

Geologic Map Compilation of the Malad City 30 x 60 Minute Quadrangle, Idaho

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Salt Lake Formation, tuff (Pliocene? to Upper Miocene) – Includes several

tuff units mapped in Sublett and Deep Creek mountains; includes white to gray,

vitric air-fall tuff and water-lain tuff, pink to gray vitric ash-flow tuff, pink to

gray, rhyolitic welded tuffs, and a 10.4-10.8 Ma (K-Ar age) (Armstrong et al.

1975) medium- to dark-gray vitric tuff with plagioclase phenocrysts in the Sublett range. Includes the brown to gray, 10.21±0.03 Ma (Ar-Ar age) Tuff of

					Description of Map Units
				r	Map units were generally taken from previous geologic maps; some units vector of the combined for readability. Edge-match discrepancies between map sources reconciled where possible; however, the field work necessary to solve remark problems was beyond the funded scope of this project.
Correlation of Map Units				_	Quaternary
Qel Qfp Qal Qc Qs Qaf Qla O Deposits of Lake Bonneville -0.01	Holocene	-		Qei	Eolian loess (Holocene to latest Pleistocene) – Unconsolidated, brown, with alcareous silt with intermixed fine-grained sand and clay; mantles older supposits and bedrock in topographic lows; thickness variable, up to 30 ft (9)
? Qt Qfg Qlf Qls Qlg Ql Qp unconformity	-Pleistocene	Quaternary		Qip f	Floodplain sediments (Holocene to latest Pleistocene) – Unconsolidated ine sand; overbank deposits of Marsh Creek in the northeast corner of the phickness probably <30 ft (9 m).
QTg QTaf QTmv - 1.8	_	δ.		Qai s	Alluvial deposits (Holocene to Pleistocene?) – Moderately- to well-sorted and, silt, and clay, deposited in stream channels, terraces, and floodplains; about 30 ft (9 m) thick. Includes older alluvium that may be pre-Lake Bonge.
Ta2 unconformity ? Tnc 3.35²	Pliocene			Qc s	Colluvium and talus (Holocene to Pleistocene?) – Poorly-sorted debris, resize from large, intact blocks to clay-sized sediment, deposited by block fawash, and creep processes on steep to moderate slopes; thickness variable.
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	_ Upper Miocene		Cenozoic	Qs I	Landslide and slump deposits (Holocene to Pleistocene?) – Landslides and composition varies with parent material, ranging from large, intact blocks or clay- to boulder-sized sediment; shifted or deposited principally by rotation or slope failure of colluvial material; thickness variable.
Tb 10.2 ² 1	_ Middle	Tertiary		gai s f (Alluvial-fan deposits (Holocene to Pleistocene) – Moderately- to poorly-so- tilt, sand, gravel, and boulders, deposited by debris-flow and sheet-wash properties fan-shaped bodies at the mouths of drainages; thickness variable, up (30 m) thick. Includes deposits of active drainages, as well as older deposits nactive drainages
unconformity	Miocene Lower Miocene			Qia t	Lacustrine and alluvial fine-grained deposits (Holocene to Pleistocene) o light-gray, moderately- to well-sorted silt, clay, and fine-grained sand, we bebble to cobble-sized clasts, deposited in lacustrine environment, but rewell modern alluvial processes, and mixed with alluvial deposits; thickness profit (10 m) or less.
Tw?	Eocene	-		Ot	Ferrace gravels (latest Pleistocene?) – Pebble to cobble-sized unconsolidate gravel terraces which are now incised by modern drainages, <30 ft (9 m) the
Pp unconformity Pzu Plsd Phoc Phoc Phox	-Lower	Permian		Qig (Bonneville flood gravel (latest Pleistocene) – Poorly-sorted cobble to bout conglomerate, mantling older alluvial surfaces; deposited by catastrophic day and subsequent flood of Lake Bonneville approximately 14.5 ka; up to 45 thick.
			eville	QIT 1	Lacustrine fine-grained sediment (Pleistocene) – Tan to yellow-tan, lamin with variable amounts of clay; locally interbedded with sand and gravel; loncludes white to brown laminated marl; thickness <40 ft (12 m).
PRODE PRO	-Late -Middle	/anian	Deposits of Lake Bonneville	QIS (Lacustrine sand (Pleistocene) – Tan to brown, well-sorted, fine-grained saleposited on beaches, offshore bars, and deltas; thickness <30 ft (9 m).
unconformity	-Early	ennsylv	oosits of L	QIg a	Lacustrine gravel (Pleistocene) – Well-sorted pebble to cobble gravel with amounts of sand as interbeds or matrix, deposited on beaches, offshore bardeltas; well-bedded where exposed; thickness generally <100 ft (30 m).
Index to Geochronology (all ages in Ma):	- Upper	Mississippian Pennsylvanian	Der	QI 1	Lacustrine deposits, undifferentiated (Pleistocene) – Gravel, sand, and silt where deposits are interbedded at scales too fine to show on map; <100 ft (hick.
¹ K-Ar age (Armstrong et al., 1975)	Lower	Mississ		Qp (Piedmont deposits (Pleistocene) – Thin, stranded, poorly or unconsolidate deposits consisting of white to tan silt, sand, and pebble to boulder gravel; unknown.
² Ar-Ar age (Kellogg et al., 1994) and Dh	Upper - Middle	_ Devonian			Quaternary and Tertiary
Pope et al., (2001) Tephra correlation age (M. Perkins, unconformity	Lower _		Paleozoic	QIG (Quaternary-Tertiary gravel (Pleistocene to Pliocene?) - Unlithified to mo consolidated, locally-derived, pebble to boulder-sized alluvial-fan gravels o conglomerates; unconformably overlie Tertiary and Paleozoic map units; er deeply dissected by active drainages; <480 ft (160 m) thick.
University of Utah, in Long et al., 2006) 4U-Pb age (Fanning and Link, 2004)	and Upper –	Silurian		ا بەرلا	Alluvial fan deposits (Pleistocene to Pliocene?) – Moderately to poorly-spebble- to cobble-gravel; bedding not exposed; eroded and deeply dissected drainages; up to 400 ft (120 m) thick.
Ofh Osp	Upper Middle	Ordovician	Q	≀imv a	Formation of Marsh Valley (Pleistocene to Pliocene?) – Interbedded clay and ashes alternating with pebble gravels and channel-fill deposits. Depos alluvial, and lacustrine environments; unconformably overlies the Salt Lake F.
Pzl Ogc OCsc	 _Lower	Ordc			Age is between 3.3 Ma and 600 ka (Kruger et al., 2003); <5575 ft (1700 m Fertiary
€n €bo	-Upper			15 [Salt Lake Formation, undifferentiated (Pliocene? to Middle Miocene) – gray, tan, and brown, and locally green sandstone, conglomerate, diamictite, to sandstone, siltstone, and mudstone, rare lacustrine dolomite and limestone, a
€lb €u	-Middle	Cambrian		1 f I	ain tuff deposited in alluvial fan and lacustrine environments; represents b from Miocene-Pliocene extensional events. The total age range for correla Lake Formation units in the map area that have been dated and subdivided -12 to 3 Ma; however, no ages have been determined for map unit Ts in the relickness is variable, estimated from 490 ft (150 m) up to 9840 ft (3000 m)
Cg Csp		O		Ta2	Salt Lake Formation, pediment gravel (Pliocene) – Locally-derived cobble gravel and diamictite, with local silty or tuffaceous matrix; depe alluvial processes on broad, smooth erosional surfaces, up to 250 ft (75
Ghou Ewp €ws	Lower	-		Tnc	Salt Lake Formation, New Canyon member (Pliocene) – Parallel-bedd supported, well-rounded, pebble to cobble conglomerate, exposed only of Mountain in the southeast part of map area; tephra correlation indicates <4.4-5.1 Ma (Janecke and Evans, 1999); thickness may exceed 3280 ft (
EZb EZcm Zm Zi Zc Zpc		proterozoic	cambrian	Tb	Salt Lake Formation, basalt (Pliocene to Middle Miocene) – brown, and dark-gray, variably vesicular basalt, with aphanitic groundmass and fine- to medium-grained olivine and plagioclase phenocrysts, up to 300 m) thick. K-Ar whole-rock ages of 12.6±0.5 Ma and 13.1±0.5 Ma were in the Sublett Mountains (Hurlow, 2004); however, ages reported for basouth of the map area, in northernmost Utah, range between ~14.9 and

