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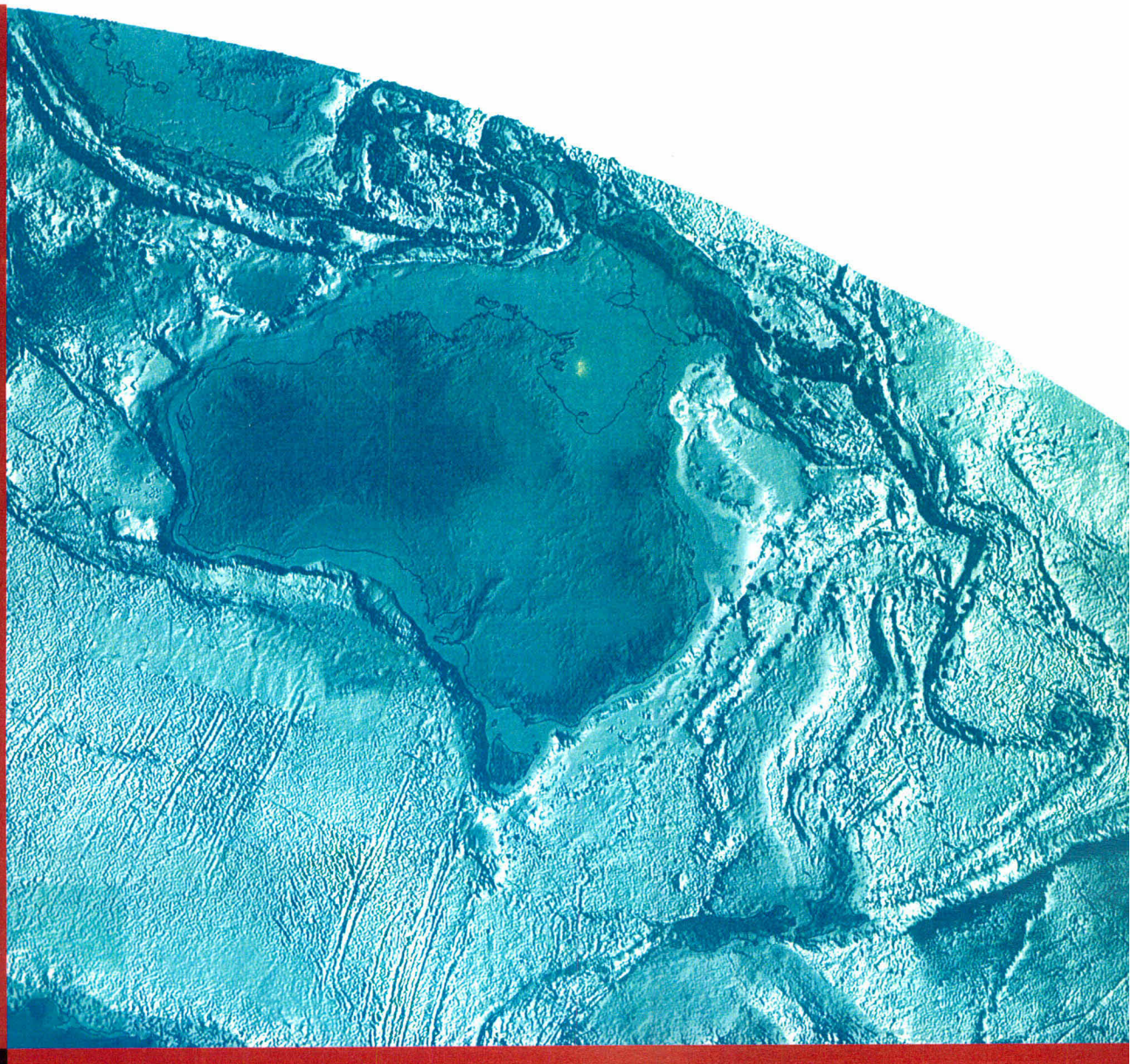

