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The Central Costa Rica Deformed Belt: Neotectonics of the Eastern Segment

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Abstract

The Central Costa Rica Deformed Belt (CCRDB) is an east-west system of neotectonic faults, located in the central part of Costa Rica (Fig. 1). The Turrialba and Siquirres regions, in the eastern segment of this zone, are characterized predominantly by strike-slip faults. Based on the geometry of faulting, six different faults systems were recognized: Atirro-Rio Sucio, Navarro, Kabébeta, Pacuare, Siquirres-Matina and the Irazú-Turrialba volcanoes. Quaternary volcanic and sedimentary deposits were found to be deformed by the main faults. Linear valleys, deflected streams, shutter ridges, scarps, pressure ridges, sag ponds, and offset streams were also identified from the geomorphologic and remote sensing studies along the traces of the main faults.
During the period 1992-2002, the seismicity was characterized by shallow earthquakes (< 19.6 km) and low magnitudes (1.7-4.4 Md and 1.0-4.1 ML). 359 seismic events in the study area were relocated and 7 well constrained focal mechanism were determined (Fig. 2, 3). They were selected from the data base of the National Seismological Network of Costa Rica. The distribution of the relocated epicenters suggests that the following faults are active: Siquirres, Irazú, Guayabo, Navarro, Lajas Turrialba, Azul, Tucurrique, Pacuare, and Kabébeta..
There is a strong relationship between the orientation of the faults and the type of displacement (Fig. 4). Right lateral faults are oriented N30-50W, left lateral faults are N40-50E, normal faults are N0-20E, and reverse faults are N70W. The geometry of faulting suggests that the crustal deformation is controlled by a maximum compressive horizontal stress N0-20 E, which is related to the shallow subduction of the Cocos Ridge beneath southeastern Costa Rica.

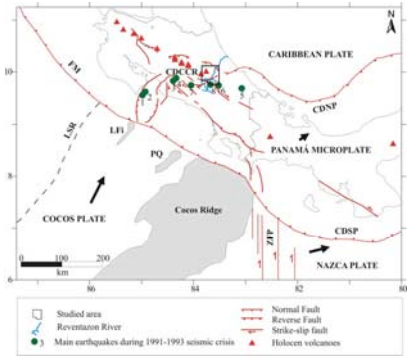


Figure 1. Tectonic setting and location of the studied area.

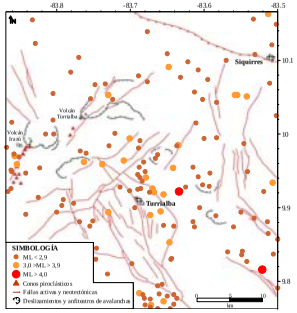


Figure 2. Relocated seismicity (period 1992-2002).

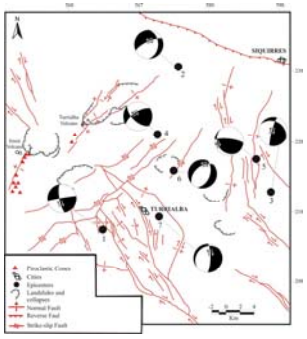


Figure 3. Well constrained focal mechanism determined in the studied area.

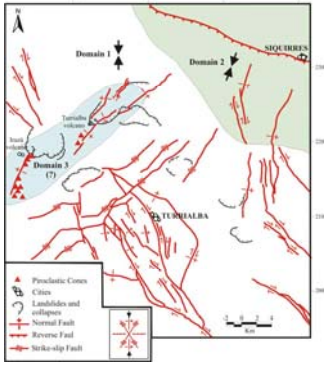


Figure 4. Neotectonic Model for the studied area. Three domains were defined considering the geometry of faulting.

Neotectonic Evidence of Fault Systems

1. Navarro Fault System

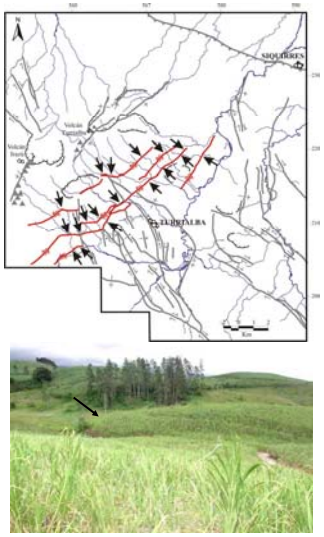


Figure 5. Ridge blocking the drainage of the Chiz river.

