CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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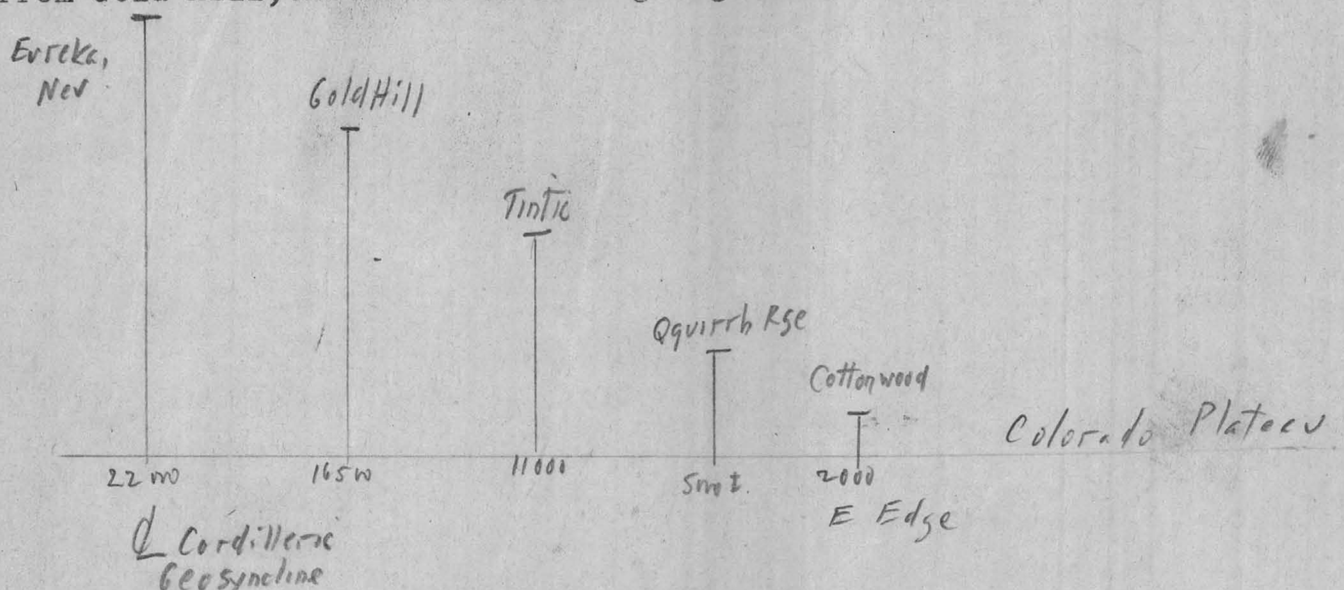
MINING 111B 3B-5. GOLD HILL, UTAH

T.B.Nolan: The Gold Hill Mining District, Utah.USGS PP177,1935.

Gold-complex metal limestone camp. Here is a region of flat thrusts,one above the next,like Muddy Mts.,that is nevertheless mineralized,tho' not a camp of the first rank.

In a very deep trough of the Cordilleran geosyncline as shown on Paleotectonic map, S Nevada and W Utah. 30,000 ft. Paleo seds. Nearly 3 times as thick as Goodsprings. (See below) Nolan Fig.3, p.24,shows pre-Carbonif.seds.thin greatly going east from Gold Hill,thicken even more going west:



Rock section as shown,moderately competent.This is a purely relative term,for the strength of rock depends on the size of the mass deformed,and the strain or deformation it undergoes varies not only with the size of the deformation,but with the intensity of the deformation. With moderate-size,moderatly strong deformation the Laketown-Fishhaven dolomites might crack while the thinner-bedded rocks above and below might fold and flow;with a mighty deformation all members of section might fold and flow.

Igneous Rocks:Eocene or Oligocene QM as big stock,8 mi.N-S,6 mi.E-W,W part shown on map. Roof pendants,small,within exposure,large,outside main exposure. Scattered outcrops xxx in area 10 mi.N-S.

Widely distributed QMP and aplite dikes.

Here is one difference from Muddy Mts.

Structure: Extremely complex owing to 5 deformation pulses producing three thrust systems, one above the other, with the structure different each side of a thrust. Cycles numbered on structural map: (1), insignificant, just S Lat. 40^{o}-7'-30". Small thrust, and normal faults. (2) Dutch Mt. thrust; recumbent anticline shown on Section D-D', other folds; normal faults etc. (3) Ochre Mt.& N Pass thrusts, normal faults, Pool Canyon strike fault, (4) 4 more big Strike faults, Dry Canyon, Blood Canyon, one N of Clifton, Garrison Monster just off map to N.

Thrusts deformed, but in general they root or steepen to W: see structural contours on Dutch Mt. thrust and Ochre Mt. thrust.

N-S anticline, S part of map shown because it lies below all known thrusts; rest of folding cannot be shown because any given area where structure is exposed lies above a thrust, and in many cases, below another. Only the warping and folding of various thrusts can be shown.

1st Cycle unimportant.

2nd " : Stage A. Folding, most intense of any cycle. Major, sharp anticline on S, probably overturned to E; cut off by Eastern Border fault of 2nd 2nd cycle, which suffered great resumption of movement in Basin Range time.

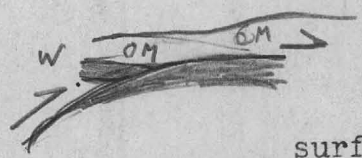
Another N-S anticline N of Blood Canyon fault, but it is represented by folding of N. Pass thrust, 3rd cycle, hence later anticline. But Twin Peaks recumbent anticline on N, which lies above Ochre Mt. thrust, probably (Sec); and has been distorted (Plan) does belong to Cycle 2; probably it lay before Ochre Mt. thrusting farther W.

Only important 2nd Cycle thrust is Dutch Mt, which may be relatively minor (see below). We have therefore the most intense folding in the district completed before the major thrusting was initiated..

Dutch Mt. thrust only shows (younger) Ochre Mt. over (next older)

Woodman.

May have cut across Woodman, then followed Woodman-Ochre Mt. formation contact. Minor thrust, not exposed where it thrust upper plate over erosion surface, if it did anywhere.



Cf. restored sketch, Sec. D-D' with Schematic Diagram, Deformation Plate I II. Sketch made by reversing effects of BR fltg and faulting of Cycles 3.4. Points to high uplift on W, with at least one major fold overturned down slope. Muddy Mts., Weiser anticline. Def. Plate II: Metaline Quad., Wash.; Tintic, Utah; Appalachians.

Each Cycle had as second stage, B normal fltg. Cycle 2 here had at least one antithetic fault that operated after rock folded as much as possible, work-hardened: Tank "ash fault; also big normal fault bounding PM qtzite on W, east side Section. Spotted Fawn flt. zone. Other west-dipping faults marked as later very likely, initiated during Stage B, Cycle 1.

Note that Oquirrh formation involved in Twin Peaks folding, which exposes only Oquirhh, from 22,000' up in Section on upward. Way up in cover here, recumbent folding of weak strata.

Simple S fold brings you only to Woodman, 15,000' up in section, with competent Prospect Mt. qtzite as cofe; basement may lie not far below lowest exposed beds of PM, 4500' up in section.

