Limestone Case Study

1. Introduction

Terravision Radar conducted enhanced GPR surveying for a limestone quarry extension proposal in 2014. The following images and data are excerpts from the study and are reproduced with the permission of the client. A more comprehensive description of Terravision Radar including case studies can be found at www.terravisionradar.com. The enhanced radar is capable of high resolution surveying penetrating to depths of up to 250m.

2. Objectives

The overall objective of the site investigation program was to prove the presence of a practically and economically recoverable limestone resource. Ultimately targeting the borehole locations by obtaining as much information as possible on the geometry of any karstic features and mineralized zones / old mine workings.

3. Methods Used

The light weight, highly portable system is set up on the survey area. Depending on the geological conditions, Terravision's operator adjusts the settings of the device and programs the radar to fire automated regular shots. The radar can be pulled either manually or behind a 4x4/ATV across the surface and can cover rough and rocky terrain.

Fig 1. Radar system being towed by mule on moorland.

The radar can be set to "automatic" when dragged behind a 4x4 or ATV. The timing of the shots depends on what mode the system is set to. Binary is quick (1 shot every half second), logarithmic delivers more detailed data and has a longer "calculation time" (one shot every second).

a. **Data**

Terravision Radar's geophysical sections are referred to as 'Radargrams'. All data is exportable to other commonly used software systems including (but not only) SURPAC, VULCAN and REFLEX (most suitable with high frequency collection.)

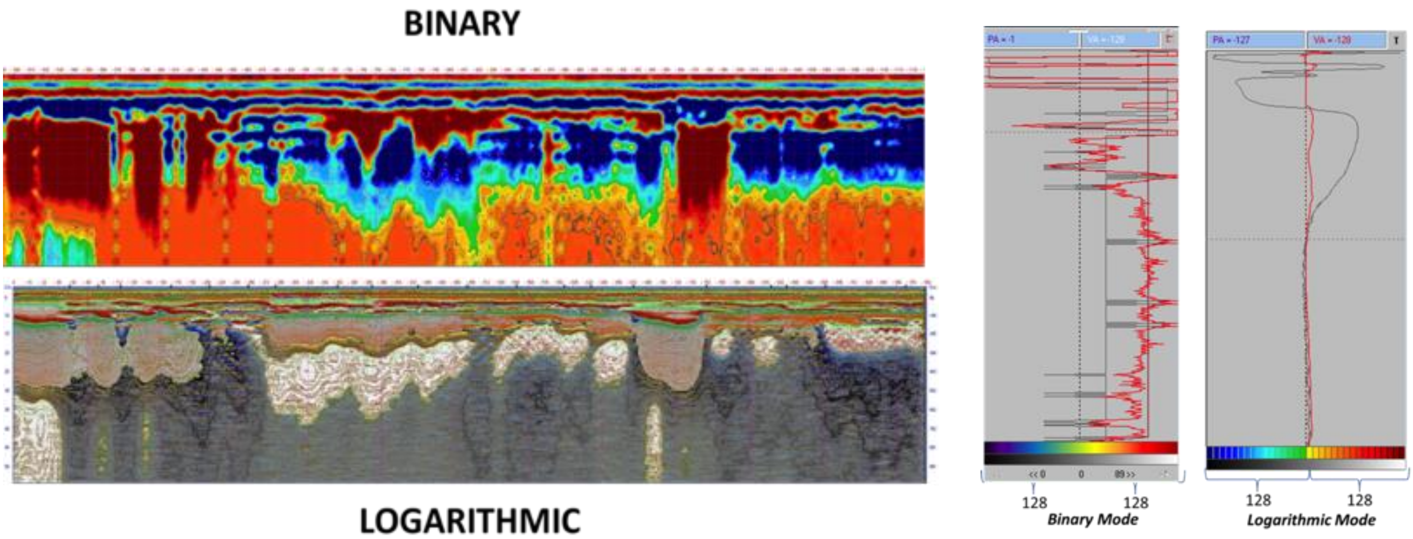


Fig 2: Recording of the EM wave, showing different parameters - binary is a "quick method" using just one pulse of energy, Logarithmic uses many pulses to determine more detail.

