MISCELLANEOUS FIELD STUDIES
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PAMPHLET

MINERAL RESOURCE POTENTIAL OF THE CHAMA RIVER CANYON WILDERNESS AND CONTIGUOUS ROADLESS AREA, RIO ARRIBA COUNTY, NEW MEXICO

By

Jennie L. Ridgley, U.S. Geological Survey
and
Thomas D. Light, U.S. Bureau of Mines

STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and related acts, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Chama River Canyon Wilderness and contiguous Roadless Area (03098), Santa Fe and Carson National Forests, Rio Arriba County, N. Mex. The area was established as a wilderness by Public Law 95-237, Feb. 24, 1978.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The Chama River Canyon Wilderness and Roadless Area have a moderate to high potential for the presence of small deposits of copper with associated uranium and silver. These deposits, as yet undetected, would occur in the Permian Cutler Formation and in the lower part of the Triassic Chinle Formation, rock units that are, for the most part, present only in the subsurface. The presence of these deposits is inferred because such deposits occur in rocks of equivalent age in adjacent areas. Gypsum, of probable minable quality and quantity, occurs throughout the area. Oil and gas are possibly present in Pennsylvanian strata in the subsurface, although no drilling in the study area has tested this hypothesis. Other commodities, including noncopper-related uranium, kaolinite, chromium, vanadium, manganese, and bitumen, although present locally in anomalous concentrations, do not appear to constitute potential resources for these commodities.

INTRODUCTION

The Chama River Canyon Wilderness, in Rio Arriba County, north-central New Mexico, was established by Congress in 1978 (fig. 1). It covers 50,300 acres (20,365 hectares) within the Coyote and Cuba Ranger districts of the Santa Fe National Forest and the Canjilon Ranger district of the Carson National Forest. In 1979 the U.S. Forest Service, under the Forest Service Roadless Area Review and Evaluation (RARE II) program, designated three additional areas, contiguous to the wilderness, for further planning to assess wilderness characteristics (fig. 1). These areas, totaling 4,800 acres (1,925 hectares) were collectively designated Roadless Area 03098.

The Chama River Canyon Wilderness and adjacent Roadless Area are approximately 70 mi (120 km) northwest of Santa Fe and nearly 130 mi (220 km) north of Albuquerque. The areas are accessible by several Forest Service roads that join major highways in the vicinity (fig. 1).

The wilderness and adjacent roadless area consist of the steep canyons and adjacent slopes cut by the Rio Chama, Rio Gallina, and their tributaries. The elevation ranges from 6,300 ft (1920 m) above sea level along the valley of the Rio Chama to 8,900 ft (2715 m) at Mesa Alta, in the southern part of the wilderness.

GEOLOGY

Rock units exposed in the study area range in age from Permian to Quaternary. Permian rocks consist of sandstone, siltstone, and mudstone of the Cutler Formation that formed from sediments deposited in fluvial and coastal marine environments (Ridgely, in Green, 1982). They are exposed only in two small areas, one within the southern part of the roadless area and the other in the western part of the wilderness along the western margin of the major north-south-trending fault in the area. Permian rocks are unconformably overlain by Triassic sedimentary

