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VOLCANISM IN THE MOUNT TAYLOR REGION

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INTRODUCTION

Mount Taylor and its adjoining field of late Cenozoic cones am domes, Mesa Chivato, are prominent features on the western horizoi of Albuquerque (fig. 1). The purpose of this paper is to synthesize ou current knowledge about volcanism in the Mount Taylor region.

Volcanic fields occur intermittently along the margin of the Colorad(Plateau, and locally, it is difficult to categorically define where on volcanic field ends and another begins. In this review the Mount Taylo region shall be defined as a region bounded on the east by Mesa PrieL in the Rio Puerco valley, on the west by the Bandera volcanic field on the north by Cabezon Peak volcanic neck, and on the south by Zun Salt Lake (fig. 2). The Mount Taylor "field" encompasses Pliocene Pleistocene basalts and differentiated rocks capping high mesas at th(foot of the Mount Taylor composite volcano and adjacent high mesas The Mount Taylor region includes the collective areas of volcanisn overshadowed by Mount Taylor, such as the volcanism in the Bander area of the Zuni Mountains and the young McCartys lava flow (se(Maxwell, this guidebook).

OVERVIEW OF VOLCANISM

Volcanism in the Mount Taylor region is similar to that occurrinl elsewhere along the boundary between the Colorado Plateau and the Basin and Range province (see Laughlin and others, this guidebook) Mount Taylor is similar in many respects to the other large composite "andesitic" volcanoes along the periphery of the Colorado Plateau. I forms a composite accumulation of rhyolite, trachyte, alkali andesite and other mafic rocks erupted in late Cenozoic time, and it is surroundec by fields of older and younger monogenetic, dominantly basaltic cinde] cones and flows.

Volcanism throughout the Mount Taylor region appears to have occurred over the last 4 m.y. (Table 1), or 7 m.y. if Mesa Gallina, southeasi of Mount Taylor, is included. A histogram of all available dates (fig. 3) reveals that the bulk of the dated flows lie in the 3.5 m.y. to 2.(my. range. The increased number of flows younger than 500,000 year may reflect a sampling bias toward younger flows.

Some of the oldest activity recognized in the region includes trachyte and rhyolite dome-building eruptions, which initiated volcanism at the present site of Mount Taylor (Bassett and others, 1963; Lipman am others, 1978). Rhyolite ash and pumice underlie many of the oldesi basalts capping high mesas around Mount Taylor, and they have beer found beneath the lowest flow units as far north as the northern end ol Mesa Chivato.

Table 1. Radiometric and archeologic dates of volcanic rocks in the Mount Taylor region.

Sample Number*	Rock Type and Sample Location	Age (m.y.)	Source
1	obsidian, NE of Grants Ridge	3.4	1
2	obsidian, NE of Grants Ridge	3.5	1
3	obsidian, Obsidian Canyon	2.7	1
4	obsidian, Obsidian Canyon	3.1	1
5	obsidian, N side Grants Ridge	3.8	1
6	perlitic obsidian, Grants Ridge	3.5	1
7	perlite, Perlite Quarry	3.2	1
8	obsidian, La Jara Mesa	2.3	1
9	obsidian, La Jara Mesa	3.2	1
10	obsidian, La Jara Mesa	3.5	1
11	andesite, SW flank of Mt. Taylor	2.3	1
12	andesite, SW flank of Mt. Taylor	2.8	1
13	andesite, SW flank of Mt. Taylor	1.8	1
14	andesite, SW flank of Mt. Taylor	1.1	1
15	Mesa Prieta, east side	2.2 ± 0.3	2
16	early trachyte, Mt. Taylor	4.26 ± 0.27	3
17	white trachyte, Mesa Chivato	3.22 ± 0.20	3
18	lower basalt	2.85 ± 0.86	3
19	rhyolite, Grants Ridge	3.26 ± 0.16	3
20	north end Mesa Chivato	2.8 ± 0.20	3,6
21	cinder cone, Cerros de Guadalupe, Mesa Chivato	2.68 ± 0.30	3
22	late pyroclastic flow, Mt. Taylor	2.59 ± 0.15	3
23	late pyroclastic flow, Mt. Taylor	2.45 ± 0.25	3
24	late pyroclastic flow, Mt. Taylor	2.66 ± 0.16	3
25	basalt of low mesa	2.36 ± 0.18	3
26	basalt of high mesa	1.52 ± 0.17	3
27	late tholeiitic basalt, Laguna	0.37 ± 0.25	3,6
28	Fence Lake flow	1.38 ± 0.29	4
29	Zuni River flow	0.68 ± 0.55	4
30	pre-McCartys flow	0.188 ± 0.042	4
31	McCartys flow	~700 A.D.?	5
32	Carrizo Mesa	3.7 ± 0.4	6
33	Mesa Gallina	7.2 ± 0.6	6

*Numbers 1-33 refer to Figure 2.

1 = Bassett and others, 1963; 2 = Armstrong and others, 1976; 3 = Lipman and Mehnert, written commun., 1976; 4 = Laughlin, written commun., 1976; 5 = Nichols, 1946; 6 = Bachman and Mehnert, 1978.

