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INDUSTRIAL MINERALS AND ROCKS IN SANTA FE COUNTY, NEW MEXICO

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Abstract—Santa Fe County has a rich mining history with hundreds of mines and quarries that date from prehistoric time to the present. The 172 industrial mineral and rock sites listed herein are scattered throughout the county. They include significant production of sand and gravel; caliche and adobe; numerous varieties of stone; scoria, pumice and volcanic ash; and gypsum. The following were produced in smaller amounts: clay and shale, turquoise and other semiprecious materials, barite, iron oxide, mica, garnet, and silica sand.

INTRODUCTION

Santa Fe County has a long mining history, with many hundreds of mines and quarries including the 172 industrial mineral and rock sites listed herein (Fig. 1, Table 1). The Ortiz and San Pedro Mountains in the west-central part of the county contain many old gold mines, some of which were worked in the last century. Madrid was an early coal-mining center. The Cerrillos mining district is famous for turquoise, copper, lead and zinc. Beginning in the latter part of the 19th century and continuing into the 20th century, many nonmetallic or industrial minerals and rocks were also mined in the county. Although not as widely known as the metals and fossil fuels, these minerals and rocks have been important in the economic development of the region.

Native Americans extensively mined turquoise, obsidian, chert, jet, malachite, hematite, salt, stone and sand and gravel in the Santa Fe region in the past (Northrop, 1959; Warren, 1974; Schroeder, 1984; Peckham, 1984; Cordell, 1984) and continue to do so today. Locating prehistoric mine sites is difficult because only minor amounts were needed in prehistoric societies, the workings were small, or the materials were collected as float.

Turquoise was a major prehistoric export from New Mexico to Mesoamerica and elsewhere. Mt. Chalchihuitl in the Cerrillos mining district, the largest prehistoric source of turquoise, was mined by Pueblo Indians such as the Tewas (Schroeder, 1984), for widespread export to nearby Navajo ornament makers and others. Galena from Cerrillos was mined for pottery glaze (Akright, 1979). The Castillian Mining Claim of 1879 and the Mount Chalchihuitl Claim (Elston, 1967) were among the first European-American turquoise mining claims in the U.S.

Industrial minerals are a diverse group of mostly nonmetallic minerals, rocks and materials. They range in value from highly prized, gem-quality turquoise worth thousands of dollars per ton to sand and gravel worth a few dollars per ton. The uses for industrial minerals and rocks in Santa Fe County are numerous. For example, buildings are constructed of concrete, adobe, stone, wallboard (gypsum) and glass (silica sand); roads are made largely from sand and gravel or crushed stone; pottery is fired from clay; and sculpture is carved from special types of stone.

The process of producing industrial minerals and rocks consists of four steps: geology (exploration); production (mining and milling); transportation (truck, rail, barge, ship); and marketing (consumer specifications). This process is driven by consumers' needs expressed as specifications to producers for the industrial minerals and rocks they consume. Most of the industrial minerals and rocks market consists of low-value high-volume materials (such as sand or stone) the retail value of which is greatly affected by transportation costs. Thus, location relative to consumers (place value), along with the transport type(s) available, is of prime importance in determining final cost. When nearby deposits are driven out or closed, as often happens where urban areas expand, costs for housing and infrastructure may rise dramatically.

INDUSTRIAL MINERALS AND ROCKS

Sand and gravel

Sand and gravel is produced in the largest volume and has the largest total value of raw materials now mined or quarried in Santa Fe County. It was produced at 13 active pits in 1994 (Hatton et al., 1994). Sand and gravel pits are concentrated near highways (New Mexico Highway Dept., 1964, 1968, undated) or urban areas to minimize transport costs. Deposits are most commonly formed by fluvial processes, such as those associated with the Rio Grande, in which fines, such as clay, or grains chemically reactive in water are removed. Thus, large reserves exist in Recent and Quaternary river and terrace deposits (Carter, 1965). Sand and gravel is used extensively as construction aggregate in concrete, for base course in highways, and aggregate in blacktop.

