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THE COLD SPRING AND RELATED CLAY DEPOSITS ALONG THE WESTERN SLOPE OF THE CENTRAL BLUE RIDGE IN VIRGINIA

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Much of Virginia's history is known only through documents and artifacts preserved in museums or collections. There are a few places, however, where features of historical interest can easily be seen. One feature is about 14 miles south of Staunton in Augusta County, Virginia. This feature, the tailings pile of the Cold Spring Kaolin (clay) Mine, is a tan-colored, rectangular, earthen mass. It is located along the lower, western flank of the Blue Ridge on Bare Mountain (part of Big Levels) southeast of Greenville. The tailings pile is visible from the higher parts of Interstate Highway 81/64 and U.S. Highway 11 (Figure 1).

The Cold Spring kaolin deposit appears from a distance to be a very local feature on the side of Bare Mountain. Actually, the clay deposit continues along the mountainside for many miles (Figure 2). In some areas, however, it may have been covered by alluvium or colluvium or removed by erosion. Clay has been prospected and/or mined in several other places in Augusta and Rockbridge Counties. The oldest workings are near Lipscomb, Augusta County at a place known in 1883 as "Porcelain", Virginia. Other clay deposits include a prospect near Lofton, one east of Pekin, and pits along the eastern side of Chalk Mine Run just north of Buena Vista, Rockbridge County (Figure 3).

Kaolin is a grayish-white clay; soft and easily abraded, and is mainly the mineral kaolinite, $[Al_2(SiO_2O_5)(OH)_4]$. It has sometimes been incorrectly called "chalk" and the workings of the mines referred to as "chalk mines" or "chalk deposits". Although at one time, similar clay from the Buena Vista area was used as "blackboard chalk" (Ruffner, 1889), this

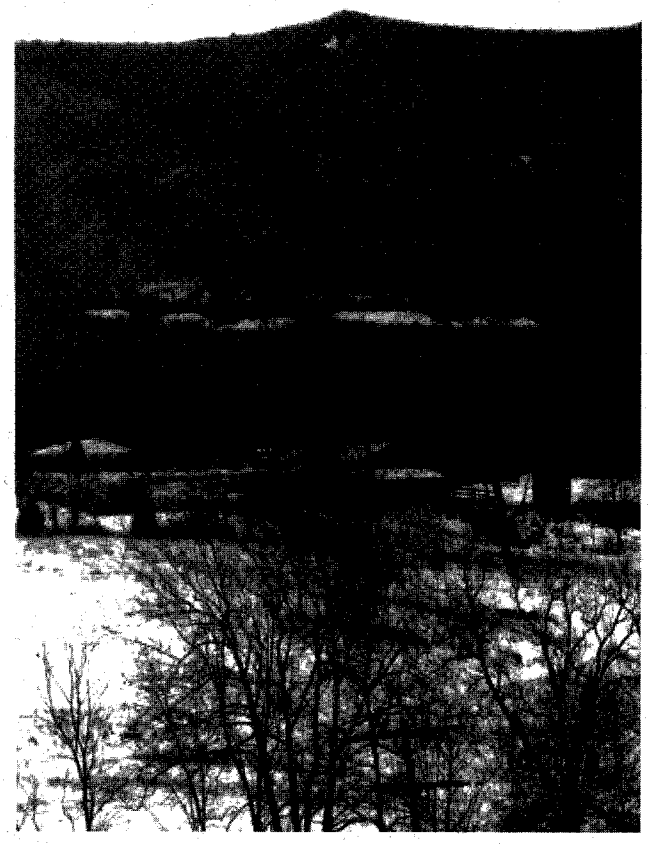

Figure 1. Tailings of the Cold Spring Kaolin Mine as seen from the west along State Road 662.

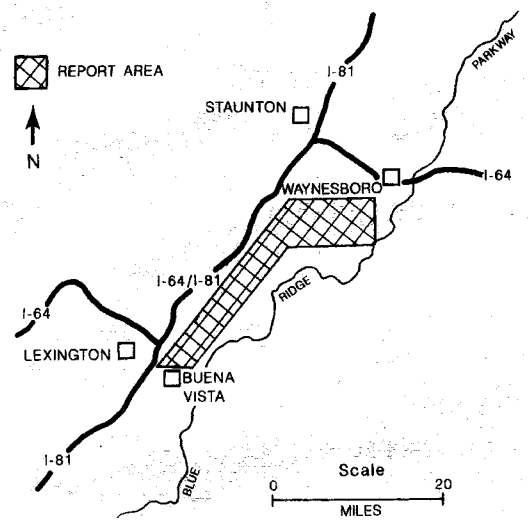

Figure 2. Location of report area.

use was probably due to necessity. True chalk is white, soft, friable limestone composed of marine microfossils and the mineral calcite and would have better served the purpose.

