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PETROGRAPHY AND GEOCHEMISTRY OF GARREN GROUP VOLCANIC ROCKS, CHISPA MOUNTAIN QUADRANGLE, CULBERSON AND JEFF DAVIS COUNTIES, TEXAS

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INTRODUCTION

Location and Setting

The Chispa Mountain Quadrangle is located approximately 32 km southeast of Van Horn, Texas, astride the boundary of Culberson and Jeff Davis Counties (fig. 1). The area is composed primarily of Tertiary volcanic rocks called the Garren Group which vary in age from 33.3 to 38.6 m.y. (McDowell, 1978).

The volcanic rocks of this area are considered to be the northwestern extension of the Davis Mountains volcanic field (Hay-Roe, 1958). They occur as part of a larger north-trending linear horst, referred to by Hay-Roe (1958) as the Wylie Mountain uplift. To the immediate north, and in contact with the volcanic rocks, are uplifted Precambrian metamorphic rocks and Permian and Cretaceous marine strata that form the Wylie Mountains.

The uplift occurs as an intermediate topographic expression within a larger structural depression. The Salt Basin forms a large graben lying to the north of the uplift. Michigan Flat flanks the uplift to the east.

Previous Work

The first published geologic studies in the area were by von Streeruwitz (1889) and Baker (1927). Parts of the area were mapped as master's thesis projects (University of Texas at Austin) by Woodward (1954) and Wightman (1953).

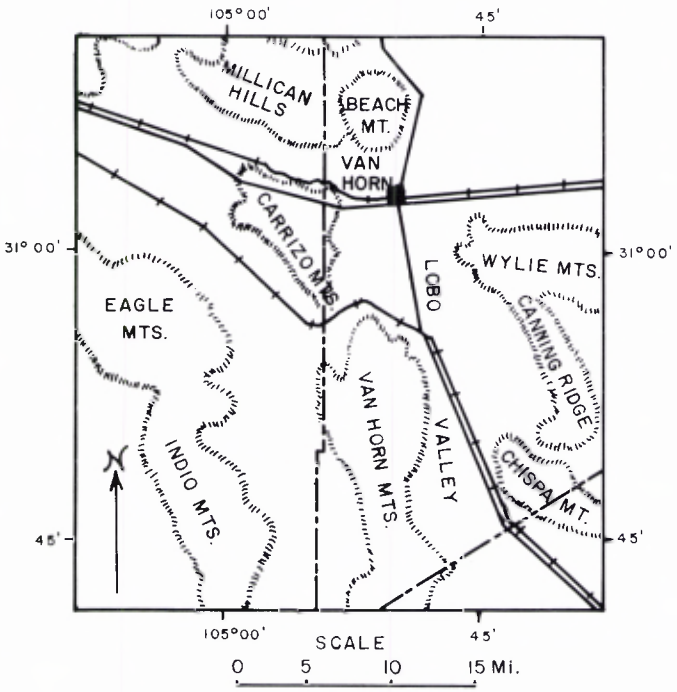

Figure 1. Index map of the Chispa Mountain area.

The most comprehensive study of the area has been published by Hay-Roe (1957, 1958) who mapped the Wylie Mountains and the volcanic rocks to the south.

The Chispa Mountain Quadrangle was mapped by Teal during the summer of 1978 as a part of the University of Texas at El Paso geothermal program. Eight columnar sections were measured and approximately 135 samples were collected from the ten exposed units. Thin sections were prepared and described for each unit.

STRATIGRAPHY

Introduction

The stratigraphy of the volcanic units in the Chispa Mountain Quadrangle was first defined by Hay-Roe (1957). He designated seven major volcanic formations, six of which occur in the Chispa Mountain Quadrangle. Two of the units, Means Trachyte and Fairbury Trachyte, were divided into a number of members. Based upon more detailed field mapping, Teal (1979) has indicated that most of the above members have distinct lithologic character, are mappable in the field and therefore should be elevated to formational status.

Volcanic Units

The volcanic rocks in the Chispa Mountain Quadrangle have an aggregate thickness of over 900 m; they consist of lava flows, welded tuffs and breccias ranging in composition from andesite to rhyolite. The lava flows are predominantly andesites or trachytes whereas the welded tuffs are more acidic and are classed as rhyolites or quartz trachytes.

The revised volcanic stratigraphy proposed by Teal (1979) is included in Table 1. Teal has divided the Garren Group volcanic rocks in this area into ten formations. The occurrence, thickness, description and equivalence to Hay-Roe's units are summarized in Table 1.

GEOCHEMISTRY

A total of 66 chemical analyses have been obtained from the volcanic units. The analyses were performed by Hoffer utilizing X-ray fluorescence methods (ORTEC non-dispersive x-ray fluorescence analyzer Tefa model 6110). The results of the initial analyses are given in Table 2. Additional chemical analyses are currently in progress which, it is hoped, will aid in the interpretation of the origin and evolution of the volcanic rocks in the Chispa Mountain Quadrangle.

The volcanic units, in common with those of other parts of Trans-Pecos Texas, are rich in soda and potash. The rocks vary widely in silica content from just over 50 percent to over 76 percent.

A plot of the Na, K, Al and SiO_2 values indicates that the rocks are metaluminous to slightly alkalic (fig. 2). The Garren Group

Table 1. Summary of the stratigraphy of the volcanic units of the Garren Group, Chispa Mountain Quadrangle (after Teal, 1979) (outcrops of these units are shown in Figure A).

UNIT	*THICKNESS (m)*	*OCCURRENCE*	*PETROGRAPHY*
Bell Valley Andesite	155-186	Caps Chispa Mt., lies on Fairbury Tuff with slight unconformity	Andesite porphyry lava, andesine plagioclase (60-67%), hypersthene (5-10% altered to iron oxides), augite (10-15%), biotite (2-5%), hornblende (1%)
Fairbury Tuff	36-38	East end of Bell Valley, contains fragments of Means Trachyte; includes Bell Valley and upper zone of Fairbury Trachyte Tuff of Hay-Roe (1957)	Poorly to non-welded crystal-lithic, water-laid rhyolitic tuff; contains lithic (3-10%) and pumice (30-70%) fragments set in a tuffaceous matrix of glass shards; crystals consist of quartz (5-10%) and biotite (1%)
Bonito Trachyte	35-53	South of Bonito Arroyo and southeast corner of quadrangle; equivalent to Felsite lentil of Means Trachyte of Hay-Roe (1957)	Trachyte lava, composed of microcrystalline laths of K-feldspar (50-55%) oligoclase (20-25%) with minor quartz and hornblende (5%), abundant interstitial magnetite and hematite (15%)
Crosby Tuff	32-43	West of Crosby Well, in ridges at east end of Pronghorn Flat; equivalent to Breccia lentil of Means Trachyte of Hay-Roe (1957)	Moderately welded lithic-crystal-vitric rhyolitic tuff; composed of lithic (10-15%) and large pumice fragments and phenocrysts of K-feldspar (15-25%), biotite (3-5%) and quartz (2-5%) in a matrix (40-55%) of deformed glass shards
Means Trachyte	161	Chispa Mountain and south-central part of the area	Trachyte flow, vesicular, composed of K-feldspar (25-35%), oligoclase (15-20%), interstitial actinolite (tr-15%) and augite (1-2%) set in a matrix (35-40%) of primarily hematite
Water Tuff	36	East end of Bell Valley, includes Lower zone of the Fairbury Trachyte Tuff Member and the Anorthoclase Member of Hay-Roe (1957)	*Lower Member*—densely welded tuff, rhyolite basal vitrophyre (7m) grades upward into densely welded, vitric-crystal tuff with anorthoclase (10-20%), oligoclase (2-4%), quartz (1%) and secondary chalcedony (20%) and opal (5-10%); *Upper Member*—densely welded vitric crystal tuff composed of K-feldspar (6-10%) and augite (1%) in devitrified matrix
Buck Mountain	48-119	North face of Buck Mt., Bell Valley and Fairbury Draw; formerly the Plagioclase Member of Fairbury Trachyte (Hay-Roe 1957)	Densely welded vitric-crystal rhyolite tuff; andesine (7-10%) and K-feldspar (2-3%) with minor quartz and pyroxene phenocrysts set in devitrified matrix; collapsed pumice visible
Garren Mountain Tuff Breccia	33-132	Pantera Peak and west to Garren Mt.; formerly the Breccia Member of Fairbury Trachyte (Hay-Roe, 1957)	Angular to rounded fragments of scoria and lithic material set in microcrystalline pyroclastic matrix; phenocrysts of andesine (2-8%), quartz (2-10%) and biotite (1-2%)
Pantera Ignimbrite	27-91	Extensive in northwest part of quadrangle	Densely welded tuff with basal vitrophyre (1.5 m); phenocrysts of andesine (15-20%), K-feldspar (10%), augite (3-5%), and minor quartz, biotite and hornblende in mostly devitrified matrix.
Hogeye Tuff	46-64	Northern portion of the quadrangle; overlies Permian or Cretaceous rocks	Crystal-lithic welded andesite tuff; densely welded basal zone grades upward into moderately to poorly welded tuff; phenocrysts of K-feldspar (5%), oligoclase (3-5%), hornblende (2%), and lithic (10%) and pumice fragments in a microcrystalline devitrified matrix; trachytic near top

