

Maximize Mass Spectrometer Mud Gas Data - Experienced Analysis Matters*

Tracy Wicker¹

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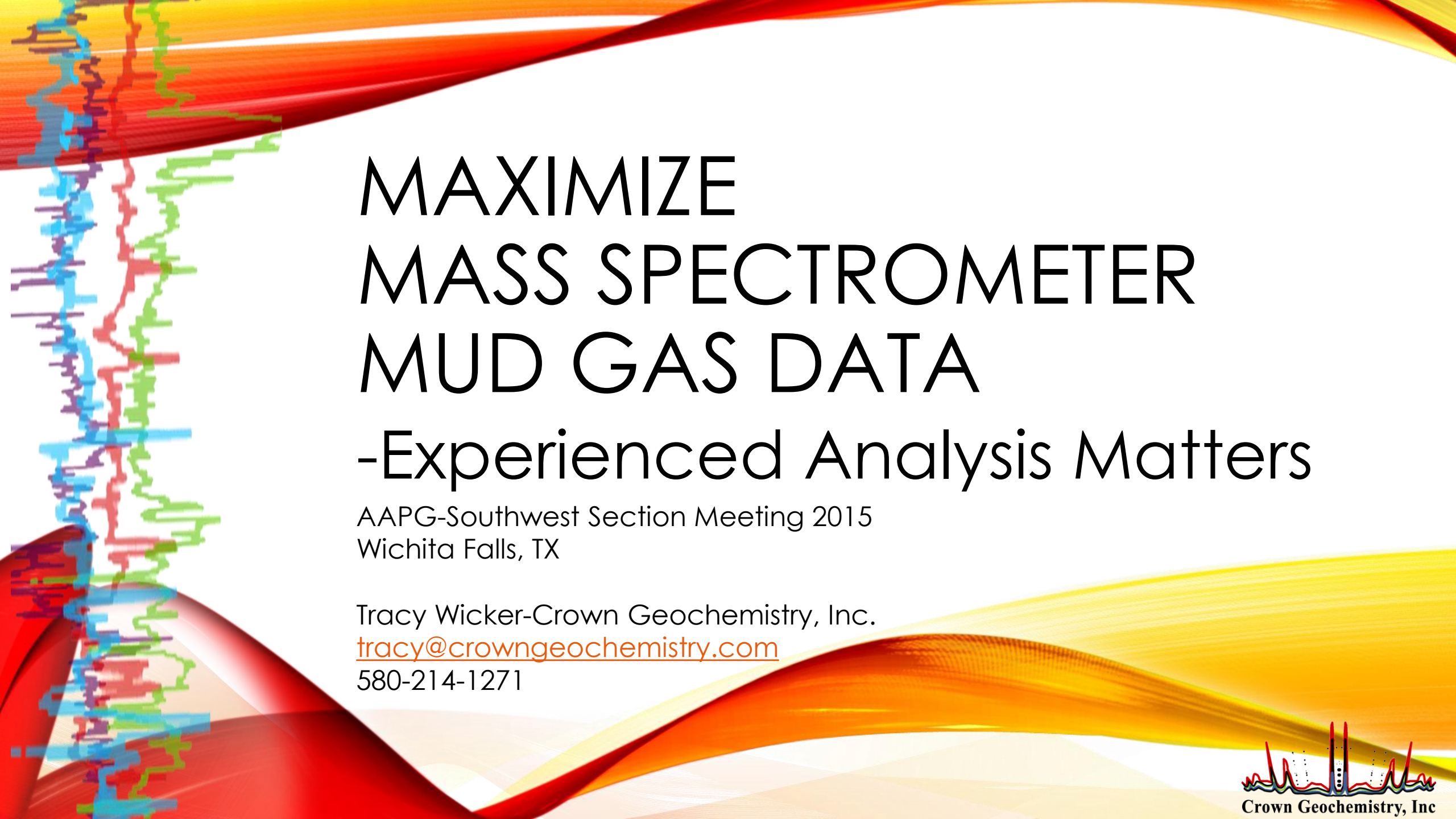
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¹Crown Geochemistry, Inc., Burns Flat, OK, USA (tracy@crowngeochemistry.com)

Abstract

Modern surface logging of mud gases at the well site while drilling often makes use of a mass spectrometer. Today's portable mass spectrometers have detection capabilities, which far exceed traditional gas chromatography. While the mass spectrometer's mud gas data provides a tremendous amount of information, it is not fully understood and greatly underutilized. The mass spectrometer gas curves can provide useful information given by more than visual inspection of individual curves, but a much greater understanding of their meaning and use comes with statistical analysis, ratios, cross-plots, and experienced interpretation.

Statistical analysis of mud gas data can reveal reservoir qualities not otherwise readily observed. For example, normalizing mud gas values and direct comparison with various molecular weight species can begin to characterize hydrocarbon compositions and isolate zones of interests. Standardizing mud gas values and comparison with rate of penetration can establish a mean value across a well's data set and allow gas curves to be evaluated as they deviate from average, which can be indicative of particular "sweet spots" or even depleted sections. Applying gas component ratios and cross-plotting the mass spectrometer data set provides convincing evidence for zones of "likeness" or "unlikeness" which may signal compartmentalization, compositional variations, water saturation, secondary porosity/permeability and other notable geologic conditions.



