

Vertical Datums in a Fault Zone: Influences of Plate Tectonics in Trinidad, West Indies

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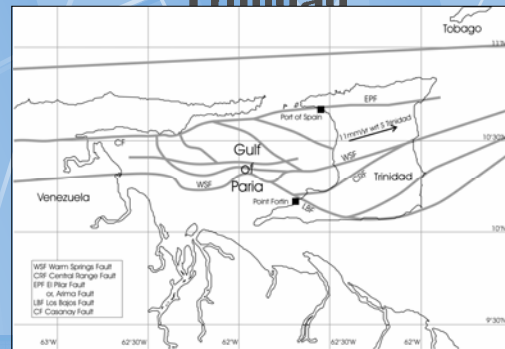
The Caribbean Tectonic Plate



Fault Zones in the SE Caribbean



The Fault Zone Across Trinidad



The Gulf of Paria

- A pull-apart fault
- Tectonic movement has separated Trinidad from Venezuela
- The space has filled with unconsolidated sediments
- Western Trinidad is sinking into the void
- Geoidal model, geology and topography provided further evidence.

Northern Range descends West



The Geoid in the SE Caribbean



Variation in density North/South

- Using WGS84 spheroid and the CARIB97 model developed by NGS
- Change in geoid/spheroid separation of over 3m on a North South line in West Trinidad
- Deflection of the vertical of 11 seconds

Vertical Motion in the West

- Tide Gauges located at North West and South West Trinidad over 8 and 6 year periods, late 1980's early 1990's.
- Variations in vertical references established from the mid 1800's and 1930's.
- Relative to MSL North West Trinidad is sinking at 1mm/yr, South West at 4mm/yr

Vertical Motion in the East

- Raised beaches
- Elevated Mangroves
- Suggest that the land mass in the East may be rising

Influences on Vertical Land Datum

- Vertical datum was initially tied to MSL in Port of Spain in 1938, but observations preceded this
- While vertical control in Port of Spain is now about 0.06m above MSL, it may be as much as 0.4m different in South Trinidad
- In the East of the country vertical control may have risen above MSL

Chart Datum

- In Port of Spain this is 0.73m below MSL, while in South West Trinidad the difference is 0.824m
- Using land based control to establish chart datum for hydrographic surveys will give more clearance than expected

Integration of Land and Marine Data

- Modern digital applications take data from different sources on different datums to integrate information
- Variations in chart datum leads to an immediate problem due to discontinuities
- Land and marine data can be integrated provided existing land based control was used to reference hydrographic control

Integrating data from GPS

- Use of GPS still presents a problem as geoidal models within the region are not sufficiently accurate
- Even on the short distance along the West coast of Trinidad there is a large (3m) variation in the geoid/spheroid separation

Requirements for vertical control

- Constant potential for drainage applications
- No discontinuities for seamless digital data
- More accurate geoidal models for GPS use
- Velocities are significant and need to be incorporated

Vertical Motion Exists

- The ITRF frame provides a basis for high precision GPS users to incorporate velocity. CORS sites are being installed in Trinidad now
- The vertical reference frame, which must be related to some potential surface also needs to accommodate velocities

Conclusion

- Geology can have a significant impact upon vertical control
- Small island developing states such as Trinidad require accurate data, yet little consideration is being given to datum issues
- In reviewing policy and practice, the requirements of small island states are significant within developing a framework