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Geoheritage Potential of Bukit Panau, Kelantan, Malaysia

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Abstract. Bukit Panau (Panau Hill) is an isolated hill located in Pasir Mas District, in between Tanah Merah and Pasir Mas town, in the state of Kelantan, Malaysia. It is increasingly popular with tourists, especially those who enjoy trekking. The first discovery of Sauropod in this location was a piece of shocking news for not only Kelantan, but also the whole country. However, there are many arguments regarding the actual existence of this fossil in this area. Bukit Panau is geologically composed of igneous and sedimentary rocks. This paper aims to assess the geoheritage potential of Bukit Panau based on three stages: the qualitative assessment, quantitative assessment and evaluation. The qualitative assessment focused on identifying the geodiversity, geoheritage values, scope, scale and level of significance. The quantitative evaluation was split into two parts: one for possible geotourism sites, and the other just for potential for geoheritage based on calculations and an equation that was provided. SWOT analysis was the final technique, which was evaluation. Based on this study at Bukit Panau, five geoheritage values have been identified: scientific, aesthetic, recreational, cultural, and ecological values. The level of significance for this area is regional and the geoheritage feature scale is small to medium based on our assessment. The quantitative assessment showed that this study area was about right to become a geotourism site and high in terms of geoheritage potential.

1. Introduction

Bukit Panau is one of the attractive spots for hikers and nature photographers in Tanah Merah District, Kelantan, Malaysia. It is situated 4 kilometres north of Tanah Merah town, halfway between that town and Pasir Mas. The recent discovery of sauropod trackways [1] is still arguable among geologists around the country. If this fossil footprint is really existed and well preserved, it will be another value added for attraction spot of Bukit Panau. However, this paper aims to assess generally the geoheritage potential of Bukit Panau, including the questionable fossil footprint site.

This hill has a sharp slope and is surrounded by level land, save for a moderate hilly section in the north. The hill is around 250 metres high and 1.25 km wide. Bukit Panau is made up of volcanic rock units overlaid by clastic sedimentary units, both of which are intruded by granite. Intercalations of well-bedded tuff and lapilli tuff compose the majority of the volcanic rock unit. The Malaysia-Thailand Border Joint Geological Survey Committee [2] designated the clastic sediment unit Panau beds. The Panau Formation is made up of alternating sandstone, mudstone, and siltstone. [2] suggested that the age of the formation is Cretaceous based on plant remains. In some locations, grey granite units containing medium-crystal K-feldspar, plagioclase, biotite, and quartz, as well as hornblende, are discovered. The pink colour of the granite is a result of its orthoclase-dominant mineral composition. The granite is most likely the same age as Noring granite from the Cretaceous period. Figure 1 shows the geological map of Bukit Panau and its vicinity.



