Finding and Protecting Energy Assets With Geochemical Tools

David Seneshen – Vice President

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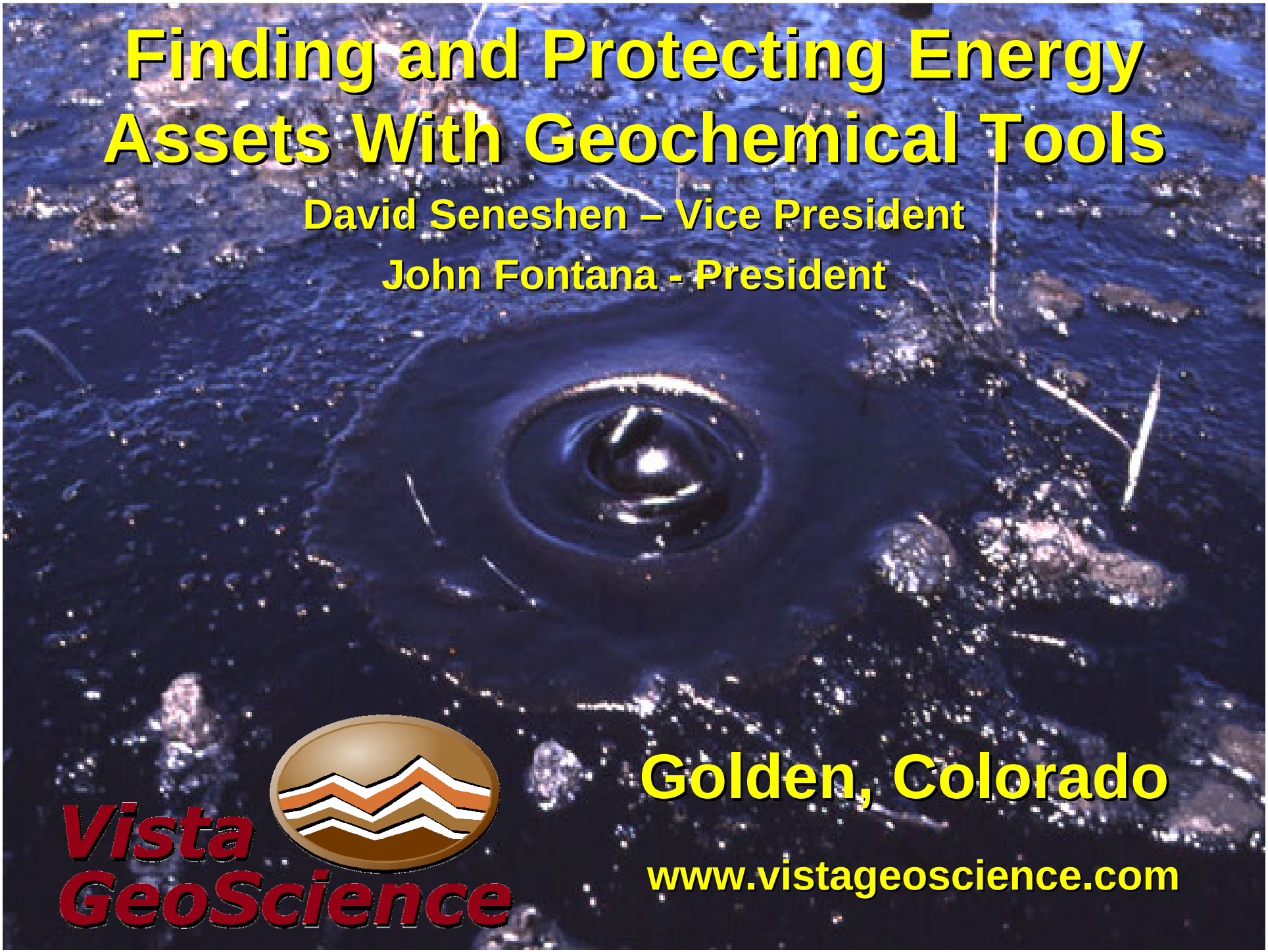

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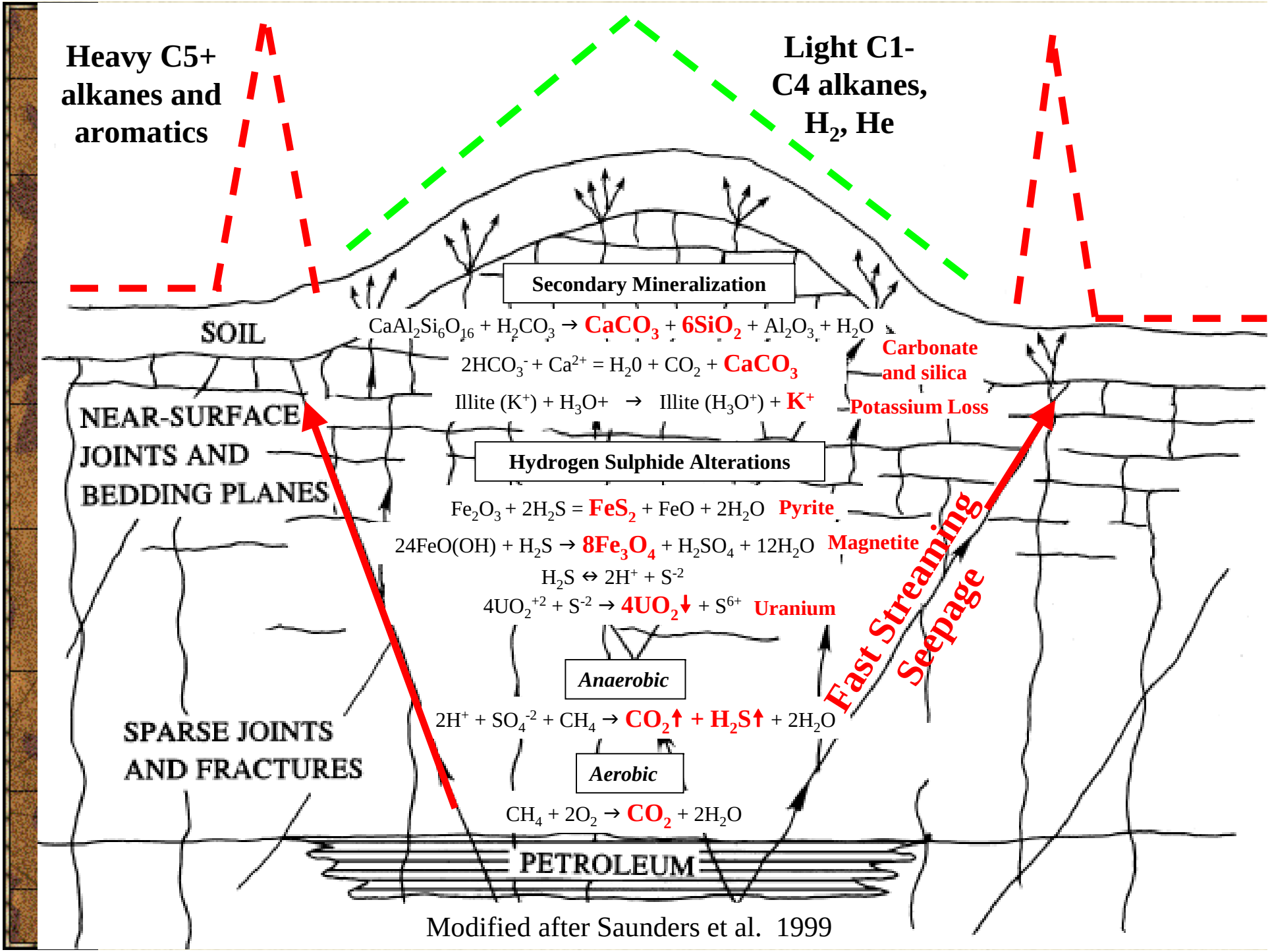
Outline of Presentation

- Types of Anomalies Over Oil & Gas Fields
- Sampling and Analysis
- Finding Energy Assets With Geochemical Tools
  - ✓ Grant Canyon Oil Field (Great Basin, Nevada)
  - ✓ Matapedia (Gaspe Peninsula)
  - ✓ Jonah Gas Field (Green River Basin, WY)
  - ✓ Fractured Trenton Dry Gas (Appalachian Basin, NY)
- Protecting Energy Assets With Geochemical Tools



