THE INGENIEUR

Geothermal Energy Potential in Malaysia

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Note: This article were partially presented by the author, at the Stanford University Programme, San Francisco, California, USA in 2016

In Peninsular Malaysia, there are at least 51 thermal spring sites (see Figure 1) in granitic systems, that have been recognised and about 23 of these were selected by the author (in the years 2009 and 2010) in collaboration with Tenaga Nasional Berhad (Research) Branch (TNB), for studies on their sub-surface reservoir temperatures, using data collected since 1980s by the Department of Minerals and Geoscience Malaysia (JMG).

The range of reservoir temperatures for the selected thermal springs was calculated and it was found that the reservoir temperatures ranged from 105.3°C-154.2°C (using the T-quartz method), 127.3°C-199.7°C (using the T Na/K method) and 115°C-208°C (using the T Na-K-Ca method). Estimations of reservoir temperatures however, using the T-Chalcedony method are generally low and do not truly reflect the temperature geothermal systems. This is probably due to dilution during the ascent of the geothermal fluids. Therefore, the T-quartz method was used, together with cation geothermometers to more accurately estimate the reservoir temperatures. The findings of the reservoir temperatures are encouraging and warrant further geothermic investigation; however, drilling is needed to confirm the exact temperatures.

In the Sabah region, based on a survey in the Apas Kiri area in Tawau, which was conducted by the author during the years 2001 to 2009, the estimated geothermal resource potential was 67 MWe (one million watts of energy) and after further detailed studies done by Tawau Green Energy Sdn Bhd (TGESB), the potential was recalculated to be 85MWe. Another area surveyed by the author for geothermal resource potential, included areas such as Segaria-Sungai Jipun-Gunung Pock. Based on a preliminary calculation, this has a minimum capacity of 40.25MWe.

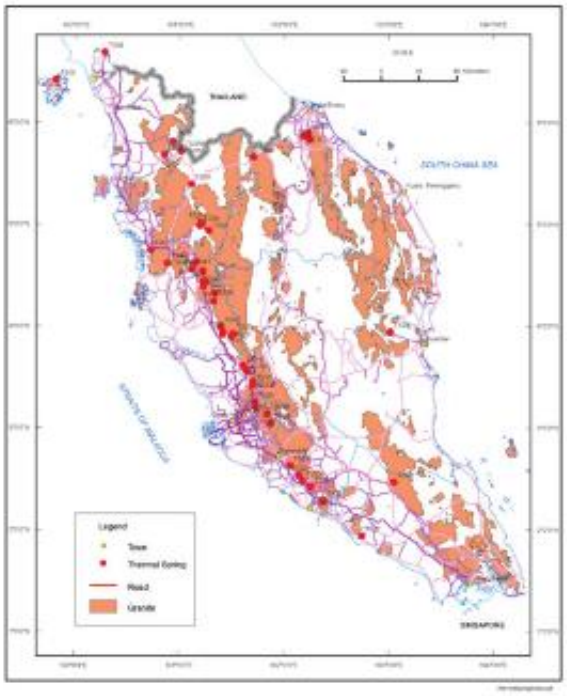


Figure 1: Location map of all thermal springs in Peninsular Malaysia (compiled from previous works).

PENINSULAR MALAYSIA REGION

Ulu Slim Area

The geothermal survey at Ulu Slim (see *Figure 2*), Perak was conducted in collaboration with SEDA Malaysia and JMG from January 2014 until April 2016. Based on the survey, the estimated

Figure 2: Potential Resource in Peninsular Malaysia. Source of base map: Google Maps

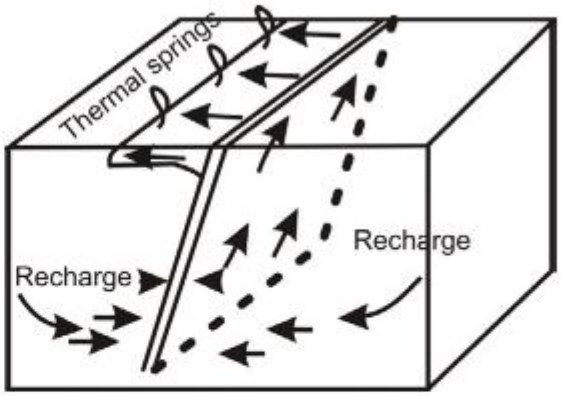


Figure 3: Conceptual model for geothermal resources in granitic systems.

