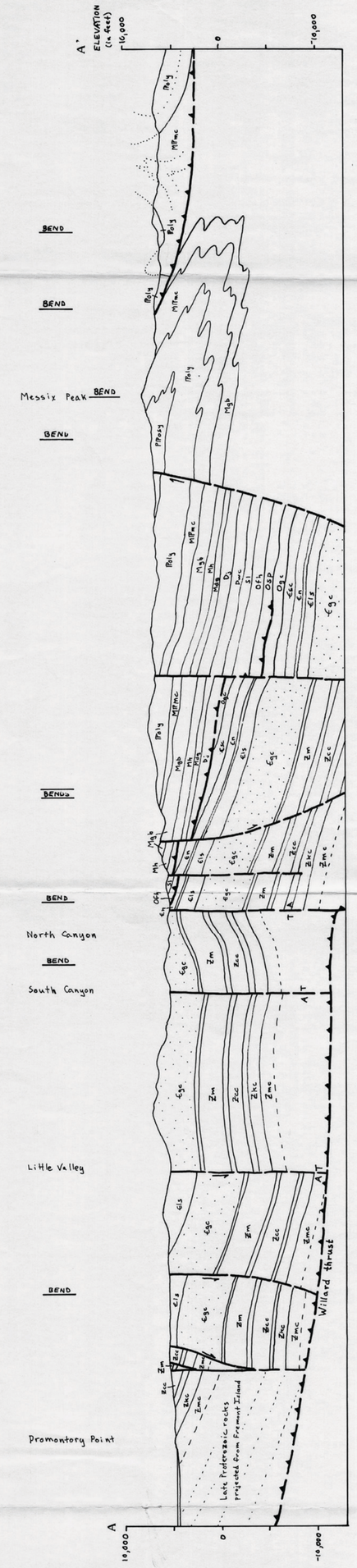
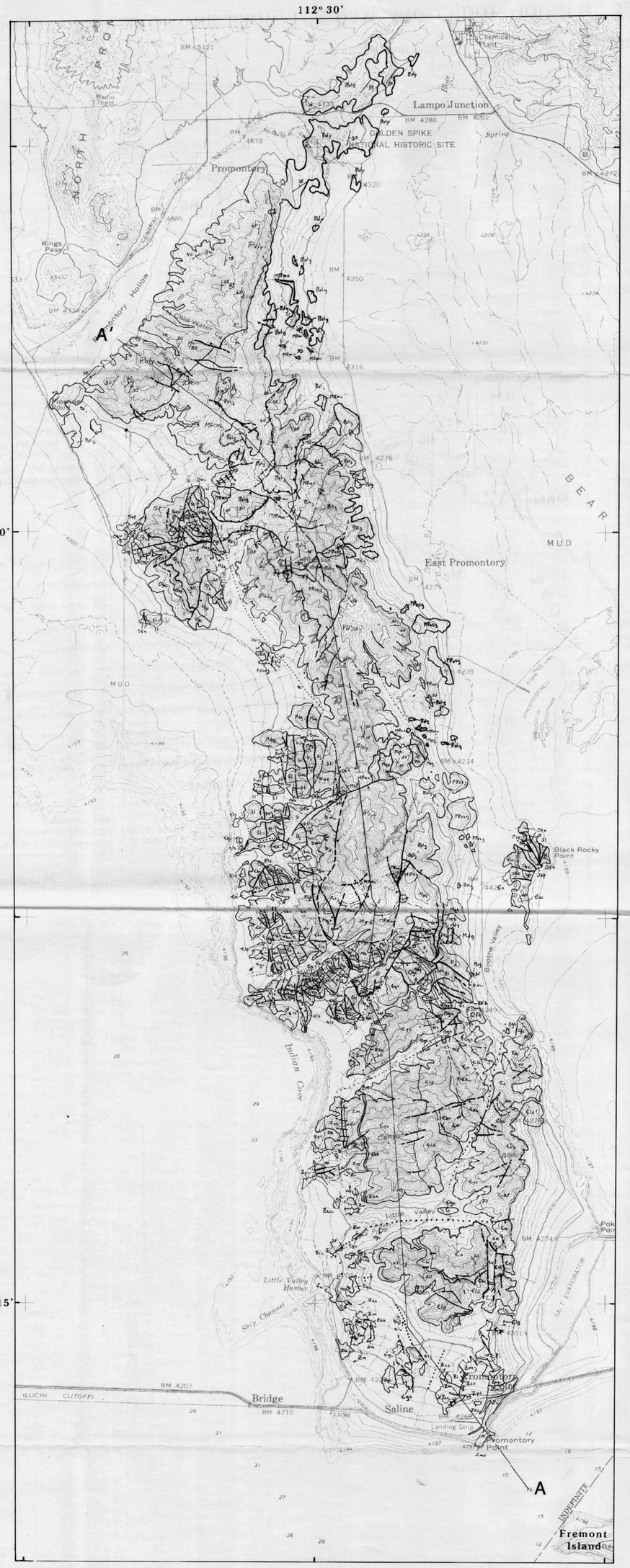
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 88-646



