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ATLAS DE GEOQUÍMICA ORGÁNICA DE COLOMBIA

UNA HERRAMIENTA EXPLORATORIA PARA LAS CUENCAS COLOMBIANAS

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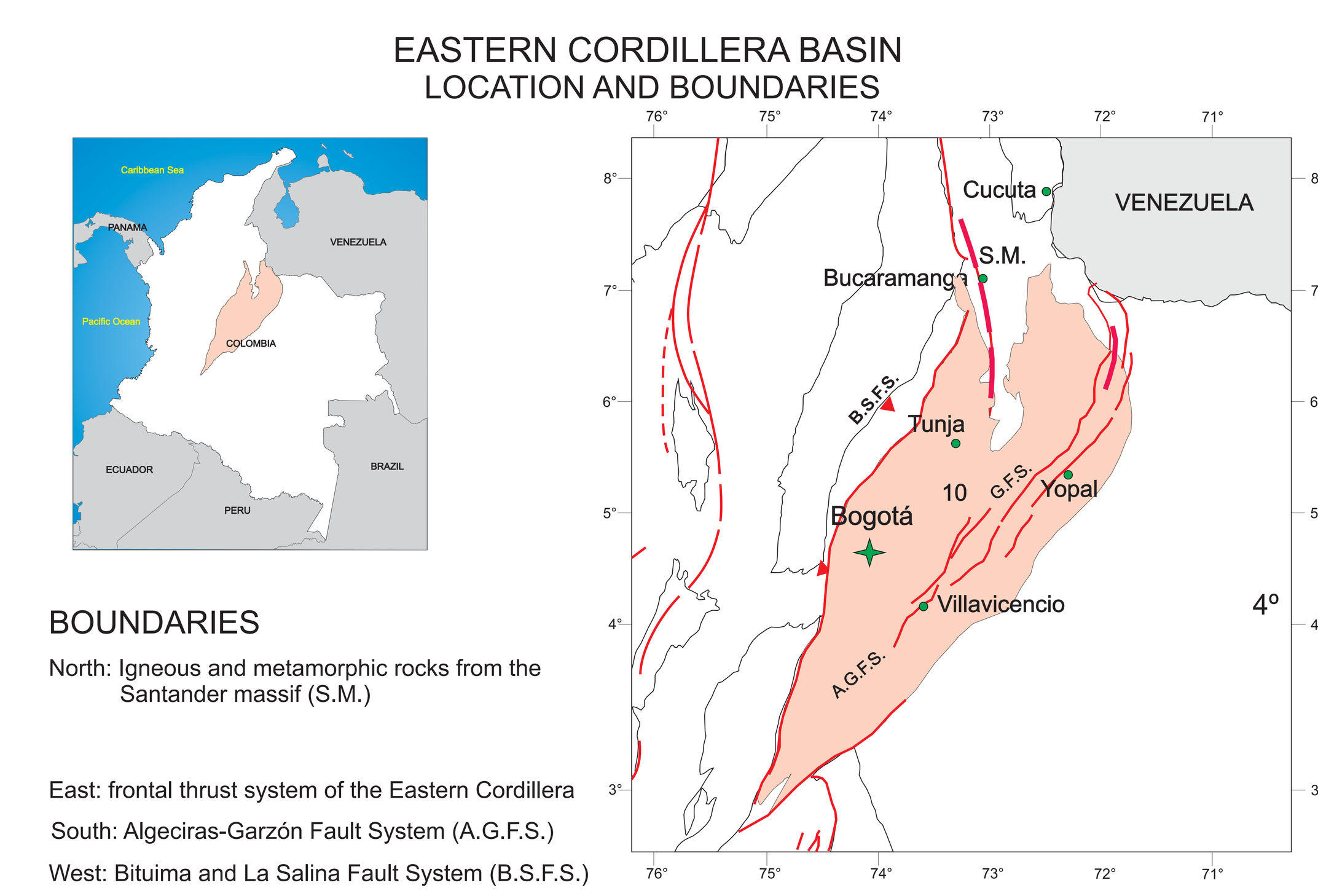
El Atlas de Geoquímica Orgánica de Colombia presenta en una forma simple y gráfica un vistazo del estado del arte del conocimiento geoquímico de las cuencas Colombianas, de utilidad tanto para expertos como para novatos, interesados en tener información actualizada que sea útil para la toma de decisiones exploratorias en Colombia y el norte de Suramérica.

