GPR Technology Vol 8, No. 32, October 2012

Subsurface Views

Sensors & Software Inc.

EKKO_Project - Complete GPR Data Analysis

EKKO_Project is the new PC-based software for GPR data management, plotting, processing, interpretation and reporting. In future all Noggin, pulseEKKO PRO, Conquest and SPIDAR GPR systems will exploit the power of EKKO_Project.

EKKO_Project features project (.gpz) files that contain all the GPR data, associated files and attached files. An entire GPR survey, along with all the processed and interpreted data, is contained in just one file, making it easy to store and share data with others.

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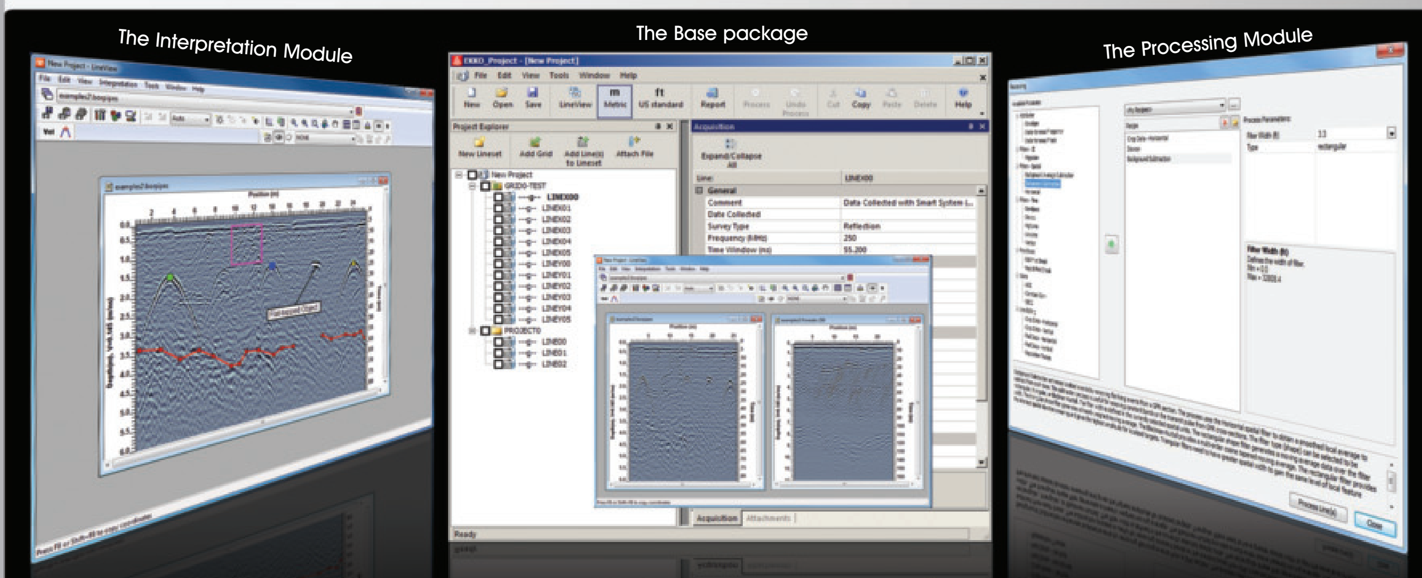


EKKO_Project has a simple, intuitive interface with many powerful features.

From our customers' files

Gansu Dunes - GPR research in China

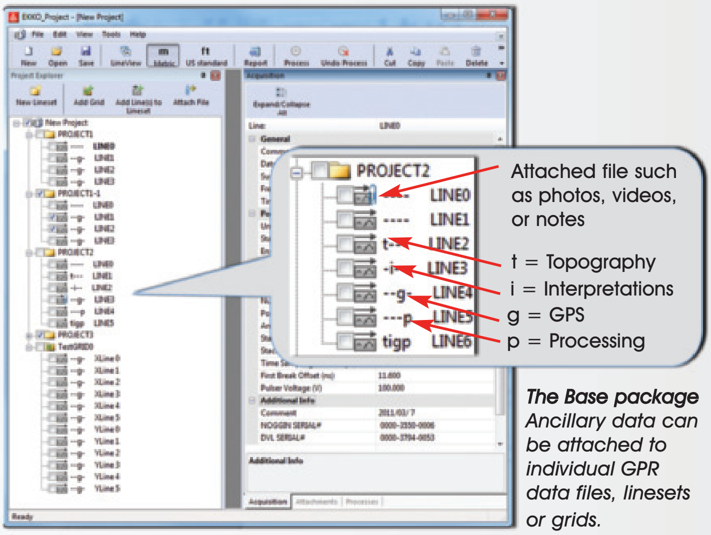
The Cold and Arid Regions Research Institute in Lanzhou in Northwest China carries out extensive GPR surveys for numerous applications. Their interests include glaciers and monitoring the current state of ice thickness. Another area of particular importance is the extensive dune region in Gansu Province.

