Shannon estuary in Co. Clare the same formation ('Striped Limestones') was recognised by Hodson & Lewarne (1961) and Austin & Husri (1974) on Inishtubrid Island in the River Fergus, where mud-mounds are known in the succession. A thin grainstone bed from the upper part of the Parsonage Formation yielded a typical Brigantian (Cf6δ Subzone) foraminiferal assemblage [O7] (Sleeman & Pracht 1999; Somerville & Somerville, unpublished data). The overlying Corgrig Lodge Formation comprises a variable unit of alternating thick beds of burrow-mottled cherty wackestone and thick black laminated mudstone, and in the middle of the formation a shale-rich interval containing rare thin beds of crinoidal packstone and grainstone. Foraminiferal faunas recovered from the formation are of the Cf6δ Subzone, and the conodonts *Lochriea nodosa* and *Vogelgnathus postcampbelli* have been identified from the Foynes Borehole (GSI-97/148; Sleeman & Pracht 1999; Somerville & Somerville, unpublished data) confirming a late Brigantian age [O8].

Namurian

Within the Shannon Basin, the lowermost part of the Namurian succession is represented by the Shannon Group (c. 1200 m thick), comprising the Clare Shale, Ross Sandstone and Gull Island formations. The lowermost Clare Shale Formation is composed mostly of black shale with a basal cherty unit and rare argillaceous limestone (bullions) containing well preserved ammonoids and nektonic bivalves. The Clare Shale Formation of the axial area (Ballybunion; Fig. 22.2, Col. 6) is conformable on Visean strata and contains marine bands of Pendleian age extending up to the *Homoceras beyrichianum* (H_{1b}) Marine Band [+9], whereas in north Co. Clare (Fig. 22.2, Col. 7), in a condensed section, the formation rests unconformably on Visean limestone with a phosphatized contact. The lowest marine band in the condensed succession is the *Isohomoceras subglobosum* Marine Band ($H_{1a}1$) with *Reticuloceras paucicrenulatum* ($R_{1a}3$) at the top [+11] (Collinson *et al.* 1991; Sevastopulo 2001). The Clare Shale Formation of the Ballybunion area may not have an equivalent in the north, although Wignall & Best (2000) have proposed that the St. Brendan's Well Phosphate Bed, present at the base of the group in north Co. Clare, has a wide-ranging Arnsbergian age, broadly equivalent to the Clare Shale Formation of the axis area. The overlying Ross Sandstone Formation is a turbiditic sandstone unit (Lien *et al.* 2003), the base of which is exposed at Ballybunion (Fig. 22.2, Col. 6). The lower part of the formation is characterised by tabular non-channellized turbidites, whereas the upper part contains sheet-like and channelized turbidites as well as major slump/slide horizons (Collinson *et al.* 1991; Chapin *et al.* 1994; Lien *et al.* 2003). The amalgamated sandstone units show thickening-upward successions and palaeoflow measurements indicate a general northeastward dispersal (Lien *et al.* 2003). The Ross Sandstone Formation contains spectacular sand volcanoes (Gill & Kuenen 1958; Gill 1979) and slumps (Collinson *et al.* 1991), the latter moving mostly southeastward into the basin, with turbidity currents moving northeast along the axis. The Ross Sandstone Formation contains goniatites associated with the *Hudsonoceras proteum* ($H_{2a}1$) to *Reticuloceras dubium* ($R_{1a}5$) marine bands in the Shannon Estuary area (Fig. 22.2, Col. 6 [+10]) and is interpreted to be absent in north Co. Clare (Fig. 22.2, Col. 7; Sevastopulo 2001), although

Wignall & Best (2000) postulated that the formation is represented by a thin development of the Cronagort Sandstones. In the Loop Head Peninsula in SW Co. Clare (Fig. 22.2, Col. 6), the Gull Island Formation is a mud-dominated succession with subordinate sandstone turbidites and contains abundant slumped horizons with movement predominantly to the southeast (Martinsen 1989; Martinsen & Bakken 1990; Martinsen *et al*. 2003). Here, the base of the formation occurs at the level of the *R. paucicrenulatum-R. subreticulatum* marine bands ($R_{1a}3$) $^{+11}$, which occur together within a 4 m-thick mudstone unit. In the axial section at Ballybunion, these marine bands are separated by some 70 m of turbidites. The same succession can be traced northward away from the axis into north Co. Clare, where it thins and contains the spectacular Fisherstreet Slide (Gill 1979). The Clare Shale and Ross Sandstone formations are of deep-water basinal character, whereas the Gull Island Formation comprises a lower mud-rich turbidite-bearing section that lapped onto the basin margins, and an upper turbidite-free interval thought to record the eastward progradation of an intermittently unstable basin-filling slope (Martinsen *et al*. 2003).

