The Impact of CA-IDTIMS on the Understanding of Permian and Triassic Lithostratigraphy and Correlation in Eastern Australian Coal Basins*

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Abstract

In recent years, numerous correlations of the Permian and Triassic successions in the eastern Australian coal basins (Sydney, Gunnedah, Bowen and Galilee basins) have been attempted based on broad scale lithostratigraphy, sequence stratigraphy and biostratigraphy. However, detailed correlation of these successions has proved difficult. The development of Chemical Abrasion-Isotope Dilution Thermal Ionisation Mass Spectrometry (CA-IDTIMS), with its dramatically increased precision, has allowed more precise correlations to be obtained. This is in part because of the large number of tuffs in these eastern Australian basins, which range from the lowest Permian to the middle Triassic and number in the several hundred. The new correlations have resulted in numerous revisions to the ages of important units in eastern Australian basins. For example, the uppermost coal successions in the Sydney Basin (Newcastle Coal Measures, Illawarra Coal Measures) extend to very near the Permian-Triassic boundary and have a shorter duration than previously thought. The underlying Tomago Coal Measures/Whittingham Coal measures, rather than extending from the basal Wordian to earliest Wuchiapingian extend from the middle Capitanian to middle Wuchiapingian. Similarly, the top of the Greta Coal Measures, rather than being middle Kungurian are now known to be middle

Roadian. In the Gunnedah Basin, the top of the Millie Group was basal Wordian, but is now considered middle Capitanian, while the overlying Brothers Subgroup, which was thought to extend up to the middle Capitanian is now known to be middle Wuchiapingian. The overlying Coogal Subgroup has been dramatically shortened in duration, and now lies entirely within the middle Wuchiapingian. In the Bowen Basin, the changes are similar, with the base of the Peawaddy Formation changed to late Wuchiapingian rather than middle Wordian, the base of the overlying Black Alley Formation now being latest Wuchiapingian rather than late Capitanian, and the base of the Bandanna Formation reassigned to earliest Changhsingian, rather than early Wuchiapingian. This recalibration of stratigraphy allows for a much improved understanding of basin history and the correlations between stratigraphic units, within and between eastern Australian basins.

Reference Cited

Price, P.L., 1997, Permian to Jurassic palynostratigraphic nomenclature of the Bowen and Surat basins, *in* P. Green, ed., The Surat and Bowen Basins, southeast Queenslan, Queensland.Department of Mines and Energy, Brisbane, p. 137-178.

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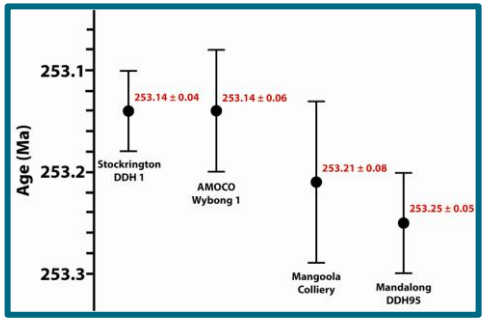

