

HYDROCARBON PROSPECTIVITY OF THE VAUPES-AMAZONAS BASIN, COLOMBIA

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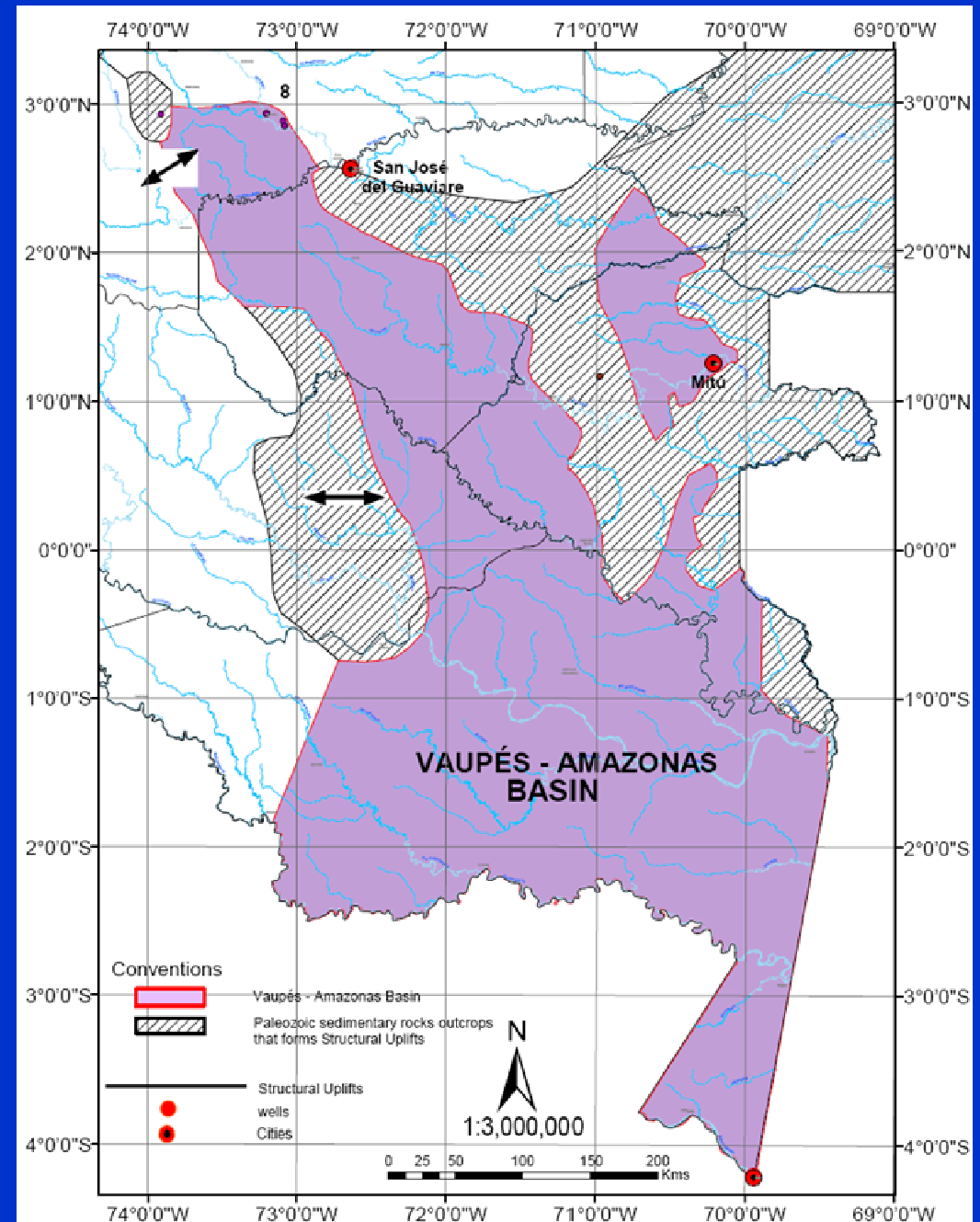
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OUTLINE

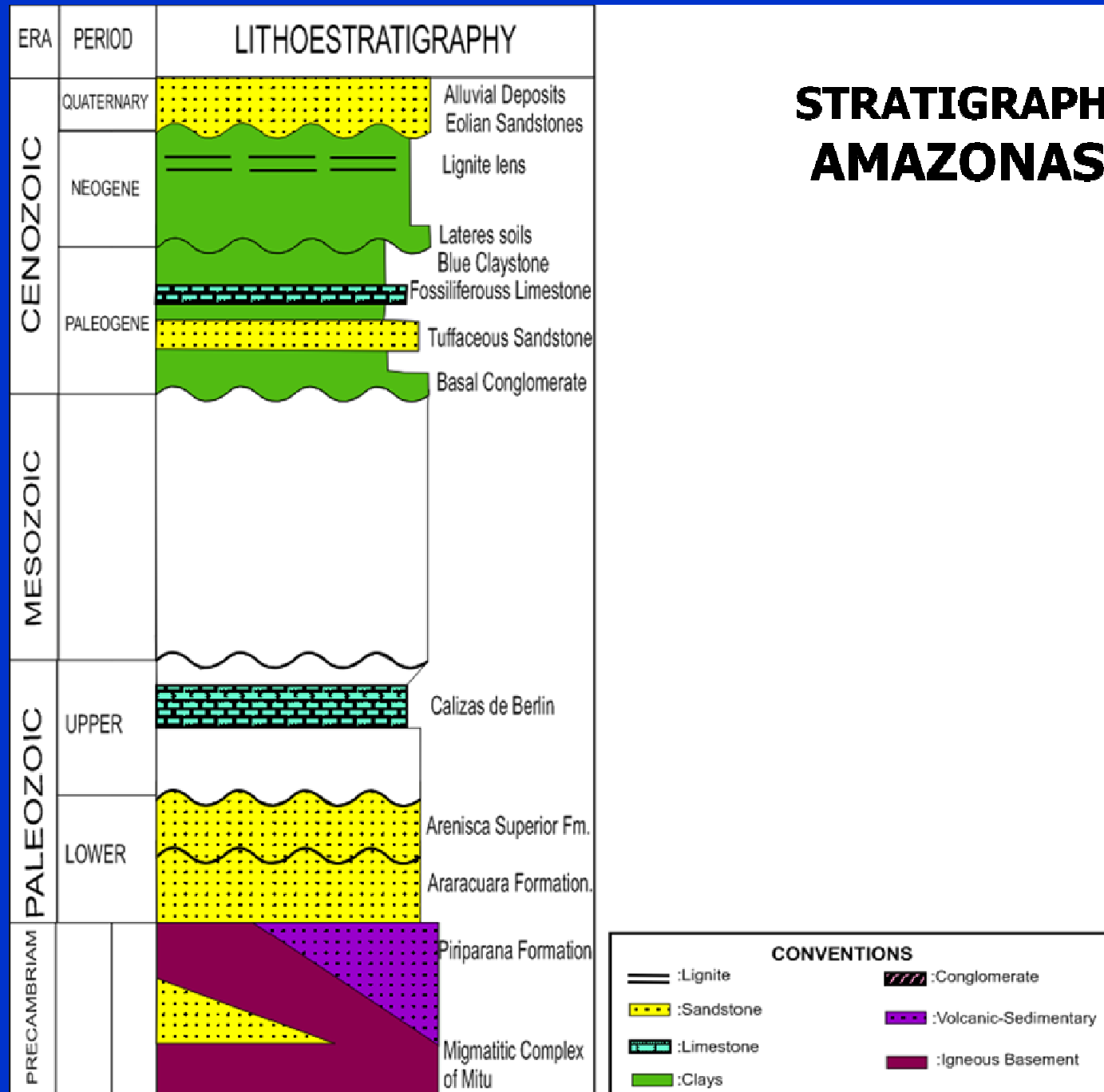
- Geological Setting
- Stratigraphy
- Geophysical information
- Structural Geology
- Geochemistry
- Conclusions

