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Subsurface Views

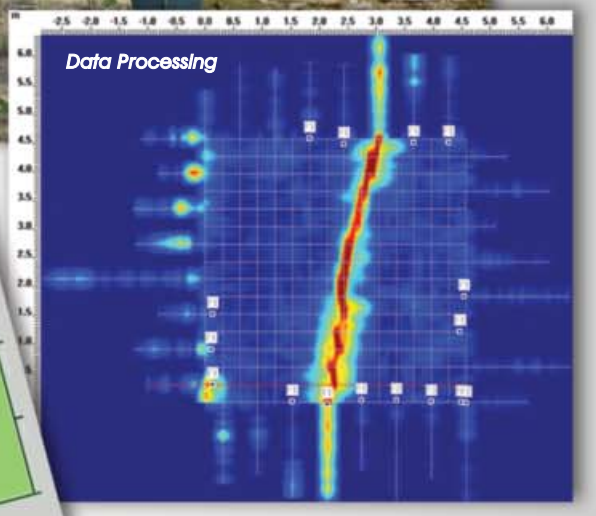
Sensors & Software Inc.

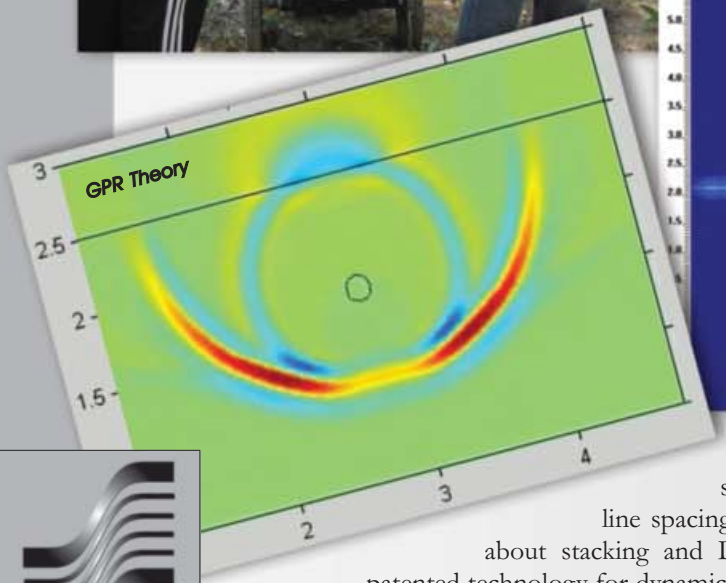
Advanced support

3 Day GPR Course 2013

Sensors & Software has conducted a 3-Day GPR course since 1998; hundreds of students have attended over the years. After 15 years of having the course in July, this year we decided to mix things up and hold it in May. This decision proved to be so popular that we had to make room for extra students.

The course provides total immersion in GPR and is designed for GPR practitioners who want to learn more about GPR theory, data acquisition, and data analysis. In just three days we cover basic and advanced GPR theory, case studies and field work with a variety of systems and frequencies, data processing, visualization, interpretation, and reporting.





Day 1 features GPR theory taught by Sensors & Software 's CEO, Dr. Peter Annan, who has been involved in GPR since the 1970s and is the author of hundreds of papers in the GPR field. Major topics that Peter presented were GPR History, Physics of Radio Waves, Material Properties, Wave Properties, and GPR Instrumentation.

Another topic, Survey Design, involves understanding GPR system parameters such as antenna frequency, time window, step size, grid line spacing, temporal sampling interval, and triggering methods. Students learned about stacking and DynaQ, Sensors & Software's patented technology for dynamically enhancing data quality.

Survey design is not important to basic GPR users because most modern GPR systems have default settings, so anyone can turn the system on, move it around, and collect data.

(continued on page 2)

In this issue

Borehole GPR

Sensors & Software is mostly known for surface-deployed Ground Penetrating Radar (GPR) products such as Noggin, Conquest, and pulseEKKO PRO, but did you know that we have been manufacturing GPR antennas for borehole surveys since 1998?

