by Jon King

SKINNER PEAKS REVIEW

Most of the ideas are in the text and the map looks solid. The text needs some reorganization and the cross-sections need better control. The best part of the text is the descriptions.

General problems (more important first)

Jon did a very thorough literature check - I'm sure you'll find some of these useful.

1. Incomplete use of references (in rough chronological order)

Witkind, 1982 UGA guidebook--Seem to use some of his ideas on halotectonics without citing paper. For me, his summary of the Arapien deformation-intrusion would make a good introduction to that portion of the text. Check this and see what you think.

Hardy and Zeller, 1952 GSA Bulletin--This paper provides published control on the geology to the east and should be cited with Zeller M.S. thesis. This paper shows the West Gunnison monocline in the Chriss Canyon quadrangle rather than the Skinner Peaks quadrangle; is this correct?

John, 1964 BYU Geology Studies and M.S.--Not cited though it is the only comprehensive paper on the Tertiary intrusions in the area. It would help define regional intrusion composition, form and age.

Kearns, 1987 UGA guidebook--Lists oil and gas exploration drill holes in the quadrangle, and formation tops. This information provides a third dimension in control of the cross-sections, which at present is missing.

Witkind and Marvin, 1989 GSA Bulletin--This paper was cited, but the isotopic (radiometric) dates on igneous intrusions in the area didn't make it into your work. This resolves part of the problem at the bottom of page 23.

Clark, 1990 UGS map--Please cite this publication with his thesis when appropriate; my reasoning is that the publication is probably more readily available than the thesis. Also check the join between your map and this Juab quadrangle map to see if contacts, faults and unit designations match.

Yes

Oviatt, 1992(1990) UGS publications--Other papers by Jack are cited, but this paper defines the Quaternary geology (with Hintze's, 1991 UGS open-file report 226) in the Mills quadrangle west of Skinner Peaks. This publication provides the elevation of the Bonneville highstand and origin of your Qdf (delta fines) map unit, which you speculated on, and references unpublished information from Jack. The join with Hintze's map (OFR 226) should also be resolved (see marked copy of your submitted map).

Jackson, 1991 UGS publication--This excerpt from his 1988 thesis provides paleo-seismic data from trenches across the Wasatch fault zone scarps just west of Skinner Peaks and north of the

quadrangle. These data include fault offset and surface rupture dates, which would put "meat" in the hazards section. This information should be included because the quadrangle is astride the Wasatch fault zone. As an aside--Because the surficial geology of this segment of the fault zone has not been mapped, you should be very careful with your placement of uplift-bounding faults, even when they are concealed.

Zoback, 1992 USGS publication--After years of work, she finally got the research published that she mentioned in the 1983 paper you cited. This comprehensive paper on tectonic history provides her view of the deformation history in the Juab Valley area, and might help you explain your ideas.

2. Please note when the field work and writing were done; if the work was done for a thesis or as part of employment, please cite thesis or list employer. When the field work and writing were done is important, because it lets a reader know what geologic literature was available during report preparation. Some of the papers I have noted in problem 1 (above) probably came out after report preparation, so weren't used. By simply stating dates of preparation you remove at least some questions of "Why didn't he/she look at this paper?".

You might also list your affiliation during mapping and report preparation, and present affiliation on the title page.

3. As noted in problem 1 above, using available drill data would reduce speculation in the cross-sections and provide real three dimensional control. Drill hole data also provide another source of unit thickness, including valley fill.

Good

4. I would suggest reorganizing the stratigraphy section such that broad lumped units come before individual units. This would place the units of Skinner Peaks (TKu) before Tertiary units; the logic is Cretaceous comes before Tertiary. Because North Horn is not mapped separately, it might best be included as a subheading under TKu (and thereby eliminate some redundancy as well).

Good

5. I don't clearly understand the lateral and vertical facies relationships in the Green River Formation. A simple diagram showing West (and South) Hills and Gunnison Plateau on horizontal dimension and "stacking" in vertical dimension would help me, and might help other readers.

Good

6. I got lost in the Quaternary (and Tertiary-Quaternary) subheadings, so I didn't know which map unit was which age and exactly what field relationships were seen. I would suggest making a subheading for each map unit to lead the reader along and allow someone looking at the map to turn directly to the unit description. As an aside--Putting map unit labels in the text after subheading titles would also help lead the reader (for any unit, not just Quaternary units).

7. I talked with Grant Willis about the relative ages of Colorado

Plateau development, and Basin and Range normal faulting. My perception is that they are broadly coeval, so I would discuss them together in the structure section and geologic history. If you have specific evidence to date this tectonism, please include it in the text and let the order of presentation reflect the timing (oldest first).

8. From Witkind (1982), the Arapien diapirism seems to have begun before Basin and Range normal faulting and should therefore be discussed before normal faulting in the structure section. Because this topic is complex, the subsection on diapirism needs an introductory paragraph to lead the reader through the discussion. Also need to resolve and explain whether Arapien contact is an unconformity and/or intrusive diapiric.

only if you want to - I think you can discuss it at the end

9. Because you have a geologic history section, I would suggest keeping the stratigraphy section descriptive, and limiting interpretations or placing them in the geologic history section. This would reduce redundancy (This is a weak ha-ha, but I hope you get the idea). The other alternative is to eliminate the geologic history section. Do whatever is the easiest.

10. Be careful about just calling features Sevier, some may be Laramide (see Lawton, 1985; Weiss, 1969). If you get a stickler for orogeny timing as a reviewer they might complain. Having spent time in Wyoming, I consider them different facets of the same orogeny that overlap spatially and temporally in Utah.

11. I would strongly suggest having some location map of the quadrangle that shows and labels towns, county lines, major roads, valleys, mountain ranges, reservoirs, adjacent quadrangles, and features you refer to in the text (see many of my "where's this on the map, this isn't on the map"). Look at some of the references you've cited, and possibly modify an index or location map that has already been done. I suggest to contract mappers that I supervise that they make index maps that cover at least the 8 quadrangles around the quadrangle of interest.

12. I've made lots of suggestions on tightening up the text that usually produce longer sentences but actually shorten the text. These suggestions also help resolve what "it" refers to. Because you include a measured section, descriptio^n of the Tku rocks in the text can also be reduced. Just be careful so that none of the information is omitted.

I agree - this is an important point

13. Do you have a measured section of the Flagstaff Formation north of Mills Gap? Is so, it would make a good addition in an appendix.

14. Please check the clastic volcanic rock classification that you used. Was it Schmid (1981, in Geology? If so, some problems have been noted in the text. If not, please tell the reader what classification did you use.

15. Finally a question of clarity. Do you really mean contacts and faults are dashed where inferred, or do you mean where located approximately? The difference is subtle and most geologists don't seem to care; so this is for my curiosity.

Renew: Jon King

Address differences with Vogel (can't find)

Hence withkind et al 30'x60'

Table of contents (outline helps)

INTERIM GEOLOGIC MAP OF THE SKINNER PEAKS QUADRANGLE, JUAB AND SANPETE COUNTIES, UTAH

By Tracey J. Felger

Department of Geology

University of Minnesota-Duluth

where actually now

bimictic not in AGI

Map joins

Mixed units cm, ft etc

Shorten it is, these etc

ABSTRACT

Tracey,
I found Jon's comments hard to follow. Do the best you can but don't worry about ones you don't understand.
S.W.

The Skinner Pea… entral Utah, just west of the lea… and-thrust belt, and in the transitio… lateau and the Basin and Range. Th… of the quadrangle reflect s… ding the Sevier Orogeny, formation o… asin and Range extension. Local di… Shale, which probably was initiat… [promoted, enha… ents, further modified the structu… complicated (also affecte… hy. [modify implies after]

Broadly coeval?

Implies initial or single yet are multiple events.

Exposed bedrock units in the quadrangle include sedimentary, pyroclastic, and intrusive rocks that range in age from Middle Jurassic to Late Oligocene. An unconformity separates Middle Jurassic marine strata of the Arapien Shale from the overlying Cretaceous-Tertiary strata. These Cretaceous-Tertiary strata include, in ascending stratigraphic order, the North Horn, Flagstaff, Colton, Green River, and Goldens Ranch Formations.

Vary

sedimentary rocks

and

and

rocks

(?)

Is the unconformity important? correlation Chart implies it not an unconformity but is structural.

Strata of the North Horn, Flagstaff, and Colton Formations

(?)

not 9?

Reviewer: Jon King

Address differences with Vogel (can't find)

Hence Wilkinson et al 30'x60'

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Mixed units cm, ft etc

Shorten it if, these etc

ABSTRACT

The Skinner Peaks quadrangle is located in central Utah, ~~just west of the leading edge of~~ in the Sevier fold-and-thrust belt, and ~~in~~ the transition zone between the Colorado Plateau and the Basin and Range. The stratigraphy and structure of the quadrangle reflect several tectonic events, including the Sevier Orogeny, formation of the Colorado Plateau, and Basin and Range extension. Local diapiric movement of the Arapien Shale, which probably was initiated by these major tectonic events, further ~~modified~~ complicated the structure and ~~affected the~~ stratigraphy in the area.

Exposed ~~bedrock units~~ in the quadrangle ~~include sedimentary, pyroclastic, and intrusive rocks that~~ range in age from Middle Jurassic to Late Oligocene. An unconformity separates Middle Jurassic marine ~~strata~~ sedimentary rocks of the Arapien Shale from the overlying Cretaceous and Tertiary strata. These Cretaceous and Tertiary ~~strata~~ rocks include, in ascending stratigraphic order, the North Horn, Flagstaff, Colton, Green River, and Goldens Ranch Formations.

~~Strata of~~ the North Horn, Flagstaff, and Colton Formations

Isn't some pre-Sevier?

Broadly coeval?

salt? (Shale + salt?) in

[promoted, enhanced, triggered?]

Implies initial or single yet are multiple events.

[modify implies after]

Vary

Is the unconformity important? correlation chart implies it's not an unconformity but is structural.

not 9?

Not exposed!

represent the alluvial fan and plain, lacustrine, and fluvial conditions that dominated the Sevier foreland basin during the Late Cretaceous and Early Eocene. Eocene Green River strata record inundation of the basin by Lake Uinta, and the volcaniclastic Goldens Ranch Formation is representative of the widespread volcanism that was occurring throughout Utah during Oligocene time; Two small igneous intrusions also were mapped as were unconsolidated surficial lacustrine, fluvial, colluvial, alluvial fan, and landslide deposits ranging in age from Late Tertiary to Recent.

Major structures in the quadrangle are the Sage Valley Fault, the Western Juab Valley Fault Zone, the Wasatch Fault Zone, the West Gunnison Monocline, the Juab Valley Graben, and Flat Canyon Graben.

Economic deposits include sand and gravel, gypsum, tuff, carbonate rock, manganese, and water. Earthquakes, mass movements, karst development, and groundwater contamination are potential geologic hazards in the Skinner Peaks quadrangle.

INTRODUCTION

The Skinner Peaks 7.5 minute quadrangle is located approximately 100 miles south of Salt Lake City in Juab and Sanpete Counties, central Utah. The quadrangle extends from 39° 22' 30" to 39° 30' north latitude, and from 111° 52' 30" to 112° west longitude. It lies in the transition zone between the Colorado Plateau and Basin and Range Provinces; the Colorado Plateau Province is represented by the Gunnison Plateau, which terminates just east of Utah Highway 28. In

~~addition to the Gunnison Plateau~~, the Skinner Peaks quadrangle also includes the southern ~~end of the~~ West Hills, ~~Mills Gap~~, the South Hills, ~~and part of Juab Valley~~. Total relief in the quadrangle is approximately 1,700 feet; base elevation is 5,000 feet above sea level.

~~The first geologic map of the Skinner Peaks quadrangle was made by James W. Vogel of Ohio State University in 1957.~~ Vogel mapped the geology ~~at a scale of~~ 1:31,680 ~~on an imprecise~~ planimetric base map (constructed from aerial photos); ~~no suitable topographic map of the area existed at that time.~~ Witkind and others (1987) ~~included~~ the Skinner Peaks quadrangle ~~as part of~~ the Manti 30' x 60' quadrangle, ~~although most of the geology that appears on the Manti Sheet was compiled from Vogel's original work.~~

~~Other~~ early investigations of the ~~structure and stratigraphy~~ of central Utah were conducted by ~~E. M.~~ Spieker (1946, 1949) and his students ~~from Ohio State University~~ (e.g., Zeller, 1949; Muessig, 1951; Vogel, 1957). Faculty and students from Ohio State, Brigham Young, and Northern Illinois Universities have continued to expand and modify Spieker's earlier work.

STRATIGRAPHY

Sedimentary, ~~pyro~~clastic, and igneous rocks, ~~ranging~~ in age, from Middle Jurassic to Late Oligocene, are exposed in the Skinner Peaks quadrangle. These rocks consist of the Arapien Shale, North Horn, Flagstaff, Colton, Green River, and Goldens Ranch Formations,

and two igneous intrusions. Unconsolidated lacustrine, fluvial, colluvial, alluvial fan, and mass-movement ~~sediments ranging~~ in age from ~~Late~~ Tertiary to ~~Recent~~ were mapped ~~in addition to the bedrock units~~.

Precambrian and Paleozoic ~~strata~~ are not exposed ~~as bedrock~~ in the quadrangle, but ~~they~~ are exposed in the nearby Valley Mountains, Canyon Range, and southern Wasatch ~~Mountains~~ (Hintze, ~~1975~~); well data ~~indicate~~ these strata also underlie the study area (Standlee, 1982). ~~Although Precambrian and Paleozoic strata are not exposed in the study area~~, clasts of Precambrian and Paleozoic ~~strata~~ are prevalent in the conglomerates of the North Horn, Flagstaff, Colton, Green River, and Goldens Ranch Formations, and in the various unconsolidated Tertiary and Quaternary deposits.

JURASSIC

Arapien Shale (Ja)

The Arapien Shale, ~~which was deposited in a narrow seaway during Callovian time~~, is exposed ~~east of Utah Highway 28~~ along the west flank of the Gunnison Plateau. ~~It underlies~~ Skinner Peaks, ~~and it also is exposed in and adjacent to Little Salt Creek Canyon~~.

