Available online at www.sciencedirect.com
ScienceDirect
Tectonophysics 424 (2006) 19–39
TECTONOPHYSICS
www.elsevier.com/locate/tecto

Surface rupture of the Cariaco July 09, 1997 earthquake on the El Pilar fault, northeastern Venezuela

Franck A. Audemard *

Funvisis, Caracas, Venezuela

Received 1 December 2005; received in revised form 24 April 2006; accepted 28 April 2006
Available online 24 July 2006

Abstract

This paper discusses the surface rupture of the Cariaco July 09, 1997 Ms 6.8 earthquake in northeastern Venezuela – located at 10.545°N and 63.515°W and about 10 km deep. The field reconnaissance of the ground breaks confirms that this event took place on the ENE–WSW trending onshore portion of the dextral El Pilar fault (between the Gulfs of Cariaco and Paria), which is part of the major wrenching system within the Caribbean–South America plate boundary zone. Dextral slip along this fault was further supported by the structural style of this rupture (en echelon right-lateral R shears connected by mole tracks at restraining stepovers) and by larger geometric complexities (pop-ups at Las Manoas and Guarapiche), as well as by the focal mechanism solutions determined for the event by several authors. This 1997 surface ruptre comprised two distinct sections, from west to east: (a) a main very conspicuous, continuous, 30-km-long, rather straight, 075°N-trending alignment of en echelon surface breaks, with a rather constant, purely dextral coseismic slip of about 25 cm, but reaching a maximum value of 40 cm slightly northwest of Pantoño; and (b) a secondary discontinuous, 10-km-long, boomerang-shaped rupture, with a maximum coseismic slip of 20 cm at Guarapiche. The onshore extent of the surface rupture totalled 36 km, but may continue westward underwater, as suggested by the very shallow aftershock seismicity. This aftershock activity also clearly defined the steep north dip of the fault plane along the western rupture, suggesting tectonic inheritance on this major fault.

From many locals' accounts, the rupture seems to have propagated from Pantoño to the west (highly asymmetric bidirectionality). This suggests that earthquake nucleation happened at or near the Casanay–Guarapiche restraining bend and rupture quickly propagated westward, allowing only a small fraction to progress eastwards beyond the bend. Additionally, the large fraction of after-slip (or creep) released is to be related to such restraining bend, which seems to have partly locked slip during rupture.

Keywords: Cariaco earthquake; Surface rupture; Nucleation; After-slip; El Pilar fault; Caribbean

1. Introduction

Northeastern Venezuela was struck by a Ms 6.8 (Mw 6.9) earthquake on July 09, 1997, at 19:24:10.8 GMT. Its hypocenter was located at 10.545°N and 63.515°W and 9.4 km in depth (FUNVISIS, 1997; FUNVISIS et al., 1997; Pérez, 1998b; Romero et al., 1998; details on earthquake depth dispersion are given in Baumbach et

* Venezuelan Foundation for Seismological Research –FUNVISIS–, Apartado Postal 76880, Caracas 1070-A, Venezuela. Tel.: +58 212 2575153x234.
E-mail address: faudemard@funvisis.gob.ve.

0040-1951/$ - see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.tecto.2006.04.018

