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Hydrothermally Emplaced, Lower Mississippian, Tripolitic Chert and Its Possible Relationship to the Tri-State Lead-Zinc Mining District

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Running title: Tripolitic Chert and its Possible Relationship to the Tri-State Lead-Zinc Mining District

Abstract

Across the southern Ozark Region, northern Arkansas, southwestern Missouri, and northeastern Oklahoma, exposures of the Lower Mississippian Boone Formation and its equivalents exhibit well-developed tripolitic chert that has been mined, more or less continuously, for at least 80 years. The tripolitic chert is a replacement of an interval within the basal portion of the upper Boone Formation in Arkansas and Oklahoma, and equivalent to the Elsey Formation in Missouri. The movement of silica-rich, hydrothermal fluids appears to have been much like that of a confined aquifer. It followed the basal upper Boone Formation (Arkansas) = Elsey Formation (Missouri) and was bound below by an impermeable interval at the top of the lower Boone Formation (Arkansas) = Reeds Spring Formation (Missouri), and above by the base of the upper Boone Formation (Arkansas) = Burlington-Keokuk (Missouri). The first hydrothermal event incompletely silicified the basal upper Boone = Elsey Formation. After leaching of the remnant carbonate, thus forming the tripolitic chert, a second hydrothermal event deposited terminated and doubly terminated quartz crystals, and druse in the tripolitic chert voids. This hydrothermal event may have produced the Mississippi Valley-Type (MVT) lead-zinc deposits in northeast Oklahoma and southwestern Missouri. The famous deposits at Picher, Oklahoma, and Joplin, Missouri, appear to be positioned in the apparent path of the hydrothermal fluid migration. While timing of these hydrothermal events is unclear, they may reflect lateral secretion produced by the Ouachita Orogeny in the Late Pennsylvanian.

Pulses of Hydrothermally Emplaced Silica: Terminated and Doubly-Terminated Quartz Crystals Filling Tripolitic Chert Secondary Porosity

Tripolitic chert and euhedral quartz druse found within the tripolitic chert indicate at least two pulses of hydrothermal activity in the southern Ozark region. The initial hydrothermal fluids replaced the fine-grained calcisiltites of the basal upper Boone Formation (Arkansas) = Elsey Formation (Missouri) producing a very fine-grained, white chert interval with remnant, pseudo-nodular masses of unaltered calcisiltites (Figure 1).

Figure 1. Basal upper Boone outcrop of tripolitic chert with pseudo-nodular, but unaltered, calcisiltite bodies (gray) surrounded by tripolitic chert (white); Pineville, Missouri, roadcut; hammer for scale.

This interval between the top of the lower Boone Formation (Arkansas) = Reeds Spring Formation (Missouri) and the base of the upper Boone Formation (Arkansas) = Burlington-Keokuk (Missouri) was then exposed to groundwater invasion that dissolved most of the carbonate remaining in the very fine-grained, white chert. The resulting porous, siliceous lithology was designated tripolitic chert (Tarr 1938) (Figure 2).

Further examination of the porosity of the tripolitic

chert using scanning electron microscopy (SEM) has revealed terminated and some doubly terminated quartz crystals as well as druse filling some of these cavities (Figures 3, 4). Presence of the quartz druse suggests a second pulse of hydrothermal fluids passing through the basal upper Boone (Arkansas) = Elsey Formation (Missouri).

