GEOLOGIC MAP OF THE JOHNSON PASS QUADRANGLE, TOOELE COUNTY, UTAH

By Mack G. Croft

ABSTRACT

The Johnson Pass quadrangle is in northwestern Utah, within the Basin and Range Province, about 50 miles south west of Salt Lake City, Utah. The quadrangle includes parts of the Stansbury and Onaqui Ranges, which are north-south trending block faulted mountains, typical of the eastern Basin Range Province. Normal faults bound the tilted ranges and the deep intervening sedimentary basins. Formations within the quadrangle range from Cambrian to Quaternary in age.

Cambrian rocks consist of the Opex Formation, the Dunderberg Shale and the Ajax Limestone. Ordovician rocks within the quadrangle include the Garden City Formation, the Kanosh Shale and the Fish Haven Dolomite. The Garden City consists of gray, cherty, argillaceous limestone and dolomite, and the Kanosh consists of dark colored shale and quartzite interbedded with thin bedded limestone and dolomite. The Fish Haven is nearly black, fine crystalline, thick bedded dolomite. The Laketown Dolomite, the only Silurian rocks present, consists of alternating light and dark gray, thin to thick bedded, cherty dolomite.

The Devonian System is undifferentiated, and the rocks consist of brown sandstone, quartzite, and silty, thin to medium bedded limestone and dolomite. North of the quadrangle in the Stansbury Range, Mississippian rocks rest on Cambrian rocks, due to uplift during Devonian time. Devonian rocks flanking the uplift, consist of conglomerate and sandstone and were named the Stansbury Conglomerate by Arnold (1956), and described by Rigby (1958). Carbonate rock formations present in adjoining ranges appear to interfinger with the Stansbury Conglomerate in the Johnson Pass area.

Mississippian rocks are represented by 4 formations and the Manning Canyon Shale which spans the Mississippian and Pennsylvanian boundary. The Gardison is the oldest formation and it consists largely of gray dolomite in the lower part and of gray, cherty, fossiliferous limestone in the upper part. The Deseret Limestone overlies the Gardison and consists mainly of gray cherty limestone. The Humbug Formation is a series of alternating sandy limestone, encrinal limestone, and calcareous sandstone and quartzite. The Great Blue Limestone forms the high crest line of the Stansbury and Onaqui Ranges. The beds are mainly thin to massive bedded, blue gray, clastic limestone. The highly erodeable Manning Canyon Shale consists of 3 units, a lower black shale, a medial limestone and an upper shale and quartzite.

The Pennsylvanian System consists of the upper part of the Manning Canyon Shale and the Oquirrh Group. The Oquirrh is now divided into several formations. Three of the lower most formations are present in the quadrangle and they rest unconformably on the Manning Canyon. The West Canyon is present only on the east side of the Onaqui Range and consists of 85 to 150 feet of dark gray limestone. The Butterfield Peaks Formation is divided into 2 units. The lower unit consists of gray clastic limestone, siltstone, and reddish-brown sandstone. The upper unit consists of gray siliceous limestone, reddish- brown sandstone and quartzite. The basal beds of the Bingham Mine Formation consist of arenaceous, cherty limestone. Above the base, the beds are largely reddish-brown calcareous sandstone and quartzite.

Unconsolidated to partly consolidated deposits of sand and gravel flank both sides of the ranges. A fanglomerate deposit presumably of Tertiary age lies on a ridge crest on the west flank of the Stansbury Range. The debris consists of cobbles, gravel and sand derived from the Humbug Formation. An alluvial fan system believed to range from Tertiary to Quaternary in age was probably deposited in 2 cycles. On both flanks of the Onaqui Range the oldest debris overlies a pediment surface, and is darker in color than the younger rocks due to moderately developed soil profiles. The younger alluvial deposits are light colored and have little or no soil devel;opment. Quaternary units consist of Bonneville Lake beds, eolian sand, and young Holocene alluvial-fan deposits.

The core of the ranges is a large north-south trending fold of Paleozoic rocks ruptured into blocks that are tilted and rotated to both the east and west by normal and branching north-south en echelon faults. The ranges are uplifted several thousand feet. An easterly dipping anticlinal limb from the Stansbury Range extends into the northern part of the Onaqui Range south of Johnson Pass where it forms a forms a faulted, south plunging syncline. The Stansbury fault parallels both ranges on the west flanks and north of Lees Canyon tilts them to the east. The Grasshopper Ridge fault branches from the Stansbury Fault and parallels the south part of the Onaqui Range on the east flank, tilting it to the west. Major east-west transverse faults connect with the north-south normal faults, dividing the ranges into blocks. Uplift of the ranges along the bounding normal faults occurred intermittently block by block and in some areas is continuing to the present.

Water resources are the most valuable economical commodity of the quadrangle. Many prospect pits and a drift have been dug in the Devils Gate area, but records indicate no ore has been shipped from the area.

