



# STAR 2017

## The Pacific Islands Science, Technology and Resources Conference

26 – 29 June 2017

Tanoa International Hotel, Nadi, FIJI

ABSTRACT VOLUME

&

CONFERENCE PROGRAM



Pacific  
Community  
Communauté  
du Pacifique



[The island motifs used here is a collage of island designs that are representative of the Pacific Region. Individual motifs are based on various popular island designs. Images have been downloaded from the "Tapa Cloths from the Pacific and Artwork" website: [www.tapapacific.com](http://www.tapapacific.com), accessed 10 November 2016. The use of the images are gratefully acknowledged.]



[STAR 2017 Abstracts Volume]

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The Abstracts Volume is available online at the STAR Website via the following link:  
<http://star.gsd.spc.int/index.php/meetings/star-2017>

**Cover picture:** The upper reaches of the Namosi Creek. Down in this tranquil setting mining in the river has occurred. The Namosi Creek passes down from the Nausori highlands joining the Nadi River. This is the area which will be visited in the STAR 2017 Conference field trip.



[STAR 2017 Abstracts Volume]

## PREFACE

The Science, Technology and Resources (STAR) Network was founded in 1984 as a joint initiative between SOPAC<sup>1</sup> and the IOC/UNESCO<sup>2</sup>. STAR met annually for nearly three decades in conjunction with the SOPAC Governing Council Meeting. SOPAC provided secretariat support to STAR until its suspension in 2010. SOPAC became a new division of the Pacific Community (SPC) and internal policy does not require divisions to hold annual meetings, therefore STAR has not met since 2013. In April 2015 at a Regional Geoscience Steering Group Meeting an agenda item considered the future of STAR. The inaugural meeting of the revitalised STAR was held in Nadi 6-8 June 2016. At the conclusion of the STAR 2016, the STAR Business meeting decided:

- to strongly support the continuation of STAR because of its value in refreshing and animating scientific alliances and showcasing useful work, techniques and instrumentation that may be adapted to address development issues of the Pacific;
- to further explore how STAR could become more independent in particular with respect to administration and financial matters;
- that for the future of STAR to be sustained, STAR needed to secure ownership by the Pacific islands, hence Malakai Finau, [then] Director of Mineral Development of Fiji, was reaffirmed as the STAR Chair to take forward the independence and reinvigoration causes; and
- requested the Geoscience Division of the Pacific Community to support the Chair of STAR with convening a June 2017 STAR Conference and future STAR Conferences where conference fees would be charged as a start to searching for a model for STAR's independence.

The STAR 2017 Conference was held from 26 to 28 June 2017 at the Tanoa International Hotel under the overall theme of “**Geosciences and Sustainable Ocean and Island Resources in the Pacific Islands Region.**”

This booklet provides the final conference program and the collection of abstracts of papers presented during the conference.

The STAR Steering Committee has worked over the past year to plan the STAR 2017 Conference program and field trip. We hope the 4 days are professionally fulfilling for each participant. We also thank you all for affirming that the self-funding model for the STAR can work just as well in the Pacific as it does in other regions; and we wish you a pleasant stay in Fiji (for the visitors).

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**STAR Steering Committee Members:**

Permanent Secretary, Fiji Ministry of Lands and Mineral Resources, **Malakai Finau** (Chair)  
Chief Geohazards Scientist, Geoscience Division (SPC), **Paul Taylor**  
Technical Adviser (Fiji) & former Director of SOPAC, **Russell Howorth**  
Director of Mineral Development, Fiji Ministry of Lands and Mineral Resources, **Raijeli Taga**  
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Junior Geologist, Geoscience Division (SPC), **Christine Prasad**  
Divisional Administrator, Geoscience Division (SPC), **Litia Waradi**  
MRD Administrative Officer, Fiji Ministry of Lands and Mineral Resources, **Sereima Koli**

<sup>1</sup> SOPAC: Pacific Islands Applied Geoscience Commission, now the Geoscience Division of the Pacific Community.

<sup>2</sup> IOC/UNESCO: Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization

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## Conference Program

### Sunday 25 June 2017

15:00-19:00 Registration

### Monday 26 June 2017

08:00-09:00 Registration

#### Session 01 Official Opening

09:00-10:00 Conference Opening

10:00-10:20 Group Photo

10:20-10:45 Morning Coffee

#### Session 02 Deep Sea Minerals

Chair: Russell Howorth (Matadrevula Advisory Services, Fiji)

10:45-11:05	Tomohiko Fukushima	Appropriate Environmental Impact Assessment Technologies for Seabed Mining
11:05-11:25	Tetsuro Urabe	Development of Exploration System for Seabed Mineral Resource in Japan
11:25-11:45	H. Koshikawa	Onboard Ecotoxicological Technique to Qualify the Surface Water Safety During Full-scale Mining Operation of SMS Deposits
11:45-12:05	Ki-beom Ahn	Development Status and Mission Operation Plan of GOCI-II
12:05-12:25	Savin Chand	Projected changes in El Niño-driven Tropical Cyclones in the Pacific
12:25-13:30		Lunch

#### Session 03 Climate Change and Oceans

Chair: Malaki Finau (Minerals and Lands, Fiji)

13:30-13:50	Matt Blacka	Considerations for the Design of Rock Armoured Coastal Protection on Fringing Reef Coastlines
13:50-14:10	Kristen D. Splinter	Laboratory Experiments into the Effect of Reef Width on Extreme Water Levels During Cyclone Events
14:10-14:30	Matt Blacka	Affordable Coastal Protection in the Pacific Islands: Desktop Review, Model Testing and Development of Design Guidance
14:30-14:50	Veenil Ratten	Monitoring Surveys - Climate and Oceans Support Program in the Pacific
14:50-15:10	Camillia Garae	Estimating Rates of Shoreline Retreat for Mele Bay and Teouma Bay
15:10-15:30	Wolf Forstreuter	Mapping African Tulip with WoldView-2 Image Data
15:30-15:50		Afternoon Coffee

#### Session 04 Climate Change, Oceans and GIS and Remote Sensing

Chair: Paul Taylor (SPC-DRP, Fiji)

15:50-16:10	Sara Beavis	Natural Resource Management Using a Consultancy Approach to Undergraduate Education: Linking Student Learning and Stakeholder Needs
16:10-16:30	Shayal Kumar	Marine Habitat Mapping of Komave on the Coral Coast in Fiji
16:30-16:50	Mika Seru & Marika Rotova	Relocation of Narikoso, Ono Kadavu Island Group
16:50-17:20	Lalit Kumar	Use of GIS and Remote Sensing for Risk Assessment Related to Climate Change in the Pacific
19:00-21:00		Welcome Reception (hosted by Government of Fiji)

**Tuesday 27 June 2017**

**Session 05 Geo Resources, Land Use and Maritime**  
**Chair: Akuila Tawake (SPC GSD, Fiji)**

08:40-09:00	Tomoko Kakee	Marine Governance and the use of International Standards
09:00-09:20	Onesimo Fonmanu	Sinkhole Incident at Vatukola Gold Mine Limited
09:20-09:40	Erick Kowa	Regional supply of LPG to the Pacific Islands from Papua New Guinea
09:40-10:00	Filimoni Yaya	Pacific Regional Maritime Boundaries
10:00-10:20	Morris Harrison	Towards an Integrated Tsunami Warning System for Port Vila and Luganville, Vanuatu
10:20-11:00		Morning Coffee

**Session 06 Hydro Geology**  
**Chair: Shaun Williams (NIWA, NZ)**

11:00-11:20	Anesh Kumar	Elevation Surveying Application for Groundwater Investigation
11:20-11:40	Andreas Antoniou & Erie Sami	Hydrogeology of West Ambae, Vanuatu as inferred by geo-electrical resistivity survey
11:40-12:00	Amini Loco, Jiutiti Vono & Ilaitia ulai	Groundwater Exploration in Disaster-prone Communities in NW Viti Levu Using Electrical Resistivity
12:00-12:20	Philip Yasiro Irarue	A Preliminary Geophysical Reconnaissance Mapping of Emirau Ground Water Resources, Emirau Island, New Ireland Province PNG
12:20-12:40	Pilia Niru	Challenge of Developing Ground Water Project Along Fault Line Boera Ground Water Project, PNG
12:40-13:00	Peter Sinclair	Water Security in Atolls Through Improved Groundwater Management
13:00-14:20		Lunch

**Session 07 Geo Resources**  
**Chair: Rajeli Taga (MRD Fiji)**

14:20-14:40	Russell Howorth	The Neglected Georesources: Their Current and Future Value to Sustainable Socioeconomic Development in the Pacific Islands
14:40-15:00	Christine Prasad	Baseline Assessment of Development Mineral in Fiji
15:00-15:20	Robert Smith	The Navua River Basin: A Pandora's Box for Sand and Gravel Extraction
15:20-15:40	Venasio Nasara	Licensing and Monitoring Framework for Development Minerals Extraction in Fiji.
15:40-15:50	Sung Yoon	Biofuel Plant Briefing
15:50-16:10		Afternoon Coffee
16:10-17:30	Russell Howorth & Akuila Tawake	Geo Resources Working Group

**Wednesday 28 June 2017**

07:30-17:00		Field Trip
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**Thursday 29 June 2017**

**Session 08 Ocean Islands Volcanism**  
**Chair: Camillia Garae (Geology & Minerals Unit, Vanuatu)**

09:00-09:20	Károly Németh	Volcanic Geoheritage of the SW Pacific and its Role for Sustainable Development Programs with Strong Influence of Indigenous Knowledge
09:20-09:40	Paul W Taylor	The 1943 Eruption of Niuafu'ou: An Eruption Chronology and the Effects of Volcanic Pollution as Provided by Local Informants
09:40-10:00	Gary McMurtry	Field-Portable Helium Isotope Detector for Continuous Monitoring of Volcanic Unrest and Large Earthquakes: a Development Update
10:00-10:20	Károly Németh	Phreatomagmatic Volcanic Hazard in Rift Edge in Coastal Regions of Volcanic Islands
10:20-10:40	Paul W Taylor	Submarine Volcanic Activity in the SW Pacific: Looking in the Right Place at the Right Time
10:40-11:00	Gary McMurtry	Volcanic Gas Analytical Monitor (VGAM): Compact and Low Power Mass Spectrometer-based Instrumentation for Volcanic Gas Monitoring
11:00-11:20		Morning Coffee
11:20-12:40	STAR Chair	STAR Annual Business Meeting
12:40-14:00		Lunch

**Session 09 Science and Risk Assessment Issues**  
**Chair: Gary McMurtry (SOEST, Hawaii, USA)**

14:00-14:20	Kevin Maitava	The Pacific Science and Technology Advisory Group (P-STAG)
14:20-14:40	Shaun Williams	Partnerships in the Pacific: Aligning Multiple Risk Assessment Tools for Evidence-based Decision Making
14:40-15:00	Craig Arthur	Enhancing Disaster Response Planning with Impact Mapping Tools
15:00-15:20	Ranasinghe Amaradasa	Some analysis of scientific publications in Pacific Island Countries
15:20-15:40	Keleni Raqisia	Pacific Regional Navigation Initiative: Data Management
15:40-16:20		Afternoon Coffee
16:20-17:30	Sara Beavis & Russell Howorth	Education Working Group
19:00-21:00		Informal Closing Refreshments

*All times are approximate*

**Session 10 Posters**

Károly Németh	Samoa Geopark Project: A Strategic Plan to Promote the Volcanic Geoheritage of Savai'i Island, Samoa
Mika Seru	Relocation of Narikoso, Ono Kadavu Island Group
Sereima Dibula	Mine Land Rehabilitation @ Naibulu Bauxite Mine, Bua, Vanua Levu, Fiji Islands
Wonkook Kim	GI-JOON (Global Insitu Joint Ocean Reference Network) for GOCI and GOCI-II
Sandip Chand	Inundation Survey on Koro Island following Tropical Cyclone Winston
David Heron	Hazard and Risk Mapping in Vanuatu – Developing Safer Communities – A year on
Jonati Railala	Posters on Groundwater Development and Reticulation work on Navakawau Village, South Taveuni to mitigate water problem.
Biljana Lukovic	Rock fall and cliff-collapse hazard and risk in the Port Hills following the 2011 Christchurch earthquake
Sandip Chand	Geotechnical Assessment: Landslide Assessment for Qamea Island, Taveuni, Fiji Islands

**# Working Groups not included in the above agenda may be convened at suitable times following the end of each day's sessions**

## Abstracts of Papers

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AHN

### Development Status and Mission Operation Plan of GOCI-II

***Ki-beom Ahn<sup>1,2</sup>, Seongick CHO<sup>1,2</sup>, Eunsong Oh<sup>1,2</sup>, Heejeong Han<sup>1</sup>, Wonkook Kim<sup>1</sup>, YoungJe Park<sup>1</sup>***

<sup>1</sup> Korea Ocean Satellite Center, Korea Institute of Ocean Science & Technology, Republic of Korea,

<sup>2</sup> Space Optics Laboratory, Dept. of Astronomy, Yonsei University, Korea

GOCI-II (Geostationary Ocean Color Imager-II) is the next generation of GOCI, which was the first ocean color imager in the world operating on the geostationary orbit. GOCI has been monitoring ocean color around the Korean Peninsula in order to detect, monitor, quantify, and predict short term changes of coastal ocean environment for marine science research and application purpose. GOCI-II has improved radiometric and geometric performance in comparison with GOCI. GOCI-II is a multi-spectral imaging radiometer in order to observe ocean color around the Korean peninsula and to cover full earth disc even if the platform does not provide a pitch/roll tilt. It acquires data in 12 VNIR spectral bands (370~885nm) with a spatial resolution of about 250m GSD (Ground Sampling Distance) at nadir. GOCI-II will be operated at the same orbital position (128.2°E Longitude in geostationary orbit) with GOCI.

