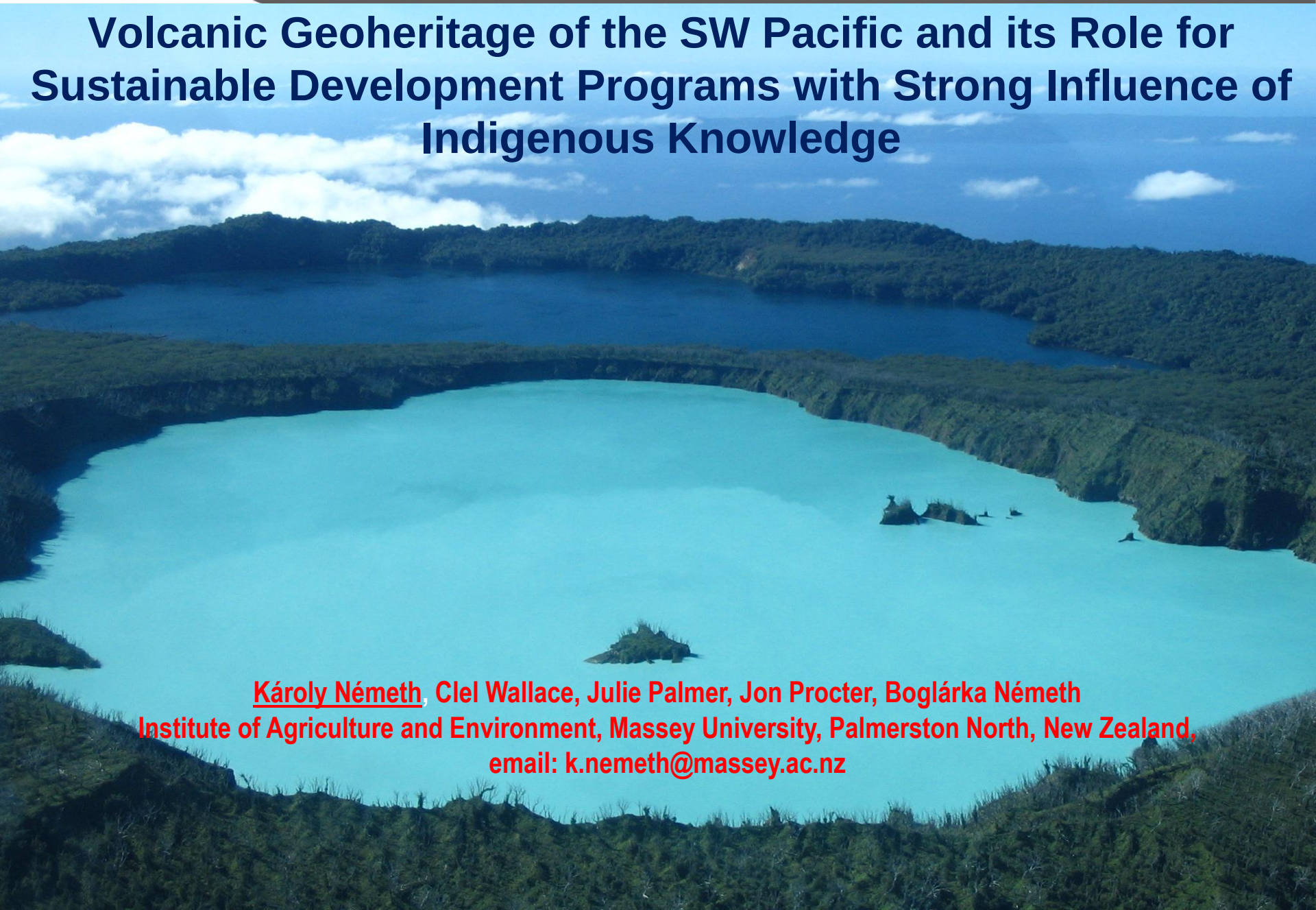
Volcanic Geoheritage of the SW Pacific and its Role for Sustainable Development Programs with Strong Influence of Indigenous Knowledge



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Why we care for this? And why is it important for the SW Pacific?

