COLORADO GEOLOGICAL SURVEY

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Evaluation of Mineral and Mineral Fuel Potential of Teller County State Mineral Lands Administered by the Colorado State Land Board

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The Colorado Geological Survey (CGS) is releasing an evaluation of the mineral and mineral fuel resource potential of the nearly 12,240 acres of state mineral lands located in Teller County as part of its long-term evaluation of approximately 4,000,000 acres of state lands administered by the State Land Board. The CGS divided the lands, for evaluation purposes, into 21 individual tracts that range from approximately 160 acres to 640 acres. Mr. James A. Cappa, minerals geologist and staff member of the CGS, is the author of this report. Mr. John Keller, minerals geologist and staff member of the CGS, edited substantial portions of this text.

This open file report includes a general overview summary of the geology and mineral potential of the entire Teller County along with maps of tract locations, oil and gas tests, and industrial mineral prospects. The main body of the report is an evaluation of each individual tract.

Four general categories of resources are included in this inventory:

- oil and gas
- coal
- metallic minerals
- industrial minerals and construction materials.

Each individual tract evaluation includes:

- A bar graph which ranks each tract's resource potential for each of the four mineral categories. An explanation of the categories may be found with the tract summaries.
- Tract identifier number, county name, and county location map.
- Tract location on a 7-1/2-minute United States Geologic Survey topographic map.
- Tract location on a United States Geologic Survey surface outcrop map.
- Location as to section, township, and range and approximate acreage.
- Overview of tract geology.
- Specific assessment of the resource potential for the four resource categories.
- References used in assessing tract potential.

All maps showing Teller County tract boundaries were prepared by Ms. Melissa J. Crane, University of Colorado geology student serving an internship at the CGS. These maps were assembled by overlying the boundaries provided on a State Land Board computerized base map onto the United States Geologic Survey map bases in a Geographic Information System environment. Tract boundaries were not checked against the State Land Board's detailed land records because of time constraints.

Introduction

Teller County is located in the broad southern arch of the Front Range Highlands. A large part of the county consists of X and Y age Proterozoic igneous and metamorphic rocks that make up the core of the Front Range. The Trout Creek graben consists of a block of Paleozoic sedimentary rocks north of Woodland Park and along Trout Creek. The bounding fault on the north is an extension of the north-northwest-trending Ute Pass Fault. There is another area of Paleozoic rocks in the southern part of the county; however, this area is not related to a major structural feature, like the Ute Pass Fault. The southern part of the county is partially covered by Early Tertiary volcanic rocks of the Thirtynine Mile Volcanic field and the Wall Mountain Tuff. The Florissant Lake beds are exposed in the in the western part of the County south of Florissant. Locally, there are exposures of the Tallahassee Creek Conglomerate and Echo Park Alluvium. The mid- to late Oligocene Cripple Creek diatreme, which consists of phonolite and phonolite breccia and other alkalic volcanic rocks, was intruded along the junction of four major Proterozoic rock units.

Oil and Gas Resources

Teller County has no potential for oil and/or natural gas production.

Coal Resources

Teller County has no known coal bearing rocks.

Metallic Mineral Resources

The Cripple Creek district of Teller County is one of the most important gold producing districts in the U.S. Since its discovery in 1893 the district has produced 24 million ounces of gold. Currently (1999) there is a large open pit mine, the Cresson open pit Mine, in the district producing about 235,000 ounces of gold per year from low grade disseminated ore in the phonolite and phonolite breccia. The Cripple Creek intrusive-diatreme complex consists primarily of a large mass of heterolithic breccia. Phonolite, latite-phonolite, syenite, and alkali basalt intrude the breccia throughout the complex. The Cripple Creek breccia is a heterolithic breccia and tuff composed of fragments of Proterozoic igneous and metamorphic rocks and Tertiary rocks. The breccia is at least 3,300 feet thick (Thompson and others, 1985) and occupies three separate subbasins (Loughlin and Koschmann, 1935). There are fluvial and lacustrine sediments interbedded with the Cripple Creek breccia in the eastern half of the complex. Carbonized tree trunks and coal layers are also present within the breccia at depths up to 800 feet (Lindgren and Ransome, 1906). Phonolite and latite-phonolite are the most widespread igneous rocks in the Cripple Creek district. The latite-phonolite is a distinctly porphyritic phase with phenocrysts of orthoclase, oligoclase, and pyroxene up to 1 centimeter in size (Thompson and others, 1985). The phonolite occurs as dikes, upward-flaring domes, flows, and tabular bodies. Although it is generally aphanitic, locally it is slightly porphyritic with mostly sanidine phenocrysts. Wobus and others (1976) reported potassiumargon dates of 27.9 and 29.3 Ma for the phonolite. Argon-argon isotope dates on sanidine from the phonolite by Kelley and others (1993) indicate an emplacement age of 31.4 to 32.5 Ma.

