Active Location Technology

Magnetic versus Electromagnetic

Development of Impulse Electromagnetic
from 1970 to the present

AAt the beginning of 1970, reports from the field of archaeology claimed that a new search method was capable of reaching previously unattained depths. Contact was made with the inventor of this new technology, Claus Colani, Munich, who had recognized the decay phenomenon displayed by metal objects in a pulsed magnetic field. When a metal object is briefly excited, the so-called jump function results in a magnetic reaction that decays for a longer period of time with a specific signature. This magnetic echo is recorded by the transmitter loop and converted into a signal.

In 1973 EBINGER acquired the Colani pulse patents and became the first manufacturer of pulse induction detectors (modern name of the process: TDEM) in Germany. Practical implementation was not easy, but we believed in the analytical properties of the PI or TDEM procedure and knew that this technology was the future. The road from a simple PI detector to an intelligent bomb detection system was long but extremely successful.

First, so-called support loops, such as UPEX® 740, were developed. These became standard equipment for many explosive ordnance clearance services around the world. The next step was the small UPEX 740® MF-3 drive system, the electronics of which have undergone a practical further development. The small travel system can be operated by a single person.
The advantage of the system is its broad application for both large and small caliber ammunition as well as the suppression of splinters and fragments, mineralized and magnetic soils. Wherever passive probes (gradiometers) become bogged down with the interference of magnetic noise, EBINGER pulse induction technology (TDEM) is a sensible supplement.

Figure 1: UPEX® 740 MF-3 fully equipped, including GPS, during operation

Magnetic or Electromagnetic?

A current question of probing technology

The active UPEX® 740 MF-3 travel system is the smallest and therefore the most cost-effective solution for surface mapping, achieving a daily output of up to 2 ha under favourable terrain conditions. With appropriate programming, the search system detects small ammunition, e.g. 20 mm shells at a depth of approx. 30 cm, larger shells up to 1.5 m and bombs up to 3 m deep. The major advantage of this system is that it can be programmed according to the specific requirements of the search task or boundary conditions of the site in a way that enables interference from small scrap and magnetic soil to be suppressed.

Additional Features of UPEX® 740 MF-3:

· Modular, dismountable design
· Analogue search or digital data recording
· GPS support
· 3 amplification levels depending on search task
· Delay times 25 - 250 µs depending on search task
· Frequency shift for EMI suppression
· Detection of magnetically indifferent ammunition/bombs
· Use on mineralized/magnetic soils
· Suppresses magnetic noise
· Detects all metals

UPEX® 745 DF

Active TDEM drive system

This drive system represents a further boost in technical features for the purpose of active large area and depth sounding. The system is not intended for the detection of small ammunition but rather designed to detect compact, larger calibers and bombs, especially in regions that are unsuitable for gradiometer use due to magnetic disturbance. These include:

· Magnetic surfaces and/or fills (sports fields, parking lots)
· Disturbed search areas: construction sites, urban areas, industrial wasteland, burnt material, bricks, roads, motorways, etc.

Additional Features of UPEX® 745 DF:

· Areas of up to 2 ha/day possible
· Separate transmitter
· 2 receiver coils (arranged one above the other at a distance of 70 cm)
· 4 channels per receiver (3 digital differential channels)
· Total of 8 channels at 5 time slots
· Digital data recording
· Adjustable frequency for noise suppression
· Suppression of small scrap, splinters
· Can be expanded to include GPS via EBINGER Software EPAD®/EPAS®
· Digital noise reduction (patent pending)
· Transient analysis via temporal functions and depth determination

Figure 2 UPEX® 745 DF

Comparison of Active and Passive Measurement

Explanation of mapping

Figures 3 and 4 show one magnetic and one active UPEX® probe. The setting is a sports field with a typical reddish-brown backfill as is commonly used on tennis courts. Type of backfill and magnetic susceptibility are currently unknown.
Figure 3: The attempt with the magnetic probe can be classified as unsuccessful!

Figure 4: By contrast, active UPEX® probing shows clear anomalies that may indicate hidden ammunition. Interesting is the fact that the gate on the right side is recognizable as well as anomalies in its immediate surroundings. The fence around the sports field is clear too, but of special interest are the more or less patchy anomalies worth excavating in the immediate vicinity. The search area at the top right, which has likewise been mapped, also shows fundamental differences between passive and active, providing sufficient information for every expert.

