Geomorphology of the Pigeon Island National Park, Sri Lanka

Jinadasa Katupotha[1] and Chandana Senevirathna[2]

[1] Emeritus Professor, Department of Geography, University of Sri Jayewardenepura Nugegoda 10250, Sri Lanka, Email: *katupotha@gmail.com*
[2] District Project Coordinator, PCZRSM Project, Trincomalee, Sri Lanka

IFAD/GEF Participatory Coastal Zone Restoration and Sustainable Management Project

National Research Symposium - Sharing Knowledge for a sustainable management of Pigeon Island National Park

April 27th -28th 2017 at Sea Lotus Park Hotel Trincomalee, Sri Lanka.

INTRODUCTION

Pegeon Island is located within the northern latitude of 8º43′17″- 8º43′23″ and longitude of 81º12′06″ 81º12′26″.

It is away 2.3 km from Nilaweli Beach boat landing point to the Pigeon Island boat landing point.

As a tropical tiny (small) island, the Pigeon Island National Park is encompassing a total area of 471 hectares.

The island's name derives from the rock pigeon which has colonized it.

The island was used as a shooting range during the colonial era, and this Island was designated as a sanctuary in 1963. Later, it was redesignated as a national park in 2003.

The island is situated within the dry zone of Sri Lanka with the mean annual temperature is around 27.0 °C.

The annual rainfall ranges between 1,000-1,700 mm while most of the rainfall received during the northeastern monsoon season from October to March.

Pigeon Island consists of two parts (islands); triangle shaped island (A), and Elongated shape island (B).

The maximum depth varies between the main island of Sri Lanka and the Pigeon Island about 29m.


2/10/2014
Island A
(Part I)
Island B
(Part II)
200 m
Image © 2016 CNES / Astrium

EVOLUTION OF THE PIGEON ISLAND

- **Many plate reconstructions suggest that the foundation or basement rocks in Sri Lanka could be of Archaean age, whici is lasted a long time, 2,800 Ma ago (Hölzl et al. 1991; Krönert et al. 1991).**

- **The landmass of Sri Lanka remained joined with other landmasses of Africa, Madagascar, Seychelles, India and Antarctica (Braun 2003, Cooray, 1994).**

- **Breaking up signs of Gondwanaland into Africa, Madagascar, Seychelles, Sri Lanka, India and Antarctica-Australia complex were in Lower Permian period of Paleozoic Era (298.9 to 279.3 Ma ago).**

- **The geological formations, mainly the Jurassic and Miocene formations were formed during the long span of time on the northwestern coastal zone and northwestern coastal belt by Neogene Period.**

- **The salient feature of very long time period is the south western to northeastern island and islets surrounding Sri Lanka form by Highland complex Vijayan Complex rocks**

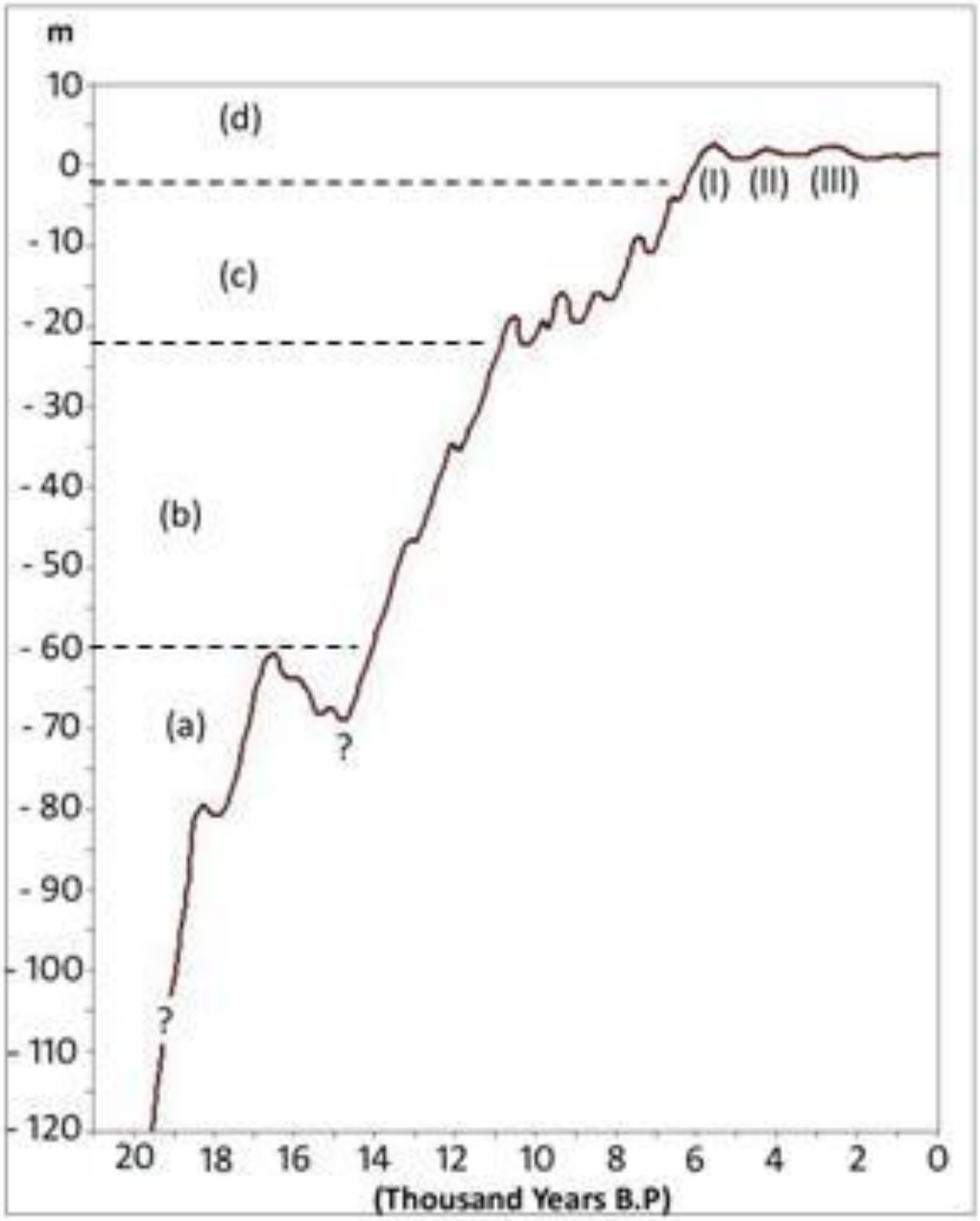
- **They were subjected to sea level fluctuations ever and anon.**

- **The present morphological features of the Pigeon Island developed since Flandrain Transgression (*Upper Pleistocene* (18,000-17,000 B.P), and during the *Holocene* Epoch (from 6500 B.P to the present).**

- **These rapid sea level rise has evidently influence to the evolution of tropical large and small islands like Pigeon Island.**

- **Except rock outcrops and boulders, other geomorhologicl features have developed during the Holocene Epoch.**


Pigeon Island
2.3 km
Nilaweli Beach
1000 m
Image © 2016 CNES / Astrium



Sea level oscillations in Sri Lanka since Last Glacial Maximum (Katupotha, 1993.

Evidently, sea level rise in Sri Lanka is related to Mid and Late Holocene fluctuations.

These fluctuations have been summarized by Katupotha (1994 & 1995), and recognizes five stages (phases) in the Late (Upper) Pleistocene and Holocene events.

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PURPOSE OF THE STUDY

This preliminary study reveals the:

- **basic geomorphic zone**
- **their characteristics**
- **Geomorphological evolution, and**
- **geologic evolution of the Pigeon Island**

METHODOLOGY

The geomorphic features of the Pigeon Island were studied by a field survey, conducted on 3 April 2017, and satellite map (Google Earth Image).

The different morphological units of the beach (low, mid, and high-tidal zones and berms), old beaches, boulders and rock outcrops, and extension of inter tidal zone studied the visual field experience on beach morphology, constituents of the beach material, mineralogical and structural characteristics of the boulders and rock outcrops.