The Arapien is composed of grayish-green, thinly-bedded limestone, micrite, and calcareous siltstone; thinly-bedded, rippled, calcareous sandstone, and grayish-green or red calcareous mudstone; or with locally ~~occurring~~ pods of gypsum. These rock types are representative of units B and C of Hardy (1952).

Thinly bedded siltstone, shale, and rippled sandstone matching the description of unit C ~~occurs in both the Little Salt Creek Canyon and Skinner Peaks vicinity~~. These beds locally contain fossils tentatively identified as Ostrea sp., an observation that is congruent with that of Zeller (1949, p.19), who noted the occurrence of Ostrea sp. in unit C sandstone in upper Little Salt Creek Canyon.

In ~~outcrop~~ the Arapien shale "...generally occurs as highly folded, contorted and faulted strata..." (Vogel, 1957, p. 32) that ~~weathers to~~ form steep, rugged, sparsely vegetated, gray hills. Most ~~of the~~ units ~~within the~~ Arapien weather into small chips or thin plates; ledges occur locally where ~~more~~ resistant sandstone or siltstone is present.

Stratigraphic relationships between the Arapien and adjacent units are ~~complex~~. The base of the ~~formation~~ is not exposed ~~within or adjacent to~~ the study area; ~~however, data collected from~~ drill-holes ~~in SE Juab County indicate~~ that the Arapien is underlain conformably by the Twin Creek Limestone (Sprinkel, 1982). ~~This relationship can be observed in outcrop in the Mona quadrangle, 15 miles NE of the Skinner Peaks quadrangle~~. In ~~normal~~ sequences, the Arapien is overlain conformably by the Twist Gulch Formation; however, in the Skinner Peaks quadrangle, the Arapien is ~~most commonly~~ overlain unconformably by the Green River Formation. Locally, ~~it is overlain unconformably~~ by the North Horn Formation or the Goldens Ranch Formation. These unconformable relationships are best observed ~~immediately south of Little Salt Creek Canyon and on the~~ Skinner Peaks ~~themselves~~.

Determination ~~of~~ an accurate thickness for the Arapien has been

TJF in part redundant with preceeding sentence

TJF Doesn't seem important. If it is important, tell me why. Lead me by the hand.

not ¶

not ¶

Does this help in biostrat?; If not leave out.

This name it not on topo map; in the Christ Canyon Quad?

usually reserve quotes for great mind pictures aka Gilbert

? and ?

? and ?

long term, possibly episodic diapiric movement of the Arapien shale (need this up front)

(seem to be intrusive.)

in the quadrangle complicated by

Arapien shale

nearby surface and

show (demonstrate)

data

Southern

see

can you combine like I have?

? undeformed ?

the Twist Gulch is absent and

and

(?)

? and ?

around

of

Again, this name is not on the topo map of the quad so say in Christ Canyon quad or give T+R location

Possibly put in quotes or small case formation since not formal usgs name.

hampered by poor exposure ~~(Sprinkel, 1982)~~ and ~~the~~ intense deformation ~~of the strata~~ (Sprinkel, 1982; Standlee, 1982); estimates ~~range~~ vary from 3,000 to 11,000 feet ~~throughout~~ in the area of its exposure (Eardley, 1933; Spieker, 1946; Hardy, 1952; Standlee; 1982). In this study, a thickness of approximately 440 feet was calculated from an incomplete, undeformed section of Arapien south of Little Salt Creek Canyon. Approximately 2,000 feet of Arapien ~~was~~ were logged in a test hole in the ~~NW~~ northwest corner of the quadrangle.

best estimate

How do you know this? Isn't the contact NOT intrusive?

How? ? drill?

give ref.; well name etc.

This name is not on topo map. use another name or give T+R loc

CRETACEOUS-TERTIARY

~~North Horn Formation(?)~~ and mixed coarse

following TT is on Cretaceous & Tertiary not North Horn

Large quantities of coarse-grained, clastic sediments were ~~led~~ shed from the Sevier ~~H~~highland during the Late Cretaceous and ~~E~~early Tertiary and deposited ~~as a series of~~ in alluvial fans in the foreland basin to the east. These alluvial fans formed a conglomerate ic sequence that is ~~represented by~~ known as the Indianola Group, Price River Formation, and North Horn Formation. This sequence ~~of conglomerates~~ is almost 10,000 feet thick on the Gunnison Plateau (see Hintze, 1988).

This is where TRu unit heading belongs

In the Skinner Peaks quadrangle, beds that tentatively have been identified as North Horn Formation are exposed in a narrow band on the ~~NE~~ northeast side of Skinner Peaks. The North Horn Formation is not exposed ~~anywhere~~ else in the quadrangle, ~~although it does crop out~~ North Horn is documented in the West Hills ~~just~~ and north of the ~~NW corner of the quadrangle~~ study area in the Juab quadrangle~~). It also occurs~~ in ~~the~~ subsurface in Juab Valley (Clark, 1987). The tentative correlation is based on the similarity of these beds in the Skinner Peaks quadrangle (see Appendix) to the description of "high escarpment and inner canyon" North North Formation by Mattox (1990, p. 80) in the Hells Kitchen Canyon NE quadrangle.

Ok?

Note measured section

Outcrops of North Horn Formation (?) in the Skinner Peaks quadrangle are ~~composed of~~ clast-supported, poorly sorted, bimictic, cliff- and ledge-forming conglomerate. ¶ Clasts are subangular to subrounded pebbles, cobbles, and boulders of purple and tan quartzite and dark blue-gray carbonate. ↳ what's this mean? It's not in AGI dictionary.

Purple clasts were probably derived from the Precambrian Mutual Formation and tan quartzite, respectively, ~~tan clasts were derived from the~~ Cambrian Tintic Quartzite; ~~dark blue-gray~~ carbonates ~~represent~~ clasts could be from [any of several] a variety of Paleozoic formations. Matrix is poorly-sorted, medium- to fine-grained, calcareous, lithic sandstone.

Fix description since on 1st pg. No is different

¶ not

Clast size decreases up-section and the top of the ~~section~~ outcrops consists of interbedded conglomerate and sandstone. ~~There is also an increase in the quartzite-to-carbonate clast ratio~~ percentage of clasts of total clasts also increases up-section; ~~the lower part of the section has a 0%/100% carbonate/quartzite clast ratio, whereas the top of the section has a~~ to 75%/~~25%~~ carbonate/~~quartzite~~ clast/~~ratio~~. The ~~color of the~~ unit ~~also varies in an up-section direction; it~~ is gray at the base, red in the middle, and gray at the top. The description of this section of North Horn is similar to Mattox's (1986, p. 80) description of "high escarpment and inner canyon" North Horn strata.

Is this the reason for tentative correlation?

The Skinner Peaks North Horn(?) beds are anomalous compared to regional North Horn characteristics

(1) In most sections, especially farther east, the North Horn Formation lies conformably on top of the Price River Formation, and is ~~in turn~~ conformably overlain by the Flagstaff Formation; however, in the Skinner Peaks quadrangle, the North Horn Formation lies unconformably on top of the Jurassic Arapien Shale, and the relationship between it and the overlying strata is unclear.

Not ¶ ~~The thickness of the North Horn Formation is also anomalous~~. The

North Horn(?) around ? about ? 350 ? yet,
exposed ~~section on~~ Skinner Peaks is only 300 feet thick; ~~however, only~~ 6 miles to the north west in the West Hills, Clark (1987) reported a thickness of approximately 800 feet, and approximately 1,700 feet of North Horn Formation was logged in a ~~test~~ drill hole just south of Chicken Creek Reservoir. ref ?

not ¶ The drastic thickness variations and the relationship between the North Horn Formation and adjacent units is discussed in detail in the "Interpretation of the Stratigraphy of Skinner Peaks".

Insert rest of →

TERTIARY ~~Eocene~~

Flagstaff Formation

The Flagstaff Formation ~~represents a major~~ has been interpreted as lacustrine ~~phase of~~ deposition that occurred between the alluvial fan and floodplain dominated ~~conditions~~ deposition recorded in the ~~represented by~~ the North Horn ~~Formation~~ and ~~the~~ Colton Formation. ~~Strata of~~ the Flagstaff Formation ~~range in age from~~ is Paleocene to Eocene; ~~this~~ in age range, ~~is~~ based ~~primarily~~ on paleontologic evidence ~~that has been~~ gathered ~~by various workers~~ throughout central Utah (LaRocque, 1951; Newman, 1974; Fouch and others, 1982).

~~In the Skinner Peaks quadrangle~~, the Flagstaff Formation is exposed in ~~the~~ east-dipping cuestas ~~of~~ on the West Hills in the ~~NW~~ northwest corner of the quadrangle. Skinner Peaks Beds tentatively identified as Flagstaff Formation also ? may be ? are exposed along the ~~NE~~ northeast side of Skinner Peaks, ~~and are discussed in~~ see the "Interpretation of the Stratigraphy of Skinner Peaks". for details

not ¶ ~~A section of Flagstaff Formation was measured in the West Hills north of Mills Gap.~~ Calcareous mudstone, sandstone, sandy limestone,

I'd like this in Appendix if it's a measured section.

(see p.)

limestone, and conglomerate (listed in order of decreasing abundance) are the major rock types in ~~this~~ a stratigraphic section measured in the West Hills north of Mills Gap. These strata are equivalent to the carbonate-clastic facies defined by Clark (1987) in the Juab quadrangle to the north.

not 91 ~~The color of the~~ strata ~~varies~~ colors from grayish-yellow to pale reddish-orange, with various hues of yellow being most common. The calcareous mudstone ~~is massive; it weathers to~~ forms a slope and ~~ranges from~~ is 20 to 80 feet ~~in~~ thick~~ness~~. The sandstone is usually calcareous, and ~~composed of~~ medium- to coarse-grained ~~quartz and lithic sand;~~ locally, ~~it is~~ cross-bedded; compositionally, the sandstones are quartz arenites, sublitharenites, and lithic arenites (Clark, 1987; Auby, 1985). ~~Beds of~~ sandstone beds form ledges ~~that are 1-4 feet thick, and commonly~~ are laterally discontinuous. ~~Massive beds of~~ sandy limestone and limestone beds form resistant ledges 2 to 20 feet thick; locally, these carbonate units are platy, weathering to slopes with ~~local~~ ledges. Beds of clast-supported conglomerate and conglomeratic sandstone occur locally throughout the section. These clastic units are laterally discontinuous, often channel-form in shape, and 1 to 10 feet thick. Clasts are subangular to subrounded, poorly-sorted pebbles and cobbles of quartzite and sandstone. The matrix is medium- to coarse-grained calcareous sandstone that is composed of quartz and lithic sand.

The relative abundance of coarse-grained clastic material, the presence of cross-bedded sandstone, and the lateral discontinuity of the sandstone and conglomerate beds suggests that the Flagstaff Formation in the Mills Gap section was deposited in a near-shore, shallow-water environment. This interpretation is consistent with

To me it says fluvial.

those of Muessig (1951), Lambert (1976), and Clark (1987).

The base of the Flagstaff Formation is not exposed in the West Hills within the Skinner Peaks quadrangle; however, it is exposed in the Juab quadrangle to the north, and there the contact with the underlying North Horn is conformable and gradational (Clark, 1987), as is the contact between the Flagstaff and the overlying Colton Formation. The Flagstaff Formation is approximately 525 feet thick.

ref?

WHERE?

Colton Formation

redundant?

Fluvial and alluvial plain sediments, ~~which are assigned to~~ now rocks of the Colton Formation, ~~represent~~ that were the final infilling of the Sevier foreland basin which occurred during the Early Eocene.

This is convoluted to me.

In the Skinner Peaks quadrangle, the Colton Formation is ~~exposed in~~ a conspicuous red swath in the east-dipping cuestas of the West Hills; Beds that tentatively have been identified in this study as Colton Formation are exposed on Skinner Peaks, and are discussed in the "Interpretation of the Stratigraphy of Skinner Peaks".

not 91

In the West Hills in the ~~Skinner Peaks~~ quadrangle, the Colton Formation is ~~composed of~~ reddish-brown, poorly indurated, calcareous mudstone, sandstone, and conglomerate. thin beds of limestone occur locally throughout the ~~section~~ formation and are considered to be ~~the~~ deposited in ~~of~~ short-lived local lakes. ~~The Colton Formation as a whole is not well indurated, and it weathers to~~ form a saddle between the more resistant Flagstaff Limestone and Green River Formation cuestas. The mudstone ~~is calcareous and~~ weathers to a slope, while The sandstone ~~is friable and~~ weathers to a slope with ~~locally occurring~~ ledges. ~~It~~ The sandstone is ~~calcareous and is composed of~~ friable

subrounded, medium- to coarse-grained quartz, feldspar, lithic fragments, and mica. Studies by Marcantel and Weiss (1968) and Stanley and Collinson (1979) show that Colton sandstones are commonly finer grained and contain greater amounts of mica and feldspar than the sandstones in the Flagstaff Formation. ~~Beds of~~ limestone beds are sandy, and ~~they occur locally as~~ low, discontinuous ledges.

The conglomerate (figure 1) is clast-supported, moderately sorted, ~~and~~ bimictic; clasts are subrounded pebbles of ~~approximately equal amounts of~~ purple and tan quartzite (from the Mutual Formation and Tintic Quartzite), and dark blue-gray Paleozoic limestone. ~~This suite of~~ clasts indicates derivation from the Sevier Highland to the west. The matrix, ~~which comprises approximately 20 percent of the rock,~~ is sandstone ~~that is~~ calcite-cemented ~~and~~, ~~composed of~~ medium- to coarse-grained, quartz and lithic sand. Conglomerate beds are 5 to 10 feet thick, channel-form, and laterally discontinuous; ~~they occur as~~ ledges and cliffs. Regionally, conglomerate is rare in the Colton; ~~and~~ it occurs here ~~only~~ because the area was close to the edge of the basin.

The high percentage of mudstone, laterally discontinuous beds of conglomerate, sandstone, and limestone, and the red color of the strata attest to the fluvial (floodplain and channel) origin of the Colton Formation (Marcantel and Weiss, 1968).

In the West Hills in the Skinner Peaks quadrangle, the Colton Formation is underlain conformably by the Flagstaff Formation, and overlain conformably by the Green River Formation. ~~The formation~~ is approximately 300 feet thick.