1) Tourism is in general a major sector in most of the economy of the countries including the SW Pacific countries;

2) Sustainable tourism (hence stable revenue generating) is commonly associated with the identification of the type of tourism a region intend to manage, attract or sustain;

3) Sustainable tourism is commonly associated with aspects of promoting values, beauties and resources of the Earth, hence commonly identified as geotourism;

4) Sustainability is heavily depending on the type of geoconservation associated with it;

5) Geotourism – Geoconservation links directly to Geoeducation;

6) Geoeducation is a powerful tool to disseminate information, knowledge and human behaviour models toward natural resources and natural disasters such as volcanism, seismicity, land movements, coastal processes of tsunamis (listing the most common natural hazards only);

7) All the above listed aspects strongly linked to geoheritage through identified and evaluated geosites;

8) The SW Pacific is a region where various natural hazards part of life; it is a region where a wealth of indigineous knowledge is underutilized to understand the environments (and/or not mixed well with western scientific approaches); and it is also a region where geotourism already attract large number of people, but they receive very limited quality of information relevant to the regions' very diverse geological build up. New Zealand is not different in this aspect from any other Pacific nations …

Geoheritage – Geoconservation - Geotourism

The term **geoheritage** derives from the **word heritage**, which means something that has been transmitted from the past, or has been handed down by tradition. The term is used internationally and carries a notion of the heritage of features of a geological nature. It axiomatically conveys the idea that there is something (valuable or otherwise) to inherit from the past and pass on to the future. The term geoheritage evolved from "geological heritage" (just as the term biodiversity evolved from the term biological diversity).

The term "**geological heritage**" first makes its appearance in the First International Symposium on the Conservation of our Geological Heritage at Digne, France in 1991 (Anon 1991). The term **geoheritage** first makes its appearance in the literature in the Malvern International Conference, the 2nd international conference dealing with geological and landscape conservation, held in the Malvern Hills (UK) in 1993 (Joyce 1994b; O'Halloran et al 1994) .

Geoheritage is an applied scientific discipline which focuses on unique, special and representative geosites, supporting the science of geology and its place in modern culture

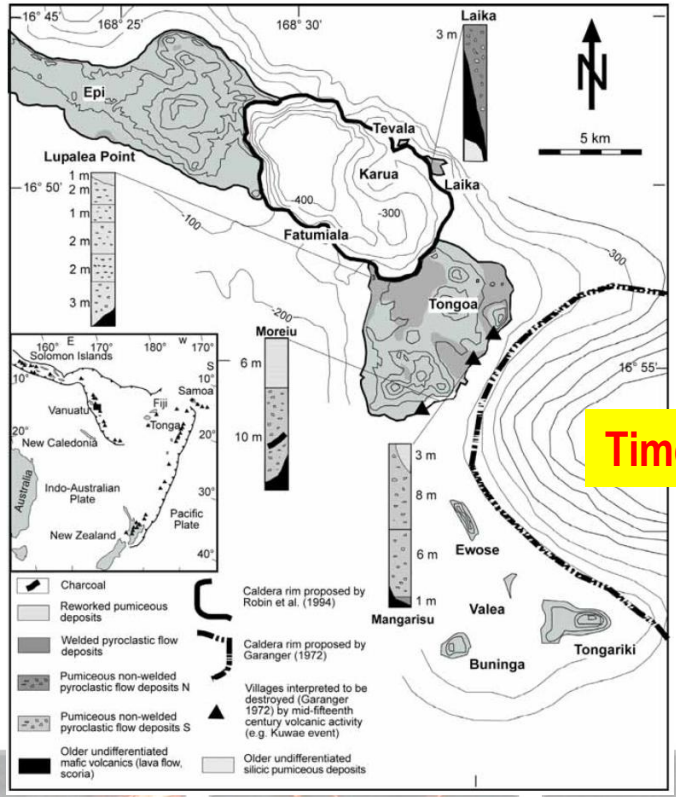
Very Western Scientific Approach – Need to be blended with traditional knowledge and concept of local communities on their geoheritage

Geoheritage - Definition

Intrinsically important sites may be globally unique, while culturally important sites may be common globally, but have a human value, acknowledging that some sites have both an historic as well as an intrinsic value.