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NEW PALYNOLOGY OF THE CASTERTON FORMATION

SAWPIT-1

OTWAY BASIN

AUSTRALIA

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1 ABSTRACT

The age of the Otway Basin's Casterton Formation has long been a contentious issue, due to a wide range of isotopic dates (Mitchell *et al.*, 1997) and the absence of decisive key palynological taxa (Partridge, 1994 [*unpub.*] cited in Mitchell *et al.*, 1997). Most previous palynological interpretations have broadly assigned the Casterton Formation to the *Retitriletes watherooensis* to *Ruffordiaspora australiensis* Spore-Pollen Zones of the Late Jurassic to Early Cretaceous (Morgan *et al.*, 1995; Price, 2002). Where a younger (Neocomian) age has been construed, Mitchell *et al.*, (1997) have proposed that, despite similar lithologies, the Casterton Formation, as currently defined, is not a chronostratigraphic unit, and the 'Casterton Formation' east of the Merino High is younger than the Casterton Formation in the west (Mitchell *et al.*, 1997).

The palynological analysis of newly collected samples from Sawpit-1 in the Penola Trough demonstrates a younger age than previously determined west of the Merino High and indicates that the Casterton Formation is a chronostratigraphic unit. Although new key spore and pollen taxa that were previously unidentified from the western Casterton Formation have been recorded, no significant age refinement can be obtained based on those sporomorphs alone. The first discovery of the dinoflagellate cyst *Gagiella mutabilis* in the Otway Basin has provided the evidence to further refine the age of the Casterton Formation. The presence of *G. mutabilis* restricts the age of the Casterton Formation in Sawpit-1 to the Valanginian *Gagiella mutabilis* Microplankton Zone (Backhouse, 1988).

2 INTRODUCTION

The oldest sediments recorded in the Otway Basin are the pre-rift to syn-rift sediments of the Casterton Formation. The Casterton Formation is predominantly composed of carbonaceous shales with minor interbedded siltstone, sandstone, volcaniclastics and basalt flows (Boult *et al.*, 2002; Morton *et al.*, 1994; Mitchell *et al.*, 1997). The age of this unit has proven difficult to determine until now through palynological or radiometric dating. Palynology has provided limited age resolution due to the scarcity of key spore and pollen taxa in the few samples studied. This has resulted in a broad age determination spanning multiple spore-pollen zones. Fission track and radiometric dating have produced varied and wide ranging results with broad error bands (Mitchell *et al.*, 1997), hence a definitive age for the Casterton Formation had not been resolved. Therefore, the aim of this study was to conclusively determine the age of the Casterton Formation.

3 MATERIAL

A total of 17 cuttings samples from Sawpit-1 (Figure 1) were collected over a 100m interval from 2425m to 2525m, covering the basal Pretty Hill Formation, the entire Casterton Formation (2450m – 2507m) and the uppermost basement (Price 2002). Each cuttings sample from Sawpit-1 contains sediment collected over 2.5m intervals. The palynological material from Sawpit-1 was relatively well preserved and enabled species identification and age determination.

