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TECTONIC ANALYSIS OF HAWTHORNE & TONOPAH QUADRANGLES, NEVADA

Based on: Structural Geology of the Hawthorne & Tonopah Quadrangles, Nev. H.G. Ferguson & Siemon W. Muller. USGS PP 216, 1949.

For stratigraph sectio, see ~~xy~~ Plate 1. Tertiary formations omitted: they overlie and largely conceal older rocks and structures. Oldest Tertiary are lavas of various types with minor IB seds. Miocene. These overlain unconformably by Esmeralda, late Mio-early Plio: fresh-water and subaerial seds. IB with rhy flows, tuff. Block fltg preceded dep. of Esmeralda, latter in part at least deposited in basins resulting fron the fltg. In places thick rhy lies conformably on Esmeralda; rhy stocks cut and distort the beds.

Unconformably on these is thick series andesite, andes. agglom., Plio. Qtz latite flows overlies Esmeralda unconformably in Toyabe and nearby ranges. An erosion surface preserved on crests of present ranges truncates the tilted, faulted andesite and qtz latite. Basalt flows above gravels, Pleistocene, are later than this erosion surface.

Tectonic History:

Older Paleozoic.

Cambrian, Ordovician, Devonian appear all conformable. Laid down within Cordilleran geosyncline, perhaps somewhat NW of its center line.

T.B. Nolan: The Basin & Range Province in Utah, Nevada, California. USGS PP 197-D, 1943: p.146-7. Great Basin part of Cord. geosyncline. Geosynclinal seas extended far N of Great Basin province. Latter defined by boundaries: on West, Sierra Nevada; on E, western borders of Wasatch range & Colorado Plateau. On N arbitrary line, Susanville to McDermitt, thence E along N boundaries of Nevada and Utah to Wasatch Range. SE, Colorado River; SW, San Andreas rift. See white print, Tectonic Map of W N.A.

Debatable whether geosynclinal seas extended to SW. Few OCs of Paleo seds in Mojave and Colotado deserts, SE Calif. But trends in thickness N of here, and lithology of beds just N of Mojavae desert indicated geosyncline must have extended S along its projected axis, Absence of Paleo seds in this S region due to either intense deformation or to erosion following differential movement along Garlock flt.; possible uplift along this flt. also. Cambrian, Ordovician very thick, may exceed 23000'; but Silurian, Devonian seas extended beyond boundaries of GB, so have much thinner sections. 6000'. At end of Devonian geosyncline split by geanticline in W Nevada, hence Miss., Penn. seds known only in central E parts of GB. Genticline eroded by Permian: Permian strata in most parts except S GB, where another geanticline which persisted into Mesozoic, began to rise coincidentally with disappearence of older one.

Nolan's W Nevada geanticline is shown on my version, Plate ~~1~~ (axis), on my Fig. 1. It is described in PP 216 under

Pre-Permian Folding. (My Fig. 1).

T.B. Nolan: A late Paleozoic Positive Area in Nevada. Am. Jnl. Sci. 5th. ser. 16, 1928, 153-161. "...elevation along the geanticline was accomplished by folding or warping on so broad a scale that the angular discordance beneath the overlapping Permian is scarcely discernable. In view of the

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INSERT.

My Fig.1 shows relation of pre-Permian folding to Nolan's geanticline. Candelaria-Miller Mt.area,folds swing around westward bulge in uplift, and are overturned down-slope,as usual. In Toyabe Range,Sec.B-B' may repr-sent autonomous uplift,perhaps along center line of Eardley Miss-Penn. geanticline;or part of major fold overturned to E,on E slope of Nolam gea-nticline.

thickness of beds that were probably removed, this implies that a fairly wide area was involved. Locally, however, the elevation was accompanied by more intense folding of the Ordovician, as in the Candelaria-Miller Mountain area". My Fig.1.

PP 216: W part of Candelaria Hills, steep folds in Ordovician trend NE; in part overturned to NW; these overlain by Permian & Lower Trias, strike W dip gently N. See my Fig.2, for folds in overlying Excelsior on this S rim of Luning Embayment. Angular unconformity between Ordovician & Permian in Monte Cristo Range and Toyabe Range. (My Fig.1). Here general structural trends of Pre-Permian and Permian about parallel; this means pre-Permian uplift, truncation, laying down of Permian volcs. and seds., renewed, more gentle uplift along same lines. In S part of area uplift remained more positive, less sinking below sea-level, for Permian is thin, missing in places; greatest thickness not over 400 ft., and consists of 100 ft. cgl., coarse grit, ss., sub-aerial. In NE, Toyaba Range Permian 6000', upper 4000' domiantly volcanic. Series here grades upward from basal ss., grit as in S, thru chert, bedded tuff, to greenstone, breccia. Uplift again toward Trias., for upper part has grit also. Thus, volcanism connected with uplift. See opposite page, INSERT.

Post-Permian Deformation
Pre-Lower Triassic

Post-Permian, pre-Triassic uplift confirmed by fact that Lower Trias. Candelaria exists only in Candelaria Hills, where it rests on Permian with erosional unconformity: Permian uplifted without folding, eroded, subsided, Candelaria sh. ss cglg. laid down. Permian, thin at best here in S, eroded during epoch mentioned, Candelaria in places rests directly on Ordovician folds described above. Even if Permian had been originally thick in S, its almost complete erosion shows uplift, pre-Lower Triassic.

Post-Lower Triassic Deformation
Pre-Middle Triassic.

Lower Trias. Candelaria missing in Shoshone Mts. (see my Fig.2); only 800' Middle Trias. (Grantsville): this rests with angular unconformity on Permian volcanics. Uplift at close of Lower Trias.

Pre-Upper Triassic Folding (My Fig.2).

