Comparison survey with the Geoscanners AB antennas

GCB200, GCB300, GCB400, GCB500, FLB390

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Introduction

In this paper we will try to make it easier for all to grasp the difference between the antennas manufactured by Geoscanners AB, Sweden. Instead of duplicating the dry data sheets technical information this paper works as a visual showcase. Hopefully it will make the task of choosing the right antenna for the job much easier.

How to get the ”best” antenna:

- Decide what kind of GPR surveys you wish to conduct most often and consult with the manufacturers what device better suits your needs.
- Find out at least rough information on types of soil or other material you plan to conduct the surveys on, namely you want to know the relative dielectric permittivity, electrical conductivity or EM attenuation (dB/m) and consult with the manufacturers what is the best choice.
- Try to get the most advanced equipment when it gets to sensitivity and signal-to-noise ratio. You are better off having a bit less penetration if the system is producing high quality data for the range it can penetrate to than having a large range with poor data. High penetration without quality data is not going to get you far.
- See if the manufacturer/salesman is available for the demo presentation. Even if he charges for the demonstration it is much less, compared to buying the wrong equipment.

After buying the antenna:

- Invest into official/unofficial training with the equipment for your working crew. A knowledgeable operator will understand the problem and will search for the possible solutions, rather than waiting for the Customer support to provide an answer.

Survey

Most of the manufacturers love to brag about the high penetration depths they can achieve with their equipment. This is a common trap for many first time GPR users. In order to avoid this we decided to do a comparison survey over the same profile line with different antennas. For each of the antennas, we collected the data with 3 different time ranges. The values for the ranges were selected so that the collected profiles can be meaningfully compared. The ranges for the survey are: 120ns, 80ns, 40ns.

The survey site conditions can affect the results of any GPR system you can find on the market. This can happen in a such a drastic manner that all of the equipment you used on one site with good results, might give poor results or if you're lucky excellent results on another. This kind of deviation is normal because the efficiency of the GPR equipment is influenced by the electrical properties of the material through which the wave travels.

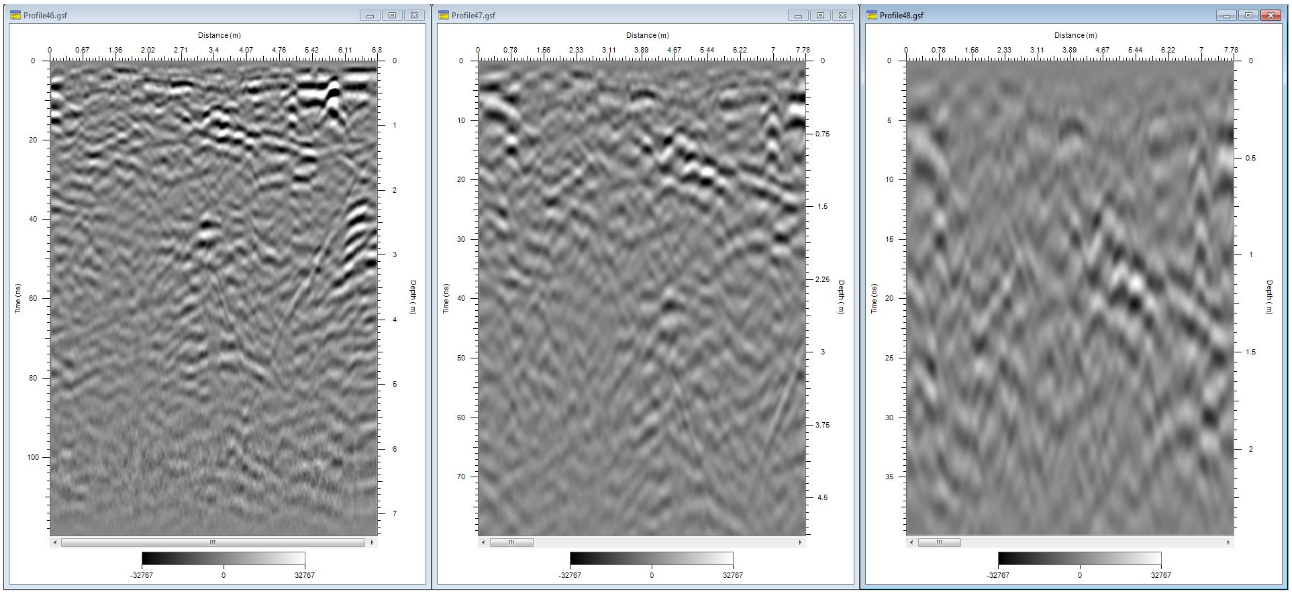
Equipment under test:

