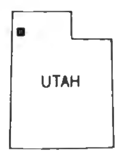
GEOLOGIC MAP OF THE LUCIN 4 NW QUADRANGLE, BOX ELDER COUNTY, UTAH

Linda L. Glick and David M. Miller
U.S. Geological Survey



UTAH GEOLOGICAL AND MINERAL SURVEY
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UTAH DEPARTMENT OF NATURAL RESOURCES
MAP 93 **1986**

GEOLOGIC MAP OF THE LUCIN 4 NW QUADRANGLE, BOX ELDER COUNTY, UTAH

By Linda L. Glick [1] and David M. Miller [2]

INTRODUCTION

The Lucin 4 NW quadrangle in northwest Utah (fig. 1) comprises lowland of the Great Salt Lake Desert, the north end of the Silver Island Mountains (known as Crater Island), and part of the Little Pigeon Mountains. In this part of Utah "island" is commonly applied to a mountainous feature that rises from mud flats or other flatland of the desert. Crater Island and the Little Pigeon Mountains, at elevations of 4,575 feet (1,394 m) and 4,480 feet (1,366 m), respectively, are the highest points in the quadrangle. The low desert land slopes gently southeastward from 4,270 to 4,220 feet (1,301 to 1,286 m) in elevation.

Mountainous parts of the Lucin 4 NW quadrangle are underlain by Permian sedimentary rocks of the Cordilleran miogeocline and by Jurassic granitoid rocks. The remainder of the quadrangle is covered by surficial deposits of Quaternary age, including alluvium, lake sediments, and eolian sand. Much of the Quaternary sediment was deposited in Pleistocene Lake Bonneville, which covered the entire quadrangle at its highest stand. The major structural features and physiography of the quadrangle—mountain ranges composed of pre-Cenozoic rocks and broad valleys filled with thick sequences of Cenozoic strata—resulted from one or more episodes of upper crustal extension in Neogene time.

Previous geologic studies in the quadrangle include small-scale mapping by Doelling (1980) and a detailed study of Crater Island by Anderson (1960). Companion reports to this one include the Pigeon Mountain, Jackson, and Lemay Island quadrangles (fig. 1; Glick and Miller, in press; Miller and Glick, 1986, in press).

STRATIGRAPHY

Permian Rocks

The Permian Badger Gulch Formation (Pbg) is exposed in a small area of the Little Pigeon Mountains within the Lucin 4 NW quadrangle, where it forms a broad wave-cut bench consisting of black, platy fragments of silty limestone. Interbedded with the silty limestone are thick bioclastic limestone beds that in some cases carry abundant fusulinids. The Badger Gulch Formation is correlated with the early Leonardian lower part of the Pequop(?) Formation in the Pilot Range (Miller, 1984).

Jurassic Rocks

In the northern part of Crater Island, part of a porphyritic biotite granitoid pluton greater than 3 miles^2 (7 km^2) in area is exposed. The bulk of this pluton is medium- to coarse-grained biotite granodiorite (Jpg) with phenocrysts of pink potassium feldspar up to 1 inch (2.5 cm) diameter. Hornblende and sphene are common accessory minerals. The coarse-grained granodiorite grades over a distance of 32 to 66 feet (10 to 20 m) into fine-grained, sparsely porphyritic monzogranite (Jfg). The phenocrysts in the fine-grained monzogranite are identical to the phenocrysts in the coarse-grained phase, including its phenocrystic potassium feldspar, and typically constitute about 10 percent by volume. The fine-grained phase contains at least one xenolith of the coarse-grained phase, about 1.6 inch (0.5 m) diameter, indicating that it is younger. A zone of fracturing, limonitic alteration, and quartz veins locally affects the fine-grained granite.