This distinction is important, in that the former may comprise **globally unique sites**, while the latter may be **important only culturally**, e.g., unconformities may be common globally, and may be better examples than at Siccar Point where Hutton described them for the first time, but the location at Siccar Point represents an important historic as well as (an intrinsically) important geologic site.

Intrinsically Important Site – Kuwae 1452/53 Eruption Site



Culturally Important Site – Matavanu 1905-11 Eruption Site

Time-variable Concepts

Geoheritage - Definition

"**Geoheritage**" is a generic but descriptive term applied to sites or areas of geologic features with ***significant scientific***, ***educational***, ***cultura***l, **or** ***aesthetic*** value.

Scientifically and educationally significant geoheritage sites include those with textbook geologic features and landscapes, distinctive rock or mineral types, unique or unusual fossils, or other geologic characteristics that are **significant to education** and **research**.
Culturally significant geoheritage sites are places where geologic features or landscapes played a role in cultural or historical events.
Aesthetically significant geoheritage sites include landscapes that are visually appealing because of their geologic features or processes. Many geoheritage sites can be tourist destinations and provide local and regional economic benefits."
GSA Today 2011 April/May, pp. 56-58.

Scientifically Important - Ambrym

Culturally Important - Savaii

Aesthetically Important - Upolu

Geoheritage – Grade of Significance

International

National

State-wide

Regional

Local

Levels of significance is a matter that needs to be addressed in classification and site selection, and be incorporated into any planning and management strategy so that geoconservation can be addressed in local and regional issues, as well as the axiomatic protection of sites of international and national importance

Brocx & Semeniuk 2007

Why one of them has higher significance than the other while both of them are geologically very similar??

A Big Problem – Scientific Approach Needed

Scale term	Frame of reference	Examples
Regional scale	100 km x 100 km or larger	mountain range scale or drainage basin scale: Dampier Archipelago complex
Large scale	10 km x 10 km	large outcrop scale: limestone barrier at Port Hedland
Medium scale	1 km x 1 km	small mesas and adjoining plain
Small scale	10–100 m x 10–100 m	outcrop scale: such as local cliff face exposure
Fine scale	1 m x 1 m	bedding scale: such as fossils in a shelly lens
Very fine scale	1 mm x 1 mm, or smaller	crystal features

Geoheritage Scale of References

Scale - Scope – Significance

The Scope Problem

Causal processes (process-oriented)

VS

Sites offer insight for seeking to historically reconstruct the Earth's development (product-oriented)

Geoheritage - UNESCO World Heritage

Outstanding Universal Value

Selection Criteria:

(vii) to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;

(viii) to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;

The **protection**, **management**, **authenticity** and **integrity** of properties are also important considerations.

Geoheritage – Geosite Assessment

Brocx & Semeniuk 2007

The level of importance attributed to a given feature of geoheritage significance is related to one of two factors:

1. **how frequent, or common, is the feature within a scale of reference?; and**
2. **how important is the feature intrinsically or culturally?**

Main questions for evaluation geoheritage values are?

- Are they unique?
- In what level they are significant? Local, - Regional, National or International?
- In what scale they are unique or significant?
- Are there enough scientific background to present them scientifically in a correct way?
- Are they accessable?
- Are they carry specific geoheritage values, that can be linked to other cultural or historic heritage values?
- Are they intact?
- Are they in danger?
- Are they under some sort of protection?

Scale: Regional, Large, Medium, Small, Fine, Very Fine

Scope: Process-oriented, Product-oriented

Grade of Significance	Aestethic	Cultural	Scientific *Educational*
International			
National			
Regional 2			
Regional 1			
Local			

Geoheritage Values →

Geosite – Geotope

Geosites – Geomorphosites are the smallest "units" with measurable geoheritage values

Geotopes – Geomorphotopes are complex systems that can be linked into a natural network of items with significant geoheritage values.

Geoparks are sites established along significant geoheritage values presented through a structured geoeducational concept that based on natural geological values deeply embedded in a local and global human environment.

