Mineral Resources of Jefferson County

Earth Science Week 2001

Field Trip Guidebook

Presented by:
The Colorado Geological Survey

http://geosurvey.state.co.us/

Field Trip Guide – Mineral Resources of Jefferson County, Colorado

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(Note – this field trip has been re-scheduled for Fall, 2002)

Introduction

Jefferson County has a long history of mineral production, from the early coal mines that helped fuel steam locomotives and the gold mills up in Clear Creek and Gilpin Counties, to the modern crushed stone aggregate quarries that provide much of the raw material for the immense growth in the Front Range region today. High-quality clays along the base of the Front Range have been mined for years to make bricks and ceramics. One of the largest single uranium deposits in the U.S. is located only seven miles from Golden and has been mined up until last year. Gold, derived from the erosion of the large lode deposits to the west, has been mined from the gravels along Clear Creek, sometimes as a byproduct of gravel pits. Even a small oil field once produced crude oil in Jefferson County. Although overshadowed by larger industries such as construction, defense, beer-making, and others, the economic mineral resources of Jefferson County have been an important part of the development of Colorado.

The historic New Loveland Coal Mine, Golden, CO. This area is now a residential subdivision.

Oil

Jefferson County has had only one marginally commercial oil well. This well was located about one-half mile southeast of Soda Lake near Bear Creek Lake Park in Lakewood. The well produced about 16,000 barrels of oil between 1955 when it was completed and 1962 when it was abandoned. The oil was produced from a depth of over 9,000 feet, in the Niobrara Limestone of Upper Cretaceous age. Oil can be seen squeezing out of the Dakota "J" Sandstone in *seeps* at the Highway 285 roadcut through the Dakota Hogback at Turkey Creek Canyon (Stop 2).

A geologist points out oil seeps in the Dakota Sandstone, Highway 285 roadcut (Stop 2)

Gas

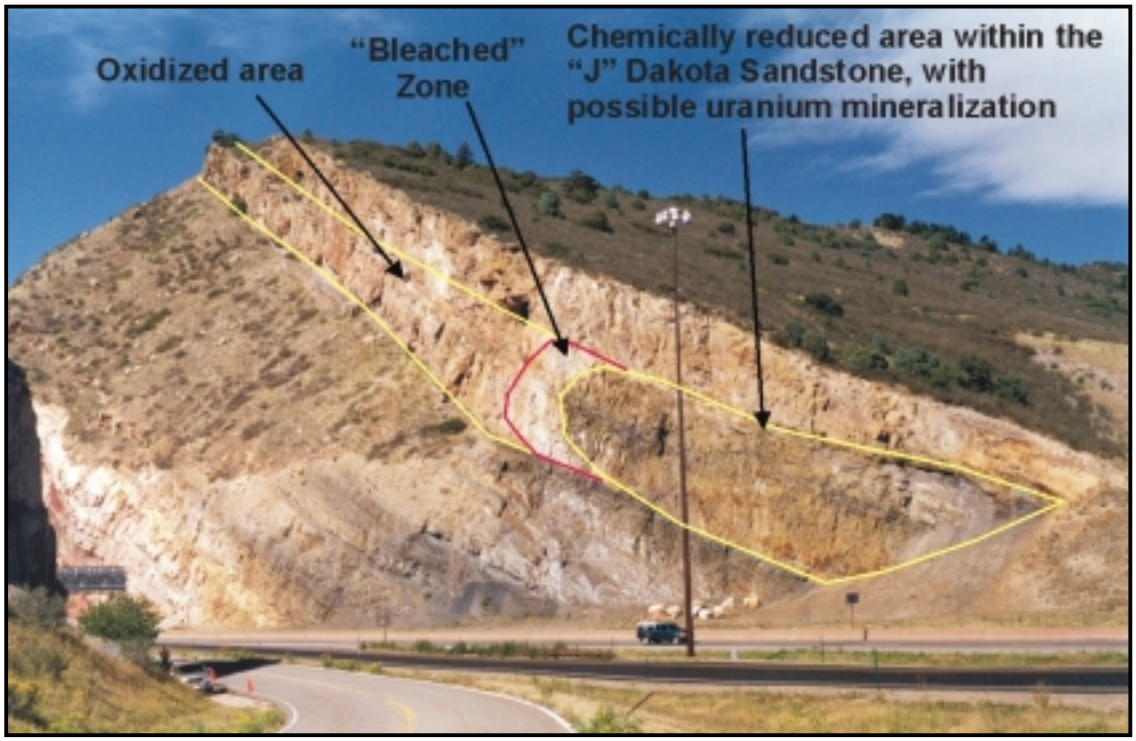
The coals exposed at the surface in Jefferson County contain naturally-occurring methane gas that was responsible for a mine fire at the Leyden Coal Mine between Golden and Boulder in 1910. Methane gas can now be extracted from coal using a typical drilling rig used by the petroleum industry. This natural gas is used for heating and generating electricity. The Colorado Geological Survey has recently completed a study in the Denver Basin that documents some potential for what is known as coalbed methane. No coalbed methane production exists yet in the Denver Basin.

