USGS
science for a changing world

Buffalo Creek (Spring Creek/South Platte) field trip, Saturday, June 11, 2005
Granite, Pegmatite, Fires, and Floods in the South Platte Watershed
Colorado Scientific Society one-day field trip

Pete Modreski, U.S. Geological Survey
pmodreski@usgs.gov, 303-202-4766

Meet at 7:15 a.m. to get ready for a 7:30 departure at the Cold Spring RTD Park-and-Ride, at Union Blvd. just south of 6th Avenue, in Lakewood. Our alternate meeting place for people coming from the mountains is in the Safeway parking lot in Conifer at about 8:00, or at 8:45 at the Colorado Trail trailhead and footbridge across the South Platte, about a mile south of the confluence of the North and South Forks of the South Platte by the old South Platte townsite.

The valley of Spring Creek, a tributary drainage to the South Fork of the South Platte River was severely affected by the Buffalo Creek forest fire of May, 1996. On July 12 of that summer, a thunderstorm caused severe flash flooding in the burned area, and the loss of two lives near the town of Buffalo Creek. Spring Creek, uninhabited and within Pike National Forest, was greatly changed by the fire and by erosion and deposition of sand and gravel from the flood. It is a remarkable place to see the effects of recent geologic processes in action, and to observe the continued readjustments that take place in this ecosystem.

The bedrock in this area is the Pikes Peak Granite, part of a 1000-square-mile *batholith* of 1.0-billion-year old granite. In places one can see different textures in the granite, *xenoliths* which are fragment of country rock (gneiss and schist) carried into the granite, *grus* (granite decomposed into a coarse gravel), and *pegmatite* (dikes of very coarse-grained granite, composed of large intergrown crystals of quartz and feldspar +/- mica).

[A couple of miles further upstream on Spring Creek is an area where Spring Creek descends over ledges of Pikes Peak Granite which it has sculpted into smooth channels, potholes, and small waterfalls—one of my favorite out-of-the-way and seldom seen places in Colorado. On today's hike, we will not be going far enough upstream to see this place. It is more easily reached by hiking downhill, beginning along State Highway 126 south of Buffalo Creek, where the Colorado Trail crosses the highway and leads eastward; one can follow the Trail for just a short distance, then cut off cross-country down into the headwaters of Springs Creek.]

The area of the hike is on the Platte Canyon 7.5-minute quadrangle. If you want to look at the topo map on the internet, use www.topozone.com or the Geographic Names Information System (GNIS) on the USGS website (http://geonames.usgs.gov/) to search for Spring Creek (Douglas Co.) or South Platte, or Raleigh Peak, to get into the right vicinity. The White Cloud pegmatite is shown as two mine symbols with the word "Quarries" in the SW 1/4 of sec. 36.

To Bring:

Comfortable/sturdy hiking shoes & clothing (suitable for loose gravel, rocks, steep hillsides, wet places).

Rubber sandals (i.e., "Tevas") you can wear to walk through water—not necessary, but fun to do (and feels good on a hot day), to take off your boots, put them in or tie them to your pack, and wear sandals to walk down the creek bed, which is generally not more than about 2 inches deep. This will also facilitate wading across the South Fork of the South Platte at the end of the trip.

Day pack.

Water, lunch, energy snacks.

Sunscreen, hat, rain gear.

Optional: Notebook, camera, hand lens, magnet, binoculars.

Plan for the day:

The headwaters of Spring Creek are near State Highway 126, south of Pine and Buffalo Creek and north of Deckers. It flows into the South Fork of the South Platte River about two miles south of the confluence of the North and South Forks of the South Platte (from which the river and the Colorado Trail lead east to Strontia Springs dam and Waterton Canyon.) . We will drive west on highway 285, then turn south just past Conifer on South Foxton Road (Jefferson County Road 97). It is 15 miles from the C-470/US-285 interchange to South Foxton Road, then 8 miles to the North Fork of the South Platte River. There we turn left and follow Jefferson County Road 96 about 5.5 miles, past Dome Rock to the confluence of the two forks. From here it is about 1.7 miles further south to the Colorado Trail parking area, trailhead, and footbridge that crosses the South Fork of the South Platte. When we first pull in here we will not yet get out of the vehicles, but we'll drive about a mile further south the spot where Spring Creek flows into the South Platte, to view the valley, erosional effects remaining from the 1996 flash flood, and the White Cloud pegmatite visible on the opposite ridge top.

Our hike will begin by following a switchback portion of the Colorado Trail for about ¾ mile westward from its crossing of the South Fork of the South Platte. Near the ridge top, we leave the Trail and drop a short distance down the south side of the ridge—the north side of the Spring Creek Valley—to visit the White Cloud pegmatite, a pair of small old quarries where a large, cylindrical intrusion of granite pegmatite was once quarried for massive quartz, feldspar, fluorite, and uranium-bearing rare earth minerals. This will be our longest stop, to examine the quarry and have lunch there.

The best published reference for information about the White Cloud and the many other small quarries in the South Platte pegmatite district is Rare-earth Pegmatites of the South Platte District, Colorado, Colorado Geological Survey Resource Series 11, by Wm. B. Simmons and E. Wm. Heinrich, 1980, 131 p. This publication is still available from the CGS and only cost $4.

We'll then hike down a steep hillside (500 elevation drop in about ¼ mile) to Spring Creek, follow Spring Creek about ½ mile to its confluence with the South Fork of the South Platte River, then wade across the river (conditions permitting; if no more than knee-deep) to the east bank where we will have left one or two cars, to facilitate the 1-mile trip back to the trailhead.

Itinerary:

7:15 Meet at Cold Spring Park-and-Ride

7:30 Leave Park and Ride

8:00 Meet to pick up more cars/riders at Safeway parking lot, Conifer

8:45 Reach Colorado Trail footbridge and trailhead, 1.7 mile south of "Two Forks" confluence

9:00 Drive about 1 mile further upriver to see the confluence of Spring Creek with South Fork of South Platte; view of the White Cloud pegmatite on ridge top north of the creek. Ascertain that the river is not flowing too high to ford back across on the way back. Leave one or two cars here for transportation back to the trailhead at the end of the hike.
9:30 Return to Colorado Trail parking area and begin hike.
10:30 After following Colorado Trail for approx. 3/4 mile, then turn left off the trail to visit the White Cloud and Lesser White Cloud pegmatites. 11:00 The two pegmatites were once quarried for feldspar, quartz, and/or fluorite and rare earth/uranium minerals. Our quarry visit and lunch stop there will be from approximately 11:00 to 1:00.
1:00 Leaving the quarry, proceed carefully down steep hillside to Spring Creek (1/4 mile, 500 foot elevation drop).
1:45 Reach Spring Creek; walk downstream, about ½ mile, to the South Fork South Platte; examine wide gravel stream bed occupying the valley, the braided small stream which occasionally disappears into the gravel, variety of Precambrian rock transported by the stream, remaining evidence of erosion from the 1996 downpour and flash flood, and revegetation taking place since then.
2:30 Reach South Fork South Platte. Wade across river to the east bank; use cars to relay people back to the trailhead.
3:00 Return to Colorado Trail trailhead; trip is complete. For those who wish, we'll make a side trip on the way back to the Bucksnort Saloon (Sphinx Park, between Pine and US-285) for a little supper (burgers their specialty) and perhaps some refreshing beverages.

The trailhead is at an elevation of about 6100'. The ridge top we ascend to is about 6650', the quarries are at about 6550', and Spring Creek below the quarries is about 6150'.

Having checked ahead of time today (Wednesday 6/8 through Friday 6/10) as to the level of the South Fork of the South Platte River, it appears to be quite low (having been dropping throughout the past week) and probably suitable for wading across as I would like to do, but Friday's rain may have raised it significantly. To check this yourself, before the field trip, go to the webpage under USGS real-time streamflow data for Colorado:
http://waterdata.usgs.gov/co/nwis/uv/?site_no=06701900&PARAmeter_cd=00065,00060
and you'll see the past week's stream flow record for a site on the South Fork of the South Platte, downstream of Cheeseman Reservoir, which should be a good indication of how the water is where we'll be. If the water in the South Fork is HIGH, then our only alternative (unless someone has a folding canoe) is to hike back up the 500' hill past the White Cloud pegmatite and rejoin the Colorado Trail for the hike back to the trailhead. Or, we may choose to not hike down into the Spring Creek Valley at all, if we can't get back out across the river.

references:

Moody, J.A., and Martin, D.A., 2001, *Hydrologic and sedimentological response of two burned watersheds in Colorado*: USGS Water Resources Investigative Report 01-4122, 138 p. + data CD.

