



A Texas Study of Dissolved Methane in Fresh-Water Aquifers

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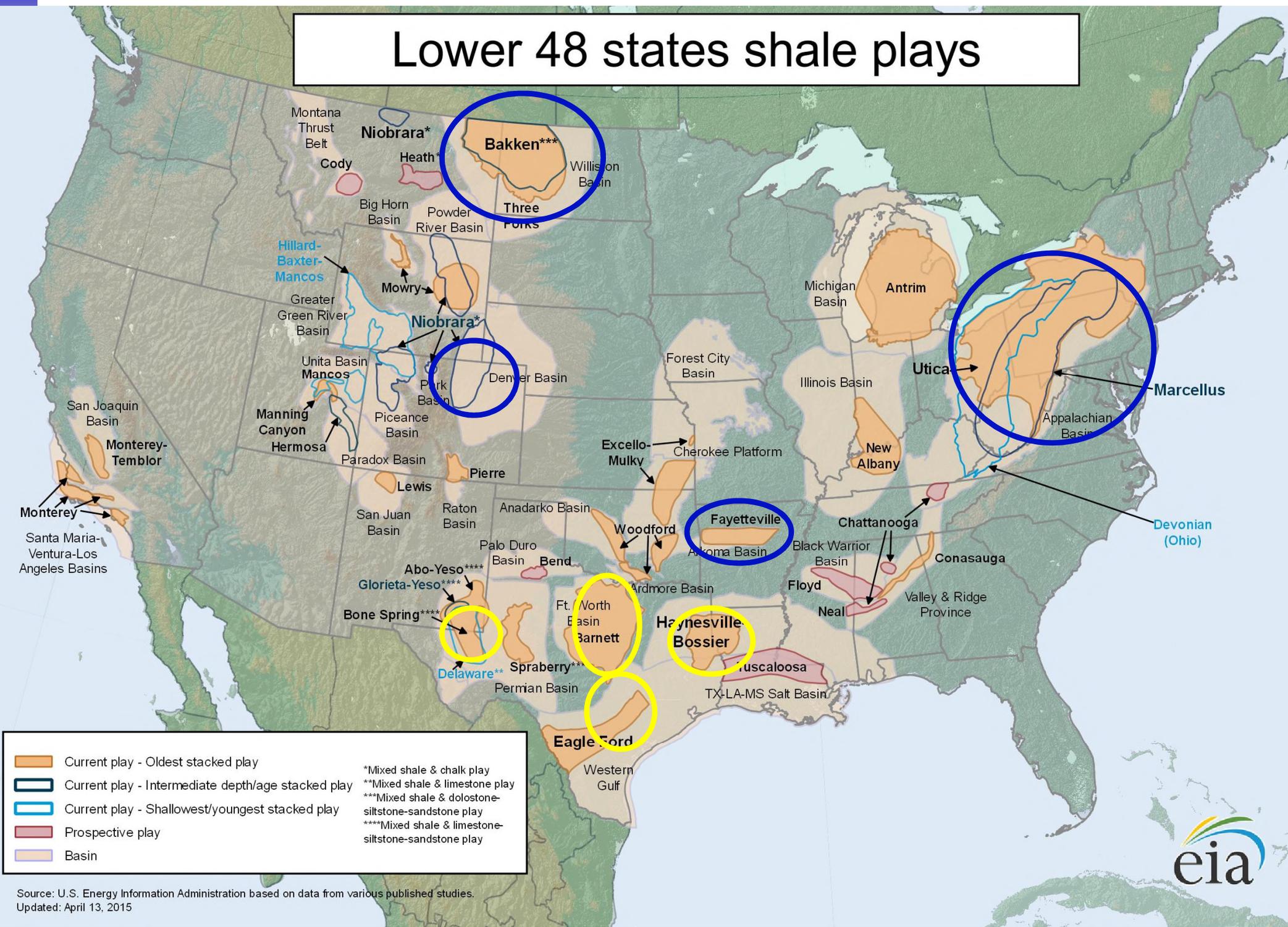
**10th National Monitoring Conference, Tampa, FL
May 3, 2016**

***: University of Michigan, Ann Arbor – Inform Environmental, Dallas, TX
St. Edwards University, Austin, TX – TWDB**

Study funded by RPSEA / NETL-DOE

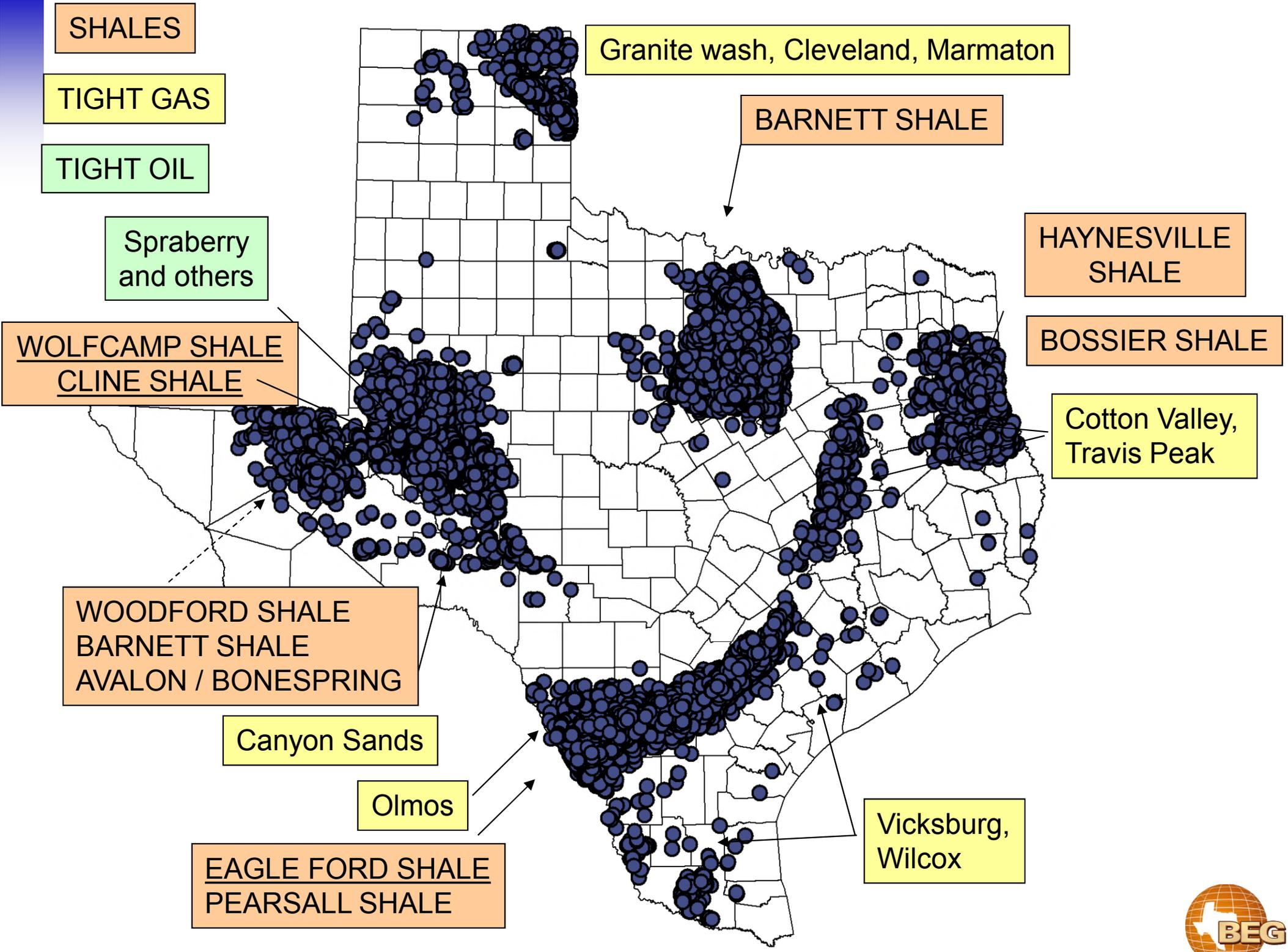


Lower 48 states shale plays



Source: U.S. Energy Information Administration based on data from various published studies.
 Updated: April 13, 2015





