Non-Destructive Imaging of Shallow Sandstone in Support of Hydraulic Study of Litho Logic Unit, Green River Area, Utah

Data Acquisition and Processing
Supervised by

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Summary of work conducted:

Multiple parallel ground penetrating radar (GPR) profiles were acquired at our Green River test site in Utah in June, 2000. The intent was to determine whether the non-invasive GPR tool could be used to determine the strike and dip of bedding and air-filled fracture planes within a sandstone lithologic unit that was exposed at the earth's surface. Geologic investigations on site (concurrent with GPR study) indicated the bedding and fracture planes of primary interest have unit thicknesses on the order of one inch. Field investigations also indicated a depth investigation on the order of ten feet was desired (inasmuch as the sandstone unit of interest was covered by sandy soil throughout much of the study area). The sandstone unit studied was a potential aquifer further to the east where it was overlain/encompassed within shales.

Equipment used:

The GPR system used consisted of a SIR System 10B recording unit and multiple antennae (400 MHz, 900 MHz and 1500 MHz; manufactured by Geophysical Survey Systems Inc.). The power source was a portable, gasoline-powered generator.

The GPR system was operated with one person running the main computer, a second person moving the antenna, and a third person guiding the antenna over or around obstacles. The antenna was connected to the computer by a 100 foot long cable. The computer was placed in a mobile cart, such that it was possible to run continuous lines longer than 200 foot.

Operation of equipment:

Operating the antenna requires pulling it by hand in a relatively straight line and at a steady pace. Larger rocks were moved where possible, but most rocks were pebble size and the antenna was dragged over them. The GPR profiles were electronically flagged at five foot intervals. Line locations were determined using GPS control.

Data Processing:

The processing software package Radan (Geophysical Survey Systems Inc.), was used to process the data. This processing software downloads the field data from our recorder and stores it on computer. Basic processing consisted of filtering, the application of static corrections, and migration only.

Similar processing steps were applied to each acquired GPR profile. The profiles were filtered with high and low pass vertical filters, and with a high pass horizontal filter. These filters remove random background interference, as well as "noise" produced by the radar unit itself and objects such as fences or vehicles. After the application of static corrections, the data were migrated. All data were initially stored on computer. Once processing was completed, a hardcopy of each profile was printed and evaluated (interpreted).

Summary:

The evaluation of the processed GPR profiles indicates that internal resolution and depth of investigation are a function of the frequency of the antennae employed, and the material investigated. In terms of vertical resolution and depth of investigation (in dry sand/sandstone environment), the following was concluded:

1. The GPR profiles generated using the 1500 MHz antenna provided the vertical (1") resolution required to adequately image the target bedding and fracture planes. Unfortunately, depth of investigation afforded by the 1500 MHz was limited to about 2 feet. In most areas, the thickness of the soil cover was greater than 2 feet. (This information was not available prior to our arrival on site.)

2. The profiles generated using the lower (900 and 400 MHz) frequency antennae provided greater depth penetration - but were not capable of imaging the thin-bedded features of interest.