Antenna name	Recommended settings			Size of target (m)	Recommended area of application
	HP(MHz)	LP(MHz)	Range (ns)		
GCB200	100	400	30-200	0.25	Stratigraphy, utility survey, archeology, environmental surveys
GCB300	150	600	20-120	0.15	Stratigraphy, utility survey, archeology, environmental surveys
FLB390	195	780	25 - 100	0.125	Stratigraphy, utility survey, archeology, environmental surveys
GCB400	200	800	15-75	0.125	Stratigraphy, utility survey, archeology, environmental surveys
GCB500	250	1000	10-50	0.1	Stratigraphy,utility and archeology survey, environmental surveys

Results and Conclusions

After collecting the data we opened the profiles in the GPRSoft™PRO post processing package for the GPR data. By using basic processing steps we cleaned the data and made it ready for comparison over different ranges and between the antennas.

GCB-200

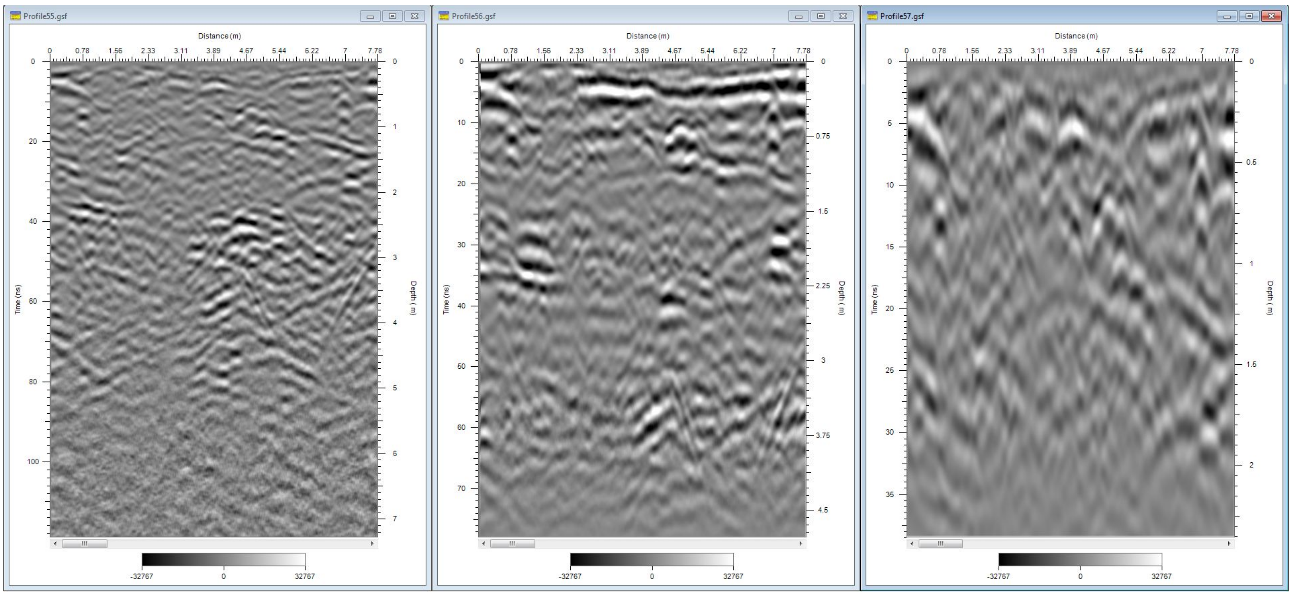


GCB-200, range left to right 120ns , 80ns , 40ns

As expected the antenna with the lowest frequency in this test gave good results when it comes to higher ranges. The antenna successfully reached the depth of 6.5 meters and recorded good data to work with. The data taken with the range of 80ns is still readable and could be interpreted. However, when trying to use this antenna with a range of just 40ns only the most significant reflections could be interpreted. Also we can clearly see the “blind zone” of the antenna influencing the first 5-7ns of the data.