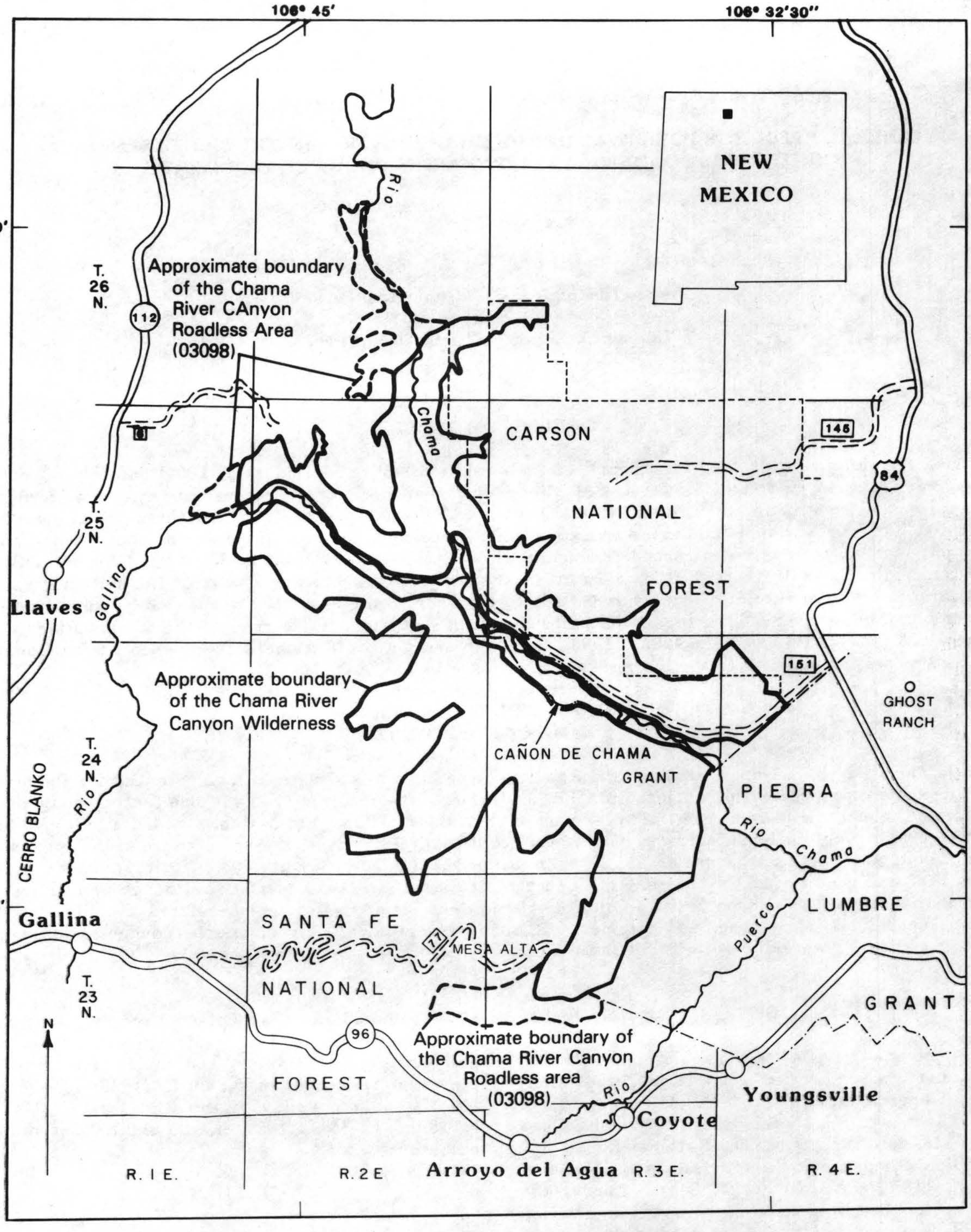

Figure 1.--Index map showing the location of the Chama River Canyon Wilderness and contiguous Roadless Area (03098), Rio Arriba County, N. Mex.

rocks. The Triassic units include red beds of the Chinle Formation that consist of sandstone, siltstone, and mudstone; locally, these rocks are interbedded with pebble conglomerate and limestone. Rock units of Triassic age were deposited in low-energy fluvial and lacustrine environments. Triassic rocks are present throughout the southern two-thirds of the study area.

Triassic rocks are unconformably overlain by Jurassic rocks that consist of sandstone, siltstone, mudstone, limestone, and gypsum. The Jurassic rocks were deposited in a variety of environments that include eolian, lacustrine, possible marine, and fluvial (Ridgley, 1977). The Jurassic rocks in the study area are assigned to the Entrada Sandstone, Todilto Limestone, and Wanakah and Morrison Formations. The Jurassic rocks are unconformably overlain by Cretaceous rocks, which consist of the Burro Canyon(?) Formation and the Dakota Sandstone, which are separated by an unconformity. Cretaceous rocks consist of conglomerate, sandstone, and shale that formed from sediments deposited in fluvial and coastal marine environments. Jurassic and Cretaceous rocks are found throughout the study area where they form the walls of canyons and mesa tops.