In E Garfield Hills (Sec.F, my Fig.2) and in Pilot Mts. (Sec.H, my Fig.2) Middle Trias. Excelsior is strongly folded and overturned to the N. Probably on N flank of uplift mentioed above, recurrent. Above the Excelsior in this area the Upper Trias. Luning is thrust to the S.

My Fig.2 shows distribution of Excelsior and folding in it. Folds are parallel to the eastward trend of the uplift, are sharp and overturned as usual, down-slope. Since the Upper Triassic Luning overlies the Middle Triassic Excelsior (in the few places where depositional contacts of the 2 are seen) with marked angular unconformity, the Excelsior folding preceded deposition of the Luning. Which means that erosion suceeded folding; which in turns means that the uplift on the S was higher at the time of the Excelsior folding than at the time of deposition of the Luning, although even at that time the uplift was land, bounding the Luning embayment on the south. See below.

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INSERT

Thus the S border of the Embayment coincided with the N slope of an E-W uplift (my Fig.2) which came into being immediately after deposition of Middle Triassic Excelsior, largely tuffs, flows, breccias, Cambrian exposed along S border, Fig.2 marks core of this uplift, as it did that of the pre-Permian uplift, as shown by the overturned folds that tend to parallel it, over which the Triassic seds. lie unconformably. Probably the E-W trend of the Cambrian (Fig.2) is due to the E-W post-Excelsior uplift superimposed on the NNE pre-Permian uplift?

Luning Embayment

Was a local easterly bight in the margin of a broad Upper Triassic N-S seaway. Smargin in central & E parts of Hawthorne quad. trended E-W, not far from present S margin of Luning formation, Upper Trias., the first formation deposited in the trough. Here it is bounded on S by older rocks, Cambrian to Middle Triassic. I have shown above (also in Figs.1,2) that this area, and that E of the Embayment, were positive (1) in Miss., Penn.; (2) in post-Permian, and during Permian in S (very thin there); (3) at this time, post-Middle Trias. Excelsior: slump folding down N slope. INSERT

Evidence for E-W southern margin of Embayment offered by abundant cgl. derived from ~~xxxxxx~~ Excelsior, in S Garfield Hills and Pilot Mts. Such cgls. occur as much as 3000 ft. above base, while elsewhere there is little cgl. above the basal member. Means uplift was mobile, travelling N into embayment. Ideal trigger or shaking conveyor to induce slump folding. Cf. Spieker, Central Utah.

Warping that gave the Embayment determined by preexisting structure, i.e. old positive area on S and probably on E. Ferguson seems to recognize overturned fold as a mark of a slope, for he says p.8: "...the folds overturned northward in the Excelsior formation of the Pilot Mountains and Garfield Hills as opposed to the thrust southward of the nearby Luning formation, indicate that at least the easterly trend of the southern border of the Embayment was controlled by older structural trends."

Within Embayment were quietly, conformably deposited 10,000 ft. of ~~xxxxx~~ Upper Trias. Luning, Jura-Trias Gabbs and Sunrise. Luning 8000, ls., dol., more cgl. toward margins. Land surrounded its basin of deposition. p.9: "The coarse conglomerates in the lower part of the Luning formation suggest that there may have been locally considerable topographic relief, Irregularities in outline and inequalities of either erosional or structural origin in the floor may have influenced the later structures. The mass of the Excelsior formation in the southeastern Garfield Hills, between Mina and Luning, may have persisted as an island throughout at least a part of the period of Luning deposition, There is no evidence that the depositional area of the Sunrise and Gabbs formations differed essentially from that of the Luning."

Jurassic Deformation.

This as shown above was superimposed on previously folded rocks; it was by far the most intense in the Luning Embayment, where the Luning-Gabbs-Sunrise seds. may have been still mushy. Sunrise is marine shale, thin-bedded ls. Dunlap deposited in a broad basin whose S border overlapped the S margin of the Luning Embayment: meaning a recession of uplift to the S, or a rejuvenation of the uplift that produced the Luning cgls., with its E-W axis somewhat S of the S margin of the Luning deposition. Lower part of Dunlap red cross-bedded ss and cgl. Typically marginal trough along N side of uplift, along Excelsior-Luning contact. Sinking goes with uplift, as in cenyral Utah, Denver Basin etc. Outside of this local sharp basin and N of the uplift the sea-way was as usual, for in NW Garfield Hills & in Gabbs Valley Range Dunlap is conformable on Sunrise or shows moderate erosional unconformity: Dunlap cgls have pebbles from Luning, Sunrise.

Fig 3A, Dunlap in Excelsior Mts & Grand Cedar Mts

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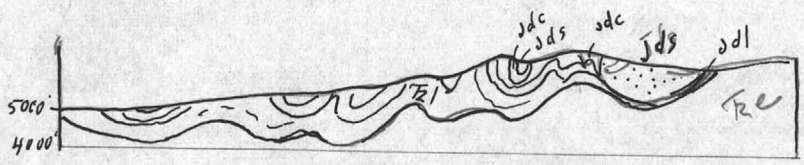
2. Local folding, thrusting; development of troughs. Change now from down-warping to real folding, See my Fig.3. The very thick(12000') resistant Excelsior acted as a basement for the thinner youngers strata. Fig.3 attempts to show the contours of this basement, upon which the younger strata slid, slumped, deformed.

Two main troughs, (1) NW Pilot Mts., (2) N Garfield Hills (see my Fig.3 and Fig.3A). At Luning-Excelsior contact. (1) is at margin of Luning Embayment, but (2) borders an inlyer of Excelsior N of S border of Embayment At (1), Pilot Mts., upper 1500' of Dunlap is cgl., fanglom. derived from the Luning; same for upper 1000' at (2), Garfield Hills trough.