RESULTS AND DISCUSSION

The main features are Holocene submerged and emerged coral patches; Contemporary sandy beach patches; Indented shoreline and the beach; and Mangrove swamp patches; and Rock outcrops and boulders.

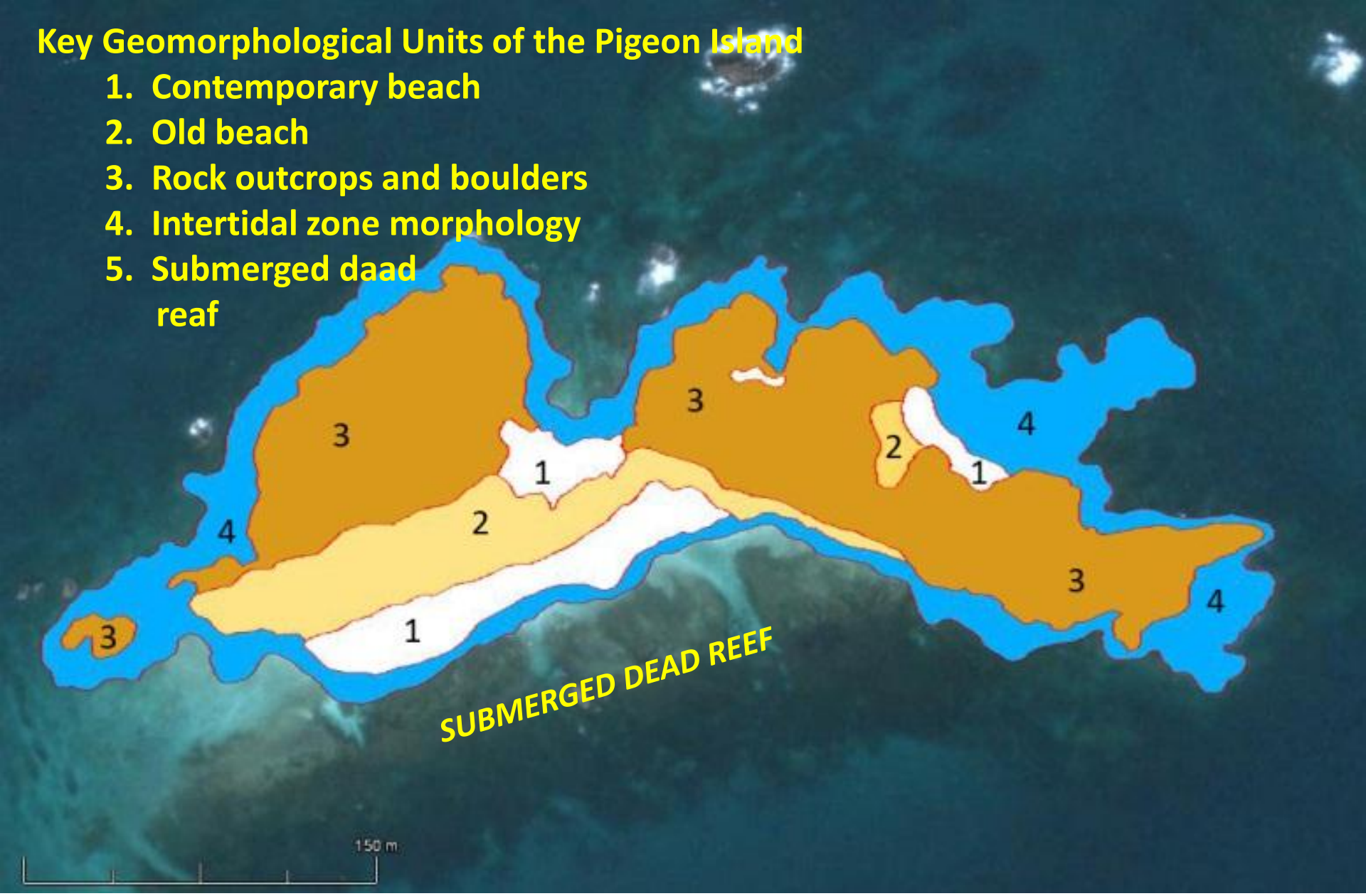
The rock outcrops and boulders belong to the Vijayan Complex of Precambrian age.

The other morphological features have been developed since Flandrain Transgression (*Upper Pleistocene* (18,000-17,000 B.P.), and during the *Holocene* Epoch (from 6500 B.P to the present).

These rapid sea level rise has evidently influence to the evolution of tropical large and small islands. Except rock outcrops and boulders, other mentioned geomorhologicl features have developed during the Holocene Epoch.

Key Geomorphological Units of the Pigeon Island

1. Contemporary beach
2. Old beach
3. Rock outcrops and boulders
4. Intertidal zone morphology
5. Submerged daad reaf



Beaches of the Pigeon island

- The area adjacent to a seashore of the Island.
- The area covers by sand, pebbles or coral rubbles along a shore.