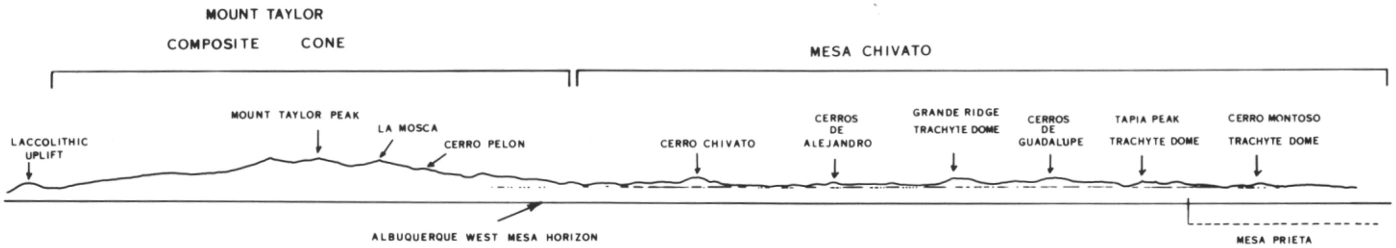

Figure 1. Principal peaks of the Mount Taylor volcanic field as visible most days of the year for an observer at an altitude of 1,675 m (5,500 ft) or greater in Albuquerque. Cabezon Peak is off the sketch to the right and may or may not be visible depending on the altitude of the observer.

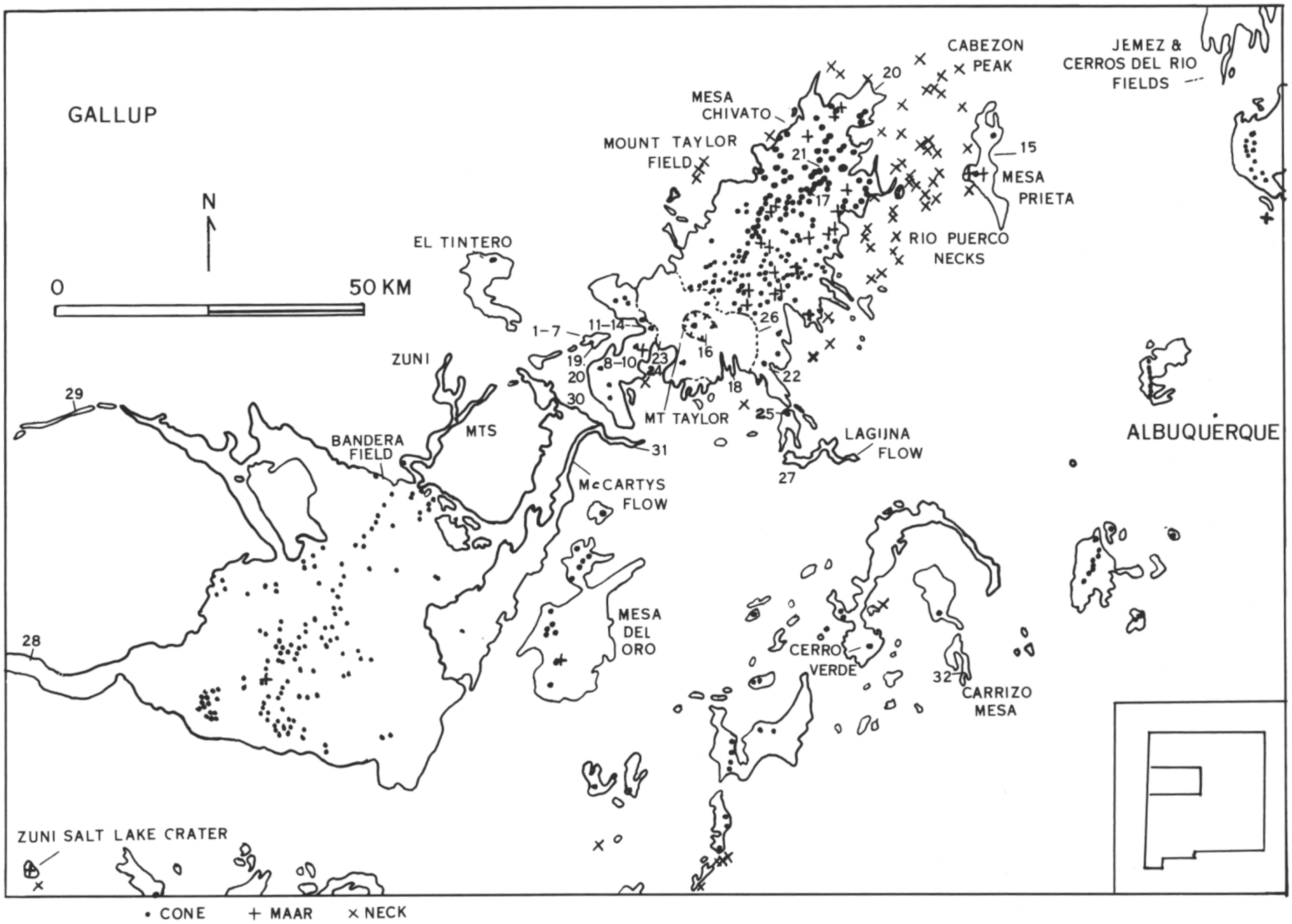

Figure 2. Distribution of late Cenozoic volcanic rocks in the Mount Taylor region. Numbers refer to dated units in Table 1. Map modified from Luedke and Smith (1978).

