



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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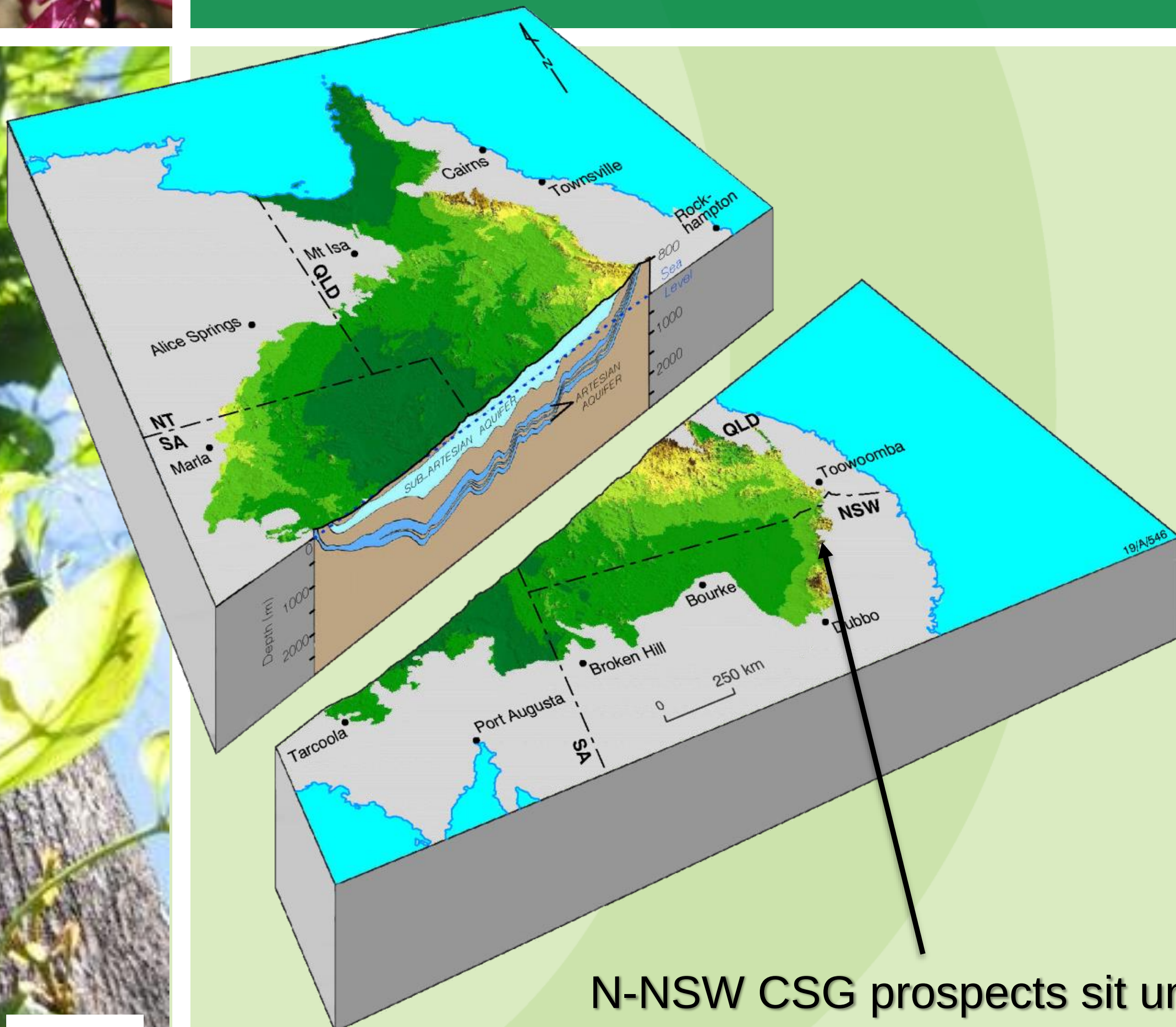
N° abstract - 1570

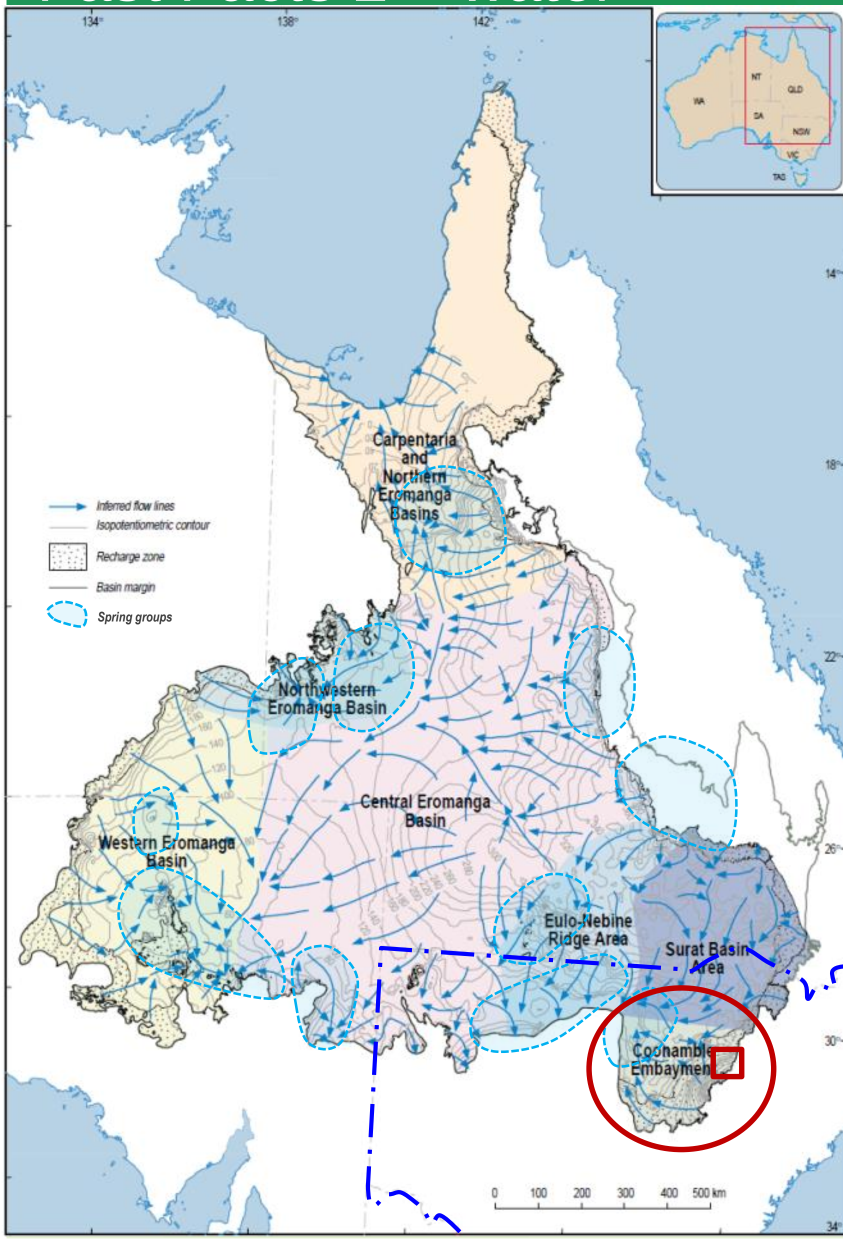
The Critical Resource: The Great Artesian Basin (GAB) Fast Facts 1 – geology



