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Stratigraphy of the Yellow Limestone (Eocene) on the western part of the Clarendon Block, Jamaica

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Abstract. This paper describes the lithostratigraphy of the Yellow Limestone that is developed in northern St Elizabeth and southern St James on the western part of the Clarendon Block. The succession of formations, based on different lithologies is distinguished as follows: Stettin, Papkin (new name), Camperdown (new name); Litchfield; Chapelton, Spring Vale (new name), Merrywood (new name), Ipswich and Appleton (new name).The older formations show alternations of clastic rocks (Papkin and Litchfield formations) with carbonate rocks (Stettin, Camperdown and Chapelton formations); the upper formations show alternations of platform interior facies (Chapelton, Merrywood and Appleton formations) and platform edge facies (Spring Vale and Ipswich formations). The ages of the formations are constrained using larger benthic foraminifers. The cycles developed are compared to standard sequence stratigraphy cycles. The new name Mount Edmondson Formation is introduced for a Cretaceous Formation in the Maldon Inlier.

Keywords: White Limestone Group; Lithostratigraphy; Cenozoic (Paleogene, Neogene); Jamaica; shallow-water facies.

1. Introduction

Central western Jamaica, including northern St Elizabeth (particularly the region around Ipswich and Elderslie) and southern St James, exposes extensive outcrops of the Yellow Limestone on the western margin of the Clarendon Block (**Figure 1**). The area was important for establishing the Ipswich Member (**Versey, 1957**), which was originally assigned to the White Limestone, whereas the succession in the Yellow Limestone around the Maldon Inlier was worked out by Zans (as reported by Chubb in **Zans et al., 1963**) and **Atkinson** (**1969**). **Versey** (**1957**) considered that the Ipswich Member showed a transition from the middle to upper Eocene (which he took at the entry of *Lepidocyclina*), something that he also recognized in the section at Swanswick House, the type locality of the Swanswick Member of the White Limestone (**Hose and Versey, 1956**, Versey in **Zans et al., 1963**). The Geological Survey subsequently mapped the Ipswich Member and Swanswick Formation as a single unit (e.g., **Bateson, 1972a**, **1972b**), which led to a misunderstanding of the stratigraphy of this area. Details of the succession have also been given by Robinson and **Mitchell** (**1999**), **Robinson et al.** (**2018**) and **Gold et al.** (**2018**, based on a fieldtrip led by this author). Some of the units present in this area are the same as those found surrounding the Central Inlier, and those names are retained here. Other units have no representation around the Central Inlier, or show different facies developments, and new names are introduced for them. In this paper a formal lithostratigraphy is proposed for the succession in this area.

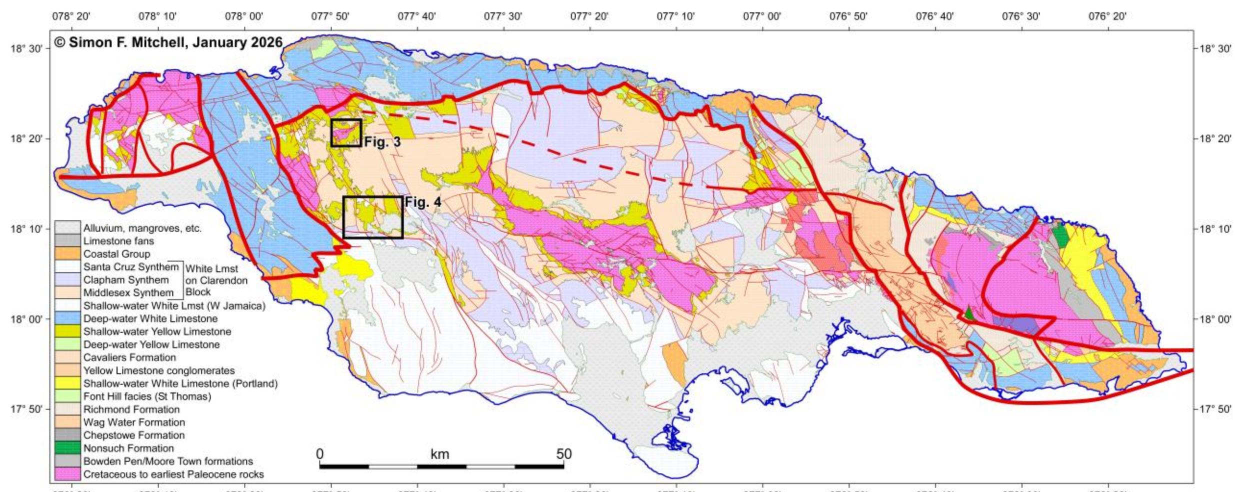

Figure 1. Simplified geology of Jamaica showing blocks and belts (based on White Limestone palaeogeography) and the principal areas studied in this paper.

2. Lithostratigraphy

During the Upper Eocene, the Clarendon Block of central Jamaica can be identified based on the presence of shallow-water facies in the White Limestone Group, which is surrounded by deep-water facies (chalks) of the White Limestone Group found in the Wag Water, North Coast and New Market (ex Montpelier–Newmarket) belts (**Figure 1**). This work follows **Mitchell** (**2016**) as separating the late Paleogene and early Neogene limestones of Jamaica into two groups, the

Yellow Limestone and White Limestone groups, with the base of the White Limestone defined by the base of the Troy Formation.

In this paper the lithostratigraphy and sedimentology of the Yellow Limestone is described, with Larger Benthic Foraminifers (LBF) used for biostratigraphy (**Mitchell et al., 2022**, **2024**). Eight formations are recognized (**Figure 2**) in the Yellow Limestone and are described in detail. The geology of two areas is presented which show the succession of formations in the area: **Figure 3** shows the area around the Maldon Inlier and **Figure 4**, the area around Elderslie; a key is provided in **Figure 5**. In both maps, the unconformity at the base of the Troy Formation (**Figure 6A** and **6B**) is obvious. Ipswich House, which was referred to by **Versey** (**1957**) is now a ruin (**Figure 6C**), but good exposures are still found along the disused Ipswich railway (**Figure 6D**). Following the formal descriptions, the development of cycles is discussed and placed in a sequence stratigraphic framework.

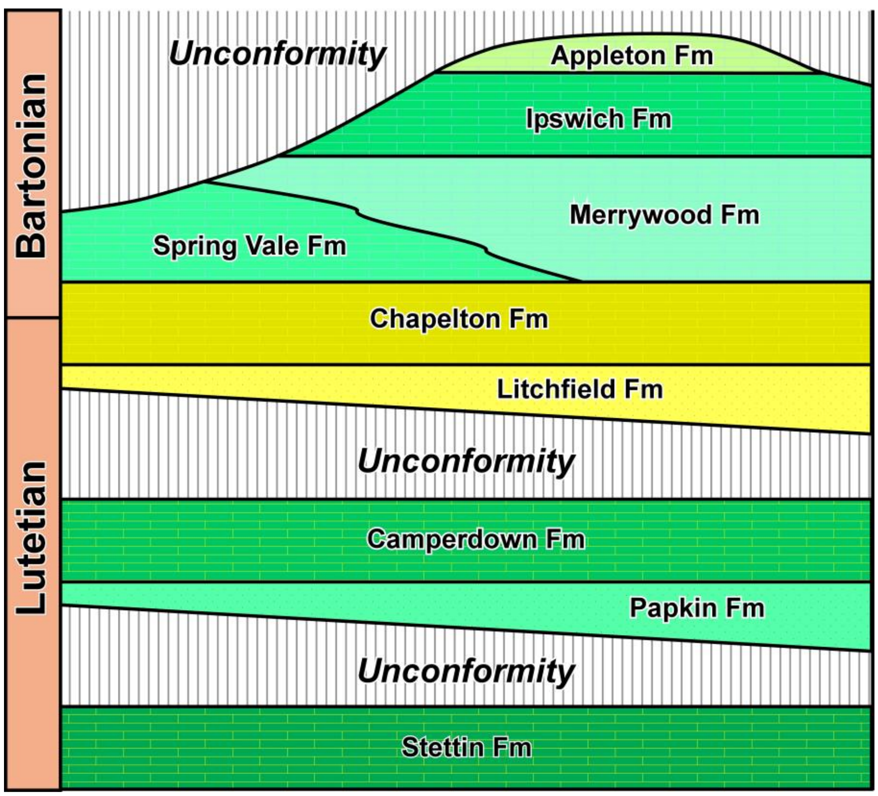

Figure 2. Diagrammatic stratigraphical relationships of the rocks of the Yellow Limestone of the western Clarendon Block.

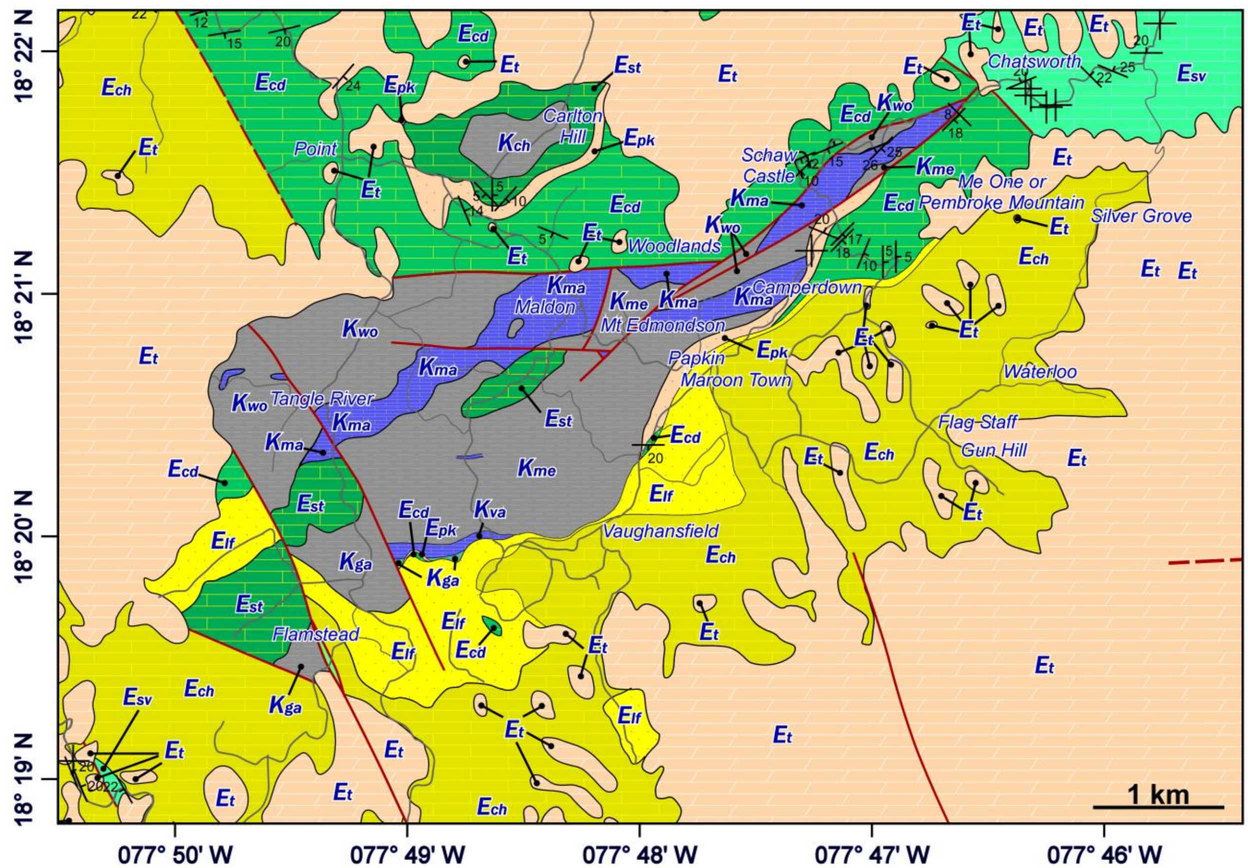

Figure 3. Geology of the area around the Maldon Inlier showing the Yellow Limestone succession and relationships with the underlying rocks of the Cretaceous (updated from Gunter and Mitchell, 2005) and the overlying Troy Formation (White Limestone). See Figure 5 for key.

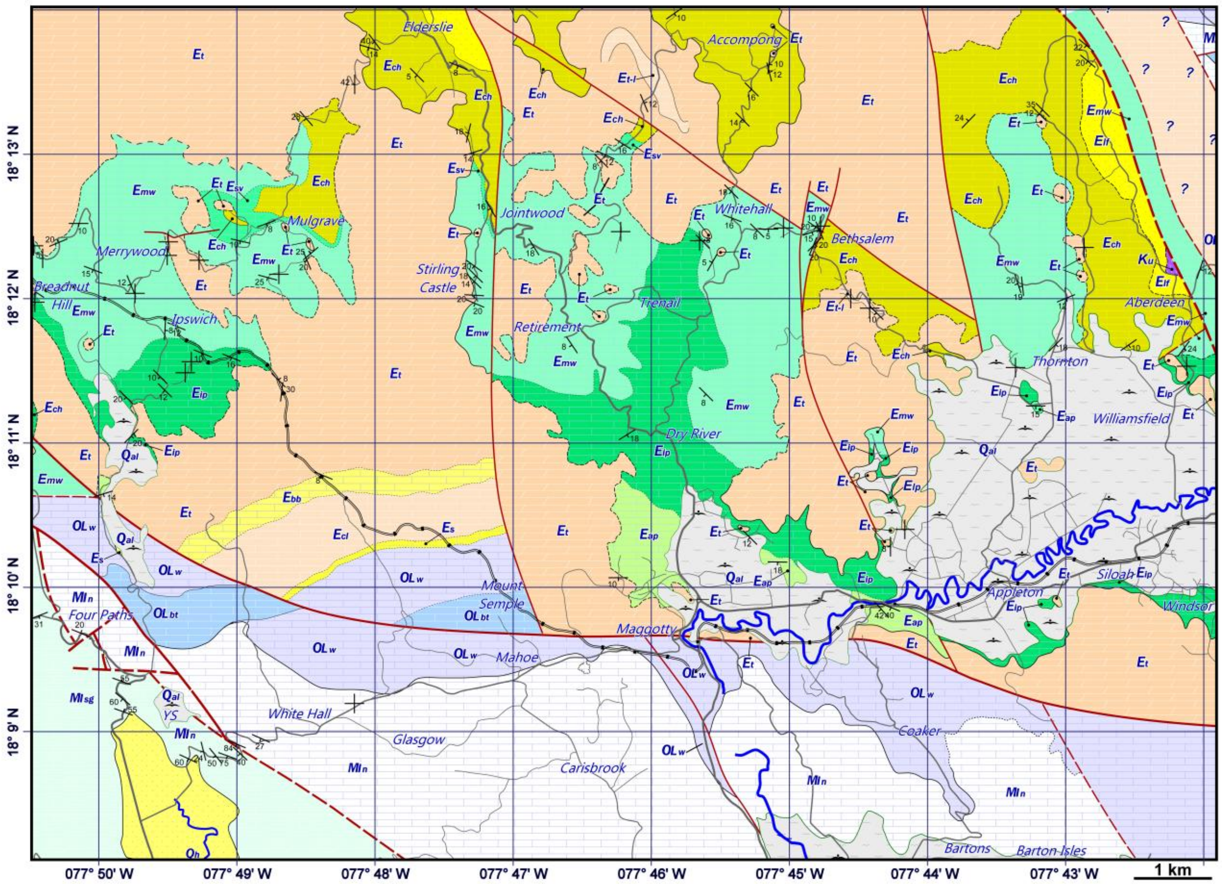

Figure 4. Geology of the area around Elderslie showing the Yellow Limestone succession and relationships with the overlying Troy Formation (White Limestone). See Figure 5 for key.

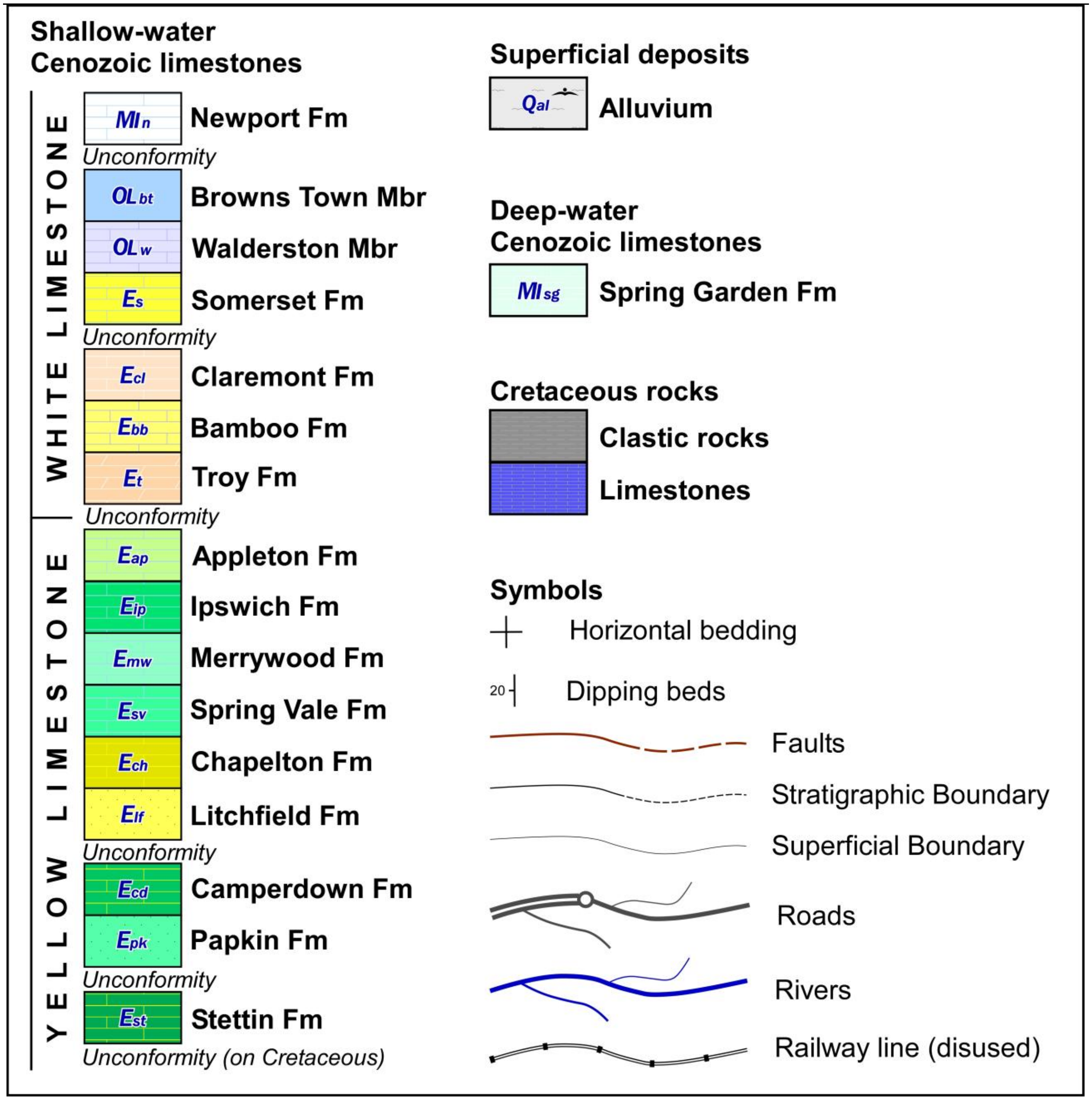

Figure 5. Key to maps shown in Figures 3 and 4.

Figure 6. Illustrations of the unconformity at the base of the Troy Formation and general views of the area. **6A**, Unconformity between the Troy Formation and Ipswich Formation in a field on the road from Ipswich to YS Falls – note the cave with stalactites (above Julian's head) formed in the Ipswich Formation immediately below the unconformity surface; the Troy Formation is horizontal and the Ipswich Formation dips down to the left (south) at 29°. **6B**, Unconformity between the Troy and Merrywood formations on the road from Retirement to Accompong – the unconformity is the irregular surface dipping gently to the right (about halfway up the image on the right), and the Merrywood Formation dips down towards the left at 15°. **6C**, Ruins of Ipswich House (the type section of the Ipswich Formation is where the road to Ipswich House meets the 'Main Road'. **6D**, Tunnel on the disused railway line between Ispwich and Maggotty – this section is critical for understanding the relationship between the Ipswich Formation and the overlying White Limestone succession (Troy, Bamboo, Claremont and Somerset formations).

2.1. Stettin Formation

Introduction. The name Stettin Member was introduced by **Porter and Robinson** (in **Wright, 1974**, p. 41) for the lower unit of limestone in the Yellow Limestone around the Central Inlier. This had previously been called: the Cascade Limestone (**Versey** in **Zans et al., 1963**), the Lower

Limestone of the Chapelton Formation (**Robinson et al., 1972**) and the Cavalier Member of the Chapelton Formation (**Bateson, 1974**). The usage of names is given in **Mitchell et al**. (**2026**, this volume) and is not repeated here.

[These three paragraphs are retained here for review purposes and will be removed from the final version. The name Cascade Formation was used in an unpublished oil company report by **Kozary** (**1956**, p. 10), where it was briefly described; the name was first published as Cascade Limestone by **Versey** (in **Zans et al., 1963**, p. 26), and was subsequently used by **Arden** (**1975**, p. 651). The name is inappropriate as the community of Cascade is situated on rocks belonging to the upper parts of the Litchfield and lower parts of the Chapelton formations; and, in any case, the name Cascade Formation is preoccupied by a Campanian (Cretaceous) unit in the St Ann's Great River Inlier (**Chubb, 1958c**; **Mitchell et al., 2011**) which was formally published prior to the publication of the name Cascade Limestone by **Versey** (in **Zans et al., 1963**).