MAXIMIZE MASS SPECTROMETER MUD GAS DATA -Experienced Analysis Matters

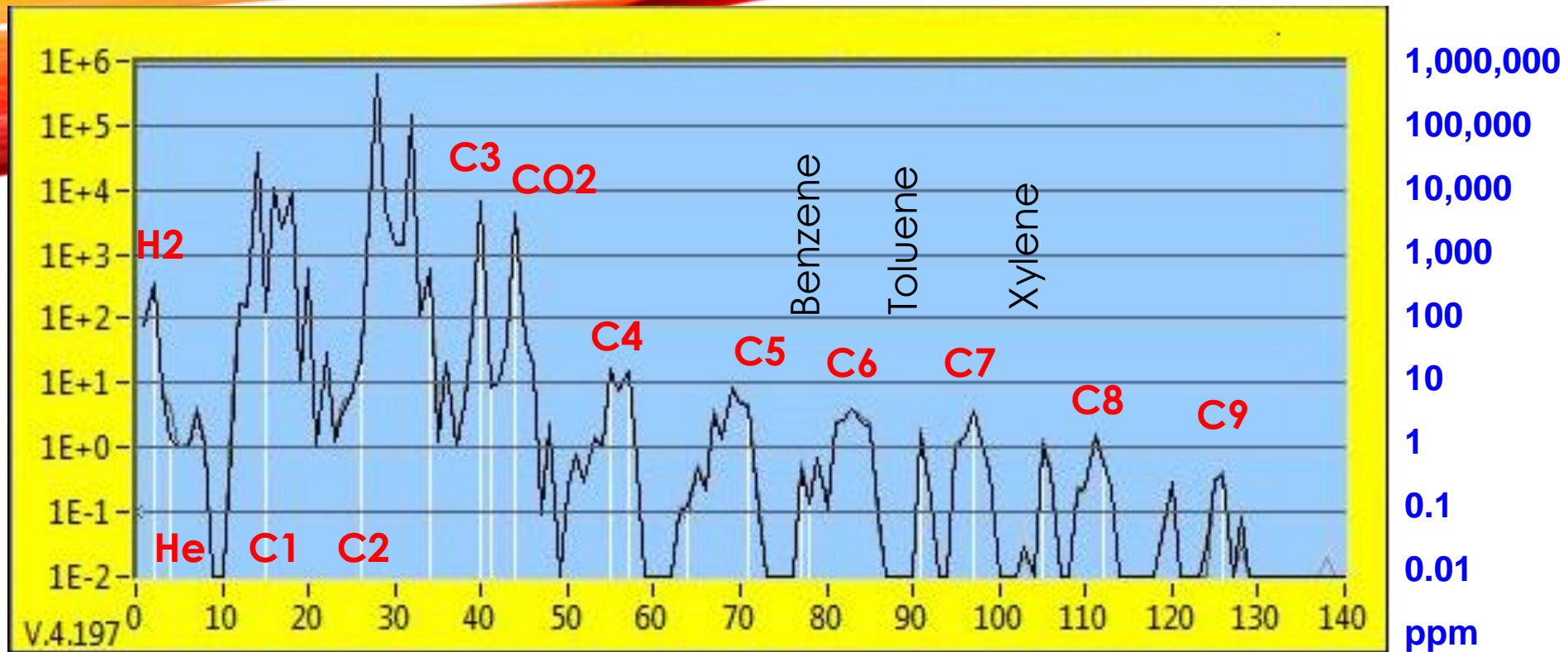
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Tracy Wicker-Crown Geochemistry, Inc.
tracy@crowngeochemistry.com
580-214-1271

COMPARISON OF GAS DETECTION DEVICES

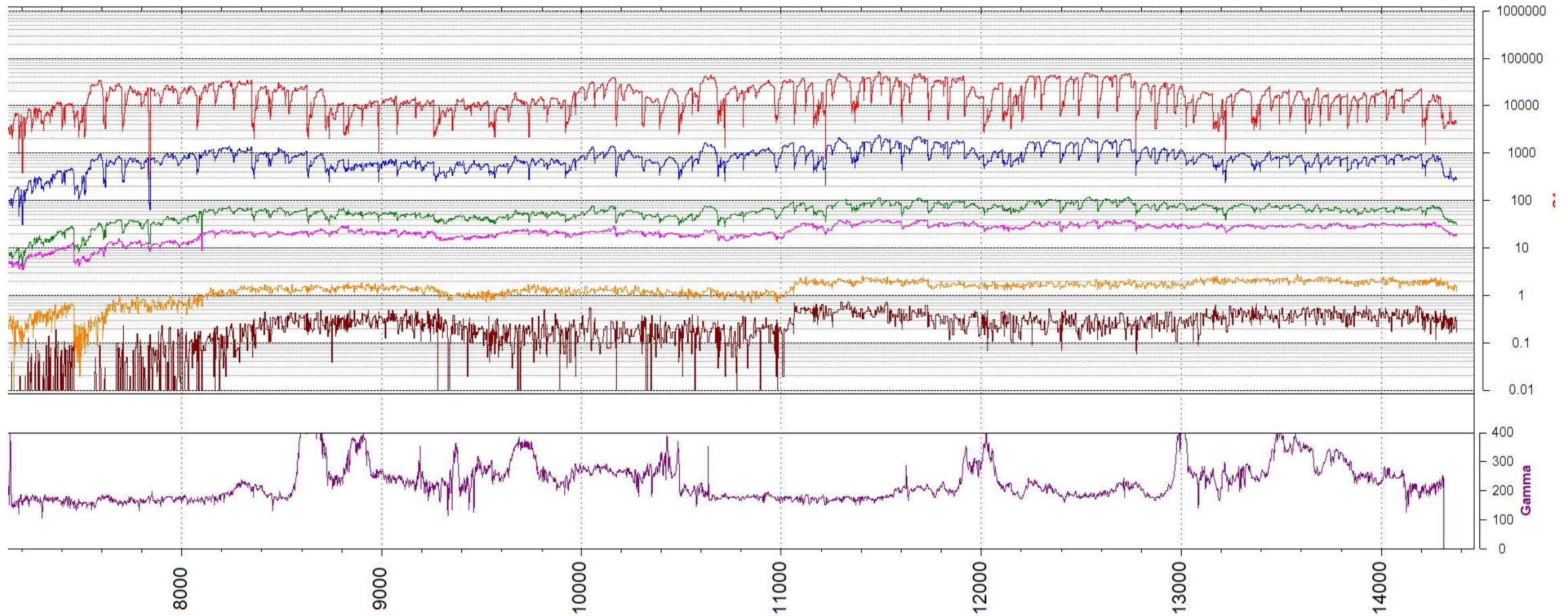
	Hydrocarbons										Inorganics and Atmospherics						Relative Sw Indicators				Sulfurs			
						Oil Indicators																		
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	He	H2	CO2	N	N2	O2	Benzene	Toluene	Xylene	Acetic Acid	CS2	SO2	SO	H2S
FID GC																								
Pason Gas®																								
GC Tracer™																								
DQ1000™																								

- DQ1000™ mass spectrometer is patented by FIT, Inc.