- Area = 1.7 million km^2 (*1/5 of Australia – 207,000 km^2 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*)

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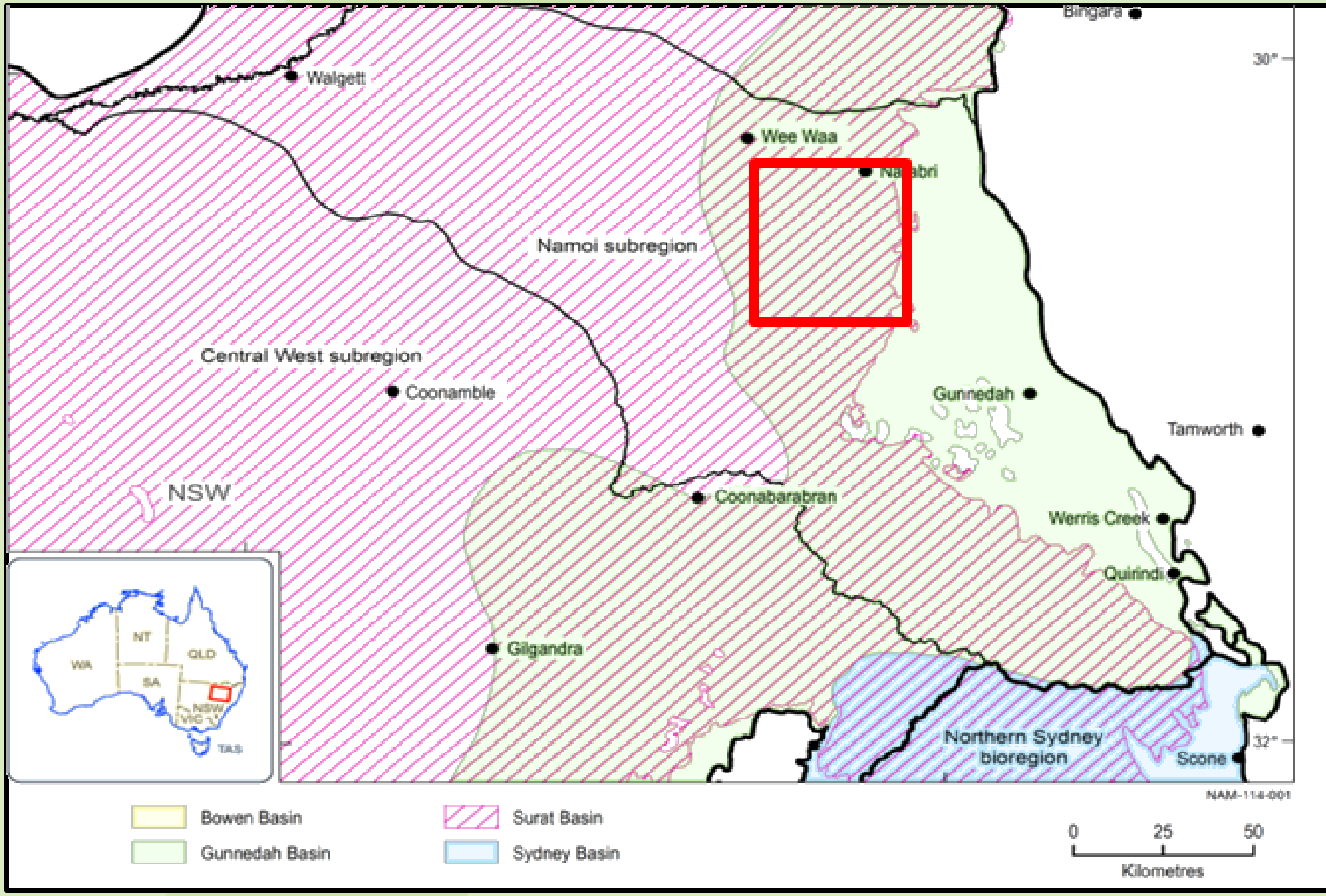
Study location: Northern NSW, Australia