Adobe soil, clay and shale, and caliche

Soil for adobe blocks is taken from pits throughout the county (Smith and Austin, 1989). Older adobe yards, particularly in or near the city of Santa Fe, quarry soil elsewhere and truck it to the yard. These commercial yards use material that contains about 67% sand-and-larger-size, 25%

TABLE 1. List of industrial mineral and rock deposits of Santa Fe County. The symbols are keyed to Figure 1.

Industrial Rock or Mineral	Deposit Name	Location (Sec T R)	Symbol #
SAND AND GRAVEL			
Sand and gravel	5427	SE¼ 23 16N 8E	△ 1
Sand and gravel	5453	SW¼ 32 17N 9E	△ 2
Sand and gravel	5480	SE¼ 31 17N 9E	△ 3
Sand and gravel	54137	NE¼ 14 19N 8E	△ 4
Sand and gravel	5568	SW¼ 18 20N 9E	△ 5
Sand and gravel	5574	SE¼ 8 19N 9E	△ 6
Sand and gravel	5629	NE¼ 12 20N 8E	△ 7
Sand and gravel	57107	SE¼ 15 19N 7E	△ 8
Sand and gravel	58124	SE¼ 6 19N 9E	△ 9
Sand and gravel	5909	S½ 2 16N 8E	△ 10
Sand and gravel	6032	SW¼ 5 19N 9E	△ 11
Sand and gravel	6318	NW¼ 8 19N 9E	△ 12
Sand and gravel	6618	S½ 26 15N 7E	△ 13
Sand and gravel	6621	SW¼ 27 16N 8E	△ 14
Sand and gravel	6635	S½ 2 20N 8E	△ 15
Sand and gravel	6717	W½ 6 19N 8E	△ 16
Sand and gravel	6813	SW¼ 1 16N 8E	△ 17
Sand and gravel	7018	SW¼ 6 15N 8E	△ 18
Sand and gravel	0744	NW¼ 20 15N 7E	△ 19
Sand and gravel	5607	NE¼ 20 14N 8E	△ 20
Sand and gravel	0687	NE¼ 29 11N 9E	△ 21
Sand and gravel	0692	SE¼ 29 11N 7E	△ 22
Sand and gravel	40-13-2	SW¼ 26 10N 11E	△ 23
Sand and gravel	5523	N½ 19 18N 10E	△ 24
Sand and gravel	5641	E½ 1 15N 10E	△ 25
Sand and gravel	5946	NE¼ 12 20N 9E	△ 26
Sand and gravel	0745	NW¼ 19 20N 10E	△ 27
Sand and gravel	0749	N½ 2 16N 9E	△ 28
Sand and gravel	0750	SE¼ 33 17N 9E	△ 29
Sand and gravel	25-15-5	26,27,34,35 15N 7E	△ 30
Sand and gravel	25-15-8	29 16N 8E	△ 31
Sand and gravel	80-9-S	SE¼ 8 14N 10E	△ 32
Sand and gravel	80-4-S	11 19N 7E	△ 33

TABLE 1. (continued)