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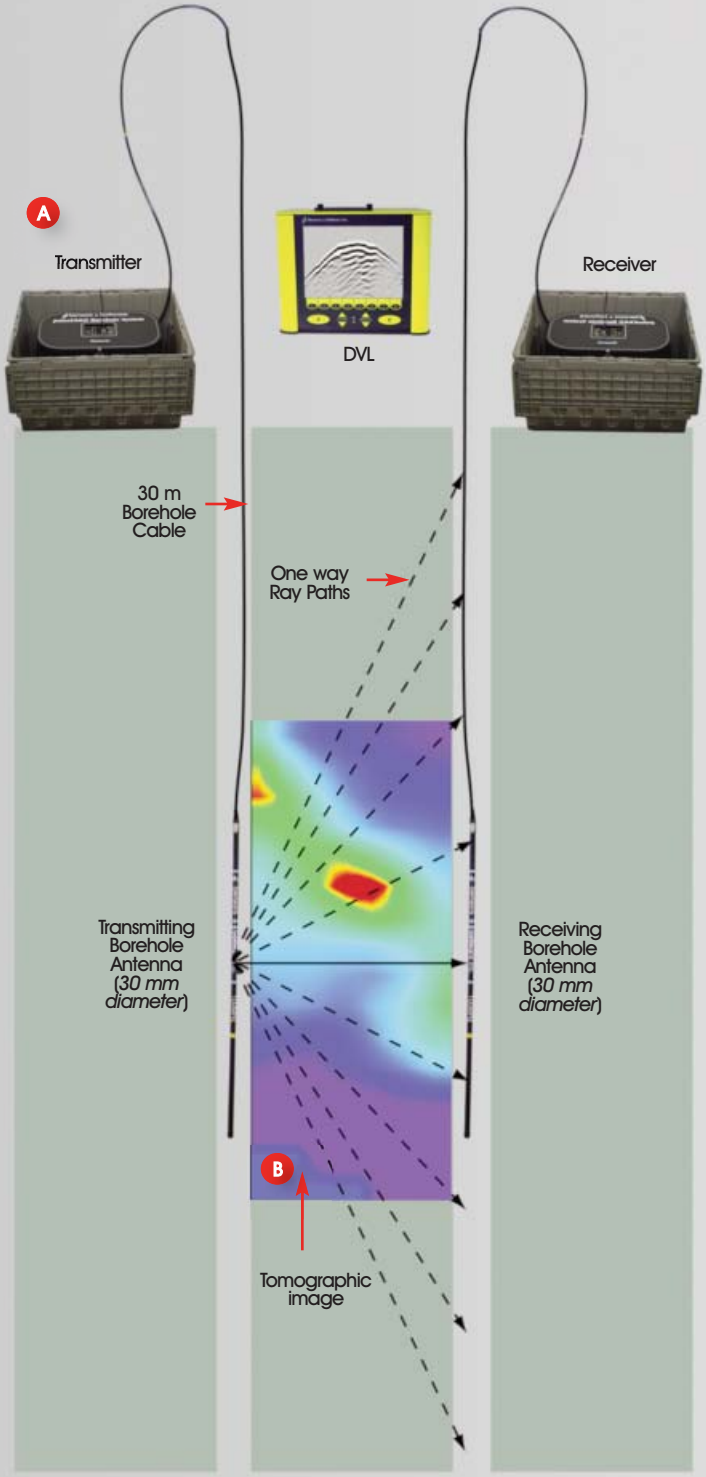

3 Day GPR Course

(continued from page 1)

However, a good understanding of GPR system parameters is critical when your survey is different than the norm or when you are mapping an area by collecting a grid. Understanding these parameters ensures that you always collect the highest-quality, properly-sampled data possible, no matter what the application.

On Day 2, the students were ready to apply the knowledge they gained on Day 1. The field day was held north of Toronto at the Canadian Forces Base Borden; this area is famous in hydrogeological circles as the focus of 30+ years of studies by researchers from the University of Waterloo. Borden is an ideal area for GPR as it has electrically-resistive beach sand and gravel deposits underlain by a clay aquitard at depths from 2 to 15m.

On Day 3 the students returned to the classroom and were provided with laptops loaded with GPR data processing software and the data they collected on Day 2. EKKO_Project software was used to organize the GPR data and plot GPR lines and important concepts such as properly gaining GPR data. Extracting velocity for better depth estimates and applying topographic corrections were discussed and practiced. Students also learned how to extract GPR velocities from the Common Mid Point (CMP) data. The Interpretation module allowed participants to add interpretations to the GPR data and extract that information to report files and Google Earth (Page 3).

Students worked with EKKO_Mapper software to display depth slices from the Noggin 500 grid survey (Page 1). Since the Noggin 500 SmartCart had an integrated GPS, the depth slices were also viewed in Google Earth, superimposed on the actual location of the grid (Page 3). Finally, the grid data was converted into a 3D file and visualized. Everyone enjoyed the spinning cubes of data and peering inside to find high amplitude targets.

