GROUND PENETRATING RADAR IN SEDIMENTARY ROCKS. J. B. Lee[1,3], S. K. Sahai[2,3], and S. T. Paxton[2], [1]University of Arkansas Physics Department, 226 Physics Building, Fayetteville, AR 72701 (jblee@uark.edu), [2]Geology Department, 105 Noble Research Center, Oklahoma State University, Stillwater, OK 74078, [3]Arkansas-Oklahoma Center for Space and Planetary Sciences, OK State University, Stillwater, OK 74078.

Introduction: Ground Penetrating Radar (GPR) is used to image the subsurface of soil and rock layers. GPR uses electromagnetic waves, in the radio frequency range, to investigate shallow subsurfaces. The wave is produced by a transmit antenna, scattering on layers of varying impedance, then recorded by a receive antenna.

Application: NASA and the ESA (European Space Agency) are interested in GPR because GPR can be used to find water or ice in the shallow subsurface of Mars. Since the water / ice will be housed in sediments or sedimentary rocks, documenting GPR response in sediments could assist NASA in evaluating the location of water / ice in the Mars subsurface. Figure 1 shows an example of how GPR data can be used to find a water table on Earth.

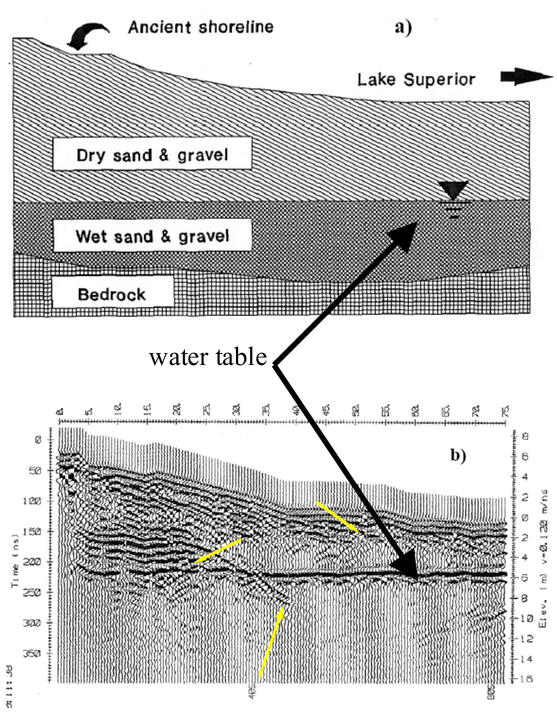

Fig. 1

Field Methods: Standard procedures for obtaining GPR data are as follows:

- Get permission to do a noninvasive survey of the desired location.
- Bring all of the GPR equipment to the site.
- Connect the GPR to the battery and the control box.
- Turn on the DVL (Digital Video Logger).
- Make all the proper selections. When the DVL is ready to receive data, the electric beeper or the DVL may be used to initiate data collection.
- The step size, antennae separation, and antennae frequency is chosen based on the site that is to be imaged.
- Finally, after all the data lines are collected for the day, the GPR is packed up and taken to a computer for data transfer and analysis.

Results: Figure 3 shows GPR data of Permian sandstone. This data can be used to determine the position of the sandstone contact with the underlying shale. Figure 2 is a picture of an outcrop in Stillwater OK. Figure 3 is an image of the area in the outcrop. Shale has high conductivity, therefore penetration in and through shale is limited. The line at 50 ns in figure 3 shows where the shale meets the sandstone. The bottom line in figure 2 shows the same line where the shale meets the sandstone. The top left line in figures 2 and 3 show where a channel was in the McElroy site in Stillwater, OK.

3D data: Figure 4 shows three-dimensional GPR data. This type of data can be acquired by surveying several lines at a certain spacing. After the lines are acquired, 3D GPR data processing software is used to render the 3D object. Valuable data about channels can be seen with 3D GPR data. Slices of the 3D data can be used to track the flow of a channel in the sandstone.

References: [1] Ground Penetrating Radar in Sediments; C. S. Bristow and H. M. Jol; Geological Society Special Publication 211; 2003.

[2] Ground Penetrating Radar; Stephen Griffin, Timothy Pippett (http://leme.anu.edu.au/Pubs/OFR144/09GroundRadar.pdf)

Acknowledgments: The guidance of Steve Hadaway is appreciated. This work was done as part of a Research Experience for Undergraduates (REU) project sponsored by the National Science Foundation.