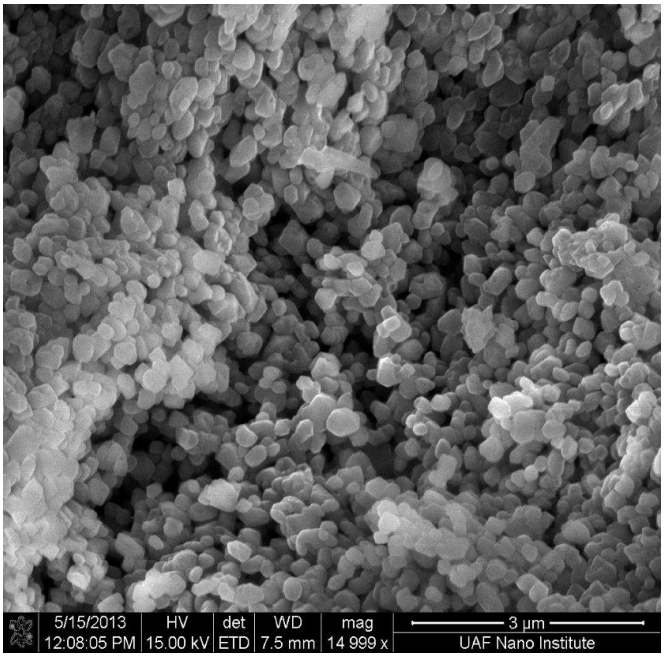

Figure 2. SEM image of tripolitic chert from the Pineville roadcut in Figure 1. Note porosity and very high magnification (image from Minor, 2013).

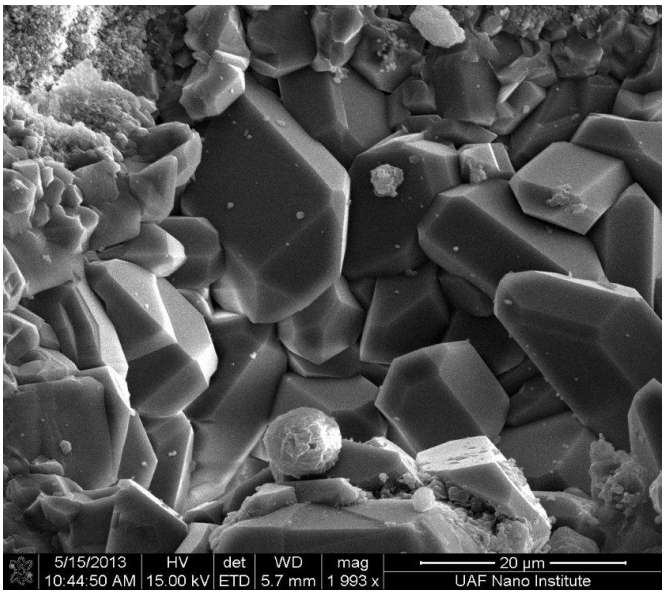

Figure 3. SEM image of terminated quartz crystals in a cavity within the tripolitic chert from the Pineville roadcut in Figure 1 (image from Minor, 2013).

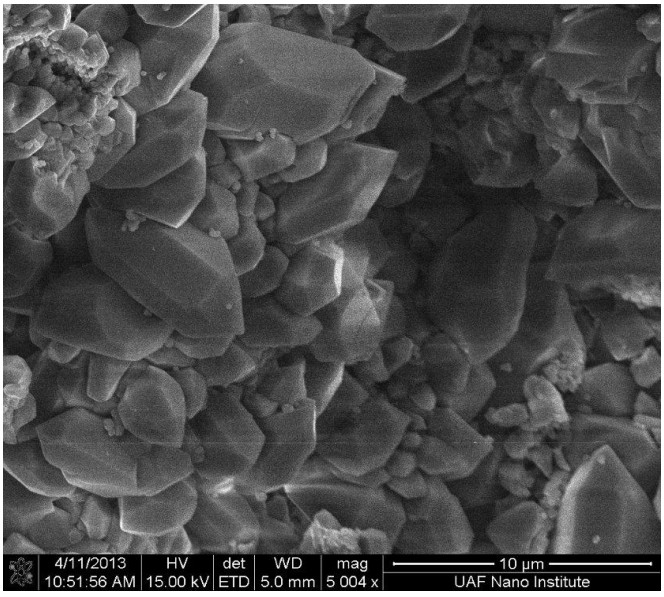

Figure 4. SEM image of quartz crystals, some with double terminations, in a cavity within the tripolitic chert from the Pineville roadcut in Figure 1 (image from Minor, 2013).

