# Geyser Creek Fanglomerate (Tertiary) La Sal Mountains, Eastern Utah

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CONTRIBUTIONS TO STRATIGRAPHY

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*Stratigraphic and structural history of the Geyser Creek Fanglomerate in the La Sal Mountains region*

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# GEYSER CREEK FANGLOMERATE (TERTIARY), LA SAL MOUNTAINS, EASTERN UTAH

By W. D. Carter and J. L. Gualtieri

## ABSTRACT

The Geyser Creek Fanglomerate, a name here applied to an extensive conglomerate deposit of Tertiary age, crops out within the Taylor Creek syncline on the southeast flank of the North Mountain group of the La Sal Mountains. The formation, ranging in thickness from very thin to 1,000 feet, consists mainly of well-consolidated, yellowish-brown conglomerate and sandstone in lenticular beds. Pebbles, cobbles, and boulders derived from the igneous rocks and upturned sedimentary rocks of North Mountain compose the conglomerate.

The formation unconformably overlies the Mancos Shale of Late Cretaceous age and is unconformably overlain by the Harpole Mesa Formation of early Quaternary age. Tilting of the beds and angular unconformities, which mark the upper and lower contacts, indicate that the fanglomerate was folded prior to glaciation in the mountains. The fanglomerate is considered to be of probable Pliocene age and correlative with a similar conglomerate in Castle Valley.

## INTRODUCTION

Fanglomerate deposits, of probable Tertiary age, have been reported on the north and west flanks of the La Sal Mountains of east-central Utah. Baker (1933, p. 56) described conglomerate near Pack Creek in San Juan County, Utah, as a consolidated mixture of angular to round pebbles, cobbles, and boulders of igneous and sedimentary origin, resting on folded Mancos Shale of Late Cretaceous age. Because it is lithologically different from more recent alluvial deposits in the Moab Valley and because it lies on Mancos Shale in the ridge between Cane and Pack Creeks, Baker tentatively assigned the conglomerate at Pack Creek to the Tertiary System.

In 1952, Hunt found a similar deposit of late Pliocene or early Pliocene age in Castle Valley, Grand County, Utah (Hunt, 1958, p. 314). The north end of that deposit dips about 17° S. and rests unconformably on the salt-anhydrite core of the Castle Valley anticline. In contrast, the southernmost exposures of the deposit are nearly vertical or dip steeply to the north near the igneous rocks of North Mountain. Hunt attributed the folding of the conglomerate to collapse as a consequence of solution and removal of the underlying salt during the Pleistocene Epoch.

Richmond (1962, p. 25–34), in studies of the Quaternary stratigraphy of the La Sal Mountains, found that the oldest deposit of undoubtedly Quaternary age, the Harpole Mesa Formation, consists of poorly consolidated gravel and boulder fans, till, and eolian sand and silt, all of which dip away from the three laccolithic centers of the mountains. He found that the Harpole Mesa Formation was younger than the Castle Valley fanglomerate deposits but lithologically similar to and correlative with the conglomerate at Pack Creek. He therefore included the latter in the Harpole Mesa Formation.

In 1956 during the course of a geologic study of the eastern La Sal Mountains area, made on behalf of the U.S. Atomic Energy Commission, the authors found fanglomerate deposits on the southeast flank of North Mountain near Geyser and Deep Creeks that are similar to the deposit described by Hunt. This report names and defines the Geyser Creek Fanglomerate.

## GEOLOGIC SETTING

Gently folded strata surround the laccolithic igneous cores of the La Sal Mountains in the northeastern part of the Colorado Plateau (fig. 1). These strata, ranging in age from Pennsylvanian to Late Cretaceous, are separated by unconformities that record a long history of continental deposition interrupted by periodic folding and marine invasions. The most recent transgression took place during Late Cretaceous time and was followed by uplift, folding of the sedimentary rocks, and intrusion of the igneous rocks of the La Sal Mountains. Mountain building was accompanied by erosion that established the major drainage pattern and formed alluvial fans on the mountain flanks. Glaciers steepened the topography of the upper valleys and deposited moraine and outwash in the lower valleys of the plateau surrounding the mountains. Postglacial erosion has cut deep valleys through the glacial cover and has exposed the underlying strata.

