Using V_P/V_S to explore for sandstone reservoirs: well log and synthetic seismograms from the Jeanne d'Arc Basin, offshore Newfoundland

David Emery and Robert Stewart

November 30, 2006

UNIVERSITY OF CALGARY

CREWES

Study Objectives

- Determine what V_P/V_S values can be expected from the varies formations in the Jeanne d'Arc Basin.
- Evaluate the practicality of using Vp/Vs for lithology interpretation using Garotta (1987) interval travel time analysis.
- Estimate results for a future OBS survey

Outline of Talk

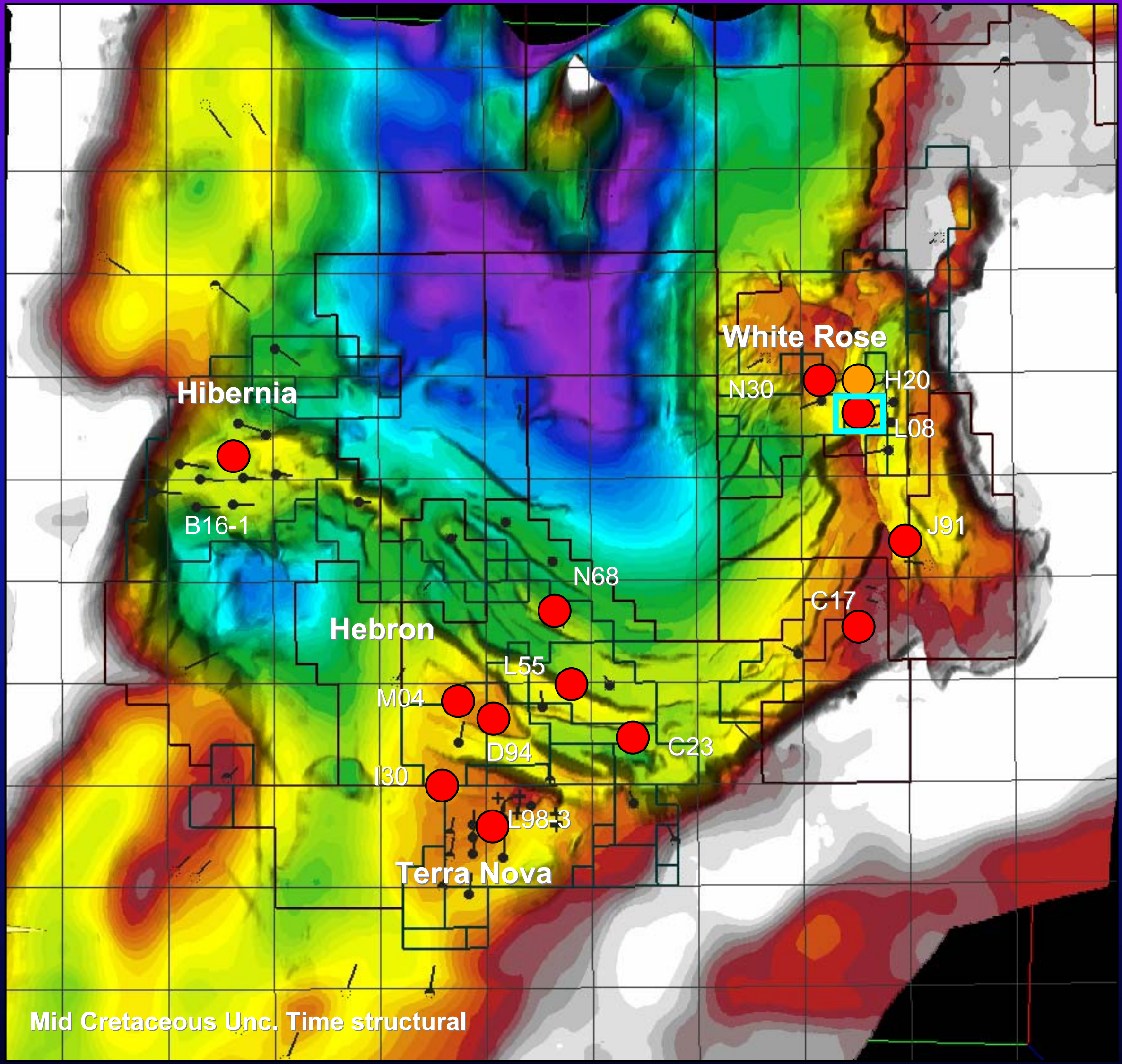
- P-wave and S-wave petrophysical relationships for the major formations
- What should be able to be determined from the estimated V_P/V_S
- Travel time analysis using *SYNGRAM* PP and PS synthetic seismogram
- Pitfalls of overextending Garotta V_P/V_S analysis
- Recommendations

UNIVERSITY OF CALGARY

CREWES

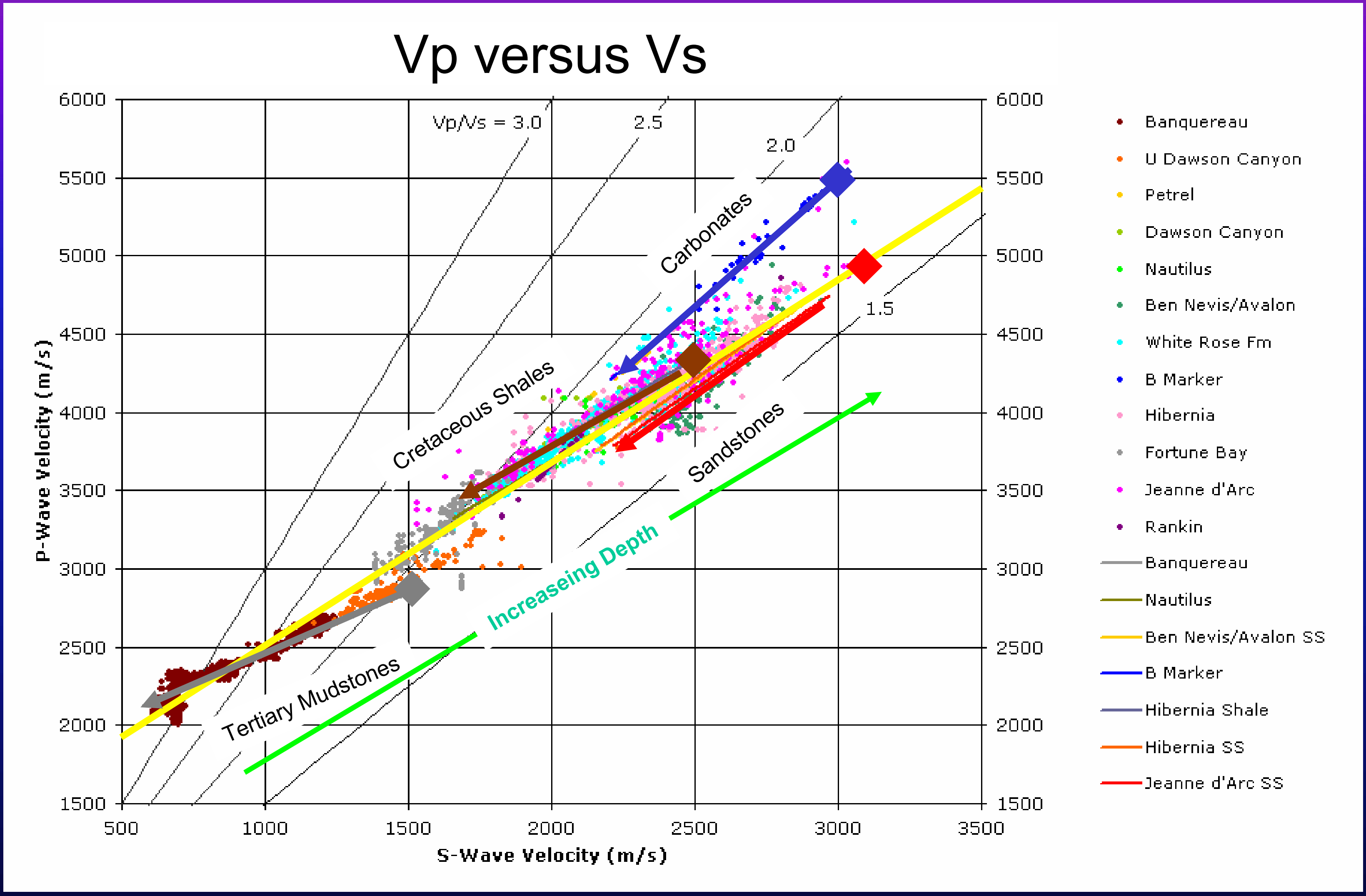
Multi-component Data in the Jeanne d'Arc Basin

- Offset VSP with both PP and PS images (donated by Husky Energy)
- 2002 Mariprobe OBS survey
- 12 wells with both P- and S-wave sonic logs
- Addition S-wave logs have been acquired but no digital data available publicly



