75-0001-SMRI

Texas A&M University
Department of Geophysics

ELECTROMAGNETIC WAVE PROBING FOR SALT DISCONTINUITIES

Twelfth Biannual Report
May, 1975

Prepared for the
Solution Mining Research Institute
by

Dr. Robert R. Unterberger
Professor of Geophysics
Department of Geophysics
Texas A&M University

Research Conducted Through the
Texas A&M University Research Foundation, Project 682A
College Station, Texas 77843

CHAPTER I

TWO PAGE SUMMARY

A. Research at Cayuga Lake Salt Mine - Chapter II

This salt mine is in bedded salt about 2350 ft below the surface. We found good radar transmission in this bedded salt and obtained a single radar velocity to be used in interpreting radar probing data. Mine management wished us to probe ahead of mining (to the east) and to also probe to the north and to the south. We did this mostly with both radars. We found the salt clean to the north for 600 ft; here most stations were occupied only with Charlie II radar. To the south we found a few reflections with both low and high power radar. To the east we found a few reflections with both low and high power radar. All the possible hazards, i.e. reflections, detected are plotted in Figure 9A, on page 22.

B. Theory of Radar Detection of Boreholes in Salt - Chapter III

As a beginning graduate student, I asked Mr. Paul Tarantolo to look into the theory of detecting boreholes in salt by radar probing. The only salt mine in Great Britain was almost lost because of undercutting such a borehole. The results are given in Chapter III plus Appendices B and C for those wishing more detail. Our conclusions are:

1. Use vertical antennas to find possible boreholes in salt because the backscattering cross section is larger.
2. The borehole detection distance depends strongly on the tan δ of the salt.

3. The borehole radius has only a small effect on its detectability.
4. Theory says that a 10 inch borehole in salt can be detected 2329 ft away using the full power of Bravo II, if the salt has a tan δ of 10^{-3}. Charlie II with its lower power needs to be at least within 738 ft to detect the same borehole.

C. Other Research - Chapters IV and V

Sonar probing research is continuing. We are working on problems of coupling the sound energy into the salt, see Chapter IV. A new radar probing system is being constructed which will be short range (up to 150 ft), high resolution, see Chapter V. Three technical services of a radar probing nature have been accomplished during this time period, but are not reported herein. We are set to go to the Detroit mine of International next week. This summer we expect to visit the Fairport mine also.

D. Budget

This is the final report under this research contract which ends 31 August 1975. We have developed a unique set of radar tools to probe salt for information ahead of mining, above the mining level (top of salt configuration) or out to the side (dome flank location). The past requests for our radar probing services have proved the value of this research. More work needs to be done of course, to refine our techniques and to gain interpretation experience that comes only with field use of these tools. We trust that our past salt company sponsors will continue to support our research at the lower level of funding indicated in Mr. Lloyd Webre's letter dated April 10, 1975 to the salt company sponsor representatives.