Arbon Valley (Morgan and McIntosh, 2005), containing sanidine, smoky quartz, and biotite phenocrysts, and two brown to gray, reworked air-fall tuffs in the Deep Creek range; up to 50 ft (15 m) thick. **Eolian loess (Holocene to latest Pleistocene)** – Unconsolidated, brown, windblown, - Brown to black, palagonitized, basaltic scoria lapilli and peperite tuff, and calcareous silt with intermixed fine-grained sand and clay; mantles older surficial deposits and bedrock in topographic lows; thickness variable, up to 30 ft (9 m). Walkley Peak in the northeast part of the map area. Youngest basalt flow has an Ar-Ar age of 3.35 Ma (Pope et al., 2001). Thickness up to 120 ft (36 m). Floodplain sediments (Holocene to latest Pleistocene) – Unconsolidated mud and fine sand; overbank deposits of Marsh Creek in the northeast corner of the map area; Salt Lake Formation, Third Creek member (Pliocene to Upper Miocene) - Gray, tan, and white pebble to cobble conglomerate, sandstone, tephra, and Alluvial deposits (Holocene to Pleistocene?) – Moderately- to well-sorted gravel, sand, silt, and clay, deposited in stream channels, terraces, and floodplains; up to 1999); exposed only in Bannock and Malad ranges in southeast area of map; about 30 ft (9 m) thick. Includes older alluvium that may be pre-Lake Bonneville in >5575 ft (1700 m) thick. Colluvium and talus (Holocene to Pleistocene?) – Poorly-sorted debris, ranging in size from large, intact blocks to clay-sized sediment, deposited by block fall, slope and hornblende-bearing rhyolite flows, rhyolite breccia, a dacite flow, and wash, and creep processes on steep to moderate slopes; thickness variable. rhyolitic pumice; layered and normally-graded pumice, along with pumice Landslide and slump deposits (Holocene to Pleistocene?) – Landslides and slumps; composition varies with parent material, ranging from large, intact blocks of bedrock to clay- to boulder-sized sediment; shifted or deposited principally by rotational slides Basin; thickness variable, up to 1600 ft (487 m). Alluvial-fan deposits (Holocene to Pleistocene) – Moderately- to poorly-sorted clay, silt, sand, gravel, and boulders, deposited by debris-flow and sheet-wash processes; to cobble-conglomerate and fanglomerate beds, and diatomaceous marl; age forms fan-shaped bodies at the mouths of drainages; thickness variable, up to 100 ft is between Ar-Ar rhyolite flow ages of 6.63 and 6.09 Ma (Pope et al., 2001); (30 m) thick. Includes deposits of active drainages, as well as older deposits of nowexposed in Hawkins Basin, just west of Wakley Peak; thickness up to 500 ft Lacustrine and alluvial fine-grained deposits (Holocene to Pleistocene) – White to light-gray, moderately- to well-sorted silt, clay, and fine-grained sand, with sparse white, pebble to cobble conglomerate in a sandy, tuffaceous matrix, with interbedded primary ash; age is <9.5 Ma according to tephra correlation data pebble to cobble-sized clasts, deposited in lacustrine environment, but reworked by modern alluvial processes, and mixed with alluvial deposits; thickness probably 33 (DeVecchio et al., 2002), >2000 ft (733 m) thick. Salt Lake Formation, lower tuff and basalt unit (Upper Miocene) - Tan, Terrace gravels (latest Pleistocene?) – Pebble to cobble-sized unconsolidated alluvial gray, and green, waterlain and airfall, devitrified rhyolitic tuffs of Hawkins gravel terraces which are now incised by modern drainages, <30 ft (9 m) thick. olivine and plagioclase phenocrysts; exposed on Wakley Peak and in Hawkins Bonneville flood gravel (latest Pleistocene) – Poorly-sorted cobble to boulder Basin. Thickness up to 1000 ft (305 m), basalts are up to 40 ft (12 m) thick. conglomerate, mantling older alluvial surfaces; deposited by catastrophic dam failure and subsequent flood of Lake Bonneville approximately 14.5 ka; up to 45 ft (14 m) Salt Lake Formation, Third Creek-Cache Valley transitional member (Upper Miocene) – Tan-gray limestone and tufa, white to green tuffaceous sandstone and siltstone, pebble conglomerate, and primary tephra; 650-1265 Lacustrine fine-grained sediment (Pleistocene) – Tan to yellow-tan, laminated silt, ft (198-386 m) thick. with variable amounts of clay; locally interbedded with sand and gravel; locally Salt Lake Formation, Cache Valley Member (Upper to Middle Miocene) Lacustrine sand (Pleistocene) – Tan to brown, well-sorted, fine-grained sand, with lacustrine limestone, tufa, and primary tephra beds; locally displays extensive green zeolitic alteration; deposited in a regional lacustrine system; age range is ~12-9 Ma according to tephra correlation data (DeVecchio et al, 2002; Long et al, 2004), but in the southeast part of the map area, it does not ☐ Lacustrine gravel (Pleistocene) — Well-sorted pebble to cobble gravel with variable exceed 10.2 Ma, which is the age of the Arbon Valley tuff member, exposed amounts of sand as interbeds or matrix, deposited on beaches, offshore bars, and at the unit's base (Morgan and McIntosh, 2005); >2800 ft (1026 m) thick. Salt Lake Formation, Skyline member (Upper to Middle Miocene) - White, Lacustrine deposits, undifferentiated (Pleistocene) – Gravel, sand, and silt, mapped where deposits are interbedded at scales too fine to show on map; <100 ft (30 m) gray, and green tuffaceous pebble to cobble conglomerate, with interbedded is ~12-10 Ma, according to tephra correlation data (Long et al., 2004; 2006); up to 2250 ft (685 m) thick. **Piedmont deposits (Pleistocene)** – Thin, stranded, poorly or unconsolidated alluvial deposits consisting of white to tan silt, sand, and pebble to boulder gravel; thickness Salt Lake Formation, lower conglomerate unit (Middle Miocene) – Gray to white, pebble to cobble conglomerate in a sandy tuffaceous matrix with

