THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

UQ and Onshore Natural Gas in QLD

Research Aiming to Improve our Forecasting of CSG Cumulative Impacts on Groundwater

Australian Water Association: Sydney breakfast meeting: June 23, 2015
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Chair Petroleum Hydrogeology, Centre for CSG

Disclosure

- The UQ, Centre of Coal Seam Gas is currently funded by the University of Queensland 20% ($5 million) and the Industry members 80% ($20 million) over 5 years.

- The Centre is developing leading research capability through the appointment of Professorial Chairs in
  1. Geosciences
  2. Petroleum Engineering
  3. Water
  4. Social Performance

- For more information about the Centre's activities and governance see… http://www.ccsg.uq.edu.au/

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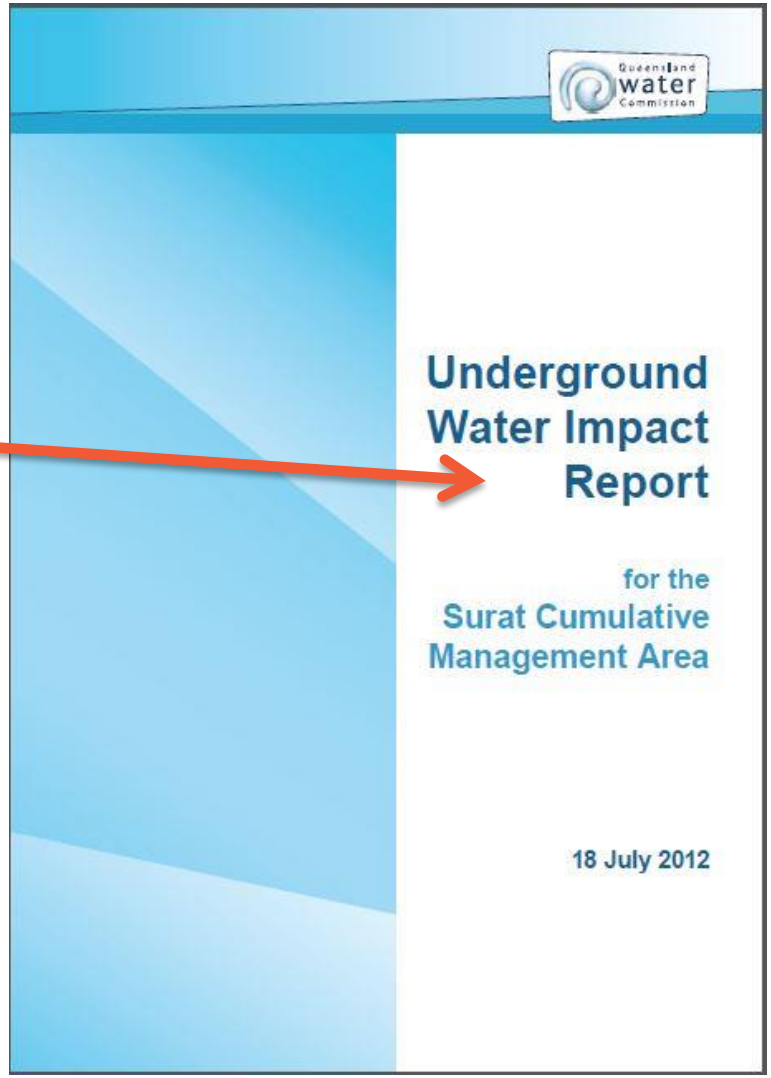
This presentation has not been independently peer reviewed and is not intended for wider publication.

CSG – Aquifer Interaction

The Office of Groundwater Impact Assessment (OGIA):

Established under the *Water Act 2000 and funded by an industry levy.*

- maps of predicted water level impacts



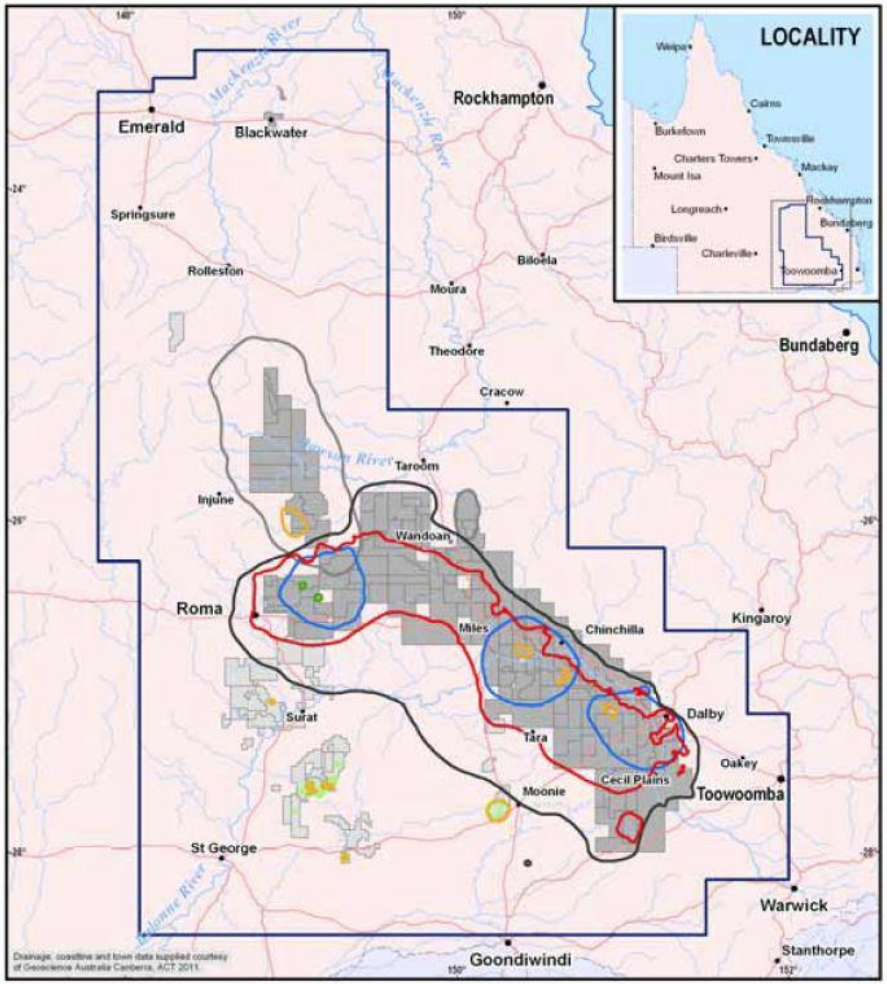
CSG – Aquifer Interaction

Underground Water Impact Report for the Surat Cumulative Management Area (OGIA, 2012): Long Term Affected Areas