The granitoid pluton at Crater Island was divided in two stocks, termed the Sheepwagon and North stocks, by Anderson (1960), who considered them to be Tertiary. We consider the rocks to belong to one composite pluton. K-Ar determinations on biotite collected from the coarse-grained phase south of the Lucin 4 NW quadrangle gave 150.6 ± 3.8 Ma (J. K. Nakata, 1985, written commun.).

Quaternary Deposits

Alluvium, consisting in part of reworked late Pleistocene Lake Bonneville deposits, is exposed over much of the

[1] Operational Geologist, U.S. Geological Survey, Menlo Park, CA

[2] Geologist, U.S. Geological Survey, Menlo Park, CA

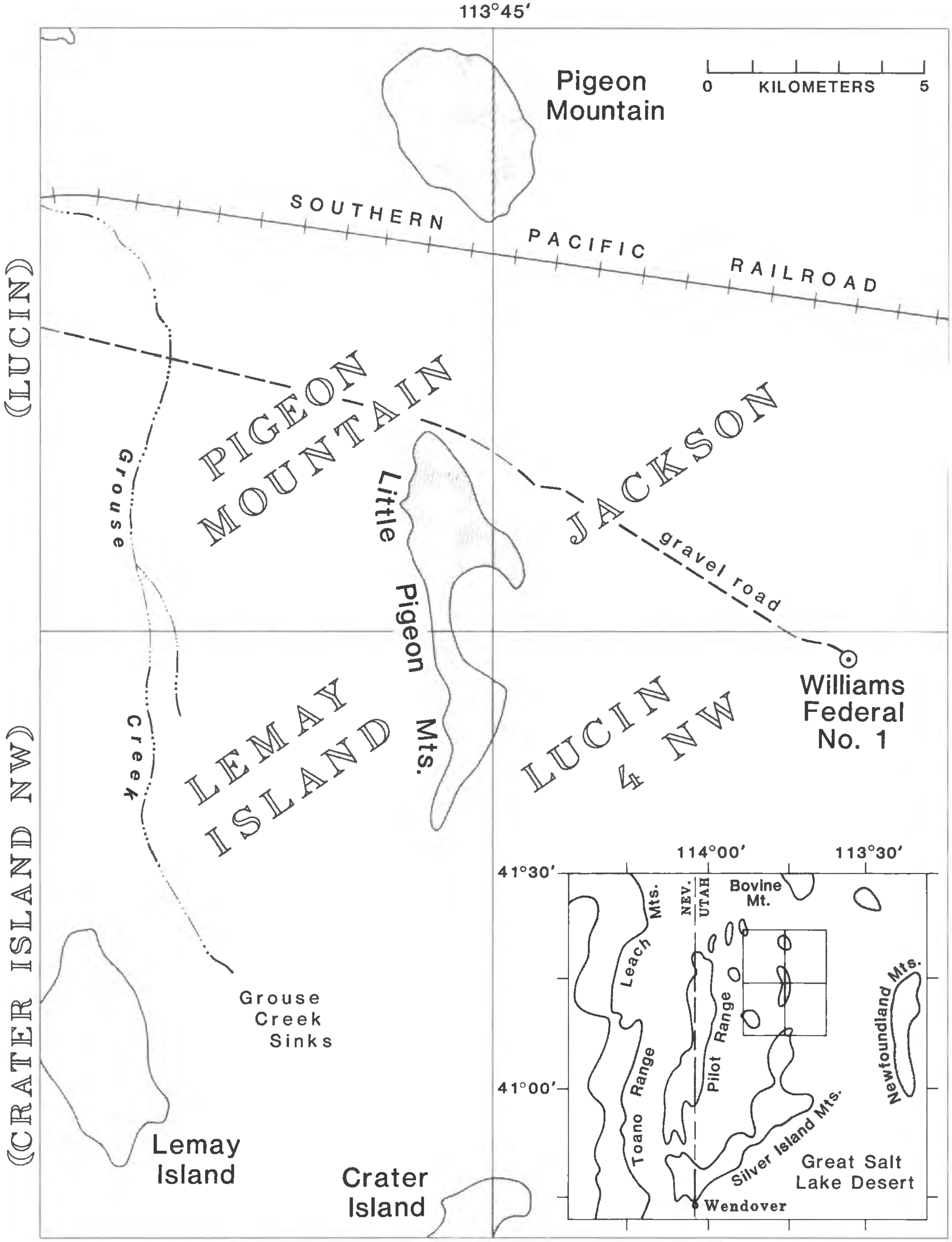

Figure 1. Location map showing mountains (shaded areas) and cultural features in the Lemay Island, Pigeon Mountain, Jackson, and Lucin 4 NW quadrangles, and location of quadrangles in northwest Utah.

quadrangle. A road to the Gulf-Williams Federal No. 1 drill hole (fig. 1) provided access to the northern part of the quadrangle where the Quaternary units were studied in detail. These units were extrapolated southward by interpretation of aerial photographs. The deposits in the Lucin 4 NW quadrangle are continuous with, and similar to, those in the adjacent Jackson and Lemay Island quadrangles (Miller and Glick, in press; 1986), to which the reader is referred for further detailed descriptions.

The Gilbert stand of Pleistocene Lake Bonneville is represented by shoreline gravel deposits at 4,260 feet (1,298 m) elevation in northern Crater Island and slightly higher along the west side of the Little Pigeon Mountains. This shoreline elevation, higher by 6.5 to 10 feet (2 to 3 m) than counterparts observed in the margin of the lake basin (Currey and others, 1984), closely matches elevations in the adjoining Jackson and Lemay Island quadrangles (Miller and Glick, 1986; in press; Currey, 1982) and in the Silver Island Mountains (D. M. Miller, 1985, unpubl. mapping).

