TRENCH INVESTIGATION ACROSS THE OCA-ANCON FAULT SYSTEM, NORTHWESTERN VENEZUELA

Franck A. AUDEMARD M.

Venezuelan Foundation for Seismological Research (FUNVISIS)
Apartado Postal 76880, Caracas 1070-A, Venezuela

RESUMEN: Dos trincheras de exploración paleosismológica ejecutadas sobre las fallas de Oca y Ancón, evidenciadas por microescarpes afectando rampas detríticas cuaternarias de las llanuras costeras de Buchivacoa, al Este de Maracaibo, confirmaron la actividad cuaternaria en transcurrencia dextral de éstas y permitieron estimar respectivamente sismos máximos probables de magnitud 7.4 y 7.5 con periodos de retorno de 4300 y 1900 años.

KEY WORDS: Neotectonics, Paleoseismology, Seismic Hazard Evaluation, Trenching.

INTRODUCTION

The Oca-Ancon fault system is a major east-west, right-lateral strike-slip tectonic feature of northern South America which trace extends eastward from the Colombian atlantic-coast, near Santa Marta, to the town of Puerto Cabello located on the caribbean coast of Venezuela, across the Goajira Peninsula, the outlet of Lake Maracaibo, the coastal plains of Buchivacoa (northwestern Falcon State) and the central Falcon range (Fig. 1). This system truncates the north ends of the Santa Marta block and Perija Range. The Oca-Ancon system converges with the Bocono-San Sebastian-El Pilar system on the Aroa - Golfo Triste depression.

Spectacular diagnostic geomorphic features of Quaternary activity have been reported along this tectonic system since the late forties. VOORWIJK (1948) photointerpreted pluri-kilometric fault scarplets related to both Oca and Ancon faults in the Quaternary alluvial plains of Buchivacoa, some fifty Kilometers East of Maracaibo. Few years later, MILLER (1960) observed displacement of Holocene beach strandlines in Sinamaica, slightly North of The city of Maracaibo. This second site was trenched by CLUFF & HANSEN (1969) who could put in evidence the Quaternary activity of the Oca fault but they only could establish the occurrence of the latest seismic event on that segment of the system which has happened in the last 2700 years.

Despite all these evidences, many authors in recent times have seismically underestimated this fault system and they have occasionally considered it inactive. On the contrary, other authors have overestimated its lateral displacement to fit Caribbean Geodynamics models. In fact, Oligocene rocks outcropping along the axis of the Falcon anticlinorium on both sides of the fault system leads to estimates of apparent dextral displacement of 30±3 Km (SOULAS,1987; AUDEMARD,1991). Moreover, JANSSEN (1979) has proposed no more than 50 Km of post-Middle Cretaceous apparent right-lateral displacement along this system based on the apparent offset of the Cogollo Group isopach map from northern Lake Maracaibo and TSCHANZ *et al.* (1974) have estimated 65 Km of apparent right-lateral offset measured on Mesozoic metamorphic rocks. This estimates do not fit in many Geodynamics models where large transcurrent movements are required along the southern boundary of the Caribbean plate.

Still more amazing is the fact that very few authors have mapped thoroughly the fault trace farther East of Maracaibo since the fifties (JAECKLI & ERDMAN,1952; MENDEZ & GUEVARA,1969; SOULAS,1987; AUDEMARD,1991 and AUDEMARD *et al.*,1992) where profuse geophysical and geological information has been collected by oil companies. In fact, this fault system has been very frequently skechted across the Falcon anticlinorium following diverse positions and trends in order to connect the known western segment of the fault (westward of Maracaibo) with the Bocono-San Sebastian-El Pilar fault system (AUDEMARD*et al., op. cit.*)

GEOLOGICAL SETTING

In the western coastal plains of Falcon State and East of Maracaibo, the Oca-Ancon fault system is farely simple as it is composed by two sub-parallel fault strands: the Oca and Ancon faults (Fig.1). Their traces are defined by pluri-kilometric scarplets in Quaternary alluvial ramps that were reported by VOORWIJK (1948). These scarplets of the Oca and Ancon faults have been smoothed and they are 0.3m and 1.2m in height respectively. Both scarplets face each other and they limit a large area of probable present subsidence because large swamps are present, rivers become meandering and drainage flow is erratic. I believe that the western portion of this area is an active pull-apart basin located in the right-stepover between the dèxtral Oca and Ancon faults which seems to be corroborated by seismic profiles (AUDEMARD,*op. cit.*).

