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Lenggong Valley – Revisit our national treasure

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Abstract: Lenggong Valley was incepted as UNESCO World Heritage Site in 2012 for its marvellous cultural value. However, the status will be in peril if the valley is left neglected and nothing is done. The area is renowned for the discovery of prehistoric human settlement. Numerous studies and researches have been conducted at Lenggong Valley to increase the scientific knowledge of the surrounding areas for further conservation and development. Toba ash deposit from volcanic eruption in Sumatra, Indonesia and possible meteorite impact were also discovered within the valley. Geoelectrical resistivity survey have been conducted to determine the thickness of Toba ash. The results were correlated with borehole log from the Department of Mineral and Geoscience Malaysia (JMG), that shows the Toba ash layer is around 10 m in depth and presents low resistivity range of values (<100 Ωm). Water geochemical analysis at one of the known water spring shows the surface temperature is 27.6 °C, with a pH value of 7.47. Truth be told, Lenggong Valley has a diversity of archaeological sites and geosites that can be established as a geopark and a group of committee will be materializing it in year 2021 or 2022.

Keyword: Lenggong, archaeology, Toba, meteorite impact, cool spring, geopark

INTRODUCTION

Malaysia has always been considered as an international tourist destination for its precious heritage and fascinating natural wonders. Lenggong Valley has been named as Malaysia's fourth and most recent UNESCO World Heritage Site for its outstanding cultural value, yet this amazing site has still not received great attention from the public compared to the other sites such as Malacca and George Town Historic Cities, Gunung Mulu National Park and Kinabalu Park. Over the unprecedented year where the COVID-19 pandemic had limited the movement of citizens, this article is hoped to promote our country heritage. The subtopics below will describe Lenggong Valley through few scientific aspects.

Geological setting

Generally, the Lenggong Valley consists of several lithologies such as alluvium, granite and limestone (Nordiana *et al*., 2014). The granitic rock is from Jurassic end - Carbonaceous low era and form the basement rock of the whole valley. Most of the alluvium units are quaternary sediments and situated along the Perak River area. Toba ash studies had been conducted by earlier researchers and the ashes are believed to be scattered around 70 km square in Lenggong Valley (Rapidah *et al.,* 2018). Figure 1 shows the general geological map of Lenggong Valley, Perak.

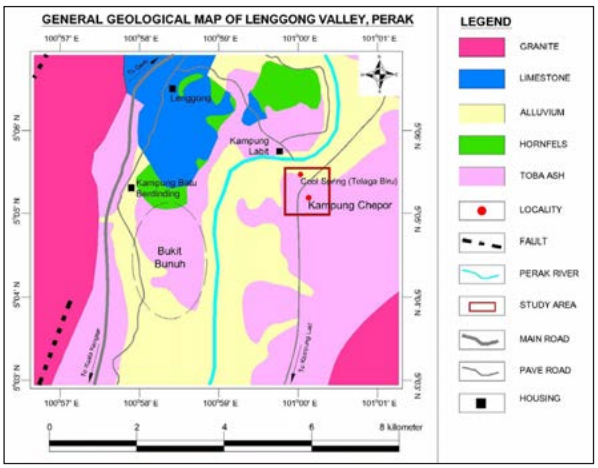

Figure 1: General geology of Lenggong Valley showing the area is covered with alluvium and Toba ash. Source: Modified from Nur Asikin, 2013.

Archaeological site

The Lenggong Valley World Heritage Site is located in an ancient, narrow valley in Perak State, northern part of Peninsular Malaysia, and it is the oldest known place of human activity. The valley is an important archaeological site where evidences of human settlement throughout the prehistoric periods (Palaeolithic, Neolithic and Metal) were found.

Lenggong Archaeological Museum was built at Kota Tampan to exhibit the archaeological findings of the area. Most discoveries found in Lenggong have been associated with caves. Artefacts, stone tools and skeletal remains from the archaeological excavations are displayed in the museum to provide informative prehistoric knowledge in Peninsular Malaysia. One of the most significant archaeological discoveries is the Perak Man or "Orang Perak", an 11,000 years old human skeletal remains at Gunung Runtuh Cave, Lenggong. Even though human skulls had also been found at Niah Cave in Sarawak which is said to be older in terms of age, Perak Man by far is the best preserved entire human skeleton found in the South East Asia region.