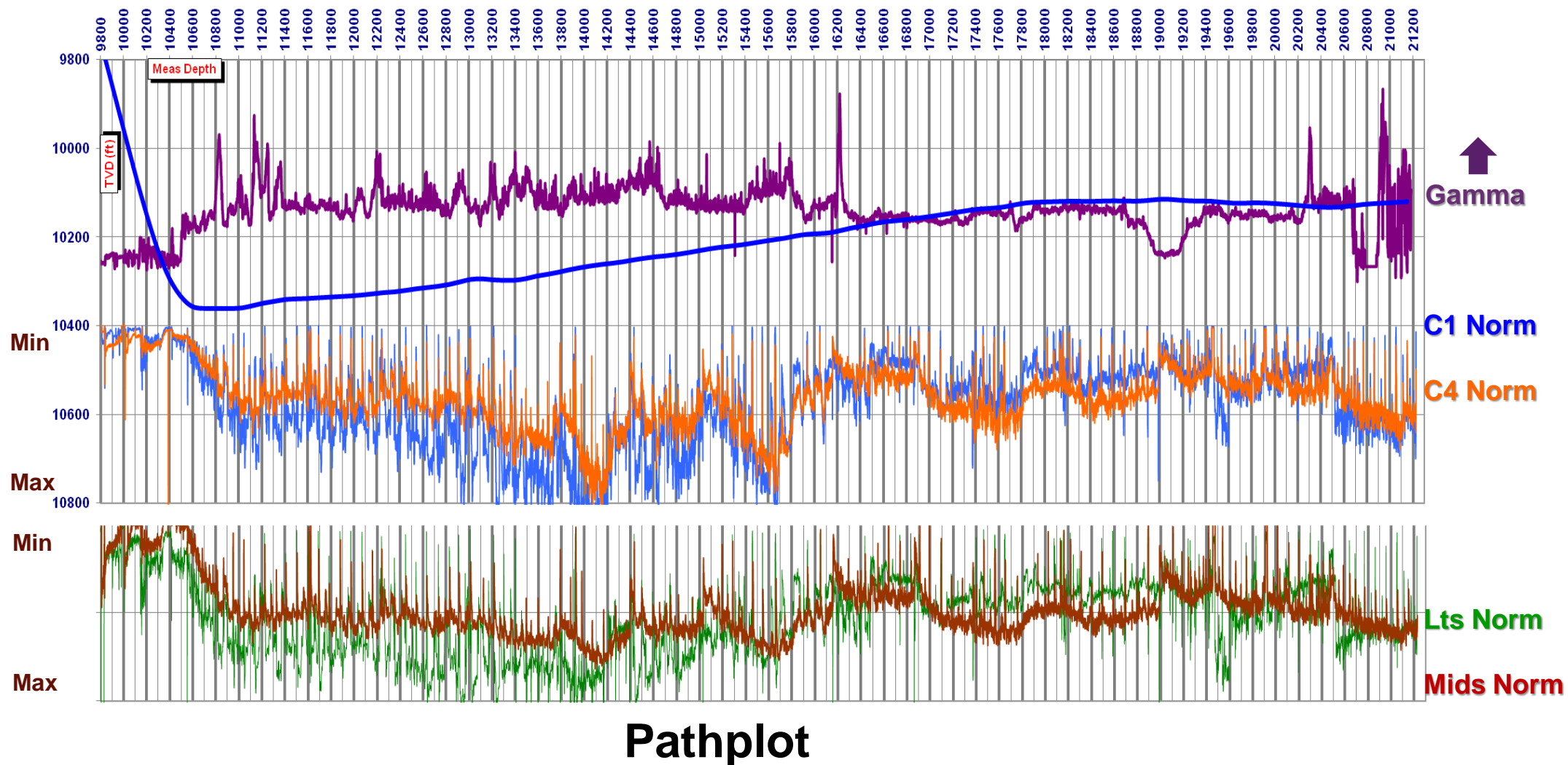


- Volatile components of mass/charge ratio 2-140 amu
- The scale is set closely approximate to ppm; linear.
- The range is about 7.5 orders of magnitude, which is 2–3 times the range of other field devices.

