



NORAD supported project in MRRD covering
Capacity Building and Institutional Cooperation in the
field of Hydrogeology for Faryab Province
Afghanistan

Introducing MRRD Geophysical Borehole Logging Capabilities

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Welcome to this short presentation on the new geophysical borehole logging capabilities of MRRD.



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Last year we received a Toyota Landcruiser from MRRD, for conversion into a geophysical logging truck.

We developed a conceptual design as a group exercise together with geophysicists and hydrogeologists of MRRD.

The first step was to remove the side windows, and line the inside of the vehicle with insulation material and a durable, waterproof surface.



The conceptual design was converted into reality in the workshop of the Toyota garage here in Kabul.

We tried out many different options, and had numerous discussions to optimize the design.



On the top left is Engineer Jamal carrying out one of the final inspections on the system to secure the box containing the geophysical logging sondes.

On the top right is Engineer Poya inspecting the box we designed to carry fragile equipment during transport, and act as a work table during logging operations.

We built a retractable bench that can sit up to four people comfortably in this rather confined space.

On the bottom right you can see how everything is secured for transport. Safety is one of our main concerns, so it is important that nothing can become loose.



The logging truck is ready for operations.

But first, lets look at some of the applications of geophysical borehole logging.

Applications of geophysical borehole logging

- 1) Geological mapping of boreholes
- 2) Groundwater quality mapping in boreholes
- 3) Water well inspections



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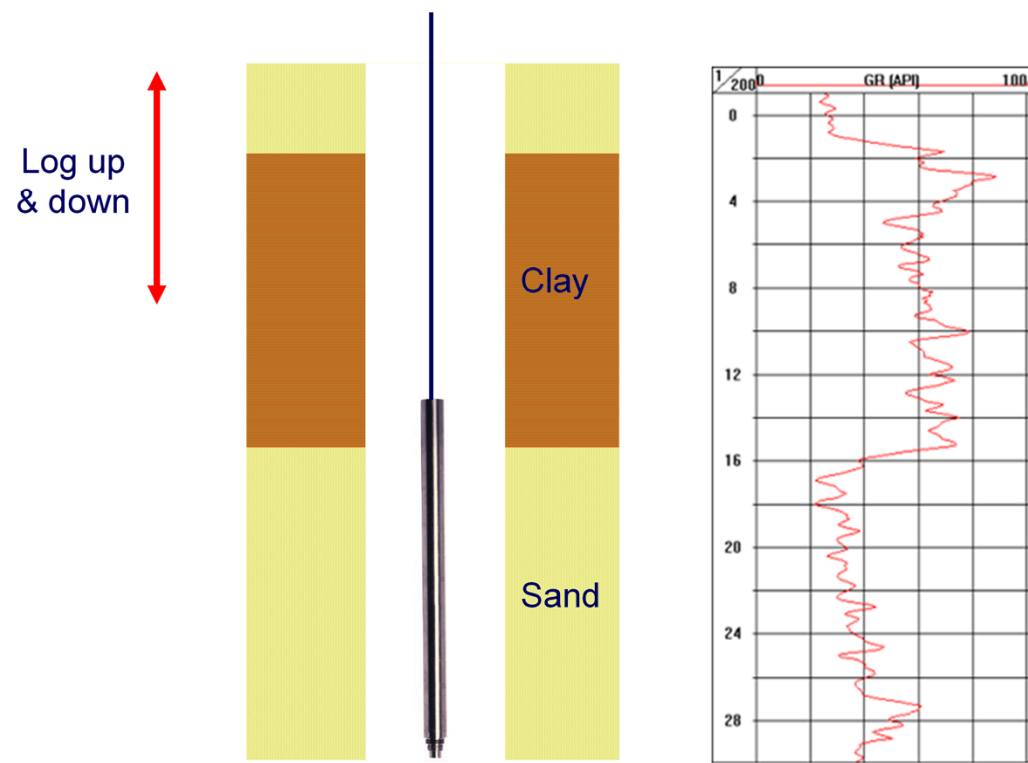
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There are three key areas where geophysical borehole logging is very useful.

These are:

- 1) The geological mapping of boreholes, to identify lithologies and water bearing aquifers.
- 2) The mapping of vertical changes in groundwater quality within wells and boreholes.
- 3) The inspection of newly completed and also old and abandoned water wells.

