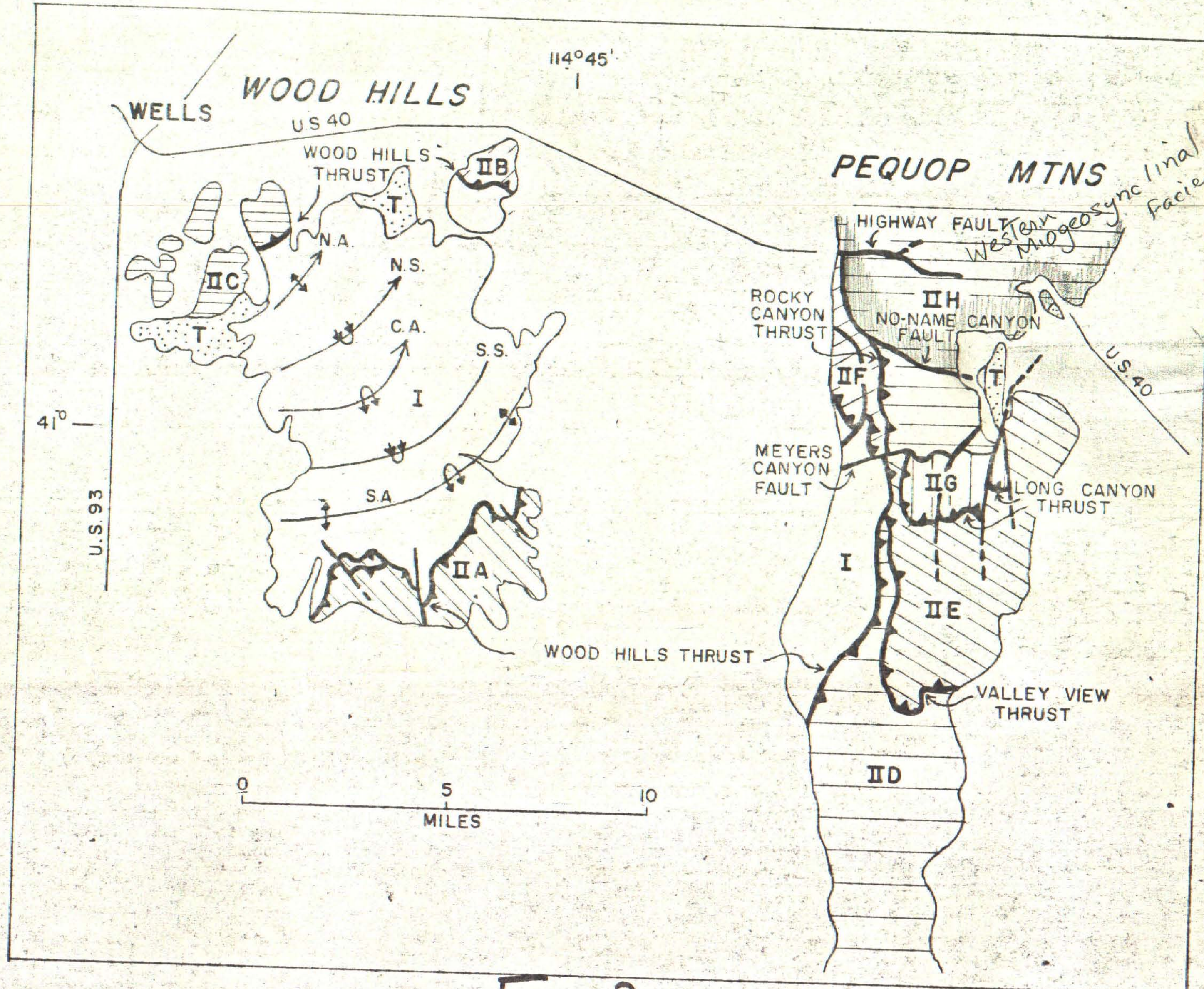

Fig. 2.

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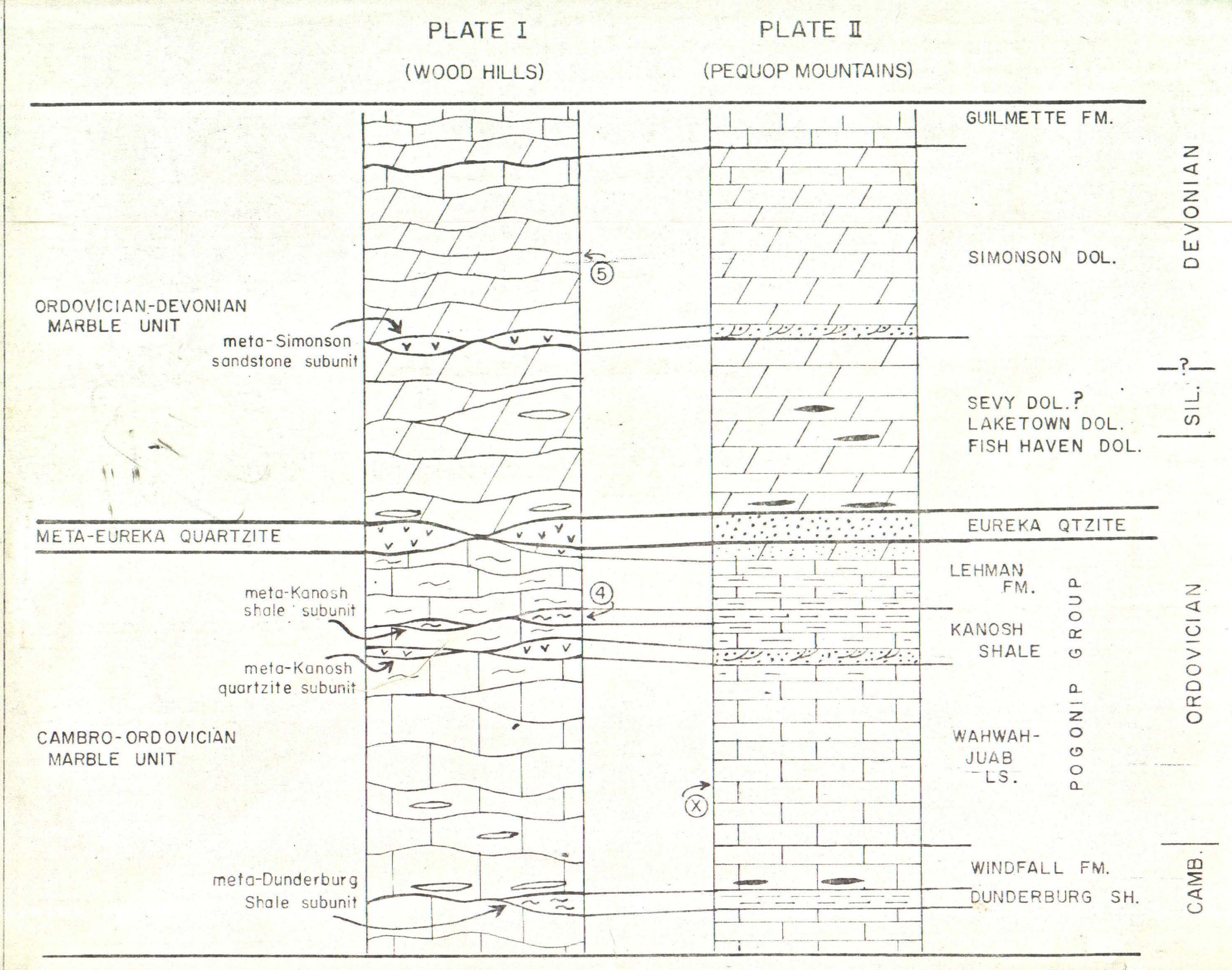


PLATE I
(WOOD HILLS)
PLATE II
(PEQUOP MOUNTAINS)
GUILMETTE FM.
DEVONIAN
SIMONSON DOL.
ORDOVICIAN-DEVONIAN MARBLE UNIT
meta-Simonson sandstone subunit
5
SEVY DOL.?
LAKETOWN DOL.
FISH HAVEN DOL.
SIL.
?
META-EUREKA QUARTZITE
EUREKA QTZITE
LEHMAN FM.
meta-Kanosh shale subunit
4
KANOSH SHALE
meta-Kanosh quartzite subunit
POGONIP GROUP
ORDOVICIAN
CAMBRO-ORDOVICIAN MARBLE UNIT
WAHWAH-JUAB LS.
X
WINDFALL FM.
meta-Dunderburg Shale subunit
DUNDERBURG SH.
CAMB.

0007

southern Pequop Mountains, in apparent structural continuity with subplate IID (George Fraser, personal communication, 1968), younger Permian and Triassic strata are present (Snelson, 1955).

The Permian Plympton? Formation (Hose and Repenning, 1959) occurs in a small fault block in the northwestern Wood Hills (subplate IIC). Lithologically, the formation is a thick-bedded, medium-gray dolomite with abundant medium-bedded, reddish-brown chert. These rocks are assigned to the Plympton on the basis of similarity to Guadalupian rocks north of the Wood Hills and in the northernmost Pequop Mountains.