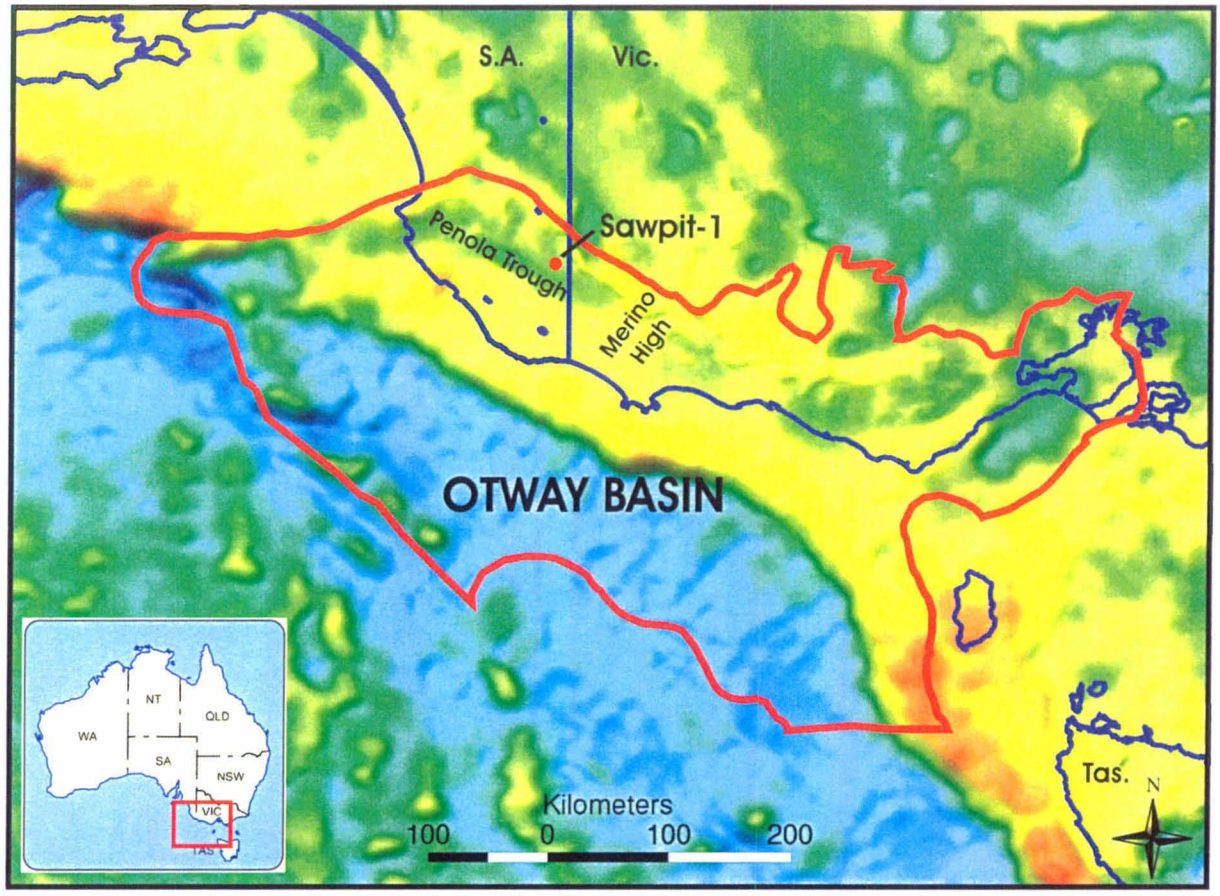


Figure 1 – Location of the Sawpit-1 well in the Otway Basin.

4 PALYNOSTRATIGRAPHY

The high density sampling of Sawpit-1 revealed higher yielding and more diverse microflora than previously reported from the Casterton Formation. Important spore and pollen taxa identified in the Sawpit-1 samples include *Aequitriradites sp. cf. spinulosus, Ceratosporites equalis, Coronatispora perforata, Microcachryidites antarcticus, Murospora florida, Retitriletes facetus, Retitriletes watherooensis, Ruffordiaspora australiensis, Cicatricosisporites sp.* and *Foraminisporis wonthaggiensis* (Plate 1). *F. wonthaggiensis* is especially important because this taxon had not been found within the Casterton Formation prior to this study.

These key spore and pollen taxa indicate an *F. wonthaggiensis* Zone age for the Casterton Formation from Sawpit-1, although the *R. australiensis* Zone can not be excluded due to the possibility of caving. Placing these samples in the *F. wonthaggiensis* to *R. australiensis* Zones is not decisive, since the Casterton Formation would still be either Latest Jurassic or Early Cretaceous in age. Therefore, the spore-pollen results alone are not sufficient to significantly refine the age of the Casterton Formation.