Key Aquifers & CSG Reservoirs

- Gabberamunda Sandstone
- Springbok Sandstone
- Walloons Coal Measures
- Hutton Sandstone
- Precipice Sandstone
- Clematis/Showgrounds Sandstone
- Bandanna Formation

How can we help reduce uncertainty in model forecast?



CCSG Recharge Estimation Project – Multi-Scale Approach

1. Regional Scale Methods

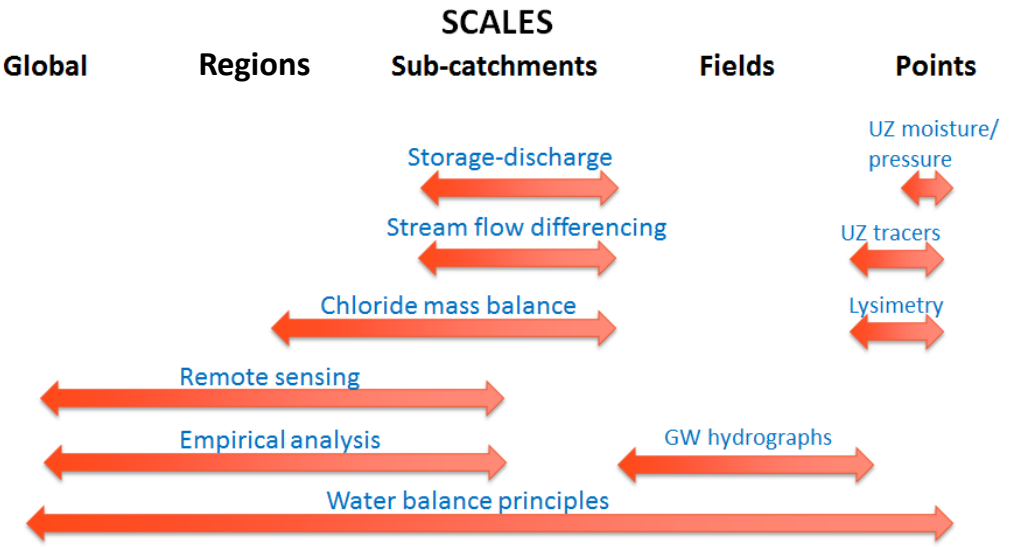
- Water balance using remotely sensed data
- Deep drainage estimates from modelling

2. Catchment Scale Methods

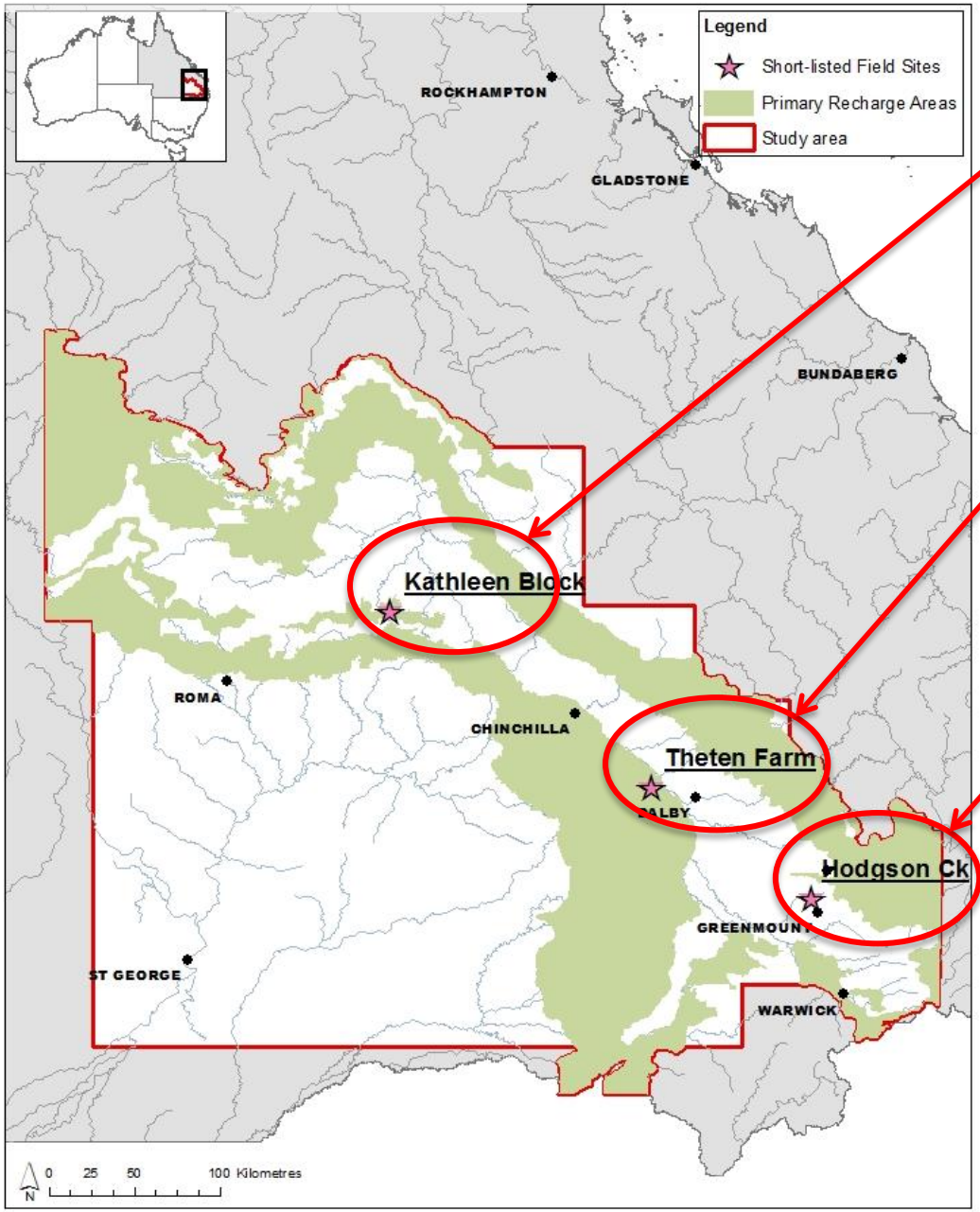
- Recharge estimation based on surface water flow data