Industrial Rock or Mineral	Deposit Name	Location (Sec T R)	Symbol #
Sand and gravel	73-3-S	W½ 15 16N 8E	△ 34
Sand and gravel	76-21-S	NE¼ 8 NW¼ 9 19N 9E	△ 35
Sand and gravel	8521-S	NW¼ 18 14N 8E	△ 36
Sand and gravel	8718-S	NE¼ 23 12N 9E	△ 37
Sand and gravel	Leeder Pit	2 16N 8E	△ 38
Sand and gravel	San Pedro Gravel	27 12N 7E	△ 39
Sand and gravel Sand and gravel	— —	(NE¼ 11 14N 7E) (10 13N 7E)	△ 40 △ 41
Sand and gravel	—	7 19N 8E	△ 42
Sand and gravel	—	NW¼ 11 10N 7E	△ 43
Sand and gravel	—	SE¼ 23 10N 7E	△ 44
Sand and gravel	—	NW¼SE¼ 8 10N 8E	△ 45
Sand and gravel	—	NW¼ NE¼ 18 11N 11E	△ 46
Sand and gravel	—	NE¼ 27 10N 10E	△ 47
Sand and gravel	Waldo Pit	S½ 33 15N 7E	△ 48
Gravel	5560	SE¼ 15 11N 8E	△ 49
Gravel	0678	SE¼ 6 14N 7E	△ 50
Gravel	0686	E½ 13 12N 8E	△ 51
Gravel	0690	NW¼ 15 10N 7E	△ 52
Gravel	58126	SW¼ 24 18N 9E	△ 53
Gravel	0747	SW¼ 8 18N 10E	△ 54
Gravel	0638	NE¼ 23 12N 9E	△ 55
Gravel	25-15-2	SE¼ 6 14N 7E	△ 56
Gravel	Basset Pit	35 10N 7E	△ 57
Gravel and dirt	Blotter Construction Pit	9 16N 8E	△ 58
CALICHE AND ADOBE SOIL			
Caliche	0688	SE¼ 30 10N 9E	▲1
Caliche	0642	NE¼ 15 11N 9E	▲2
Caliche	White Lakes Area	SW¼ 15 11N 10E	▲3
Caliche	0643	SE¼ 31 12N 11E	▲4
Caliche	—	16 11N 10E	▲5
Caliche and gravel	0644	NE¼ 27 11N 11E	▲6
Adobe soil	Sun and Soil Pit	W½ 24 10N 7E	▲7
Adobe soil	Gallegos Sand and Gravel	(NW¼ 27 17N 9E)	▲8
Adobe soil	Steve Romero	(SW¼ 27 17N 9E)	▲9
Adobe soil	Archie Rivera	(NE¼ 27 17N 9E)	▲10
Adobe soil	Adobe Bricks of New Mexico	SE¼ 12 20N 8E	▲11
Adobe soil	Rodriguez Brothers	NW¼ NE¼ 6 16N 9E	▲12
Adobe soil	Eloy Montanyo	(NW¼ NW¼ 12 16N 8E)	▲13
Adobe soil	Ridge Adobe	W½ 19 16N 9E	▲14
SOIL (LIMESTONE, MARBLE, SANDSTONE, GRANITE, MONZONITE, RHYOLITE, AND BASALT)			
Limestone	5920	NW¼ 36 16N 11E	○ 1
Limestone	6243	S½ 31 10N 10E	○ 2
Limestone	6464	SE¼ 27 10N 7E	○ 3
Limestone	6815	NE¼ 31 16N 11E	○ 4
Limestone	6922	NW¼ 35 10N 7E	○ 5
Limestone Limestone (quartzitic)	75-5-S 0646	SW¼ 31 11N 7E NW¼ 23 10N 10E	○ 6 ○ 7