In a general sense, the Cripple Creek basin is elongated in a northwest-southeast direction, which probably reflects a major tectonic direction in the underlying Proterozoic rocks. The basin walls are generally steeply dipping and irregular in form. There are local overhangs especially in the southwestern part of the basin. The ore-bearing veins and vein systems of the Cripple Creek district are radially dispersed about a central granite block and are related to structural features in the underlying Proterozoic rocks, such as buried granite horsts, and zones of sharp bending in the contact of the volcanic basin rocks and Proterozoic rocks (Koschmann, 1949). The Cripple Creek district consists of a broad uplifted area of Proterozoic igneous and metamorphic rocks that was intruded by an alkalic intrusive-diatreme complex during the late Oligocene (approximately 32 Ma for the most differentiated intrusive rocks to 28 Ma for samples from the more mafic phonolites [Kelley and others, 1993]).

The origins of this intrusive complex, well outside the northeast-trending Colorado mineral belt, are still debatable; however, Thompson and others (1985) indicated that the early stages of the opening of the Rio Grande Rift, which extends from New Mexico through central Colorado, were responsible for the alkalic intrusive-diatreme complex. The main episode that produced all of the various types of ore deposits in the Cripple Creek district followed the main stage of intrusive and diatreme emplacement. The first hydrothermal event was essentially a high temperature event (>350° C) resulting in widespread propylitic alteration and enhanced rock permeability. The second hydrothermal event had many stages all at approximately 180° C with low salinities. An extensive amount of the potassium feldspar alteration is associated with this hydrothermal event (Pontius, 1993). The mineralizing fluids followed structural zones and other permeable pathways to create the large vertical extent of mineralization of both gold tellurides and the free gold.

Early reports of gold ores in the district in 1874 and 1884 did not result in the establishment of the vibrant mining district of later years (Penrose, 1895). A local rancher named Robert Womack made a gold discovery in 1891 and located the El Paso claim in Poverty Gulch, which was later developed into the Gold King Mine, the first of series of gold discoveries, which lead to the rapid development of the district. The rich underground mines in the early years of the district's history had an average grade of 1 to 2 ounces of gold per ton. The Cripple Creek district has produced more than 24 million ounces of gold. In the peak year of production, 1900, 879,000 ounces of gold were produced. By 1920 production from the district had declined because of labor shortages, wage disputes, and water problems. In 1933 the price of gold increased from $20.67 to $35.00 an ounce which fostered mining in the district until the outbreak of World War II and the closure of all non-essential mines by the War Production Board in 1942.

All restrictions on the price of gold were lifted during the mid-1970s and interest focused on low grade, bulk-tonnage gold deposits in the district. The main areas of interest in the recent years are the low-grade, hydrothermal breccia deposits at Globe Hill and Ironclad. Texasgulf Minerals and Metals Co. and Golden Cycle Corporation formed the Cripple Creek and Victor Gold Mining Company (CCVGMC) and explored the area in the early 1980s. CCVGMC processed some old dump materials. Nerco Minerals bought Texasgulf Minerals and Metals Co. interest in 1989 and formed Pikes Peak Mining Company (PPMC). At that time there were no economic reserves known in the district. In the years from 1990 to 1993 PPMC drilled more than 900,000 cores mostly in the area of the Cresson Mine and the Globe Hill and Ironclad open pit mines. They discovered a drill-indicated resource of 3,400,000 ounces of gold that has within it a proven and probable reserve of about 1,850,000 ounces (Pontius, J.A., PPMC, written communication, 1993). During 1991 PPMC produced 15,500 ounces of gold and 10,000 ounces of silver from old waste dumps in the district. Mining operations commenced at the Globe Hill and Ironclad open pits late in that year. The announced reserve was 4 million tons of ore at 0.04 ounces per ton. In 1992 production from the two open pit mines jumped up to 42,400 ounces of gold and 11,900 ounces of silver. Gold Production in 1993 was 49,100 ounces of gold and 7,900 ounces of silver. Mining operations at the Globe Hill open pit mine ceased during 1993 and the Ironclad Mine closed in 1994.