3. Point/Field Scale Methods

- Water balance monitoring
- Process based modelling
- Groundwater hydrograph analyses, soil moisture, evapotranspiration and tracers



Short Listed Sites



Recharge to the Gubbermunda Formation: Catchment Scale natural systems

Recharge to the Condamine Alluvium above the Kumbarilla Beds and the Walloon Coal Measures: Field-Point Scale modified systems

Recharge to the Walloon Coal Measures through the Main Range Volcanics

It is likely that both diffuse recharge and focussed recharge are occurring at each site (but field measurements are required to confirm this)

Recharge Project Objectives

- To provide new evidence about recharge (vadose zone) processes and rates at selected priority recharge sites
- To regionalise this information to similar sites in the Surat
- To produce new broad-scale recharge estimates by merging estimation methods including remote sensing based methods
- To make recommendations for refinements to the recharge inputs used in the OGIA groundwater impacts assessment model

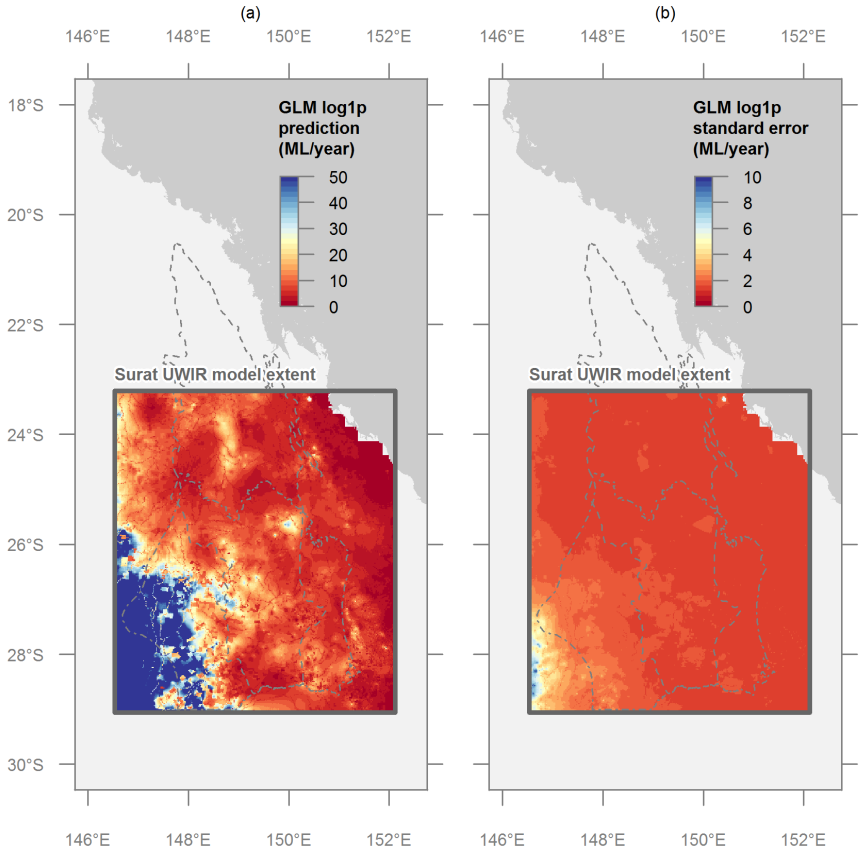
Estimation of non-CSG Groundwater Uses: Results so far

Phase 1: six month feasibility study

- Datasets collated
- Various estimation techniques were trialled

Main findings:

- Primary data are limited, but secondary datasets are of suitable quality for estimation
- Statistical methods have advantages over previous estimation methods in quantifying prediction error
- Techniques most likely to be useful are Generalised Linear Modelling methods or Kriging with External Drift methods



