Channel and channel belt attributes of the Mungaroo Formation on the Rankin Trend

STONER, Scott and HOLBROOK, John : The University of Texas at Arlington

UT ARLINGTON™ GEOSCIENCES

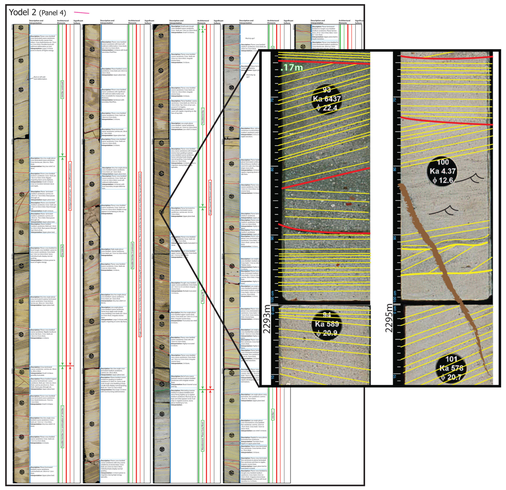
Abstract

In fluvial reservoirs accurately estimating sand body dimensions to the degree possible with available data is essential. Cores from several wells from the Mungaroo on the Rankin Trend were analyzed to estimate paleo channel depths, channel widths and channel belt widths. A variety of methods were used to provide these estimates. High accommodation sections were described and channels were measured were they were present. The low accommodation sheet sands were analyzed in detail on a set by set basis. An attempt was made to learn to recognize valleys and multi-valleys in the thick sheet sands.

The first parameter which must be calculated is paleo channel depth as all the other measurements depend on an accurate assessment of it. Two methods were used. The first involves using empirical equations developed by LeClair and Bridge, 2001. Using these equations cross-sets are measured to determine mean dune height and this in turn is used to determine channel depth. Channel depth and channel belt width are estimated using equations developed by Bridge and Mackey, 1993. Channel belt width is also estimated by comparison with charts developed from measuring the belt width to channel belt depth ratio in ancient and modern rivers. Three charts were used. One is an internal Woodside chart by Simon Lang, one is from Fielding and Crane, 1987, and one is from Gibling, 2006. The second method involves picking out architectural elements of channels from the core photos and picking sequences that appear to represent a complete channel. Channels identified by this method were also included from previously described cores from the Rankin Trend.

The range of channel sizes identified in the Mungaroo on the Rankin Trend is wide. This appears to reflect the fact that there are approximately 3 different channel size populations represented in the area. These are a 5m to 7m population, a 8m to 10m population and a population of very large channels in the 15m range. This is confirmed by the flattened seismic slices in the Goodwyn Field which show channels widely ranging in size and type.

Methods



1) Low accommodation sections were analyzed in depth by drawing in every line to identify the type of bedding style. Roots and slumping were also identified to help determine the architectural unit. Sets were measured where appropriate (2-d and 3-d dunes). Channel thicknesses were also calculated by architecture where possible

2) The average cross-set thickness was calculated for a given core. This average was multiplied by 2.9 to get average dune height. Average dune height is related to bankfull channel depth. The average dune height was multiplied by 6 and 10 to get a range of bankfull channel depths (Bridge and Mackey, 1983, Leclaire and Bridge, 2001, Adams and Battacharya, 2005, McClarin and Steel, 2007).

3) Bankfull channel depth ranges were converted to mean bankfull depth (dm) which is about 1/2 bankfull depth and plugged into empirical equations by Bridge and Mackey, 1993 to get channel width (Wc)

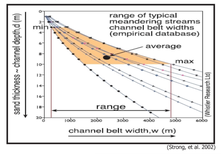
$$w_c = 8.88 d_m^{1.82}$$

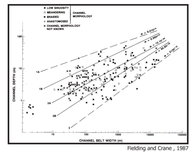
and a range of channel belt widths (cbw)

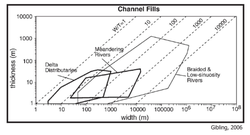
$$cbw = 59.9\, d_m^{1.8}$$

$$cbw = 192\, d_m^{1.37}$$

4) Bankfull channel depths were plugged into these charts by Gibling, 2006, Fielding and Crane, 1987, and Lang to estimate a range of channel belt widths. The charts are based on measurements from actual modern and ancient channel belts.