Within the Shannon Basin (Fig. 22.2, Col. 6), the uppermost part of the Namurian succession is represented by the Central Clare Group (900 m thick), which comprises at least 5 major cyclothemic units (I-V) made up of mudstone, siltstone, sandstone and occasional coal seams that form cliffs in west Co. Clare. The cyclothems range in thickness from 2–300 m, and comprise large-scale upwards-coarsening units, major channel sandstone bodies and minor upwards-coarsening units. Palaeocurrent data suggest a source region to the west. The Central Clare Group is a shallow marine and non-marine deltaic and fluvial succession. The cyclothems were originally considered to be coarsening-upward deltaic units related to prograding deltas and capped by laterally extensive distributary channel sandstone bodies (Rider 1974). More recent studies (Elliott & Pulham 1990; Hampson *et al.* 1997) have recognised erosion surfaces with large-scale relief at the base of the thick, multi-storey channel sandstone units and these are now regarded as palaeovalleys, associated with lowstands. The delta-front successions show widespread development of growth faulting (Rider 1978; Wignall & Best 2004). The Central Clare Group ranges in age from Kinderscoutian to Marsdenian (zones R_{1b} – R_{2c}) in south Co. Clare (Fig. 22.2, Col. 6 $^{+12}$), although south of the Shannon estuary the succession extends into the Westphalian (Sevastopulo 2001). Correlation of these successions within the region has been achieved by identifying marine bands containing distinctive zonal ammonoids (Hodson 1954; Hodson & Lewarne 1961).

In the East Limerick Syncline (Fig. 22.2, Col. 5), lying disconformably on upper Visean limestone are Namurian clastic rocks of the Longstone Formation (Strogen 1988), which comprises a lower shale member (80 m thick), succeeded by a flaggy sandstone member (105 m thick), capped by a massive coarse-grained sandstone member (6 m thick). Ammonoids of the *Bilinguites bilinguis* (R_{2b}) Biozone age $^{+2}$ have been recorded from the shale member of the Longstone Formation (Archer *et al.* 1996).

In the Leinster Coalfield (Fig. 22.2, Col. 4), the Namurian strata (c. 400 m thick) overlie Visean rocks with sharp disconformity. The lowermost Luggacurren Shale Formation comprises dark grey to black shale, with basal beds of chert and shale (Nevill 1956; Higgs 1986; Tietzsch-Tyler & Sleeman 1994). The formation contains bivalves and ammonoid bands that establish the age as Arnsbergian to Kinderscoutian $^{+8}$ (Zones E_{2c}–R_{1c}). The overlying Killeshin Siltstone Formation consists of dark grey argillaceous siltstone and fine-grained flaggy interbedded sandstone, becoming sandier towards the top (McConnell & Philcox 1994; Archer *et al.* 1996). The formation thins to the south and west in the Slieve

Ardagh Coalfield (Archer *et al.* 1996). It contains ammonoids of Kinderscoutian to Yeadonian age [+9] (Zones $R_{2a} - G_{1a}$). The succeeding Bregaun Flagstone Formation consists of thick, flaggy-bedded grey sandstone and siltstone with subordinate amounts of silty, grey and commonly micaceous, shale (McConnell & Philcox 1994). The lower part of the formation is sandstone-dominated, the sandstone being coarser and more micaceous than that in the underlying Killeshin Siltstone Formation. The sandstone is succeeded by cyclothemic, mud-dominant strata with minor sandstone units of the Moyadd Coal Formation (Nevill 1956; Higgs 1986). A local thin anthracite grade coal horizon is present at the base of the Moyadd Coal Formation (No. 1 Rockafoil coal) with Yeadonian *Cancelloceras cumbriense* marine band ($G_{1b}1$) in the roof [+10]. In the Kanturk coalfield the *Cancelloceras cancellatum* (G_{1a}) marine band has been recorded (Nevill 1966; Fig. 22.2, Col. 2 [+9]), although details of the succession are sparse.

Rocks of probable Namurian age in south Co. Wexford are known from boreholes (Clayton *et al.* 1986). The Park Formation comprises fissile, laminated, pyritic dark grey mudstone resting unconformably on the Visean Wexford Formation (Fig. 22, Col. 3).