Surrounding the La Sal Mountains are a group of parallel northwestward-trending folds. The most conspicuous are breached anticlines marked by large elongate valleys surrounded by steep cliffs in which the stratigraphy is well displayed. Angular unconformities along the margins of the anticlines indicate repeated folding due to plastic flow of thick saline strata of Pennsylvanian age that make up the cores of the folds. In places, irregular bodies of contorted salt, anhydrite, and limestone crop out in the valley floors. Solution and

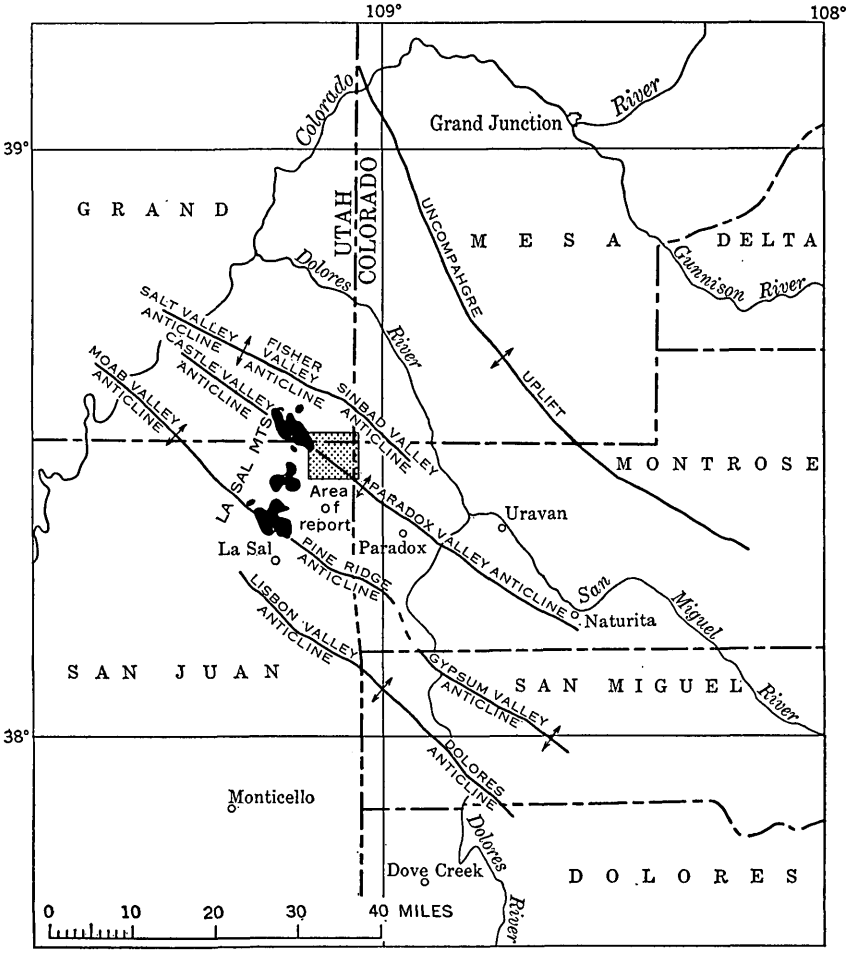



FIGURE 1.—Generalized structure map of the northeastern part of the Colorado Plateau showing location of the Pine Flats area, Utah.

removal of the upper parts of the saline cores of the anticlines during late Cenozoic time resulted in collapse of overlying beds. Between the anticlines are broad synclines that in some areas have become deeply dissected to form high mesas separated by narrow canyons.

The laccolithic La Sal Mountains are divided into three topographic groups: North Mountain, Middle Mountain, and South Mountain. The igneous cores of the North and South Mountain groups were intruded along two anticlines and uplifted upper Paleozoic and Mesozoic sedimentary rocks that were subsequently exposed by erosion. The Middle Mountain intrusives, however, are in what was once a broad intervening syncline and have uplifted and exposed upper

Triassic, Jurassic, and Cretaceous strata. It is here that the laccolithic nature of the intrusives is best displayed. Narrow subsidiary synclines now separate Middle Mountain from the other groups.