The ”Blind zone” exists for all antennas. The zone stretches from zero depth to the depth equal to 1.5 wavelengths in material. Due to the larger wavelengths, this zone is more noticeable for low frequency antennas. In this part of the recorded data any reflected signal gets superimposed by the direct coupling wave. This effect causes the interpreting of data hard or even impossible in some cases. The ignorance about this effect caused wrong interpretations and confusion for many surveyors. The GPR practitioners disregarding this fact either declared the zone to be a homogeneous layer or were desperately trying to locate known elements in the data.

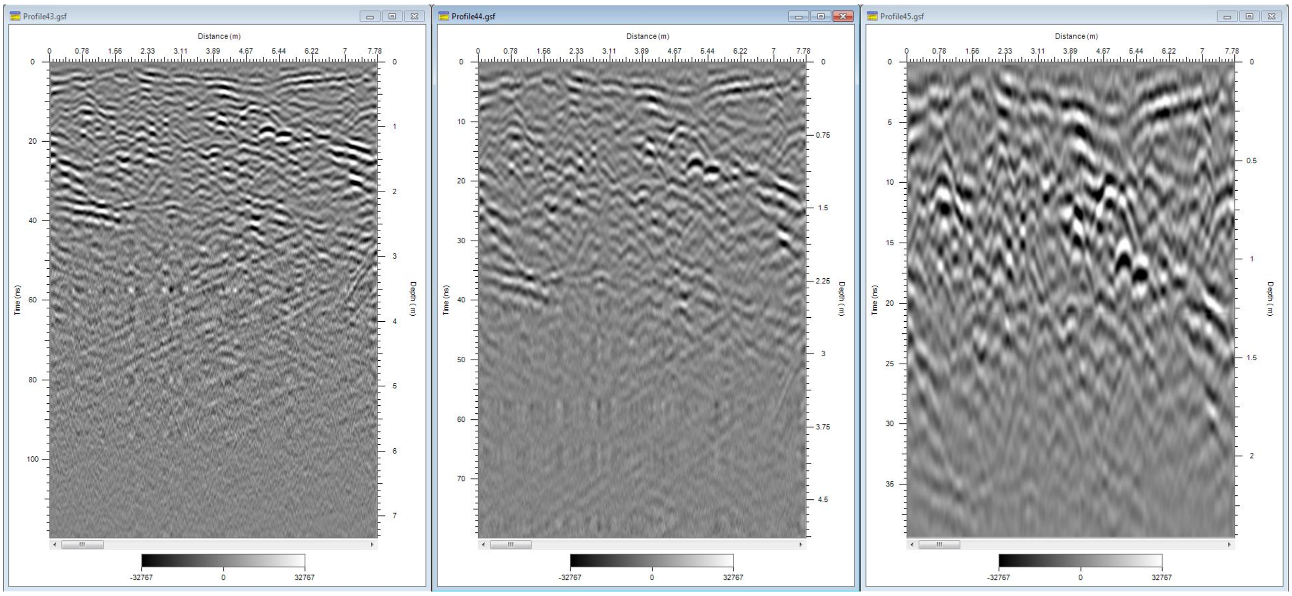
GCB-300



GCB300, range left to right 120ns , 80ns , 40ns

The GCB-300 is a product trying to balance good resolution and deep penetration. As such it is doing it's job fairly well. The depth of penetration has dropped to 5.5m when compared to the GCB-200, but the resolution is much sharper and reveals more details in the 120ns and 80ns ranges. When it comes to the 40ns range, although a slight improvement in the resolution can be seen, the “blind zone” and coarseness of the resulting image is still high.