interbedded ash beds, and rare limestone; age >11.8 Ma, according to tephra correlation data (DeVecchio et al., 2002); thickness >2200 ft (807 m). Quaternary-Tertiary gravel (Pleistocene to Pliocene?) - Unlithified to moderately-Starlight Formation, undifferentiated (Upper Miocene) - Light-colored, friable, rhyolitic tuffs, and tuffaceous sandstones, with local marl, conglomerate, ash-flows, conglomerates; unconformably overlie Tertiary and Paleozoic map units; eroded and and one basalt flow; exposed only in the Sublett Range, in the northwest corner of the map area; K-Ar age is 10.4-6.5 Ma (Armstrong et al., 1975). Alluvial fan deposits (Pleistocene to Pliocene?) – Moderately to poorly-sorted Wasatch? Formation (Eocene?) – Lower section of fluvial, pebble to cobble af pebble- to cobble-gravel; bedding not exposed; eroded and deeply dissected by active conglomerate with red, mud-rich matrix; upper section of poorly-consolidated, mudrich, white quartzite boulder-bearing beds; thickness varies from 40 ft (13 m) up to >620 ft (189 m). Tentatively correlated with strata of the Eocene Wasatch Formation of Marsh Valley (Pleistocene to Pliocene?) – Interbedded clays, silts, Formation of western Wyoming, northern Utah, and southeastern Idaho (Long et and ashes alternating with pebble gravels and channel-fill deposits. Deposited in alluvial, and lacustrine environments; unconformably overlies the Salt Lake Formation. Age is between 3.3 Ma and 600 ka (Kruger et al., 2003); <5575 ft (1700 m) thick.