Students usually come to the course with their special area of interest top of mind. Because we are restricted in applications on Day 2 in the field, we spend time discussing and answering questions about particular applications. Case studies give students an appreciation of the large number of applications there are for GPR. Many were interested to learn that GPR is used in such varied applications as diamond mining, groundwater contamination, airport runways, finding unexploded ordnance, tree root mapping, and at ski resorts for measuring snow thickness. We couldn't resist telling them that GPR has also been shown on Ice Road Truckers, CSI, Bones, and other crime scene investigation shows.

The next 3 Day GPR course is scheduled for May 28-30, 2014, and the registration form is available on our website. We offer special pricing for students and professors. Register early as we anticipate another sell-out next year.

This year featured an international crowd with students from around the globe – Chile, Finland, UK as well as many U.S. states – Texas, Florida, Maryland, Illinois, and North Carolina.

When asked why they had travelled so far for a course, Sandra Pino Dubreuil and Fernando Rodriguez Silva from Chile explained that they have seen higher requirements for GPR jobs and "we feel it's good to have some direct interaction with our suppliers."

Randy Lash said "The course was great and well put together. I had a great time and would recommend this course to anyone who uses any type of GPR."

Ask-the-Expert

Can GPR detect stacked pipes and cables?

GPR users often question if a target can be detected when it is directly beneath another target. For example, two pipes buried in the same trench or two mats of rebar in concrete.

With the proviso that the GPR pulse length allows the two targets to be resolved (i.e. targets are spaced sufficiently apart vertically), GPR can detect both targets. The reason is simple; GPR antennas, when ground coupled, transmit and detect energy travelling in a cone-shaped zone beneath the GPR (see Figure 1a).

As the GPR traverses along a line over the targets, energy can reach both targets and result in both being detected (see Figure 1b). The GPR cross section will show two hyperbolas at two depths. A field example over two pipes is shown in Figure 2.

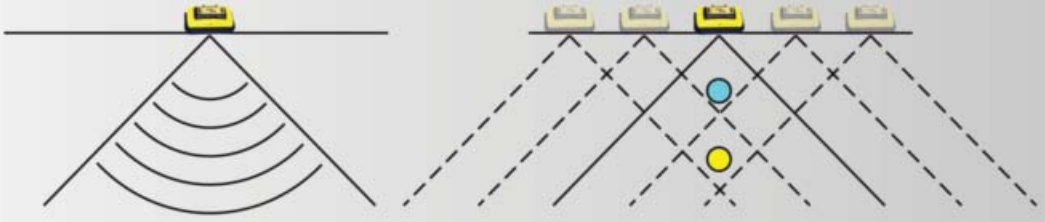

Figure 1a

Figure 1b

Figure 1: *Gound coupled GPR antennas transmit and detect energy travelling a cone shaped zone beneath the GPR. Energy can reach two or more targets so they are all detectable.*

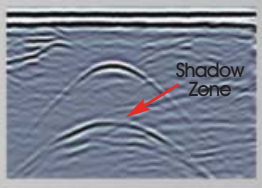

Figure 2:
A field example over two pipes. The deeper pipe is slightly shadowed by the shallower pipe.

Of course there are some limits – a large diameter target over a small diameter target may create a large shadow, making the smaller target undetectable. Fortunately, such extremes seldom occur. ■

Borehole GPR *(continued from page 2)*

Borehole surveys are very different from the far more common reflection surveys. In reflection surveys the transmitting and receiving antennas are on the same surface requiring the GPR signal to travel twice the depth of an object – from surface to object, reflect, and then back to the surface.

Transillumination borehole surveys only require the GPR signal to travel one way between the transmitting antenna in one borehole and the receiving antenna in the other borehole (Page 2 - Figure A), or from borehole to surface. As a result the signal only travels half the distance of reflection surveys and is more suitable for soils with higher signal attenuation.

Analyzing the received signals reveals areas of high attenuation and velocity contrasts, similar to medical imaging techniques like CT scans.

Borehole surveys can also be used to survey areas that are difficult to access such as under building foundations.

Borehole antennas with center frequencies of 50, 100, and 200 MHz are available for the pulseEKKO PRO system. They are only 30mm in diameter and easily fit into small-diameter open or PVC-cased boreholes up to 30 meters deep.

Sensors & Software has recently upgraded our borehole system using a new manufacturing technique for the borehole cables; these stealth cables minimize interference and noise for high fidelity signal. We are also partnering with Daryl Tweeton, co-author of the Migratom tomographic analysis software, and now with GeoTom, LLC, to offer the TomTime and GeoTomCG software for borehole data analysis (Page 2 - Figure B).

See our website, or contact us for more details. ■