Caribbean Source Rocks & Oils

Brief: "*Is there a regional play of some sort in the Caribbean*?"

Source rocks: "*What's the distribution of the La Luna, is there an Albo-Aptian source rock?*"

CaribX

Finding Petroleum,
Geological Society, London,
October 21, 2016.
Chris Matchette-Downes,
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North coast Cuba production
Offshore Cuba exploration
Dominican Republic oil seeps

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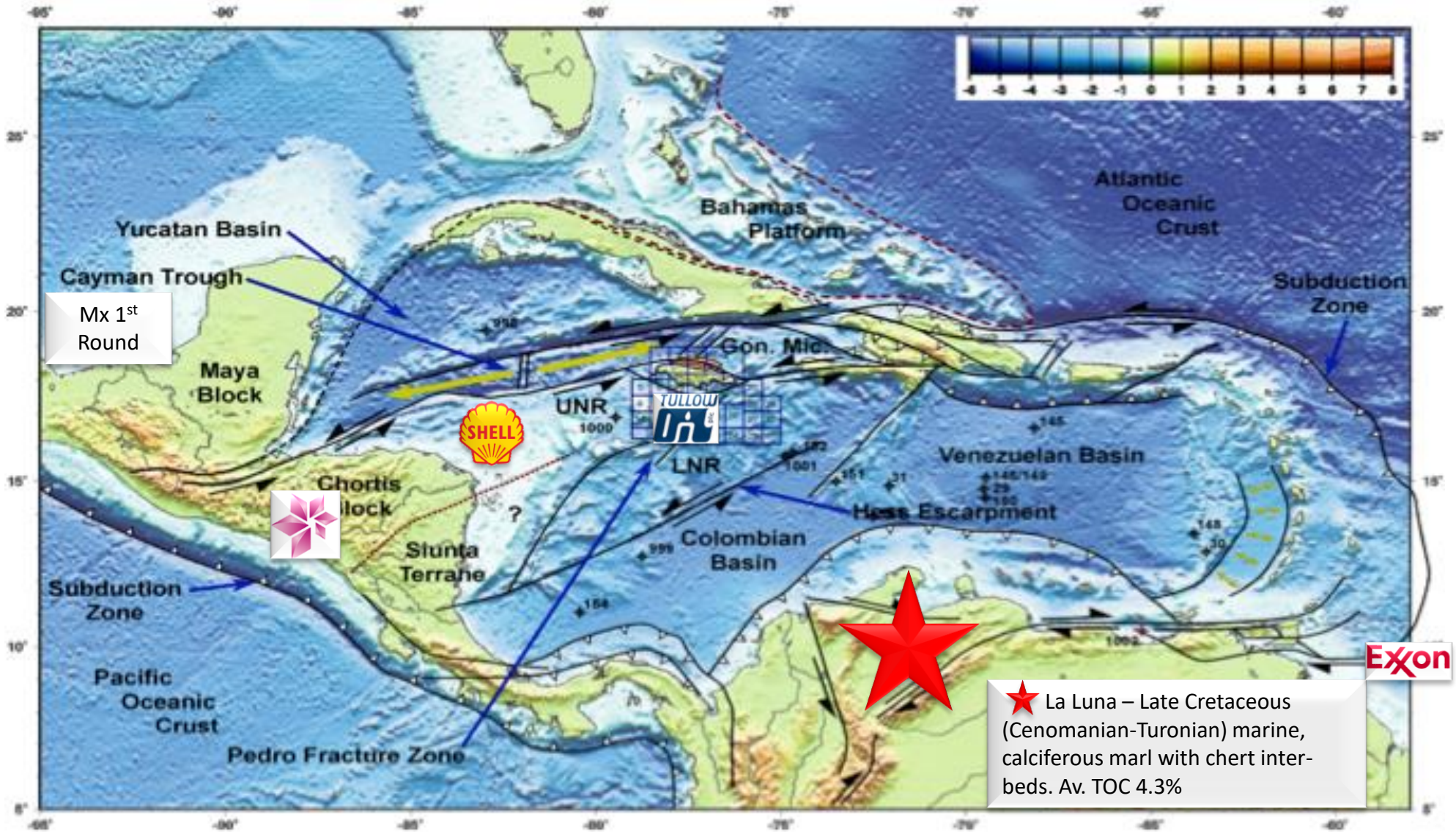
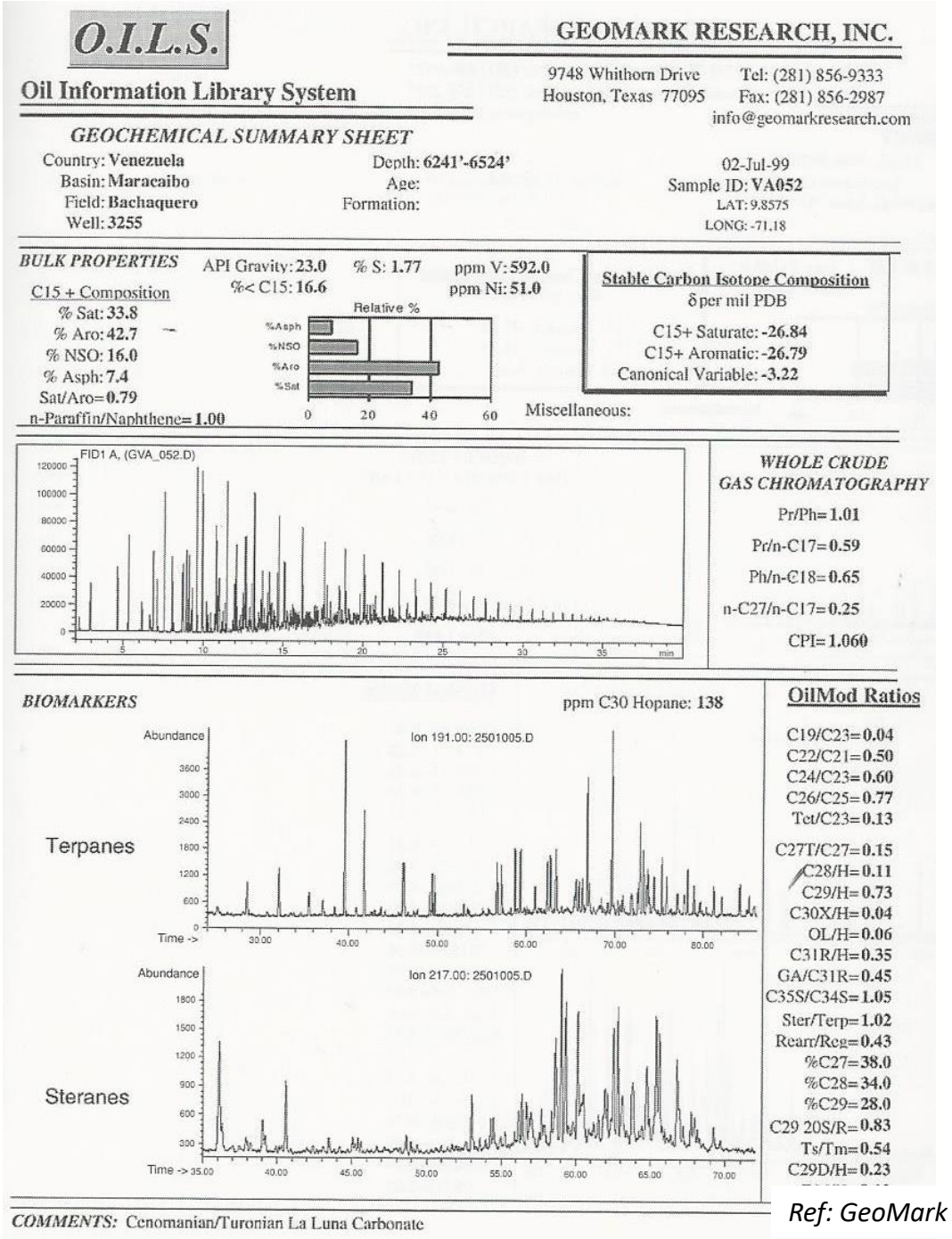
Caribbean geological fabric