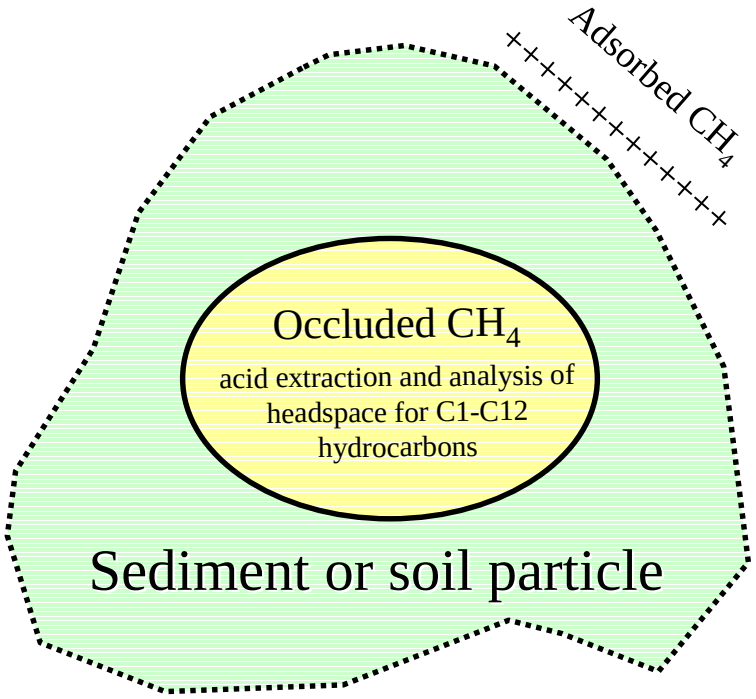
Modified after Saunders et al. 1999

Sampling Surface Media For Hydrocarbon and Metals Analysis

Shallow Soils

Shot-hole Sediments

Lake Sediments



HC Extraction Methods

- **Heat**
- **Acid**
- **Organic Solvent**

Deep Soils

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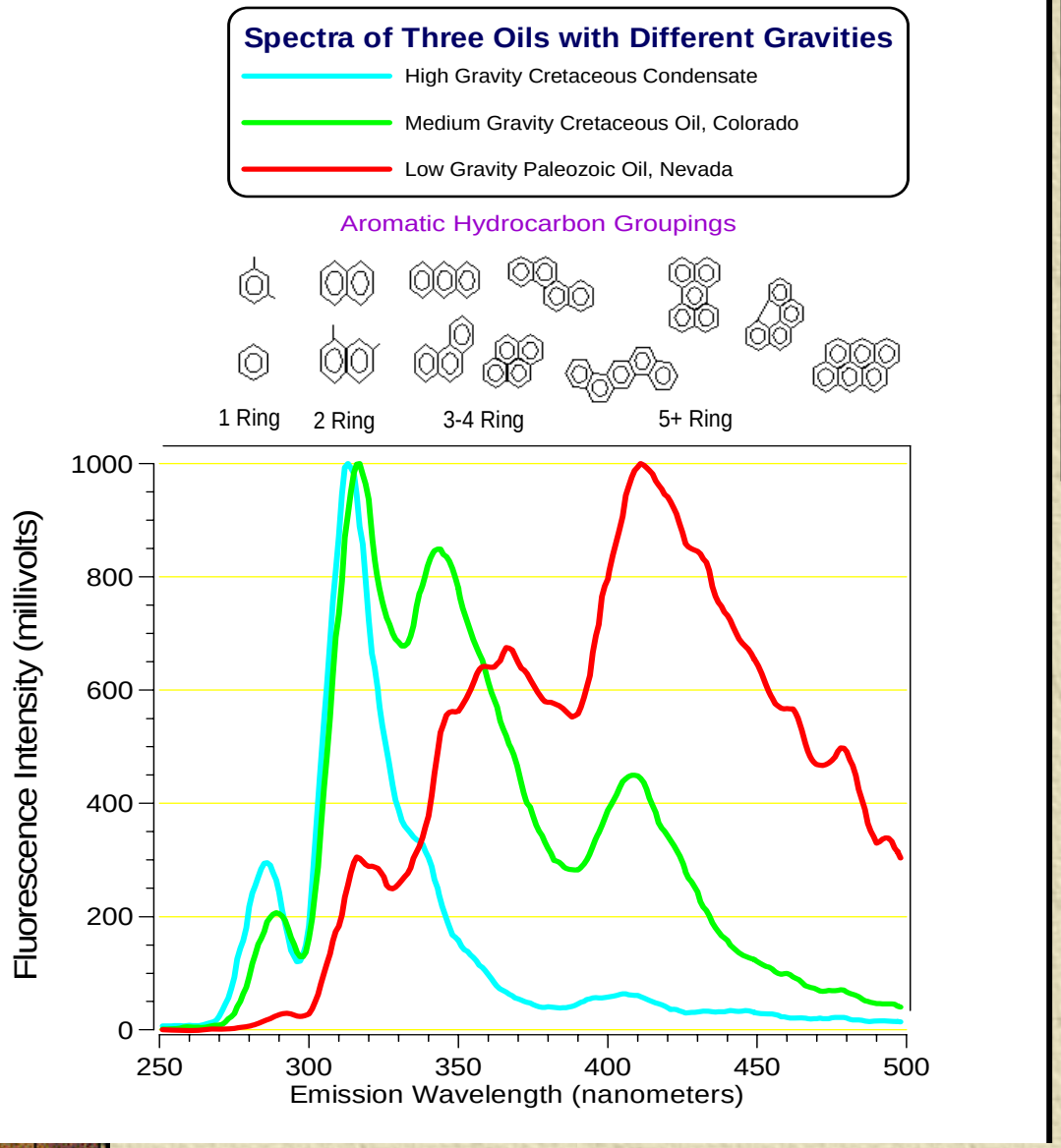
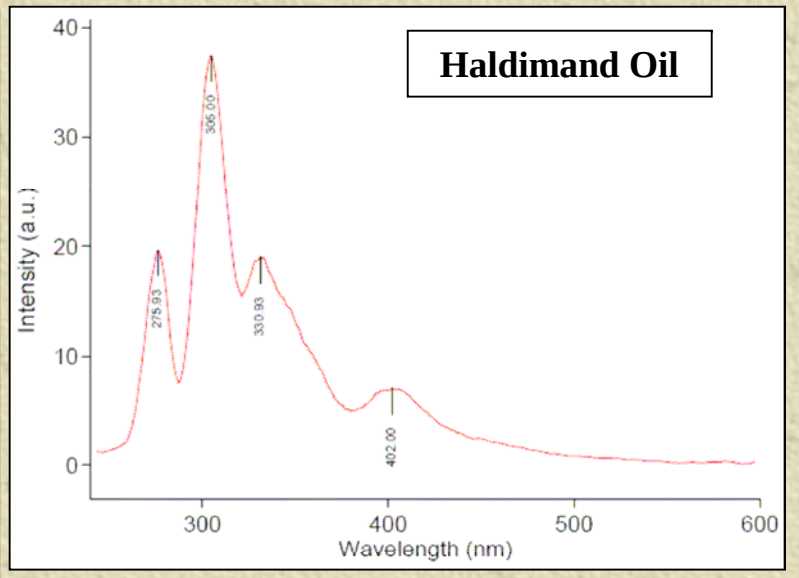
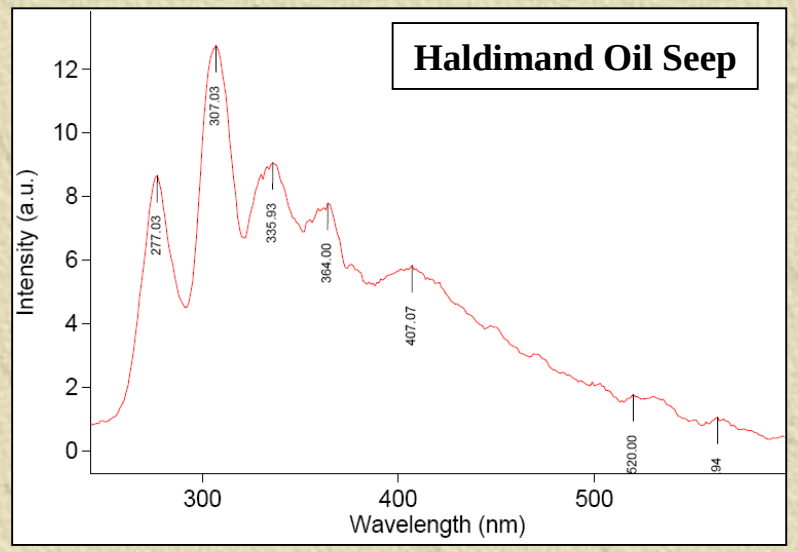
SYNCHRONOUS SCANNED UV-FLUORESCENCE







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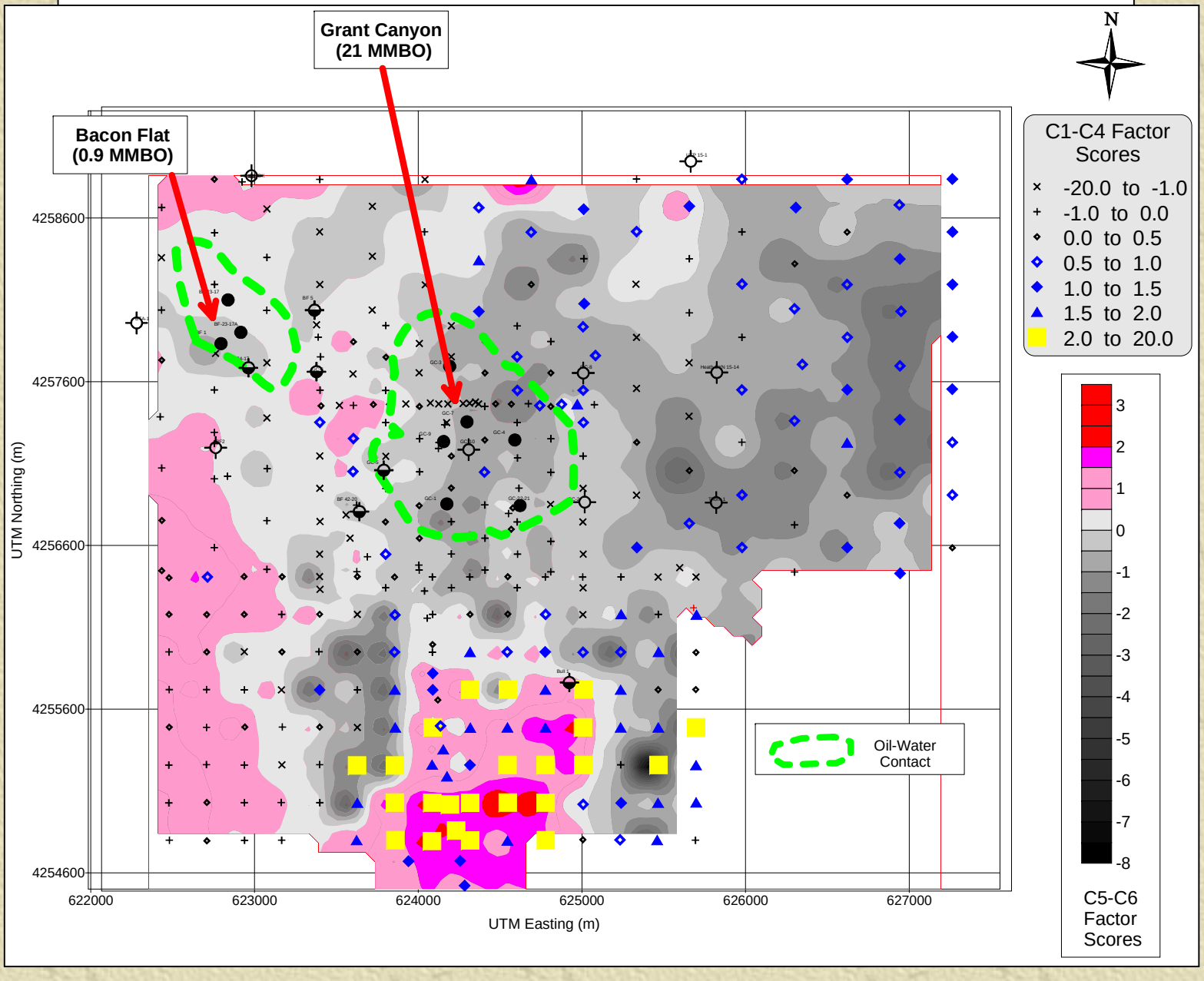
Soil Hydrocarbon Anomalies – Grant Canyon