Western Miogeosynclinal Succession - Subplate IIH

Rocks comprising this succession, especially Silurian and Devonian strata, are characteristic of central Nevada. This succession occurs in the northern end of the Pequop Mountains. It is not meant that these are the westernmost rocks of the miogeosyncline, but that they are western lateral equivalents to the strata contained in subplates IIA-IIG, and have been juxtaposed by eastward movement along the Wells fault and related faults.

The Lower Ordovician Pogonip Group is the oldest unit in subplate IIH (see Pogonip Group above). Formations recognized are the Juab Limestone, Kanosh Shale, Lehman Formation and Crystal Peak Dolomite. A cross-bedded quartzite in the basal Kanosh Shale in the eastern succession (Fig. 3) was not observed in this succession. Also, the Crystal Peak Dolomite is markedly different from that in the eastern succession.

The Middle Ordovician Eureka Quartzite is badly fractured due to bedding-plane faulting and does not form prominent ridges. One section measured is about 400 feet thick.

The Upper Ordovician Fish Haven Dolomite, which is 595 feet thick, differs somewhat from that in the eastern succession. Some of the marker beds in the eastern succession do not occur in this succession and several fossiliferous beds occur at horizons where none were noted in the eastern succession and vice versa. In view of these differences, one might argue to use the term Hanson Creek Formation (Merriam, 1940) for these rocks, the Upper Ordovician formation typical of the western portion of the miogeosyncline. Another possibility is that this particular section is transitional between the Fish Haven and Hanson Creek facies.

The Silurian Roberts Mountains Formation (Merriam, 1940) comprises 595 feet of light-gray, platy limestone. Forty-five feet of argillaceous soft weathering dolomite occurs at the top. These beds are concordantly succeeded by dark dolomite of the Lone Mountain Dolomite. The Roberts Mountains Formation in central Nevada is Silurian in age (Merriam, 1963; Berry and Roen, 1963). Identifiable fossils were not found in the formation in the Pequops. Merriam (1963, p. 39) states that "Monograptus-bearing lower beds of the Roberts Mountains Formation are probably equivalent to the lower part of the Laketown". A similar correlation is suggested in the Pequops on the basis of lithology (Fig. 4), the lower 530 feet of the Laketown being tentatively correlated with the Roberts Mountains Formation.

The Silurian Lone Mountain Dolomite (Hague, 1883 and 1892; Merriam, 1940) consists of 620 feet of light- to medium-gray, saccharoidal dolomite. The contact with the overlying Sevy Dolomite is quite sharp and appears to be concordant. The Lone Mountain in central Nevada is chiefly, if not entirely, Late Silurian in age (Merriam, 1963). No fossils were found in the Pequop section. Tentatively, the Lone Mountain is correlated with the upper 580 feet of the Laketown in the southern portion of the Pequop Mountains (subplate IID) (see Fig. 4).

The Lower Devonian Sevy Dolomite is a dense to fine-grained, cream-colored dolomite, and is markedly different from the Sevy in the eastern succession. The unit is 85 feet thick in a faulted section; this thickness, however, appears to be representative.

The Middle Devonian Simonson Dolomite is similar to the Simonson in the eastern succession, but the sandy basal unit, noted in the eastern succession, is absent. The formation is about 970 feet thick.

The Upper Devonian Guilmette Formation is similar, though not identical, to the Guilmette in the other subplates. Exposures are excellent along Highway 40, the uppermost beds forming prominent 200- to 300-foot cliffs on the west side of the Pequop Mountains.

The Early Mississippian Joana Limestone rests disconformably on the Guilmette, as in the eastern succession, and is Kinderhookian in age (Appendix A). Three members comprise the formation: 1) a basal member consisting of 65 feet of medium- to coarse-grained encrinite; 2) an intermediate 280 feet of interbedded platy, buff siltstone, black chert and platy, fine-grained limestone; 3) an upper member of approximately 1,400 feet of platy to thin-bedded, fine-grained, in part argillaceous limestone. The upper member is not characteristic of the Joana in east-central Nevada; however, it has been recognized at numerous localities by the writer and Oversby (1969) ten to fifteen miles north and northeast of Wells.

The Mississippian Chainman Formation is quite different from the Chainman described above in that black shale is an important lithology, and graywacke and chert-pebble conglomerate occur within a few feet of the base. The age of the basal Chainman is probably older than basal Chainman of the eastern succession. Protocanites lyoni (Meek and Worthen), a late Kinderhookian and late Tournaisian goniatite, was reported from black shale in the Chainman at Pequop Pass (Furnish, Miller and Youngquist, 1955). Early Mississippian clastics, lithologically similar to the Chainman-Diamond Peak, occur north of Wells (Brian Oversby, personal communication, 1969) and near Carlin (Gordon and Duncan, 1961).

A bedding-plane fault marks the contact with the Joana (Plate 6, Fig. 4), and several tectonic lenses of Joana occur in the basal portion of the formation. Bissell (1967, p. 799) states that the Chainman is 2,000 feet thick in this subplate; the writer disagrees with this figure. A reliable thickness can not be obtained as the formation is complexly faulted at the base as well as internally, and exposures are sparse and poor. If a thickness were to be obtained, it would probably be at least 4,000 feet.

The Late Mississippian-Early Pennsylvanian Diamond Peak Formation is up to 500 feet thick. At many localities it is difficult to determine the Chainman-Diamond Peak contact (see above discussion of Diamond Peak).

The Early Pennsylvanian Ely Limestone is variable in thickness below the Late Pennsylvanian unconformity and contains clastic units at a few localities. Approximately 30 feet of Ely is disconformably overlain by the Pequop Formation along Highway 40, whereas, about 450 feet of Ely plus 370 feet of Hogan? is disconformably overlain by Wolfcampian strata (Bissell, 1967, p. 799) three miles north of Pequop Summit.

Roberts et al. (1965, p. 1932) state that the Carlin sequence, Pennsylvanian and Lower Permian clastic units interbedded with limestone, was deposited in a trough in approximately the same position as the earlier Chainman-Diamond Peak trough adjacent to the Antler orogenic belt. They would assign Pennsylvanian rocks of subplate IIH (western succession) to the Carlin sequence (Moleen, Tomera, and Strathearn Formations). This writer prefers the name Ely Limestone, though there are some clastic interbeds in the basal portion of the unit, as the formation as a whole is typical of the Ely; this terminology has been used previously for these same rocks by Steele (1960) and Bissell (1967). Again, here is a case where the rocks may be transitional between two facies. A few miles to the west of this northern Pequops locality, Pennsylvanian rocks are best assigned to the Carlin sequence.

The Leonardian Pequop Formation disconformably overlies the Ely Limestone north of Highway 40. Younger Permian strata occur in the northernmost Pequop Mountains, which are overlain disconformably by Triassic units in ranges to the north (Clark, 1960).

Permian rocks north of the Pequop Mountains are very different in lithology and thickness from equivalent strata in the southern Pequop Mountains, the eastern succession (Roberts et al., 1965, Fig. 15).

CENOZOIC ROCKS

Three units of nonmarine rocks are assigned to the Cenozoic. Neither the absolute nor the relative ages of these units are known, as none of them has been dated, and as each occurs in a separate area. On the basis of regional stratigraphic and structural relationships tentative ages are suggested. All of the units underlie low rolling, in part gravel-capped, hills on the margins of the ranges. The gravel-capped hills appear to be part of an erosional surface, probably a pediment. It is difficult to trace individual beds as they are exposed only in gullies, though in some places trends are detectable on air photos through the veneer of gravels.

Unit I, exposed in the north and northwestern portions of the Wood Hills, contains two members. The lower member, ranging from approximately 200 to 500 feet in thickness, is derived from Ordovician through Devonian rock types; the thickness of the upper member is in excess of 400-600 feet.

The lower member consists of firmly cemented dolomite breccias which were derived from the Fish Haven, Laketown, Sevy and Simonson Dolomites. A white orthoquartzite breccia, derived from the Eureka Quartzite, forms a basal zone ranging from a few feet to more than 100 feet in thickness. There is a continuity to the stratigraphy on a small scale, roughly 500-600 feet laterally and 100-150 feet vertically, but this does not hold true on a larger scale. Contrasting rock types are juxtaposed laterally yet the member maintains a distinct layered character. All of the rocks are either brecciated or pervasively fractured. Many of the rocks display a box work fracture system, the fractures being silicified and usually stained reddish brown.

Houten (1956); the unit is considered correlative with Snelson's Starr Valley unit in the East Humboldt Range.

Unit II, exposed in the northeastern Pequop Mountains, comprises more than 500 feet of volcanic rocks which rest unconformably on Mississippian through Permian strata of Plate II. The volcanics dip easterly at approximately the same angle as the underlying Paleozoic rocks. A light-colored porphyritic rhyolitic to dacitic, moderately compacted vitric tuff occurs locally at the base of the unit. The dominant rock of Unit II is a dense porphyritic dacitic vitric tuff, which is generally light-gray to cream-colored, though locally it is a brilliant green. A dark-brown porphyritic andesite was observed at one locality. Unit II is similar in lithology to and may be correlative with Van Houten's "vitric tuff unit" of Mio-Pliocene age (1956, p. 2814-2819).

