Applying Geophysical Methods to Archaeological Rockshelters in the Western Cape, South Africa

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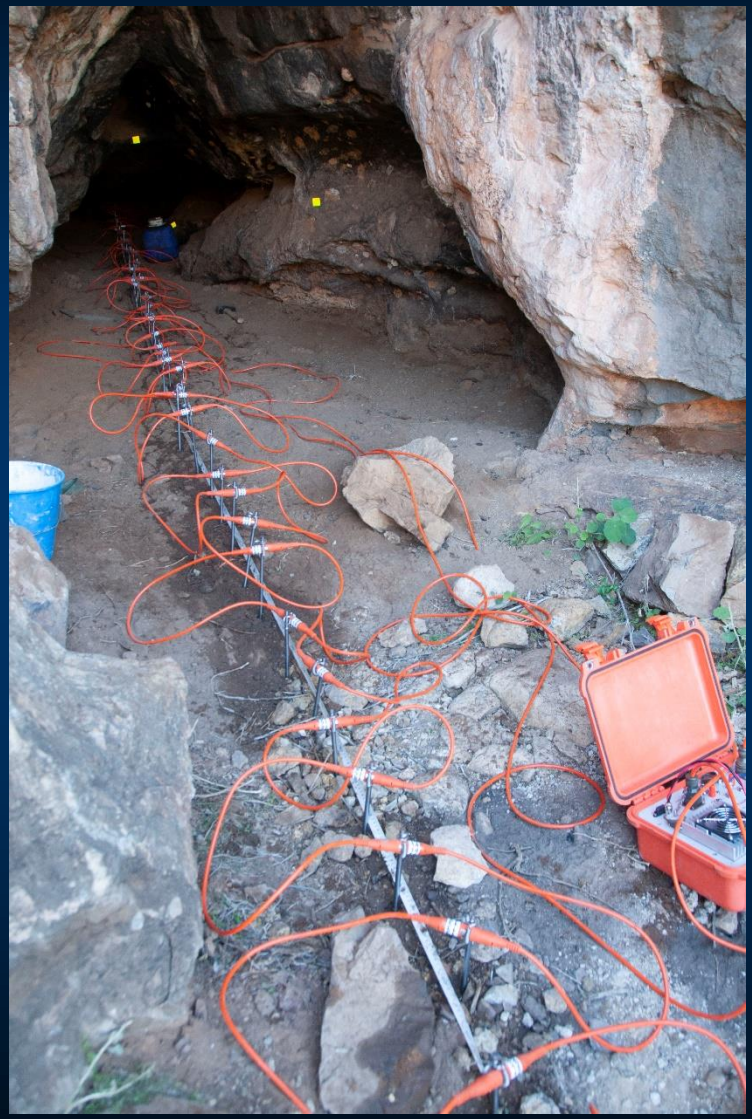
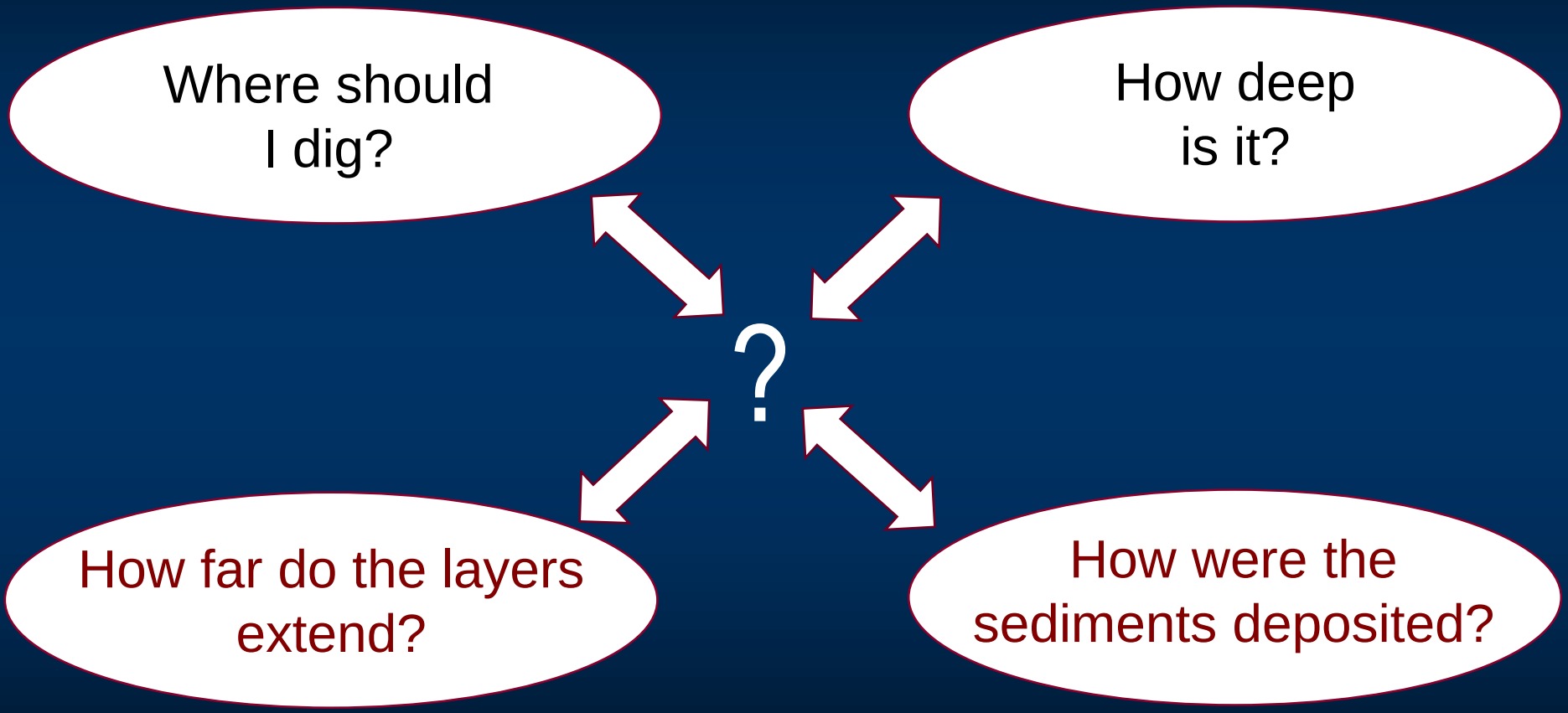
Why Geophysics in Rockshelters?

