

QUANTIFYING MACROPORE GEOMETRY AND DISTRIBUTION USING IMAGE ANALYSIS AND GEOGRAPHICAL INFORMATION SYSTEMS

Alex Manda

Florida International University, Department of Earth Sciences
Miami, Florida, USA
Amand001@fiu.edu

Image analysis and Geographical Information System techniques were used to quantify the geometry and spatial distribution of macropores in a limestone sequence. Hydrologic properties derived from core provide an incomplete picture of aquifer dynamics, and may not characterize the most significant flow pathways in an aquifer. High-resolution televiewers, on the other hand, capture a continuous image of dissolution features intersected by the wellbore. A 55-foot wellbore section was remapped according to a porosity versus matrix classification. Two populations of dissolution features were observed: irregular-shaped macropores and horizontal channels that are continuous across the wellbore. The horizontal channels are at various stages of development, ranging from incipient (small aperture with limestone bridges) to mature (complete separation with apertures up to 50 cm). Geometric attributes of the macropores were obtained in the Geographical Information System environment, including macropore area, perimeter, centroid location and dimensions of the best-fit ellipse. The spatial distribution of macropore density and area is not random. Rather, stratigraphic intervals of enhanced macropore development alternate with intervals of lesser development. The ArcView Spatial Analyst Extension was used to generate profile histograms of 2-D porosity, defined as the percentage of surface area occupied by solution cavities within a rectangular window. Results identify horizontal solution channels as regions exceeding ~80% porosity. Stratigraphic horizons with 50-80% porosity are regions of enhanced macropore development. Upon further dissolution, these regions may develop into continuous horizontal channels. Thus, image analyses combined with Geographical Information Systems provide a unique perspective on characterizing major flow pathways in aquifers.