Quaternary deposits consist of alluvium, talus, and landslides. Older alluvium consists of semiconsolidated clay, silt, sand, and gravel that form blanket deposits on surfaces topographically above the modern valley floor. Younger alluvium consists of unconsolidated clay, silt, sand, and cobbles deposited in modern perennial and ephemeral stream valleys and their adjacent flood plains. Talus and landslide deposits consist of rocks and blocks of various sizes derived from the adjacent cliffs.

The Chama River Canyon Wilderness and adjacent Roadless Area are in the southern part of the Chama basin, in the southeast part of the Colorado Plateaus physiographic province. The wilderness and contiguous roadless area are in a structural transition zone. Rocks in the western part of the study area are folded and faulted and form the southern part of the Archuleta anticlinorium, a series of faulted anticlines and synclines that separate the Chama basin from the San Juan basin to the west. These structural features formed during the Laramide orogeny of Late Cretaceous and early Tertiary age. Structural features that characterize the eastern part of the study area consist of gently north- and northwest-dipping strata, broad open folds or warps, and a few steep, normal faults (Smith and others, 1961).

GEOCHEMISTRY

Reconnaissance geochemical studies of the Chama River Canyon Wilderness and adjacent Roadless Area were conducted to check for indistinct or unexposed mineral deposits. The different rock units of each formation were sampled at several localities throughout the study area to assess background and anomalous concentrations of various elements. Dry stream-sediment and panned-concentrate samples were collected from nearly all first- and second-order drainages in the study area. The minus 80-mesh stream-sediment fraction was chemically analyzed and the resultant data examined for anomalous concentrations of certain elements. Only the nonmagnetic parts of the panned concentrates were chemically analyzed. Mineralogical identification of several of these samples was performed. Data gathered from these geochemical studies indicate anomalous concentrations of several elements; however, none of these anomalies is considered large enough to indicate a potential mineral resource.

Uranium in anomalous concentrations was found in three dry stream-sediment samples and two rock samples. Dry stream sediments contained 5 ppm (parts per million) uranium at Berry Canyon, in the northern part of the study area; 2.2 ppm and 3.0 ppm uranium at two closely spaced sample sites at the head of Canada de las Fuertes, in the southern part of the study area; and 3 ppm uranium at a sample site along the north side of the Rio Chama. No known uranium prospects or mines occur at either of the first two localities. The drainage in Berry Canyon passes through the Dakota Sandstone and Burro Canyon(?) Formation. The drainage in Canada de las Fuertes passes through the Dakota Sandstone, Burro Canyon(?) Formation, and Brushy Basin Member of the Morrison Formation. In both places, the sample sites are at the wilderness boundary. At Canada de las Fuertes, the areas drained lie outside the study area.

The uranium anomaly at the Rio Chama sample site is associated with known uranium prospects in the Triassic Chinle Formation (Light, 1983, sample sites 27-36). The drainage system passes through this locally mineralized area.

An anomalous concentration of uranium (26 ppm) was detected in one limestone sample from the Todilto Limestone at Mesa Alta. This area adjoins a part of the roadless area that is known to contain a uranium prospect in the Todilto (Hilpert, 1969; Light, 1983, sample site 47). The uranium is not associated with any refractory mineral in this sample. An anomalous concentration of uranium (46 ppm) was detected in a siltstone sample from the upper part of the Chinle Formation in the central part of the study area. This sample also contains an anomalous concentration (2,000 ppm) of vanadium. No known uranium prospects occur in the Chinle in this area.