No reason to separate facies or units if not mapped or shown in general way in figure

Green River Formation

Sediments that were deposited in Lake Uinta from the Early through Late Eocene ~~formed the strata~~ are now rocks of the Green River Formation. In the Skinner Peaks quadrangle, strata of the Green River Formation reflect the lake-marginal ~~location~~ setting of the quadrangle, and four distinct lithofacies are recognized from the base of the ~~unit~~ formation upward, they are ~~the~~ equivalent to mudstone, clastic, and mudstone-micrite lithofacies of Clark (1987), ~~and~~ the Tawny facies of Zeller (1949).

Need to clarify relationship of Tripartite lithofacies to tawny lithofacies not 91

The best exposures ~~of strata~~ of the mudstone, clastic, and mudstone-micrite lithofacies ~~of the Green River Formation~~ are in the cuestas of the West Hills, ~~while~~ the best exposures of the ~~Tawny~~ fourth facies are ~~found~~ considered equivalent to in the vicinity of Skinner Peaks; this unit is

Mudstone facies: The ~~mudstone lithofacies~~ is ~~composed~~ mostly ~~of~~ thinly bedded, grayish-yellow mudstone that is very ~~incoherent~~ poorly consolidated - indurated and ~~subsequently~~ consequently weathers to a slope. Thin, laterally discontinuous beds of quartzite pebble conglomerate and sandy limestone also occur locally throughout the unit. The unit is capped by a resistant bed of stromatolitic limestone that contains brown and gray chert nodules; the stromatolites ~~occur as~~ are laterally-linked hemispheroids up to 2 feet in diameter.

Clastic facies: The clastic facies ~~consists of~~ contains conglomerate, conglomeratic sandstone, mudstone, and sandstone. ~~The~~ conglomerate and conglomeratic sandstone ~~is~~ are reddish-brown or grayish-yellow, ~~it is~~ bimictic ~~with~~ with poorly-sorted pebbles and cobbles of quartzite and

what's this mean? not in AGI.

poorly indurated and laterally discontinuous

carbonate in a medium- to coarse-grained sandstone matrix. ~~These conglomerate and conglomeratic sandstone units are poorly indurated and laterally discontinuous~~. Mudstones are reddish brown, thinly laminated slope-formers. Sandstones are gray, calcite-cemented, and composed of quartz and lithic fragments; compositionally, these sandstones are sublitharenites, lithic arenites, and lithic wackes (Clark, 1987). Sandstone beds form low ledges that are laterally discontinuous. Beds of oolitic limestone that have been replaced by silica also occur locally throughout the clastic facies; ripple marks commonly are preserved on the tops of these oolitic beds.

Mudstone-micrite facies: Alternating beds of red ~~or~~ and yellow ~~or~~ and gray micrite dominate the ~~mudstone-micrite lithofacies~~ unit. The mudstones are very thinly-bedded, poorly indurated, and, consequently, they weather to slopes; mudstones comprise ~~total~~ over 50 percent of the ~~mudstone-micrite facies~~ unit (Clark, 1987). The micrite beds are ~~relatively coherent, and, consequently, they~~ indurated form a resistant cap over the easily-eroded mudstones, and ~~These micrite beds~~ are commonly platy and fossiliferous. fossils include plant fragments, gastropods, and Clark (1987) noted pelecypods and ostracodes sp. as well.

A thickness of 1,200 feet was calculated from outcrop width and bedding attitude for the Green River Formation in the West Hills of the Skinner Peaks quadrangle. This thickness is approximately 300 feet greater than thicknesses calculated by Vogel (1957) and Clark (1987) for the same general area. This suggests the presence of a fault in the section, but no evidence for a fault was seen in the

field.

litho This unit is
Tawny facies: ~~Tawny Beds consist of~~ green, red, and variegated mudstone, and yellowish-tan coarse-grained sandstone, conglomerate, conglomeratic sandstone, and limestone. The sandstone is ~~very coherent; it is~~ usually well-cemented with calcite, and composed of quartz and minor amounts of lithic fragments; sandstone ~~beds~~ form ledges that are several feet thick and laterally discontinuous; numerous vertebrate fossils are ~~contained~~ present in sandstone ~~beds~~ near the top of the ~~section~~ unit. Channel-form beds of conglomerate and conglomeratic sandstone ~~also~~ are very coherent. Clasts are subrounded to rounded pebbles of dark blue-gray carbonate (>75%), and tan and purple quartzite (<25%); matrix is sandstone similar to that described above. Limestone is very dense and commonly fossiliferous, containing teeth and bone fragments, as well as gastropods of ~~the~~ species Australorbis (LaRocque, 1960). ~~Strata of the~~ Tawny facies rocks match the description of strata in Millen's (1982) alluvial facies, which ~~represents an~~ is interpreted as being from alluvial or delta plain ~~environment of~~ deposition.

Put in 1st TP on Green River

Complex stratigraphic relationships separate the Tawny Beds from adjacent units. With the exception of Hunt (1950), all workers (Vogel, 1957; Millen, 1982; Norton, 1986) agree that the contact between the Tawny Beds and the underlying Green River Formation unit is conformable and gradational; this relationship was confirmed in this study as well. Tawny Beds also unconformably overlie the Arapien Shale south of Little Salt Creek Canyon. They are, in turn, overlain conformably by strata of the Goldens Ranch Formation.

Fix
Meaning obscure
Try diagram

How? Tawny beds in one area & others in another area

WHAT?

Move to before North Horn pg. 6

Cretaceous and Tertiary rocks

~~Interpretation of the Stratigraphy~~ of Skinner Peaks, undivided (TKu)

The stratigraphy ~~on~~ around Skinner Peaks is complex and ~~abnormal~~ unusual, and, thus, poorly understood. Approximately 550 feet of conglomerate, conglomeratic sandstone, sandstone, sandy limestone, and oncolitic limestone grade vertically into strata ~~of~~ here identified as the Tawny facies of the Green River Formation. Vogel (1957), and Witkind and others (1987) mapped these strata as ~~pad~~ part of the Tawny facies of the Green River Formation. ~~A~~ In this study, examination closer ~~evaluation~~ of these ~~units~~ rocks around Skinner Peaks indicates that they ~~more accurately represent~~ are both Late Cretaceous and Early Tertiary strata (TKu on map), as first suggested by Douglas A. Sprinkel of the Utah Geological Survey (UGS). ~~Evidence to support this interpretation is cited throughout the following section.~~ Unit numbers in the following text (e.g., unit 4) correspond to the unit numbers found in the Skinner Peaks measured stratigraphic Section in the Appendix.

~~A~~ In the measured section, ~~of~~ poorly sorted conglomerate and conglomeratic sandstone, ~~which is~~ approximately 300? feet thick (units 3, 4 and 5), lies unconformably on the Arapien Shale. These conglomerates ~~were described in detail in the section on the~~ are tentatively identified as the North Horn Formation; ~~only a summary description is presented here.~~

Follow with North Horn Fm pg. 6-8 and eliminate redundancy's

~~The conglomerate in the lower 220 feet of the section (unit 4) is massive, clast-supported, poorly-sorted, and bimictic. Clasts include subangular to subrounded pebbles, cobbles, and boulders of purple and tan quartzite, and a small percentage of dark blue-gray carbonate; matrix is poorly-sorted, medium- to fine-grained lithic sandstone. Clast size, and quartzite/carbonate clast ratio decreases up-section. The color of the unit also changes from gray to red up-section. This unit, which represents an alluvial fan deposit, is overlain by 55 feet~~

ck for contradicting

of interbedded conglomerate and sandstone (unit 5).

The conglomerate of unit 5 is gray, clast-supported, moderately-sorted, and bimictic. Clasts are subangular to subrounded cobbles of carbonate (75%) and quartzite (25%). The sandstone is composed of quartz; it is light-gray, medium-grained, well-sorted, and locally cross-bedded. This unit is indicative of an alluvial plain environment.

The North Horn(?) conglomerate sequence is overlain by approximately 100 feet of limestone (unit 6) and oncolitic limestone (unit 8; figure 2). The limestone is light-gray, massive, and finely-crystalline; it forms a ledge that is 10 feet thick. The oncolitic limestone, which contains oncolites up to three inches in diameter, forms cliffs and is 80 feet thick.

Is this in measured section? I see it don't need to repeat it

The oncolitic limestone is overlain by 110 feet of interbedded sandy limestone and sandstone (unit 9), and interbedded sandstone and conglomerate (unit 10). These rocks are here interpreted as part of the Flagstaff Limestone or North Horn Formation. The interbedded sandstone and sandy limestone is reddish-brown. The sandstone in this unit is calcareous and is composed of medium-grained quartz and minor amounts of lithic fragments; it forms local ledges throughout the slope-forming sandy limestone. This sequence is overlain by interbedded sandstone and conglomerate. The sandstone in this unit is also calcareous and is composed dominantly of medium-grained, well-sorted quartz sand. It also contains algal mat pieces and oncolites that may have been derived partially from the underlying oncolitic limestone. The conglomerate is clast-supported, moderately-sorted, and bimictic. It is composed of approximately equal amounts of subrounded pebbles of

dark-blue-gray carbonate and purple and tan quartzite. Approximately 20 percent of the rock is matrix which is composed of quartz sandstone. Strata of these units represent a lake-marginal and fluvial environment which was typical of both the Flagstaff Formation and Colton Formation in this area; these strata grade vertically into the overlying Tawny Beds. The contacts between the lower units appear to be conformable.

The section is a fining-upward sequence that represents a transition through the following environments: alluvial fan (unit 4), alluvial plain (unit 5), lake-marginal and shallow-water lacustrine (units 6-10). The lithology and stratigraphy of the units described above are characteristic of the North Horn, Flagstaff, and Colton Formations. It is difficult, however, to assign each unit to a specific formation. The conglomerates of units 4 and 5 match the regional description of North Horn strata. The limestone and oncolitic limestone of units 6-8 could be placed in either the North Horn Formation or the Flagstaff Formation. The sandy limestone, sandstone, and conglomerate of units 9 and 10 could be placed in either the Flagstaff Formation or Colton Formation; although the lack of a distinctive red color and abundant mudstone suggests that these strata are more representative of the Flagstaff Limestone than they are of the Colton. Regardless of which formation each unit is assigned to, this section is far more representative of the regional sequence of Late Cretaceous-Early Tertiary strata than it is representative of Tawny Beds.

Based on this interpretation of the stratigraphy, very attenuated

sections of North Horn Formation and Flagstaff Formation are present on Skinner Peaks. The North Horn Formation is 300-400 feet thick depending on where the North Horn/Flagstaff contact is drawn. Likewise, the Flagstaff Formation is 110-220 feet thick. These thickness values are significantly less than values from the West Hills to the west and from the Gunnison Plateau to the east. The most logical explanation for the drastic thickness variations ~~that occur~~ over such a short distance is that welts of Arapien Shale formed local topographic highs in the basin during Late Cretaceous-Middle Tertiary time. This conclusion is supported by the presence of an unconformity between the Arapien Shale and Late Cretaceous-Early Tertiary strata and the presence of the oncolitic limestone. Oncolites, which are concretions of algae and sediment, form in shallow water, near-shore lacustrine environments. Weiss (1969) has shown that oncolites within the North Horn and Flagstaff Formations occur preferentially along what were actively-rising tectonic ridges.

Because the units described above were identified only tentatively, the strata of this section were mapped as Cretaceous-Tertiary undivided.

Goldens Ranch Formation

The onset of wide-spread volcanism in Utah occurred during the Early Oligocene. This volcanism produced deposits, such as the volcaniclastic Goldens Ranch Formation, which occurs throughout approximately one-third of the area of the Skinner Peaks quadrangle. In the western half of the quadrangle, the formation can be traced southward from the Chicken Creek Reservoir through the South Hills and

Don't use given cultural implications

into the outcrops that flank the eastern side of the Sevier Bridge Reservoir. In the eastern half of the quadrangle, it occurs south of Chriss Canyon, and forms a "moat" that surrounds Skinner Peaks. Potassium-argon dates ranging from 38.5-29.9 m.y (Evernden and James, 1964; Witkind and Marvin, 1989) were obtained from samples collected from various units within the Chicken Creek Tuff Member. These dates confirm the Oligocene age of the formation.

In the Skinner Peaks quadrangle, the Goldens Ranch Formation is separated into five distinct, mappable units ~~(Units I-V, this study)~~ (1 through 5; oldest to youngest). Map lc Units ~~I~~ 1 through ~~IV~~ 4 correspond to the informal Chicken Creek ~~Tuff~~ lc ~~Member~~ lc of Meibos (1983), and unit ~~V~~ 5 is the informal Hall Canyon ~~Conglomerate~~ lc, or its equivalent. of whom?

Do you have a measured section?

Unit ~~I~~ 1: Unit ~~I~~ 1 is ~~an epiclastic~~ limestone, bentonitic shale, sandstone and conglomeratic sandstone, forming a coarsening-upward sequence (figure 3). ~~The thickness of this unit is variable, ranging~~ that is about from 100 to ~~approximately~~ 500 feet thick. The exposed contact between ~~it~~ unit 1 and the underlying ~~Eocene~~ Green River Formation is gradational, ~~wherever it is exposed, as in the NE 1/4 of section 27, T. 16 S., R. 1 W.~~

used 1-5 on map so should conform. easiest to change text

Unit ~~I~~ 1 forms slopes, ledges, and cliffs, and is either blue, gray or green in color. It contains a variety of sedimentary structures, including laminae, trough and tabular cross-bedding, channels, pebble/cobble lenses, scour-and-fill structures, and normally and reversely graded beds.

not 97

Just above the 15 contact ~~with the Green River Formation~~, lc Unit ~~I~~ 1 is composed of bentonitic shales interbedded with thin, platy limestone. ~~This unit~~ shales? grades upward into sandstone, and finally into conglomeratic

Is this really important?

