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EAST GRANTS RIDGE—A MINERAL POTPOURRI

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Abstract—East Grants Ridge is relatively small, yet contains a variety of important mineral deposits. It lies only a few km northeast of Grants, New Mexico, and is composed of Mesozoic through Tertiary sedimentary and volcanic rocks. These rocks contain deposits of pumice, uranium and perlite that are being mined or were mined in the recent past. Scoria, limestone, topaz, garnet and obsidian also occur. These rocks and minerals interest the geologist as well as the collector, not only as specimens, but as indicators of other possibly economic mineral deposits.

INTRODUCTION

East Grants Ridge lies a few km northeast of Grants, New Mexico and, with West Grants Ridge and Grants Ridge to the west, forms a 14.5-km-long, 3-km-wide discontinuous topographic high (Fig. 1). This paper presents a brief review of the geologic setting of East Grants Ridge. Previously unpublished production data for the uranium and perlite mines is tabulated. The mineral potential and exploration targets are highlighted.

East Grants Ridge is composed of Jurassic and Cretaceous sedimentary rocks and is capped by a Tertiary volcanic complex (Johnston, 1953). A pumice deposit lying below the basaltic cap was mined in the 1940's. The east end of the ridge has a partial envelope of rhyolitic rocks which contain concentrations of perlite that are being mined presently. The sedimentary rocks of East Grants Ridge contain uranium which was mined in the 1950's and 1970's.

GEOLOGY

Up to 300 m of Jurassic and Cretaceous sedimentary rocks are at the base of East Grants Ridge and are described elsewhere in this guidebook. Jurassic units, from oldest to youngest, consist of the Entrada Sandstone, Wanakah Formation (formerly the Todilto Limestone and Summerville Formation; Condon and Peterson, 1986), Cow Springs Sandstone and Morrison Formation. Most of the exposures are on the north side of the ridge (Thaden et al., 1967). Cretaceous rocks, from oldest to youngest, consist of the Dakota Sandstone, Mancos Shale, Gallup Sandstone and Crevasse Canyon Formation.

The volcanic rocks of East Grants Ridge consist of an older rhyolitic phase and a later mafic phase. The older crystal-vitric ash consists of interlayered pale-yellowish-brown fragmental pumice, powdery ash and colorless glass shards (Thaden et al., 1967). Spheroidal, black, obsidian bombs and xenoliths of Precambrian granitic rocks are common. A large dome of very pale-gray, thinly flow-banded rhyolite containing abundant small feldspar phenocrysts was emplaced within the crater of the rhyolitic cinder cone. The outer part of the rhyolitic body consists of concentric envelopes of perlite and obsidian. A partial envelope of pale pink to pale-pinkish-purple, thinly flow-banded rhyolite contains abundant lithophysae. Potassium-argon dates on obsidian and perlite indicate that the unit is 3.3 ± 0.3 my old (Bassett et al., 1963a, b).

The mafic phase on East Grants Ridge consists of basalt flows on the high mesas and basaltic dikes, sills and plugs (Thaden et al., 1967). The flows are 6–12 m thick and were fed by central vents, one of which is prominently exposed near the inactive pumice quarry on the south side of East Grants Ridge (Figs. 2, 3). The mafic phase postdates the rhyolitic phase and represents the final volcanic units on the ridge.

The flanks of East Grants Ridge are mostly covered by talus and numerous basalt-capped landslide blocks. The beds in the blocks generally dip inward toward the ridge at up to 70°, suggesting rotation of the blocks. Such blocks (torevas) may be up to 600 m long and several hundred m wide (Kerr and Wilcox, 1963). The Entrada and Wanakah, as well as Cretaceous rocks are exposed in the torevas. At East Grants Ridge, the torevas are restricted to areas underlain by Cretaceous mudstone and probably represent failure of these units.

ECONOMICALLY IMPORTANT ROCKS AND MINERALS

Pumice

Pumice is a highly cellular, light-colored volcanic glass usually of rhyolitic composition. It occurs as a fragmental aggregate with individual particles ranging in size from coarse sand to blocks several m in diameter. Pumice is used as a natural lightweight aggregate, in scouring and cleaning compounds, as abrasives, soil conditioners, pozzolanic concrete additives and in many other minor end uses.