Eolian oolitic sand: Eolian sand (Qeo) composed of greater than 50 percent ooids is exposed in the northeastern portion of the quadrangle. The sand is white to cream-colored and consists of spherical and strongly elliptical calcareous ooids. The ratio between spherical and elliptical ooids is about 2:1. The sand contains about 15 percent detrital evaporite minerals and variable, but small, amounts of rock fragments. The eolian oolitic sand forms dunes that generally trend north and are as high as 36 feet (11 m).

Alluvial mud: Alluvial mud deposits (Qam) in the Lucin 4 NW quadrangle underlie gray and brown, sparsely vegetated plains. Evaporite salts as patchy thin crusts and radially oriented cracks and ridges caused by dessication and salt expansion are common. Thin, platy chips of well indurated calcite locally are scattered on the surface. In the northern part of the quadrangle near outcrops of lacustrine oolite in the Jackson quadrangle, ooids are present in the alluvial mud. Western exposures of the alluvial mud unit are somewhat darker and coarser than to the east, only rarely contain evaporite minerals, and are moderately vegetated with small shrubs and occasional black algae.

Alluvial gravel: Sinuous gravel ridges grading laterally into, and overlain by, finer grained alluvial deposits probably represent stream channel deposits. These gravel deposits (Qag) are continuous with east-trending gravel deposits (Qag_E) in the Pigeon Mountain quadrangle. The deposits form slightly raised ridges showing topographic inversion due to the high erosional resistance of the gravel relative to that of the surrounding alluvium.

STRUCTURAL GEOLOGY

No structures are exposed in bedrock or Quaternary surficial deposits in the Lucin 4 NW quadrangle. Cook and others (1964) inferred, on the basis of sparse data from gravity surveys, that shallowly buried bedrock connects Crater Island and the Little Pigeon Mountains as a continous ridge. Northeast of Crater Island, the gravity survey delineated a graben about 5,400 feet (1,646 m) deep. This graben apparently shoals to the north; in the northern part of the Lucin 4 NW quadrangle a drill hole intersected Paleozoic(?) strata at a depth of 2,660 feet (811 m) (Cook and others, 1964, p. 733). This drill hole, the Gulf-Williams Federal No. 1, is located on the accompanying map.