GENERALIZED CROSS SECTION

No vertical exaggeration



Base from U.S. Geological Survey, 1:125,000, Great Salt Lake and Vicinity, Utah, 1974

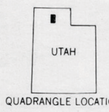
Geology mapped 1979-1981, assisted by Larry Smith 1979 and Joel Schneyer 1981

SCALE 1:100 000

1 ½ 0 1 2 3 4 5 STATUTE MILES

1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 100 FEET



QUADRANGLE LOCATION

CORRELATION OF MAP UNITS

PPosy	PERMIAN
IPoly	PENNSYLVANIAN
MPmc	MISSISSIPPIAN
Mgb	
Mh	
Mdg	
Dj	DEVONIAN
Dwc	
Sl	SILURIAN
Ofh	ORDOVICIAN
Osp	
Ogc	
Csc	
Cn	
Cbc	CAMBRIAN
Cls	
Cgc	
Zbh	LATE PROTEROZOIC
Zm	
Zi	
Zcc	
Zpc	
Zkc	
Zmc	

DESCRIPTION OF MAP UNITS

Oquirrh Formation--Divided into:

PPosy **Sandy member (Permian and Pennsylvanian)**--Sequence of alternating medium-gray- to tan-weathering non-resistant calcareous sandstone or siltstone, and limestone. Shows marked bioturbation beginning about 300 m above the base, which appears as 1-2 mm curved burrows filled with pale greenish-gray silt that weather out as crescentic pits particularly evident on surfaces normal to bedding. A 50-m-thick unit of pale brown-weathering calcareous quartzite is present near the top of the unit. Top not exposed.

IPoly **Limy member (Pennsylvanian)**--Ledge-forming medium-gray, coarse-grained, medium- to thick-bedded, bioclastic limestone, and non-resistant light-brown-weathering siltstone or sandstone. Individual limestone beds are 1 to 10 m thick and commonly can be traced for 1-2 km along strike. Limestones commonly are very fossiliferous with abundant brachiopods, corals, and bryozoans. Fusulinids abundant in upper part of member. Dark-brown-weathering, sandy-appearing chert becomes increasingly abundant downward, in places forming intricately interlaced networks that constitute as much as 50% of limestone beds up to 1 m thick.

MPmc **Manning Canyon Shale (Lower Pennsylvanian and Upper Mississippian)**--Black phyllitic shale, thin-bedded brown-weathering limy siltstone, and very fine-grained sandstone. Virtually the only resistant beds are massive ledges of dark-brown-weathering cross-bedded quartzite 10 to 30 m thick, locally shown on map as pair of solid lines. The uppermost beds of the formation include thin-bedded pinkish-gray limestone containing abundant brachiopods and bryozoans, by which the formation grades into the overlying Oquirrh Formation.

