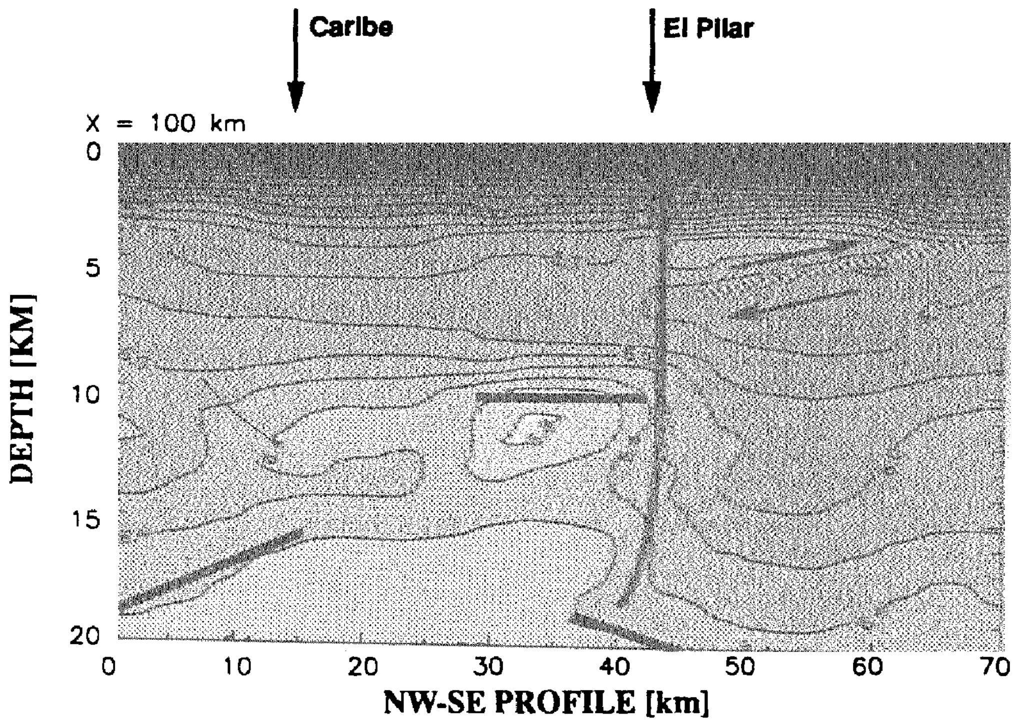

Figure 12: Cross-section at X=100km. Arrows are indicating the suerface expression of the El Pilar and North Coast faults. (For more explications see text).