Salt Lake Formation, undifferentiated (Pliocene? to Middle Miocene) – Includes gray, tan, and brown, and locally green sandstone, conglomerate. diamictite, tuffaceous sandstone, siltstone, and mudstone, rare lacustrine dolomite and limestone, and waterlain tuff deposited in alluvial fan and lacustrine environments; represents basin-fill from Miocene-Pliocene extensional events. The total age range for correlative Salt Lake Formation units in the map area that have been dated and subdivided is from ~12 to 3 Ma; however, no ages have been determined for map unit Ts in the map area; thickness is variable, estimated from 490 ft (150 m) up to 9840 ft (3000 m) thick. Salt Lake Formation, pediment gravel (Pliocene) – Locally-derived pebble to cobble gravel and diamictite, with local silty or tuffaceous matrix; deposited by alluvial processes on broad, smooth erosional surfaces, up to 250 ft (75 m) thick. PPo | Consists of units a through d, shown where source mapping did not differentiate Salt Lake Formation, New Canyon member (Pliocene) – Parallel-bedded, clastsupported, well-rounded, pebble to cobble conglomerate, exposed only on Oxford

Mountain in the southeast part of map area; tephra correlation indicates age is

Map units were generally taken from previous geologic maps; some units were

combined for readability. Edge-match discrepancies between map sources were

reconciled where possible; however, the field work necessary to solve remaining

<4.4-5.1 Ma (Janecke and Evans, 1999); thickness may exceed 3280 ft (1000 m). Salt Lake Formation, basalt (Pliocene to Middle Miocene) – brown, black, and dark-gray, variably vesicular basalt, with aphanitic groundmass and subhedral fine- to medium-grained olivine and plagioclase phenocrysts, up to 300 ft (100 m) thick. K-Ar whole-rock ages of 12.6 ± 0.5 Ma and 13.1 ± 0.5 Ma were obtained in the Sublett Mountains (Hurlow, 2004); however, ages reported for basalts just south of the map area, in northernmost Utah, range between ~14.9 and ~3.6 Ma Salt Lake Formation, basalt sills (Pliocene? to Upper Miocene?) – Dark brown, green, and red scoriaceous basalt, intruded into the Salt Lake Formation; tops and bottoms of flows are altered; exposed only in southeast corner of map area; <66 ft (20 m) thick. Salt Lake Formation, diabase sill (Pliocene? to Miocene?) – Dark-green,

coarse-grained, metamorphosed diabase, with orthopyroxene phenocrysts; forms a sill-like tabular body that appears to intrude and follow Tertiary low-angle normal faults on Oxford Mountain. Salt Lake Formation, alluvium (Pliocene? to Upper Miocene) – Poorly-exposed pebble to cobble gravel deposited in alluvial-fan and stream environments, mapped below map unit Tb; only in southwest part of the map area, up to 215 ft (65 m)

Salt Lake Formation, upper tuff and basalt unit (Pliocene to Upper Miocene) dark-gray to black basalt flows with plagioclase phenocrysts; exposed only on limestone; conglomerates are interpreted as fluvial and deposited by east-flowing streams; age is ~10-5 Ma, according to tephra correlation (Janecke and Evans, Salt Lake Formation, rhyolite unit (Upper Miocene) – Dominantly consists of light-gray, biotite and obsidian-bearing rhyolite; includes smaller porphyritic blocks and bombs are mined in the map area, in the Hess Pumice pit mine just east of Wakley Peak (Pope et al, 2001); rhyolite flows yield Ar-Ar ages of 6.63 and 6.09 Ma (Pope et al., 2001); exposed only on Wakley Peak and in Hawkins Salt Lake Formation, rhyolite debris flow unit (Upper Miocene) – Rhyolite and pumice debris flow with granule to cobble-sized clasts; includes rare pebble-Salt Lake Formation, upper conglomerate unit (Upper Miocene) – Gray to Basin and Marsh Valley, interbedded with two dark-gray basalt flows, containing – White, gray and green, reworked tuffaceous siltstone and sandstone, interbedded tephra and rare lacustrine limestone; deposited in alluvial fan environment; age

en medium-gray, cliff-forming dolomite, upper section of ledge-forming, medium-to

Permian and Pennsylvanian Upper Paleozoic, undifferentiated (Lower Permian to Lower Devonian) -Includes strata of the Oquirrh Group (unit d), the Permian limestone, sandstone, and dolomite unit, and the Phosphoria Formation. **Phosphoria Formation (Lower Permian)** – Light-gray fetid shale, medium- to light-gray limestone, minor sandstone, minor phosphate rock, with dark-gray bedded chert, brown siltstone, and argillite near top of section; complete section not exposed; thickness in adjacent map areas is up to 540 ft (165 m) (Link and Stanford, 1999). Limestone, sandstone, and dolomite (Early to Late? Permian) – Light-gray to Plsd tan, well-bedded calcareous sandstone, buff to tan, sandy, variably fossili dolomite, gray bedded chert, and medium-gray limestone, >2300 feet (700 m) thick. Oquirrh Group, undifferentiated (Early Permian to Early Pennsylvanian) -