## TYPE SECTION

The Geyser Creek Fanglomerate is herein named for Geyser Creek, and eastward-flowing tributary to Roc Creek. The formation consists of fanglomerate and sandstone, which are best exposed in low escarpments along Deep Creek and Geyser Creek near their junctions with Roc Creek. The distribution of the formation and its probable south limit are shown in figure 2. Between the Deep Creek and Geyser Creek canyons and also in areas to the north and south, the formation is covered by terrace gravels of the Harpole Mesa Formation.

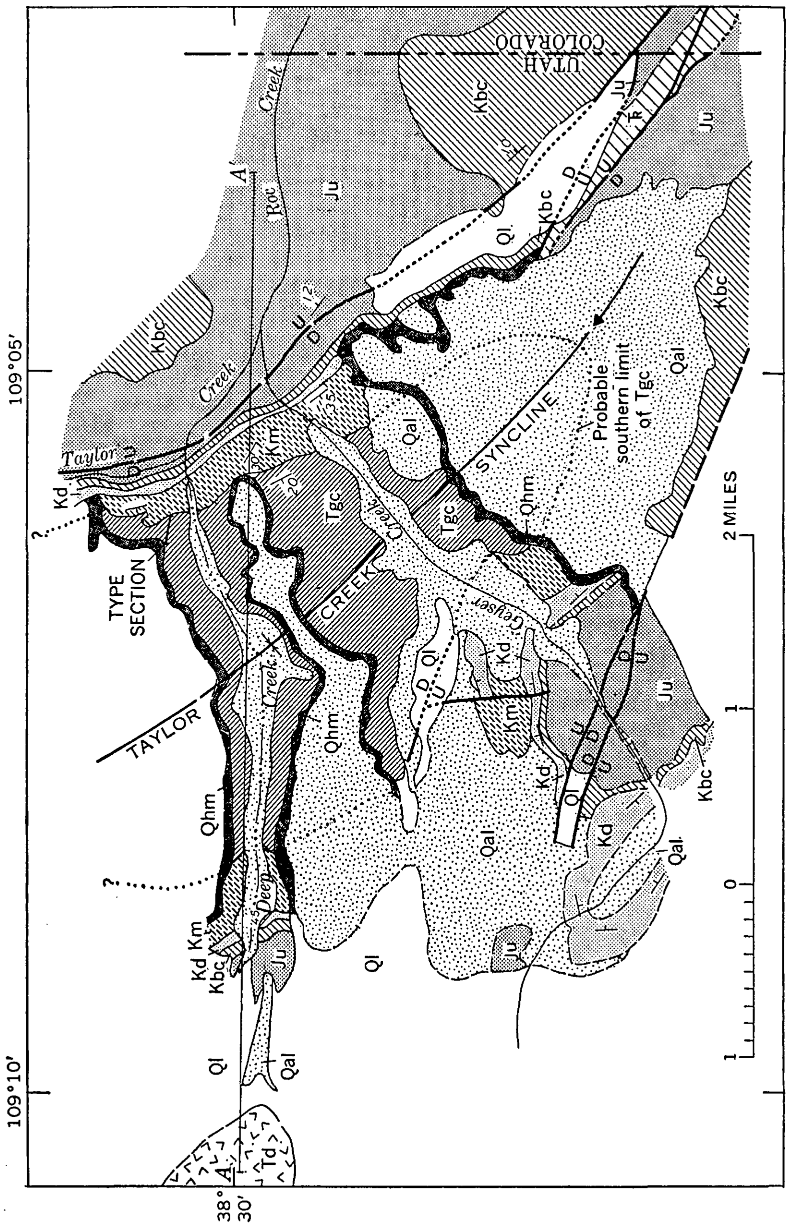
The formation is best exposed at the type section (fig. 2), measured on the north side of Deep Creek, about 2,000 feet west of its junction with Taylor Creek. It crops out as a distinctive yellowish-brown rock in a cliff that marks the east limit of the deposits and stands above smooth slopes of dark-grayish-green Mancos Shale. The following measured section is typical of the formation.

