

# RADAR AND SONAR PROBING OF ROCKSALT

Dr. Robert R. Unterberger &  
Mr. Luis Lopez-Aguilar  
Department of Geophysics  
Texas A&M University  
College Station, Texas 77843

## ABSTRACT

In past SMRI-supported researches in salt mines, we have discovered how to "see" through rocksalt with both radar and sonar, but have always used radars of a single carrier frequency. In this paper we have used the recently developed carrier-less radar, called a ground probing radar or GPR. This radar emits a broad band of frequencies via a wide-bandwidth antenna to accomplish the task of irradiating the rock below with a number of frequencies. In this paper we show the use of GPR radar to detect what is beneath a salt floor, and show the use of spot checks with sonar to verify the radar data.

The radar scans were done in the area of new (upper level) mine workings where the old (lower level) mine workings overlapped. 23 radar scans, probing downward, were made in the Grand Saline mine of the Morton Salt Co. The GPR radar used was an Oyo-Geospace Corp. Georadar I, Model 2441, kindly loaned to us by Oyo. Each single trace on the printed record consists of a number (up to 256) of subsurface interrogations, added up to increase the signal-to-noise ratio in the resulting single printed scan. A radar scan was taken about every foot for total radar record lengths of up to 440 feet. The range of depths that the radar can penetrate depends on the electrical properties of the salt, but in the Morton mine (which has excellent dry salt and a correspondingly low loss tangent), we usually used the maximum permitted by the GPR of 1000 nanoseconds in time or a range of 200 feet in salt. Thus each GPR record yields what looks like a vertical section through the salt along the axis of the radar line itself. In this respect it is analagous to the stacked seismic record produced in oil exploration.

The GPR records revealed subsurface tunnels that were not found on the presently-used mine maps, but were later shown to be true by comparison with older mine maps. Excellent GPR records show the old mine working locations, as well as some air targets and an artifact put in by the radar itself, but always at 425 ns (or 86 feet) in salt. We believe that the GPR radar has great potential for use not only in salt and potash mines, but also for "looking" through other kinds of rocks such as granite, marble, and sandstone.