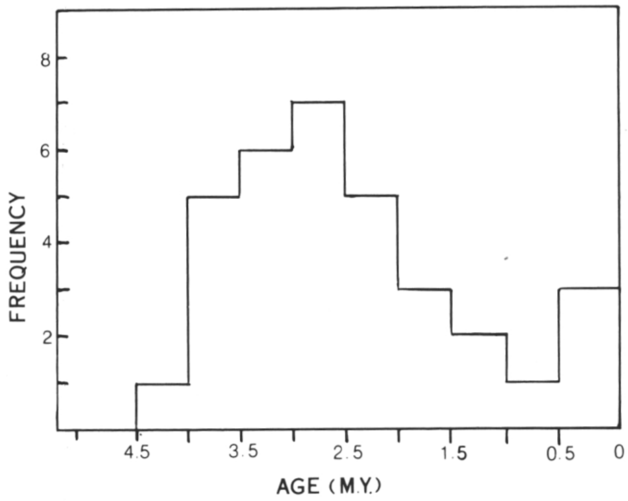

Figure 3. Relative frequency of ages for volcanic rocks in the Mount Taylor region.

Most of the radiometric dates are concentrated in the area immediately surrounding Mount Taylor and little is known about the chronology of basalts to the southeast of Mount Taylor (however, see Baldridge, road-log segment II.B, this guidebook). One basalt flow in the Lucero Mesa area (Carrizo Mesa) was dated at 3.5 my. (Bachman and Mehnert, 1978).

Younger basaltic activity is widely dispersed south of Mount Taylor. This includes the Laguna basalt flow, El Tintero flow west of Grants, McCartys basalt flow, and the Bandera area in the southern Zuni Mountains area, all of which are in the 500,000-1,000 year age range.

Many of the vents for basalts in the region show linear alignment indicative of control by dominating northeasterly and west-northwesterly basement structures (see Laughlin and others, this guidebook). In the northern part of the Mount Taylor field (Mesa Chivato), surface faults follow several northeastward-trending fissure vents and formed subsequent to fissure volcanism. The reverse is also true; thus, showing the complex relationship that exists between recent structural movements and basaltic volcanism in the region (Crumpler, 1980). Similarly, several vents in the Bandera area are closely related to faulting, such as the Paxton Springs and Cerro Colorado vents which erupted in structurally-controlled canyons within the Zuni Mountains (Laughlin and others, 1972b). Both of these vents occur in the Precambrian crystalline terrane of the Zuni Mountains.

The overall northeasterly alignment of the Mount Taylor and Bandera areas with the Jemez, Raton, White Mountain, and Pinacate fields has suggested to some researchers that a major continental northeast-trending basement weakness has played a part in controlling the location of the volcanism (Mayo, 1958; Laughlin and others, 1972b; Laughlin and others, this guidebook). It has been suggested that this lineament represents a hot-spot trace (Suppe and others, 1975). However, the local age of eruptions appears to be randomly distributed along the lineament (Lipman and Mehnert, 1975), and this does not support the simple age progression model normally attributed to moving hot spots.

The Bandera field is situated on the southern edge of the Zuni Uplift; whereas, the Mount Taylor field lies on the Acoma Sag. Although volcanism on uplifted terrain is not uncommon, volcanism situated on sags is more anomalous. The Mount Taylor field is anomalous in other respects, including extreme Tia, enrichment of early basaltic rocks and overall similarity of its volcanism with oceanic aseismic volcanism. Any simple explanation of the sag-volcanism relationship at Mount Taylor must address these unique characteristics.

LATE QUATERNARY ERUPTIONS

The tholeiitic McCartys lava flow is one of the most voluminous recent flows in the world. Its youthful "malpais" topography assured its recognition by non-scientists and scientists alike, and, as a landmark, it has figured in tales of gold and fictional adventures of cowboys (Dobie, 1967; L'amour, 1960). Several studies and maps have encompassed at least parts of the flow (Nichols, 1946; Kuiper and others, 1966; Thaden and others, 1967a; Renault, 1970; Leeman, 1970; Hatheway, 1971; Laughlin and others, 19726; Lipman and Moench, 1972; Carden and Laughlin, 1974; and Maxwell, this guidebook).

The total volume of the McCartys flow is about 7 km' (Williams and McBirney, 1979); this compares with the eruption of the Laki fissure of Iceland in 1783 which poured out 12 km' of basalt. From its source at an inconspicuous vent 40 km south of 1-40, to its terminus near the village of McCartys in the Rio San Jose valley, it flowed along a broad valley confined by cliffs of Zuni Sandstone on the east and along the margin of an older flow (30, Table 1) of similar volume and extent on the west.

The age of the McCartys flow is not well established. The flow existed at the time of the Coronado expedition in 1540. The expedition followed a well-traveled Indian trail across it, but whether ancestors of the Pueblo Indians witnessed its eruption is not clear. Darton (1915) cited local Indian legends of a river of fire in the Rio San Jose valley that had buried fields cultivated by their ancestors. Other legends speak of the "year of fires" (Navajo mythology holds that the flow is the congealed blood of Big Monster, killed by the War Twins on Mount Taylor; see Reichard, 1974). The archeologic date of 700 A.D. given by Nichols (1946) is based on the observation that the flow overlies alluvium similar to that several kilometers farther down the valley in which pottery fragments from Pueblo I period were found. The correlation of the alluvium is doubtful, but an age of 1,300 years seems reasonable considering the lack of erosion and bioturbation. Only a few recent generations of trees and their associated root systems have caused wedging and disruption of surface slabs on the pahoehoe crust; therefore, pffion and juniper vegetation has been established recently.