Unit III, exposed along the western front of the Pequop Mountains, consists of sedimentary breccia and conglomerate, in part monolithologic, derived from the major rock types found within the range. These coarse clastics are believed to be genetically related to Cenozoic basin-range faulting. Though exposures are poor, it appears that the unit is faulted against the Paleozoic rocks along a north-south trending range-front fault; this is based in large part on photo interpretation. If this interpretation is correct, then Unit III is younger than Unit II, as the latter was tilted during range faulting.

STRUCTURE

Wood Hills Thrust

The Wood Hills thrust forms the contact between Ordovician-Silurian, Devonian and Pennsylvanian formations of Plate II and the metamorphosed

The lower member rests discordantly on brecciated Chainman, Diamond Peak and Ely Formations of subplate IIC. The nature of the brecciation along the contact is quite different from the shearing observed associated with thrust faults in this and adjacent ranges in that the rocks appear to have been under little overburden pressure when brecciated. There are large angular blocks and lenses in the basal zone of the lower member, and there is no evidence for strong shearing.

The upper member consists of thin-bedded freshwater limestone, conglomerate and breccia, tuffaceous sandstone and shale, and pumice. In the northwestern portion of the range the upper member rests on the lower member; where exposed, the contact is marked by caliche-cemented fanglomeratelike conglomerate and breccia derived from the underlying rocks. Along the northern edge of the Wood Hills, tuffaceous sandstone and shale appear to grade laterally into conglomerate and breccia which rests on Plate I rocks. Though exposures showing this relationship are lacking, the finer clastics which are exposed along U. S. Highway 40 can be traced along strike into the coarser clastics on air photos.

The heterogeneous layered and fractured nature of the lower member coupled with the brecciated basal zone is interpreted as indicating that the rocks attained their present position as landslide blocks. Similar features are described by Snelson (1957, p. 154) on the east flank of the East Humboldt Range, six miles west across the valley in his Starr Valley unit. Here Sharp (1939, p. 137) and Snelson found "Paleozoic-limestone breccias" intercalated with rocks similar to the upper member of Unit I.

Unit I is assigned a Mio-Pliocene age as its general lithology strongly resembles that of the Humboldt Formation as described by Sharp (1939) and Van

Ordovician through Devonian rocks of Plate I. Plate II attained its present position after the metamorphism of the Plate I rocks, as postmetamorphic cataclasis and brecciation of Plate I as well as Plate II rocks is ubiquitous at the contact (Plate 6, Fig. 2). The fault zone varies in thickness from less than five feet to more than 100 feet. At Moor Hill (northeastern Wood Hills) post-thrusting mineralization has occurred along the thrust, accompanied by recrystallization of many of the rocks.

Truncation of beds above and below the thrust is well displayed along the east side of Southwest Canyon in the southern Wood Hills (Plate 3, Fig. 1). Here nearly the entire marble interval between the meta-Kanosh quartzite and Meta-Eureka Quartzite is cut out, the meta-Kanosh quartzite being only twenty to thirty feet below the thrust; the beds are truncated at angles up to 15°. Above the thrust most of the Fish Haven-Laketown Dolomite is cut out and the basal Simonson Dolomite is just a few hundred feet from the thrust; the beds dip into the thrust at angles up to 30° to 40°. At this locality the Meta-Eureka Quartzite is caught up in the fault zone. On the geologic map a thrust is placed above and below the Meta-Eureka as postmetamorphic cataclasis is evident at both contacts, and there is structural discordance with over- and underlying units; the thrust is distributed throughout the Meta-Eureka Quartzite, with the major movement having taken place along its contacts.

Overturned drag folds and related structures above and below the thrust indicate a relative southeastward movement of Plate II over Plate I. Folds are generally less than one foot high and asymmetrical to overturned. At one locality, fractures that had developed in the Meta-Eureka Quartzite are folded. At Moor Hill (northeastern Wood Hills) small scale folds are overturned in many different directions.

Two high-angle faults, which trend north and northwest, cut the Wood Hills thrust in the southern portion of the range. Between the two faults the Wood Hills thrust is marked by a zone of imbricate slices from both plates, a feature not observed elsewhere. As the imbricate structures can not be correlated across the faults, the latter are believed to be tear faults related to the Wood Hills thrust.

The Wood Hills thrust has been folded into a series of elongate north-trending domes. One dome is exposed in the Wood Hills where the fault plane dips away from the center of the range; this doming also affects the major fold axes (see below). In the Pequop Mountains the thrust forms the east half of a similar dome. Snelson (1957, p. 164) described comparable folded thrusts in the northern Ruby and East Humboldt Ranges.

Plate I

Wood Hills. Shearing-off, bedding-plane thrusting and imbricate structure are present throughout the plate. The major folds are warped along the north-south domal axis which passes through the middle of the range, trending easterly west of and northeasterly east of the domal axis. Most of the folds are asymmetrical to overturned to the north, having wave lengths and amplitudes of one to two miles. They are, from southeast to northwest, the South anticline, South syncline, Central anticline, North syncline and North anticline (Fig. 2). Interpretation of the internal structures of Plate I is based primarily on the geometry of the Meta-Eureka Quartzite, for it appears to best reflect the folds and imbrications.

Small-scale folding occurs at many localities, the folds ranging in size from a foot or so in height to microscopic. These folds generally are overturned. Where the direction of overturning is uniform it is to the northwest. At a few localities, notably on Moor Hill, small-scale folds are overturned in all directions.

The style of deformation in the Cambro-Ordovician Marble Unit is quite different from that in the Ordovician-Devonian Marble Unit. The former, which is dominantly calcite marble, responded plastically and structures are similar to those of the Meta-Eureka Quartzite. In contrast, the Ordovician-Devonian Marble Unit, predominantly dolomitic, responded in a more brittle manner and structures are locally sharply discordant with those of the quartzite. Structures commonly are discontinuous in the dolomite unit, and their detailed mapping is extremely difficult because individual markers, such as the meta-Simonson sandstone, are discontinuous and tend to terminate abruptly. Where dolomite and calcite marbles are interbedded the dolomite commonly forms boudins within the calcite marble, and generally is strongly jointed (Plate 6, Fig. 1).

Bedding-plane thrusting is best seen along the upper contact of the Meta-Eureka Quartzite. Discordant relationships exist between the overlying marbles and the quartzite (best seen at the head of East Canyon and in the core of the range) (Plate 3, Fig. 1). The general absence of dark dolomite with black chert stratigraphically above the Meta-Eureka Quartzite indicates a discordant tectonic contact. In Plate II the rock directly above the Eureka Quartzite is a dark dolomite with black chert (basal Fish Haven Dolomite). The interval separating several marker beds from the quartzite varies markedly over short distances. The shearing-off and bedding-plane thrusts above and below the Meta-Eureka Quartzite move up and down section independently of each other and locally converge. Where the faults converge, the quartzite displays boudinage structure (especially on the overturned limb of the Central anticline); small-scale tear faults were noted at the terminations of a few quartzite lenses. There probably are bedding-plane thrusts at other structural levels in Plate I, but due to a lack of marker beds they have not been detected.

When viewed on a large scale, the movement above and below the Meta-Eureka Quartzite represents a folded detachment zone within Plate I. Locally it developed into a low angle thrust on the southern limb of Central anticline repeating the Cambro-Ordovician Marble Unit and Meta-Eureka Quartzite, and cutting out the Ordovician-Devonian Unit. To show a thrust contact everywhere on the geologic map along the upper and lower contacts of the Meta-Eureka Quartzite might have been more realistic, but this has not been done (except in the above-mentioned case), mainly because displacement is believed subordinate to that at other thrusts, and as the resulting map pattern would be confusing.

Meta-Simonson sandstone occurs as irregular, discontinuous lenses and bands throughout the Ordovician-Devonian Marble unit; this is believed to be due to imbrication and associated tear faulting. At several localities there are two meta-sandstones. These may be 1) isoclinal folds, 2) imbricate structures, or 3) more probably, primary-stratigraphic, as seen in subplates IIA, IID and IIF, where there are two sandy beds at the base of the Simonson Dolomite.

Pequop Mountains. Structures within Plate I can not be worked out until the ages of the units present are ascertained. The units are essentially concordant although considerable tectonic thinning is evident. A variety of structural interpretations may be made, depending on the correlations adopted. Bedding-plane thrusting similar to that described in the Wood Hills is probably present.

Plate I is cut into two segments by an east-west trending vertical fault herein named the Meyers Canyon fault. The fault offsets the Wood Hills thrust vertically for a few hundred feet and extends upward into Plate II where the Rocky Canyon thrust merges with it. On opposite sides of the fault within Plate I the same general stratigraphic sequence is present but there are several important minor differences (see Table 2).

Plate II

Plate II in the Wood Hills comprises three subplates (IIA, IIB and IIC) which are not in contact with each other but are each in contact with Plate I along the Wood Hills thrust (Fig. 2; Table 4). These subplates may well represent separate tectonic units within Plate II, similar to those in the Pequop Mountains. A small klippe of Guilmette limestone rests on Plate I east of Gobel Well.

Plate II in the Pequop Mountains comprises five subplates (IID through IIH) separated by thrust faults (Fig. 2; cross sections on Plate 2; Table 4). Subplates IID and IIF are thrust over Plate I along the Wood Hills thrust and are in turn overthrust by subplates IIE, IIG and IIH. Thrusting brings both younger over older and older over younger rocks.