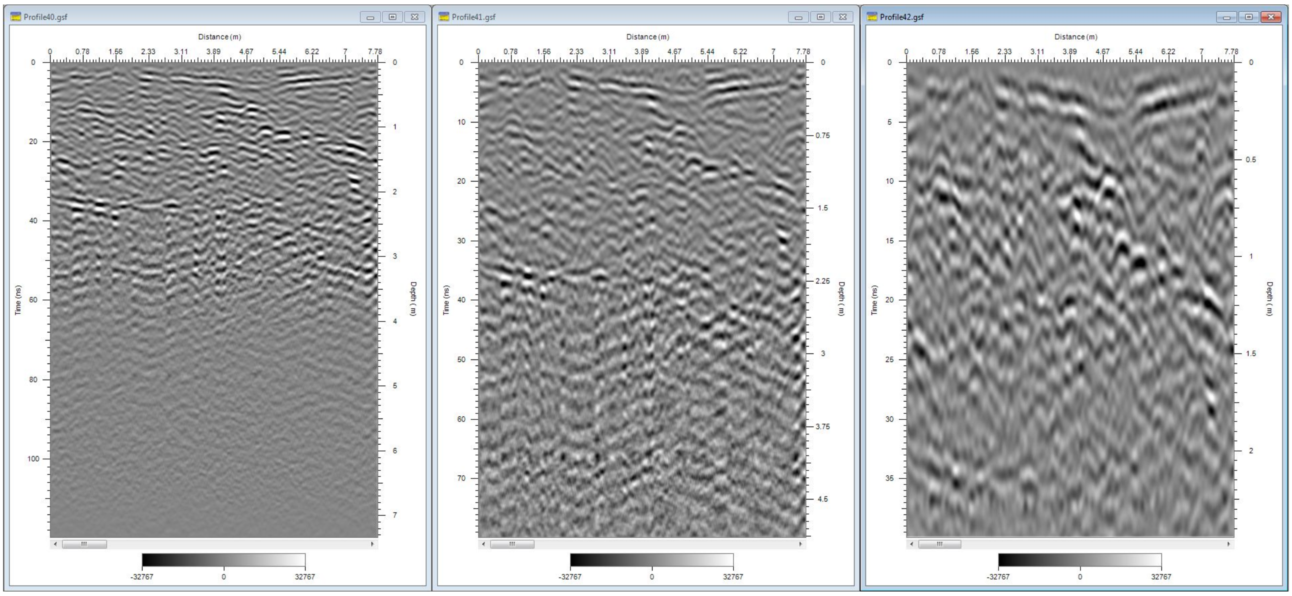
GCB-400



GCB400, range left to right 120ns , 80ns , 40ns

The GCB-400 is a utility detection tool of choice for the majority of users. It is a perfect union of resolution and penetration depth when it comes to utility targets. Since most of the utilities are in the first 3 meters depth, this antenna is tuned to deliver a clear record of that area. Setting the ranges unreasonably high will usually create a vertically compressed data with only a partially useful record. Adjust the range to concentrate on the good data. From the comparison images it is obvious that this antenna will cover the shallow and medium range of utility detection surveys with ease.