- Rockshelters/caves contain abundant records of skeletal material, material culture and palaeoenvironmental indicators.
- Understanding these sites is essential to unravelling human evolution.
- Excavations often proceed without much information which is inefficient and risks missing important material.



A Critical Research Challenge



Problems with Conventional Geophysics

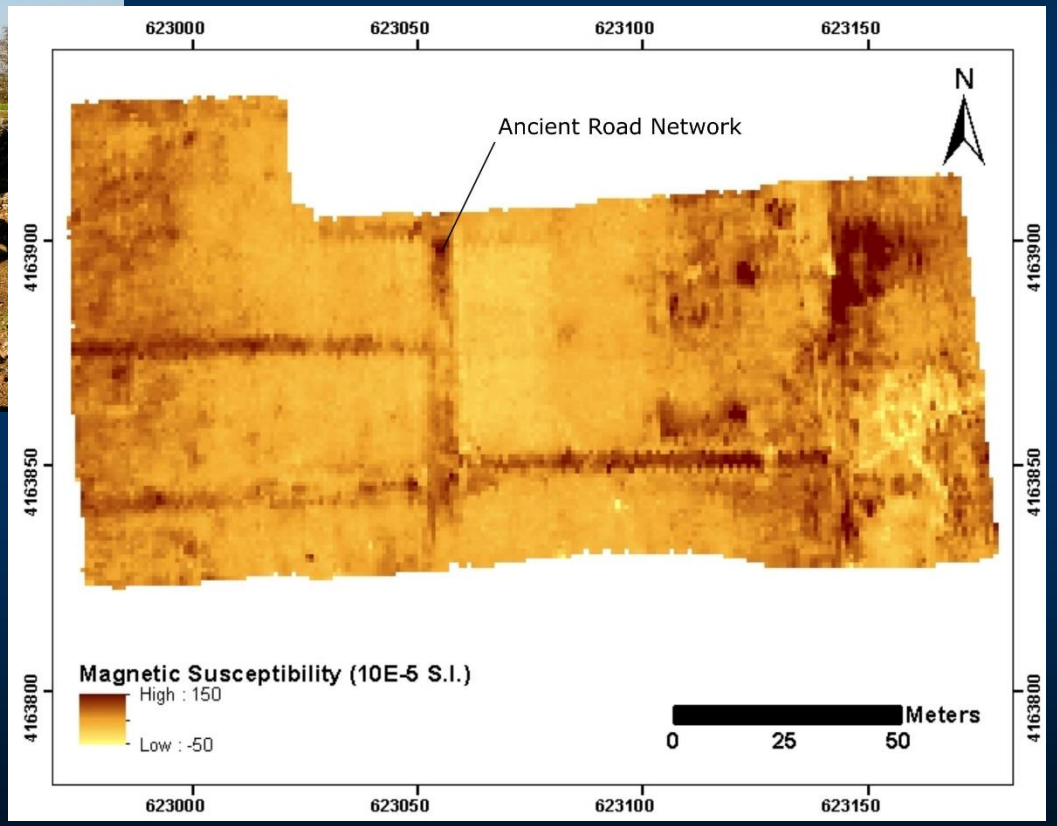
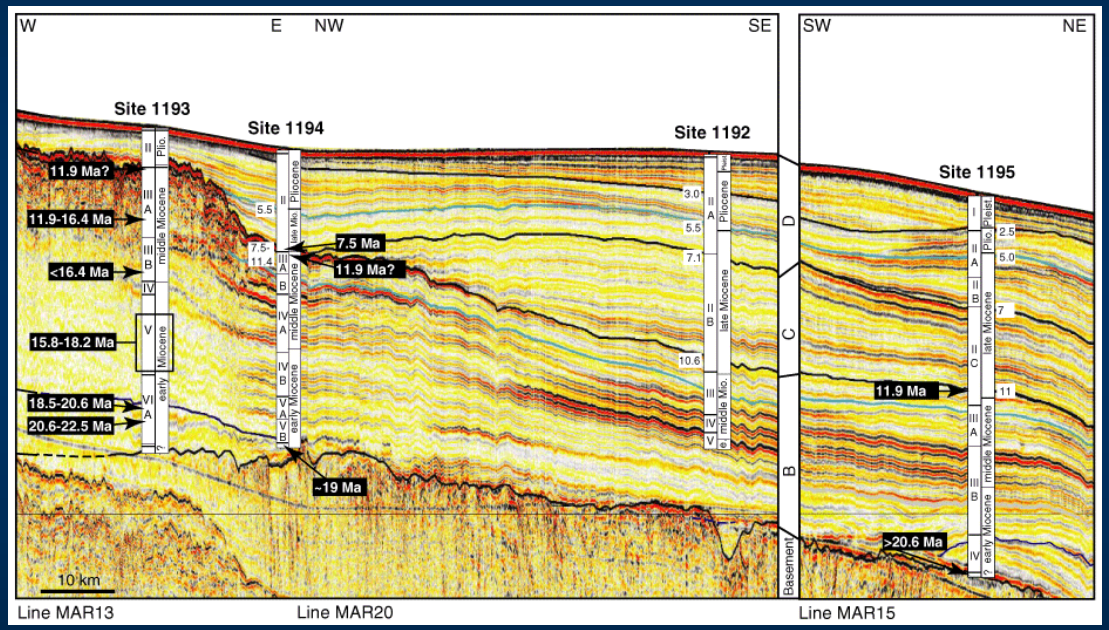


