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## BOULDER CREEK BATHOLITH, COLORADO

### Introduction

The Boulder Creek batholith is located east of the Front Range and just west of Boulder, Colorado. It was emplaced in the catazone at a depth of 12-20 Km, 1,700 mya. It is the best known and studied of a series of calc-alkaline bodies. Its rocks range in composition from granodiorite through quartz diorite, quartz monzonite to gneissic aplite. The early stage of the batholith is composed dominantly of Boulder Creek granodiorite, with the more leucocratic rocks, Twin Spruce quartz monzonite, emplaced during the mush stage before the batholith completely crystallized.

There were two quite similar magmas which were emplaced essentially simultaneously. The northern body is somewhat more mafic than the southern body which is richer in potassium feldspars. The magmas were emplaced during a major regional metamorphic period. Strongly foliated granodiorites and streams of oriented dark inclusions abound. In addition the north-south variations in composition, there are east-west gradations, particularly in the northern body. Somewhat more potassic rocks occur to the east and more calcic rocks to the west.

The western boundary of the batholith is marked by crudely aligned comagmatic mafic rocks, enclosed in strongly deformed, high grade metamorphic rocks - garnet-cordierite gneisses.

Dolores J. Gable, USGS, provided detailed locations of geologically documented outcrops (see Fig. 3 p. 5, PP1101) from which the suite was largely drawn. Her Professional Paper, The Boulder Creek Batholith, Front Range, Colorado, USGS PP 1101 was the main source of additional information. We are most grateful to Dr. Gable for her generous assistance.

### References

- Boos, M.F., & Boos, C.M., 1934, Granites of the Front Range - the Longs Peak - St. Vrain batholith: GSA Bull 45, 302-322.
- Gable, D.J., 1969, Geologic Map of the Nederland Quad., Colo. USGS GQ 833.
- 1972, Geologic Map of the Tungsten Quadrangle, Colorado, USGS GQ 978.
- 1977, Preliminary Geologic Map of the Gold Hill Quad., Colorado, USGS Open File report 77-849.
- Gable, D.J., & Sims, P.K., 1969, Geology and Regional Metamorphism of some high-grade Cordierite Gneisses, Front Range, Colorado. GSA Specil Paper 128, 87p.
- \*\* Gable, D.J., 1980, The Boulder Creek Batholith, Front Range, Colorado, USGS PP 1101, 88p.
- Lovering, T.S. & Twets, O.L., 1953, Geology and Ore Deposits of the Boulder County Tungsten Dist., Colorado. USGS PP 245, 199p.
- Topographic Maps - Gold Hill, Boulder, Nederland, Tungsten, Eldorado Springs, Central City, Black Hawk.