Oquirrh Group unit d (Early Permian) – Brown to tan non-calcareous sandstone grading to quartzite, with interbedded dolomite and silty limestone near top of section, and interbedded cross-bedded sandstone near middle of section, 2200-3300 ft (670-1000 m) thick. Bioclastic limestone unit of Oquirrh Group (Early? Permian to Early? **Pennsylvanian**) – Medium- to dark-blue-gray bioclastic limestone, with variable amounts of bedded and nodular gray chert, ~600 ft (183 m) thick. Mapped as klippe above rocks of similar age in North Hansel Mountains. Oquirrh Group unit c (Early Permian to Late Pennsylvanian) - Interbedded medium-, tan-, and yellow-gray, sandy to silty limestone and gray to tan calcareous sandstone to siltstone, with rare bioclastic limestone; lithology identical to unit b, 3800->6000 ft (1160->1830 m) thick.

Tussing sandstone of Oquirrh Group – (Early Permian to Middle **Pennsylvanian**) – Yellow-gray to orange, sandy to silty limestone and calcareous quartz sandstone, with local chert grit layers; split out only in Sublett Mountains in northwest corner of map area. **Oquirrh Group units b and c undifferentiated (Early Permian to Early? Pennsylvanian**) – Interbedded sandy to silty limestone and calcareous sandstone to siltstone, with rare bioclastic limestone. Shown where source maps did not differentiate between Oquirrh Group sufficiently to assign to either units b or

Oquirrh Group unit b (Late to Early? Pennsylvanian) – Interbedded sandy to silty limestone and calcareous sandstone to siltstone, with rare bioclastic limestone; lithology identical to unit c, 1600-2750 ft (490-840 m) thick. Oquirrh Group unit a (Early to Middle? Pennsylvanian) - Medium- to bluegray, thick-bedded, fossiliferous, cherty or sandy limestone, with interbedded calcareous sandstone near top, 1300-1450 ft (400-440 m) thick. Manning Canyon Shale (Lower Pennsylvanian and Upper Mississippian) – Darkgray, black, and green shale and mudstone, with interbedded gray to brown crossbedded subarkosic quartzite, >260 ft (80 m) thick.

Great Blue Limestone (Upper Mississippian) – Medium- to dark-blue-gray weathering, coarse-crystalline, variably cherty and fossiliferous limestone, 1180 ft **Humbug Formation (Upper Mississippian)** – Dark-brown calcareous sandstone and siltstone, equivalent to Little Flat Formation north of map area, 920 ft (280 m) Lodgepole Limestone (Lower Mississippian) – Light- to medium-gray limestone

with abundant chert nodules and lenses, 395 ft (120 m) thick. Bierdneau Formation (Upper Devonian) – Interbedded tan sandstone and ten-Db weathering gray dolomite, up to 820 ft (250 m) thick. Hyrum Dolomite (Upper and Middle Devonian) – Light- to dark-gray dolomite

with local fossiliferous limestone and chert-bearing layers, 1180 ft (360 m) thick. Lower section contains light-gray sandstone and limestone. Includes strata mapped as Jefferson Formation southeast of Malad City. Water Canyon Formation (Lower Devonian) – Gray to white, silty and sandy dolomite, with local brown sandstone and argillite interbeds, <460 ft (140 m) thick. Laketown Dolomite and Fish Haven Dolomite undifferentiated (Upper Silurian

SOfl to Upper Ordovician) – Dark- to light-gray, coarse-crystalline, medium- to thickded, chert-bearing, locally bioclastic dolomite, 1600 ft (488 m) thick. Laketown Dolomite (Middle and Upper Silurian) – Light-gray to white-weathering, chert-bearing, coarse-crystalline, fossiliferous dolomite, up to 1150 ft (350 m) thick. Fish Haven Dolomite (Upper Ordovician) – Medium to dark-gray, coarse-crystalline, sugary-textured, thick-bedded to massive, bioclastic, variably chert-rich dolomite, 1050 ft (320 m) thick.

492-1150 ft (150-350 m) thick. Lower Paleozoic, undifferentiated (Middle Ordovician to Middle Cambrian) Pzl | Lower Paleozoic, unumercinated Gradus States | Includes strata of the Nounan, St. Charles, and Garden City formations Garden City Formation (Middle and Lower Ordovician) – Lower section consists Ogc of medium-gray, medium-bedded, fossiliferous limestone, with common tan silty partings and intraformational conglomerate; upper section consists of medium-gray, thick-bedded, fossiliferous limestone, with interbedded dolomite and common black chert; total section is up to 1425 ft (435 m) thick.

Osp | bioturbated, vitreous quartzite, with brown micaceous siltstone and shale at base;

Swan Peak Quartzite (Middle Ordovician) – White, massive, cliff-forming, locally

Saint Charles Formation (Lower Ordovician to Upper Cambrian) – Lower OCsc Saint Charles Formation (Lower Oracles August 2018) section consists of the Worm Creek Quartzite Member, a very fine-grained, tan mottled, medium-gray, silty dolomite and limestone, locally rich in gray to brown chert nodules and stringers, 1045 ft (320 m) thick.

Nounan Formation (Upper and Middle Cambrian) – Lower section of light- to

dark-gray, medium-bedded, silty to sandy limestone, up to 1375 ft (420 m) thick.