Uranium

One of the largest single uranium mines ever to operate in the U.S. is the Schwartzwalder Mine, located in the foothills about seven miles northwest of Golden. The underground mine, owned since 1965 by the Cotter Corp. of Lakewood, shut down in March, 2000 because of low uranium prices. Total production over the years from the Schwartzwalder Mine has been approximately 17 million pounds of uranium oxide (data retrieved from http://www.cotterusa.com/).

The uranium mineralization was discovered at the site in 1949 by Fred Schwartzwalder, a high school janitor and rock collector from Golden (see Time Magazine article, Dec. 6, 1954 attached). An earlier attempt (in the 1890s) was made to mine copper at the site, with no success. Small amounts of copper occur with uranium minerals. The uranium occurs primarily as the black mineral, pitchblende (UO_2). The pitchblende is concentrated in brecciated, iron-stained quartz-rich material along a series of north to northwest-trending, steeply-dipping faults within Precambrian metamorphic rocks.

Uranium also occurs in another geological setting in the county, as demonstrated at Stop 2 at the Highway 285 roadcut at the Dakota Hogback. Uraninite and other oxide minerals occur in the upper member of the Dakota Sandstone ("J" Sand). Two small mines produced uranium near the roadcut in the late 1950s, the Mann Mine and the Morrison Mine. These mines produced a total of 18,000 pounds of uranium oxide. Several other smaller uranium deposits have been found in the Dakota Sandstone elsewhere in the county.



Looking north at the Highway 285 roadcut at the Dakota Hogback, Turkey Creek. The Dakota "J" Sandstone at this location is host to small uranium deposits. The "J" Sandstone is also one of the most important oil and gas reservoir in the Denver Basin.