GEOLOGICAL SETTING OF THE AMAZONAS BASIN

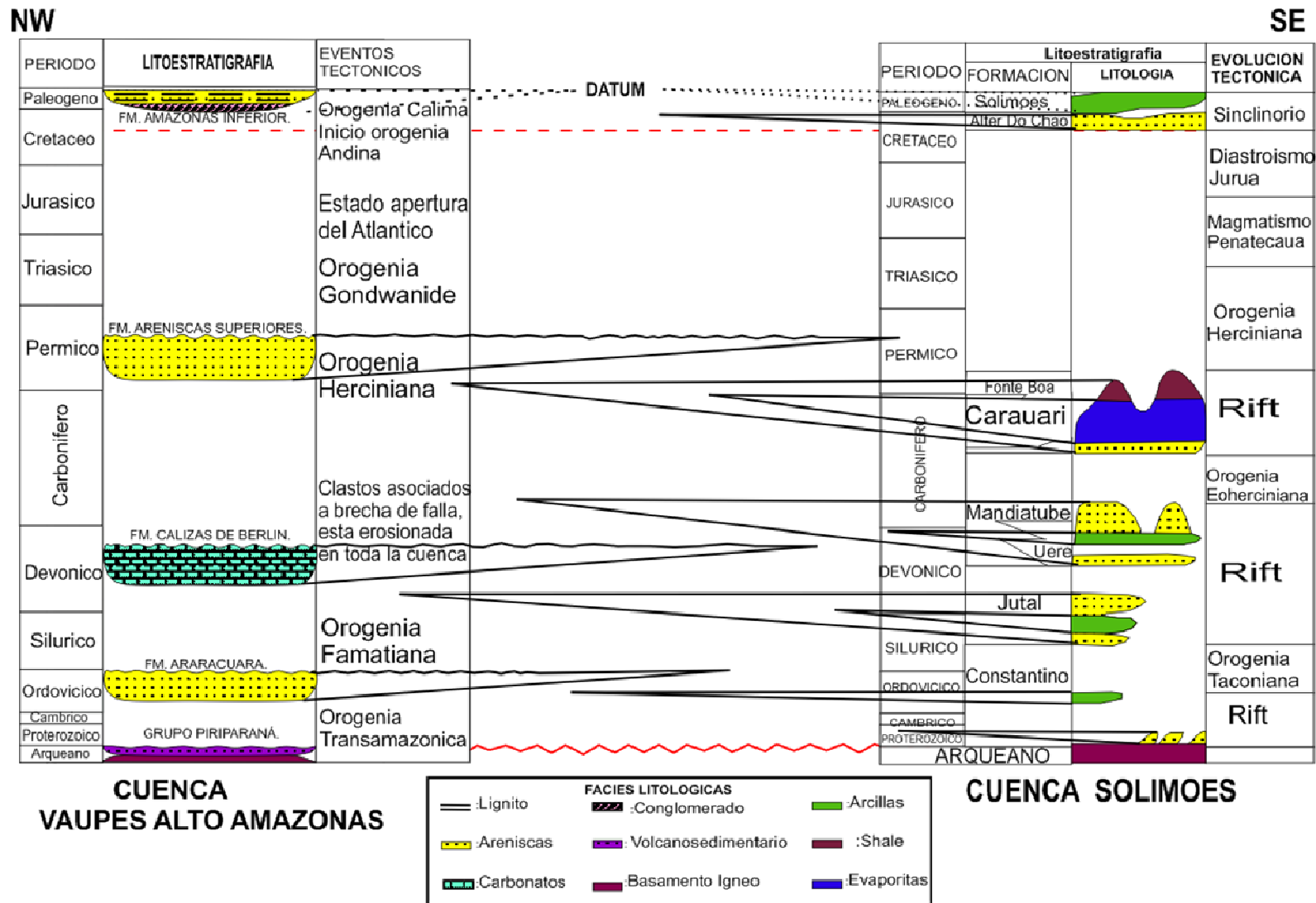


STRATIGRAPHY

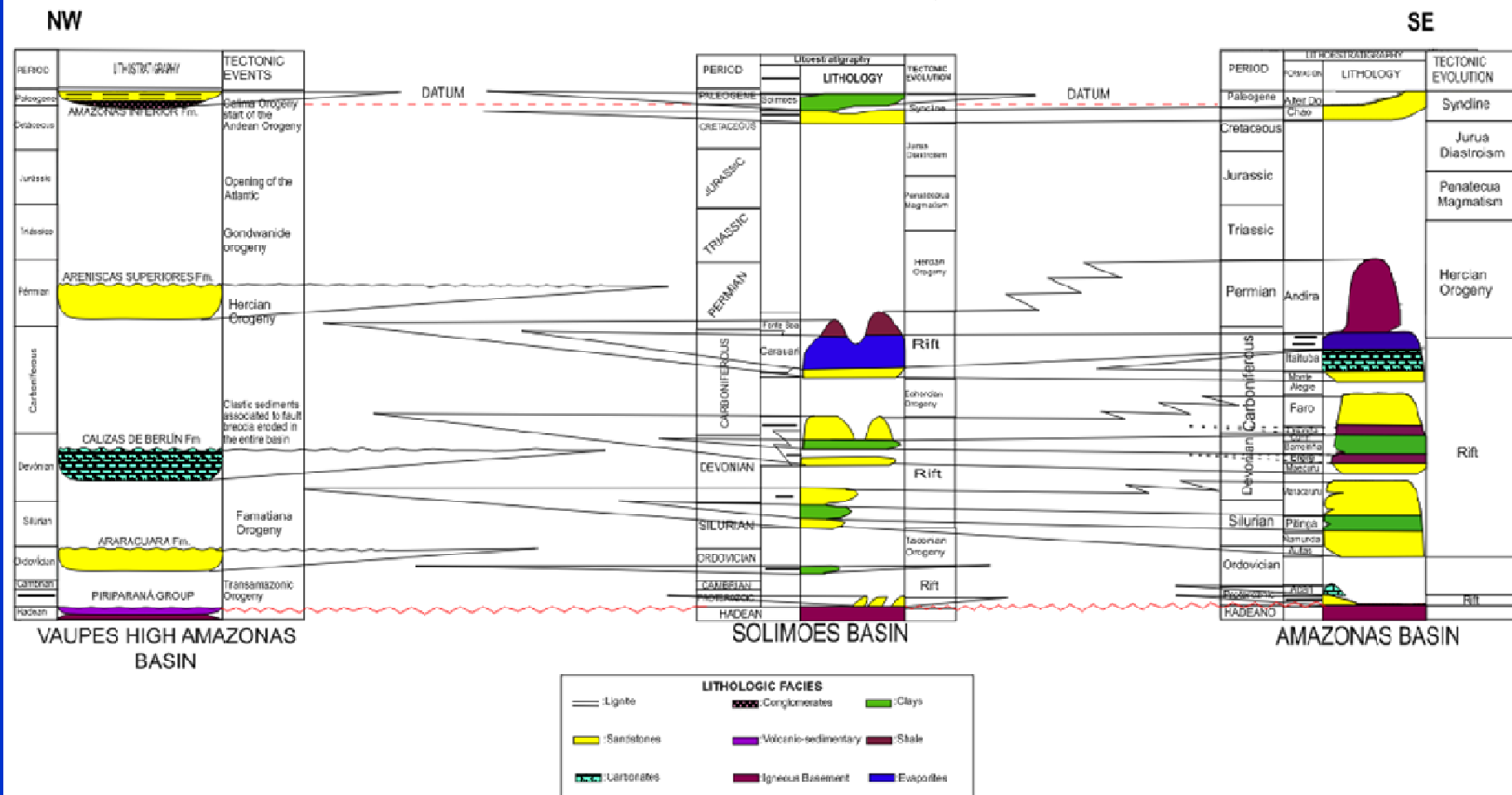
STRATIGRAPHIC CHART AMAZONAS BASIN



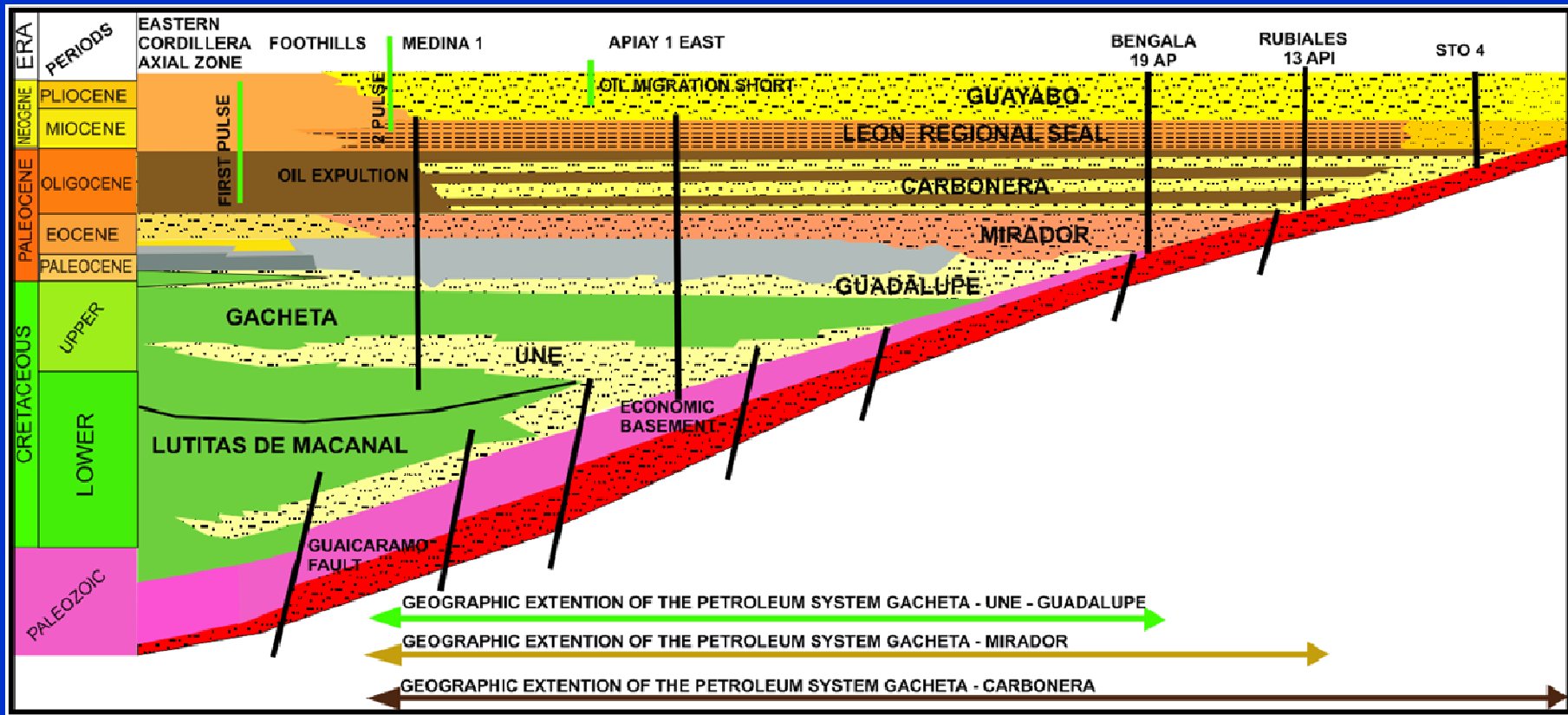
CORRELACION ESTRATIGRAFICA ENTRE LAS CUENCAS VAUPES ALTO AMAZONAS Y SOLIMOEES.



STRATIGRAPHIC CORRELATION BETWEEN VAUPES HIGH AMAZONAS, SOLIMOES AND AMAZONAS BASINS



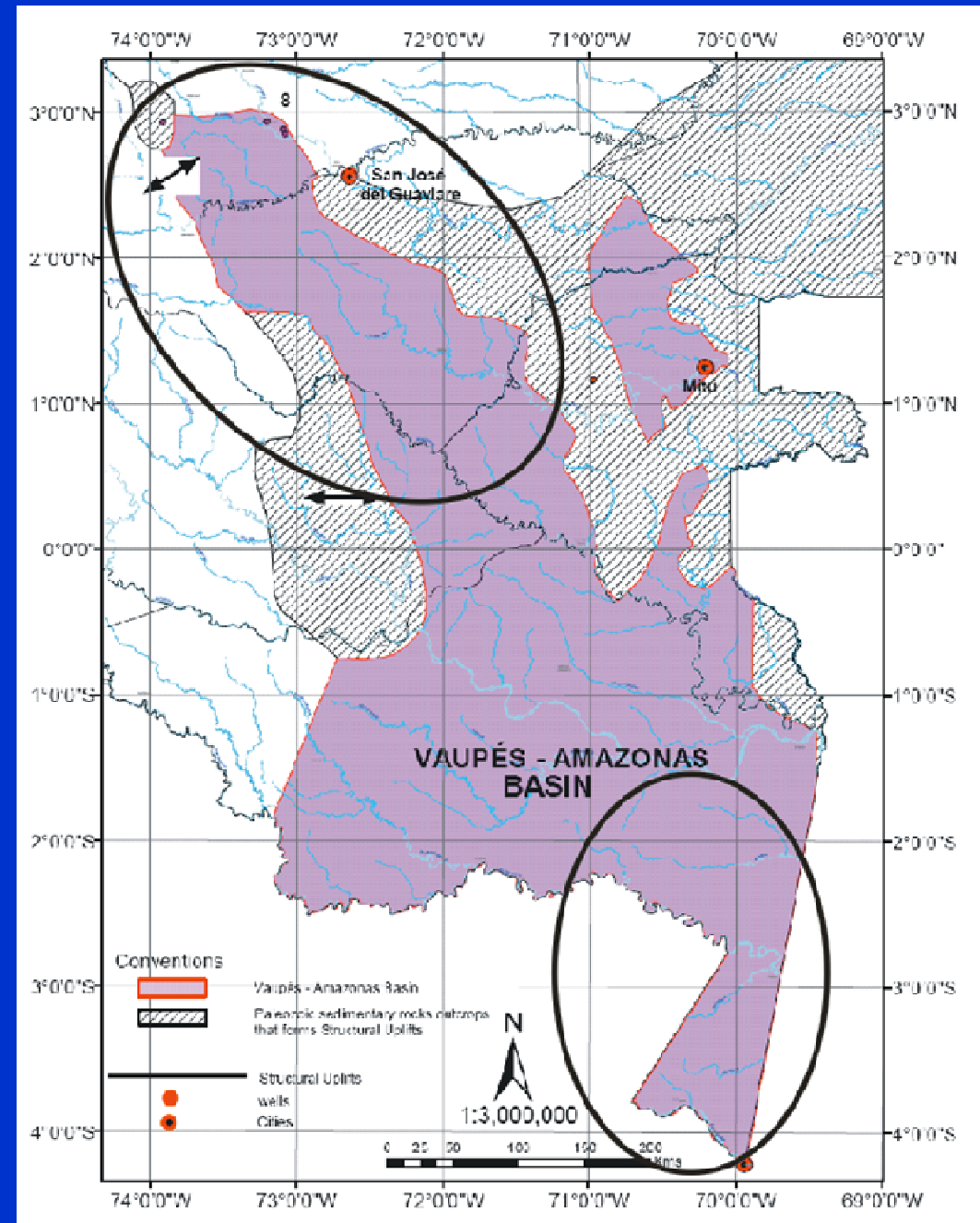
The sedimentary sequence becomes narrower to the east. In the lower Amazonas of Brazil, the sequence looks thicker whereas in Colombia, a large part of the sequence has eroded. This figure depicts how the Vaupes-Amazonas basin has been isolated from the Solimoes Basin through structural highs.



Petroleum systems of the Eastern Plains basin. In the boundary between the Eastern Plains Basin and the Vaupés-Amazonas Basin, the Gacheta-Carbonera petroleum system has been identified.

Prospective areas in the Vaupés – Amazonas basin.