INTRODUCTION

The Johnson Pass Quadrangle is in northwestern Utah, with in the Basin and Range Province, about 50 miles south west of Salt Lake City (fig.1). Johnson Pass, the gateway to the Dugway proving ground which is about 15 miles further to the west, separates the Stansbury and Onaqui Ranges. Terra, a small village is about 2 miles south west of Johnson Pass. The highest Peak in the quadrangle is in the Stansburys and is about 9000 feet. Northward other peaks rise over 10,000 feet elevation. The highest peak in the Onaqui Range is about 8800 feet elevation, about 5 miles south of the pass.

The Stansbury and Onaqui Mountains are north-south trending block- faulted ranges typical of the eastern Basin and Range province. Erosion in these ranges expose great thicknesses of carbonate and clastic miogeosynclinal sedimentary rocks that accumulated during late Proterozoic and Paleozoic time. The sediments were eroded from nearby continental margins. Later during the Cretaceous, the rocks were folded and thrust faulted eastward. During the latter part of the Cenozoic, probably beginning during late Oligocene or early Miocene time, the region was tectonically extended. High and low angle normal faults formed, bounding the present tilted ranges and intervening deep sedimentary basins. Rupturing along many fault zones continues to the present time. Former surfaces that were nearly flat or rolling prior to the faulting, are now eroded uplands on the tilted blocks. Bajadas and Pediment surfaces flank the ranges.

Several reconnaissance geologic studies have been made in the Stansbury and Onaqui ranges. Rigby (1958) mapped the Stansbury Range and outlined major elements of the stratigraphy. Teichert (1959) and Sorensen (1982) produced maps of the southern part of the Stansburys. Moore and others (1978) produced a reconnaissance map of the Onaqui Mountains South Quadrangle. The author (Croft,1956) mapped the Northen Onaqui Mountains for an M.S. thesis. Aerial photography now available is of much higher quality than when the earlier studies were made. This map of the quadrangle was made to update the stratigraphic terminology and to reinterpret structural relations not apparent in the previous studies.

Veteran geologist Lehi Hintze provided advice and other assistance, and Ether Pratt alleviated some transportation problems.

STRATIGRAPHY

Rock formations within the quadrangle range from Cambrian to Quaternary in age. The lithology, age, and interrelationship are included in this section. Stratigraphic names and definitions of the Paleozoic sections, for the most part, were extended to the Johnson Pass area from studies made by Morris and Lovering (1969 and 1979) in the Tintic Mountains, by Gilluly (1932), Tooker and Roberts (1970) in the Oquirrh Range, and Rigby (1958) in the Stansbury Range. A summary of the rock stratigraphic units is in the stratigraphic column.

Cambrian System

Cambrian rocks are exposed in a small area in the north west corner of the quadrangle on the north wall of Barlow Hollow.

Opex Formation and Dunderberg Shale undifferentiated

The Opex Formation includes carbonate and clastic rocks that are well exposed at the mouth of Barlow Hollow on the north wall. They are the oldest rocks in the quadrangle. Rigby (1958, p.23) mapped 2 units as Opex, but probably only the upper unit occurs within the map boundary. The Dunderberg Shale according to Rigby consists of about 15 feet of green shale in Deadman Canyon a few miles to the north, but if present in Barlow Hollow, the Dunderberg is covered with slope wash.

The upper unit of the Opex in Barlow Hollow is largely alternating, thin to medium bedded limestone, grey dolomite, silty and sandy buff grey dolomite, and sandy, silty shale. Some sand stone beds weather tan or reddish brown. Rigby states the Opex is about 450 feet thick in Dry Canyon, to the north.

Ajax Limestone

The Ajax Limestone consists of light to dark grey, thick to massive bedded ledge forming dolomite, on the north wall of Barlow Hollow. Grey to black nodules and stringers of chert are common. Algae heads may be present. According to Rigby (1958) about 750 feet of Ajax occurs at the south end of the Stansbury Range, but only 100 to 200 feet are exposed in Barlow Hollow that are within the quadrangle.

Ordovician System

Garden City Formation

Rocks of the Garden City occur north west of Johnson pass and near Barlow Hollow. Only partial sections are exposed as they are generally highly weathered and partly covered with eolian sand. Rigby (1958) divided the formation into 4 distinct stratigraphic units, but poor exposures did not allow subdivision in the Johnson Pass quadrangle. The rocks consist of dark, cherty , sandy, silty, and argillaceous gray limestone, and dolomite. There are a few inter beds of siltstone. On weathering the siltstone forms a wavy pattern and is commonly yellow, pinkish or gray brown. The chert occurs as rusty brown stringers. According to Rigby (1958, p.28) the formation is 1100 to 1300 feet thick, but only several hundred feet of the upper part of the unit is exposed.