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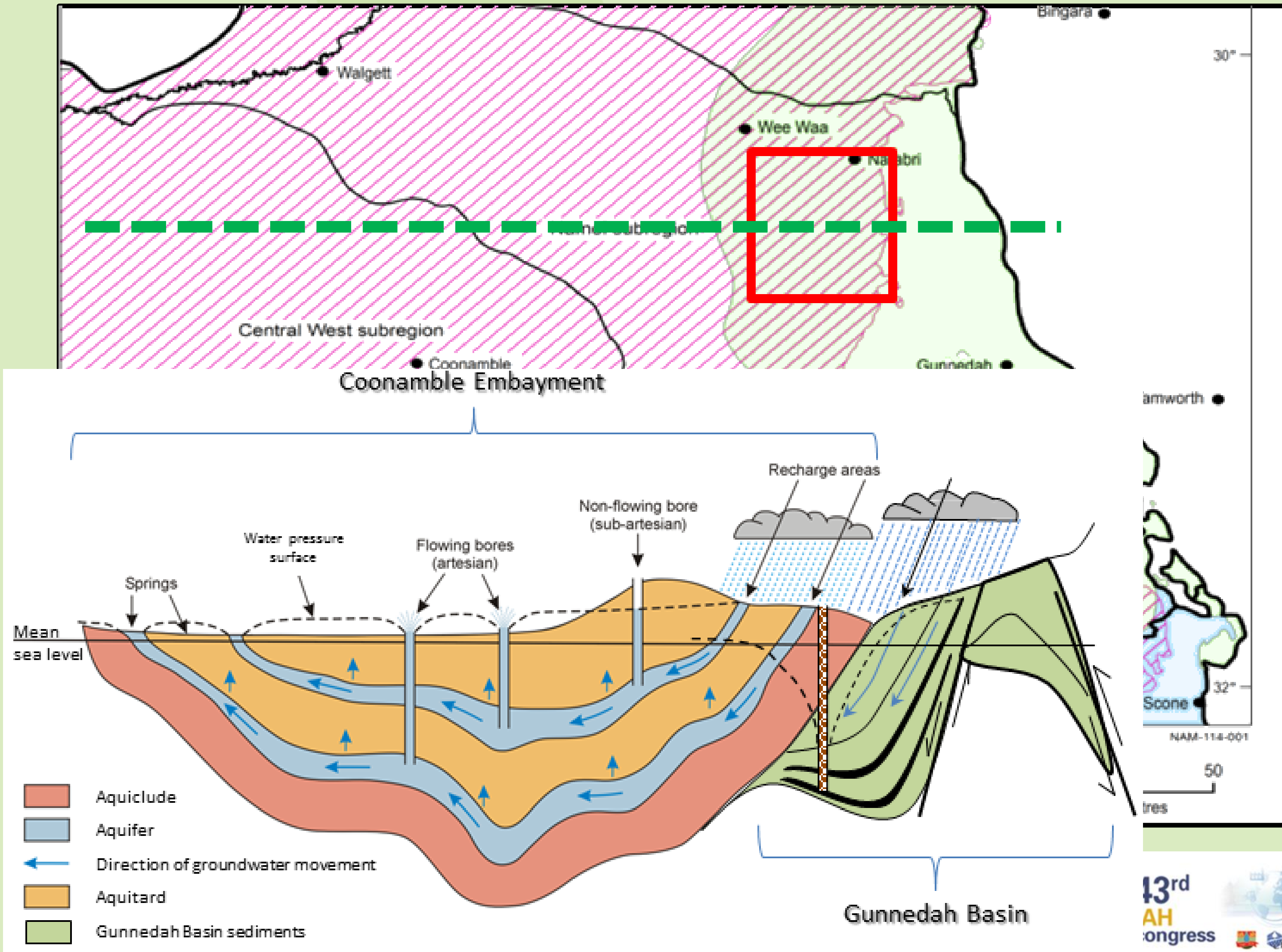
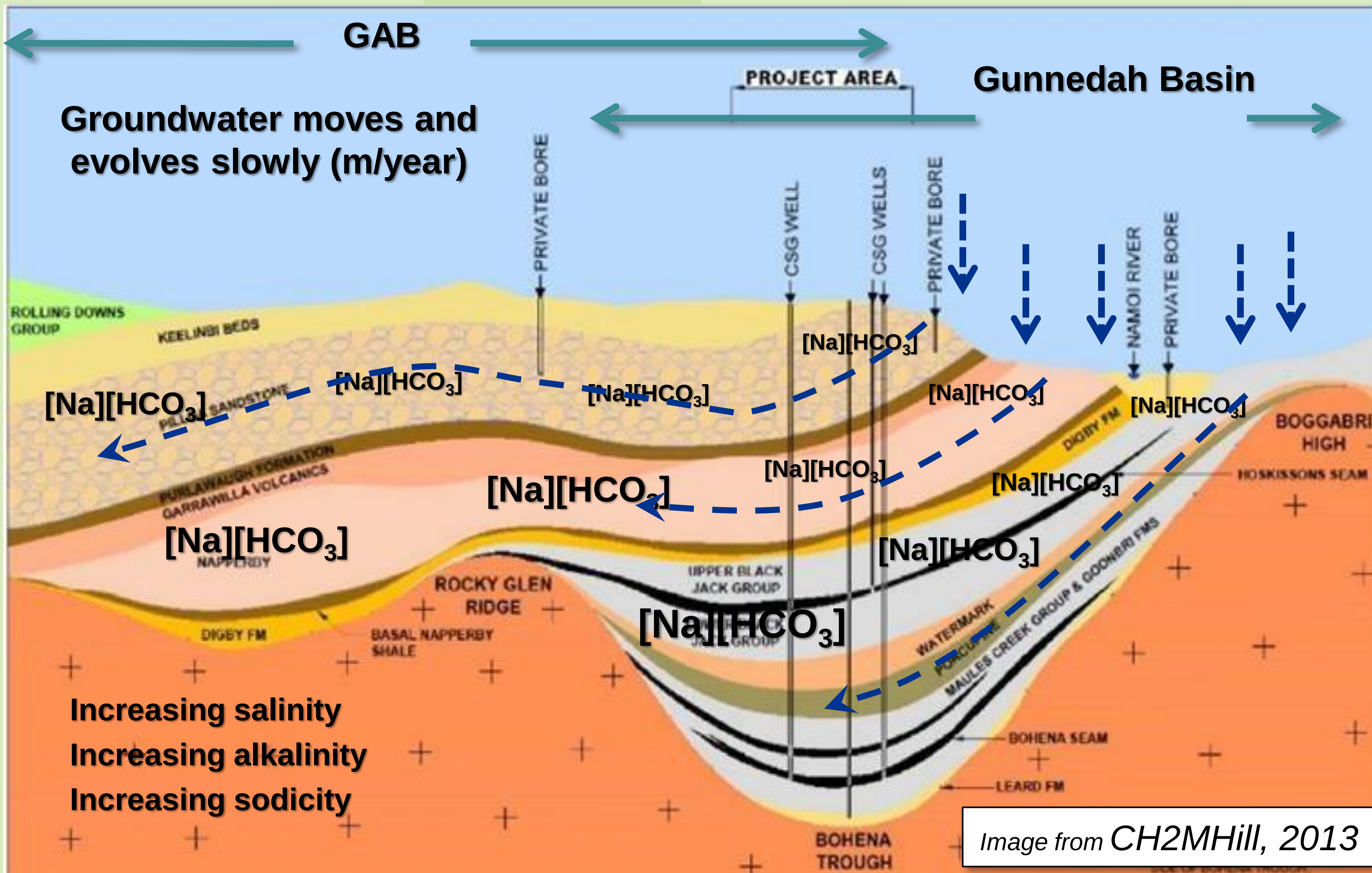
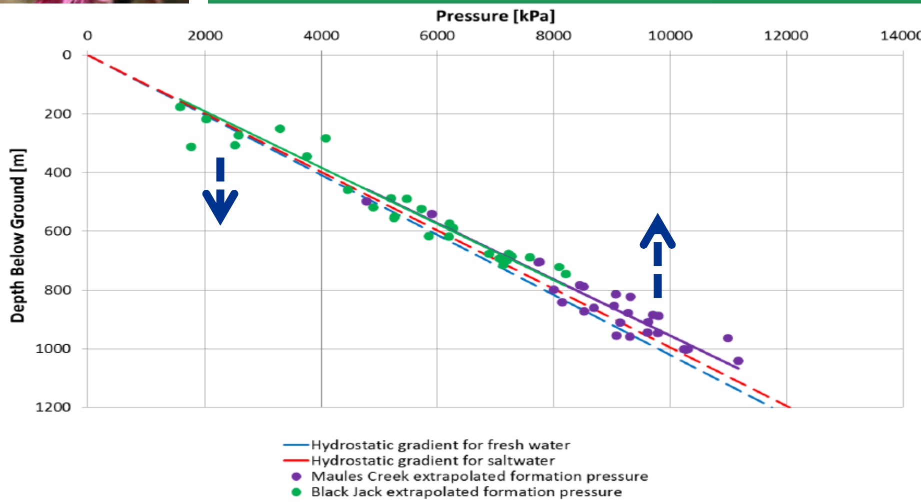
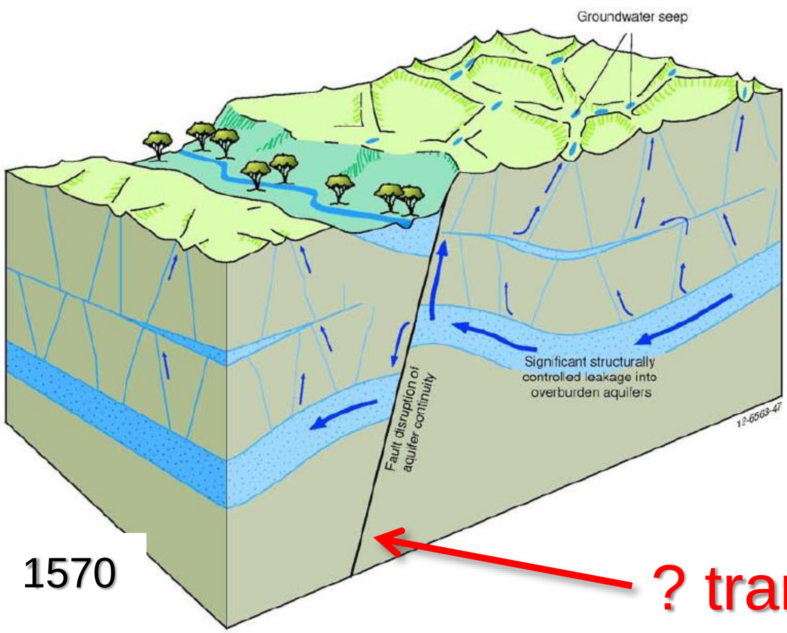