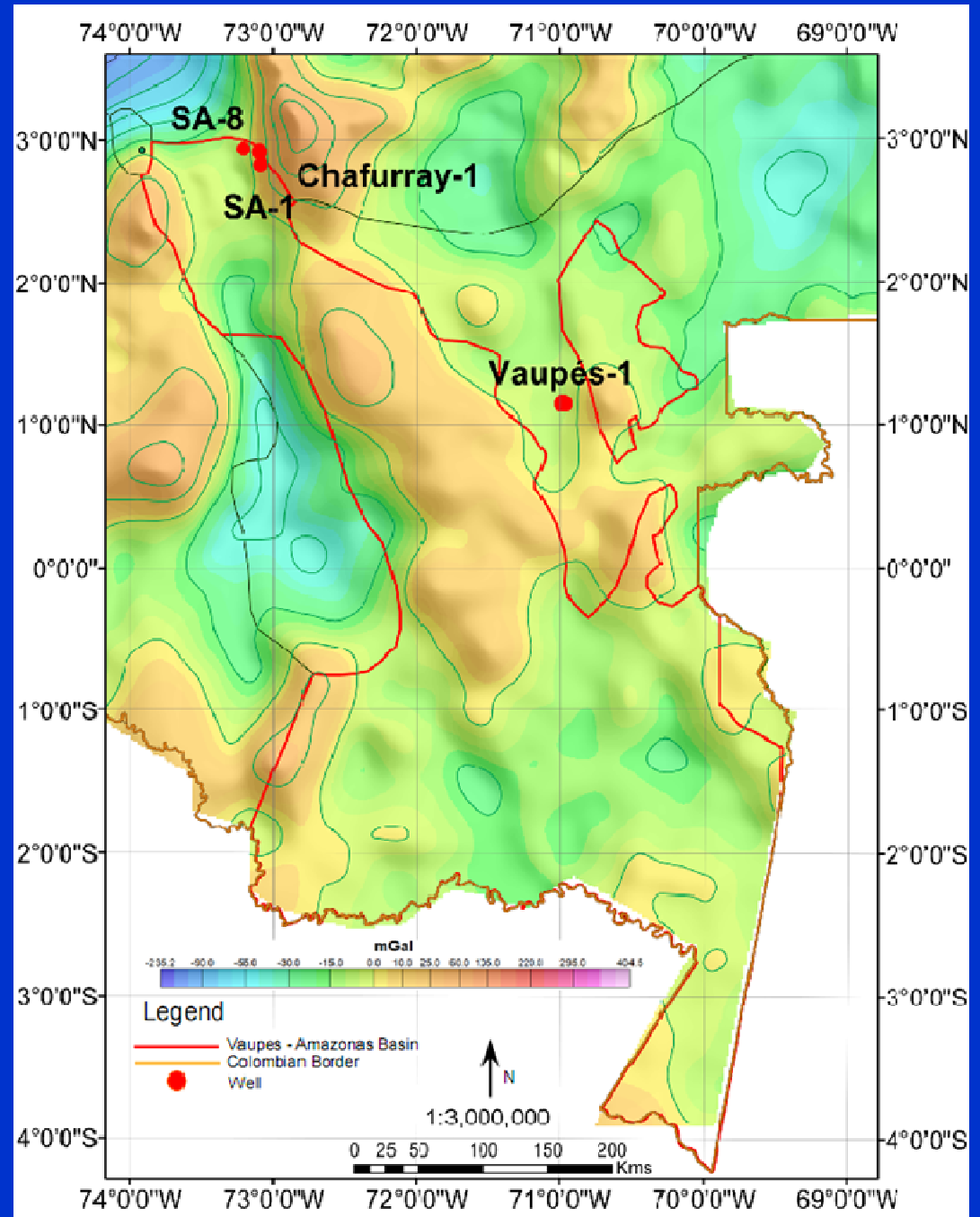
- A) The northeast area, in the boundary with the Eastern Llanos basin, where the presence of heavy oils has been proven through wells.
- B) The southeast area of the basin, close to the Leticia city, where the seismic demonstrates the continuity of seismic reflectors of the Paleozoic in the Jandiatuba sub-basin (Solimões Basin in Brazil), associated with hydrocarbon production.



SEISMIC AND GRAVIMETRY

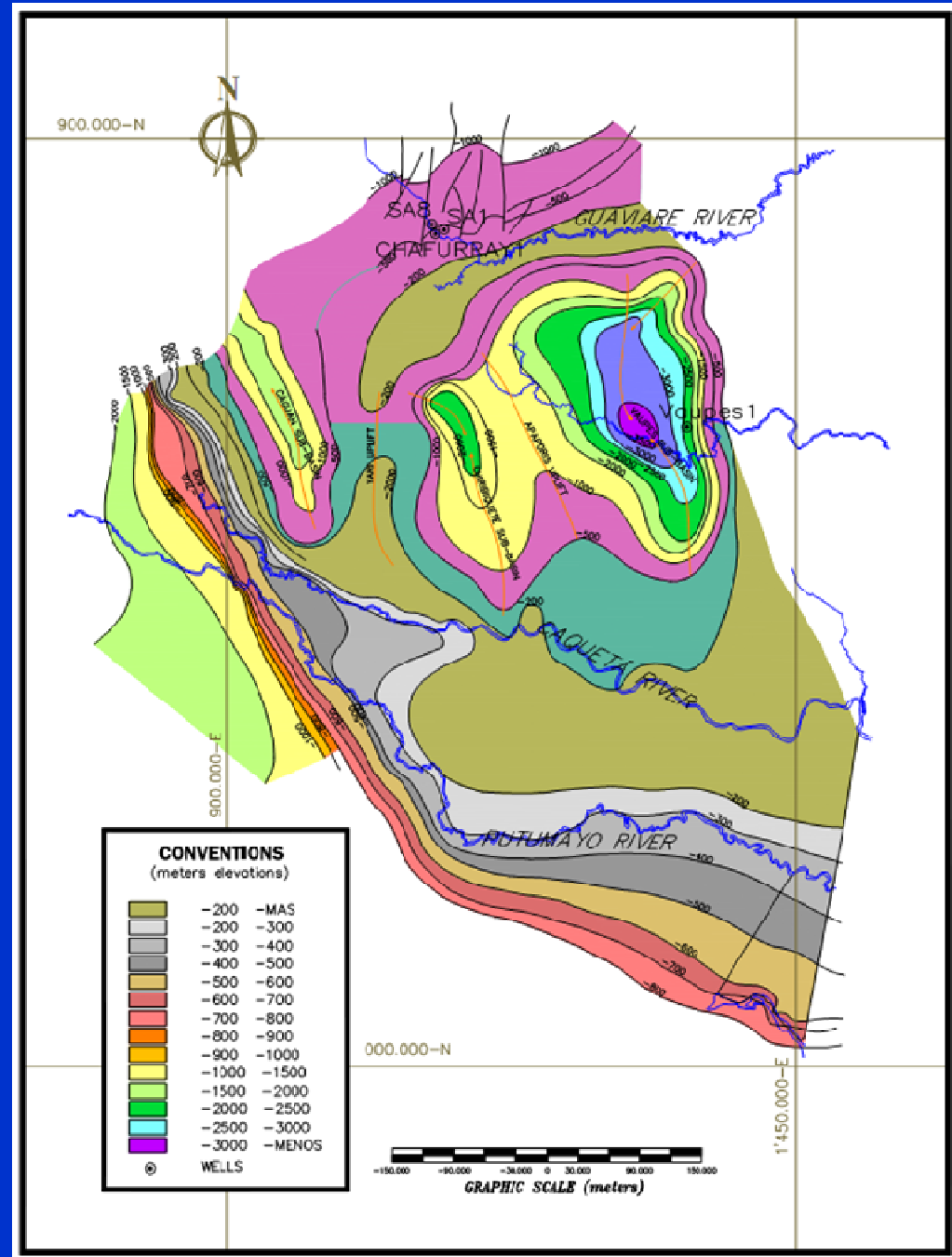
Total Bouguer anomaly Map. Two depocenters in the Vaupes – Amazonas Basin can be observed, corresponding to the Chiribiquete and Vaupes sub-basins.

- A) Chiribiquete**
- B) Vaupés**









Location of depocenters, based on gravimetry and seismic studies. Curves illustrate the top of the basement, and allows to identify three sub-basins or depocenters in the area of study, from west to east, as follows: Caguán, Chiribiquete and Vaupés

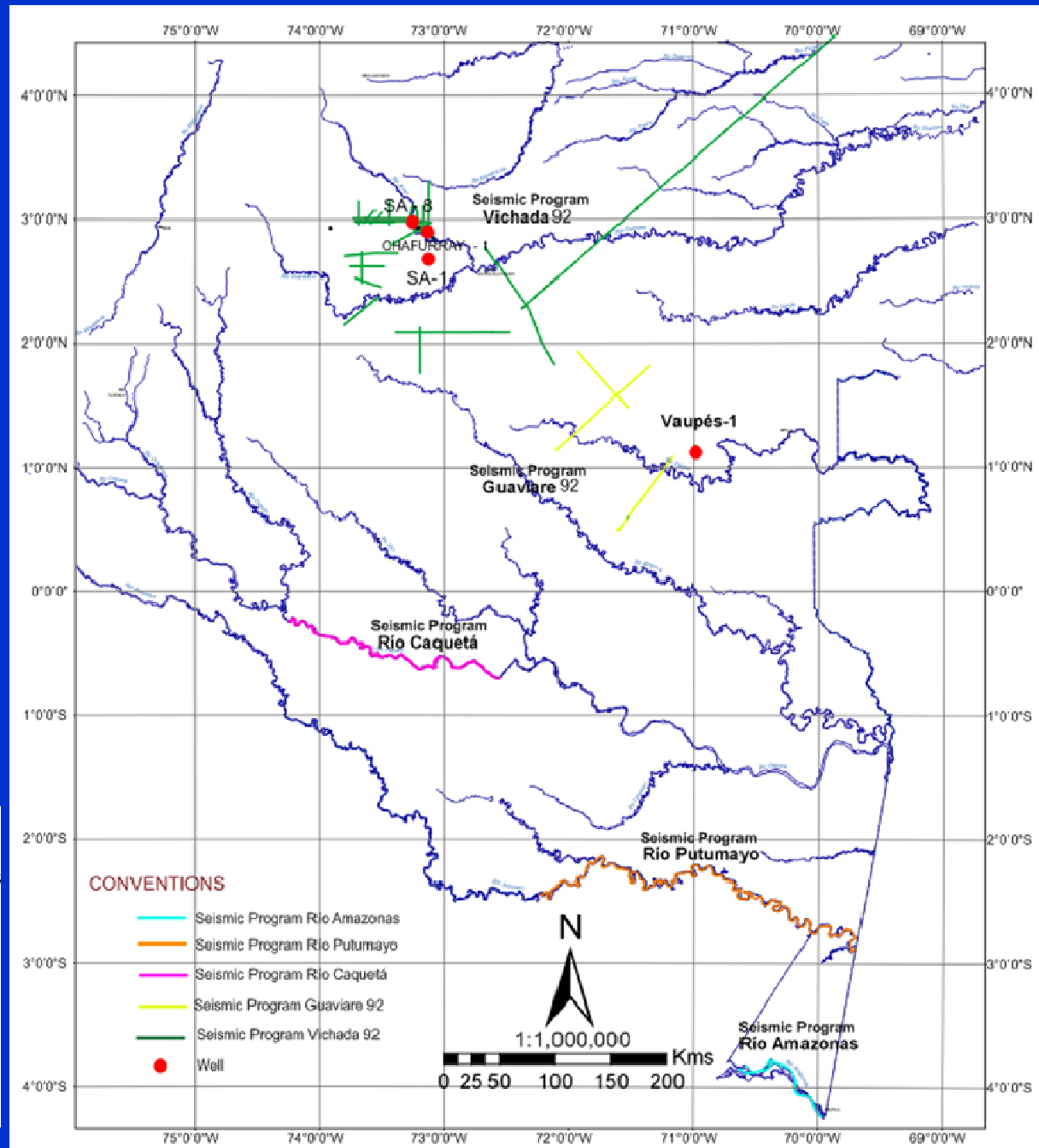
- A) Caguán
- B) Chiribiquete
- C) Vaupés