For this survey, a variety of products/analysis techniques[1] were used to highlight the varying capabilities. In addition both high and low frequency readings were taken to highlight different properties of the target area[2].

b. **Survey**. Limestone, as a sedimentary, porous rock is a very good medium for the propagation of electromagnetic waves. As a result, Terravision Radar was able to penetrate to over 200m with high levels of resolution. Radargrams clearly indicate horizontal and sub horizontal boundaries that characterize the different depositional environments, tectonic and geomorphic changes, undergone by the limestone horizon historically.

c. **Scale**. In order to fit all the varying lengths of profiles in to an A4 document, the scales have to vary by image. A scale of depth (m) can be found on the left hand side of every radargram. Distance (length) of the profile (m) can be found along the top. The scale on the right hand side refers to the time in nano seconds (ns) for the wave to return to the antenna.[3]

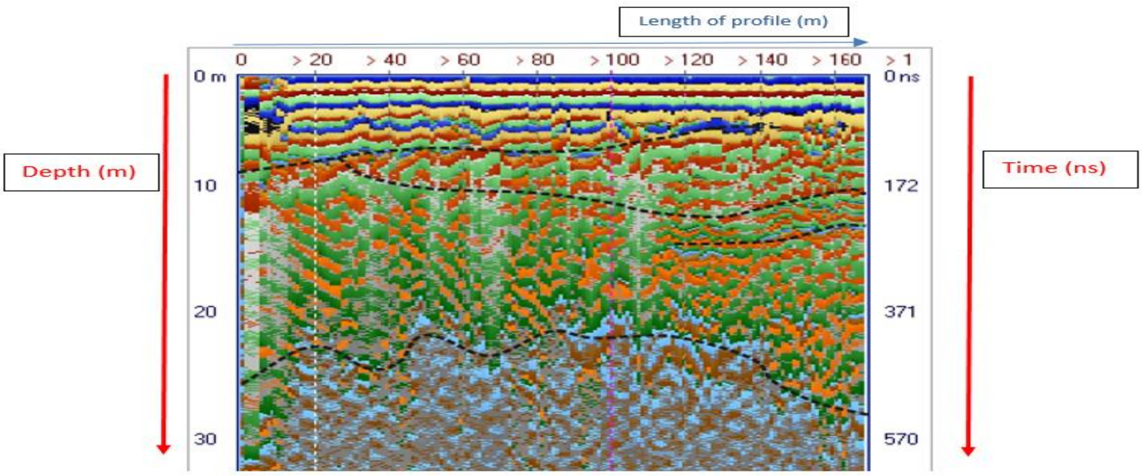


Fig 3. Radargram illustrating scales

[1] This includes using different filters on the same data to highlight different aspects.

[2] All the data was corroborated with known drill hole data from the area.