Estimation of non-CSG Groundwater Uses: Results so far

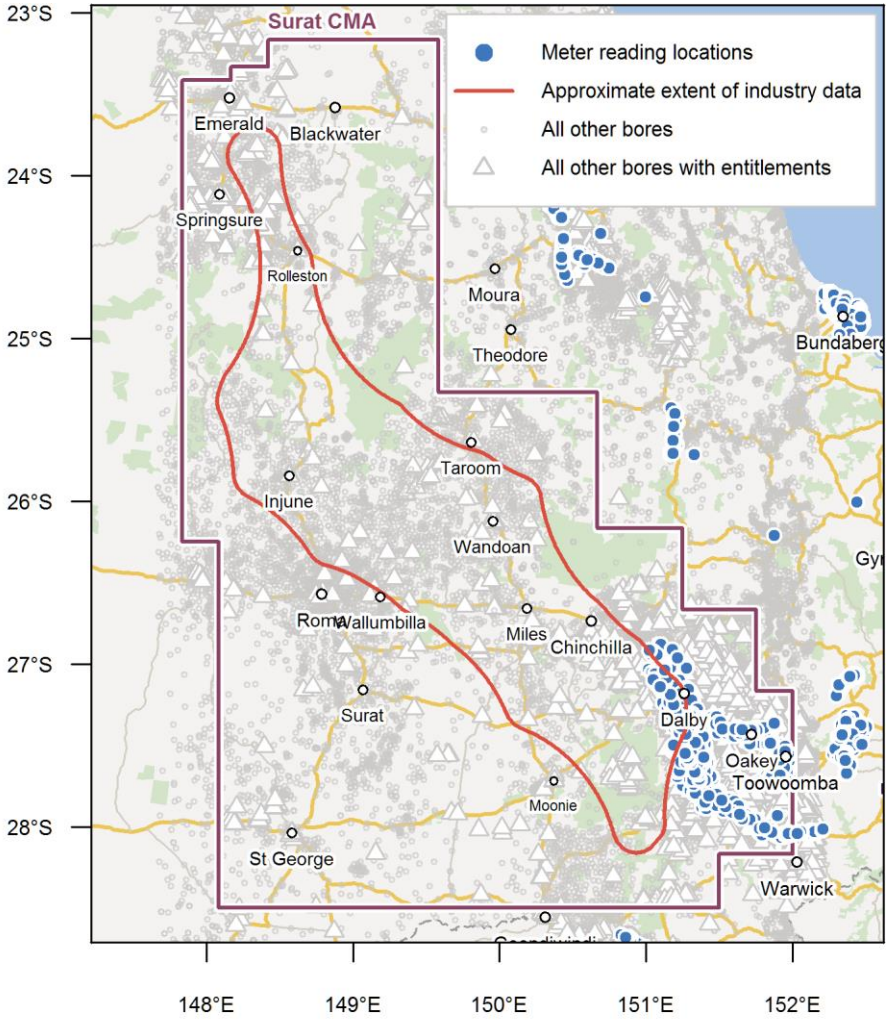
Unfortunately not a lot of metered data for calibrating and validating the models:

- Mainly in the Condamine
- Mainly for irrigation
- What about outside the Condamine?
- What about Stock and Domestic?
- What about large corporate users?

Where should we focus our data collection?

- Review has found Hutton, Gubberamunda are strongest candidates for data collection:
  - not well metered
  - high apparent groundwater use
  - fair representation in baseline assessment datasets
  - fairly geographically extensive

- Want to balance:
  - good coverage in areas close to production wells
  - distributed across the Surat CMA



Metering options

Factors to consider

- ease of installation
- liability considerations interfering with bores)
- portable (clamp-on) ultrasonic flow metering is a good option
  - Good accuracy (provided full flowing pipe)
  - Low cost option – telemetry not required, can be left unattended for months / years depending on sampling frequency

Fugitive Methane Motivation:

- Concerns of “fugitive” methane in water and air
- Concerns of climate impacts
- Production won’t be 100% efficient
- What is the baseline?
- We can learn about the sealing strata

http://www.miningaustralia.com.au/news/no-conclusion-yet-for-condamine-river-csg-seepage

Year	Location	No. of Samples	Methane Range [ppm]
1983	Giligulgul (Wandoan)	258	2.5 - 48
1987	Chinchilla	58	1.2 - 25.5
1988	St George	314	1.9 - 89.1
	Bungil (South of Roma)	322	0.1 - 48.7
1989	Kalima (near Roma)	158	1.7 - 14.8
	Chinchilla	150	1.7 - 22.1
1991	Glenmorgan	534	8.09 - 42.45

Gas Fields Commission, Queensland

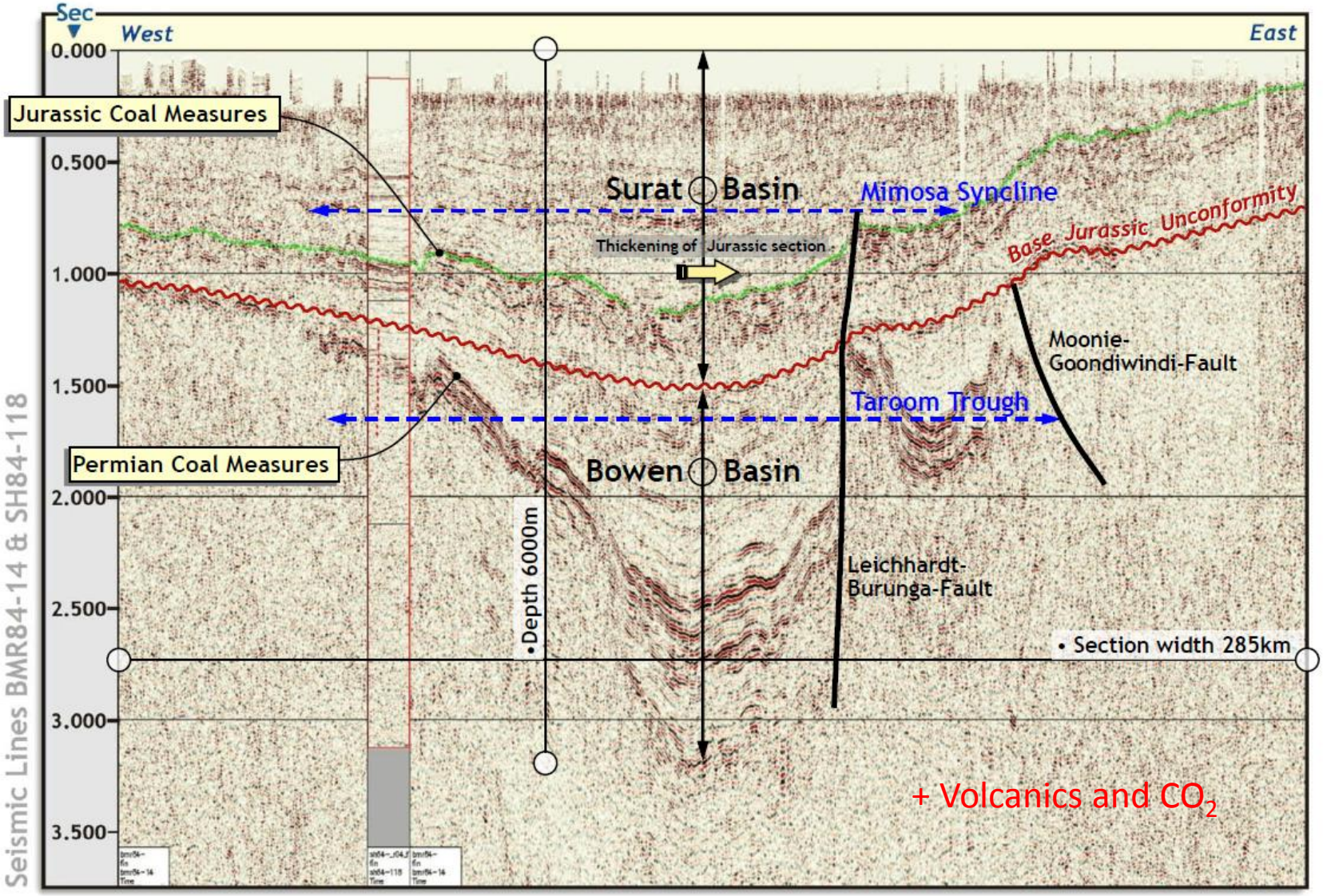
Sub-surface Processes are not 100% efficient