Location and Description of Specimens

\*Specimen No. in USGS PP 1101

1. Boulder Creek granodiorite (138)\* outcrop on Highway 119 on S leg of U curve 0.2 mi. SE of Wheelman and .15 mi. SW Red Signal Mine near SW cor. sec 32, T 1 N, R 71W, Boulder Quad. Modal analysis Table 1 p 16. Analysis Table 10 p 42. PP 1101.
2. Boulder Creek granodiorite, somewhat foliated (106) on N side Highway 119, just S of last "0" in 6800 and NE of word "Boulder" near SE cor. sec 36, T 1 N, R 71 W, Gold Hill Quad (1 mi S of SE cor. of quad). Modal analysis Table 1, p 14, Chem. analysis Table 10 p. 42.
3. Boulder Creek granodiorite, Highway 119, NE of Dam at Barker Reservoir, 1/8" L of T of Tungsten. SE $\frac{1}{4}$ , SW $\frac{1}{4}$  sec 8, T 1 N, R 72 W, Tungsten Quad. No analyses.
4. Boulder Creek granodiorite (71) porphyroblastic. Highway 72, roadcut above and below highway, above RR tracks about  $\frac{1}{2}$  mi NW of Pinecliffe,  $\frac{1}{4}$ " SE of large black building symbol near cen. NW $\frac{1}{4}$ , NW $\frac{1}{4}$  sec. 27, T 1 S, R 72 W, Tungsten Quad. Modal analysis Table 1 p. 14, no chem analysis.
5. Twin Spruce quartz monzonite on W limb of U curve opening to N, E of cen. of NW $\frac{1}{4}$ , NW $\frac{1}{4}$  sec. 36, T 1 S, R 72 W. (77) Tungsten Quad. About 5/8" WSW of BM 8772. Modal analysis Table 8, p. 30, no chemical analysis.
6. Diorite (352) on Highway 119, E side of road 1/8" E of M of BM 8591 near cen. NW $\frac{1}{4}$ , NW $\frac{1}{4}$  sec. 6, T 2 S, R 72 W, Tungsten Quad. Chem. analysis Table 12, p. 46.
7. Pyroxenite (?) (353) See Fig. 12 lower, p. 27. N side of Highway 119, 3/16" S of southern building of 2 large black building symbols. Sec. 6, T 2 S, R 72 W., Tungsten Quad. Chemical analysis Table 12, p. 46.
- 8.9.10. See Fig. 10, p. 25.(334)
8. Mafic inclusion (large lens of diorite?) contains light feldspar strings and knots. About  $\frac{1}{2}$  mi. NE of Castle Rock on Highway 119,  $\frac{1}{4}$ " W of E line of sec. 9, T 1 S, R 72 W, Tungsten Quad. Mafic inclusion band or large pod collected about 30 feet W of the inclusion illustrated in Fig 10. We wanted to be sure that we did nothing to disturb the area of the Figure. It is worth seeing. Chem. analysis Table 11 p. 44. Modal Analysis Table 11 p. 45. (334)
9. Pegmatitic pod, 20-30 Ft. W of Fig 10.
10. Boulder Creek granodiorite (country rock), somewhat more leucocratic than normal. 8 - 10 at same locality.
11. Boulder Creek granodiorite, migmatitic, with many feldspar strings and diklets. N side of Highway 119 near E end of Barker Reservoir SW $\frac{1}{4}$ , NE $\frac{1}{4}$ , NE $\frac{1}{4}$  Sec. 18, T 1 S, R 72 W. Tungsten Quad. Very near the W edge of the batholith.
12. Granite gneiss, foliated (359) cen. of U curve which opens NW, Highway 119, about  $\frac{1}{4}$ " L of red 2 indicating Sec. 2, T 1 S, R 72 W. Tungsten Quad. Modal analysis Table 9 p. 36.
- 13,14. same locality. On Four Mile Creek Road across from side road to Packer Gulch near NW cor. NE $\frac{1}{4}$  sec. 20, T 1 N, R 71 W, Boulder Quad.
13. Mafic inclusions (385) Chem. Analysis Table 11, p. 44. Modal Analysis Table 11 p. 45. Many inclusions in long pods or streamers.
14. Boulder Creek granodiorite country rock.
15. Silver Plume quartz monzonite. (359-74) Roadcut N side of Left Hand Creek Road near cen. NE $\frac{1}{4}$ , NW $\frac{1}{4}$  sec. 18, T 1 N., R 72 W. Gold Hill Quad.
16. Sillimanite gneiss, N side of Left Hand Creek Road near Cen. SW $\frac{1}{4}$  sec. 1, T. 1 N, R 72 W, Gold Hill Quad. (roadcut)



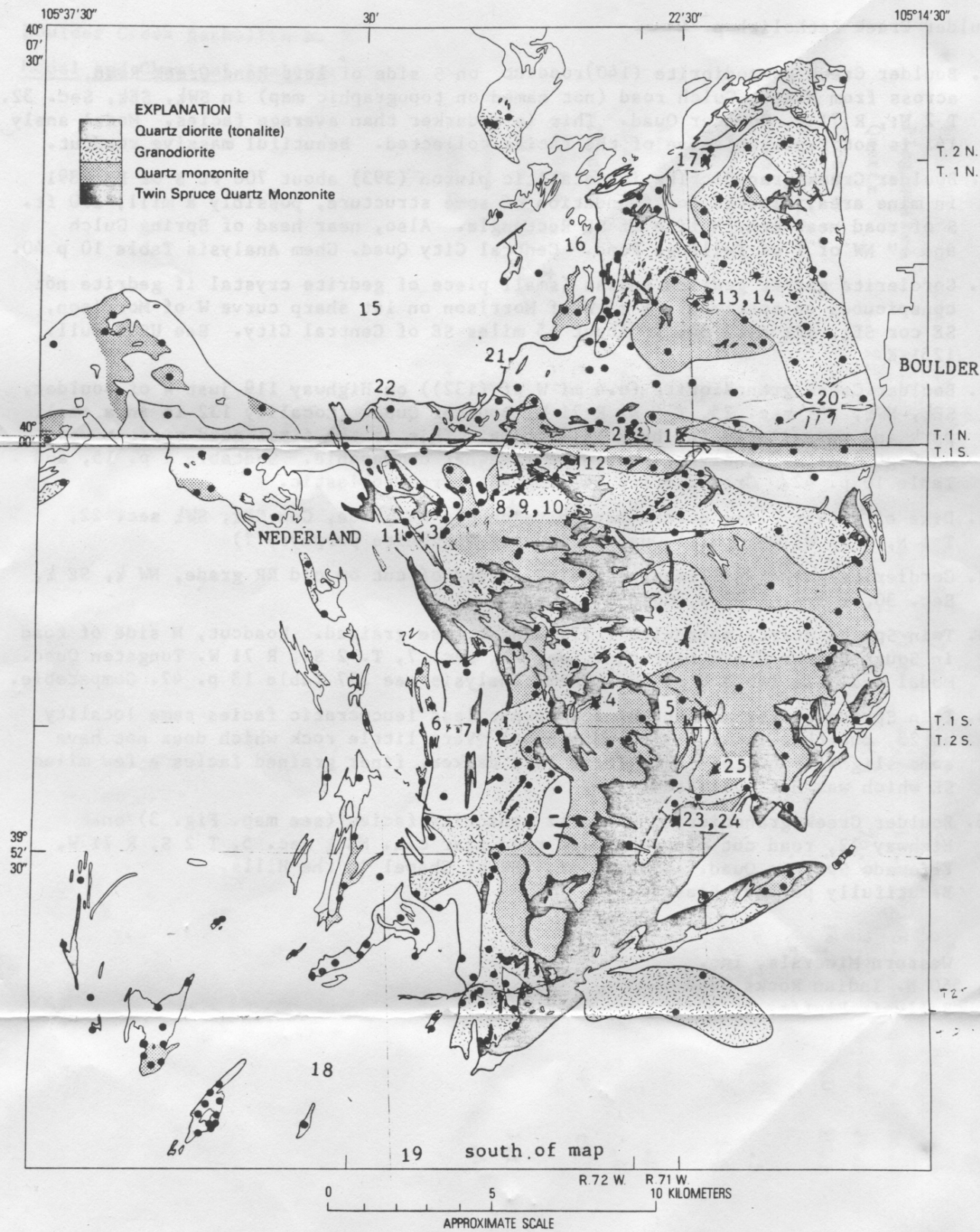


FIGURE 3.—Boulder Creek batholith showing rock types as indicated from modes. Dots are mode localities; dashes represent areas of insufficient data to place boundaries accurately.

Numbers indicate location of specimens  
 An X through the dot indicates analyses  
 From Gable Fig. 3 p. 5.

Boulder Creek Batholith p. 4

17. Boulder Creek granodiorite (140) roadcut on S side of Left Hand Creek Road, across from Nugget Gulch road (not named on topographic map) in SW $\frac{1}{4}$ , SE $\frac{1}{4}$ , Sec. 32, T 2 N, R 71 W, Boulder Quad. This is a darker than average facies. Modal analysis 141 is not representative of the facies collected. Beautiful massive roadcut.
18. Boulder Creek granodiorite in satalitic pluton (393) about 700 Ft S of BM 8891 in mine area, blasted for foundation of some structure, possibly a mill, 200 ft. S of road near cen. N line of SE Rectangle. Also, near head of Spring Gulch and  $\frac{1}{4}$ " NW of T of Tailings Pond. Central City Quad. Chem Analysis Table 10 p 40.
19. Cordierite garnet gedrite gneiss (small piece of gedrite crystal if gedrite not conspicuous on specimen).  $\frac{1}{2}$  mi W of Morrison on 1st sharp curve W of Morrison, SE cor SE $\frac{1}{4}$ , SE $\frac{1}{4}$  sec. 34, . About 15 miles SE of Central City. See USGS Bull. 1251 E.
20. Boulder Creek granodiorite (o.4 mi W of (132)) on Highway 119 just W of Boulder, SE $\frac{1}{4}$ , NW $\frac{1}{4}$ , NE $\frac{1}{4}$  sec. 25, T 1 N, R 71 W, Boulder Quad. Locality 132 is in a small park and unavailable for bulk collecting. This is the first good roadcut west on Highway 119. Analyses should be somewhat comparable. See table 1 p. 15, and Table 10 p. 42. Granodiorite is somewhat porphyroblastic.
21. Dike of Silver Plume quartz monzonite on old RR grade, Cen SE $\frac{1}{4}$ , SW $\frac{1}{4}$  sec. 22, T 1 N, R 72 W, Gold Hill Quad. (quartz monzonite porphyry ?)
22. Cordierite-garnet-sillimanite gneiss, E end of cut on old RR grade, NW  $\frac{1}{4}$ , SE  $\frac{1}{4}$ , Sec. 30, T 1 N, R 72 W. Gold Hill Quad.
23. Twin Spruce quartz monzonite ( 77) med. coarse grained. Roadcut, N side of road in South Beaver Creek near cen. SW $\frac{1}{4}$ , SE $\frac{1}{4}$  sec. 7, T. 2 S., R 71 W. Tungsten Quad. Modal analysis Table 8 p. 30. Chem. analysis see 377 Table 13 p. 47. Comparable.
24. Twin Spruce quartz monzonite, a somewhat less leucocratic facies same locality as 23, but this is minor. (23 dominant) Very little rock which does not have some slight iron staining. There is a darker, finer grained facies a few miles SE which was not collected.
25. Boulder Creek granodiorite - quartz monzonite facies (see map. Fig. 3) on Highway 72, road cut opposite side road near cen. NE  $\frac{1}{4}$  sec. 5, T 2 S, R 71 W, Eldorado Springs Quad. About  $1\frac{1}{2}$  mi. NW of Chapel in the Hills. Beautifully porphyroblastic.