ECONOMIC DEPOSITS

No mines, quarries, or prospect pits were observed in the Lucin 4 NW quadrangle during mapping, nor were any described in a recent compilation of the economic geology of Box Elder County by Doelling (1980). Two possible sources for mineral resources occur in the quadrangle; the potential for each is unknown and has not been evaluated.

(1) Jurassic granodiorite in Crater Island has skarn mineralization just south of the Lucin 4 NW quadrangle. Tungsten (Doelling, 1980) and industrial-grade garnet are possible resources. Such a skarn deposit may be buried under lacustrine deposits in the Lucin 4 NW quadrangle. Reddish-brown limonitic alteration of the granodiorite occurs in a highly fractured zone containing quartz veins in sections 23 and 24, T. 5 N., R. 17 W. Casts of pyrite in this zone suggest metal enrichment.

(2) Brines at shallow depth in playas along the southern and eastern parts of the Lucin 4 NW quadrangle may contain resources such as potash and lithium (Nolan, 1927; Lines, 1979).

GEOLOGIC HAZARDS

Flooding caused by locally heavy precipitation or sustained areal precipitation is a hazard in the Lucin 4 NW quadrangle. The roughly 95 percent of the quadrangle forming poorly drained flatland is subject to short-duration floods during local heavy rainfall. Fine-grained and sparsely vegetated soils in the flatland are generally slippery and soft when wet. The low topographic gradients in the Lucin 4 NW quadrangle promote the distribution of waters along meandering channels and by sheetflood processes, making it difficult to predict flood locations.

The eastern part of the quadrangle lies at elevations near levels that have been flooded by lakes during the late Holocene (C. G. Oviatt, 1985, written commun.), suggesting that climatic changes in the future could cause submergence of this area by water ponding in this closed basin or by the floodwaters of the enlarged Great Salt Lake which would spill westward to join this basin's floodwaters.

Unstable eolian sands, which are more than 3 feet (1 m) thick in about 5 percent of the quadrangle and are present as thinner deposits in much of the remainder of the quadrangle, are subject to migration, particularly when disturbed.

Faults bordering the Pilot Range about 14 miles (24 km) west of Crater Island cut Quaternary deposits and may be as young as early Holocene (Miller and others, 1982; Miller and Schneyer, 1985). Although the frequency and magnitude of earthquakes along this fault system are unknown, there is potential for earthquakes affecting the Lucin 4 NW quadrangle.

ACKNOWLEDGMENTS

We are indebted to Jack Oviatt for providing helpful expertise during field visits and discussions. Geochronologic data were provided by John K. Nakata. Helpful reviews by Paul Stone and Jack Oviatt greatly improved earlier versions of this manuscript.