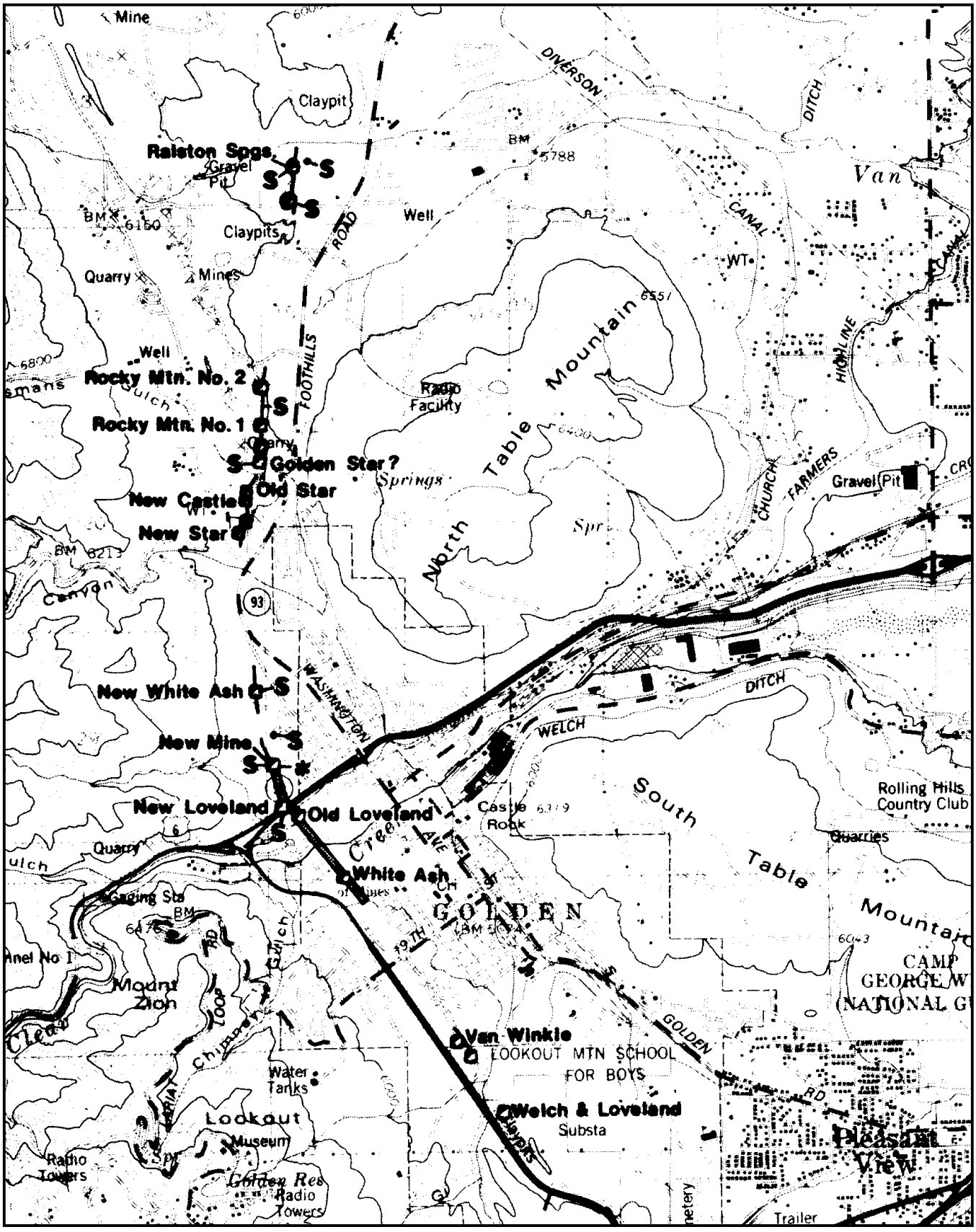
Coal

Many people are surprised to learn that Jefferson County was once a fairly important coal mining area. Coal mining in Colorado began soon after the first settlers and miners arrived in the Front Range. There were 55 producing coal mines in Jefferson County between 1876 and1950. Almost seven-million tons of coal were removed by blasting, pick, and shovel in that time span. Known as the Foothills coal field, mines existed from the Boulder County line in the north to near the present intersection of Garrison St. and Ken Caryl Ave. in Littleton. 800 million tons of subbituminous coal are estimated to still be in place in the county, mostly from 1,000 to 2,000 feet deep.

White Ash and New Loveland Mines in the 1890s. The view is northward from the present day Colorado School of Mines campus, near Stop 3 on this field trip. The White Ash coal mine is in the foreground and the New Loveland coal mine is on the north side of Clear Creek.

In Jefferson County, coal was mined only from the Laramie Formation of Upper Cretaceous age. This formation is exposed along the western edge of the plains near the foothills. Because of faulting and uplift of the Front Range to the west, most of the coal seams mined are steeply inclined or vertical. Only near the old coal town of Leyden, north of Golden, were flat-lying coal seams mined.

Map showing the locations of historic coal mines near Golden, Colorado.