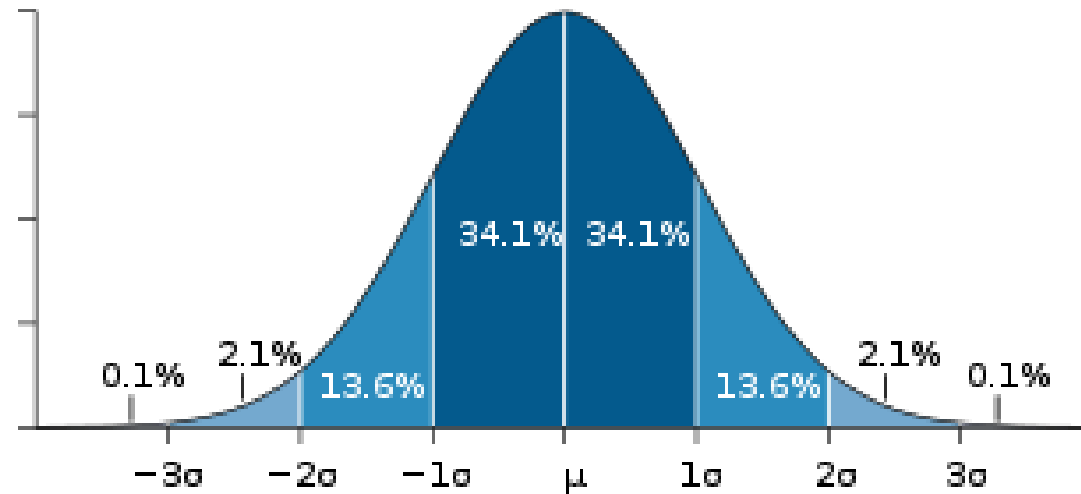
UNTREATED GAS CURVES



NORMALIZATION OF CURVES FOR VOLUME COMPARISON

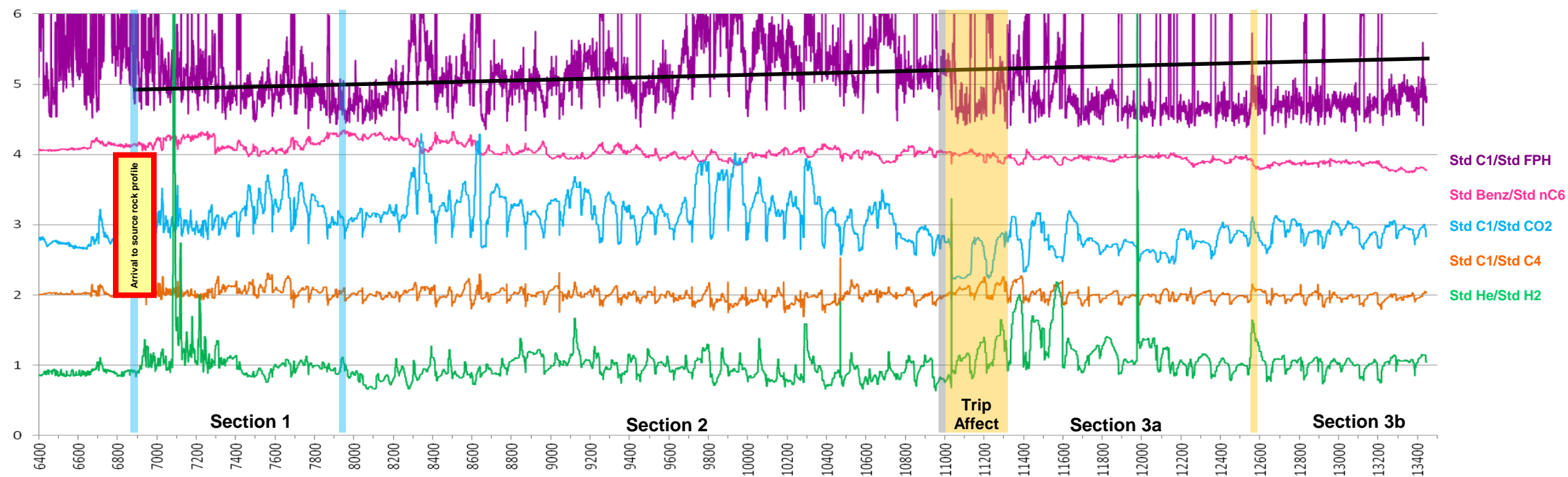
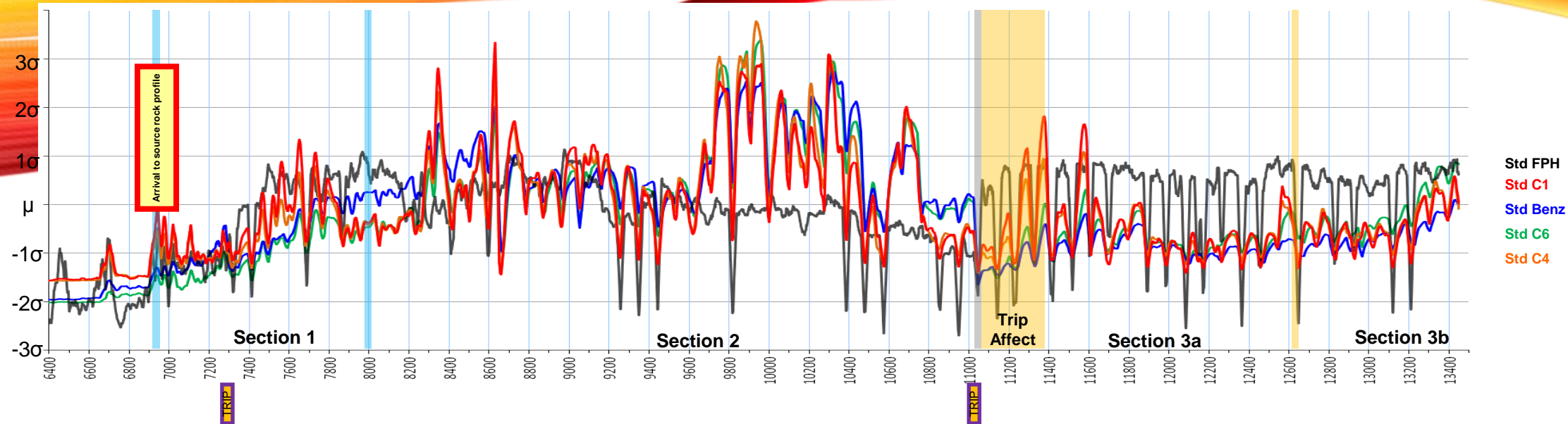