The Bandera field on the western side of the Mount Taylor region is a relatively young complex of cinder and spatter cones and associated flows of both alkalic and tholeiitic affinities. Bandera-crater cinder cone and adjacent lava tubes and ice caves are the most prominent landmarks of the area. The extensive network of lava tubes was documented by Hatheway and Herring (1970) and Hatheway (1971), whereas Laughlin and others (1971) and Causey (1971) reported on the petrology and chemistry of basalts and ultramafic inclusions of the field. The recent flow, which emerged from Zuni Canyon and flowed into the valley immediately south of Grants, is from the Cerro Colorado vent, one of two centers which erupted within the Zuni Mountains in the Bandera field. Laughlin and others (19726) estimate that this flow is older than the McCartys flow but younger than the flow which is directly overlain by the McCartys near its terminus (i.e., <188,000 years).

The Zuni Salt Lake crater, 80 km southwest of the Bandera field, is a young maar-type vent in which many primary morphologic features of typical maars are preserved (Bradbury, 1967; Cummings, 1968; Aubele and others, 1976). It is unusual, however, in that it has cinder cones built on its floor. In fact, the Zuni Salt Lake maar is the type locality for this type of maar.

Somewhat older, but still preserving many primary flow features, is the tholeiitic El Tintero cone and flows west of Grants (Thaden and Ostling, 1967; Lipman and Moench, 1972). Another older tholeiite flow (370,000 years) fills the Rio San Jose valley near the site of Laguna Pueblo (Moench, 1963a, b; Schlee and Moench, 1963a, b; Lipman and Moench, 1972), where it was responsible for stagnating the flow of the Rio San Jose and creating the cienega there. The location of the vent for this flow has not been determined.

Other relatively recent eruptions occur 25 km south of Mesita and 1-40 (Moench, 1964) and include the Cerro Verde lava cone and Cerro Colorado cinder cone. The primary pressure-ridge type topography of the Cerro Verde flows is preserved locally. Judging from other flows of similar preservation that have been dated, it may be the result of an eruption on the order of 200,000 to 400,000 years ago; however, little is known about the volcanism of this area (Kelley and Wood, 1946; Jicha, 1958).

LATE TERTIARY AND EARLY QUATERNARY VOLCANISM OF THE MOUNT TAYLOR FIELD

All of the eruptions discussed in the section above lie at or near the present drainage levels, and even without radiometric-age evidence their positions in present valley bottoms attest to their relative youth. In terms of volume and numbers of vents, most of the volcanism in the Mount Taylor region is much older, and many older flows cap mesas that stand 100 to 500 m above present drainages. Dates indicate that the highest levels around Mount Taylor represent the regional land surface approximately 2.5 my. ago (Bachman and Mehnert, 1978; Armstrong and others, 1976). Therefore, erosional down-cutting must have been extreme in the interval between about 2.5 my. and 500,000 yrs in order to account for the difference in the elevation of high mesa basalts and flows in the valley floors (see Grimm, road log segment II-B).There is some evidence that later flows erupted onto Mesa Chivato but subsequently cascaded to lower levels (Crumpler, 1980), suggesting that erosion began to isolate high mesas even while eruptions were still continuing in high-mesa fields.

These observations demonstrate that immense quantities of rock have been removed in geologically short periods of time. This can be observed by standing on the western rim of Mesa Chivato and looking out over the desert floor, some 500 m below. Only after some tens of kilometers can one see mesas of equivalent height. This erosion has exposed the internal, intrusive structures of cinder cones, fissures, and maars in the Rio Puerco valley, between the Mount Taylor field and Mesa Prieta, to form the Rio Puerco volcanic necks. The Rio Puerco necks are among the most concentrated and best exposed examples of volcanic necks in the world. Aside from early reconnaissance by Dutton (1885), Johnson (1907), and Hunt (1938) and recent petrochemical studies (Brunton, 1952; Brown, 1968; Brown and Kudo, 1969; Kudo and others, 1972), the Rio Puerco necks have received little attention. However, they provide instructive examples of the internal structure and dynamics of cinder cones, feeder dikes, and maars.

Some of the Rio Puerco necks are relatively simple feeder dikes or monolithic accumulations of homogeneous basalt, jointed with classic sweeping columnar structure. Cabezon Peak is a good example of this simple form. Although impressive in size, it is relatively devoid of the more complex structures.

A natural cross-section of a vent can be seen along the edge of Mesa Chivato, exposed on the East Grants Ridge (Bassett and others, 1963; see road-log segment II-B). An oblique section occurs at Cubero volcano on 1-40 near the village of Cubero. Here, the relationship between cone and the underlying basaltic plug is one in which the massive plug gives way upward to numerous dikelets, which in turn invade and complexly intertwine among the cinders at the core of the cone.

There are a few volcanic necks and dissected cinder cones exposed on the western side of Mesa Chivato in the drainage of the Arroyo Chico, but these are even more poorly known due to the difficulty of access. Cerro Alesna ("awl") is a particularly fine example of a neck showing sweeping columnar structure.