Image: Moffat et al. 2015

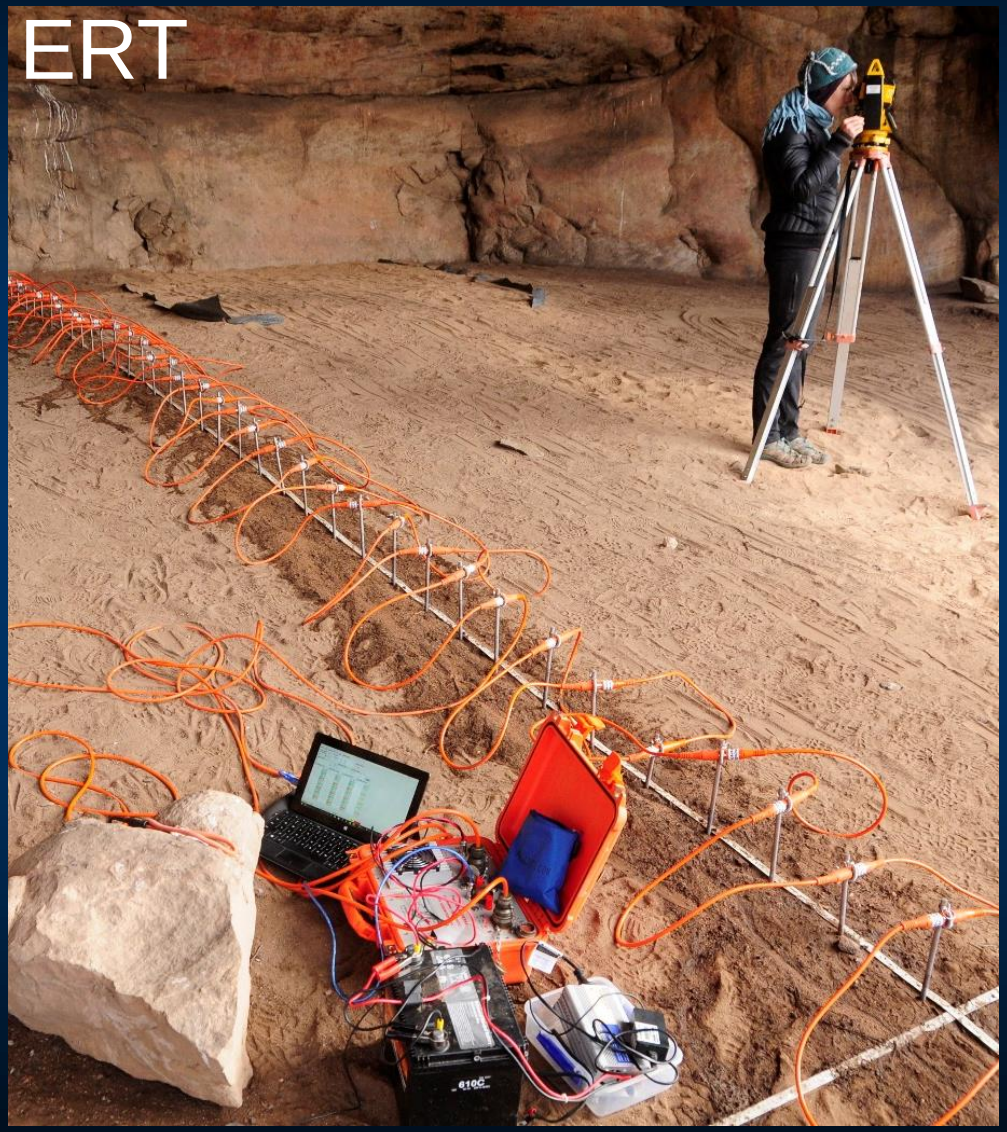
We already have a solution (sort of)



The Drumbeat of Human Evolution Project

- Systematically trialing multiple geophysical methods in a variety of rock shelters
- Current study sites in South Africa, Indonesia and Australia
- Please get in touch if you are interested in collaborating on other sites

Methods

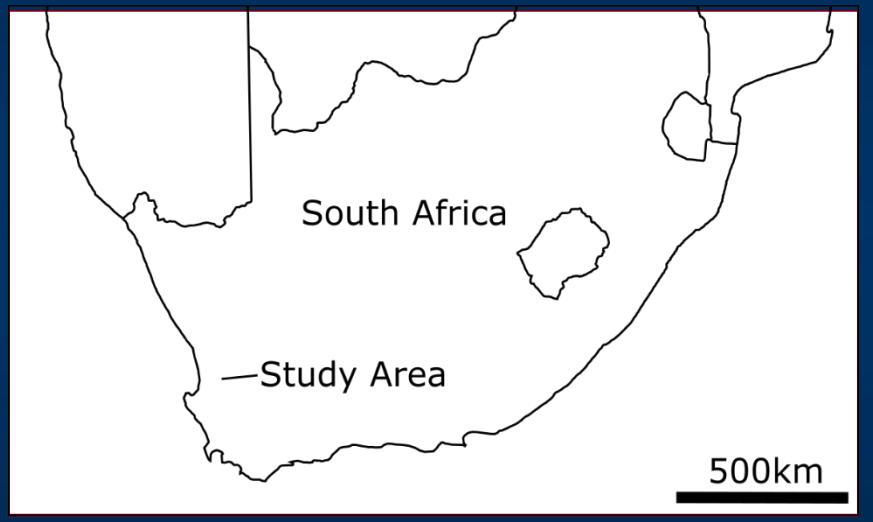


Methods

	GPR	ERT
What does it measure?	Dielectric permittivity	Resistivity
Resolution?	~2cm	~20cm
Depth of Penetration?	Dependent on soil and antenna frequency	1/3 of total array length
Can image?	Lithology, bedrock, sedimentary structures	Lithology, bedrock
Problems	Conductive soil, ground coupling	Resistive soil, geometry