- What are the various sources of hydrocarbons and other gases?
- What is the relative timing of generation?
- How do these relate to what we know about stratigraphic seals and fault seals?
- Is there enough data to constrain computer models?
- Will be we able to say something about the distribution and volume of leakage?
- Can we use this to interpret surface gas detection data and reduce fugitive emissions?

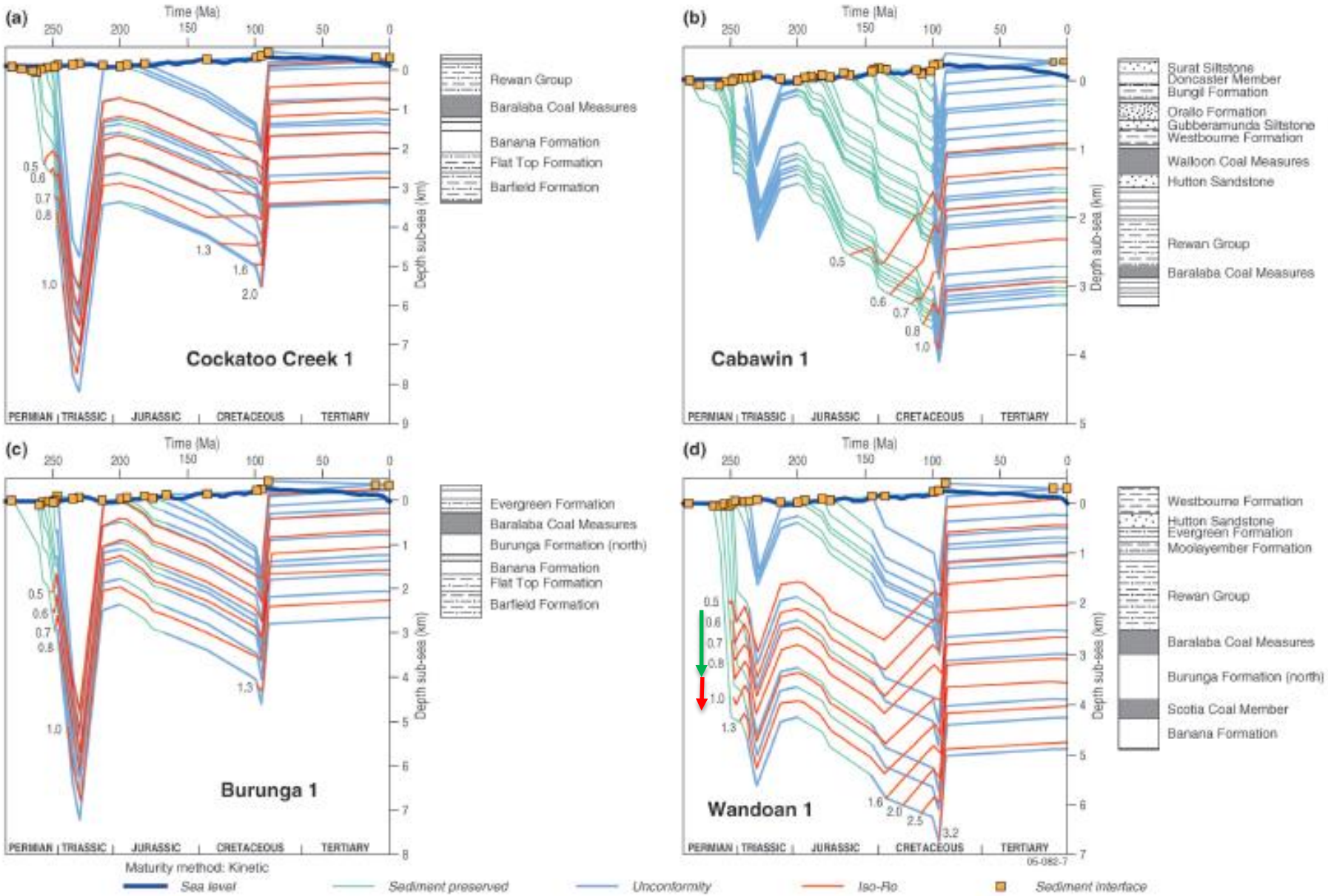
CSG – A study of Seals

