Archaeological Manifestations of Cyanide Reprocessing at the Nineteenth Century Stonewall Mine, San Diego County, California

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Abstract

Stonewall Mine, the most productive gold mine in current San Diego County, operated from 1870 to 1892. Tailings from the stamp mill operation were reprocessed using cyanide in the period of 1898 to 1901. The use of cyanide was a relatively new method to extract gold ore at the time; the first cyanide mills were built in the U.S. in 1891. Archaeological evidence of cyanide reprocessing at the Stonewall Mine site included building flats, structural remains aligned one below the other on a hillside, reprocessed tailings, a pond and dam, a cabin site, and artifacts from the period. An account in an 1894 California Mining Bureau report and data from other archaeological projects are consistent with the recent findings at the Stonewall Mine cyanide reprocessing site.

Introduction

By 1889 the processing of gold using cyanide was determined to be economically viable (Scheidel 1894:12-15). Soon after, this new method was brought to the United States, profoundly changing mining practices throughout the West and beyond (Young 1970:283-286; Hardesty 1988:51). Cyanidation created a new gold rush where entrepreneurs “... descended upon every old tailing heap in the world, ran it through their vats, and decamped with the proceeds” (Young 1970:285). The imprint of cyanidation on the Stonewall Mine in San Diego County is consistent with accounts from the nineteenth century technical literature and descriptions in other archaeological studies. This innovative extraction process made other techniques obsolete, and a new era in mining was born.

Stonewall Mine and an associated town, designated as CA-SDI-18502, are situated at the northern end of Cuyamaca Rancho State Park on a peninsula of land bordered by Cuyamaca Lake and meadow. Cuyamaca Rancho State Park is located within the mountains of central San Diego County, which lies in the southwestern end of California (Figure 1). The geomorphic province that includes Cuyamaca Rancho State Park is composed primarily of granitic rock of the Southern California batholith. Tonalite and granodiorite are the most common rock units within the batholith. Weber (1963:23) dated the batholith as Late Cretaceous. Weber (1963:133) also described the geologic character of the Stonewall Mine, writing that “The Stonewall Deposit consists of a large gold-bearing quartz body enclosed in hybrid rocks composed of quartz diorite and schist.”

History

The real story behind the discovery of the gold ore deposits of the Stonewall Mine remains a matter of debate (Rensch 1953; Weber 1963:135; McAleer 1986:11-12; Fetzer 2002:59-63). There is agreement
Figure 1. Project location.

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among all accounts that the gold discovery occurred in March 1870. Ownership of the Stonewall Claim became the subject of litigation, though by early 1871 A. P. Frary and J. M. Farley had purchased all claims to the Stonewall Mine and had a full mining operation in place (Figure 2). Frary and Farley sold their mine holdings in January 1876 to settle financial difficulties (McAleer 1986:23-24; Fetzer 2006:44-45).

The Stonewall mine reopened in early 1885 and reportedly produced at a rate of $40 per ton (Hanks 1886:89; Fetzer 2006:45). By September 1886 the mine was sold again to Robert W. Waterman (McAleer 1986:25-26; Fetzer 2006:44-46). Subsequently, Waterman purchased lands of the Rancho Cuyamaca Grant (McAleer 1986:33), which is now within Cuyamaca Rancho State Park. Waterman was elected Lieutenant Governor of California in 1886, an event that led him to turn over supervision of the mine to his son, Waldo. In 1887, Waterman became governor when the incumbent governor died. Stonewall Mine had many successful years under Waterman’s ownership; Waldo Waterman served as mine superintendent during these years. Waldo, who held a degree in mining engineering from UC Berkeley, directed the day-to-day operations and served as overseer of the Cuyamaca Grant. Waldo Waterman and his wife, Hazel, lived in the mining community at the superintendent’s house located a short distance north of the mine (McAleer 1986:27-30, 74; Fetzer 2006).