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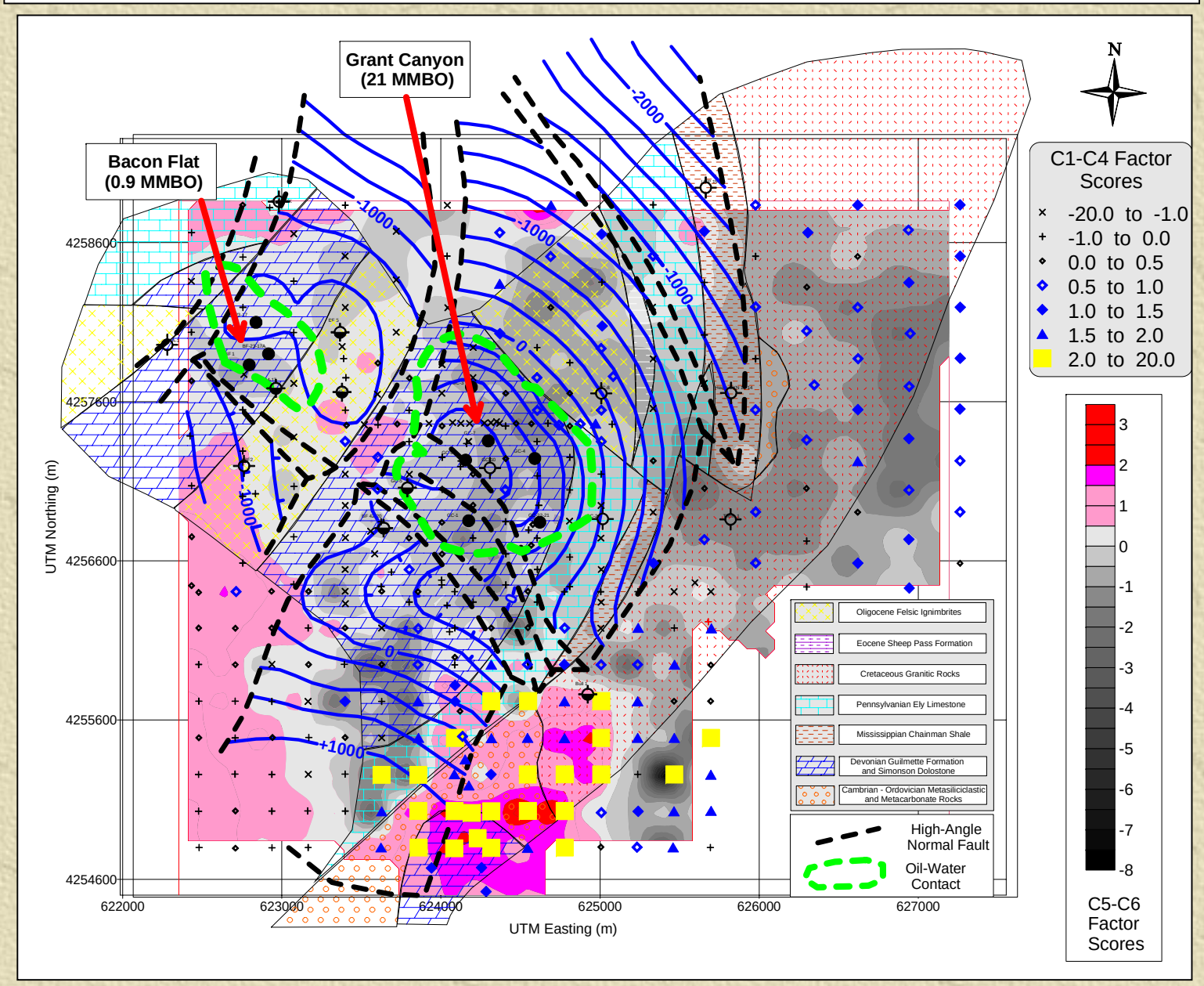
Why geology must be integrated with surface geochemistry!



Geology (Hulen et al. 1994) and structure (McCutcheon and Zogg, 1994)

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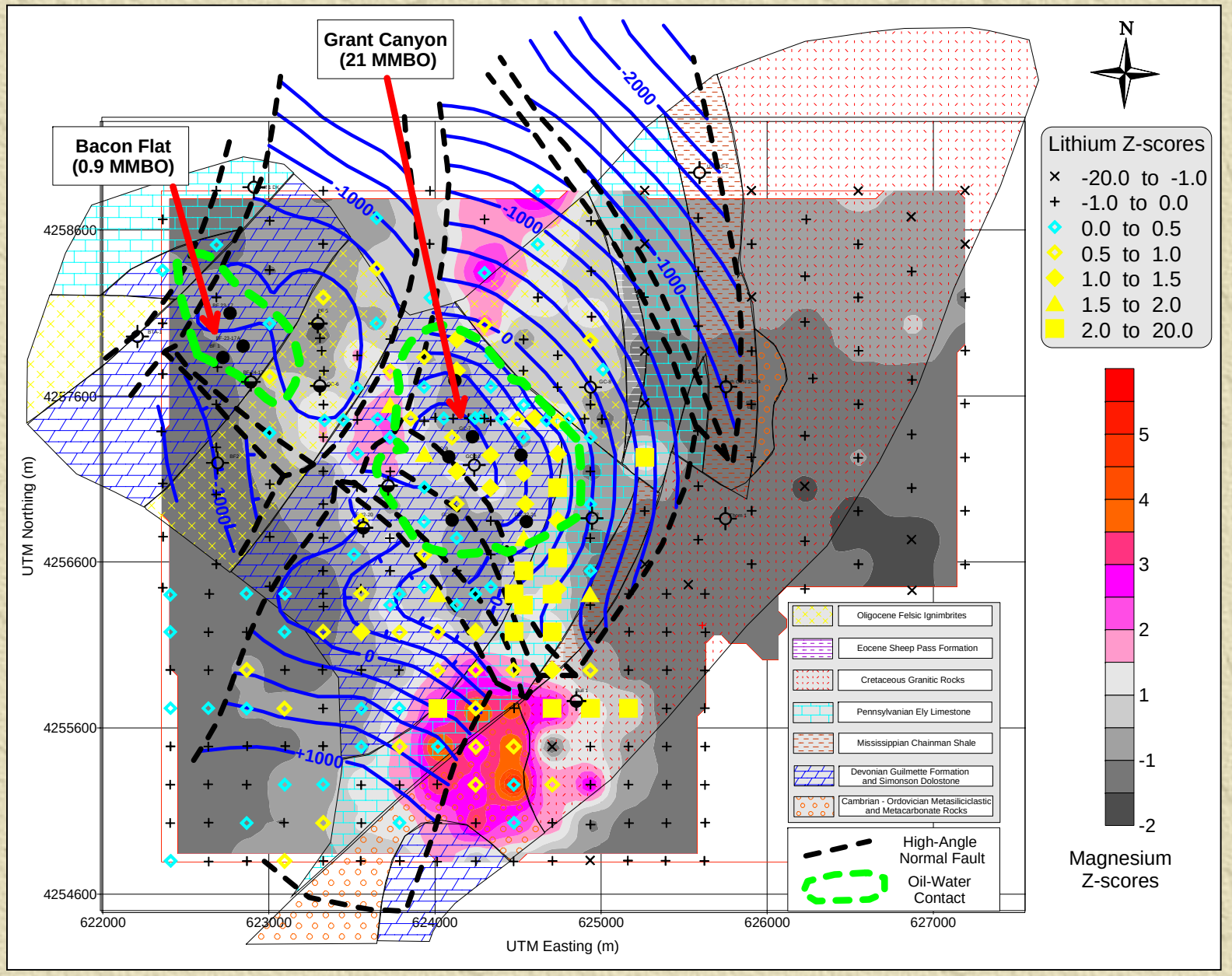
Magnesium and Lithium Anomalies – Direct Link to Reservoir?



Geology (Hulen et al. 1994) and structure (McCutcheon and Zogg, 1994)

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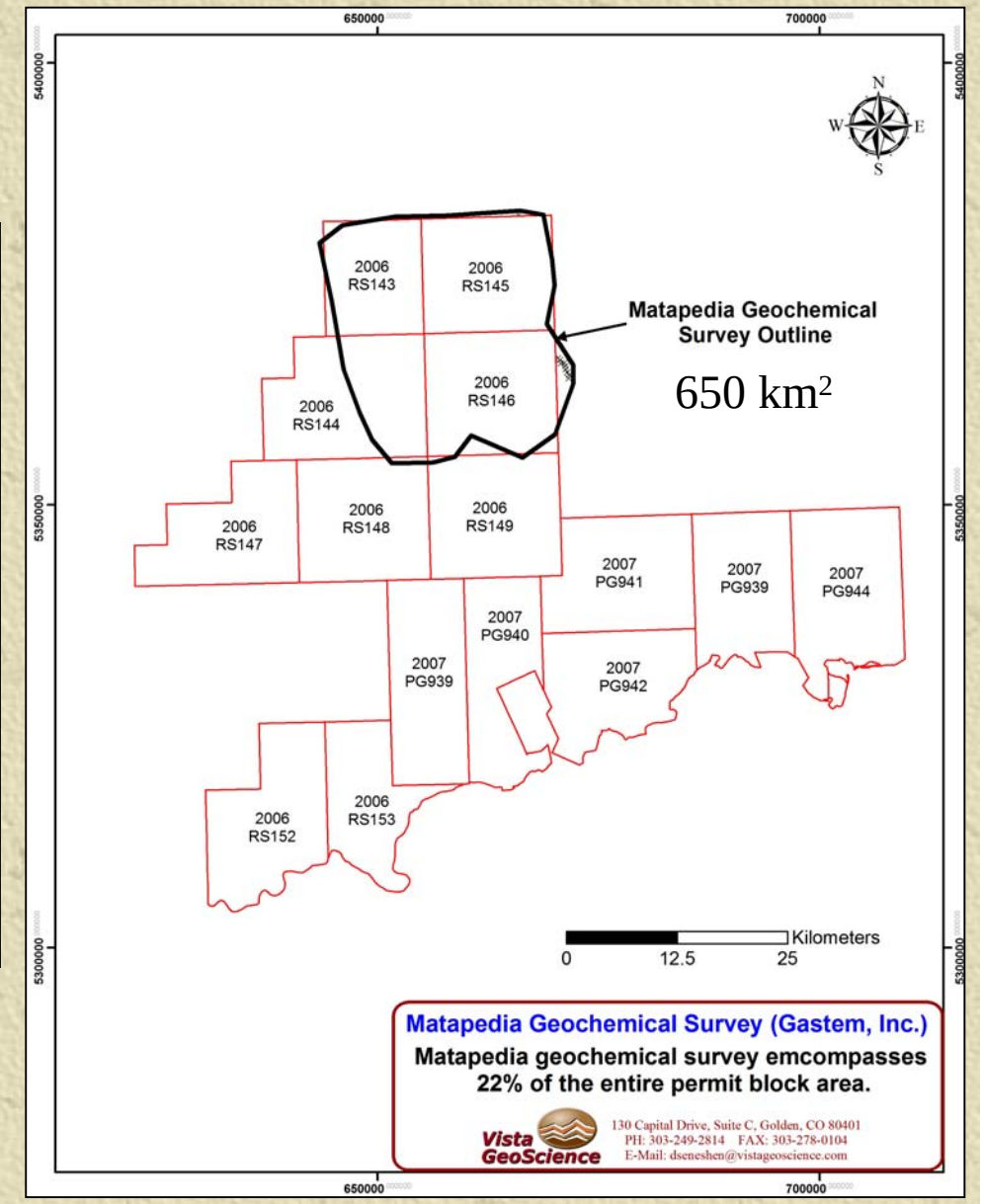
Composition of produced water from oil and dry wells – Grant Canyon

Hulen et al (1994)

Concentrations (mg/kg)	GC #3 Oil Well	WGC Dry Well 21-31
K	72	14.6
Ca	56.3	31.8
Mg	7.2	3.4
Sr	1.07	0.93
Br	4.86	0.63
Li	1.8	0.21
Cs	0.058	0.025
Rb	0.31	0.09

Matapedia Geochemical Survey (Gaspe Peninsula, Quebec)