[The name Cavalier Formation was used by **Bateson** (**1974**) in the side notes to the 1:50,000 Falmouth quadrangle geological map (Geological Survey, Sheet 8), but is preoccupied by the Cavaliers Conglomerate, an Eocene conglomerate unit overlying the granodiorite in the southern part of the Above Rocks Inlier (**Green, 1972**).

[Kozary (**1956**) used the rank of 'formation' for his Cascade Formation, presumably because it was mappable. Although the rank of the Stettin was originally given as 'member' by Versey (in **Zans et al., 1963**), **Robinson and Mitchell** (**1999**) changed the rank to formation. The Stettin Formation is widely distributed around the central and north-western margins of the Central Inlier; and in St James, is only preserved in a fault blocks to the south-west of the Maldon Inlier. Elsewhere across the northern margins of the Cornwall-Middlesex Block it has been remove by erosion prior to the deposition of the Papkin or Litchfield formations.]

Description. In the area around Maldon, the Stettin Formation consists of pale weathering limestones that are unbedded. Molluscs and larger foraminifers are abundant. Polished limestone slabs and thin sections show packed wackestones and floatstones composed of gastropods (**Figure 7**). A complete description of this formation will be given in the paper of the

Yellow Limestone exposed around the Central Inlier where there are much more extensive exposures (**Mitchell et al., 2026 [this volume]**).

Type section. The type section for the formation is located along the road from Freemans Hall to Stettin (Porter and Robinson in **Wright, 1974**, p. 41; **Mitchell et al., 2026**, this volume).

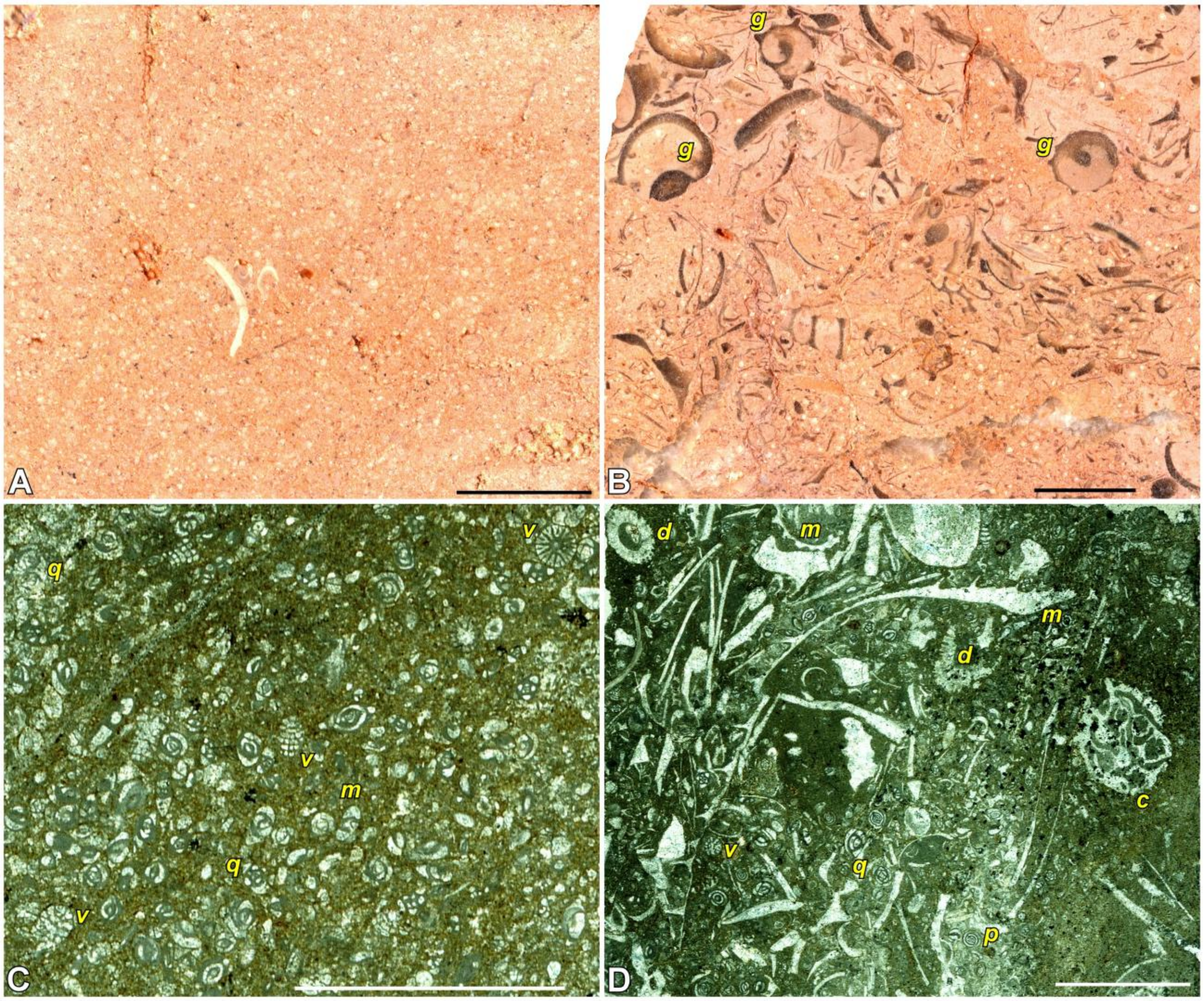

Figure 7. Stettin Formation polished slabs and thin sections from around the Maldon Inlier, St James. **7A** (WL2931), miliolid packed wackestone (polished slab); scale bar = 10 mm. **7B** (WL2933), gastropod (g)-miliolid packed wackestone (polished slab); scale bar = 10 mm. **7C** (WL2931 ii; thin section, ppl), miliolid packed wackestone with quinqueloculine miliolids (q) and *Verseyella jamaicensis* (v); scale bar = 5 mm. **7D** (WL2933 ii; thin section, ppl), sparse floatstone with a packed wackestone matrix containing mollusc debris, branched corals (c), dasycladacean algae (d), quinqueloculine miliolids (q), planispiral miliolids (p), and *V. jamaicensis* (v); scale bar = 5 mm. Both from the western side of the Maldon Inlier: WL2931, 18° 19.866' N, 077° 49.505' W; WL2933, 18° 19.936' N, 077° 49.558' W.

Palaeontology and age. In southern St James, the Stettin Formation contains molluscs and LBF. Amongst the molluscs, gastropods predominate. The LBF include miliolids (quinqueloculine and flat, biserial planispiral forms) and *Verseyella jamaicensis*. Very rare examples of *Helicostegina* belonging to the *H. minor*–*H. gyralis* lineage are also present. Based on the presence of the latter, and the absence of nummulitids, the formation is best attributed to **ABZ6** (**Mitchell et al., 2022**, **2024**).

Distribution. The Stettin Formation occurs in areas within and to the south of the Maldon Inlier. It is only preserved in three small fault blocks, two of which only show the Stettin Formation, and the third of which shows Cretaceous shales overlain by the Stettin Formation which in turn are overlain by sandstones of the Papkin Formation.

Thickness. The formation is relatively thin an estimated thickness of 10–15 m is probably present around the Maldon Inlier.

Discussion. Faunally, the Stettin Formation cannot be easily distinguished from the base of the Camperdown Formation. It is distinguished as a unit since in underlies the Papkin Formation, whereas the Camperdown Formation overlies the Papkin Formation.

2.2. Papkin Formation

Introduction. **Chubb** (**1958**) introduced the name Popkin Series for a series of shales and conglomerates exposed on the road from Maldon to Maroon Town that he believed lay between the Maldon (Cretaceous limestone) and Vaughansfield (Cretaceous limestone) series. The shales contain Cretaceous fossils (**Gunter and Mitchell, 2005**) are attributed to the Cretaceous, but the conglomerates contain only reworked Cretaceous fossils and are attributed to the Yellow Limestone Group here. Although the origin of the name 'Popkin' was stated to be unknown (**Mitchell et al., 2016**), following a discussion with local residents of Maroon Town, it is clear that the name is an incorrect spelling of Papkin Spring, a permanent spring, that issues from the conglomerates on the road from Maroon Town to Maldon. Tim **Atkinson** (**1969**) produced a map for the Maldon Inlier, but was apparently unaware of **Chubb**'s (**1958**) paper (it is not cited). **Atkinson** (**1969**) introduced a different nomenclature, recognizing separate Maldon, Shaw Castle and Vaughansfield limestones (all of Cretaceous age) separated by Cetaceous mudstones (the Summerhill Mudstones below the Maldon Limestone and the

Woodlands Mudstones both between the Maldon and Shaw Castle limestones and above the Vaughansfield Limestone and indicated as of Cretaceous age. The Maroon Town Mudstones are shown above an un-named basal conglomerate, with the conglomerate overlying the Shaw Castle Limestone (between Maroon Town and Shaw Castle) and the Vaughansfield Limestone to the east of Vaughansfield. **Atkinson** (**1969**) attributed the Maroon Town Mudstones to the Cretaceous. From **Atkinson**'s (**1969**, pl. 2) map, however, the basal conglomerate is better interpreted as unconformably cutting across the Cretaceous succession (although **Atkinson**, suggests that the conglomerates represent a tidal channel cut within the Cretaceous limestone 'reef' facies).

Gunter and Mitchell (**2005**) made a separate interpretation based on Gavin Gunter's Ph.D. work. They considered that the Cretaceous (Maastrichtian) rocks of the Maldon Inlier consisted of (from base upwards): Woodlands (corrected from **Chubb**'s, **1958**, Woodland Series) Formation, Maldon Formation (including the Shaw Castle Limestone of **Atkinson, 1969**), Popkin Formation {sic}, Vaughansfield Formation and Flamstead Formation. The name Popkin Formation is a miss-spelling of Papkin and, as noted above, is inappropriate for the Cretaceous rocks; here the name Mt Edmondson Formation (**Appendix 1**) is introduced as a replacement (the community of Mount Edmondson or Mt Edmondson is located on the road from Maldon to Maroon Town on the outcrop of the Cretaceous mudstones between the Maldon and Vaughansfiled formations). The name Flamstead Formation is preoccupied by the Flamstead Limestone of **Matley and Raw** (**1942**), but the name Garlands Formation (after Garlands-Mocho Series of **Chubb, 1958**, and Garland Series of **Chubb, 1960**) is available. **Gunter and Mitchell** (**2005**) placed both the basal conglomerates and the overlying mudstones within the Maroon Town Formation, and it was indicated that these were separated from both the Cretaceous rocks and the Yellow Limestone by unconformities, and the Maroon Town Formation was attributed to the Paleocene or early Eocene.

New geological mapping indicates that the conglomerates underlie the Camperdown Formation and that a unit of sandstones and mudstones underlies the Chapelton Formation, but to the north the Camperdown Formation is present between these two clastic units. The name Papkin Formation is introduced for the unit of conglomerates beneath the Camperdown Formation, and the incorrect spelling Popkin Formation is retired (this should lead to little confusion, as the names are spelt differently). The Maroon Town Formation is also retired because of ambiguity about its age (Maastrichtian, Paleocene or Eocene), and the name Litchfield Formation, proposed in the Central Inlier (**Mitchell, 2016**, **2021**) is used instead. The Litchfield Formation can be seen cutting out the Papkin and Camperdown formations towards the south, suggesting either ongoing tectonic deformation (between the deposition of the Camperdown and Chapelton formations) or sequence stratigraphic control (a retrogradational sequence set).

Description. The Papkin Formation consists of a thin unit of pebble to cobble, clast-supported conglomerates (**Figure 8A–B**). The clasts are generally subangular to subrounded and consist largely of igneous lithologies (andesites and basalts). Reworked, abraded Cretaceous rudists (*Titanosarcolites* sp.) and limestone clasts also occur within the Papkin Formation. In the upper part of the formation, medium- to coarse-grained sandstones are present. The contact with the overlying Camperdown Formation is not exposed, and it is unknown whether there is a transitional unit of siltstones in the upper part of the Papkin Formation.

Type locality. The type locality lies on the road from Maldon to Maroon Town at Papkin Spring, where typical conglomerates of the Papkin Formation are exposed (**Gunter and Mitchell, 2005**, fig. 8).

Thickness. It is difficult to determine the thickness of the formation, but at least 20 m of conglomerates appear to be present.

Distribution. The Papkin Formation can be mapped in an area extending from Shaw Castle toward Vaughansfield on the eastern side of the Maldon Inlier. Here it forms a basal conglomerate to the Camperdown Formation and is cut out by the unconformity at the base of the Litchfield Formation. Conglomerates are also found on the eastern margin of the Sunderland Inlier to the south of Amity Hall, and these are attributed to the Papkin Formation. Further north, to the north of Virgin Valley, also on the eastern side of the Sunderland Inlier, there are further conglomerates which are also tentatively attributed to the Papkin Formation.

Discussion. The conglomerates of the Papkin Formation resemble those of the Freemans Hall Formation, but underlie the Camperdown Formation (early mid Lutetian) rather than the Stettin Formation (earliest Lutetian). They most likely formed as an incised valley system cut into the Cretaceous rocks on the northern margin of the Cornwall-Middlesex Block following faulting (creating the Northern Platform Boundary Fault) and subsequent subsidence within the North Coast Belt (although rocks older that Bartonian are not exposed in this part of the North Coast Belt).

Figure 8. Selected outcrop photographs of the Yellow Limestone from the Elderslie – Ipswich area, northern St Elizabeth. **8A–B**, Papkin Formation, pebble conglomerates, road from Maroon Town to Shaw Castle, edge of Maldon Inlier, St James. **8C**, Litchfield Formation, lignitic shales overlain by sandstones, road cut during road widening operations, Elderslie. **8D**, Chapelton Formation showing typical bedded

yellow-brown limestones, church along the road from White Hall to Accompong, northern St Elizabeth. **8E**, Camperdown Formation, cross-bedded grainstones, Point, St James. **8F**, Merrywood Formation, bedded limestones, Merrywood. Hammer (28 cm) for scale.

2.3. Camperdown Formation

Introduction. The name Camperdown Formation is introduced here for a series of yellow-brown limestones that overlie the Papkin Formation and underlie the Litchfield Formation. The unit is well-developed on the north-eastern margin of the Maldon Inlier and to the east and west of the Sunderland Inlier. This unit is not represented around the margins of the Central Inlier, where the Litchfield Formation rests erosively on the Stettin Formation.

Description. The formation is represented by medium to thickly bedded and lcally cross-bedded (**Figure 8E**) bioclastic, yellow-brown weathering limestones (wakestones, packstones, grainstones, floatstones, carbonate rudstones and grainy rudstones) and thin units of brown dolostones. The limestones are blue-grey when fresh but weather to yellow-brown with blue-hearted cores away from joints. The dolostones are dark brown and form thin inter-beds with the limestones, although in some areas thicker units of dolostones are present. The dolostones cannot be separately mapped. To the north-east of the Maldon Inlier, between the Maldon and Sunderland Inliers and to the east and west of the southern part of the Sunderland Inlier, the Camperdown Formation can be divided into three separate units. These are well-developed on the road that runs from Shaw Castle to Flagstaff. Representative polished slabs are shown in **Figures 9–13** and thin sections in **Figures 14–15**.

The lowest unit is composed on yellow-brown lime mudstones, wackestones and floatstones and is thickly bedded (**Figures 9–10, 14**). Molluscs and stick corals are common in some beds. LBF are ubiquitous and dominated by interior platform forms and *Helicostagina*. The platform interior forms are dominated by miliolids (including quinqueloculine and planispiral forms, as well as some forms with an uncoiled adult stage), *Fallotella floridana*, *Veresyella jamaicensis* and *Coskinolina* cf. *douvillei*. *Helicostegina gyralis* is locally common to abundant and occasional specimens of *Gunteria floridensis* are also present.

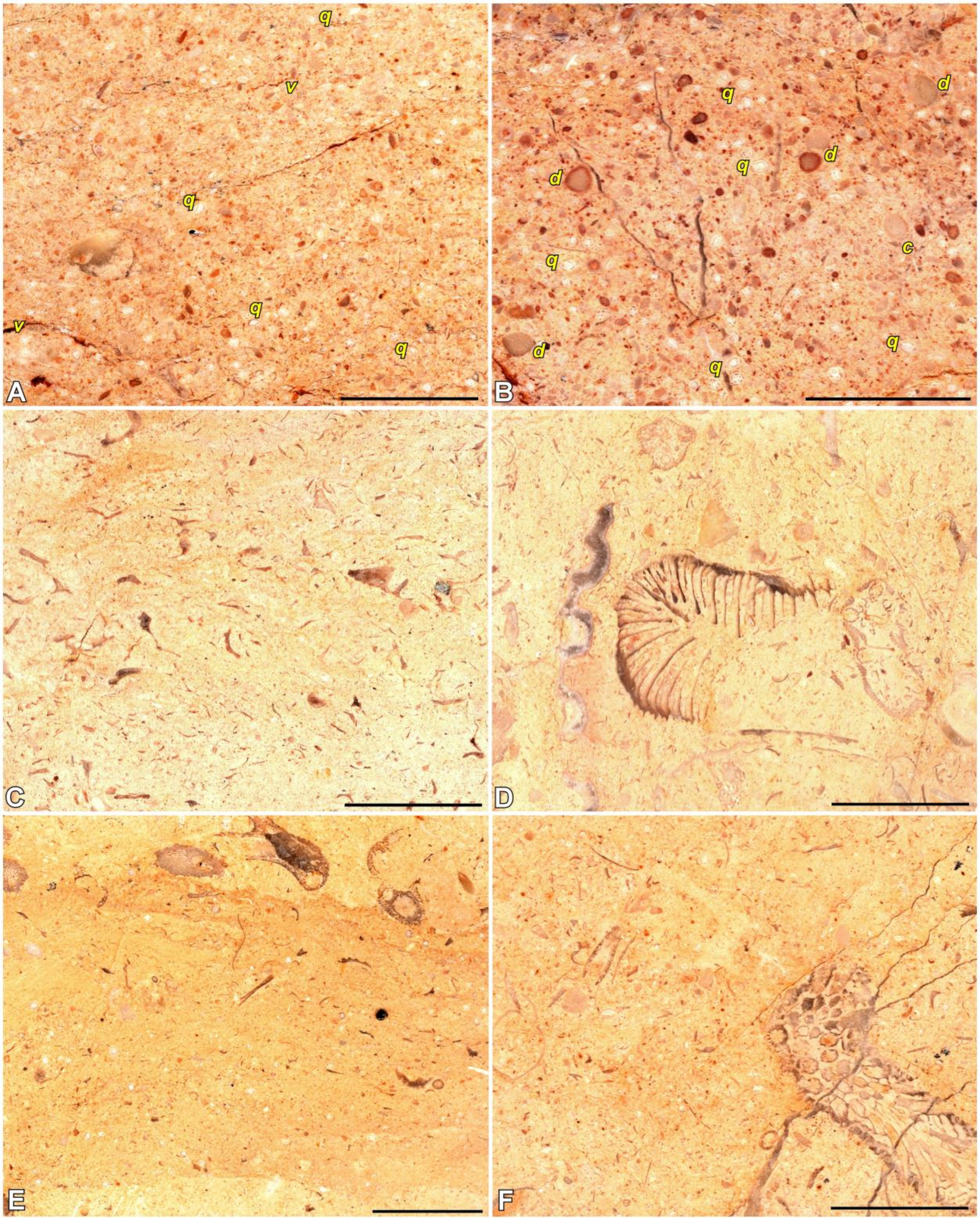

Figure 9. Camperdown Formation polished slabs, platform interior facies, Shaw Castle transect, St James. **A** (WL3209), miliolid packed wackestone to packestone, with *Verseyella jamaicensis* and *Quinqueloclina* sp. B. **B** (WL3210), miliolid-dictyoconid wackestone. **C** (WL3211), molluscan wackestone with fragments of molluscs. **D** (WL3213), packed wackestone with coral and mollusc debris. **E** (WL3214), wackestone to packed wackestone, with coral fragments and miliolids. **F** (WL3216), packed wackestone with coral ragments, miliolids and dictyoconids.

Bioclasts: dictyoconids (d), *Coleiconus zansi* (c), *Quinqueloculina* sp. B (q), and *V. jamaicensis* (v); scale bar = 10 mm.