The age of the Casterton Formation was definitively determined in the new samples from Sawpit-1 with the positive identification of the dinoflagellate cyst *Gagiella mutabilis* (Plate 2). *G. mutabilis* was first described by Backhouse (1988) from the Perth Basin. Backhouse (1988) identified *G. mutabilis* as being associated with restricted-marine to lagoonal, brackish-water, and possibly non-marine environments that do not contain Late Jurassic or Early Cretaceous marine dinoflagellate cysts. Backhouse (1988) determined that *G. mutabilis* was confined to the Valanginian stage in the Perth Basin. Auld (2002) and Tupper *et al.* (2002) have restricted the *G. mutabilis* Zone range further to be entirely contained within the

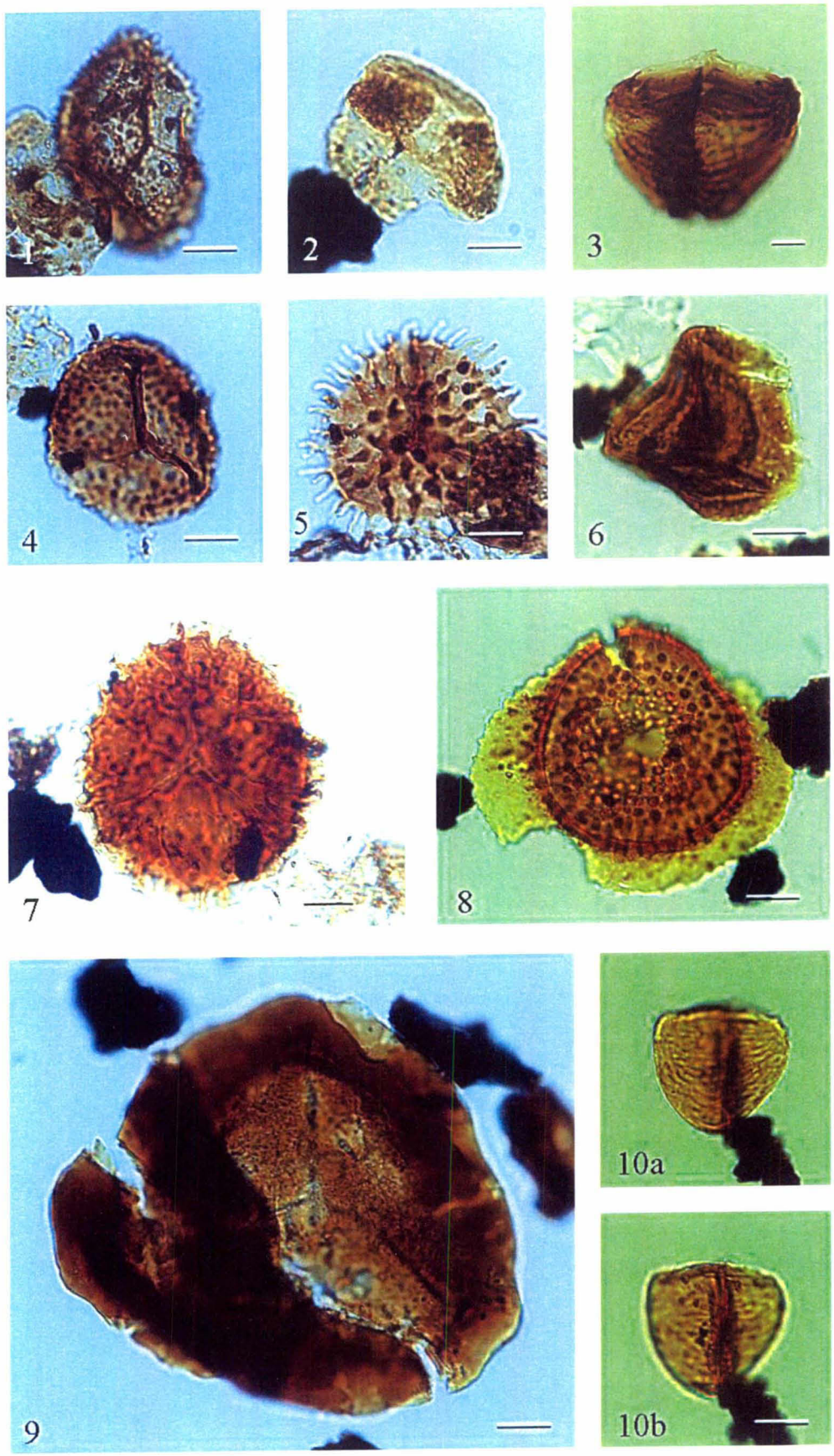


Plate 1 – Selected key species from the Sawpit-1 samples. (Scale bar is 10 micrometers.)