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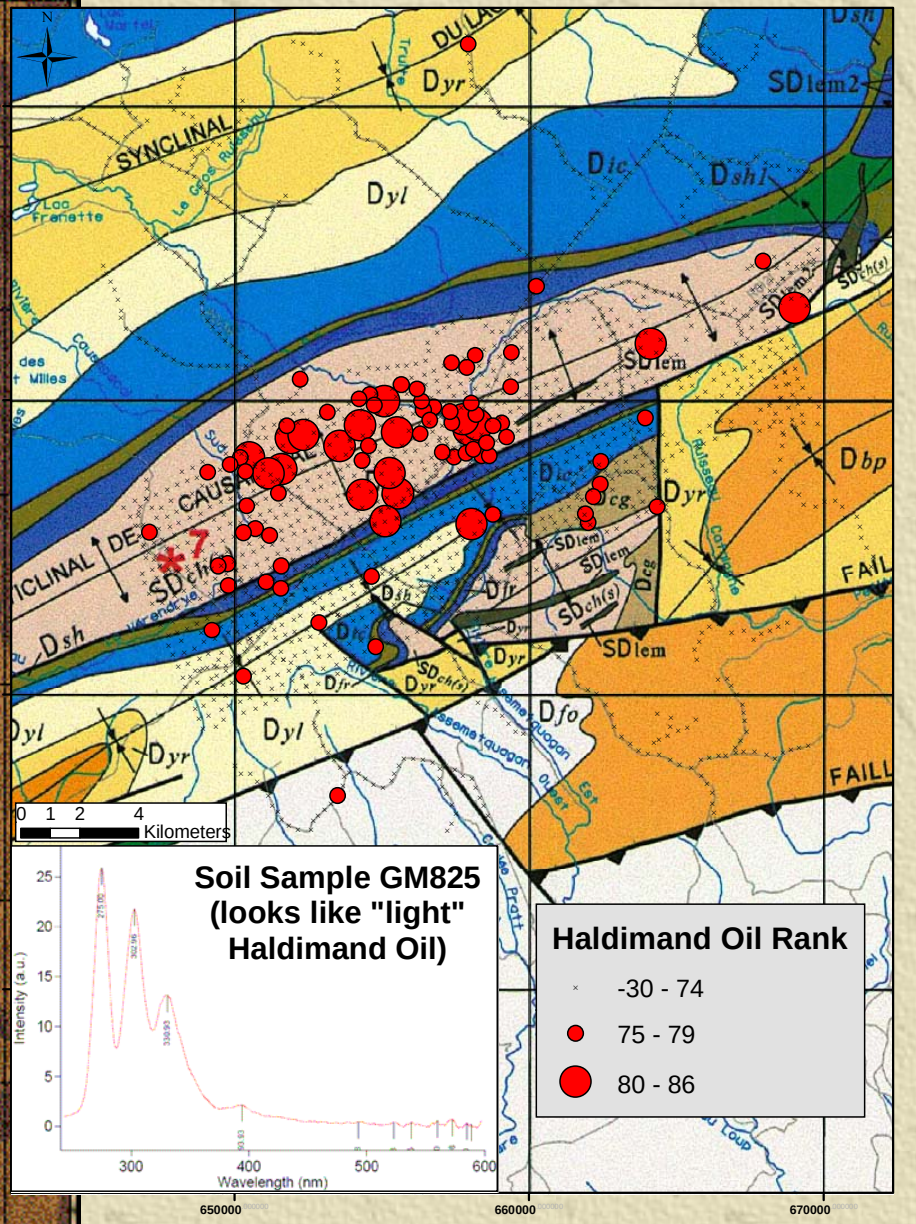
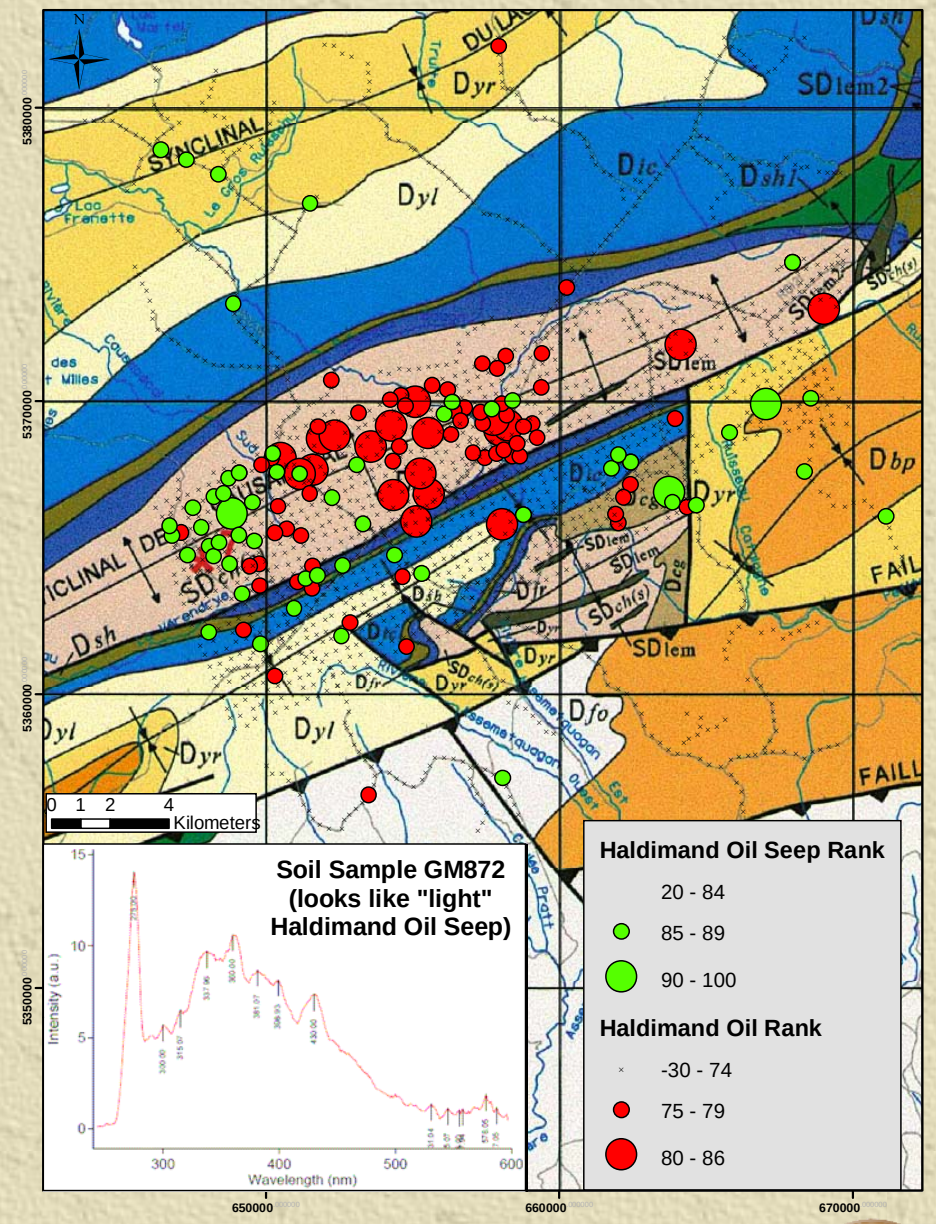
Haldimand Oil Rank



Haldimand Oil Rank

- -30 - 74
- 75 - 79
- 80 - 86

Haldimand Oil and Seep Rank



Haldimand Oil Seep Rank

- 20 - 84
- 85 - 89
- 90 - 100

Haldimand Oil Rank

- -30 - 74
- 75 - 79
- 80 - 86

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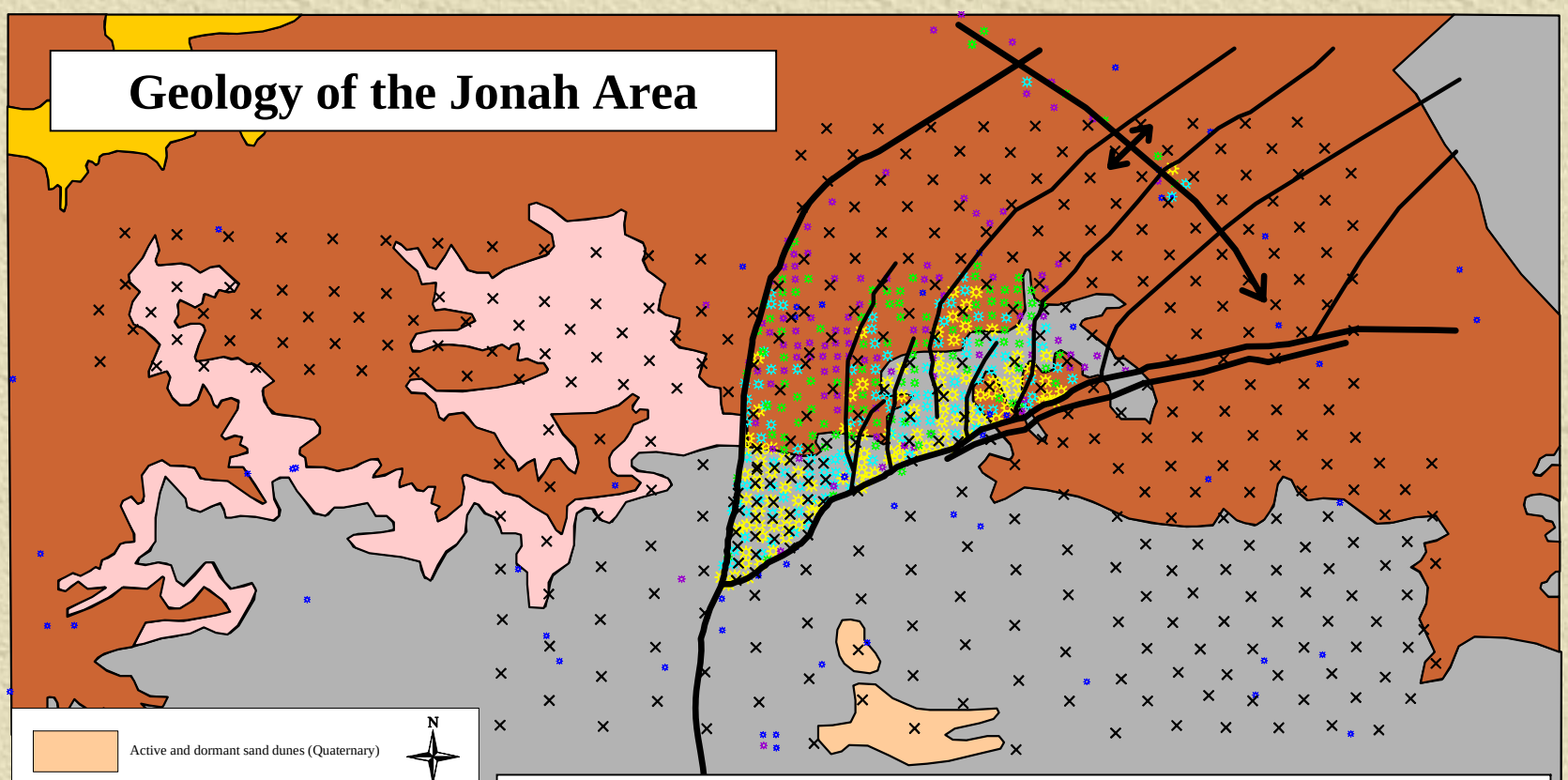
Geology of the Jonah Area



Produced Gas Composition (DuBois et al. 2004)

C1	C2	C3	iC4	nC4
91.56	4.96	1.54	0.34	0.33
iC5	**nC5**	**C6+**	**N2**	**CO2**
0.12	0.10	0.08	0.20	0.77

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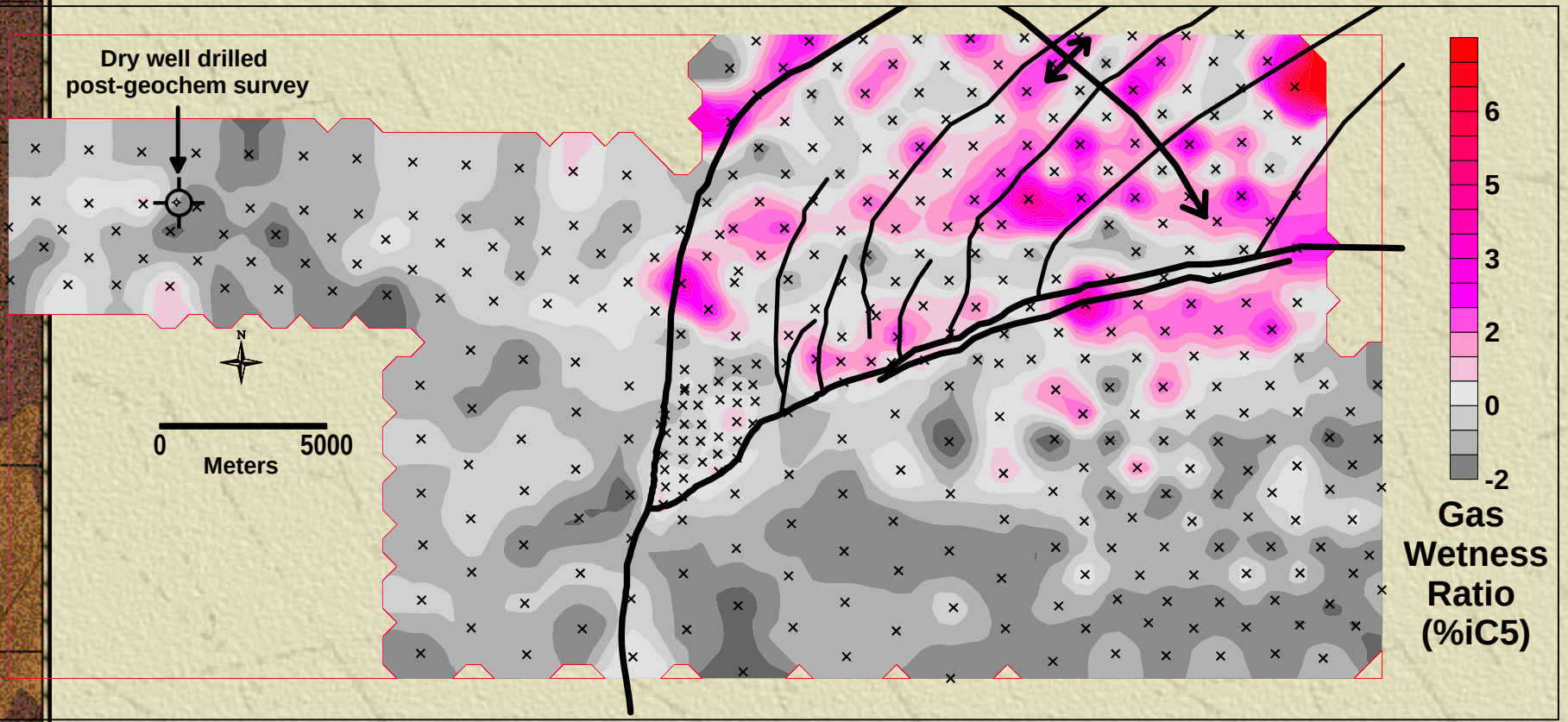
Spatial Correlation of Hydrocarbon Anomalies and Overpressure



Structural Geology (Hanson et al. 2004)

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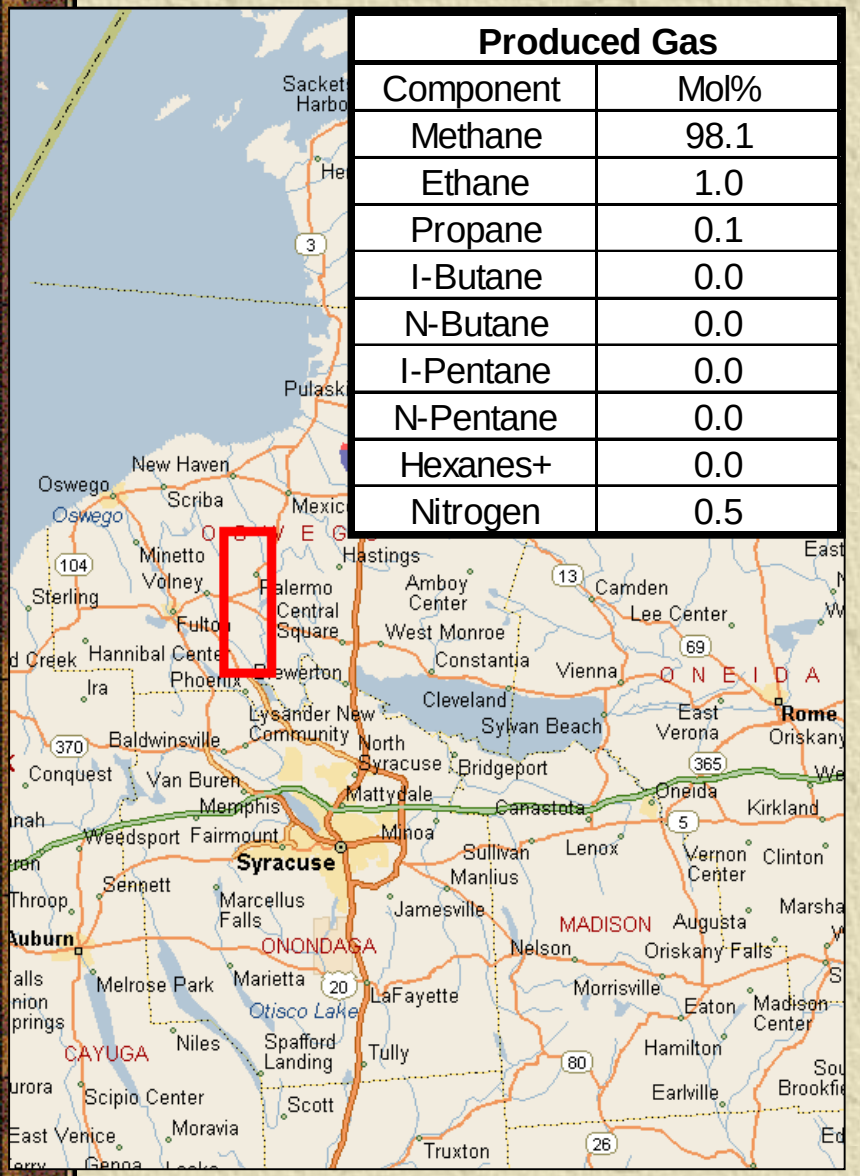
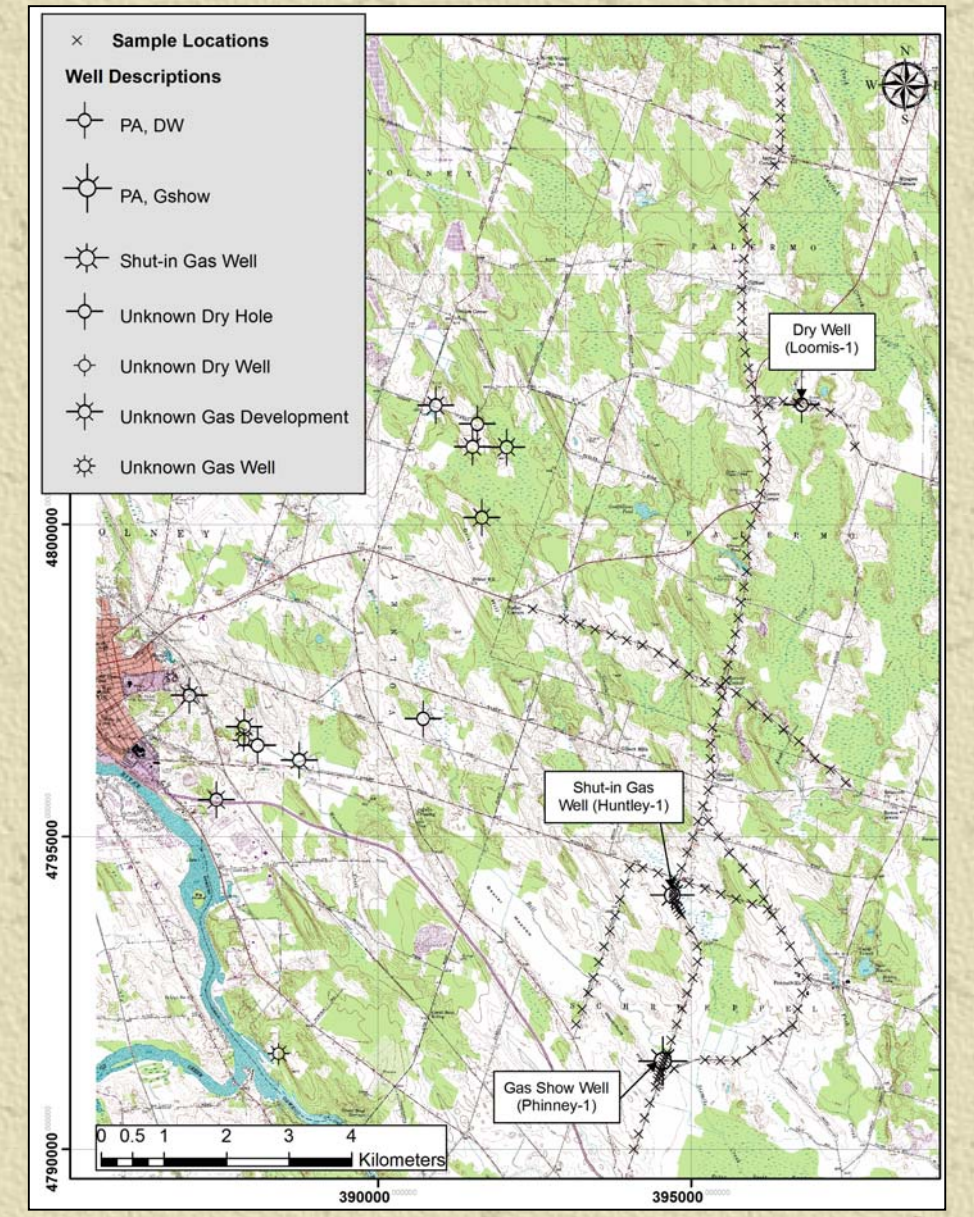
Geochemical Survey Over Fractured Trenton Gas Play, Northern New York

