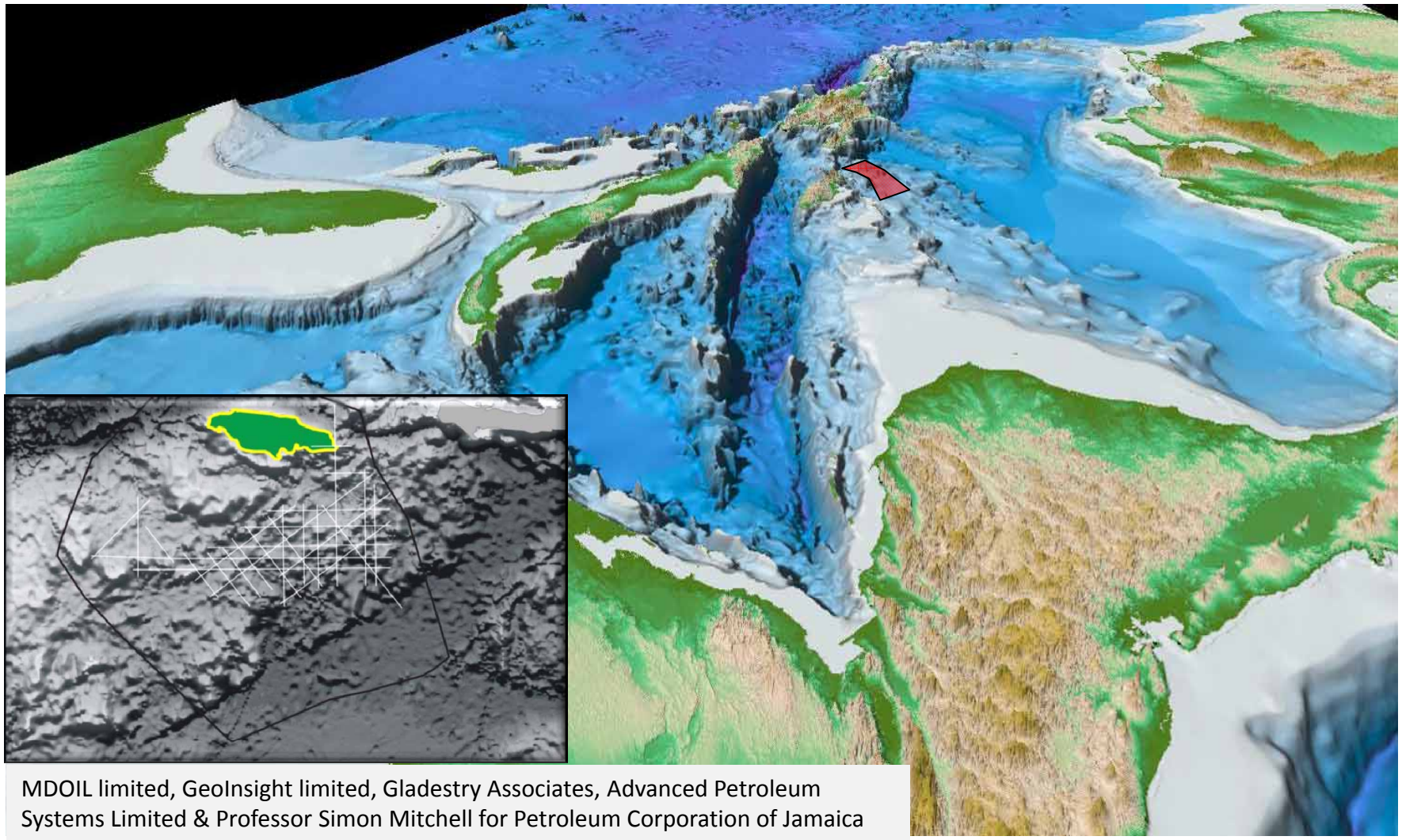
The petroleum potential of the Jamaican onshore and offshore, the 2nd Round, biding procedures, Terms & Conditions,London 1 March 2010

CJ Matchette-Downes



MDOIL limited, GeoInsight limited, Gladestry Associates, Advanced Petroleum Systems Limited & Professor Simon Mitchell for Petroleum Corporation of Jamaica

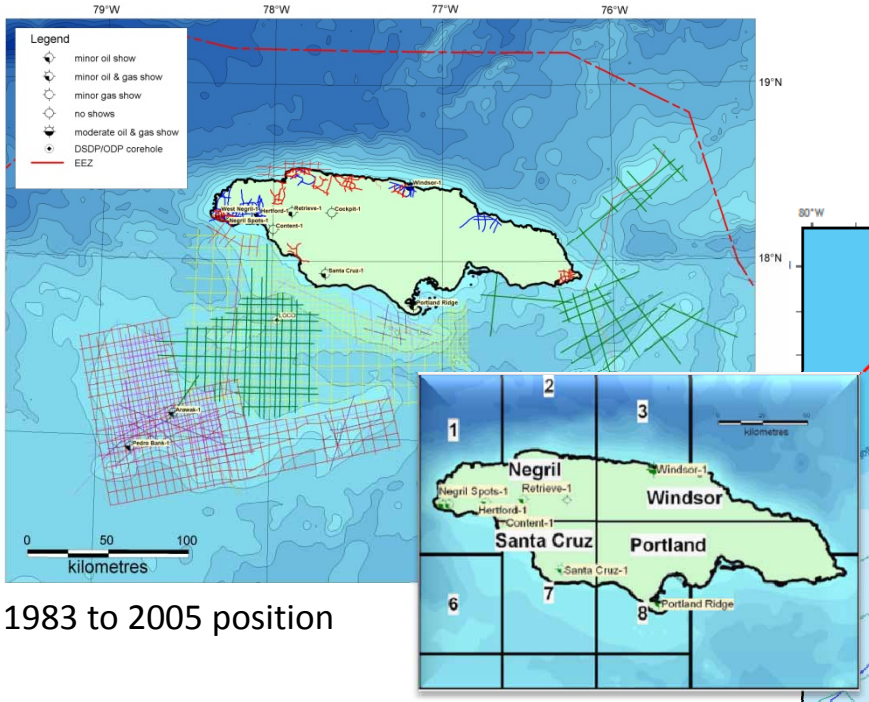
Review of the source rocks and hydrocarbons of the greater Jamaica area

- The Jamaica region, the wells, the seismic, the blocks, the players and the opportunities
- Northern terrain on and offshore source rocks & hydrocarbons
- Onshore and offshore Upper Nicaraguan Rise source rocks and hydrocarbon occurrences
- Lower Nicaraguan Rise source rocks, offshore (& Eastern Jamaica)
- Other indications of oil and gas shows in the greater Jamaican region

"The papers express a wide variety of understanding of Caribbean geology. They cannot all be correct" Ref page vii Geological Society Special Publication #328 The Origin & Evolution of the Caribbean Plate 2009

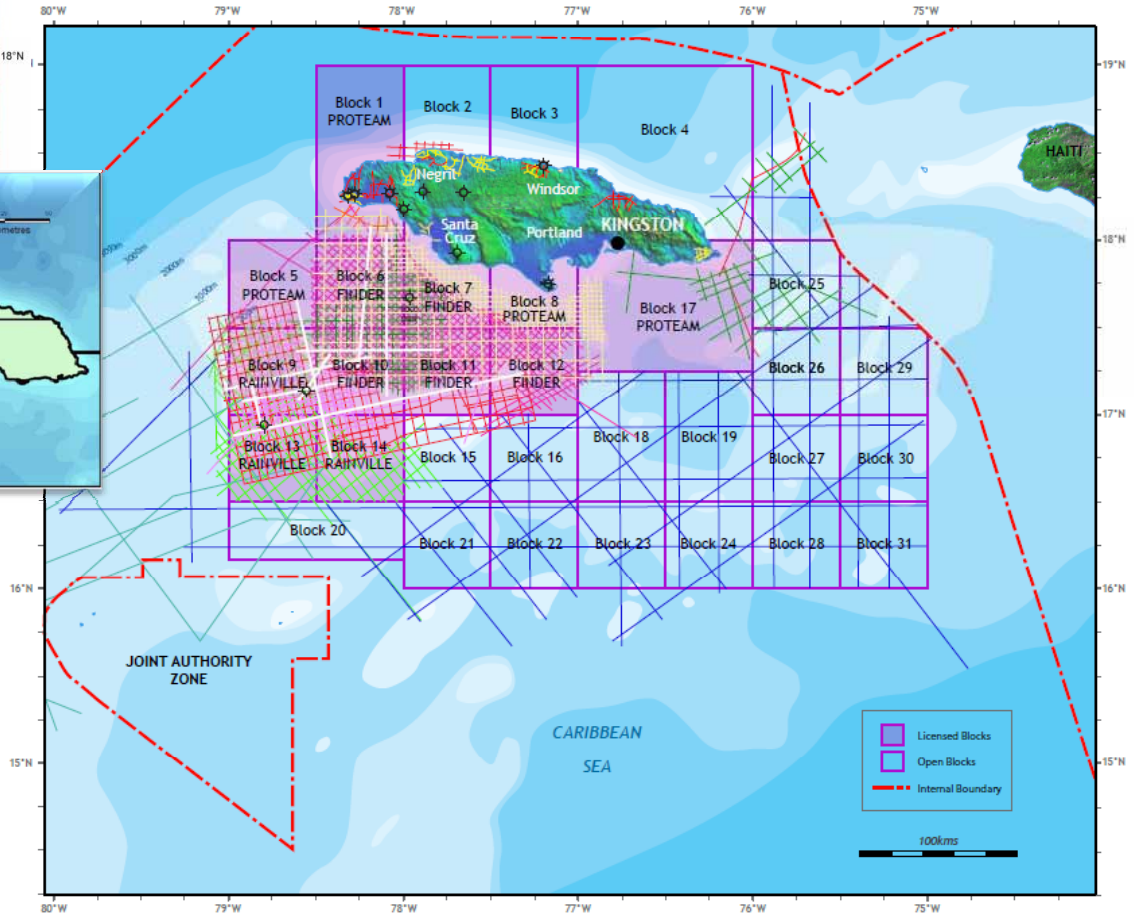
The wells, available acreage & seismic data coverage

- 11 wells all but 1 had oil and or gas shows
- Seismic to 1983 (16,126 line km), several vintages
- JEBCO 2004 reprocessed 9 lines (1,100km) & reconstructed 11,000 line km
- 2006 MDOIL reconstructed 1,000 km Morant basin data



1983 to 2005 position

- 2006 Fugro for Finder/Flow Energy (formerly Gippsland) acquired 6,968 line km of long offset data & 23,974 km gradiometry data
- 2009 CCGV acquired 6,118 line km of long offset multiclient seismic data, phase I
- 2009 CCGV for Rainville acquired 2,594km (3,000 km) line km of long offset multiclient seismic data, phase II