Volcanic Geoheritage
Volcanic Geosites/Geomorphosites
Volcanic Geotopes/Geomorphotopes
Volcanic Geoparks

Size – Accessibility - Scientific value - Geotourism appeal - Educational value - Historical significance - Cultural, spiritual and social value - Economic value - International significance - Link with biodiversity - Aesthetic quality – Representiveness - Stratigraphic landmark - Palaeo-biodiversity - Rare or unique character - Precious character – Vulnerability - Refuge for rare and threatened species.

Geopark vs UNESCO World Heritage

- Two very different mechanisms can be envisioned for the promotion, protection and management of the SW Pacific region:
- 1) the "Geopark" approach and the
- 2) "World Heritage" approach.
- The recently revised **UNESCO Global Geopark** program has goals and regulations that differ in important ways from the **UNESCO World Heritage** program.
- The idea of geoparks needs to be discussed with local communities.

Participatory Methods Could Be Applied
Same as it has been applied for volcanic hazard education

Geopark Aspect

Very strong comparative study that scientifically super stable

World Heritage Aspect

Geopark Concept

- Through the creation of a world network of natural parks with significant geological features, labelled UNESCO Geopark, UNESCO promotes the twin goals of conserving a healthy environment and enhanching sustainable economic development.
- Geoparks are designed to become a tool for a better understanding of the geological heritage and wise use of of the Earth´s crust, by public awarnes for a balanced relationship between humankind and the Earth.
- Geoparks are regions where the geological complexity and interrelationships between different processes are clearly visible, commonly in a form of spectacular structures and/or preservation of rock formations.
- Geoparks – Volcanparks are even more dramatic landscapes than other geological sites, therefore they are excellent regions to present geology for the general public.
- Geotops (Biotops) – Geosites – Geomorphosites
- Classification of volcanic landforms: small vs large – general, non-geologist audience
- Assesing volcanic gesites/geomorphosites – outstanding versus representative approach
- UNESCO World Heritage versus Geoparks
- ONLY two volcanic UNESCO Wolrd Heritage Site exist (Jeju and Teide/Canary Islands), it isunlikely that new sites will be accepted in future – these two sites carry significant responsibility to promote Global Geopark promotions – monogenetic versus polygenetic volcanic systems.
- About 57 Geoparks (2008) listed by UNESCO – only few are clearly volcanic – dominated by monogenetic volcanic fields: 1) Eifel Vulkanpark, Germany; 2) Kanawinka Global Geopark, Australia, 3) Giant's Causeway, Ireland, 4) Wudalianchi Geopark, China.
- About 6 new volcanic geopark listed recently from China

UNESCO World Heritage Concept

- UNESCO World Heritage Site as a Natural Property **arguable outstanding globally** in both criterion:
- **criterion (vii):** **Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance** (Badman et al. 2008) and also on the
- **criterion (viii):** **Be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features**.

Is this a potential World Heritage Site???

Geosite Assessment Methods (GAMs)

	0	0.25	0.5	0.75	1	TEST GEOSITE
Scientific/Education (VSE)						
Rarity	common	regional	national	international	only	0.75
Representativeness	none	low	moderate	high	utmost	0.5
Kowledge on geoscientific issues	none	local publications	regional publications	national publications	international publications	1
Level of interpretation	none	moderate process/hard to explain	good process/hard to explain	moderate process/easy explain	good process/easy explain	1
Scenic/Aesthetic (VSA)						
Viewpoints	none	1	2 to 3	4 to 6	6+	0.5
Surface	small	-	medium	-	large	0.5
Surounding landscape and nature	-	low	medium	high	utmost	0.75
Environmental fitting of sites	unfitting	-	neutral	-	fitting	1
Protection (VPr)						
Current condition	totally damaged	highly damaged	medium damaged	slightly damaged	no damage	0.75
Protection level	none	local	regional	national	international	0.25
Vulnerability	irreversable	high	medium	low	none	0.25
Suitable number of visitors	0	0 to 10	10 to 20	20 to 50	50+	0.75
Functional (VFn)						
Accessibility	inaccessible	low	medium	high	utmost	0.75
Additional natural values	none	1	2 to 3	4 to 6	6+	0.5
Additional anthropogenic values	none	1	2 to 3	4 to 6	6+	1
Vicinity of emissive centers	100 km+	100 to 50 km	50 to 25 km	25 to 5 km	5 km>	0.75
Vicinity of important road network	none	local	regional	national	international	0.75
Additional functional values	none	low	medium	high	utmost	0.75
Toursitic values (VTr)						
Promotion	none	local	regional	national	international	0.25
Organized visits	none	<12/year	12 to 24/year	24 to 48/year	48/year+	0.25
Vicinity of visitor center	50 km+	50 to 25 km	20 to 5 km	5 to 1 km	< 1 km	0.75
Interpretative panels	none	low quality	medium quality	high quality	utmost quality	0.25
Number of visitors	none	low (<5000/yr)	medium (5000-10000/yr)	high (10000-100000/yr)	utmost (100000+)	0.5
Tourism infrastructure	none	low	medium	high	utmost	0.25
Tour guide services	none	low	medium	high	utmost	0
Hostelry service	50 km+	25 - 50 km	10 - 25 km	5 to 10 km	< 5km	1
Restaurant service	25 km+	10 - 25 km	10 - 5 km	1 to 5 km	<1 km	0.75

