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A REVIEW OF THE VOLCANIC HISTORY AND STRATIGRAPHY OF NORTHEASTERN NEW MEXICO

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INTRODUCTION

This paper is a brief outline of the volcanic stratigraphy and history of northeastern New Mexico. The information is summarized from the following sources: Baldwin and Muehlberger, 1959; Collins, 1949; Muehlberger and others, 1957, Stormer, 1972a, 1972b.

GENERAL STATEMENT

The volcanics of northeastern New Mexico represent the eastern limit of late Cenozoic volcanism in western U.S.A. and lie on the edge of the stable mid-continent area with the tectonically active orogenic and post-orogenic rift provinces to the west. Structural control appears to have played a role in emplacement as volcanic centers are aligned in a northwesterly direction in an en echelon fashion paralleling the axis of Clapham anticline and in a northeasterly axis paralleling the axis of the Sierra Grande arch (Baldwin and Muehlberger, 1959).

The earliest volcanic activity began over 8 m.y. ago (Stormer, 1972a). Since then, over 100 volcanic centers, mainly cinder and shield cones, have been formed and flows from hidden fissure eruptions now cover about 25 percent of Union and Colfax Counties. Compositionally the dominant eruptions are sodium-rich alkali olivine basalts, some containing nepheline and hauynite, but quartz-normative basalts or basaltic andesites and more silicic rocks such as andesites and dacites make up a significant portion of the volume of rocks erupted.

Many geomorphological features of volcanism are present in the area. Capulin Mountain, a National Monument, is a good example of a virtually uneroded cinder cone, and Sierra Grande, of a shield volcano with slopes less than 10 degrees. Three spatter cones less than 50 ft high are found at the Purvina Hills. Flow features include pressure ridges, natural levels, squeeze-ups and lava tubes. Many of the flows display columnar jointing.

VOLCANIC HISTORY

According to Baldwin and Muehlberger (1959), there are three stratigraphically distinct eruptive phases of basalts (Table 1). The oldest, the Raton basalts (7.2 to 3.2 m.y.; Stormer, 1972a), are alkali olivine basalts which cap the highest mesas in the western half of the volcanic province and lie conformably on the Tertiary Ogallala Formation. The Clayton basalt (of Collins, 1949) is the next youngest basalt (2.5 to 2.2 m.y. B.P.; Stormer, 1972a). Baldwin and Muehlberger (1959) subdivided it into an older basalt (similar in composition to the Raton basalts) that forms an extensive flow sheet capping the high mesas east of Sierra Grande (the type Clayton basalt of Collins, 1949), and a younger feldspathoidal basalt (1.8 m.y. Stormer, 1972a) of the Folsom sequence which is restricted in area to pyroclastic cones and flows near Folsom, New Mexico. The feldspathoidal basalts of East Emery Peak, Emery Peak, East Big Hill, Big Hill, Bellisle Mountain, Robinson Mountain, Jose Butte, Mud Hill-Great Wall, Augite Vents and Purvine Mesa are all of the Folsom Sequence of the Clayton Basalts. Stormer (1972a, 1972b) combines the lower Clayton basalts (type-Clayton of Collins, 1949) with the Raton basalts and calls this unit the Raton-Clayton basalts, but he treats the Folsom sequence of the Clayton basalts of Baldwin and Muehlberger (1959) as a separate unit which he calls Felspathoidal Lavas. Perhaps these "late" Clayton basalts of the Folsom sequence should be renamed the Folsom basalts to preserve the non-compositional, geographic nomenclature. The youngest basaltic eruptive phase is termed the Capulin basalts (10,000 to 4500 B.P., from Baldwin and Muehlberger, 1959) and includes the young cinder cones of Capulin Mountain, Twin Mountain, Purvine Hills, and Baby Capulin.

Two silicic periods, during which the Red Mountain dacites and Sierra Grande andesite were erupted, occurred nearly contemporaneously with the type Clayton basalts. The Red Mountain dacite is probably younger than the Raton basalts as the dacite appears to have erupted through the latter on Johnson Mesa at Red Mountain and Towndrow Peaks and at Hunter and Meloche Mesas (Muehlberger and others, 1967). Stormer (1972a) obtained a K-Ar age of 8.2 m.y. on hornblende from a sample of Red Mountain dacite collected at Cunningham Butte. This probably is an anomalous age possibly due to excess Ar in the hornblende. The age (K-Ar, whole rock) on the Sierra Grande andesite by Stormer (1972a) is 1.9 ± 0.5 m.y. Based on differences in chemistry, mineralogy, and differentiation trends, Stormer (1972b) concluded that the Sierra Grande andesite and Red Mountain dacites did not have a genetic relationship nor a common origin.

