A NEW METHOD OF "SEEING" INTO SALT

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ABSTRACT

Many members of the SMRI have supported our radar and sonar research for six years in our efforts to "see" into rock salt. We have been successful in obtaining reflections from inhomogeneities in salt, such as fractures filled with water, dry fractures, sylvite and/or anhydrite stringers, and the edges and/or tops of salt domes. Ranges of up to 2000 meters (over 6000 feet) have been obtained, depending on (1) the type of salt, (2) the nature of the inhomogeneity, and (3) the salt probing system used. In salt with > 0.1% moisture content, radar is attenuated rapidly because of the dipole moment of the water molecules. We recognized this years ago and shifted to sonar probing. However, there is a problem. Whereas radar beams are narrowed on entering salt from air, sonar beams are broadened when entering from a low-velocity coupling fluid. Thus although we can "see" into wet salt quite well with sonar, the beam is so broad that we do not have a good idea where the target is located. Normally the solution to this problem is to use a bigger transducer. There is however a way around this. Use a nonlinear sonar system. This is what this paper is all about.

First we worked on the theory of whether salt could be driven nonlinearly. This was shown theoretically and experimentally by Unterberger, Muir, and Wang in a paper given at the Society of Exploration Geophysicists meeting in Houston in 1984. Next, we built a 24 kHz nonlinear sonar system and showed good results in salt in Morton's mine in Texas. Now, we are building a 6 kHz nonlinear sonar system to obtain longer ranges of probing, (due to the lower frequency), and yet still have a narrow beam. A description of this system and some results of nonlinear probing of salt will be given. We expect this system to not only probe salt, but also other rocks as well, such as potash, limestone, sandstone, etc. provided they can be driven nonlinearly.