Simmons, W.B., and Heinrich, E.W., 1980, *Rare-earth Pegmatites of the South Platte District, Colorado*: Colorado Geological Survey Resource Series 11, 131 p.

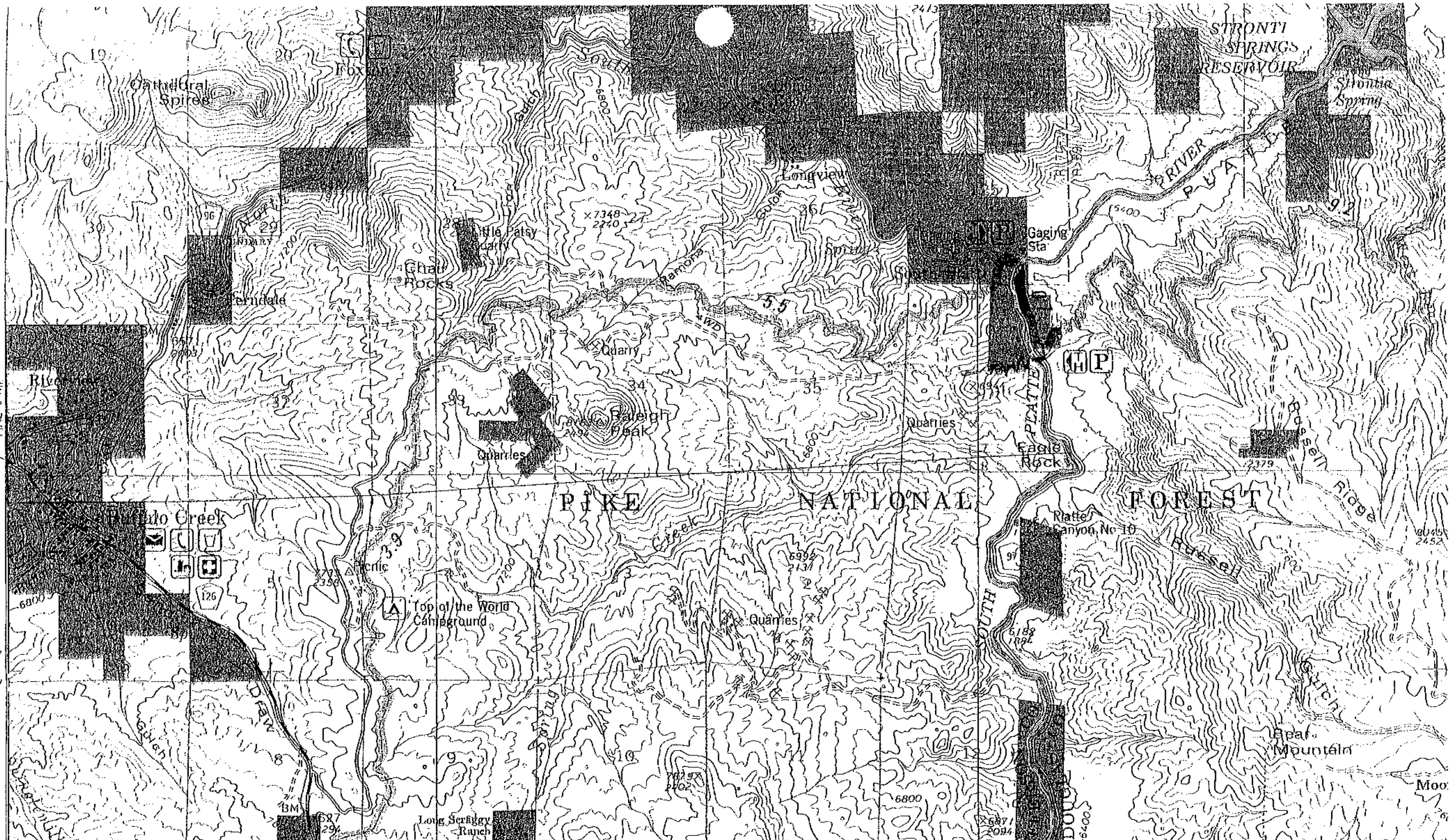
Simmons, W.B., Webber, K.L., and Falster, A.U., 1999, Anorogenic, NYF-type pegmatites of the South Platte district, Pikes Peak batholith, Colorado: *in* NYF-type Pegmatites of the Pikes Peak Batholith, Field Trip Guidebook, The Eugene E. Foord Memorial Symposium on NYF-type Pegmatites, Denver, Colorado, 1999, p. 1-22.

Participants signed up – CSS South Platte River & Pegmatite Field Trip, June 11, 2005

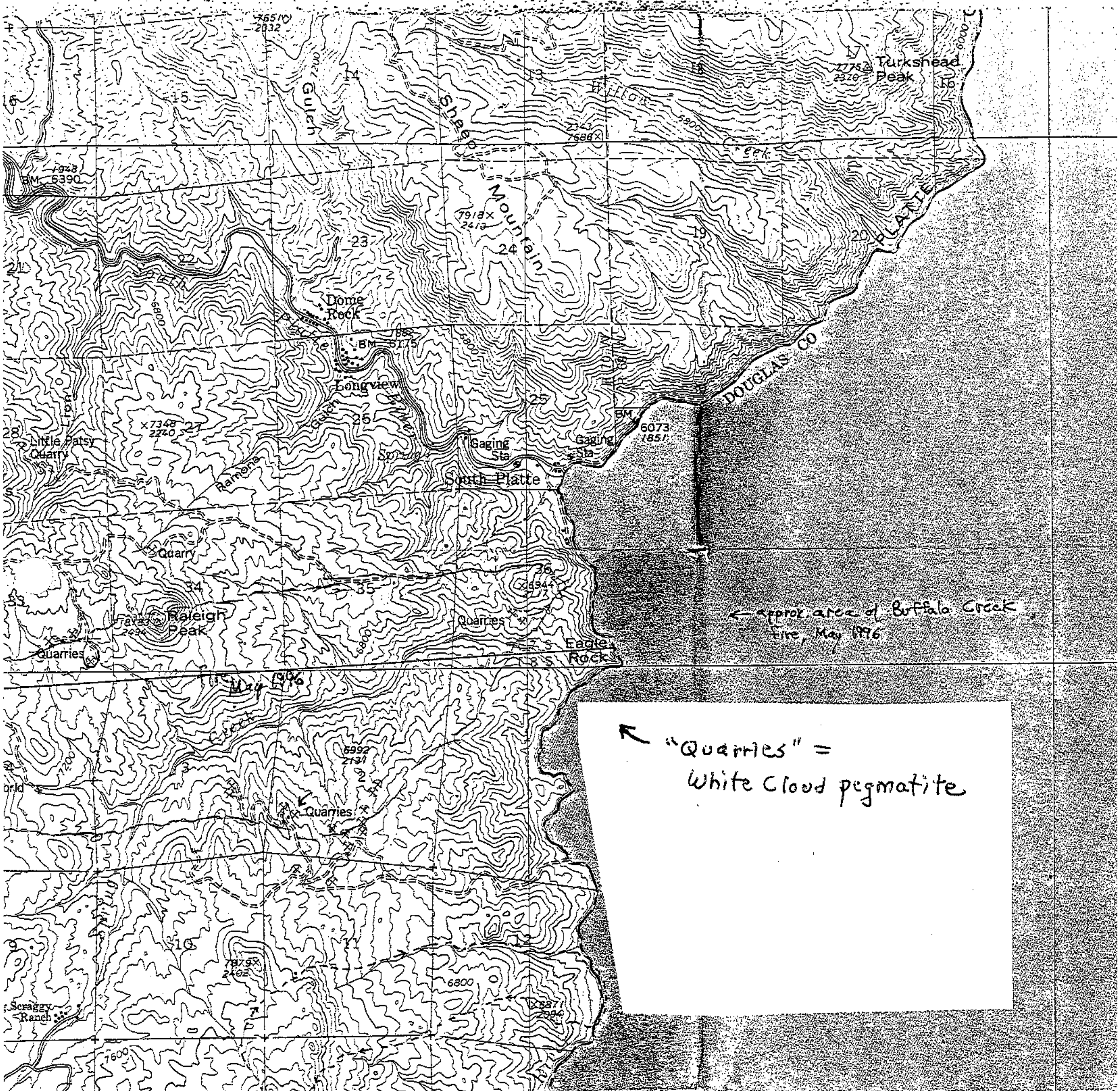
1 Emmett Evanoff
2 Celia Greenman (may not make it)
3 Terry Hiester
4 Sue Hirschfeld
5 Chuck Kluth
6 Peter Laux
7 Chris Morrison
8 Lin Murphy (will meet at trailhead)
9 Richard Nielsen
10 Dick Pratt
11 Damon Runyon
12 Dwight Schmidt
13 Lee Shropshire (probably won't make it)
14 Beth Simmons (will meet at trailhead)
15 Betty Skipp
16 Bruce Wahle