The Dunlap deposited during folding of the Luning, which took place mainly down the slopes of the margins of these troughs. (My Figs.3,3A,4A.) In the Garfield Hills trough, while folding during Dunlap deposition was relatively gentle, depression of the trough continued during folding. PP 216 Section E-E', Plate 2, shows following: folding of Luning, down-slope from Excelsior inlier ; truncation of earlier Luning folds; laying down of basal ls. cgl. of Dunlap; folding of the latter.



Ferguson is confusing here, probably because a downward of a bed is a fold to him. The section would seem to imply laying down of the Luning; folding of the beds down-slope from the Excelsior inlier; exposure above the water of those folds highest up the hill and their consequent truncation; laying down of basal Dunlap in revived basin, which was deepest next the upliftmand died out to N, where Luning not folded in the early period and hence Dunlap laid down on it conformably; folding of the whole works with sharpest folding next uplift, on steepest part of slope. Uplift revived sharply to give thick local ss and grit of Jds. Uplift continued during entire deposition of this thickness: no secular change, coarser to finer. Basin sinking as rapidly as S shore rose,

In the Pilot Mts. basin, thrusting from the north occurred. My Fig. 4A, 4B, C shows earliest such thrusts, Mac & Spearmint. Cgl., fanglomerate of upper Dunlap deposited on surface in front of Mac thrust while upper plate was moving forward. (Cf. Muddy Mts.) Upper plate of Mac thrust moved into trough, which continued to downwarp: this buckling plus accumulation of boulery cgl in front of plate impeded further southward movement, Mac thrust bogged down in cgl. but continued pressure from N forced new break: Spearmint thrust (Fig.4B) overrode erosion surface cut on upper Mac plate; this bogged down for same reasons (4D). Further pressure relieved by folding of both thrusts and by development of new thrusts from N(NW, 4E; Dunlap Canyon etc., 4F).

Fig.4 is an attempted expansion of Ferguson's Plate 3, by including the Gabbs valley region to the north. Fig.4 was constructed as follows:

With Plate 3 as a basis: SSe end of Section held fixed in space (Pt.G). Section telescoped from NNW, and G progressively raised with respect to a pt. in space (or bottom of section lowered). Fig.4F shows present state. To go backwards to Stage A, the Gabbs Valley section must be raised, for each step, the amount that G is lowered, since G, in normal time sequence, progressive-

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ly rose with respect to the northern area, hence at the start the latter area was higher with respect to G than at the end.

In the same way, since there was marked shortening from the NNW toward G, the section in reversing the normal time sequence, must be stretched, In the S area Fergusons stretched his area 300% (4 miles into 12). To the N it was assumed that stretching decreases N, so the space between the two sections was stretched 100%, the N section itself only about 50%.

Fig.4 suggests tome the following: Luning Embayment region of crustal instability. Gabbs Valley Range on N, Pilot Mts. on S, jerkily rising. Area between, negative or neutral, at start. Cover is very thick: over 28,000', Meso plus Permian(?); rest of Paleozoic at least 10,000, probably much more. Folding would occur in such a thick cover on a very slight slope, altho' locally the thick, competent Excelsior might act as a basement, Block faulting in the basement would never make it upward thru such thick cover, until the soft cover beds were work hardened by close folding.

With these premises, the following is concluded: Slope on north, down to S, over 15°, or about same as with equally thick cover in Bannock area. Presence of a basin flanked on N by a scarp shown by deposition of Dunlap coarse flastics. (Fig.4A). On S, marked fold at D coincides with position of Mac thrust, and was probably caused by thrust. This would cause overturn upslope. The scarp at the N end likewise coincides with position of N.Y. Canyon thrust; but since latter thrust, much flatter than Mac, was probably a track thrust, the fold is probably a slump fold which travelled along the N.Y. thrust track. The sagging marginal basin on the extreme S accentuated the D fold, and truncated its S flank.

Slumping of the cover down the S flank of the N uplift turned over to the S marginal faults associated with that uplift. Cover is so thick that the Mac fault, for example, projected down to N at 35-40°, would at 40,000' depth come below the S margin of the N uplift. As shown in Fig.4A, the N dip of the beds, away from the S uplift, would also serve to deflect a synthetic fault, turning it over toward the S. Goodsprings. The Mac & Spearmint thrusts, however, bogged down in the marginal basin and against the rising S highland, whioe material continued to slump fown the slope from the N highland. This blocking to the S caused the major buckling anticline in thecenter.

The entire deformation can perhaps be explained by the sketch, right-hand side of Fig.4F. A synthetic fault, or a series of them, turnedover to the S (1) by flow of material south, down slope of N uplift; (2) by deflection, roughly, along contact between competent Excelsior basement below and soft cover above (Fig.4A), wanders in that manner at the higher horizons, far S of its parent uplift and enters the region of sag. The thick, strong Excelsior basement can transmit stress, so this series of faults can shove its upper plates up and to S. Thus the soft stuff above the Excelsior piled up in a great imbricated mass against the sirsing front of the S Highland (1) because it was shoved there, in front of the major mass slumping down from the N Highland; (2) because the Mac series of overturned marginal faults, which according to Ferguson have their "roots... concealed under the lava and gravel in the area between the northwestern part of the Pilot Mountains and the suthern part of the Gabbs Valley Range" (p.32) by their displacement, in block-fashion, as opposed to slump or creep, translated imbricate slices of the Excelsior, with the soft cover about it, south into the marginal trough. The cover not only slumped into the marginal trough: it was carried there, in slices, on a conveyor belt.

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Each successive thrust adopted the erosional surface carved in the upper plate of the previous thrust (to the south and lower), hence all were guided into the area of the marginal trough. This trough finally became filled with work-hardened material so that the later thrusts, NW, Dunlap Canyon, South Fork and East Ridge, shot above it. All probably spring from a parent marginal fault at depth; each in turn avoided the closely-folded, hardened stuff, picking stuff less hardened above it. But the Cinnabar Canyon thrust got below the cover, chosing the Excelsior contact and following the upper part of the Spearmint thrust.

