



AN OVERVIEW OF THE GEOTHERMAL POTENTIAL OF PAPUA NEW GUINEA

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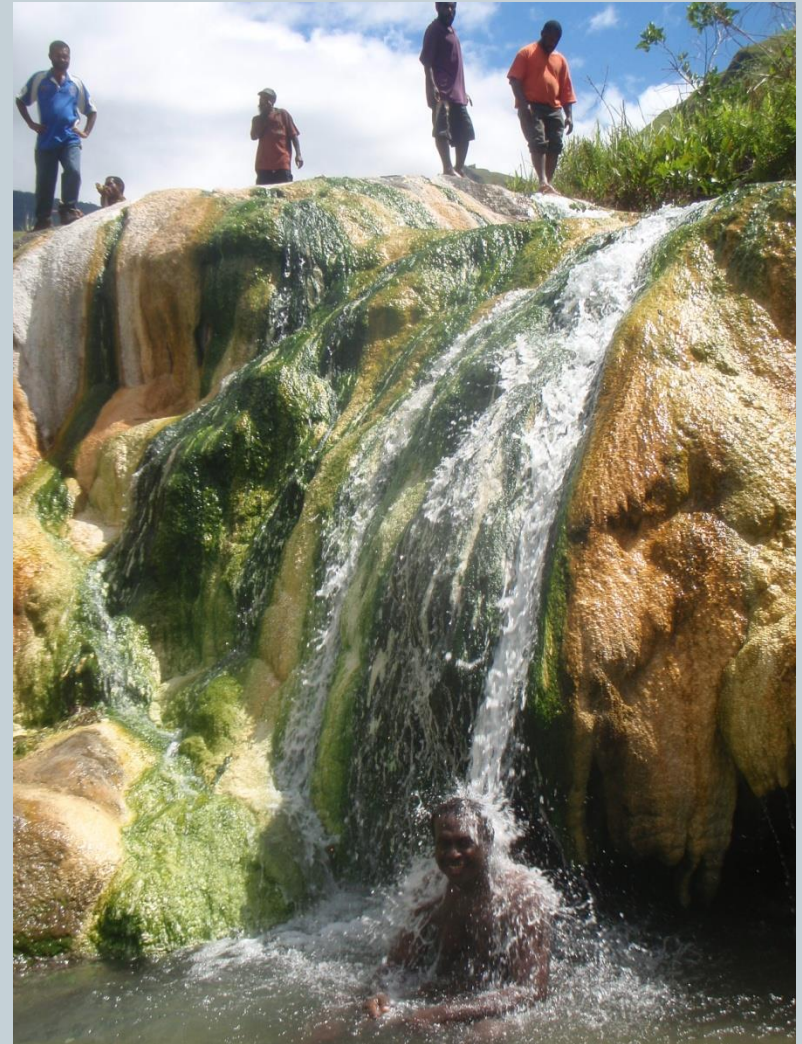
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INTRODUCTION



- PNG Energy Statistics

- Installed Capacity ~ 700 MW (2010)
- Power generation ~ 3333 M kWh (2010)
- Power consumption ~ 3100 M kWh (2010)
- Power sources :
 - Fossil fuel ~ 49.6%
 - Hydro ~ 42.1%
 - Geothermal ~ 8.3%