Source of the Silica-bearing Hydrothermal Fluids

Quartz crystals are the state mineral of Arkansas, although surprisingly both their age and emplacement are poorly understood. H. D. Miser, a native Arkansan whose entire geological career was with the U.S. Geological Survey, had a life-long interest in quartz crystals and examined their origin and occurrence in detail, publishing several papers on the subject (e.g. Miser 1959). The greatest concentration of quartz crystals is in the Ouachita Mountains, where Miser was able to define the northern and southern limits of the "quartz belt" (Figure 5). Strata representing the upper Cambrian through middle Pennsylvanian are all cross-cut by quartz veins. Unfortunately, the mineral quartz cannot be dated by standard isotopic methods. There are intrusions, all Lower Cretaceous, within the Ouachita Mountains, as well as on the adjacent coastal plain. Interestingly, these intrusions are either felsic (Granite Mountain and the Bauxite region) or ultra-mafic (Magnetic Cove, Potash-Sulfur Springs, Murfreesboro), and none contain quartz crystals (Miser 1959).

The silica-bearing, hydrothermal fluids that have left a record in the upper Boone and Elsey Formations of Arkansas and Missouri may possibly be related to the mineralization of the Mississippi Valley-Type (MVT) ore deposits found within the Tri-State Lead-Zinc Mining District of northern Arkansas, southwestern Missouri, and northeastern Oklahoma.

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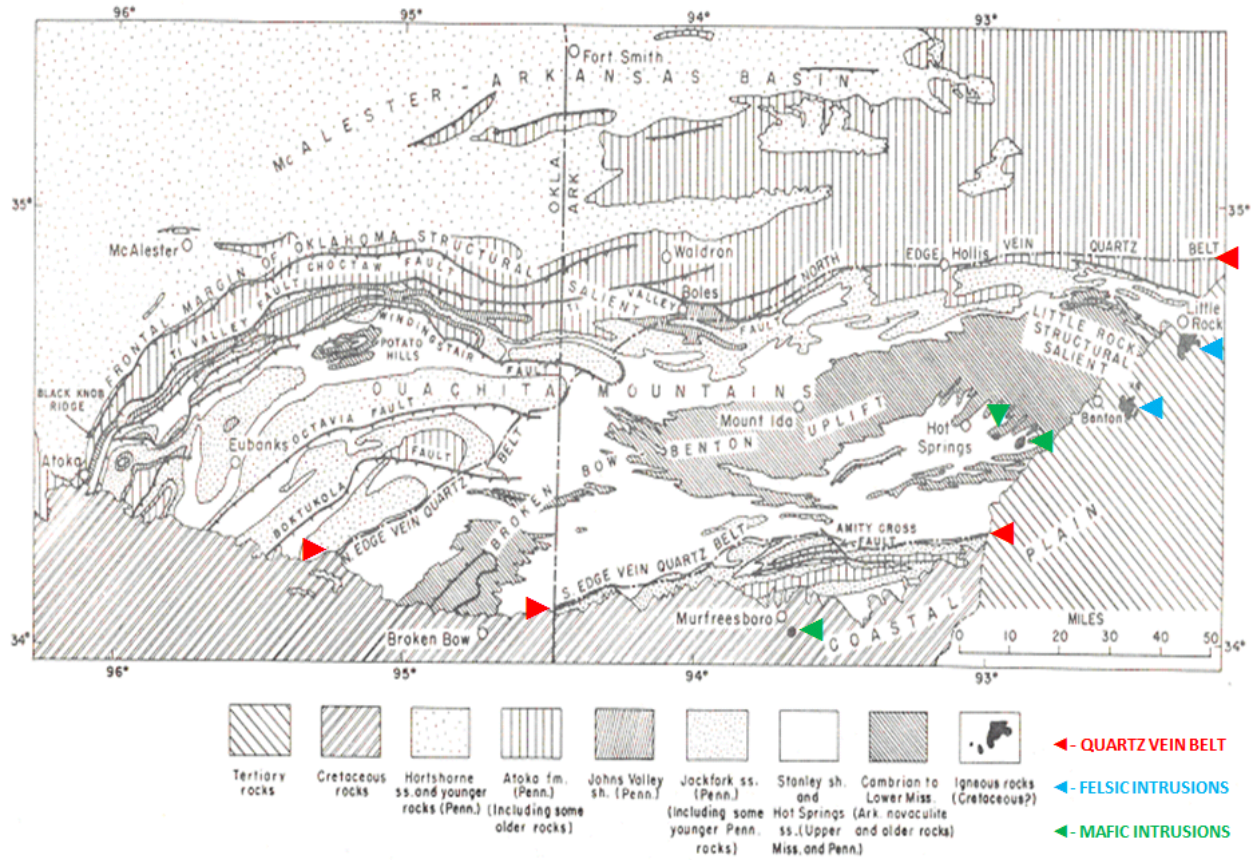

Figure 5. Map of the Ouachita Mountains showing the limits of the "quartz belt" and the felsic and ultramafic intrusions (Miser 1959).