Do we see different kinds of folding in the two areas? A compressional earth-shrinking geologist would say that during Cycle 2, in the N there was extremely strong compression producing acute, overturned, even recumbent folds, while in S compression relatively mild, given open folds. N folded area might look like S one, deep in its core. Always have more intense fold-ing up toward top of thick section. Explainable by slump or glide folding of weak cover down slope of an uplift. Deformation Plate II.

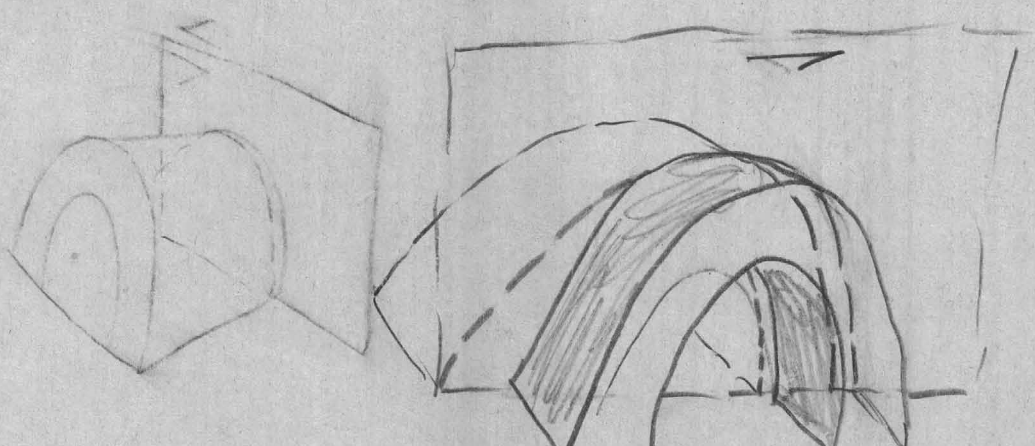
Sevy Canyon, N.Pass and minor strike-slip faults formed at this time. Nolan thinks them due to horizontal compression frrom NNW,parallel to strike of these faults.

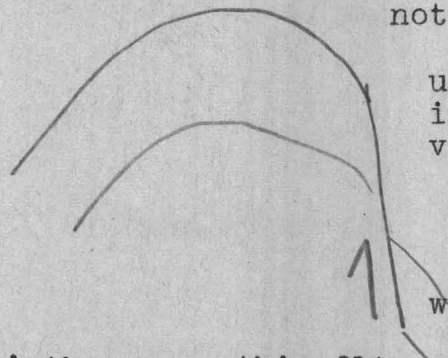
Such phenomena,tearing open of "tension fissures" parallel to direction of compression,very doubtful in nature. Strength of rock under compression from 20 to 70 x that in tension. That is why tension,as arching,stretching of a plate,is so effective in cracking rock.On the other hand,the stress needed to crack rock open under direct compression is astronomical.

These strike-slip faults cross the S anticline are appear to be tension fissures,like those at Pioche (which turned into antothetic flts);only the Gold Hill ones were larger,broke clean across.Continued uplift of an anticline so broken into segments involves differential movement of the blocks, one against the next;they topple,shift sideways.

These cross-fissures formed during the folding: p.68;Nolan shows that displacement on Sevy Canyon fault,S side E on far E is 600',increasing uniformly to west to 4000'. In part result of steepening in W dip on bedding on S side of fault,not on north side.

Why this abrupt change in bedding dip,right along flt.planemunless beds were bending differntially,more intensely to S of fault, as faulting went on? Or fault could have been inert break,on either side of which bending,of differing intensity,went on:





E Border flt.aided this uplift;does not mark a later period of relaxation but on theory of vertical uplift,not compressional folding is part of same orogeny. With vert.push,no anticline can form unless flanks are anchored. But after folding,E flank ruptured. Shove continued,broke uplift,with its cross-fissures which formed along with the folding,loose from its anchor.
4000' of total 6000' throw on this flt.assigned to Cycle 2.

The other normal faults connected with Cycle 2 are the antithetic flts. mentioned,associated with the Twin Peaks uplift. The last such antithetic flt.to the E,Spotted Fawn zone,turned into a synthetic fault for a slightly later uplift on the E,which shoved up the PM qtzite,lowest exposed rock in district to the present surface.

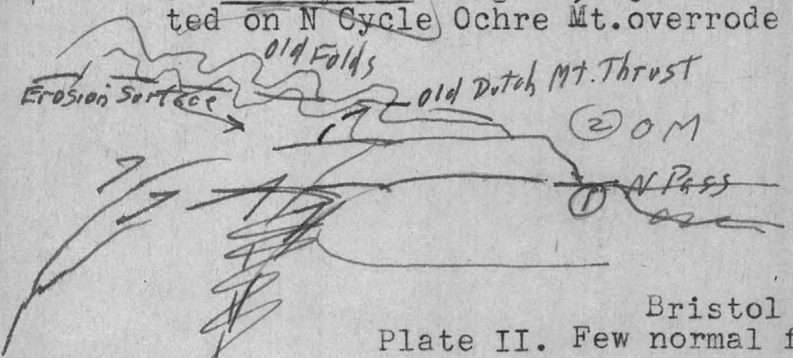
Note that this rise of blocks east of major uplifts happened at Goodsprings,where a late component of the Bird Springs uplift occurred;in the Muddy Mts.(late bowing up of the Weiser syncline;at Pioche (Combined Metals or Ely Range uplift on E).

These secondary uplifts out in the E frame of a primary,major uplift, are expedited by using the antithetic flts.connected with the major uplift as synthetic faults. Thus utilizing these preexisting faults uplift occurred without folding. Without the faults there would have been an arch or anticline formed.

Possible long erosion period,levelled S Cycle 2 anticline and Eastern Boundary fault;thin thrust plate overrides the flt., probably an erosion thrust.

11/2/51

3rd Cycle: Stage A,major thrusting.N Pass thrust the earlier,~~seems limited on N Cycle~~ Ochre Mt.overrode it.slightly later.Both erosion thrusts.



Older N-S uplift planed by erosion after 2nd Cycle,which produced a highland just W of district. Then a greater uplift occurred farther W(note pre-Cambrian SW of Gold Hill on paleotectonic map S Nevada) Gold Hill in its eastern frame.Cf.Pioche, Bristol Range thrust.Cf.Schematic Diagram, Def. Plate II. Few normal flts,Stage B. Deformation mainly off to W.

4th Cycle: Stage A. 4 great strike-slip faults,horiz.movement on each or some may have been over a mile.Dry Canyon flt.,only 1000'.Blood Canyon,S side may have moved E 1 mi. Fault heading toward QM,appears in roof pendant.N side may have moved E. Garrison Monster,N of map. Dies out to W.How come? These like Sevy Canyon rift,probably due to xxxxxx tilting,hinge action of segmented uplift to W.

Folding non-existent in this stage.

<u>5th Cycle:</u> Monaonite intrusion. Main stock seems limited by preexisting faults,E-W:Pool Canyon on N,Blood Canyon,S. Thesemmay kimitxthex may limit,on N and S,the N Pass thrust,which may have fractured rock; sake for overlying Ochre Mt.thrust. On W of stock a series of major normal faults,parallel " edge,synthetic, E side up. These faults greatly displace Ochre Mt.thrust,only major faults that do.Deep transgressive features. Nolan points out lack of doming in seds.bordering the stock. No doming required where borders of congealed intrusive ruptured as by these N-S faults.Uplift by block-faulting,not flexing of beds.

