RELATIONSHIPS OF REGOLITH AND TREE SURVIVAL IN A EUCALYPTUS BLUE GUM PLANTATION

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THE ISSUE

Revegetation using plantation crops is a major initiative of the current state government. Particularly in the study area of South West Western Australia, pine and Eucalyptus plantations are a growing element of the community. Revegetation is being used to tackle salinity and rising water-table problems, as carbon dioxide sinks and as a source of bioenergy, with an increasing need for revegetation of farmland to restore hydrological balances. With the increase in capital being invested into plantation trees there is a need for optimum plantings. Evaluations of sites for revegetation have thus become important to determine sustainability and profitability.

Factors involved in determining site suitability include climate, local hydrology, soil fertility and hazards such as salinity. Recently soil water storage has been shown by CALM researchers to be important in sustaining plantation performance over drought periods. The type of regolith over an area, especially the depth of soil and depth of the entire weathering profile, is an important consideration. In areas in which a deeper weathering profile occurs, there is a greater amount of soil and thus greater soil water storage. The study site is thought to contain patches where the trees have a shallow level of soil due to a visual soil change to sandy soils. Gravelly soils underlie well-developed trees and are an indication of the deeper weathering profile. These surface correlations between regolith and tree survival have promoted the use of geophysics in my project to compare the subsurface regolith nature to surface soil morphology.

BACKGROUND

In the research area and other areas in southwest WA, CALM has observed a phenomenon of patches where the plantations have not survived drought periods. The plantation studied after plantings in 1997, has linearly delineated areas which were affected by the 2000-2001 summer drought in SWA.

Previous research conducted by CALM indicated links between the soil profile and thus soil water storage and its influence on vegetation. Studies completed by Richard Harper (Harper *et al.* 1999) indicate soil depth as a major contributing factor to tree mortality, with > 2 m soil needed to sustain tree growth over drought periods. John McGrath defined the distribution of pine tree deaths as proportional to the capacity of soil water storage over summer / drought periods. One of the conclusions of their study was that individual tree basal area showed increasing “drought symptoms” with decreasing soil depth.

PRELIMINARY RESULTS

The regolith mapping (or characterization) undertaken via several techniques illustrates the extent of properties to be measured, and therefore enables identification of areas that would be unable to sustain tree growth due to limited soil water storage capacity or restriction to groundwater flow in the regolith.

Three sites were chosen based on the presence of distinct transition from dead to living trees which occurred in areas showing surficial soil changes indicative of a change from a shallow to deep weathering profile.

Geological Methods

Remote sensing data utilized included aerial photography and Landsat TM images. These techniques were able to highlight areas of the plantation where dead patches occurred. Further studies comparing dead vegetation patches identified via remotely sensed techniques to broad low-resolution magnetic data would be useful.

Drill samples and geochemical analyses were performed at the junction of each Vertical Electrical Soundings (VES) transect and Ground Penetrating Radar (GPR) transect. The drill samples were analyzed for moisture content and particle size, which enabled the basic textural differences to be deciphered and estimates of layer boundary depths to be picked. Two drill hole positions from each site were analyzed for chemical and mineral composition using X-ray fluorescence and X-ray diffraction. The geochemical results indicated a dolerite dyke at one site, which is in agreement with the magnetic survey at this site. Greater amounts of Na_2O, along with K_2O are present in soils below the dead trees than the living ones. The

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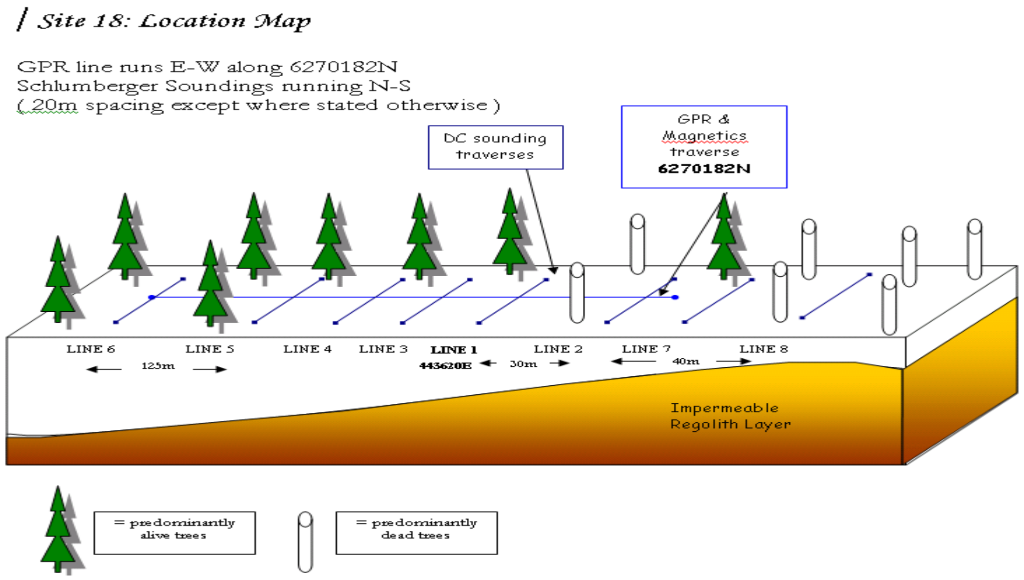
consistently greater values of alkali and alkaline earth metals in the shallow regolith under the dead tree patches was taken as an indication of a slightly shallower depth of weathering profile than in the living sections, because alkali and alkaline earths are soluble and mobile during weathering and tend to be leached from the more deeply-weathered bedrock. Overall, the sites chosen were over saprolite rather than transported regolith.

Geophysical Methods:



Ground Penetrating Radar (GPR), was surveyed along one main E-W transect at each site, from dead to living vegetation areas. It was able to indicate general subsurface regolith layers. Diffractions, indicating contrasting features, were evident at positions correlating to the dead / living tree boundaries. A small rise in bedrock of ca. 1 m was picked at the transition to living trees at one of the sites. This change in the impenetrable boundary is thought not to be a substantial enough change to be the bedrock change expected across the dead to living boundary.

Four ***ground magnetic*** traverses were surveyed E-W at each site. Anomalies occurred at 2 sites, the positions correlating to the dead / living boundary. These were both N-E trending, linear anomalies, and the contrast could indicate mafic dykes as the soil sample from one site along this boundary confirmed the presence of mafic material or another impenetrable boundary restricting water flow over this transition.

Five to eight ***Vertical Electrical Soundings*** (VES) transects were surveyed at each of the 3 sites. These were modeled and the results indicating the apparent resistivity property of the layers and the depths to these layers. Preliminary results suggest a consistent depth to basement of about 5-6 m across all sites, as confirmed in the GPR.

USING GEOPHYSICS FOR PLANTATION SITE ANALYSIS

Geophysics could be beneficial in site analysis prior to planting to optimize the tree survival of plantings. Further geophysical surveying should be undertaken to strengthen the comparison of results between techniques. A survey over a known deep regolith profile on the plantation would be beneficial to gauge possible regolith profile changes. Broad scale magnetics over the plantation might also illuminate possible areas susceptible to restrictions to water flow.

Results are still being processed and further analysis may indicate more correlations than thus far.

REFERENCES

HARPER R.J., EDWARDS J.G., MCGRATH T.J., REILLY & WARD S.L. 1999. *Performance of Eucalyptus globulus plantations in South-Western Australia in relation to soils and climate*. CALM.

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