1 *Foraminisporis wonthaggiensis*
2 *Microcachryidites antarcticus*
3 *Ruffordiaspora australiensis*
4 *Retitriletes watherooensis*
5 *Ceratosporites equalis*
6 *Coronatispora perforata*
7 *Retitriletes facetus*
8 *Aequitriradites sp. cf. spinulosus*
9 *Murospora florida*
10 *Cicatricosisporites* sp – (a) high focus, (b) low focus

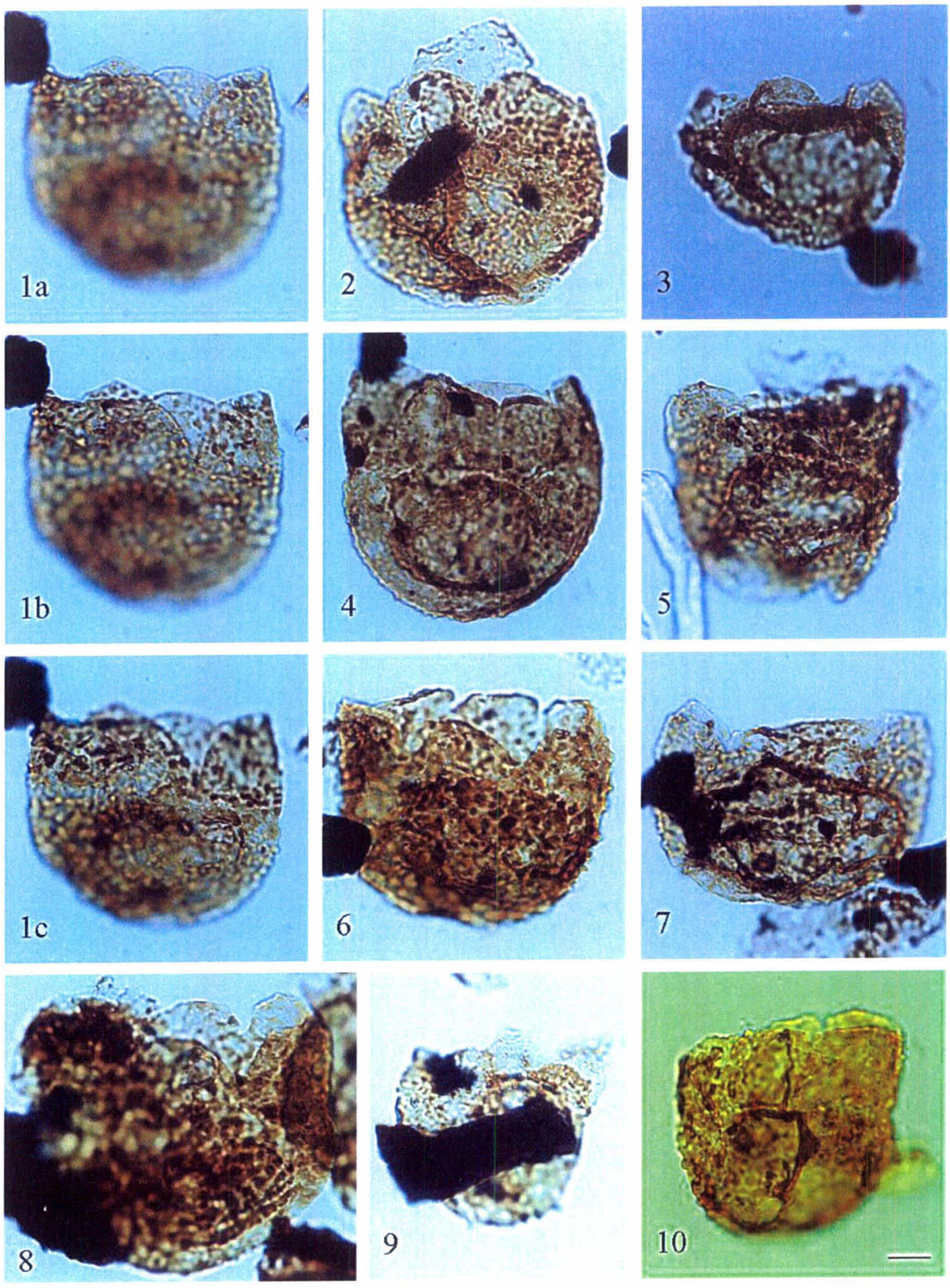
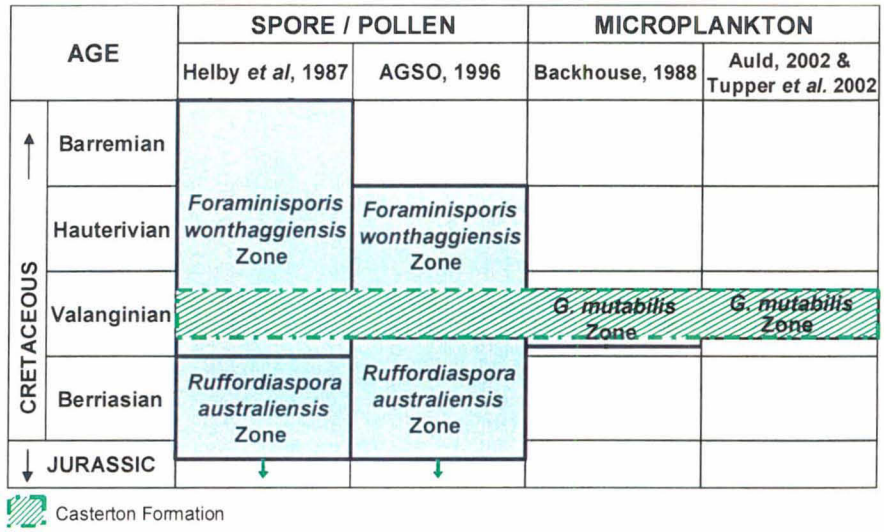