Sand and coral rubbles

Coral rubbles


Coral rubles of different species
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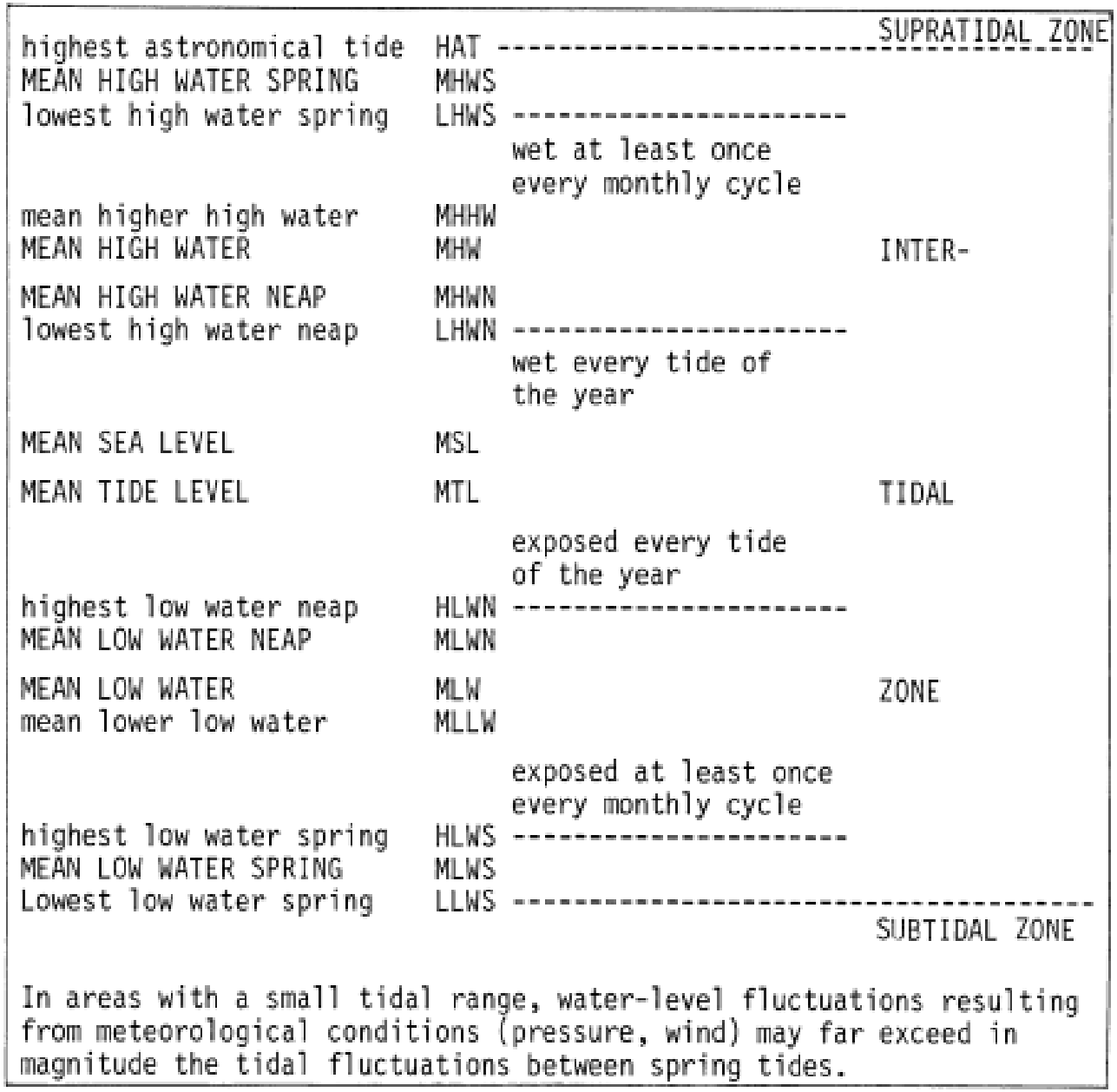
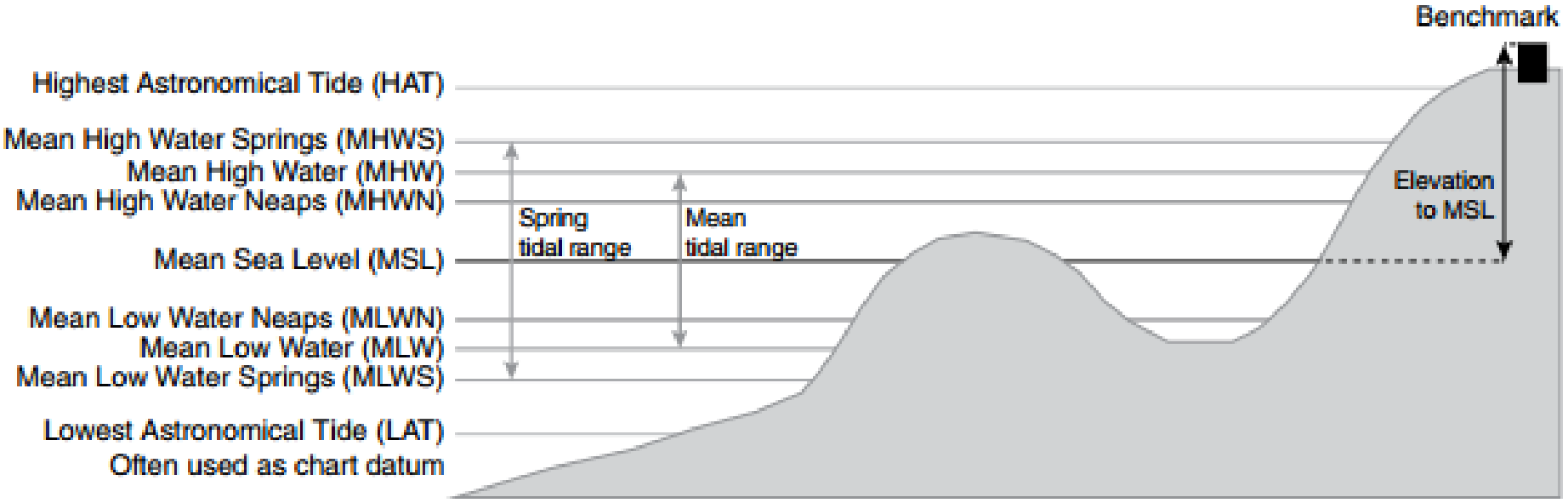
Coral rubbles and sandy beach (Contemporary Beach)