Produced Gas	
Component	Mol%
Methane	98.1
Ethane	1.0
Propane	0.1
I-Butane	0.0
N-Butane	0.0
I-Pentane	0.0
N-Pentane	0.0
Hexanes+	0.0
Nitrogen	0.5





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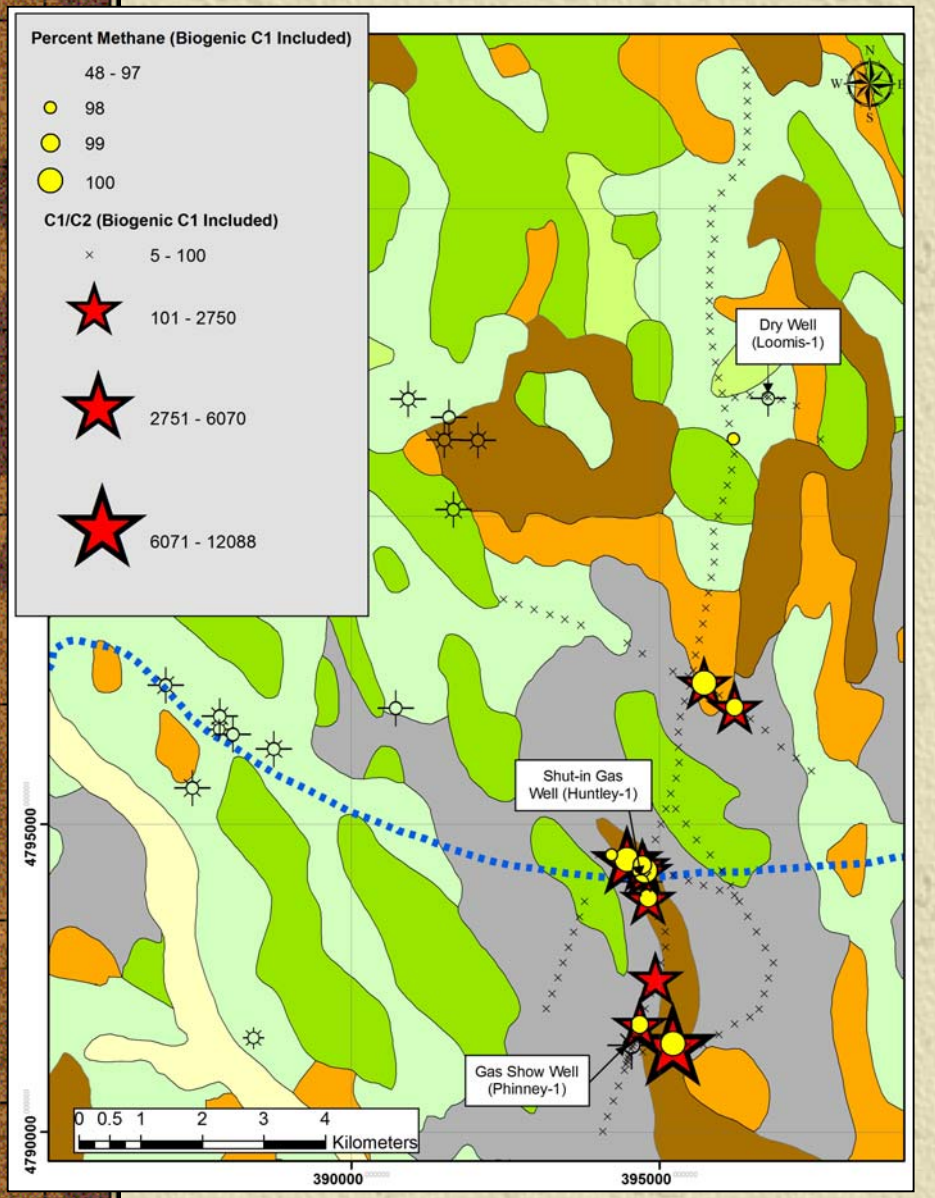
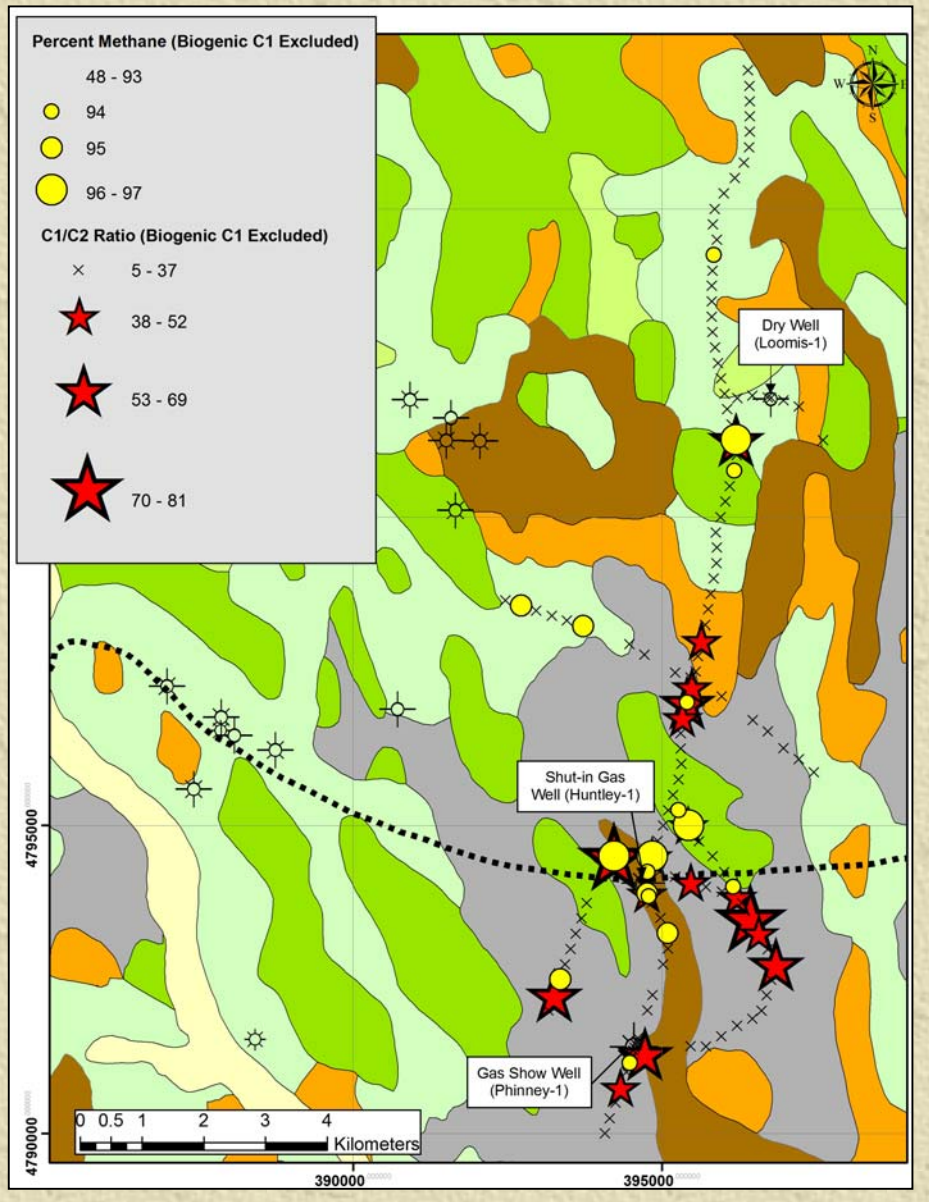
Biogenic Methane – Deep Soils



Thermogenic Methane – Deep Soils



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Problems "Attributed" to Oil & Gas Development

- Loss Of Property Value
- Declining Water Well Quality
  - Sulphurous smell
  - Corrosive to Plumbing
  - Discolored, Tastes Bad
- Declining Water Well Yields
- Dissolved & Free Methane or BTEX in Water Well
- Greatest Public Concern/Fears Regarding:
  - HYDRAULIC FRACTURING – Communication With Surface
  - METHANE EXPLOSIONS
  - SURFACE DISPOSAL OF PRODUCED WATER (Coal Bed Methane Production)

What is a Baseline Survey?

- Documents Environmental Conditions Prior to Drilling & Monitors Changes During Development or Exploration
- Provides Opportunity to Document & Gain Valuable Information
  - Natural Gas Seeps
  - Water wells (static water levels and quality)
  - Capture Local/Traditional Knowledge
- Provides Basis For Managing Complaints
  - Assign Accountability and Responsibility
  - Legal Recourse
- Requires Consistent Sampling Protocols And QA/QC
  - Reliable Forensics Depends On It
  - Legally Defendable

Benefits to Oil & Gas Producers

- "Insurance" for Potential Litigation Following Development
- Ensure Safe Drilling Sites
  - (i.e. Find Explosive Levels of Methane)
- Improve Community Relations
- Save $$$$ on Lost Gas Production from Leaky Infrastructure