Pumice is produced from explosive volcanism when expansion of magmatic gases, principally water vapor, in hot plastic fragmental silicic ejecta causes rapid vesiculation. The particles are rapidly chilled so they retain their cellular texture and commonly have a specific gravity less than 1.0, compared with 2.5 for solid volcanic glass. Pumice deposits are found downwind from silicic eruptions in beds ranging from a few mm thick to widespread blankets many m thick.

The pumice exposed on the south side of East Grants Ridge near the prominent volcanic plug was of sufficiently high quality to yield 59,473 short tons of abrasives from 1946 to 1952 (Fig. 4). A large, but unknown, amount of pumice was produced during World War II. The Pumice Corporation of America separated lapilli and blocks of pumice from rhyolite, exotic rocks fragments and white ash by gravity separation in a mill (Fig. 5) just below the mine (Weber, 1965). Most of the mine and mill workings are gone, but the mine serves to expose further the basaltic plug and gives a striking view of the evolution of the volcanic rocks present on East Grants Ridge.

Perlite

The United States is by far the leading producer of crude perlite and is the leading consumer of expanded perlite products. New Mexico is the leading domestic producer, contributing about 85 to 90% of the total crude perlite mined in the U.S. in recent years.

About one-half to two-thirds of perlite consumption is related to construction, commonly as aggregate for plaster, concrete, insulating board and thermal insulation. Other major end uses are as a filtration medium and cryogenic tank insulation. Lesser amounts are used as a soil conditioner, soil substitute, packing material and as an extender, filler or carrier. Because of the bulkiness of the expanded product, perlite is commonly shipped in the crude form and expanded near where it is used. As a result, New Mexico has no major expansion plants within its borders, although a small plant is present in Albuquerque.

Expansion of perlite is done commercially by injection of properly sized perlite aggregate into gas- or oil-fired furnaces at temperatures of 600–900°C. The specific gravity of crude perlite ranges from 2.2 to 2.5 with a bulk density of 139–150 lbs/ft^3. Bulk density of the expanded products ranges from about 1.5 to 11 lbs/ft^3. Crude perlite expands or "pops" because it contains between 2 and 6% combined water that flashes into steam upon heating of perlite to its softening point. Expanded perlite is a white to light gray, cellular, glassy aggregate of very low density. Therefore, it is bulky, has a large surface area, low heat and sound transmission and is chemically inert in most environments.

