

Disaster Resilient Cities: Forecasting Local Level Climate Extremes and Physical Hazards for Kuala Lumpur

The role of urban geoscience in building a more resilient Kuala Lumpur

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Content

- What is urban geoscience?
- Urban geology legacy for Kuala Lumpur
- New drivers and technologies
- Concentrations of stakeholders
- The NUOF project and its contribution
- Remaining knowledge gaps, including geological and geomorphological complexity
- Data presentation and the value of stakeholder engagement

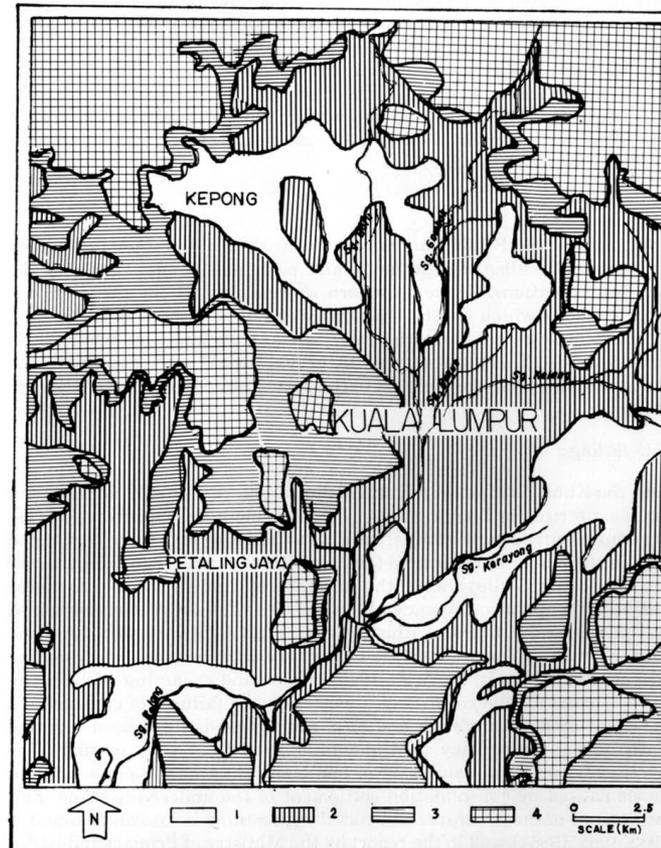
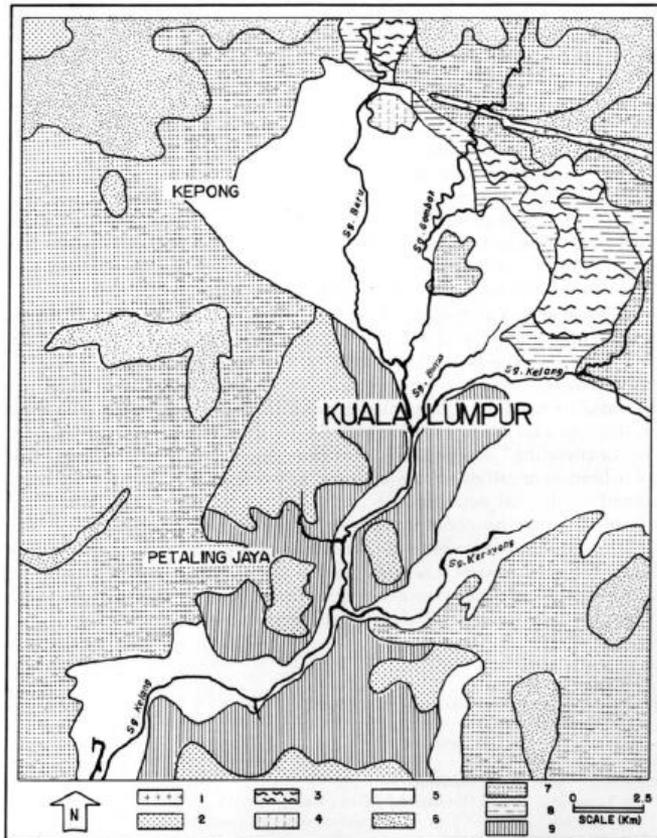