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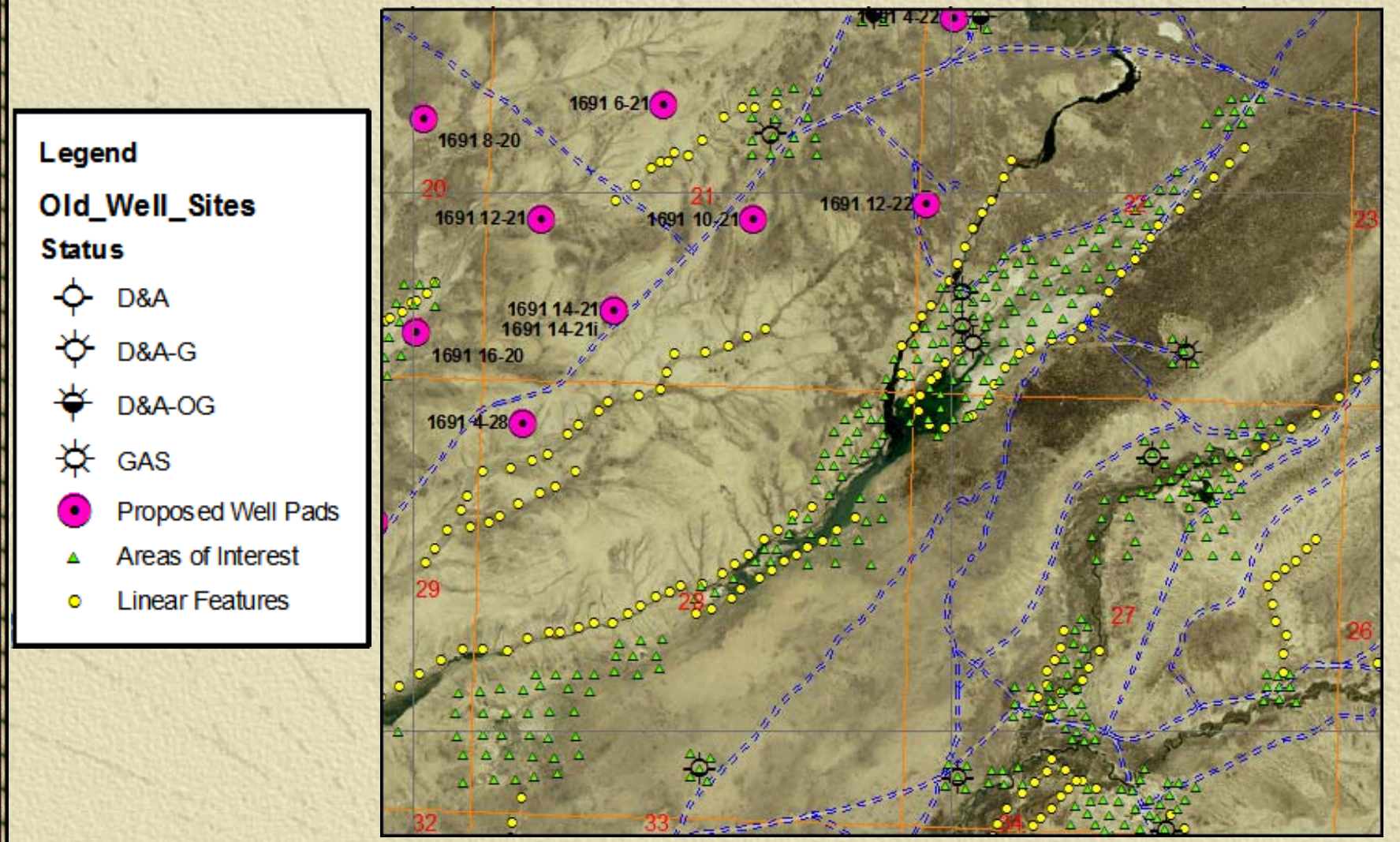
Baseline Measurements

- Air Photo Anomalies Inventoried
  - Stressed Vegetation
  - Lineaments
- Soil Gas Seep Surveys
  - Oil/Gas Wells & Infrastructure Leaks
  - Infrared Ambient Air Surveys
  - Foot FID/PID Ambient/Ground Seep Surveys
- Surface & Ground Water Observations
  - Domestic Well Chemistry
  - Natural Spring Chemistry
  - Surface Water (Streams, Ponds) Observations

Baseline Survey Progression
Identify Targets from Aerial Photography



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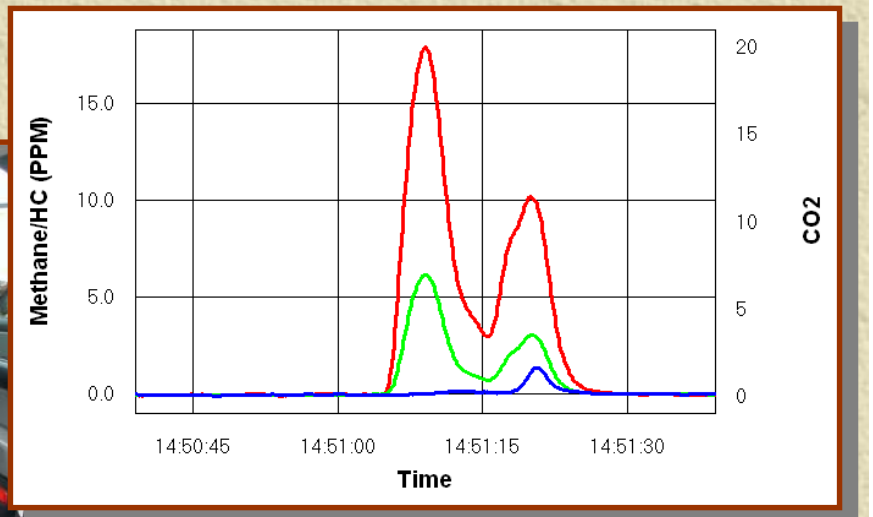
Ambient Air Methods
Mobile Infra-Red Spectroscopy

- Real-time sub-ppm airborne CH_4 , C_2+, CO_2
- <1-ppm sensitivity



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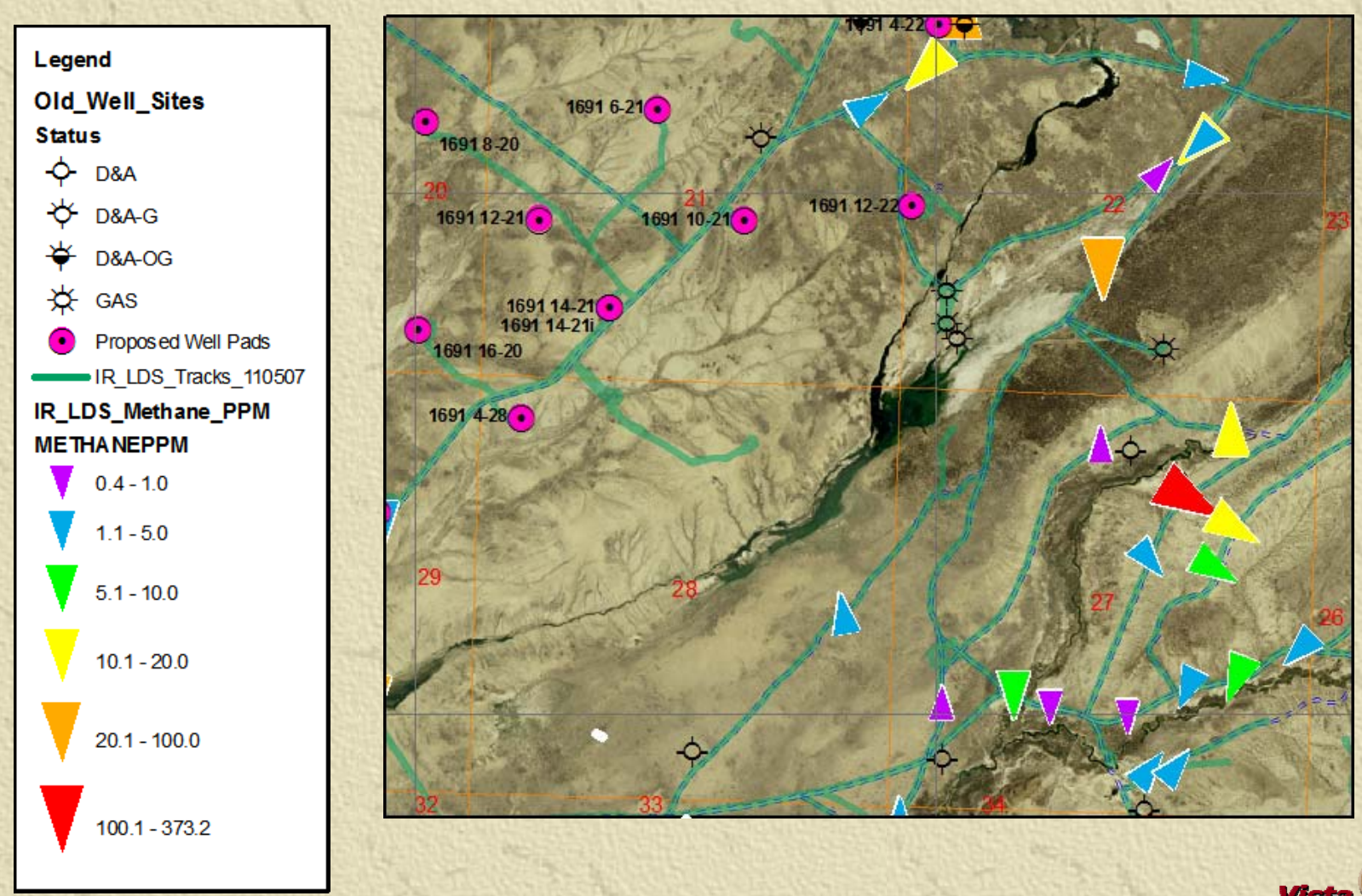
Baseline Survey Progression

Truck-mounted infra-red sensor survey



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Ambient Air Methods
FID/PID Survey

- FID/PID Gas Seep Surveys
- Unique & Rapid Method
- 1 ppm CH_4 Sensitivity

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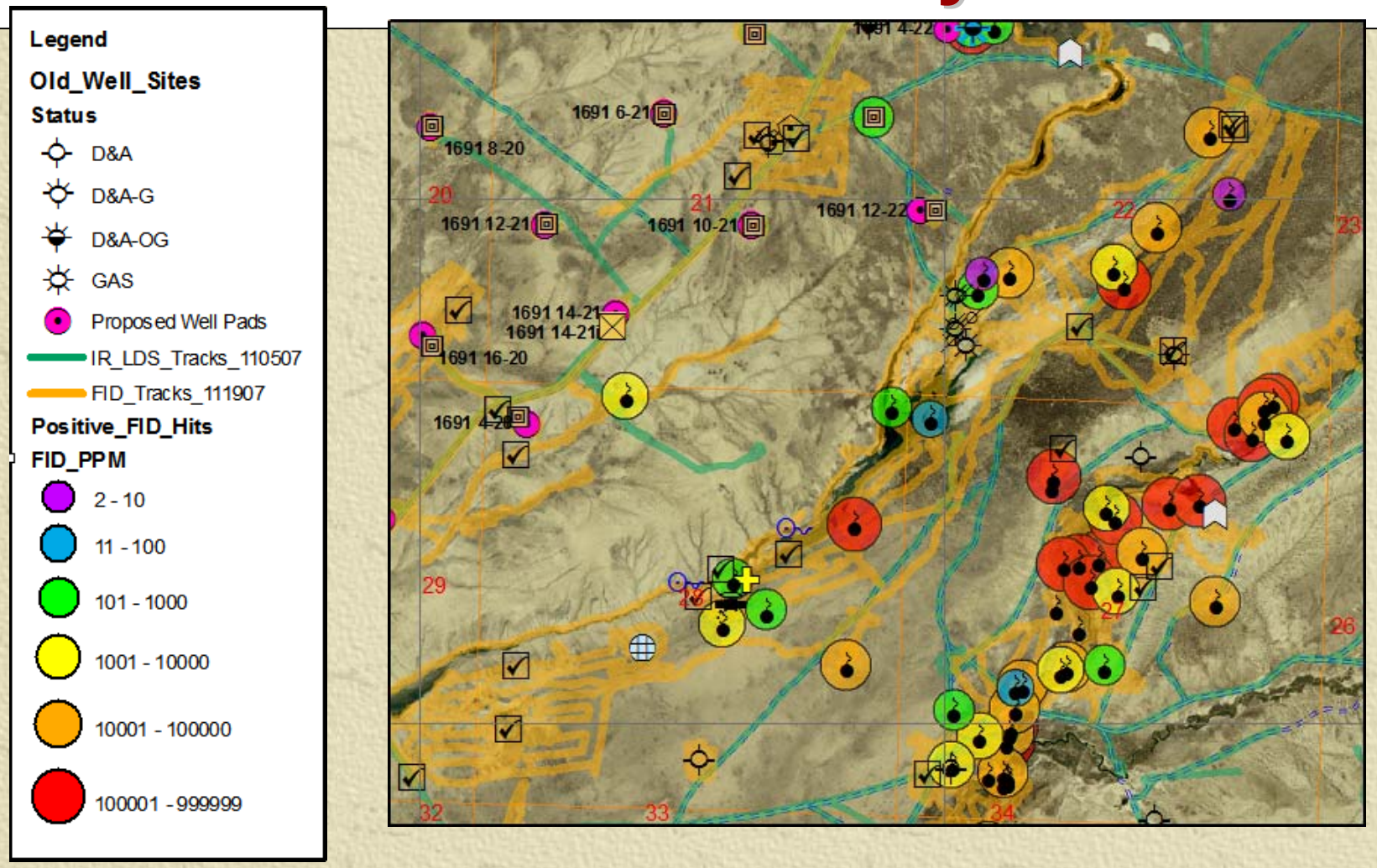
Baseline Survey Progression
FID/PID Survey