Kanosh Shale

The Kanosh Shale is the lower unit of the Swan Peak quartzite of north east Utah. Only the shale extends into the Stansbury Range. The name was proposed by Cohenour (1957) and Rigby (1958) for the lower shale. The formation , 250 to 270 feet thick, is partially buried by talus and aeolian sand along the outcrop from Johnson Pass to Barlow Hollow. Exposures consist of dark green and black shale inter bedded with gray limestone and dolomite. A few thin beds of reddish brown quartzite may be present. The shale weathers dark brown or gray and forms a platy rubble. Fossils identified by Croft (1956) from the unit include the graptolites

Didymograptus patulus
Didymograptus nitidus
Didymograptus murchisoni

Fish Haven Dolomite

The Fish Haven dolomite crops out in the western foothills of the Stansbury Range from Johnson Pass northward to Barlow Hollow. The beds unconfomably overlie the Kanosh Shale according to Rigby (1958, p.32) and the beds consist of medium to dark gray to nearly black, fine crystalline, thick bedded dolomite. Beds in the upper part of the unit that contain cystoid stems and several genera of corals, weather to cliffs and massive ledges. Thickness is about 290 feet. The corrals (Croft, 1956) include

Favistella aveolata
Halysites gracilis
Streptolasma sp.

Silurian System

Laketown Dolomite

The Laketown Dolomite is exposed from Blue Canyon at Johnson Pass northward to Barlow Hollow on the west flank of the Stansbury Range. The beds of the underlying dark gray Fish Haven grade upward into the lighter colored Laketown, making the contact between the two formations somewhat arbitrary. The Laketown consists of light to dark gray, thin to thick bedded, fine to coarse grained, cherty dolomite. The beds in the lower part of the unit have a banded appearance. Thin stringers and nodules of white chert and fragments of pentamerid brachiopods and favositid corals are commonly distributed through out the rocks. For about a mile north of Blue Canyon the upper part of the unit is displaced by faulting, but in the Rock Springs area the unit is 600 to 660 feet thick, according to Rigby (1958).

Devonian System undifferentiated

Rocks of Devonian age extend from Blue Canyon at Johnson Pass northward on the west flank of the Stansbury Range to the Rock Springs area. They consist of brown sandstone and quartzite, sandy and silty, thin to medium bedded , gray limestone and dolomite. Thickness is about 1100 feet. North of Blue Canyon for about a mile the lower part of the unit is displaced by faulting with the underlying Laketown.

A thick section of Paleozoic rocks in the Stansbury Range, several miles north of the quadrangle were removed during a Devonian uplift, according to Arnold (1956) and Rigby (1958). Mississippian rocks rest upon Cambrian rocks in the central part of the range. In the southern and northern part of the range, about 1700 feet of sandstone and conglomerate that flank the uplift was named by Arnold (1956) the Stansbury Formation. In adjoining ranges Devonian rocks consist of the Sevy, Simonson, and Pinyon Peak formations. These formations and the Stansbury Formation appear to inter finger north of Johnson Pass. Because access is difficult and exposures are poor no attempt was made to subdivide the Devonian rocks further.

Mississippian System

Gardison Limestone

Rocks mapped as Gardison are largely correlative to units that have been mapped in other ranges as the Gardner, Madison and Jefferson Formations. The latter terms have been largely abandoned in the region. The Gardison Formation is exposed on the west face of the Stansbury range and in the south east part of the quadrangle on the east face of the Onaqui Range south of Lee Canyon. The lower part of the formation consists largely of dark gray, thick bedded, cherty dolomite with a few beds of buff colored limestone. These beds commonly weather to low cliffs and ledges. Thin to thick bedded fossiliferous light gray, cherty limestone form most of the upper unit. These upper beds are fine- to medium grained and are mainly fossil hash. Many corals are silicified and stand in relief above the rock surface. The formation is about 1700 feet thick north of Johnson Pass. The following fossil forms were identified by Croft (1956).

Syringopora sp.
Lithostrotionella sp.
Multithecopora sp.
Caninia sp.
Euomphalus sp.

Deseret Limestone

The Deseret Limestone was originally named by Gilluly (1932, p.25) for rocks in the Oquirrh Range. The formation is exposed on the west face of the Stansbury Range and on the east face of the Onaqui Range south of Lee Canyon. The name is adopted for this report for the nearly equivalent Pine Canyon Limestone that has been used in the Stansbury, and Onaqui Ranges and in other areas by previous authors. Morris and Lovering (1961, p.43) dropped the use of Pine Canyon and updated the definition of the Deseret in the east Tintic Mountains. With some reservation the mapped unit which consists mainly of cherty gray limestone appears to best fit the term Deseret. Rigby (1958, p.43) described the Pine Canyon as being 950 feet thick at the north end of the Stansburys and 170 feet thick at the south end. However the stratigraphic marker beds described by Morris and Lovering (1961) and Rigby (1958) to define the top and bottom of the formation were not identified. The lower boundary of the Deseret is gradational and some what arbitrary with the underlying Gardison. Above this boundary is about 150 to 400 feet of cherty gray limestone. The upper boundary was mapped at the first prominent sandstone at the base of the overlying Humbug Formation, a method which is a common field practice.