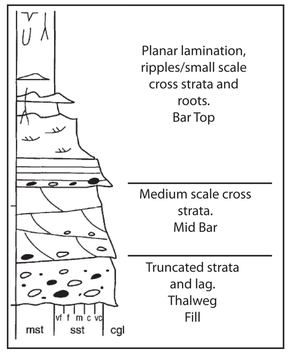




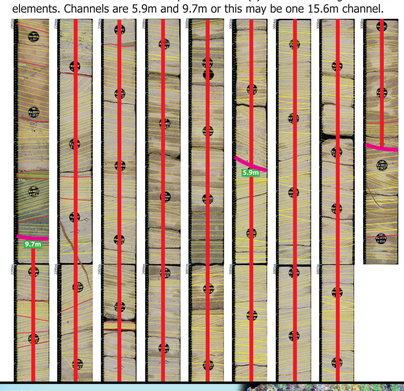


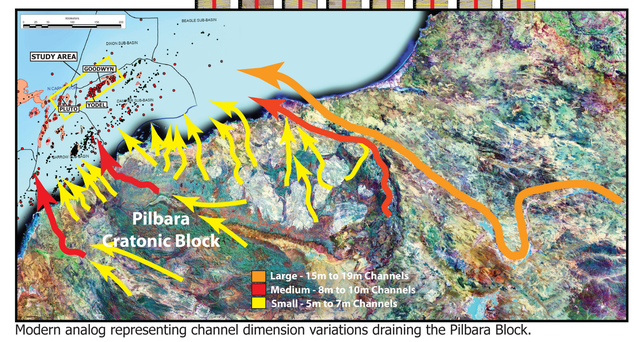
5) Channels were identified by picking out architecture that probably represents one channel from the cores like the sequence below.

Typical channel sequence. May grade up to abandonment phase. After Bridge and Tye, 2000.



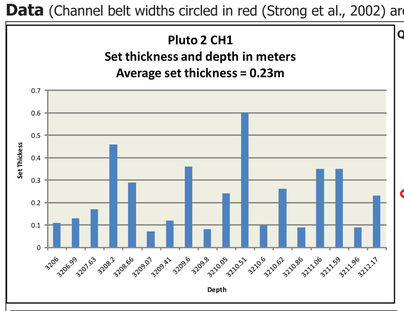
Yodel 2 2992.9m-3008.5m. Example of channel(s) measured using architectural elements. Channels are 5.9m and 9.7m or this may be one 15.6m channel.

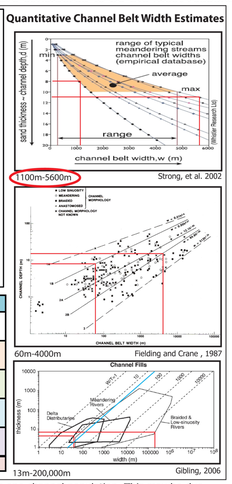




Modern analog representing channel dimension variations draining the Pilbara Block.

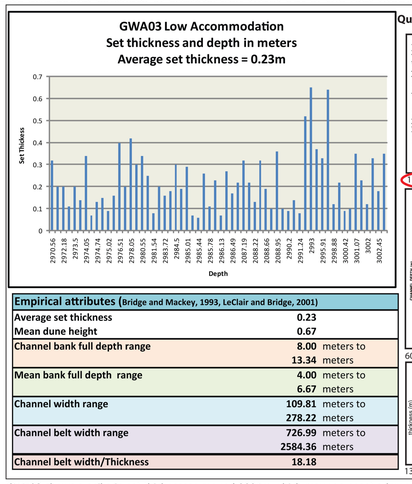
Data (Channel belt widths circled in red (Strong et al., 2002) are considered to be the most reasonable and useful estimate of channel belt width out of the four methods used).

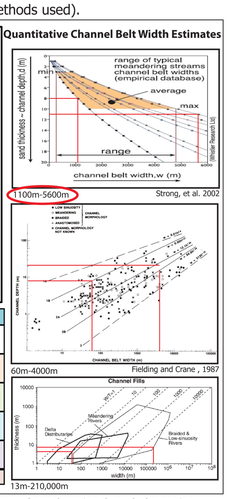




Empirical attributes (Bridge and Mackey, 1993, LeClair and Bridge, 2001)		
Average set thickness	0.23	
Mean dune height	0.67	
Channel bank full depth range	8.00	meters to
	13.34	meters
Mean bank full depth range	4.00	meters to
	6.67	meters
Channel width range	109.81	meters to
	278.22	meters
Channel belt width range	726.99	meters to
	2584.36	meters
Channel belt width/Thickness	18.18	

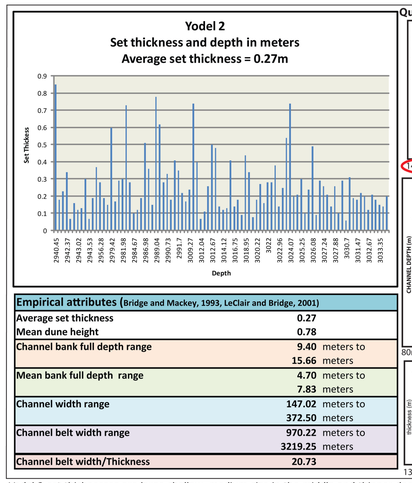
Pluto 2 shows a consistant range of set thicknesses and thus probably represents one channel population. This may be due to the fact that this is a realtively thin (14m) section of sand in a otherwise high accommodation section.

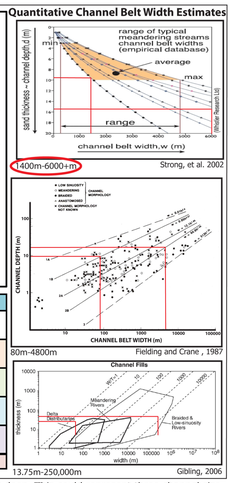




Empirical attributes (Bridge and Mackey, 1993, LeClair and Bridge, 2001)		
Average set thickness	0.23	
Mean dune height	0.67	
Channel bank full depth range	8.00	meters to
	13.34	meters
Mean bank full depth range	4.00	meters to
	6.67	meters
Channel width range	109.81	meters to
	278.22	meters
Channel belt width range	726.99	meters to
	2584.36	meters
Channel belt width/Thickness	18.18	

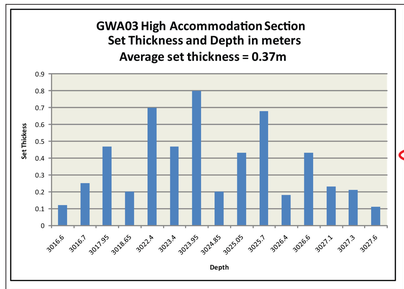
GWA03 shows a spike in set thicknesses around 2991m which may represent a larger channel moving through the section.

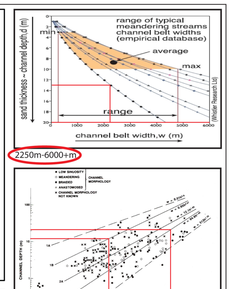




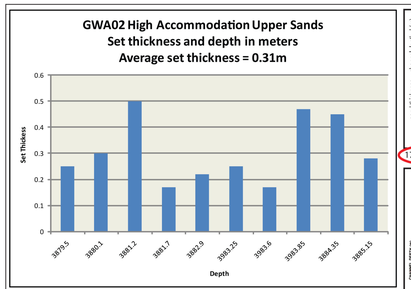
Empirical attributes (Bridge and Mackey, 1993, LeClair and Bridge, 2001)		
Average set thickness	0.27	
Mean dune height	0.78	
Channel bank full depth range	9.40	meters to
	15.66	meters
Mean bank full depth range	4.70	meters to
	7.83	meters
Channel width range	147.02	meters to
	372.50	meters
Channel belt width range	970.22	meters to
	3219.25	meters
Channel belt width/Thickness	20.73	

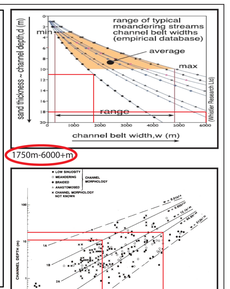
Yodel 2 set thicknesses are large shallow, medium size in the middle and thinner deep. This could represent three channel size populations and at least represents two.



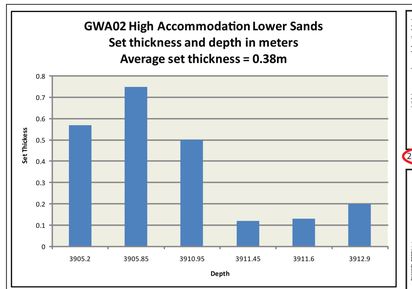


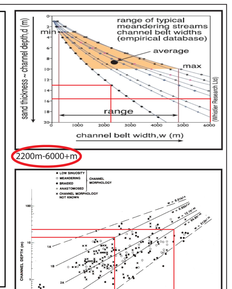
Empirical attributes (Bridge and Mackey, 1993, LeClair and Bridge, 2001)		
Average set thickness	0.37	
Mean dune height	1.07	
Channel bank full depth range	12.88	meters to
	21.46	meters
Mean bank full depth range	6.44	meters to
	10.73	meters
Channel width range	260.86	meters to
	660.96	meters
Channel belt width range	1710.72	meters to
	4957.04	meters
Channel belt width/Thickness	26.85	





Empirical attributes (Bridge and Mackey, 1993, LeClair and Bridge, 2001)		
Average set thickness	0.31	
Mean dune height	0.90	
Channel bank full depth range	10.79	meters to
	17.98	meters
Mean bank full depth range	5.39	meters to
	8.99	meters
Channel width range	189.04	meters to
	478.99	meters
Channel belt width range	1244.13	meters to
	3890.02	meters
Channel belt width/Thickness	23.22	





Empirical attributes (Bridge and Mackey, 1993, LeClair and Bridge, 2001)		
Average set thickness	0.38	
Mean dune height	1.10	
Channel bank full depth range	13.22	meters to
	22.04	meters
Mean bank full depth range	6.61	meters to
	11.02	meters
Channel width range	273.83	meters to
	693.83	meters
Channel belt width range	1794.84	meters to
	5141.50	meters
Channel belt width/Thickness	27.44	

It is very likely this data set is skewed by a small sample number.

Channel depths from architectural elements

Pluto 2	
3m: 3186m-3188m	
5m: 3207.6m-3212.6m	
Pluto 3	
7m: 2183m-2190m	
5m: 3176m-3182m	
6m: 3183m-3189m	
Yodel 2	
11.6m: 2944.4m-2956m	
8.5m: 2984.4m-2992.9m	
9.7m: 2992.9m-3002.6m	
5.9m: 3002.6m-3008.5m	
or alternatively one channel	
15.6m: 2992.9m-3008.5m	
GWA02	
10.6m: 3902.6m-3913.2m	

Conclusions

There are a wide range of fluvial system sizes in the Mungaroo on the Rankin Trend. They appear to represent three fluvial system size populations. They are 5m to 7m channel depth, 8m to 10m channel depth and large 15m plus channel depth systems. This is probably due to the small and medium channels that originated from the Pilbara (yellow and red) plus the continental drainage size systems draining from highs in the east (orange). They agree in general with observations made from seismic slices except that smaller systems are detected. This is due to seismic resolution issues.

Channel and Channel Belt Dimensions of the Mungaroo on the Rankin Trend

Small 5m to 7m channel depth systems	
Channel Width Range	**47m to 86m**
Channel Belt Width Range	**600m to 2850m**
Medium 8m to 10m channel depth systems	
Channel Width Range	**110m to 165m**
Channel Belt Width Range	**3400m to 6000+m**
Large 15m plus channel depth systems	
Channel Width Range	**345m**
Channel Belt Width Range	**6000m+**