Mgb **Great Blue Limestone (Mississippian)**--Lower part (250 m) is massive, cliff-forming dark-gray limestone characterized by very abundant corals (Faberophyllum). Upper part (260 m) is medium- to thin-bedded dark-blue-gray silty limestone and limey siltstone, less resistant and cliffy than lower part. Fossils mostly bryozoans and sparse brachiopods.

Mh **Humbug Formation (Mississippian)**--Thick-bedded, reddish-brown-weathering sandstone and medium-gray-weathering limestone.

Mdg **Deseret Limestone and Gardison Limestone, undivided (Mississippian)**-- Upper part is thick-bedded dark-gray-weathering cherty limestone and dolomite. Lower part is thin-bedded medium-gray-weathering limestone and silty limestone with very abundant small solitary corals, brachiopods, and bryozoans. Along the east side of the range opposite Booth Valley this unit rests on the Jefferson Formation. To the northwest, however, on Mt. Tarpey, the thin-bedded limestone of the Gardison appears to rest directly on pale-gray laminated beds of the Water Canyon Formation.

Dj **Jefferson Formation (Devonian)**--Dark-gray to black, massive limestone containing ovoid vugs and pods of white calcite scattered along bedding planes. Includes a few beds of white- to pale-brown-weathering quartzite up to 1 m thick.

Dwc **Water Canyon Formation (Devonian)**--Very pale gray, thick-bedded, commonly laminated dolomite. Locally may be intercalated with a few thin beds of pale-gray quartzite that have yielded fish plates.

Sl **Laketown Dolomite (Silurian)**--Thick-bedded, massive, mainly medium-gray dolomite with sparse colonial corals. On the west side of the range the unit includes a 25-m-thick bed of very-dark-gray dolomite at the top, which separates it from the overlying light-colored beds of the Water Canyon Formation.

Ofh **Fish Haven Dolomite (Ordovician)**--Thick-bedded, massive, nearly black dolomite spangled by vugs and intersecting veinlets of white calcite. Locally contains abundant colonial corals.

Osp **Swan Peak Quartzite (Ordovician)**--Thick-bedded, massive, white, pale gray, or light brown quartzite that is dense, vitreous, and fine-grained. Grades downward into platy-weathering light-brown shale. In many parts of the area the quartzite shows extreme brecciation and is drastically thinned; in such places the shale typically is absent. Pods and lenses of quartzite breccia appear along many faults.

Ogc **Garden City Formation (Ordovician)**--Medium- to thick-bedded, medium-gray limestone characteristically netted by wavy laminae of siltstone. Locally contains abundant intraformational conglomerate. In most places, the contact with the underlying St. Charles Dolomite can be readily identified by the sudden downward change to dolomite. Locally, parts of the Garden City are dolomitized (as along the north slope of North Canyon east of Squaw Flat); even there, however, the typical netted pattern can be recognized.

Ꞓsc **St. Charles Dolomite (Upper Cambrian)**--Thin- to thick-bedded dark-gray dolomite characterized by a variety of mottled and twiggy structures like those of the underlying Nounan. Separated from the latter by a few meters of fine-grained sandstone (Worm Creek Quartzite member) whose grains are well-rounded with a suggestion of wind-polish.

Ꞓn **Nounan Dolomite (Upper Cambrian)**--Thick-bedded, massive, medium- to dark-gray dolomite marked by a wide variety of mottled and spotted patterns expressed in degrees of gray color and grain size, on which are superimposed a series of twig-like structures formed of light-gray to white calcite.

Ꞓbc **Calls Fort Shale Member of the Bloomington Formation (Middle Cambrian)**--Distinctive unit consisting of nodular limestone enclosed in cherty shale. It is correlated with the Calls Fort Shale Member of the Bloomington Formation of the Cambrian section in the Bear River and Wasatch Ranges to the east (Maxey, 1958; Oviatt, 1986).