Westphalian

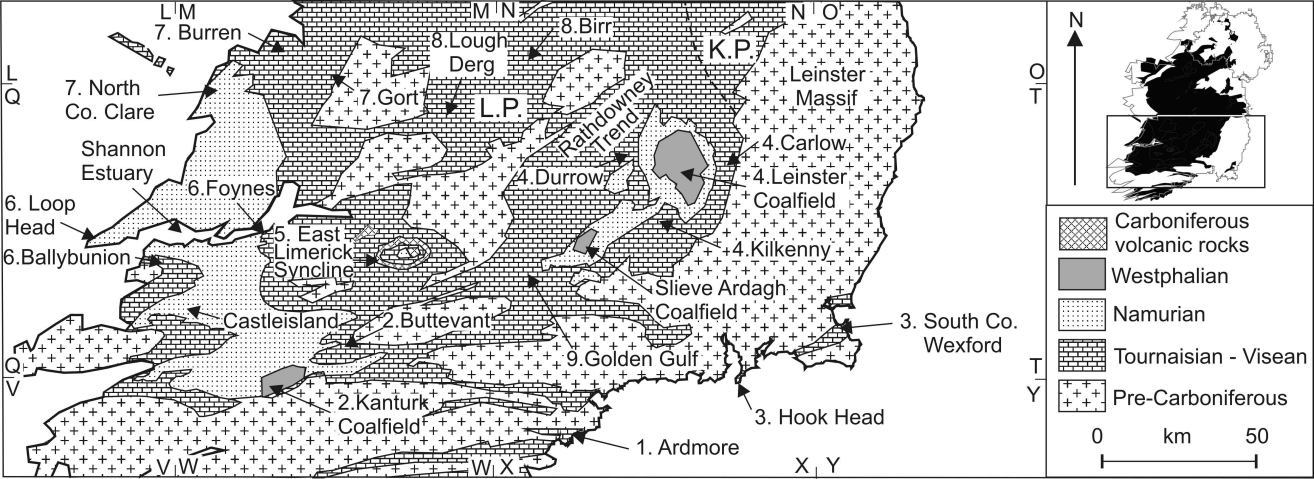
The most complete Westphalian successions are within the Leinster and Slieve Ardagh coalfields (Fig. 18.3). In the Leinster Coalfield (Fig. 22.2, Col. 4), the Namurian rocks are overlain conformably by coal-bearing rocks of Langsettian age (250-300 m thick). The Subcrenatum Marine Band [+11] (Nevill 1956), marking the base of the Langsettian (Archer *et al.* 1996), occurs within the Moyadd Coal Formation with diagnostic fauna, whereas in the Slieve Ardagh Coalfield only a *Lingula* band is recorded. The distinctive Fleck Rock, a bioturbated grey argillaceous siltstone, is developed in the basal marine band. A second important transgression is marked by Listeri Marine Band. The overlying Clay Gall Sandstone Formation is a fine-grained quartzose feldspathic sandstone, containing conspicuous mudstone pebbles above the markedly erosive base. The youngest unit is the Coolbawn Formation, comprising shale, sandstone (including a distinctive laminated siliceous sandstone) and thin coals (Tietzsch-Tyler & Sleeman 1994). Amphibians have been recorded from the shale immediately overlying the Jarrow Coal (near the middle of Coolbawn Formation, Fig. 18.3), with non-marine bivalves from the Lenisulcata and Communis chronozones [~12] confirming a Langsettian age (Eagar 1975).

