LATE TERTIARY – QUATERNARY STRUCTURAL STYLES : SERRANIA DEL INTERIOR ORIENTAL FOOTHILLS, NORTHEASTERN VENEZUELA

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Abstract

Compressive structures have been identified , along the Serranía del Interior Oriental Range foothills, using 2D seismic reflexion profiles, recorded by PDVSA. Major tectonic elements, shown are: Urica fault, Tala - Pirital thrusts and the Mud-diapir trend. Thrusts and associated ramps occurred during the Late Miocene - Pliocene. Extensional features to the east, might have been triggered during the last 5 Ma. by remobilisation of lower Miocene shale.

INTRODUCTION

The Serrania del Interior Oriental range, represents the easternmost branch of the Andean uplift (Figure 1). It is located in the northeast corner of Venezuela, and it covers an area of aproximately 6000 square kilometers. Cretaceous rocks dominate around 70% of total outcrops; the other 30%, is represented by paleogene and neogene sediments, as well as, some sparse pleistocene alluvial fans and erosional terraces, across the main rivers .The existence of jurassic evaporites have been proposed in the literature;this evaporitic sequence, would act as a main detachment level,associated with the major neogene compressive contractional structures.

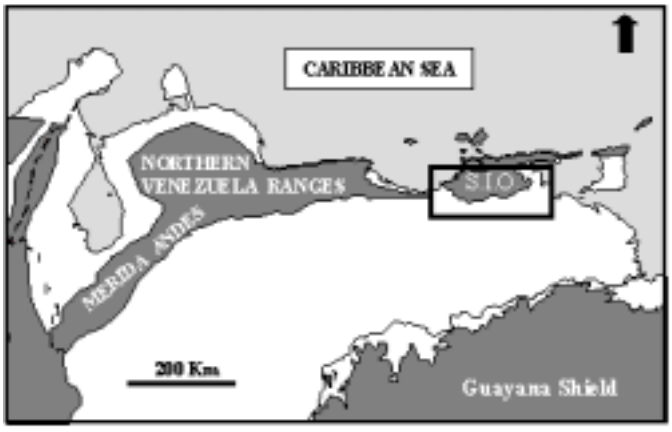

Figure 1 - Location of the Serrania del Interior Oriental Range (S.I.O.).

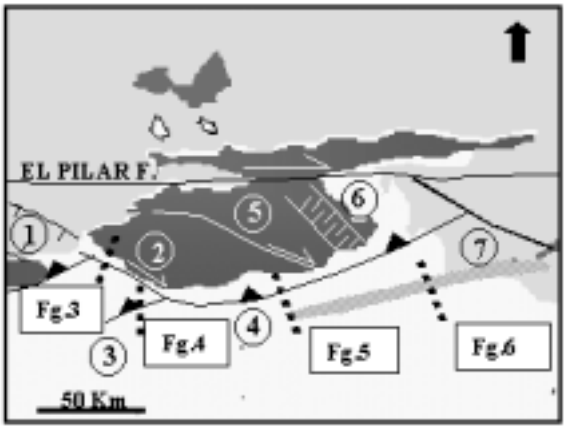

Figure 2 - Tectonic setting: 1. Píritu Graben, 2. Urica Fault, 3. Tala thrust, 4. Pirital Thrust, 5. San Francisco Fault, 6. San Juan Graben, 7. Mud-diapir Trend.

The northernmost boundary of the Serrania del Interior Oriental range, is controlled by right lateral strike-slip motion. It includes the El Pilar Fault system (Figure 2), a major dextral fault, considered to be the main contact between Caribbean and South American plates; it´s dextral movement, seems to have started in the upper Miocene; current slip rate is about 1 cm / year and total offset is around 70 kms (AUDEMARD and GIRALDO, 1997). An igneous – metamorphic belt (Caribbean belt), lying to the north of the El Pilar fault, was progressively emplaced, against the South American passive margin (from west to east), during the Eocene / Miocene times (AUDEMARD and LUGO,1994). Towards the east, the Serrania del Interior Oriental range, ends up against a series of plio / pleistocene grabens (i.e. San Juan) , related to a NE-SW tectonic extension. Four seismic reflexion profiles, recorded by PDVSA

in the last 2 decades, will be shown in this paper. They have been recorded across major tectonic elements, located along the foothills: Urica Fault, Tala Thrust, Pirital Thrust and the Mud-diapir trend. More information, about seismic stratigraphy and tectonics , appears in DI CROCE (1995) , HUNG (1997) and YSACCIS (1997).