Plate 2 – *Gagiella mutabilis* from the Sawpit-1 samples. (Scale bar is 10 micrometers.)

lower *S. tabulata* Microplankton Zone, suggesting a mid-Valanginian or younger age (Figure 2). As a result, the Casterton Formation is here dated as Valanginian.

Figure 2 – Comparison of the spore and pollen and microplankton biozonations for the Casterton Formation.



Gagiella mutabilis is the only identifiable dinoflagellate cyst found in the Sawpit-1 samples and occurs in seven consecutive samples (2467.5 - 2470m to 2520 - 2522.5m). This research was conducted on cuttings, so the possibility of contamination by cavings can not be excluded. The presence of a single specimen of *G. mutabilis* at 2520 - 2522.5m, which is typically a barren basement sample, is due to caving. However, the *G. mutabilis* stratigraphic top coincides with the top boundary of the Casterton Formation sediments (at 2466m) and its distribution is strictly limited to this interval, suggesting these specimens are *in situ* and not caved from sediments higher up the stratigraphic section. This contention is supported by the calliper log, which shows no evidence of significant caving. In addition each sample that contains *G. mutabilis* is associated with a unique palynofacies. It could be argued that all the *G. mutabilis* specimens from 2480 - 2482.5 to 2520 - 2522.5m were the result of cavings from 2477.5 - 2480m due to its large number of *G. mutabilis* specimens. If this was true, then 2480 - 2482.5 to 2520 - 2522.5m could also be expected to contain the distinctive cuticular matter that is located at 2477.5 - 2480m, but none of the other samples contain this cuticle. All of this evidence strongly supports the interpretation that *G. mutabilis* is an *in situ* occurrence.