Bachaquero 3255– La Luna sourced oil



O.I.L.S.

Oil Information Library System

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GEOCHEMICAL SUMMARY SHEET

Country: Venezuela
Basin: Maracaibo
Field: Bachaquero
Well: 3255

Depth: 6241'-6524'
Age:
Formation:

02-Jul-99
Sample ID: VA052
LAT: 9.8575
LONG: -71.18

BULK PROPERTIES
API Gravity: 23.0
% S: 1.77
ppm V: 592.0
ppm Ni: 51.0
C15 + Composition
% Sat: 33.8
% Aro: 42.7
% NSO: 16.0
% Asph: 7.4
Sat/Aro= 0.79
n-Paraffin/Naphthene= 1.00
%< C15: 16.6

Relative %
%Asph
%NSO
%Aro
%Sat
0 20 40 60

Stable Carbon Isotope Composition
δ per mil PDB
C15+ Saturate: -26.84
C15+ Aromatic: -26.79
Canonical Variable: -3.22

Miscellaneous:

FID1 A, (GVA_052.D)

WHOLE CRUDE GAS CHROMATOGRAPHY
Pr/Ph= 1.01
Pr/n-C17= 0.59
Ph/n-C18= 0.65
n-C27/n-C17= 0.25
CPI= 1.060

BIOMARKERS
ppm C30 Hopane: 138

Terpanes
Abundance
Ion 191.00: 2501005.D
Time ->

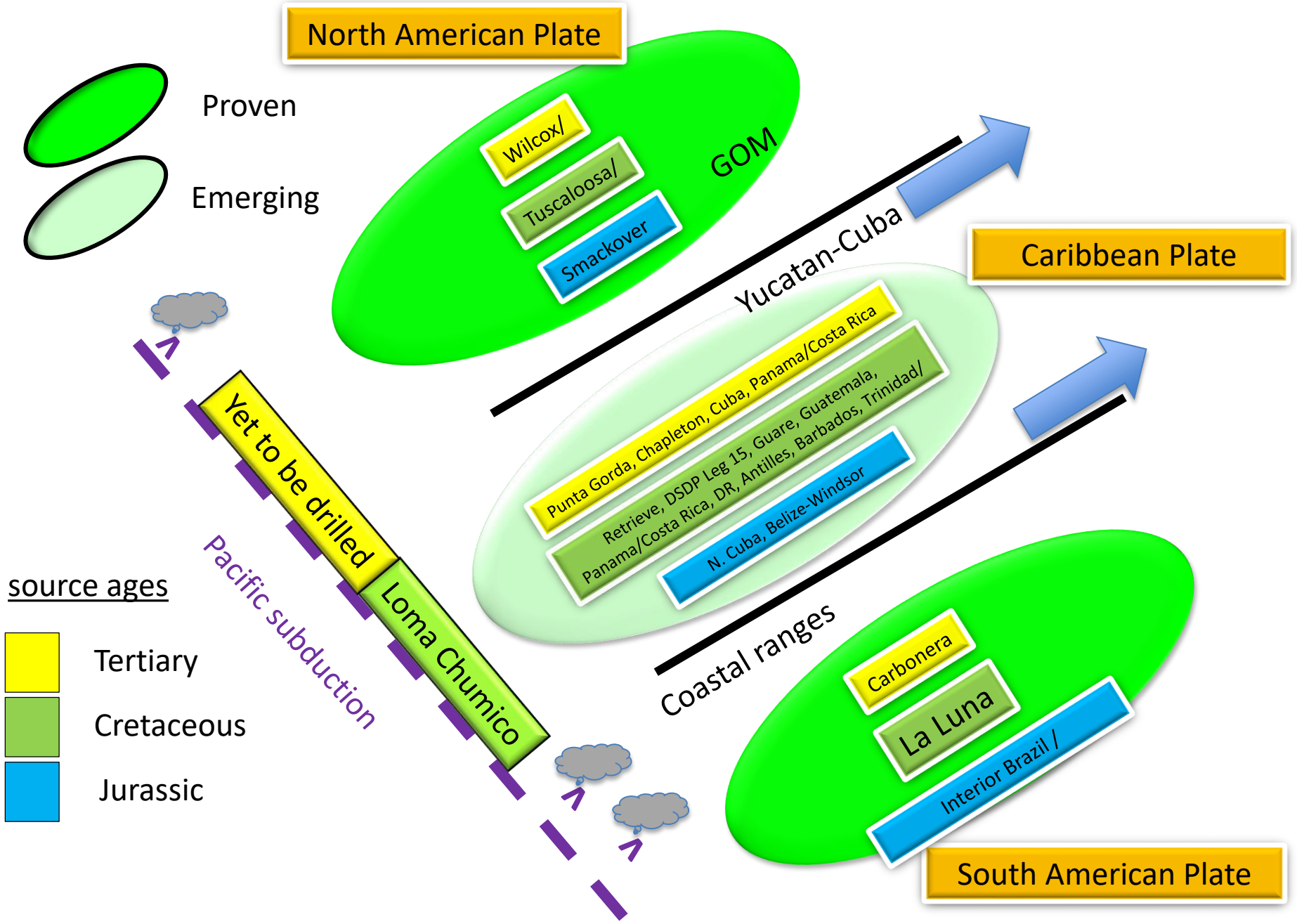
Steranes
Abundance
Ion 217.00: 2501005.D
Time ->

