UNCOVER: Cover-thickness mapping technical workshop summary and outcomes

It is generally agreed that a major impediment to effective mineral exploration in Australian greenfield areas is an accurate and cost-effective determination of cover-thickness. Of primary economic importance is the resolution of cover depth down to ~1 km within 20% error. Apart from pattern drilling, geophysical techniques provide the only means of mapping this variation. Stakeholder engagement between Geoscience Australia and industry has highlighted that current cover-thickness maps are grossly inaccurate. To address this problem over 60 participants representing industry, government and academia attended the UNCOVER cover-thickness mapping technical workshop, held over one and a half days at the University of Adelaide on 2–3 April 2014.

The aim of the workshop was twofold:

1. Identify the most cost-effective geophysical methods of cover-thickness mapping.
2. Devise strategies to improve cover-thickness mapping across Australia.

For the purpose of this workshop cover-thickness was defined as the depth to an arbitrary layer of interest at a maximum depth of 1 km over a 5 km by 5 km area. The workshop consisted of a series of 25 minute talks outlining geophysical techniques used to estimate cover-thickness, followed by discussion in five breakout groups. Slides from these talks will be uploaded to the UNCOVER website.

Cost-effectiveness of geophysical methods

Breakout group discussion initially focused on ranking the cost-effectiveness of each geophysical method by filling in Table 1. For the purpose of this exercise it was assumed that an ideal rock property contrast exists at the cover-basement interface. A broad consensus emerged, reported in Table 2. Magnetic, electromagnetic and gravity methods were viewed as most cost-effective followed by seismic and other methods. In detail the ordering of preferred techniques varied between groups. This variation is likely to be an expression of the lack of clarity within the community regarding the uncertainty associated with cover-thickness estimates as outlined in the talks. Despite this uncertainty, there was a consensus that all geophysical methods can provide cover-thickness estimates to within 5-20% error, with the possible exception of magnetotelluric derived estimates.

Table 1: Table filled in during breakout groups in order to stimulate discussion concerning the applicability of each geophysical method to mapping cover-thickness.

Method	Unique-ness of solution ranking	Cost effective-ness ranking	Property	Min & max depth (m)	Max depth res. (m)	Max x, y res. (m)	Station spacing (m)	Survey design (e.g. station spacing)	Cost (per km^2)	Data processing time
e.g. Gravity										

Table 2: Ranking of geophysical methods in order of decreasing cost-effectiveness based on discussions within five breakout groups (1 = effective, 10 = ineffective). It was assumed that an ideal rock property contrast exists at the cover-basement interface. Minimum and maximum values report the range of suggested rankings.

Method	Minimum	Average	Maximum
Magnetics	1	**1.4**	3
Airborne electromagnetics	1	**3.0**	6
Gravity	2	**3.4**	6
Ground electromagnetics	4	**5.0**	6
Passive seismic	3	**5.3**	7
Active seismic	5	**5.9**	8
Ground electrical methods	5	**6.5**	8
Magnetotellurics	6	**7.3**	7
Remote sensing and radiometrics	7.5	**8.4**	10

Strategies to improve cover-thickness mapping

Each breakout group was to consider five questions. The following is a summary of their replies.

1. What information is required to test the cost-effectiveness ranking of each geophysical technique?
    - Benchmarking geophysical methods over a range of cover types where cover-thickness is or will be known through drilling. Ideally the physical properties of the cover in these benchmarking areas needs to be characterised in order to effectively evaluate the success of each technique.
    - Error associated with each technique can be quantitatively assessed if multiple benchmarking studies are performed. Currently, uncertainty is not assessed during the application of any of the methods considered during the workshop.
2. Are there new technologies on the horizon that will shift the ordering of these techniques?
    - There was a general consensus that forthcoming technological advancements will only incrementally improve the techniques considered and would not reorder their cost-effectiveness ranking.
    - The routine acquisition of airborne gravity gradiometry and towed active seismic data were highlighted as notable new advances.
    - Joint inversion of magnetic, gravity and airborne electromagnetic data was sought.

3. What information is required by explorers to select which technique to use over their tenements?
    - A point data repository of legacy cover-thickness and character estimates with error attributes was sought in order to guide exploration in undercover areas. Cover-thickness surfaces and cover-character maps (e.g. physical properties, expected wavelength and amplitude of variation) were suggested as useful derivative products which may arise from this data compilation.
4. Is there a need for a national repository of cover-thickness estimates? If so who should do this and how should we approach the task?
    - There was an overwhelming consensus that a national repository of cover-thickness and character estimates was needed. Emphasis was placed on data reliability and the need to compile a physical property characterisation of the cover.
    - It was proposed Geoscience Australia lead a collaborative national effort to compile cover-thickness estimates. State and territory geological surveys were identified as principle partners with data input from exploration companies.
    - Additional reporting requirement for exploration companies were suggested as a viable means of capturing industry cover-thickness and cover-character data.
5. Are there any other suggestions to facilitate cover-thickness mapping?
    - Development of a pool of resources/infrastructure for grid drilling designed specifically for cover-thickness and cover-characterisation studies.
    - Construction of “type cover sections” over Australian’s geological provinces.

Outcomes

Geoscience Australia has adopted the recommendations from this workshop in shaping its work program for the 2014/2015 financial year and beyond. New activities include:

1. Implementation of a new project aimed at mapping cover-thickness and cover-character across Australia. In the 2014/2015 financial year focus will be placed on developing a data repository to host cover-thickness and cover-character estimates over a case study area. Emphasis will be placed on preserving data provenance and uncertainty. State and territory geological surveys as well as exploration companies will be consulted during this process.
2. Geoscience Australia’s pre-drilling geophysical data acquisition program will be expanded to encompass the gamut of geophysical techniques pertinent to cover-thickness mapping. This program is the first step to benchmarking the range of geophysical techniques against well-characterised drill sites.