The West Ridge "thrust" mdipping south, is proof of uplift of the S Highland.

3. Folding and thrusting in the Luning Embayment.

First, uplift of the folded areas. Advance of S uplift, evidenced by late West Ridge marginal thrust, northward. p.10: "It is believed that uplift of the folded area bordering the Dunlap troughs of the Garfield Hills and Pilots Mts. was in progress during most if not all of this stage"(3). In the northern Garfield Hills, east of Garfield Peak (pl.2; Fig. 3), and in the northwestern Pilot Mountains (pls.2,7), this uplift and compaction of the previously folded area diverted the trend of the later folds and caused local backfolds which in places developed into small thrusts." Thus in the N Garfield Hills the prevailing (earlier) west trending folds changes sharply to a SW trend; s.t. these folds are overturned NW (i.e. opposite to the overturning of the earlier folds). Pl.2, secs.C, D. In NW Pilot Mts. the folds above the Dunlap Canyon thrust change in trend from east to SE and in one place are overturned to NE. Sec.B-B', Plate 7 (location shown on my Fig.3) shows Dunlap ss and conform. overlying fanglomerate on Excelsior basement, dipping 50°N. Unlike Sec. A-A' to the west, at Sec.B-B' the Luning is entirely lacking, showing that either this area is south of the Luning Embayment or Luning eroded here prior to deposition of Dunlap. At any rate the post-Dunlap fanglomerate uplift is very marked, causing a present steepening of the thrusts from the north, the upper plates of which did not run nearly so much uphill as appears today. With increasing post-Dunlap uplift of the S Highland, these thrusts would make excellent tracks for slump folding downslope to the N.

IMP. However, in the preceding period (2) there must have been a tendency, once a thrust bogged down, for its upper plate to slide backward, down to the N. Such a sliding would intensify the involution of an overturned fold as suggested strongly by the Spearmint thrust, Figs.4C, 4D., where the lower limb of the recumbent syncline has probably slid down the Spearmint thrust surface.

Most recumbent folds are found in "geosynclinal troughs"; they are inclined away from the bordering uplift or hinterland, which in many cases had marginal faults, so that the above mechanism may explain some recumbent folds, especially in the Alps.

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After the folded areas described were uplifted, large-scale thrusting t took place, confined to the area of Luning deposition. Evidence that New York Canyon,Garfield,Marble Quarry,Ashby,East Ridge thrusts moved at or near the surface;they mostly did not cut the Excelsior and are thought by authors to have originated at base of Luning or along bed planes within the Luning,breaking thru to the surface as movement reached increasing resistance on the S,near the marginal Excelsior..p.11:For the most part...the basement rocks were involved in the deformation only to a slight extent,and it is believed that these thrusts tore the Luning from its moorings and carried it toward the borders of the embayment." Good picture of slump movement along a track.

The basal member of the Luning is usually thin-bedded limestone,but in the Garfield Hills the middle member,slate with cgl.,at least 2000' thick,lies at the base. Massive ls.and dolomite found only at the top. The thinbedded ls,about 1500' thick,is incpmpetent;total incompetent, all at bottom. 3500' plus,over half or about half the total thickness of the Luning. How could such stuff be shoved over these flat thrusts by lateral compression? by a force that ignors the massive competent underlying Excelsior greenstones and concentrates on the soft cover? Only gravity,which acts on each particle equally thruout the mass could transport such soft stuff without totally disrupting it.

Movement on these thrusts relatively small,since no major differences in facies of the Luning are involved.Movement a few miles.

Notes on thrusts of this series.

New York Canyon: Fig.3. Relative movement of upper plate,several miles S or SE. Folded or warped. May be same as E Ridge. See Fig.4F.

Garfield Flat,Marble Quarry Thrusts. Resemble New York Canyon thrust. Flat, have been warped.Upper plate moved S.Thrust seems to root to N. Marble Quarry thrust roots to N.

Ashby Thrust:like the others. p.24: "...the relatively steep dip of the eastern segment of the thrust may be the result of later uplift of the marginal Excelsior.

All these thrusts,like those of the Pilot Mts.are thought to be tracks for slump movement from an uplift to the north.

The uplift of the S highlands mentioned,occurring during this period, is evidenced by "backfolding",folds overturned to NW in Garfield Hills,to NE in Pilot Mts. Mining N thrusts like W.Ridge.

IMP Fig.3,which shows structural contours on Excelsior erosion surface (i.e.basement for Luning etc. demonstrates the essential parallelism of Luning-Dunlap folds with the structural contours.Cf Big Horn Basin region. Folds not parallel to basement contours usually in upper plate of a thrust. Now the Excelsior surface has jo relation to folding in the Excelsior:it truncates these folds. No laminar folding of Excelsior possible. Hence base ment could not fold with the cover. Must be slump folding.

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4. Large-Scale Thrusting

Mainly eastward, southeastward. These do cut the Excelsior, indicating greater nearness to roots. Slices of Excelsior carried above Luning.

McGee, Pamlico cut only thin slices of the Excelsior and are probably big brothers of the Marble Quarry etc. Gillis on the contrary cuts deep into Excelsior; it has a well-defined trend also, NNW parallel to Sierra Nevada batholith not far W. Upper plate of all 3 thrusts travelle E or possibly SE.

On the other hand, the Shoshone thrust and the N thrust in the Toyabe Range show W movement of upper plate. Note that all rocks E of these thrusts are Permian or older: N-S uplift, thrusts dip into uplift.

Referring the Deformation Plate II, Schematic Diagram, the test of a "track thrust", i.e. one that has made out into the passive frame along a bed or an erosion surface, is that, since the upper plate slumped and folded, it should be highly folded while the lower plate is not. This holds for Cinnabar Canyon-Garfield Flat thrust (assuming they are same, displaced by flaw or rift in Soda Spring Valley, Fig. 2) and probably for the Marble Quarry.