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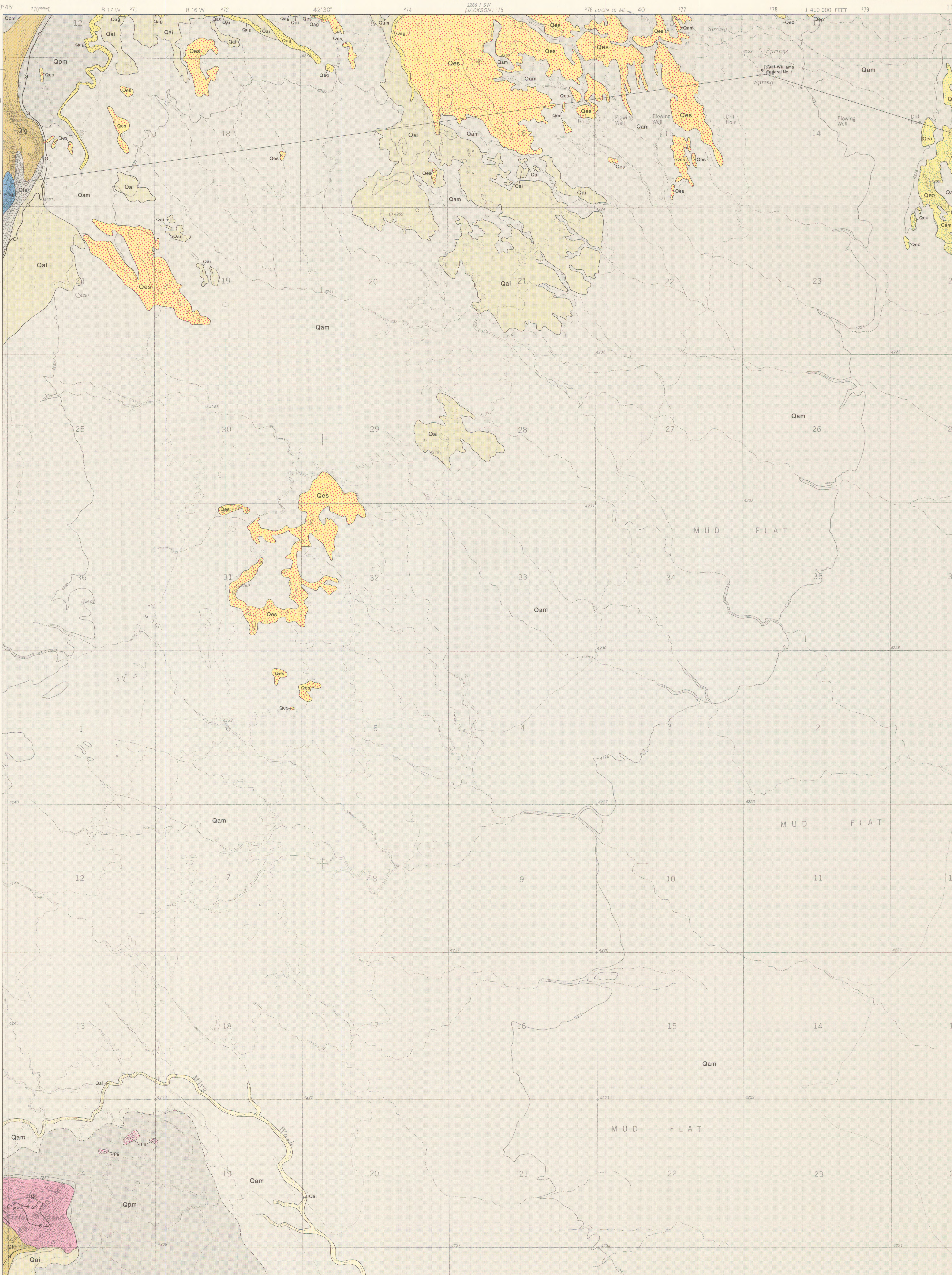

Base from U.S. Geological Survey, Lucin 4 NW Quadrangle 1983

SCALE 1:24 000

1 MILE

7000 FEET

1 KILOMETER

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Field mapping by authors in 1984-85.
Patricia H. Speranza, Cartographer