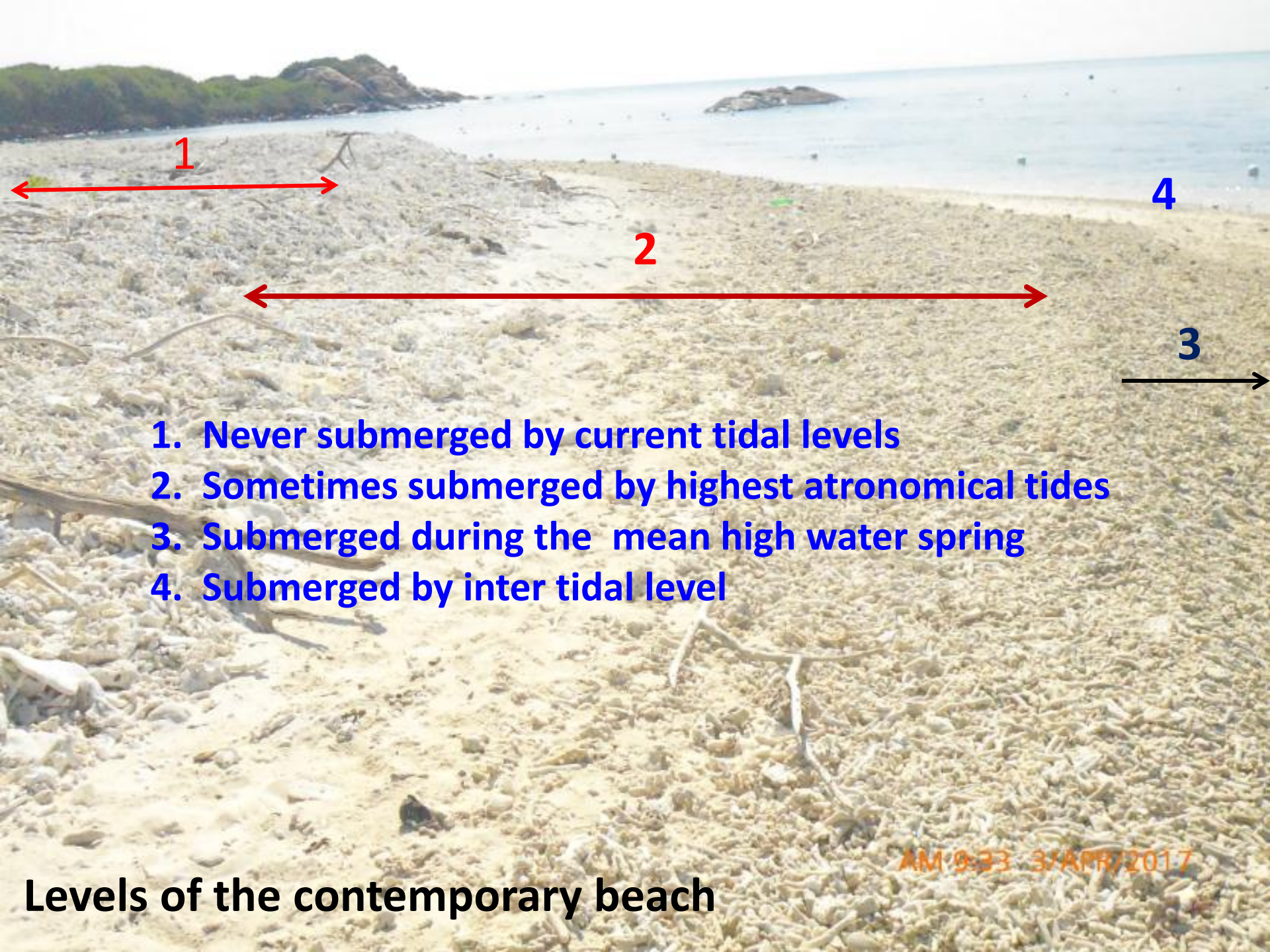
Nomenclature of the tidal levels

Sea-level research: ED BY Orson van de Plassche, 1986

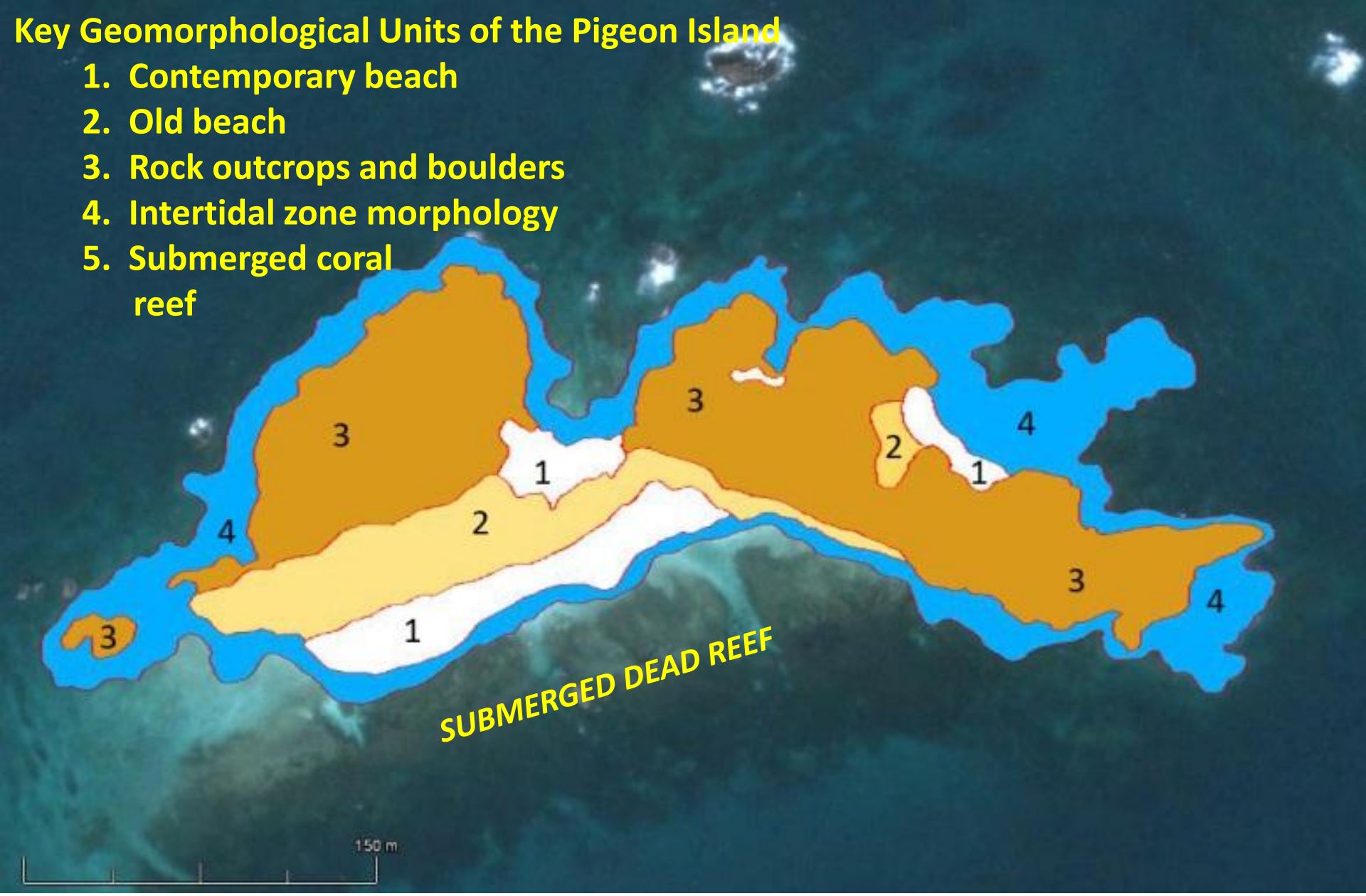


Main reference water levels for a location that experiences semidiurnal tides.

Handbook of Sea-level Research. Edited by Ian Shennan, Antony J. Long, and Benjamin P. Horton, 2015



Levels of the contemporary beach


Key Geomorphological Units of the Pigeon Island
1. Contemporary beach
2. Old beach
3. Rock outcrops and boulders
4. Intertidal zone morphology
5. Submerged coral reef
3
4
2
1
3
2
1
4
3
4
3
1
SUBMERGED DEAD REEF
150 m


Material piled up
by wave action
AM10:26 3/APR/2017


Material piled up
by wave action
AM10:26 3/APR/2017

Seasonal waves built a beach ridge, and can be identified as somewhat high and wide tombolo or beach ridge. During the mid- or late high sea levels the both islands *(A & B)* were formed as separate islands.