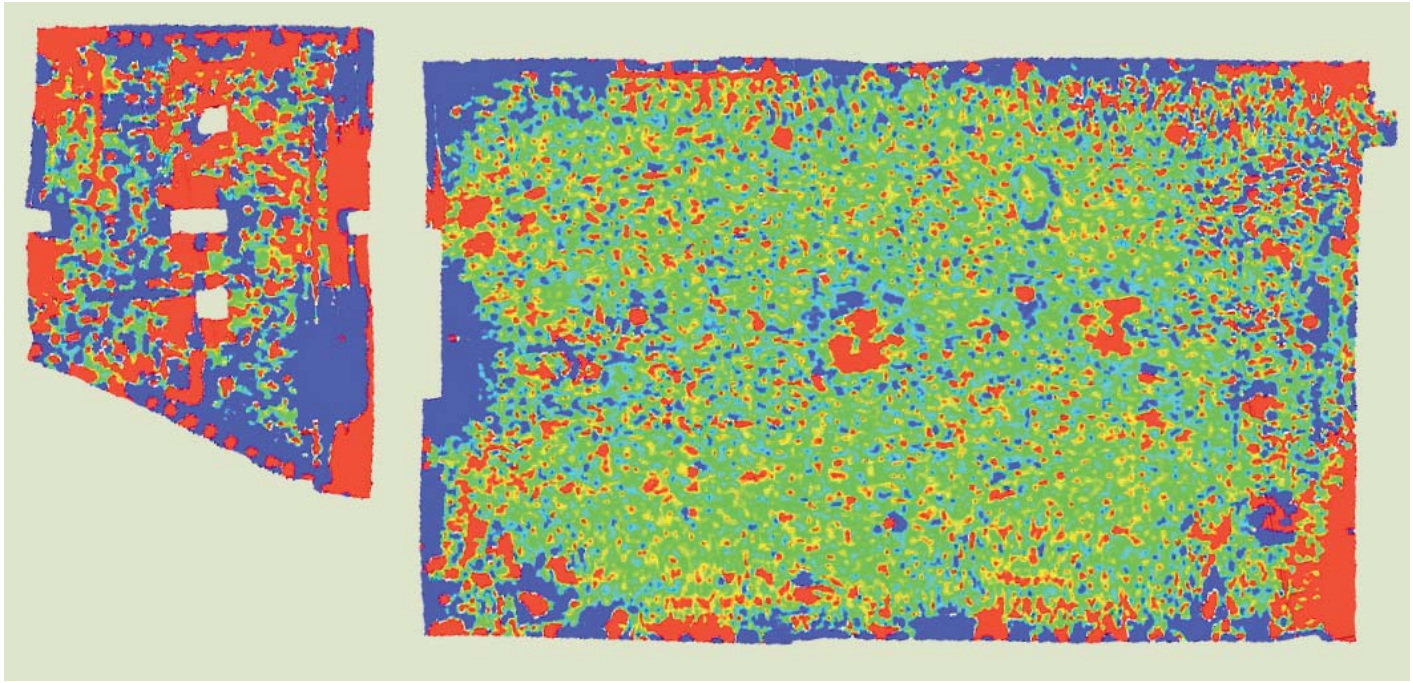

Figure 3: Colour map of a sports field created by magnetic large area probe

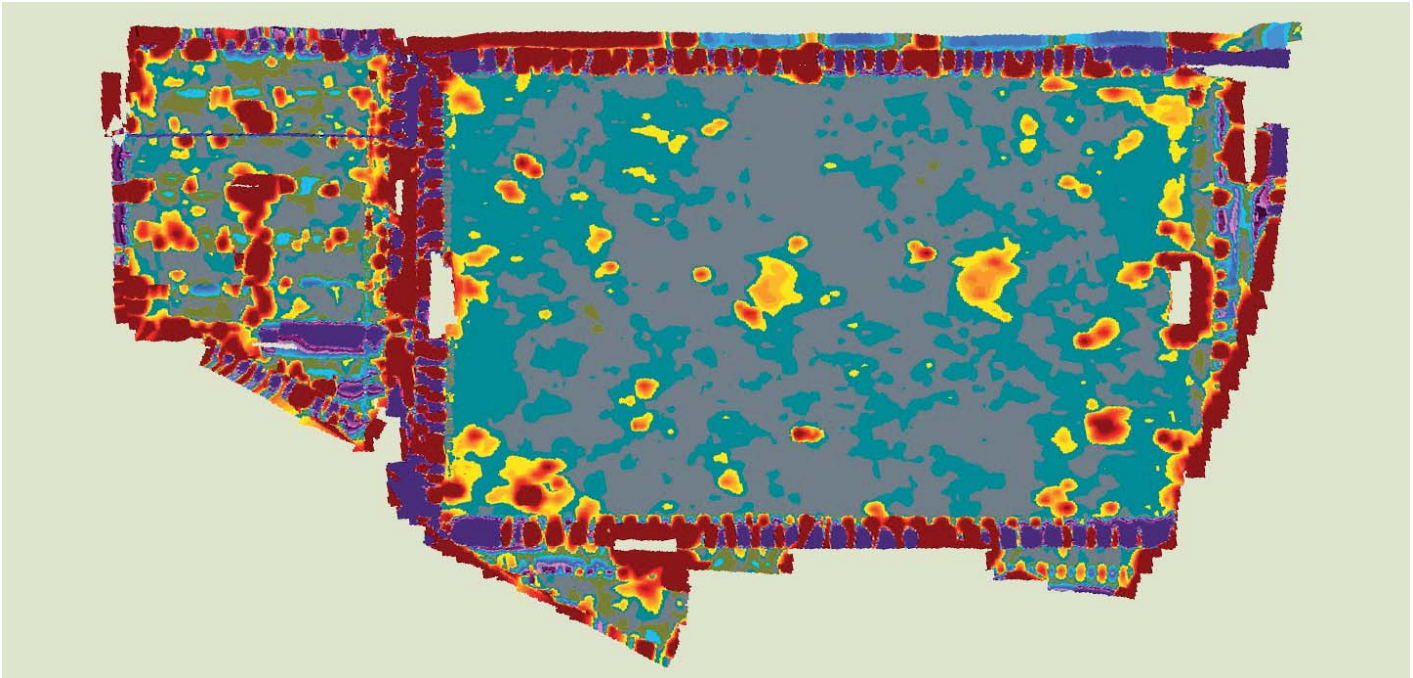

Figure 4: Colour map of a sports field created by active UPEX® 745 DF large area probe

UPEX® 745 P²I

Stationary large loop search system

In the detection of explosive ordnances in industrial and/or military areas as well as in inner-city areas in particular, the fundamental question arises: magnetic or electromagnetic? This applies both to soils of volcanic origin and to the deposition of magnetic stones from terminal moraines.

In contrast to the mobile UPEX® search systems described above, the UPEX® 745 P2I is a stationary large loop system. This system features the option of a transmitter loop (Tx) measuring 20 x 20 m or 40 x 40 m for depth detection and borehole sounding. This takes over the function of the pulse transmitter, generating a relatively homogeneous and above all depth-reaching, pulsed magnetic field in the action range of the loop. Through the primary excitation of the pulse transmitter, search objects become so-called transmitters, emitting a secondary pulsating magnetic field. The UPEX® 745 P2I system was already described by EBINGER back in 2009, when the benefits for the user were still of limited use. In principle, it is a solution for the most challenging search tasks under adverse magnetic boundary conditions on site, where magnetic surface soundings cannot lead to success!

Baunatal was our big, official breakthrough. Due to magnetic rock interference there, magnetic probes were unable to produce good results. Even a large anomaly, a sewerage system, could not be detected magnetically! For more information, please refer to our NEWS No. 11/16 Fig. 5 sewerage system Baunatal, where we were able to detect all relevant search objects at depths of approximately 4 m!