This N-S fault zone is locus of a belt of high-temperature ore deposits Torumaline,scheelite.
Zone thought to represent primary channel up which stock intruded. These faults or this fault system used before magma solidified,as channel field evidence;used preexisting faults on S side also:note Cycle 2 normal faults,QM making out along them. Then,after magma congealed,N-S fault system used as vehicle for uplift. In general way,stock localized by comobination of N Pass brecciation,with Pool Canyon,Blood Canyon strike-slip flts on N and S respectively. Cf Ely.

ORE DEPOSITS.

Not imp. Classes :

1. .Pegmatite masses in QM,pipes of tüngsten,molybdenum.NG.
2a.Veins wifh silicates in gangue
2a-1:Lenticular or vein-like bodies associated with scheelite pipes/ QM/NG
2a-2In QM and seds.Fg silicatescopper over tungsten. Lucy L to Clifton, along fault zone,W side QM.Along pre-mineral fractures or narrow sheeted zones,some reopened over long period,many generations vein minerals. Frankie vein in narrow QM dike in Oquirrh ls,ss:1.pre-intfusion flt. 2 dike;3 silicates,garnet diopside,amphibole,tourmaline. These cut by sheeting, copper deposited.Some gold.

2a-3. Gold type,in ls.near QM. Rube,Alvarado,CR or big roof pendant,N end of stock. Ls.now tactite. Ore in small shoots along leniea or planar

igneous contacts. Midas,S end of stock,ore along bedding fractures.Rhyt
Rhythmic deposition of qtz.,calcite;ccpy,py,bornite,asreon.,galena.

2b.Qtz-sulphide veins;mainly in QM.,widely scatterd.Veins may betraced long distances,but ore shoots sparse,small.Arseop.,py,ZnS,PbS,ccpy,. Arsenop,earliest. Qt only abundant gangue; frags wall rock in vein indicate tension perp.walls.

2c.Veins with carbonate,sulphate in gangue.Unimp but as elsewhere repre

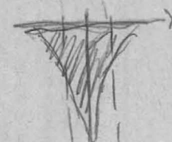
sent dying stages of mineraliz. Thru QM and adjacent seds.Many follow structural features older than QM. Some follow,linear contacts of QM with seds,which contacts were in turn determined by older flts. One place carb.vein introduced into older galena-bearing fissure.

Show banding,colloform s.t.Caracol structure,Mexican epithermal deposits. S.t. minor sulphs.,limited to veins showing mainly qtz., minor carb.

This mineralization varies from hypothermal,earliest,to epithermal,l latest. Must mean,for the given present erosional surface near which all the types occur,progressive stripping of cover and therefore marked uplift at time of mineralization. IMP for zoning study:means that xxx xxmetals did not come in all at one time,in one set of solutions, HT minerals ppting out first,at depth,then lower,higher or farther fron conduit etc.

On contrary, at Gold Hill HI temp.minerals came first,deposited at depth under great cover;as cover stripped lower*T minerals deposited at less depth but also in and around stock,very considerably later than HI temp minerals. All ended up at about same horizon with respect to sea-level. Effect of progressive cooling at depth?

3A.As replacement deposits:Gold Hill(on E)of W.Utah Cu Co.,and Gold Hill of U.S.Smelting.Most imp.In Ochre Mt,rrof pendants enclosed in QM.Ore prefers fresh ls over tactite. Localized by (1)major fissure cr crossing strike of beds,(2) one or more bedding fissures.Gives

triangular plan: 

Solutions could notmreact with ls except for shorts distances away from circulating channels.

xxxx(xxxxxxxxxxxxxxxxxxx Arsenop.Brecciated,minor py,ZnS,galena,ccpy. qtz(Over long period)introduced.Qtz replaces arsenop.

3b.-1. Cu-Pb-Ag bodies associated with As bodies. In above 2 mines. Along a wall of the As ore,or replacing same bed in which As ore occurs but farther away from major channel fracture.Peripheral position. Have some arsnop,older than rest of sulphs. Py next to form after arser replaced by base sulphides. Then ZnS,ccpy,galena.

General: Rock formations above Ochre Mt.thrust barren;dammed upward flow of solutions by stopping upward continuation of fractures formed inQM & in seds.below thrust. Lower N Pass thrust may have dammed off solutionz too and prevented G.H.from becoming a major mining district.

Areal relations of ore deposits to stock very apparent. Nothing away from stock. Note that stock came up early,presumably deep-going faults; or solutions did the same. Repeated fracturing and fact that HI temp.mineral are the oldest accounts for lack of areal zoning.p.107:"..the repeated fracturing of the QM..provuded channels for the ore-depositing solutions in regions that might otherwise have been closed to them through sealing of the earlier-formed fractures by older,higher-temperature ore bodies." Since type of ore grades from hypothermal to epithermal,fracturing cknnected with repeated uplift to give erosion.

Gold Hill production less than $5,000,000 from great number of scattered small OBs. Stock climbed high thru sediments,past two thrusts that thickened the rock section,along steep fissures that cut the thrusts and the thick rock section.

Relation to Mid-Cretaceous Orogenic Period: White Sage Eocene continenta ls.not intruded but is metamorphosed,hence intrusion may be as late as Eocen But note 5 cycles of deformation,long erosion period between 2 and 3. Orogeny began in mid-K.

Basin-and-Range Faulting:Region now a fault block tilted east;probable N-S fault bounding QAl on W,dip and downthrow to W;antithetic,because he figures both walls moved,FW up 500' shown by tilting,HW gravel down at least 1000',shown by attitude of gravel . .p.61:"It is rather strongly indicated ..that the movement along the fault has been accomplished by a combination of elevation in the footwall block and depression in the hanging wall block." Add the tilting he mentions and you get an antithetic fault,dipping w est,indicating major Pleistocens uplift on W.

GOLD HILL, UTAH. TECTONIC ANALYSIS.

Refer to columnar section, Section D-D' and Structural Map.

~~Five deformation cycles, each showing~~

Structure very complex owing to 5 deformation cycles and three thrust systems, one above the other. Strcuturs different each side of a thrust. In the south part of the district a major, sharp anticline is shown because it lies below the North Pass, ~~the lowest and oldest~~ thrust (~~3rd~~ 2nd cycle). May be overturned to E; is certainly assymetric, dips must be steeper on E. Cut off by Eastern Border fault, of same cycle; resumption of movement in BR time.

Remaining folding cannot be shown because any given area lies above a thrust, and in many cases, below another. Hence the warping or folding o of the various thrust planes is shown (North Pass, Ochre Mt., Dutch Mt.

Each cycle seems to possess an initial, "compressive" stage, and a second normal faulting or tensional stage. Further, there is a progressive variation in the nature of the structures developed during the successive cycles. Early cycles, (1) folding dominant (1.2). Great flat thrusts characterize compressive stage of 3rd cycle (Ochre Mt). Transvers, rift c or tear faults, later cycles.

Thinks this change due to progressively lighter load: folding, heavy load (Baily Willis, mechanics of Appalachian structure; tear faults develop best under light load. At any rate, lighter load must have been supplied by erosion; great erosion must have had uplift to work on.

2nd-stage normal faults shows decrease in number and intensity in successive cycles.

<u>1st Cycle:</u> Small thrusts(?) and normal faults, center of map.