Geosite Assessment Methods (GAMs)

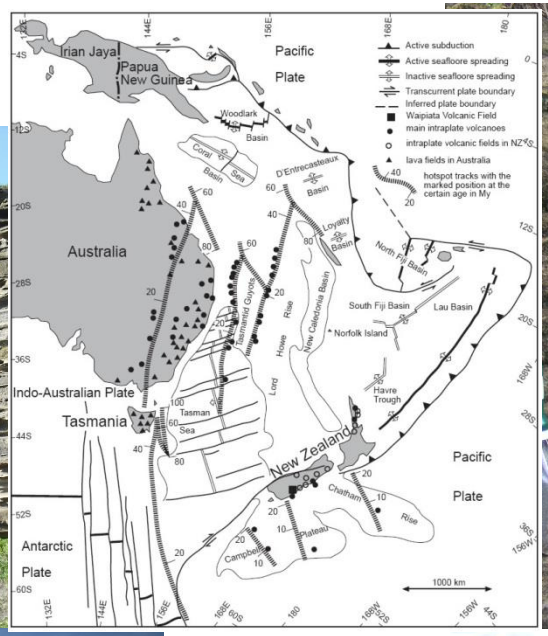
			Weight		
Integrity	0.75			0.75	
Representation	0.5			0.5	
Rarity	0.5			0.5	
Paleogeographical value	0.25			0.25	
Scientific Value Total	0.5			0.5	
Ecological Impact	1			1	
Protection	0.5			0.5	
Ecological Value Total		0.75	0.15		0.75
View Points	0.5			0.5	
Aesthetic Structure	0.75			0.75	
Aesthetic Value Total		0.625	0.25		0.625
Religeous Value	1			1	
Historical	1			1	
Artistic Literature	0.75			0.75	
Geohistorical	0.25			0.25	
Cultural Value Total		0.75	0.5		0.75
Economical Value Total		0.25	0.1		0.25
Additional Values Total		0.59375	1		0.59375

Large number of GAMs exist

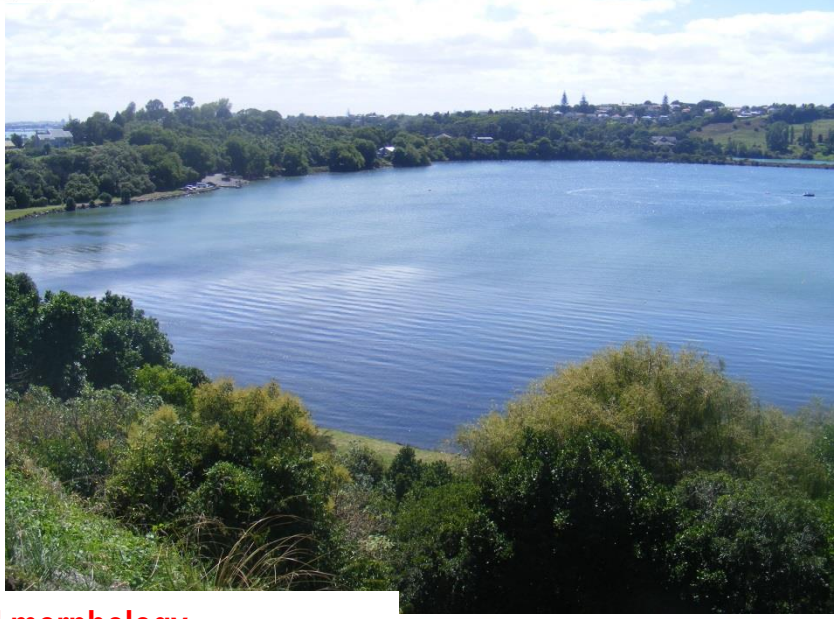
Most of them underutilize traditional knowledge and/or indigenous cultural aspects of a site