GOCI-II mission operation mode consists of Global (Full Disk) mode, Local mode, Star imaging, Moon imaging, and Solar Calibration. Global mode is new capability of GOCI-II for global monitoring and research on the long-term climate change. Observation area of the global mode is a circle field of  $\pm 60^\circ$  longitude and latitude central to the spacecraft nadir. Full disk will be accumulated a image during 1 day. GOCI-II also operated in user-definable LA mode. The user of GOCI-II can select the observation local area within the full disk area. Full Disk (FD) and user-defined Local Area (LA) observation mode of GOCI-II is implemented for the ocean observation over clear sky without clouds and special ocean event area over specific region in anytime and anywhere.

For the moment, GOCI-II is planned to observe the Pacific Islands area once per day, but more frequent observations can be discussed. In this conference, we present the potential application of GOCI-II for the Pacific Islands in the frame of the international cooperation between Korea and the Pacific Islands.

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AMARADASA

### Some Analysis of Scientific Publications in Pacific Island Countries

***Ranasinghe Amaradasa and Danian Singh***

*The University of Fiji, Lautoka, Fiji.*

The attributes connected to science & technology in the Pacific Island Countries (PICs) such as existing potential, trends and directions of scientific research can be assessed by investigating the scientific publications generated within the region. An attempt was made to analyse the scientific publications from PICs during last six years and measure the volume and trend of publications, features of co-authorship, and the level of citations received for those publications. The information available in the "Scopus" database was used to conduct those analysis.

The analysis indicates a positive growth in number of scientific publications in the PICs. Fiji, PNG and New Caledonia dominate the volume of scientific publications, but limited to few scientific disciplines such as medical sciences, biological sciences and agriculture. The level of co-authorship is highly skewed towards neighboring two big brothers in the region. The citation analysis which is an indicator for quality of research publications provides evidence for the existence of high quality research in few selected areas. A samples data set from PNG shows an average of six or more citations within first three years after publication in bio-medical and chemistry disciplines whereas the average figure for publications in environment science and earth sciences reach above three. Except in medical sciences, all other disciplines show more than one year delay in citations from the year of publication.

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ANTONIOU

### **Hydrogeology of West Ambae, Vanuatu as Inferred by Geo-electrical Resistivity Survey**

**Andreas Antoniou<sup>1</sup>, Peter Sinclair<sup>1</sup>, Aminisitai Loco<sup>1</sup>, Erie Sam<sup>2</sup>, Anesh Kumar<sup>1</sup>**

<sup>1</sup>*Water and Sanitation Programme, Geoscience Division, Pacific Community, Suva, Fiji,*

<sup>2</sup>*Vanuatu Department of Water Resources, Vila, Vanuatu.*

As part of the resilience-building component of SPC's recovery support for Tropical Cyclone Pam in collaboration with Vanuatu's Department of Water Resources, geophysical surveys were carried out using electrical resistivity in the N'dui and Walaha districts of West Ambae, Vanuatu, for the identification of exploitable groundwater targets and of potential drilling sites.

In the absence of drilling and subsurface information in general, survey locations were selected based on surficial features including eruptive cones and fissures, and lineaments with the potential to cause high-elevation groundwater impoundment. In addition, geological maps were used to infer locations where groundwater may occur at relatively shallow depth along contacts between lava flows of different age. Ten geo-electrical transects were performed (> 5 km total length) allowing for the 2D representation of the spatial distribution of electrical resistivity up to 90 m depth.

The interpretations suggest a limited presence of localized aquifers, either impounded within fractured basalt or perched due to the presence of impervious formations like ash or tuff layers between lava flows. The presence of springs at higher elevations supports the conceptual model of perched aquifer systems while the existence of brackish water springs along the coast suggests that infiltrating rainwater finds its way through the fissured basaltic lava flows and highly porous scoriae and eventually discharges into the sea. The small number and limited extent of identified potential targets highlights the value of performing detailed resistivity surveys prior to any drilling operations to minimize costs and risks associated with "wildcat" drilling.

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ARTHUR

### **Enhancing Disaster Response Planning with Impact Mapping Tools**

**Craig Arthur<sup>1</sup>, Saane 'Ake<sup>2</sup> & Sachindra Singh<sup>3</sup>**

<sup>1</sup>*Community Safety Branch, Geoscience Australia, Canberra, Australia,*

<sup>2</sup>*Building Safety and Resilience in the Pacific, NEMO, Tonga,*

<sup>3</sup>*Geoscience Division, Pacific Community, Suva, Fiji*

Natural hazards are a part of life in the Pacific region, and to assist communities to strengthen their resilience to disasters, the Australian Government is collaborating with SPC and partner countries to develop and deploy the PacSAFE impact mapping tool. PacSAFE combines spatial hazard and exposure data to produce realistic disaster impact scenarios, in an easy-to-use software and data

package. PacSAFE supports users to make informed decisions for disaster response, and to develop evidence-based policies for enhanced disaster resilience.

In the first stage of the project, Geoscience Australia and SPC held a PacSAFE Training Workshop, hosted by NEMO (Tonga) to provide Tongan government officials with an introduction to the PacSAFE tool, to assist with those agencies in supporting disaster management. Through the week-long training, representatives from NEMO, MAFFF, Tonga Met Service, Statistics Department, Natural Resources Division, Ministry of Lands and MEIDECC were guided through installation, running and interpreting the maps and reports generated from a number of disaster scenarios.

In this presentation, we will highlight the maps and reports generated by participants using the packaged disaster scenarios and exposure data delivered with PacSAFE, including the tailored needs requirements reports. We will also highlight key recommendations from participants and facilitators for future training sessions, and developments to the PacSAFE application.

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BEAVIS

### **Natural Resource Management Using a Consultancy Approach to Undergraduate Education: Linking Student Learning and Stakeholder Needs**

**Sara Beavis**

*Fenner School of Environment and Society, Australian National University, Canberra, Australia*

Natural resource management in an increasingly uncertain world involves highly complex planning and decision making. This complexity imposes boundaries on how much can be achieved by key stakeholders due to the limits on funding and human resources. However, educators are developing and engaging in research-active curricula that help tertiary students to understand, and to be better prepared professionals in, natural resource management from both disciplinary and inter-disciplinary perspectives. In step with this educational approach, we have developed a 'consultancy approach' to teaching water resources management. This engages students in authentic field-based research that links them with key stakeholders who are faced with management issues for which they have limited resources. The learning that takes place is student-centred, exposing them to the realities of what it is like to be a working professional. On the other hand, stakeholders are provided with reliable data and high quality reports which can inform their decision making. This partnership between universities and government, NGOs and community groups has dual benefits to undergraduate learning and on-ground planning and management. This model can be applied across different fields of natural resources management and provides a unique opportunity for capacity building.

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BLACKA

### **Considerations for the Design of Rock Armoured Coastal Protection on Fringing Reef Coastlines**

**Matt Blacka<sup>1</sup>, Kristen Splinter<sup>1</sup> and Rebecca Killalea<sup>2</sup>**

*<sup>1</sup>Water Research Laboratory, School of Civil and Environmental Engineering, UNSW Sydney, NSW 2052, Australia,*

*<sup>2</sup>Aecom, Sydney, Australia.*

The wave climate on coastline of many Pacific Islands is mediated by fringing coral reefs that naturally reduce wave conditions impacting the coast. However, during extreme swell and cyclonic wave conditions larger than expected waves have been seen to travel across reefs/lagoons as a result of the steep bathymetric profiles that are often immediately seaward of the fringing reef, and

complexities of infragravity waves generated within the reef and lagoon systems. Historically these issues have contributed to the significant damage caused by large wave and storm surge events.

There are many applications of rock armoured seawalls and breakwaters around the Pacific, which have been built to provide protection from waves and storm surge for coastal infrastructure such as ports, roads and airports, as well as low-lying coastal communities. Despite this very important role, information on the design of coastal protection specifically for these “fringing reef” coastlines is almost non-existent. The methods available to engineers for designing coastal protection structures were not intended for these coastline types and their applicability when shallow water bore waves and infragravity surges dominate is unknown. This leaves more uncertainty and risk in the design of coastal protection for many coastlines of the Pacific Islands, with the potential for over or under conservative designs.

This presentation summarises the results of a wave flume physical modelling investigation undertaken at the UNSW Water Research Laboratory, which set out to explore the applicability of available design methods for coastal protection structures on reef mediated coastlines. The investigation considered a range of rock armoured slopes typical of seawalls and breakwaters found on the coast of many Pacific Islands, with comparisons between observed rock armour damage in the model and that predicted by available design methods. Preliminary guidance will be provided on the suitability of available design methods for rock armoured coastal protection when applied to reef-type situations.

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CHAND

### **Inundation Survey on Koro Island Following Tropical Cyclone Winston**

***Sandip Chand and Rigieta Ravuisasa***  
*Mineral Resources Department, Suva, Fiji*

Category 5 Tropical Cyclone Winston hit the Fiji Group on 20<sup>th</sup> February 2016. Koro Island was one of the most affected areas in the country following the aftermath of the cyclone.

Koro Island is the second largest island in the Lomaiviti Group. It is 16 km long from north to south and about 9km in width at the northern coast. It is 104km<sup>2</sup> in area with a quarter of its land mass lying above 300 m. Several peaks on the island are above 500 m with the highest point at 522 m above sea level. Koro Island has a total of 14 villages with seven villages located on the eastern side and the remaining seven located along the western side of the island.

The villages located along the eastern side of the island namely; Mudu Village, Nakodu Village, Namacu Village, Sinuvaca Village, Nasau Village, Tuatua Village and Nacamaki Village were all inundated with storm surge waters and strong winds during the cyclone. The villages located on the western part of the island namely; Vatulele Village, Nabuna Village, Tavua Village, Navaga Village, Kade Village were not inundated by storm surges but were affected by the strong winds. The devastating effects of the cyclone; uprooted trees, destructed buildings and houses, barren hills and slopes were evident when the team visited the island after the cyclone had passed.

Inundation survey was carried out as relocation was proposed for the 13 villages on Koro Island; as all these 13 villages are located along the coastline. In relocating the villages, it was critical that the villages be relocated to stable and elevated ground not prone to inundation from storm surge waters or from flooding by nearby creeks or rivers.

Detailed geohazard mapping, inundation survey and aggregate survey were carried out to ensure the villages on Koro Island were successfully relocated.

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CHAND

### **Geotechnical Assessment: Landslide Assessment for Qamea Island, Taveuni, Fiji Islands**

**Sandip Chand, Samisoni Raiwalui, Iliesa Bacita, Keresi Tuimanono & Agnes Hansen**  
*Mineral Resources Department, Suva, Fiji*

In the 2016/2017 cyclone season, Fiji was continuously affected by tropical disturbances and depressions. From the 12th to the 18th of December, 2016, Tropical Depression (TD04F) brought heavy rain that affected much of the country. Qamea Island, off the east coast of Taveuni, was one of the most affected islands due to the heavy downpour with widespread landslides affecting all villages on the island. In response, the government deployed a multi-agency team to attend to the urgent needs of villagers. An urgent request was made to the Department to conduct geohazard assessments for the affected villages and settlements.

Qamea Island is situated within a reef system that extends 2 km east-northeast of Veitalacagi point on Taveuni. The island has an area of 31 km<sup>2</sup> and is separated from Taveuni by a 2.7 km wide channel. The island is characterized by high hills (some 300 meters in height) and steep valleys. The central and western parts of Qamea represent the deeply eroded remnants of the western of two Pliocene volcanic cones that originally formed what are now Qamea and Laucala (Woodhall, 1998).

