

MGPALAEO

geological and
stratigraphical consultants

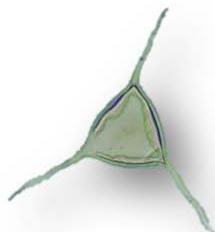
Palynological Toolbox

Palynomorphs (spores, pollen, dinocysts, acritarchs, and algae) are microfossils that are found in marine and non-marine settings from the Precambrian to the present day.

These microfossils are geographically widespread, abundant, and readily preserved, meaning they are an excellent tool for:

- Relative age dating of rocks
- Correlating sedimentary successions
- Palaeodepositional environments
- Sequence stratigraphy
- Thermal maturity

This toolbox provides a guide to palynological analysis, from choosing a good sample through to working with palynological datasets.



Sampling

To get good biostratigraphic results, you need to start with a good set of samples.

Key factors to consider before collecting samples:

- What are the issues or questions that need resolving? What are you hoping to get from the biostratigraphic data?
- Consider lithology: it is always best to target dark-coloured mudstones or siltstones first for palynology.
- Sands and coals can still be productive, particularly with modern processing and longer acid digestion techniques.
- Sample type: outcrop, cuttings, SWC, and core are all a great source of data, each with its own advantages, and we can help to devise a sampling strategy that best suits your needs.
- The finer the sampling interval, the better the results.
- All microfossils are sensitive to high temperatures: geological processes such as volcanism can have a detrimental effect on palynomorphs so avoid sampling too close to such features.
- Drilling issues: oil-based drilling muds require more extensive washing so it is always best to provide more sample.



General rule of thumb: as grain size increases, the volume of material collected for sampling should likewise increase. With a good mudstone, only 20g of sample is required.



Having an on-site laboratory also allows for constant quality control during processing. The methodology can be tweaked as necessary to ensure the best slides possible, all at no additional cost.

Using Palynological Data

It is important to be consistent when correlating palynological data. Make sure you are using the one zonation scheme for all your data, or that you clearly understand the differences between them, because there can be substantial differences as shown in the figure below.

The latest MGPalaeo zonation scheme (MGP 2014) was developed in 2014, the framework of which was built upon earlier industry standard schemes such as Morgan, Hooker and Ingram (MHI 2002), and Helby, Morgan and Partridge (HMP 1987 and HMP 2004).

MGP 2014 has been used for almost 2000 wells in our North West Shelf Stratigraphic Database to aid in consistent correlations.

Slightly modified versions of MGP 2014 exists for other basins across Australia and for Papua New Guinea, again built upon decades of work.

GTS 2012		Eastern Australian Spore-Pollen Zonation (Price 1997)	Pan Australian Spore-Pollen Zonation (HMP 1987/2004)	HMP Zones (2006)	Subzones	MHI 2002 Dinocyst Zones	MGP 2014 Dinocyst Zones	Subzones	Woodside Sequences (Marshall & Lang, 2013)	Regional Play Intervals (Marshall & Lang, 2013)			
Period, Epoch	Stage												
Jurassic	Tithonian	APJ6	Retitriletes watheroensis	Pseudoceratium iehiense	4cia-4cic	Pseudoceratium iehiense	Pseudoceratium iehiense	B. ferox I. kondratjevii P. inusitatum Egmonto. sp. A	J56.0 SB	J50			
				Dingodinium jurassicum	5aia-5aid	Dingodinium jurassicum	Dingodinium jurassicum	Biii Bii Bi Aiv Aiii Aii Ai	J54.0 SB				
				Omatia montgomeryi	5c	Omatia montgomeryi	Omatia montgomeryi	B A	J53.0 SB				
		Cribrerodinium perforans	5d	Cribrerodinium perforans	Cribrerodinium perforans	C B A	J50.0 SB						
		Dingodinium swanense	6aia-6aiib	Dingodinium swanense	Dingodinium swanense	D C B A	JT						
		Wanaea clathrata	6bi-6biib	Wanaea clathrata	Wanaea clathrata	B A	J47.0 SB						
	Late Kimmeridgian	AJP5	Murospora florida	A							J40		

Palynological Reports

MGPalaeo's palynological reports will contain a zonation scheme explaining which zonation is being used, a summary table listing the details for each sample, simple text description of the key diagnostic features of each zone, and a StrataBugs chart.