The New York Canyon thrust (Sec. G-G' attached) shows a striking resemblance to the Schematic Diagram, its lower plate showing strong monoclinal folding toward the west, where the thrust roots, which dies out to the E, in the passive frame.

Age of Diastrophism: Intrusion of Sierra Nevada batholith later than all the compressive movements; but latest major thrust, the Gillis, has granitic rock intruded along it: scarecly possible with a passive flat thrust (E.W.)

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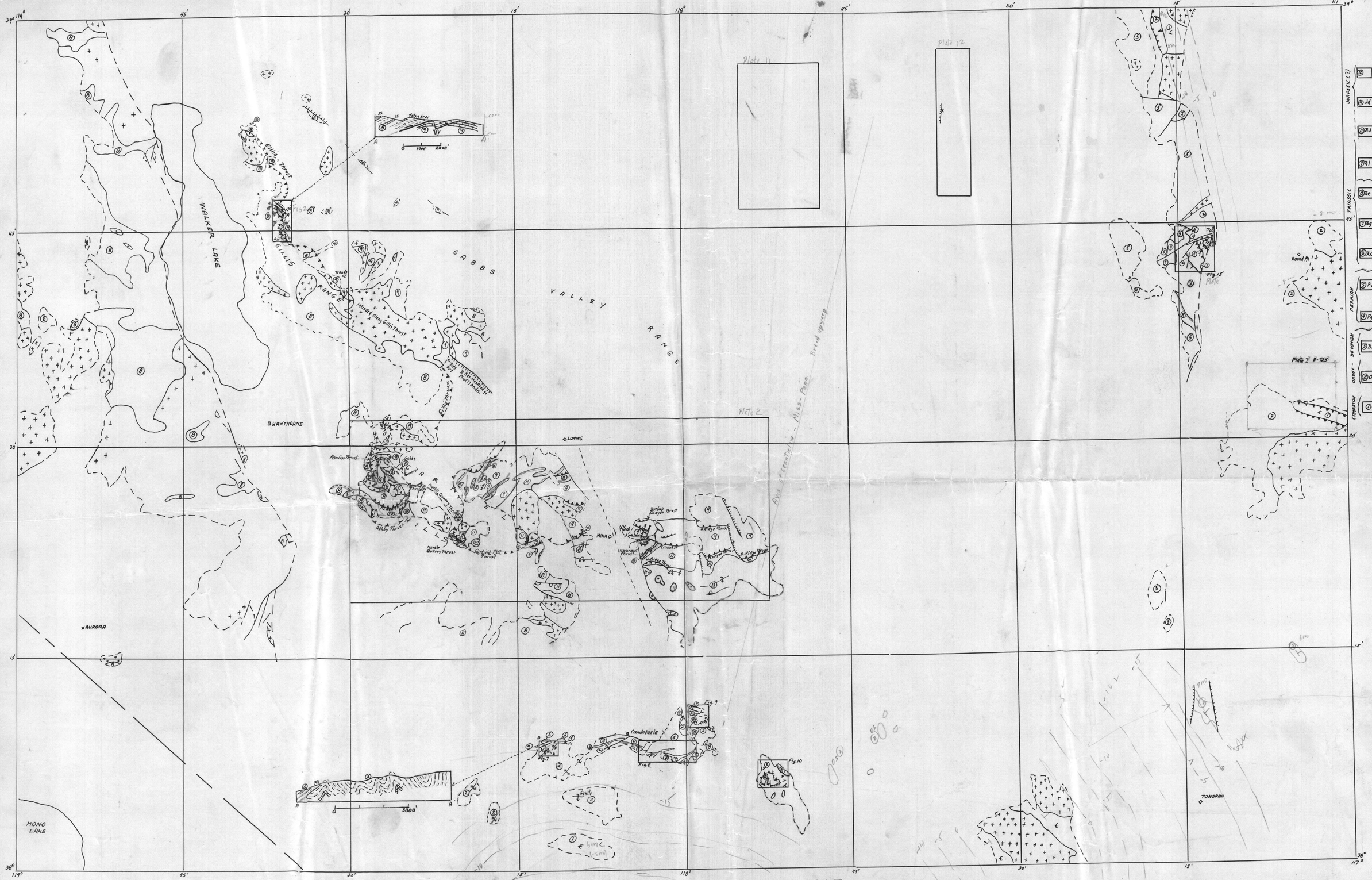
Thrusts from N:

Late Large-scale thrusts: E or SE
(Cor Excelsior)
Thinly: McGee, Pimlico Earlier
Deeper Gillis - Ex. small thrusts
Later E ?? - deep, steep?