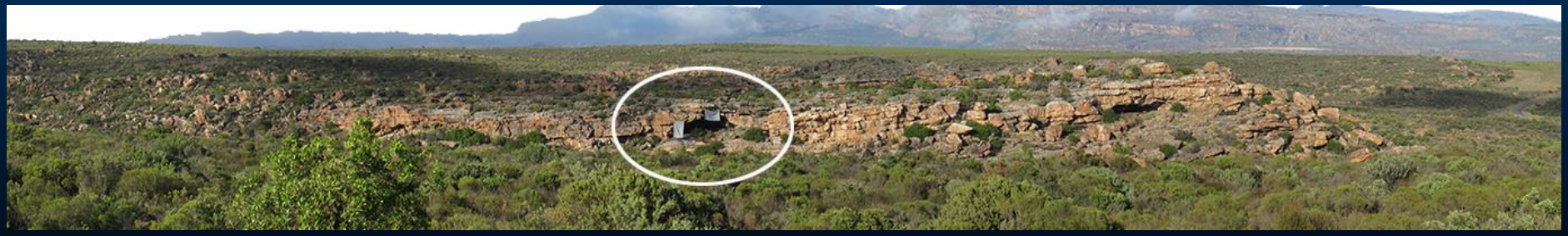
Case Studies: Klipfonteinrand and Mertenhof

- Located in the Eastern Cederberg of South Africa
- Formed in Ordovician aged sandstone from the Table Mountain Group
- Bedrock depth to a maximum of ~3m
- Contain archaeological material from Early Middle Stone Age to Robberg covering MIS5-MIS1