SHALES

TIGHT GAS

TIGHT OIL

Spraberry
and others

WOLFCAMP SHALE
CLINE SHALE

WOODFORD SHALE
BARNETT SHALE
AVALON / BONESPRING

Canyon Sands

Olmos

EAGLE FORD SHALE
PEARSALL SHALE

Granite wash, Cleveland, Marmaton

BARNETT SHALE

HAYNESVILLE
SHALES

BOSSIER SHALE

Cotton Valley,
Travis Peak

Vicksburg,
Wilcox

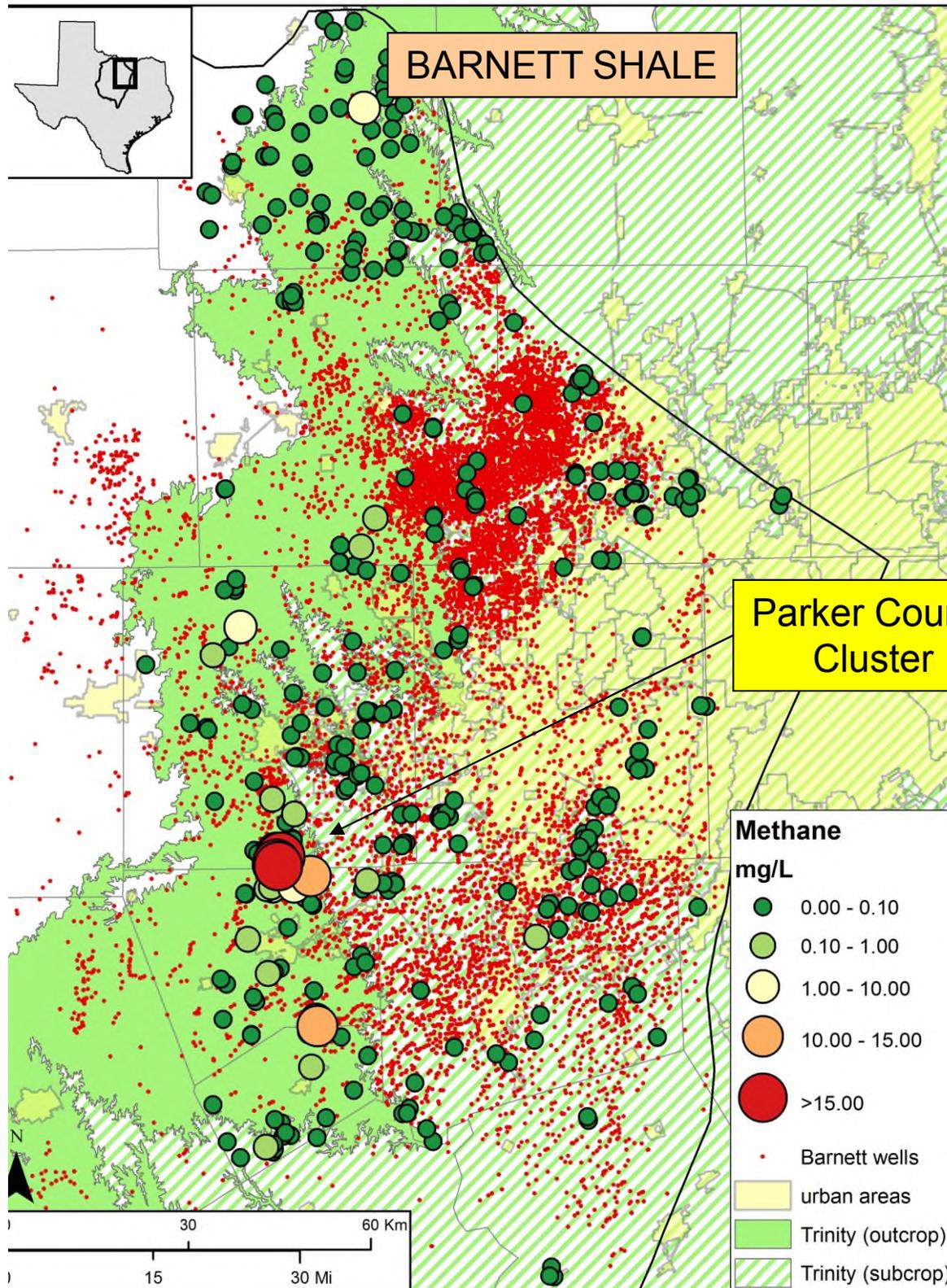


Large sampling campaign across Texas

- 843 water samples from different plays
 - 555 / 612 Barnett shale footprint (with du- and tri-plicates)
 - 118 Eagle Ford shale footprint
 - 70 Haynesville-TX shale footprint
 - 43 Delaware Basin (West Texas)
- Consistent sampling method
- In-house analyses of dissolved gases and carbon isotopes + major and minor species + nitrogen isotopes + noble gases

Dissolved Methane in the Barnett Footprint

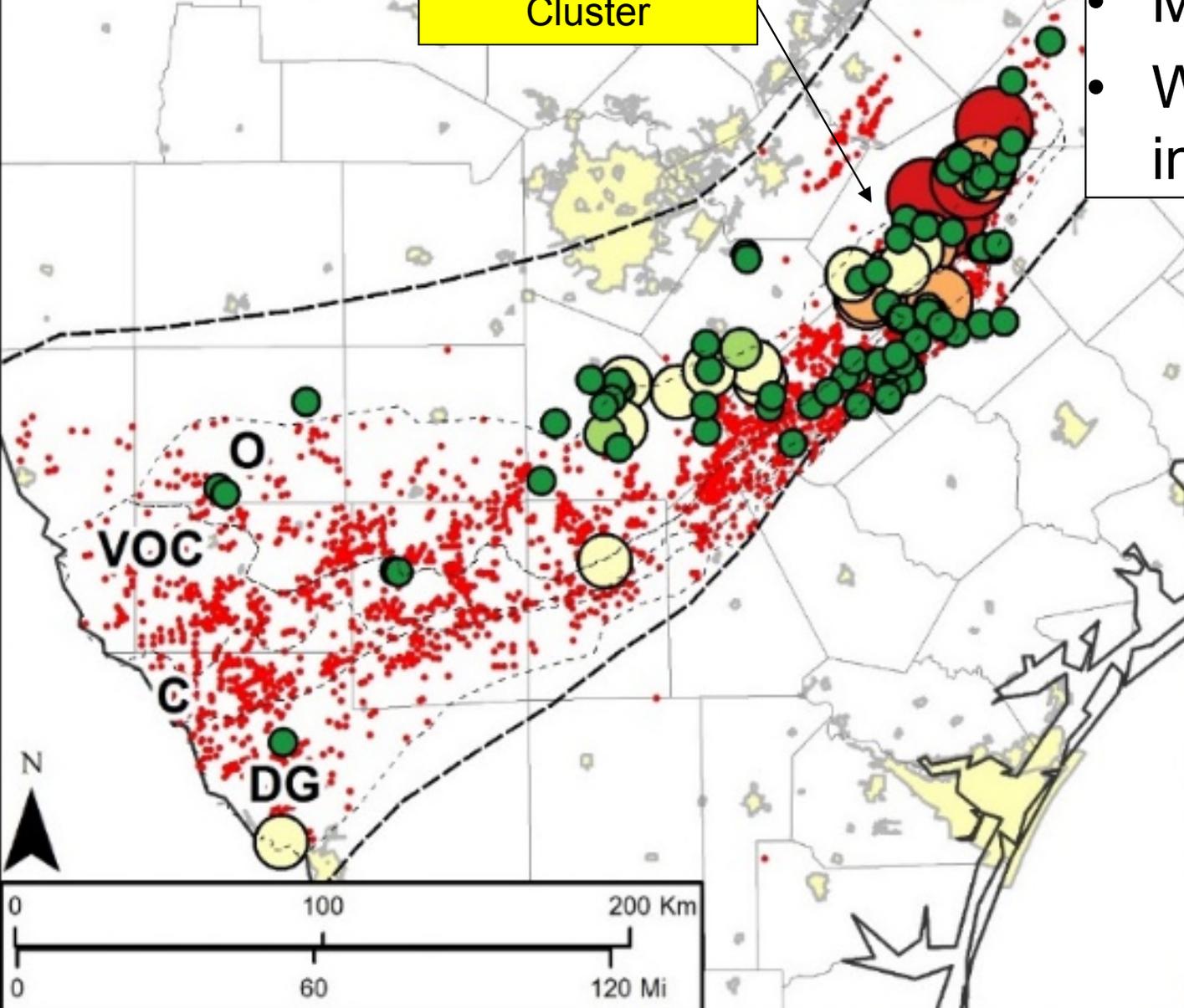
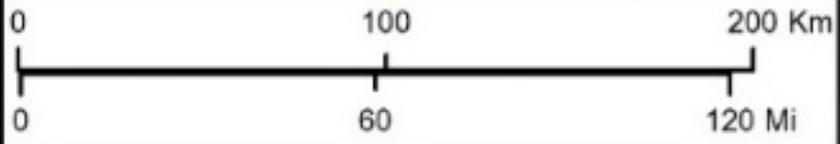
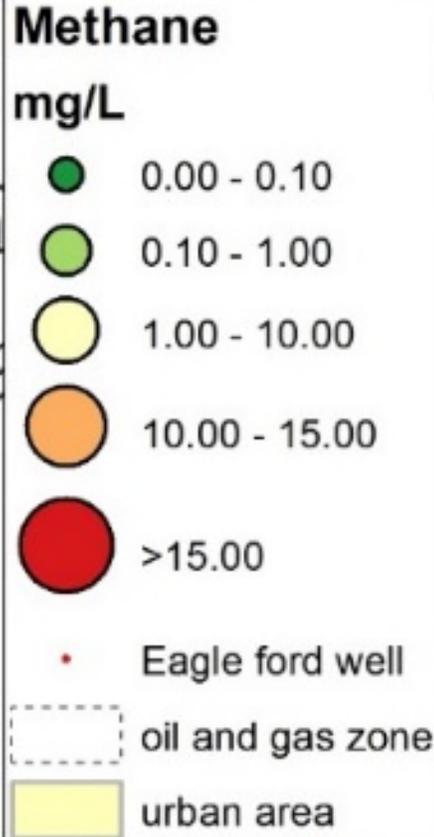
- 500+ water samples from the Trinity aquifer
- Most are <0.1 mg/L
- Several low microbial concentrations
- Local high thermogenic concentrations