Northern block and the Upper Nicaraguan Rise

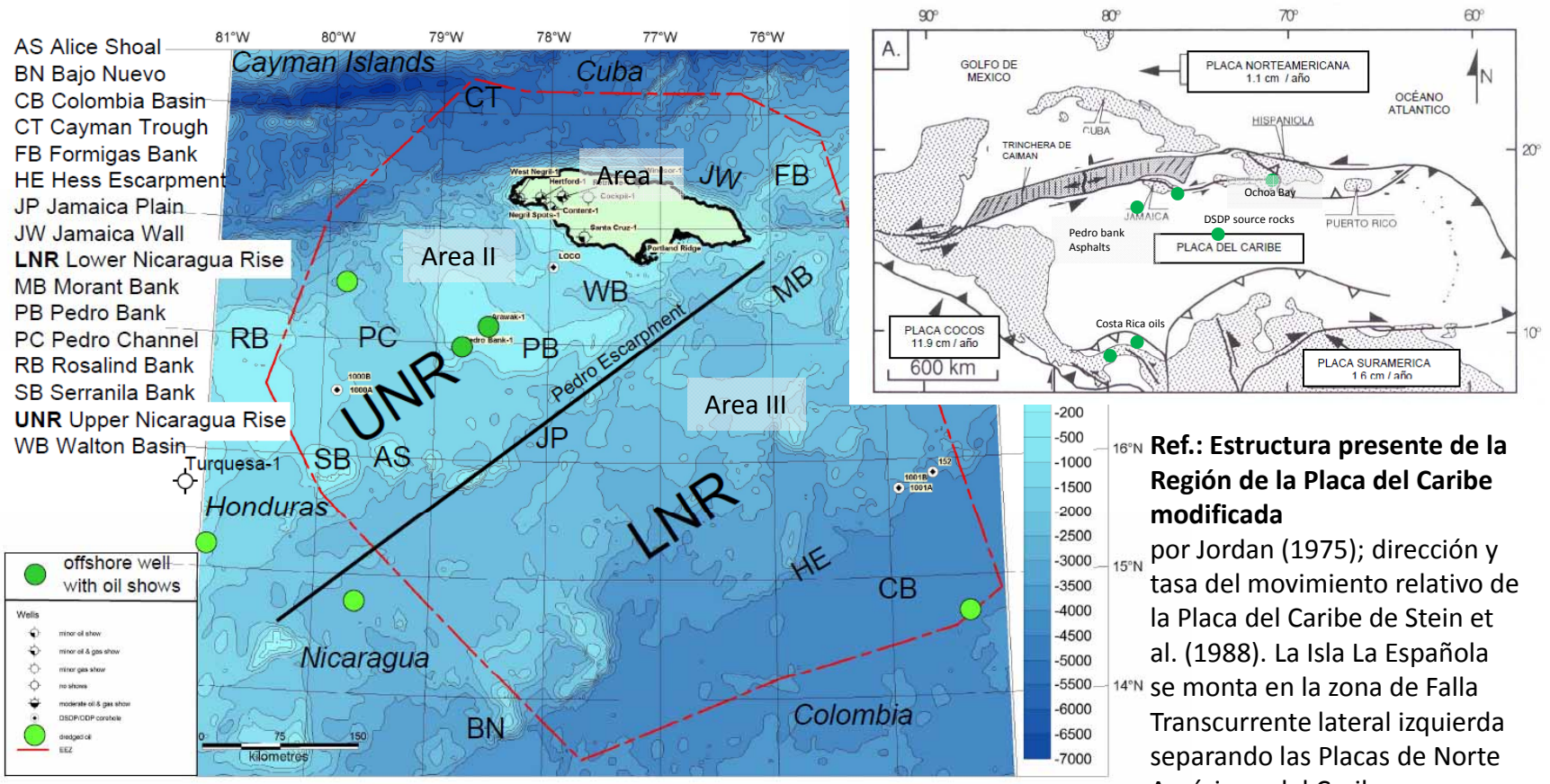
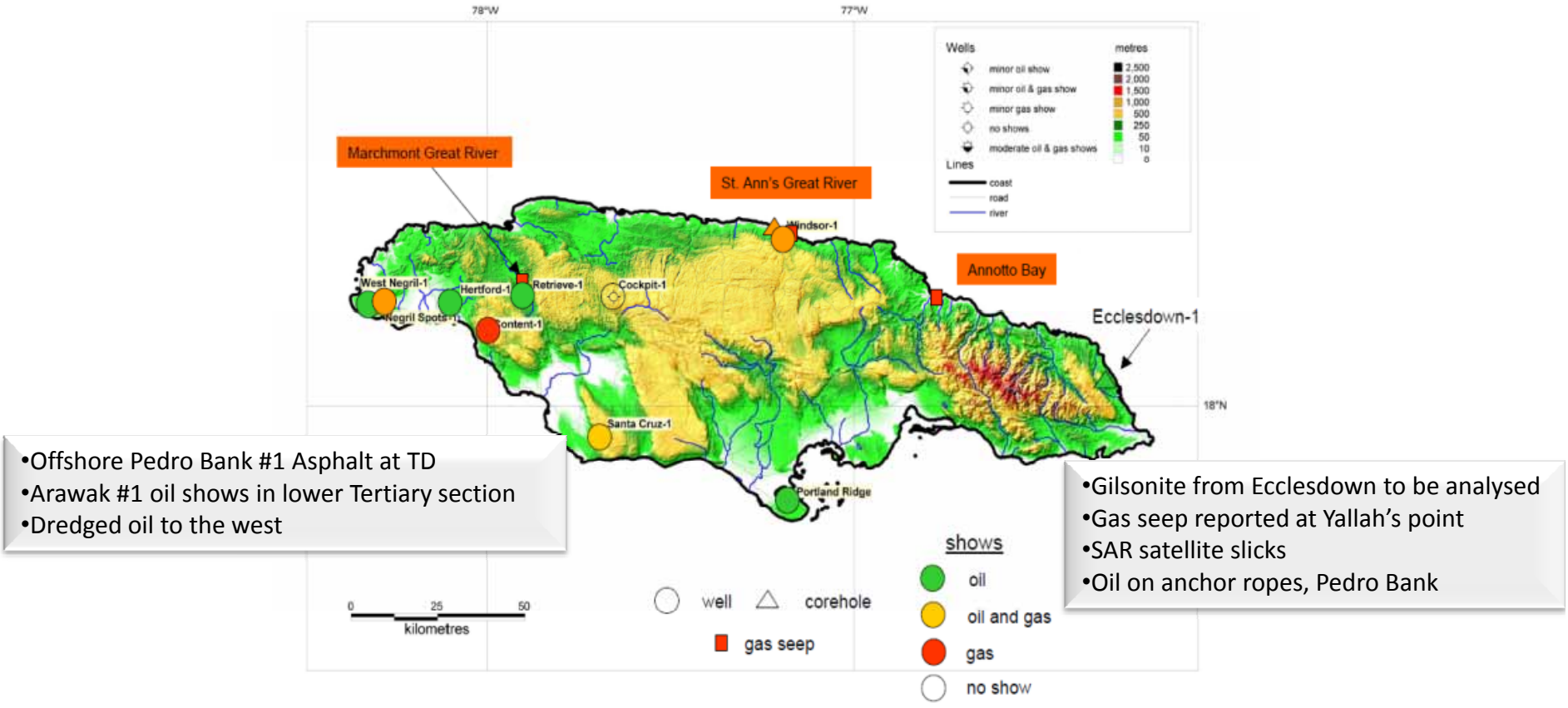


Figure 1.1. Jamaica and its EEZ, showing bathymetric features, wells, and offshore coreholes.

Ref.: Estructura presente de la Región de la Placa del Caribe modificada por Jordan (1975); dirección y tasa del movimiento relativo de la Placa del Caribe de Stein et al. (1988). La Isla La Española se monta en la zona de Falla Transcurrente lateral izquierda separando las Placas de Norte América y del Caribe.

Ref JEBCO Alliance report 2004

Jamaican onshore well corehole and seep locations



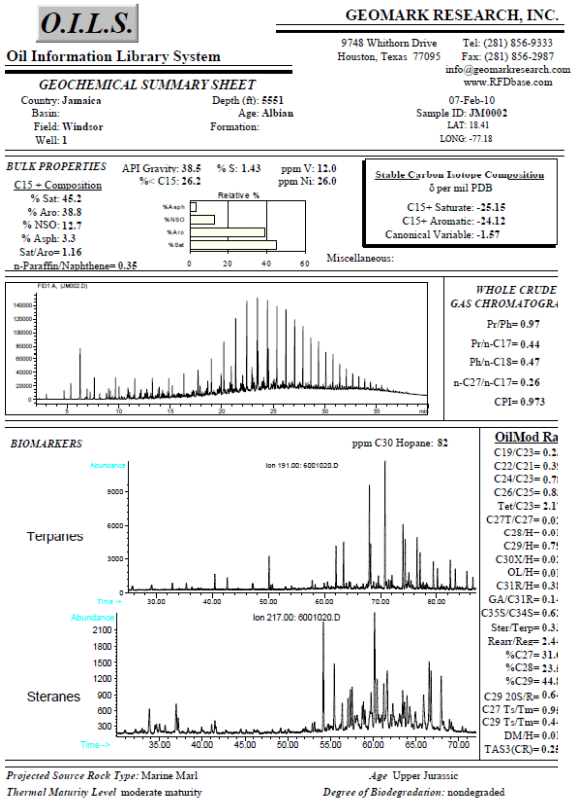
- Offshore Pedro Bank #1 Asphalt at TD
- Arawak #1 oil shows in lower Tertiary section
- Dredged oil to the west

- Gilsonite from Ecclesdown to be analysed
- Gas seep reported at Yallah's point
- SAR satellite slicks
- Oil on anchor ropes, Pedro Bank

Figure 1.2. Jamaican onshore well, corehole and seep locations.

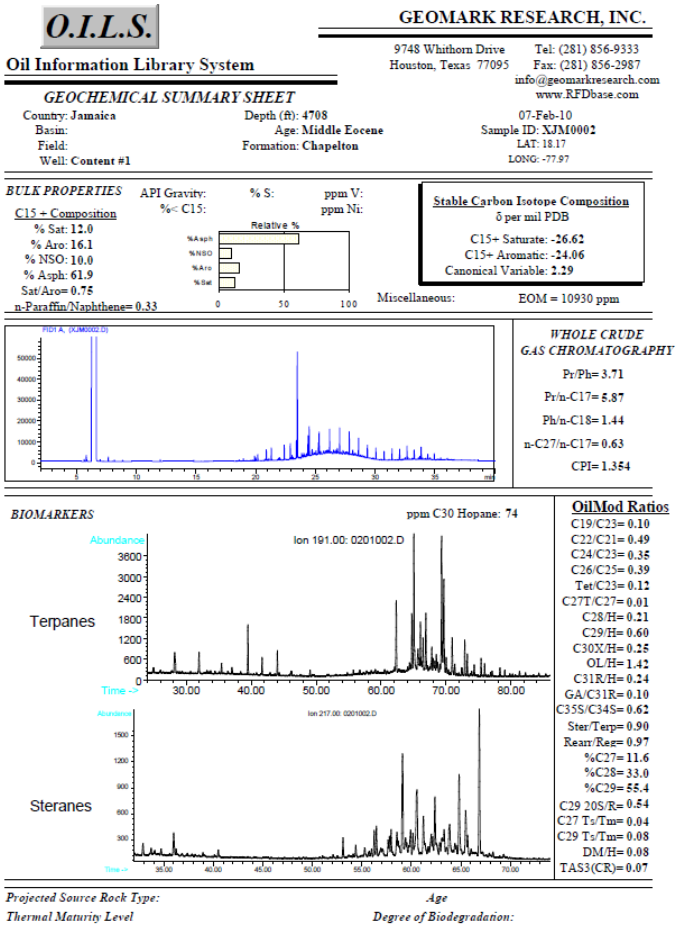
Ref JEBCO Alliance report 2004

The three oil families of Jamaica - onshore



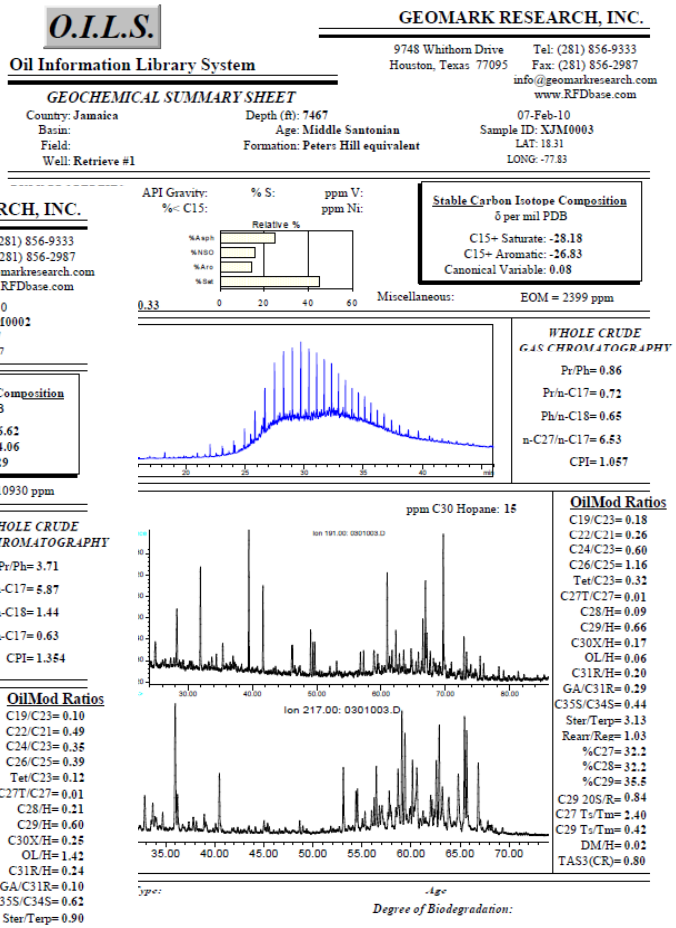
Oil Family #1

- Windsor #1 & Windsor core hole
- Smackover Formation equivalent
- Upper Jurassic marl source



•Oil Family #2

- Content #1 possess a 434ft interval with high TOC's & elevated HI values in the Lower Eocene
- Punta Gorda Formation equivalent eg Shell's Perlas #3