El Atlas se encuentra organizado alfabéticamente, siguiendo la nomenclatura y límites de cuencas sedimentarias de Colombia propuestos por la Agencia Nacional de Hidrocarburos de Colombia (ANH). E incluye información geoquímica y geológica de 18 cuencas, incluyendo análisis de roca generadora, contenido de material orgánica (%TOC), pirolisis Rock-Eval, petrografía orgánica, análisis de crudos y extractos, cromatografía líquida y gaseosa, biomarcadores e isótopos. Además de los datos mencionados, dos temas adicionales están presentes en el Atlas, uno acerca del origen de los hidrocarburos a partir de datos de geoquímica de superficie y otro sobre sistemas petrolíferos a partir de correlaciones crudo-roca.

La información existente y disponible en la base de datos de geoquímica orgánica de la Agencia Nacional de Hidrocarburos (ANH) se empleó para generar gráficas de la caracterización deposicional, de madurez térmica y calidad de crudos y rocas generadoras, junto con mapas de calidad y madurez de algunas de las principales rocas generadoras presentes en las cuencas Colombianas. Con base en esta información se presentan algunas ideas sobre las rocas generadoras, el origen de los hidrocarburos y los sistemas petrolíferos.

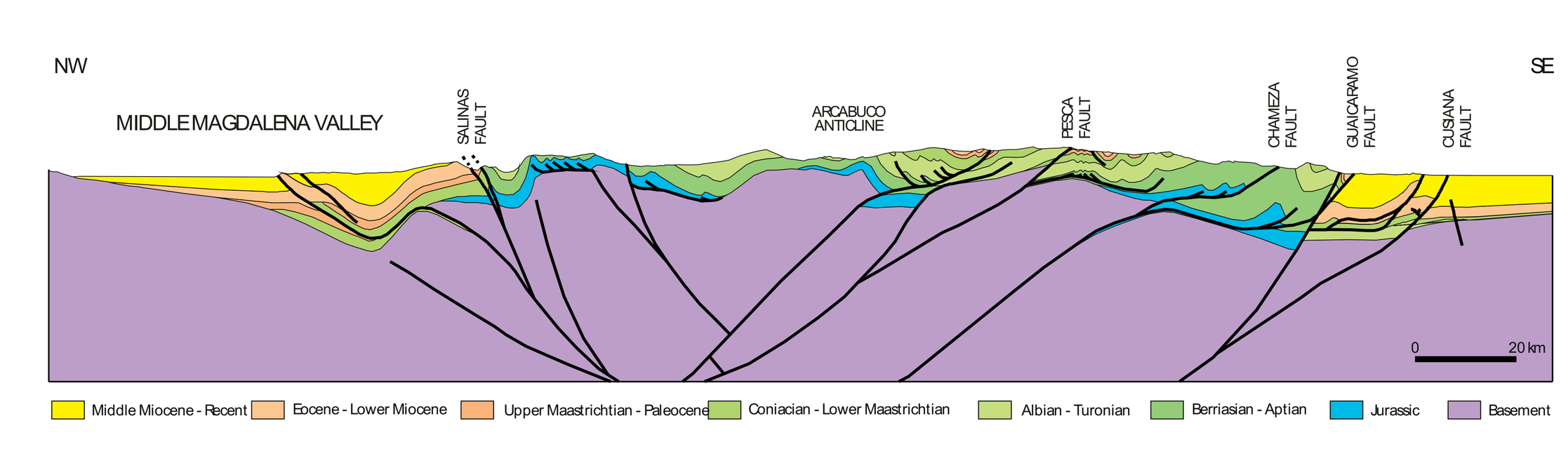
El Atlas de Geoquímica Orgánica de Colombia se ha desarrollado como una herramienta exploratoria que sirva de apoyo a los profesionales involucrados en la exploración y producción de hidrocarburos, interesados en entender el origen y evolución de las rocas generadoras y las acumulaciones de crudo y gas presentes en las cuencas de Colombia, y adicionalmente como una guía para el trabajo futuro necesario para mejorar el conocimiento y reducir el riesgo exploratorio, especialmente en las cuencas frontera de Colombia.