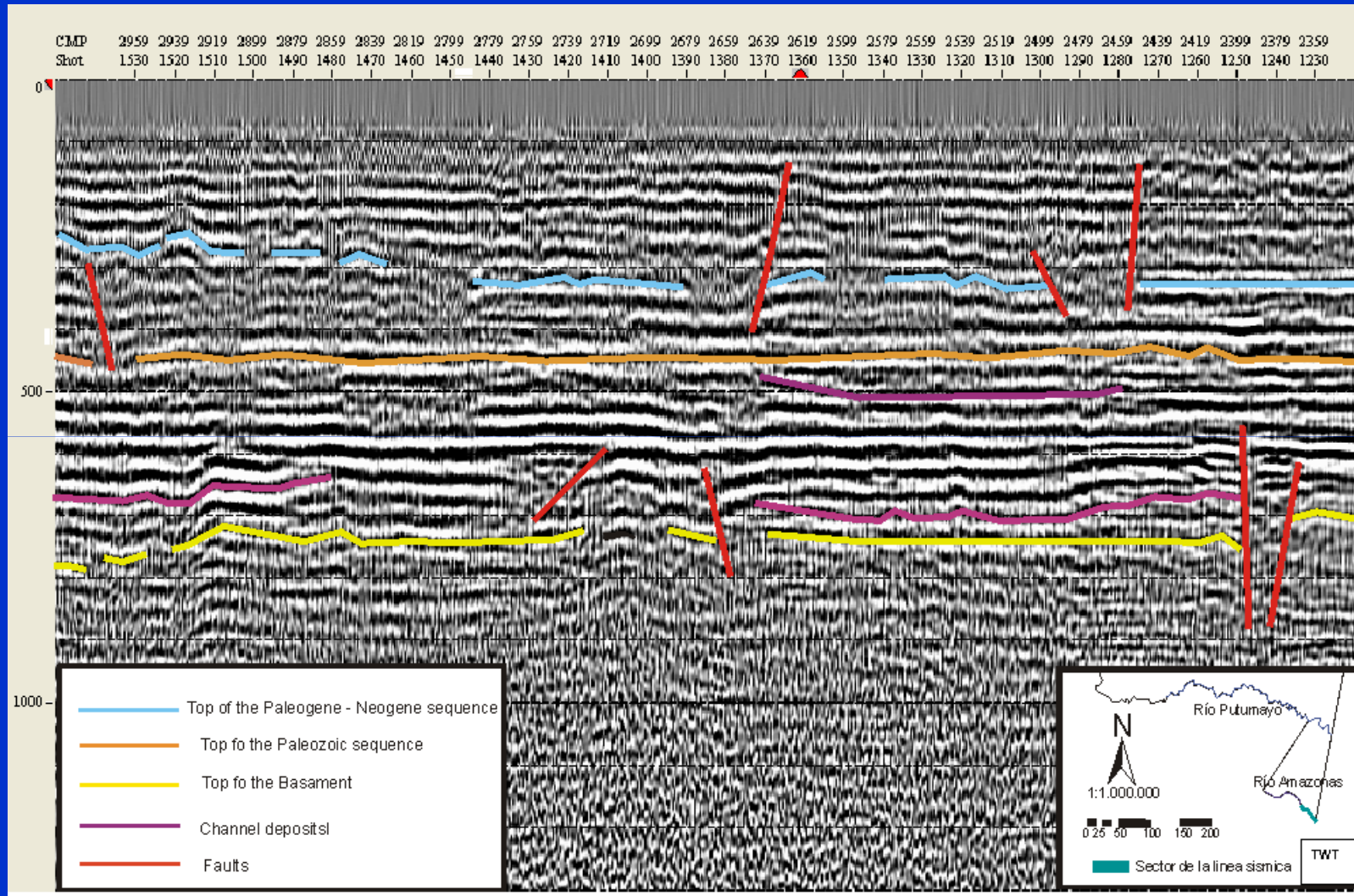
Seismic lines and wells of the Amazonas Basin

CONVENCIONES

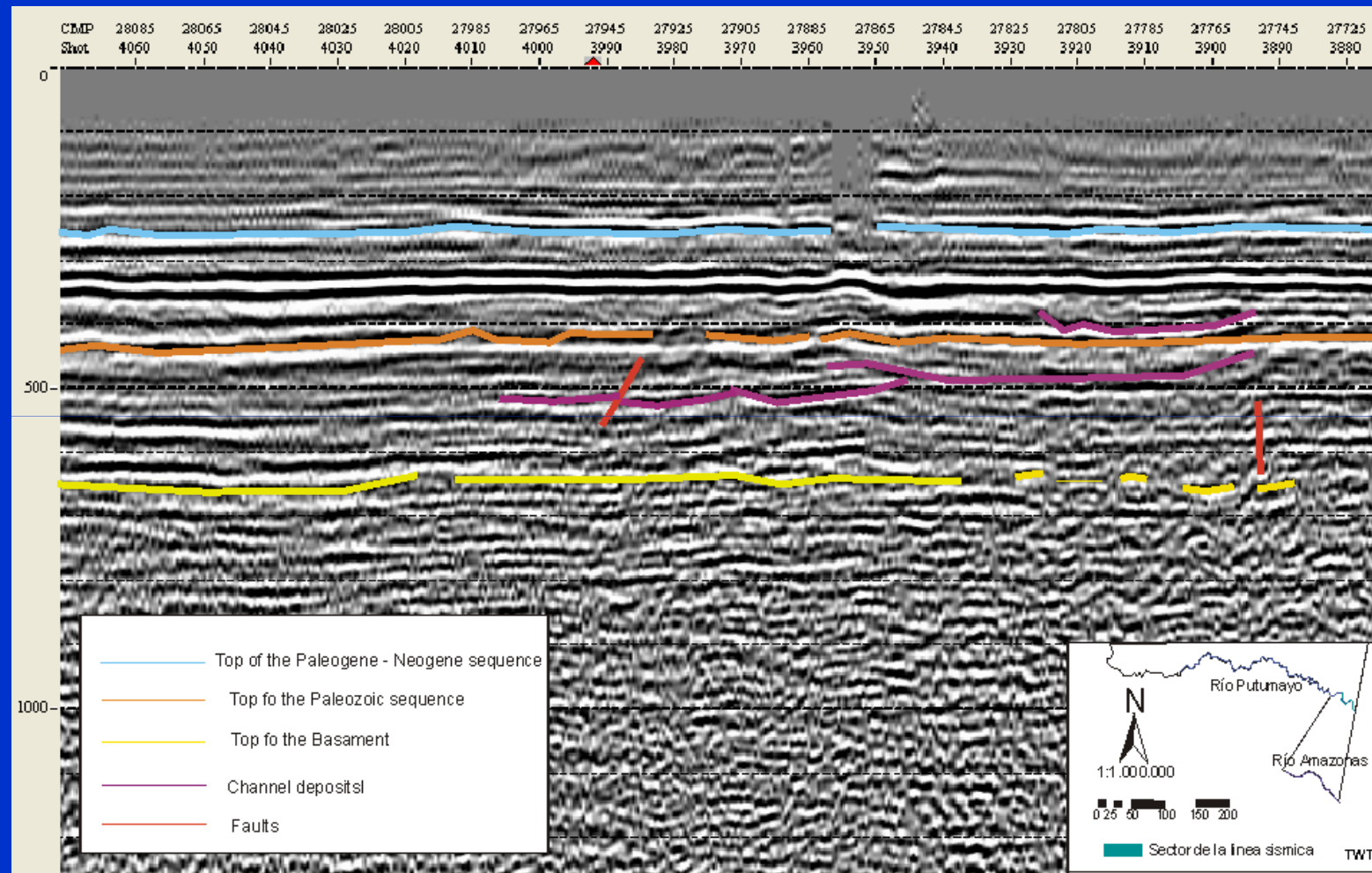
-  Programa sísmico Río Amazonas
-  Programa sísmico Río Putumayo
-  Programa sísmico Río Caquetá
-  Programa sísmico Guaviare 92
-  Programa sísmico Vichada 92
-  Pozo