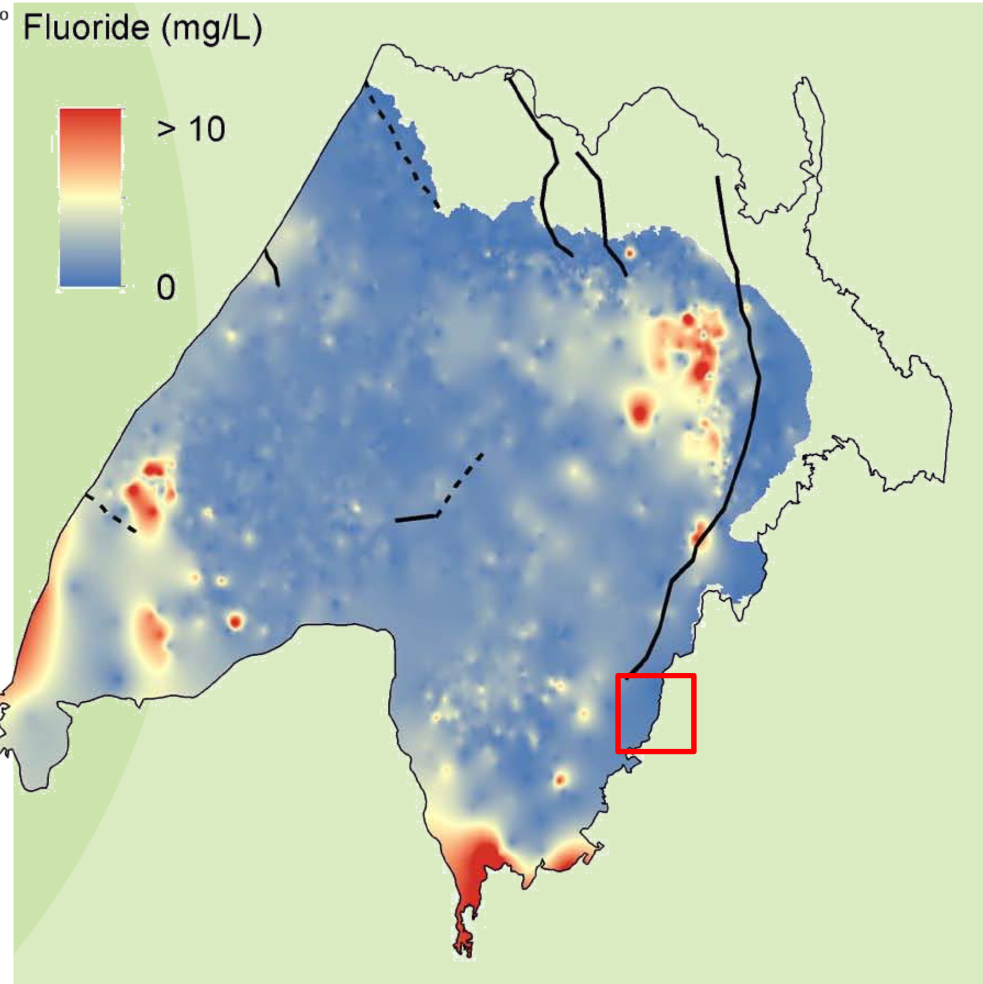
Can we use chemistry and isotopes to describe/understand groundwater transport processes in and around the region?