Natural Gamma for lithology identification

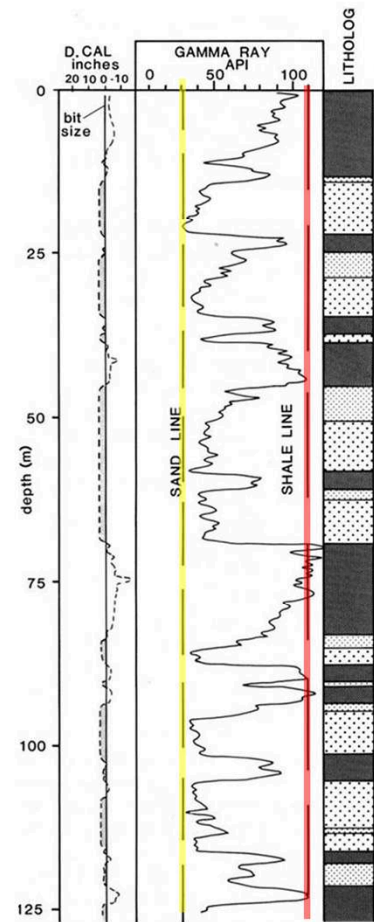


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Here is an example of the natural gamma sonde. It measures naturally occurring radiation in the ground, and is very useful for mapping clay rich horizons.

Natural Gamma Log Interpretation



$$V_{sh} = \frac{GR_{log} - GR_{min}}{GR_{max} - GR_{min}}$$

where;

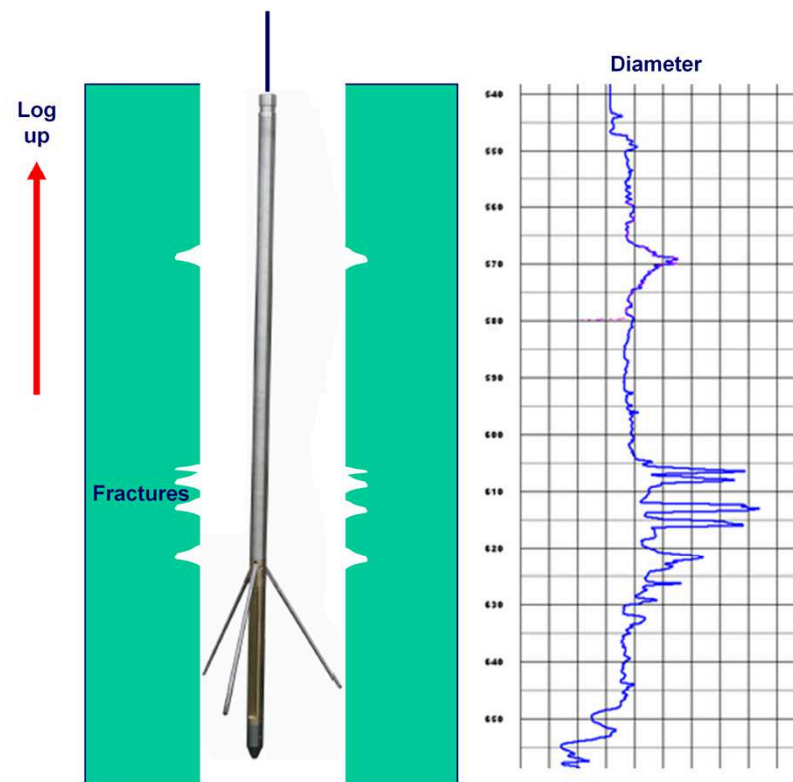
- $V_{(sh)}$ = shale volume (%)
- $GR_{(log)}$ = gamma radiation value from log
- $GR_{(max)}$ = gamma radiation value from log at shale line
- $GR_{(min)}$ = gamma radiation value from log at sand line

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We can use the natural gamma sonde to estimate the clay content of aquifers.