*Type section of the Geyser Creek Fanglomerate as measured in the north side of Deep Creek in NE¼ sec. 36, T. 26 S., R. 25 E., Grand County, Utah*

Harpole Mesa Formation (dips gently to east).
Angular unconformity.

| | Thickness (feet) |
|---|---|
| Geyser Creek Fanglomerate (dips 16°–25° W.): | |
| 14. Conglomerate and quartz sandstone, yellowish-brown; medium- to coarse-grained matrix weakly cemented by calcium carbonate. Conglomerate fragments are angular to subrounded pebbles and boulders of sandstone and diorite; they are as much as 18 in. long. Near base several cobbles averaging 3 in. in length are weathered to powdery limonite; thin calcite crust marks contact of cobble with surrounding conglomerate | 7.5 |
| 13. Sandstone, grayish-orange-pink, very fine to coarse-grained, poorly sorted. Composed mainly of quartz (80–90 percent), sparse black and brown chert; angular to subangular fragments of calcite and aragonite | 1.5 |
| 12. Conglomerate similar to unit 14. Boulders of diorite and sandstone as much as 12 in. long, 6 in. wide, 5 in. thick. Most sandstone boulders are gray, very fine to fine grained, massive, and closely resemble Wingate Sandstone. Upper 5 ft partially covered | 8 |
| 11. Covered interval | 16.5 |

| Geyser Creek Fanglomerate (dips 16°–25° W.)—Continued | *Thickness (feet)* |
|---|---|
| 10. Conglomerate and quartz sandstone, light-brown, fine- to coarse-grained, poorly sorted; matrix weakly cemented by calcium carbonate. Boulders, subangular to well-rounded, are as much as 24 in. in diameter. About 30 percent of the boulders is diorite. Another 30 percent includes both lavender to reddish-brown sandstone (probably from Kayenta Formation), light-gray to light-brown fine-grained sandstone (Wingate Sandstone), and reddish-brown to reddish-orange-brown silty sandstone (Chinle Formation). About 20 percent includes pebbles and boulders from younger formations, angular fragments of red chert (Summerville Formation), light-gray to light-brown fine- to medium-grain sandstone (Salt Wash Sandstone Member of Morrison Formation), white to light-gray fine-grained orthoquartzite (Burro Canyon Formation), light-green platy siltstone (Brushy Basin Shale Member of Morrison Formation, or Burro Canyon Formation), and dark-gray-green limestone (Mancos Shale). Remaining 20 percent not identifiable, mainly of sandstone and siltstone. Thin sandstone lenses also present | 24 |
| 9. Conglomerate composed mainly of pebbles and cobbles ranging from 6 to 12 in. in diameter. About 40 percent consists of unweathered igneous rock; remainder is sandstone and siltstone. Some silty sandstone pebbles have weathered to powdery limonite | 2.5 |
| 8. Sandstone, light-brown, fine-grained to medium-fine-grained, poorly sorted, with calcium carbonate cement. Lenticular, containing sparsely scattered pebbles and coarse-grained sandstone along base of lenses. Coarser-grained sandstone is more firmly cemented and forms riblike projections on outcrops. Pebbles include partially weathered diorite and sandstone | 9 |
| 7. Conglomerate, sandstone, and siltstone, yellowish-brown, lenticular. Conglomerate consists of weathered moderately rounded fragments, as much as 4 in. and averaging 2 in. in diameter, composed of diorite (about 60 percent) and reddish-brown and yellowish-brown (limonitic) sandstone and siltstone (about 40 percent). Sandstone, medium-fine-grained to very fine grained; in places grades to siltstone, so poorly sorted that siltstone locally contains coarse sand grains. Calcium carbonate cement appears to be more abundant in sandstone lenses that project several inches from face of outcrop | 9.5 |
| 6. Conglomerate consists of fragments, as much as 3 in. in diameter, composed chiefly of red sandstone and siltstone, in part weathered to powdery limonite and partly weathered diorite; matrix is very fine to very coarse grained sandstone, well indurated with calcium carbonate; a lens | 1 |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UTAH
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TYPE SECTION
TAYLOR CREEK SYNCLINE
Probable southern limit of Tgc
Taylor Creek
Roc Creek
Deep Creek
Geyser Creek
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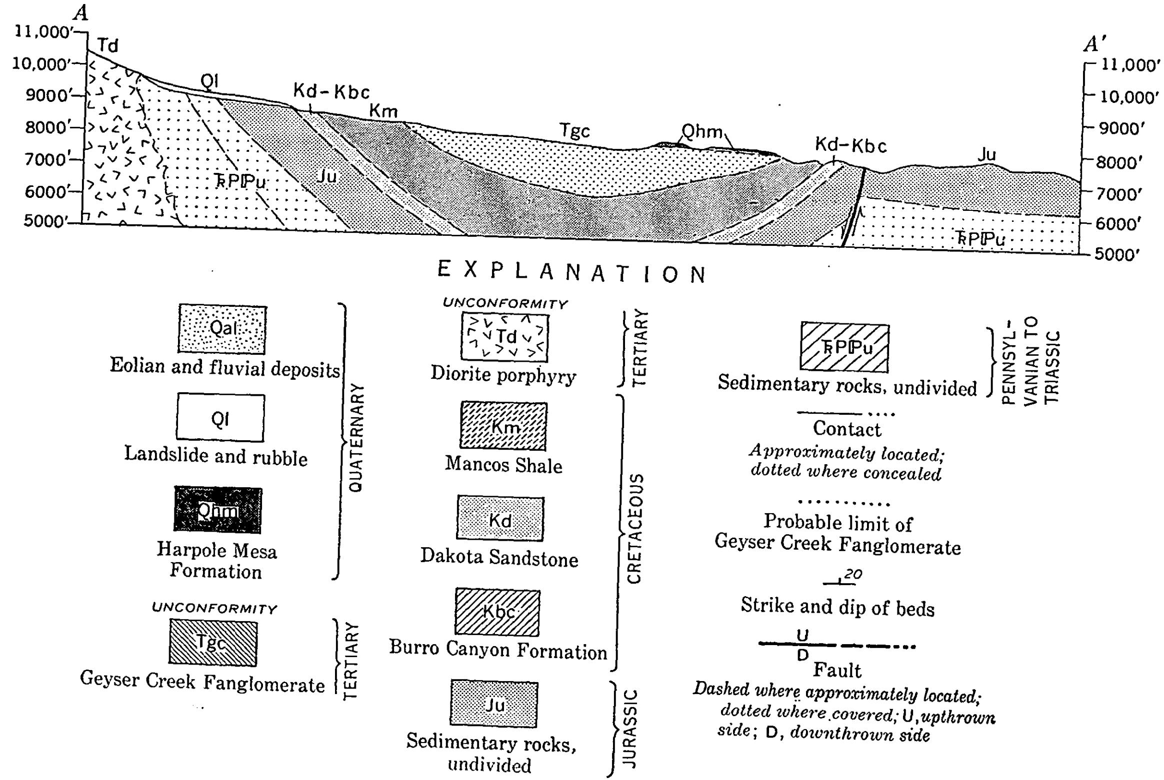