Ꞓls **Limestone and shale (Middle and Lower Cambrian)**--Interbedded thin-bedded medium-gray limestone and olive-drab shale. The carbonate rocks in the upper part of the unit, immediately below the overlying Calls Fort Shale, include one or more beds from 1 to 3 m thick of pale-gray to nearly white laminated dolomite enclosed in limestone formed of two colors-- dark-gray and medium-blue-gray. This distinctive part of the unit is recognized in the Wasatch Range and at Promontory Point. Limestone intervals in the lower parts of this map unit consist of medium-gray limestone marked by wavy tan silty wisps characteristic of the Cambrian. Shale intervals correlated with the Wheeler Shale and Spence Shale occur within the limestone and shale unit. At its base is intensely folded, dense, yellowish-gray cherty argillite and medium-gray to pinkish limestone that was referred to as the Pioche Formation by Olson (1960). This Pioche unit commonly is highly deformed as a result of shearing along the contact with the underlying quartzite.

Ꞓgc **Geertsen Canyon Quartzite (Lower Cambrian)**--Uppermost 100 m consists of deep reddish-black hematitic quartzite. This unit closely resembles rocks that form the upper part of the Prospect Mountain Quartzite in the Drum Mountains and the nearby Dugway Ranges in central western Utah. The main body of the Geertsen Canyon consists of pale-gray, pinkish-gray, or light-brown quartzite, commonly with scattered pebble-size clasts, dominantly of vein quartz, but generally including some red jasper. A zone of pebble- to cobble-conglomerate a few tens of meters thick is usually recognizable about a third of the way up in the formation. The basal 50 to 100 m of the formation is commonly coarse grained and commonly shows a distinctive streaky mixture of bluish-purple and greenish-gray colors, and contains abundant angular fragments of salmon-colored microcline. As a result, it is non-resistant compared with both the remainder of the formation and with the immediately underlying vitreous quartzite of the Browns Hole Formation.

Zbh **Browns Hole Formation (Late Proterozoic)**--Pale-gray, very-fine-grained vitreous quartzite. Both the grain-size and the color cause this unit to form a marked light-colored band that contrasts with the quartzites of the overlying and underlying units.

Zm **Mutual Formation (Late Proterozoic)**--Thick-bedded coarse-grained quartzite intercalated with a few beds of siltstone and shale, both characterized by a distinctive color commonly referred to as red-purple (grayish-red of the color chart). This unit is particularly well exposed in quarries on the southwest side of the Promontory Range where it was used as a source of rip-rap for the Southern Pacific causeway across the western arm of the lake. In these quarries and on the slopes immediately to the east, the Mutual is cut by numerous dark-brown-weathering igneous dikes that were the site of considerable prospecting activity in early days. Another feature of these exposures is that the characteristic grayish-red color is widely altered to a dirty brown or green. The color change may have been caused by bleaching or have resulted from sedimentary facies changes.

Zi **Inkom Formation (Late Proterozoic)**--The massive ledges of the Mutual Formation rest on a non-resistant unit consisting largely of thin-bedded siltstone, shale, and a few beds of a distinctive and widespread white vitric tuff. In outcrops in the Wasatch Range east of Huntsville, the Inkom is a distinctive two-part unit, the lower part typically olive drab or greenish-gray, and the upper part grayish-red, matching that of the overlying Mutual. In exposures along the west side of the Promontory Range the Inkom is much more variable, including considerably more quartzite than the same unit in the Wasatch, and the color is also considerably greener. It seems probable that these changes are a result primarily of sedimentary facies changes associated with deeper water and a less oxidizing environment.