Mesa Chivato, the broad plateau extending northeastward from the base of Mount Taylor, is the site of an incredible array of fissure vents, collapse (pit) craters, maars, and trachyte domes (Aubele and others, 1976; Crumpler, 1980). In fact, the greatest concentration of individual vents in the Mount Taylor region occurs in this area. In addition to morphologic diversity, Mesa Chivato exposes a rare oceanic-type alkalic volcanic suite ranging from basanite through trachyte in a sequence in which basalt was extruded first and trachyte domes were extruded last. The few dates available from the area (17, 20, 21, 26, Table 1) indicate that volcanism on Mesa Chivato occurred from about 3.2 to 1.5 my. ago. The abundance of maars in the region indicates that the climate of that time was an extremely wet one.

The geology of Mount Taylor itself is poorly understood. Aside from the work of Hunt (1938), only petrochemical studies (Baker and Ridley, 1971) had taken place until 1978, when Lipman and others (1978) mapped the Mount Taylor quadrangle and Crumpler (1978) mapped the northern and western flanks. The results of these two mapping projects are compiled in Figures 4 and 5. The main cone is not as eroded as was previously thought. The margins of many of the more silicic flows are still intact locally, as are numerous pyroclastic flows and mud flows.

Central volcanism commenced between 4.3 and 3.3 my. ago with the eruption of trachyte and rhyolite domes and basanite flows. These were followed by increasingly "andesitic" or porphyritic rocks of intermediate composition which were responsible for the cone-building activity. At the same time, alkali basalts (some bearing lherzolite and pyroxenite nodules) were erupted high on the flanks together with some alkalic differentiates (mugearite and benmorite). Mud flows began to build an extensive apron around the main cone. Most of the andesitic flows overlie the most voluminous volcanoclastic debris, and it is probable that an early cone had been destroyed by explosion to yield some of this extensive volume of debris. Volcanism culminated with the injection of a radial dike swarm in the interior of the main cone, and these dikes are now visible in the erosional amphitheater. This phase probably was allied closely with the extrusion of dacitic domes and flows high up on the flank of the main cone. Several pyroclastic flows which swept down the flanks of the cone duirng this latest activity have been dated at around 2.5 my. (22, 23, 24, Table 1). Altogether, the formation of Mount Taylor took between one and two million years. The erosional amphitheater which opens out to the east to form Water Canyon is similar to that seen in the San Francisco Mountain composite cone of Arizona, and both bear a suspicious resemblance to the crater of Mount St. Helens. It is possible that both Mount Taylor and San Francisco Mountain owe the existence of their interior valleys to a late stage eruption similar to that of Mount St. Helens. The abundant volcanoclastic debris now capping the walls of Water Canyon may in part be the remains of a similar lateral blast eruption, affected by two million years of erosion.

PETROLOGY AND ISOTOPIC DATA

Figures 6 through 9 are summaries of all available petrochemical and isotopic data for the Mount Taylor region. For detailed discussions of these and other data, the interested reader is referred to the appropriate references cited below.

The alkalies-silica plot of Figure 6 indicates that many of the youngest eruptions are tholeiitic; whereas, the oldest volcanoes are strongly alkalic. The mafic rocks of the Mount Taylor volcano are more alkalic than the more silicic rocks of the main cone-building stage.

One of the unusual aspects of the basanites (high nepheline-normative basalts) not shown here is their exotic TiO2 content. Several samples exceed 3.5 percent TiO2, and a few basanites (Lipman and Moench, 1972; Crumpler, 1977) exceed 4 and 5 percent TiO,. This high TiO, content is seen in few terrestrial lavas, the highest TiO, typically being that of oceanic, alkalic suites (-3.5 percent).

Compiling all of the alkalic rocks of the Mount Taylor field on a standard AMF plot (fig. 7) results in a classic alkalic-suite trend, with the exception of the dacitic and andesitic rocks which appear to have no mafic, subalkalic counterparts. A distinct gap occurs in compositions between hawaiite and mugearite which Crumpler (1980) had originally interpreted as a sampling problem. However, this compilation indicates that the gap is real. The rhyolites, dacites, and andesites are separate from the true alkalic lineage. The intermediate position of the andesites and the dacites between rhyolite, which Baker and Ridley (1970) indicated may be anatectic melting products, and trachytes, which Crumpler (1980) argued were the results of fractional crystallization, suggests that mixing of both end members may have occurred to generate the observed intermediate andesitic to dacitic rocks. Dacites and andesites of the Mount Taylor complex have strong alkalic affinities and are not of strict calc-alkalic parentage. They are not true andesites or dacites of the island-arc type, either.

This interpretation of the dacites as the product of magma mixing is supported by the strontium-isotopic data (Table 2 and fig. 8). A granite xenolith in rhyolite pumice yielded an "Sr/"Sr value of 0.9193, and a dacite sample value is 0.7193 suggesting the probability of contamination of mantle-derived magmas with crustal melts to form dacitic products. Contamination of other rocks in the field, including the andesitic rocks of Mount Taylor, appears less probable (fig. 9) as the lavas with the highest strontium content tend to have the highest radiogenic-strontium contents. This is the inverse of what would be expected for a contamination origin of the high ratios. This tendency appears in several alkalic suites throughout the world, and it has not been satisfactorily explained.

CONCLUSIONS

The following is a summary of the salient points based on a survey of what is now known about volcanism in the Mount Taylor region.