Qamea Island comprises lava flows in most exposures, which consist of interlayered units of grey massive lava and reddish-grey autoclastic breccia. The autoclastic breccia is composed of compact, angular to sub-angular, highly vesicular pebble and cobble-sized fragments. The prolonged rainfall, loose soil material, highly weathered geology steep topography and subsistence farming along the slopes all contributed to the severe landslides around Qamea.

Hence, it is recommended that the affected areas be revegetated with vertiver grass and large trees for soil stability. Also, buffer zones were marked out to relocate households as these were of high risk to future landslides. Furthermore, waterways have been created by the failures and these are to be trenched well to channel water away from the village and prevent future flooding issues. In addition, restrictions are to be placed on any farming activity on the ridges adjacent to any settlements as it has disturbed the overburden soil. All in all, it is highly advised that the recommended mitigation measures are strictly adhered to.

#### ***Bibliography:***

Woodhall, D. (1998). *Geology of Taveuni, Qamea, Laucala, Cikobia and nearby islands*. Suva, Fiji: Mineral Resources Department. Bulletin No. 6.

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CHAND

### **Projected Changes in El Niño-driven Tropical Cyclones in the Pacific**

**Savin Chand**

*Faculty of Science and Technology, Federation University Australia, Victoria, Australia*

Tropical cyclones are generally projected to become more intense but less frequent in a warming world. However, recently published research in *Nature Climate Change*, led by Dr Chand, found that this is not necessarily the case during future El Niño years. Despite the overall decrease in future tropical cyclone frequency, some areas of the Pacific (including Fiji, Vanuatu, Marshall Islands and Hawaii) will experience more tropical cyclones during future El Niño years than current El Niño years. This result has important implications for climate change and adaptation pathways for vulnerable Pacific Island nations.

Results from this *Nature* publication, as well as future research in this area, will be discussed in this presentation.

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DES COMBES

### **The Pacific Science and Technology Advisory Group (P STAG)**

***Helene Jacot Des Combes<sup>1</sup>, Sarah Hemstock<sup>2</sup>, Timothy Wilcox<sup>3</sup>, Paul Taylor<sup>4</sup>, Clare White<sup>4</sup>***

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The Sendai Framework for Disaster Risk Reduction 2015-2030, adopted at the Third UN World Conference on Disaster Risk Reduction held in Sendai Japan on March 2015, recognises the importance of science and technology, calling to "*Enhance the scientific and technical work on disaster risk reduction and its mobilization through the coordination of existing networks and scientific research institutions at all levels and all regions with the support of the UNISDR Scientific and Technical Advisory Group...*"

To meet this requirement of the Sendai Framework, to ensure evidenced based implementation of the FRDP and to serve the needs of Pacific countries, territories and stakeholders more directly, following the example of the Science and Technology Group and of the Asian Science and Technology Academic Advisory Group, the Science and Technology for DRM community in the Pacific region is organising itself into a Pacific Science and Technology Advisory Group (PSTAG). The PSTAG will include members from different organisations and institutions and cover different disciplines

The principal goal of the Pacific Scientific and Technical Partnership and its Advisory Group (PSTAG) is to establish a voluntary group to provide scientific and technical support to the Pacific Island countries and territories (PICTs) for the implementation of the Sendai Framework, FRDP and other like frameworks and to advise UNISDR on S&T issues in the region

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DIBULA

### **Mine Land Rehabilitation @Naibulu Bauxite Mine**

***Sereima Dibula***

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Mining causes the destruction of natural ecosystems through removal of soil and vegetation. The restoration of mined land in practice can largely be considered as ecosystem reconstruction — the reestablishment of the capability of the land to capture and retain fundamental resources.

The rehabilitation of land disturbed by mining is a statutory requirement as in Environment Management Act 2005 and Mining Act Cap 146. Effective rehabilitation is essential for maintaining a 'social licence to operate'. It reduces risk for mining companies by minimising residual risk payments, reducing administrative uncertainties at closure and creating an agreed transition to post-mining landscapes.

In Fiji, bauxite mining apart from the Vatukoula Gold Mine which is an underground mine is operating as an open pit mining. There has been two (2) lease issued for bauxite mining both in Bua. With the

surface removal of soil, the topmost part is stripped of vegetation thereby resulting to soil erosion during rainy season. This then sets the soil particles and associated minerals to eventually reach the freshwater and marine water bodies nearby. As soil erosion continues, the waters in the seas and river systems adjoining the mine areas appear red. This invites criticisms from the environmentalist groups, fearing that the continued mining operation can disrupt the natural dynamics in the area.

Rehabilitation work at the first bauxite mine site is progressing as the mining method was soil excavation/stripping which was later shipped to China for processing. With the 2 new sites, bauxite is washed on site and water and sediment ponds with red water/mud discharging into the river system. Construction of sediment pond with no proper geotechnical assessment will have an impact on the planning of the rehab work to be carried out. In terms of heavy metal contamination (physical and biological environment), types of vegetation suitable for the area after its completely mined out, research study ; mine rehab design to be stable, research work non - polluting, safe and acceptable to end users. The fear is the impact of the mining and the rehabilitation work to suit the environment and be acceptable to the local community.

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FONMANU

### **Sinkhole incident at Vatukoula Gold Mine Ltd**

***Onesimo Fonmanu & Ratu Seone Lum***

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This report aims to highlight the sinkhole incident that occurred at Vatukoula Gold Mines Limited mine site on 6<sup>th</sup> February 2017. At approximately 12:50 pm on the day, a sinkhole was created near Freddy's crossing. Whilst driving along the bypass, Mr Kamal Singh drove his vehicle into the sinkhole as the ground gave way. A team from the Mineral Resources Department was sent to the scene to conduct an investigation on the cause of the incident. The results of the investigation show that the sinkhole was created due to a ground failure at 3 Level working areas directly below. The ground failure occurred due to periodic water seepage into the 3 Level working areas from the Veiquwawa Creek. Recommendations were given to the company by the Department on how to address the sinkhole issue. The company has chosen to divert the creek from the sinkhole area as their long term remedial measure. However, continuous monitoring of surface run-offs to the problem area will need to be conducted by the company to ensure that no further sinkholes are created.

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FUKUSHIMA

### **Appropriate Environmental Impact Assessment Technologies for Seabed Mining**

***Tomohiko Fukushima***

*Japan Agency for Marine-Earth Science and Technology, Japan*

Interest is growing in seabed mineral resources and private enterprises as well as governmental organizations are beginning to develop them. Along with this, more applications for development of new areas beyond national jurisdiction (ABNJ) have been submitted to the International Seabed Authority (ISA). In response to these developments, appropriate environmental impact assessments technologies (EIA technologies) are required. However, the word "appropriate" includes various meanings. From the standpoint of contractors with ISA, needless to say validity and economic rationality is important. On the other hand, as resources in ABNJ are the common heritage of mankind (CHM), methods that can be applied only by advanced countries do not follow the ideals of the United Nations Convention on the Law of the Sea (UNCLOS). In addition, considering the international trend towards raising bar for the environmental protection, EIA technologies needed to

consider accuracy and precision. Given those circumstances, the present author discuss about important concepts for appreciate EIA technologies, such as objectivity and reliability of data, working efficiency and technical feasibility, and then provide technical information of a long-term seafloor observation system, metagenomics analysis and imaging flow cytometry, which are developed by Japanese governmental project named the Cross-ministerial Strategic Innovation Promotion Program (SIP).

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GANILEO

### **Land Use and Infrastructure Development on Pacific Islands: The Case of Vanuatu**

***Williams P. Ganileo***

*Ministry of Lands, Port Vila, Vanuatu*

Most land use types in our island states do not reflect the land policy types found within an island or our country. This has caused land degradation and more so, the impacts that have continued to cause climate changes in our country and worldwide. In Vanuatu, infrastructure development, land use types within the rural and urban are done on improper planning without due knowledge of soil types, land policy, vegetation, topography, environmental built up and microclimates that contributes to the changes that may cause effects on the environments.

Climatic conditions in the Pacific Island have a lot of effects on the development types we produce. For the country to experience a minimal effect to its national developments, the development proposals rest on better planning that requires a holistic design that requires a broad analysis of the effects that may cause to the development and or land use types. For a better approach to a land use type, a process is required for our country the requires a need for good analytical process that includes Remote Sensing, GIS analysis of the areas on spatial data for both vector and raster to ensure, mathematical analysis that will prove what development type could we provide that does not have effects on the landscape and environments. It will be only this way that we can lessen the effects of degradation which in return will minimise the effects of El Niño in Vanuatu and across the Pacific Rim.

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GARAE

### **Estimating Rates of Shoreline Retreat for Mele Bay and Teouma Bay**

***Camillia Garae***

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Coastal erosion is evident along some of the shorelines of Efate Island in Vanuatu particularly Mele Bay and Teouma Bay. The effect of the phenomena poses a hazard to people living close to these coastal areas. To identify the relative risk along the shorelines of these areas, it is useful to determine the rate of shoreline retreat.

This study determined the shoreline changes between 1962, 1986 and 2012 of Mele Bay and changes between 1972, 1986 and 2012 at Teouma Bay. A combination of aerial photograph analysis and the use of software called Digital Shoreline Analysis System (DSAS) on Arc GIS were used to determine long term rate of retreat. The aerial photographs were scanned, geo-referenced and the shoreline digitized. This followed the application of DSAS software to generate intersection points and compute the data. Although the method was used for determining the rate of retreat, there were challenges encountered. The edge of vegetation cover is usually difficult to determine from aerial

photographs due to the shadows obscuring the ground surface. Thus, only areas of clear defined vegetation edge were digitized.

The results obtained from DSAS analysis produced a rate of retreat of -0.2 m /year for Mele Bay and a rate of -1.1 m /year for Teouma Bay. The likely causes of rapid rate of shoreline retreat are due to increase in sand mining over the past years to support the growing infrastructures being built in Port Vila. Mele Bay and Teouma Bay are the two main sand source supplies for Port Vila. The Government has taken some control measures by including some policy directions in the Vanuatu National Environment Policy and Implementation Plan for 2016-2030. The Policy target is that by 2020 there is a ban on commercial coastal sand mining

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GAUNAVOU

### Mapping African Tulip with WoldView-2 Image Data

**Litia Gaunavou and Wolf Forstreuter**

*Geoscience Division, Pacific Community, Suva, Fiji.*



African tulip in Fiji during flowering

**Background:** African tulip (*Spathodea campanulata*) is an invasive species with African origin and most probably was introduced to Fiji as ornamental tree for his red flowers. African tulip tree cover is growing in Fiji, it populates abandoned grazing land and forest openings after logging. There are two reasons to map areas where African tulip has high percentage of the species composition. (i) These areas can be indicators of forest degradation. Forest degradation is difficult to map directly in opposite to deforestation. Deforestation is clearly visible with very high resolution image data such as WorldView-2, WorldView-3 or WorldView-4. African tulip as secondary species will indicate forest degradation. (ii) Fiji Government is working with a Korean investor to develop wood pellets using the African tulip. Pellets are highly compressed wood products that are used to fuel power plants to generate energy and heat. An African tulip inventory is currently carried out in Sigatoka and East Viti Levu. The inventory needs maps at 1:10,000 scale level indicating African tulip dominated areas within the forest cover.

**Mapping with WorldView Image Data:** In Fiji, African tulip flowers from August to December and during this time the colour of the flowers indicate the species in the visible bands of the satellite images allowing a clear delineation of African tulip groups within the other forest cover. However, due to frequent cloud cover the time window of August to December is not sufficient to capture data for all areas in Fiji. Mapping outside the flowering season is important. The mapping at 1:10,000 scale is performed with WorldView-2 and WorldView-3 image data, which are



The leaves of the African tulip must have a different spectral signature to

identical in the visible and near infrared range and utilised for the mapping. In difference to other very high resolution image data such as GeoEye or Pleiades, WorldView data has an additional narrow channel in the beginning of the infrared portion called red-edge. This channel or band could allow the separation of African tulips by its leaf reflectance only.

For an area near Sigatoka no very high resolution image data was available recorded during the flowering season. Areas were identified at 1:50,000 scale using Landsat 8 data recorded in 2012 during the flowering season. The areas were then delineated at 1:10,000 scale level using

WorldView-3 data outside the flowering season. African tulip was visible with this data in the red edge band combination green, red, red edge. The reflectance graph shows that a separation is possible utilising the red edge band. The mapping results are currently verified by field teams. The first investigations also show that the second infrared band is suitable for separation. A band which only is available at 1:10,000 scale level from the WorldView satellites. The additional employment of this part of the spectrum will be investigated.

**Results:** At this stage a mapping verification is not available yet, however, it seems that the spectral leave signature allows a mapping outside the flowering season. The investigation will provide quantitative results how far the mapping with WoldView data is applicable.