~~sandstone, forming a coarsening-upward sequence.~~ goes after sentence on bentonitic shales

not 97 The upper three-quarters of ~~Unit I~~ are composed of sandstone and conglomeratic sandstone. The ~~sandstone and matrix of the conglomeratic sandstone is most~~ are commonly a poorly-sorted lithic or arkosic ~~sandstone,~~ grains ~~Grains~~ that are subangular, and ~~range~~ vary in size from 0.5-10 mm, with an average of 1 mm. The cement is typically calcareous, and the rock is friable to moderately coherent.

not 97 Clasts in the conglomeratic sandstone are angular to subrounded, and poorly sorted, ranging in size from 1.5-7.0 cm, with an average size of 5 cm. Approximately 90 percent of these clasts are volcanic in origin and were probably derived from ash and lava flows of the East Tintic District. The other 10 percent are quartzite clasts that were derived from the Precambrian Mutual Formation and the Cambrian Tintic Quartzite, or from pre-existing conglomerates.

Need Evidence for this statement or a reference

~~The coarsening-upward sequence of~~ redundant Unit ~~I~~ ~~represents~~ are interpreted as being deposited a shallow lacustrine/marginal lacustrine/fluvial environment ~~of deposition~~ that marks the end of Lake Uinta (De Vries and others, 1988).

not on reference list

not 97

classification see Schmid 1981 Geology

BALANCE OF TREATMENT?

Unit ~~II~~: Unit ~~II~~ is a crystal vitric tuff that is 40-70 feet thick. The contact between Unit ~~I~~ and ~~Unit~~ ~~II~~ is concordant and sharp. This tuff is slightly welded, pink (weathered and fresh), and usually forms slopes. It is composed of 30-35 percent crystals and 65-70 percent glassy ~~matrix~~ material. The crystals are euhedral and average 1 mm in size. Approximately 60 percent of these crystals are biotite, 40 percent are bipyramidal quartz, and sanidine occurs in trace amounts. The ~~matrix~~ glassy material is composed of pumice fragments (25%-30%), which range in size from

Is it welded or lithified?

implys not all tuff

Witkind & Marvin suggest these are epiclastic.

0.5 to 20 mm, and ash (70%-75%). Bubble wall shards are visible in thin section.

Unit III: Unit III is coarse-grained epiclastic sandstone that is 50-90 feet thick, ~~This unit is red or gray in color,~~ and forms resistant ledges and cliffs, and displays cross-bedding and channels. ~~It~~ The sand is ~~composed of~~ approximately 60 percent bipyramidal quartz crystals, 5-15 percent lithic fragments, 15 percent sanidine, and traces of hematite. The lithic fragments are subrounded and range in size from 2-15 mm. The quartz crystals, hematite, and sanidine are subhedral to euhedral and average 2 mm in size. This unit is cemented by both silica and calcite, and is moderately to very coherent.

Unit II and ~~Unit III~~ are separated by an erosional contact. The nature of the contact and the presence of clasts of ~~Unit~~ the Unit II within ~~Unit~~ the Unit III suggest that ~~Unit~~ the Unit III was derived at least in part from the top of ~~Unit~~ the Unit II. Unit III apparently represents a period of volcanic quiescence ~~that occurred~~ between ~~the eruptive episodes that~~ deposited ~~Unit~~ the top of Unit II and Unit IV.

Unit IV: Unit IV is an orange- or tan-~~colored~~ vitric lithic tuff that is approximately 70-100 feet thick. The contact between ~~it and~~ the Units III and IV is sharp and concordant. This tuff is less welded at the base where it weathers to form slopes; the upper part of the unit is better welded and it weathers to form vertical cliffs that commonly are cavernous.

~~The tuff of~~ Unit IV ~~is composed of~~ contains 75 percent matrix, 20 percent glassy material

implys not tuff

glassy material

lithic fragments, and 5 percent crystals. The ~~matrix~~ is composed of 50 Ø percent ash and 50 Ø percent pumice that ranges in size from 1-10 cm and is commonly flattened in the bedding plane. The pumice ~~forms a coarsening~~ fragment size increases upward ~~sequence within the tuff~~. ~~The~~ lithic fragments are subangular to round, range in size from 0.5-2 cm and are composed of volcanic rocks and quartzite. Biotite, bipyramidal quartz, and a trace of sanidine constitute the crystal fraction of the tuff. These crystals are euhedral, and range in size from 0.5-2 mm.

not tuff size

Look at Whitehead Marvin for contradictory interpretation.

so use the name?

Unit ~~V~~ 5: Unit ~~V~~ 5 is the Hall Canyon Conglomerate or its equivalent. It is an epiclastic sandstone and conglomeratic sandstone, of unknown thickness. In the Skinner Peaks quadrangle, the base of the unit is exposed in only one place, the top is not exposed at all (due to erosion), and the section is further complicated by faulting. Clark (1987) reported that the thickness of the Hall Canyon Conglomerate varies from 0-400 feet in the Juab quadrangle. The contact between Unit ~~V and Unit IV~~ 5 4 and 5 is erosional and sharp.

NEED: Note on query on map.

at least ~~xxx~~ feet thick

doesn't sound very

not 71

The basal part of ~~Unit V~~ lc 5 is an epiclastic sandstone that is ~~very~~ similar to ~~Unit III~~ lc 3; however, it is thin (rarely greater than 10 feet thick), and contains sand-sized grains of ~~Unit IV~~ lc 4. The rest of ~~Unit V~~ lc 5 is ~~very~~ similar to ~~Unit I~~ lc 1 in terms of texture and composition. The principal difference between ~~Units I~~ lc 1 and ~~V~~ 5 is the presence of angular clasts of ~~Unit IV~~ lc 4 within ~~Unit V~~ lc 5; ~~Unit V~~ lc 5 also contains more sandstone and less conglomeratic sandstone than ~~Unit I~~ lc 1. The sandstone is relatively homogeneous in terms of grain-size and composition (medium- to coarse-grained lithic sandstone); it contains very large-scale,

which?

only mentioned cross-bedding

not documented

tabular cross-bedding. The sedimentary structures, thickness, and overall stratigraphy of this unit suggest ~~that~~ it is an alluvial fan or a fan-delta deposit. (ref?)

what's this mean sed pet, distribution?

Igneous ~~I~~intrusions

classification scheme since >50% mafics and felds mostly plag implies diorite or gabbro

Two small intrusions of hornblende monzonite porphyry occur in the Arapien Shale (in the northeast portion of the quadrangle ~~One is located in the~~ NW 1/4, NE 1/4 ~~of~~ section 36, T. 15 S., R. 1 W., and ~~the other is located in the~~ SW 1/4, SE 1/4 ~~of~~ section 25, T. 15 S., R. 1 W.). These intrusions ~~are not very resistant, and they~~ weather to a grus-like talus that is black or dark-gray due to the abundance of hornblende. These and other intrusions in the vicinity were ~~classified as~~ considered dikes by Zeller (1949), Hunt (1950), and Vogel (1957). WHAT ABOUT John Byn M.S.

Not on map

area?

From microscopic examinations of

Two thin sections, ~~of the intrusions were examined under a petrographic microscope.~~ Approximately 65 percent of the rock is composed of phenocrysts, while the other 35 percent is a light-colored, aphanitic groundmass of highly altered plagioclase and orthoclase. Approximately 75 percent of the phenocrysts are hornblende; feldspar and magnetite make up the remaining 59 percent. The hornblende phenocrysts ~~occur as~~ are euhedral to subhedral laths ~~that range from~~ 0.01 to 2.5 cm ~~in length~~ long. Most feldspar phenocrysts are blocky, subhedral to euhedral, highly altered plagioclase crystals.

not 97

lc

lc

what? 25%?

0.01

big dogs

size?

These intrusions are post-Jurassic in age based on the ~~cross-cutting~~ geologic relationships in the Skinner Peaks quadrangle. Witkind and others (1987) ~~cite~~ show an Oligocene(?) to Upper Eocene age for similar intrusions in the vicinity; ~~however, the relationship of these~~

not 97

Please look at Ec John M.S. thesis

Please cite intrusions in Witkind & Marvin for age ~23 to 36 latest Oligocene-earliest Miocene also note John

redundant

~~intrusions to Tertiary units is not exposed in the Skinner Peaks quadrangle.~~

NEED TO KNOW WHAT relative ages of Q+T unconsol units are based on; ie carbonate, direction or what

and mixed coarse

TERTIARY-QUATERNARY unconsolidated deposits

A variety of alluvial, colluvial, and lacustrine deposits blanket extensive areas of the Skinner Peaks quadrangle. These sediments range in age from Late Tertiary to Recent. They were deposited in response to tectonic and climatic events such as the development of the Gunnison Plateau and West Gunnison Monocline, the onset and continuation of Basin and Range faulting, and the advance and retreat of Lake Bonneville.

Rework ¶ since includes Quaternary units.

Note: Oviatt 1992 has no QTap.

climate controlled

~~Older~~ Alluvial Fans ~~and Pediment Alluvium~~

we don't know where these are since not in introduction

Better put in geologic history?

Sediment ~~that was~~ eroded from the Gunnison Plateau and West Gunnison Monocline was ~~shed off~~ deposited to the west in a series of alluvial fans, much like those that have formed in the present-day Juab Valley. ~~The uplifted remnants of~~ The old alluvial fans are exposed along the flank of the West Gunnison Monocline ~~in an area that extends~~ from Broad Canyon to the southern edge of the quadrangle. ~~The~~ The material that forms these deposits is semiconsolidated, massive to poorly-stratified, poorly-sorted (ranging in size from sand to boulders), and yellowish-gray in color. It is composed predominantly of sandstone, limestone, and conglomerate derived from the Green River Formation and includes clasts of pebbly sandstone from the Crazy Hollow Formation and volcanic clasts derived from the Goldens Ranch Formation.

conglomerates?

Vague

Haven't heard of this before

The remnants of the old alluvial fans overlie the Goldens Ranch Formation, Green River Formation and Arapien Shale at various

elevations and reflect deposition over irregular paleotopography. This paleotopography may have been due in part to episodic Basin and Range faulting which began in the Miocene, shortly after development of the plateau and monocline. The thickness of these older alluvial fans varies from a few feet to 300 feet (Vogel, 1957). It is possible that these drastic thickness variations also reflect deposition over irregular paleotopography, ~~with the thickest deposits representing paleo-lows and the thinner deposits representing paleo-highs~~.

Pediment alluvium, which caps the Goldens Ranch Formation in the South Hills, reflects an old erosional surface that developed during and after uplift of the South Hills area. The pediment alluvium, which is 0-20 feet thick, is ~~very~~ similar in texture and composition to the material that forms the old alluvial fans to the east. The most noticeable difference is the ~~increased~~ abundance of volcanic clasts and the local occurrence of red, semi- to moderately-consolidated, pebbly sandstone and sandy limestone. The red, pebbly sandstone and sandy limestone which occur locally as pods between the Goldens Ranch Formation and the poorly consolidated upper pediment alluvium may ~~represent~~ local ponds that formed on the erosional surface (Oviatt, personal communication, 1989). Like the old alluvial fans, the pediment alluvium occurs at relatively high elevations, reflecting the uplift and dissection that occurred after deposition.

The distribution of the pediment alluvium and the alluvial fans reflects Lustig's (1969) prediction that areas with larger highlands favor alluvial fan development, and areas with lower highlands favor

pediment development.

The age of the older alluvial fans and the pediment alluvium is ~~not known for~~ uncertain. They are probably no older than Early Miocene because ~~they formed after the~~ the relief needed to create them only developed ~~of the plateau and~~ after the onset of Basin and Range faulting. They are probably no younger than Earliest Pleistocene because Lake Bonneville sediments locally surround the bases of hills that these old ~~alluvial~~ deposits cap.

An isolated ~~solitary~~ alluvial fan (~~mapped as~~ Qaf2 ~~in this study~~ or Qafo) corresponding to Qaf_3 of Clark (1987) was mapped in the ~~NW~~ northwest corner of the quadrangle. This fan is very dissected, faulted, and higher in elevation than a younger fan which surrounds it. It is composed of light-brown, poorly-sorted, clay- to boulder-size material that is subangular to subrounded. The poorly-sorted nature of the deposit, plus its proximity to the mouth of a deeply incised canyon that cuts through the Flagstaff Formation, ~~indicate~~ suggests that this fan is a debris flow as (see also Clark (1987) ~~suggested~~. Clark (1987) estimates that the fan is at least 50 feet thick. Based on its relatively high elevation and on the very dissected and faulted nature of the fan, it formed either in the Latest Tertiary or Earliest Quaternary.

QUATERNARY unconsolidated deposits

Older ~~Coalescing~~ Alluvial Fans

Areas covered by old alluvial fans ~~and pediment alluvium~~ were differentially uplifted by Basin and Range faulting and then eroded, leaving ~~only~~ remnants of ~~these~~ old alluvial deposits capping the hills along the flank of the monocline and in the South Hills. The material

geologic history

that was eroded from these uplifted areas was deposited as a series of coalescing alluvial fans that fill present-day Juab Valley. Material that was derived from the South and West Hills was shed primarily to the east, although some was deposited in the low spots to the west of the South Hills. Material derived from the Gunnison Plateau was shed into Juab Valley to the west. As Clark (1987) noted, the fans from the Gunnison Plateau are significantly larger than those emanating from the West and South Hills; consequently, the convergence line of the two fan systems lies west of the center of Juab Valley.

Unit name →

~~Coalescing~~ fan alluvium is reddish-brown to yellowish-gray, unconsolidated, poorly-sorted, and massive to crudely bedded with local channels ~~suggest a fluvial environment of deposition~~ (redundant with fan origin (ie alluvial fan)). Material is clay- to boulder-size, although sand- and pebble-size material is most common; grain size decreases in a down-fan direction. Quartzite, limestone, sandstone, and volcanic rocks form the majority of the pebble- and cobble-size clasts. Data from a regional gravity ~~survey~~ map and cross-section (Zoback, 1983) across northern Juab Valley indicates that ~~alluvial fan deposits are~~ basin fill is approximately 3,900 feet thick, ~~in that portion of the valley.~~ ~~Since~~ Because the Juab valley becomes shallower to the south, the equivalent deposits in the Skinner Peaks ~~area~~ quadrangle ~~to the south~~ are probably thinner ~~than those to the north~~.

This is Tertiary Quat basin fill so this doesn't belong here

The youngest sediment contained in the coalescing fans was deposited on the fan surfaces during recent time; the oldest sediment contained in these fans was probably deposited in the late Tertiary, although there is no observable evidence to confirm this. Lake Bonneville sediments overlap coalescing fan deposits in the southwest

out of order if late Tert

corner of the quadrangle, indicating that the deposits must be at least as old as ~~Earliest~~ Pleistocene.