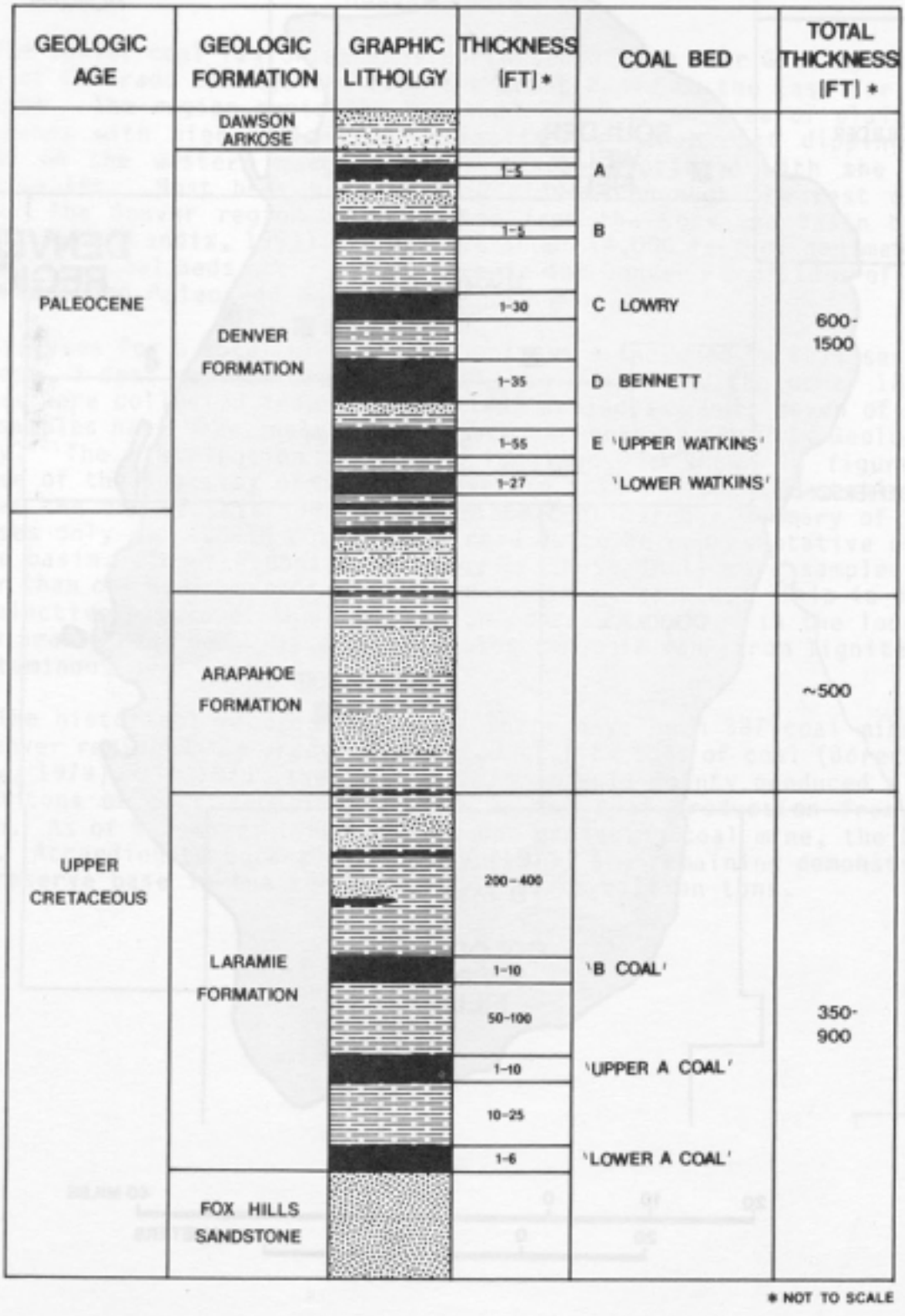


Figure A3. Generalized stratigraphic section showing the coal-bearing rocks in the Denver Region (after Brand, 1980).

