SOME CRETACEOUS-TERTIARY RELATIONSHIPS IN SOUTHEASTERN ARIZONA AND NEW MEXICO

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In Courtright's (1) report on this subject it was pointed out that the presumed age of certain volcanic rocks described in the literature as Cretaceous was subject to question. It was concluded that the field evidence in the Silver Bell, Stanley, Winkleman-Christmas and other areas indicated that the rocks which frequently have been mapped as Cretaceous volcanics are distinctive in character, being composed predominantly of andesite breccia of probable volcanic-mudflow origin, and are not interbedded with sediments of certain or probable Cretaceous age. Instead, they are resting on an erosion surface cut in deformed Cretaceous and older sediments, and are probably early Tertiary in age. These andesitic rocks are locally termed the "Silver Bell" formation. Field information accumulated since the first report expands and lends further support to these concepts.

The accompanying chart which covers nine localities, including five of those previously reported, shows postulated age relationships and correlations based on lithology and stratigraphic position. We are aware of the great distances between some of the observation points, and admit a deficiency of supporting detail. Nevertheless, we believe these correlations merit consideration.

The presence of igneous pebbles (most andesitic porphyries) in some Cretaceous beds in southern Arizona suggests contemporaneous or earlier igneous activity somewhere in the region. However, we contend that volcanism on a widespread scale did not begin until after the destruction of Cretaceous sedimentary basins had started, and that the age of these eruptions is most probably early Tertiary.

The principal purpose of this paper is to call further attention to the problem and to encourage the undertaking of critical field studies.

DESCRIPTION OF PRINCIPAL OCCURRENCES

Silver Bell

Recent field studies have determined that the "Silver Bell" formation is underlain by a thick series of clastic beds termed the "Claflin Ranch" formation. From their composition it may be judged that the arkoses of this formation were derived in part from erosion of underlying dacite agglomerate; some beds are conglomerates which contain abundant arkosic fragments derived from probable Cretaceous rocks, while others contain much schist and andesite. Enclosed within these thin- to thick-bedded clastics are a few angular blocks of "Cretaceous-type" arkose as much as 10' in length, and a few blocks of andesite-schist conglomerate over 50' in length and 25' in thickness. Except for the absence of large limestone blocks, this formation resembles Kinnison's (2) Tucson Mountain chaos as it is exposed 1/2 mile south of Gates Pass.

The "Silver Bell" formation consists largely of angular to sub-rounded fragments of andesite in a mud-like andesitic matrix. It unconformably overlies the "Claflin Ranch" formation and in turn is overlain by welded pyroclastics which are lithologically identical to the Cat Mountain rhyolite in the Tucson Mountains.

South Tucson Mountains

Except for the absence of the "Silver Bell" formation, the sequence here is similar to that in the Silver Bell district.

As described by Kinnison, the Tucson Mountain chaos is a giant breccia --unusually large rock blocks in a clastic matrix--that was deposited on an early Tertiary(?) erosion surface (the Tucson surface). Parts of this formation, and also a series of andesite-pebble conglomerate beds in the Piedmontite Hills, had previously been mapped by Brown (3) as Cretaceous volcanics. A recent study of the Piedmontite Hills was made by Colby (4) who reported the occurrence of a rhyolite tuff in these clastics. The field evidence indicates to us that this rhyolite is an intrusive rather than a pyroclastic.

At this time none of the volcanics of the Tucson Mountains can be demonstrated to be Cretaceous. Locally, andesite underlies the Tucson Mountain chaos; the relationship to older rocks is not definitely known, but we believe that it is most probably post-Cretaceous.

South Twin Buttes District

A considerable thickness of the Silver Bell-type formation is well exposed southeast of the Esperanza mill. From west to east, massive andesite flows and "clastic" breccias pass into unsorted, coarse conglomerates made up of angular to sub-rounded andesite fragments and well rounded boulders of granite, quartzite, and other rock types. A few thin, pebbly beds are present. The formation is overlain unconformably by rocks of the Cat Mountain rhyolite type. Its basal relations in this area are not known.

