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Healing of Rock Salt Fractures

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ABSTRACT

Healing effectiveness of fractures in rock salt has been assessed experimentally in terms of stress states, fracture types, and time. Tension-induced fractures and fractures formed by saw-cut surfaces and by polished surfaces have been tested. Series of gas flow testing measure the changes of the fracture permeability under pressurization. All tests are conducted at room temperature. Brazilian tensile strengths and point load strengths are used as an indicator of the healing effectiveness. The results suggest that the primary factors governing the healing of salt fractures are the origin and purity of the fractures, and the magnitudes and duration of the fracture pressurization. The hydraulic conductivity for all salt fractures decreases with increasing pressure and time. The reduction of fracture permeability due to the closure does not necessarily mean that the healing has occurred. The fracture closure can enhance the fracture healing. Both processes are time-dependent. The closure involves the visco-plastic deformation of the salt on both sides of the fracture. Under preferable conditions and environment, a complete healing of rock salt fractures is possible.

1. INTRODUCTION

It is defined here that healing is the closure of fractures without any precipitation of materials inside. It is a chemical and physical process in which the material properties evolve with time or in which the defects (voids and cracks) decrease. Healing of rock fractures may occur on various scales. In geology, fracture healing is an important mechanism controlling the circulation of fluid in the earth crust. This process can change the fluid circulation and interactions between the lower crust and the surface. In a smaller scale, circulation of solution or fluid in rock mass can result in a precipitation or deposition of minerals and ores in fracture zones. The factors that may affect the rate of crack healing are time, stress, temperature, saturation, geometry of contact surfaces, and chemical alterations (Renard, 1999).

Healing of fractures in rock salt formations can prevent brine flow from contaminating the upper surface or nearby rock formations. Damage in rock salt can be healed under hydrostatic and non-hydrostatic compression. When cracks are closed, permeability can be reduced by several orders of magnitude. The healing capability of fractures is one of the advantages for rock salt to