Toba ash

74,000 years ago, Toba super-volcano erupted and formed Lake Toba in Northern Sumatra, Indonesia. Over thousands cubic kilometres of scalding hot ash (Youngest Toba Tuff, YTT) belched out from the volcano into the Earth's atmosphere, travelled far and wide then descending upon vast areas in the southern and south eastern Asia, the South China Sea, and the central Indian Ocean Basin (Gatti & Oppenheimer, 2012). Several sites of terrestrial tephra fall deposits from the Toba eruption have been identified in Indian Peninsula and Malaysia, including Lenggong Valley as shown in Figure 2.

The first reported Toba ash sediment in Malaysia was found near Sungai Perak in 1932 by Scrivenor. Since then, these volcanic ashes were discovered in the western part of Pahang, Selangor and Kedah (Stauffer & Batchelor, 1978; Debaveye *et al*., 1986). The evidence of Toba ash in Lenggong Valley was found during an archaeological expedition which noticed a thick layer of volcanic ash above a Palaeolithic stone tool workshop in Kota Tampan, Lenggong. This finding suggests that the Toba volcanic eruption had a direct impact on life at that period of time.

Subsequently, more study on the Toba ash has been carried out in the Lenggong Valley that has contributed to scientific knowledge until present time. Geophysical study had been carried out by the author in order to determine the thickness of the Toba ash. Figure 3 shows the study location nearby Masjid Lama Kampung Chepor, Lenggong with coordinate 5°5'14.13" N, 100°59'55.02" E. Figure 4 and Figure 5 show an example of exposed Toba ash deposit at Masjid Lama Kampung Chepor, Lenggong and the geophysical survey results, respectively.

Two geological layers were interpreted from the obtained geoelectrical resistivity results. The top layer is characterised by lower resistivity values ranging < 100 Ωm.

