



## **Effect of fracture network characteristics on the simulation of variable-density flow: Which degree of network complexity do we need?**

Eugenia Hirthe and Thomas Graf

Leibniz Universität Hannover, Institute of Fluid Mechanics in Civil Engineering, Hannover, Germany  
(graf@hydromech.uni-hannover.de)

Open fractures can have a significant impact on fluid flow and variable-density salt transport in a variety of hydrogeological systems. Hydraulic conductivity of fractures is several orders of magnitude larger than that of the unfractured rock matrix. Fractures are therefore preferential pathways for the transport of salt and potentially contaminants. Fracture networks are characterized by fracture aperture, spacing, orientation, and connectivity. Real fracture networks are very complex because a large number of differently sized and oriented fractures exist. Also, the fracture density can vary locally, such that the connectivity of the fracture network remains an important measure in the characterization of a fracture network and in the prediction of the fate of a dense plume. In the present study, we investigate the necessary complexity of fractured rock in variable-density flow and transport problems. We are using the discrete fracture model HydroGeoSphere. Discrete fracture models are attractive for modeling because fracture network characteristics (e.g. fracture size, orientation, aperture) reflect the physical properties of the rock, and make it possible to investigate the impact of fracture network characteristics on plume transport. Using a two-dimensional simulation domain of a fractured rock, we are asking the question whether we need to incorporate all fracture network characteristics of a potentially real fracture network, or whether a fracture network can be simplified. The degree of possible simplification is assessed for a variety of hydrogeological problems (flow only, conservative salt transport, variable-density flow/transport). An insight into possible connectivity effects for three-dimensional problems is also given.