THE NEW GALENA LEAD-ZINC MINES, BUCKS COUNTY, PA

Lake Galena Lunch Stop for the 83rd Field Conference of Pennsylvania Geologists October 5 and 6, 2018

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Abstract

 A small, but very high grade lead and zinc district was located about 2 km NE of our bucolic lunch stop for both days. The mines are presently at a depth of 7 fathoms below the surface of Lake Galena, a public water supply reservoir. The veins consisted of nearly pure galena and sphalerite hosted by the Lockatong Formation. The margins of the veins were mostly dolomite. Based on fluid inclusions, the main stage sphalerite formed at 140 ± 5 OC, a lower temperature than that at two other at Mesozoic Pb-Zn-Cu vein deposits located closer to the present, southern margin of the Newark Basin.

Introduction

 The various shafts and exploration and development efforts in three of the quadrants created by the former intersection of Old Limekiln Road and the North Branch of Neshaminy Creek were mapped by the author and his wife in May 1972 using a tape and compass. This map appears herein as Figure 1, but was originally Figure 84 of Smith (1978, p. 240). This mapping was undertaken as bulldozing for the water supply reservoir to become known as Lake Galena was in progress.

Location

 The New Galena mining shafts were centered on the above noted road and creek intersection which was located in New Britain Township in the Doylestown 7 ½’ Quadrangle topographic map and 5.4 km NW of Doylestown, Bucks County, Pa. Coordinates estimated from that topographic map and the current Figure 1 are summarized in Table 1.

Table 1. Location coordinates for the major features in the New Galena Pb-Zn district from Smith (1978, p. 238).

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| Feature Located | Latitude North | Longitude West | Comments |
| NE quadrant Shaft Cluster | 40 19 48 | 75 11 01 | Three shafts and a possible fourth plus three small pits. Missed in reports done in 1923, 1924, and 1950.  |
| SE quadrant gauphin | 40 19 44 | 75 11 08 | Engine shaft and an unobserved shaft to the Dickinson vein plus a large gauphin (longitudinal opening). |
| SW quadrant shafts | 40 19 39 | 75 11 12 | Two shafts, one with an adjacent pit. |
| N Branch Neshaminy Creek-Old Limekiln Rd. intersection | 40 19 47 | 75 11 12 | Pre-G.P.S. Coordinates for the bridge center in the midst of the mined area about 2 km NE of our lunch pavilion. Note that the bridge and mines are now under Lake Galena.  |

Mining

 Smith (1978, p. 242- 245) had access to unpublished mine reports and attempted to summarize them as best he could. The engine shaft had a cross section of 8x12’ and was reported to be 167’ deep. From 40 to 70’ below the surface, the vein consisted of 2’ of galena aside 10” of sphalerite. It was sunk from the gauphin (longitudinal opening) which, in 1972, was 121 x 79’ across at the surface and was reported to have been 20 to 44’ deep. The Dickinson was the only other shaft known to have been named. It was reported to be 5x8’ in cross section and 38’ deep. It followed a galena vein reported to be 3 to 18” wide. There were approximately 8 other shafts in the district. Most of them are guessed to have been only a few tens of feet deep based on the small dump piles. Some were reported to have encountered veins having a galena width of up to 4’. Sphalerite was not an economic mineral during much of the mining and the widths of sphalerite in the veins are poorly documented. Sphalerite was more abundant than galena on the mine dumps and chunks weighing a few kg and consisting of >90% sphalerite were common on the dumps, especially in the NE quadrant. Smith (1978) estimated a production of 200,000 cubic feet of ore which in 1976 would have had a value of $14 M of zinc and $70 M of lead. The galena probably averaged 9 ± 2 oz. of Ag/ton. Most of the mining probably occurred from circa 1860 to 1930. Unmined galena and especially sphalerite in the immediate district could have likely supported a small mine in the mid-20th century.

Minerals

 The primary ore minerals were galena and sphalerite and the interior of most veins was solid galena plus sphalerite. Mine promoters tended to report that the ratio of galena to sphalerite increased with depth and economic geologists tended to report the opposite. The major gangue minerals were dolomite (some ferroan) and quartz, which tended to occur only on the vein margins making hand-cobbing of the ore to remarkable high grades possible. Lead shipments ran 75 to 76 % Pb vs. 86.6 % Pb for theoretical pure galena. Minor pyrite occurred in the SE and SW quadrants. Smith (1978, p. 239) reported the minor to trace supergene minerals and a rather complex paragenesis with fine-grained galena and dark sphalerite preceding ore tectonic deformation and lighter colored sphalerite and coarse galena following. A.V. Heyl (personal communication to Smith, 1968) reported that galena from the district contained 1,700 ppm U and 370 ppm V. One cannot rule out that his sample contained trace Lockatong Formation black shale, but high U and V would be consistent with that formation having been the source of the metals in the hydrothermal veins. For example, Smith (2015) reported median U and V concentrations of small U occurrences (N=4) in the Lockatong Formation of 26 ppm U and 149 ppm V vs. 9 ppm U and 101 ppm V for uranium occurrences (N=3) in the Stockton Formation.

