



Protecting Critical Groundwater Resources above Coal Seam Gas Operations: The Roles of Chemistry and Isotopes

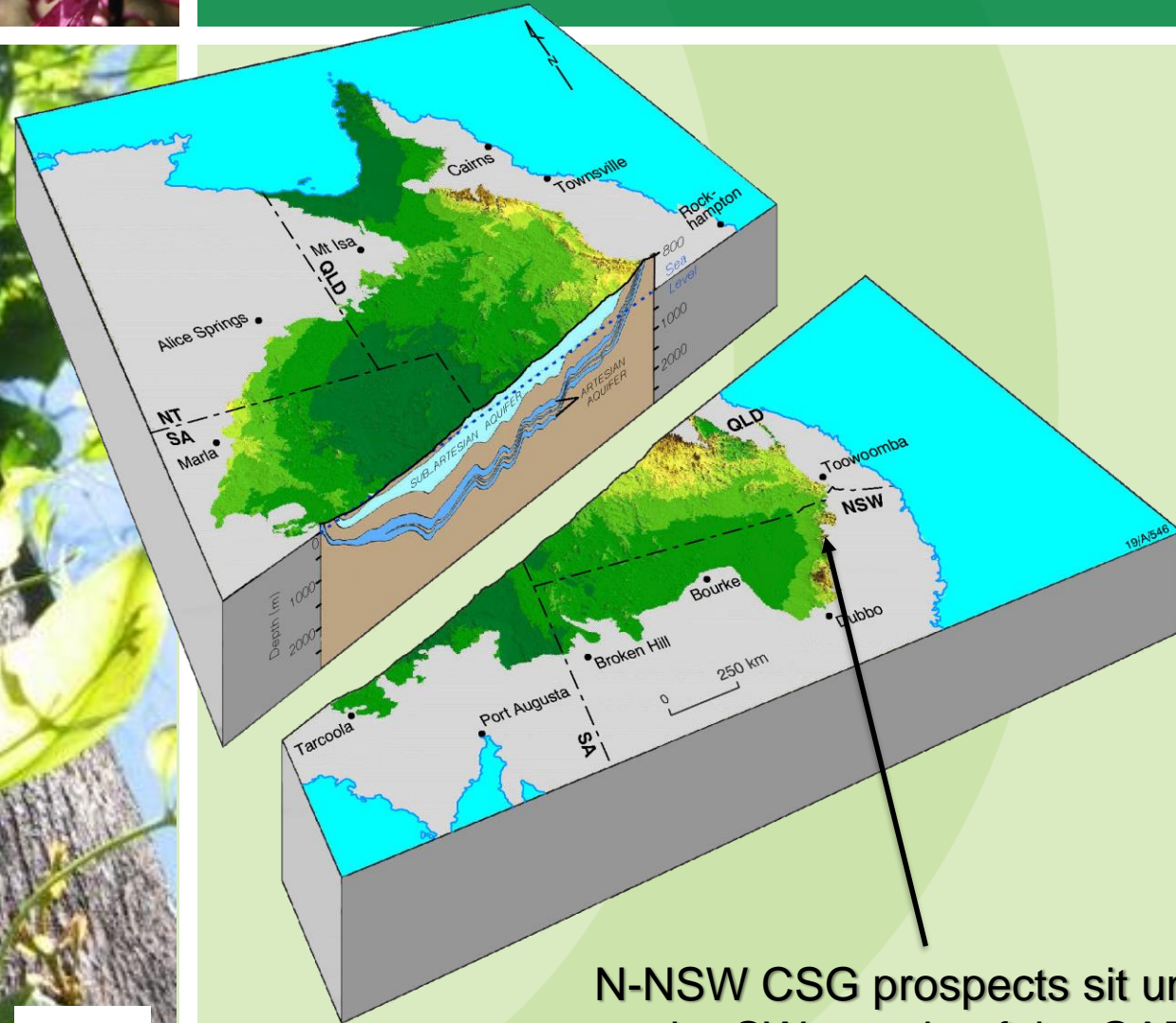
AN EXAMPLE FROM NORTHERN NEW SOUTH WALES, AUSTRALIA

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N° abstract - 1570

The Critical Resource: The Great Artesian Basin (GAB) Fast Facts 1 – geology

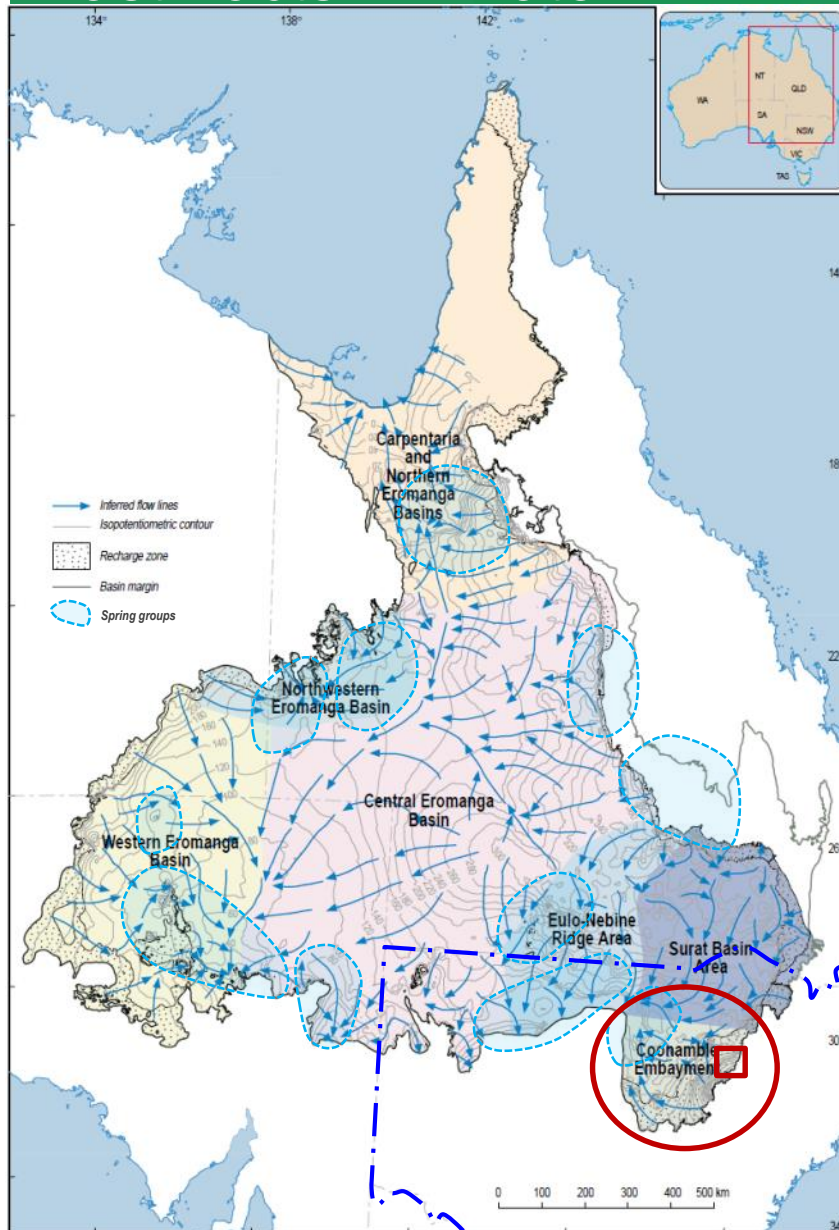


- Area = 1.7 million km² (1/5 of Australia – 207,000 km² in NSW)
- Multi-layered, wrinkled saucer, tilted to SW; uplifted to east; draped over older basins
- Sedimentary rock sequence forming artesian aquifer systems, up to 3,000m thick (up to 600m in NSW)
- 100-200 million year-old sandstone aquifers, confined by siltstones & mudstones (120-180 million years old in NSW)

N-NSW CSG prospects sit under the SW margin of the GAB

The Critical Resource: The Great Artesian Basin (GAB)