Iron and manganese deposits are associated with the clay deposits along the flanks of the Blue Ridge (Figure 3). Where present, the iron ore, a moderate reddish-brown limonite, is usually in residuum overlying the Antietam Formation (Hack, 1965). Most of the manganese ore is in nodules, large concretionary masses, and irregular sheets imbedded within the clay deposits. The manganese masses locally enclose portions of clay.

GEOLOGIC SETTING

When viewing the Cold Spring Kaolin Mine from the west, the most striking features are the massive mountain ridges above and surrounding the mine site. Bare Mountain is a spur of the larger Big Level Mountain or Big Levels. This area of uplands is present because of very hard sandstone of the Chilhowie Group that has not eroded as rapidly as other rocks. Big Levels is underlain mainly by the Antietam Formation which is predominately a quartzite. This rock unit is about 600 feet thick and very resistant to erosion because of its composition; metamorphism has cemented or "welded" the quartz grains together.

The Shady Dolomite, a dolostone, is west of and stratigraphically above the Antietam Formation. It is a softer rock than the Antietam, is chemically unstable in an acidic environment and dissolves very slowly (over millions of years) in contact with weakly acidic rainwater. No exposures of dolostone occur in this area because of deep chemical weathering. However, the Shady is exposured near Natural Bridge (33 miles to the southwest), where it is about 1200 feet thick (Edmundson, 1958).

The Rome Formation, a sequence of shales and carbonate rocks, overlies the Shady Dolomite. Carbonate rocks are formed by the lithification of limy muds rich in calcium carbonate, whereas shales are formed by the lithification of muddy sediments or materials generally rich in clay, silt, and very fine sand. Both carbonate rocks and shales are commonly deposited in relatively quiet waters. The weathering relationships of these rocks seem to be very important to the presence of the clay deposits which are near the base of the Rome Formation. Since most of the Shady Dolomite may have been removed by weathering and erosion, the clay appears to be a residual material from the Shady above the top of the Antietam Formation and just below the Rome. Whether the Shady contributed to the origin of the clay chemically, mineralogically, or just provided a void for the clay to accumulate will be addressed in a later section.

HISTORY OF MINING

PORCELAIN DEPOSIT

Porcelain, Virginia was 1.5 miles south of Lipscomb or about 6 miles southwest of Waynesboro, Augusta County (Figure 3). The village of Porcelain was named for the porcelain ware produced from locally mined clay. The first use of this clay was around 1863 (Fontaine, 1883). The Virginia Porcelain Company made various pieces of coarse pottery by mixing a blue clay from the Bare Mountain Iron Mine (on the west flank of Bare Mountain) with white clay from the locality at Porcelain.

The porcelain ware, noted for its great durability and strength, was marketed under the trade name "Rockingham Ware" (Ries and Somers, 1920). Much of the Rockingham Ware was dark, but some was of a cream color. This color variation may have been due to the length of time the ware was fired, firing temperature, or differences in proportions of the two clays. The reasons for mixing the two clays are not known, but Fontaine (1883) suggests that the pure white clay was disposed to crack. He also states that the company attempted to make a white ware, but it "...failed in the glaze". Fontaine thought the clay formed a uniform deposit as much as 30 feet thick and occurred under at least 25 acres of land.

The property was sold about 1870 to an English company, theVirginia Porcelain and Terra Cotta Company. According to Fontaine (1883):

> "This latter company began operations in 1871-2, under the management, as it is said, of men not acquainted practically with the business, and who did not attend to the finances of the company. They spent a good deal of time and money in making preparations. A large amount of machinery was finally put up, and among the rest a fine engine. Two cupola furnaces were built and other preparations made for manufacturing on a large scale. During these preparations a fire destroyed everything, but this did not deter them. A good deal, if not all of this machinery is still present, but is of course much out of repair. Finally the company collapsed from bad management. This took place before they had made an at-

