A Geochemical and Geological Study of a Small Field Area, South of Three Mile Mnt. Thirtynine Mile Volcanic Field, Central Colorado.

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INTRODUCTION

When the Thirtynine Mile volcanic field was first mapped and studied, the volcanics were not precisely classified. During the summer of 1987 the Keck consortium funded the first project to extensively study the chemistry of the Thirtynine Mile volcanic field in detail. The 1990 Keck project headed by Stan Mertzman and Reinhard Wobus, continues the work of the earlier project. This study is one aspect of this project.

The goal of this independant study is to map and classify the volcanics of a small area within the Thirtynine Mile volcanic field, and to unravel and understand the the geologic history of that small area. This study incorporates many different fields of geology including petrology, mineralogy, geochemistry, volcanology, structural geology, and geomorphology. It is hoped that the combination of these various fields will build a complete and firm geologic history for the study area, and that this history can be expanded to help understand the geology of the Thirtynine Mile volcanic field.

LOCATION

The Thirtynine Mile volcanic field covers approx 2000 square kilometers of central Colorado (fig. 1). It is located west of the the Front Range, south of of South Park, east of the Arkansas River Valley, and north of the Wet Mountains . It lies approximately 9000 ft above sea level. At the center of the the field is the small town of Guffey.

The field area for this study is located approximately 10 miles northwest of Guffey. It covers four and a half square miles of Pike national forest south of Three Mile Mountain. The field area includes the southern portion of Three Mile Mountain, a portion of the northwest flank of Thirtynine Mile Mountain. and the drainage valley of Three Mile Creek. Colorado State route nine crosses the field area in a Northwesterly direction. This region is bounded by the longitudes 105 40' and 105 37' and latitudes 38 50' and 38 52'.

The volcanic rocks of this region were previously mapped within the lower member of the Thirtynine Mile andesite. The Current Creek Fault, also previously mapped here, runs approximately one quarter mile parallel to Colorado Nine. Blocks of Paleozoic and Precambrian were also mapped along this fault (Epis and others, 1979).

FIELD METHODS

All the mapping within the area was done by foot traverses. One hundred and seven locations were mapped on a USGS topographic base. At each location the rocks were described and classified by their mineralogy, color, and character. At several locations specimens were collected for petrologic and chemical analysis. Also joint measurements and strike and dip measurements were taken where possible. Due to the extensive soil cover in many places some sections of the area were roughly mapped from regolith and float found within the soil.

Seventy specimens were collected in the field. Most of these were chosen to represent the surrounding rocks, but a few were picked to study the alteration and silicification caused by faulting in the area. In many of the mud and ash flows, the specimens were taken from the more dense and less weathered volcanic bombs found within them.

LAB METHODS

Thirty of the specimens were prepared for thin section analysis. Of these thirty, eighteen were chosen for chemical analysis. These chemical specimens were chosen for their value as a representative sample and for their lack of alteration and chemical weathering.

The chemical analysis was completed at Franklin and Marshall College using X-Ray Florescence and Inductively Coupled Plasma techniques. The specimens where analyzed for major element analysis, trace element analysis, and rare earth analysis.

X ray powder diffraction was also used to study some of the alteration and silicification of some of the rocks.

Air photos were used to complete a liniment study that would supplement the structural data measured in the field.

OBSERVATIONS AND RESULTS

Within this field area the lower member of the Thirtynine Mile andesite can be split into five distinctive rock units, the youngest being unit one (fig.2).

Unit one- A light grey rhyolite tuff bearing plagioclase and biotite phenocrysts.

Unit two- Dense tabular flows of trachydacite, brown red to grey colored, containing plagioclase and hornblende phenocrysts, with at least two flows are present.

Unit three- Expansive unit of latite forming laharic breccias and intermittent lava flows. They are highly vesicular and weathered except for dense volcanic bombs, brown to black in color and containing hornblende phenocrysts. In the area just south of Three Mile Mountain this unit is cut by dikes of shoshonite. These are dense, black intrusions averaging two to three meters in width. They contain clinopyroxene and some olivine phenocrysts.

Unit four- A small flow of dense black basalt, containing olivine phenocrysts. The chromium value for this unit is significantly higher than any other sample found in the study area (fig. 3).

Unit five- Extensive tabular flows of dense latite, light red to grey in color, and containing large hornblende phenocrysts averaging 2 cm in length.

The western portion of the field area has been largely deformed by the Current Creek fault zone. The fault zone is approximately three quarters of a mile wide and strikes N 10 E. The rocks within this area are fractured, altered, and silicified. Blocks of Precambrian, earlier tertiary volcanics, and other unidentifiable rocks have been moved in to the area by the fault.

Many of the volcanics were altered and silicified. This alteration ranges from hematite staining, to complete oxidation of mafics, to a total break down of the volcanics into a kaolin clay. The silicification is in the form of both chert and zeolites filling amygdaloidal cavities. XRD has identified some of the zeolites as thomsonite.

A plot of the joints measured in the region show two major sets of joints (fig. 4). The most notable is a set of conjugate joints that strike N 10 W and N 20 E. The other major joint set may or may not be conjugate. They strike N 80 W and N 60 W. The liniment analysis also reveals that most of the major lineaments share the same strike as these joints, although some major liniments have a N 0 S strike.

