Gamma-Ray Spectrometry – Mapping Soil Variability

More and more farmers are becoming interested in implementing variable rate technology, this is largely being driven by the increased costs of fertiliser and soil ameliorants. Management decisions to implement variable rate fertilisers or gypsum and lime need to take into account what the soils physical and chemical barriers are that may be limiting production. To do this growers need to be able to identify the major soil types on their farms, many can do this by drawing soil type maps with a reasonable degree of accuracy. However with the use of geophysical sensing technology such as Electromagnetic surveys (EM38) and Gamma-ray spectrometry (Radiometrics) we are now in a position to define these soil type boundaries with a high degree of accuracy. Coupled with ground truthing via targeted soil testing we have been able to correlate the soils physical and chemical barriers to root growth on zone basis ready for site specific prescriptions.

Figure 1 – Highly Conductive Soil, Duplex Sand over Clay.

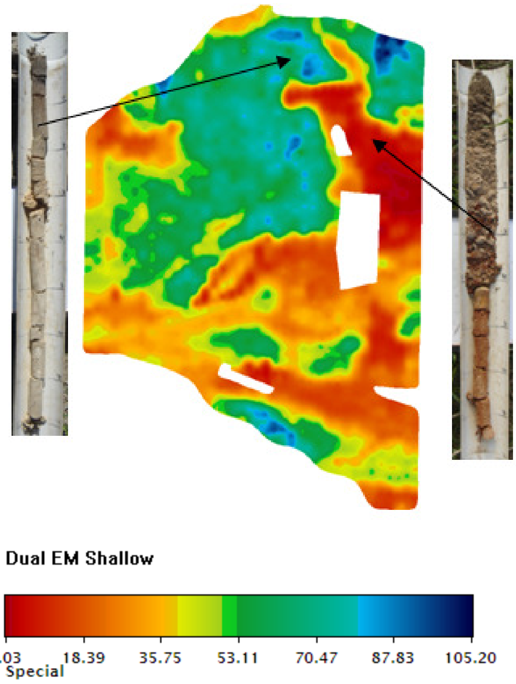
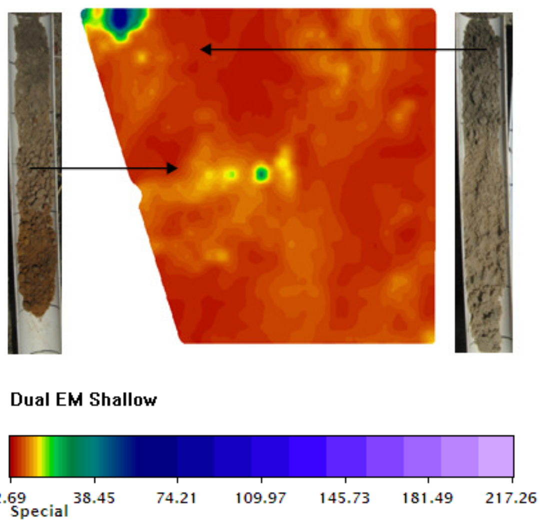


Figure 2 – Very Low Conductive Soil Sand and Gravel



Geophysical Sensing

Precision Agronomics Australia (PAA) have been using Geophysical sensing to map soil type boundaries for many seasons predominantly in the Esperance and Great Southern region of WA on duplex soils using EM38 surveys.

EM38 (Electromagnetics)

This technology measures the soils electrical conductivity by inducing two electrical currents into the soil, one current to a depth of 0.5mt from the soil surface and the second to a depth 1.5mt from the surface. Soils become more conductive as clay content, moisture and electrolyte salts increase. When this data is logged across a paddock it can be processed into a conductivity map showing soil type variation based on electrical conductivity. EM38 surveys have been an excellent tool on duplex soil types with a good range of electrical conductivity (Figure 1). However PAA have discovered that EM38 has limitations on soils that are very low in conductivity such as deep sand and gravel based soil. Where EM surveys have been conducted on these soils the Conductivity values are very low and it is nearly impossible to distinguish a sandy soil from a gravel soil. However this is where the Gamma-ray spectrometry or Radiometrics has a great fit.

Gamma-ray Spectrometry (Radiometrics)

Precision Agronomics Australia (PAA) have recently introduced radiometrics to enhance their soil mapping service.

Radiometrics is providing an excellent means to distinguish sand from gravel in low conductive environments. Soil profiles contain natural radioactive isotopes of potassium, uranium and thorium. Gamma-ray emissions by these radioisotopes can be measured and logged by using a Gamma-ray spectrometer (Figure 3).