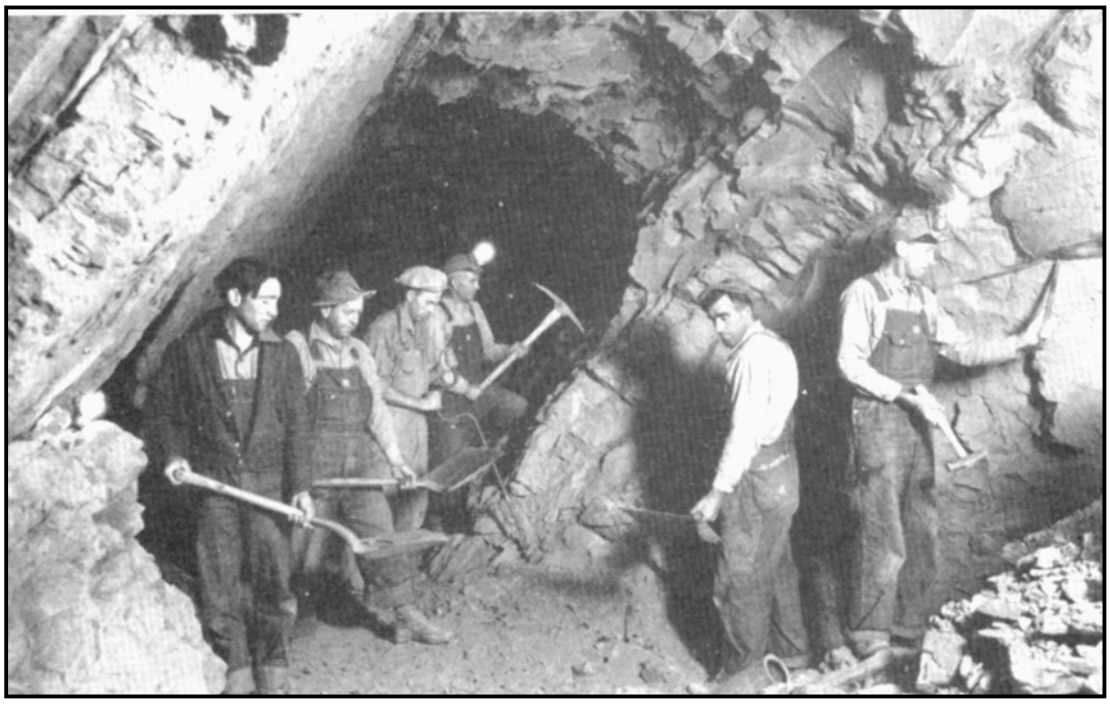
Clay

Jefferson County has abundant resources of clay that can be used to manufacture a variety of products including construction brick, refractory bricks (used in boilers, industrial furnaces, etc.), crucibles for laboratories, electrical insulators, porcelain, and pottery. Different types of clay are suitable for different purposes. Sedimentary formations on the eastern flank of the Front Range contain a wide array of clays suitable for various uses.

Remnants of a structure related to a clay mine north of Golden.

The most common type of clay is brick clay. Many of the houses and other buildings in the Denver Metro area are made of bricks with clay from Jefferson County mines, and brick manufacturing is one of the state's oldest industries. Brick clay may also be used to make tile. Brick clay is mined from beds in three formations of Upper Cretaceous age: Laramie Formation, Fox Hills Sandstone, and Benton Shale. The Laramie Formation hosts the most significant clay deposits. These formations all lie to the east of the Dakota Hogback, stratigraphically above the Dakota Sandstone.

Fire clay is the name given to clays that, because of various physical and chemical properties, are good for manufacturing ceramic items or bricks that can withstand very high temperatures. This type of clay is less common than brick clay, but deposits are present in Jefferson. Fire clays were mined from beds within the Dakota Sandstone of Lower Cretaceous age. Early-day mining of these beds was often done underground, and the remnants of structures related to this mining can still be seen at many places along the Dakota Hogback (photo).



Miners at work in an underground pottery clay mine in Jefferson County (1940s). Note the steep dip to the left (east) of the sedimentary beds.

Pottery clay was mined in the past from thin beds in the Dakota Sandstone, usually stratigraphically close to the fire clay beds. This type of clay was extracted from both surface pits and underground mines.

Clay continues to be mined in significant quantities in Jefferson County. Several local brick manufacturing companies operate their own clay mines in the area. Open cuts can be seen in some places along the Dakota Hogback, and just east of C-470 southwest of Green Mountain. Some bricks made from the local clays have such a desirable color that they are shipped as far away as Japan.

Gold (placers)

Gold was mined from placer deposits in the gravels of Clear Creek, from west of Golden to the city of Denver. The total recorded production of gold in the county through 1947 was about 12,000 ounces. The largest production of gold occurred during the Great Depression between 1934 and 1937 when a dry-land dredge worked the gravels along Clear Creek west of Golden. Production since then has been relatively small, mostly as a byproduct of sand and gravel operations.

The gold in the Clear Creek gravels is derived from erosion of the large gold deposits in bedrock (lodes) that occur upstream, around Idaho Springs, Central City, Blackhawk, and Georgetown. Placer gold in the Clear Creek gravels were discovered as early as 1859, shortly after the first important gold discovery in Colorado was made in present-day suburban Denver, in Cherry

Creek gravels. The prospectors followed the Clear Creek gold upstream to find the bigger lode deposits in the mountains shortly thereafter.

Aggregate Resources

Crushed Stone

Crushed stone is a construction material used mainly as an aggregate for the manufacture of concrete, and for road base material. Several large quarries are present in the foothills west of the Denver metro area. The hard, dense metamorphic and igneous rocks of Precambrian age (about 1.7 billion years old in this area) that form the core of the Front Range make excellent sources of for aggregate. Hard volcanic rock of Tertiary-age (about 60 million years old) also makes good aggregate, and is being quarried at the Ralston Quarry (Asphalt Paving Co.), Stop 4 on this field trip.