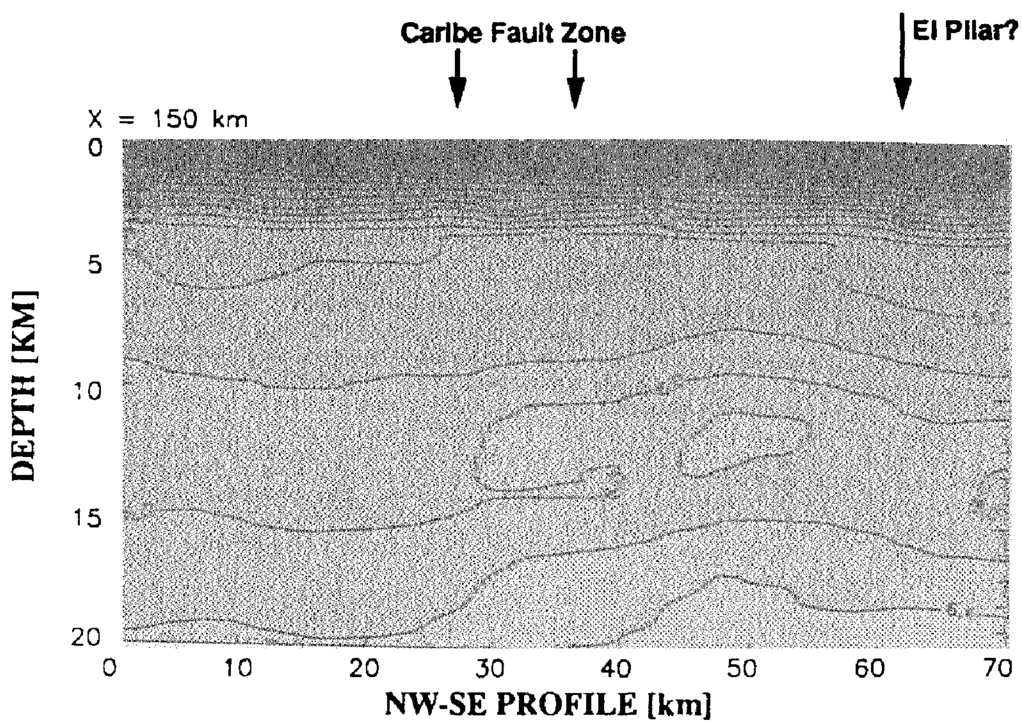

Figure 13: Cross-section at X=150km. Arrows are indicating the suerface expression of the El Pilar and North Coast faults. (For more explications see text).

Discussion and conclusions

The discussion will focus on two of the structural elements of the region: the Paria-Trinidad terrane and the Serrania del Interior.

The Paria-Trinidad terrane resolution is good between 3 and 20 km depth by the simultaneous inversion. The depth of the Conrad Discontinuity was determined at 15 km for 0 to 75 km along the X-axis. Further along, it decreases to approx. 10 km depth. This value coincides with the interface derived in the spectral analysis of gravity anomalies by Russo and Speed (1993). Due to the lack of seismic and borehole data, they deny its origin as the transition of upper and lower crust.

The thrust and deformation belt, the Serrania del Interior, reveals a complex imbricate structure of reverse and thrust faults. The upper 3 to 4 km could not be resolved by this method. However, the lower structures indicate that the shallower structural elements are influenced by them. Hence, a possible explanation for the rotation and back-thrust of some faults, e.g. the Rio Grand Fault (Rossi et al., 1987), as an effect of fault propagation faults and detachments along the interface of sediment strata and crystalline basement. Also responsible could be underplating/decollements along deeper discontinuities, e.g. Conrad Discontinuity, in a later phase, e.g. in Figure 8 there are three main interfaces indicated (heavy broken lines):

1. The upper thrust plane (4-8 km) divides the high-velocity wedge from the sediment strata of the Mesozoic foreland basin of the Guyana shield as a former frontal accretion or frontal ramp during the genesis of the Serrania del Interior.

2. The middle (9-17 km) separates the sediment strata along the crystalline basement with the San Juan graben as lateral boundary (depth inferred by Franke, 1993).

3. The deepest is an assumed basal decollement which corresponds with the dipping Conrad Discontinuity (between 17 km and more than 20 km).

The latter does not have to be the actual plane along which the movement takes place but serves as an indicator of possible deep-seated thrusting. In the same depth, Russo and Speed (1993) found the interface of upper and lower crust.

In conclusion, it was found that the methodology of tomography gives the possibility of achieving three-dimensional velocity models if the data are good enough. How sensibly the algorithm reacts, was indicated by the S-wave travel time inversion.

The velocity model itself offers the chance to study the neotectonics in more detail than it could be presented here, and the dynamic evolution of the Serrania del Interior could be reconstructed by a balanced structural interpretation (Roure et al., 1990; Mitra ,1992).

Acknowledgements

We thank Maria Isabel Munoz who worked with us on the phase-pickings. This work was partly funded by the European Community under contract No. C11-0461-D(AM) and C11-0460-VE(A).