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







Images from *CSIRO, 2012*

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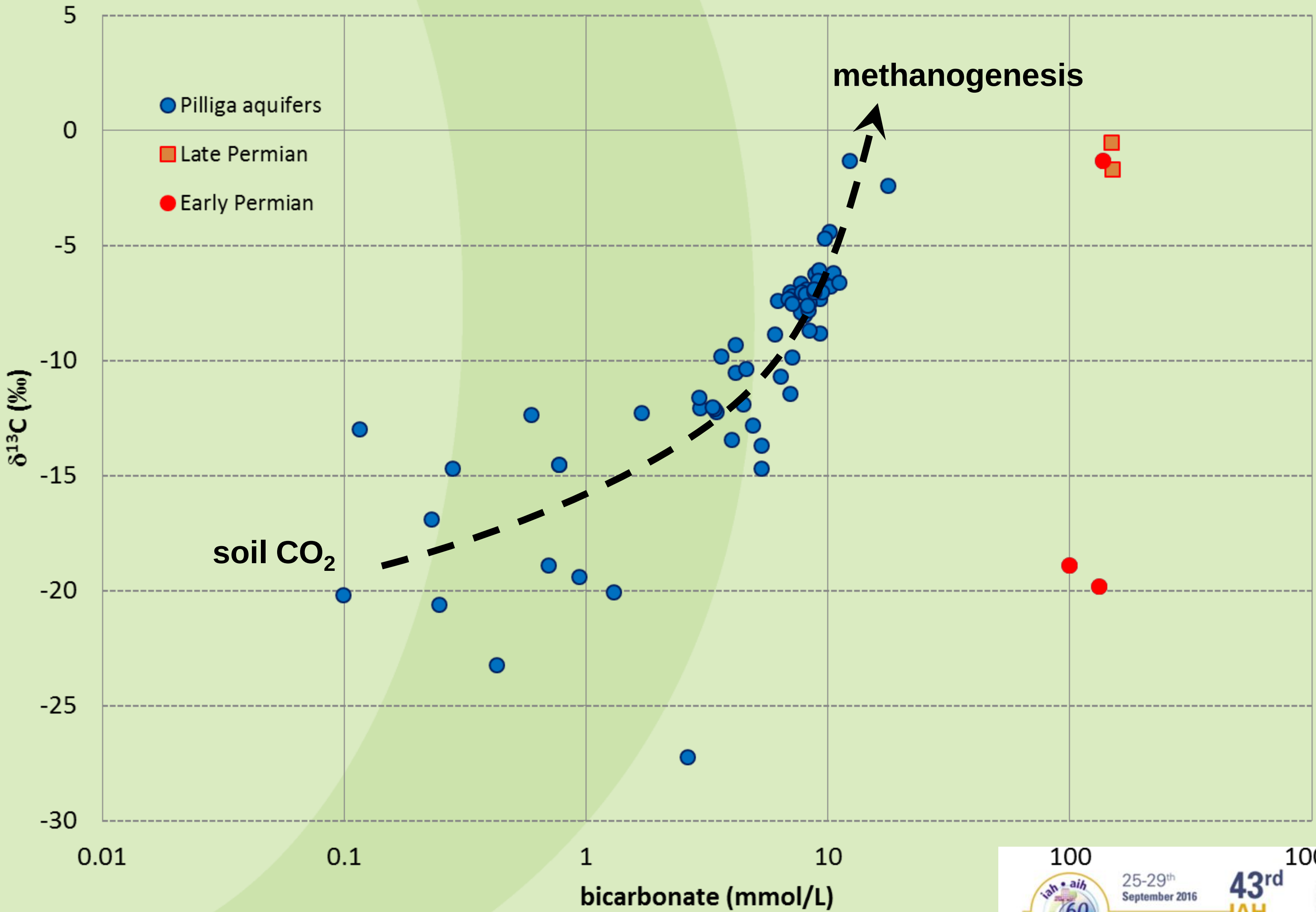
? transmissive faults

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



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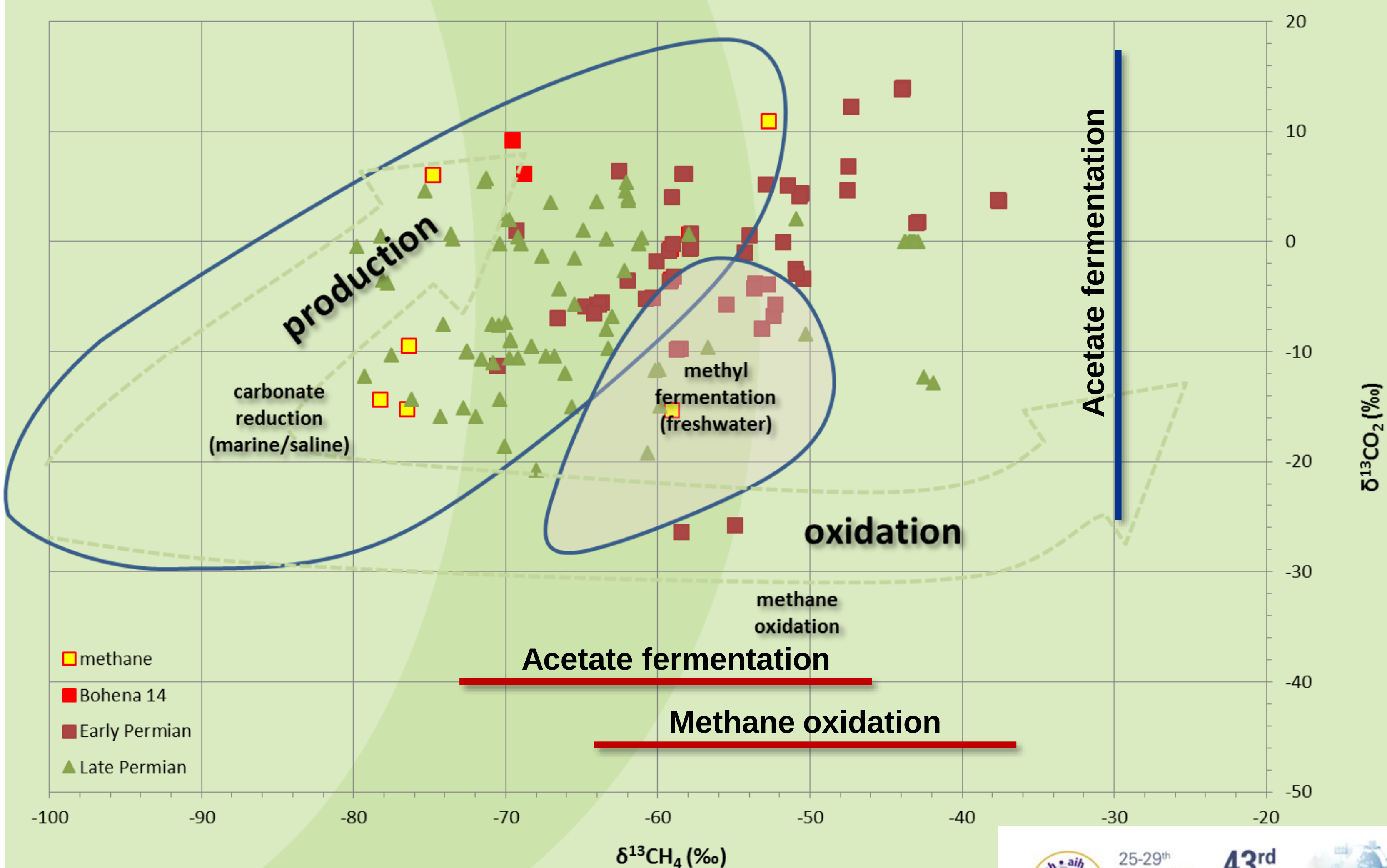
Can we identify and characterise the different groundwater sources, particularly the coal measures? – methane isotopes