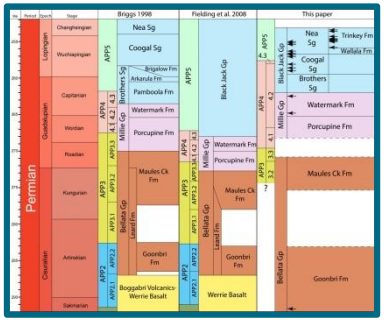

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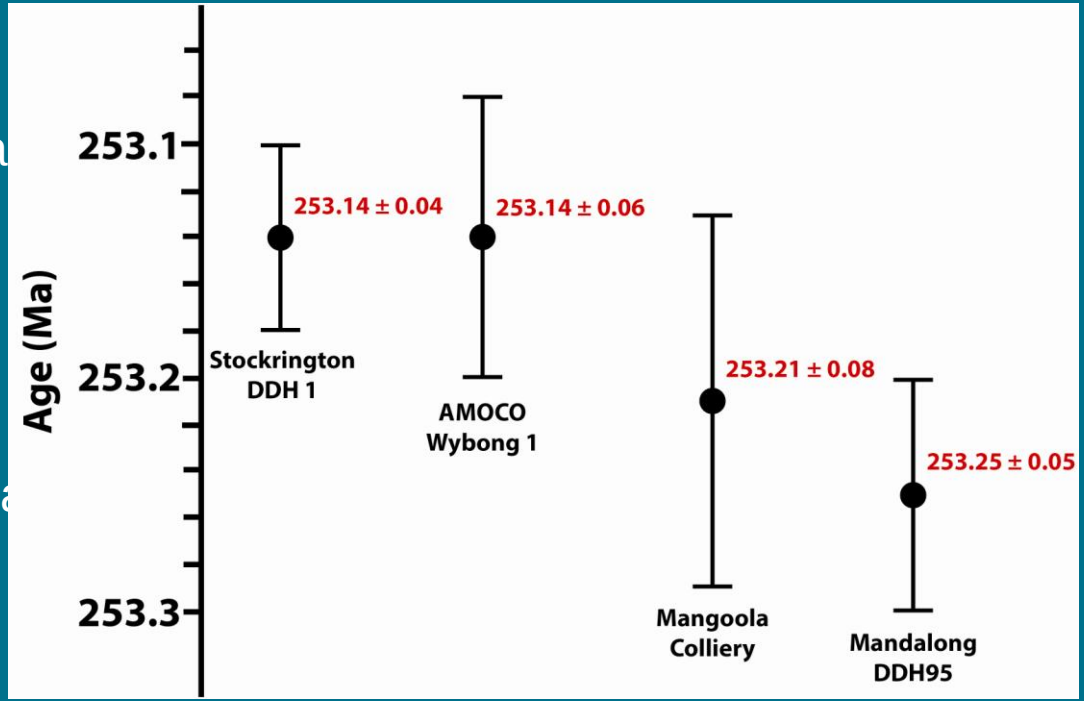
CA-IDTIMS

Chemical Ablation Isotope Dilution Thermal Ionisation Mass Spectrometry

- Zircon crystals from volcanic a
- Radiometric U-Pb dating
- High precision (e.g. ± 100 ky)
- Some Limitations
  - Dwell time of zircons in ma



CA-IDTIMS

- Multiple applications
  - regional & international correlation
  - timing of tectonic events
  - tying tuff beds to their volcanic source
  - depositional rates

- Best results obtained with a sequence of dates

The technique be used throughout the stratigraphic column, give us an ash bed with zircons, we can probably date it!

Volcanic eruptions

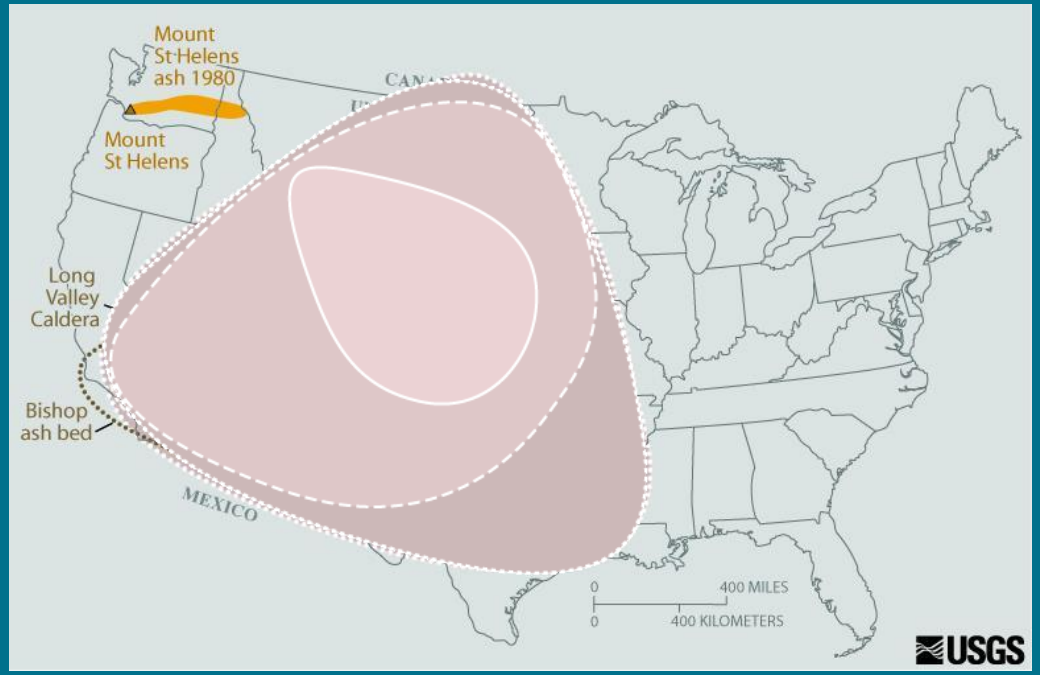
Plinian eruptions create extensive ash beds, providing a time horizon across a broad area