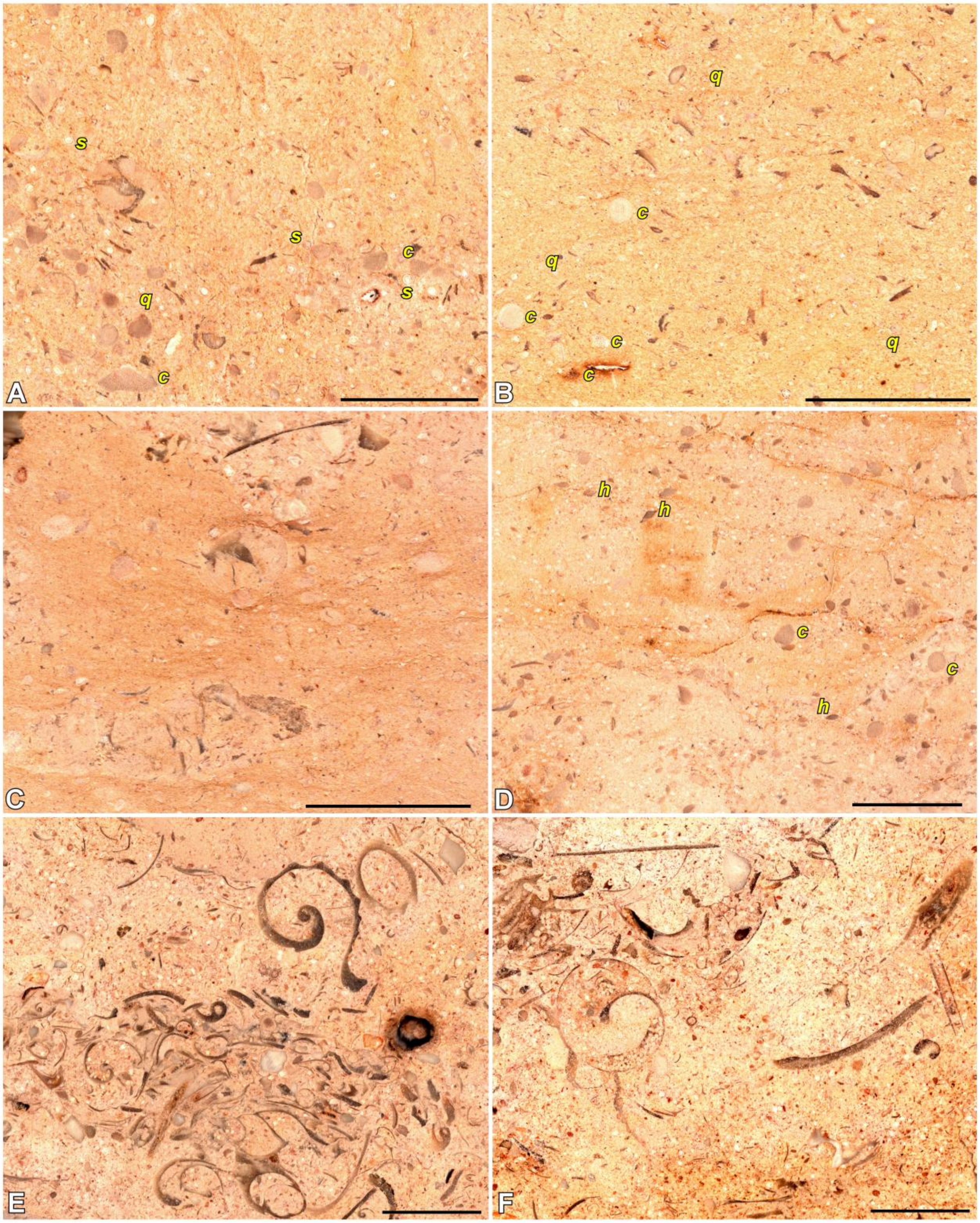

Figure 10. Camperdown Formation polished slabs, platform interior facies, Shaw Castle transect, St James. **A** (WL3217), miliolid-dictyoconid packed wackestone, with Coleiconus zansi and miliolids. **B** (WL3219), miliolid-dictyoconid packed wackestone, with C. zansi and miliolids. **C** (WL3220), burrow-mottle wackestone with wispy (more marly) flasers. **D** (WL3223), packed wackestone with wispy (more marly) flasers and *Helicostegina gyralis*, *C.*

zansi and miliolids. **E–F** (WL3224), molluscan packstone with gastropods and miliolids, different slabs. Bioclasts: *Coleiconus zansi* (c), *Quinqueloculina* sp. B (q), *Spiroloculina* sp. A (s), and *Helicostegina gyralis* (h); scale bar = 10 mm.

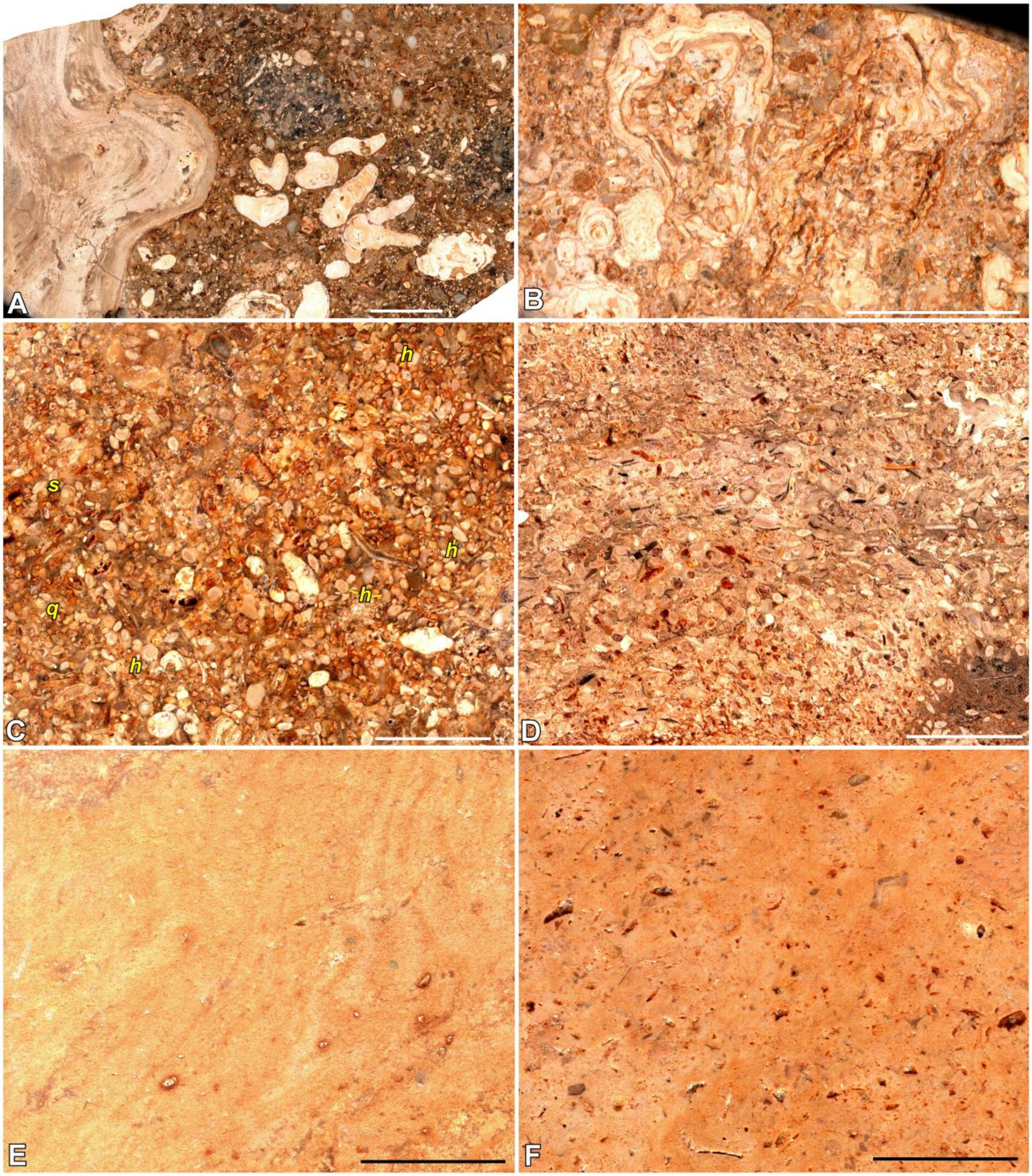

Figure 11. Camperdown Formation polished slabs, platform margin facies, Shaw Castle transect, St James. **A** (WL3229), oncoidal floatstone, with red-algal oncoids and rhodoliths set in a dark, coarse-grained bioclastic sand matrix. **B** (WL3230), oncoidal carbonate rudstone, with a dark, coarse-grained bioclastic sand matrix. **C** (WL3230), Poorly washed carbonate grainstone with common *Helicostegina gyralis*, some *Quinqueloculina* sp. B, and micritized grains. **D** (WL3231), foraminiferal grainstone with abundant *Helicostegina gyralis*/*dimorpha*. **E** (WL3232),

dolostone (no primary fabrics preserved). **F** (WL3233), dolostone, vugs after allochems. Bioclasts: dictyoconids (d), *Helicostegina gyralis/dimorpha* (h), *Quinqueloculina* sp. B (q), and *V. jamaicensis* (v); scale bar = 10 mm.

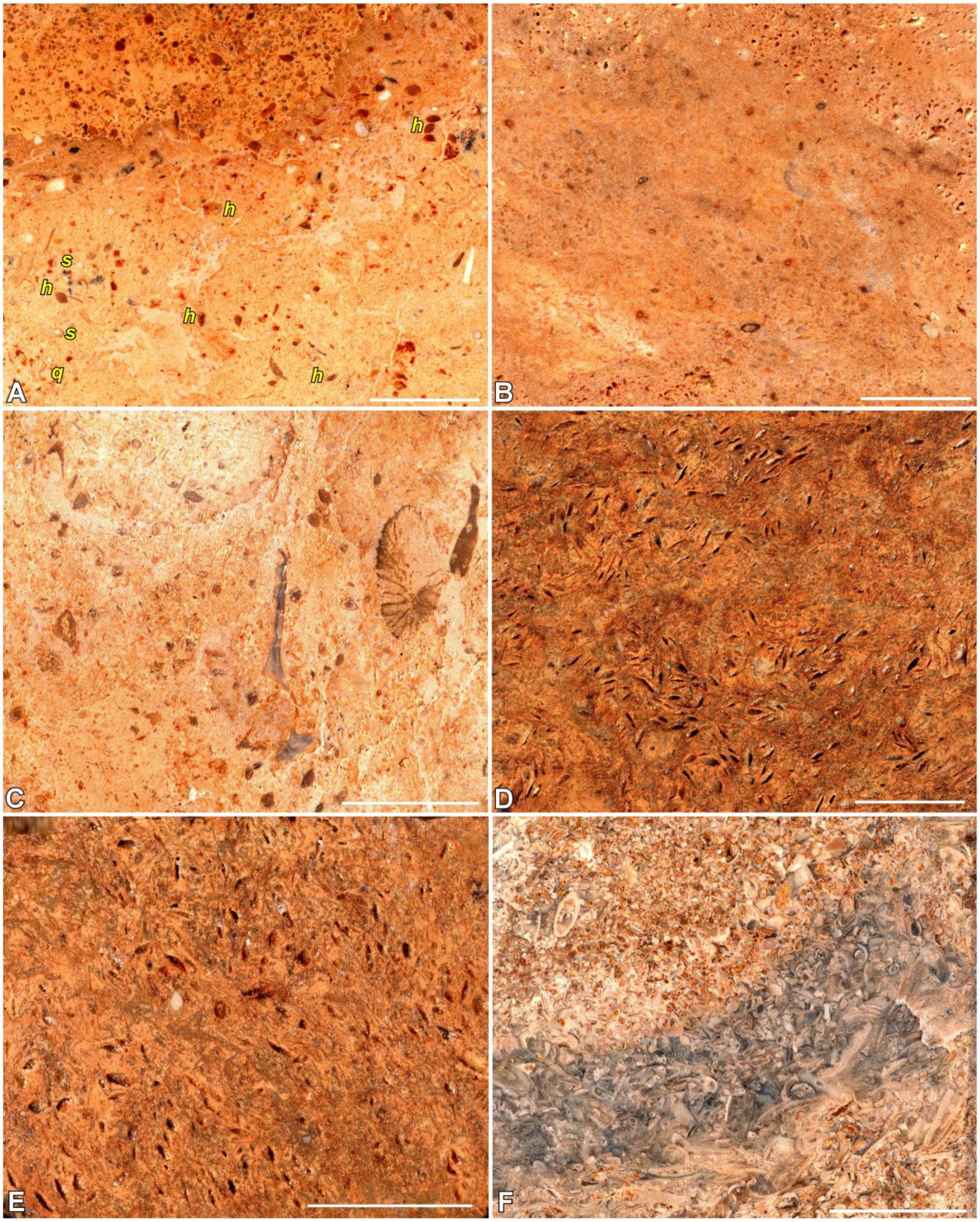

Figure 12. Camperdown Formation polished slabs, platform interior facies, Shaw Castle transect, St James. **A** (WL3234), partially dolomitized limestone, with miliolids resisting dolomitization, and *Helicostegina* showing partial dolomitization; matrix (particularly at top) completely dolomitized. **B** (WL3236), dolostone. **C** (WL3237), dolostone, with coral and calcitic bivalve resisting dolomitization. **D** (WL3238), dolostone with vugs after lenticular

foraminifers. **E** (WL3242), dolostone with vugs after lenticular foraminifers. **F** (WL3242A), grainstone with miliolids and rarer lepidocyclinids and mollusc fragments; differential colours due to weathering. Bioclasts: *Helicostegina gyralis/dimorpha* (h), *Quinqueloculina* sp. B, *Spiroloculina* sp. (s); scale bar = 10 mm.

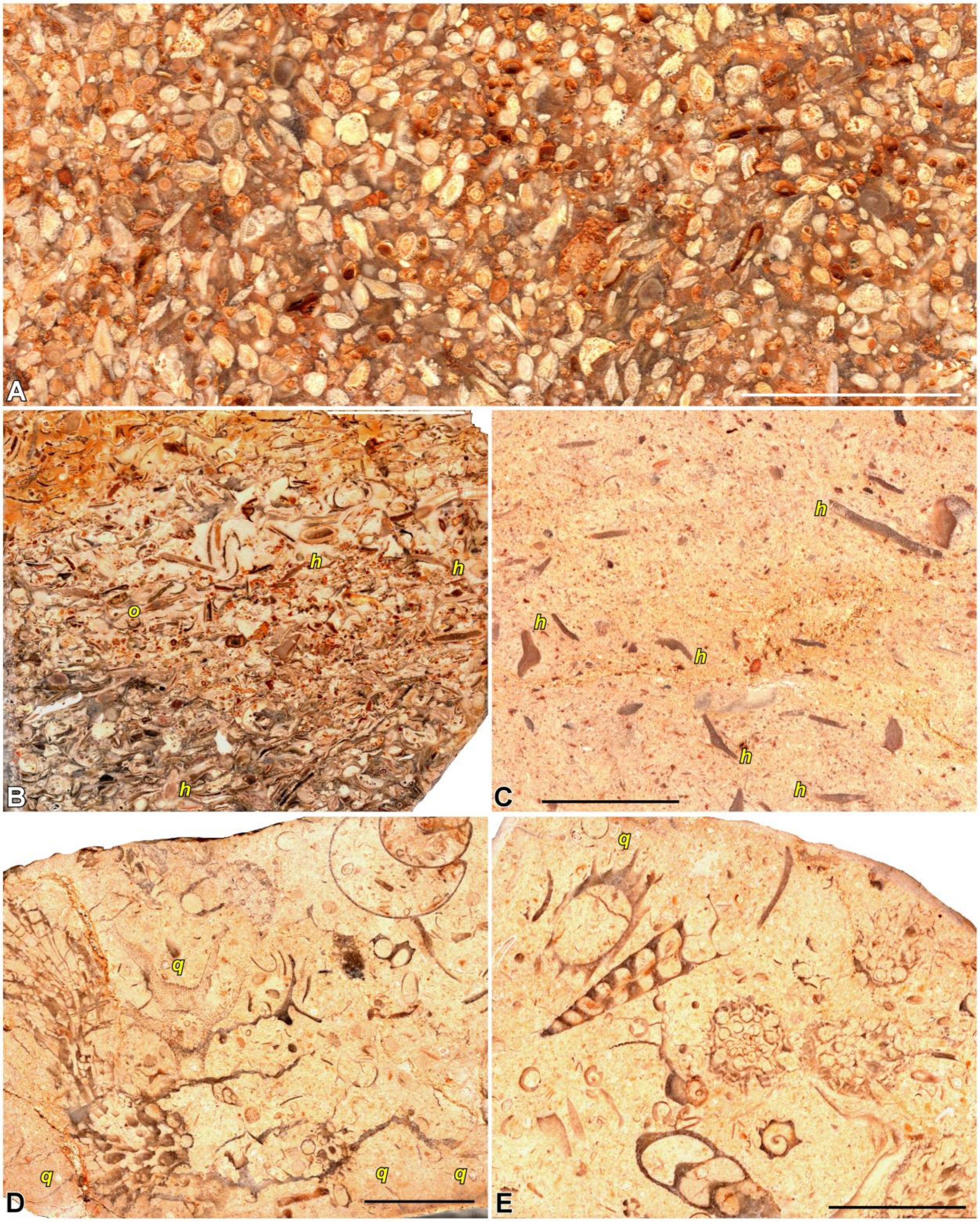

Figure 13. Camperdown Formation polished slabs, platform margin facies (A-B) and platform interior facies (C-E), St James. **A** (WL2875), bioclastic grainstone with abundant *Helicostegina dimorpha*, *Polyorbitoinella*? and *Fabiania.* **B** (WL3243), bioclastic grainstone/grainy rudstone with bivalve fragments and rarer foraminifers (*Helicostegina*

jeannemairae (h), *Operculinoides* sp. (o)). **C** (WL3244), wackestone with common *H. jeannemairae* (h). **D–E** (WL3245), packed wackestone to floastone (two different slabs) with gastropods and branched corals, miliolids (*Quinqueloculina* sp. rare (q)). Scale bar = 10 mm.

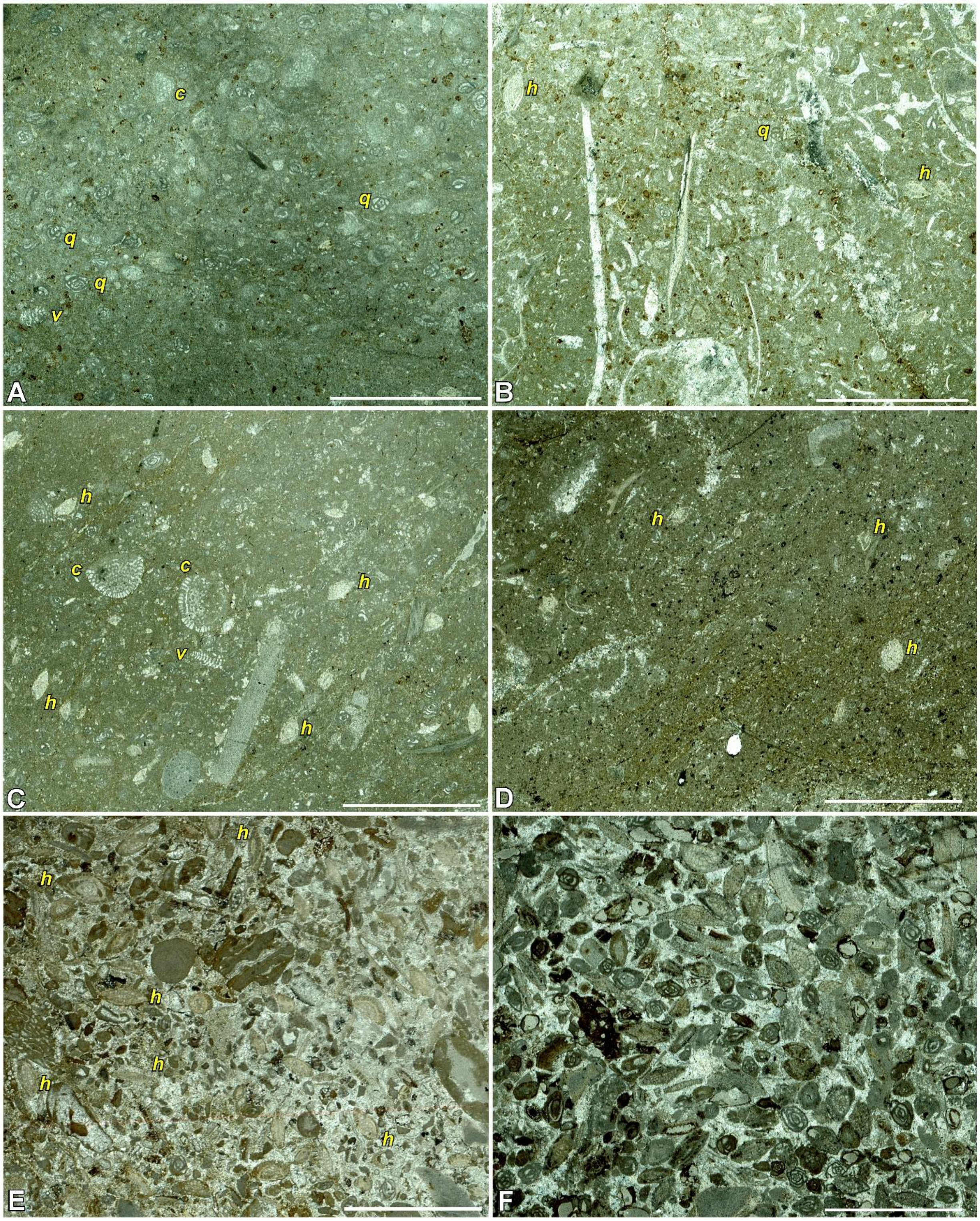

Figure 14. Camperdown Formation thin sections. **A** (WL3216-2), packed wackestones with dictyoconids. **B** (WL3216), floatstone with mollusc fragments, *Helicostegina* sp. and *Quinqueloculina* sp. **C** (WL3223), floatstone with *Coleiconus zansi*, *Helicostegina* sp., and *Verseyella jamaicensis*. **D** (WL3228), wackestone with *Helicostegina*

sp. **E** (WL3229), grainstone with bioclasic debris and *Helicostegina* sp. **F** (WL2875), grainstone with abundant *Helicostegina dimorpha*, miliolids and rarer lepidocyclinids. Bioclasts: dictyoconids (d), *Coleiconus zansi* (c), *Quinqueloculina* sp. (q), and *V. jamaicensis* (v); scale bar = 5 mm.