Humbug Formation

The Humbug Formation forms part of the west face of the Stansbury Range north of Johnson Pass , and part of the east face of the Onaqui Range south of Lee Canyon. The formation conformably overlies and consists of alternating and inter bedded sandy light to dark grey limestone, nearly pure encrinal limestone, calcareous sandstone, and quartzite. The sandstone beds are lenticular, cross bedded and range from a few inches to several feet in thickness. The sandstone and quartzite commonly weather to a rusty red to light brown rubble or talus slope. From a distance the formation appears as a grassy slope on elevated mountain sides with few junipers or other trees present. The formation is about 900 feet thick. The following corals are abundant in some limestone beds (Croft, 1956).

Ekvasophyllum sp.
Lithostrotion whitneyi
Diphyphyllum sp.

Great Blue Limestone

The Great Blue Limestone conformably overlies the Humbug Formation and grades upward into the overlying Manning Canyon Shale. The beds form the high crest line of the Onaqui and Stansbury Ranges. Gilluly (1932, p.291) divided the formation into 3 members, the middle member which occurred in the lower part of the Formation, he named the Long Trail Shale. In the quadrangle a shale unit occurs in the formation in the upper part, but few good exposures were found, and the shale unit was traced laterally only with difficulty. The approximate out crop pattern is shown for some areas on the map with a dashed line. The long Trail where exposed consists of about 50 feet of black, carbonaceous shale, interbedded with sandstone and quartzite.

The upper and lower units of the formation are composed of cliff forming, thin to massive bedded, nearly homogenous blue gray limestone devoid of any distinctive beds. The limestone is typically clastic, slightly argillaceous, and fine to medium grained. Bryozoans and nodules of black chert are common throughout. Upon weathering thin argillaceous beds may develop a reddish or pinkish cast. Thickness is about 1300 feet. Corals which are abundant in some sections are often distorted and the following species were identified by Croft (1956).

Caninia sp.
Ekvasophyllum inclinatum
Ekvasophyllum turbineum
Lithostrotion whitneyi

Mississippian and Pennsylvanian Systems

Manning Canyon Shale

A thick sequence of the Manning Canyon Shale is exposed southward from Vickery Ridge forming a wide valley on the east flanks of the Stansbury and Onaqui Ranges, southward to Lee Canyon. Manning Canyon Shale is also exposed near the Dell in the foothills west of the Onaqui Range in the south west part of the quadrangle. The formation is rapidly reduced by weathering and erosion, forming a valley topography, and good exposures are not readily found in most areas. The outcrop pattern suggests a thickness of 1000 feet or more.

The formation consists of 3 units. The lower beds consist of black shale and the medial member consists of thin to thick bedded, gray limestone. The limestone may contain thin black chert nodules. The upper unit consists of black shale and quartzite. The quartzite commonly develops a scintillating appearance on weathering.

Pennsylvanian System

Gilluly (1932, p.34) named rocks of Pennsylvanian and Permian age in the Oquirrh Range the Oquirrh Formation. They are a thick sequence of alternating limestone, siltstone, and sandstone beds more than 15,000 feet in thickness. The Oquirrh formation has since been raised to a group level and subdivided into several formations that are described by Tooker and Roberts (1970). Three of the lower formations are present in the quadrangle. The Oquirrh formation rests unconformably on the Manning Canyon. Exposures in the quadrangle suggest the unconformable relation increases westward from the east side of the ranges to the west side of the ranges, and according to Rigby (1958, p.88), the unconformable relation increases northward from the Johnson Pass area.

West Canyon Limestone

The West Canyon Limestone is exposed as a thin band about 85 to 150 feet thick extending roughly south from Clover Creek to Lee Canyon on the east flank of the Onaqui Range. The limestone is generally dense, dark- gray to black, and finely crystalline. Black chert and thin laminar stringers of fine sand occur in some beds. Few fossils are present, but an algal biostrome was found near the upper most beds in some areas. In the Oquirrh Range about 15 miles to the east the formation is 1060 to 1436 feet thick, according to Tooker and Roberts (1970, pA24). North of Clover Creek on the east side of Big Hollow the formation was not found. On the west side of the Onaqui Range, the formation is not present and the overlying Butterfield Peaks appears to lie directly on the Manning Canyon.

Butterfield Peaks Formation

On the east flank of the Onaqui Range the Butterfield Peaks Formation conformably overlies the West Canyon Limestone, but east of Big Hollow and at the Dell the formation appears to unconformably overlie the Manning Canyon. On the east side of the Onaqui and Stansbury Ranges the formation was divided into 2 units. On the west side of the Onaqui Range the upper unit has been removed by erosion. The lower unit consists of thin to thick bedded gray clastic limestone, siltstone, and reddish brown sandstone. There commonly are only a few thin beds of quartzite. The limestone commonly consists of fossil hash, and algal bodies, that are interbedded with a few nodules of black chert. The limestone and sandstone form a ledge and slope topography. The lower unit ranges from 1700 to 3000 feet in thickness. The following fossils were identified by Croft (1956)..

Tabulipora sp.
Lithoproductus sp.
Rhombopora sp.
Spirifora sp.
Fenestrellina sp.

