PAPUA NEW GUINEA GEOSCIENCE NETWORK

March 2019

News from the MRA:
Symposium on Global Climate Change and Geo-Environment Evolution

IGPNG
Institute of Geoscientists in Papua New Guinea

New Publications

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Welcome to the second newsletter for the Papua New Guinea Geoscience Network!

The Papua New Guinea Geoscience Network continues to grow. The wider network and outreach now encompass over 20 organisations with representation from government, academia, and both the minerals and oil and gas sectors. Strong growth of the network highlights the desire of the geoscience community to engage, collaborate and share their experiences. On a similar note, I would also like to congratulate the executive and board of the Institute of Geoscientists in Papua New Guinea (IGPNG) for formation of the institute. We look forward to collaborating with the IGPNG to further develop and promote geoscience in PNG. The emergence and growth of such organisations illustrates the desire of the wider geoscience community to contribute to building the institutional capacity in PNG and to address contemporary challenges.

Activities amongst the geoscience community in PNG continue to provide a vision of the bright future that exists for the field and provide a platform from which to grow. In coming months we anticipate significant advances will be achieved from this work, which includes new and emerging research projects and collaborations that will advance the field of geosciences both within PNG and globally, emerging initiatives in sustainable geoscience, in particular utilising geotourism to promote community engagement and awareness, and working towards creation of conference proceedings and workshops from which to promote and share these experiences. Stay tuned for updates from the Papua New Guinea Geoscience Network on the latest activities.

As it is still early days for the Papua New Guinea Geoscience Network, I would like to take this opportunity to reiterate the vision for the network. Through collaboration among the PNG geoscience community there is a real opportunity to contribute to building the institutional capacity in PNG and develop an innovative and sustainable geoscience agenda that will foster knowledge sharing and support the development aspirations of PNG. To attain meaningful outcomes, we need bring together the next generation of researchers and professionals to address challenges within PNG as well as achieving advances in the global geoscience field.

One of the aims of the network is to promote the exceptional work that is being done in PNG. We would like to share your experiences with the network through future contributions and updates. This could include new publications, any events such as conferences or field work, researcher or student profiles, or any project updates and short articles. As the network develops, the website (www.pnggeoscience.com), this newsletter and the associated LinkedIn group will serve as outlets to update everyone on the goings on and up-to-date news. Please promote these within your circles to encourage organic outreach and help to build a strong platform from which to further grow the network.

Rob Holm

Call for Projects

We welcome enquires about potential geoscience research projects for undergraduate and graduate studies, and to develop collaboration between academics and professionals from all geoscience sectors. Drawing on the Papua New Guinea Geoscience Network we can connect you with scientists both within Papua New Guinea and internationally. We can match you with the best people to answer those nagging questions.

Please contact **info@pnggeoscience.com** for more information.

Symposium on Global Climate Change

Moira Lunge

Moira Lunge, a geologist from the Mineral Resources Authority (MRA) was invited by the China Geological Survey (CGS) to attend the Symposium on Global Climate Change and Coastal Geo-Environment Evolution in Nanjing, China on 13 to 17 December 2018. The symposium was organised by CGS of the Ministry of Natural Resources at the support of the Ministry of Finance of the People's Republic of China. The objective of the symposium was to gather experts from APEC member countries to understand the latest progress in geoscience research on coastal zones, to exchange ideas on how to deal with the challenge of global climate change and its effects on coastal geo-environment, and to give a boost to mutual cooperation.

In her address to the participants, Moira thanked the Chinese government for being a good friend to Papua New Guinea especially through the China Geological Survey and MRA-Geological Survey collaboration. Moira said climate change is a global dilemma that is causing distress to all humans. Our planet Earth's health and well being from climate change is a major concern to all of us. Just like doctors attending to sick patients, environmental scientists and policy makers globally are discussing the climate change agendas but often forget their counterparts 'the geoscientists' (geologists) who are experts in studying of earth's natural processes and should be on call to assess the earth's viability to support life.

Given PNG's location in a tectonically active region of the world, with ongoing earthquakes and volcanic activity the risks of rising sea levels and tsunamis are so real. The country has recently experienced some of the worst natural disasters in its history. On 17th July 1998, a major earthquake struck the northern coast of PNG which triggered a tsunami that killed close to 2000 people and displaced more than 10,000 others. In 1994, a volcanic eruption off the eastern islands of PNG displaced thousands of lives. Volcanic activity still continues today on some of the outlying islands. And just last year PNG experienced another earthquake that crippled the nation on February 26, which struck the Central Highlands of PNG killing hundreds of people and displacing many more.

Papua New Guinea is situated within the 'Pacific Ring of Fire' which makes it favorable for the high rate of tectonic plate movements. This same geological events which formed the rich minerals, oil and gas fields and supplies the country's vast natural resources, likewise has the reverse implications for geo-hazard risks due to the same tectonic movements, which on a global scale is contributing to climate change effects.