FIGURE 2.—Geologic map of the Pine Flats area, Utah, showing distribution and type section of the Geyser Creek Fanglomerate.

| Geyser Creek Fanglomerate (dips 16°–25° W.)—Continued | *Thickness (feet)* |
|---|---|
| 5. Conglomerate, yellowish-brown, crossbedded in lower part, flat bedded at top. Matrix poorly sorted yellowish-brown (limonitic) sandstone; weathered pebbles, cobbles, and boulders—as much as 18 in. in length—primarily of sandstone and siltstone. Diorite pebbles (about 10 percent) are less weathered. Basal contact sharp and marks an old channel scour | 11.5 |
| 4. Sandstone, conglomeratic, light-green to yellowish-brown; fine- to coarse-grained sandstone containing conglomerate as thin lenses. Sparse pebbles 2 in. in diameter. Limonite abundant in lower part of unit. Flat bedded and crossbedded | 4.5 |
| 3. Conglomerate, yellowish-brown, intensely stained by limonite. Angular to subangular fragments as much as 24 in. in diameter but mostly 2 to 3 in. in diameter, coarser in top 3 ft, composed mainly of poorly cemented to well-cemented siltstone and sandstone, flat bedded and crossbedded | 6 |
| 2. Siltstone, sandy, light-yellowish-green; with fragments of fossils and aragonite from Mancos Shale. Lower 9 in. are reddish brown (limonite), very friable | 6 |
| 1. Conglomerate, yellowish-brown, with rounded pebbles, cobbles, and blocks up to 18 in. in length. Larger fragments mainly of sandstone and siltstone; sparse pebbles of diorite. Matrix sandy with scattered fragments of shell, aragonite, and calcite. Limonitic, friable sandstone at base of exposure. Basal contact with Mancos Shale covered by debris | 10 |
| Total thickness of Geyser Creek Fanglomerate | 117.5 |

Angular unconformity.
Mancos Shale (dips 45°–55° W.)

