COLOMBIA:
The perfect ... environment for hydrocarbons

ANH
The people to speak to

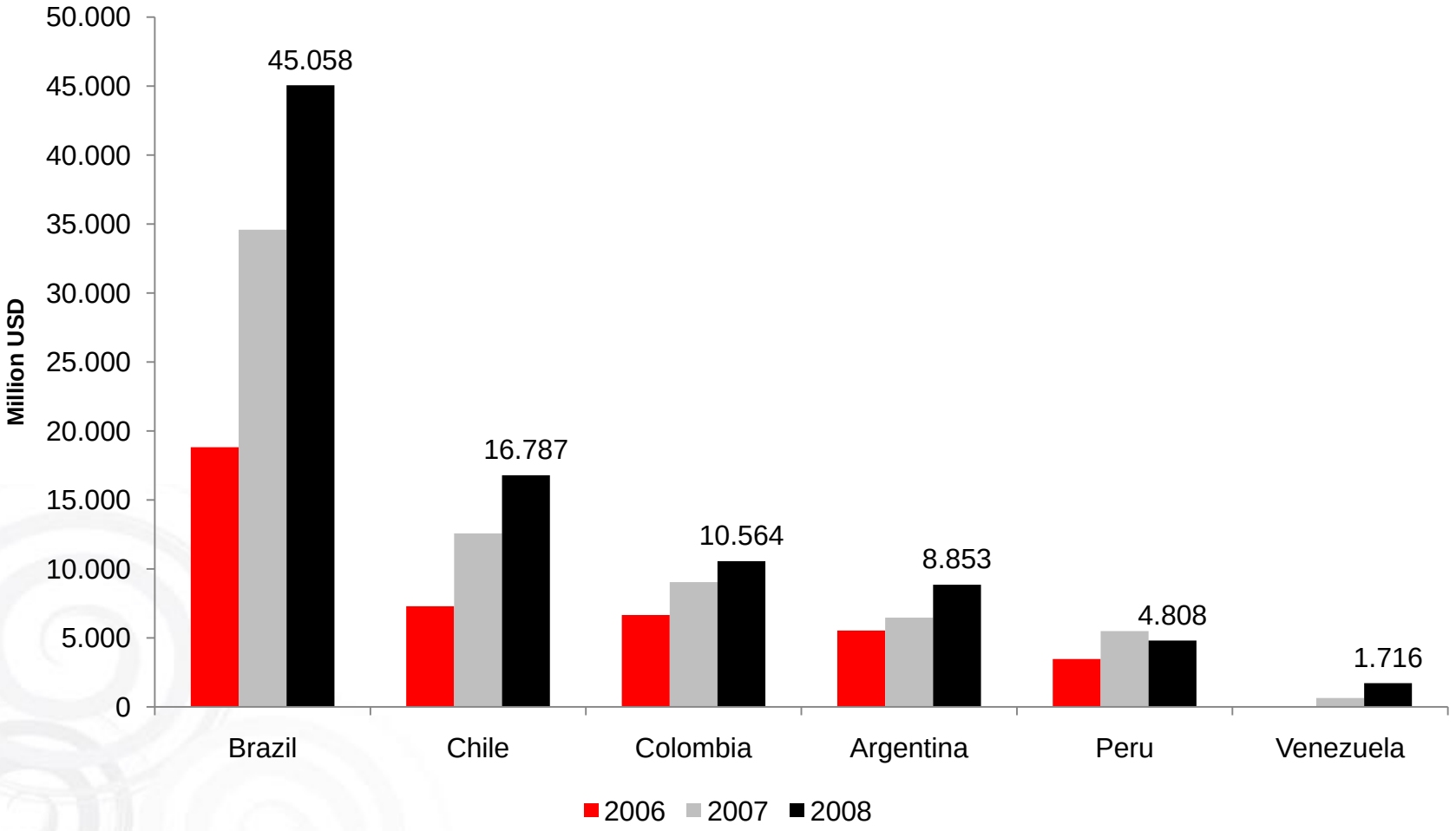
Contents – Part I

1. Colombia
2. Industry background
3. Open Round Colombia 2010
4. Legal aspects and Contracts
5. Communities and environmental priorities

Colombia in South America:

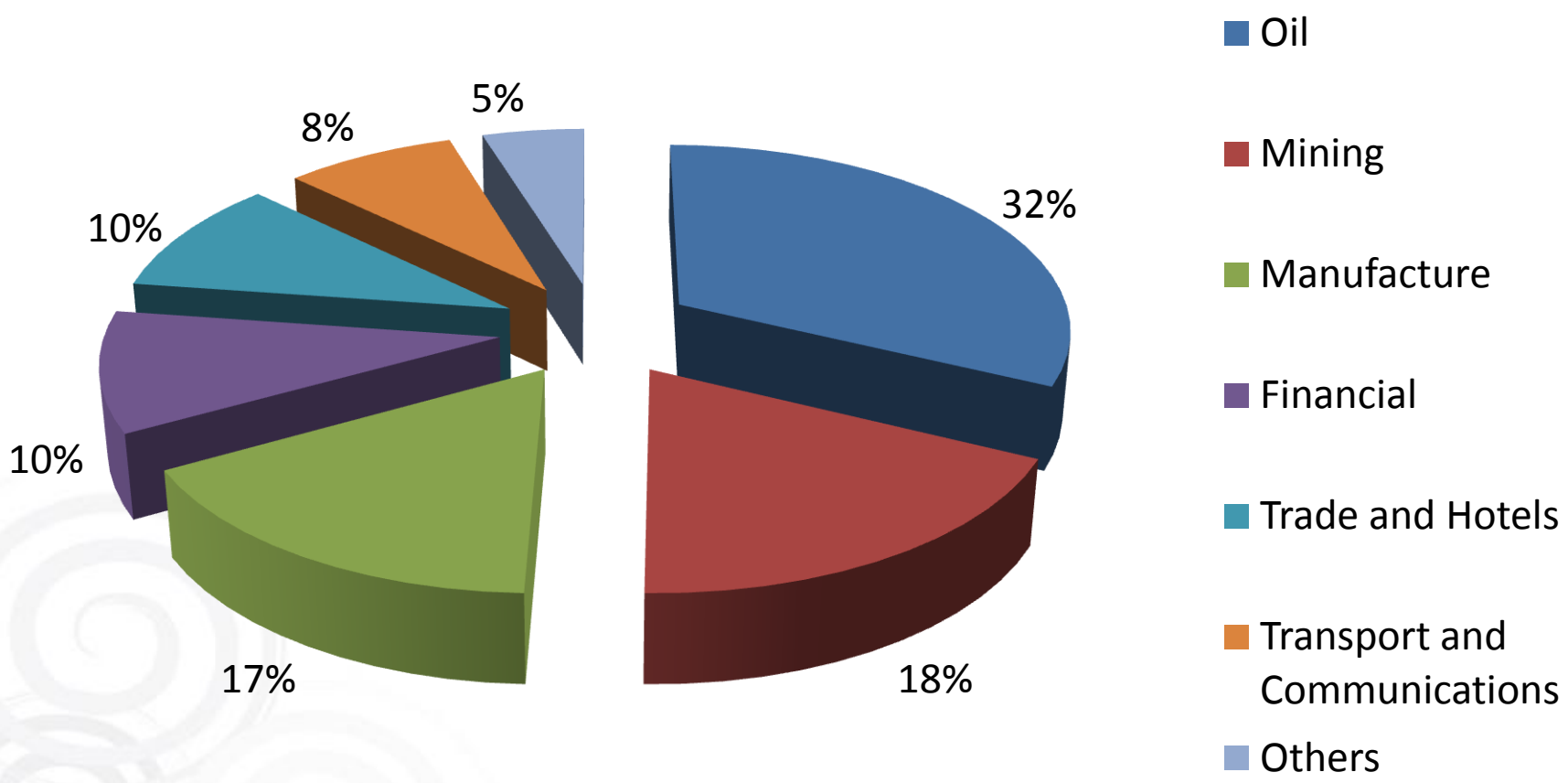
- ✓ Oldest democracy
- ✓ 2nd population : 45 million
- ✓ 3rd crude producer: 800,000 b/d (2010 est.)
- ✓ 3rd economy : GDP: US$395 billion
  US$8500/Cap (PPP)
- ✓ 3rd recipient of FDI : US$10.6 billion (2008)
  - in oil & gas : US$ 3.4 billion (2008)
- ✓ 4th Land surface area: 1.2 million sq km
- ✓ - sedimentary (land) : ~ 0.8 million sq km
- ✓ - marine : ~ 0.9 million sq km

FDI flows in South America



Source: UNCTAD

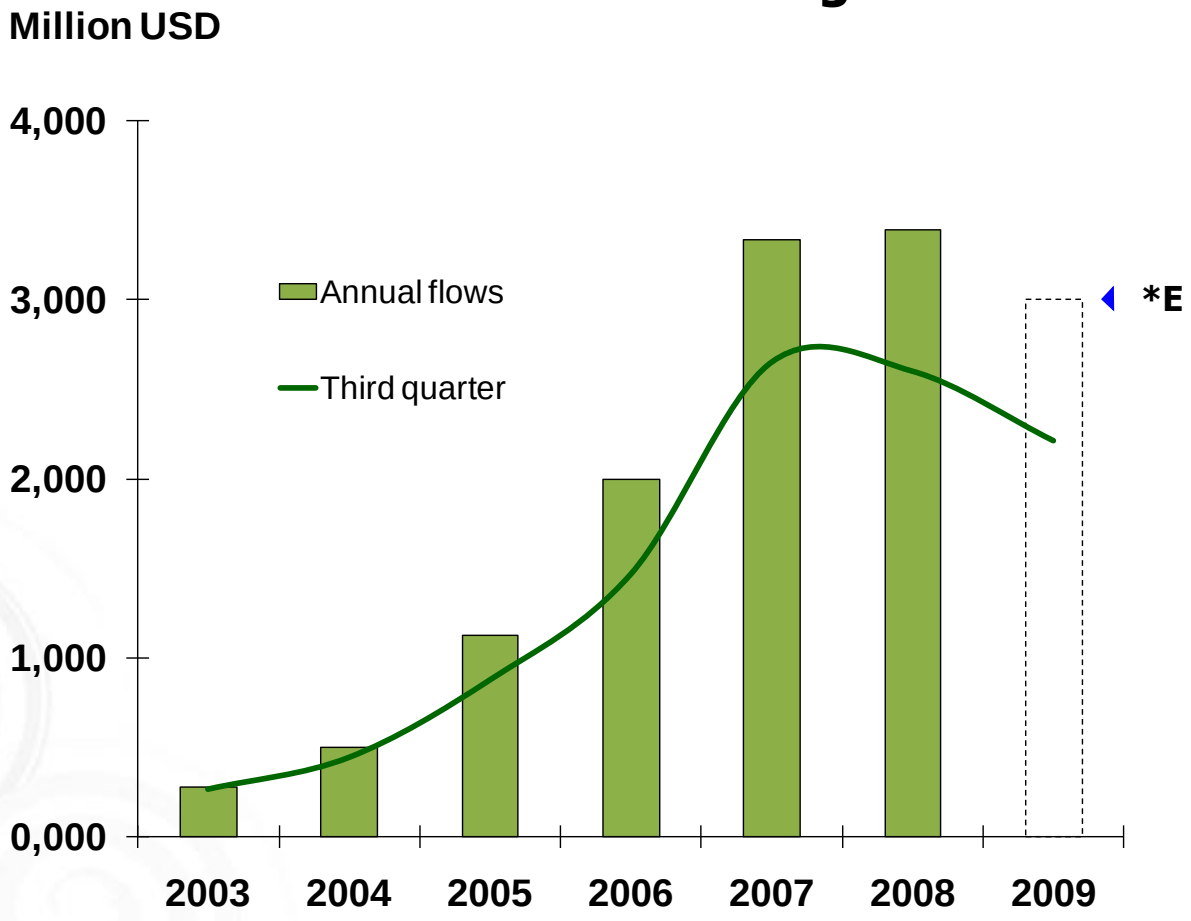
FDI by economic activity (2008)



Source: Banco de la República

Growing investment in hydrocarbons

Historic FDI in oil & gas



*E = estimated

Source: Banco de la República

Institutional framework - since 2003

Ministry of Mines and Energy	Policy-making and control
ANH AGENCIA NACIONAL DE HIDROCARBUROS	Administration and promotion of the hydrocarbons resources
ecopetrol	Explores, produces, refines, transports and markets

Strategic framework

Mission

The ANH is the agency responsible for promoting the optimal and sustainable exploitation of the country's hydrocarbons resources;

through an integrated administration approach, seeking a balance between the interests of the State, Colombian society and industry

Vision

The ANH shall be recognized globally as a model government institution by:

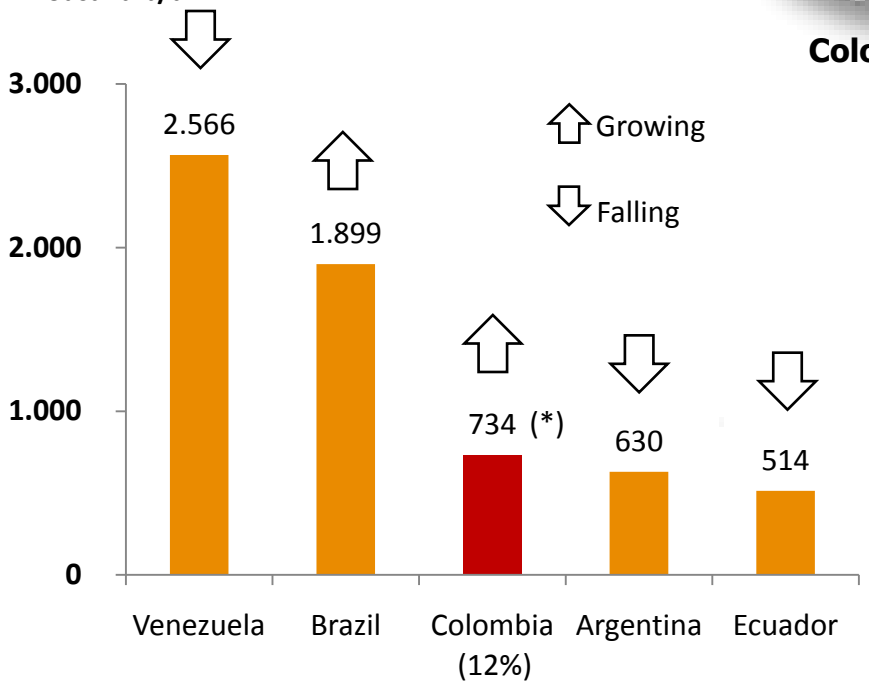
- its knowledge of the Colombian geological potential and the optimization of its exploitation;
- its efficient and transparent administration of the hydrocarbon resource and coordinated work with both industry and community; and
- its professional staff, its high technological level and the agility of its process

Contents

Oil in South America

Production

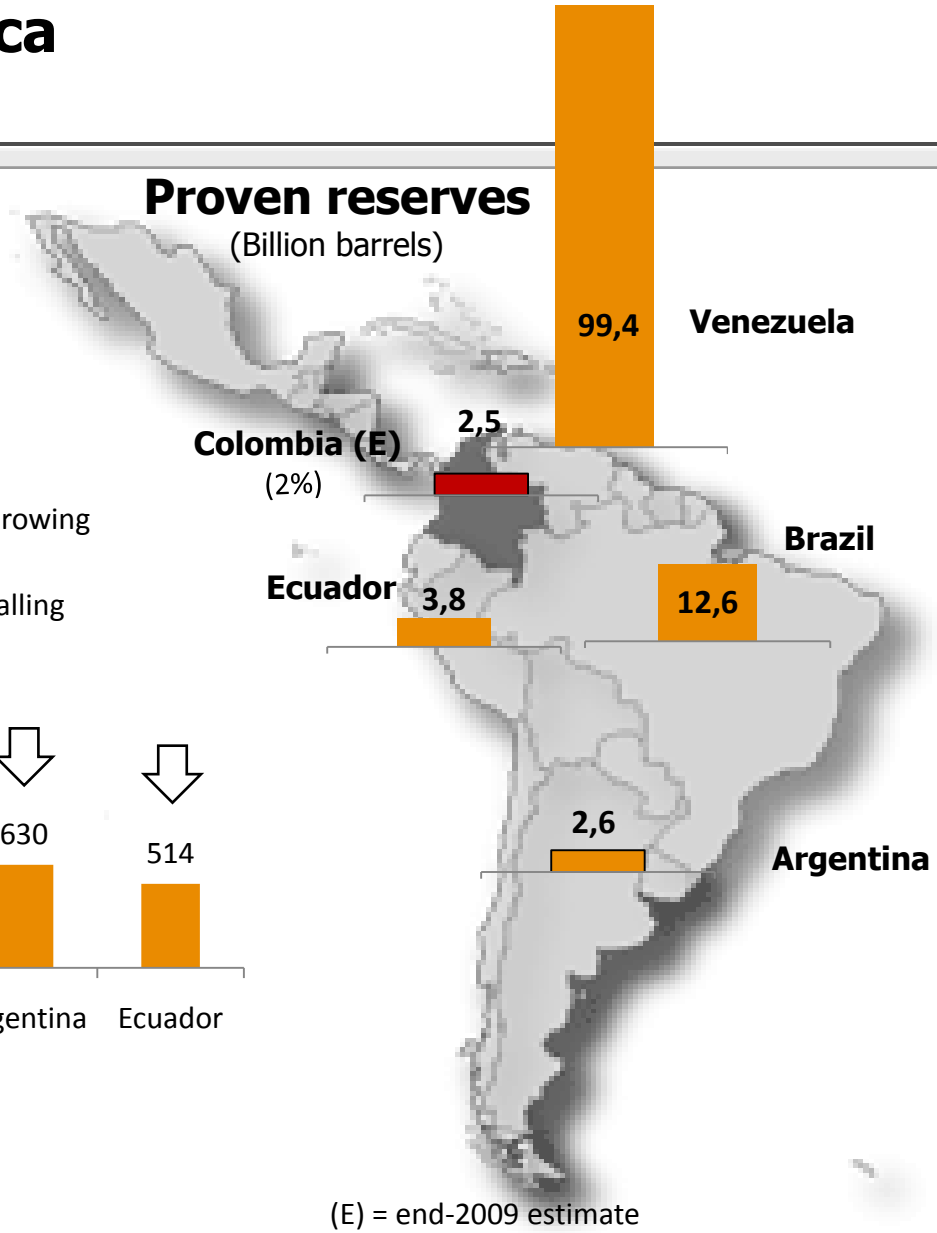
Thousand b/d



(*) Production as of December 2009

Proven reserves

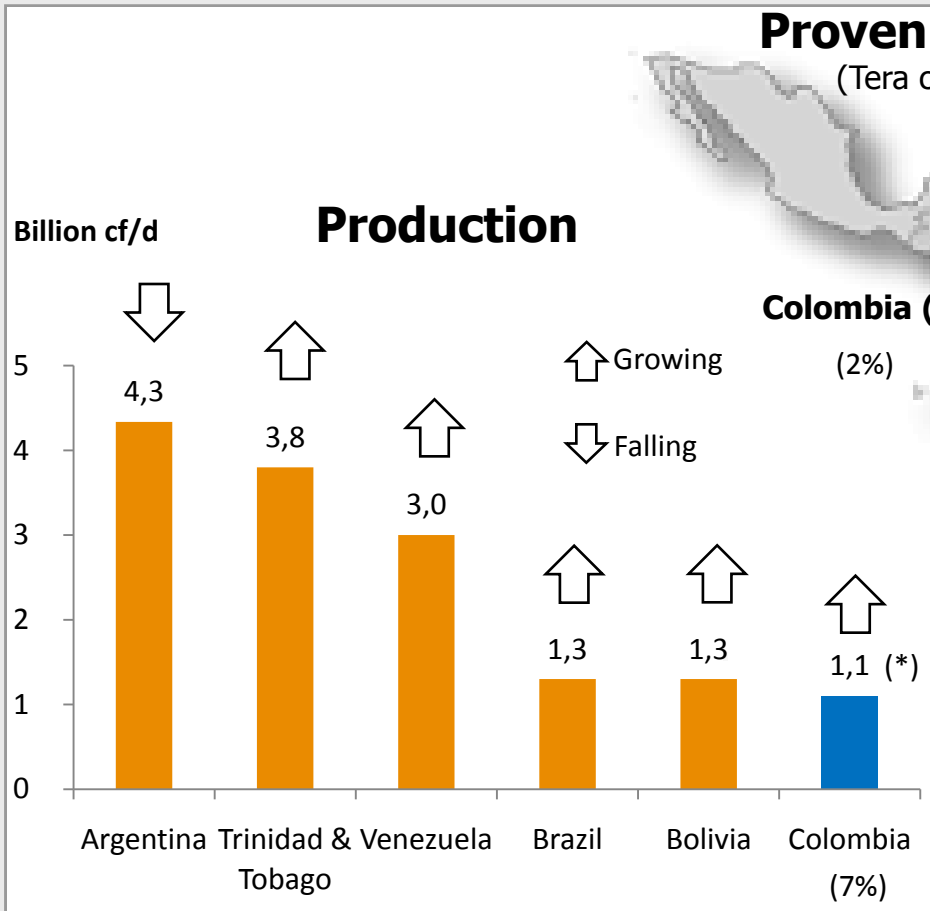
(Billion barrels)

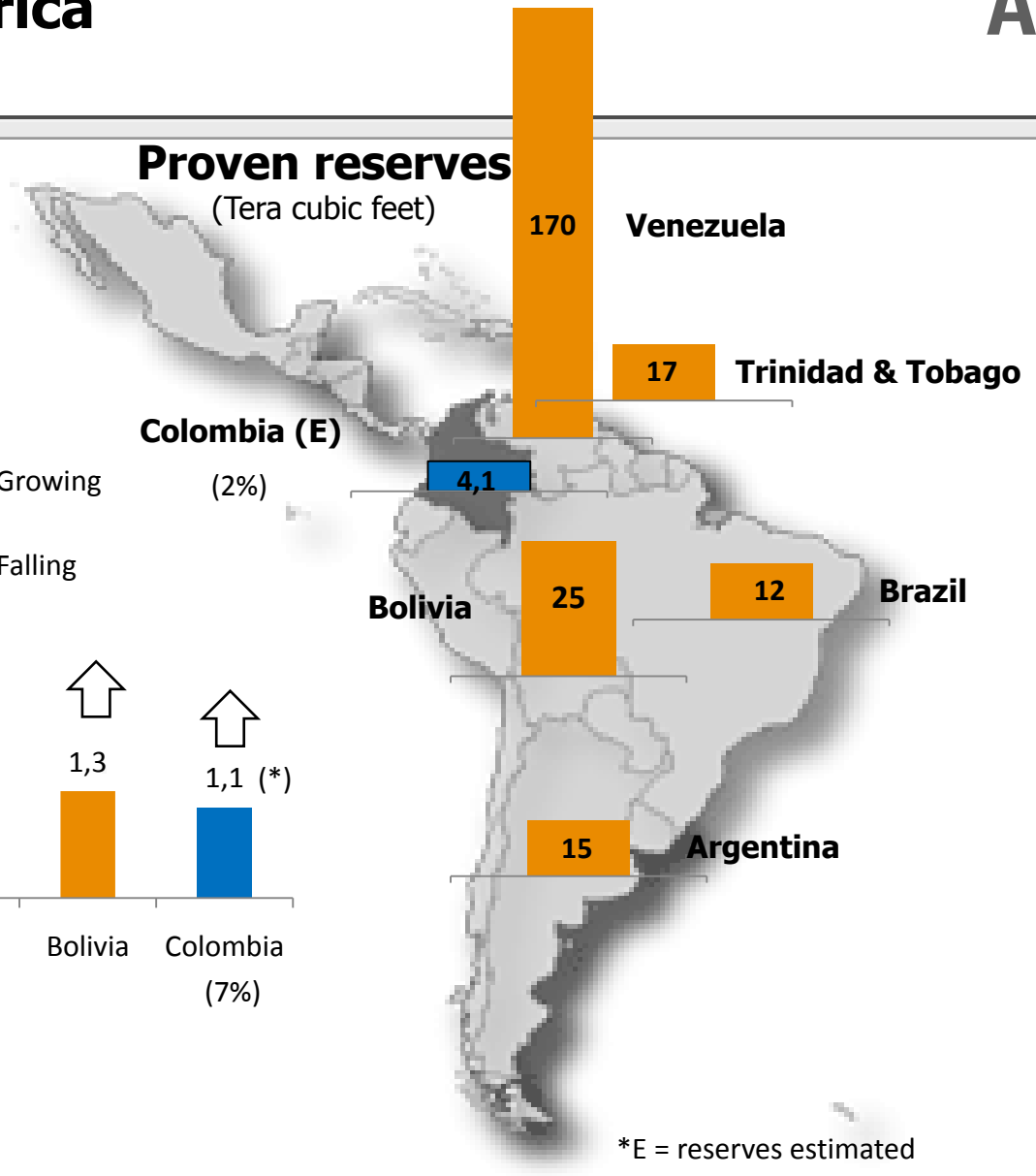


(E) = end-2009 estimate

Sources: BP Statistical Review 2009; ANH Analysis

Gas in South America





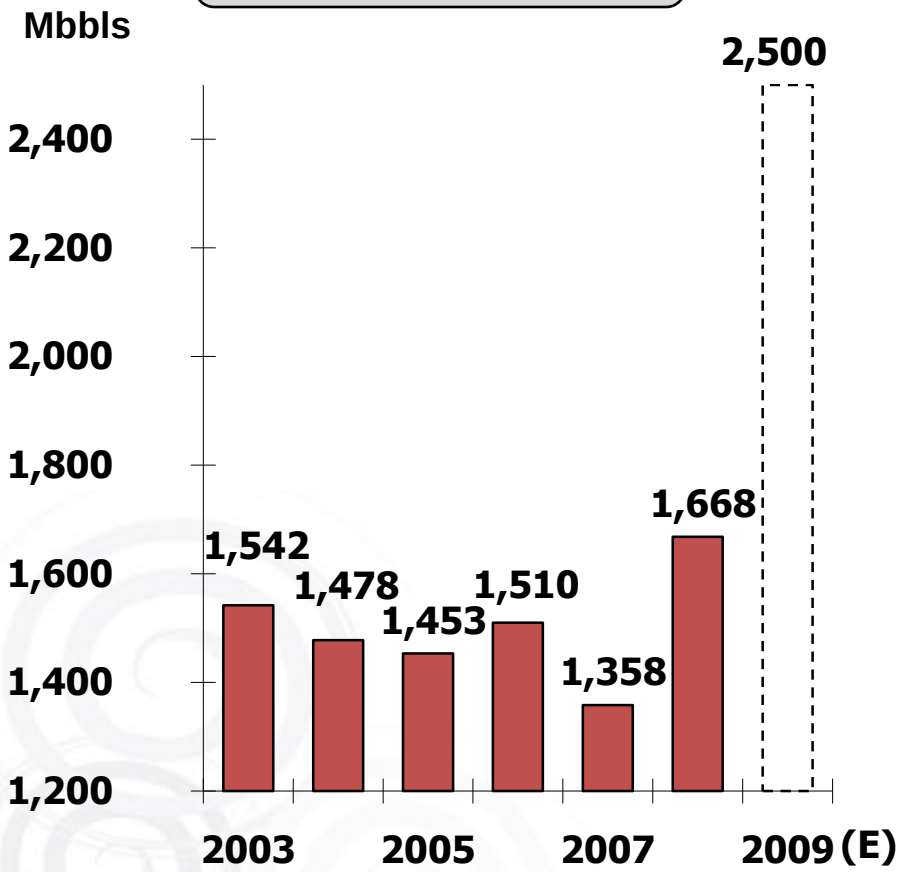
(*) Production as of December 2009

*E = reserves estimated

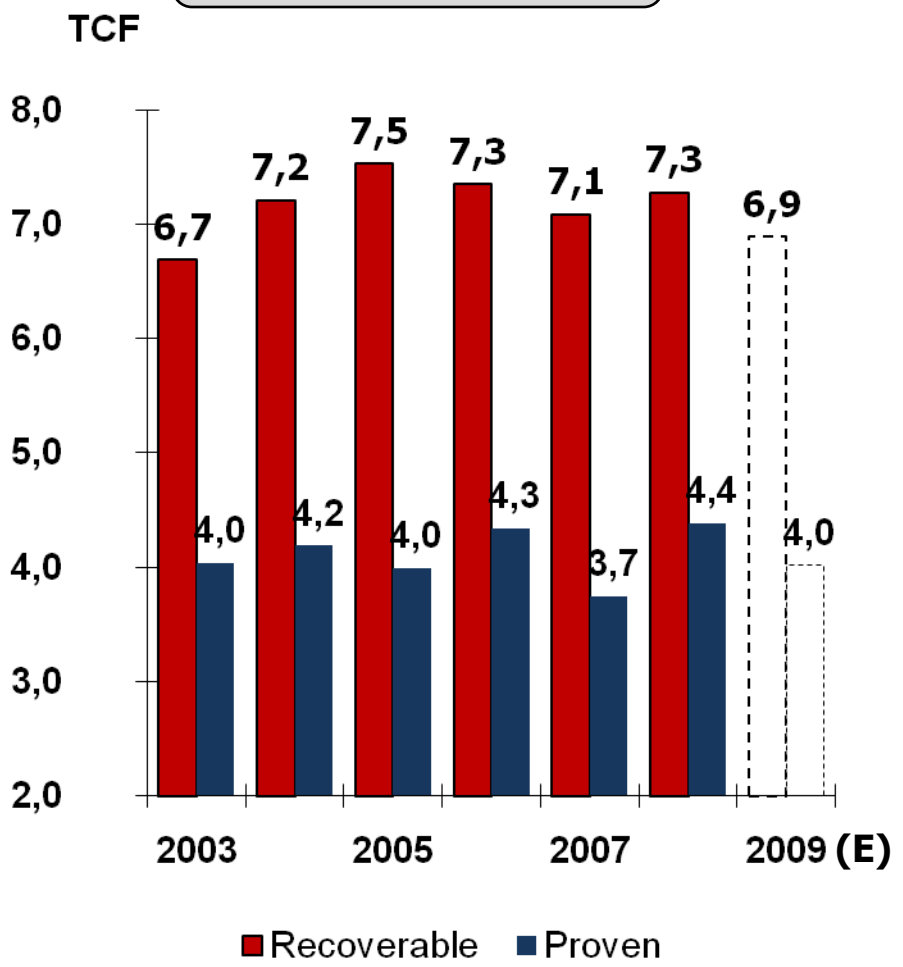
Sources: BP Statistical Review 2009; ANH Analysis

Reserves

Oil

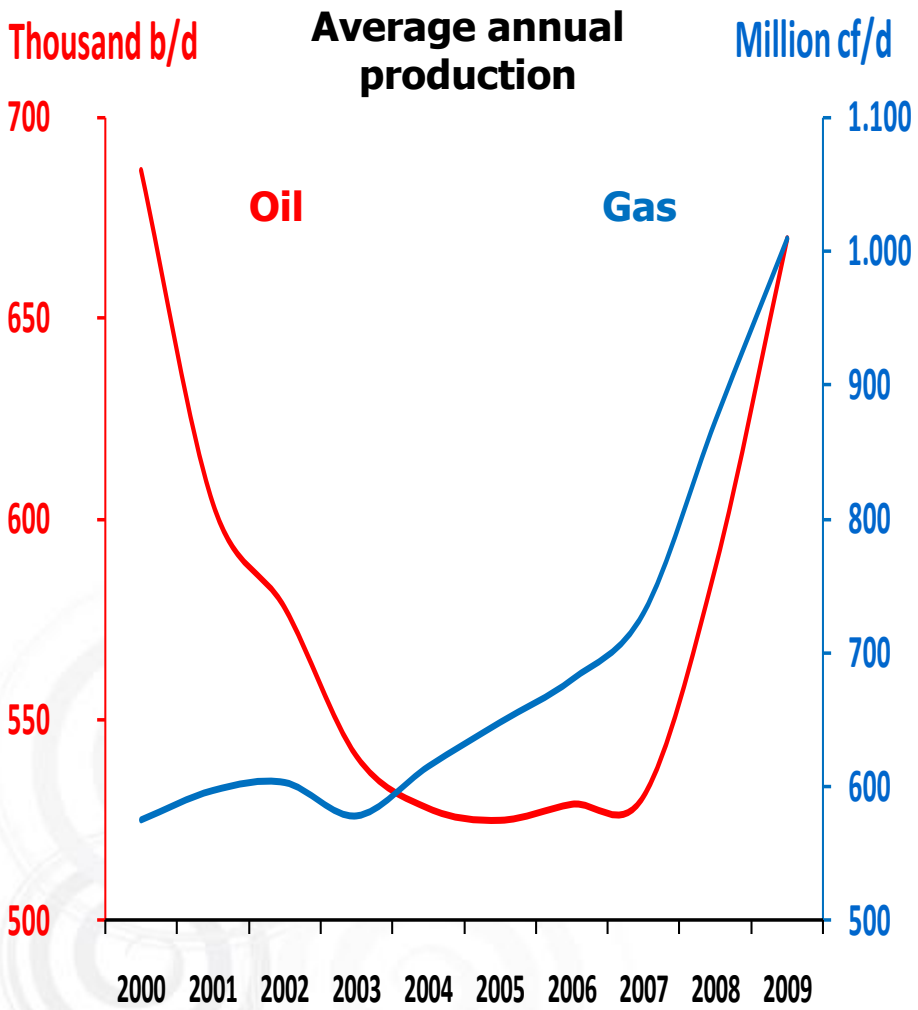


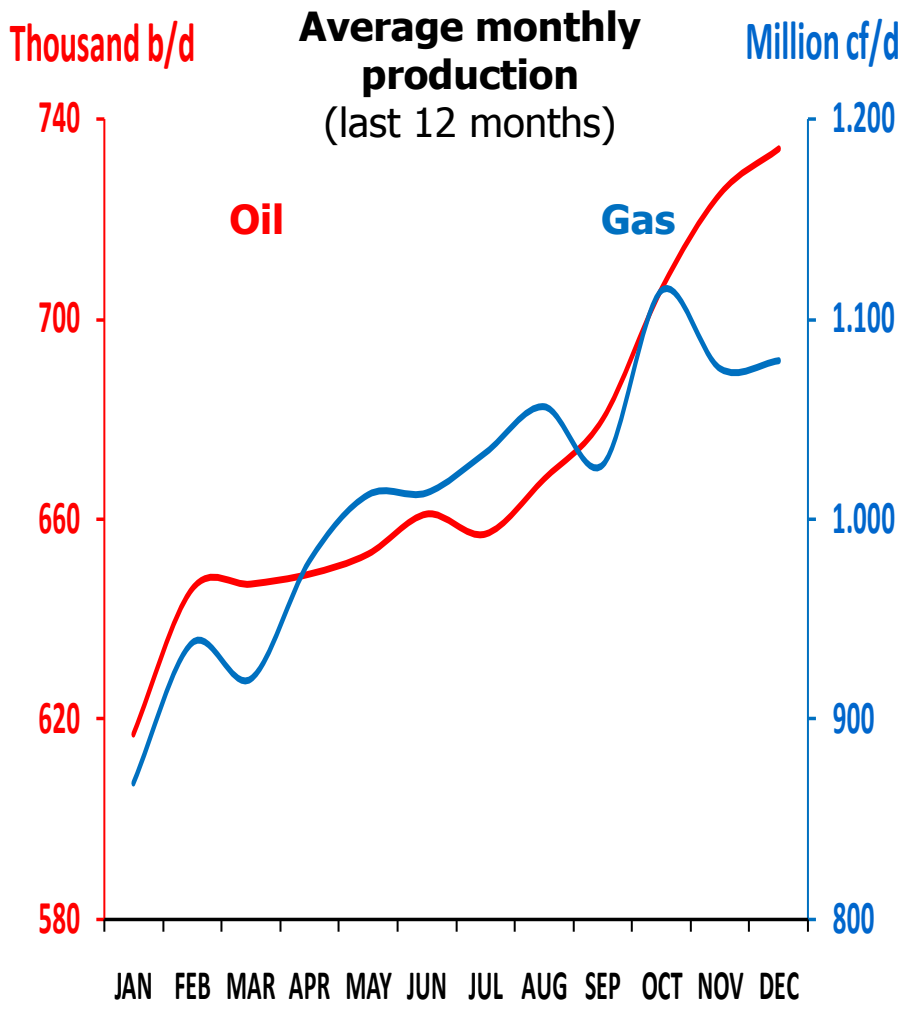
Gas



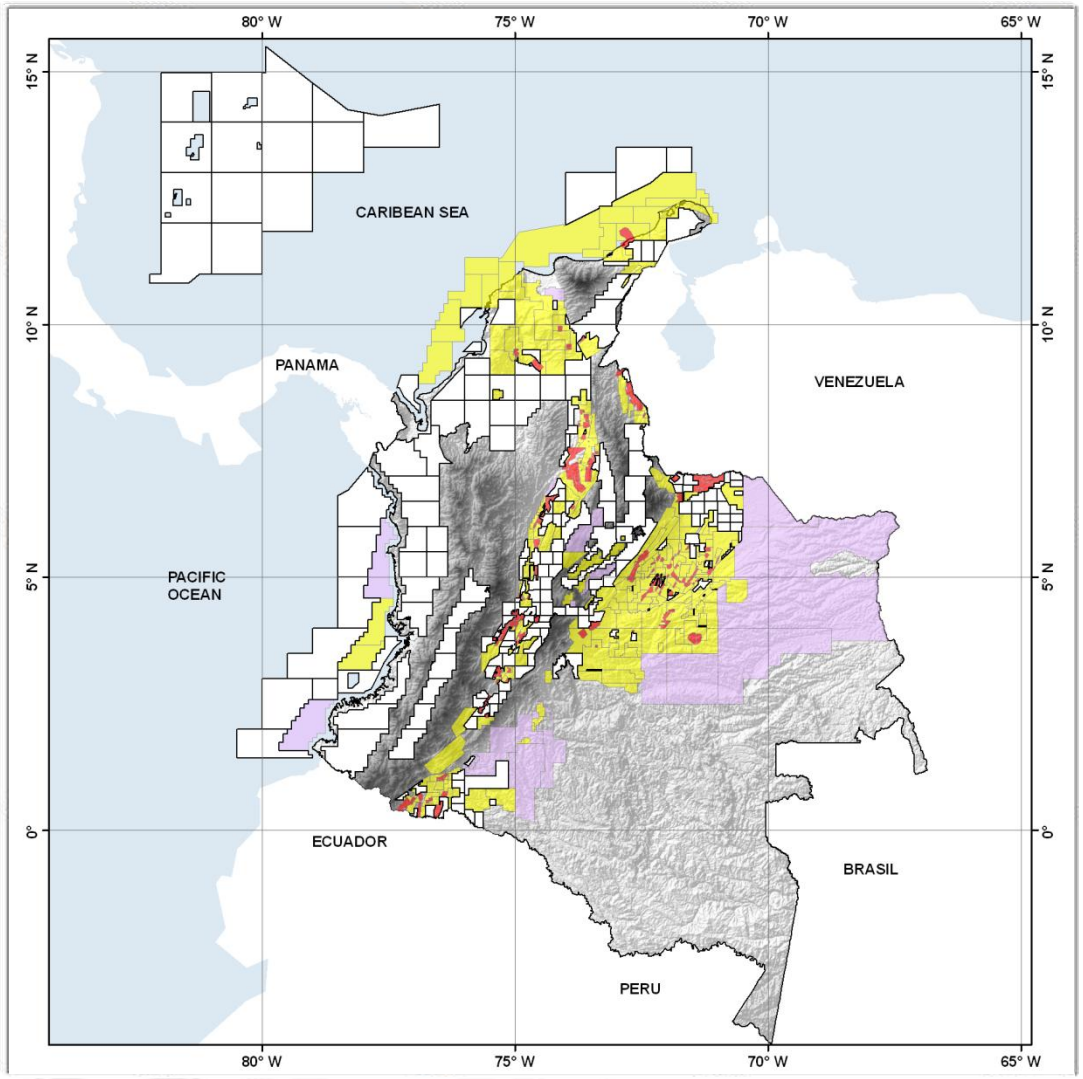
(E) = end-2010 estimate

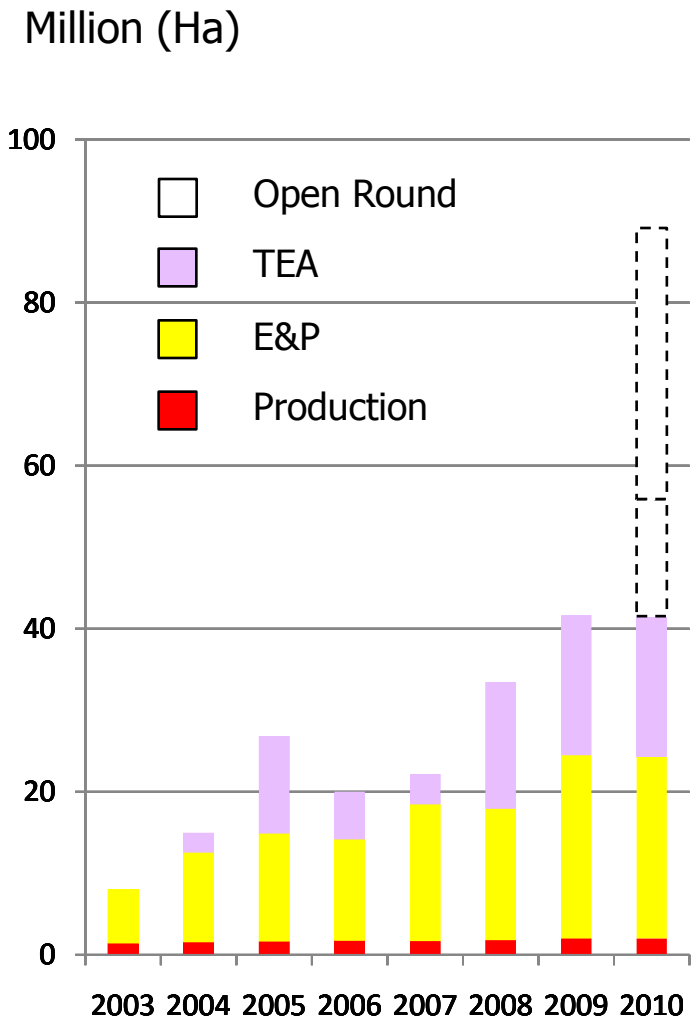
Growing production



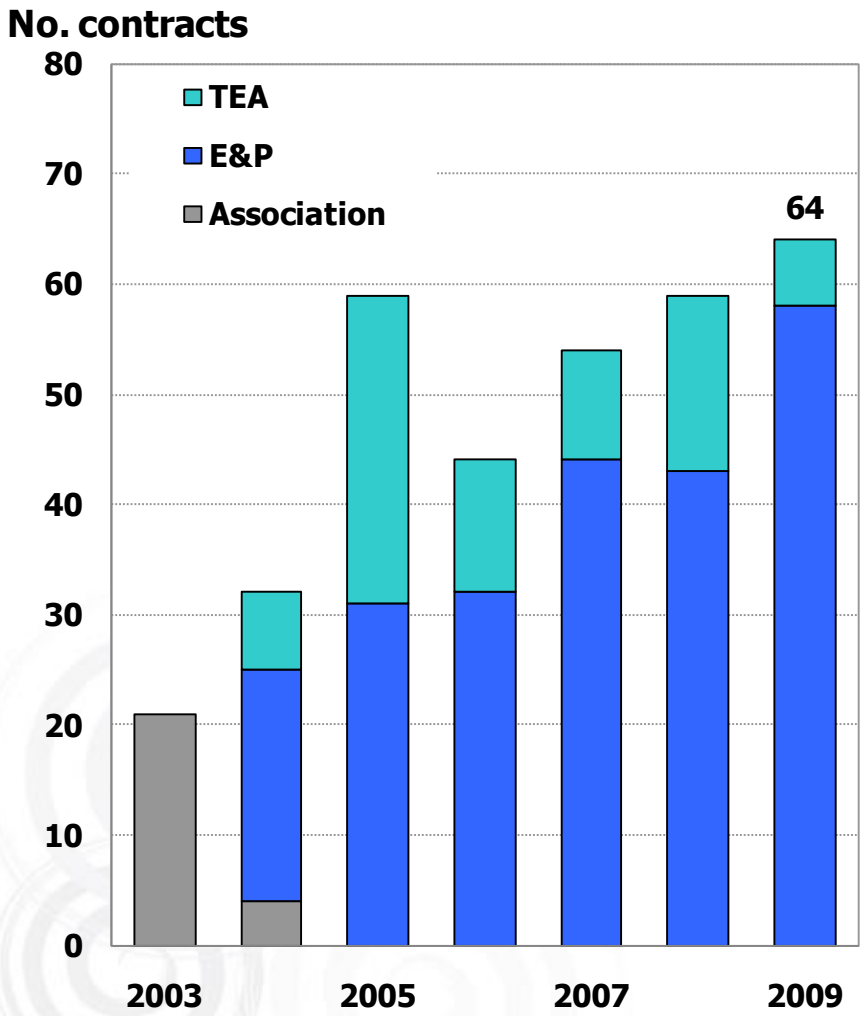


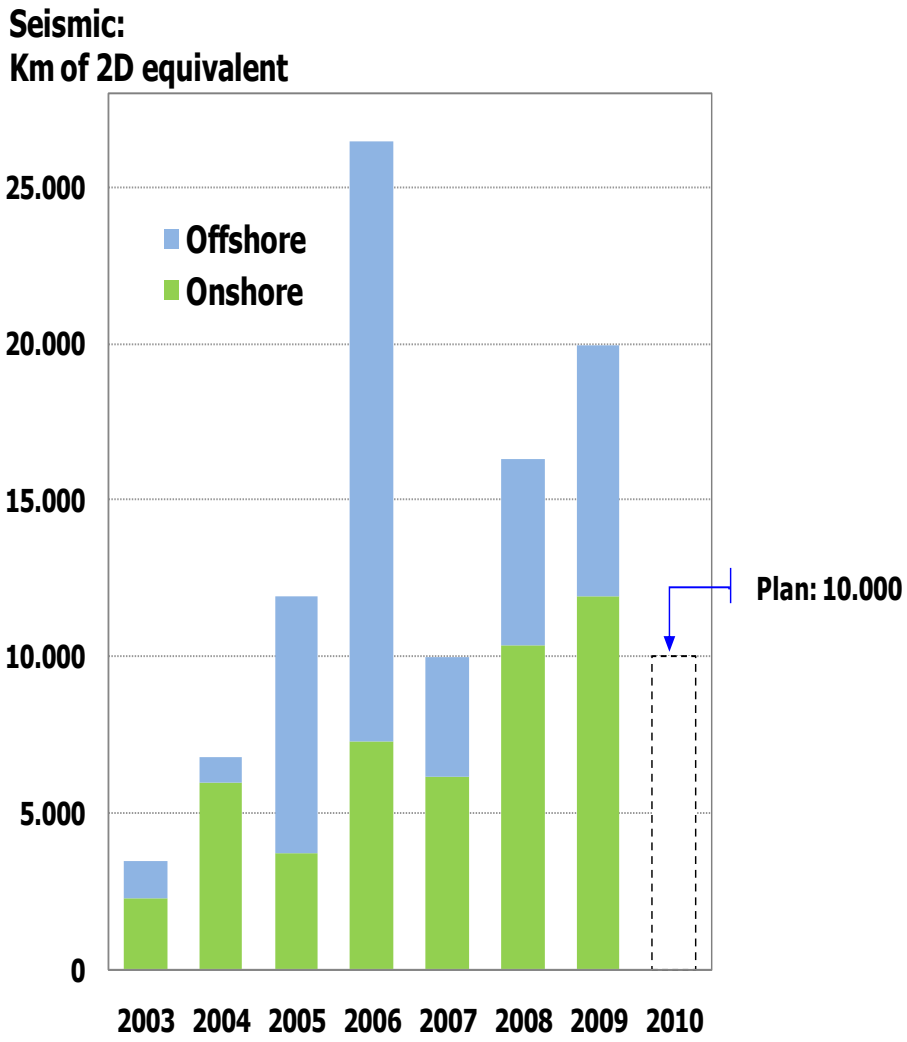
Exploration activity has increased considerably





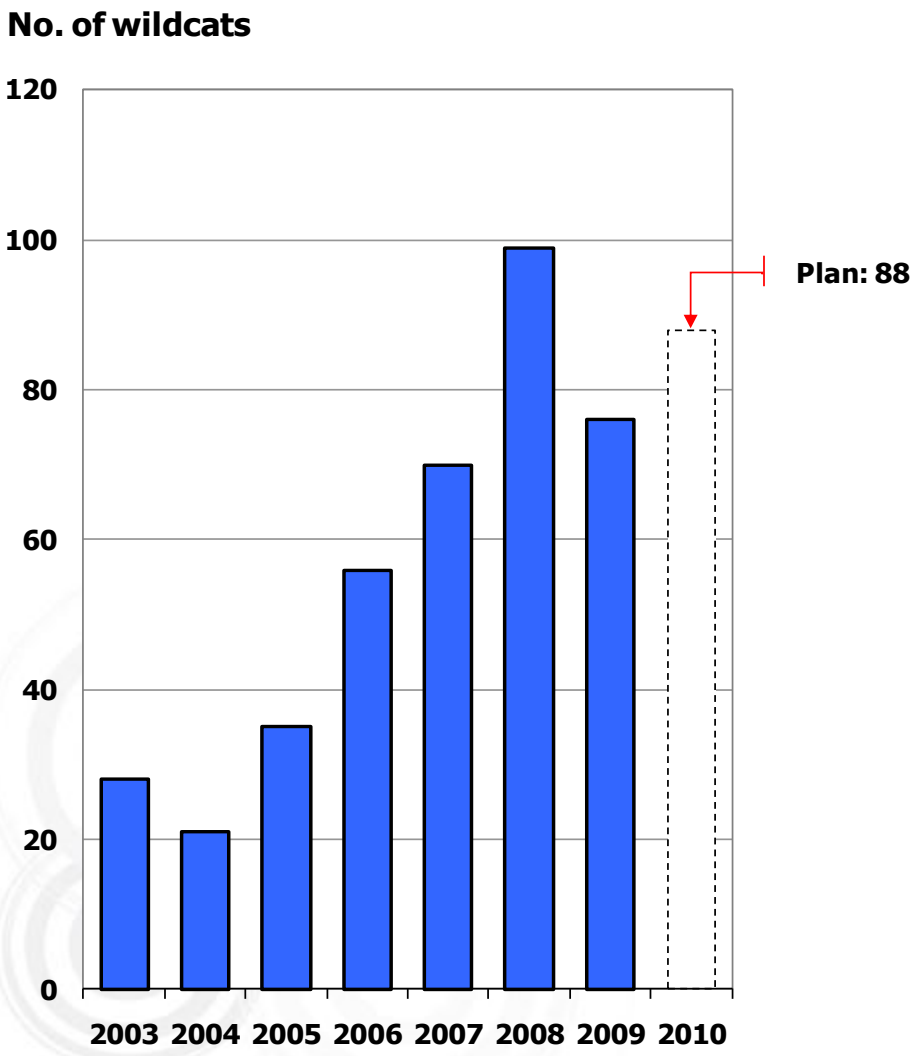
Licensing activity continues to increase and seismic data acquisition activity is high …

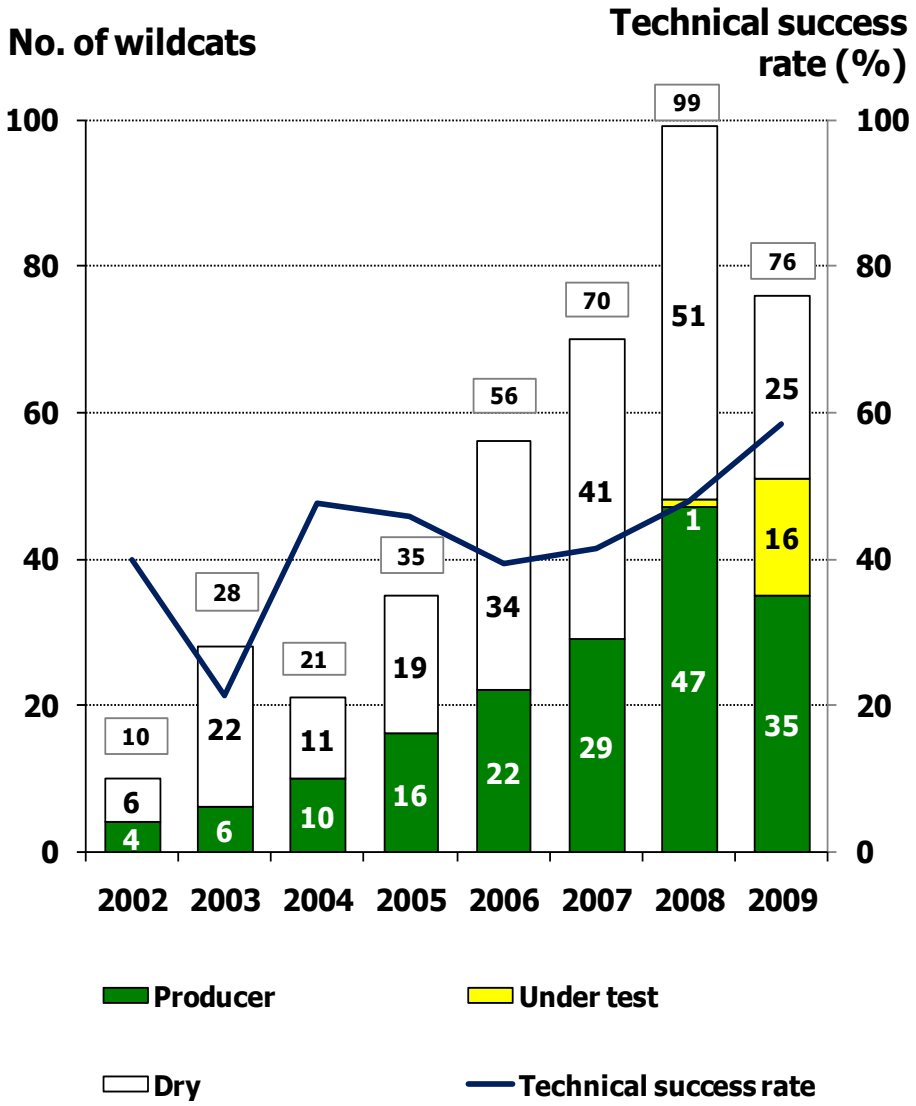




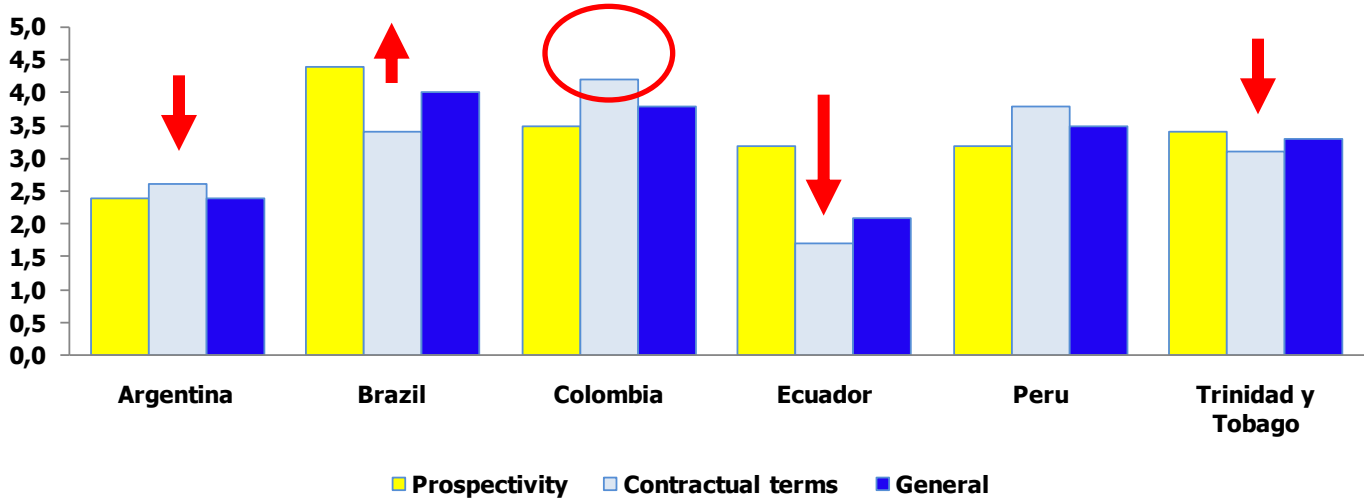
* **TEA**: Technical Evaluation Agreement

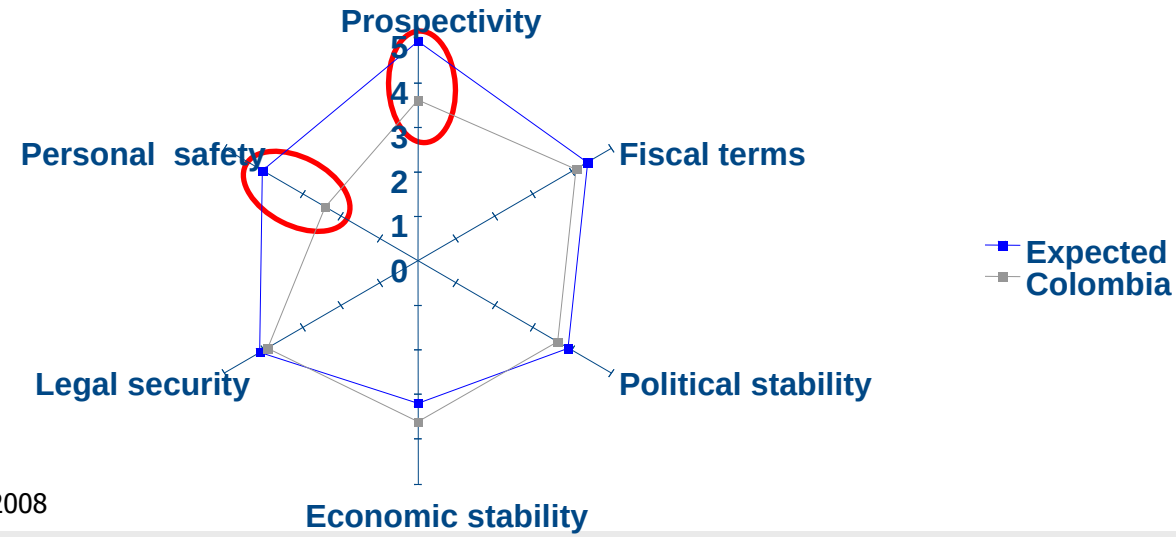
… the highest number of exploratory wells and high success rates …





Perceptions on Colombia´s attractiveness





Source: Arthur D. Little, 2008

E&P operator companies in Colombia

MAJOR	7	BHP BILLITON BP EXPLORATION COMPANY	EXXONMOBIL NEXEN INC.	RELIANCE INDUSTRIES LTD SK ENERGY CO LTD	TALISMAN OIL & GAS LTD
NOC	3	ECOPETROL S.A.	ONGC VIDESH LIMITED	PETROBRAS	
IOC	76	ALPHA CONSULTORES AMERISUR ARGENTA OIL & GAS BD PRODUCTION CO,, INC. C&C ENERGÍA CARBOPETROL SA CEPCOLSA COLOMBUS ENERGY COMPAÑÍA DE TRAT DE LODOS SA COMPETROL LTDA CENERCOL S.A. DRUMMOND LTD EL TRIUNFO EMERALD ENERGY PLC EMPESA S.A. ERAZO VALENCIA SA FÉNIX OIL & GAS SA GEOKINETICS INTERNATIONAL INC. GEOPRODUCTION OIL AND GAS	GOLD OIL PLC GOLDEN OIL CORPORATION GRAN TIERRA ENERGY LTD GREAT NORTH ENERGY INC. HARKEN DE COLOMBIA LIMITED HOCOL S.A. HUNT OIL COMPANY HUPECOL INEPETROL S.A. CONEQUIPOS ING LTDA INTEROIL EXPL Y PROD KAPPA RESOURCES COLOMBIA LTD LEWIS ENERGY COLOMBIA, INC. MAUREL & PROM COLOMBIA B.V. MAXIM WELL SERVICES LTD META PETROLEUM CORP MOMPOS OIL COMPANY INC MONTECZ S.A. MORICHAL PETROLEO Y GAS C.A.	NCT ENERGY GROUP CA NEW HORIZON EXPLORATION INC OCCIDENTAL ANDINA LLC OMEGA ENERGY COLOMBIA OMMIMEX OIL & GAS OPEN CHOKE EXPLORATION LLC OPERACIONES PETROLERAS AND S.A. OPICA BLC. S.A PACIFIC STRATUS ENERGY CORP PAN ANDEAN COLOMBIA PARKO SERVICES S.A. PETROANDINA COLOMBIA LTD. PETROCOLOMBIA PETROLEOS COLOMBIANOS LIMITED PETRÓLEOS DEL MAR PETROLEOS DEL NORTE PETROLERA MONTERRICO S.A. PETROLIFERA PETROLEUM LIMITED PETROMINERALES COLOMBIA LTD	PETROPULI LTDA PETROTESTING COLOMBIA S.A. PLUSPETROL RESOURCES CORP. RAMSHORN INTERNATIONAL LIMITED RANCHO HERMOSO S.A SHONA ENERGY COLOMBIA LIMITED SOGOMI ENERGY S.A. SOLANA PETROLEUM EXPL LTD TC OIL & SERVICES S.A. TECPECOL S.A e INEPETROL S.A. TEXICAN OIL LTD THETYS PETROLEUM THORNELOE ENERGY TRAYECTORIA OIL & GAS TURKISH PETROLEUM INT. CO. LTD VAROSA ENERGY LIMITADA VETRA COLOMBIA WELL LOGGING LTDA WINCHESTER OIL AND GAS
TOTAL	86				

Plus 70 non operators

Colombia offers good business opportunities

- A prolific geology
- A good business environment
- An appropriate institutional framework
- A competitive and fair contract
- Competitive rounds
- Stability remains in the sector
- … still a window of opportunity

Challenges

- Community consultations
- Community relations
  - Social investment
  - Employment of locals
  - Roads
  - Salaries
  - Local politics
- Environmental licensing

Book in your agendas

IV Colombia Oil & Gas
WPC Regional meeting LA

Latinamerican solutions
for global energy challenges

Junio 22-25, 2010. Cartagena-Colombia

Cartagena, 22 - 25 June , 2010

IV Colombia Oil and Gas Investment Conference

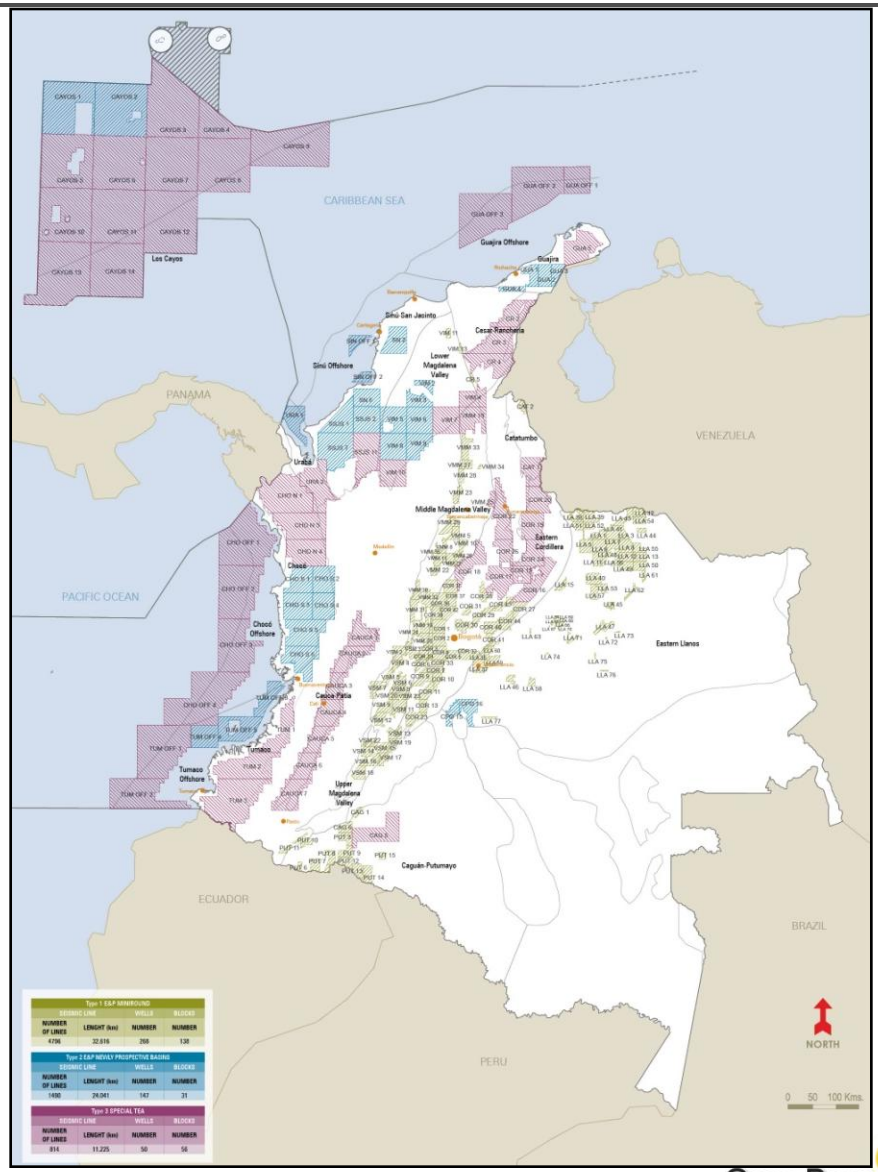
Contents

Areas on offer

	Area (Ha)	Number of Blocks
Type 1 E&P MINIROUND	5.893.685	138
Type 2 E&P NEWLY PROSPECTIVE BASINS	8.459.046	31
Type 3 SPECIAL TEA	33.253.683	56
Total	47.606.414	225

Historic activity	Number of Wells	Seismic (Km)
Type 1 E&P Miniround	268	32.616
Type 2 E&P New prospective basins	147	24.041
Type 3 Special TEAS*	50	11.225
Total	465	67.882

*TEA: Technical Evaluation Agreement



Minimum exploratory program

Type 1	
Basins	Activities
All	Phase I (36 Months): - one (1) exploratory well Phase II (36 months): - two (2) exploratory wells, or - one (1) exploratory well and relinquishment of 50% of area

Minimum exploratory program

Type 2	
Basins	Activities
On-shore: • Guajira, • Lower Magdalena, • Llanos • Sinú – San Jacinto,	Phase I (36 months): - 20 km of 2D seismic for each 10.000 Ha - one (1) exploratory well Phase II (36 months): - two (2) exploratory wells, or - one (1) exploratory with relinquishment of 50% of the area.

Type 2	
Basins	Activities
Chocó - onshore	Phase I (36 months): - multi-spectral analysis or high density aerogeophysics (5 km grid) - 10km 2D seismic per10.000 Ha Phase II (36 months): - two (2) exploratory wells, or - one (1) well with 50% area relinquishment

Type 2	
Basins	Activities
Off-shore: • Cayos • Sinú • Tumaco • Urabá	Phase I (36 months): - multi-spectral analysis - piston core sampling (one per 20.000 Ha.) Phase II (36 months): - 15 km^2 of 3D seismic per 20.000 Ha. - one (1) exploratory well

Type 3	
Basins	Activities
All on-shore, except: • Caguan-Putumayo • Chocó • Tumaco	Single phase of thirty six (36) months: - two orthogonal seismic lines (ANH-specified) - one (1) stratigraphic well,

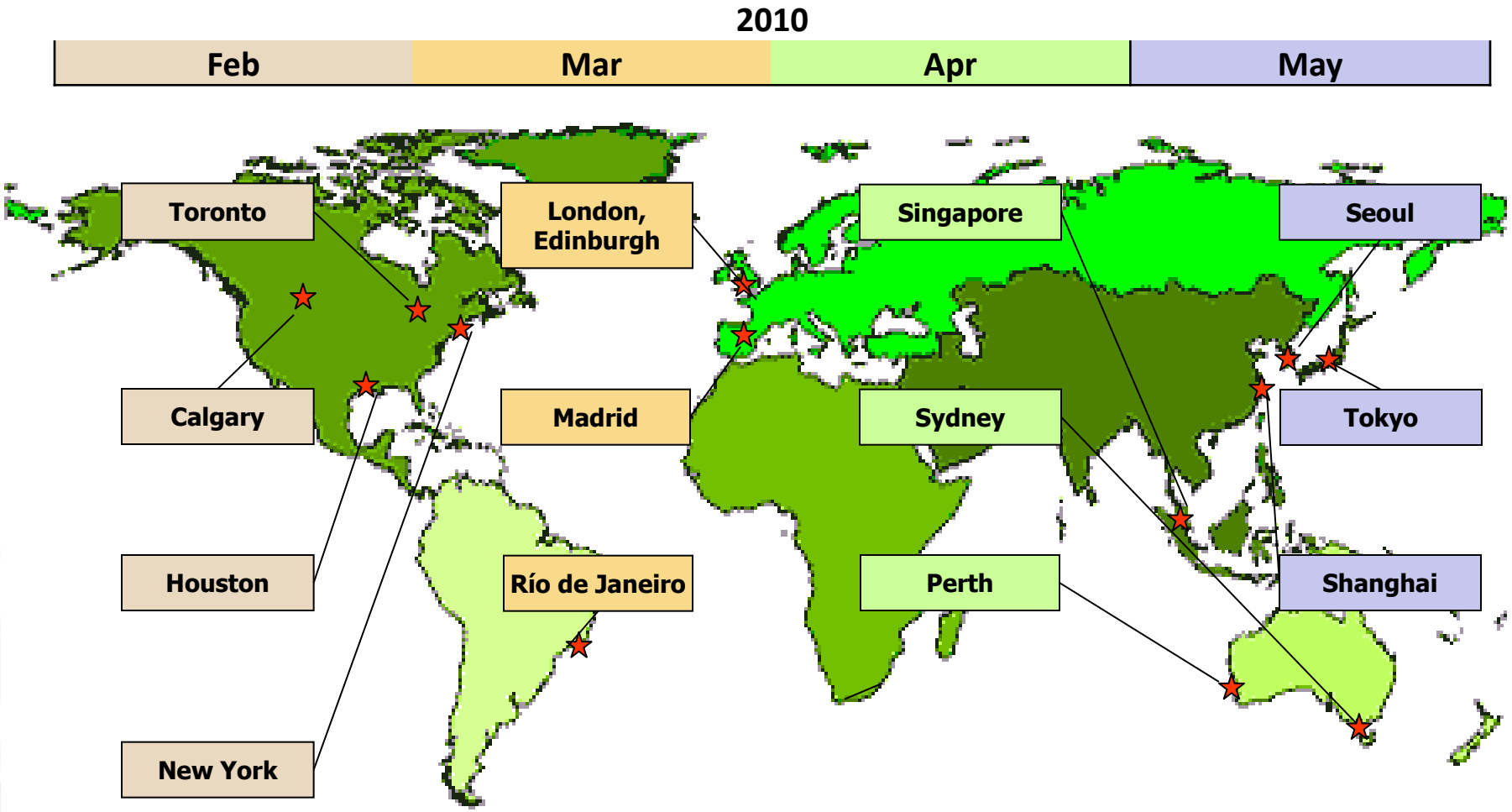
Type 3	
Basins	Activities
On-shore: • Caguan-Putumayo • Chocó • Tumaco	Single thirty six (36) months phase: - multi-spectral analysis or high density aero-geophysics (5 km grid) - Two orthogonal seismic lines (ANH-specified)

Type 3	
Basins	Activities
Off-shore: • Cayos • Colombia • Chocó • Guajira • Tumaco	Single thirty six (36) months phase: - 20 km of 2D seismic per 10.000Ha - 20 km high resolution bathymetry per10.000Ha

Key Milestones

Preliminary terms of reference	15th October, 2009
Final terms of reference	19th February, 2010
Pre qualification documents	19th February - 19th April, 2010
Pre qualification list	24th May, 2010
Bidding	22nd June, 2010 Cartagena

Road Show


2010
Feb
Mar
Apr
May
Toronto
London, Edinburgh
Singapore
Seoul
Calgary
Madrid
Sydney
Tokyo
Houston
Río de Janeiro
Perth
Shanghai
New York

Data packs

Area type	Cost USD *	Blocks
1	20.000	Miniround
2 & 3	100.000	E&P and special TEA

* Gives the right to participate in the process

Exploratory programs

- The minimum exploratory program of areas object of this process shall be expressed in Unitary Prices (PU), previously established by ANH
- Additional investment in seismic and wells shall be credited on the basis of Unitary Prices' Table
  - Other investments on the basis of paid invoices

Pre qualification criteria

- Legal
- Financial
- Operational
- Technical
- Environmental
- Corporate social responsibility

Types of company qualification

Category	All participants	Operator	Restricted operator
Legal	√	√	√
Financial (*)	√	√	√
Operational		√	
Technical			√
Environmental		√	√
CSR		√	√

(*) Additive within consortia

Required pre-qualification documents

- Letter of intent to participate in process, signed by legally empowered representative (mandatory in all cases)

- Documents as required for pre-qualification
  - Legal
  - Financial
  - Technical
  - Operational
  - Environmental and
  - Corporate social responsibility

- Documents for legal pre-qualification: original documents in Spanish language or translated by official translator. Other only in Spanish or English

  (No apostille necessary at this stage)

Consortia

- Pre-agreement includes: object, parties, rules, etc. or the respective letter of intent (MOU)
- Participation interest of Operator must be at least 30%.
- Duration: at least for validity of E&P contract and/or Special TEA plus one more year
- Each participant and its members shall be individually evaluated

No participant may submit more than one bid for the same area or be part of more than one association or plural bidder for the same area

Note: no temporary unions are allowed to bid

Financial aspects

Minimum equity (net assets) per block (*) :

- Type 1 Area: US$6 MM
- Type 2 Area: US$20 MM
- Type 3 Area: US$200 MM

Financial statements with notes for last three (3) years in USD, dully audited

The above requirements per block are cumulative

(*) Individually or per consortium

Financial aspects

Individual companies or consortia are exempted from presenting financial documentation when an individual proponent or one member of a consortium is:

- listed in the last publication of "The Energy Intelligence Top 100: Ranking the World's Top Oil Companies" issued by "Petroleum Intelligence Weekly", or

- has a risk qualification within last 12 months equal or higher than:

Risk Qualifying Agency	Grade
Standard & Poor's	BBB
Moody's	Baa
Duff & Phelps	BBB

Technical criteria

Only for Restricted Operator:

- Petroleum Engineer
- Geologist
- HSE Professional

Operational capacity

Block type	Reserves Boe	Production Boed
1 *	1,000,000	500
2	5,000,000	5,000
3	50,000,000	20,000

* At least two (2) wells drilled in the last three (3) years

Participants listed in the last issue of "The Energy Intelligence Top 100: Ranking the World's Top Oil Companies" qualify automatically

Allowance for restricted operators

- Only one block in Type 1 areas
- 3 contracts if total equity ≥ US$100.000.000

Environmental and corporate social responsibility documents

- Environmental policy document
- Last environmental management annual report
- Corporate social responsibility policy document
- Last corporate social responsibility annual report

Bidding documents

- Official envelope
- Cover letter (model provided in ToR)
- Bidding format with:
    - Additional investment proposed - in multiples of USD 100,000
    - "X%" – percent participation in production
- Letter of intent to conform consortium, if applicable
- Guarantees

Award criteria

Area type	Criteria	
	Primary	Secondary (*)
1 & 3	additional investment in exploration phase I	participation in production (X%)
2	participation in production (X%)	additional investment in exploration phase I

(*) tie-braker

Contents

Contractual aspects

Contents:

1. Legal framework
2. Contract generalities
3. Main contract provisions
4. Special TEA Contract
5. Common aspects of E&P and special TEA contracts

Legal Framework

- 1991 Constitution: articles 101, 102 and 332.
- Law 80 of 1993, Article 76.
- Decree-Law 1760 of 2003.
- Regulation 008 of 2004 with amendments.

1. Legal framework
2. Contract generalities
3. Main contract provisions
4. Special TEA Contract
5. Common aspects of E&P and special TEA contracts

General principles

An E&P contract grants:

- permission to remove the hydrocarbons owned by the state from its natural reservoir and to transport them to the surface

The contractor shall:

- perform all activities at its own cost and risk
- obtain all required permits
- indemnify the ANH free of any liabilities
- observe best oil industry practices
- procure national good and services when possible, under equal conditions

1. Legal framework
2. Contract generalities
3. Main contract provisions
4. Special TEA Contract
5. Common aspects of E&P and special TEA contracts

Contract duration and stages

- Duration: 30 years
  - ✓ Exploration: 6 years
  - ✓ Production: 24 years
- Exploration period
  - ✓ Two phases of 36 months each.
  - ✓ The first phase is mandatory.

Notice of discovery and evaluation program

- Presence of hydrocarbons shall be notified within 4 months following any discovery
- Evaluation program must be submitted within six (6) months after notice of discovery
- Maximum duration of evaluation is one (1) year, with possible extensions:
  - ✓ 1 additional year when exploratory wells are included
  - ✓ 2 years in case of natural gas or heavy crude diescovery

Production period

- Up to 24 years
- Starts after declaration of commerciality and submission of development plan
- Possible extension, subject to conditions

Economic terms

Standard:

- Royalties
- Use of subsoil (to cover administration costs)
- Participation in high prices
- Technology transfer

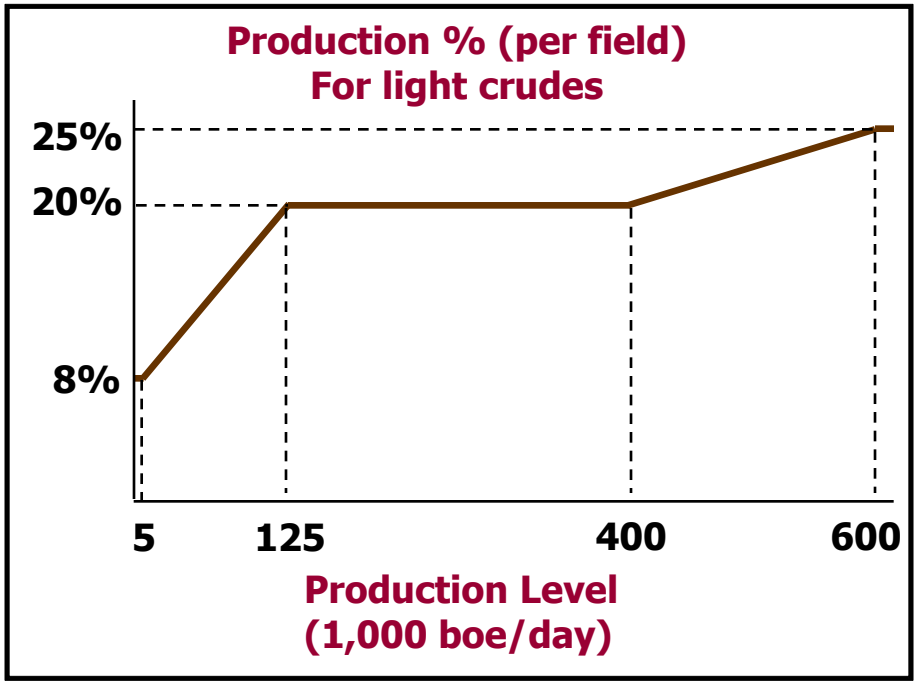
Plus: share of production offered in bidding round

Economic terms

Category	Form	Value
Royalties	Share of production	8% - 25%
Use of subsoil (administration)	Surface fee/ charge per boe	USD1,63 to 4,88 per Ha. Offshore: USD 0,81 Production: - US$ 0,1162/bl
High prices	Share of production	30% - 50% of WTI over trigger level - after first 5MMBls produced
Technology transfer	Percent of Use of Subsoil payment	10% (Maximum USD100.000)

Royalties

- Paid monthly
- Applied to gross average volume of production by field
- Paid in cash or kind at ANH's choice



Discount relative to light crude rates	
Gas	- 20%
Heavy Crude < 15° API	- 25%
Gas offshore (> 1000 ft)	- 40%

High price participation (oil)

A share of production (Q) equivalent to the established percent (S) of the part of the average monthly reference WTI price (P) that exceeds a base price (P_o), divided by the average monthly reference price (P)

– applies after cumulative production reaches 5MMBls

$$Q = \frac{P - P_o}{P} \times S$$

Where:

P = WTI monthly average price (in USD)

P_o = Base price (in USD) [table 1]

S = established percentage [table 2]

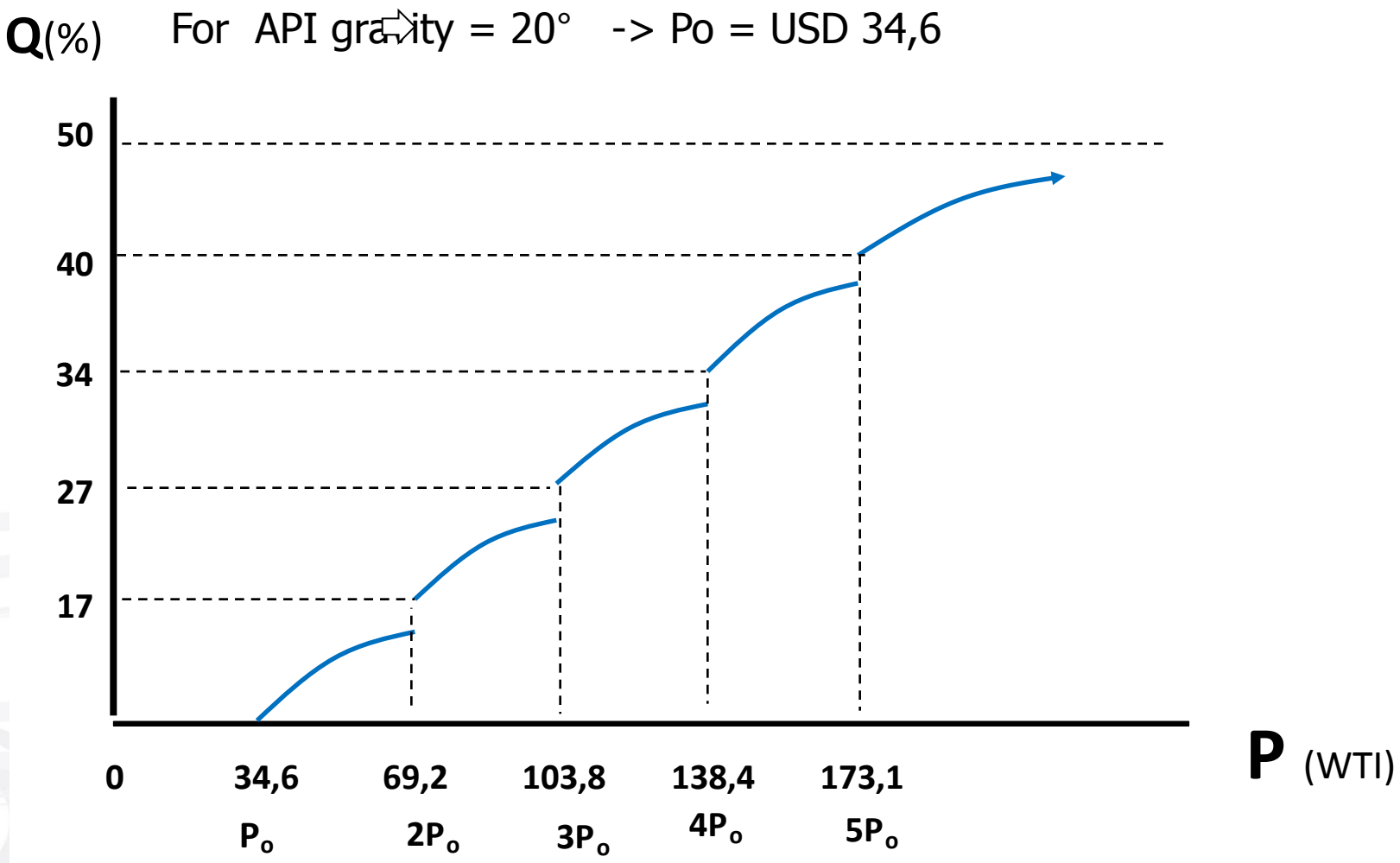
table 2

P	S
Po≤ P< 2Po	30 %
2Po ≤ P < 3Po	35 %
3Po ≤ P < 4 Po	40 %
4Po ≤ P < 5Po	45 %
5Po ≤ P	50 %

table 1

API Gravity	Po (2010 USD$/bl)
Under 10º	N/A
>10° and ≤15º	49.43
>15° and ≤ 22°	34.61
>22° and ≤ 29°	33.37
>29°	32.13
Discoveries at more than 300m of water depth	39.55

Illustration



High price participation (gas)

- Applies after the 5th year of production of gas for export, when the Henry Hub reference price exceeds the base price (P_o).
- Participation in production (Q) is equivalent to:

$$Q = \frac{P - P_o}{P} \times S$$

Where:

- ✓ P = Henry Hub Price, and
- ✓ P_o = Reference base price (see table)
- ✓ S = Participation percentage (same as oil)

Distance to destination port (km)	Po 2010 US$/MMBTU
0 to 500	$7.42
>500 to 1000	$8.65
>1000 or LNG plant	$9.89

Confidentiality of information

- All technical information must be submitted to the ANH as it is produced (includes data interpretation and reports)
- All information subject to confidentiality agreements:
  - ✓ Data : 5 years
  - ✓ Interpretation and analysis : 20 years

- Legal framework
- Contracts general information
- Exploration and Production Contract
- **Special TEA Contract**
- Common aspects of E&P and special TEA contracts

Special TEA Contract

Technical Evaluation Agreement

- Object:

  The conduct of technical evaluation activities for the selection of a prospective areas for an E&P contract

- Duration: thirty six (36) months

- Economic terms:

  ✓ Surface fee

Special TEA Contract

Technical Evaluation Agreement

Appraiser´s rights:

- Reservation of extensive area to carry out technical evaluation activities
- Selection of one area for an E&P contract
- Exclusivity period until selection of an E&P contract, or end of term
  - Third parties may nominate areas for E&P contracts within TEA area after exclusivity is lifted

Special TEA Contract

Technical Evaluation Agreement

Additional rights:

- Matching of one third party proposal for an E&P contract, after exclusivity is lifted, or
- Selection of a second area for an E&P contract, waiving its rights to match a third party proposal
- Nomination of additional areas for E&P within TEA area

Special TEA Contract

Technical Evaluation Agreement

Third party rights:

- Proposing an E&P Contract once exclusivity right has been lifted
- Nomination of additional areas for E&P contract
- Participation in competitive processes on third party nominations for E&P contract(s)

Special TEA Contract

Technical Evaluation Agreement

Confidentiality:

- During the duration of the TEA or,
- Until the TEA holder proposes an E&P

- Legal framework
- Contracts general information
- Exploration and Production Contract
- Special TEA Contract
- Common aspects of E&P and Special TEA contracts

Common aspects

- Right to assign interest to a thrid party
- Right to invoke arbitration for dispute resolution
- Area relinquishment:

  Within the first eighteen months of the contract, contractor may relinquish up to 50% of the contract area.

- Obligation to:
  - Follow community consultation procedures when required
  - Obtain environmental license when required

Guarantees

Bank letter of credit for:

- 10% of minimum exploratory program
- 100% of additional investment
  - ✓ 50% upon signature of the contract
  - ✓ 50% at end of first 18 months

-> Additional investment guarantee may be reduced as the value of activities are credited after their completion

Contract relinquishment

Opportunity: within the first 18 months of the first phase

Condition: the contractor shall transfer to the ANH 50% of the value of all non-fulfilled activities of the Minimum Exploratory Program and 100% of the balance of additional investment not used in exploration.