17 John Ghist (will meet us in Conifer)
18 Mel Schulman (will meet us in Conifer)
19 Jon Vail
20 Arne Ward (will meet at trailhead)
21 Ulli Limpitlaw (not sure)
22 Alan Silverstein (not sure)

23 Pete Modreski, leader



Cathedral Spires
Foxton
STRONTI SPRINGS RESERVOIR
Strontia Spring
SOUTH PLATTE RIVER
Longview
Little Patsy Quarry
Chair Rocks
Ferndale
Ramona
Gaging Sta
Quarry
Raleigh Peak
Quarries
Eagle Rock
PIKE NATIONAL FOREST
Buffalo Creek
Riverside
Picnic
Top of the World Campground
Creek
Platte Canyon No 10
Russell Ridge
Russell Gulch
Bear Mountain
Draw
Gulch
Spring
Long Scraggy Ranch
Twin Cedars
Nighthawk
Long Scraggy Peak
Willow Bend Picnic Ground
Creek
PINE 3 MI.
DECKERS 10 MI.
DECKERS 8 MI.
(Joins Map 3)
39° 22′ 30″


Turkshead Peak
Sheep Mountain
Gulch
Willow Creek
PLATTE
DOUGLAS CO
South Platte
Dome Rock
Longview
Gaging Sta
Gaging Sta
South Platte
Little Patsy Quarry
Ramona
Quarry
Raleigh Peak
Quarries
Quarries
Eagle Rock
Fire May 1996
Quarries
Scraggy Ranch
← approx area of Buffalo Creek fire, May 1996
"Quarries" = White Cloud pegmatite

Section 1–INTRODUCTION

In May 1996, the Buffalo Creek Fire burned approximately 50 km^2 in the Pike National Forest southwest of Denver, Colorado. The fire burned two adjacent sixth-level watersheds (U.S. Forest Service, 1995), Buffalo Creek and Spring Creek (fig. 1.1). A larger proportion of the Spring Creek watershed burned, 79 percent, compared with the Buffalo Creek watershed, 21 percent (table 1.1). Bruggink and others (1998), characterized the majority of the burned area as severely burned (63 percent), based on the consumption of litter and duff and the visible effects of the fire on the needles and branches of conifers, the predominant woody vegetation. Two months after the fire, an intense rainstorm (110 mm in an hour; Jarrett, 2001) caused severe flooding, erosion, and the death of two people. The flood transported large quantities of sediment and organic debris to Strontia Springs Reservoir on the South Platte River, a major water-supply reservoir for the cities of Denver and Aurora. The Denver Water Department and the U.S. Forest Service provided funding to assess the potential impact of sediment erosion in the burned watersheds and on the downstream water-supply systems.

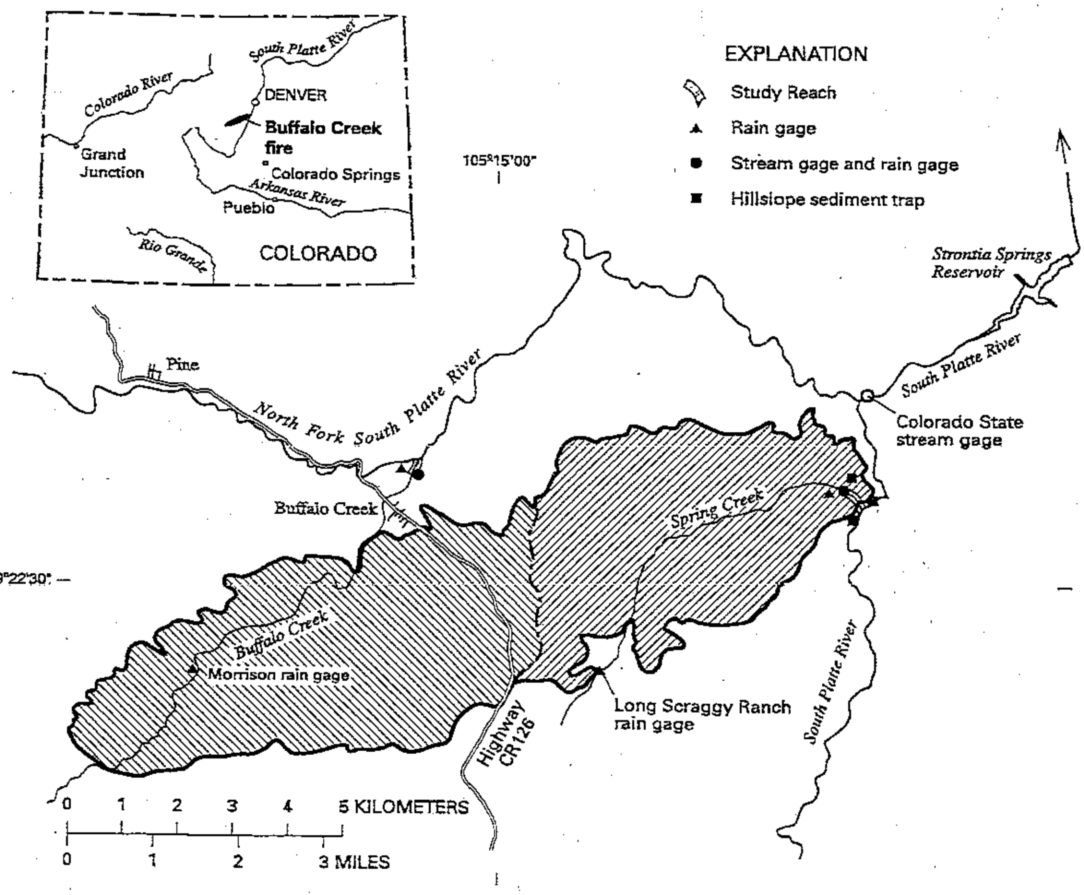


Figure 1.1 Location of the study sites within the two burned watersheds.

COLORADO'S Flood Information

Buffalo Creek Flash Flood Event

On the night of July 12, 1996, a thunderstorm occurred in the area of the community of Buffalo Creek, Colorado. The storm produced heavy precipitation over a short period of time. A flash flood occurred along Buffalo Creek, Sand Draw, Spring Gulch, the North Fork of the South Platte River (North Fork) below its confluence with Buffalo Creek, and several other tributary streams in the area. Two lives were lost as a direct result of the flooding. Roads, bridges, water lines, and other utility lines were damaged or destroyed. Numerous homes, outbuildings, and vehicles were damaged or destroyed as well. A large quantity of sediment and debris was carried from the watershed and deposited along the affected stream reaches. Although the geographic area affected was smaller than in some other floods, the July 12 Buffalo Creek flood event was truly a disaster. Other smaller scale floods have occurred in Buffalo Creek between June and September of 1996 as well.

In May of 1996, less than two months before the July 12 flood event, a wildland fire burned about 12,000 acres of forested area in the Buffalo Creek vicinity. The fire burned intensely and quickly, leaving behind charred timber and a barren landscape devoid of vegetation and ground cover. The burned soils exhibited hydrophobic (water repelling) properties, and the burned area's natural erosion control and runoff inhibiting characteristics were altered by the fire. Those conditions, in conjunction with a heavy rainstorm on July 12, were the recipe for disaster in Buffalo Creek.

Peak discharges for the July 12 event for the North Fork, Buffalo Creek, Sand Draw, and other tributaries were estimated by the Colorado Water Conservation Board and the USGS. The CWCB obtained detailed surveyed cross-sections on the North Fork of the South Platte River, Sand Draw, and Buffalo Creek. The preliminary discharge estimates, along with published FEMA 100-year flow values, are shown in Table 1. The estimated flow rates on July 12 range from 4 to 25 times the published FEMA 100-year flow values. Obviously, the Buffalo Creek flash flood produced enormous flow magnitudes and was extremely dangerous.