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Historic Geodetic Constraints on: Caribbean - South America Relative Plate Motion, Plate Boundary Zone Kinematics and Seismic Hazard

J.C. Weber[1], W.B. Ambeh[2], T.D. Dixon[3]
R.C. Speed[1], L.L. Lynch[2], and D. Jeyanandan[4]

1. Northwestern University
Dept. of Geological Sciences
Evanston, IL 60208, USA
2. Seismic Research Unit
The University of the West Indies
St. Augustine, Trinidad
3. University of Miami
RSMAS-MGG
Miami, FL 33149-1098, USA
4. The University of the West Indies
Dept. of Land Surveying
St. Augustine, Trinidad

Abstract

We are undertaking a cooperative geodetic experiment in Trinidad and Tobago to quantify historic strain rates and their distributions in this part of the Caribbean (Ca)-South America (SA) plate boundary zone (pbz). In ~ March 1994 we will remeasure with Global Positioning System (GPS) ~ 10 recently recovered first-order monuments from an historic triangulation network built and originally measured by the British Ordnance Survey in 1901-03 across Trinidad. We will also establish a number of new baselines from these historic marks to several monuments in Tobago from which we can monitor length and orientation changes due to motions between the two islands with second-epoch and subsequent GPS campaigns. From these studies, our objectives are to constrain the rate and direction of Ca-SA relative plate motion and to quantify the distribution of Ca-SA motion in the pbz. These data which are now lacking, are critical in the establishment of earthquake hazard exposure levels in the region. The low level of shallow (<50 km) seismicity, at all magnitudes, in Trinidad and Tobago since 1953 indicates that lithospheres in this portion of the pbz are either :(1) not straining or straining at a very low rate: or (2) (a) they are straining completely aseismically (creeping) or (2) (b) straining away from locked faults with large seismic potentials. Our historic data should allow us to distinguish between possibilities (1) and (2). Geodetic strains approach total strains, that is, the sum of seismic plus aseismic strain. Hence we should be able to "see" straining that studies of seismicity alone cannot. We will be measuring the accumulation of strain over nearly a century; this is much longer than our local record of instrumental seismicity in the region. Monuments in the 1901-03 network may not be sufficiently closely spaced that we are able to establish whether spatial gradients along which displacements and strains diminish to zero on locked faults exist (possibility 2b). Should significant strain be detected in the historic network we will build additional monuments and conduct further GPS measurements to distinguish case (2a) from case (2b).

Our strain rate determination threshold is fixed by: (1) the precision of the 1901-03 triangulation data, (2) strain and plate motion rates and their spatial partitions in the pbz, (3) the precision of our GPS measurements, and (4) the duration of time between the 2 sets of geodetic measurements. Regional GPS measurements are precise to at least parts in 10^8 tracking satellites with a global network (e.g. Tralli and Dixon, 1988; Dixon, 1991), which is our plan. Angular measurement errors between first-order triangulation stations represent distance errors of less than 1 part in 10^5; these are often as low as several parts in 10^6 (e.g.

Turcotte and Schubert, 1982; Billiris et al., 1991). Hence, our strain rate threshold is fixed by triangulation, not GPS measurement errors. Given average baseline lengths in the network of 30 km, we should be able to detect relative motions between monuments of at worst several tens of cm, and at best, at the cm-level. NUVEL-1 (DeMets et al., 1990), a global model of current plate motions, indirectly estimates relative Ca-SA angular motion to be $\omega = 63.1^{o}N$, $15.2\ ^{o}W$, $0.13\ my^{-1}$; that is 13±3 mm/yr of relative Ca-SA motion directed toward S68±10 ^{o}E in Trinidad and Tobago. Hence, over the past century > 1 m of displacement may have accumulated in the pbz. We should be able to determine whether a significant portion of this motion is being taken up in Trinidad, and if so how; and after second-epoch GPS measurements, the nature of deformation between Trinidad and Tobago where many place the lithospheric Ca-SA boundary.

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