1. What is urban geoscience?

- The use of **new techniques and methods** that can be applied **to understanding the complex geoscience processes** that occur **under our cities** and towns.
- Which can be considered in terms of the urban centre's construction environment, geological hazards and its resource **catchment** and hinterland.
- Typically, for Kuala Lumpur City this applies to **understanding the ground conditions for new transport networks and better integration of geohazard research**, for example, but not exclusively karst and landslides. That the majority of these landslides have occurred at cut slopes, road embankments, highways and other man-made slopes (Althuwaynee, 2017), suggests a planning opportunity.



2. Legacy: Urban engineering geology is not new to Malaysia



Engineering geological

characteristics: derived from bedrock type and weathering grade

Relative slope stability map

1 unstable; 2 stable; 3 generally stable, and 4 marginally stable to unstable

3. New drivers: Kuala Lumpur, a modern and vibrant city



Working towards the sustainability goals

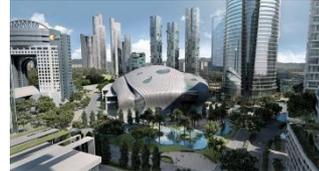
MRT



Pressure on space

Population growth

Urbanisation



KL Metropolis



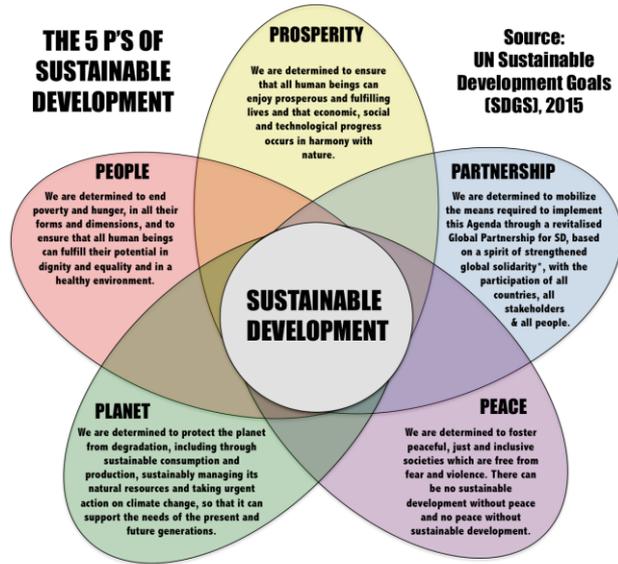
Tun Razak Exchange



KL118

(<http://kualalumpur2020.com/>)