<u>2nd Cycle:</u> 1st Stage. Folding most intense. Fold in S part mentioned, belongs to this period; another N-S anticline N of Blood Canyon fault; but this is not the same because it overlies North Pass fault of 3rd cycle. Finally, Twin Peaks recumbent antcline in NW part. Each of these three folds lies in different thrust plate: S fold, below North Pass 3rd cycle thrust; central fold, between North Pass and Ochre Mt. thrusts; Twin Peaks, above ~~North R~~ Ochre Mt. thrust, probably. Only important 2nd Cycle thrust is Dutch Mt., shown on plan and in ection D-D'.

Compare restored sketch, lower part, Section D-D' with Schematic Detail. eformation Plate 2. Dutch Mt. shoves younger over older, hence did not emerge on surface, which checks thick cover idea of Nolan's. Definite- steepens to W as shown by Section D-D'.

Reversing
~~Restoring~~ effects of Basin*range faulting and Cycles 3, 4 faulting, we have high uplift on W, possibly culminating not far west of map. At least one major fold, overturned down flank of this anticline, like Muddy Mts. Gelndale thrust. At least one antithetic fault (Tank Wash); probably others shown used Cycle 2 similar faults. See also big normal flt. bounding G pm on W.

Since Oquirrh formation is involved, cover was enormous-all but dop few thousand feet of the 30,000 ft. (You must conceive of each thrust block and its deformation as a unit, carried bodily along by the underlying thrust movement). We see deformation, where the folding is acute (Twin Peaks anticline) entirely in the Oquirrh formation, from 22,000' up in the section on up.)And base of Prospect Mt. not exposed).

The simple fold, south part, involved formations no higher than the Woodman, 15,000' up. And the highly competent Prospect Mt. qtzite was its core. See Eardley for probable total thickness of Cambrian, lower, here. Does this comparision necessarily mean different kinds of folding in the two areas? "Acute, overturned, strong compression" vs. relatively "mild, open"? It could, of course; but a hunch is that in the S fold we are looking at the simple core of an uplift, while in the N fold we see contortions of the thick, rather incompetent cover on one slope of an uplift equally simple at its core, if we could see it. If this hunch is right some concepts of tectonics may have to be radically revised.

The Sevy Canyon, North Pass and minor rift faults formed at this time. Nolan things them due to horiz. compression from NNW; high-pressure experiments by Griggs etc, show that the force to do this is astronomical. Strength of rocks under tension averages about 1/20 to 1/10 of that under compression. These are tension fissures connected with same uplift. Uplift of broken anticline involves uneven movement of blocks, one against the next; they topple and shift slightly sideways.

Eastern border fault aided this uplift; it does not mark a following period of relaxation but is part of the same orogeny. Naturally the folding would come first; no synthetic faults so long as rock folded because it could not fold unless its flanks were anchored. Cross-fissures formed along with the folding. Then the uplift ruptured, broke loose from its frame. 4000' of the 6000' throw on this fault is assigned to the No. 2 cycle (because North Pass thrust of Cycle 3 displaced only 2000')

INSERT:

If cross-fissures formed during folding there is a simple explanation for at least part of the horizontal movement. On p. 66 Nolan says: " The offsetting of formations along the fault increases rather regularly westward. Thus outcrops of the Cabin shale" (on the far E just above G pm) are shifted about 600 feet" (S side E)" the Young Peak dolomite about 1200', the Fish Haven dolomite about 2000 feet, and the Guilmette formation about 4000 feet. This variation is in part the result of subsidiary thrust faults and in part the result of a steepening in the westward dip of the bedding on the south side of the fault but not on the north side." - p. 67.

Why should there be this abrupt change in bedding dip, right along the fault plane, unless the beds were bending as the faulting went on? The fault could have been an inert break, on either side of which bending occured. Folding during faulting has been recognized in S. Calif. Clark, Bucher.

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Second Stage: Normal faults of this cycle, many of which were loci of later movements, are E Boundary fault mentioned, Trail Gulch, Tank Wash, Bar Creek, and Spotted Fawn, all the latter in N Part. As shown in Section D-D', probably all of these were originally antithetic faults associated with the uplift on the west. The Tank Wash remaine so; but the others apparently served as synthetic faults aiding a slightly later uplift on the east, climaxed by the shoving up of the Є pm., lowest exposed, to the surface on " side Dutch Mt.

Same thing happened at Goodsprings (late component of Bird Spring uplift); Muddy Mts. (late bowing up of Weiser syncline etc.) Pioche (Combined Metals uplift on E).

Note that such secondary uplift, out in the frame from a primary uplift, are expedited by using the antithetic faults set up by the primary uplift. Uplift without folding. The original anthetic faults probably originated in the basement, which deformed differently from the sliding skin of incompetent cover, breaking into tension fissures. After cover had folded all it could, antithetic faults formed in it, or broke through it possibly from below.

Possible Long Erosion Period

3rd Cycle.- 1st Stage. Major thrusting, minor rifting, slight folding. North Pass thrust, earlier and overriden by later Ochre Mt. thrust seems limited on N by Pool Canyon rift fault; on the south by the North Pass rift.

Cycle 2 anticline and Eastern Boundary fault must have been levelled by erosion at time of North Pass thrust for thin thrust plate overrides the fault. Thinks it an erosion thrust. Thinks limitation of North Pass thrust to Pool Canyon-North Pass fault block due to erosion exposing resistant Єpm north and south of the bounding faults, preventing the overriding found between the faults, where pm deeply buried. This is HS: North Pass fault does not deeply bury pm, but there is terrific normal throw on Blood Canyon 4th period fault, down to N. Pool Canyon faults pm against Oquirrh. Dropped block in center.

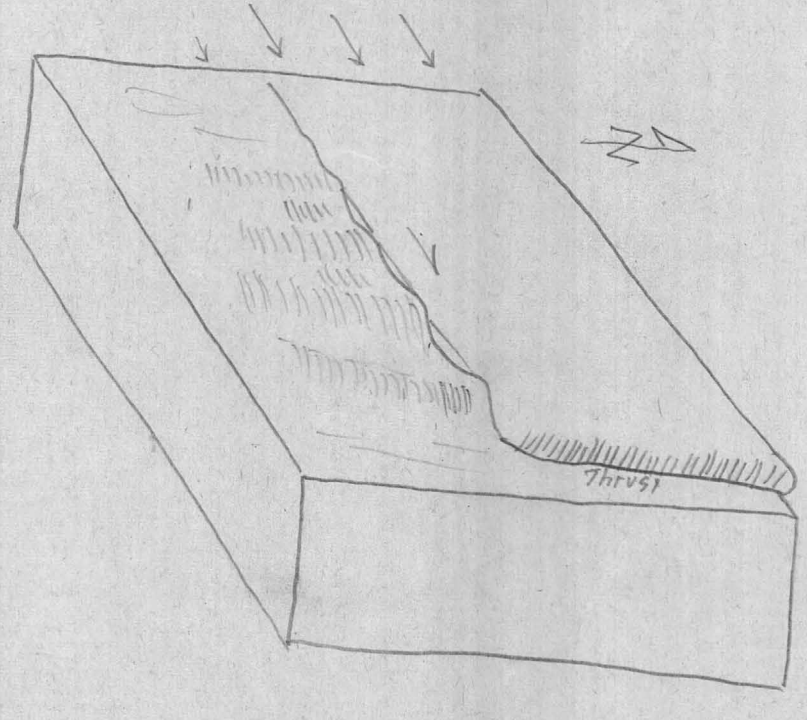
Ochre Mt. also an erosion thrust, and younger than Pool Canyon rift. Ochre Mt. younger than N. Pass thrust, but not greatly.