Caliper logging for fracture identification



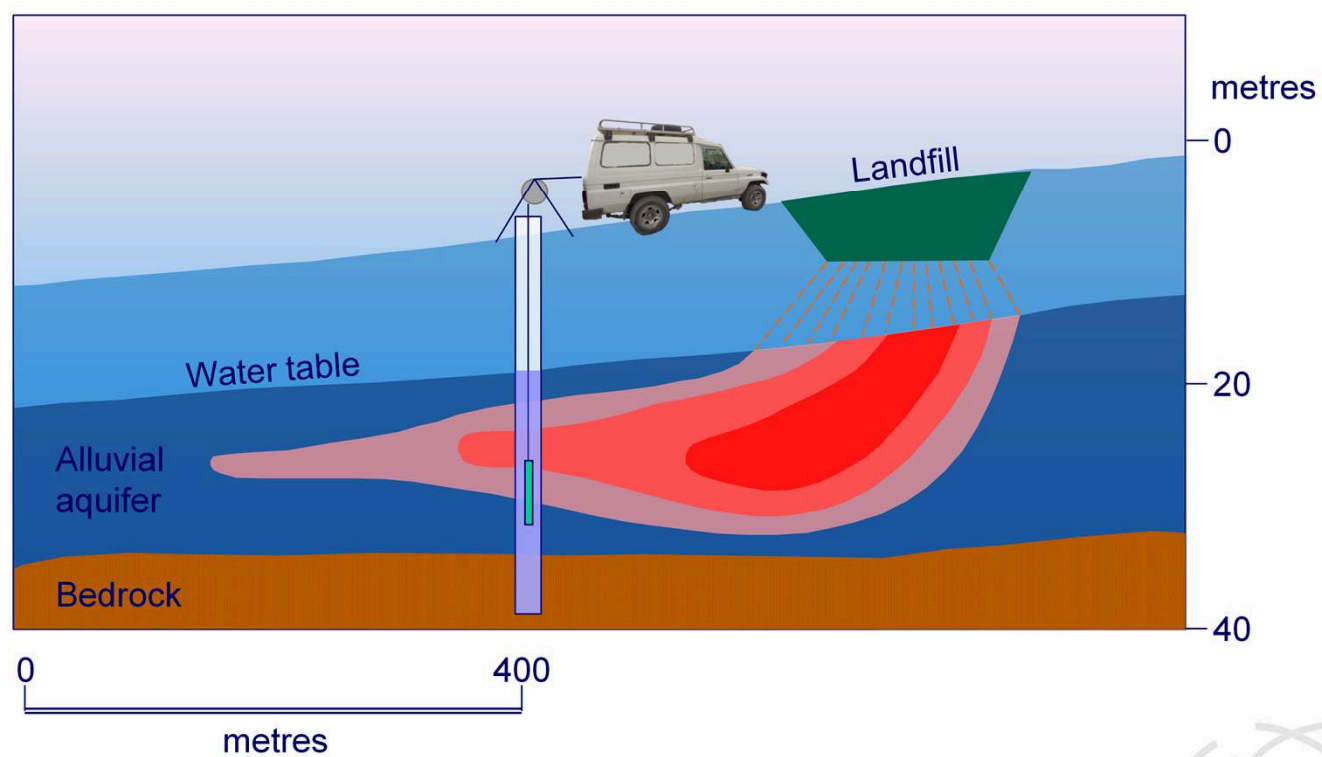
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This is an example of a borehole in a bedrock aquifer where groundwater occurs in fractures.

The caliper tool measures the diameter of the borehole using these three arms, and when it passes across a fracture you will see a change in the borehole diameter.

