

THREE-DIMENSIONAL DISCRETE FRACTURE MODELS, NEVADA AND UTAH

LAWRENCE O. ANNA¹

1. US Geological Survey, PO Box 25046, MS 421, Lakewood, CO 80225

Three-dimensional discrete fracture modeling is an important method used to evaluate water and gas flow through two geologically different areas - fractured tuffs of Miocene age at Yucca Mountain, Nevada, and fractured coal beds of the Upper Cretaceous Ferron Sandstone, central Utah. In two Yucca Mountain studies flow models are important for site characterization and performance assessment. In the Utah study flow models are important for predicting local effects of water production in association with methane production from coal. Because most of the water and gas flow is thought to be in fractures, conventional equivalent continuum models may not adequately represent the flow system. Discrete fracture models offer an alternative to equivalent continuum models. Discrete fracture networks can be constructed and used to determine fracture connectivity, quantification of rock anisotropy and continuum properties for one and two-phase flow and determination of spatial relation.

Methods used to analyze fractured tuffs at Yucca Mountain included: (1) identification of the number and probability of fracture connections and pathways; (2) calculation of rock block size to define a volume distribution of matrix blocks bounded by fractures; (3) calculation of bulk permeability in the direction of hydraulic gradient; (4) calculation of bulk permeability in a variably saturated network; and (5) evaluation of equivalent continuum properties of the network. The Ferron Sandstone study is in progress, and the proposed methods of analysis are similar to methods used in Yucca Mountain studies. In addition to evaluating pathways and flow characteristics of the fracture network in the coal, the overlying and underlying siltstone and sandstone are included to help evaluate effects of current and future water production. After the hydraulic parameters and characteristics are determined, the coal beds will be included as part of a regional modeling study to calculate local and regional effects of water production.