STANDARDIZING CURVE DATA TO ESTABLISH PROPORTION TO ONE ANOTHER



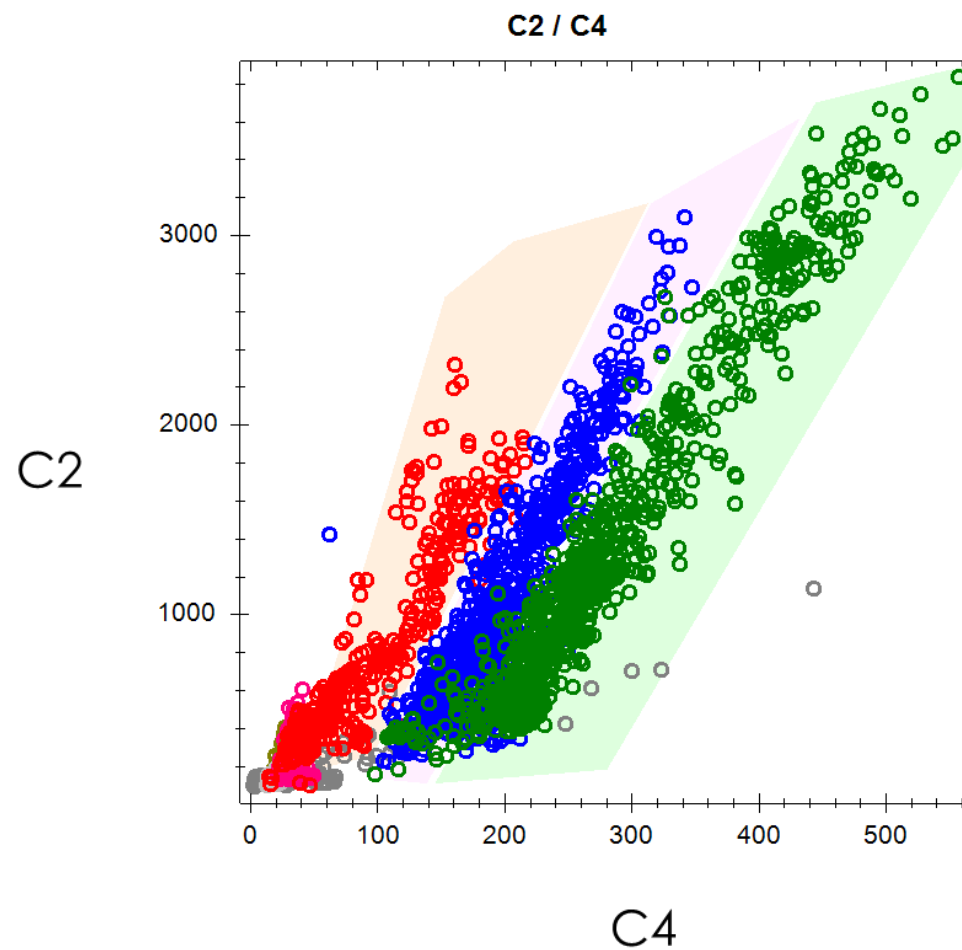
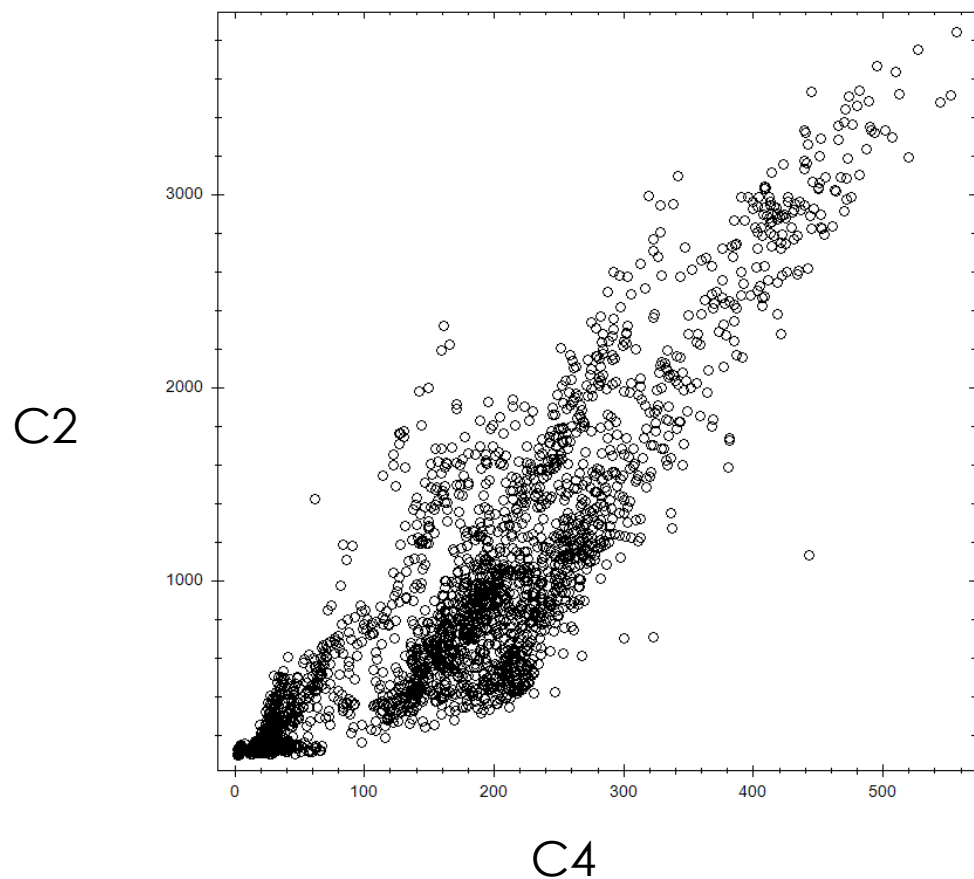
Increasing methane values