Induction logging to map leachate plume



Source: Adapted from UK Groundwater Forum

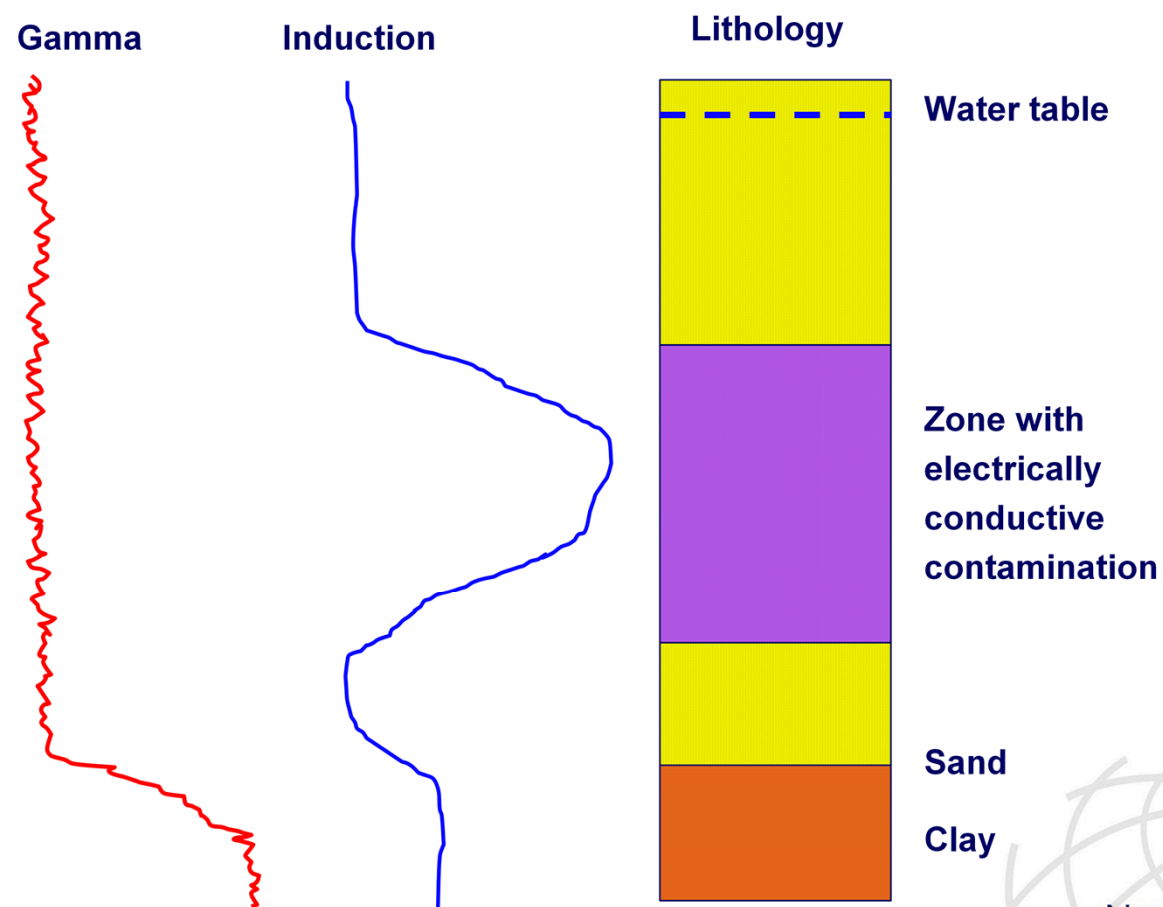
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The induction sonde can look through PVC casing to map changes in the water quality in the aquifer.

In this example the induction log is used to map a leachate plume from a landfill site, which has a higher salinity than the naturally occurring groundwater.

This tool will also be very useful to look for naturally occurring saline groundwater layers.

Induction logging to map leachate plume



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Here are the kind of responses we would expect from the previous example.

We can use the natural gamma log to map clay rich horizons, and the induction log to identify layers of more saline groundwater.

Another important sonde for monitoring water quality is the temperature- conductivity sonde which measures the properties of the water inside the well.

Downhole camera for well inspection



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The downhole video camera is a very powerful tool for the inspection of water wells. It records a continuous film of the inside of the well.

On the bottom left you can see an example of a stainless steel wire-wrap screen.

On the bottom right you can see water entering the well from fractures above the water table.

To the best of my knowledge MRRD currently has the only functioning camera sonde in Afghanistan.



Lets see the MRRD logging truck in action.

Here we are backing up towards the MRRD test well inside the compound.



The first task is to open the box and remove the sensitive equipment.



Then we take out the generator, which is attached securely to the body of the vehicle during transport.



Then we set up the tripod over the well.