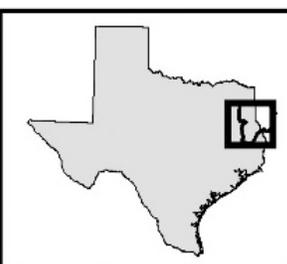


EAGLE FORD SHALE

Gonzales County Cluster

- 120+ water samples from various aquifers
- Many are <0.1 mg/L
- Mostly microbial
- With thermogenic input





HAYNESVILLE SHALE

Bureau of Economic Geology

Panola County Cluster

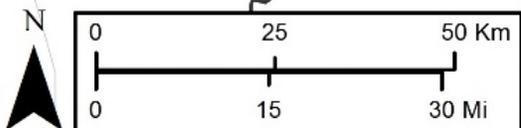
- ~70 water samples from the Wilcox Aquifer
- Many are <math><0.1\text{ mg/L}</math>
- Mixed microbial and thermogenic

Methane
mg/L

- <math>< .01</math>
- 0.10 - 1.00
- 1.00 - 10.00
- 10.00 - 15.00
- > 15.00

urban area

• Haynesville well



Dissolved methane sampling



Sampling methods for dissolved gas

- Consistent sampling method
 - (direct fill)
 - (inverted bottle)
 - (copper tube)
 - Flow-through vial:
Somewhat similar to the copper tube method



Sampling methods for dissolved gas

- Consistent sampling method
 - (direct fill)
 - (inverted bottle)
 - (copper tube)
 - Flow-through vial
 - Isoflask: developed by the private company Isotech/Weatherford and has become a fool-proof standard but needs to be processed by Isotech