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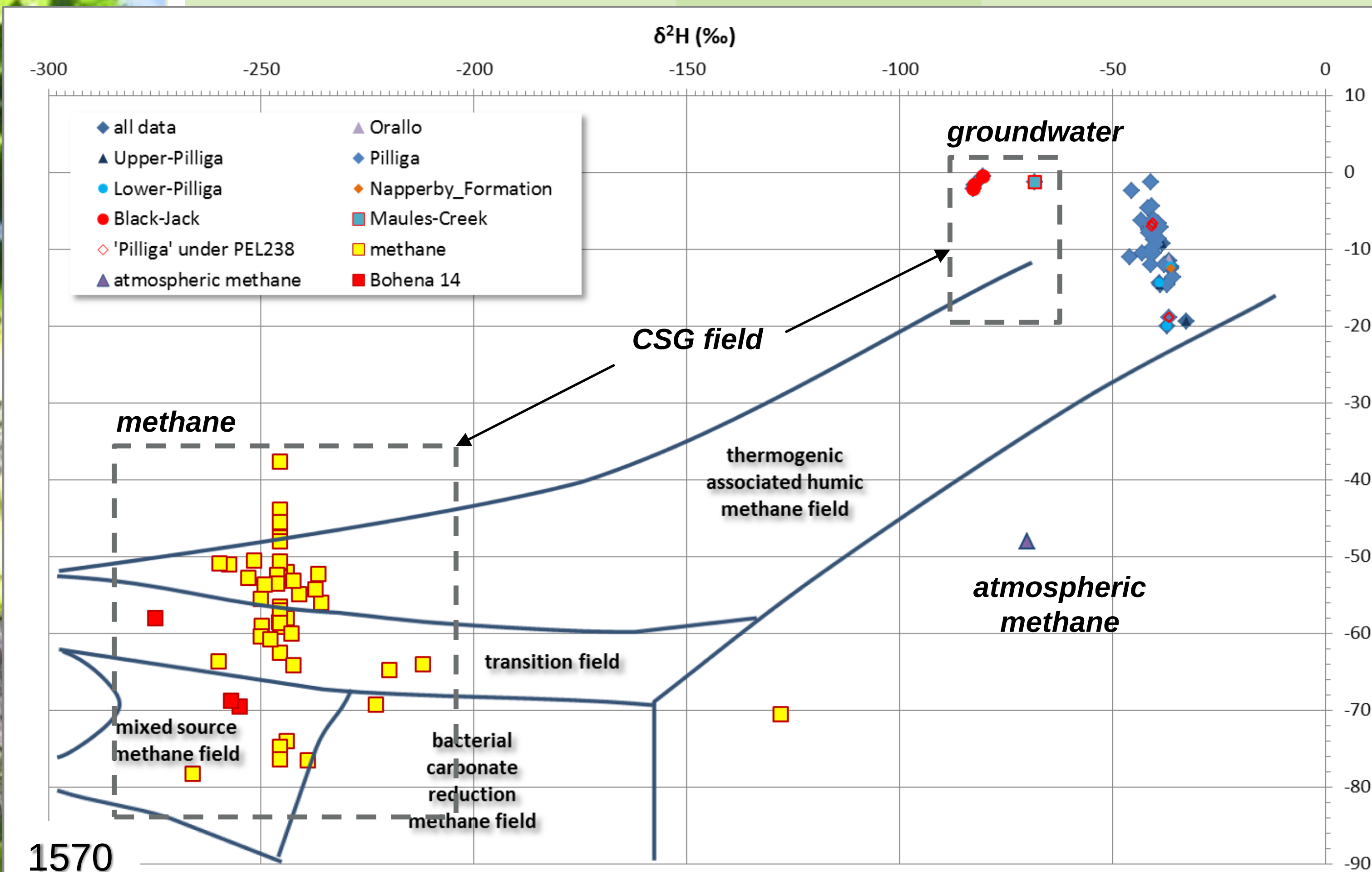
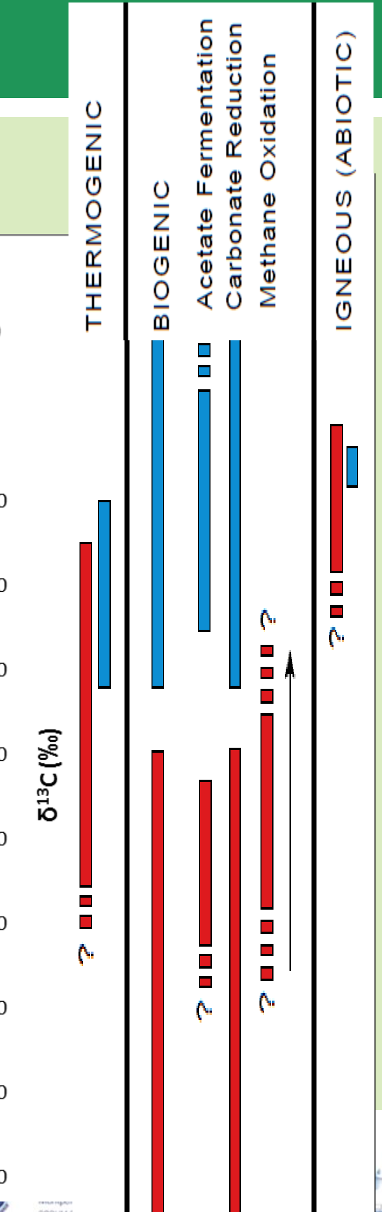
Can we identify markers or tracers that allow us to determine any connectivity between the coal measures and overlying aquifers?