FIG. 3A

1" = 10 MI

Plate I



USGS PP216. Plate I
1:250000

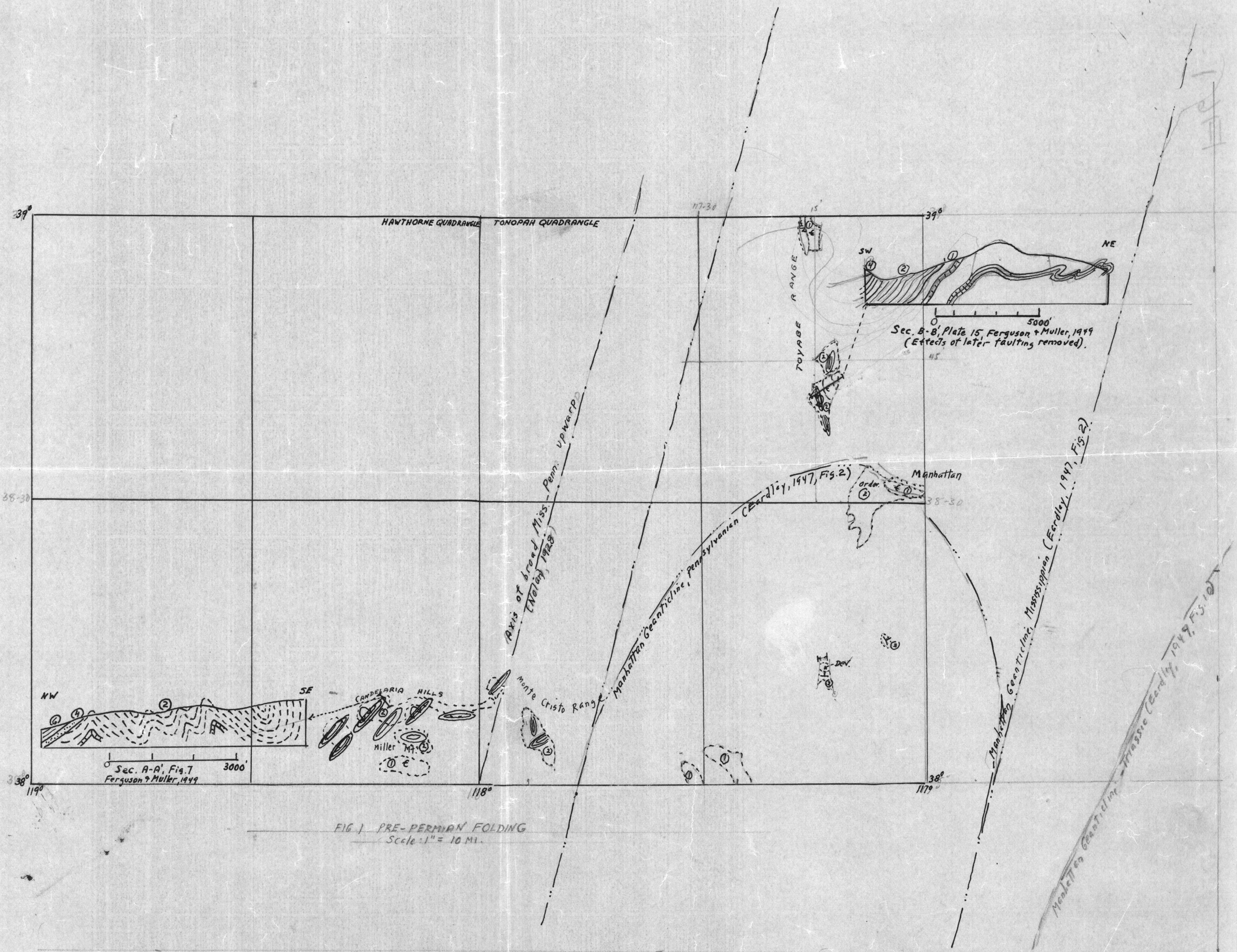


FIG. 1 PRE-PERMIAN FOLDING
Scale: 1" = 10 MI.

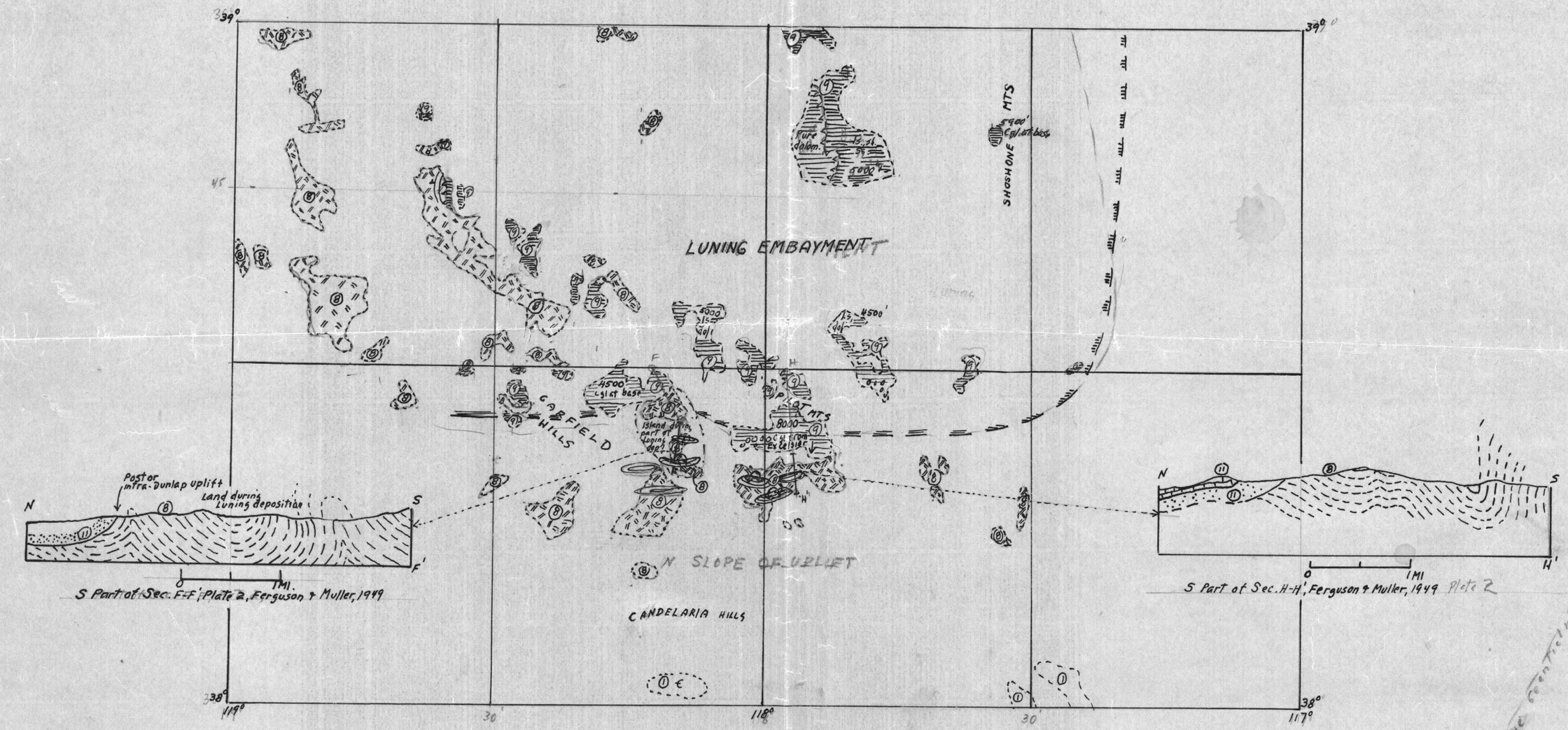
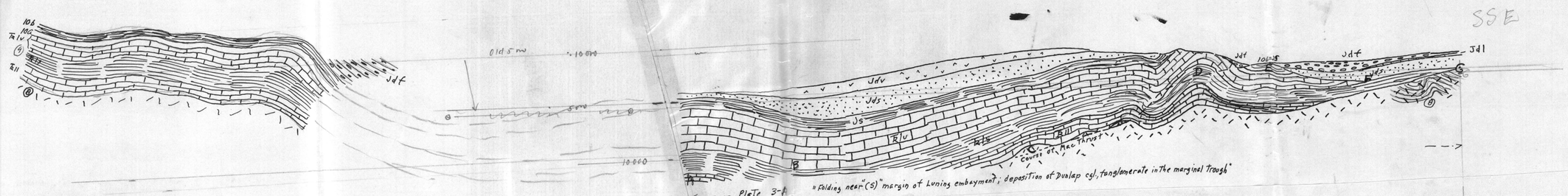