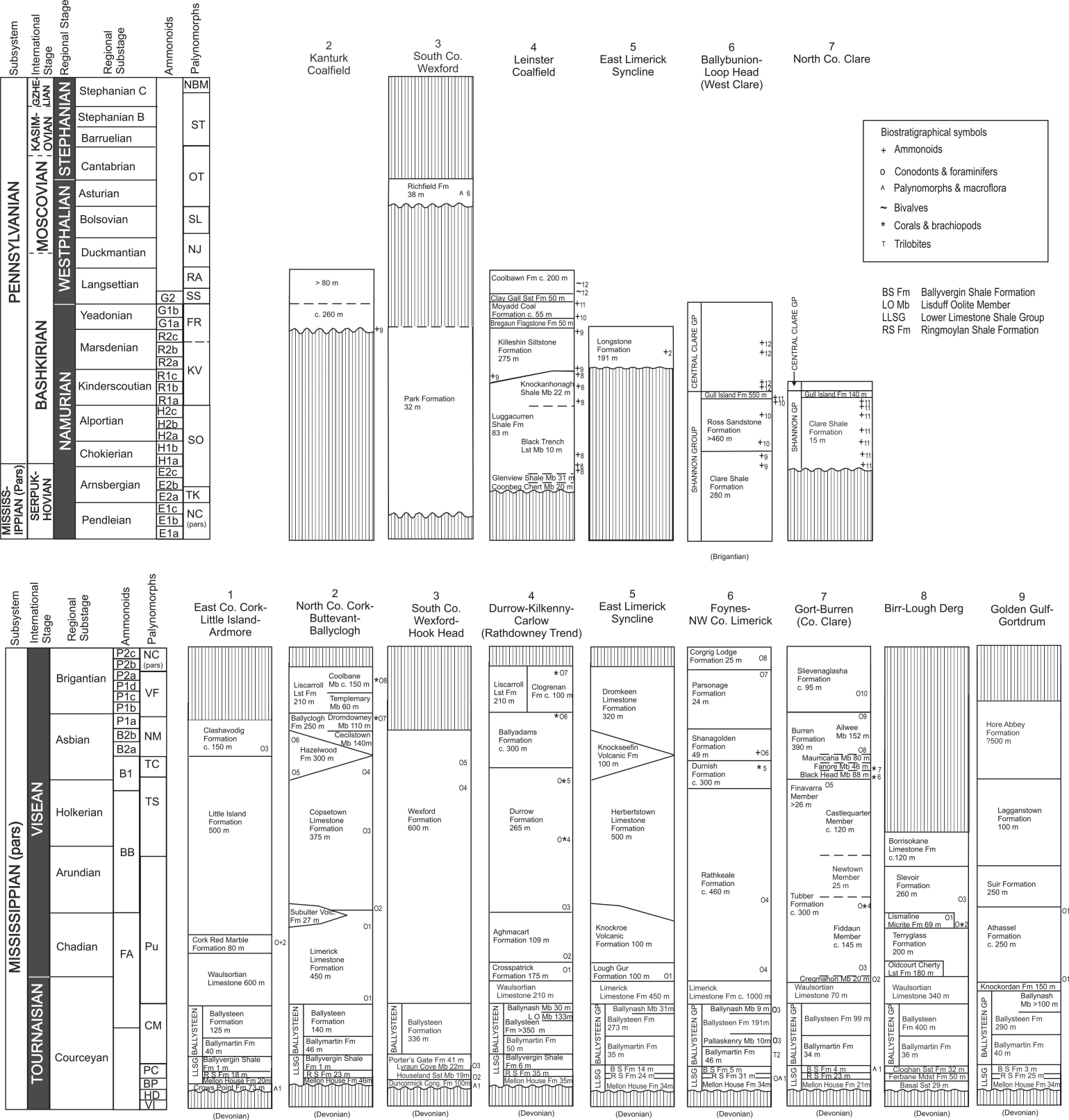
In the Kanturk coalfield more than 80 m of mudstone and sandstone with coal seams occur within the Lenisulcata Chronozone, but there is an absence of marine bands (Ramsbottom *et al.* 1978; Sevastopulo 2001).

In south Co. Wexford (Fig 22.2, Col. 3 [^6]) palynomorphs of Asturian (Westphalian D) age have been identified in a borehole below Permo-Triassic conglomerate and sandstone (Clayton *et al.* 1986). This sequence, named the Richfield Formation, comprises sandstone and mudstone, including a thin bituminous coal containing spores. It is considered that this formation rests unconformably on Namurian strata and that most of the Westphalian A-C is absent.

Fig. 22.1 Geological map showing the distribution of Carboniferous strata from south central Ireland, adapted from GSI (1972), with modifications from Sevastopulo and Wyse Jackson (2001) and Sevastopulo (2001).