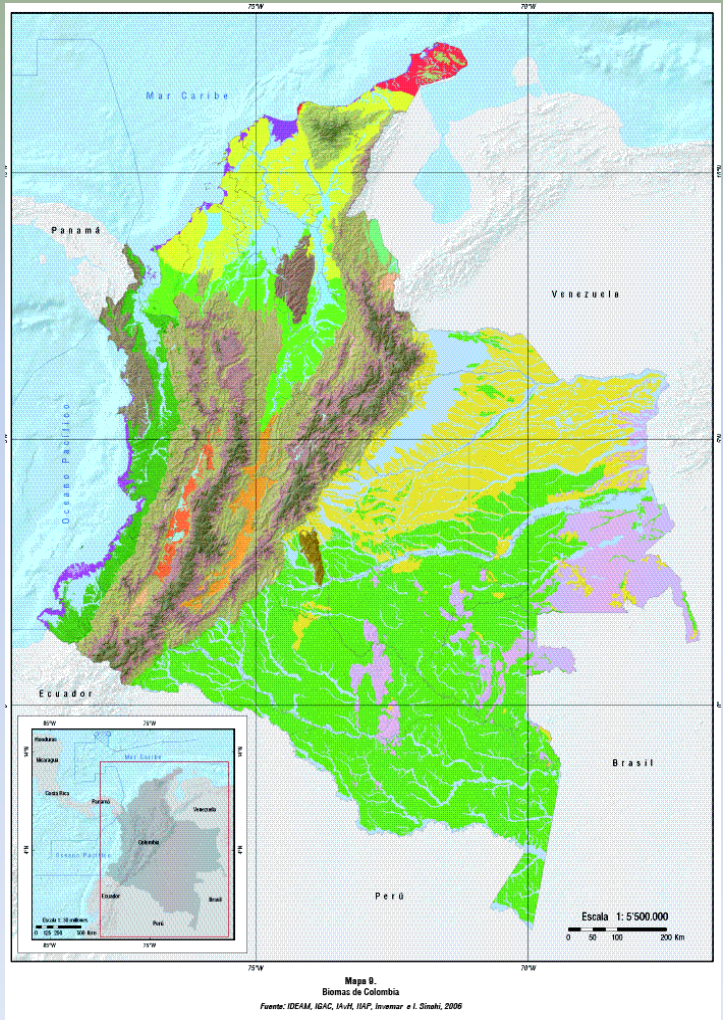
Contents

MINISTRY OF ENVIRONMENT, HOUSING AND TERRITORIAL DEVELOPMENT

Environmental and Social Priorities

Viceministry of Environment

COLOMBIA, A MEGADIVERSE COUNTRY

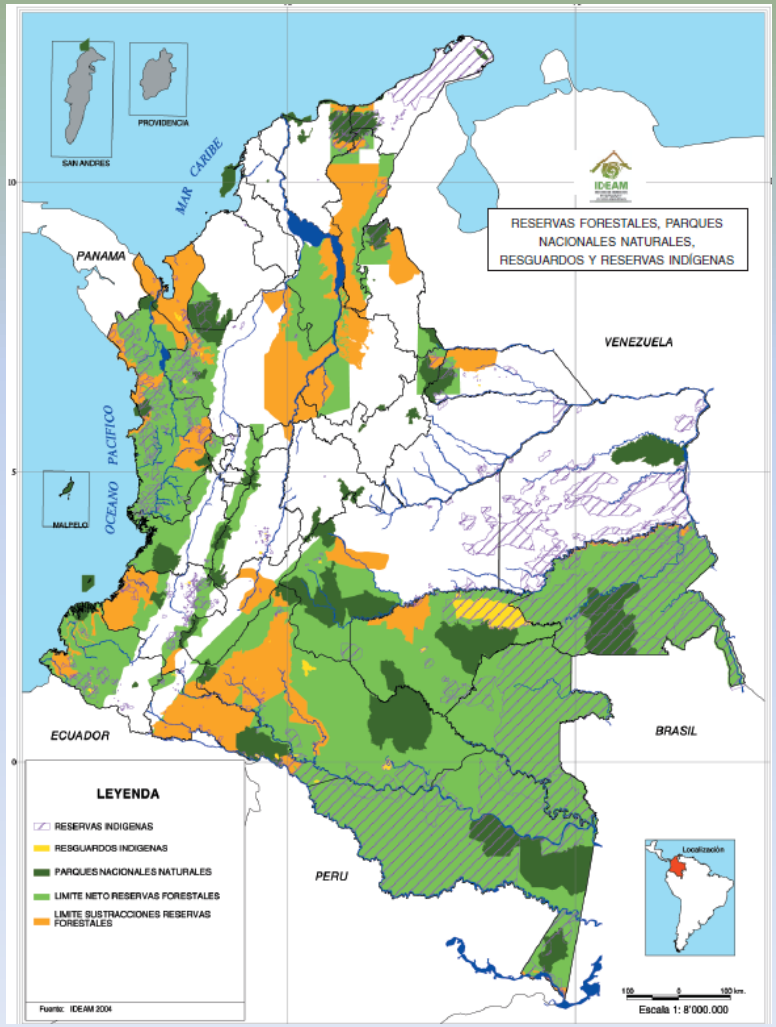


Mapa 9.
Biomas de Colombia
Fuente: IDEAM, IGAC, IAvH, IIAP, Invemar e I. Sinchi, 2006

- ✓ Lodges nearly 10% of the planet's biodiversity
- ✓ 2nd country with more biodiversity in the world
- ✓ 1st in species biodiversity by square kilometer
- ✓ 68,7% of the continental surface is covered by natural ecosystems, including rainforests, grasslands and natural water bodies.
- ✓ Colombia has 150 sp. of Corals and 2200 sp. marine molluscs.
- ✓ 61 million ha. of natural rainforest
- ✓ 2 million ha. of paramos
- ✓ 16 million ha. of savannas
- ✓ 24.5 million ha. of dry lands (arid and semiarid)
- ✓ 2.5 million ha. of wetlands (natural continental water bodies, continental hydrophytes, coastal lagoons, mangrove swamps)
- ✓ 11,6 million ha. of protected areas.

COLOMBIA, A MEGADIVERSE COUNTRY

- ✓ 35 million ha. inhabitated by local communities (Indigenous reservations, Afro-Colombians)
- ✓ 87 Indigenous ethnics
- ✓ 3 groups of Afro-Colombian population: San Basilio de Palenque raizals (roots of people), San Andrés, Providencia and Santa Catalina raizals and Afro-Colombian population in general
- ✓ 1.392.623 Indigenous: 3.43%
- ✓ 4.311.757 Afro-Colombians: 10.62%
- ✓ 4.858 town - people “rom” or gipsy: 0.01%

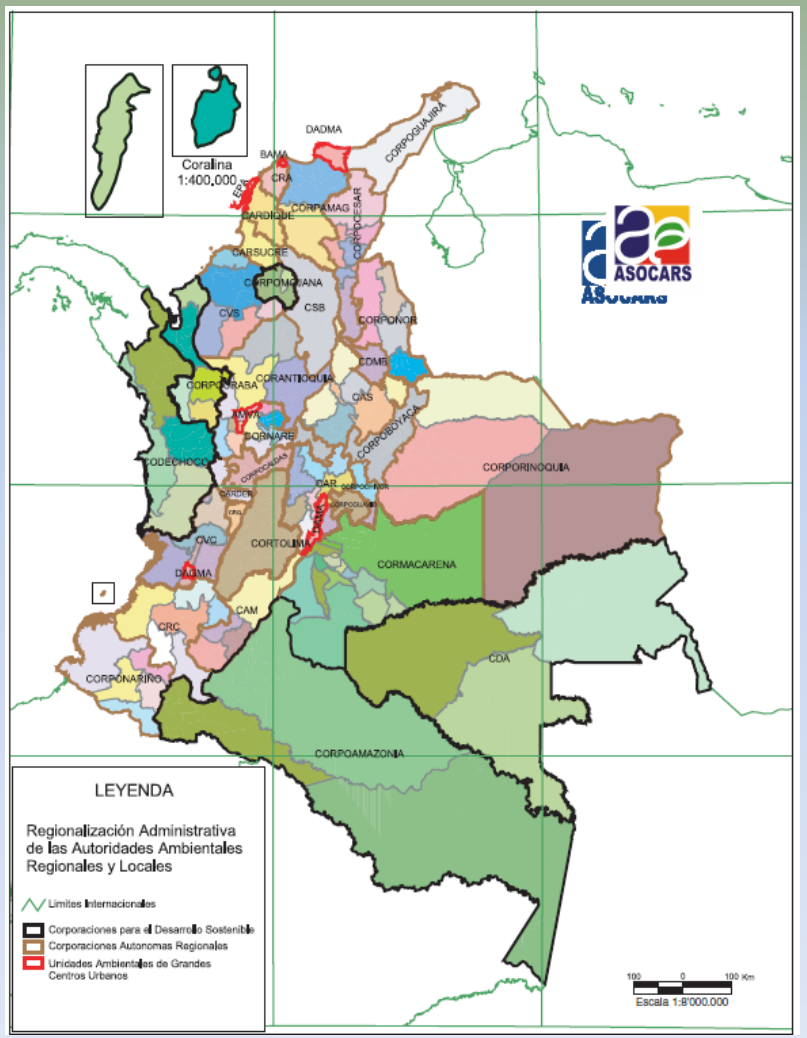


INSTITUTIONAL QUALITIES

Environmental National System (SINA)

- ✓ MAVDT: Central Level
- ✓ 33 CARS: Regional Level
- ✓ 6 AA: Urban Level
- ✓ 5 institutes dedicated to environmental investigation

- ✓ MAVDT has the private competency for the hydrocarbon sector

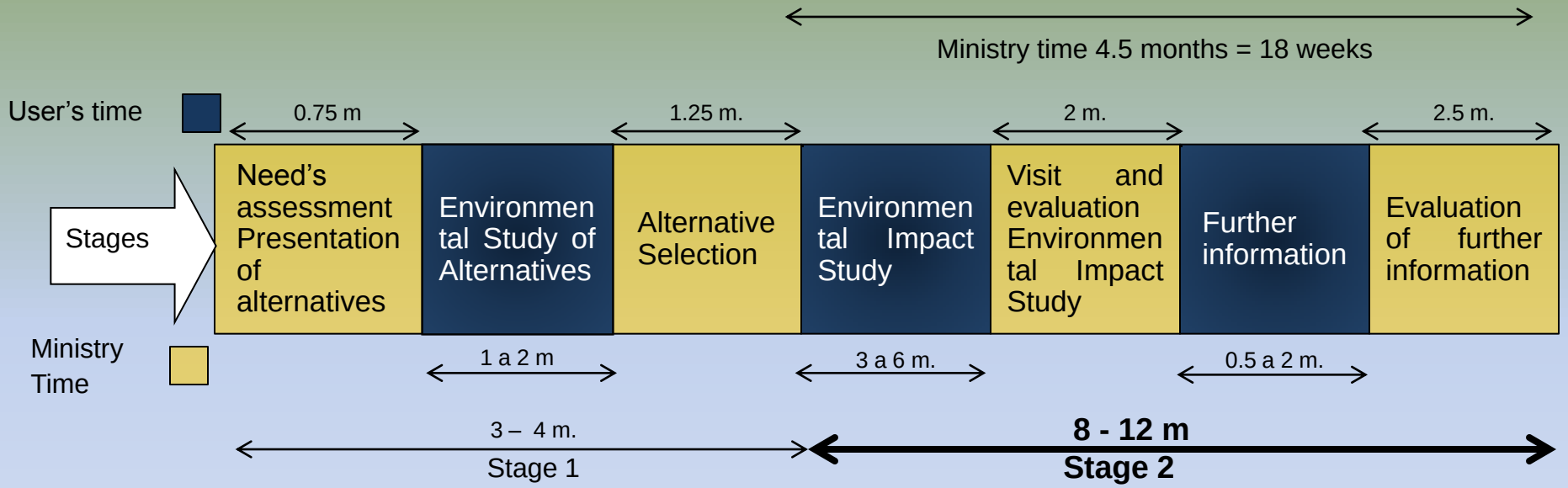


LICENSING FOR THE HYDROCARBON SECTOR

ACTIVITY	REQUEST
Seismic	• Compliance with the Environmental Basic Guide to Programmes of Seismic Land Exploration. • Environmental Licence is not needed unless a road construction component is involved. • Consultation process is made in advance in case of presence of Indigenous Communities and/or Afro-Colombians
Exploration and Exploitation	• Environmental Licence requested • Certification of presence of Indigenous Communities and/or Afro-Colombians and/or these communities' titled lands. Prior consultation process is needed on any of these cases. • In case the project takes place on protected rainforest areas, it is compulsory the acknowledge of the terms of reference for exploitation • Conduct Environmental Impact Studies (EIA), including information on exploitation, reserves and prior consultations, when it is applicable.

- ✓ It is not possible to carry out any activity at National Parks.
- ✓ The permissions for water use, air use and species banned, among others, are implicit on the Environmental Licence.
- ✓ Environmental Impact Studies are elaborated according with the existing terms of reference.
- ✓ Any project could be considered by public hearing
- ✓ The Diagnostic of Environmental Alternatives is request only in the hydrocarbons sector for the tubes transport

ENVIRONMENTAL LICENSING STAGES



- Less than 5% of the projects carry out stage 1, regarding an Environmental Study of Alternatives (The actual exploration and exploitation projects of hydrocarbons are on the potential oil wells)
- Environmental Impact Studies are done by companies simultaneously with the project design.
- Total process time at the hydrocarbon sector is 11 months. The user takes 6 months approximately. Source: Oil Colombian Association, 2008.
- Prior Consultation and / or Public Hearing are not included

COLOMBIA: WE ARE 50% SEA

- ✓Marine Areas: 892.118 Km2.
- ✓Land Area: 1.139.951 Km2
- ✓Coastal line: 3.513 Km
- ✓Territorial Water Area: 892.118 km2
- ✓Emerged Coastal Area: 15.232 Km2

ENVIRONMENTAL LICENSING PROCESS - OFFSHORE

- ✓ Additionally to the requirements established for the Environmental Licensing, a permission for investigation needs to be asked to the General Maritime Direction (DIMAR).
- ✓ Terms of reference are available for hydrocarbons exploitation and exploration activities offshore

REGULATORY FRAMEWORK

Ministry of Environment, Housing and Territorial Development	Ministry of Interior and Justice
Act 99 de 1993	Act 70 de 1993
Decree 1220 de 2005 “Whereby environmental licences are regulated”	Decree 1320 de 1998 “Whereby prior consultation with communities (Indigenous and Afro-Colombian) are regulated
•Enforceability of Environmental Licence •Environmental Studies (DAA y EIA) •Procedure	•Process of participation •Requirements •Procedure

PRIOR CONSULTATION – KEY FACTS

- Ethnic communities should get involved, at least, within the following aspects:
  1. Characterization of the area of influence
  2. Identification and evaluation of impacts to their culture
  3. Definition of management measures that meet the identification and evaluation of impacts.

- This process should count on:
  1. Accompaniment of the Ministry of Interior and Justice
  2. Verification from the MAVDT along the process and prior consultation, to be included in the Environmental Licence

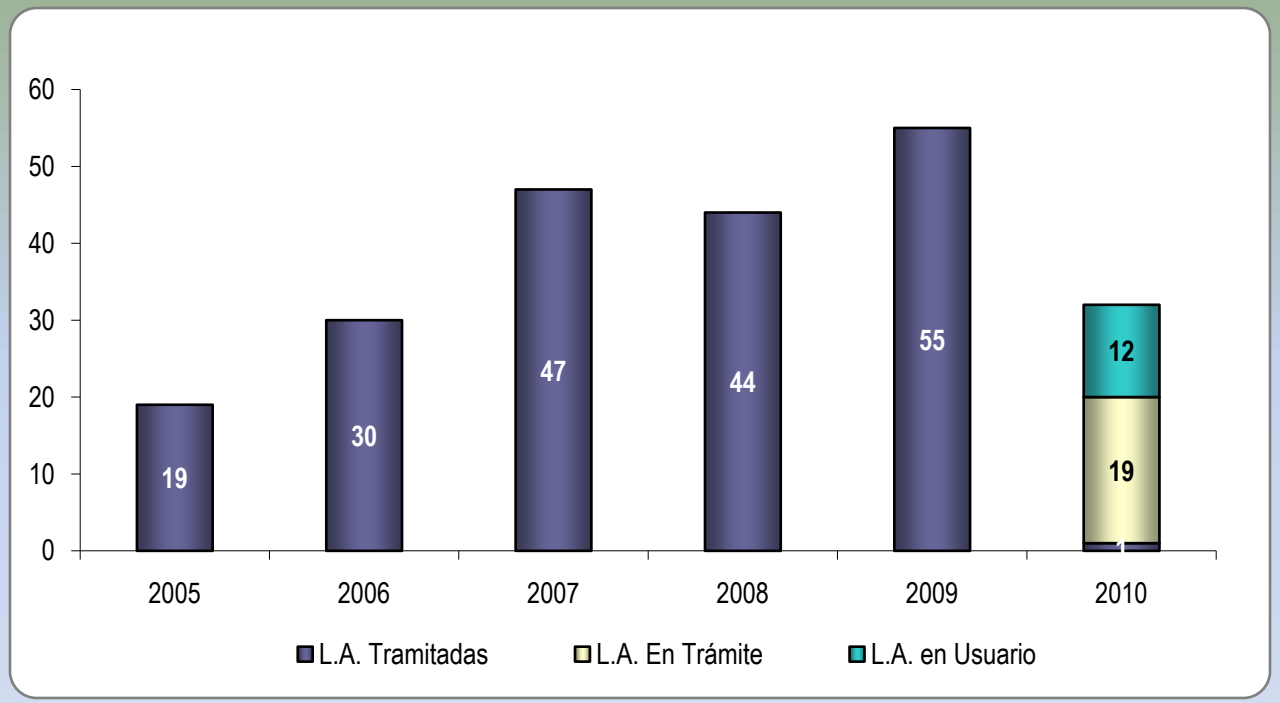
  - Colombia has a differents mechanism of civil society participation

  1. Stackeholders
  2. Public audiences
  3. Environmental Observants

ENVIRONMENTAL LICENSING – KEY FACTS

- Identify if the project requires removal of forest reserve areas.
- Control of the quality of the environmental studies specifically.
- Collect primary information during the exploratory stage of the project
- Fulfill the guidelines of participation

ENVIRONMENTAL LICENSING - HIDROCARBONS



- ✓ At 2010 approximately 400 companies of the hydrocarbon sector, request environmental licenses

THANK YOU

COLOMBIA: The perfect ... environment for hydrocarbons

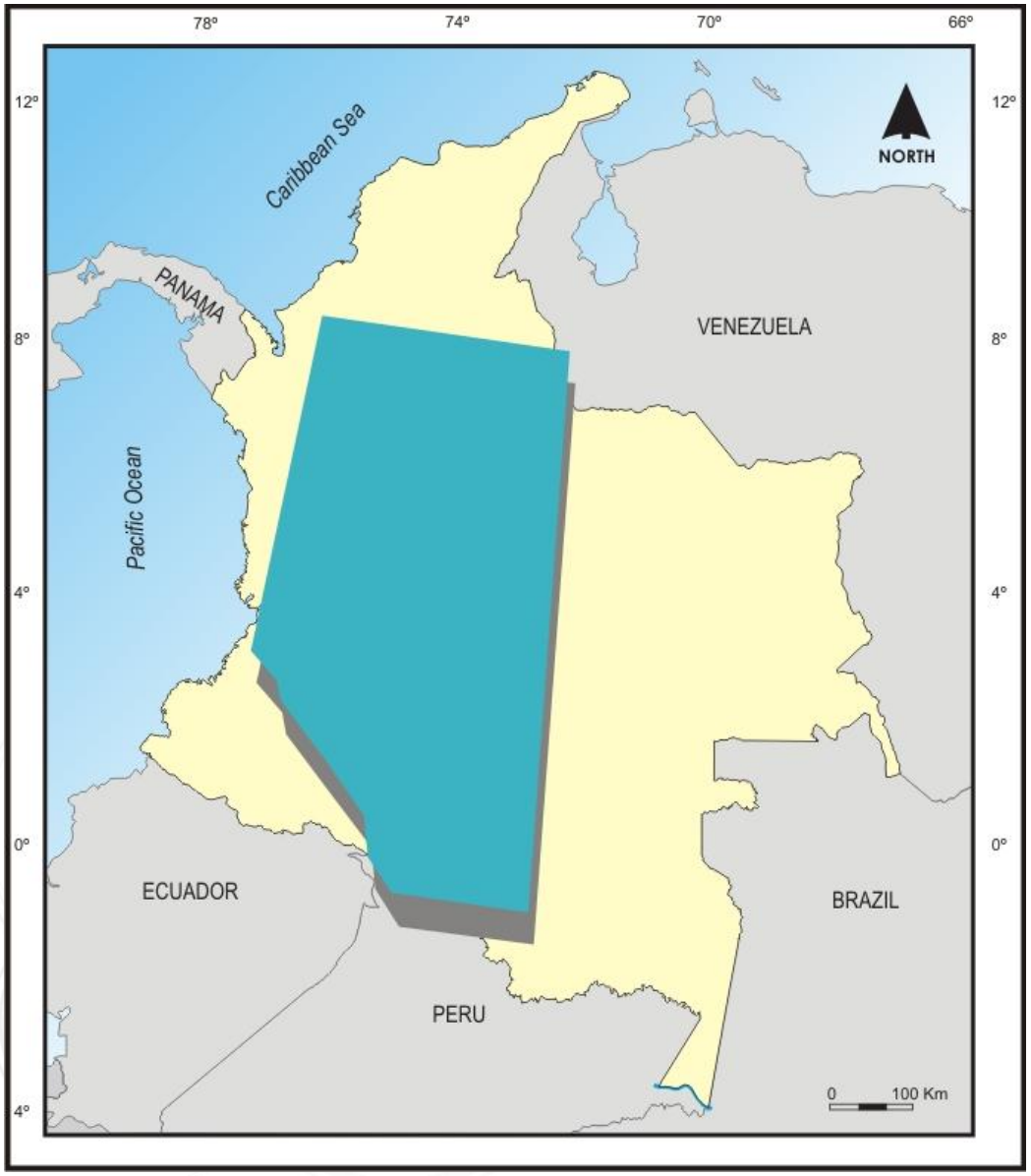
Open Round COLOMBIA 2010

ANH
The people to speak to

OPPORTUNITIES AND IMPRESSIONS

G. Warfield Hobbs, MSc., PG
Managing Partner, Ammonite Resources
Robert K. Merrill, PhD, PG, PGeol
Senior Exploration Advisor, Ammonite Resources
Steven Schamel, PhD, PG
Senior Consultant, Ammonite Resources

Area Comparison



Colombia

1,141,748 Km²

Texas

696,241 Km²

Texas is about 60% of the size of Colombia

Alberta

661,848 Km²

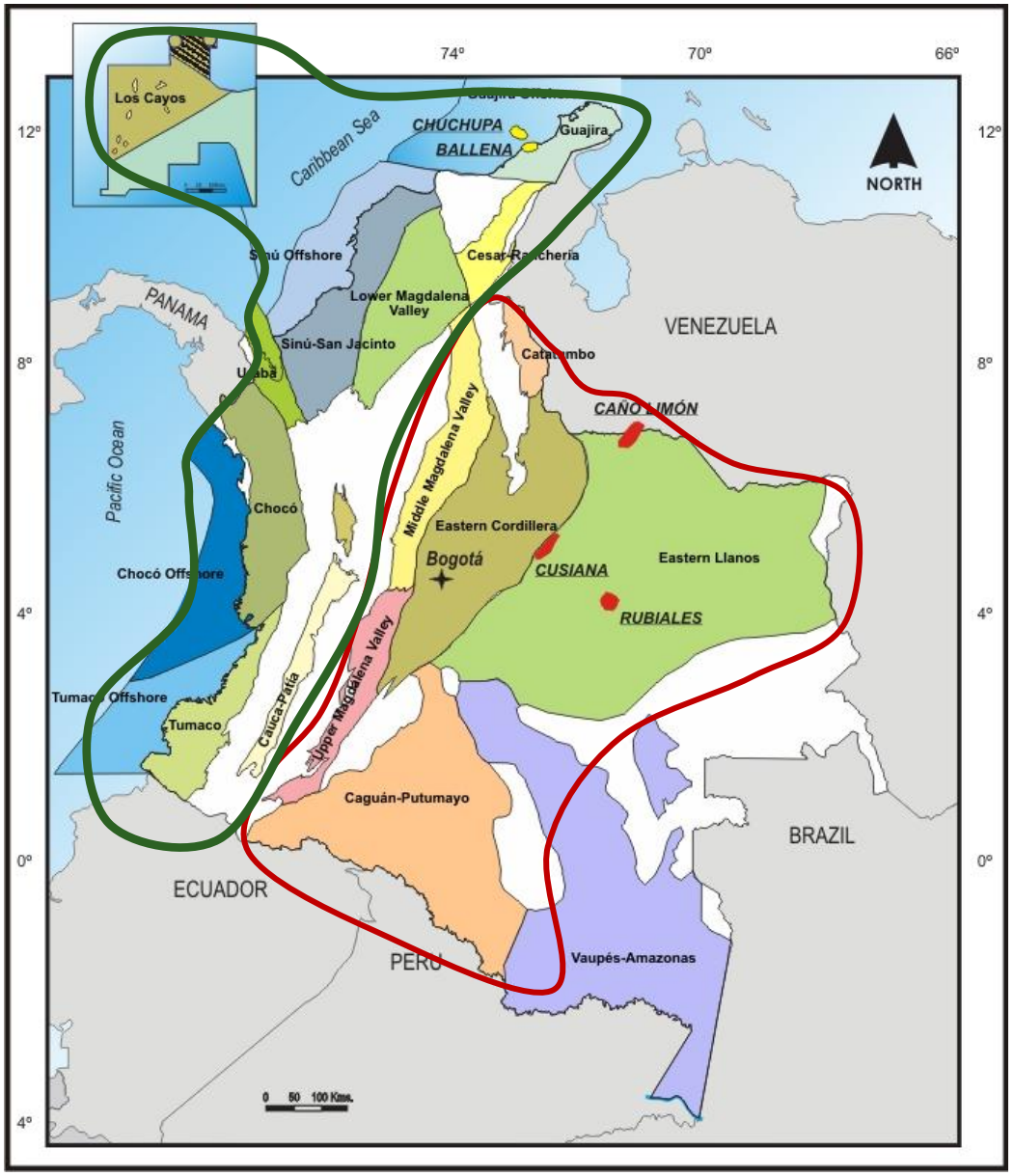
Alberta is about 60% of the size of Colombia

Basins of Colombia

Colombia is blessed with a large number of proven and highly potential oil and gas basins:

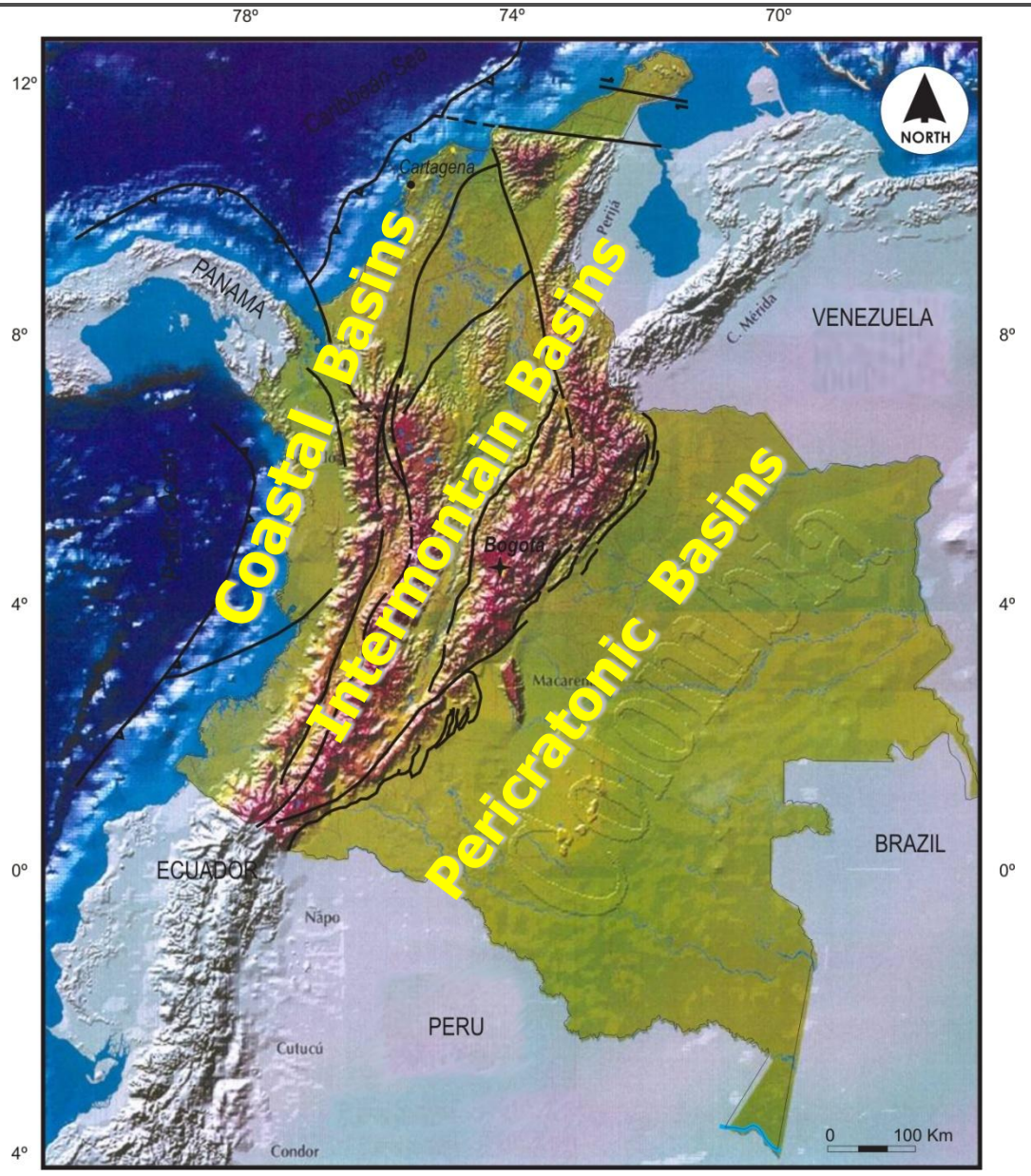
<u>Mature and emerging</u> pericratonic and intermountain basins in the east and center of Colombia.

<u>Emerging and frontier</u> coastal and offshore basins in the west and north of Colombia.



Colombia's Diverse Geology

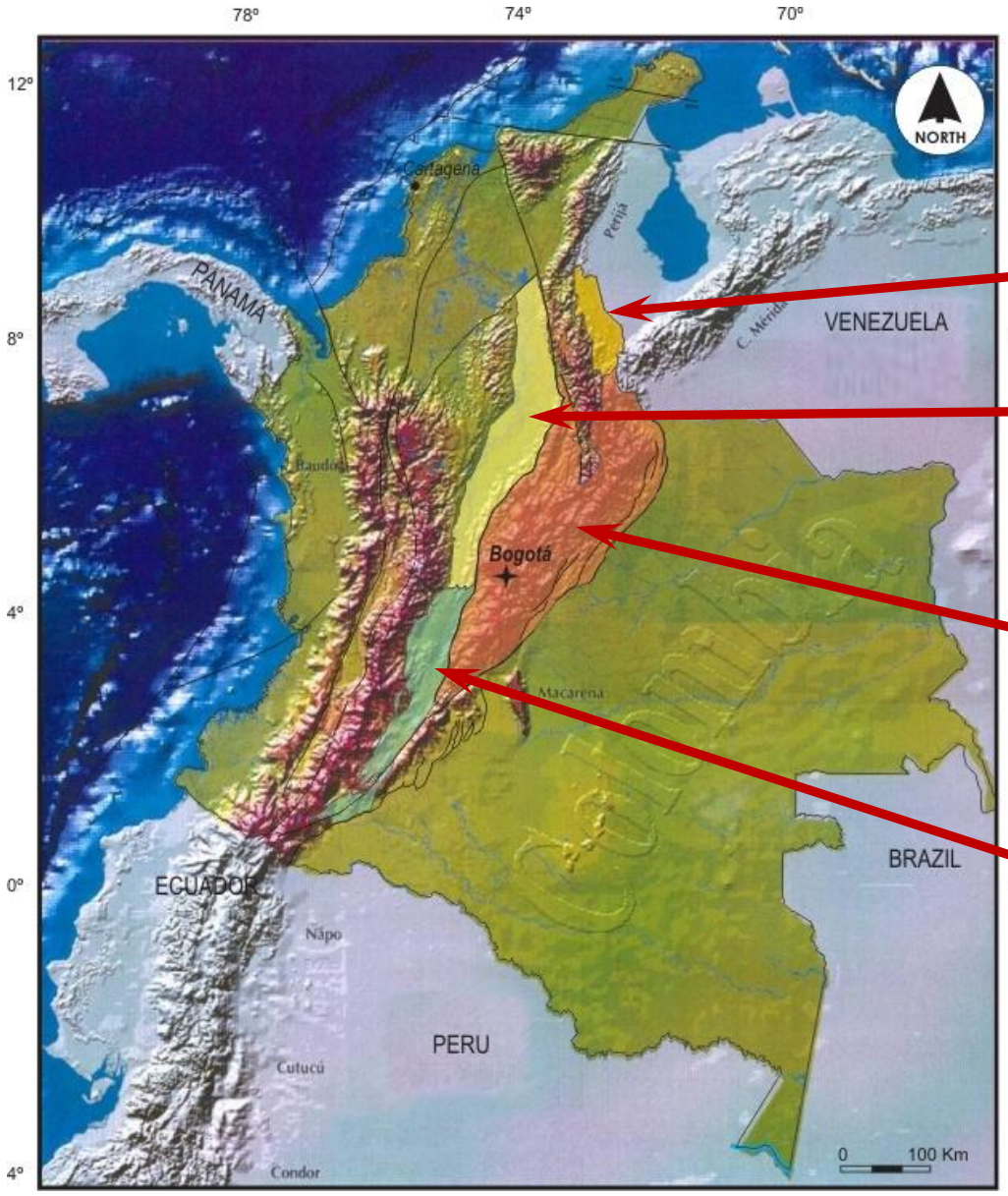
= Something For All Explorers!



AGENCIA NACIONAL DE **HIDROCARBUROS**

Pericratonic Basins

Cordillera and Inter-Cordillera Basins



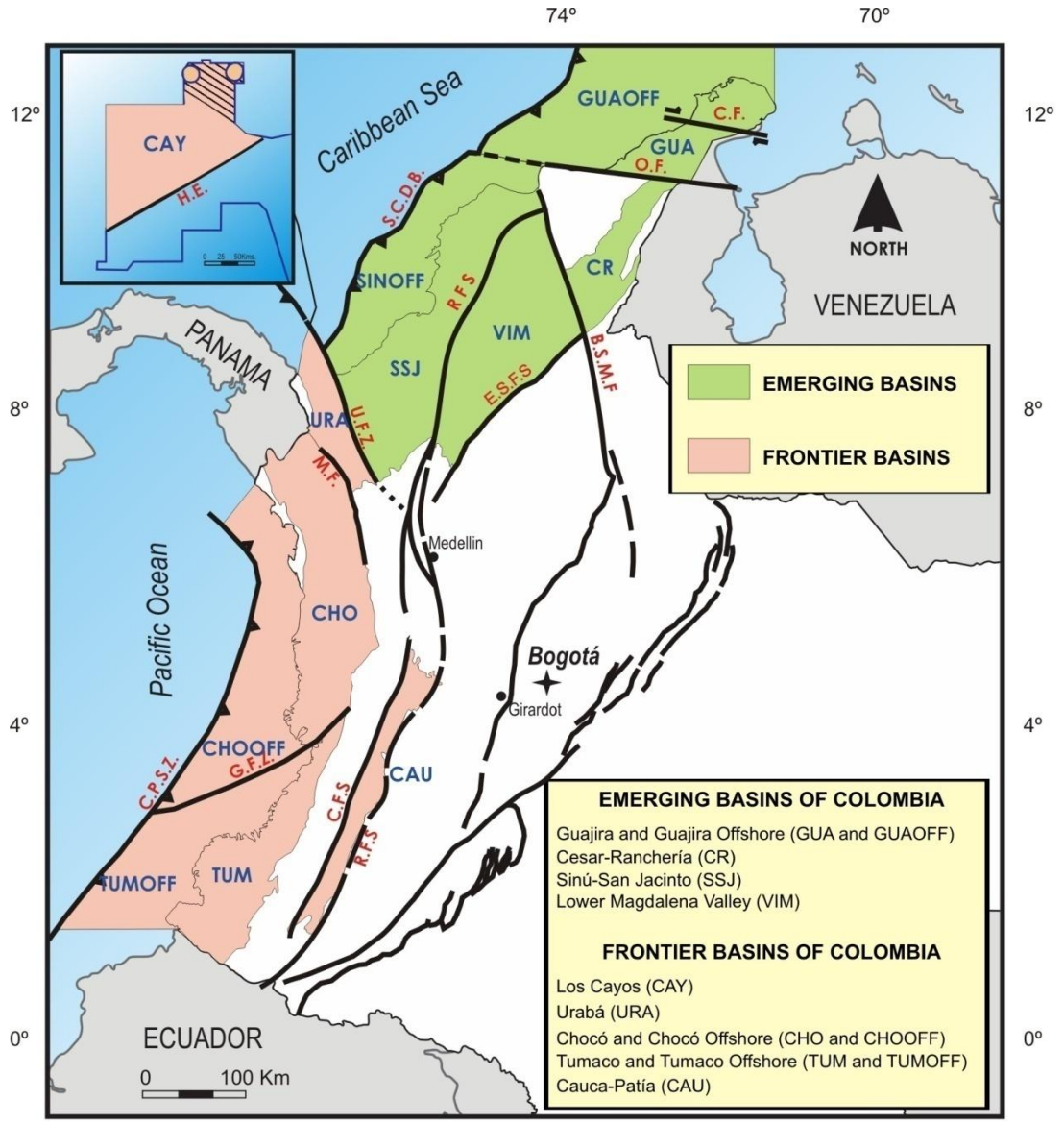
Catatumbo

Middle Magdalena Valley

Cordillera Oriental

Upper Magdalena Valley

Emerging and Frontier Basins



Forearc Basins And Delta Complexes

Significant Opportunities For Bold Explorers!

Colombia has Room to Explore!

Western Sedimentary Basin of Canada

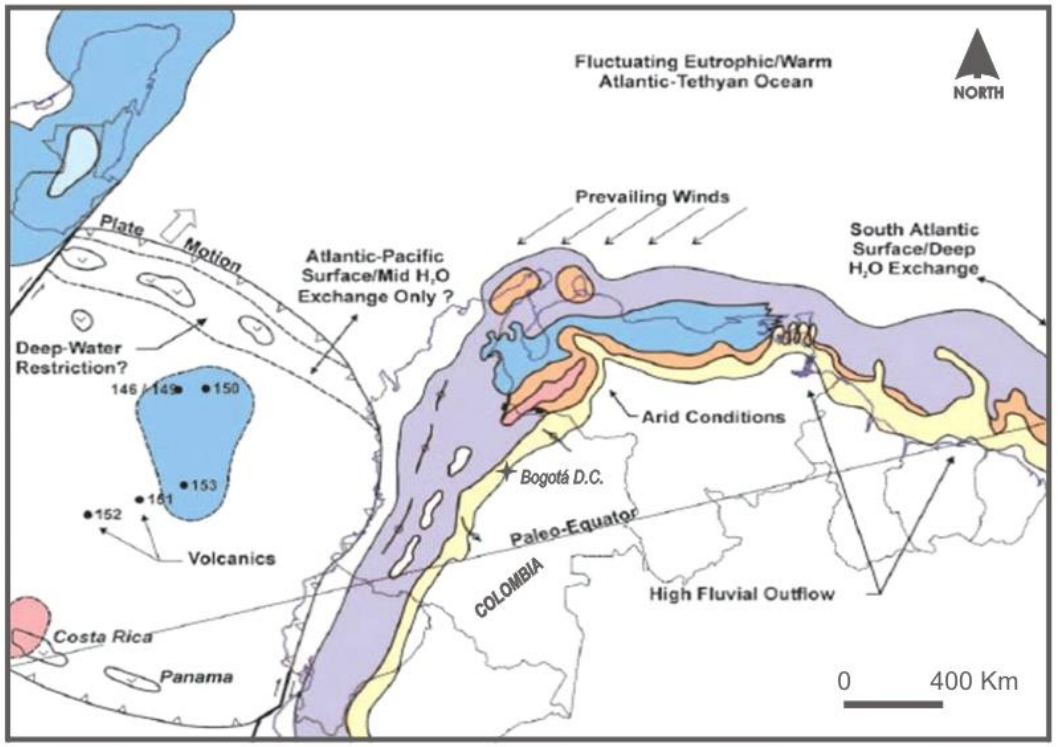
Approx. 525,000 wells
1 well / 2.5 km²

Eastern Cordillera-Llanos-Putumayo
2,026 wells
1 well / 200 km²

Colombia has World-Class Source Rock!

- ✓ **Mid-Cretaceous La Luna / Cansonna – A rich, regional hydrocarbon source rock**
- ✓ **Tertiary carbonaceous shale and coals**

In the shallower basins, these rocks are known to generate commercial quantities of biogenic methane.



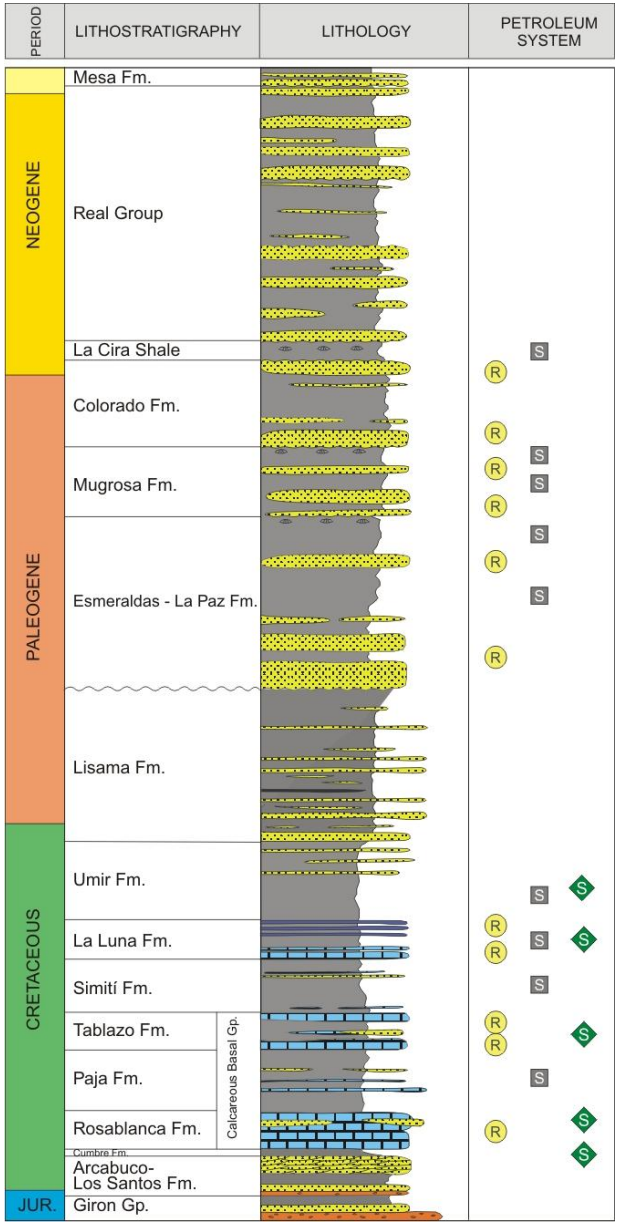
From Erlich et al., 2003, AAPG Memoir 79

Late Cenomanian-Turonian paleogeography of NW South America. La Luna / Cansonna deposition in purple and blue.

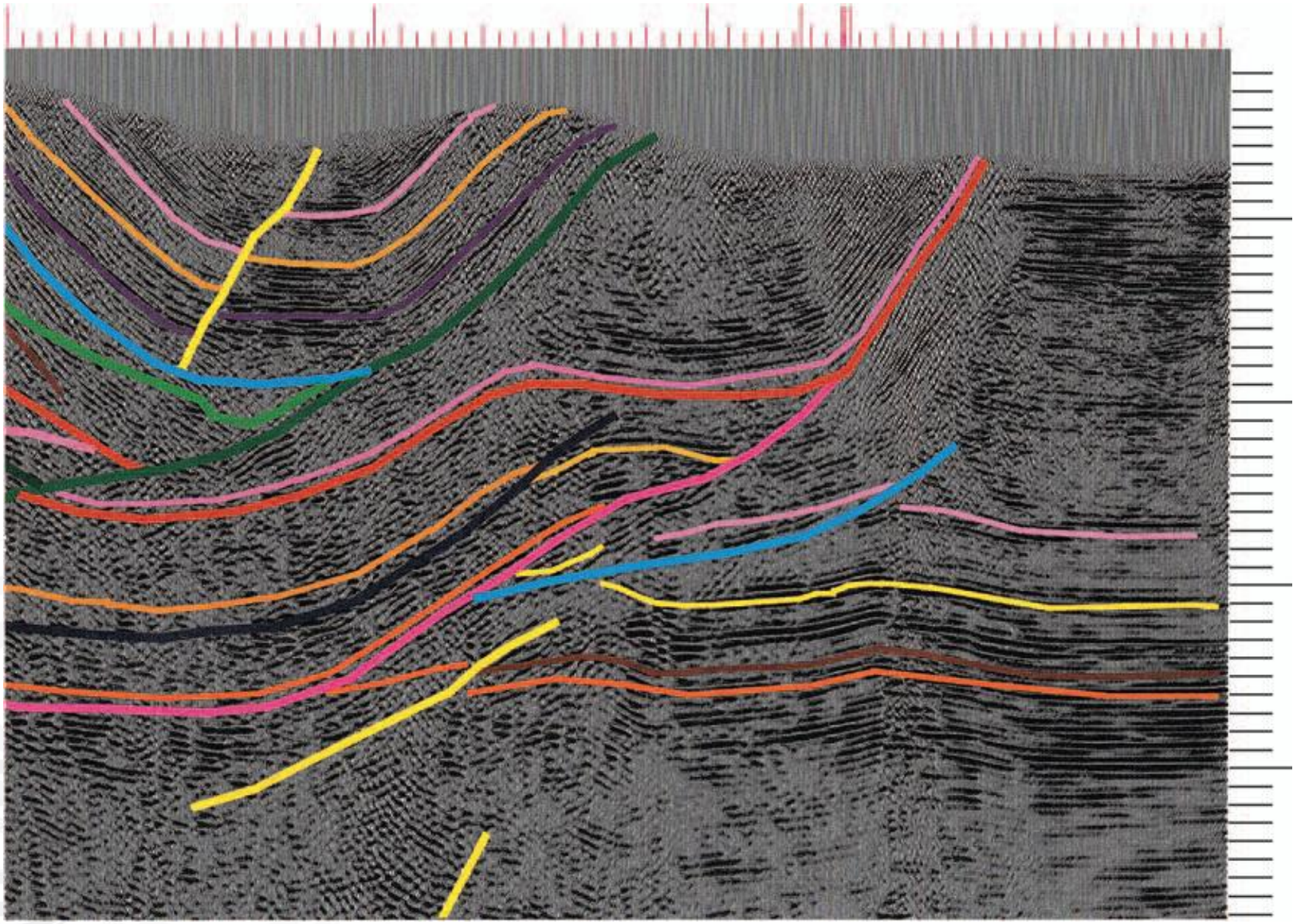
Colombia has Reservoirs!

Middle Magdalena Basin Reservoirs

Colorado Fm Mugrosa Fm Esmeralda Fm La Paz Fm	Sandstones Porosity: 15 – 20% Permeability: 20 – 600 md
La Luna Fm Tablazo Fm Rosablanca Fm	Fractured Limestone



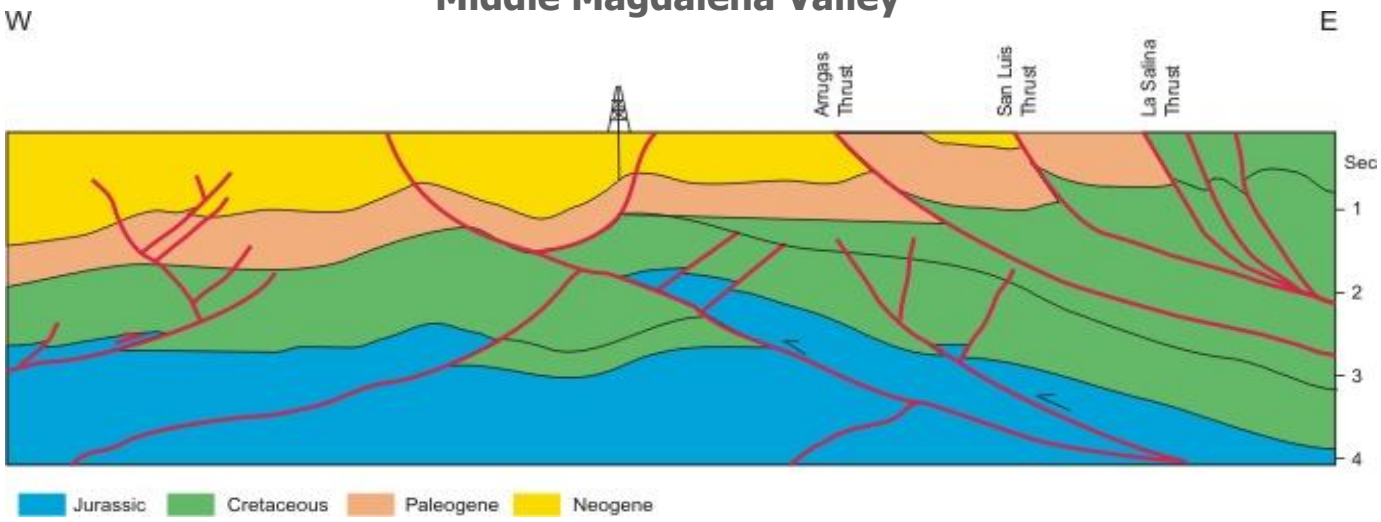
You Want Structure? Colombia Has it!



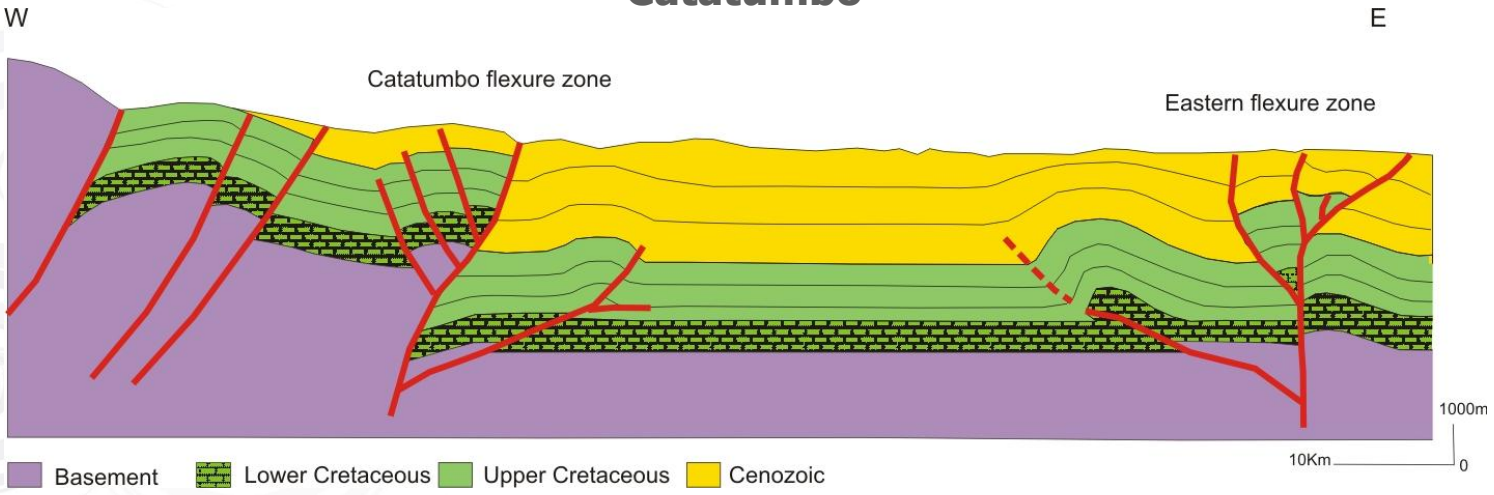
From: Villamil, 2003, AAPG

Colombia Has World Class Structure!

Middle Magdalena Valley

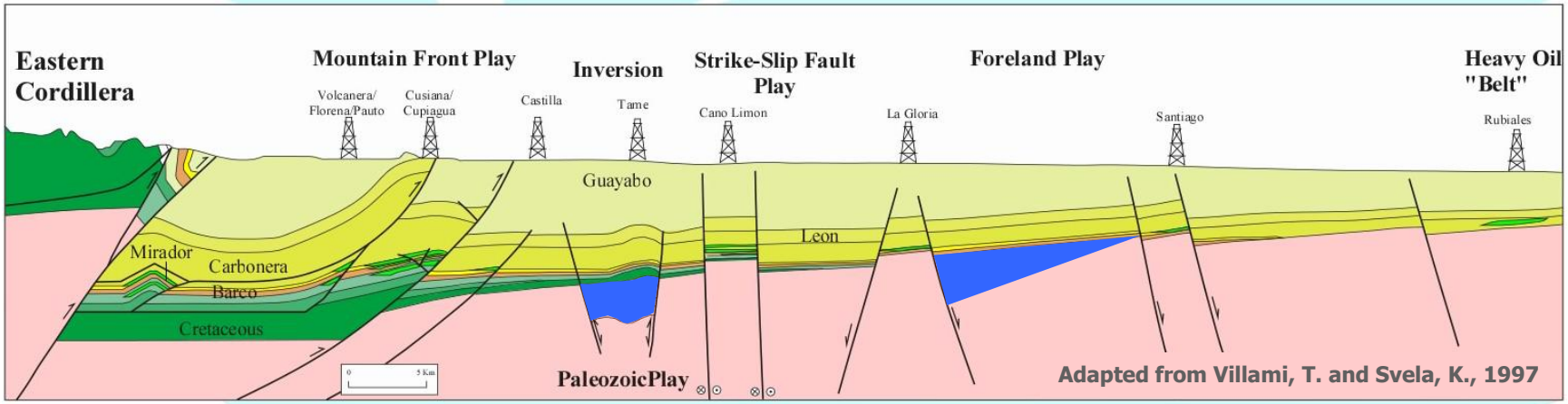


Catatumbo

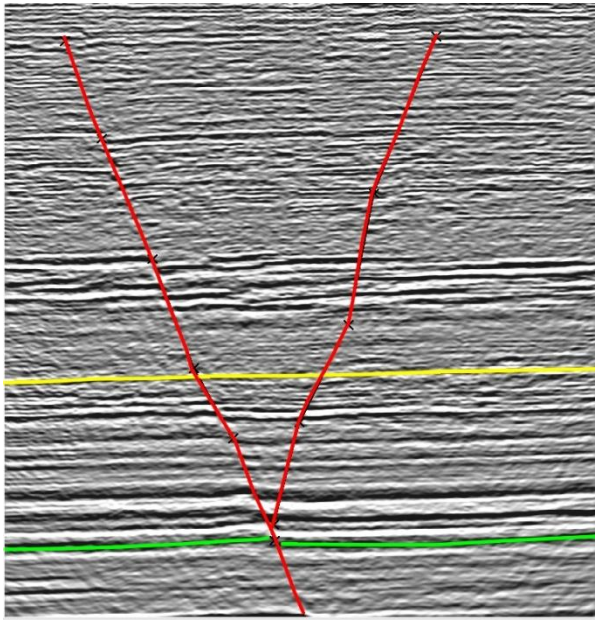


Colombia Has World Class Structure!

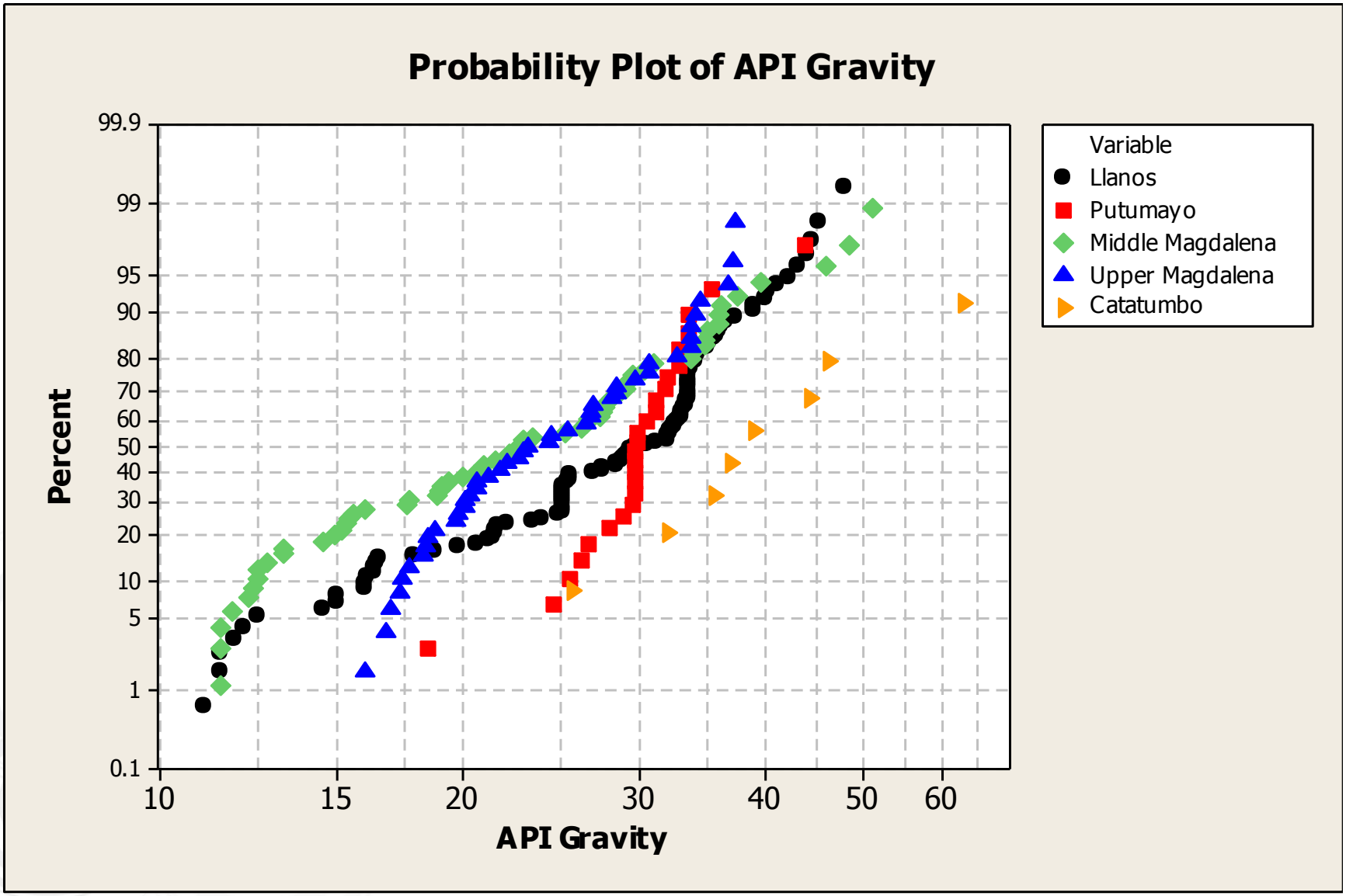
Llanos Oriental



- Antithetic normal faults
- Inversion structures
- Anticlines over inversion faults
- Stratigraphic traps
- Fault-propagation folds
- Potential Paleozoic structures



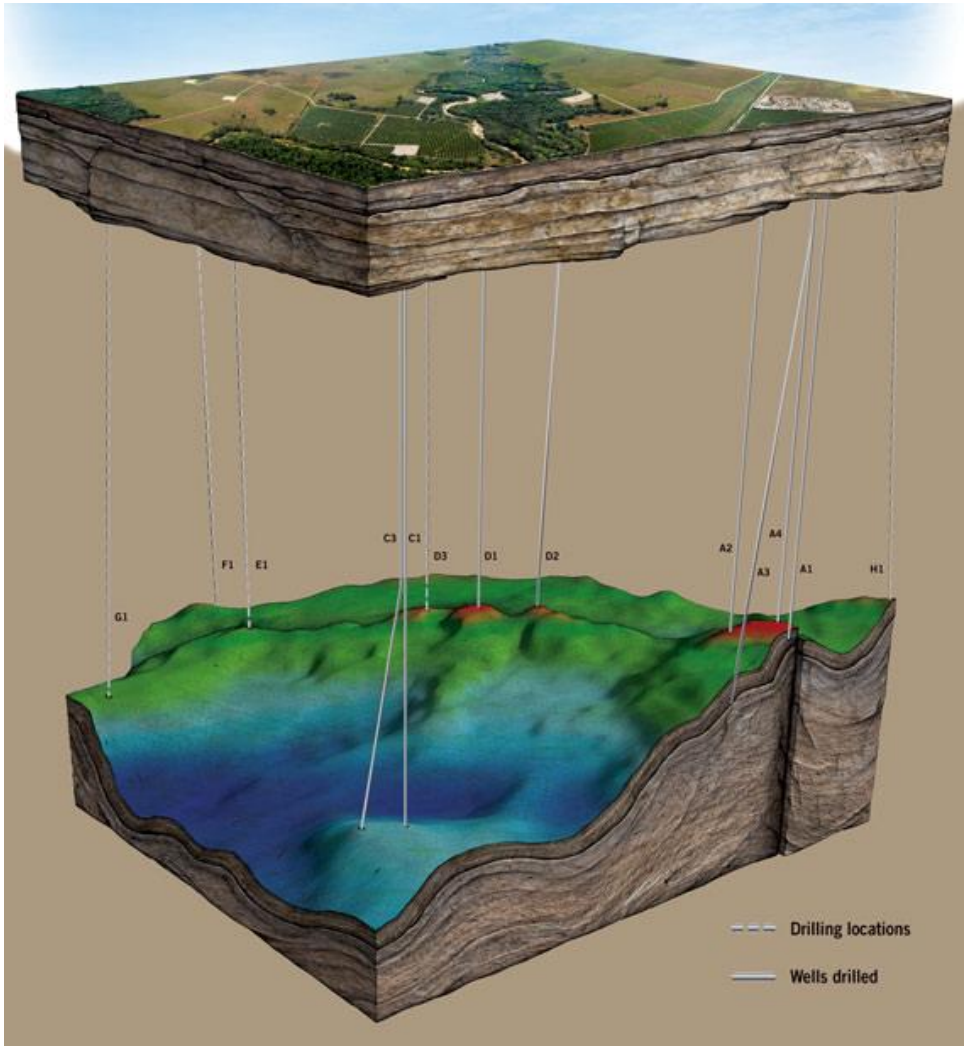
A Range of Crude Oils



3D Seismic is Transforming Colombia!

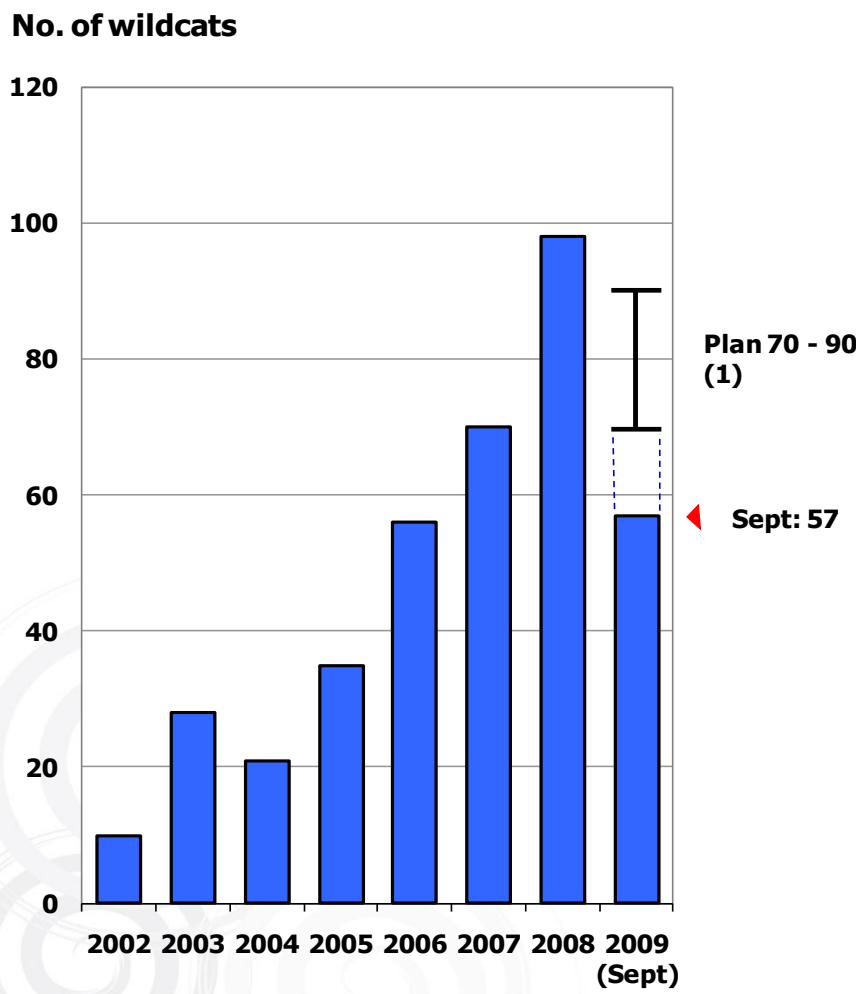
- ✓ **Better imaging has led to high success rates**
- ✓ **Delineating stratigraphic traps**
- ✓ **Optimizing mature field in-fill drilling programs**
- ✓ **Imaging subthrust prospects in the Upper and Middle Magdelena basins.**

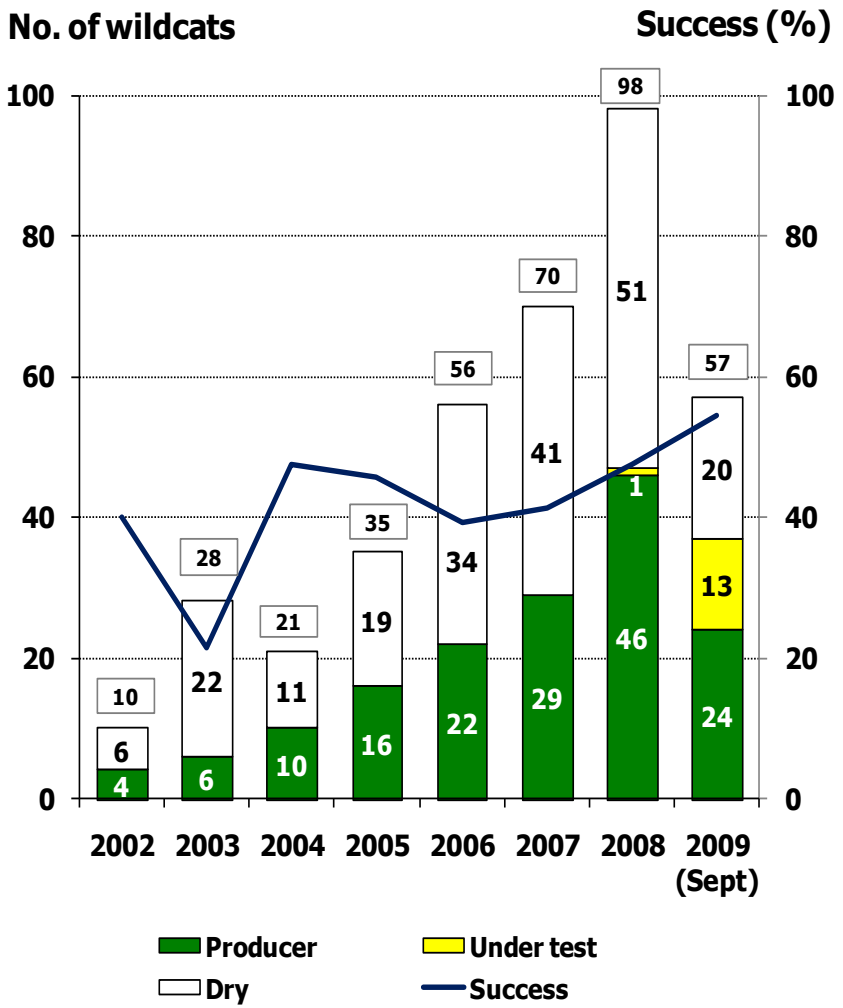
Mirador Fm. Structure at Corcel Field



From: Petrominerales, 2009

>40% Wildcat Success - 2008



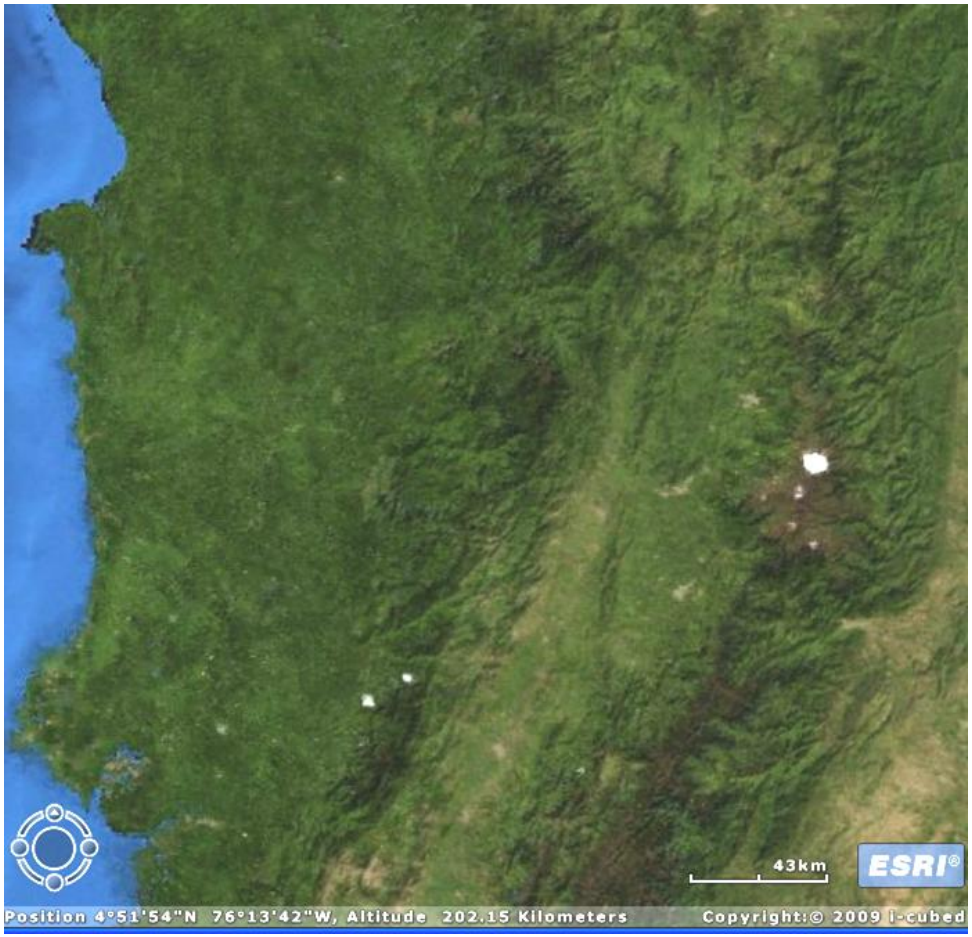


Technology is Opening the Frontier Basins

For Example:

- ✓ **Satellite Imagery**
- ✓ **Seismic field acquisition**
- ✓ **Geochemical Survey methods**
- ✓ **High resolution gravity and magnetics**
- ✓ **Slim-hole stratigraphic tests**

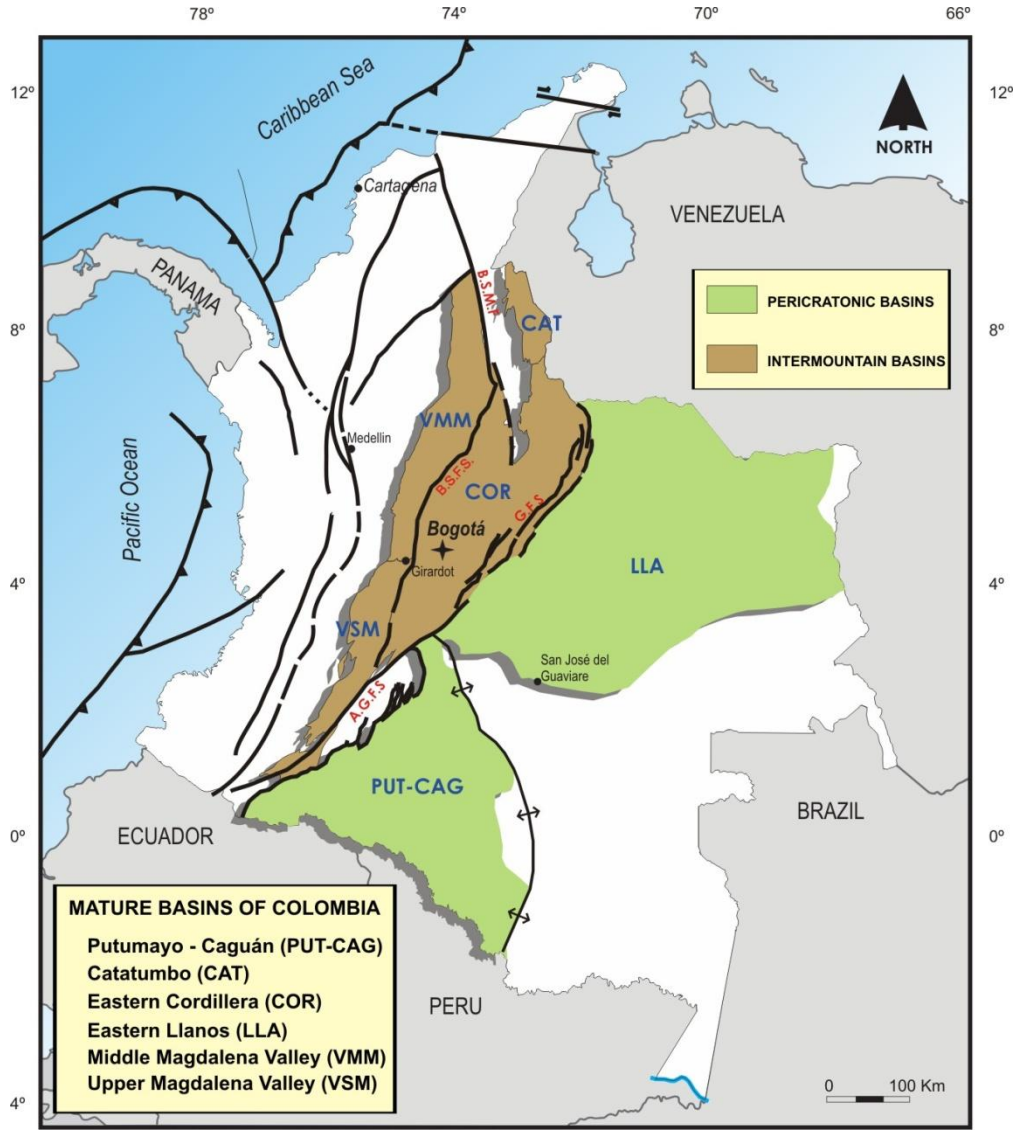
Satellite image of the heavily forested southern Chocó Basin



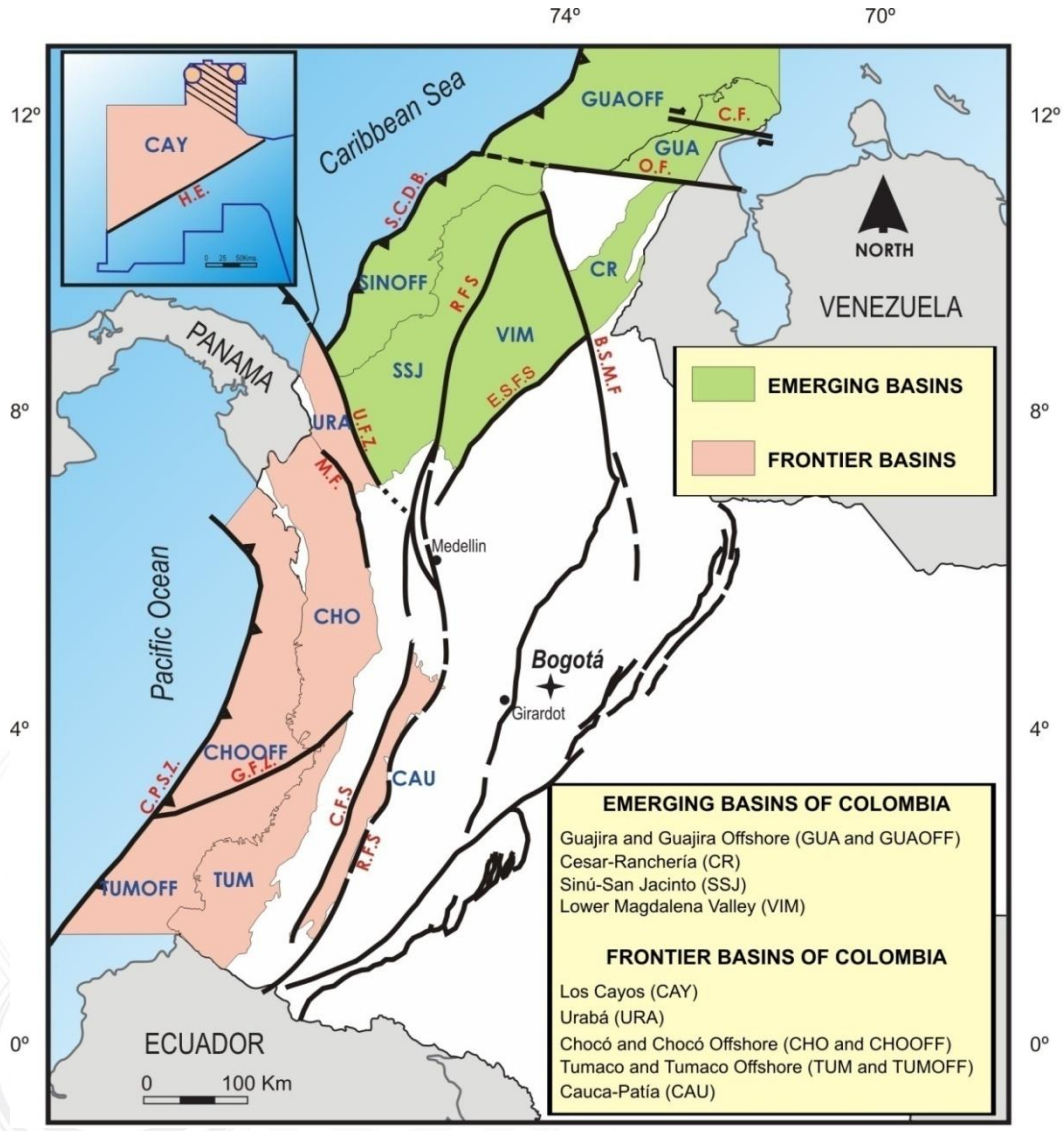
Colombian Mature Basins

Area of Mature Basins

BASIN	AREA (Km²)
EASTERN LLANOS (LLA)	225,603
PUTUMAYO-CAGUÁN (PUT - CAG)	110,304
MIDDLE MAGDALENA VALLEY (VMM)	32,949
UPPER MAGDALENA VALLEY (VSM)	21,513
CATATUMBO (CAT)	7,715
EASTERN CORDILLERA (COR)	71,766



Emerging and Frontier Basins



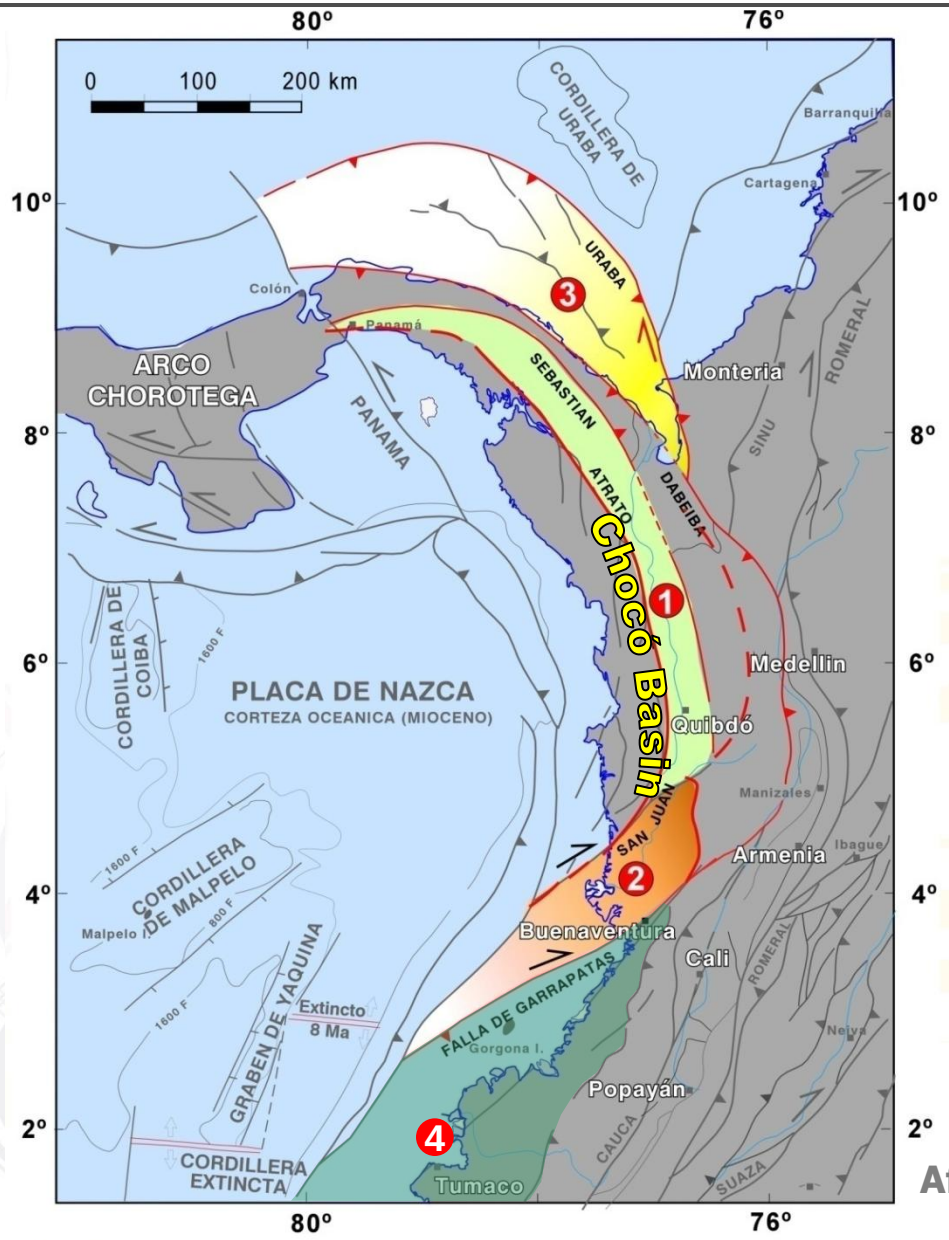
Colombian Coastal Fore-Arc Basins drilled 1956-1983

Prior drilling has demonstrated active petroleum systems.

ANH shooting new seismic and drilling deep stratigraphic wells

New Data + New Technologies + New Licenses = New Discoveries!

Frontier Basin Tectonic Setting



1. Atrato Sub-basin
2. San Juan Sub-basin
3. Urabá Basin
4. Tumaco Basin

Multiple Oil and Gas seeps
Good stratigraphic control
Large structures

No drilling since 1983!

After: Cediel, et al., 2003

Forearc Basins Are Very Productive!

The Sinu-San Jacinta, Cauca-Patia, Choco and Tumaco are all forearc basins or successor basins in forearc settings.

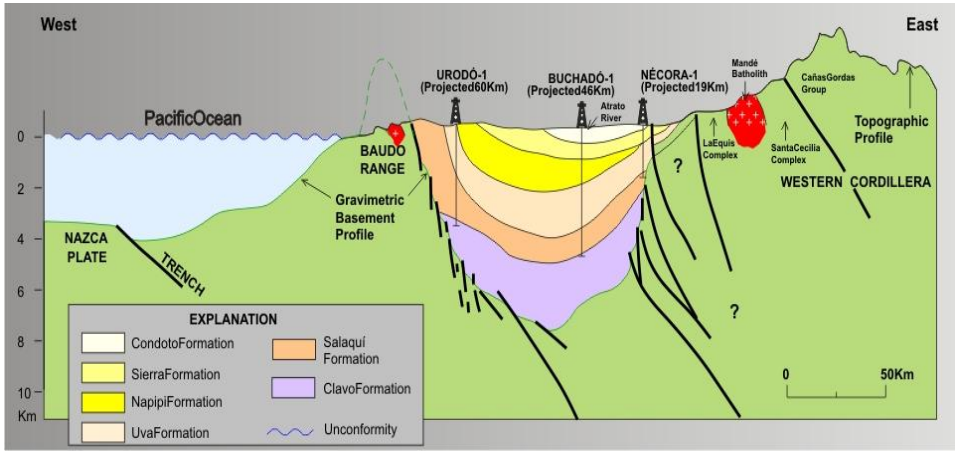
✓Deep sediment-filled trough containing sandstone reservoirs.

✓Sacramento Basin in Northern California is an excellent analog, which has produced about 10Tcf of gas with minor condensate and oil.

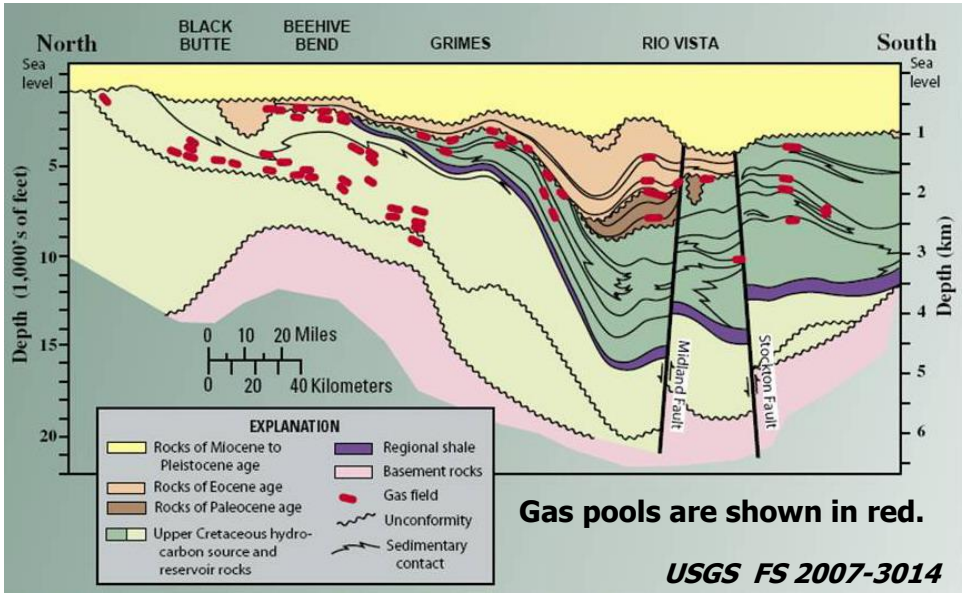
✓The Sacramento and Chocó basins have similar depths.

✓Active petroleum system indicated by oil and gas seeps.

Chocó Forearc Basin



Sacramento Forearc Basin, California



Gas pools are shown in red.

USGS FS 2007-3014

Deltas are Prime Exploration Targets!