One of the dunes appears in Figure 1 and shows a small oasis in an otherwise undulating field of large and endless dunes. The area is spectacular from a scenic point of view.

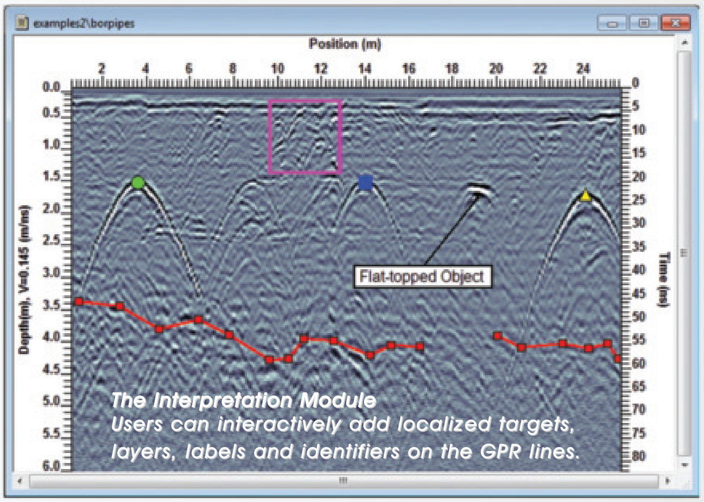
The major concern with the underlying geology is the depth of the groundwater in the area. These dunes move with time and the maintenance of oasis areas and monitoring the changes with time are critical.

(continued on page 3)

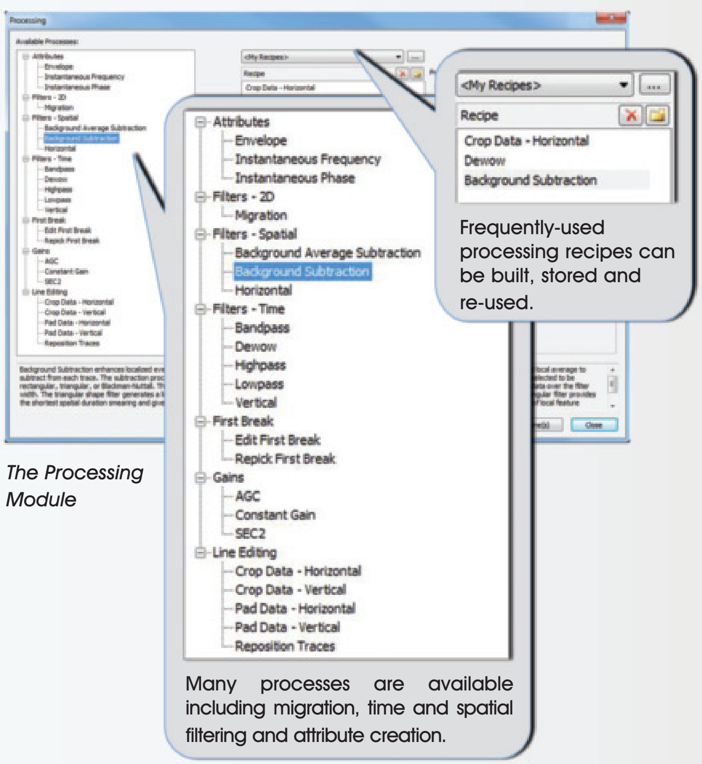
In this issue



The Base package Ancillary data can be attached to individual GPR data files, linesets or grids.



The Interpretation Module
Users can interactively add localized targets, layers, labels and identifiers on the GPR lines.



Frequently-used processing recipes can be built, stored and re-used.

Many processes are available including migration, time and spatial filtering and attribute creation.

The Processing Module

EKKO_Project

(continued from page 1)