<http://www.isotechlabs.com>



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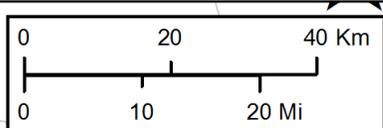
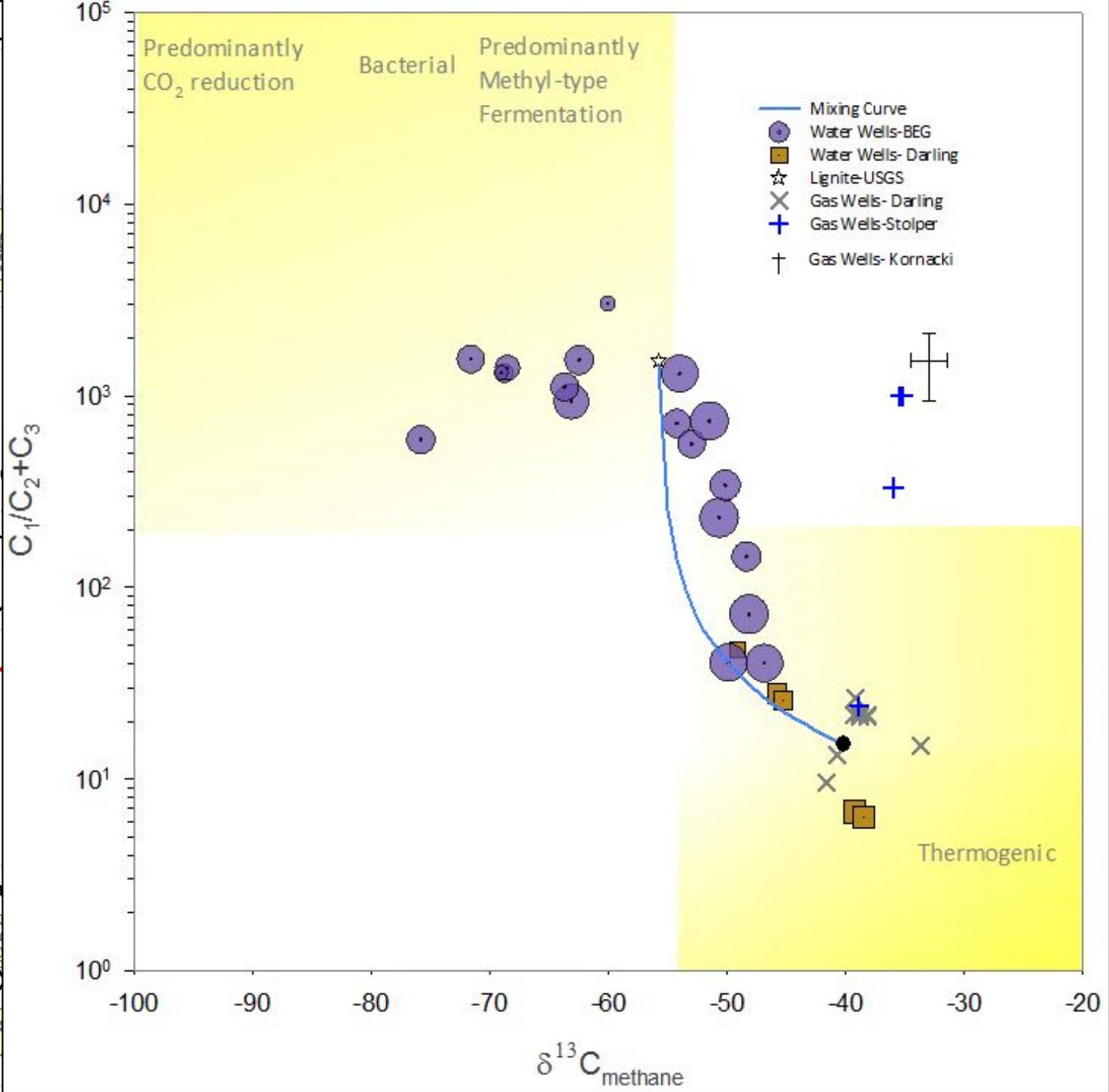
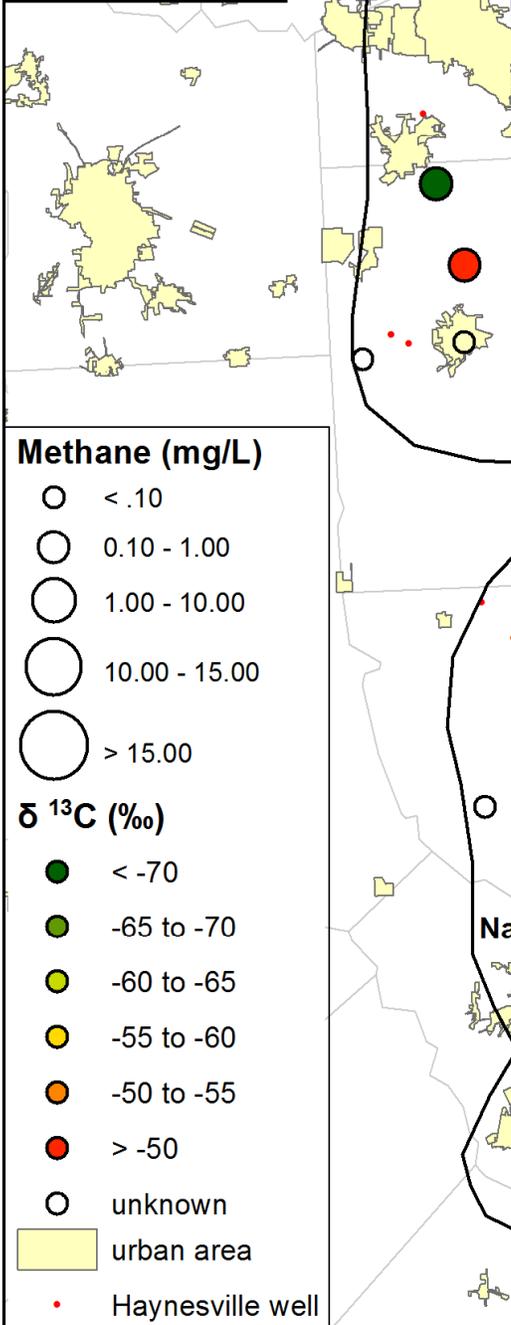
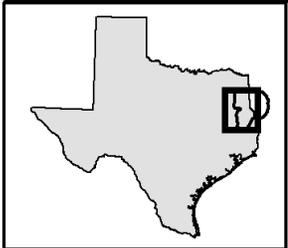
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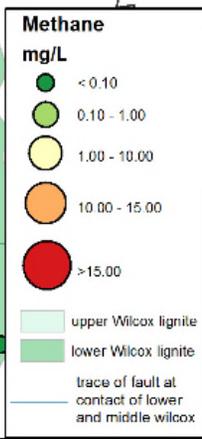
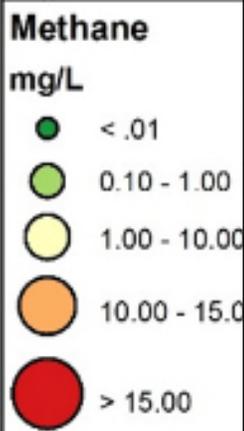
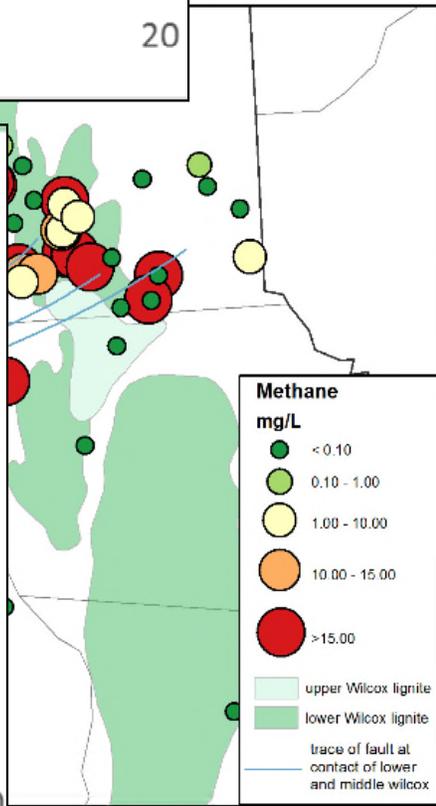
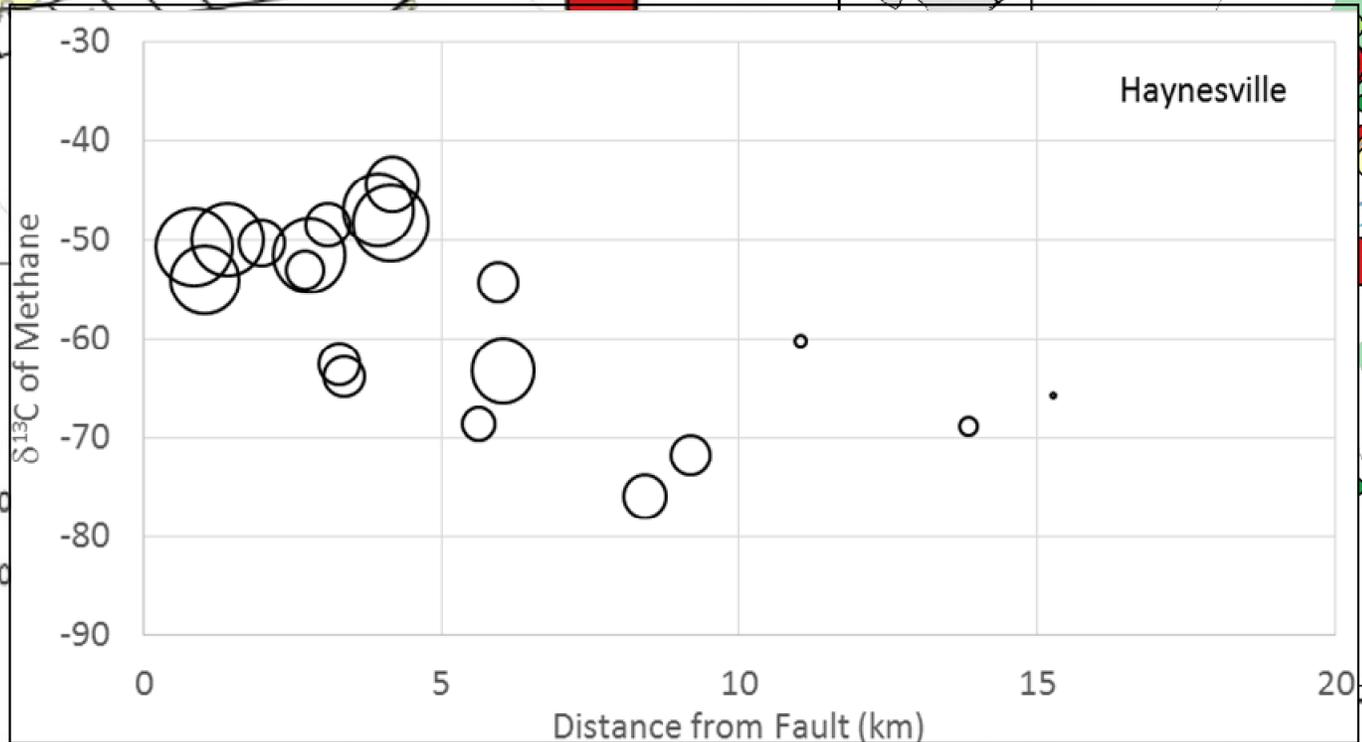
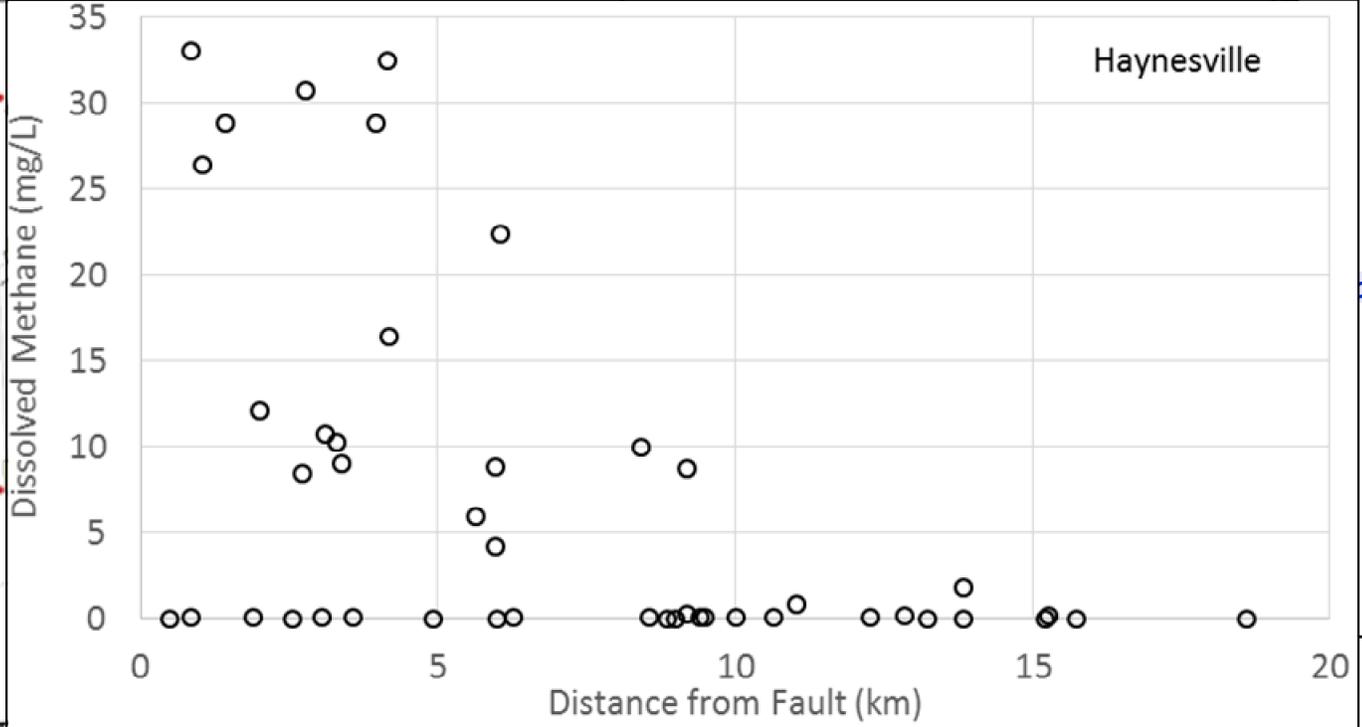