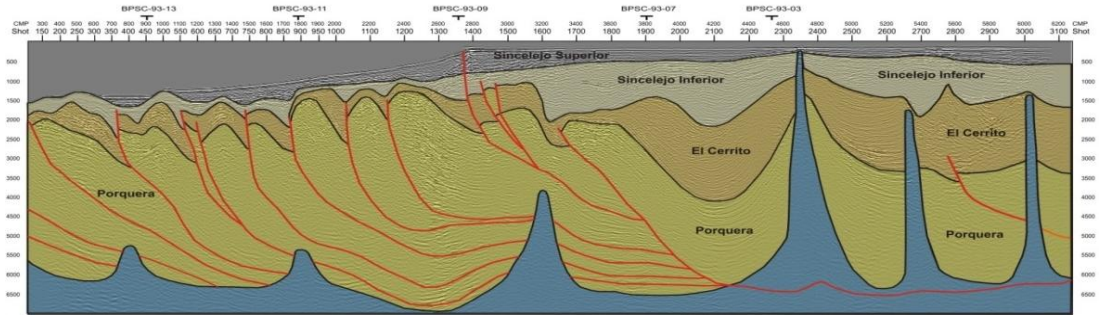
The offshore Sinú, southern Chocó, and Tumaco basins are large Tertiary delta complexes.

About 15% of known giant oil & gas fields are found in delta provinces.

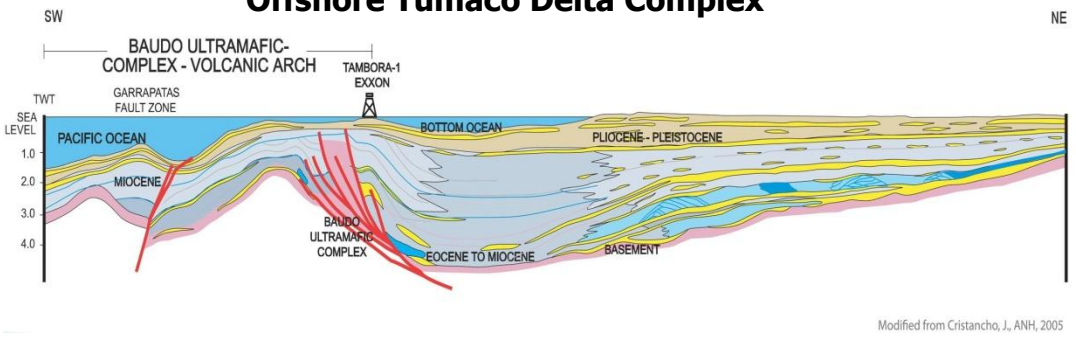
***Barum/Brunei Delta* is a close analog**

Traps generated by complex interaction of gravity-driven tectonics and transpressive or compressive basement tectonics

Offshore Sinú Delta Complex

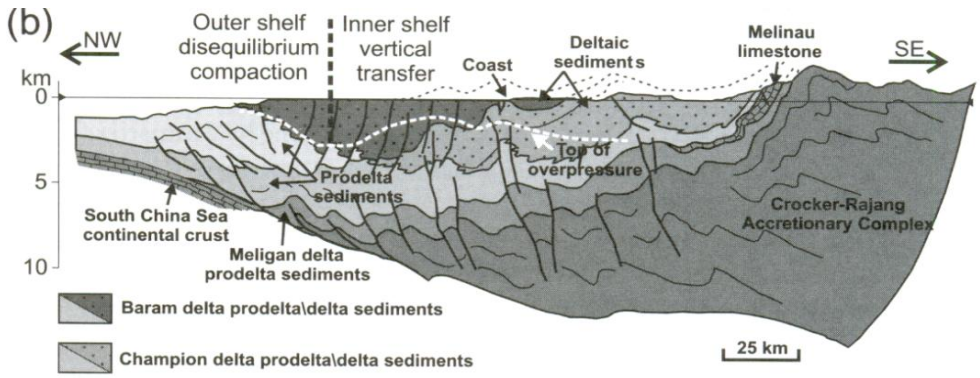


Offshore Tumaco Delta Complex



Modified from Cristancho, J., ANH, 2005

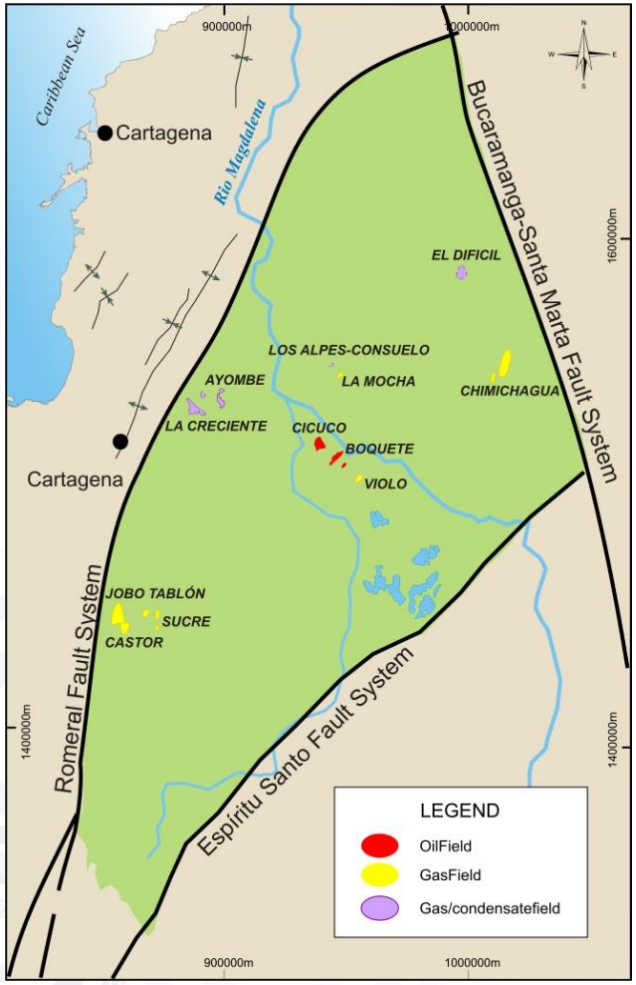
Barum Delta Complex, Brunei



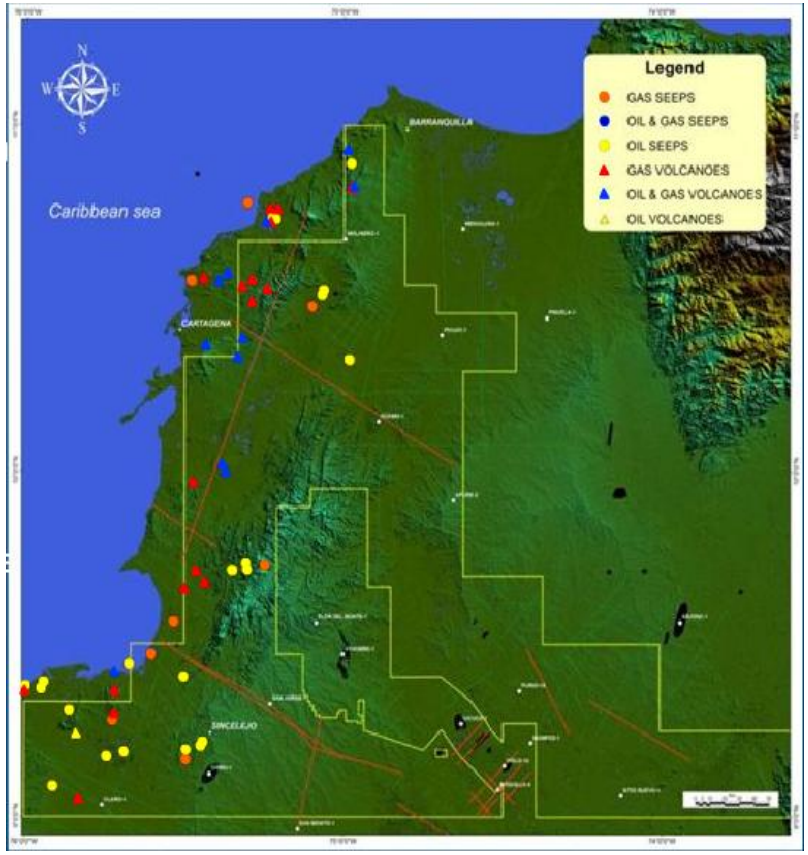
From Tingay et al. (2009) AAPG Bulletin

Emerging Basin Opportunities

Discoveries in the Lower Magdalena Valley



Abundant oil and gas seeps in the San Jacinto – Sinú Basin



These basins have seen very little Exploration!

Frontier Basin Opportunities

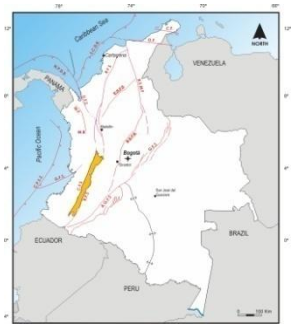
Cauca-Patia Basin

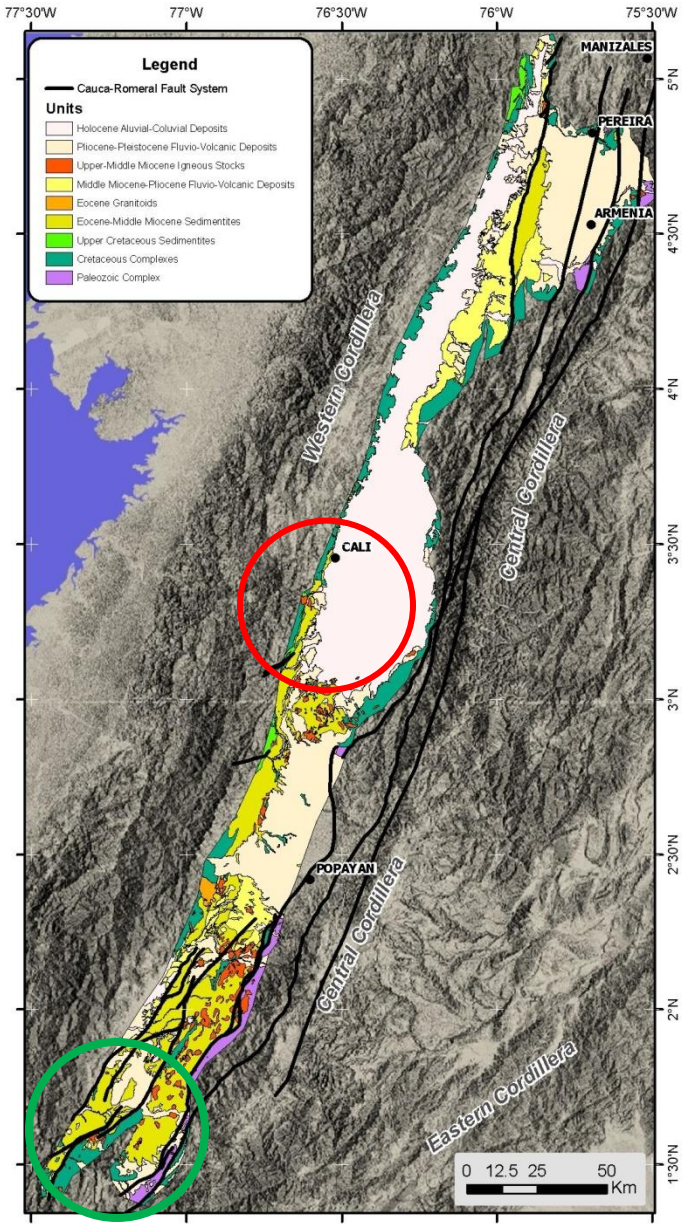
A northeast trending, 440 km intermountain depression separating the Cordillera Central and Cordillera Occidental.

Gas and oil prone coals

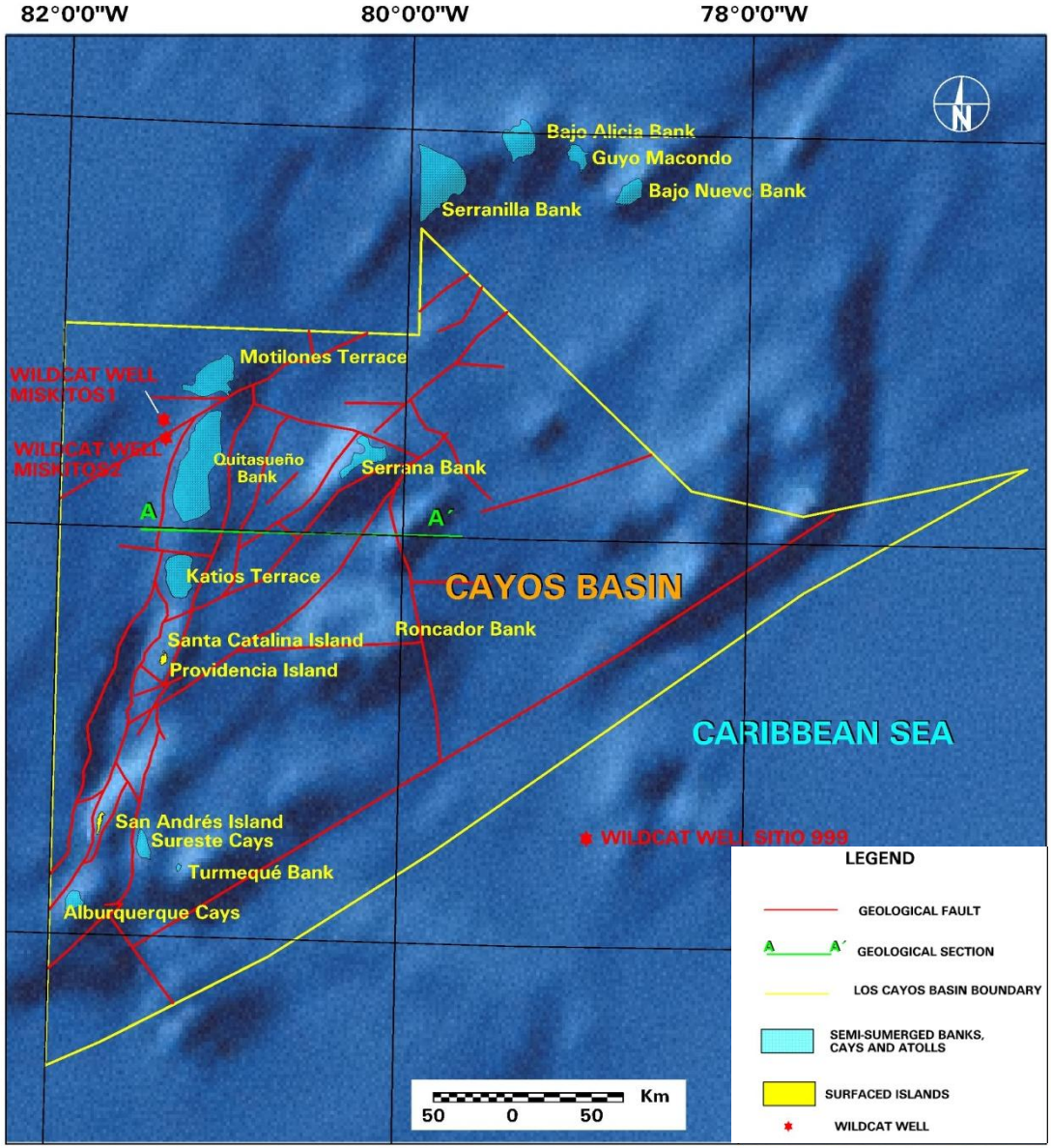
✓Gas shows in wells in the Cali area (red circle)
✓Cali is a good gas market for any discoveries in the basin.
✓Surface oil seeps in the Patía sub-basin (green circle).

✓Only 5 wells drilled in Basin



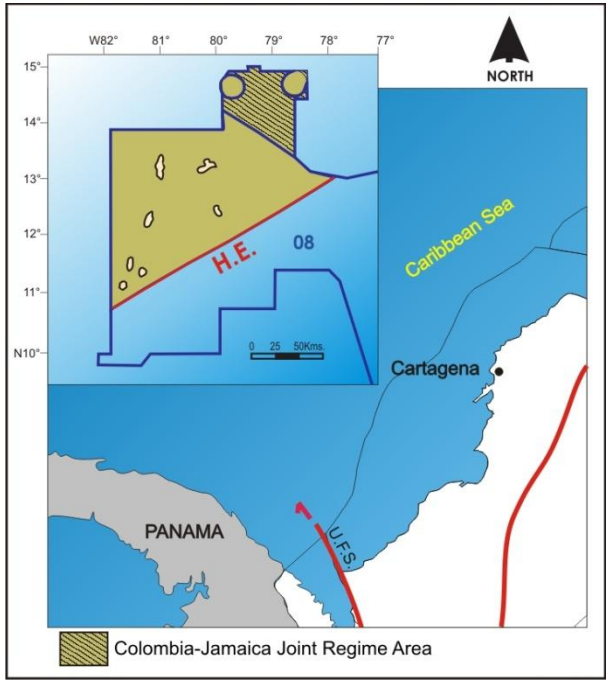


Rank Frontier Basins



Los Cayos Basin

Numerous structures
Potentially mature Source rocks
Carbonate reservoirs



Future Potential

New Ideas + New Technologies + New Licenses

=

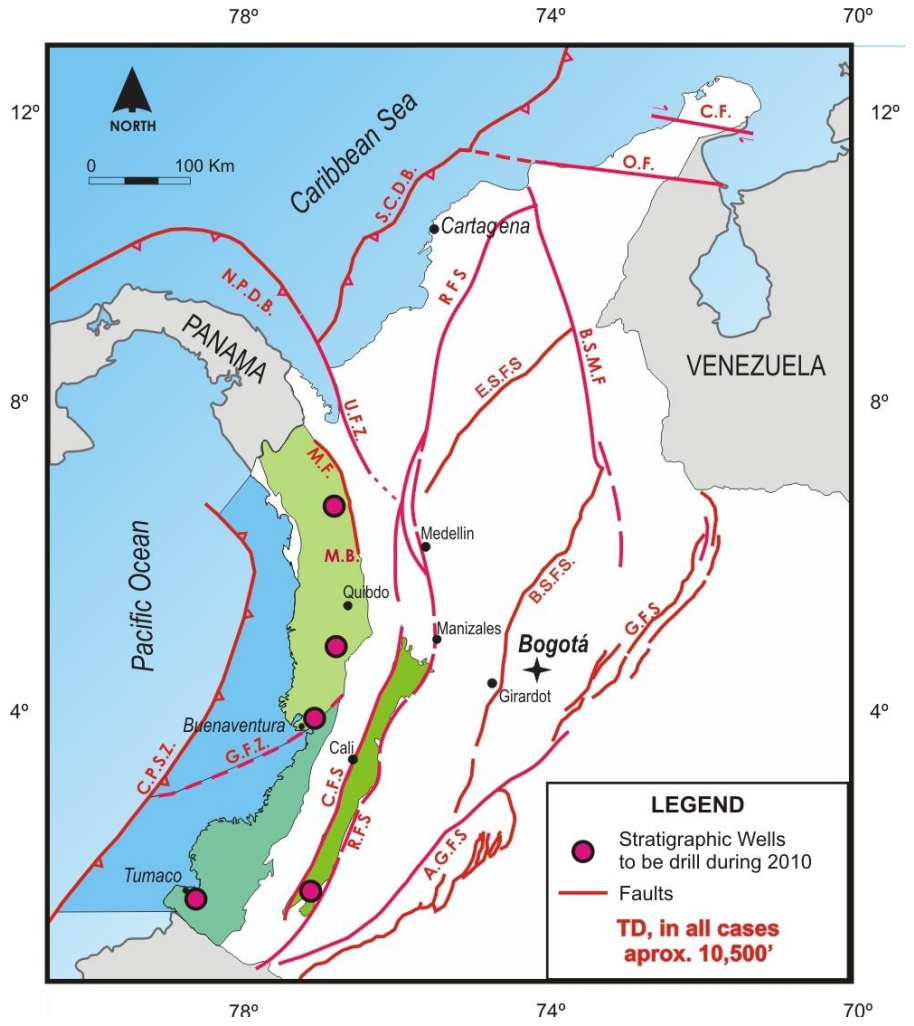
Significant new discoveries

Colombia has Data!

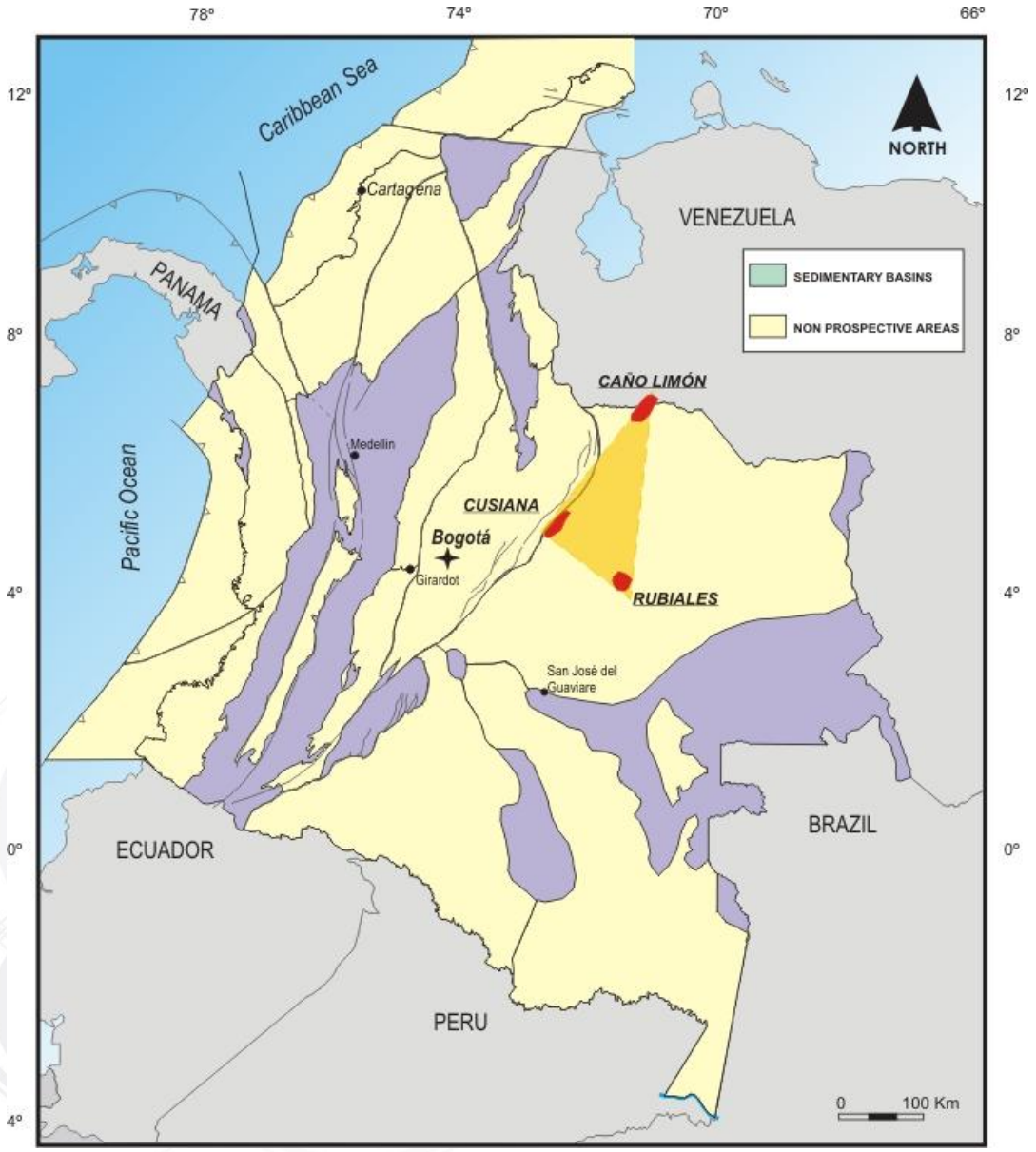
ANH has an excellent geological and geophysical database that is user friendly.

	No. Wells	Seismic (Km)
Type 1 E&P Mature Basins	192	25,194
Type 2 E&P Emerging and Frontier Basins	147	24,017
Type 3 Technical Evaluation Agreements (TEA)	50	11,449
Total	389	60,660

Deep stratigraphic wells planned for Frontier basins



The "Golden Triangle"



Caño Limón
1.3 Billion BO

Cusiana-Cupiagua
1.3 Billion BO

Rubiales
344 Million BO

E. Cordillera + Llanos + Putumayo =2,026 Total Wells Drilled (1 well/201 km2)

Giants yet to be Discovered?

Mature Basins

Basin	Current Production (BOPD)	Percent National Production	N. Fields	Light Oil	Medium Oil	Heavy Oil
Eastern Llanos	425,231	66.45%	118	50	33	35
Middle Magdalena Valley	98,687	15.42%	61	10	17	34
Upper Magdalena Valley	88,149	13.78%	44	11	16	17
Putumayo-Caguán	24,000	3.75%	26	8	17	1
Catatumbo	3,283	5.10%	6	5	1	0
Eastern Cordillera	79	1.00%	1	0	0	1
Total	639,429	100 %	256			

Basin Statistics as of July 2009

Emerging and Frontier Basins Statistics

Emerging Basins

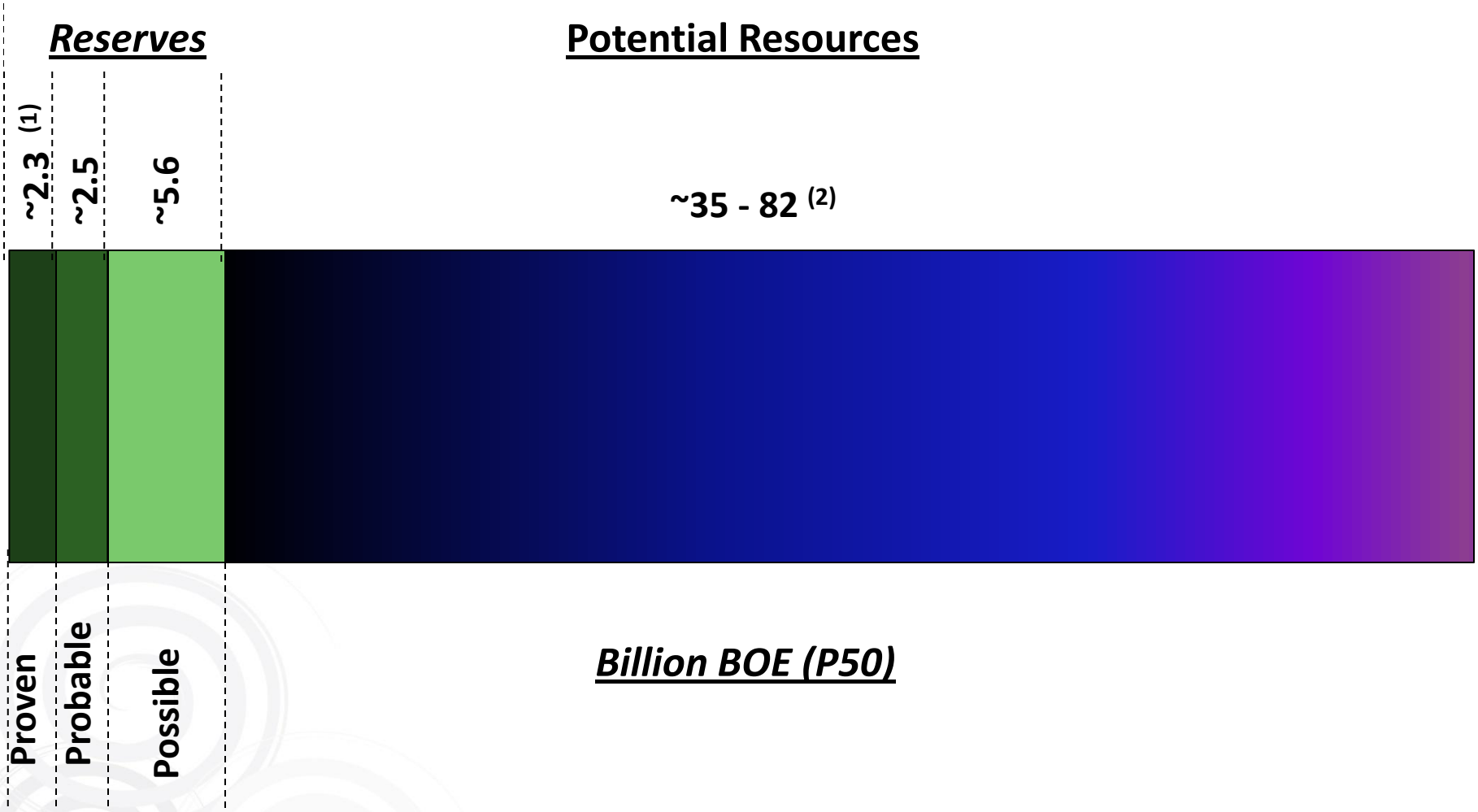
Basin	Basin Area (Km^2)	Production	Discoveries	Number of wells	2D seismic (Km)
Guajira and Guajira offshore	66,639	3.72 TCFG	5 gas	78	24,074
Cesar-Ranchería	11,668	ND	2 oil + 3 gas (NCP)	67	3,458
Sinú-San Jacinto	69,221	ND	3 gas	205	26,343
Lower Magdalena Valley	38,017	0.35 TCFG + 64.2 MBO	4 oil + 8 gas	273	16,704

Frontier Basins

Basin	Basin Area (Km^2)	Production	Oil & Gas Seeps	Wells with Shows	Number of wells	2D seismic (km)
Los Cayos	144,755	-		2 oil & gas	2	4,739
Urabá	9,449	-	✓	2 gas	5	4,665
Chocó and Chocó offshore	73,675	-	✓	1 oil & gas	5 (Atrato)	6,599
Tumaco and Tumaco offshore	58,285	-	✓	1 oil & 2 gas	5	9,452
Cauca-Patía	12,823	-	✓	1 gas	5	968

Basin Statistics as of July 2009

Reserves and Potential (BOE)

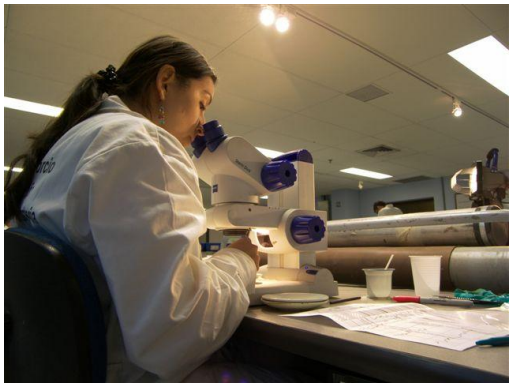


(1) Last updated on April 30th 2009 by the operators
(2) Compiled sources: IHS, UIS, ZIFF Energy, EAFIT, Universidad Nacional, Halliburton

Colombia:

A GREAT PLACE TO INVEST IN PETROLEUM EXPLORATION & DEVELOPMENT

- Diverse geology and play opportunities
- Small to giant field discovery potential
- Light to heavy oil, and natural gas
- Onshore and offshore opportunities
- Well-established oil services industry
- Production infrastructure
- Atlantic and Pacific export markets



Opportunities for the small independent to the major international oil companies

Colombia:

OPPORTUNITIES FOR THE SMALL INDEPENDENT TO THE MAJOR, INTERNATIONAL OIL COMPANIES

- A good business environment.
- Favorable contract terms under a new institutional framework.
- Competitive licensing rounds.
- Educated workforce.
- Access to growing domestic and international markets for oil and gas

Security has returned to Colombia!

The Canadians are in Colombia!

Company	Market Cap $Cdn	Net BOE/day
Pacific Rubiales	3.2	52,582
Petrominerales	2.2	24,557
Gran Tierra Energy	1.3	14,000
Alange Energy	0.4	3,773

Pre-Tax Net-back/ BOE = US$35-$45

Data from Company websites

¿ Why Colombia ?

Ammonite Resources believes Colombia has excellent exploration opportunities on a global scale in mature, emerging and frontier basins.

We urge you to talk with ANH About the 2010 Round!

AMMONITE RESOURCES

Geologists, Geophysicists and Engineers
Energy and Mineral Advisors Since 1982

Advisors to ANH for the 2010 Licensing Round

G. Warfield Hobbs, MSC., PG. – Ex-Texaco, Amerada Hess
Robert K. Merrill, PhD., PG, C.Geol., Ex- Cities Service, Unocal
Steven Schamel, PhD., PG, Ex- ESRI (U of South Carolina)

Each consultant has more than 35 years international E&P experience, including experience in Colombia

www.ammoniteresources.com

Open Round COLOMBIA 2010

ANH

Gracias,
See you in Colombia!

www.anh.gov.co

COLOMBIA:
The perfect ... environment for hydrocarbons

Open Round
COLOMBIA 2010

ANH
The people to speak to

Contents

HYDROCARBON POTENTIAL OF COLOMBIA

Prof. Carlos A. Vargas J.

Departamento de Geociencias

Universidad Nacional de Colombia

WHAT STARTS HERE CHANGES THE WORLD
THE UNIVERSITY OF TEXAS AT AUSTIN
JACKSON SCHOOL OF GEOSCIENCES
UTIG
CBTH PHASE II
University of Stavanger
UNIVERSIDAD NACIONAL DE COLOMBIA

Agenda

- **Introduction and geologic setting**
- **Methodology**
- **Results**
- **Conclusions**

Agenda

- **Introduction and geologic setting**
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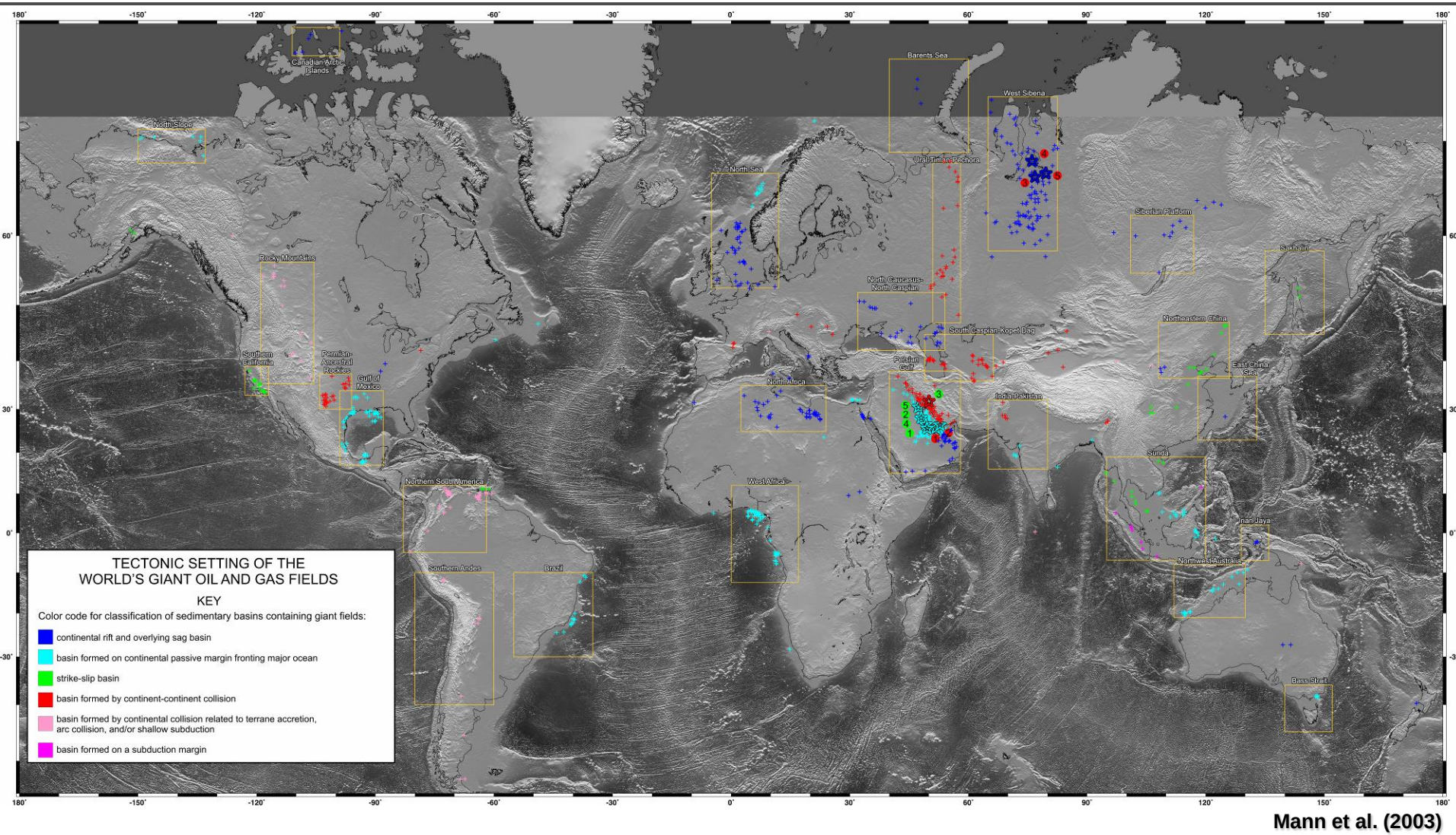
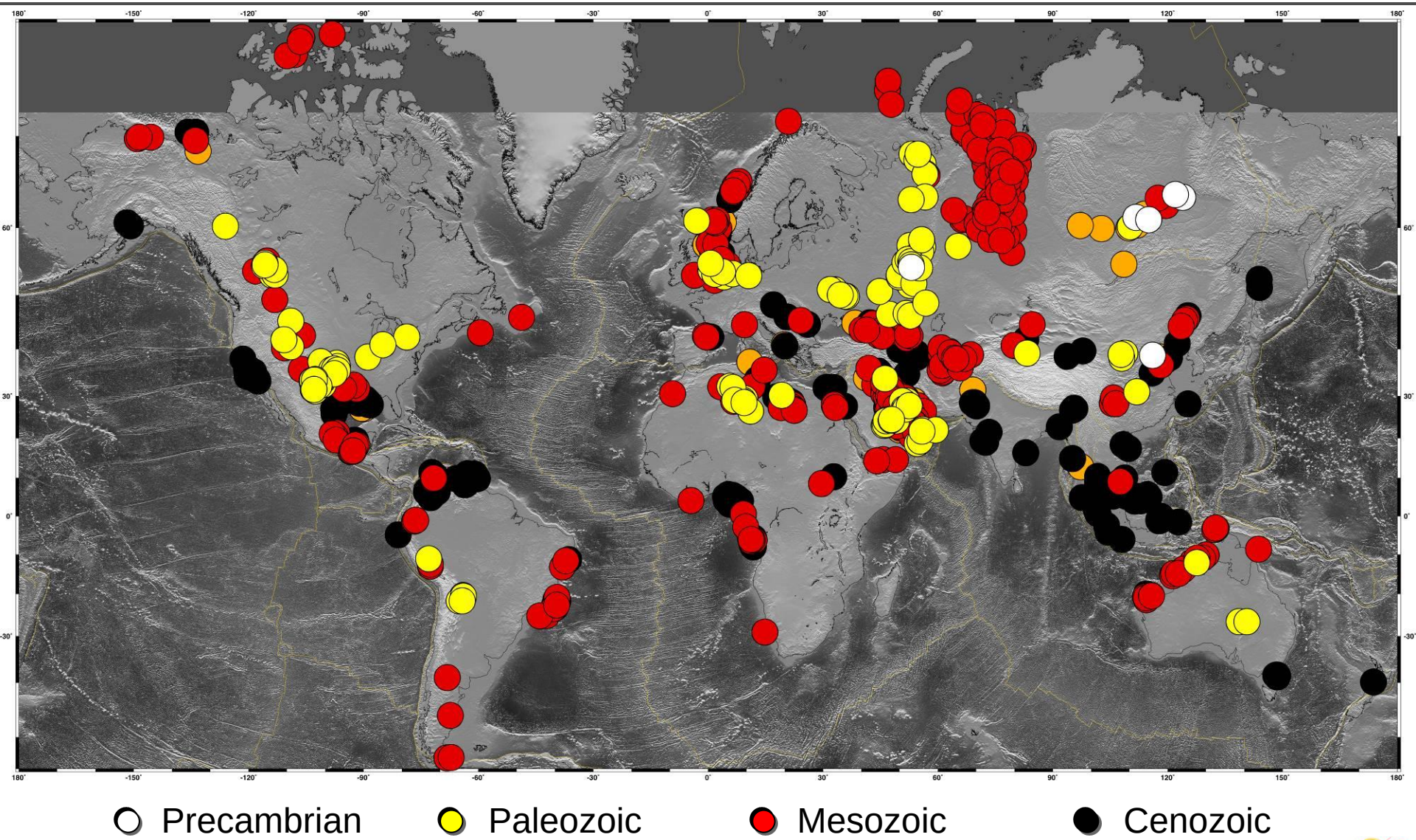
Giant fields classified by type of basin



Mann et al. (2003)

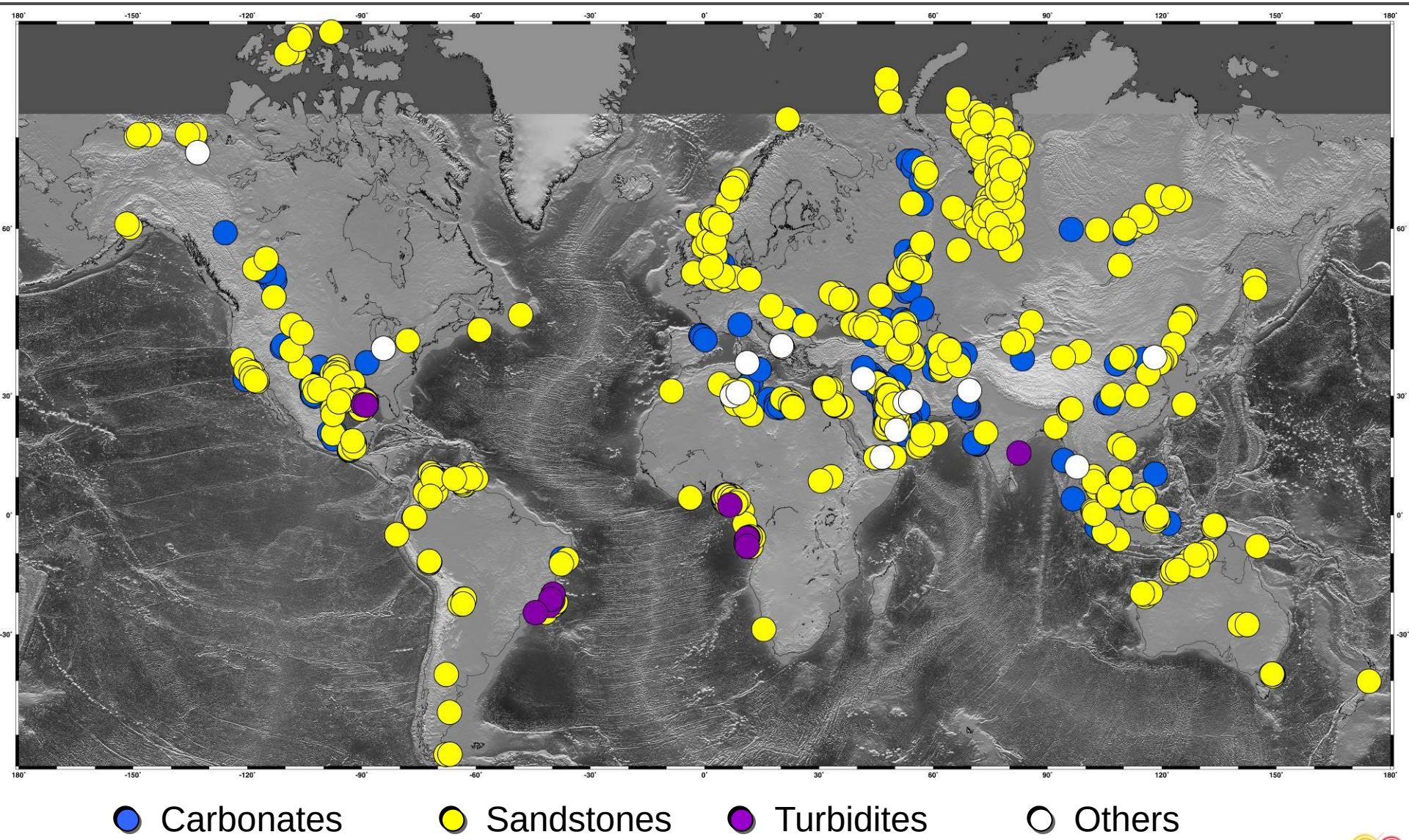
Giant fields classified by age

(911 Oil & Gas fields)



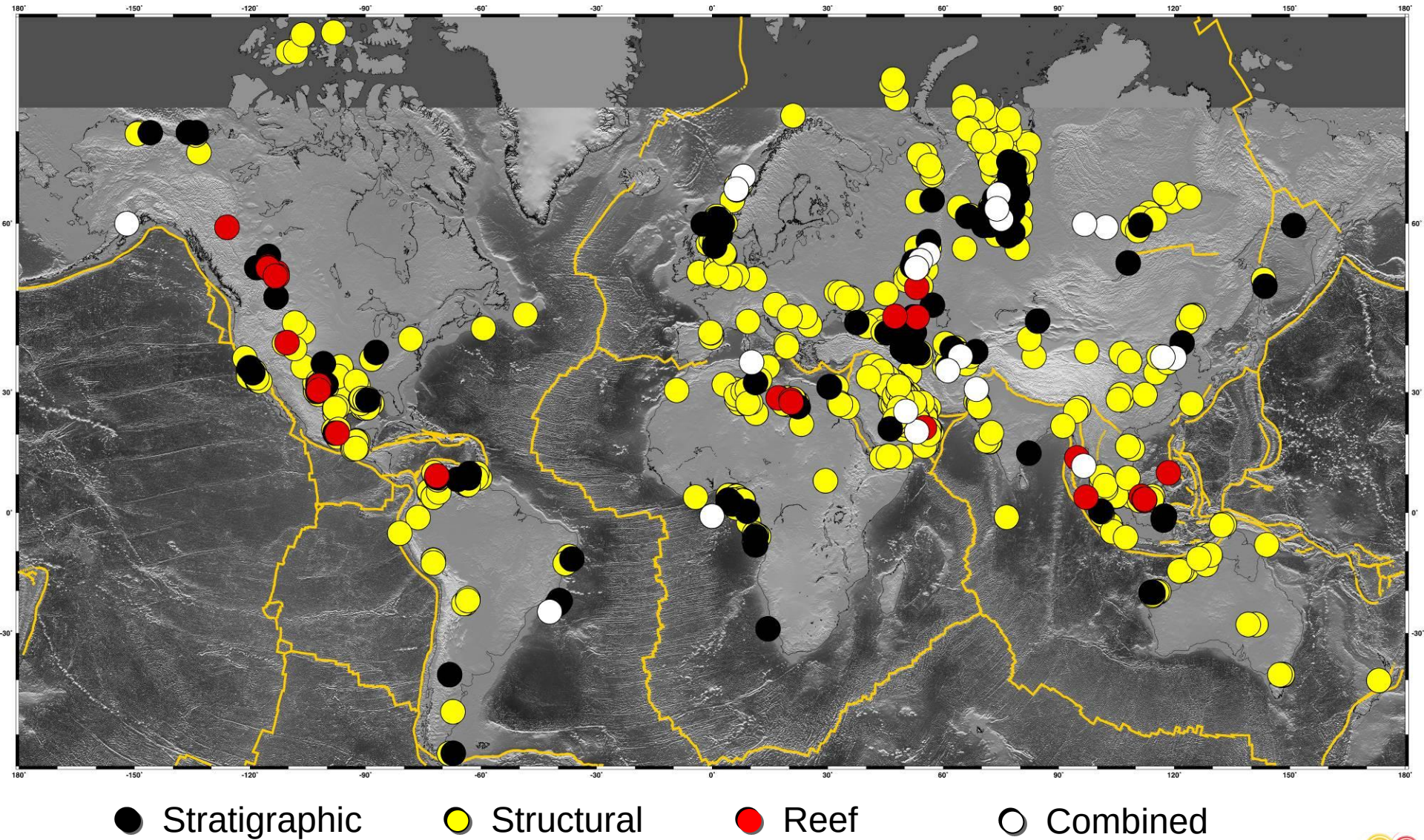
Giant fields classified by reservoir rocks

(911 Oil & Gas fields)



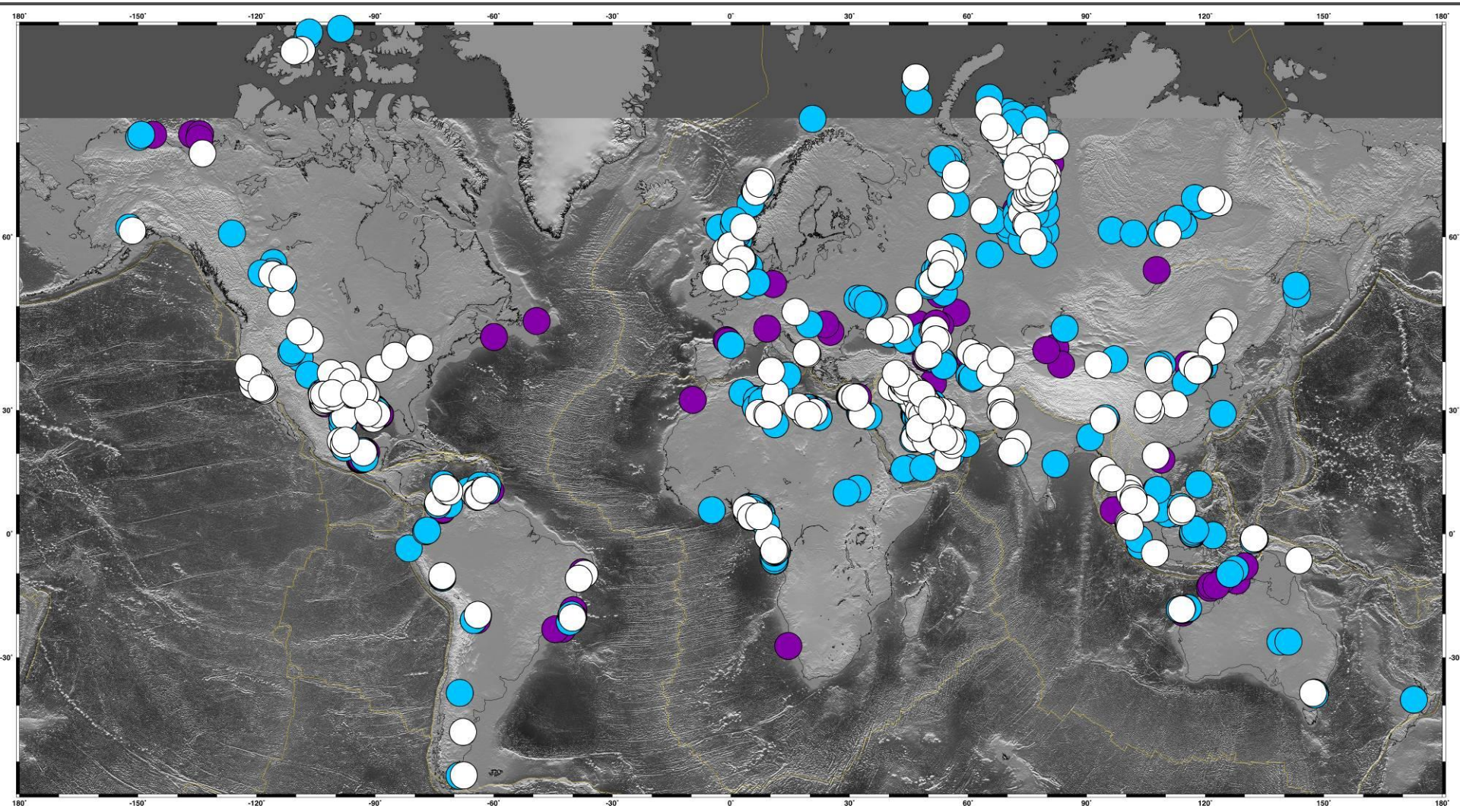
Giant fields classified by trap

(911 Oil & Gas fields)



Giant fields classified by depth

(911 Oil & Gas fields)

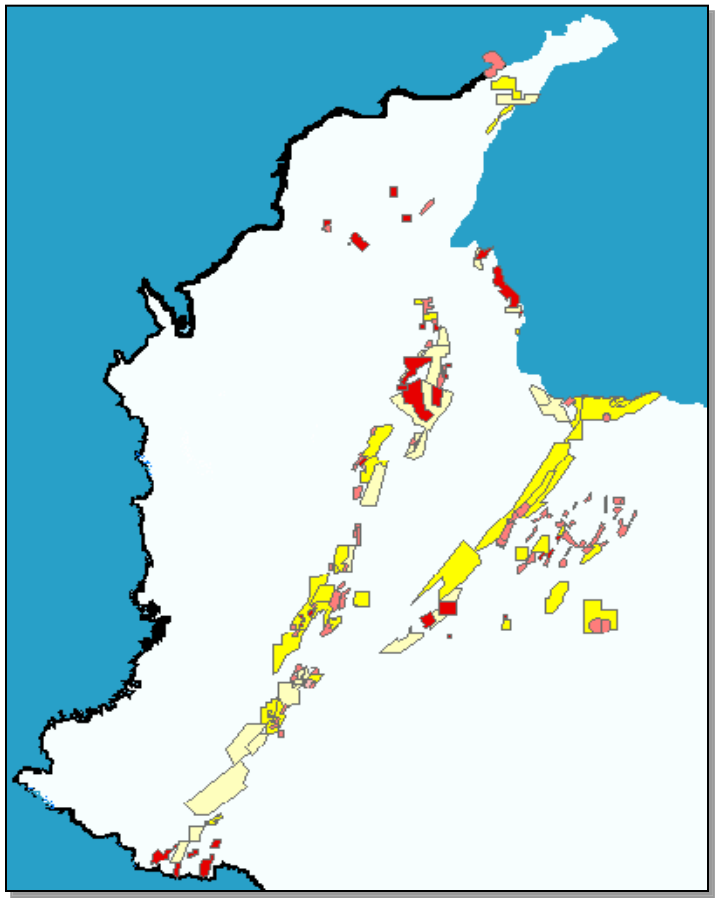


○ <1.5km ● 1.5km ≤ depth < 3.0 km ● > 3.0km

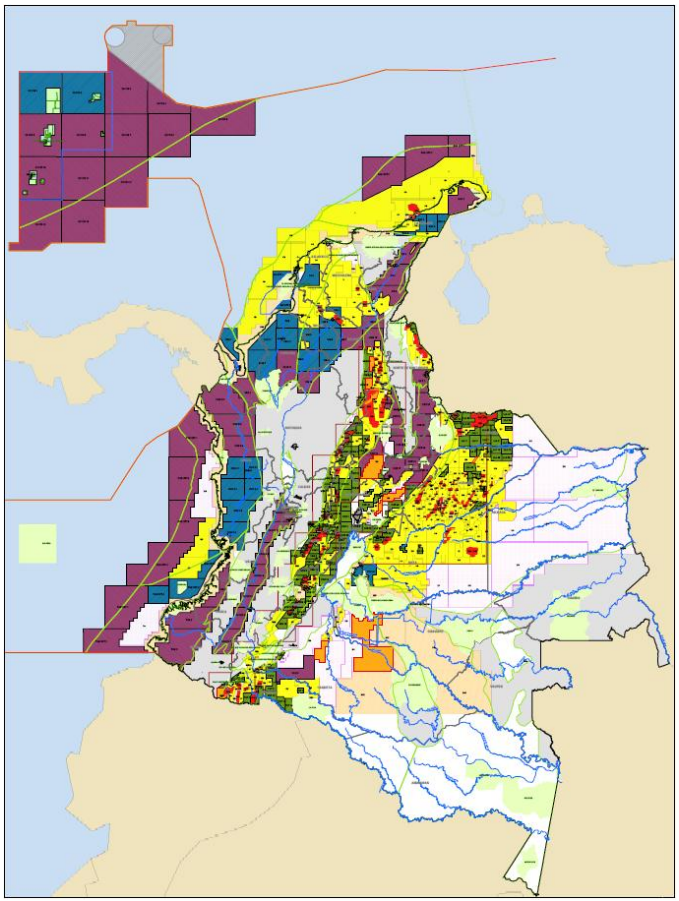
New patterns derived from incorporation of data in the frontier exploration's acres

ANH

2003

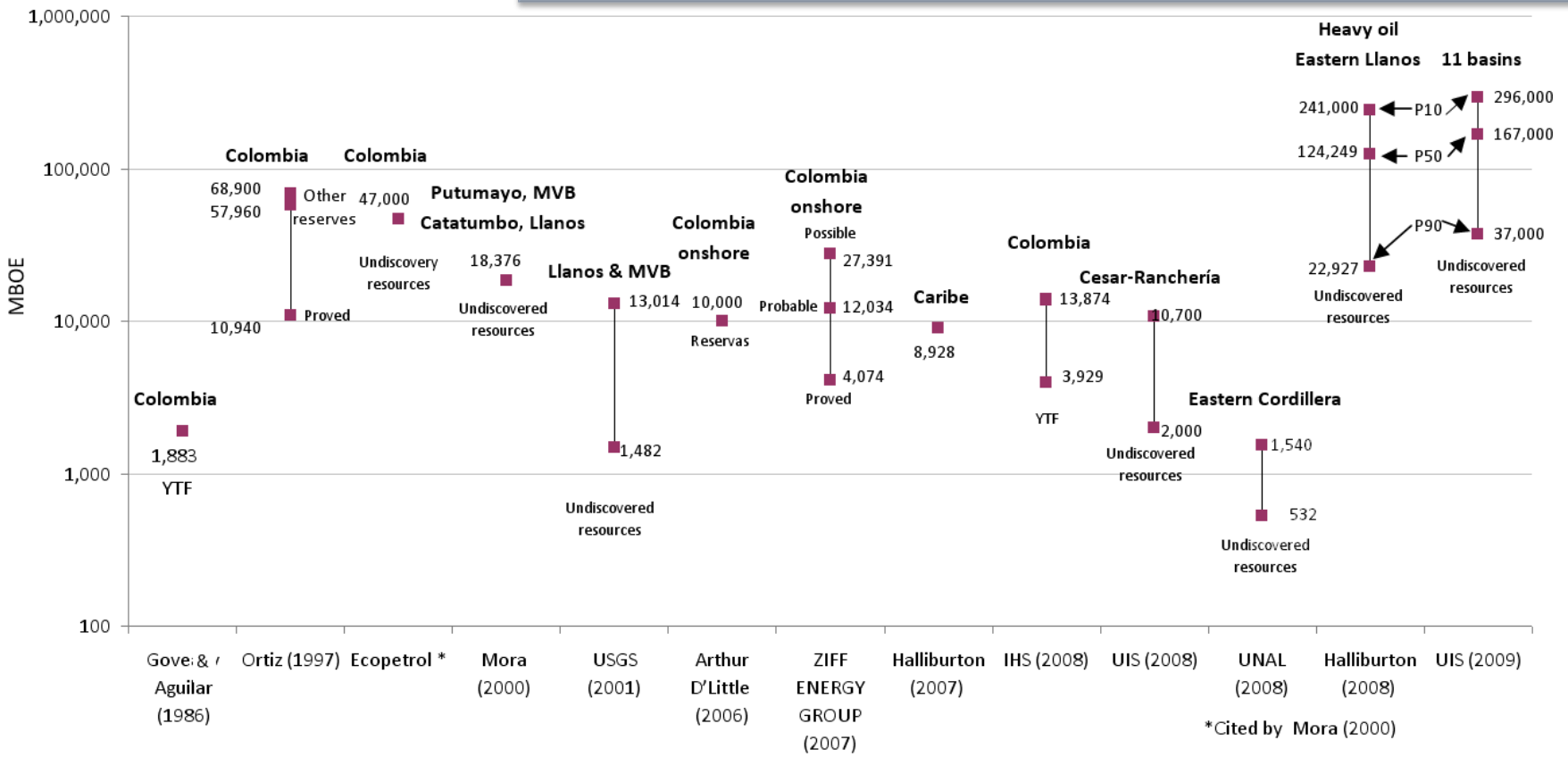


2010



HC resources in Colombia

Different methodologies, different expectations and different results ...



Example: Eastern Llanos

- 8.300km 2D-seismic
- 36 wells
- Aero-geophysical data
- Geological and geochemical data

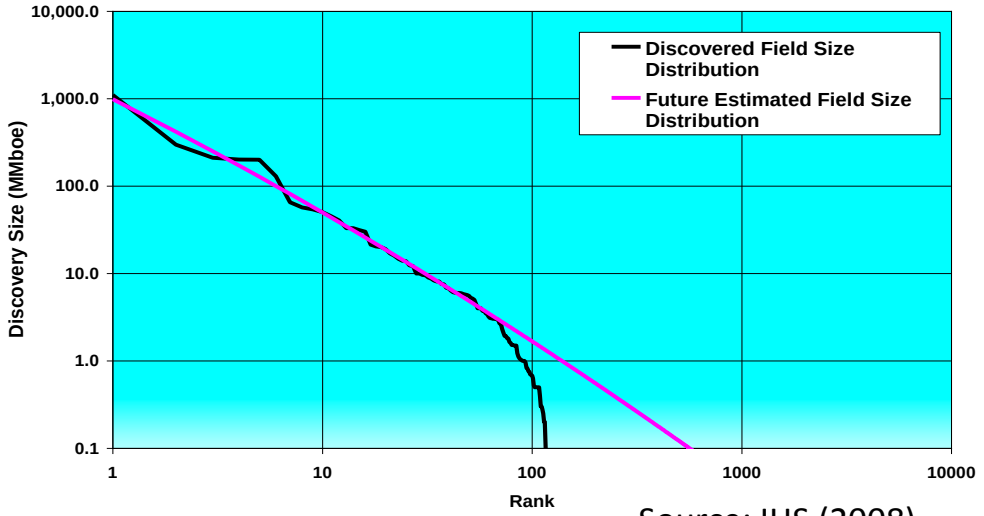
40 areas heavy oil prospects

	STOIIP	GR	PRF
		MBOE	
P10	708,947	54,044	8,760
P50	3,518,916	122,057	22,927
P90	6,830,048	222,203	57,850

Source: Halliburton (2008)

YTFL	YTFB	YTFH
	MBOE	
421	500	2438

Field Size Distribution and Estimated Total Recoverable Eastern Llanos



Source: IHS (2008)

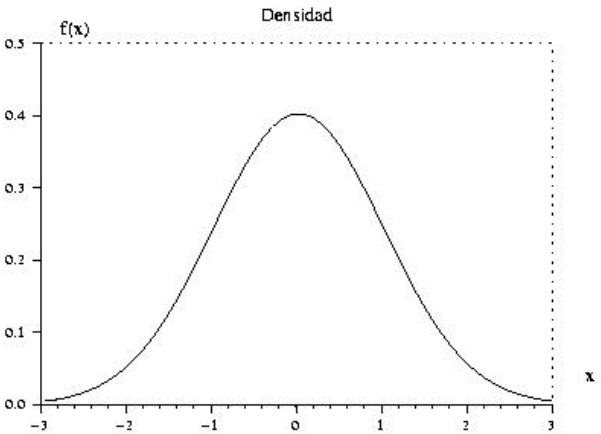
Agenda

- Introduction and geologic setting
- **Methodology**
- Results
- Conclusions

Methodology: Montecarlo

$$OOIP = \frac{7758 * \phi * A * h * (1 - S_w)}{B_{oi}}$$

High variability and uncertainty of variables



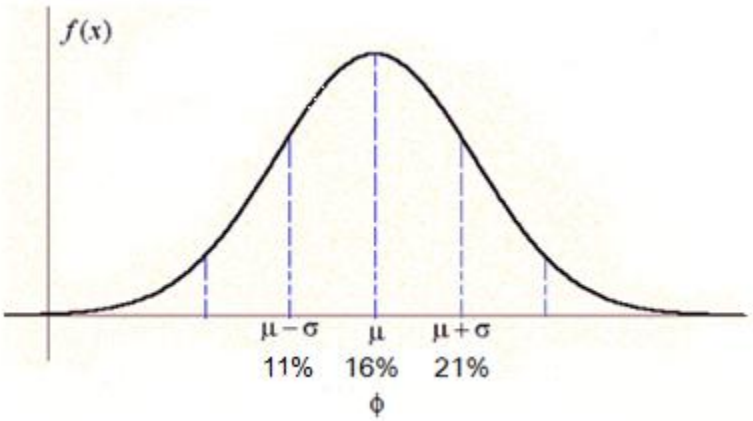
Hauy octahedron

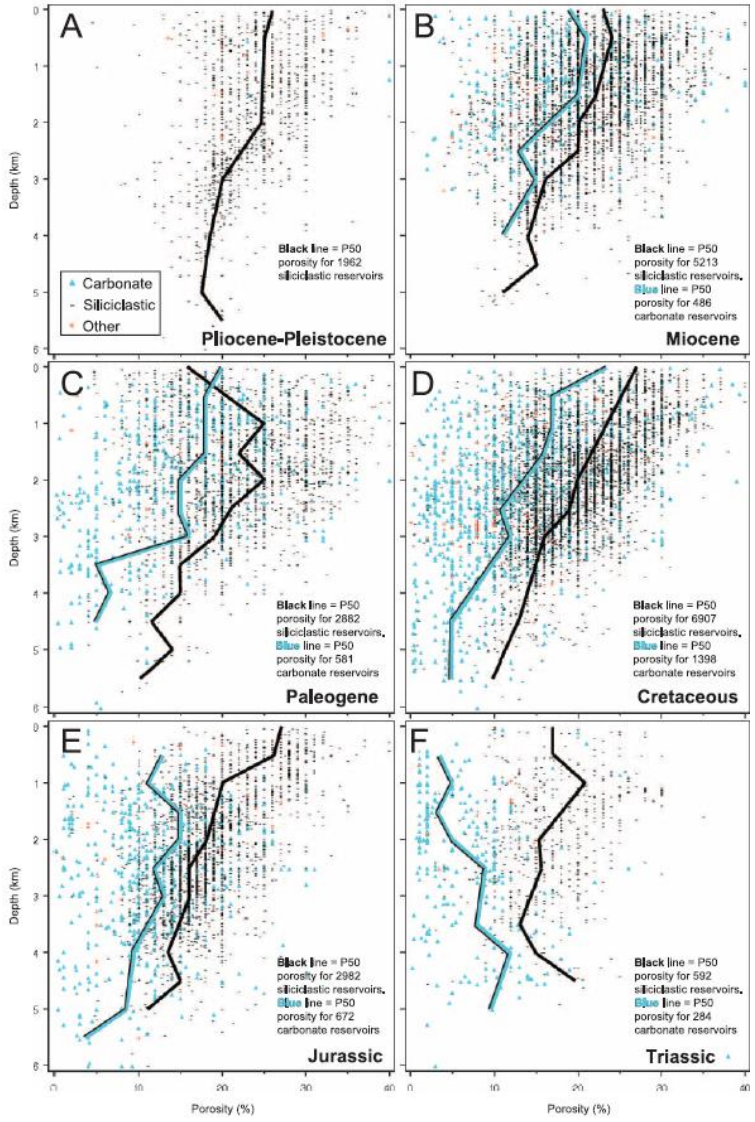
Geologic risk

Recovery factor

Porosity

$$OOIP = \frac{7758 * \phi * A * h * (1 - S_w)}{B_{oi}}$$

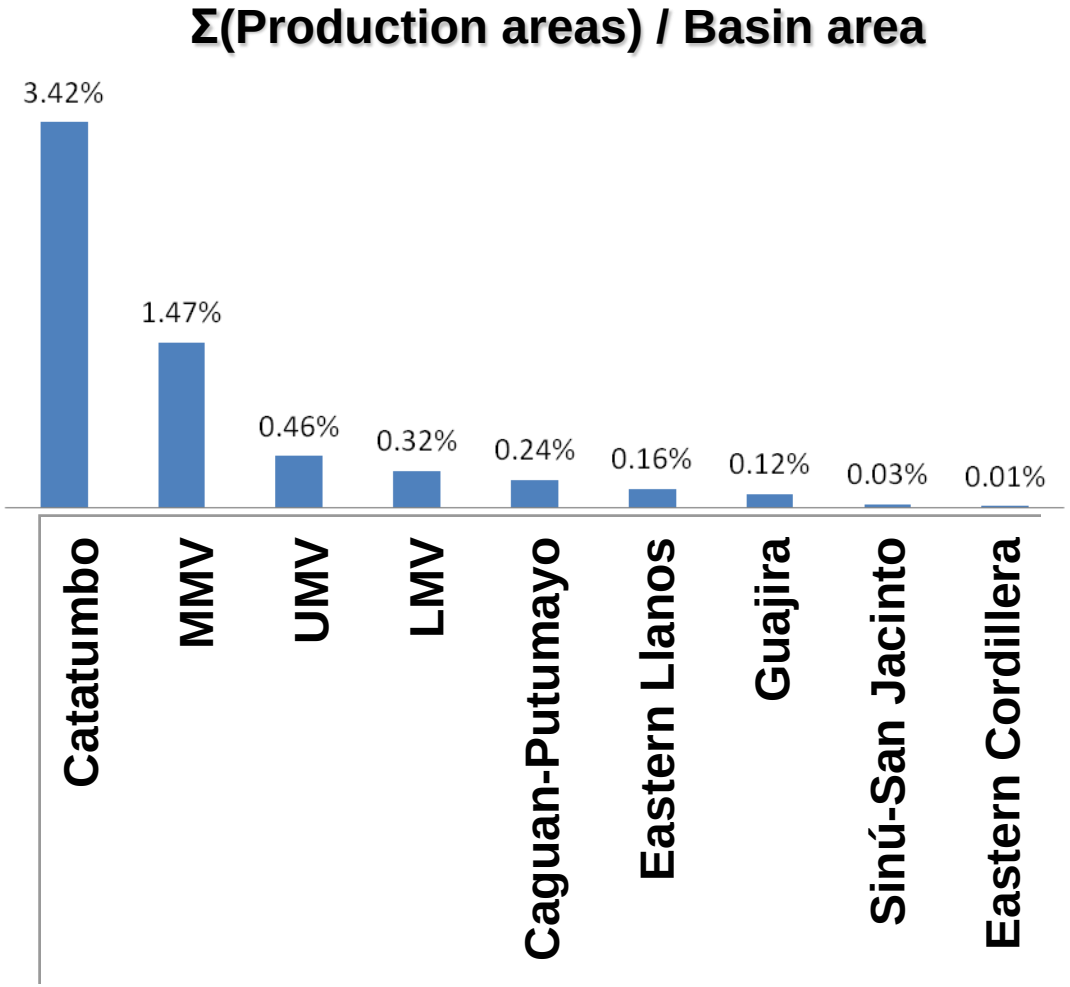




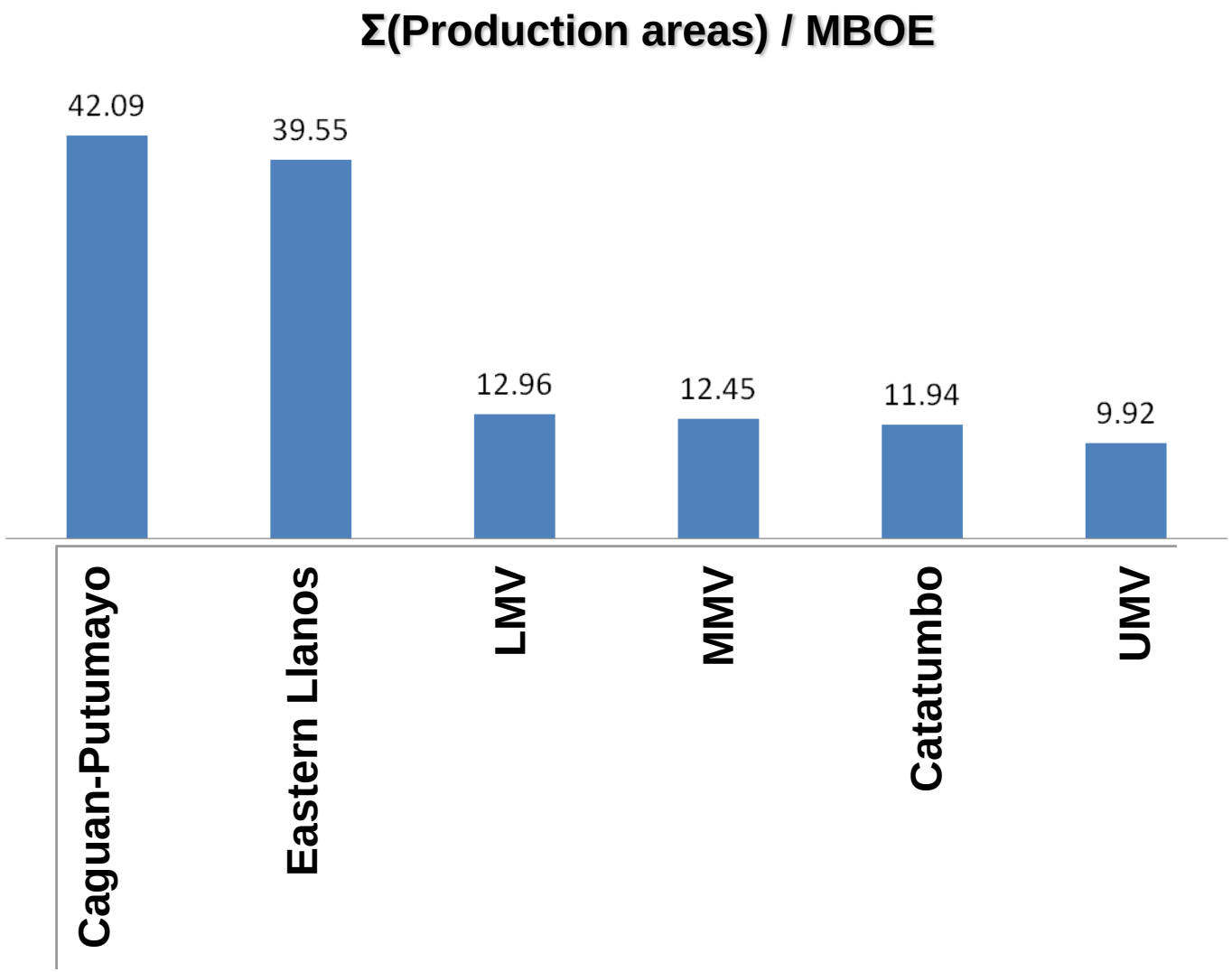
Petroleum reservoir porosity versus depth: Influence of geological age. AAPG Bulletin, v. 93, no. 10 (October 2009), pp. 1281–1296.

Corollary 1

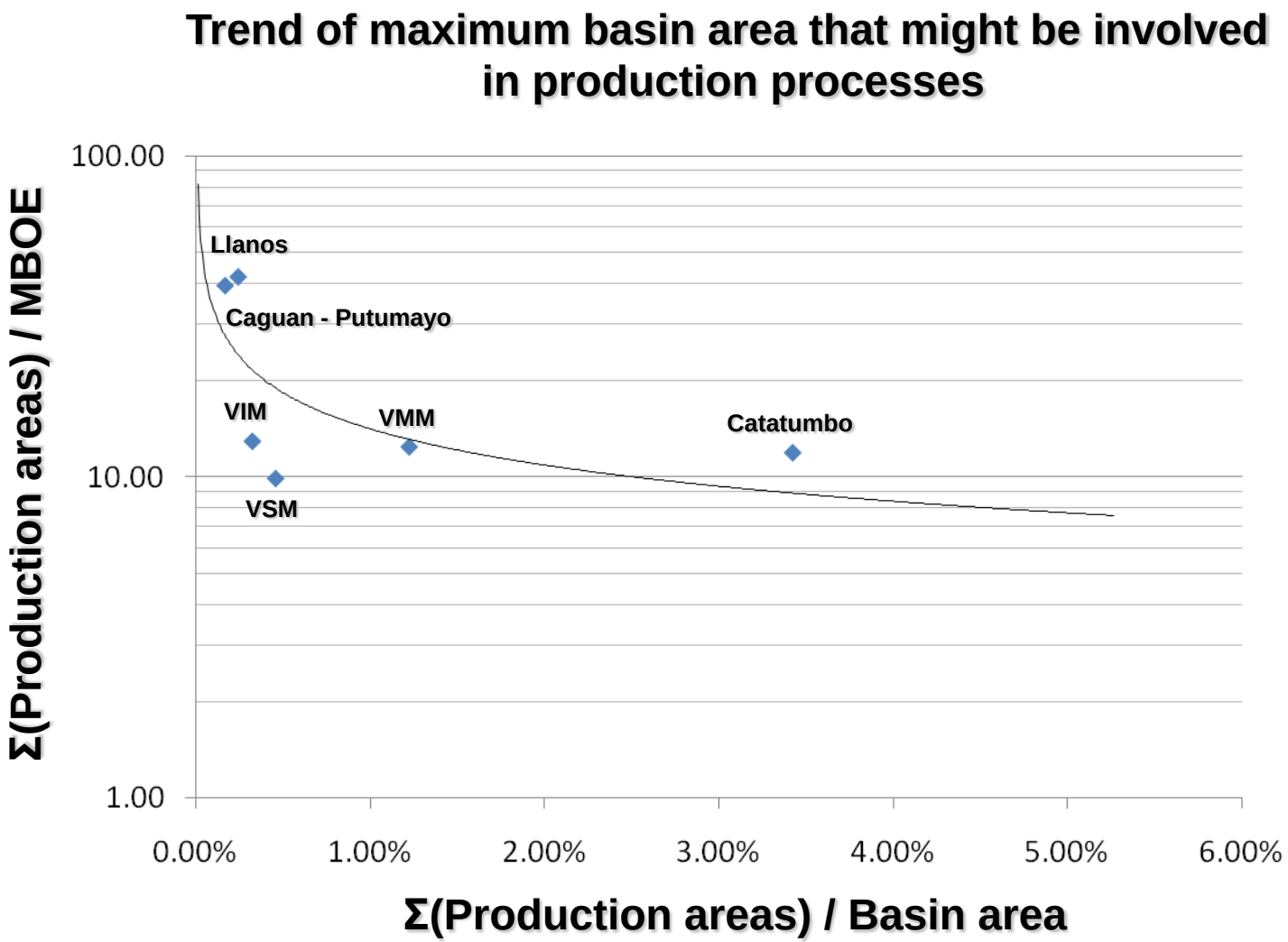
$$OOIP = \frac{7758 * \phi * A * h * (1 - S_w)}{B_{oi}}$$



Corollary 2

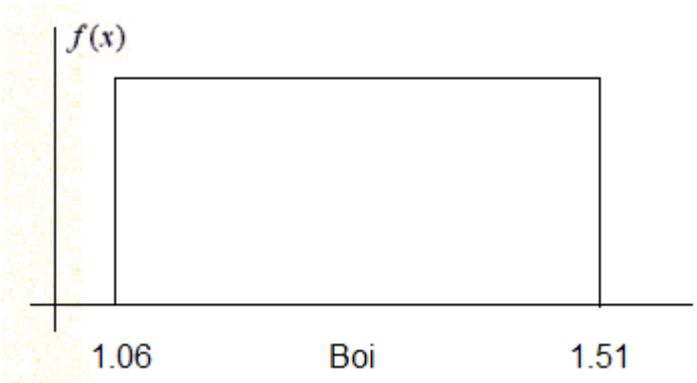

Σ(Production areas) / MBOE
42.09
39.55
12.96
12.45
11.94
9.92
Caguan-Putumayo
Eastern Llanos
LMV
MMV
Catatumbo
UMV

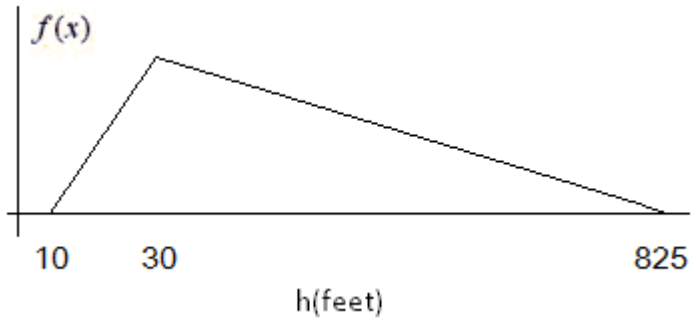
Hypothesis

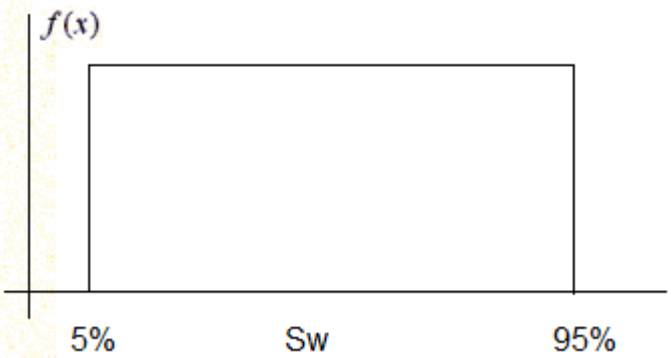

Trend of maximum basin area that might be involved in production processes
Σ(Production areas) / MBOE
100.00
10.00
1.00
Llanos
Caguan - Putumayo
VIM
VMM
Catatumbo
VSM
0.00%
1.00%
2.00%
3.00%
4.00%
5.00%
6.00%
Σ(Production areas) / Basin area

PDF of h, S_w and B_{oi}

$$OOIP = \frac{7758 * \phi * A * h * (1 - S_w)}{B_{oi}}$$





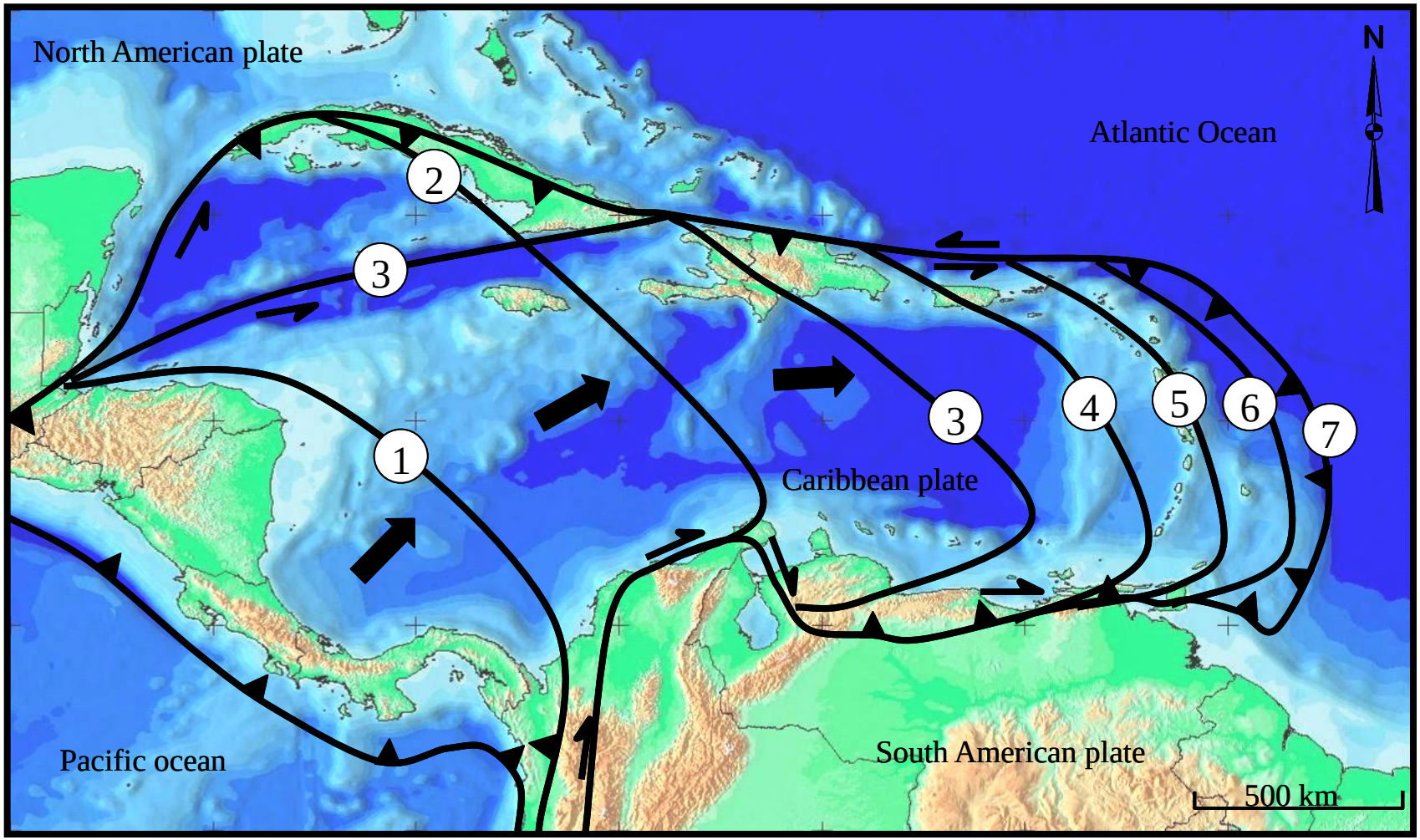


Questions that arise from the assumed hypothesis

1. How to support with geologic evidence, the observation that production acres are limited to up to 6% of the total area in the Colombian basins?