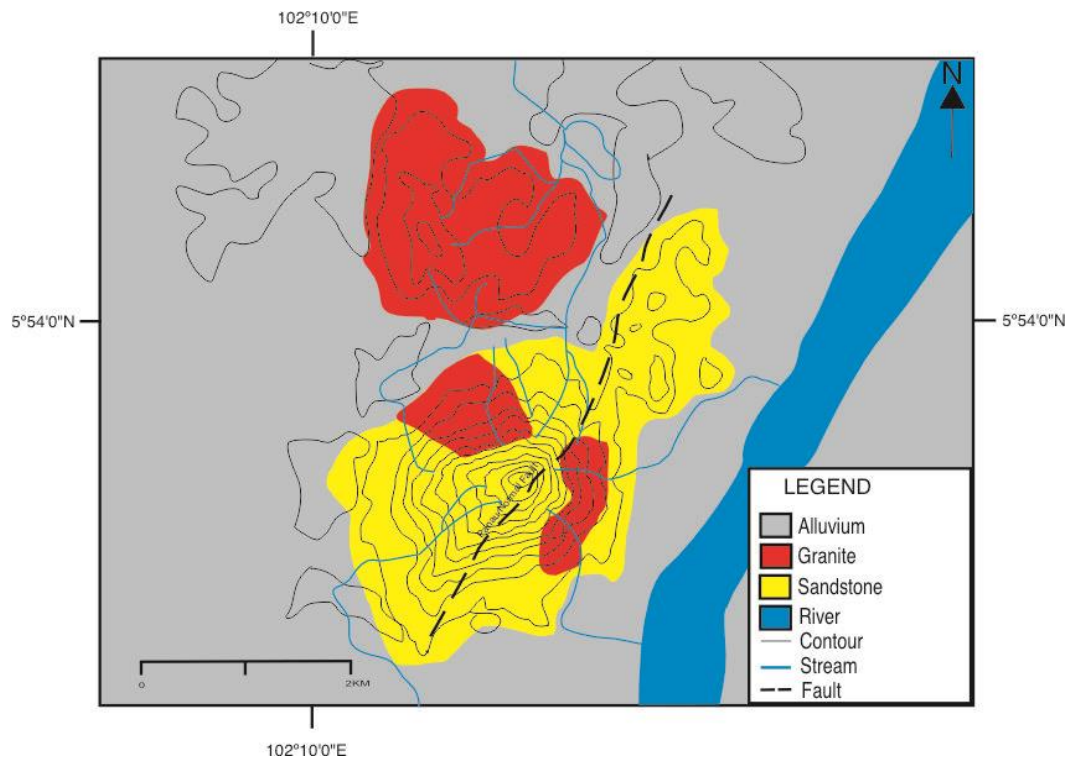


Figure 1. The Geological map of Bukit Panau and its surrounding area.

2. Methods and materials

In this study, three stages of geoheritage assessment methods had been used, which were: qualitative assessment, quantitative assessment and evaluation. The first stage, which is the qualitative assessment was based on classifying the geodiversity [3], geoheritage values, scope [4][5], scale [4] and level of significance [4] that present in the study area.

The second stage is the quantitative assessment, where the geoheritage values assessed by given the ranking score for each value [6]. The quantitative assessment was divided into two parts: a general scoring [7] and the ranking score of geoheritage values based on criteria presented in Table 1. The first part covered six ranking scores which are 0 to 5, where it resembles the none, very bad, bad, fair, good and very good respectively [7][8]. The geotourism site's quality as described in Table 2 will be reflected in the overall value for this ranking scores [9]. Meanwhile, the second part considered a detail calculation where the scores for all criteria were summed up using the equation of geoheritage potential as proposed:

$$GP = ((0.45 Sv + 0.15 Av + 0.2 Rv + 0.10 Cv + 0.10 Ev)/19) \times 100$$

where, GP = Geoheritage Potential
 Sv = Scientific Value
 Av = Aesthetic Value
 Rv = Recreational Value
 Cv = Cultural Value
 Ev = Ecological Value

The percentage of Geoheritage Potential calculated in the previous equation, has then been ranked based ranking shows in Table 3.

The final stage is to evaluate all prospective geoheritage resources in terms of their SWOT analysis where S is referring to strengths, W is referring to weaknesses, O is referring to opportunities, and T is referring to threats. These evaluations can be used to help with geoconservation and management of

possible geoheritage resources. However, this number is less accurate and may be influenced by subjectivity due to the assessor's knowledge.

Table 1. The scoring parameters/ criteria for second part of the quantitative assessment (modified from [10] and [11]).

SCORE FOR ALL CRITERIA			
SCORE	1	2.5	5
SCIENTIFIC VALUE			
Geodiversity (Sv1)	<25%	26 – 74%	>75%
Scientific report (Sv2)	<2 general report	2/3 general report	>3 general report
Geological history (Sv3)	Single types of history	Combination of moderate history	Local story
Representativeness (Sv4)	Low	Moderate	High
Integrity (Sv5)	Almost destroyed	Strong deteriorated	Intact
AESTHETIC VALUE			
Panoramic (Av1)	No/ Low	Moderate	High
Landscape Different (Av2)	No/ Low	Moderate	High
Rarity (Av3)	No/ Low	Moderate	High
RECREATIONAL VALUE			
Attraction (Rv1)	No low attraction	Moderate attraction, 2/3 attractions	High attraction >3
Accessibility (Rv2)	No access	Can be access using pathway	Easily access from main road
Scenery (Rv3)	No/Low scenery	Moderate scenic	High scenic
CULTURAL VALUE			
Religion (Cv1)	No/ Low	Moderate	High
Belief (Cv2)	No/ Low	Moderate	High
Legends/ Myths (Cv3)	No/ Low	Moderate	High
ECOLOGICAL VALUE			
Ecological Impact (Ev1)	No/ Low	Moderate	High
Protection Status (Ev2)	No/ Low	In spots	In large parts

Table 2. The quality of geotourism site based on the total value from the general ranking score.