Perlite of economic grade and tonnage occurs on the eastern part of

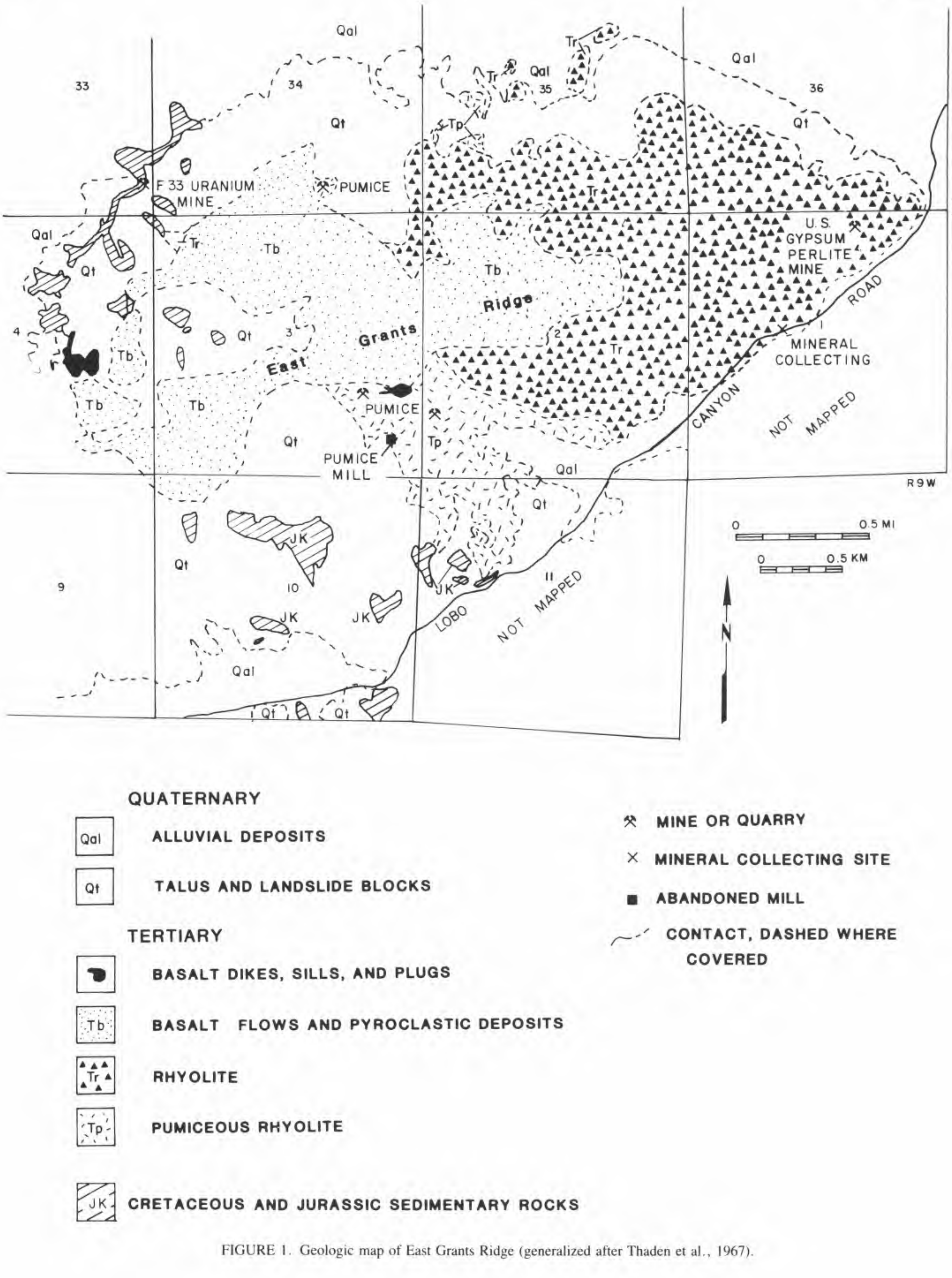

FIGURE 1. Geologic map of East Grants Ridge (generalized after Thaden et al., 1967).

FIGURE 2. Prominent basaltic plug projecting through light-colored pumice beds on the southern side of East Grants Ridge. Compare to Dutton's (1885) view in Figure 3.

FIGURE 3. View of the volcanic plug as seen by C. E. Dutton in the early 1880's (from Dutton, 1885).

East Grants Ridge. Commercial perlite deposits are usually composed of pumiceous "granular" perlite rather than of the glassy "onionskin" variety. The granular perlite tends to be of more uniform physical and chemical composition over large areas compared to classic perlite which is much more variable. U.S. Gypsum has mined granular perlite here for many years (Fig. 6), although glassy perlite crops out on the west side of East Grants Ridge. Production data from 1977–1988 (Table 1) show 127,621 tons shipped from the mill in Grants. Their mine and mill is one of four perlite operations in New Mexico. U.S. Gypsum mines perlite intermittently (Fig. 7), sizes the material at its mill in Grants (Fig. 8) and ships to various U.S. Gypsum plants nationwide as needed. The perlite is expanded at its destination and used primarily for lightweight plaster and joint compound with some used in soundproofing.

A grab sample of the perlite from the U.S. Gypsum mine was expanded at the New Mexico Bureau of Mines and Mineral Resources. Results are in Tables 2 and 3 based on a furnace temperature of 700°C and a −50 + 100 mesh fraction. A standard −50 + 100 mesh based on

FIGURE 4. Photograph of the pumice operation on East Grants Ridge during the 1940's looking west and upward toward the mine.

FIGURE 5. Photograph of the pumice mill on East Grants Ridge in the 1940's.