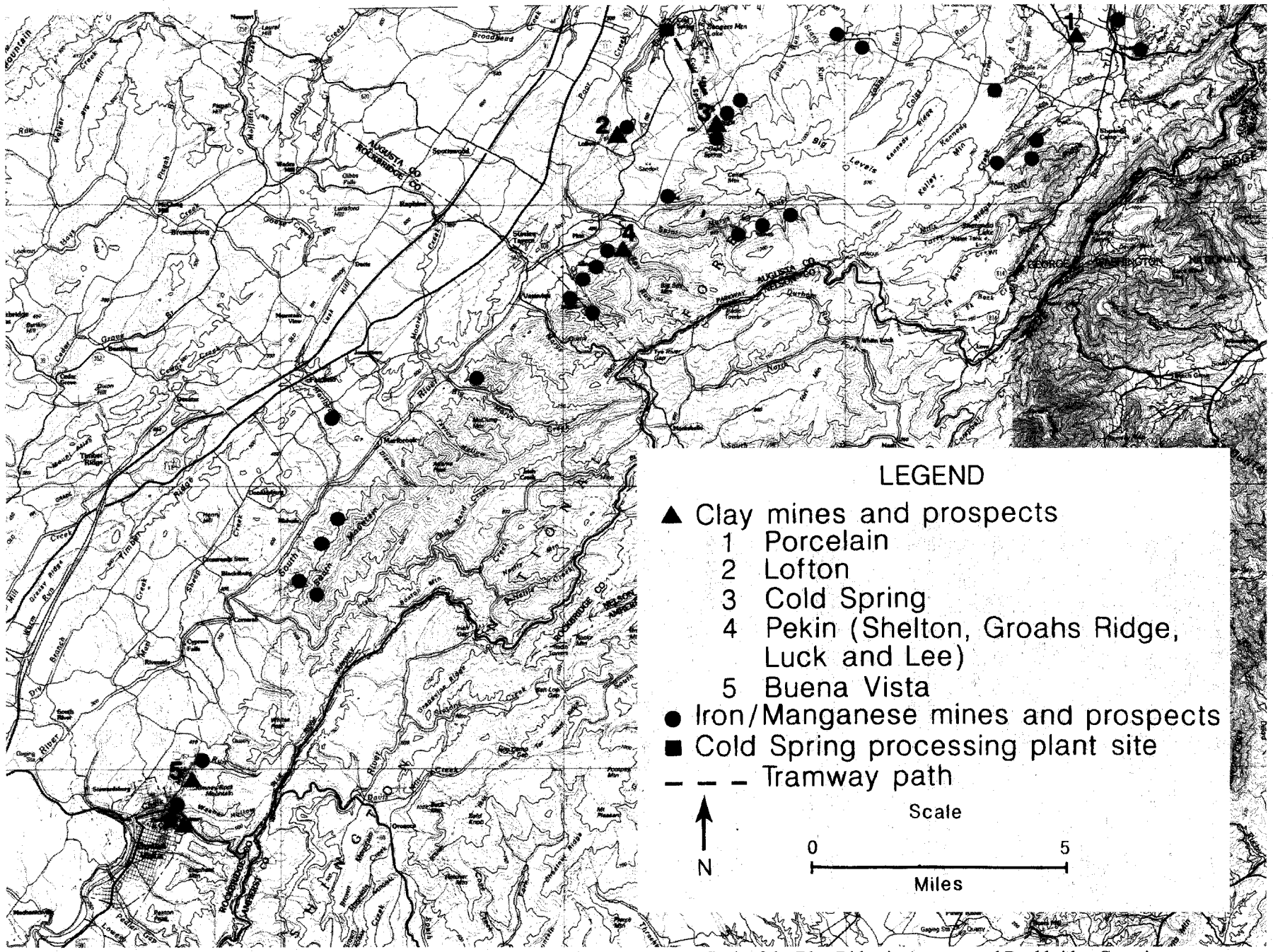

Figure 3. Clay mines/prospects and iron/manganese mines and prospects along the western flank of the Blue Ridge in Augusta and Rockbridge Counties.

tempt to manufacture any pottery. From all that I could learn it seems clear that no fair trial of the capacity of the clay has been made. This company made some fire-brick and drainage tiles. The tiles seem to be very good. The fire-brick is of two kinds. Some of the clay appears to have more silica than the average, and the brick made from this seems to be hard and of good quality. Most of the clay, however, has but little free silica, and the bricks from this are too soft. This defect could be easily remedied, for an abundance of fine sand may be obtained not far off, and by mixing this in proper proportions with the clay, a good firm brick could be made. So far as the physical character of the clay is concerned, I see no reason why ware equal to the best made from the New Jersey clays, cannot be made from it. The location is good, clays, ochres, and sands abound in the region, and the conditions seem favorable for the carrying on of varied manufactures. The siliceous kaolin of Nelson and Amherst is not far off, and might possibly be utilized in connection with these clays, especially in the fire-brick."