Total Value Score	Quality of Geotourism Site
0-7	Much too low
8-14	A little too low
15-21	About right
22-28	Little too high
29-35	Much too high

Table 3. The proposed ranking value for Geoheritage Potential of Bukit Panau.

VALUE	RANK
< 25%	Low
26% -74%	Intermediate
> 75%	High

3. Results and discussion

3.1. Qualitative assessment

Bukit Panau is composed of sedimentary rock overlain the igneous rock. It is dominated by various types of rock with different mineral contents [12], landforms and a few fossils [12] which make it unique as geodiversity resources. Five geoheritage values were identified for this site, which has geological features on a small to medium scale, as indicated in Table 4.

Table 4. The qualitative assessment of Bukit Panau.

Geological site	Geodiversity [1]	Scope [2][3]	Scale [2]	Geoheritage Values [4]	Level of significance
Bukit Panau	Rocks, landform/landscape process, fossils	Petrological site, geomorphological site, paleontological site	Medium scale	Scientific, Aesthetic, Recreational, Cultural, Ecological	Regional

3.2 Quantitative assessment

The quantitative approach focused on numbering or scoring certain geoheritage potential values, primarily scientific and educational that is essential for understanding the Earth's history and dynamics as well as its geological records. The aesthetic values, on the other hand, correspond to any interesting or distinctive geological features, whereas the recreational values to varied leisure activities, the cultural values to historical occurrences, and ecological values to ecological influence or protected status. [3][8][13] (Table 1).

The first part of the quantitative assessment was summarized in Table 5, where the scientific values show the highest values, 5, followed by ecological values and recreational values, 4, with aesthetic and cultural have the lowest numbers, 3. The total ranking score is 19, which indicates that geotourism sites are ranked as about right [9].

On the other hand, for the second part of the quantitative assessment, the scientific value has an accumulated score of 17.5 with the majority criteria scores were 3. The two highest criteria Sv1 and Sv2, which were geodiversity and scientific report, whilst the criteria with score of 3 were geological history, representativeness and integrity. The aesthetic value in Figure 2 accumulated a total score of 12.5. Criteria Av1, panoramic and Av2, landscape different manage to score 5 as both parameters are higher in the study area.

The recreational value in Figure 2 has accumulated a total score of 15 from all three criteria listed. All three criteria scored 5 as Bukit Panau is an active attraction spot remarkably. Next, the cultural value had a total score of 7. As shown in Figure 2, majority its criteria were recorded as 1, only one manage to score 5, which was the legend criteria. This criteria was related to the story about Hang Tuah who stayed on this hill to gain his power in martial art skill. The last geoheritage value, which was ecological value shows the total score of 7.5.

From the equation of geoheritage potential (shown in the methodology section), the value of GP obtained as;

$$\begin{aligned}
 (\text{GP}) &= ((0.45 \times 17.5) + (0.15 \times 12.5) + (0.20 \times 15) + (0.10 \times 7) + (0.10 \times 7.5) / 19) \times 100 \\
 &= 75\%
 \end{aligned}$$

Table 5. The summary of quantitative assessment for Bukit Panau based on the Geoheritage values, evidence (Figure 3) and ranking scores [7].

No	Geoheritage values & Evidences	Ranking score
1.	Scientific/ educational - Various rocks -Fossils -Landform processes -Geological history	5
2.	Aesthetic - Isolated hill - Good panoramic	3
3.	Recreational - Hiking -Jungle trekking	4
4.	Cultural -Legend about Hang Tuah	3
5.	Ecological - Highly forestry (biodiversity) - House for several animals	4
		19

3.3 Evaluation

The final stage of this study was evaluation, during which possible geoheritage resources in the area were assessed for their strengths, weaknesses, opportunities, and threats (SWOT analysis), as shown in Table 6.

