

New Study Revises Papua New Guinea's Geologic Origins

Oblique 3D SEEBASE image of subduction zones and intrusive arc basement in PNG

On Feb. 26, 2018, Papua New Guinea experienced a 7.5 magnitude earthquake that killed 140 people and produced 200 aftershocks over two months.

Earthquakes are nothing new for the 460,000-square-mile Commonwealth nation located northeast of Australia and east of Malaysia. Papua New Guinea, called PNG by locals and neighbors, is highly complex, in terms of society and geology.

John Chambers, AAPG member and PNG country manager with Santos Limited, said the country shares similarities to its southern neighbor.

"The Papuan Basin is very similar in its early evolution to other basins along the northern and western margin of Australia with Triassic-Lower Jurassic rifting, a sag phase with shallow to deep marine sedimentation in the Upper Jurassic to Cretaceous and then a passive margin phase with shelf carbonates in the Tertiary," he said.

"The difference in PNG is that compressive tectonics along the northern margin of the Australian plate has resulted in reactivation of the extensional terrain and formation of a thrust belt beginning in the late Miocene," Chambers added.

The geology fascinates Rob Holm, New Zealand native and senior geoscientist at Frogtech Geoscience, who began researching PNG during his doctoral studies at James Cook University 10 years ago.

"Compared to many regions around the world, Papua New Guinea is a relative 'blank slate,' and there is a very real opportunity to come up with new and exciting ideas," he said.

Holm recently completed a six-month project with Frogtech Geoscience, an Australian-based company that provides multidisciplinary regional studies focusing on the geological basement.

The project, PNG SEEBASE, considers geological origins dating back 250 million years and concludes that much of Papua New Guinea formed on the eastern margin of Queensland, Australia, not adjacent to northern Australia as many theories propose.

Conflicting Models

Holm said studying PNG geology unearths a plethora of different and conflicting models to explain the development of the region. He credits the sheer number of contrasting models to the lack of data and evidence regarding the region's history.

Holm's team at Frogtech searched for answers by collecting and integrating diverse sources of data within the company's global terrane framework and performing regional tectonic reconstructions.

"Creating continuous tectonic reconstructions provides an opportunity to test different scenarios for where specific terranes were at certain times and to explore the different plate boundaries that would



Santos Exploration Papua New Guinea Country Manager John Chambers with his wife Dawn at the Goroka Sing-Sing Festival.

result," he said. "This work has a habit of creating eureka moments that highlight relationships between far removed geologic phenomena and suddenly everything 'clicks' and the model explains the elusive links between discrete ideas and evidence."

A Long Journey

Holm said the study's most important finding is that PNG traveled a long way to get to its current location.

"Past studies of Papua New Guinea assumed that these terranes largely formed in place. These ideas first emerged prior to a time when mainstream plate tectonic theory was widely adopted, but in the intervening time these ideas have not been widely challenged or scrutinized in scientific literature," he said.

The Frogtech study combines data from throughout the region and purports that much of PNG formed along the eastern Gondwana margin comprising part of the Tasmanide

Orogenic Belt of eastern Australia.

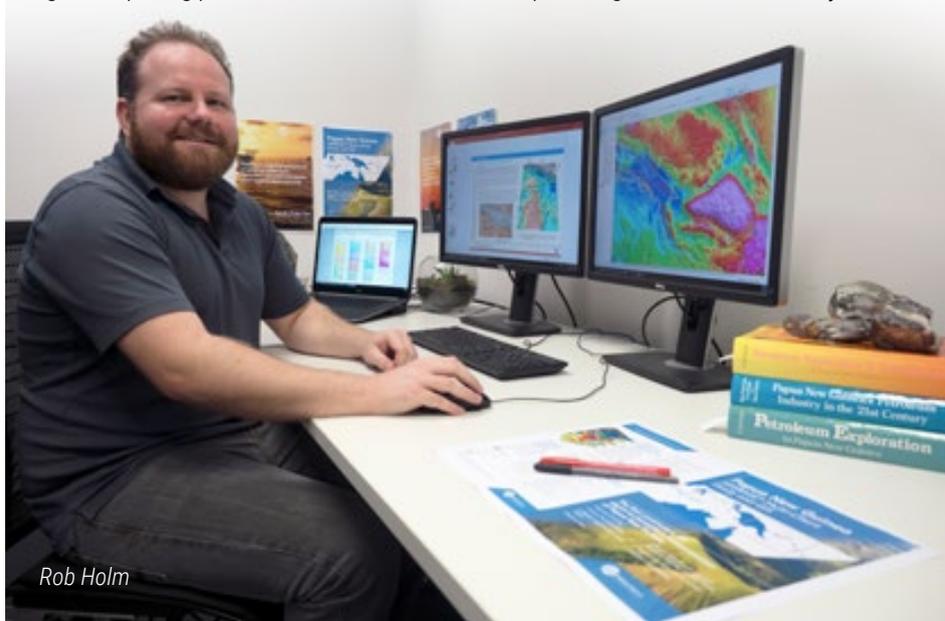
Holm noted that the findings have important implications not only for the geology of PNG, but also for the development of eastern Australia and the wider region.