The summary table (below) lists the confidence level, spore-pollen colour, zonal pick, depositional environment, and key species of each palynology sample.

DEPTH [mbRT]	SAMPLE TYPE	MICROFOSSIL YIELD	PRESERVATION	PERCENTAGE			DIVERSITY			SPORE-POLLEN COLOUR	ZONE	ENVIRONMENT	KEY DATUMS
				DINOFLAG.	SPINY AC.	OTHER	SPORE-POLLEN	MICROPLANK.	SPORE-POLLEN				
1120 / 1130	CUTTS	Very high	Good	25	<1	16	59	Very high	High	Orange-brown	M. australis - M. testudinaria	Nearshore marine	P. neocomica, M. australis, S. attadalicum, D. cerviculum
1160 / 1170	CUTTS	Very high	Good - Moderate	20	<1	11	69	Very high	High	Orange-brown	?P. burgeri	Nearshore marine	?G. lowii, S. tabulata, P. burgeri, M. testudinaria, M. australis
1180 / 1190	CUTTS	Low	Moderate	13	<1	16	71	Low	Moderate	Orange-brown	P. burgeri or older	Nearshore marine	S. areolata, C. magna
2000 / 2010	CUTTS	Low	Moderate	27	0	8	65	Low	Moderate	Light Brown	W. indotata or younger	Nearshore marine	W. indotata, Sentusidinium spp.

Depth (mbRT)	Sample Type	Microfossil Yield	Preservation	Percentage				Diversity	
				Microplankton			Spore-Pollen	Microplank.	Spore-Pollen
				Dinoflag.	Spiny Ac.	Other			
1120 / 1130	CUTTS	Very High	Good	25	<1	16	59	Very High	High
1160 / 1170	CUTTS	Very High	Good - Moderate	20	<1	11	69	Very High	High
1180 / 1190	CUTTS	Low	Moderate	13	<1	16	71	Low	Moderate
2000 / 2010	CUTTS	Low	Moderate	27	0	8	65	Low	Moderate

Allows for an indication of the confidence level for that sample (e.g., low yields of poorly preserved microfossils might indicate low confidence in the results for that sample, while high yields of well preserved species could indicate higher levels of confidence).

Zonation age based on MGP 2014.

Broad environmental subdivisions giving a general impression of proximity to shoreline.

Spore-Pollen Colour	Zone	Environment	Key Datums
Orange-Brown	M. australis - M. testudinaria	Nearshore Marine	P. neocomica, M. australis, S. attadallense, D. cerviculum
Orange-Brown	?P. burgeri	Nearshore Marine	?G. lowii, S. tabulata, P. burgeri, M. testudinaria, M. australis
Orange-Brown	P. burgeri or older	Nearshore Marine	S. areolata, C. magna
Light Brown	W. indotata or younger	Nearshore Marine	W. indotata, Sentusidinium spp.

Guide for determining thermal maturity, which in turn can be related to hydrocarbon generation. With increasing temperatures and pressures, the fossil colours change from yellow (immature) through to black (post-mature).