Three sets of high-angle faults cut Plate II. The first set occurs in an east-west strip about one mile wide, paralleling Highway 40 (Interstate 80) and consists of northeast- and northwest-trending normal faults with displacements on the order of 50 to 500 feet. These faults terminate to the south against the Highway fault (described below), and to the north, against a fault outside the map area.

The second set of faults, restricted to the northern portion of the range, trends east-west to northwest-southeast and includes the Meyers Canyon fault (see above), and the No-Name Canyon and Highway faults. Many subordinate high- and low-angle faults are terminated by these faults. The Highway fault is structurally below and appears to terminate at the thrust at the base of the Chainman. Vertical displacement on the Highway fault is about 500 to 700 feet; there may be as much or more lateral movement involved (discussed below). The No-Name Canyon fault merges with a north-trending complex fault system on the west side of the range. This system may include the northern extension of the Rocky Canyon thrust. On the east side of the range, Tertiary volcanics are believed to overlie the No-Name Canyon fault.

Normal faults of the third set have offset and repeat thrusts and rocks of all units. These faults appear to be nearly vertical, dipping slightly to the west, and have displacements up to 2,000 feet. They are interpreted as being antithetic to range uplift.

A normal fault along which the range was tilted to the east occurs on the west side of the range. Numerous geomorphic features observed on air photos, such as offset streams, contrasting stream densities and stage of slope development associated with lineaments, were used to determine the position of the fault, as most of it is located west of the range front. The amount of displacement probably varies considerably along the range front, depending on the number and magnitude of antithetic faults within the range. Displacement of 10,000 to 20,000 feet would seem to be a minimum figure.

PALEOZOIC HISTORY

From some time in the Early or Middle Cambrian, when deposition began in this portion of the Cordilleran geosyncline, to Middle Devonian pre-Simonson Dolomite time, the geosyncline was fairly stable except for very broad and short-lived epeirogenic uplifts. Prior to Simonson deposition, erosion differentially removed earlier rocks such that the Simonson was deposited on Silurian Laketown Dolomite (subplate IID) and Lower Devonian Sevy Dolomite (very thin in subplate IIH, while seemingly a normal thickness in IIA). The Sevy is missing and Simonson rests on Laketown to the east in the Pilot Range (Blue, 1962 and personal communication) and Silver Island Mountains (Schaeffer, 1960).

A second episode of uplift and erosion is reflected by the pre-Joana Limestone unconformity. In most areas to the south and east the Late Devonian Pilot Shale occurs between the Guilmette Formation and Joana Limestone. Its absence in the Pequop Mountains is attributed to erosion. Uplift of the Antler orogenic belt began during Late Devonian in central Nevada, followed by formation of the Roberts Mountains thrust along which eugeosynclinal rocks were thrust eastward over miogeosynclinal rocks (Roberts, 1964). Smith and Ketner (1968) have dated the Roberts Mountains thrust as pre-Late Kinderhookian and post-late Late Devonian in the Carlin-Pinyon Range area (sixty miles to the west-southwest). Schaeffer (1960) reports a pre-Joana Limestone unconformity in the Silver Island Mountains (forty miles to the southeast) where the Pilot Shale occurs locally below the unconformity; he considers this to be related to uplift of the Uinta-Gold Hill Arch. It would thus appear that there is one continuous unconformity marking synchronous events in latest Devonian and earliest Mississippian time, as indicated by Roberts (1960), from the Antler orogenic belt on the west across the miogeosyncline to the Uinta-Gold Hill Arch.

Uplift of the Antler belt caused the deposition of clastics with limestones during Joana time (Early Mississippian) in the Carlin-Elko area (Smith and Ketner, 1968; Gordon and Duncan, 1961), while clastics did not reach the map area until post-Joana time, reflected by 4,000 feet of Chainman-Diamond Peak. The Wood Hills-Pequop Mountains occur at or near the axis of the Chainman-Diamond Peak trough (Roberts, et al., 1965, p. 1931).

A third unstable period is marked by the unconformity in Late Pennsylvanian. To the west, in the Elko-Carlin-Eureka area, Dott (1955, p. 2255) calls this the sub-Strathearn unconformity. In the eastern Great Basin, the youngest rocks below the unconformity are upper Desmoinesian and the oldest above it are lower Missourian (Steele, 1959, p. 211, and 1960).

MESOZOIC HISTORY

Metamorphism and folding of Plate I rocks and development of the Wood Hills thrust and related structures occurred during widespread Late? Jurassic to Early? Cretaceous and possibly Late Cretaceous orogeny. Regionally, the orogeny has been assigned to the mid-Mesozoic by Misch (1960) and Misch and Hazzard (1962) who consider regional metamorphism at low levels and attending folding to represent an earlier Mesozoic event than décollement-type thrusting and thrusting at higher levels. Armstrong (1968) has suggested that two distinct episodes of late Mesozoic orogeny occurred: the Nevadan orogeny, during Jurassic, when orogeny and metamorphism occurred in eastern Nevada and western Utah west of the Sevier belt, and the Sevier orogeny, during Cretaceous, associated with large-scale thrusting in the Sevier belt (Fig. 1). On the basis of data available in the study area, events can not be dated. However, it is possible to establish a sequence of events and to correlate this with regional events.

Regional metamorphism of Plate I was the earliest orogenic event. Synchronous or prior to the metamorphism, movement occurred along both contacts of the Meta-Eureka Quartzite. The Ordovician-Devonian Marble Unit attained its basic heterogeneous nature moving as a relatively "brittle" mass, while the underlying Cambro-Ordovician Marble Unit was deformed plastically. Relative movement at this time appears to have been towards the northwest, on the basis of small-scale overturned folds in the banded tectonitic marbles.

Large-scale northwest overfolding of Plate I rocks (Central anticline, etc.) followed, apparently postdating the metamorphism, as many of the rocks display minor cataclasis throughout the plate. The extremely heterogeneous structures observed in the Ordovician-Devonian Marble Unit in the core of South syncline are believed to have been accentuated by this folding. Two northwest overturned synclines occur in Plate II in the Pequop Mountains, one in Ordovician strata in subplate IIE and the other in late Paleozoic strata in the southernmost Pequop Mountains (Snelson, 1955). It is not possible to demonstrate, with available data, that these folds are genetically related to the northwest overfolding of Plate I strata.

Southeastward movement of Plate II along the Wood Hills thrust postdates the above events, as cataclastic metamorphism is superposed on rocks of both plates along the fault plane and Plate I structures are truncated. Plate II broke up into its many subdivisions during its emplacement. Some of the thrusts within Plate II could have developed prior to the Wood Hills thrust. However, the sense of movement, where data is available, indicates southeast overriding by all subplates. Therefore, the fragmentation of Plate II and subsequent internal thrusting are believed related to movement along the Wood Hills thrust and not to earlier events.

Bedding-plane faulting along the Joana-Chainman contact, in subplate IID, predated the Valley View thrust. This bedding fault may be the northern expression of a much larger thrust in the southern Pequop-Spruce Mountain area (as indicated earlier, this area is the southern continuation of subplate IID), where Mississippian through Permian strata are thrust over ~~Silurian and~~ Ordovician through Devonian rocks (Harlow, 1956; Roger Hope, personal communcation).

Subplate IIE was thrust southeast over subplate IID along the Valley View thrust, which came up out of the Wood Hills thrust, bringing older rocks over younger, while thrusting of younger over older rocks occurred along the Long Canyon thrust (IIG over IIE) (Plate 4, Fig. 1 and Plate 6, Fig. 3). Subplate IIF overrode Plate I along the Wood Hills thrust, and subplates IIF and IIG were overridden along the Meyers Canyon fault and Rocky Canyon thrust by subplate IIH, bringing older over younger rocks.

The Meyers Canyon fault and Rocky Canyon thrust are part of a major east- to southeast-trending tear fault system, herein named the Wells fault, with right-slip displacement measurable in tens of miles (Thorman, 1968 and MS, 1970), which extends across northeastern Nevada (Fig. 6). Movement along the Wells fault was probably synchronous with that of the Wood Hills thrust. The No-Name Canyon and Highway faults and the associated northwest-northeast conjugate fault system in the northern Pequops are believed to be genetically related to this system. The main fault crosses the Pequop Mountains just north of Pequop Pass, beneath a thick cover of Chainman shales and sandstones. It reaches the surface to the south, alternating between a low angle thrust (Rocky Canyon thrust) and high-angle reverse faults (Meyers Canyon, No-Name Canyon and Highway faults), thus resembling stairs leading up to the south (cross section, Fig. 6). Right-slip movement along the Wells fault is indicated by the juxtaposition of markedly different Paleozoic facies in the Pequop Mountains. Subplate IIH contains a western miogeosynclinal facies, while the underlying and adjacent subplates (IID, IIE, IIF) contain typical eastern miogeosynclinal facies (Fig. 4).

CENOZOIC HISTORY

Intermittent erosion and deposition throughout the early Cenozoic occurred until Plate I was exposed in the Wood Hills by Mio-Pliocene? time. Considerable relief must have been developed, possibly by faulting, as indicated by the landslide blocks comprising the lower member of Tertiary Unit I. A possible source of the landslide blocks is the central portion of the range, as a klippe of Guilmette rests on Plate I and older rocks are preserved on the southern flank of the range.