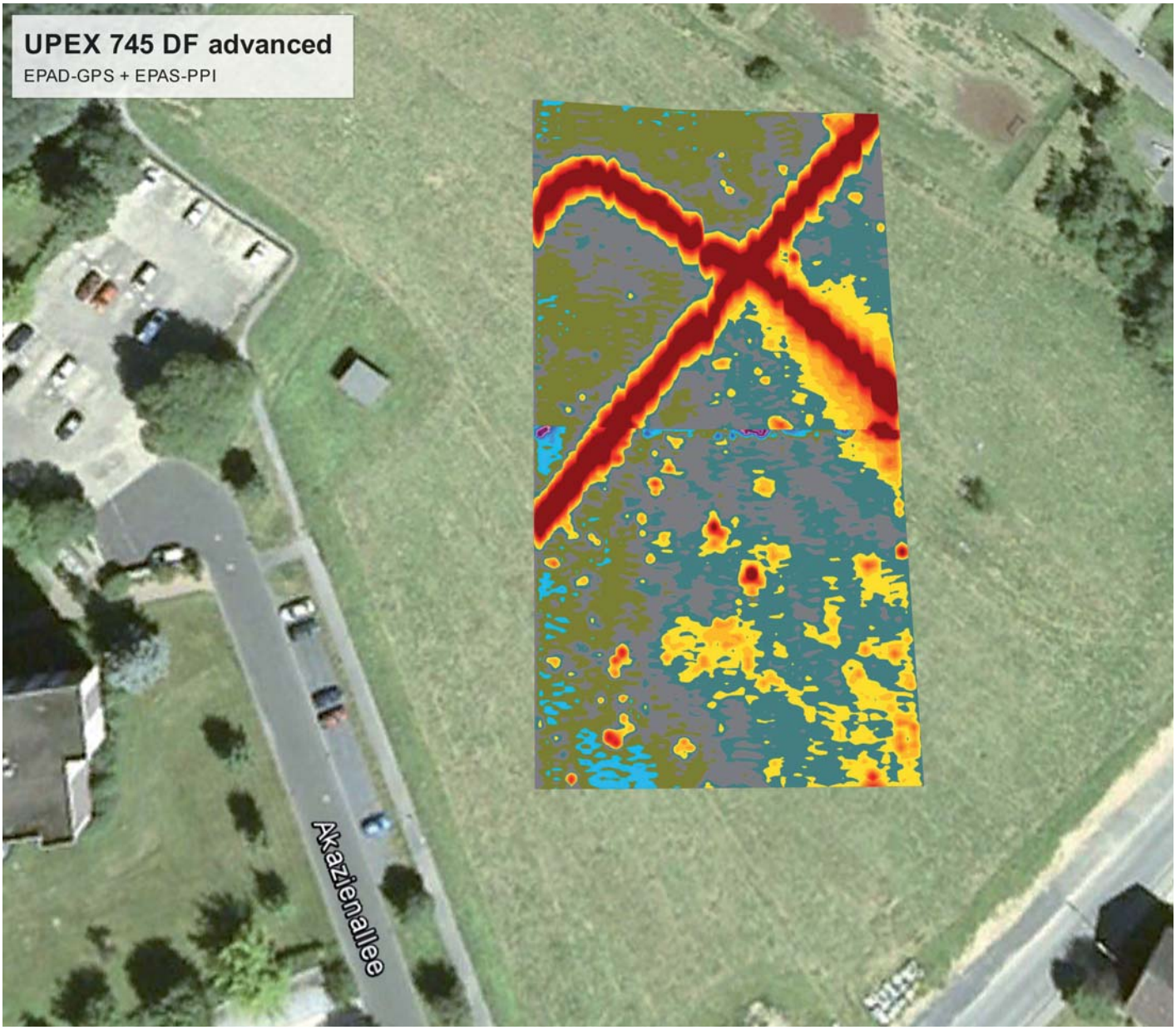

Figure 5: Mapping UPEX® 745 DF, sewerage system on property, Baunatal

Passive Measurements

Trial run on the test field (Part 1)

Two areas at our company site were probed: the test field with known buried search objects – the deepest object being an MK 82 at approximately 3 m – and a neighbouring area filled with basalt stones and grit.

On the 20 nT colour chart (see Figure 6) the test field objects (upper partial surface) are clearly visible. By contrast, the mapping of the neighbouring area (lower part) is more reminiscent of a „colourful carpet".