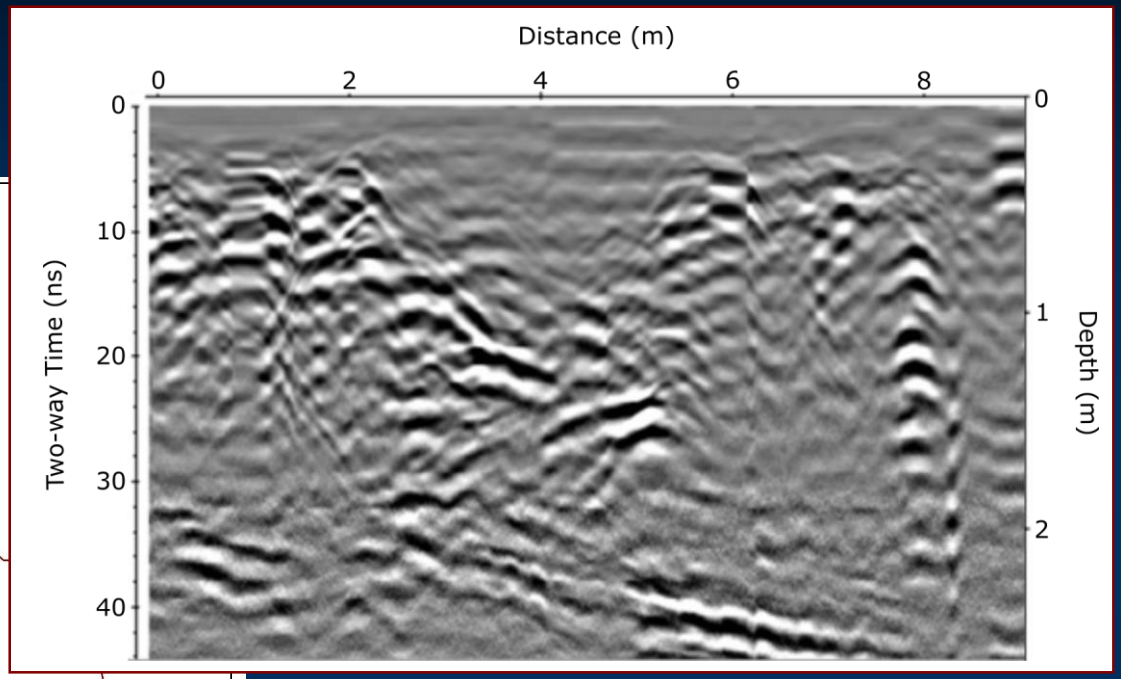


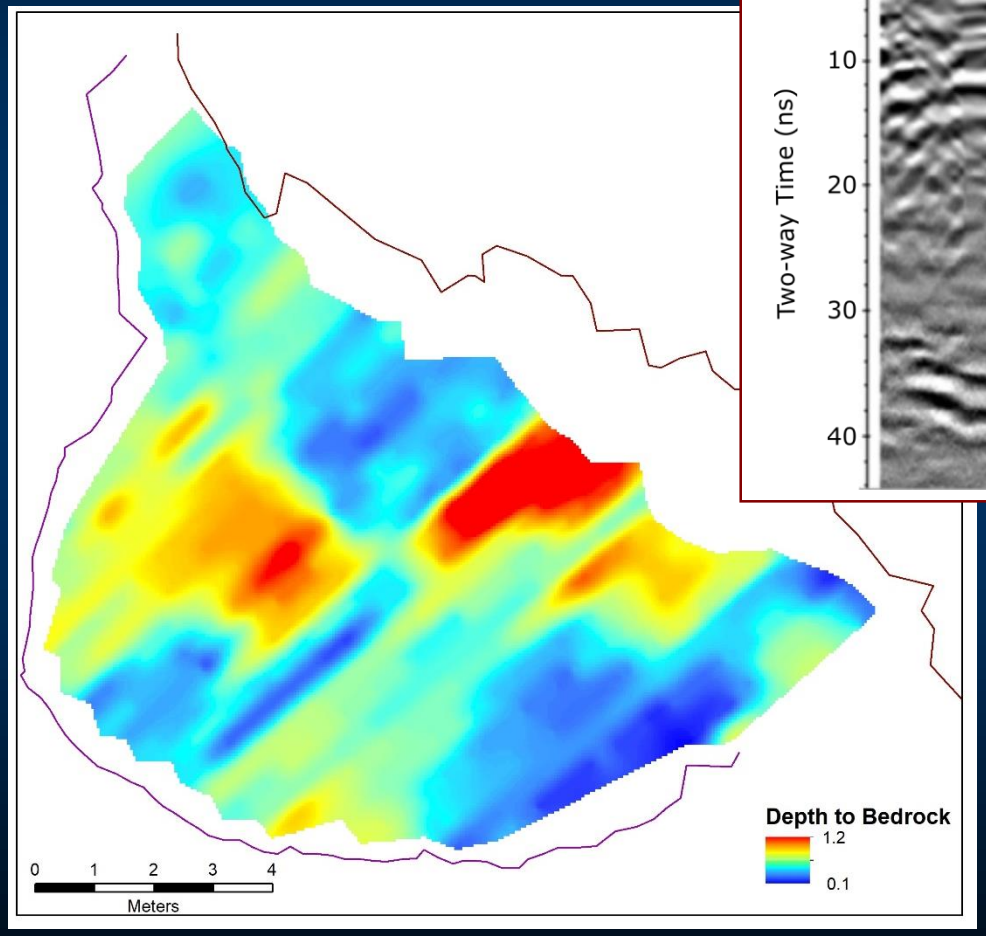
Case Study: Klipfonteinrand

- 18m x 13.5m with a maximum depth of 1.5m
- First excavated in 1969, subsequently 2011-2012