- **Project Explorer** - is a window similar to Windows Explorer for managing the GPR data. It lists all the GPR data (Linesets and Grids) in the project. New Linesets can be easily added or created and GPR lines copied or cut from one lineset and pasted into another.
- **GPR Line Acquisition tab** - displays all the survey parameters and other data acquisition details of the GPR line including Antenna Frequency, Start Position, End Position, Step Size, Time Window and Stacks.
- **LineView** - GPR lines are quickly displayed using the LineView module. LineView emulates EKKO_View, software developed and advanced over many years, for cross-sectional viewing of GPR line data. Features include color and/or wiggle trace displays, multiple color palettes, axes control, simple gains, zooming, contrast and sensitivity adjustment and velocity calibration tools. Every GPR line in the project is available in LineView; specific lines can be displayed, or the entire survey can be plotted and viewed at once.
- **GPS & Topography files** - are automatically integrated with the associated GPR lines. When plotted with LineView, the GPS position of every trace is displayed and an elevation axis can replace the default depth axis.
- **Interpretation Module** - the optional Interpretation Module operates within LineView, allowing the user to add interpretations directly on the GPR lines. Interpretation options are points, polylines, boxes and annotations. Interpretation reports list local and globally-positioned interpretation files that are easily imported into GIS and AutoCAD software or 2D or 3D surface visualization software.
- **Attached Files** - the files associated with a project can be added to an EKKO_Project .gpz file and attached to a Lineset, Grid or a specific GPR line. The possibilities are endless but some examples include:
  - photos of the survey site,
  - videos of the site or data collection
  - audio files describing the site or data collection
  - field notes document

  EKKO_Project launches the associated software, such as Word, Media Player and Photo Editor, to open the attached file.
- **Processing Module** - is an optional add-on for EKKO_Project. It provides GPR line editing such as cropping data and repositioning traces, time gains, time filtering (lowpass, highpass and bandpass), spatial filtering, migration and instantaneous attributes. Favourite processing streams can be saved as "recipes" to be applied to data in other project files.

Some Sensors & Software GPR systems already generate project (.gpz) files in the hardware that can be copied to a PC and opened in EKKO_Project. Users with older hardware can still take advantage of the benefits of EKKO_Project for data management and analysis. Any collection of GPR lines, either a Lineset or a Grid, is easily imported into EKKO_Project and saved as a .gpz file.

EKKO_Project is now shipping with all Noggin and pulseEKKO PRO GPR systems. It is also available as an upgrade to current users of EKKO_View, EKKO_View Deluxe and EKKO_Interp. Contact us for the details. ■

Gansu Dunes

(continued from page 1)

The research institute has carried out a number of GPR surveys to investigate the base of the dune area. A pulseEKKO PRO GPR with antenna frequencies of 50, 25 and 12.5 MHz is most commonly used for these investigations.

Figure 1 shows a survey crew moving the 12.5 MHz antennas over the crest of a dune. A large official team of researchers and observers participated in this inaugural test of the GPR investigation method. The key aspect of the photo is the wide-open view of the oasis.

Data from a 50 MHz GPR survey line are shown in Figure 2. These data clearly indicate that the GPR sees through the dune to the underlying base formation: a water-saturated silt-mud deposit. Except for the compensation for topography and a minor adjustment in the amplitude time gain function to display the data in the most effective manner, the GPR line shows raw data.

Use of GPR in this interesting and vital area of China is ongoing. The spectacular nature of the geography is one of true beauty. Understanding this area in more depth is of great value to the Chinese community. ■

***Figure 1:** Survey team carrying 12.5 MHz antennas along the crest of the dune in north western China.*

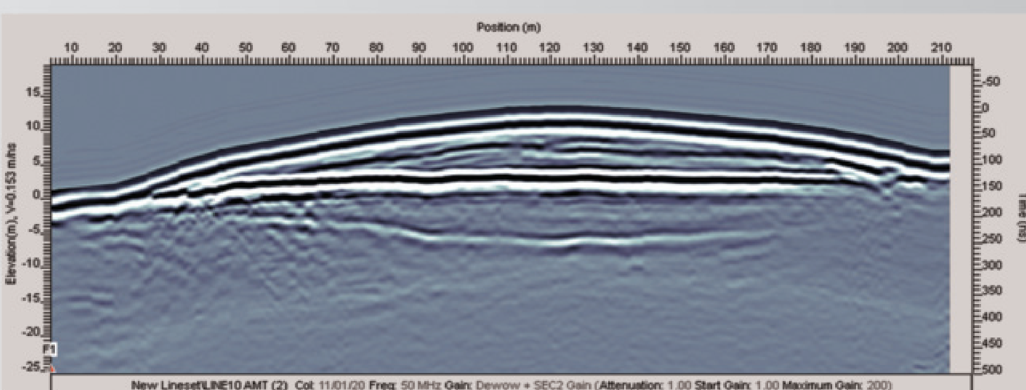


***Figure 2:** Example 50 MHz GPR profile over a dune. Data have been compensated for topographic variations.*

Ask-the-Expert

Can GPR be used to image the bottom of a cave?

The short answer is yes but in reality it is very difficult and the bottom of a cave is seldom imaged effectively. To image the bottom of a cave, GPR signals must travel from the transmitting antenna on the surface through the soil and rock to the top of the cave.