Bloomington Formation (Middle Cambrian) – Lower section of slope-forming

medium-gray, medium-bedded, locally oncolitic and oolitic limestone containing

beds of intraformational conglomerate; upper section of slope-forming, tan, brown,

interbedded green shale and limestone (Hodges Shale Member); middle section of

and green shale and siltstone, rich in green micrite nodules (Calls Fort Shale Member); total section is up to 1600 ft (487 m) thick Blacksmith Limestone (Middle Cambrian) – Dark-gray, thick-bedded to massive, mottled, locally fossiliferous, cliff-forming, silty limestone; locally dolomitic; up to **Ute Formation (Middle Cambrian)** – Dark- and blue-gray oolitic and oncolitic

limestone interbedded with tan to green mudstone and shale, 1280 ft (390 m) thick. Equivalent to upper section of Lead Bell Shale of the Portneuf Range of southeast Idaho (Armstrong and Oriel, 1971). Langston Formation (Middle Cambrian) – Lower part consists of medium- to blue-gray, sandy limestone, and upper part consisting of black to gray, micaceous shale and claystone, > 655 ft (200 m) thick. Equivalent to Twin Knobs Limestone and lower section of Lead Bell Shale of the Portneuf Range of southeast Idaho (Armstrong and Oriel, 1971).

brown, and gray argillite, green and brown quartzite, and blue-gray limestone; stratigraphically equivalent to the Lead Bell Shale, Twin Knobs Limestone, Sedgwick Peak Quartzite, and Windy Pass Argillite; mapped only in Bannock Range in east part of the map area; ~ 1740 ft (530 m) thick. Lead Bell Shale of Brigham Quartzite (Middle Cambrian) – Lower section of brown, gray, and black shale and siltstone, upper section of interbedded tan to green siltstone and light-gray oolitic and oncolitic limestone, up to 1150 ft (350 m) thick. Equivalent to Ute Formation and upper section of Langston

Gibson Jack Formation (Middle and Lower Cambrian) – Interbedded green,

Formation of northern Utah (Armstrong and Oriel, 1971). $\label{lem:constrain} \textbf{Twin Knobs Limestone of Brigham Quartzite (Middle Cambrian)} - \text{interbedded}$ tan siltstone and blue-gray, silty, bioclastic limestone, up to 300 ft (91 m) thick. Equivalent to lower section of Langston Formation of Utah stratigraphy (Armstrong and Oriel, 1971).

Sedgwick Peak Quartzite and Windy Pass Argillite of Brigham Quartzite undifferentiated (Lower Cambrian) - Interbedded green to tan, micaceous, thin-bedded argillite, and green to brown, fine-grained, micaceous, arkosic quartzite, up to 1605 ft (490 m) thick. Sedgwick Peak Quartzite of Brigham Quartzite (Lower Cambrian) – Green to light brown, medium- to thick-bedded quartzite, with local shale and siltstone

interbeds, and local skolithos burrows; up to 560 ft (170 m) thick.

Windy Pass Argillite of Brigham Quartzite (Lower Cambrian) – Brown, tan,

and green ferruginous quartzite interbedded with brown, micaceous argillite, 250-570 ft (76-230 m) thick.

Brigham Group, undifferentiated (Lower Cambrian to Neoproterozoic) – Shown only in northeast corner of map area, includes strata of the Camelback Mountain Quartzite, Mutual Formation, Inkom Formation, Caddy Canyon Quartzite, and Papoose Creek Formation, with combined thickness of 4300 ft (1310 m). Camelback Mountain Quartzite (Lower Cambrian to Neoproterozoic) - White to tan, vitreous, thick-bedded, medium- to coarse-grained, locally conglomeratic

Neoproterozoic Mutual Formation (Neoproterozoic) – Maroon to purple, medium- to coarse-grained locally conglomeratic quartzite, with rare thin purple argillite interbeds, >1475 ft (450 **Inkom Formation (Neoproterozoic)** – Maroon and green siltstone and argillite, defined as the lowest argillite identical to those in Mutual Formation, ~16 ft (5 m) thick (section is thinner than areas to north and east); exposed only on Oxford Peak.

Caddy Canyon Quartzite (Neoproterozoic) – White, vitreous, medium-grained quartzite, with siltstone and brown, silty limestone interbeds, ~460 ft (140 m) thick (section is thinner than in areas to north and east). Papoose Creek Formation (Neoproterozoic) – Gray and brown interbedded fine-

quartzite, up to 1570 ft (479 m) thick.

grained sandstone and siltstone, with distinctive clastic dikelets of sandstone, >1150 Pocatello Formation, Scout Mountain Member (Neoproterozoic) – Green to brown siltstone, fine- to coarse-grained sandstone, black pebble- to boulder diamictite, and cobble conglomerate, metamorphosed to greenshist facies; at least 1135 ft (346 m) thick. Unit has a U-Pb age of 709 ± 5 to 667 ± 5 Ma based on studies north of the map area (Fanning and Link, 2004); the upper member of the Pocatello Formation, which is exposed in several localites to the north, is faulted

Pocatello Formation, Bannock Volcanic Member (Neoproterozoic) - Mafic, foliated, metavolcanic greenstone, with local pillow breccia and diabase, >820 ft (250 m) thick. Forms the stratigraphically lowest strata exposed on Oxford Mountain; a clast from this member has a U-Pb age of 717 ± 4 Ma (Fanning and