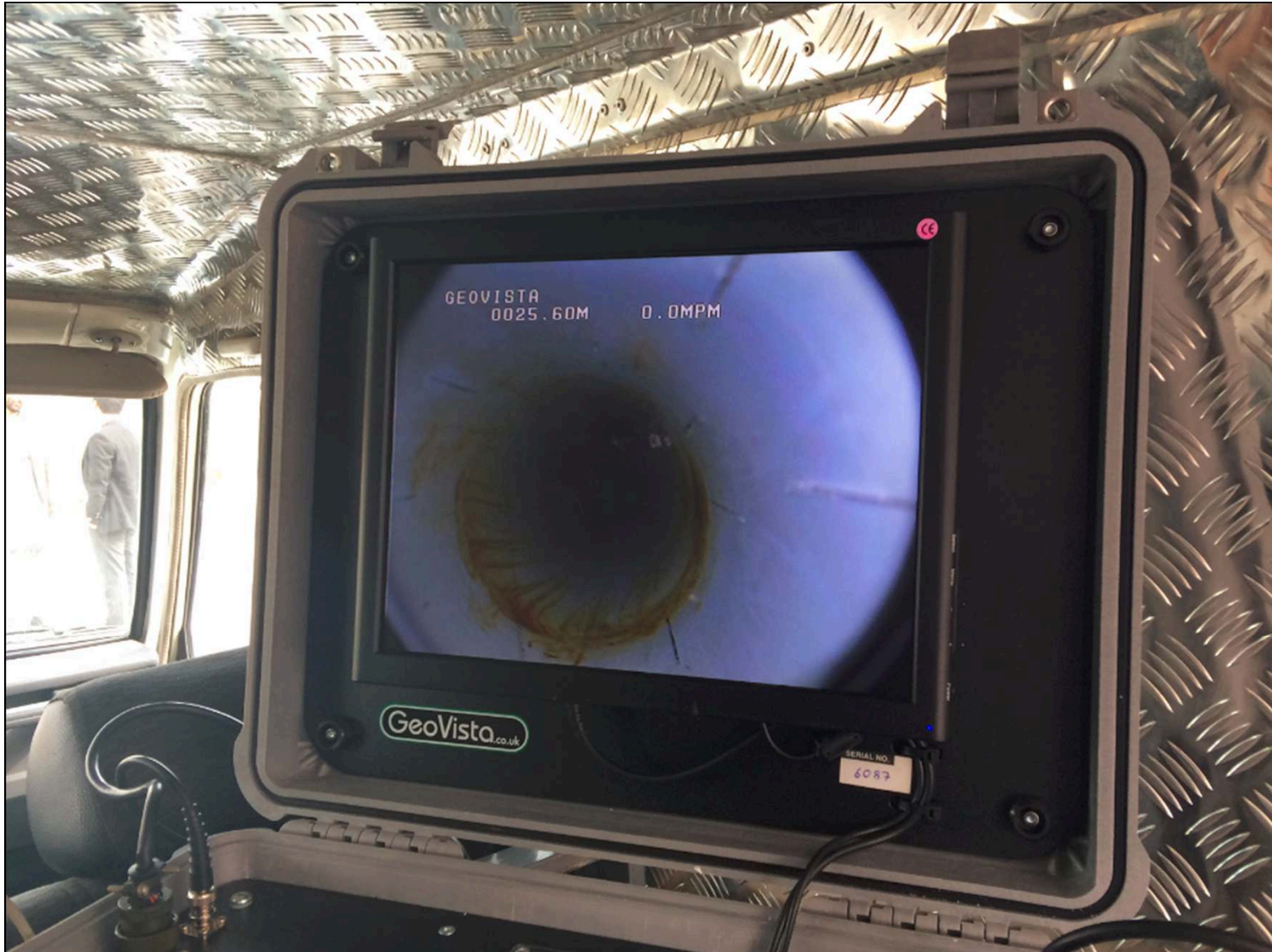
Here you can see the Camera Control Unit set up for logging.



Some last minute adjustments to the camera sonde with Engineer Jamal.



We insert the camera sonde into the well.



This is what the inside of the well looks like on the screen. Here we can see the hand-cut slots inside the white PVC screen. The brown colour is glue that has been used to join two pieces of screen together. Some of it has run down the inside of the screen.

**Thank you
for your attention!**



During May and June we will be running practical training courses in geophysical borehole logging and also in the interpretation of geophysical logging data for hydrogeology.

Thank you for your attention!