Volcanic Geoheritage in the SW Pacific

Newer Volcanic Province
Kanawinka Geopark



Auckland Volcanic Fleld
?????? Global Geopark



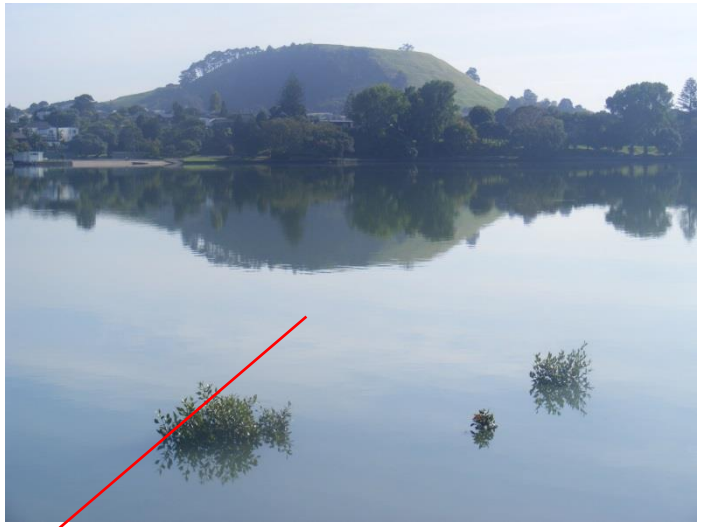
Surface exposures – near original morphology

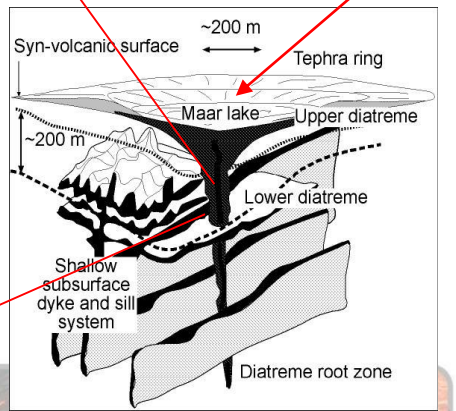
Global Link Aspects – Geoeducation Design

To link geoparks (geosites/geotops) of (monogenetc) volcanic fields on a global scale = integrated global effort needed

Chubut (Argentina) diatreme field

Auckland, New Zealand





Potential link to demonstrate deep and surface architecture of phreatomagmatic volcanoes