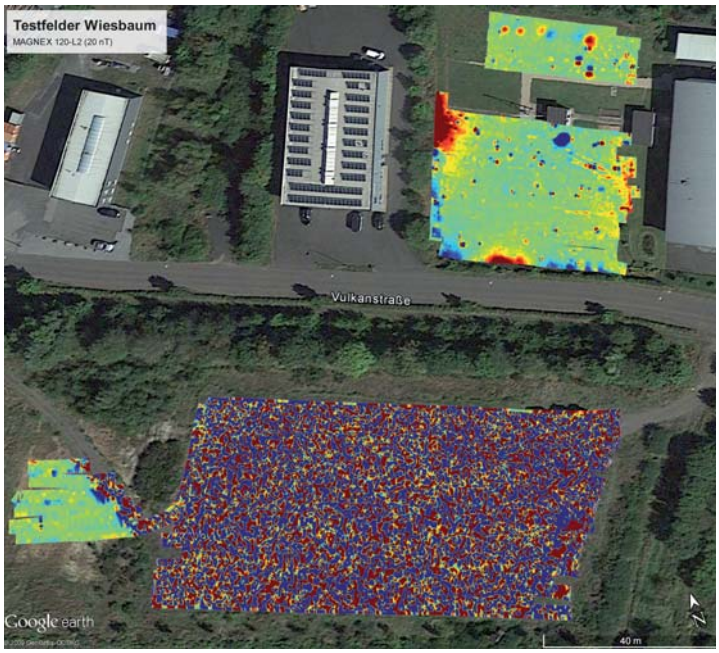

Figure 6: Magnetic measurement – the search objects are not recognizable on the resulting map.

At a scale of 200 nT (see Figure 7), the magnetic stones of the neighbouring surface are only visible as patchy, yellow anomalies. On the test field (upper partial surface), however, none of the buried search objects can be detected any more!

We have heard that there are indeed „specialists" who scan and map magnetically disturbed terrain at a scale of approximately 200 nT. However, with munition detection in the broadest sense, this is not a feasible technical approach!

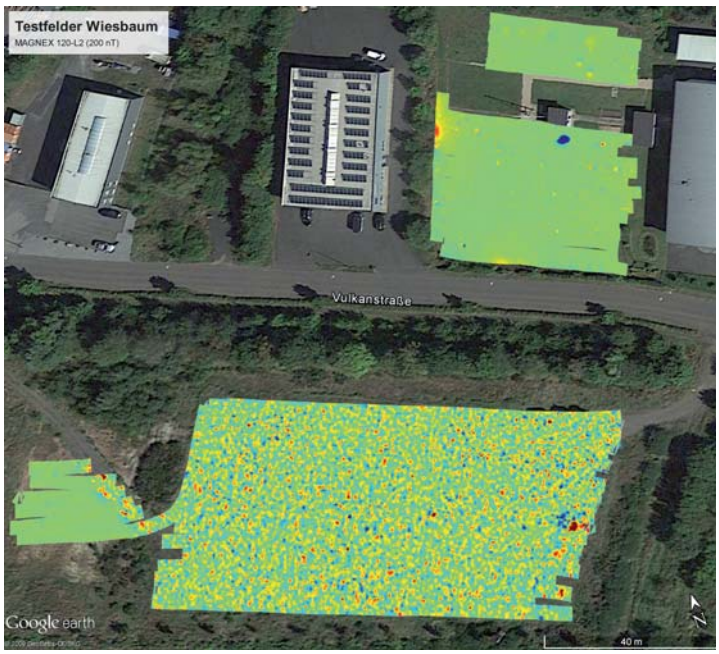

Figure 7: Magnetic measurement – the search objects are barely recognizable on the resulting map.

Summary

Klaus Ebinger

Klaus Ebinger founded the company Ebinger Such- und Ortungstechnik in 1969 and is considered a pioneer in the development of active search and locate systems.

