



Defining a chemostratigraphic framework for the Adavale Basin

Inorganic and stable isotopic analysis of 10 petroleum
wells from the Adavale Basin, Queensland

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Boree Salt, image courtesy of Errol Fries



Acknowledgement of Country

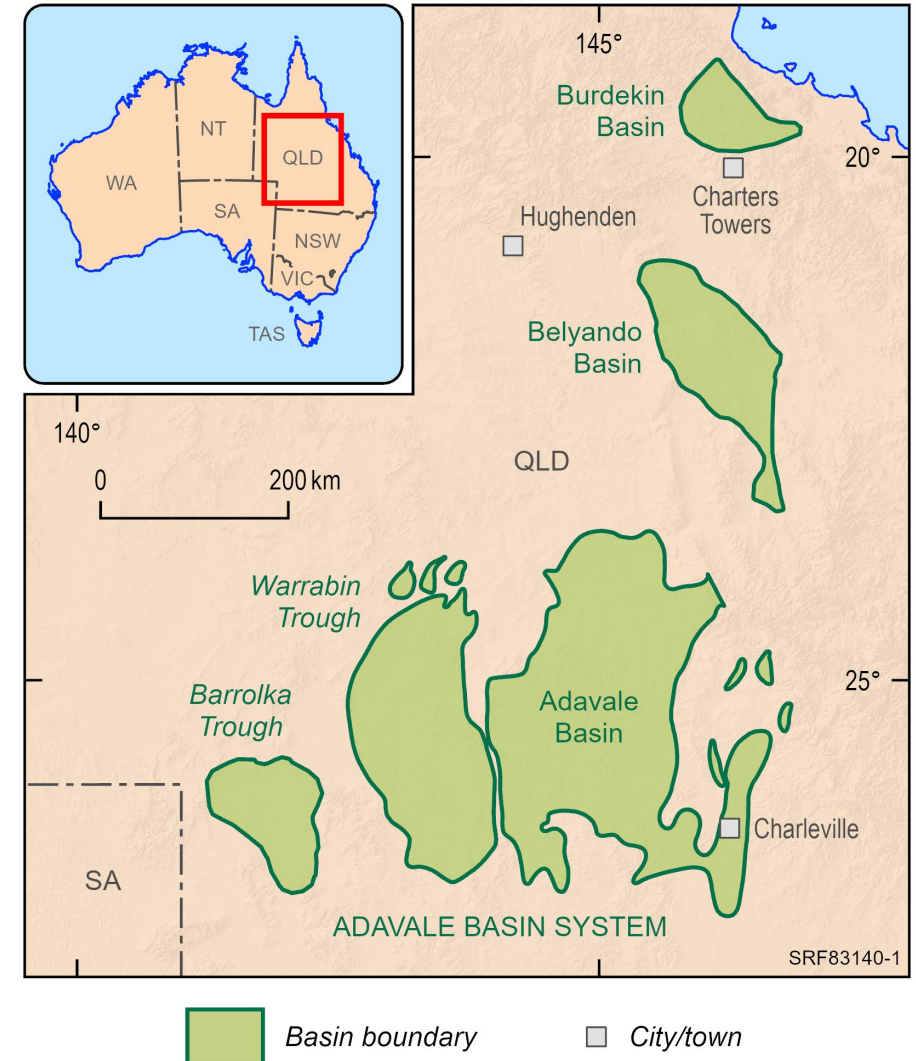
I would like to acknowledge the traditional owners and custodians of Country throughout Australia and acknowledges their continuing connection to land, waters and community. I pay my respects to the people, the cultures and the elders past and present.



Image: Caterpillar Tracks: Artwork by Roseanne Kemarre Ellis on Geoscience Australia's Alice Springs antenna

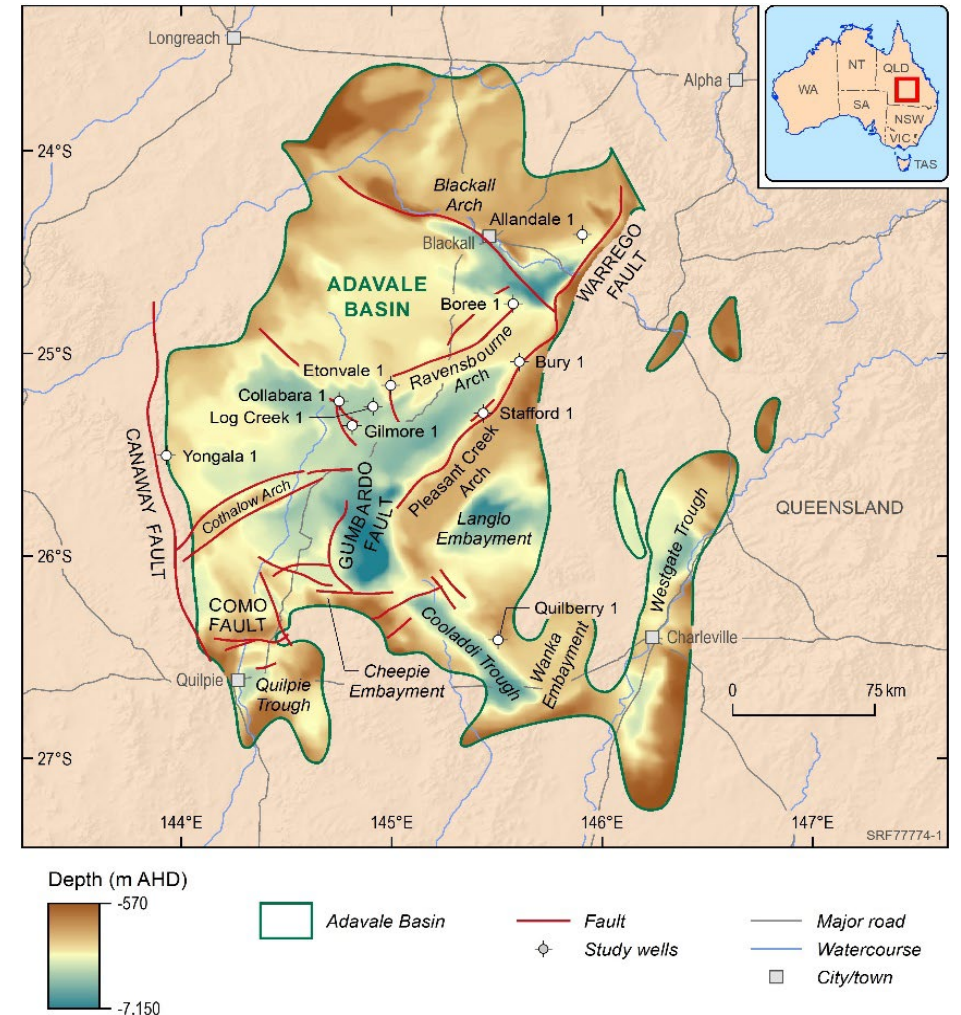
Introduction

- Data Driven Discoveries (DDD) program
 - \$30.9 million over 3 years
- Identify opportunities in a buried, underexplored basin in south-central Queensland
- New analysis of legacy datasets to gain new insights on the geological history and prospectivity of the basin
- Chemostratigraphy is one important component of the program
- Feeds into the creation of an integrated program of seismic acquisition, reprocessing and the drilling of a deep stratigraphic well



What have we done?