Limestone and shale	Old prison area	(NE½ 23 12N 7E)	○ 8
Limestone and shale	—	NW¼ NE¼ 16 17N R10E	○ 9
Limestone and shale	—	(SE¼ NE¼ 17 17N 10E) & (SE¼ NE¼ 17 17N 10E)	○ 10
Limestone and shale	—	(SW¼ SW¼ 17 17N 10E)	○ 11
Limestone and shale	—	(NW¼ NE¼ 20 17N 10E)	○ 12
Limestone and shale	—	(SE¼ 20 17N 10E)	○ 13
Travertine	Borrego Mesa area	E½ 35 21N 10E	○ 14
Marble	Old Timer	14 16N 11E	○ 15
Sandstone	Sander Ranch	14 14N 11E	○ 16
Sandstone	Old Sandstone Quarries at Cerrillos	NE¼ 20 14N 8E	○ 17
Sandstone	—	NW¼ 13 14N 7E &	○ 18
		NE¼ 14 14N 7E;	
		NE¼ 14 14N 7E &	
		NW¼ 13 14N 7E	
Sandstone	Bishop's Quarry	(SW¼ 4 14N 10E)	○ 19
Sandstone	—	(SE¼ 18 12N 11E)	○ 20
Sandstone	—	(NW¼ SE¼ 18 17N 10E)	○ 21
Moss Rock (Sandstone)	Fangio Mesa area	20 15N 11E	○ 22
Moss Rock	Padre Springs area	E½ 22 15N 11E	○ 23
(Sandstone)			
Granite	5820	E½ 3 17N 10E	○ 24
Granite	55105	SE¼ 3 17N 10E	○ 25
Granite	—	NE½ 8 18N 8E	○ 26
Granite	Santa Fe City Quarry	(NE¼ 17 17N 10E)	○ 27
Granite, micaceous	0746	5 19N 10E	○ 28
Monzonite	0636	NW¼ 28 13N 9E	○ 29
Monzonite	0637	SE¼ 2 12N 9E	○ 30
Monzonite	0742	SW¼ 32 16N 8E	○ 31
Monzonite	6814	SE¼ 27 15N 8E	○ 32
Monzonite	25-15-3	SE¼ 28 15N 8E	○ 33
Monzonite	Devil's Throne Quarry	NW¼ 18 14N 8E	○ 34
Monzonite	Mina de Tiro	NW¼ 8 14N 8E	○ 35
Monzonite	25-15-6	30 15N 8E	○ 36
Monzonite	25-15-11	31 16N 8E	○ 37
Monzonite, hornblende	0681	SW¼ 5 14N 8E	○ 38
Rhyolite	—	E½ 19 13N 8E	○ 39
Latite/Rhyolite	Guaje Canyon area	4,5,31 19N 7E	○ 40
Basalt Basalt	25-15-7 0732	21 15N 7E NW¼ 7 18N 8E	○ 41 ○ 42
Basalt	—	W½ 32,33 18N 8E	○ 43
Basalt	Caja del Rio Grant	20,21,16 17N 7E	○ 44
Basalt	Cerro Seguro area	E½ 19 16N 8E	○ 45
Basalt and cinder	—	E½ 17 16N 8E	○ 46
Gneiss	—	E½ 30 19N 9E	○ 47
Granite Gneiss	Scout Camp area	29,30 20N 10E	○ 48
Granite Gneiss	Sangre de Cristo Center	NE¼ 8 18N 8E	○ 49
Metamorphic	6043	W½ 2 17N 10E	○ 50
CLAY			
Clay	Galisteo Mine	SW¼ 33 13N 9E	● 1
Clay	—	NE¼ NE¼ 2 20N 10E	● 2