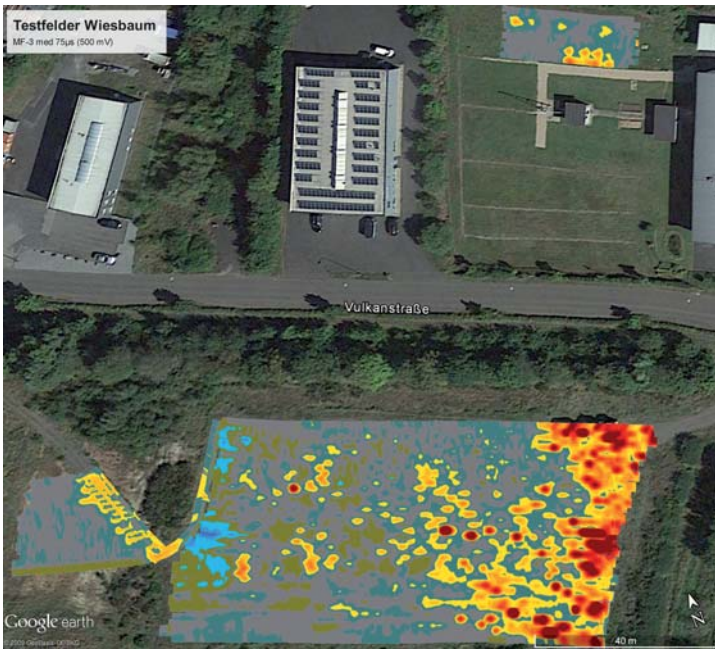

Figure 8: Active measurement UPEX® 740 MF-3 – the search objects are clearly recognizable on the resulting map.

Active Measurements

Trial run on the test field (Part 2)

The same area was then recorded with our UPEX® 740 MF-3 (Delay 75 µs) mobile drive system (see Figure 8).

The buried search objects in the test area (above) are clearly displayed.

Large-scale anomalies appear on the neighbouring surface, which are completely missing from the magnetic mapping (Figure 6).

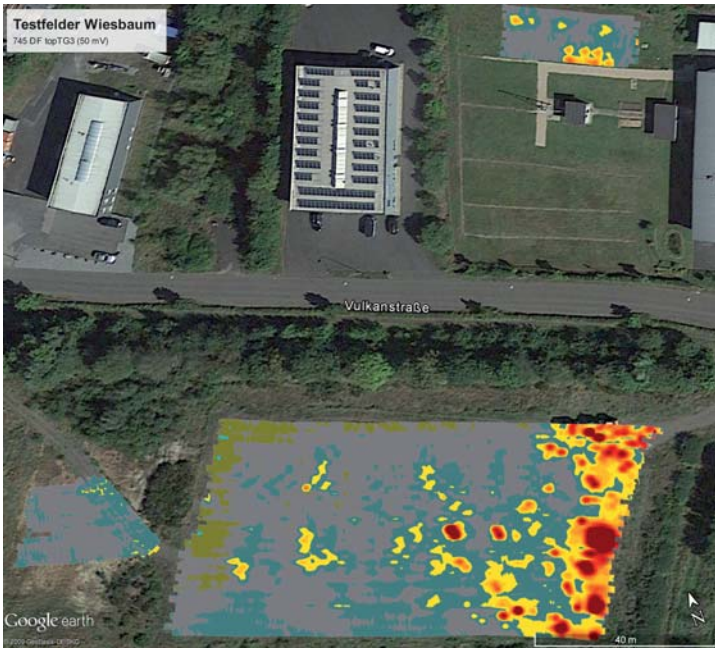

Figure 9: Active measurement UPEX® 745 DF – the search objects are clearly recognizable on the resulting map.

The same was tried again with our UPEX® 745 DF drive system (Figure 9). In this case only the more compact metal objects had an effect on the mapping.

Both measurement results of the UPEX® systems 740 MF-3 and 745 DF illustrate the special advantages of active pulse electromagnetics, which can no longer be ignored today.

These are useful supplements for all cases where passive gradiometer probing fails due to the very nature of the technology. Electromagnetics suppresses magnetic ground disturbances, as we have already demonstrated in Baunatal.

The ingenious achievements of Dr. Förster, who brought out the well-known Förster probe (in my time type 4.011, the heavy tube probe) after World War II are still admirable today! With the help of this probe, thousands of bombs and shells of all calibres have been cleared from the ground over the decades. Gradiometer technology, i.e. passive sounding, has thus established itself internationally. As development continued, the probes became lighter and more powerful, but essentially nothing has changed in the actual search procedure. I had the fortune to meet Dr. Förster personally, since as a detector developer and supplier I was not unknown to him. At that time, no one could have guessed that I would demonstrate active bomb detection after more than 2 decades.

Today, both procedures, passive and active, work together symbiotically in the field of explosive ordnance clearance. In locations where gradiometer probes become bogged down in magnetic noise, active technology, my life's goal, is called for! EBINGER has meanwhile proven throughout the world that it works! My profession became my calling; I've been practising it now for over 50 years.

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