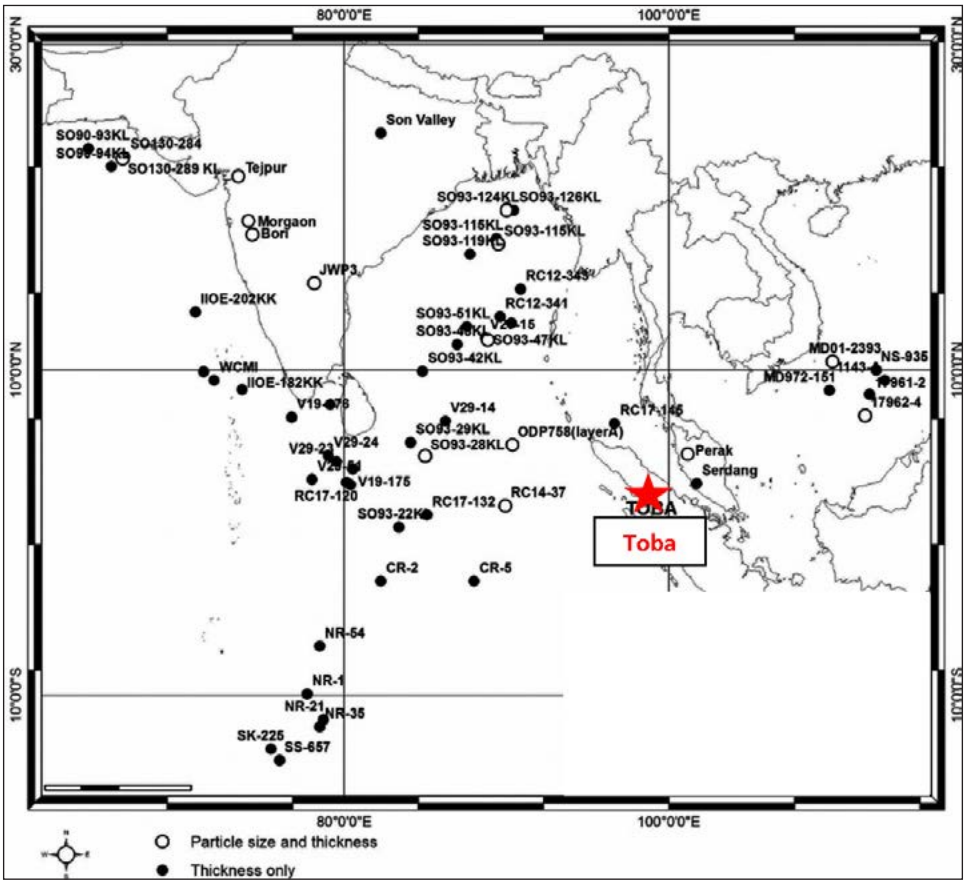

Figure 2: Youngest Toba Tuff (YTT) tephra distribution in Asia. Source: Gatti & Oppenheimer, 2012.

This layer is about 7 m to 10 m in thickness that might consist of alluvium, which is believed to be Toba ash with mixture of sand and clay. The second layer has higher resistivity range of above 300 Ωm which probably represents weathered granite bedrock. The resistivity results correlated well with the previous study by USM and JMG borehole where the Toba ash distribution in the Lenggong Valley is found to be around 10 m thick (Rapidah *et al*., 2018).

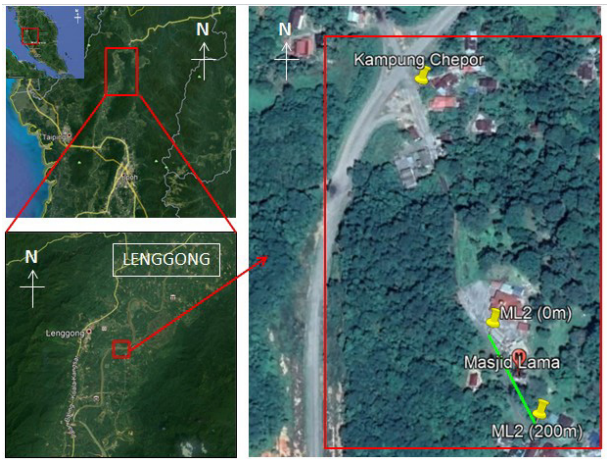

Figure 3: Google Earth Satellite photo showing the study area (red box) and geoelectrical resistivity survey line (green line) where Toba ash can be observed around the Masjid Lama at Kampung Chepor, Lenggong.

Meteorite impact

Little do people know that Lenggong Valley is the only place in Malaysia that has the evidence of meteorite impact that had taken place around 1.83 million years ago. The unanticipated discovery is due to the land redevelopment to change rubber estate into oil palm estate that revealed a huge amount of boulders at Bukit Bunuh. Since then, various researchers in Malaysia notably from Universiti Sains Malaysia (USM) and Universiti Kebangsaan Malaysia (UKM) started to discover the evidence around the possible meteor impact site through geological and geophysical studies. Figure 6 shows the result of gravity survey to model the possible meteorite impact crater. More interestingly, stone tools embedded in the suevite rock (a type of rock which formed due to meteorite impact) were found at the site during archaeological studies (Saidin,

Figure 4: Exposed Toba ash as basement of Masjid Lama at Kampung Chepor, Lenggong.