- PNG Current status

- 2003 – 26 MW commissioned – Lihir Island
- 2005 – upgraded to 56 MW





INTRODUCTION



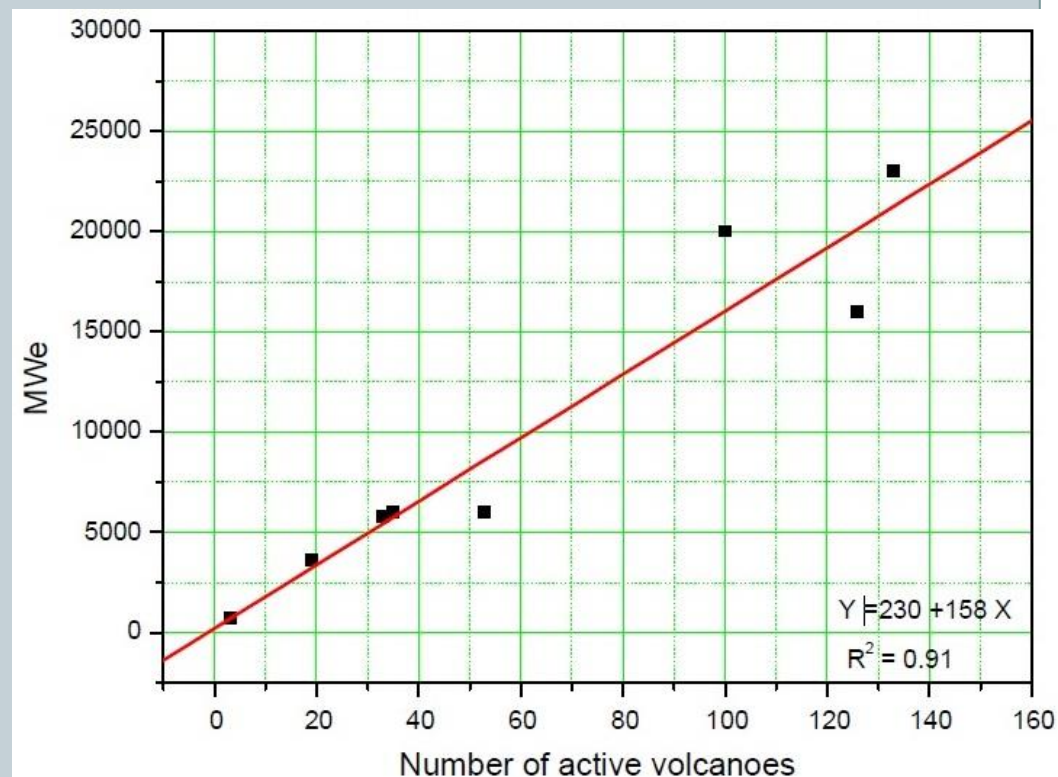
- What is PNG's geothermal potential?
 - 1970s
 - ✦ Early exploration
 - 2009 , 2011
 - ✦ GNS Science (NZ) conducts study on Pacific Island States, incl. PNG, geothermal potential. Identified PNG, Fiji to have potential for geothermal utilisation.
 - 2010
 - ✦ Renewed interest in geothermal resource mapping (Kairiru Island, Wau Bulolo areas)



INTRODUCTION



- What is PNG's potential?
 - Large geothermal power projects (>100 MW) are economical in active or recently active volcanoes
 - There is a simple linear relationship between number of active volcanoes and generating power potential
 - On the average each active volcano can sustain 158 MW electric
 - With >60 active volcanoes PNG's total generating potential can easily exceed 9000 MW, ranking within the top 5 geothermal producers in the world!



Source: Stefansson V., 2005: World Geothermal Assessment. Proc. World Geothermal Congress



INTRODUCTION



- **2012**
 - MRA secures World Bank funding for geothermal desk-top study
 - MRA staff attend training in NZ and Iceland. So far PNG trained 5 (4 MRA, 1 CEPA)
 - West New Britain and Milne Bay Provinces selected for WB-funded sampling program, based primarily for their economic potential
 - Sampling program commences in West New Britain



Sample preparation training



Awareness in WNB



Sampling in WNB



STUDY AREA 1 - WEST NEW BRITAIN



- 2011 Population ~242,678
- Total land area: ~21000 sq.km
- Economy base: Oil palm, logging, potential for mining
- Energy sources: Hydro (2.3MW), fossil fuel, bio-fuel (1.5MW), solar (rural village-based)
- Demand exceeding 5MW



STUDY AREA 1 - WEST NEW BRITAIN



Governor Westnewbritain added 5 new photos.