Doming of both ranges appears to predate tilting of the Pequops, which is a block from the eastern half of a dome. The north-trending faults in the Pequops may be related to east-west tension during the doming, as these faults occur mainly in the central portion of the range near the crest of the dome, as shown by the outcrop pattern of the Wood Hills thrust.

Tertiary Units II and III in the Pequops predate uplift of the range. The north-trending fault system is antithetic to and was probably accentuated by or synchronous with range uplift, a tilting to the east with a dip-slip component of 10,000 to 20,000 feet.

REGIONAL INTERPRETATIONS

The time sequence of events of the mid-Mesozoic orogeny in the Wood Hills and Pequop Mountains must be considered in any regional structural interpretation. Two interpretations have been put forth: one fits the the field and petrographic data in these ranges and the other does not.

Misch and Hazzard (Misch, Hazzard and Turner, 1957; Misch, 1960, 1966; Misch and Hazzard, 1962) picture the upper contact of the metamorphic Paleozoic rocks as the zone along which the regional décollement commonly developed throughout much of eastern Nevada, western Utah, and southernmost Idaho, following regional metamorphism. They stated that later mid-Mesozoic decollement-type thrusting definitely postdates earlier mid-Mesozoic regional metamorphism, on the basis of abrupt juxtaposition of metamorphic and nonmetamorphic rocks in the décollement zone, of truncation of metamorphic zones and structures in the metamorphic rocks by this zone, and of post-metamorphic mylonitization along this zone. They concluded that rocks subjected to previous Mesozoic metamorphism responded like basement at the time of décollement thrusting.

Armstrong and Hansen (1966) consider much of the décollement-type thrusting to have taken place during the regional metamorphism, and they rename the décollement an "Abscherungszone" (décollement=Abscherung=shearing-off) separating a mobile basement, the infrastructure, from a more rigid and less deformed layer, the suprastructure. The "Abscherungszone" is visualized by them as a zone of an exceptionally steep metamorphic gradient, with? along which differential movement took place such that the infrastructure was metamorphosed and deformed, while the suprastructure behaved passively and was not metamorphosed.

A mobile basement or infrastructure most probably developed during the regional metamorphism, as suggested by both interpretations. However, the timing of thrusting relative to regional metamorphism is critical. The steep metamorphic gradient proposed by Armstrong and Hansen is not present in the Wood Hills or Pequop Mountains. Where there is a change in grade of metamorphism, it is a gradual one over a distance of thousands of feet within Plate I. The Wood Hills thrust, as now preserved, is not an "Abscherungszone" as described by them, for it is a fault which post-dates the regional metamorphism and cuts across structures within Plate I. Their concept of a steep metamorphic gradient does not fit the field or petrographic data in these two ranges, while the data does support the time sequence of events outlined by Misch and Hazzard.

CONCLUSION

The Wood Hills and Pequop Mountains are underlain by Paleozoic miogeosynclinal rocks which were metamorphosed, folded and faulted during a mid-Mesozoic orogeny. Regional metamorphism and accompanying deformation predates large-scale decollement-type thrusting. Cambrian through Devonian strata, comprising Plate I, attained the almandine to staurolite-kyanite zones. Plate I rocks were subsequently overfolded to the northwest. Still later, nonmetamorphosed Ordovician through Permian strata, comprising Plate II, were sheared off Plate I, along the Wood Hills thrust, and moved eastward to southeastward relative to Plate I.

Displacement along the Wood Hills thrust may be as much as twenty to thirty miles or as little as five to ten miles. If rocks as young as Devonian were metamorphosed throughout the presently defined limits of Plate I in the Wood Hills and Pequop Mountains, including the intervening valley, then movement was greater than about twenty miles, as nonmetamorphosed Ordovician, Silurian or Devonian strata are everywhere at the base of Plate II. However, if the upper limits of the regional metamorphism formed an undulating surface cutting across the Ordovician, Silurian and Devonian boundaries, then it would be possible to obtain the present structural relationship with possibly only five to ten miles of displacement. Data available in these two ranges is not adequate to ascertain the geometry prior to thrusting.

APPENDIX A

Fossil Localities

Locations for all localities are given by section, township and range based on the Wells and Elko AMS sheets. The base map was enlarged 12½ times from the original map scale of 1:250,000 and section lines were projected equally from the township and range grid. University of Washington Paleontology Museum numbers are indicated by the letters UW-A ___.

* 1) UW-A1630 Conchidium? sp. - Wenlock or Ludlow age - identified by
** J. G. Johnson. Collected from the Laketown Dolomite 480 feet from the top (below Simonson Dolomite). NE/4 SW/4 22-35N-65E.

* 2) 7-27-66-1 Siphonodella sp. - "... although it is a young growth stage it can be identified with the genus. From what we have found in this area I would say this represents basal Joana." Identified by D. L. Clark. SE/4 SE/4 34-35N-65E.

3) MJ#2 Siphonodella cooperi Hass, S. crenulata? (Cooper), Diplododella sp., Polygnathus spp., Hindeodella sp., Spathognathodus sp. - "The (fauna) is the same as that which ranges through the Hannibal and Chouteau of the Mississippi Valley and this means middle and/or upper Kinderhookian. More particular, we have found elements of this fauna from 80-100 feet above the base of the Fitchville in Utah and in the middle part of the Joana in the Diamond Range. Older Siphonodella faunas have been found at the base of the Joana in the Confusions and in the Illipah Creek area east of Eureka." Identified by D. L. Clark. Collected from medium- to coarse-grained crinoidal limestone from the basal forty feet of the Joana south of Pequop Pass. SW/4 NW/4 36-37N-65E.

*** 4) UW-A1709 Didymograptus sp. (of the D. bifidus type), D. sp. (robust dependent form), D. sp. (of the D. protoindentus type, but stipes seem to be more divergent), Tetragraptus fragments?, biserial scandent forms?, dichograptid stipe fragments - "This assemblage of dependent didymograptids is suggestive of an Early Whiterock age and a possible correlation with the Swan Peak Quartzite and Kanosh Shale. These two units bear dependent didymograptids among which is D. bifidus. The presence of questionable fragments of Tetragraptus and some biserial scandent form with the didymograptids reinforces the possibility of an Early Whiterock (Early Middle Ordovician) age for the rocks bearing the graptolites." Identified by W. B. N. Berry. Collected from biotite phyllite of subunit meta-Kanosh shale in the Cambro-Ordovician Marble Unit on the east side of South Canyon. NE/4 NE/4 2-35N-63E.

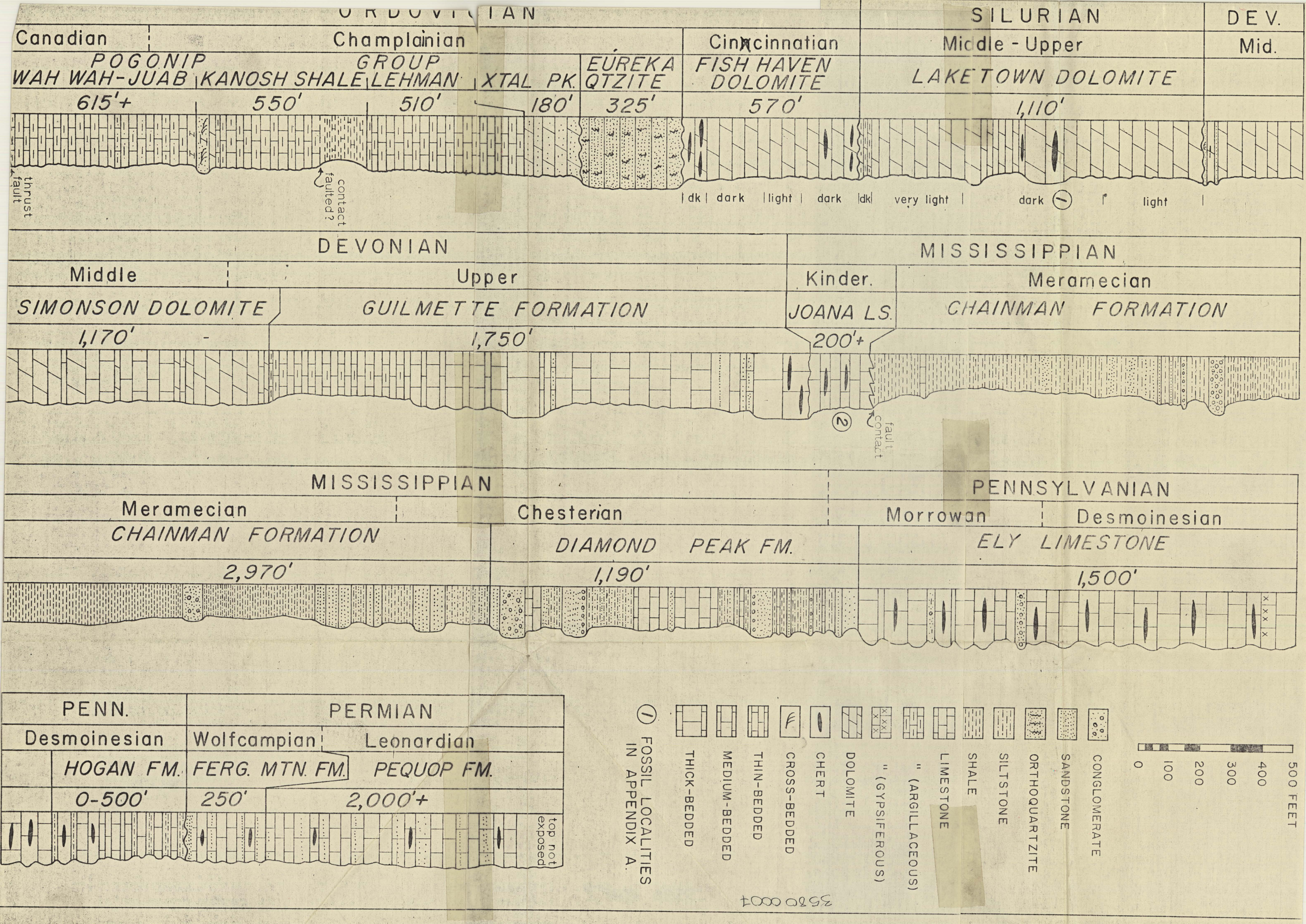
*** 5) UW-A1710 Heliophyllum sp. - "The coral specimen has a distinct peripherial platform on the calyx and appears to have carinate septa. It is a species of Heliophyllum and therefore the bed from which it came is of Middle Devonian age". Identified by Erwin C. Stumm. Collected above the meta-Simonson sandstone subunit in the Ordovician-Devonian Marble Unit. NE/4 NE/4 12-36N-63E.