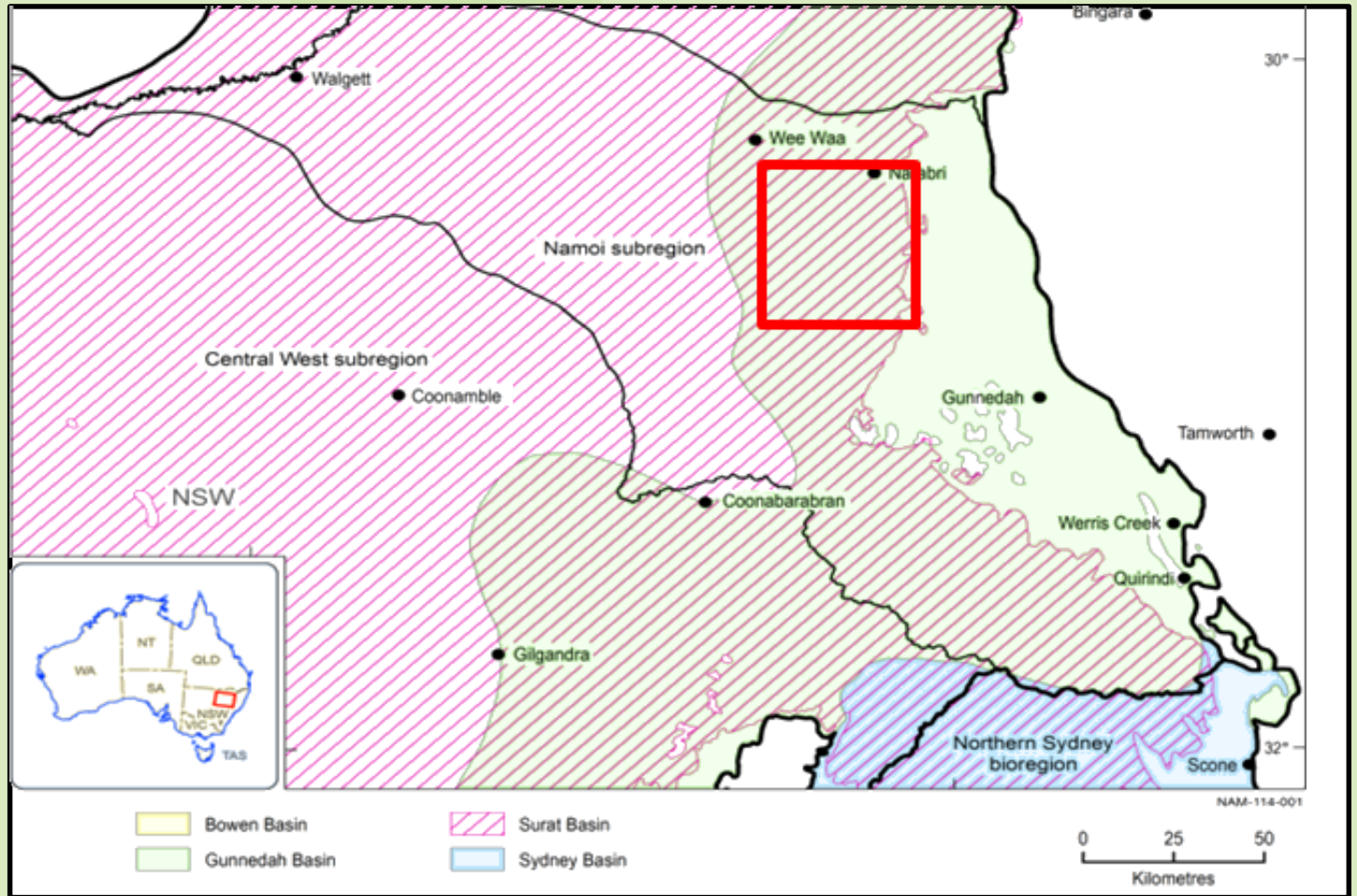
Fast Facts 2 – water



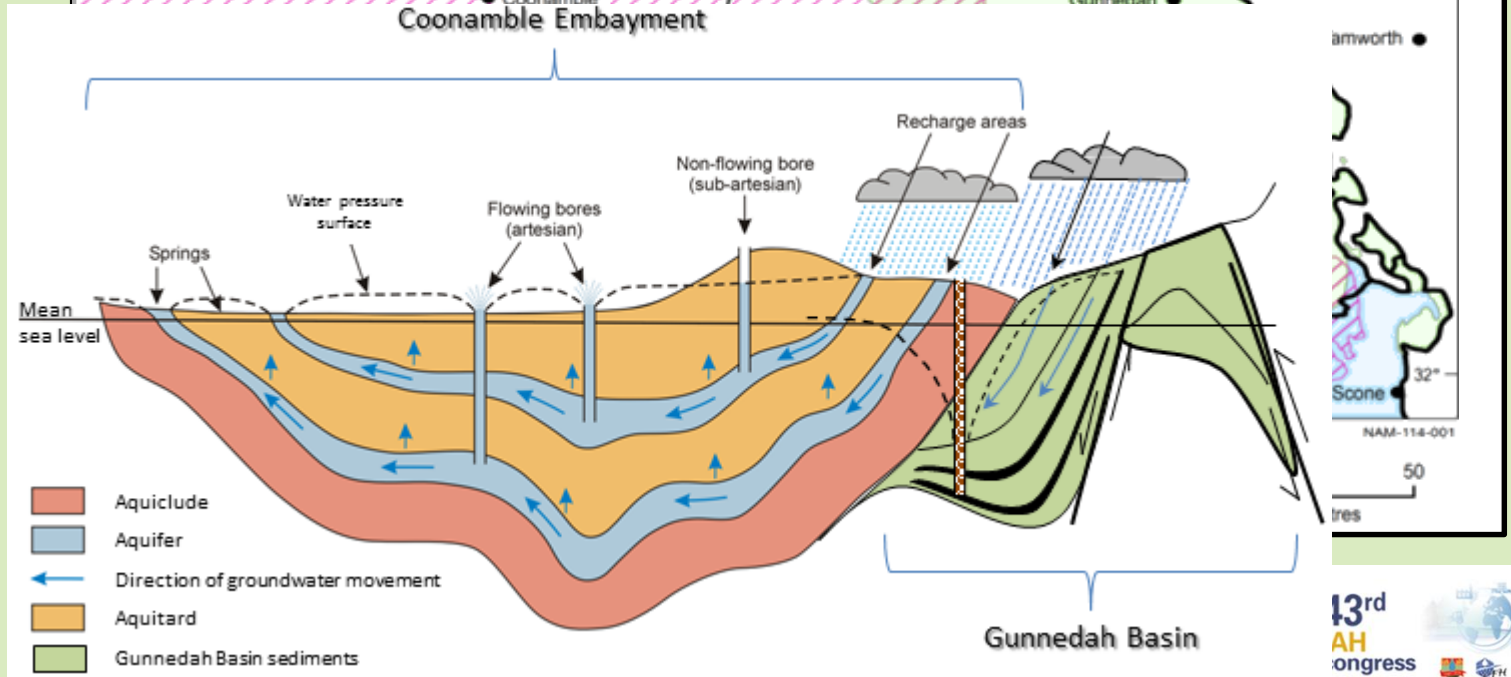
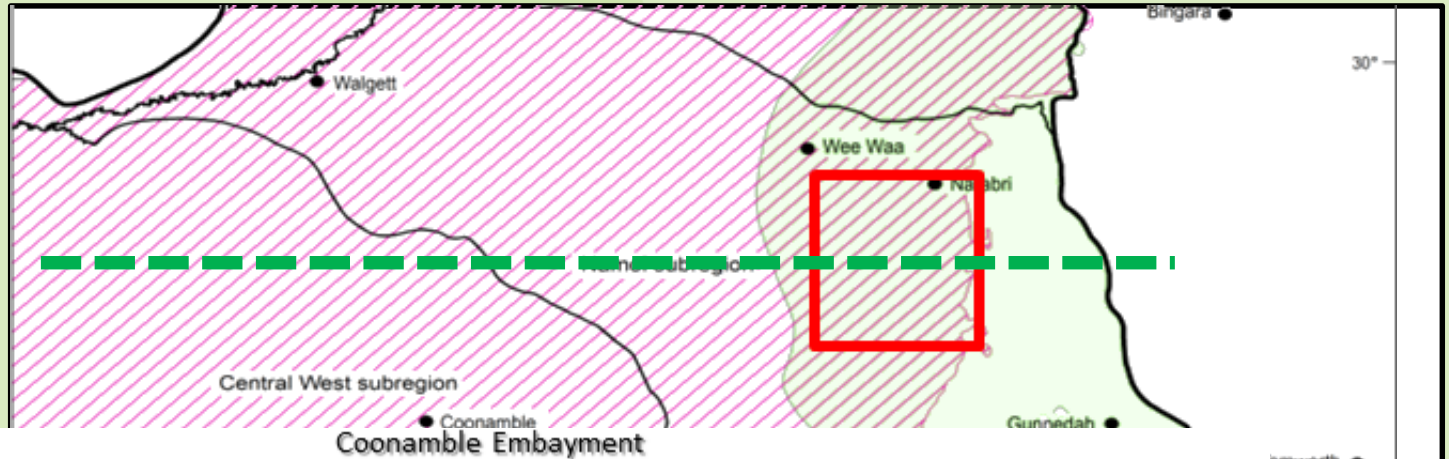
- 4 major and 3 minor groundwater basins (including the Coonamble sub-basin in NSW)
- Recharges about 1,000 GL/year along the Great Dividing Range (**84 GL/year to the Coonamble Embayment**)
- Stores about 8,700,000 GL of groundwater (about **500,000 GL in the Coonamble Embayment**)
- Discharges about 1,200 GL/year (**90 GL/year in the Coonamble Embayment** ~800 bores (85 GL/year); springs (0.2 GL/year) and upward leakage)