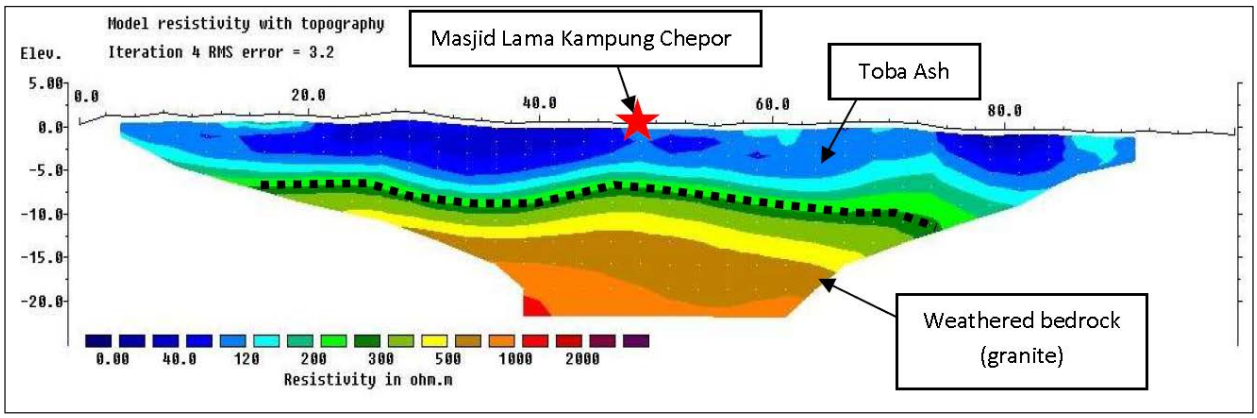

Figure 5: Geoelectrical resistivity result for Toba ash thickness (average: 10 m) study at Masjid Lama, Kampung Chepor, Lenggong.

Table 1: Geoelectric resistivity survey details.

Survey Line	Survey Length (m)	Maximum Penetratration (m)	Start of Line		End of Line	
			Latitude	Longitude	Latitude	Longitude
ML2	100	21.5	5°5'15.45"U	100°59'54.07"T	5°5'12.54"U	100°59'55.54"T

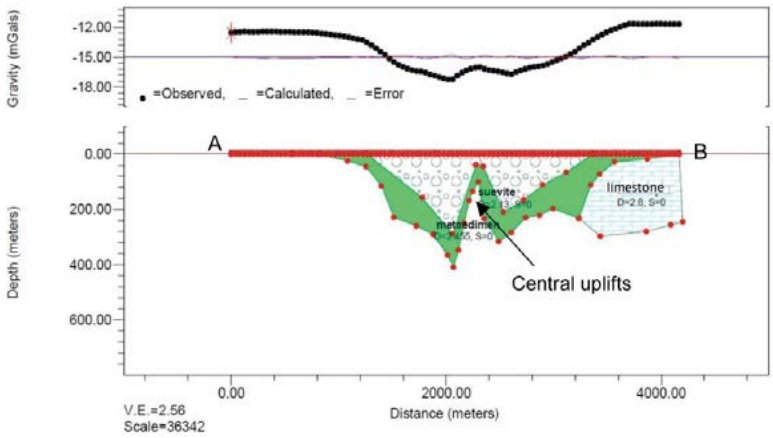

Figure 6: 2D gravity model of the possible meteorite impact crater at Bukit Bunuh, Lenggong. Source : Samsudin *et al*., 2012.

2021). These discoveries mark the presence of earliest hominid in South-East Asia outside of Africa continent.

Cool spring (Telaga Biru Lenggong)

A water spring is a natural occurrence where cold or hot groundwater issues from the earth on a regular basis. The groundwater flows through the interconnected pores within the aquifer or crack system such as faults and fracture planes in the subsurface. When the groundwater is heated and circulates upwards to the surface through buoyancy or pressure by the shallow intrusions of magma in volcanic area, or cooling magma and geothermal gradient at non-volcanic area such as Peninsular Malaysia, hot spring is occurred (Baioumy *et al*., 2014).

One of the known water spring, name Telaga Biru by local villagers has existed in Kampung Chepor, Lenggong for about 200 years (Rashidi, 2020). The coordinate of this spring is 5°5'31.34" N, 100°59'52.54" E and the spring is shown in Figure 7. Geophysical and water geochemical study had been conducted at the water spring by the author to understand the geological structure present in the subsurface and to study the characteristics of the water.

Generally, the mineral content in groundwater increases as it moves along through the pores and fracture openings in rocks. Table 2 below shows the result of water geochemical analysis with selected parameter. The in-situ test of water sample is recorded using Thermo Fisher Eutech 5+, showing the surface temperature is about 27.6 °C and pH value of 7.47. The obtained water geochemical analysis results have been shared in this

Figure 7: Cool spring (Telaga Biru Lenggong) situated at Kampung Chepor, Lenggong.

article. The geophysical results are still in progress as more surrounding geological information are needed for correlation and interpretation. Through this additional research, the origin of the water spring can be identified and the potential usage of this water spring can be evaluated.