The signal needs to travel through the air or water filling the cave and reflect from the bottom. It then needs to travel the reverse direction back to the surface to be detected by the receiving antenna (Figure 1a). Every step of the way, the signal is being scattered and attenuated, leaving very little, if any, to detect. Assuming that the attenuation does not completely absorb the signal, the biggest factor for detecting the bottom of the cave is the shape. Flat or round surfaces reflect the most signal back to the surface; this why we can routinely see the bottom of flat ice (Figure 2) or the bottom of a round, non-metallic pipe (Figure 3).

(continued on page 4)

Technical Papers & Notes

1. **Creating an Isosurface Image with Voxler 2 Using 3D Data from ConquestView 3 or EKKO_Mapper 4 -** Sensors & Software Inc. Technical Note; 2010
   By: Sensors & Software Technical Staff **ref 444**

2. **Creating 3D Animations with Voxler 2 -** Sensors & Software Inc. Technical Note; 2010
   By: Sensors & Software Technical Staff **ref 445**

Upcoming GPR workshops

Imaging Concrete with GPR workshops - November 15, 2012 - New York, NY

See us at ...

AGU
San Francisco, CA
December 3 - 7, 2012
http://fallmeeting.agu.org/2012/

Arctic Technology Conference
Houston, TX
December 3 - 5, 2012
http://www.arctictechnologyconference.org/

Ask-the-Expert

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The bottom of caves, however, can have very complex shapes that scatter the GPR signals in all directions, significantly reducing the amount of signal reflected back to the surface (Figure 1b).

Other factors are the velocity of the GPR signals within the cave and the height of the cave. GPR signals travel in air at the speed of light (0.3 meters or about 1 foot per nanosecond) about 2-3 times faster than rock and about 9 times faster than water. This means that if the cave is only a few feet high, the reflection from the bottom of the cave comes just a few nanoseconds after the reflection from the top of the cave. This potentially interferes with the bottom reflection and makes it difficult to interpret with confidence (Figure 4). As the height of the cave increases, or if the cave is full of slow-velocity water, the signal takes longer to travel through the cave. The reflection from the bottom of the cave will then separate from the reflection from the top, making interpretation easier. ■

Figure 1a **Figure 1b**

Figure 1: *The bottom of a smooth-bottomed cave is detectable but most caves have a complex shape that scatters away the GPR signal before it can reach the surface.*

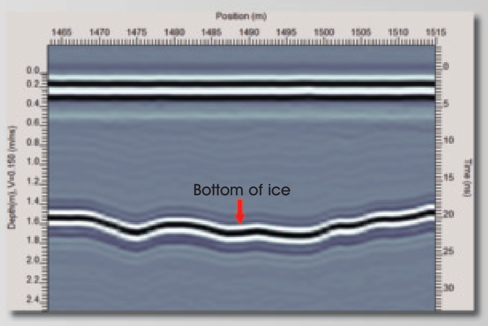

Figure 2: *The bottom of ice is usually a smooth boundary and gives a very clear and strong reflection as indicated here.*

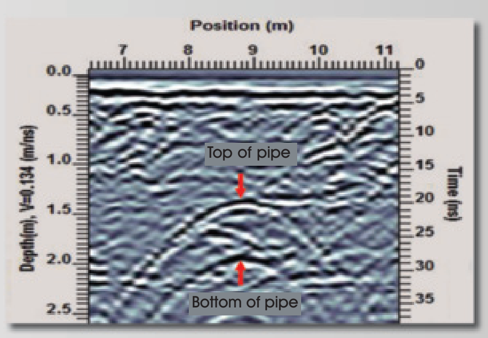

Figure 3: *The top and bottom of non-metallic pipes are analogous to a cave but regular in shape. In this data example, the top and bottom of a water filled pipe are detected.*

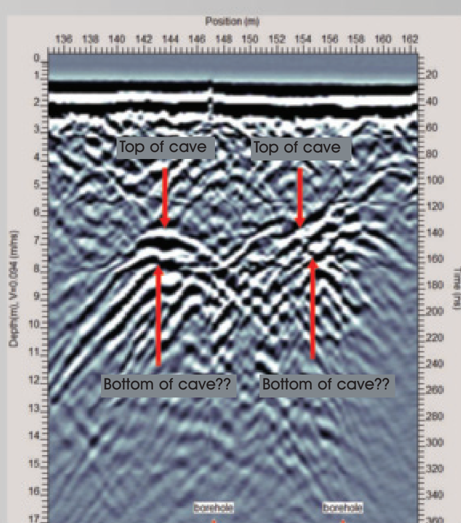

Figure 4: *The GPR reflected signal from the bottom of an air-filled cave is difficult to see in this example because the reflections and scattered response from the top of the cave interfere with and mask the bottom reflections. The two events are close together in time because the travel-time in the high velocity air is so short.*

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