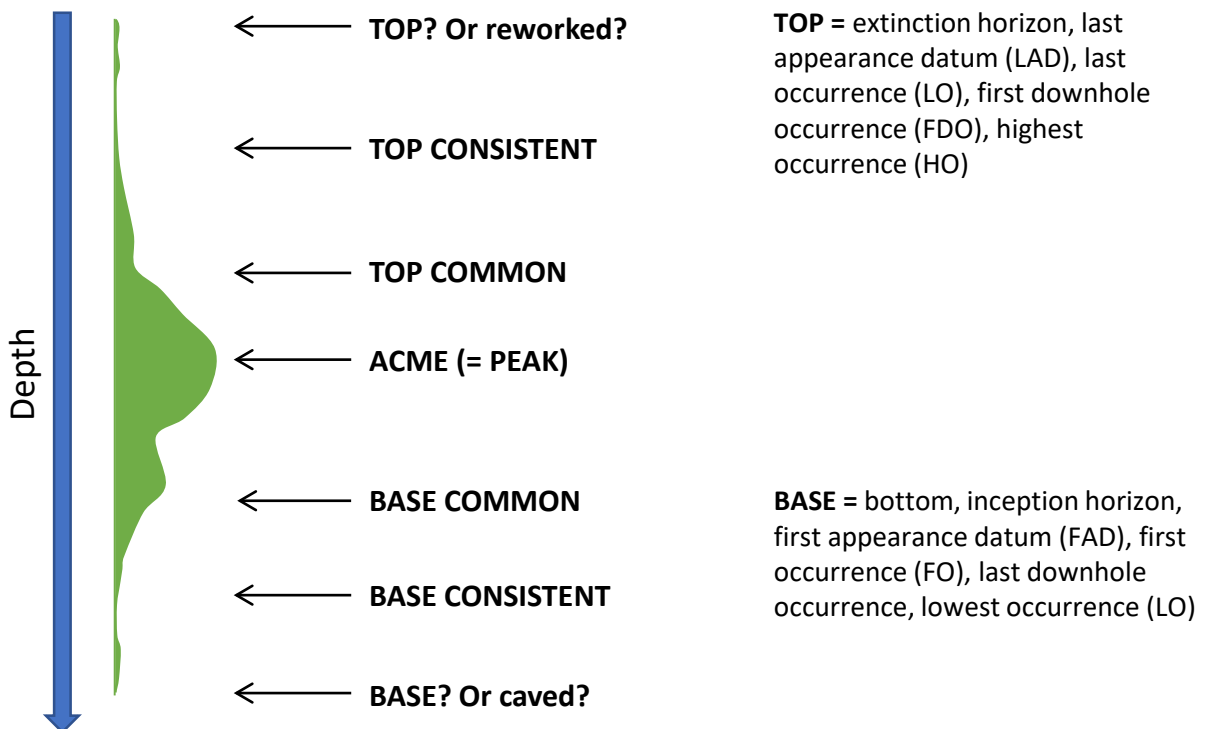
Key species used to define the zonal age.

Palynological Reports

Some points to keep in mind with regards to Zones/Subzones listed on the summary table:

- **Ranged zonation age (e.g., *M. australis* – *M. testudinaria*):** indicates that the sample didn't contain a good enough assemblage of fossils to be able to confine it to a single zone, but it did contain enough to limit it to a range of zones.
- **A zonal assignment with a question mark before it (e.g., ?*P. burgeri* Zone):** indicates this is the best zonation estimate based on the evidence at hand.
- **Zonal age 'or older' (e.g., *P. burgeri* Zone or older):** the sample only contained enough fossils to indicate that it can't be any younger than the zone mentioned. However, there isn't enough evidence to restrict it to this zone; it could be a little older, or a lot older.
- **Zonal age 'or younger' (e.g., *W. indotata* Zone or younger):** the sample only contained enough fossils to indicate that it can't be any older than the zone mentioned. However, there isn't enough evidence to restrict it to this zone; it could be a little younger, or a lot younger.