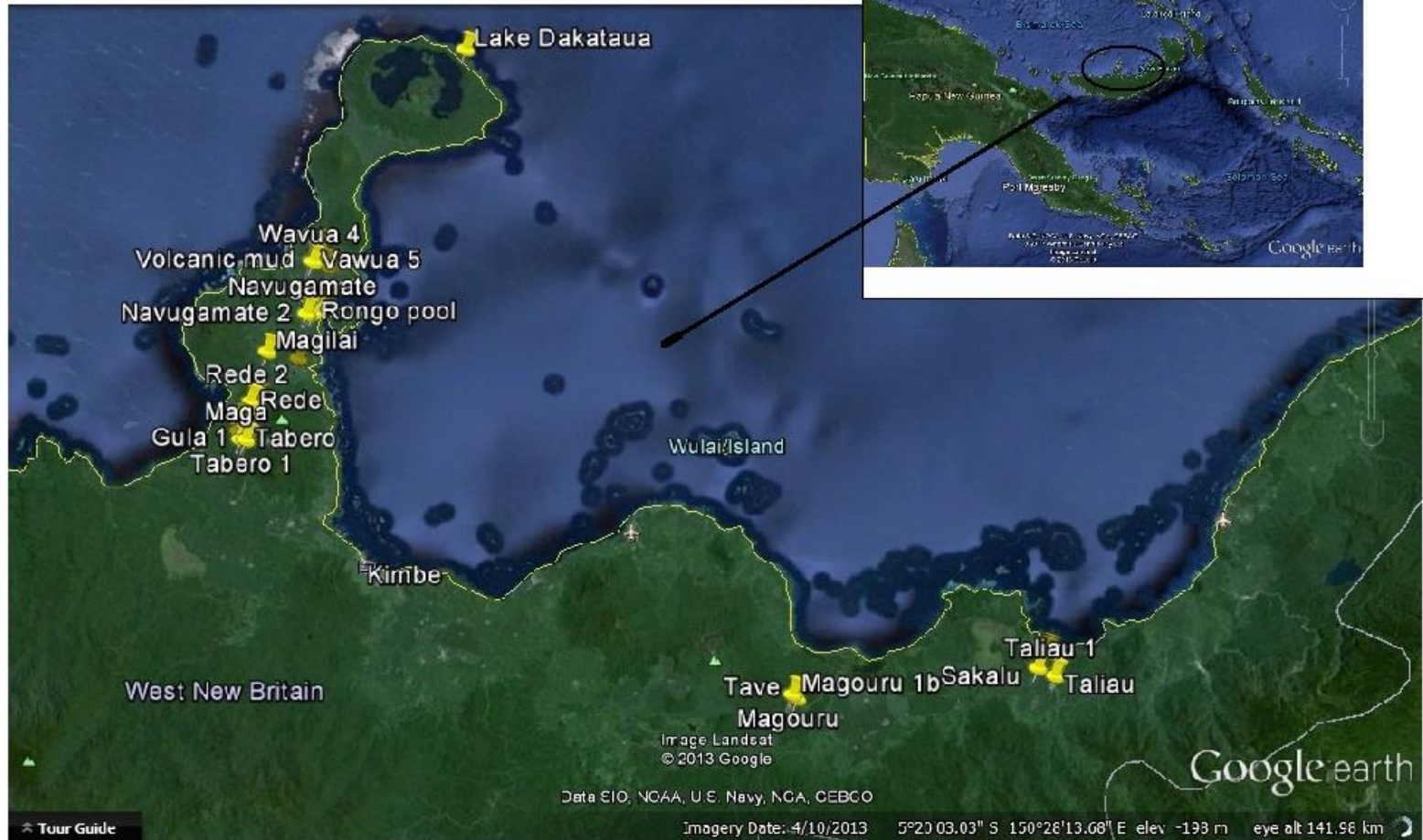
November 18, 2013 · 🌐

Finally Barefoot colleg founder Bunker Roy and his advisor Ms.Meagan arrived to WNB this morning, visited Aka village in Kandrian Island and Vituhu in Vit and tomorrow they will visit Tarobi yo select two grand mot from each village to travel to India to attend 6 months training to becom solat engineer. I am grateful that Indian Govt will sponsor for my 6 moth to travel to india and attend training, cloths, allowance all paid for. I am amazed with Mr.Bunker and Ms.Meagan's selection procesd. Thq qualification is 35 to 45 yrs old grandmother or single mother, illiterate, and tge least expected in the community got selected and anonymously accepted by the whole community. Some places, husbands are the problem, do not want to allow tgeir wives to travel out. The psycology behind empowering grand mothers are if we train a yiung man, immedia after training he or she will look for a shop in Port Moresby or Kimbe tov they won't stay in the village but the grandmother will certainly come bac her village and help solar electrify her whole village and also train the y ones. More than 10 countries will attend training and total capacity is to train a mixture of 40 members coming from all over the world and our mothers will get a wider exposure. For whole PNG Even whole pacific)t have only allocated 8 seats and 6 are selected from WNB and the otger mothers will come from Highlands region through Mr.Anthony Smare, so 8 mothers should travel to India by March and return ad solar engineers in