Table 6. The SWOT analysis of Bukit Panau.

No.	SWOT	Remarks
1.	Strengths	<ul style="list-style-type: none"> - Possibilities for research and education are good - High geoheritage values, such as those related to science, education, aesthetics, the environment, recreation, and culture. - Good accessibility - Information panels had been built through this area to attract more tourist to come
2.	Weakness	<ul style="list-style-type: none"> - Lack of support from the main authority for geoheritage preservation as it is a public area
3.	Opportunity	<ul style="list-style-type: none"> - Hiking is the satisfactory activity in this area - The collaboration between local authorities, community and universities can be a good ooperation between local authority, university's student and community
4.	Threats	<ul style="list-style-type: none"> - Possible vandalism by tourists - Uncontrollable trash from hikers or tourists

4. Conclusion

In order to investigate or assess the geological features of a specific location for geoheritage goals, several scientists develop unique assessments of geosite analyses or evaluations. In this study, the combination previous methods [3][4][5][6][7][9] together with the proposed method in second part of quantitative assessment, were used to assess and evaluate the geoheritage potential of Bukit Panau.

Technically, the ranking for geotourism site is about right with the value of 19 [9] and the potential of geoheritage in Bukit Panau is high based on the calculated values of 75%. The level of significance

is regional as this hill was uniquely formed isolated from other hill and have a different geological history for the usual hill around the area.

In terms of geoheritage values, this study area have scientific, aesthetic, recreational, cultural, and ecological values where all these values

