SEGMENTATION AND HORIZONTAL SLIP-RATE ESTIMATION OF THE EL TIGRE FAULT ZONE, SAN JUAN PROVINCE (ARGENTINA) FROM SPOT IMAGES ANALYSIS.

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KEY WORDS : El Tigre Fault, segmentation, slip rate and cosmonucleids.

INTRODUCTION

In the subduction areas associated with oblique convergence, relative plate motion should be partitionned between displacements along the subduction plane and parallel-to-the margin strike-slip deformation within the overriding plate. The Nazca/South American N76°convergence off Chile is strictly oblique and has to be mechanically accommodated by strike-slip (shear) deformation (Fitch, 1972; Jarrard, 1986; Sébrier and Bellier, 1993; Bellier and Sébrier, 1995; Ego et al., 1995) which could be localised, at about 30°-31°, along the El Tigre Fault (Bastias and Uliarte, 1988; Bastias et al., 1990). This N10°E-trending dextral fault is located on the eastern side of the intra-Andean Calingasta-Iglesia Valley (Armijo and Sébrier, 1991) (Fig.1). Geomorphologic analysis on SPOT images allow us to precisely characterize the fault geometry and to quantify the active deformation along the El Tigre Fault Zone.

Segmentation and Geometry of the El Tigre Fault Zone

The 120-km-long El Tigre Fault Zone, is subdivided, from South to North, into 26, 48 and 46 km-long main segments (Fig.1). Both Quaternary to recent geomorphologic features and stream channel offsets outstandingly agree with the apparent Present-day fault activity. According to previous studies (Bastias, 1990) this fault should have a 800 km long rupture length. Nevertheless, no evidence has been observed from the SPOT images analysis to justify such a rupture length. Indeed, the southern tip of the southernmost segment (#1 Fig.1) is characterized by a merging within the Precordilleran Paleozoic strata and, because of its very distributed surface deformation, the northernmost segment (#3 Fig.1) is interpreted as the northern termination of the El Tigre Fault Zone.

Late Quaternary horizontal displacement along the El Tigre Fault Zone

The high resolution (10 m a pixel) panchromatic SPOT images provide evidences of recent tectonic activity such as stream channel offsets within Quaternary fan deposits along the central segment (#2 Fig.1). These alluvial fans are composed by imbricated detritic fans which can be related to locally or regionaly significant climatic pulses. The measured offsets range between 60 and 180 m. The larger offsets inside the fans are assumed to be the older because they are probably not as much rejuvenate by erosion than the smaller on the borders. Thus, as a mean value we assume 170 ± 10 m to be the maximum Late Quaternary right-lateral strike-slip displacement on the El Tigre Fault Zone.

Seismic Hazard of the El Tigre Fault Zone

The geometric parameters (surface rupture lengths and horizontal displacements) inferred from the SPOT images analysis allow us to improve the seismic hazard evaluation along the El Tigre Fault Zone using statistical empirical laws (Wells and Coppersmith, 1994). Estimates of the moment magnitude (Mw) for the maximum expected earthquake, i.e. earthquake reactivating the total segment length, are of about 7 ± 0.5.

Horizontal slip-rate estimation using in-situ produced ^{10}Be

In order to constrain the El Tigre Fault Zone horizontal slip-rate we decided to date the along-strike displaced morphological features as it has been performed in Mongolia (Ritz et al., 1995). We thus sampled alluvial fan surfaces to determine their cosmic ray exposure dates using in situ-produced ^{10}Be (Lal, 1991; Cerling and Craig, 1994). Preliminary results, obtained at the Tandetron AMS facility (Gif-sur-Yvette, France), seem to indicate that each detritic pulse that led to the deposition of the alluvial fans is related to known interglacial stages. These data, combined with the measured-offsets of stream channels allow us to estimate an horizontal slip-rate roughly of the order of 1 mm/year.

CONCLUSIONS

Considering the linkage between the Precordilleran mountain ranges geometry and the segmentation of the fault, a crustal signification is given to the El Tigre Fault Zone. Parallel to the mountain belts motion on the faults depends on the mountain belts trending with respect to the plate convergence (N76°E), thus reverse motion should occur on N-S to NNW-SSE trending structures, whereas transpressive motion should occurs on NNE to SSW trending structures. The Calingasta-Iglesia Valley, and the Precordillera at 30°-31°S, can be seen as a transpressive zone of crustal scale : deformation being partitioned between right-lateral strike-slip motion along the El Tigre Fault Zone and reverse motion on the Precordilleran thrust faults.