Table 1
Summary of Estimated Peak Discharges: July 12, 1996
Vicinity of Buffalo Creek, Colorado

Stream Name	Location	CWCB Estimated Peak Flow (cfs)	USGS Estimated Peak Flow (cfs)	FEMA Flood Insurance Study 100-yr Flows (cfs)
N. Fork South Platte River	Just d/s of confluence with Buffalo Creek	16,000	10,000 to 14,000	2,300
Buffalo Creek	Just u/s of mouth	16,000	8,000 to 16,000	630
Sand Draw	Just u/s of mouth	7,700	6,000 to 7,000	675

Background

On May 18, 1996, a 12,000-acre forest fire started west of Forest Road 543 and continued east driven by high winds until it reached the South Platte River. Although ponderosa pine can normally survive ground fires, the Buffalo fire burned extremely hot and crowned into the tops of the trees, killing most of them.

A large flood occurred on July 12th causing massive damage along Buffalo Creek, Sand Draw and Spring Creek. Part of the North Fork of the Platte River and the Platte River also received flood damage. This resulted in the closure of Forest Road 543 where it parallels Buffalo Creek and severe damage to the Buffalo Picnic area, Baldy and Tramway campgrounds. Major erosion also resulted in the loss of Shinglemill, Morrison, and part of Gashouse Gulch trails.

Rehabilitation

Emergency rehabilitation has been ongoing since these events. Aerial seeding of sterile white oats was applied. Crews cut dead trees and keyed them crosswise to the slope to slow down runoff. Sand bags and straw bales where placed in the upper parts of several watersheds.

Heavy machinery has been used to plow the soil to make it more absorbent to the rains and snow and to create new seed beds. A second aerial seeding of native grasses was completed in late winter.

Some sediment has been removed from Buffalo Creek and Spring Creek and the area has been revegetated.

Closures

These major events have also changed the way the area is managed. Morrison, Shinglemill and parts of Gashouse trails have been closed. Top of the World, Baldy and Tramway campgrounds and Buffalo Picnic area are closed and will be removed. Forest Road 543 is closed to public motorized use from the Forest boundary near Highway 126 to the intersection of Forest Road 550 near Buffalo Campground. Camping within 1/4 mile either side of Buffalo Creek in this area is also not allowed because of the risk of further flooding. **There is no parking in the lower east section of Forest Road 543.** Please do not block access on this route. Forest Road 538, the Top of the World road is closed to public motorized use. Motorized Trail 695 is closed to **all** use. The bridge at the South Platte River for the Colorado Trail was lost in the flood. To continue on the Colorado Trail non-motorized users may ford the river. The Trailhead at Highway 126 and the Colorado Trail was relocated to Forest Road 550 and Highway 126.

Openings

Additional camping sites have been added to Buffalo Campground. A new trailhead facility near Meadows Group Campground includes 20 parking spaces to replace trailheads which were closed. In 1995-96 additional trails were constructed near Jefferson County Pine Valley Ranch Park, which serves as a trailhead and access to the area unaffected by the fire and floods.

Because of these changes you may wish to consider rerouting your access to the area. Trailheads at Highway 126, Forest Road 550, and Meadows Campground can be used to access the Colorado Trail and the southeast portion of the area. Trailheads at Pine Valley Ranch Park just off Highway 126 and Miller Gulch, Forest Road 552, serve the north and west sections of the area. You can follow County Road 68 southeast from Bailey and access much of the area faster than through Buffalo Creek and Highway 126.

Tread Lightly!

Buffalo Creek

1997 UPDATE

PIKE
NATIONAL FOREST
SOUTH PLATTE RANGER DISTRICT

For information call:
(303) 275-5610

NYF-Pegmatites guidebook, 1999, p.27

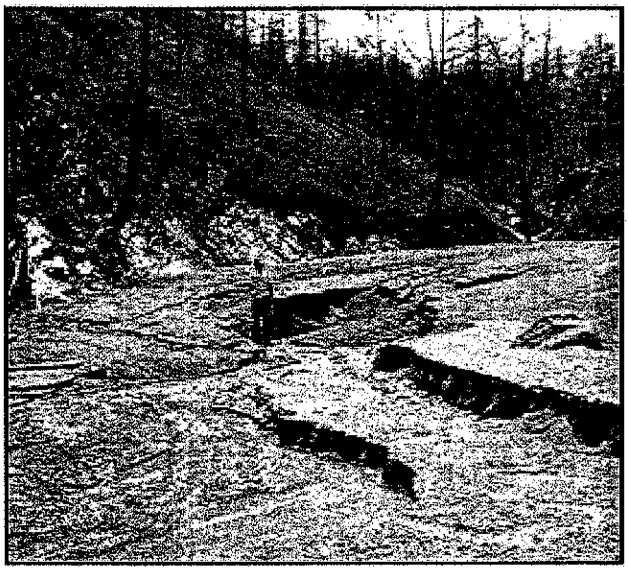
BUFFALO CREEK FIRE

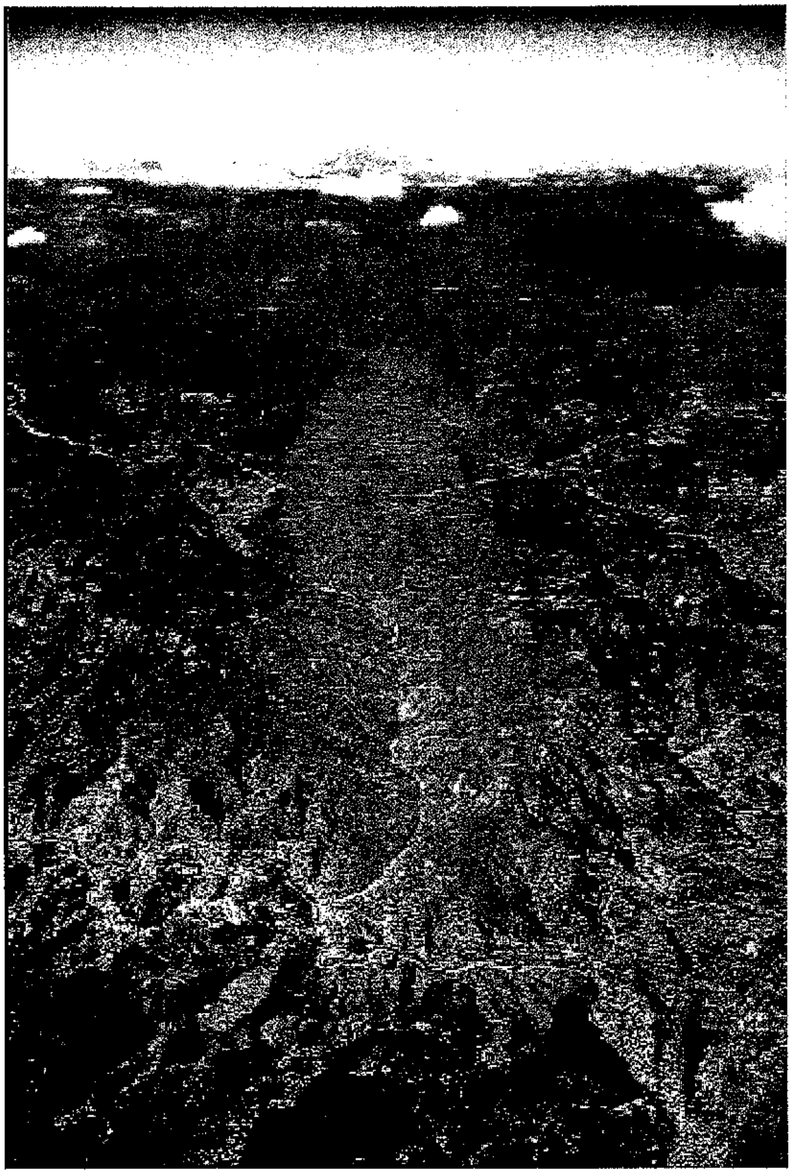
DANIEL E. KILE, U.S. Geological Survey, 3215 Marine St., Boulder, Colorado 80303