UNIVERSITY OF CALGARY

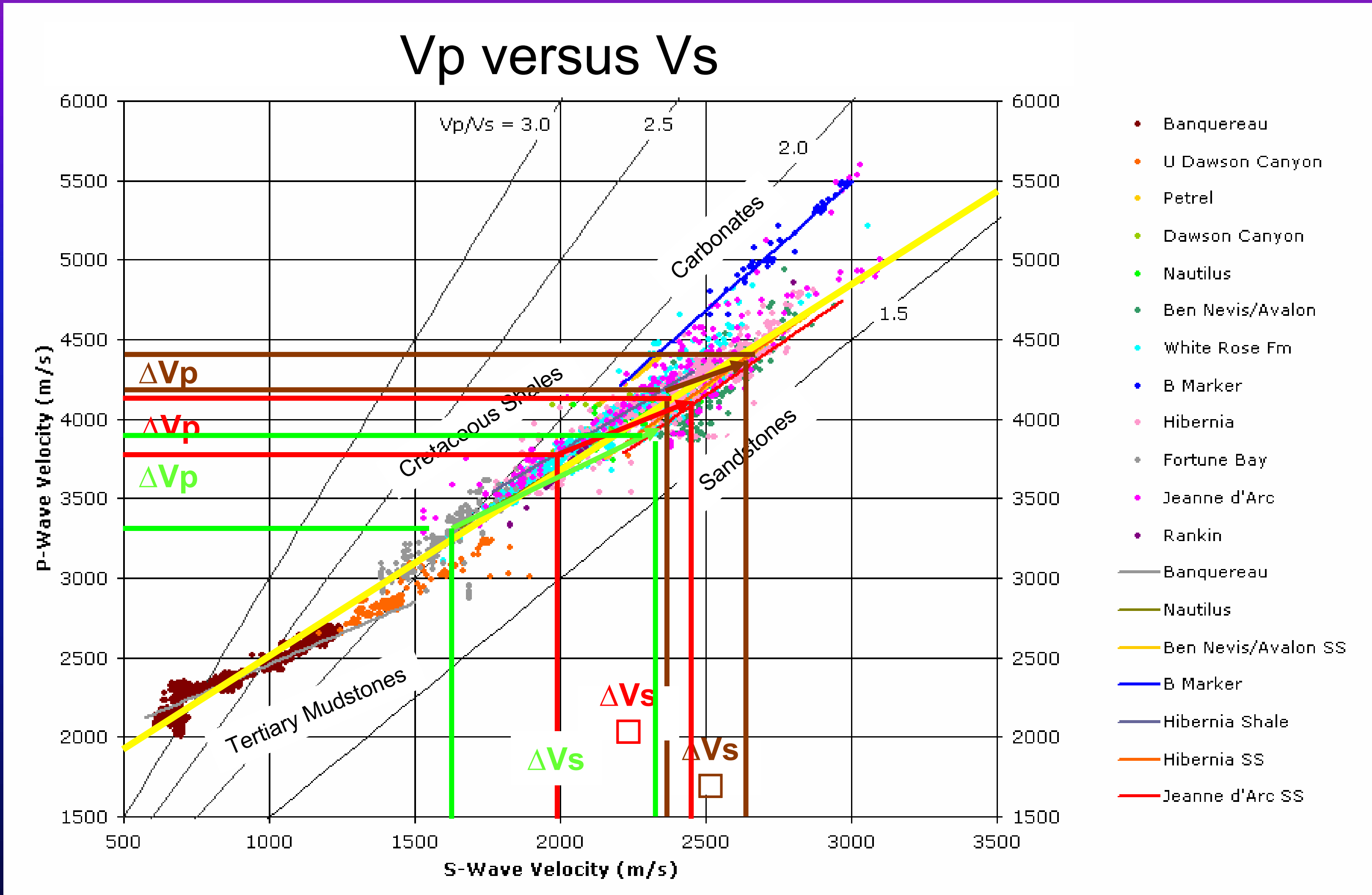
CREWES



The four major lithology fall in different location on a V_P versus V_S plot

UNIVERSITY OF CALGARY

CREWES

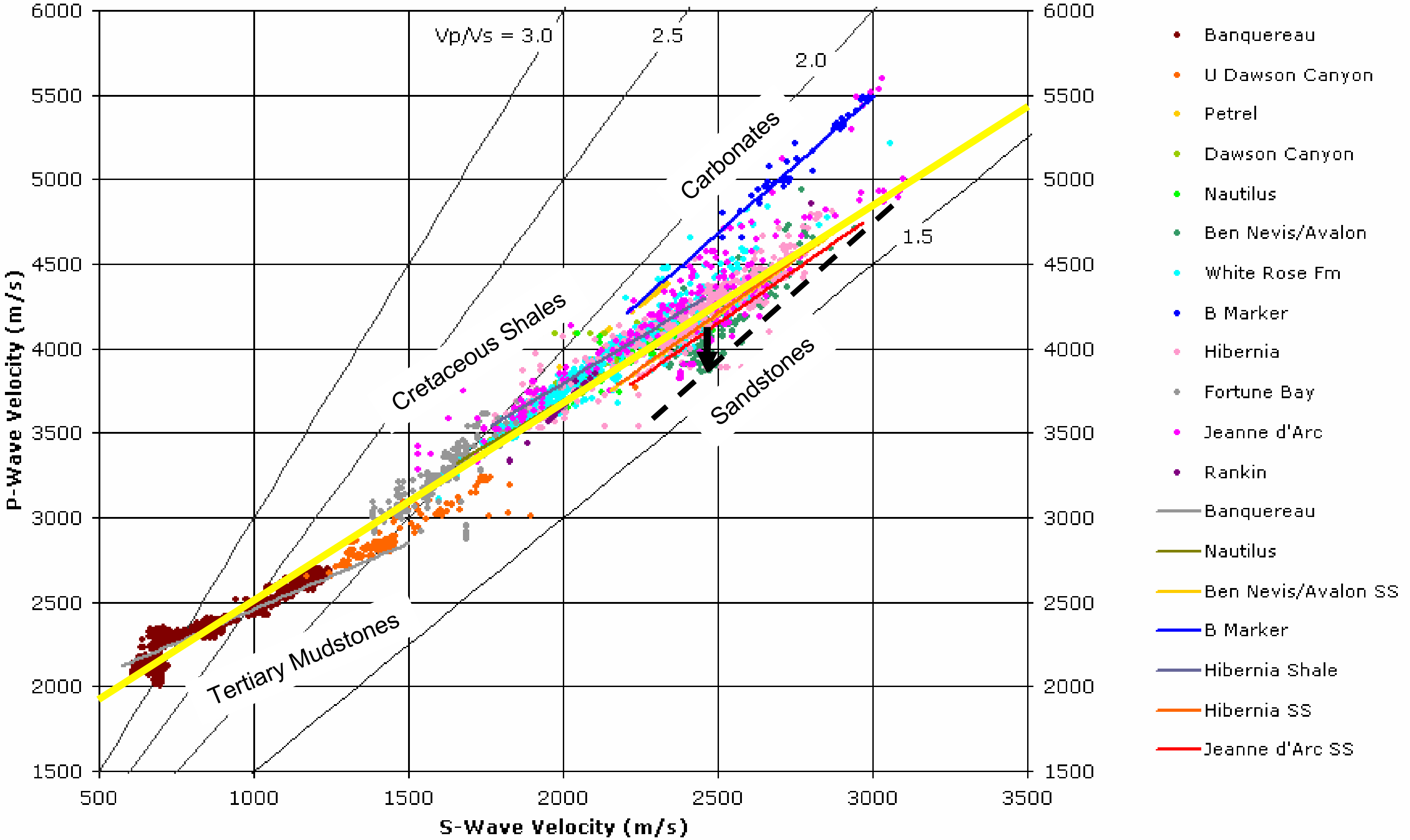


P- and S-wave contrast decrease with porosity

UNIVERSITY OF CALGARY

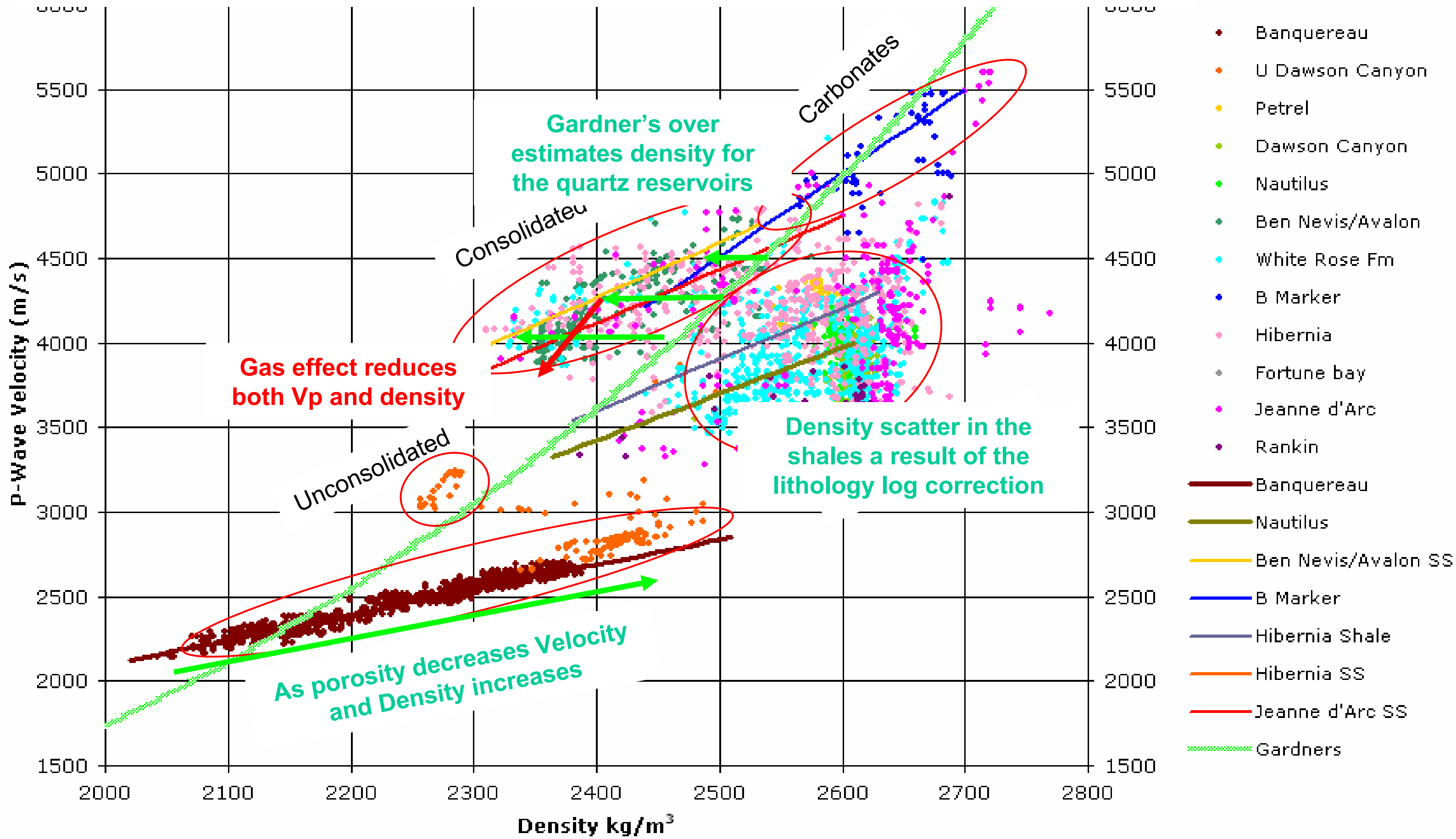
CREWES

Vp versus Vs



Gas affect the P-wave velocity with out changing the Vs

Vp versus density



$$V_P = V_{Pma}\,(1-\Phi/C) + V_{Fluid} \times \Phi/C \quad (\Phi<C)\ ,\ V_P = V_{Fluid}\ (\Phi \geq C)$$

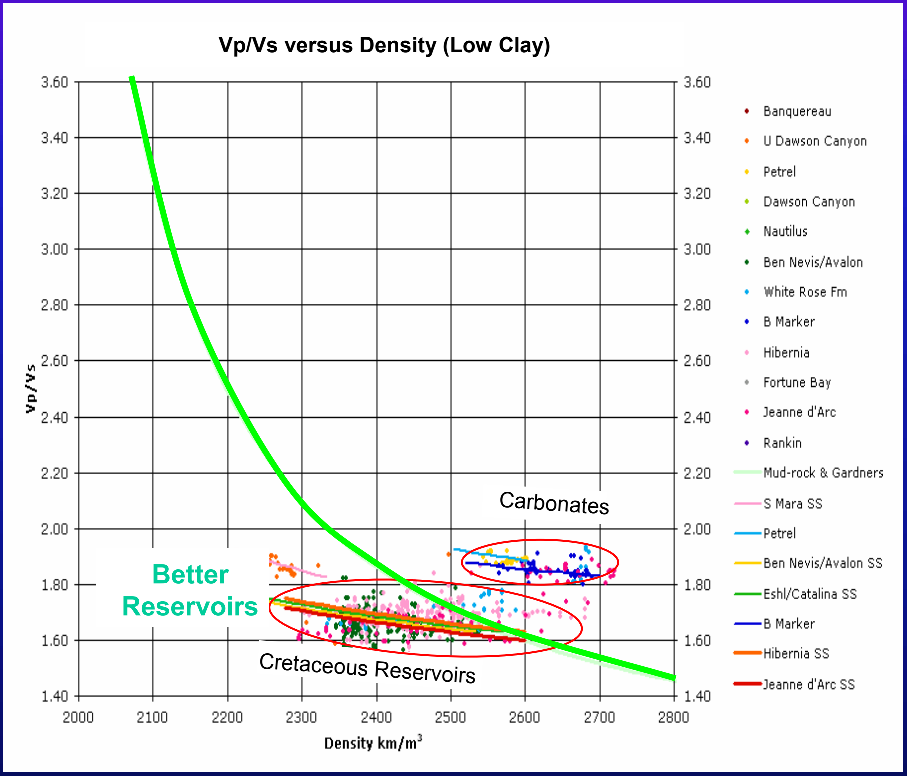
$$\rho = \rho_{ma} \times (1-\Phi) + \rho_{fluid} \times \Phi$$

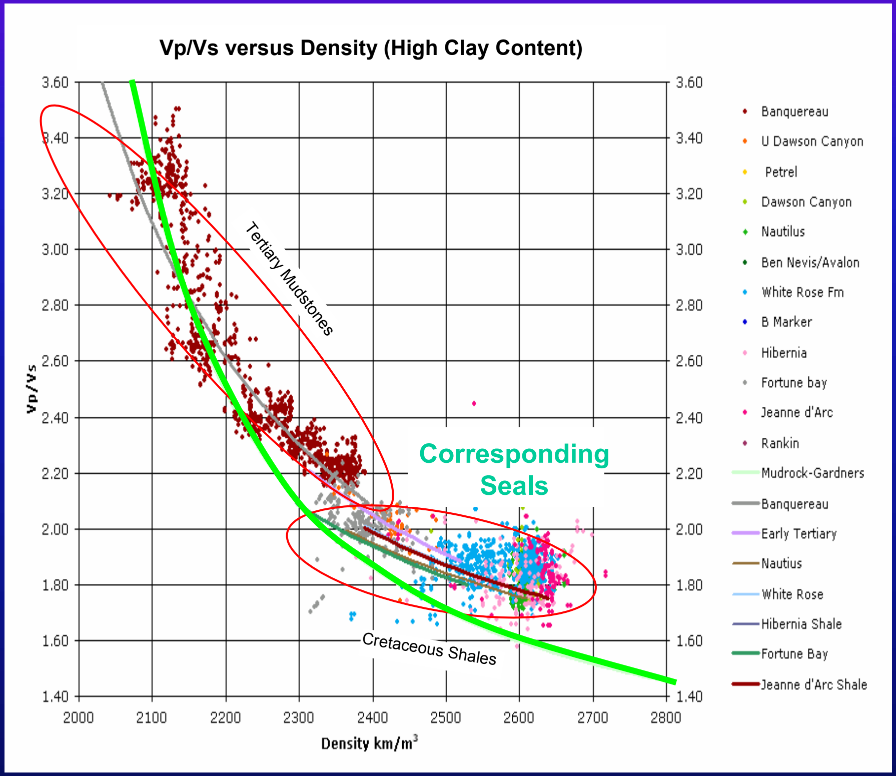
Gardner (1974) $\rho = 1741 \times (V_P/1000)^{0.25}$

UNIVERSITY OF CALGARY

CREWES

Vp/Vs vs. density





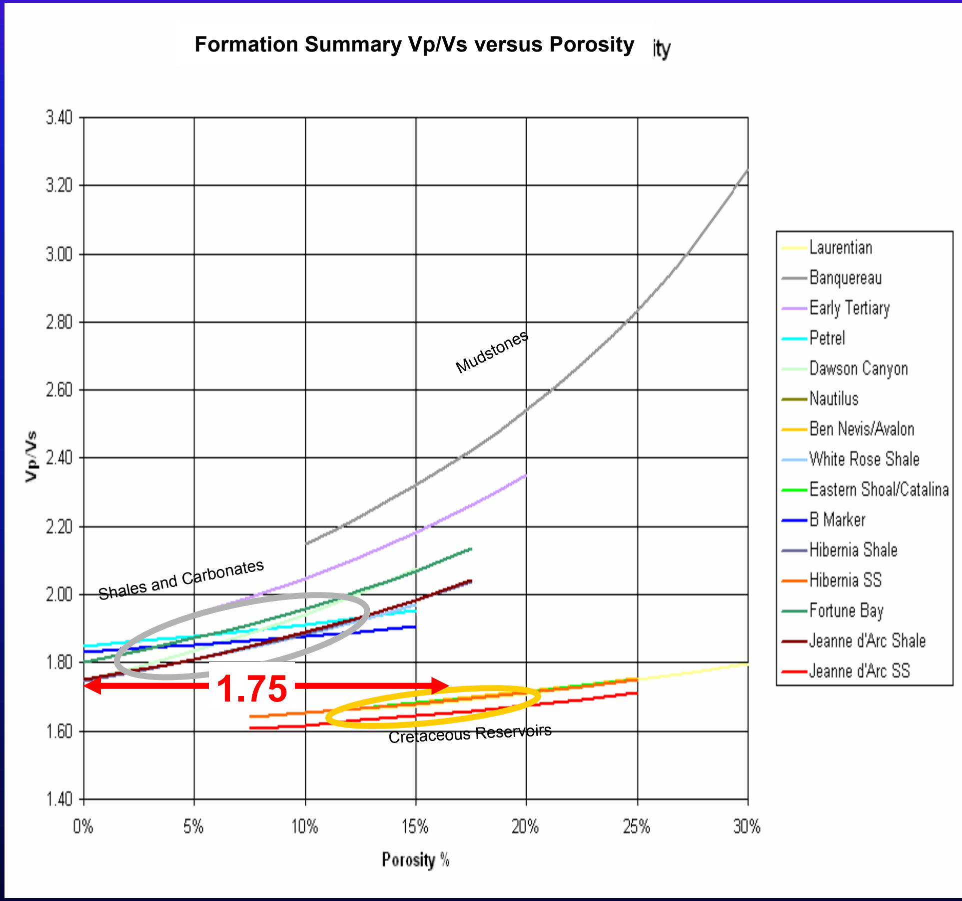
- Carbonates and sandstones are relatively linear
- Mudstone and shales show a pronounce curved relationship

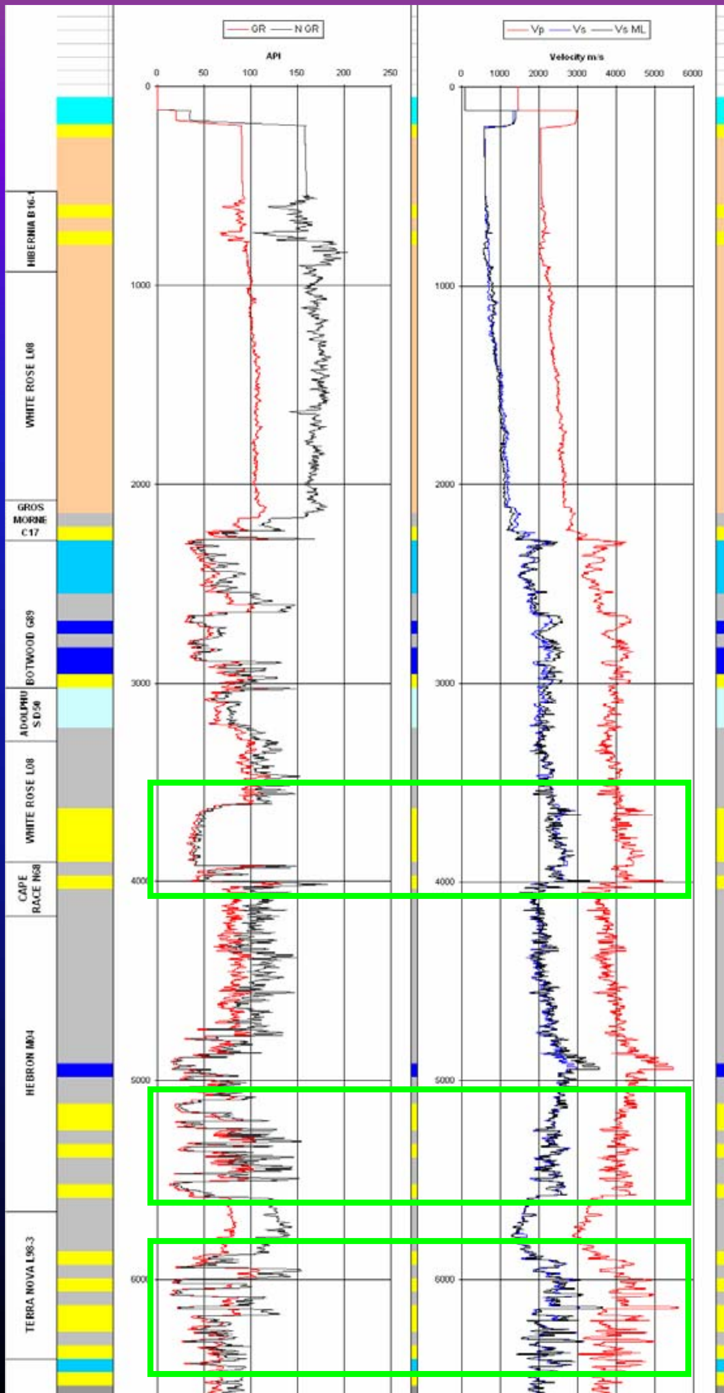
UNIVERSITY OF CALGARY

CREWES

Potential of V_P/V_S analysis

- Reservoirs formations have V_P/V_S between 1.6 and 1.76 (1.68 ± 5%)
- Seals have V_P/V_S between 1.75 and 2.2
- Carbonate V_P/V_S overlie the consolidated shales
- A V_P/V_S of 1.75 should differentiate a shales and sandstone
- Vp/Vs differences decrease as reservoir quality increases



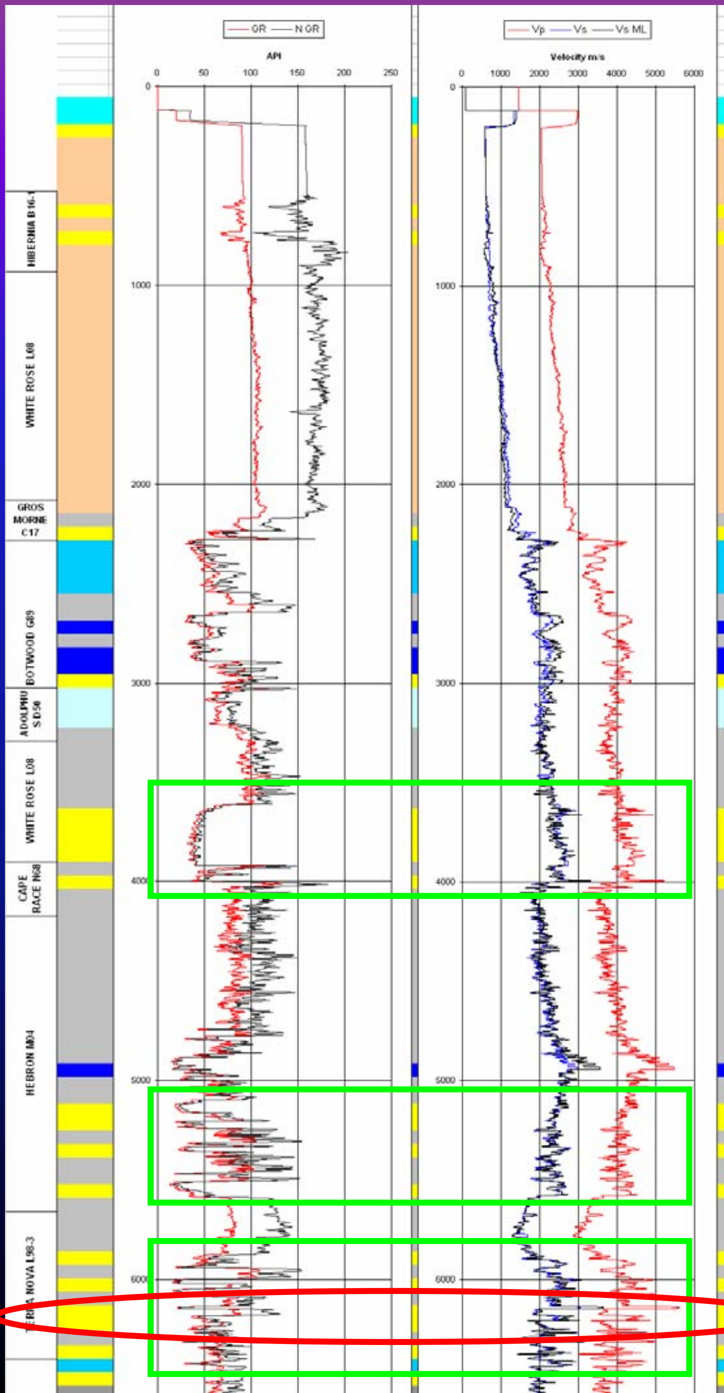


Vp/Vs analysis using synthetic data generated from a composite log

- Composite reference log was created using input well data
- Castagna (1985) mudrock relationship was used for zones without S-wave information
- Gardners (1974) density relationship was used when density was missing
- CREWES *SYNGRAM* software used to generated PP and PS synthetic seismograms
- Synthetic data was offset limited to 30º
- PP synthetic 5/10-80/95 zero phase
- PS synthetic 5/10-70/85 zero phase
- Frequency panels created by band pass filtering
- All horizons were autopicked
- Exact V_P/V_S solution known
- Wavelet known but tuning effects unknown

CREWES

Formation scale Vp/Vs values



Banq Vp/Vs = 2.9

Base Banq Vp/Vs = 2.0

Dawson Canyon Vp/Vs = 1.93

Petrel Vp/Vs =1.95

Dawson Canyon Vp/Vs = 1.93

Nautilus Vp/Vs = 2.1

Ben Nevis/Avalon Vp/Vs =1.7

White Rose Vp/Vs = 1.87

B Markerl Vp/Vs =1.83

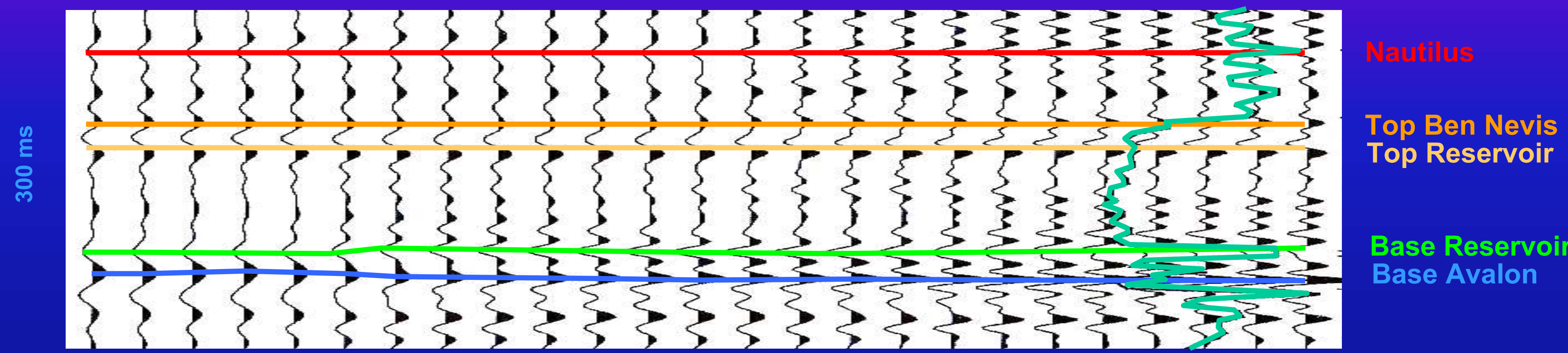
Hibernia Vp/Vs = 1.72

Fortune Bay Vp/Vs = 2.1

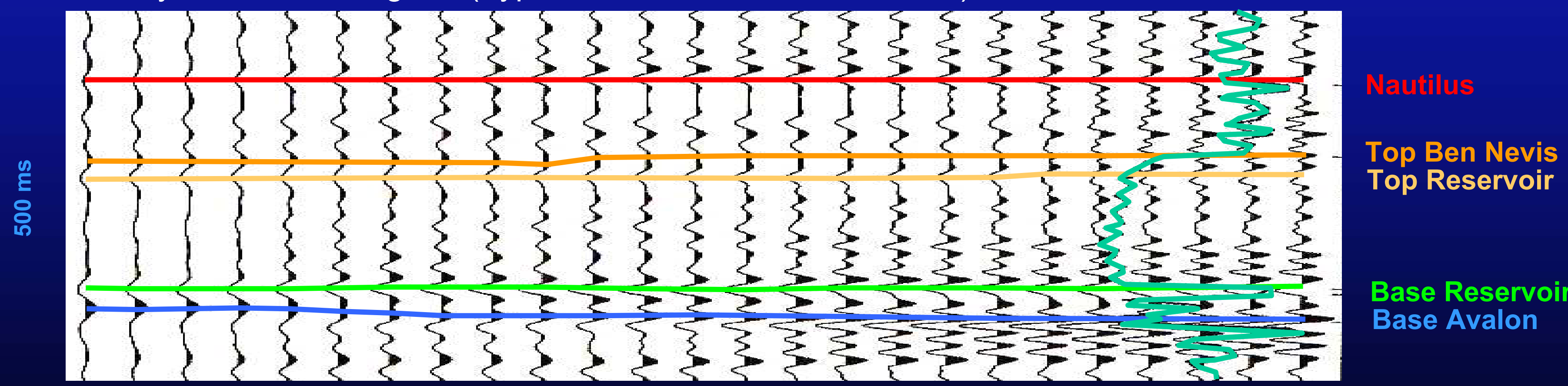
Terra Nova Vp/Vs =1.82

Ben Nevis/Avalon Fm PP and PS response

PP Synthetic Seismogram (Type section for White Rose L-08)



PS Synthetic Seismogram (Type section for White Rose L-08)



Low ← Decreasing Frequency ← High

UNIVERSITY OF CALGARY

CREWES

Ben Nevis/Avalon Fm Vp/Vs analysis

Ben Nevis Sandstone - Vp/Vs

PP	Top	2615	2615	2615	2615	2616	2615	2615	2615	2615	2614	2614	2614	2615	2616	2616	2616	2616	2616	2617	2617	2617	2617	2617	2617	2617
PP	Base	2763	2763	2764	2764	2763	2762	2761	2761	2761	2762	2762	2762	2762	2763	2763	2763	2763	2763	2760	2759	2758	2758	2758	2759	2759
PS	Top	4650	4654	4653	4653	4652	4652	4651	4651	4650	4650	4650	4653	4654	4654	4654	4654	4654	4654	4654	4653	4653	4653	4653	4652	4652
PS	Base	4851	4852	4852	4851	4850	4849	4849	4849	4849	4849	4850	4850	4850	4849	4848	4847	4846	4847	4847	4848	4848	4849	4849	4849	4849
	ΔPP	6/12-30/45	6/12-32/47	6/12-34/49	6/12-36/51	6/12-38/53	6/12-40/55	6/12-42/57	6/12-44/59	6/12-46/61	6/12-48/63	6/12-50/65	6/12-52/67	6/12-54/69	6/12-56/71	6/12-58/73	6/12-60/75	6/12-62/77	6/12-64/79	6/12-66/81	6/12-68/83	6/12-70/85	6/12-72/87	6/12-74/89	6/12-76/91	6/12-78/93
ΔPS	Isochron	[illegible]	[illegible]	148.6	148.4	147.6	146.6	146.3	146.5	[illegible]	[illegible]	[illegible]	[illegible]	147.3	147.0	146.9	147.1	147.3	146.8	143.8	141.8	141.3	141.3	141.4	141.7	142.0
6/12-20/35	200.9	[illegible]	1.71	1.70	1.71	1.72	1.74	1.75	1.74	1.74	1.73	1.72	1.72	1.73	1.73	1.74	1.73	1.73	1.74	1.79	1.83	1.84	1.84	1.84	1.84	1.83
6/12-22/37	197.7	[illegible]	1.66	1.66	1.66	1.68	1.70	1.70	1.70	1.70	1.69	1.68	1.68	1.68	1.69	1.69	1.69	1.68	1.69	1.75	1.79	1.80	1.80	1.80	1.79	1.78
6/12-24/39	198.7	1.67	1.68	1.67	1.68	1.69	1.71	1.72	1.71	1.71	1.70	1.69	1.69	1.70	1.70	1.71	1.70	1.70	1.71	1.76	1.80	1.81	1.81	1.81	1.80	1.80
6/12-26/41	198.6	1.67	1.68	1.67	1.68	1.69	1.71	1.71	1.71	1.71	1.70	1.69	1.69	1.70	1.70	1.70	1.70	1.70	1.71	1.76	1.80	1.81	1.81	1.81	1.80	1.80
6/12-28/43	198.0	1.66	1.67	1.66	1.67	1.68	1.70	1.71	1.70	1.70	1.69	1.68	1.68	1.69	1.69	1.70	1.69	1.69	1.70	1.75	1.79	1.80	1.80	1.80	1.79	1.79
6/12-30/45	197.7	1.66	1.66	1.66	1.66	1.68	1.70	1.70	1.70	1.70	1.69	1.68	1.68	1.68	1.69	1.69	1.69	1.68	1.69	1.75	1.79	1.80	1.80	1.80	1.79	1.78
6/12-32/47	197.8		1.67	1.66	1.67	1.68	1.70	1.70	1.70	1.70	1.69	1.68	1.68	1.69	1.69	1.69	1.69	1.69	1.69	1.75	1.79	1.80	1.80	1.80	1.79	1.79
6/12-34/49	198.3			1.67	1.67	1.69	1.71	1.71	1.71	1.70	1.69	1.69	1.69	1.69	1.70	1.70	1.70	1.69	1.70	1.76	1.80	1.81	1.81	1.80	1.80	1.79
6/12-36/51	199.1				1.68	1.70	1.72	1.72	1.72	1.71	1.71	1.70	1.70	1.70	1.71	1.71	1.71	1.70	1.71	1.77	1.81	1.82	1.82	1.82	1.81	1.80
6/12-38/53	199.4					1.70	1.72	1.73	1.72	1.72	1.71	1.70	1.70	1.71	1.71	1.71	1.71	1.71	1.72	1.77	1.81	1.82	1.82	1.82	1.81	1.81
6/12-40/55	199.8						1.73	1.73	1.73	1.72	1.71	1.71	1.71	1.71	1.72	1.72	1.72	1.71	1.72	1.78	1.82	1.83	1.83	1.83	1.82	1.81
6/12-42/57	197.2							1.70	1.69	1.69	1.68	1.67	1.67	1.68	1.68	1.68	1.68	1.68	1.69	1.74	1.78	1.79	1.79	1.79	1.78	1.78
6/12-44/59	196.3								1.68	1.68	1.67	1.66	1.66	1.67	1.67	1.67	1.67	1.67	1.67	1.73	1.77	1.78	1.78	1.78	1.77	1.76
6/12-46/61	195.4									1.66	1.65	1.65	1.65	1.65	1.66	1.66	1.66	1.65	1.66	1.72	1.76	1.77	1.77	1.76	1.76	1.75
6/12-48/63	193.7										1.63	1.62	1.62	1.63	1.64	1.64	1.63	1.63	1.64	1.69	1.73	1.74	1.74	1.74	1.73	1.73
6/12-50/65	192.8											1.61	1.61	1.62	1.62	1.62	1.62	1.62	1.63	1.68	1.72	[illegible]	[illegible]	[illegible]	1.72	1.72
6/12-52/67	192.8												1.61	1.62	1.62	1.62	1.62	1.62	1.63	1.68	1.72	[illegible]	[illegible]	1.73	[illegible]	1.72
6/12-54/69	192.8													1.62	1.62	1.62	1.62	1.62	1.63	1.68	1.72	1.73	1.73	1.73	1.72	1.72
6/12-56/71	193.3														1.63	1.63	1.63	1.62	1.63	1.69	1.73	1.74	1.74	1.73	1.73	1.72
6/12-58/73	194.2															1.64	1.64	1.64	1.65	1.70	1.74	1.75	1.75	1.75	1.74	1.74
6/12-60/75	195.2																1.65	1.65	1.66	1.71	1.75	1.76	1.76	1.76	1.76	1.75
6/12-62/77	195.8																	1.66	1.67	1.72	1.76	1.77	1.77	1.77	1.76	1.76
6/12-64/79	196.3																		1.67	1.73	1.77	1.78	1.78	1.78	1.77	1.76
6/12-66/81	196.8																			1.74	1.78	1.79	1.79	1.78	1.78	1.77
6/12-68/83	197.4																				1.78	1.79	1.79	1.79	1.79	1.78

Vp/Vs determined from logs 1.65

Vp/Vs diff			
± 5 %		Min	1.61
± 10 %		Avg	1.72
± 15 %		Max	1.84
		SD	0.05

Type section well from White Rose L08 2818-3120 m MD (302 m)

2002 OBS

Streamer Seismic

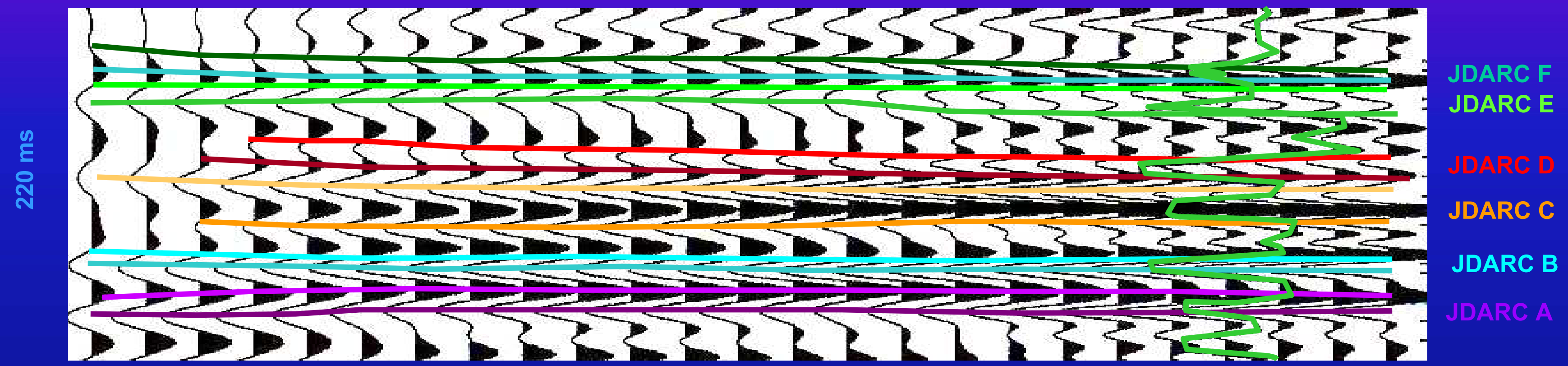
VSP's

UNIVERSITY OF CALGARY

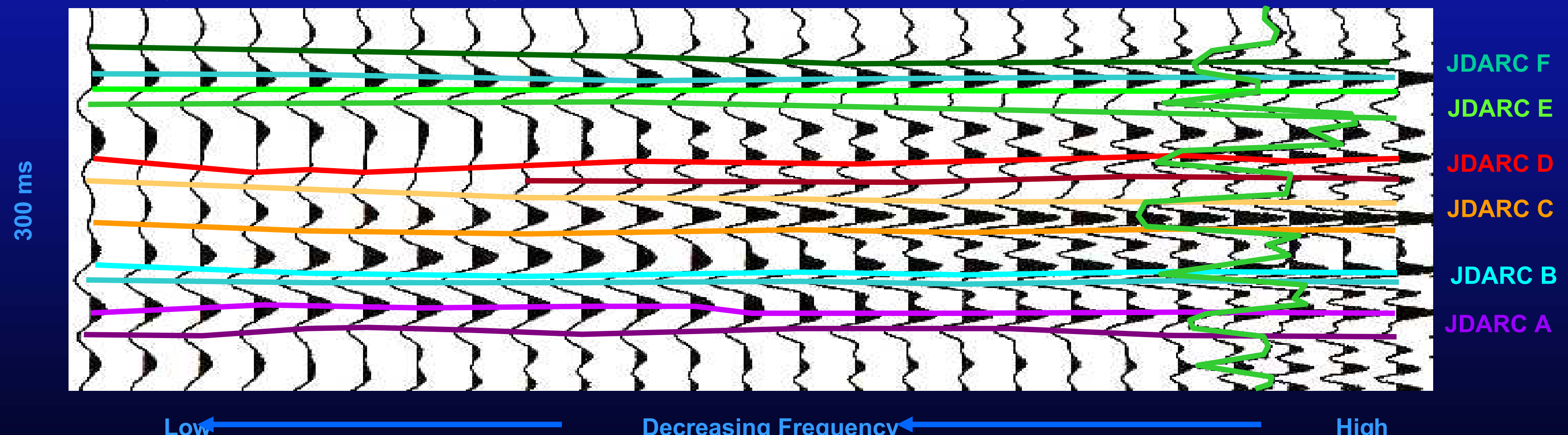
CREWES

Terra Nova Fm PP and PS response

PP Synthetic Seismogram (Type section for Terra Nova L-98-3)



PS Synthetic Seismogram (Type section for Terra Nova L-98-3)



UNIVERSITY OF CALGARY

CREWES

Terra Nova Fm Vp/Vs analysis

Jeanne d'Arc Fm - Interval Vp/Vs

PP	Top	3765	3766	3768	3771	3772	3773	3773	3773	3773	3773	3773	3773	3773	3773	3773	3774	3774	3774	3775	3775	3775	3775	3775	3775	3775
PP	Base	3937	3936	3936	3935	3935	3934	3934	3933	3932	3932	3932	3933	3933	3935	3935	3935	3933	3934	3934	3933	3933	3933	3933	3933	3933
PS	Top	6284	6286	6288	6289	6290	6290	6291	6291	6291	6291	6291	6292	6292	6292	6292	6293	6293	6293	6292	6292	6293	6293	6293	6293	6293
PS	Base	6518	6517	6517	6516	6515	6512	6512	6512	6513	6514	6514	6514	6512	6510	6509	6510	6510	6510	6510	6511	6510	6510	6510	6510	6510
	ΔPP	6/12-30/45	6/12-32/47	6/12-34/49	6/12-36/51	6/12-38/53	6/12-40/55	6/12-42/57	6/12-44/59	6/12-46/61	6/12-48/63	6/12-50/65	6/12-52/67	6/12-54/69	6/12-56/71	6/12-58/73	6/12-60/75	6/12-62/77	6/12-64/79	6/12-66/81	6/12-68/83	6/12-70/85	6/12-72/87	6/12-74/89	6/12-76/91	6/12-78/93
ΔPS	Isochron	172.3	170.3	167.7	164.1	162.5	161.7	161.2	160.4	158.9	158.8	158.8	160.0	160.3	162.3	162.0	161.5	159.0	159.9	158.8	158.2	157.8	157.4	157.2	157.3	157.4
6/12-20/35	233.8	1.71	1.75	1.79	1.85	1.88	1.89	1.90	1.92	1.94	1.94	1.94	1.92	1.92	1.88	1.89	1.90	1.94	1.92	1.94	1.96	1.96	1.97	1.97	1.97	1.97
6/12-22/37	230.7	1.68	1.71	1.75	1.81	1.84	1.85	1.86	1.88	1.90	1.91	1.91	1.88	1.88	1.84	1.85	1.86	1.90	1.89	1.91	1.92	1.92	1.93	1.94	1.93	1.93
6/12-24/39	228.7	1.65	1.69	1.73	1.79	1.81	1.83	1.84	1.85	1.88	1.88	1.88	[illegible]	1.85	1.82	1.82	1.83	1.88	1.86	1.88	1.89	1.90	1.91	1.91	1.91	1.91
6/12-26/41	227.1	1.64	1.67	1.71	1.77	1.80	1.81	1.82	1.83	1.86	1.86	1.86	1.84	1.83	1.80	1.80	1.81	1.86	1.84	1.86	1.87	1.88	1.89	1.89	1.89	1.89
6/12-28/43	224.6	1.61	1.64	1.68	1.74	1.76	1.78	1.79	1.80	1.83	1.83	1.83	1.81	1.80	[illegible]	1.77	1.78	1.83	1.81	1.83	1.84	1.85	1.85	1.86	1.86	1.85
6/12-30/45	221.7	1.57	1.60	1.64	1.70	1.73	1.74	1.75	1.76	1.79	1.79	1.79	1.77	1.77	1.73	1.74	1.75	1.79	1.77	1.79	1.80	1.81	1.82	1.82	1.82	1.82
6/12-32/47	220.8		1.59	1.63	1.69	1.72	1.73	1.74	1.75	1.78	1.78	1.78	1.76	[illegible]	[illegible]	1.73	[illegible]	1.78	1.76	1.78	1.79	1.80	1.81	1.81	1.81	1.81
6/12-34/49	220.7			1.63	1.69	1.72	1.73	1.74	1.75	1.78	1.78	1.78	1.76	1.75	1.72	[illegible]	1.73	[illegible]	1.76	1.78	1.79	1.80	1.80	1.81	1.81	1.80
6/12-36/51	221.3				1.70	1.72	1.74	1.75	1.76	1.79	1.79	1.79	1.77	1.76	1.73	1.73	[illegible]	1.78	[illegible]	1.79	1.80	1.80	1.81	1.82	1.81	1.81
6/12-38/53	222.2					1.73	1.75	1.76	1.77	1.80	1.80	1.80	1.78	1.77	1.74	1.74	1.75	1.79	1.78	1.80	1.81	1.82	1.82	1.83	1.83	1.82
6/12-40/55	222.6						1.75	1.76	1.78	1.80	1.80	1.80	1.78	1.78	1.74	1.75	1.76	1.80	[illegible]	1.80	[illegible]	1.82	1.83	1.83	1.83	1.83
6/12-42/57	221.9							1.75	1.77	1.79	1.79	1.79	1.77	1.77	1.73	1.74	1.75	1.79	1.78	[illegible]	1.81	[illegible]	1.82	1.82	1.82	1.82
6/12-44/59	219.6								1.74	1.76	1.77	1.77	1.75	1.74	1.71	1.71	1.72	1.76	1.75	1.77	[illegible]	1.78	[illegible]	1.79	1.79	1.79
6/12-46/61	217.4									1.74	1.74	1.74	1.72	1.71	1.68	1.68	1.69	1.73	1.72	1.74	1.75	[illegible]	1.76	[illegible]	1.76	1.76
6/12-48/63	216.3										1.72	1.72	1.70	1.70	1.67	1.67	1.68	1.72	1.71	1.72	1.73	1.74	1.75	1.75	[illegible]	1.75
6/12-50/65	217.5											1.74	1.72	1.71	1.68	1.69	1.69	1.74	1.72	1.74	1.75	1.76	1.76	1.77	1.77	1.76
6/12-52/67	217.4												1.72	1.71	1.68	1.68	1.69	1.73	1.72	1.74	1.75	1.76	1.76	1.77	1.76	1.76
6/12-54/69	217.5													1.71	1.68	1.69	1.69	1.74	1.72	1.74	1.75	1.76	1.76	1.77	1.77	1.76
6/12-56/71	217.2														1.68	1.68	1.69	1.73	1.72	1.74	1.75	1.75	1.76	1.76	1.76	1.76
6/12-58/73	218.9															1.70	1.71	1.75	1.74	1.76	1.77	1.77	1.78	1.78	1.78	1.78
6/12-60/75	217.3																1.69	1.73	1.72	1.74	1.75	1.75	1.76	1.76	1.76	1.76
6/12-62/77	217.0																	1.73	1.71	1.73	1.74	1.75	1.76	1.76	1.76	1.76
6/12-64/79	216.9																		1.71	1.73	1.74	1.75	1.76	1.76	1.76	1.76
6/12-66/81	217.0																			1.73	1.74	1.75	1.76	1.76	1.76	1.76
6/12-68/83	217.2																				1.75	1.75	1.76	1.76	1.76	1.76

Vp/Vs determined from logs 1.81

Vp/Vs diff		
± 5 %	Min	1.57
± 10 %	Avg	1.78
± 15 %	Max	1.97
	SD	0.07

Base of F Sand to Mid Kim Unc. From Terra Nova L98-3 3332-3643 m

Vp/Vs variances is larger than the range for sandstone porosities

Terra Nova C Sand - Vp/Vs analysis

Jeanne d'Arc C SS

PP	Top	3843	3845	3847	3847	3848	3849	3849	3850	3850	3850	3850	3850	3850	3850	3850	3850	3850	3850	3850	3851	3851	3851
PP	Base	3872	3873	3872	3874	3874	3874	3874	3875	3874	3874	3874	3873	3873	3872	3871	3871	3870	3869	3869	3869	3869	3869
PS	Top	6383	6385	6387	6388	6389	6391	6393	6394	6395	6395	6395	6395	6396	6396	6396	6397	6397	6398	6399	6399	6399	6399
PS	Base	6418	6422	6422	6423	6423	6424	6424	6424	6424	6424	6423	6422	6421	6420	6420	6421	6421	6421	6421	6421	6420	6420
	ΔPP	6/12-30/45	6/12-32/47	6/12-34/49	6/12-36/51	6/12-38/53	6/12-40/55	6/12-42/57	6/12-44/59	6/12-46/61	6/12-48/63	6/12-50/65	6/12-52/67	6/12-54/69	6/12-56/71	6/12-58/73	6/12-60/75	6/12-62/77	6/12-64/79	6/12-66/81	6/12-68/83	6/12-70/85	6/12-72/87
ΔPS	Isochron	28.8	27.8	25.5	26.5	25.9	25.4	25.0	24.7	24.5	24.1	23.7	23.4	22.7	21.9	21.1	20.5	19.8	19.0	18.6	18.4	18.1	17.7
6/12-20/35	35.4	1.46	1.55	1.78	1.67	1.73	1.79	1.83	1.87	1.89	1.94	1.99	2.03	[illegible]	[illegible]	2.36	2.45	2.58	2.73	2.81	2.85	2.91	3.00
6/12-22/37	36.7	1.55	1.64	1.88	1.77	1.83	1.89	1.94	1.97	2.00	2.05	2.10	2.14	2.23	2.35	2.48	2.58	2.71	2.86	2.95	2.99	3.06	3.15
6/12-24/39	35.3	1.45	1.54	1.77	1.66	1.73	1.78	1.82	1.86	1.88	1.93	1.98	2.02	2.11	2.22	2.35	2.44	2.57	2.72	2.80	2.84	2.90	2.99
6/12-26/41	34.4	1.39	1.47	1.70	1.60	1.66	1.71	1.75	1.79	1.81	1.85	1.90	1.94	2.03	2.14	2.26	2.36	[illegible]	[illegible]	2.70	2.74	2.80	2.89
6/12-28/43	34.1	1.37	1.45	1.67	1.57	1.63	1.69	1.73	1.76	1.78	[illegible]	1.88	1.91	2.00	2.11	2.23	2.33	2.44	[illegible]	[illegible]	2.71	2.77	2.85
6/12-30/45	33.4	1.32	1.40	1.62	1.52	1.58	1.63	1.67	1.70	1.73	[illegible]	[illegible]	1.85	1.94	2.05	2.17	2.26	2.37	2.52	2.59	[illegible]	[illegible]	2.77
6/12-32/47	31.6		1.27	1.48	1.38	1.44	1.49	1.53	1.56	1.58	1.62	[illegible]	[illegible]	1.78	1.89	2.00	2.08	2.19	2.33	2.40	2.43	[illegible]	[illegible]
6/12-34/49	30.5			1.39	1.30	1.36	1.40	1.44	1.47	1.49	1.53	1.57	[illegible]	[illegible]	1.79	1.89	1.98	2.08	2.21	2.28	2.32	2.37	[illegible]
6/12-36/51	29.8				1.25	1.30	1.35	1.38	1.41	1.43	1.47	1.51	1.55	[illegible]	[illegible]	1.82	1.91	2.01	2.14	2.20	2.24	2.29	2.37
6/12-38/53	29.5					1.28	1.32	[illegible]	1.39	1.41	1.45	1.49	1.52	1.60	[illegible]	[illegible]	1.88	1.98	2.11	2.17	2.21	2.26	2.33
6/12-40/55	28.0						1.20	[illegible]	1.27	1.29	1.32	1.36	1.39	1.47	1.56	[illegible]	[illegible]	1.83	1.95	2.01	2.04	2.09	2.16
6/12-42/57	26.5							1.12	[illegible]	1.16	1.20	1.24	1.26	1.33	1.42	1.51	1.59	[illegible]	1.79	1.85	1.88	1.93	1.99
6/12-44/59	25.2								[illegible]	[illegible]	1.09	1.13	1.15	1.22	1.30	1.39	1.46	1.55	1.65	1.71	1.74	1.78	1.85
6/12-46/61	24.5									[illegible]	[illegible]	1.07	1.09	1.16	1.24	1.32	1.39	1.47	1.58	1.63	1.66	1.71	1.77
6/12-48/63	24.1										[illegible]	[illegible]	1.06	1.12	1.20	1.28	1.35	1.43	1.54	1.59	1.62	1.66	1.72
6/12-50/65	23.7											[illegible]	[illegible]	1.09	1.16	1.25	1.31	1.39	1.49	1.55	1.58	1.62	1.68
6/12-52/67	23.3												[illegible]	[illegible]	1.13	1.21	1.27	1.35	1.45	1.51	1.53	1.57	1.63
6/12-54/69	22.8													[illegible]	[illegible]	1.16	1.22	1.30	1.40	1.45	1.48	1.52	1.58
6/12-56/71	22.1														[illegible]	[illegible]	1.16	1.23	1.33	1.38	1.40	1.44	1.50
6/12-58/73	21.5															[illegible]	[illegible]	1.17	1.26	1.31	1.34	1.38	1.43
6/12-60/75	21.1																1.06	1.13	1.22	1.27	1.29	1.33	1.38
6/12-62/77	20.5																	1.07	1.16	1.20	1.23	1.27	1.32
6/12-64/79	19.7																		1.07	1.12	1.14	1.18	1.23
6/12-66/81	19.0																			1.04	1.07	1.10	1.15
6/12-68/83	18.5																				1.01	1.04	1.09

Vp/Vs determine from logs 1.74

Vp/Vs diff		
± 5 %	Min	0.99
± 10 %	Avg	1.79
± 15 %	Max	3.22
	SD	0.55

Type section well from Terra Nova L98-3 3521-3483 m (38 metre

Unconsolidated Shale

Correct Answer

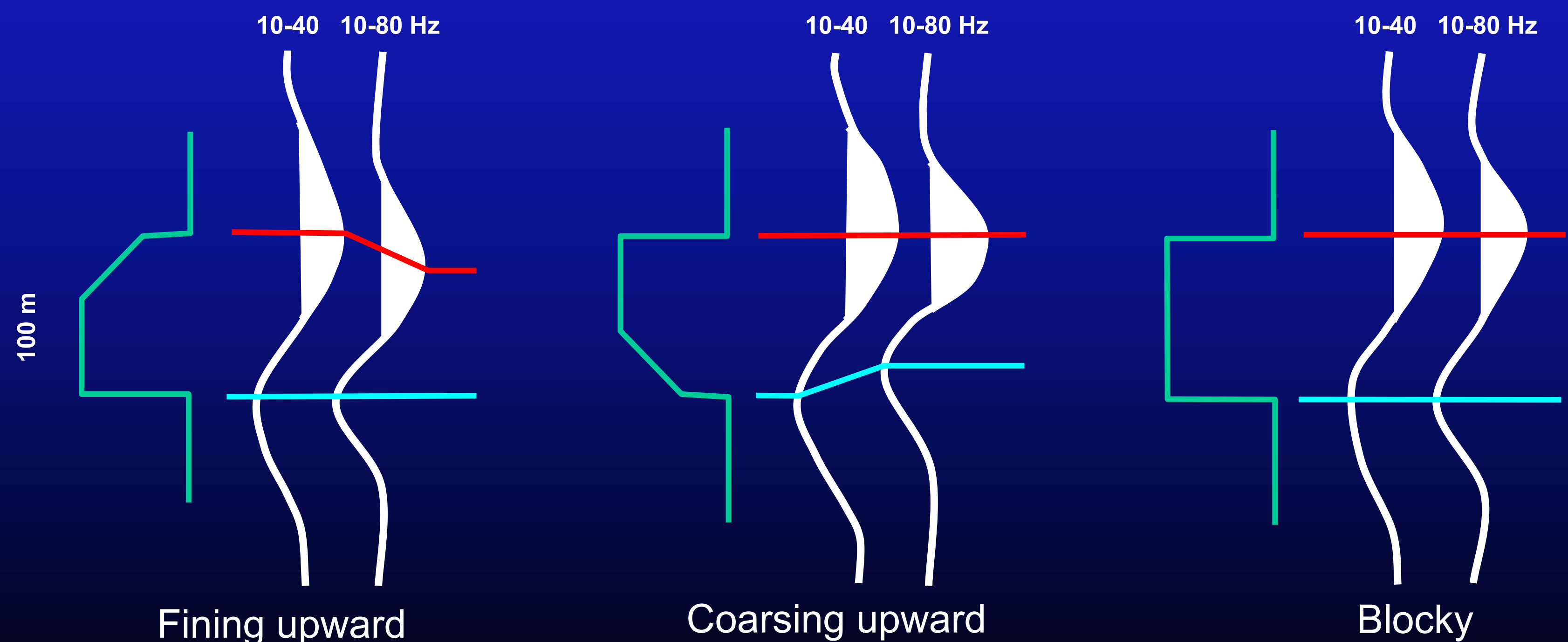
Physical Impossible

UNIVERSITY OF CALGARY

CREWES

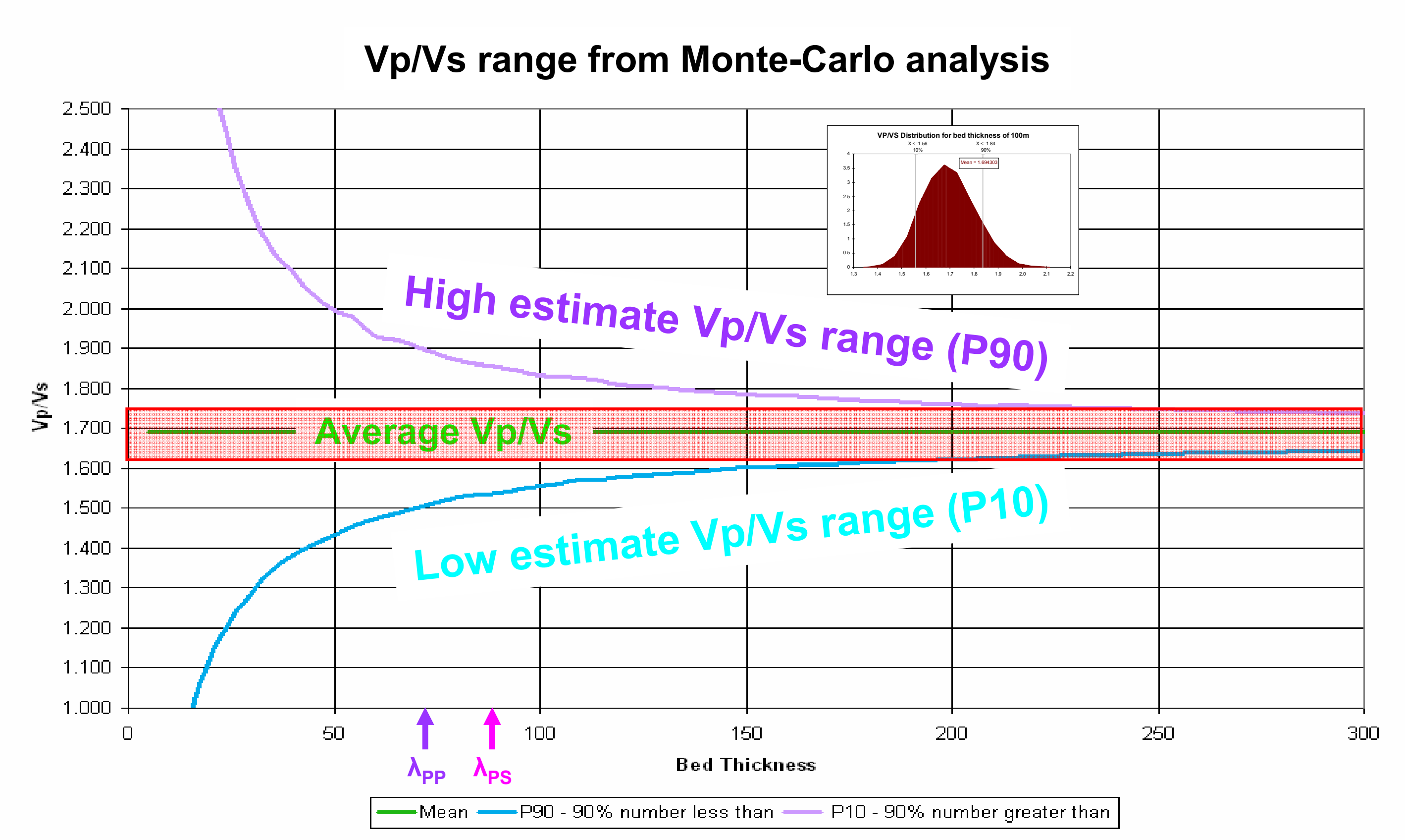
Pitfalls with V_P/V_S analysis (Tuning)

- ¼ λ vertical resolution (PP=17.8 & PS=21.2 m for a 15% porosity Vp = 4260 m/s Vs = 2520 sandstone)
- The location of the top and base reflectors are affected by the seismic frequency
- The error decreases as the formation becomes more blocky



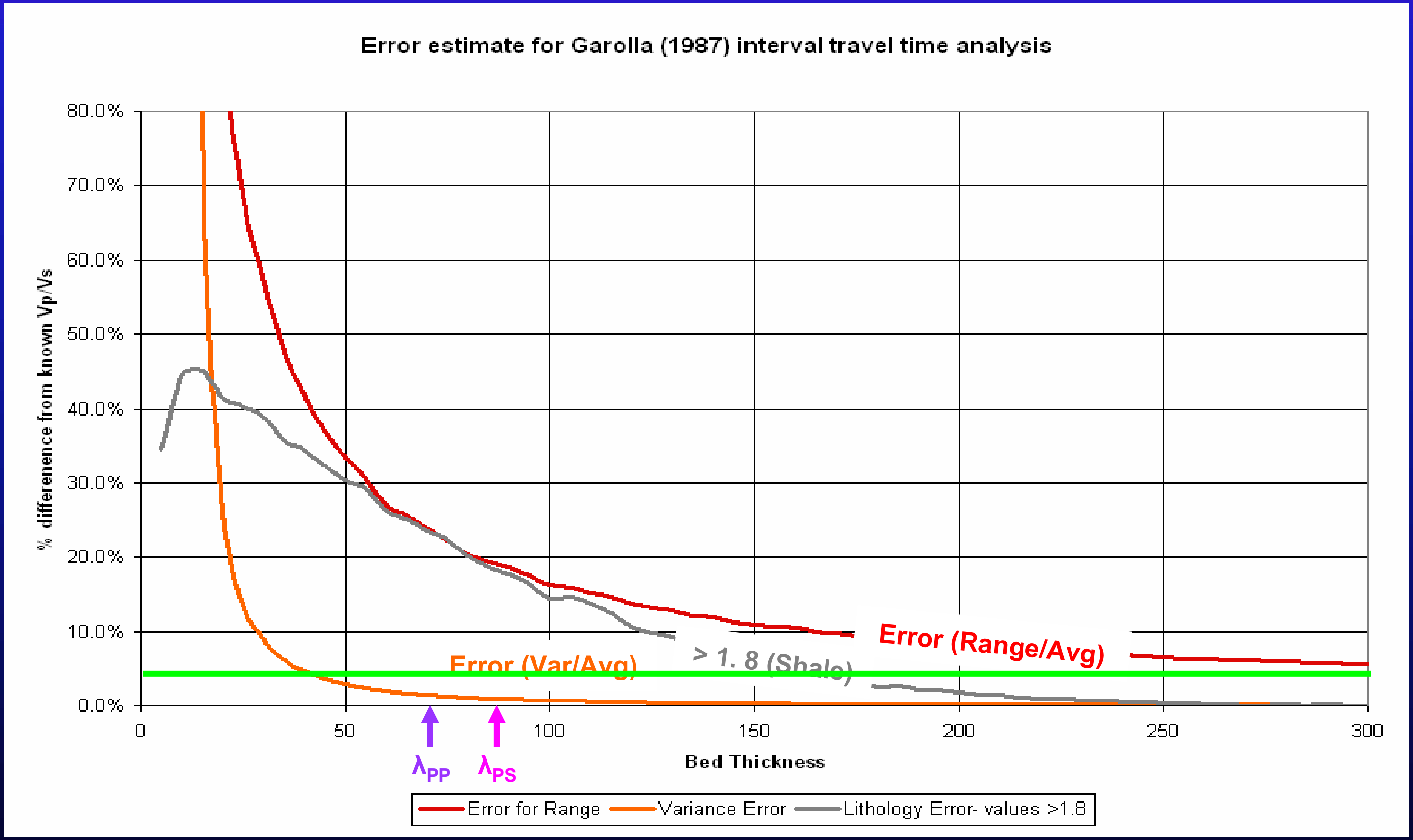
Resolution limitation on V_P/V_S analysis

Bed thickness and the pitfall of picking uncertainty (1/8 λ)



Resolution limitation on V_P/V_S analysis

Bed thickness and the pitfall of picking uncertainty (1/8 λ)



UNIVERSITY OF CALGARY

CREWES

Conclusions

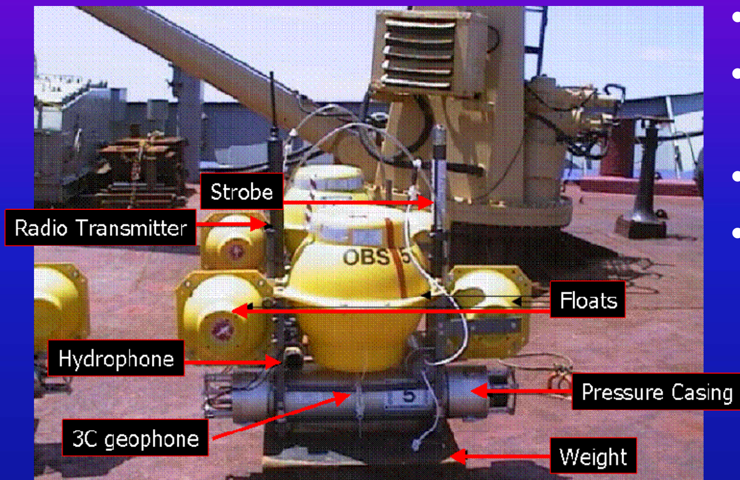
- V_P/V_S analysis using interval travel times can differentiate quartz dominated formations from shale and carbonate formations
- Analysis using Garotta (1987) $2\ \Delta T_{PS} / \Delta T_{PP} - 1$ method, appear to require both the top and base reflectors to be clearly separated and homogeneous
- Analysis intervals are recommend to be at least 1 wavelength in thickness.

Recommendation and Future Work

- Improvement in structural interpretation, may on it own, justify an OBS survey
- I would recommend rerunning the CREWES OBS survey, without the high cut filter, prior to undertaking a larger and more costly commercial program
- Additional VSP work would be warranted to investigate the PS bandwidth
- A study on PP and PS joint inversion would be highly recommended

New OBS acquisition

CREWES Mariprobe 2002 OBS tests



Source: Dalhousie Seismic Group, http://www.phys.ocean.dal.ca/seismic

- 2002 OBS seismic data (old technology)
- Program took advantage of spare ship time resulting in a narrow acquisition time window
- Only 21 instruments limited receiver coverage
- Improved acquisition will provide more answers for industry.