Chromium was detected in anomalous concentrations in sandstone from the Wanakah Formation at two sample localities; one near Navajo Peak and the other at Mesa Alta. Amounts detected were 150 and 70 ppm, respectively. The form of the chromium in these rocks is not known. The sample site at Navajo Peak is at a locality that was prospected for uranium. Geochemical data from this area did not reveal any other anomalies, although fairly high manganese concentrations were noted locally. Light (1983) and Hilpert (1969) have reported minor uranium anomalies from this area. Chromium anomalies were also detected in two stream-sediment samples, one from Presa Spring near the southwestern wilderness boundary, and the other from along the south side of the Rio Chama, east of the mouth of Canada del Potrero. Amounts detected were 200 and 150 ppm, respectively. At Presa Spring, rocks drained are the Dakota Sandstone, Burro Canyon(?) Formation, and the upper part of the Morrison Formation. No anomalous concentration of chromium was detected in rock samples from these formations during this study. The sample site along the south side of the Rio Chama is in a stream that drains the Chinle Formation. No anomalous amounts of chromium were detected in rock samples of the Chinle; however, background levels of chromium are higher than in rocks from other formations.

Anomalous amounts of chromium (700 to 1,000 ppm) were detected in four panned-concentrate samples; however, the sites of these samples do not coincide with anomalous stream-sediment or rock-sample localities. The sites are along the Rio Gallina and Rio Chama, and in Ojitos Canyon. What minerals contain the chromium are not known. Also, it is not known whether rocks in these areas contain more chromium or whether the chromium-bearing minerals are more concentrated in these four drainages. None of the chromium anomalies suggest any significant concentrations of this element.

Anomalous vanadium (2,000 ppm) was detected in one siltstone sample from the Chinle Formation in the central part of the study area. Other rock samples from the Chinle, including one from near this sample site, contained 100 ppm or less vanadium. Further study is necessary to delineate the extent of this anomaly.

Manganese (5,000 ppm) was detected in siltstone, sandstone, and conglomerate samples from the upper part of the Chinle at three widely spaced localities. Although these values are anomalous compared to concentrations (500-2,000 ppm) of manganese detected in the other Chinle samples of similar lithology, the amounts are not large enough to be potential mineral resources.

MINING DISTRICTS AND MINERALIZATION

Prior to the field investigation, the published and unpublished literature on the geology and mineral activity in the study area was reviewed in detail. Mining-claim location notices were examined at the Rio Arriba County Courthouse in Tierra Amarilla. Records of the U.S. Bureau of Land Management State office in Santa Fe were checked for patented claims and oil and gas leases. Mining-claim files were checked at the Santa Fe National Forest supervisor's office.

The Chama River Canyon Wilderness and Roadless Area are not within a formal mining district but have been referred to as part of the Abiquiu, Coyote, Gallina, or Mesa Alta districts.

Mining claims have been located in and around the study area for uranium, kaolinite, platinum-group metals, and rare-earth metals. During the mid-1950's, when uranium exploration was at its peak, many mining claims were located throughout the area. Exploration for uranium was revived during the 1970's, and many more claims were staked. Prospect pits have been dug at several locations, but no production has been recorded from any of the properties in or near the Chama River Canyon Wilderness and Roadless Area.

The Ensign claim, secs. 2 and 11, T. 23 N., R. 2 E., is the only patented claim in the vicinity of the wilderness. Claims that could be accurately plotted are shown on the mine and prospect map of the Chama River Canyon Wilderness and Roadless Area (Light, 1983). No production has been recorded in the vicinity of the wilderness, and the only activity in 1980 was assessment work on claims.

Field investigations by U.S. Bureau of Mines personnel focused on known mines, prospect workings, and mineralized areas. Surface and underground workings within 1 mi (1.6 km) of the wilderness and roadless area were sampled and mapped. Supposed locations of mining claims were examined and sampled where workings or mineralized rock were found. All known uranium-bearing areas were examined using a scintillometer. Chip samples taken at each working were analyzed for uranium content. A total of 48 samples was collected, including chip, select, and dump samples from workings, stream-sediment samples, stream panned-concentrate samples, and outcrop samples. Results of sample analyses and detailed maps of surface and underground workings are shown on the mine and prospect map of the wilderness (Light 1983) and are available from U.S. Bureau of Mines, Intermountain Field Operations Center, Mineral Land Assessment Section, Building 20, Box 25086 Federal Center, Denver, Colorado 80225.

