A Genetic Link between Hydrothermal Dolomite and MVT Mineralization in Eastern Wisconsin

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Paleozoic dolostones along the western margin of the Michigan basin preserve abundant evidence of a Late Devonian to Mississippian hydrothermal system that was distinct from the Upper Mississippi Valley ore district. Field, petrographic, and geochemical evidence suggests a genetic link between pervasive dolomite, MVT mineralization, and Ksilicate mineralization in eastern Wisconsin Paleozoic rocks. Constraints were placed on the conditions of water-rock interaction using fluidinclusion methods, cathodoluminescence and plane-light petrography, isotopic analyses, and organic maturity data. Water-rock interaction occurred in the presence of dense Na-Ca-Mg-Cl-H_2O brines (13 to 28 weight%, NaCl equivalent) at temperatures between 65°C and 120°C. These hydrothermal dolomites are unusual because they display planar instead of saddle shaped crystal morphology. Radial fluid flow out of deeper portions of the basin along Cambrian and Ordovician sandstone aquifers is inferred from this and other studies. In addition, a significant component of vertical advection from the Precambrian basement is required to satisfy lead-isotopic data from galena throughout the region stretching from eastern Wisconsin to the Upper Mississippi Valley ore district. Stratigraphic reconstructions and vitrinite reflectance on Devonian materials (R_o = 0.5 – 0.62%) indicate low thermal maturity for these sediments and are consistent with short-term heating rather than long-term sustained burial. Limited mechanisms can accomplish radial fluid flow rates high enough to preserve elevated temperatures while under low burial conditions. A proposed mechanism includes a combination of gas-displacement and pressure-solution compaction in deeper parts of the basin, aided by vertical advection out of the Precambrian basement beneath the study area.