GEOLOGY
OF THE
MOUNT MOSES QUADRANGLE, NEVADA

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INTRODUCTION

The geologic map of the Mount Moses quadrangle, Nevada, is part of a project for the study of the Sonoma Range 1-degree area. The preliminary results of the work are published as four 30-minute quadrangles, of which this is one. For regional relations reference is made to the adjoining quadrangles—Winnemucca (northwest), Mount Tobin (west), and Golconda (north), fig. 1.

Field work was done in parts of the 1908, 1909, and 1911 field seasons, and shorter visits were made to the area in 1912 and 1916. The work was almost entirely of a reconnaissance nature; detailed study was confined to the areas of pre-Tertiary rocks in the southern part of the Tobin Range and the eastern and northern parts of the Fish Creek Mountains. Mapping of the Sonoma Range was confined to reconnaissance of areas easily accessible from the road bordering the west flank. The higher parts of the ranges and the east slope were not visited.

H. G. Ferguson was in charge of the work and is responsible for the present form of the text, except for the sections dealing with Mesozoic rocks, by S. W. Muller, and those on igneous rocks and ore deposits, by Ralph J. Roberts. Roberts has also made a detailed study of the Antler Peak 15-minute quadrangle north of the eastern half of this quadrangle, the results of which have been published separately (Roberts, 1911). During the 1916 season Ward Smith was associated with the project. Efficient assistance in the field was given at different times by J. F. McAllister, A. E. Granger, M. F. Erickson, and J. L. Hill.

The ages of the Paleozoic formations are based on determinations by James Steele Williams and Lloyd Hewitson in the Winnemucca and Golconda quadrangles, and their assistance in the field and later study of the material collected is gratefully acknowledged. Fossils from the Triassic formations were determined by Muller.

The area is in north-central Nevada, within the Basin and Range physiographic province, and contains the Fish Creek Mountains and parts of the Tobin Range and Sonoma Range, which rise to heights of about 4,000 feet above the intervening desert valleys. The nearest town and railroad point, Battle Mountain, is about 15 miles south of the southeast corner of the quadrangle. The highway from Battle Mountain to Austin follows the valley of Reese River to the eastern part of the quadrangle; pseudo roads traverse Pumpkin and Jersey Valleys in the western part.

GEOLOGY

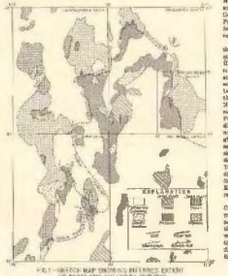
STRATIGRAPHY

Pre-Tertiary rocks crop out over only a relatively small part of the area, so that conclusions as to their relations are necessarily derived from study of the adjoining quadrangles. It is thought that all the exposed Paleozoic and Triassic rocks form part of the upper plate of the Golconda thrust (fig. 1). The Pumpkinseed and Havallah formations of Pennsylvanian(?) and Permian(?) age respectively were highly folded during the Permian and are unconformably overlain by the volcanic Koipato formation, also of Permian age, which does not crop out in the quadrangle. After an erosion interval, formations ranging from Lower to Upper Triassic were deposited in conformable sequence. The Triassic rocks, though titled and faulted, are not highly folded. Efficient Paleozoic rocks of the lower plate of the Golconda thrust, which show an entirely different sequence and include no original conformities within the Pennsylvanian, do not crop out in this quadrangle.

The pre-Tertiary rocks are cut by granitic intrusives, presumably of late Jurassic or early Cretaceous age.

Tertiary lavas compose most of the bedrock now of the quadrangle. The Fish Creek Mountains and Sonoma Range are made up largely of Tertiary rhyolite and pyroclastic rocks, and there are basalt lavas of Quaternary age on the northern flank of the Fish Creek Mountains.

The present ranges are largely bounded by normal faults, but it is uncertain to what extent the present relief is due directly to faulting and how much to erosion controlled by resistant rock forms.



PALEOZOIC ROCKS AND CORRELATION

Except for rocks of undetermined age, possibly Cambrian, on the west flank of the Sonoma Range, the Pumpkinseed and Havallah formations are the only Paleozoic rocks exposed in the quadrangle. These formations, each several hundred feet thick, are conformable. Outcrops west face of the Fish Creek Mountains in the extreme northwest corner of the quadrangle, a composite bed of quartzite overlying the dark phyllite, clastic, and greenstones of the Pumpkinseed and Havallah formations and the interbedded and fine-grained quartzites and limestones of the Havallah. In the Tobin Range, on the other hand, the western is transitional with the north, with the quartzite and limestone of the Havallah formation cropping out in the central portions. In the southern part of the area, small areas of the Havallah are also being the Pumpkinseed formation shown the Havallah on the eastern flanks of two of the ridges. Only about 8 miles of highly altered middle Paleozoic limestone the southernmost outcrops of the folded Pumpkinseed formation and the undivided Triassic of Augusta Mountain (Mount Tobin quadrangle), so it is assumed that here, as in the Golconda quadrangle, the folds are of Permian age although the trend differs from the general northerly direction of Permian folding.

Only the southern part of the section of the Tobin Range within the quadrangle was mapped in detail. Here the Pumpkinseed formation is represented into a series of sandstone, shale, and limestone, with numerous intercalations of basaltic lava flows and tuffs, and at the contact with the Havallah formation there is local unconformity. Note the northern border of the quadrangle the section of Havallah and Pumpkinseed near the range front dips to the northwest, but farther north, within the Golconda quadrangle, the general trend is a few degrees east of north. The two broad faults shown are evidences of these that a short distance to the west (Mount Tobin quadrangle) are cut by a west-dipping thrust, which to the north is itself overlapped by the Permian Koipato formation (Golconda quadrangle).

At the northern end of the Fish Creek Mountains the Havallah formation dips steeply to the west and northwest. There is no outcrop of the Permian Koipato formation, which in other quadrangles overlies the folded Havallah. If present, the formation must be concealed beneath the lavas to the south.

TRIASSIC AUGUSTA MOUNTAIN FORMATION

The incomplete Triassic section, exposed in the vicinity of McCoy in the northern part of the Fish Creek Mountains, includes the Middle Triassic Favret, Panther Canyon, and Augusta Mountain formations and the Upper Triassic Cane Spring and Gabbs. The section is interesting as the type between that of Augusta Mountain (Mount Tobin thrust) and China Mountain (Golconda thrust). The Middle Triassic is dominantly carbonate and the Upper Triassic principally clastic. The Lower Triassic Table and Dixie Valley formations are not exposed, and the Middle Triassic Favret formation, with an exposed thickness of about 300 feet is overlain by the clastic Panther Canyon formation, not present in the Augusta Mountain section. The Augusta Mountain and Cane Spring formations are here only half as thick as at their type localities in Augusta Mountain. Only the lower part of the overlying Gabbs formation is exposed.

The Favret lithology and fauna, particularly the Ceratite *Arcestes* and *Meekoceras*, are recognized also in the Pride formation of the upper plate facies, thus furnishing a datum plane for the correlation of the two facies. Key, although the Favret was not originally subdivided and extended through areas unexposed by fresh plates of the great thrust, it did not extend far to the northwest, at least on the upper plate, for in China Mountain (Golconda quadrangle), 18 miles northwest, the Favret-like marine sediment fails unconformably and pass into the clastic Panther Canyon formation, which overlies the Favret. The Panther Canyon formation, containing fragments of coarse clastics only pebbles derived from the Permian Havallah formation, is not present in the thicker sections of the upper plate facies in the Tobin Range and Augusta Mountain (Mount Tobin quadrangle), where the Augusta Mountain formation overlies the Favret conformably, but thickens to the northward in China Mountain (Golconda quadrangle) and neighboring areas in the Sonoma Range (Winnemucca quadrangle) and is not conformably replaces the Favret.

The Triassic rocks of the upper plate of the Golconda thrust in this and the adjoining quadrangles, though thick and locally small faults, show only gentle dips. These beds have contact with the underlying folding of the Triassic rocks of the lower plate facies. In the McCoy area the general structure is a low northward plunging anticline cut off along much by the intrusive. The rocks are broken by many small faults, most of which do not displace the overlying Tertiary and continuity is thus fixed by determinable units, and for the most part the displacements are small. Thrusts of this character are known in the Golconda quadrangle, and it is probable that they are also present in the Augusta Mountain section.

JURASSIC ROCKS

Intrusive rocks in the quadrangle include granitic, quartz monzonite, granodiorite, and diorite. The largest body is that of the McCoy district; here the intrusive is exposed for a length of 6 miles and a width of about 2 miles, but its full extent is concealed in the southwest by Tertiary volcanic rocks. The intrusive at McCoy is largely granodiorite and quartz monzonite. A diorite facies is developed on the contact where the Triassic limestone is present, and pegmatite dikes formed by segregation also with the limestone. In the southwestern part of the intrusive, aplitic and aplitic facies of the igneous intrusive are present along the contact where the Triassic rock is shale and quartzite. The aplitic facies suffer the Mesozoic ranges and is almost entirely to hornfels, and the quartzite has been recrystallized; but no distortion of structure is evident. The intrusive rock exposed on the east side of the Tobin Range is granite and quartz monzonite.

TERTIARY AND QUATERNARY VOLCANICS

Tertiary lavas with some interbedded sedimentary occupy a large part of the quadrangle, but were not studied in detail and were subdivided only where they adjoin areas in which the older rocks were mapped in some detail. In this and the three adjoining quadrangles, rhyolite is the dominant Tertiary lava and during the Tertiary marked accumulation of the region.

Erosion intervals and deposition of sediments interrupted the sequence of lavas. On the west slope of the Fish Creek Mountains the oldest lava is andesite. It was deeply weathered and eroded prior to the succeeding rhyolite and is now present only as small remnants. After erosion that cut deeply into the underlying Paleozoic rocks of the west flank of the Fish Creek Mountains came inflammable rhyolite. It lasted it was largely eroded before the smoldering of the succeeding tuffs flow of andesite. Fenwick was relatively widespread and extended through areas unexposed by fresh plates of the great thrust. It did not extend far to the northwest, at least on the upper plate, for in China Mountain (Golconda quadrangle), 18 miles northwest, the Fenwick-like marine sediment fails unconformably and pass into the clastic Panther Canyon formation, which overlies the Favret. The Panther Canyon formation, containing fragments of coarse clastics only pebbles derived from the Permian Havallah formation, is not present in the thicker sections of the upper plate facies in the Tobin Range and Augusta Mountain (Mount Tobin quadrangle), where the Augusta Mountain formation overlies the Favret conformably, but thickens to the northward in China Mountain (Golconda quadrangle) and neighboring areas in the Sonoma Range (Winnemucca quadrangle) and is not conformably replaces the Favret.

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