Fig. 2 Folding of Excelsior (Middle Triassic ⑧) on N slope of uplift bounding Luning Embayment on the South. Deposition of Luning (Upper Triassic)
Scale: 1" = 10 MI.

Fig. 3

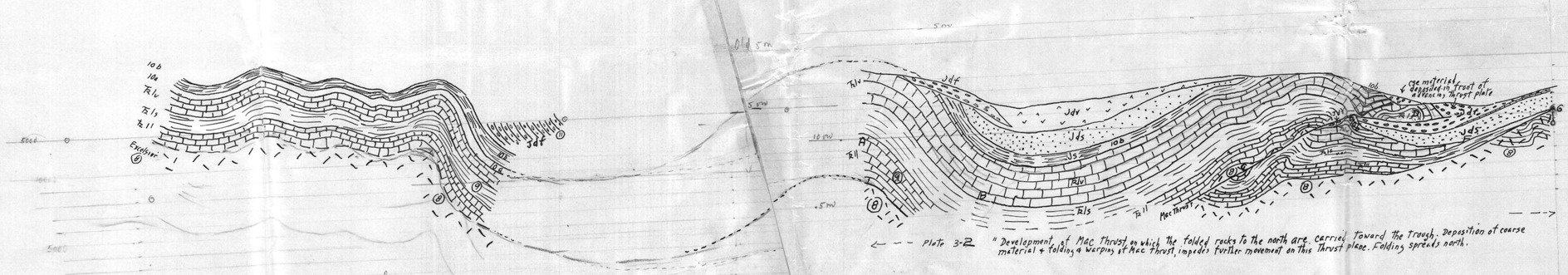
USGS PP 216
Plate 4
~~1:62500~~
1:250 000

Folds, Thrusts in Luning etc.
Contours on Excelsior Top Surface – Basement for deformation of Luning & later strata.
Blue – Contours on certain Thrust Surfaces
↘ Direction of relative movement, upper plate of Thrust.



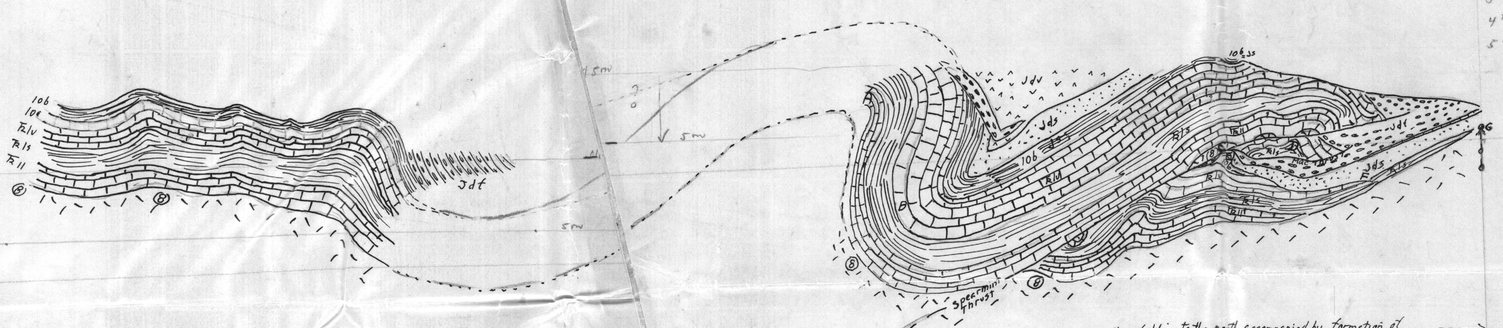
← - - Plate 3-A "Folding near (S) "margin of Luning embayment"; deposition of Dunlap cgl, fanglomerate in the marginal Trough"