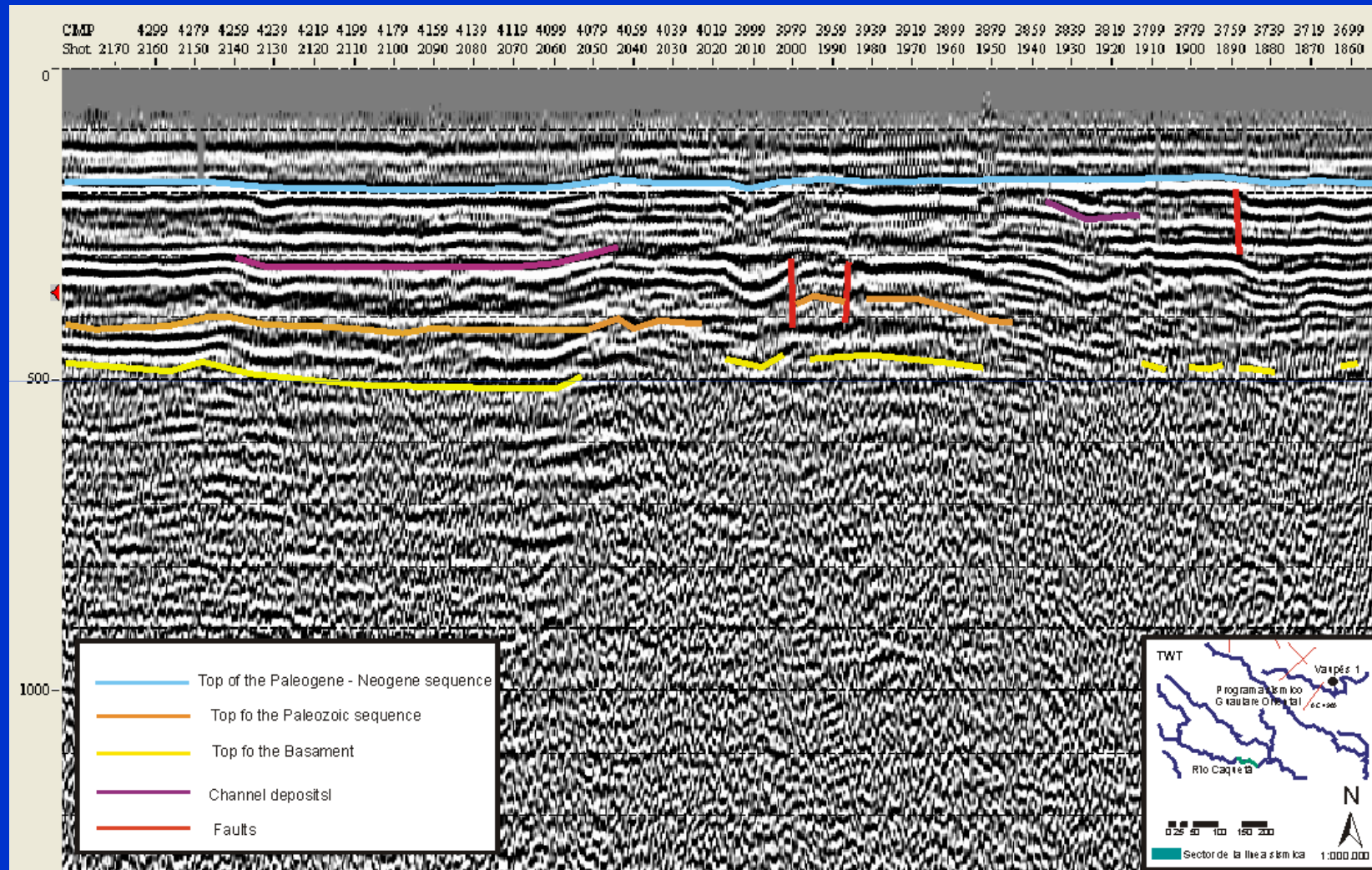
SEISMIC LINE RA-91-01



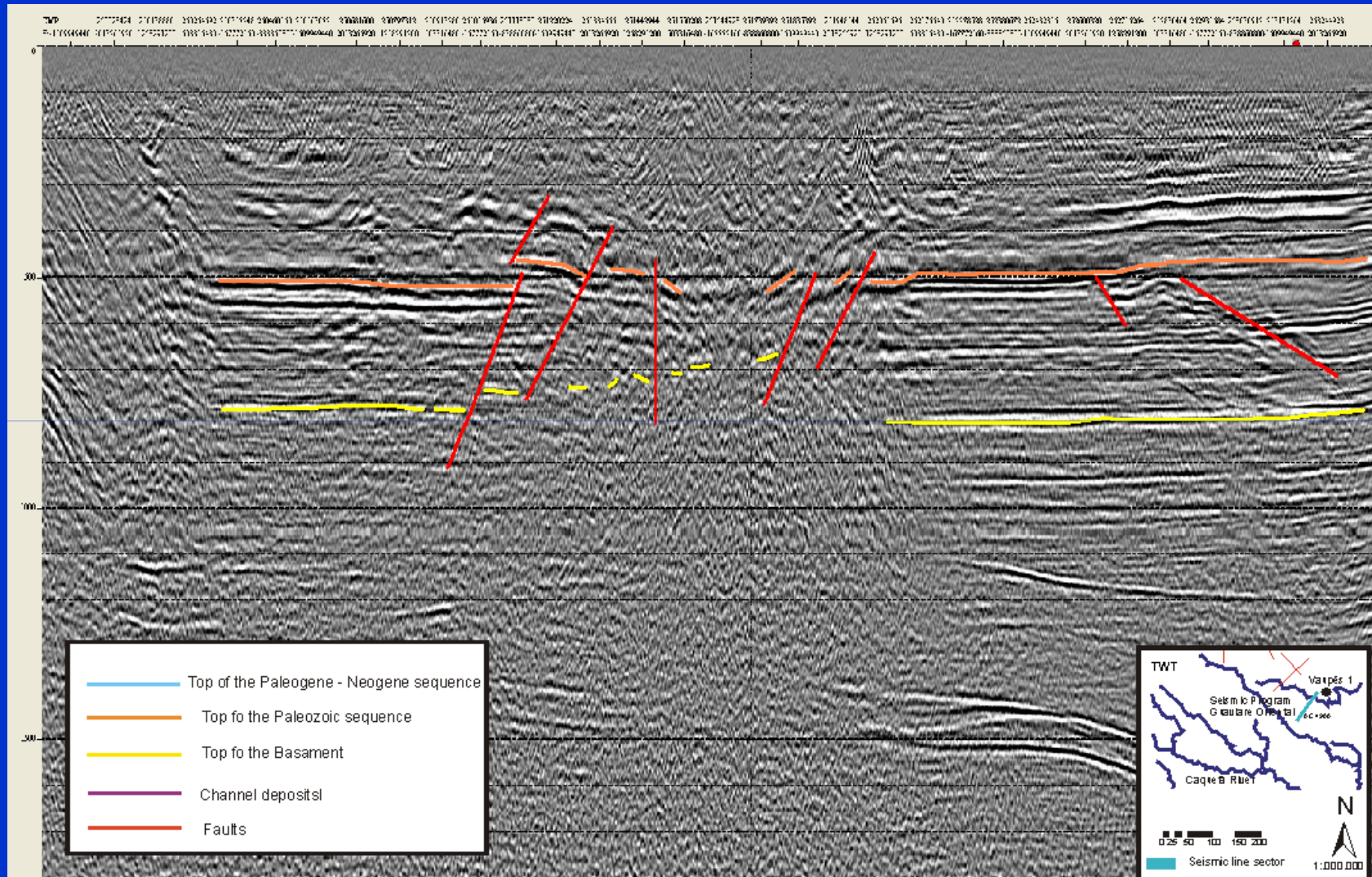
SEISMIC LINE RP-91-08



SEISMIC LINE RC-91-02

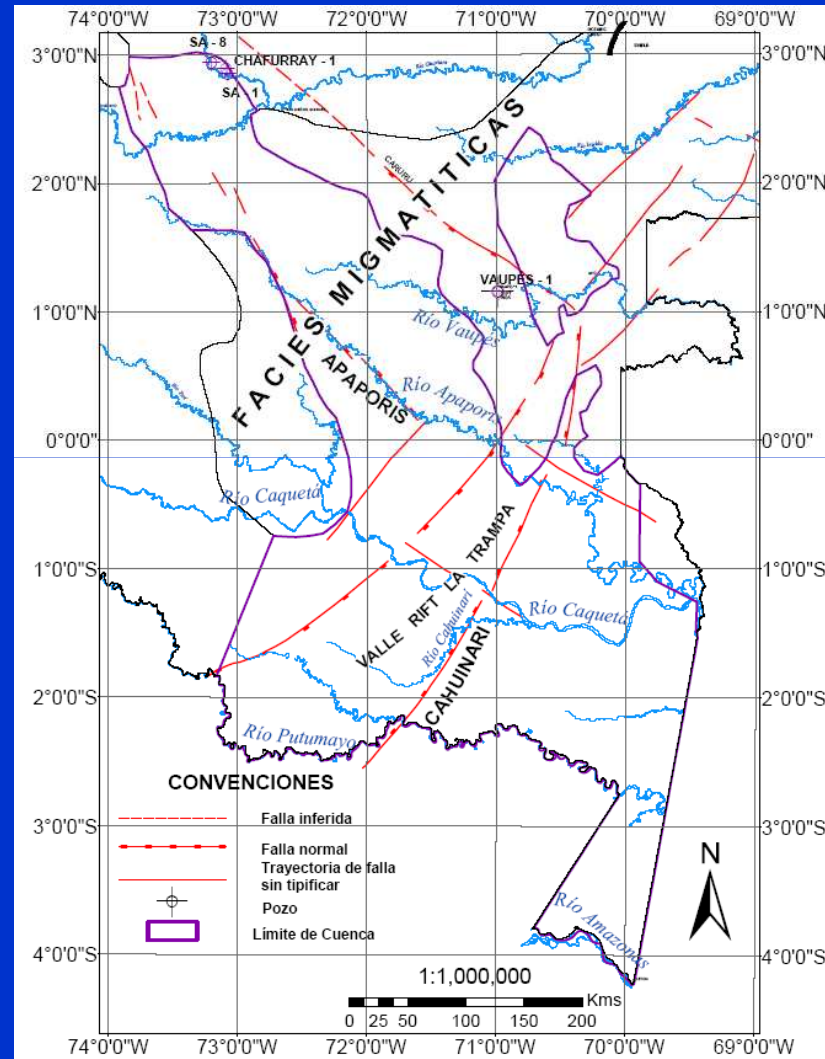


SEISMIC LINE AC-4900

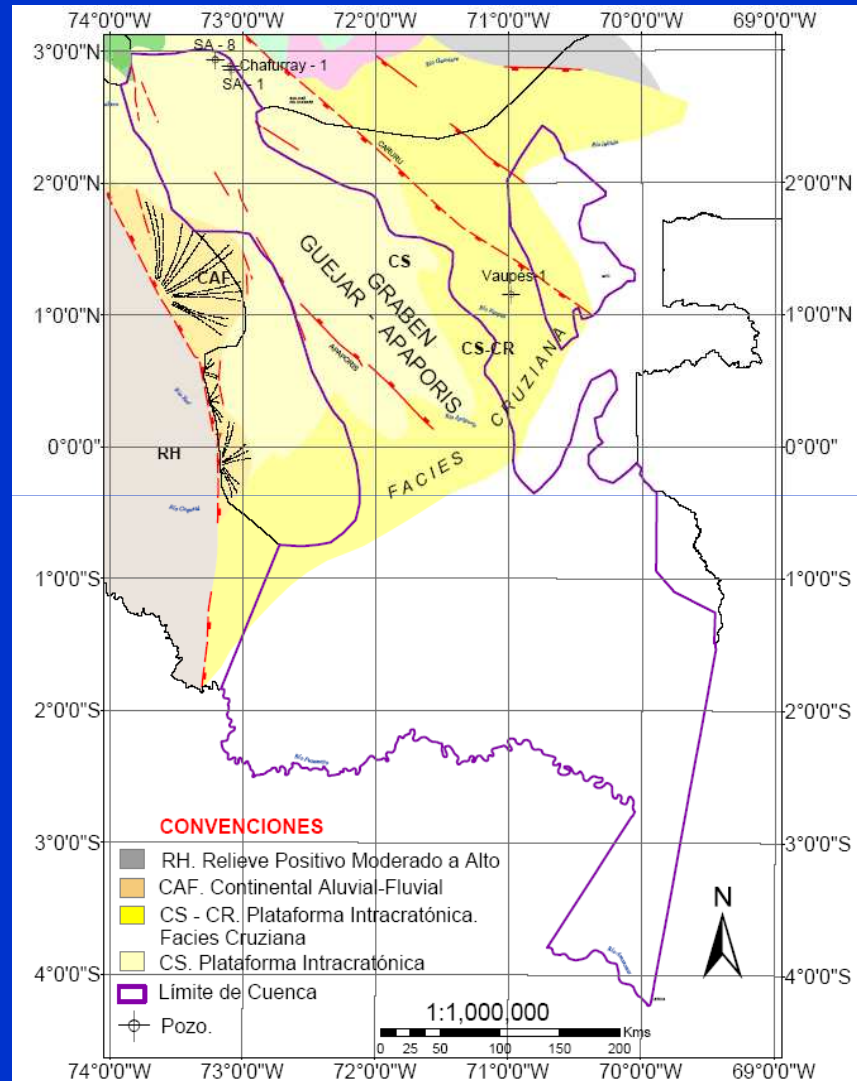


STRUCTURAL GEOLOGY

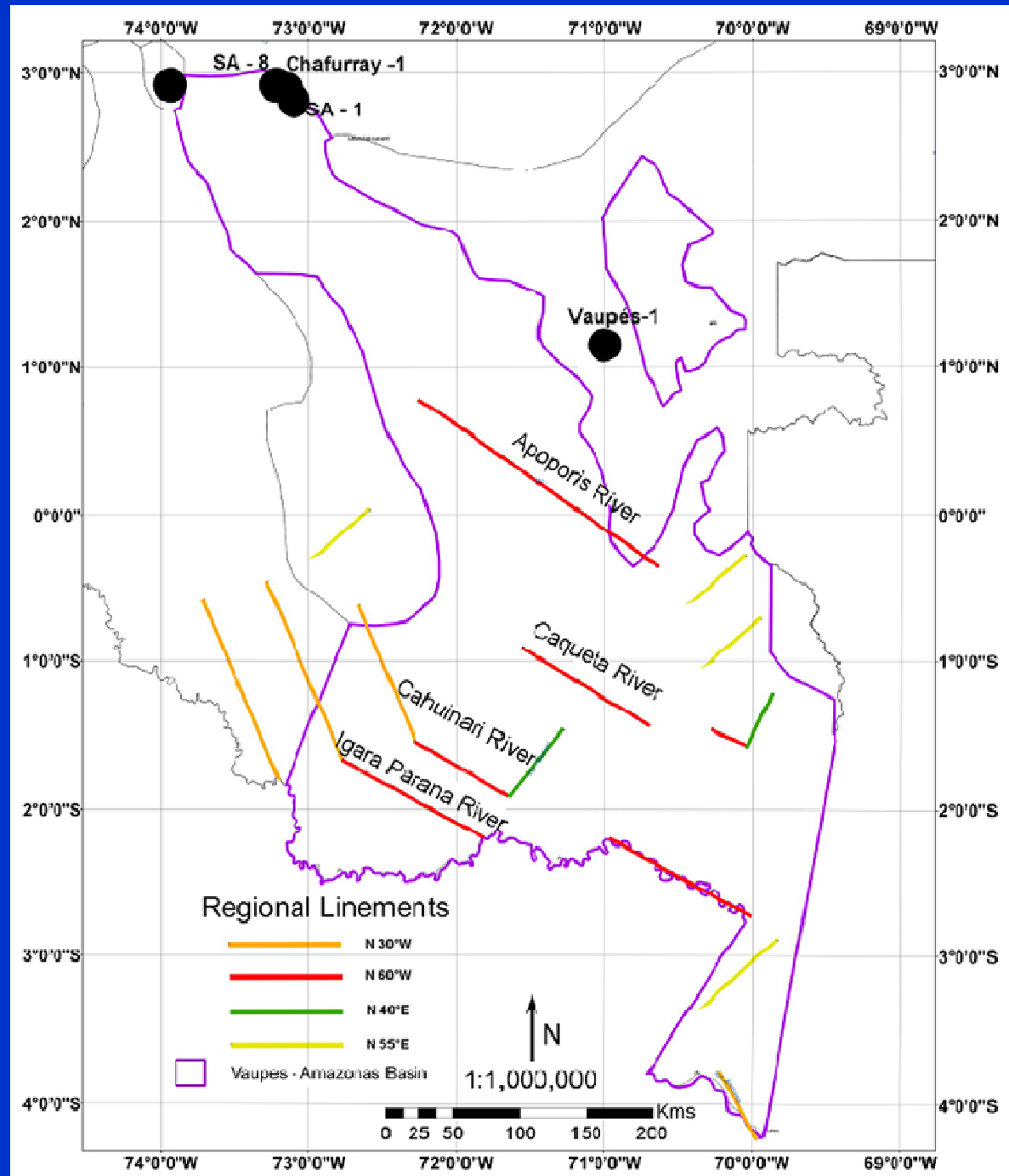
Formation of rifts during the Proterozoic in the Basin. Note that the Amazonas Basin is formed by rift tectonics with the presence of the La Trampa rift valley and the Guejar-Apaporis rift. Modified from Cediél *et al.* (2003).