Few normal faults in 2nd stage of Cycle 3.

4th Cycle.-1st Stage. Main feature 4 4 big E-W rifts, horiz. movement may have been 1 mi. plus. These rifts cut both North Pass & Ochre Mt. thrusts and their normal fault accompaniments. 2nd Cycle Rifts, North Pass and Pool canyon strike WNW, but 4th cycle rifts E-W.

S to N: (1) Dry Canyon fault. Vert.; shift 1000' only, N side E.
(2) Blood Canyon.-Steep on W: on E. flatter N dip. S side moved 1 mi. E maybe.
(3) Rift on S side Ochre Mt., heads for QM, shown in roof pendant, also flattens to E. Don't know which if any side moved E; maybe N side. 1 mi.
(4) Garrison Monster, just off map on N. N side E 1.5 mi. But fault dies out to west. How could this be? More evidence that horiz. movement really a result of tilting, hinge actio. Thinks rift turns to thrust on E:

Cf Garlock & thrusts

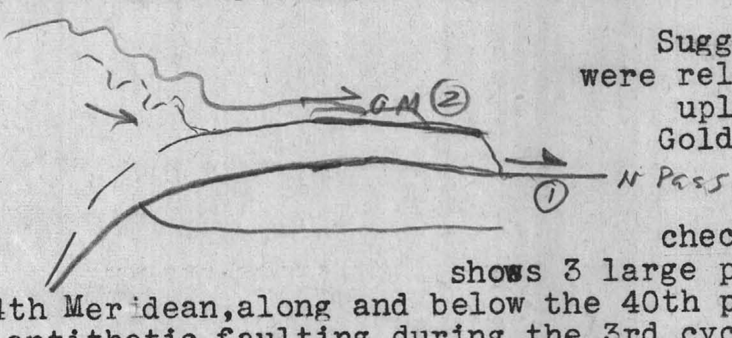


Dominance of faulting over folding extreme. 2nd Stage.-No normal faulting,

5th Cyclne. Faults related to monzonite intrusion. Normal faults on W side of stock,parallel contact. Greatly displace Ochre Mt. thrust.Such large faults do not cut thrust except here next intrusive. This fault zone also coincides with belt of hight-temp.ore deposits. Hence zone thought to mark location of primary channel thru which stock intruded. Ely.

General.- Note that older Dutch Mt.thrust is higher in space than Ochre Mt.thrust. On Deformation Plate II,this corresponds to an uplift expanding to the east.?The Dutch Mt.thrust is probably small and it is directly related to the uplift which produced on its E flank the Twin Peaks recumbent anticline. 2nd cycle.Relation to O.M.coincidental. Great time interval between Cycles 2 and 3.

On the other hand Cycle 3 produced no acute folding:on the contrary,it produced major thrusting,flat,with slightly earlier North Pass thrust being overriden by younger Ochre Mt.,both erosion thrusts.



Suggests that folds of 2nd cycle were relatively minor and that a great uplift existed well to the west; Gold Hill in its E frame. Pioche.

For once this seems to check, for the Geologic Map N.A. shows 3 large p-Є archean exposures west of the 114th Meridean,along and below the 40th parallel. Run down. No normal or antithetic faulting during the 3rd cycle,which checks. Note on the map that most such faults belong to the 2nd stage,that of local uplifts. Plus E Bdry synthetic fault in S. (Except BR faults).

Basin Range: Region a fault block tilted east;deduces hidden flt. bounding main Qal area on east,N-S,dip and dwonthrow W. Both walls moved, FW up,shown by tilting, HW gravel down at least 1000' as shown by alttitude of gravel. p.61:"It is rather strongly indicated, therefore, th

that the movement along the fault has been accomplished by a combination of elevation in the footwall block and depression in the hanging-wall block."Antithetic fault if you add tilting.

BR faults on E side also:E of Dutch Mt.,E.Bdry fault and others.

Tectonics of QM intrusion.- Note Ochre Mt.thrust preserved in roof pendants;faults cutting these but blotted out by QM probably related to emplacement of latter. W border,parallel faults have been mentioned. Ore zone along these flts shows tourmaline,scheelite,axinite,boro-silicate of Al,Ca wit Fe, Mn. Marks channel for QM,faulting along it bein 2ndary consequence of upswelling magma. But faulting before massive solidified,faults used by magma asdending.Used older flts,too,S side.

Little or no doming. In general way,intrusion thought to have been localized by combination of Pool Cnyon,Blood Canyon rifts and North Pass thrust brecciation rocks at depth. Ely.

ORE DEPOSITS.

12/8/50

Varied, not important. 3 classes: (1) pegmatite masses in QM,pipes W, Mo. Unimportant. (2)Veins (a) with silicates in gangue; (b) qtz-sulphides;(c) carbonte gangue with or without qtz.3replacement O^{D}s(a)As dominant (b) Cu-Pb*Ag-minerals dominant.
2a. Fg silicates;copper greater than W.Between Clifton & Lucy L.
~~2c-gold.In ls near QM. Alvarao,Rube, Midas. Ore in small shoots,often~~
Sheeted zones or fractures,some of latter reopened:x(1)Frankie mine west of Lucy L and along old fault zone. Copper with some gold.
(1)CR Ocquirrh ls,ss.(1) fault active before intrusion.(2) narrow QM dike.(3)silicates (4) cut by close parallel fractures,copper.

2c.Gold. Type In ls near QM. Alvarado, Rube, Midas.Small shoots localized often along linear igneous contacts. Ls now tactite,mainly wollastonite. Ccpy py,bornite,arsenop,Pbs. Rhythmoc deposition of qtz.,cal.

2b. Qtz-sulph.veins.Mainly in QM.

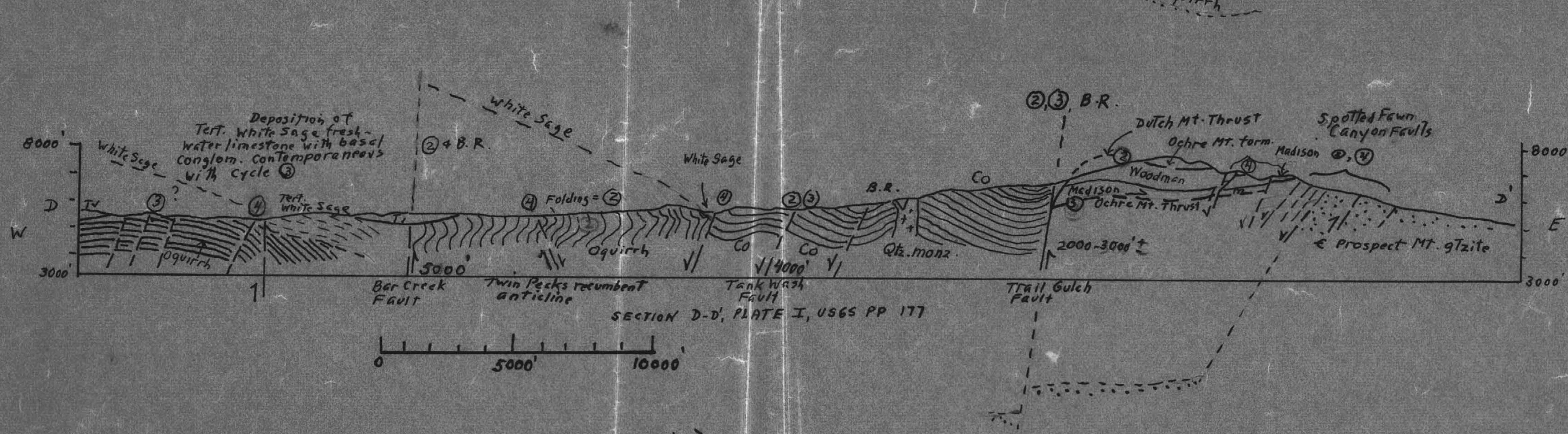
3a.Arsenic replacments.Gold Hill ofnW.Utah Cu Co.,and Gold Hill(U.S. Smelting). Largest in district. Ochre Mt .ls roof pendents enclosed in QM. Prefers fresh ls,not tactite etc.Needed (1) major fracture across beds (2)bed fissures.