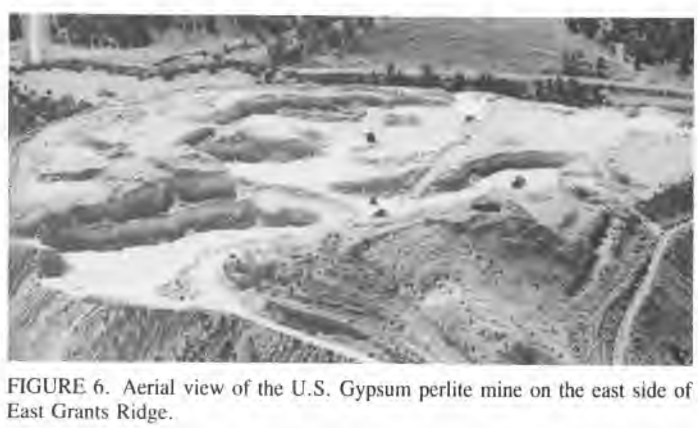

FIGURE 6. Aerial view of the U.S. Gypsum perlite mine on the east side of East Grants Ridge.

No Agua perlite from the Grefco mine was run at the same time as a control. The samples are similar in quality although slight differences occur. The U.S. Gypsum material had superior brightness and compacted density. The Grefco perlite had better yield, fewer nonexpansibles (sinkers) and broader tails (more corase and fine material) than the U.S. Gypsum perlite. Both of these perlites are of excellent commercial quality.

TABLE 1. Perlite shipped from the U.S. Gypsum mill during 1977–1988. Perlite shipped equals perlite produced (L. R. Stokes, U.S. Gypsum Co., personal commun., 1989).

Year	Perlite Shipped	Monthly Average
1977	17,200.60	1,433.55
1978	17,109.02	1,425.75
1979	15,554.90	1,296.24
1980	11,869.53	989.13
1981	9,392.22	782.69
1982	9,007.40	750.62
1983	9,340.57	778.38
1984	9,315.86	776.32
1985	8,833.51	736.13
1986	8,337.49	694.79
1987	6,279.75	523.31
1988	5,380.22	448.35
TOTAL	127,621.07	886.26

TABLE 2. Expansion data of U.S. Gypsum perlite ore from East Grants Ridge compared to the Grefco No Agua Standard. Furnace temperature was 755°C (1300°F) and sample size was 75 g sized to –50+100 mesh.

Sample Number	Percent Yield	Expanded Density	Percent Brightness	Percent Sinkers	Compacted Density
Grefco STD	97.60	2.72	60.47	0.67	3.54
US Gypsum	95.60	2.79	64.77	4.00	3.30

TABLE 3. Weight percent of expanded perlite retained on mesh after sieving. Parameters are the same as Table 2. Screens were in the Ro-tap for five minutes.

Sample Number	Mesh Size						
	20	30	50	70	100	140	PAN
Grefco STD	1.83	26.23	64.03	6.43	6.63	0.71	0.77
US Gypsum	0.31	30.31	57.31	6.31	4.51	0.71	0.61

FIGURE 8. U.S. Gypsum perlite mill, Grants, New Mexico.

TABLE 4. Uranium production from the F-33 uranium mine, East Grants Ridge. Production for 1954–1959 is from U.S. Atomic Energy Commission production records. Production from 1971 to 1977 estimated by W. L. Chenoweth (personal commun., 1989). *Some vanadium was probably produced by United Nuclear-Homestake Partners as part of their vanadium circuit.

Year	Tons Ore	U_3O_8%	V_2O_5%	$CaCO_3$%	Shipper
1954	149	0.14	0.06	71.8	Anaconda
1955	4,345	0.18	0.08	76.0	"
1956	4,755	0.18	0.08	76.0	"
1957	3,371	0.24	0.14	71.8	"
1958	20,180	0.33	–	–	"
1959	15,886	0.33	–	–	"
Subtotal 1954–1959	48,686	–	–	–	Anaconda
1971–1977	156,000	0.21	*	–	United Nuclear-Homestake Partners
Total 1954–1977	205,000	0.21	–	–	–

FIGURE 7. U.S. Gypsum perlite mine on East Grants Ridge near Grants, New Mexico.