Cemented calcareous material, coral sand and other and with pebbles

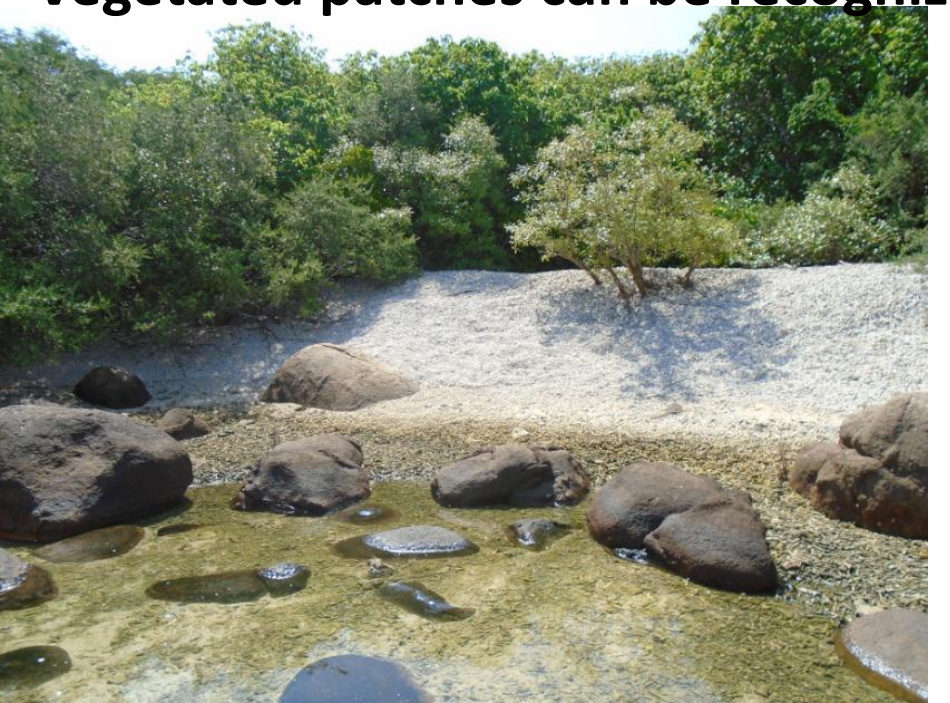

Cemented beach material


Boulder
beach

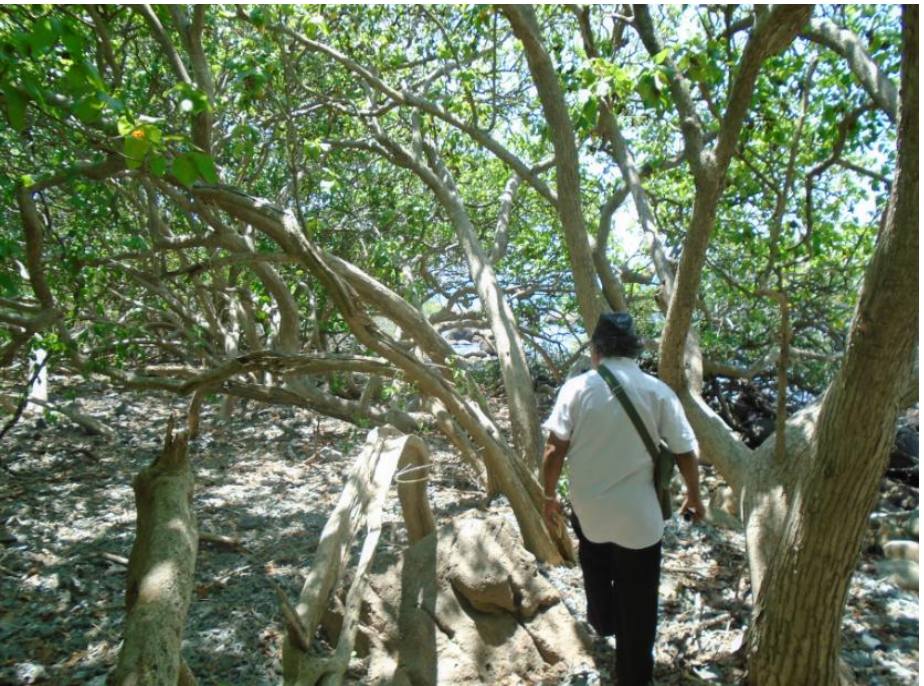

Old beach (Holocene)
with vegetation cover

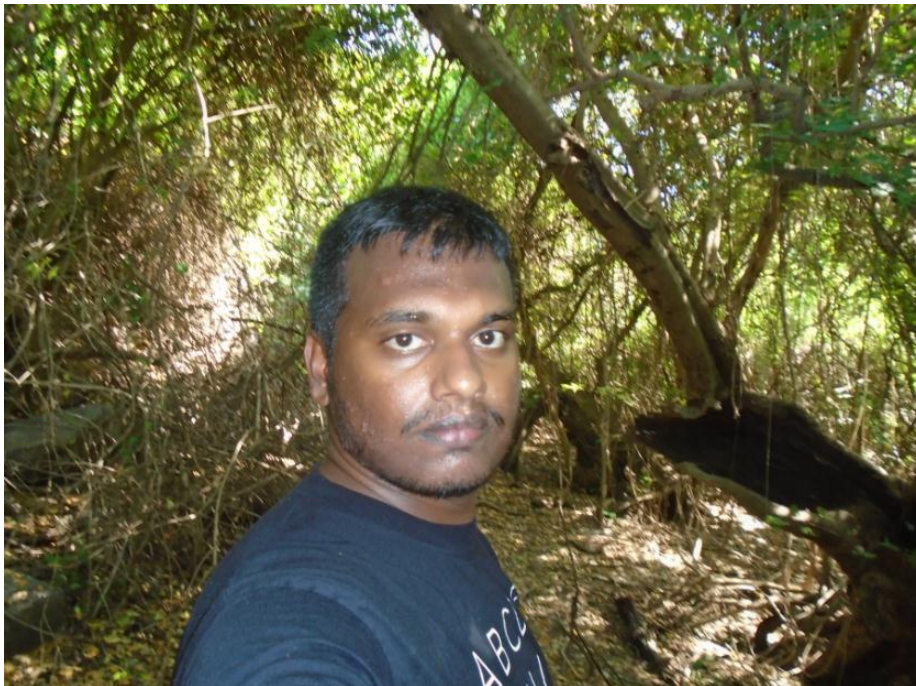

Old beach (Holocene) with vegetation cover

Vegetated patches can be recognized as old beaches

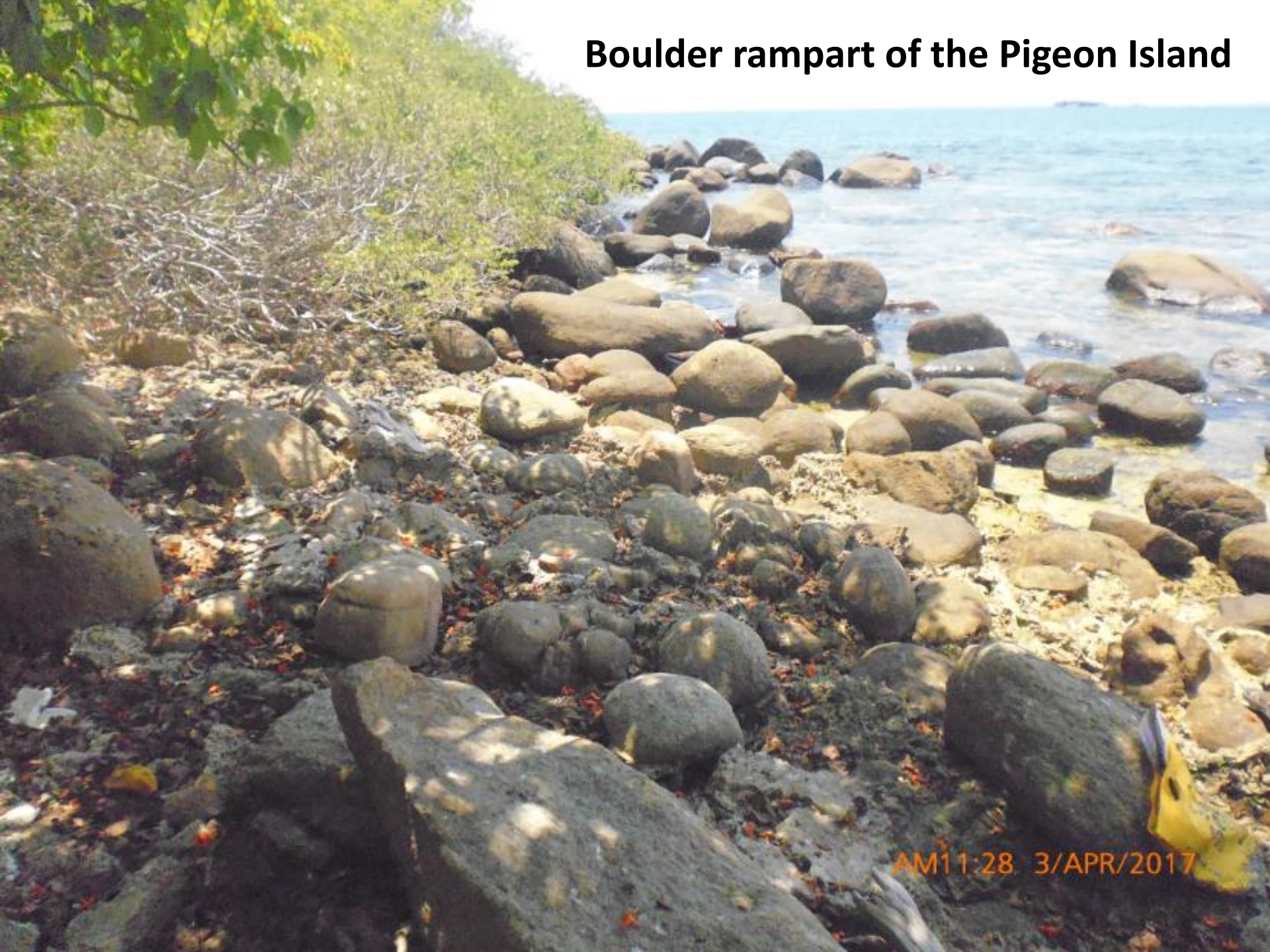


Inside of the old beach patches of the Pigeon Island





Boulder rampart of the Pigeon Island



Boulder beach or rampart


Tidal pocket boulder rampart
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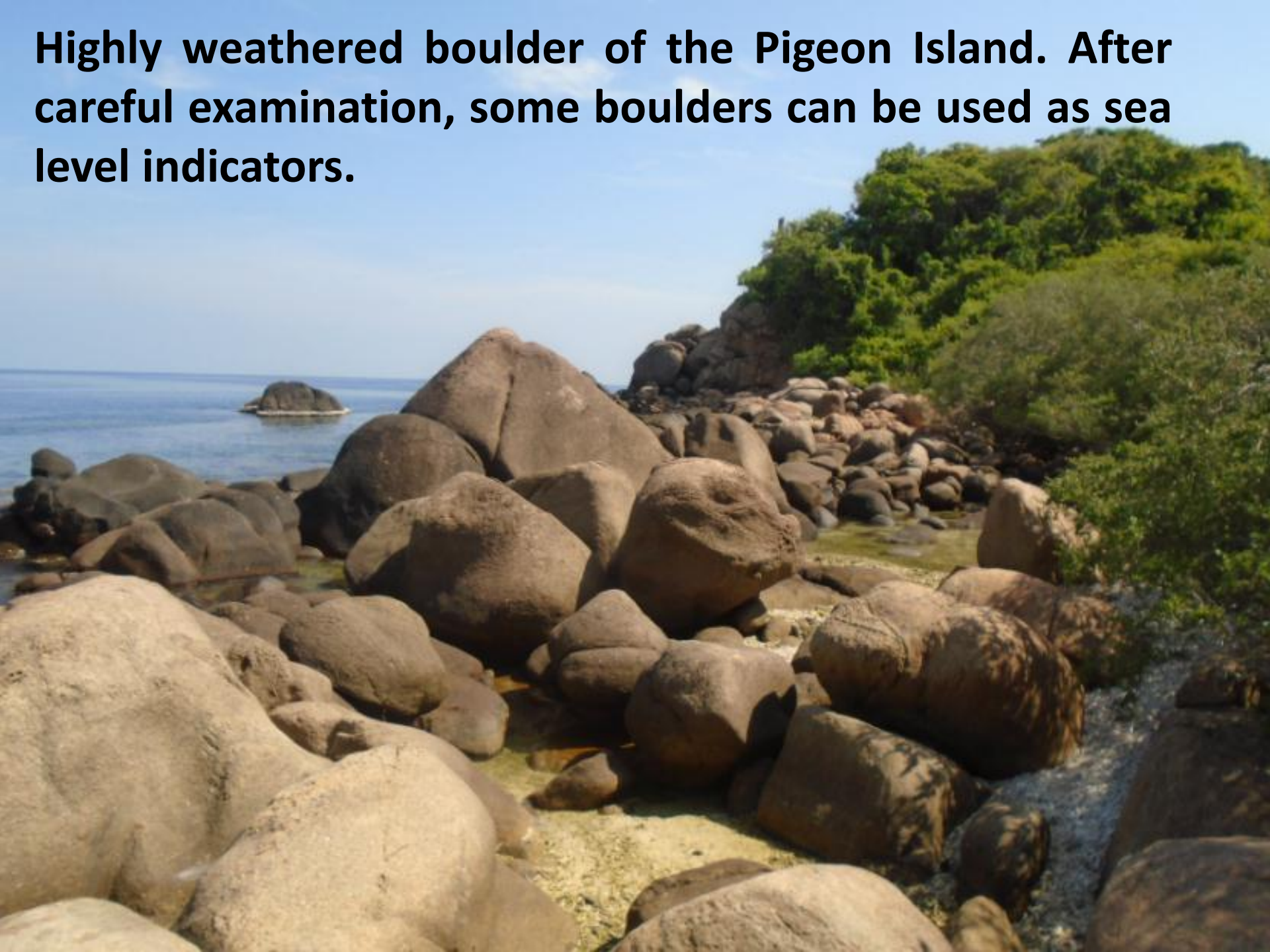

Highly weathered boulder of the Pigeon Island. After careful examination, some boulders can be used as sea level indicators.


AM 9:49 APR/2017

Quartzofeldspathic gneiss of the Vijanan Complex rocks could be of Archaean age (Precambrian).


Rock outcrops could be shaped by former severe wind action followed by dry climatic conditions
AM10:03 3/APR/2017

A barnacle is a type of arthropod constituting the infraclass Cirripedia in the subphylum Crustacea, and is hence related to crabs and lobsters.

Barnacles are exclusively marine, and tend to live in shallow and tidal waters, typically in erosive settings.

Living barnacles tend to live in tidal waters on rock outcrops/ islets of the Pigeon Island. If it is possible to find out dead barnacles from former sea level mark areas that fossils are very useful for radiometric dating.

Barnacles are exclusively marine, and tend to live in shallow and tidal waters


Man made
structure
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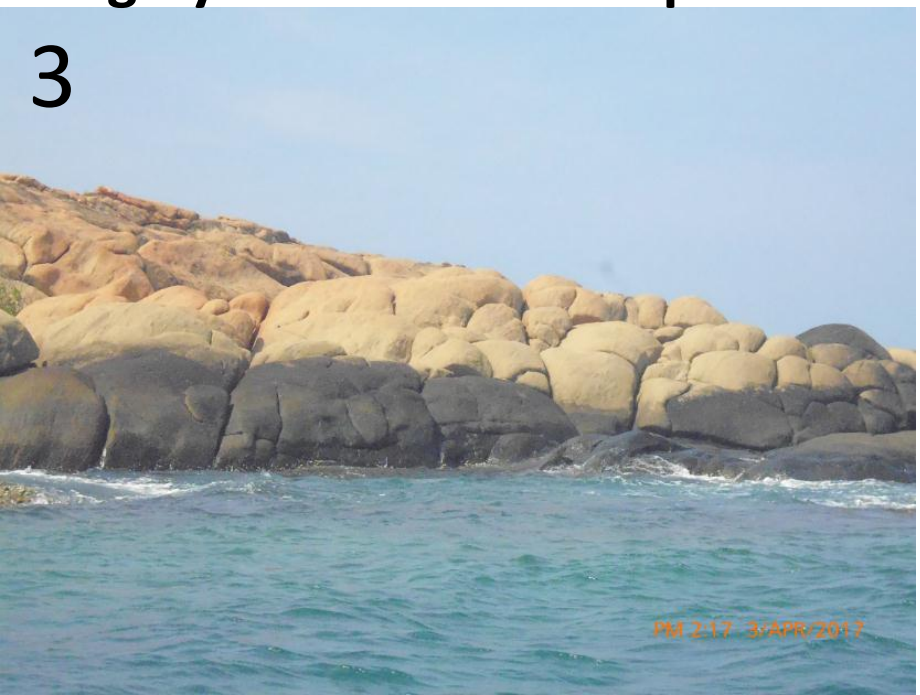
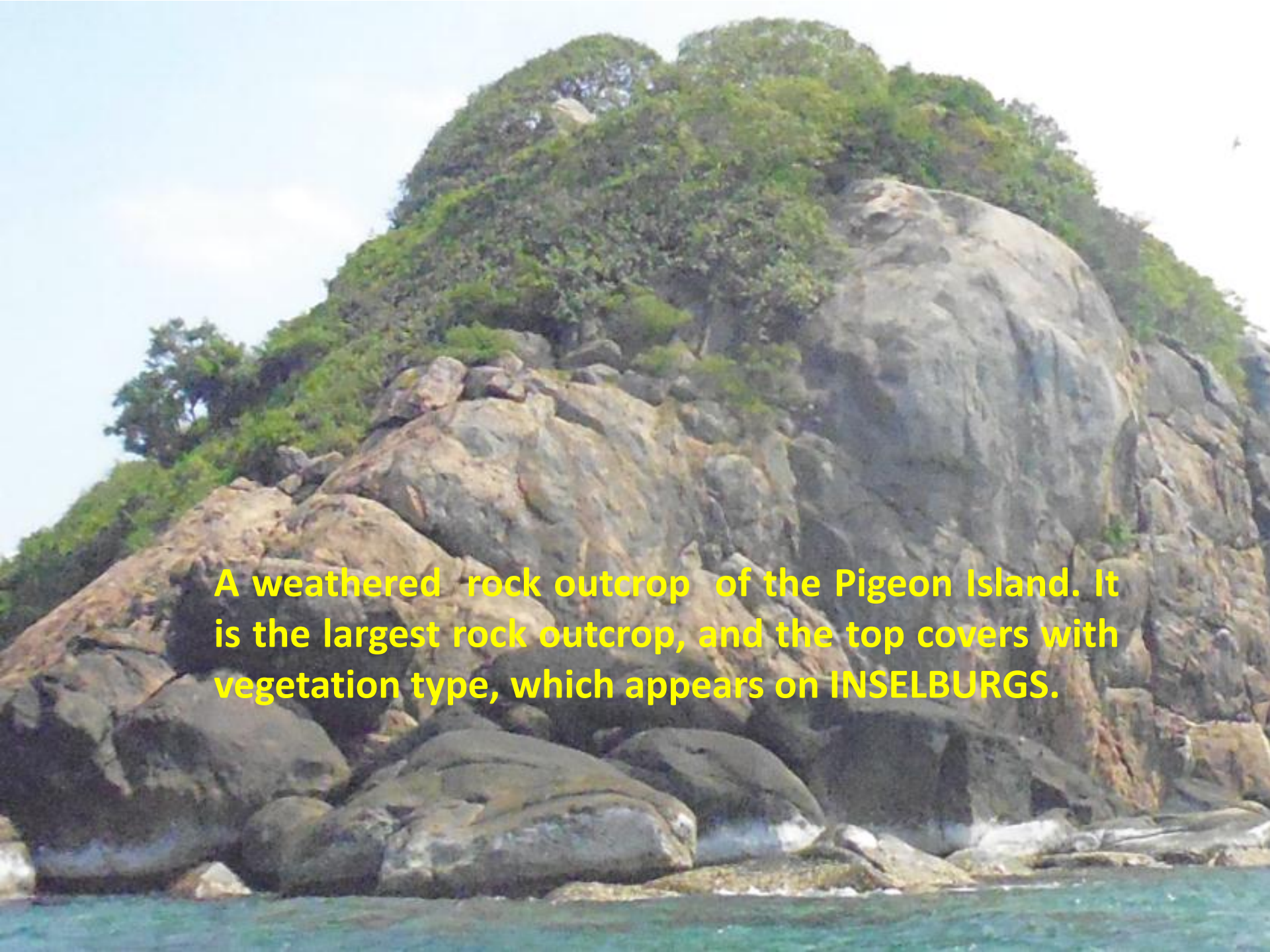
Manmade structure (partly built) is on the rock outcrop of Island A

A pocket beach has formed between rocky headlands

Highly weathered rock promontory extends to the east




Cracks, joints with highly weathered bedrock boulders


A weathered rock outcrop of the Pigeon Island. It is the largest rock outcrop, and the top covers with vegetation type, which appears on INSELBURGS.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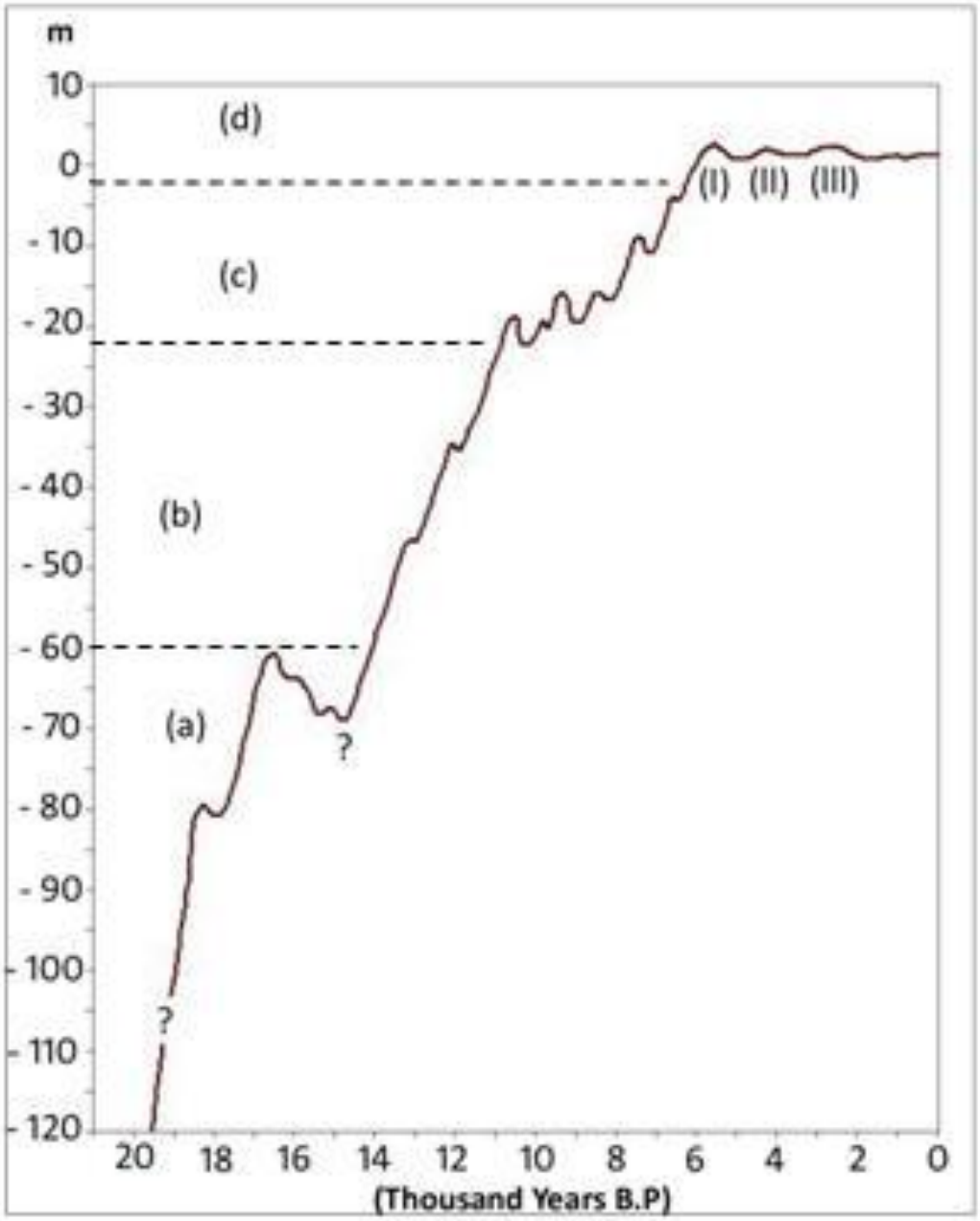