Hotchkiss (1883) announced that the property had new owners stating that:

"The Virginia China Clay and Fire Brick Company has been chartered by the state of West Virginia, with a capital of $75,000. This company will own, improve and operate the `Porcelain' property, on the line of the Shenandoah Valley RR., near Sherando station, Augusta County, Va. Messrs. Sweeney and Walton, of Wheeling, W. Va., who purchased this property a few months ago, have had samples from the large deposit of kaolin at Porcelain made into white ware, tested as fire-clay for fire-bricks, etc. The ware made from it is of a very fine quality, equal to the best imported, judging by the samples they have shown us and the testimonials of manufacturers; its color is very rich and clear and there is no question but that it will be eagerly sought for when put upon the markets. A crude brick made from it and subjected to a high heat alongside one of the noted Mt. Savage fire-bricks, came through the ordeal but little changed, while its rival was badly damaged. Glass pots made from it proved better than any now in use."

McCreath (1884) reported that the company washed about eight tons of China clay to produce 3000 bricks per day. He said that they were employing 50 men and had the production capacity of 252,000 bricks per month. The principal market in 1884 was East Liverpool, Ohio. Production was stopped in about 1887, perhaps for the lack of skilled workmen.

When Ries and Somers visited the Porcelain property in 1916, a shaft was still present, and they described an open drift of 30 feet in length that was open to the southeast.

COLD SPRING CLAY DEPOSIT

The first reference found regarding the Cold Spring clay deposit was made in an article by Fontaine (1883) published in *The Virginias*. Fontaine describes the Bare Bank Iron Ore Deposit, on the northwest face of Bare Mountain as abandoned open cuts. He stated that the ore was contained in two ledges which projected from the clay and had a combined width of 30 over feet.

These old iron excavations were reopened in 1906 and supplied ore to the Cotopaxi Furnace, 3 miles southwest of the iron mine along the Saint Marys River, Augusta County (Watson, 1907). A tunnel several hundred feet long was constructed during the iron mining, and consequently cut through a large body of white clay (Ries and Somers, 1920). Ries and Somers further state:

"Following the discovery of this (clay) a line of test pits was sunk for a distance of 500 or 600 feet in a south of west direction from the iron-ore pit, with the result that white clay was encountered in the test pits at depths of 3 to 20 feet below the surface, the overburden being mostly wash from the higher mountain slopes. Although these test pits were made as early as 1912, very little had been done toward developing the clay up to 1915. In the last three years the deposit has been actively worked and in 1918, one pit having a maximum depth of about 60 feet had been excavated, while a second one is being started."

Previously Ruffner (1889) stated that:

"In Pennsylvania the pure white kaolin has been used from these clays for 'weighting' paper, for which purpose it was bought by the paper mills at seven to fifteen dollars per ton. The kaolin was divided into three grades. No. 1, white; No. 2, mixed white and yellow; No. 3, buff color. No. 2 brought nine dollars per ton. The work was discontinued upon the exhaustion of bed No. 1."

The Cold Spring Mining Company, a subsidiary of the Georgia Kaolin Company of Elizabeth, New Jersey, mined and processed the clay from 1918 until the summer of 1951, when the processing plant burned (Caskie, 1957). The kaolin was called white clay to take advantage of lower freight charges. One layer was 50 feet thick and several other layers were 6 to 20 feet thick. According to Caskie (1957), the white clay was used for the production of paper for the "Saturday Evening Post." Ten to 30 train-car loads of clay were shipped per month. During the 1920s about 100,000 short tons of white clay (valued at almost $850,000 in 1920-1930 dollars) were produced from this mine (Sweet, 1983). The material in the large deposit was exhausted by 1929, and the other deposits were siliceous and impure. The impurities were not removed because the cost of constructing large settling tanks to remove them was determined to be too great.

By 1931, the clay was also being used as a filler in oil paints, rubber, and paper. During World War II, the yellow and tan clay was used as a filler in camouflage paint, and after the war, as a filler in paint and fertilizers.