Most of the mineral exploration around the Chama River Canyon Wilderness and Roadless Area has been for uranium. Several prospects have been dug in the Todilto Limestone, and Morrison and Chinle Formations.

High-quality gypsum is irregularly distributed in the upper member of the Jurassic Todilto Limestone. The Todilto crops out in the canyon walls along the Rio Chama, and the gypsum is inferred to underlie the mesas.

Kaolinite occurs locally at the contact between the Cretaceous Burro Canyon(?) Formation and the Cretaceous Dakota Sandstone. Drilling operations at the Ensign claim by the Southwestern Kaolin Corp. indicated that kaolinite more than 50 ft thick may be present in the Mesa Alta area (Reeves, 1963, p. 248).

Stratiform or red-bed-type copper deposits with associated uranium and silver occur in the Permian Cutler Formation and in the Agua Zarca Sandstone Member of the Triassic Chinle Formation within several miles of the Chama River Canyon Wilderness and Roadless Area. The most favorable locations for deposits are in paleochannels containing abundant carbonaceous material (Kaufman and others, 1972). LaPoint (1974) has suggested that the source of the mineralization is the Precambrian metavolcanic terrains to the north.

OIL AND GAS

Wells in the Puerto Chiquito field, T. 25-27 N., R. 1 E., have produced oil from the Niobrara Member of the Cretaceous Mancos Shale (Arnold, 1974, p. 325). Much of the land in and around the wilderness has been previously leased for oil and gas. The Mancos is not present within the wilderness, and nearby wells were not deep enough to penetrate the Pennsylvanian units that contain oil and gas elsewhere in the San Juan basin.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Examination of geologic, geochemical, and mine and prospect data indicates the possibility for several types of mineral resources in the Chama River Canyon Wilderness and contiguous Roadless Area. However, these resources, if present, are not likely to be very substantial. A moderate to high potential exists for the presence of as yet undetected red-bed stratiform copper deposits with associated uranium and silver in the Permian Cutler (Abo equivalent) and lower part of the Triassic Chinle Formations (fig. 2). These rock units occur for the most part in the subsurface; thus, drilling would be necessary to locate anomalous areas. Rock facies of both of these formations are presumed to be similar to those that are locally mineralized outside the study area. Stratiform copper deposits are present in the Chinle and Cutler Formations in the nearby Cuba, Gallina, and Coyote areas (Chenoweth, 1974). These deposits range in size from a few thousand to several hundred thousand tons containing 0.5 to 5 percent copper. Chemical analyses of samples from some of these deposits indicate the presence of several hundred parts per million uranium and as much as 50 ppm silver (Green, 1982).

Gypsum in the Todilto Limestone is the resource having the highest known potential in the Chama River Canyon Wilderness and Roadless Area (fig. 3). This unit is presently being mined to the south at San Ysidro, N. Mex., and workings have recently been started on Cerro Blanco, near Gallina. The quality of gypsum is apparently suitable for wallboard. Approximately 50 percent of the wilderness and 75 percent of the roadless area contain gypsum in the Todilto. The Todilto Limestone is not easily accessible in the study area and is closer to better road systems outside of it, so that any current mining potential in the wilderness area is reduced.

The potential for noncopper-related uranium resources is considered to be low to nonexistent for all formations, except the Todilto Limestone. In the southern part of the San Juan basin, the Morrison Formation is the host for major uranium resources. Facies that contain significant uranium resources in this area are absent from the study area. In the study area, uranium in the Morrison is usually associated with fossil bone fragments. Lack of favorable facies coupled with the fact that the formation is either exposed, and thus subject to leaching, or eroded throughout the wilderness, indicate no potential for uranium resources in the Morrison.