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HARRISON

### **Towards an Integrated Tsunami Warning System for Port Vila and Luganville, Vanuatu**

***Morris J Harrison<sup>1</sup>, Noel Steven<sup>2</sup> and Florence Iautu<sup>1</sup>***

<sup>1</sup> *Vanuatu Meteorology and Geohazards Department,*

<sup>2</sup> *National Management Disaster Office*

Through the Mainstreaming and Disaster Risk Reduction Project in Vanuatu, the Vanuatu Meteorology and Geohazards Department, and the National Disaster Management Office are establishing an integrated end-to-end Tsunami Warning System for the 2 main urban centers of Port Vila and Luganville. The project has installed more than 300 Tsunami Evacuation Signs and 126 Tsunami Information Boards in Port Vila and Greater Port Vila, and in Luganville and Greater Luganville areas. 19 Tsunami sirens were installed as part of the project to enhance the Tsunami Early Warning System for the 2 municipalities and surrounding areas; 9 sirens were installed on South Efate to gather for Port Vila and Greater Port Vila communities, and 10 sirens installed on and offshore South Santo to gather for Luganville and Greater Luganville communities. Tsunami Evacuation Maps are produced for communities in Port Vila and Greater Port Vila, and those in Luganville and Greater Luganville. A total of 67 Tsunami Evacuation Maps are produced; 38 maps for communities in wards and area councils in Port Vila and Greater Port Vila, and 29 maps for those in Luganville and Greater Luganville wards/area councils. Tsunami Response Plans for different levels of authority (Provincial/Municipality, Area Council/Ward and Community Disaster Committees) in the 2 project sites are being developed to be trialed out in upcoming Tsunami Simulation Exercises. The project is the first of its kind in Vanuatu to pilot an integrated end-to-end Tsunami Warning System for the 2 main Urban Centers.

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HERON

### **Hazard and Risk Mapping In Vanuatu: Developing Safer Communities – A Year On**

***David Heron<sup>1</sup>, Biljana Lukovic<sup>1</sup>, Graeme Smart<sup>2</sup>, Doug Ramsay<sup>2</sup>, Graeme Roberts<sup>3</sup>, Lesley Hopkins<sup>3</sup> & Sylvain Todman<sup>4</sup>***

<sup>1</sup> *GNS Science, New Zealand,*

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The Republic of Vanuatu, like many other Pacific Island states, has experienced many significant natural hazard events that have killed people and destroyed housing and infrastructure. Previous studies of hazard and risk in Vanuatu were aggregated to a level not useful for informing local decision making. To help address this, the Mainstreaming Disaster Risk Reduction Project, funded

by the Government of Japan through the World Bank and implemented by the Vanuatu Meteorology and Geo-Hazards Department (VMGD), included the Risk Mapping and Planning for Urban Preparedness (RMPUP) Project. GNS Science, NIWA and Beca undertook the RMPUP Project between March 2015 and August 2016 to take the existing science and make it more useable for planning and risk reduction purposes. The project focus was the greater Port Vila and Luganville areas.

The RMPUP project focused on five natural hazards: earthquake, flood, wind, coastal inundation and tsunami. The key objective of the project was the development of “realistic” “science-based” hazard models to inform planning and risk reduction activities.

Based on the hazard models, risk maps were created for use by planners and other key stakeholders. Conventional risk maps show unsettled areas as having no risk, as risk is deemed to occur only where a hazard is present at a location occupied by people or property that are vulnerable to that hazard. Such maps have little use for informing planners who want to assess land that could be potentially settled with the minimum of risk. For this reason, Potential Risk Maps were produced by using an equal spread of people and buildings across the entire landscape.

As a separate exercise an Urban Risk Assessment was undertaken using the actual distribution of people and buildings. The exercise confirmed previous studies that the majority of the population of Port Vila and Luganville live with moderate or higher levels of risk from natural hazards.

The project concluded that the risk associated with each identified hazard could be significantly reduced using one or more of a number of available options, including risk-sensitive land use planning, development controls (e.g. building codes), community education, and the use of early warning systems to trigger evacuations.

Public and village consultations were undertaken by VMGD staff to disseminate the hazard and risk information and to seek input into the tsunami evacuation plans. Over 100 meetings were held and more than 5000 people attended across the two study areas. In 2017 the project was nominated for and won the Best Practice (Non Statutory) Award from the New Zealand Planning Institute.

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HOWORTH

### **The Neglected Geo-resources: Their Past, Current and Future Value to Sustainable Socioeconomic Development in the Pacific Islands**

***Russell Howorth***

*Matadrevula Advisory Services, Fiji*

The Pacific Islands are rich in geo-resources, many of which are neglected (forgotten or overlooked) by society today. At the same time many of these resources have a value that is ignored or grossly underestimated in the context of their importance to future sustainable socioeconomic development in Pacific Islands.

Some of these geo-resources have very real traditional/cultural value such as the columnar basalt used in construction of Nan Madol on Pohnpei in the FSM, or the coral limestone from Palau used as “money” in Yap.

Geo-resources have been known of and in some instances with significant export economic value and as a consequence mined and shipped off the islands for over one hundred years. These include phosphate from Nauru and Ocean Island (Banaba, Kiribati), nickel from New Caledonia and gold from Papua New Guinea, Solomon Islands and Fiji.

Oil and gas exports from Papua New Guinea, and groundwater from Fiji are relatively recent geo-resources that today figure significantly in the export earnings of those countries.

Geothermal and hydropower resources have each long been important at the local level for cooking and power, the latter is now a significant contributor to renewable energy in several countries. But the most neglected geo-resource is undoubtedly sand and gravel (commonly referred to as aggregates). This neglect is not just a symptom amongst the small island developing states here in the Pacific, but globally in most developed as well as other developing countries.

This paper will explore sand and gravel recovery and use around the region from the high volcanic islands to the low lying atoll islands. Issues to be discussed with examples include the following:

- The labelling of sand and gravel as a “low value, high volume” resource will be reviewed as it is evident that the export of sand and gravel and value added products such as concrete blocks is now taking place in increasing instances and volumes.
- The sustainable future use given traditional/cultural historic and current uses and future resource availability and demand.
- The environmental issues versus development demand and resource location, quarries, river beds, beaches, reef flats and lagoon dredging. Inevitably is there a vulnerability issue here in regard to climate change and sea level rise??
- Current and future importance to island economies given the expected growth in demand to support development and limited legislative and regulatory capacity.

The need for capacity building, particularly education at the technical level to ensure the future development of the sand and gravel sector is well managed.

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IRARUE

### **A Preliminary Geophysical Reconnaissance Mapping of Emirau Ground Water Resource, Emirau Island, New Ireland Province, Papua New Guinea**

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Resistivity surveys (vertical electrical soundings) employing Schlumberger array method were conducted over selected areas of the Emirau Island by the geophysicists from the Mineral Resources Authority (MRA) of Papua New Guinea (PNG) following the findings and recommendations of a preliminary hydrogeological investigations by the Hydrogeology section of MRA, PNG.

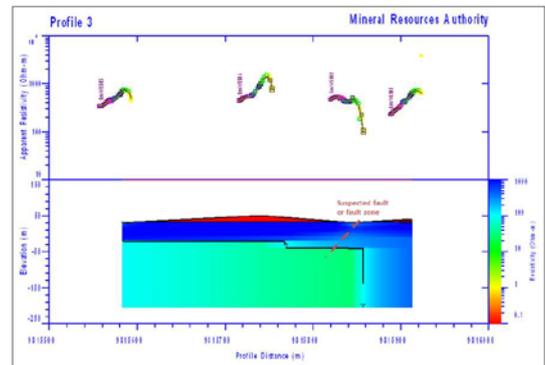
The main objectives of the resistivity surveys were:

- to understand aquifer (or ground water bearing layer) depth, thickness and distribution with respect to topography (elevation) of the island and the sounding sites.
- to understand and establish whether the ground water flow and storage on the island is structural controlled or lithological or both
- to locate potential aquifer and recommend suitable sites for test drilling based on the resistivity survey results.

A total of 18 resistivity soundings were conducted from 12 – 21 February, 2017. The sounding locations were selected in such a way that some soundings were conducted along a suspected geological structure (fault / fault zone) while others were conducted on either sides of the suspected structure and on other selected sites.

The results (subsurface resistivity section) of 1D inversions of soundings EmiVES05, EmiVES04, EmiVES03 and EmiVES02 across profile 3 revealed a distinct discontinuity (conductive pathway) beneath EmiVES03. Sounding EmiVES03 was conducted over the suspected fault / fault zone.

Other soundings (EmiVES06 and EmiVES16) conducted further south and away from the suspected geological structure also revealed a probable aquifer at relatively shallow depth and thick enough for ground water development.



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KAKEE

## Mining Governance and the Use of International Standards

### **Tomoko Kakee**

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This paper examines the use of international standards for governance in mining sector. There are not many international agreement concerning mining. Ones of those few examples are the United Nations General Assembly Resolution concerning Permanent Sovereignty over Natural Resources, and the Principle of the Common Heritage of Mankind in the United Nations Convention on the Law of the Sea. Being adapted for redistribution of global wealth from natural resources in the context of decolonization, those instruments are formulated in the state-to-state system; rights of some states and obligations of others.

However, since late 1990s, there was a shift of discussion from state-to-state system towards multi-stakeholder system due to recognition of the important role of multi-national corporations in global governance, more political influence of NGO(civil society) in the push for anti-corruptions, and more emphasis on international cooperation towards “Good governance” rather than conflict between the South and the North. With those background, there is a tendency towards more use of International voluntary Standards to give practical guidelines for countries to regulate and implement international and domestic rules to utilize benefit from mining for better economic development, and to minimize/prevent harms. Examples of those standards are Extractive Industries Transparency Initiative (EITI) and ISO standards.

The EITI was established in 2003 as a tool to improve capacity of some resource-rich developing countries to effectuate the potential of their enormous deposits of natural resources, instead struggling with growing poverty, conflict and corruption. Among Pacific Islands States, Papua New Guinea and Solomon Islands are the members. Not a binding treaty, but rather a multi-stakeholder initiative of governments, corporations and civil society, the EITI aims to increase transparency in financial transactions between governments and extractive industry corporations. To that end, the EITI requires the publication and verification of corporate payments to governments and government revenues from corporations.

ISO (International Standard Organization) is an independent, non-governmental international organization with a membership of 164 national standards bodies. At ISO/TC8/SC13/WG4, our project is participating in the discussion on standards for Marine Environment Impact Assessment. We think that ISO standard can be a good technical basis complementary to legal instruments such as ISA regulations, BBNJ and domestic legislations.

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KIM

### **GI-JOON (Global Insitu Joint Ocean Reference Network) for GOCI and GOCI-II**

***Wonkook Kim, Young-Je Park, Seong-Ik Cho, Tae-Hyun Han***

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Korean Ocean Satellite Center (KOSC), as the government-designated operating agency, has successfully operated Geostationary Ocean Color Imager (GOCI) and conducted various calibration and validation activities since its launch in 2010. Upon the launch of its successor GOCI-II, which is scheduled in 2019, KOSC is planning to establish Global In-situ Joint Ocean Reference Network (GI-JOON) over the hemispherical area of GOCI-II field of view (namely, full-disk area). The primary objective of GI-JOON is the vicarious calibration of GOCI-II radiometric data. Provided with the in-situ radiometric measurements on the ocean surface and the concurrent atmospheric measurements towards the GOCI viewing angle, at-sensor top-of-atmospheric radiance of GOCI-II can be simulated for each station of GI-JOON. By calibrating the difference between the simulation and the measured radiance, radiometric quality of GOCI-II can be satisfied.

KOSC plans to install multiple stations for the GI-JOON, both in Korean seas and in the international areas including Fiji. The domestic network will start from KIOST-owned facilities in Tong-Young, Ullueng Island, and the international network will be inaugurated based upon the success in the domestic stations. Candidates for the international stations include Fiji, State of Chuuk, where collaboration with KIOST is ongoing, and other countries who have interested in join exploitation of GOCI-II data such as Australia and Philippines.

GI-JOON stations in Fiji is extremely valuable for GOCI-II because Fiji is located in the rim area of GOCI-II field of view, which have extreme viewing geometry with very high viewing zenith angle. Data processing such as atmospheric correction and bidirectional reflectance correction tends to have higher uncertainty in such high zenith angle case, making the overall quality of the image in the rim area relatively poor than the center area around the nadir point. Installation of GI-JOON station will greatly enhance the usability of GOCI-II data for many countries particularly in the Pacific Ocean.