In May 1993, Independence Mining announced that it had acquired 100 percent of PPMC. Plans for the future include the construction of the new Cresson open pit mine scheduled to be in production by 1995. The ore deposit at the new Cresson open pit mine is a disseminated, low-grade, bulk-tonnage type ore body in contrast to the historical high grade veins and "vugs" of the Cresson Mine. Rock types in the new open pit mine include phonolites, hydrothermal breccias, syenites, and various ultramafic lamprophyres. The primary mineralized structural trend is north-northwest which follows pre-existing structures in the Proterozoic basement rocks. Alteration is ubiquitous and ranges from propylitic to strong argillic and potassic.

The new Cresson deposit contains only native gold associated with pyrite and hydrous iron and manganese oxides. No telluride mineralization has been discovered in the disseminated deposit (Pontius and Butts, 1991). Mining at the Cresson open pit began in December 1994. In 1995 the mine produced 7,155,400 tons of ore at a grade of 0.033 ounce of gold per ton for a total of 76,589 ounces of gold. In 1996 production increased to 174,000 ounces of gold. Production in 1997 and 1998 has been about 235,000 ounces of gold per year. Currently (December 1999), Anglo American Gold is the owner and operator of PPMC. The Tallahassee Creek Conglomerate and Echo Park alluvium are known to contain uranium mineralization in the Tallahassee Creek uranium district in Fremont County.

The Tallahassee Creek district contains two main deposits totaling 13 million kilograms of U_3O_8. The average grade of the deposits is 0.08% U_3O_8 (Dickinson, 1981). In the Tallahassee Creek district, uraninite, coffinite, and meta-autinite are found in an ash fall (bentonite) layer in the Tallahassee Creek Conglomerate and in the sandstones, mudstones and conglomerates of the Echo Park Alluvium. The mineralization in the Echo Park Alluvium has the characteristics of a “roll front” type uranium deposit (Dickinson, 1981). The Pikes Peak Granite in this region hosts uranium, fluorite, gem minerals including beryl and topaz, tungsten, rare earth mineral, and minor placer gold occurrences. It appears from the geological map that these occurrences are structurally controlled along north-south and east–west trending faults.

Industrial Mineral Resources

There are no known construction material or industrial mineral deposits on any of the State Land Board tracts in Teller County. GrŸs derived from the Pikes Peak Granite is mined in several localities and used for a construction material. Some units including the Echo Park Alluvium, Tallahassee Creek Conglomerate, and the Gravel at Divide have described lithologies that could be adequate for construction purposes.

Stratigraphic Units Occurring on Teller County State Land Board Tracts

Qp – Piney Creek Alluvium (Holocene) -S ilty to gravelly humus-rich alluvium along all valleys.

Qfo – Older Fan Alluvium (Pleistocene) - Gravel, sand, silt, and locally, boulders in fan-shaped deposits above present drainage Qfo1—Younger fan deposits in Manitou Park area. Qfo2—Older fan deposits in Manitou Park area.

Qc – Colluvium (Holocene and Pleistocene) - Non-sorted, non-stratified, coarsegrained slopewash in mountains and a fine-grained deposit on plains. In southeastern part of quadrangle includes some loess and residuum.

Qpo – Pinedale Glaciation Outwash (Pleistocene) - Gravelly deposits along the east flank of the Sangre de Cristo Range and around Pikes Peak.

Qpt – Pinedale Glaciation Till (Pleistocene) - Terminal and lateral moraines of glaciers in the Sangre de Cristo Range and around Pikes Peak.

Qbo – Bull Lake Glaciation Outwash (Pleistocene) - Gravelly deposits at two levels along the east flank of the Sangre de Cristo Range and at one level north of Pikes Peak.

Tdg – Gravel at Divide (Pliocene and Miocene) - Bouldery gravel and crudely stratified sand, silt, and clay as much as 200 feet (60 m) thick.

Ttd – Trachydolerite (Miocene) - Sill-like mass at Bull Cliff between Cripple Creek and Victor.

Tph – Phonolite (Miocene) - Dikes and plugs of dense rock having platy structure near Cripple Creek.

Tsy – Syenite (Oligocene) - A stock and several dikes of medium- to fine-grained feldspar-pyroxene syenite near Victor.

Tlph – Latite-Phonolite (Oligocene) - Dikes and irregular masses of dense rock within the breccia near Victor.

Tbt – Breccia and Tuff (Oligocene) - Altered fragmental rock composed mostly of latite phonolite near Victor.

Ttmu – Thirtynine Mile Andesite (Oligocene) - Upper member – Stratified lava flows on the flanks of the Guffey volcanic center.

Ttml – Thirtynine Mile Andesite (Oligocene) - Lower member - Laharic breccia from local vents.

Tf – Florissant Lake Beds (Oligocene) - Thinly stratified water-laid andesitic ash and volcaniclastic rocks less than 150 feet (45 m) thick.