Lake Bonneville ~~Sediments~~

During the high stand of Lake Bonneville, ~~which occurred~~ approximately 16,~~000~~-17,000 years ago, water from the lake spilled through Leamington Canyon, drowning the Sevier River and forming a fresh-water estuary (Oviatt, personal communication, 1989) that extended almost as far south as Redmond (Currey, 1982). The eastern shore of this estuary cut across the southwestern corner of the Skinner Peaks quadrangle. Sediments deposited in the estuary are exposed in the low, gently-sloping, dissected, fan-shaped patches in the Washboard and in wave-cut cliffs along the Sevier Bridge Reservoir. These sediments occur ~~up to an~~ elevation ~~of~~ 5,090 feet, ~~which was~~ the ~~overflow~~ elevation of the ~~lake during the~~ Bonneville ~~Stage~~ (Currey, 1982). A change in vegetation pattern that is best observed on aerial photos ~~also~~ occurs between 5,090-5,100 feet; it is presumed, based on this elevation, that this change in vegetation marks the shoreline of Lake Bonneville. It ~~also~~ is ~~presumed~~, on the basis of elevation, that water from Lake Bonneville spilled through Mills Gap and flooded the Chicken Creek Reservoir area. There are no deposits or shoreline features to substantiate this, ~~but~~ it is possible that Lake Bonneville sediments and shoreline features ~~were there once but have been obliterated since by~~ present-day Chicken Creek Reservoir.

Although exposures are poor except along the Sevier Bridge

Reservoir, the sediments are fairly distinctive (especially on aerial photos) and can be distinguished from the surrounding alluvium ~~without much difficulty~~. Poor exposures obscure the nature of the contact between the Lake Bonneville sediments and the surrounding alluvium, but at one location (section 30, T. 16 S., R. 1 W.), the lake sediments clearly overlap the Quaternary-Tertiary pediment alluvium. Elsewhere (e.g., on the Washboard), the Bonneville sediments are slightly higher than the adjacent alluvium which suggests deposition of the Lake Bonneville sediments on top of the adjacent alluvium. This observation is consistent with the relationships observed by Mattox (1986) in the Hells Kitchen Canyon SE quadrangle, 10 miles southeast of the present study area.

The Bonneville sediments are light brown, unconsolidated, coarse- to fine-grained sand, silt, and mud. These sediments form a fining-upward sequence that is 30-60 feet thick and are composed mostly of silt and mud. Deposits are finely laminated and cross-laminated; soft-sediment deformation ~~structures~~ and ripple cross-lamination are common near the base of the exposed section. These characteristics, combined with the lack of foreset and bottomset beds, fit Oviatt's (1984) description of underflow fan deposits, which are similar to deltaic deposits.

Younger ~~Coalescing~~ Alluvial Fans

A series of younger coalescing alluvial fans rests on top of older ~~coalescing~~ alluvial fans north of Little Salt Creek Canyon. The younger fans are very similar to their older counterparts; however,

they are considerably smaller in size, ~~and they~~ slope more steeply toward the valley, ~~The composition of these younger fans is also~~ and differ~~ent~~ in composition from their older counterparts. most of the material in the younger fans is angular, pebble-size fragments of limestone ~~that were~~ derived from the Arapien Shale. These deposits are only 50 to 100 feet thick.

Younger alluvial fans, such as those that are found north of Little Salt Creek Canyon, probably form~~ed~~ in response to climatic or tectonic changes that lower~~ed~~ base level (see Pazzaglia and Wells, 1989; Bull, 1990). In the Skinner Peaks area, base level could have been lowered by the retreat of Lake Bonneville, ~~continued~~ Basin and Range normal faulting, or a combination of both of these events.

The ~~very local~~ restricted occurrence of the younger alluvial fans suggests that they formed in response to renewed uplift along a fault segment ~~and not~~ rather than in response to ~~the~~ regional lowering of base level, like that which would ~~have resulted from~~ occur with the retreat of Lake Bonneville. This hypothesis is supported by the presence of Recent (Holocene) fault scarps that cut the older ~~coalescing~~ alluvial fans; however, the older coalescing alluvial fans in Juab Valley and the Lake Bonneville sediments are incised by gullies that are as much as 15 feet deep, which suggests a regional lowering of base level. Perhaps the deep gullies are an expression of a regional lowering of base level that was due to the retreat of Lake Bonneville, and the younger alluvial fans reflect Recent Basin and Range activity on a local fault segment. Assuming that these younger alluvial fans are related to the Basin and Range faulting that produced the fault scarps, the age of these fans is late Pleistocene to Recent.

fix by separating

Colluvium, Alluvium, and Landslide Deposits

The youngest sediments in the quadrangle are colluvium, alluvium, and landslide deposits which are all Recent in age. The colluvium forms steeply-sloping, cone-shaped deposits along the base of the slopes from which it was derived. It is unconsolidated, very angular, very poorly-sorted, clay- to boulder-size material. The color and composition of these deposits reflect the formation or formations from which they were derived. These deposits are 0-15 feet thick.

The alluvium occurs along most drainages; at higher elevations, such as Flat Canyon and the South Hills, it forms broad, even surfaces of low relief. Like the colluvium, the composition and color of the alluvium reflect the local bedrock from which it was derived. In most cases, it is unconsolidated, gray or brown in color and massive to poorly stratified. Alluvial material is clay- to cobble-size, subangular to subrounded, and poorly- to well-sorted. These deposits are generally less than 30 feet thick.

Two landslides ~~are the only mass-movement deposits that~~ were observed in the Skinner Peaks quadrangle ~~One of the landslides occurred on the~~ north side of Chriss Canyon ~~in the~~ SE 1/4 ~~of~~ section 11, T. 16 S., R. 1 W.; ~~the other is located south of Skinner Peaks in the~~ SE 1/4 ~~of~~ section 22, T. 16 S., R. 1 W.). Both of these landslides occurred in ~~strata of~~ the Green River Formation and consequently are composed of very angular, poorly-sorted blocks of carbonate and sandstone in a matrix of mudstone. The Chriss Canyon landslide occurred in 1984 (Weiss, personal communication, 1989) after a period of heavy rain. ~~Presumably~~ the Skinner Peaks landslide, ~~which is~~ as

fresh as the Chriss Canyon landslide, also occurred in 1984.

STRUCTURE

The structural geology of the Skinner Peaks quadrangle is the result of Sevier thrusting, formation of the Colorado Plateau, Basin and Range faulting, and local diapirism of the Arapien Shale. ~~The structures that were produced during one tectonic event were superimposed on the structures that formed during the previous tectonic event.~~ This resulted in complex and confusing geologic relationships.

Sevier Thrusting

The Sevier Orogeny, ~~which~~ began in the Late Jurassic and continued into the Paleocene (Armstrong, 1968), ~~was~~ the first tectonic event ~~that affected~~ the Skinner Peaks quadrangle. ~~It was~~ characterized by eastward-directed thrusting which placed Precambrian, upper Paleozoic, and lower Mesozoic strata over ~~strata~~ as young as Middle Jurassic. Middle Jurassic marine shales such as the Arapien are structurally incompetent and consequently acted as glide planes for the thrusting that built the Sevier Highland.

There is very little surface evidence of Sevier thrusting in the Skinner Peaks quadrangle. ~~However~~, substantial subsurface evidence (Standlee, 1982; Lawton, 1985; Clark, 1987) indicates that some surface features can be attributed to the event. Data collected from drill-holes in and adjacent to the study area reveal several stratigraphic repetitions. These repetitions indicate thrust faults

that formed during Sevier thrusting (Standlee, 1982; Lawton, 1985). Drastic variations of the thickness of the Arapien Shale and adjacent units are also attributed to thrusting.

The only surface evidence that can be attributed directly to Sevier thrusting is the highly contorted strata of the Arapien Shale. It is possible, however, that the unconformity that occurs between the Arapien Shale and strata of the North Horn, Green River, and Goldens Ranch Formations may be related to the Sevier orogenic event.

~~A recent study by~~ Sims and Morris (1989) ~~indicates~~ that thrusting of a competent unit over an incompetent unit ~~(e.g., the Sevier fold-and-thrust belt)~~ will cause the incompetent unit to shorten and thicken close to the hinterland, ~~and~~ uplift ~~will occur~~ over the thickened region. As a result, the incompetent unit should be highly deformed, as is the Arapien Shale. Another possible result of this process is the formation of topographic highs in the area of thickening. Standlee (1985, personal communication to S. Mattox) suggested that thrusting and folding indirectly may have caused the local Indianola highs observed by Weiss (1969) and Mattox (1986). It is also possible that the paleo-highs are the result of diapiric movement of the Arapien Shale. Differential loading or tectonic activity is often necessary to initiate diapirism (Lemon, 1985; Jackson and Talbot, 1986); the influx of coarse-grained clastic material from the highland to the west and the eastward directed thrusting that was occurring at this time would have provided both of these mechanisms. The presence of a thick section of oncolitic limestone on Skinner Peaks supports the theory that this area was

belongs in 91 with ambiguous Arapien evidence

but can't they be due to diapirism Need to address this.

Put solid evidence after sentence on little surface evidence on pg 32. Then ambiguous Arapien evidence.

[an abstract isn't a study]

problem is some is due to diapirism.

this is not an unconformity it's structural.

claim

redundant

with

Is this surface evidence?

same thing? so would the another?

what? This type of reference should be avoided

can't observe paleo highs

not 91

Good.

refs ok but they are on halokinesis not halotectonism.

what area

How can a limestone support uplift? clastics support adjacent uplift but not uplift at Skinner Pks.

actively rising during deposition.

Regardless of which explanation is correct, it is certainly reasonable to conclude that the unconformity that occurs between the Arapien Shale and strata of the North Horn, Green River, and Goldens Ranch Formations is related to Sevier thrusting.

Formation of the Gunnison Plateau

~~West Gunnison Monocline~~

In the Skinner Peaks quadrangle, the Colorado Plateau Province is represented by the Gunnison Plateau which terminates as the West Gunnison Monocline inside the east edge of the quadrangle. The West Gunnison Monocline is approximately 18 miles long, and it extends from Fayette Wash in the Hells Kitchen Canyon SE quadrangle to Buck Canyon, north of Little Salt Creek Canyon (Mattox, 1986).

In the Skinner Peaks quadrangle, the West Gunnison Monocline consists of Green River Formation and Goldens Ranch Formation strata which dip 25 to 30 degrees to the west or southwest. Dips of 55 degrees and greater were observed in Green River strata on Skinner Peaks, but these values are anomalously high and may reflect diapiric modification by the underlying Arapien Shale.

A thick section of Arapien Shale cores the monocline and extends eastward under the synclinal structure of the plateau. In general, the Arapien is highly deformed, and attitudes are quite variable. Attitudes measured in a relatively undeformed section below the Arapien-Green River unconformity south of Little Salt Creek Canyon dip consistently 40 to 45 degrees SE; these attitudes are consistent with

those observed by Zeller (1949) in Arapien strata east of the Skinner Peaks quadrangle.

Based on the interpretations of Standlee (1982) and Lawton (1985), the Arapien core of the monocline represents a ramp structure that formed during Sevier thrusting; it is likely that the variable attitudes of the Arapien strata reflect deformation due to the thrusting event, as well as later modification by tectonically activated diapirism.

The West Gunnison Monocline and the Gunnison Plateau formed during Late Oligocene or Early Miocene time. The timing of this event is constrained by the Oligocene Goldens Ranch Formation, which ~~represents~~ is the youngest strata on the monocline. The conformable contact between the Green River Formation and overlying Goldens Ranch Formation indicates that monoclinal warping had not begun prior to deposition of the Goldens Ranch Formation.

Basin and Range Extension

The structural geology of the Skinner Peaks quadrangle is dominated by north-south trending, high-angle normal faults, including the Sage Valley Fault, the Western Juab Valley Fault Zone (WJVFZ), and the Wasatch Fault Zone (WFZ). Smaller normal faults also dissect the area.

Sage Valley Fault

The Sage Valley Fault is a high-angle, down-to-the-west fault which bounds the west side of the West Hills and the east side of Sage

Valley. The fault trends approximately N 10° E; Clark (1987) states that the fault has at least 2,900 feet of throw. Triangular facets that have formed along the western side of the West Hills help define the fault scarp. ① The fault ~~does not cut any Quaternary units~~ is not exposed within the Skinner Peaks quadrangle. ← insert what clark ~~said~~ documented and speculated from the Juab quad. then own speculations.

Western Juab Valley ~~Fault~~ fz ~~Zone~~ fz — doesn't bound Juab Valley in Juab quad, cause it doesn't in Skinner Pks quad. poorly exposed less important that Wasatch so put after Wasatch

Is it Documented in Juab quad?

The ~~Western Juab Valley Fault Zone~~ fz fz (WJVFZ) ~~bounds~~ separates the West Hills ~~on the east and~~ from the Juab Valley ~~on the west~~. This fault zone is thought to be ~~part of a zone of~~ a set of concealed down-to-the-east, high-angle normal faults. Surface evidence for the WJVFZ is sparse. Southeast of Chicken Creek Reservoir the fault appears to place upper Goldens Ranch Formation against Green River Formation and lower Goldens Ranch Formation. Throw on the fault, which trends roughly N 40° E, ~~has an~~ is here (?) estimated ~~throw of~~ as about (?) 1,000 feet.

Problem note part shown on map as down to west with Tgr on west

Zoback (1983, Fig. 1) does not show a fault on the west side of Juab Valley; but does on Fig. 3a; Fig. 6 1:2 km valley fill ~~2:1~~ 2.6 km offset in N Juab Valley; Fig. 7 N Juab Valley gravity profile + model is assymetric; implying no fault; supposedly has seismic section at 1.16

Proprietary data shows it's a graben with ~ 4600 ft fill at Levan

Wasatch ~~Fault Zone~~ fz? fz

The Wasatch Fault Zone (WFZ) bounds the ~~west edge of the West Gunnison monocline and the~~ east side of Juab Valley, the fz It is a set of high-angle normal faults ~~and is characterized by~~ with down-to-the-west movement. The location of the fault is implied by breaks in slope at the top of alluvial fans, and Triangular facets ~~or~~ faceted spurs of Arapien Shale south of Little Salt Creek Canyon Fault. Post Pleistocene movement is demonstrated by and fault scarps in ~~Pleistocene~~ alluvial fans ~~attest to the presence of the fault~~. The ~~fault~~ fz sz scarps, ~~which can be seen just west of Skinner Peaks, show approximately~~ have about 5 to 10 feet of displacement. The Wasatch ~~Fault~~ zone trends approximately N 20° E and has an estimated throw of approximately 5,000 feet.