STUDY AREA 1 - WEST NEW BRITAIN





STUDY AREA 1 - WEST NEW BRITAIN



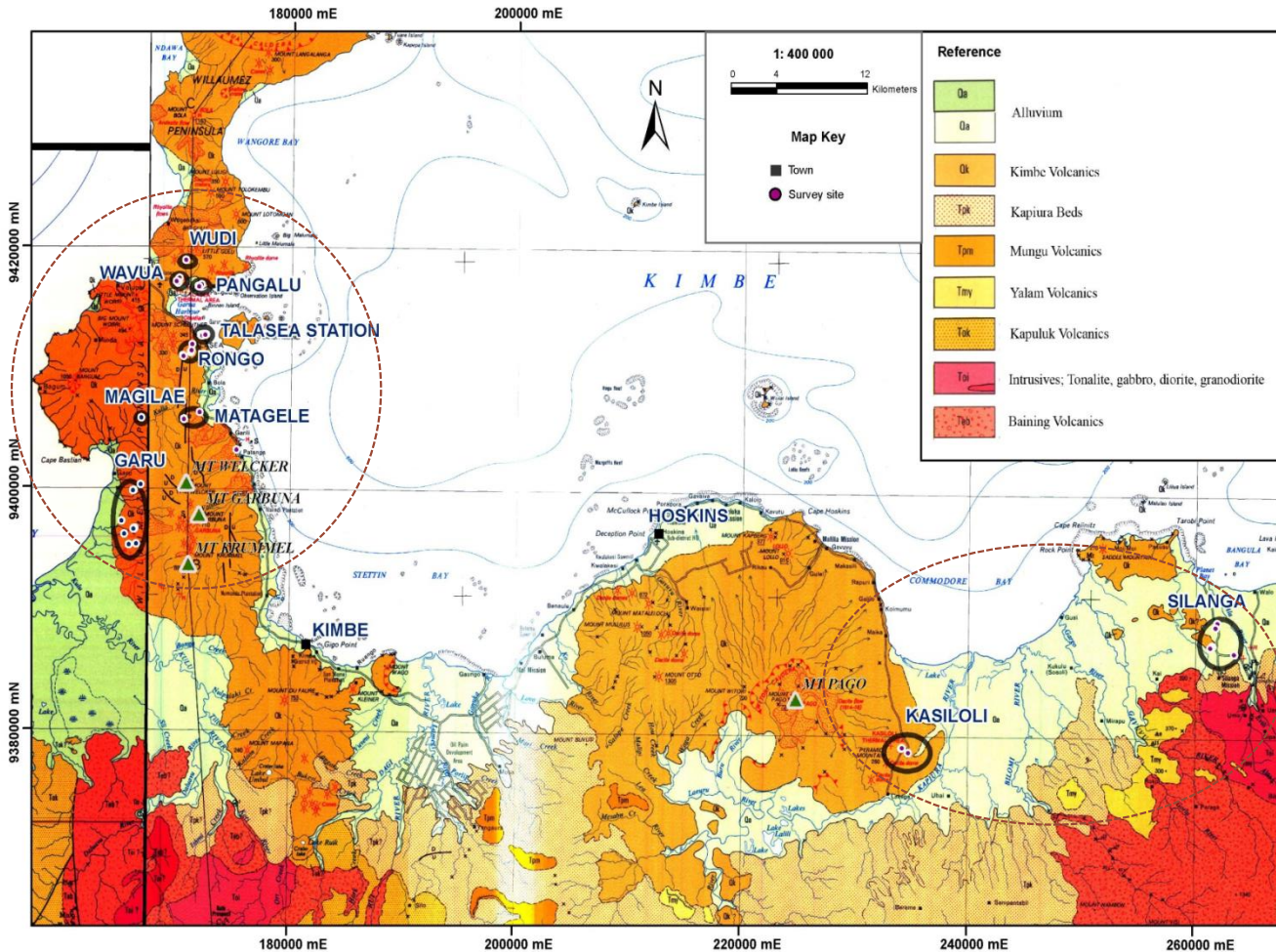
● GEOTHERMAL OCCURRENCES

- Two main geothermal fields: Talasea & Hoskins
- 35 thermal sites were visited and sampled for water, gas and rocks
- Occurrences characterised by hot springs, mud pools, mud geysers, geysers, fumaroles, hot and altered ground.
- Connectable to main grid





STUDY AREA 1 - WEST NEW BRITAIN



- Confined within the Quaternary Kimbe Volcanics
- Controlled by deep-seated N-S structures
- low pH – near neutral waters
- Temp. 60 - >100 C