Southwest Sierrita Mountains

Massive andesite breccias of the Silver Bell type are underlain by Precambrian (?) granite and overlain by a fragment-bearing rhyolitic formation which may correlate with the Cat Mountain rhyolite of the Tucson Mountains. Both contacts appear to be erosional unconformities.

Southwest Empire Mountains

Galbraith (5) recognizes two major units (northern and southern) in the Cretaceous(?) beds below the thrust fault on the west side of the Empire Mountains. Of the southern series, he states: "Their relationship to the other Cretaceous(?) strata is not known, but they are presumably younger than the arkosic sandstone and shale, because they contain numerous fragments of arkosic rocks which appear to be identical with those exposed to the north. This series may in part be as young as Tertiary in age." This implies that an unconformity may exist between these two series.

This unconformity is exposed in a south fork of Barrel Canyon, three quarters of a mile S60E from Barrel Springs. There, steep-dipping arkose and shale beds terminate against a thin arkosic bed containing scattered pebbles and boulders of arkose, andesite and other rock types. This sharply angular unconformity, near vertical in dip, is visible on both sides of the canyon. The thin arkose bed passes stratigraphically upward into a coarse, unsorted conglomerate 100 feet or more in thickness, and then into andesite breccia of the Silver Bell type. The contact with the latter is not well exposed; but on the north slope of a ridge about a mile and a quarter N75W of the Martinez Ranch, the andesite breccia can be seen unconformably overlying arkose boulder conglomerates similar to those near Barrel Springs. These conglomerates contain occasional andesite blocks over 20 feet in diameter, and a few 5- to 10-foot blocks of arkose and limestone.

A younger boulder-conglomerate which may overlie an erosion surface cutting the Silver Bell-type andesite, the Cretaceous beds, and the intervening conglomerate crops out about one mile south of Barrel Springs.

Tombstone

Gilluly (6) describes the lower half of the Bronco volcanics as being made up largely of clastic andesite breccias--andesite fragments in an andesitic mud matrix--which probably originated as volcanic mud flows. As these rocks

unconformably overlie the Cretaceous Bisbee formation, he regards their age as late Cretaceous or early Tertiary.

This lower unit of the Bronco volcanics is megascopically identical to the "Silver Bell" formation. In an outcrop about 2 miles due east of Bronco Hill, or 7 miles S60W of Tombstone, red sandstone and mudstone beds of the Bisbee formation are overlain unconformably by 60 feet of conglomerate made up of well rounded cobbles of arkose, chert, quartzite, and limestone in a friable matrix of andesitic debris. Between the conglomerate and the overlying andesite breccias is a 50-foot thickness of greenish, gritty siltstone containing a few large (± 8 feet in dia.) angular boulders of limestone conglomerate and massive andesite or felsite. This bed and the underlying conglomerate together are considered a probable correlative of the "Claflin Ranch" formation.

Hatchita Mountains (New Mexico)

Perhaps the most detailed study of volcanic rocks of designated Cretaceous age in the region was made by Lasky (7) in the Hatchita Mountains, New Mexico. The principal unit, the Hidalgo volcanics, is described to be unconformably overlain by the Howell's Ridge formation which is assigned to the lower Cretaceous on fossil evidence. Other volcanics reportedly are interbedded in the Ringbone shale and Skunk Ranch conglomerate. The volcanics are confined to the northern part of the Hatchita Mountains, but the associated sedimentary formations, excepting the Ringbone shale which underlies the Hidalgo volcanics, continue several miles into the southern part. This lack of continuity, which in the case of Hidalgo volcanics involves a decrease in thickness from 5000 feet to zero in 4 miles along strike, is regarded by Lasky as being due to deep erosion both before and after extrusion of the volcanics.

We suggest certain alternative interpretations. These are summarized on the accompanying chart which shows proposed correlation of the "Claflin Ranch" and "Silver Bell" formations with the Ringbone shale and Hidalgo volcanics respectively.