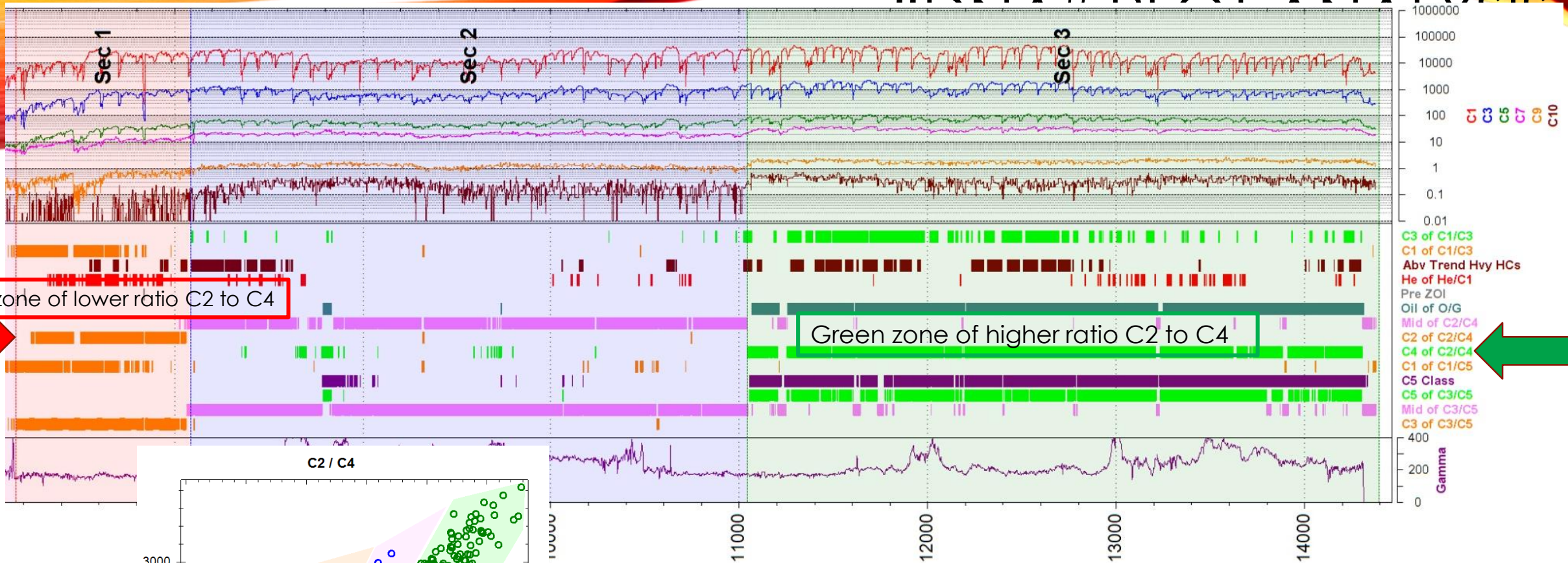
Number of entries at each value



Standardized Data Plot

CROSS PLOT ANALYSIS

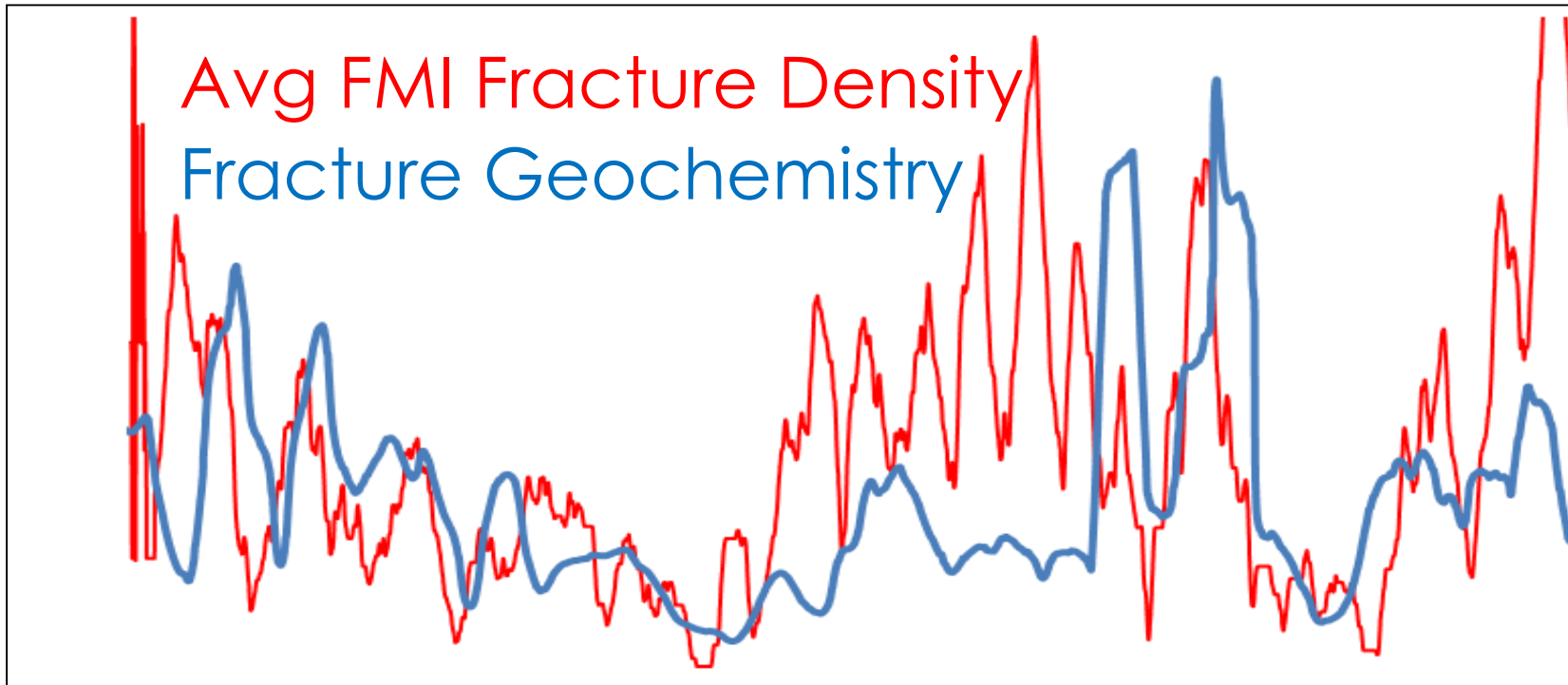