URICA FAULT

The Urica fault system (Figure 2), is located at the western termination of the Serrania del Interior Oriental range; this tectonic feature, seems to be an oblique ramp, of the Pirital Thrust. The pliocene Piritu Graben (Figure 2), is aligned parallel to the Urica fault, but, not be considered as it´s northernmost extension, as was mentioned by MUNRO and SMITH (1984) and BLANCO and GIRALDO (1992).

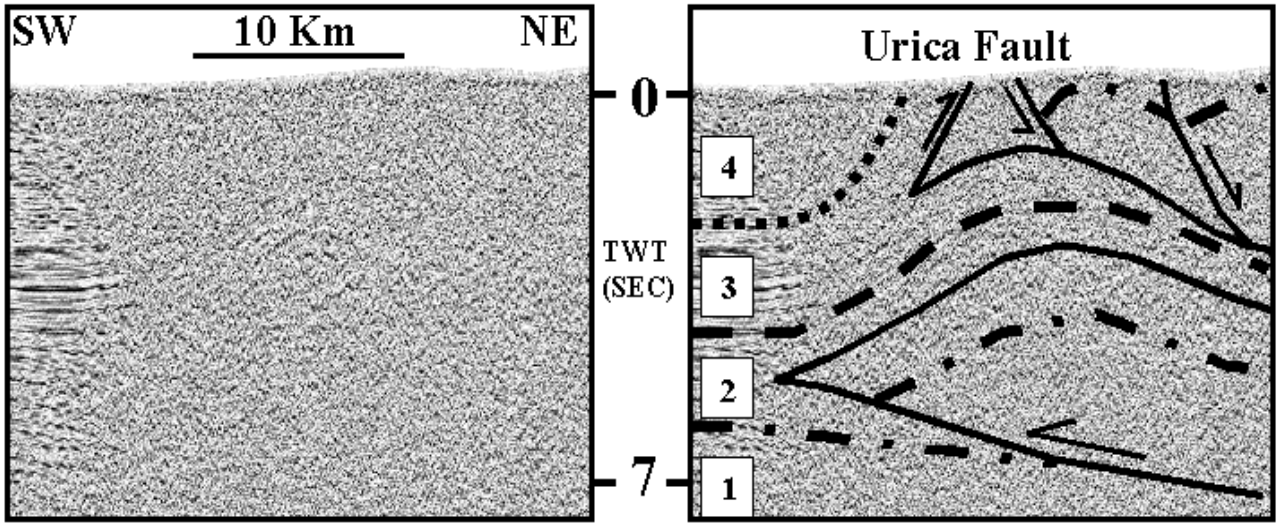

Figure 3. Seismic section across the Urica fault. 1.Cretaceous, 2.Oligocene, 3. Lower Miocene, 4. Middle Miocene.

A 30 km long seismic reflexion section is shown in Figure 3. It is oriented NE-SW, orthogonal to the Urica Fault system, which has been mapped (ROD,1956) , for more than 100 km. Sedimentary sequences are well date along this line; the youngest unit is the middle Miocene mollasse, Quiamare Formation . The Urica fault zone has been interpreted as a northeast dipping ramp, having an upper Miocene age; also, a southwest dipping feature, can be interpreted, forming thus , a triangle zone. The detachment level, is located in the lower Miocene sequence, known as the Capiricual Formation; also, it can be inferred, that this shallow detachment, has been deformed by a younger and deeper one, developped during the upper Miocene – Pliocene (?) .The anticline observed underneath the Urica fault, has a northwest-southeast direction, extending for aproximately 10 kms.

TALA-PIRITAL THRUST

The southern boundary of the Serrania del Interior Oriental range is represented by the Pirital thrust, which runs subparallel to the range trend, accomodating thus, some of the southward tectonic transport. A total shortening of 80 kms h` s been proposed by (PARNAUD et al.,1995); these authors also considered that partitionning in eastern Venezuela is accomodated between the El Pilar fault (relative motion to the east), and the Pirital – Furrial thrust systems (southward tectonic transport). Figure 4 shows a seismic line , recorded orthogonal to the Tala thrust zone, probably the easternmost extension of the Pirital thrust (Hernández Leroy , pers.comunication). The tectonic transport is clearly well defined to the south, and has occurred during the Upper Miocene - Pliocene; compressive deformation, extends towards the Plio - Pleistocene, because the youngest unconformity is folded and subtly faulted. Preliminary interpretation shows, that a detachment level, occurs along the lower Miocene shale. It can be also interpreted , that youngers triangle zone structure, folded the shallower detachements. The seismic section in Figure 5 was recorded iacross the Pirital Thrust and Mud-diapir trend. The interpretation suggest that, this “elephant-like” structure, is a consequence of two processes: the first one, being the emplacement of the Pirital thrust, during the upper Miocene and the second one, arcilokinesis developed during the Plio-Pleistocene.