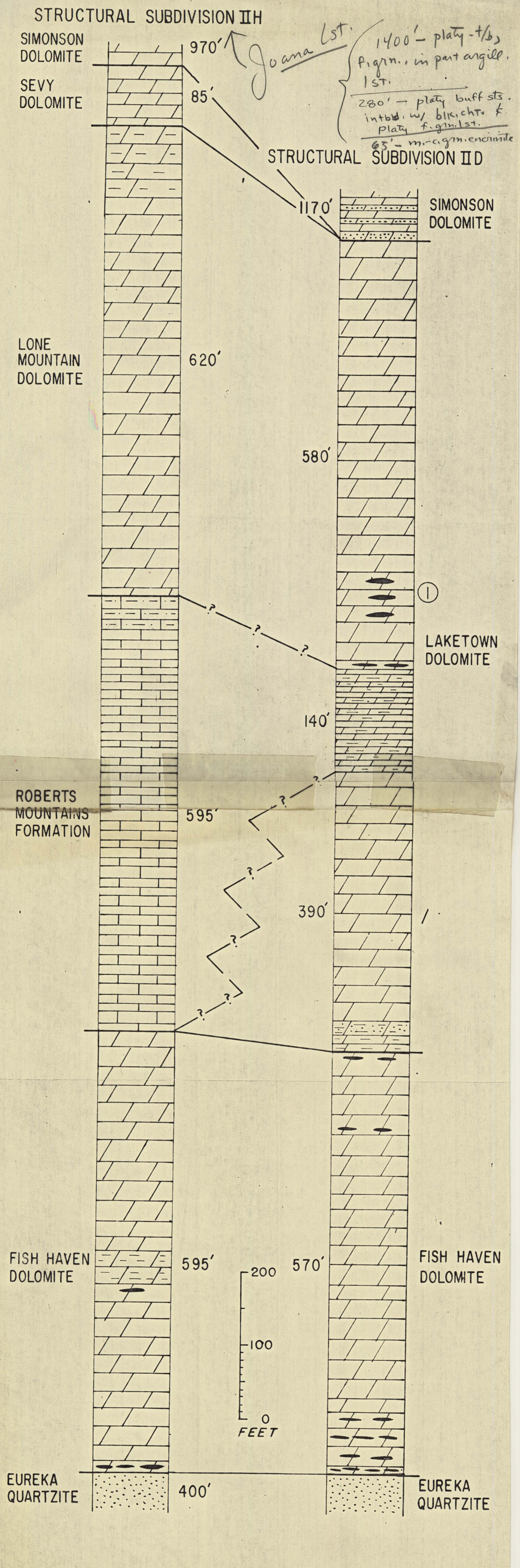
* Stratigraphic position shown on Figure 3