I don't see that this is in Skinner Peaks quad.

not on index map

In the quadrangle?

~~Recent~~ gravity and seismic data presented by Zoback (1992) indicate that Juab Valley, ~~which is~~ bounded on the west by the Western Juab Valley Fault Zone and on the east by the Wasatch Fault Zone, is an asymmetric graben that contains up to 3,000 feet of alluvial fill.

Other Faults

Other faults that occur throughout the quadrangle include high-angle cross-faults such as those in the West Hills and the fault which parallels Old Botham Road ~~in~~ the South Hills ~~area~~. These structures are possibly related to local strain accommodation that occurred during Basin and Range extension.

~~Other Structures~~

Basin and Range normal faulting not only produced the major structures described above, it also affected the structure of the West Gunnison Monocline by dissecting the west-dipping strata into a series of west-dipping fault-blocks that are bounded by north-south-trending normal faults. Strata in the southern end of the quadrangle have been affected most noticeably.

Vertical joints, which trend approximately 30 degrees west and east of north, are prevalent in Green River and Goldens Ranch strata. The joints probably represent shear fractures that formed due to east-west extension.

Diapirism of the Arapien Shale

Evidence throughout the quadrangle indicates that diapiric

movement of the Arapien Shale modified the structure of the area locally. This local, episodic diapirism was probably initiated by tectonic events such as Sevier thrusting, development of the West Gunnison Monocline, and Basin and Range extension.

Flat Canyon ~~Graben and Skinner Peaks~~

Flat Canyon Graben is a structure that may represent an extensional graben that has been modified by diapiric collapse. This structure is approximately one mile wide. It begins near Timber Canyon in the Hells Kitchen Canyon SE quadrangle and extends north to Chriss Creek where it bends to the west. This graben is bounded on the east by the high-angle, down-to-the-west normal fault which parallels the southwest front of the Gunnison Plateau. It places Hall Canyon Conglomerate against Flagstaff and Green River strata. The west edge of the graben is bounded by a down-to-the-east normal fault which places the Hall Canyon Conglomerate against Green River and Arapien strata.

The bend in the graben parallels the northwest trend of Skinner Peaks which cuts across the otherwise north-south trending structures that are related to the Basin and Range-Colorado Plateau provinces. The graben, like Skinner Peaks, is underlain by Arapien Shale. The presence of the Arapien in the subsurface beneath the Flat Canyon graben is manifest in salty well water and sink holes (W. Jay Dalley, landowner, personal communication, 1989). ~~It seems reasonable to assume from~~ this evidence supports the concept that the structure of the Flat Canyon Graben and the adjacent Skinner Peaks is controlled, in part, by diapiric

collapse of the Arapien. It also seems reasonable to assume, based on the timing of the event, that the mobility of the Arapien was triggered by Basin and Range faulting.

explain how timing is constrained

NEED P on Ja in NE portion of quadrangle

~~Other Diapir Related Structures~~

Rootless fault blocks of Green River formation can be observed "floating" in Arapien Shale on the flanks of Skinner Peaks ~~in the~~ NE 1/4 ~~of~~ section 22 and ~~the~~ SW 1/4 ~~of~~ section 15 T. 15 S., R. 1 W. These blocks are similar to the detached blocks of Colton and Green River Formation described by Willis (1986) approximately 30 miles ~~to the~~ south in the Salina quadrangle. I ~~concur with~~ believe that Willis' (1986) interpretation ~~that~~ of these detached blocks ~~are~~ as slump blocks ~~which,~~ is applicable here, and, in this case, slid off ~~of the~~ Skinner Peaks ~~block~~.

If so show on map as

A small syncline in Green River ~~strata~~ that unconformably overlie the Arapien Shale in the ~~NE~~ northeast corner of the Skinner Peaks quadrangle is also thought to have ~~formed~~ be the product of diapiric movement of the Arapien (Sprinkel, personal communication, verbal-written? month 1989). Contacts between the Arapien and overlying units, which in what area are often sheared, with slickensides and well-foliated clays, similar to ~~those~~ contacts? described by Willis (1986) in the Salina quadrangle. These ~~contacts~~ features are also indicative of movement.

Problems No strong evidence this is syncline. Where exist on map?

FIX: economic and deposit imply past profitable production

~~ECONOMIC~~ GEOLOGY (C RESOURCES

Do we really care about vicinity?

Economic deposits in the Skinner Peaks quadrangle ~~and vicinity~~ include sand and gravel, gypsum, tuff, carbonate rock, manganese, petroleum products, oil and gas, and water. The sand and gravel occurs ~~as~~ in alluvial, colluvial, and lacustrine deposits. Material ranges in size

implies processed

water is not a deposit

from clay to boulders; most material is sand and gravel composed of quartzite and carbonate clasts, with local concentrations of volcanic clasts. The sand and gravel, which is used primarily as road ~~ballast~~, is quarried from numerous gravel pits throughout the quadrangle.

Active quarrying of gypsum from the Arapien Shale on the ~~NE~~ side of Skinner Peaks began in 1989. This gypsum can be used in ~~the production of~~ dry-wall or ~~as a bonding agent~~ in cement.

Tuff from ~~Unit IV~~ (Tvg_4) of the Goldens Ranch Formation ~~formerly~~ was quarried south of Skinner Peaks and in the Painted Rocks area for use as poultry grits, and soil mineralizer and conditioner ~~(Vogel, 1957)~~. This operation was run by the Azome Utah Mining Company of Sterling, Utah, and the products were marketed under the trade name "Azomite" (Vogel, 1957).

Carbonate rock ~~that is found~~ in the Flagstaff Limestone and Green River Formation ~~possibly could~~ be used as building or dimension stone. Unfortunately, in the Skinner Peaks quadrangle, neither of these formations contain sufficient amounts of limestone or dolomite to make quarrying a profitable economic venture because both formations contain anomalously high amounts of coarse-grained clastic material.

Small amounts of manganese occur in fault zones within the volcaniclastic Goldens Ranch Formation. The manganese occurs as dendritic pyrolusite in a calcite matrix. Pyrolusite is a secondary mineral that results from the alteration of manganese minerals (Edwards and Atkinson, 1986) which are present in small amounts in most crystalline rocks (Hurlbut and Klein, 1971). The manganese that forms the pyrolusite was probably leached from the surrounding Goldens

Ranch Formation and deposited with calcite along the fault zones.

Oil and gas exploration has taken place throughout central Utah because of the structural similarities between it and the producing overthrust belt of Wyoming (Clark, 1987). Several oil companies have drilled test wells in Juab Valley and on the Gunnison Plateau in SE Juab County; no productive reservoirs have been discovered to date.

WATER RESOURCES

Water resources are somewhat limited in the Skinner Peaks quadrangle. Surface water occurs in the Chicken Creek and Sevier Bridge Reservoirs, in Chicken Creek, and as small springs in the vicinity of the Skinner Peaks. Depth to the top of the water table is more than 100 feet (Bjorklund and Robinson, 1968) in the area of Juab Valley that lies between the South Hills and the west margin of the Gunnison Plateau.

GEOLOGIC HAZARDS

Earthquakes, mass movements, ~~karst development, and groundwater contamination~~ are the potential geologic hazards in the Skinner Peaks quadrangle and vicinity.

The Skinner Peaks quadrangle is ~~centered roughly~~ on the Wasatch Fault Zone ~~which is part of the Intermountain seismic belt (McKee and Arabasz, 1982);~~ the potential for catastrophic earthquakes is high. Earthquakes may result in destructive ground shaking, surface rupture of alluvium, soil liquefaction, and differential settling (Clark, 1987); they also may trigger mass movements such as snow avalanches

and landslides. Landslides also may occur simply because strata are incompetent or poorly consolidated. Heavy rain or large volumes of melt-water moving over steep, sparsely-vegetated mudstone slopes may result in mass wasting.

~~The development of karst topography and contamination of groundwater are both related to the Arapien Shale.~~ The evaporite-rich Arapien Shale underlies much of the Skinner Peaks quadrangle. Groundwater moving through the Arapien dissolves the evaporates causing subsurface collapse and subsequent formation of sink-holes; evaporite dissolution also results in the ~~contamination~~ degradation of the groundwater. Land-owner W. Jay Dailey (19?? verbal comm) reported the development of sink-holes and collapse structures in hay fields ~~in Flat Canyon, he also reported~~ and salty water in a stock well in Flat Canyon. Vogel (1957) and Hunt (1950) cite similar reports from local residents concerning the quality of well water.

GEOLOGIC HISTORY AND INTERPRETATIONS

Aspects of the geologic history of the Skinner Peaks quadrangle were discussed throughout the stratigraphy and structural geology sections of this manuscript. A brief synopsis of the geological history is presented here along with interpretations concerning the structure and stratigraphy of the quadrangle.

The Precambrian through Early Jurassic interval was dominated by deposition of marine and continental sediments in the Cordilleran miogeocline. These rocks are not exposed as bedrock in the quadrangle, but they do occur in the subsurface and as clasts in

conglomerate of the North Horn, Flagstaff, Colton, Green River, and Goldens Ranch Formations. The oldest exposed strata are the marine shales of the Middle Jurassic Arapien Shale. The sediments that comprise these strata were deposited by a shallow arm of the sea which advanced from Canada, through central Utah, and into northern Arizona. By the Late Jurassic this sea had retreated to the north. Compression caused by the subduction of the Pacific Plate under the North American Plate also started to affect central Utah around this time. Eastward-directed thrusting placed Precambrian, Paleozoic, and Mesozoic strata over the incompetent Arapien Shale which acted as a glide plane. This thrusting built the Sevier Highland and corresponding foreland basin.

In Middle and Late Cretaceous time, the Skinner Peaks quadrangle, which was located in the foreland basin just east of the Sevier Highland, began to receive sediment that was being eroded from the highland and deposited in the basin as alluvial fans. Continued thrusting to the east and the differential loading that was caused by the influx of sediment from the west initiated diapiric movement of the evaporite-rich Arapien Shale. This local, episodic diapirism produced local topographic highs of Arapien Shale within the basin. Consequently, unconformities developed between the Arapien and various Cretaceous-Tertiary units that were being deposited in the foreland basin. Based on the stratigraphic relationships and the abundance of oncolitic limestone on Skinner Peaks, this area was the site of an actively rising topographic high of Arapien Shale.

The unconformity between the Arapien and the Green River

Formation indicates that tectonically activated diapirism continued through the Early Tertiary during which time the foreland basin was dominated by alternating lacustrine and fluvial conditions which produced the strata of the Flagstaff, Colton, and Green River formations. In the Skinner Peaks quadrangle, these formations have an anomalously high clastic fraction because the quadrangle was located along the western margin of the basin.

Wide-spread volcanism dominated the landscape of central Utah in the Oligocene, producing formations such as the volcaniclastic Goldens Ranch Formation. Episodic diapirism was still occurring, based on the unconformable contact between the Arapien and the Goldens Ranch Formation.

The Gunnison Plateau and the West Gunnison Monocline formed in the Late Oligocene after deposition of the Goldens Ranch Formation. Sediment was eroded from the plateau and monocline and deposited into coalescing alluvial fans in the basin to the west.

Basin and Range extension began shortly after the formation of the monocline. The extension dissected the area with north-south trending normal faults such as the Sage Valley and Wasatch faults and produced east- and west-dipping fault blocks. Uplifted areas were dissected and eroded, and the sediment was deposited as alluvial fans in present-day Juab Valley.

In the Pleistocene, Lake Bonneville reached the Bonneville Stage, flooding the Sevier River and depositing underflow fan sediments. Approximately 2,000 years later the lake retreated catastrophically, lowering the regional base level. Active down-cutting through the

alluvial fans in Juab Valley and in stream gullies attests to the change in base level; continued Basin and Range extension also steepened the average regional gradient. Fault scarps that cut alluvial fan deposits, and the formation of secondary alluvial fans are evidence of Recent Basin and Range faulting.

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green River Tg So goldens ranch Tgo or Tg

note to Diapiric Arapien - me Ja(d)

REFERENCES

Armstrong, R.L., 1968, Sevier orogenic belt in Nevada and Utah: Geological Society of America Bulletin, v. 79, p. 203-232.

Auby, W.L., 1985, Petrologic study of a measured section of Flagstaff Formation: Unpublished report, Northern Illinois University.

got a better one

like a MS or USGS map ISS

Bjorklund, L.J., and Robinson, G.B., 1968, Ground-water resources of the Sevier River Basin between Yuba Dam and Leamington Canyon, Utah: U.S. Geological Survey Water-Supply Paper 1848, 79 p.

Bull, W.B., 1990, Tectonic and climatic alluvial fans: Geological Society of America Abstracts with Programs, v. 22, no. 3, p. 11.

is something missing?

be wary of abs.

Clark, D.L., 1987, Geology of the Juab quadrangle, Juab County, Utah: Unpublished M.S. thesis, Northern Illinois University, 323 p.

map scale

USGS map

Currey, D.R., 1982, Lake Bonneville: Selected features of relevance to neotectonic analysis: United States Geological Survey Open-File Report 82-1070, 30 p.

got something better? several I'd recommend

Eardley, A.J., 1933, Stratigraphy of the southern Wasatch Mountains, Utah: Michigan Acad. Sci. Papers, v. 19, p. 377-400.

spell out

obscure?

Edwards, R., and Atkinson, K., 1986, Ore Deposit Geology, University Press, Cambridge, 466 p.

filler

Evernden, J.F., and James, G.T., 1964, Potassium-argon dates and the Tertiary floras of North America: American Journal of Science, v. 262, p. 945-971.

filler?

didn't find this referenced

DeVries and others, 1988

Fouch, T.D., Lawdon, T.F., Nichols, D.J., Cashion, W.B., and Cobban, W.A., 1982, Chart showing preliminary correlation of major Albian to Middle Eocene rock units from the Sanpete Valley in central Utah to the Book Cliffs in eastern Utah, in Nielson, D.L.,

East of study area

editor, Overthrust belt of Utah: Utah Geological Association Publication 10, p. 267-272.