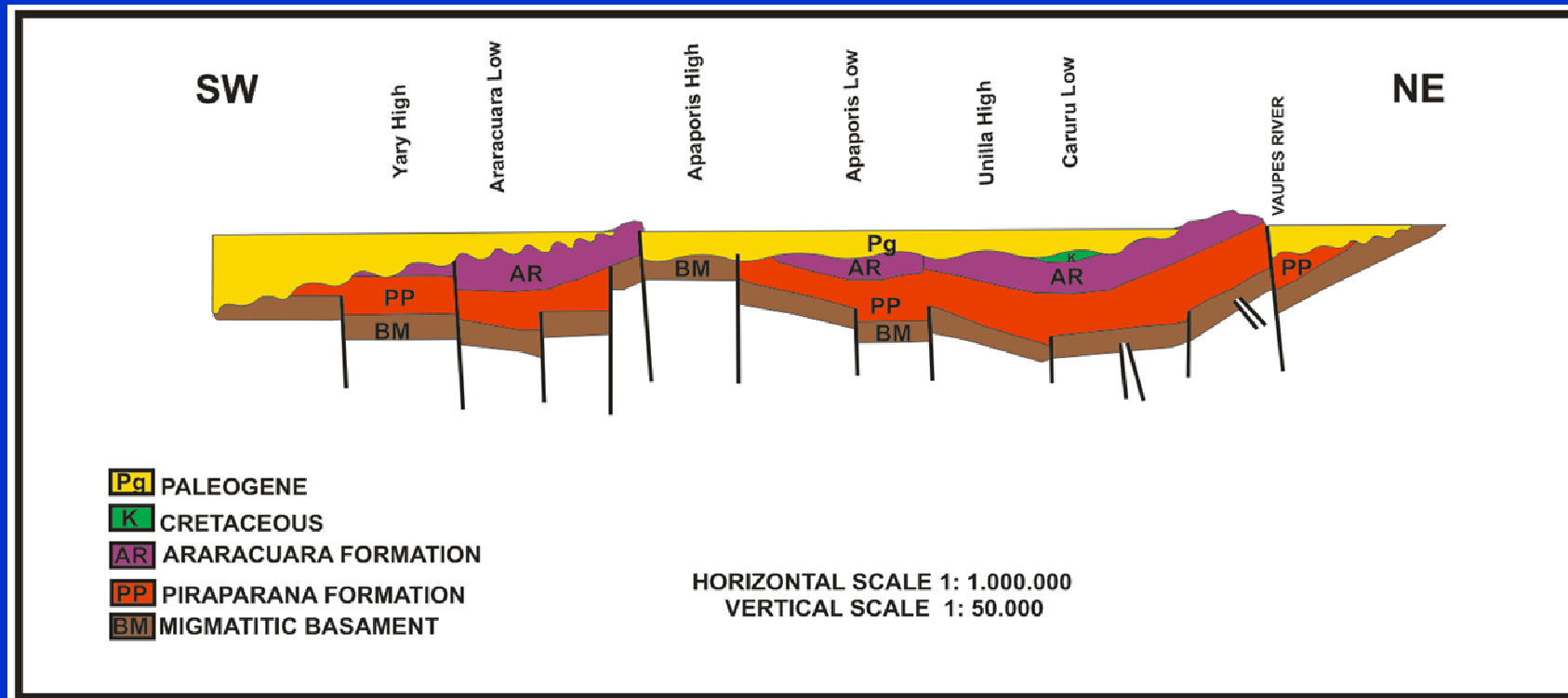
Formation of the Guejar-Apaporis Graben in the Vaupés-Amazonas Basin during the Lower Paleozoic. Modified from Cediel *et al.* (2003).



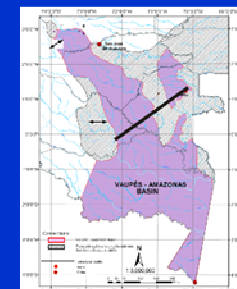
Main Faults and Structural Alignments present in the Vaupes Amazonas Basin



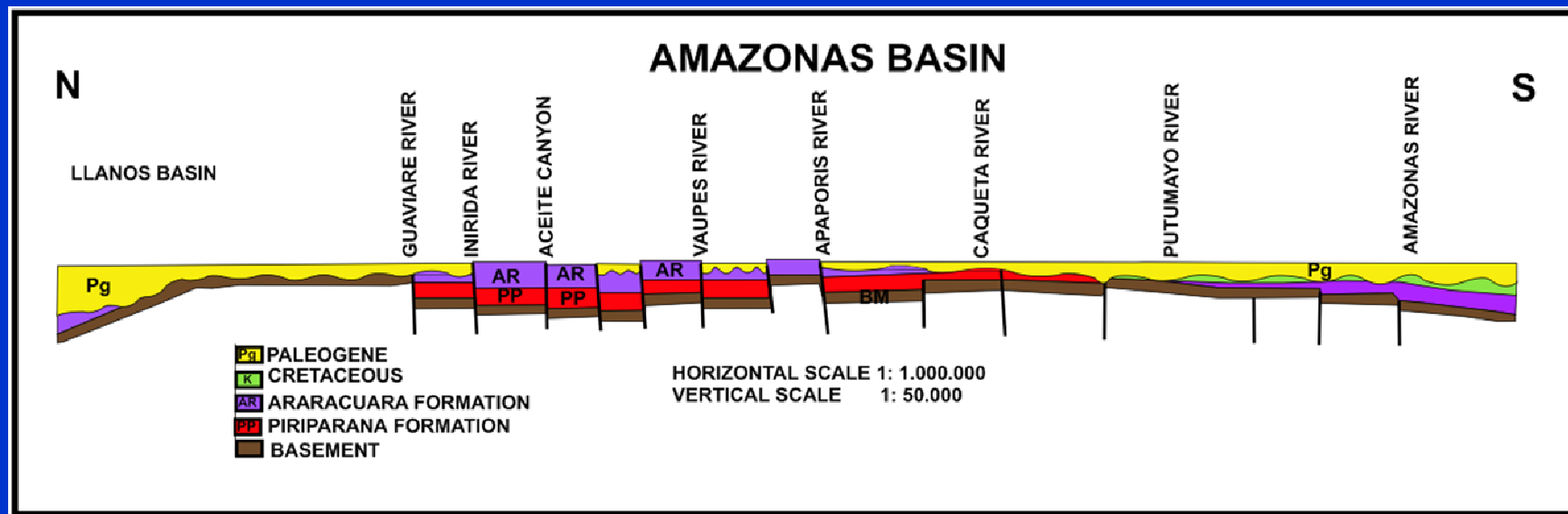
Structural Cross Section



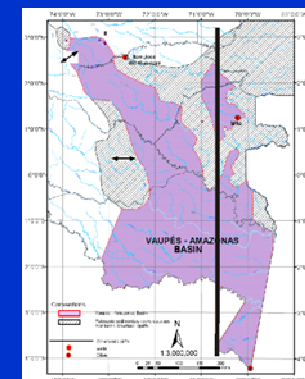
Structural Conceptual Cutting of the Vaupes - Amazonas Basin in the South West - North East Direction