preliminary resource potential of the area was 148 MWe. There are remaining sites (hot springs) in Peninsular Malaysia that need to be further explored such as Lojing (Kelantan), Ulu Langat and Batang Kali (Selangor) and Sungai Denak (Perak) to determine their geothermal potential (*Javino, 2010; Work done by JMG for TNB-Research Branch*).

The information on potential reservoir temperatures gathered from this study by using previous data (since 1980s) is of high significance and useful, but further detailed studies will have to involve more expensive techniques.

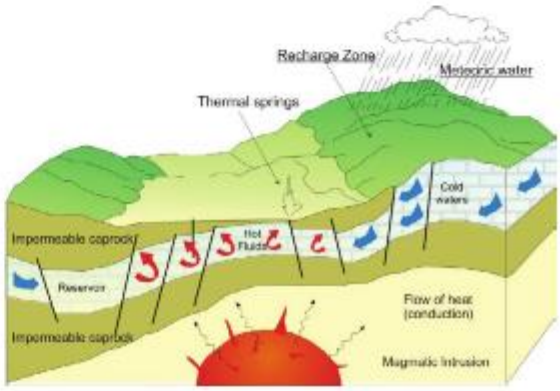


Figure 4: An example of general conceptual model for Hulu Slim, Perak and Lojing, Kelantan, within a granitic geothermal resources system.

