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Meeting Paper

A Tentative Classification of Salts According to their Creep Properties

by

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Spring 1998 Meeting
New Orleans, Louisiana, USA
April 19-22, 1998

INTRODUCTION

Many laboratory works have been devoted to the rheology of rock-salt. The matter exhibits a fascinating complexity. Together with actual stresses, stress history, temperature and humidity play a significant role. A wide literature is available (for instance, see Hardy and Langer, 1984, 1988; Ghoreychi, Bérest, Hardy and Langer, 1996; Aubertin and Hardy, 1997). Despite this complexity, many authors agree on several main features of rock-salt constitutive behavior:

- First, salt behaves like a fluid in the sense that it flows even under small deviatoric stress. Salt is a non-newtonian fluid and its strain rate is proportional to a rather high power of applied deviatoric stress (which means that the creep rate of a cavern is a highly non-linear function of its internal pressure or, more precisely, of the gap between the lithostatic pressure at cavern depth and its internal pressure).
- The strain rate is also strongly influenced by temperature; enlarging by one or two orders of magnitude when the temperature increases by 100°C, (i.e. 180°F).

This means that cavern depth will influence cavern convergence both through the influence of overburden pressure and through rock mass temperature.

On the other hand, few well-documented field data are available. Some deep natural gas storages have experienced large volume losses; well known cases include the Eminence Salt Dome gas storage in Louisiana (Baar, 1977), the Kiel gas cavern in Germany (Kuhne *et al.*, 1973), and the Tersanne Te02 cavern in France (Boucly, 1982) (see Figure 1). Several shut-in tests or brine flow measurements have been performed in different sites. The results are, in general, heavily influenced by brine thermal expansion (Bérest *et al.*, 1998), where the real effect of creep is hidden by the leading part played by brine temperature variations. We have measured brine outflow in a small 930 meter deep cavern in the Etrez site, several years after the end of leaching, when brine thermal expansion becomes negligible (Brouard, 1998).