2. Atirro–Río Sucio Fault System

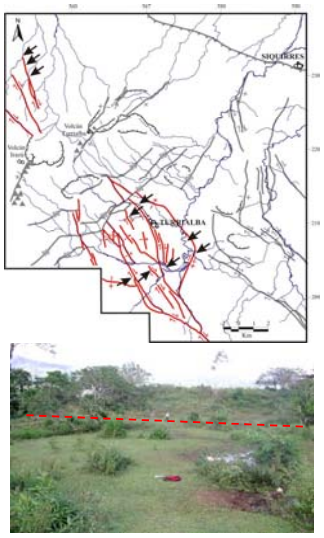


Figure 6. 8-meters scarp on Turrialba fault.

3. Pacuare Fault System

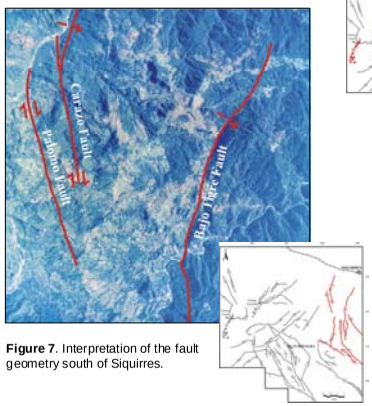


Figure 7. Interpretation of the fault geometry south of Siquirres.

4. Faulting in the Irazú and Turrialba volcanoes

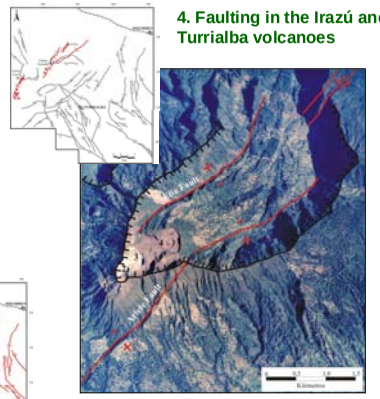
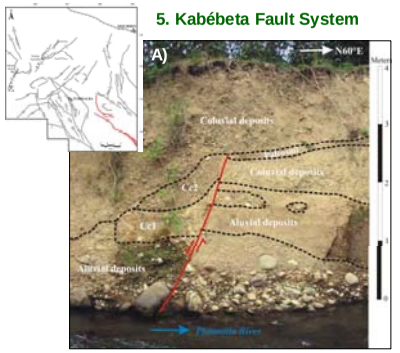


Figure 8. Graben on the summit of the Turrialba Volcano. It has 4 craters and 2 piroclastic cones named Armado y Tiendilla (Aereal photo Terra # 11–143, L34A)

5. Kabébeta Fault System



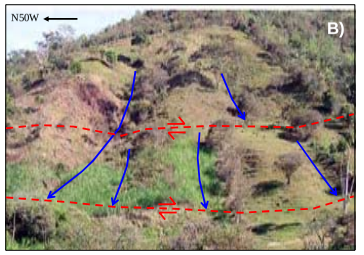


Figure 8. A) Kabébeta Fault cutting Holocene deposits. Cc1 y Cc2 are deposits related to the erosion of paleo scarps after the occurrence of earthquakes. **B)** Offset streams by the Kabébeta fault.

Conclusions

1. The eastern segment of the Central Costa Rican Deformed Belt is characterized by both active and neotectonic faults with different geometries. Predominantly, there are strike-slip faults. Based on the geometry of faulting, there are six different faults systems: Atirro–Río Sucio, Navarro, Kabébeta, Pacuare, Siquirres–Matina and the faulting in the Irazú and Turrialba volcanoes.
2. There are 17 active faults (defined based on stratigraphic, geomorphic and seismological aspects): Alto Grande, Río Sucio, Tucurrique, Turrialba, Florencia, Azul, Atirro, Navarro, Guayabo, Irazú, Ariete, Elia, Kabébeta, Lomas, Pacuare, Cabeza de Buey and Siquirres.
3. The geometry of faulting is controlled by the direction of a Maximum Compressive Horizontal Stress N0°E y N20°E. There is a strong relationship between the orientation of the faults and the type of displacement. Right lateral faults are oriented N30-50°W, left lateral faults are N40-50°E, normal faults are N0-20°E, and reverse faults are N70°W.
4. During 1992–2002, the seismicity was characterized by shallow earthquakes (<19,6 km) with magnitudes 1,7–4,4 Md and 1,0–4,1 ML. During that period of time, earthquakes took place in the following faults: Siquirres, Irazú, Guayabo, Navarro, Lajas Turrialba, Azul, Tucurrique, Pacuare y Kabébeta.