GEOLOGIC MAP OF THE FAUST QUADRANGLE, TOOELE COUNTY, UTAH

by Stefan M. Kirby

UTAH DNR GEOLOGICAL SURVEY

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SCALE: 1:24,000

Cover photo: *View to the northwest across the southern part of the Faust quadrangle. The community of Faust is along the right edge of the picture, and the southeast flank of the Onaqui Mountains is in the distance.*

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INTRODUCTION

Location and Geographic Setting

The Faust quadrangle covers part of Rush Valley in southeastern Tooele County, Utah (plate 1). State highway 36 runs north to south across the quadrangle. The Pony Express and Overland Stage Route runs east to west across the southern part of the quadrangle. Faust Creek flows to the north-northeast across the quadrangle. The quadrangle includes the southeastern part of the Onaqui Mountains, the northernmost Vernon Hills and adjoining parts of the valley floor.

Scope of Work

The Faust quadrangle was mapped in conjunction with adjoining Saint John quadrangle to the north as part of the 2010 U.S. Geological Survey STATEMAP award number G10AC00386 made to the Utah Geological Survey (UGS). This geologic map continues geologic mapping in the adjacent Vernon NE, Lofgreen, Vernon, Saint John, and Ophir quadrangles (see Kirby, 2010a, b, c, and d; Kirby, 2012), and was completed in conjunction with a larger mapping project for the Rush Valley 30' x 60' quadrangle (Clark and others, 2012), and a hydrogeologic framework study of the Rush Valley area (Gardner and Kirby, 2011).

I mapped geologic contacts directly on available digital orthophotography and 1:24,000-scale Faust topographic base map using ArcGIS. I also examined available 1:20,000-scale black and white air photos and 5-meter digital elevation data to delineate unit contacts. I completed several weeks of mapping and field checking of units in the Faust quadrangle during the spring of 2010.

Previous Investigations and Mapping Background

Several investigators mapped the geology of the Faust quadrangle at various scales smaller (less detailed) than 1:24,000, including Heylmun (1965), Bucknam (1977), Moore and Sorensen (1979), and Everitt and Kaliser (1980). Several adjoining quadrangles have been mapped recently at 1:24,000 scale (Kirby, 2010a, b, c, and d; Kirby, 2012) and adjoining areas have been mapped recently at 1:62,500 scale (Clark and others, 2012). Perkins and others (1998) provided age control for the Salt Lake Formation using an ash correlation methodology for several sites in the study area. Adjoining mapping relevant to both bedrock and unconsolidated deposits includes Gilluly (1932), Disbrow (1957), Groff (1959), Cohenour (1959), Armin and Moore (1981), and Clark and others (2012). Work by Hood and others (1969) and Gardner and Kirby (2011) examined the hydrogeology of the Rush Valley area including the Faust quadrangle.

Geologic Summary

Sedimentary rocks exposed in the quadrangle include Pennsylvanian bedrock of the Oquirrh Group and consolidated Tertiary basin fill of the Salt Lake Formation. Pennsylvanian-age Oquirrh Group bedrock, including the Butterfield Peaks and Bingham Mine Formations, is exposed in the southeastern part of the Onaqui Mountains and the northern Vernon Hills. Oquirrh Group bedrock is structurally complicated by folds and faults. Oquirrh Group bedrock in the northern Vernon Hills generally dips to the east but is interrupted by several north- and northwest-trending folds and faults. The Oquirrh in the Onaqui Mountains is broadly folded across a south-southeast plunging anticline-syncline fold pair.

The Salt Lake Formation in the southeast part of the quadrangle is exposed in a series of railroad cuts, road cuts, and quarries, as well as numerous other outcrops where it is mantled by unconsolidated deposits. Water-well logs indicate that unconsolidated deposits directly overlie the Salt Lake Formation near and to the south of Faust (Utah Division of Water Rights, 2010). The Salt Lake Formation was deposited in a series of fault-bounded lacustrine-dominated basins formed by regional extension during the Miocene to Pliocene (Heylmun, 1965; Perkins and others, 1998). Ash correlation and interpolation ages for tephra from the Salt Lake Formation, exposed in this quadrangle and the adjacent Vernon NE quadrangle, indicate deposition between about 6.6 and 9.8 Ma (Perkins and others, 1998). Dipping Salt Lake Formation is mapped in fault contact with the Oquirrh Group bedrock in the northern Vernon Hills and rests unconformably on Oquirrh Group bedrock in the subsurface throughout the quadrangle.

Most of the Faust quadrangle is covered by unconsolidated deposits of Holocene to Pleistocene age. These deposits include various alluvial fan and channel deposits, and lacustrine units deposited during the maximum transgression of Lake Bonneville. Alluvial fan and channel deposits slope away from bedrock in the Onaqui Mountains in the northwest corner and the Vernon Hills in the southeast corner of the quadrangle, and from higher elevation parts of the valley floor in the Vernon quadrangle to the south. Several large areas of seasonal or perennial standing water, hydric soils, and shallow groundwater exist along Faust Creek in the southern part of the quadrangle. The Lake Bonneville highstand shoreline, as mapped in the northeast quarter of the quadrangle, is marked by erosional escarpments and/or depositional beach, spit, and bar deposits near the 5220-foot (1591 m) elevation (Currey, 1982) (table 1). Below this level a variety of lacustrine sediments are mapped, including gravel, sand, or marl.

Two prominent systems of fault scarps are mapped within the quadrangle. Faults of the "Onaqui East Marginal fault" (Everitt and Kaliser, 1980) cut late Pleistocene and older alluvial-fan deposits in the western part of the quadrangle. Most of these scarps face to the east, and scarp heights range between 3 and 20 feet (1–7 m). Trenching studies of the "Onaqui East Marginal fault" have not been performed, and numerical age control is lacking for surface faulting along this structure. In the southeast corner of the quadrangle, scarps of the "Vernon Hills fault zone" (U.S. Geological Survey and Utah Geological Survey, 2006) are mapped on alluvial-fan deposits. A sharp contact between Pennsylvanian-age bedrock and adjoining older fan deposits is interpreted to be the result of Quaternary-age normal faulting. Other west-facing faults of the "Vernon Hills fault zone" cut late Pleistocene-age alluvial fan deposits west of the Vernon Hills. Scarp height is 3 to 6 feet (1–2 m) and there is no evidence of faulting in Holocene-age deposits.

Rush Valley area gravity data suggest a significant thickness of basin fill overlies bedrock near the northeast corner of the quadrangle (Everitt and Kaliser, 1980; Pan-American Center for Earth and Environmental Studies, 2010). Much of this thickness is likely consolidated basin fill correlative to the Salt Lake Formation exposed near Faust and in the adjoining Vernon NE quadrangle. Basin-fill thickness decreases to the west and south away from the northeast corner of the quadrangle. The total thickness of basin fill is unconstrained by well data, but correlation of gravity anomalies in the quadrangle with those in areas of known basin depth in the adjoining Vernon NE quadrangle indicates a total thickness of up to 4000 feet (1220 m) along the north boundary of the quadrangle. Just southwest of Faust, depth to Oquirrh Group bedrock is between 400 and 700 feet (120–210 m) based on water well logs.

The early tectonic history of the quadrangle is recorded by exposed Pennsylvanian strata that were deposited within the rapidly subsiding Oquirrh basin (Geslin, 1998). These rocks were then folded and faulted by dominantly east-directed thrust faulting and compression during the Late Jurassic to Eocene Sevier orogeny (Armstrong, 1968; DeCelles and Coogan, 2006, and references therein). Exposures of folded and faulted rocks directly related to the Sevier orogenic event occur in the adjoining Vernon, Lofgreen, and Onaqui Mountains South quadrangles (Groff, 1959; Armin and Moore, 1981; Kirby, 2010b and c). During the Eocene, crustal shortening was replaced by roughly east-west extension (Sevier orogenic belt collapse) and significant regional volcanism (Constenius, 1996; Constenius and others, 2003). Overlying the Pennsylvanian-age bedrock is a thick section of basin fill deposited during Miocene to Holocene Basin-and-Range extension. Extension remains the dominant tectonic style in the area, but it has varied in magnitude, style, and extent across Eocene to Holocene time (Stewart, 1998). Major pulses of extension during the Miocene and possibly the Pliocene, correlate with deposition and deformation (faulting and folding) of the Salt Lake Formation (table 2) (Perkins and others, 1998). Subsequent extension has controlled deposition of unconsolidated sediments and surface faulting during the Quaternary (Everitt and Kaliser, 1980).

MAP UNIT DESCRIPTIONS

QUATERNARY

Human Disturbance

Qh **Fill and disturbed areas** (Historical) – Excavations and associated fill; mapped fill along the Union Pacific railroad track in the eastern part of the quadrangle and at several small earthen dams along Faust Creek; mapped at small gravel pits and at two ash quarries in the Salt Lake Formation near the Pony Express Road; material includes sand, gravel, angular cobble-size clasts, silt, and clay; variable thickness 0 to 30 feet (0–10 m).

Alluvial Deposits

Qal_1 **Level-1 stream deposits** (upper Holocene) – Moderately to well-sorted sand, gravel, silt, and minor clay in active stream channels and flood plains; mapped along the lower reaches of Faust Creek and along smaller streams draining areas of shallow ground water and marshes in the south part of the quadrangle; includes deposits on active channel and minor terraces less than 5 feet (1.5 m) above stream level and locally includes small colluvial deposits along stream embankments; deposits equivalent to the younger part of young alluvial deposits (Qaly); exposed thickness less than 5 feet (1.5 m).

Qaly **Younger alluvial deposits, undivided** (Holocene to upper Pleistocene) – Moderately to well-sorted sand, pebble and cobble gravel, silt, and minor clay; deposited along major drainages; locally includes small alluvial-fan and colluvial deposits; mapped solely along the upper reaches of East Faust Creek; includes stream deposits that cannot be differentiated because of map scale or in areas where the specific age of Holocene alluvial deposits cannot be determined; postdates regression of Lake Bonneville; includes deposits on active channel and minor terraces less than 5 feet (1.5 m) above stream level and locally includes small colluvial deposits along stream embankments; thickness variable, probably less than 15 feet (5 m).

Qaf_1 **Level-1 alluvial-fan deposits** (upper Holocene) – Poorly to moderately sorted,crudely stratified or massive, pebble to cobble gravel with boulders near bedrock exposures, sand, silt, and minor clay; clasts angular to subrounded and commonly matrix supported; deposited principally by sheet floods adjoining the active Faust Creek channel, at the mouths of small, intermittent stream channels draining bedrock, or near the mouths of other channels in older alluvial-fan and other unconsolidated deposits; locally incised in and/or overlying older alluvial-fan deposits; deposits equivalent to, and grade into the younger part of young alluvial-fan deposits (Qafy); differentiated from other alluvial-fan deposits due to a relatively smooth undissected fan surface radiating away from a defined fan apex and incision within other alluvial fan deposits; exposed thickness less than 10 feet (3 m).

Qaf_2 **Level-2 alluvial-fan deposits** (middle Holocene to lower Holocene) – Poorly to moderately sorted, crudely stratified or massive, pebble to cobble gravel with boulders near bedrock exposures, sand, silt, and minor clay; clasts angular to subrounded and commonly matrix supported; deposited principally by debris flows and sheet floods; locally incised in and/or overlying older alluvial-fan deposits; deposits equivalent to, and grade to the older part of Qafy, locally above younger Qafy deposits; fan surface is abandoned and commonly slightly dissected and irregular; deposits grade above modern stream (Qal_1) or alluvial-fan level (Qaf_1); mapped north and east of the Vernon Hills; exposed thickness less than 15 feet (5 m).

Qaf_3 **Level-3 alluvial-fan deposits, Bonneville lake cycle, undivided** (upper Pleistocene) – Poorly to moderately sorted, crudely stratified or massive, sand, pebble gravel, silt, and minor clay; clasts subangular to subrounded and commonly matrix supported; deposited principally by debris flows and sheet floods; locally incised in older alluvial fan deposits; locally above younger Qafy deposits; fan surface grades near and just below the Lake Bonneville highstand shoreline and exposures of Lake Bonneville sediments; deposition was contemporaneous with transgression, regression, and highstand of Lake Bonneville in Rush Valley and no shorelines exist on these alluvial fans; surface is incised by active drainages; three small fault scarps 3 to 5 feet (1–2 m) high are mapped on Qaf_3 deposits north of East Faust Creek in the western half of the quadrangle; exposed thickness less than 15 feet (5 m).

Qafy **Younger alluvial-fan deposits** (Holocene to upper Pleistocene) – Poorly to moderately sorted, crudely stratified or massive, pebble to cobble gravel with boulders near bedrock exposures, sand, silt, and minor clay; clasts angular to subrounded and commonly matrix supported; deposited principally by debris flows and sheet floods at the mouths of intermittent stream channels draining bedrock, near the mouths of other channels in older alluvial-fan and other unconsolidated deposits, or across large alluvial slopes where individual fan surfaces cannot be differentiated; includes level-1 and -2 alluvial-fan deposits (Qaf_1 and Qaf_2) that postdate Lake Bonneville and the youngest part of alluvial fans deposited during Lake Bonneville regression (Qaf_3); also mapped in areas where the specific age of alluvial deposits that postdate the Lake Bonneville highstand cannot be determined; thickness variable, probably less than 40 feet (12 m).

Qafo **Older alluvial-fan deposits, pre-Bonneville lake cycle** (upper to lower? Pleistocene) – Poorly sorted, sand, silt, and pebble to cobble gravel, locally bouldery, in a matrix of sand, silt, and clay; deposited principally as debris flows and sheet-floods across broad alluvial slopes; mapped in areas where pre-Bonneville lake cycle alluvial-fan deposits are undifferentiated because they are poorly exposed or lack distinct geomorphic expression; unit incises oldest alluvial fan deposits (QTaf) near the Onaqui Mountains and the Vernon Hills; unit also forms relatively smooth, rounded, and partly hummocky low-gradient surface south of Faust; unit is incised by and alternately overlain by syn- and post-Bonneville alluvial fan units (Qafy, Qaf_1, Qaf_2 , and Qaf_3) and alluvial channel units (Qaly, Qal_1); exposed thickness less than 60 feet (20 m).

Lacustrine Deposits

Qlgb **Lacustrine gravel and sand deposits, transgressive phase of the Bonneville lake cycle (upper Pleistocene)** – Moderately to well-sorted, subrounded to rounded pebble gravel, sand, and minor silt; deposited as gravel bars and sheets at and below the Lake Bonneville highstand; mapped as series of broad, flat-topped constructional bars flanking the Faust Creek drainage and as barriers, bars, and sheets elsewhere in the quadrangle; deposited during the transgressive phase of Lake Bonneville; locally contains small gastropod shells; thickness is less than 40 feet (12 m).

Qlsb **Lacustrine sand deposits, transgressive phase of the Bonneville lake cycle** (upper Pleistocene) – Moderately to well-sorted, sand, silt, and minor gravel, deposited in bars and sheets below the Lake Bonneville highstand; deposited during the transgressive phase of Lake Bonneville; mapped as fine-grained part of a major bar northwest of the Faust Creek drainage; thickness is less than 30 feet (10 m).

Qlmb **Lacustrine silt, marl, and clay deposits, transgressive phase of the Bonneville lake cycle** (upper Pleistocene) – Light-colored, well-sorted silt, marl, clay, and very fine grained sand deposited in sheets and pods below the Lake Bonneville highstand; deposited during the transgressive phase of Lake Bonneville; composition of Qlmb is similar to Qllb but differentiated by map pattern that is not restricted to locations bounded by prominent bars and barriers; mapped at two locations near the Faust Creek drainage; thickness is less than 10 feet (3 m).

Qllb **Lacustrine lagoon deposits, transgressive phase of the Bonneville lake cycle** (upper Pleistocene) – Light-colored, well-sorted silt, clay, sand, and marl deposited leeward of barrier bars and spits of Qlgb near the Lake Bonneville highstand; deposited during the highstand of Lake Bonneville; composition of Qllb is similar to Qlmb but differentiated by map pattern that is restricted to locations bounded by prominent bars and barriers near the Lake Bonneville highstand shoreline; sediment in this unit may also include alluvial material transported into areas bounded by barrier bars (Qlgb); mapped at two locations northwest of Faust Creek; thickness less than 25 feet (8 m).

Eolian Deposits

Qes **Eolian sand deposits (Holocene)** – Very well sorted, very fine and fine-grained sand and minor silt; deposited in small dunes and localized interdune sand flats below the Lake Bonneville highstand shoreline in one area along the east edge of the Faust quadrangle; overlies mixed lacustrine and alluvial deposits (Qlao); dunes are partially vegetated and may not be currently active; thickness 0 to 9 feet (0–3 m).

Spring Deposits

Qsm **Spring and marsh deposits** (Holocene) – Moderately to well-sorted silt, sand, clay, and dark organic-rich material in areas of high water tables, perennial spring flow, and seasonal standing water in the Faust quadrangle; mapped in several broad low-gradient areas and confined channels along the Faust Creek drainage with seasonal or perennial standing water and/or shallow groundwater; total thickness up to 30 feet (10 m).

Mixed-Environment Deposits

Qlay **Lacustrine deposits and younger alluvial-fan deposits, undivided** (Holocene to upper Pleistocene) – Poorly to well-sorted sand, silt, clay, and marl; deposited below the Lake Bonneville highstand as smooth sloping sheets of sediment; generally lacks well developed shorelines; includes a variety of lacustrine and alluvial facies either too complex or too poorly exposed to map; differentiated from Qlao by a lack of shoreline features and a relatively smooth and undissected surface topography similar to Qafy mapped below Bonneville highstand shoreline in the northeast quarter of the quadrangle; thickness less than 40 feet (12 m).

Qlao **Lacustrine deposits and older alluvial-fan deposits, undivided** (upper Pleistocene) – Poorly to well-sorted sand, pebble gravel, silt, clay, and marl; deposited below the Lake Bonneville highstand as sloping sheets and swales of sediment; incised by post-Bonneville alluvial channels and fans; includes a variety of lacustrine and alluvial facies either too complex or too poorly exposed to map; locally contains small gastropods several millimeters in diameter; mapped below Bonneville highstand shoreline; contact with Qaf_3 syn-Bonneville alluvial fans is approximate and shoreline features are commonly absent along this contact; elsewhere shoreline features are mapped on Qlao; thickness less than 60 feet (18 m).

Qac **Alluvial and colluvial deposits, undivided** (Holocene to upper Pleistocene) – Poorly to moderately sorted pebble or cobble gravel, sand, silt, and clay; generally locally derived and mapped in areas where alluvium and colluvium cannot be subdivided; unit deposited by alluvial, fluvial, and slope wash, and by soil creep in topographically confined parts of the Vernon Hills; total thickness 0 to 40 feet (0–13 m).

Stacked Unit Deposits

Qc/IPo **Colluvium over Pennsylvanian Oquirrh Group, undivided** (Holocene to upper Pleistocene/Pennsylvanian) – Locally derived angular cobble- to gravel-size blocks, sand, silt, and clay deposited primarily by slope-wash processes along swales, slopes, and drainages; mapped where colluvium thinly mantles and partially obscures outcrops and bedding in Oquirrh Group bedrock in the northern Vernon Hills and the southeast Onaqui Mountains; thickness 0 to 10 feet (0–3 m).

QUATERNARY-TERTIARY

QTaf **Oldest alluvial-fan deposits** (lower Pleistocene? to upper Pliocene?) – Poorly sorted boulder, cobble, and pebble gravel, sand, silt, and clay; unit composed of unconsolidated boulders, cobbles and gravels; clasts include sandstone, limestone, and quartzite likely derived from nearby Oquirrh Group bedrock; near the Onaqui Mountains, also includes various Paleozoic carbonates in addition to sandstone and limestone clasts derived from the Oquirrh Group; unit lies directly over Oquirrh Group bedrock in the northwest and southeast corners of the quadrangle; QTaf is the highest standing alluvial-fan unit and is deeply incised by all younger alluvial-fan units including Qafy and Qafo; fault scarps between 15 and 20 feet (5–7 m) high are mapped on QTaf in the northwest corner of the quadrangle; absolute age is unknown, but this unit may be much older than all other unconsolidated deposits; thickness up to 300 feet (90 m).

TERTIARY

Tsl **Salt Lake Formation** (Miocene) – Tan, light-brown to pale gray or white, interbedded tuffaceous sandstone, tephra, calcareous sandstone, gritty or pebbly sandstone, limestone, sandy mudstone, siltstone, marl, and claystone; sandstone intervals are generally fine grained except for a single coarse-grained and partially pebbly interval exposed along a hogback just east of Faust Creek; clast composition in this pebbly sandstone includes various volcanic and minor Paleozoic carbonate clasts similar to rocks exposed in the Vernon and Lofgreen quadrangles to the south; tephra and ashy sandstone and siltstone are common along the Pony Express Road in the southeastern part of the quadrangle; limestone intervals are pale gray, medium to thick bedded, sandy, crystalline and locally silicified; the base of the Salt Lake Formation is not exposed but unit likely rests in angular unconformity on underlying Paleozoic-age rocks primarily of the Oquirrh Group; commonly crops out as topographically low hills and hogbacks; the Salt Lake Formation near Oquirrh Group bedrock in Vernon Hills is fine grained and likely in fault contact with bedrock; ages in the Faust quadrangle are between 6.7 ± 0.03 and 9.3 ± 0.17 Ma (table 2), and extend to 9.8 ± 0.23 Ma for Rush Valley, based on tephra interpolations and correlations from Perkins and others (1998); these data are corroborated by a maximum depositional age based on a single grain in a detrital zircon sample of 6.49 ± 0.38 Ma (Utah Geologic Survey and Apatite to Zircon Inc., 2013) for a sandstone sample (sample #1835 on plate 2) collected upsection and to the west of the ash correlation samples of Perkins and others (1998); in the southeast part of the Faust quadrangle interbeds between 3 and 40 feet (1–13 m) thick of planar-bedded to cross-bedded, or rippled, semiconsolidated tephra has been periodically mined at several small pits and quarries for use as a cement additive; faulting and folding complicates thickness estimates but continuous exposed thickness is 4480 feet (1370 m) in the Faust quadrangle and up to 2850 feet (870 m) in the adjoining Vernon NE quadrangle (Kirby, 2010a); total thickness in the subsurface is 3600 to 4200 feet (1100-1280 m) based on several drill holes along the Pony Express road in the adjacent Vernon NE quadrangle (Kirby, 2010a).

PENNSYLVANIAN

IPobm **Bingham Mine Formation of the Oquirrh Group** (Upper Pennsylvanian [Virgilian-Missourian]) – Brown- to tan-weathering, fine- to medium-grained calcareous and quartzitic sandstone, and interbedded medium- to thick-bedded, medium-gray, fine-grained sandy and cherty limestone; calcareous and quartzitic sandstone dominate this unit, limestone is less common; sandstone is typically light brownish gray, planar bedded, and locally displaying low-angle cross-stratification and small-scale cross-bedding; both calcareous and quartzitic sandstone exist in nearly equal proportions; limestone intervals are typically medium gray and commonly sandy with very fine to fine-grained sand; fossils include rugose corals, crinoids, brachiopods, fossil hash, and fusulinids in localized beds; the Bingham Mine Formation is delineated from the underlying Butterfield Peaks Formation by a comparatively greater amount of sandstone versus limestone; crops out as float-covered highstanding hills and slopes in the northern Vernon Hills; the lower contact is not exposed in the Vernon Hills and the Bingham Mine Formation is apparently in fault contact with the underlying Butterfield Peaks Formation; Late Pennsylvanian (Missourian and Virgilian) age of unit is from fusulinid samples (table 3) (Kirby, 2010b and c); in the Vernon Hills an incomplete section of the Bingham Mine

Formation is 1860 to 3180 feet (570–970 m) thick (Kirby, 2010c), in the Faust quadrangle up to 3120 feet (950 m) of IPobm is exposed; the formation is up to 6500 feet (1980 m) thick in the Oquirrh Mountains (Swenson, 1975).

IPobp **Butterfield Peaks Formation of the Oquirrh Group** (Middle to Lower Pennsylvanian [Desmoinesian-Morrowan]) – Interbedded, brown- to gray-weathering, fine- to medium-grained calcareous and quartzitic sandstone, and medium-gray, fine- to medium-grained limestone and sandy limestone; unit characterized by repeated intervals of quartzitic or calcareous sandstone overlain by intervals of gray limestone or sandy limestone; contains minor siltstone; sandstone is typically light brownish gray and planar bedded, and locally displays low-angle cross-stratification and small-scale cross-bedding; both calcareous and quartzitic sandstone exist in nearly equal proportions; limestone intervals are typically medium gray, medium to thick bedded, commonly sandy with very fine to fine-grained sand; fossils include rugose corals, crinoids, brachiopods, fossil hash, and fusulinids in localized beds; locally contains black chert nodules and thin chert beds; limestone and sandy limestone commonly grade upward to finer grained, platy-weathering limestone and argillaceous limestone and siltstone; siltstone is tan to brown gray and thin bedded, and generally poorly exposed and commonly bioturbated; unit forms ledgey slopes and ridges in the northern Vernon Hills and Onaqui Mountains; age of Butterfield Peaks exposures in the Vernon Hills is Middle Pennsylvanian (Atokan) based on fusulinid samples collected in the field (table 3) (Kirby, 2010c); incomplete thickness of 1120 to 1260 feet (340–380 m) in the Vernon Hills (Kirby, 2010b and c), and at least 1330 feet (410 m) in the southeast Onaqui Mountains; IPobp is in fault contact with the Bingham Mine Formation; the formation is about 9000 feet (2765 m) thick in the Oquirrh Mountains (Tooker and Roberts, 1970).

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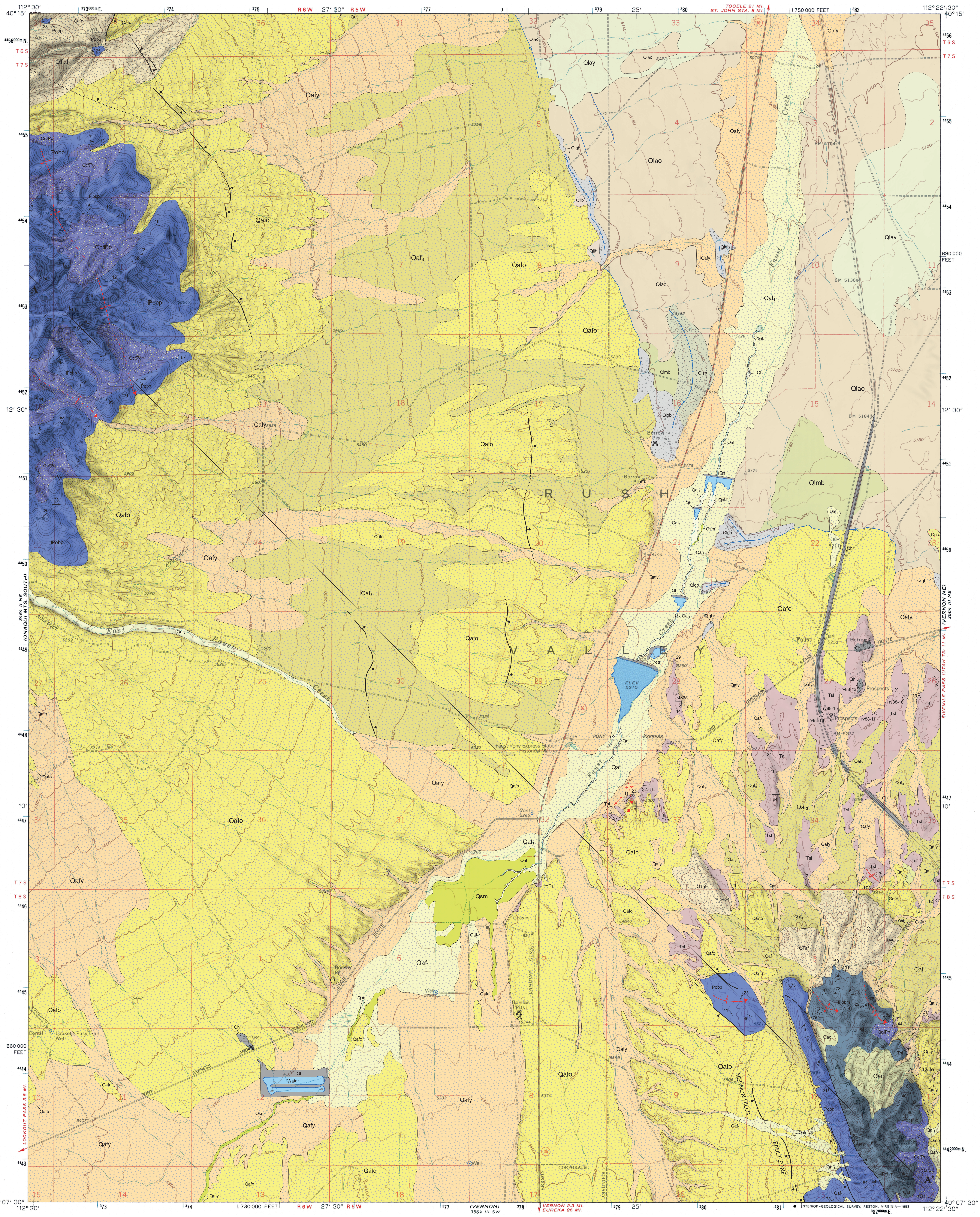

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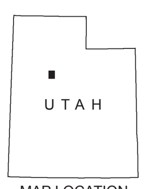

MAP LOCATION

SCALE 1:24,000

1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET

GEOLOGIC MAP OF THE FAUST QUADRANGLE, TOOELE COUNTY, UTAH

by

Stefan M. Kirby

2013

Base from USGS Faust 7.5' Quadrangle (1993)
Projection: UTM Zone 12
Datum: NAD 1927
Spheroid: Clarke 1866

Project Manager: Donald L. Clark
GIS and Cartography: Jay C. Hill, Richard L. Emerson

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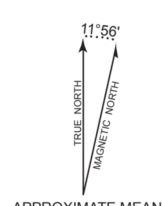
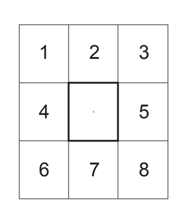


APPROXIMATE MEAN DECLINATION, 2013



1. Johnson Pass
2. Saint John
3. Ophir
4. Onaqui Mts. South
5. Vernon NE
6. Lookout Pass
7. Vernon
8. Lofgreen

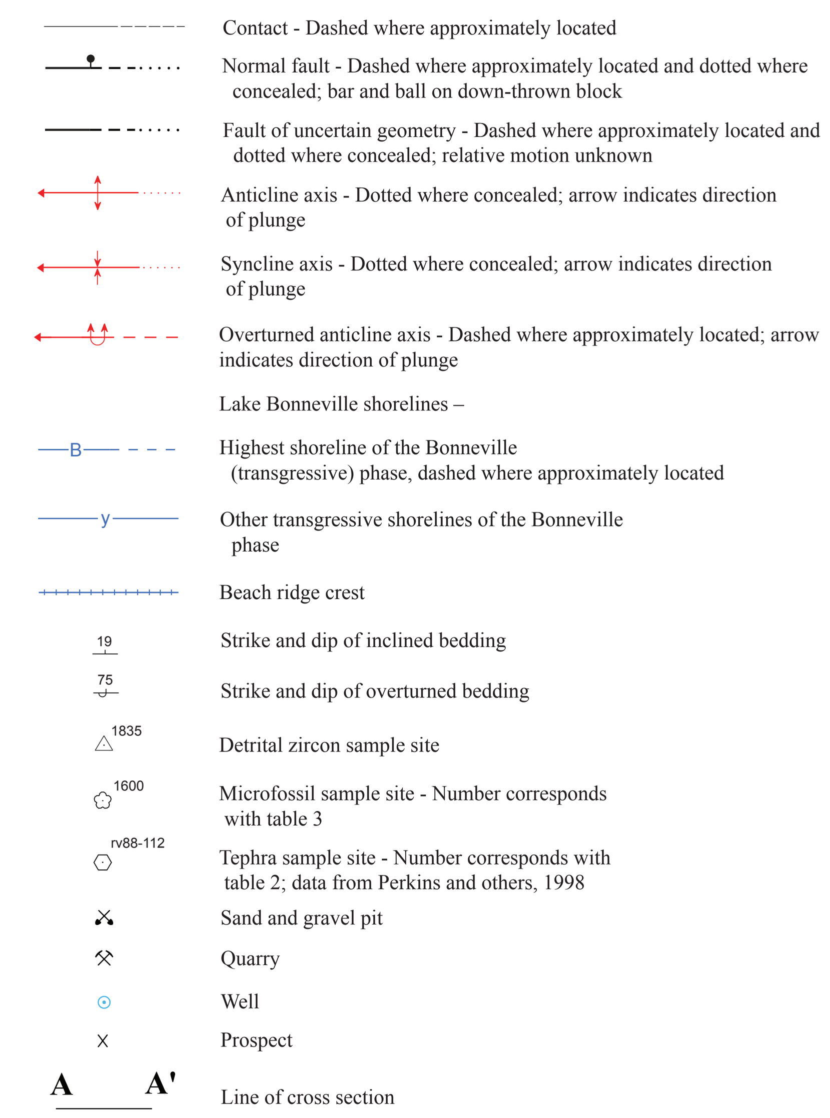
ADJOINING 7.5' QUADRANGLE NAMES

Table 1. *Ages and elevations of major shorelines of Lake Bonneville in Rush Valley.*

Lake Cycle and Phase	Shoreline (map symbol)	Age		Elevation feet (meters)
		radiocarbon years (^{14}C yr) B.P.	calendar-calibrated years B.P.	
Lake Bonneville				
Transgressive Phase	Bonneville (B)	14,800[1]	18,000[2]	5200–5230 (1585–1594)
	flood			
Regressive Phase[4]	Shambip[3]	14,300–13,300[4]	17,400–16,200[2]	not present
	Smelter Knolls[3]	age not constrained[4]	_	not present

[1] Miller and others, (2012).
[2] All calendar calibration made using OxCal ^{14}C calibration and analysis software (Reimer and others, 2009).
[3] Burr and Currey (1988, 1992) reported that regressive-phase shorelines in Rush Valley fluctuated independently from the main body of Lake Bonneville subsequent to construction of the Stockton Bar and lowering of the lake level below this threshold following the Lake Bonneville flood. Both the Shambip and Smelter Knolls lake levels (~5050' [1539m] and ~5010' [1527m] respectively) form erosional shorelines in transgressive Bonneville deposits near Stockton and must therefore have occurred at sometime following the initial regression of Lake Bonneville.
[4] Nelson (2012)

GEOLOGIC MAP SYMBOLS



LITHOLOGIC COLUMN

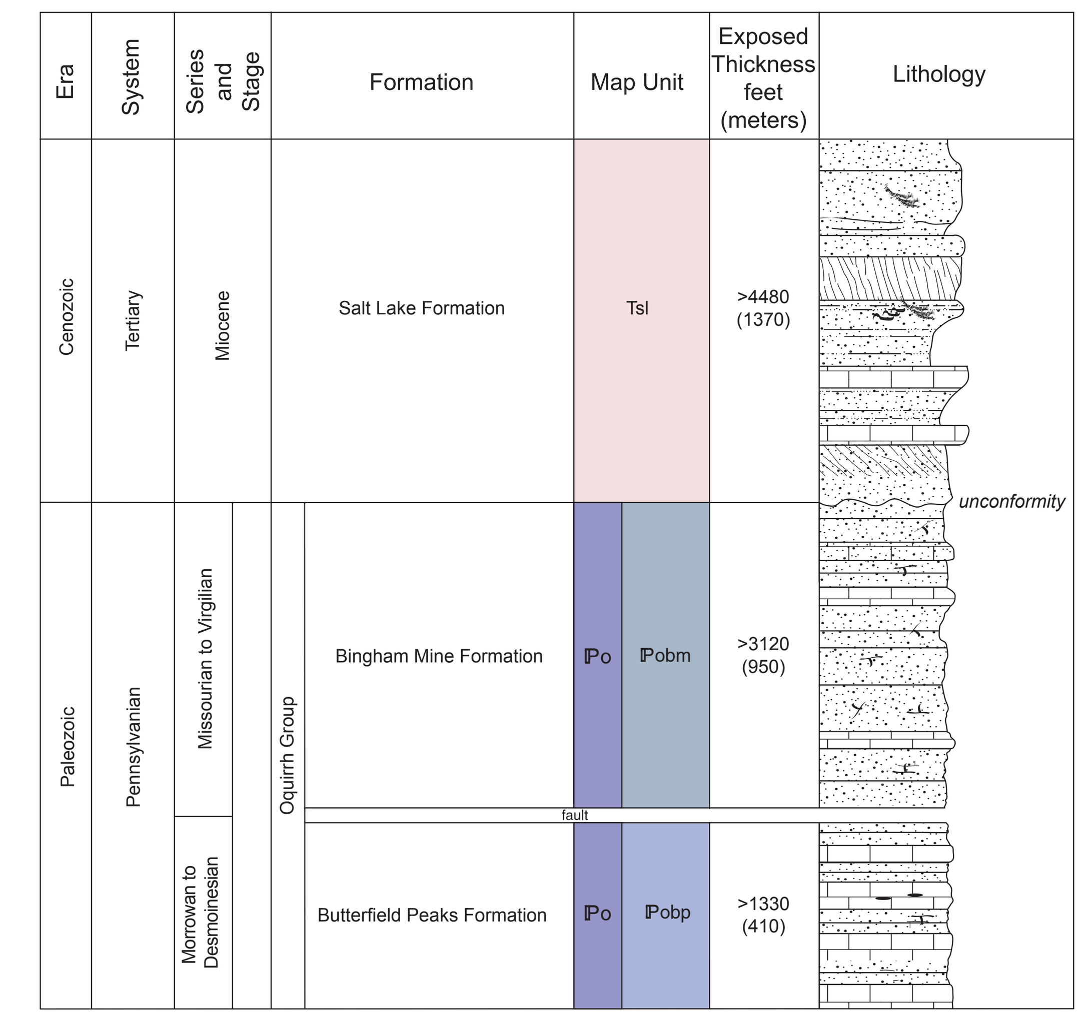


Table 2. *Tephra correlation and interpolation ages from Perkins and others (1998) for the Salt Lake Formation in the Faust quadrangle. For detailed data and correlation and interpolation methodology see Perkins and others (1998).*

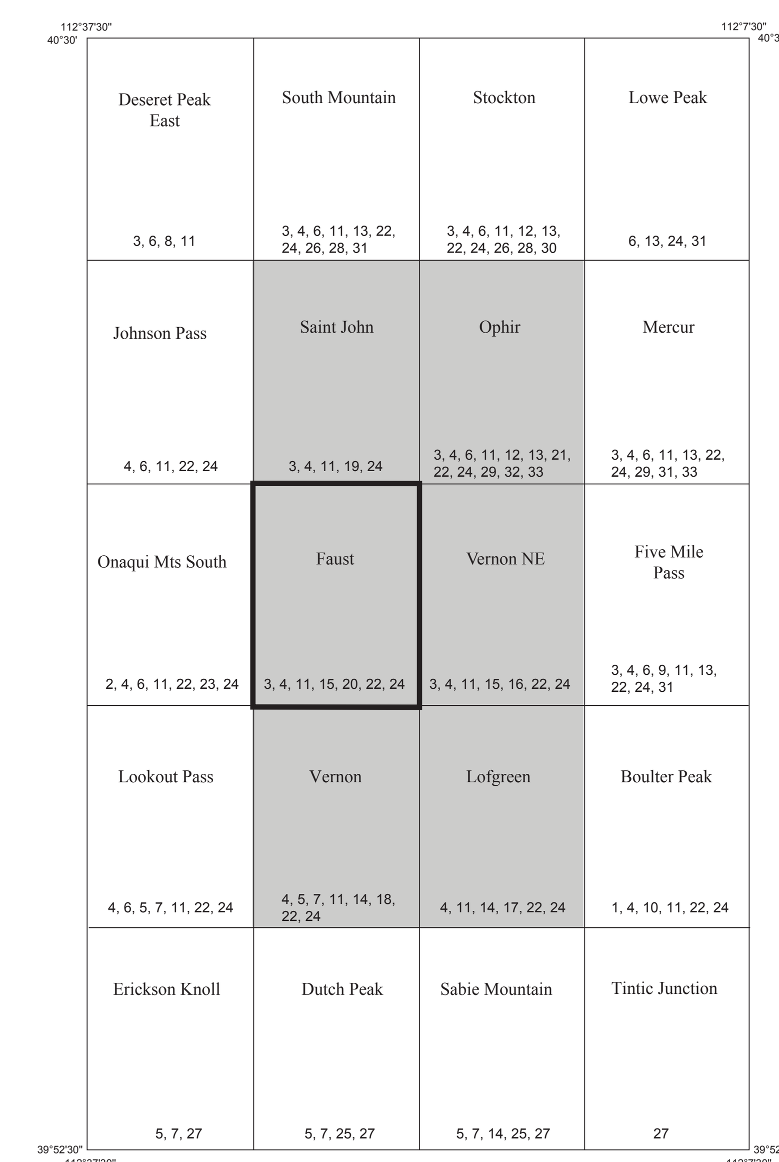
Sample	East[1]	North[1]	Quadrangle	Age (Ma)	Age error (Ma)	Type
rv88-18	381534	4448046	Faust	6.66	0.03	correlation Ar/Ar
rv88-15	381668	4448043	Faust	7.54	0.04	correlation Ar/Ar
rv88-12	381984	4448376	Faust	8.39	0.24	correlation U/Pb
rv89-11	382159	4448048	Faust	8.59	0.18	interpolation
rv88-10	382520	4448227	Faust	9.30	0.17	interpolation

[1]Coordinates in UTM NAD 27 zone 12 N

Table 3. *Summary of microfossils collected from rocks of the Oquirrh Group in the Faust quadrangle. Microfossil analysis and interpretation performed by A.J. Wells (independent).*

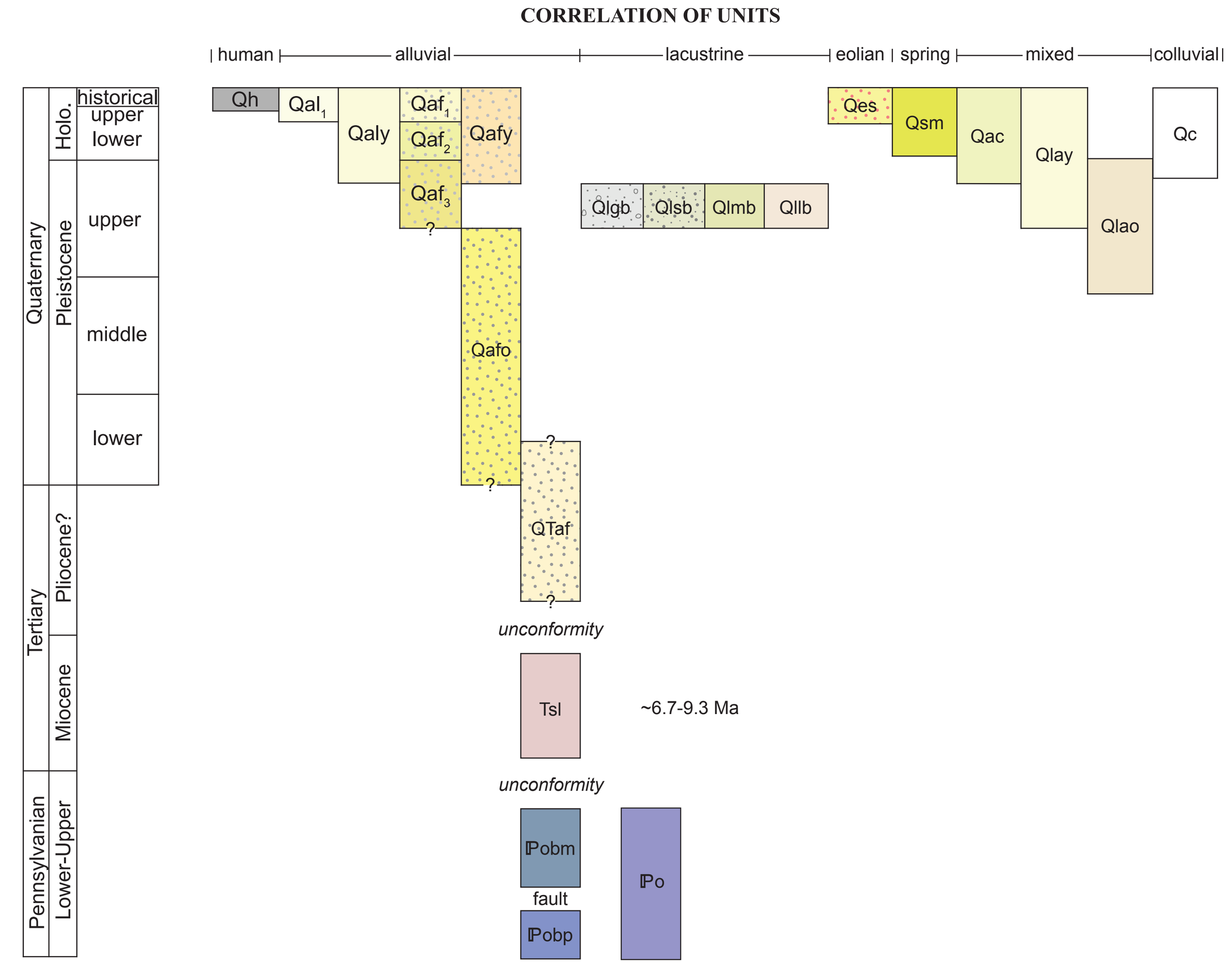
Site ID	East[1]	North	Map Unit	Quadrangle	Rock description	Fossil types	Fauna	Calcareous algae present	Preservation and abrasion	Assigned age
447	381857	4443049	IPobm	Faust	Biomicrite: Wackestone	Fusulinid	*Triticites* cf. *T. cullomensis*	no	good	lower middle Virgilian
1600	382450	4443329	IPobm	Faust	Wackestone	Fusulinid	*Triticites*	no	good	lower Missourian
1641	372987	4452702	IPobp	Faust	Wackestone	Fusulinid	*Profusulinella*	no	poor	lower Atokan

[1] Coordinates in UTM NAD 27 Zone 12



Index to U.S. Geological Survey 7.5-minute quadrangles, and sources of geologic information (refer to numbered list). Gray color includes quadrangles mapped for this project. Numbers correspond to references in the text.

CORRELATION OF UNITS



Interbedded limestone and sandstone of the Butterfield Peaks Formation of the Oquirrh Group in the Vernon Hills.