Area Selectors (left)-identify data points with “like” ratio

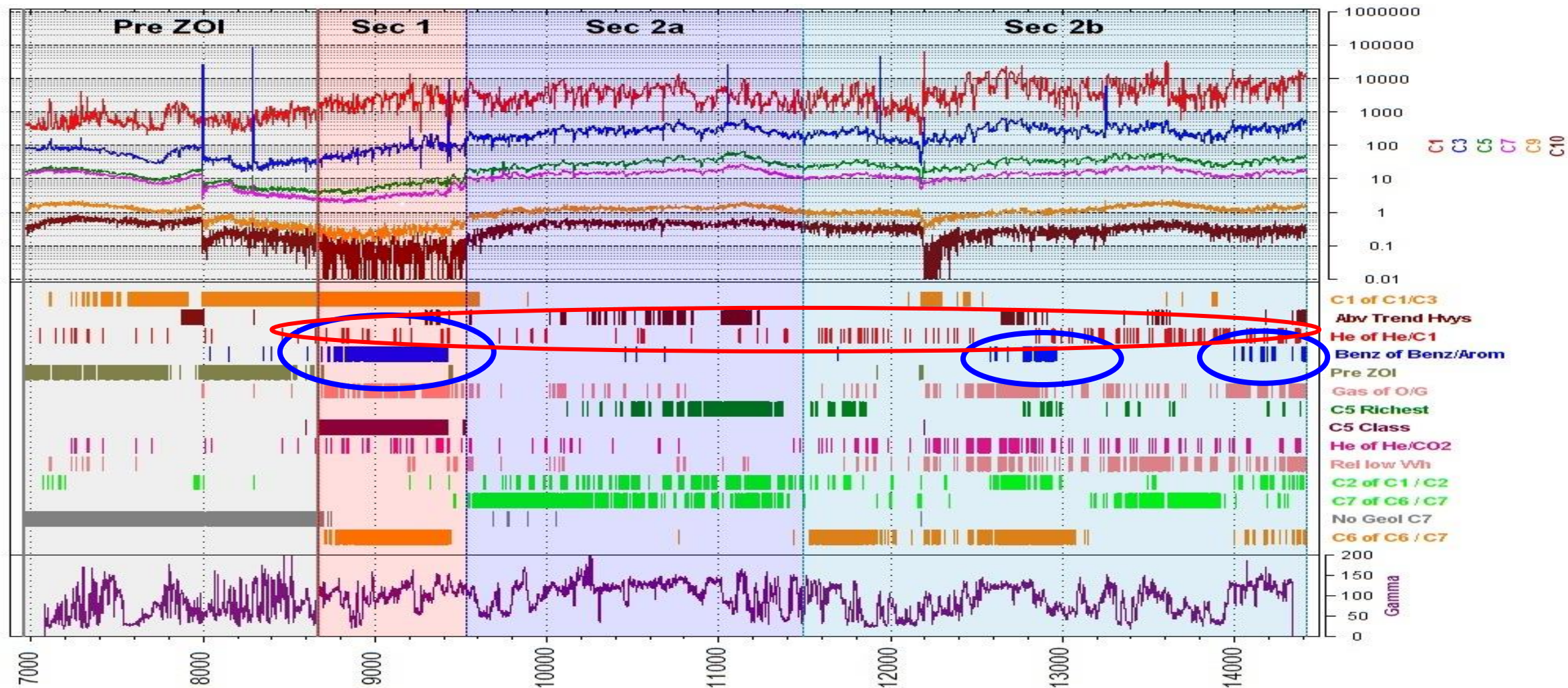
Range Selectors (above)-show where points of “likeness” occur within footage