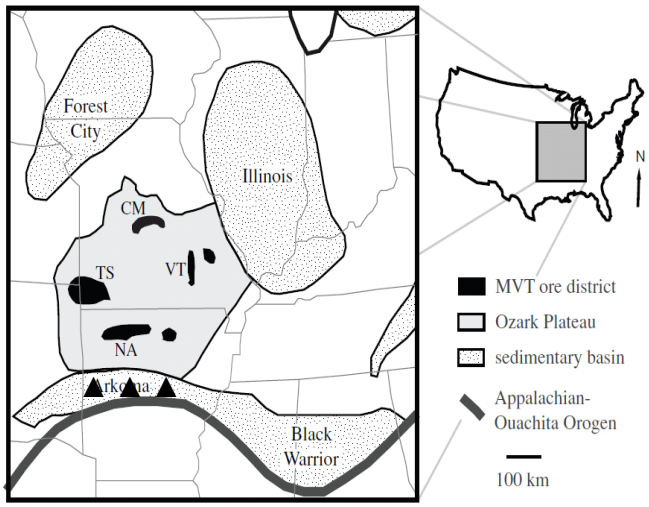

Figure 6 – Relationship and proximity of the MVT ore district to the Ouachita Mountains (arrows denote presumed delivery direction of silica-bearing fluids) (Wenz *et al*. 2012).

As can be seen readily in Figure 6, the alignment of the MVT ore deposits is directly north of the Ouachita flexure, and could have been emplaced by lateral secretion generated by the Ouachita Orogeny in the Late Pennsylvanian.

Conclusions

The tripolitic chert is a replacement of an interval within the base of the upper Boone Formation in Arkansas and Oklahoma, and equivalent to the Elsey Formation in Missouri. The movement of silica-rich, hydrothermal fluids acted like a confined aquifer system bound by impermeable intervals at top of the Lower Boone = Reeds Spring Formation, and the base of the Upper Boone = Burlington-Keokuk Formation. The first hydrothermal event silicified the basal upper Boone = Elsey Formation, while the second hydrothermal event produced terminated and doubly terminated quartz crystals and druse in the voids left in the tripolitic chert. This hydrothermal event may have produced the MVT lead-zinc deposits in northeastern Oklahoma and southwestern Missouri. Although the timing of the series of hydrothermal events is unknown, they may reflect lateral secretion produced by the Ouachita Orogeny in the Late Pennsylvanian.

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Literature Cited

Minor PM. 2013, Analysis of tripolitic chert in the Boone Formation (lower Mississippian, Osagean), Northwest Arkansas and Southwestern Missouri [MS thesis]. University of Arkansas. 80 p.

Miser HD. 1959. Structure and vein quartz of the Ouachita Mountains of Oklahoma and Arkansas. *In* Cline LM, WJ Hilseweck, and DE Feray, (editors.). The Geology of the Ouachita Mountains – A Symposium: Dallas Geological Society and Ardmore Geological Society. p 30-43.

Tarr WA. 1938. Terminology of the chemical siliceous sediments. National Research Council, Division of Geology and Geography, Committee on Sedimentation. Annual Report for 1937-1938, Appendix A, Exhibit A., p 8-27.

Wenz ZJ, MS Appold, KL Shelton, and **S Tesfaye.** 2012. Geochemistry of Mississippi Valley-Type mineralizing fluids of the Ozark Plateau; A Regional Synthesis. American Journal of Science. 70(1):22-80.

https://scholarworks.uark.edu/jaas/vol71/iss1/29

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