Before the fire in 1951, the clay was mined from an open pit

Figure 4. Steam shovel loading ore cars at the Cold Spring Kaolin Mine. View is toward the northeast. (Photograph courtesy of the U.S. Forest Service)

Figure 5. Loading ramp at the Cold Spring Kaolin Mine where the ore cars were transported to the tramway. View is toward the north. (Photograph courtesy of the U.S. Forest Service)

Figure 6. Tramway cars (full car on top cables headed to processing plant and empty car on bottom cables returning to loading shed) at the Cold Spring Kaolin Mine. View toward the northwest. (Photograph courtesy of the U.S. Forest Service)

Figure 7. Tailings pile being extended by dumping rail car filled with overburden at the Cold Spring Kaolin Mine. (Photograph courtesy of the U.S. Forest Service)

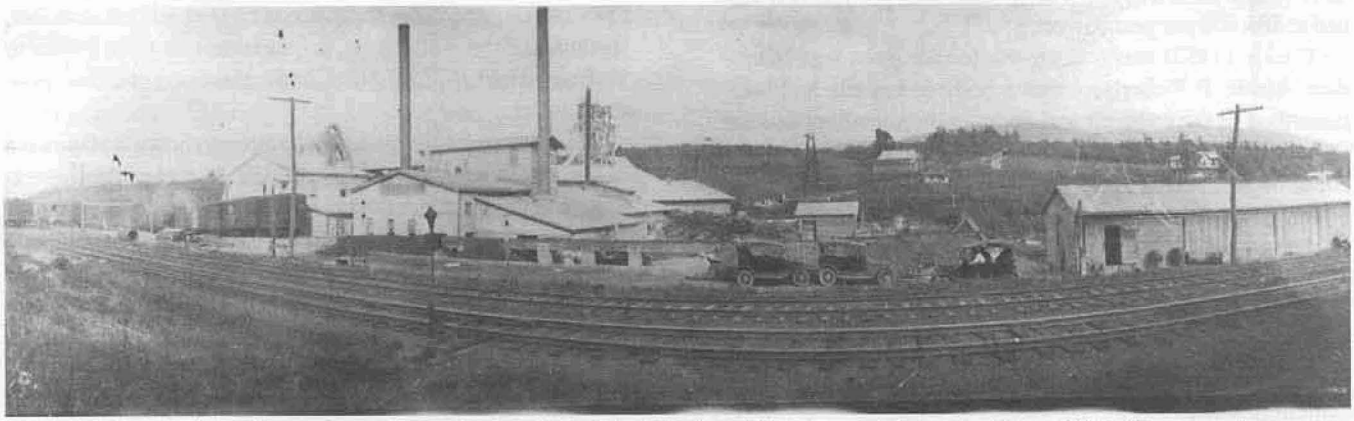

Figure 8. Processing plant and terminus of tramway at Cold Spring. View toward the east. Circa 1925 (Photograph courtesy of Mr. Minor Ramsey, Stuarts Draft, Virginia)