Planning is ongoing

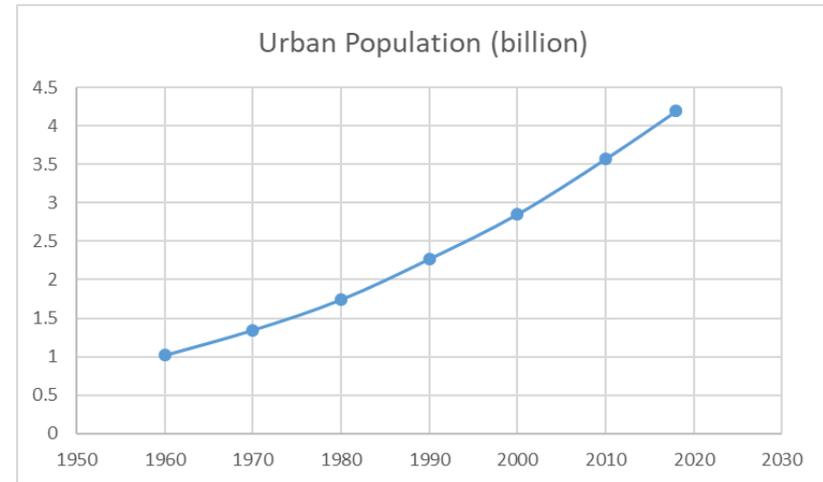
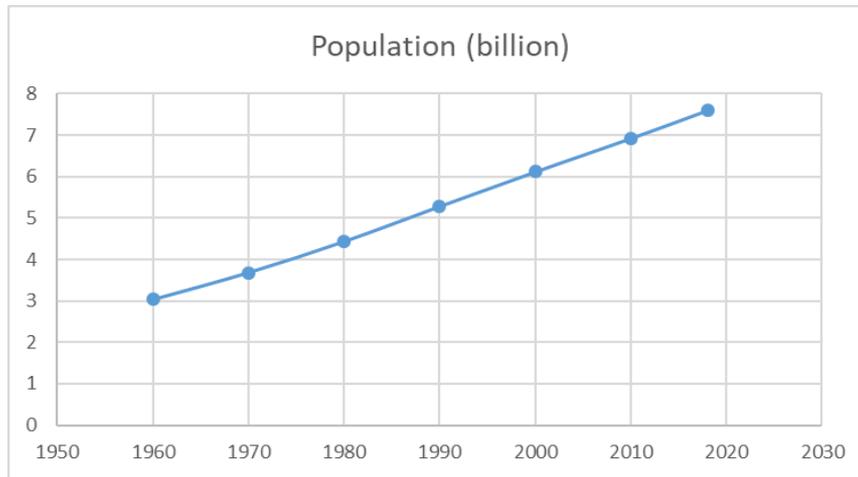


CC Wayne Visser 2015

* focussed in particular on the needs of the poorest and most vulnerable and with the participation of all countries. SD = Sustainable Development



3. New and ongoing drivers: Urban population growth



World Bank Statistics

Federal Territory of Kuala Lumpur @ a Glance						
		2015	2016	2017	2018	2019
Area (km²)*		243	243	243		
Population (million)						
	Total	1.78	1.79	1.79	1.79	1.78 ^e
	Male	0.91	0.92	0.92	0.92	0.92 ^e
	Female	0.87	0.87	0.87	0.87	0.86 ^e

Department of statistics Malaysia, official portal

Kuala Lumpur: current growth estimate 0.6%; decrease from 1.1% 2018

3. New drivers: Environmental change

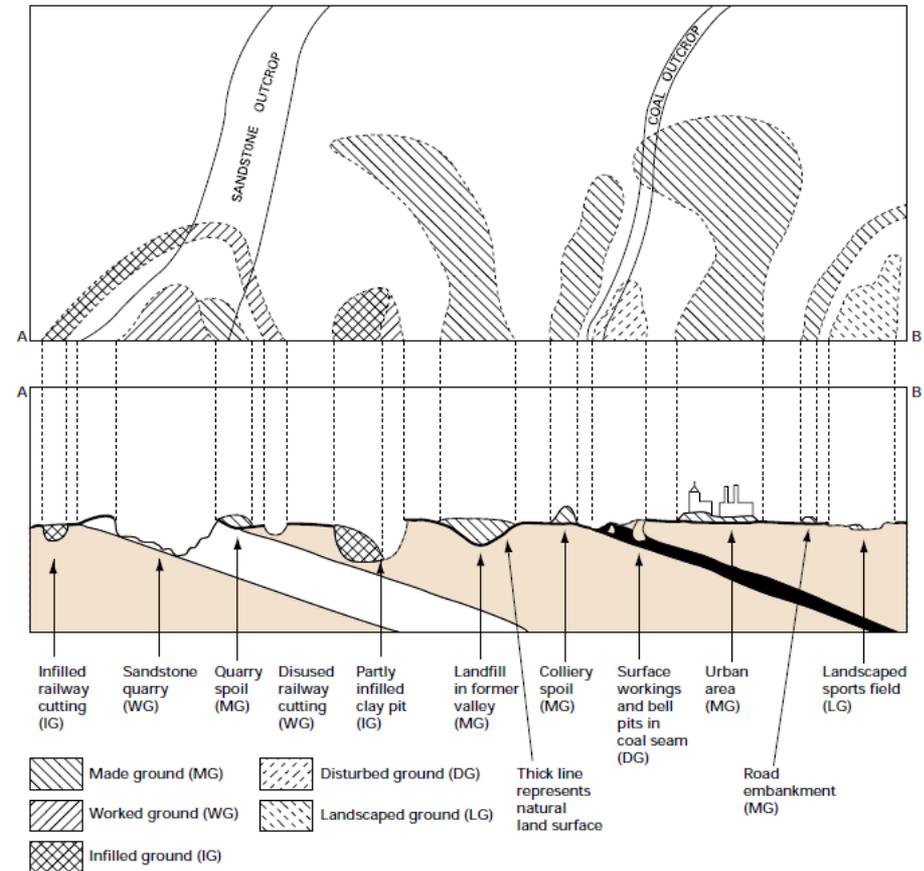
Anthropocene recognised in 2000 by Paul Crutzen and Eugene Stoermer to denote the ever increasing influence of humans on Earth