## STRATIGRAPHIC RELATIONS

Mancos Shale of Late Cretaceous age is well exposed both east and west of the known limits of the Geyser Creek Fanglomerate. On the east, Mancos Shale dips 30°–55° SW., and the overlying Geyser Creek dips 17°–22° SW. Although the contact between the Mancos Shale and overlying Geyser Creek Fanglomerate is not clearly exposed, it can be located within a few feet. The greater dip of the Mancos beds and the presence of Mancos fragments in the reworked zone at the base of the Geyser Creek indicate that the east contact is an angular unconformity.

Near the flank of North Mountain, Mancos Shale and older formations are exposed west of the Geyser Creek Fanglomerate in the headwaters of Deep Creek Canyon. The contact of the Mancos Shale with the overlying Geyser Creek is covered by soil and vegetation and was located only approximately. Scattered outcrops, however, indicate that the Geyser Creek wedges out 2,000 feet east of ridges formed by the Dakota and Burro Canyon Formations near North Mountain and probably dips gently to the northeast.

The measured section shows that the vertical distribution of rock fragments is more or less inverse to the local stratigraphy, so that progressively older sedimentary rocks of the hogbacks and finally the diorite core of North Mountain are represented in successively younger conglomerate layers. For example, in the lower units (1 and 2) the dominant rock types are shale, limestone, and fossil fragments from the Mancos which underlies and crops out along the margins of the fanglomerate. No fossil fragments of sufficient size or preservation were obtained to determine how many different horizons of the Mancos might be represented in the Geyser Creek Fanglomerate. Remnants of Mancos decrease upward in the overlying units. Poorly cemented sandstones of the Dakota and Burro Canyon Formations probably contributed most of the quartz sand and chert pebbles that compose the sandy material of the fanglomerate units. More durable rocks from older formations were the principal source of blocks, cobbles, and pebbles of the conglomerate lenses. Diorite fragments are generally absent or sparse in the lower conglomerate lenses (units 1 through 6). They show a marked increase and are most abundant (about 60 percent) in unit 7. In the upper units they generally compose about half the fragmental material. Unit 10 is the thickest (24 ft) and most complex of the sequence. Fragments of all formations exposed in the source area that contain rock types capable of surviving weathering and erosion appear to be represented. Coarse fragments in units 12 through 14 are mainly diorite and probably Wingate Sandstone. Such a vertical distribution of fragments was apparently caused by headward stream erosion in a restricted source area.

The Geyser Creek Fanglomerate is overlain by the Harpole Mesa Formation of early Quaternary age, which in this area consists of a thin mantle of poorly consolidated terrace gravels covering a slope that dips gently eastward from the mountain area. These gravel beds increase in thickness toward the mountains and cover the north and south limits of the Geyser Creek. The east contact of the two is an angular unconformity, for along its eastern exposure the Geyser Creek dips 17°–22° SW., in contrast to the gentle eastward dip of the overlying gravel beds. The upper contact of the Geyser Creek is not exposed along the west margin of the basin; probably Geyser Creek strata dip more steeply to the east than those of the overlying Harpole Mesa Formation.

The full thickness of the Geyser Creek Fanglomerate is not known, but it may range from 0 to as much as 1,000 feet thick. The deposit wedges out on the west along both Deep and Geyser Creeks. It is exposed in the side of Geyser Creek Valley (SE¼ sec. 1, T. 27 S., R.

25 E., San Juan County, Utah) near the axis of a structural trough, where it is estimated to be at least 280 feet thick. There, however, the base of the formation is not exposed, and interpretation of the covered part suggests that the Geyser Creek Fanglomerate may be 600 to 1,000 feet thick in the deepest part of the trough. On the east margin the formation is 120 feet thick at the type section.