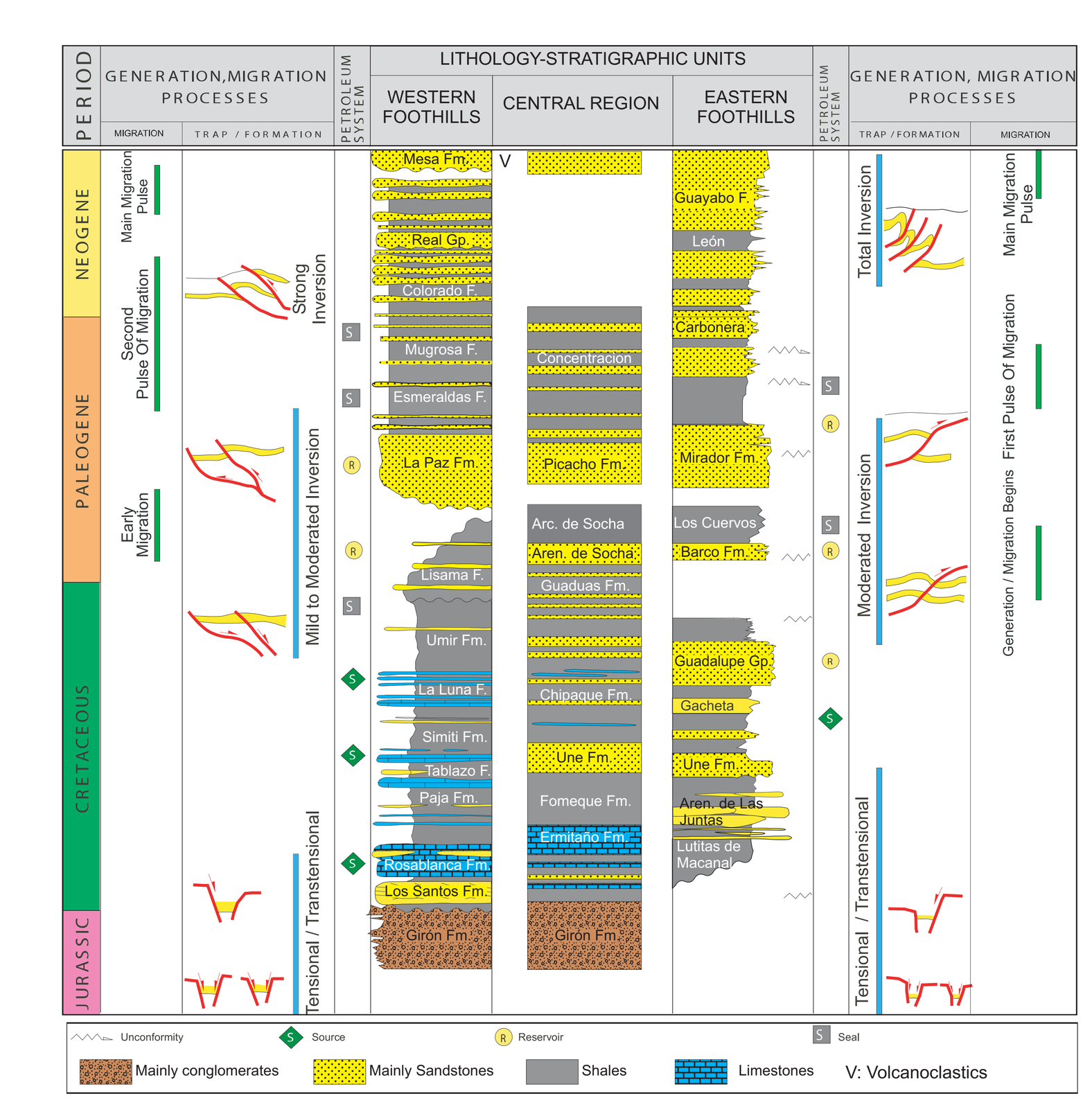
Generalities



The source rock geochemical information interpreted for the Eastern Cordillera Basin includes %TOC and Rock-Eval Pyrolysis data from 1512 samples taken in 9 locations; additionally 369 organic petrography samples from 8 locations were interpreted.

Crude oil and extracts information from 4 bulk analysis samples, 111 liquid chromatography samples, 114 gas chromatography samples, 125 