Study location: Northern NSW, Australia

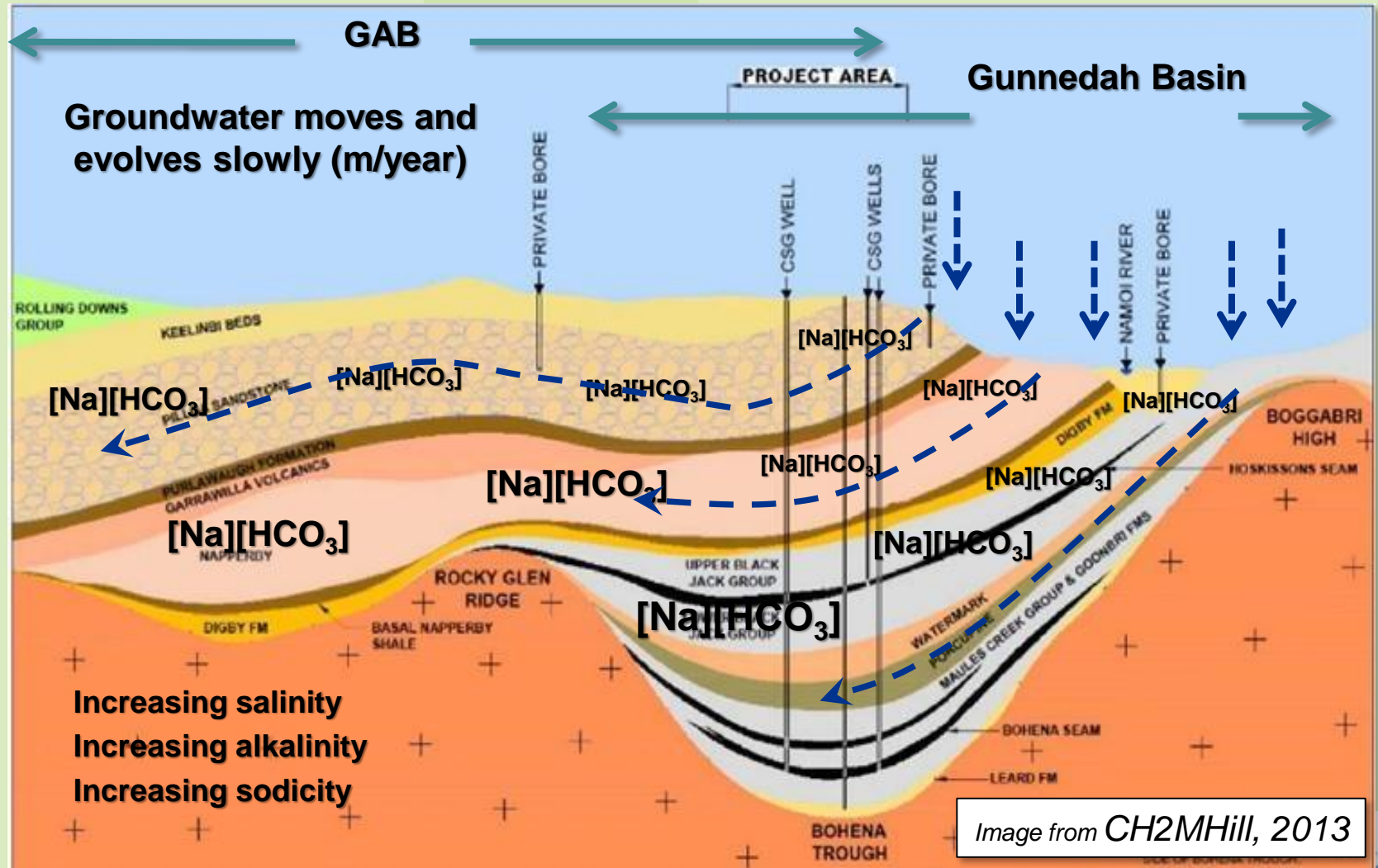


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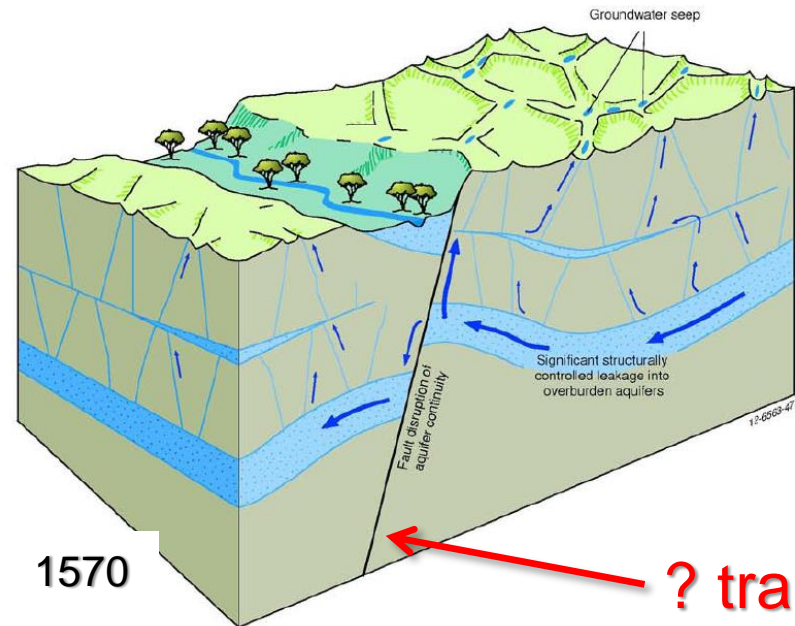
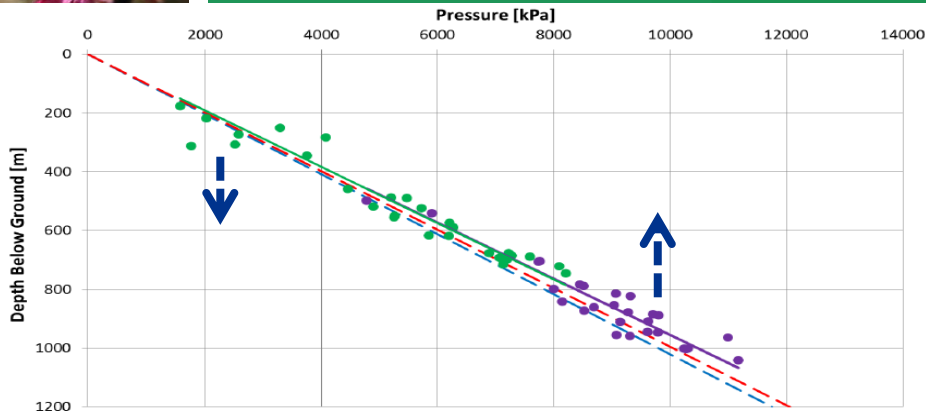


Can we use chemistry and isotopes to describe/understand groundwater transport processes in and around the region?

