


Investigation of Clay Content as Being a Cause for Suppression of Pyrolysis Tmax Maturity Data in the Wolfcamp B

AAPG 2019 International Convention & Exhibition, Buenos Aires, Argentina August 27th-30th

Nikolaus Svihlik¹, Albert Maende², & Mathew Riley³

1. Impac Labs, Midland, TX, United States
2. Wildcat Technologies, Humble, TX, United States
3. Headington Energy Partners, LLC, McKinney, TX, United States

1



Outline

- Assess Well for Organic Richness and Economical Production
 - Perform XRD, XRF, and Pyrolysis on 10' cuttings
 - Outline Zones of Interest
- Determine Cause of Thermal Maturity Regression
 - Primary Cause Influenced by Clays, Depositional Environment, or Hydrocarbons
- Mass Spectrometry
 - Used During the Drilling Process
- GC-MS
 - Analyzed Produced Fluids for CCLD (Whole Oil) During the Different Stages of Production (Not Included in Presentation)

2

Location of Study

- Delaware Basin
- Wolfcamp A – Wolfcamp B
- 1700' Vertical Section
- 10' spot samples
- OBM

PERIOD	SERIES	DELAWARE BASIN FORMATION
LEONARD	GUADALUPE	LAMAR BELL CANYON
		REBUSBY CANYON
		UPPER AVALON SHALE
		LOWER AVALON SHALE
		1ST BONE SPRING
		2ND BONE SPRING
		3RD BONE SPRING
		WOLFCAMP
WOLFCAMP		WOLFCAMP
PENN		PENNSYLVANIAN

PERIOD	SERIES	CENTRAL PLATFORM FORMATION
		KANSIEL
		YATES
		RIVERS
		SPRABERRY
		SAN ANTONIO
		GLOBIFIA
		PAIDRA
		BLINERY
		WUB
		ABO
		DEFENSE
		HULLOG
WOLFCAMP		WOLFCAMP
PENN		PENNSYLVANIAN



PERIOD	SERIES	MIDLAND BASIN FORMATION
		KANSIEL
		YATES
		RIVERS
		SPRABERRY
		SAN ANTONIO
		GLOBIFIA
		UPPER LEONARD
		UPPER SPRABERRY
		LOWER SPRABERRY
		DEAN
WOLFCAMP		WOLFCAMP
PENN		PENNSYLVANIAN

3

Wolfcamp Deposition

- Distal Portion of a Semi-Enclosed Basin
- Siliclastic and Carbonate Primarily Gravity Fed
- Carbonate Beds Mapped to the Central Basin Platform



4

Analysis Overview

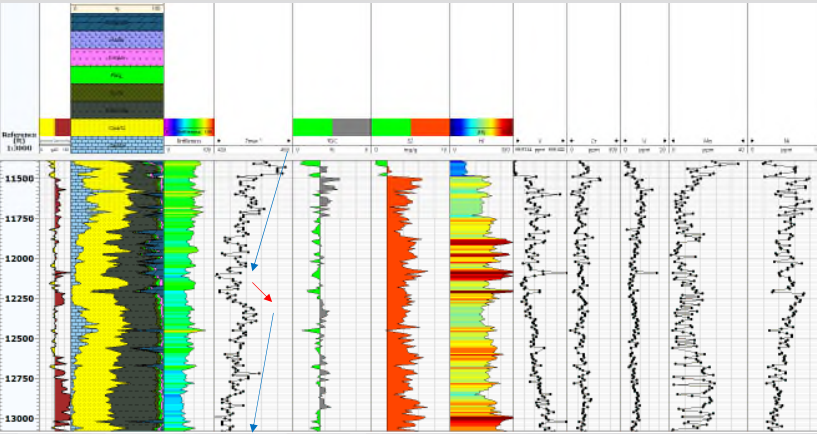
- Pyrolysis- Samples were cleaned with DCM (Dichloromethane)
 - Samples were analyzed using classical pyrolysis methods with two heating stages and one oxidization stage.
 - Instrument: Wildcat Technologies, Hawk
- XRD Bulk and Clay
 - Measurements were performed on 4-micron homogenized samples.
 - Powder was used for direct bulk measurement
 - Clays were performed using the Reynolds Method
 - Instrument: Bruker D2
- XRF
 - Homogenized material were pressed into a 35mm pellet
 - Samples were evaluated for 12 major elements and 20 trace elements
 - Instrument: Bruker S2 Ranger

5






Completed Analysis

- Double Decline Curve for Tmax
- Thermal Maturity Ranges from Gas Window (11500') to Early Oil Window (13000')
- Decline Boundary Defined by Carbonate (12300')
- Organics: S2 average 4.51 mg HC/g, TOC average 2.06%
- Hydrogen Index average 221 (Mixed Kerogen System)