OilMod Ratios
C19/C23= 0.04
C22/C21= 0.50
C24/C23= 0.60
C26/C25= 0.77
Tet/C23= 0.13
C27T/C27= 0.15
C28/H= 0.11
C29/H= 0.73
C30X/H= 0.04
OL/H= 0.06
C31R/H= 0.35
GA/C31R= 0.45
C35S/C34S= 1.05
Ster/Terp= 1.02
Rearr/Reg= 0.43
%C27= 38.0
%C28= 34.0
%C29= 28.0
C29 20S/R= 0.83
Ts/Tm= 0.54
C29D/H= 0.23

COMMENTS: Cenomanian/Turonian La Luna Carbonate

	Paleocene	Thanetian	55.8	58.7	2.90	
		Seelandian	58.7	61.7	3.00	
		Danian	61.7	65.5	3.80	42.47
Cretaceous	Senonian	Maastrichtian	65.5	70.6	5.10	
		Campanian	70.6	83.5	12.90	
		Santonian	83.5	85.8	2.30	
		Coniacian	85.8	89.3	3.50	
		Turonian	89.3	93.5	4.20	
	Gallic	Cenomanian	93.5	99.6	6.10	
		Albian	99.6	112.0	12.40	
		Aptian	112.0	125.0	13.00	
		Barremian	125.0	130.0	5.00	
	Neocomian	Hauterivian	130.0	136.4	6.40	
		Valanginian	136.4	140.2	3.80	
		Berriasian	140.2	145.5	5.30	145.5
ZOIC		Tithonian	145.5	150.8	5.30	
		Kimmeridgian	150.8	155.7	4.90	

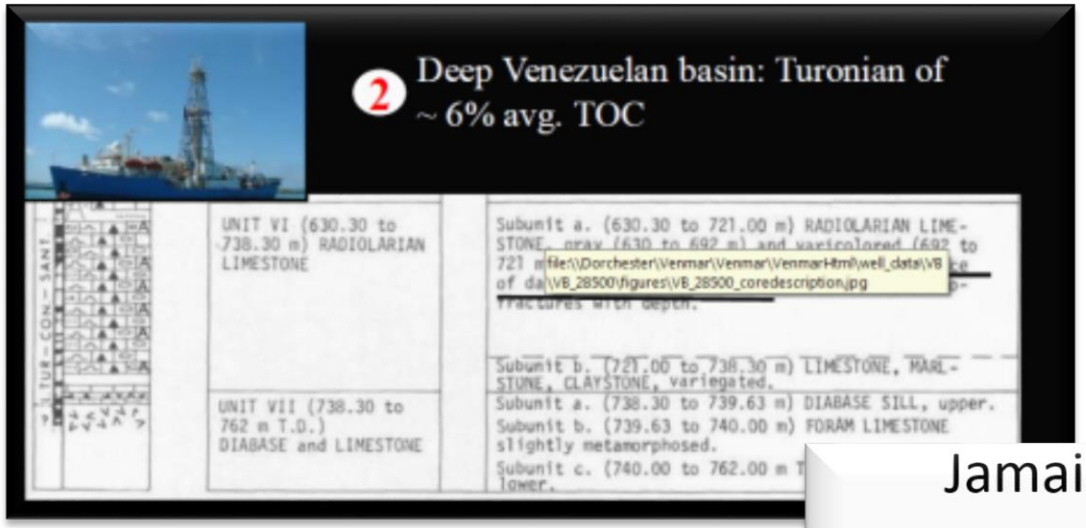
Ref: GeoMark Research Inc., The Biomarker Guide, 2004



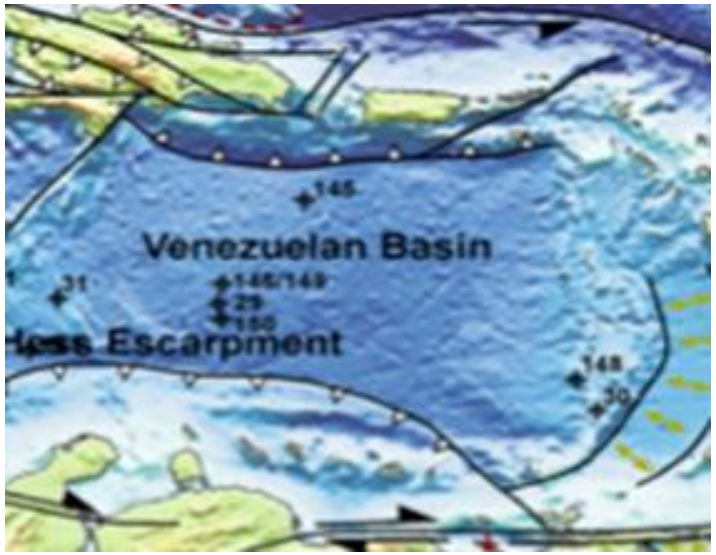
Caribbean principal region source regimes – CaribX 2009