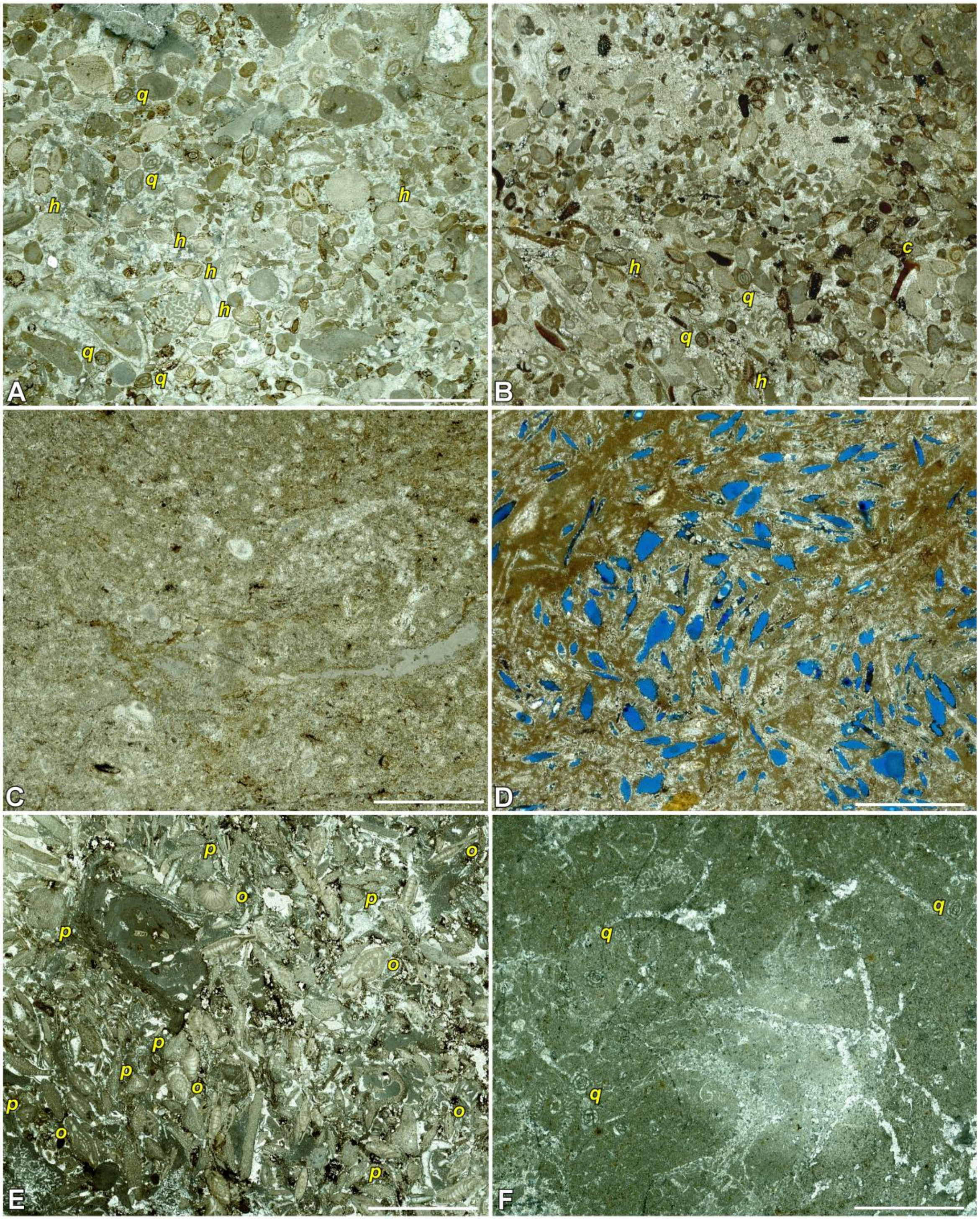

Figure 15. Camperdown Formation thin sections (plane polarized light). **A** (WL3230), bioclastic grainstone with abundant *Helicostegina* sp., also *Quinqueloculina* sp. **B** (WL3231), bioclastic, poorly washed grainstone with abundant *Helicostegina* sp. (some clearly *H. dimorpha*), also *Quiqueloclina* sp. **C** (WL3235), dolomitized limestone with ghosts after bioclasts. **D** (WL3240), dolomitized limestone with bioclasts (lenticular foraminifers) as voids (filled with blue dye) or filled with a fringe cement of calcite crystals. **E** (WL3241), grainstone with early pressure

solution; fauna includes *Operculinoides* sp. and *Polyorbitoinella*? sp. **F** (WL3245), wackestone with scattered corals and *Quinqueloculina* sp.; also calcite veins. Bioclasts: *Helicostegina* sp. (h), *Quinqueloculina* sp. (q), *Operuclinoides* sp. (o) and *Polyorbitoinella*? sp. (p). Scale bar = 5 mm.

The middle unit consists of yellow-brown packstones, grainstones, floatsones and rudstones; locally ripple-cross-lamination and small-scale, low-angle cross stratification are present indicating deposition under currents (**Figure 8E**). LBF dominate and there is a notable presence of platform-edge taxa. *Helicostegina* cf. *dimorpha* is abundant and occurs with common *Operculionides* spp. and rarer *Eolepidina* sp. Thin units of brownish sucrosic dolostone characterise the tops of some beds, and have distinctive lens-shaped voids after the LBF. In the lower part of the unit, red algae and rhodoliths are frequent to abundant. Molluscan debris is common in the upper part of this unit which is represented by packstones and carbonate rudstones, and this part of the succession contains scattered examples of *Helicostegina jeannemairae*.

The upper part of the formation sees a return to yellow-brown wackestones with some molluscs and scattered examples of *H. jeannemairae*. This part of the sequence is not well exposed on the road section above Shaw Castle, but was exposed on the upper section of the road from Point to Carlton Hill (**Mitchell et al., 2022**).

Type Locality. The type locality is on the road from Shaw Castle to Flagstaff between 18° 21.241' N, 077° 47.129' W and 18° 21.123' N, 077° 46.973' W. A thickness of 70 m of limestone has been logged with an unexposed interval (maybe 30 m) above.

Age. The succession of LBF was investigated in the road section at Shaw Castle, St James. The succession begins with a relatively restricted LBF assemblage containing *Fallotella*, *Verseyella jamaicensis*, *Coskinolia* cf. *douvillei* and *Heterostegina gyralis*. This assemblage can be dated as upper **ABZ6**. The appearance of *Operculinoides* spp. marks zone **ABZ7**, whereas the presence of *Eolepidina* and *H. jeannemairae* marks zones **ABE7** and lower **ABZ8**. The Camperdown Formation is therefore of early to mid Lutetian age.

Distribution. The Camperdown Formation is only found in southern St James. It occurs extensively around the northern margin of the Maldon Inlier, between the Maldon and Sunderland Inliers and to the east and west of the southern part of the Sunderland Inlier. In southern St James, the Litchfield Formation can be seen to cut out the Camperdown Formation towards the south. Elsewhere, the formation is absent and was either, not deposited or it has been removed by erosion prior to the deposition of the Litchfield Formation.

The lithofacies and biofacies of the Camperdown Formation suggest a transgressive-regressive cycle. The transgessive conglomerates of the Papkin Formation are overlain by more restricted limestone facies in the lower part of the Camperdown Formation, suggesting deposition in protected carbonate lagoons on the platform interior. The middle part of the Camperdown Formation sees ripple-cross laminated and cross-stratified grainstones with a platform edge LBF assemblage including leipidocyclinids and nummulitids. This suggests a more open marine environment with the ripple-cross-lamination and low-angle-cross stratifications suggesting the migration of sand waves and sand bars on a wave washed shelf. The presence of dolostones capping some of these units suggests diagenesis leading to early domolitization. The return to more micritic facies suggests regression and progradation of platform interior deposits. The Camperdown Formation records the third marine transgression onto the Cornwall-Middlesex Block.

2.4. Litchfield Formation

Introduction. The name Litchfield Formation was introduced by **Mitchell** (**2016**) for the clastic unit at the base of the Chapelton Formation in the Central Inlier that had been assigned to the Guys Hill Formation (**Burke et al.**, **1969**; **Coates**, **1969**). However, the Guys Hill Formation is of mid Ypresian (Early Eocene) age and the Litchfield Formation is of mid Lutetian (early Middle Eocene) age (**Mitchell, 2016**). The name Litchfield Formation is now used for all the clastic units that lie below the Chapelton Formation in St Mary, St Catherine, Manchester, Trelawny, St James and St Elizabeth.

The Litchfield and Chapelton formations are partially age-equivalent facies in the transgressive Litchfield–Chapelton cycle as seen around the Central Inlier (**Maharaj and Mitchell**, **2000**). Around the Central Inlier, sandstones and shales dominate in the south, but pass into impure limestones towards the north. This is particularly well demonstrated by the Dump Limestone Tongue (**Robinson, 1969**) within the Litchfield Formation (in the Coleyville-

Dump area) which passes into the lower part of the Chapelton Formation to the north. Exposures of the Litchfield Formation are generally poor in the Maldon Inlier–Elderslie area, making the formation difficult to map. A good exposure was temporarily available during the widening of the road due south of Elderslie (**Figure 8C**).

Description. The Litchfield Formation consists of alternating units of yellow-weathering sandstones and grey mudstones and shales. At the base is a thin unit of pebble and cobble conglomerate which was cored in the PCJ Elderslie-#1 Corehole. The sandstones consist of medium grained sub-litharenites which range in thickness from a few deci-metres to several metres. The mudstones and shales are dominated by claystones and siltstones and are locally laminated. Thin lignite-rich shales are developed at some levels. The unit thins towards the north, but can be mapped in the areas around Vaughansfield, Maroon Town and Point, where it separates the Camperdown Formation from the Chapelton Formation.

Age. In southern St James and northern St Elizabeth, the Litchfield Formation is unfossiliferous. A Lutetian age can be attributed based on the ages of the underlying (Camperdown) and overlying (Chapelton) formations.

Thickness. There is no complete section showing the full thickness of the Litchfield Formation in the northern St Elizabeth area. The Elderslie-#1 Corehole penetrated 60 m which are attributed to the Litchfield Formation, but the upper boundary lies away from the corehole locality, and at least another 10 m must be added to this figure. The thickness adjacent to the Aberdeen Inlier appears to be significantly thinned, and it is absent around the area of Spice Grove in Manchester.

Remarks. The Litchfield Formation is important as a potential hydrocarbon source rock and as reservoir rocks. It contains organic-rich shales up to several metres thick which have yielded high TOC values around the Central Inlier (**Mitchell et al., 2026, this volume**). Where well exposed around the Central Inlier, the unit is attributed to a deltaic environment in the north and a fluvial environment in the south (**Mitchell et al., 2026** [this volume]).

2.5. Chapelton Formation

Introduction. The historical use of the name 'Chapelton beds' or 'Chapelton Formation' has been given by **Mitchell et al.** (**2026, this volume**) and need not be repeated here. The name is applied to the yellow-brown limestones that occur above the Litchfield Formation. In the western part of the Clarendon Block, the Chapelton Formation is succeeded by pale grainstones of the Spring Vale Formation, or by pale wackestones of the Merrywood Formation.

Type Locality. Hill (1899, p. 61) clearly states that the Chapelton beds have typical sections along the main street through Chapelton and in the lower road that parallels the main street.

Description. The Chapelton Formation consists of a series of impure, bedded limestones which typically weather to yellow brown, but are blue-grey when fresh (blue-hearted limestones). They are characterized by wackestones, packstones, floatstones and carbonate rudstones, with subsidiary grainstones. Bioclasts consist of molluscs (bivalves and some gastropods) and LBF. Locally, echinoids occur in abundance. The bedded limestones are interbedded with impure clastics (shales and siltstones); these are thicker and more frequent in the lower part of the formation.

In general, the Chapelton Formation can be divided here into a thicker lower unit of yellow-brown limestones with a platform edge LBF assemblage, and a thinner upper unit of yellow-brown limestones with a platform edge assemblage of LBF (**Figures 16** to **20**). The lower part consists of bedded yellow-brown lime mudstones, wackestones and occasional packstones and carbonate rudstones with molluscs (better preserved, calcitic forms being referred to *Cubitostrea*, *Flemingostrea* and *Carolia*), stick-morphology corals and inner platform LBF. In the lower part, siltstones are inter-bedded with the bioclastic limestones. The LBF assemblage typically includes *Pellatispirella matleyi*, *Fabularia* sp. and locally very rare specimens of *Helicostegina jeannemairae*. The latter suggests assignment to **ABZ9** (**Mitchell et al, 2022**). The upper part of the formation consists of packstones with *Yaberinella* spp. and common examples of *Eolepidina gardnerae* and *Polylepidina chaiapsensis* allowing assignment to **ABZ10** and **ABZ11** (**Mitchell et al, 2022**). It is notable that there is no stratigraphic overlap in the ranges of *Helicostegina* and *Yaberinella*. The upper facies is absent in the east, but thickens progressively to the west and is well-developed around Pisgah. An echinoid-rich interval can be recognized in the Chapelton Formation in the area around Thornton, and specimens weather out into the soils. The fauna from here was described by **van den Ende and Donovan** (**2015**) and included: *Acanthechinus peloria* (Arnold and Clark), *Oligopygus* sp., *Fibularia jacksoni* Hawkins, *Neolaganum* sp., *Eupatagus alatus* Arnold and Clark and *E.* cf. *clevei* (Cotteau). This assemblage was attributed to the Dump Member (**van den Ende and Donovan, 2015**), but is better placed in the Chapelton Formation (**Mitchell, 2015**) – the Dump Member is not developed in this area. Extensive exposure also occur around Nottingham and Appleton, but have not be investigated in detail.

Age. The Chapelton Formation contains a platform interior LBF assemblage in the lower part and includes some platform edge LBF in its upper part (particularly in northern and western exposures). In the Elderslie area, the lower part of the Chapelton Formation contains *Verseyella jamaicensis* and rare *Helicostegina jeannemairae* suggesting **ABZ9**. The upper part here contains *Yaberinella* ex. gr. *hottingeri* and *Eo. gardnerae* indicating **ABZ10**. The uppermost part of the Chapelton Formation south of Elderslie contains *P. chiapasensis* allowing assignment to **ABZ11**. The Chapelton Formation is therefore of late Lutetian to earliest Bartonian age.

Thickness. The thickness is difficult to determine as no complete section is available. It probably ranges from 50 to 70 m thick.

Remarks. The Chapelton Formation is the most widespread unit of the Yellow Limestone across the Clarendon Block and western Jamaica.

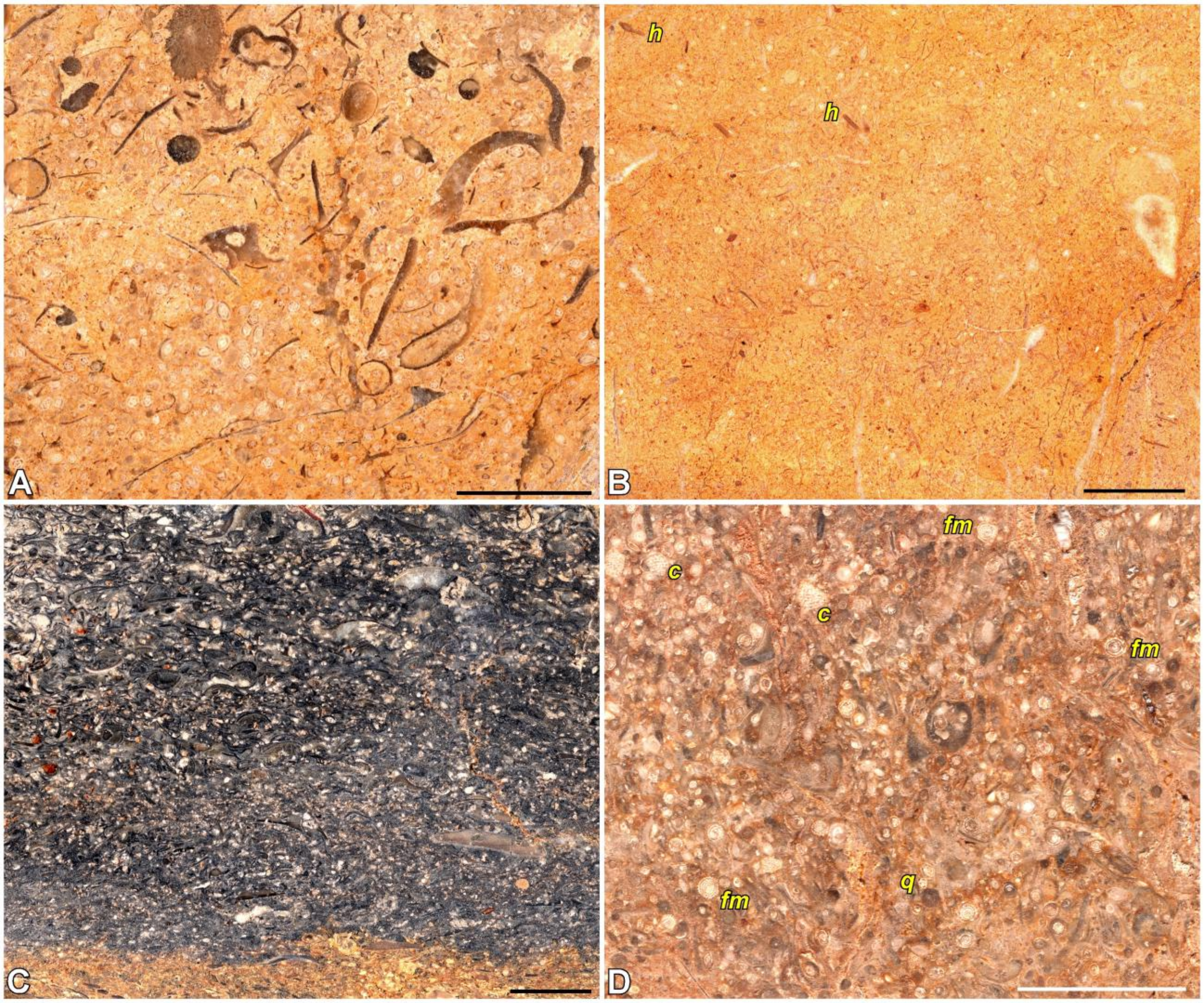

Figure 16. Chapelton Formation polished slabs from northern St Elizabeth and southern St James. **A** (WL2611), miliolid molluscan wackestone. **B** (WL2602), packed wackestone with miliolids and scattered *Helicostegina jeannemairae* (h). **C** (WL2613), molluscan packstone to grainstone with scattered miliolids; the dark grey colour is fresh (blue-hearted) limestone, and the yellow-brown colour (lower part of photograph) is the weathered limestone. **D** (WL2614), yellow-brown packstone with *Fabularia matleyi* (fm), *Coeliconus christianiensis* (c) and *Quinqueloculina* sp. (q). Scale bar = 10 mm.

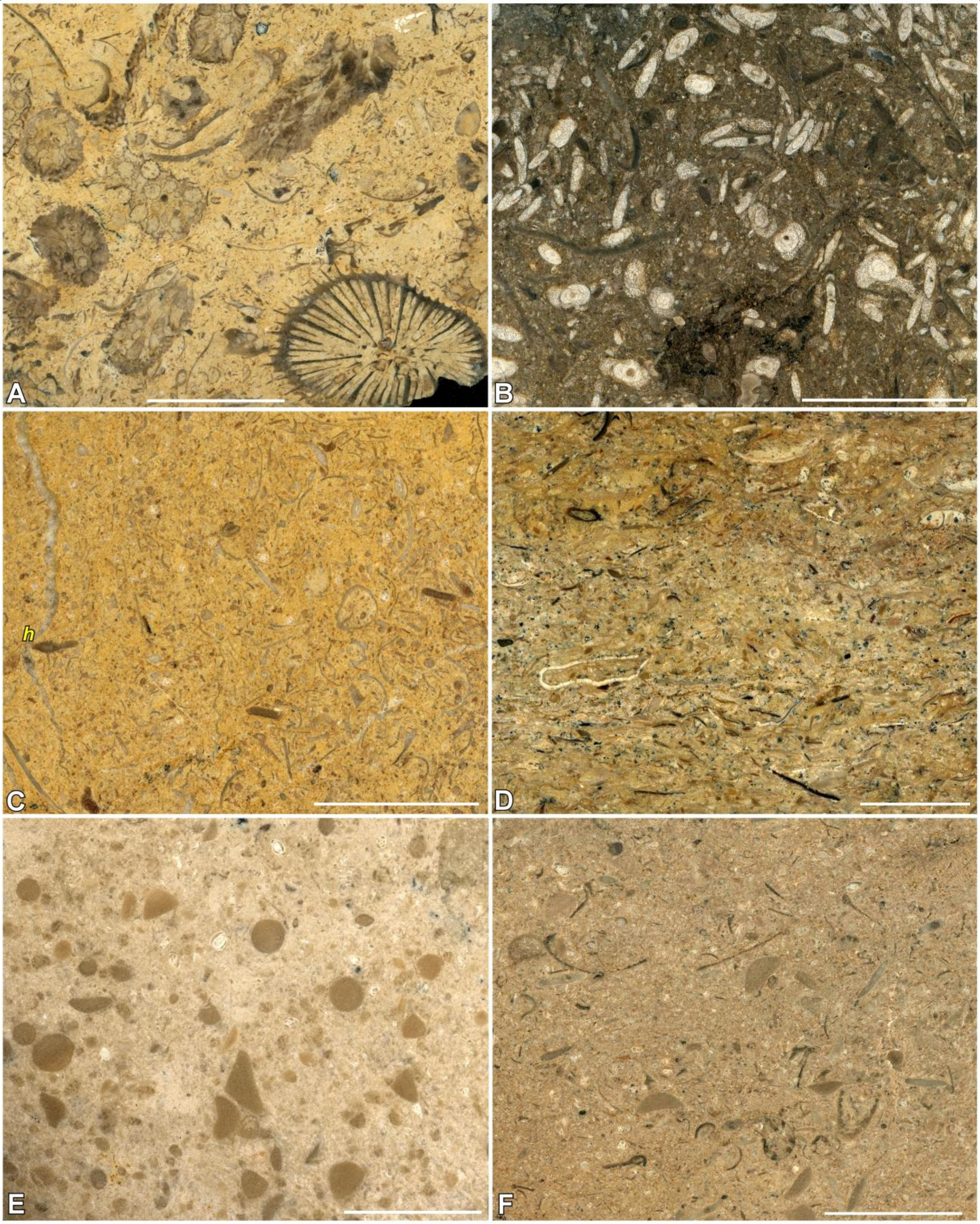

Figure 17. Chapelton Formation, polished slabs. **A** (WL2622), floatstone with a carbonate mudstone matrix and abundant corals. **B** (WL2908), packed wackestone with abundant *Yaberinella* cf. *hottingeri*. **C** (WL2602), fine-grained packstone with scattered *Helicostegina jeannemairae.* **D** (WL2970), packstone with scattered crab fragments (white). **E** (WL2948), packed floatstone with a fine-grained packstone matrix and common dictyoconids. **F** (WL2949), floatstone with a fine-grained packstone matrix and common dictyoconids. Scale bar = 10 mm.