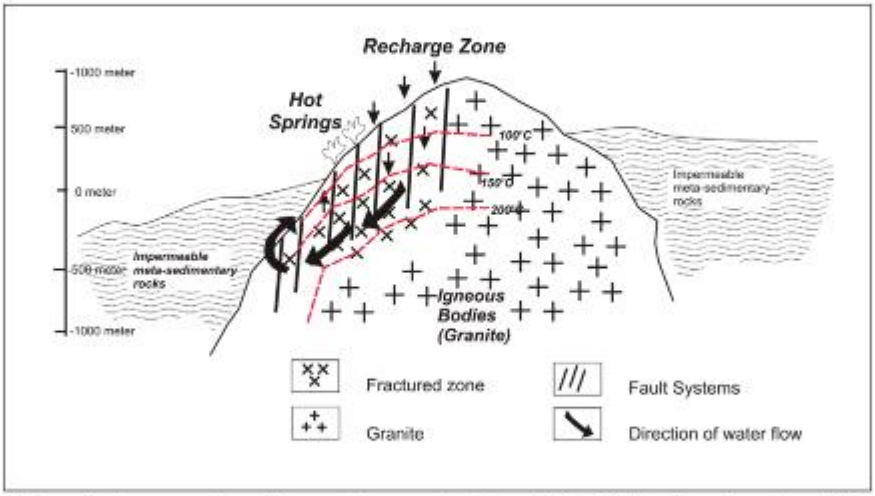
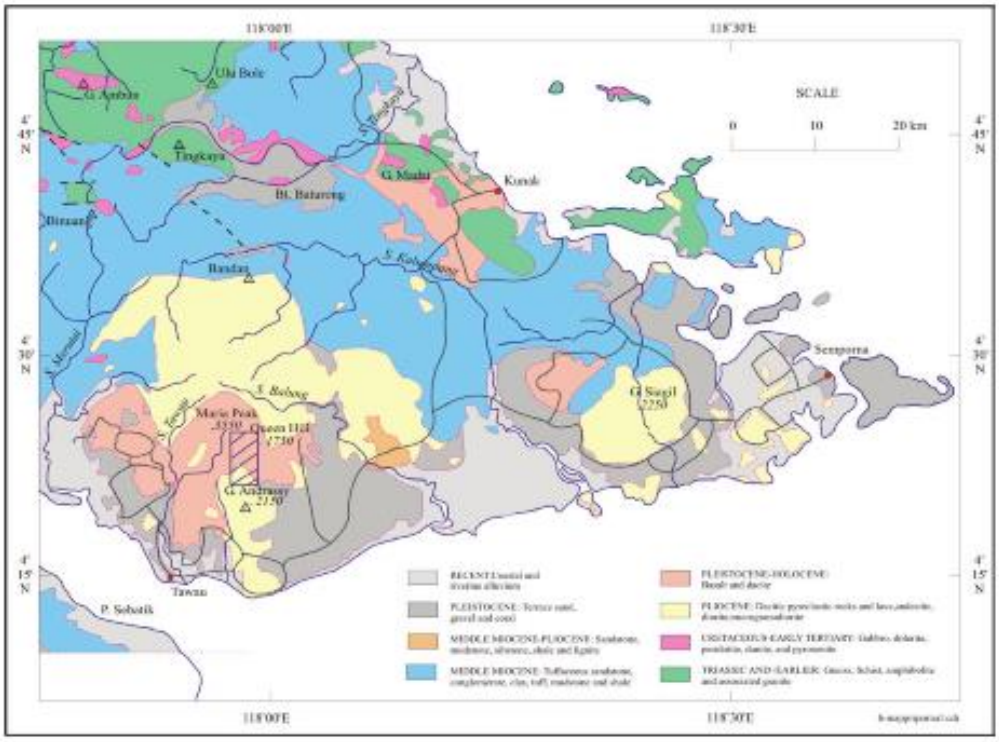
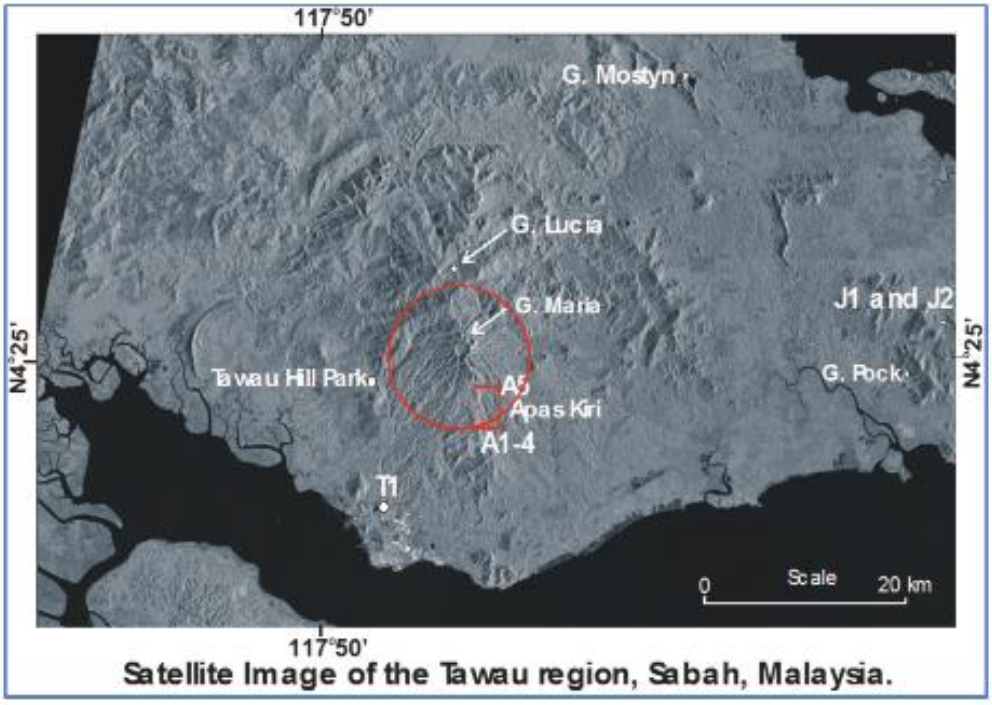


Figure 5: An example of general conceptual model for Hulu Slim, Perak, within a granitic geothermal resources system.



SIMPLIFIED GEOLOGY OF THE TAWAU-SEMPORNA REGION

Figure 6: Simplified geological map of the Tawau-Semporna region, Sabah.