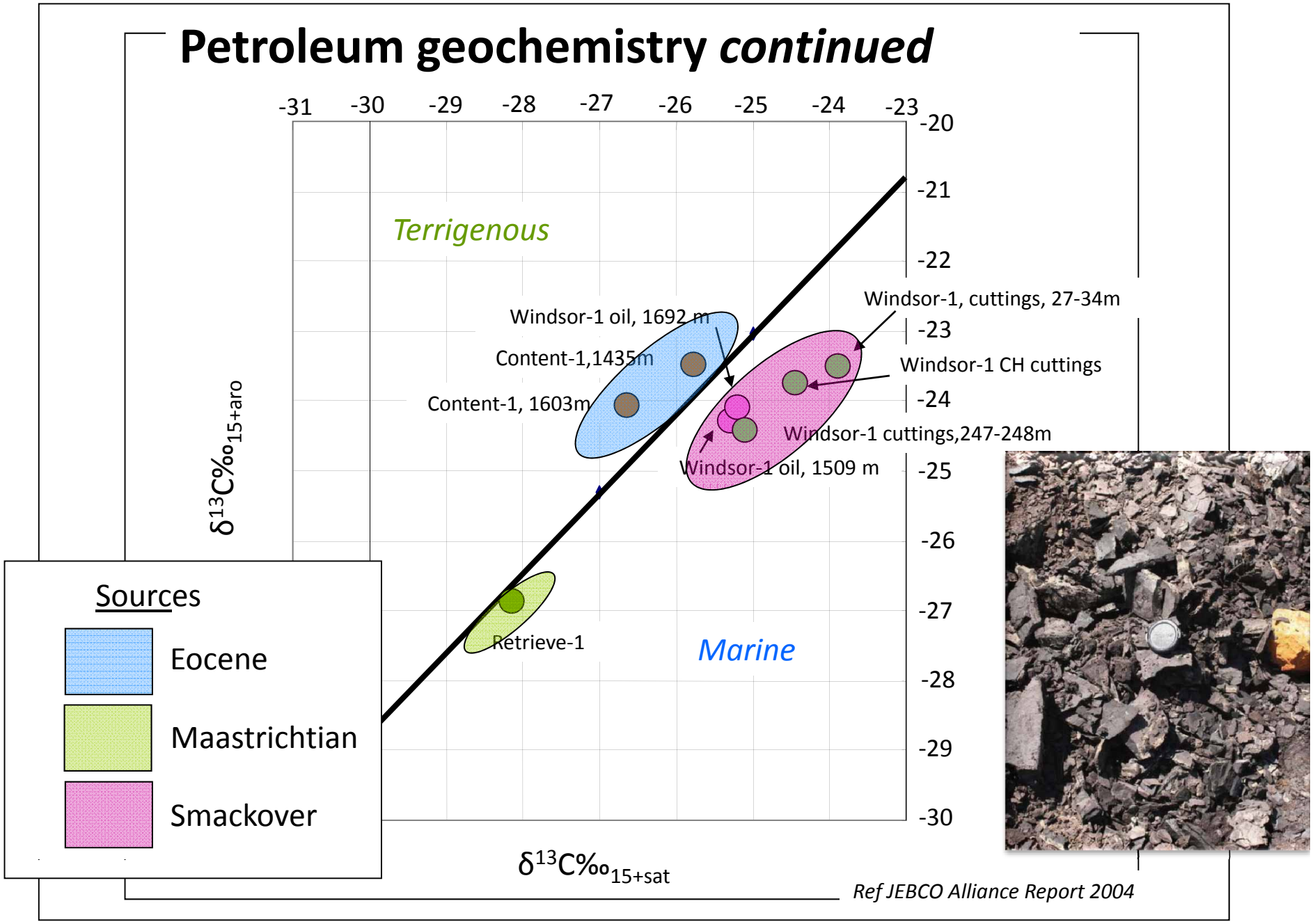


•Oil Family #3

- Retrieve #1
- Affinities with to Upper Cretaceous Loma Chemico Fm in Marote #1
- Cretaceous littoral source.
- Limited Oleanane, slightly depleted ^{13}C

Ref JEBCO Alliance report 2004

Petroleum geochemistry *continued*



Ref JEBCO Alliance Report 2004

Stable carbon isotope compositions.

Northern block/Upper Nicaraguan Rise hydrocarbons

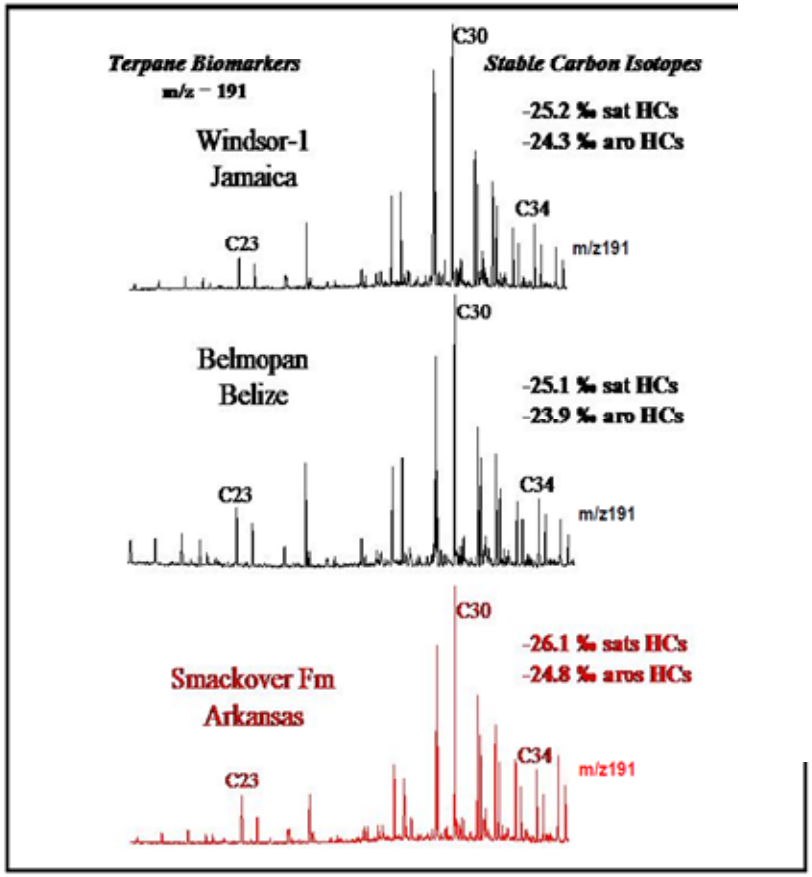


Figure 9.13. Comparison of the Windsor-1 oil (1509 metres) with a Belmopan Field (onshore Belize) oil and a Smackover Formation oil from Arkansas, USA.

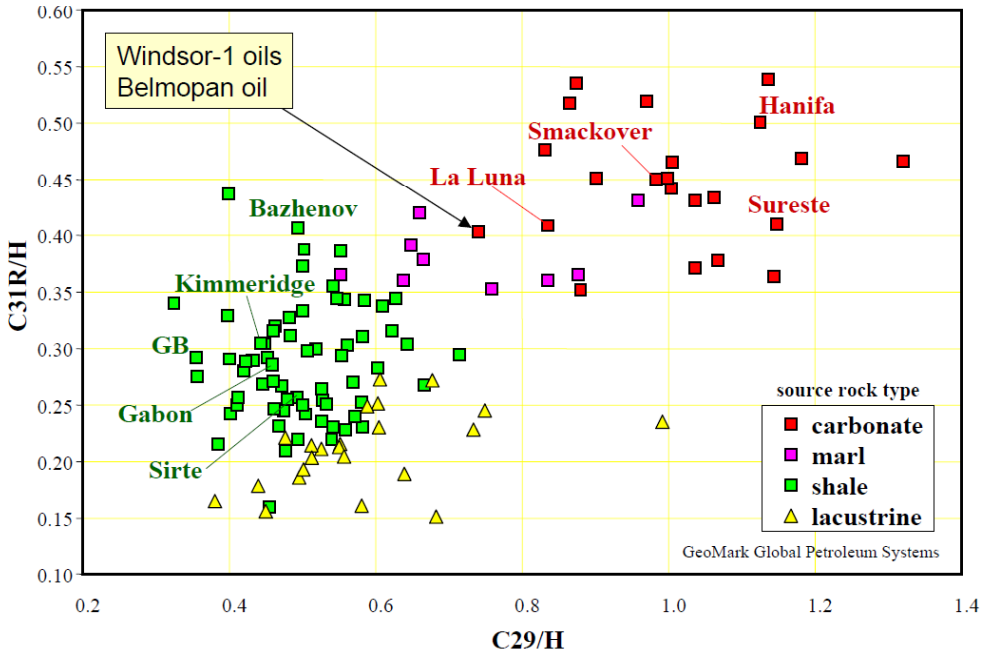
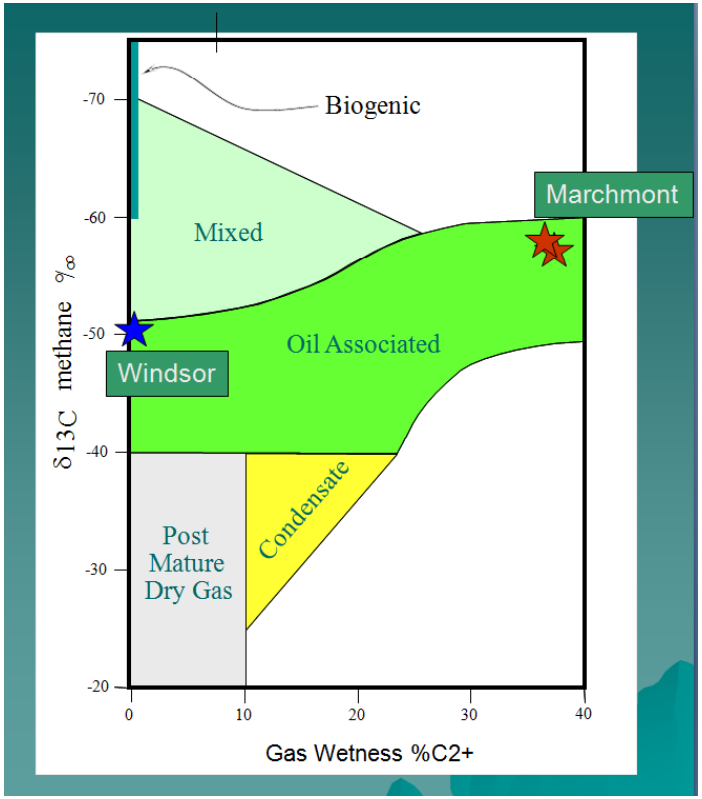


Figure 9.14. The Windsor oils compared with global sources.

Oil family I, north coast compared Belmopan, Smackover & other oils

Ref JEBCO Alliance report 2004

Northern block & UNR gas seeps



- Hertford #1, Marchmont #1 & Windsor #1 all cored thick Cretaceous shale sequences that could be considered for shale gas extraction
- Eocene shales will not be brittle enough to be exploited for shale gas

Windsor gas composition

methane 98.75%
methane 0.056%
propane 0.0045%
i-butane 0.0022%
n-butane 0.0022%
i-pentane 0.0015%
n-pentane 0.0021%
CO2 1.19%
% C2+ 0.07
$\delta^{13}C$ -48.9‰ PDB (±0.3)

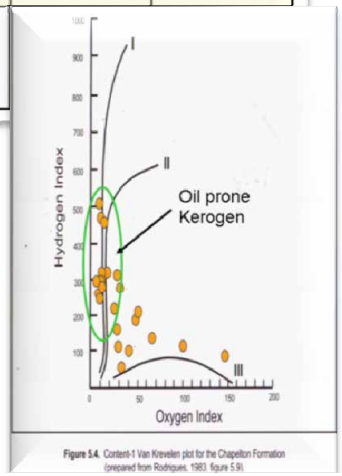
Ref JEBCO Alliance report 2004

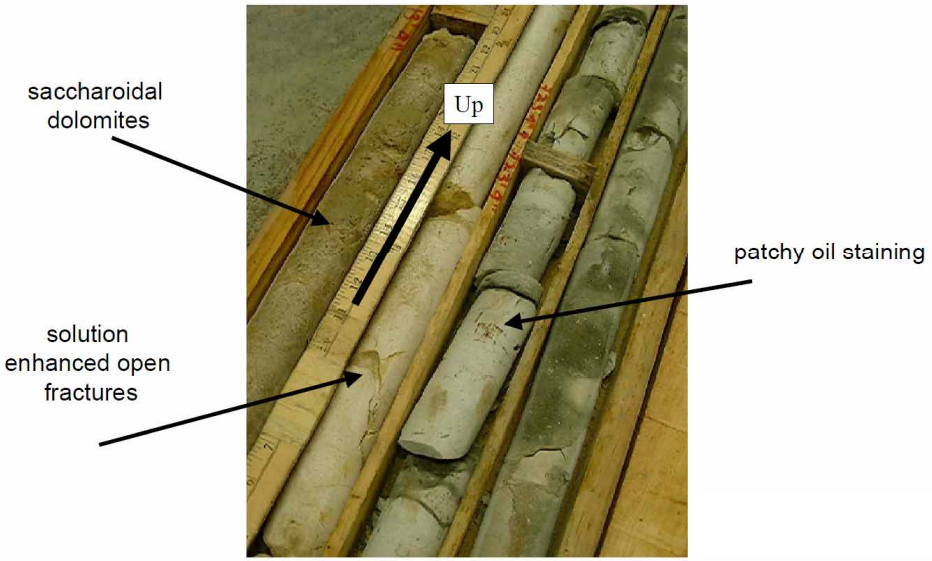
NB Availability of onshore blocks

Eocene, Chapleton Formation, Content #1 & core section from Blowfire Hill core hole with oil staining

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		
1819	0.89	0.18		
1828	0.49	0.06		