Indicators of physical, chemical and biological change

Hazard of moving out to more marginal land

Constraints on space for use of the subsurface

Anthropogenic change + climate change = Environmental change



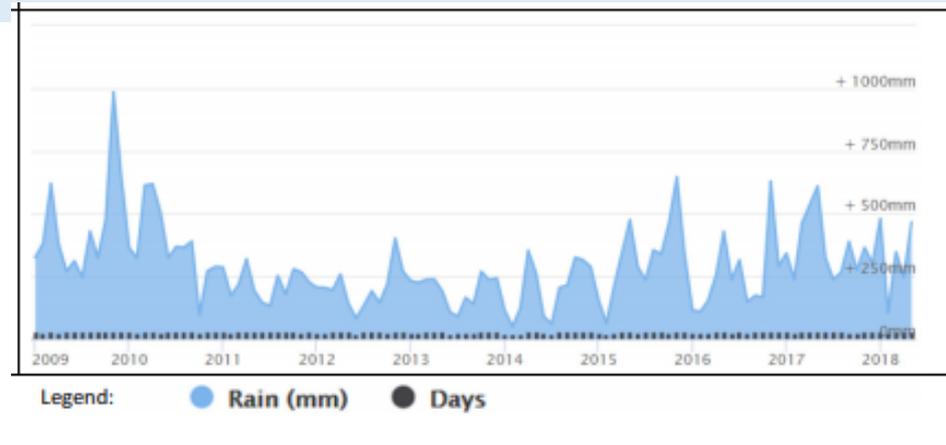
McMillan, A A, and Powell, J H. 1999 BGS Rock Classification Scheme Volume 4 British Geological Survey Research Report, RR 99-04.

Classification of artificial (man-made) ground and natural superficial deposits — applications to geological maps and datasets in the UK

Similarities and differences Kuala Lumpur and UK

3. New drivers: Climate change

- **Annual mean temperature**, occurrences of **extreme weather events** are rising, while **rainfall** shows **variability**.
- Future predictions point to **continued rise of temperature, mean sea level rise and numbers of extreme events** until the end of this century



Average Rainfall and Rainy Days of Kuala Lumpur *(WorldWeatherOnline, 2018)*

Kuok Ho Daniel Tang 2019

- IPCC ongoing reporting appears to support this, including:
 - Climate and the land
 - Oceans -Sea-level rise is accelerating because the Greenland and Antarctic ice sheets are melting at an increasing rate with a sea level rise of 3 feet forecast by 2300 with no more than a 2 degree rise