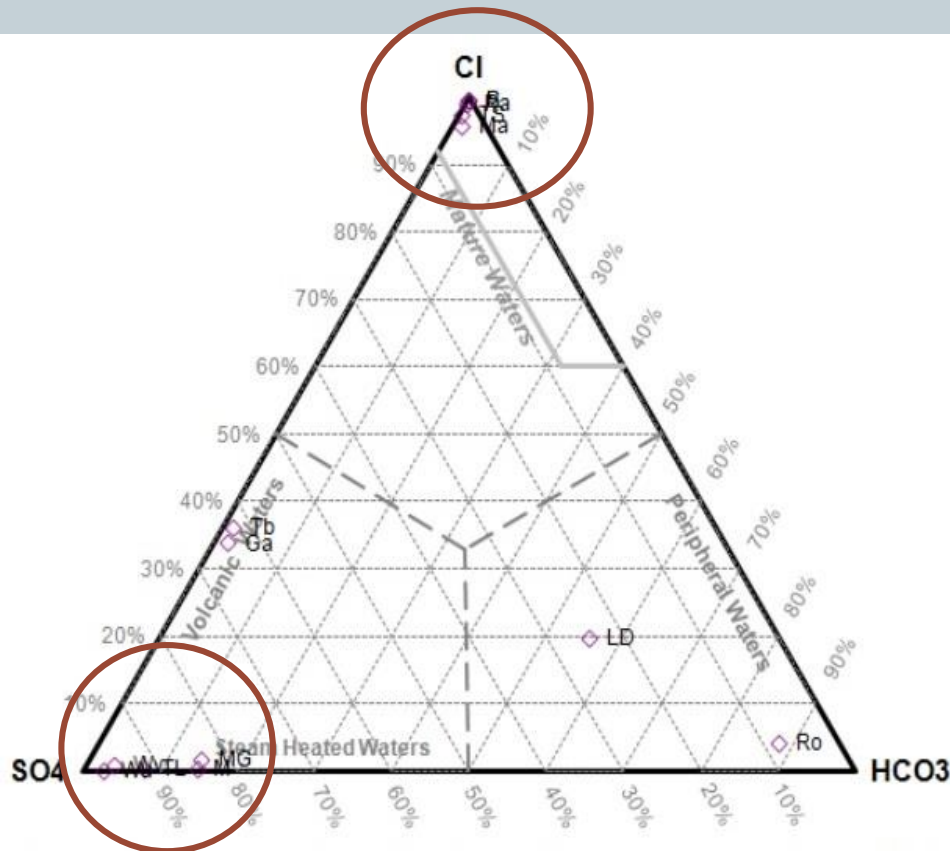


STUDY AREA 1 - WEST NEW BRITAIN



ANALYTICAL RESULTS

- Analytical testing conducted at GNS Science laboratory
- Geothermal water classification using $Cl-SO_4-HCO_3$ ternary plot



Rabili	Ra
Wavua 1	Wv
Talasea Station	TS
Rongo 1	Ro
Matagele	M
Magilae	MG
Lake Dakataua	LD
Wudi	Wu
Galu	Ga
Tabero	Tb
Bakama 1	B
Taliau	TL
Sakalu	S
Magouru	Ma

Magouru, Rabili, Sakalu
Talasea station – Mature
Waters

Taliau, Magilae, Matagele
Wudi, Wavua 1 –
Volcanic
Waters

Lake Dakataua, Rongo –
Immature waters



STUDY AREA 1 - WEST NEW BRITAIN

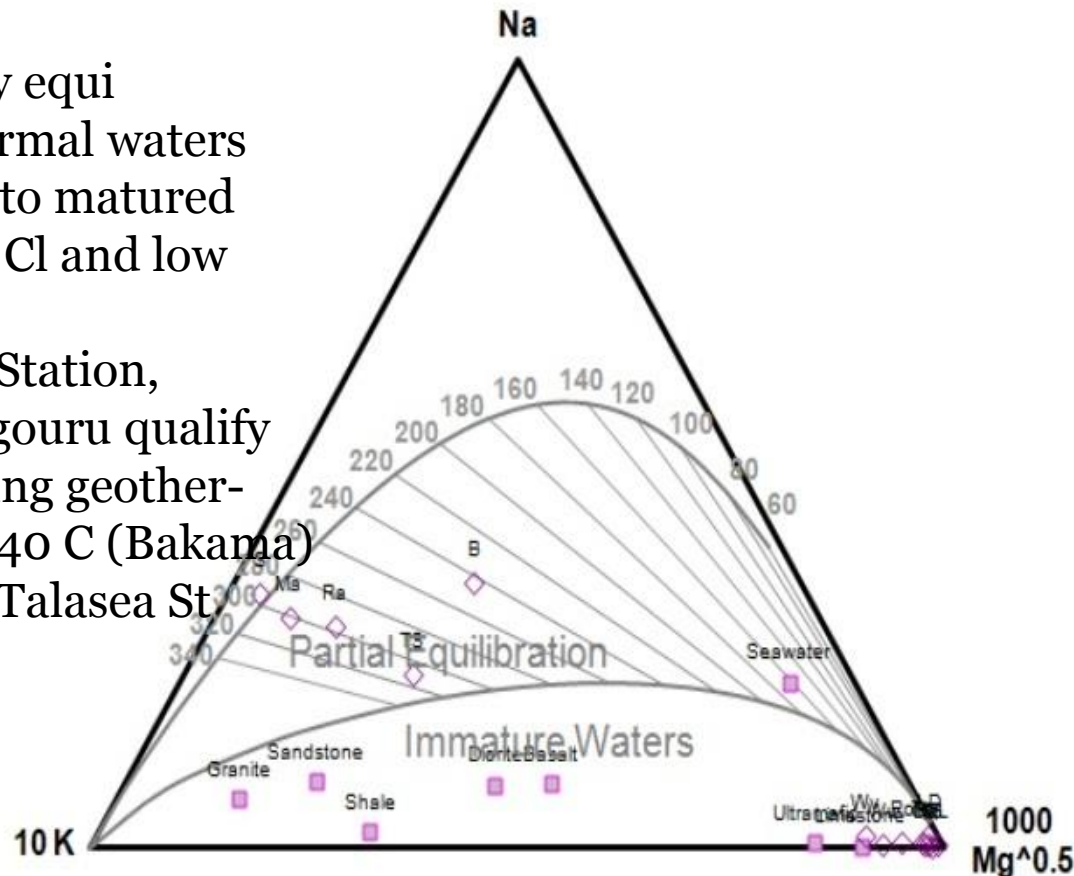


ANALYTICAL RESULTS

- Geothermometry using *Na-K-Mg* geothermometers

Conditions:

- applied on fully equilibrated geothermal waters
 - Must be applied to matured waters with high Cl and low SO₄
 - Rabili, Talasea Station, Bakama, and Magouru qualify
- Temperatures using geothermometry range 240 C (Bakama) 300-320 (Rabili, Talasea Station and Magouru)



Rabili	Ra
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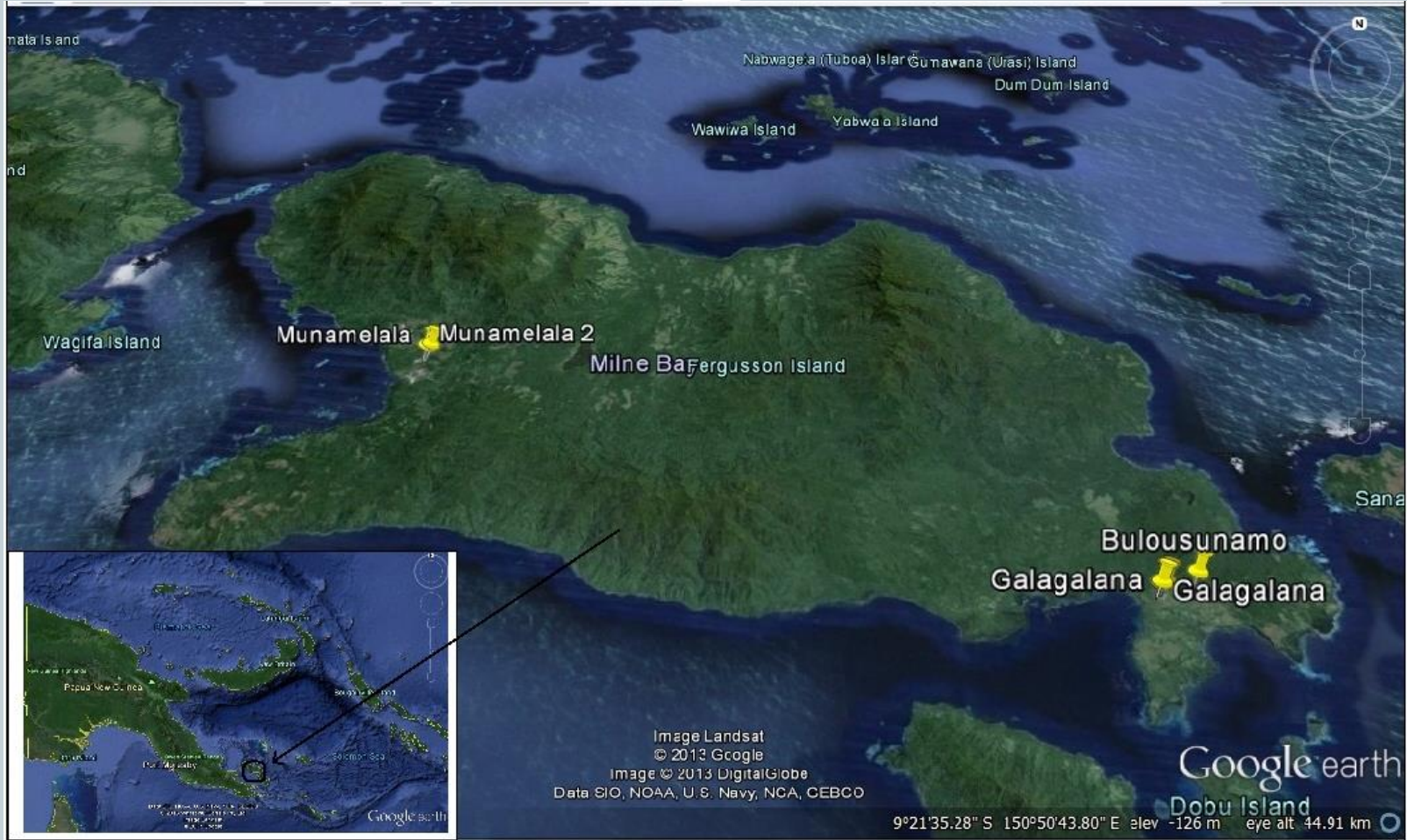
STUDY AREA₂ – MILNE BAY



- Population: ~209,054
- Total land area: ~14000 sq.km
- Economic base: Oil palm, tourism, mining
- Power source: Fossil fuel
- Totally dependent on fossil fuel