Ore solutions needed fractures to replace ls.
Arsenop,mbrecciated,qtz py,sericite,ZnS
PbS, ccpy introduced

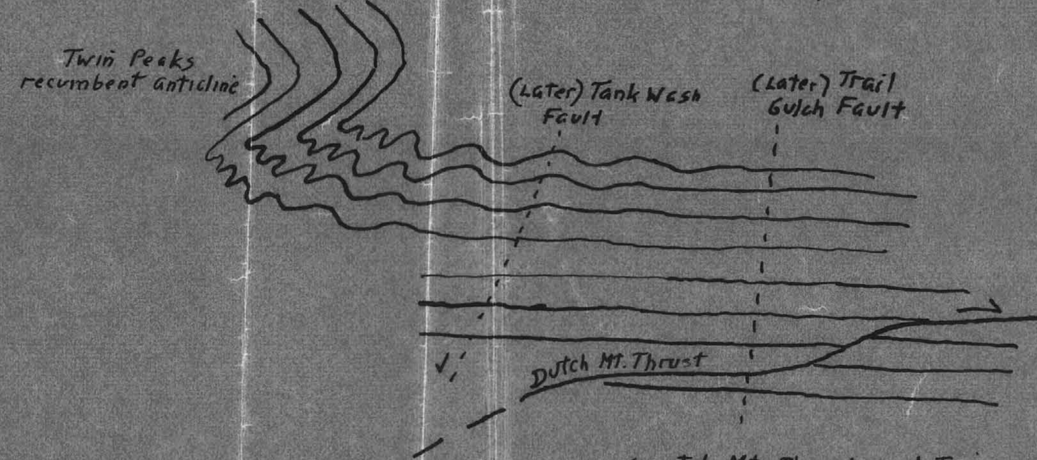
The As OBs in both mines mere side lights of shoots Pb-Ag,little As. Latter bodies younger, occur either aling wall of As ore or in same mineralized bed,but away from As ore,farther away from feeder.

3b.Cu-Pb-Ag replacment bodies. Just described. Other.minor ones.

Formations above Ochre Mt.thrust barren.Thrust prevented continuation upward of fractures formed in QM and in rocks below thrust. Lower North Pass thrust may have seiously dammed off solutions.