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Modal and Chemical Analyses

Specimen No. and USGS No.	1(138)	2(106)	4(71)	5(77)	8(334)	12(359)	13(385)	2(377)	20(132)
Potassium feldspar	6.4	2.0	18.8	47.8	15.6	56.4	1.9	31.2	4.9
Plagioclase	46.9	54.7	43.5	21.6	42.7	14.8	46.7	29.1	46.0
Quartz	25.4	21.3	26.9	28.8	15.5	26.9	7.7	4.4	21.3
Biotite	12.2	15.3	10.0	1.3	19.0	.6	14.8	2.0	20.3
Muscovite				.1	.2	.5	tr		
Ores	.8	.5	.3	.04	3.0		tr	.7	.5
Hornblende	5.4	5.1		tr			23.5		5.0
Pyroxene							tr		
Allanite	.1	tr		tr	.3		tr		.1
Apatite	.9	.3	.1	tr	.9	tr	1.2		.4
Zircon		tr	tr	tr					
Calcite	.1						.3		
Epidote/Zoisite	.9	.3					2.1		1.1
Sphene	.5	.5	tr		2.6		.5		.4
Prehnite	.1						tr		

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1977 Preliminary Geology of the Boulder Hill Quad., Colorado, USGS Open File Map G-1000  
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Specimen No. and USGS No.	1 (138)	2 (106)	5 (352)	7 (353)	8 (334)	13 (385)	15 (395)	17 (140)	18 (393)	20 (132)	23 (377)
SiO <sub>2</sub>	63.1	62.3	7.8	50.5	57.6	53.6	61.1	63.5	64.09	62.8	72.4
Al <sub>2</sub> O <sub>3</sub>	16.2	17.0	14.3	8.8	16.6	15.6	14.9	16.4	14.03	15.4	14.0
Fe <sub>2</sub> O <sub>3</sub>	1.8	1.8	3.6	2.9	4.7	2.9	4.2	1.0	3.44	2.1	.34
FeO	2.7	2.0	7.0	5.8	5.0	5.5	3.4	3.0	2.71	2.8	1.9
MgO	2.2	1.5	9.7	13.4	3.0	4.4	1.0	2.4	1.14	3.0	.45
CaO	5.4	5.8	9.8	12.4	5.4	7.9	6.3	5.1	3.91	4.9	.92
Na <sub>2</sub> O	3.8	3.8	2.0	.73	3.3	3.1	3.2	3.7	2.31	3.4	3.0
K <sub>2</sub> O	2.6	2.2	3.5	1.6	3.7	2.6	2.3	1.9	4.18	3.1	5.3
H <sub>2</sub> O+	.65	.60	1.1	.61	.11	1.3	.68	.74	.38	1.1	.69
H <sub>2</sub> O-	.12	.1	.16	.09	1.1	.09	.29	.31	.16	.32	.17
TiO <sub>2</sub>	.67	.7	1.1	.84	2.7	.64	1.7	.65	1.31	.79	.36
P <sub>2</sub> O <sub>5</sub>	.54	.66	.86	1.10	1.1	.71	1.1	.50	.56	.70	.07
MnO	.06	.06	.18	.21	.12	.18	.08	.05	.09	.08	.07
CO <sub>2</sub>	.08	.08	.05	.03	<.05	.02	.08	.036	.12	.22	<.05
Cl	.02	.02	.09	.03	.03	nd	.02	.02	.05	.01	.011
F	.07	.09	.32	.24	.20	nc	.40	.12	.59	.15	.06
S	.01	nd	nd	nd	nd	nd	nd	.01	.03	.01	nd
BaO	nd	nd	nd	nd	nd	nd	nd	nd	.24	nd	nd

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