The Cretaceous Burro Canyon(?) Formation and Dakota Sandstone are hosts for small, low-grade uranium deposits near Canjilon, N. Mex., east of the wilderness. Trace amounts of uranium in these formations in and immediately adjacent to the wilderness suggest that uraniferous ground water passed through these rocks. However, these formations, for the most part, have been eroded from the wilderness. In the wilderness, they generally are present only in the outer part of the canyon rims. In the southern part of the wilderness, where more of the Burro Canyon(?) Formation and Dakota Sandstone lie within the wilderness, surface geologic examination indicates that the formations are oxidized; thus, any uranuim present would probably have been leached. Evidence of leaching and erosion of significant parts of the formations indicates that these formations have no potential for uranium resources in the study area.

Only the Todilto Limestone may have potential for containing noncopper-related uranium resources. In the southern part of the San Juan basin, uranium deposits in the Todilto have been mined. The presence of one uranium anomaly and two prospects in the Todilto in the wilderness and adjacent roadless area, and one small uranium prospect outside the wilderness near Coyote, N. Mex. (Chenoweth, 1974) that was mined, suggest that the uranium potential of the Todilto should not be overlooked. All of the surface area of the wilderness has probably been prospected at one time or another. No additional uranium prospects have been reported in the literature. Drilling coupled with reconnaissance geochemical sampling, in particular using changes in vanadium concentration (Ridgley, 1983), would be necessary to identify any subsurface uranium occurrences.

All the uranium anomalies, prospects, or mines in the Todilto occur in the limestone facies that are not overlain by the gypsum facies. In these areas sandstone of the Wanakah Formation overlies the limestone facies of the Todilto. Target areas for uranium exploration thus are where the gypsum facies of the formation is absent (fig. 3).

Small kaolinite resources exist at Mesa Corral just south of the wilderness area. The kaolinite deposit is in the upper part of the Burro Canyon(?) Formation. Although this kaolinite is of high quality, the potential for any significant resources in the wilderness is low because the formation has been eroded from much of the wilderness. In areas where the formation lies within the wilderness, these kaolinite-rich lenses are locally absent owing to erosion prior to deposition of fluvial sandstone of the overlying Dakota Sandstone.

The oil and gas potential of the wilderness has not been adequately tested. The Dakota Sandstone, which yields oil, in the eastern part of the San Juan basin is either at the surface or has been eroded from most of the wilderness, and thus has no potential for any oil or gas resources. Pennsylvanian strata, which have yielded oil and gas in the San Juan basin, have not been sufficiently drilled to determine the potential for favorable facies and the presence of structural or stratigraphic traps at depth.

Fitter (1958) reported that at the Skelly Oil Co. #1 Crittenden drill hole, spudded in 1948, shows of oil were found in Pennsylvanian strata at two horizons. The well was drilled in sec. 36, T. 24 N., R. 1 E., several miles outside the study area. No commercial amounts of oil and gas were found. Pennsylvanian rocks from this hole were described as gray, fine- to medium-crystalline limestone, gray and maroon shale, and medium- to coarse-grained, angular, arkosic sandstone (Fitter, 1958). These data suggest that the study area, which is underlain by Pennsylvanian strata, may have a low to moderate potential for oil and gas resources (fig. 2).

Bitumen has been reported in the Todilto Limestone (Foster, 1965, p. 118). However, geologic examination of the Todilto did not reveal any oil-producing bitumen resources within the wilderness and roadless area. Thus, the potential for this resource is considered nil to low.

Geochemical surveys of the wilderness and adjacent roadless area indicate the presence of minor anomalous concentrations of chromium, vanadium, and manganese; none of these elements appear in concentrations that might be indicative of potential mineral resources.