biomarker sample, 42 isotopes and 349 surface geochemistry samples were also interpreted.





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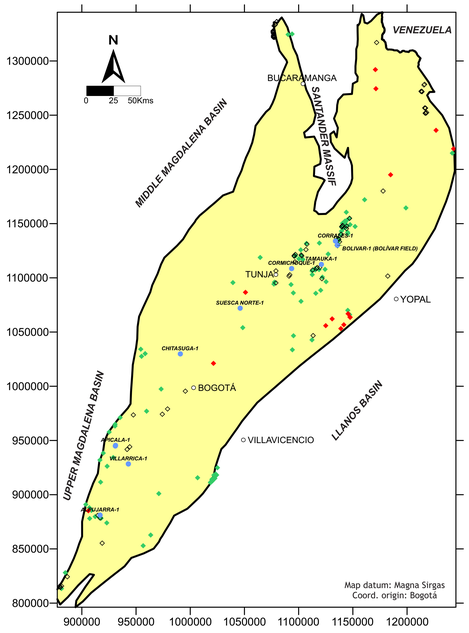
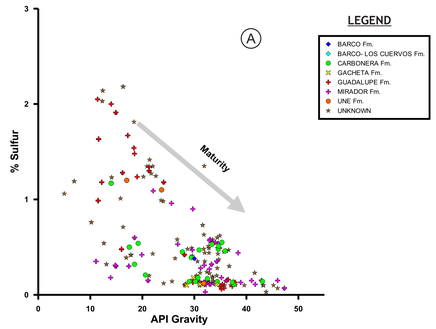
Wells and Seeps

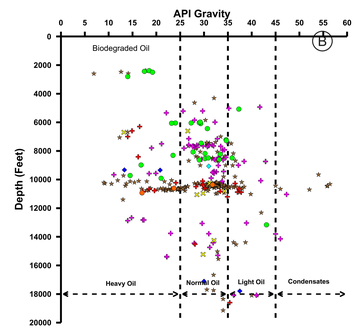


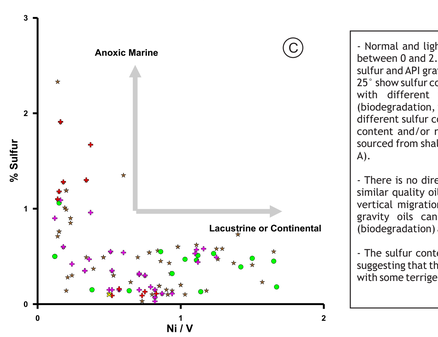
The number of wells and/or surface locations with geochemical information in the Eastern Cordillera Basin is 12 .