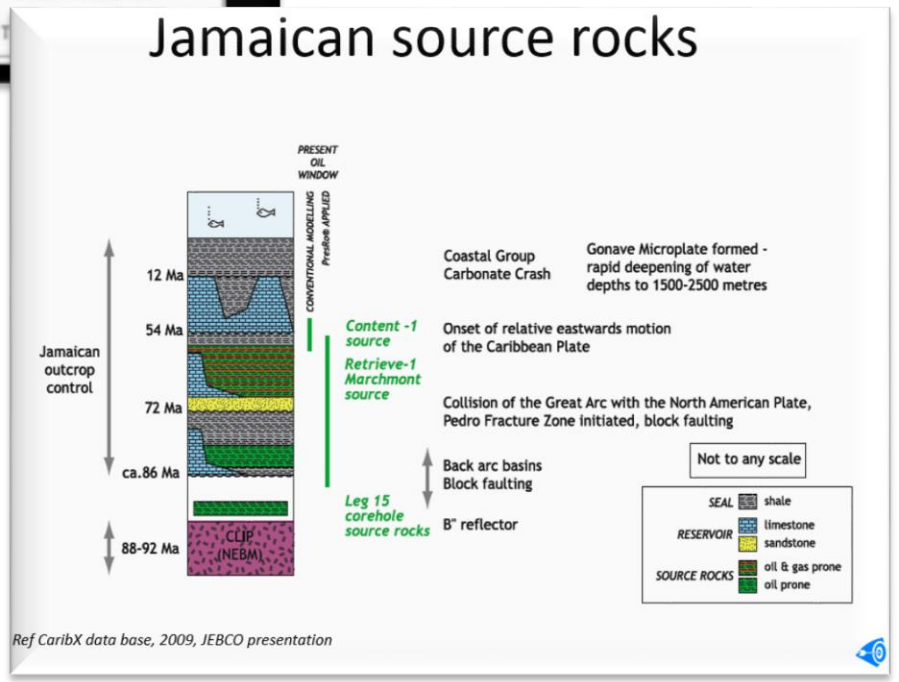
Regional Cretaceous source rocks

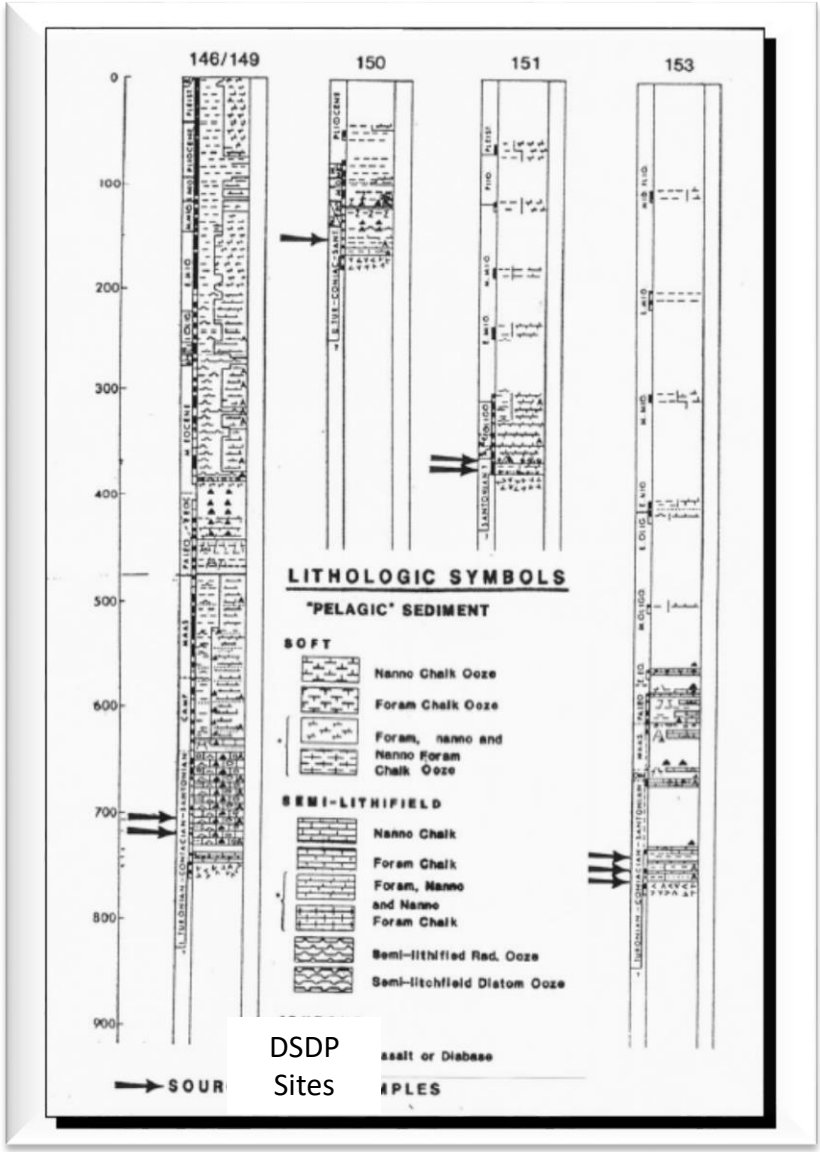
DSDP Leg 15 core holes drilled SE Jamaica (Sites 145, 146, 149, 150 & 153), Saunders et al., 1973. TOC peak at 11.1%, (Bode, 1973), HI range 114-535, δC^{13} av. -28‰



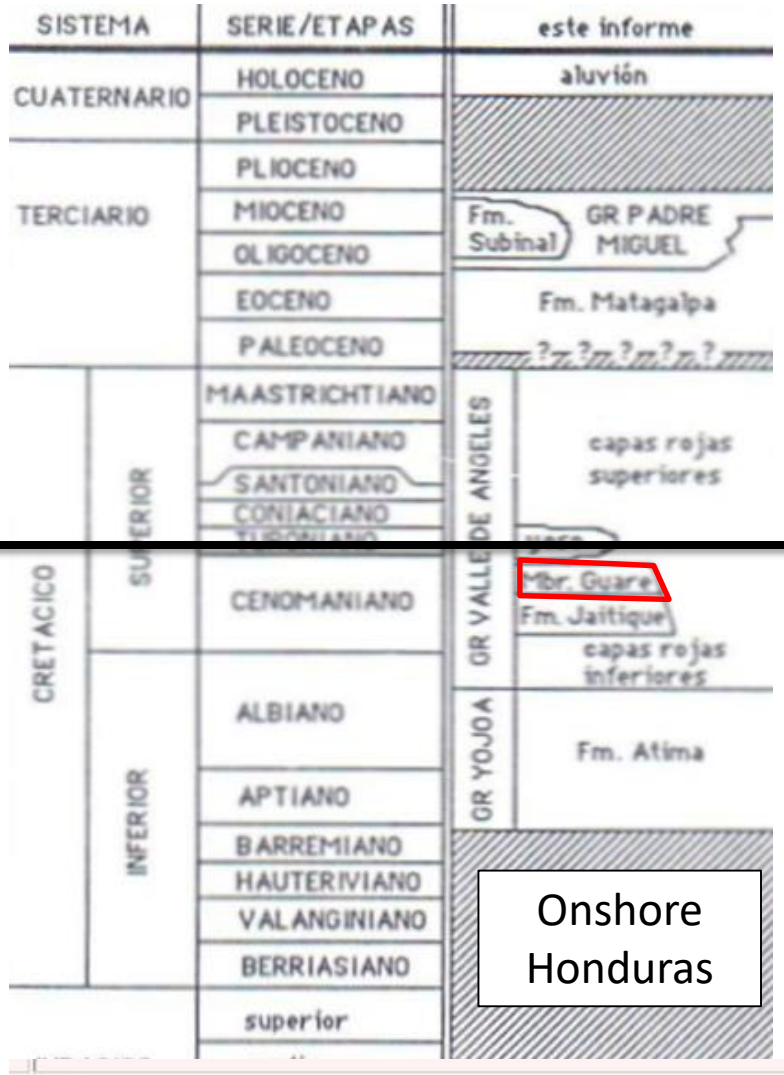
Turonian Venezuelan basin source – same age as the La Luna