Stream and river gravel is often a better aggregate resource than crushed stone, because it is cheaper to mine and process. Gravel only needs to be scooped up, sorted, and cleaned, while stone needs to be drilled and blasted to loosen it, then crushed to the appropriate size. But because so much of the low-lying gravel deposits around creeks and rivers along the base of the Front Range have been either used up or built upon, crushed stone is becoming more widely used.

Sand and Gravel

Sand and gravel continue to be mined from stream deposits in Jefferson County, especially along Clear Creek east of the foothills. Sand and gravel are basic construction materials, used for such purposes as concrete-making and road construction.

The large sand and gravel deposits along Clear Creek were created by the erosion of the mountains to the west. Much of the sand and gravel, or *alluvium*, was deposited during or shortly after the great episodes of glacier activity in the high mountains. The glaciers were powerful agents of erosion. Although the glaciers never reached the plains, the very large rivers of meltwater that came out of them during the summers was able to move huge amounts of gravel and sand. Much of the transported sand and gravel came to rest on the plains just east of the mountains where the rivers were no longer powerful enough to carry the load.

Lightweight Aggregate and the Pierre Shale

The Pierre Shale of Upper Cretaceous age is currently being quarried in Jefferson County for use as *lightweight aggregate*. Lightweight aggregate is used in place of regular sand, gravel, or crushed stone in applications where excessive weight is undesirable, such as floors and walls in multi-story buildings. Cinder blocks are made with lightweight aggregate. The Pierre Shale is not naturally "lightweight", but must be made so by processing. The raw shale is heated until it expands (almost like popcorn). Small amounts of water physically trapped in the shale quickly vaporizes when heated to a certain point, expanding the shale. The Txi shale quarry and plant are located in Jefferson County, just north of the Rocky Flats facility.

Recycled Material

Asphalt and concrete can be recycled and used again as road construction material. An example of this can be seen in the new student parking lot at the Colorado School of Mines near Stop 3 on this field trip. The parking lot was made with crushed recycled asphalt. One company based in

Arvada operates "urban recycling centers" and also has several mobile recycling plants which create the new aggregate by crushing and screening used concrete and asphalt.

Selected References

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Field Trip Road Log

Set your car's trip-meter to zero!

- **Mile 0.0, Starting Point and <u>Stop 1</u>**: Meet at the northeast parking lot (T-Rex) at I-70 and the Morrison Exit (Point of Geological Interest) at 8:00 AM.
  I-70 roadcut geologic overview. 15 minutes at stop. Leave parking lot at 8:15 AM.

<u>Directions-</u>

- From parking lot, turn left on Hwy 26, toward Morrison.
- At the stoplight in Morrison (mile 3.5), turn right on Hwy 8
- Drive 0.2 miles to where Hwy 8 turns left, and turn left
- Follow Hwy 8 south 1.6 miles (trip mile 5.3) to Turkey Creek Rd – turn left (easy to miss)
- Drive east on Turkey Creek Rd. 1.5 miles, to the east side of the hogback roadcut, park on the right <u>(STOP 2)</u>

<u>Along the way-</u>

Mile 0.6 – small uranium prospects on Dakota Hogback to the left. These prospects are in the Morrison Formation (Jurrasic, or about 150 million years).

Mile 1.6 – Red Rocks – These famous rocks consist of the Fountain Formation of Permian and Pennsylvanian age (about 300 million years).

Mile 4.9 – In the foothills to the west is the Aggregate Industries' Morrison Quarry. This quarry produces crushed stone from Precambrian metamorphic and igneous rock. The quarry site was chosen partially because the hills screen most of the operation from view.

- **Mile 6.8, <u>Stop 2</u> (arrive 8:30 AM):** Dr. Robert Weimer, Professor Emeritus of the Colorado School of Mines, will talk about the rock at the Turkey Creek roadcut and oil and gas resources of the Denver Basin. Geologist Norb Cygan will discuss the uranium deposits of the Dakota Sandstone. (Estimated 1 hour at this stop)

- From Stop 2, continue driving east 0.6 miles to Quincy Ave. – turn left, then a quick right and get on C-470 (Westbound)
- Take C-470 all the way to 6th Ave. West (U.S. Hwy 6, westbound) in Golden, using the new extension. (approx. 7 miles)
- Take 6th Ave. West (U.S. Hwy 6) to 19th St., turn right at 19th (mile 16.9 of trip)
- Drive only 0.2 miles on 19th, and turn left on Elm St.
- Right on 16th St to Maple St.
- Left on Maple, four blocks to 12th St., turn left. Drive 0.2 miles to far side of football stadium, and park – <u>STOP 3</u>

<u>Along the way-</u>

Mile 9.0 – Soda Lake field, the only oil field in Jefferson County, had only one well. It was abandoned in 1962.