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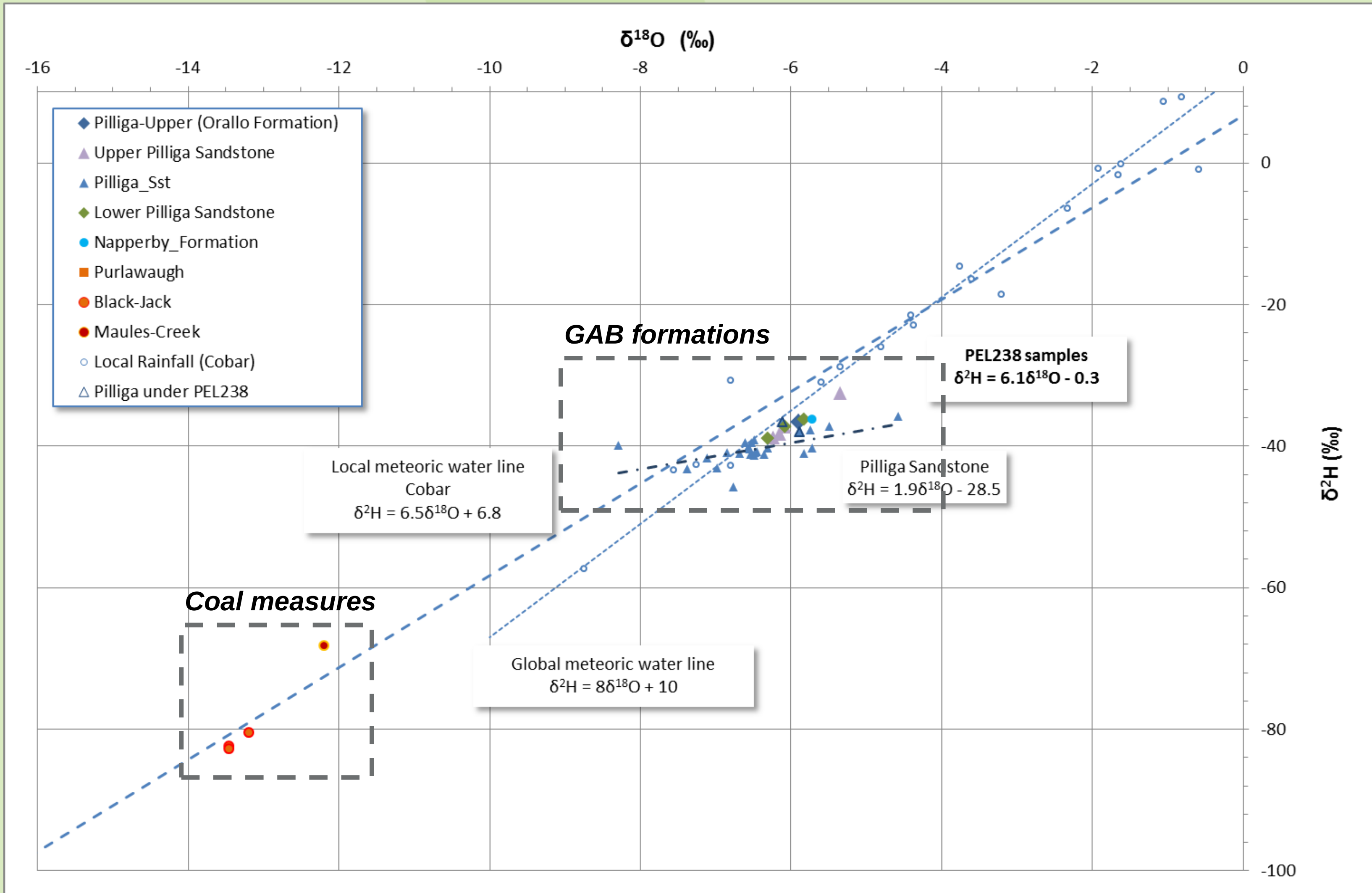
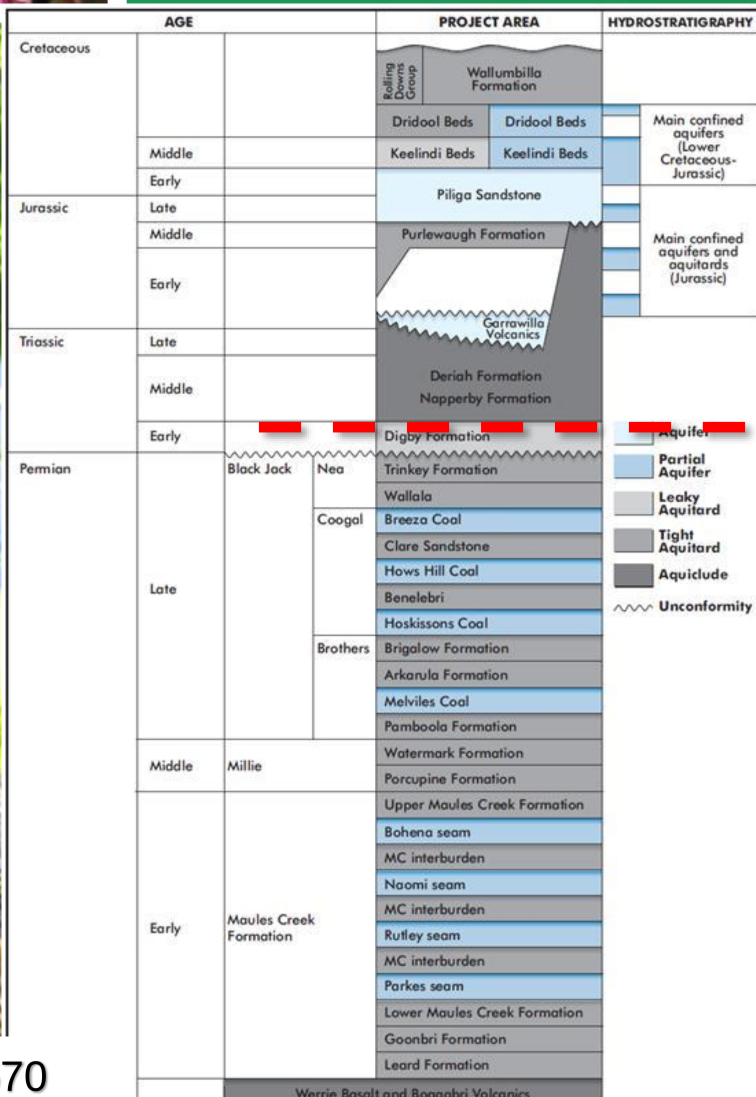
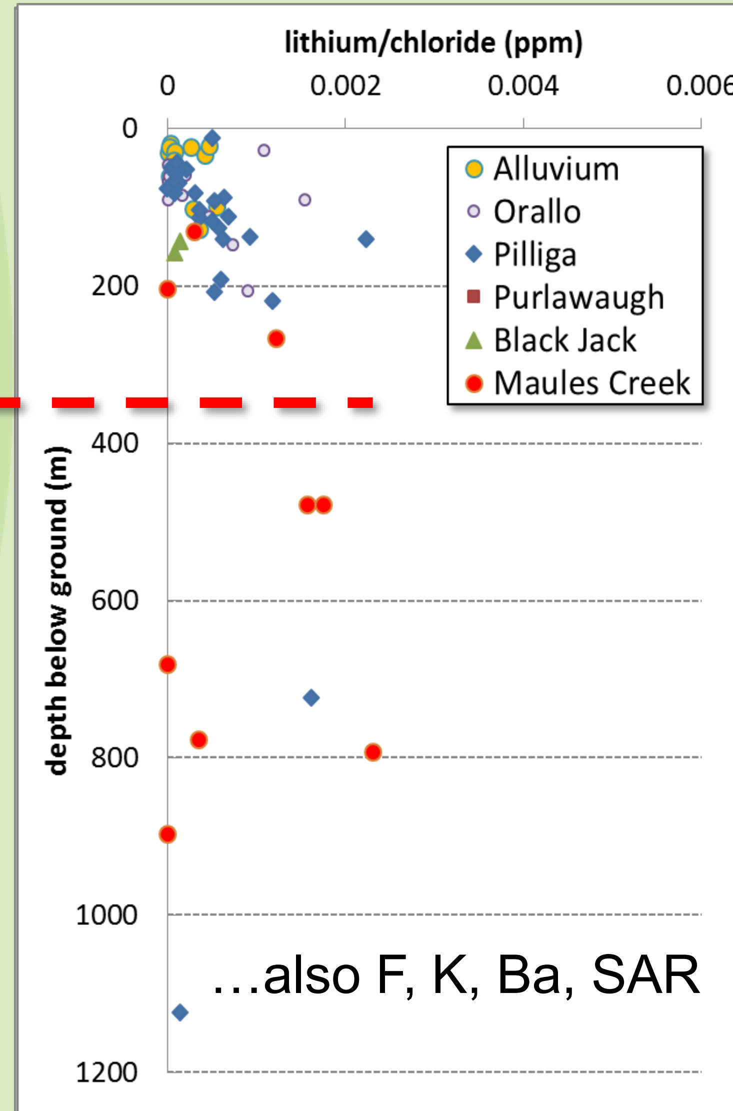
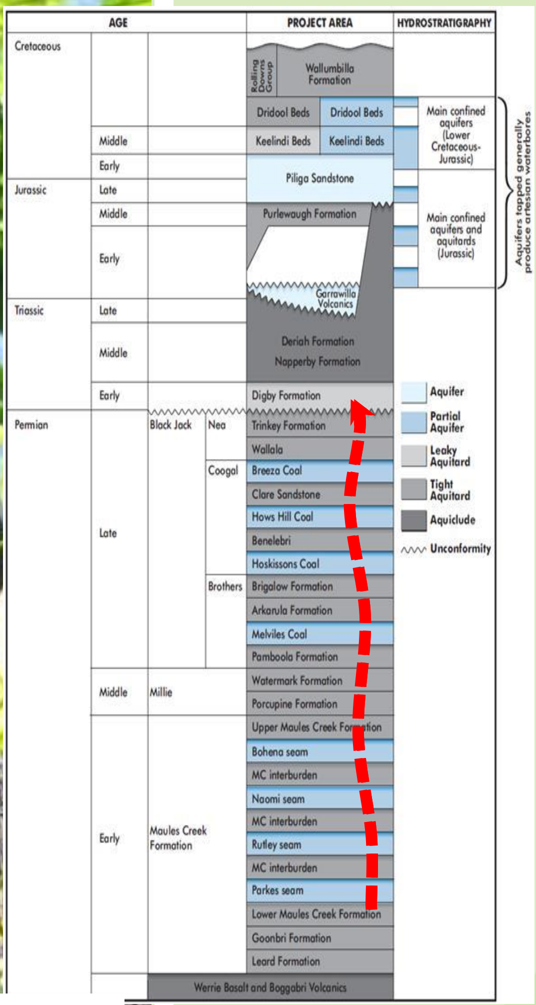


Can we identify markers or tracers that allow us to determine any connectivity between the coal measures and overlying aquifers?





Conclusions: Separating aquifers above CSG



- Similar, natural, carbonate and silicate reactive processes occur in <u>all</u> 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
  - ➢ <u>BUT</u> 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 fro the Coal Measures
  - ➢ the local signatures for the Pilliga Sandstone does not indicate an influence from deeper groundwaters.
  - ➢ methane <u>is</u> detected in a few shallow samples, but these are <u>not related</u> to CSG activity
- **Isotopes and minor elements provide good tracers of groundwater movement through and between aquifers**

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