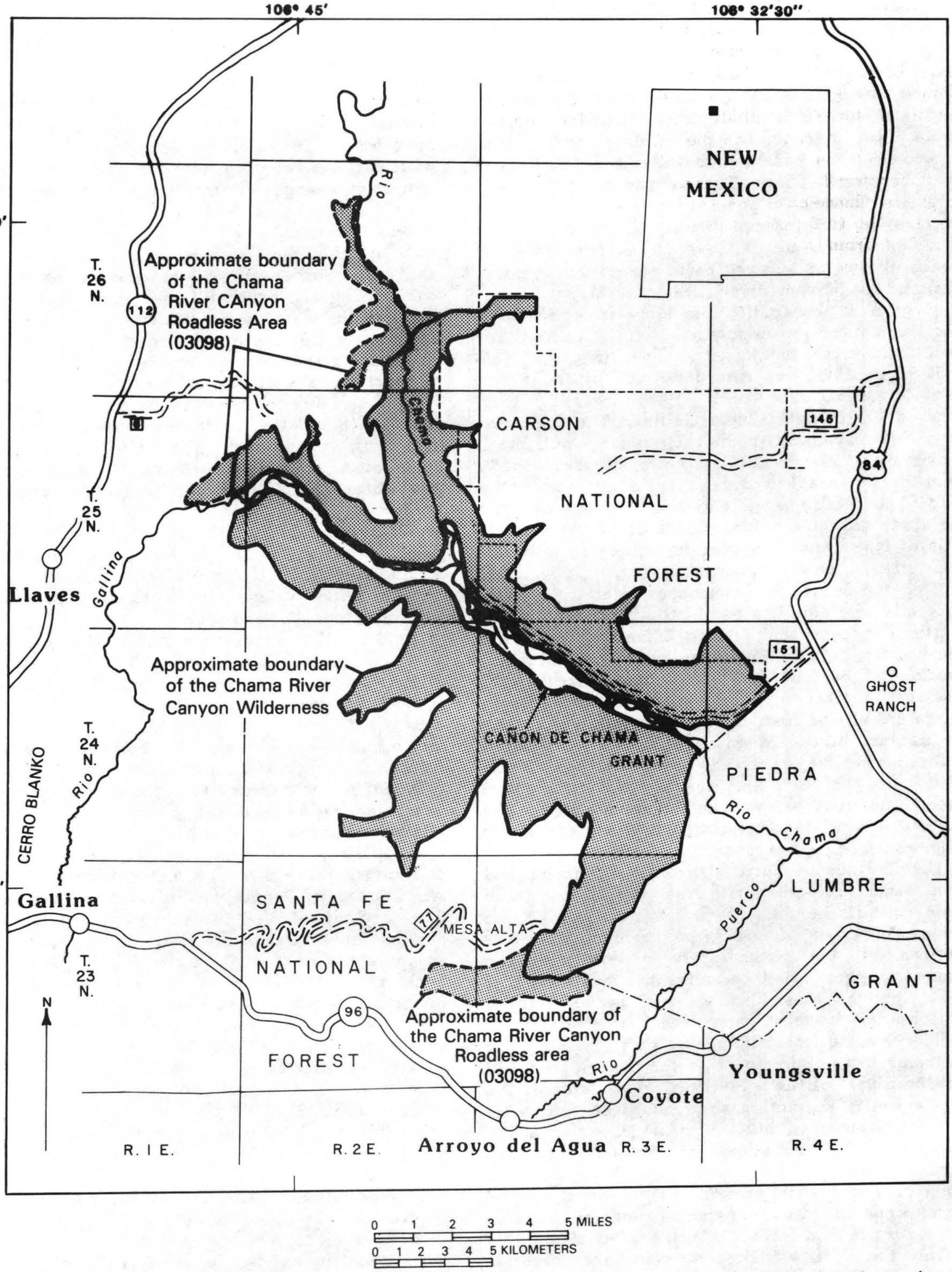

Figure 2.--Map showing resource potential for copper with associated uranium and silver, and for oil and gas, Chama River Canyon Wilderness and adjacent Roadless Area.