3 Please note for REFLEX sections, the depth and time scales are on the opposite sides of the image.

4. **Results - Data Representation - Radargrams.**

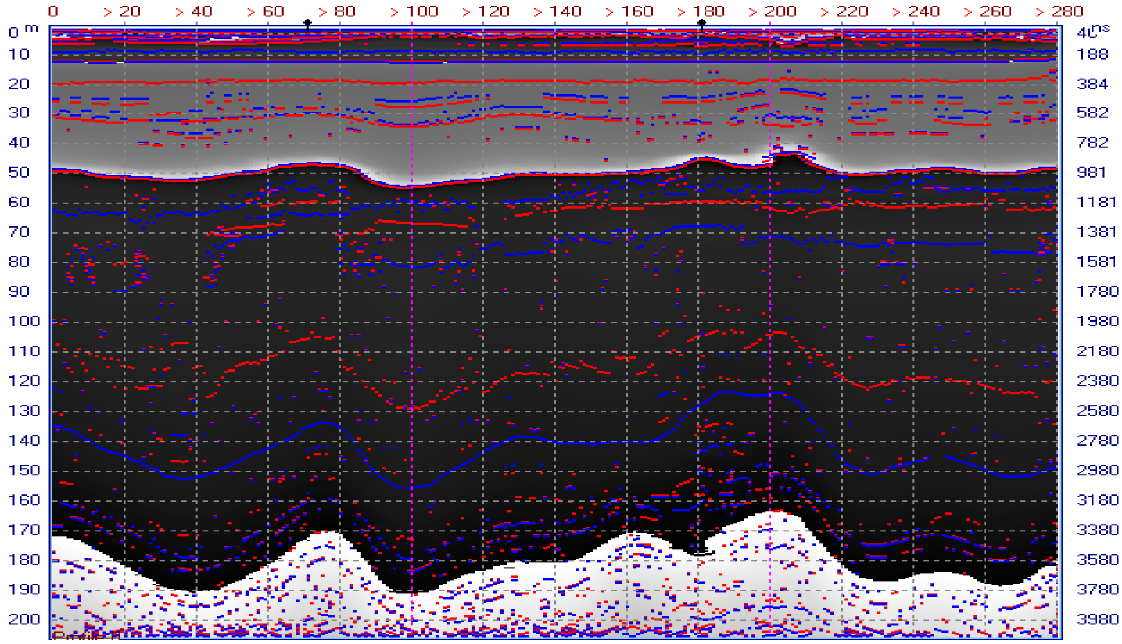


Fig 4. An example of a Terravision Radargram, Low Frequency (LF), collected on the project

In Fig 4 the blue and red lines, indicative of a change in density and electromagnetic permeability, at the 60-70m depth were found to correlate with the higher silicate bands.

a. High Frequency REFLEX

REFLEX is best suited for the higher frequency (shallower) profiling. In Fig 5, the red schematics have been added to accentuate key features. Including voids (circle), geophysical boundaries (continuous lines) and geological changes (dotted lines).

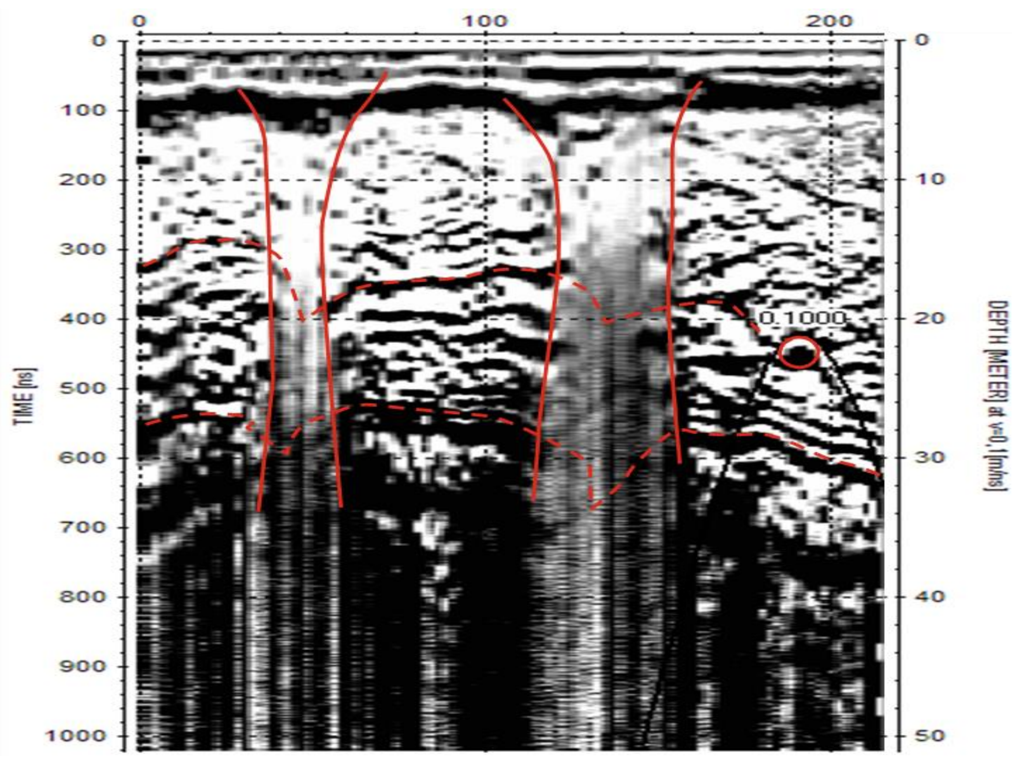


Fig 5. REFLEX presentation of the Terravision HF survey.

b. LF Radargrams

High frequency settings were used to review the close to surface and man-made anomalies. For a wider understanding of the geological trends and also to identify the large solution forming karsts, the LF settings were used. Fig 6 is an example of such a Radargram again with illustrative schematics. Fig 7 represents the combined sections orientated within 3d to further illustrate the larger trends and anomalies.