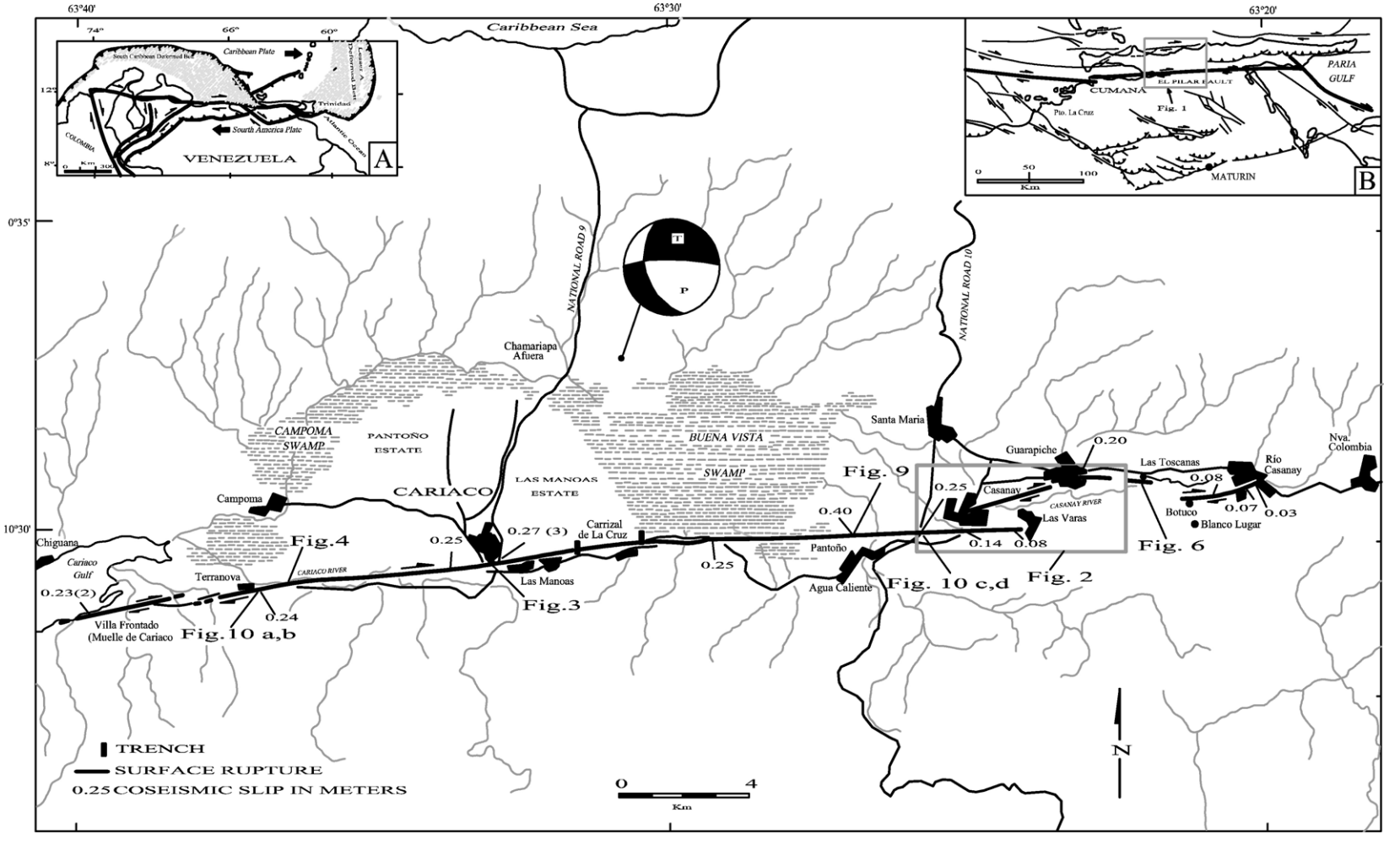

Fig. 1. Mapping of surface faulting during the Cariaco July 09, 1997 earthquake extending eastward along the El Pilar fault between Villa Frontado – on the seashore of the Cariaco Gulf – and Río Casanay, state of Sucre. Coseismic slip measurements are reported along rupture, as well as the focal mechanism determination based on p-wave first arrivals recorded by the Funvisis national seismologic network (after Audemard et al., 2005). (A) Geodynamic setting of northern Venezuela (after Audemard et al., 2000). (B) Active transpressional tectonic setting of northeastern Venezuela, where the right-lateral strike–slip El Pilar fault plays a major role in strain partitioning (after Audemard et al., 2000, 2005). Box in (B) indicates coverage of Fig. 1. Locations of several other figures are also reported.