Species Abundance



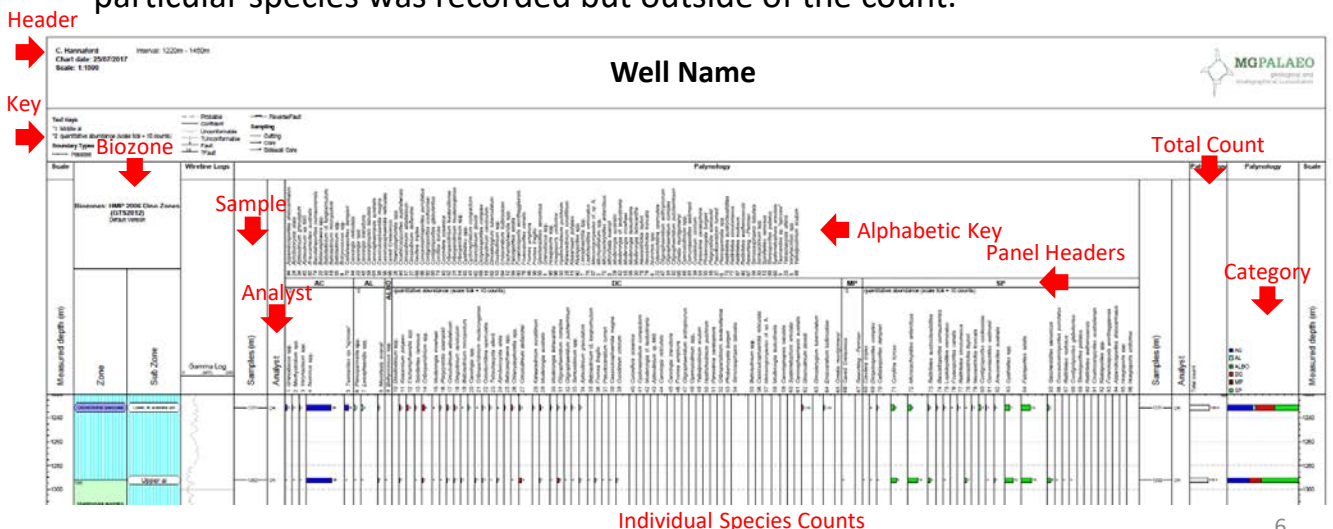
Key terms used in defining the geological range of a microfossil.

Distribution Charts

StrataBugs charts illustrate the microfossil content of each sample in stratigraphic order.

The main components of a StrataBugs chart as shown on the figure below are:

- **Header:** main background text for the well.
- **Key:** has the unplaced text and sample types that can't fit on the actual chart.
- **Biozone:** indicates which zones are being used (dinocyst zones and/or spore-pollen zones).
- **Sample and Analyst:** important when multiple vintages of data and mixed sample types are used. Details who carried out the work on each sample.
- **Alphabetic Key:** helps to locate a particular fossil species as most times, the fossils are displayed in the chart in order of their first downhole occurrence.
- **Panel Headers:** indicates if absolute or relative abundances have been used.
- **Total Count:** shows the total number of palynomorphs counted for each sample (generally, a count of 200 fossils per slide is carried out, with a scan of the rest of the slide to record any key markers that might be present). It is important to identify the lean samples.
- **Category:** useful to see what the dominant palynomorph groups are.
- **Individual Species Counts:** indicate the number of specimens of a particular species recorded in each sample. Where there is a question mark, it means only a questionable specimen was recorded, and where there is a '+' that means a particular species was recorded but outside of the count.



Further Information

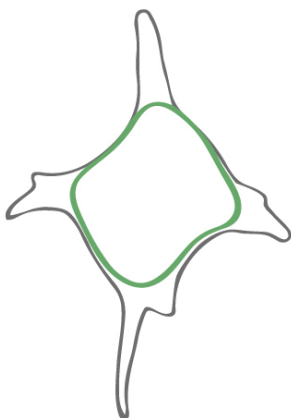
MGPalaeo also offers a comprehensive range of sedimentological services, leading to a better understanding of stratigraphic development and depositional models. These include:

- Core description and Reporting
- Image Log Interpretation
- Core workshops
- Wireline log interpretation
- Rock Typing from cuttings
- Sidewall core descriptions

For further information regarding how we can help you, please don't hesitate to contact us at info@mgpalaeo.com.au.

Our website: www.mgpalaeo.com.au

We're also happy to help advise on sampling programs for all new wells or review projects.



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