Ref Rodrigues 1983



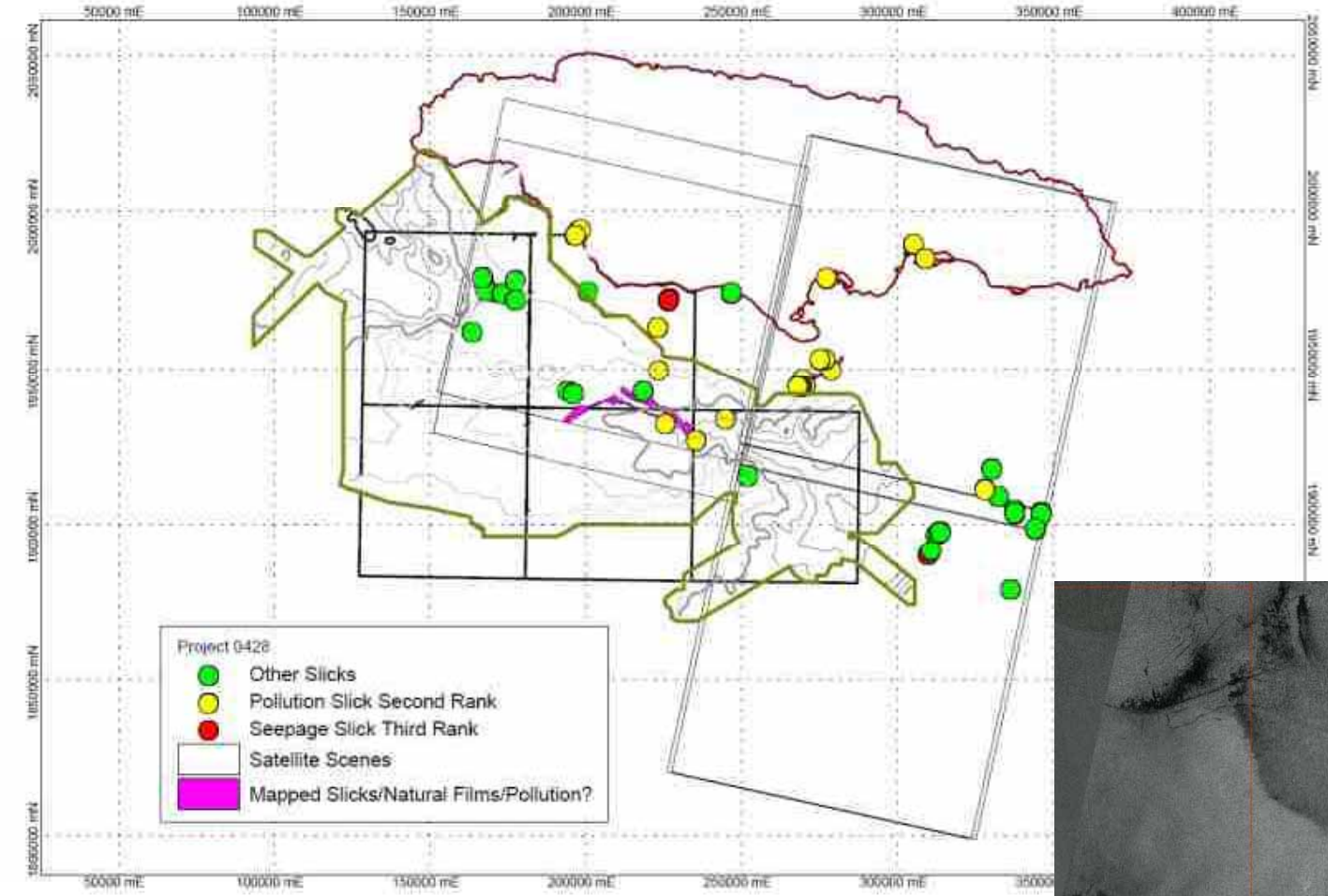


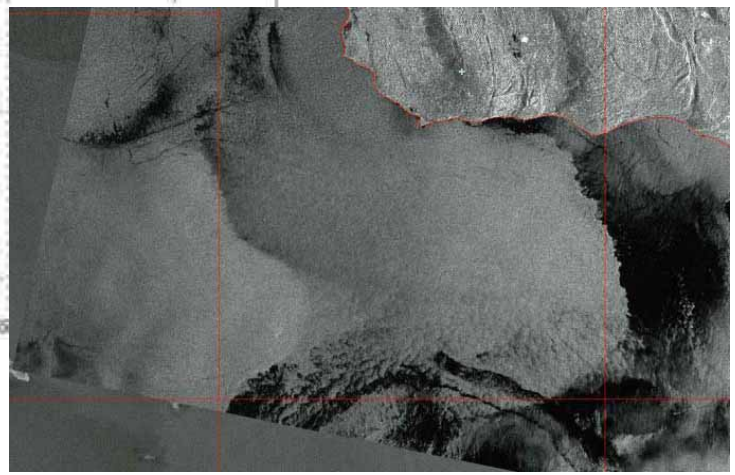
Some of the samples analysed in 2004 by JEBCO Alliance

Blowfire Hill-1 CH core, ca. 227 (745') staining reported and seen
Content-1 core, 1,434.9 (4,708')
Content-1 core, 1,602.9 (5,259') 77.54 kg/t S2, HI 506
Ecclesdown-1 CH core, 386 (1,265') Gilsonite, **to be analysed**
Hertford-1 unwashed cuttings for 2,514-2,518 (8,250- 8,260') show reported
Retrieve-1 core, 2,276 (7,468.33') bleeding oil reported,
Windsor-1 unwashed cuttings for 24-27 (90-110') strong oil shows
Windsor-1 unwashed cuttings for 52-55 (170-180') strong oil shows
Windsor-1 unwashed cuttings for 247-248 (810-815') strong oil shows
Windsor-1 CH core, ca. 78 (ca. 257') tarry oils seams reported
Windsor-1 CH core ca,. 81 (ca. 265') tarry oils seams reported

Ref JEBCO Alliance report 2004

Satellite SAR data





Ref Gippsland (Flow Energy) Finder Houston 2007 & 2010

Recommend that this initial work is extended to the deep water and backed up with Seepfinder™ airborne technology and seabed coring to include the GORE Sorber ™ surface geochemistry technologies
Other technologies such as gradiometry have open up the offshore with spectacular success.