TABLE 1. (continued)

Industrial Rock or Mineral	Deposit Name	Location (Sec T R)	Symbol #
Clay	BLM Community Pit	S½ 32 20N 9E	● 3
Clay	Galisteo area	S½ 24 14N 9E	● 4
Clay	Quarteles Arroyo	S½ 32 20N 9E	● 5
Clay	Borrego Trail	SW¼ 6 20N 11E	● 6
Clay (bentonite)	Santa Cruz	6 20N 9E	● 7
SCORIA, CINDERS, AND PUMICE			
Scoria	BLM Community Pit	1 15N 8E	□ 1
Scoria	—	SW¼ 22 16N 7E	□ 2
Scoria	Crego mine	SW¼ 18 16N 8E	□ 3
Pumice	American Pumice Mill	2 16N 9E	□ 4
Pumice	Copar Cuyamungue Plant	28 19N 9E	□ 5
Pumice	Guaje Canyon mine	31,32 19N 7E	□ 6
Pumice	—	15 20N 9E	□ 7
Pumice	—	SE¼ 17 19N 9E	□ 8
Cinders	Cerrito Pelado mine	NE¼ SE¼ 36 17N 7E	□ 9
Cinders	La Cienega	18 16N 8E	□ 10
Cinders	5429	W½ 14 15N 7E	□ 11
Pumice	—	S½ 32 20N 7E	□ 12
Pumice	—	NW¼ 17 16N 9E	□ 13
Pumice	White Eagle Pumice mine	4 19N 7E	□ 14
Volcanic ash	Arroyo Seco	S½ 15 20N 9E	□ 15
SEMIPRECIOUS MATERIALS			
Turquoise	Turk (Turq) #1	21 15N 8E	■ 1
Turquoise	Mt. Chalchihuitl	SW¼ 5 14N 8E	■ 2
Turquoise	Blue Jay/Blue Bell	NW¼ 9 14N 8E	■ 3
Turquoise	Cerro de la Cossna	SW¼ 32 15N 8E	■ 4
Turquoise	Verde 1-3 Claims	NW¼ 5 14N 8E	■ 5
Turquoise Beryl	Tiffany mine area Rocking Chair Claims	21 15N 8E 1 20N 10E	■ 6 ■ 7
Beryl	Santa Rita (Cordova)	7 20N 11E	■ 8
Beryl	Big Buck Prospect	18 20N 11E	■ 9
Quartz	Andrews Tunnel	NW¼ 30 15N 8E	■ 10
Petrified wood	No Name	23 14N 8E	■ 11
Petrified wood	—	SE¼ 31 14N 9E	■ 12
Petrified wood	Thornton Ranch	10,11 14N 9E	■ 13
MISCELLANEOUS MATERIALS			
Barite	El Cuervo Butte	15 10N 10E	1
Barite	Cuervo Ranch	N½ 23 10N 10E	2
Garnet	San Pedro mine	NW¼ 27 12N 7E	3
Gypsum	Rosario	32 15N 7E	4
Gypsum	La Bajada/ Rosario area	SW¼ 30 15N 7E	5
Gypsum	San Cristobal Ranch	(SW¼ 17 12N 11E)	6
Gypsum and limestone	—	(SW¼ 4 14N 10E)	7
Iron oxide	Iron Queen mine	NE¼ 23 12N 7E	8
Iron oxide	Old Timer area	NW¼ 21 12N 7E	9
Silica sand	Oro Quay	SE¼ 23 12N 7E	10
Mica	B.A.T.	E½ 1 20N 10E	11
Mica	B.A.T. Claim #5	SE¼ 3 20N 10E	12
Mica	Lucky Star Group	6,7 18N 11E + NE¼ 1 18N 10E	13
Mica	Tip Top mine	SE¼ 2 20N 10E	14
Mica	—	SE¼ 2 20N 10E	15