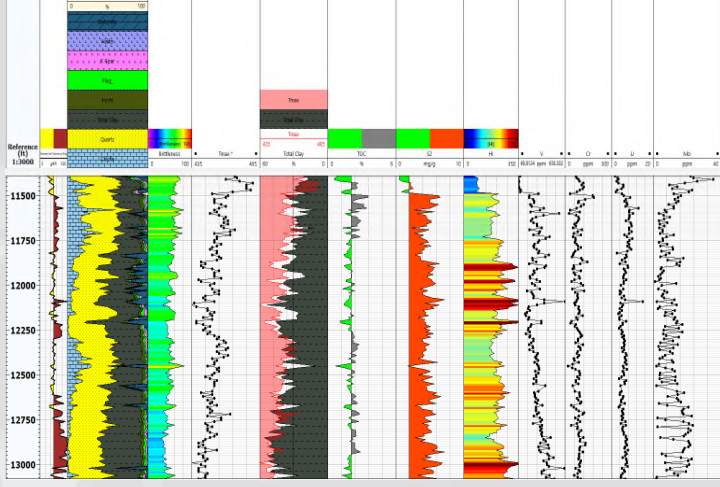


6






Causes for Tmax Regression

- Elemental Markers for Activity After Deposition Showed No Correlation.
- Separated Total Clay Track from Mineralogy and Overlaid with Tmax Track.
- Was it the clay composition that affected the Tmax or an absorption factor with Heavier Oils being trapped?
- Next Step is Clay Speciation and Hawk-PAM to determine the primary cause



7

Path to the Answer

Tmax Regression

Heavy Hydrocarbon Impact

- Classical Pyrolysis
- Hawk-PAM

↓

Hydrocarbon Generation Control

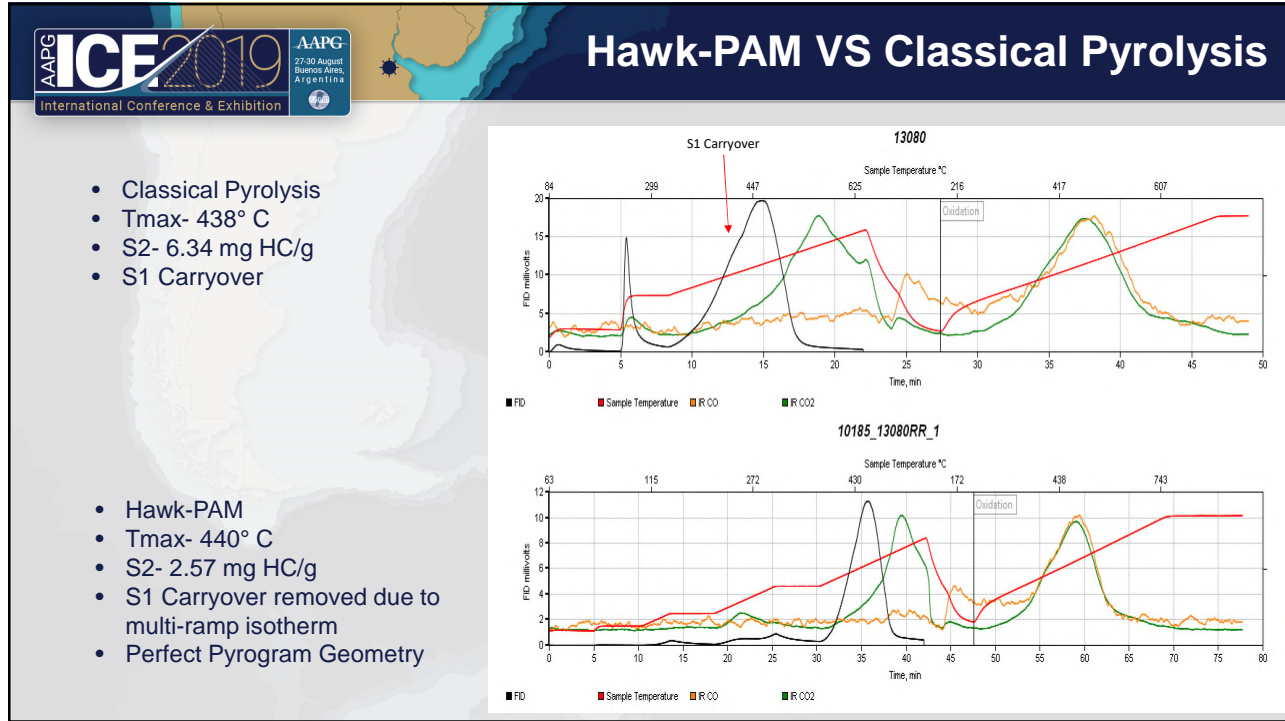
Clay Impact

- Total Clay the Driver
- Clay Species a Factor


↓

Depositional Controls (Distal Environment)