*Table 2. Chemical analyses (weight percent) of the Garren Group volcanic rocks. (Analyses by J. M. Hoffer. *Total iron reported as Fe_2O_3).*

Units (No. of Samples)	SiO_2	TiO_2	Al_2O_3	Fe_2O_3*	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	TOTAL
Bell Valley Andesite (9)	55.72	1.99	15.40	7.10	0.14	3.10	8.52	4.23	2.46	0.97	99.63
Fairbury Tuff (5)	76.52	0.17	11.70	2.36	0.31	1.12	1.33	3.67	3.93	0.12	101.23
Bonito Trachyte (4)	60.75	0.98	17.52	7.01	0.18	0.69	2.15	5.38	4.53	0.40	99.59
Crosby Tuff (3)	67.87	0.62	15.44	3.30	0.23	2.02	1.80	4.79	4.65	0.18	100.90
Means Trachyte Upper (4)	50.69	2.08	15.71	9.42	0.16	6.00	8.02	4.08	2.23	0.88	99.27
Lower (7)	61.75	0.62	15.23	7.91	0.20	1.68	2.46	5.01	5.18	0.27	100.31
Water Tuff (6)	72.49	0.57	12.64	4.17	0.12	0.43	1.02	3.46	5.09	0.14	100.13

Table 2. (continued)

Units (No. of Samples)	SiO_2	TiO_2	Al_2O_3	Fe_2O_3*	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	TOTAL
Buck Mountain Tuff (5)	68.78	0.64	15.13	3.58	0.19	0.49	1.50	5.11	5.13	0.28	100.83
Garren Mtn. Tuff (5)	61.25	1.57	15.26	8.33	0.20	0.99	3.66	3.98	3.68	0.65	99.57
Pantera Ignimbrite (10)	68.45	1.06	13.97	5.65	0.26	0.68	2.44	3.87	4.07	0.43	100.88
Hogeye Tuff Upper (1)	61.52	1.04	15.91	6.05	0.12	2.96	5.32	3.46	2.72	0.47	99.57
Lower (7)	54.12	1.74	15.71	8.07	0.15	4.61	7.13	4.09	2.91	0.65	99.18