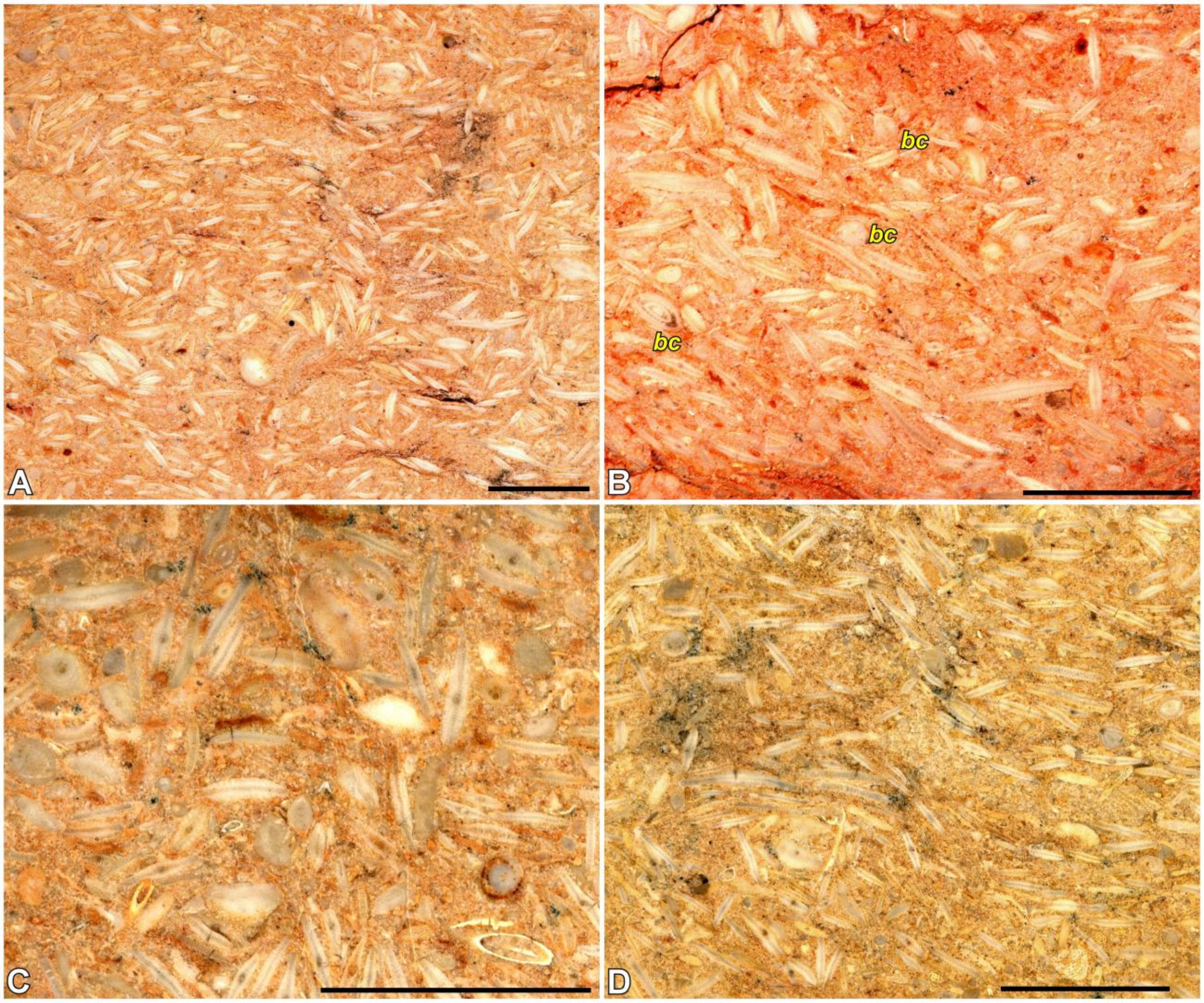

Figure 18. Chapelton Formation (lepidocyclina facies) polished slabs, St Elizabeth. **A** (WL3199), yellow-brown packstone with abundant *Polylepidina chiapasensis*. **B** (WL2617), yellowish grainstone with common *P. chiapasensis* and scattered *Butterliniana cubensis*. **C** (WL2617), yellow-brown packstone, with *P. chiapasensis* with equatorial sections. **D** (WL2618), yellow-brown packstone, with *P. chiapasensis*. Scale bar = 10 mm.

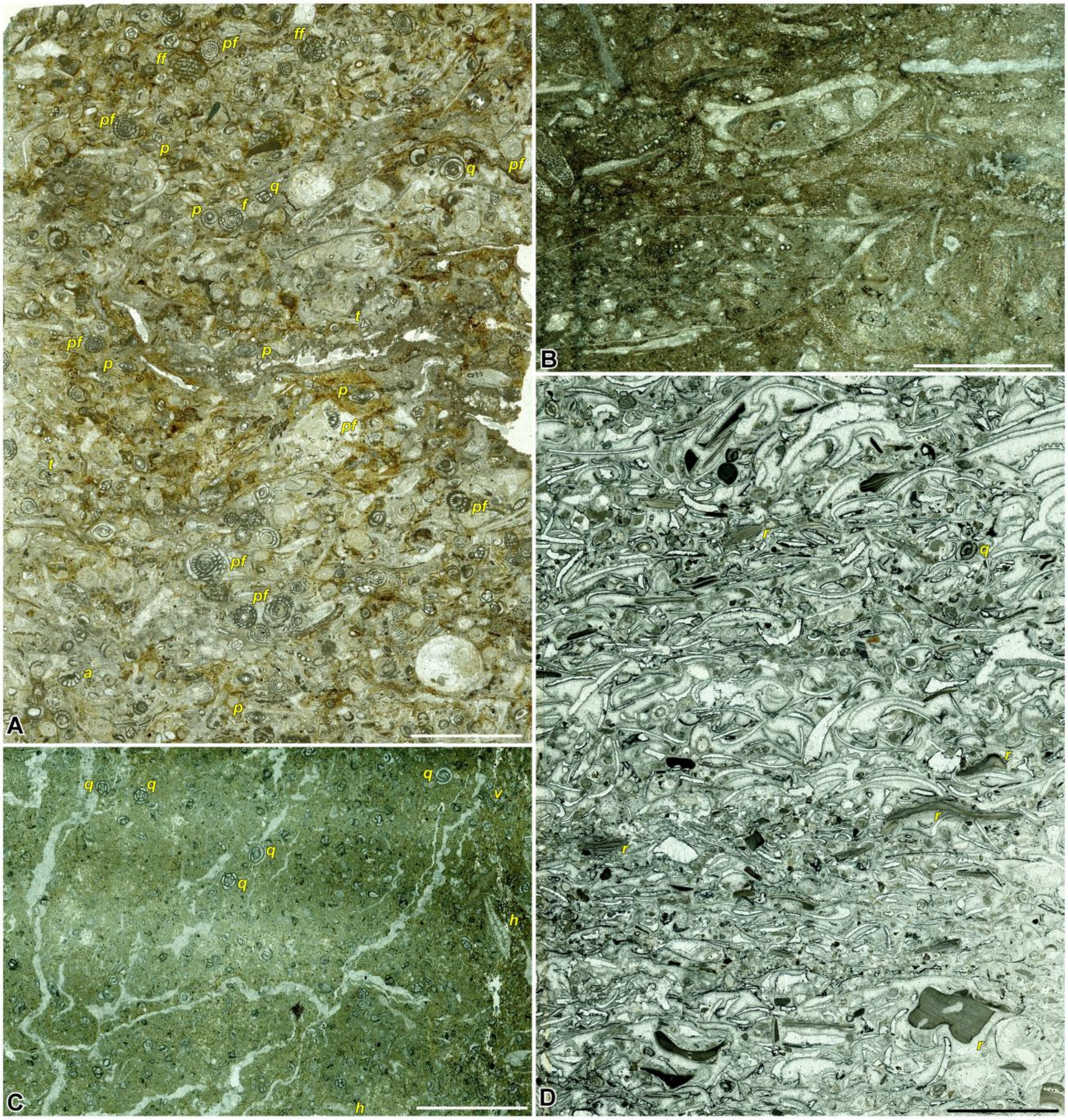

Figure 19. Chapelton Formation, inner platform facies (thin section scans in transmitted plane polarized light). **A** (WL2614), packstone, *Pseudofabularia matleyi* (pf), triloculine (t) and quinquelocline (q) miliolids, *Pelatispirella matleyi* (p), *Fallotella floridana* (ff) and *Arenagula floridana* (a). **B** (WL2908), wackestone with *Yaberinella*. **C** (WL2602), wackestone with calcite veins: common quinqueloculine miliolids (q); rarer *Verseyella jamaicensis* (v) and *Helicostegina jeannemairae* (h). **D** (WL2613), grainstone with abundant disarticulated and fragmented aragonitic bivalves (replaced by calcite), mudstone rip-up clasts (r) (some bored) and rare quinqueloculine miliolids (q). Scale bar: 5 mm.

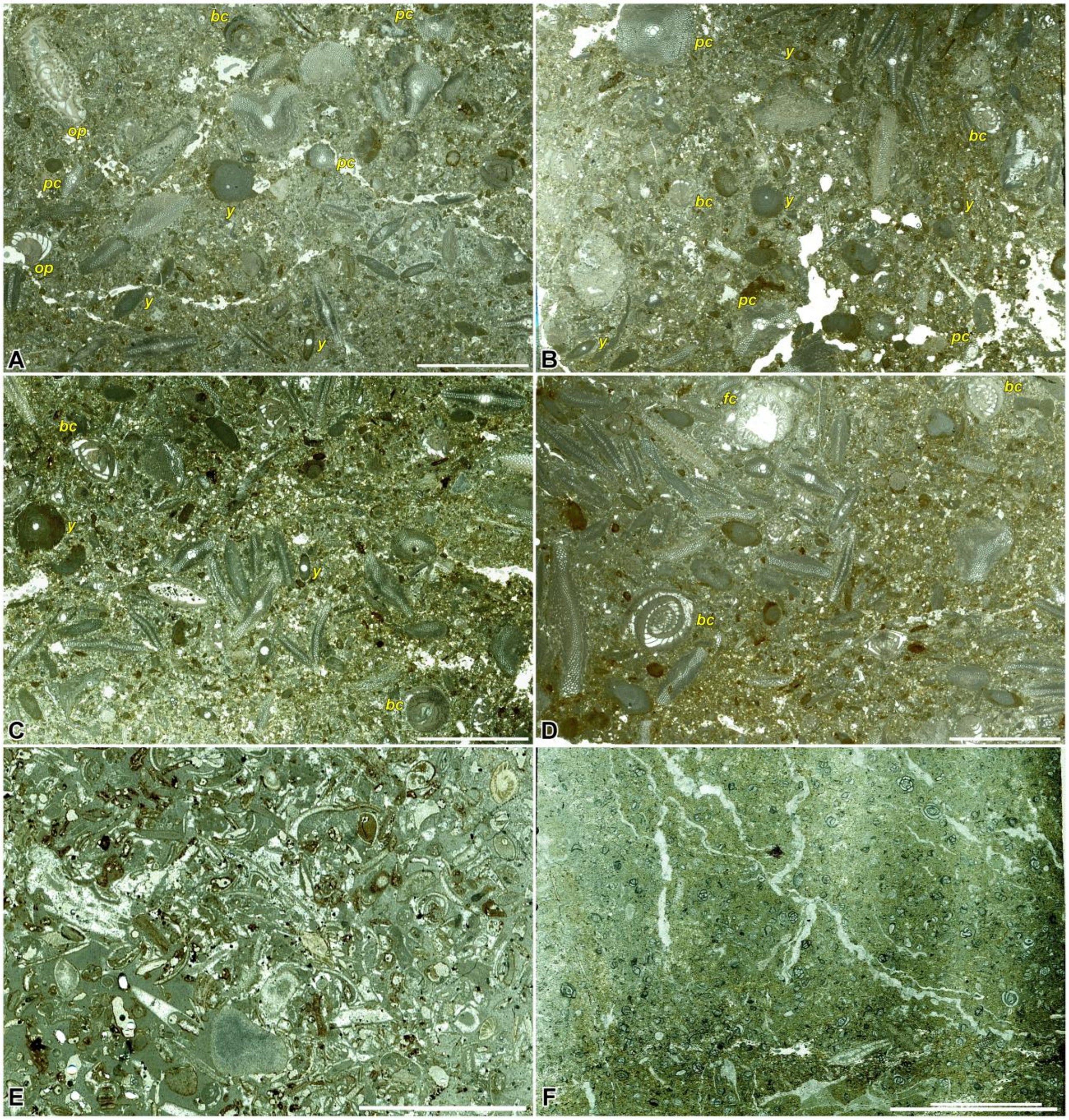

Figure 20. Thin sections from the Chapelton Formation (lepidocyclina facies). **A** (WL3199-3), yellow-brown packstone with *Polylepidina chiapsensis*, *Operculinoides* and *Yaberinella*. **B** (WL3199-6), yellow-brown packstone with *P. chiapasensis*, *Yaberinella* and *Butterliniana cubensis*. **C** (WL3199-5), yellow-brown packstone with *P. chiapasensis*, *Yaberinella* and *B. cubensis*. **D** (WL3199-1), yellow-brown packstone with *P. chiapasensis*, *Yaberinella*, *Fabiania* sp. and *B. cubensis*. **E** (WL2881), carbonate rudstone with mollusc fragments. **F** (WL2602), wackestone with scattered miliolids. Scale bar: 5 mm.

2.6. Spring Vale Formation

Introduction. The name Healthy Hill Formation was introduced by **Mitchell** (**2013**) as the basal unit of the White Limestone in the parish of St Ann for a "unit of white grainstones and minor packstones and wackestones that occurs between the Chapelton Formation (Yellow Limestone Group) and the Troy Formation (White Limestone Group) on the northern margin of the Clarendon Block." It is now considered that the Healthy Hill Formation is equivalent to the Bamboo Formation on the northern margin of the Clarendon Block where the Troy Formation pinches one. The white grainstones in St James and their thin equivalents in St Elizabeth require a new name and the name Spring Vale Formation is proposed for them.

Description. The Spring Vale Formation consists of predominantly white grainstones with subsidiary white packstones and wackestones (**Figures 21** to **23**). It ranges from thickly bedded to unbedded, and contains abundant foraminifers. The thickness of the Spring Vale Formation varies considerable due to lateral facies changes. In southern St James the formation is probably up to 100 m thick, but thins to the south laterally transitioning into the Merrywood Formation. In north-western St Elizabeth (Elderslie to Ipswich area) the Spring Vale Formation is probably up to 5 to 10 m thick in the west, but thins rapidly before pinching out to the east; thus in the west the Spring Vale Formation is underlain by the Chapelton Formation and overlain by the Merywood Formation, but to the east (Aberdeen area) the Merrywood Formation overlies the Chapelton Formation.

Type section. The type section lies on the southern margin of Spring Vale and is exposed in the road from Chatsworth to Spring Vale were extensive good exposures are available (**Figure 2**).

Age. No free specimens of LBF have been collected from most sections showing the Spring Vale Formation due to its strongly cemented character. As such, an age assignment is difficult. The upper part of the Chapelton Formation contains *Po. chiapasensis* and can be assigned to **ABZ11**. *Polylepidina* is present in the Spring Vale Formation in northern St Elizabeth suggesting assignment to **ABZ11**. Further north it is probable that the Spring Vale Formation represents probably **ABZ11** and **ABZ12** (judging by the morphology of *Yaberinella*), but good populations of lepidocyclinids are not available.

Thickness. The formation is absent in the south-east but thickens towards the north. Its thickness in southern St James is probably in the range of 30 to 50 m.

Remarks. The Spring Vale Formation, as noted, represents a transgressive deposit of early Bartonian age (ABZ11) with subsequent progradation of platform interior (Merrywood Formation) facies towards the north and west in St Elizabeth and St James. It superficially looks similar to the Bamboo Formation (= Swanswick Limestones of **Hose and Versey, 1956**), but they contain completely different foraminferal assemblages. The Spring Vale Formation contains primitive lepidocyclinids and abundant examples of *Yaberinella* and underlies the Troy Formation. In contrast, the Bamboo Formation contains advanced lepidocyclinids, lacks *Yaberinella*, and lies above the Troy Formation.

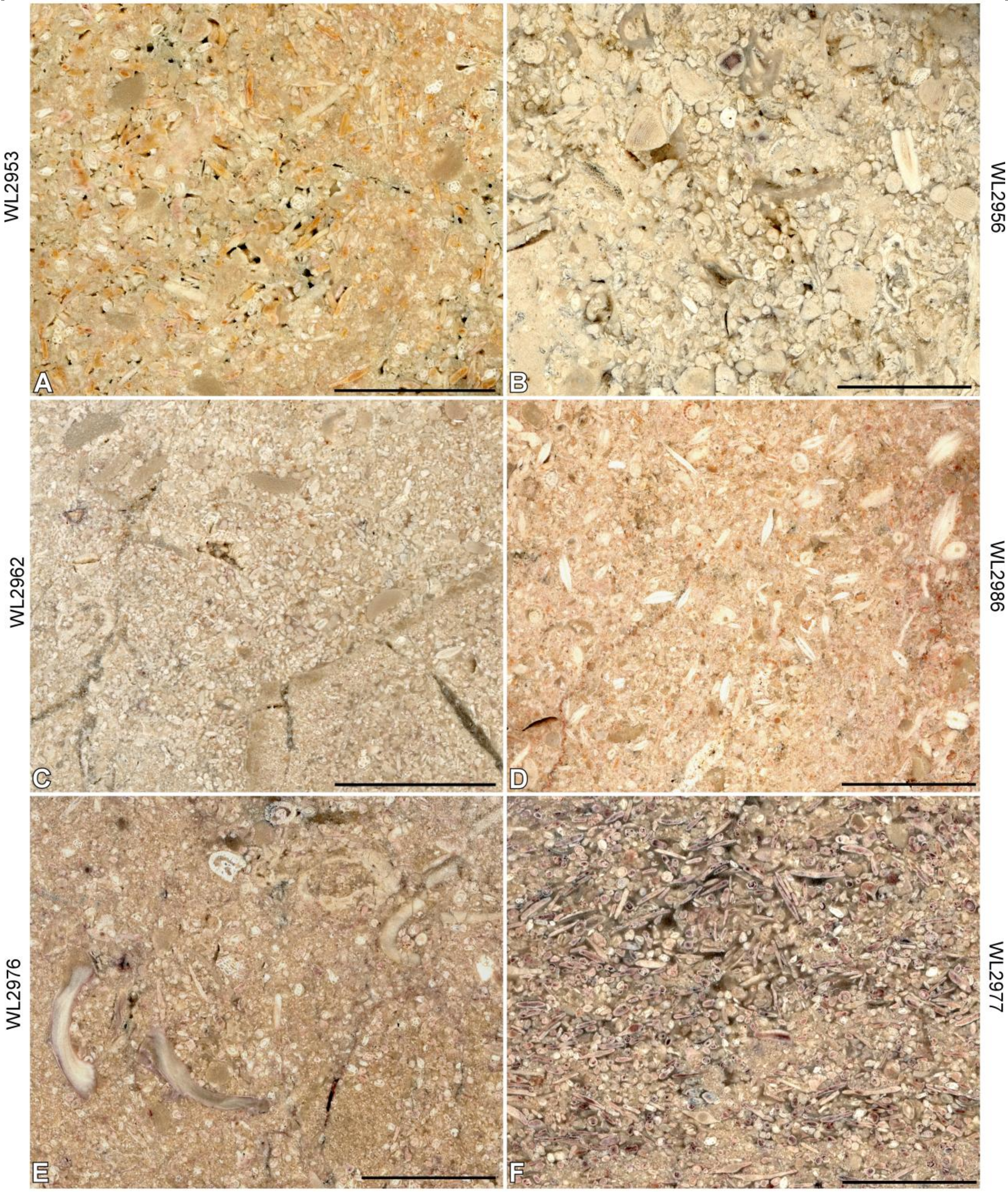

Figure 21. Polished slabs from the Spring Vale Formation. **A** (WL2953), foraminiferal grainstone with a superficial cement. **B** (WL2956), foraminiferal floatsone with a foraminiferal grainstone matrix. **C** (WL2962), foraminiferal grainstone with miliolids. **D** (WL2986), floatstone (with *Polylepidina*) with a foraminiferal grainstone matrix (largely miliolids). **E** (WL2976), floatstone (with molluscs and *Fabiania*) with a foraminiferal grainstone matrix. **F** (WL2977), floatsone (*Yaberinella*) with a foraminiferal grainstone matrix. Scale bar = 10 mm.