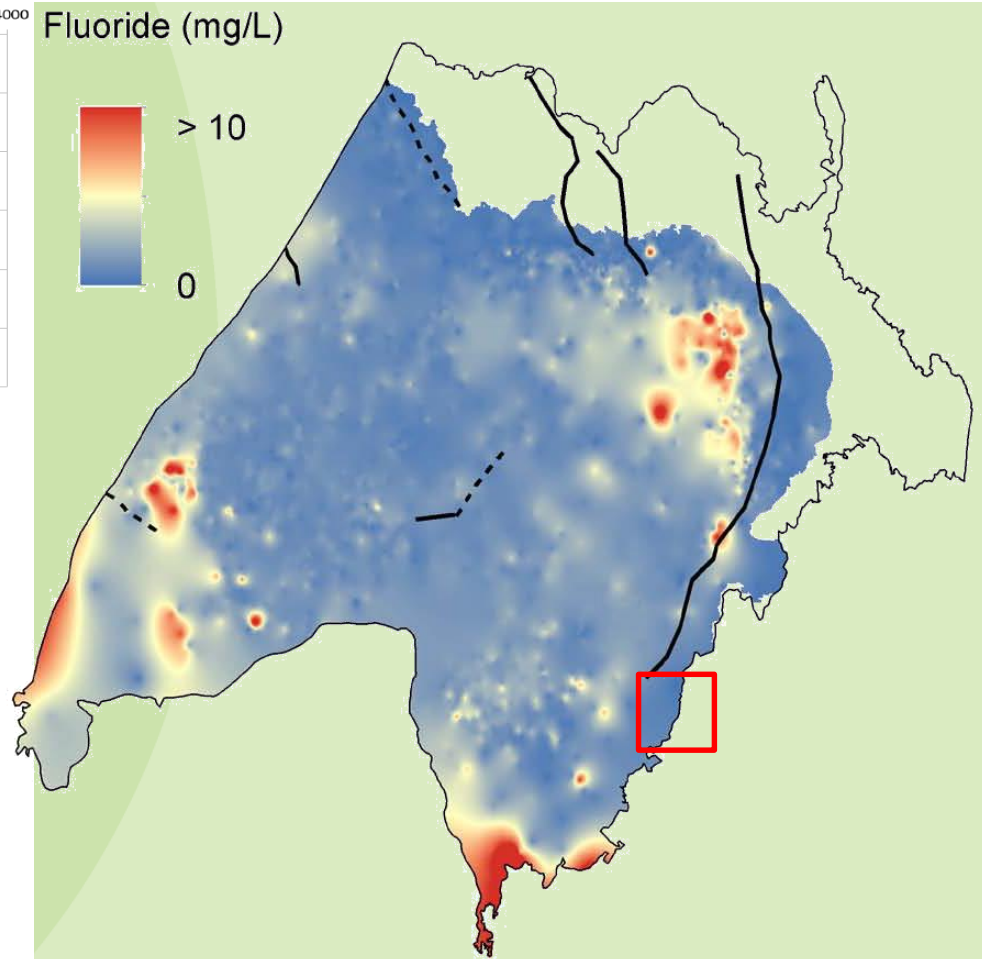




Can we identify preferred pathways/potential leakage using chemistry (and/or isotopes)?



? transmissive faults



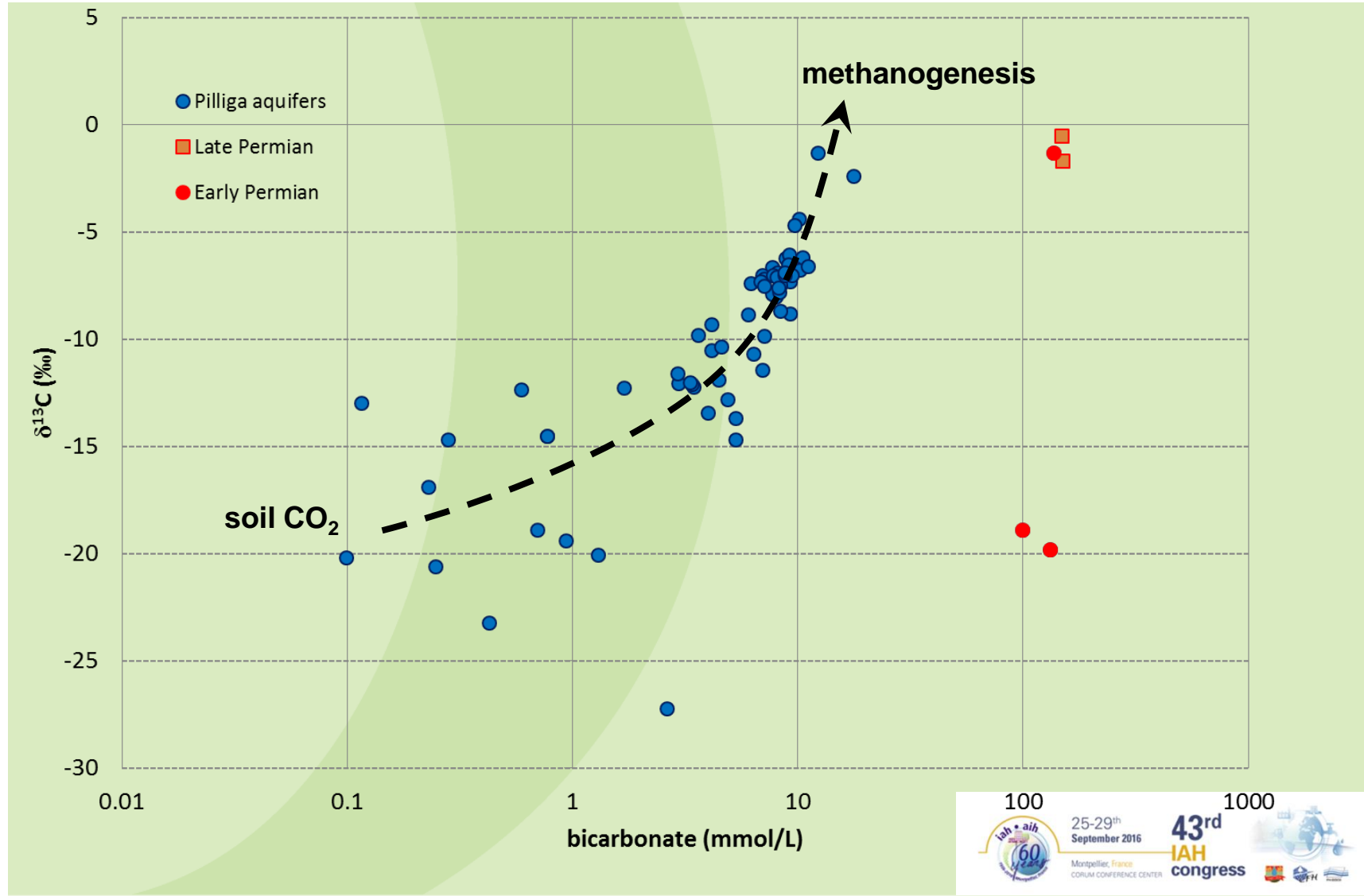


Can we identify and characterise the different groundwater sources, particularly the coal measures?