- Legacy lithostratigraphic picks in the basin are highly uncertain
- New study sampled 1,489 legacy cuttings from 10 wells used to establish a new, independent chemostratigraphic framework and correlations
- Involved elemental, XRD and isotopic data
- XRD used as a training set to develop a mineral model
- The chemostratigraphic study is part of the DDD pre-competitive data package to become publicly available in due course



Depth to basement map (after OzSeabase 2021)

Explanation of elemental chemostratigraphy

“the characterisation and correlation of sedimentary successions based on up-well changes in bulk rock inorganic geochemistry”

1 hydrogen 1 H 1.0079	2 helium 2 He 4.0026																																					
3 lithium 3 Li 6.941	4 beryllium 4 Be 9.0122	13 boron 5 B 10.811	14 carbon 6 C 12.011	15 nitrogen 7 N 14.007	16 oxygen 8 O 15.999	17 fluorine 9 F 18.998	18 neon 10 Ne 20.180																															
11 sodium 11 Na 22.990	12 magnesium 12 Mg 24.305	13 aluminium 13 Al 26.982	14 silicon 14 Si 28.086	15 phosphorus 15 P 30.974	16 sulfur 16 S 32.065	17 chlorine 17 Cl 35.453	18 argon 18 Ar 39.948	21 scandium 21 Sc 44.956	22 titanium 22 Ti 47.867	23 vanadium 23 V 50.942	24 chromium 24 Cr 51.996	25 manganese 25 Mn 54.938	26 iron 26 Fe 55.845	27 cobalt 27 Co 58.933	28 nickel 28 Ni 58.693	29 copper 29 Cu 63.546	30 zinc 30 Zn 65.39	31 gallium 31 Ga 69.723	32 germanium 32 Ge 72.64	33 arsenic 33 As 74.922	34 selenium 34 Se 78.96	35 bromine 35 Br 79.904	36 krypton 36 Kr 83.80															
19 potassium 19 K 39.098	20 calcium 20 Ca 40.078	37 rubidium 37 Rb 85.468	38 strontium 38 Sr 87.62	39 yttrium 39 Y 88.906	40 zirconium 40 Zr 91.224	41 niobium 41 Nb 92.906	42 molybdenum 42 Mo 95.94	43 technetium 43 Tc [98]	44 ruthenium 44 Ru 101.07	45 rhodium 45 Rh 102.91	46 palladium 46 Pd 106.42	47 silver 47 Ag 107.87	48 cadmium 48 Cd 112.41	49 indium 49 In 114.82	50 tin 50 Sn 118.71	51 antimony 51 Sb 121.76	52 tellurium 52 Te 127.60	53 iodine 53 I 126.90	54 xenon 54 Xe 131.29	55 caesium 55 Cs 132.91	56 barium 56 Ba 137.33	57-70 lanthanide series	71 lutetium 71 Lu 174.97	72 hafnium 72 Hf 178.49	73 tantalum 73 Ta 180.95	74 tungsten 74 W 183.84	75 rhenium 75 Re 186.21	76 osmium 76 Os 190.23	77 iridium 77 Ir 192.22	78 platinum 78 Pt 195.08	79 gold 79 Au 196.97	80 mercury 80 Hg 200.59	81 thallium 81 Tl 204.38	82 lead 82 Pb 207.2	83 bismuth 83 Bi 208.98	84 polonium 84 Po [209]	85 astatine 85 At [210]	86 radon 86 Rn [222]
87 francium 87 Fr [223]	88 radium 88 Ra [226]	89-102 actinide series	103 lawrencium 103 Lr [262]	104 rutherfordium 104 Rf [261]	105 dubnium 105 Db [262]	106 seaborgium 106 Sg [266]	107 bohrium 107 Bh [264]	108 hassium 108 Hs [269]	109 meitnerium 109 Mt [268]	110 darmstadtium 110 Ds [271]	111 roentgenium 111 Rg [272]	112 unnilium 112 Uub [277]	113 ununium 113 Uut [284]	114 ununquadium 114 Uuq [289]	115 ununpentium 115 Uup [288]	116 ununhexium 116 Uuh [292]	117 ununseptium 117 Uus [291]	118 ununoctium 118 Uuo [294]																				

	Feldspar
	Mafic
	Clay
	Heavy Mineral

■ Lanthanide series	lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
■ Actinide series	actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

Sample analysis; ICP, Isotopes, XRD



Check

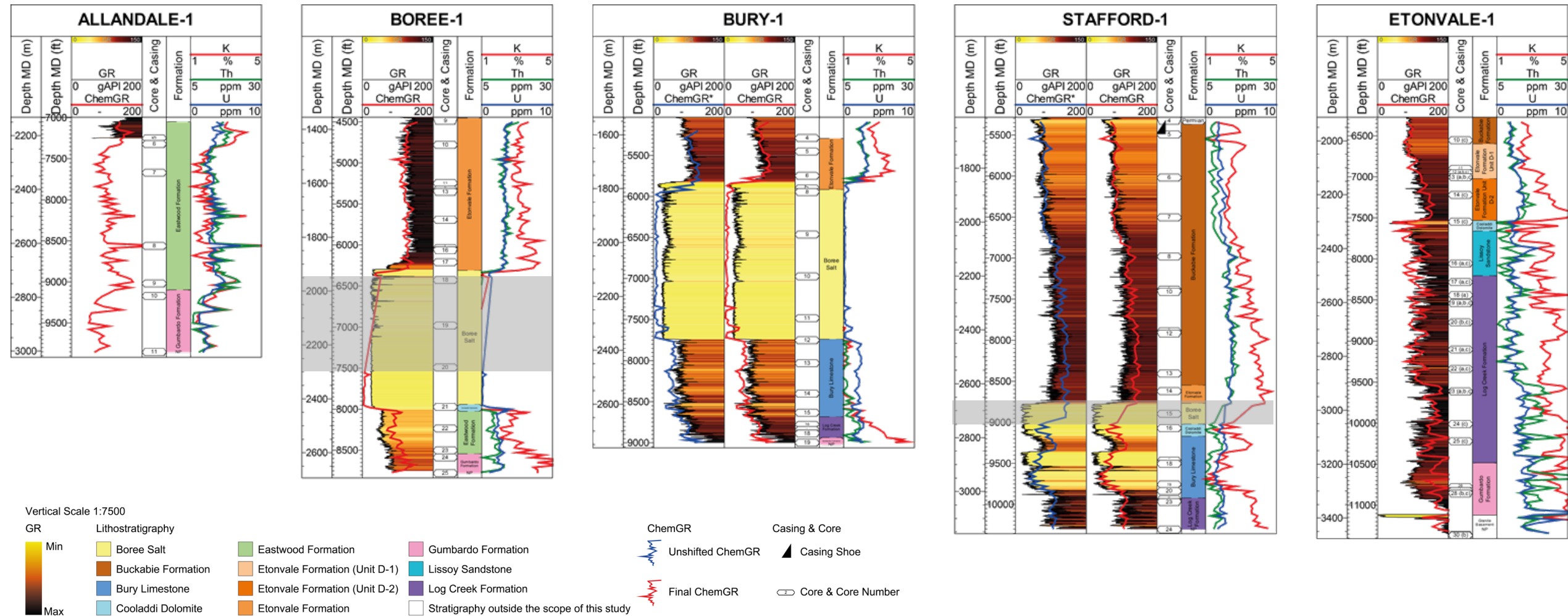


Preparation



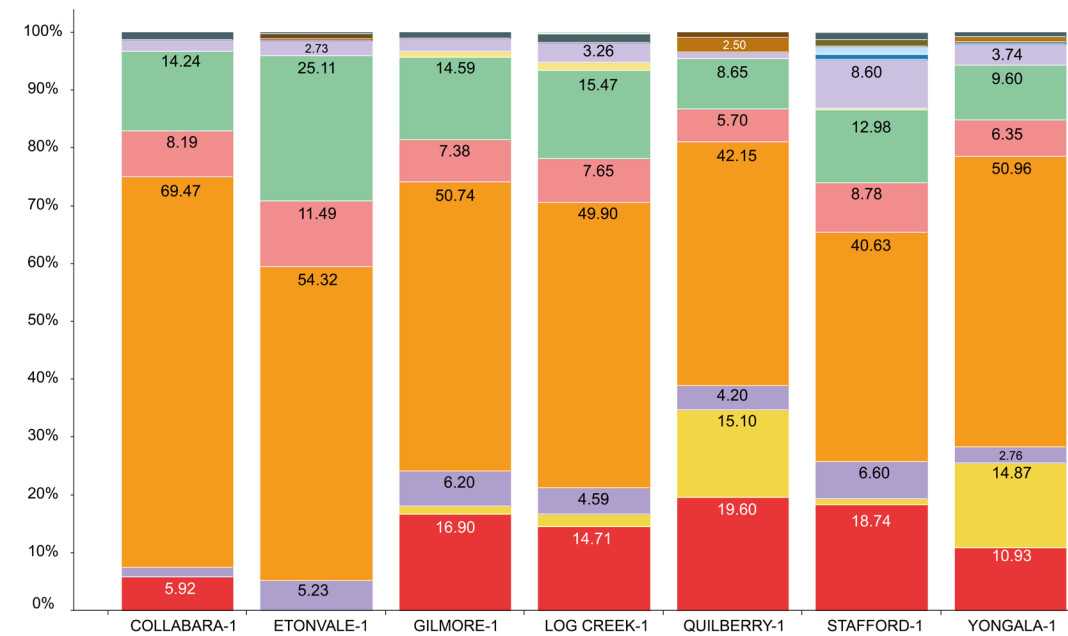
Analysis

Sample quality; do the samples represent the lithology at the depth they were taken?

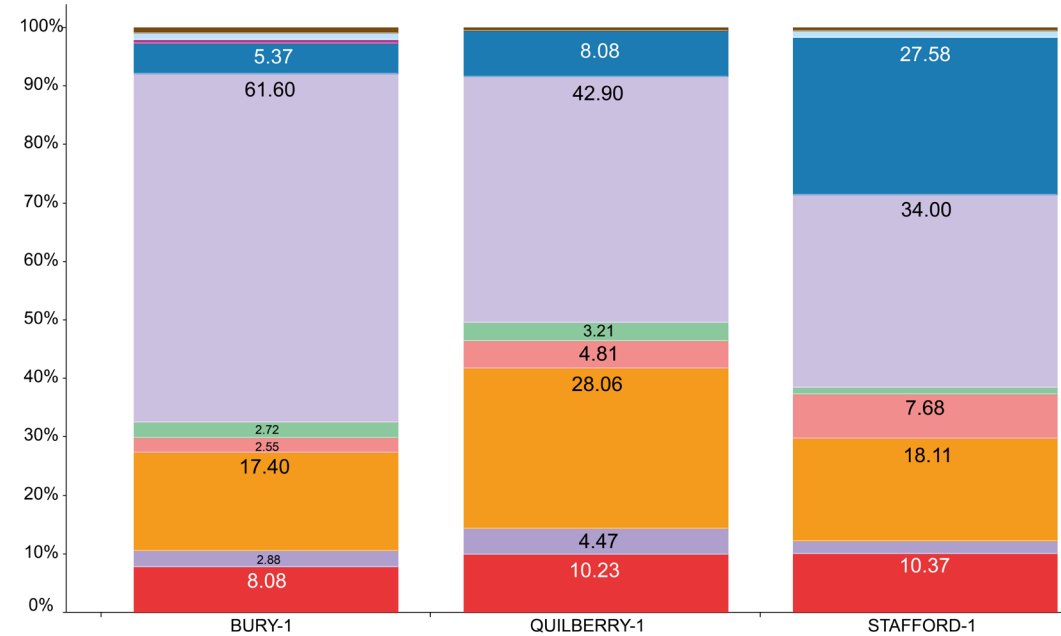


XRD mineralogy percentages on legacy cuttings

Buckabie Formation



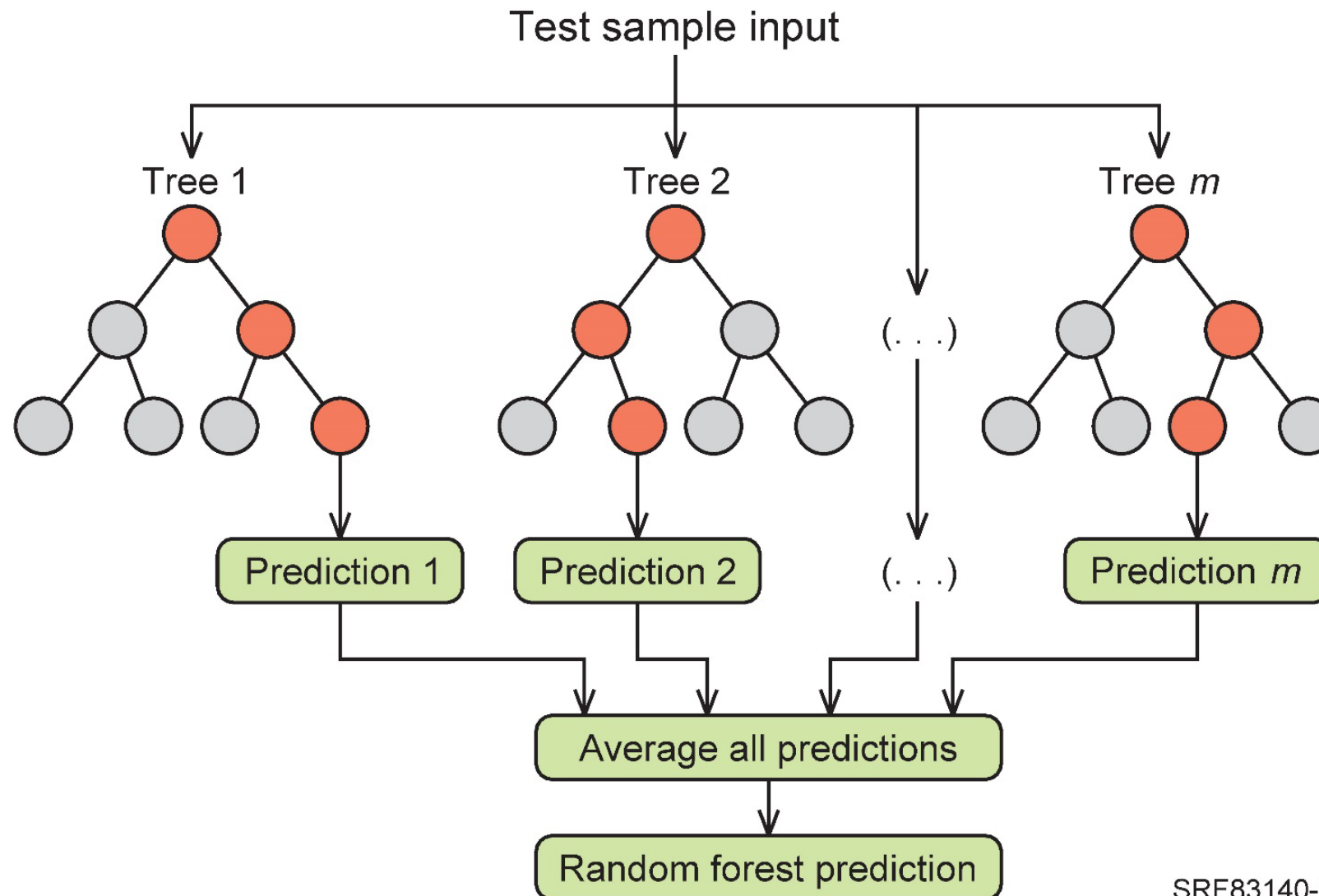
Bury Limestone



Mineralogy

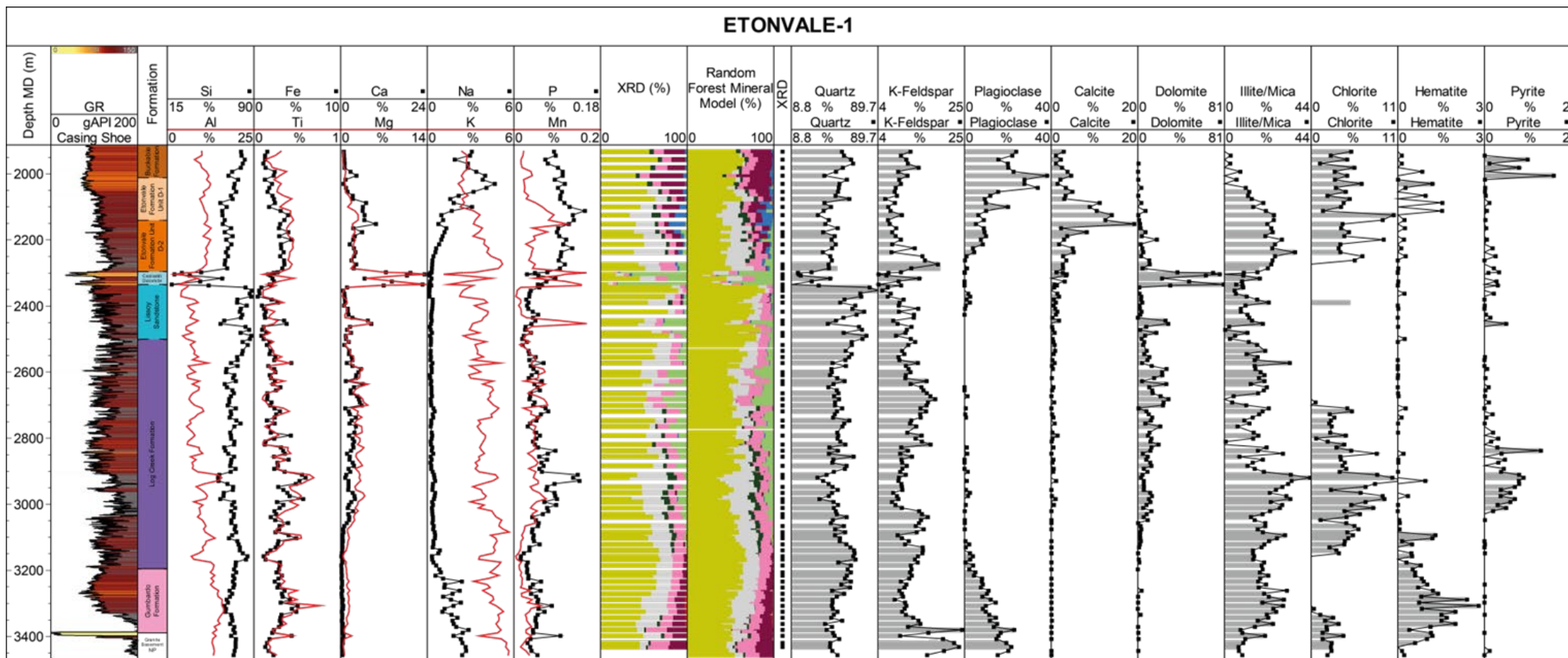
- Smectite
- Illite/Smectite
- Illite+mica
- Kaolinite
- Chlorite
- Quartz
- K Feldspar
- Plagioclase
- Pyroxene
- Analcime
- Laumontite
- Calcite
- Dolomite
- Siderite
- Halite
- Anhydrite
- Barite
- Vaterite
- Sylvite
- Pyrite
- Hematite
- Magnetite

Mineral model, geochemistry to mineralogy

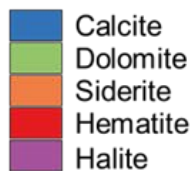


SRF83140-8

Mineral model - results



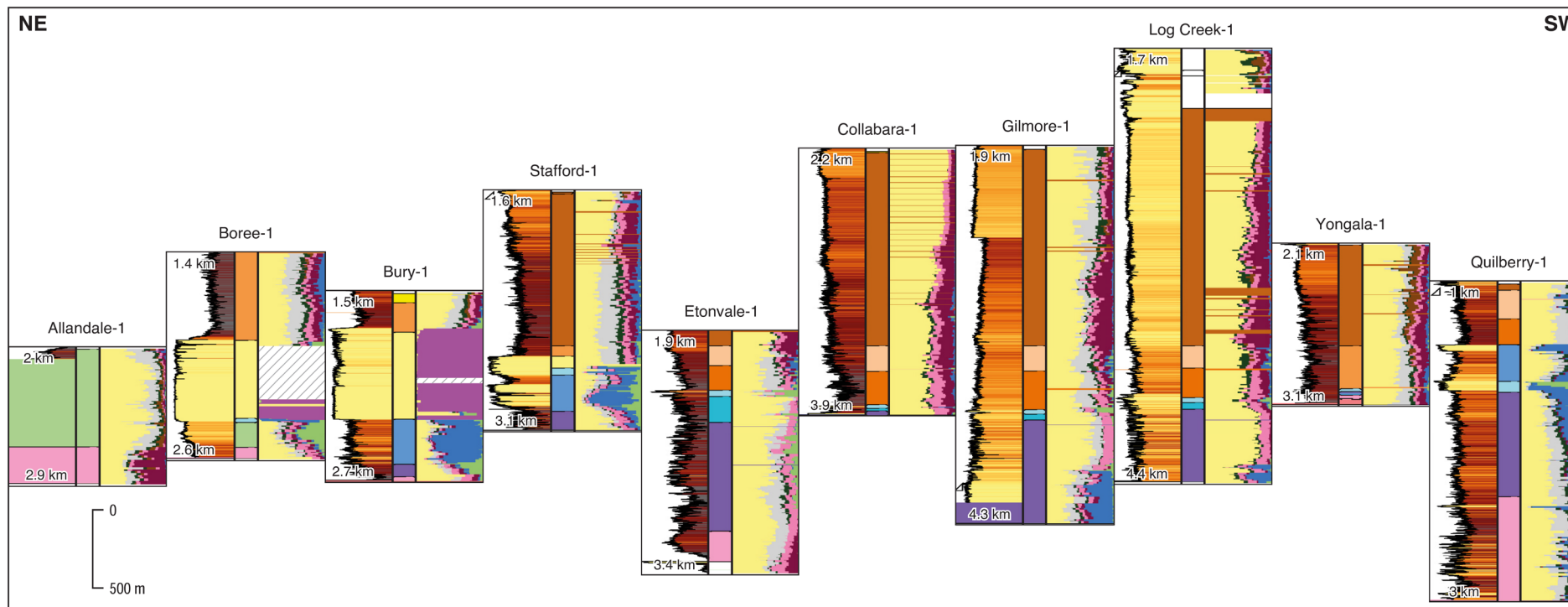
XRD (%)



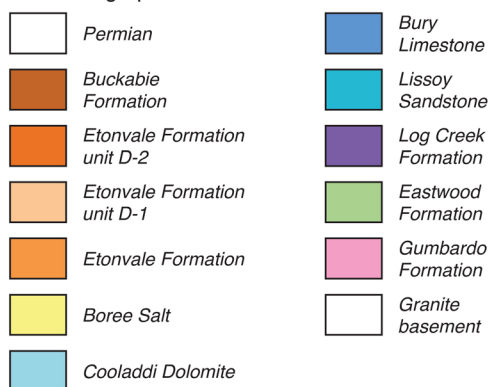
Random Forest Mineral Model (%)



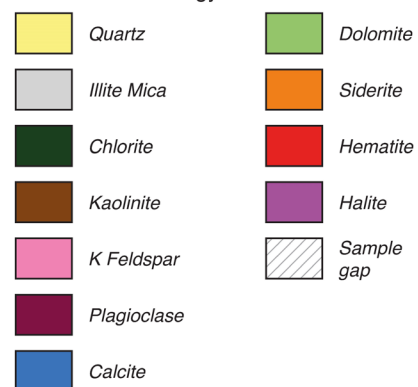
Mineral model - results



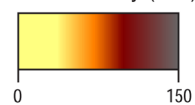
Lithostratigraphic unit



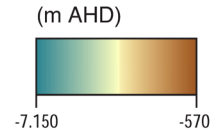
Modelled mineralogy



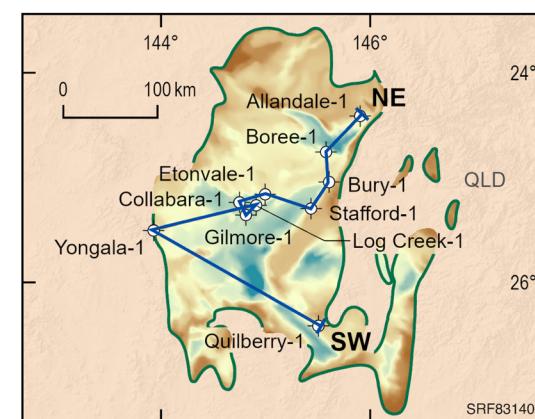
Gamma Ray (API)



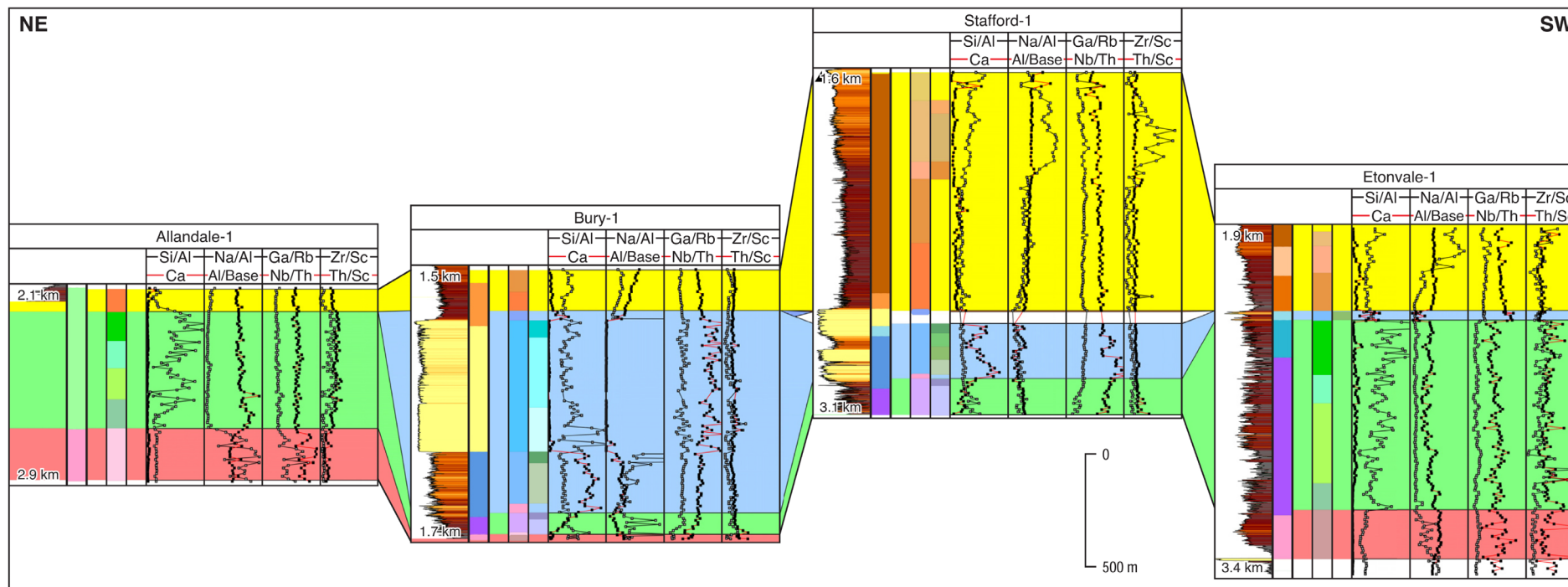
Depth to basement (m AHD)



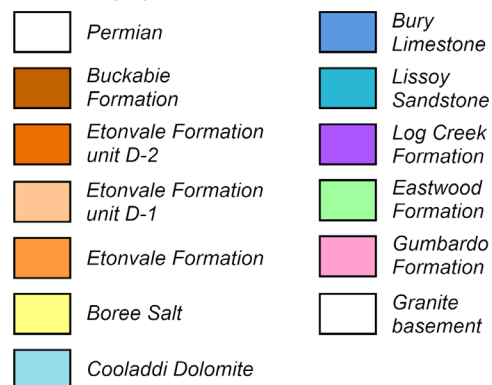
— Well transect line
 ⊕ Study wells



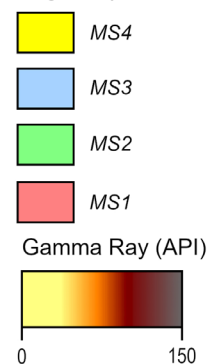
Four chemostratigraphic mega-sequences defined



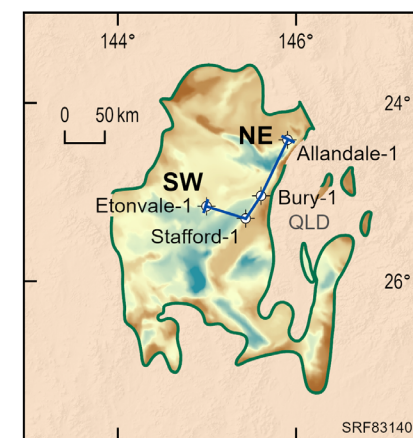
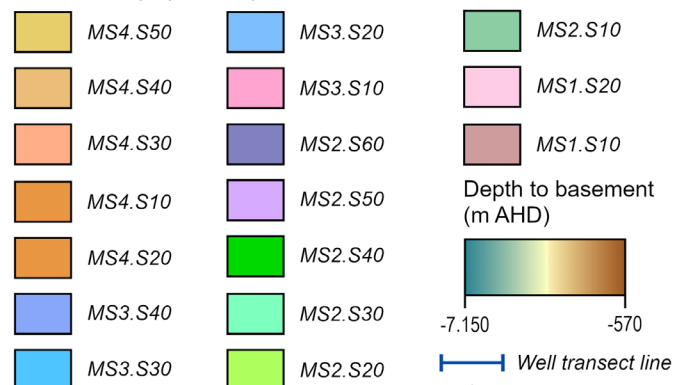
Lithostratigraphic unit



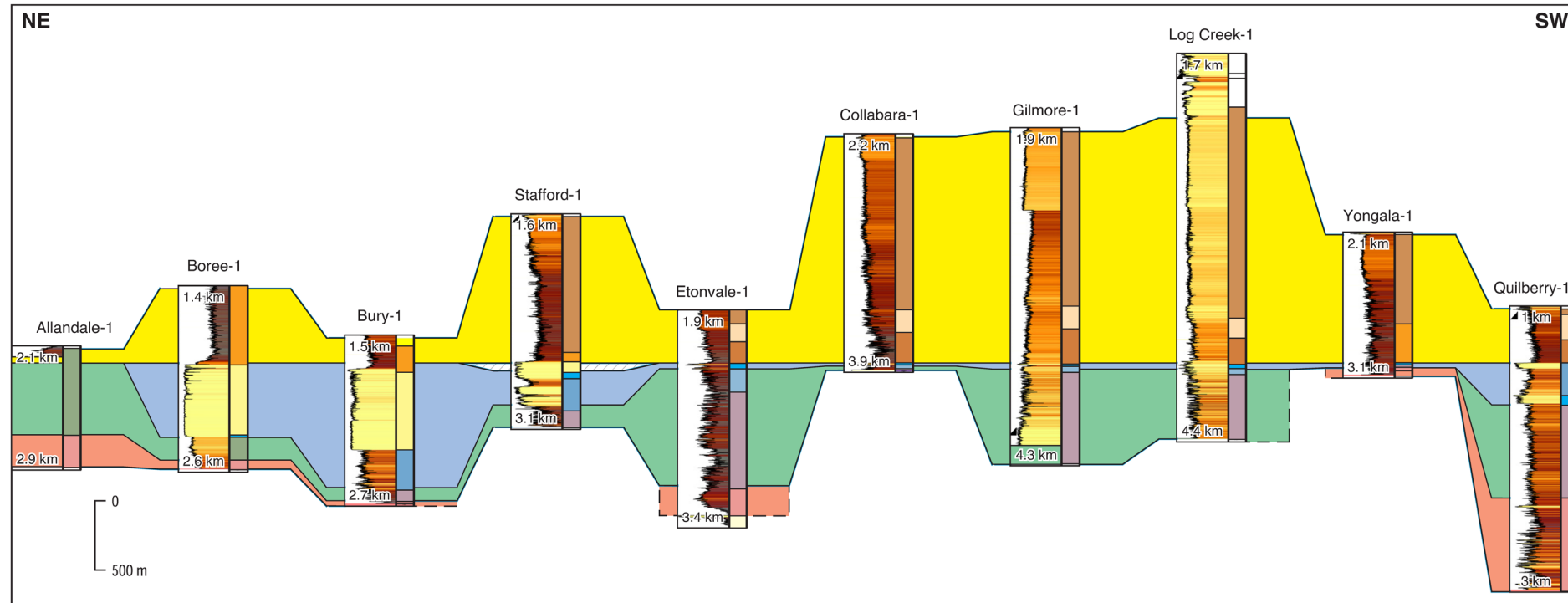
Chemostratigraphic Mega-sequence



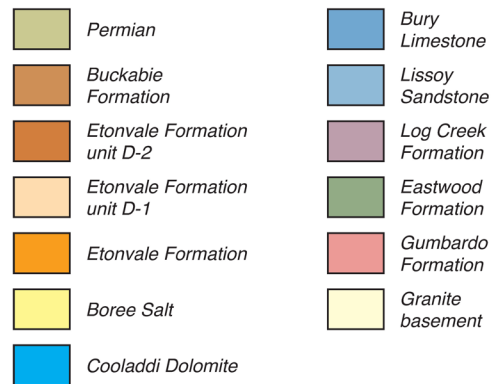
Chemostratigraphic Sequence



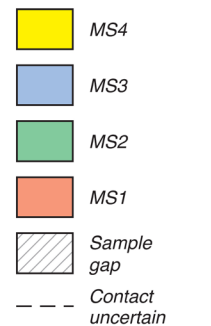
Correlation of the 4 Chemostratigraphic Mega-sequences (MS)



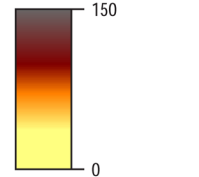
Lithostratigraphic unit



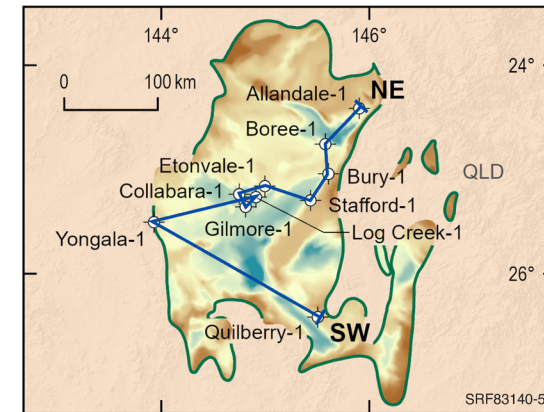
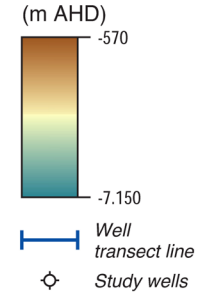
Chemostratigraphic Mega-sequence



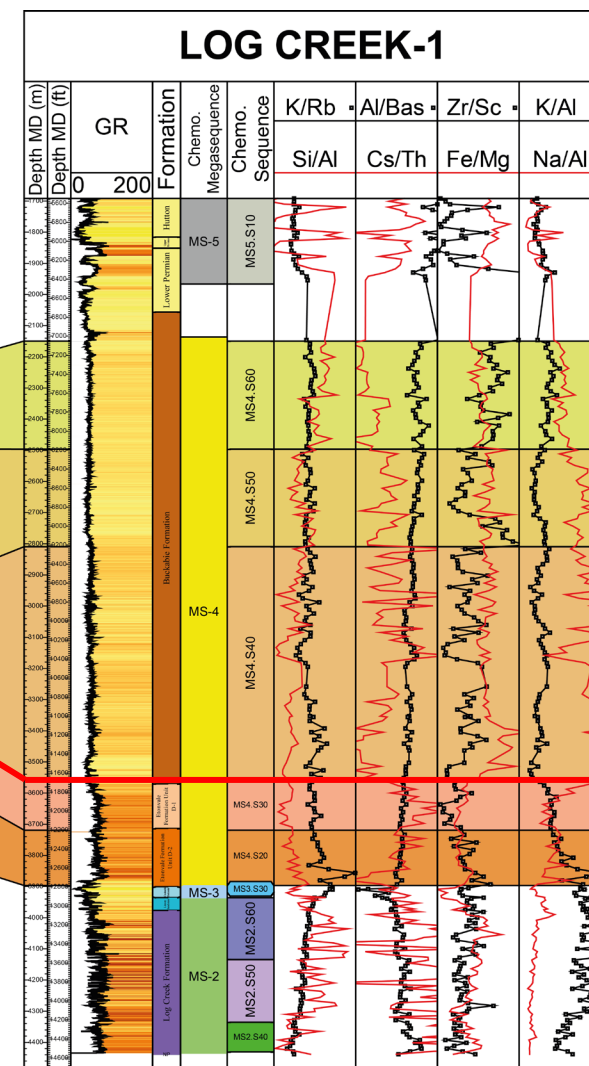
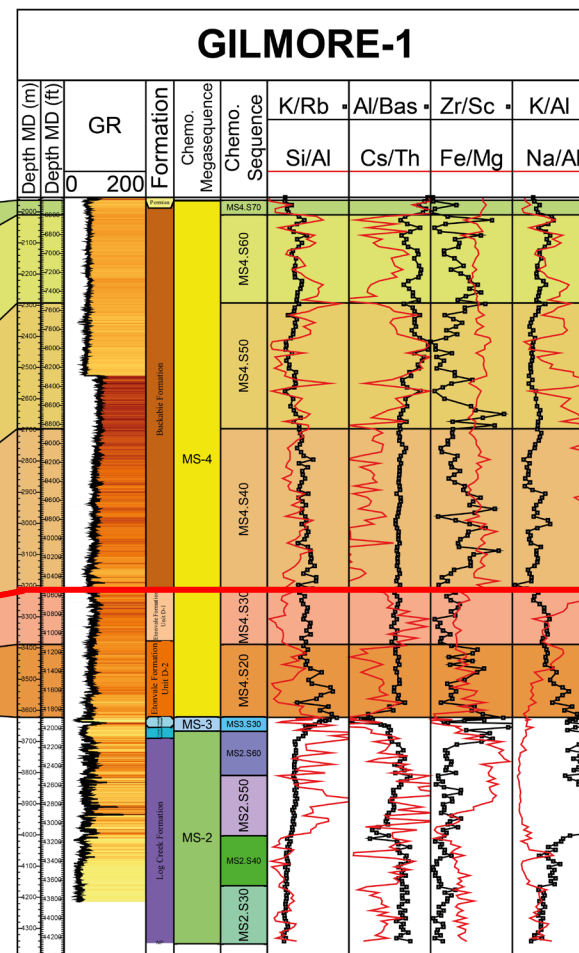
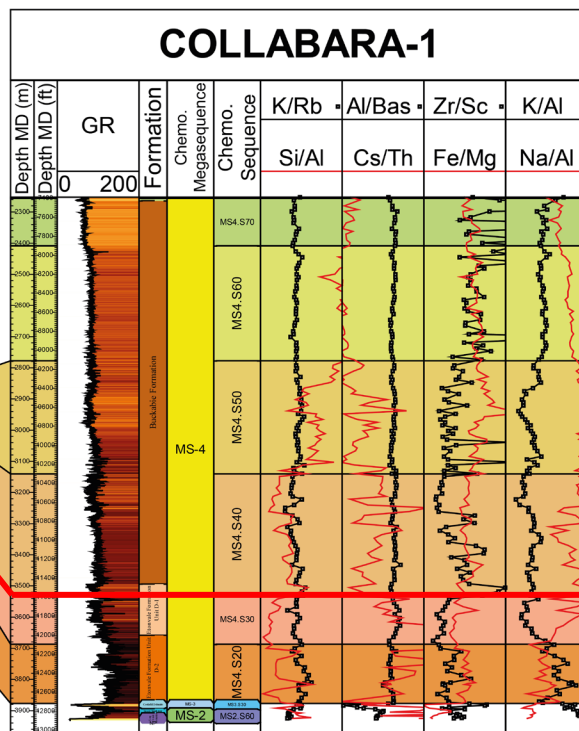
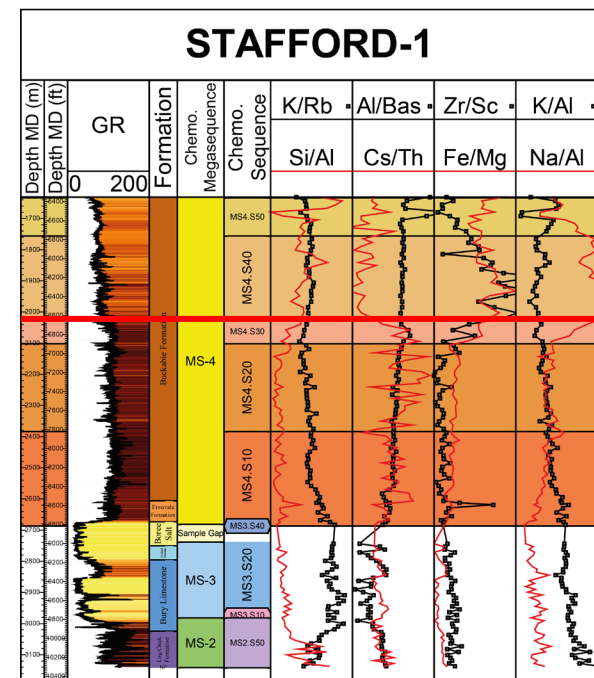
Gamma Ray (API)



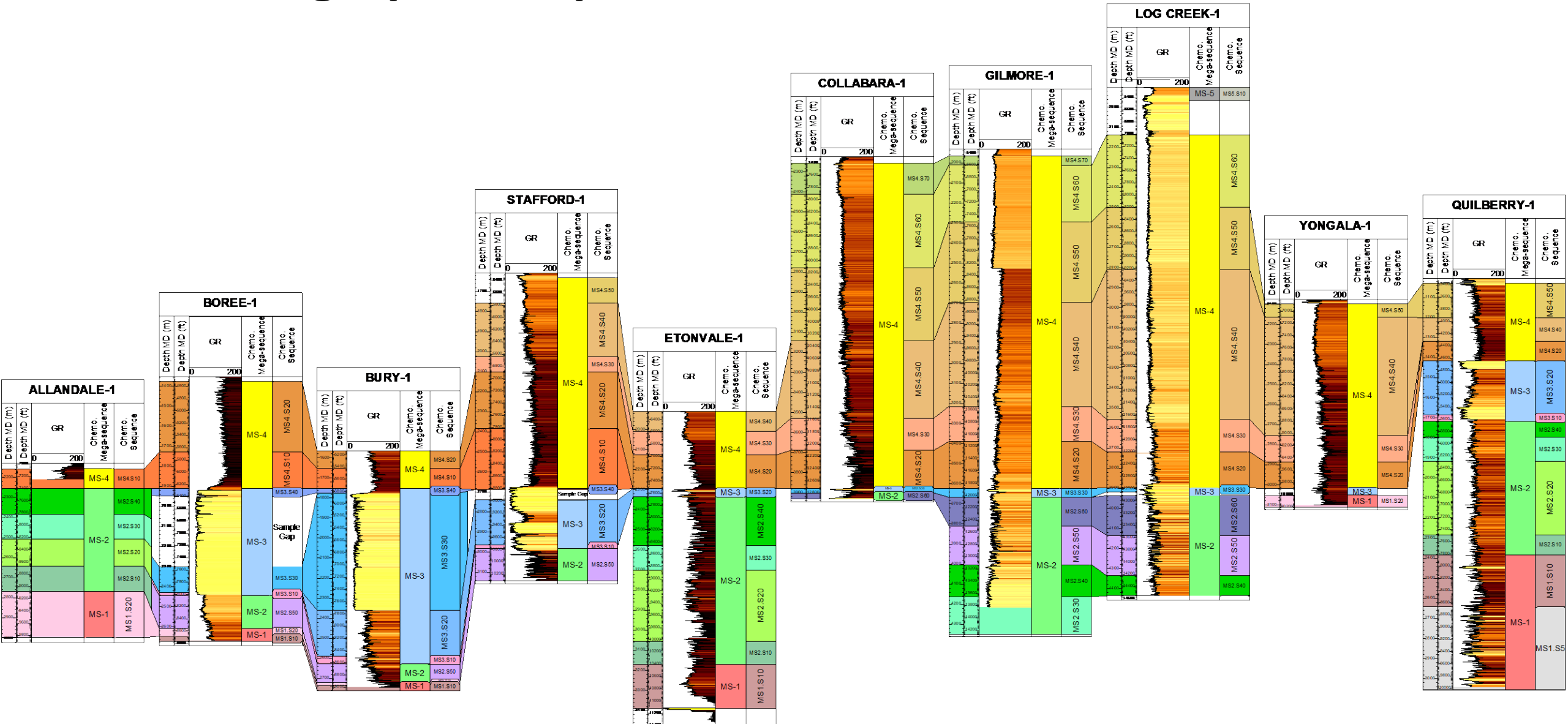
Depth to basement (m AHD)



Breaking out the chemostratigraphic detail in MS4



Chemostratigraphic sequence correlation



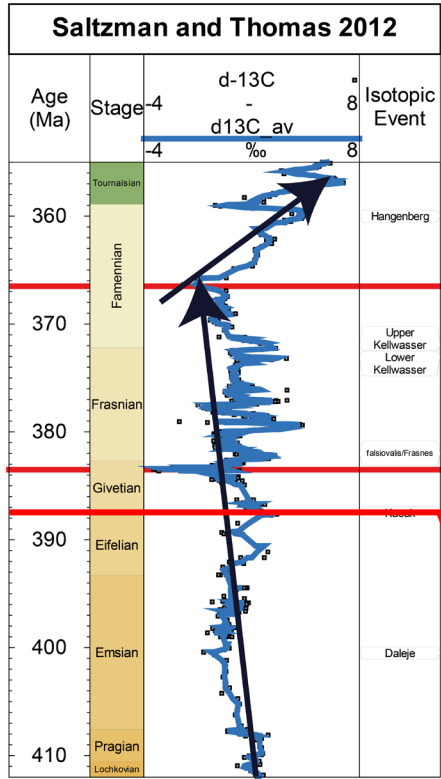


Relative timescale

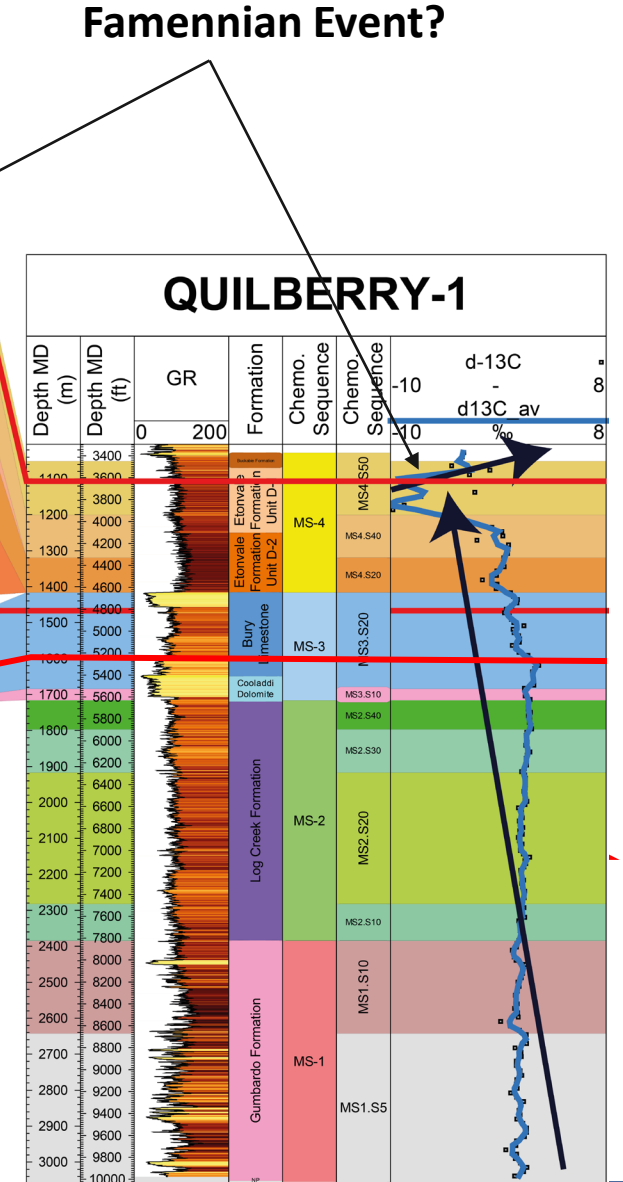
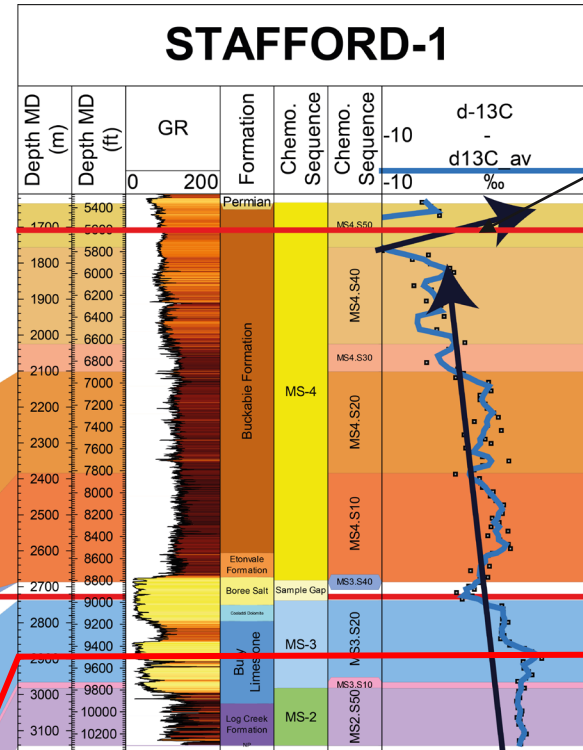
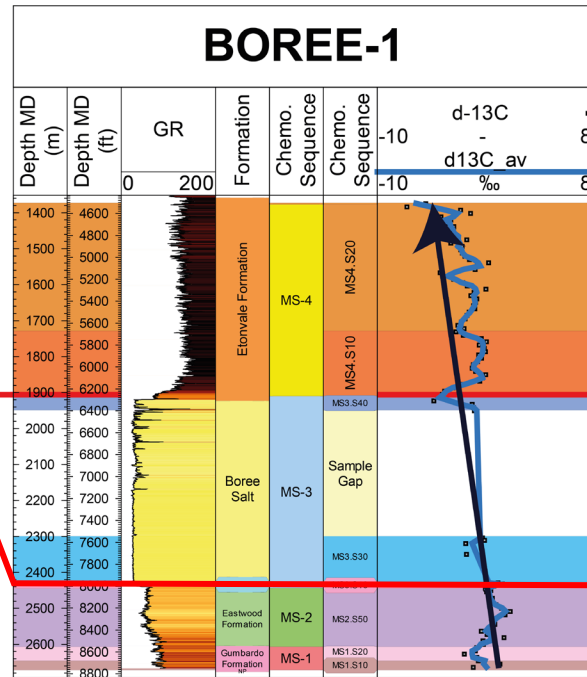


Absolute timescale

Constraining the relative framework to absolute time



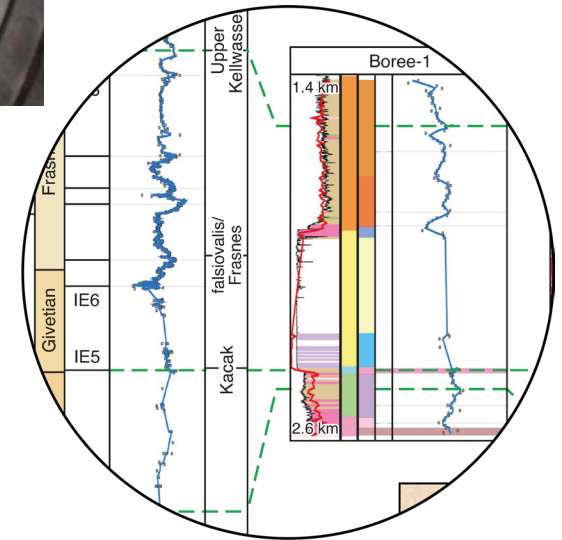
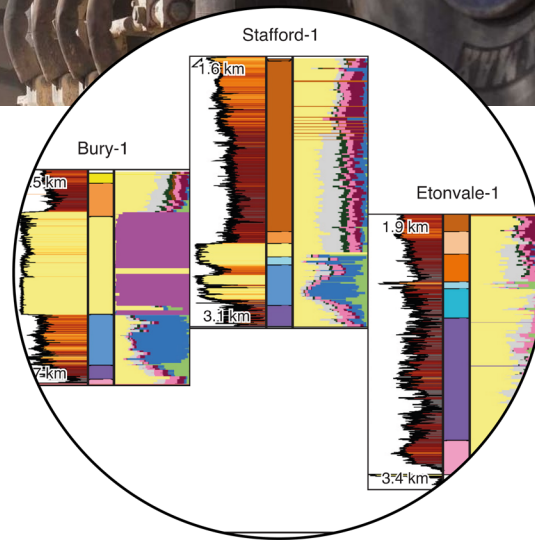
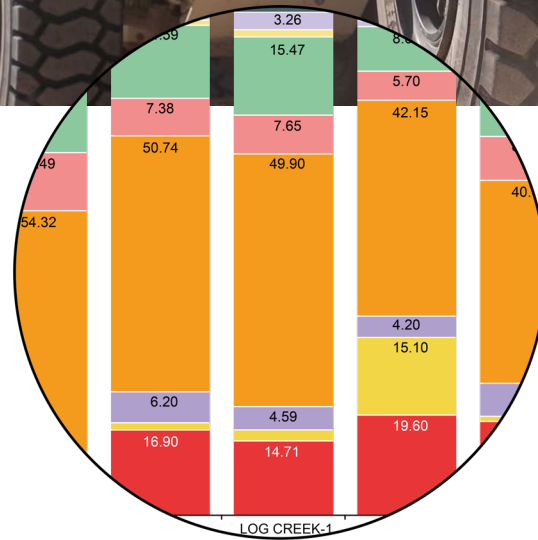
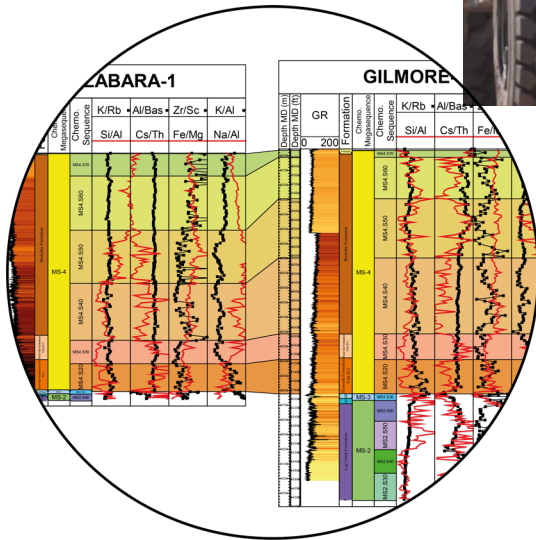
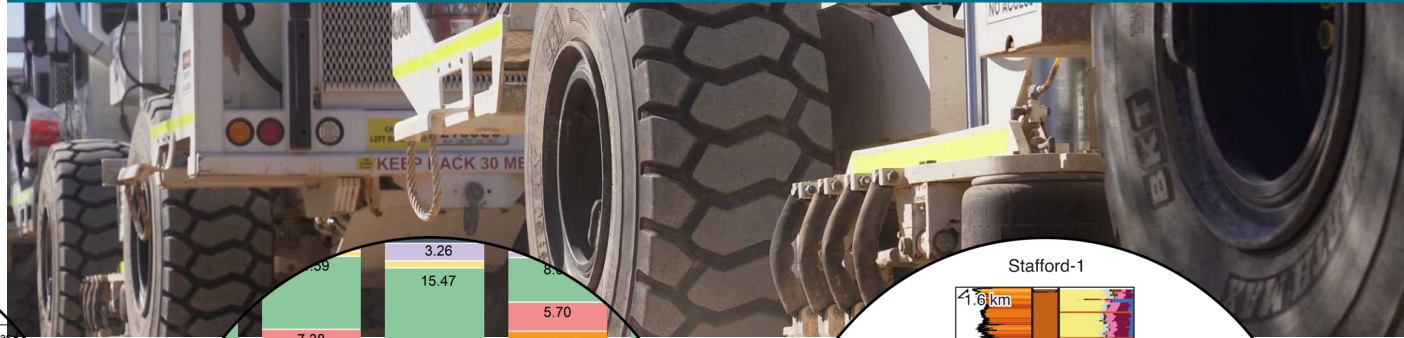
Global carbon isotope curve tied to the GTS



Conclusions

Data Driven Discoveries Program – Adavale Basin

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Acknowledgments

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Thank You

Further information



**Data Driven Discoveries
Program – Adavale Basin**



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