1. Volcanism appears to have occurred from about 4 m.y. ago to the present.
2. Up to 500 m of rock were eroded, over a broad region, in as little as 3 million years after initial volcanism.
3. The youngest flows are dominantly tholeiitic and the oldest flows are alkalic. A complete alkalic suite was erupted in the Mount Taylor field. Some of the alkali basalts contain over 4 percent TiO2. The chemical character of the Mount Taylor field lavas is oceanic.
4. Orientation of volcanic vents in the region was strongly controlled by regional northeasterly (and, to a lesser extent, west-northwesterly) faults involving crystalline basement rocks.
5. Mount Taylor is the result of 2 million years of eruption of alkalic mafic, intermediate, and probably anatectic rhyolitic lavas. The last activity occurred 2.5 m.y. ago.

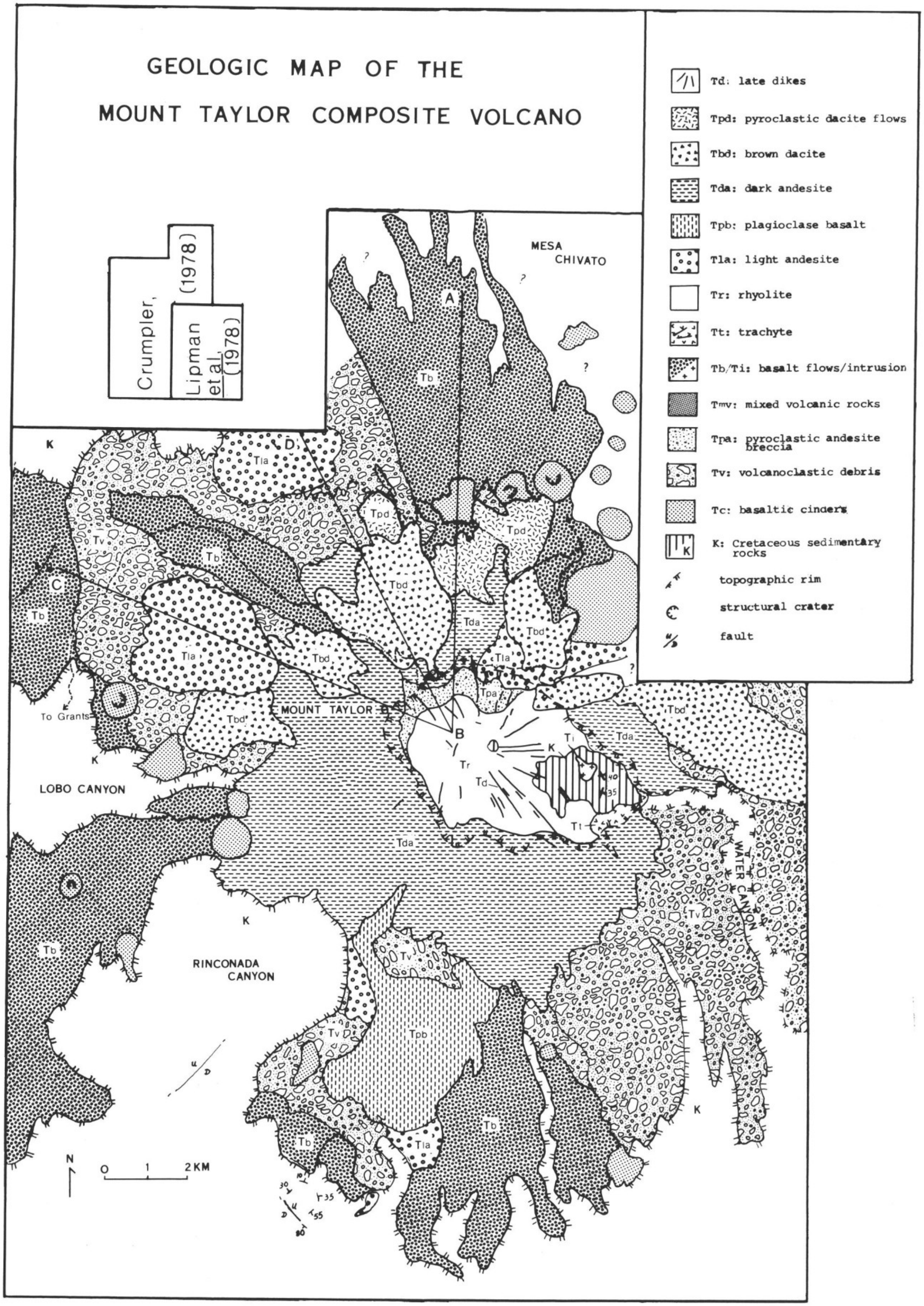

Figure 4. Geologic sketch map of the Mount Taylor composite volcano, compiled and simplified from Lipman and others (1978) and Crumpler (1978). For a description of units and stratigraphy see Lipman and others (1978) or Crumpler (1978).