Tuffs in coals

Volcanic ash deposits over peat swamps create distinctive geological layers

These types of layers are abundant in the Eastern Australian coal basins

Extent of Yellowstone eruptions relative to Eastern Australia



http://volcanoes.usgs.gov/volcanoes/yellowstone/yellowstone_sub_page_91.html

Tying tuff beds to their volcanic source

Numerous Tuffs around the same age:

- Trinkey Formation - 254.57
- Trinkey Formation - 254.65
- Trinkey Formation - 254.67
- Wybong 1 - 254.82
- Huntley Claystone - 254.86
- Trinkey Formation - 254.87
- Nobby's Tuff - 254.88

Wandsworth volcanics:

- 254.66 ± 0.14 (at Attunga Creek)
- 254.85 ± 0.28

Dating tuffs in the Gunnedah and Sydney basins

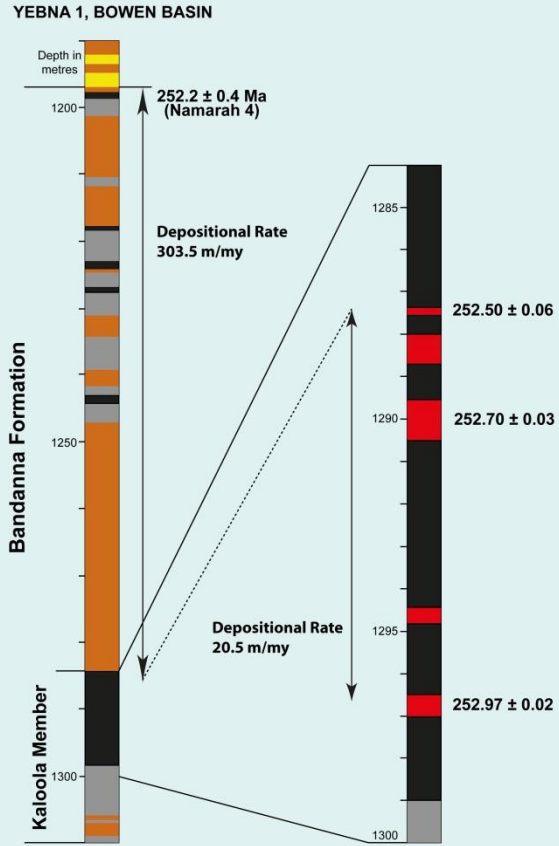
In the Newcastle Coalfield

More than 10 major tuff beds in the Newcastle Coal Measures

In the Hunter Coalfield

124 tuff beds in 350-450 m of Newcastle Coal Measures (8 beds more than 1 m thick)

29 tuff beds in the Wittingham Coal Measures (6 beds more than 1 m thick)



Depositional rates

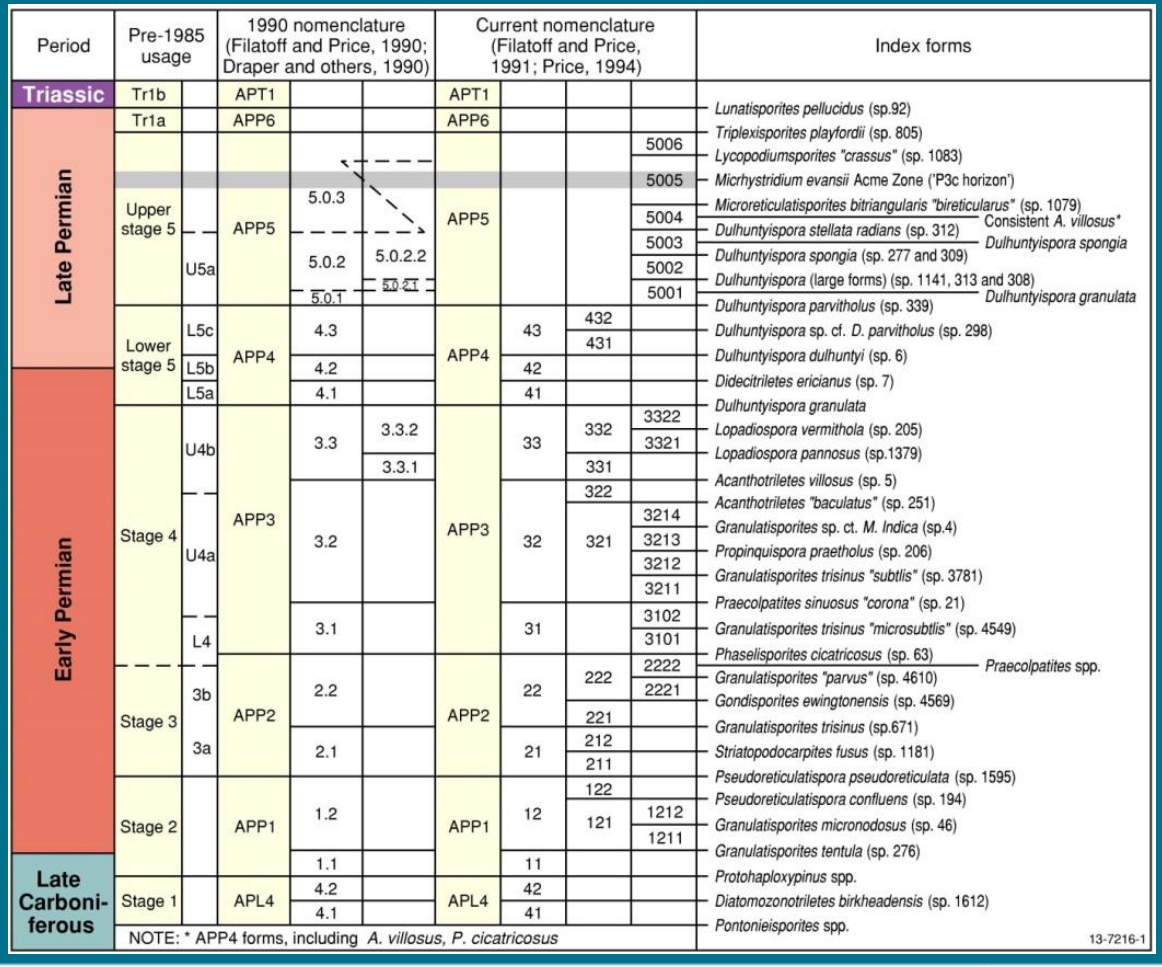
Yebna 1, Bowen Basin

Bandanna Formation including Kaloola Member

Depositional rate of Kaloola Member 20.5 m/my

Depositional rate of remainder of Bandanna Formation 303.5 m/my

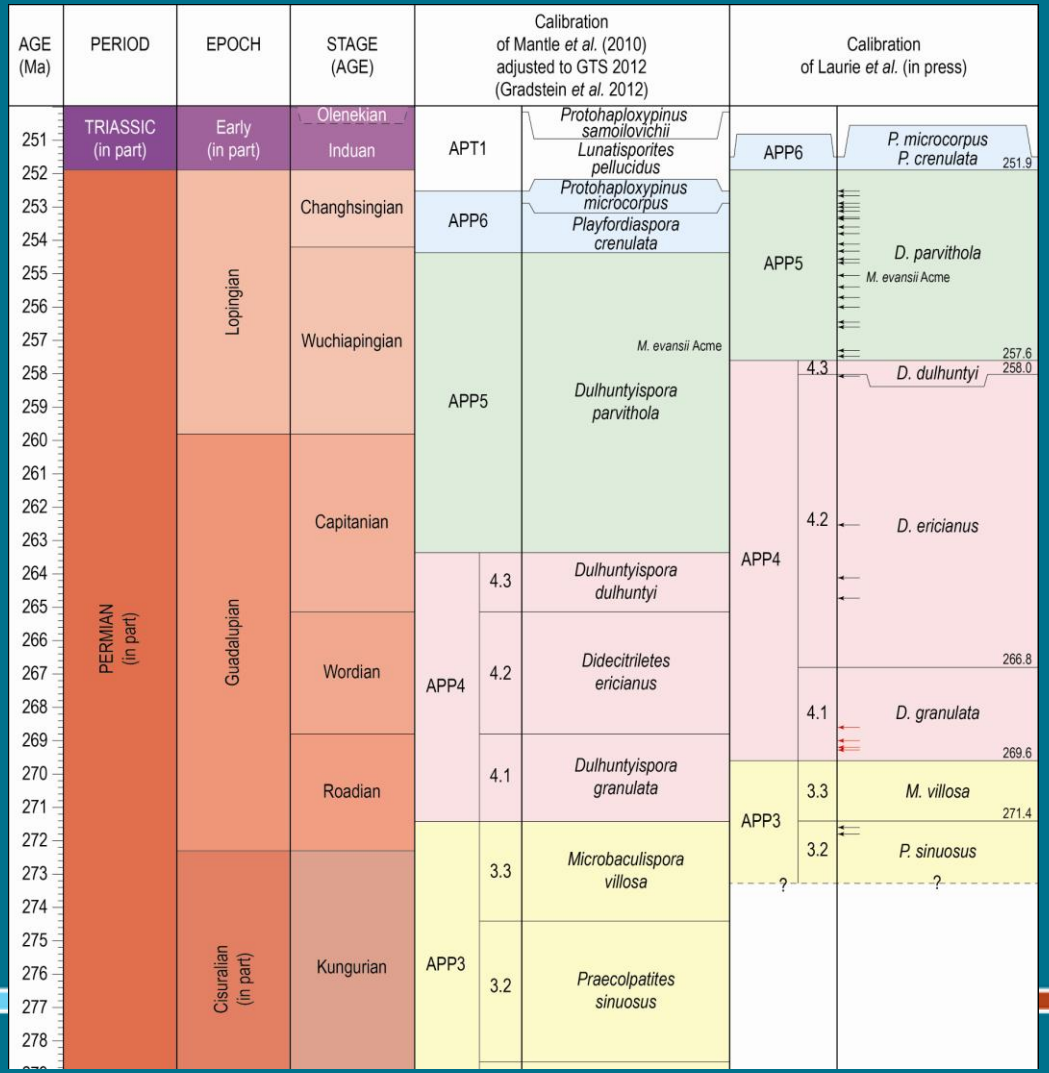
Price et al. 1997 biozones



After Price et al. 1997

Revised palynostratigraphy for the Guadalupian and Lopingian

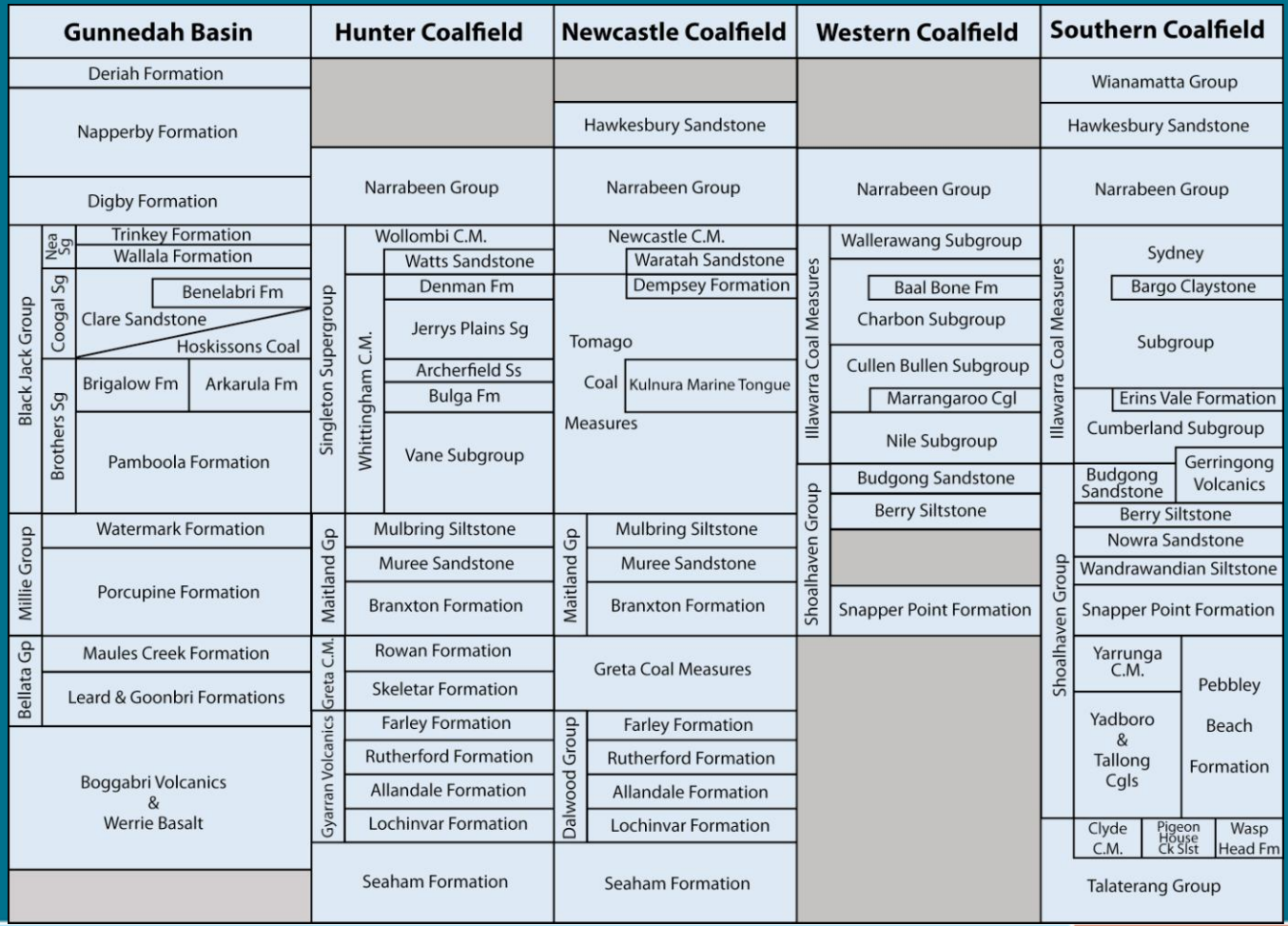
Arrows indicate CA-IDTIMS dated samples with palynological control



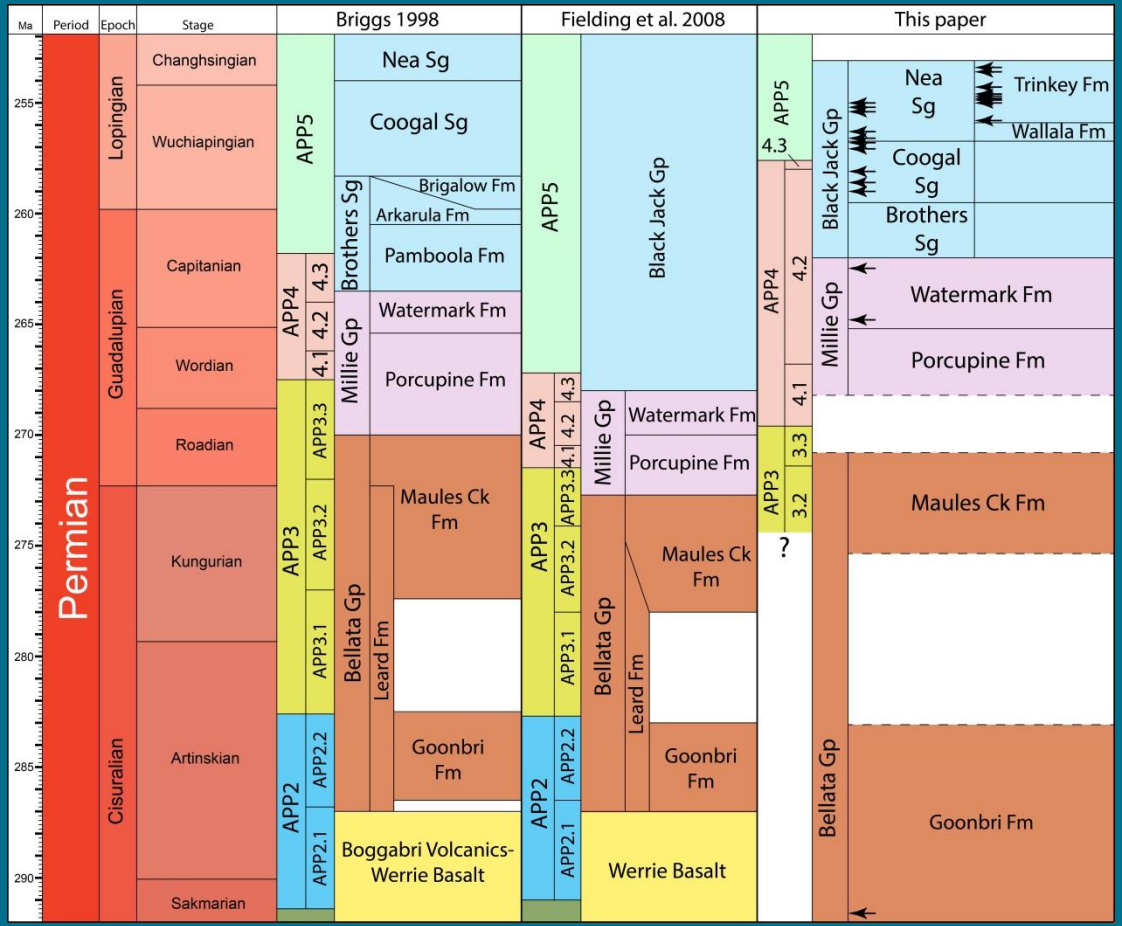
Revised Permian palynostratigraphy

Ma	Period	Epoch	Age/Stage		
250	Triassic	Early	Olenekian	APP6	*Playfordiaspora crenulata, Protohaploxypinus microcorpus, Triplexisporites playfordi*
			Induan	251.9	
		Lopingian	Changhsingian	APP5	251.9
255			Wuchiapingian	257.6	*Dulhuntyispora parvithola*
				APP4.3	257.6
				258.0	*Dulhuntyispora dulhuntyi*
260		Guadalupian	Capitanian	APP4.2	258.0
					Didecitriletes ericianus
265			Wordian	266.8	266.8
				APP4.1	*Dulhuntyispora granulata*
270	Permian		Roadian	269.6	269.6
				APP3.3	*Microbaculispora villosa*
		Cisuralian		271.4	271.4
				APP3.2	*Praecolpatites sinuosus*
275			Kungurian	275.0	275.0
				APP3.1	*Phaselisporites cicatricosus*
280				280.0	280.0
			Artinskian	APP2.2	*Granulatisporites trisinus*
285					
				290.0	290.0
290			Sakmarian	APP2.1	*Pseudoreticulatispora pseudoreticulata*
				295.0	295.0
295	Carboniferous			APP1.22	*Pseudoreticulatispora confluens*
			Asselian	297.0	297.0
				APP1.21	*Granulatisporites tentula*
300		Late Penn.	Gzhelian	300.0	300.0