Stonewall Mine was well publicized as a highly successful mining operation by 1886. Gold production at the mine continued to be strong throughout 1886, 1887, and 1888. For example, 5,182 tons of gold ore was mined and processed in 1888 with a total value of $198,666 (McAleer 1986:33, Table 2). By the end of 1888, Stonewall Mine continued to use the old 10-stamp mill, and Waterman indicated plans to build a new mill (McAleer 1986:33). Robert Waterman attempted to sell the mine and its land holdings in both 1889 and 1890, but the sales were never completed.
By 1889 the mining operation had accumulated a significant amount of ore ready for processing in the stamp mill, and so plans for adding a 20-stamp mill to the existing 10-stamp mill capacity were devised and construction began. The construction of the new 20-stamp mill, directed by Waldo Waterman, was completed by 1890. This addition consisted of the latest in efficient mining technology, and it required five workers, two engineers, two amalgamators, and one rock breaker. Reportedly, 300,000 bricks were made on-site for use in the new stamp mill. In this same year, the work force reached 200 men, and the mine had been sunk to a depth of 400 ft (122 m). Other significant improvements completed by 1890 (Figure 3) included a hoist building, a blacksmith shop, a carpenter shop, a mine office, an assay office, a meeting room, a powder house, and an oil house (McAleer 1986:38). The mine shaft, identified as Feature 81, reached a depth of 600 ft (183 m) in 1892. The mine ended production in early 1892, when Waterman experienced financial problems and gold productivity decreased significantly (McAleer 1986:40-44). Total gold ore production from 1888 through the first three months of 1892 was 57,754 tons with a value of $906,063 (McAleer 1986:Table 2). Thus, Stonewall Mine enjoyed its most productive years under the ownership of Robert W. Waterman. According to Weber (1963:133-135), Stonewall Mine was the most productive gold mine in current San Diego County (the county was much larger until 1907) with a total yield of approximately $2,000,000 over its entire span of operation.

In 1898 the Strauss and Shin Company purchased an option to work the Stonewall Mine stamp mill tailings, six years after the mine ended its 1886-1892 stamp mill operations (San Diego Union 24 August 1898; Weber 1963:135; Woodward 1981:78; Fetzer 2002:73). The company chose to employ the new technology of cyanidation. According to a San Diego Union newspaper article dated March 14 1898, the

Figure 3. Stonewall Mine in 1889 or 1890 showing hoist building that stood over the mine shaft. (Photo courtesy of California State Parks Archives.)
Strauss and Shin operation included the construction of “several large buildings,” with “one containing the tanks being 200 feet [61 m] long and 60 feet [18 m] wide, and another containing the cyanide plant being 40 by 60 feet [12 by 18 m].” A contemporary photograph of one building for the cyanide operation clearly shows a large-sized structure with vertical plank siding and high gable roof (Figure 4). According to Weber (1963:135), the Stonewall Mine cyanide reduction plant processed 35,000 tons of tailings and reportedly yielded an average of $4 to $6 of gold per ton. Woodward (1981:92) referenced another local source of historical information that identified the total production figure as $150,000 for the cyanide reprocessing operation.

In a report for the California Mining Bureau, Scheidel (1894:15) noted cyanide processing “… can be advantageously applied to many gold ores and many silver ores …” The treatment of gold ores with a dilute solution of cyanide of potassium dissolves the metal and forms soluble cyanide (Scheidel 1894:15-16). Percolation was a cyanide processing method commonly employed at gold mines where the ores were already crushed, such as at Stonewall Mine. According to Scheidel (1894:22), the choice of construction material for use in percolation vats, or tanks, would be either wood, iron, concrete, brick and cement, or steel. Thomsen (1915:154) recommended the use of wood in the construction of cyanide tanks. Thomsen (1915:152) stated that such tanks “…are almost always circular and cylindrical, owing to the greater ease of construction and support when in shape.” Vat size could vary depending upon requirements of a particular job site and the amount of material that would be processed each day (Scheidel 1894:22; Thomsen...
1915:154). The vats were held together by steel hoops. An iron pipe, typically measuring two inches in diameter, was set into the bottom of the vat, preferably in the center (Scheidel 1894:22). The percolation vats were filled almost to the top with a .2 to .8 percent cyanide solution, and the tailings remained in this solution for roughly 12 hours (Scheidel 1894:25). The next step in this process involved recovering the gold. The solution left the percolation vats through a metal pipe and was then passed through appliances called precipitation boxes with divided chambers, to which zinc shavings had been added. These devices precipitated out the gold from the ore. From there, the solution flowed to a sump for reuse after gold extraction had occurred (Scheidel 1894:24, 31, 70; Thomsen 1915:206-209, 221; see also discussions in Young 1970:284; Hardesty 1988:51-65).

In 1923 all the mine buildings at Stonewall Mine were dismantled, the two mine shafts were backfilled, and the mining equipment was sold as scrap metal (McAleer 1986:55). California State Parks acquired the property in 1933, and a year later the Girl Scouts were permitted to begin operation of a camp near the abandoned mine. The Civilian Conservation Corps (CCC) constructed new buildings at the scout camp in the late 1930s and reconstructed the old mine reservoir (McAleer 1986:54-55). Significantly, no buildings from the mining operation at Stonewall Mine or the subsequent cyanide reprocessing work remain standing today. The cyanide operation of 1898-1901 represented an opportunistic enterprise in which the cyanidation equipment was brought onto the site and then likely removed to a new work location upon completion of the Stonewall Mine job. Any conspicuous equipment, tools, or accumulated debris remaining from the cyanide operation were no doubt removed during the Ralph Dyar demolition work in 1923 and the subsequent CCC work at the Girl Scout camp, which had stood adjacent to the cyanide operation worksite. The Girl Scout camp was closed and removed from Cuyamaca Rancho State Park in 1975, which may have further disturbed remains of the mine site. The minimal numbers of artifacts and structural members found at the Stonewall Mine can be explained in large part by the latter circumstances.

**Discovering Cyanide Features and Artifacts at the Stonewall Mine Site**

In the spring of 2006, archaeologists from California State Parks in San Diego conducted test excavations that revealed information about archaeological features associated with the 1898-1901 cyanide reprocessing operation (Figure 5). Additional information about fieldwork and results of this project is available in Sampson (2006).

A rectangular-shaped structural flat cut into the hillside where a building had contained percolation vats (or “leaching tanks”) is represented as Feature 177 (Figure 5). A study of Feature 177 revealed architectural details regarding the cyanide reprocessing operation on its eastern half. A series of four shallow rectangular depressions with intervening earthen mounds was observed; the depressions were most conspicuous when viewing the flat in low-angle sunlight. These architectural remains lie close to the south edge of the flat, that is, just above the cyanide operation tailings (designated Feature 176). The four depressions on Feature 177 had the following measurements (east to west): 9.4 m (31 ft) N-S by 5.5 m (18 ft) E-W, 9.1 m (30 ft) N-S by 6.1 m (20 ft) E-W, 9.1 m (30 ft) N-S by 6.4 m (21 ft), and 9.1 m (30 ft) N-S by 5.2 (17 ft) E-W. The distance between the five intervening mounds averaged 10.4 m (34 ft), measured to the tops of the mounds. This latter feature is the location of the percolation vats employed during the 1898-1901 cyanide operation. The metal bands found on-site may have been used to bind the vats, a construction technique noted in a contemporary technical report (Scheidel 1894:22). A section of iron pipe uncovered during the excavations on Feature 177 is interpreted as being part of the system for moving solution from the percolation vats down to the precipitation tanks (Figure 6). The historic photograph of the percolation vat building (Figure 4) also shows at least four doorways that open to
Figure 5. Map of 1898-1901 cyanide reprocessing features.
the south, downslope, from where the tailings are found today. The doors appear to have opened along the edge of the flat and may indicate how tailings were removed from the building. Today, one finds a series of east-west trending mounds contiguous to the south edge of Feature 177 and the north edge of Feature 176 (Figure 7), the piles of spent tailings that correspond with the doorways seen in the historic photograph of Figure 4.

Feature 176, initially documented by Storm et al. (1986:78, 112) as tailings left from the 1898-1901 cyanide processing operation, measures 1.3 ha (3.2 acres). The tailings, located just below Feature 177, consist of light yellowish colored, loose sandy silts with no rock. The very fine grained, loose nature of the tailings is typical of sediments that were crushed in a stamp mill. The historic data for the site indicate that tailings from the 1886-1892 operation were transported to this part of the site for cyanide reprocessing (Figure 8). The 1886-1892 Stonewall Mine operated initially with a 10-stamp mill, but by early 1890 a new and more efficient 20-stamp mill was added because of...
increased mining activity (Figure 9), which created more tailings that were later available for reprocessing using cyanidation.

A sizable oval-shaped, steep sided depression measuring approximately .25 ha (.61 acre), identified here as a holding pond, forms a break within the tailings (Figures 5 and 10). At its south end the depression narrows down to a curved, V-shaped channel that terminates at a tall, east-west trending berm of tailings. This berm would have formed an effective dam at the south edge of the tailings pond (Figure 11). The depression, or “pond,” is believed to have held spent cyanide solution for reuse. An account in the May 8, 1899 San Diego Union about the new cyanide operation stated that a dam was built to prevent the cyanide solution from contaminating the water of nearby Cuyamaca Lake, a drinking water source for the city of San Diego.

The bottommost structural flat, identified during the 2006 project as Feature 230 (Figure 5), measures 17.4 m (57 ft) northwest-southeast at its longest and 12.2

Figure 8. Scrapers transporting tailings from the 1886-1892 stamp mill to be processed by cyanide, circa 1899-1901. Tall building sits atop the mine shaft; the stamp mill is the building with one smokestack at the right side of photo. (Photo courtesy of California State Park Archives.)

Figure 9. Interior view of new 20-stamp mill constructed in 1889. (Photo courtesy of California State Park Archives.)
m (40.1 ft) at its widest. This structural flat is a possible location for machinery used to pump the cyanide solution upslope to the building housing the percolation vats. A 7.6 cm (3 in) diameter iron pipe protrudes from the earthen dam and extends over Feature 230 (Figure 12). This pipe probably conveyed solution from behind the dam out to machinery on the flat. No other dam or dam-like structure was observed in the project area. A riveted metal item found within this same structural feature appears to represent part of the machinery that formerly stood here (Figure 13). Cyanide processing of this time period included a means to capture the cyanide solution for reuse as standard practice (Scheidel 1894:24, 48; Burney et al. 1993:6.24). The cyanide solution could have been returned to the percolation vats for reuse after being captured from the processing operation in the holding pond. The May 8, 1899, San Diego Union story also pointed out: “In a short time the water will be pumped back to the works and the last vestige of cyanide taken and saved from it.”

Features 178 and 228 (Figure 5), located just below the western end of Feature 177, yielded good evidence of a structure associated with the cyanide operation,
consisting of numerous nails, bolts, unidentified metal, window glass, a small piece of sheet metal, and remnants of a milled wood plank. The sizable, artificially flattened floor and the resultant cut into the slope further indicated the former presence of a structure, most probably where the precipitation boxes stood (Figure 14). Feature 178, located just below the western end of Feature 177 (the percolation vats location), measured 12 m (39.4 ft) by 5.9 m (19.4 ft). Feature 228, a roughly “L” shaped flat, lies to the south and slightly downslope from Feature 178. Feature 228 measured 12.2 m (40 ft) at its longest axis and 8.4 m (27.5 ft) at its widest. Similarly, the structural flat identified as Feature 174 (Figures 5 and 15) had some artifactual evidence of a building; this evidence included a milled plank with square nails, pieces of sheet metal, glass fragments, barrel hoops, parts of steel drums, along with the flattened cut into the hillside.

The configuration of seven structural remains situated on different levels of the hillside where gravity could be used to advantage is consistent with a late nineteenth or early twentieth century cyanide operation. The contemporary technical literature (Scheidel...
indicated how cyanide operation structures would be configured on a slope, similar to that identified during the 2006 project at Stonewall Mine (Figure 16). Observations from other archaeological investigations of cyanide processing sites in the western United States show that features were configured on a hillside with structures situated at different levels (Hardesty 1988:51-65; Burney et al. 1993:6.23). The Hedges Mine, located in the Colorado Desert east of the Stonewall Mine, had similar dates of operation, 1893 to 1905 (Burney et al. 1993:6.23-6.28), and a study of that site strengthened my identification of features at the Stonewall Mine cyanide site.

A concentration of historic artifacts (Figure 17), in particular, consumer goods, kitchen items, clothes parts, a stove part, other domestic debris, bricks, window glass, roofing nails, and cuts into the slope at the west end of one structural flat feature provided good evidence of the previously undocumented historic use of this spot as a modest-sized residence for a cyanide operation worker. Overall, evidence of residential occupation was sparse, which would be expected given...
the cleanup work conducted at the site in the 1920s and in later years.

Conclusions

The spring 2006 archaeological fieldwork at the Stonewall Mine site provided strong evidence of remains related to the 1898-1901 cyanide reprocessing operation. The spatial organization of features matched expectations for the remains of cyanide reprocessing facilities. A series of shallow rectangular depressions with intervening earthen mounds, for example, are consistent with descriptions of percolation vats provided by Scheidel (1894:22-24). One large-sized cultural feature consisted of reprocessed mine tailings (gold ore crushed in a stamp mill to a fine powder), a holding pond, channel, and earthen berm or dam. This feature was both part of the mechanism by which the used cyanide solution was captured for reuse and the final resting place of the spent tailings that had been reprocessed (Figures 10 and 11). Additional structural flats containing relatively small numbers of wood planks, nails, bolts, and corrugated sheet metal were documented on the same hillside downslope from the latter features (Figure 5). The structural components of the Stonewall Mine cyanide processing operation were aligned one below another in a configuration consistent with the technical literature of the period and the relatively minimal data available from other archaeological studies.

Figure 16. Typical configuration of cyanide plant works from the 1890s, as depicted in Scheidel (1894:86). Note the placement of machinery and tanks on a slope.
Taken by themselves, archaeological features found at the Stonewall Mine site would not be sufficient to adequately interpret mining activities occurring after the technological innovation of cyanide reprocessing became available. Historic photographs and descriptions greatly complement interpretation of the site and help us understand the mining processes. Hardesty (1990:44-45) has noted that one important goal of archaeological work in mining districts should be the reconstruction of past technological processes. I am confident that the descriptions of our archaeological findings at the Stonewall Mine cyanide reprocessing site can be employed as a guide for the recognition of cyanide reprocessing features at other gold mining sites. Fortunately for future researchers and history enthusiasts, the site of Stonewall Mine is preserved and protected in perpetuity within Cuyamaca Rancho State Park.

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