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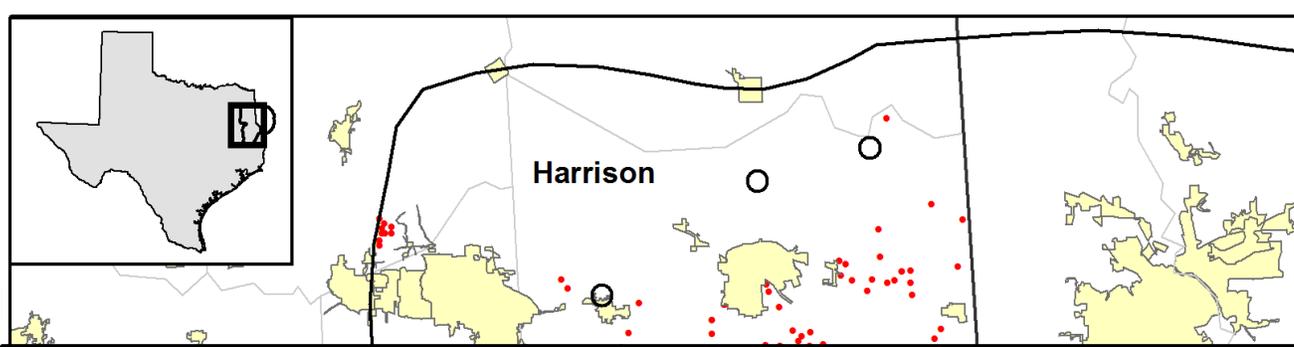
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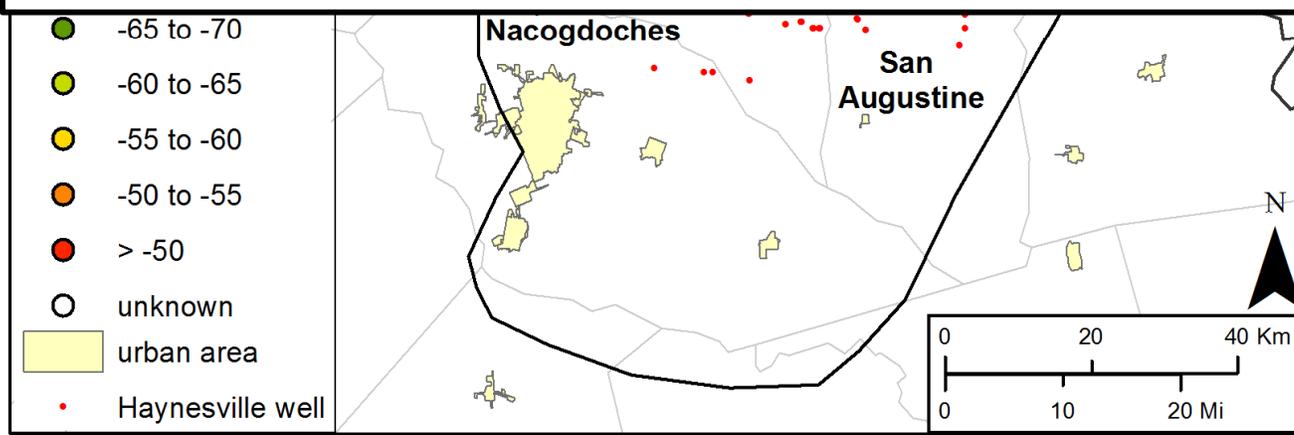
urban area
Haynesville well