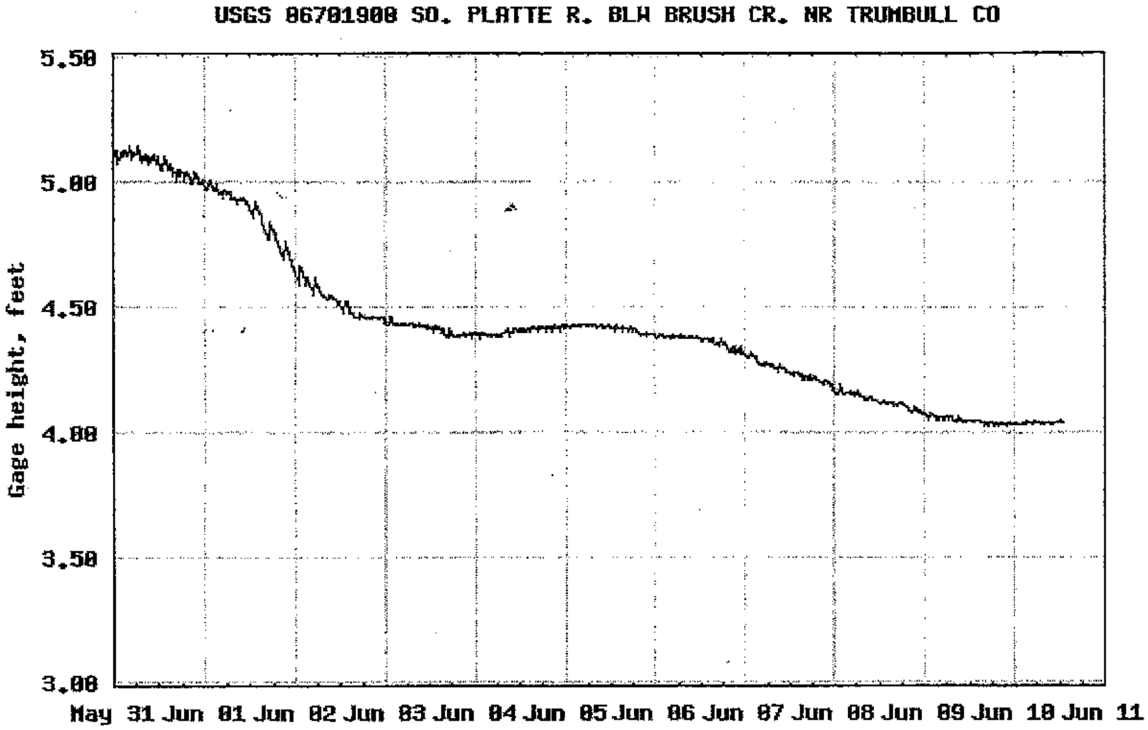
The burned area in the vicinity of the town of Buffalo Creek, as well as areas surrounding the pegmatites in the South Platte district, are the result of a carelessly tended campfire, which, during the extended hot and dry weather in May of 1996, was rapidly spread out of control by strong winds. Fed by a buildup of both ground and ladder fuels (partly a result of a long-standing policy of fire suppression), 11,900 acres burned, 8,000 acres of which was characterized by high intensity crown fire. Although there was no loss of life, there was property damage to dwellings, as well as damage to the surrounding watershed. Equally devastating was the July flood that followed this fire, the effects of which can be seen along the route through Buffalo Creek. Runoff from an intensive rainfall of 3 - 5 inches within 1 hour was dramatically intensified by a loss of vegetation and creation of hydrophobic soils created by the intense heat of the fire. Property damage to the town of Buffalo Creek was significant, and two lives were lost during this event. Effects of this flood impacted the Strontia Springs Reservoir that is a part of the Denver water supply system with an influx of 396,000 cubic yards of coarse sediment (representing about 30 times the annual rate of sedimentation) in the 3 months following the fire. Along with this high sediment load was a concurrent increase of Mn that required additional treatment to allow use as potable water; the source of this Mn, whether biogenic or otherwise, has yet to be determined. The susceptibility to flooding in this watershed remains high as a result of fire damage.

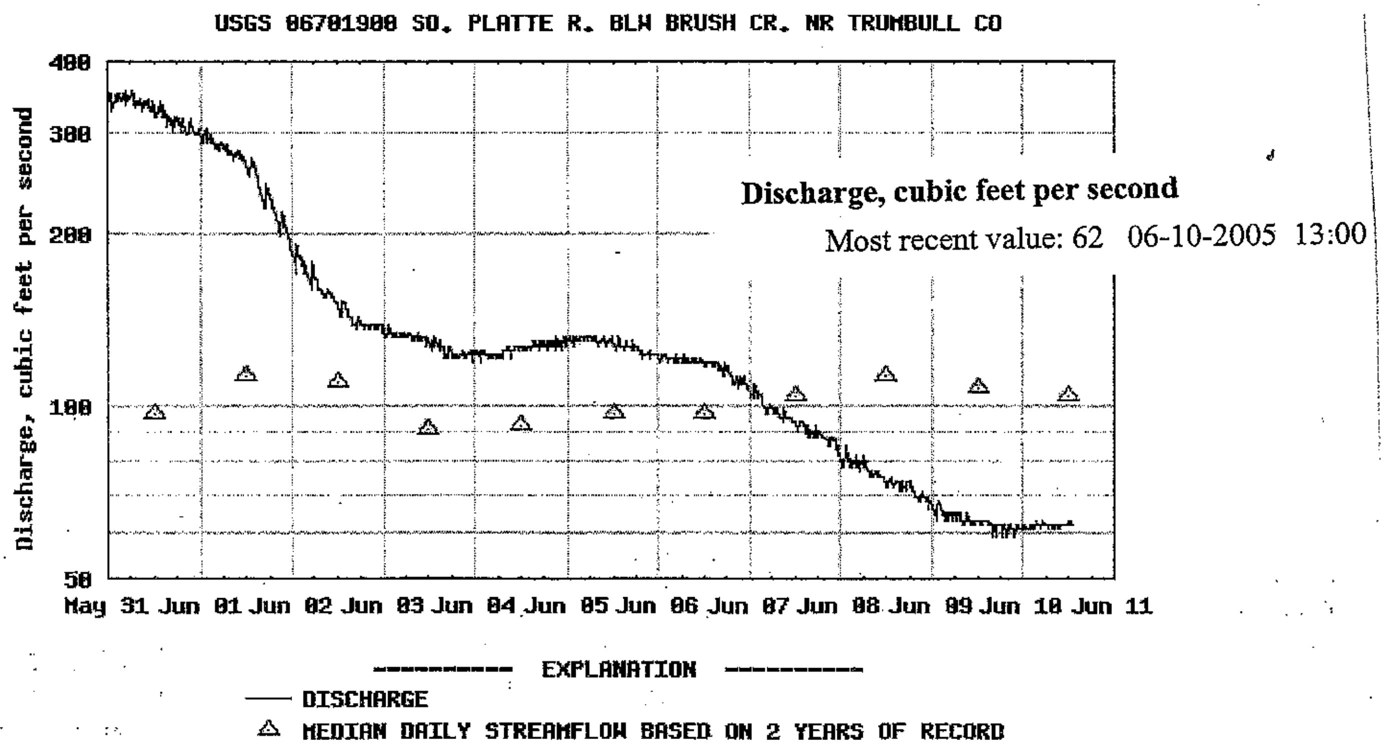
ACKNOWLEDGEMENT

Deborah Martin, U.S. Geological Survey, kindly provided statistics regarding the Buffalo Creek fire of 1996.









Download a presentation-quality graph

Parameter Code 00060; DD 02

Daily mean flow statistics for 6/10 based on 2 years of record in ft^3/sec

Current Flow	Minimum	Mean	Maximum	80 percent exceedance	50 percent exceedance	20 percent exceedance
62	68	104	139		104	

Percent exceedance means that 80, 50, or 20 percent of all daily mean flows for 6/10 have been greater than the value shown.