Use hydrocarbon systems as fingerprints

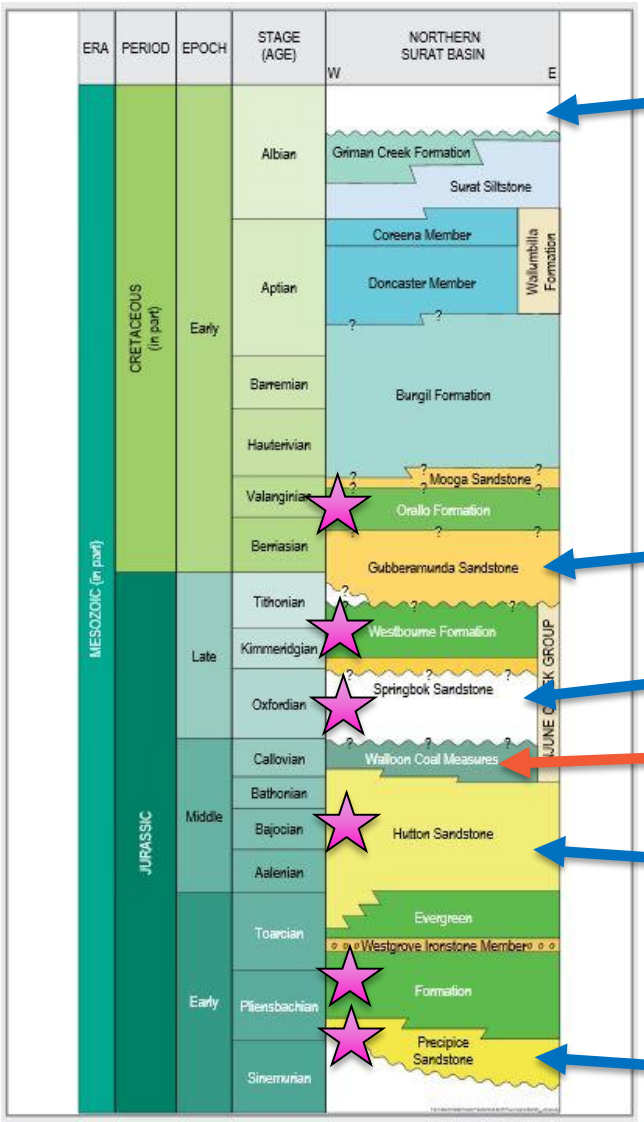
Key elements of the petroleum systems operative in the Surat/Bowen Basin can be represented on a selected regional seismic line through the basin



Burial History & Source Rock Maturation



With a complex basin geology



Alluvial Aquifers

Minor coal

Gubberamunda Aquifer

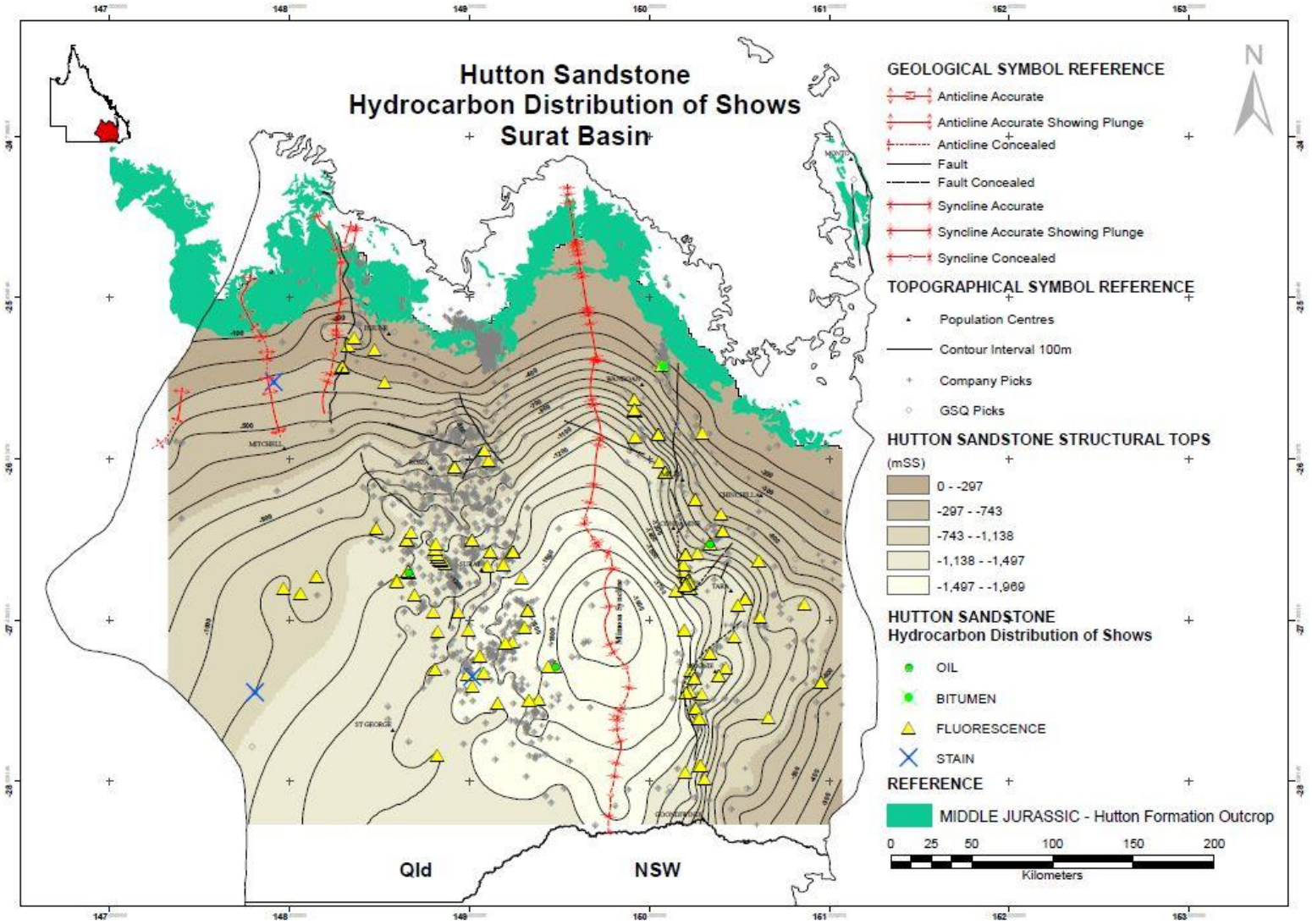
Springbok Aquifer

Commercial coal seam methane (Walloons)