An example of the ability of radiometrics to map soil types can be seen below in (figure 4) where the EM38 map is showing very little variability in conductivity. The Thorium map of the same area is quite clearly demonstrating variability where the high Thorium readings (Blue) is gravel to the surface and the low Thorium readings (Red) in this example represents 40cm of sand over gravel. The Potassium map of the same area is also demonstrating a high level of variability where the low Potassium readings (Dark Brown) is deep sand and the high Potassium areas (Green) are either gravel or sand over clay at depth.

Figure 3; Gamma-ray spectrometer mounted on front of survey vehicle and EM38 towed on sled at rear.

Variable Rate Opportunities

Ground thruthing of the radiometric data through targeted soil testing has revealed that the Thorium layer is strongly correlated to Gravel % and depth to gravel.

This will be very helpful in determining the soils water holding capacity and yield potential. The Potassium layer is strongly correlated to Colwell K or plant available K as can be seen in (Figure 5), this information can be used to make Variable rate potash maps targeting only those areas that require potassium.

The potassium layer is also strongly correlated to surface and subsoil pH as can be seen in (figure 6), this information allows us to make variable rate lime maps with rates that target surface acidity problems and higher rates where subsoil acidity is restricting root growth and yield. Radiometrics potassium also appears to be well correlated to oganic carbon %, which would indicate that soils with higher radiometric potassium levels are also likely to be the most fertile.

Figure 4.

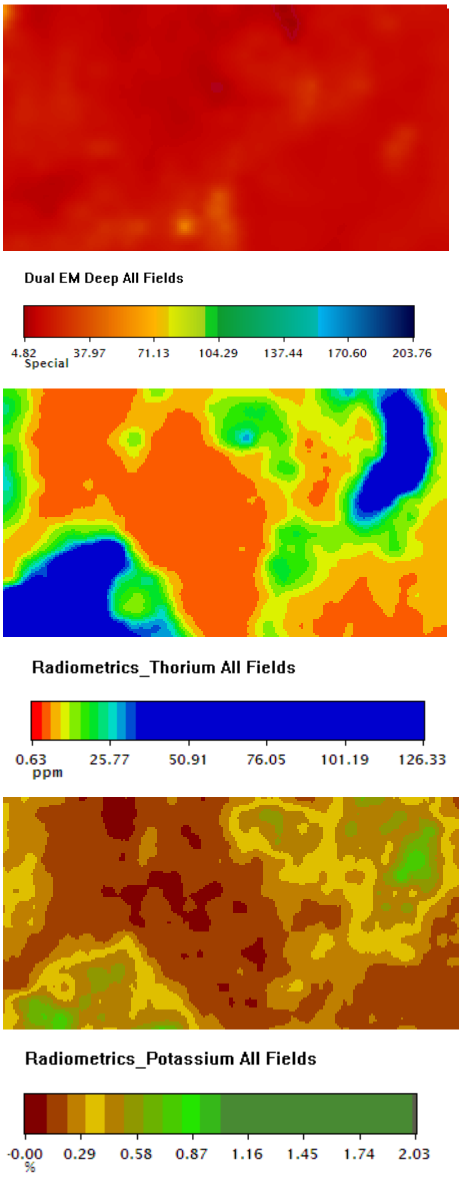


Figure 5.

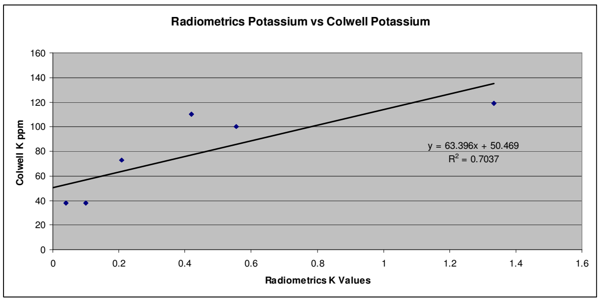
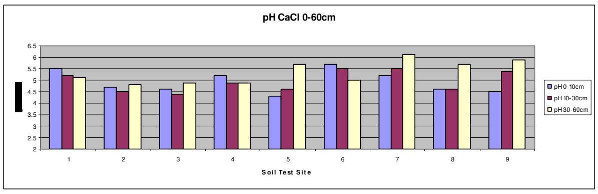


Figure 6



More Information

For more information on EM38 or Radiometrics or to organize your farm to be surveyed contact Precision Agronomics Australia.