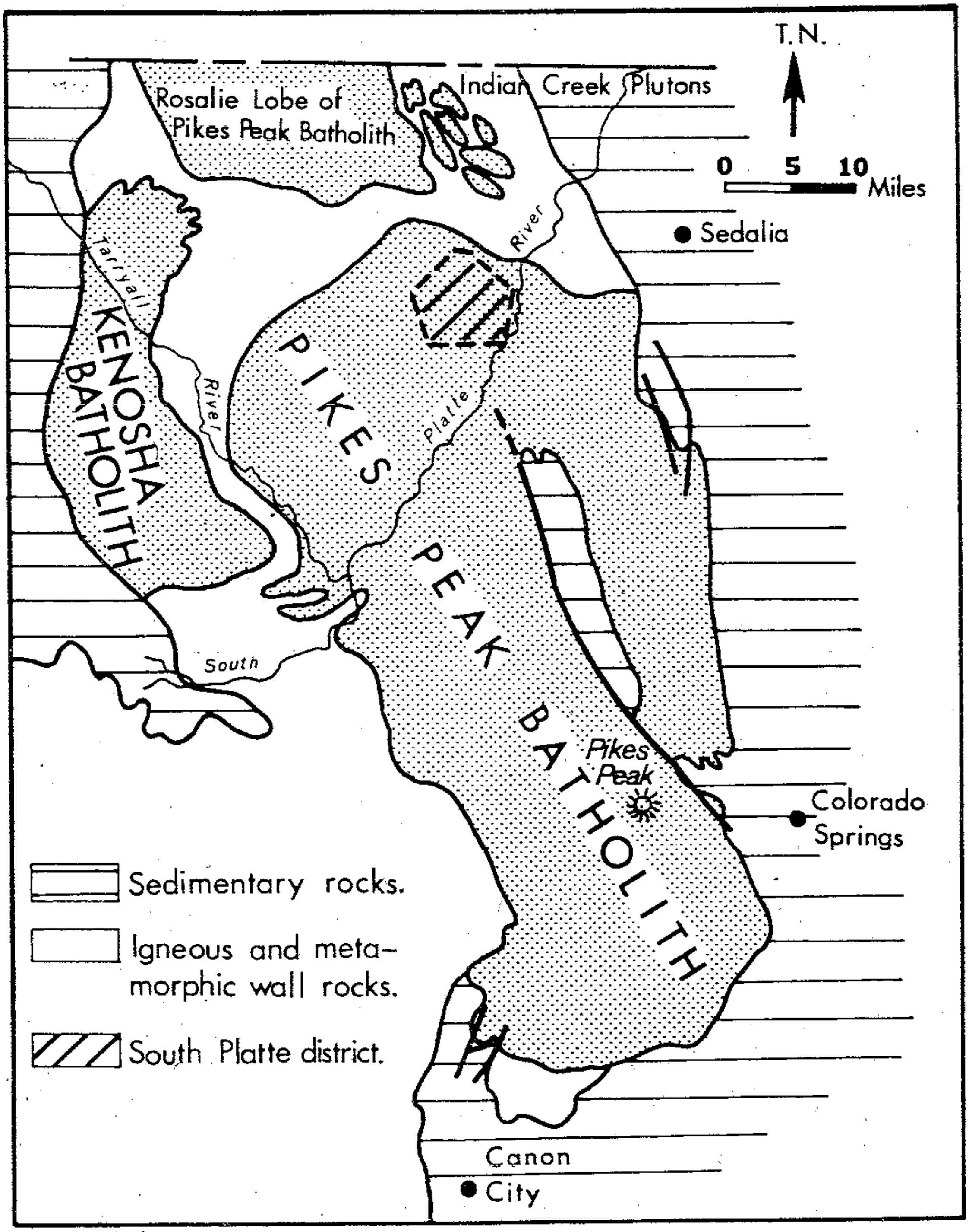


Figure 2. Generalized geologic map showing location of the South Platte district within the Pikes Peak batholith (modified from Hutchinson, 1960).

3. Post-batholithic rocks
    a. Quartzite dikes
    b. Fluorite veins
    c. Grus
    d. High-level Tertiary gravel

from Simmons & Heinrich, 1980

PIKES PEAK GRANITE PLUTON

General

The Pikes Peak granite pluton is exposed over about 1,700 square miles in the southern Colorado Front Range (Figure 2). The entire batholith extends about 60 miles northward from the Canon City Front Range embayment into southern Jefferson County, Colorado and extends about 30 miles westward from its eastern faulted contact with Paleozoic sediments between Denver and Colorado Springs to its contact with older gneisses and schists on the west. One large block of down-faulted Paleozoic sediments overlies the granite north of Pikes Peak. Within the batholith there are widely scattered bodies of younger igneous rocks, of both younger Precambrian and Laramide ages, small caps of Paleozoic sediments, and xenoliths and roof pendants of older metamorphic rocks such as those in the South Platte area.

Structure

The South Platte district lies within the northernmost end of the Pikes Peak batholith near its contact with the metamorphic rocks. The primarily structural features within this part of the batholith described by Hutchinson (1960) are: 1) concentrically curved, approximately vertical, linear and planar flow structures paralleling the trend of the contact of the batholith and the wall rocks, 2) inward-dipping marginal fissures filled with pegmatite and aplite, 3) radial dikes of pegmatite and aplite subnormal to the plan flow structures, 4) aplite-filled shears, 5) hydrothermally altered primary tension joints in radial arrangement near the contact, and 6) near-concordance of the igneous and metamorphic foliation within the batholith.