The upper unit of the Butterfield Peaks Formation is composed of gray siliceous limestone and light reddish brown sandstone and orthoquartzite. Much of the limestone contains numerous chert nodules and has a conglomeritic texture. The quartzites are generally thick to massive bedded and are the basis for subdivision of the unit. The base of the upper unit was drawn at the base of the lower most, thick quartzite. The sandstone and quartzite beds are resistant to weathering and form a ledge and slope topography. The upper unit east of Big Hollow is about 1800 feet thick.

Bingham Mine Formation

Rocks of the Bingham Mine Formation are exposed east of Big Hollow where they conformably overlie the Butterfield Peaks Formation. The basal beds are an arenaceous cherty limestone, possibly equivalent to the Jordan or Commercial limestone marker beds of others. Above the base the unit consists largely of medium to thick and massive bedded, yellow to reddish- brown calcareous sandstone and orthoquartzite. Inter bedded with the quartzite are a few thin beds of gray limestone. The beds are highly resistant to weathering and form a ledge and slope topography. Corals and brachiopods are abundant in some of the limestone beds. About 4000 feet of the lower part of the formation is present.

Tertiary System

Oldest Fanglomerate

An old alluvial deposit, presumably of Tertiary age, lies on a westward sloping ridge crest about 1 mile north of Johnson Pass, on the west flank of the Stansbury Range. It is about 1000 feet above the valley floor, and the slope of the surface would indicate the fan is older than the thick alluvial deposits bordering the range on the west, because of its higher elevation. The surface of the fans and the deposit do not align. The debris consists of cobbles, gravel, sand and silt, eroded mainly from the Humbug Formation that is exposed higher up the slope.

Tertiary and Quaternary Systems

Oldest Alluvial Deposits

Unconsolidated to partly consolidated coarse sand and gravel deposits designated Qtaf, flank both the east and west sides of the Stansbury and Onaqui Ranges. The rock debris forming the bajadas and fans indicates the alluvial material was derived from the adjacent ranges in their present physiographic location. They are obviously older than the Bonneville beds, as Bonneville beach and strand lines considered to be about 30,000 to 10,000 years in age, are carved into them. This alluvial unit probably includes 2 alluvial depositional cycles, mapped by others as QTaf3 and Qaf2. The unit is shown as QTaf in this report because the separation of 2 alluvial formations on the map was not possible nor practical, though it was obvious in some areas at least 2 different fans are present. Partial erosion of the older fans , with deposition of younger alluvial fan material on top of the older fans, would have made the mapping of 2 units very inprecise. They are discussed below as old and young alluvial deposits, and descriptions at several locations provided where recognition is possible.

The old alluvial deposits in some areas overlie a pediment surface and are the alluvial fans formed prior to during the early stages of block faulting. The surface of these deposits may be channeled by streams and they may overlie and conceal some of the older faults that border the uplifted ranges. The deposits may be partly consolidated, are generally light reddish brown and have moderately developed soil profiles. The beds consist mainly of fine gravel, sand, silt, and clay. Large boulders are not common. North west of the Dell nearly to Terra these beds are thin, probably not more than 10 or 20 feet thick, where they overlie a pediment surface that is partially exposed along a ½ mile wide strip east of the Bonneville shoreline. Manning Canyon in this area is the underling bedrock. Some of the gravel on the pediment surface may be as old as Miocene, or at least older than shown in the stratigraphic column. Pack and Park springs occur where westward flowing ground water, collected in gravel at the mountain front, comes to the surface in the thin alluvial deposits above the impermeable rocks of the Manning Canyon. North of Terra to Barlow Hollow, the Oldest Alluvium is probably several hundred feet thick and is incised by steams coming off the Stansbury Range. The surface of the fans slope upward to the east, and align with some of the lower ridge tops. The beds overlap and conceal the Stansbury fault. A few exposures are visible along the highway west of Johnson Pass. Thin old alluvial deposits are exposed about 3/4 mile east of the Grasshopper Ridge fault below Lee and Cove Canyons and appear to overlie a pediment surface. The beds are reddish brown and have moderately developed soils. Adjacent the fault the older alluvium is buried by younger, light colored gravel beds considered to be young alluvial deposits. South of Cove Canyon the older alluvium thickens, and is channeled by intermittent streams flowing eastward from the Onaqui Range.

The young alluvial deposits consist of poorly sorted and unconsolidated boulders, gravel, sand, silt, and clay, generally forming thick gravelly fans below youthful fault scarps. On the back side of the tilted Stansbury and Onaqui fault blocks they blanket the older alluvial material. They underlie most of Big Hollow and extend southward to Lee Canyon. They are generally light colored, and display little soil development. They are exposed around the Dell, and extend northward between Park and Pack springs and the Stansbury fault, to the vicinity of Terra. Below the Grasshopper Ridge fault, aerial photography shows they lie on the older, dark colored alluvial fanglomerate in a 3/4 mile wide strip east of the fault.

