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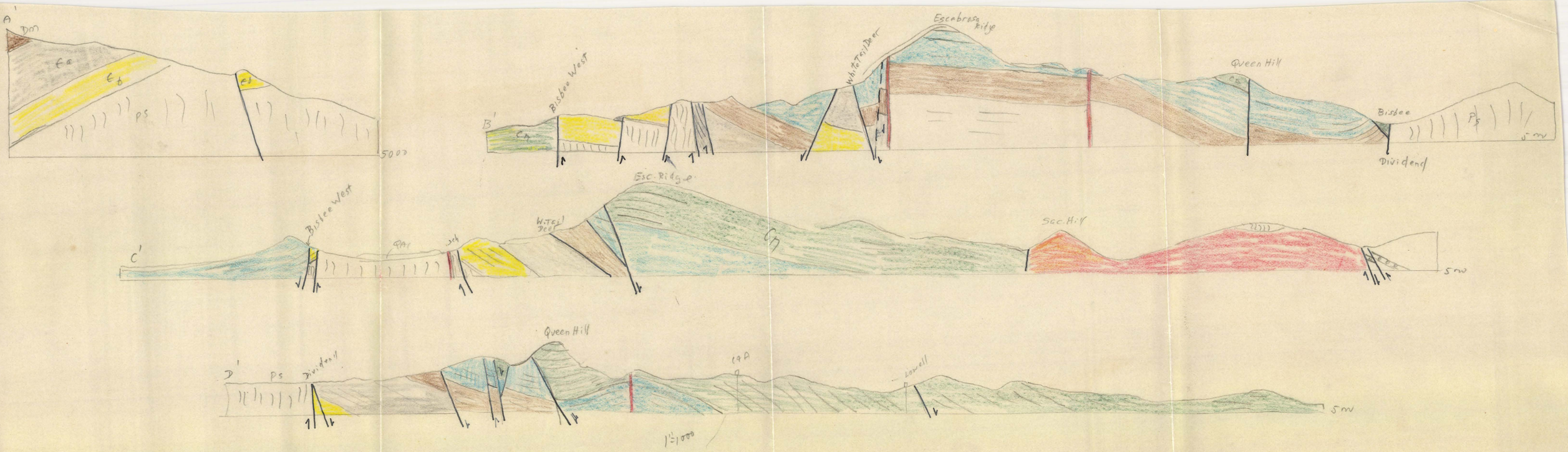
Structural Contour Stereogram
Hedberg Area, Bisbee


A'
Dm
Ea
Eb
Es
Ps
5000
B'
Bisbee West
Ch
Escabrosa Ridge
White Tail Deer
Queen Hill
Bisbee
Dividend
Ps
5 mi
C'
Bisbee West
PPr
Jch
Esc. Ridge
White Tail Deer
Cm
Scc. Hill
5 mi
D'
Ps
Dividend
Queen Hill
Cm
Lowell
5 mi
1"=1000'

INTRUSIVE BRECCIAS AT BISBEE

At Bisbee there are a great number of unusual breccias whose existance is not generally known to outside geologists. They are called intrusive breccias as the term implies that the breccia fragments have been intruded into the formations where they are now found.

The Bisbee intrusive breccias are a hetergeneous agglomeration of rock fragments comprising rocks from underlying formations.. By some mechanism, not clearly understood, the component fragments have been forced through the overlying rocks for great distances following whatever path offered the least resistance to their passage. The fragments may have migrated a short distance only and be similar to the wall rock enclosing the breccia or they may comprise all lower formations including the Bolsa Quartzite and Pinal Schist as well as porphyry.

Fragments of nearly any size are locked in a matrix of cementing material. Thin section examination of the matrix reveals that it is composed of smaller fragments of the same rocks that make up the breccia; the matrix is often cemented by calcite and silica introduced after the breccia was intruded.

In form the breccias are extremely irregular. A few are dike-like but characteristically they may follow a joint for a short distance, then switch abruptly to a bedding place or an interseting fracture. Sometimes they are tabular but often they swell out to occupy irregular volumes in the limestones.

The breccias may be very small masses of perhaps pencil width occupying joints or fissures or they may be masses of considerable size with dimensions on a single level of several hundred feet.