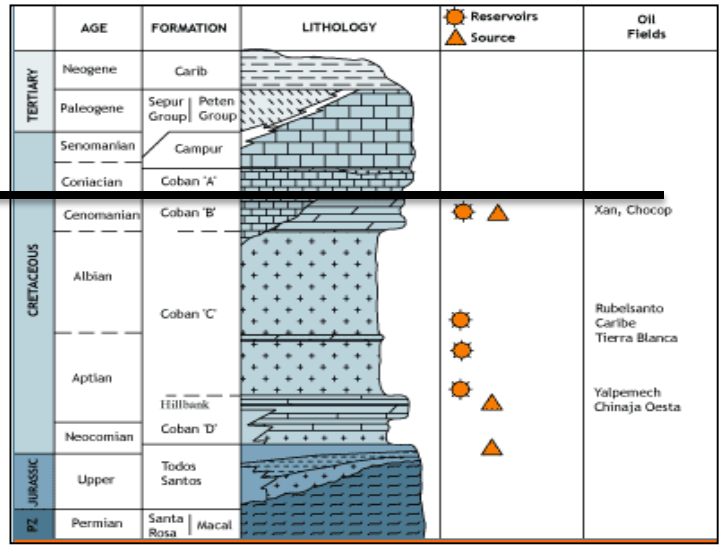
Honduran & Guatemalan Cretaceous sources

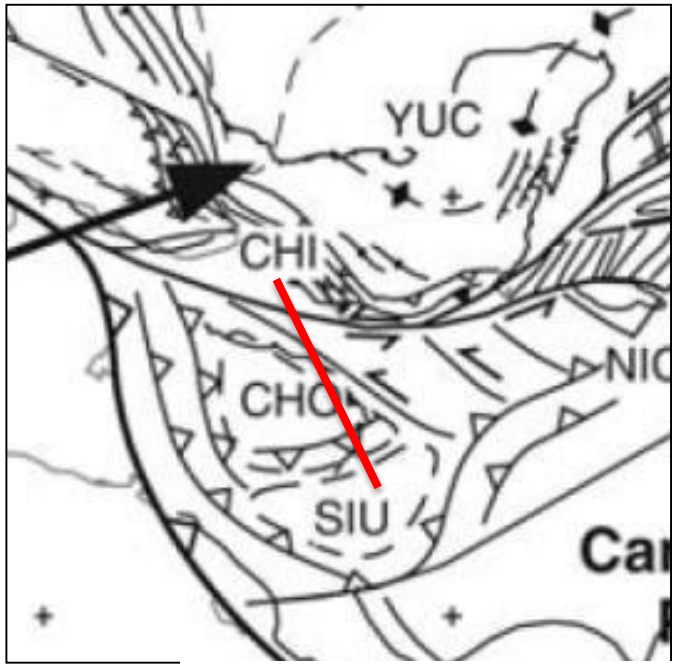


Yojoa Group
Yojoa Group: Dark gray, massive, fossiliferous limestone of the Atima Formation with interbedded black shales, thinnly bedded iron-bearing, fossiliferous limestones with fetid odor when broken and appears to be the Cantarranas Formation.
Honduras Group

The Cantarranas Formation is Albian and older

Guatemala (PetroLatina)





46 Ma (Pindell and Kennan, 2009. figure 16)

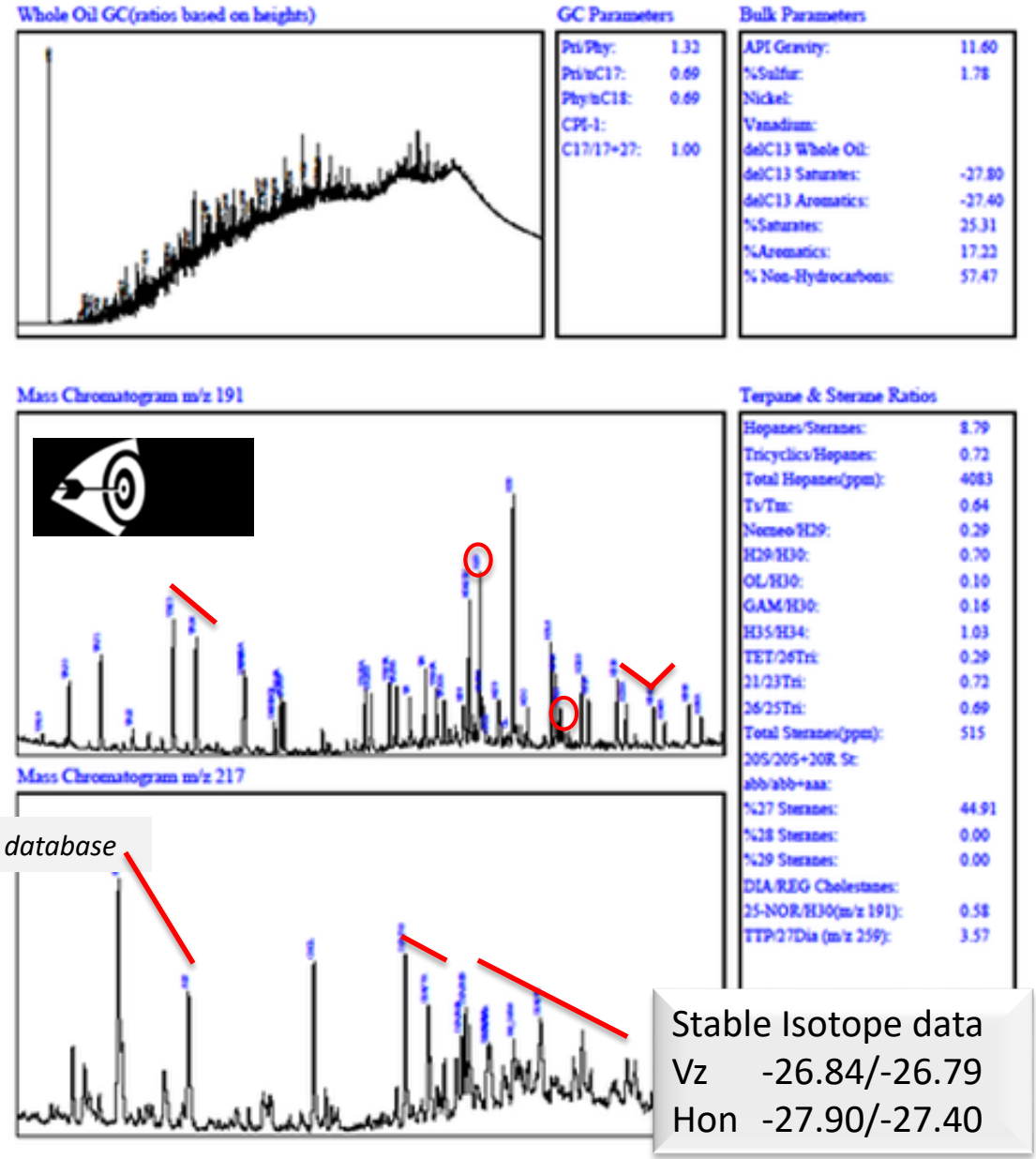
Jaitique Formation (Kj) and Guare (Kg)

Above the Valle de Angeles group rests a limestone unit composed of two members. The lowest member comprise of massive layers of dark limestone and fine layers of calcareous shale. Ocassionally these layers have the characteristic of becoming thin or thick producing ondulatory surfaces.