Quaternary System

Bonneville Lake Beds

At altitudes below the Bonneville shore line (-B-) inter layered unconsolidated deposits of lacustrine and alluvial origin are mapped as Qla. This unit consists of thin, wave worked, older alluvial deposits consisting of gravel, sand, silt, and clay, and sediments deposited in the lake. The topography below the shoreline has been beveled smooth by lake action. The highest level of the Bonneville shore line is an elevation of about 5220 feet on the topographic base map. The lake dried up about 10,000 years ago. Thickness is 0 at the shore line to about 50 feet at the map margin.

Young alluvial- Fan Deposits

Young alluvial- fan deposits of Holocene age are mapped as Qaf1. They consist of poorly sorted, unconsolidated, sand, silt, and clay and post date the Bonneville and younger shore lines. The beds are currently forming and have little weak soil profiles. The deposits form steep fans below the mouths of streams descending youthful faulted escarpments and they form ribbon-like features in stream channels that are cut into older fanglomerates. They also overlie Bonneville lake beds where they occur as nearly featureless flood plains. The beds are probably not more than 10 to 20 feet thick.

Eolian Sand

Thin sheets and dunes of light brown sand and silt of Holocene age form discontinous deposits on the west flank of the Stansbury and Onaqui Ranges. The sand blankets the older alluvial deposits and the Bonneville lake beds from Terra northward to Barlow Hollow. The sand and silt was probably derived from alluvial and playa beds north west of the area during high wind storms. The sand appears to be fine to medium grained and mainly quartz. Most dunes are about 10 feet thick.

STRUCTURE

Rocks of the Stansbury and Onaqui Ranges were intensely compressed and folded in the Sevier and Laramide orogenys during the Cretaceous and Paleocene periods. Sever erosion followed the folding and beveled the uplifted rocks in early Tertiary time. Rocks in the ranges were then subjected to uplift and normal faulting during the Basin and Range disturbance, which is dated as following the eruption of volcanic rocks now exposed on both flanks of the Stansbury Range further to the north (Rigby, 1958). According to Rigby (1958, p.77) rupturing along the Stansbury boundary fault is believed to be post volcanic, as the volcanics that are on both sides of the range were probably one extrusion, and thus connected. The volcanics probably are about 40 Ma as suggested by a chart published by Best and others (1989,fig.3), and thus are late Eocene in age. An angular discordance separates the volcanics and the immediately overlying deposits.

The topography and the geomorphology suggests that the rupturing along the west side of the Stansbury and Onaqui Ranges is younger south of Johnson Pass, than to the north. The ridge crest along the western face of the Onaqui Range, is much lower in elevation and the fault escarpment is considerably less eroded, and much more youthful in appearance. Other reasons for this belief will be given later.

Major Folds

The core of the Stansbury and Onaqui ranges is a large north- south trending fold of Paleozoic rocks, brocken into blocks that are tilted and rotated to both the east and west by normal faults. The major fold structure in the southern Stansbury Range forms the east limb of an anticline that extends southward into the quadrangle. This fold has been referred to as the Deseret Anticline, by some previous authors. The easterly dipping limb of this structure extends into the northern part of the Onaqui Range southward to Lee Canyon. South of Johnson Pass the structure becomes the west limb of a syncline.

The synclinal structure formed of Paleozoic rocks have a southward plunge. The west limb has dips that range from 8 to 80 degrees to the east. East of Big Hollow and north of Johnson Pass the Paleozoic rocks appear to be complexly faulted and fractured, and separated from the eastward dipping limb of the Deseret anticline by a reverse fault, repeating the Great Blue Limestone. The Great Blue which undelies Vickery Ridge and the rocks of the Oquirrh Group north east of Big Hollow have a general easterly dip of as much as 78 degrees. Therefor it appears that the rocks of Vickery Ridge and the Oquirrh rocks east of Big Hollow are a hanging block, separated from the Deseret Anticline and the syncline to the south by the east-west faulting through Johnson Pass and by poorly understood buried reverse faulting that extends southward from Vickery Ridge, beneath Big Hollow.

South of Lees Canyon the synclinal structure is interrupted by a transverse, or cross fault. The Paleozoic section forming the backbone of the Onaqui Range south of Lee Canyon is tilted to the west by the Grasshopper Ridge fault, with bedding dips that range from 12 to 30 degrees, opposite the dip of the rocks to the north. Grasshopper Ridge is the name of the high ridge south of Lee Canyon on early BLM maps.

Normal Faults

The Stansbury and Onaqui Ranges are uplifted several thousand feet along a series of branching and en echelon north- south trending, normal faults. The Stansbury fault parallels both ranges on the west flank and tilts the ranges north of Lees Canyon to the east. The Stansbury fault branches to the Grasshopper Ridge fault in the southern part of the Onaqui Range; becoming en echelon. The Grasshopper Ridge fault parallels part of the Onaqui Range on the east flank and tilts the range south of Lees Canyon to the west. Movement along these faults has been intermittent, and is continuing in some areas to the present time. Four major east-west transverse faults connect with the north- south boundary ruptures and subdivide the ranges into 5 blocks. Uplift of the ranges appears to be have occurred intermittently, block by block. Displacement along the transverse faults more than likely first occurred during earlier folding, and was reinitiated during later block uplift. This is suggested because the transverse faults connect with the normal block faults, but the rock out crop pattern can not be fully explained with simple uplift or block rotation.