Zcc **Caddy Canyon Quartzite (Late Proterozoic)**--The non-resistant beds of the Inkom Formation rest on a series of quartzite beds with a few intercalated shales that are correlated with similar rocks that occupy a corresponding position in the section at Pocatello, Idaho (Crittenden and others, 1971; Trimble, 1976). In exposures along the western side of the range, south of Squaw Flat, the uppermost beds of the Caddy Canyon Quartzite form a projecting slickensided wall that can be traced readily both on the ground and on aerial photos. The quartzite that forms the upper part of the Caddy Canyon Quartzite is thick-bedded, locally conglomeratic, and marked by large (1-3 m) strongly-distorted rip-up clasts of olive-drab shale. Farther down-section the unit consists of thick beds of gray or tan quartzite locally intruded by sills of greenish-brown andesite or basalt. Locally these sills bulge out to form bulbous masses up to 150 m thick. A; its base, the Caddy Canyon is intercalated with thin-bedded dark-gray siltstone that grades into the underlying Papoose Creek Formation.

Zpc **Papoose Creek Formation (Late Proterozoic)**--The Caddy Canyon Quartzite grades downward into thin-bedded dark-gray shale, siltstone, and quartzite that exhibit the distinctive bedding features that characterize the Papoose Creek Formation both in Idaho and in the Wasatch Range to the east. In both areas, dark-brown- or green-weathering siltstone partings alternate with thin beds of pale-gray fine-grained quartzite. Bedding surfaces typically show syneresis cracks injected with fine-grained light-gray or greenish quartzite. On surfaces at right angles to bedding, the cracks can be seen to have been compressed normal to bedding, resulting in distinctive "squiggled mud cracks" that are regarded as characteristic of the formation. These features have been recognized from Pocatello, on the north, through the northern Wasatch, the Promontory Range (here), to the Sheep Rock Range in central Utah. In the Wasatch, the Papoose Creek can be seen to grade abruptly into the dark shales of the underlying Kelley Canyon Formation, but the base is not exposed in the Promontory Mountains.

Zkc **Kelley Canyon Formation (Late Proterozoic)**--Thin-bedded, friable, black sooty graphitic shale and thin beds of brown-weathering fine-grained sandstone, both intruded by intensely altered sills of diabase. These lithologies are well exposed in pits dug along the railroad right-of-way east of the marina at the south tip of Promontory Point.

Zmc **Maple Canyon Formation (?) (Late Proterozoic)**--Beginning at the inner end of the old sheep-loading pier, at the south end of the peninsula, is exposed a series of distinctive units that are tentatively assigned to the Maple Canyon. These include several meters of very-dark-gray pebbley granule quartzite that resembles the matrix of diamictite units in the Formation of Perry Canyon (exposed to the south at Fremont Island). Immediately over the granule quartzite is 2-3 m of pale pinkish-buff laminated dolomite that resembles beds in the Maple Canyon Formation in the Wasatch Mountains east of Huntsville. After an interval covered by the ditch conveying brine from the western arm of the lake, the section continues to expose thick-bedded massive quartzite beds that form the knoll at the inner end of the new jetty. These units bear little resemblance in detail to the beds of the Maple Canyon Formation of the Wasatch, and are only questionably assigned to this unit. These beds are the lowest exposed on Promontory Point, and it seems certain that the Late Proterozoic section continues on Fremont Island to the south, where it includes beds of glacial origin assigned to the Formation of Perry Canyon.

STRUCTURE

Since the recognition of the Willard thrust in the Wasatch Mountains by Blackwelder (1910), it has been supposed that this structure must underlie that part of the Wasatch Mountains characterized by a thick section of Late Proterozoic rocks, and presumably that part of the Great Basin with a similar character as well. Further, it has been hypothesized for some time (Crittenden, 1972, 1982) that the subsurface trace of the Willard thrust in the downthrown western block of the Wasatch fault passes somewhere between Antelope and Fremont Islands. Recent restudy by Hedge and others (1983) of the crystalline rocks that form the bulk of Antelope Island has confirmed their assignment to the Farmington Canyon Complex that crops out almost continuously from Ogden to Bountiful (Bryant, 1979). For much of this distance, the Farmington Canyon is overlain unconformably by the Tintic Quartzite; rocks of Late Proterozoic age that characterize the upper plate of the Willard thrust are generally absent in this lower plate. The trace of the Willard thrust apparently passes south of the thick Late Proterozoic sequence of the Promontory Mountains and Fremont Island, and north of the lower plate exposures of the Farmington Canyon Complex at Antelope Island.