Above these carbonates the superior member is located, Guare member, which is recognized due to its thin layers of limestone and interlayered shale thin layers; it has a thickness of 100m approximately. These dark layers of limestone have the particularity of having an **oil smell when it is broken**. Additionally there are many occurrences where this formation is fractured, folded, and filled with gypsum veins.

Guare Fm- fish beds. NE Honduras

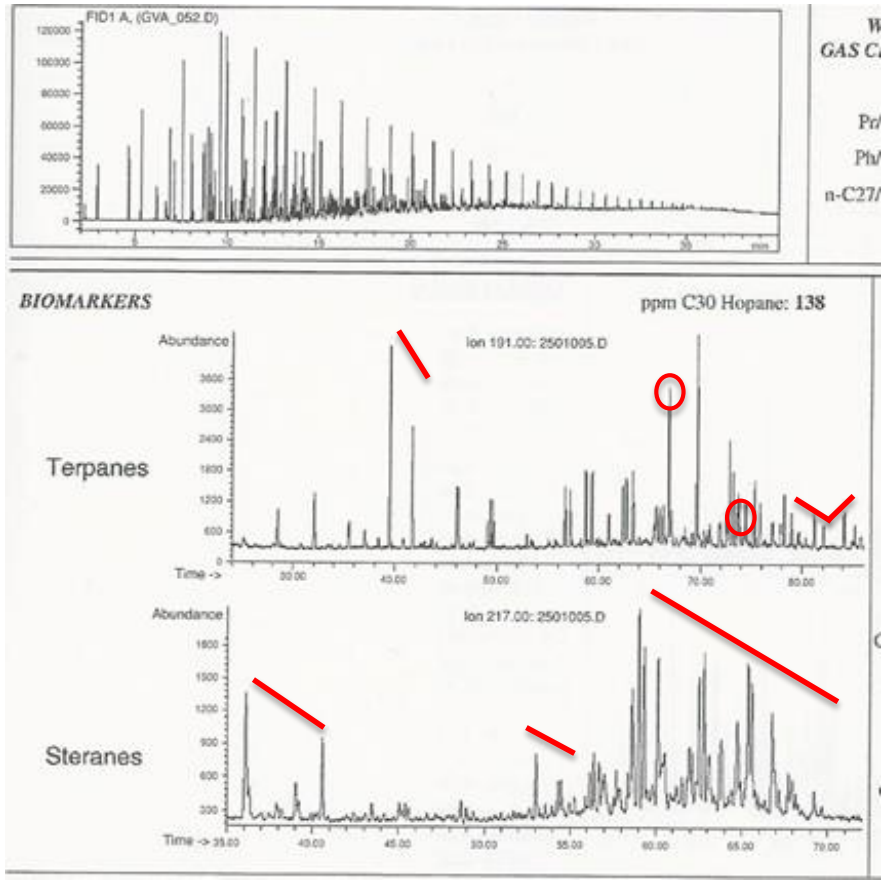
Honduran vs. Venezuelan oil



Ref CaribX oils database

Stable Isotope data

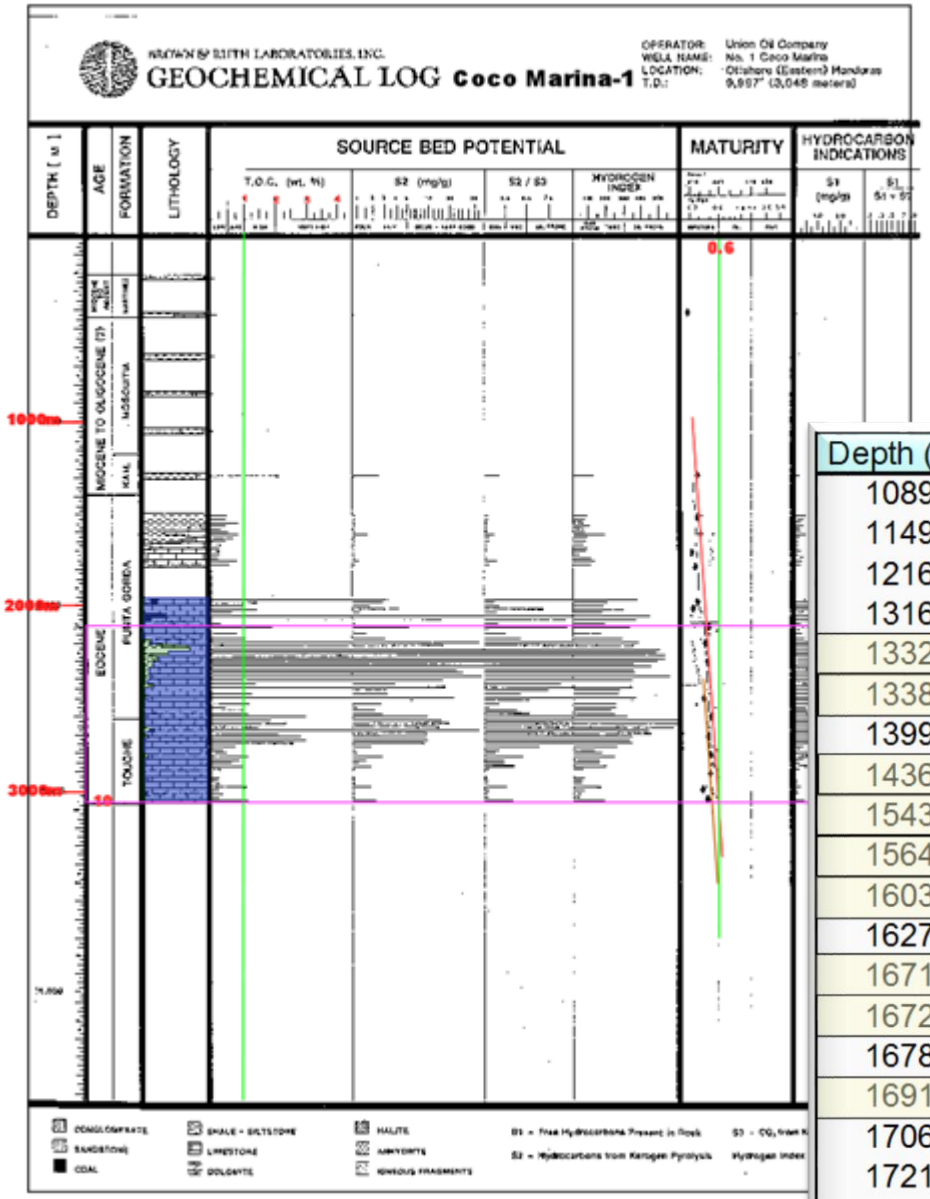
Vz	-26.84/-26.79
Hon	-27.90/-27.40



GC & m/z 191 & 217 Ion reconstructions, GeoMark Research. Ref. The Biomarker Guide, 2004