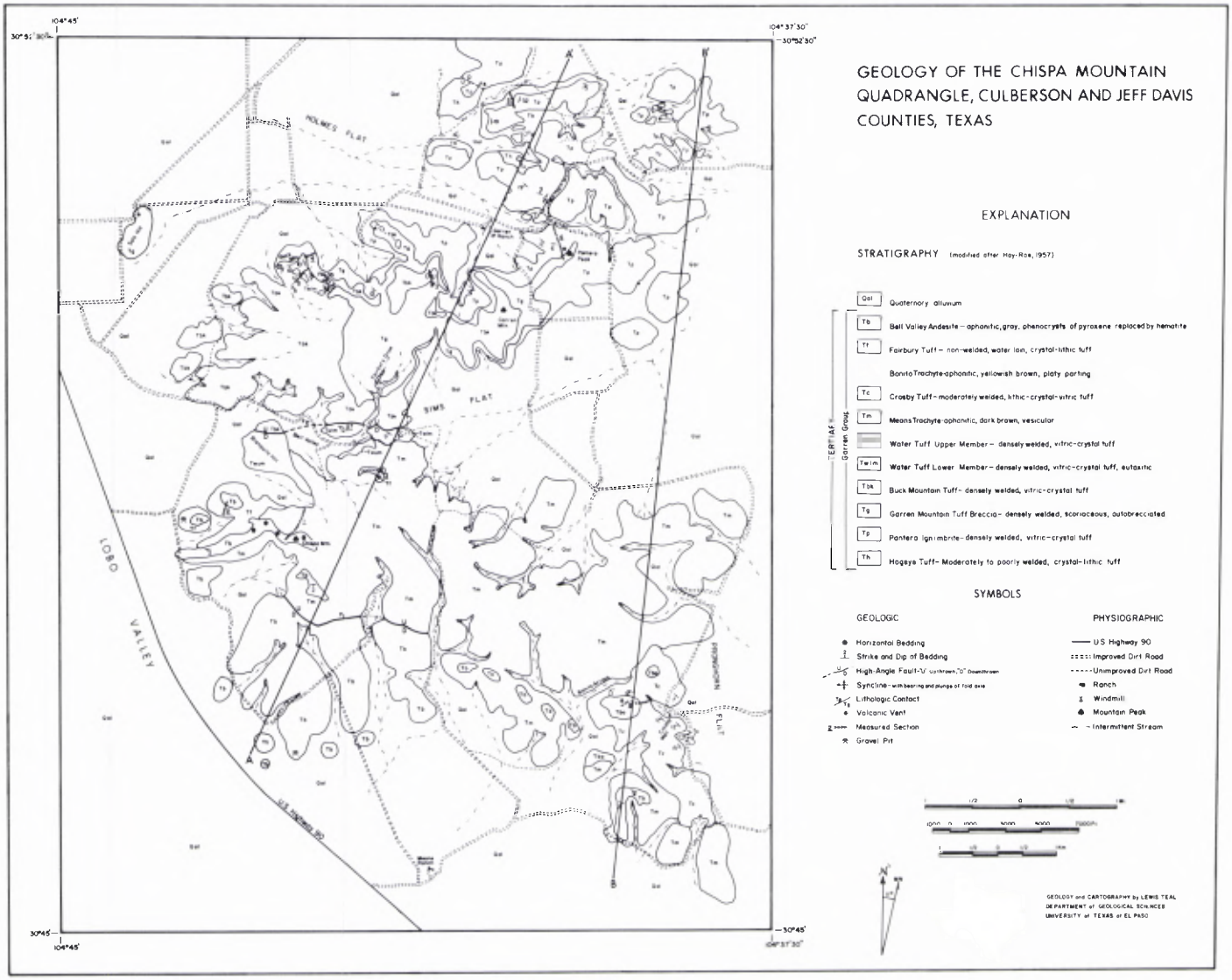

Figure A. Geologic map of the Chispa Mountain Quadrangle.

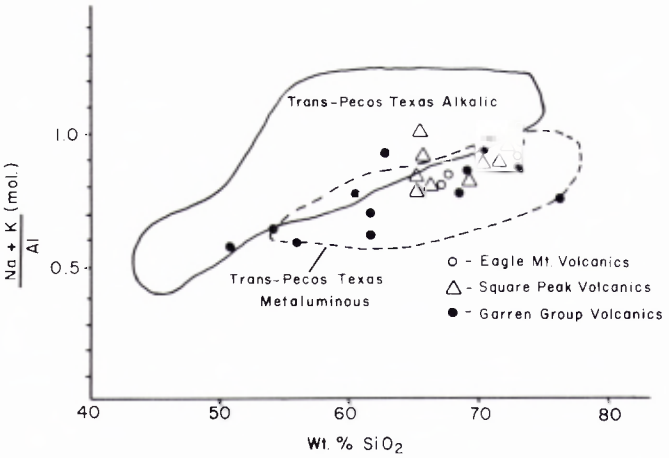

Figure 2. Alkalinity versus percent SiO_2 for Tertiary volcanic rocks of the Eagle Mt., Square Peak, and Garren Group volcanics (alkalic and metaluminous fields from McDowell and Clabaugh, 1979).

volcanics, along with those from the Eagle Mountains and northern Quitman Mountains (Square Peak volcanics) are included in Figure 2 along with the fields of the Trans-Pecos alkalic and metaluminous rocks as defined by McDowell and Clabaugh (1979). This diagram illustrates the wide variation in silica content of the Garren Group volcanic units compared with those of the Eagle and northern Quitman Mountains.

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Feather plant and spikelet, *Enneapogon desvauxii*.