UTM GRID AND 1983 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

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U.S. Geological Survey

QUADRANGLE LOCATION

1986

CONTACT

Dashed where gradational

TRACE OF LAKE SHORELINE

—S——S— Stansbury

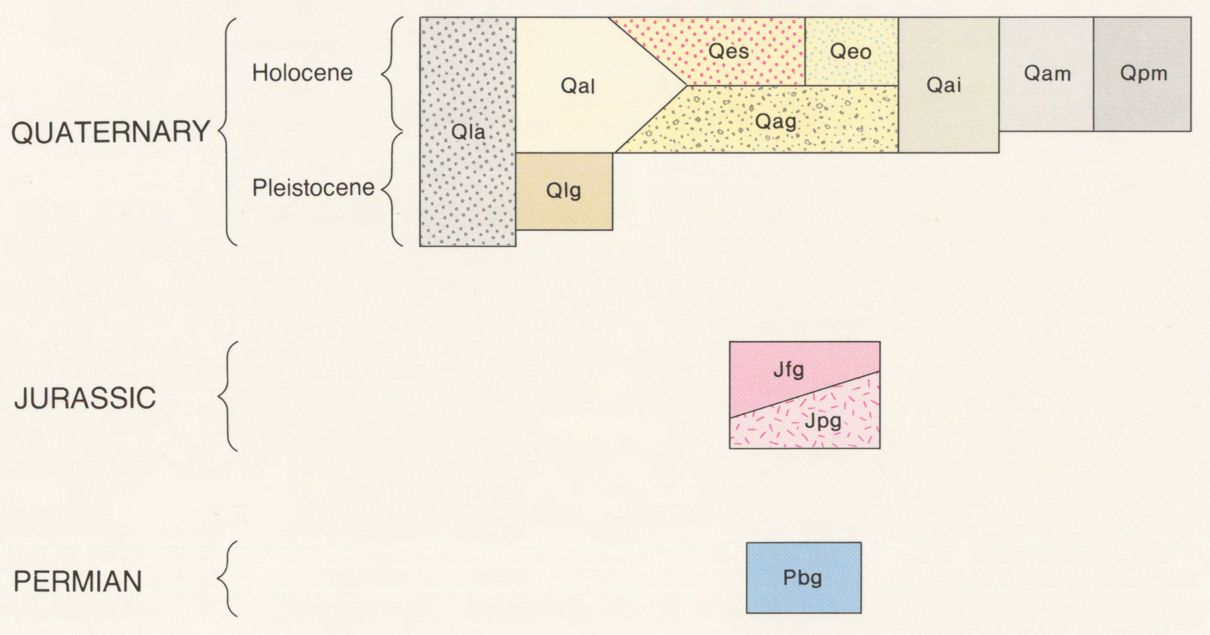
—G——G— Gilbert

ZONE OF ALTERATION

DRILL HOLE

FORMATION	SYMBOL	THICKNESS feet (meters)	LITHOLOGY
Badger Gulch Formation	Pbg	400 (120)	

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qla — Lacustrine and alluvial deposits, undivided—*Alluvium older than Lake Bonneville etched by erosional shorelines, and locally covered by thin lacustrine gravel and sand deposits.*

Qal — Alluvium—*Unconsolidated silt, sand, and fine pebble gravel in ephemeral streams and washes.*

Qes — Eolian sand—*Unconsolidated tan to light-brown, fine- to medium-grained sand and tan silt, occurring as complexes of small (2-m-high) dunes. Commonly contains detrital evaporite minerals; locally also ooids. Most dune complexes are vegetated.*

Qeo — Eolian oolitic sand—*White oolitic sand sheets and dunes as high as 11 m. Clasts are predominantly spherical and elliptical ooids with lesser quartz silt and evaporite minerals.*

Qai — Alluvial silt—*Unconsolidated tan silt, clay, and fine sand. Generally underlies flat surfaces, but locally includes eolian mounds less than one meter high. Dessication features, vegetation, and black algae are common.*

Qam — Alluvial mud—*Unconsolidated clay, silt, and soluble salts in low-lying areas with characteristic development of ephemeral, low-gradient drainage systems.*

Qpm — Playa mud—*Unconsolidated clay, silt, and white soluble salts in nearly level, undrained, vegetation-free basins.*

Qag — Alluvial gravel—*Fine to coarse pebble gravel deposited in stream channels discordant with present drainage systems. Maximum clast size is about 3 cm. Deposits generally form narrow, sinuous ridges.*