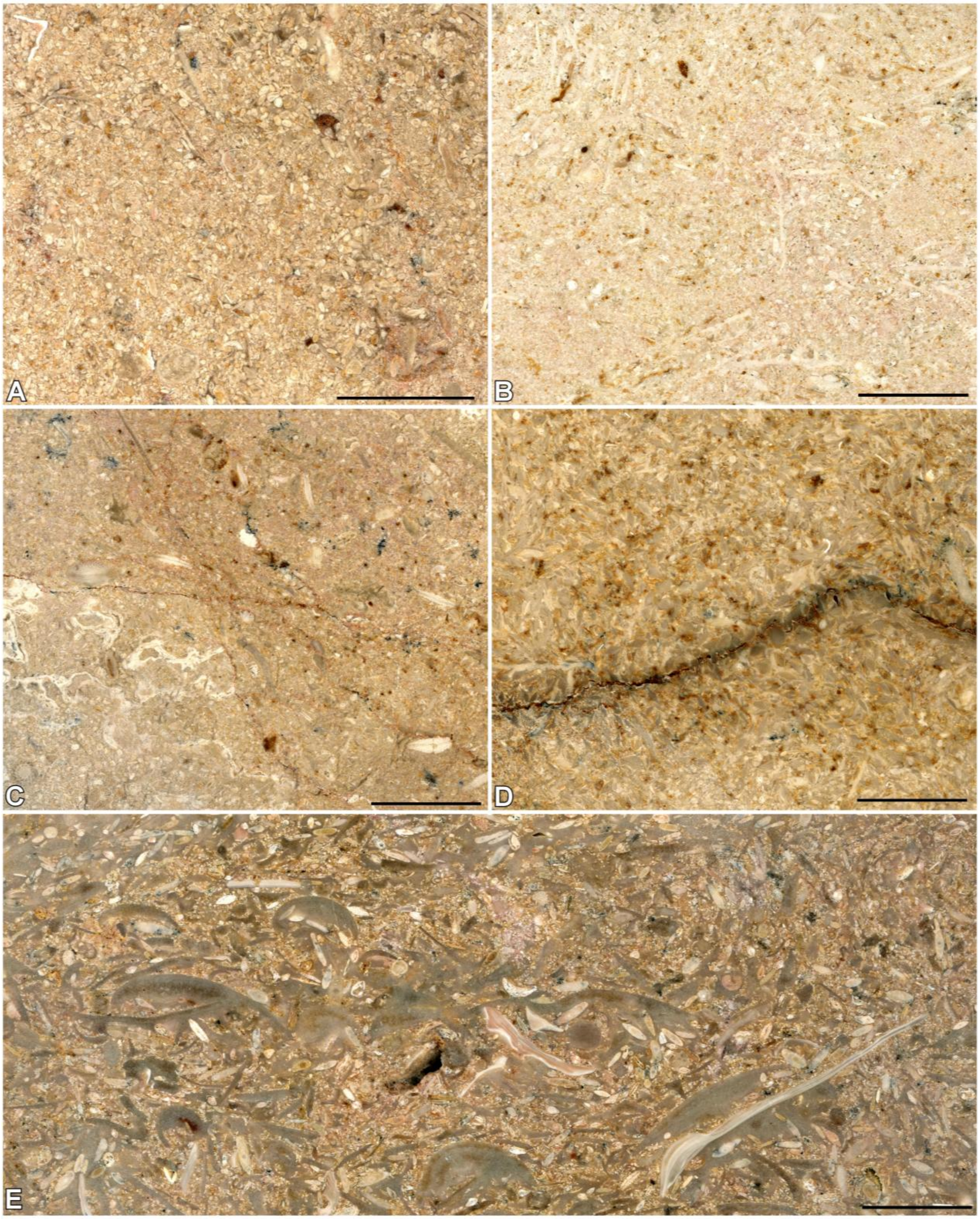

Figure 22. Polished slabs from the Spring Vale Formation. **A** (WL2942), foraminiferal grainstone with miliolids. **B** (WL2960), foraminiferal grainstone with *Yaberinella*. **C** (WL2969), Sparse floatstone with a packstone matrix, oncoid in lower left and scattered lepidocyclinids. **D** (WL3032), foraminiferal grainstone with abundant lepidocyclinids and a fabric crossing stylolite. **E** (WL2985), *Yaberinella* molluscan matrix rudstone with a grainstone/packstone matrix. Scale bar = 10 mm.

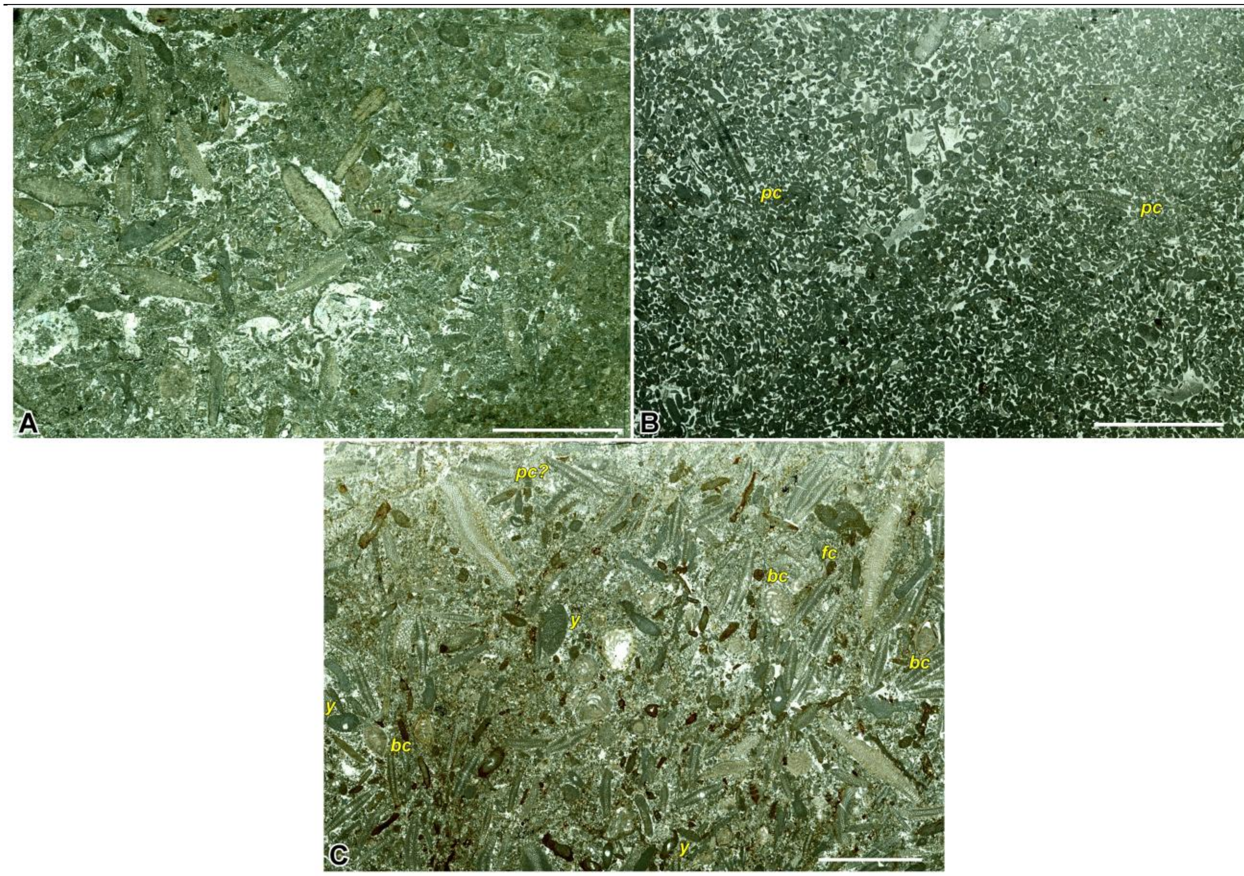

Figure 23. Thin sections from the Spring Vale Formation. **A** (WL2615), floatstone with a pale grainstone matrix containing lepidocyclinids (*P. chiapasensis*). **B** (WL2616), white grainstone with scattered lepidocyclinids (*P. chiapasensis*, *pc*). **C** (WL2617), floatstone to carbonate grainstone with a pale grainstone matrix containing lepidocyclinids (P. chiapasensis), *Yaberinella* (*y*), *Butterliniana cubensis* (*bc*) and *Fabiania cassis* (*fc*). Scale bar = 5 mm.

2.7. Merrywood Formation

Introduction. The name Merrywood Formation is introduced here for a series of thickly bedded, pale weathering limestones, which lie between the yellow-brown limestones of the Chapelton Formation or white grainstones of the Spring Vale Formation (below) and the Ipswich Formation (above). In the south-east, the Merrywood Formation rests on the Chapelton Formation, but towards the west and north a tongue of the Spring Vale Formation is present between the Chapelton and Merrywood formations. The Spring Vale Formation thickens at the expense of the Merrywood Formation both to the north and to the west.

Description. The Merrywood Formation consists of a monotonous succession of thickly bedded, pale weathering limestones, with carbonate mudstone, wackestone and floatstone fabrics. Bioclasts consist of molluscs (bivalves and gastropods), stick corals, red algae and LBF.

Type Locality. The type locality is situated at Merrywood on the road from Elderslie to Ipswich. Typical exposures of the formation are found in this area as well as at many other areas in northern St Elizabeth.

Age. The Merrywood Formation contains a platform interior LBF assemblage which cannot be directly related to the American Benthic Zonation of **Mitchell et al.** (**2022**, **2024**). The LBF assemblage present includes: *Coleiconus christianiensis*, *Yaberinella* spp. This assemblage is found in the Chapelton Formation at Coleyville below beds containing an **ABZ13** LBF assemblage. The same **ABZ13** assemblage is also found in the lower part of the Ipswich Formation. The Merrywood Formation can therefore probably be assigned to either **ABZ11** or **ABZ12**.

Thickness. In northern St Elizabeth the Merrywood Formation has a thickness of 40 to 60 m.

Remarks. The Merrywood Formation marks a more restricted interval between the more open marine conditions of the upper Chapelton/Spring Vale formations, below, and the Ipswich Formation, above, with their platform edge (lepidocyclinid-nummulitid) LBF assemblages.

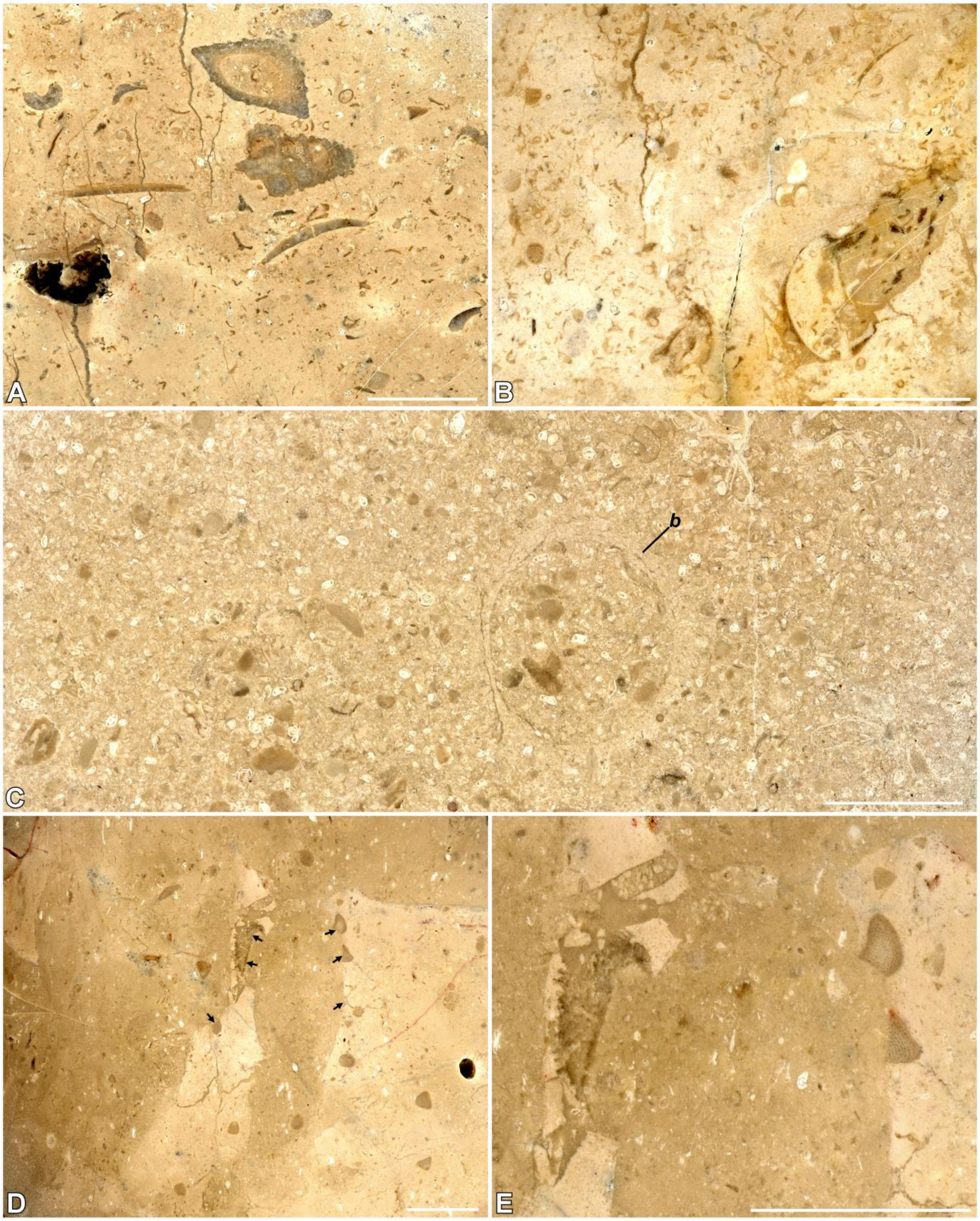

Figure 24. Merrywood Formation, polished slabs, St Elizabeth. **A** (WL2954), sparse floatstone with molluscs. **B** (WL2951), packed wackestone with scattered molluscs. **C** (WL2955), foraminiferal packstone with lined burrow (b). **D–E** (WL2952), hardground, showing truncated LBF (dictyoconids). Bioclasts: *Psudofabularia matleyi* (pm), *Cushmania americana* (ca), and *Yaberinella* sp. (y); scale bar = 10 mm.

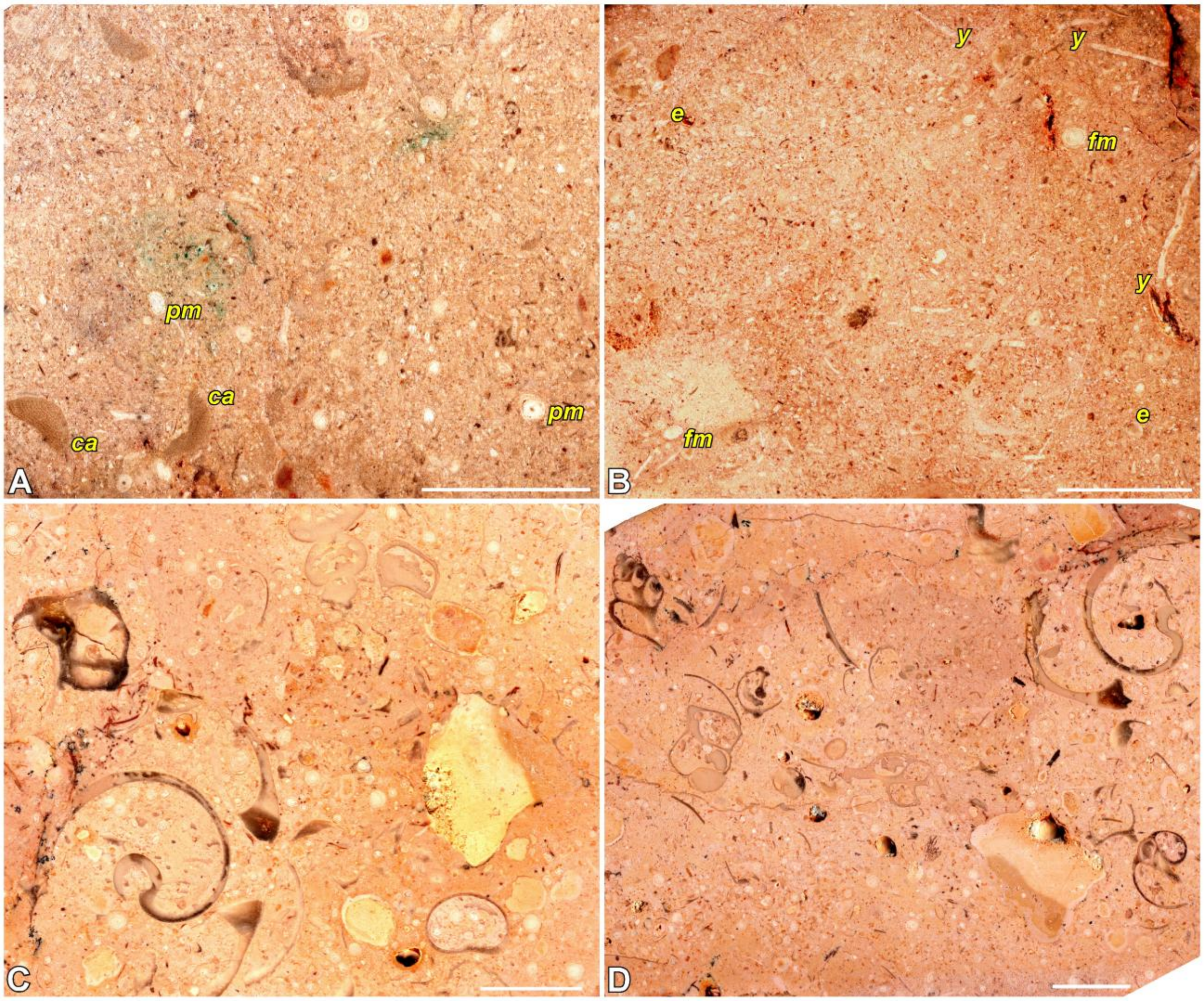

Figure 25. Merrywood Formation, polished slabs, St Elizabeth. **A–B** (WL2553), packed wackestone with *Pseudofabularia matleyi*, *Yaberinella* and dictyoconids, views of two cuts. **C–D** (WL2555), packed wackestone with molluscs (gastropods), lithoclasts, miliolids and *Ps. matleyi*, views of two cuts. Bioclasts: *Psudofabularia matleyi* (pm), *Cushmania americana* (ca), and *Yaberinella* sp. (y). Scale bar = 10 mm.

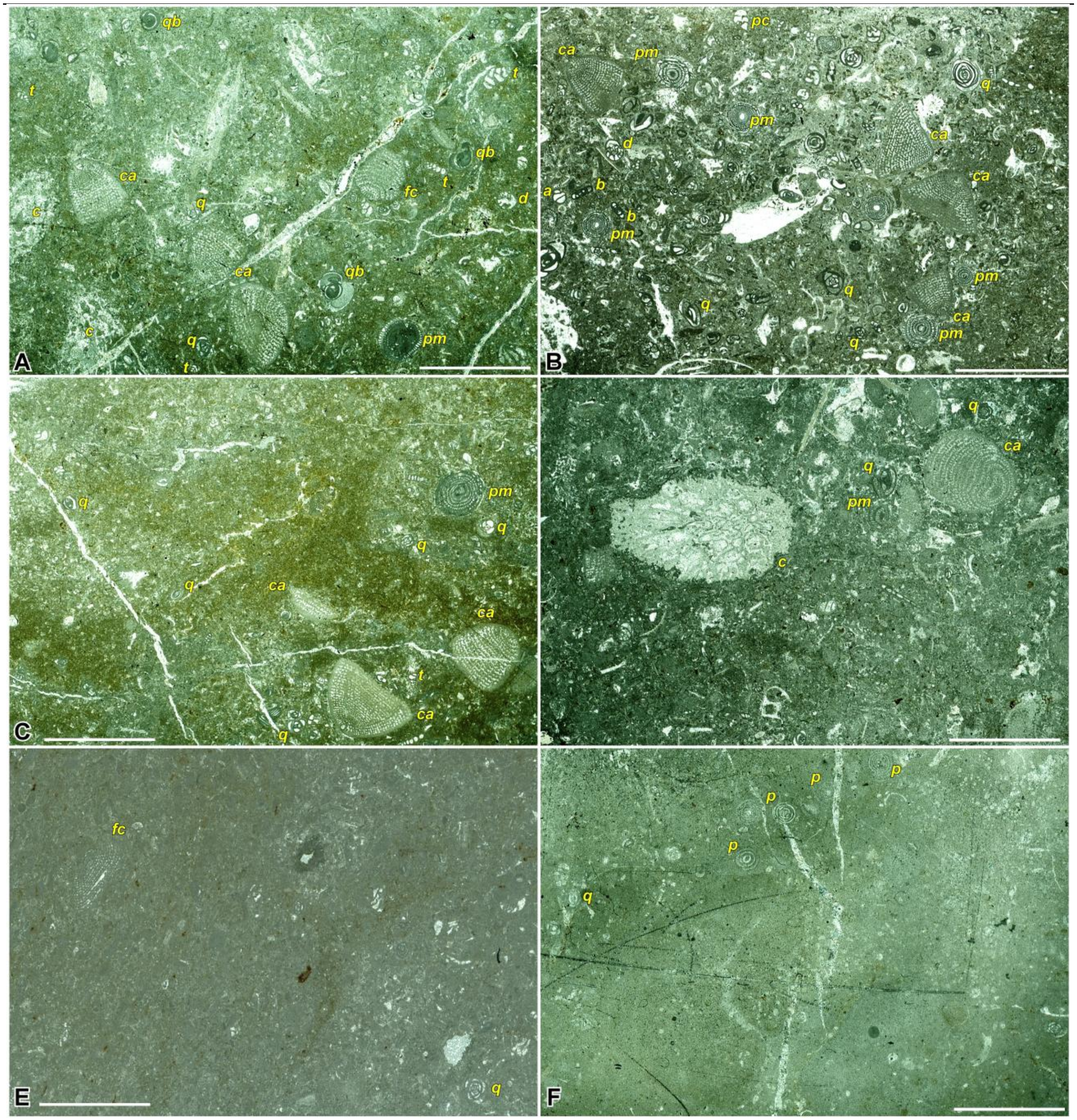

Figure 26. Merrywood Formation (thin sections). **A** (WL4923 - 2), packed floatstone. **B** (WL2554), packed wackestone: corals (c), aragonitic molluscs (m) and common quinqueloculine miliolids (q). **C** (WL4923), wackestone. **D** (WL4922). **E** (WL4924), lime mudstone. **F** (WL2555), lime mudstone with scattered bioclasts (miliolids and *Ps. matleyi*) (some scratches). Bioclasts: corals (c), *Cushmania americana* (ca), *Falloetlla cookei* (fc), *Discorinopsis gunteri* (d), quinqueloculine miliolids (q), biserial, flat miliolids (b), quinquelocline miliolids with a thick basal shell layer (qb), *Pseudofabularia matleyi* (p), *Yaberinella* (y), *Lepidocyclina* (l), *Psuedochrysalidina floridana* (pc) and *Textularia* sp. (t). Scale bar: 5 mm.