Hardy, C.T., 1952, Eastern Sevier Valley, Sevier and Sanpete counties, Utah with reference to formations of Jurassic age: Utah Geological and Mineral Survey Bulletin 43, 98 p.

Hardy and Zeller

Hintze, L.F., 1975, Geological highway map of Utah: Brigham Young University Geology Studies, Special Publication 3, 1 sheet.

1:500,000

Don't use this, too general. Use state map

Hintze, L.F., 1988, Geologic history of Utah: Brigham Young University Geology Studies, Special Publication 7, 202 p.

Hunt, R.E., 1950, The geology of the northern part of the Gunnison Plateau, Utah: Unpublished Ph.D. dissertation, Ohio State University, 267 p.

map scale

Hurlbut, C.S., and Klein, C., 1977, Manual of Mineralogy, 19th edition (after J.D. Dana), John Wiley and Sons, New York, 532 p.

filler

Jackson, M.P.A., and Talbot, C.J., 1986, External strain rates and dynamics of salt structures: Geological Society of America Bulletin, v. 97, p. 305-323.

This is Halokinesis not Halotectonics, so may not be applicable

Lambert, D.L., 1976, A detailed stratigraphic study of initial deposition of Tertiary lacustrine sediments near Mills, Utah: Brigham Young University Geology Studies, v. 23, pt. 3, p. 9-35.

LaRocque, A.L., 1951, Molluscan fauna of the Flagstaff Formation, central Utah: Geological Society of America Bulletin, v. 62, p. 1457-1458.

LaRocque, A.L., 1960, Molluscan faunas of the Flagstaff Formation of central Utah: Geological Society of America Memoir 78, 100 p.

Lawton, T.F., 1985, Style and timing of frontal structures, thrust

belt, central Utah: American Association of Petroleum Geologists Bulletin, v. 69, no. 7, p. 1145-1159.

Lemon, N.M., 1985, Physical modeling of sedimentation adjacent to diapirs and comparison with Late Precambrian Oratunga breccia body in central Flinders Ranges, South Australia: American Association of Petroleum Geologists Bulletin, v. 69, p. 1327-1338.

Lustig, L.K., 1969, Trend surface analysis of the Basin and Range Province and some geomorphic implications: U.S. Geological Survey Professional Paper, 500D.

Marcantel, E.L., and Weiss, M.P., 1968, Colton Formation (Eocene: fluviatile) and associated lacustrine beds, Gunnison Plateau, central Utah: Ohio Journal of Science, v. 68, no. 1, p. 40-49.

Mattox, S.R., 1986, The geology of the Hells Kitchen Canyon SE quadrangle, Sanpete County, Utah: Unpublished M.S. thesis, Northern Illinois University, 448 p.

McKee, M.E., and Arabasz, W.J., 1982, Microearthquake studies-across the Basin and Range-Colorado Plateau transition in central Utah, in Nielson, D.L., editor, Overthrust belt of Utah: Utah Geological Association Publication 10, p. 137-150.

Meibos, L.C., 1983, Structure and stratigraphy of the Nephi NW 7 1/2-minute quadrangle, Juab County, Utah: Brigham Young University Geological Studies, v. 30, pt. 1, p. 37-58.

Millen, T.M., 1982, Stratigraphy and petrology of the Green River Formation (Eocene), Gunnison Plateau, central Utah: Unpublished M.S. thesis, Northern Illinois University, 220 p.

Muessig, S.J., 1951, Geology of a part of Long Ridge, Utah: Unpublished Ph.D. dissertation, Ohio State University, 213 p.

Newman, K.R., 1974, Palynomorph zones in early Tertiary formations of the Piceance Creek and Uinta basins, Colorado and Utah, Guidebook to the energy resources of the Piceance Creek basin, Colorado: Rocky Mountain Association of Geologists Guidebook 25th Annual Field Conference, p. 47-55.

Norton, K.L., 1986, Paleogeography and lithofacies study of the Crazy —— Hollow Formation, central Utah: Unpublished M.S. thesis, Northern Illinois University, 183 p.

Oviatt, C.G., 1984, Lake Bonneville stratigraphy at the Old River Bed and Leamington, Utah: Unpublished Ph.D. dissertation, University of Utah, 122 p.

Pazzaglia, F.J., and Wells, S.G., 1989, Relative role of tectonism and climatic change on the evolution of Quaternary depositional landforms along a segmented range-front fault, Rio Grande rift: Geological Society of America Abstracts with Programs, v. 21, no. 6, p. A269.

Sims, D., and Morris, A., 1989, Structural control in fold-thrust belts by low-competence units: Geological Society of America Abstracts with Programs, v. 21, no. 6, p. A135.

Spieker, E.M., 1946, Late Mesozoic and early Cenozoic history of central Utah: U.S. Geological Suwey Professional Paper 205-D, p. 117-161.

Spieker, E.M., 1949, The transition between the Colorado Plateau and the Great Basin in central Utah: Utah Geological Society

Guidebook 4, 106 p.

Sprinkel, D.A., 1982, Twin Creek Limestone-Arapien Shale relations in central Utah, in Nielson, D.L., Overthrust belt of Utah: Utah Geological Association Publication 10, p. 169-180.

Standlee, L.A., 1982, Structure and stratigraphy of Jurassic rocks in central Utah: their influence on tectonic development of the Cordilleran foreland thrust belt, in Power, R.B., editor, Geological Studies of the Cordilleran Thrust Belt: Rocky Mountain Association of Geologists, p. 357-382.

Stanley, K.O., and Collinson, J.W., 1979, Depositional history of Paleocene-Lower Eocene Flagstaff Limestone and coeval rocks, central Utah: American Association of Petroleum Geologists Bulletin, v. 63, p. 357-382.

Vogel, J.W., 1957, The geology of southernmost Juab Valley and adjacent highlands, Juab County, Utah: Unpublished M.S. thesis, Ohio State University, 152 p.

Weiss, M.P., 1969, Oncolites, paleoecology, and Laramide tectonics, central Utah: American Association of Petroleum Geologists Bulletin, v. 53, p. 1105-1120.

Willis, G.C., 1986, Geologic map of the Salina quadrangle, Sevier County, Utah: Utah Geological and Mineral Survey Map 83, 1:24,000.

Witkind, I.J., and Marvin, R.F., 1989, Significance of new potassium-argon ages from the Goldens Ranch and Moroni Formations, Sanpete-Sevier Valley area, central Utah: Geological Society of America Bulletin, v. 101, p. 534-548.

- geology compiled in 1981

Witkind, I.J., Weiss, M.P., and Brown, T.L., 1987 (1982), Geologic map of the Manti 30 x 60 minute quadrangle, Carbon, Emery, Juab, Sanpete and Sevier counties, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map 1-1631. Scale

Zeller, H.D., 1949, The geology of the west-central portion of the Gunnison Plateau: Unpublished M.S. thesis, Ohio State University, 83 p. map scale

Zoback, M.L., 1983, Structure and Cenozoic tectonism along the Wasatch fault zone, Utah, in Miller, D.M., and others, editors, Tectonic and stratigraphic studies in the eastern Great Basin region: Geological Society of America Memoir 157, p. 3-27.

Other references

what about? - Hardy + Zeller 1953 GSA v. 64 p. 1261-

Oviatt 1990 (1992) OFR-187 Scipio Valley special study 79

- Witkind + Sprinkel 1982 UGA #10 salt Diapirism - important
  , + Witkind 1982
  - Mattox 1982 Hells Kitchen SE Map 98
  - E.C. John 1964 BYU MS on intrusives in Levan + Chris canyon Quad v.11 p. 67-96 also UGA 1972 #2 p. 97-107

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Volkert 1980 Colton Fm, NIU MS

Picard 1980 Arapien UGA # 8 p. 129-150

Witkind 1983 salt GSA Memoir 157

Witkind + Weiss 1991 Nephi 30x60' I-1937

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Fred May Bull-1633-B J+K

Clark USGS Map 132

Soil Survey

GSA special paper 208 - B+R Colorado Plateau transition mostly seismicity

87 UGA Guidebook Kearns OTG

USGS PP 1500 - Zoback et al Wasatch faulting Machette et al - Levan segment

USGS IS 78, p. seismic - in Skinner Peaks Quad Jackson

WHAT'S the highlight of the quad? where's the photo of it?

FIGURE CAPTIONS – ~~use of photos just to have photos~~

Figure 1: Clasts of Paleozoic quartzite and carbonate in conglomerate of the Colton Formation in the West Hills north of Mills Gap.

Figure 2: Oncolitic limestone in North Horn or Flagstaff strata on Skinner Peaks. (Photo by S.R. Mattox)

Figure 3: Outcrop of epiclastic conglomeratic sandstone of Unit 1 of the Goldens Ranch Formation. Note the cross-bedding, pebble lenses, and typical blue-gray color. Hammer for scale in center of photo. Photo taken in the Painted Rocks area. (Photo by S.R. Mattox)

APPENDIX

SKINNER PEAKS SECTION

This section was measured on a southwest traverse beginning on the 5700 ft contour, just south of the jeep trail in the SE 1/4 of section 15, T. 16 S., R. 1 W.; strata dip approximately 30 degrees SW.

I'd put description on left after unit # with thickness squeezed to right

UNIT # (SAMPLE)	UNIT THICKNESS (FT km?)	CUMULATIVE THICKNESS	DESCRIPTION
13	17.0	745.0	Sandy limestone, grayish-yellow (5Y 8/4); slope-forming.
12	15.0	728.0	Calcareous sandstone, pinkish-gray (5YR 8/1), weathered and fresh; massive, ledge-forming;sand is 80% quartz, subangular to subrounded, moderately-sorted.
11	95.0	713.0	Sandy limestone, variable color; weathers into plates; sand is medium-grained, subrounded quartz.

Incomplete with GREEN RIVER FORMATION

Make sure descriptions are more complete than text

LOWER CONTACT OF GREEN RIVER FORMATION

which is it? I didn't even catch this quandry in the text

FLAGSTAFF LIMESTONE OR NORTH HORN FORMATION (?)

10	50.0	618.0	Interbedded pebble conglomerate and sandstone lenses; sandstone contains algal mat pieces (up to 5 inches) and oncolites; composed of medium-grained, well-sorted, subangular to subrounded quartz; conglomerate clasts are 50% quartzite (rounded tan and purple from the Cambrian Tintic Quartzite, and the Precambrian Mutual Formation) and 50% carbonate (Paleozoic).
9	60.0	568.0	Sandy limestone and sandstone, pale-reddish-brown (10R 5/4); forms a slope with local ledges; sand is medium-grained quartz.
8	81.0	508.0	Oncolitic limestone, yellowish-gray (5Y 7/2); cliff-forming; oncolites up to 3 inches in diameter.
7	15.0	427.0	Covered slope.
6	10.0	412.0	Limestone, finely-crystalline,

			light-gray (N7); massive, ledge-forming.
			LOWER CONTACT OF FLAGSTAFF LIMESTONE OR NORTH HORN FORMATION(?) total thickness
			NORTH HORN FORMATION(?)
5	55.0	402.0	Conglomerate interbedded with sandstone; cliff and ledge-forming; sandstone is light-gray (N7); composed of medium-grained, subangular to subrounded, well-sorted quartz; locally cross-bedded; conglomerate is clast-supported; 80% of the clasts are subangular to subrounded cobbles composed of Paleozoic carbonates (75%) and Precambrian/Cambrian quartzite (25%); matrix is medium-grained, well-sorted, rounded quartz sand.
4	220.0	347.0	Conglomerate; cliff and ledge-forming; clasts are subangular to subrounded pebbles,

			cobbles, and boulders of purple and tan quartzite derived from the Precambrian Mutual Formation and Cambrian Tintic Quartzite respectively; matrix is coarse-grained quartz sand; unit is gray at base and changes to red up-section.
3	90.0	127.0	Slope covered with rubble of quartzite boulders and cobbles; derived from the conglomerate that is up-slope.

total thickness?

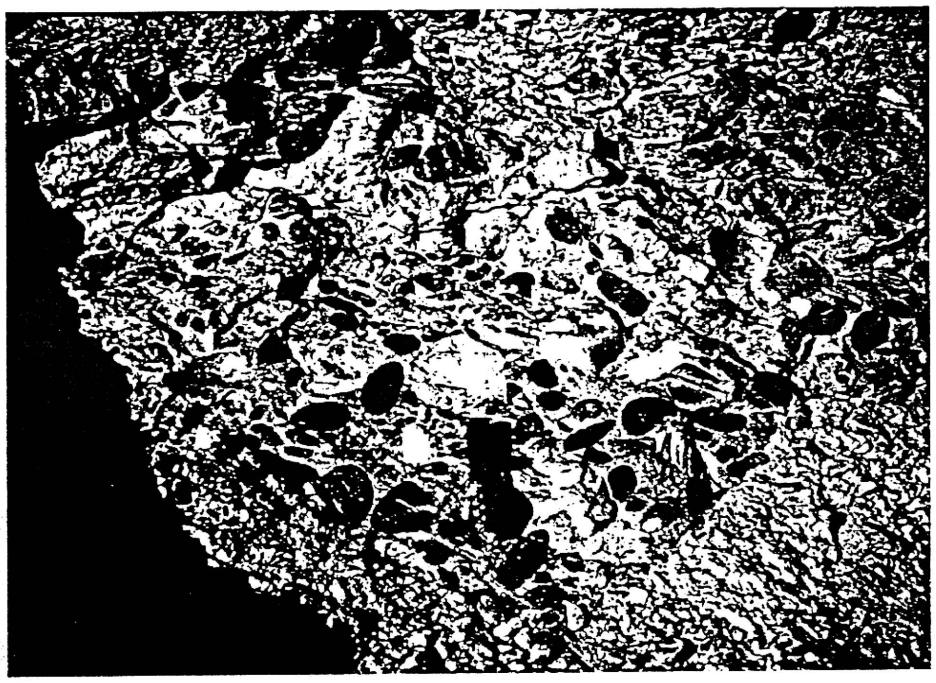
LOWER CONTACT NORTH HORN FORMATION(?)