The Promontory Mountains exhibit some 8 km thickness of the upper plate of the Willard thrust, in which three major structural units are indicated by their internal structure: (1) a lower unit containing Late Proterozoic and Cambrian strata, (2) a middle unit of Ordovician to Upper Mississippian strata, and (3) an upper unit of Upper Mississippian to Lower Permian strata. The lower structural unit consists of approximately homoclinal blocks bounded by northeast-striking high-angle faults. Locally (at Broadmouth Canyon), a thrust fault duplicates Cambrian strata. The second structural unit is floored by a low-angle fault that omits stratigraphic section near the Swan Peak Quartzite, placing rocks as young as Mississippian on Cambrian. This middle structural unit is highly broken by high-angle faults of virtually all orientations, and the basal low-angle fault is only exposed in a few locations. The upper structural unit occupies the northern half of the range, comprising the Manning Canyon Shale and overlying Oquirrh Formation. This unit exhibits folds, overturned to the southeast, that have amplitudes of hundreds to thousands of meters. Locally, a low-angle fault places the Manning Canyon Shale over the Oquirrh Formation.

High-angle faults in the lower structural unit may have acted as tear faults for the underlying Willard thrust, and probably in part were formed during Cenozoic extension as well. The homoclinal structure of the lower and middle structural units strongly contrasts with the giant overturned folds of the upper structural unit, suggesting that the upper unit is detached from the others, perhaps within the Manning Canyon Shale (Crittenden, 1982). The highly broken middle structural unit may represent a different material response than the folding above, or may represent a faulting event separate from that represented within the other units.

The degree of disharmony between the upper structural unit and underlying rocks appears to decrease southward within the Promontory Mountains. This relation perhaps indicates that the southern margin of the detached region to the north, where the Oquirrh Formation has been thrust eastward along a decollement within the Manning Canyon Shale (Oriel and Platt, 1979; Allmendinger and Jordan, 1981; Crittenden, 1982; Allmendinger and Platt, 1983; Allmendinger and others, 1984), lies within the Promontory Mountains.

ACKNOWLEDGEMENTS

The geologic mapping of the Promontory Mountains was greatly aided by the capable field assistance of Larry Smith and Joel Schneyer, and by fossil identifications by R.C. Douglass, Mackenzie Gordon, Jr., O.L. Karklins, and W.J. Sando. To these persons and many others who visited in the field and enthusiastically discussed the geology of the Promontory Mountains, I am indebted.

ADDENDUM

Following the untimely death of the author, fossils from the Promontory Mountains under study by Mackenzie Gordon, Jr. revealed discrepancies within Upper Devonian and Lower Mississippian rocks. The discrepancies suggest that although the map units are internally consistent, the stratigraphic nomenclature in places does not match with fossil ages, and therefore is in need of revision. This revision will require further detailed study.

This map was assembled from materials prepared by Crittenden, and minor additions were made by David M. Miller to complete the map and explanation. Inquiries should be directed to Miller at the U.S. Geological Survey, Menlo Park, California 94025.

REFERENCES

Allmendinger, R.W. and Jordan, T.E., 1981, Mesozoic evolution, hinterland of the Sevier orogenic belt: Geology, v. 9, p. 308-313.