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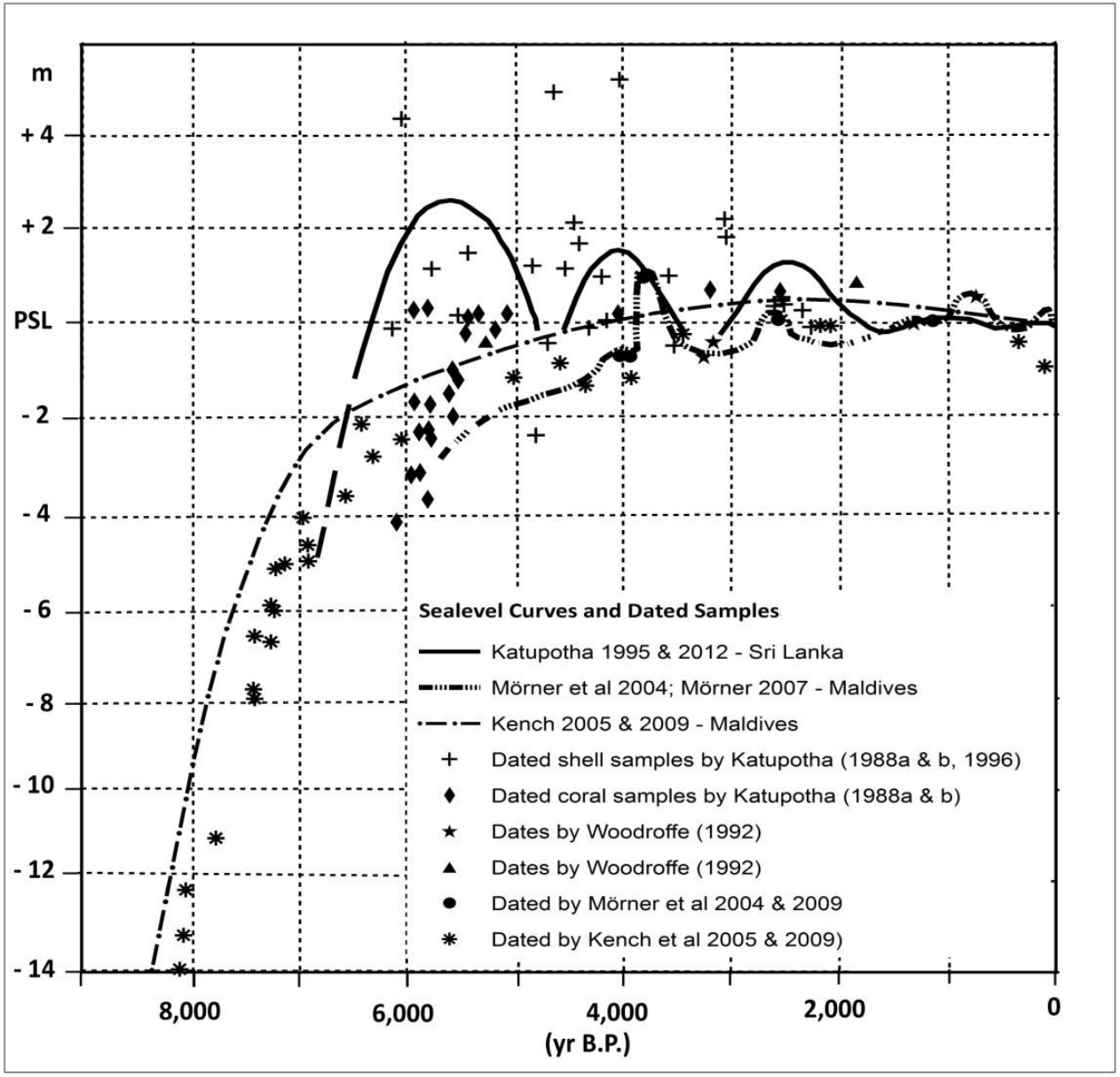
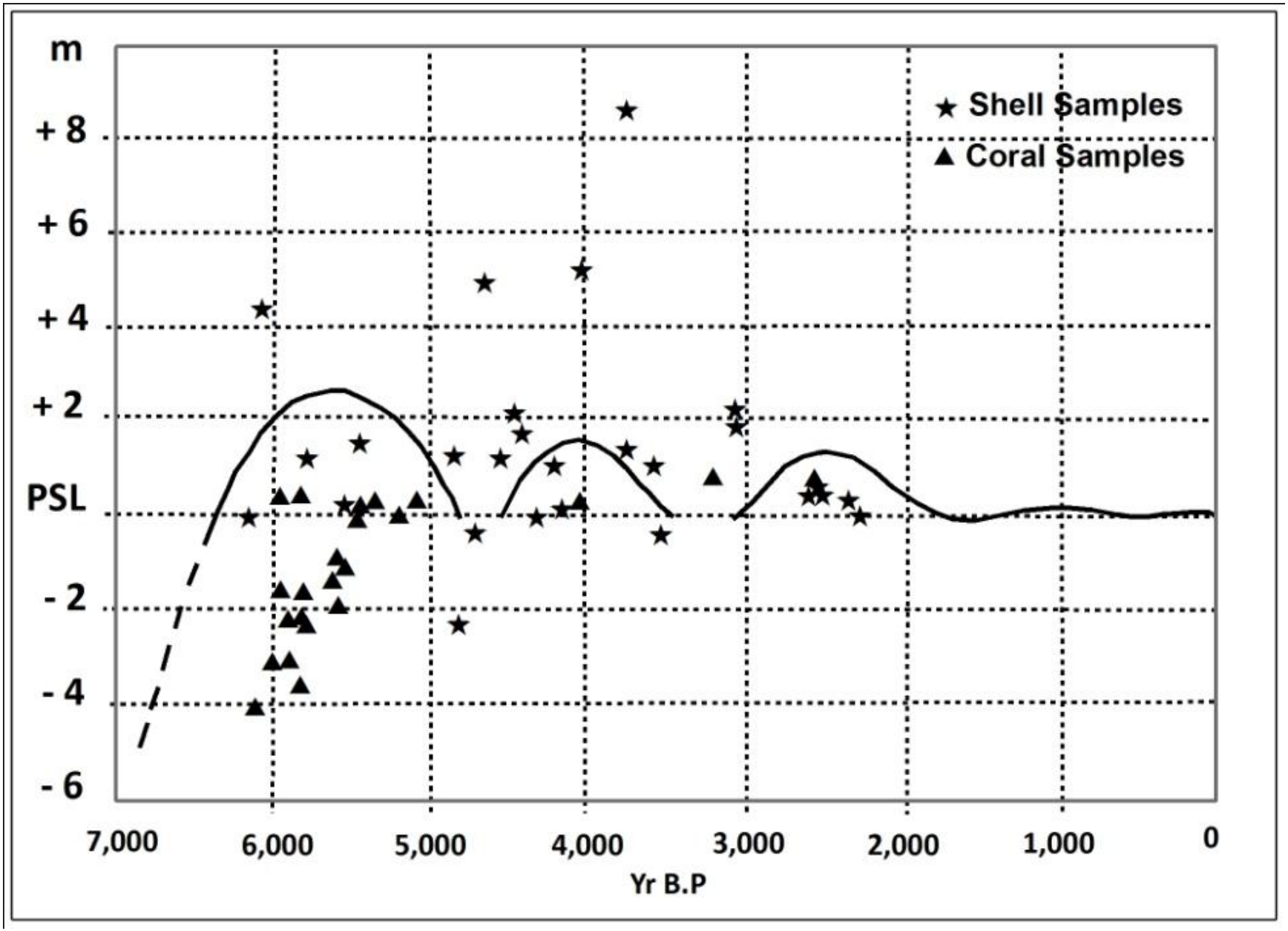


Holocene sea level fluctuations indicate that some similarities can be identified from the curves depicted by Katupotha (1994 & 1995), Kench (2005 & 2009) and Mörner et al (2004) and Mörner 2007).



Mid and Late Holocene high sea-level episodes in Sri Lanka, Katupotha 1988c, 1994 & 1995).

CONCLUSION

- Basement rocks in Sri Lanka beloging to Archaean age, whici is lasted a long time, 2,800 Ma ago.

- The landmass of Sri Lanka remained joined with other landmasses of the Indian Ocean.

- Breaking up signs of Gondwanaland several parts including in Lower Permian period of Paleozoic Era.

- The present morphological features of the Pigeon Island have been developed since Flandrain

- Except rock outcrops and boulders, other geomorhologicl features have developed during the Holocene Epoch.

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Pigeon Island National Park is one of the two marine National Parks of Sri Lanka. This National Park is situated 1 km off Nilaweli, Trincomalee, Sri Lanka. The island's name derives from the Rock Pigeons which have been colonized it. The National Park contains some of the best remaining coral reefs of Sri Lanka. Pigeon Island was designated as a sanctuary in 1963. In 2003 it was re-designated as a National Park. This national park which is governed by the Department of Wildlife Conservation and it is the 17th National Park in Sri Lanka.

Pigeon Island consists of two islands. The large island is fringed by a coral reef and is about 200m long and 100m wide. Area of this National Park is 471.4 Hectares (1.820 sq. mi/ 4.71 sq. km) The small island is surrounded by rocky islets.

The large Pigeon Island's coral reef's vegetation is dominated by *Acropora* species with some *Montepora species, Faviidae, Mussidae and Poritidae* species dominate the coral reef around the rocky islets. Areas with soft corals such as *Sinularia, Lobophytum and Sacrophyton* can also be observed.

Many of the 100 species of corals and 300 coral reef fishes recorded around the Trincomalee area are found in this National Park. Juvenile and adult Black tip reef sharks are seen around the shallow coral areas. Hawk bill turtle, Green turtle and Olive ridley are the visiting sea turtles of the coral reef. The Island is an important breeding ground for the Rock Pigeons.

THANK YOU

GIVE YOUR HANDS TO PROTECT