– water isotopes

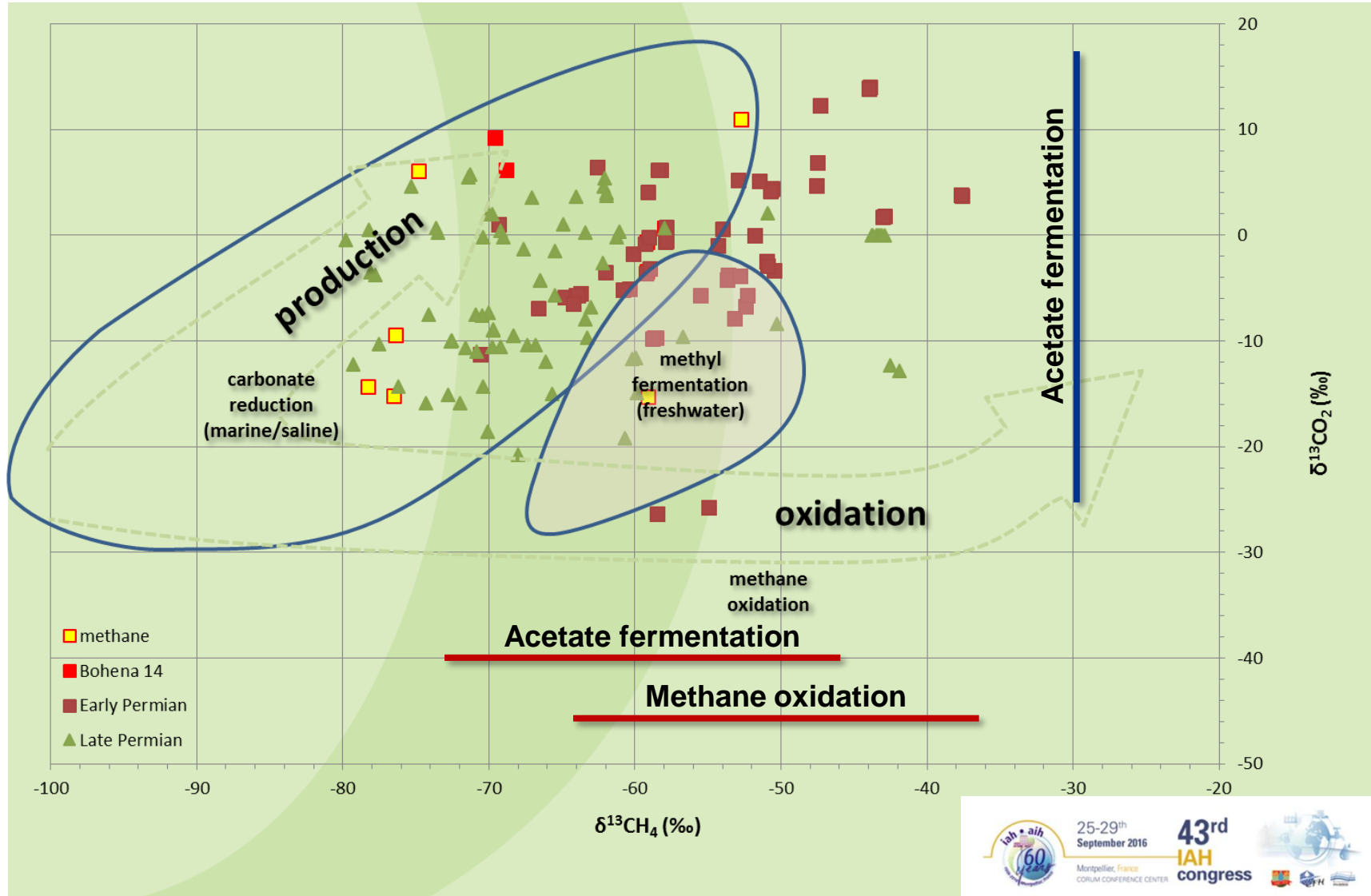


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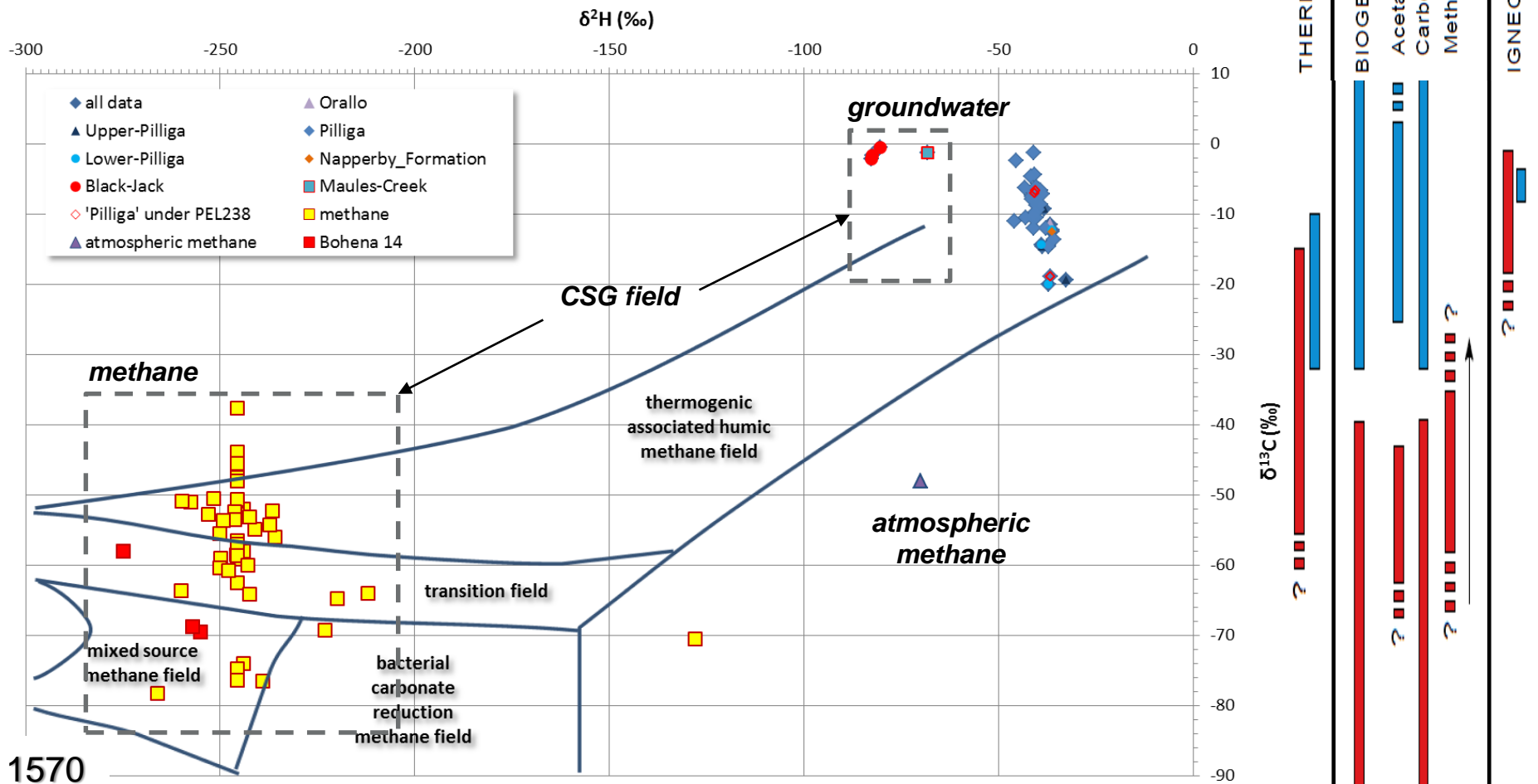




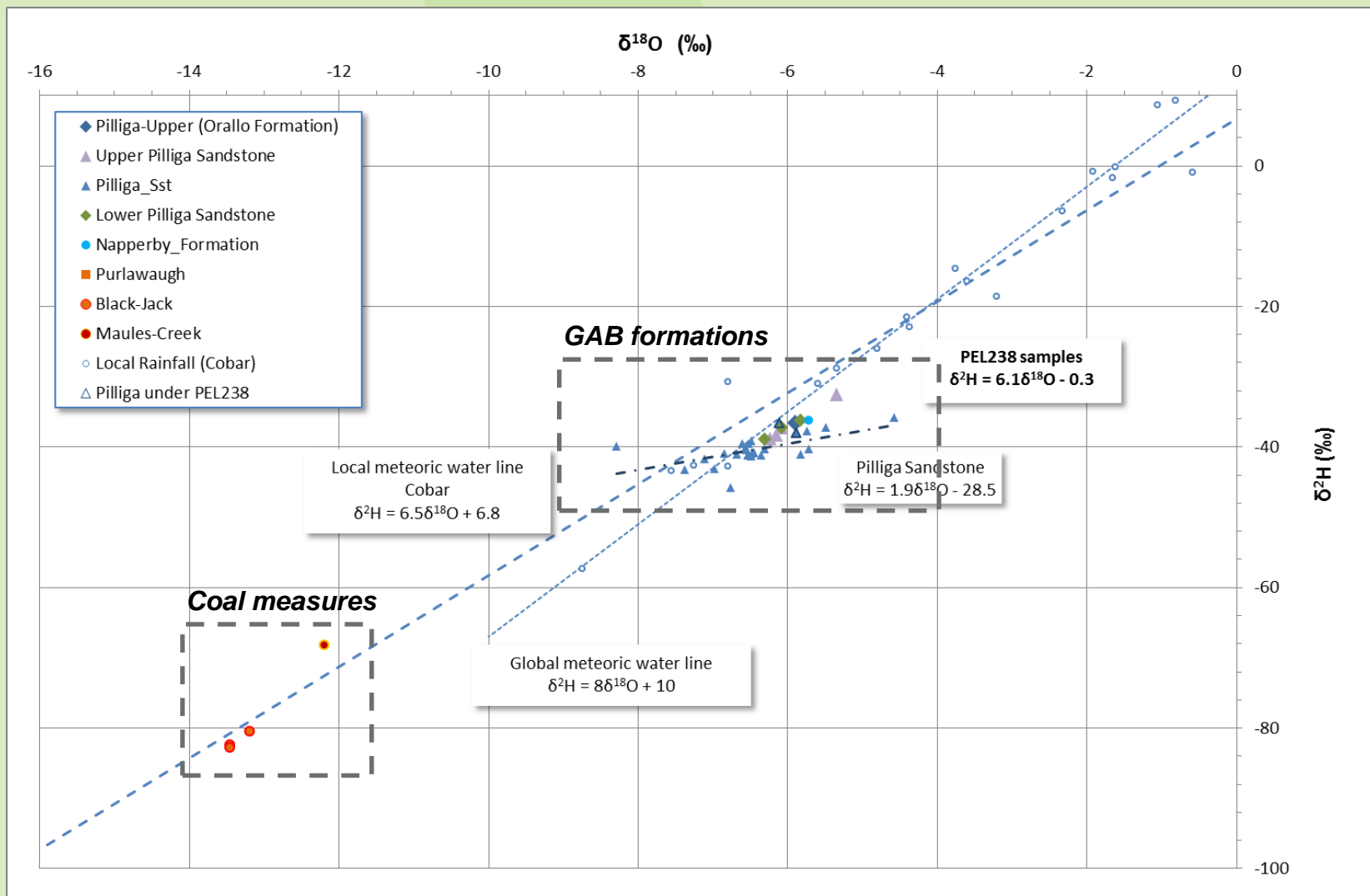
Can we identify and characterise the different groundwater sources, particularly the coal measures? – methane isotopes



Can we identify markers or tracers that allow us to determine any connectivity between the coal measures and overlying aquifers?