Stratigraphy & source rocks: NCB to UNR to LNR

J Jurassic

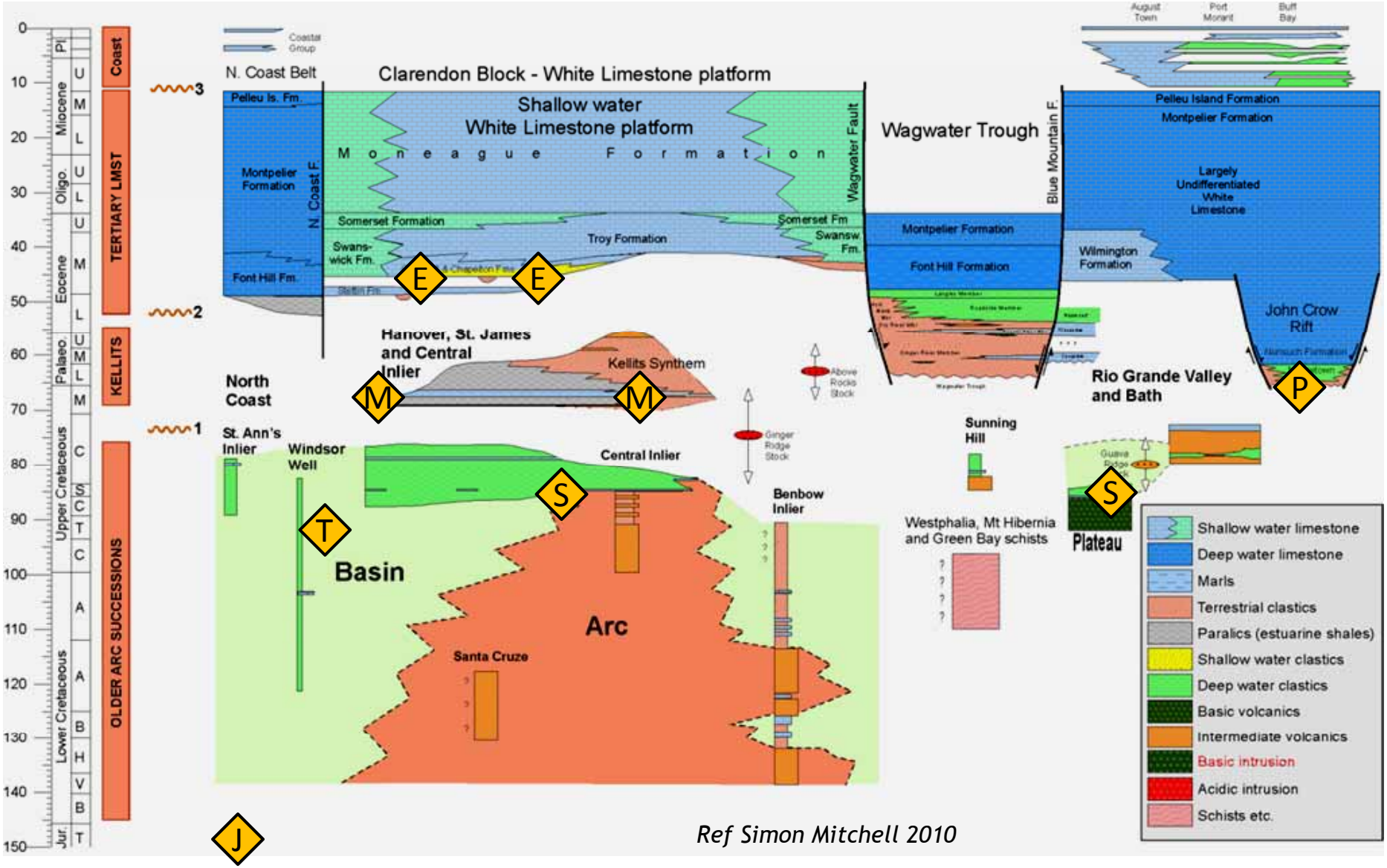
M Maastrichtian

S ?Coniacian-Santonian

T Turonian

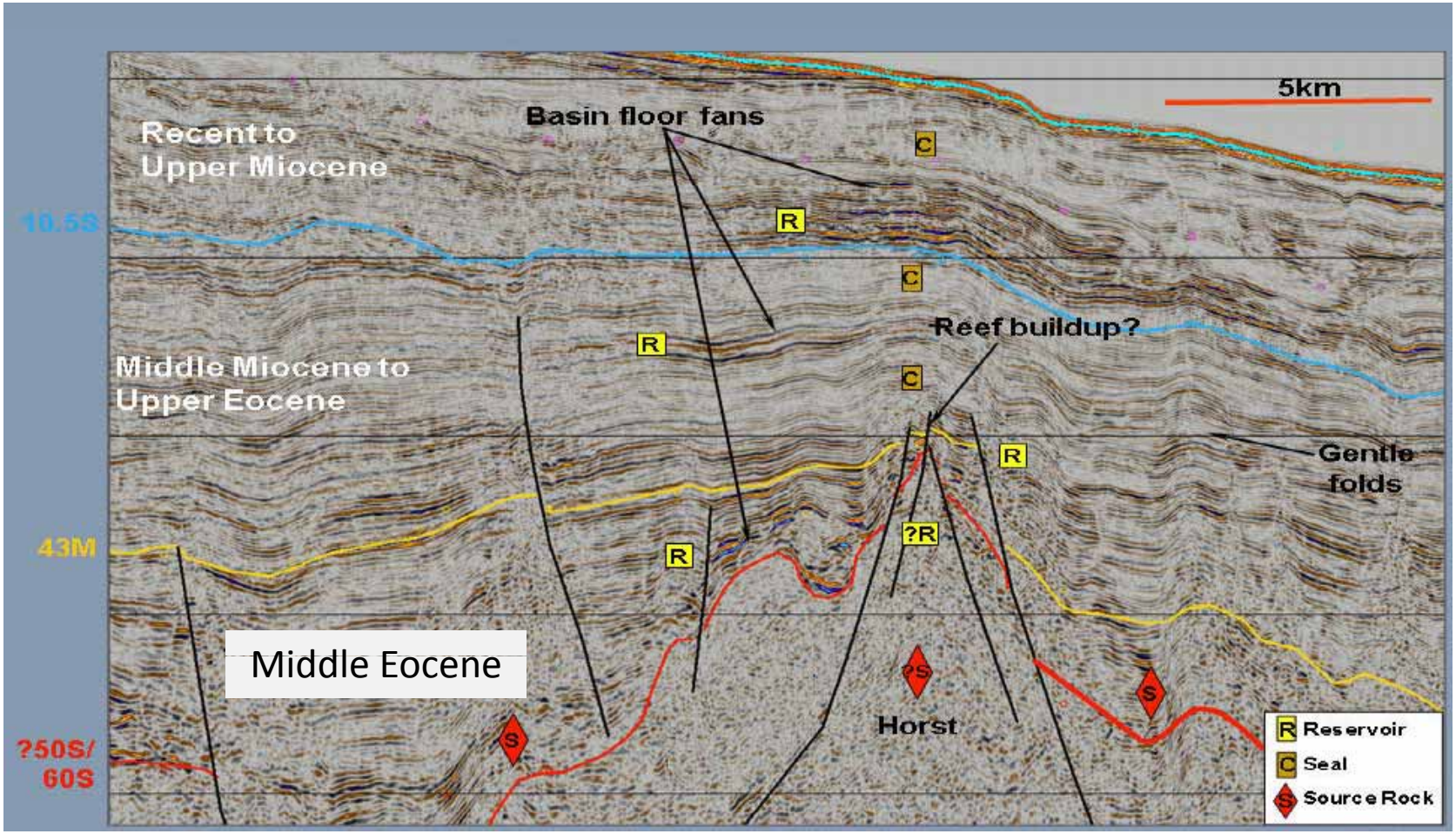
E Eocene

P Palaeocene



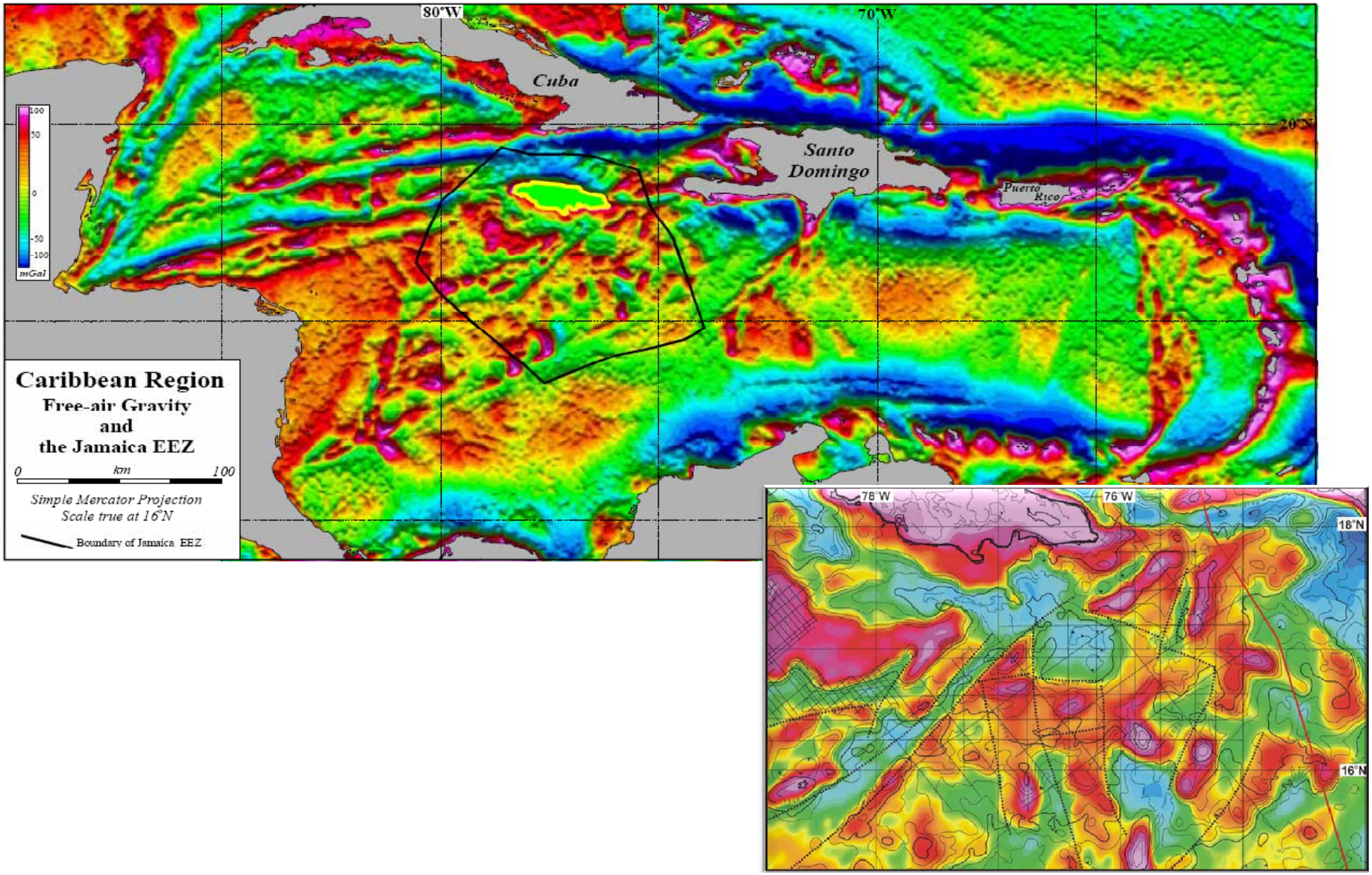
Ref Simon Mitchell 2010

Upper Nicaraguan Rise, Walton Basin section – illustrating play types and source rock location