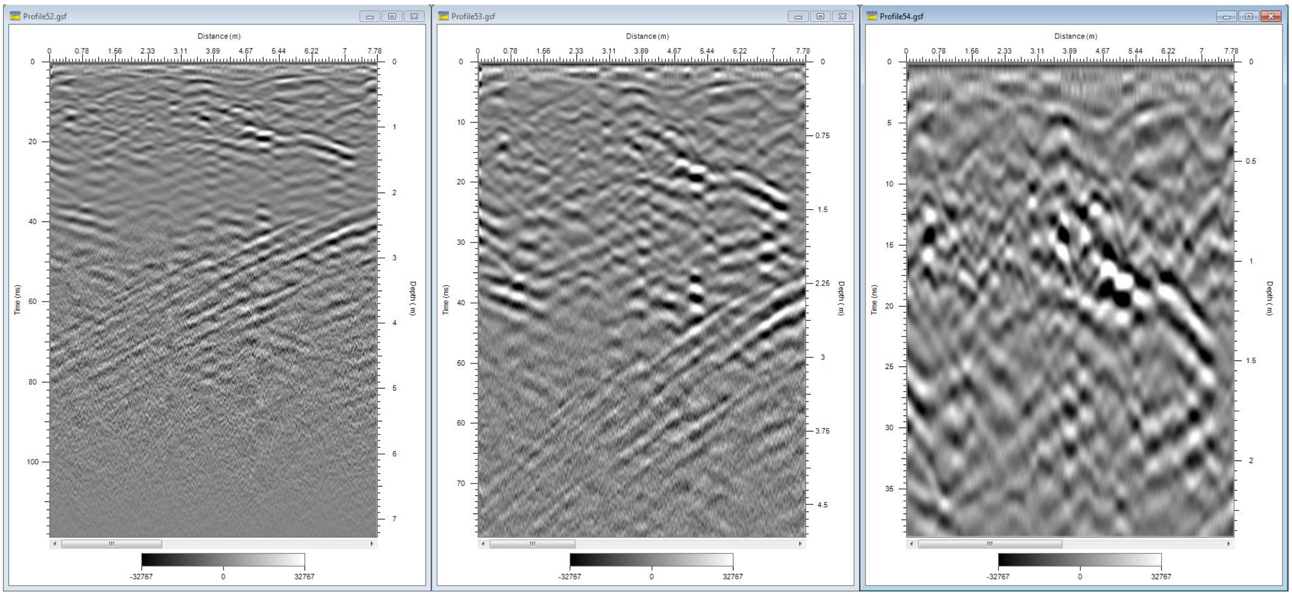
GCB-500



GCB500, range left to right 120ns , 80ns , 40ns

If your depth of interest is even shallower this antenna could provide you with an additional edge. The increase in the details you can interpret could help you untangle the criss-crossing or near to one another utilities, easier than with the GCB-400. This antenna is also known to give excellent results in archaeological surveys (depth of interest ≤2m). It is important to keep the ranges reasonable in order to avoid vertically compressed data with a large and useless time window.

FLB-390



FLB390, range left to right 120ns , 80ns , 40ns

Specially designed to address the surveys not allowing a constant contact with the surface, the FLB-390 results fall in between GCB-400 and GCB-500. It is important to note that there are some differences unique to the airborne antenna concept. The first thing to observe is the the contraction of the hyperbolas in the data as a result of a narrower beam of the antenna. This might make the interpretation of point targets difficult. Another often disregarded issue is the “false layer reflection” which is a direct result of the antenna not being in contact with the ground. However, if you are careful to take these two problems into account , you could surely benefit from the ability to do the long and high speed surveys or work on an impossible rough terrain.

The “False layer reflection” is a problem connected with airborne antennas. It is a result of a wave bouncing of the surface at an angle almost parallel to the ground. If there is a vertical object nearby, that wave will reflect from it and return to the antenna. Assuming that you are moving toward or from that object (e.g. moving towards the wall) the radar unit will record this reflections as a sloping layer.
These false layers can confuse you for a moment but can easily be identified and removed from the final interpretation by doing the velocity analysis.