2.7. Ipswich Formation

Introduction. The name Ipswich Member was proposed by **Versey** (**1957**) for a member within the White Limestone, but which had characteristics (impurities giving it a yellow-brown colour) of the Yellow Limestone. **Mitchell** (**2004**, **2013**) upgraded the unit to a formation and placed the Ipswich Formation in the Yellow Limestone Group. **Versey** (**1957**) considered that the Ipswich Formation was a time-equivalent to the Swanswick Member (=Bamboo Formation), based on the LBF assemblages. However, at Swanswick House in Trelawny a Yellow Limestone of Lutetian age is overlain or faulted against White Limestone of Priabonian age. Furthermore, **Versey** (**1957**) considered that the Ipswich Member passed laterally into the Troy Member. This is now known to be erroneous and that the Troy Formation rests unconformably on the Ipswich Formation, and that this unconformity can be mapped out (**Mitchell, 2016**). The Geological Survey mapped the Ipswich Formation as part of the Swanswick Formation, and this has led to inaccuracies in the published maps. The Ipswich Formation contains a LBF assemblage of mid Bartonian age, whereas the lower part of the White Limestone (including the upper part of the Swanswick type section) contains a Priabonian LBF assemblage. The Ipswich Formation, therefore, has nothing to do with the White Limestone Group and is separated from it by an angular unconformity.

Description. The Ipswich Formation consists of thickly bedded yellow-brown, brown and red packstones, grainstones, floastones, and matrix and grainy rudstsones (**Figures 27** to **29**). Bioclasts are dominated by LBF with lepidocyclinids, nummulitids, *Yaberinella* and *Fabularia*.

Type section. The stratotype is located on the main road from Ipswich to Four Paths opposite the road that used to lead to Ipswich House. Here the upper parts of the Ipswich Formation are well exposed.

Age. The LBF fauna includes: *Lepidocyclina ocalana*, *Fabularia hawazani*, *Yaberinella panamensis*, *Operculinoides* spp. and rare examples of *Pliolepidina tobleri* in the mid to upper part. The presence of *L. ocalana* in the absence of *P. tobleri* indicates **ABZ13** whereas the presence of *P. tobleri* indicates **ABZ14** (**Mitchell et al., 2022**, **2024**).

Thickness. The formation has an estimated maximum thickness of 50 to 60 m. The Ipswich Formation is well exposed on roads around Ipswich and north of Appleton.

Remarks. The Ipswich Formation is characterized by platform edge LBF assemblages and represents the last Yellow Limestone transgression onto the Clarendon Block. A similar LBF assemblage is found in the upper part of the Chapelton Formation at the Forrest Reserve, Coleyville, on the margin of the Central Inlier. The Ipswich Formation is therefore a lateral equivalent of the upper part of the Chapelton Formation found on the south-west side of the Central Inlier.

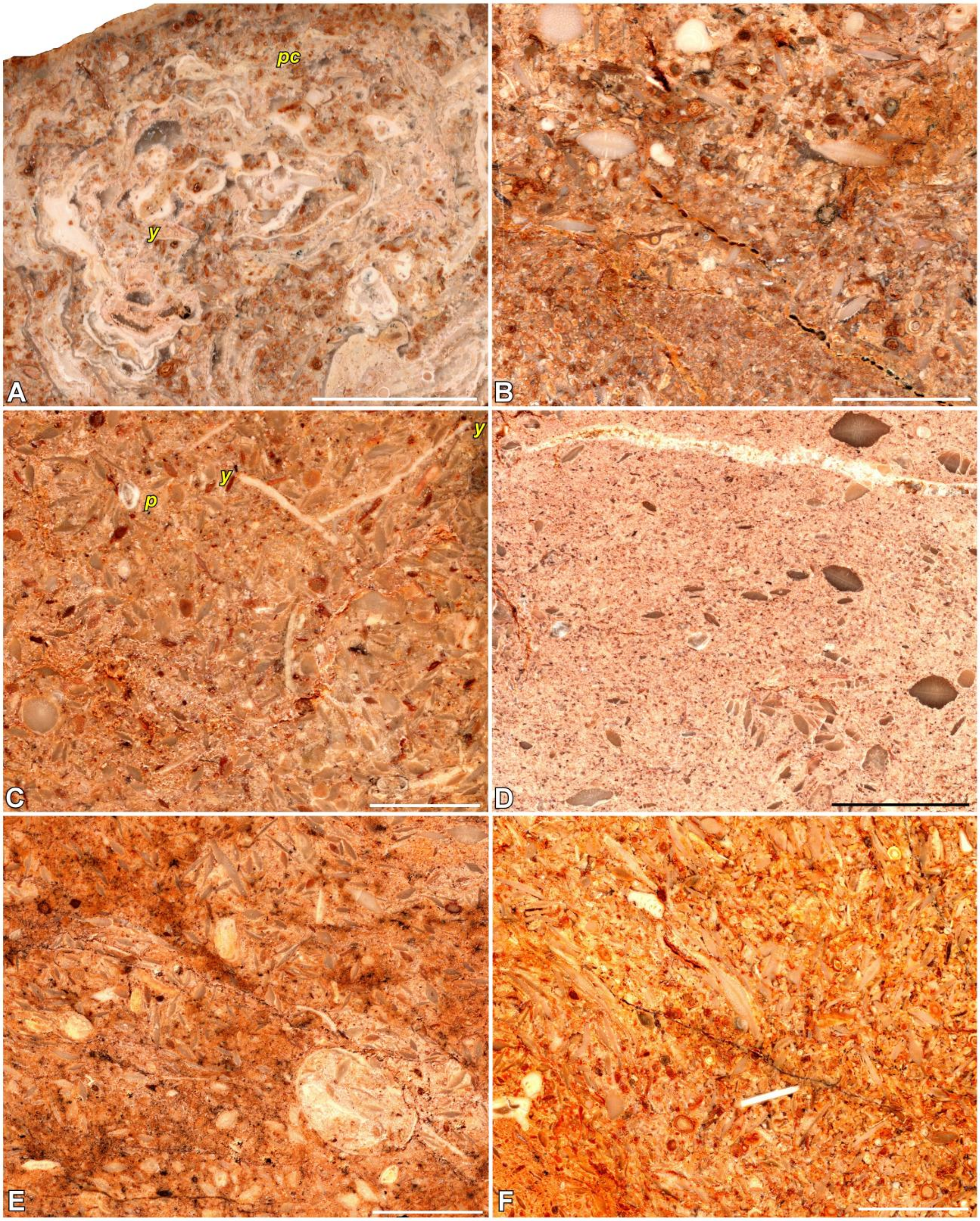

Figure 27. Polished slabs from the Ipswich Formation. **A** (WL2552A), floatsone with a packestone matrix containing rhodoliths. **B** (WL2552B), floastone with a packestone matrix containing lepidocyclinids. **C** (WL2547), floatstone with a grainstone matrix containing common lepidocyclinids and scattered *Butterliniana cubensis*. **D** (WL2548), packed wackestone with

lepidocyclinids, matrix dolomitized (note ragged edges to lepidocyclinids) due to proximity of Troy Formation dolomitic front. **E** (WL2549), lepidocyclinid floatsone with a packstone matrix containing an echinoid. **F** (WL2550), lepidocyclinid carbonate rudstone with a packstone matrix. Bioclasts: *Yaberinella* sp. (y), *Butterliniana cubensis* (bc); scale bar = 10 mm.

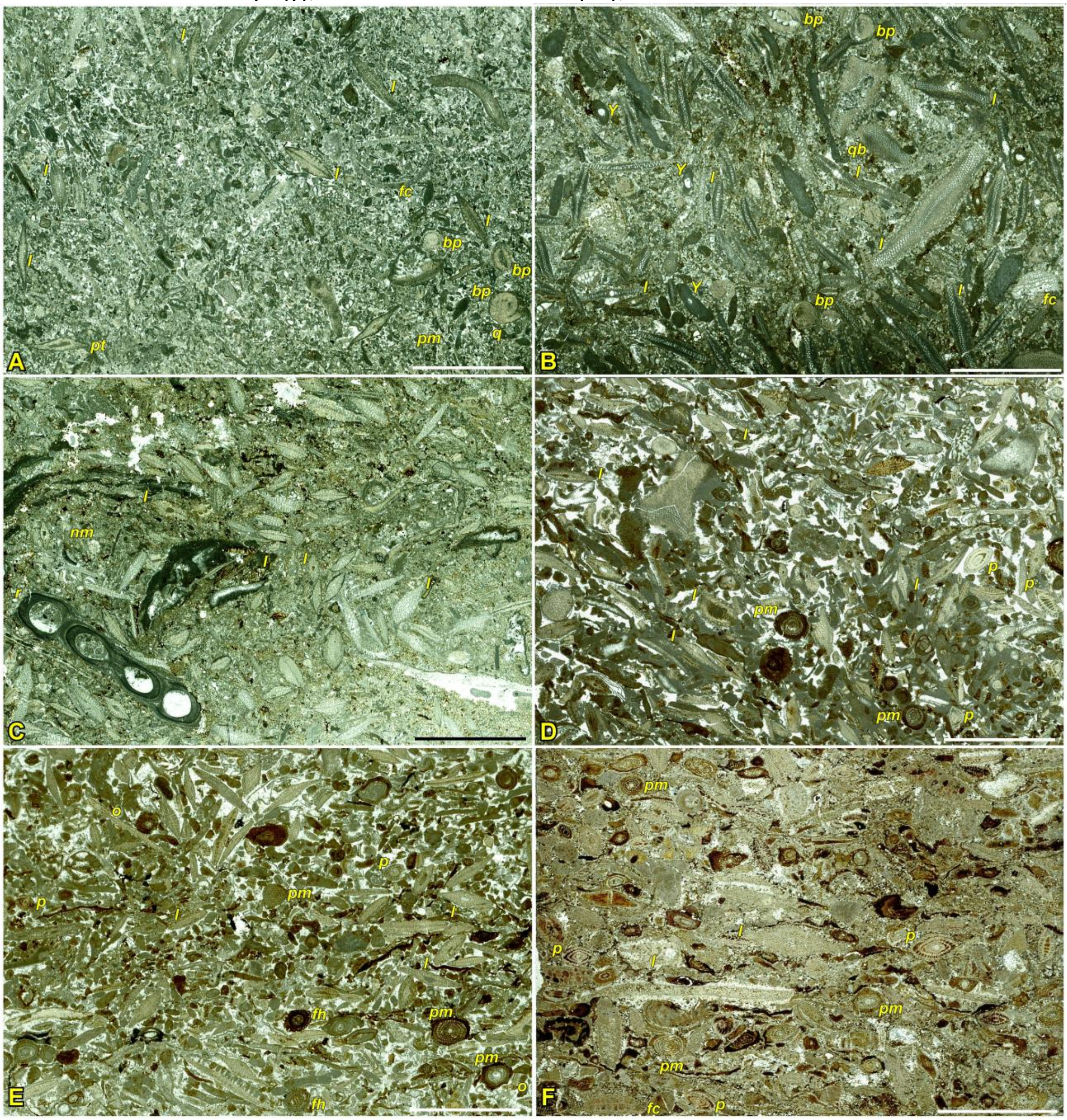

Figure 28. Thin sections from the Ipswich Formation. **A** (WL2546 - 2), grainstone with lepidocyclinids (upper part of Ipswich Formation). **B** (WL2546), grainstone/grainy rudstone with lepidocyclinids (upper part of Ipswich Formation). **C** (WL2549), floatstone with grainstone matrix containing serpulid (*Rotularia* sp.). **D** (WL2550), grainstone with lepidocyclinids and *Pseudofabularia*. **E** (WL2551), grainstone/grain rudstone with lepidocyclinids and *Pseudofabularia*. **F** (WL4913), grainstone/grain rudstone with lepidocyclinids and

Pseudofabularia. Bioclasts: corals (c), serpulid *Rotularia* (r), *Cushmania americana* (ca), *Fallotella cookei* (fc), *Discorinopsis gunteri* (d), quinqueloculine miliolids (q), biserial, flat miliolids (qb), *Fabiania cassis* (fc), quinquelocline miliolids with a thick basal shell layer (qb), *Pellatispirella matleyi* (p), *Pseudofabularia matleyi* (pm), *Fabularia hanzawai* (fh), *Operculinoids* sp. (o), *Psuedochrysalidina floridana* (pc), *Neorotalia mexicana* (nm), *Pliolepidina tobleri* (pt), lepidocyclinids (l) and *Textlaria* sp. (t). Scale bar: 5 mm.

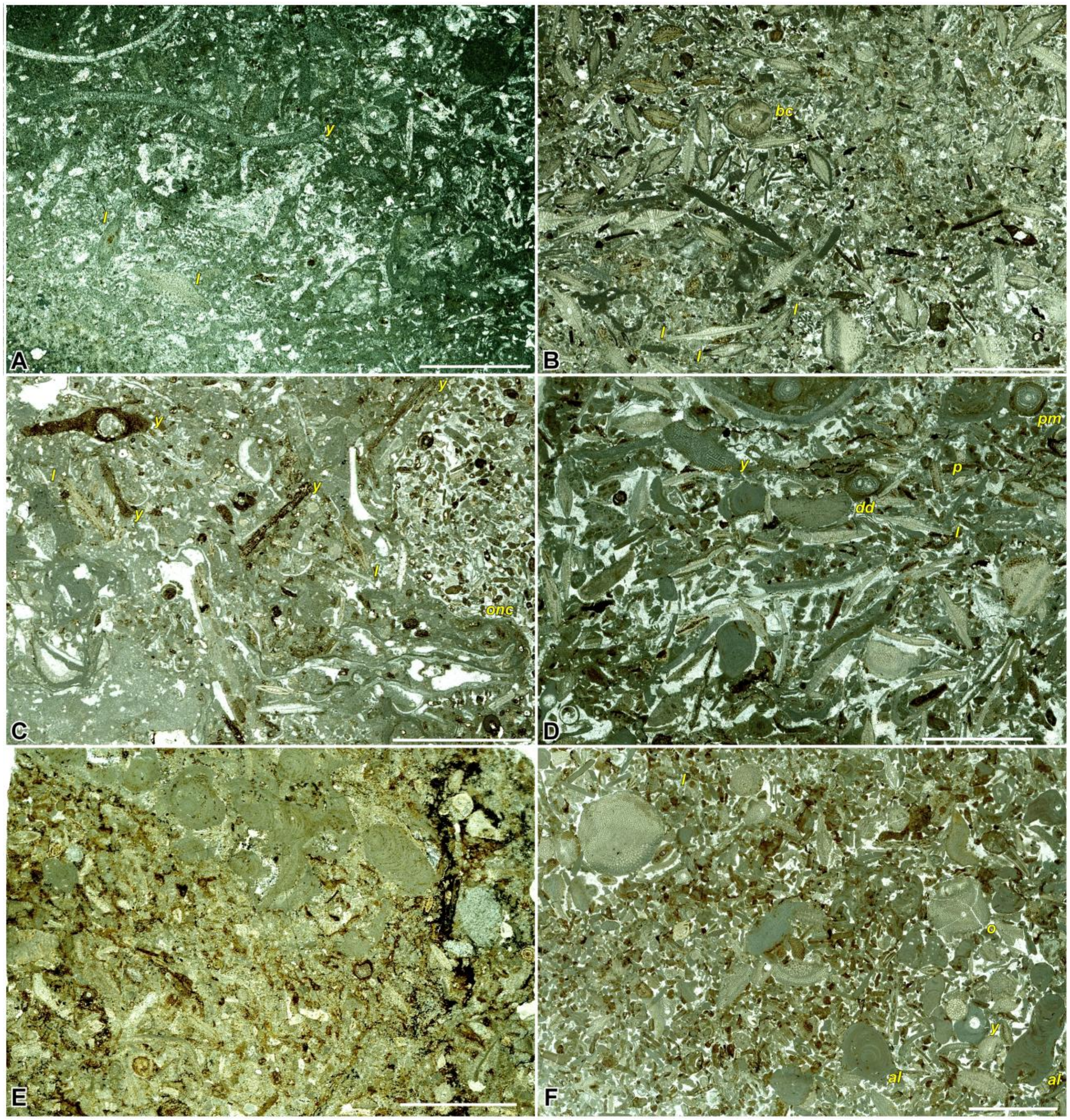

Figure 29. Thin sections from the Ipswich Formation. **A** (WL4926), grain rudstone with scattered *Lepidocyclina* and *Yaberinella* (at junction between Merrywood and Ipswich formations). **B** (WL2547), grainstone/grain rudstone with lepidocyclinids. **C** (WL2552A), grain rudstone *with Yaberinella* (including one good *Y. jamaicansis*) embedded in oncoid (onc) with grainstone

matrix to top right). **D** (WL4915), grainstone/grain rudstone with lepidocyclinids. **E** (WL4928), packstone/matrix rudstone with rhodolith (top, centre), slightly recrystallized. **F** (WL4930-2), grainstone/grain rudstone with lepidocyclinids and red algae. Bioclasts: corals (c), *Cushmania americana* (ca), *Falloetlla cookei* (fc), *Discorinopsis gunteri* (d), quinqueloculine miliolids (q), biserial, flat miliolids (b), quinquelocline miliolids with a thick basal shell layer (qb), *Pseudofabularia matleyi* (p), *Yaberinella* (y), *Lepidocyclina* (l), *Psuedochrysalidina floridana* (pc), dictyoconid with dense structure (dd) and *Textlaria* sp. (t). Scale bar: 5 mm.

2.8. Appleton Formation

Introduction. The name Appleton Formation is introduced for the highest formation within the Yellow Limestone Group of northern St Elizabeth. This limestone is pale coloured and sees a return to platform interior facies.

Description. The formation consists of thickly bedded, pale carbonate mudstones, wackestones, floatstones and rarer packstones. Bioclasts are characterised by inner platform LBF, including *Cushmania*, *Fallotella* and miliolids.

Type locality. The type locality lies on the road from Appleton to Maggotty, just north of the road bridge over the Black River. Exposures here show pale wackestones which are typical of the formation.

Age. The transition from the Ipswich Formation to the Appleton Formation sees a change from brown to yellow-brown to pale cream limestones and the texture changes from packstones/grainstones/grainy rudstones with lepidocyclinids to wackestones/floatstones with platform interior facies LBF. The transition zone contains specimens of *Pliolepidina tobleri* indicating **ABZ14** (late Bartonian; **Mitchell et al., 2022, 2024**) and all of the formation is probably of this age.

Thickness. The formation has a maximum thickness of about 30 m in northern St Elizabeth. The formation is only found in the vicinity of Maggotty and Appleton. Good exposures are found on private land that once belonged to the former Western Cement Company.