In PNG, climate change affairs are managed under the Ministry of Environment through the Climate Change and Development Authority (CCDA). The Authority's mission statement is to build a climate resilient and carbon neutral pathway for climate compatible development in PNG supporting the global aims of Green Climate. However, domestically the climate change issues are being addressed without considering geology and tectonic processes where climate change and global warming are direct impacts of geological processes and human-induced activities on the environment.

Participants of the Symposium on Global Climate Change and Coastal Geo-Environment Evolution in Nanjing, China on 13 to 17 December 2018

Visiting the Yangtze River Delta on the eastern coast of China

PNG is now diversifying its mineral base from the known copper and gold to now exploring for rare earth elements including iron sands, nickel, bauxite and chromite. In the government's quest for new energy options to serve our societies, we are exploring for coal and will build our first coal power plant in the country contributing to environmental pollution in the absence of remedial technologies. Without sound geoscience research it is impossible to predict what causes these extractive industries may have on the environment and people at large.

Apart from PNG, about 45 participants came from Vietnam, Canada and Thailand including many from within China comprising students and geoscience researchers. There were 14 presentations on various topics relating to research in marine geosciences, coastal geoscience evolution, from engineering and construction to monitoring. China took the lead with their displays from the various Geological Survey Institutions showcasing different work on geoscience research.

Moira was given a tour around the Nanjing Geological Survey Laboratory which houses all their science research equipment from XRF to highly sensitive ICPMS machines and met some of their highly skilled technicians. She was also given a tour of the wetlands, which a big wetland river delta area is called Yangzing River Delta, off the eastern coast of China; about 2 hours' drive outside of Shanghai. Similar to the Sepik River delta in PNG, the Yangzing River Delta is undergoing land restoration with efforts towards the conservation of the flora and fauna, hence promoting eco-tourism. It has become a wild park where tourists come to visit. Another site she visited was the Land Subsidence Monitoring Station in Shanghai. There are about 38 monitoring stations in Shanghai alone with real time measurements monitoring land subsidence from the effects of sea water influx and infrastructure development.

With a great learning experience, Moira is willing to share her knowledge in developing PNG through geoscience development, where she sees that the current focus for geoscience learning through the tertiary academic programs is aligned towards the mining and oil and gas sectors while a greater need exists for its collaboration with other sectors such as the climate change and environment (geo-hazards), tourism (geo-tourism), health (medical geology), education (geo-education), fisheries (marine geology), agriculture (agro-geology), forestry (geo-forestry) including the general lands and physical planning aspects in line with development projects. These academically aligned pathways will create opportunities to address development issues; including climate change.

PNG needs to learn from environmental protection strategies of other countries and develop a high level management strategy as a way to promote climate change awareness and mitigation. More significantly in this Anthropocene age, the negative influence of humans on the environment must be monitored through geoscience insights to maintain the Earth's overall health and well being and its viability to sustain life. Hence, geoscience understanding and how geological processes dictate changes to human communities, is fundamental for good corporate governance and the implementation of high level environmental management.

The Institute of Geoscientists in Papua New Guinea (IGPNG)

The IGPNG was recently established to cater for the interests of every geoscientist in Papua New Guinea. The institute is an organisation for all student and professional geoscientists encompassing both the mining and exploration, and petroleum and LNG sectors with a mission to create a platform for every geoscientist to collaborate, share common goals and take part in research and education in Papua New Guinea.

The aim of the IGPNG is to facilitate the development of the geoscience profession with a specific emphasis on exploration for and production of minerals, petroleum and natural gas, while ecouraging the adoption of improved methods of exploration and exploitation.

To achieve these goals the IGPNG will encourage and promote the dissemination of pertinent geoscientific and technological data and strive to maintain a high standard of professional conduct on the part of its members.

For more information please visit www.igpng.org or email admin@igpng.org.

IGPNG
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New Publications

Late Cretaceous to Oligocene burial and collision in western Papua New Guinea: Indications from low-temperature thermochronology and thermal modelling

Luke Mahoney, Sandra McLaren, Kevin Hill, Barry Kohn, Kerry Gallagher and Martin Norvick

Published in Tectonophysics, Volume 752 (2019), 81-112.