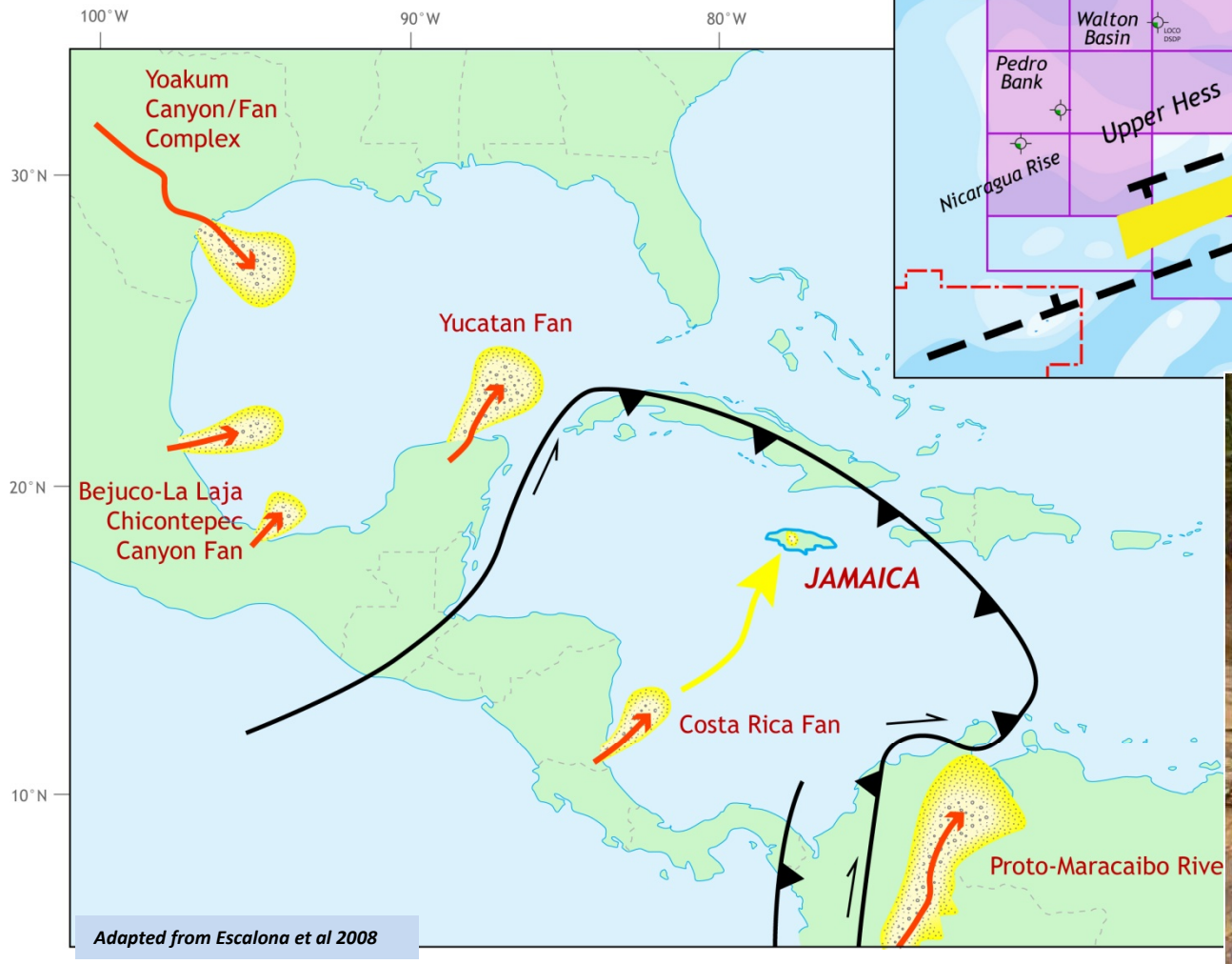


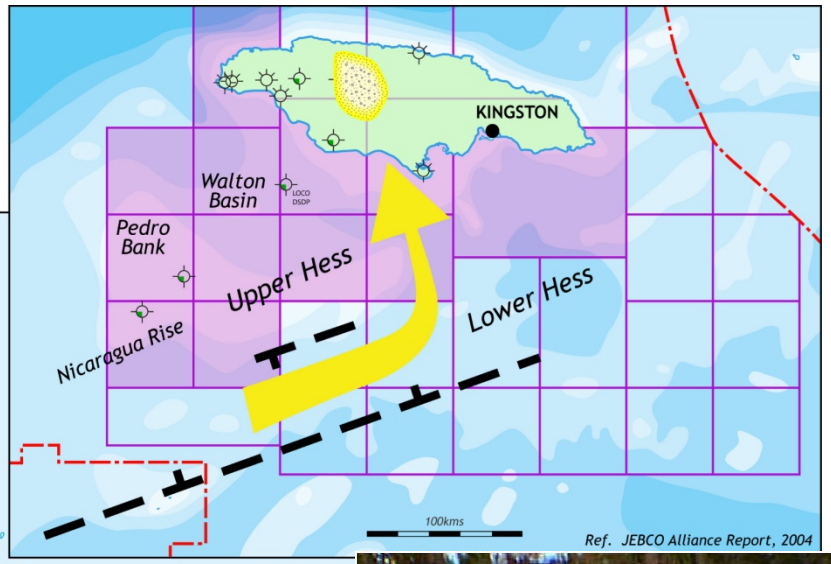
Ref Flow Energy APPEX 2010

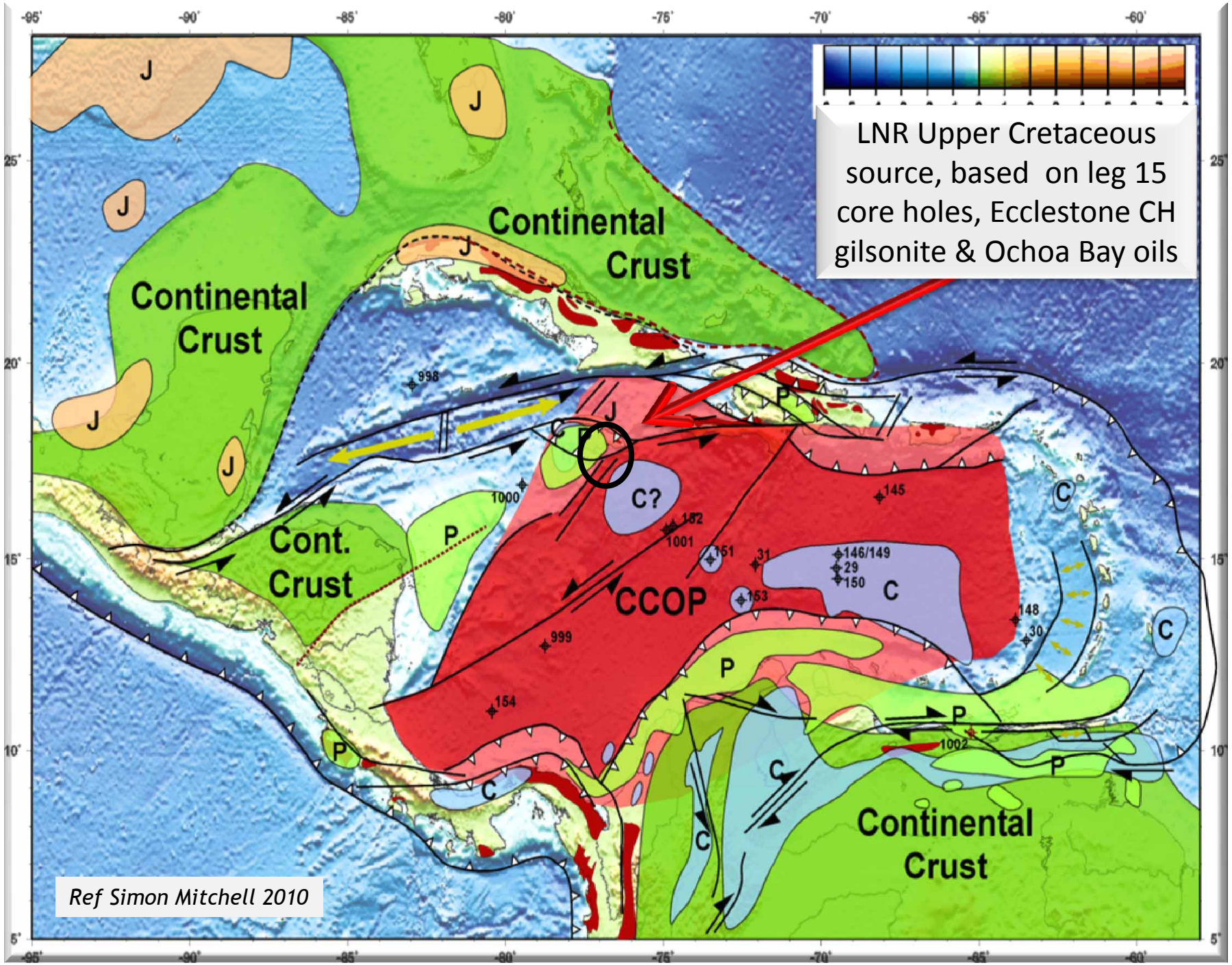
The Lower Nicaraguan Rise opportunity

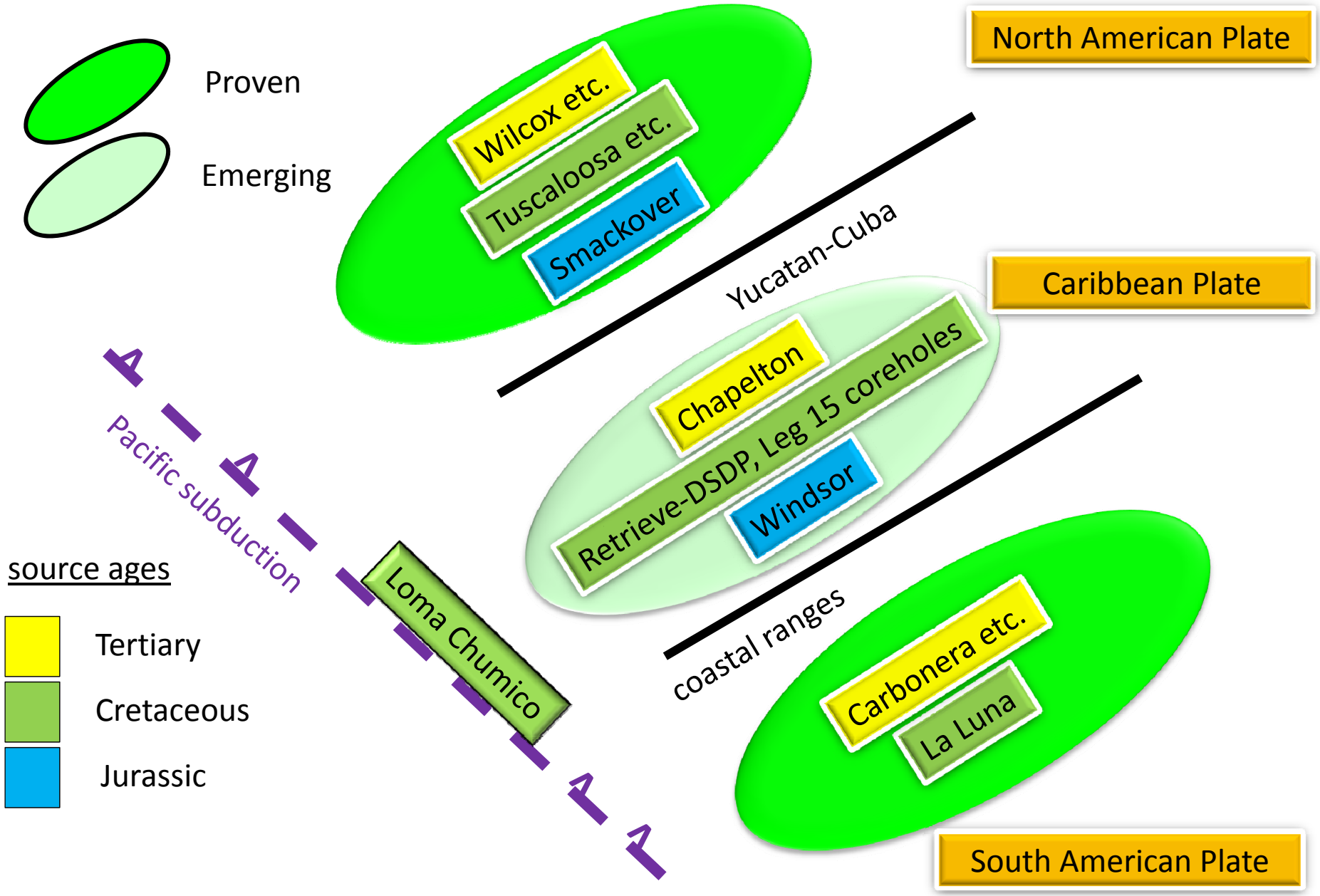


For the source of the thick Maastrichtian sand succession onshore Jamaica, and by analogy offshore, we have to look in part to the west, to the western end of the Nicaraguan Rise






LNR Upper Cretaceous source, based on leg 15 core holes, Ecclestone CH gilsonite & Ochoa Bay oils
Continental Crust
Continental Crust
Continental Crust
Cont. Crust
CCOP
C?
J
P
C
998
1000
1001
1002
999
154
145
146/149
29
150
151
153
148
30
31
-95°
-90°
-85°
-80°
-75°
-70°
-65°
-60°
25°
20°
15°
10°
5°
Ref Simon Mitchell 2010



Caribbean region source regimes

2D zigzag line tieing Pedro Bank to DSDP 1001 through 2010 license blocks- interpreted

Seismic data available CGGV

Of the Caribbean:

"Two time intervals are the most important: the Cenomanian to Santonian, and the Miocene to Pliocene. These account for over 60% of the entire regional source rock potential. They are followed by source rocks in the Late Triassic to Jurassic and the Palaeocene to Early Eocene time intervals, which have about 10% each, and finally the Oligocene with about 5%".

Ref OGJ Leahyet et al 2004

The depo-centres:

Lower Nicaraguan Rise, open blocks, example SW – NE line

- Seismic line available via CGGV

Base Coastal Group

Base Maastrichtian/ Campanian

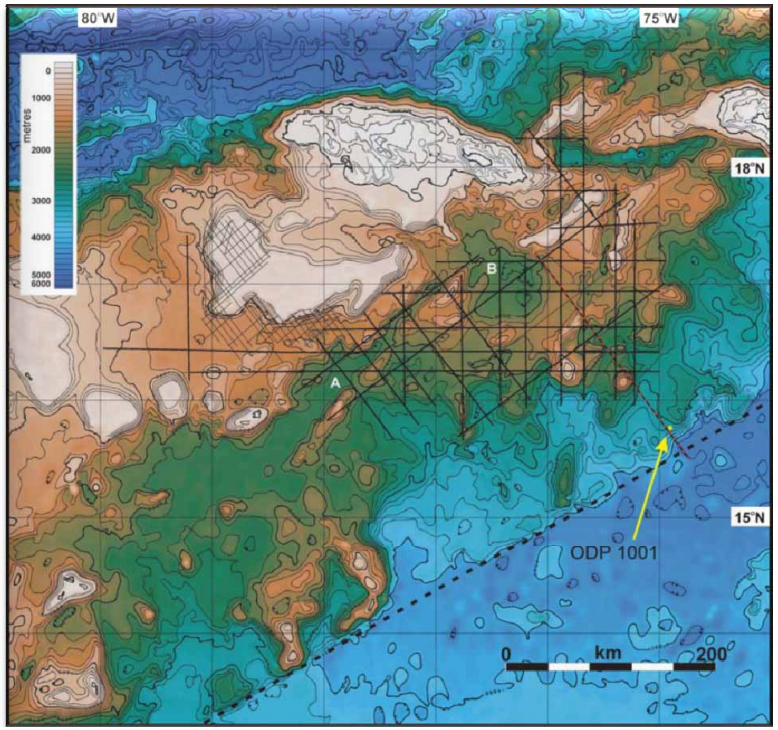
Base Cretaceous

Ref CCGV 2009 Jamaica seismic & PCJ interpretation

Bathymetry of the Jamaica waters, showing the recently acquired Rainville (thin black lines) and CGG-Veritas (bold black lines) seismic grids

Amplitude anomalies present on some CGGV data

Ref Supplementary report 2010 Jamaica seismic & PCJ interpretation



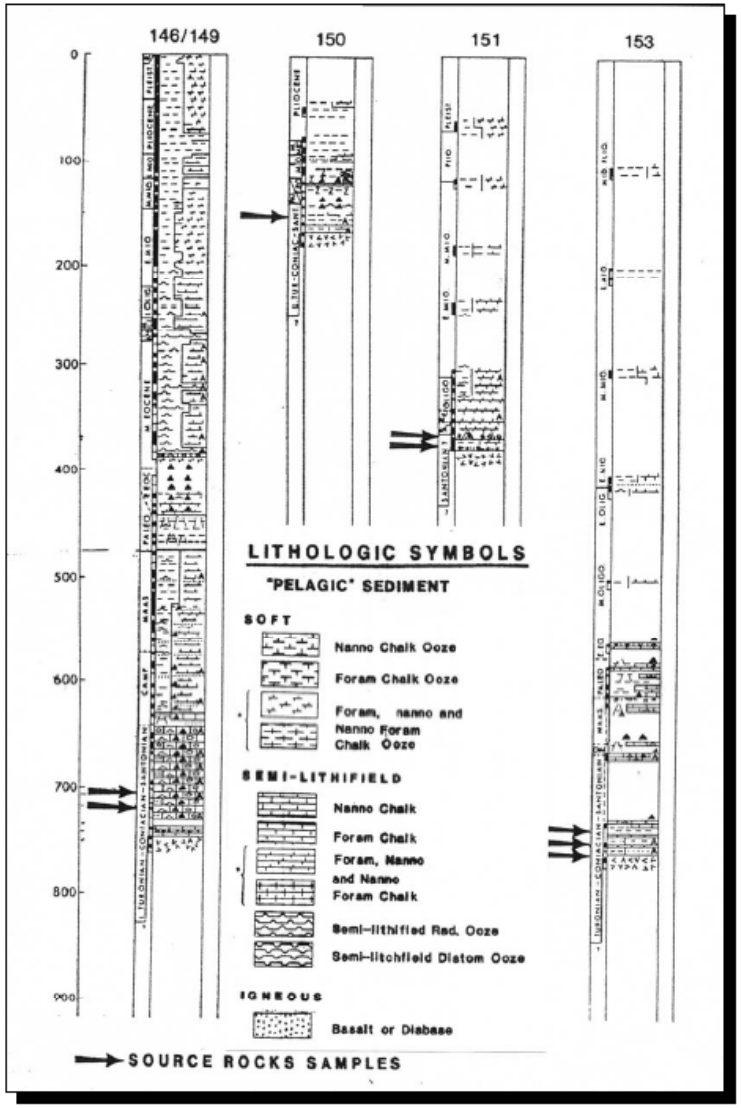
Regional Cretaceous source rock

- Carbonaceous, organic rich zones are present in the DSDP Leg 15 coreholes drilled to the south east of Jamaica (Sites 145, 146, 149, 150 and 153), Saunders et al., 1973).

- Only TOC values were published, but these peaked at 11.1% TOC at 715.06 metres in corehole 146 (Bode, 1973; all the depths are sub-seabed). In corehole 151 there was a 4.2% TOC peak at 367.26 metres and 6.2% TOC was present in corehole 153 at 732.87 metres

- Source quality and maturity information are available for at least part of the cored sections, with Pierce (2002, page 42) observing: "….. with TOCs ranging from 1.06 to 4.4%, and HIs from all but one sample of 114-535. The C13 values averaged -28‰ PDB. The Ro indicated immature source rocks

- (Ro 0.55 to 0.60%) and was expected because the samples were only buried to 367-750 metres..." A sample with an HI of 535 and a TOC of 4.4% would have an S2 of 23.5 kg/tonne and would be an excellent oil-prone source when mature



Regional Cretaceous source rocks

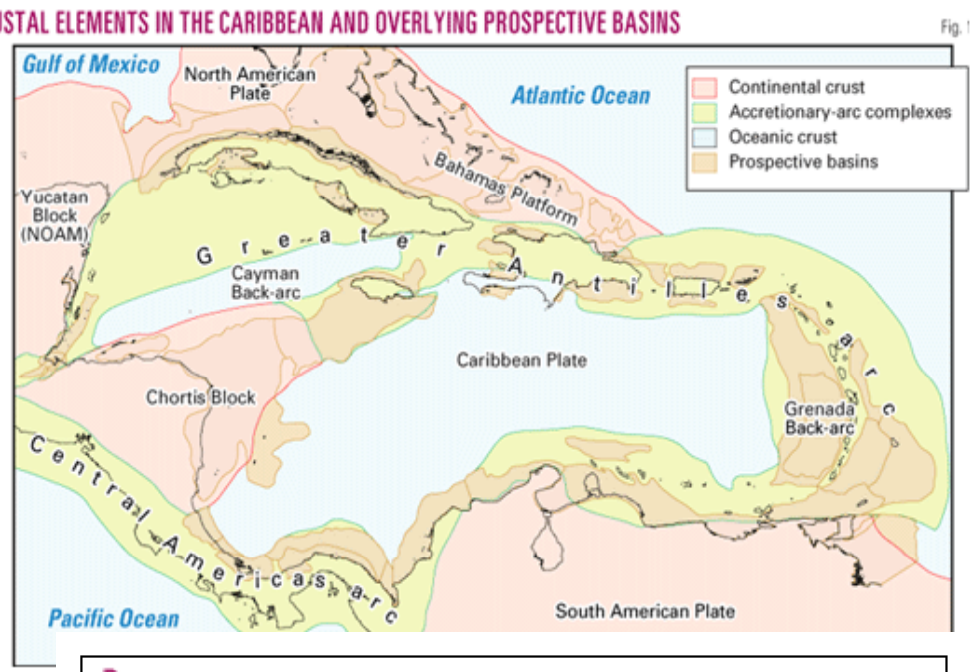
Core 38-1, corehole 146 (1973a, page 33): carbonaceous layers within radiolarian limestone's, cherts and ashes. These beds are of undefined Santonian to late Turonian age.

Core 12-1, corehole 151 (1973e, page 307): carbonaceous clays below marls of early Santonian age.