As mapped by Lasky, the Hidalgo volcanics along the northeast slope of Howell's Ridge dip under the Howell's Ridge formation. The contact is mapped as depositional. Close inspection of all good exposures revealed that the two formations are separated by a fine-grained diorite intrusive. Elsewhere, the Miss Pickle fault forms the contact. Thus, evidence for Lasky's postulated age relationship between the Howell's Ridge formation and the Hidalgo volcanics appears lacking. In some outcrops, strong shearing in the volcanics was observed along the diorite contact, suggesting that the diorite may have intruded a fault plane--possible a thrust. According to Zeller (8) "...Lasky's section may include at least one duplication. If this contention is true, the section in the Little Hatchet Mountains will be virtually the same in lithology, fauna, and in thickness as that of the Big Hatchet Mountains." Zeller's Lower Cretaceous section in the Big Hatchet Mountains contains no volcanic units.

The only other occurrence of Hidalgo volcanics crops out as an irregular area surrounded by the Howell's Ridge formation, immediately south of Howell's Wells. Lasky interprets this exposure of the volcanics to be formed by erosion of overlying sediments along the axis of an anticline; however, the postulated anticline in this area is not evidenced by the attitudes recorded on the map. During our field check, an intrusive was found to occupy the western end of the area mapped as volcanics; and elsewhere the limits of the volcanics were either concealed or obscured by alluvium. The areal pattern of these volcanics in relationship to the topography suggests that they were deposited on an erosion surface cut in the sediments.

The Ringbone shale is distinctive because of the abundance of andesitic material in many of its beds, which range in composition from fine silts to coarse conglomerates. Also, it contains unusually large blocks (over 50 feet in diameter) of andesitic rock. Lasky describes a basalt porphyry flow, interbedded in the Ringbone shale and repeated in the outcrops by faulting. These outcrops were investigated and the basalt occurrences appear to be sills. It is notable that the few fossils collected in this formation are not among those listed by

Lasky as diagnostic of the Lower Cretaceous. His assignment of the Ringbone shale to the Lower Cretaceous, therefore, rests entirely on his structural and stratigraphic interpretations. There appears to be no question that the Ringbone shale is stratigraphically lower than the Hidalgo volcanics; but there is reasonable doubt that the Hidalgo volcanics are stratigraphically lower than the Cretaceous Howell's Ridge and overlying formations.

The Hidalgo volcanics are lithologically similar to other localities of Silver Bell-type andesite breccia. In view of this and of the possibility that they overlie a post-Howell's Ridge erosion surface, we tentatively suggest a correlation with the "Silver Bell" formation.

Stanley and Winkleman-Christmas Areas

As pointed out by Courtright (1), the andesite breccias and flows are not interbedded with, but overlie, Upper Cretaceous sandstones and shales in the Stanley area; in the Winkleman-Christmas area they overlie Paleozoic limestones. The surface of deposition is marked by a few feet of greenish silt and grit.

GENERAL

Volcanics and clastics of the Silver Bell-Claflin Ranch types have been observed in several other localities, including the Silver City district of New Mexico. There, they have been mapped (9) as Cretaceous-Tertiary extrusives unconformably overlying the Upper Cretaceous Colorado formation. In the Chiricahua Mountains they have been mapped by Sabins (10) as the Nipper formation which unconformably overlies Lower Cretaceous and older rocks. As mapped by Guillerman (11) in the Peloncillo Mountains, they likewise overlie a post-Lower Cretaceous erosion surface.

In the foregoing paragraphs we have described the interval between the Tucson surface (2) and the overlying acid pyroclastics of the Cat Mountain rhyolite type as being occupied principally by two formations: the older clastics of the "Claflin Ranch" or chaos type and the younger andesites of the "Silver Bell" type. This may be an over-simplification of the inter-relation of these two rock types. Actually, there may have been repeated episodes of deposition of clastics and volcanics, with local intervals of erosion. Thus, the sequences may be found to differ in order and number of units from place to place. The important points are that these rocks as a group are lithogically similar over wide areas; they lie on an erosion surface cut in Cretaceous and older rocks; and this surface usually marks a pronounced change in the environment of sedimentation.

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REFERENCES

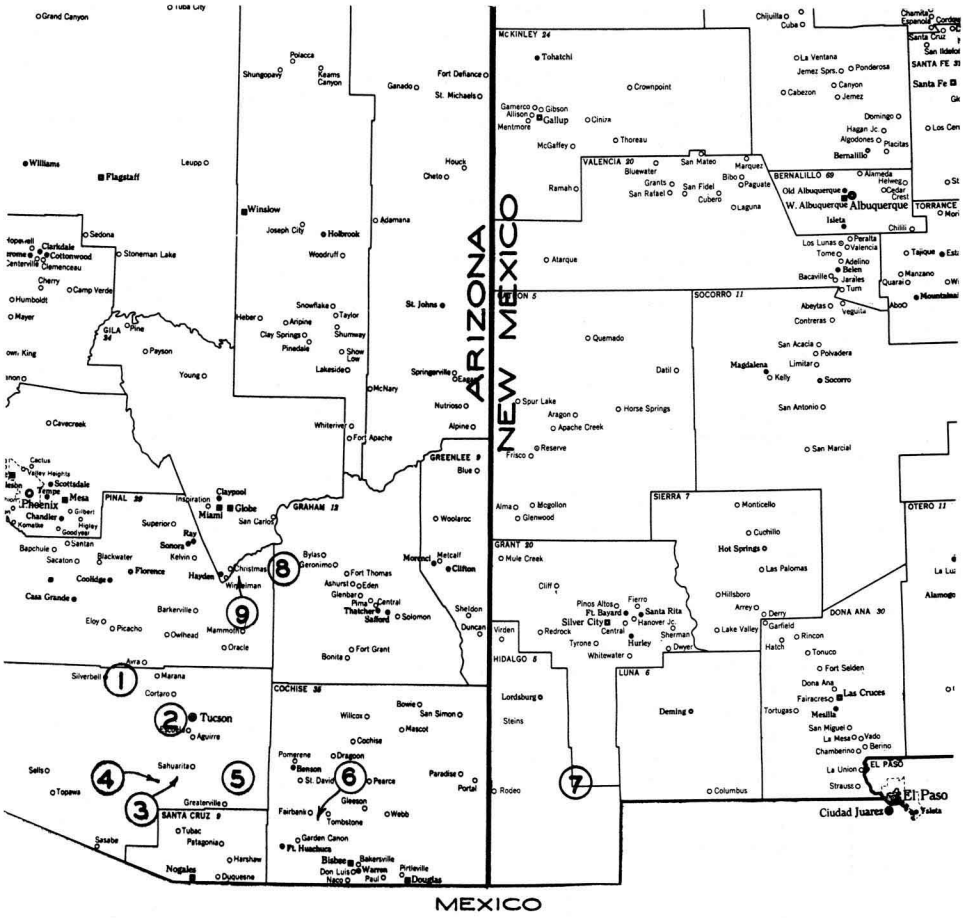
(1) J. H. Courtright: Progress Report on Investigations of Some Cretaceous-Tertiary Formations in Southeastern Arizona, Arizona Geological Society Digest, October, 1958.

(2) John E. Kinnison: Chaotic Breccias in the Tucson Mountains, Arizona, Southern Arizona Guidebook II, Arizona Geological Society, 1959.

(3) W. H. Brown: Tucson Mountains, an Arizona Basin-Range Type, G. S. A. Bulletin (1939) Vol. 50, pp. 697-760.

(4) Robert E. Colby: Unpublished M. S. Thesis, University of Arizona, 1958. The Stratigraphy and Structure of the Recreation Red Beds.

(5) F. W. Galbraith: The Empire Mountains, Pima County, Arizona, Southern Arizona Guidebook II, Arizona Geological Society, 1959.