The most northern block is north of Barlow Hollow , but it was not examined in much detail because only a very small part is present in the quadrangle. A scarp that begins north of Barlow Hollow, and immediately east of the Stansbury fault is considerably eroded but faulting activity may have occurred recently along the scarp as aerial photos show a linear fracture for about a quarter mile in the alluvium south of Barlow Hollow .

A major transverse fault parallels the highway through Johnson Pass and extends into Big Hollow, where it probably connects with north-south reverse faults in Big Hollow that are not expressed at the surface. It connects with the Stansbury Fault and near the top of Johnson Pass it connects with several branching faults that extend to the north and south. Faulting of the block north of the Pass probably began much earlier than on the block to the south, as erosion has removed most of fault scarp. Alluvial fans slope upward to the east and align with several of the lower ridges that are remnants of the eroded range front. Canyons now extend about 2 miles east of the fault zone. One of the ridges is capped with alluvial debris. Older alluvial (Qtaf) deposits overlaps the Stansbury fault along this segment, and in some stream channels the alluvium extends about a 1/4 mile east of the fault zone. Bedrock adjacent the old fault scarp is highly weathered. Recently made aerial photos suggest fault activity along this section has been dormant since deposition of the alluvial, except for a very short section south of Barlow Hollow, where a lineal marking on the photo appears. This faulting activity is probably related to movement of the block north of Barlow Hollow.

Faulting activity of the block south of Johnson Pass probably began much later than on the block to the north. The block extends about 1 ½ miles south of the pass, and the well defined youthful scarp that parallels the front has eroded the ridge crest about 1 mile east of the fault zone. The Onaqui ridge crest is lower in elevation than the Stansbury ridge crest to the north. Stream channels coming off the escarpment have a high pitch and dumped young alluvial (QTaf)deposits near the frontal escarpment, concealing the fault zone. Aerial photos show no lineal north- south fractures in the alluvium along this section of the Stansbury fault zone. The south end of the block is at the junction with the Grasshopper Ridge fault.

The Fourth block to the south is bounded by the Stansbury fault on the west and the Grasshopper Ridge fault on the east. The block is about 2 ½ miles long, and extends to the transverse fault near Lee Canyon. At the southern end of the block, the Stansbury fault branches into a disconnected en echelon pattern. The ridge crestt is eroded about ½ mile eastward from the Stansbury fault zone. Streams coming off the escarpment dump their load overlapping the fault zone, but north-south lineal fractures are present on recently made aerial photos indicating the fault position in the Holocene and Quaternary sediments in the area east of Park Spring. North of the Dell a small graben structure formed on the hanging block. The en echelon fault on the western side of this graben, shown by the aerial photo, is a recently made north-south trench in the alluvium. An escarpment of highly erodeable up thrown Manning Canyon Shale is west of the Grasshopper Ridge fault at the head of Chokecherry Canyon. Faulting activity is apparently more recent along this block than the blocks to the north.

The lower most block is south of the transverse fault at Lee Canyon and is a west tilted horst bounded by both the Stansbury and Grasshopper Ridge faults. The throw of the main branch of the Stansbury Fault diminishes near the Dell and branches en echelon to faults west of Slater Spring. The Grasshopper Ridge fault has a prominent, easterly dipping fault plane and the trace of the fault is evident in Holocene alluvial material in Settlement and Big Canyons. The scarp is youthful and canyons have been eroded westward about 1 mile near Big Canyon.

ECONOMIC GEOLOGY

Water resources are the most valuable economic commodity available in the quadrangle. Water from springs in the ranges is piped to Terra and is used for irrigation and watering of livestock that use the land for pasture. The ranges are also a recharge area for ground water. Numerous prospect pits and the Ahlstrom drift, were dug for ore exploration, near Devils Gate. The Ahlstrom drift extends for several hundred feet in a north- northeastern direction along a brecciated zone. According to Teichert (1959) and Rigby (1958) records indicate that no metallic ore has been shipped from the area. There are no limestone quarries in the quadrangle, but the Great Blue Limestone would be a good prospect. Sand and gravel resources are abundant but there has been little development, probably because of the distance to markets and probably because most of it is of inferior quality.