Component fragments also vary in size as is evidenced by the specimens on display. The biggest specimen observed by the writers was a perfectly rounded boulder perhaps three feet in diameter in a bench of the Lavender Pit. It was not accessible so its composition could not be determined.

The relative age of the intrusive breccias seems to be clearly established. They frequently contain rounded boulders of porphyry and ore, therefore post porphyry. They also often contain rounded pebbles of barren pyrite showing that a period of intense pyritization had occurred prior to intrusion of the breccias. The breccias themselves are sometimes more or less completely replaced by ore minerals.

Assuming a genetic relationship between the porphyry and the pyritic mineralization the sequence of events would then be:

1. Intrusion of the quartz manzanite porphyry into the paleozoic limestones;

2. A period of pyritic mineralization in which the porphyry was sparsely pyritized and portions of the surrounding paleozoic limestones suffered massive replacement by pyrite;

3. Intrusion of "pebble dikes" or intrusive breccias into the paleozoic limestones, the porphyry stock and into the schist north of the Dividend Fault;

4. The period of ore mineralization which resulted in the "halo" of limestone replacement ores as well as the desseminated protore of the Sacramento Stock.

An interesting feature of the breccias is that the degree of rounding of the fragments appears to be a function of the distance traveled. A breccia whose component fragments are predominately limestone may be made up of angular boulders; the quartzite and schist boulders observed in the breccias are usually rounded and resemble stream worn boulders.

In a number of places it has been possible to observe the mechanics of assimilation of wall rock fragments into the clastic stream of intrusive breccia fragments. Intrusive breccia material occupying irregular channels isolates and engulfs projecting blocks of the host limestone or surrounds big blocks of rock cut on all sides by fractures. The next stage is an intrusive breccia whose angular fragments would all obviously fit together like pieces of a jigsaw puzzle but are held apart by the matrix material. The final stage is a breccia of rounded boulders thousands of feet from their source.

The intrusives are found throughout the productive area and are seemingly most abundant in the immediate ore area. They are particularly abundant in the main Sacramento Stock. They have also been observed in the limestones outside of the known productive area and in the schist above Brewery Gulch north of the Dividend Fault. They occur in every formation up to and including the Naco Limestone. The intrusive breccias form a "halo" around the Sacramento Stock area just as the limestone replacement ores do but of greater radius; some are well over a mile horizontally from the closest porphyry of the Sacramento Stock.

Increasing familiarity with intrusive breccias disclosed that they are closely associated with ore deposits in a great many cases. Mineralizing solutions frequently tended to follow the same paths followed by the breccias and in many cases the breccia was replaced more or less completely by ore. Schist and quartzite fragments were more resistant to replacement than were the limestone fragments. In many of our ore deposits the intensity of replacement actions has nearly obliterated the breccia structure but often a careful examination will reveal ghosts of the old rounded or subangular fragments.

It is probable that over 90 percent of Bisbee ore bodies are directly associated with intrusive breccias; if it were possible for the geologists to study every stope round by round as mining progressed it might develop that the percentage is even higher.

If it is born in mind that the ore in Bisbee occurs not in an ore body but in literally hundreds of isolated, separate and discreet ore deposits this association of intrusive breccias and ore becomes truly remarkable.

ORIGIN OF BRECCIAS

A great many theories have been offered by various geologists as to the origin of the Bisbee breccias. Many of them are subject to some serious objection. For purposes of discussion a few of the most commonly held theories are summarized.

1. The fragments were "floated" through the rock under very high pressure. The matrix probably contained a high percentage of sulphide and thus formed a high

density slurry to float the rock fragments.

Objection: While some of the breccias have a sulphide matrix this is undoubtedly due to subsequent replacement. Thin section examination shows the average matrix to be identical in composition to the larger fragments which can be identified by

2. The dikes were plugs of solid material driven ahead of an advancing magmatic intrusion.

Objection: The dikes are post Sacramento Stock porphyry. No evidence of another intrusion has been found.

3. The "contact breccia" represents explosion material which has blown high in the air and tumbled back into the void of what is now the Sacramento Hill Stock. The porphyry was intruded later and engulfed most of the explosion breccia leaving only patches around the stock. This theory has enjoyed considerable popularity and has been expressed in a number of publications.

Objections: The breccia dikes are definitely post porphyry. The theory entirely ignores the dikes which extend for a mile or more out into the surrounding rocks. The writers know of no evidence whatever that the breccias were formed by this means.

4. The entire area was under extreme pressure. There was a sudden release of pressure caused by an eruption of molten material or gas through to the surface. This sudden release of pressure caused a violent migration of material toward the point of release.

Objection: The spider web of dikes out from the Sacramento Hill Stock shows that material was forced up or out by a deeper seated pressure rather than inward toward a point of sudden release.

5. The magma of Sacramento Stock was intruded into the limestones but was not extruded onto the surface. Cooling and crystallization started with a consequent rise in pressure of the remaining magmatic solution. This resulted first in pyritization of the

limestones. Later as crystallization progressed and solution pressures rose sufficiently an escape of gases or liquids along all available paths occurred. The gases, having velocity, were then able to force along their myrid channels fragments of the outer solidified shell of porphyry together with fragments of all rocks traversed. Fragments of this clastic stream helped abrede the walls of the channel and enlarge it; gas pressure ahead of the intrusive pressure helped open channels for the fragmental material. Later ore solutions followed these breccia dikes replacing susceptible portions of the dikes on the adjacent limestones.

This last explanation is favored by the writers. While it is hardly susceptible of proof, it does answer most of the problems posed by the Bisbee breccia dikes.

The same idea of rising pressure due to crystallization of a silicate system has been used by others to account for intrusive breccias--notably by W. H. Emmons and F. M. Chase.

W. G. Hogue & H. E. Metz
Bisbee, Arizona
May, 1956

BISBEE ANALYSIS.

Source Data: (with notes + E.W. ideas added)

1. Geology & Ore Deposits of the Bisbee Quadrangle. F.L.Ransome:USGS PP 21 (1904).

Age of faults. (1) Post-Pennsylvanian, pre-Cretaceous: Dividend, Quarry, Bisbee West and most of the faults on the S slope of Escabrosa ridge. The flat thrust W of the Bisbee West mine probably belongs in this group, although it my be earlier; probably the Abrigo fault. (2) Post-Cretaceous: the steep faults NE of Bisbee; Gold Hill and Glance thrusts.

District divided into blocks,each block described as follows: (refer to 1:62500 quadrangle map).

Bisbee Block. NW of Bisbee; wedges out on NE side of Dividend fault. Contains the Pinal schist, invaded by the Juniper Flat granite and the Sac Hill porphyry. S of pre-C schist area is a triangular area of Paleo beds with gentle SW dip. Highest block structurally. Pinal schist lamination mainly vert.,strike E by N. Juniper Flat stock has straight SW boundary,striking NW parallel to Escabrosa ridge dike and fault zone:intruded along such a zone. Sac Hill stock came up Dividend fault.

Escabrosa Block. Mainly Abrigo on surface; general SW dip. It seems to comtain an anticline,which possibly pitches SE. Toward the Escabrosa fault-dike zone, beds flexed nearly vertical.

Naco Block. A gentle anticline which pitches N at 15°.

Copper Queen Block. A fragment of a NW canoe-shaped syncline pitching SE.The NW limb is cut off by the Dividend fault and relatively upheaved,the Paleo beds having been removed by pre-Cretaceous erosion. The Copper Queen block preserves the NE end (NW end?) of the SW half of the canoe. The Gold Hill thrust block is partly shoved over the Copper Queen block.

Gold Hill Block.-Boun ded on the N and E by the Gold Hill thrust. Cretaceous bedd arched into NW anticline. Entire block thrust from the SW up a gently undulating fault,a distance of two miles.

Geologic History.

1. Pinal schists ex-seds. Folded,compressed, elevated.
2. Eroded.
3. Cambrian-sea. Bolsa qtzite dep.along shore line. Abrigo ls depositedin deeper waters. No Silurian. Devonian and Carboniferous,open sea, moderate depth.