Symbols Stratigraphic contact: dashed where approximately located. High-angle normal fault: dashed where approximately located, dotted where concealed; ball and bar on downthrown side. Low-angle normal fault: dashed where approximately located, dotted where concealed; ball and bar on downthrown side. Thrust fault: dashed where approximately located, dotted where concealed teeth on upper plate. Structural lineament: dashed where approximately located, dotted where concealed; displacement sense uncertain. Anticline: trace of axial plane; dashed where approximately located, dotted where concealed; large arrow indicates direction of plunge. Overturned anticline: trace of axial plane; dashed where approximately located, dotted where concealed; large arrow indicates direction of plunge. Syncline: trace of axial plane; dashed where approximately located, dotted where concealed; large arrow indicates direction of plunge. Overturned syncline: trace of axial plane; dashed where approximately located, dotted where concealed; large arrow indicates direction of plunge.

dotted where concealed; large arrow indicates direction of plunge. Strike and dip of bedding Strike and dip of overturned bedding Approximate strike and dip of bedding: estimated from aerial photographs. Horizontal bedding Vertical bedding

Monocline: trace of axial plane; dashed where approximately located,

Strike and dip of foliation Bonneville-level lake shoreline: at approximately 5120 ft elevation. Provo-level lake shoreline: at approximately 4780 ft elevation. Location and age of sample (Ma) used for geochronology (superscripts used on map are same as shown on correlation chart). Abbreviations used on map: BCF = Bull Canyon Fault CD = Clifton Detachment DCF = Deep Creek Fault DOF = Dayton-Oxford Fault ES = Elbow SynclineJHA = Jenkins Hollow Anticline MCT = Manning Canyon Thrust

ORA = Oxford Ridge Anticline

SCF = Steel Canyon Fault

WCF = West Cache Fault

WF = Wasatch Fault

References Cited Armstrong, F.C., and Oriel, S.S., 1971, Uppermost Precambrian and Lowest Cambrian rocks in southeastern Idaho; United States Geological Survey Professional Paper

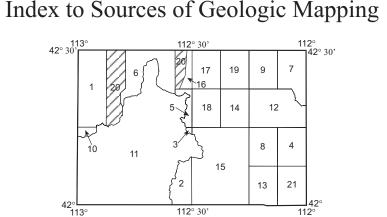
Armstrong, R.L., Leeman, W.P., and Malde, H.E., 1975, K-Ar dating Quaternary and Neogene volcanic rocks of the Snake River Plain, Idaho: Americal Journal of Science, v. 275, p. 225-251. DeVecchio, D.D., Oriel, S.S., and Link, P.K., 2003, Geologic Map of the Downey East Quadrangle and Regions of the Swan Lake, Oxford, and Cottonwood Peak Quadrangles, Bannock County, Idaho: Idaho Geological Survey Technical Report T-03-2, scale 1:24,000, 1 sheet. Fanning, M.C., and Link, P.K., 2004, U-Pb SHRIMP ages of Neoproterozoic (Sturtian) glaciogenic Pocatello Formation, southeastern Idaho: Geology, v. 32, p. 881-

Hurlow, H. A., 2004, Interim Geologic Map of the Curlew Valley Drainage Basin, Box Elder County, Utah, and Oneida and Cassia Counties, Idaho: Utah Geological Survey Open-File Report 436; 1 sheet. Janecke, S.U., and Evans, J.C., 1999, Folded and faulted Salt Lake Formation above the Miocene to Pliocene New Canyon and Clifton detachment faults, Malad and Bannock Ranges, Idaho, field trip guide to the Deep Creek half-graben and environs: in Hughes, S.S., and Thackray, G.D., eds., Guidebook to the geology of eastern Idaho: Idaho Museum of Natural History, Pocatello, Idaho p. 71-96.

Kellogg, K.S., Harlan, S.S., Mehnert, H.H., Snee, L.W., Pierce, K.L., Hackett, W.R., adn Rodgers, D.W., 1994, Major 10.2 Ma rhyolitic volcanism in the eastern Snake rvier Plain, Idaho--Isotopic age and stratigrpahic setting of the Arbon Valley Tuff Member of the Starlight Formation: U.S. Geological Survey Bulletin

Kruger, J.M., Crane, T.J., Pope, A.D., Perkins, M.E., and Link, P.K., 2003, Structural and stratigraphic development of Neogene basins in the Marsh Valley, Lava Hot Springs, and Wakley Peak areas, southeast Idaho: Two phases of extension; in Raynolds, R., and Flores, R., eds., Cenozoic Systems of the Rocky Mountain Region: Denver, Colorado, Rocky Mountain Section SEPM (Society for Sedimentary Geology), p.1–51. Link, P.K., and Stanford, L.R., 1999, Geologic map compilation of the Pocatello 30 x 60 minute quadrangle, Idaho: Idaho Geological Survey Technical Report Long, S.P., Link, P.K., Janecke, S.U., Perkins, M.E., and Fanning. M.S., 2006, Multiple phases of Tertiary extension and synextensional deposition of the Miocene-Pliocene Salt Lake Formation in an evolving supradetachment basin, Malad Range, southeast Idaho, U.S.A.; Rocky Mountain Geology, v. 41, no. 1. Long, S.P., 2004, Geology of the Henderson Creek quadrangle, Oneida County, Idaho: Multiple phases of Tertiary extension and deposition [M.S. Thesis]: Pocatello, Idaho State University, 158 p. Morgan, L.A., and McIntosh, W.C., 2005, Timing and developments of the Heise volcanic field, Snake River Plain, Idaho, western USA; Geological Society of America Bulletin, v. 117, p. 288-306. Pope, A.D. Blair, J.J., and Link, P.K., 2001, Geologic Map of the Wakley Peak

Quadrangle, Bannock and Oneida Counties, Idaho: Idaho Geological Survey Technical Report T-01-4, scale 1:24,000, 1 sheet.



1. Armstrong, R.L., unpublished (1977), Geologic Map of the Northern Sublett Range,

2. Allmendinger, R.W., 1983, Geologic map of the North Hansel Mountains, Idaho and Utah: U.S. Geological Survey Map MF-1643, 1 plate, scale 1:24,000, Allmendinger, R.W., unpublished, dates unknown, geologic map of the north part of Sheep Creek Spring 7.5' quadrangle, scale 1:24,000, 1 sheet. 4. Carney, S.M., Janecke, S.U., Oriel, S.S., Evans, J.C., and Link, P.K., 2002, Geologic map of the Clifton Quadrangle, Franklin and Oneida Counties, Idaho: Idaho Geological Survey Technical Report T-03-4, scale 1:24,000, 2 sheets. 5. Coward, R.I., 1979, Geology of the Buist quadrangle, southern Idaho [M.S. Thesis]: Bryn Mawr, Pennsylvania, Bryn Mawr College, 30 p., scale 1:24,000, 5 sheets. 6. Cress, L.D., 1981, Stratigraphy and structure of the south half of the Deep Creek Mountains, Oneida and Power Counties, Idaho [Ph.D. Dissertation]: Boulder, Colorado School of Mines, 251 p., scale 1:48,000, 6 sheets. 7. DeVecchio, D.D., Oriel, S.S., and Link, P.K., 2003, Geologic Map of the Downey East Quadrangle and Regions of the Swan Lake, Oxford, and Cottonwood Peak Quadrangles, Bannock County, Idaho: Idaho Geological Survey Technical Report T-03-2, scale 1:24,000, 1 sheet. 8. Evans, J.C. Janecke, S.U., Oriel, S.S., and Carney, S.M., unpublished (1998), geologic map of the Malad City East 7.5' Quadrangle, scale 1:24,000, 1 sheet. 9. Hennings, B.G., Link, P.K., and Thackray, G.D., 2002, Geologic Map of the Downey West 7.5' Quadrangle; Plate 1 in Neogene structural evolution of southern Marsh Valley and Oxford Ridge: Dismemberment and uplift of a through going basin [M.S. Thesis]: Pocatello, Idaho State University, 100 p. 10. Hoggan, R.D., and Hait, M.H., Jr., unpublished (1981), Geologic map of the southern part of the Sublett Range, Oneida County, Idaho: scale 1:24,000, 11. Hurlow, H. A., 2004, Interim Geologic Map of the Curlew Valley Drainage Basin, Box Elder County, Utah, and Oneida and Cassia Counties, Idaho: Utah Geological

12. Link, P.K., 1982, Geologic Map of the Oxford and Malad Summit Quadrangles, Southeastern Idaho; Plate 1 in Geology of the Upper Proterozoic Pocatello Formation, Bannock Range, southeastern Idaho [Ph.D. Dissertation]: University of California, Santa Barbara, 131 p. 13. Long, S.P., Link, P.K., Janecke, S.U., and Rodgers, D.W., 2004, Geologic map of the Henderson Creek quadrangle, Oneida County, Idaho: Idaho Geological Survey Technical Report T-04-3, scale 1:24,000, 2 sheets. 14. Oriel, S.S., Platt, L.B., and Allmendinger, R.W., 1991, Reconniassance geologic map of the Elkhorn Peak Quadrangle, Bannock and Oneida Counties, Idaho United States Geological Survey, Miscellaneous Field Studies, Map MF-2162,

Survey Open-File Report 436; scale 1:100,000, 1 sheet.

15. Platt, L.B., 1977, Geologic Map of the Ireland Springs-Samaria area, Southeastern Idaho and Northern Utah: United States Geological Survey, Miscellaneous Field Studies, Map MF-890, scale 1:48,000, 1 sheet. 16. Platt, L.B., unpublished, dates unknown, geologic map of the Arbon 7.5' Quadrangle, 17. Platt, L.B., unpublished, dates unknown, geologic map of the Dairy Creek 7.5'

Quadrangle, scale 1:24,000, 1 sheet. 18. Platt, L.B., unpublished, dates unknown, geologic map of the Daniels 7.5' Quadrangle, scale 1:24,000, 1 sheet.

19. Pope, A.D. Blair, J.J., and Link, P.K., 2001, Geologic Map of the Wakley Peak Quadrangle, Bannock and Oneida Counties, Idaho: Idaho Geological Survey Technical Report T-01-4, scale 1:24,000, 1 sheet. 20. Rember, W.C., and Bennett, E.H., 1979, Geologic map of the Pocatello Quadrangle, Idaho; Idaho Geological Survey Geologic Map GM-13, scale 1:250,000, 21. Steely, A.N., and Janecke, S.U., 2005, Geologic Map of the Weston Canyon Quadrangle, Oneida County, Idaho: Idaho Geological Survey Technical Report