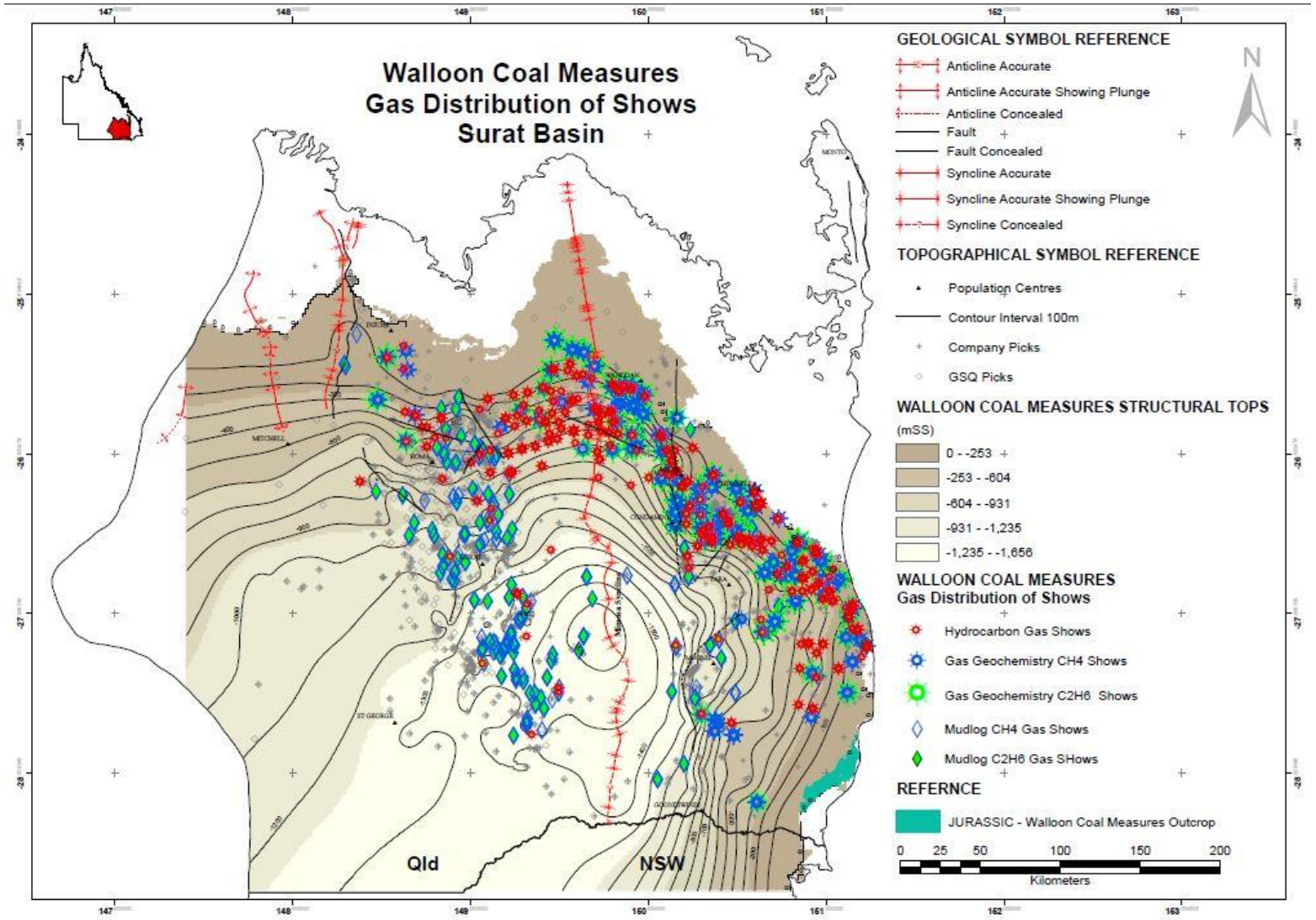
Hutton Aquifer

Precipice Aquifer

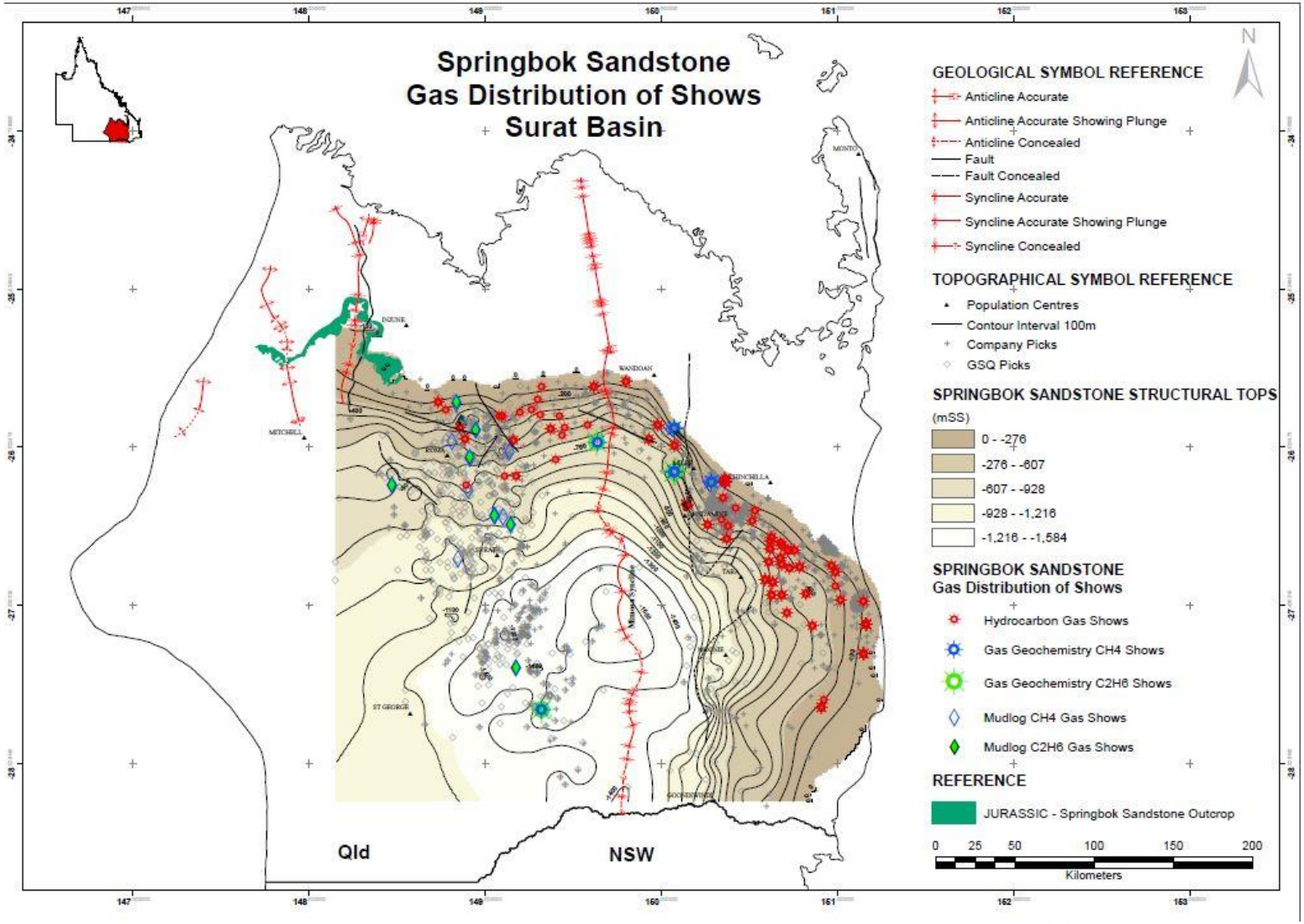
Fingerprints of oil migration through the Hutton