NOTE: ( ) = projected location by section, township and range on unsurveyed land grant

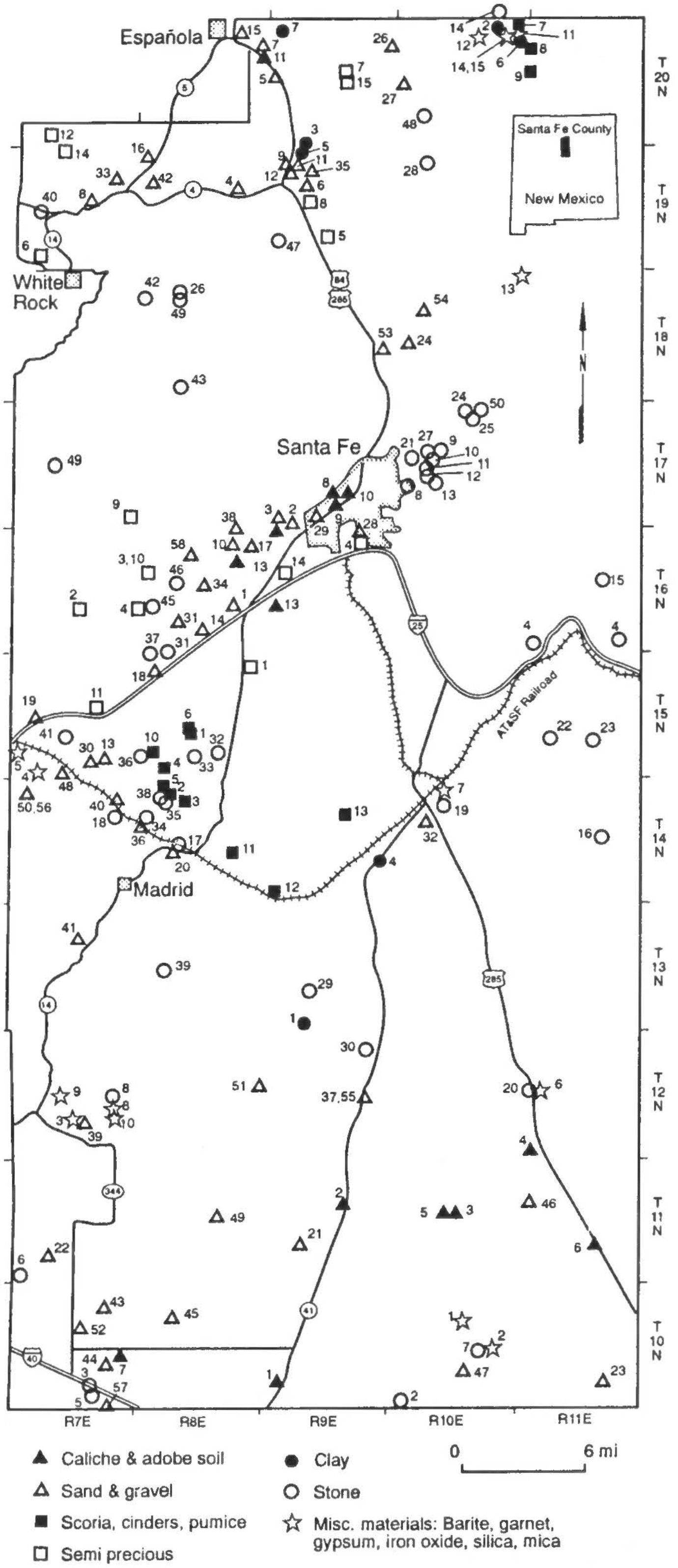

FIGURE 1. Location map for industrial mineral and rock deposits from Santa Fe County, listed in Table 1.

silt-size, and 6–8% clay-size particles (Smith and Austin, 1989). The "cement" binding these particles into unburned but durable adobe bricks consists of clay minerals and calcite and/or gypsum. The clay minerals are commonly equal parts of expandable (smectite and mixed-layer illite-smectite) and nonexpandable (kaolinite, illite, chlorite) clay minerals. During evaporation of the "hard" (rich in soluble salts) water used in adobe production, fine-grained calcite and gypsum form in the interstitial spaces of adobe. Soluble salts generally account for 10% of adobe soils with much of it as interstitial cement. Some yards blend sand, clay and straw with petroleum or portland cement stabilizers to yield more durable adobe bricks. Builders in Santa Fe probably use most of the commercial adobe block produced in the state.

Shale and clay interbedded with limestone of the Sandia Formation exist in several pits north and east of Santa Fe. Early in the century, they were fired to red tile or brick at the state penitentiary (Kottlowski in Spiegel and Baldwin, 1963). Presently, the principal use of those materials in Santa Fe County is to add to soils that are too sandy to make good adobe. The volume, however, is small and the value is low. Small amounts of clay are also quarried by potters, but the value of this material can amount to as high as $1.50/lb after proper preparation (New Mexico Bureau of Mines and Mineral Resources unpubl. files). In Santa Fe County, pottery clays consist of red clayey silt found as beds in the Tertiary Santa Fe Group and micaceous clays developed from the weathering of Precambrian gneiss, schist, and pegmatites. The former commonly consists of equal parts of expandable and nonexpandable clay and fire into red and brown ceramic objects. The latter have larger amounts of the same clay minerals but include sand- and silt-size muscovite mica flakes and various clastic grains. Ceramic objects made from this micaceous clay material may fire to lighter colors because of the lower amount of iron, and develop a sheen due to the mica.

Calcium carbonate in the arid alkaline climate of New Mexico often precipitates from rain or groundwater in soil. It slowly forms a hard, resistant layer of caliche (hardpan), making excavation, root propagation or efficient watering difficult. Most caliche is used as fill or on gravel roads, often because it is the only local material, but some is used in cement or is hydraulically pressed into soil blocks for wall construction.

Stone

Stone is quarried and used statewide but the center of stone use is in Santa Fe County and surrounding parts of north-central New Mexico. Active quarries are in the Ribera, San Miguel, Las Vegas, Anton Chico, Tecolote, Abiquiu, Albuquerque and Santa Fe areas (Austin et al., 1990). Most building stone is quarried for construction, particularly for government or large commercial buildings. Some uses require a specific stone or mineralogy, such as travertine for veneer or granite for grave monuments or memorial statues. Certain physical characteristics may be preferred, such as fissility that forms flagstone.