Western Science vs Volcanic Geoheritage

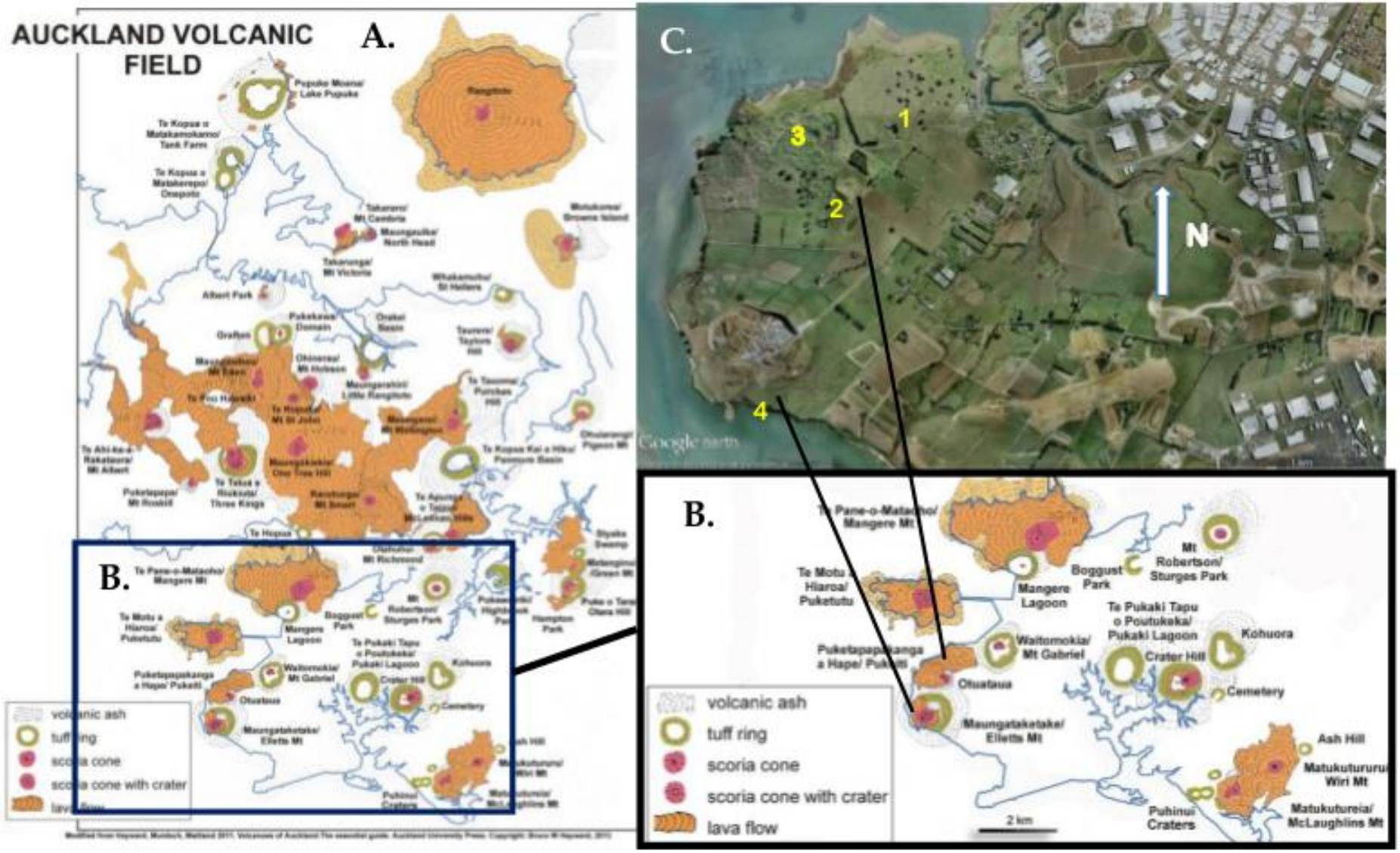
Auckland Volcanic Field
It was the host of a major conference on monogenetic volcanism (IAVCEI-IAS 4th International Maar Conference February, 2012)

Payunia/Llancanelo Volcanic Field
It was a host of a major conference on monogenetic volcanism (IAVCEI-IAS 3rd International Maar Conference)

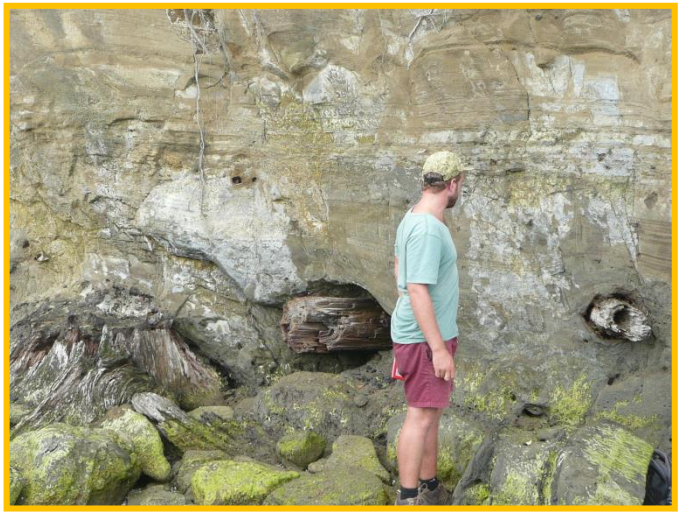
Auckland Volcanic Field
Auckland, New Zealand
No plan
Would be good candidate, extensive research, limited or unexplored external support