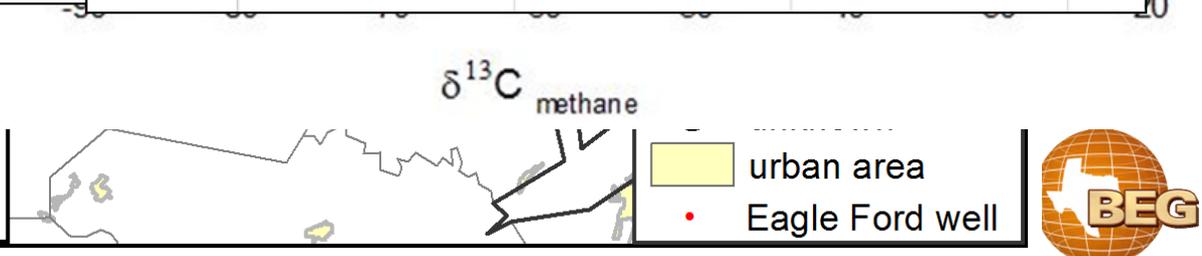
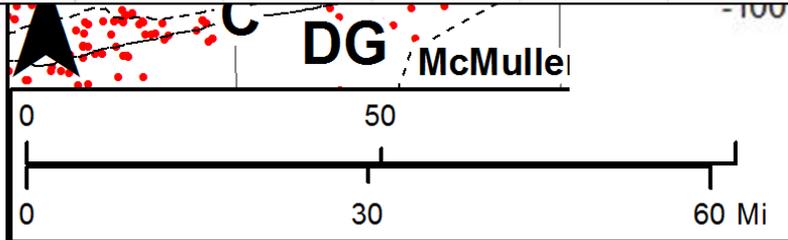
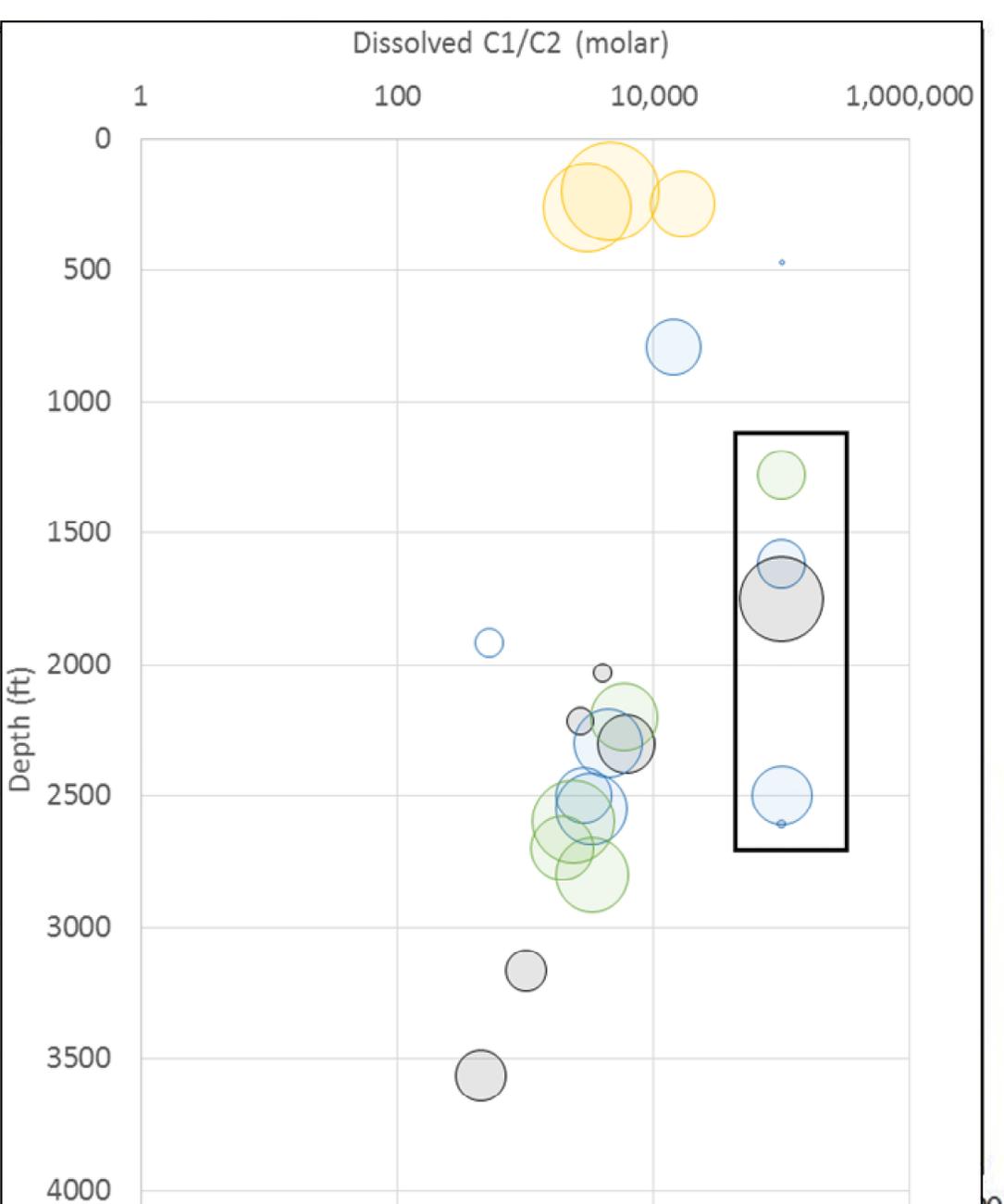
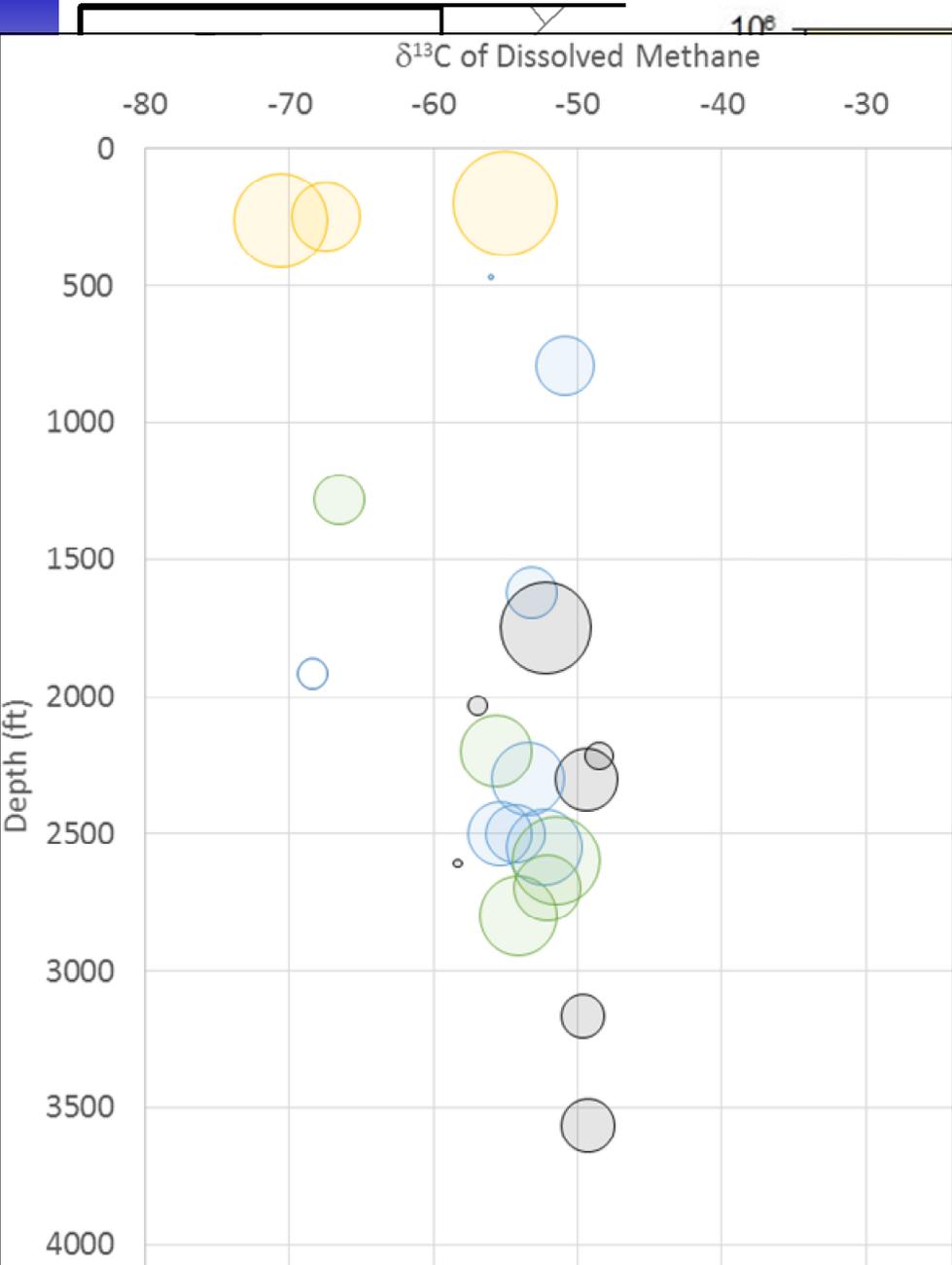


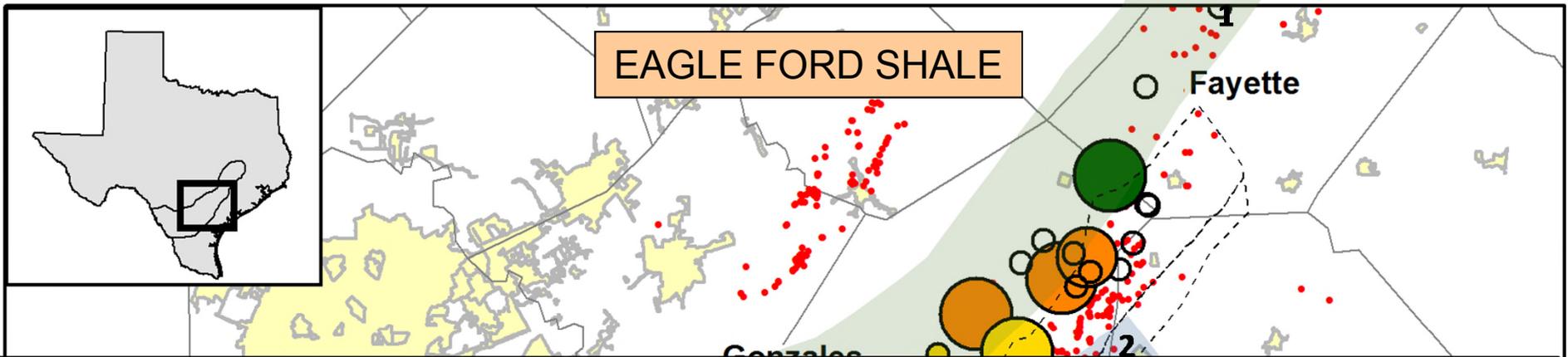


Haynesville Shale:

- Haynesville at ~12,000 ft
- Some methane in groundwater
- When present, biogenic or of mixed character
- Mostly associated with the Mount Enterprise fault zone
- Possibly genetically related to the Wilcox lignite

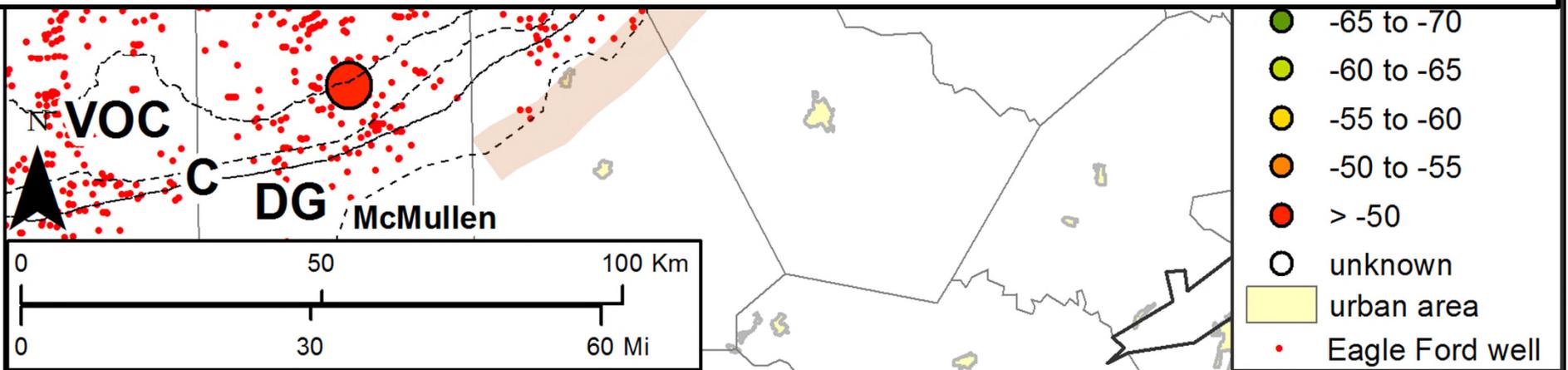


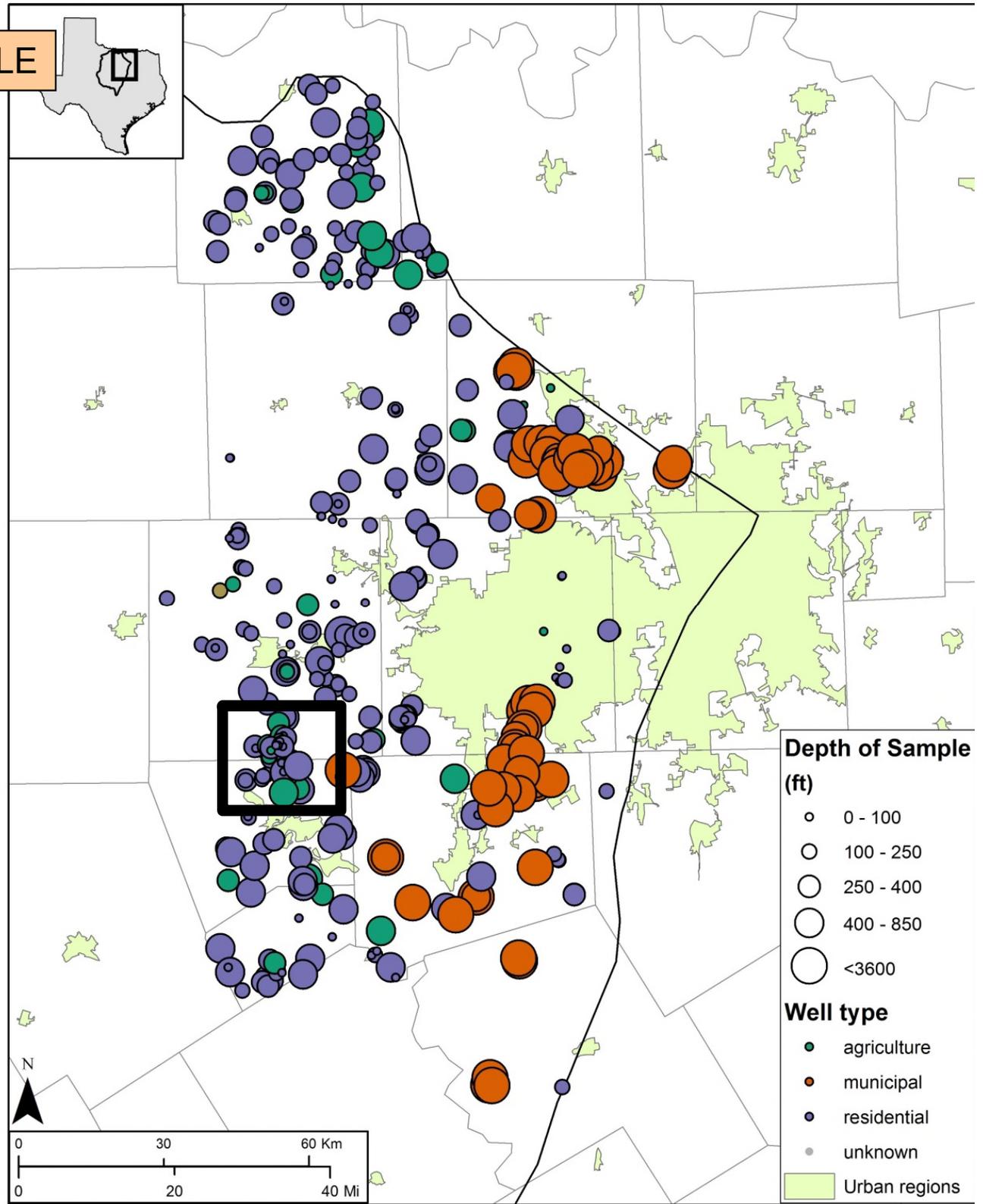
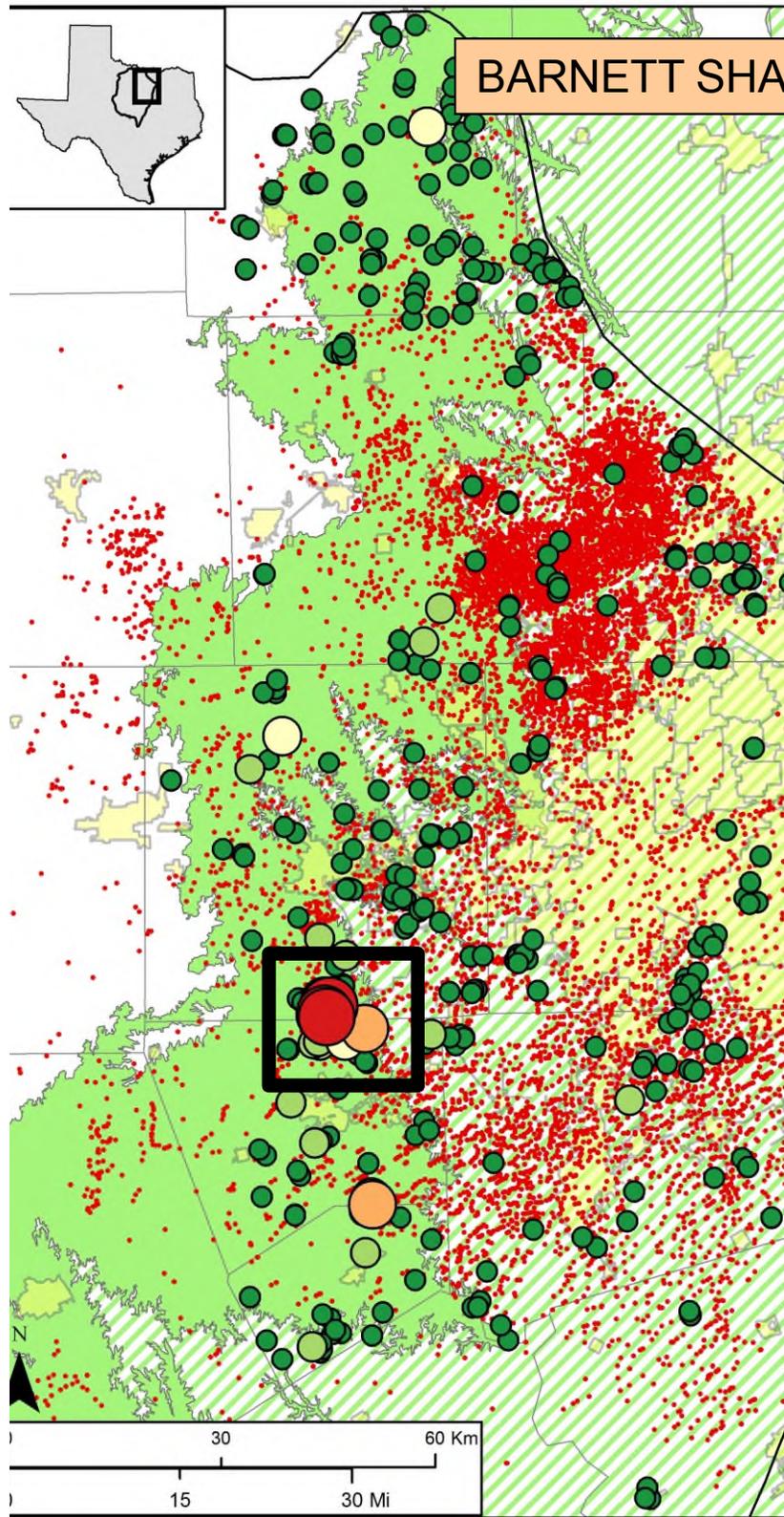