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KOSHIKAWA

### **Onboard Ecotoxicological Technique to Qualify Surface Water Safety during the Full-Scale Mining Operation of SMS Deposits**

***H. Koshikawa, T. Yamagishi, S. Fuchida, N. Tatarazako & M. Kawachi***

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Seafloor mining process with the recovery of the hydrothermal ores to the mining support vessel would be well-designed to minimize environmental impacts. However, there is a risk of accidental spillage or leakage of both the recovered ores and mining wastewater on the ocean surface from the support vessel or during the reshipment of the ore from the support vessel to the transport ship. During these processes, one of the environmental concerns caused by accidents is the release of environmental toxicants, such as toxic metals derived from the ore and artificial chemicals if used, in natural seawater and their adverse effects on the marine ecosystem. Hence, a scheme for constant monitoring of water quality, in particular for the levels of toxic substances, should be introduced at each deep-sea mining site. The ISA guidelines (ISBA/19/LTC/8) also state that a rapid assessment of ore and plume toxicity onboard the survey/support vessel using an approved assay during both the exploration and exploitation phases is recommended.

We think “bioassay” is one of the effective technologies for that purpose. The water quality management systems with “bioassay” such as WET, DTA, and WEA are recently becoming popular worldwide especially for evaluating and regulating effluents from factories/sewage plants. Besides, the latest MIDAS report (2016) for policy makers and future regulations raises the subject of ecotoxicology among the EIA issues.

In this presentation, firstly, we introduce our scientific research results about the release potential of metals and metalloids from mineral particulates and the impact of the leaching metals on marine phytoplankton communities. Secondly, based on our results, we propose a small and rapid bioassay system, though it is still under development, as the onboard seawater safety monitoring system which can detect the unexpected pollution at seafloor mining sites.

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KOWA

### **Regional Supply of LPG to the Pacific Islands from Papua New Guinea**

***Erick Kowa***

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Due to limited regional hydrocarbon resources, many countries within the Pacific Islands region are, by necessity, energy price takers when it comes to petroleum and gas. While there are ongoing regional initiatives to progress, and promote, the use of renewable energy sources, petroleum remains as the region’s major energy source. Reliance on imported oil and gas therefore exposes the region to variable market costs and poses challenges for energy security.

LPG has been used in the Pacific Island Countries and Territories (PICT’s) for 50 years and is an environmentally friendly, clean, efficient and reliable energy source. It has displaced inefficient fuels and its main uses are for cooking, heating, autogas and air-conditioning but market penetration and growth remain relatively low. This is due to the extended and fragmented supply chain which elevates costs for price-sensitive buyers. A new regional supply of LPG could simplify the supply chain and reduce transportation costs. The opportunity to address these challenges exists in Papua New Guinea (PNG) which is one of the region’s largest petroleum producers. PNG also relies heavily on imported petroleum fuels and the government is encouraging domestic gas supply which is regulated under the Oil & Gas Act. As the proponent for the first offshore Pasca A gas-condensate field development, Twinza Oil (PNG) Limited will be supplying LPG to the PNG domestic market, and has sufficient production to satisfy the current PICT LPG demand.

To supply LPG from PNG to the Pacific Islands requires cooperation from key stakeholders such as regional Governments, Development Agencies and from the private sector. The presentation will examine ways in which LPG can be supplied to the Pacific Islands at a lower cost and increase LPG adoption while improving regional energy security.

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KUMAR

### **Elevation Surveying Application for Groundwater Investigation**

***Anesh Kumar, Peter Sinclair, Andrick Lal, Dave Mundy, Andreas Antoniou, and Aminisitai Loco***

*Geoscience Division, Pacific Community, Suva, Fiji*

Global Navigation Satellite System, GNSS, provides opportunities for vastly improved rapid surveying techniques, of fit for purpose accuracy, to be more readily available for an ever increasing

number of applications without the need for a team of highly skilled and qualified surveyors. An increasing number of industries and professions rely upon more and more accurate survey information to carry out their business, to improve their investigations, interpretations, recommendations, and implementation. While handheld global positioning systems, GPS, have been readily available since the mid 1990's level of accuracy, especially for altitude is relatively poor and insufficient for many applications. Similarly the cost of a team of surveyors and equipment to carry out more detailed surveys is often prohibitive resulting in the reliance on inadequate data sets which can be a limitation.

In collaboration with the surveyors of the Pacific Community the application of precise point positioning, PPP, has allowed non surveyors to obtain elevation data to a degree of accuracy (+/- 0.5m), fit for purpose, in a fast and efficient manner. While this approach will not replace the need for surveyors where more accuracy is required it does increasingly allow for the use of more accurate elevation data at affordable and efficient manner into more and more applications. A user's perspective is presented on the use and application of PPP in recent groundwater investigations to guide future considerations in the application of this approach.

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KUMAR

## **Use of GIS and Remote Sensing for Risk Assessment related to Climate Change in the Pacific**

***Lalit Kumar***

*University of New England, Armidale, NSW 2051, Australia*

Here we present two projects utilizing spatial information technologies to assess risk from climate change in the Pacific.

In the first project, regional-scale, strategic information was used to estimate the relative susceptibility of islands in the central Pacific to climate change based on a comparison of their lithology and form. An index of indicative susceptibility of islands has potential for expedient identification of islands most susceptible or most resistant to such processes. In that context the index may be used as a tool for rapid appraisal by international and regional agencies as well as national governments for prioritization of adaptation measures. The measure of susceptibility developed here is based on the physical composition and geometry of whole islands. A regional-scale susceptibility index was developed for 1779 islands across 26 Pacific island countries using the variables of lithology, elevation, area and shape (circularity). 29% of the 1779 islands fall into the high, moderate (23%) and low (23%) susceptibility classes, whilst the remainder are nearly equally split between the extremes of very high (12%) and very low (13%). Eleven countries have all levels of indicative susceptibility, and eight have a majority of islands with high and very high ratings.

In the second project we undertook a comprehensive analysis of the exposure of built infrastructure assets to climate risk for 12 PICs. We found that 57% of the assessed built infrastructure for the 12 PICs is located within 500m of their coastlines, amounting to a total replacement value of US\$21.9 billion. Eight of the 12 PICs have 50% or more of their built infrastructure located within 500m of their coastlines. In particular, Kiribati, Marshall Islands and Tuvalu have over 95% of their built infrastructure located within 500m of their coastlines. Coastal adaptation costs will require substantial financial resources, which may not be available in developing countries such as the PICs, leaving them to face very high impacts but lacking the adaptive capacity.

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KUMAR

### **Marine Habitat Mapping of Komave on the Coral Coast in Fiji**

***Shayal Kumar, Herve Damlamian, Cyprien Bosserelle***

*Geoscience Division, Pacific Community, Suva, Fiji*

Marine habitat mapping is a broad term encompassing strictly geological maps produced from acoustic survey of the seabed, to mapping of defined biological groups like coral reef, sea-grass bed and Algae. Marine habitat map allows us to visualize what we have and where it is in relation to human use of the marine environment. Therefore it is an essential means of assessing marine resources for coastal management and ecological analysis purposes. Likewise, it supports decision making processes in coastal management. There are great deals of questions to be answered concerning the standards to use in acquiring and processing data, habitat classification terms and the reliability of the maps produced. An efficient way to produce habitat map is done by remote sensing technique called Semi-Automatic Classification. As part of an USAID project named *Developing Base Maps of Tropical Aquatic Resources in the Pacific*, led by the University of Fiji, the Pacific Community (SPC) investigated the use of a free and open source tool - the Semi-Automatic Classification Plugin (SCP) in QGIS to produce reliable marine habitat baseline map.

This talk will focus on the work undertaken at SPC toward the development of a marine habitat map of Komave on the Coral Coast in Fiji.

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LAL

### **Monitoring Surveys - Climate and Oceans Support Program in the Pacific**

***Andrick Lal, Marika Kalouniviti, Veenil Rattan***

*Geoscience Division Pacific Community, Suva, Fiji.*

Sea level rise is one of the major concerns of our world today, effects of it are visible around Pacific island countries and this is due to climate change. The Pacific Sea Level Monitoring which operates under the Climate and Oceans Support Program in the Pacific (COSPPac) generates an accurate record of variance in long term sea level for the Pacific also provides information about the processes, scale and implications of sea-level rise and variability of extreme events for the Pacific communities. It also makes sea-level data more readily available and usable to support management of coastal infrastructure and industries. When we talk about data that is readily available here, these refers to both the availability of sea level data which is important to some while we also have GNSS data which is critical in other field of expertise.

This presentation will share brief history of geodetic survey as part of the Pacific sea level monitoring project, participating countries which are part of this project, the monitoring survey activities, technique used for levelling exercise and data reduction, importance of carrying out levelling exercise between tide gauge and GNSS station, discussion on the challenges faced while carrying out survey and what information can the general public access out of this project.

Also we will give brief summary on some of the results from the project, we will be talking on the some of the findings on how the pillar and the tide gauge reacts with each other what are the effects it has on sea level data.

All these comes to the point of the establishment of the Geodetic Unit within the Geoscience Division of SPC and how we can assist the Pacific communities.

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LAL

### **Pacific Regional Maritime Boundaries**

***Andrick Lal, Emily Artack, Filimoni Yaya***

*Geoscience Division, Pacific Community, Suva, Fiji*

Since 2002, under the legal and technical guidelines of the United Nations Law of the Sea, the Secretariat of Pacific Islands Applied Geoscience Commission (SOPAC) now known as SPC's Geoscience Division determines the manner in which boundaries and limits in the seas may be drawn. GSD is based in the Fiji Islands and has (14) project member countries that include Cook Islands, Federated States of Micronesia, Fiji Islands, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

In the light of new mapping system and surveying technology, archipelagic baselines and normal baselines in the Pacific Islands and atolls were established in international datum. This comprehensive task took over the years to complete and to be completed for Pacific Island coastal states with the input of geospatial data and information in the form of a regional spatial database, Pacific Islands Regional Maritime Boundaries Information System (PIRMBIS). PIRMBIS is being upgraded to new IHO and IMO standards known as S121 under the Marine Cadastre project with FFA. The S121 is a mechanism that simply allows countries to exchange accurate digital maritime boundary information that would potentially be a format for depositing boundary information with the United Nations in conformance with UNCLOS. The Regional Global Positioning Systems (GPS) network was used to complete this task where there are obsolete reference (datum or grid) systems. The Pacific Regional Maritime Boundaries Unit has successfully facilitated and provided technical support for the 48 shared boundaries within the Pacific Islands Forum Countries out of which 35 have been signed as treaties and 13 are still left to be negotiated.

Over the past years, GSD together with its technical project partners has facilitated for its project member countries to lodge its potential extended continental shelf claims to the United Nations to meet its deadline. The unit provides advice, build national capacity and also assist in relevant provisions under United Nations Convention on the Law of the Sea (UNCLOS). In addition the Unit also acts as a repository for all maritime data under the 14 member countries

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LOCO

### **Groundwater Exploration in Disaster-prone Communities in NW Viti Levu Using Electrical Resistivity**

***Amini Loco<sup>1</sup>, Peter Sinclair<sup>1</sup>, Andreas Antoniu<sup>1</sup>, Anesh Kumar, Jiutiti Vono<sup>2</sup> and Ilaitia Bula<sup>2</sup>***

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<sup>2</sup>*Mineral Resources Department, Ministry of Lands and Mineral Resources, Government of Fiji, Suva, Fiji.*

The vulnerability of sugar cane farming communities of northwest Viti Levu, Fiji to droughts and tropical cyclones is well known. Limited water resources with a reliance on creeks and springs, and rainwater harvesting are vulnerable to impacts from climate extremes, resulting in recurring financial cost related to emergency water cartage for government. Severe tropical cyclones, such as the 2016 TC Winston, brought episodic high rainfall that caused highly turbulent flows and high siltation in these surface water sources, rendering the sources unsafe for human consumption, requiring government to provide alternate water supply in the form of water cartage. Coupled with severe and frequent dry periods the existing water sources often become inadequate for community water demands.

Groundwater has been considered in the past as an alternative and attractive water source option because of its high quality and delayed response to meteorological drought conditions, providing reliable and a safe water source to improve a community's resilience. Very good supplies have been found in the past in the area, including Yaqara's famous Fiji Water source, however locating targets for usable groundwater supplies has been difficult due to the complex nature of the hydrogeology.

In collaboration with the Mineral Resources Department (MRD), groundwater assessment was undertaken around the Qerelevu area in Ba, north western Viti Levu. Electrical resistivity (ER) geophysics, coupled with geological mapping and satellite-imagery lineament analysis, is utilised to develop hydrogeological conceptual models and identify potential targets for groundwater development.

Resistivity profiles produced high-resolution vertical and horizontal subsurface images providing insight into the likely occurrence, depth and extent of potential groundwater targets. This information has proven to be critical in providing much needed information to the government of Fiji to assist them with the design of a drilling programme and contribute to the overall hydrogeological understanding of Qerelevu.