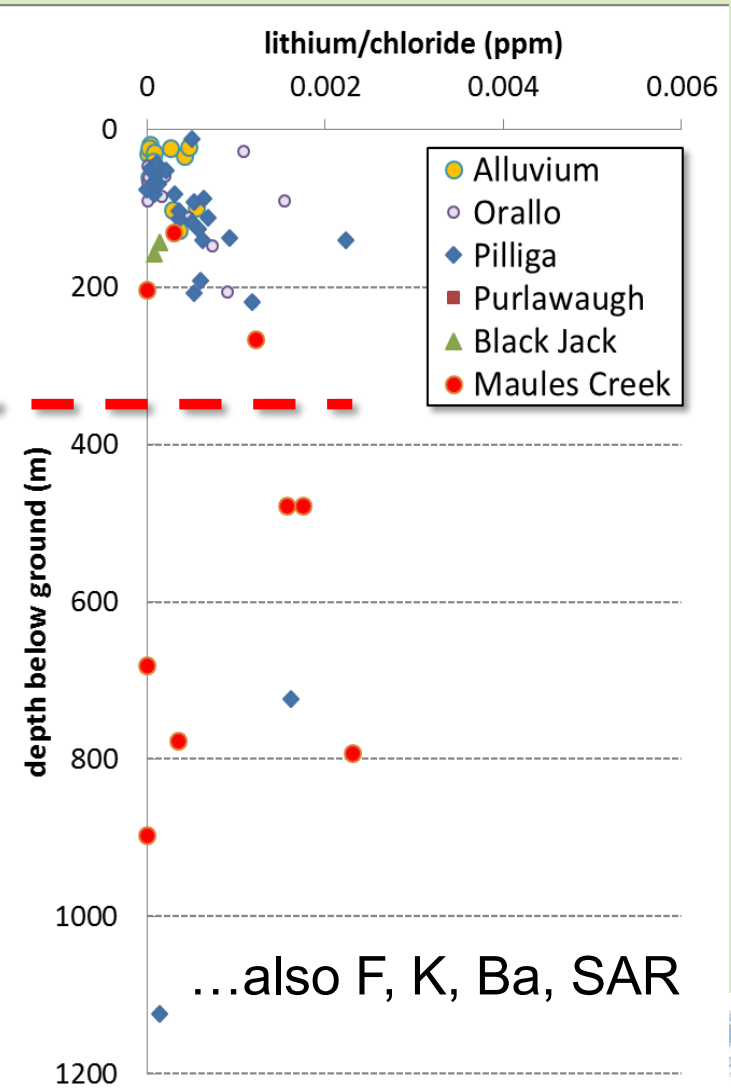
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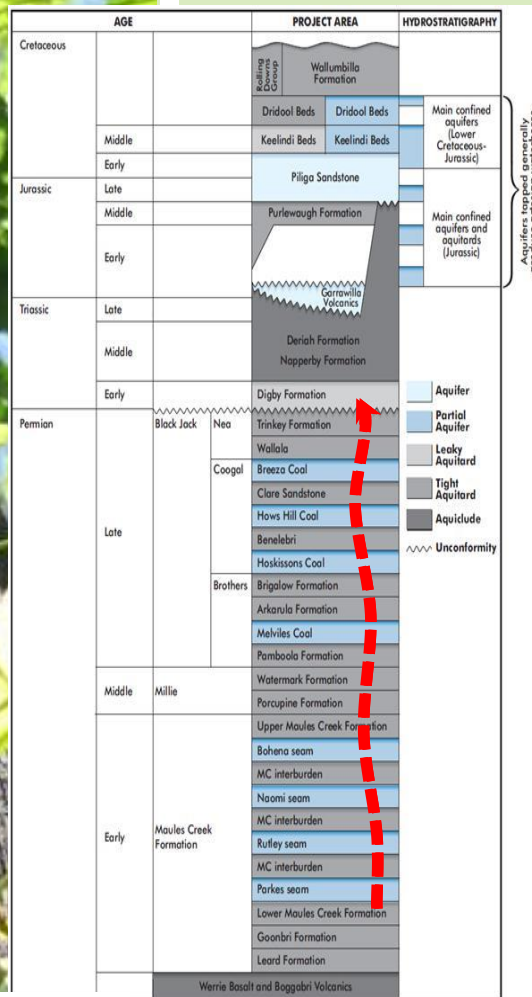
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AGE		PROJECT AREA		HYDROSTRATIGRAPHY	
Cretaceous		Rolling Vines Group	Wallumbilla Formation		Main confined aquifers (Lower Cretaceous-Jurassic)
	Middle		Dridoal Beds	Dridoal Beds	
	Early		Keelindi Beds	Keelindi Beds	
Jurassic	Late		Pilliga Sandstone		Main confined aquifers and aquitards (Jurassic)
	Middle		Purlawaugh Formation		
	Early		Garrawilla Volcanics		
Triassic	Late		Deriah Formation		Aquifer
	Middle		Napperby Formation		
	Early		Digby Formation		
Permian	Late	Black Jack	Nea	Trinkey Formation	Partial Aquifer
				Wallala	Leaky Aquitard
			Coogal	Breeza Coal	Tight Aquitard
				Clare Sandstone	Aquiclude
				Hows Hill Coal	
				Benelebri	
				Hoskissons Coal	Unconformity
			Brothers	Brigalow Formation	
				Arkanula Formation	
				Melvilles Coal	
	Middle	Millie	Watermark Formation		
	Early		Maules Creek Formation	Upper Maules Creek Formation	
				Bohena seam	
				MC interburden	
				Naomi seam	
			MC interburden		
			Rutley seam		
			MC interburden		
			Parkes seam		
		Lower Maules Creek Formation			
		Goonbri Formation			
		Leard Formation			
		Werrie Basalt and Boggabri Volcanics			

Aquifers tapped generally produce artesian waterbores



Conclusions: Separating aquifers above CSG



- Similar, natural, carbonate and silicate reactive processes occur in all groundwaters and result in:
 - generally increasing salinity with distance and depth
 - decreasing chloride to bicarbonate ratio with distance along groundwater flow paths, and
 - a significant increase in the sodium adsorption ratio
 - BUT at different rates.
- Despite a strong upward hydraulic pressure gradient, there is **no evidence** that deeper (Coal Measures) groundwaters are impacting on the shallower aquifers above the Gunnedah Basin.
 - Strong isotopic separation and no trace element transfer from the Coal Measures
 - the local signatures for the Pilliga Sandstone does not indicate an influence from deeper groundwaters.
 - methane is detected in a few shallow samples, but these are not related to CSG activity
- Isotopes and minor elements provide good tracers of groundwater movement through and between aquifers**



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