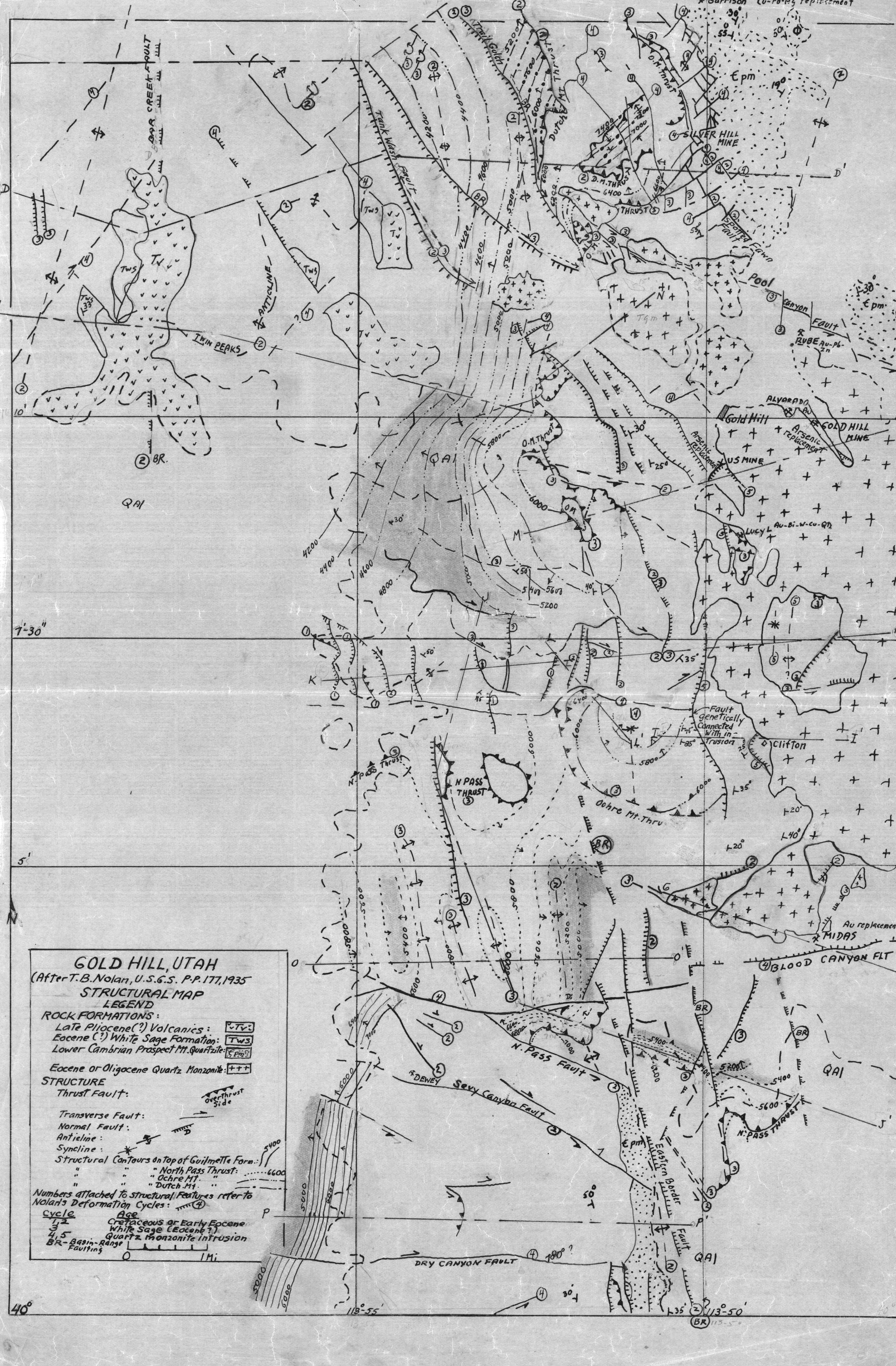
SECTION D-D', PLATE I, USGS PP 177

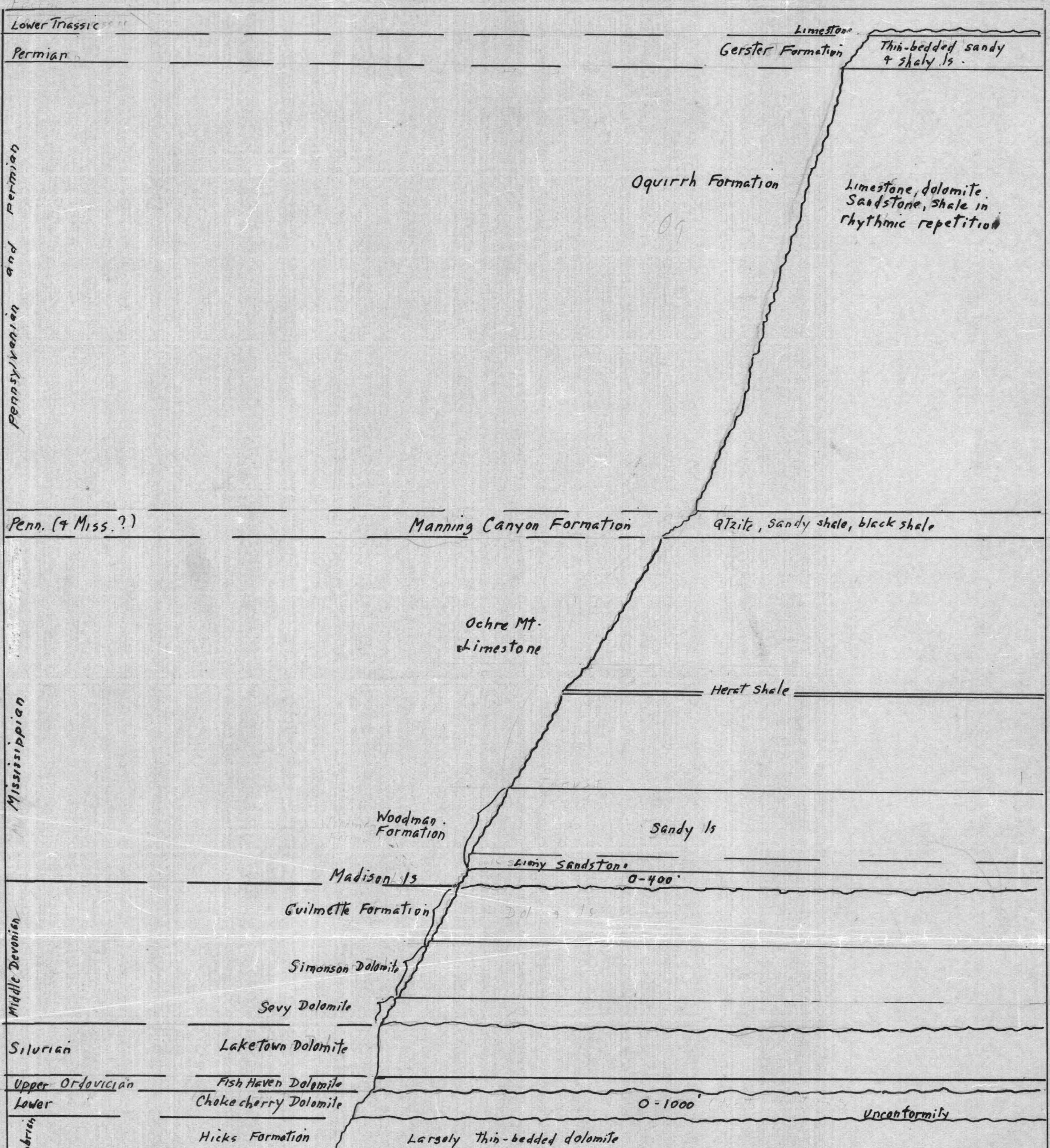


Restored Relations of Dutch Mt. Thrust and Twin Peaks recumbent anticline.
FIG. 11, USGS PP 177

GOLD HILL, UTAH. After T. B. Nolan, USGS PP 177, 1935
Numbers ① etc. correspond to Nolan's orogenic cycles.
B.R. = Basin Range epoch of faulting.