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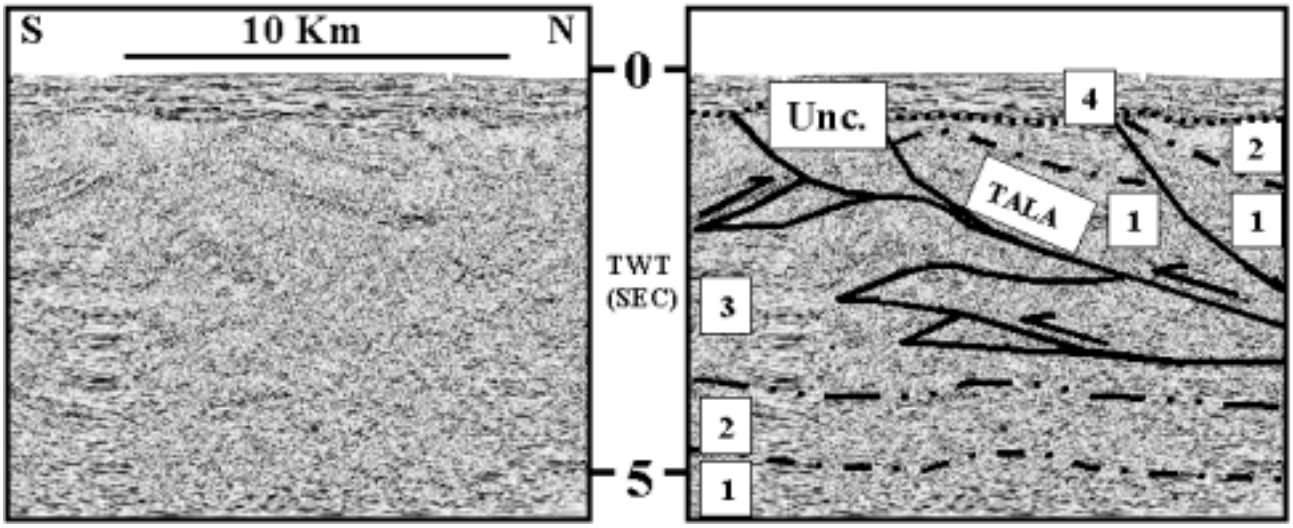

Figure 4. Seismic section across the Tala thrust. 1.Cretaceous, 2.Oligocene, 3. Miocene, 4.Plio?- Pleistocene; Unc.= Unconformity

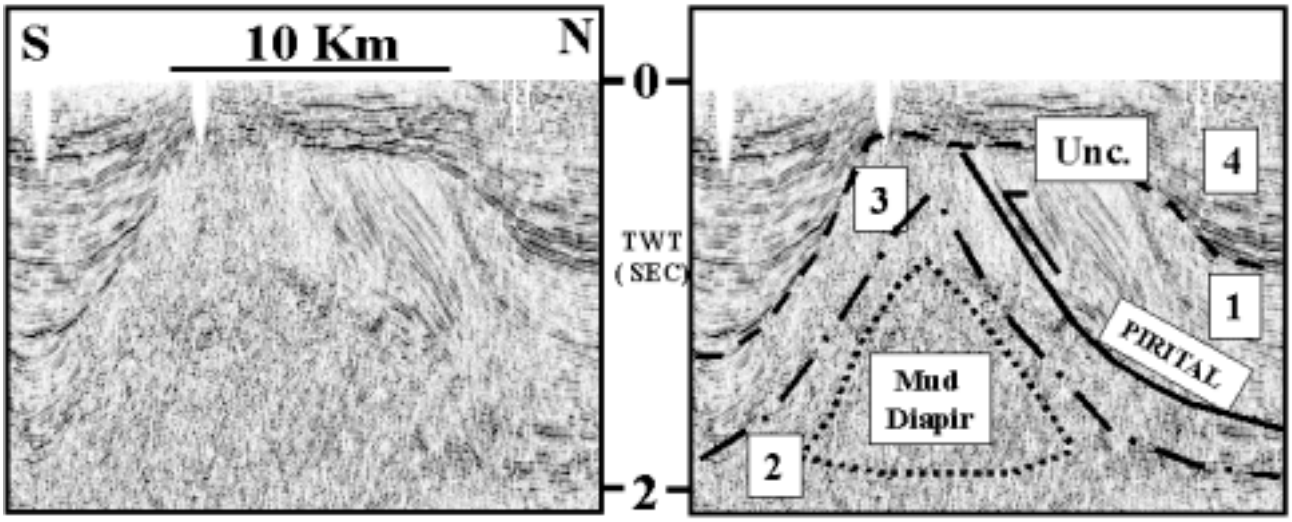

Figure 5. Seismic section across the Pirital thrust and the Mud-diapir trend. 1.Cretaceous, 2.Lower Miocene Shale, 3. Middle Miocene, 4. Plio-Pleistocene; Unc.= Unconformity

