GROUND PENETRATING RADAR IN SEDIMENTARY ROCKS. J. B. Lee[1,3], S. K. Sahai[2,3], S. T. Paxton[2], and S. Hadaway[2], [1]University of Arkansas Physics Department, 226 Physics Building, Fayetteville, AR 72701 (jblee@uark.edu), [2]Geology Department, 105 Nobel 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 view 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. Since metal objects can greatly influence the quality of the GPR data, Oklahoma State University's GPR (the Pulse EKKO 100) is designed with a minimal amount of metal. The Pulse EKKO 100 comes with a PVC support system for the antennae instead of a metal support system. Another way to reduce noise in the data is to use fiber optic cable, instead of copper cable. The cable is required to send the transmit signal, send the receive signal, and to retrieve the data. Fiber optic cable greatly reduces noise, but is expensive and fragile. Figure 1 shows some of the basic components of a Pulse EKKO 100.

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 GPR to battery and 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.
- 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.

Application: NASA and the ESA 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 Stillwater could assist NASA in evaluating the location of water / ice in the Mars subsurface. Figure 4 shows an example of how GPR data can be used to find a water table on Earth.

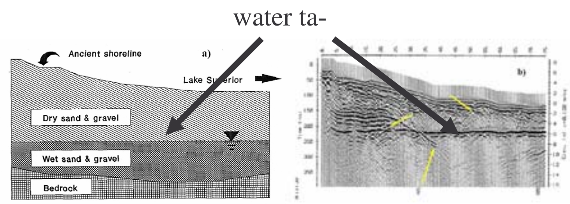

Fig. 4

Conclusions: Figure 5 shows GPR data of Permian sandstone. This data can be used to determine the position of the sandstone contact with the underlying shale. Figure 5 and 6 are pictures of the McElroy site in Stillwater. Shale has slight conductivity, therefore the GPR data starts to distort. This can be seen below the blue line in figure 5. The blue line in figure 6 is distorted because of erosion. Features that are similar in figures 5 and 6 are displayed by the green and yellow lines. The green line shows where a channel has carved through a sandstone layer.

3D data: Figure 7 shows three-dimensional GPR data. This type of data can be aquired by surveying several lines at a certain spacing. After the lines are aquired, 3D GPR data processing software is used to render the 3D object. Valuable data about channels can be seen with 3D GPR data.

References: [1] Ground Penetrating Radar; Stephen Griffin, Timothy Pippett (http://leme.anu.edu.au/Pubs/OFR144/09GroundRadar.pdf) [2] Sensors and Software Inc. (http://www.sensoft.ca)

Acknowledgments: The guidance of Dr. Surender Sahai, Dr. Stanley Paxton, and Steve Hadaway is appreciated. The National Science Foundation grant and the Oklahoma-Arkansas Center for Space and Planetary Science program made this research possible.

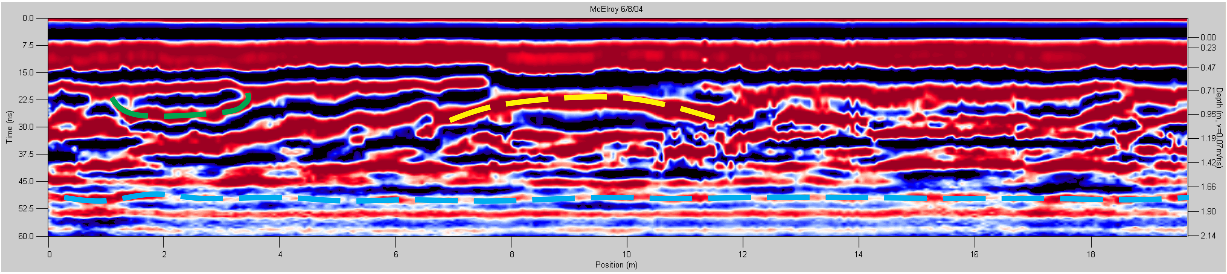

Fig. 5

Fig. 6

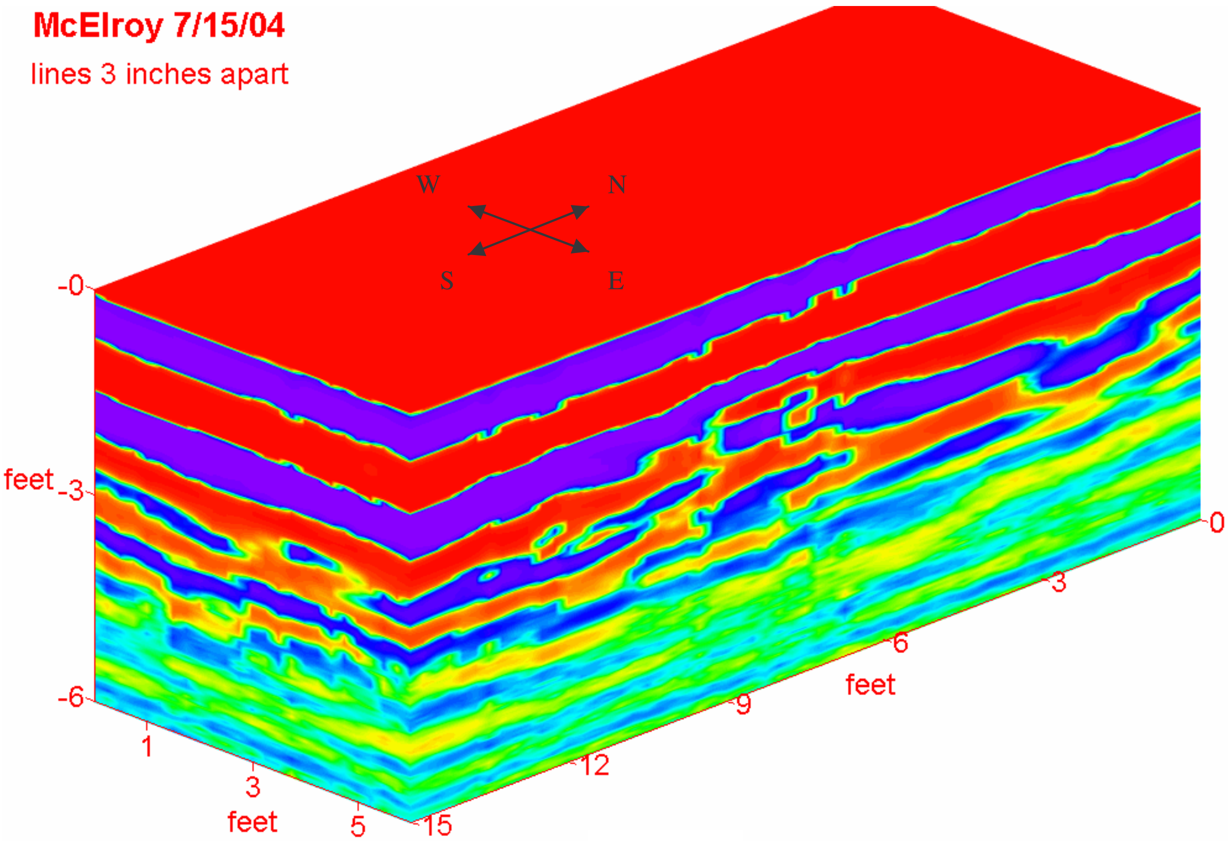

Fig. 7