There is an active and obvious Tertiary source system working in the western Caribbean – however there also appears to be a Cretaceous source system. [The Honduran oil is very mature and biodegraded] – A robust Cretaceous source therefore can be traced across most of the Caribbean

Regional Tertiary source system



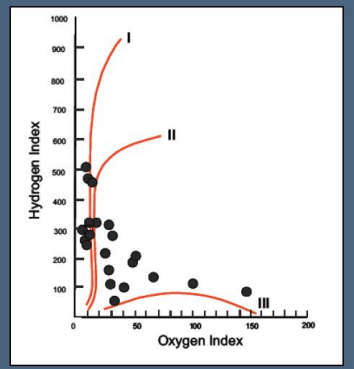
Ref SERNA database

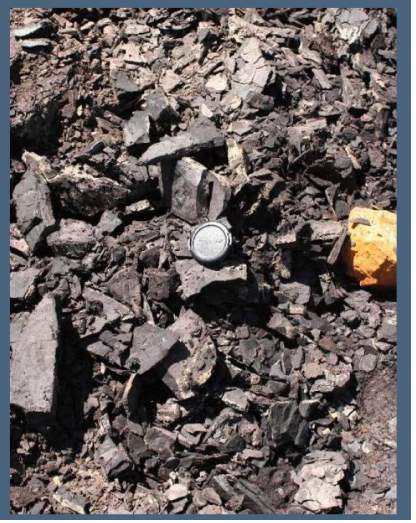
Coco Marina #1, (Honduras/Nicaragua) ~770m of world class source rocks – Punta Gorda Formation – also seen in Jamaica where it is called the Chapleton Formation† and in many Honduran/Nicaraguan wells eg Punta Gorda #1.

Depth (m)	TOC%	S1	S2	HI
1089	1.17	0.02	2.41	206
1149	1.73	0.12	2.73	158
1216	0.51	0.02	0.59	115
1316	1.66	0.42	5.16	311
1332	9.39	3.16	43.31	461
1338	3.57	1.17	16.06	450
1399	0.99	0.13	1.78	180
1436	6.83	2.09	17.92	262
1543	5.52	1.77	13.33	242
1564	7.16	2.92	21.38	299
1603	15.32	6.42	77.54	506
1627	0.84	0.10	0.45	54
1671	5.58	4.38	17.83	320
1672	3.88	2.65	11.59	299
1678	0.81	0.82	1.10	136
1691	6.66	3.54	21.62	325
1706	1.79	0.46	3.85	215
1721	0.38	0.04	0.32	84
1737	1.16	0.24	1.28	111
1766	13.57	5.43	38.75	290
1793	1.55	0.49	4.26	275
1819	0.89	0.18	0.9	101
1828	0.49	0.06	0.1	20

Middle Eocene Source Rocks – Central Jamaica — Guys Hill Formation

- TOC up to 22% in marine shales
- Oil-prone



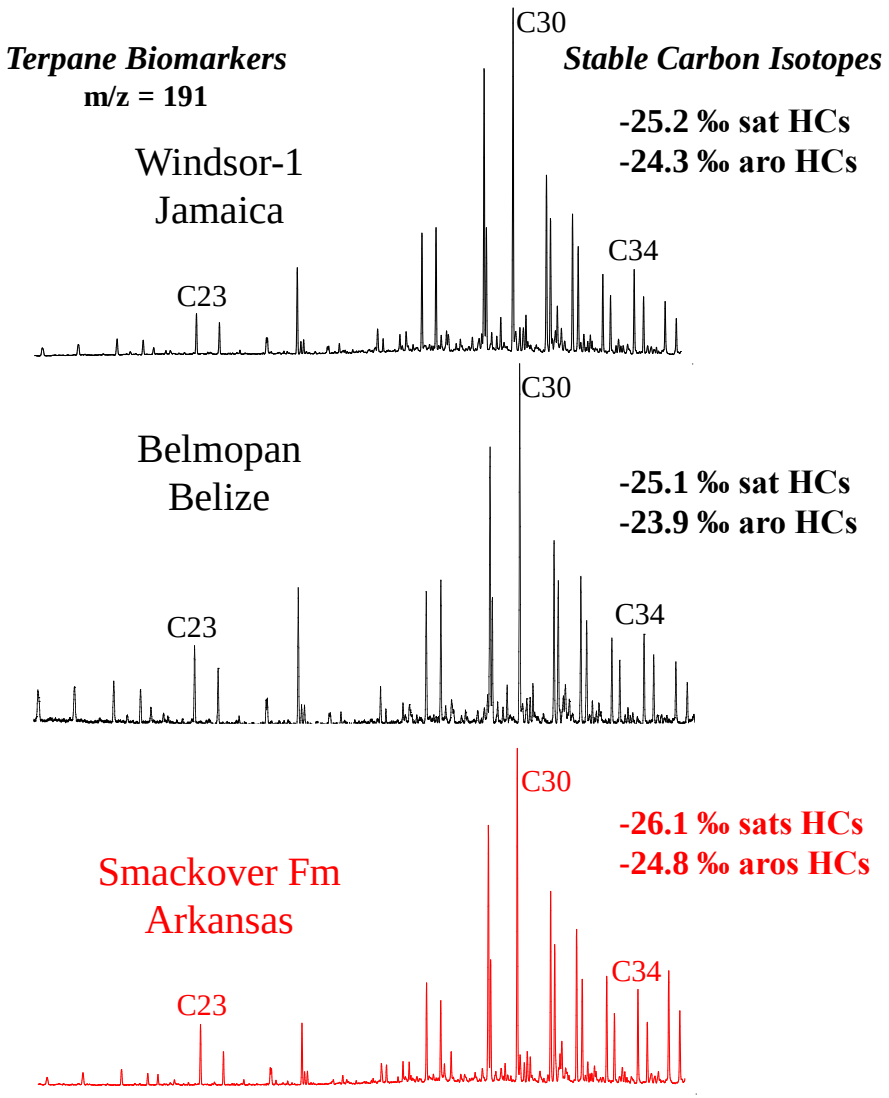


Ref CaribX Caribbean review / data base 2009-2015 – CJMD & PCJ field trip 2004

† recently renamed

Content #1, ~700m of elevated TOC/HI. Ref Rodrigues 1983

Jurassic source system



Ref JEBCO Alliance report, 2004, analysis by GeoMark Research

The Oxfordian Smackover Formation, USA is a prolific source rock in the Gulf of Mexico

The Caribbean does contain Jurassic source rocks, but in common with the GOM it also contains Cretaceous and Tertiary aged source rocks