** Stratigraphic position shown on Figure 4

*** Stratigraphic position shown on Figure 5

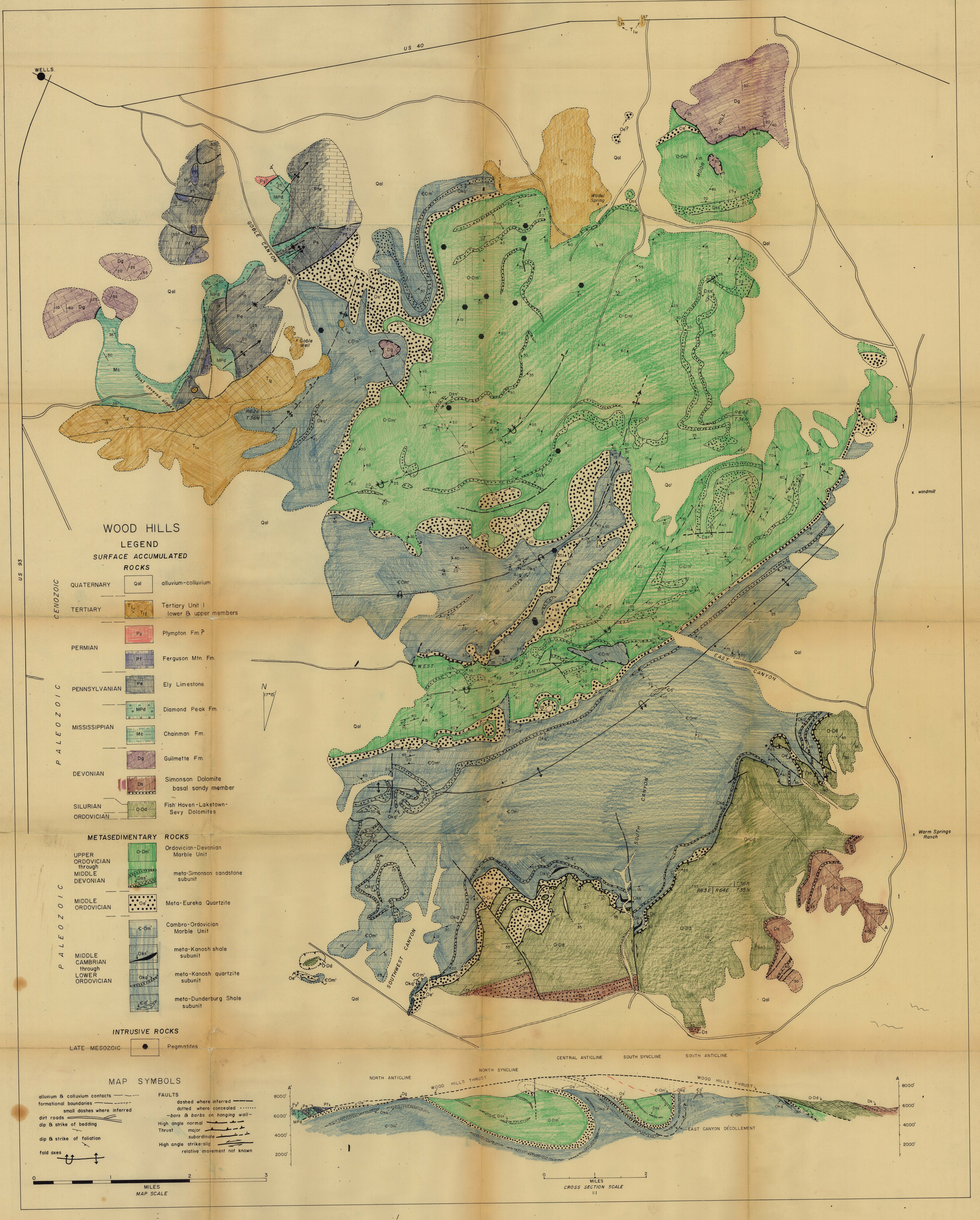

3590 0007
GEOLOGIC MAP
OF THE
WOOD HILLS
ELKO CO., NEVADA
CHARLES H. THORMAN
1962
legend
SURFACE ACCUMULATED ROCKS
CENOZOIC
QUATERNARY
Qal Quaternary alluvium
TERTIARY
Ts Tertiary sediments
① bx (some monolithologic) ② conglomerate ③ Few w/b. red-brn, f.grn. f/w lsts non-foss.
PALEOZOIC
PERMIAN
Pf Ferguson Mountain Fm.
Ce Ely Limestone
CARBONIFEROUS
Cdp Diamond Peak Fm.
Cc Chainman Fm.
DEVONIAN
Dg Guilmette Fm.
Ds Dss Simonson Dolomite basal sandy member
SILURIAN
ORDOVICIAN
OSel Ely Springs-Laketown Dol.
METASEDIMENTARY ROCKS
① Synkinematic stage Staurolite zone of Reg. Meta.
② Static stage - poikiloblastic mica, random orien.
LOWER AND MIDDLE PALEOZOIC
UPPER ORDOVICIAN THROUGH MIDDLE DEVONIAN
UNIT uOSD' (Ely Springs, Laketown, ?Sevy, & Simonson Dolomites; possibly lower portion of Guilmette Fm.) dol. marbles w/ intb. calc. marbles at Top
subunit Dss' (basal sandy member of Simonson Dol.) Sandy dol. marble
MIDDLE ORDOVICIAN
UNIT Oe' (Eureka Quartzite)
MIDDLE CAMBRIAN THROUGH MIDDLE ORDOVICIAN
UNIT CO' (Middle Cambrian through Middle Ordovician carbonates) calcite marble
subunit Opul' (upper portion of Lehman Fm.) quartzose marble
subunit Opk' (Kanosh Shale) biotite phyllite
subunit uCd' (Dunderburg Shale) Al-Sil. bearing mica schist
INTRUSIVE ROCKS
MESOZOIC
Mp PEGMATITES
MAP SYMBOLS
QUATERNARY ALLUVIUM BOUNDARY
FORMATIONAL BOUNDARIES, small dashes where inferred
DIRT ROADS
DIP & STRIKE OF BEDDING
VERTICAL
OVERTURNED
DIP & STRIKE OF SCHISTOSITY
VERTICAL
OVERTURNED
LOCATION OF SECTIONS MEASURED
ANTICLINAL AXIS
OVERTURNED
SYNCLINAL AXIS
OVERTURNED
FAULTS
dashed where inferred
dotted where covered by alluvium
MAJOR THRUSTS
SUBORDINATE THRUSTS
HIGH ANGLE
ONE MILE
CONTOUR INTERVAL 200 FEET
N
17°
US 40
US 93
WELLS
Ely Springs-Laketown Dolomite
Simonson Dolomite
upper portion of the Simonson Dolomite
Ely Springs-Laketown Dolomite
undiff. Cdp-Ce-Pf
WEST CANYON
CANYON
SOUTHWEST CANYON
SOUTH CANYON
WINDMILL
WARM SPRINGS RANCH
A
A'
6000
7000
8000
6000'
7000'
8000'


ORDOVICIAN
Canadian
Champlainian
Cincinnatian
POGONIP GROUP
WAH WAH-JUAB
KANOSH SHALE
LEHMAN
XTAL PK.
EUREKA QTZITE
FISH HAVEN DOLOMITE
615'+
550'
510'
180'
325'
570'
thrust fault
contact faulted?
SILURIAN
Middle - Upper
LAKETOWN DOLOMITE
1,110'
DEV.
Mid.
dk
dark
light
dark
dk
very light
dark
1
light
DEVONIAN
Middle
Upper
SIMONSON DOLOMITE
GUILMETTE FORMATION
1,170'
1,750'
MISSISSIPPIAN
Kinder.
Meramecian
JOANA LS.
CHAINMAN FORMATION
200'+
2
fault contact
MISSISSIPPIAN
Meramecian
Chesterian
CHAINMAN FORMATION
DIAMOND PEAK FM.
2,970'
1,190'
PENNSYLVANIAN
Morrowan
Desmoinesian
ELY LIMESTONE
1,500'
PENN.
Desmoinesian
PERMIAN
Wolfcampian
Leonardian
HOGAN FM.
FERG. MTN. FM.
PEQUOP FM.
0-500'
250'
2,000'+
top not exposed
1 FOSSIL LOCALITIES IN APPENDIX A.
THICK-BEDDED
MEDIUM-BEDDED
THIN-BEDDED
CROSS-BEDDED
CHERT
DOLOMITE
" (GYPSIFEROUS)
" (ARGILLACEOUS)
LIMESTONE
SHALE
SILTSTONE
ORTHOQUARTZITE
SANDSTONE
CONGLOMERATE
0
100
200
300
400
500 FEET
3580 0007



3580 0007

Fig 4



WOOD HILLS
LEGEND
SURFACE ACCUMULATED ROCKS
CENOZOIC
QUATERNARY
Qal
alluvium-colluvium
TERTIARY
Tertiary Unit I lower & upper members
PALEOZOIC
PERMIAN
Py
Plympton Fm.?
Pf
Ferguson Mtn. Fm.
PENNSYLVANIAN
Pe
Ely Limestone
MPd
Diamond Peak Fm.
MISSISSIPPIAN
Mc
Chainman Fm.
Dg
Guilmette Fm.
DEVONIAN
Ds
Simonson Dolomite basal sandy member
SILURIAN
ORDOVICIAN
O-Dd
Fish Haven-Laketown-Sevy Dolomites
METASEDIMENTARY ROCKS
UPPER ORDOVICIAN through MIDDLE DEVONIAN
O-Dm'
Ordovician-Devonian Marble Unit
Dss'
meta-Simonson sandstone subunit
MIDDLE ORDOVICIAN
Oe'
Meta-Eureka Quartzite
€-Om'
Cambro-Ordovician Marble Unit
MIDDLE CAMBRIAN through LOWER ORDOVICIAN
Oks'
meta-Kanosh shale subunit
Okq'
meta-Kanosh quartzite subunit
€d'
meta-Dunderburg Shale subunit
INTRUSIVE ROCKS
LATE MESOZOIC
Pegmatites
MAP SYMBOLS
alluvium & colluvium contacts
formational boundaries
small dashes where inferred
dirt roads
dip & strike of bedding
dip & strike of foliation
fold axes
FAULTS
dashed where inferred
dotted where concealed
-bars & barbs on hanging wall-
High angle normal
Thrust major
subordinate
High angle strike-slip
relative movement not known
0 1 2 3
MILES
MAP SCALE
WELLS
US 40
US 93
GOBLE CANYON
Goble Well
Wodel Spring
MOOR HILL
WEST CANYON
EAST CANYON
SOUTH CANYON
SOUTHWEST CANYON
x windmill
x Warm Springs Ranch
R63E R64E T36N T35N
N 17°15'
NORTH ANTICLINE
NORTH SYNCLINE
CENTRAL ANTICLINE
SOUTH SYNCLINE
SOUTH ANTICLINE
WOOD HILLS THRUST
EAST CANYON DÉCOLLEMENT
A'
A
8000'
6000'
4000'
2000'
0 1 2
MILES
CROSS SECTION SCALE
1:1

Plate 1


3580 0007
Nevada Fm + Guilmette
Need to tie to Oversby's work
major fault zone
OF - Fish Haven
Okl = Kanosh-Lehman
Op - lower Pogonip
Op
Okl
Oe
OF
Px?
Ps
Pk
Pp
Pe
Mdp
Px
?- messy area - some Pe + Mdp + ? units
Joins E half
this is different from Pk in northern Pequops
Pk - chert, ls + dol
Ps - blk sh + minor cht-pebble congl.
Px - sandy, siliceous ls - ? Oquirrh type
Pp - Pequop or equivalent
Pe - Ely Ls
Mdp - Diamond Peak
Thorman 1967


GEOLOGIC MAP
OF THE
PEQUOP MOUNTAINS
ELKO CO., NEVADA
CHARLES H. THORMAN
1962
N
legend
SURFACE ACCUMULATED ROCKS
CENOZOIC
QUATERNARY
Qal Quaternary alluvium
rhyolite to andesite - poorly exposed.
TERTIARY
Tv Tertiary volcanics
PERMIAN
Pequop Fm.
Pfp Ferguson Mt.-Pequop Fm.
PENNSYLVANIAN
Ce Ely Limestone
Cdp Diamond Peak Fm.
MISSISSIPPIAN
Cc Chainman Fm.
DCp? Pilot? Fm.
PALEOZOIC
DEVONIAN
Dg Guilmette Fm.
Dsi Dss Simonson Dolomite sandy dolomite member
SILURIAN
OSel Ely Springs-Laketown Dol.
ORDOVICIAN
Oe Eureka Quartzite
Op Pogonip Group undiff.
Opl - Lehman Fm.
Opk - Kanosh Shale
UNDIFFERENTIATED PALEOZOICS
uODc undiff. Ordovician - Devonian carbonates
uPd undiff. Paleozoic dolomites
METASEDIMENTARY ROCKS
UPPER ORDOVICIAN THROUGH MIDDLE DEVONIAN?
B UNIT B
MIDDLE ORDOVICIAN
Oe' UNIT Oe'
LOWER & MIDDLE ORDOVICIAN
C UNIT C
A UNIT A
① members
INTRUSIVE ROCKS
MESOZOIC
Mp PEGMATITES
MAP SYMBOLS
QUATERNARY ALLUVIUM BOUNDARY
FORMATIONAL BOUNDARIES, small dashes where inferred
DIRT ROADS
LOCATION OF SECTIONS MEASURED
DIP & STRIKE OF BEDDING
VERTICAL
OVERTURNED
DIP & STRIKE OF SCHISTOSITY
VERTICAL
OVERTURNED
FAULTS
dashed where inferred
dotted where covered by alluvium
MAJOR THRUSTS
SUBORDINATE THRUSTS
HIGH ANGLE
U
D
SYNCLINAL AXIS
OVERTURNED
ONE MILE
CONTOUR INTERVAL 200 FEET
Pequop
U.S. 40
Qal
Tv
X Oasis
X MEYERS RANCH
"MEYERS CANYON"
X Johnson Ranch
D
D'
C
B
A
A'
6000
7000
8000
9000
9308
Measured section