4. New technologies and richness of data in urban environments

InSAR and other types satellite data

Drones

LiDAR – air and ground

GIS and Sigma Mobile

Sensor technologies including ERT

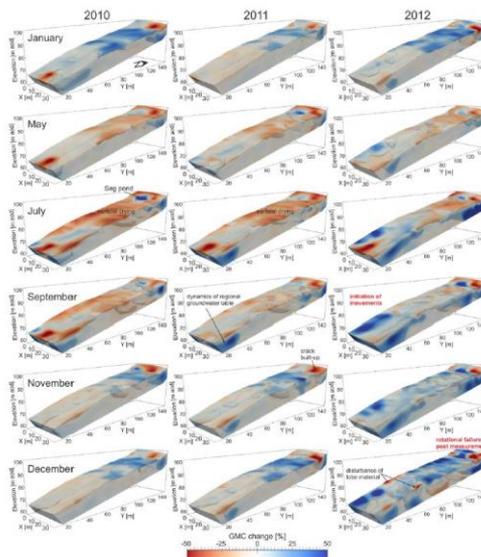
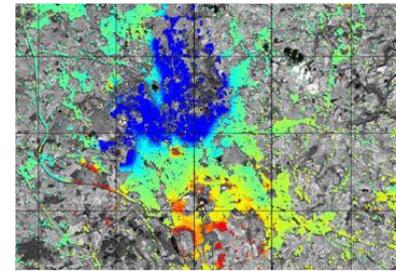
Mapping and sensing the underworld

Multi sensor platforms

Real time monitoring

3D Modelling

Data presentation resources



Measurement and modelling of the changing moisture content in four dimensions *Uhlemann, S. et al 2016*

This requires the **integration of core geoscience skills** (geological mapping, hydrogeology, mineral resource evaluation and engineering geology) with **new skill sets**, such as planning and the management, manipulation and presentation of large datasets



5. Concentrations of stakeholders

Workshop on Disaster Resilient Cities: Risk Assessment and Forecasting of Geophysical and Atmospheric Hazards 9-10 March 2017

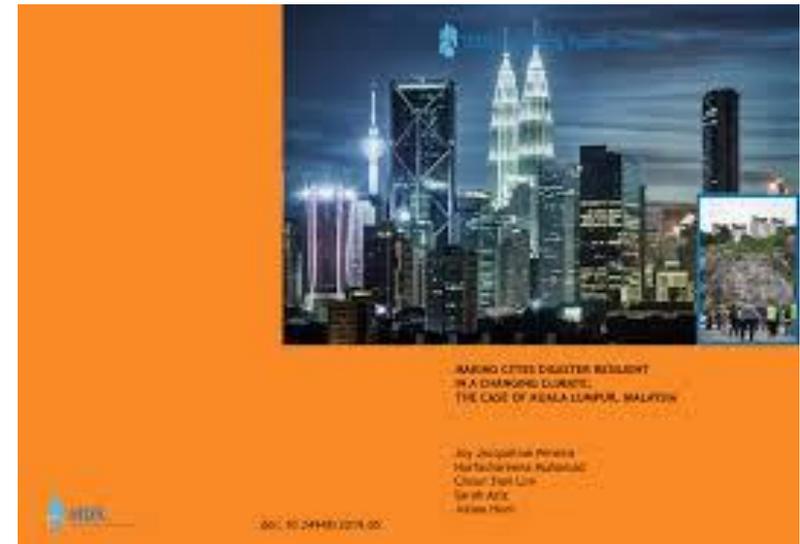
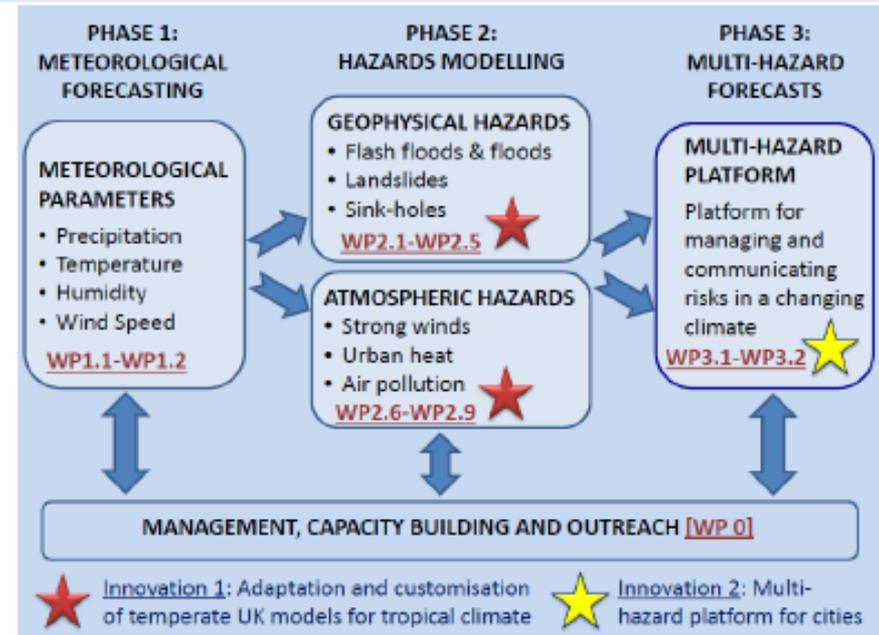
Nurfashareena Muhamad & Joy Jacqueline Pereira (2017)