STUDY AREA2 – MILNE BAY





STUDY AREA₂ – MILNE BAY



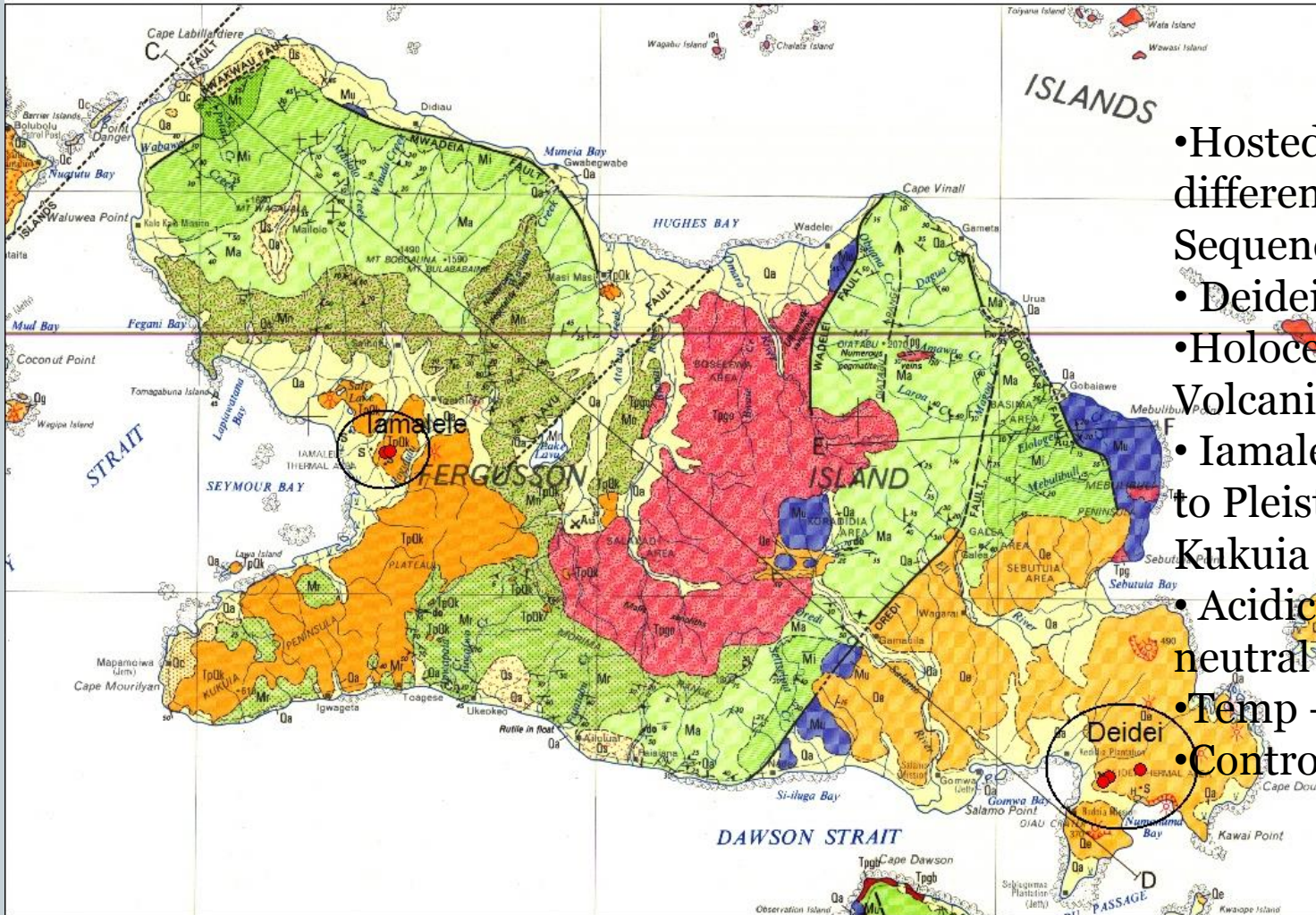
● GEOTHERMAL OCCURRENCES

- Two main geothermal fields: Deidei & Iamalele
- 6 Features were sampled at the site
- Occurrences are characterised by geysers, mud pools and hot streams
- Isolated from the main town