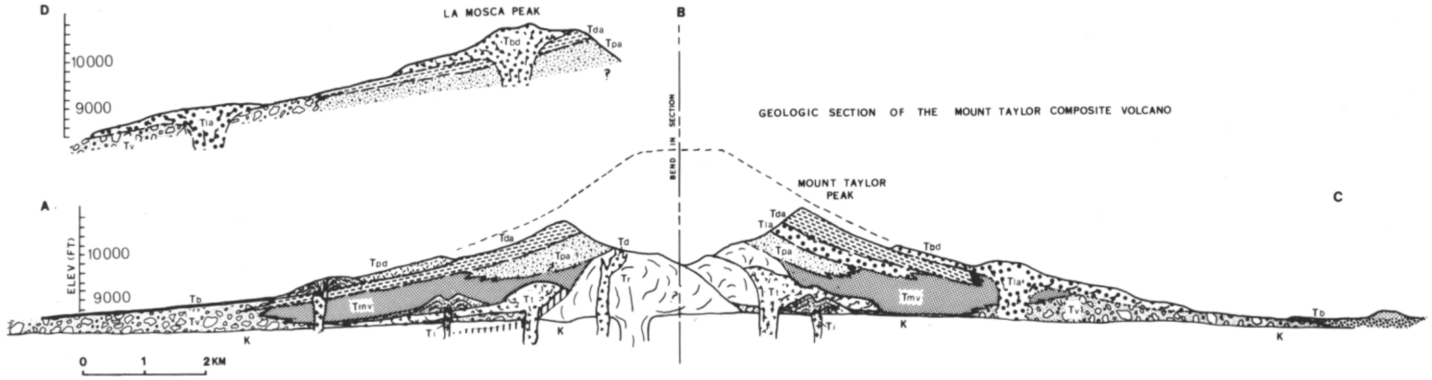

Figure 5. Geologic cross sections of the Mount Taylor composite volcano; see Figure 4 for location of cross sections and explanation of symbols.

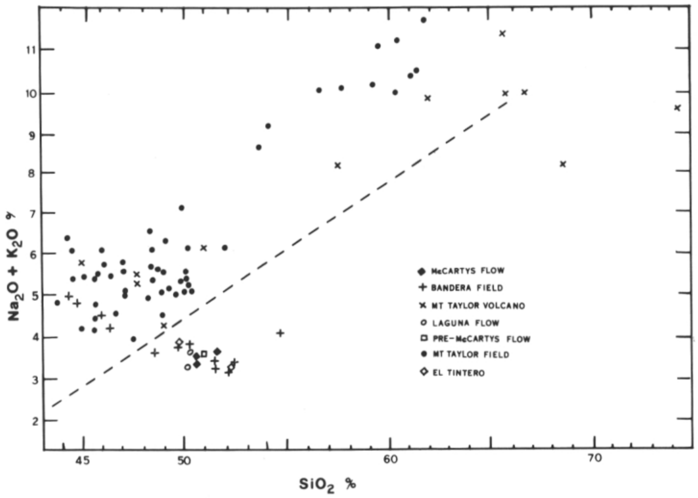

Figure 6. Macdonald-Katsura alkalies-silica diagram with alkalic/subalkalic division line of Irvine and Baragar (1971). Analyses compiled from Hunt (1938), Baker and Ridley (1970), Leeman and Rogers (1970), Laughlin and others (1971, 1972b), Kudo and others (1972), Lipman and Moench (1972), Carden and Laughlin (1974), Aoki and Kudo (1976), and Crumpler (1980).

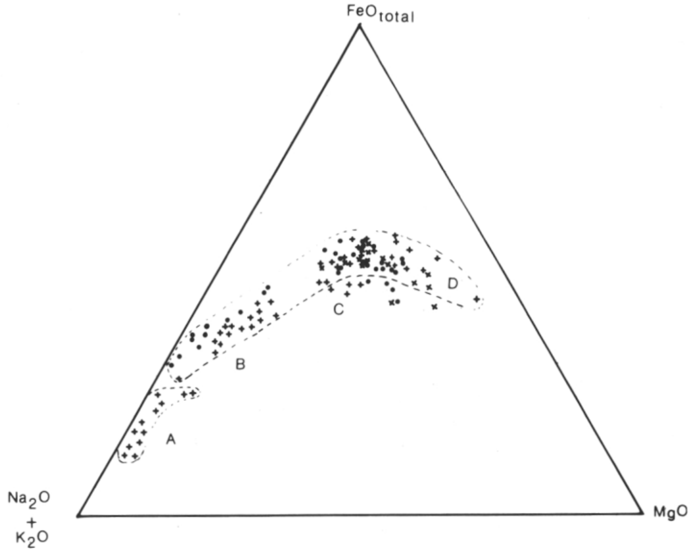

Figure 7. AFM diagram for Mount Taylor field only. A = rhyolites, dacites, and andesites; B = trachytes, benmorites, and mugearites; C = hawaiites and alkali basalts; D = basanites. Solid circles from Crumpler (1980), crosses from Baker and Ridley (1970), and oblique crosses from Lipman and Moench (1972).

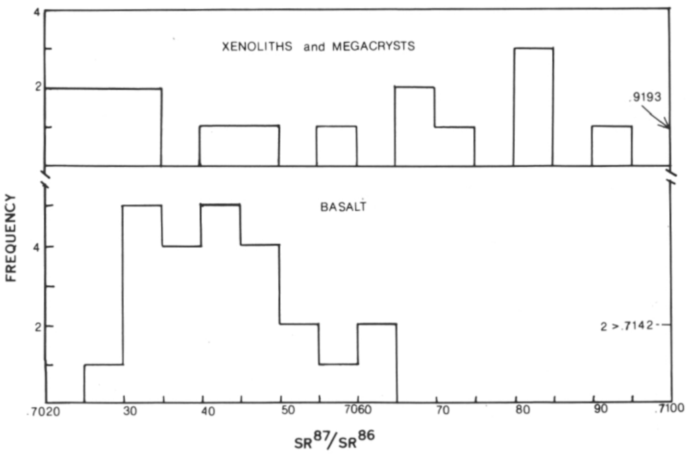

Figure 8. Frequency of occurrence of $^{87}Sr/^{86}Sr$ data for the Mount Taylor region. Most of the basalts fall in the range 0.7030 to 0.7050, consistent with mantle provenance. Data from Leeman (1970), Laughlin and others (1971, 1972a), and Brookins and others (1977).