Imply no text contact for above this slope. How was it mapped

---

Incomplete section of ARAPIEN SHALE

2	2.0	37.0	Limestone, finely-crystalline, grayish-green (10GY 5/2); ledge-forming; separated from unit 3 by a fault.
1	35.0	35.0	Calcareous mudstone, grayish-green (10GY 5/2).



clasts

Figure 1: ~~Clasts of~~ Paleozoic quartzite and carbonate in conglomerate of the Colton Formation in the West Hills north of Mills Gap. scale

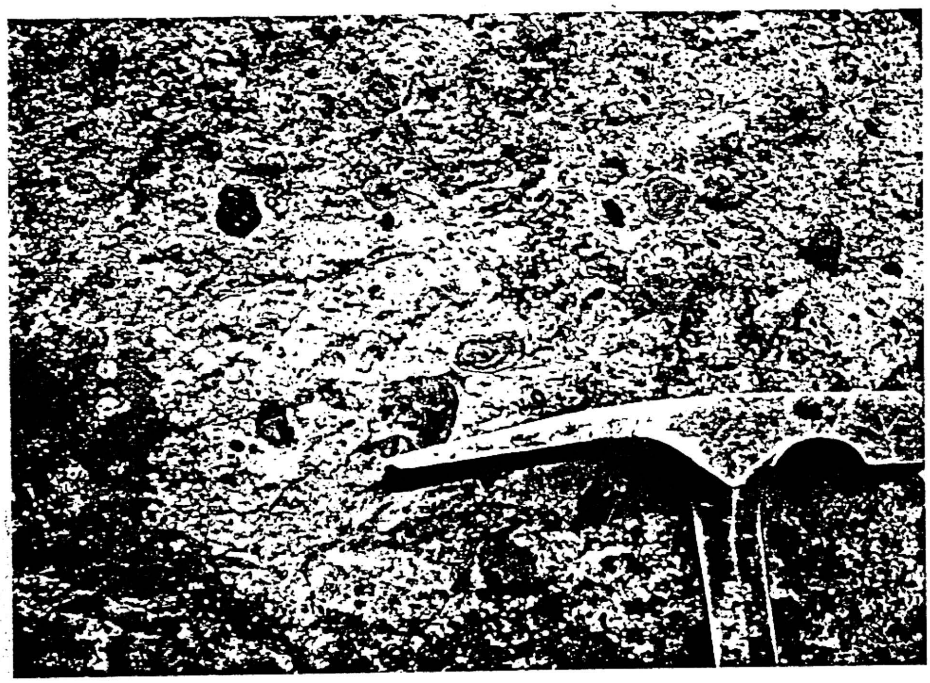


Figure 2: Oncolitic limestone in North Horn or Flagstaff strata on Skinner Peaks. (Photo by S. R. Mattox.)

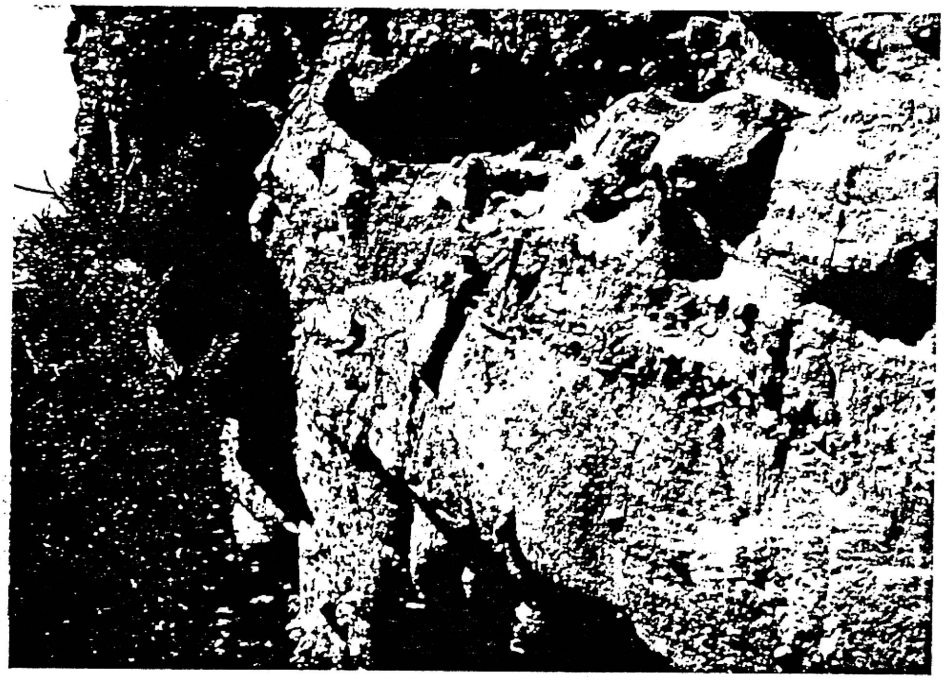


Figure 3: Outcrop of epiclastic conglomeratic sandstone of Unit I of the Goldens Ranch Formation. Note the cross-bedding, pebble lenses, and typical blue-gray color. Hammer for scale in center of photo. ~~Photo taken~~ in the Painted Rocks area. (Photo by S. R. Mattox.)

For Plate 2

DESCRIPTION OF MAP UNITS

Qal — Alluvium - Clay- to boulder sized material; locally derived; occurs along most drainages.

Qc — Colluvium - Steeply-sloping, cone-shaped deposits; material is unconsolidated, very angular, very poorly-sorted; color and composition reflect the formation from which the deposits were derived.

Qls — Landslide deposits - Angular, poorly-sorted blocks of carbonate and sandstone in a mudstone matrix; material was derived from the Green River Formation.

Qaf1y — Younger ~~coalescing~~ alluvial fans - Small alluvial fans located north of Little Salt Creek Canyon; composed of angular, pebble-sized fragments of Arapien Shale.

See Correlation Chart

Qaf2u — Older ~~coalescing~~ alluvial fans - Reddish-brown to yellowish-gray, unconsolidated, poorly-sorted clay, sand, pebbles, cobbles, and boulders; deposits are massive to crudely bedded; clasts are composed of quartzite, limestone, sandstone, and volcanic rocks.

Qdf — Fine-grained deltaic sediments - Light brown, unconsolidated, coarse- to fine-grained sand, silt, and mud

deposited ~~by~~ in Lake Bonneville; ~~deposits are~~ finely laminated and cross-laminated; soft-sediment deformation structures and ripple cross-lamination are common near the base of the exposed section.

Qaf3 ~~Solitary~~ alluvial fan - Solitary alluvial fan located in the ~~NW~~ northwest corner of the quadrangle; composed of debris from the Flagstaff Formation; very dissected and faulted.

QTaf ~~Old~~ alluvial fans - Poorly-sorted sand, pebbles, cobbles, and boulders; forms distinctive yellow caps in the hills north of Skinner Peaks.

QTp Pediment ~~alluvium~~ - Poorly sorted sand, pebbles, cobbles, and boulders; also contains red pebbly sandstone and sandy limestone; alluvium occurs as dissected caps in the South Hills.

Tvg Goldens Ranch Formation (undi~~fferentiated~~vided)

Tvg5 Unit ~~V~~ 5 of the Goldens Ranch Formation - Equals the Hall Canyon Conglomerate of Meibos (1983); blue-gray epiclastic conglomerate and conglomeratic sandstone; contains clasts of ~~Unit IV~~ 4.

Tvg4 Unit ~~IV~~ 4 of the Goldens Ranch Formation - Orange or tan

vitric lithic tuff; contains flattened pumice up to six inches in length; weathers to vertical cliff that are commonly cavernous.

Tvg3 Unit III of the Goldens Ranch Formation - Coarse-grained red or gray epiclastic sandstone that contains cross-bedding and channels; composed of approximately 60% bipyramidal quartz crystals; forms resistant ledges.

Tvg2 Unit II of the Goldens Ranch Formation - Pink crystal vitric tuff containing biotite, bipyramidal quartz, sanidine, and pumice; weathers to form slopes.

Tvg1 Unit I of the Goldens Ranch Formation - Blue-gray or green epiclastic conglomerate and conglomeratic sandstone; forms cliff and ledges that display cross-bedding and channels.

Ti Igneous Intrusions - Intrusions of hornblende monzonite porphyry; less than 30 feet in width, weather to a grus-like talus.

Tgr Green River Formation - Interbedded grayish-yellow to brown mudstone, limestone, sandstone, and conglomeratic sandstone; limestone is commonly fossiliferous or oolitic; a conspicuous bed of stromatolitic limestone occurs in the bottom part of the section; sandstone near top of section

contains vertebrate fossils.

TKu — Cretaceous and Tertiary strata (undifferentiated) - Includes Tc (Colton Formation), Tf (Flagstaff Formation), and TKnh (North Horn Formation).

Tc — Colton Formation - Reddish-brown mudstone, sandstone, and conglomerate; conglomerate is clast-supported, and moderately-sorted; clasts are composed of Precambrian quartzite and Paleozoic carbonate; thin beds of limestone occur locally throughout the section.

Tf — Flagstaff Formation - Grayish-yellow to pale reddish-orange calcareous mudstone, sandstone, sandy limestone, limestone, and conglomerate.

TKnh — North Horn Formation - Red and gray, poorly-sorted cliff and ledge-forming conglomerate; clasts are composed of quartzite and carbonate that was derived from a variety of Precambrian and Paleozoic formations. Shown only in cross-sections.

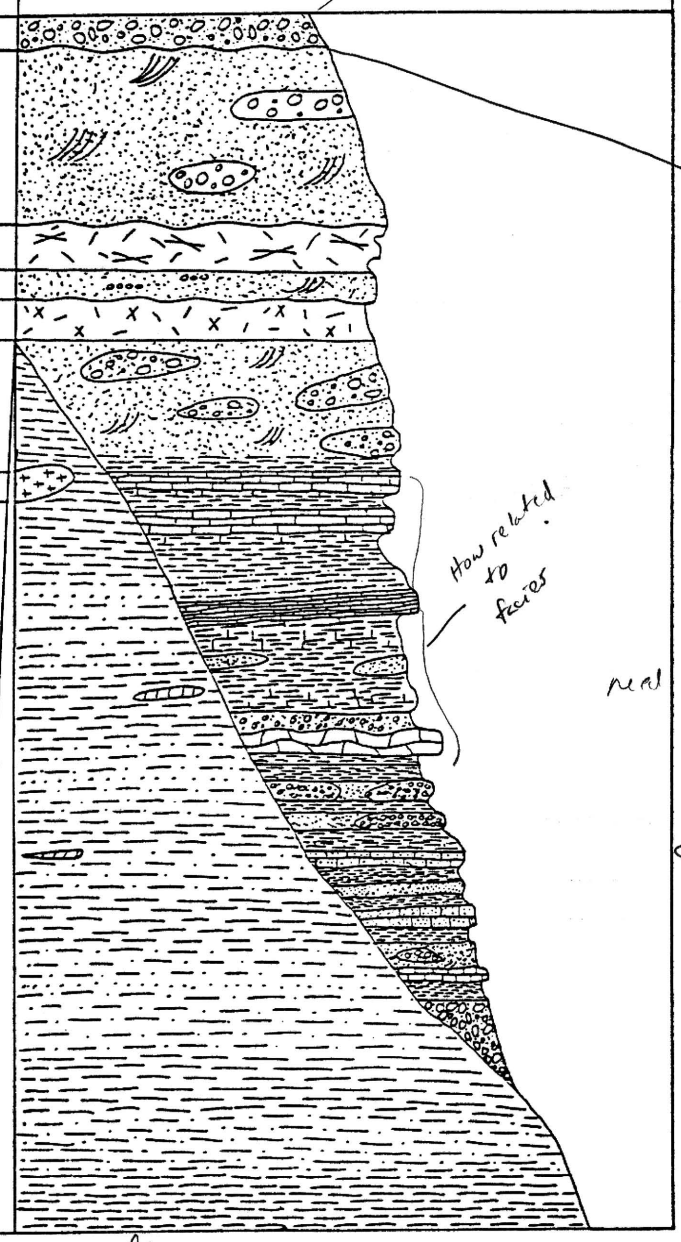
KJu — Jurassic and Cretaceous strata (undifferentiated) - Includes Kpr (Price River Formation), Ki (Indianola Group), Kcm (Cedar Mountain Formation), and Jtg (Twist Gulch Formation). These units are shown only in cross-sections.

Ja Arapien Shale - Grayish-green thinly-bedded limestone, micrite, calcareous siltstone, rippled sandstone, and grayish-green or red mudstone; pods of gypsum occur locally throughout the section.

Jtc Twin Creek Formation - Shown only in cross-sections.

Plate 2

Formation		Map Symbol	Thickness
Surficial Deposits		Q	0-300
Goldens Ranch Formation	Unit 5	Tvg_5	400-700
	Unit 4	Tvg_4	70-100
	Unit 3	Tvg_3	50-90
	Unit 2	Tvg_2	40-70
	Unit 1	Tvg_1	100-500
	Intrusive Rocks	Ti	20
Green River Formation		Tgr	1000-1500
Colton Formation		Tc	100-300
Flagstaff Formation		Tf	100-550
North Horn(?) Formation		TKnh	300-400
Arapien Shale		Ja	400-3000



scale

Alternative is section down to North Horn(?) and then break with diapiric intrusive contact noted would leave Ti out of section since cross-cutting

T. Felger
Skinner Peaks 7.5' Qu

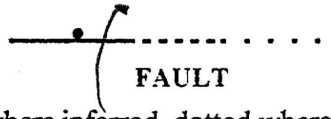
for Plate 2

MAP SYMBOLS

CONTACT

Dashed where inferred; dotted where concealed

located approximately



FAULT

Thrusts ? Slides Halotectonic

Dashed where inferred, dotted where concealed; bar and ball on downthrown side

Test well – what kind

Tie-line (connects areas of like lithology) the same map unit

Sand ? Gravel pit

boundarys of surface mine for ~~Open-pit~~ gypsum ~~mine~~

STRIKE and DIP of BEDS

Inclined

Horizontal

Vertical

For Plate 2

CORRELATION OF MAP UNITS