Neotectonics in Papua New Guinea, Insights from Space Geodesy

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Introduction

Geodetic analysis of GPS observations from an extensive network of sites in PNG (Figure 1) have provided great insights into the tectonic setting of this complex region, located along the northern margin of the Australian Plate.

Nearly all types of tectonic processes are active in PNG, making the country an ideal natural laboratory for the application of geodetic methods to study these processes.

Fieldwork

RSES has conducted extensive GPS field campaigns, in collaboration with other International and PNG institutions:

- PNG National Mapping Bureau
- PNG University of Technology
- Rabaul Volcanological Observatory
- Geological Survey of PNG
- University of California, Santa Cruz
- Institute of Geological & Nuclear Sciences, NZ

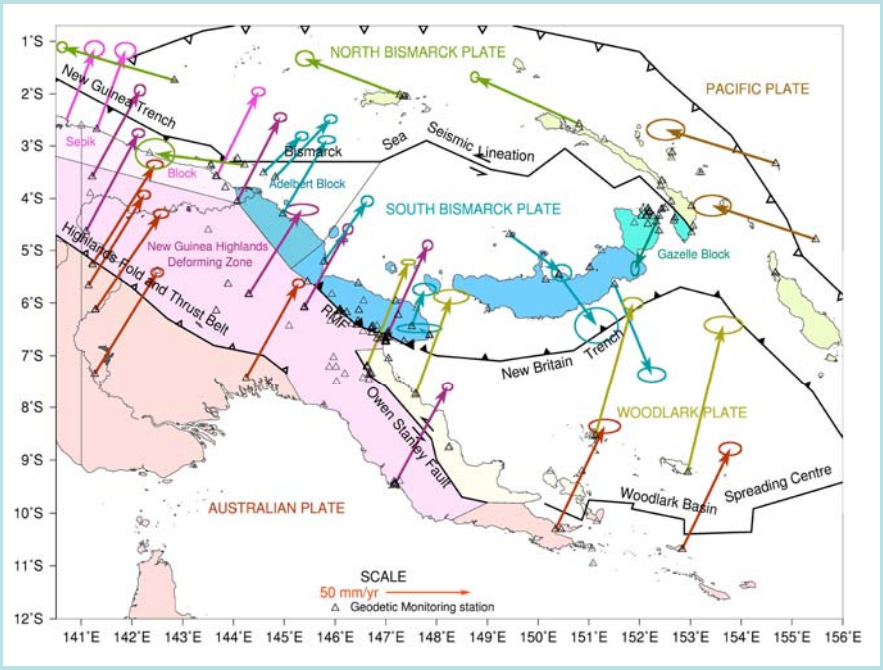

Figure 2. Plot of the velocity field and tectonic setting of PNG. The velocity fields in the Gazelle Block and the Ramu-Markham Fault Zone have been omitted for the sake of clarity. Vectors show the ITRF site velocities for selected geodetic monitoring sites.

Figure 2. Geodetic Monitoring Sites in PNG, clockwise from top; Mt. Amungwiwa Ekuti Dividing Range, Pillar on the Duke of York Islands, Angoram (Sepik River in background)

Tectonic Interpretation

Site velocities are inverted to obtain poles of rotation of the PNG tectonic plates. Relative velocities are also used to estimate strain rates on locked faults (figure 4). These estimates, together with the measurement of co-seismic displacement and post-seismic relaxation resulting from large earthquakes in PNG (figure 5), have improved our understanding of the kinematics of active faults and the elastic nature of the lithosphere.

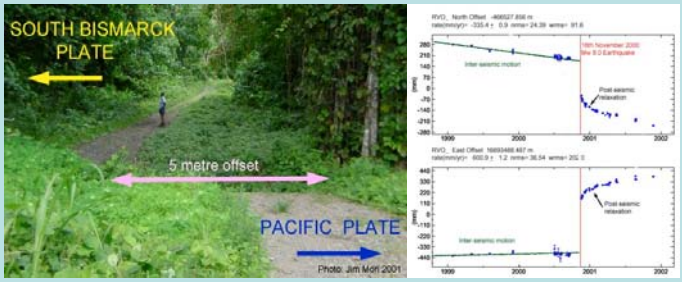

Figure 5. Co-seismic displacement and post-seismic relaxation resulting from the Mw8.0 earthquake on the Weitin Fault, Southern New Ireland, 16th November 2000. The timeseries is for RVO_ (Rabaul Volcanological Observatory) located some 40 km from the epicentre of the Mw8.0 event.

Geodetic Analysis

The PNG GPS data have been analysed using the GAMIT/GLOBK software using GPS orbit data and GPS site data from the global IGS network. Daily solutions are estimated to produce a loosely constrained (free) network solution. The free-network is then transformed into ITRF2000 (International Terrestrial Reference Frame) by computing a seven-parameter conformal transformation constrained by a selection of core IGS sites. ITRF site velocities are then estimated by performing a weighted linear regression analysis of the changes in site positions over time (Figure 3).

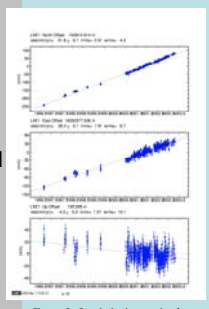

Figure 3. Geodetic time series for LAE1 IGS Site located at PNG Unitech, Lae

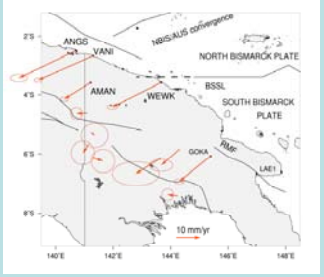

Figure 4. Preliminary analysis of the kinematics across the New Guinea Highlands, from fieldwork in 2003.

Future Work

The existing analysis demonstrates the benefits of using GPS observations to study the kinematics of Papua New Guinea. We intend to install new monitoring networks spanning the western and eastern Highlands, the Papuan Peninsula, continue monitoring the New Ireland/New Britain region as well as study co-seismic and post-seismic effects of any major earthquakes that might occur in the near future.

References

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Web-site
http://rses.anu.edu.au/geodynamics/gps/png