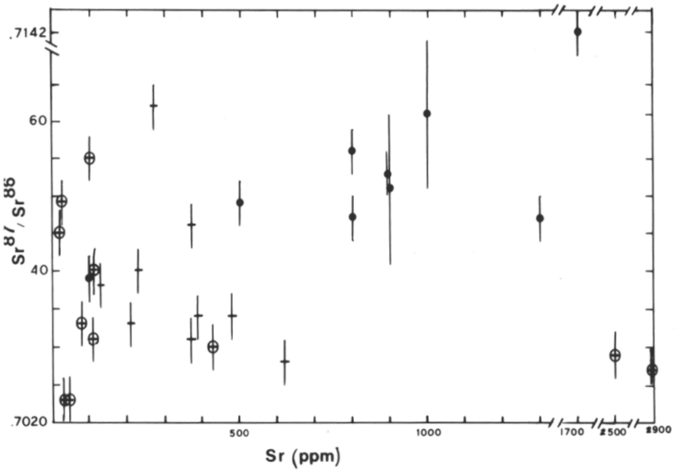

Figure 9. Plot of available strontium isotopes versus total strontium content for alkalic suite (solid circles), basalts of Mount Taylor region (crosses), and xenoliths and xenocrysts (crossed circles). Data from Leeman (1970), Laughlin and others (1971, 1972a), and Brookins and others (1977).

Table 2. $^{87}Sr/^{86}Sr$ data for the Mount Taylor region.

Location	Rb	Sr	Rb/Sr	^{87}Sr/^{86}Sr	Source
Bandera					
Zuni Canyon	11	368	0.03	0.7031 ± 0.0003	1
Paxton Springs	14	479	0.03	0.7034 ± 0.0003	1
McCartys	14	225	0.06	0.7040 ± 0.0003	1
La Tetera	24	370	0.06	0.7046 ± 0.0003	1
Hoya de Cibola	5	128	0.04	0.7038 ± 0.0003	1
Pre-McCartys	9	211	0.04	0.7033 ± 0.0003	1
Bandera basalt	—	390	—	0.7034 ± 0.0003	1
Bandera basalt	—	430	—	0.7030 ± 0.0003	1
Bandera basalt	—	620	—	0.7028 ± 0.0003	1
Bandera anorthoclase	—	2900	—	0.7027 ± 0.0003	1
Bandera red-spinel lherz.	—	20	—	0.7045 ± 0.0003	1
Bandera green-spinel lherz.	—	38	—	0.7023 ± 0.0003	1
Bandera red-spinel lherz.	—	25	—	0.7049 ± 0.0003	1
Bandera green-spinel lherz.	—	110	—	0.7040 ± 0.0003	1
Bandera red-spinel lherz.	—	100	—	0.7055 ± 0.0003	1
Bandera gabbro	—	80	—	0.7033 ± 0.0003	1
Bandera green-spinel lherz.	—	47	—	0.7023 ± 0.0003	1
Bandera anorthoclase	—	2500	—	0.7029 ± 0.0003	1
Bandera green-spinel lherz.	—	108	—	0.7031 ± 0.0003	1
McCartys	19	270	0.07	0.7062	2
Mesa Chivato					
basanite	—	900	—	0.7051 ± 0.001	3,4
hawaiite	—	900	—	0.7053 ± 0.0003	3,4
mugearite	—	1700	—	0.7142 ± 0.0003	3.4
benmorite	—	1300	—	0.7047 ± 0.0003	3,4
trachyte	—	800	—	0.7047 ± 0.0003	3,4
trachyte	—	500	—	0.7049 ± 0.0003	3,4
trachyte	—	100	—	0.7039 ± 0.0003	3,4
alkali basalt	—	800	—	0.7056 ± 0.0003	3,4
hawaiite	—	1000	—	0.7061 ± 0.001	3,4
Puerco Necks					
basalt	25	430	0.06	0.7039 ± 0.0003	5
lherzolite	2.8	3.2	0.9	0.7090 ± 0.0003	5
lherzolite	0.8	5.9	0.14	0.7083 ± 0.0003	5
lherzolite	—	—	—	0.7068 ± 0.0003	5
lherzolite	—	—	—	0.7069 ± 0.0003	5
websterite	2.0	10	0.2	0.7070 ± 0.0003	5
olivine	1.2	2.9	0.4	0.7083 ± 0.0003	5
enstatite	—	—	—	0.7084 ± 0.0003	5
basalt	—	—	—	0.7040 ± 0.0003	5
basalt	—	—	—	0.7041 ± 0.0003	5

1 = Laughlin and others, 1971; 2 = Leeman, 1970; 3 = Brookins and others, 1977; 4 = Crumpler, 1980; 5 = Kudo and others, 1972.

6. Many of the high mesas and peripheral areas of volcanism in the Mount Taylor region are as yet incompletely examined.

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