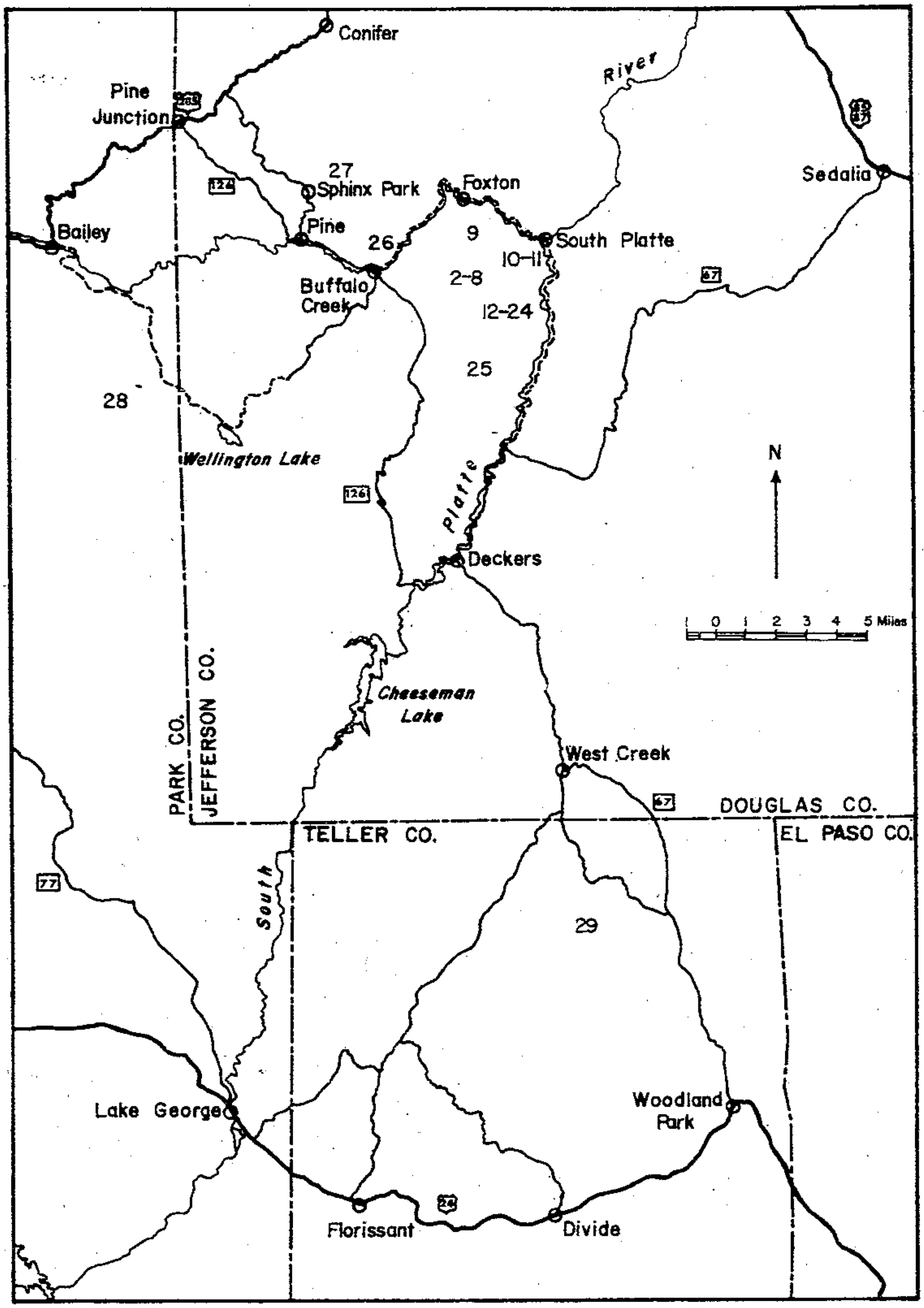
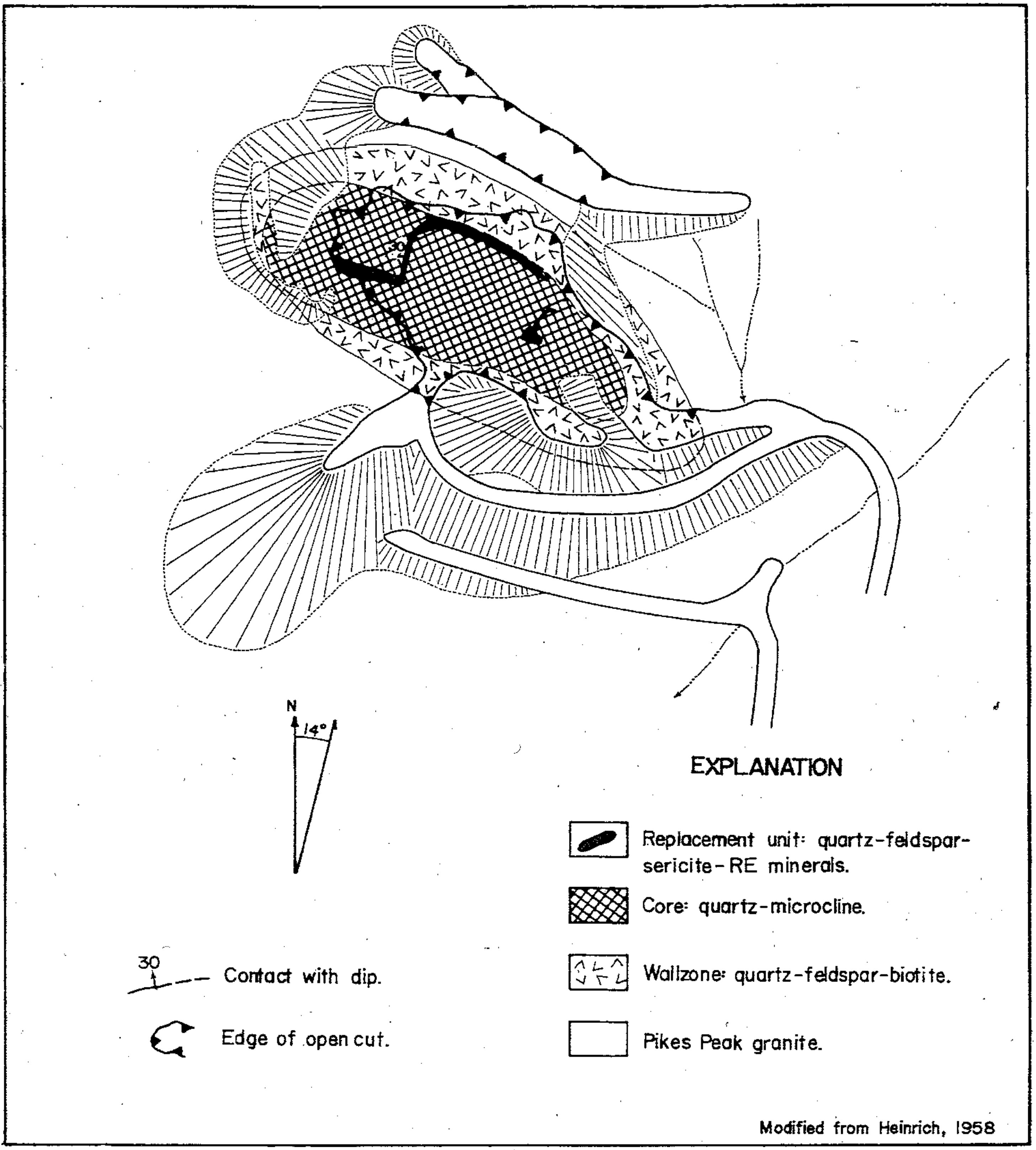
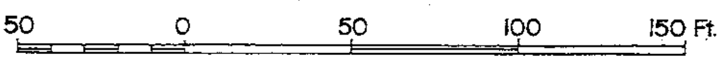
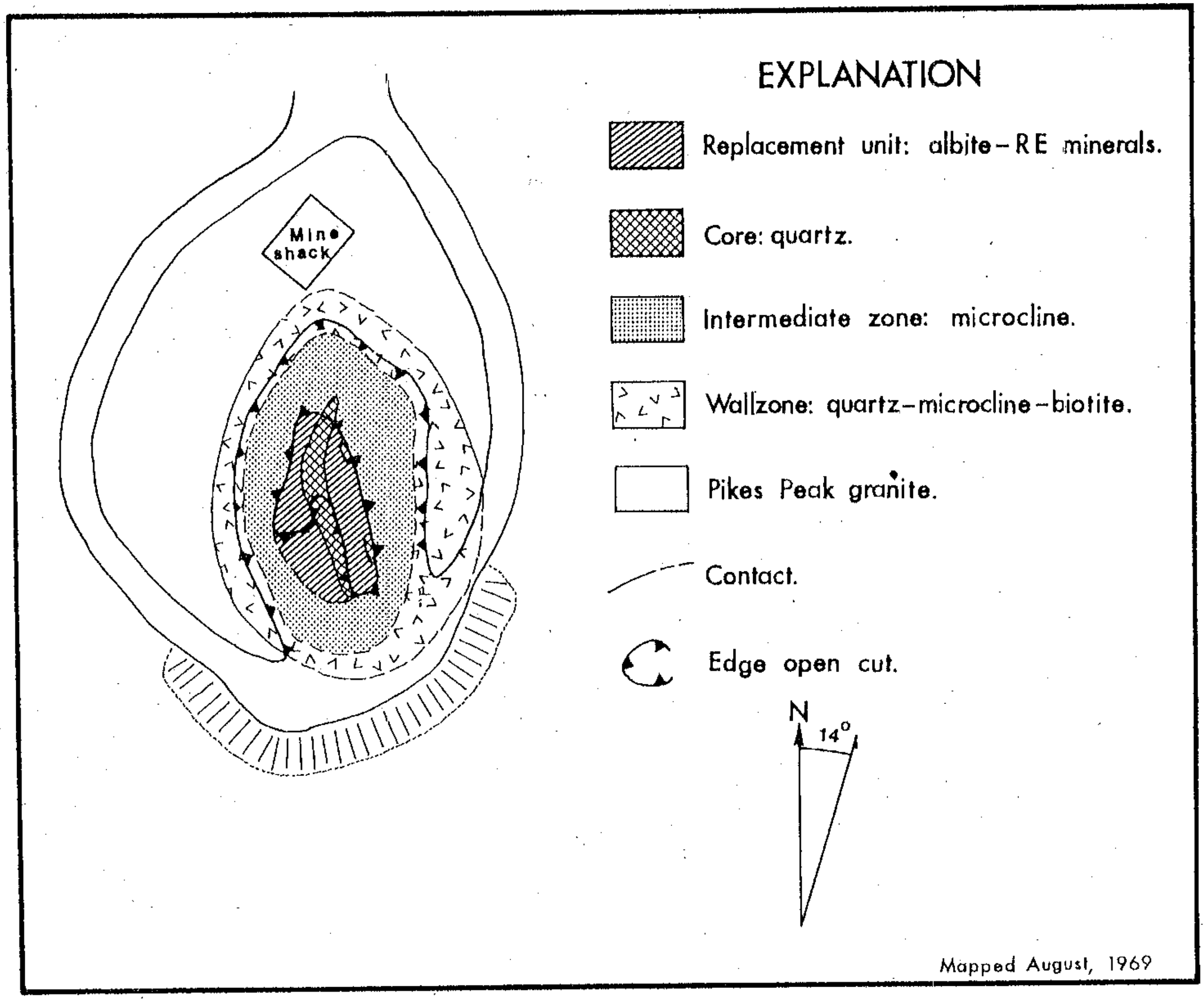


Figure 3. Map showing location of pegmatites in the South Platte district and related peripheral pegmatites. Numbers correspond to plate numbers of individual pegmatite maps.