STUDY AREA₂ – MILNE BAY



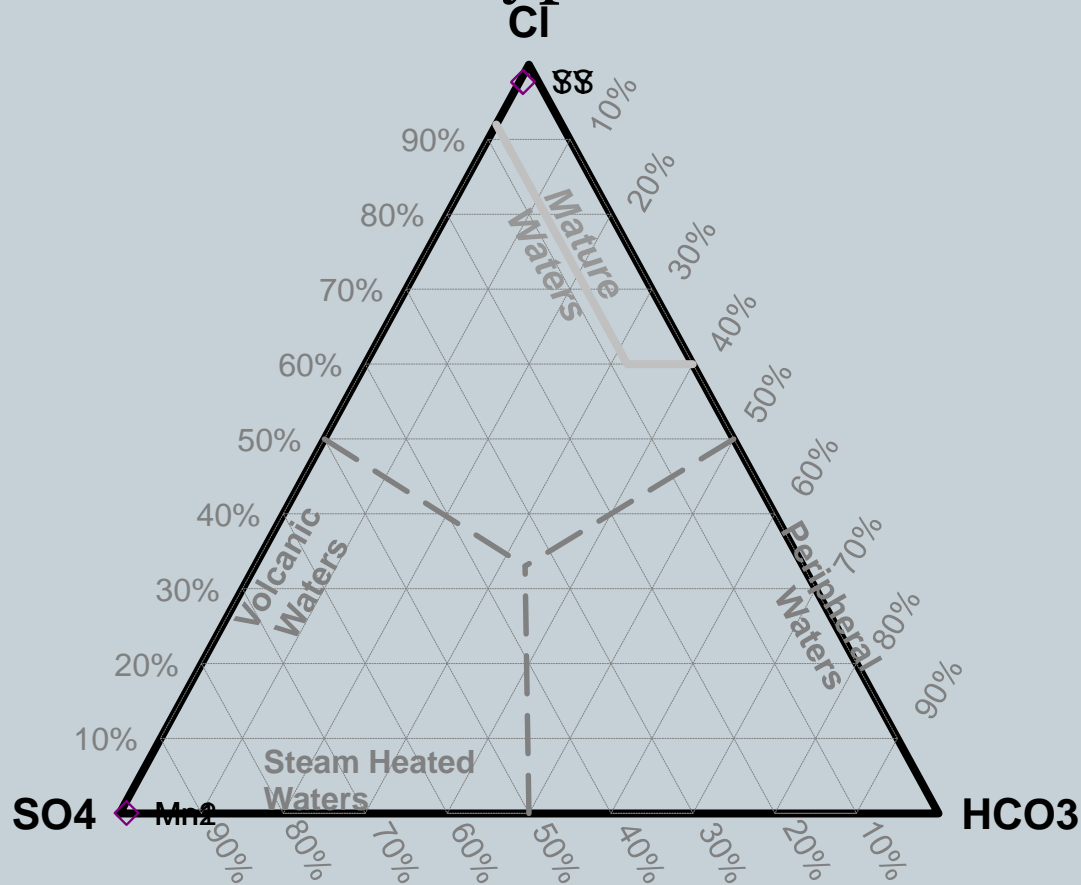
- Hosted within two different volcanic Sequences:
 - Deidei – Pleistocene to Holocene Sebuia Volcanics
 - Iamalele – Pliocene to Pleistocene Kukuia Volcanics
- Acidic to near neutral pH waters
- Temp – range 75 – 103 C
- Controlled by NE faults



STUDY AREA2 – MILNE BAY



• Results – water types



• Yaiyaiboalana (YY) and Seuseulina (SS) plot on Mature waters

• Munamelala (Mn) 1 & 2 plot on steam-heated Volcanic waters



STUDY AREA₂ – MILNE BAY



- Geothermometry

Geothermometers

Temperatures in degrees C

Sample Name	Amorphous Silica	Alpha Cristobalite	Beta Cristobalite	Chalcedony conductive	Quartz conductive	Quartz adiabatic	Na-K-Ca	Na-K-Ca Mg corr	Na/K Fournier 1979	Na/K Truesdell 1976	Na/K Giggenbach 1988	Na/K Tonani 1980	Na/K Nieva & Nieva 1987	Na/K Arnorsson 1983	K/Mg Giggenbach 1986
Seuseulina	107	185	135	220	234	209	260	260	257	239	269	281	243	243	335
Munamelala 1	112	191	141	226	240	214	273	273	273	260	283	305	258	263	351
Munamelala 2	91	168	118	201	217	197	128	63	480	591	465	694	462	556	93
	92	169	119	202	219	198	160	89	499	626	481	737	480	585	110

Given that only Seuseulina and Yaiyaiboana have matured water, geothermometry Indicates ~280 reservoir temperatures



RESULTS



- **West New Britain:**
 - Localities Talasea station, Rabili, Magouru and Bakama are mature geothermal waters with geothermometry temperature exceeding 300 – 320 degrees C
 - Waters are neutral
- **Milne Bay:**
 - Seuseulina and Yaiyaibola are mature geothermal waters with geothermometric temperatures up to 280 degrees C
 - Waters are near neutral



CONCLUSIONS



- Potentially 9000 MW
- Using World Bank funding, geochemistry of two sampled geothermal fields indicate high temperature geothermal reservoirs, $\sim 300^{\circ}\text{C}$
- We believe PNG has the potential to develop and utilise its geothermal resource
- Need to conduct deeper geophysics to define reservoir size



THE ROAD AHEAD



- Geothermal policy – Cleared by Office of State Solicitors. Next hurdle: NEC and Parliament.
- We plan to carry out further exploration on the two geothermal fields – need funding for geophysics (Resistivity or MT) and then drilling
- Plan for development of a power plant – IPP, BOT?
- Time-scale ~ within the next 5 years (I said that 3 years ago!).



ACKNOWLEDGEMENTS



- Acknowledge SPC-GSD support to PICTs in driving geothermal
- Very much welcome the support given by IRENA to help push for geothermal resources development in the PICTs