8



9



AAPG ICE 2019
International Conference & Exhibition

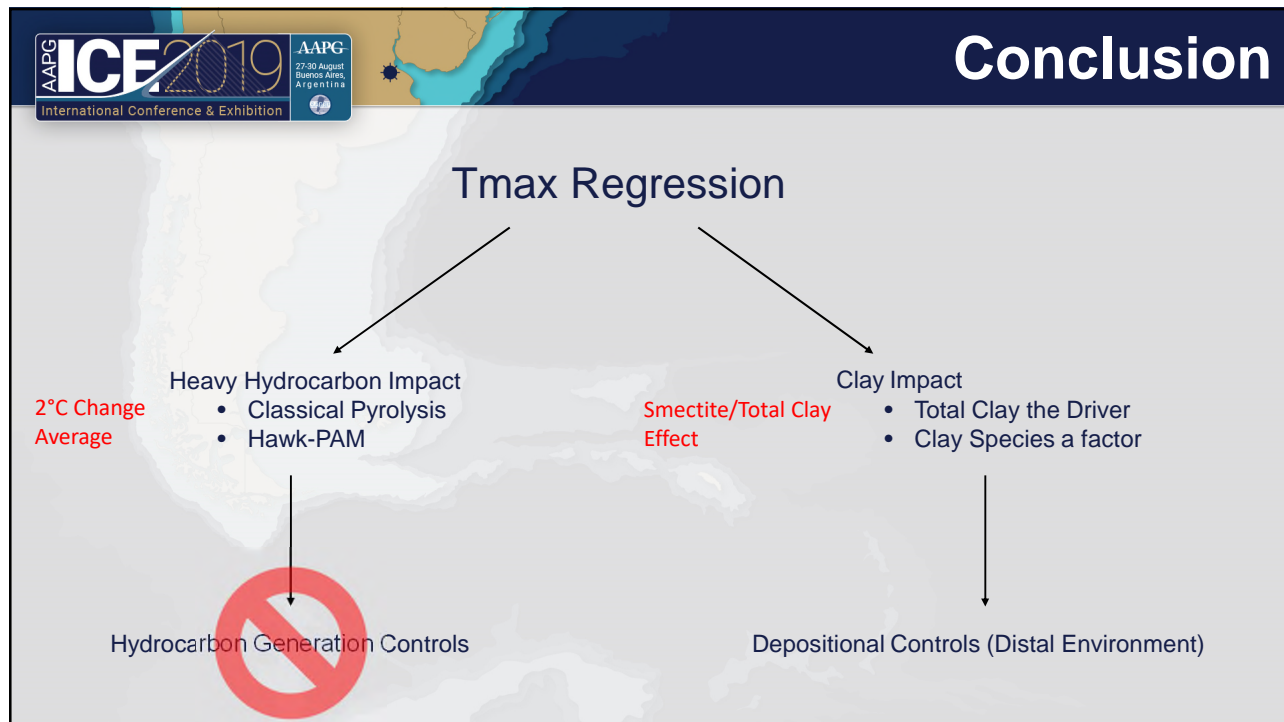
AAPG
27-30 August
Buenos Aires,
Argentina

Clay Speciation

Measured Depth	Sample Type	Hole Section	Biotite	Calcite	Dolomite	Siderite	Quartz	K-Spar	Plag.	Pyrite	Halite	Marcasite	Total Clay	Chlorite	Kaolinite	MM	I/S	Q+F	Carbonates	Others	Clays	Tmax	
Feet			%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	°C
1	Cuttings		37.8	2	1	Tr	41	2	2	4	0	0	48	1.1	0.239	33.9	12.8	45	3	4	48	441	
2	Cuttings		38.8	3	1	Tr	41	2	2	4	0	0	47	1.3	0.239	37.2	8.2	45	4	4	47	446	
3	Cuttings		38.5	2	1	Tr	41	2	3	3	0	0	48	1.5	0.375	34.3	11.8	46	3	3	48	441	
4	Cuttings		33.9	2	Tr	Tr	38	1	3	3	0	0	53	3.0	0.544	35.8	13.7	42	2	3	53	438	
5	Cuttings		35.7	5	Tr	Tr	38	1	2	3	0	0	51	1.1	0.182	41.6	8.1	41	5	3	51	440	

- Consecutive Depths Analyzed to Determine the Different Clays Present
- I/S is the Smectite (Swelling Clay) Portion
- Smectite Percentage is a Partial Controller of the Tmax Regression
- There is Variance Throughout the Entire Well for Smectite Percentage Though the Correlation is Weaker in Other Sections of the Well
- SEM Images Were Used to Verify the Clay Structures Based on the XRD Data

10



11



12