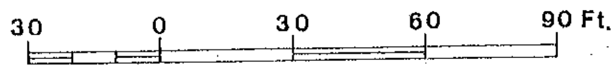
GEOLOGIC MAP OF THE WHITE CLOUD PEGMATITE
SOUTH PLATTE, COLORADO





GEOLOGIC MAP OF THE LESSER WHITE CLOUD PEGMATITE

SOUTH PLATTE, COLORADO



(This is the last para. of the "econ geol." section – follows p. 86)

Reportedly, a "carload" (about 50 tons?) of gadolinite-rich ore was produced from the White Cloud deposit.

Although the deposits of the district contain at least several thousands of tons of RE-mineral rich pegmatite rock, it is widely scattered in small bodies or lies diluted in dumps. Thus no large-scale mining of rare-earth ores in the district can be anticipated. Selective mining of fluorite units and RE-rich replacement units is required. During feldspar mining, larger pieces and crystals of rare-earth minerals were saved by the miners and accumulated. Similar accumulations have developed along with the mining of the quartz cores. Of not inconsiderable value has been the separation and sale of some rare-earth mineral masses (especially samarskite, allanite, gadolinite, and cyrtolite) as rare-mineral specimen material. About a ton of specimen topaz also has been obtained from the McGuire dumps.

fluorite.

Following the period of replacement activity, any remaining fluids were expelled through fractures which probably opened in response to the high pressures that these fluids were exerting on the enclosing rock. This period of rupturing is likely the cause of the sheared and slabby quartz found in the cores. Most of the dissolved components were apparently almost exhausted by this time, since only quartz and minor amounts of hematite and fluorite are associated with the fractures, and there is no evidence of alteration. With this final exhalation, the Pikes Peak sequence of magmatic activity came to an end in the South Platte district.

Section begins here →

ECONOMIC GEOLOGY

Feldspar

The main commerical product obtained from the South Platte pegmatites has been potash feldspars. It is believed that they were first prospected in the early 1920s, according to Mr. O. H. Jeckel (pers. comm., 1970). The Oregon and Little Patsy deposits were being mined in the 1930s at which time they were evaluated by the Fair Geologic Engineering Association of Denver, Colorado.

In all, 30 pegmatites have been mined and have produced significant amounts of feldspar. About ten more have been prospected for feldspar. It is estimated that the district has produced in the order of 300,000 tons of feldspar between 1920 and about 1970. Several deposits were being actively mined for feldspar in the late 1950s when Heinrich first examined them and mining continued at a few deposits (Patsy, Oregon No. 3, Luster No. 1) into the 1960s.

Because the pegmatites contain neither beryl nor book muscovite, they were not studied during World War II when the U.S. Geological Survey examined Colorado pegmatites for deposits of these minerals (Hanley and others, 1950).

Much of the feldspar obtained from the South Platte pegmatites was not first-grade ceramic feldspar owing to its red color resulting from exceedingly minute hematite inclusions. Most of the larger deposits have been mined out and no substantial reserves of potash feldspar remain.

Quartz

In Colorado a market for coarsely crushed snow-white quartz fragments stems from its initial use as decorative material on the roof of the chapel of the U.S. Air Force Academy at Colorado Springs. One of the first deposits used as a source of this material was the Black Cloud pegmatite (Heinrich and Gross, 1960) near Divide, Colorado. With this introduction to the market, quartz-core mining for terrazzo stone spread to other Colorado pegmatite districts, including South Platte where quartz mining begain in the 1960s. The main deposits whose cores have been mined are the Oregon No. 3, Luster No. 1, and the Dazie Bell claims.

Quartz utilized for terrazzo stone must be of uniform whiteness and thus free of limonite staining. It is estimated that the South Platte deposits have yielded a minimum of about 200,000 tons of such material.

Fluorite

Acid-grade fluorite in small quantities has been mined from several deposits, usually by expensive, selective mining and even hand-cobbing. About 1957 some 50 tons of acid-grade green fluorite was mined from the Luster No. 1 pegmatite by Robert Beal and his associated of Green Mountain Falls, Colorado. Fluorite also has been mined from the Little Bill and Dazie Bell pegmatites. Total reserves of recoverable fluorite are small inasmuch as the core-margin fluorite zones are thin and/or incompletely developed. In 1958 about 15 tons of fluorite ore was stockpiled at the Madonna No. 3, and it was estimated that approximately another 50 tons was in the dumps and cut exposures.

Rare-Earth Minerals

The technological application of rare-earth elements has within the last few years experienced a major renaissance. The traditional uses, including lighter flints, polishing abrasives, arc carbons, and glass-ceramic additives, have remained as important consumers in the rare-earth industry. To these have been added catalysts for petroleum refining, additives in ductile iron and steel, and, as high-purity individual elements and their compounds, in color television picture tubes, fluorescent lamps and X-ray intensifiers. For the last three, europium and yttrium oxides are particularly important. Recently much interest has centered on the development of the extremely powerful rare earth-cobalt alloy magnets. Another interesting development is synthesis of yttrium garnet of a commerical scale for very attractive gemstones.

The demand for rare-earth elements increased rapidly between 1969 and 1978, and the probable domestic demand for the year 2000 is projected to be 57,000 short tons of rare-earth oxides.

Because of their geochemical dichotomy, Ce, La, and the lighter rare-earth elements are available in relatively large amounts in economically important deposits such as beach placers (monazite) and carbonatites (bastnaesite at Mountain Pass, California). In contrast Y and the heavier rare earths occur in minerals (e.g., xenotime, gadolinite) whose deposits are relatively scarce and unusually small. Inasmuch as the South Platte pegmatites contain several minerals enriched in elements of the Y-subgroup, these deposits have generated considerable interest as sources of these elements.

Rare-earth ores were first found in the South Platte district in the mid-1950s in fluoritic rock from the Deep Hole pegmatite. Mining in several deposits and in several dumps was carried out by Robert Beal and Associates of Green Mountain Falls in 1955-1957. The Deep Hole eventually produced 16 tons of handcobbed high-grade RE ore (fluoritic), all of it from the dumps. Some 15 tons of gadolinite-xenotime-monazite ore was obtained from the Snowflake deposit. It is estimated that another 50 tons could be recovered from that dump by hand picking.

Rare-earth minerals that have been produced from other South Platte pegmatites include:

Samarskite - Oregon No. 3, Luster No. 1
Gadolinite - White Cloud, Dazie Bell
RE-bearing fluorite - Big Bear No. 2
Allanite - Shuttle Run
Xenotime - Big Bertha

Hand-picked fluorite ore, in amounts of 10 to about 100 tons was obtained from the Big Bear No. 2 and several other pegmatites; these ores assayed 1 to 7.5 percent Y. The rare earths occur in microscopic inclusions of xenotime and monazite in the fluorite. Samples of a crude rare-earth concentrate prepared by Robert Beal and analyzed by Dow Chemical Company of Midland, Michigan contained 47.9% Y, 2.8% Gd, 2.3% Dy, 3.7% Nd, 1 to 2% Er, Sm, Ce, and 0 to 1% Ho, La, Tb, Pr (Heinrich, 1958).

In 1957 it was calculated that the Big Bear No. 2 contained, in measured reserves, about 120 tons of fluoritic RE ore. The Big Bear ores were sold to Gows Chemical Company which produced various RE salts in 60-percent oxide concentration. These were marketed through Rare Earth Chemical Company of Colorado Springs.

see first page (p.83) for final paragraphs of econ.-geol. section

9. a) White Cloud.
   b) Westernmost pegmatite of the SE1/4 of the SW1/4 of Sec. 36, T7S, R70W; Plate 10.
   c) 300' x 125'; elliptical.
   d) WZ; C(Q+M); R.
   e) Crosscutting and core-margin rare-earth-rich replacement units of yttrofluorite, gadolinite-fluorite, sericite, doverite, minor core-margin green fluorite.
   f) Mined for microcline and rare earths.

10. a) Lesser White Cloud.
    b) Easternmost pegmatite of the SE1/4 of the SW1/4 of Sec. 36, T7S, R70W; Plate 11.
    c) 105' x 75'; oval
    d) WZ; IM; C(Q); R.
    e) Crosscutting albite replacment unit that completely bisects the core; wall zone contains stellate groups of biotite laths.