Limestone is abundant in Santa Fe County and was extensively quarried in the past. Older public buildings and large homes were constructed from limestones blocks. In Santa Fe County, it was also used for railroad abutments. Today, limestone is crushed locally and used as aggregate. Limestone suitable for high-calcium uses is abundant in the county (Kottlowski, 1962) and has been used for small scale lime production (Kottlowski in Spiegel and Baldwin, 1963).

Carbonate rock that polishes is known commercially as "marble." Thin marble panels are used as building veneers or floor tiles; blocks are carved into sculptures. Metamorphic marble is found in the San Pedro Mountains in small contact metamorphic zones (Elston, 1967).

Travertine is limestone deposited from warm or cold carbonate-charged spring waters. Impurities in travertine impart colors ranging from white to pink, tan, yellow, brown, or dark brown. If variable impurities cause color banding in layered travertine, it my be known commercially as tufa, calcareous sinter, marble, Mexican onyx, or onyx marble. In Santa Fe County, some dense travertine has been quarried for sculpture. The state capitol in Santa Fe contains travertine that was quarried, slabbed and polished near Belen (Austin and Barker, 1990).

Most sandstone quarried in Santa Fe County was used as blocks in large buildings. Bedded sandstone, when struck, may break into smooth sheets called flags now widely used in buildings or landscaping as flagstone. Rock, usually sandstone, may develop a weathered surface attractively spotted by algae, lichen, and moss. This is known commercially as "moss rock" and it is commonly used in walls and fireplace facings in Santa Fe County.

Although formerly popular in Santa Fe County for public buildings, use of granite other than for veneers over steel frames has been abandoned. Monzonite, latite and basalt have also been crushed locally for aggregate and decorative stone. Gneiss is resistant to weathering and is crushed locally for aggregate and is used in rock walls. Gneiss boulders are also used in landscaping.

Scoria, pumice, and volcanic ash

Santa Fe County has considerable amounts of volcanic rock, particularly on the west side of the county, related to Rio Grande rift and the Jemez eruptions. Scoria is a porous, red or black, volcanic cinder. Scoria is denser than pumice with higher strength. Scoria uses include aggregate in cinder blocks, landscaping, and lava rock in gas grills. Pumice is a porous, light-colored, volcanic glass foam. Its primary use is as natural light-weight concrete aggregate and as an abrasive. Pumice mined in western Santa Fe County is used in several local cinder block plants (Hoffer, 1994; Austin, 1994). In Santa Fe County, Jemez-derived volcanic ash is widespread and is interbedded with Santa Fe Group sand and gravel. It is used, particularly by Native Americans, as temper in clay mixtures for pottery.

Semiprecious materials

Semiprecious materials or minerals are those with relatively high value and great beauty. Some are near gemstones whereas others are collectibles when they have desirable characteristics. Santa Fe County and nearby areas contain turquoise, beryl, quartz, opal, petrified wood (Elston, 1967) and other semiprecious materials used by native Americans (Northrop, 1959; Warren, 1974). All were mined in the past but only a few are produced today, in minor amounts.

Miscellaneous industrial minerals and rocks

Other industrial minerals mined or quarried within Santa Fe County include barite, gypsum, iron oxide, mica, garnet and silica sand. Barite was mined at the El Cuervo deposit in southeastern Santa Fe County (North and McLemore, 1985; McLemore and Barker, 1985). Gypsum, used in wallboard plant in southern Santa Fe County and in soil conditioners, occurs in relatively small outcrops in the Todilto Formation (Weber and Kottlowski, 1959). Native Americans traditionally have used iron oxide (ocher) for yellow, brown or red pigment (Elston, 1967). Colorless mica (and gypsum as selenite) was used for windows in pueblos and by early settlers. Scrap mica has been produced in small amounts (Elston, 1967). Silica resources in the Glorieta Sandstone in the San Pedro Mountains were mined at the Oro Quay (San Pedro) Mine (Elston, 1967). Small amounts of garnet were shipped from the San Pedro mine in the early 1990s (Fattah, 1994).

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