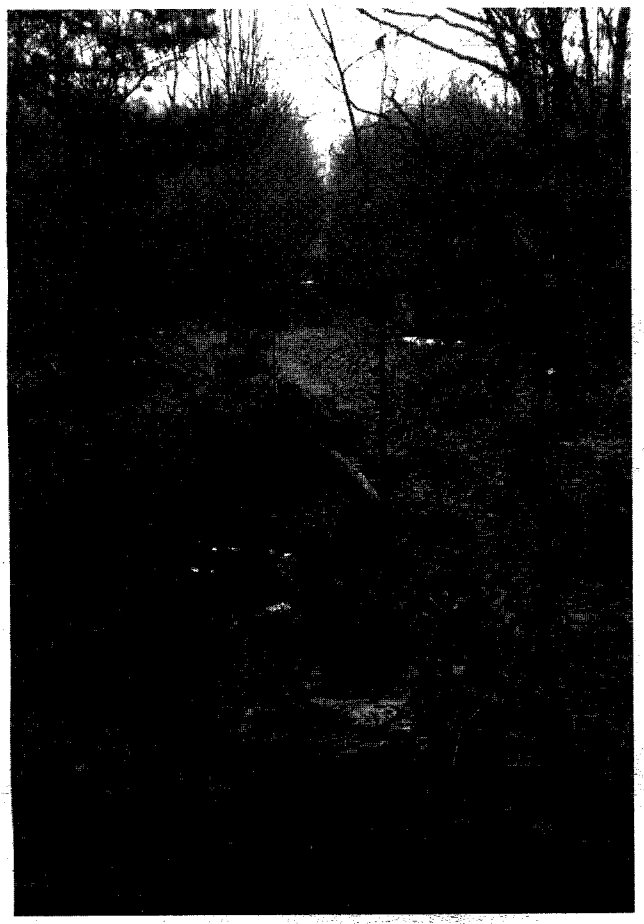

Figure 9. Footing remains of a tramway tower between the mine and the processing plant at Cold Spring (Photograph by Palmer C. Sweet).

that was 500 wide and 800 feet long and approximately 90 feet deep (Figures 4, 5, 6, and 7). The clay was loaded onto a tramway by steamshovel and transported almost 3 miles downslope to the processing plant along the railway (Figure 8). Remains of the tram tower footers can still be found along the pathway of the conveyor (Figure 9). The clay was ground, dried, and screened to 200-300 mesh at the plant. It was then blended to the desired shade and packaged in 50-pound bags. Production in 1949 and 1950 was about 6200 short tons per year and valued at $85,000 per year (Sweet, 1983).

Caskie (1957) was told by the former plant superintendent, Mr. R. P. Robertson, that a body of bauxite had been unearthed in the large pit and completely mined out several years before the fire. This low-grade bauxite deposit was about 60 feet across at the top, tapered downward to a point 90 feet below the pit level, and was completely enveloped by the white clay.

In 1982, James River Limestone Co., Inc. began trucking clay from the dump of the Cold Spring Mine to company facilities near Buchanan, Virginia to be used to produce filler material for several products including an ingredient in white cement (Sweet, 1991).

A clay sample, R-40, from this locality was obtained and tested (Calver, and others, 1964). The results of this testing indicate that the clay, with additional preparation, could be used in ceramic whiteware as a substitute for potter's flint and as a mineral filler in plastic, asphalt, and tile (Table). Another clay sample from this locality showed a high silica (55.5 %) and high alumina (28.9 %) content (Sweet and Giannini, 1990).

LOFTON AND PEKIN CLAY DEPOSITS

Two other clay prospects, the Lofton and Pekin, are near the Cold Spring Mine (Figure 3). No indication or record of mining has been found.

The Lofton prospect is in a swampy depression just west of the Lofton Limonite Mine, along a tributary of Pine Run. The clay deposit was reported to be at least 40 feet thick and ranged in color from a grayish white in its upper part to a light yellowish brown in the lower part, a difference attributed to leaching (Ries and Somers, 1920).

The Pekin clay prospect has also been referred to in the literature as the Shelton, the Groahs Ridge, and the Luck and Lee prospect. It is located about 4 miles southwest of the Cold Spring Mine, just east (upslope) of the Black Rock Iron Mine on the west flank of Groahs Ridge. Estimates by borings suggest that the deposit was 240 feet long and 30 feet thick (Ries and Somers, 1920)

In about 1945, Messrs. Luck and Lee from Richmond, hoping to find a clay deposit of commercial value, had the soil stripped away in an area about 100 yards long and 50 yards wide (Moore, 1952). The white clay they found averaged only a few inches thick and was variegated with pink, purple, and tan clays. As a result, the prospect was abandoned.

BUENA VISTA CLAY DEPOSITS

Clay has been mined in two areas northeast of Buena Vista, Virginia. The mines had their origins as 18th-Century iron mines and were worked almost continually from the Colonial Period to the early 1900s. The northernmost clay mine (Figure 3) is 1.5 miles northeast of Buena Vista, just east of Chalk Mine Run (formerly Big Chalk Mine Run). Ruffner (1889) found clay from this place to be very siliceous; in fact, it contained more microscopic quartz than clay. In a letter to Ruffner, dated July 31, 1889, M.B. Hardin, a chemist, gave the following analysis:

"....a microscopic examination having shown that the sand is composed of quartz (87%), which, to a considerable extent, is in very distinct though minute crystals, while the clay (13%) is made up of kaolinite. Without any preparation it will probably make a good molding sand. With very little manipulation, if any, it promises to make fire-bricks which may rival the celebrated Welsh 'Dinas bricks' used in construction of certain parts of furnaces where a solid and compact lining is needed."

Shortly after Ruffner's publication of this information, the Dickinson Fire Brick Company began mining this clay and

produced fire brick.

A second clay deposit near Buena Vista is located on both sides of U.S. Highway 60 just west of its crossing of South Fork (formerly Silver Mine Run). Some of the evidence of mining north of U.S. Highway 60 near Washer Run (formerly Little Chalk Mine Run) has been destroyed by the construction of an industrial park; however, one large pit was found along a drainage just north of the park. The walls of the pit on the south side of the highway are still visible on the northeast face of Mineral Ridge.

ORIGIN OF KAOLIN DEPOSITS

Kaolinite is the dominant clay mineral in residuum (in-place highly weathered rock material) and in sedimentary kaolin. Several theories have been proposed to describe the origin of the kaolin deposits in Augusta and Rockbridge Counties.

Ries and Somers (1920) state that the clay is probably residual material from former shale formations. This origin might account for the bauxite and high alumina content (39.42 %) found in the clay. Stose, and others (1919) and Knechtel (1943) also include decomposed shaly limestone, dolomite, or calcareous shale as possible parent materials for these deposits. Stose further states that some sort of mechanism for preservation would be helpful in preventing the clay from being removed. Perhaps the clay was collected and preserved in an ancient stream channel; perhaps there was a structural feature (syncline or fault), such as at the Crimora Mine near Waynesboro; or maybe a basin formed by the weathering of the carbonate rocks. In clay near Elkton, Virginia, King (1943) found veins and bedding extending from unweathered limestone into clay above showing that the clay formed in place by chemical weathering of the limestone. He observed that the clays derived from shaly rocks showed well-marked, even bedding, relatively open folding, and straight, clean-cut joints which have been preserved with relatively little change from the original rock. King thought that the clay derived from the dolostone (Shady Dolomite) had a much more irregular, chaotic structure. He postulated that the alteration of limestone and dolostone to clay had produced a much greater reduction in volume and that this chaotic structure was in part the result of slump and compaction; perhaps as a cavern (void) filling.

Caskie (1957) suggested that kaolinitic material, derived from feldspars of older rocks from higher elevations, was transported and deposited contemporaneously with sand and limy materials into large solution basins or cavities. The more soluble constituents were then leached out by meteoric waters which permitted slump and compaction.

ECONOMIC POTENTIAL

Calver and others (1964) described the clay from the Cold Spring kaolin deposit as being white with mottled zones of pink and yellowish coloring. Most of the clay was partially consolidated, dense, and waxy with portions showing distorted laminations which might have represented original bedding. They suggested that this clay, with additional preparation, could be a potential source for ceramic whiteware as a substitute for potter's flint. It was also deemed useful as a mineral filler in plastics, asphalts, and tile. In Rockbridge and Botetourt Counties, Calver and others (1964) found similar clays to be useful in pottery, brick, and chimney-flue tile. The following table describes raw properties and potential uses of six samples from Augusta and Rockbridge Counties. Because the clay is usually covered by alluvium and/or colluvium, any determination as to its extent and thickness would have to involve trenching, boring, or perhaps seismic data.

The abandoned tailings piles associated with the Cold Spring kaolin deposit are located just west of the pits and contain a high percentage (up to 80 percent) of very fine silica sand. With screening and washing, these wastes may be suitable for foundry sand or facing material. These sands might also be used as a filler in plastic and asphalt or with clay from other sources as a binding or hardening agent in ceramic products and bricks.

Table. Raw properties and potential uses of six clay samples from Augusta and Rockbridge Counties (Calver and others, 1964).

COUNTY SAMPLE	RAW PROPERTIES	POTENTIAL USE(S)
AUGUSTA		
R-40	Not plastic, short and fine gritty working	With additional preparation, could be used in ceramic whiteware as a substitute for potter's flint and as a mineral filler in plastics, asphalts, tiles, etc.
ROCKBRIDGE		
R-13	Very plastic and smooth working	Ceramic whiteware, for intermediate-duty refractories, as a basic pottery material, and possibly as a mineral filler
R-14	Plastic, smooth working, slightly sticky	Could probably be used with less plastic materials to improve plasticity and increase green strength
R-1911	Plastic, fairly sticky, slightly gritty	Chemical stoneware, pottery, decorative brick and tile, and chimney flue tile
R-1912 and R-1913	Very plastic, slightly short, sticky, and gritty working	Brick, sewer pipe (?)

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