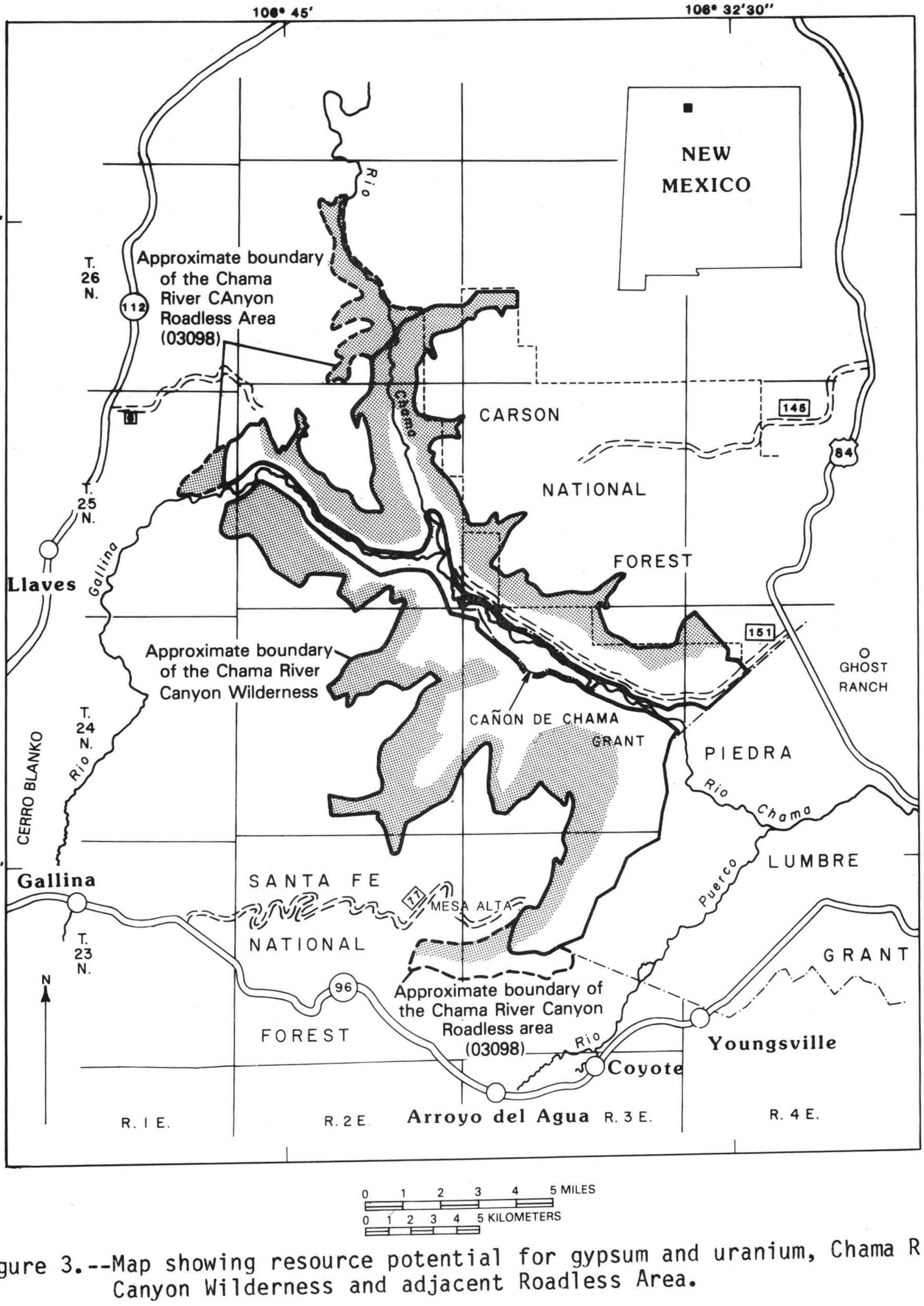

Figure 3.--Map showing resource potential for gypsum and uranium, Chama River Canyon Wilderness and adjacent Roadless Area.

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