Hydrology

Most streams in the quadrangle are intermittent or flow only short distances from their sources, with one exception, Clover Creek. This Creek begins at a large spring east of Johnson Pass and the flow in the creek appears to gain for several miles downstream. The flow is year round and the water is used for irrigation in Rush Valley. An analysis of the water is in table 1. Slater spring is in the southwestern corner of the quadrangle. Water from the spring flows westward for about a mile below the spring in a deep canyon before it percolates into the alluvium. Discharge in the creek appears to gain below the spring. Springs and seeps occur at the head of Chokecherry and Serviceberry Canyons. The discharge from these springs percolates into alluvium after it flows off the Manning Canyon Shale. The flow in Chokecherry and Serviceberry Canyons appears larger than when the area was visited in 1956. Heavy stands of juniper were present during the earlier mapping, but have been removed prior to this mapping. The water in Park, Pack, Slater, Willow, Clover, and Grantee Springs appears to surface where the underlying Manning Canyon Shale becomes exposed or is at a very shallow depth. The Manning Canyon Shale forms an impermeable lower barrier. Recharge for these springs is at a higher elevation where the bedrock consists of fractured carbonate rocks or permeable sand and gravel. Samples (table 1) from 3 springs have a low TDS indicating the water is generally of good chemical quality.

Table 1.-- Chemical analysis of spring flow, mg/l
Analysis by Utah Department of Health

Spring	Location	Date	Ca	Mg	Na	HCO3	CO3	SO4	Cl	TDS	Sp. Cond.	Ph
Clover Cr.	T5S./R6W. 32BB	9-23-87	47	11	6	200	0	6	6.9	220	310	
Willow	T5S./R7W. 35CB	8-15-88	53	29	21	302	0	16	26	302	553	8.2
Grantee	T5S./R6W. 20CB	8-15-88	75	7	11	270	0	13	9	250	454	7.9

BIBLIOGRAPHY

Baker, Arthur A.,1964, Geology of the Orem Quadrangle, Utah: U.S. Geol. Survey Map GQ-241

Barnhard, T.P., and Dodge, R. r.,1988, Map of fault scarps formed on unconsolidated sediments, Tooele 1 degree X 2 degree quadrangle, Northwestern Utah: U.S. Geol. Survey Map, MF-1990

Best, Myron G., Christiansen, Eric H., Deino, Alan L., Gromme, Sherman, McKee, Edwin H., and Noble, Donald C., 1989, Eocene through Miocene volcanism in the Great Basin of the Western United States: New Mexico Bureau of Mines and Mineral Resources, Memoir 47

Croft, Mack G., 1956, Geology of the Northern Onaqui Mountains, Tooele County, Utah: Brigham Young University M.S. Thesis, 44p.

Cohenour, R.E.,1957, Geology of the Sheep Rock Mountains, Tooele and Juab Counties, Utah: Unpublished Ph.d. thesis, University of Utah, 308p.

Disbrow, A.E., 1957, Preliminary Geologic Map of the Five Mile Pass Quadrangle, Tooele and Utah Counties, Utah: U.S. Geol. Survey Map MF 131

Gilluly, James, 1932, Geology and Ore Deposits of the Stockton and Fairfield Quadrangles, Utah: U.S. Geol. Survey Professional Paper 173, 171p

Hem, John D. 1970, Study and Interpretation of the Chemical Characteristics of Natural Water : U.S. Geol. Survey W.S.P. 1473, 363p

Moore, William J., Preliminary Geologic Map of the West Traverse Mountains and Northern Lake Mountains, Salt Lake and Utah Counties, Utah: U.S. Geol. Survey Map, MF- 490

Moore, William J, Sorensen, Martin L., and Armin, Richard A., 1978, Reconnaissance Geologic Map of the Onaqui Mountains South Quadrangle, Tooele County, Utah: U.S. Geol. Survey Map MF- 921

Moore, W.J., and Sorensen, M.L., 1979, Geologic Map of the Tooele 1 degree X 2 degree Quadrangle, Utah: U.S. Geol. Survey Map I, 1132

Morris, H.T., and Lovering, T.S., 1961, Stratigraphy of the East Tintic Mountains, Utah: U.S. Geol. Survey Professional Paper 361, 145p.

Morris, H.T., Douglas, R.C., and Koph, R.W., 1977, Stratigraphy and Microfaunas of the Oquirrh Group in the South East Tintic Mountains, Utah: U.S. Geol. Survey Professional Paper 1025, 22p.

Morris, H.T., and Lovering, T.S., 1979, General Geology and Mines of the East Tintic Mining District, Utah and Juab Counties, Utah: U.S. Geol. Survey Professional Paper 1024, 203p.

Rigby, J. Keith, 1958, Geology of the Stansbury Mountains, Tooele County ,Utah: Utah Geol. and Mineralogical Survey Guide Book to the Geology of Utah, No. 13, 168p.

Sack, Dorothy, 1993, Quaternary Geologic Map of Skull Valley, Tooele Valley, Utah: Utah Geol. Survey Map 150.

Sorensen, Martin L., 1982, Geologic Map of the Stansbury Roadless Areas, Tooele County, Utah: U.S. Geol. Survey Map MF 1333A

Teichert, John A., 1959, Geology of the Southern Stansbury Range, Tooele County, Utah: Utah Geological and Mineralogical Survey Bull. 65, 75p.

Tooker, E.W., and Roberts, Ralph J.,1970, Upper Paleozoic Rocks in the Oquirrh Mountains and Bingham Mining District, Utah: U.S. Geol. Survey Professional Paper 629-A, 76p.