Oilseeps are located widespread all over the basin

Crude Oil Quality





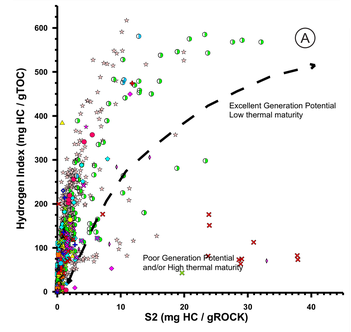


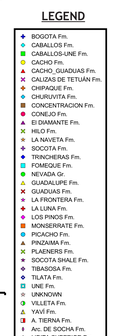
- Normal and light oils with API gravities ranging from 10° to 50° and sulfur content between 0 and 2.5% are present in the basin. There is no straight relationship between sulfur and API gravity, but oils above 25° API have sulfur values below 1%, and oils below 25° show sulfur content with values up to 3%. This suggests that in the basin there are oils with different thermal maturities and/or different degrees of preservation (biodegradation, water washing, etc.), because crudes having similar API gravities have different sulfur contents, which might indicate that biodegradation is increasing sulfur content and/or reducing API gravity, or different source rocks, considering that oils sourced from shales usually have lower sulfur content than oils from carbonates (Figure A).

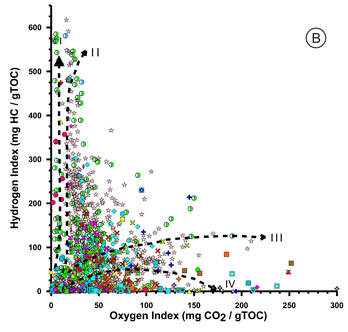
- There is no direct relationship between depth and crude oil quality, indicating that similar quality oils can be found at different stratigraphic levels, probably related to vertical migration along faults. But additionaly there is the fact that different API gravity oils can be found at similar depths, reflecting different preservation (biodegradation) and/or thermal maturities (Figure B).

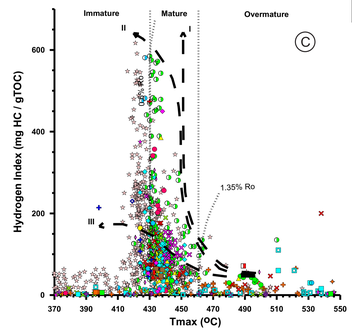
- The sulfur content of most crude oils is lower than 1%, and its Ni/V ratio below 1, suggesting that they are produced from rocks deposited in a marine suboxic environment with some terrigenous organic matter input (Figure C).

Source Rock Characterization







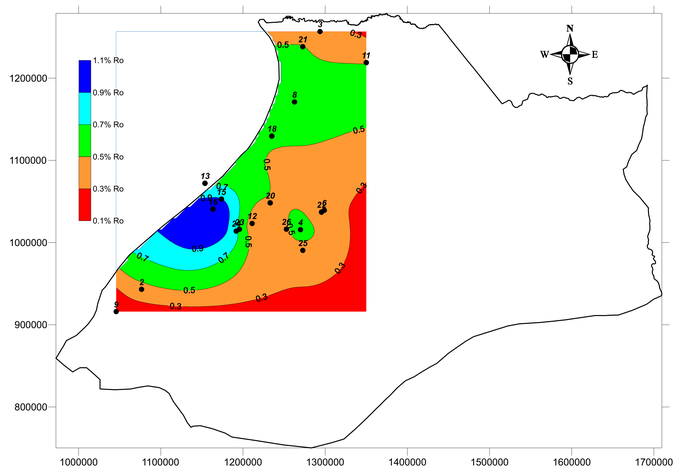


- The data obtained from pyrolysis Rock-Eval of rock samples for Hydrogen Index (HI) and S2 peak, indicate that samples from the Cretaceous Caballos, Conejo, La Luna, Villeta, Guadalupe, Los Pinos and Umir formations and the Cenozoic Arcillas de Socha Formation have good generation potential (HI > 200mg HC/g TOC and S2 > 5 mg HC/g rock). It is important to consider that these and other units with source rock characteristics, are or were deeply buried in the basin by thrusting, and the poor generation values obtained from many samples could reflect the depletion effect caused by the high thermal maturity reached by these rocks in sub-thrust sheets (Figure A).