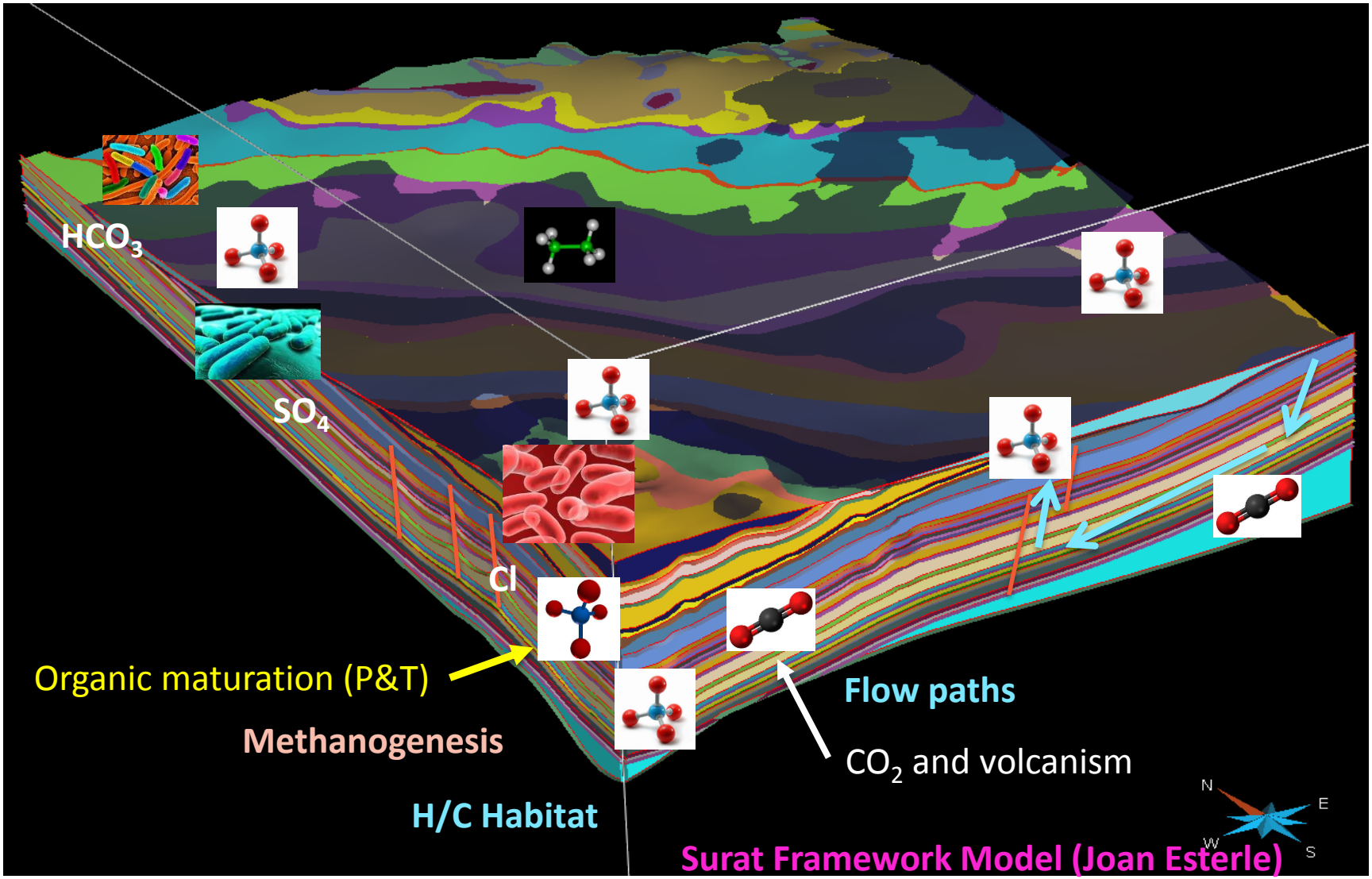
Fingerprints of Gas in the Walloons



Fingerprints of Gas in the Springbok



Understanding Basin Systems



Understanding Basin Systems

Create a Hydrocarbon Habitat

- What are the fingerprints of migrating hydrocarbons?
- Where are they located relative to stratigraphic seals and faults?
- Where are they located relative to the source rock?
- All the data displayed and manipulated within our 3D water Atlas

Check it out:
http://www.ccsg.uq.edu.au/Research/Water/WaterAtlasDevelopment.aspx

Visit our WEB page and click on each of the four research Themes: Water, Geoscience, Petroleum Engineering and Social Performance

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THANK YOU

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