2. Has there been enough HC generated for supporting the YTF expectations?

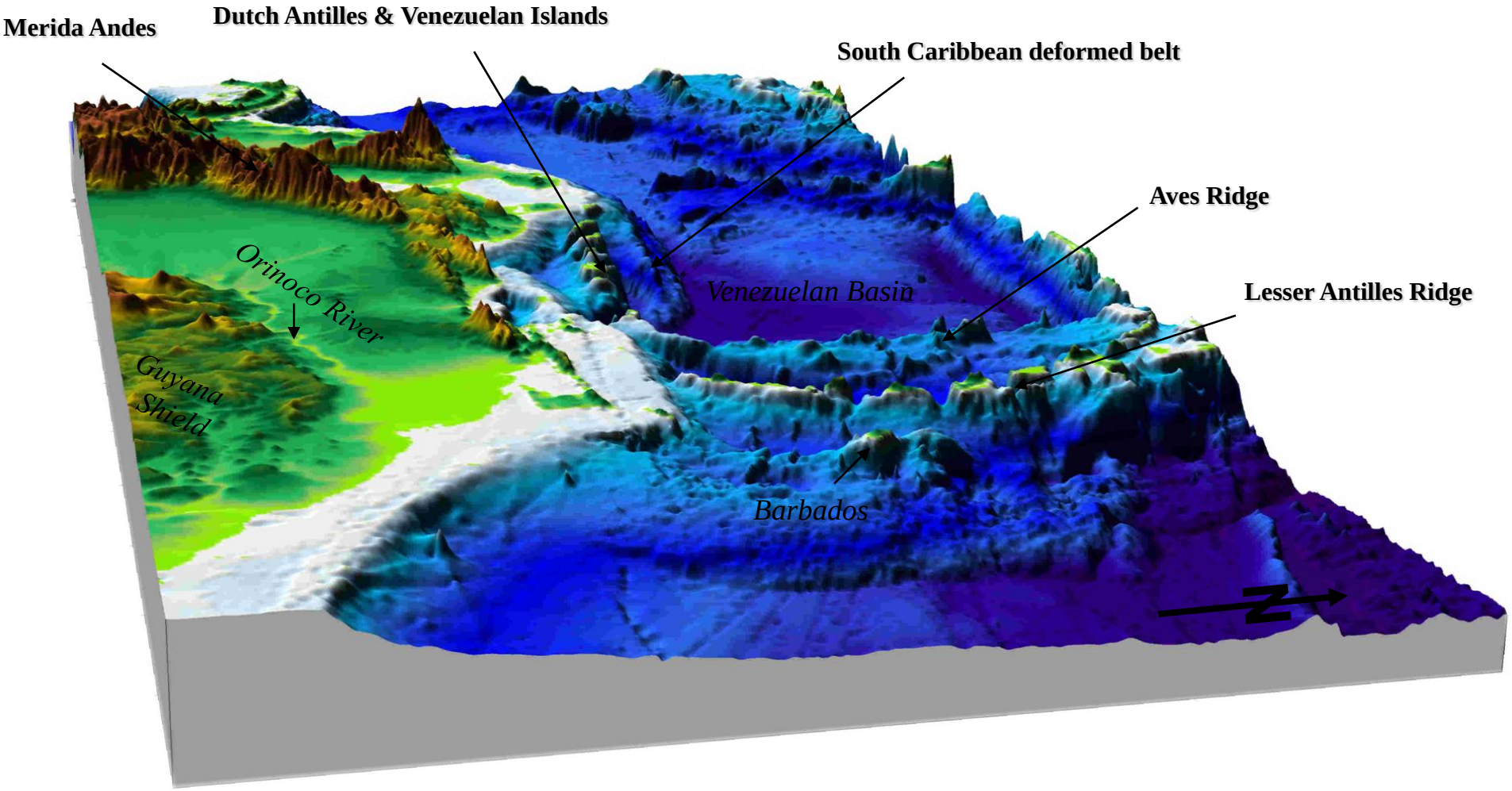
Tectonic history of Caribbean



After Lugo & Mann (2003)

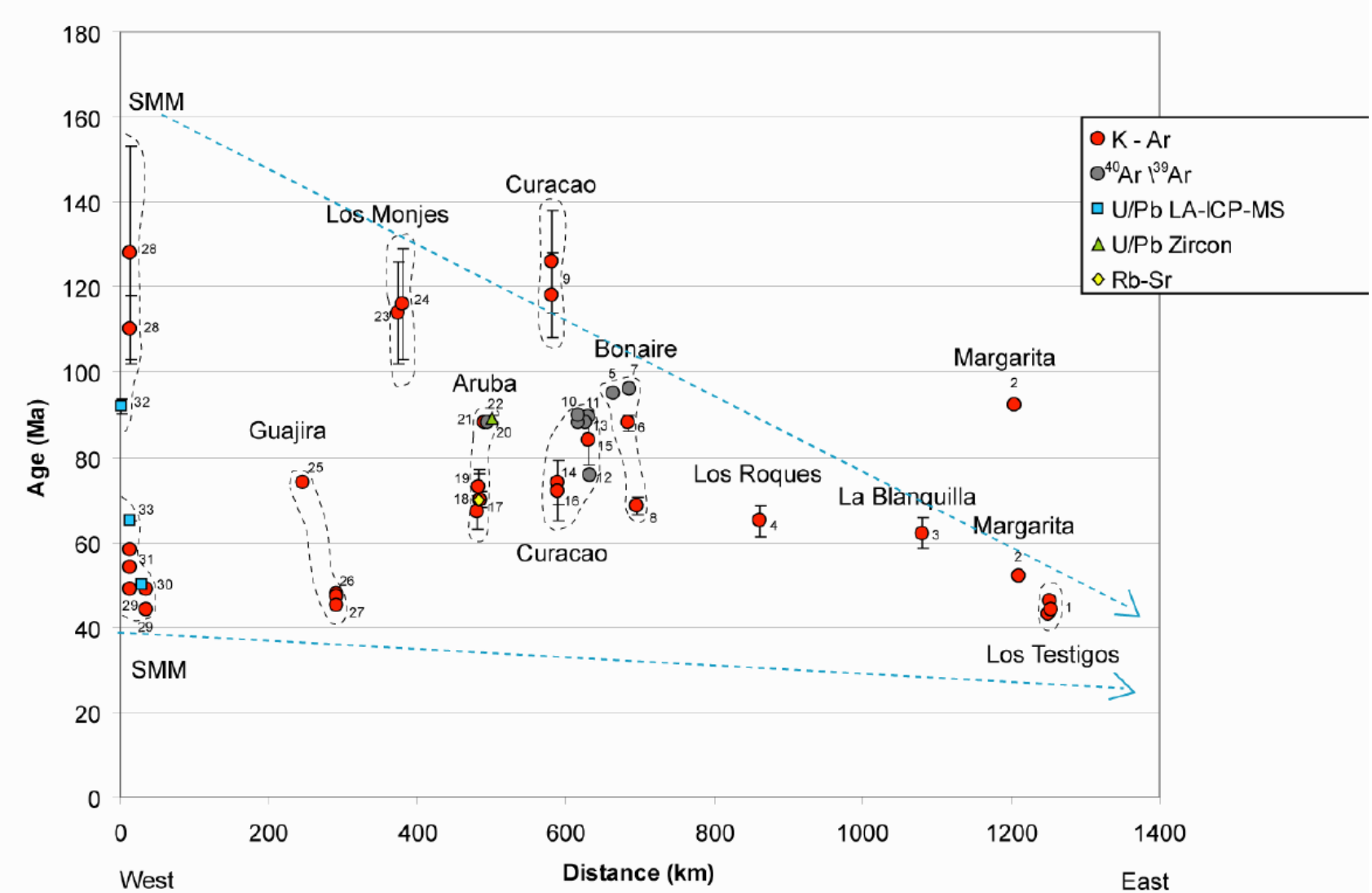
1 Late Cretaceous
2 Middle Paleocene
3 Middle Eocene
4 Middle Oligocene
5 Middle Miocene
6 Early Pliocene
7 Recent

Main morphologic features

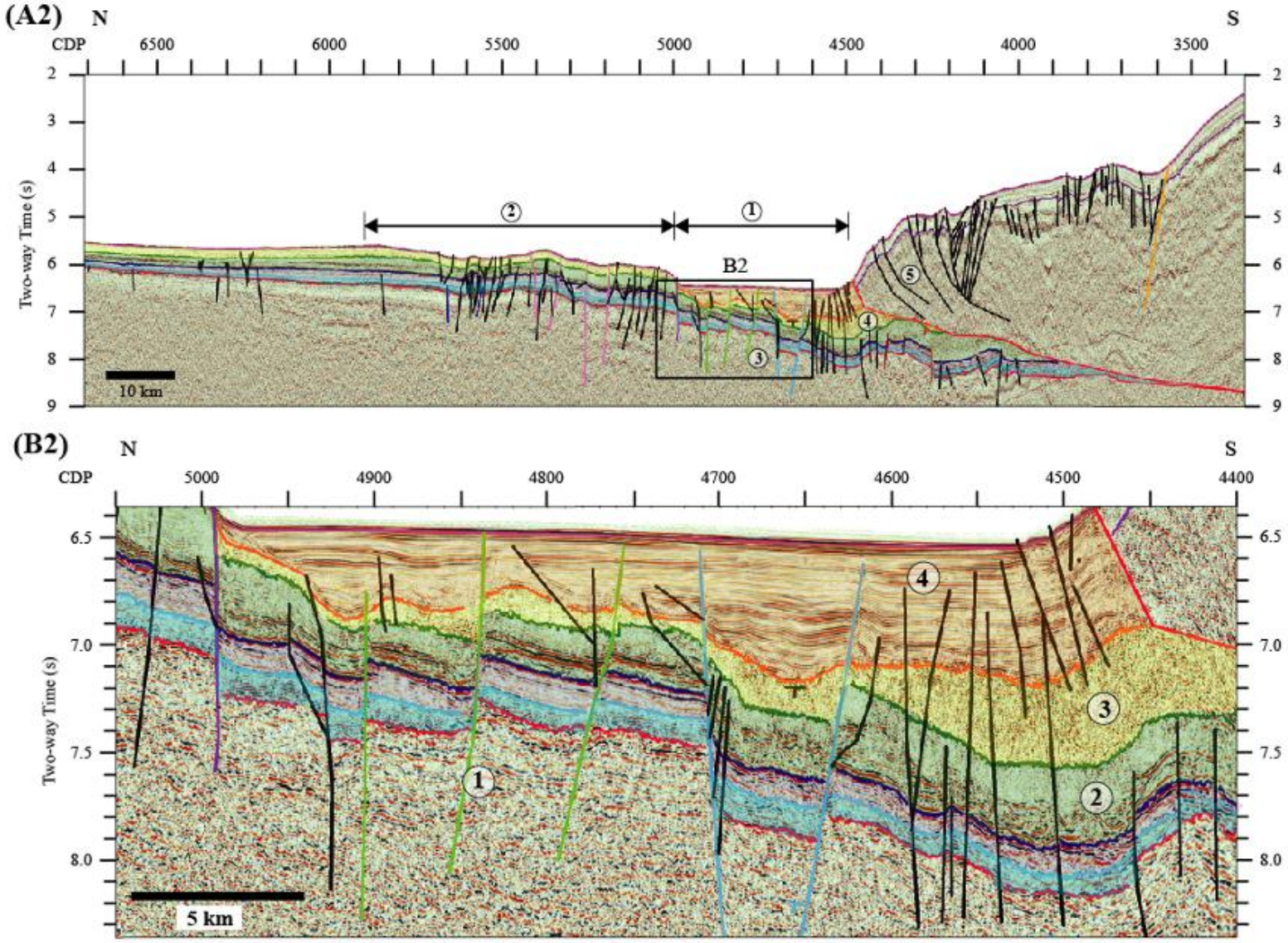


Atlas CBTH (2009)

Younger rocks toward the east

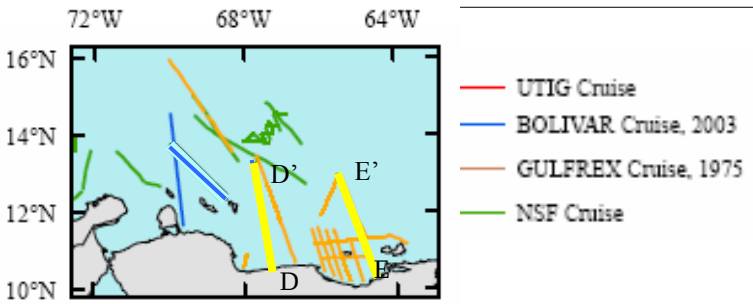


South Caribbean Deformed Belt

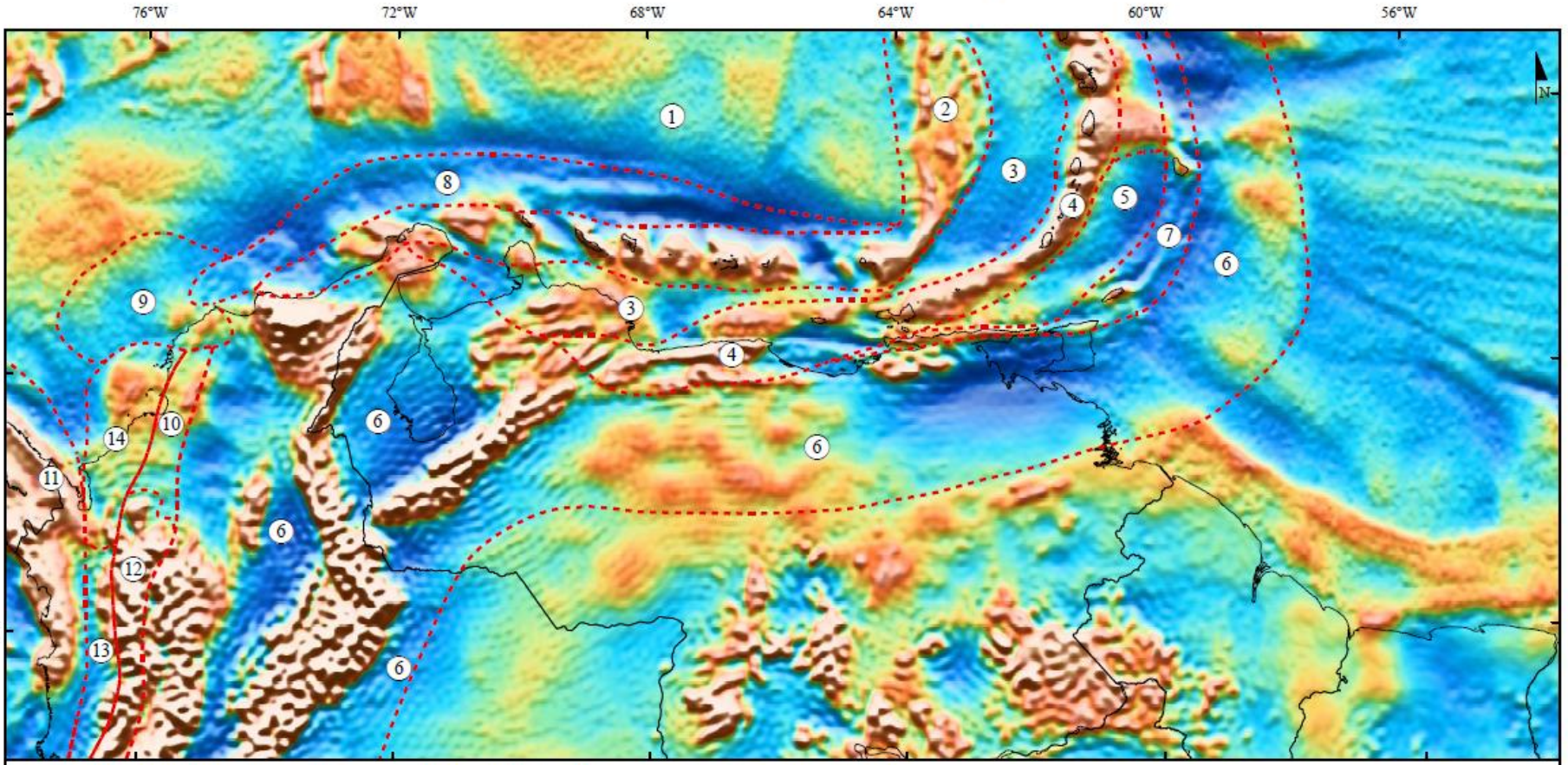


Kroehler (2007)

Evidence of the GAC



Free air anomalies



Free-air GEOSAT gravity for offshore areas and corrected free-air GEOSAT gravity for onshore areas and tectonic terranes.

1. Venezuelan basin
2. Leeward Antilles-Aves ridge island arc
3. Grenada-Bonaire-Falcon basins
4. Lesser Antilles arc-Cordillera de la Costa
5. Tobago-Carupano basins
6. Barbados accretionary prism, Eastern Venezuela, Barinas, Maracaibo, Magdalena Valley and Llanos basins
7. Barbados-Tobago ridge, Northern Range of Trinidad and Paria Peninsula
8. South Caribbean deformed belt
9. Magdalena fan
10. San Jacinto belt
11. Panama arc terrane
12. Western Cordillera
13. Atrato basin
14. Sinu belt

Tectonic terrane boundary

Free-air gravity (mgal)

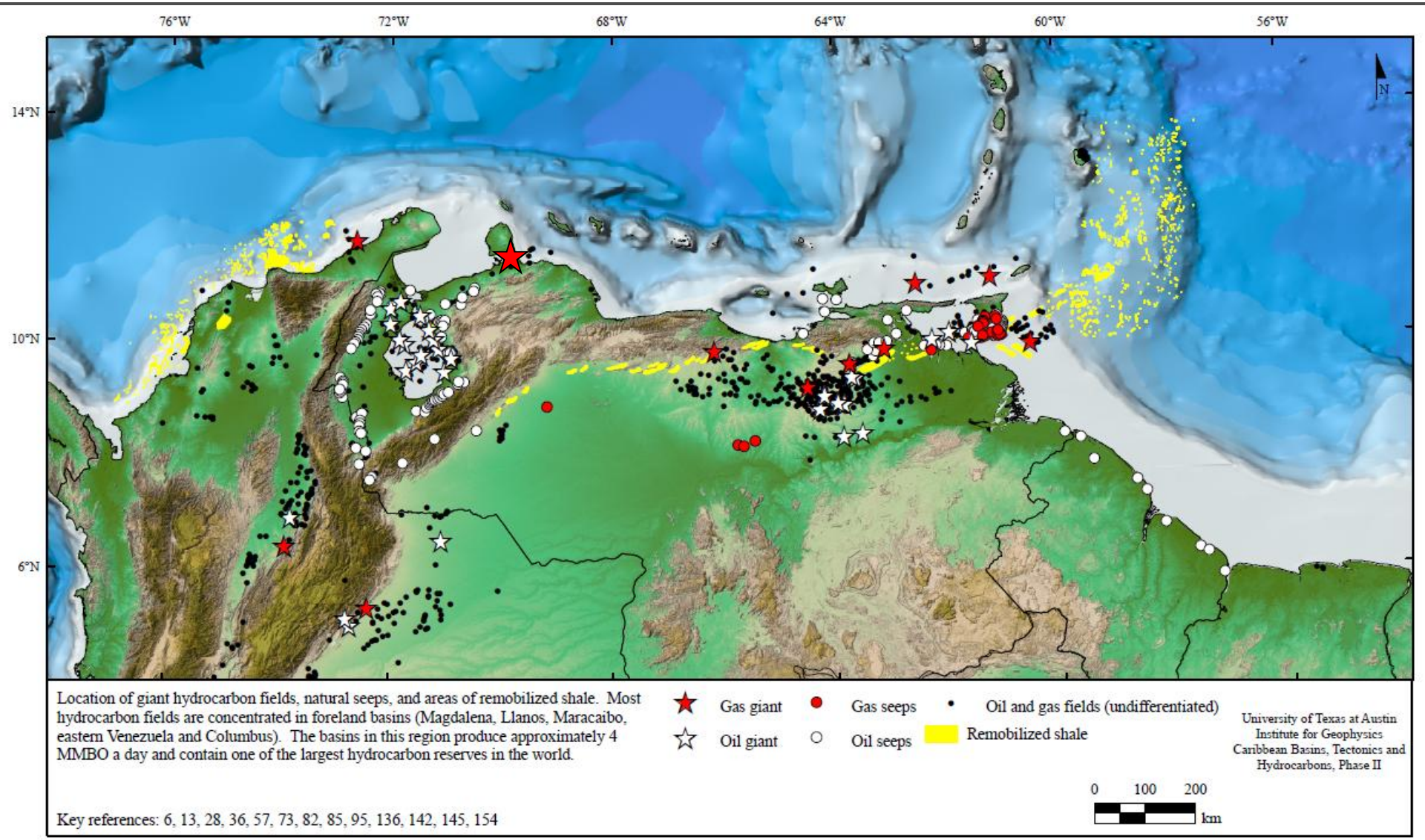
-500 200

0 100 200 km

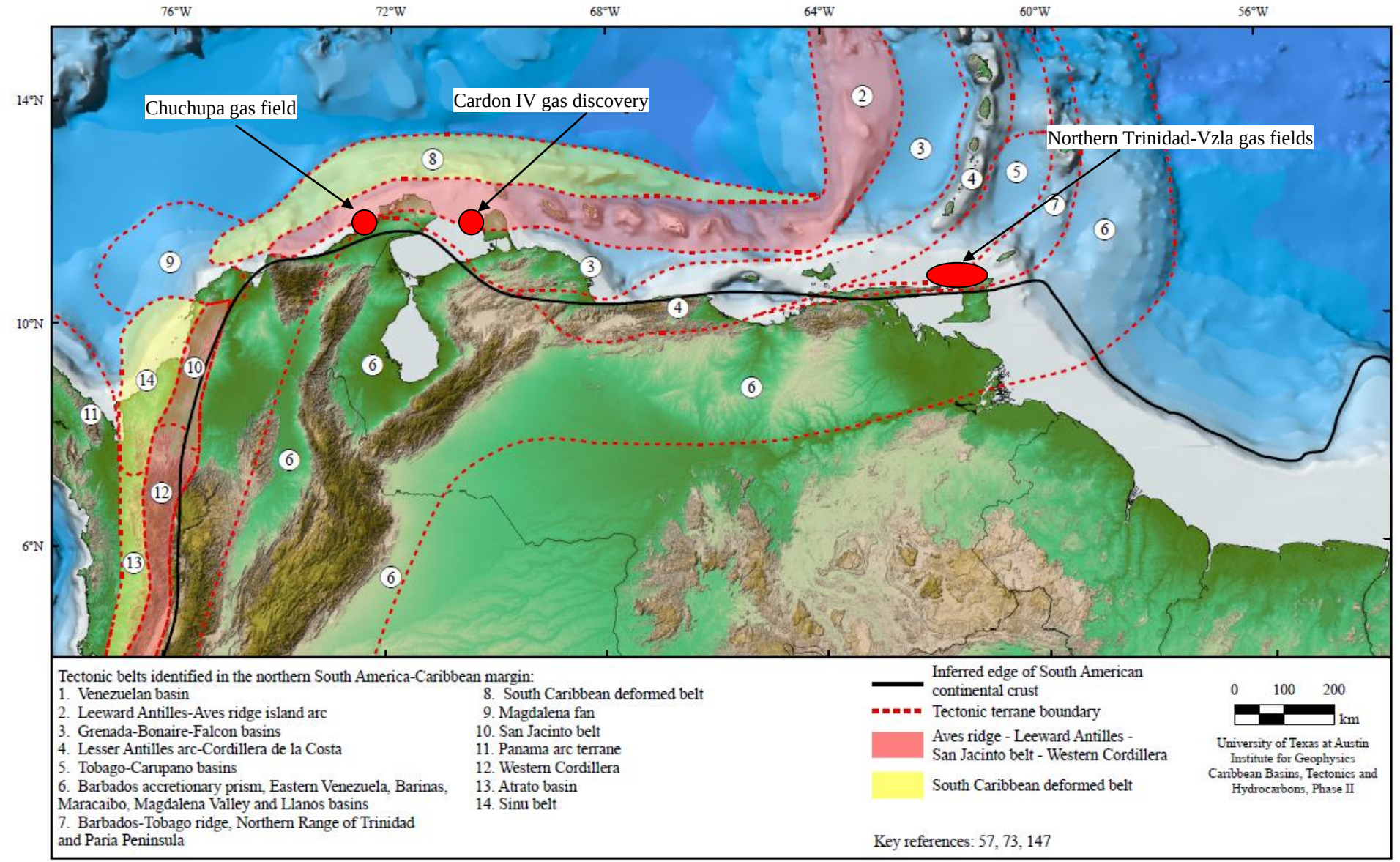
University of Texas at Austin
Institute for Geophysics
Caribbean Basins, Tectonics and Hydrocarbons, Phase II

Key reference: 126

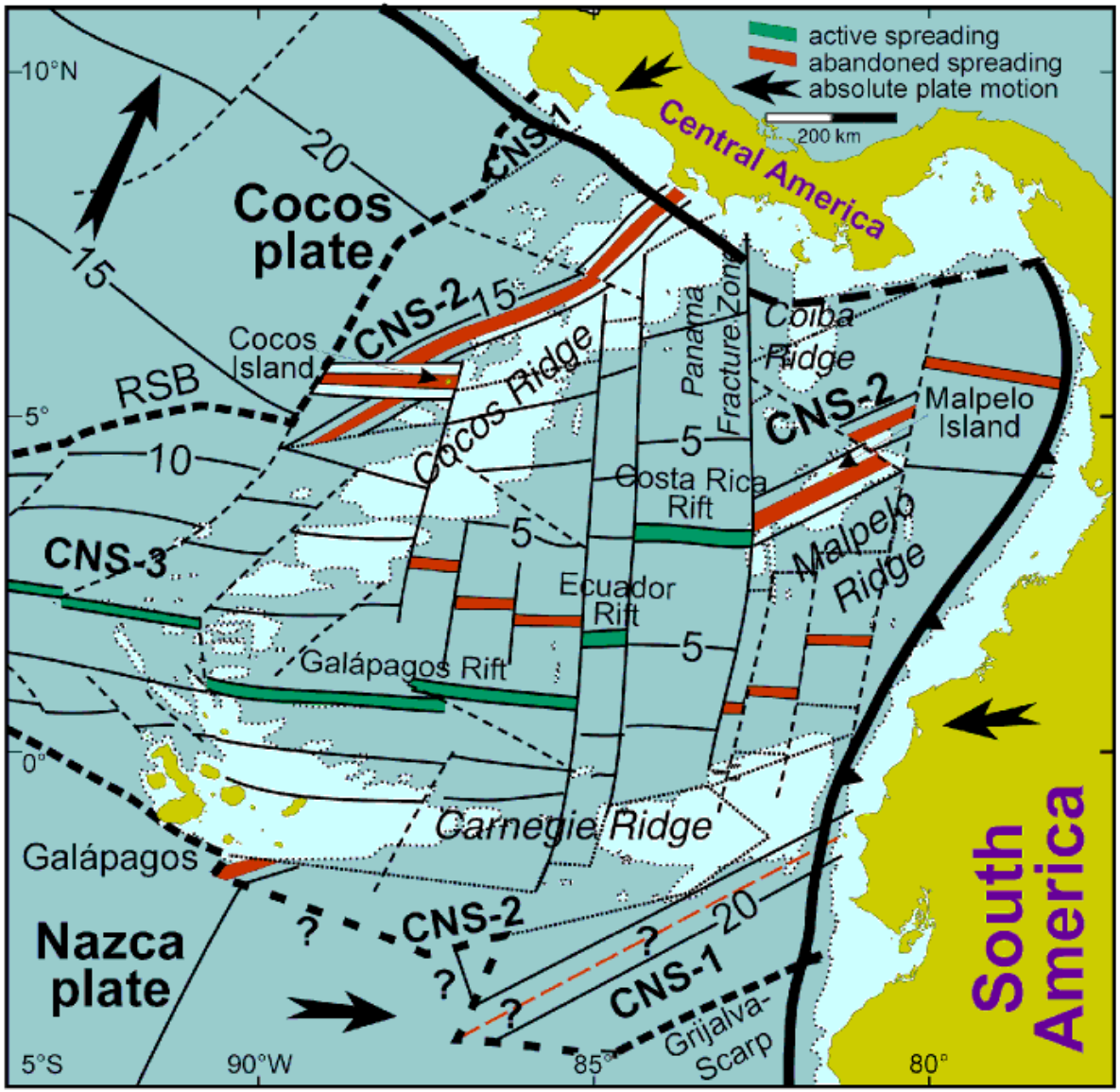
Oil & Gas fields and seeps



Tectonic terranes and the inferred SA plate border

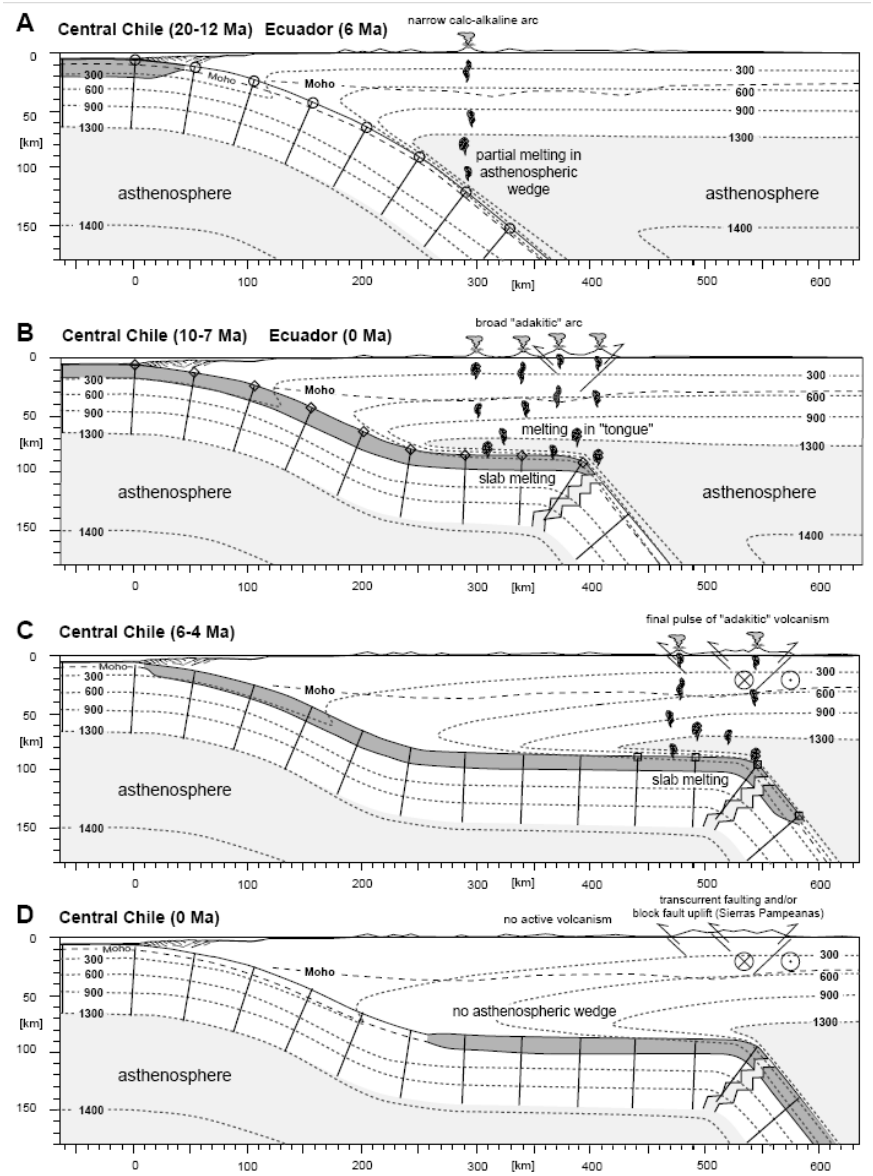


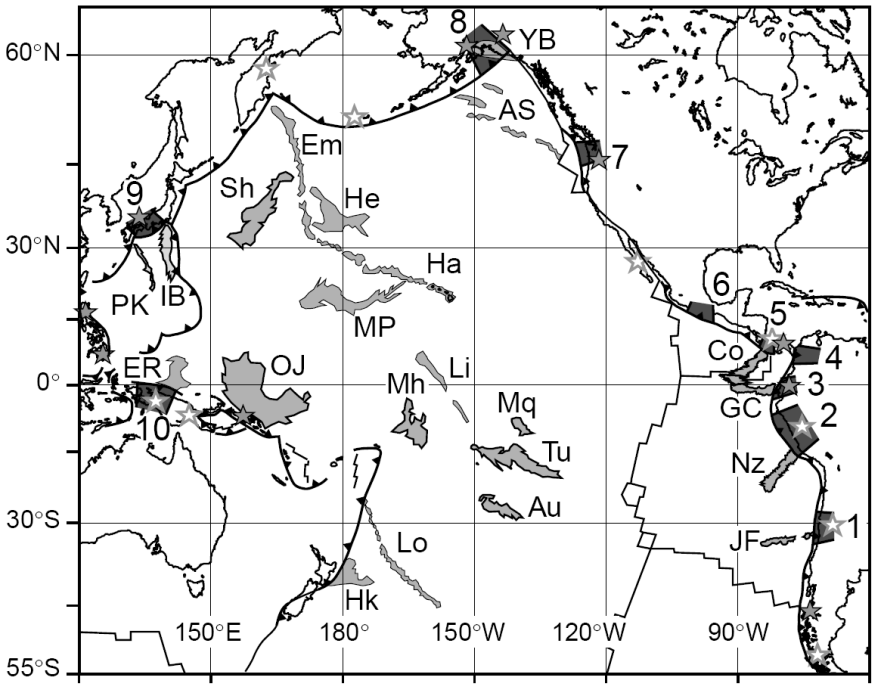
Ages and present configuration of ridges and rifts



Meschede et al. (1998)

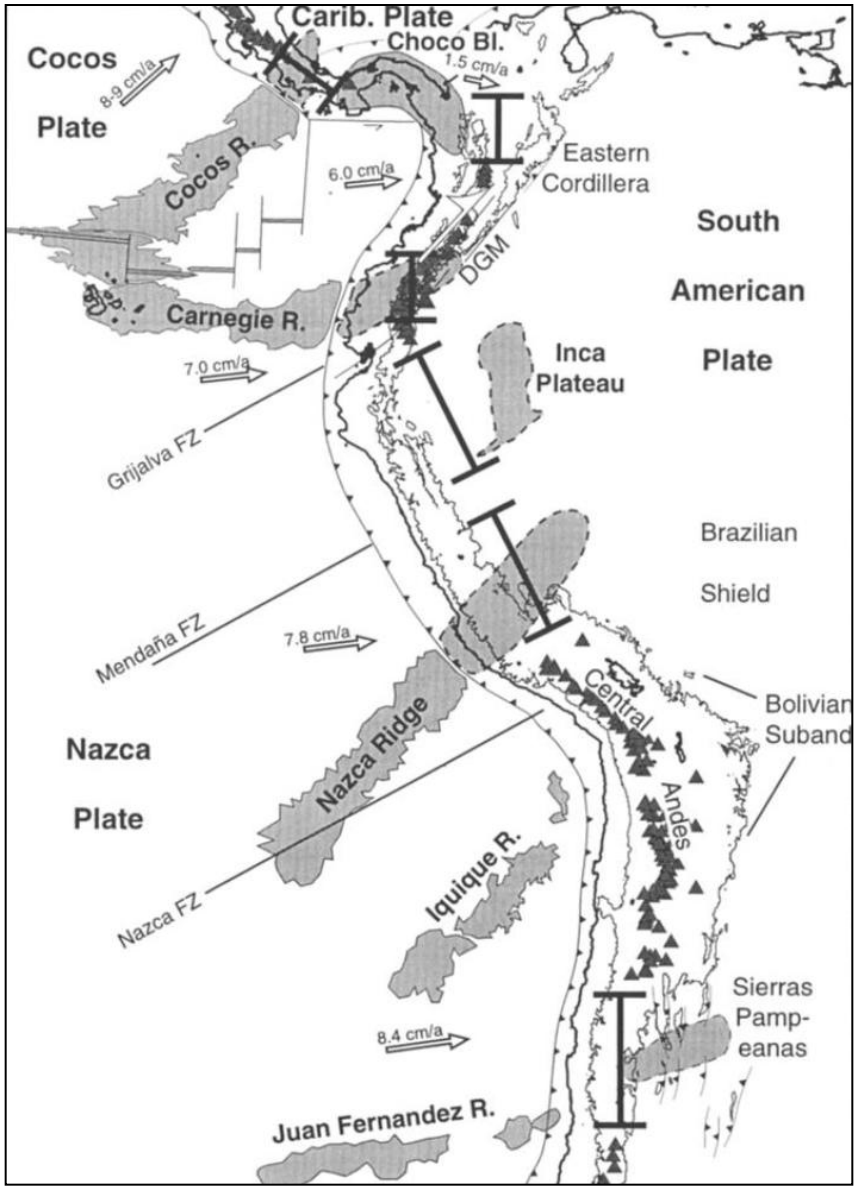
Flat subduction





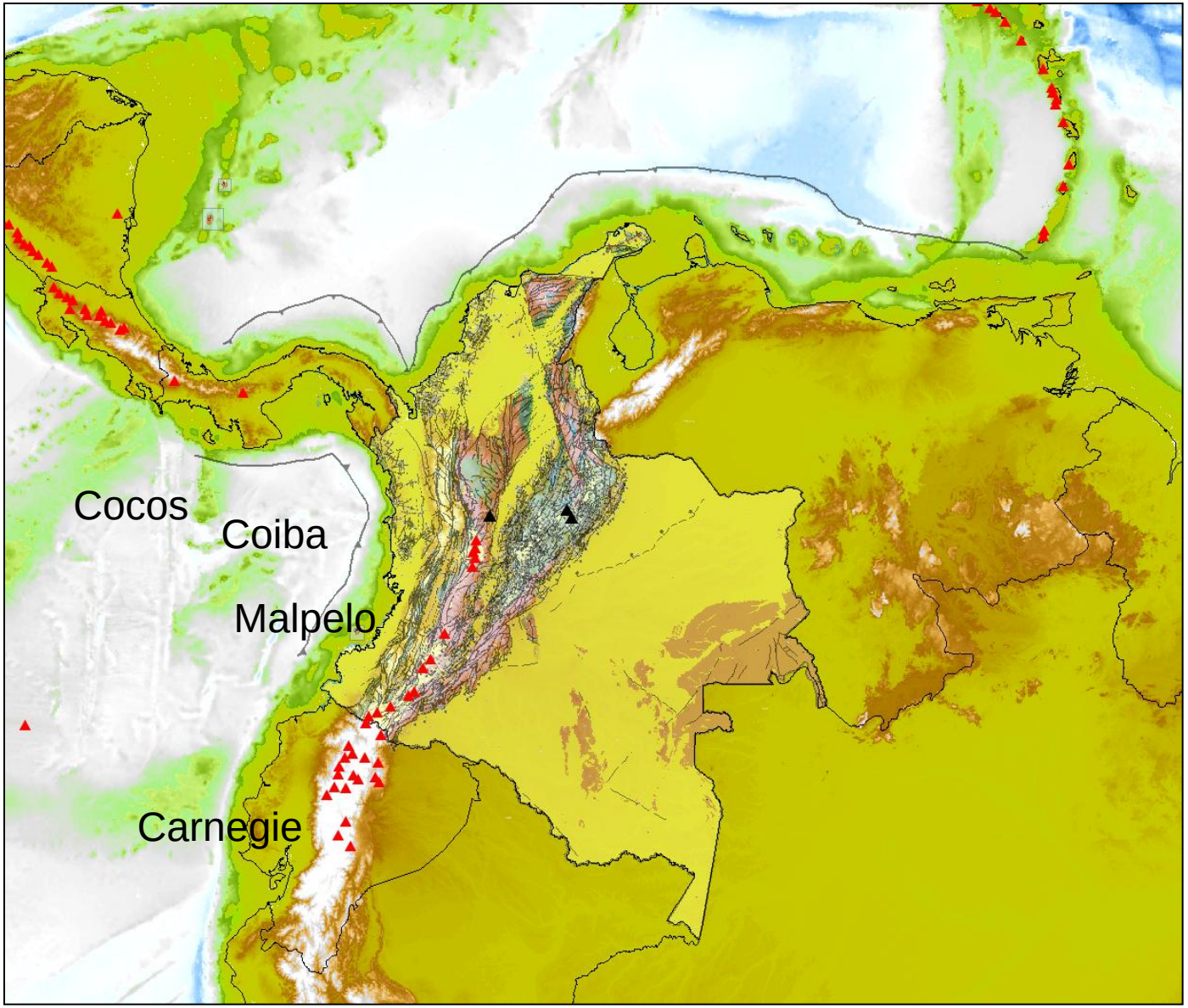
Gutscher et al. (2000)

Sunken ridges: Flat subduction

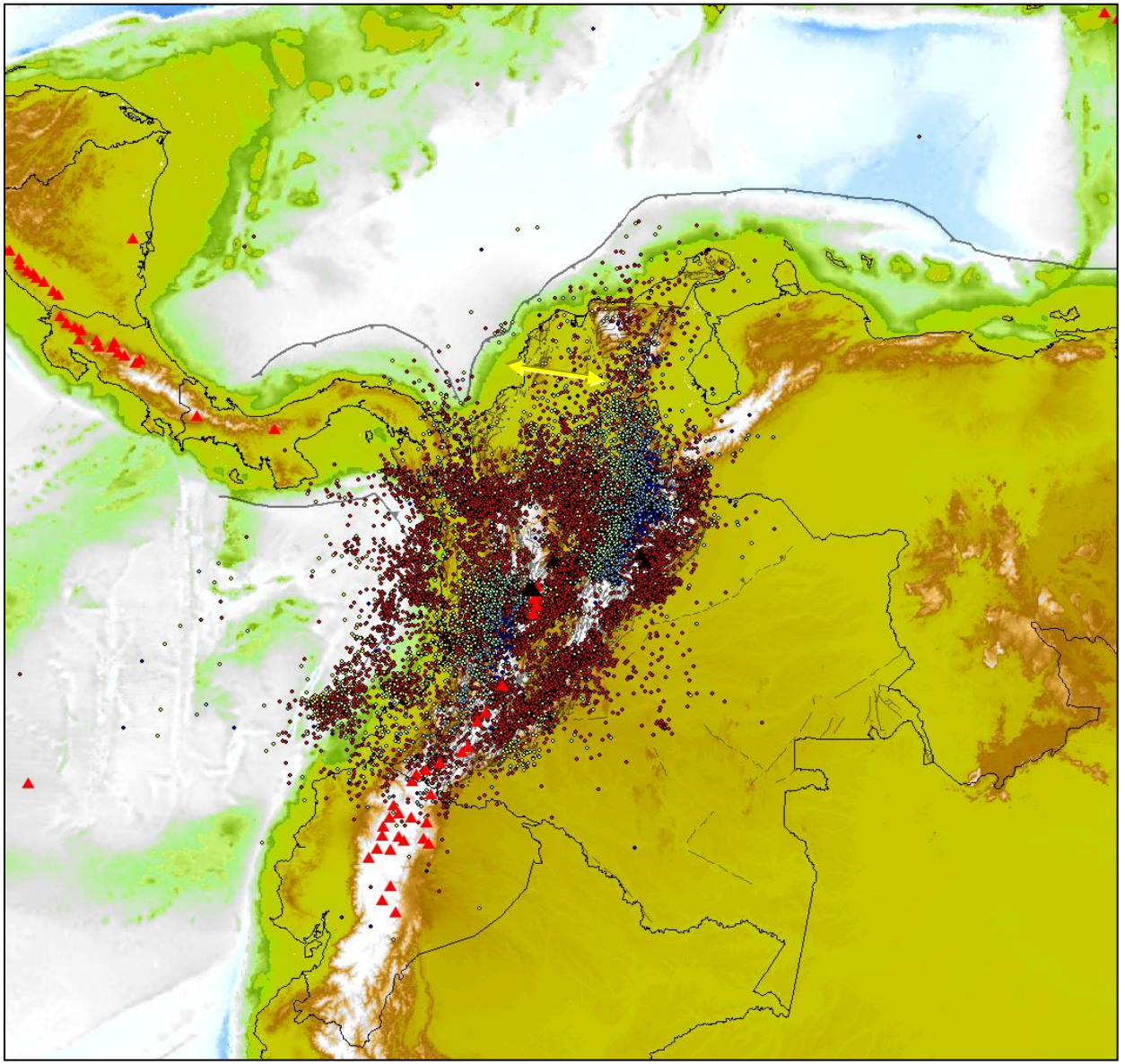


Gutscher et al. (2000)

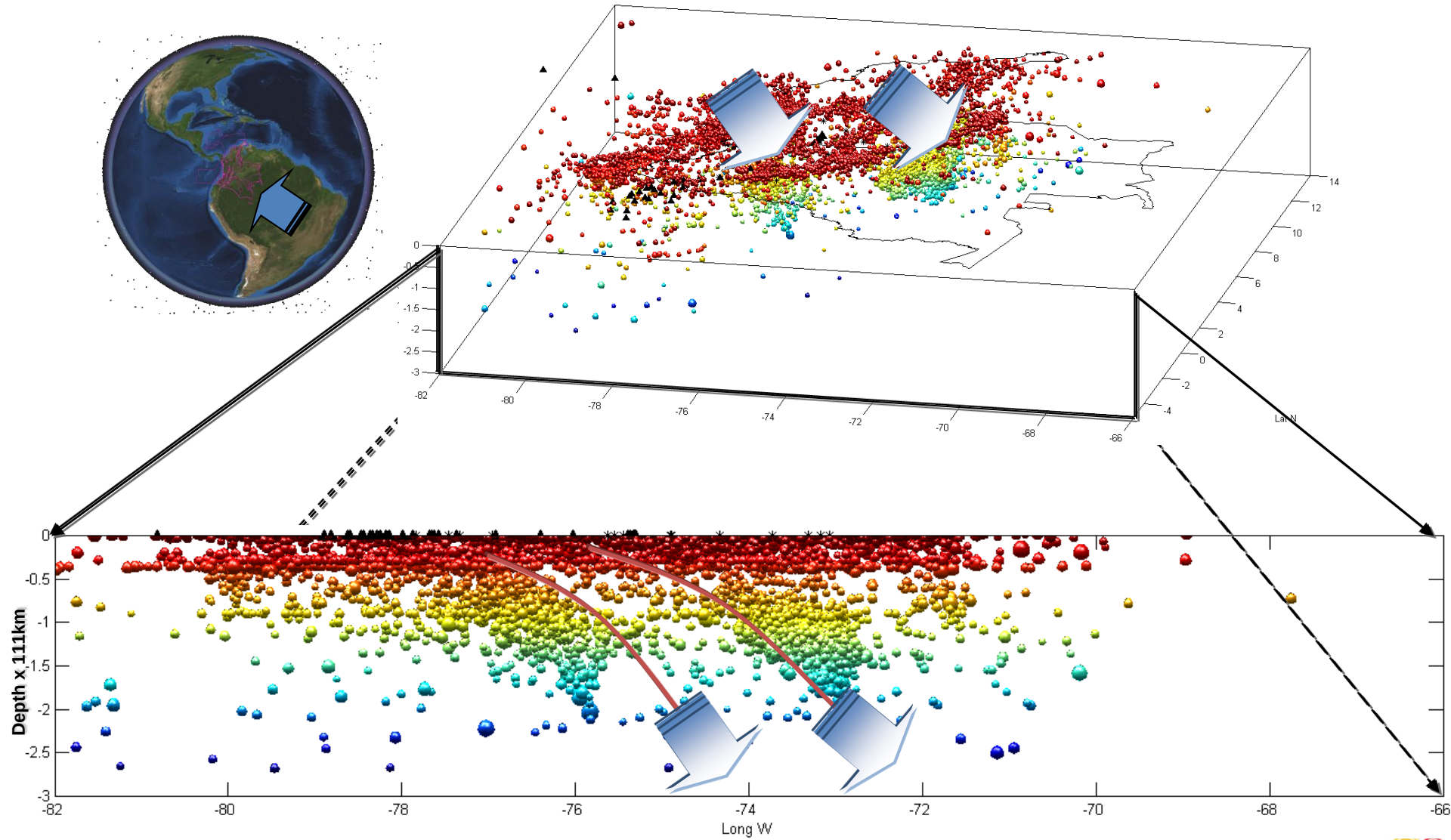
Ridges and volcanic chains



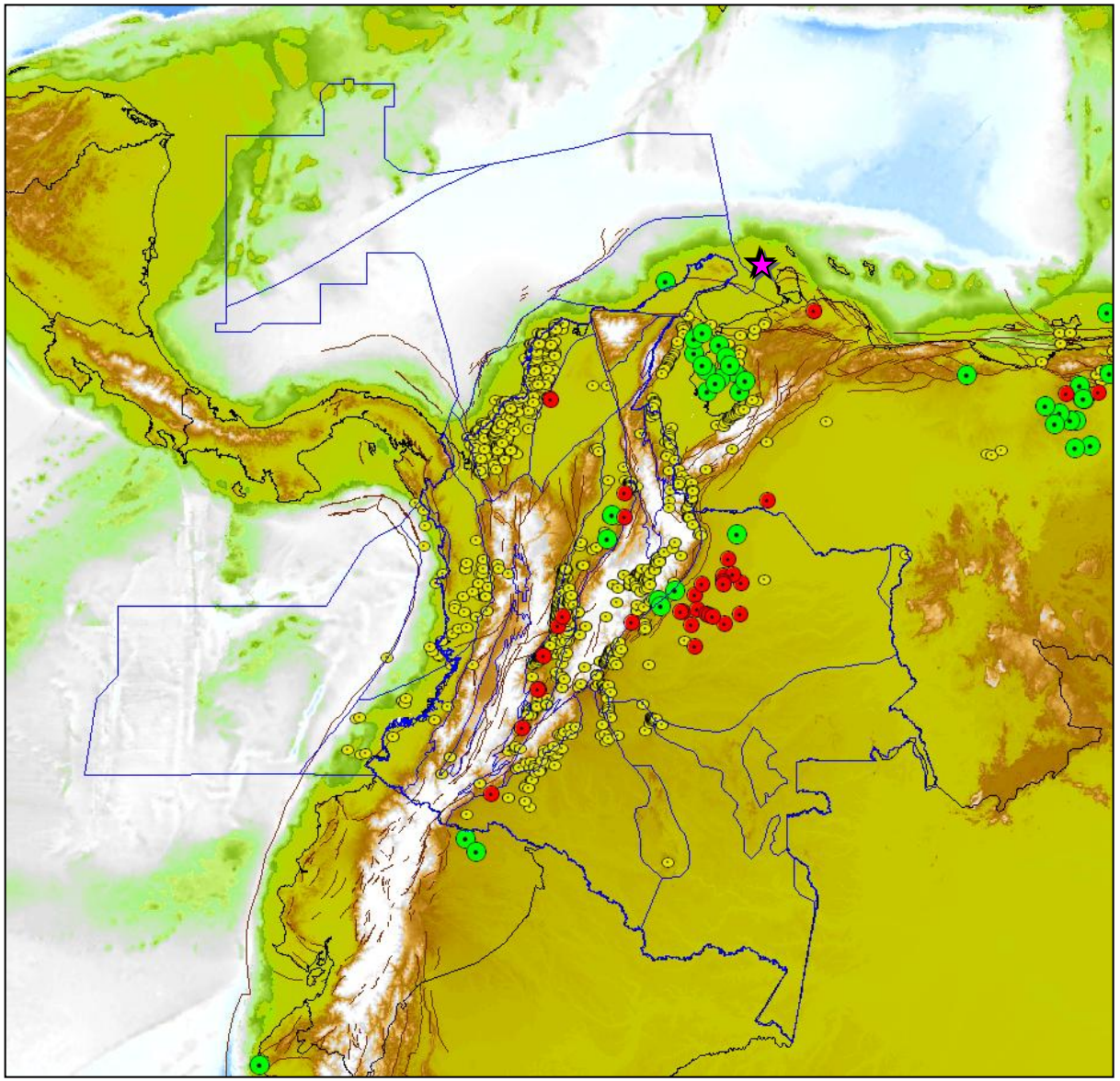
Seismicity



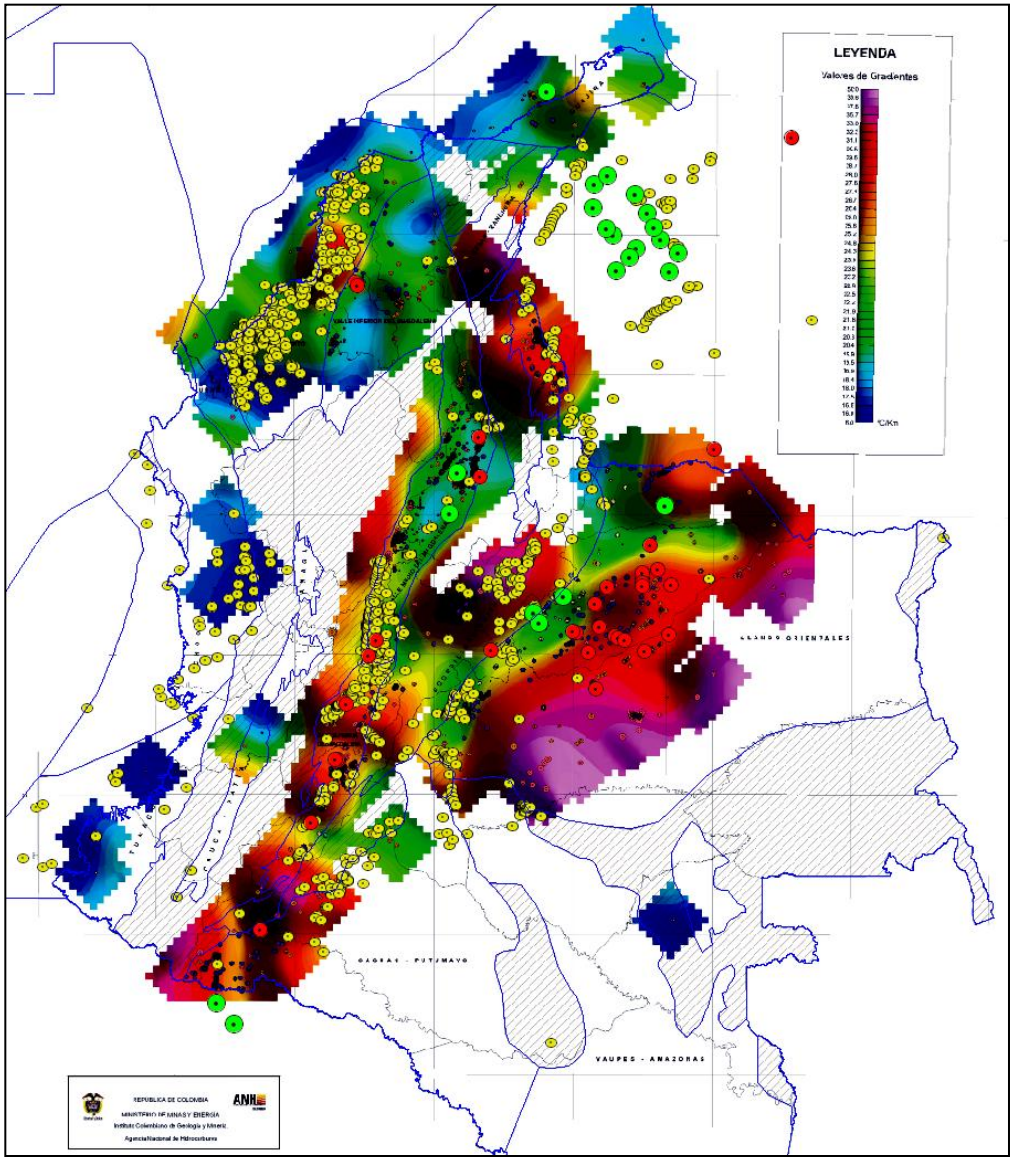
The Nazca plate is subducting with evidence of tearing



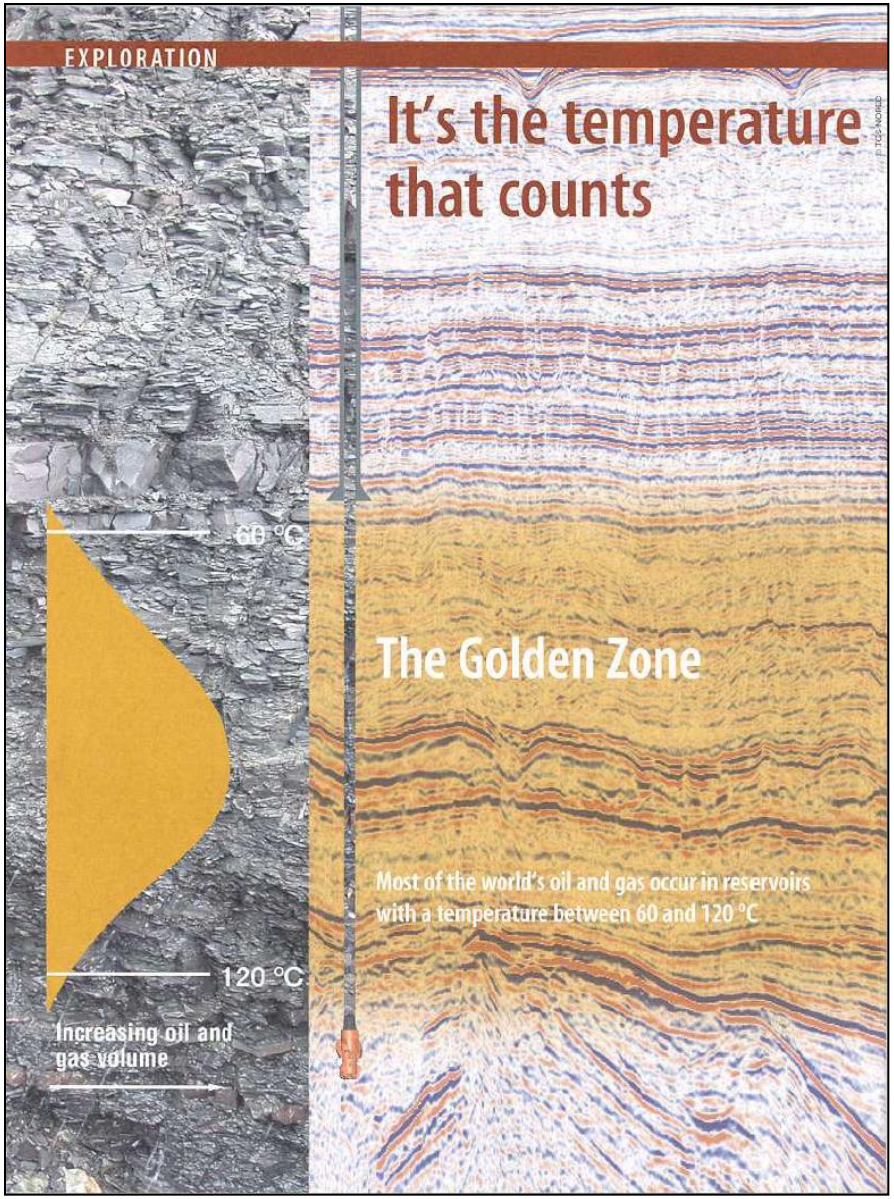
Basins and HC manifestations



Geothermal gradient and HC manifestations

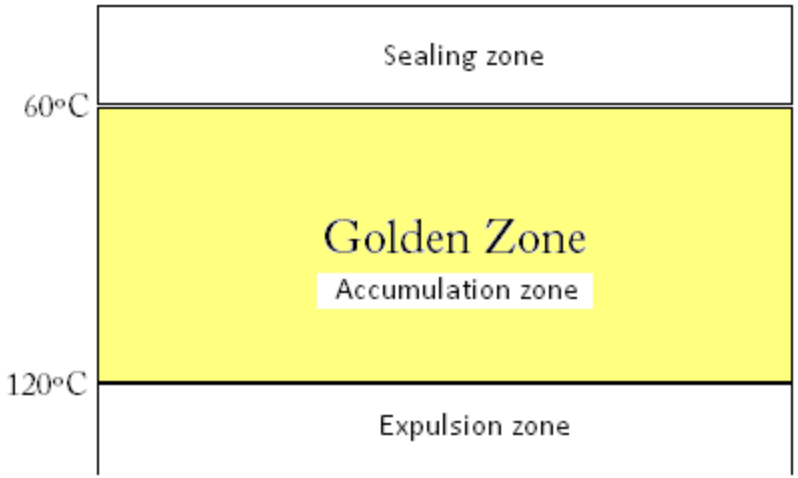


Golden zone



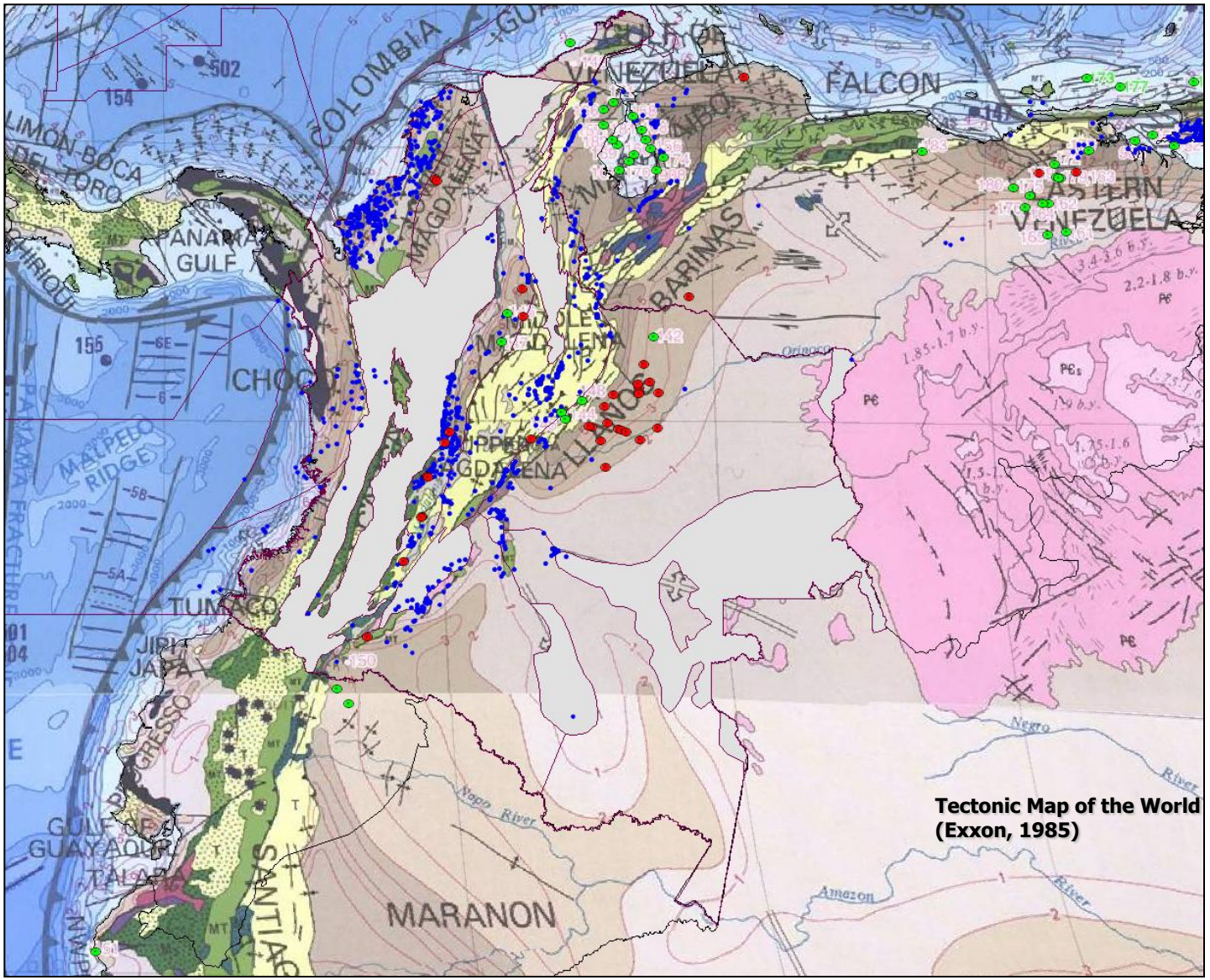
P. A. Bjorkum & P. Nadeau
STATOIL

"… the pattern in all sedimentary basins independent of the way they formed, their history of development, and age, shows an accumulation of oil and gas between 60ºC - 120ºC commonly referred to as 'The Golden Zone' ..."

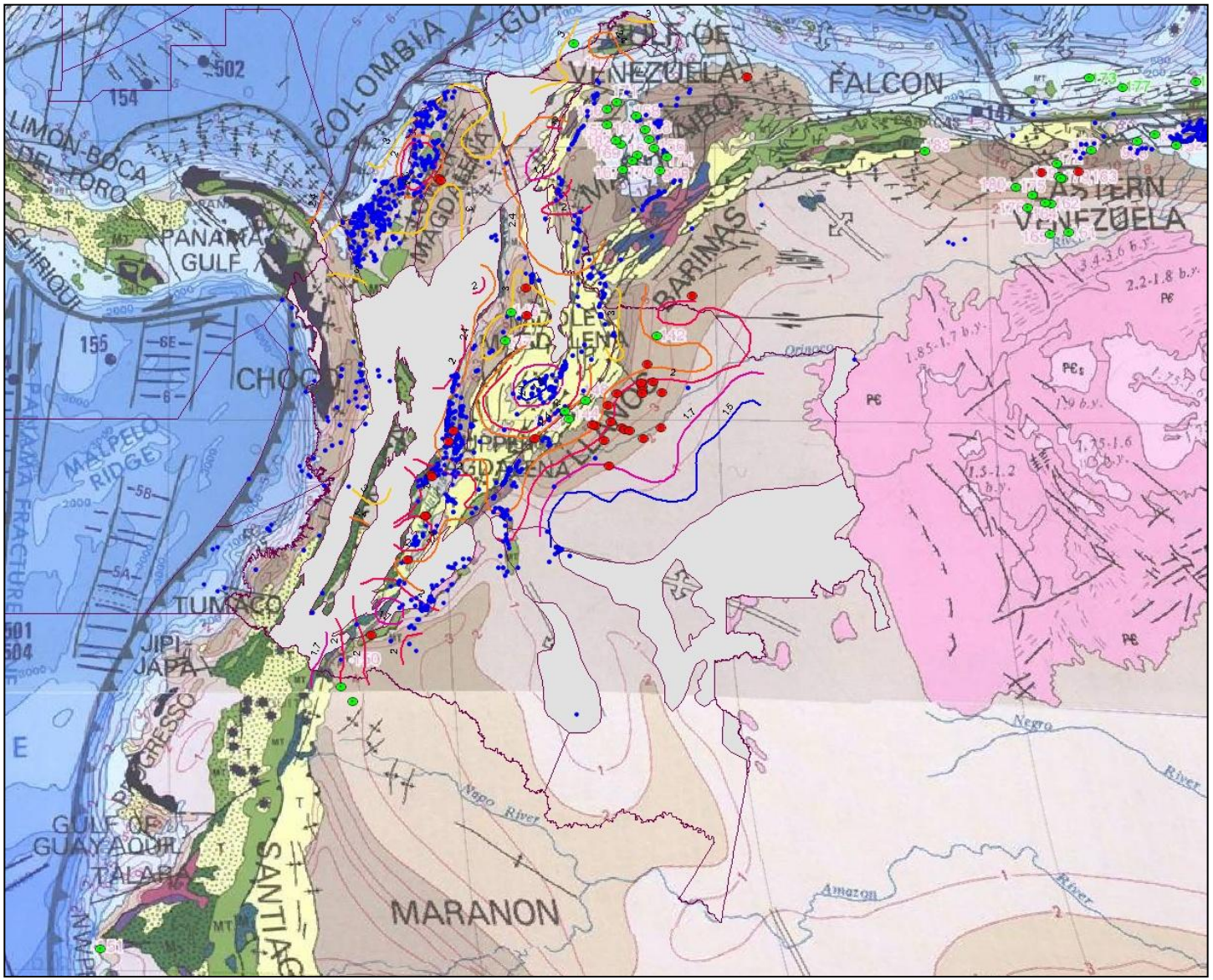


Geo ExPro (September, 2004)

Depth of basement, seeps and, oil & gas fields



Depth of basement and Golden zone



Area of basins for estimating the potential

1. How to support with geologic evidence, the observation that production is limited to up to 6% of the total area in the Colombian basins?

   A first look at several sedimentary basins of Colombia suggests that the area assumed in the hypothesis may be greater than 6%.

2. Has there been enough HC generated for supporting the YTF expectations?

Calculation of the mass of hydrocarbons generated

Volumetric Calculation of Hydrocarbons Generated, James w. Schmoker

U.S. Geological Survey, Denver, Colorado, USA.

Magoon, L. B., and W. G. Dow, eds., 1994, The petroleum system-from source lo trap: AAPG Memoir 60.

1. The source rock is identified and its boundaries defined.

2. The mass of organic carbon in the source rock is calculated.

$$M(gTOC) = [TOC\ (wt\ \%)/100) \times r\ (g/0113) \times V\ (cm^3)$$

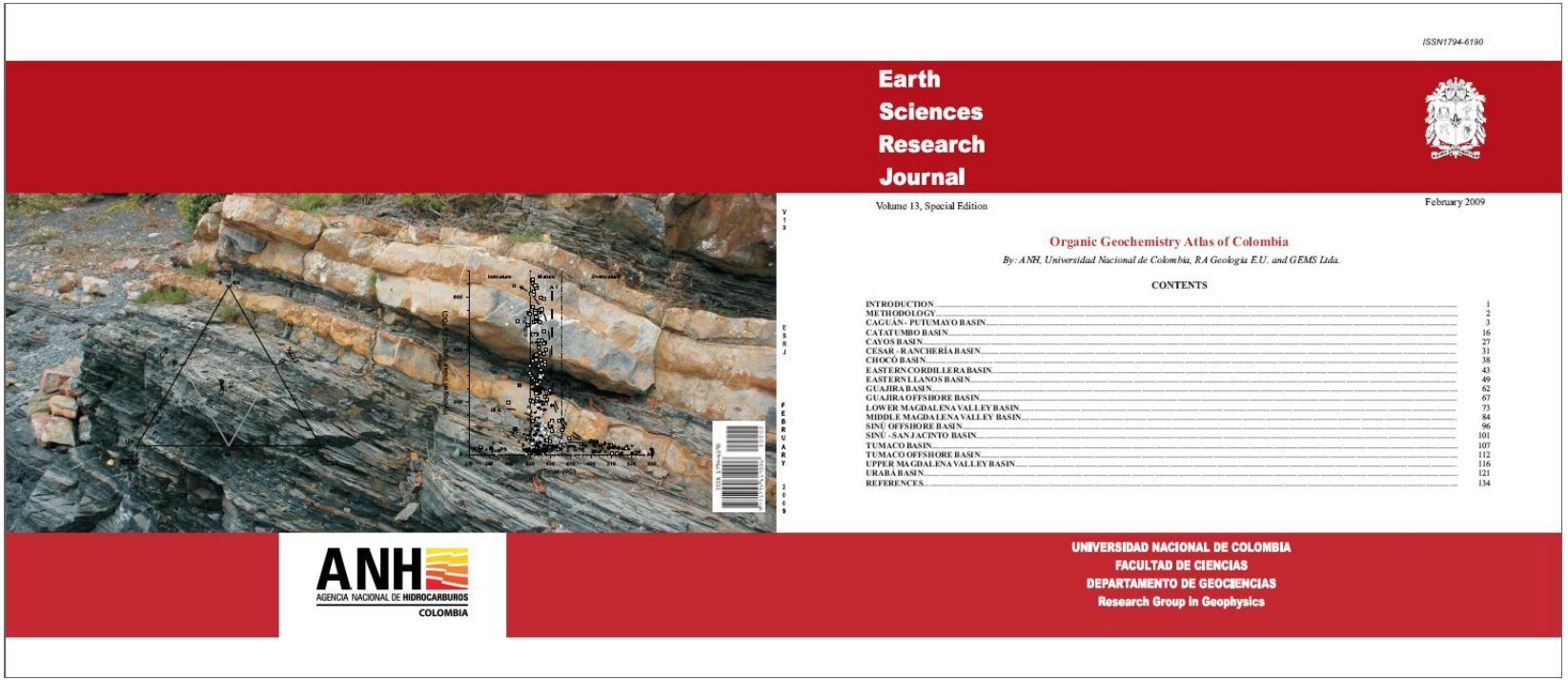
3. The mass of hydrocarbons generated per unit mass of organic carbon is estimated.

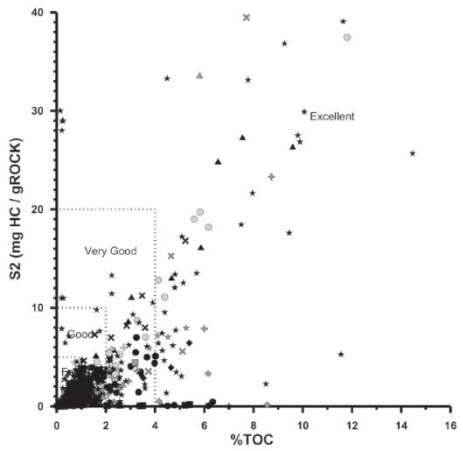
$$R(mgHC/gTOC) = HIo\ (mg\ HC/g\ TOC) - HIp\ (mg\ HC/g\ TOC)$$

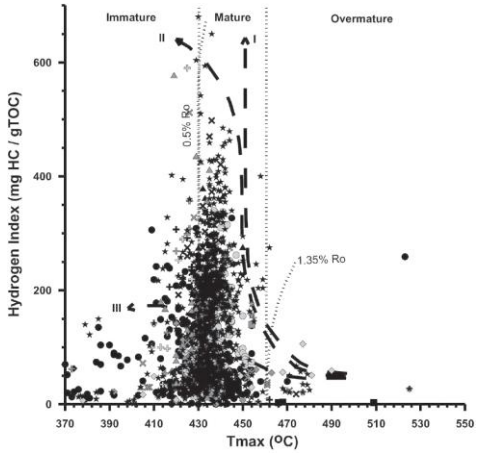
4. The total mass of hydrocarbons generated is determined by multiplication of this data.

$$HCG(kgHC) = R(mg\ HC/g\ TOC) \times M\ (g\ TOC)\ X\ 10^{-6}\ (kg/mg)$$

Uncertainties and other basins? : Montecarlo







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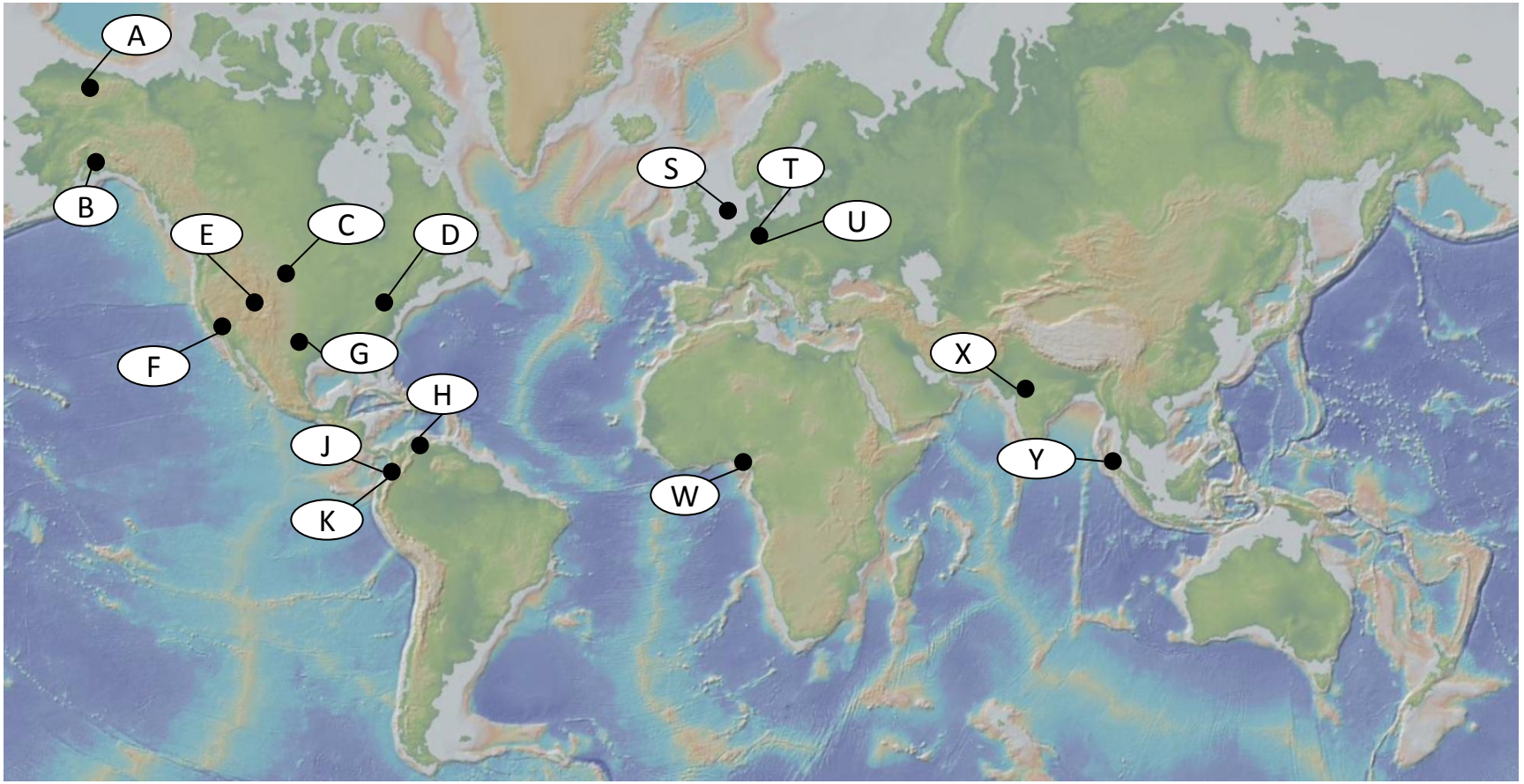
Case studies



Magoon, L. B., and W. G. Dow, eds., 1994, The petroleum system-from source lo trap: AAPG Memoir 60.

Values from case-studies used to calculate the amount of generated petroleum from pods of Active Source Rock

Map Symbol	Petroleum System	TOC (wt%)	ρ (g/cm³)	A (10^{12} cm²)	h (10^{2}cm)	v (10^{15}cm³)	M (10^{12}g TOC)	Hlo (°)	Hlo (°)	R (°)	HCG (10^{9}kg)
A	Ellesmerian (!)	3,5	2,4	900	160	14.400	-	-	-	-	-
A		2	2,4	1100	800	88.000	5.433.600	-	-	200	1.086.720
B	Tuxedni - Hemlock(!)	1,7	2,6	15	1000	1.500	66.800	300	100	200	13.400
C	Heath - Tyler (!)	2,5	2,3	400	30	1.200	69.000	600	300	300	20.700
D	Point Pleasant - Brassfield (!)	6	2,3	21	200	420	58.000	800	350	450	26.100
E	Green River (!)	6	2,3	21	200	420	58.000	800	350	450	26.100
F	Soda Lake - Painted Rock (!)	2,1	2,4	2,6	300	76	3.990	600	200	400	1.596
G	Simpson - Ellemburger (.)	1,7	2,5	96	35	336	14.600	425	150	275	4.020
H	La Luna - Misoa (!)	5,6	2,7	475	65	3.090	4.550	650	100	550	250.000
J	Villeta - Monserrate (!)	1,8	2,5	9	135	122	-	430	250	180	-
J		2,5	2,5	9	100	90	11.000	725	425	300	2.640
K	Villeta - Caballos (!)	1,8	2,5	7,5	135	101	-	430	250	180	-
K		2,5	2,5	7,5	100	75	9.120	725	425	300	2197
S	Mandal - Ekolisk (!)	6,7	2,5	11,5	1250	-	-	-	-	-	-
S		6,7	2,5	26,5	750	-	-	-	-	-	-
S		6,7	2,5	74,8	250	1.210	666	-	-	650	66.600
T	LSB Jurassic (!)	8	2,3	49,6	25	124	22.820	-	-	300	6.850
U	LSB Lower Cretaceous (!)	4,5	2,3	27,3	25	68	7.064	-	-	370	2.600
W	Akata - Agbada (!)	2,2	2,6	76,8	2310	17.700	1.012.000	232	161	71	71.850
X	Cambay - Hazad (!)	2,6	2,6	54,1	750	4.058	272.000	121	93	28	7610
Y	Bampo - Peutu	0,9	2,6	76	345	2.620	-	200	100	100	-
Y		0,7	2,7	76	460	3.500	127.100	200	70	130	14.800

Magoon, L. B., and W. G. Dow, eds., 1994, The petroleum system-from source lo trap: AAPG Memoir 60.