Administrative authorities
Geology and geoscience
Planning
Resourcing
Engineering and construction
Infrastructure management
Water
Energy
Telecommunications
Transport
Resilience forums
Education

6. The contribution of the NUOF project

- The generation of susceptibility maps has enabled the identification of the **most vulnerable communities** (Pereira et al., 2019)
- The ongoing development of rainfall trigger thresholds integrated in the multi-hazard platform will **enable the development of early warning communications**
- The success of this will, in part, be **dependent on effective communication and education of end users**, which will also contribute to resilience



7. Remaining knowledge gaps

Geological and geomorphological uncertainty: groundwater, thrust zone geometry rates of uplift, weathering and erosion

Sub-surface karst

Landslide domains

Mining

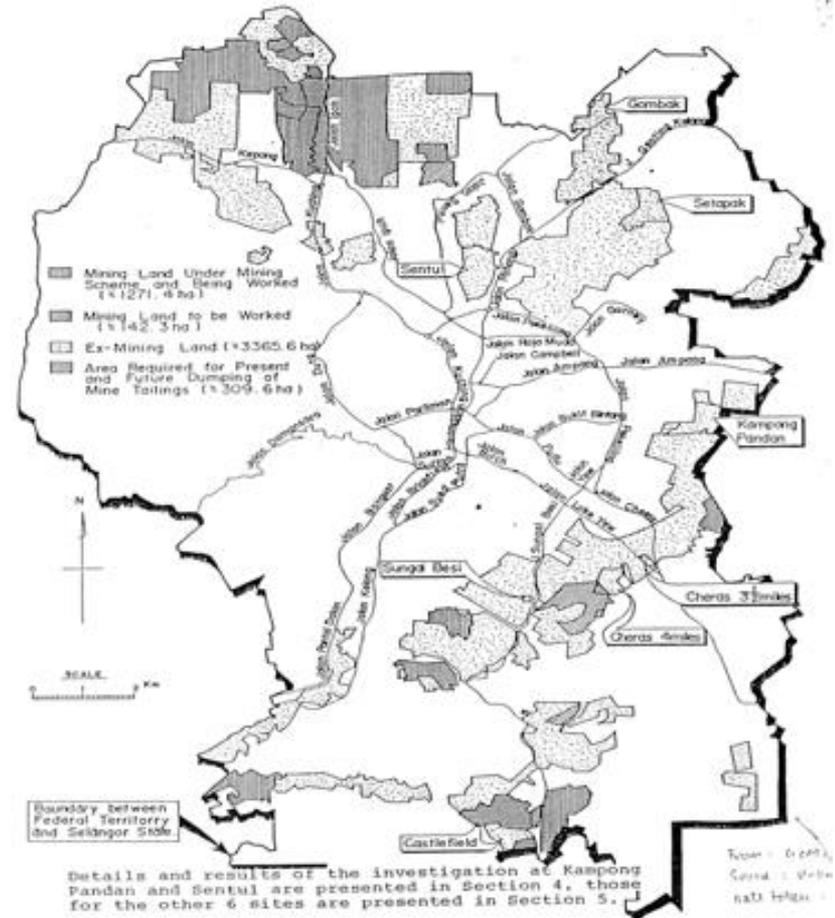
Mine waste

Radon and other ground gases

Landfill

Contaminated land

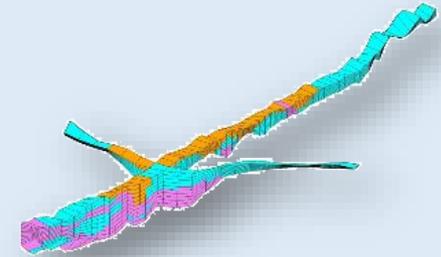
Geochemical conditions, e.g. sulphates and redox conditions



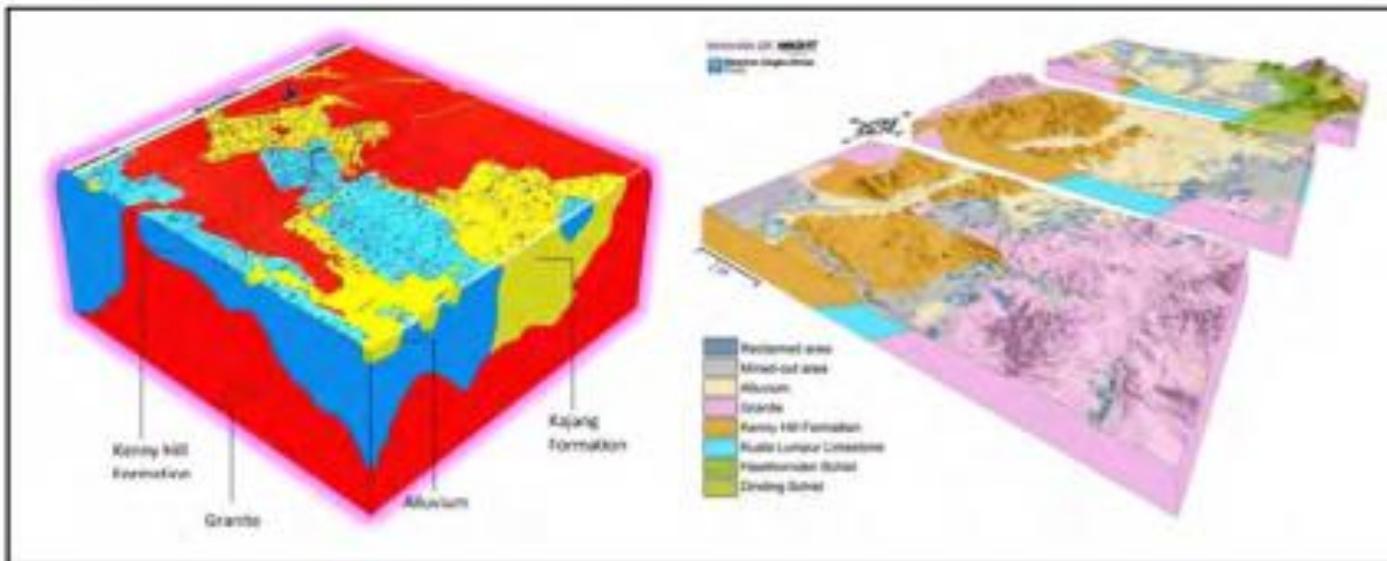
Ir Simon Tan Siow Meng,

7. Urban geoscience in Malaysia: The future

BGS ODA platform with JMG: Improvement of the understanding of the ground conditions in KL by adoption of 3D modelling approaches and application of urban geology mapping and modelling in KL



.... A good starting point



*Qalam A'zad Rosle et al.,
2019*

However, now the future lies in working with stakeholders to generate the suites of products that they need and understand for preparedness and resilience building

Thank you for the invitation to present and for your time this afternoon

It has been a pleasure to work with our UK and Malaysian partners, collaborators and stakeholders