## STRUCTURAL RELATIONS

The Geyser Creek Fanglomerate crops out within the southern part of the Taylor Creek syncline, an open northwestward-trending fold approximately 5 miles long and 2 miles wide that lies between the North Mountain anticline on the west and the Sinbad Valley collapsed anticline on the east. The Valley View fault system, which marks the northeast side of the Paradox Valley collapse zone, extends northwestward through the junction of Geyser, Deep, and Taylor Creeks with Roc Creek. This fault zone dies out to the north in a monoclinal fold on the flank of the Sinbad Valley anticline. The fault and fold mark the east limit of the Taylor Creek syncline.

The outcrop pattern of the Geyser Creek-Fanglomerate suggests that the unit underlies an area that is approximately elliptical and fills a trough which conforms to the shape of the Taylor Creek syncline. Prior to folding and erosion, however, the unit probably was a fan-shaped deposit with an apex at the southeast end of North Mountain where prominent hogback ridges, mainly of sandstone, surround a diorite core. The hogbacks are cut by a deep water gap through which Deep Creek flows to the east. The water gap and the mountainous terrain within the hogbacks are the nearest available source and also the most probable source of the fanglomerate. Faulting, folding, and subsequent erosion have modified the shape of the fanglomerate deposit by removing both its apex on the west and its east margin, where it wedged out, presumably east of the Valley View fault.

West of the fault zone the Taylor Creek syncline is marked by outcrops of strata of Cretaceous age (Burro Canyon, Dakota, and Mancos Formations) which strike northwest and dip 30°–55° SW. The overlying Geyser Creek Fanglomerate conforms to the strike of the older strata but dips about 17°–23° SW.; that is, the dips are 10°–15° gentler than those of the Mancos, and they are toward the source area rather than horizontal or dipping away from it. Angular unconformity between the Geyser Creek Fanglomerate and Mancos Shale therefore indicates that Geyser Creek deposition probably began after the Taylor Creek syncline had been partly developed. Mancos Shale and older Cretaceous strata probably dipped 20°–35° SW. along the northeast margin of the syncline before the fanglomerate was deposited. Subsequently, increased folding of the syncline tilted both Cretaceous and Tertiary strata to their present attitudes. Folding probably was caused by solution and lateral migration of salt into the adjacent Sinbad and Paradox Valley anticlines.

## AGE

The Geyser Creek Fanglomerate probably formed sometime between late Miocene and early Pleistocene time and is tentatively assigned to the Pliocene Epoch. It clearly is younger than Late Cretaceous, for the lowermost part of the fanglomerate contains shale and fossil fragments derived from the underlying Mancos Shale. No other fossils have been found. The presence of diorite fragments in the fanglomerate shows that the deposit is also younger than the La Sal Mountains intrusion to which Hunt (1956, p. 83) assigned a middle Miocene age. The Geyser Creek Fanglomerate is older than the Harpole Mesa Formation of early Quaternary age (Richmond, 1962), by which it is overlain.

The Geyser Creek Fanglomerate correlates with the conglomerate in Castle Valley of Pliocene(?) age (Hunt, 1958). Although the two formations differ in lithology and in stratigraphic relation to underlying rocks, they are similar in that both are folded and are unconformably overlain by the Harpole Mesa Formation of early Quaternary age. Their differences are considered minor and dependent on local conditions in source areas and the basins in which they were deposited.

## REFERENCES

Baker, A. A., 1933, Geology and oil possibilities of the Moab district, Grand and San Juan Counties, Utah: U.S. Geol. Survey Bull. 841, 95 p.

Hunt, C. B., 1956, Cenozoic geology of the Colorado Plateau: U.S. Geol. Survey Prof. Paper 279, 99 p.

——— 1958, Structural and igneous geology of the La Sal Mountains, Utah: U.S. Geol. Survey Prof. Paper 294–I, p. 305–364.

Richmond, G. M., 1962, Quaternary stratigraphy of the La Sal Mountains, Utah: U.S. Geol. Survey Prof. Paper 324, 135 p.