FIG. 4A



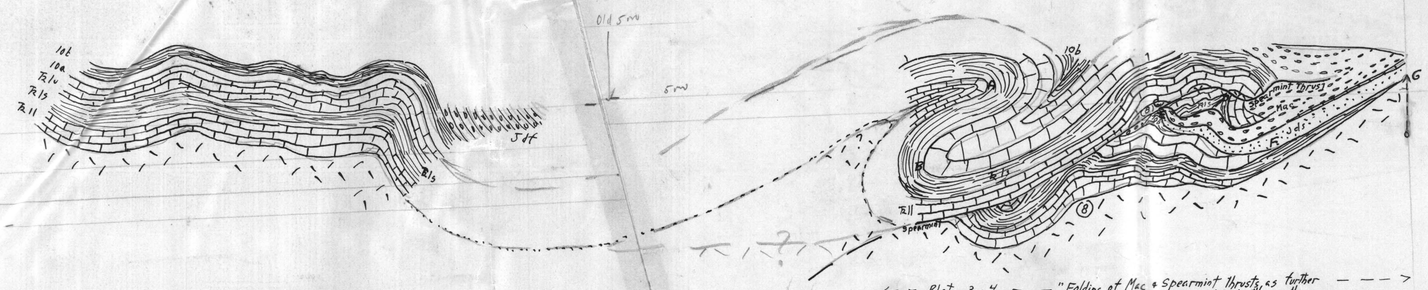
← - - Plate 3-B "Development of Mac Thrust on which the folded rocks to the north are carried toward the Trough. Deposition of coarse material + folding & warping of Mac thrust, impedes further movement on this thrust plane. Folding spreads north.

FIG. 4B



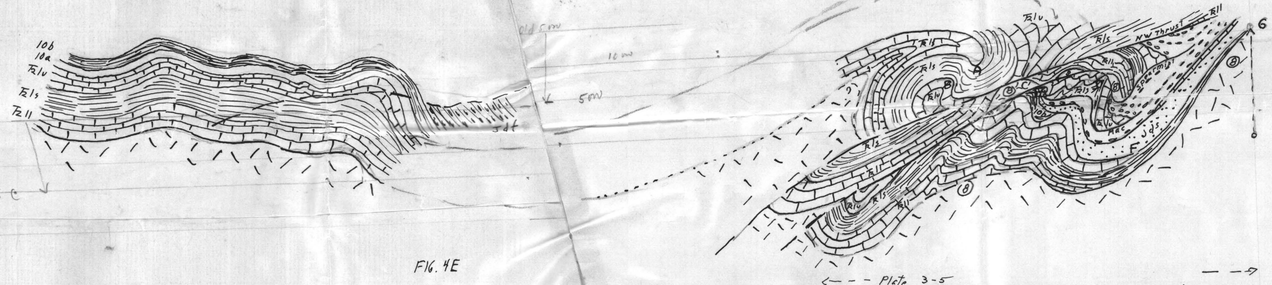
← - - Plate 3-3 - - - - "Further folding to the north accompanied by formation of The Spearmint Thrust. Movement toward the Trough was along an erosion surface cut on the upper plate of the Mac Thrust (?).

FIG. 4C



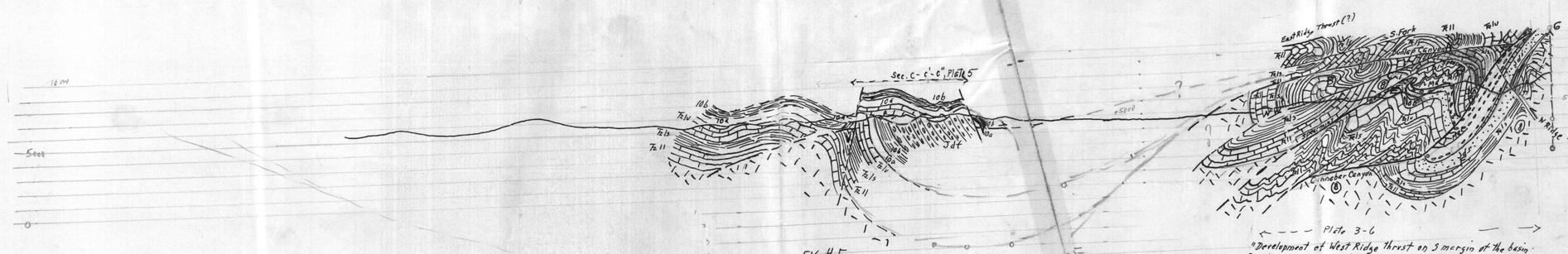
← - Plate 3-4 - - - "Folding of Mac & Spearmint thrusts as further southward movement is impeded. Major fold to the north compressed into a recumbent syncline.

FIG 4D



← - - Plate 3-5 - - - "Involution of the fold to the north & its rupture along the NW Thrust. Further folding of Mac & Spearmint Thrusts."

FIG. 4E



← - - - Plate 3-6 - - - "Development of West Ridge thrust on S margin of the basin. Southward movement of the folded mass along the Cinnabar Canyon Thrust, which is assumed to have used in part, the folded plane of the Spearmint thrust. Folds in the area to the north are carried south along the Dunlap Canyon & S. Fork thrusts above the NW thrust."

FIG 4F

Approximate Scale: 1" = 1 Mi.
For location of Section, see my Fig. 3

LEGEND

Lower Ju. Dunlap	Volcanics, interbedded sediments	: Jdv
	Conglomerate, fanglomerate	: Jdf
	Limestone	: Jdl
	Sandstone	Jds
Lower Ju. Trias, Sunrise, Gabbs	Shale, ls	: Js
Upper Trias. Luning	Massive ls., dolomite	: Ꞧlu
	Slate with cgl. lenses	: Ꞧls
	Thin-bedded ls	: Ꞧll
Middle Trias. Excelsior	Greenstone, breccia	: