SOLUTION MINING RESEARCH INSTITUTE

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MEETING PAPER

DESIGN AND STABILITY MONITORING OF SALT CAVERNS*

by

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INTRODUCTION

For some 50 or more years rock mechanics engineers and scientists have been investigating the mechanical behavior of a wide range of geologic materials, such as hard rocks and coal, utilizing a variety of laboratory, analytical and field techniques. In recent years such investigations have expanded into the area of soft rocks (Akai, 1981), and during the last 10 years detailed studies have been underway in regard to the behavior of a specific class of soft rock, generally referred to as salt. Due to the complex properties of salt, and the unique procedures required for the design and construction of structures in this material, a specialized area of rock mechanics, known as "Salt Mechanics," has developed (Hardy, 1982A).

Limited basic and applied research in the area of salt mechanics has been underway for a number of years, mainly in relation to the design and operation of salt and potash mines. In recent years, however, salt, both bedded and domal, has been found to provide an excellent medium for the construction of underground facilities for the storage of a wide range of materials, including, crude oil and various refined petroleum products, natural gas, compressed air (energy storage), and radioactive and chemical wastes. As a result extensive research and industrial development in the general area of salt cavern storage is presently underway in the U.S.A. and elsewhere. At present such activities represent a major area of interest to those involved in salt mechanics research.

Worldwide interest in the field of salt mechanics was clearly illustrated by the overwhelming success of the First Conference on the Mechanical Behavior of Salt held at Penn State in early November of 1981 (Hardy and Langer, 1982). This three day conference was attended by some 45 scientists and engineers including participants from Canada, France, West Germany, The Netherlands, The United Kingdom, and the U.S.A.

Due to the accelerated interest in the use of salt as a medium for underground storage, a wide range of research and engineering studies have been underway to optimize the design and mining techniques needed for the construction of salt caverns, and to develop suitable means for stability monitoring of such structures. During the last seven years, salt mechanics research relative to the design and performance of caverns for the storage of natural gas has been underway in the Geomechanics Section at The Pennsylvania State University. The present paper will include an outline of a number of the analytical and laboratory studies associated with this research, and a brief discussion of the application of microseismic techniques to the evaluation of salt cavern stability. It should be emphasized that, although the present paper deals specifically with the storage of natural gas, the majority of the material presented may be equally well applied to salt caverns used for the storage of pressurized fluids in general.