Core 16-2, corehole 153 (1973g, page 375): .carbonaceous layers rich in fish remains, and volcanic debris. *Zoophycus burrows are conspicuous.* This unit is Coniacian in age

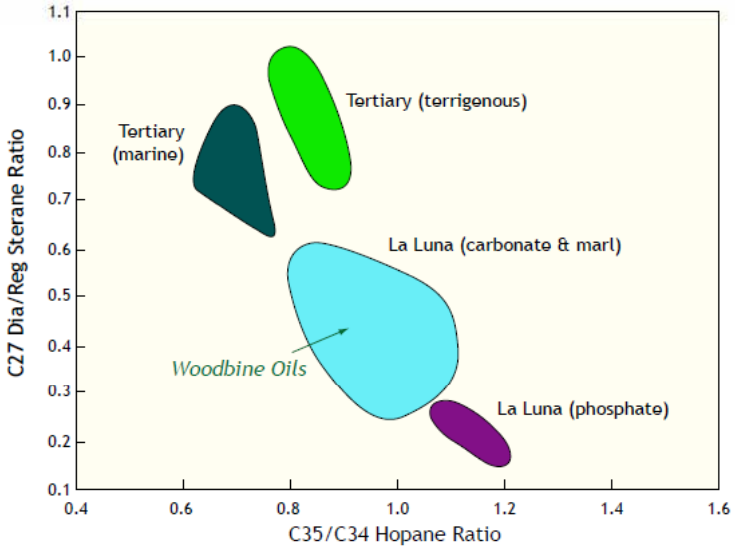
A summary diagram for the gross setting of these horizons is included in Pindell (1995, figure 2b). The origin of the source rocks is uncertain. Kerr (1988) suggested that there might be a direct relationship to the anoxia and the immediately preceding period of intense volcanicity related to the formation of the Caribbean Oceanic Plateau, but an earlier idea was that they were formed during the global stagnation of oceanic circulation in the mid- Cretaceous (Saunders *et al., 1973, pages 1,098-1,100). Both models permit* older source rocks at locations away from the highs penetrated by the coreholes. The broad regional extent of Santonian source rocks is shown in figure 2 of Leahy *et al. (2004). Pequegnat and Jeffrey (1979, figure 2)* dredged an oil which they considered to be of natural origin from the region of the DSDP coreholes (Figures 1.1 and 10.2). Their samples are thought to no longer exist (John Zumberge, GeoMark Research, pers comm., 4/04). Source rocks similar to those drilled in DSDP Leg 15 have not yet been found in Jamaica, but there are candidate horizons in the deepwater Coniacian and Santonian successions of the inliers. Tars collected from the beach at Ocoa Bay in the south central Dominican Republic were attributed to a Cretaceous source by Pierce (2002, page 42). A second active oil source is required in this area because these tars are isotopically much lighter (-26.86‰) than the exceptionally isotopically heavy Tertiary oil (-17‰).

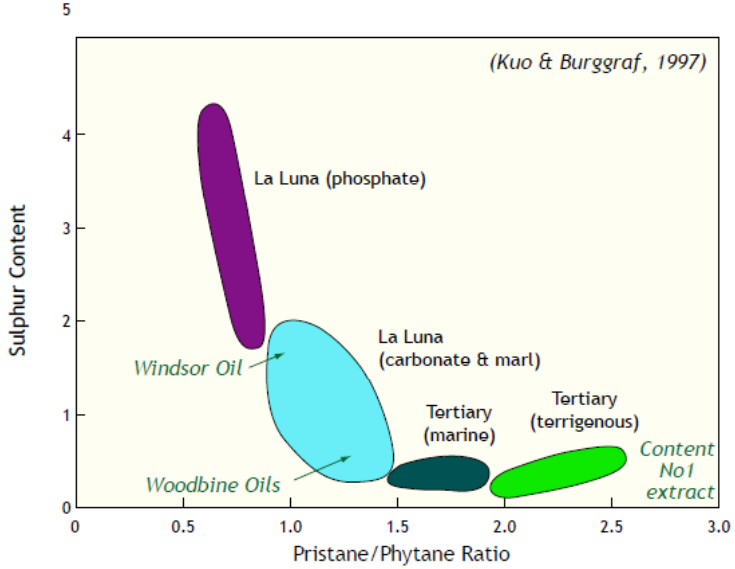
Excerpt from JEBCO Alliance report 2004



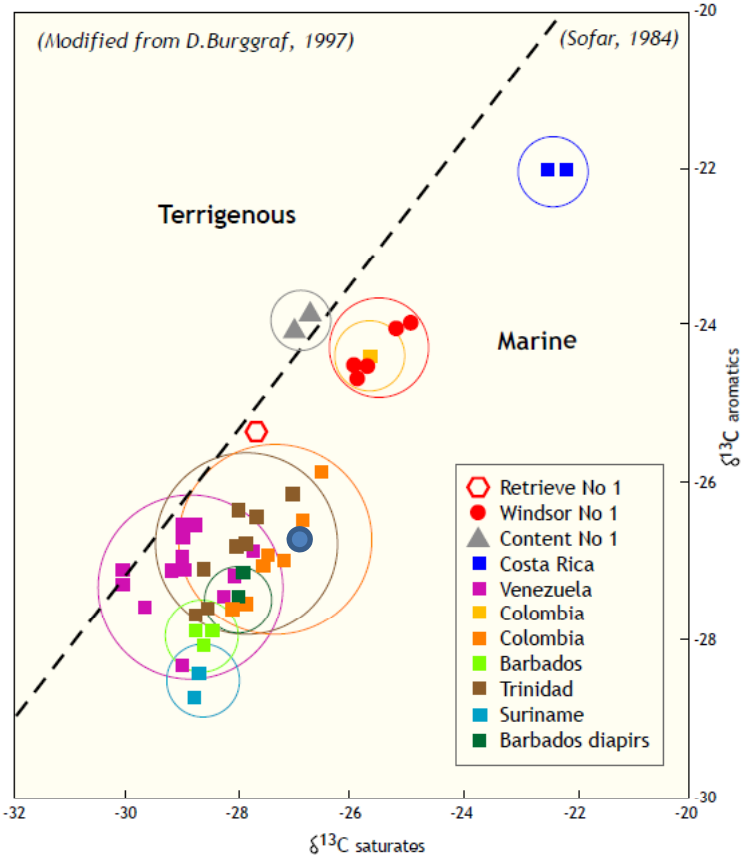
Ref OGJ Leahyet et al 2004

SELECTED LATIN AMERICAN OILS, BIOMARKER & BULK PROPERTIES





CARBON ISOTOPES



Onshore, offshore Walton basin & Lower Hess

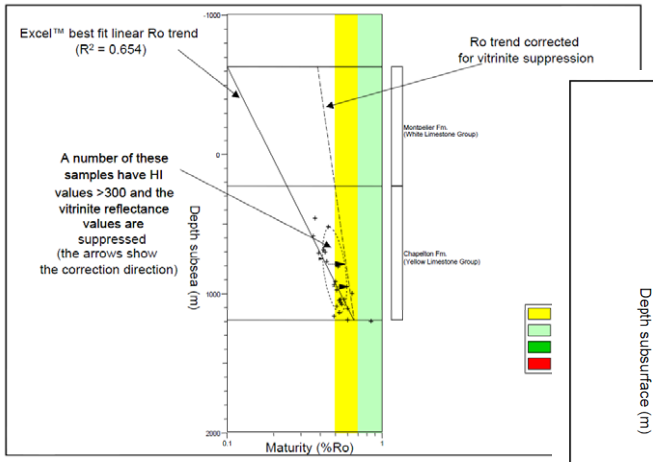


Figure 9.19. Content-1: vitrinite reflectance (Ro%) *versus* depth plot.

Onshore, Eocene

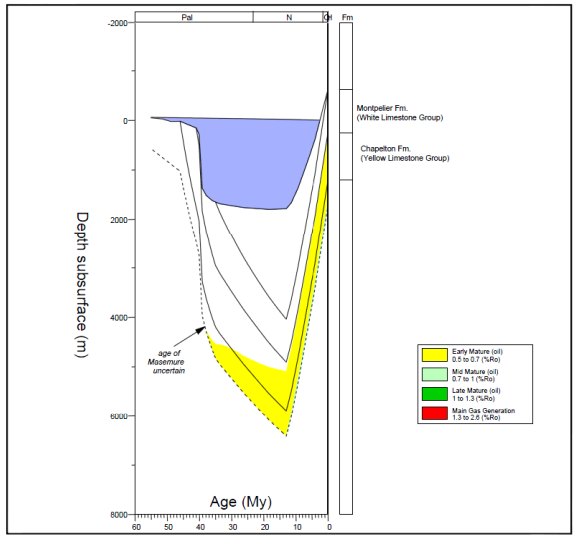


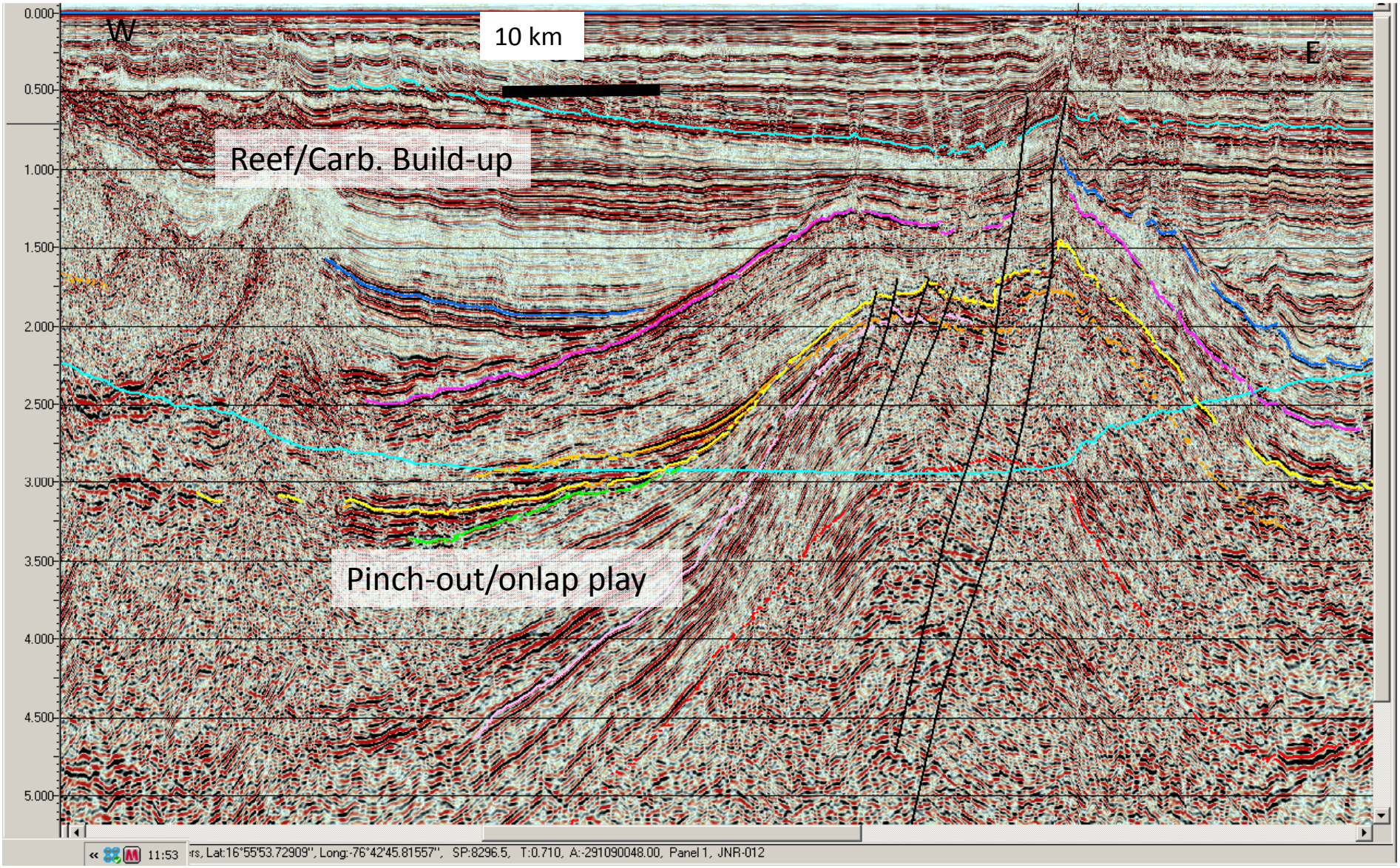
Figure 9.21. Content-1: maturation history plot for the Chapelton Formation.