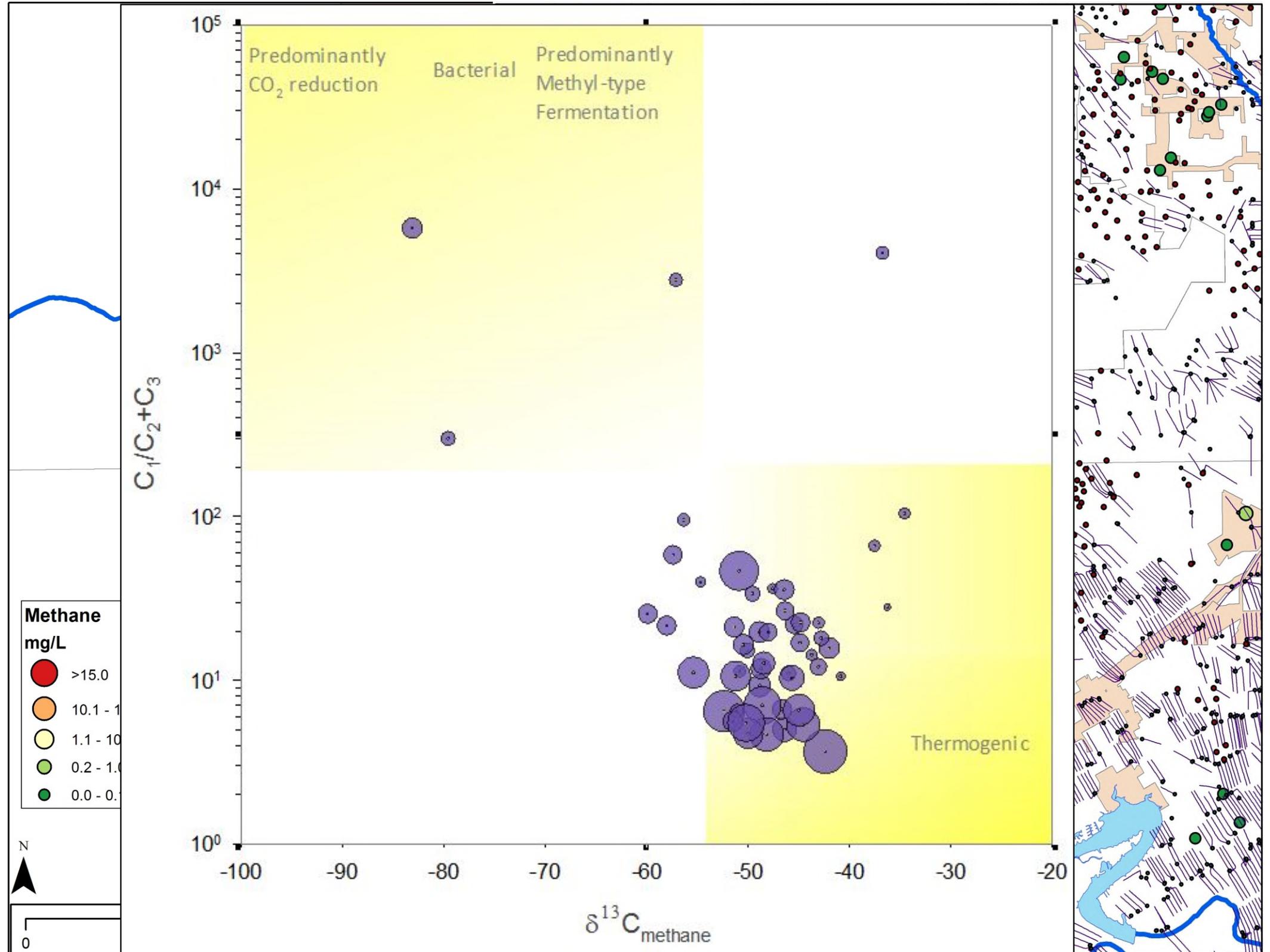


Eagle Ford Shale:

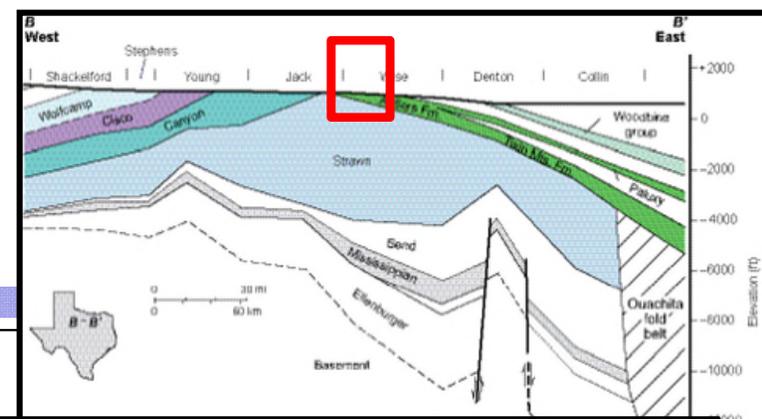
- Eagle Ford at ~8,000 ft
- Some methane in groundwater
- When present, mostly deep and likely microbial
- Possibly genetically related to Karnes Trough or Wilcox Fault Zone







Strawn water wells



Barnett Shale:

- Barnett at ~6000 ft
- Little methane in GW
- When present, mostly thermogenic
- 1 well-documented cluster (Parker County), others may exist (Hood – Palo Pinto – Wise counties)
- Genetically related to shallow Strawn reservoirs

Distance from Unconformity (ft)

600
500
400
300
200
100
0
-100
-200
-300

-150

Dissolved Methane $\delta^{13}\text{C}$



Conclusions of the study

- Methane in aquifers is not uncommon
- High methane concentrations
 - often occur in clusters
 - often have a thermogenic component
 - are often associated with some geological local features
 - are mostly naturally occurring
- But the conclusions are valid only in a statistical sense
 - impact of O&G industry still not fully solved
 - hard to prove a negative
 - detailed studies are needed in specific cases

Questions? Comments?

Tracing natural gas transport into shallow groundwater using dissolved nitrogen and alkane chemistry in Parker County, Texas by T. Larson et al.

Methane Sources and Migration Mechanisms in Shallow Groundwaters in Parker and Hood Counties, Texas, A Heavy Noble Gas Analysis by T. Wen et al.

Controls on methane occurrences in aquifers in the Haynesville Shale area by J.-P. Nicot et al.

Controls on methane occurrences in aquifers in the Eagle Ford Shale area by J.-P. Nicot et al.

Understanding and Managing Environmental Roadblocks to Shale Gas Development: An Analysis of Shallow Gas, NORMs, and Trace Metals (Texas) by J.-P. Nicot et al. (2015) <http://www.rpsea.org/projects/11122-56/>

