**Deep, deeper, deepest!**

EMerald Geomodelling can «see» underground, but how far down can they actually see? Geologist Anne H. Rasmussen tells us that she can see a lot further than is necessary for her to be able to ensure the safety of roads, railways and tunnels.

Anyone who wants to build something – whether that be a road, a rail line or a tunnel – has to know what is concealed under the ground. Miscalculations relating to ground conditions can cost dearly in both time and money, and subsoil drilling is time-consuming and expensive and leaves behind scars in the landscape. In addition, drilling provides only small, extremely localised nuggets of information, and developers have to make deductions and guesses as to what is to be found in between the drill holes. With EMerald Geomodelling’s airborne, electromagnetic geoscanning the required information can be obtained quickly and simply, not to mention the fact that it can be presented in the form of an easily understandable and user-friendly 3D-model of the ground.

**3D map**

Rasmussen has worked for 10 years as a geophysicist at SkyTEM Surveys, which is the company that does the flying for EMerald Geomodelling. Now she works for EMerald as a geologist and senior data scientist, and will be using her detailed knowledge of electromagnetic scanning to further develop what it is possible to draw out of the mass of data that is obtained.

«We generate a practical and easily accessible 3D map of where the bedrock lies and where there are challenges with, for example, quick clay,» she explains. The maps give the developers information that they can use when they are choosing between routes with, for example, more quick clay or a short way down to solid rock.

The question of how deep it is possible to measure is usually quick to arise. And the answer? «It depends entirely on where you are looking and what you are looking for.»

**Soil conducts electricity**

EMerald Geomodelling use electromagnetism to measure how well the various soil layers conduct electricity, and this knowledge of the conductive properties of the different soil types enables them to model good maps of what lies hidden beneath the ground. For example, gneiss or granite does not conduct electricity particularly well, whereas rock types that contain metals – such as iron, gold, silver or tin – are good conductors.

«The response to the question of depth depends on what sort of soil you need to see through and whether there is salt water or fresh water in the ground,» says Rasmussen. SkyTEM Surveys’ equipment was originally developed to scan for ground water storage in Denmark. It is therefore more sensitive than its competitors, which are generally used for mineral exploration within the mining industry. This Danish technology makes it possible for EMerald Geo to find quick clay in the ground, which is one of the main challenges in large-scale infrastructure projects.

**Deeply and accurately**

«Scanning takes place by means of sending rapid electrical pulses down into the ground and producing a magnetic field that we can measure. If we choose to emit a current that is strong enough to have a bit of a kick, we can get quite a long way down,» she adds. Sometimes 200 metres might be enough; at other times 600 metres is required. But she points out that deep surveys mean losing some of the resolution in the uppermost soil layers, which are usually the areas that developers need information about.

So there was just that thing about depth, then:

How far down can an electromagnetic measurement *really* provide useful information?

«It is almost impossible to say what the maximum depth of measurement might be. The equipment can get down to 800 metres when searching for diamonds and gold, for example, or we can confine ourselves to the uppermost 200–300 metres that are relevant for geotechnics. People building roads and railways need knowledge about quick clay and the distance down to bedrock and other stable layers, and we can supply that information from scanning with a high degree of accuracy,» she concludes.