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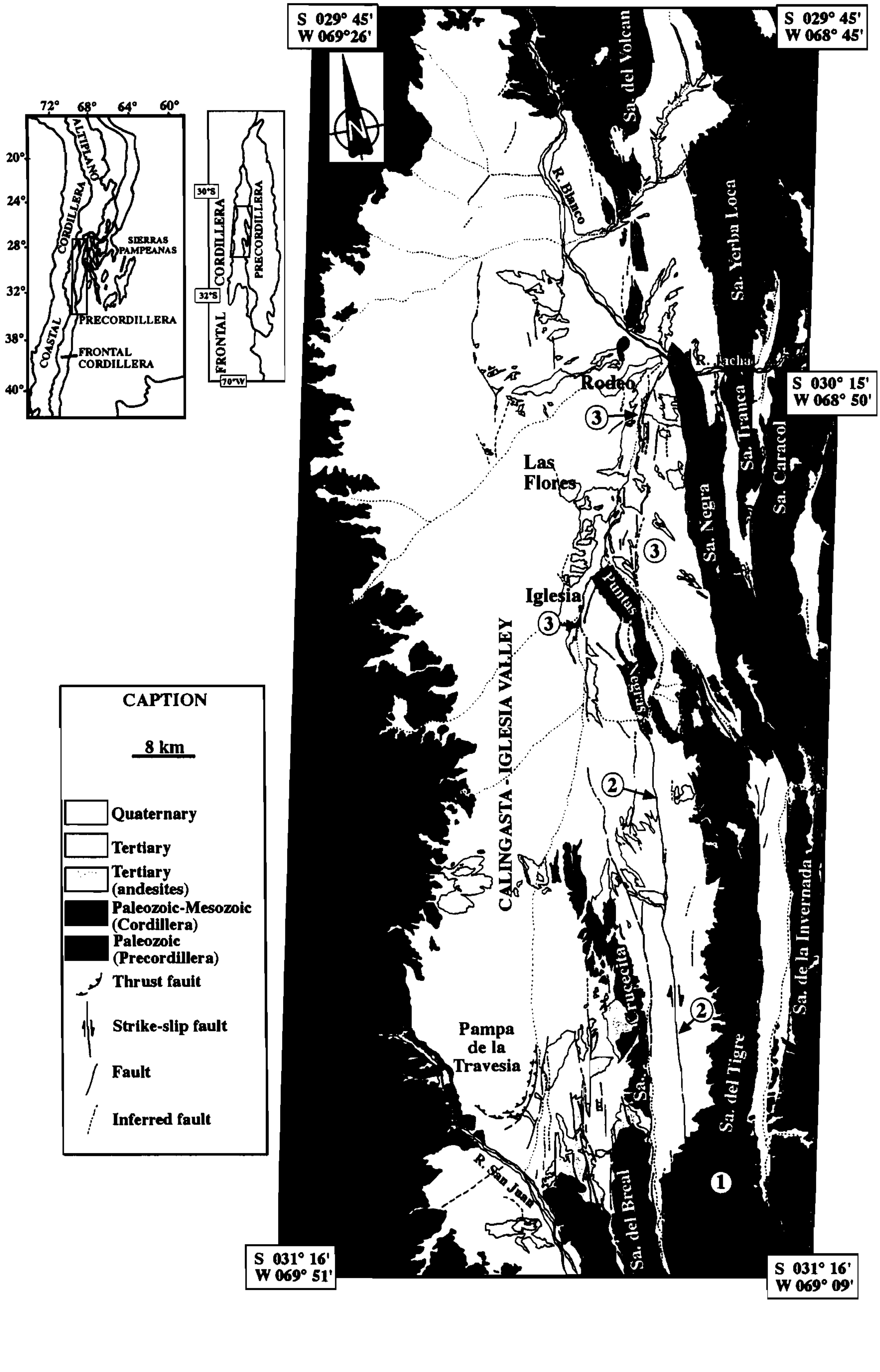
S 029° 45'
W 069°26'
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N
72°
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38°
40°
ALTIPLANO
CORDILLERA
COASTAL
SIERRAS PAMPEANAS
PRECORDILLERA
FRONTAL CORDILLERA
30°S
32°S
70°W
FRONTAL
CORDILLERA
PRECORDILLERA
Sa. del Volcan
R. Blanco
Sa. Yerba Loca
R. Jachal
Rodeo
Sa. Tranca
Sa. Caracol
Las Flores
Sa. Negra
Iglesia
CALINGASTA - IGLESIA VALLEY
Sa. de la Invernada
Pampa de la Travesia
Sa. del Tigre
R. San Juan
Sa. del Breal
Crucecita
CAPTION
8 km
Quaternary
Tertiary
Tertiary (andesites)
Paleozoic-Mesozoic (Cordillera)
Paleozoic (Precordillera)
Thrust fault
Strike-slip fault
Fault
Inferred fault
1
2
3

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