Tadros 1997 correlation

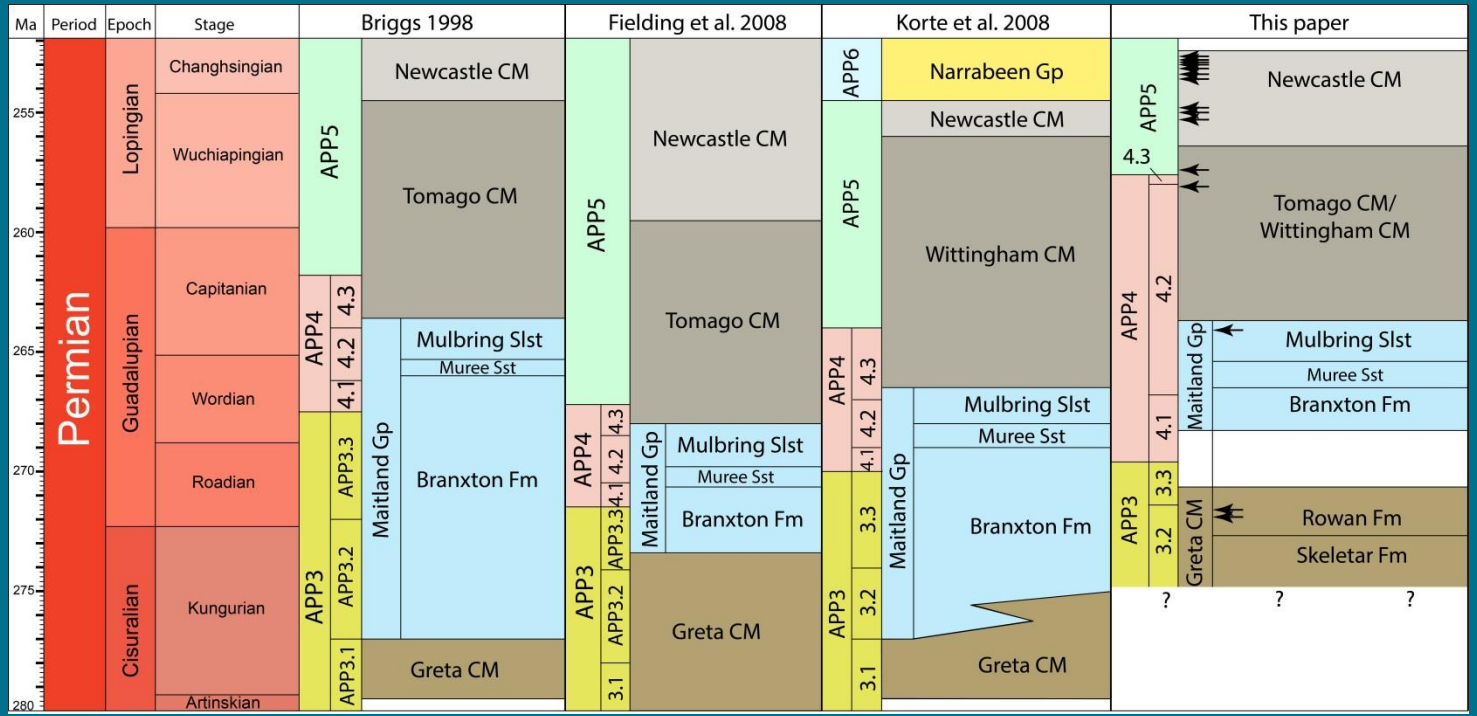


Gunnedah Basin

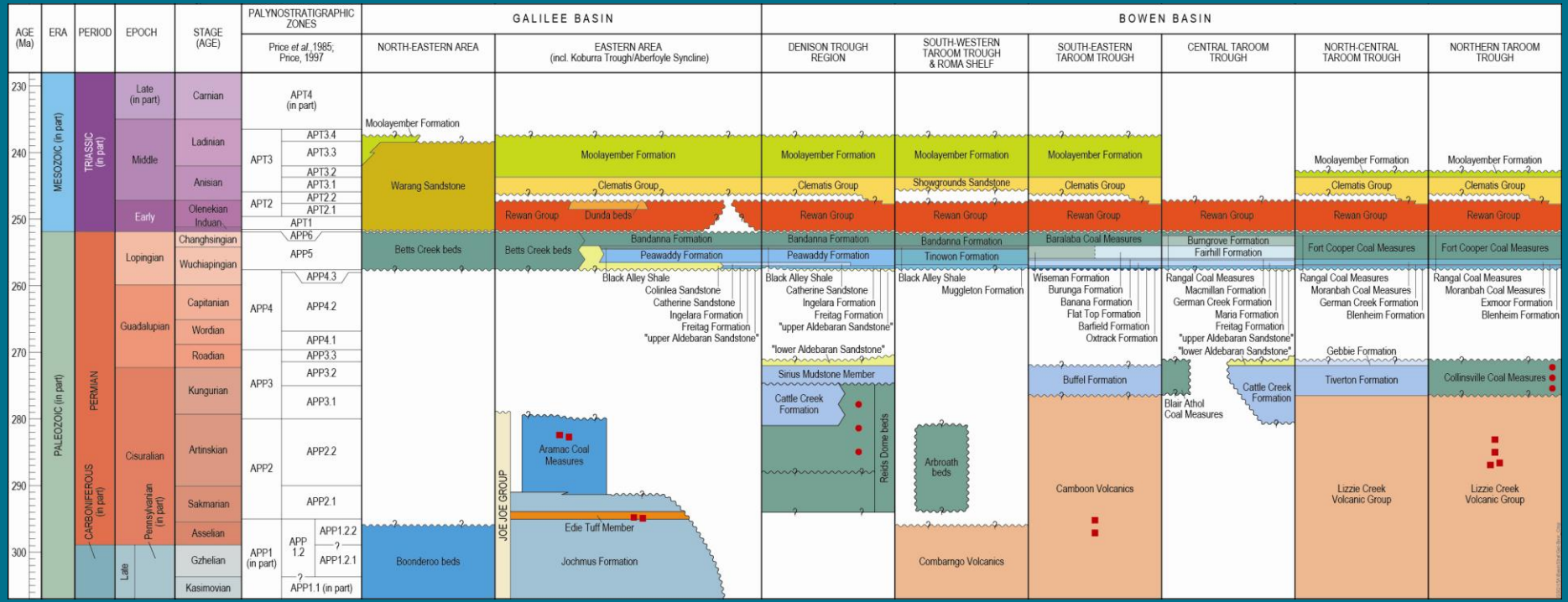


Northern Sydney Basin

Hunter and Newcastle coalfields



Galilee–Bowen transect



Summary

Whole new appreciation of stratigraphic sequence

Real control on depositional rates

Confirmation on lateral correlation within and between basins

Time control on event stratigraphy

Thank you

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