Fig. 22.2. Correlation of successions in the south central Ireland region. Col. 1 from Heselden (1991); Sleeman & McConnell (1995); Col. 2 from Hudson & Philcox (1965); Clipstone (1992); Gallagher (1992, 1996); Sleeman & McConnell (1995); Gallagher & Somerville (1997); Pracht (1997); Sevastopulo & Wyse Jackson (2001); Col. 3 from Sleeman *et al.* (1974, 1983); Clayton *et al.* (1986); Tietzsch-Tyler & Sleeman (1994); Nagy (2003); Nagy *et al.* (2005b); Col. 4 from Higgs (1986); Tietzsch-Tyler & Sleeman (1994); Archer *et al.* (1996); Shearley *et al.* (1996); Somerville *et al.* (1996); Nagy (2003); Cózar & Somerville (2005); Gatley *et al.* (2005); Nagy *et al.* (2005a); Col. 5 from Strogen (1988); Somerville *et al.* (1992c); Archer *et al.* (1996); Sevastopulo & Wyse Jackson (2001); Col. 6 from Shephard-Thorn (1963); Somerville & Jones (1985); Collinson *et al.* (1991); Somerville & Strogen (1992); Sleeman & Pracht (1999); Somerville (1999); Col. 7 from Gallagher (1992, 1996); Pracht *et al.* (2004); Gallagher *et al.* (2006); Col. 8 from Brück (1985); Gatley *et al.* (2005); Col. 9 from Steed (1986); Archer *et al.* (1996); Somerville *et al.* (1996).


L M
7. Burren
M N
8.Birr
N O
8.Lough Derg
K.P.
Leinster Massif
L Q
7. North Co. Clare
7.Gort
L.P.
Rathdowney Trend
4.Carlow
Shannon Estuary
4.Durrow
4.Leinster Coalfield
6.Foynes
6. Loop Head
6.Ballybunion
5. East Limerick Syncline
4.Kilkenny
Slieve Ardagh Coalfield
Castleisland
2.Buttevant
3. South Co. Wexford
9.Golden Gulf
Q V
2.Kanturk Coalfield
3. Hook Head
1. Ardmore
V W
W X
X Y
O T
T Y
N
Carboniferous volcanic rocks
Westphalian
Namurian
Tournaisian - Visean
Pre-Carboniferous
0
km
50