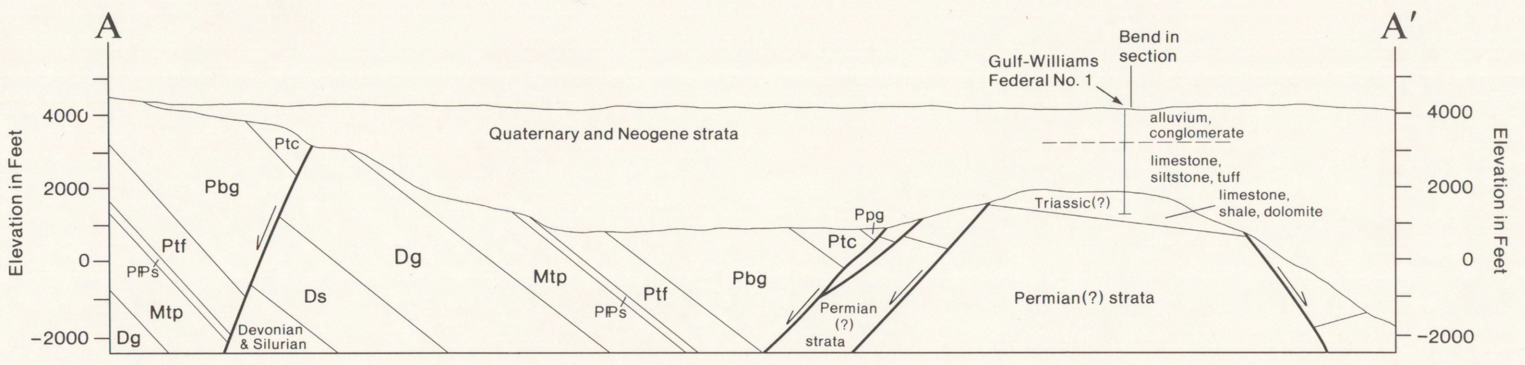
Qlg — Lacustrine gravel and sand, undivided—*Unconsolidated gravel and sand forming shoreline deposits of Lake Bonneville. Clasts are well rounded and size-sorted, commonly with little matrix. Locally forms beachrock cemented by calcareous silt.*

Jfg — Fine-grained granite—*Pale-gray, fine-grained, biotite monzogranite with sparse phenocrysts of biotite, quartz, plagioclase, and potassium-feldspar.*

Jpg — Porphyritic granodiorite—*Pale-gray, biotite granodiorite that contains phenocrysts of pink potassium-feldspar as large as 2.5 cm diameter in a medium- to coarse-grained groundmass of quartz, plagioclase, potassium-feldspar, and biotite. Diorite inclusions and pink aplite dikes common.*

Pbg — Badger Gulch Formation—*Dark-gray to black, platy, silty limestone with bioclastic beds.*

One possible configuration of subsurface structure and stratigraphy, based on outcrops, drill hole data and gravity data.



DESCRIPTION OF CROSS SECTION UNITS

QN — Quaternary and Neogene strata —*Contains lacustrine, alluvial, eolian, and playa deposits, and tuff, sandstone, siltstone, and limestone.*

Ppg — Grandeur Formation of the Park City Group—*Cherty dolomite with thin interbeds of laminated sandstone and bedded chert.*

Ptc — Trapper Creek Formation—*Bioclastic limestone alternating with thin beds of silty limestone, ribbed sandy limestone and dolomite, gray-brown dolomite, and clean gray limestone.*

Pbg — Badger Gulch Formation—*Platy, silty limestone with bioclastic beds.*

Ptf — Third Fork Formation—*Calcareous sandstone; Upper part contains interbeds of gray to black, fossiliferous, platy limestone.*

PIPs — Strathearn(?) Formation—*Conglomerate and sandstone.*

Mtp — Tripon Pass Limestone—*Black, platy, shaly to silty limestone.*

Dg — Guilmette Formation—*Massive to thick-bedded, dark-gray limestone and dolomite.*

Ds — Simonson Dolomite—*Interlayered dark- to light-gray calcareous dolomite.*