Uranium

The F-33 mine on the west side of East Grants Ridge was the largest uranium mine in the Todilto Limestone and accounted for about 13% of the total Todilto uranium production (Chenoweth, 1985). An estimated 205,000 tons of ore averaging 0.21% U_3O_8 was produced from this mine (Table 4).

Anaconda Copper Mining Company discovered the orebody in the early 1950's. Some uranium ore was shipped from surface exposures in 1954, and a decline was driven into the mesa in 1955. In 1957, the decline intersected a fault, and a second decline was driven to keep the workings on the ore. A third decline was driven north of the main portal to provide ventilation to the production areas of the mine. Anaconda ceased mining in 1959 when the company closed its carbonate-leach circuit at the Bluewater mill. United Nuclear-Homestake Partners leased the property in 1971 and operated the F-33 until 1977 when reserves were exhausted.

Uranium occurred in a cluster of deposits along northeast-trending intraformational folds in the middle and upper portions of the Todilto Limestone Member of the Wanakah Formation. The largest orebody was 30 m wide, 4.6 m thick and at least 366 m long (Hilpert, 1969; Hilpert and Moench, 1960). The ore was offset by the San Rafael fault zone (Kerr and Wilcox, 1963). Uranium minerals include carnotite, uraninite, pitchblende, coffinite and tyuyanumite with barite, fluorite and pyrite as gangue minerals. Grantsite, a rare vanadyl vanadate, was also found at the F-33 mine (Weeks et al., 1961).

MINERAL COLLECTING

East Grants Ridge is well known to many mineral collectors for excellent micromounts of quartz, clear topaz and red to red-brown garnets found in cavities and lithophysae in Tertiary rhyolite. Samples can easily be collected from rhyolite blocks on the left (north) side of Lobo Canyon road just beyond a sharp curve 3.2 mi from the Cibola National Forest boundary (Fig. 1; McLemore et al., 1989). Apache tears up to 3 cm in diameter are in the soil weathered from the rhyolite. Quartz occurs as horizontally striated crystals less than 1 mm long and

FIGURE 9. Topaz crystals (6 mm long) in vugs of East Grants Ridge rhyolite.

FIGURE 10. Red garnet in vugs of East Grants Ridge rhyolite (1 cm diameter).

forms druses on cavity linings. The crystals are colorless, clear and relatively free of inclusions. Topaz crystals, 6 mm or more in length, occasionally occur in the lithophysae (Fig. 9). Topaz generally occurs as colorless to very slightly amber, vertically striated, single crystals with well-developed terminations. Garnets are common in the rhyolite (Fig. 10) as dark red to red-brown gemmy individuals which are relatively free of inclusions and are 1 mm or less in diameter. The crystal form is most commonly a trapezohedron (211), sometimes modified by a dodecahedron (110). The garnet has been determined by microprobe analysis to be spessartine (De Mark, 1989).

ECONOMIC POTENTIAL

Currently, only perlite is being intermittently produced from East Grants Ridge. Perlite reserves are large and will continue to be mined in the future. Although some pumice remains on the ridge, it is unlikely that additional production will occur. Basaltic overburden and steep terrain at the deposit make it uneconomic to produce. Uranium reserves in the Todilto Limestone Member have been mined out, and subsequent exploration did not reveal additional deposits. The Westwater Canyon Member of the Morrison Formation is oxidized and barren of uranium mineralization in the East Grants Ridge area. Topaz and garnet in the rhyolite on the ridge suggest tin potential. The rhyolite on East Grants Ridge is similar to tin-bearing rhyolites in the Black Range of south-central New Mexico (D. I. Norman, personal commun., 1985) and should be examined for tin resources. Mineral collecting at East Grants Ridge will also continue.

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Sandstone bluff overlook, El Malpais National Monument. View looking NE of Jurassic Zuni Sandstone with Mt. Taylor on skyline. Photograph taken 22 January 1989 by Paul L. Sealey.