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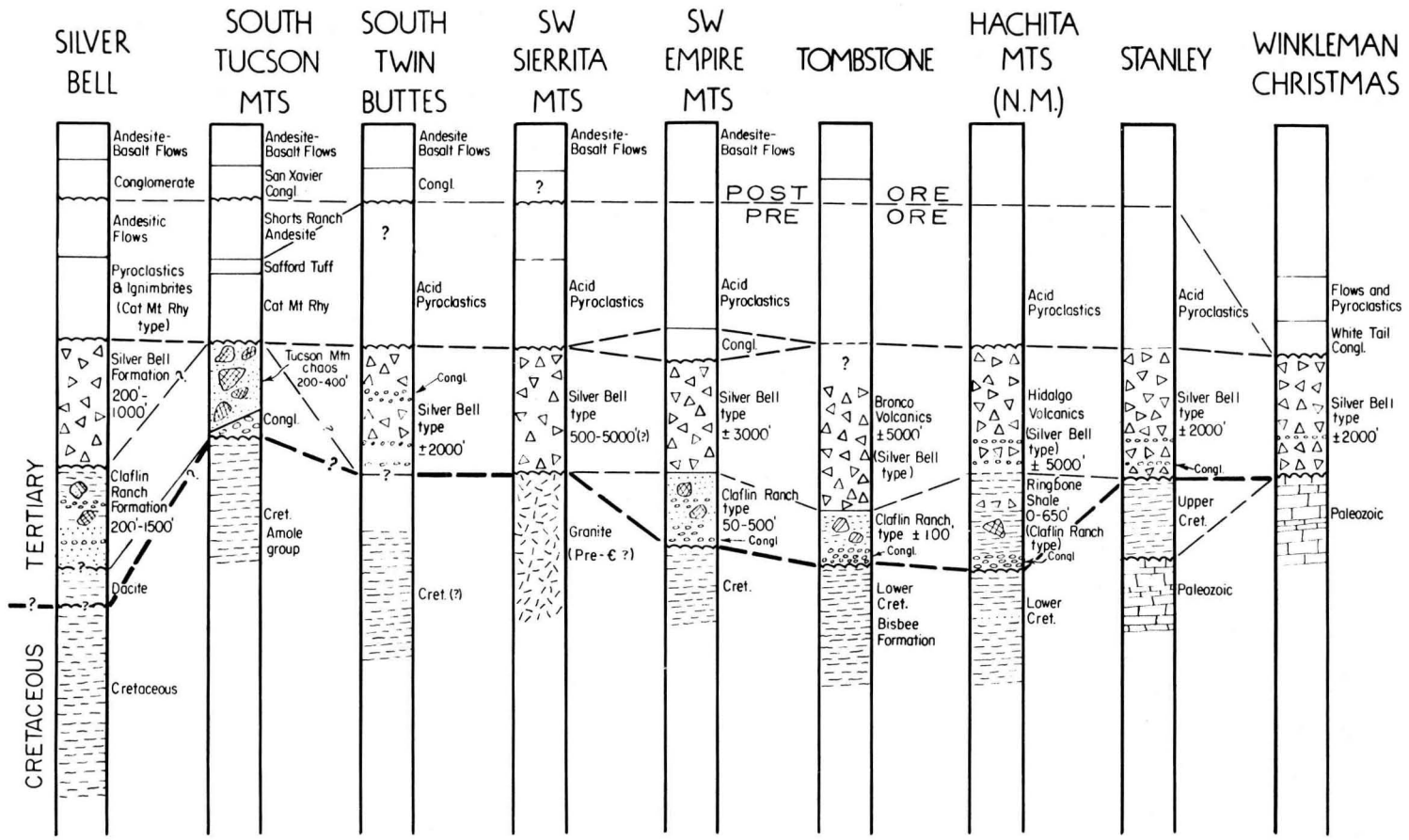

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NOT TO SCALE

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(6) James Gilluly: General Geology of Central Cochise County, Arizona, U. S. G. S. Prof. Paper 281, 1956.

(7) Samuel G. Lasky: Geology and Ore Deposits of the Little Hattcher Mountains, U. S. G. S. Prof. Paper 208, 1947.

(8) Robert A. Zeller: Lower Cretaceous Stratigraphy of Southwestern New Mexico, in New Mexico Geological Society Guidebook, 1953.

(9) R. M. Hernon and others: Geologic Map of the Central Mining District, Grant County, New Mexico, U. S. G. S. Open File Report, 1955.

(10) F. F. Sabins: Geology of the Cochise Head and Western Part of the Vanar Quadrangles, Arizona, G. S. A. Bull. Vol. 68, pp. 1315-1342, October, 1957.

(11) Elliot Guillerman: Geology of the Central Peloncillo Mountains, Hidalgo County, New Mexico, and Cochise County, Arizona, New Mexico Bureau of Mines Bull. 57, 1958.