INTERPRETATIONS

The interpretation of the chemical and petrologic data is simply that the volcanics within the lower member of the Thirtynine Mile andesite are highly varied in composition (fig. 5). They are alkaline volcanics and are very similar in chemistry to the other volcanics analyzed by the 1987 Keck project (Wobus and others, 1990). The one enigmatic unit is the small flow of basalt located at the northwest portion of the field area. This basalt's high chromium values tend to indicate that it is more of a mantle, not crustal composition.

The dominant structural feature of this area is the Current Creek Fault. The high degree of alteration and silicification of many of the volcanic rocks is a direct result of this faulting. The faulting is also the cause of the pervasive conjugate jointing that strikes N 10 W and N 20 E. The fact that some of the older volcanics are more altered than the younger ones indicates that the fault may have been recurring through time.

The other major set of joints is possibly conjugate as well. It could have been caused by the actual volcanic events of the region since they do strike in a northwesterly manner away from the Guffey volcanic center.

REFERENCES

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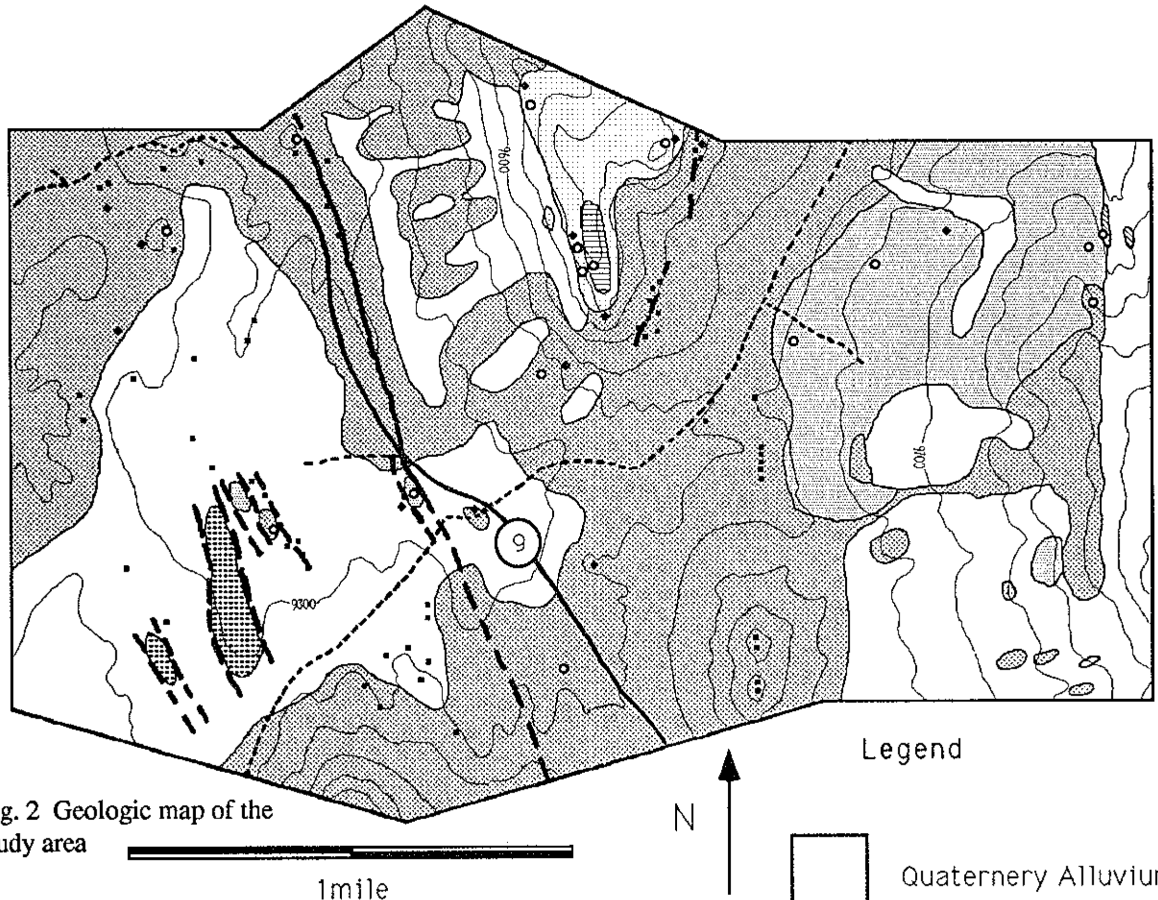


Fig. 2 Geologic map of the study area

Contour interval 100 ft.