FRACTURE CHEMISTRY PROFILE

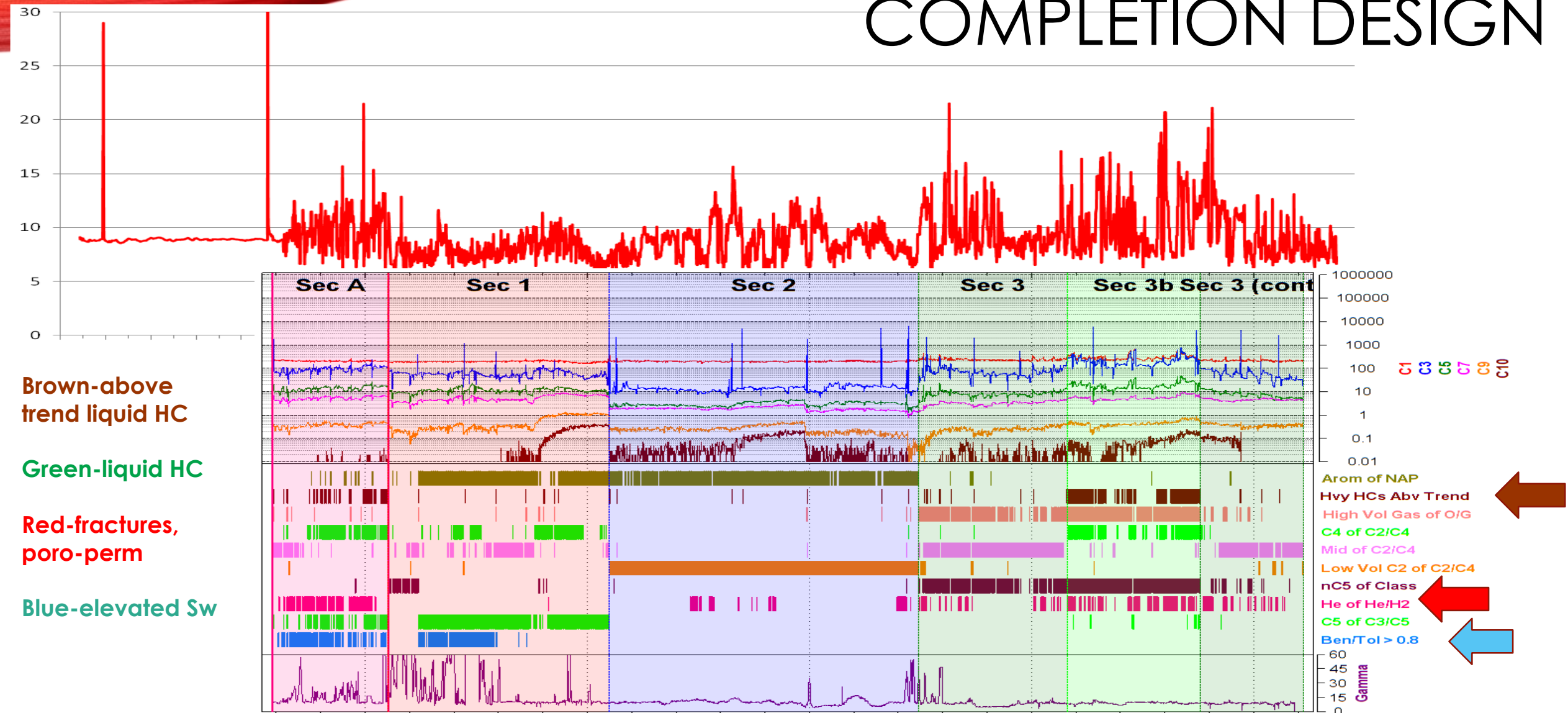


- Proprietary Fracture Geochemistry curve correlates well with FMI data
- Applicable in all lithologies, mud systems, and vertical or horizontal well bores.

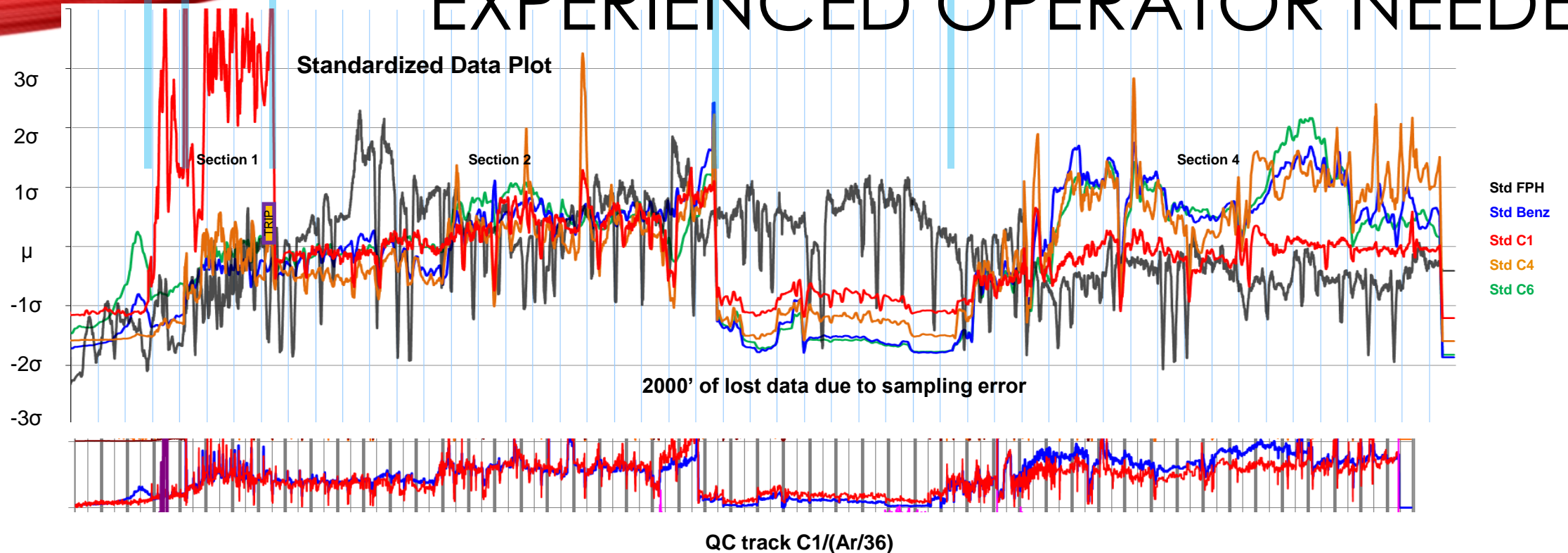
ELEVATED SW AND SECONDARY PORO/PERM



RESERVOIR EVALUATION AND COMPLETION DESIGN



EXPERIENCED OPERATOR NEEDED



Poor sampling-lost almost 2000' of data
Need 24/7 quality control by remote monitoring
C1/(Ar36) ratio used to distinguish poor sampling versus depleted zone.



CONCLUSIONS- EXPERIENCE MATTERS

- Proper sampling, QC monitoring 24/7
- Volume normalization filters out rig artifacts
- Standardization allows for relative curve activity comparison
- Cross plots locate zones of “likeness” with a reservoir
- “DNA” plots can indicate “sweet spots”, depletion, elevated Sw, fracture/poro-perm complexes, flow compartments, compositional variations, and hydrocarbon character.
- In addition to reservoir evaluation, provides insight to improve completion design.

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