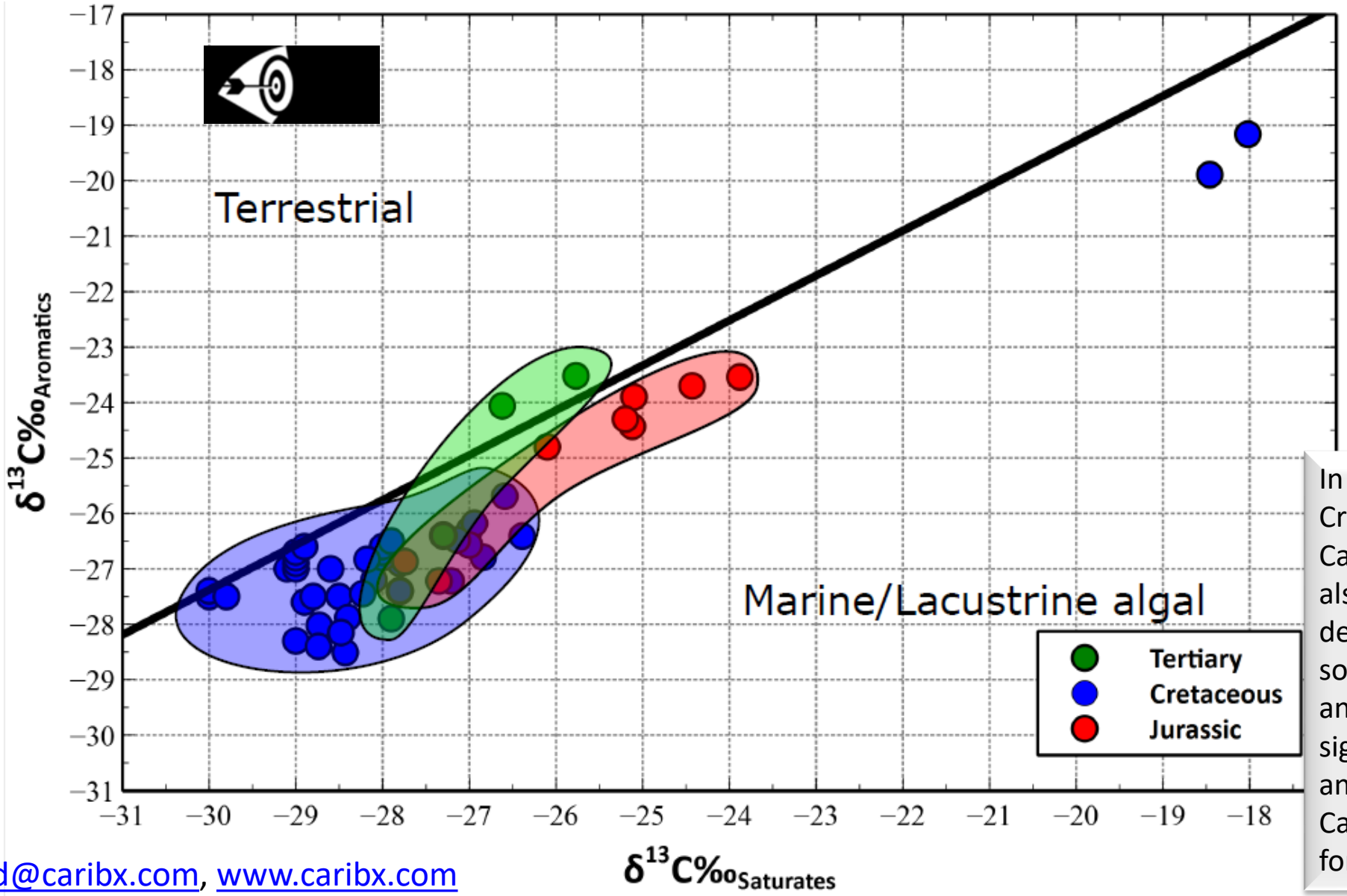
TABLE 1. Northern Gulf of Mexico Basin source intervals (ages), hydrocarbon families, and summary of established rock-oil ties.

Source interval	*Oil types*	*Rock-oil tie*
Lower Tertiary (centered on Eocene)*	Tertiary Marine Tertiary Intermediate Tertiary Terrestrial	Tie with high-maturity core, south Louisiana Multiple-maturity suites (core), south-central Louisiana Offshore Texas (salt sheath)
Upper Cretaceous (centered on Turonian)*	Marine—Low Sulfur—No Tertiary Influence	Direct ties with mature source rocks: Offshore—eastern Gulf of Mexico Onshore—Tuscaloosa trend, Louisiana and Mississippi; Giddings trend, Texas
Lower Cretaceous	Carbonate—Elevated Salinity—Cretaceous	Direct ties with source rocks, South Florida Basin
Undifferentiated Cretaceous		Calcareous—Undifferentiated Cretaceous Production from fractured Lower Cretaceous black shale— south Texas
Uppermost Jurassic (centered on Tithonian)*	Marine—High Sulfur—Jurassic Marine—Moderately High Sulfur—Jurassic Marine—Moderate Sulfur—Jurassic	Inferred tie to postmature, organic-rich calcareous shales—eastern Gulf of Mexico Oils in Lower Cretaceous reservoirs on Florida shelf where Turonian/Eocene is immature
Upper Jurassic (Oxfordian)	Carbonate—Elevated Salinity—Jurassic	Tie to postmature, organic-rich carbonates—Mobile Bay
Triassic (Eagle Mills)	Triassic—Lacustrine	Tie to postmature, organic-rich cores, northeast Texas Paleontology and palynology confirm nonmarine source character

* "Centered on" means that the source is largely contained within, but may not be restricted to, the designated interval.

Ref. Hood, K. C., L. M. Wenger, O. P. Gross, and S. C. Harrison, 2002, Hydrocarbon systems analysis of the northern Gulf of Mexico: Delineation of hydrocarbon migration pathways using seeps and seismic imaging, in Surface exploration case histories: Applications of geochemistry, magnetics, and remote sensing, D. Schumacher and L. A. LeSchack, eds., AAPG Studies in Geology No. 48 and SEG Geophysical References Series No. 11, p. 25–40.

Sofer plot, 51 oil samples, Caribbean



Oil origin	Source
Trinidad	C
Venezuela	C
Dominican Republic	C
Barbados	C
Antilles	C
Jamaica	C, J, T
Honduras	C, T
USA (GOM)	J
Cuba	J, T
Belize	J

In summary – yes there is a regional Cretaceous source system in the Caribbean of La Luna age, and there also appears to be a less extensive development of an older Cretaceous source system. In common with N and S America there is also a significant Tertiary source system and on the northern flank of the Caribbean “plate” some evidence for Jurassic source rocks

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