Structural Cross Section

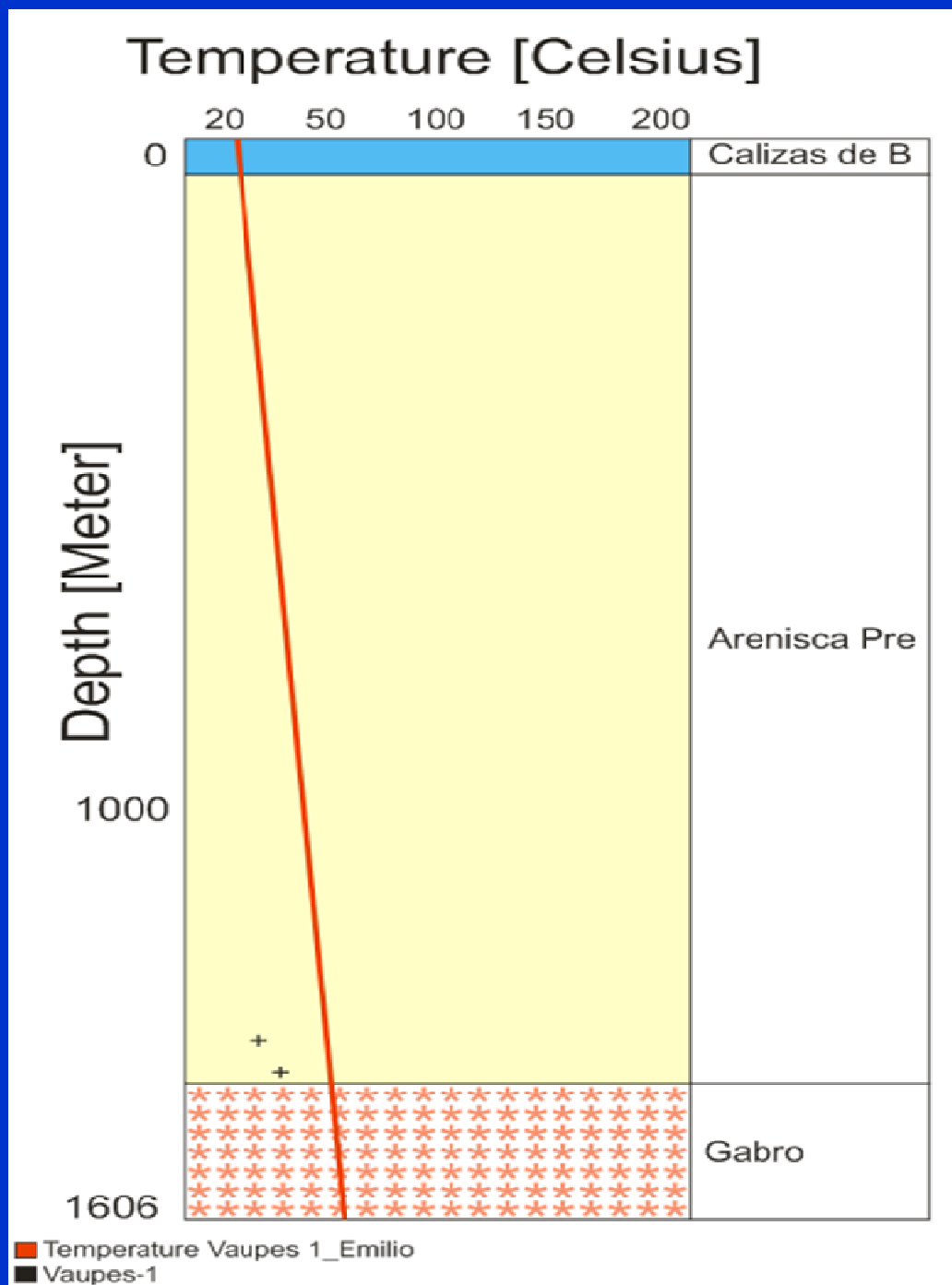


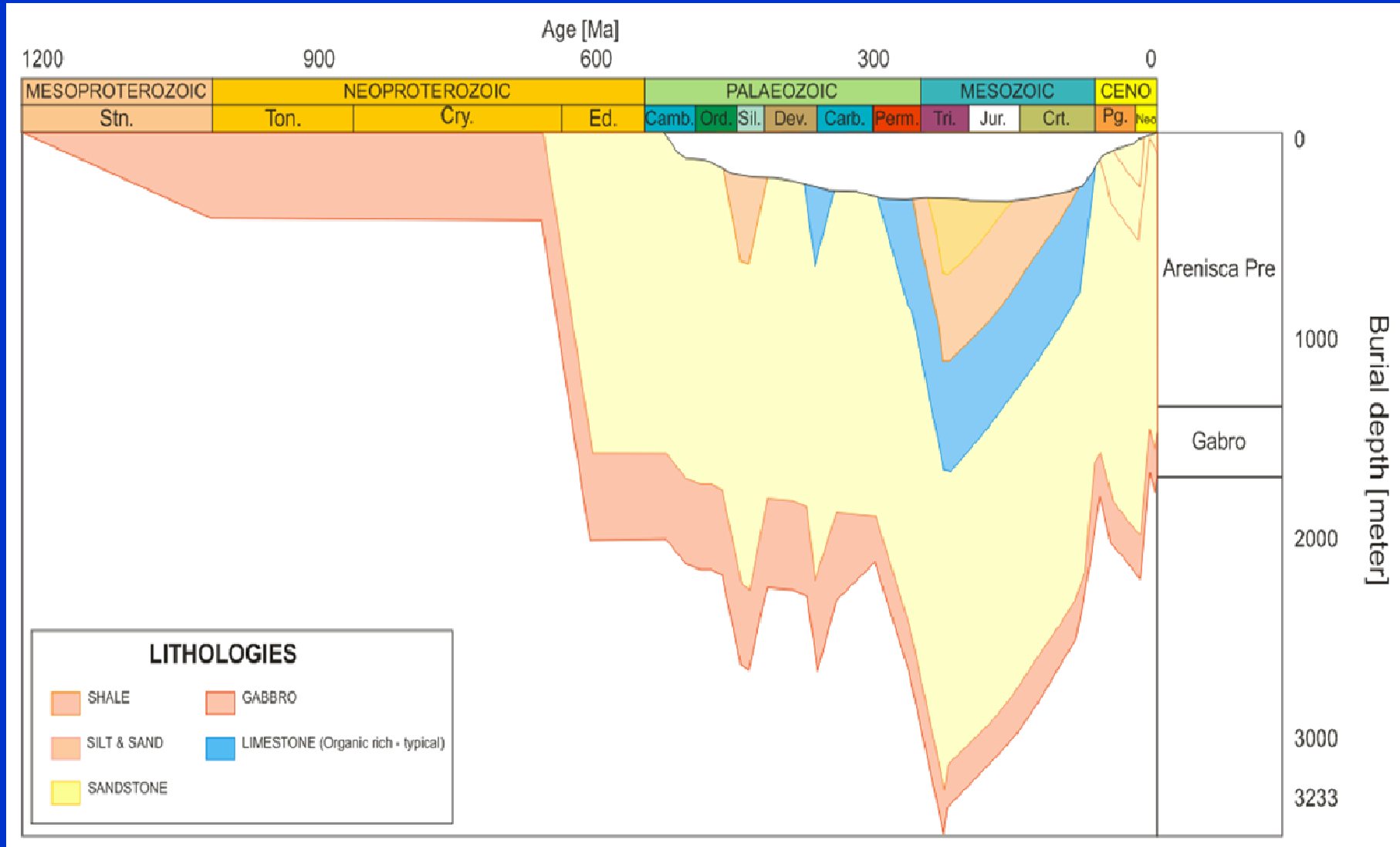
Structural Conceptual Cutting of the Vaupes - Amazonas Basin in the North - South direction



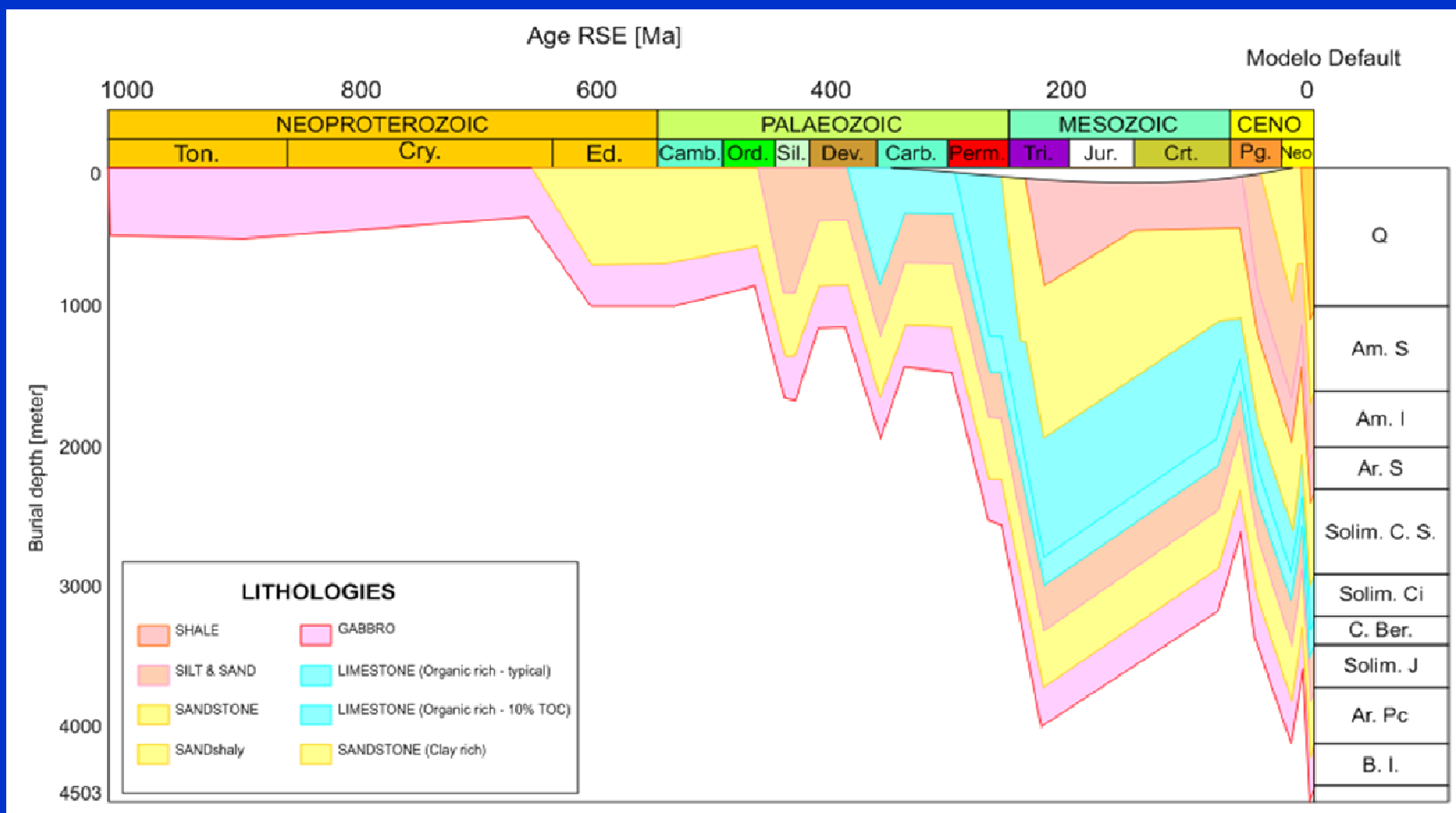
GEOCHEMICAL MODELING

Calibration of the Vaupés-1 well. Bottom temperature is approximately 43°C, calibrated with data from well perforation reports



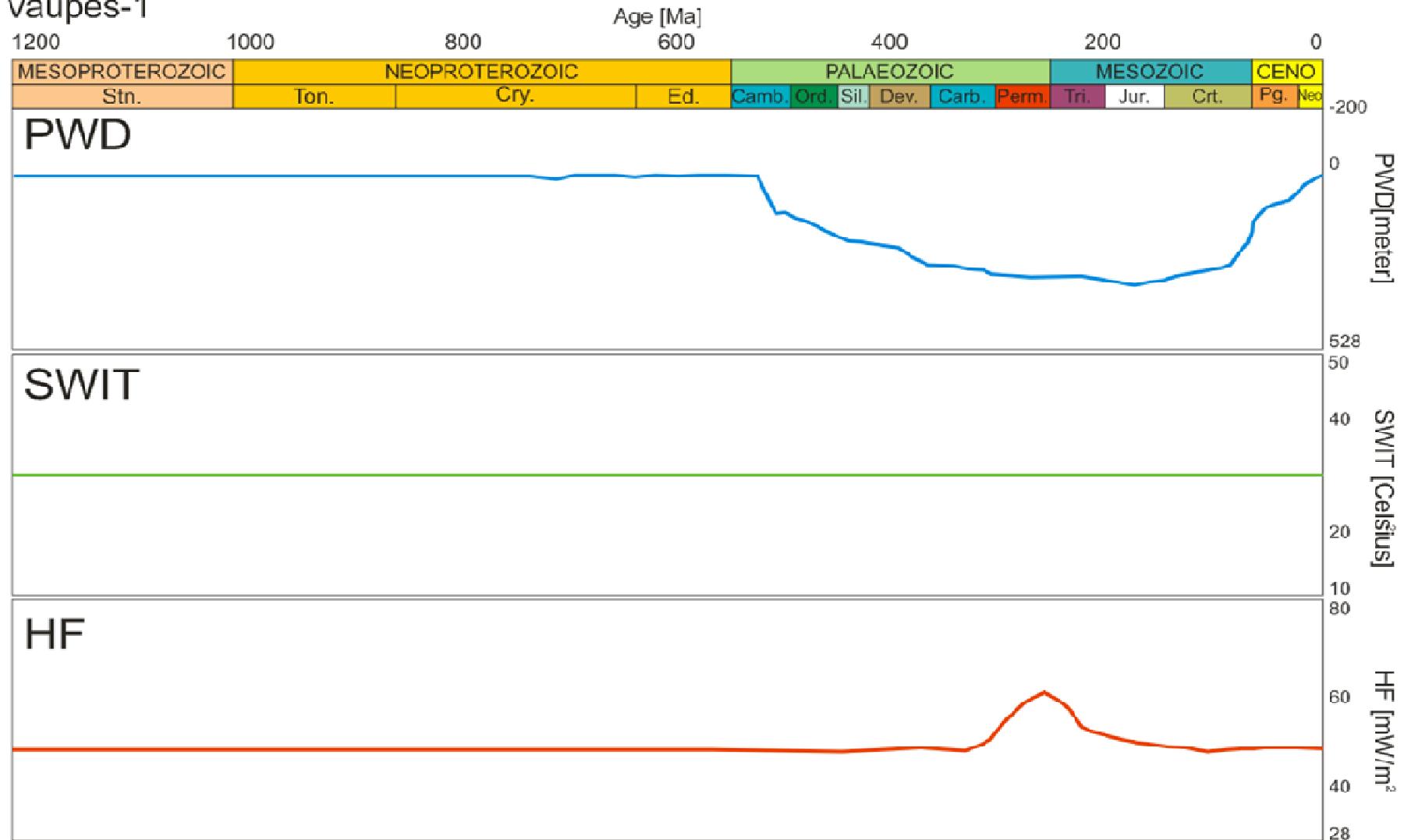


Burial History Diagram for the Vaupes - 1 Well, which shows the erosion of the Paleozoic and Mesozoic sequence, where the Precambrian sandstones remain