Fluid Inclusion Studies

 Post-deformation sphalerite from New Galena tends to occur as undeformed, gemmy cleavages ideally suited for fluid inclusion studies. Jeanne Passante Lawler (1981) studied these as well as similar cleavages supplied by B.C.S.II from the three main Zn-Pb districts in the Newark Basin of eastern Pennsylvania. These are the Audubon District in the Stockton Formation, New Galena in the Lockatong Formation, and the Phoenixville District mainly in the Pickering Gneiss but with the vein extending north into the Stockton Formation (Smith, 1977, p. 226-270). Lawler found that most inclusions in sphalerite from all three districts contained fluids having 11 to 16 equivalent weight % of NaCl, with the higher percentages from New Galena. The fluid inclusion homogenization temperatures (= temperature of formation of the sphalerites) for the most typical samples from Phoenixville ranged from 175 to 185oC, those from Audubon ranged from 160 to 170oC, and those from New Galena from 135 to 145oC. Smith (2003) hypothesized that this cooling from south to north might have also represented the direction of fluid migration, i.e. downslope into the Newark Basin.

Table 2, below, summarizes the temperature of formation of the sphalerites determined by Lawler (1981)relative to a somewhat arbitrary datum approximating the present southern margin of the Stockton Formation in the Newark Basin. Note that the Audubon District was hosted by red beds of the Stockton Formation and as such was richer in Cu extracted from hematite coatings on the detrital sediments (Rose, 1976). Smith et al. (1988) attempted to summarize many types of Cu mineralization in the Newark and Gettysburg basins of Pennsylvania, but lacked the detail provided by botanist Edgar T. Wherry (1908).

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| District Names, from South to North | Lawler (1981) fluid inclusion-based temperature of sphalerite formation | Distance N in km from datum representing present S margin of Newark Basin  | Ore veins hosted by |
| Phoenixville | 175-185 oC | 0  | Mostly Pickering Gneiss |
| Audubon | 160-170 | 2.5 | Stockton Formation |
| New Galena  | 135-145 | 24. | Lockatong Formation |

 Based on sphene, zircon, and apatite fission track data from Kohn et al. (1993), Roden and Miller (1989), and Blackmer et al. (1994), as well as the argon closure in K-spar of Sutter (1988), Smith (2003) presented a generalized Mesozoic Thermal Pulse cooling curve. If, as a working hypothesis, one uses it with Lawler’s data, then sphalerites at Phoenixville would have formed at ~ 167 Ma, those at Audubon at ~ 163 Ma, and those at New Galena at ~ 155 Ma. Thus, we know the temperatures of formation for the sphalerites in the three districts studied and have putative dates for their formation. Lawler calculated hydrostatic pressure corrections for her fluid inclusion data, but they do not seem to be appropriate for the uplifted southern portion of the Newark Basin (Smith, 2003, p. 70).

 Smith (2007) obtained limited apatite fission track analysis (F.T.A.) data suggesting more rapid cooling from the hydrothermal convection cell near the Grace Mine magnetite mega deposit, but the above three sphalerite occurrences are orders of magnitude smaller. Smith (2007) also reported similar apatite FTA cooling dates, here generalized as 140 Ma, for the southern portion of the Reading Prong and the Trenton Prong on the far side of the Newark Basin. Sphene FTA dates, here generalized as 330 Ma, for both the N. and S. sides of the Newark Basin, are also similar across the Newark Basin. However, sphene FTA dates also have a strong trend of “olding” to the east as Alleghanian orogeny influence in pre-rift border rocks declines to the east until one reaches Kohn’s (1993) 450 Ma sphene FTA date about 36 km E Into New Jersey. There, the Taconic orogeny has not been reset by the later Alleghanian orogeny. In fact, this 450 Ma data compares favorably to the 450 Ma estimate of the timing of the Taconic orogeny obtained on Smith’s monazite-(Ce) floating in vein galena from the Burnt Mill Silver Mine (= Pequea Silver Mine A), Lancaster County (Wise et al., 2007).

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