Estimating depth to bedrock in weathered terrains using ground-penetrating radar: a case study in the Adelaide Hills

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TITLE

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RUNNING TITLE

Bedrock depth estimation using ground-penetrating radar

ABSTRACT

Ground-penetrating radar (GPR) is a geophysical technique that is commonly applied to a variety of subsurface investigations, with the capability to determine depth to bedrock under favourable soil conditions. This study was conducted at three different physiographic regions that represent typical terrains in the Adelaide Hills. At each site, GPR surveys were conducted along traverses using 100, 250, 500 and 800 MHz antennae. A drilling program was conducted concurrently with the GPR survey to provide baseline bedrock depths for comparison. Electrical resistivity and electromagnetic surveys were also conducted along each traverse to determine subsurface conductivity and secondary bedrock depth estimates. The GPR results for all antennae were compared to determine the frequency that provided the best depth estimation. Rapid attenuation of GPR signal at all frequencies was observed, resulting in shallower than expected investigation depths. At two of the sites, GPR signal penetration depth was increased in areas that were highly resistive. The 800 MHz antennae displayed the highest resolution of estimated bedrock contacts in these resistive areas, and were subsequently compared to drill refusal depths using a paired *t* test. GPR estimation depths and drill refusal in electrically resistive areas strongly correlated at two of the sites, while the third site showed no correlation. Across all three transects bedrock depths were underestimated by 74% on average. This underestimation is attributed to signal attenuation, which appears to be caused by a combination of increased conductivity, clay content and the presence of iron oxides in the soil profile. Without further investigation it is difficult to quantify these factors on attenuation in the area. The results of this study suggest that GPR surveys are not suitable for bedrock depth estimation in Adelaide Hills-type terrains.

KEYWORDS

Ground-penetrating radar, bedrock depth, Adelaide Hills, site productivity, soil profile, attenuation

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