

The Relationship between Sulfide and Carbonate Mineralization and Cavernous Porosity Development in the Ordovician Galena Group Limestone (Trenton), Kane County, NE Illinois, USA

Jared T. Freiburg^{1,2}, Bruce W. Fouke², and Zakaria Lasemi¹

¹University of Illinois at Urbana-Champaign, Institute for Natural Resource Sustainability, Illinois State Geological Survey, Champaign, IL 61820, freiburg@isgs.illinois.edu, lasemi@isgs.illinois.edu

²University of Illinois at Urbana-Champaign, Department of Geology, Urbana, IL 61801, fouke@illinois.edu

Tens-of-centimeter scale calcite crystals concentrically zoned with sulfide minerals and growing within meter-scale solution cavities along NW-trending fractures were recently discovered on the SW flank of the Michigan Basin in Kane County, NE Illinois in the Ordovician Galena Group limestone (Trenton). These mineral deposits are a reflection of the temporal changes in chemical composition and the source of paleo-fluids migrating through the midcontinent. On the basis of plane-light and cathodoluminescent petrography and scanning electron microscopy, a series of diagenetic events are identified within the cavities that consist of dissolution followed by dolomite, marcasite, pyrite, and calcite precipitation, and later hydrocarbon migration. The paragenetic sequence, in conjunction with changes in isotopic ($^{87}\text{Sr}/^{86}\text{Sr}$) concentrations in calcite growth zones, reflects changes in the fluid chemistry and the source of the subsurface diagenetic waters. This paragenetic sequence best reflects the paragenesis at the world famous Upper Mississippi Valley Zn-Pb mining District in NW Illinois, suggesting that migrating warm fluids were widespread throughout northern Illinois, resulting in the formation of massive solution cavities, dolomitization, and the subsequent deposition of Mississippi Valley-type minerals. However, the geographic location and fracture focused dissolution followed by dolomitization reflect similar processes forming the productive Albion Scipio hydrocarbon reservoirs in the Michigan Basin. This suggests that similar reservoirs may also occur in the Galena Group in the Illinois Basin oil fields. This study presents a means for predicting regional subsurface paleo-fluid flow and thus provides a more accurate model for economic mineral and hydrocarbon exploration.