Ttc – Tallahassee Creek Conglomerate (Oligocene) - Poorly sorted, bouldery, volcanic conglomerate more than 350 ft (105 m) thick in paleovalleys.

Twm – Wall Mountain Tuff (Oligocene) - Biotite-plagioclase-sanidine rhyolite ash-flow tuff. As much as 200 ft

(61 m) thick.

Tep – Echo Park Alluvium (Eocene) - Poorly sorted arkosic gravel and conglomerate more than 1000 ft (300 m) thick in paleovalleys and grabens.

Jm – Morrison Formation

Jmr – Morrison and Ralston Creek Formations (Upper Jurassic) - Morrison Formation – Varicolored siltstone, claystone, and sandstone containing fossil dinosaur bones. About 320 ft (97 m) thick. Ralston Creek Formation – Generally sandstone, siltstone, and gypsum beds; sandstone and conglomerate near Canon City. About 150 ft (45 m) thick.

PPf – Fountain Formation (Permian and Pennsylvanian) - Red conglomerate and sandstone. At the base the Glen Eyrie Shale Member composed of sandstone, sandy shale, and fossiliferous black shale. Formation as much as 4,400 ft (1,320 m) thick.

MC – Mississippian, Devonian, Ordovician, and Cambrian Rocks - Leadville Limestone (Mississippian) - Gray, pink, and buff, fine- to coarsegrained limestone and dolomite. Present only in Manitou Park (T. 10-12 S., R. 69 W.) where maximum thickness is about 30 m. Williams Canyon Limestone (Devonian) - Lavender-mottled gray to buff, finely crystalline sandy dolomite or dolomitic limestone with thin interbeds of sandstone and shale. Present in Perry Park (T. 9-10 S., R. 68 W.) and Manitou Park (T. 1012 S., R. 69 W.). Thickness about 14 m. Manitou Limestone (Lower Ordovician) - Tan to brown finely crystalline, well-bedded limestone; pink to red, fine- to medium-crystalline dolomite in upper part. Present west of Air Force Academy in T. 12 S., R. 67 W. and in Manitou Park (T. 10-12 S., R. 67 W.). Maximum thickness 21 m. Peerless Dolomite (Upper Cambrian) - Red glauconitic coarsely crystalline sandy dolomite. Thickness 2.5-5 m. Sawatch Sandstone (Upper Cambrian) - White, medium- to coarse-grained quartz sandstone, commonly feldspathic in lower part. Grades into brown or red fine- to medium-grained calcareous glauconitic sandstone upward. Thickness about 27 m.

Or – Ordovician Rocks - Includes some or all of the following formations: Fremont Limestone -Gray to yellowish-gray dolomitic limestone, cherty in lower part. Harding Sandstone – White, yellow, and green quartz sandstone; red shale; quartz- or chert-pebble conglomerate at base. Manitou Limestone -Upper part of light gray to red dolomitic limestone, middle part of pink cherty dolomite, and a lower part of red dolomite with a basal quartzpebble conglomerate.

OCr – Ordovician and Cambrian Rocks - Manitou Limestone and Sawatch Sandstone

Csd – Sandstone Dike (Cambrian?) – Brown hard quartzitic sandstone filling fractures along Ute Pass fault west of Colorado Springs.

Pikes Peak Batholith (Precambrian Y):

Ywp -Windy Point Granite -Fine-grained porphyritic granite or quartz monzonite.

Ypp – Pikes Peak Granite – Pink coarse-grained biotite or biotitehornblende granite; the predominant rock type of the Pikes Peak batholith.

Lake George pluton:

Ypm – Medium-grained Pikes Peak Granite - Locally porphyritic.

Spring Creek pluton:

Ypg – Gabbro - Fine to medium-grained olivine gabbro at margin of pluton. Yps – Syenite - Medium- to coarse-grained olivine syenite.

Ycc – Cripple Creek Quartz Monzonite (Precambrian Y) - Medium-grained biotitemuscovite quartz monzonite.

Xgd – Granodiorite (Precambrian X) - Pinkish-gray, massive to foliated, medium- to coarse-grained hornblende or biotite granodiorite; locally an augen gneiss.

Xgn – Migmatitic Gneiss (Precambrian X) - Layered gneiss, chiefly feldspathic biotite-quartz-plagioclase gneiss, and garnetiferous hornblendic, and sillimanitic varieties. Formed from sedimentary and volcanic rocks that were metamorphosed to the amphibolite facies except at Boneyard Gulch west of Ilse where granulite facies is locally developed.

Xgnb – Biotite Gneiss (Precambrian X) - Layered biotite-quartz-plagioclase gneiss, locally migmatitic or sillimanitic.

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