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LUKOVIC

### **Rockfall and Cliff Collapse Hazard and Risk in the Port Hills Following the 2011 Christchurch Earthquake**

***Biljana Lukovic, David Heron, William Ries & Chris Massey***  
*GNS Science, New Zealand*

The Mw 6.2 22nd February 2011 Christchurch earthquake, centred 6 km southeast of Christchurch City, on the northern edge of the Port Hills, resulted in maximum vertical peak ground accelerations of 2.2 g and ground shaking intensities exceeding MM10 which caused rock falls over some 65 km<sup>2</sup> of the Port Hills.

The Port Hills are the eroded remnants of a large Miocene volcanic centre. The landscape of the upper part of the volcano is dominated by cliffs of hard but fractured rock with long sloping aprons below. On the lower flanks the cliffs are fronted by flat ground. Urban development existed up to the base of the cliffs on the lower flanks and on the slopes above these cliffs.

The earthquake shaking dislodged boulders from cliffs and slopes in the upper part of the Port Hills and over 6000 boulders rolled down-slope. Cliffs on the lower Port Hills also collapsed but the impact was less widespread as the debris fell onto flat ground. Cliff top recession occurred on most of the cliffs that failed in the Port Hills but was worse on the lower slopes where in some locations the cliff retreated 6m. Rolling boulders and collapsing cliffs hit about 200 homes and killed 5 people, resulting in widespread evacuations. Large aftershocks in the year after the main earthquake caused further cliff collapses.

GNS Science was engaged by Christchurch City Council to assess and advice on the life-safety risk posed by earthquake-induced rock falls in the Port Hills, including the risk from boulder rolls and cliff collapse. A pilot study covering 10 of the worst affected areas was used to develop hazard and risk models and once ground verified the methodology was extended to the whole of the Port Hills. GIS was the main tool used in the development of the risk models but drew heavily on information generated using other tools and techniques.

Life-safety risk zones were developed for the entire Port Hills, field checked and modified and presented to Christchurch City Council. These zones defined the risk to properties from future earthquake events that might dislodge more boulders, collapse cliffs or cause cliff top recession. The

results were key to the formulation of a robust land-use and rebuild policy for areas adjacent to cliffs in Christchurch.

As a result of the study, the risk to some 400 houses was considered to be too high for them to be re-occupied and they were abandoned and demolished. In February 2016, a M5.7 earthquake caused a cliff collapse at Whitewash Head. Site investigations found new cracking across the ground surface behind the cliff top, in areas where homes had formerly been sited.

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McMURTRY

### **Field-portable Helium Isotope Detector for Continuous Monitoring of Volcanic Unrest and Large Earthquakes: a Development Update**

**Gary M. McMurtry<sup>1</sup>, James R. Deluze<sup>2</sup>, David R. Hilton<sup>3</sup> & James E. Blessing<sup>4</sup>**

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The <sup>3</sup>He/<sup>4</sup>He ratio in volcanic emissions and dissolved gas in groundwater is often co-seismic with, and sometimes precursory to, volcanic unrest and earthquake activity. In strain changes associated with crustal earthquakes, this ratio operates as a “strain gauge” monitor<sup>(1)</sup>. Depending upon location, <sup>3</sup>He/<sup>4</sup>He precursory signals of volcanic eruptions can vary from several years, as in the Mt. Ontake eruption in Japan<sup>(2)</sup> to a few months, as at Mt. Etna in Italy<sup>(3)</sup>. At Mammoth Mountain volcano in eastern California, helium isotope variations were observed after seismic swarms associated with injection of basaltic magma beneath the volcano<sup>(4)</sup>, and higher temporal sampling by conventional methods there suggest weekly to daily changes of this ratio<sup>(5)</sup>.

Because of the extremely low abundance of primordial <sup>3</sup>He to radiogenic <sup>4</sup>He, and difficulties in resolving <sup>3</sup>He in the presence of hydrogen isobars such as HD, the measurement of this ratio has so far been confined to the laboratory. A field-portable He isotope instrument must overcome these analytical hurdles and be small, compact, lightweight and low enough in power consumption to deploy in critical locations. We presently use two compact mass spectrometers, an MKS ion trap and a frequency-modified quadrupole MS, with a full-range pressure gauge and waste pumps based upon ion or turbo-rough pumping. These are coupled to a high-purity quartz glass port that is heated under high vacuum. Gas samples can be separated from waters or directly analyzed by pumped circulation through a sample chamber. We monitor vacuum quality with the ion trap and use the quadrupole MS to obtain sensitive determination of hydrogen and helium isotopes. Two methods of isobaric separation are utilized: a statistical mass-2 vs. mass-3 regression intercept, and an adjusted (threshold) ionization mass spectrometry (AIMS) technique.

We recently investigated the instrument response to the Helium Standard of Japan (HESJ) and Salton Sea standards reported as 20.6 and 6.4 R/Ra, and lab air assumed to be 1.0 R/Ra. The standards are consistently (R<sup>2</sup> = 0.96) enriched by a factor of about 2. It is not due to an isotopic enrichment from diffusion through the glass, as results are similar both through the glass and by direct injection behind the glass inlet. The enrichment may at least be partially related to a “zero offset” issue being investigated.

Corrected values using the linear relation  $y' = (y/1.83) - 2.45$  are within 20% of their reported or expected values. Sampling strategies and a prototype field instrument we plan to deploy at Horseshoe Lake on the flanks of Mammoth Mountain volcano later this year, in collaboration with USGS scientists, will be presented.

- (1) Sano *et al.* (*Sci. Rep.*, 6, 37939, 2016)
- (2) Sano *et al.* (*Sci. Rep.*, 5, 13069, 2015)
- (3) Paonita *et al.* (*Geology*, 44, 499-502, 2016)
- (4) Sorey *et al.* (*J. Geophys. Res.*, 103, 15303-15323, 1998)
- (5) Dame *et al.* (*Bull. Volcanol.* 77, 23, 2015)

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McMURTRY

### **Volcanic Gas Analytical Monitor (VGAM): Compact and Low Power Mass Spectrometer-based Instrumentation for Volcanic Gas Monitoring**

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Compact mass spectrometers provide the capability of simultaneous multi-species analysis with high sensitivity and precision. For volcanic gas monitoring *in situ*, instrumental mass spectrometry requires reliability and ruggedness combined with low power usage and portability. We designed the Volcanic Gas Analytical Monitor (VGAM) that is capable of quantitative molecular analysis of a variety of atmospheric and volcanic gases by ion trap mass spectrometry. These gases include: H<sub>2</sub>, He, H<sub>2</sub>O, N<sub>2</sub>, O<sub>2</sub>, Ar, NO, N<sub>2</sub>O, CO, CO<sub>2</sub>, H<sub>2</sub>S, SO, SO<sub>2</sub> and CH<sub>4</sub>. Ratiometric mass spectral response is combined with total pressure measurements to report absolute partial pressures. Generated data can be observed in real time and are recorded to internal flash memory, with possible data telemetry from remote sites via Ethernet modem.

Analysis of volcanic plumes and of fumaroles and solfatara fields is accomplished by direct inlet of gases, after trapping excess water vapour in both the external and internal foreline. Combining the VGAM compositional data with wind direction and speed from a portable meteorological station allows flux measurements to be determined.

In July 2014, we test deployed the VGAM at Sulphur Banks solfatara on the NE rim of Kilauea Caldera, Hawaii. For this deployment, three Pb-acid batteries, two in series for the 24V-DC VGAM and one for a refrigerated condensation unit, were trickle-charged from three 55W solar panels over a 3.5-day period, with the VGAM collecting over 200 sample/background scans. Weather was a big factor: rainfall increased at the site over most of the deployment period. This wetness apparently affected the signal strength from the fumarole, as seen in the decreasing partial pressures of all gases over time. A day-night pattern is clearly displayed that reflects the small ambient temperature variation, internally measured to range from 20° to 37°C. Statistical analysis reveals that relative to water, CO<sub>2</sub> is higher at night, which suggests concentration in drier vent gas emanating at nighttime temperatures, i.e., gas solubility effects.

Daytime fumarole temperatures, occasionally measured by a hand-held TC gauge, were remarkably steady at 82.8±0.97°C (n=12). Although highly correlated, plots of Ar, O<sub>2</sub>, H<sub>2</sub>O, CO<sub>2</sub>, and CH<sub>4</sub> versus N<sub>2</sub> show slope changes that reflect increasing volcanic signature with respect to nitrogen: higher CO<sub>2</sub> and H<sub>2</sub>O and lower atmospheric Ar and O<sub>2</sub> over time. Methane is abundant but shows no trend over time; it is likely sourced from local microbial activity. Comparison of the VGAM results with conventional bottle gas samples is generally good, although the gas partial pressures in temporally adjacent samples show unexplained variability that could be real and worthy of further study.

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NASARA

## **Licensing and Monitoring Framework for Development Minerals Extraction in Fiji**

**Venasio Nasara**

*United Nations Development Programme (UNDP), Suva, Fiji*

The licensing of sand and gravel and hard rock (also called industrial minerals or neglected minerals) extraction is managed by three (3) different authorities depending on the ownership or class of land on which the particular development operation is conducted.

For State lands, the licensing authority is the Lands Department, under the Ministry of Lands & Mineral Resources, whilst for 'itaukei' or native lands it is the Itaukei Lands Trust Board (ITLTB), formerly known as the Native Land Trust Board. For any development on freehold lands, the Rural Local Authority provides the approval for such activity.

In terms of the monitoring of these activities, the Mineral Resources Department is the statutory authority which is vested with the powers under the Quarries Act, Cap. 14, to approve extraction sites and operations. They also conduct routine inspections.

For compliance in regards to the environmental aspects of the operations, the Department of Environment under the Environmental Management Act (EMA) 2005 is the approving authority for scoping, determining terms of reference for environmental impact statements and its subsequent approval.

The mention of licensing and monitoring usually brings to mind the issues of compliance with the law, licence conditions, agreements and any other legal issues for the operations. However there is more to it than just the legal obligations. In fact for more thorough and efficient monitoring and licensing, there are some guiding principles which can assist and contribute towards the process and ensures a more robust and holistic approach. Some of the guiding principles are:

- ▶ Government should take a lead role in promoting on-going discussions between government agencies, ITLTB, communities/landowners to help develop policies, practices and legal frameworks across all stages of extraction.
- ▶ Effective and efficient management of the industry to promote human development both at community and national levels.
- ▶ On-going constructive consultations between stakeholders prior to, during the course of development and post development.
- ▶ Extractive industries should be managed to maximize opportunities for employment and education.

One may pose the question as to *“why the need for guiding principle” when there is the law that governs the process?*

Whilst the law is adequate in addressing some of the issues like health & safety, reporting, roles & responsibilities, work procedures and management of the operation, it does not address more pertinent issues which are detailed in the guiding principles relating to community development, financial benefits, human development and education and employment opportunities for resource / landowners amongst others. These contribute towards ensuring the sustainable management of the operation through policies and mechanisms that can assist government in assessing, regulating and enforcing environmentally friendly practices as well social and cultural issues.

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NEMETH

### **Samoa Geopark Project: A Strategic Plan to Promote the Volcanic Geoheritage of Savai'i Island, Samoa**

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The Geoscience Division (GSD), Pacific Community and Food Agriculture Organisation of the United Nation (FAO) have cooperated to initiate a Geopark Project Phase-1 for Samoa in 2016. The idea of geopark in Samoa, based on an ongoing forestry project sponsored by the FAO, together with several numerous of volcanic-geology project carried out by the GSD on the islands in the past. Savai'i the biggest island of the Samoan group was selected as a proposed geopark, based on size of potential landscapes, well exposed volcanic features and accessibility hence it was therefore considered as an ideal site to establish a geopark in the region which is one of the first of a kind project in the SW Pacific islands. Long and short term volcanic activities since 5 My generated diverse volcanic landforms including scoria cones, lava flows, valleys, razor back ridges, crater lakes, waterfalls, pit craters and collapsed cones. Despite a few records in respect to the formation of these volcanic features however, indigenous knowledge including traditional dances, songs, legends, places names, proverbs and myth act as "*geological library*" for these eruptions. Geoheritage linkage between the volcanism and cultural values is one of the major highlight of the Samoa Geopark Project. The northern part of Savai'i is proposed to be the initial Matavanu Geopark being based on the well-exposed volcanic features of the Matavanu volcanic crater erupted from 1905 to 1911. A further proposed geopark extension toward NW Savai'i is under consideration. Like Matavanu, Tafua-Savaii cone complex on the SE Savai'i, is also proposed to be another extension later on. The Samoa Geopark project aims to contribute to improve the development of the geosites within communities in several ways: assist in tourism industry revenue, link exposed geological and volcanological features with traditional myths/stories, thereby bring economic benefits to the areas.