Subsystem
International Stage
Regional Stage
Regional Substage
Ammonoids
Palynomorphs
PENNSYLVANIAN
MISSISSIPPIAN (pars)
GZHELIAN
KASIMOVIAN
MOSCOVIAN
BASHKIRIAN
STEPHANIAN
WESTPHALIAN
NAMURIAN
SERPUKHOVIAN
Stephanian C
Stephanian B
Barruelian
Cantabrian
Asturian
Bolsovian
Duckmantian
Langsettian
Yeadonian
Marsdenian
Kinderscoutian
Alportian
Chokierian
Arnsbergian
Pendleian
G2
G1b
G1a
R2c
R2b
R2a
R1c
R1b
R1a
H2c
H2b
H2a
H1b
H1a
E2c
E2b
E2a
E1c
E1b
E1a
NBM
ST
OT
SL
NJ
RA
SS
FR
KV
SO
TK
NC (pars)
2 Kanturk Coalfield
> 80 m
c. 260 m
3 South Co. Wexford
Richfield Fm 38 m
Park Formation 32 m
4 Leinster Coalfield
Coolbawn Fm c. 200 m
Clay Gall Sst Fm 50 m
Moyadd Coal Formation c. 55 m
Bregaun Flagstone Fm 50 m
Killeshin Siltstone Formation 275 m
Knockanhonagh Shale Mb 22 m
Luggacurren Shale Fm 83 m
Black Trench Lst Mb 10 m
Glenview Shale Mb 31 m
Coonbeg Chert Mb 20 m
5 East Limerick Syncline
Longstone Formation 191 m
6 Ballybunion-Loop Head (West Clare)
CENTRAL CLARE GP
SHANNON GROUP
Gull Island Fm 550 m
Ross Sandstone Formation >460 m
Clare Shale Formation 280 m
7 North Co. Clare
CENTRAL CLARE GP
SHANNON GP
Gull Island Fm 140 m
Clare Shale Formation 15 m
Biostratigraphical symbols
+ Ammonoids
o Conodonts & foraminifers
^ Palynomorphs & macroflora
~ Bivalves
* Corals & brachiopods
T Trilobites
BS Fm Ballyvergin Shale Formation
LO Mb Lisduff Oolite Member
LLSG Lower Limestone Shale Group
RS Fm Ringmoylan Shale Formation
(Brigantian)
MISSISSIPPIAN (pars)
TOURNAISIAN
VISEAN
Courceyan
Chadian
Arundian
Holkerian
Asbian
Brigantian
P2c
P2b
P2a
P1d
P1c
P1b
P1a
B2b
B2a
B1
NC (pars)
VF
NM
TC
TS
BB
FA
CM
Pu
PC
BP
HD
VI
1 East Co. Cork-Little Island-Ardmore
Clashavodig Formation c. 150 m
Little Island Formation 500 m
Cork Red Marble Formation 80 m
Waulsortian Limestone 600 m
BALLYSTEEN
LLSG
Ballysteen Formation 125 m
Ballymartin Fm 40 m
Ballyvergin Shale Fm 1 m
R S Fm 18 m
Mellon House Fm 20m
Crows Point Fm 73 m
2 North Co. Cork-Buttevant-Ballyclogh
Liscarroll Lst Fm 210 m
Coolbane Mb c. 150 m
Templemary Mb 60 m
Ballyclogh Fm 250 m
Dromdowney Mb 110 m
Cecilstown Mb 140m
Hazelwood Fm 300 m
Copsetown Limestone Formation 375 m
Subulter Volc. Fm 27 m
Limerick Limestone Formation 450 m
Ballysteen Formation 140 m
Ballymartin Fm 46 m
Ballyvergin Shale Fm 1 m
R S Fm 23 m
Mellon House Fm 46m
3 South Co. Wexford-Hook Head
Wexford Formation 600 m
Ballysteen Formation 336 m
Porter's Gate Fm 41 m
Lvaun Cove Mb 22m
Houseland Sst Mb 19m
Duncormick Cong. Fm 100m
4 Durrow-Kilkenny-Carlow (Rathdowney Trend)
Liscarroll Lst Fm 210 m
Clogrenan Fm c. 100 m
Ballyadams Formation c. 300 m
Durrow Formation 265 m
Aghmacart Formation 109 m
Crosspatrick Formation 175 m
Waulsortian Limestone 210 m
Ballynash Mb 30 m
Ballysteen Fm >350 m
LO Mb 133m
Ballymartin Fm 50 m
Ballyvergin Shale Fm 6 m
R S Fm 35 m
Mellon House Fm 35m
5 East Limerick Syncline
Dromkeen Limestone Formation 320 m
Knockseefin Volcanic Fm 100 m
Herbertstown Limestone Formation 500 m
Knockroe Volcanic Formation 100 m
Lough Gur Formation 100 m
Limerick Limestone Fm 450 m
Ballynash Mb 31m
Ballysteen Fm 273 m
Ballymartin Fm 35 m
B S Fm 14 m
R S Fm 24 m
Mellon House Fm 34m
6 Foynes-NW Co. Limerick
Corgrig Lodge Formation 25 m
Parsonage Formation 24 m
Shanagolden Formation 49 m
Durnish Formation c. 300 m
Rathkeale Formation c. 460 m
Limerick Limestone Fm c. 1000 m
Ballynash Mb 9 m
Ballysteen Fm 191m
Pallaskenry Mb 10m
Ballymartin Fm 46 m
B S Fm 5 m
R S Fm 31 m
Mellon House Fm 34m
7 Gort-Burren (Co. Clare)
Slievenaglasha Formation c. 95 m
Burren Formation 390 m
Ailwee Mb 152 m
Maumcaha Mb 80 m
Fanore Mb 46 m
Black Head Mb 88 m
Finavarra Member >26 m
Castlequarter Member c. 120 m
Tubber Formation c. 300 m
Newtown Member 25 m
Fiddaun Member c. 145 m
Cregmahon Mb 20 m
Waulsortian Limestone 70 m
Ballysteen Fm 99 m
Ballymartin Fm 34 m
B S Fm 4 m
R S Fm 23 m
Mellon House Fm 21m
8 Birr-Lough Derg
Borrisokane Limestone Fm c.120 m
Slevoir Formation 260 m
Lismaline Micrite Fm 69 m
Terryglass Formation 200 m
Oldcourt Cherty Lst Fm 180 m
Waulsortian Limestone 340 m
Ballysteen Fm 400 m
Ballymartin Fm 36 m
Cloghan Sst Fm 32 m
Ferbane Mdst Fm 50 m
Basal Sst 29 m
9 Golden Gulf-Gortdrum
Hore Abbey Formation ?500 m
Lagganstown Formation 100 m
Suir Formation 250 m
Athassel Formation c. 250 m
Knockordan Fm 150 m
Ballynash Mb >100 m
Ballysteen Fm 290 m
Ballymartin Fm 40 m
B S Fm 3 m
R S Fm 25 m
Mellon House Fm 34m
(Devonian)