Payunia/Llancanelo Volcanic Fleld
Mendoza, Argentina
Proposed
Good candidate, initial research, good external support
Significant logistic questions

Auckland Volcanic Field, NZ



Auckland Volcanic Field, NZ



Traditional Cultural Values vs GAMs

!!!Questions!!!

Would Auckland geosite values score different if Auckland would sit on other than an active volcanic terrain?

Would have early human occupation evolved in different style/way if Auckland would be a non-volcanic (or other rock-dominated) landscape?

Would have a same cultural evolution of the region seen if Auckland would be a limestone, mudstone or flat alluvial plain?

Would have the location of the traditional significant burial sites, settlement sites or mythological sites of the region developed in different place as they evolved (hence key archaeological sites would differ)?

None of these questions are really asked in current GAMs methods

Current GAMs may miss fundamental part of the geological aspect of a site its link to the human society, culture that is the core of any heritage including geoheritage …

SW Pacific is a likely location where such aspects are potential key values for a site correct evaluation

Surtsey – 3rd day of eruption,
November 16, 1963 (Photo: Sólarfilma)

Surtseyan-style eruption
Scientific definition

Ambae 2005 – Intra-caldera Surtseyan eruption

Graham Island/Ferdinandia, Sicily – 11 July 1831, disappeared by December 1831
9 January 1832 – only shallow reef-like bank

Conclusion

Traditional Cultural Values and Legends as Part of Geoheritage in the SW Pacific?

"Myths recalling how islands were "fished up" or "thrown down" by (demi) gods are widespread in the Pacific Islands. Fishing-up myths are more numerous and are concentrated in a heartland comprising parts of Samoa, Tonga, the southern Cook Islands, and the Society Islands of French Polynesia. Geological details in many fishing-up myths suggest these recall the activities of shallow submarine (jack-in-the-box) volcanoes, notably in Tonga, and that these myths diffused to places where such volcanoes do not exist. Other fishing-up myths-particularly those recalling rapid emergence and/or successive uplift events and tectonic instability during the process of fishing-up-are suggested as recalling coseismic-uplift events (uplift coincident with large earthquakes), which are comparatively common in islands along the convergent plate boundaries of the southwest Pacific (including parts of Tonga and New Zealand). Throwing-down myths are less common in the Pacific, being effectively confined to places (near) where volcanoes erupted within the period of human occupation. Throwing-down myths are interpreted as recalling volcanic eruptions."

From Nunn PD (2003) Fished up or thrown down: The geography of Pacific Island origin myths. Annals Of The Association Of American Geographers 93(2):350-364

Conclusion

Geology deals with time and space in a form of preserved commonly not fully exposed rocks therefore the understanding of such features in general needs more input from the general public than any other subject.

The general incoherent style of presented information even in a well-confined area can give a hard time for a public to find the logical path between presented geological sites.

It can be concluded that up to now there is no or just limied pedagogical concept can be recognized in the current explanation forms in most of the protected geological sites.

We can conclude, if Geoparks are supposed to be sites where due to the good preservation potential of geological features diverse geological information may fit into a general logical path, it must be developed under a suitable pedagogical method and should be coordinated by a single authority to guarantee the homogenity of the presentation styles etc. Geoparks are an extremally powerfull sites to help to develop a valuable educational system that could pass information to people about earth sciences.

The SW Pacific clearly hold rich geoheritage that has not been utilized in a level it could be for geotourism and geoeducation.

Geheritage studies in the SW Pacific could be used in natural hazard education.

In both way (Geopark and World Heritage Aspects) geosite evaluation in the SW Pacific could only be a successful process if 1) traditional and western knowledge blended well and 2) community participation and high level management link together in assesment of sites and programs.