5 CONCLUSIONS

The spore-pollen content of the Casterton Formation samples from Sawpit-1 suggests that this formation is of *F. wonthaggiensis* to *R. watherooensis* Zone age. This age is further refined by the identification of the dinoflagellate *Gagiella mutabilis* which indicates assignment to the *G. mutabilis* Zone of the Valanginian stage. Observed occurrences of *G. mutabilis* in the Sawpit-1 samples are believed to be *in situ* and not the result of cavings because: (1) the *G. mutabilis* stratigraphic top coincides with the top boundary of the Casterton Formation sediments and its distribution is strictly limited to this interval, (2) the calliper log shows no evidence of cavings, and (3) each depth occurrence of *G. mutabilis* is associated with a unique palynofacies.

The combination of the first identification of both *G. mutabilis* and *F. wonthaggiensis* is strong evidence that the Casterton Formation in Sawpit-1 is Valanginian (*G. mutabilis* Zone) in age.

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APPENDIX 1

Summary Palynological Data: Sawpit-1, and detailed sampling data.

SAMPLE NO	GA LAB No	DEPTH from (m)	DEPTH to (m)	SAMPLE TYPE	PIRSA sample number	PICTURES	REMARKS	SPORE-POLLEN ZONE	MICROPLANKTON ZONE
Sawpit-1 1	20884	2425	2427.5	Cuttings	R586400	Sawpit1_2425	18.85g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Unknown
Sawpit-1 2	20885	2427.5	2430	Cuttings	R586401	Sawpit1_2427.5	8.62g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Unknown
Sawpit-1 3	20886	2430	2432.5	Cuttings	R586402	Sawpit1_2430	13.0g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Unknown
Sawpit-1 4	20887	2435	2437.5	Cuttings	R586403	Sawpit1_2435	12.19g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Unknown
Sawpit-1 5	20888	2440	2442.5	Cuttings	R586404	Sawpit1_2440	20.65g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Unknown
Sawpit-1 6	20889	2442.5	2445	Cuttings	R586405	Sawpit1_2442.5	10.66g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Unknown
Base Pretty Hill - Top Sub-unit A 2450m									
Sawpit-1 7	20890	2450	2452.5	Cuttings	R586406	Sawpit1_2450	8.25g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Unknown
Sawpit-1 8	20891	2462.5	2465	Cuttings	R586407	Sawpit1_2462.5	12.35g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Unknown
Sawpit-1 9	20892	2465	2467.5	Cuttings	R586408	Sawpit1_2465	9.42g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Unknown
Base Sub-unit A - Top Casterton Fm 2466m									
Sawpit-1 10	20893	2467.5	2470	Cuttings	R586409	Sawpit1_2467.5	15.41g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Gagiella mutabilis Zone
Sawpit-1 11	20894	2477.5	2480	Cuttings	R586410	Sawpit1_2477.5	9.78g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Gagiella mutabilis Zone
Sawpit-1 12	20895	2480	2482.5	Cuttings	R586411	Sawpit1_2480	10.14g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Gagiella mutabilis Zone
Sawpit-1 13	20896	2482.5	2485	Cuttings	R586412	Sawpit1_2482.5	13.69g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Gagiella mutabilis Zone
Sawpit-1 14	20897	2492.5	2495	Cuttings	R586413	Sawpit1_2492.5	15.84g	Foraminisporis wonthaggiensis to Ruffordiaspora australiensis Zones	Gagiella mutabilis Zone
Sawpit-1 15	20898	2505	2507.5	Cuttings	R586414	Sawpit1_2505	13.85g	(Foraminisporis wonthaggiensis to) Ruffordiaspora australiensis Zones	Gagiella mutabilis Zone
Base Casterton Fm 2507m (top basement)									
Sawpit-1 16	20899	2520	2522.5	Cuttings	R586415	Sawpit1_2520	14.30g	Basement	Basement
Sawpit-1 17	20900	2522	2525	Cuttings	R586416	Sawpit1_2522	14.96g	Basement	Basement