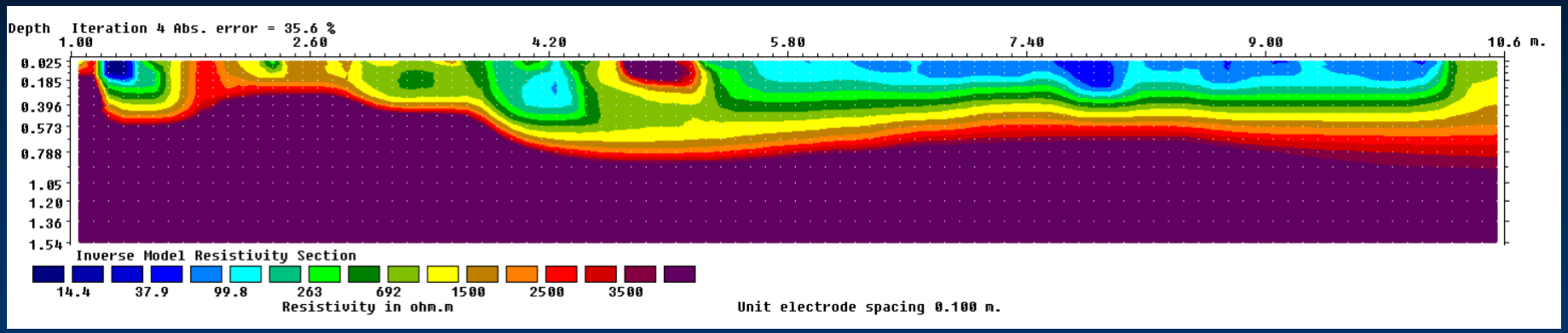
Klipfonteinrand GPR



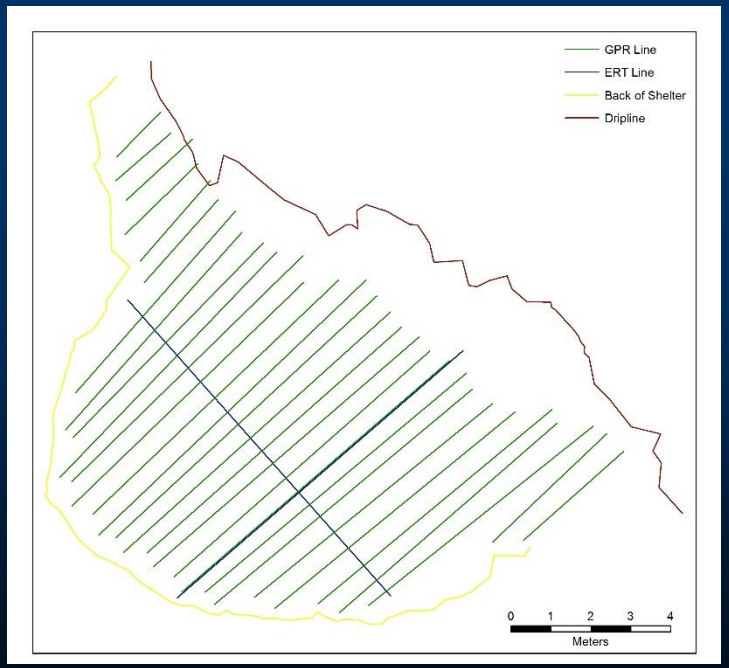


- Unexpectedly complicated bedrock geomorphology
- Little roof fall or changes in stratigraphy

Klipfonteinrand ERT

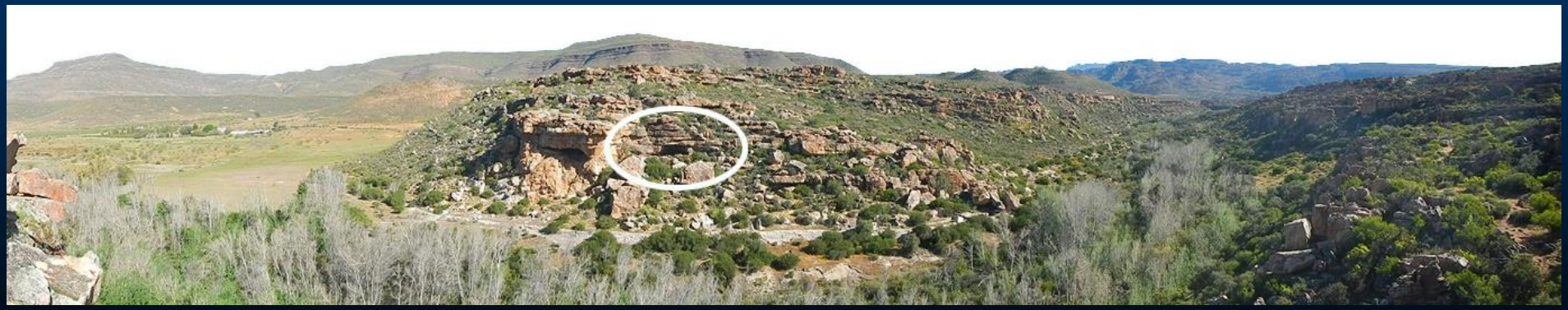


- Broadly echoes GPR bedrock map
- Significant variations in resistivity of unconsolidated sediments
- Extreme resistivity of sediments make distinguishing bedrock difficult