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MUD-DIAPIR TREND

A Plio-Pleistocene Mud-diapir trend has been well documented from seismic sections, south of the Serrania del Interior Oriental range. The age of remobilised shales is lower Miocene, and have been identified as part of the shaly section of the Carapita Formation, considered to be the major seal in the eastern Venezuela basin. This trend runs parallel to the negative gravimetric anomaly located in the foredeep . The most intense arcilokinesis effect , lies inmediatly southeast of the San Juan graben system (Figures 2 and 6); coincidentally, this is the area where the gravimetric anomaly reaches its minimun value (-200 mgals); intensity of arcilokinesis decreases progressively disappearing toward the west. Mud ridges are very conspicous ,and they occurred during Pliocene-Recent times, causing the pinching-out geometry of youngest sediments. The uplift of middle Miocene is about 2.5 seconds (TWT) and rotated onlaps are good indicators of recent uplift due to arcilokinesis; width of diapir´s trend is about 10 km. Probably, the shale remobilisation, produces a void effect towards the north, triggering or accelerating normal faulting (San Juan Graben), parallel to the maximum horizontal stress σ1.This Mud-diapir trend, has been identified by oil explorationists, since the earliest decades of this century (HEDBERG, 1950) and documented from seismic lines by LILIÚ (1990).

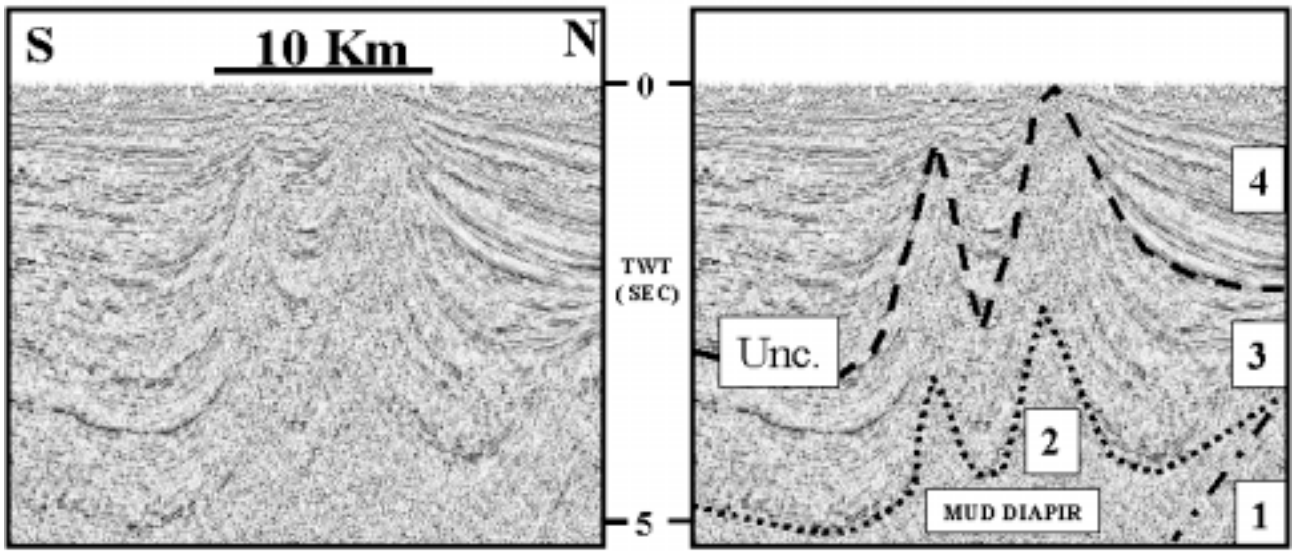

Figure 6. Seismic section across the Mud-diapir trend. 1. Oligocene, 2.Lower Miocene Shale, 2. Middle Miocene, 3. Plio-Pleistocene; Unc. = Unconformity.

CONCLUSIONS

Compression is still active in eastern Venezuela, and has been documented from seismic sections. In the western part of the foothills, young thrusts propagate underneath the shallowest ones , folding the previous detachment. Towards the east, arcilokinesis appears as an important tectonic process, occurring since Pliocene times. However , it can be suggested, that this mud remobilisation,could be triggered by,deeper active thrust structures (Furrial Thrust). Arcilokinesis and extensional structures are contemporaneous in the eastern part of the Serrania del Interior range. More detailed studies need to be accomplished , in order to have a better understanding of the different tectonic processes.

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