Direct geochemical observations of 16 basins

Caguán - Putumayo

ACAE-1	LINDA-1
ACAE-10	LUCILLE-1
ALEA-1	MANDUR-3
AZUL GRANDE-2	MANDUR-5
BAGRE WEST-1	MIRAFLOR-1
BURDINE-1	NANCY-1
CAFELINA-1	ORITO SUR-1
CAIMAN-2	ORITO-20
CAIMAN-4	ORITO-80
CALDERO-1	PAYARA-1
CARIBE-1	PINUNA-1
CARIBE-4	PUTUMAYO-1
CENCELLA-1	QUILILI-1
CHIGUACO-1	QUILLACINGA-1
CONDOR-1	QUILLACINGA-2
CONEJO-1	RIO MOCOA-1
EVELYN-1	RIO PESCADO-1
GARZA-1	SUCUMBIO-2
GAVILAN WEST-1	TAPIR-1
GAVILAN WEST-2	TEMBLON-1
GAVILAN-1A	TOROYACO-1
GUAMUES-1	UMBRIA-1
HORMIGA-1	URIBE-1
HORMIGA-1X	VENADO-1
LA TURBIA-1	YURILLA-1

Tumaco offshore

SANDI-1

Catatumbo

CARBONERA-4K
CARBONERA-5K
CERRITO-1
CERRO GORDO-3
ESLABONES-1
ESPERANZA-3
MUCURERA-3
PETROLEA-91
RIO DE ORO-14
RIO DE ORO-14K
RIO ZULIA-14
SARDINATA-1
SARDINATA-3K
SARDINATA-3K
SARDINATA NORTE-2
TIBU-178K
TIBÚ-182
TIBU-2K
TIBU-408K
TIBU-87
TIBU-87 (VETA-1)
TIBU-91K

Guajira offshore

MERO-1
SAN JOSE-1

Eastern Cordillera

ALPUJARRA-1
APICALA-1
CHITASUGA-1
CORMICHOQUE-1
CORRALES-1
SUESCA NORTE-1
TAMAUKA-1
VILLA RICA-1

Sinu offshore

BARRANQUILLA-1
CARTAGENA-2
CARTAGENA-3
CIENAGA-1
SAN DIEGO-1

Chocó

BUCHADO-1

Cesar - Rancheria

Cesar F-1X
COMPAE-1
EL PASO-3
MOLINO 1-X

Sinu – San Jacinto

BALSAMO-2
CARACOLI-1
CHINU-1
LA YE-1
LORICA-1
MOLINERO-1
MOLINERO-2
PARUMAS-1
POLONUEVO-1
ARROYO GRANDE-1
PALONUEVO 105-1
PORQUERA-1
SAN ANDRES A-1
SANTA RITA-1
TOLU-1

Urabá

NECOCLI-1

Tumaco

MAJAGUA-1

Los Cayos

PERLAS-3

TOC, HI, Tmax of 257 wells

Eastern Llanos

ALMAGRO-1	LOS TEQUES-1
ANACONDA-1	LUNA ROJA-1
APIAY-2	MARE MARE-1
APIAY-3	MEDINA-1
APIAY-4P	MORICHAL-1
ARAUCA-1	MORICHITO-1
ARAUQUITA-1	NEGRITOS-1
BUENOS AIRES X-14	PARAVARE-1
CANDILEJAS-1	POMARROSO-1
CANO CUMARE-1	PORE-1
CANO DUYA-1	PUERTO RICO-1
CANO LIMON-1	QUENANE-1
CANO VERDE-1	1127-1X
CASANARE-1	RANCHO HERMOSO-1
CHAFURRAY-5	RIO ELE-1
CHAPARRAL-1	RONDON-1
CHAVIVA-1	STRAT-XR-11A
CHIGUIRO-1	X-R-859
COPORO-1	S-11A
COROCITO-1A	SA-1
COROZAL-1	SA-11
CUMARAL-1AX	SAN JOAQUIN-1
EL MORRO-1	SAN PEDRO-1
ENTRERRIOS-1	SANTA MARIA-1
ESTERO-1	SANTIAGO-2
FLORENA A-1	SANTIAGO-3
FLORENA-1	SIMON-1
GUARILAQUE-1	SM-4
LA CABANA-1	SURIMENA-1
LA GLORIA-1	TAME-2
LA HELIERA-1	UNETE-1
LA MARIA-1	VANGUARDIA-1
LA PUNTA-1	YALI-1
LETICIA-1	

LMV

ACHI-1
ALEJANDRIA-1
ALGARROBO-1
APURE-1
APURE-2
ARJONA-1
BETULIA-1
BOQUILLA-3
CICUCO-1
EL CASTILLO-1
GUEPAJE-1
LIGIA-1
MAGANGUE-1
MAGANGUE-2
MARSELLA-1
MONTELIBANO-1
PIJINO-1X
PINUELA-1
PIVIJAY-1
RIOMAR-1A
SAN BENITO-1
SAN JORGE-1
SUCRE-1
TIERRAFIRME-1
VIOLO-1A
YATI-1

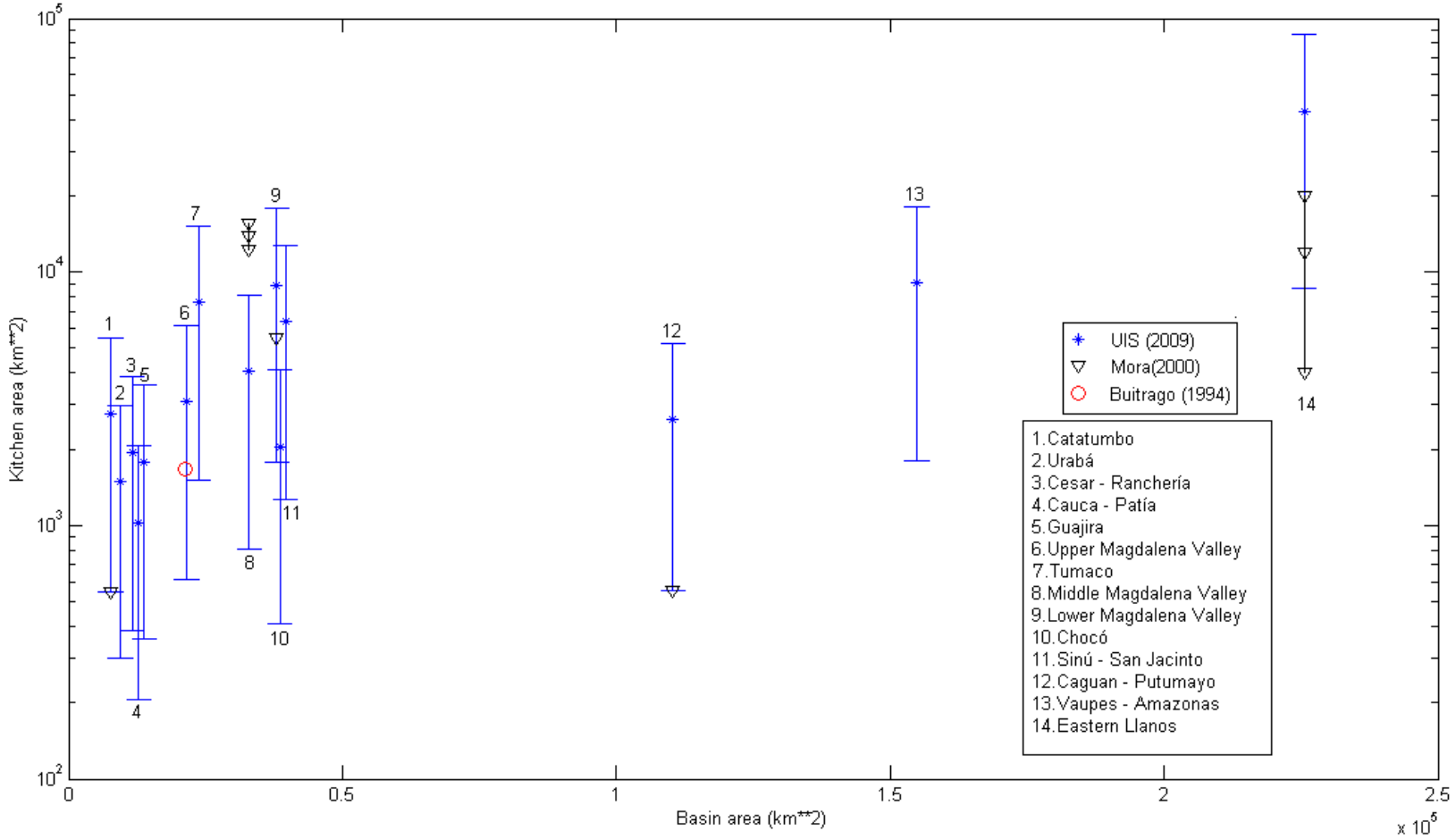
MMV

ARENOSA-1
BERLIN-2
CAPOTE-1
CASABE-199
ESCUELA-1
JERUSALEN-1
LLANITO-1
MONTERREY-1
MORALES-1
MUGROSA SUR-1
MUGROSA-5
NOREAN-1
PENA DE ORO-1
PICO-1
PIEDRAS-1
PPI-3
SAN FERNANDO X-1
TENERIFE-3

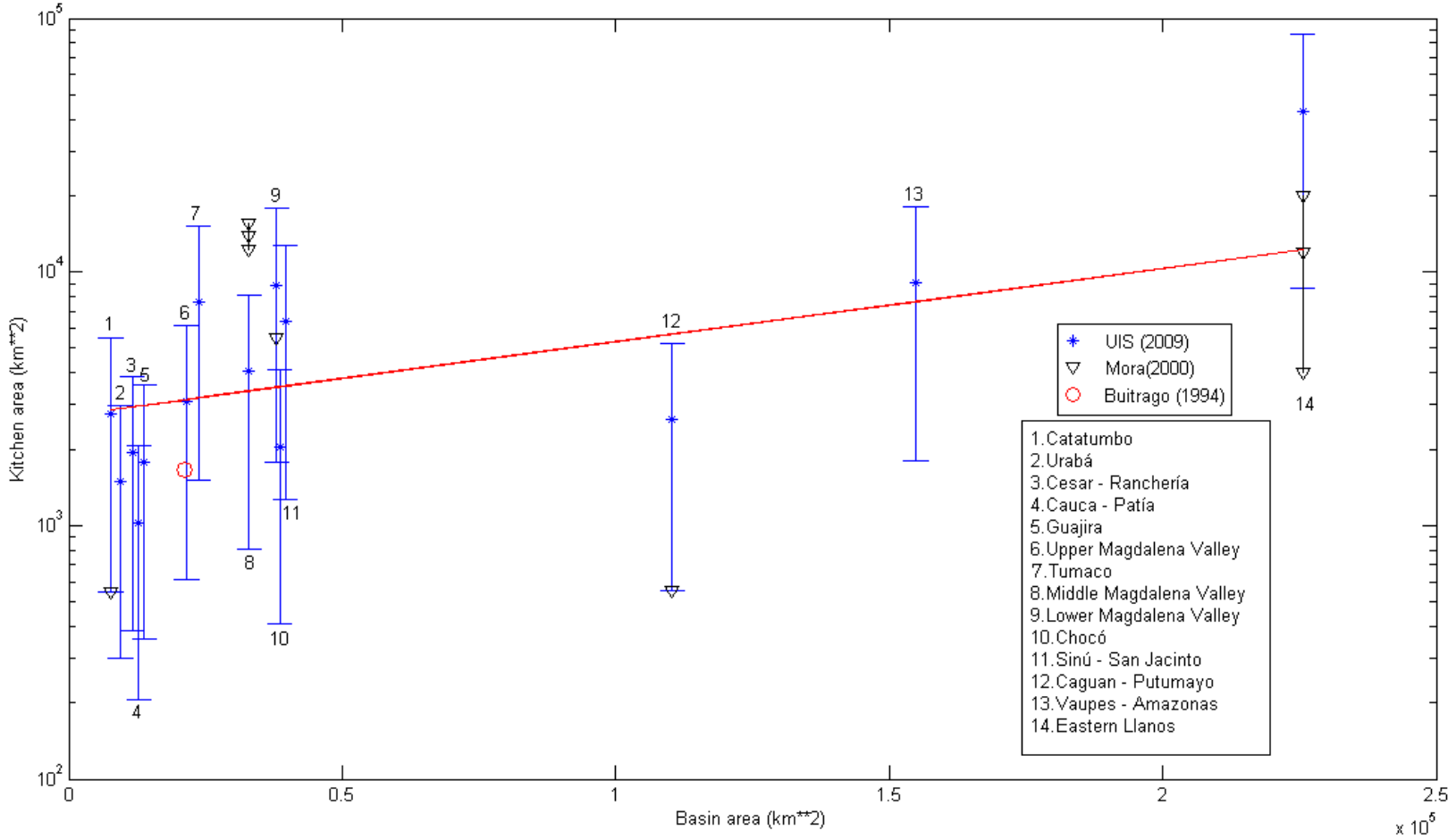
UMV

AMOYA-1	PALERMO-2
BALCON-6	PAUTA-1
BOGA-1	PEDERNALES_1
BOREAL-1	PIGOANZA-1
CERRO BUENAVISTA-1	PILU-1
CHENCHE-1	QUIMBAYA-2
CHIPALO-1	RIO SALDANA-1
COELLO-1	ROSITA-1
COYAIMA-1	SAN FRANCISCO-50
EL OLIVO-1	SANTA CLARA SUR-1
FLORENTINA-1	SANTA CLARA-2
HATO NUEVO-1	STRATIGRAPHIC-1
LA CANADA-1	SUAREZ-1
LOS MANGOS-1	TESALIA-1
LOS MANGOS-31	TOCAIMA-1
LOS MANGOS-4	TOLDADO-1
MICHU-1	TOMOGO-1
NILO-1	TOY-1
OLINI-1	VENGANZA-1
ORTEGA-1	YAVI-1
ORTEGA-12	

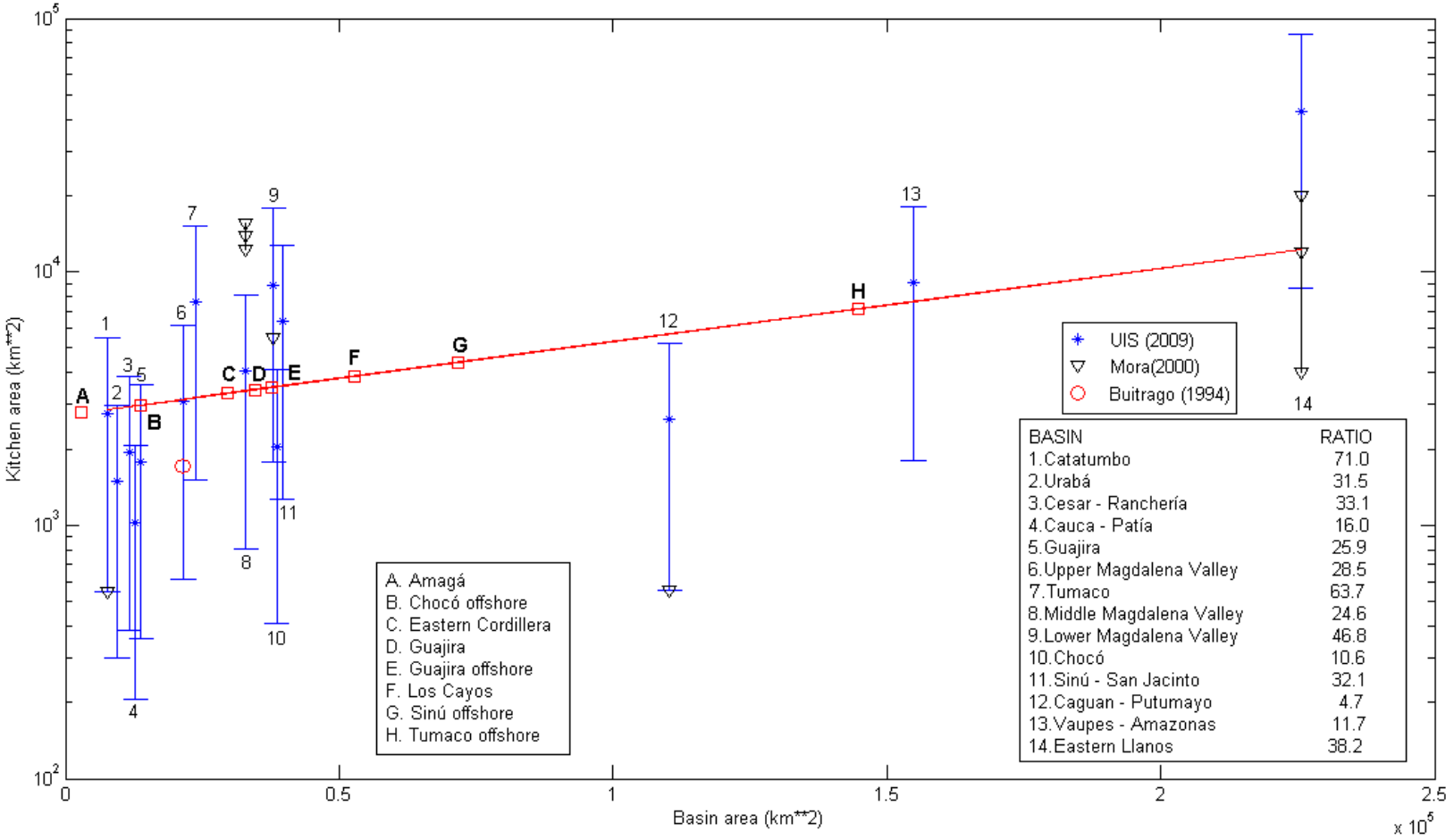
1. Identifying the source rock area



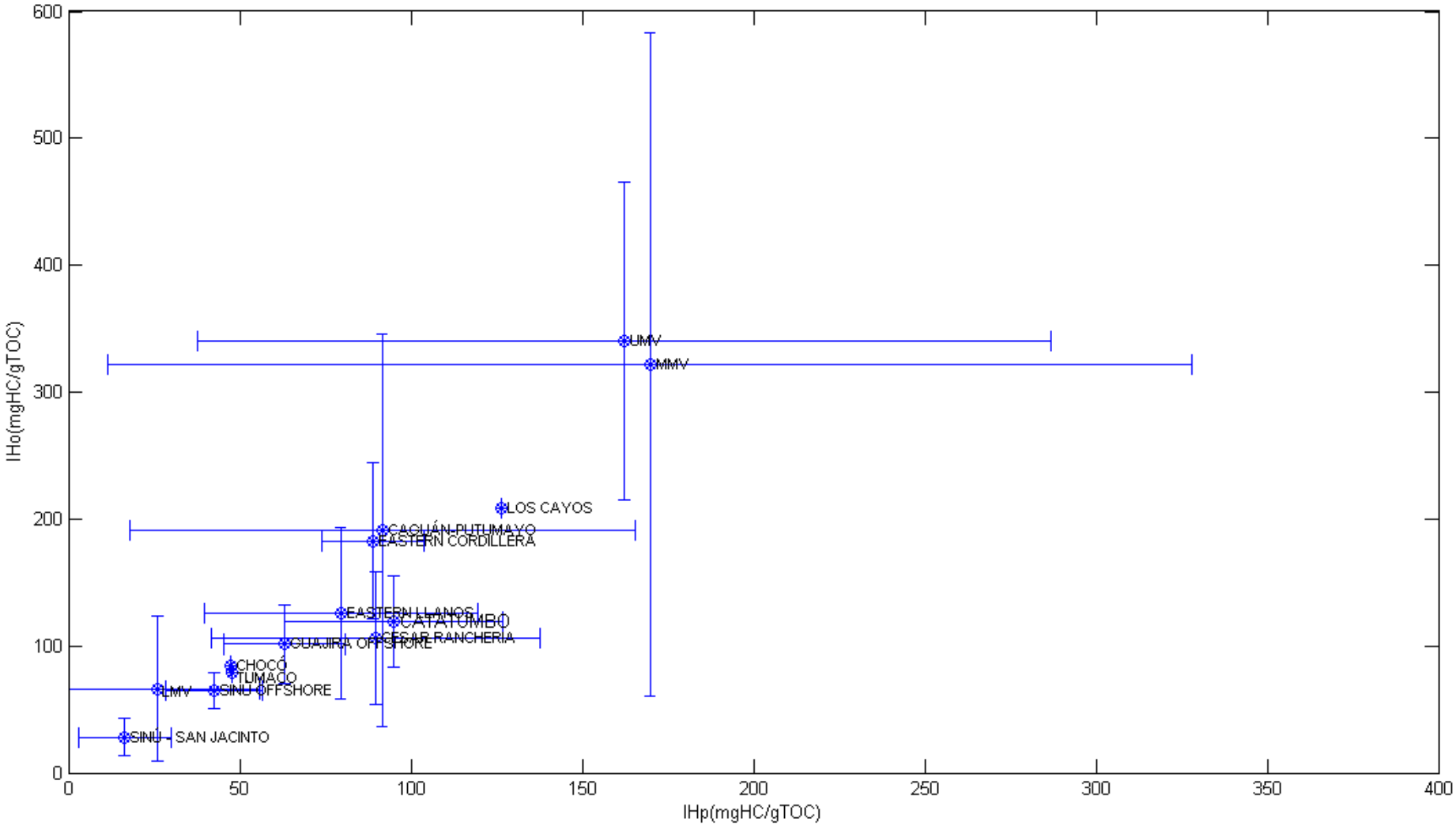
There is a trend that may well support a hypothetical assumption: the kitchen area α to the basin area



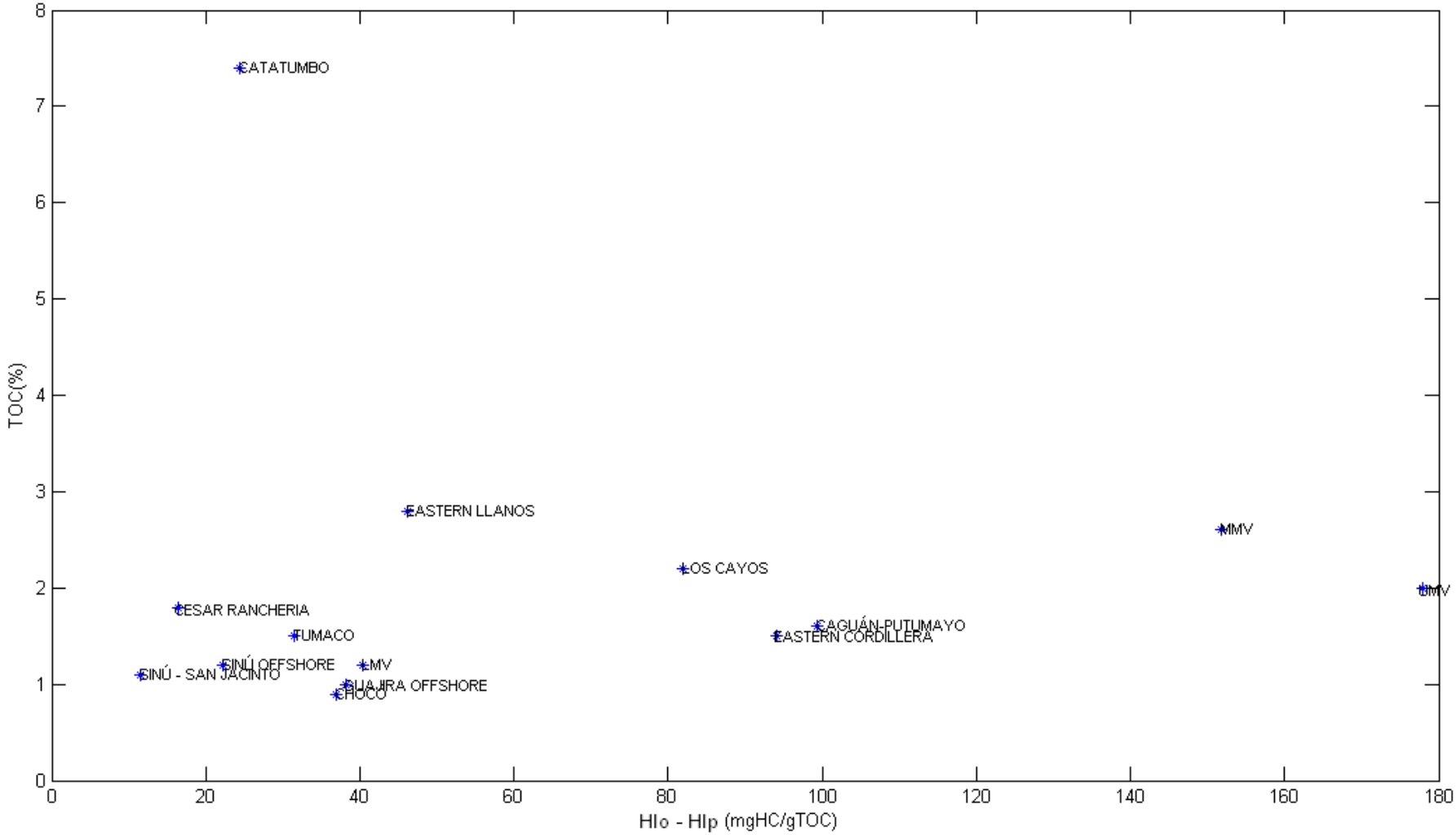
Now we are able to estimate the kitchen area in some frontier basins



Other trends are confirming the mass of HC generated from the source rock



Steps 2 and 3: Is there any relation between TOC and the mass of HC generated in the Colombian basins?



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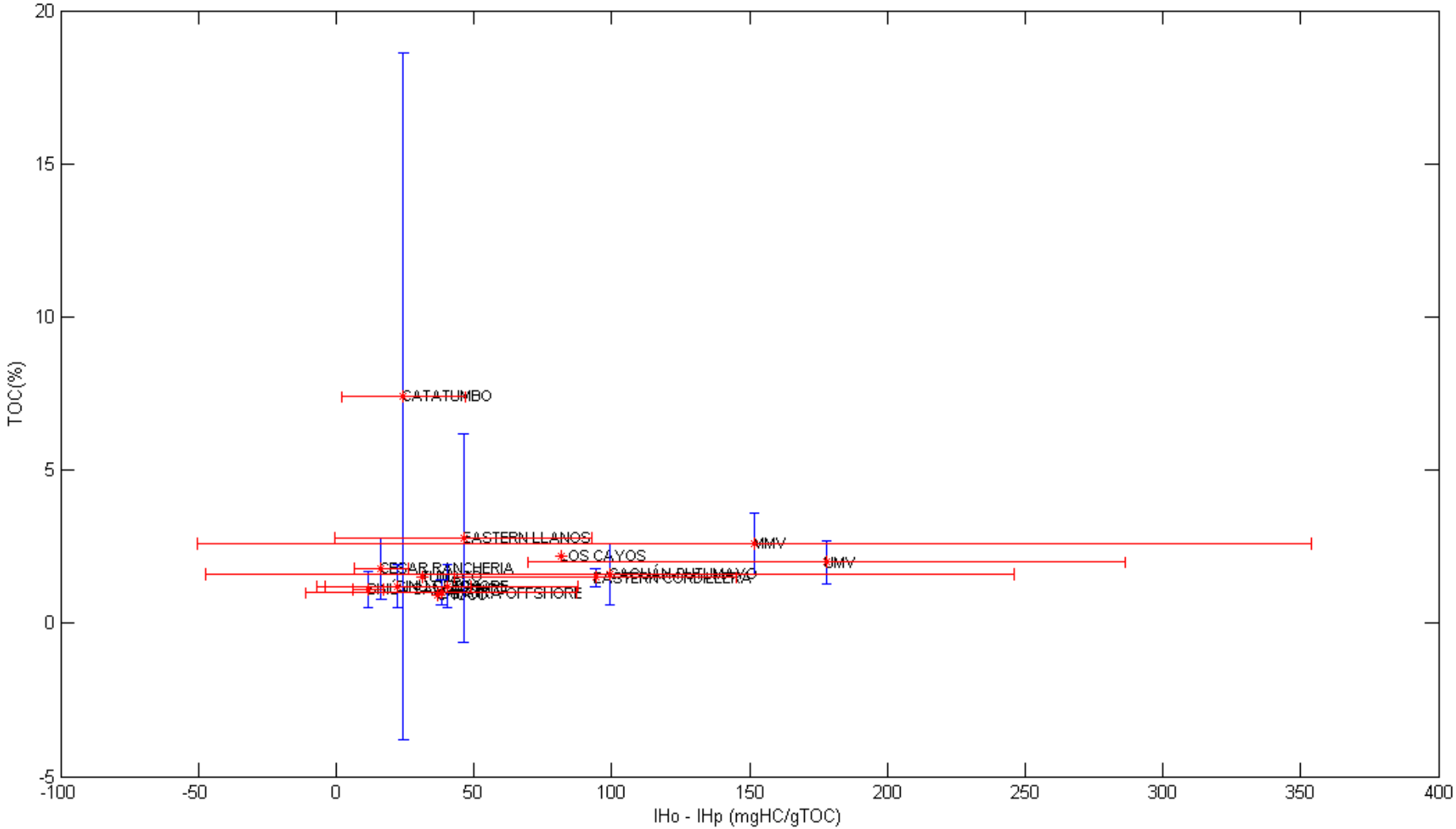
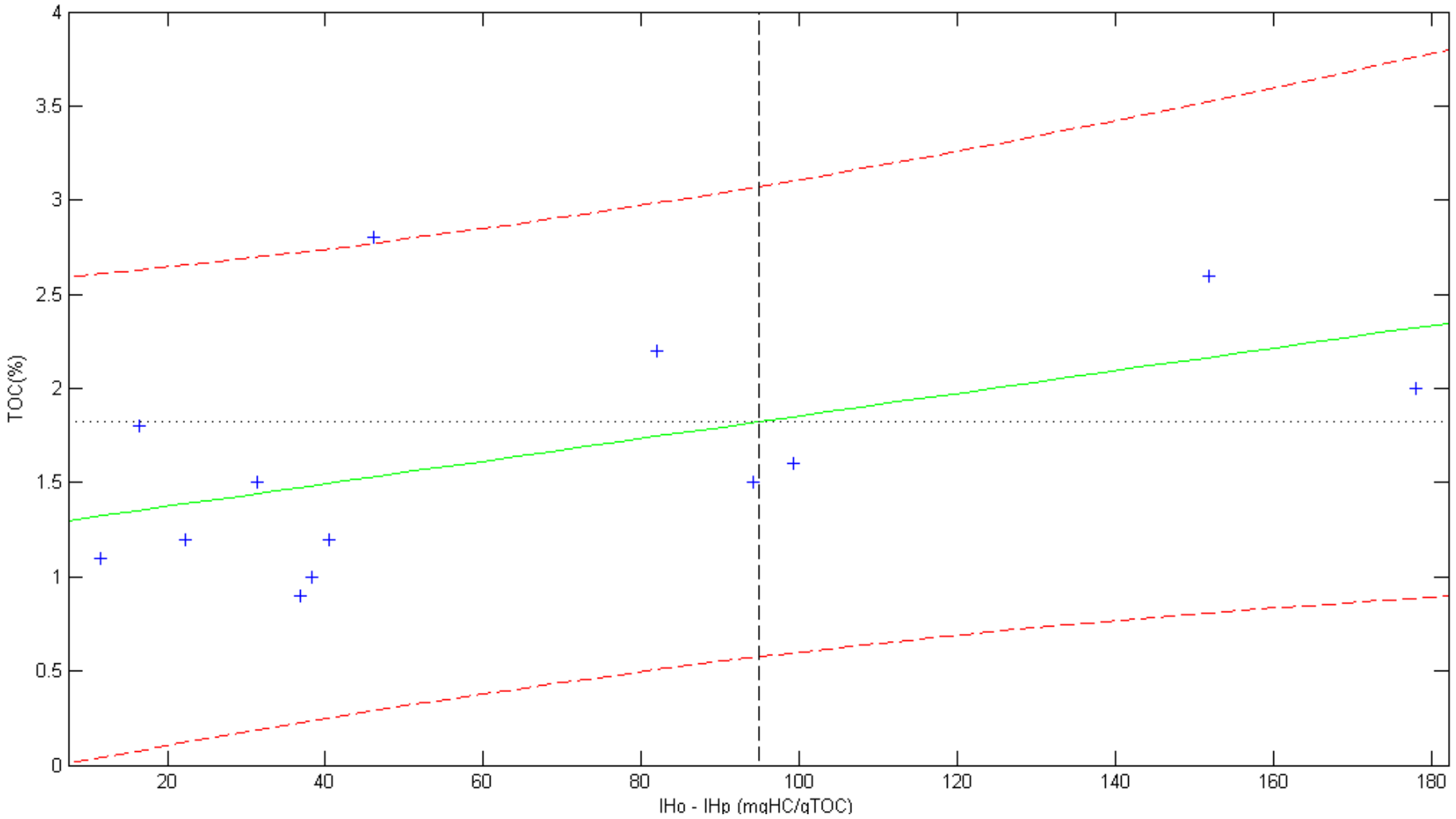
There is a trend that may support a new hypothetical assumption: TOC(%) α to the mass of HC generated

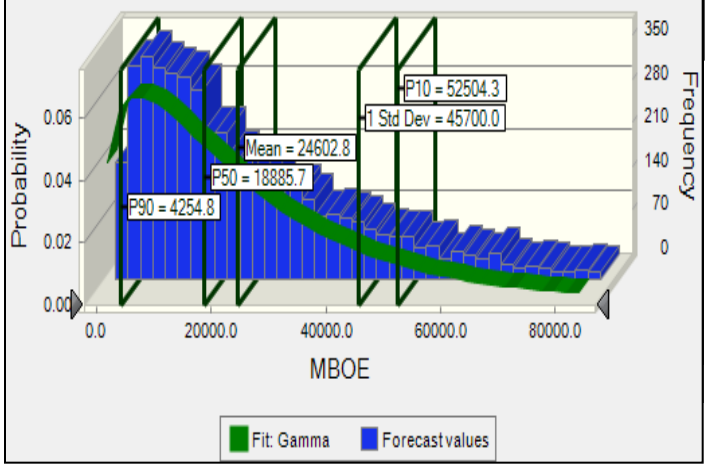


Now, knowing the TOC(%) of any basin, it is possible to calculate the mass of HC generated with degrees of confidence!

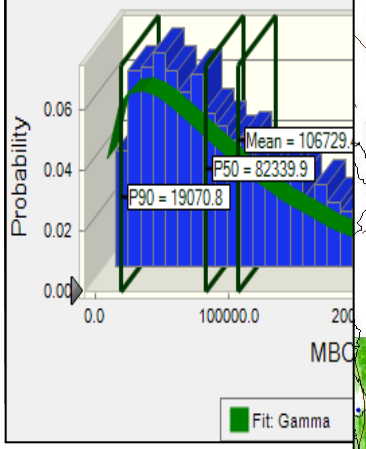


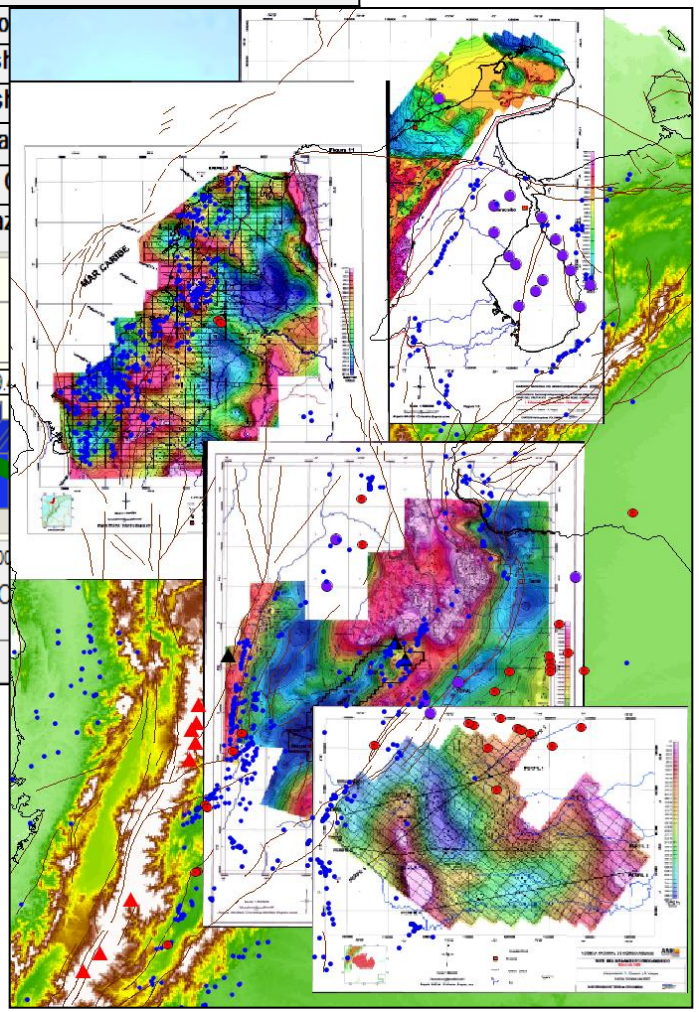
Estimations for every basin

Amagá, OOIP
Caguan - Putumayo, OOIP
Catatumbo, OOIP
Cauca - Patía, OOIP
Cesar - Ranchería, OOIP
Chocó offshore, OOIP
Chocó onshore, OOIP
Eastern Cordillera, OOIP
Eastern Llanos, OOIP
Guajira offshore, OOIP
Guajira onshore
Los Cayos, OOIP
Lower Magdalena Valley, OOIP
Middle Magdalena Valley



Sinú - San Jacinto onshore, OOIP
Sinú offsho
Tumaco onsh
Tumaco offsh
Upper Magda
Urabá,
Vaupes - Amaz

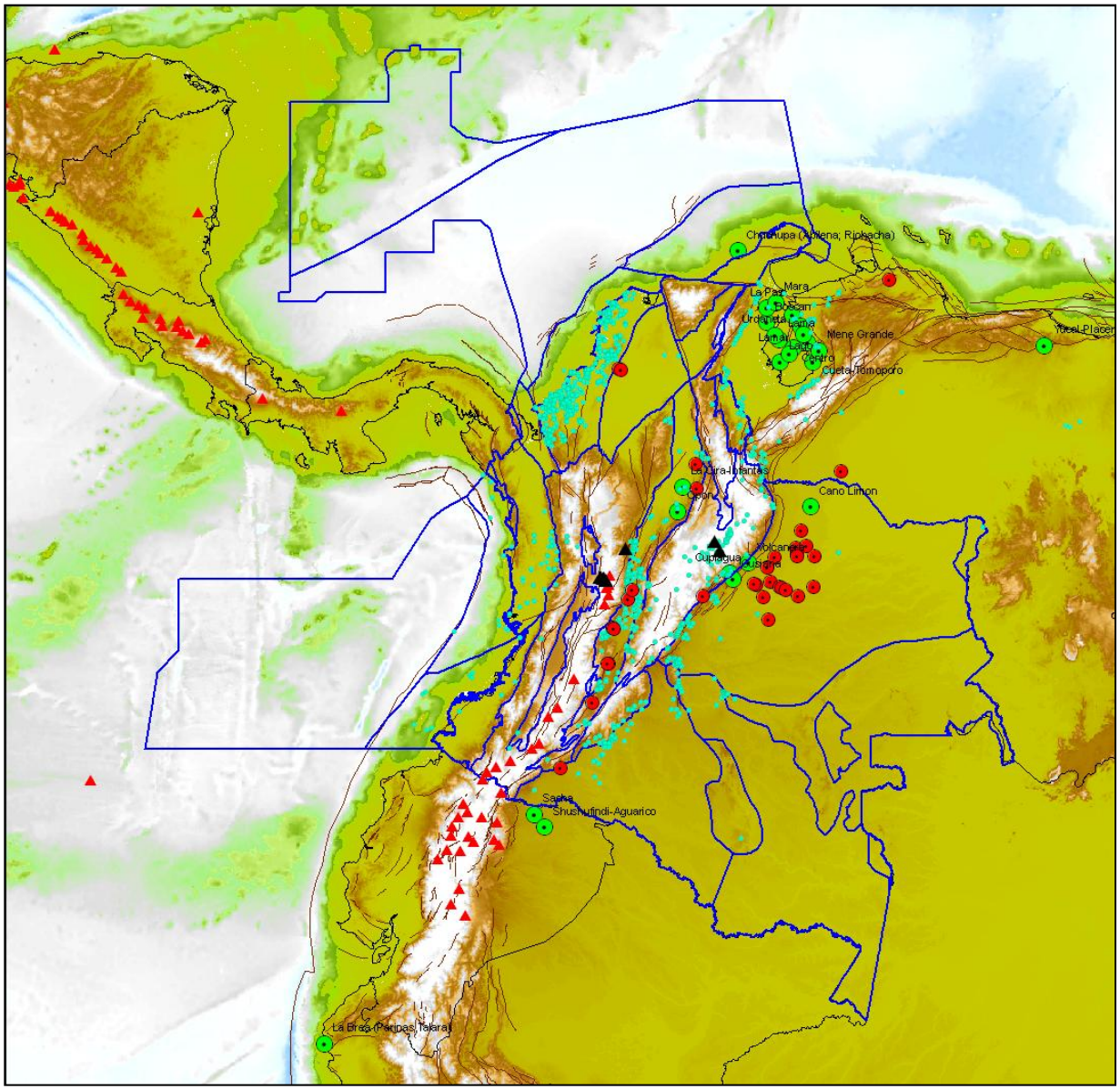




Agenda

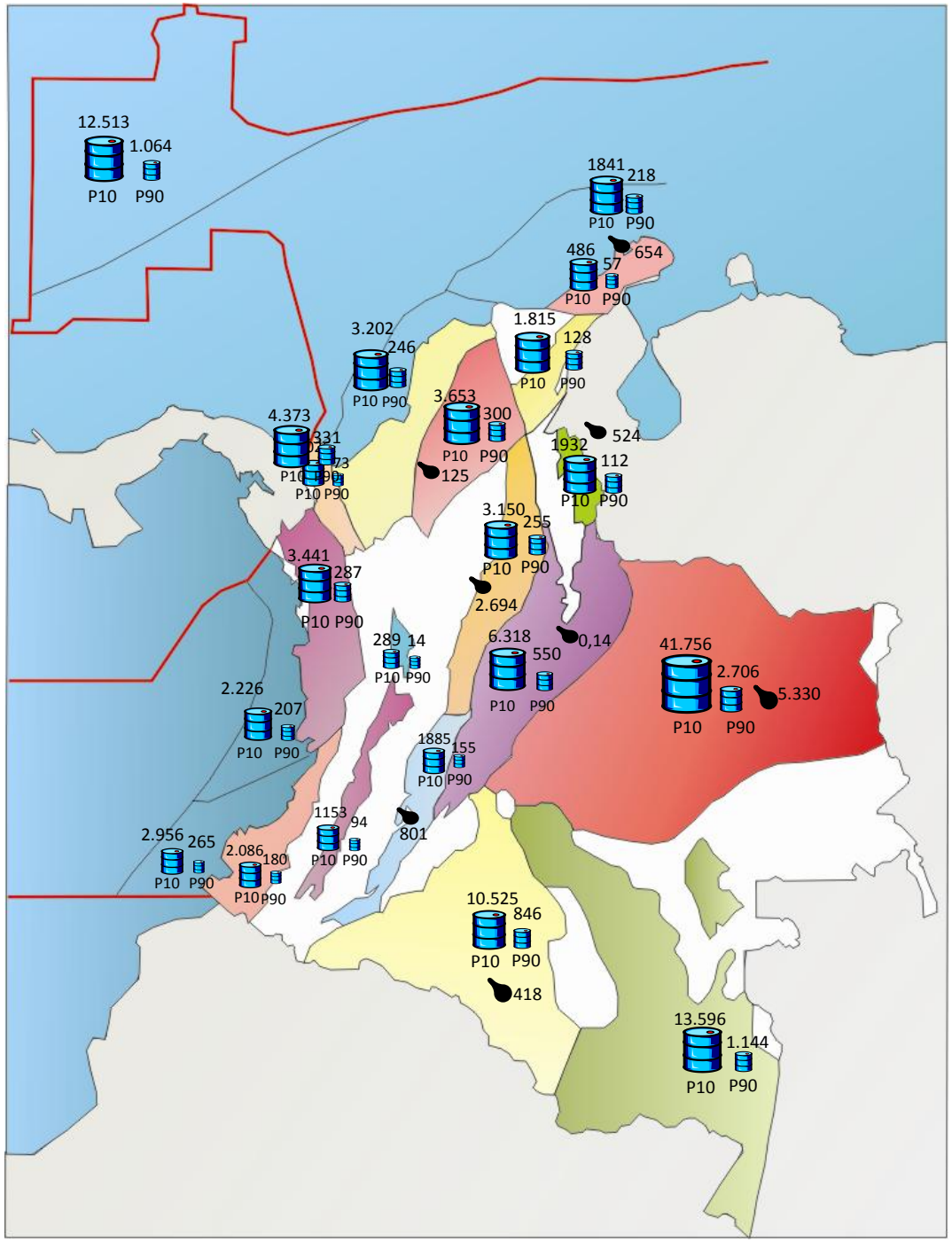
- Introduction and geologic setting
- Methodology
- **Results**
- Conclusions

Potential resources in 21 basins



HC in place Colombian basins (BBOE)	
P90	**P10**
569,0	1.368,0

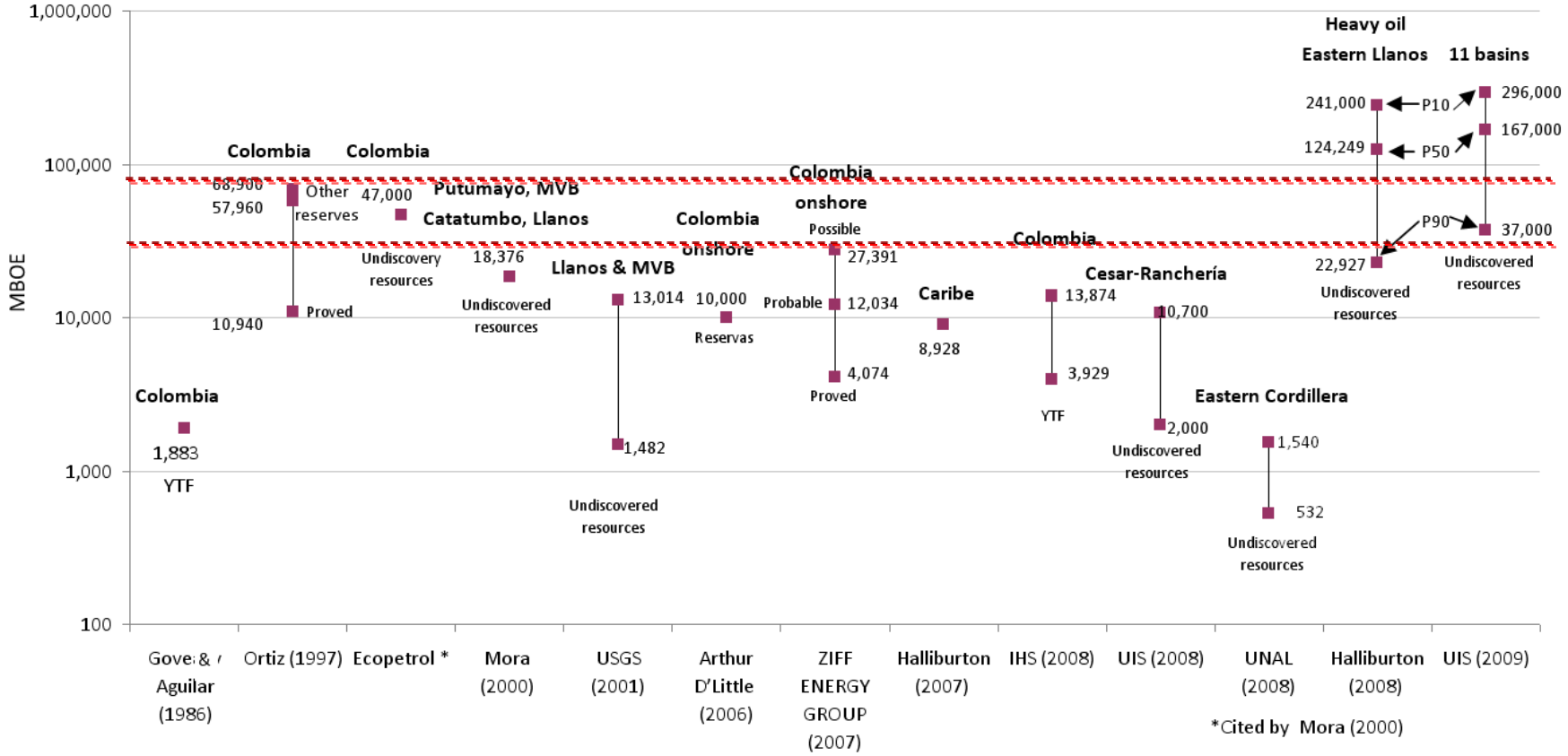
Undiscovered resources (BBOE)	
P90	**P10**
34,2	82,1


12.513
1.064
P10 P90
1841
218
P10 P90
654
486
57
P10 P90
1.815
128
P10 P90
3.202
246
P10 P90
3.653
300
P10 P90
125
524
1932
112
P10 P90
4.373
331
P10 P90
3.150
255
P10 P90
3.441
287
P10 P90
2.694
289
14
P10 P90
6.318
550
P10 P90
0,14
41.756
2.706
P10 P90
5.330
2.226
207
P10 P90
1885
155
P10 P90
801
1153
94
P10 P90
2.956
265
P10 P90
2.086
180
P10 P90
10.525
846
P10 P90
418
13.596
1.144
P10 P90

Agenda

- Introduction and geologic setting
- Methodology
- Results
- **Conclusions**

Assuming conservative scenarios (GR ~ 30% and RF ~ 20%), the undiscovered resources could range between 34,141.5 and 82,117.3 MBOE.



Recommendations and precautions

Given the regional nature of this study, it is suggested that a more representative data analysis of each basin be considered in order to refine the above undiscovered resource values.

Even accepting the numbers presented in this work, it would be necessary to systematically assess the geologic risk and the recovery factor.

Overview of the Oil and Gas Basins of Colombia

Presented by:

Jairo Mojica
Geologist, PhD.
Advisor – Technical Branch
National Hydrocarbons Agency (ANH)

Colombia

BASINS OF COLOMBIA

1. Pericratonic
2. Mountain and Intermountain
3. Coastal Onshore
4. Coastal Offshore

Colombia

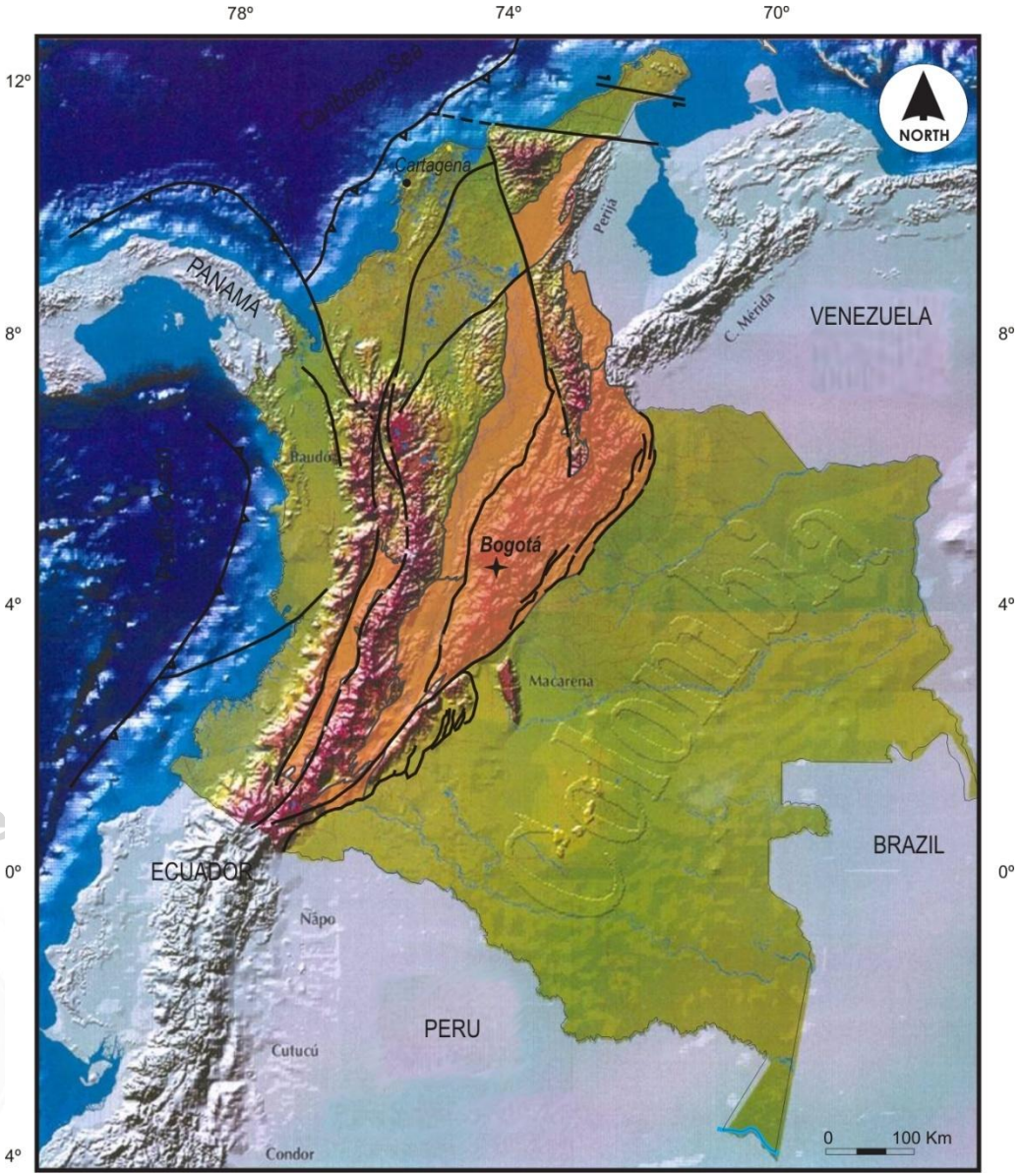
BASINS OF COLOMBIA

1. **Pericratonic**
2. Mountain and Intermountain
3. Coastal Onshore
4. Coastal Offshore

Colombia

BASINS OF COLOMBIA

1. Pericratonic
2. **Mountain and Intermountain**
3. Coastal Onshore
4. Coastal Offshore

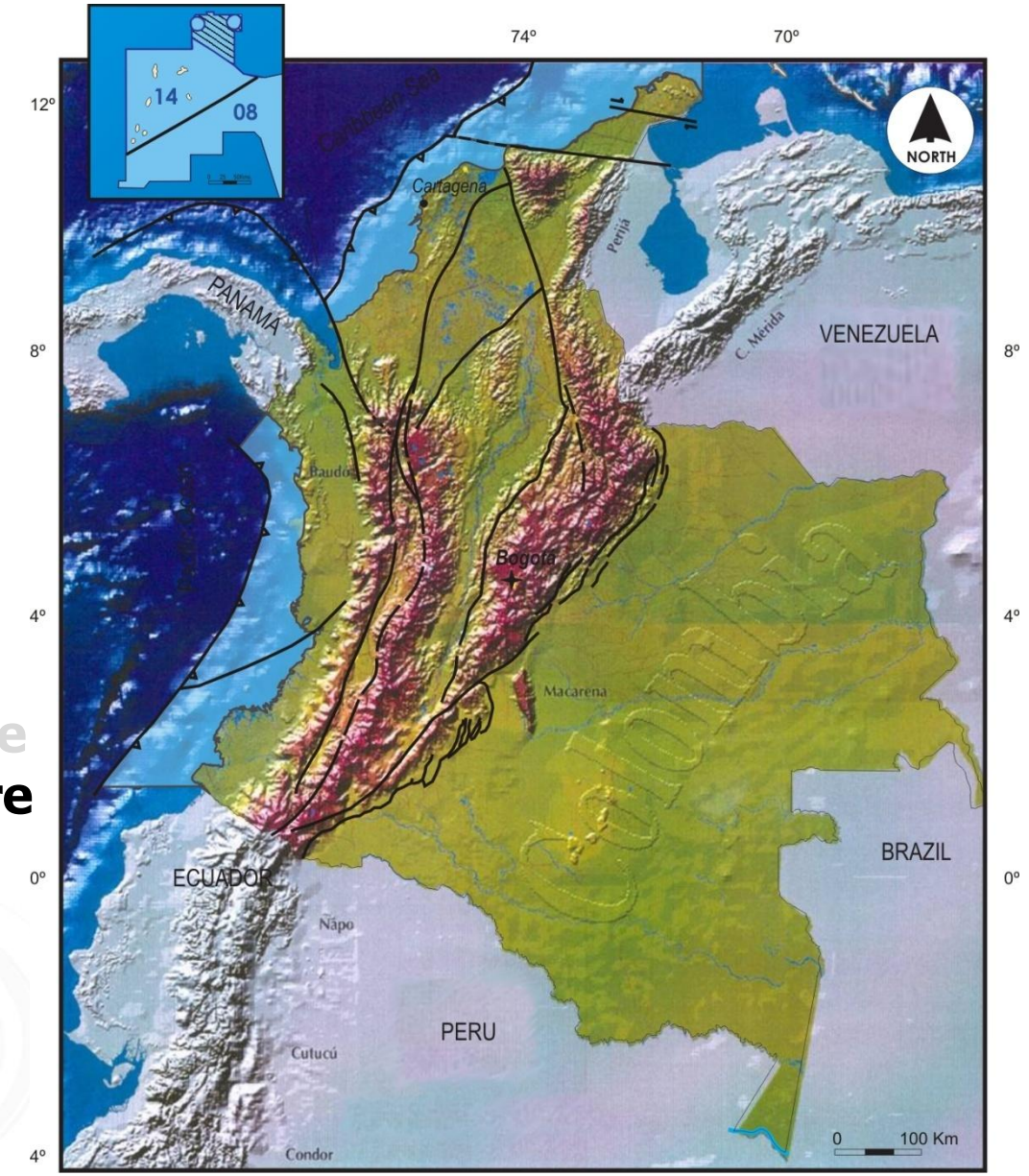


BASINS OF COLOMBIA

1. Pericratonic
2. Mountain and Intermountain
3. **Coastal Onshore**
4. Coastal Offshore

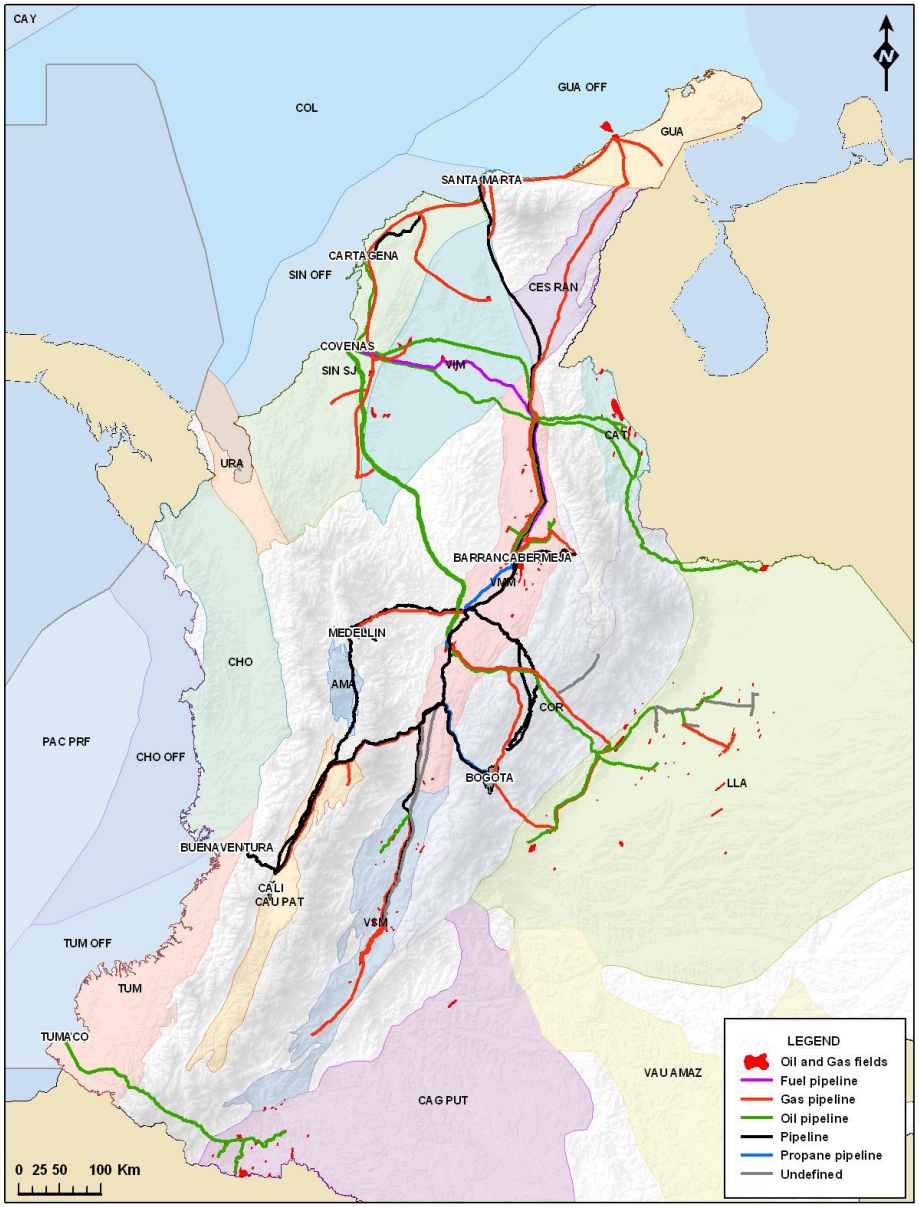
BASINS OF COLOMBIA

1. Pericratonic
2. Intermountain
3. Coastal Onshore
4. **Coastal Offshore**



Colombia

OIL AND GAS INFRASTRUCTURE

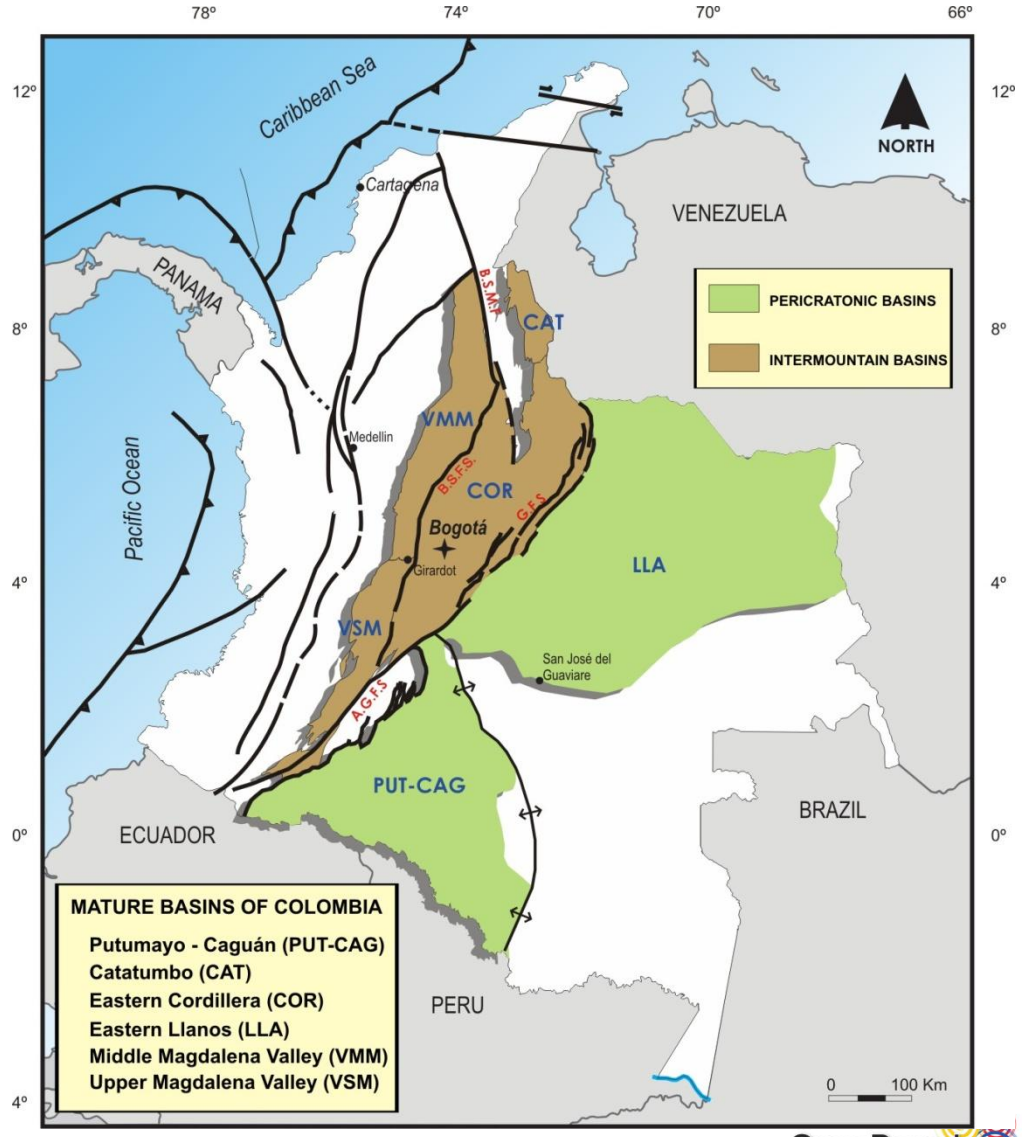


First Part
Mature Basins

Area of Mature Basins

BASIN	AREA (Km²)
EASTERN LLANOS (LLA)	225,603
PUTUMAYO-CAGUÁN (PUT - CAG)	110,304
MIDDLE MAGDALENA VALLEY (VMM)	32,949
UPPER MAGDALENA VALLEY (VSM)	21,513
CATATUMBO (CAT)	7,715
EASTERN CORDILLERA (COR)	71,766

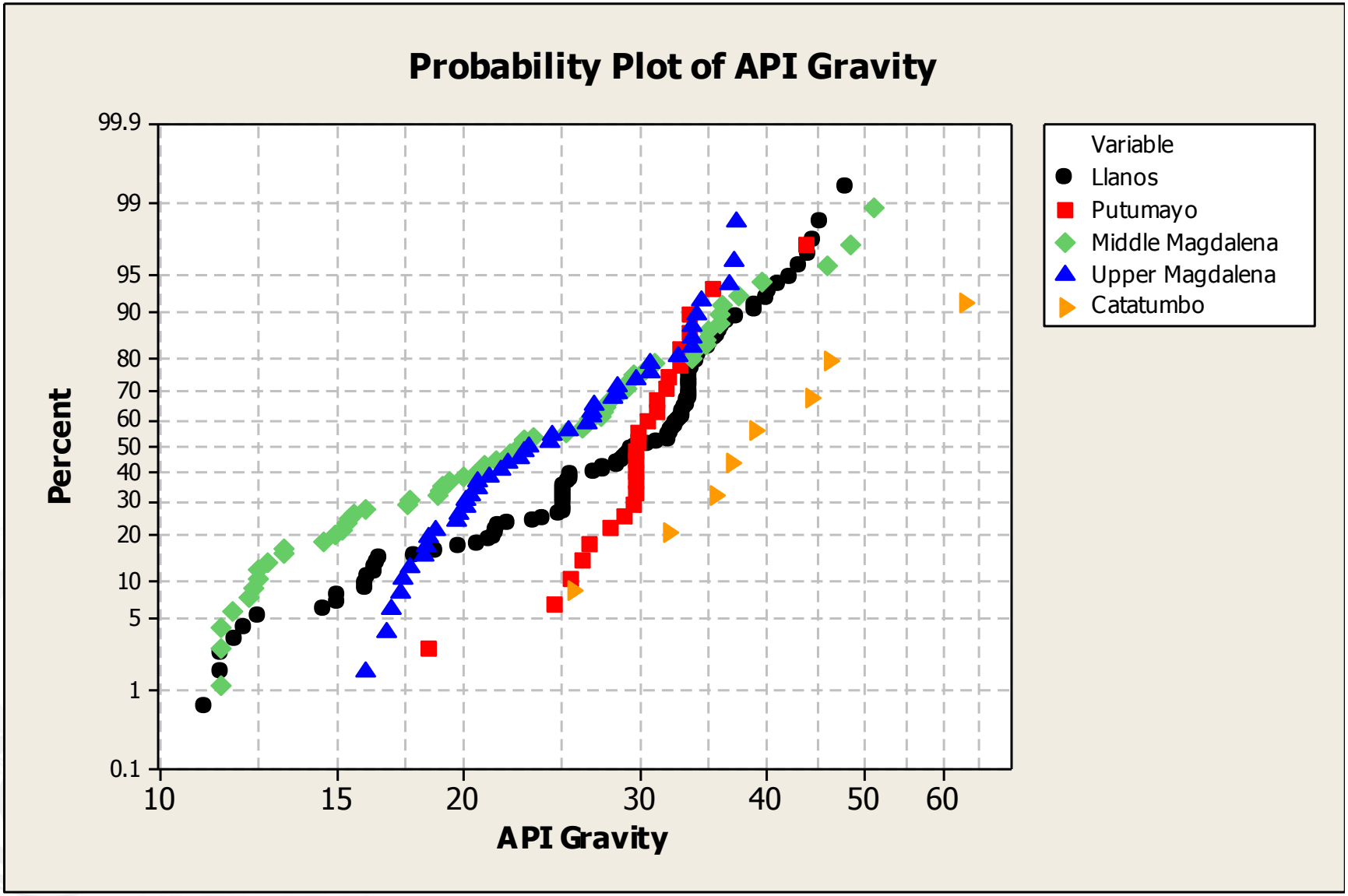
Colombian Mature Basins



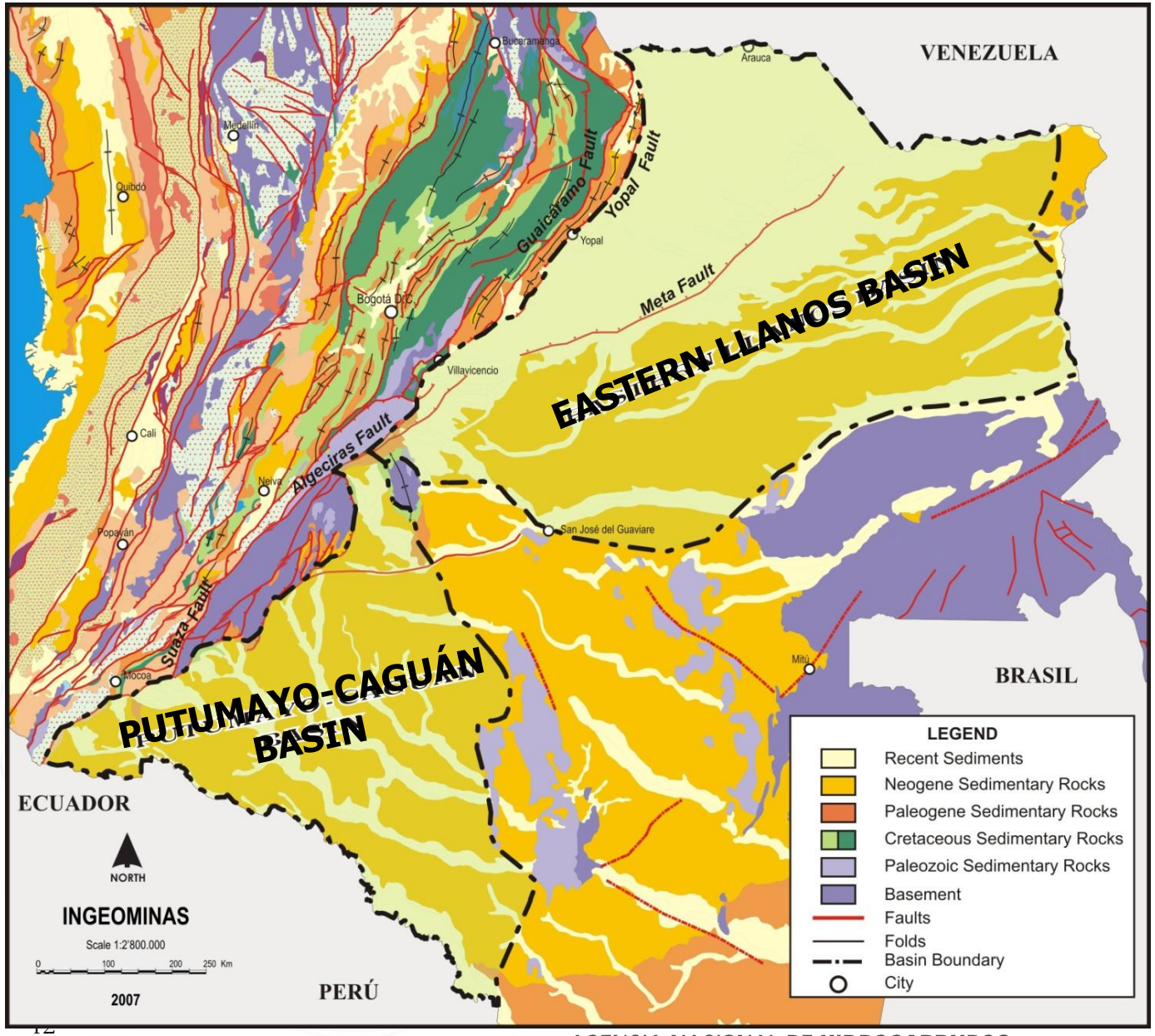
Oil production from Mature Basins

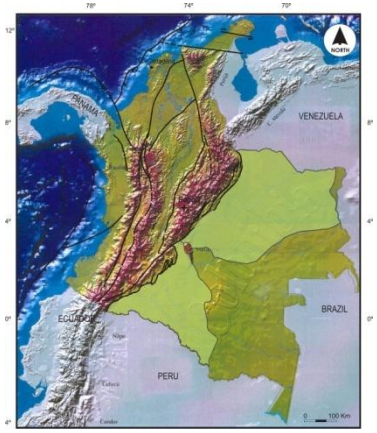
Basin	Current Production (BOPD)	Percent National Production	N. Fields	Light Oil	Medium Oil	Heavy Oil
Eastern Llanos	425,231	66.45%	118	50	33	35
Middle Magdalena Valley	98,687	15.42%	61	10	17	34
Upper Magdalena Valley	88,149	13.78%	44	11	16	17
Putumayo-Caguán	24,000	3.75%	26	8	17	1
Catatumbo	3,283	5.10%	6	5	1	0
Eastern Cordillera	79	1.00%	1	0	0	1
Total	**639,429**	**100%**	**256**	**84**	**84**	**88**

API gravity by basin



Pericratonic basins





Basins

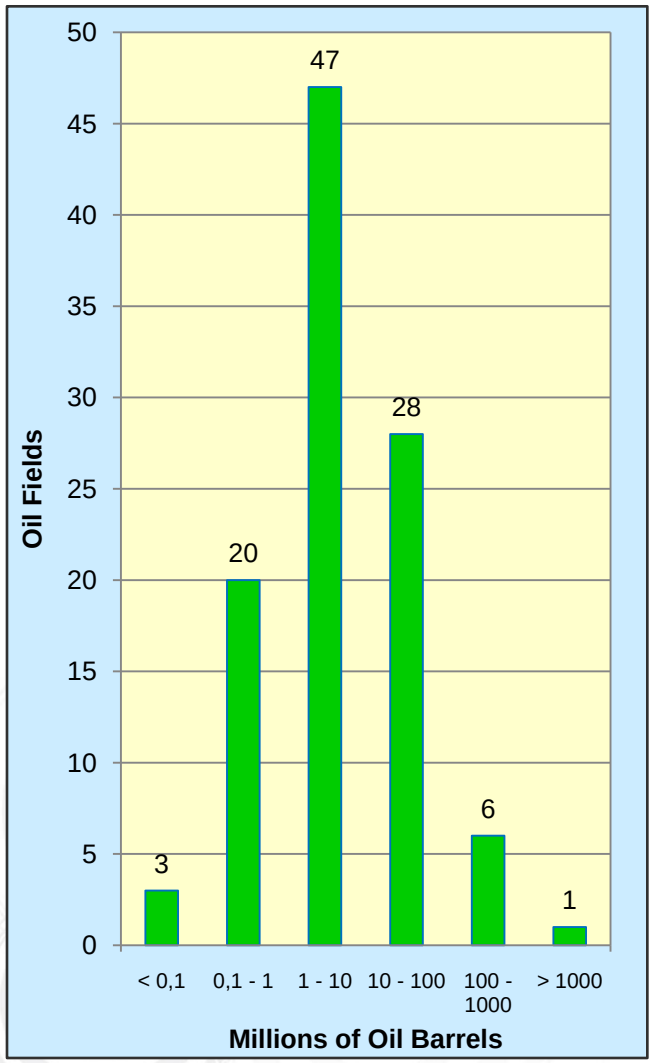
Eastern Llanos

Putumayo - Caguán

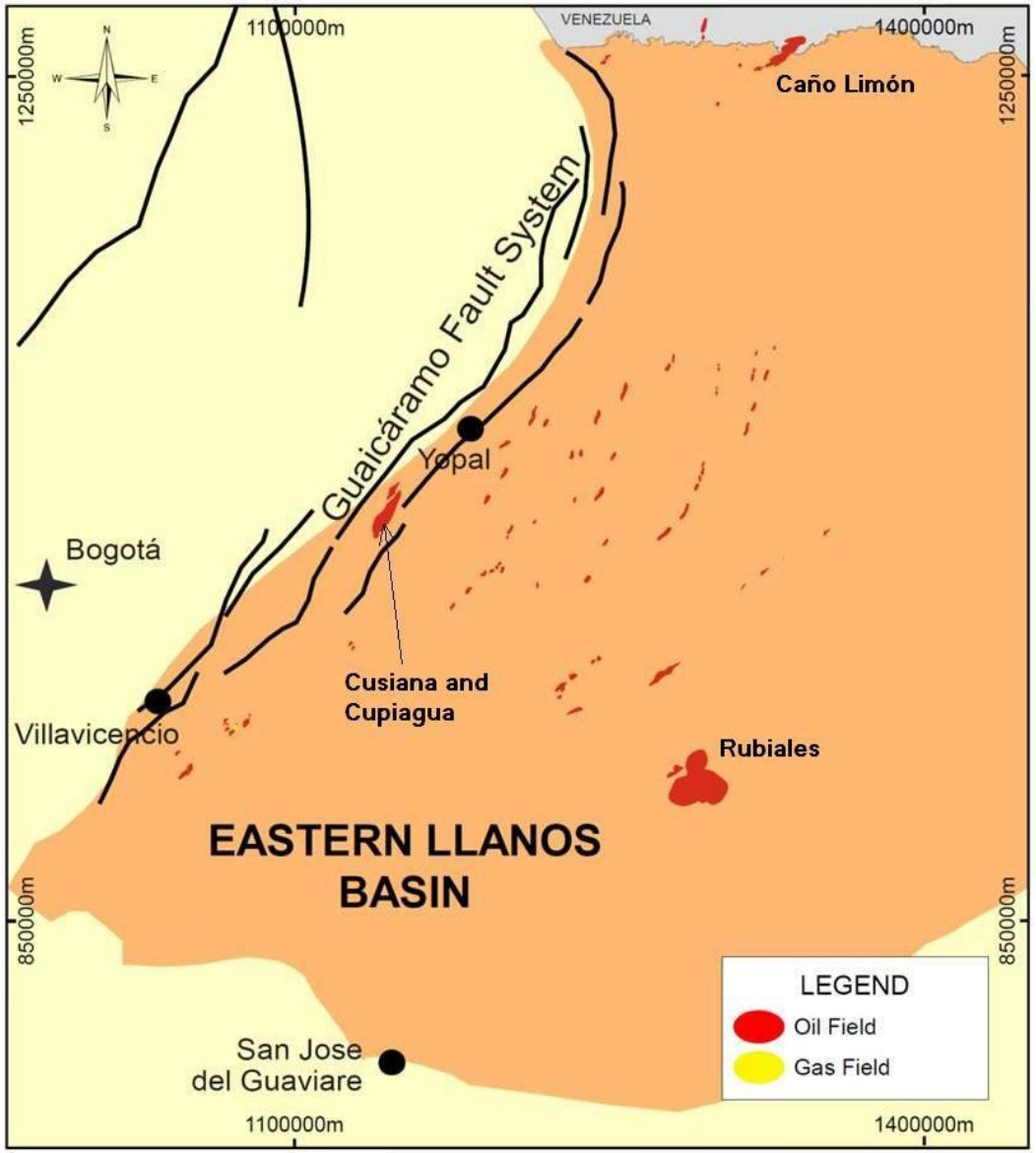
Eastern Llanos

Oil & gas fields

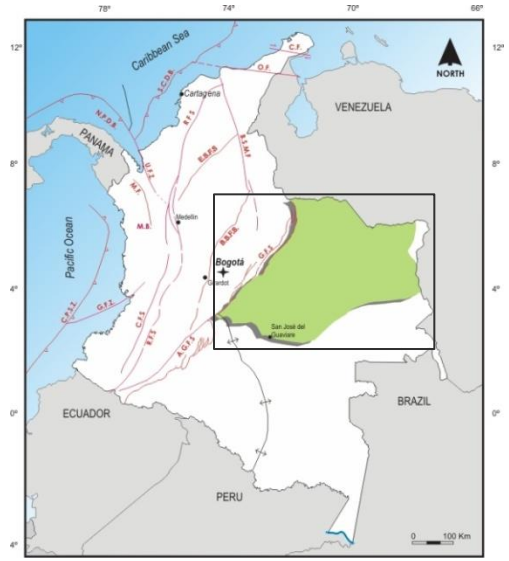
Oil Fields Size Distribution



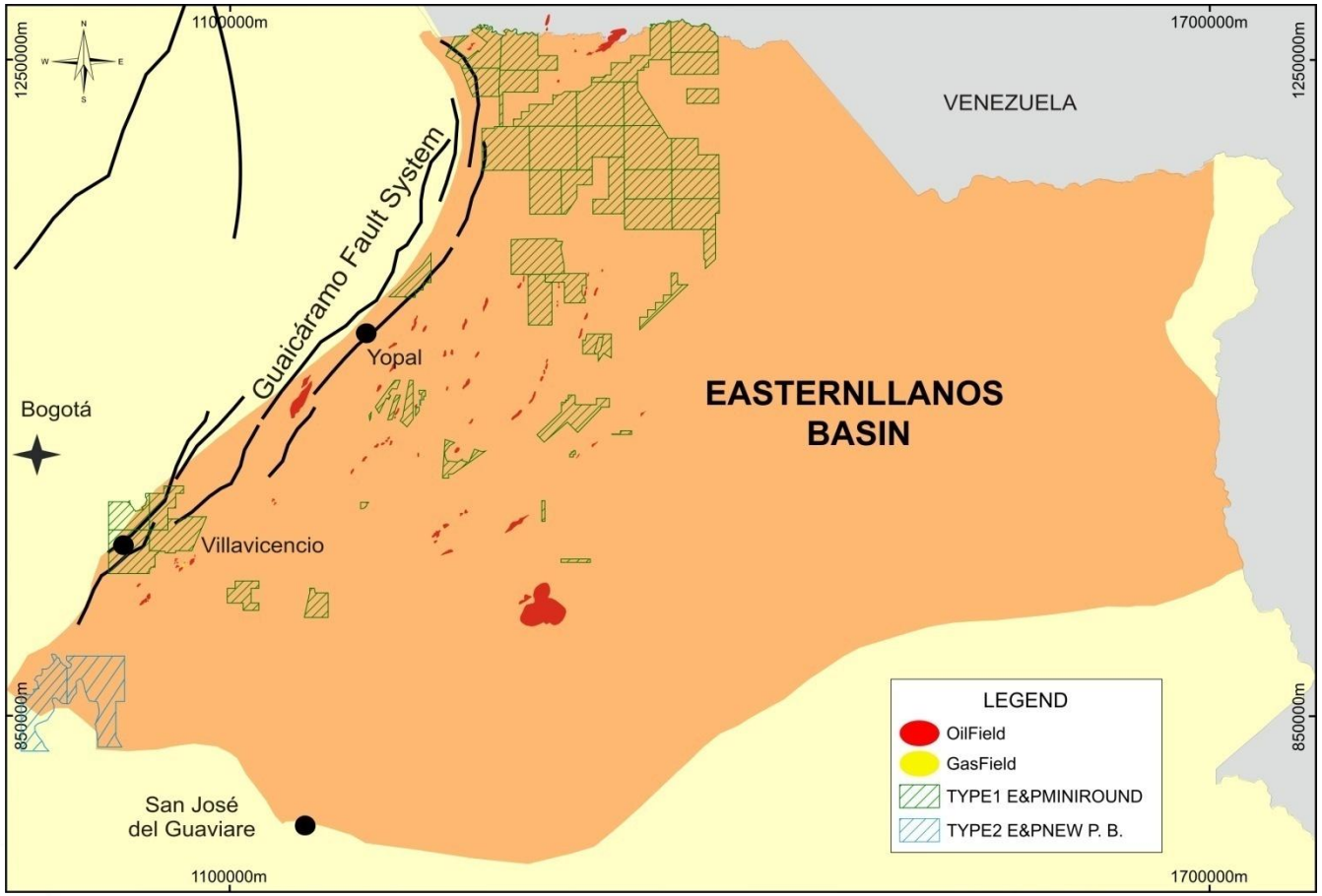
Statistics for 105 Oil Fields



Eastern llanos



Location map with the offered blocks



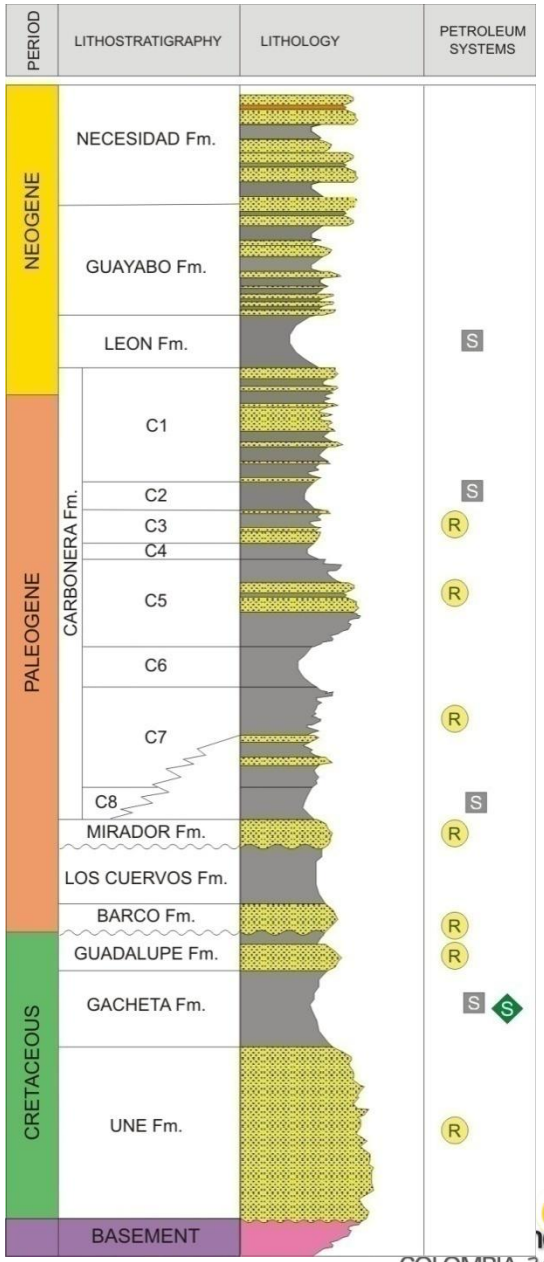
OPEN ROUND 2010 BLOCKS

Type 1: 52 Blocks
17,183 Km^2

Type 2: 2 Blocks
2,004 Km^2

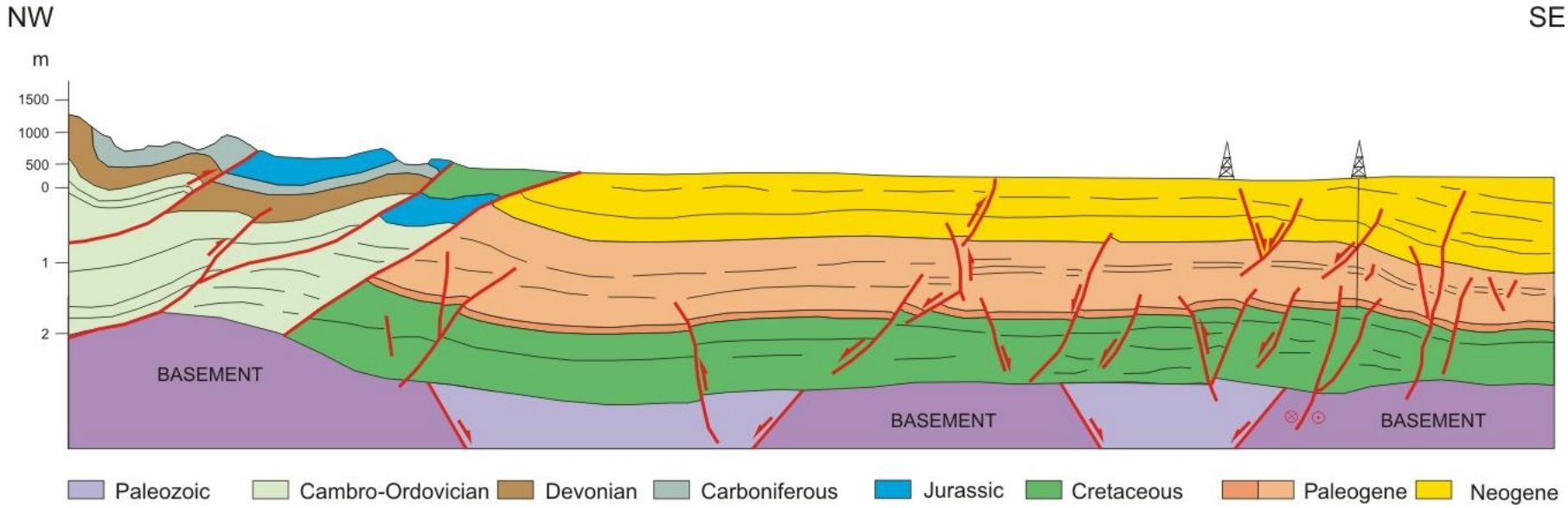
Source rock, reservoirs and seals

PETROLEUM SYSTEM ELEMENT	LITHOLOGIC UNIT	REMARKS
S Source	Gachetá Fm	TOC: 1.0 – 3.0%
R Reservoir	Carbonera Fm Mirador Fm Guadalupe Fm Une Fm	Sandstones Porosity: 10 – 30%
S Seal	León Fm* Carbonera Fm (C2, C4, C6 & C8 Zones) Interbedded shales in Guadalupe Fm & Gachetá Fm	*Regional Seal Local and intraformational shales



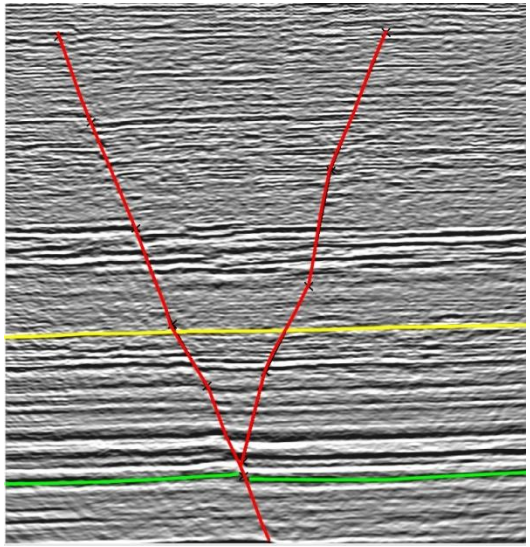
Eastern Llanos

Regional structural style



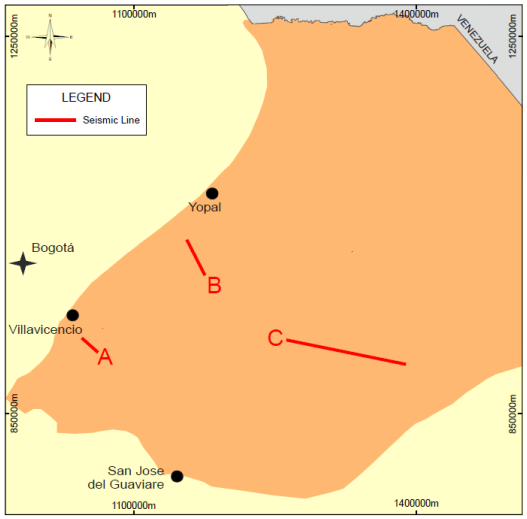
Trap styles within Llanos Basin

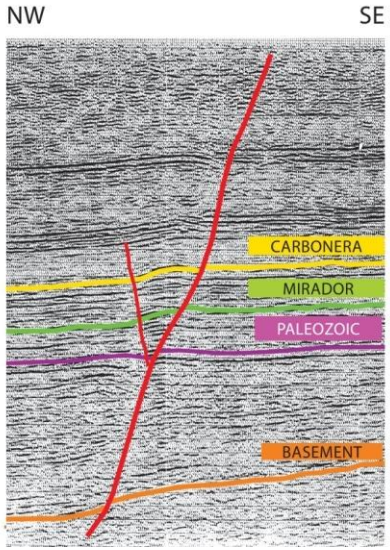
- **Antithetic normal faults**
- **Inversion structures**
- **Anticlines over inversion faults**
- **Stratigraphic traps**
- **Fault-propagation folds**
- **Potential Paleozoic structures**



Eastern Llanos

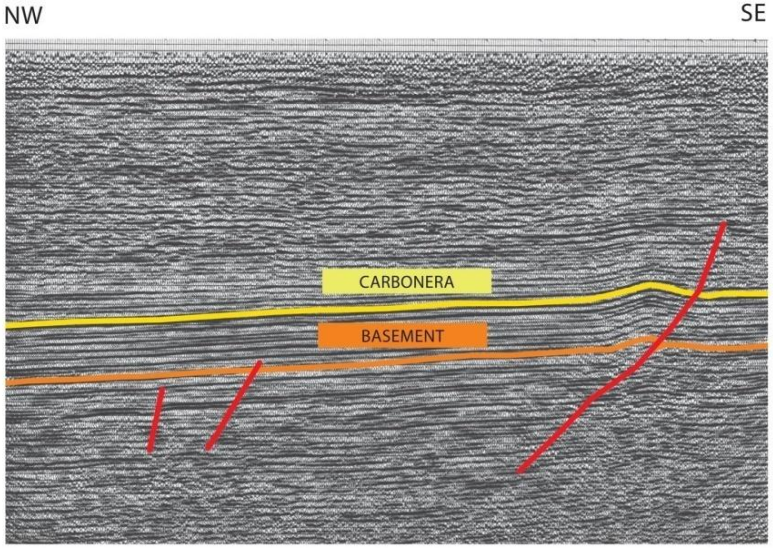
Examples of play types



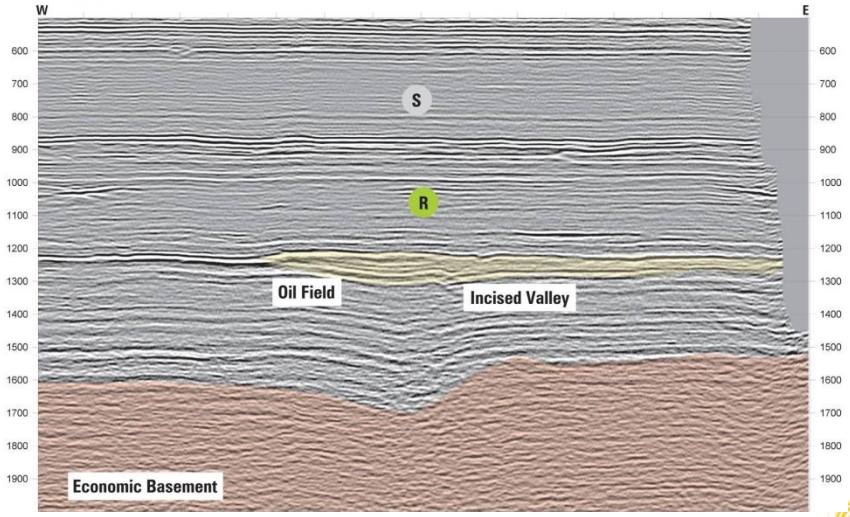


A) Roll-over anticline related to the mild inversion of a normal fault

B) Anticline related to a contractional fault. Carbonera Fm. over a basement high



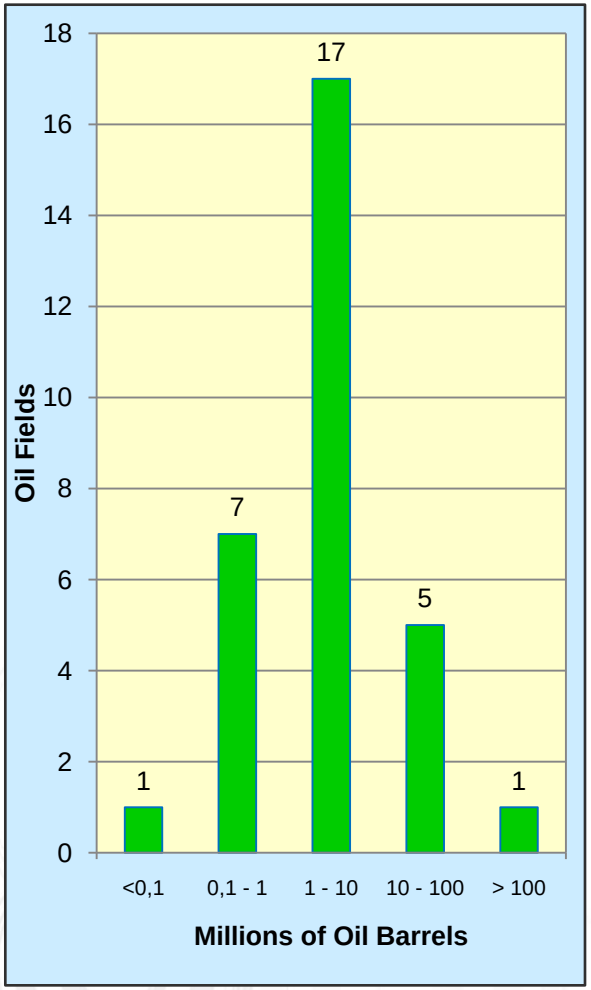
C) Stratigraphic Trap – Incised valley and lateral pinching out