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NEMETH

### **Phreatomagmatic Volcanic Hazard in Rift Edge in Coastal Regions of Volcanic Islands**

**<sup>1</sup>Károly Németh and <sup>2</sup>Nobuo Geshi**

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Population growth on active volcanic islands increasingly exposes people and environment to complex volcanic hazards. Many of the volcanic islands are dominated by a central volcano fed by network of dykes following rift zones. While the hazards those central vents pose to the environment commonly influencing the entire island, localized volcanic hazards on small-volume eruptions in coastal areas tend to be overlooked in spite the violent nature of explosive eruptions when magma interact with water, especially if it stored in confined and pressurised aquifers. Volcanic eruptions associated with dyke intrusions along the axis of rifts tend to change their style either from magmatic to phreatomagmatic explosive toward the summit or downward to the low-lying regions. This trend has been recognized from Miyakejima Island (Japan).

Dyke intrusions in a 7th century fissure eruption initiated in mid-flank of the island producing a chain of scoria and spatter cones. As eruption progressed, dyke migrated toward the summit where magma hit the water-saturated caldera infill deposits forming 5+ maars. Eruptions in 1983 started also in mid-flank as dry eruptions, following dyke migration toward the coast where maar forming

and Surtseyan-style eruptions occurred. In the 1983 eruption, the eruption style, scenario and the hazard changed dramatically within hundreds of metres producing 1) deep maar craters with accidental lithic-rich deposits and 2) chilled juvenile pyroclasts-rich deposits building tuff cones. Such variation of pyroclastic successions of coastal fissure vents is dramatic in Miyakejima historic records indicating a need to investigate the link between various internal and external parameters influencing the eruption styles of these volcanoes. Pyroclastic successions, eruption styles, volcanic landforms and their volcanic hazard of Miyakejima's coastal eruptions show great similarity to those from Ambrym, Ambae and Jeju suggesting to develop a model for the eruption style systematics of this dispersed eruptions in the low-lying regions.

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NEMETH

**Volcanic Geoheritage of the SW Pacific and its Role for Sustainable Development Programs with Strong Influence of Indigenous Knowledge**

***Károly Németh, Clei Wallace, Julie Palmer, Jon Procter and Boglárka Németh***  
*Institute of Agriculture and Environment, Massey University, Palmerston North, New Zealand*

The SW Pacific is the home of many active volcanoes, most of which have associated rich oral traditions, legends, cultural practices and world class geological features, all of which are being actively researched. The volcanic geoheritage of the region is rich, with abundant geodiversity especially in relation to the size of many islands. Geoheritage aspects of the region have not been utilized or addressed in research to identify volcanic geosites that might be used for geotourism or geoeducational purposes, or to reinforce the local community's understanding of the geological processes underpinning the volcanism. On a global scale there is a clear trend towards developing geopark projects to harvest geoheritage information to develop sustainable geotourism that can be catalyst for local economic growth, however, the concept of geoheritage sites is not well developed in the SW Pacific. A partial explanation behind this situation is that there is a rift between traditional (indigenous) knowledge and western scientific knowledge, and an absence of successful frameworks to run such geoheritage programs. Geoheritage reflects the heritage component of a geological site and is reflected through the cultural activity around the site. Supporting such research projects is desirable and will provide opportunities for the local community. To fully develop the geoheritage information about a site it is crucial that there is research into frameworks that might achieve this, and at the same time provide involvement of local communities. Here we demonstrate the effectiveness of participatory methods applied recently in Samoa and Vanuatu to harvest indigenous knowledge about volcanism. Geopark projects can be triggered through workshops mixing traditional and western knowledge. Geoparks can also be parts of a broader geoconservation-geopark strategy of the region and therefore can be designed together with local NGOs and Government Offices.

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NIRU

**The Challenge of Developing a Ground Water Project along a Fault Line: The Boera Ground Water Project, Papua New Guinea**

***Pil Niru***  
*Geological Survey, Mineral Resources Authority of Papua New Guinea, Port Moresby, PNG*

The probability of locating ground water resources for municipal use in predominantly fine grained sediments poses significant challenges for the project developers. In Port Moresby, both outcrop and subsurface bedrock is predominantly tight and ground water movement is fairly restricted by the

thinly-bedded mudstone, chert and limestone of the Port Moresby Beds. This particular formation is tightly folded and the chances of locating a ground water aquifer do not exist. In the past, approximately 200 plus bore holes (mostly privately owned bores within the Port Moresby City) have had accessed ground water resources at shallow depths of about 8-15m through a colluvium of mostly sand and gravel deposits. None of these bore holes have discovered ground water in fractured bed rock.



However, a recent ground water project undertaken in year 2016 indicated that a significant amount of ground water is entrapped in a fault-controlled fractured aquifer within the highly weathered Port Moresby Beds. Although the Port Moresby beds have very low permeability and porosity, a secondary porosity and permeability due to faulting and fracturing has paved a conduit for water to be trapped within the rock formation. This study also reveals that more ground water sources in Port Moresby can be tapped within a fault-controlled aquifer. A test bore hole has been successfully drilled and pump tested. The 24 hour pump test indicates that the flow rate of 2L/s is adequate to supply water for more than 500 houses within the newly established town. Similar ground water projects are planned within the vicinity of the newly established town and the surrounding communities.

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PRASAD

### **Baseline Assessment of Development Minerals in Fiji**

***Christine Prasad and Robert Smith***

*Geoscience Division, Pacific Community, Suva, Fiji*

Sand and gravel mining in river and streams is currently providing the bulk of the development mineral commodities required for infrastructure development in Fiji. It has been to a large degree an industry that has operated based on practices that began dating back to early road development and construction in Fiji.

Today the demand for sand and gravel continues to increase due to economic development and subsequent growth of construction activities and in particular road infrastructure maintenance and upgrades. Due to this upturn in demand for development minerals, the rivers and associated “borrow pits” in Fiji continue to be the principal source of development minerals. As a consequence if unchecked the continued exploitation of rivers will have far reaching impacts on the natural environment. As an example of this demand The Fiji Roads Authority (FRA) a Government Statutory body which is responsible for the effective management and building of roads, bridges and jetties for Fiji has an asset portfolio of some F\$11 billion. This includes but is not limited to 1,727 km of sealed roads, 5,797km of unsealed roads, 378 km of footpaths, 558 bridges. With a projected 2017/18 aggregate demand approximating some 560,000 tonnes considered the largest single consumer of development minerals in Fiji (Source FRA –Contractors workshop 26/05/2017).

In partnership with the Minerals Resources Department a key stake holder this study, supported by funding from the ACP-EU-UNP is therefore very timely and a significant first step forward to conducting a comprehensive review on the development minerals industry as a whole in Fiji. For suppliers to meet the demand for development minerals and to accommodate the best of industry practice, that is, to be sustainable, environmentally and socially responsible and benefit the

community and country as a whole data on development mineral resources is essential coupled with a robust and supportive regulatory regime.

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RAIALA

### **Groundwater Development and Reticulation Work for Navakawau Village, South Taveuni to Mitigate Water Problems (Poster)**

***Jonati Railala***

*Department of Mineral Resources, Ministry of Lands and Mineral Resources, Suva, Fiji*

Department of Mineral Resources was requested through the Office of the Prime Minister to investigate and develop groundwater resources on Navakawau village to mitigate prolong water problem. The Department has always supportive to deliver the initiative of government to have clean and safe water to public especially in the rural communities. The Department was able to identify possible potential site through the use of geophysical investigation methods and comparative assessment of the surrounding geology to determine the drilling depth of 70m.

Groundwater exploration drilling was initiated immediately to verify the geophysics data with due consideration of geological formation of the area. Exploration drilling was successful to a target depth of 70m and was evaluated to be capable of producing quality water at more than 4L/sec.

Reticulation of borehole source to household was conducted subsequently on the installation solar panels with submersible pump; installation of 36 standpipes to 136 households to directly benefit more than four hundred people include primary school and considered to be the largest reticulation project to be conducted by the Department. Under section 36 (1) of the 2013 constitution, “ every person should have adequate and acceptable quality of water” the Department has successfully completed 11 reticulation projects including two Primary Schools , two Secondary Schools, one Government Station, three settlements and four villages.

The Department also prioritized this work as part of contribution toward rehabilitation and restoration to the Navakawau communities which was tagged to be severely affected by TC Winston.

The work was completed on the 12th December, 2016 and was officially commissioned by the Honorable Prime Minister on 3<sup>rd</sup> of March, 2017

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RAQISIA

### **The Pacific Regional Navigation Initiative**

***Keleni Raqisia***

*Geoscience Division, Pacific Community, Suva, Fiji*

The Pacific Regional Navigation Initiative (PRNI) is a project funded by the New Zealand Ministry of Foreign Affairs and Trade (MFAT) that focuses on navigation-related aspects of maritime safety, in particular those necessary to support Pacific Island Countries fulfil their obligations relating to hydrography and nautical charting under UN Safety of Life at Sea (SOLAS). The Pacific Community (SPC) has been engaged by NZ MFAT to work with targeted countries to, amongst other objectives, support hydrographic capability building initiatives in conjunction with work being doing by international bodies and development partners. The presentation focuses on the activities of the first phase of the project, the Pacific Wide Data Discovery. SPC- Geoscience Division, identified as a repository for a range of maritime information in the region, is currently undertaking a stock take of all bathymetry and related information conducted previously in the region as a method of identifying

data gaps. Information collated is to provide the groundwork needed to support the Project objectives.

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SERU

### **Relocation of Narikoso, Ono Kadavu Island Group**

***Mika Seru, Marika Ritova, Isei Rayawa***

*Ministry of Lands and Mineral Resources Department, Suva, Fiji*

Climate Change is disproportionately affecting Fijian communities both inland and along the coastlines. Inundation, coastal erosion, sea level rise, flooding, severe cyclone among other climate change impacts are threatening the livelihoods of these communities. Communities are provided with assistance from funding agencies in implementing resilience to climate change adaptation impacts.

One such adaptation response is Relocation as a form of Human Mobility. Planned relocation is state-led and carried out in consultation with the communities. The process promotes an integrated approach to moving a community to a site that is less exposed or less vulnerable to hazards and climate change impacts.

For the coastal village of Narikoso in Kadavu in the Fiji Group, the impact brought about by sea level rise is no longer a future threat but an alarming reality. Village elders report that their coastline has been receding since the 1960s. The constant inundation of the village ground and homes is a “normal” situation during every high tide. This situation is aggravated during king tide and storm surge events.

The villagers realised that the village may eventually become uninhabitable. They saw that relocation of their village is the best option. In 2011, the villagers requested the Government of Fiji to prepare an alternative village site. In 2012, earthworks on the new site began and this was completed at the end of 2012.

The Narikoso village relocation project was funded by GIZ and the project is coordinated by the Climate Change Unit (CCU). MRD was requested by CCU to carry out geological and geotechnical investigations to determine slope stability, coastal mitigation and water resources management for the village.

So far two respective visits have been made to evaluate findings and follow-up visits are on-going.

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SHAND

### **Affordable Coastal Protection in the Pacific Islands: Desktop Review, Model Testing and Development of Design Guidance**

***Tom D Shand<sup>1</sup>, Matt J Blacka<sup>2</sup>, James T Carley<sup>2</sup>, Oliver Whalley<sup>3</sup> and Lorena Estigarribia<sup>3</sup>***

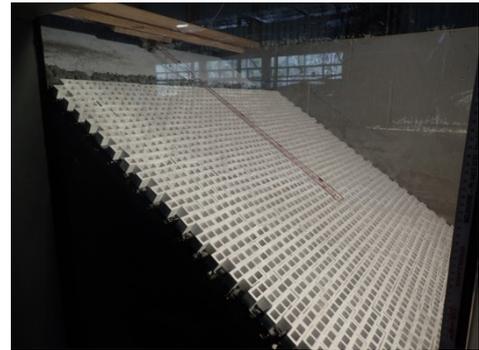
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The reshaping and loss of land due to coastal erosion is an ever-present concern for Pacific Island Countries (PICs) and may be caused by both natural and anthropogenic factors. Where erosion conflicts with road, maritime, community or aviation infrastructure, these high value assets are put

at risk. This infrastructure has high economic value and often provides critical lifelines for these geographically-dispersed nations. While a range of measures may be used to adapt to the erosion hazard, including avoidance of hazardous locations or relocation of assets, these are often not feasible, especially when land availability is limited or infrastructure is expensive to relocate. In these cases, the land and assets must be protected.



Conventional responses to coastal erosion include formalised rock or concrete revetments and seawalls. These structures are engineered to withstand scour, wave impact and overtopping, and formal design guidance is available. Major obstacles for the construction of coastal protection in PICs include the lack of suitable local materials (especially rock of sufficient size and quality) and the high cost of importing materials. A range of non-conventional or 'non-engineered' methods for coastal (land) protection have been trialled throughout the region with varying levels of success.