- The Oxygen Index vs Hydrogen Index diagram (Van Krevelen diagram) shows that rock samples from the Cretaceous Caballos, Conejo, La Luna, Villeta and Umir formations have type II oil-prone kerogen. There are also samples from these formations with type III gas-prone characteristics. In the case of the Cenozoic units (Guaduas, Concentración and Bogotá formations) their samples are indicative of type III gas-prone kerogen to type IV kerogen. (Figure B).

- The Tmax maturity parameter vs Hydrogen Index graph shows that many samples from the Cretaceous to Cenozoic units mentioned, have reached early maturity to overmature conditions in the basin. Being the samples from the Cretaceous Fomeque, Chipaque and Hilo formations the more mature in the basin (Figure C).

Gacheta Formation



Vitrinite reflectance (%Ro)

LEGEND

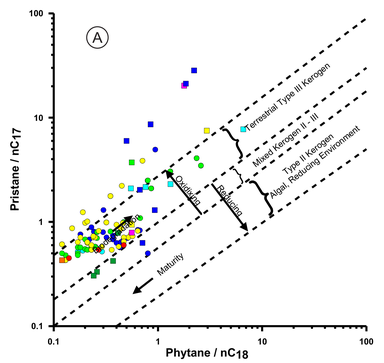
1. ANACONDA-1	15. LA MARÍA-1
2. APIAY-4P	16. LETICIA-1
3. ARAUQUITA-1	17. POMARROSO-1
4. ARIMENA-1	18. PORE-1
5. BUENOS AIRES X-14	19. QUENANE-1
6. CAÑO DUYA-1	20. RANCHO HERMOSO-1
7. CAÑO VERDE-1	21. RÍO ELE-1
8. CASANARE-1	22. SAN JOAQUÍN-1
9. CASTILLA-1	23. SANTIAGO-1
10. CHAPARRAL-1	24. SANTIAGO-2
11. CHIGUIRO-1	25. SIMÓN-1
12. ENTRERRIOS-1	26. SURIMENA-1
13. GOLCONDA A-1	27. YALÍ-1
14. LA HELIERA-1	

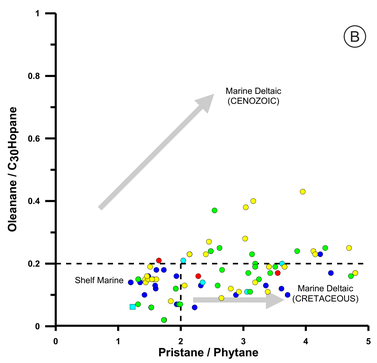
- There are very few extract samples in the basin to provide strong correlations with the oils found in the basin, but the few extracts from the Gachetá Formation show some correlation with crude oils from the Une, Guadalupe, Mirador and Carbonera reservoirs (Figure A).

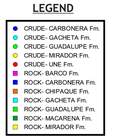
- This indicates that the Gachetá Formation could be the main source for the accumulations found in the basin. However the presence of oils with Oleanane/C30 Hopane > 0.2 is indicative of an alternate source in the basin of Tertiary age and/or with an important terrestrial organic matter input (Figure B).

-The oils with Oleanane/C30 Hopane > 0.2 are found in Upper Cretaceous (Guadalupe Fm.) and Tertiary reservoirs (Mirador and Carbonera formations), which are interbedded or in close proximity to Tertiary shale sequences deposited in transitional marine environments, which might have high terrestrial organic matter input, causing the increase of Oleanane/C30 Hopane ratios in these oils (Figure B).

Petroleum Systems (Crude-Rock Correlations)







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