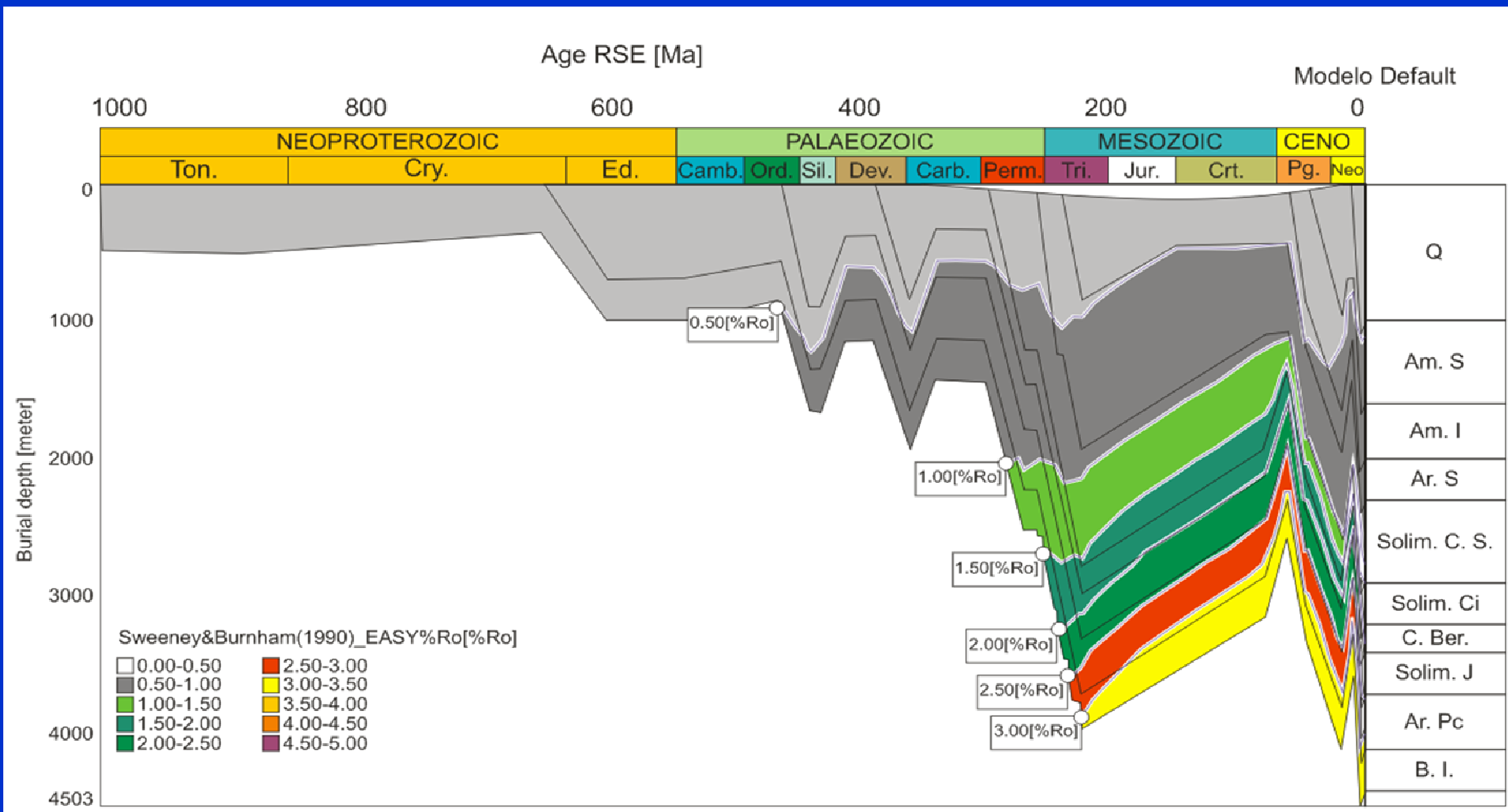


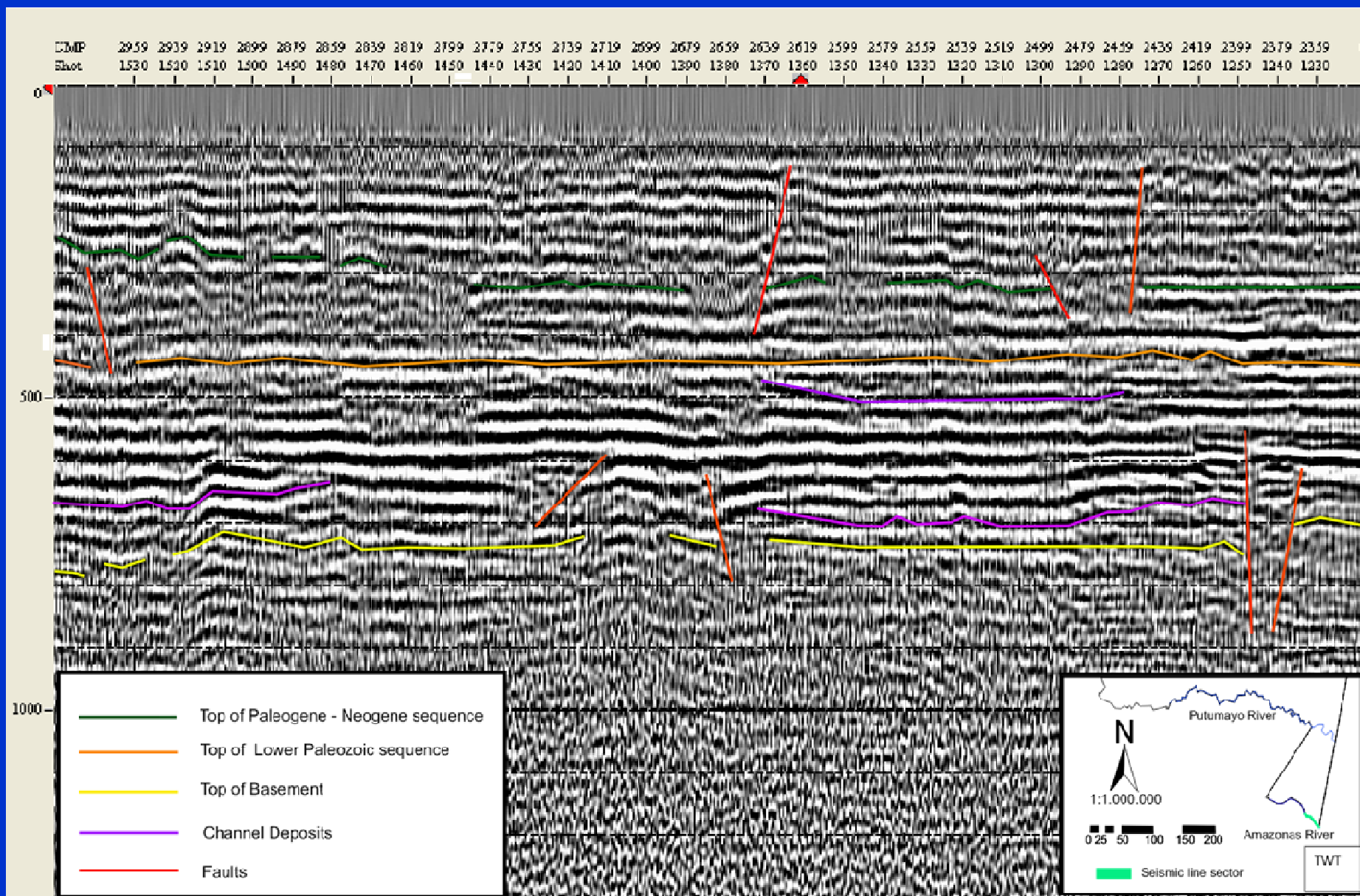
Burial History Diagram for the Pseudo Well Leticia – 1, illustrating the burial and erosion events for the Amazonas Basin. Q: Quaternary; Am. S: Upper Amazons; Am. I: Lower Amazons; Ar. S: Upper Sands; Solim. C. S: Solimoes Carauari Shale; Solim. C. S: Solimoes Carauari; C. Ber: Berlin Limestone; Solim. J: Solimoes Jutai; Ar. Pc: Pre-Cambrian Sandstones; B.I.: Igneous Basement.

Vaupes-1

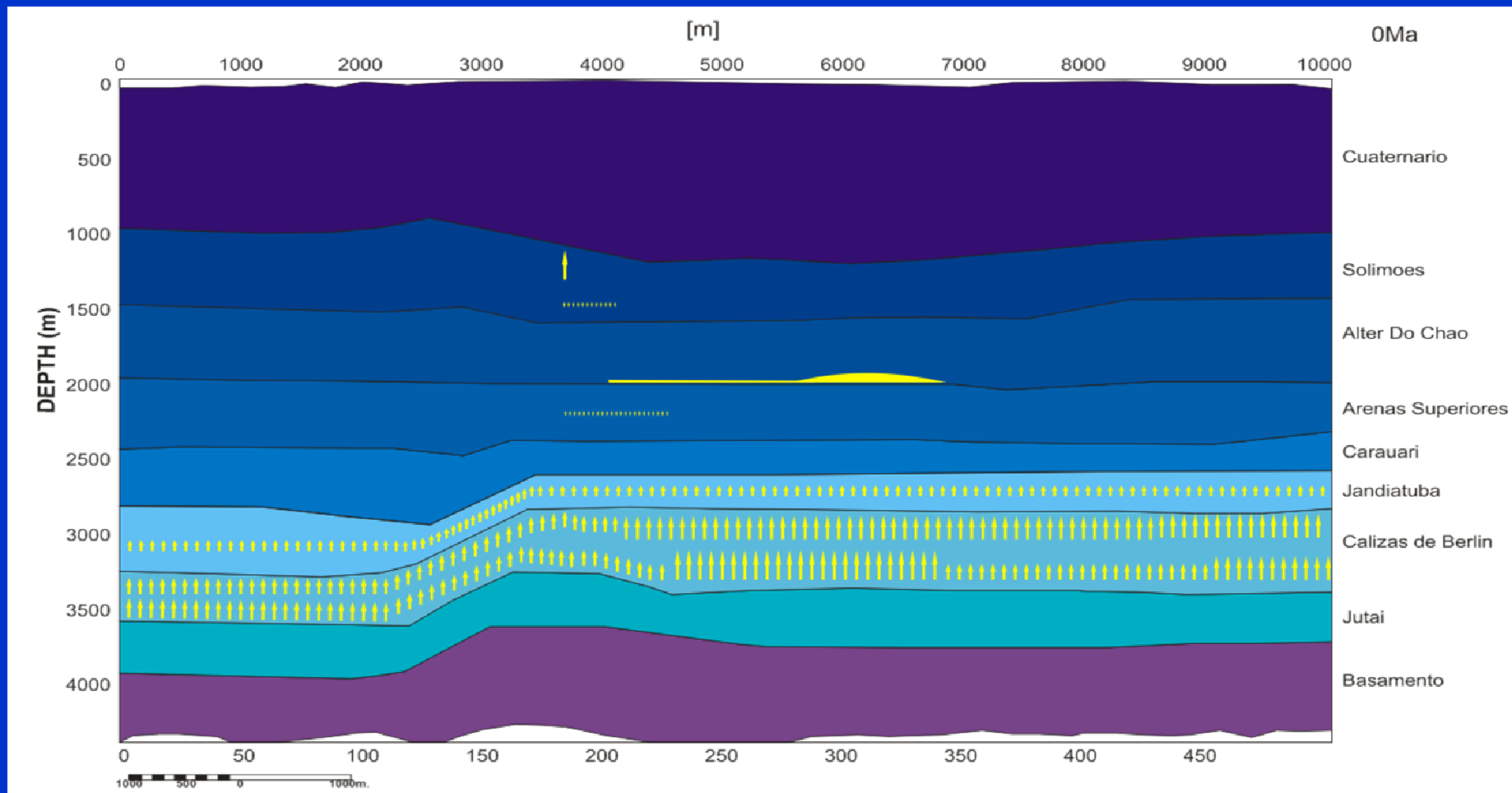


Heat flow variation with respect to time in the Amazons Basin, in the Leticia-1 pseudo-well.
 HF Heat Flow; SWIT Sediment Water Interface Temperature; PWD Paleo-depth





Seismic line RA 91-01. This line was used in the 2D geochemical modeling.



2D geochemical modeling of the seismic line RA 91-01 in the Amazonas River. The generation and accumulation of hydrocarbons is included in green.

CONCLUSIONS

- The Vaupés – Amazonas basin is the second largest basin in Colombia, with an area of 155.000 km² however this basin has not been explored.
- In the Vaupés-Amazonas basin, two new petroleum systems are proposed: 1) the Paleozoic Petroleum system, 2) the Tertiary Petroleum system and 3) the Gacheta-Carbonera Petroleum system. The first two petroleum systems have not been proved; therefore, a drilling program is required to verify its existence; whereas the third petroleum system has been proved in the Eastern Llanos Basin.
- The evaluation indicates that the Vaupés-Amazonas basin presents two prospective areas; 1) the northeast area, in the boundary with the Eastern Llanos basin, where the presence of heavy oils has been proved through wells. 2) the southeast area of the basin, close to the Leticia city, where seismic lines show the continuity of seismic reflectors of the Paleozoic in the Jandiatuba sub-basin (Solimões Basin in Brazil), associated with hydrocarbon production.
- The hydrocarbon discoveries at the Solimoes Basin are related to the Paleozoic petroleum system and to the alignments and / or faults. Therefore, the location of prospects in Colombia must be focused on the presence of alignments identified in the surroundings of Leticia city.

1D and 2D geochemical models were built to explain the possible hydrocarbon generation and accumulation. The results indicate that it is feasible to find hydrocarbons generated in the Paleozoic source rocks, which have been identified in the neighbor Solimoes Basin of Brazil. The geochemical information to build 1D and 2D geochemical models was taken from the Solimoes Basin studies.

The Neogene Petroleum system in the Vaupés-Amazonas Basin consist of coalbed methane which could be present in Chiribiquete, Araracuara and Leticia areas.