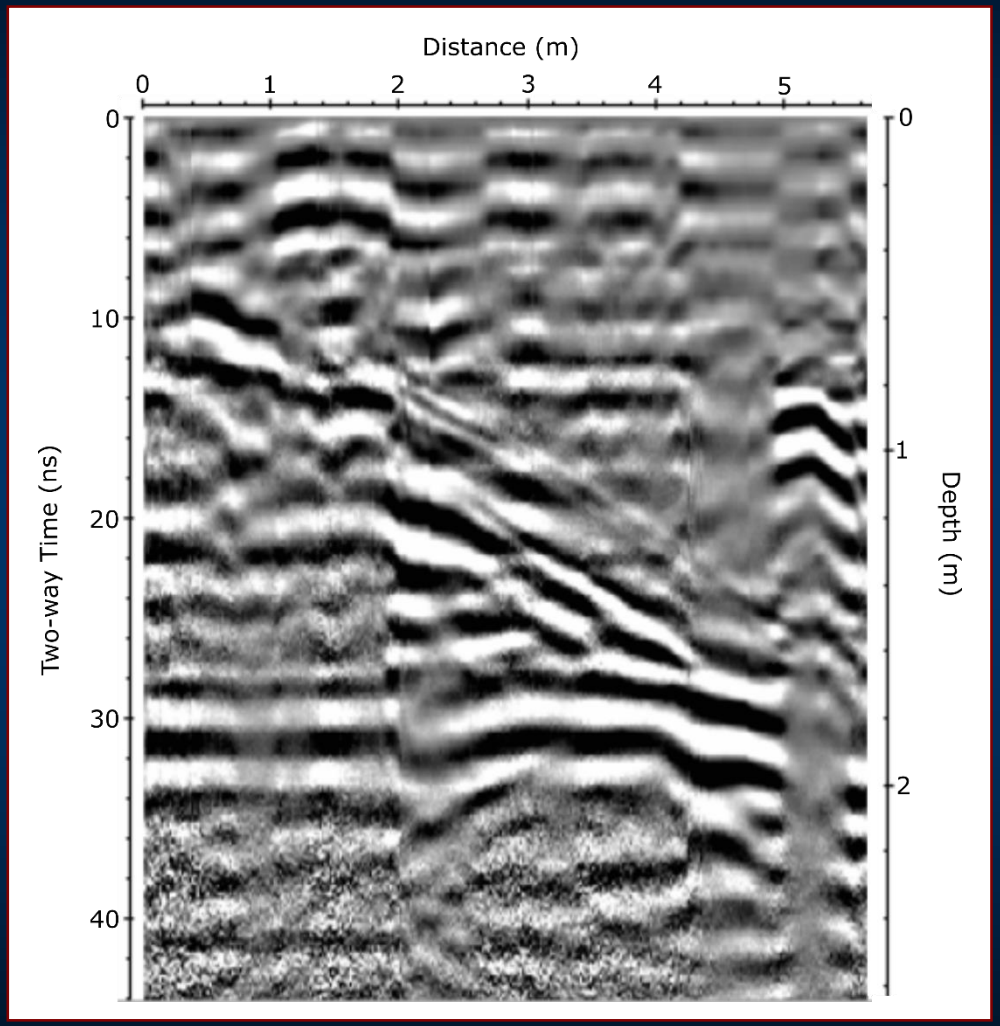


Case Study: Mertenhof

- 10m x 10m, bedrock not currently reached
- Ongoing excavations since 2013
- Geophysics complicated by a great big excavation in the middle of the site…..

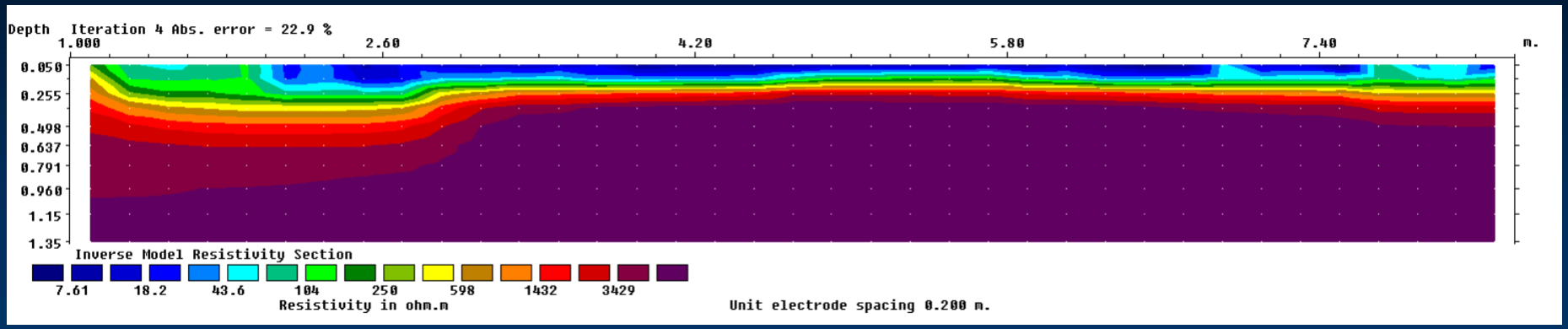


Mertenhof GPR



- Very uncomplicated bedrock geomorphology

Mertenhof ERT



- Geometry of site prevents ERT reaching bedrock depth
- ERT appears to provide some details about stratigraphy

Conclusions

- Geophysics was able to map the depth to bedrock, although further work on velocity is required.
- Geophysics suggests significant variation in the stratigraphy, which we currently don’t understand very well
- Laboratory analysis of sediments to better understand physical properties

Moving forward

- More geophysics please!
- Forget about anomalies and ask geological questions
- Multiple methods are essential, MASW to be trialed in 2019
- Better data processing to resolve subtle stratigraphic feature

Questions?

Australian Government
Australian Research Council

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