This study undertaken by the Pacific Regional Infrastructure Facility (PRIF) has catalogued existing approaches to coastal protection and critically evaluated them against engineering, environmental, social and financial criteria. Conventional approaches such as rock revetments typically have long design lives and moderate construction cost where materials and construction plant are available locally. Costs significantly increase where materials must be transported, particularly long distances to remote island locations. In these locations, alternative protection measures such as structures requiring lower material volumes or those that use local materials and labour but have shorter design lives may become more cost effective.

Two such alternative methods included the use of smaller hand-placed sand-filled geotextile containers and the use of concrete masonry "besser" construction blocks, both placed on a sloping revetment. These innovative protection options have the benefit of being either widely available or cheaper to import to Pacific Islands, and they can be placed without the need for heavy construction equipment. Physical modelling has been undertaken to investigate the performance of these alternative coastal protection methods under reef-top wave conditions and to enable the development of design guidance. This paper presents results from the desktop review, the physical model testing and summarises the subsequently developed design guidance.

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SINCLAIR

### **Water Security in Atolls through Improved Groundwater Management**

***Peter Sinclair<sup>1</sup>, Sandra Galvis Rodriquez<sup>1</sup>, Adrian Werner<sup>4</sup>, Vincent Post<sup>4</sup>, Aminisitai Loco<sup>1</sup>, Itienang Timona<sup>2</sup>, Reenate Willie<sup>3</sup>, David Hebblethwaite<sup>1</sup>, Uatea Salesa<sup>1</sup>***

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Fresh groundwater lenses in atoll environments are essential for the long-term provision of water security to its inhabitants. While often limited in their extent, finite with regard to their capacity, and sensitive to rainfall, abstraction and tides, freshwater lenses are often the main source of freshwater and the source which contributes most to a community's water security during droughts.

In the Pacific as populations increase through urbanisation to the main islands, the demands on these limited fresh groundwater lenses are also increasing resulting in the need to optimise their management to ensure that they can continue providing usable water supplies. The Bonriki water

reserve is a stressed freshwater lens which covers the water needs for the 56,000 inhabitants (census 2015) of South Tarawa. Traditional approaches of pumping to a fixed volume based on a derived sustainable yield, often without regard to the resulting water quality, are no longer appropriate in these highly worked aquifers.

A recent study undertaken by SPC in collaboration with the Government of Kiribati, the European Union, and Flinders University, has used numerical modelling to identify and test groundwater management options which result in prescriptive rules for optimal use of the available water. This groundwater management approach identifies water salinity as the main indicator for operational management. Working with the Government of Kiribati, a suite of measurable indicators are used to trigger appropriate responses to abstraction from specific pumping sites within the Bonriki water reserve to optimise abstraction while maintaining the acceptable quality and integrity of the supplied water.

The challenge now is to incorporate and extend this more dynamic, proactive and responsive approach for groundwater management into an overarching and long-term approach to community freshwater needs across all conditions. The New Zealand funded project, *Strengthening Water Security of Vulnerable Island States*, is supporting the Government of Kiribati to operationalise the approach in order to facilitate the operational practices and behavioural changes necessary to improve drought preparedness and resilience.

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SMITH

### **The Navua River Delta: A Pandora's Box for Sand and Gravel Extraction**

***Robert Smith***

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The Navua River is a major source for sand and gravel referred to as development minerals with as many as 8-10 sites operating in one year. Growth in demand for development minerals is at a premium for infrastructure development. The demand is such that concerns on the ability of rivers and streams to be continually exploited as a source for this material needs considerable resources from regulatory bodies to address the growing demand for extraction licenses and the monitoring there of. Without a clear understanding on resource sustainability and future demand the industry may falter. Here we present preliminary interpretations of the Navua River and its ability to continue providing these resources based on a span of eighty two years of data gleaned from maps, aerial photography and satellite imagery.

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SPLINTER

### **Laboratory Experiments into the Effect of Reef Width on Extreme Water Levels during Cyclone Events**

***Kristen D. Splinte<sup>1</sup>, Matt Blacka and Meixi Huo***

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Coral reefs provide protection from waves for coastal communities around much of the Pacific region. During modal wave conditions, incoming waves break on the reef edges, such that waves in the reef are considered to be depth limited. During extreme weather events, such as Tropical Cyclones, waves break on the reef slope and dissipate their energy as waves propagate across the reef lagoon. The breaking wave groups force a low frequency response of slowly varying water level on the reef known as surf beat. In these instances, waves are no longer depth-limited across the entire reef lagoon. Total water levels inside the reef are controlled by several phenomena, including wave

dissipation, wave-setup, and low-frequency surf beat. The proportion that each contributes to the total water level is a function of location within the reef and the reef width itself.

The focus of the study is the impact of reef width on the hydrodynamic processes on the reef. Wave flume modelling adopted the idealised reef profile at Avarua, Rarotonga in the Cook Islands, which was constructed in the 1.2m wave flume at the Water Research Laboratory. Four reef widths were tested ranging from 75 m to 600 m. At each reef width, 2 water levels and 3 peak wave periods were selected to mimic a variety of storm conditions.

Experimental results show that the mean water set up, surf beat and maximum total water levels have complex non-monotonic behaviours for the chosen set of initial wave height, wave peak frequency, still water level, and reef width conditions. Results suggest that shorter reef widths are more vulnerable to over-topping at the landward edge and experience higher total water levels within the reef. Reef widths of 300+ m are less vulnerable as waves had fully dissipated.

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SUNG

### **Gimco Biomass Power Project in Fiji**

***Yoon Sung***

*Eltech Limited, Fiji*

The main cause of global warming is carbon dioxide from fossil fuels which is caused by climate change and global warming. In particular, Fiji islands, one of the small islands in the South Pacific that is vulnerable to climate change, is struggling to reduce a large share of electricity production using fossil fuel, and trying to generate electricity using sustainable renewable energy such as biomass, solar power so on. This project will contribute to use of sustainable renewable energy sources efficiently which will lead to greater self-sufficiency of fuel for the energy sector. This will directly lead to reduction of subsidized fuel oil consumed, thus reducing the country's dependency on fossil fuel.

GIMCO, Eltech Limited's parent company, is currently constructing a biomass power plant generating 12MW of power from Nabou area in Fiji, is using 100% sustainable renewable wood resources as a fuel. The electricity generated from the biomass power plant will be purchased from Fiji Electricity Authority, which will result in a reduction in GHG emissions, substituting effect of fossil fuel. The plan for supplying fuel resources is to produce more than 80,000 tonnes of wood chips per year from 5,000ha of plantation area by planting *Gliricidia sepium* of species (2 years harvesting rotation). This supplying will account for more than 80% of total fuel demand, and 20% of the remaining will be used with the residues and by-product from the sawmill and harvesting site, and African Tulip, invasive species, in the Sigatoka area.

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TAYLOR

### **The 1943 Eruption of Niuafu'ou: An Eruption Chronology and the Effects of Volcanic Pollution as Provided by Local Informants**

***Paul W Taylor***

*Geoscience Division, Pacific Community, Suva Fiji*

Subaerial back-arc volcanoes are rare; however, the island volcano of Niuafu'ou, the northern-most

outlier of the Tongan Group, is one such example which has allowed the nature of volcanic processes of this unique volcanic environment to be studied.

Niuafu'ou lies some 650 kms north of Tongatapu, mid-way between Fiji and the Samoan Islands, and is the most isolated island of the Tongan Group. Since the early 1800's at least ten volcanic eruptions on the island of Niuafu'ou have resulted in the destruction of property and, in some cases, loss of life has also occurred. The activity that has occurred during historic times has been predominantly effusive events, e.g. 1853, 1867, 1912, 1929, 1935-36, 1943 and 1946, which have covered large areas of the lower flanks of the island with lava fields. As well as lava flows other associated phenomena that have also occurred during periods of activity has included tephra fall, pyroclastic surges, volcanic earthquakes, ground fracturing, subsidence and the effects of volcanic gases.

The eruption that commenced on 26 September 1943, although in volcanological terms a relatively minor event, it is clear from the few account that are available it had a devastating effect on the island and its population. Lava flows have flowed downslope from the vents, commonly entering the sea at numerous locations where they have created extensive columns of steam, ash and gas. Whilst the activity was located in an uninhabited area, it resulted in most of the island's vegetation, including the majority of the food crops, being destroyed. During the weeks/months that followed, the population experienced a period of severe famine.

When eruptions are not witnessed by scientists it is sometimes difficult to assess the extent and effects of the eruption and therefore it is important to draw information from all available sources. Due to the paucity of information, descriptions provided by local informants, some witnessing the eruption, remain the only source of information.

This paper will draw on the few available descriptions of the activity to develop a chronology of the 1943 eruption, provide detail of the character and extent of the activity, and then will assess the impact of the associated hazards that occurred, particularly volcanic pollution (laze and vog), and its effect on both the landscape and the local population.

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TAYLOR

### **Submarine Volcanic Activity in the SW Pacific: Looking in the Right Place at the Right Time**

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Frequent submarine volcanic eruptions occur along all oceanic island arcs. Many of these eruptive periods due to the nature may be entirely submarine and not result in any surface expression of the activity. Furthermore, in some localities the known centres of activity maybe somewhat remote from the inhabited islands and be rarely visited. When periods of activity do occur due to their remoteness they may not be observed or even known that an eruption is occurring.

One such island arc is the Tofua Volcanic Arc (TVA) that forms part of the Kingdom of Tonga. The TVA is located to the west of the Tonga Trench, about 30-40 kms west of the three main islands groups of Tonga. The TVA comprises both subaerial and submarine centres with *Tofua*, *Kao*, *Late* and *Fonualei* representing permanent subaerial volcanic islands. Over the past several decades numerous periods of activity have occurred with many eruptions being observed by passing ships/boats or the eruption columns being observed from the inhabited Tongan islands. Recent seafloor surveys have indicated that submarine centres predominate.

This paper will look at several submarine eruptions that have occurred along the TVA recently that have only been noted more through accident rather than good planning. Periods of activity of this nature pose some degree of risk to both surrounding islands and maritime traffic that may be transiting the area. The importance of appropriate volcano surveillance in the region will thus be highlighted.

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URABE

## **Development of Exploration System for Seabed Mineral Resources in Japan**

***Tetsuro Urabe***

*University of Tokyo, SIP Program Director, Cabinet Office, Tokyo, Japan*

After the enactment of the “Basic Act on Ocean Policy” in 2007, the Government of Japan established two major programs related to the exploration and exploitation of deep-sea mineral resources, besides those to assess and mitigate the possible impacts for marine environment.

These include the “Decadal plan for seabed energy and mineral resources development” of JOGMEC/METI and a SIP (Cross-ministerial Strategic Innovation Promotion Program) project of Cabinet Office named “Next-Generation Technology for Ocean Resources Exploration” (or “Zipangu-in-the-Ocean” Project). The former puts emphasis on developing technologies to exploit and lift Seabed Massive Sulfide (SMS) ores, besides exploration, ore dressing, smelting, and environmental impact assessment.

The latter intends to develop and transfer survey technologies of for SMS, together with basic research and environmental monitoring methods. The “Integrated Survey System for Concealed SMS Deposits” has been developed and tested. In this presentation, I will discuss the application of the system to investigate the mineral potential in volcanic arc and back-arc setting in western Pacific.

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WILLIAMS

## **Partnerships in the Pacific: Aligning Multiple Risk Assessment Tools for Evidence-based Decision Making**

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Evidence-based risk assessment using available tools provides a foundation for planning and implementation of disaster risk reduction activities. In the Pacific region, this is reinforced through

the Sendai Framework for Action 2015 – 2030 and the aligned Framework for Resilient Development in the Pacific 2017 – 2030, which calls for the uptake, use, and integration of risk assessment tools at a wide range of scales in order to facilitate disaster risk reduction and build resilience. Risk assessment modelling tools are available to help address this need in the Pacific. These tools enable the provision and incorporation of science-based evidence to help inform and support planning and emergency decisions made by the risk management community. However, there is no one tool that can meet the information needs of all users, although tools can be complementary provided they use common accepted standards. In this light, the availability of multiple tools in the region requires close coordination and alignment of support mechanisms and resources in order to best meet the needs of Pacific communities. This also helps to ensure that users know and have the confidence to use the most relevant tool depending on the given circumstances or decision that needs to be made.

Here we discuss a partnership between two complementary risk modelling tools being developed and/or tailored for use in the Pacific region via a multi-organizational initiative; RiskScape (through the Pacific Risk Tool for Resilience project – PARTneR) and PacSAFE. Challenges and opportunities of using standard approaches to risk data management are also described, in addition to discussing co-developed training and guidance materials initiated through recent knowledge exchanges. We use results of risk-related case studies from Tonga, Samoa, and Vanuatu to demonstrate the information generated via the tools including applications. PARTneR is funded through the New Zealand Aid Partnership Fund, and PacSAFE is funded through the Australian Department for Foreign Affairs and Trade.