Satellite Image of the Tawau region, Sabah, Malaysia.

Figure 7: A satellite image (Radarsat) showing the location of the Apas Kiri (A1-4, A5), the relic of volcanic crater in the Gunung Maria, and Sungai Jipun area (J1, J2), in the Tawau-Semporna region, Sabah, Malaysia.

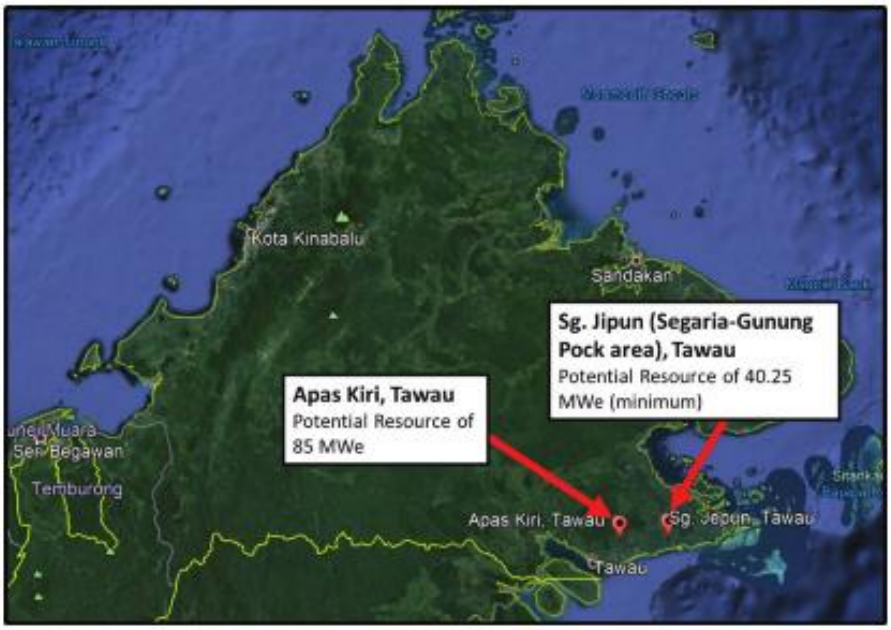


Figure 8: Potential Resource in East Malaysia (Sabah). Source: Google Maps

For granitic systems in Peninsular Malaysia, the models adopted in Figures 3, 4 and 5 may be used as general conceptual models for thermal spring occurrence. The thermal springs were found mainly within fault planes, and within contact zones of granite and metasediments.

Based on the preliminary assessments done for the selected thermal sites in Peninsular Malaysia, the most promising sites, based on sub-surface or reservoir temperatures, include areas in the Hulu Slim, Lojing, Sg. Kelah, Trong, Dusun Tua, Hulu Tamu and in Lubuk Timah. As for the Trong area in Taiping and the one in Parit Gerisek, Johor, further studies need to be carried out to ascertain the occurrence of seawater intrusion in the areas.

SABAH REGION

Apas Kiri and adjacent areas in Tawau-Semporna Peninsula

Based on geothermal surveys carried out in Apas Kiri, Tawau, (see Figures 6 and 8), conducted by the author from the year 2001-2009, with JMG, the area selected was based on young volcanic rocks, which differed from the granitic systems in Peninsular Malaysia, the estimated resource potential was 67Mwe. After a further detailed study done by Tawau Green Energy Sdn Bhd (TGESB), it was recalculated to be 85MWe (*Barnett, 2010*). Previously, TGESB was developing a 37MW Geothermal Power Plant under SEDA Malaysia's Feed in Tariff (FiT) Scheme, but the operation ceased due to some constraints. It is learnt that it will be taken over by other developers.

Other areas surveyed for geothermal potential, by JMG, included the Segaria - Sungai Jipun - Gunung Pock area, in Kunak. The area (see Figure 7), based on preliminary calculations, has minimum capacity of 40.25MWe (*JMG preliminary calculation, 2014*). ■

Note: The volume of geothermal potential cited in Peninsular Malaysia and Sabah/Labuan is based on preliminary studies. Further exploration is needed to get more accurate data on the resource potential.