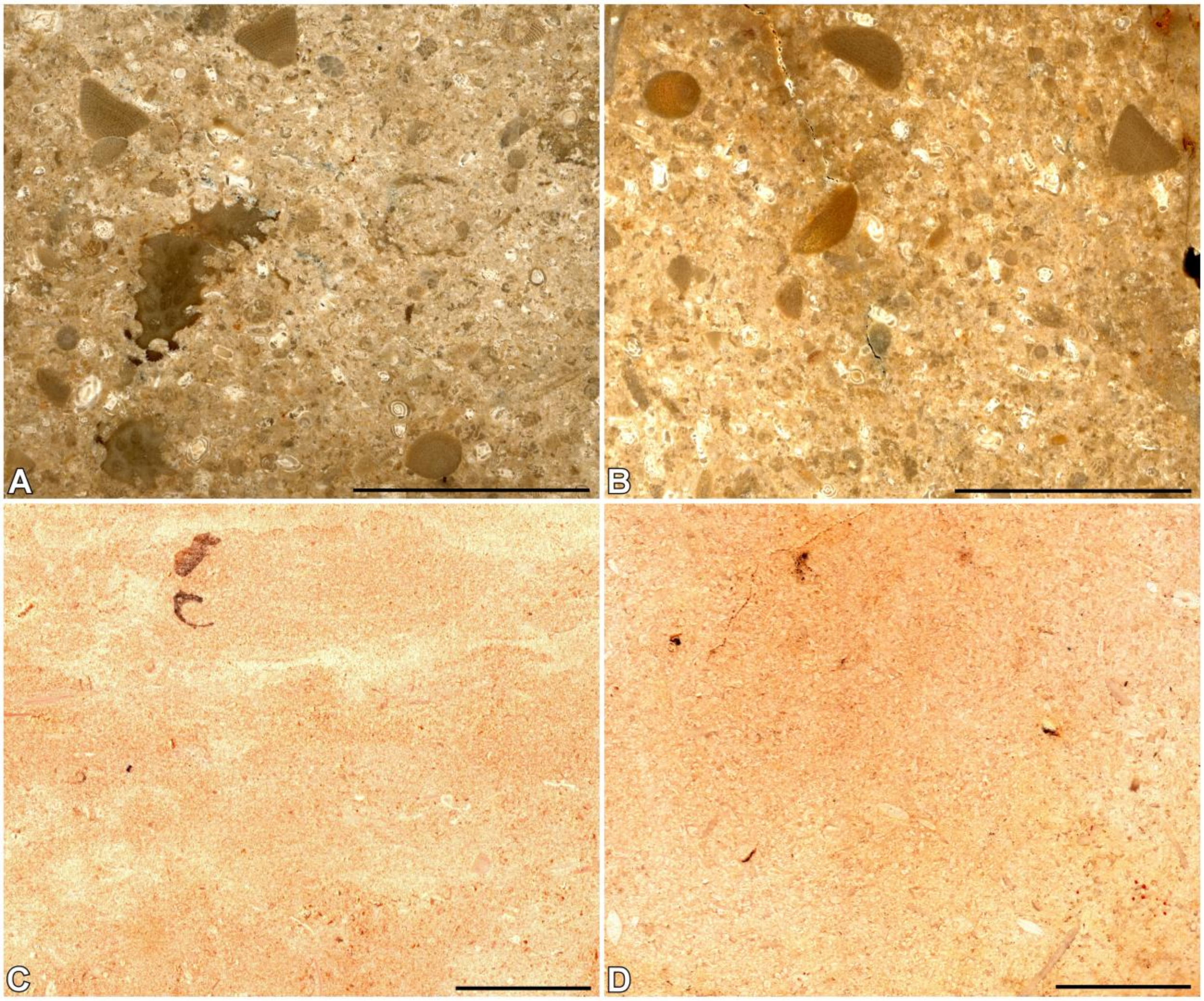

Figure 30. Polished slabs of the Appleton Formation. **A–B** (WL5551), floatstone with a packed wackestone matrix containg dictyoconids. **C** (WL2543), carbonate mudstone to sparse wackestone. **D** (WL2544) , carbonate mudstone to sparse wackestone. Scale bar = 10 mm.

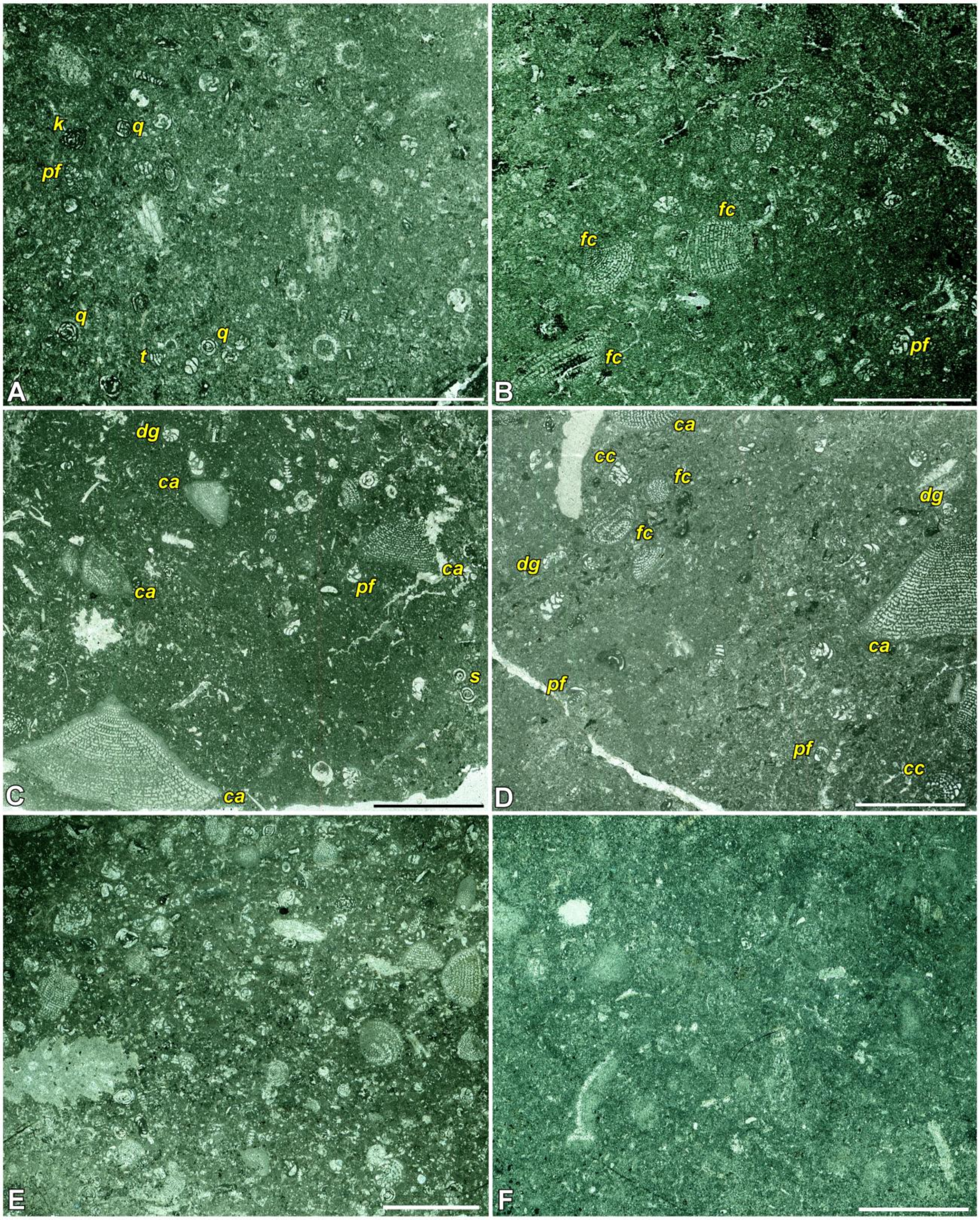

Figure 31. Thin sections of the Appleton Formation (ppl). **A** (MGD-S14), sparse floatstone with a wackestone matrix. **B** (MGD-S14), sparse floatstone with a wackestone matrix. **C** (MGD-S11), sparse floatstone with a wackestone matrix. **D** (MGD-S12), sparse floatstone with a wackestone matrix. **E** (WL5551), packed floatstone with a wackestone matrix. **F** (WL5551), sparse floatstone with a

wackestone matrix. Bioclasts: *Keramosphaera* sp.? (k), *Cushmania americana* (ca), *Fallotella cookie* (fc), *Discorinopsis gunteri* (dg), *Coleiconus chriastianiensis* (cc), *Quinqueloculina* sp. (q), *Pseudochysidiana floridana* (pf), *Spiroloculina* sp. (s). Scale bar = 5 mm.

Remarks. This is the highest formation in the Yellow Limestone Group on the Clarendon Block, and it is only preserved in structure lows where it has escaped erosion prior to the deposition of the Troy Formation.

3. Cycle and sequence development

Localities in western Jamaica on the Clarendon Block allow for a cyclostratigraphic/sequence stratigraphic interpretation of the Middle Eocene deposits using the LBF for biostratigraphy (**Figure 32**). The cycles in the lower part of the Yellow Limestone consists of alternations of clastic and carbonate rocks, whereas the cycles in the upper part, consist of mixtures of carbonate rocks with different depositional textures. Although **Gold et al.** (**2018**) attempted to suggest sequences for Jamaica, this was prior to the calibration of the LBF succession with the chronostratigraphy (**Mitchell et al., 2022**). **Figure 32** shows the onlap pattern for the western part of the Clarendon Block and recognizes 4 sequences (named after the most open marine limestones) within the Yellow Limestone (a fifth, Bamboo, represents the base of the White Limestone). The sequences can be compared to those originally proposed by **Hardenbol et al.** (**1988**) and the sea-level curve given in *The Geological Timescale* (**Speijer et al., 2020**). The Stettin Sequence corresponds to Yp10 of **Hardenbol et al.** (**1988**). Lu1 and Lu2 of **Hardenbol et al.** (**1988**) are not distinguished in Jamaica where they are represented by the Campdown Sequence. Similarly, Lu3 and Lu4 are not distinguished on the western Clarendon Block where they are represented by the Spring Vale Sequence (yet they can be distinguished around the Central Inlier where Lu3 is represented by the Dump Tongue (and limestones around Albert Town) and Lu4 by the lower part of the Chapelton Formation: **Mitchell et al., 2026, this volume**). Ba1 of **Hardenbol et al.** (**1988**) is represented by the Ipswich Sequence on the western Clarendon Block, and in the Spring Vale area of Manchester limestones belonging to this sequence rest unconformably upon Cretaceous.

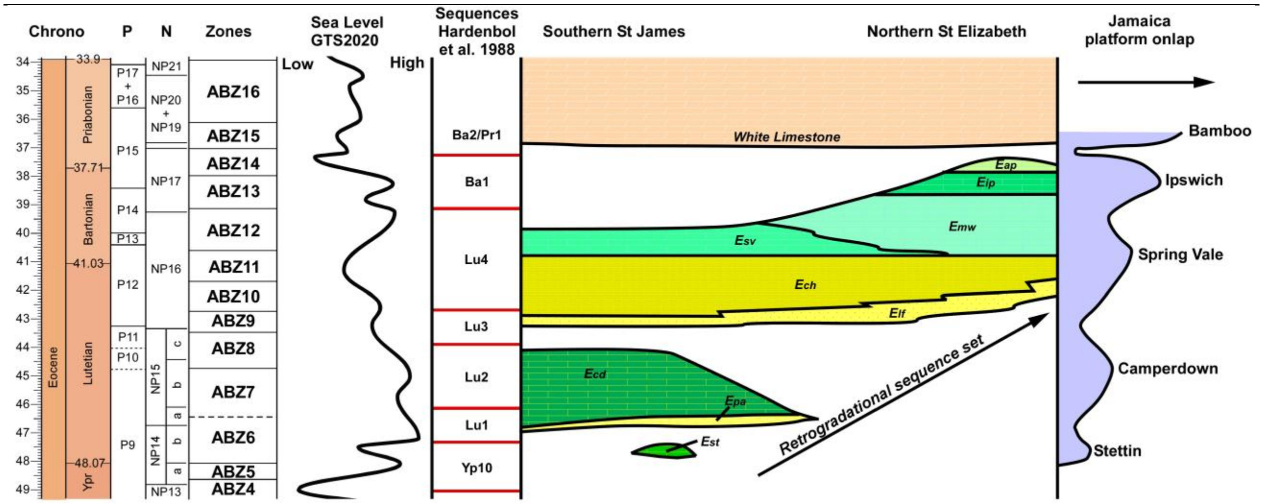

Figure 32. Sequences developed in the Yellow Limestone of the western part of the Clarendon Block. Sea Level curve from *The Geological Timescale 2020* (**Speijer et al., 2020**) and the original sequences of **Hardenbol et al.** (**1988**). See **Figure 5** to key for colours and units.

4. Conclusions

The western part of the Clarendon Block preserves the most complete shallow-water succession of Middle Eocene rocks in Jamaica. Detailed mapping and biostratigraphy based on larger benthic foraminifera has established the relationships between the different lithostratigraphic units and the presence of four depositional cycles. The lower cycles are represented by alternations of clastic and carbonate rocks, and the upper cycle by platform interior and open platform LBF assemblages. The four cycles represent a retrogradational sequence set showing progressive drowning of the Clarendon Block. The absence of the Camperdown Sequence around the Central Inlier could be due to tectonics. Yet equally, it could have been removed by erosion of a large incised valley system that was subsequently filled by fluvial and tidal deposits of the Litchfield Formation. The Yellow Limestone of the western parts of the Clarendon Block, therefore, offers an excellent opportunity to understand the relationships between clastic and carbonate sedimentation as a large land area is drowned by a transgressive sea.

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Appendix 1: Description of the Mount Edmondson Formation (Cretaceous, Maldon Inlier)

Introduction. The name Popkin Formation (**Chubb, 1958**; **Gunter and Mitchell, 2005**) is unsuitable as a unit within the Cretaceous succession of the Maldon Inlier because the type locality is situated within Eocene conglomerates. The name Mount Edmondson Formation is proposed here for the Cretaceous shales that occur between the Maldon Limestone/Formation and the Vaughansfield Limestone/Formation. This name is the only suitable name since it is the only unused name for a community on the outcrop of the formation.

Description (reproduced from **Gunter and Mitchell, 2005**, p. 5)**.** *"The Mount Edmondson consists predominately of mudstones, siltstones and sandstones, but also includes several fossiliferous limestone bands. The contact with limestones of the overlying Vaughansfield Formation is sharp. Three rudist-bearing limestone bands are given formal member status here."* The formation contains three thin limestone members that were named as the Abingdon, Tangle River and Banana Ground Member.

Reference Localities. The two reference localities, as given by **Gunter and Mitchell**, (**2005**) are retained. The first is situated to the north of Vaughansfield at Abingdon along the course of the Tangle River; the second, is located along the Dundee River beginning at its contact with the Maldon Formation and extending south along the river course to a point approximately 540 m south of the Dundee River bridge.

Palaeontology and age. **Gunter and Mitchell** (**2005**) recorded rudist bivalves from the three limestone members within the Mount Edmondson Formation. All three limestone members contain the rudist *Titanosarcolites*. The presence of *Macgillavryia nicholasi* (Whitfield) in the Tangle River Limestone suggests a correlation with beds D6 or F1 of the standard Guinea Corn Formation of late Maastrichtian age (**Mitchell, 1999**; **Steuber et al., 2002**).

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Appendix 2. GPS locations of rock slab and thin section specimens illustrated in this paper

WL2543. Appleton Formation, polished slab, 18° 10.667'N 77° 49.969' W
WL2544. Appleton Formation, polished slab, 18° 10.698'N 77° 49.954' W
WL2546. Ipswich Formation, thin section, 18° 11.053'N 77° 49.750' W
WL2546-2. Ipswich Formation, thin section, 18° 11.053'N 77° 49.750' W
WL2547. Ipswich Formation, polished slab and thin section, 18° 11.269'N 77° 49.756' W
WL2548. Ipswich Formation, polished slab, 18° 11.290'N 77° 49.745' W
WL2549. Ipswich Formation, polished slab and thin section, 18° 11.326'N 77° 49.637' W
WL2550. Ipswich Formation, polished slab and thin section, 18° 11.332'N 77° 49.587' W
WL2551. Ipswich Formation, thin section, 18° 11.475'N 77° 49.563' W
WL2552A. Ipswich Formation, polished slab and thin section, 18° 11.720'N 77° 49.495' W
WL2552B. Ipswich Formation, polished slab, 18° 11.720'N 77° 49.495' W
WL2553. Merrywood Formation, polished slab, 18° 11.775'N 77° 49.520' W
WL2554. Merrywood Formation, thin section, 18° 11.811'N 77° 49.551' W
WL2555. Merrywood Formation, polished slab and thin section, 18° 12.110'N 77° 49.731' W
WL2602. Chapelton Formation, polished slab and thin section, 18° 13.284'N 77° 45.347' W
WL2611. Chapelton Formation, polished slab, 18° 13.812'N 77° 47.705' W
WL2613. Chapelton Formation, polished slab and thin section, 18° 13.294'N 77° 48.271' W
WL2614. Chapelton Formation, polished slab and thin section, 18° 13.242'N 77° 48.412' W
WL2615. Spring Vale Formation, thin section, 18° 12.545'N 77° 48.756' W
WL2616. Spring Vale Formation, thin section, 18° 12.492'N 77° 48.824' W
WL2617. Chapelton Formation, polished slab and thin section, 18° 12.437'N 77° 48.930' W
WL2618. Chapelton Formation, polished slab, 18° 12.411'N 77° 48.966' W
WL2622. Chapelton Formation, polished slab, 18° 13.391'N 77° 47.634' W
WL2875. Camperdown Formation, polished slab and thin section, 18° 21.561'N 77° 54.510' W
WL2881. Chapelton Formation, thin section, 18° 22.454'N 77° 51.229' W
WL2908. Chapelton Formation, polished slab and thin section, 18° 15.784'N 77° 48.495' W
WL2931. Stettin Formation polished slab, 18° 19.866' N, 077° 49.505' W
WL2933. Stettin Formation polished slab, 18° 19.936' N, 077° 49.558' W.
WL2942. Spring Vale Formation, polished slab, 18° 18.262'N 77° 48.829' W
WL2948. Chapelton Formation, polished slab, 18° 19.608'N 77° 50.759' W
WL2949. Chapelton Formation, polished slab, 18° 19.601'N 77° 50.763' W
WL2951. Merrywood Formation, polished slab, 18° 19.633'N 77° 50.871' W
WL2952. Merrywood Formation, polished slab, 18° 19.717'N 77° 50.930' W
WL2953. Spring Vale Formation, polished slab, 18° 19.897'N 77° 51.242' W
WL2954. Merrywood Formation, polished slab, 18° 20.008'N 77° 51.328' W
WL2955. Merrywood Formation, polished slab, 18° 20.022'N 77° 51.499' W

WL2956. Spring Vale Formation, polished slab, 18° 19.886'N 77° 51.698' W
WL2960. Spring Vale Formation, polished slab, 18° 20.378'N 77° 52.638' W
WL2962. Spring Vale Formation, polished slab, 18° 51,563'N 77° 52.004' W
WL2969. Spring Vale Formation, polished slab, 18° 21.716'N 77° 46.873' W
WL2970. Chapelton Formation, polished slab, 18° 21.715'N 77° 46.651' W
WL2976. Spring Vale Formation, polished slab, 18° 21.993'N 77° 45.818' W
WL2977. Spring Vale Formation, polished slab, 18° 22.019'N 77° 45.783' W
WL2985. Spring Vale Formation, polished slab, 18° 17.260'N 77° 51.469' W
WL2986. Spring Vale Formation, polished slab, 18° 17.108'N 77° 51.492' W
WL3032. Spring Vale Formation, polished slab, 18° 22.623'N 77° 46.159' W
WL3199. Chapelton Formation, polished slab, 18° 12.402'N 77° 48.994' W
WL3199-1. Chapelton Formation, thin section, 18° 12.402'N 77° 48.994' W
WL3199-3. Chapelton Formation, thin section, 18° 12.402'N 77° 48.994' W
WL3199-5. Chapelton Formation, thin section, 18° 12.402'N 77° 48.994' W
WL3199-6. Chapelton Formation, thin section, 18° 18° 12.402'N 77° 48.994' W
WL3209. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3210. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3211. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3213. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3214. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3216. Camperdown Formation, polished slab and thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3216-2. Camperdown Formation, thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3217. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3219. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3220. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3223. Camperdown Formation, polished slab and thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3224. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3228. Camperdown Formation, thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3229. Camperdown Formation, polished slab and thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W

WL3230. Camperdown Formation, polished slab and thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3231. Camperdown Formation, polished slab and thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3232. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3233. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3234. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3235. Camperdown Formation, thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3236. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3237. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3238. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3240. Camperdown Formation, thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3241. Camperdown Formation, thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3242. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3242A. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3243. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3244. Camperdown Formation, polished slab, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL3245. Camperdown Formation, polished slab and thin section, logged section from 18° 21.271'N 77° 47.196' W to 18° 21.142'N 77° 46.888' W
WL4913. Ipswich Formation, thin section, 18° 11.243'N 77° 45.884' W
WL4915. Ipswich Formation, thin section, 18° 11.351'N 77° 45.846' W
WL4922. Merrywood Formation, thin section, 18° 11.818'N 77° 49.574' W
WL4923. Merrywood Formation, thin section, 18° 11.810'N 77° 49.545' W
WL4923-2. Merrywood Formation, thin section, 18° 11.810'N 77° 49.545' W
WL4926. Ipswich Formation, thin section, 18° 11.740'N 77° 49.507' W
WL4928. Ipswich Formation, thin section, 18° 11.670'N 77° 49.499' W
WL4930-2. Ipswich Formation, thin section, 18° 11.593'N 77° 49.538' W
WL5551. Appleton Formation, polished slab and thin section, 18° 9.890'N 77° 46.120' W
MGD-S11. Appleton Formation, thin section, 18° 9.899'N 77° 45.925' W
MGD-S12. Appleton Formation, thin section, 18° 9.899'N 77° 45.925' W
MGD-S14. Appleton Formation, thin section, 18° 9.878'N 77° 46.114' W