Walton basin, Eocene

WORK IN PROGRESS – image not available

Rodrigues (1983, p. 224-226) used a BHT 58° C at 2316 metres, corrected to 73° C, and a surface temperature of 24° C to calculate a present day GG of 21 °C/1000 metres

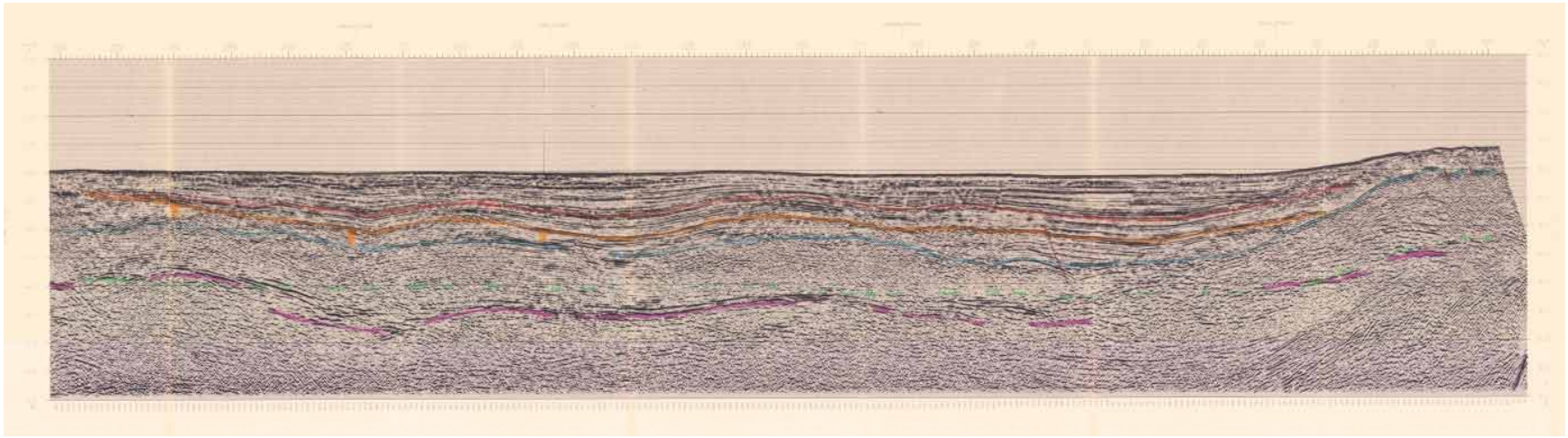
Lower Nicaragua rise – Campanian, one of several new pseudo well locations

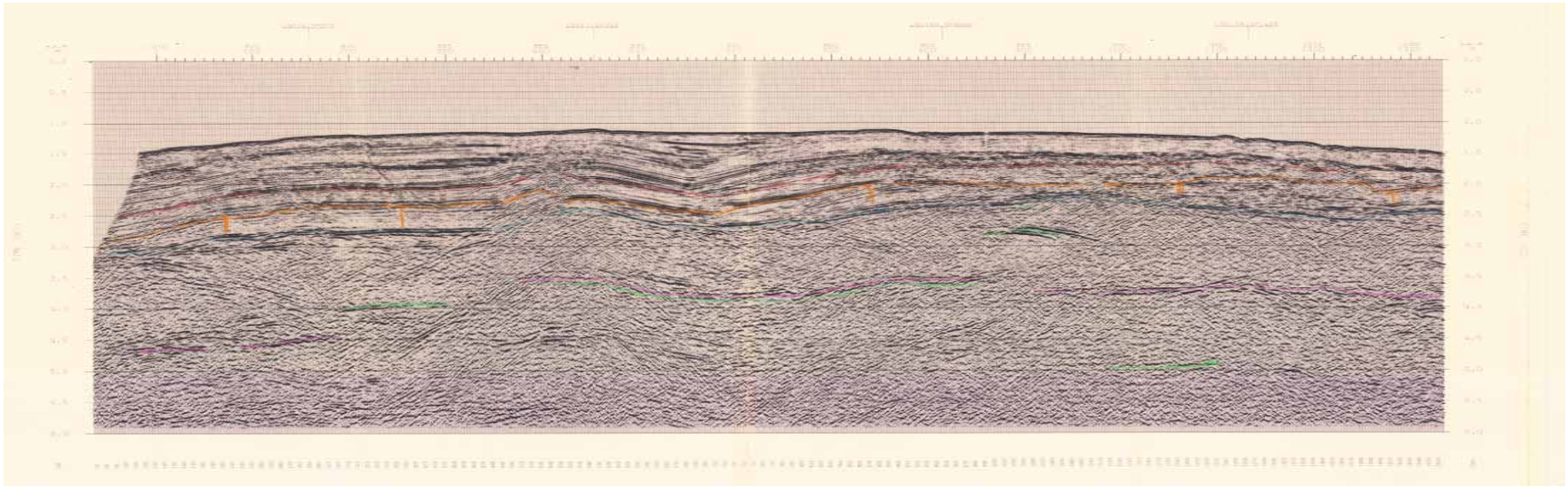

W
10 km
E
Reef/Carb. Build-up
Pinch-out/onlap play
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
11:53
rs, Lat:16°55'53.72909'', Long:-76°42'45.81557'', SP:8296.5, T:0.710, A:-291090048.00, Panel 1, JNR-012

Summary of leads/plays – Large structures and a potent source system to charge them

Lead	Type	Water Depth m	Depth m	Depth BML m	Approximate area of closure sq km	Acre	~ Relief m +/- 150	Notional STOIIP for 100ft net slab PHI=18% Sw 35% Boi 1.4; MMBO
Blks16/21/22-FD1	Fault-Dip closed	1500	2500	1000	645	159,315	600	10,329
Blk18-FD1	Fault-Dip closed	1610	3000	1390	190	46,930	750	3,043
Blk18-FD2	Fault-Dip closed	1785	6500	4715	80	19,760	200	1,281
Blk19-FD1	Fault-Dip closed	2120	5250	3130	800	197,600	900	12,811
Blk21/22-FD2	Fault-Dip closed	2000	5500	3500	165	40,755	600	2,642
Blk22-FD3	Fault-Dip closed	2285	5250	2965	55	13,585	400	881
Blk22-Amp1	Amplitude	2290	5900	3610	180	44,460	100	2,883
Blk23-FD1	Fault-Dip closed	1960	6100	4140	240	59,280	400	3,843
Blk24-FD1	Fault-Dip closed	1820	7900	6080	200	49,400	350	3,203
Blk27-FD1	Fault-Dip closed	1680	5500	3820	240	59,280	300	3,843
Various blocks	Reef Plays	shown by RF on maps						
Blk 19 in particualr	Pinch-out plays	shown by OLPO on summary maps						
Others	One-line plays	shown with Red circle on summary maps						

East of Jamaica, thick sedimentary sequence, further play opportunities – data to the east





Morant database – Also reconstructed data available

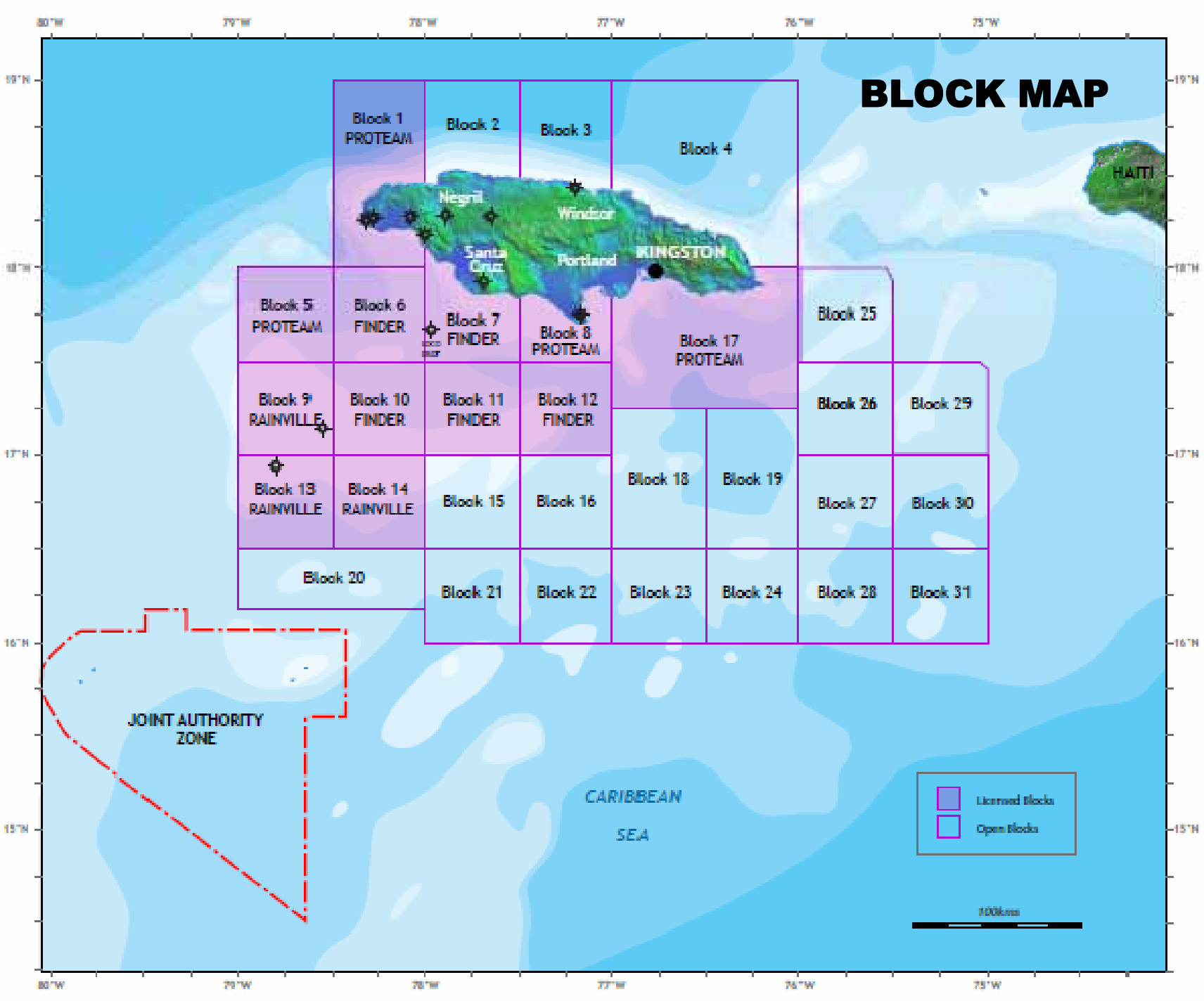
Overview of the geology of the Jamaican Offshore deep water blocks

- The Jamaican deep water blocks covered by the 2009 CGGVeritas multi-client survey with a variable density of 10 to 40 km grid, offer good primary reflection events suggesting 8 to 10 kms of sediment. The new data shows a number of structural leads with additional stratigraphic opportunities as reefs and onlap plays exist in water depths of 1500 to 2200 meters

- The Leads include carbonate build ups, pinch out geometries and clastic sediments. Structural leads could offer areal closures from 80 to 800 sq kms with the potential to contain billions of barrels of oil in place. The main leads offer good top seal potential

- Seismic lines show multiple targets vertically with good top-seal potential as the bounding faults show limited re-activation

- All 4 onshore blocks are open, together with 19 offshore blocks, 12 of the offshore blocks being licensed to 3 companies


BLOCK MAP
Block 1 PROTEAM
Block 2
Block 3
Block 4
HAITI
Negril
Windsor
Santa Cruz
Portland
KINGSTON
Block 5 PROTEAM
Block 6 FINDER
Block 7 FINDER
Block 8 PROTEAM
Block 17 PROTEAM
Block 25
Block 9 RAINVILLE
Block 10 FINDER
Block 11 FINDER
Block 12 FINDER
Block 26
Block 29
Block 13 RAINVILLE
Block 14 RAINVILLE
Block 15
Block 16
Block 18
Block 19
Block 27
Block 30
Block 20
Block 21
Block 22
Block 23
Block 24
Block 28
Block 31
JOINT AUTHORITY ZONE
CARIBBEAN SEA
Licensed Blocks
Open Blocks
100kms
80°W
79°W
78°W
77°W
76°W
75°W
19°N
18°N
17°N
16°N
15°N

Data-sets available:

MANDATORY PURCHASES

1. 1st round & supplemental 2nd round reports ($25K† + $15k)

   "The Realization of the Hydrocarbon Potential of Jamaica, Vol I & II"
   "Petroleum potential. Offshore, southern Jamaica updated, an explorationists guide"

COMPLIMENTARY DATA & REPORTS

2. Digital, seismic, well & library data
3. Geophysical interpretation of CGG data by Boz Enterprise

OPTIONAL PURCHASES

4. CGG seismic data – minimum 300km (6,118 & 2,594 km)
5. Seismic Data, digitally reconstructed, navigation corrected – Walton, Pedro & Morant areas
6. Other reprocessed seismic data – Walton & Pedro areas

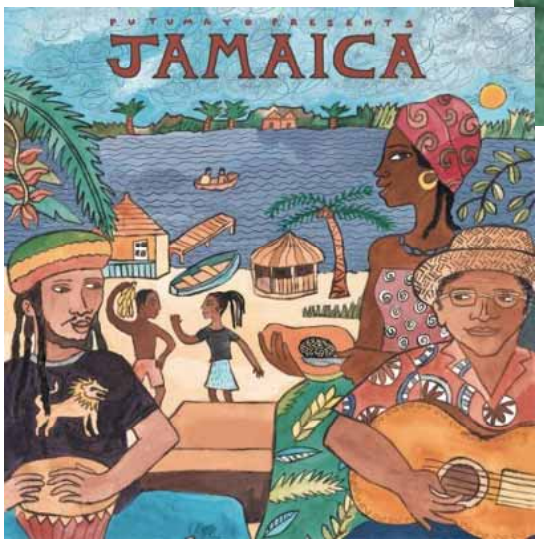
† *Not required if previously purchased (8 companies purchased)*

Bidding Arrangements TIMETABLE

March 1st 2010	Launch of 2nd Formal Bid Round.
March- May 2010	Companies arrange to purchase seismic data from PCJ/CGGV
May 1st 2010	Notification to PCJ of expression of interest in receiving data sets
March 1st 2011	Receipt of Bids by PCJ
April 2011	Interviews held with Applicants/Applicant groups
May 2011 onwards	Negotiations to be held for the awards of contracts

Contractual Terms

- Production Sharing Arrangements (PSA) system, Model Contract available
- Five year primary exploration period
- Twenty year production period, extendable by ten years
- 33⅓% max income tax rate, and/or possible tax exemption
- Ability to recoup production costs, ROR, defray tax obligations prior to sharing profit with Government
- No restriction on production exports or repatriation of capital
- Sale, farm-outs or joint venture opportunities allowable to companies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