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Soil Gas Sampling Methods

- Hand Probe

- Hydraulic GeoProbe

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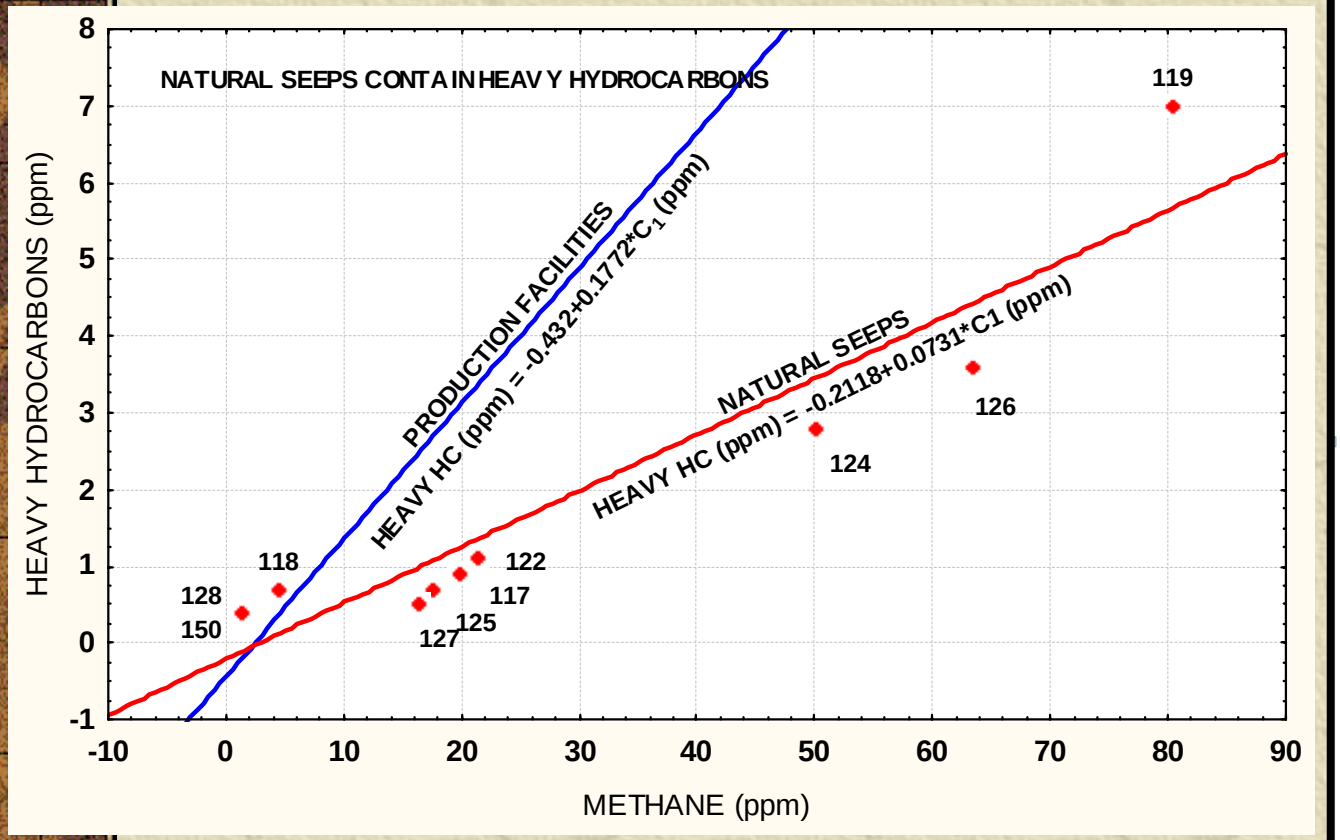
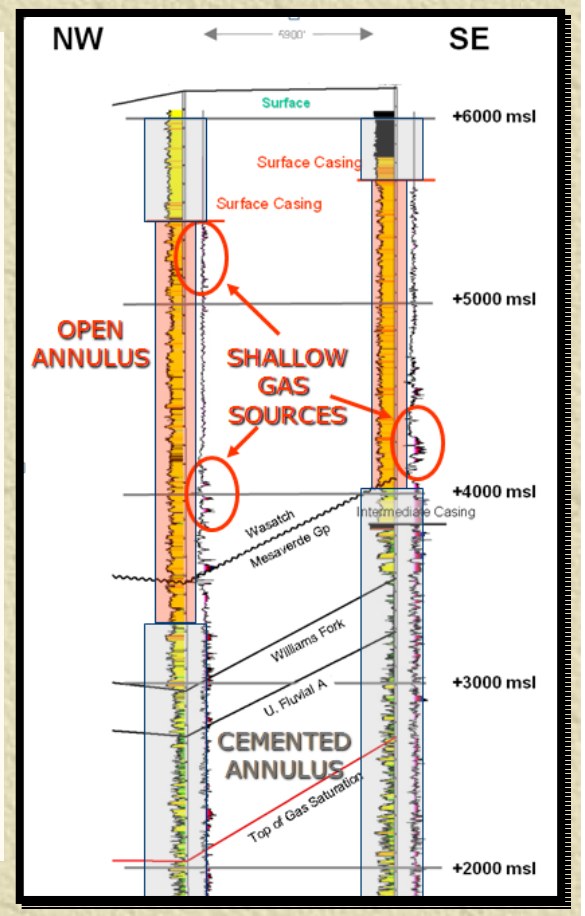
Source of gas seeps?





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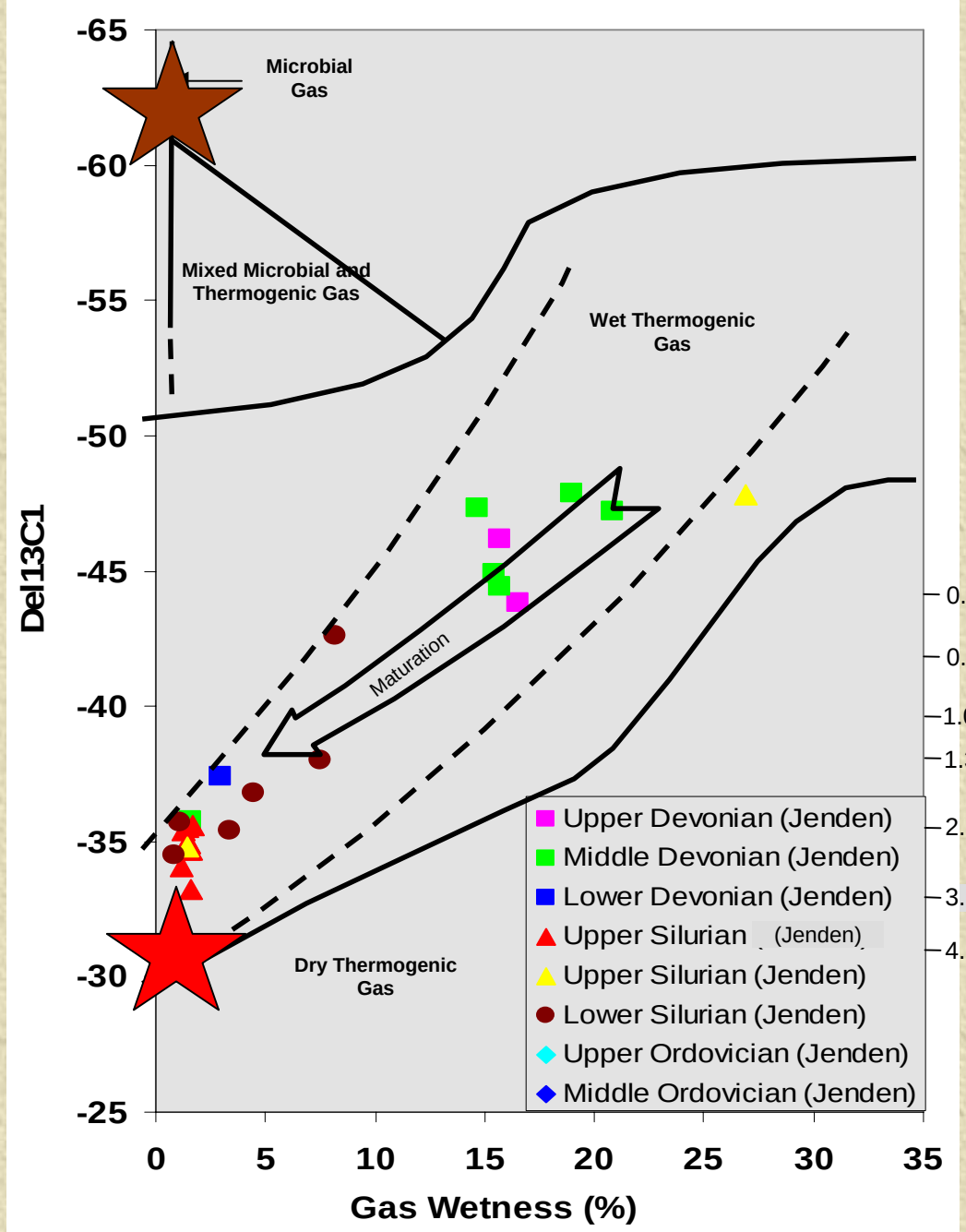
Composition of Appalachian Basin Gas



Biogenic surface gas seep

Thermogenic surface gas seep

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Summary

- *Geochemical surveys are complementary tools to reduce oil & gas exploration risk.*
- *Sample intervals are a function of target size.*
- *Wet gas and oil seeps over oil/gas fields.*
- *Oil-field Brines in HTD (Li, Mg, Sr, Ca, Br).*
- *Thermogenic methane seeps over dry gas fields.*
- *Baseline monitoring documents gas seeps and water quality prior to and during development, and it provides an "insurance policy" for oil & gas companies.*