E. Wisser 12/49

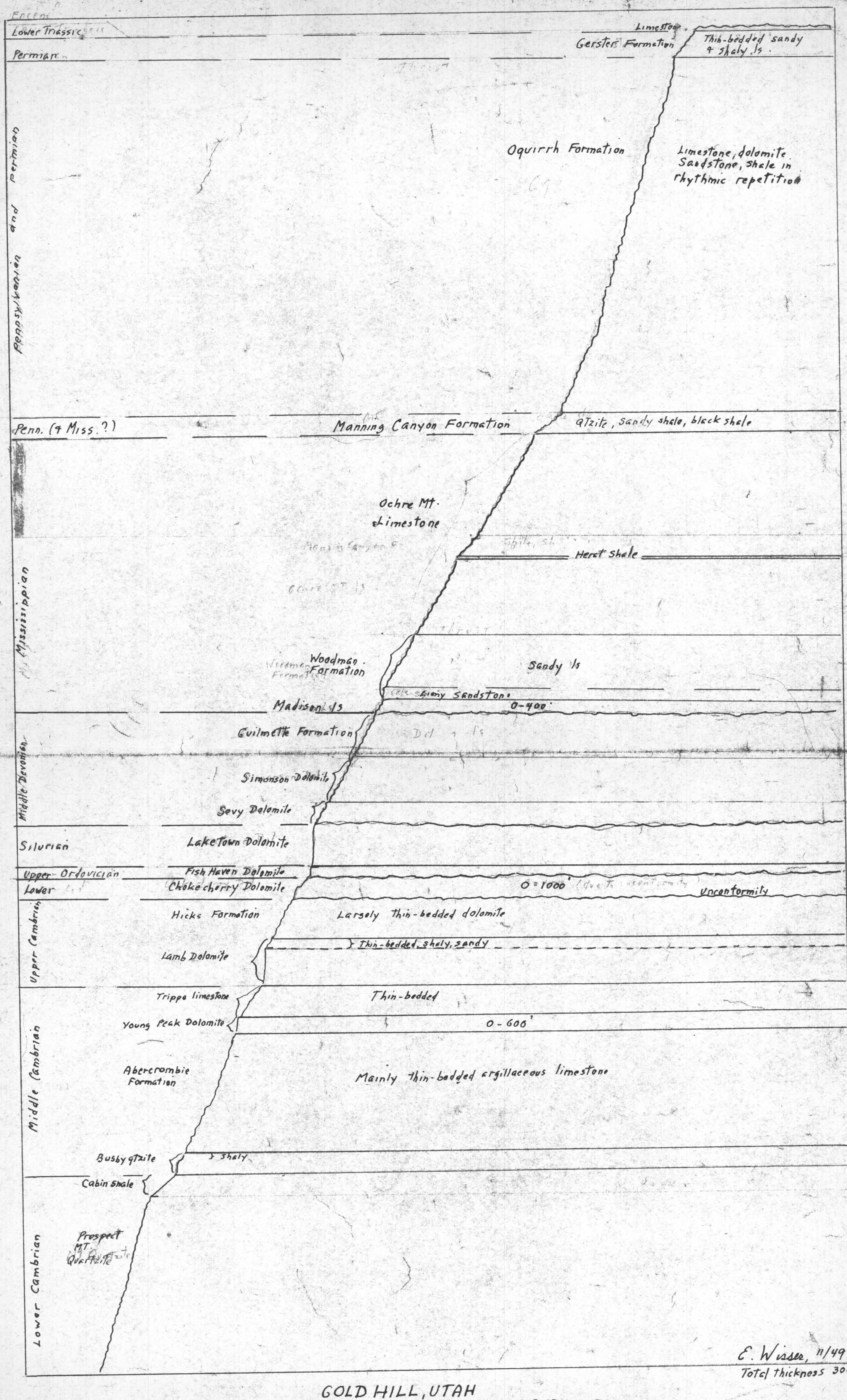

GOLD HILL, UTAH
(After T.B. Nolan, U.S.G.S. P.P. 177, 1935
STRUCTURAL MAP
LEGEND
ROCK FORMATIONS:
Late Pliocene(?) Volcanics: Tv
Eocene (?) White Sage Formation: Tws
Lower Cambrian Prospect Mt. Quartzite: Ɛpm
Eocene or Oligocene Quartz Monzonite: +++
STRUCTURE
Thrust Fault:
Overthrust Side
Transverse Fault:
Normal Fault:
Anticline:
Syncline:
Structural Contours on Top of Guilmette Form:
" " " North Pass Thrust:
" " " Ochre Mt.
" " " Dutch Mt.
Numbers attached to structural features refer to Nolan's Deformation Cycles:
Cycle Age
1, 2 Cretaceous or Early Eocene
3 White Sage (Eocene?)
4, 5 Quartz Monzonite Intrusion
BR - Basin-Range Faulting
0 1 Mi
Garrison Cu-Pb-Ag replacement
BAR CREEK FAULT
Trank Wash Fault
Dutch Mt. Thrust
SILVER HILL MINE
D.M. THRUST
O.M. Thrust
Spotted Fawn Fault
Pool Canyon Fault
RUBE Au-Pb-Zn
TWIN PEAKS
ANTICLINE
Gold Hill
ALVORADO Au
GOLD HILL MINE
Arsenic replacement
US MINE
LUCY L Au-Bi-W-Cu-Qtz
Fault genetically connected with intrusion
Clifton
N PASS THRUST
Ochre Mt. Thrust
MIDAS
Au replacement
BLOOD CANYON FLT
N. Pass Fault
DEWEY
Sevy Canyon Fault
N. PASS THRUST
Eastern Border Fault
DRY CANYON FAULT
QAl
40°
7'-30"
5'
10'
113°-55'
113°-50'



GOLD HILL, UTAH
COLUMNAR SECTION, PRE-TERTIARY SEDIMENTS

0 1000' 2000' 3000'

After T. B. Nolan: Gold Hill Mining District, Utah. U.S.G.S. P.P. 177, 1935

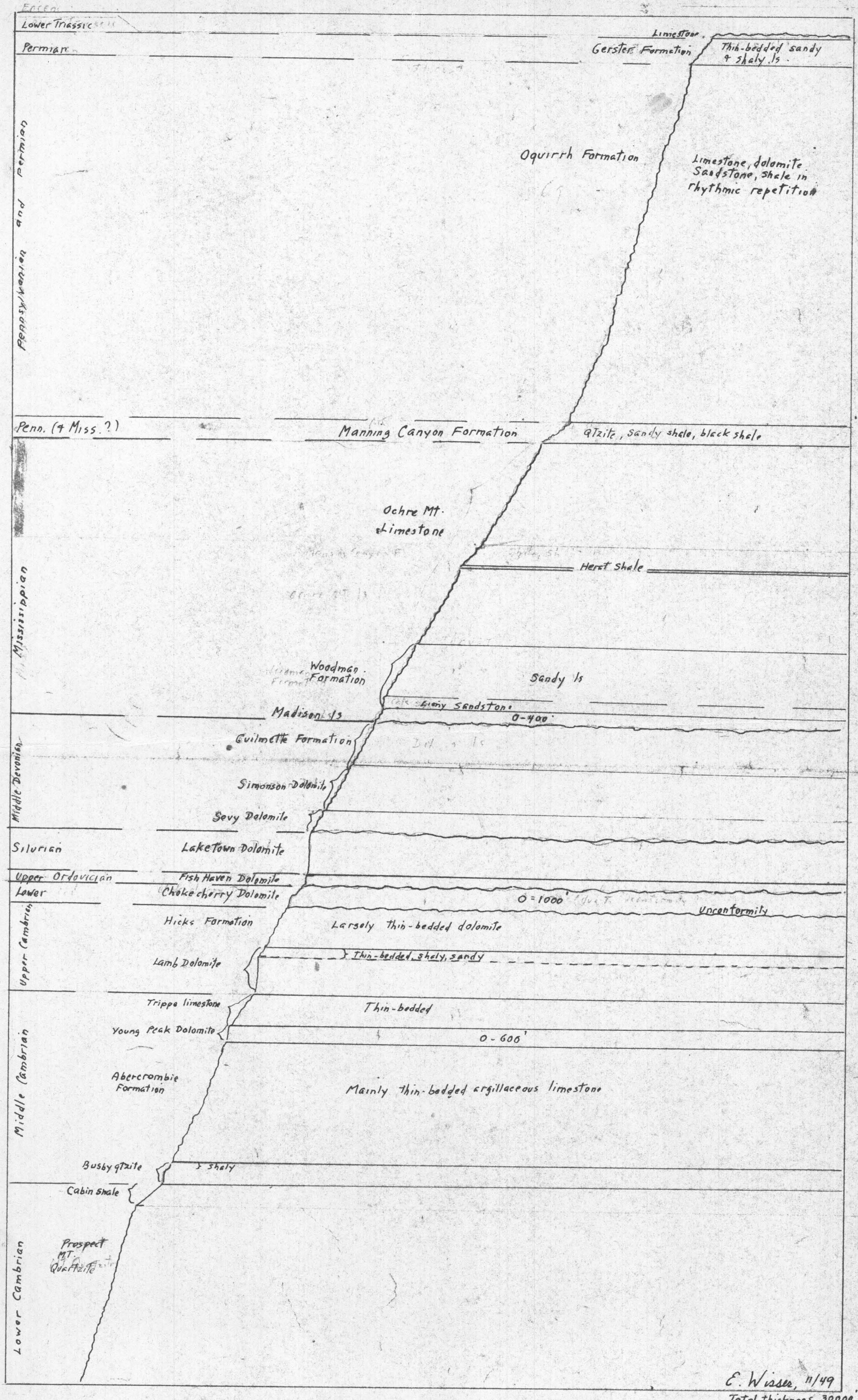


Total thickness 30000' ±

GOLD HILL, UTAH
COLUMNAR SECTION, PRE-TERTIARY SEDIMENTS

0 1000' 2000' 3000'

After T. B. Nolan: Gold Hill Mining District, Utah. U.S.G.S. P.P. 177, 1935



GOLD HILL, UTAH
COLUMNAR SECTION, PRE-TERTIARY SEDIMENTS

0 1000' 2000' 3000'

After T. B. Nolan: Gold Hill Mining District, Utah. U.S.G.S. P.P. 177, 1935