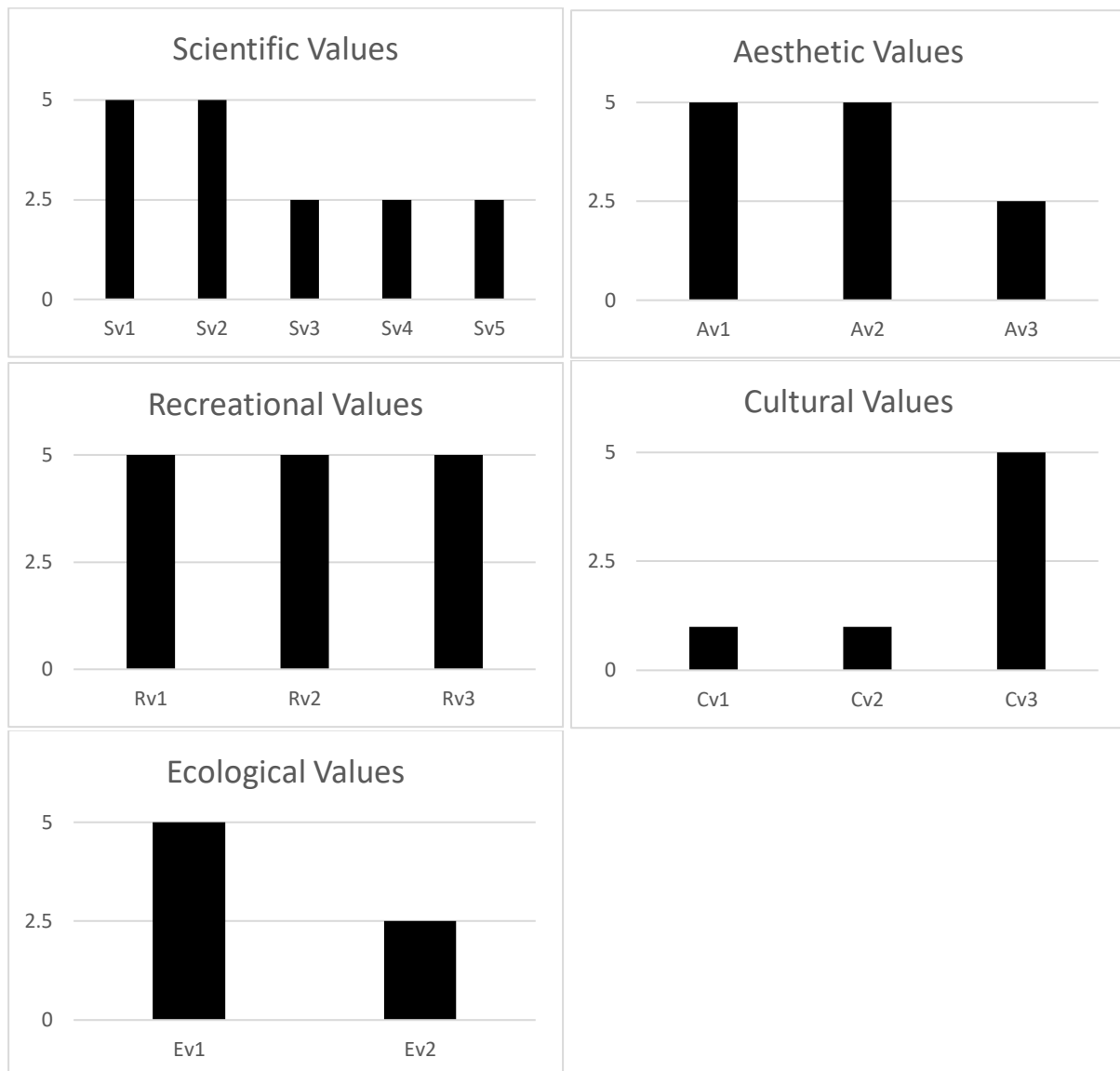


Figure 2: The score from second part of quantitative assessment in this study. These criteria resemble all geoheritage values present, which are: Scientific Value (Sv), Aesthetic Value (Av), Recreational Value (Rv), Cultural Value (Cv), and Ecological Value (Ev). The X axis on each bar charts resemble the criteria shown in Table 1 and the Y axis are score values for each parameters.



Figure 3. The panoramic views and few label panel in Bukit Panau shows that this study area is good as recreational site.

Acknowledgements

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References

- [1] Bahar A M A, Sulaiman M S, Martosuwito S and Hartono U 2020 The Sauropod Dinosaur Trackways from Tanah Merah, Kelantan, Malaysia. *IOP Conf. Series: Earth & Env. Sci.* **549**.
- [2] The Malaysian and Thai Working Groups, 2006. Geology of the Batu Melintang-Sungai Kolok Transect area. Malaysia-Thailand Border Joint Geological Survey Committee (MT-JGSC).
- [3] Gray M 2005 Geodiversity and Geoconservation: What, Why, and How? *The George W. For.* 4-12.
- [4] Brocx M, Semeniuk V 2007 Geoheritage and geoconservation—history, definition, scope, and scale *J R Soc West Aust.* **90** 53–80.

- [5] Predrag D, Mirela D 2010 Inventory of geoheritage sites – the base of geotourism development in Montenegro *Geog. Pann.* **14(4)** 126–132.
- [6] Kubalikova L 2013 Geomorphosite assessment for geotourism purposes. *Czech J. Tour.* **2(2)** 80–104.
- [7] Nazaruddin D A 2015 Systematic Studies of Geoheritage in Jeli, Kelantan, Malaysia *Geoheritage* **9(1)**.
- [8] Gray M 2004 Geodiversity: valuing and conserving abiotic nature in Gray M (2005) Geodiversity and geoconservation: what, why, and how? *The George W. For.* 43 (Chichester: John Willey).
- [9] Sulaiman N, Sulaiman N, Hussin H, Bahar A M A and Udin W S 2020 Diversification of Igneous Rocks and Geoheritage Values in Pergau, Jeli Kelantan *IOP Conf. Series: Earth & Env. Sci.* **549**.
- [10] Fassoulas C, Mouriki D, Dimitriou P D, and Illiopoulos G 2012 Quantitative Assessment of Geotopes as an Effective Tool for Geoheritage Management *Geoheritage* **4(3)** 177-193.
- [11] Ali C A, and Badang D, 2016 Geosites Characterisation and Assessment. Workshop on Geosites Characterisation and Assessment, Malaysia.
- [12] Asshari N F and Abd Kadir A 2019 Geology of Bukit Panau, Tanah Merah, Kelantan. *PLATFORM-Journal of Science & Technology* **2** 42-53.
- [13] Komoo I 2003 Conservation geology: protecting hidden treasures of Malaysia. *ASM Inaugural Lec.* 51 (LESTARI UKM).