Mile 11.5 – Clay pits in the Laramie Formation to the right (east) of the highway.

Mile 13.6 – Clay pits in the Dakota Sandstone on the hogback to the left.

Mile 15.9 – More clay pits on the right, in the Laramie Formation. Note that the hogback is not present in this area. The Golden Fault has displaced the Dakota Sandstone away from this area.

- **Mile 17.8, Stop 3 (arrive 9:45 AM):** Historic White Ash Coal Mine location. Geologist Chris Carroll will talk about Jefferson County coal deposits. Jim Cappa will talk about the important clay deposits of the county. Short discussion on placer gold deposits. (Estimated 45 minutes)

- From Stop 3, Follow the same route out and get back to 6th. Ave. West (U.S. Hwy 6), turn right (west)
- Go straight across intersection of Hwy 6, Hwy 93, and Hwy 58 at the stoplight (trip-mile 19.5 or so). This will be Hwy 93 toward Boulder
- Drive north on Hwy 93 about 4.3 miles, to trip mile 23.8, and turn left to road to Asphalt Paving's Ralston Quarry. This road comes up fast just over a hill, so its easy to miss.
- Drive up this road about 1.2 miles to the offices of the quarry (trailer-like buildings just off the main road to the right) STOP 4
- ---(WATCH OUT FOR BIG TRUCKS LOADED WITH ROCK)---

Along the way-

Mile 19.4 – Clear Creek. Placer gold was mined from the gravels of Clear Creek, from west of Golden all the way to the South Platte River.

Mile 21.4 – The Dakota Sandstone is once again present, and the hogback rises from the plains to the west of the highway. More clay mines can be seen on the east side of the hogback.

- **Mile 25.0, Stop 4 (arrive 10:45 AM):** Ralston Aggregate Quarry (Asphalt Paving Co.). Estimated stop time: one hour.

- After Stop 4, drive back out to Highway 93, and turn left (north). It may take awhile to make a left on this busy highway, so be patient – and careful
- Drive north 3.9 miles to Hwy 72 and turn left (west). Drive 1.7 miles west, turn right at the road to Plainview. Drive about 0.2 miles to the little parking area on the left just before the bridge. STOP 5 ----LUNCH TIME.

Along the way-

Mile 28.5 – Many old clay pits and mines in the small hogbacks of the Laramie Formation near the Leyden turnoff (east of road). Leyden, about 2.6 miles to the east, was the site of the largest coal mines in Jefferson County.

- **Mile 32.0, Stop 5 (arrive about 12:00 Noon):** LUNCH!!!! Coal Creek area near the rail siding of Plainview. John Keller will talk about the Schwartzwalder uranium mine, located in the Precambrian rocks of the foothills only 2.4 miles southwest of this spot. (½ hour stop)

- After Stop 5, go back to Highway 93 and turn left toward Boulder (north). Drive 3.0 miles north to trip mileage 36.8 and turn right, at the driveway into the Txi facilities. You then need to turn left at the Y in the road to get to Txi. (STOP 6)

  Along the way-

  Mile 35.5 – The Rocky Flats Plant. The plant sits on the broad, gently-sloped surface of the Rocky Flats Alluvium, a gravelly deposit that was created by erosion of the mountains to the west during the Pleistocene (probably during one of the periods of glaciation). A stream that was once much larger than Coal Creek must have once emanated from Coal Creek Canyon in order to produce this massive deposit of bouldery gravel.

- **Mile 36.9, Stop 6 (arrive at 12:45 PM):** Txi Expanded Shale Mine and Plant (lightweight aggregate). Some beds of the Pierre Shale expand when heated. This light material is then used as a lightweight aggregate for such products as cinder block. (45 minute stop)

Return to T-Rex Parking Lot at the Park-n-Ride, I-70 and Morrison exit
Estimated Return-time to T-Rex Parking Lot: 2:00 PM