Allmendinger, R.W., and Platt, L.B., 1983, Stratigraphic variation and low-angle faulting in the North Hansel Mountains and Samaria Mountain, southern Idaho, in Miller, D.M., Todd, V.R., and Howard, K.A., eds., Tectonic and stratigraphic studies in the eastern Great Basin: Geological Society of America Memoir 157, p. 149-164.

Allmendinger, R.W., Miller, D.M., and Jordan, T.E., 1984, Known and inferred Mesozoic deformation in the hinterland of the Sevier Belt, northwest Utah, in Kerns, G.J. and Kerns, R.L., eds., Geology of northwest Utah, southern Idaho, and northeast Nevada: Utah Geological Association Publication 13, p. 21-34.

Blackwelder, Eliot, 1910, New light on the geology of the Wasatch Mountains, Utah: Geological Society of America Bulletin, v. 21, p. 517-542.

Bryant, Bruce, 1979, Reconnaissance geologic map of the Precambrian Farmington Canyon Complex and surrounding rocks in the Wasatch Mountains between Ogden and Bountiful: U.S. Geological Survey Open-File Report 79-709, scale 1:50,000.

Crittenden, M.D., Jr., 1972, Willard thrust and the Cache allochthon, Utah: Geological Society of America Bulletin, v. 83, p. 2871-2880.

_____, 1982, Younger-over-older low-angle faults of the Sevier orogenic belt in the Promontory Range, northern Utah: Geological Society of America Abstracts with Programs, v. 14, p. 308.

Crittenden, M.D., Jr., Schaeffer, F.E., Trimble, D.E., and Woodward, L.A., 1971, Nomenclature and correlation of some upper Precambrian and basal Cambrian sequences in western Utah and southeastern Idaho: Geological Society of America Bulletin, v. 82, p. 581-602.

Hedge, C.E., Stacey, J.S., and Bryant, Bruce, 1983, Geochronology of the Farmington Canyon Complex, Wasatch Mountains, Utah, in Miller, D.M., Todd, V.R., and Howard, K.A., eds., Tectonic and stratigraphic studies in the eastern Great Basin: Geological Society of America Memoir 157, p. 37-44.

Maxey, G.B., 1958, Lower and Middle Cambrian stratigraphy in northern Utah and southeastern Idaho: Geological Society of America Bulletin, v. 69, p. 647-688.

Olson, R.H., 1960, Geology of the Promontory Range, Box Elder County, Utah: Unpubl. Ph.D. thesis, University of Utah, Salt Lake City, Utah, 254 p.

Oriel, S.S., and Platt, L.B., 1979, Younger-over-older thrust plates in southeastern Idaho: Geological Society of America Abstracts with Programs, v. 11, p. 298.

Oviatt, C.G., 1986, Geologic map of the Honeyville quadrangle, Box Elder and Cache Counties, Utah: Utah Geological and Mineral Survey Map 88, scale 1:24,000.

Trimble, D.E., 1976, Geology of the Michaud and Pocatello quadrangles, Bannock and Power Counties, Idaho: U.S. Geological Survey Bulletin 1400, 88 p. scale 1:48,000.

SYMBOLS

CONTACT--Dashed where location imprecise; queried where location uncertain; dotted where covered

57 HIGH-ANGLE FAULT--Dashed where location uncertain; dotted where covered. Bar and ball on downthrown side, dip indicated

LOW-ANGLE FAULT--Dashed where location uncertain; dotted where covered. Sawteeth on upper plate

BEDDING

17 Upright

Vertical

78 Overturned

FOLDS

Overturned syncline

Overturned anticline

U.S. GEOLOGICAL SURVEY RESTON VA
DEC 2 1988
LIBRARY

M(200)
R290
no. 88-646
c. 1

BEDROCK GEOLOGIC MAP OF THE PROMONTORY MOUNTAINS, BOX ELDER COUNTY, UTAH

By
Max D. Crittenden, Jr.
1988

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

USGS LIBRARY - RESTON
3 1818 00378606 6

OFR 88-646