Abstract: Recent field and analytical work have considerably improved our understanding of the structure of the Muller Range along the frontal trend of the Papuan Fold and Thrust Belt (PFTB) in western Papua New Guinea (PNG). However numerous questions remain unresolved concerning the geological evolution of the region. In particular, the Late Cretaceous to Oligocene history of the region is largely unknown due to the absence of a continuous stratigraphic record. Here, we use both new and existing low-temperature thermochronology data to investigate the geological history of the Muller Range. Thermal history models based on these data suggest two major Cenozoic cooling episodes. The youngest, and best constrained, is clearly recorded in the stratigraphic record and relates to Neogene collision at the northern margin of the Australian continent. An older episode of comparable or greater magnitude occurred in the Eocene to Oligocene and may relate to the removal of 1500–3000 m of Late Cretaceous to Eocene section across the Muller Range prior to the widespread deposition of the shelfal Darai Limestone. We suggest that extension along major faults beneath the Muller Range accommodated sedimentation from the Late Cretaceous to the Eocene, consistent with long-lived extensional structures observed in neighbouring regions. In contrast to the Muller Range area, an almost continuous Late Cretaceous to Eocene stratigraphic sequence is preserved in the hinterland <50 km to the northeast. The selective removal of this sequence across the Muller Range suggests it was uplifted in the Eocene to Oligocene, possibly in part facilitated by the inversion of extensional faults in the Muller Range area. We suggest that this inversion was related to the Eocene to Oligocene collision of the expansive Sepik Terrane to the northwest of the PNG margin. The new data and interpretations presented here have significant implications for the evolution of the PFTB and for tectonic reconstructions of PNG.

Tectonic mode switches recorded at the northern edge of the Australian Plate during the Pliocene and Pleistocene

Lloyd T. White, Robert Hall, Indra Gunawan and Barry Kohn

Published in Tectonics, Volume 38 (2019), 281-306.

Abstract: We report new data from medium-high grade metamorphic rocks found at the northern margin of the Lengguru Fold Belt in West Papua. The study involved a systematic analysis of cross-cutting structures to establish the relative timing of deformation, together with isotopic dating to define when these tectono-thermal events occurred. These data show that the region underwent multiple episodes of deformation within the last six million years. Metamorphic mineral growth was associated with the development of ductile shear zones. This episode occurred during a phase of crustal stretching associated with the formation of a metamorphic core complex. Metamorphic zircon growth at 4.9 to 5.3 Ma was documented in two of the dated samples. These data are interpreted to post-date the peak pressure and temperature conditions of the phase of regional crustal stretching. The shear fabrics associated with the metamorphic core complex were later overprinted by at least two generations of folds. The change in mode from crustal extension to shortening reflects a tectonic mode switch. A subsequent mode switch is documented by numerous brittle extensional faults that cross-cut the earlier formed ductile fabrics. We interpret ca. 0.75–1.51 Ma (U–Th)/He age data to reflect cooling associated with the later stages of crustal shortening (marked by folds) or the later extensional unroofing of the peninsula. This work demonstrates that an orogen can record multiple tectonic mode switches within several million years. These outcomes should be considered in studies of ancient orogens where analytical uncertainties associated with isotopic dating may mask short-lived mode switches.

Evolution of a rapidly slipping, active low-angle normal fault, Suckling-Dayman metamorphic core complex, SE Papua New Guinea

Little, T.A., Webber, S.M., Mizera, M., Boulton, C., Oesterle, J., Ellis, S., Boles, A., ven der Pluijm, B., Norton, K., Seward, D., Biemiller, J., Wallace, L.,

Published in GSA Bulletin, In Press, doi: 10.1130/B35051.1.

The active Mai'iu low-angle normal fault in the Woodlark rift dips as low as 16°–20° at the surface and has formed by extensional inversion of the Paleogene Owen-Stanley thrust fault. The Mai'iu fault has slipped at centimeter-per-year rates for at least 3.3 m.y., in the process exhuming a >29 km width of a largely uneroded fault surface, and uplifting the Suckling-Dayman metamorphic core complex to elevations up to 3.7 km. The exhumed fault surface is overlain by one rider block. This formed where the main fault locally became so shallowly dipping in a synformal megacorrugation that it was no longer frictionally viable for slip. Tectonic geomorphology, structural geology, and microseismicity provide evidence for a convex-upward shape and rolling hinge style of evolution for this strongly back-warped normal fault, and for an approximately Andersonian state of stress in the footwall at depth. Flexure of the exhuming footwall as a result of tectonic unloading apparently caused a late increment of extension-parallel horizontal contraction, together with a constrictional stress state. During exhumation, fault megacorrugations amplified as folds—even in the near surface.

Glassy pseudotachylytes in a meter-thick foliated cataclasite unit yield $^{40}Ar/^{39}Ar$ maximum ages of 2.2–3.0 Ma. The pseudotachylytes and interleaved ultracataclasites developed in a zone of mixed-mode seismic/aseismic slip behavior that formed near the brittle-ductile transition along a frictionally strong, high-stress ramp at 10–12 km depth. The exhumed mafic mylonite zone narrows upward and probably deformed at strain rates of up to 2.1×10^{-10} s^{-1} in its narrowest, upper part. Observed microseismicity at 10–25 km depth attests to current (interseismic) fault activity downdip of the fault trace. Rolling-hinge–style deformation causes the Mai'iu fault to dip at low angles (<22°) in the near surface. The shallowest part of the Mai'iu fault contains abundant saponite and is thus probably weak enough ($\mu<0.2$) to slip at such a poorly oriented fault dip. At depth, this microseismically active structure slips at moderate dip angles (dip 30°–40°) akin to conventional normal faults.