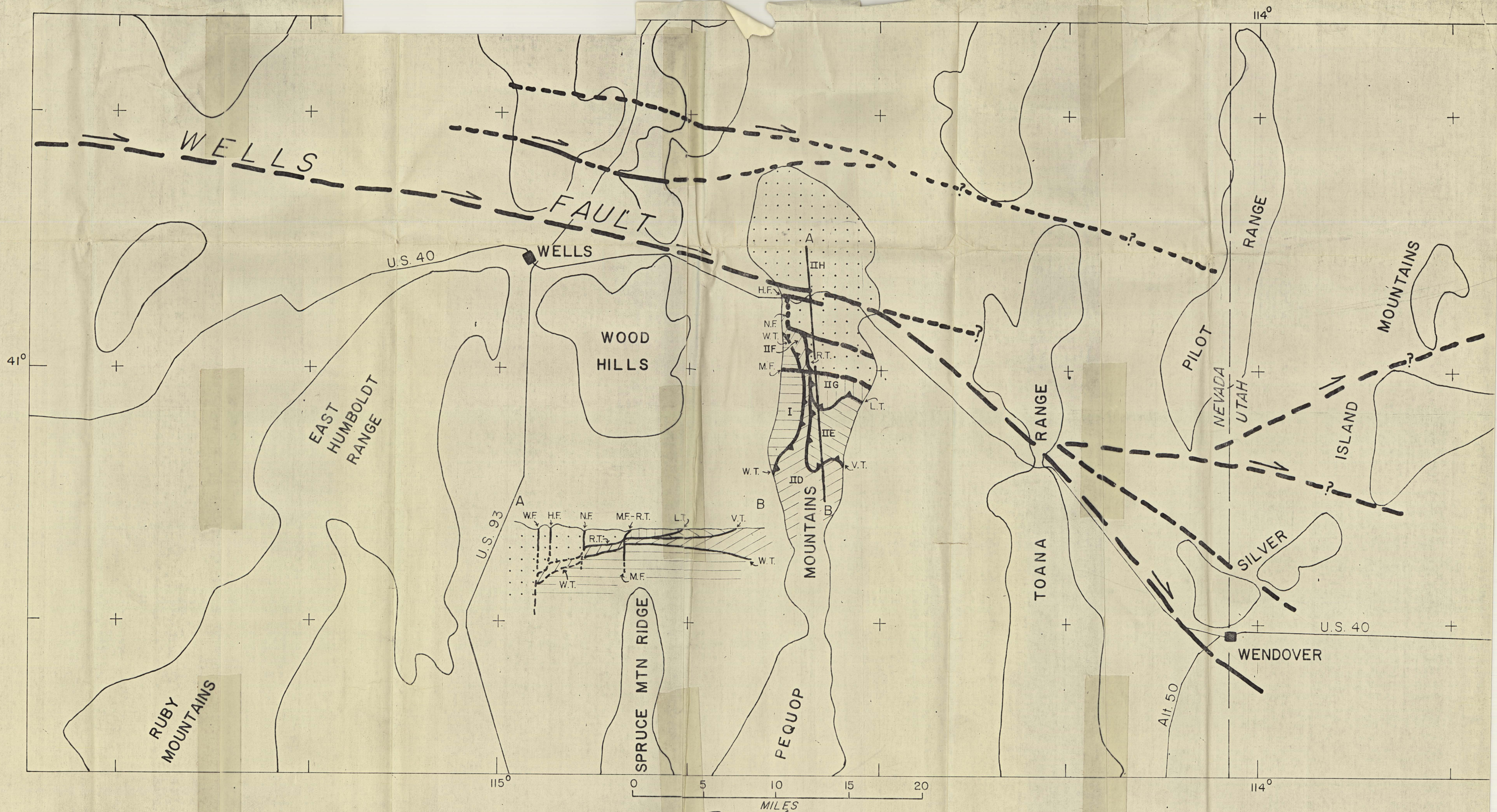
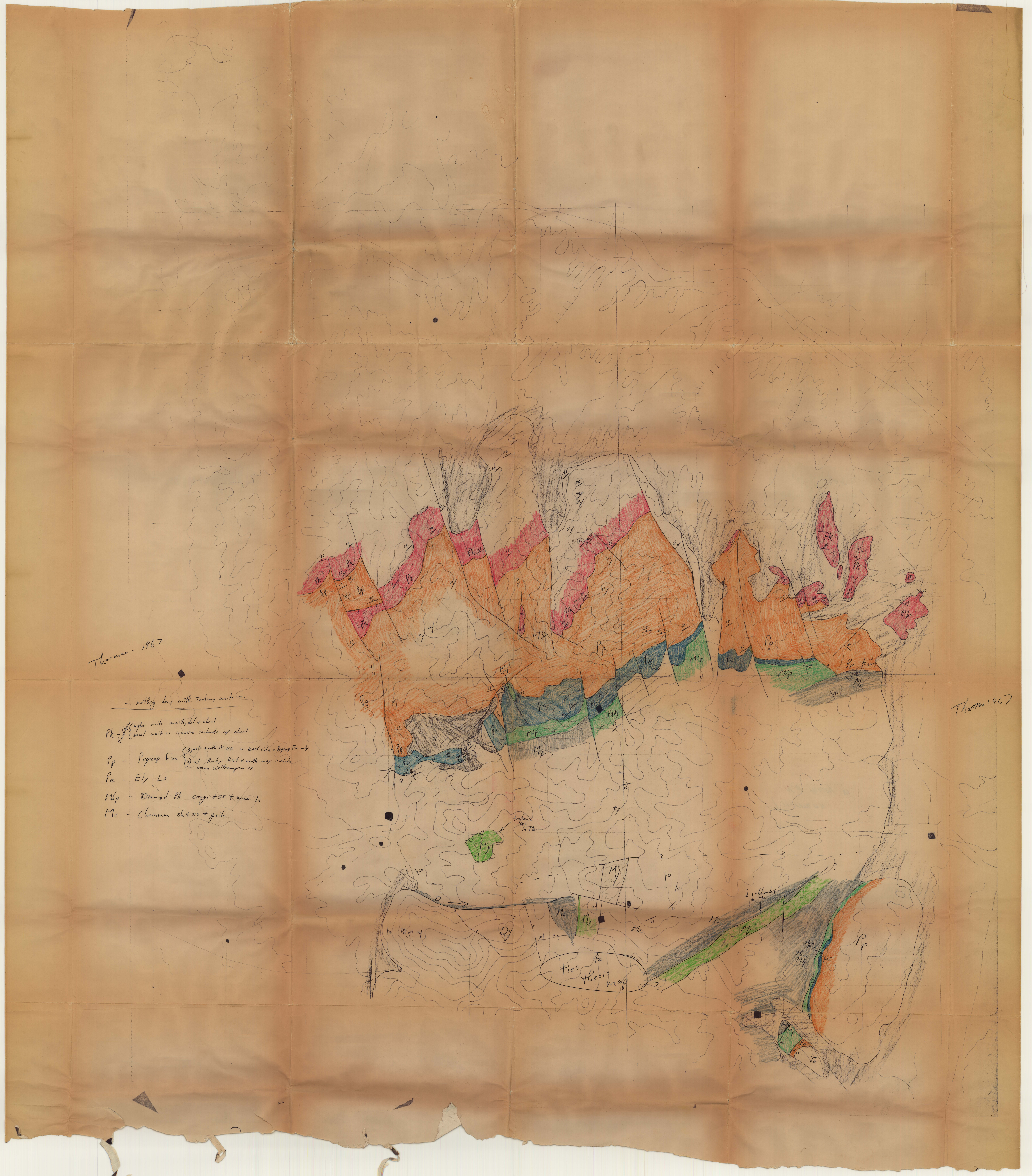

WELLS FAULT
WELLS
U.S. 40
WOOD HILLS
EAST HUMBOLDT RANGE
RUBY MOUNTAINS
U.S. 93
SPRUCE MTN RIDGE
PEQUOP MOUNTAINS
TOANA RANGE
PILOT RANGE
NEVADA
UTAH
SILVER ISLAND MOUNTAINS
WENDOVER
Alt. 50
41°
115°
114°
A
B
W.F.
H.F.
N.F.
M.F.-R.T.
R.T.
M.F.
L.T.
V.T.
W.T.
IIH
IIG
IIF
IIE
IID
I
0 5 10 15 20
MILES

Fig. 6


Thorman - 1967
— nothing done with Tertiary units —
Pk - Guadalupian { higher units are ls, dol + chert / basal unit is massive carbonate w/ chert
Pp - Pequop Fm { 1) just north of 40 on east side = Pequop Fm only / 2) at Rocky Point + north - may include some Wolfcampian rx
Pe - Ely Ls
Mdp - Diamond Pk congl + ss + minor ls
Mc - Chainman sh + ss + grits
tectonic lens in Mc
ties to thesis map
Thorman 1967