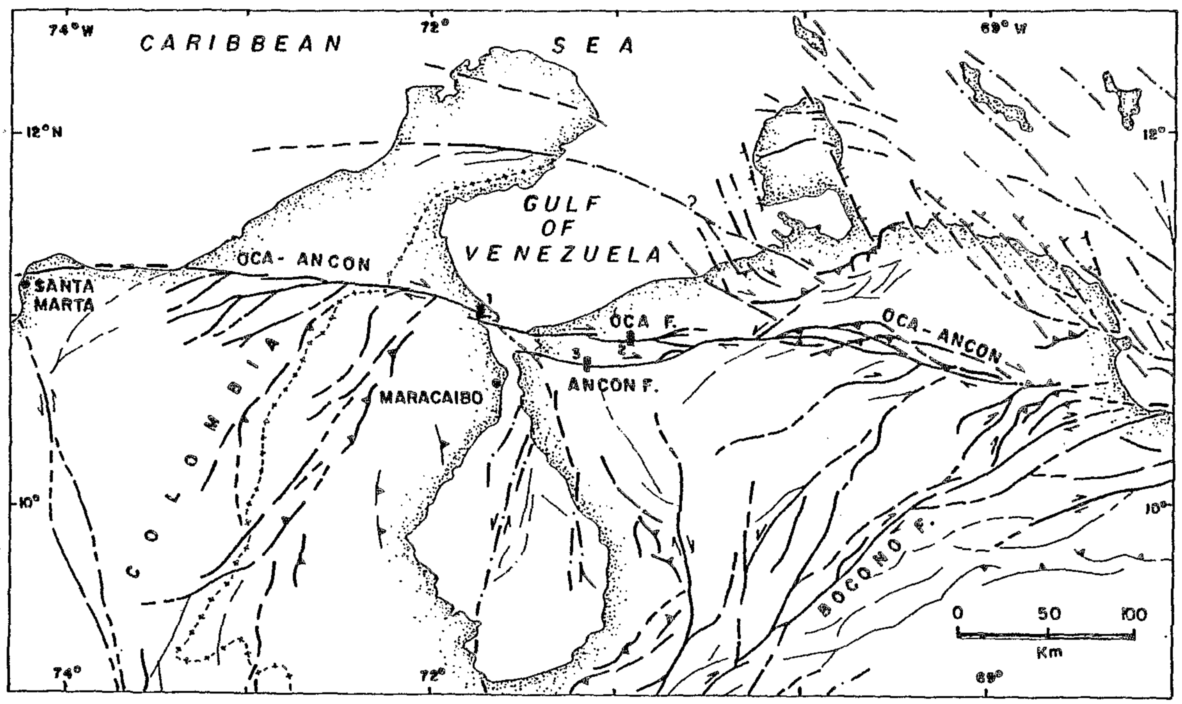

Figure 1.- Nefectonic map of northwestern Venezuela and northern Colombia. The most relevant tectonic feature of the region is the WNW-ESE right-lateral strike-slip Oca-Ancon fault system. Small boxes identify trench sites :1- CLUFF & HANSEN (1969); 2 and 3- AUDEMARD (1991). Map sources: MILLER (1960); TSCHANZ*et al.* (1969); SOULAS (1985,1987) ; AUDEMARD (1991) and AUDEMARD*et al.* (1992).

This segment of the system was chosen for trenching among others because of technical facilities and favorable geological conditions, and mainly because the simplest segment, the one West of Maracaibo, had already been trenched in the most favorable site (1 in Fig. 1 ; site described by MILLER (1960) and excavated by CLUFF & JANSEN (1969)) which proved to be poorly satisfactory as trench excavation could not go beyond 2.5 m in depth due to shallowness of water table and unconsolidation of loose sands of Holocene beach strandlines. In consequence, two trenches had to be excavated (a trench per fault strand) in order to evaluate the seismic potential of the system (2 and 3 in Fig. 1).

TRENCH DESCRIPTION AND OBSERVATIONS

Each of both trench sites were located on those scarplets previously mentioned (2 and 3 in Fig.1) and trenches were excavated by bulldozer down to 7 or 8 m in depth . Width of trenches decreased from 8 m at the top to 4 m at the bottom and length varied between 80 and 85 m. Therefore, removal of some 2.500 to 3.000 cubic meters of material per trench was required.

Both faults were clearly observed in trench walls cutting the whole sedimentary sequence, except the present soil horizon. Slickensides were measured on both fault planes. The Oca fault is dextral with a relevant north-side-up reverse component. It is composed of a single, subvertical, north dipping fault plane. On the other hand, the Ancon fault is pure right-lateral strike-slip with an apparent south-side-up component of slip. The Ancon fault is also subvertical and it presents a broader deformation zone where conjugated minor faults accomodate mass volume problems. Striations observed on both fault planes are in agreement with sedimentary layer throws measured on the trench walls and with geomorphic features (scarplets).

PALEOSEISMIC INTERPRETATION

Trench geological observations combined with radicarbon dates of several samples collected from selected stratigraphic horizons outcropping in the trenches allowed us to make paleoseismic reconstructions of the Oca-Ancon fault system and to estimate its seismic potential (AUDEMARD,1991).

The following conclusions can be drawn from this paleoseismic research :

- Three surface rupture events have occurred along the Oca fault, dated 7755±320, 6240±390 and 1945±630 years BP.
- One surface rupture event has happened within the past 3125±185 years BP on the Ancon fault.
- The Holocene slip rate of the fault system is about 2 mm/a.
- Any of both Oca and Ancon faults can generate a maximum probable earthquake of magnitude 7.4 to 7.5. Recurrence of such events on the Ancon fault is close to 1900 years while it is about as twice as long on the Oca fault (4300 years)

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