Fig. 2

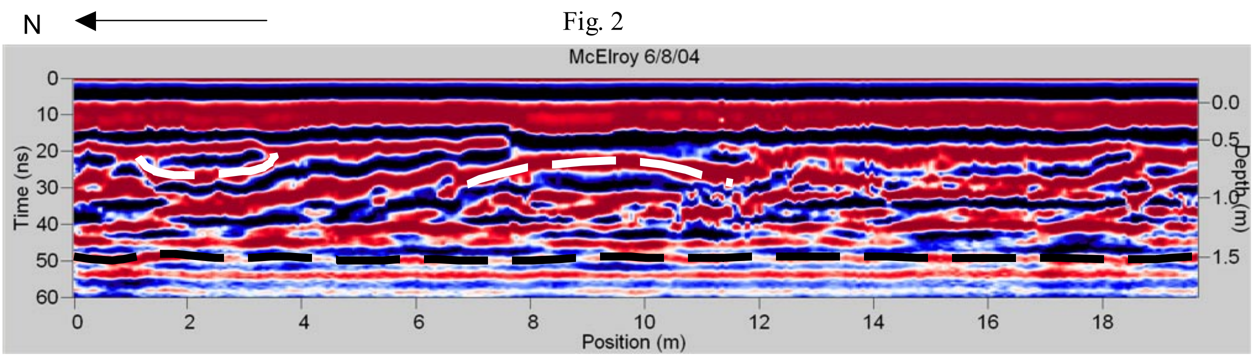

Fig. 3

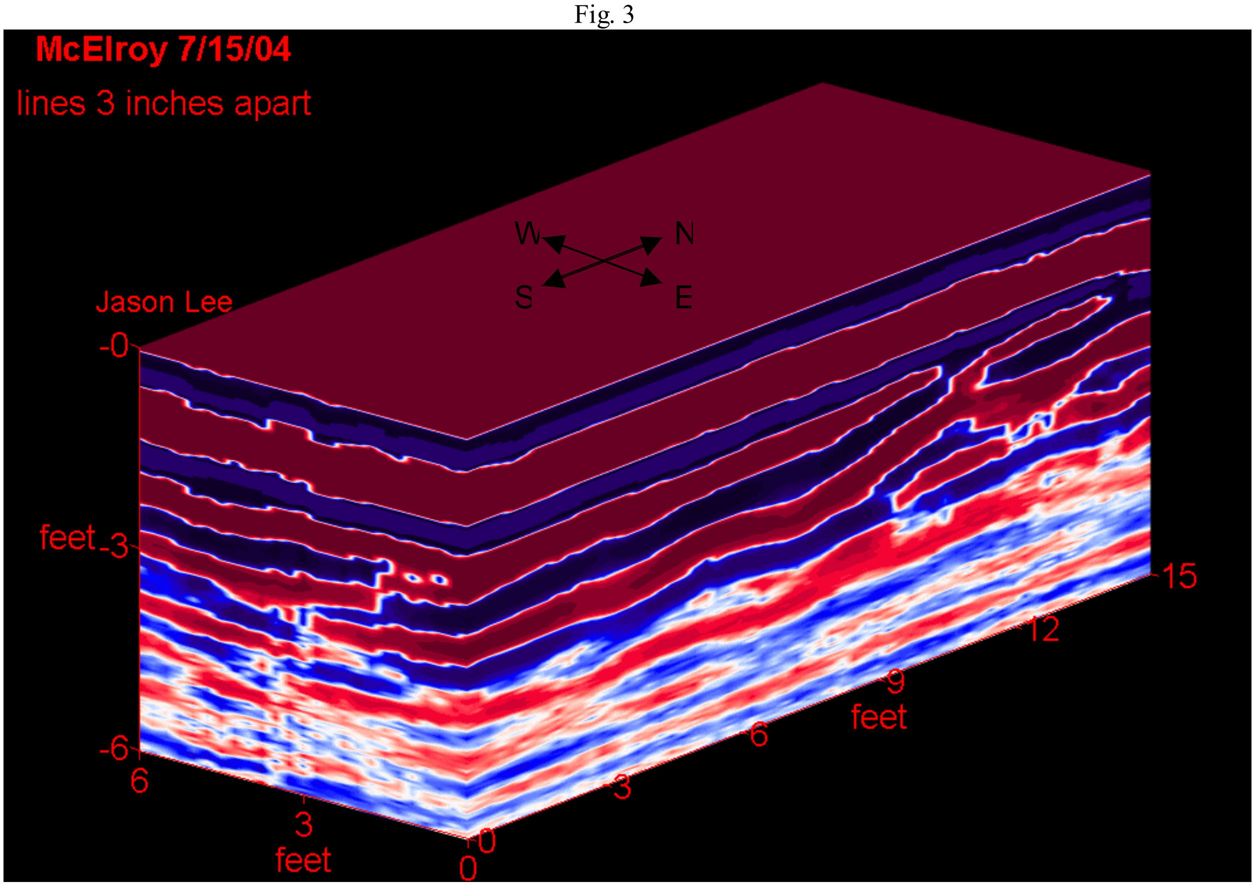

Fig. 4