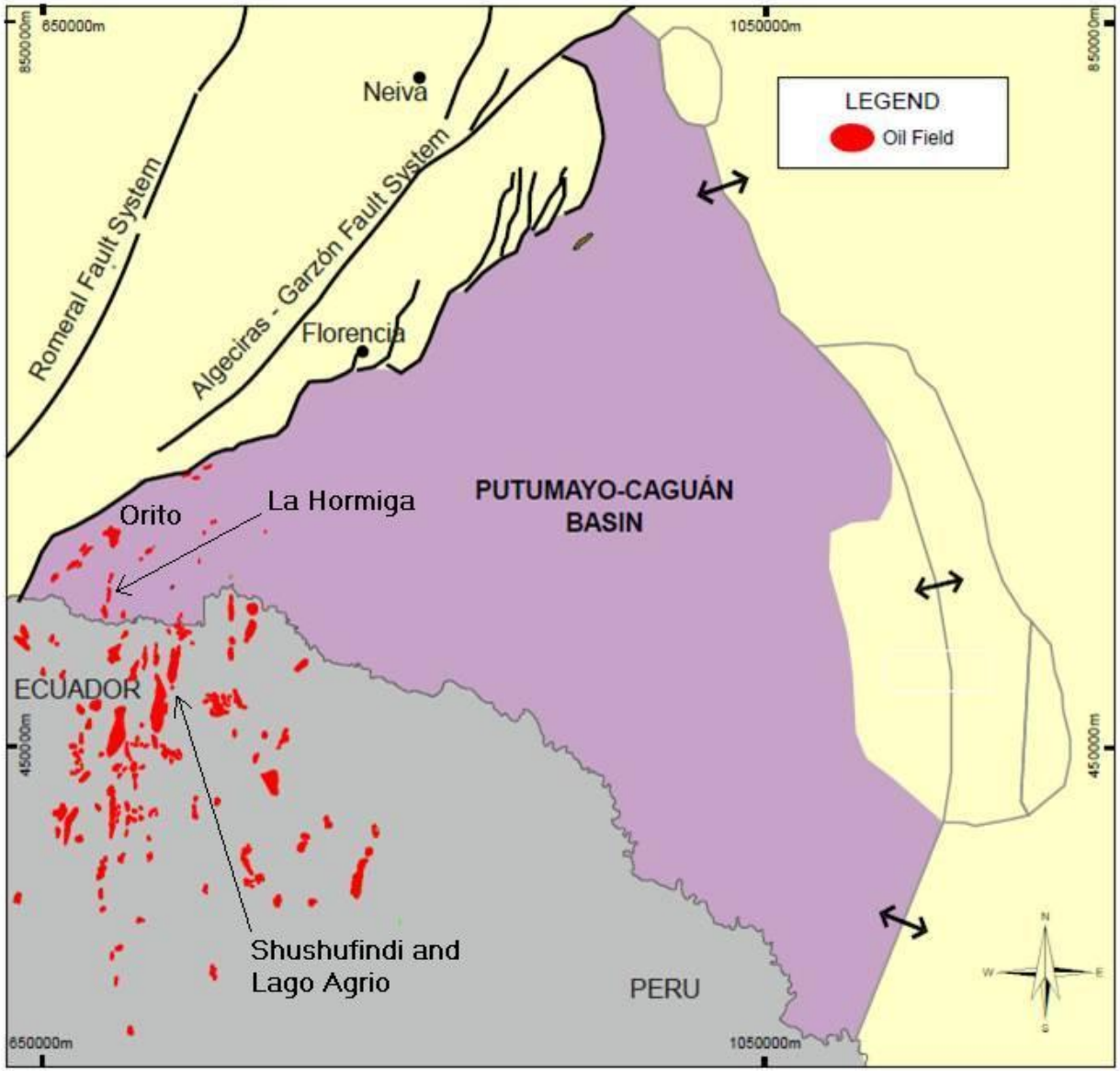
Putumayo - Caguán

Oil & gas fields

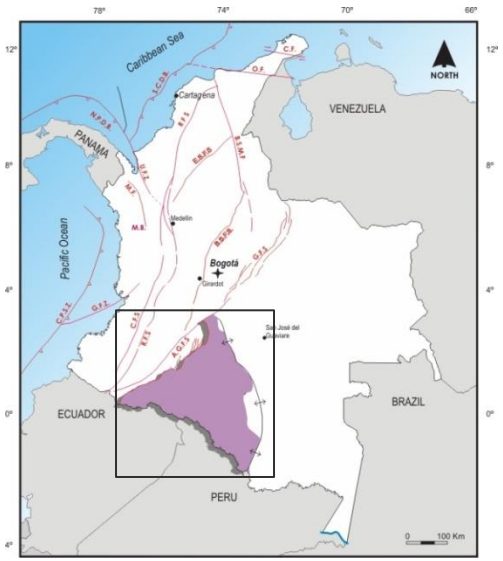
Oil Fields Size Distribution



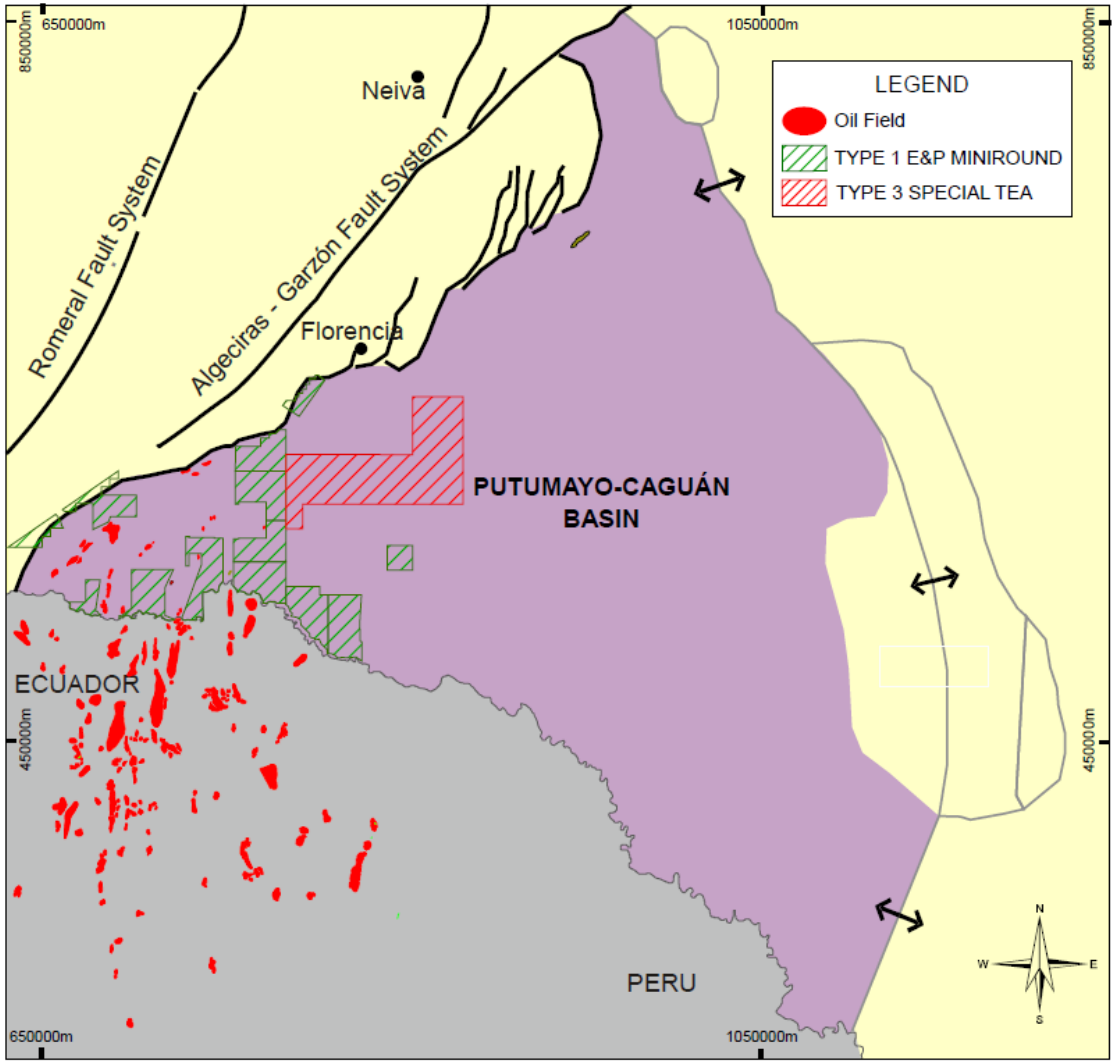
Statistics for 31 Oil Fields



Putumayo - Caguán



Location map with the offered blocks



OPEN ROUND 2010 BLOCKS

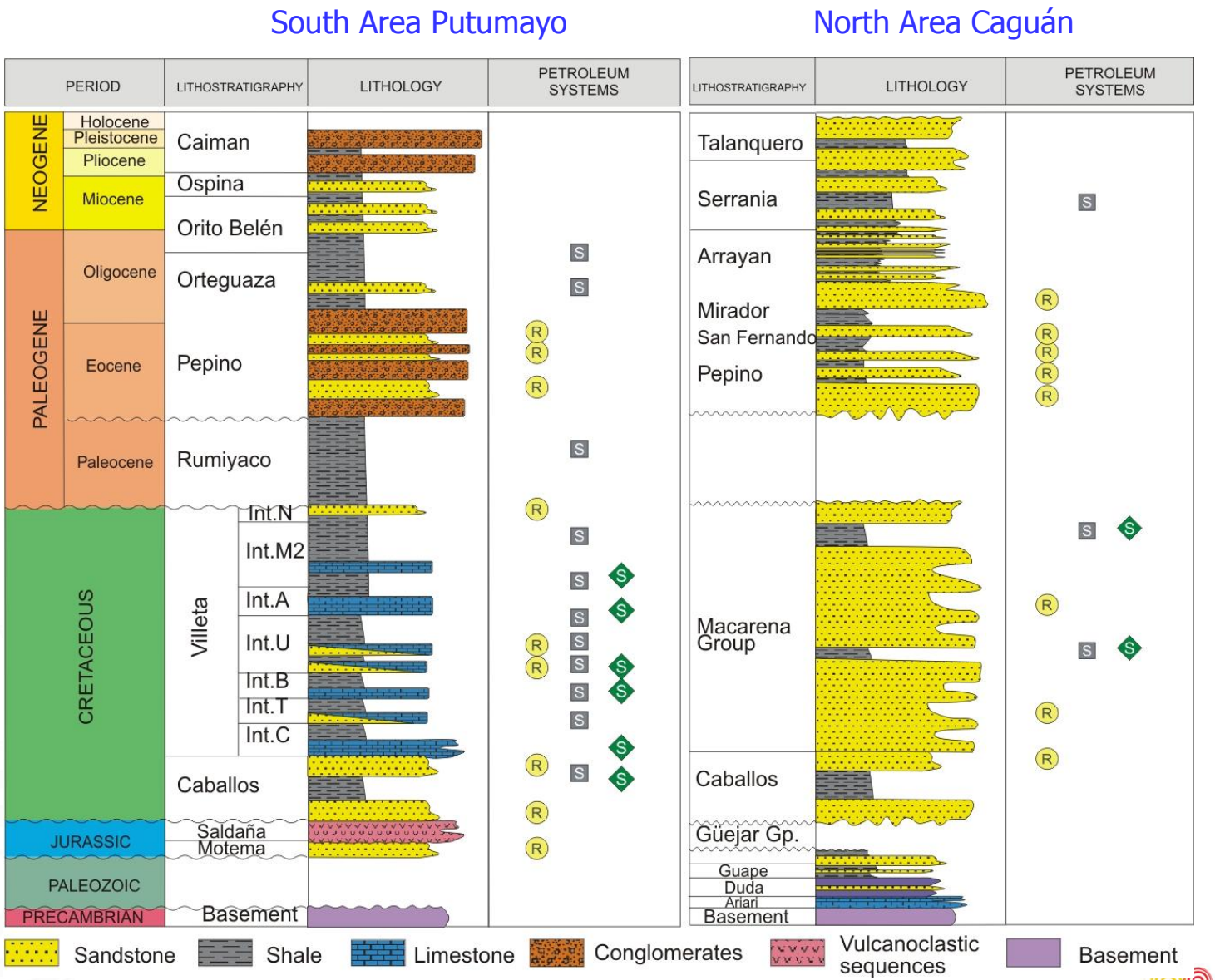
Type 1: 13 Blocks
5,615 Km^2

Type 3: 1 Block
3,720 Km^2

Putumayo - Caguán

Petroleum geology (I)

Stratigraphic chart showing source rocks, reservoirs and seals

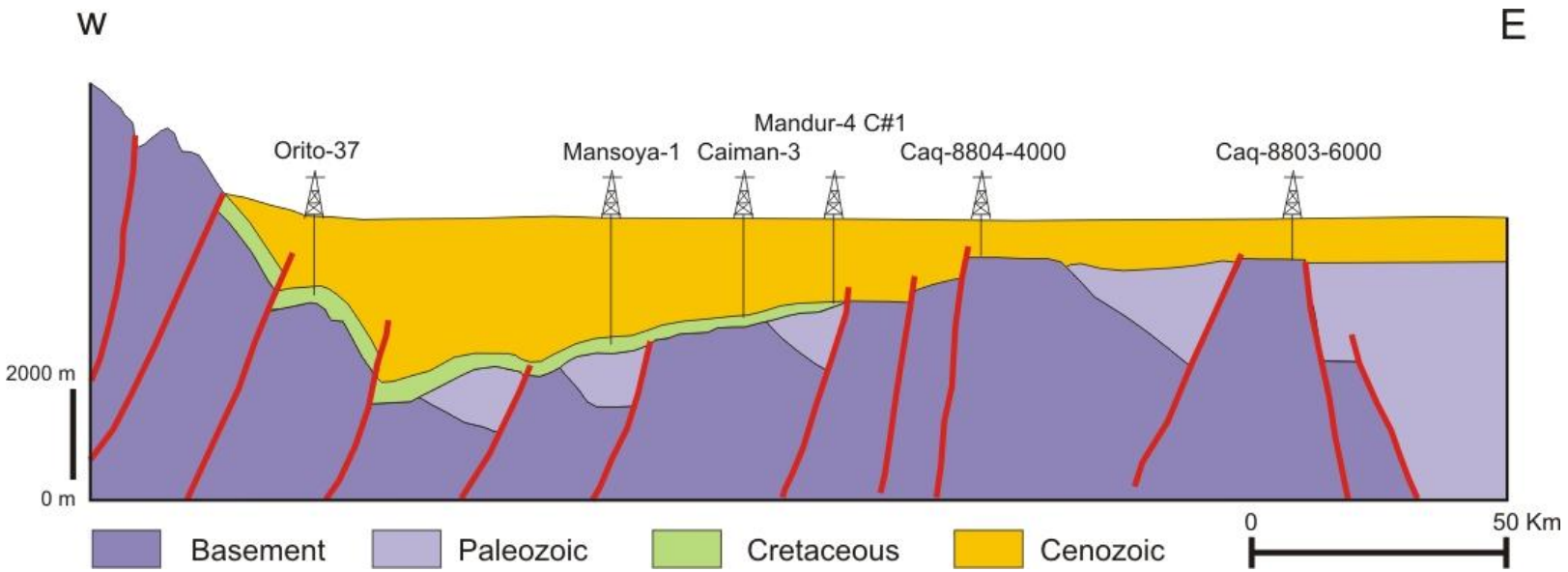


Source rocks, reservoirs and seals

PETROLEUM SYSTEM ELEMENT	LITHOLOGIC UNIT	REMARKS
S Source	Villeta Fm Caballos Fm (Middle interval)	Kerogen: Type II - III HI 100 – 500 mg HC/ g TOC
	Macarena Gp (Upper & middle intervals)	TOC: > 7.3% Kerogen: Type II
R Reservoir	Caballos Fm Villeta Fm (Limestones) Pepino Fm	Caballos Fm. Porosity: 10 – 16% Permeability: around 50 mD
	Caballos Fm Macarena Gp Cenozoic units	Transitional to fluvial sandstones
S Seal	Villeta Fm Cenozoic shales	In the foothills thrust faults may act as effective seals

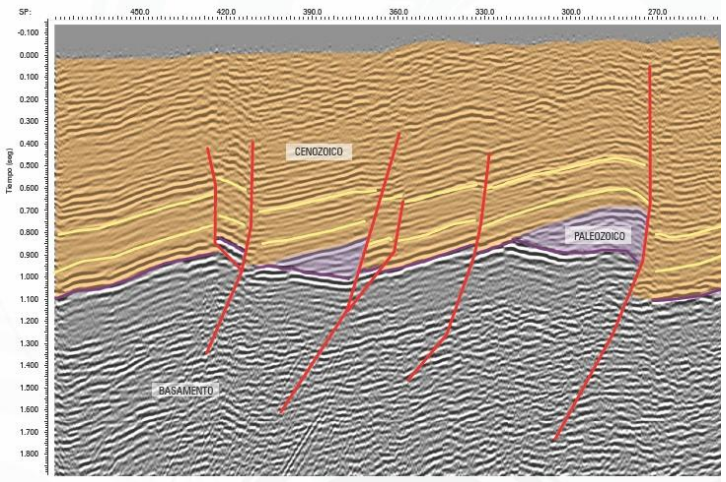
Putumayo - Caguán

Regional structural style



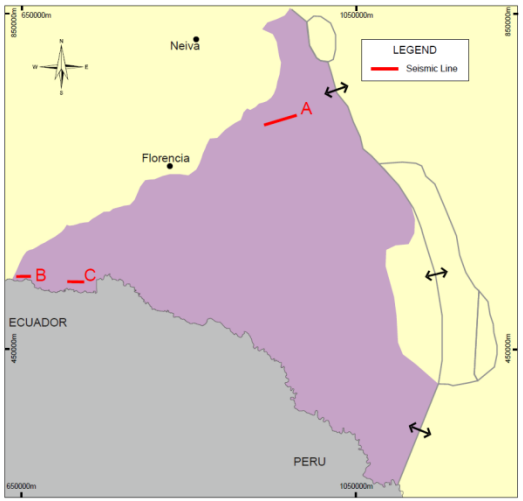
Trap styles within the Putumayo-Caguán Basin

- **Antithetic normal faults**
- **Inversion structures**
- **Anticlines over inversion faults**
- **Stratigraphic traps**
- **Fault-propagation folds**
- **Potential Paleozoic structures**

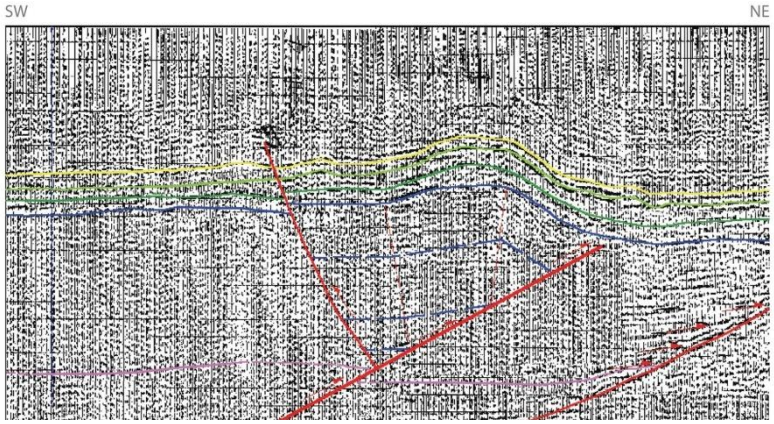


Putumayo - Caguán

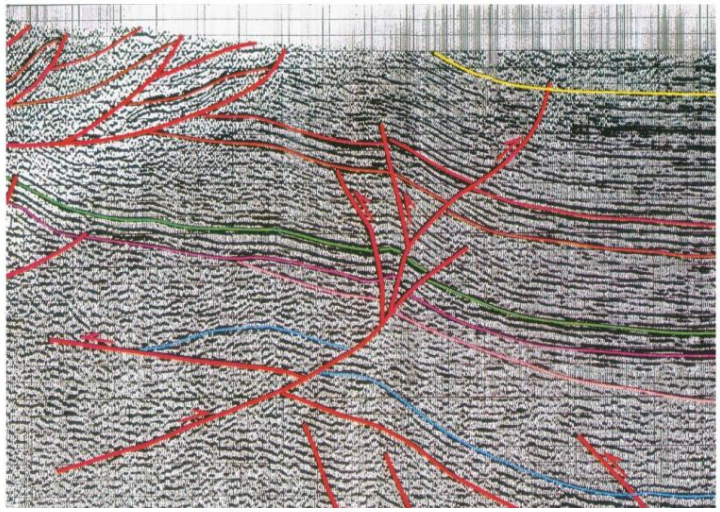
Examples of play types



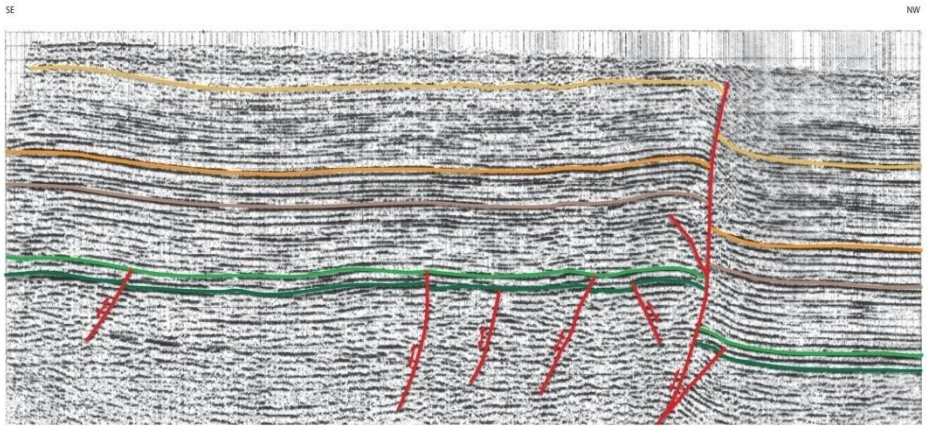
A) Wide anticline related to a reverse fault
Caguán Basin



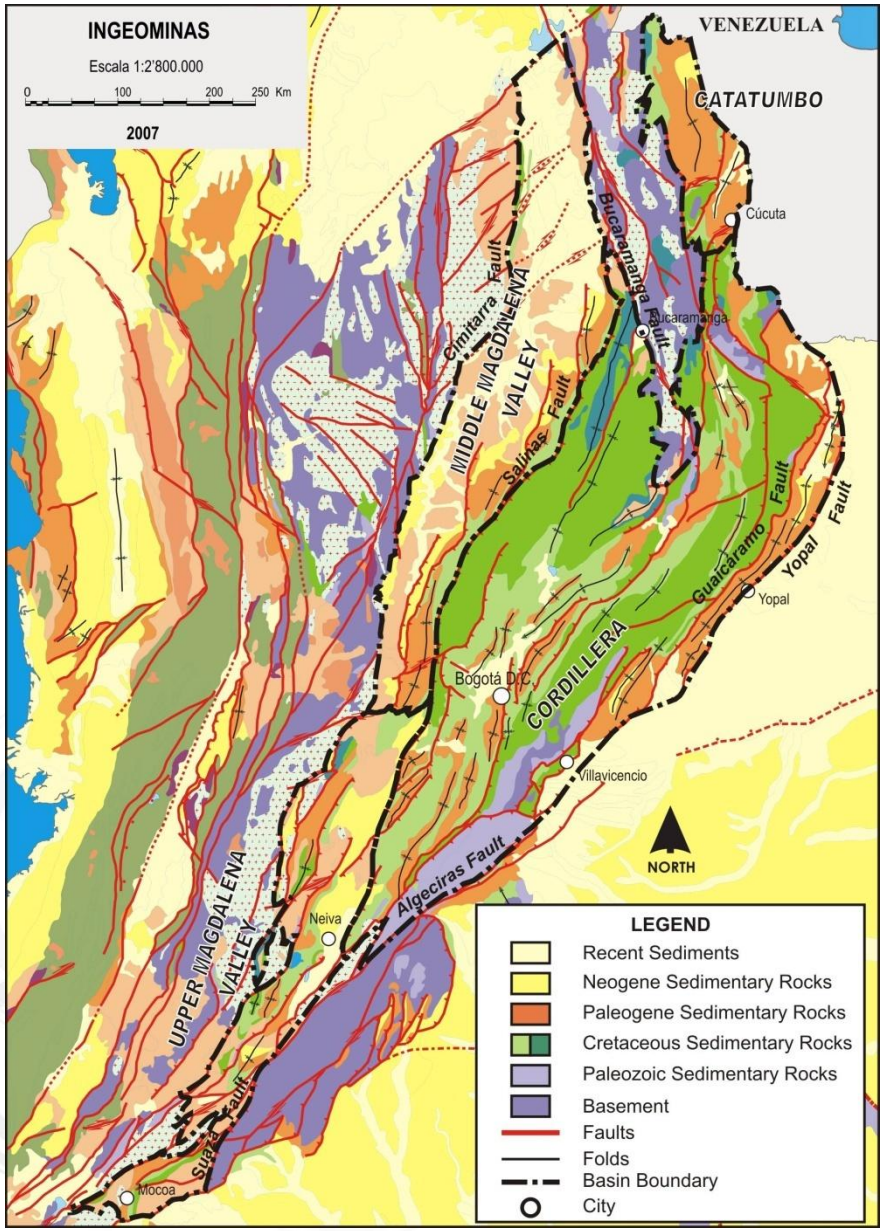
B) Anticline related to a branching reverse fault
Putumayo Basin

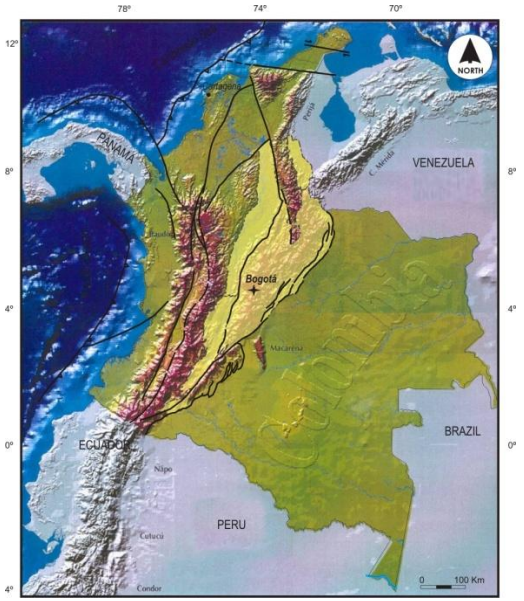


C) Drag folds in the limbs of an inverted fault
Putumayo Basin



Cordillera and intermountain basins





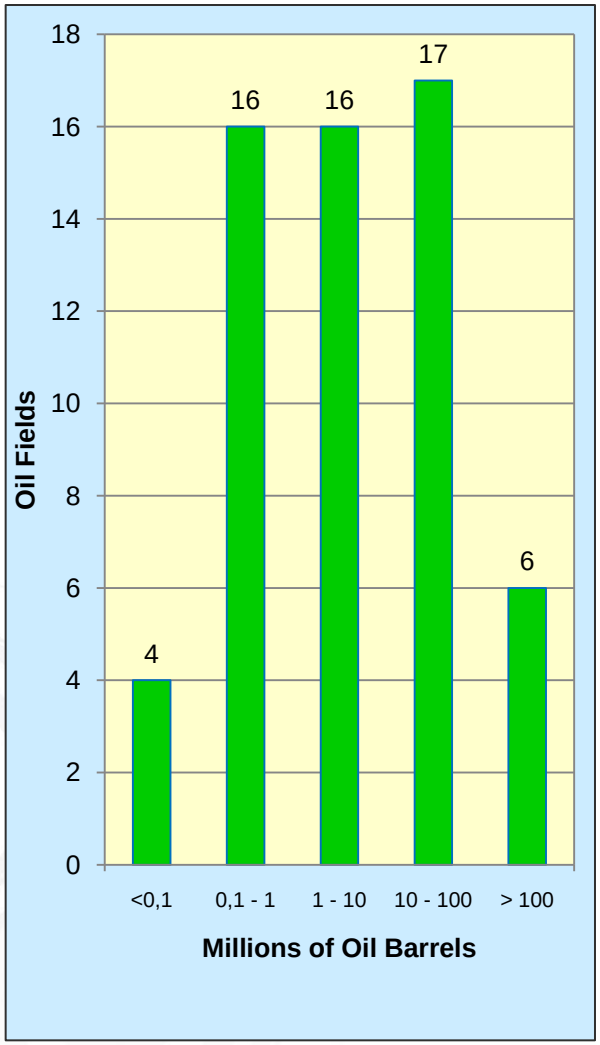
Basins

Middle Magdalena Valley
Upper Magdalena Valley
Catatumbo
Cordillera Oriental

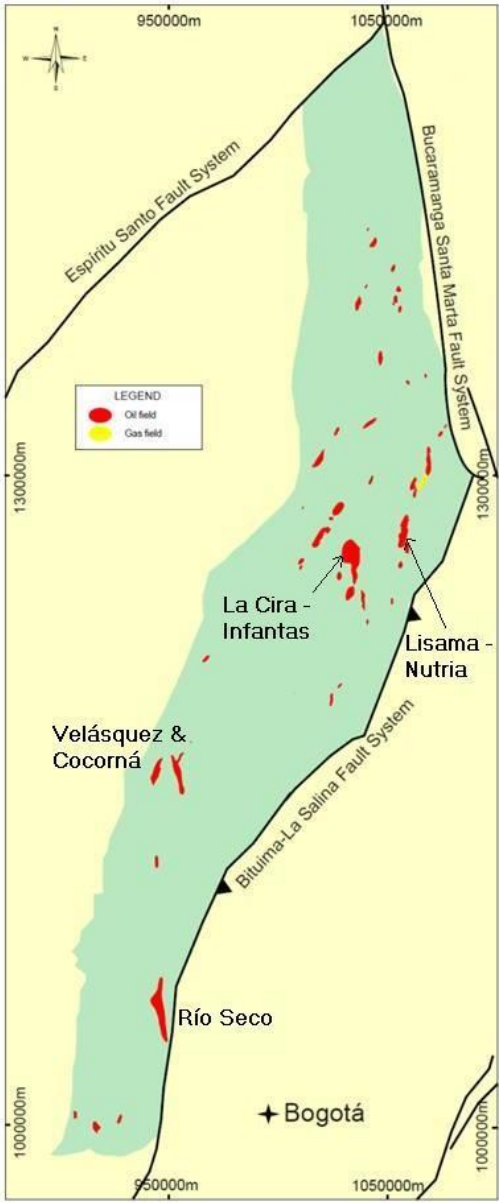
Middle Magdalena Valley

Oil & gas fields

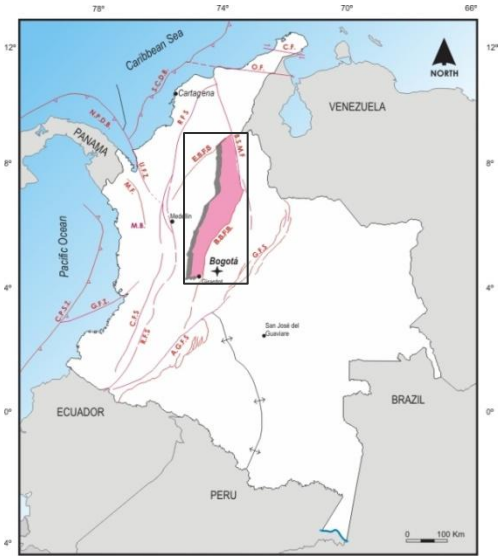
Oil Fields Size Distribution

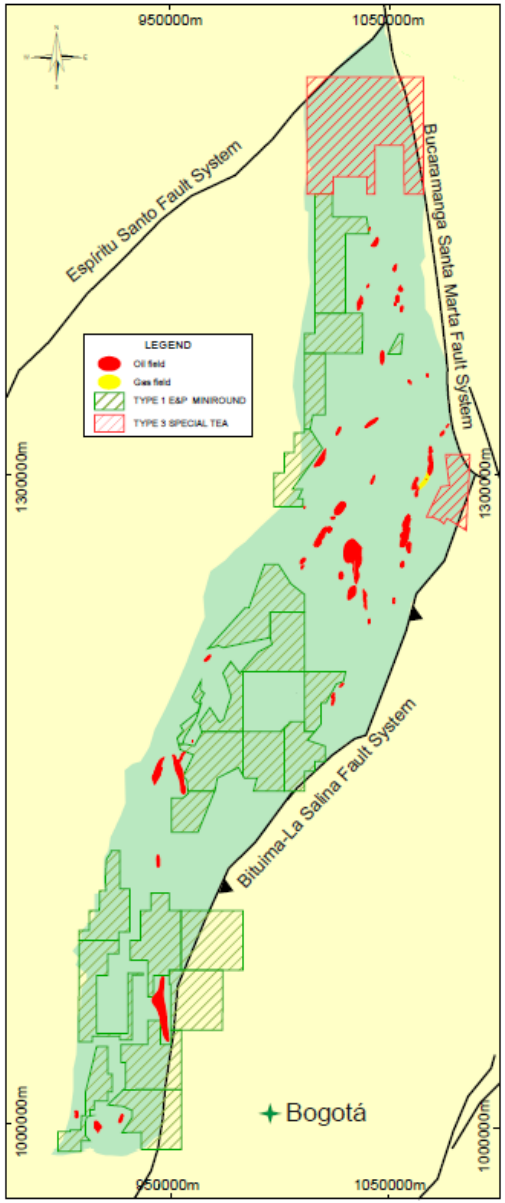


Statistics for 51 Oil Fields



Middle Magdalena Valley





Location map with the offered blocks

OPEN ROUND 2010 BLOCKS

Type 1: 20 Blocks
8,898 Km^2

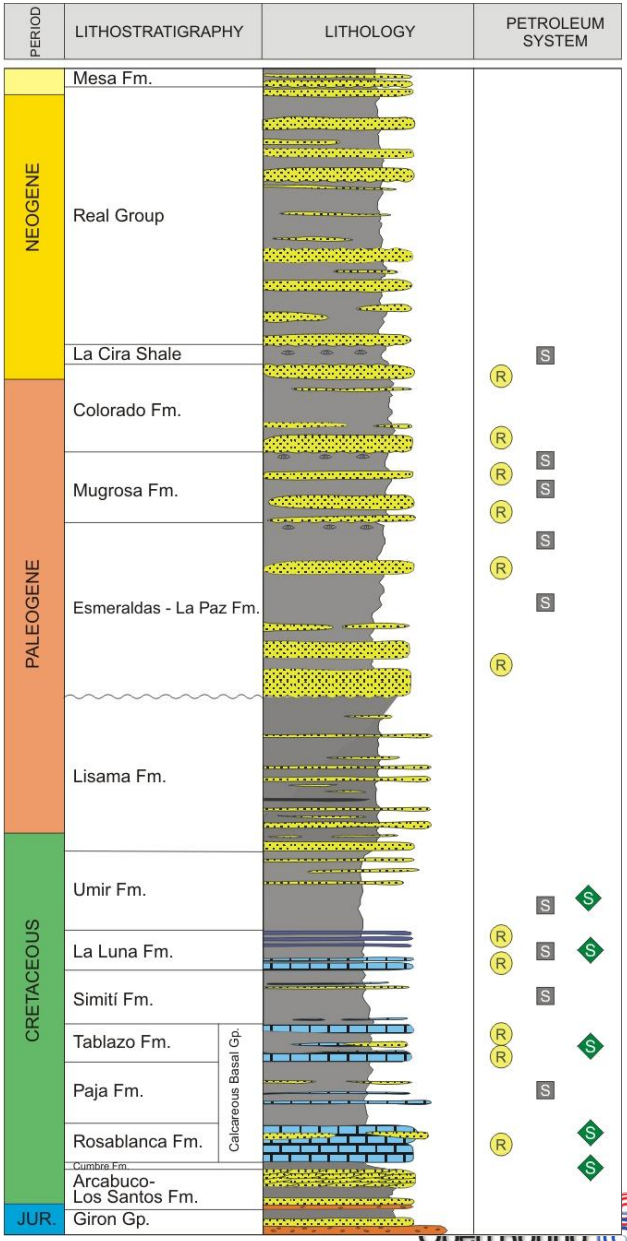
Type 3: 2 Blocks
2,996 Km^2

Middle Magdalena Valley

Petroleum geology

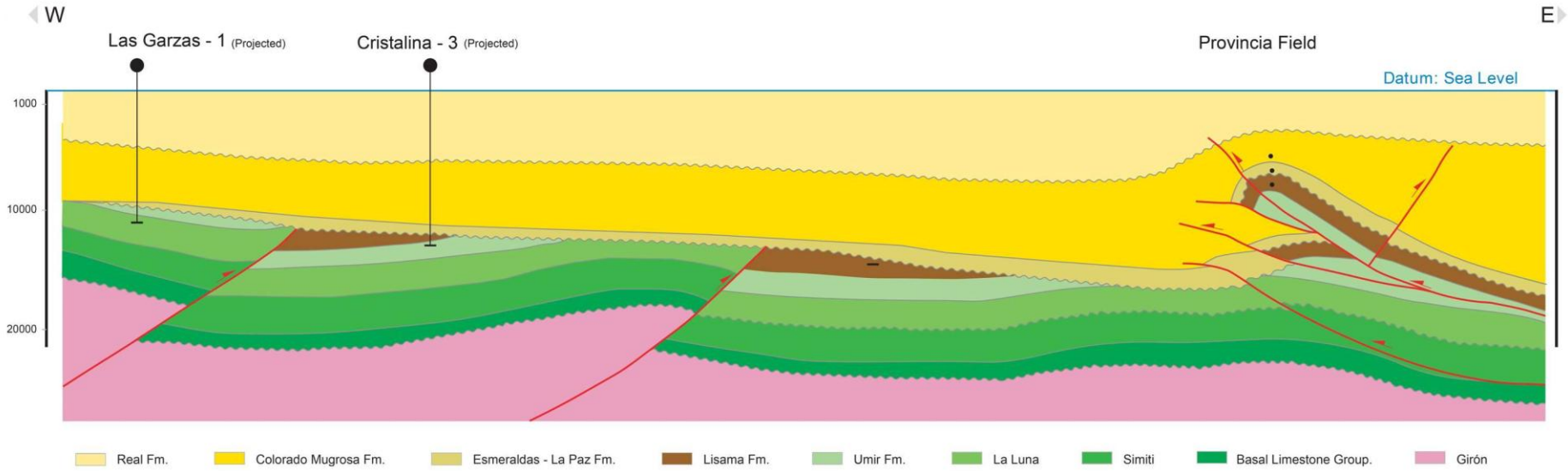
Source rocks, reservoirs and seals

PETROLEUM SYSTEM ELEMENT	LITHOLOGIC UNIT	REMARKS
S Source	La Luna Fm Simití Fm Tablazo Fm	TOC: 1.0 – 6.0% Kerogen: Type II %Ro: 1.1 – 1.2
R Reservoir	Colorado Fm Mugrosa Fm Esmeralda Fm La Paz Fm	Sandstones Porosity: 15 – 20% Permeability: 20 – 600 mD
	La Luna Fm Tablazo Fm Rosablanca Fm	Fractured limestones
S Seal	Colorado Fm(1) Esmeralda Fm(1) Umir Fm(2) Simití Fm(2)	(1) Cenozoic seals (2) Cretacous seals



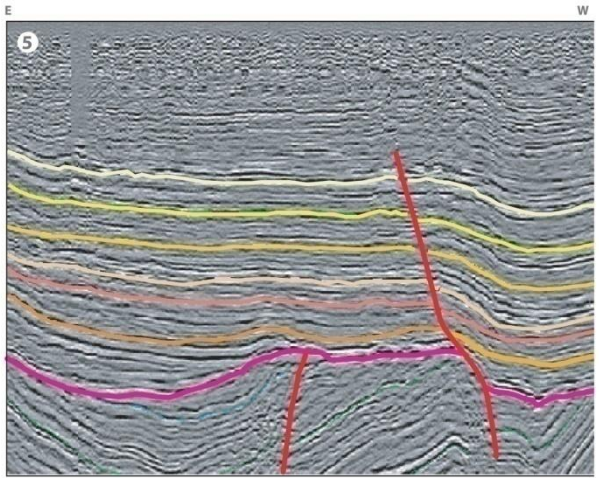
Middle Magdalena Valley

Regional structural style



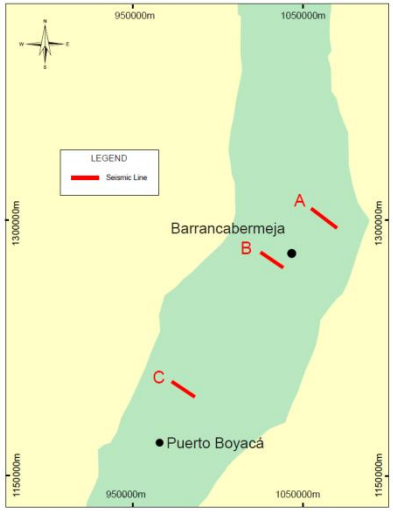
Trap styles within the Middle Magdalena Basin

- **Inversion structures**
- **Subthrust folds**
- **Duplex structures**
- **Fault seal traps**
- **Stratigraphic traps**

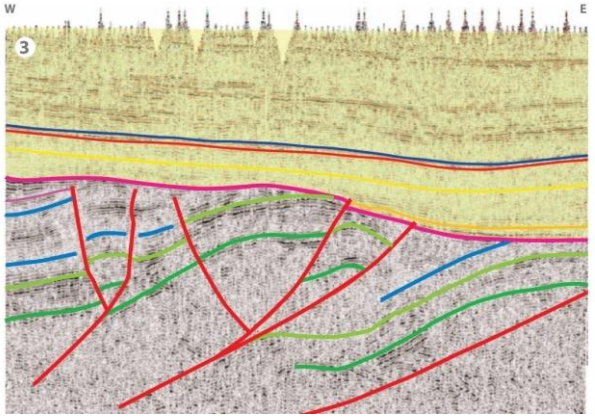


Middle Magdalena Valley

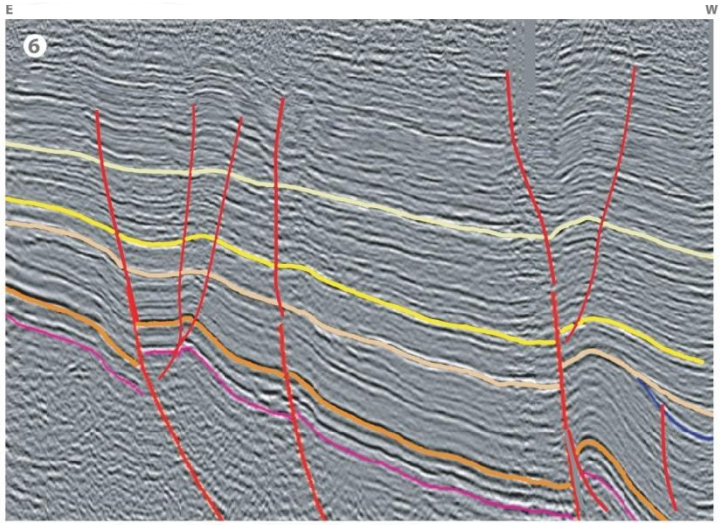
Examples of play types



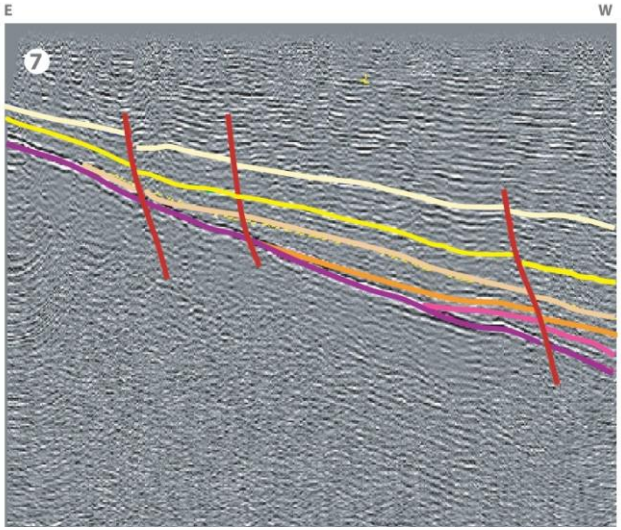
A) Cretaceous reservoirs – Anticlines related to reverse faults – Puntapiedra area



B) Cenozoic reservoirs – Anticlines related to wrench faults – Casabe area



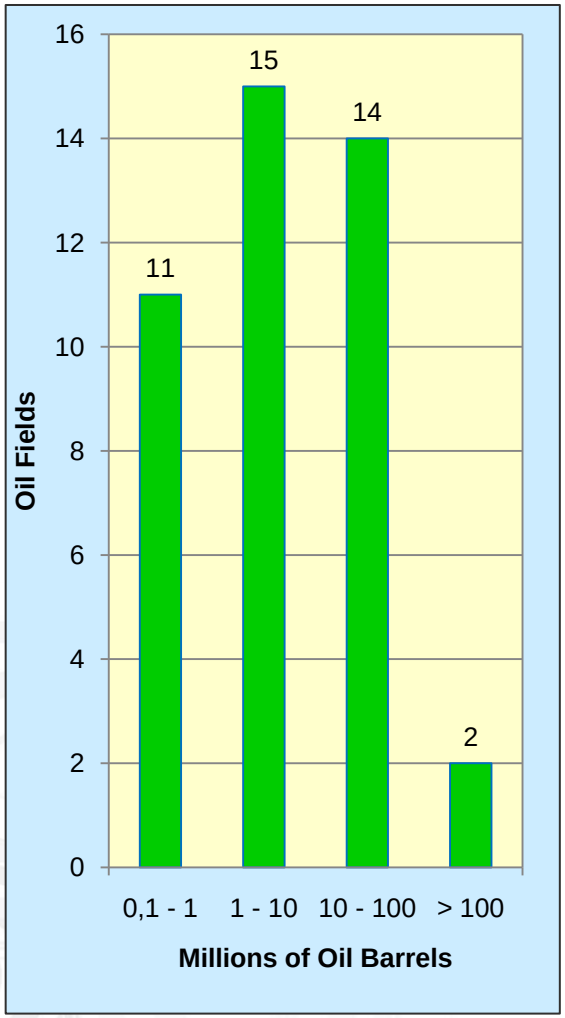
C) Stratigraphic trap – Onlap of Miocene reservoirs over the basement – Central area



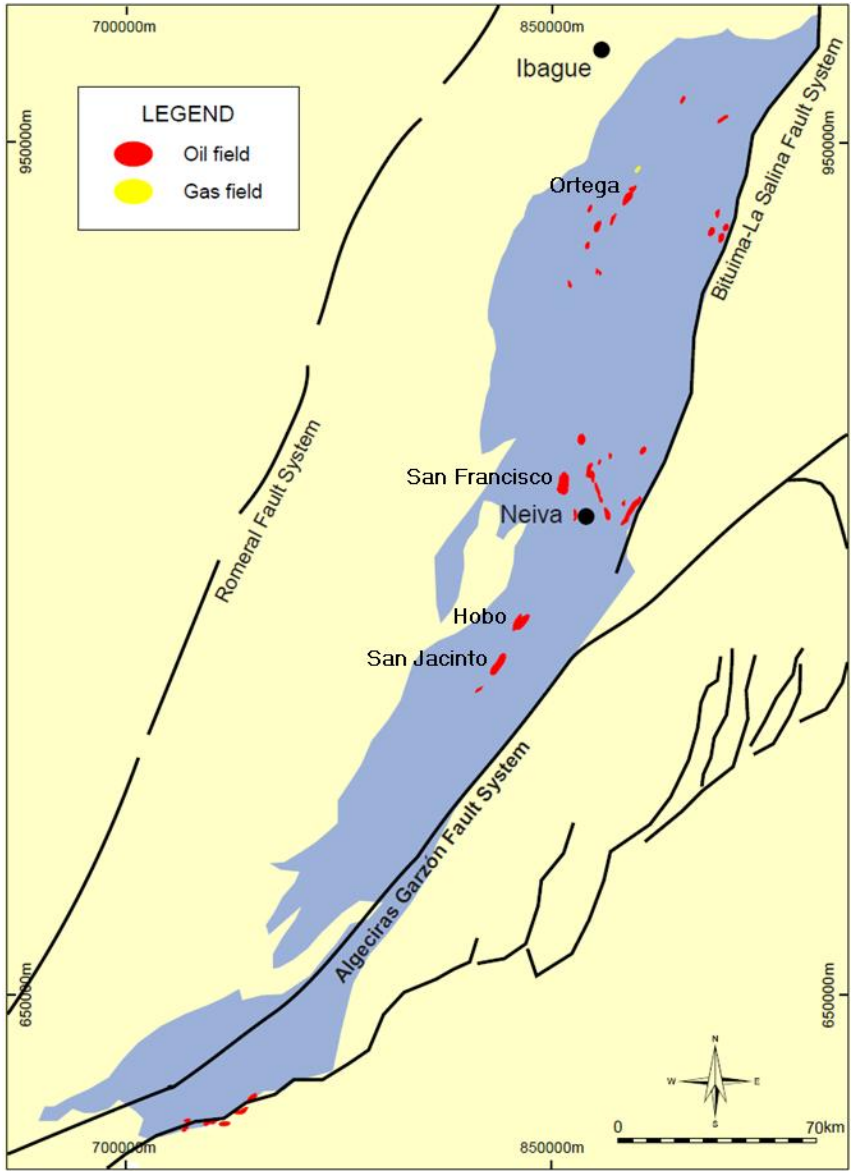
Upper Magdalena Valley

Oil & gas fields

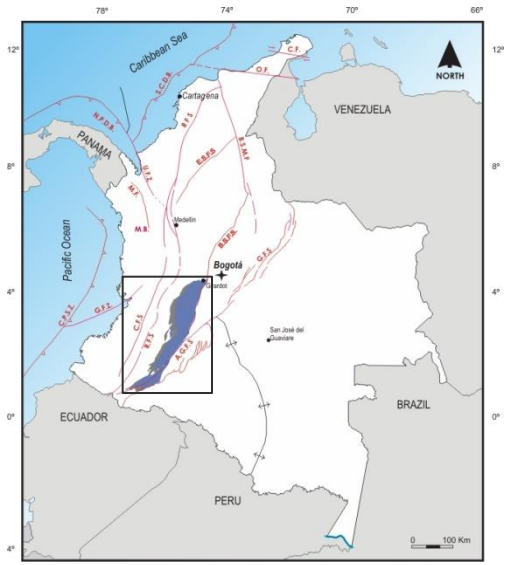
Oil Fields Size Distribution

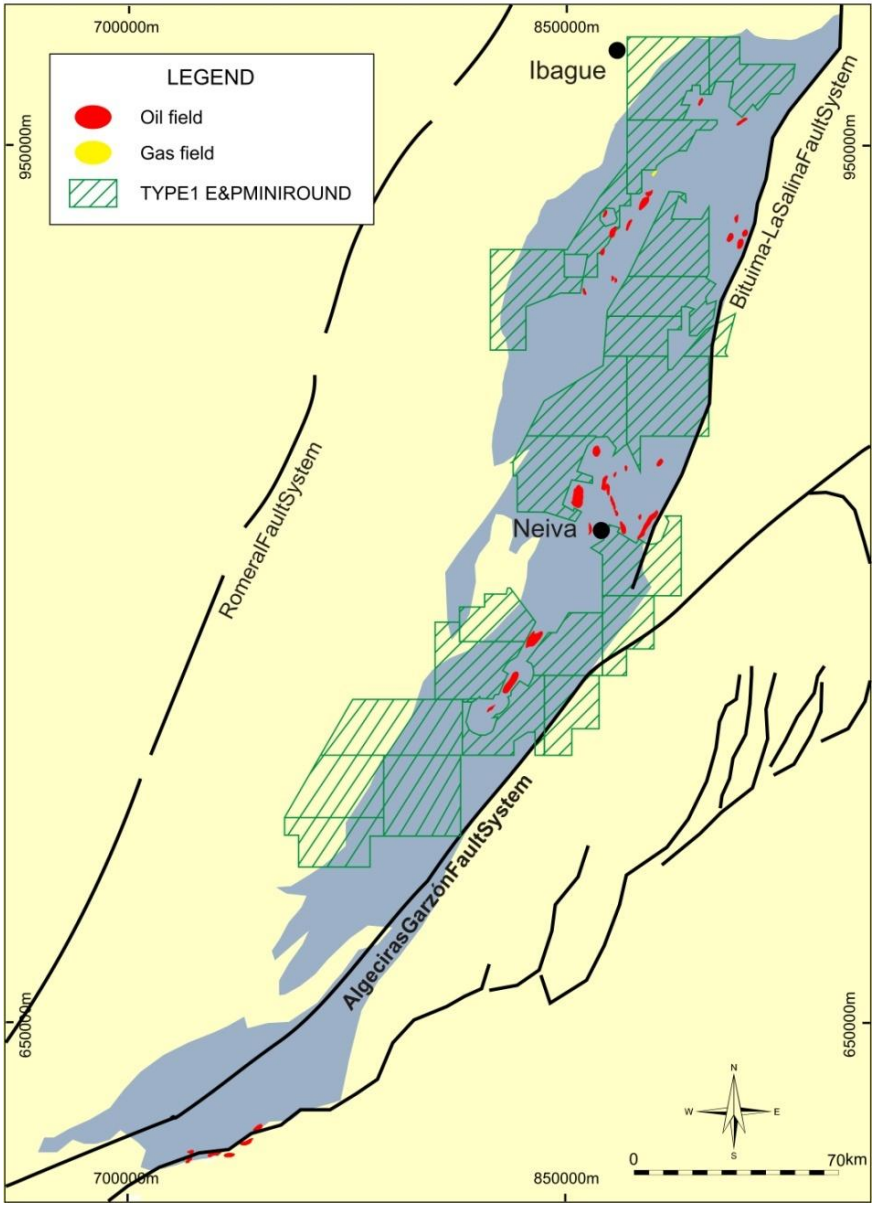


Statistics for 42 Oil Fields



Upper Magdalena Valley





Location map with the offered blocks

OPEN ROUND 2010 BLOCKS

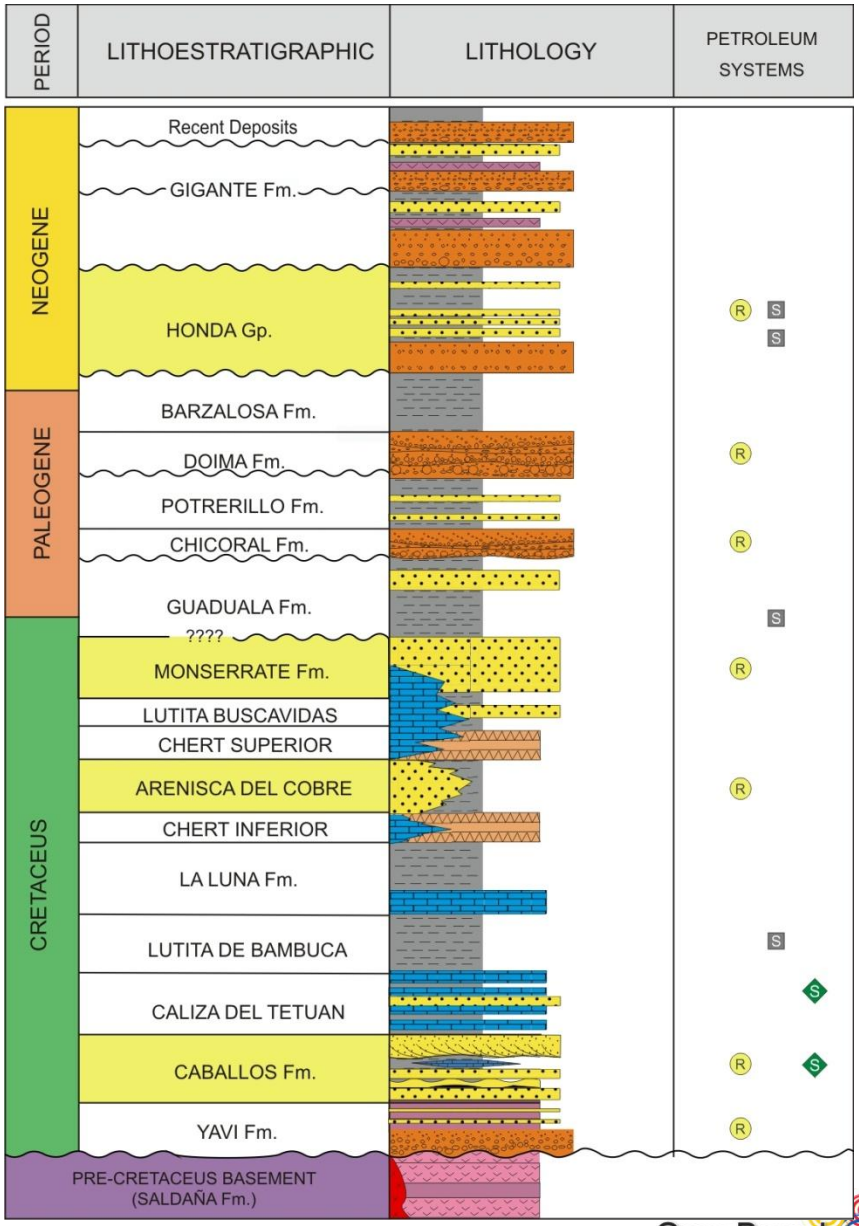
Type 1: 23 Blocks
9,846 Km^2

Upper Magdalena Valley

Petroleum geology

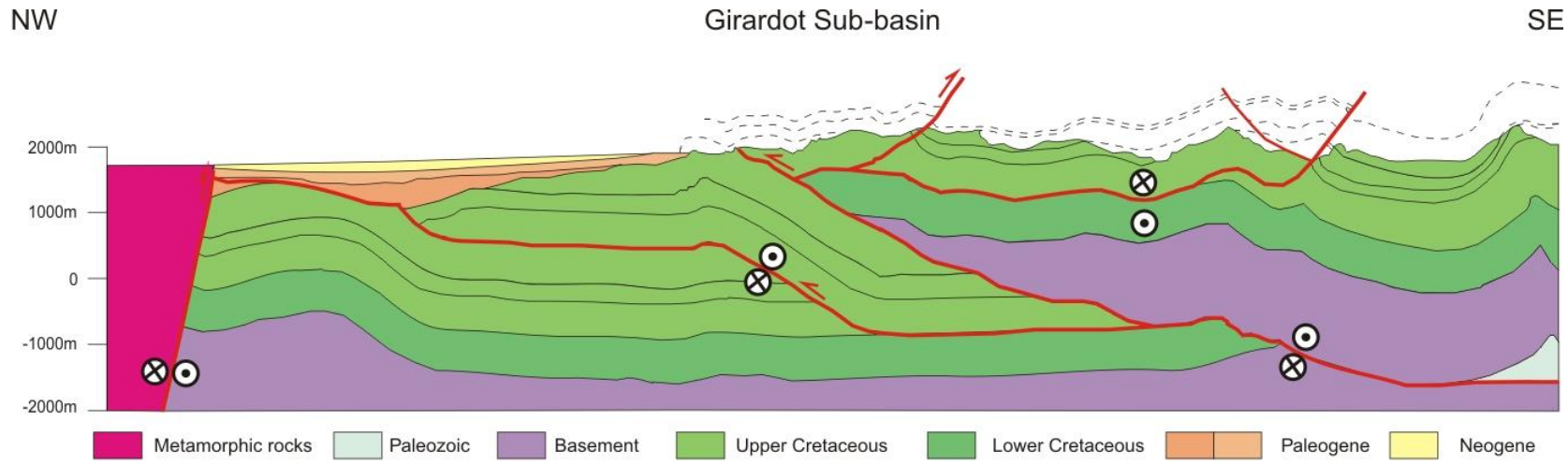
Source rocks, reservoirs and seals

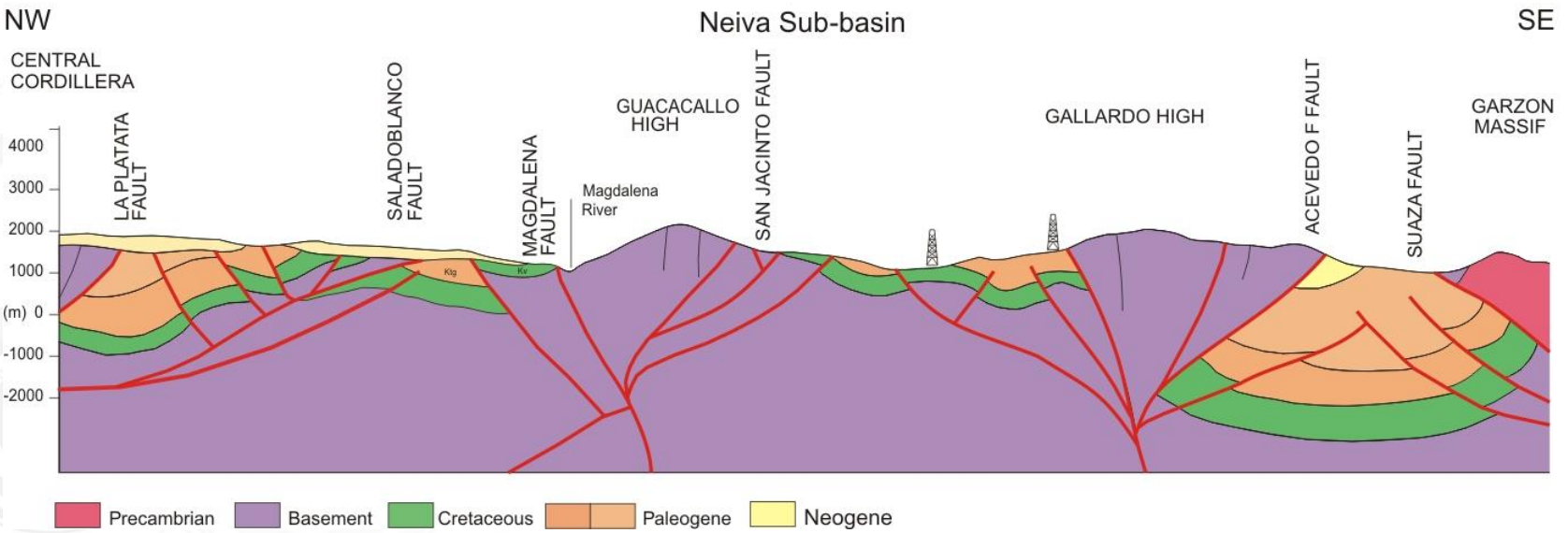
PETROLEUM SYSTEM ELEMENT	LITHOLOGIC UNIT	REMARKS
S Source	La Luna Fm Bambucá Fm Tetuán Fm	TOC: >5.0% Kerogen: Type II %Ro: 0.5 – 1.3 Tmax: 450°
R Reservoir	Honda Gp Monserrate Fm Caballos Fm	Sandstones Occasional limestone units
S Seal	Honda Gp Guaduala Fm Bambucá Fm	Regional Seals



Upper Magdalena Valley

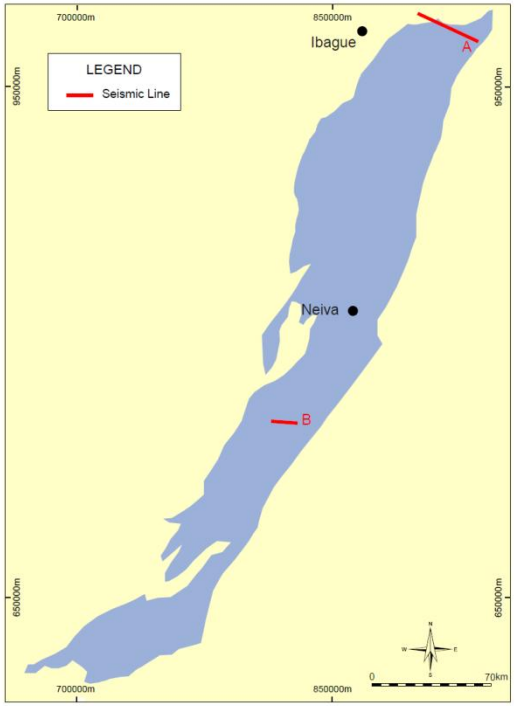
Regional structural style



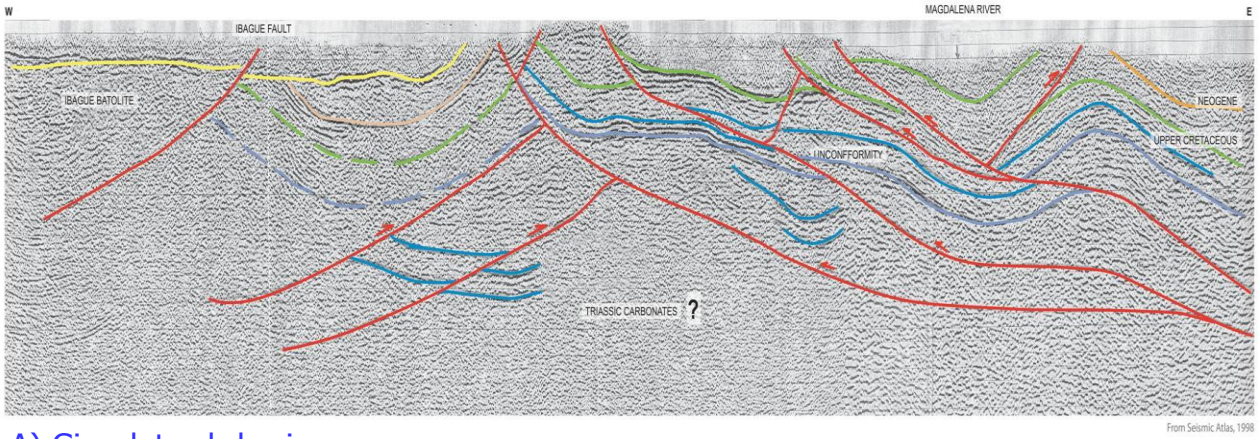


Upper Magdalena Valley

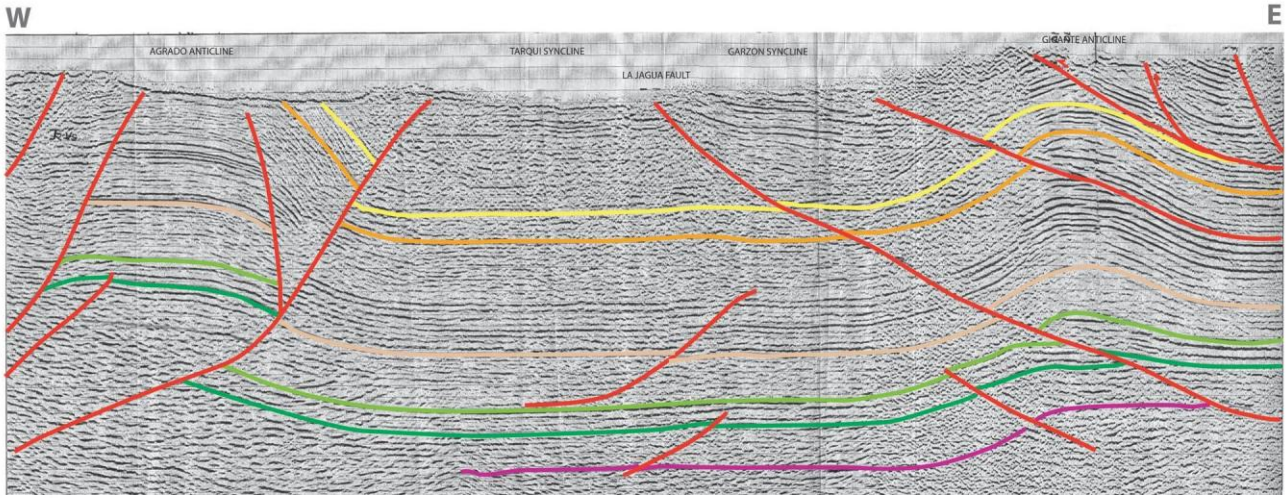
Examples of play types



Thrust and subthrust anticlinal traps
related to west-verging fault systems



A) Girardot sub-basin

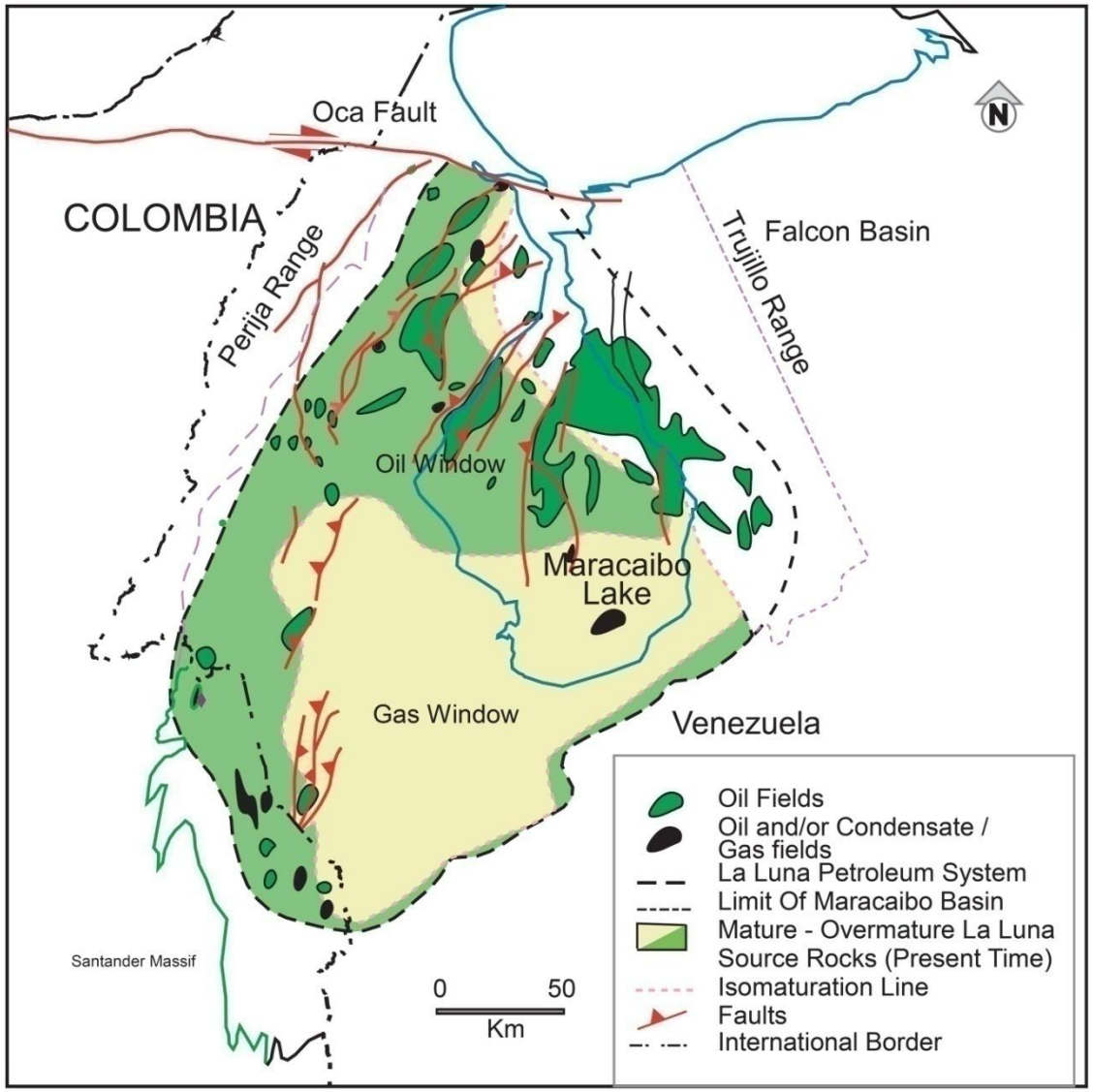


B) Neiva sub-basin

Catatumbo

Regional situation

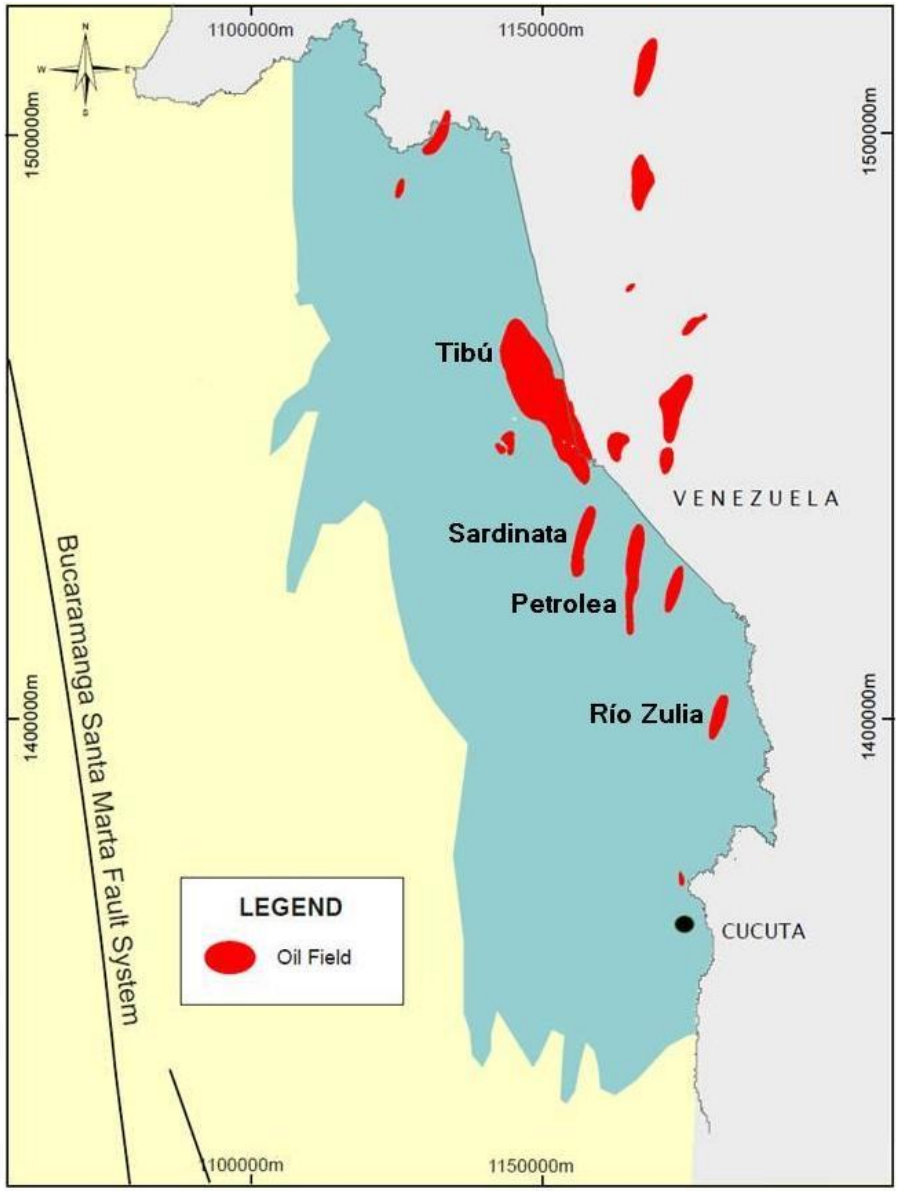
Catatumbo Basin
Southern portion of
Maracaibo Basin (Venezuela)



From Talukdar and Marcano, 1994

Catatumbo

Oil & gas fields



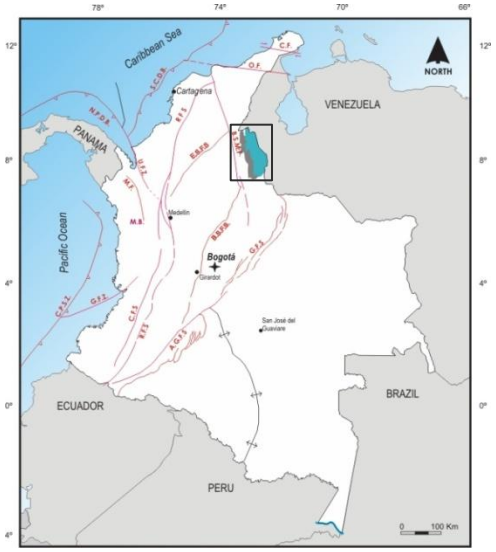
OIL FIELDS SIZE:

>100 MMBO: 2

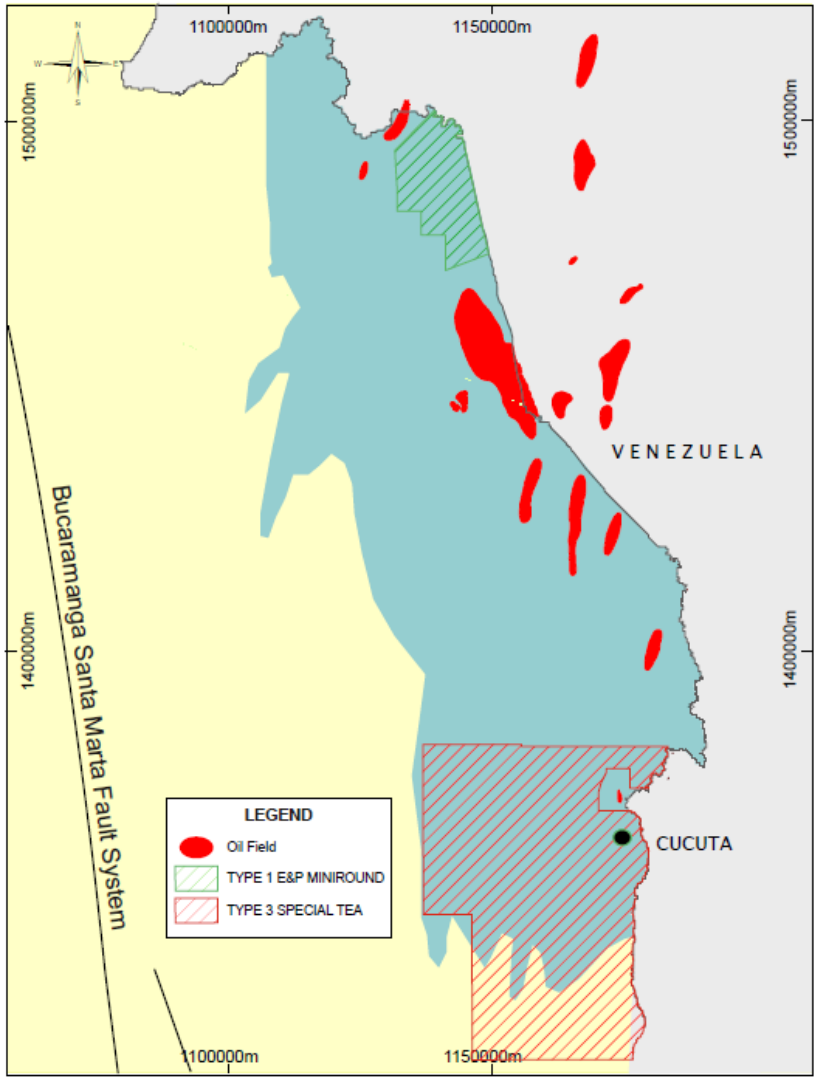
10 – 100 MMBO: 2

<1 MMBO: 2

Catatumbo



Location map with the offered blocks



OPEN ROUND 2010 BLOCKS

Type 1: 1 Block
315 Km^2

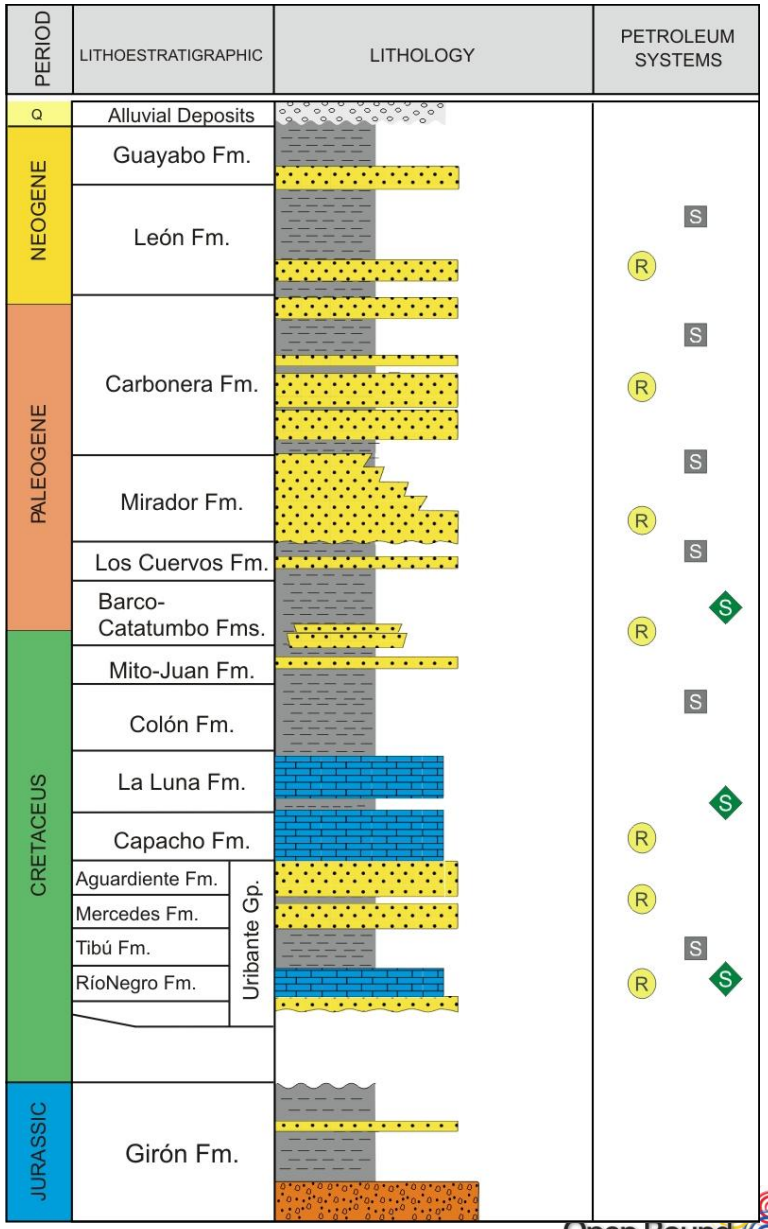
Type 3: 1 Block
2,157 Km^2

Catatumbo

Petroleum geology

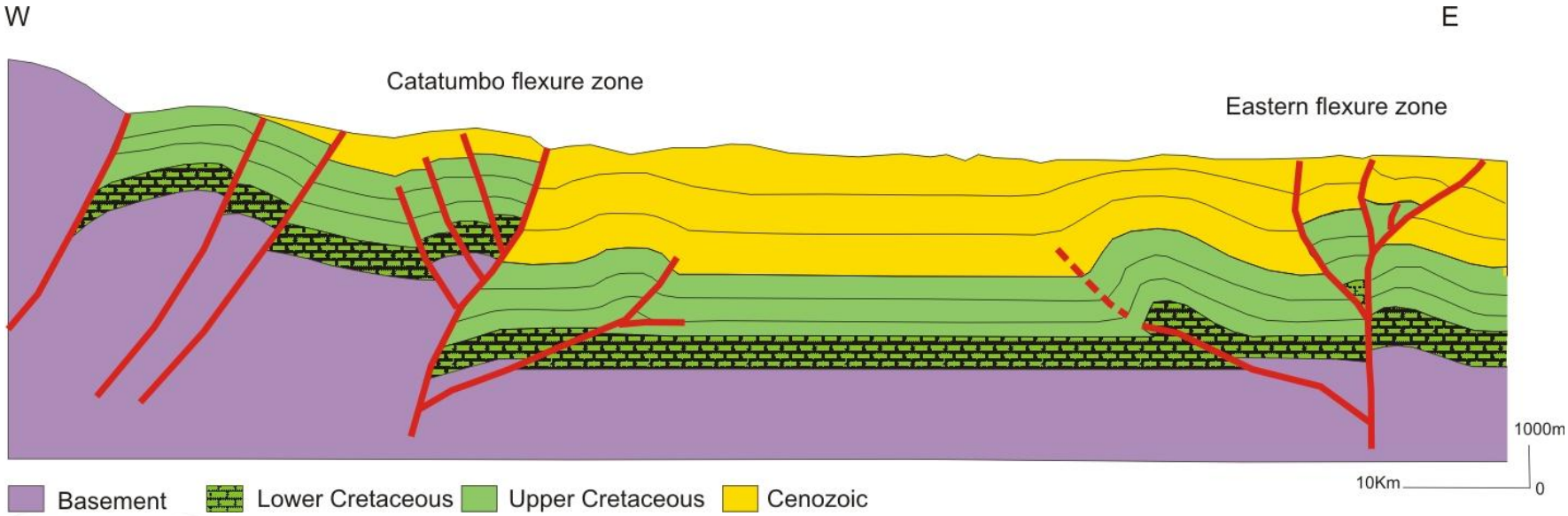
Source rocks, reservoirs and seals

PETROLEUM SYSTEM ELEMENT	LITHOLOGIC UNIT	REMARKS
S Source	La Luna Fm Capacho Fm Tibú Fm Mercedes Fm	La Luna Fm (principal source rock) TOC: 3.8%%
R Reservoir	Barco Fm Mirador Fm Carbonera Fm	Cenozoic sandstones
	Uribante Gp Capacho Fm	Fractured limestones
S Seal	Cenozoic and Cretaceous shales	León Fm (regional seal)



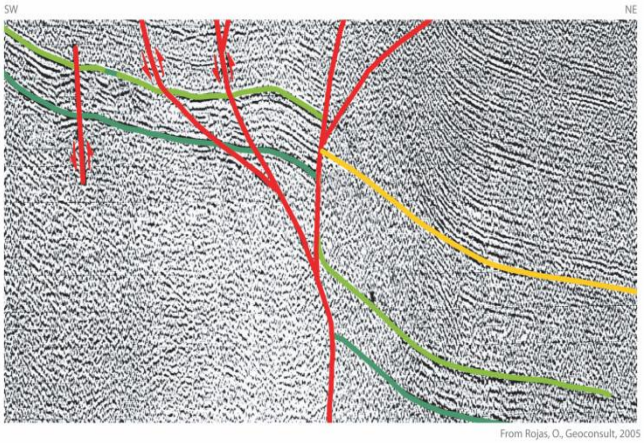
Catatumbo

Regional structural style



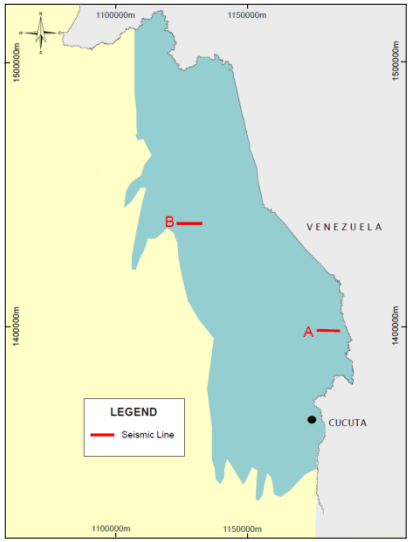
Trap styles within the Catatumbo Basin

- **Inversion structures**
- **Strike-slip faults (east)**



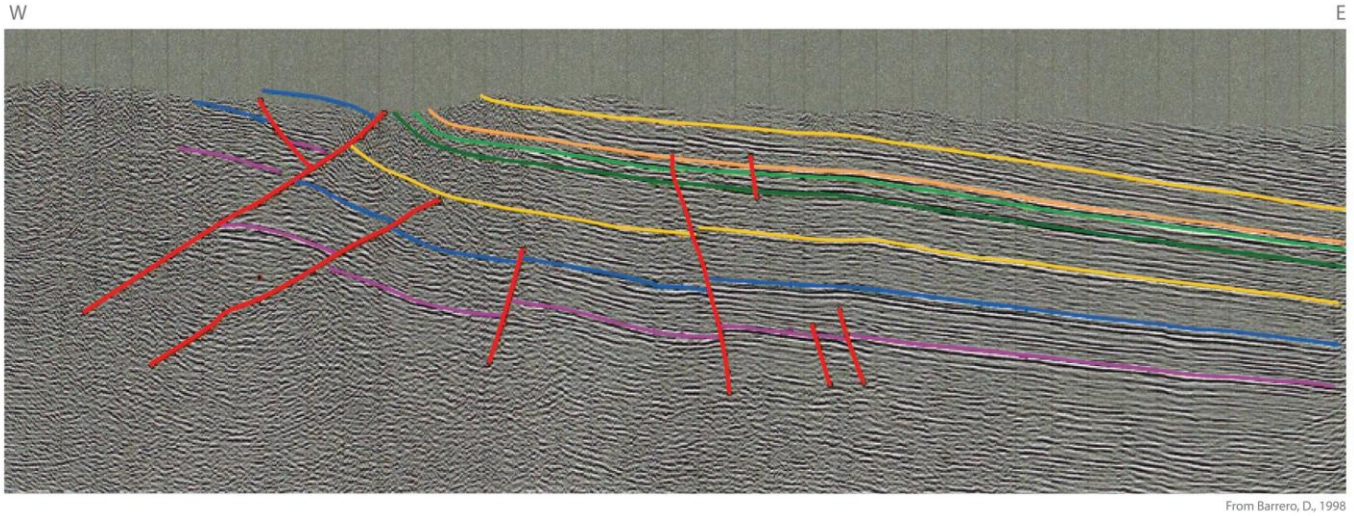
Catatumbo

Examples of play types



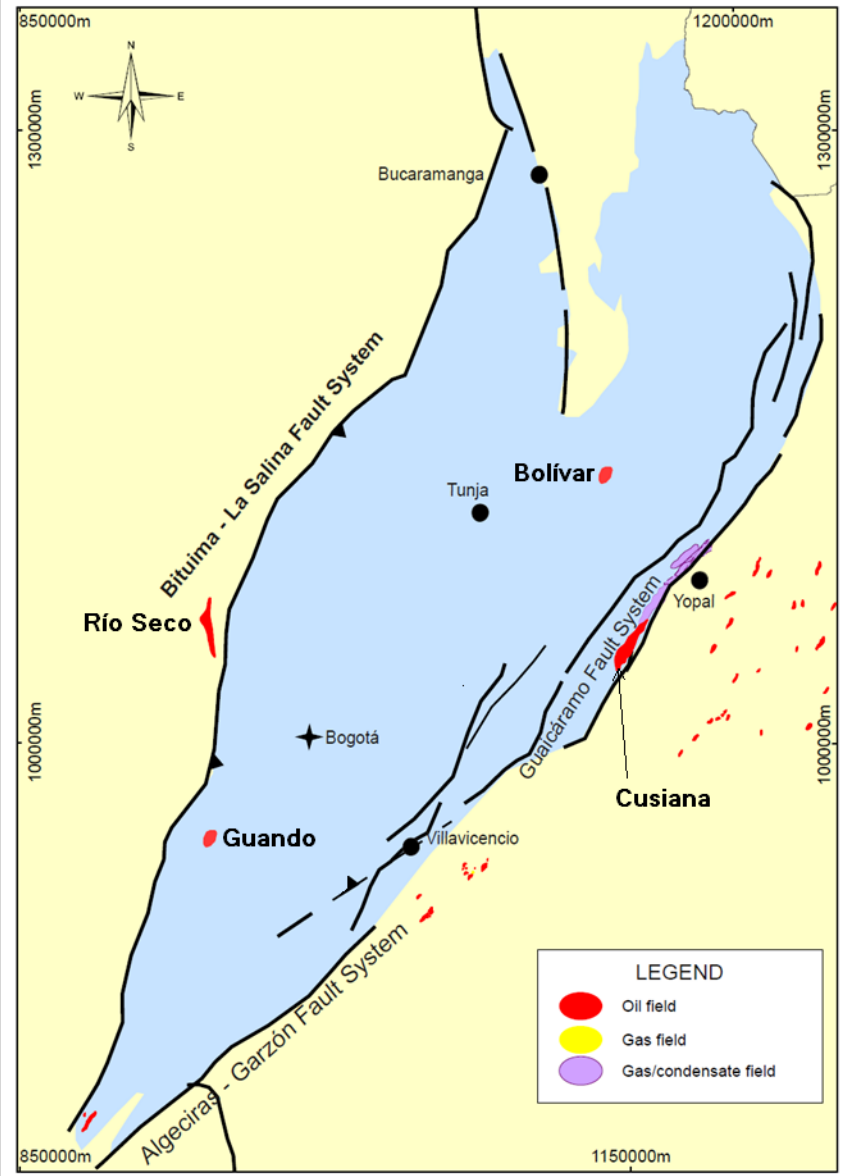
A) Anticline related to a wrench fault

B) Subthrust trap in the western margin of the basin. High side closure in central part of the profile



Eastern Cordillera

Oil & gas fields



OIL FIELDS SIZE:

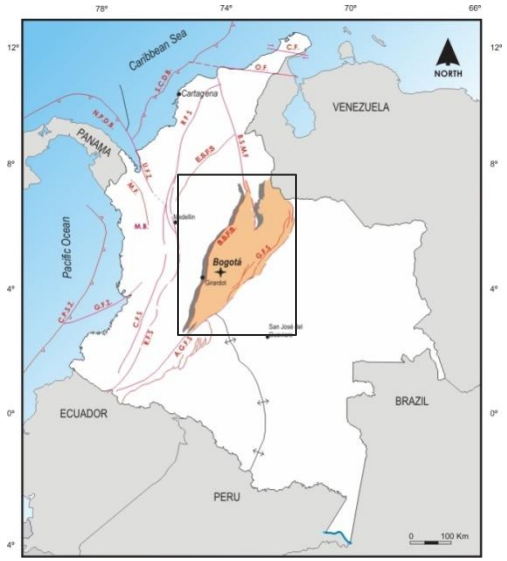
>100 MMBO: 1

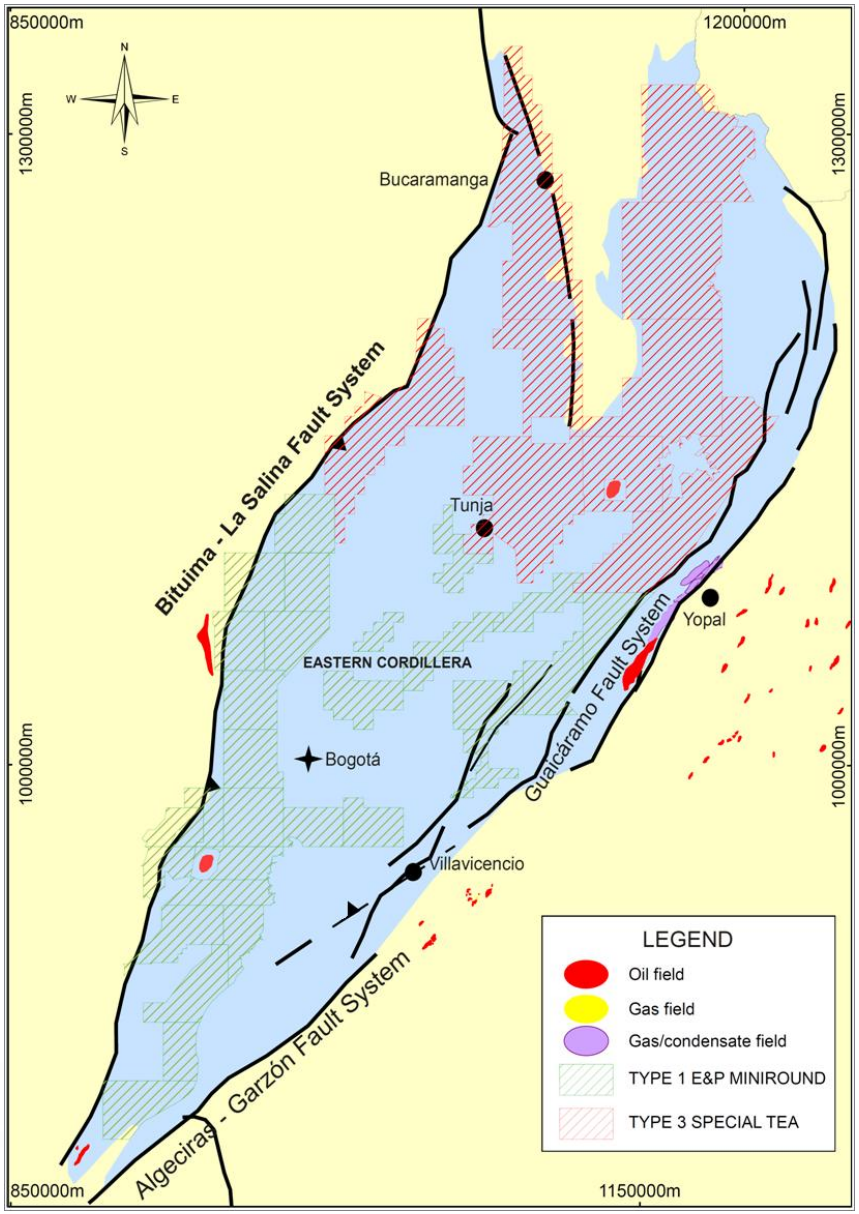
10 – 100 MMBO: 2

1 – 10 MMBO: 1

<1 MMBO: 1

Eastern Cordillera





Location map with the offered blocks

OPEN ROUND 2010 BLOCKS

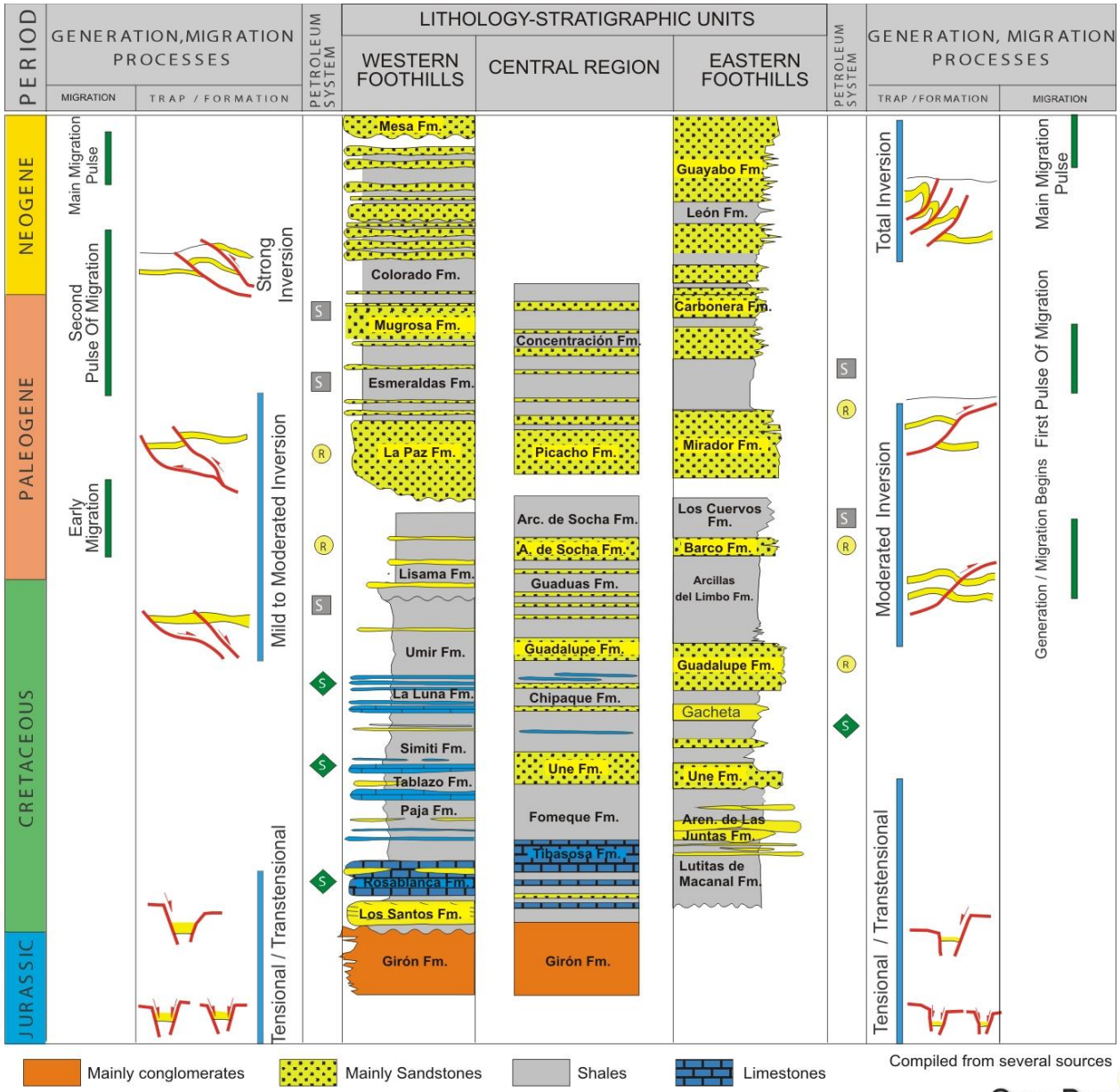
Type 1: 29 Blocks
16,648 Km^2

Type 3: 9 Blocks
21,216 Km^2

Eastern Cordillera

Petroleum geology (I)

Stratigraphic chart showing source rocks, reservoirs, seals, and tectonic events

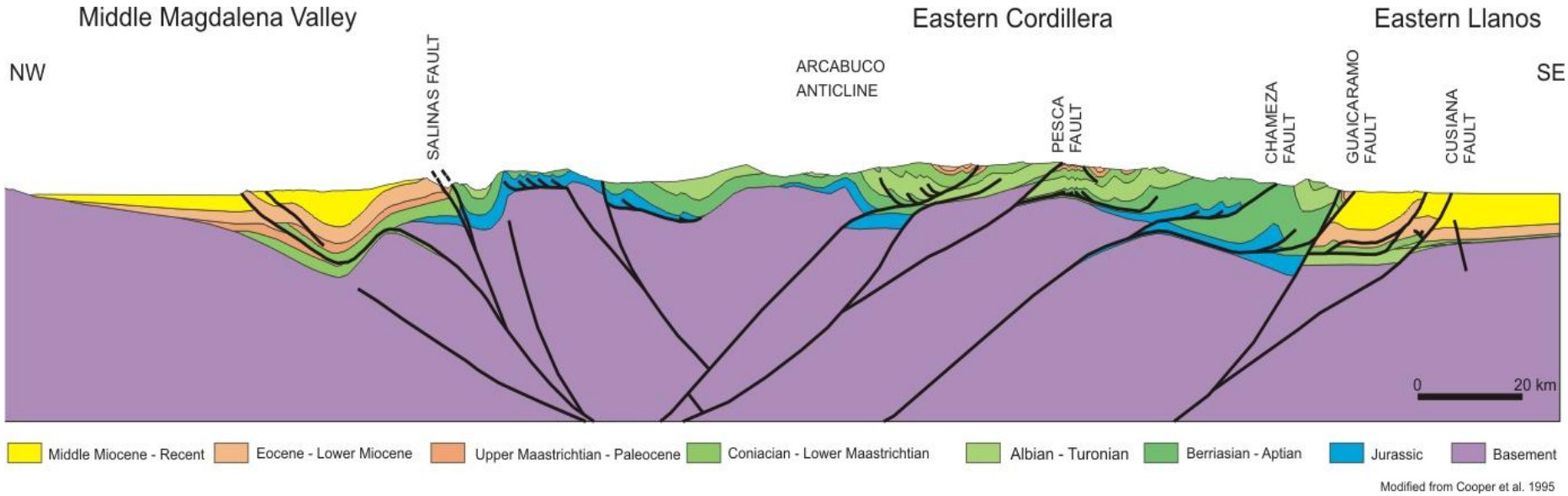


Source rocks, reservoirs and seals

PETROLEUM SYSTEM ELEMENT	LITHOLOGIC UNIT	OBSERVATIONS
S Source	La Luna Fm (N) Simití Fm (N) Chipaque Fm (E) Fómeque Fm (E) Other Cretaceous shaly intervals	TOC: 1.0 – 3.0% Kerogen: Type I and II
R Reservoir	Une Fm Guadalupe Fm Picacho Fm Mirador Fm Lower Socha Fm	Sandstones Porosity: 5 – 10% Permeability: 4 - 100 mD
S Seal	Chipaque Fm Upper Socha Fm Other Cretaceous and Cenozoic shaly intervals	Chipaque Fm and Upper Socha Fm are regional seals

Eastern Cordillera

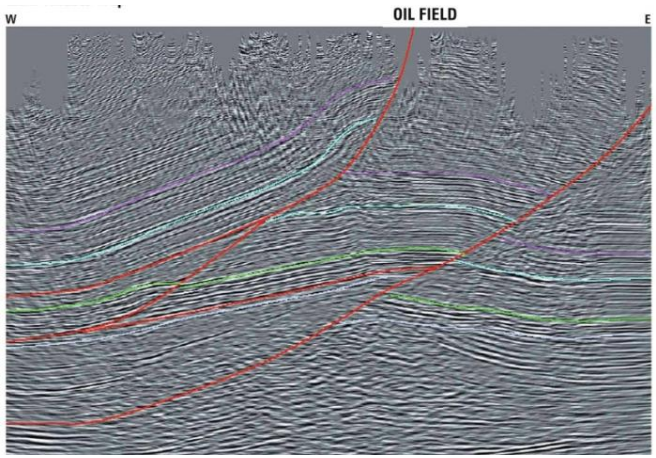
Regional structure



Modified from Cooper et al. 1995

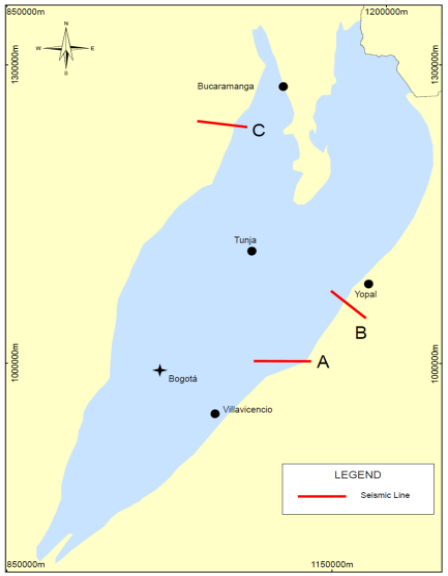
Trap styles within the Cordillera Oriental

- **Thrusts and Folds**
- **Imbricate Thrusts**
- **Duplex structures**
- **Subthrust structures**
- **Triangle zones**
- **Salt domes**

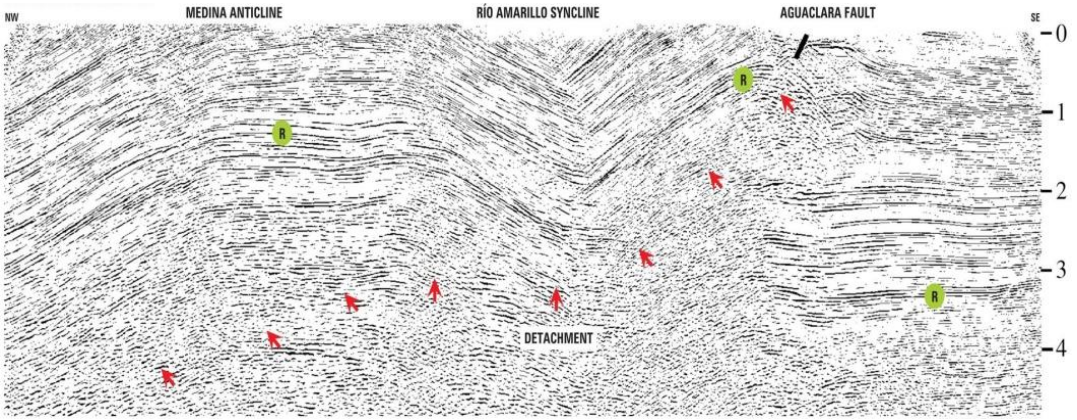


Eastern Cordillera

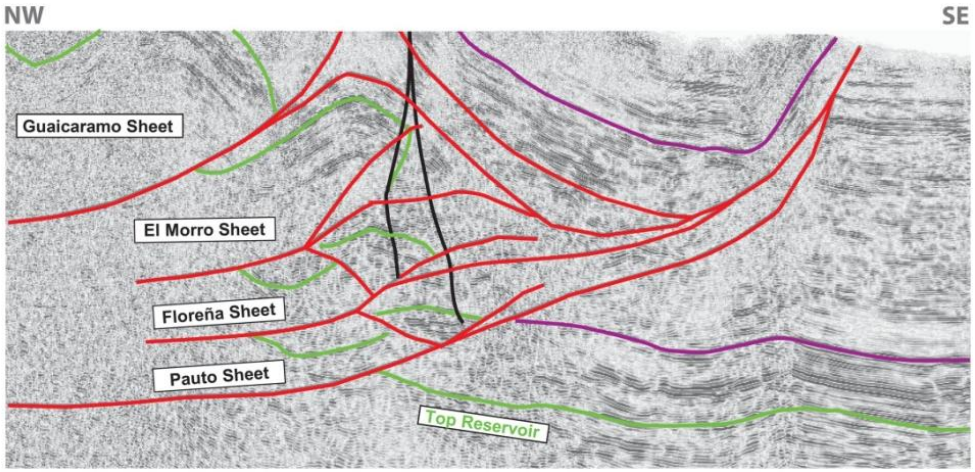
Examples of play types



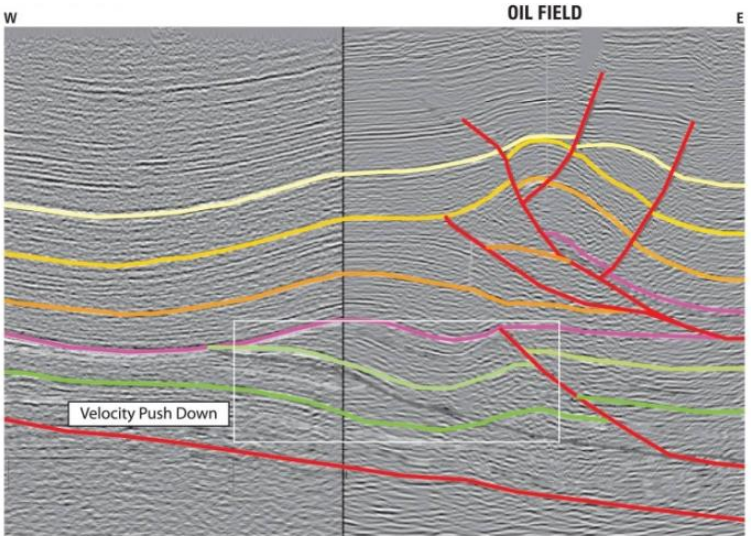
A) Wide anticline over detachement fault
Eastern foothills



B) Duplex structure – Floreña Area
Eastern foothills



C) Thrust anticline over detachement surface
Western foothills



Second Part
Emerging and Frontier Basins

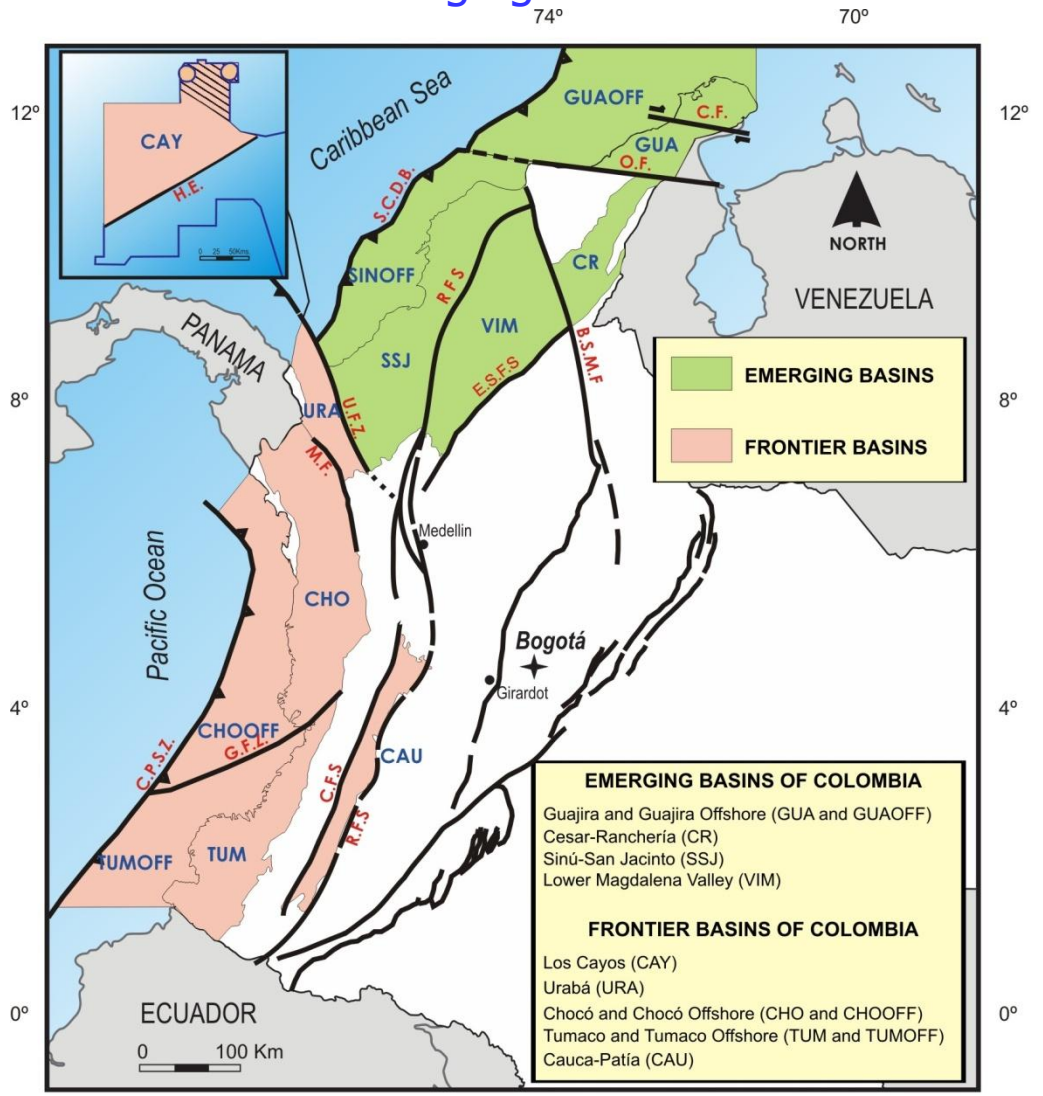
Colombia

Emerging and frontier basins

Area of Emerging and Frontier Basins

BASIN	AREA (Km²)
GUAJIRA (GUA) & GUAJIRA OFFSHORE (GUA OFF)	13,778 52,860
CESAR – RANCHERÍA (CR)	11,668
SINÚ – SAN JACINTO (SSJS) & SINÚ OFFSHORE (SIN OFF)	39,645 29,576
LOWER MAGDALENA VALLEY (VMM)	38,017
LOS CAYOS (CAY)	144,755
URABÁ (URA)	9,449
CHOCÓ (CHO) & CHOCÓ OFFSHORE (CHO OFF)	38,582 37,773
TUMACO (TUM) & TUMACO OFFSHORE (TUM OFF)	23,732 34,553
CAUCA – PATÍA (CAU)	12,823

Colombian Emerging and Frontier Basins



Emerging and frontier basins

Statistics

Emerging Basins

Basin	Basin Area (Km²)	Production	Discoveries	Number of wells	2D seismic (Km)
Guajira and Guajira offshore	66,639	3.72 TCFG	5 gas	78	24,074
Cesar-Ranchería	11,668	ND	2 oil + 3 gas (NCP)	67	3,458
Sinú-San Jacinto	69,221	ND	3 gas	205	26,343
Lower Magdalena Valley	38,017	0.35 TCFG + 64.2 MBO	4 oil + 8 gas	273	16,704

Frontier Basins

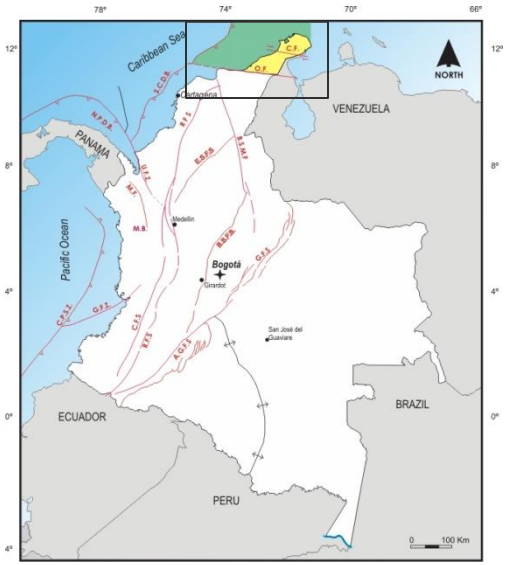
Basin	Basin Area (Km²)	Production	Oil & Gas Seeps	Wells with Shows	Number of wells	2D seismic (km)
Los Cayos	144,755	-		2 oil & gas	2	4,739
Urabá	9,449	-	✓	2 gas	5	4,665
Chocó and Chocó offshore	73,675	-	✓	1 oil & gas	5 (Atrato)	6,599
Tumaco and Tumaco offshore	58,285	-	✓	1 oil & 2 gas	5	9,452
Cauca-Patía	12,823	-	✓	1 gas	5	968

Basin Statistics as of July 2009

Emerging Basins Caribbean Region

Fields, oil and gas seeps, oil shows in wells

Guajira



OPEN ROUND 2010 BLOCKS

Onshore

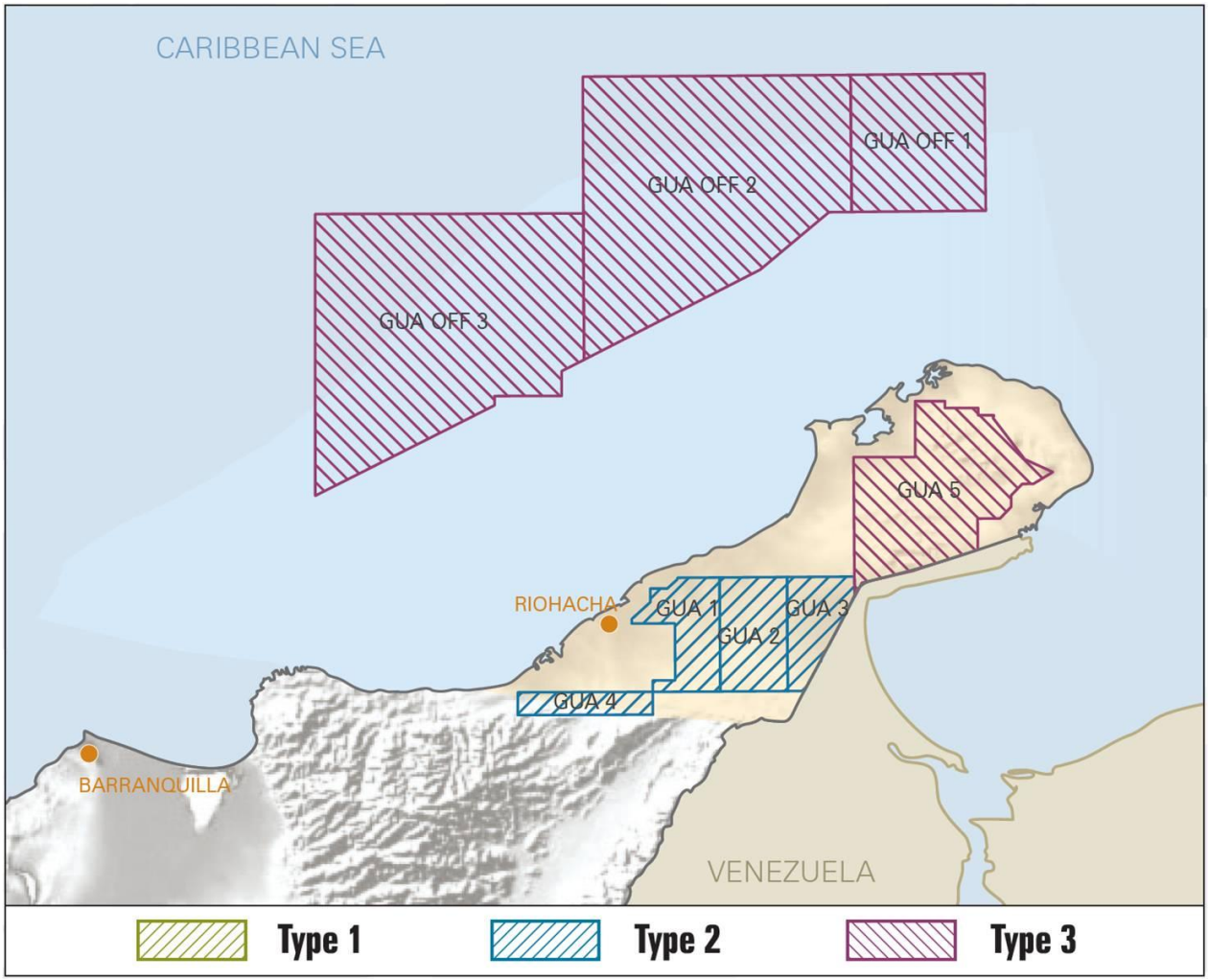
Type 2: 4 Blocks
3,691 Km²

Type 3: 1 Block
3,461 Km²

Offshore

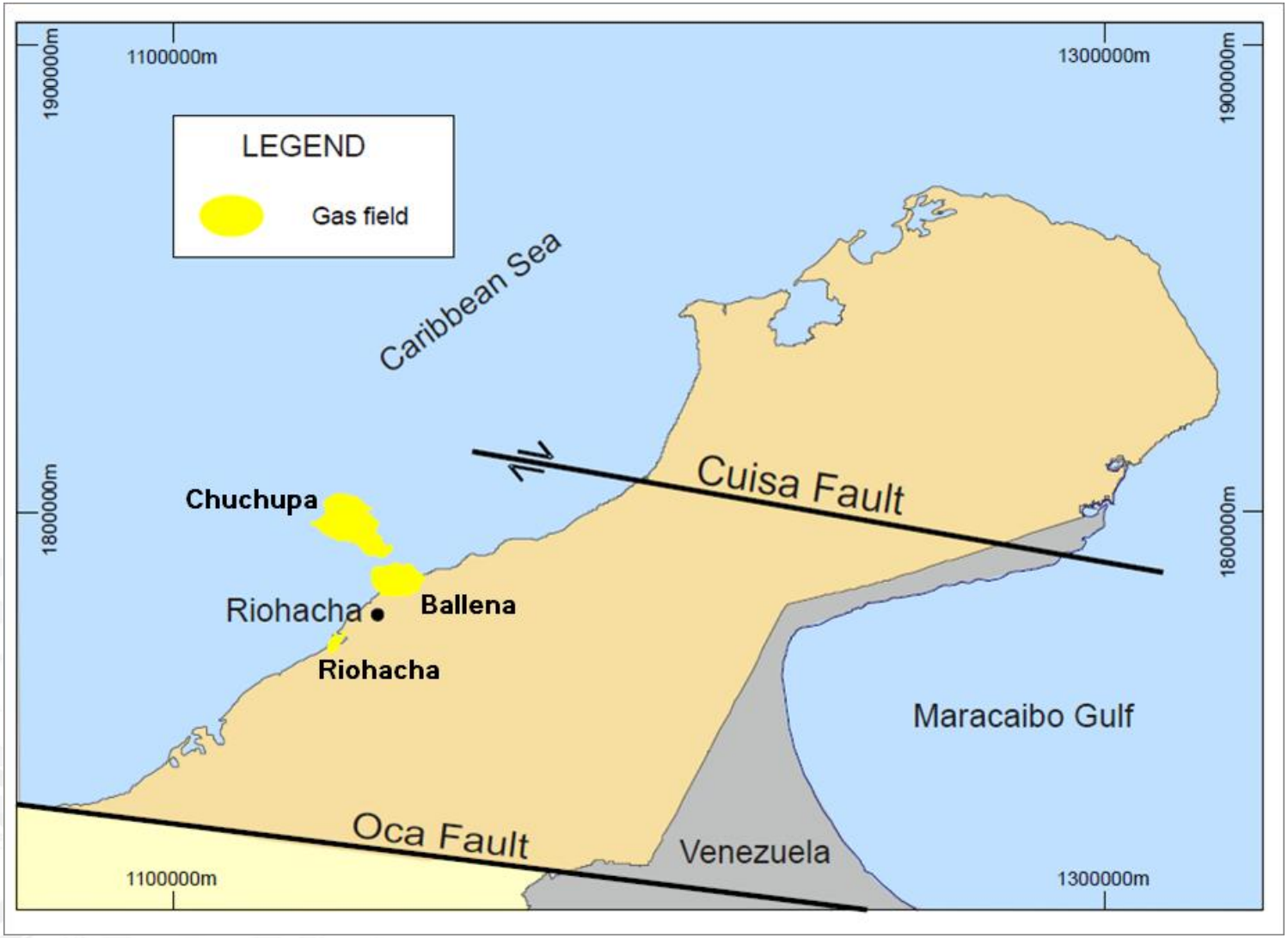
Type 3: 3 Blocks
21,765 Km²

Location map with the offered blocks



Guajira

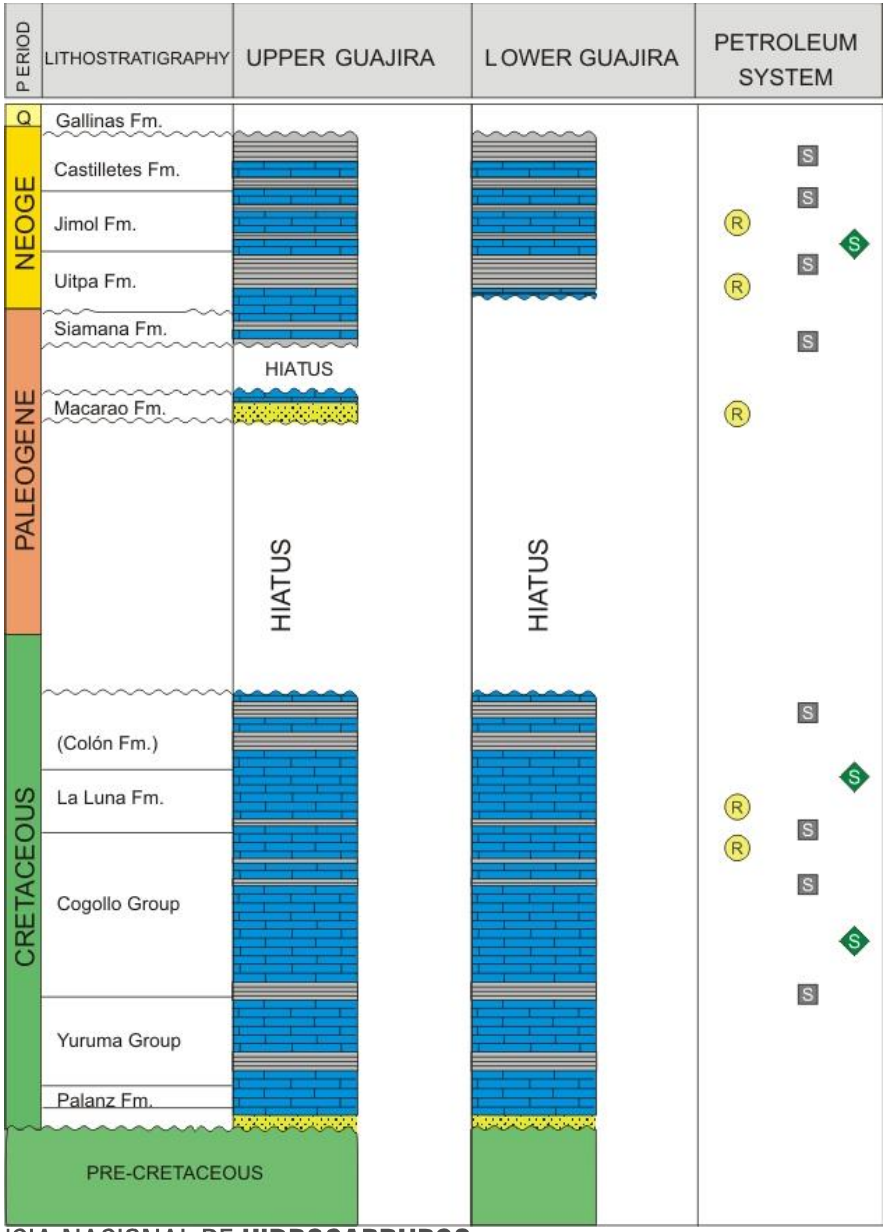
Gas fields



Guajira

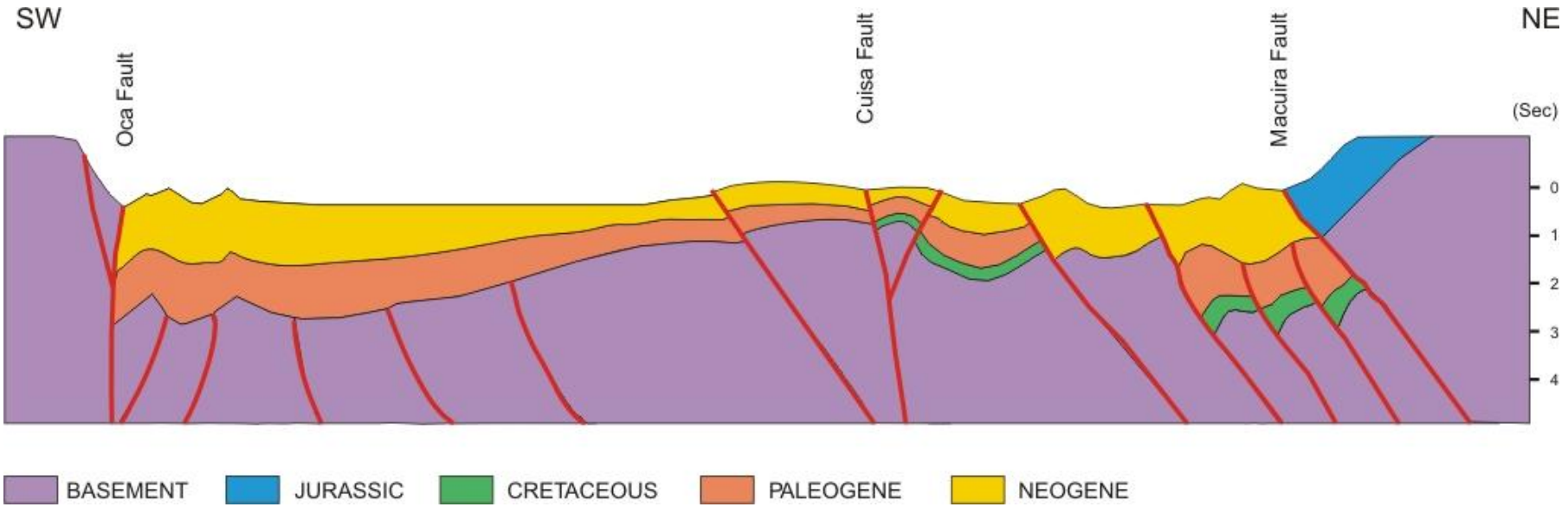
Petroleum geology

Stratigraphic columns of the Upper and Lower Guajira showing source rocks, reservoirs and seals



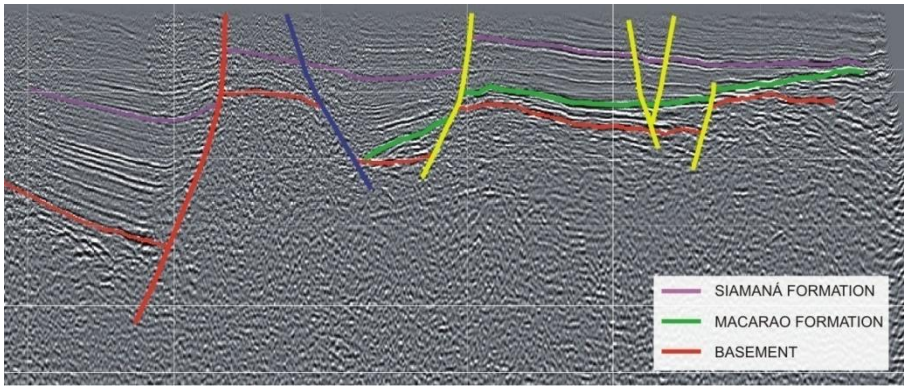
Guajira

Regional structural style



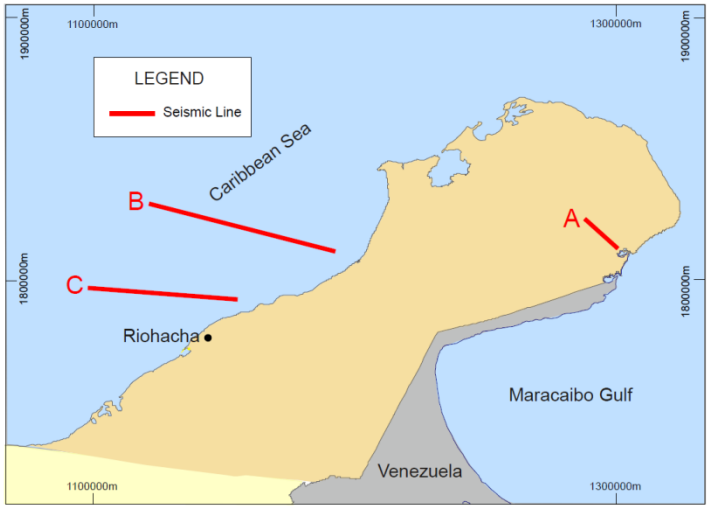
Trap types within Guajira basin:

- **Reverse and normal fault traps**
- **Flower structures**
- **Tectonic wedges**

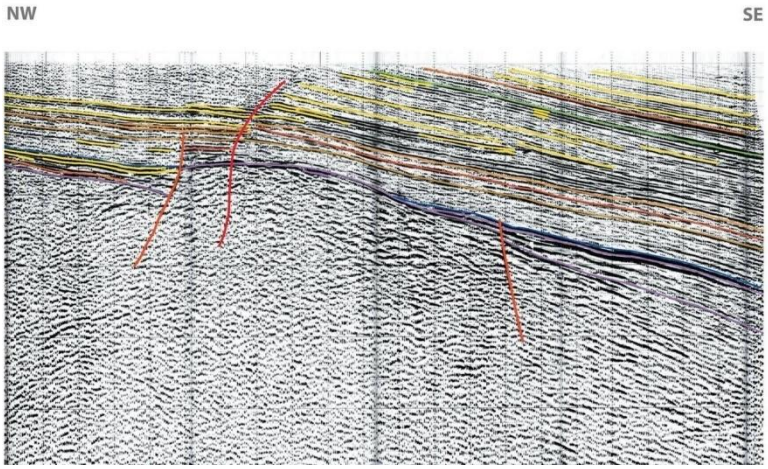


Guajira

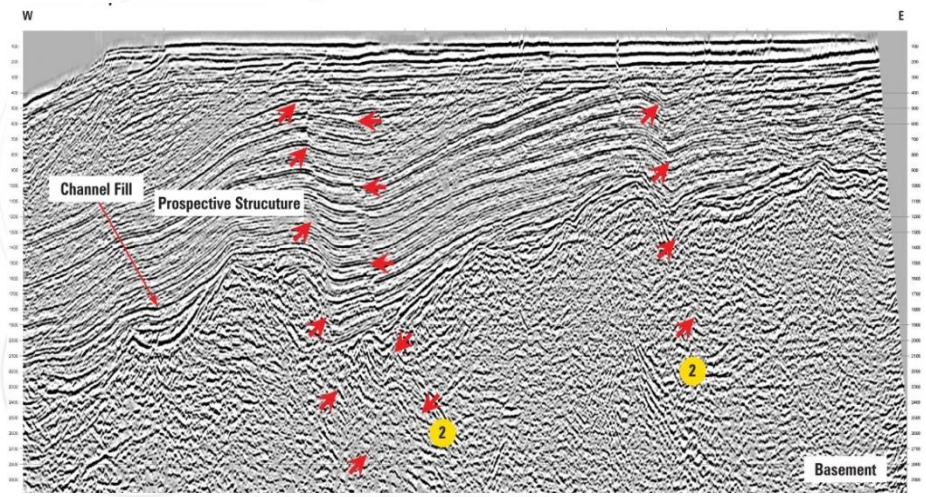
Examples of play types



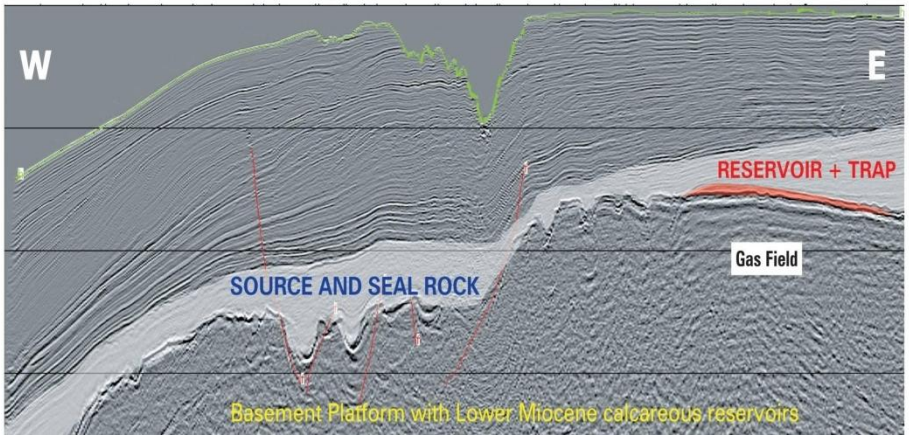
A. Onlapping over basement



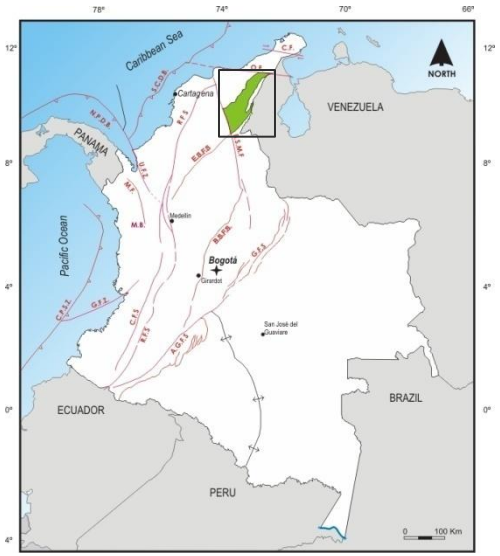
B. Positive structures related to planar normal faults

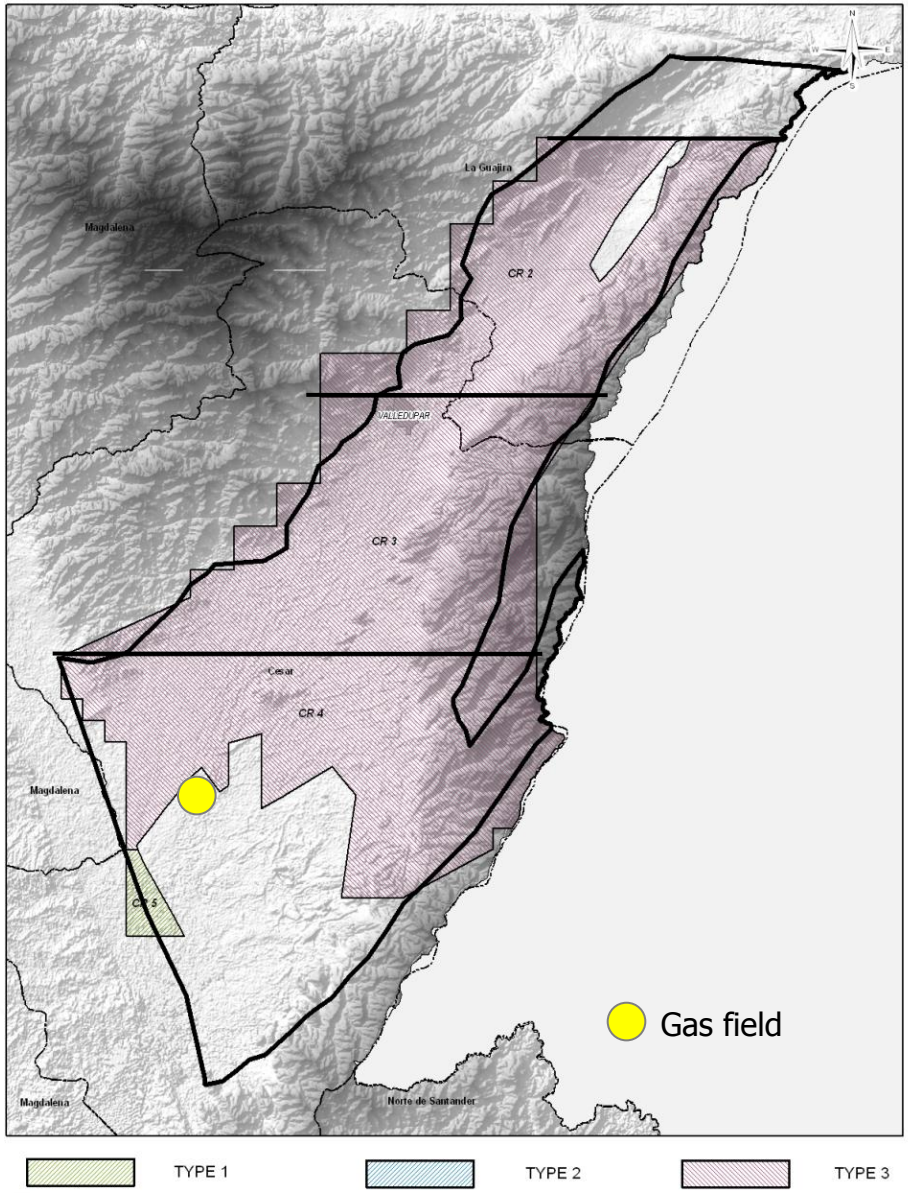


C. Combined structural - stratigraphic trap



Cesar - Ranchería





OPEN ROUND 2010 BLOCKS

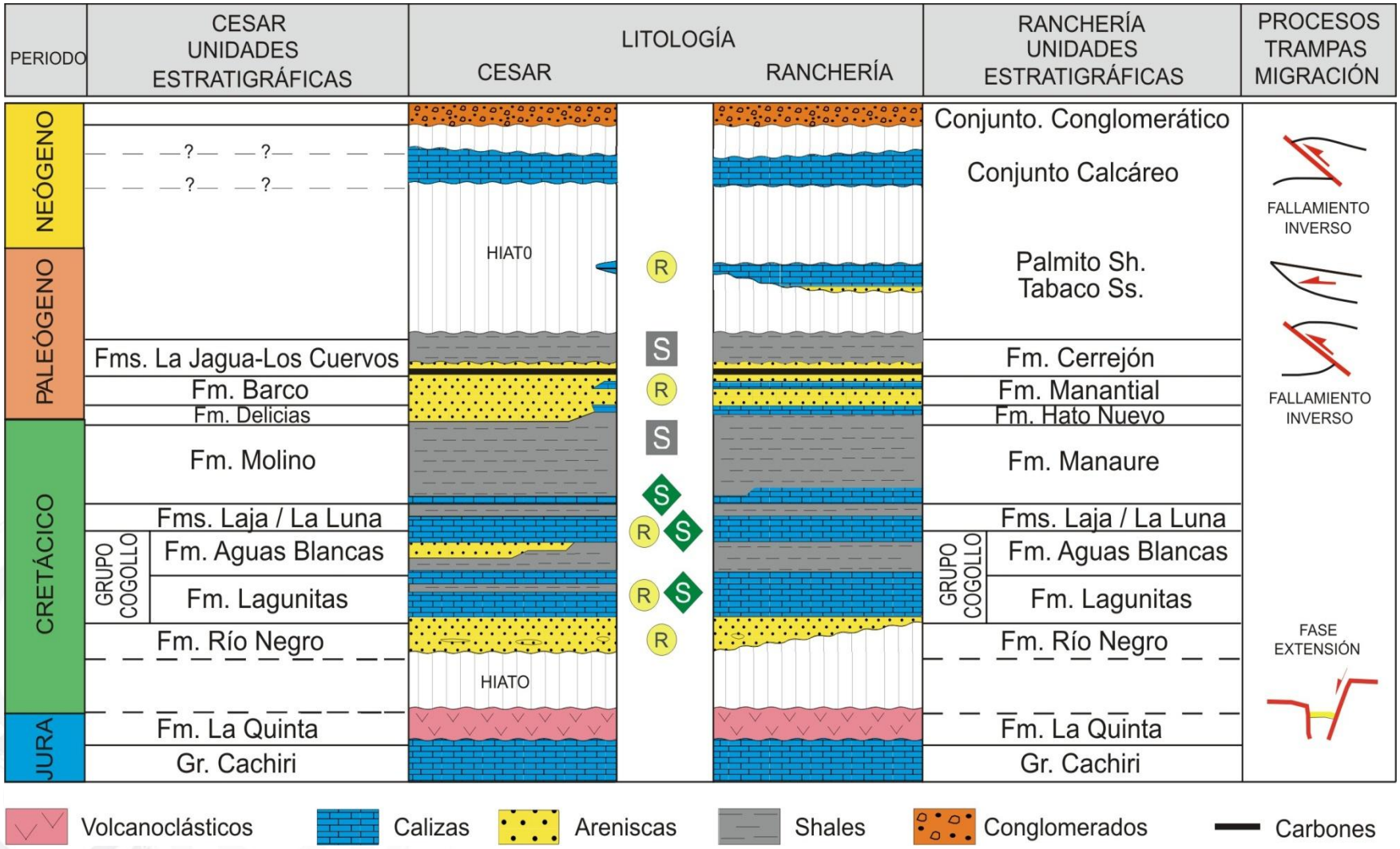
Type 1: 1 Block
135 Km^2

Type 3: 3 Blocks
9,591 Km^2

Location map with the offered blocks

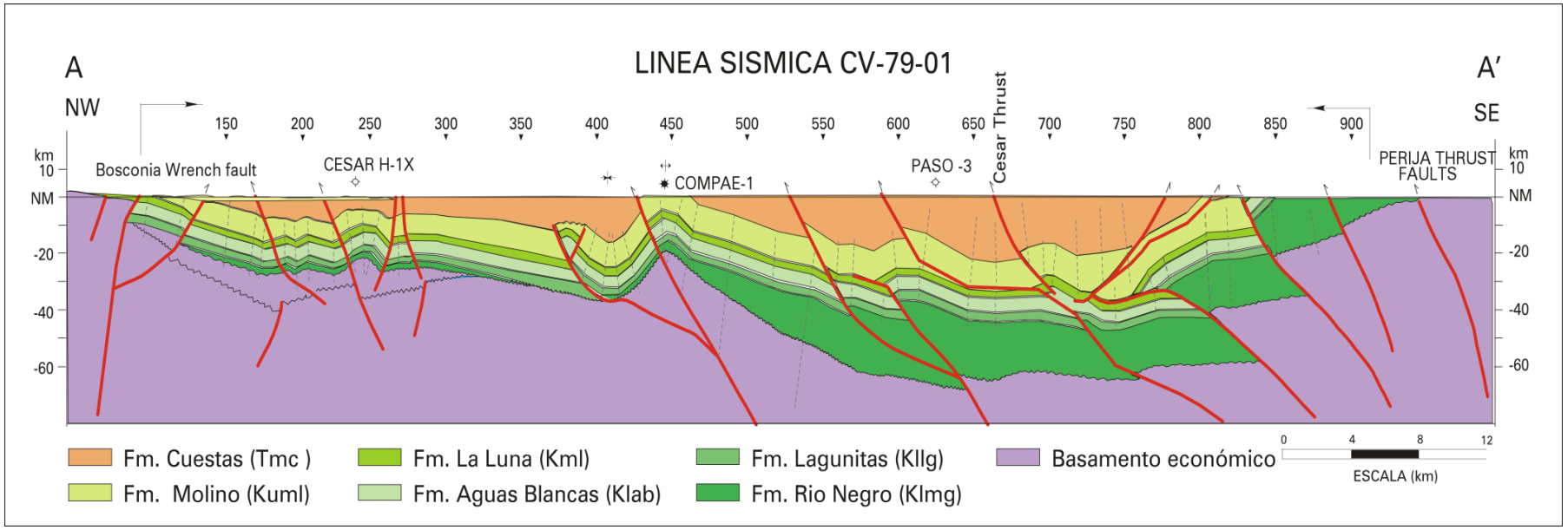
Cesar - Ranchería

Petroleum geology



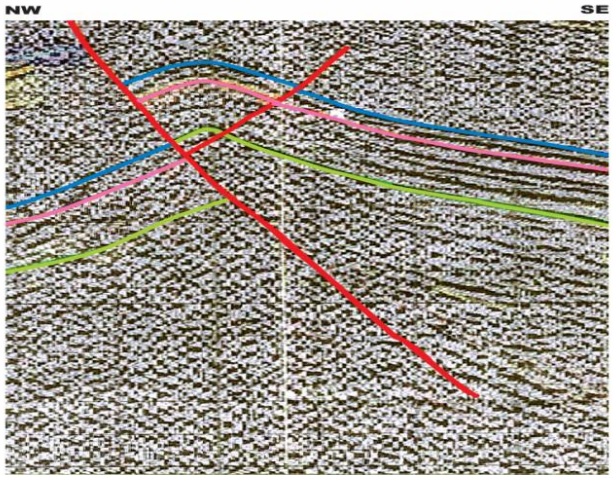
Cesar - Ranchería

Regional structural style

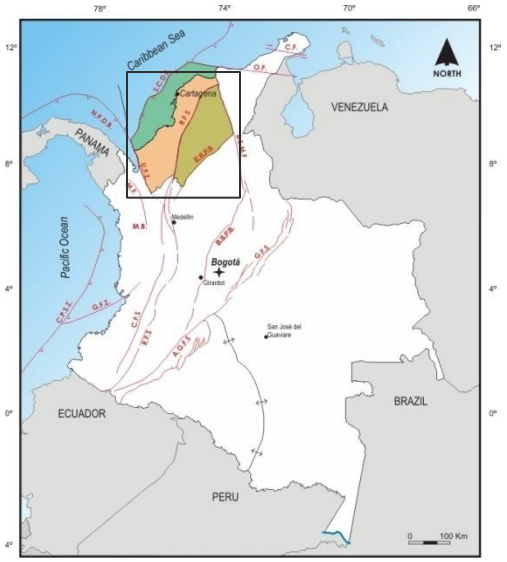


Traps within Cesar – Ranchería basin:

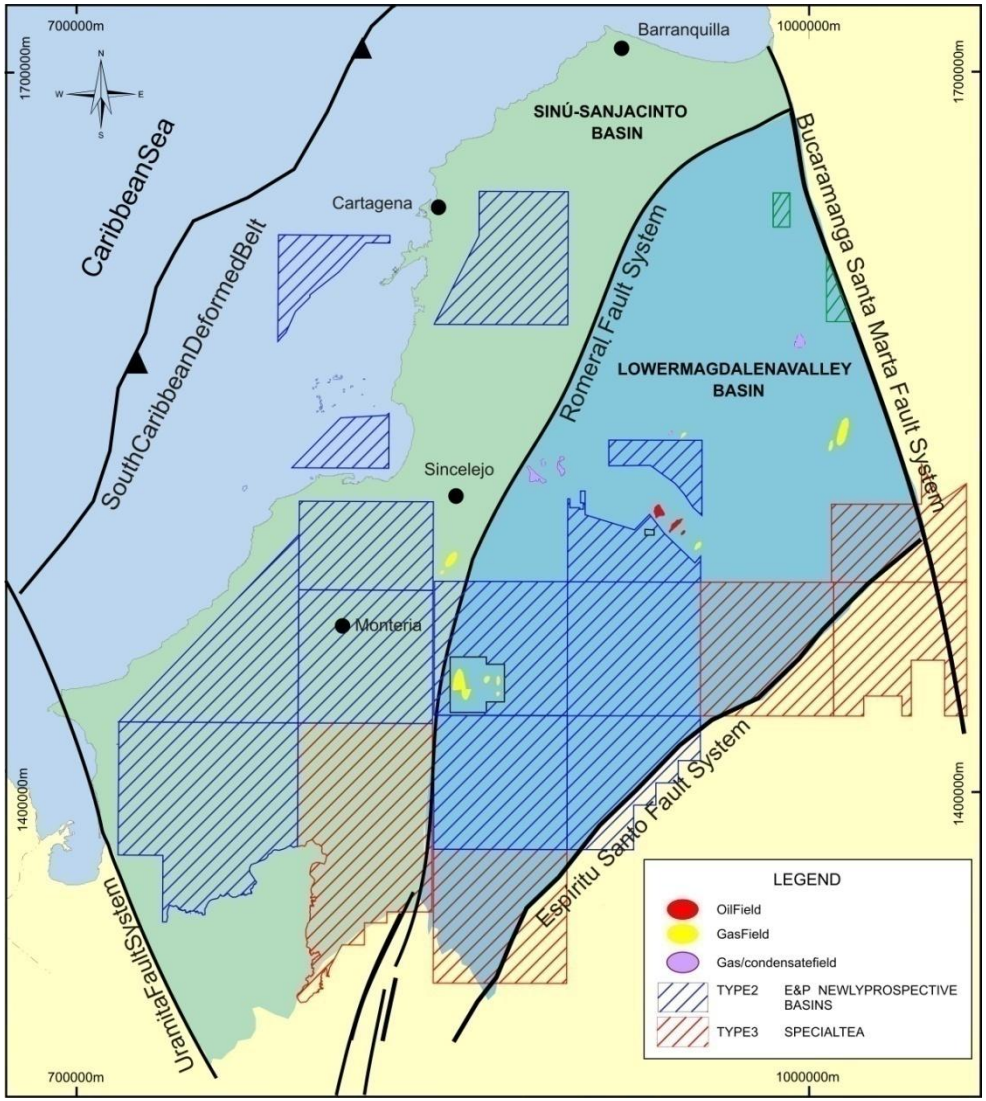
- **Thrust faults**
- **Regional unconformities at the base of the Cretaceous and the Cenozoic**



Sinú – San Jacinto – Lower Magdalena Valley (LMV)



Location map with the offered blocks

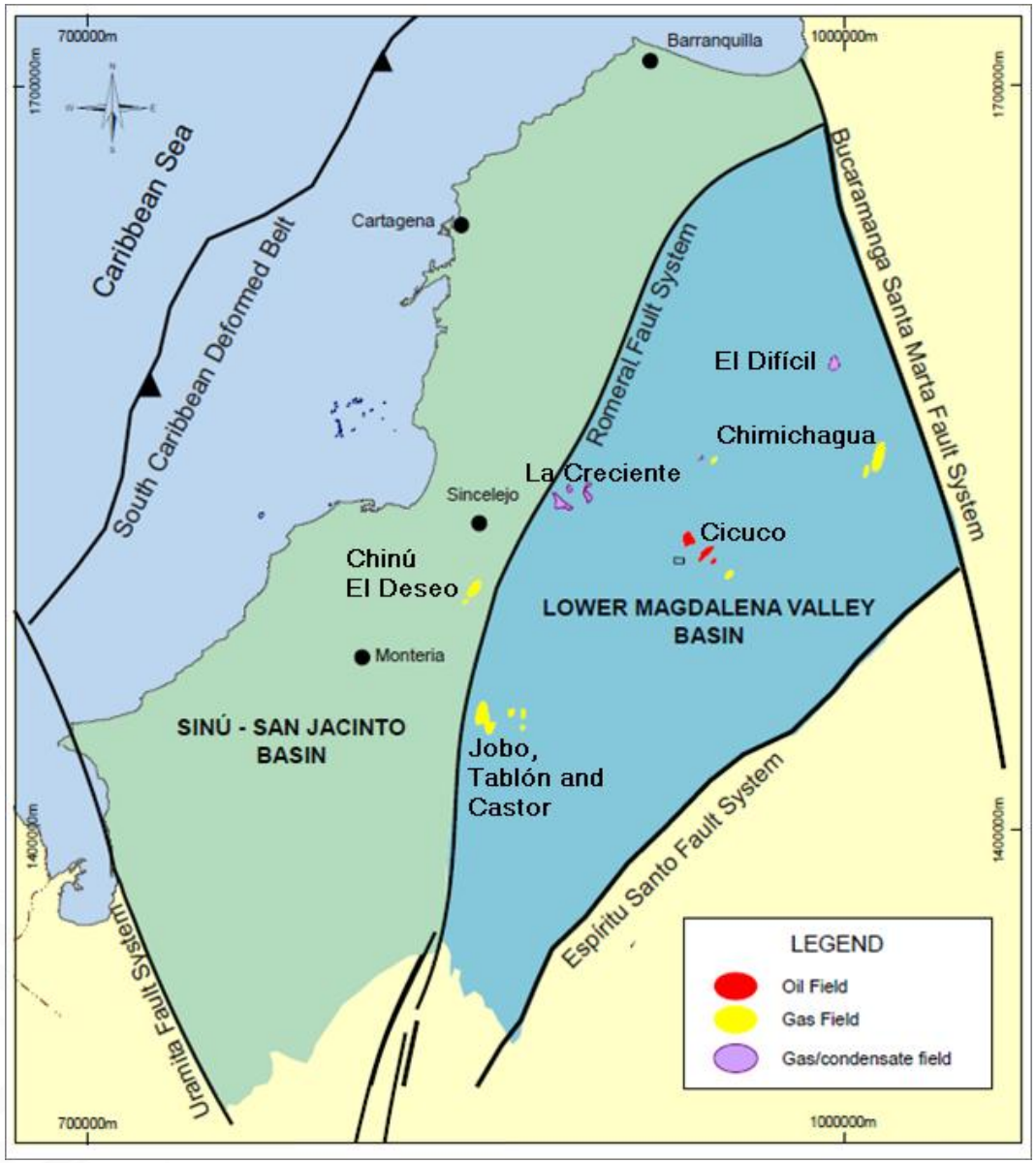


OPEN ROUND 2010 BLOCKS

Offshore	Onshore
Type 2: 2 Blocks 1,452 Km²	Type 1: 2 Blocks 293 Km²
	Type 2: 11 Blocks 27,874 Km²
	Type 3: 4 Blocks 12,668 Km²

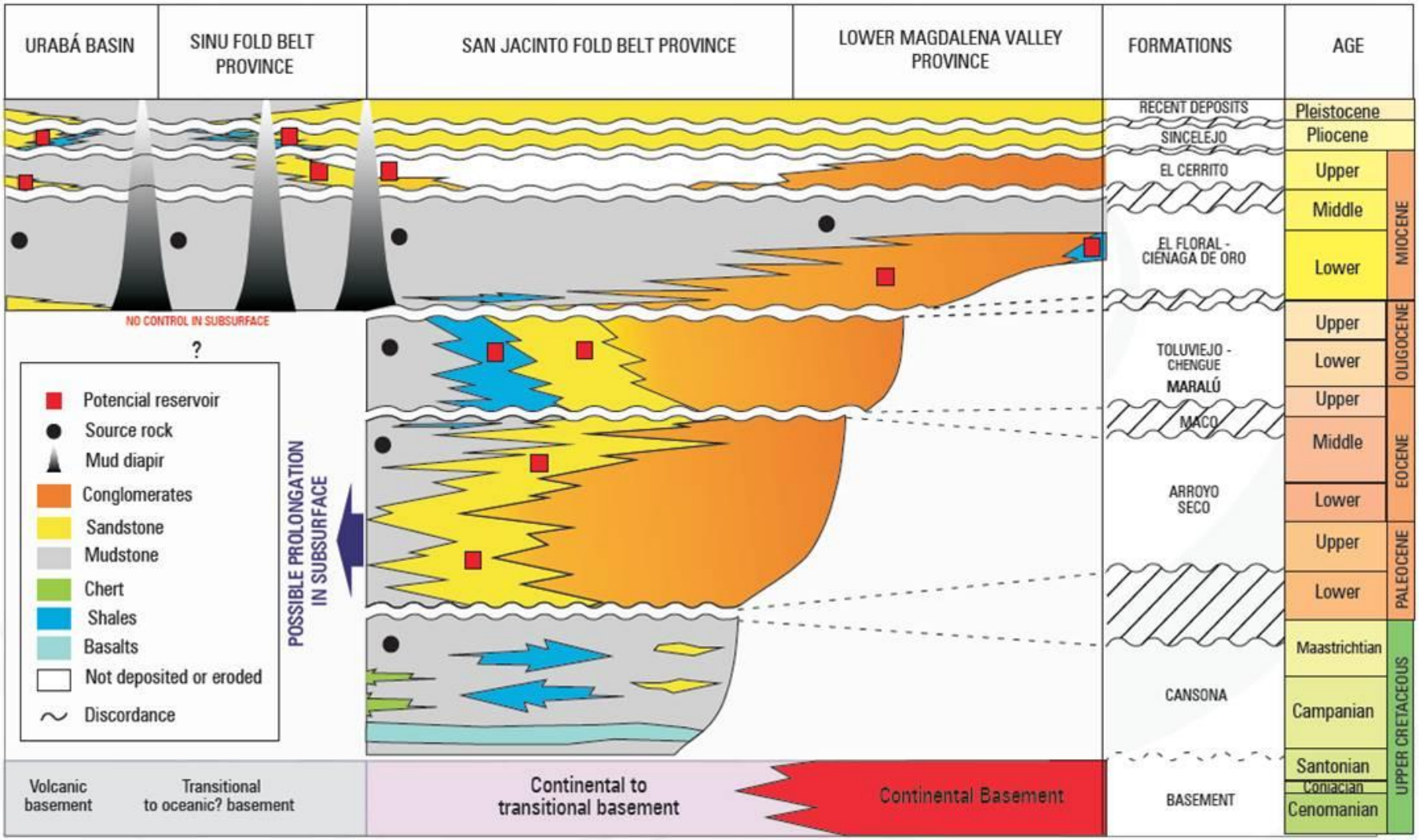
Sinú – San Jacinto – LMV

Oil & gas fields



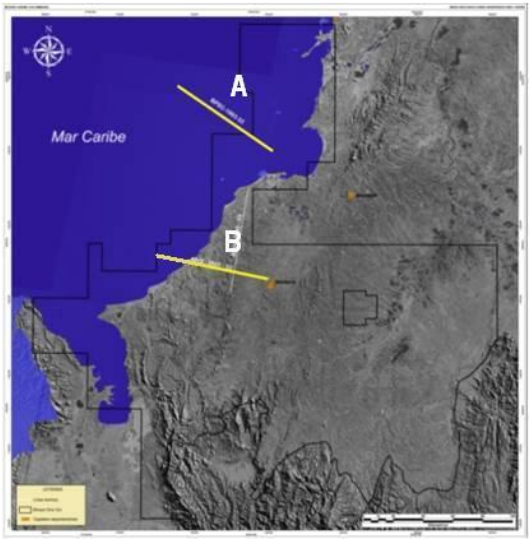
Sinú – San Jacinto – LMV

Petroleum geology

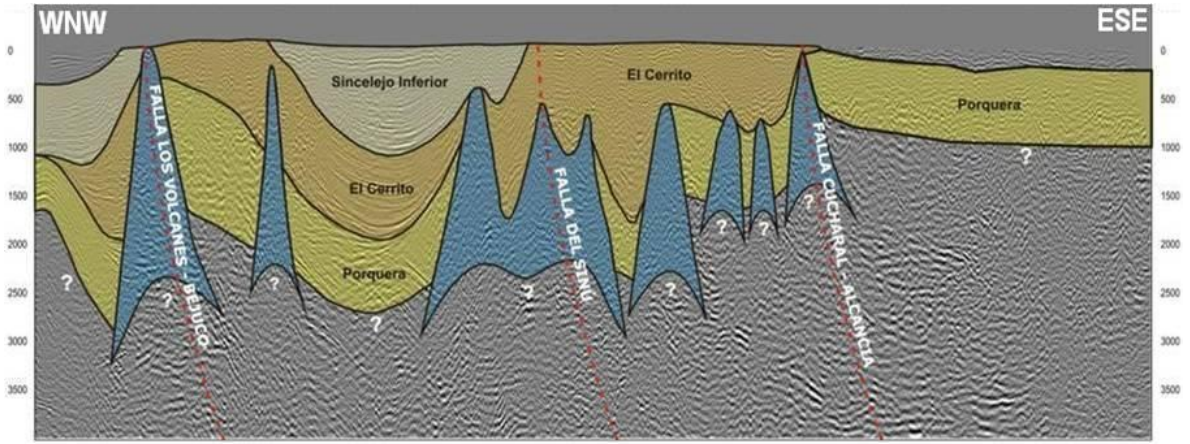


Sinú

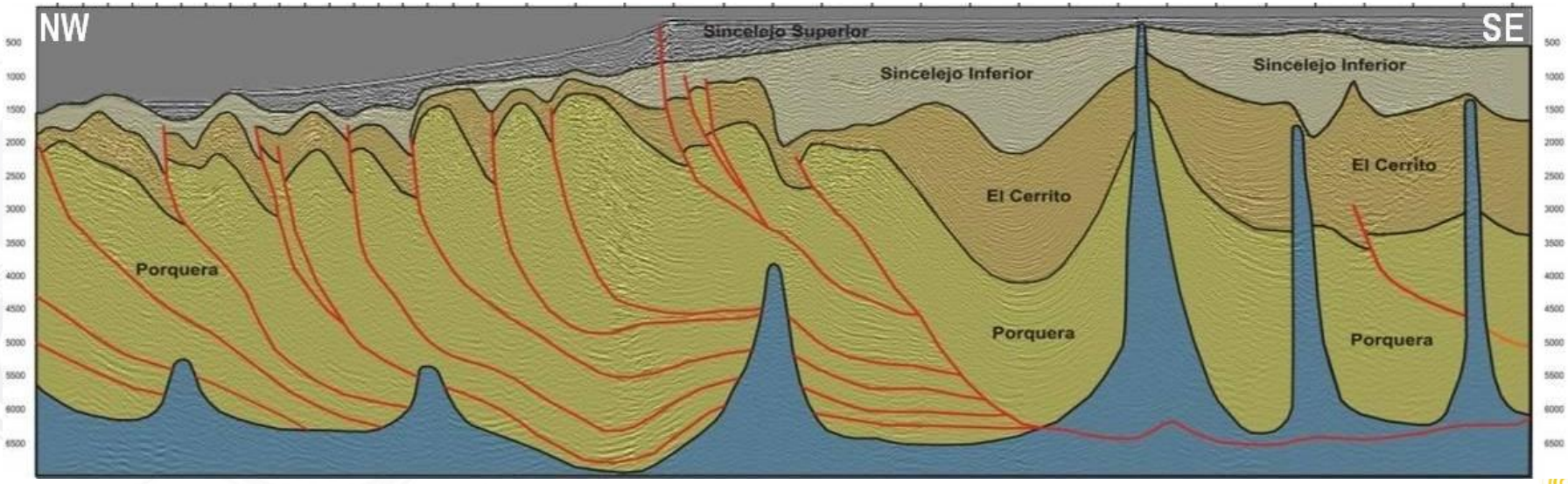
Structural style and play types



A) Traps flanking mud diapirs

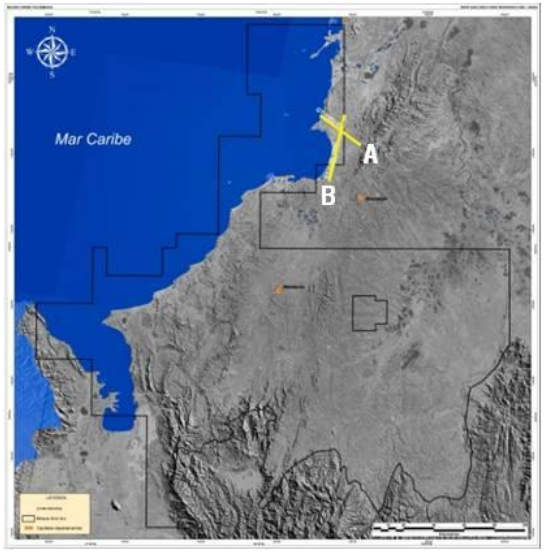


B) Traps related to reverse faults (NW) and mud diapirs (SE)

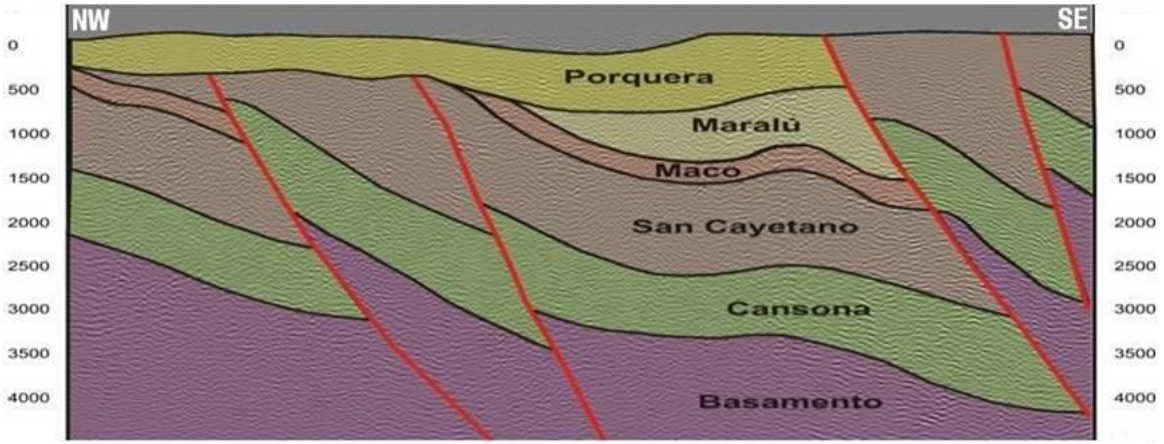


San Jacinto

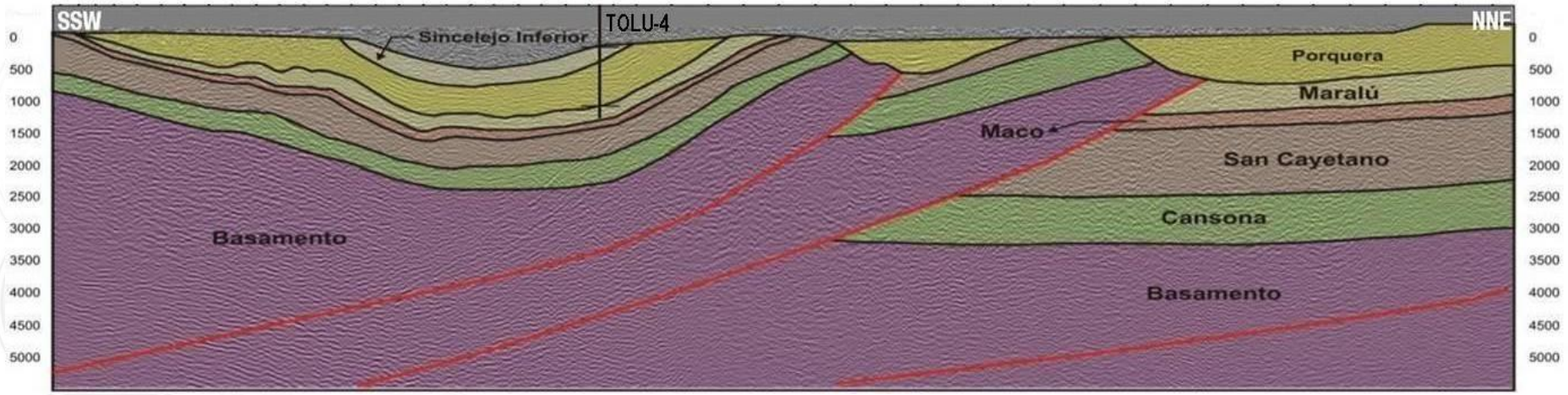
Structural style and play types



A) Folds related to west-verging reverse faults

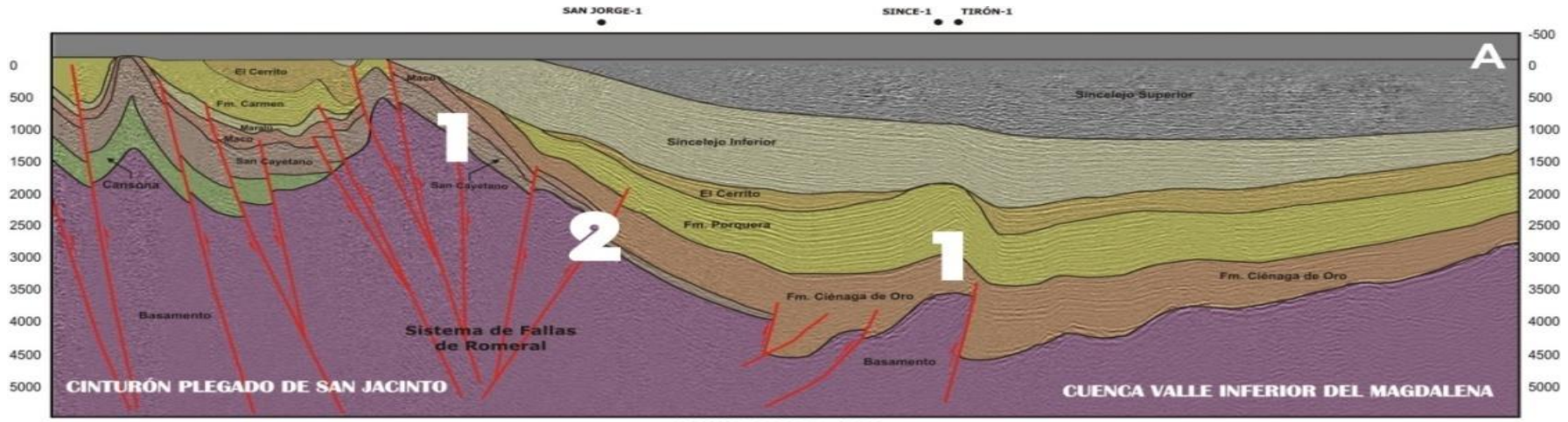


B) Stratigraphic traps associated to regional unconformities

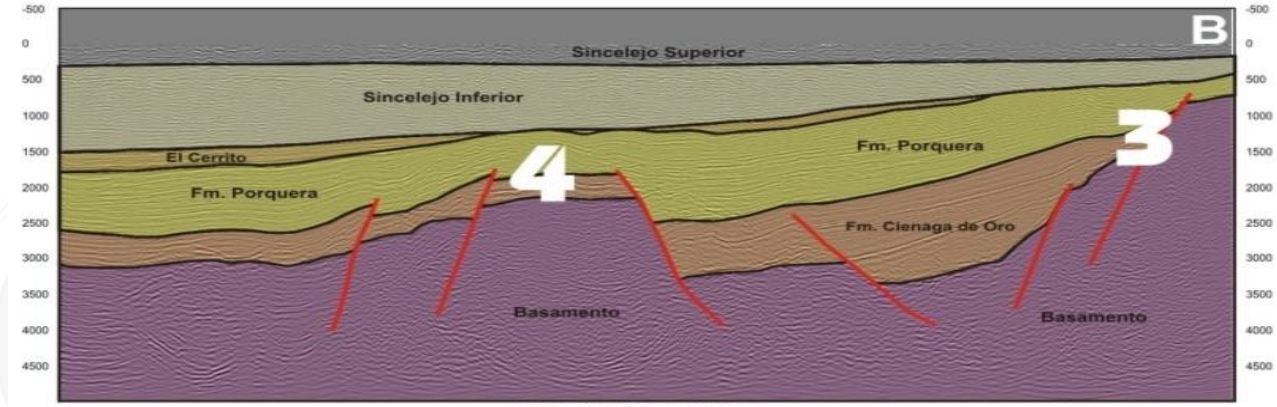


Lower Magdalena Valley

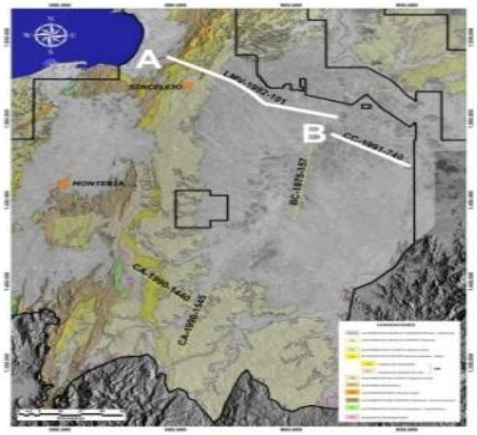
Structural style and play types



LMV-1992-101



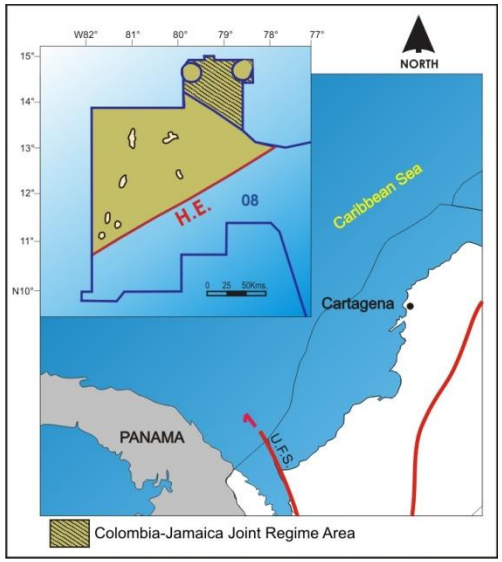
CC-1991-740



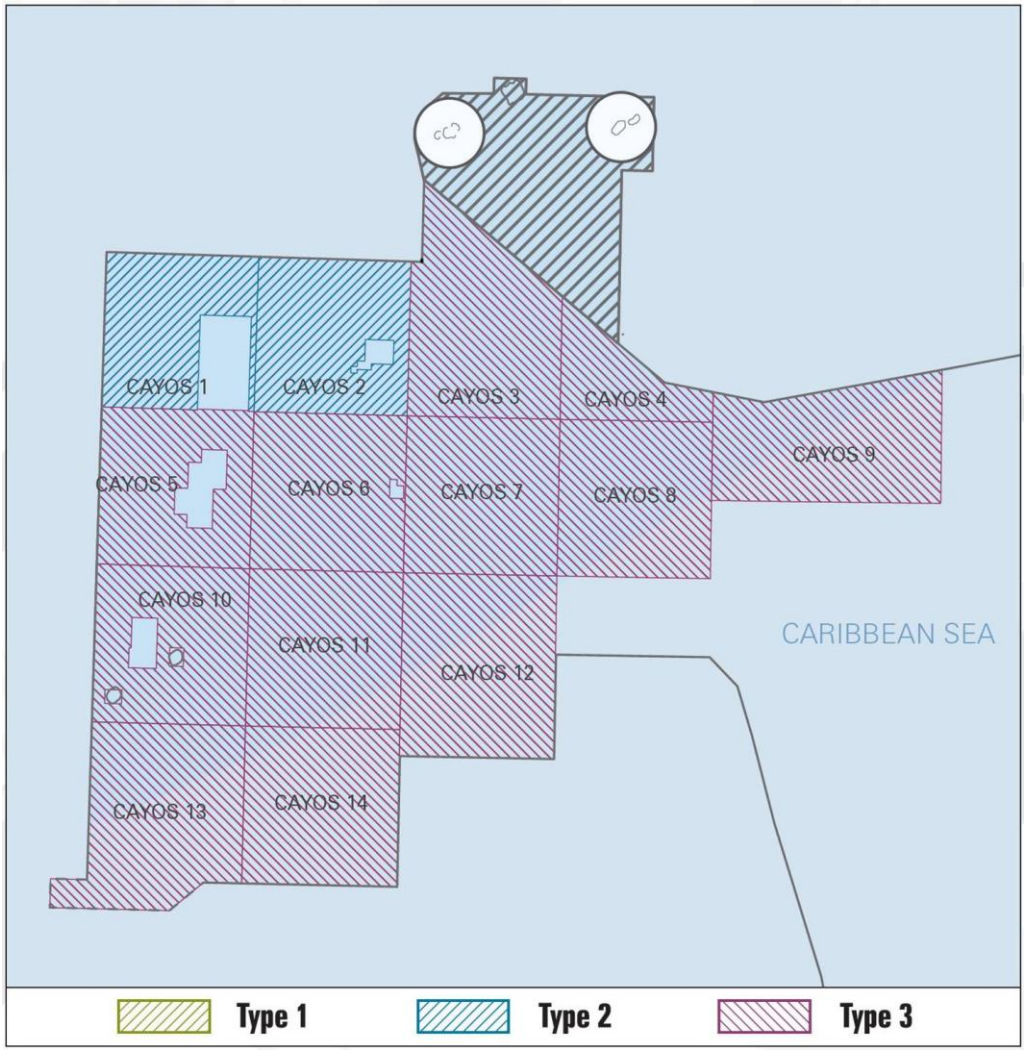
Trap Types within Lower Magdalena Valley:

1. **Anticlines related to reverse faults.**
2. **Extensional and compressive fault traps.**
3. **Onlapping over basement.**
4. **Basement highs.**

Los Cayos



Location map with the offered blocks



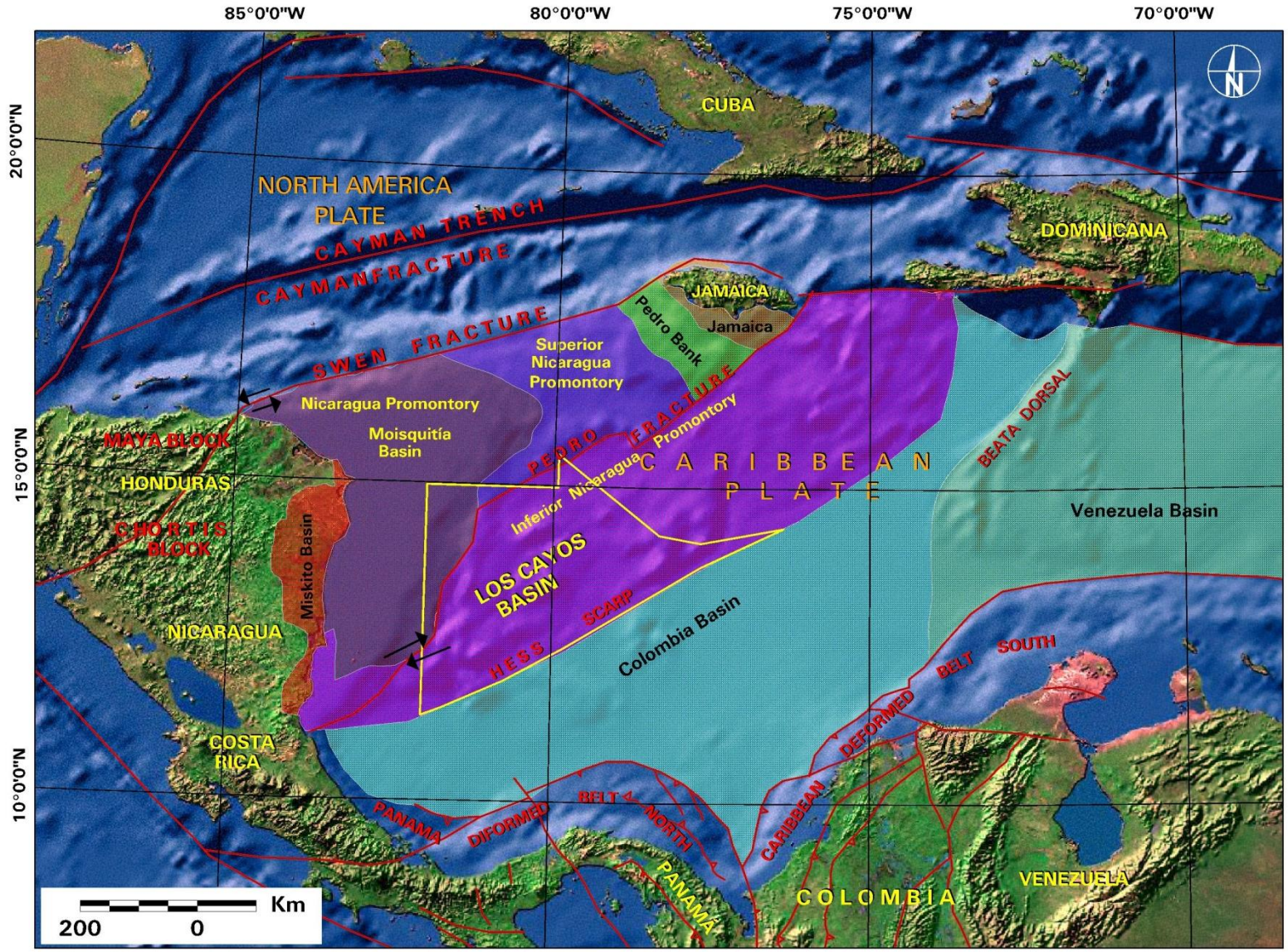
OPEN ROUND 2010 BLOCKS

Type 2: 2 Blocks
20,899 Km^2

Type 3: 12 Blocks
142,580 Km^2

Los Cayos

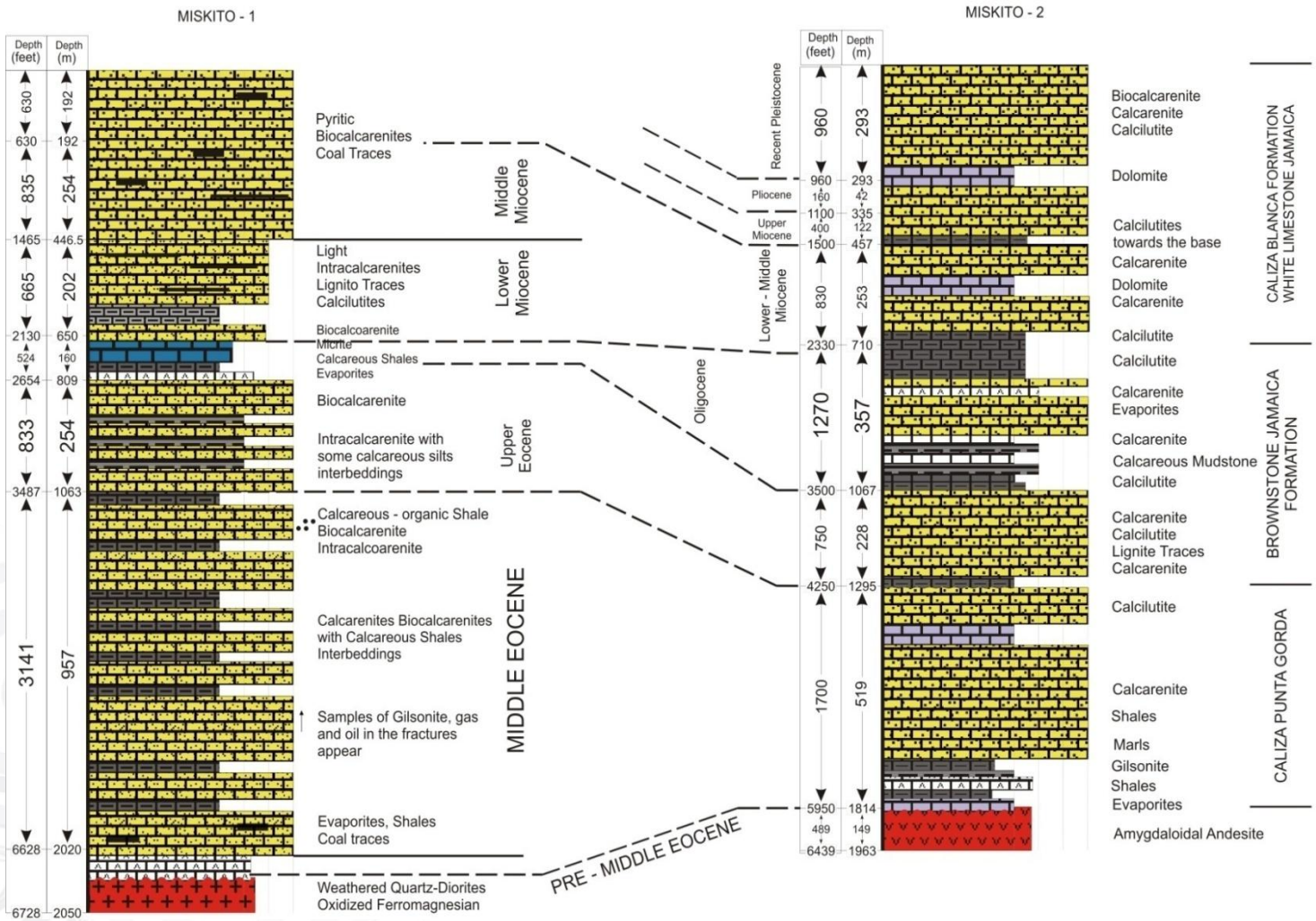
Regional tectonic setting



Los Cayos

Petroleum geology

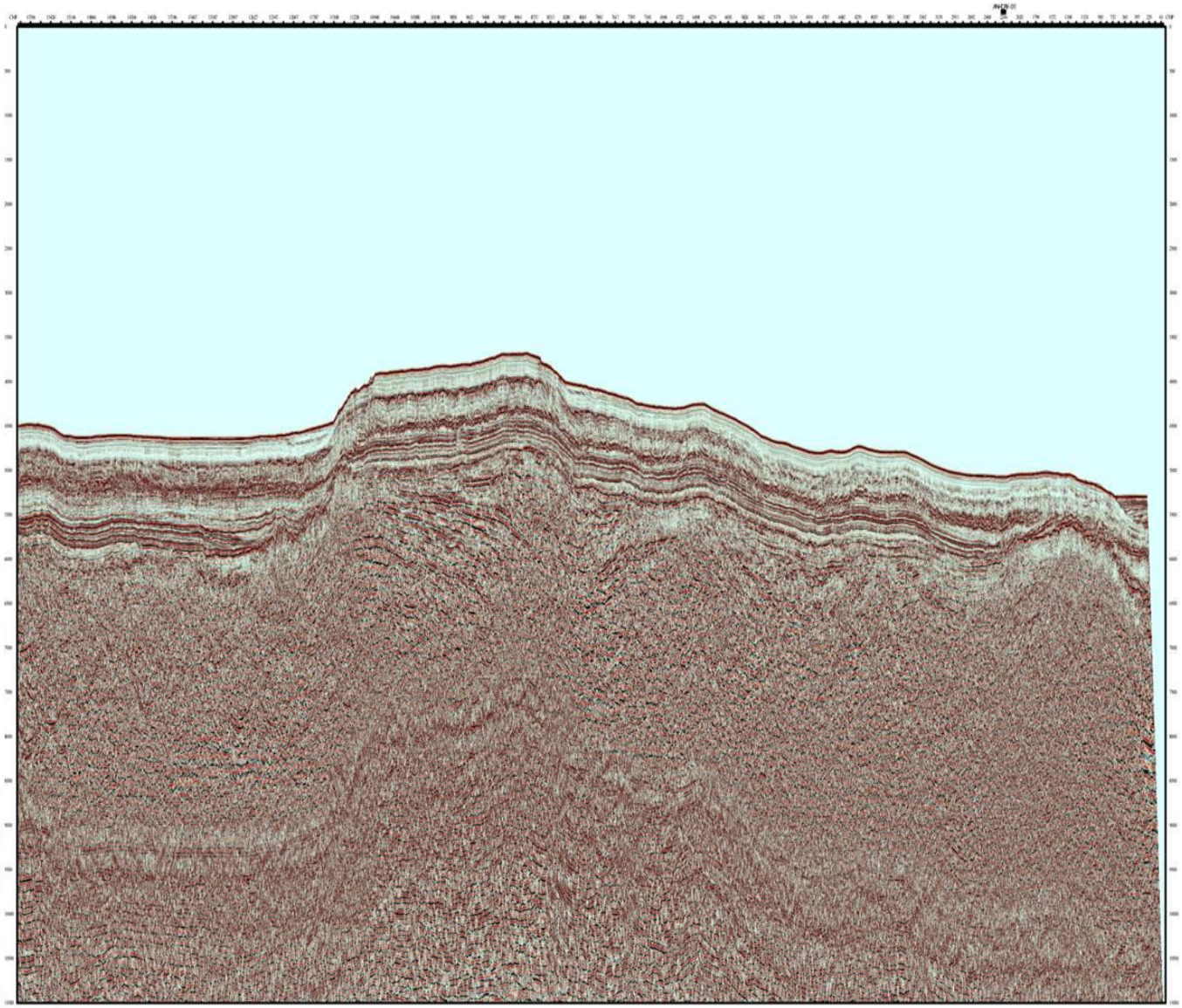
MISKITO-1 AND MISKITO-2 WELLS SCHEMATIC STRATIGRAPHIC COLUMNS CORRELATION



Reservoir Rock **Source Rock**

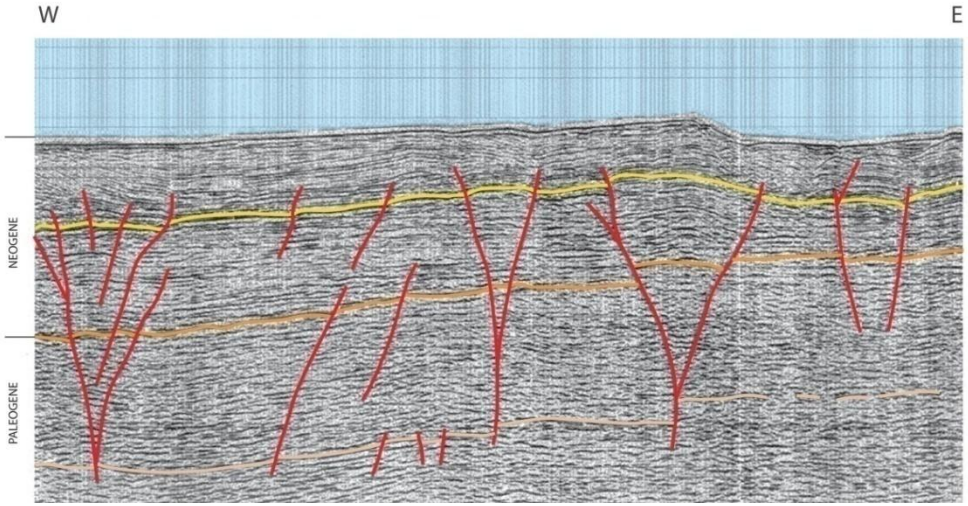
Los Cayos

Regional structure

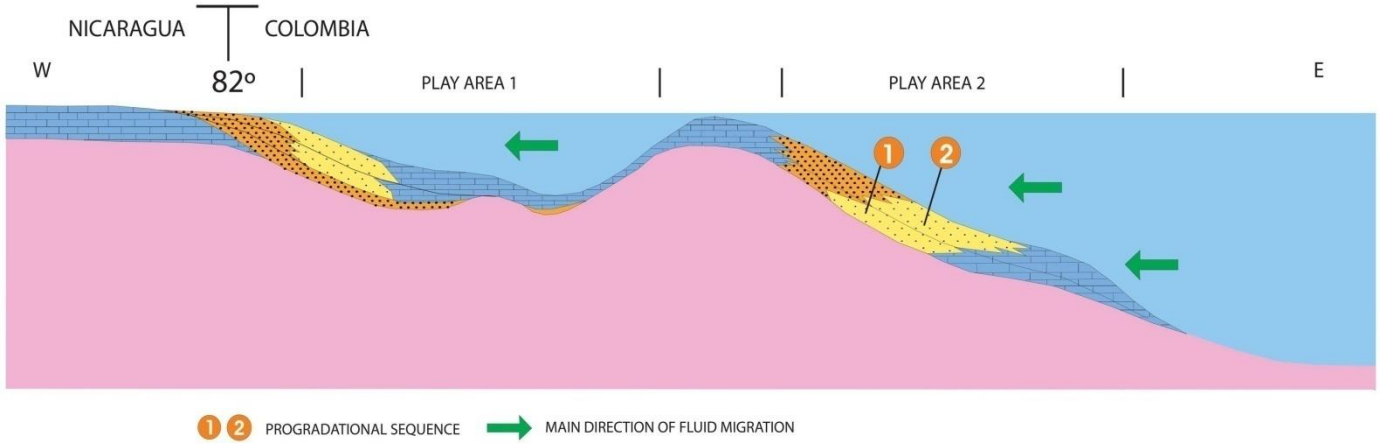


Los Cayos
Play types

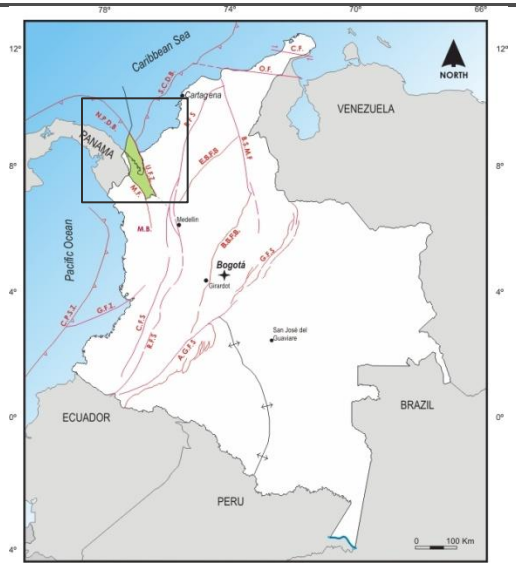
Structural traps
Gentle anticlines related to transpressive faults



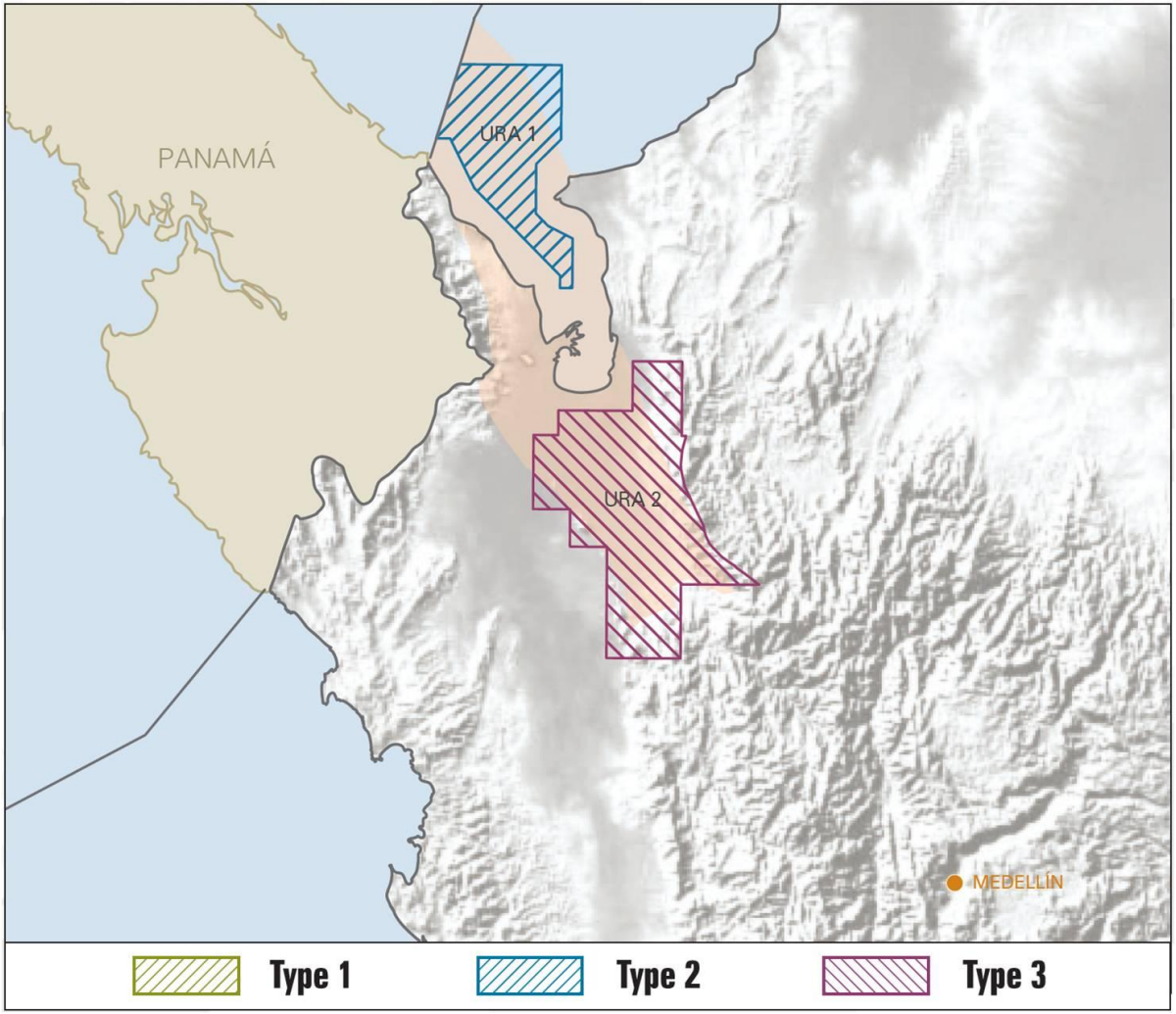
Stratigraphic traps
Prograding sequences



Urabá



Location map with the offered blocks



OPEN ROUND 2010 BLOCKS

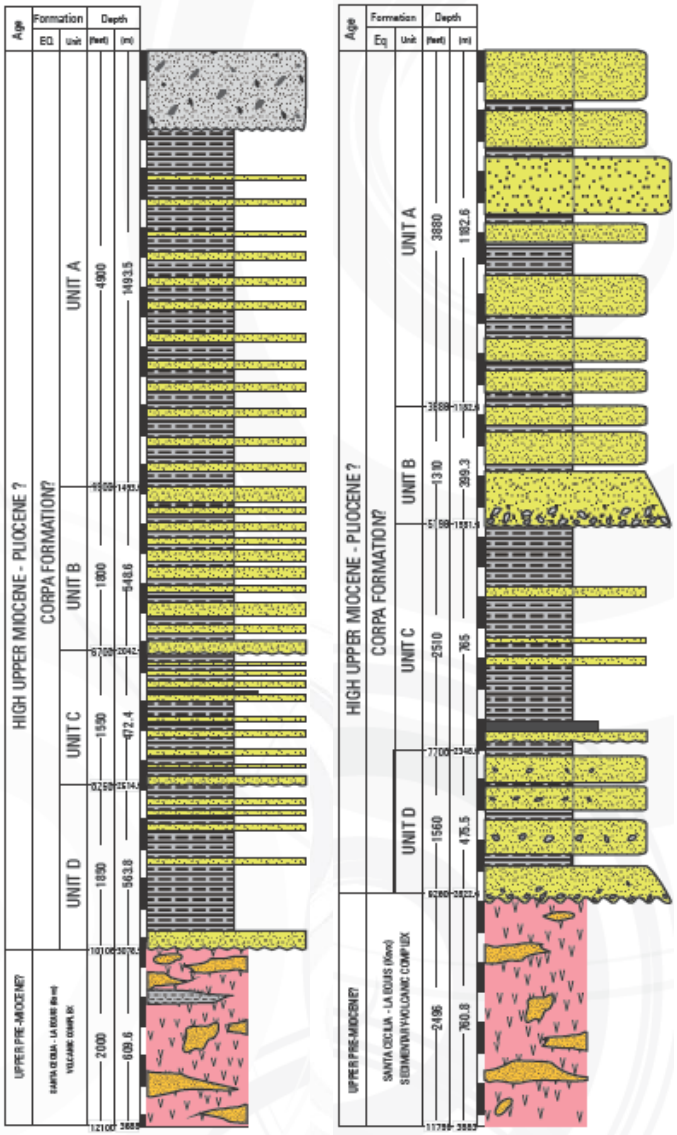
Type 2: 1 Block
2,206 Km^2

Type 3: 1 Block
4,441 Km^2

Urabá

Petroleum geology

Pozo Apartado-1 Pozo Chigorodo-1



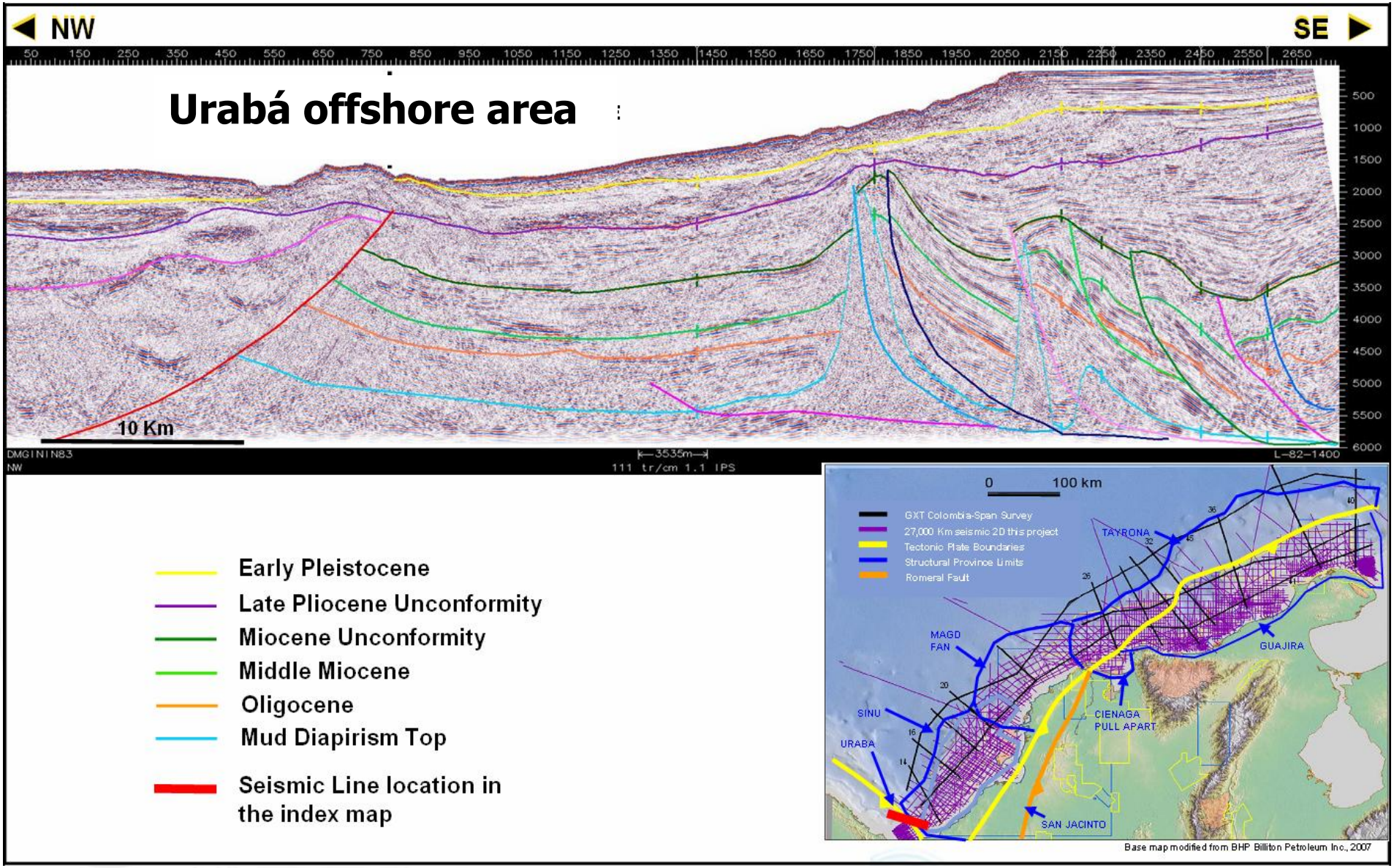
Exploration wells penetrate numerous potential sandstone reservoirs throughout the thick upper Miocene-Pliocene basin fill. Intercalated shales may be effective intraformational seals.

Trap styles include: structural-stratigraphic traps tied to known normal and reverse faults cutting the basin, and to stratigraphic pinchouts on basement in the southeast part of the basin.

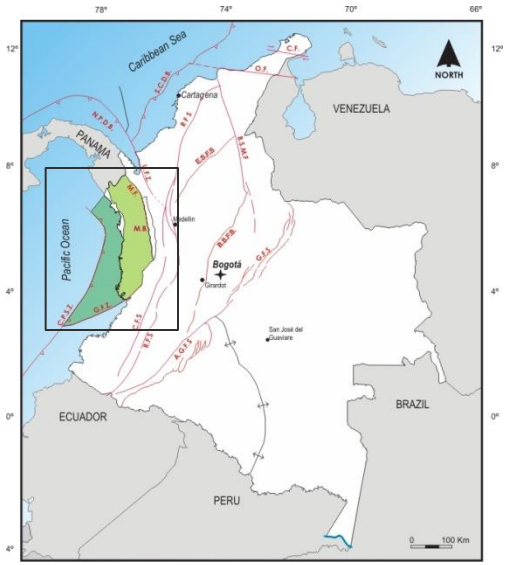
Biogenic gas is a strong possibility in this thick deltaic sedimentary section.

Urabá

Structural style & play types



Chocó



OPEN ROUND 2010 BLOCKS

Onshore

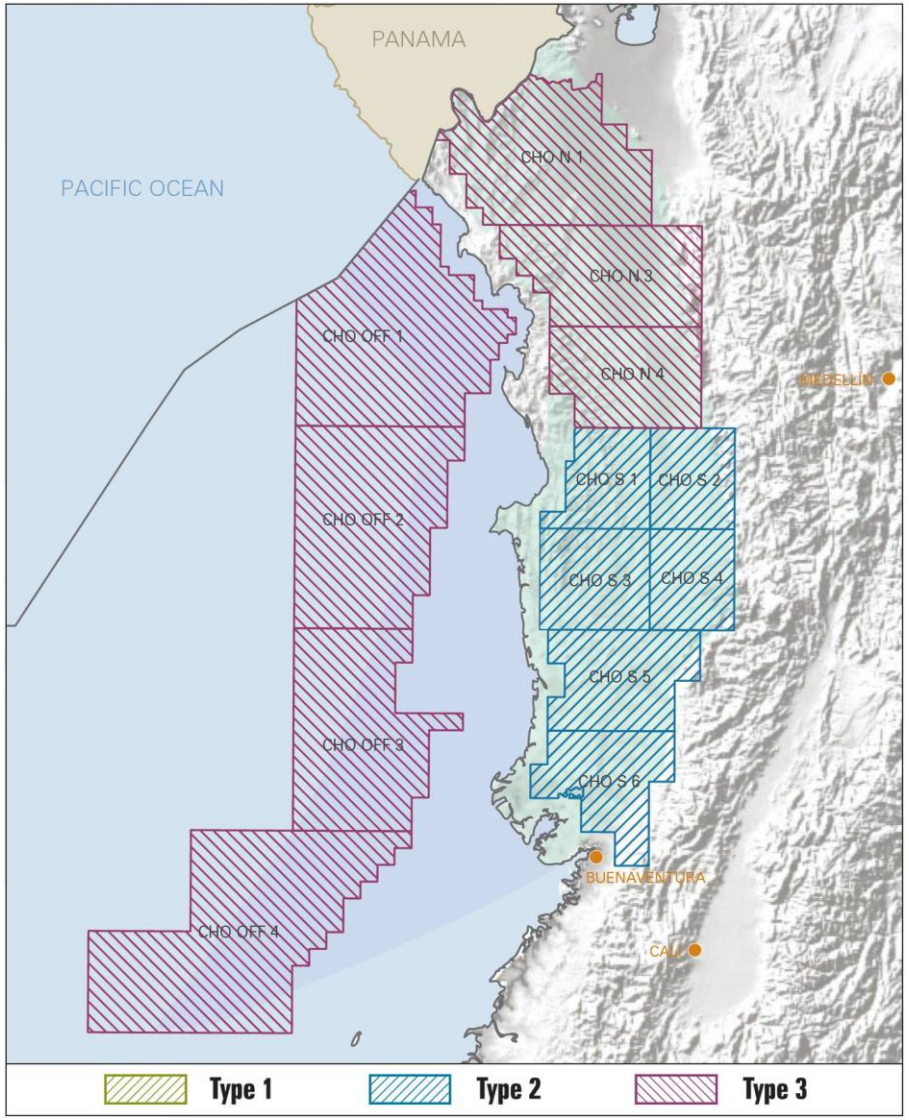
Type 2: 6 Blocks
18,690 Km^2

Type 3: 3 Blocks
16,783 Km^2

Offshore

Type 3: 4 Blocks
38,210 Km^2

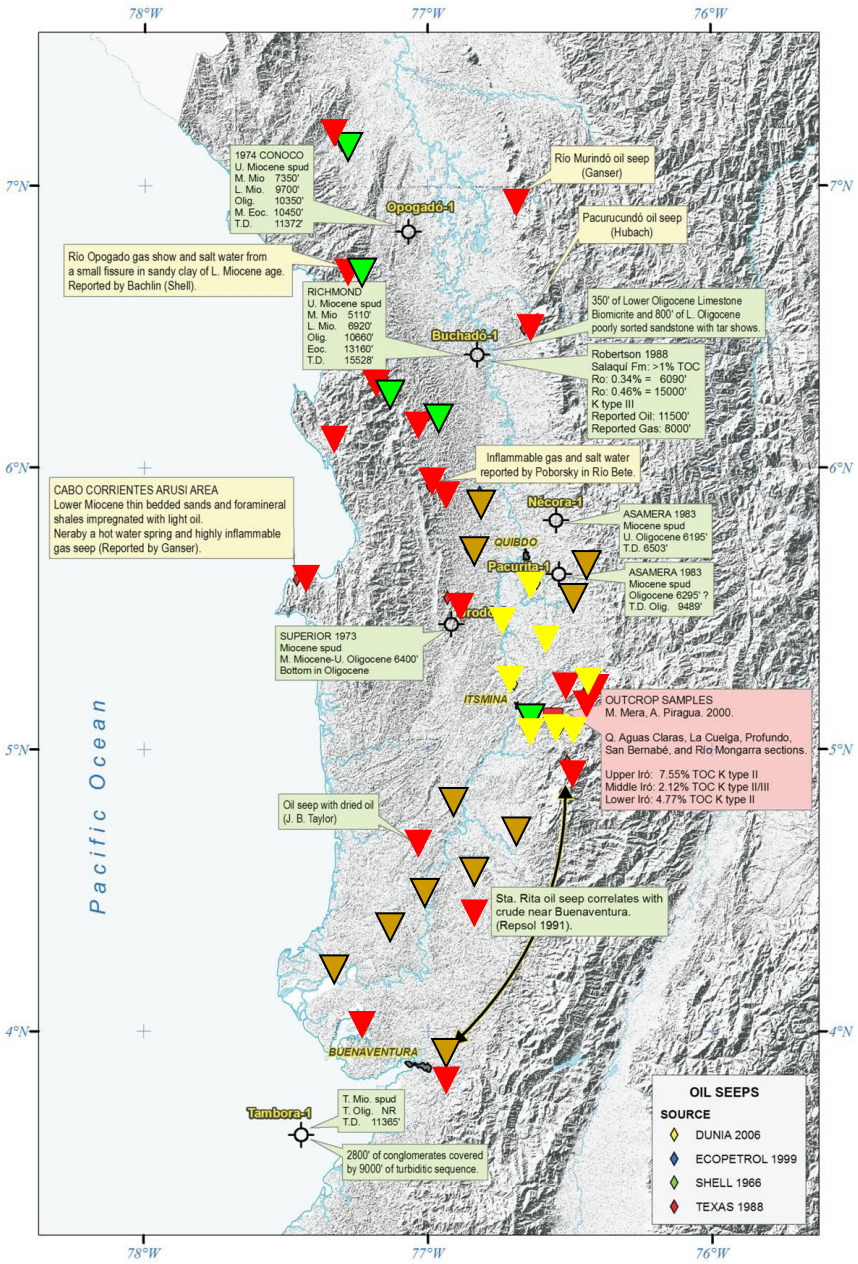
Location map with the offered blocks



Chocó

Oil seeps & wells

Location of Oil seeps and drilled wells along the Chocó basin



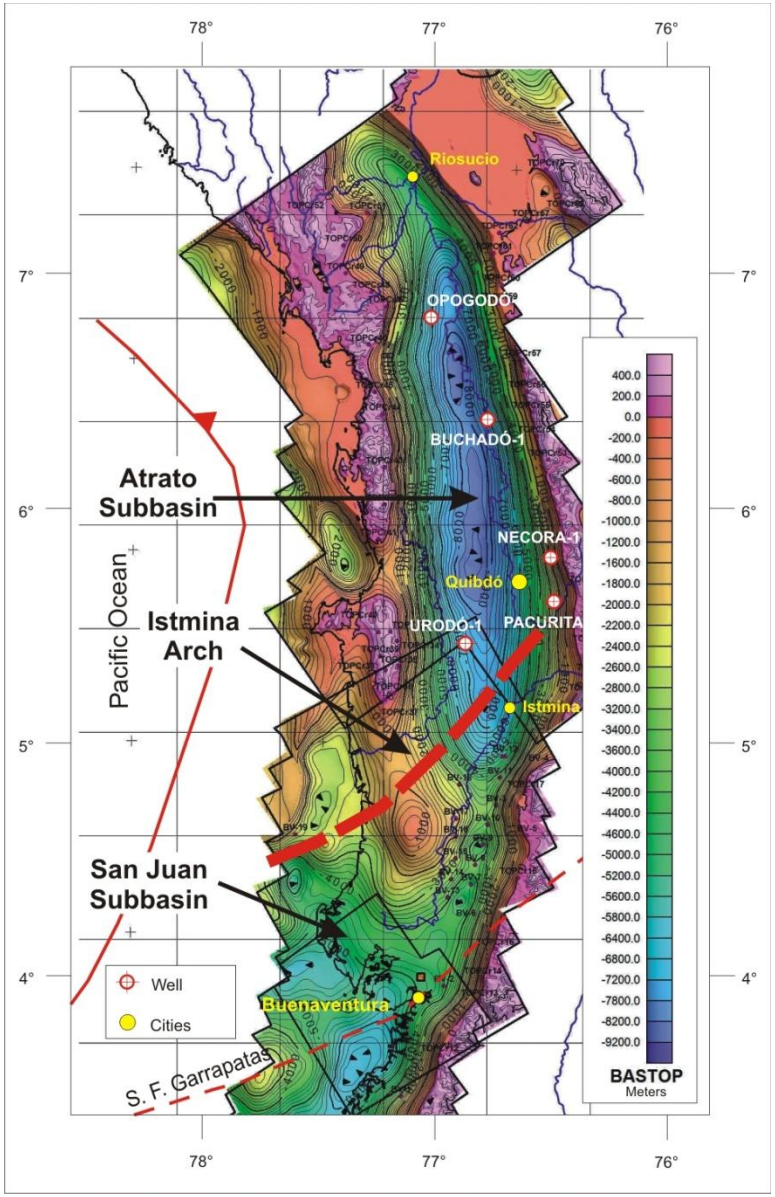
Texas 1988 **Shell 1966**

Eopetrol 1999 **Dunia 2006**

Chocó

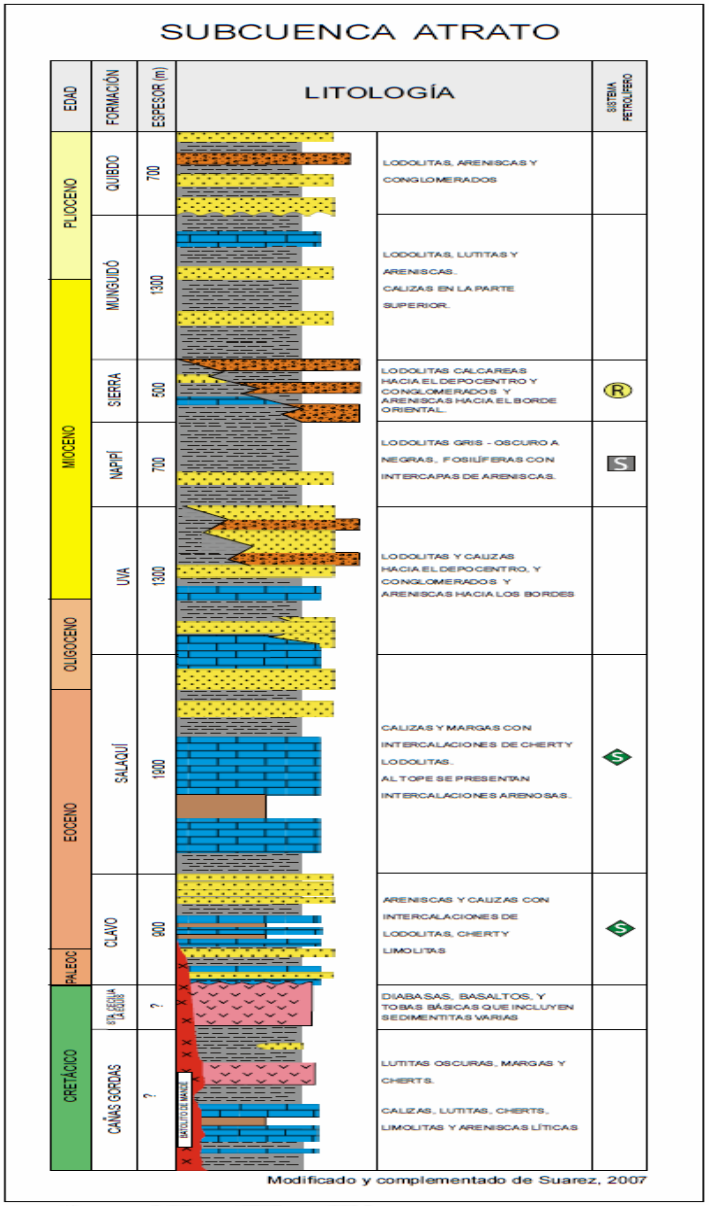
Structural provinces

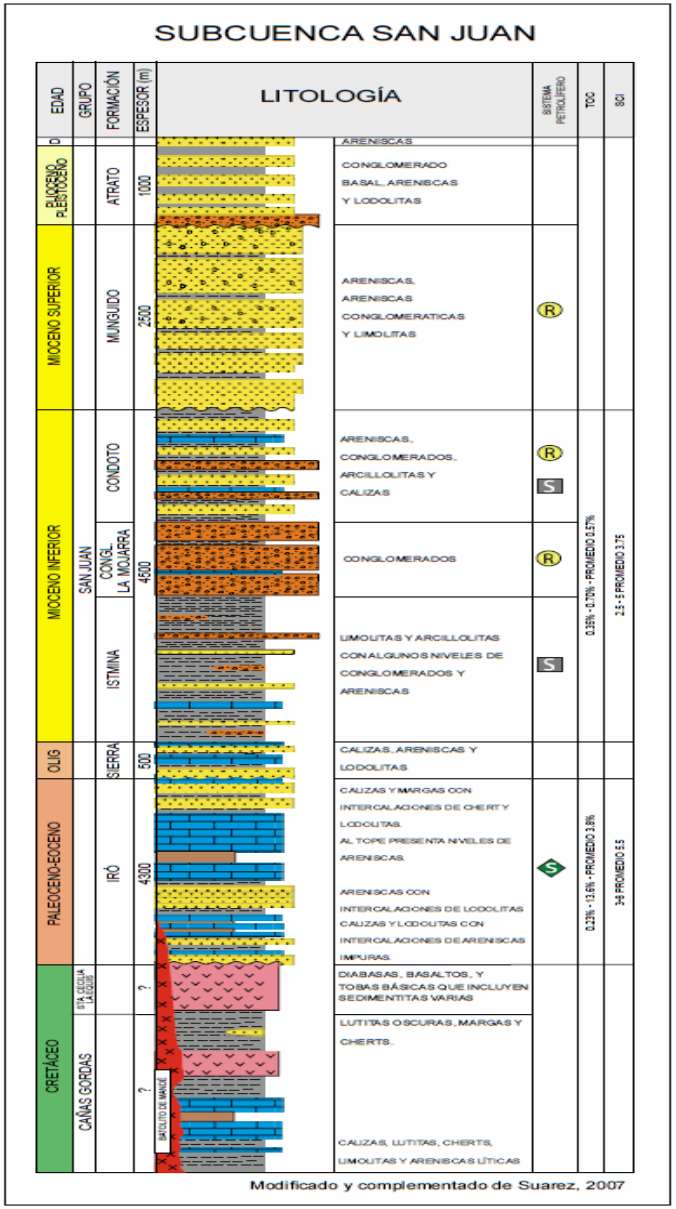
Basement depth contour map with the location of Atrato and San Juan sub-basins and Istmina Arch.



Chocó

Petroleum geology



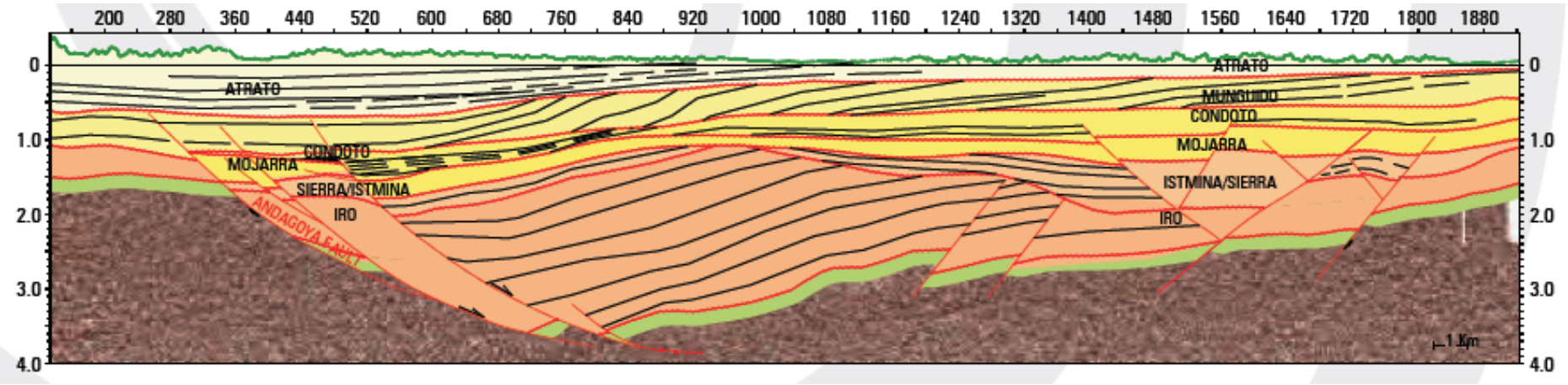


Chocó

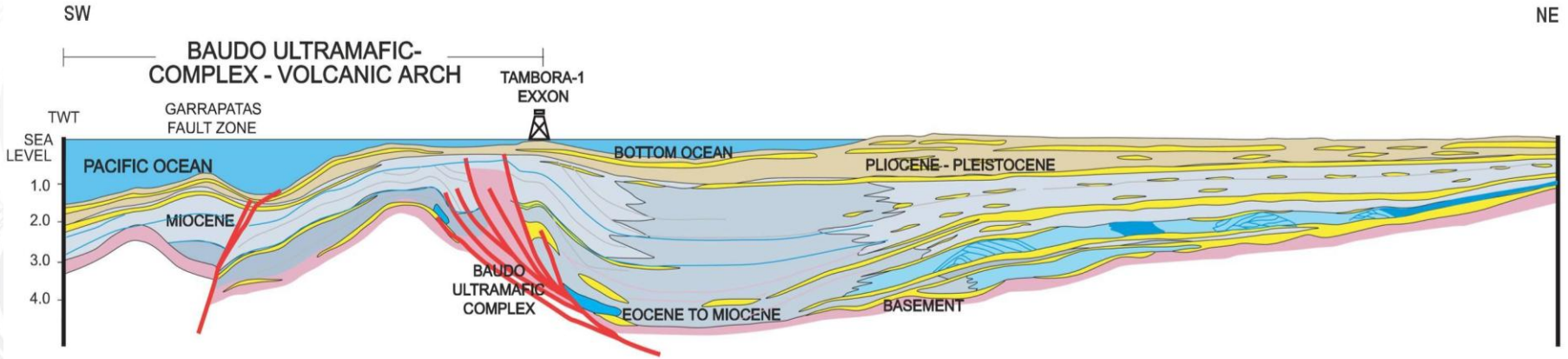
Regional structural style

NNW **SSE**

Longitudinal section of the San Juan sub-basin

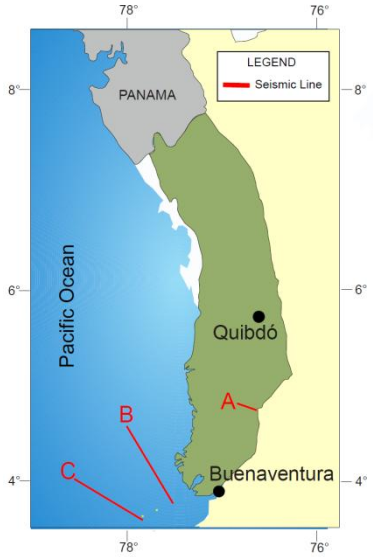


Longitudinal section of the San Juan Delta

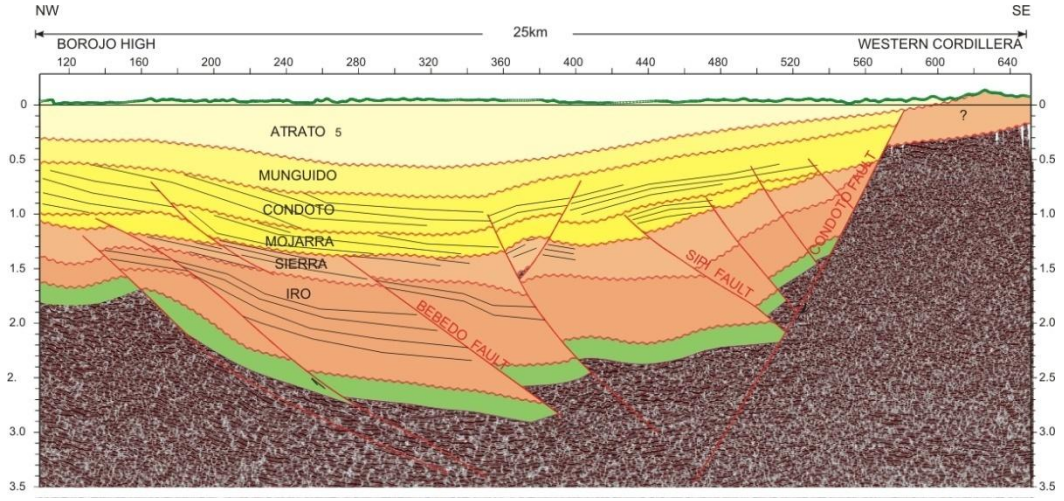


Chocó

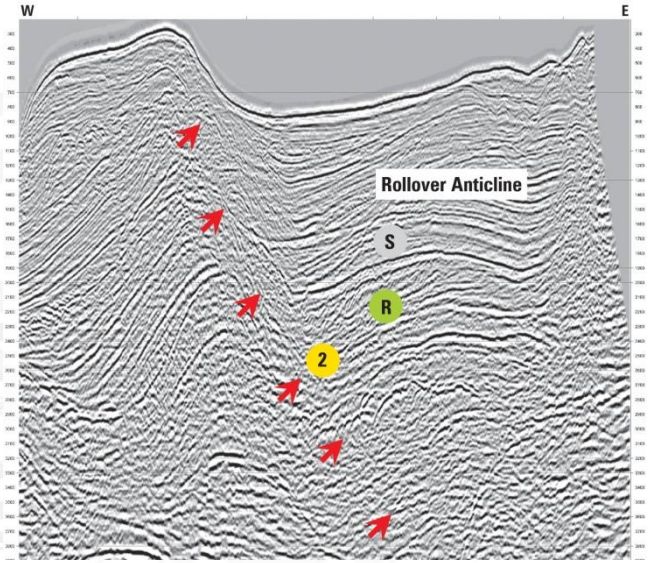
Examples of play types



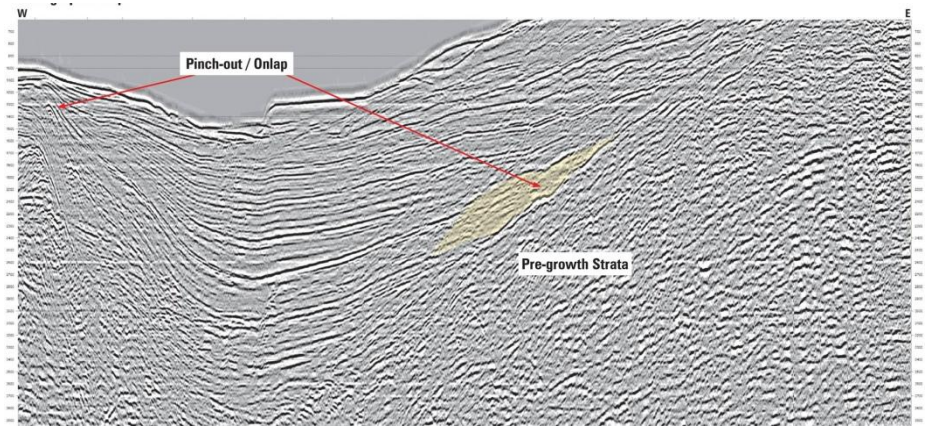
A) Positive structures related to inversion tectonics (Nóvita graben)



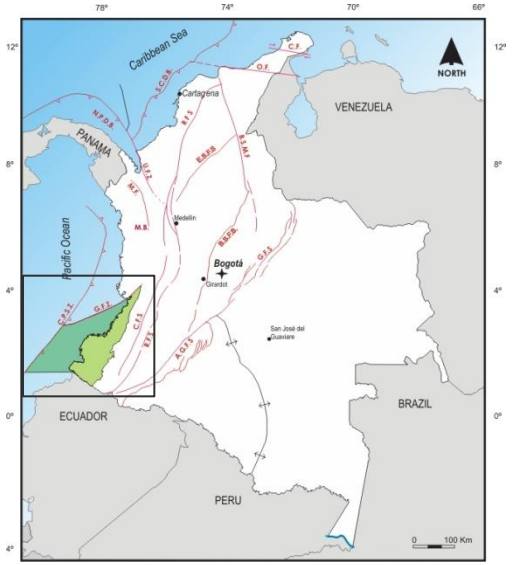
B) Roll-over anticline



C) Stratigraphic traps – pinch-out and onlap over the basement



Tumaco



OPEN ROUND 2010 BLOCKS

Onshore

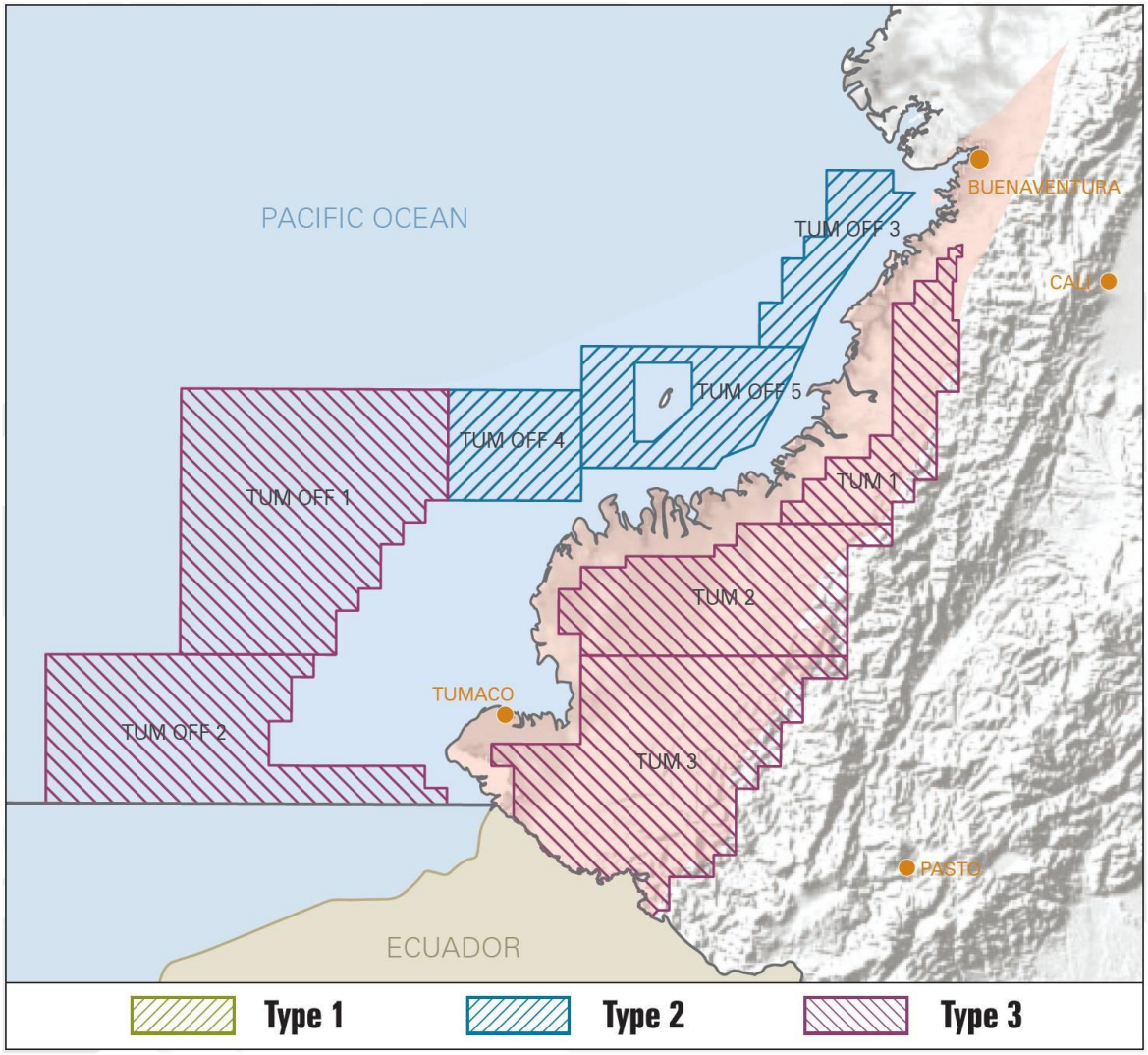
Type 3: 3 Blocks
17,443 Km^2

Offshore

Type 2: 3 Blocks
7,771 Km^2

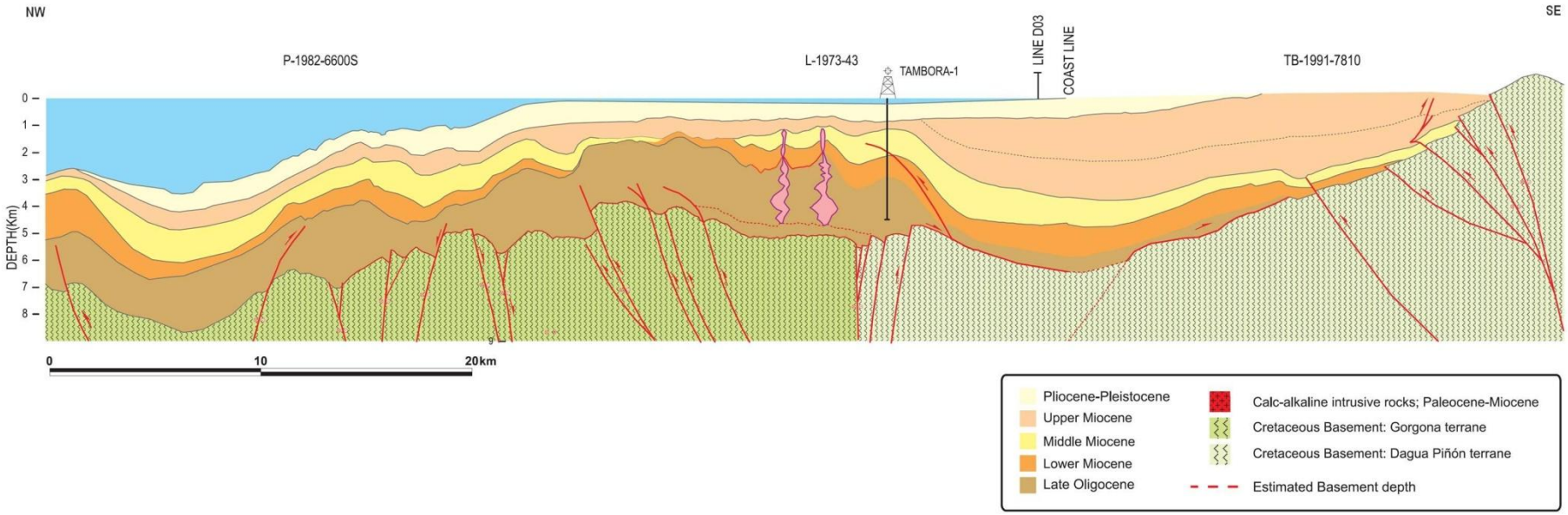
Type 3: 2 Blocks
17,729 Km^2

Location map with the offered blocks



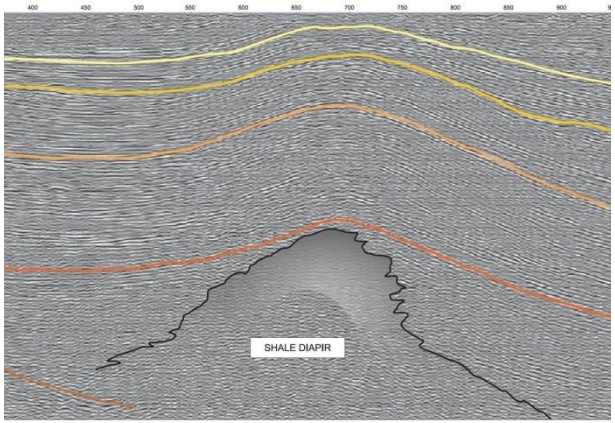
Tumaco

Regional structural style



Traps within Tumaco basin:

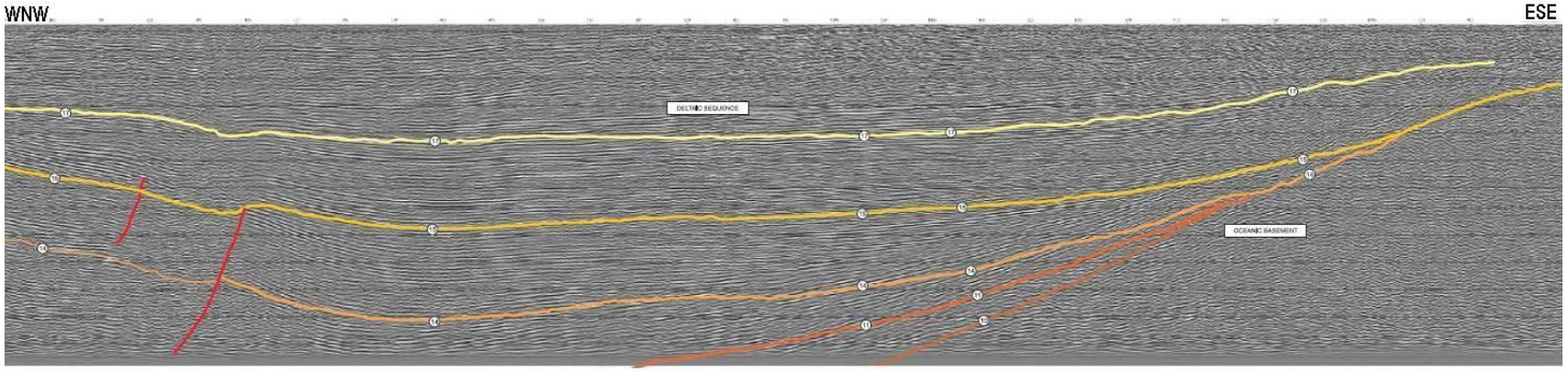
- **Anticlines associated to mud diapirs**
- **Roll-over folds related to normal faults.**
- **Fault-propagation folds**
- **Thrust related anticlines**
- **Stratigraphic traps**

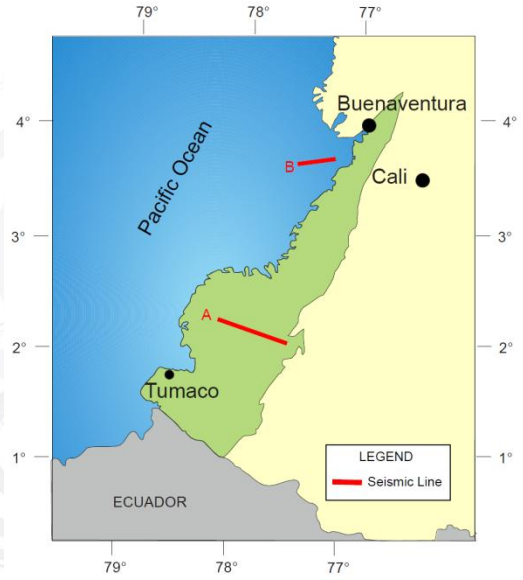


Tumaco

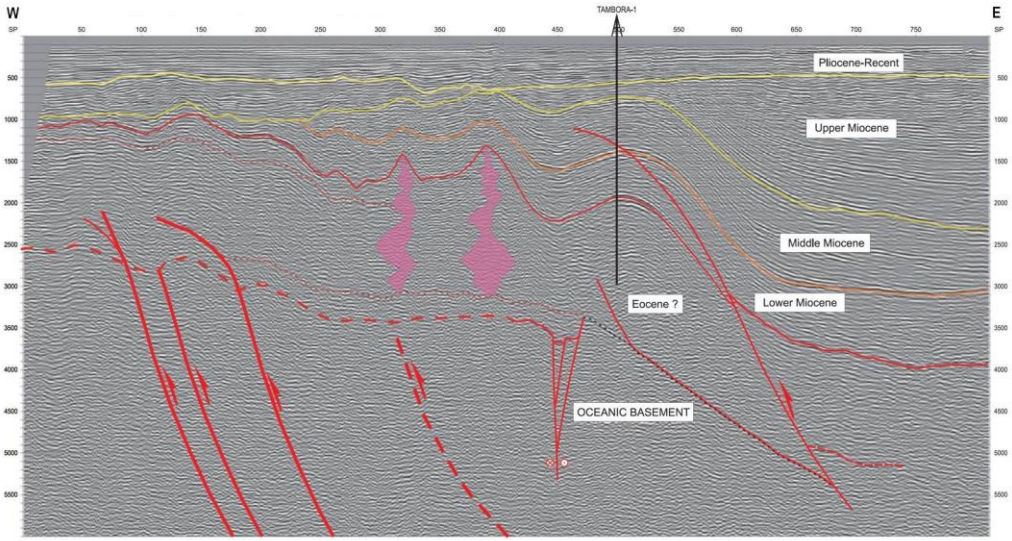
Examples of play types

A) Onlapping over the basement and roll-over folds associated to normal faults

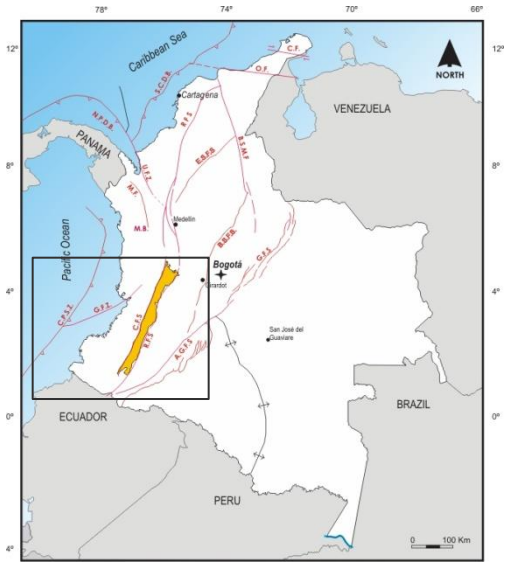




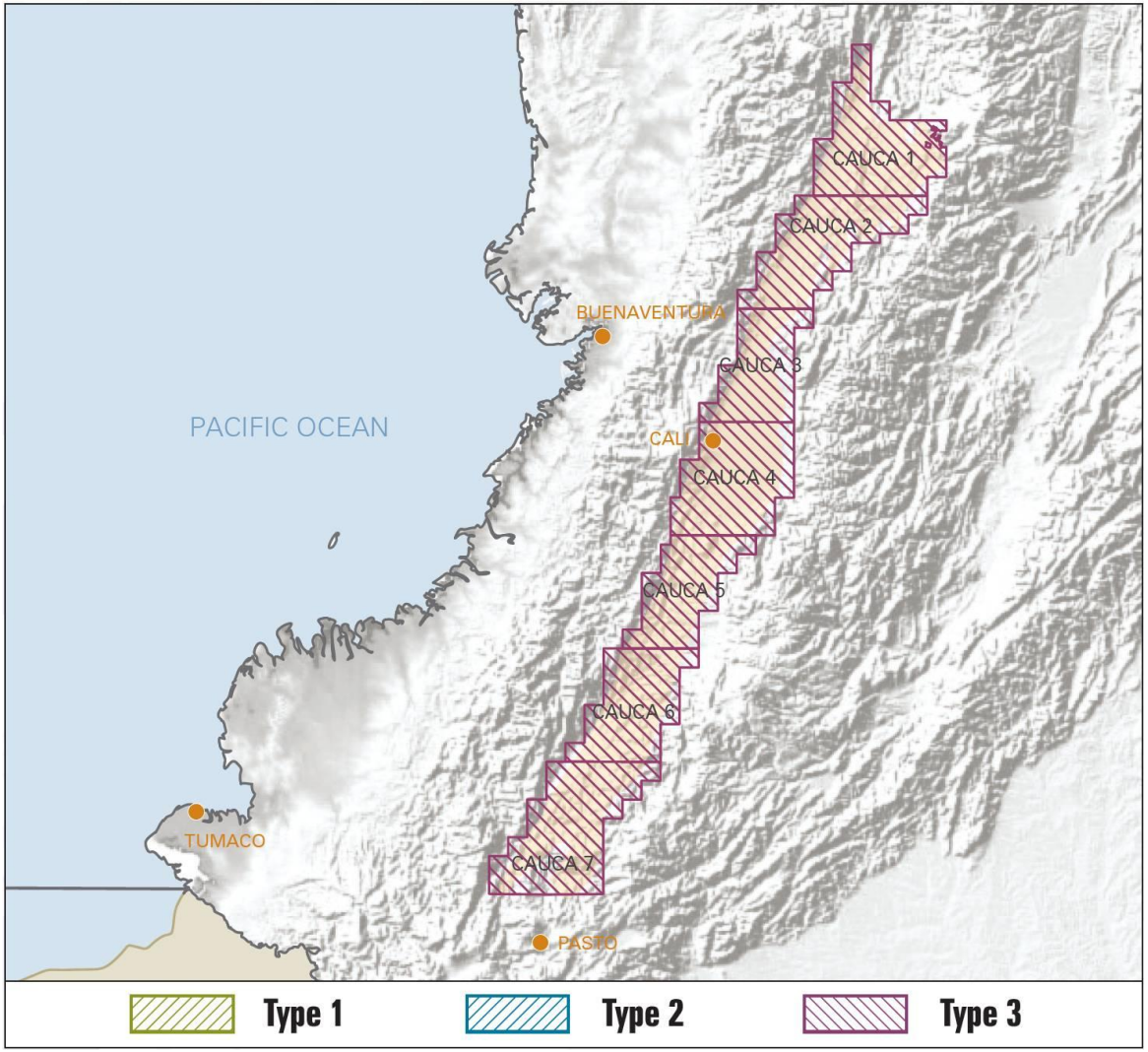
B) Fault-propagation folds related to high angle reverse faults



Cauca - Patía



Location map with the offered blocks

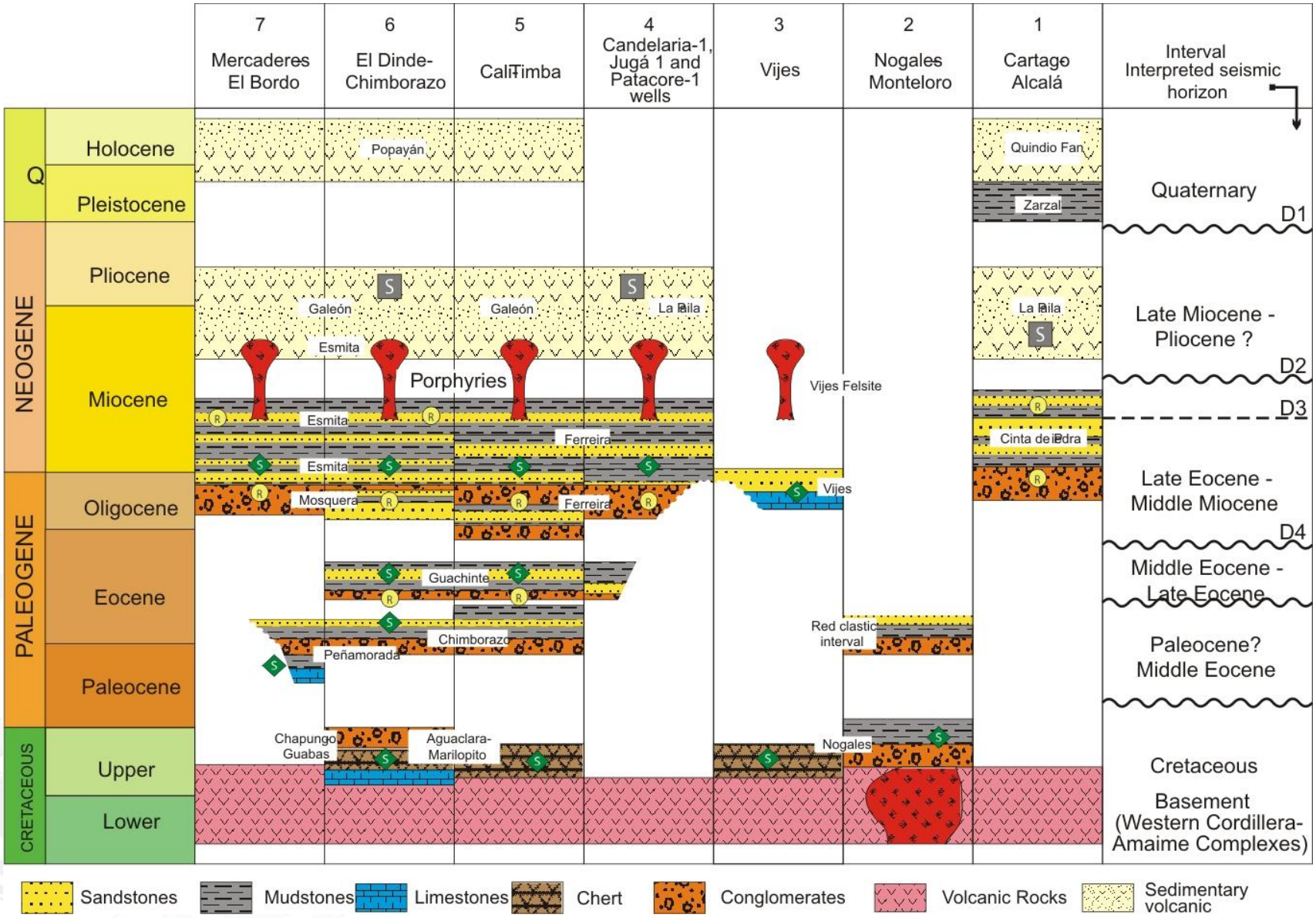


OPEN ROUND 2010 BLOCKS

Type 3: 7 Blocks
17,768 Km^2

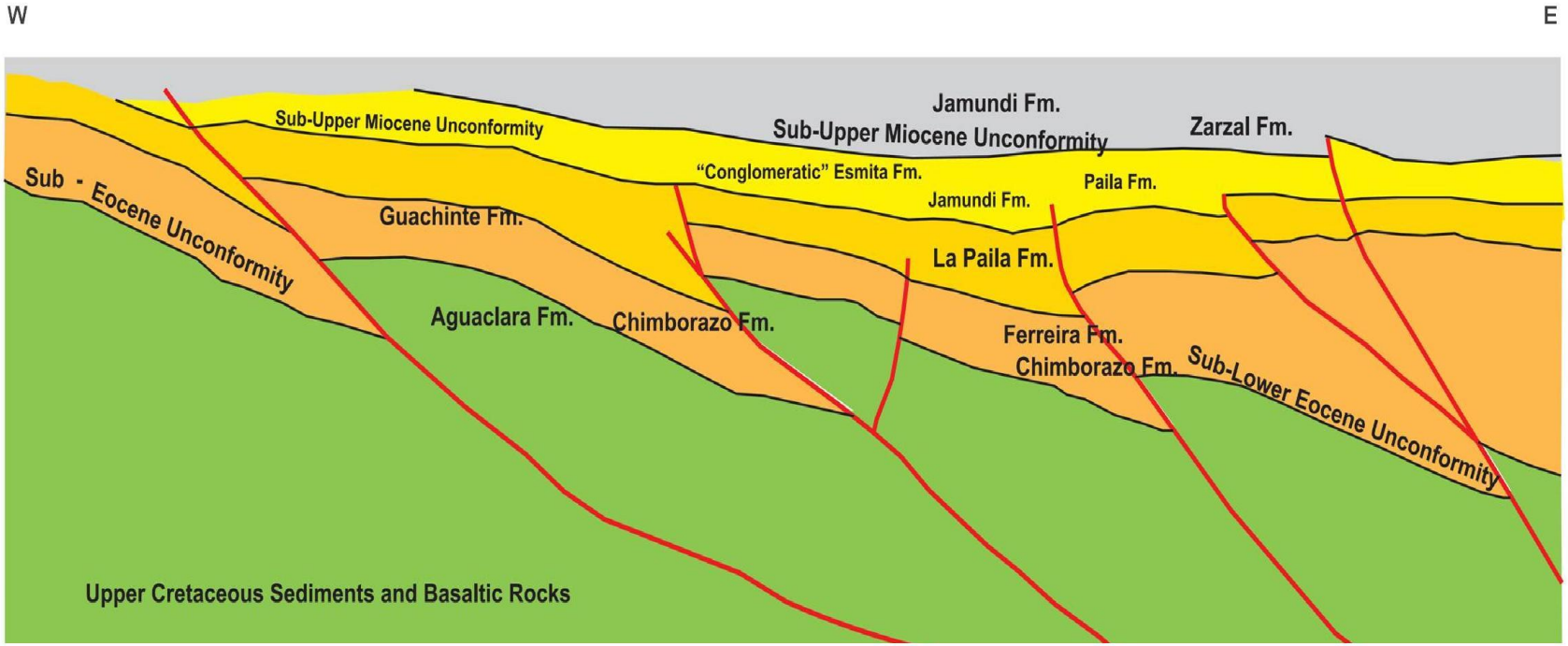
Cauca - Patía

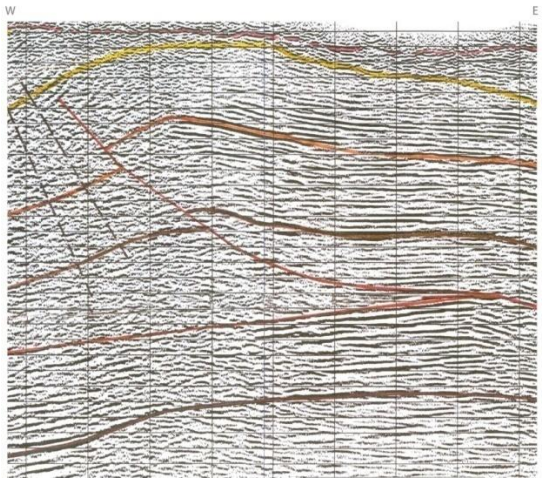
Petroleum geology



Cauca - Patía

Regional structural style



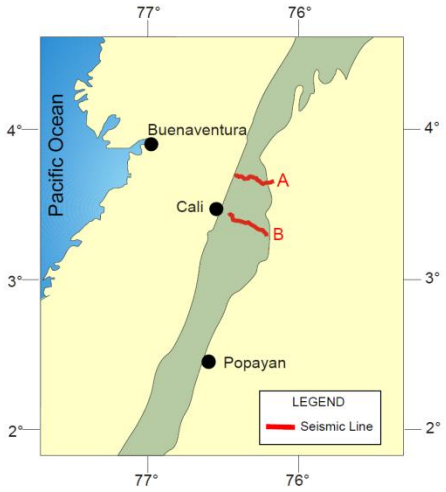


Trap styles within Cauca – Patía Basin

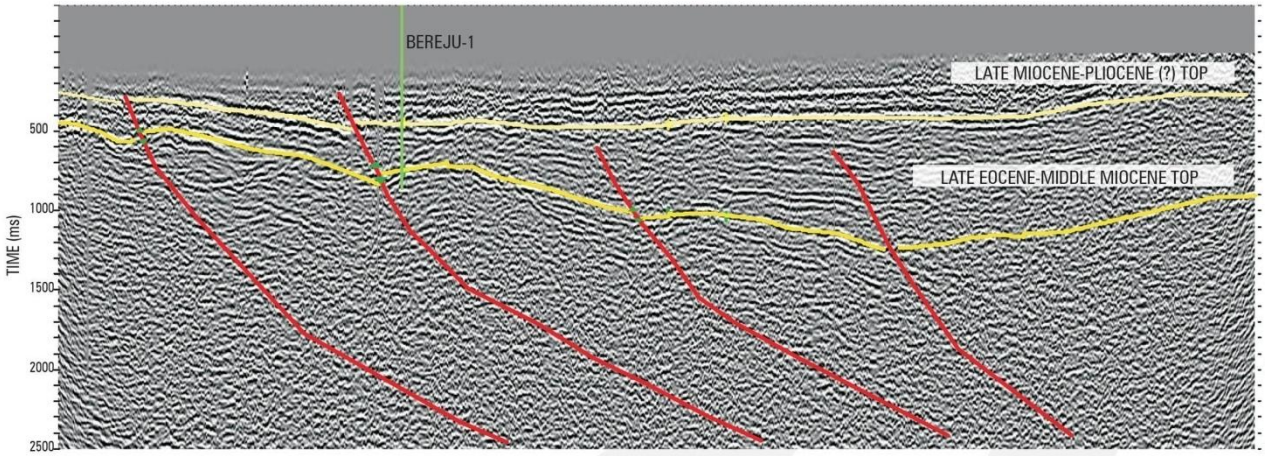
- **Fault-propagation folds**
- **Inversion structures**
- **Basement highs**

Cauca - Patía

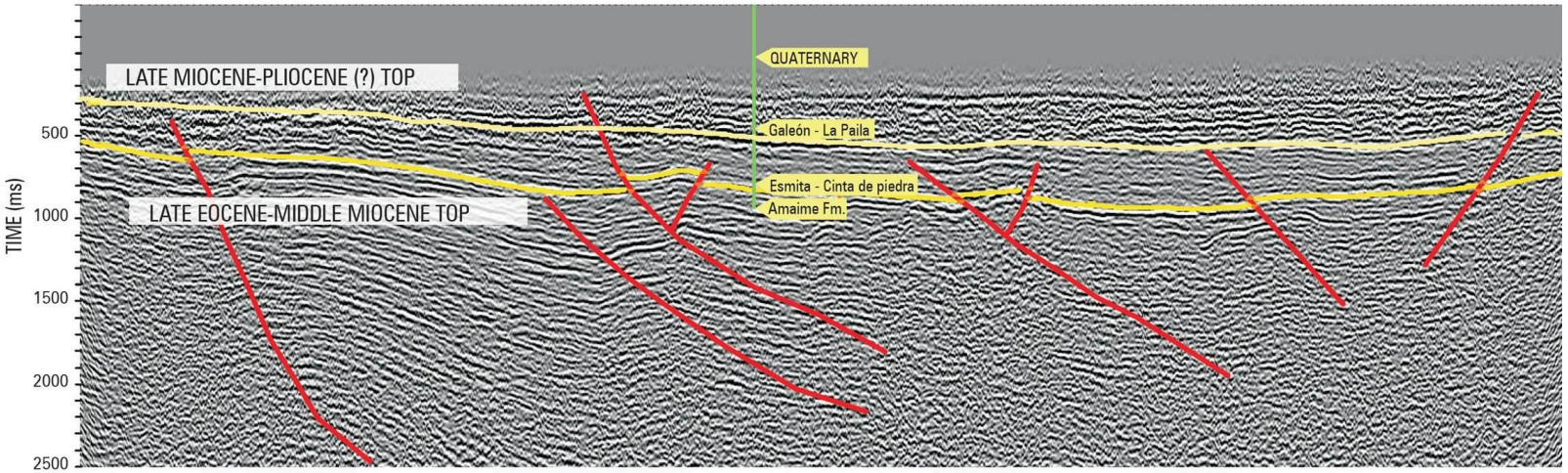
Examples of play types



A) Wide anticlines related to west-verging reverse faults



B) Anticlines related to reverse faults and associated back-thrusts

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