The water sample from the spring has been compared to the World Health Organisation (WHO) and Malaysia Ministry of Health (MOH) standard on raw and drinking water quality. The result shows that the sample is within the acceptable value for usage. However, more detailed geochemical analysis such as biological aspect for bacteria test should be conducted to make sure the water from spring is suitable for domestic usage.

Geopark

Geopark is a unified geographical area where geoheritage sites are part of a holistic concept of protection,

Table 2: Geochemical analysis result of water from the spring compare with Water Quality Standard from World Health Organisation (WHO) and Malaysia Ministry of Health (MOH).

No	Parameter / Element	Unit	Result	Recommended Raw Water Quality (Acceptable Value)		Drinking Water Quality Standards (Maximum Acceptable Value)	
				WHO	MOH	WHO	MOH
1	pH	-	7.47	6.5-8.5	5.5-9.0	-	6.5 – 9.0
2	Temperature	°C	27.6				
3	Total Silica, SiO_2	mg/l	44	-	-	-	-
4	Calcium, Ca	mg/l	8.97	200	-	200	-
5	Magnesium, Mg	mg/l	3.28	150	150	200	150
6	Potassium, K	mg/l	8.07	-	-	-	-
7	Sodium, Na	mg/l	13.4	200	200	200	200
8	Iron, Fe	mg/l	0.004	1	1	2	0.3
9	Bicarbonate, HCO^{3-}	mg/l	7.47	-	-	-	-
10	Sulphate, SO_4	mg/l	27.6	250	250	500	250
11	Chloride, Cl	mg/l	44	250	250	200	250
12	Fluoride, F	mg/l	8.97	1.5	1.5	1.5	0.4-0.6

Source: Malaysia Ministry of Health 2016 & WHO 2017

education and sustainable development (Komoo, 2014). Malaysia comprises of 5 geoparks to date, which includes Langkawi UNESCO Global Geopark, Jerai National Geopark, Lembah Kinta National Geopark, Kinabalu National Geopark and Mersing National Geopark.

In terms of landscape, Lenggong Valley possesses beautiful geological landforms and unique geological phenomena such as hills, caves and rivers. With its myriad and fascinating archaeological and geological values, Lenggong Valley can be known as a national treasure that is a pride of the nation. Although the area has the coveted UNESCO heritage status, sustainable developments are needed to sustain the status. Therefore, the academic researchers in Malaysia are currently working on promoting Lenggong Valley to be the next geopark that is yet to be established in the coming years (National Geoparks Malaysia, 2020). The purpose of geopark establishment is to emphasize the importance of improving the socio-economic status of local communities by taking into account the advantages that exist both naturally and heritage.

Tourism industry is a way to help citizens to rediscover the treasures around the country and visit it's rich heritage. Continuous promotions on ecotourism will not only sustain and expand the tourism industry, but will also provide growth for other supporting industries such as accommodation services, transportation and local businesses. Apart from that, active conservation and preservation values of the geopark are needed through more research and developments to maintain the cultural heritage. By involving the local communities in the conservation program of geoparks, unemployment rate can be reduced as this can create many job opportunities.

Another goal for the geopark establishment will be to work on the science education in order to draw visitors' interest and to raise awareness of its fragility. It is hoped that the localized scientific study conducted by the author at Kampung Chepor, Lenggong will be able to contribute more facts and information to the committee who will be working on materializing the Lenggong Geopark.

CONCLUSION

Potential threats such as change of land use and building constructions while developing the UNESCO World Heritage Site needed to be addressed through specific measures. The appropriate protection measures can be done with the collaboration among ministries and government agency such as the Department of Mineral and Geoscience Malaysia (JMG), local universities, research centers as well as local communities to preserve the existing value. The Lenggong Valley treasure trove of history should not be forgotten by the public and it will be a great loss if we cannot preserve and manage well the historic values that have been on our home soil for millennia.

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