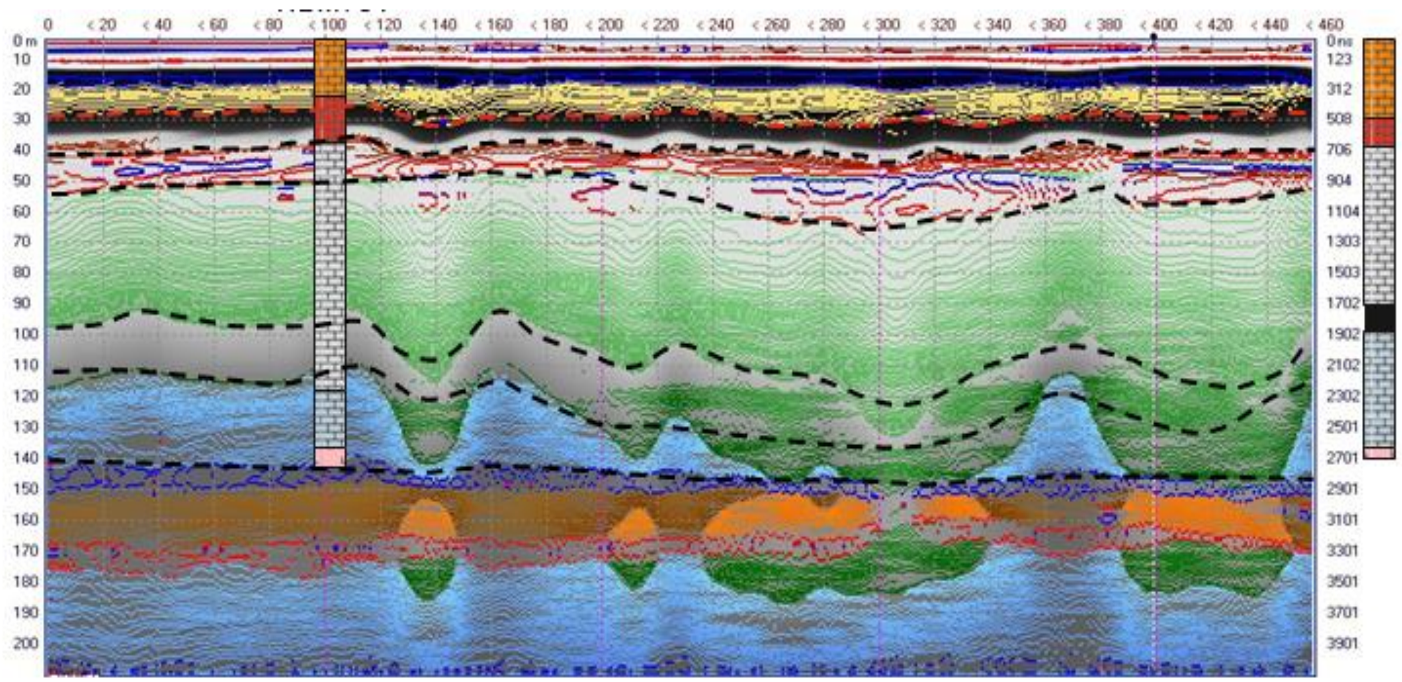


Fig 6. LF Radargram with borehole lithology overlaid.

5. Void Detection

Deep		Thickness	Log	
0,01	0,90	0,89	Ovb	
0,90	54,60	53,70	Hsil	
54,60	61,70	7,10	UHsil	
61,70	142,95	81,25	Lsil_upper	
142,95	143,60	0,65	Tuff	
143,60	163,60	20,00	Lsil_lower	
163,60	166,00	2,40	Basalt	

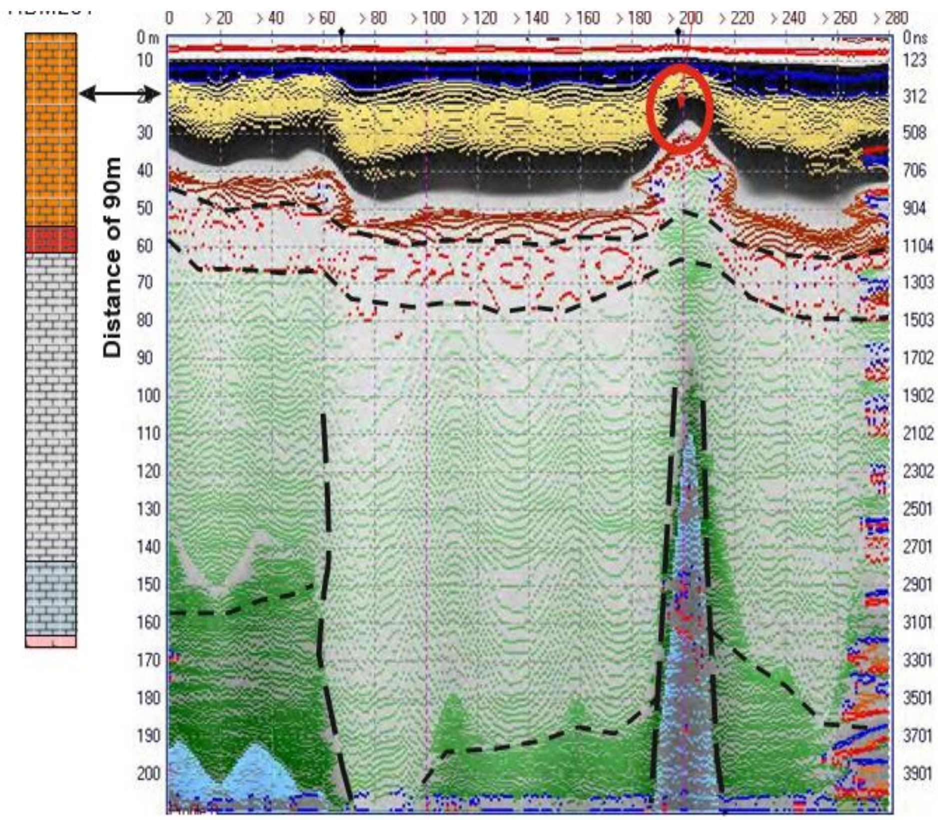
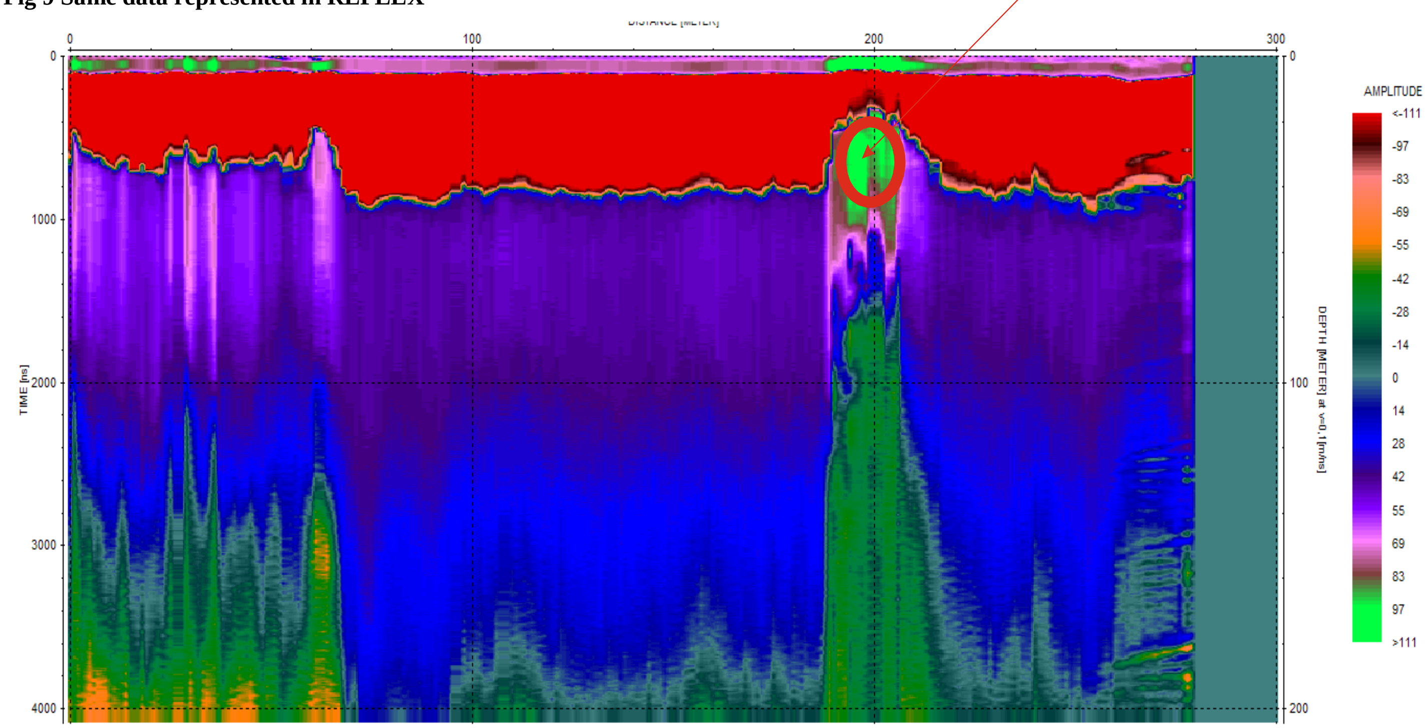


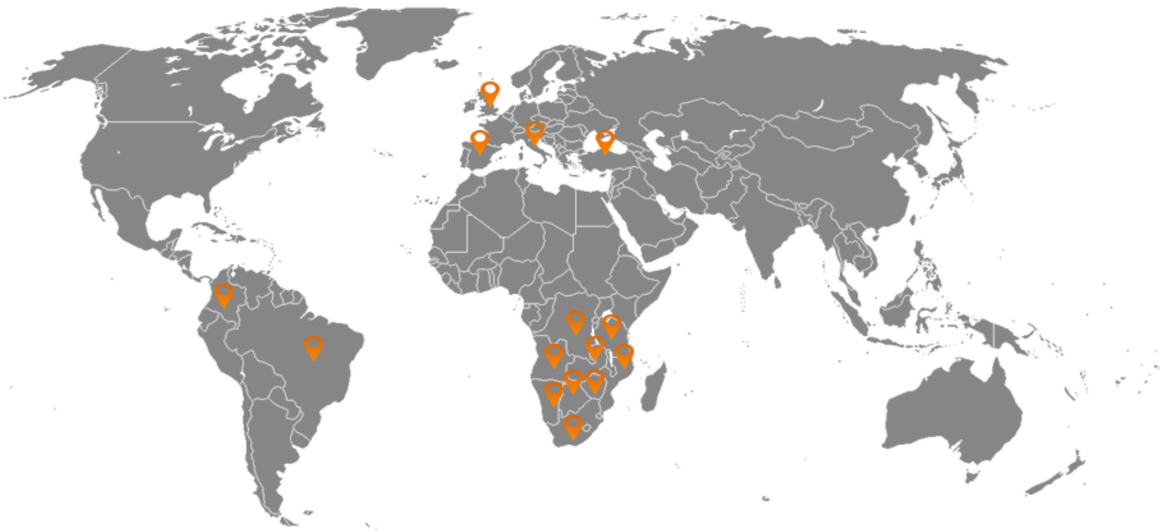
Fig 8. LF data with borehole correlation and showing a vertical karstic feature.

Fig 9 Same data represented in REFLEX



6. **Operations**

Terravision Radar has been operating to date in the following areas:



For a full client list and further case study examples please visit:

www.terravisionradar.com

7. **Enquiries**

For further enquiries please contact:

Charlie Williams
CEO, **Terravision Radar**

Email: Charlie.williams@terravisionradar.com
Skype: cevwilliams
Mob: 07810823858

Or visit the website at:
www.terravisionradar.com

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