DESCRIPTION OF THE STRATIGRAPHIC UNITS

Raton basalts. These basalts cap the high mesas between Raton and Trinidad on the west and Capulin and Folsom on the east. They were erupted as continuous sheets (over 40 miles long) which range in thickness from 10 to 100 ft. The

Table 1. Volcanic units in northeastern New Mexico: their ages and nomenclature.

Baldwin and Muehlberger (1949)	Stormer (1972b)	Age
Capulin basalt	Capulin basalt	18,000 to 4,500 B.P.*
Folsom sequence of Clayton basalt	Feldspathoidal Lava	1.8 ± 0.1 m.y.**
Sierra Grande andesite?	Sierra Grande andesite	1.9 ± 0.05 m.y.**
Red Mountain dacite	Red Mountain dacite	
Clayton basalt (type Clayton of Collins, 1949)	Clayton basalt	2.5 to 2.2 m.y.**
Raton basalt	Raton basalt	7.2 to 3.5 m.y.**

*Baldwin and Muehlberger (1959)

**Stormer (1972a)

basalt is gray, and fine- to coarse-grained, with small olivine phenocrysts making up about 10 percent of the rock. Plagioclase and augite phenocrysts are present with the olivine in some basalt samples. The holocrystalline groundmass commonly is composed of labradorite, augite, olivine and magnetite, and diktytaxitic texture is common. These basalts are alkali olivine basalts similar to the average basalts of the Basin and Range Province (Leeman and Rogers, 1970).

Clayton basalts. The Clayton basalts occur as continuous sheets capping high mesas in the Clayton area and cover a wide area (about 60 mi long) from Clayton on the east to as far west as the Canadian River, 10 miles south of Raton. These basalts are identical chemically and mineralogically to the Raton basalts.

Red Mountain dacites. The Red Mountain dacites occur as plugs, domes and flows which overlie the Raton basalts on Johnson Mesa. They range in composition from andesites containing phenocrysts of altered hornblende in a fine-grained groundmass of oriented plagioclase laths and augite, to dacites with amphibole and plagioclase phenocrysts in a hypocrystalline groundmass.

Sierra Grande Andesite: The Sierra Grande Andesite is relatively homogeneous with two pyroxenes (hypersthene and augite) as phenocrysts. The groundmass varies from hypocrystalline to microcrystalline with feldspars, two pyroxenes, iron oxides and glass.

Folsom sequence of Clayton basalts (Feldspathoidal Lavas): These basalts are characteristically undersaturated with high alkalis and contain hauynite and/or nepheline in the groundmass. Olivine phenocrysts constitute about 15 percent of the rock but augite phenocrysts (5%) commonly occur with the olivine. One vent has hauynite phenocrysts (5 to 10%). Typically the groundmass contains plagioclase, augite, feldspathoids, and magnetite. Melilite in the groundmass was reported by Stormer (1972b) in one sample.

Capulin basalts: The Capulin basalts typically have plagioclase with corroded zones that Stormer (1972b) described as "clouded" or "dusty," but a variation in their phenocryst content from center to center has been suggested by Baldwin and Muehlberger (1959). The Capulin Mountain lavas have large plagioclase and small olivine phenocrysts in an aphanitic groundmass. The phenocrysts constitute about 10 percent of the rock. The other cones have clouded plagioclase and olivine, but their phenocrysts of plagioclase are rare. At Baby Capulin, olivine is the only common phenocryst, making up only 5 percent of the rock. The basalts at Twin Mountain and Purvine Hills are almost aphyric (according to Baldwin and Muehlberger, 1959) with only rare small olivine and plagioclase phenocrysts.

Stormer (1972b) has proposed the following origins for the rock types: Raton-Clayton basalts were formed by partial melting in the mantle; the Sierra Grande andesites and the feldspathoidal Folsom sequence of Clayton basalts were generated possibly simultaneously by wet melting in the mantle; but the Red Mountain dacites originated by fractional wet-melting of lower crustal amphibolite. The proposed origin of the Capulin basalts is equivocal.

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