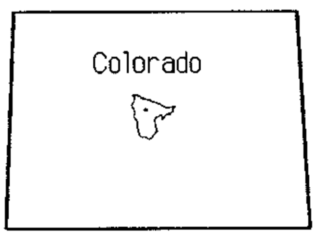
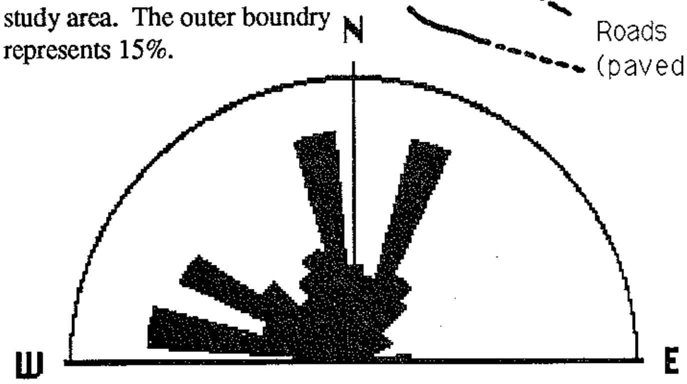


Fig. 1

Fig. 4 Rose diagram representing the joint data collected from the study area. The outer boundry represents 15%.



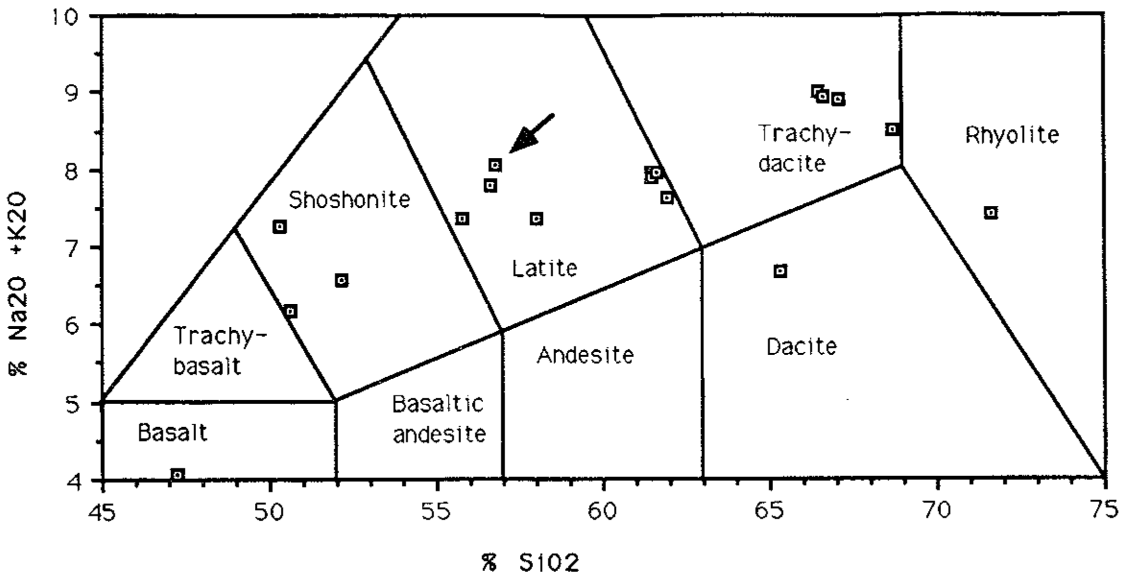


Fig. 5 A graph depicting the chemical classification of 17 specimens collected within the study area (Le Bas and others, 1986). The plot indicated by the arrow is a specimen of the Upper member of the Thirtynine Mile andesite. It was collected 1/2 mile south east of the study area.

Specimen	Unit 1	Unit 2	Unit 3	Unit 4	unit 5	Shoshonite dike
SiO2	71.64	67.21	56.83	47.21	61.6	51.05
Tio2	0.33	0.39	1.02	1.76	0.69	1.43
Al2O3	13.85	16.31	17.24	13.69	17.1	16.39
Fe2O3	0.78	2.77	6.2	6.38	4.19	4.04
FeO	1.74	0.31	1.21	4.76	0.88	5.55
MnO	0.13	0.12	0.11	0.17	0.17	0.16
MgO	0.21	0.32	1.82	7.59	1.24	3.6
CaO	1.91	2.33	5.02	10.15	4.15	7.12
Na2O	3.14	3.95	3.72	3.06	3.77	3.33
K2O	4.29	4.91	3.87	1	4.09	3.34
P2O5	0.15	0.18	0.69	0.72	0.28	0.76
LOI	1.89	0.93	2.15	3.66	1.47	3.08
Total	100.06	99.73	99.88	100.15	99.73	99.86
Rb	109	126	112	44	120	60.67
Sr	519	633	1122	1036	827	1131
Ba	1750	2109	1817	1379	1749	1589
Y	27	31	32	31	31	32.33
Zr	285	344	323	191	293	237
V	16	26	108	262	58	194
Ni	2	4	5	81	3	15
Cr	1	6	3	225	4	16
Be	1.8	2	2.6	2	2.3	2.2
Co	2.4	4	16	41	9.9	29
Sc	3.8	4	10	28	7.3	18
La	57	71	74	46	63	66
Ce	123	141	146	96	124	126
Yb	2.8	3	3.2	2.5	3	3
SiO2	71.64	67.05	56.83	47.21	61.6	51.05
Na20 +K2	7.43	8.85	7.59	4.06	7.86	6.66

Fig 3. The average chemical abundances for each rock unit described in the study area.