"These allochthonous terranes potentially record geological events that can fill the gaps in the regional Southwest Pacific geological record that have not been previously considered," he said.

From Theory to Practice

For Holm, the study results impact not only the geoscience community, but also the PNG population, whose economy depends on the oil and gas and minerals sectors.

"This study seeks to provide a regional knowledge base that gives explorers more certainty in their models, reduces the risk in exploration, and may open frontier regions to new ideas and target generation," he said. "Any study which promotes exploration success will provide growth in the economy and critical



Rob Holm

support to the developing regions."

Exploration success and economic development are key goals for Chambers, who has worked in PNG since 2006.

As country manager, Chambers oversees Santos' interest in the PNG LNG Project, which produces gas from the Hides and Kutubu Fields discovered in the 1980s. In late 2016, Santos along with its partners Oil Search and ExxonMobil made a discovery at Muruk-1.

Despite recent discoveries, PNG remains underexplored, primarily due to lack of infrastructure.

Chambers noted that, like most Australian Mesozoic basins, PNG is gas prone with some oil, but until LNG exports began in 2014, there was no route to market for significant volumes of gas. As a result, exploration activity in PNG lagged behind that of other regional basins.

Improving infrastructure is a key objective for Santos and other companies in the region, Chambers said.

"Now that the PNG LNG Project is up and running, our objective is to ensure that there are sufficient gas supplies for the existing project plus expansion for many years to come," he said.

Santos aims to build additional plants to bring gas from provinces isolated from the company's current plant at Port Moresby. PNG's mountainous, jungle covered terrain make doing so a challenging task.

"Not only do we face the normal challenges of geology, we have complex logistical challenges in construction of infrastructure in remote and mountainous parts of PNG," Chambers said.

Exploration companies often use helicopter-portable rigs to reach areas with no roads.

Opportunities for the Community

Chambers described how bringing energy to remote areas of PNG provides tangible benefits for the population.

"Many of the communities in the highlands of PNG have lived in isolation from the outside world for thousands of years," he said. "Naturally they have their own cultural values and views of the world that differ from those who are more familiar with the modern world. However, when you engage with people and try to understand what they want in their communities it is almost universally along the lines of better medical, schools, markets for their produce. If the oil and gas business can help bring some of these positive changes, then we can be a force for good."

For Chambers, investing in PNG requires a long-term commitment.

"PNG is an exciting developing country with a lot of potential and a need for responsible investment that benefits not only the investing company but the local people and the nation as a whole," he said. "The population is growing fast, and there is a need to create jobs for an emerging workforce and to develop the nation's infrastructure."

Keeping Geology in Mind

Holm said an understanding of geology and geologic risk not only helps promote exploration success and long-term development, it also keeps residents safe in the short-term.

"PNG lies in a very active geological region encompassing several active plate boundaries, and characterized by very large earthquakes and active volcanism," he said. "An understanding of the regional geological framework is essential in comprehending the natural hazards the country faces, and our ability to prepare and mitigate for such disasters," he said.

For now, Holm and Chambers work to promote geological understanding and economic development that might make PNG's next earthquake less of a tragedy. 