4. At close of Penn,region elevated,beds gently folded along NW trends. Some thrusting. Then nearly vert.normal flts,reversed intrusion faults; intrusion of Juniper Flat & Sac Hill stocks. (Most of the intrusionfaults shown on the sections are steep "normal";with synthetic faults the salient feature is that one side moved up,regardless of whether the fault dips like a "normal" fault or not. Note that the NW intrusions along the crest of the general uplift suggest that the

uplift took place during the intrusion;opening of these dike-fissures was not due to cracking along an anticlinal axis during NE-SW lateral compression,because the NW dikes descend into the Pinal schist basement. The Hedberg graben is discussed below;the NW QP dikes are later than the main graben,so that if the QP is pre-Cretaceous,the Hedberg graben is also pre-Cret. But I think with Tenney that the QP is post-Cret.)and the main uplift also).

5. Triassic-Jurassic-erosion. Paleo beds largely stripped from block east of Dividend fault (which implies the main movement on the Dividend fault was pre-Cret. It certainly preceded intrusion of Sac Hill stock;with the evidence that the QP dikes along the crest of the uplift-Escabrosa Ridge- came in as the uplift formed,it seems certain that the QP intruded everywhere at the time of arching;and the Cret. beds are arched.Before reading Rove's paper(see below) I suggested in my notes that the Sac Hill porphyry probably topped at the base of the Glance Cgl.;Rove says it does).

6. Cretaceous-rapid subsidence (more likely, sudden elevation formed coarse Glance cgl. Then subsidence below sea-level,Morita ss and sh.,Mural ls.,Cintura ss and silts.

7 Post-Comanche-general NE tilting at 20°(he omits uplift).This may be reflection of gentle anticlinal arching of Cret Paleo and basement.

Source Data 2: Guides to Ore in the Bisbee District,Roland Blanchard,Oct.1926.

Structural Features: Ls S of Dividend make up a distorted E-W syncline,with its N flank truncated by the Dividend fault.(Hence formation of the syncline pre-main Dividend movement,which has beenshown above thebe pre-Cret. The plunge,to the east is due to the arching to be described.). S flank extends to Gold Hill,total distance of 6 miles. Sac Hill stock invades syncline along Dividend fault. At W end of syncline is a rectangular ls block,15000' x 9000',downfaulted. Bounding faults: Dividend & White Tail Deer system; Quarry & Mexican Canyon.Down 1500',Dividend, 800', WTD. This block more broken than rest of country;many dikes, sills andirreg.masses of Sac Hill Por. Block contains all imp.ore mined.

Main OBs crescent shaped around Sac Hill,in outer part of alteration halo. Fracturing of rock,both in and out of halo,main localizer. Outside of halo, ore localized along 3 main SW fault zones: Czar-SW-Shattuck, Cole-Nighthawk,Junction-Briggs, Denn-Campbell. Ore between these major zones also localized on minor parallel zones. The major faults (Czar,Silver Bear, Lucky Jack etc) seldom carry ore or localize it in favorable beds. Ore localizers are the minor fractures of a fracture zone.

Source Data 3:Report on Don Luis area,E.W.1926. Strip 1,adjoining White Tail Deer fault on N. Normal Paleo series, Bolsa qtzite to Naco ls.NW, dip NE. Broken Promise NW fault,bounding area on NW, probably blocks on WTD fault. Section A shows Broken Promise and Wolverine flts are antithetic,dip W,beds dip E.

Source Data 4: Report on Hedberg Area by E.W. 1926. Quarry-Hedberg graben: internal structure synclinal, NW syncline. Bowl at S end accentuates this. Numerous porphyry masses, stopping going up at about present surface, suggests large por.mass below. Shrinkage may have caused bowl -this is supposed to have happened at the Gardner.

Notes from sections and new stereogram. The synclinal structure within the Hedberg graben, and perhaps even the bowl as well, is no more than the SE continuation of the NW syncline west of the Quarry flt. That there has been no extra sagging within the graben is shown by the fact that the displacment on the Quarry flt. is actually greater in the NE part of the graben (1200') than in the bowl area (900').

On the east side of the stereogram the west endof the Copper Queen syncline, as commonly recognized, appears. It axis lines up fairly well withthat of the syncline west of the Quarry fault; the Bisbee quadrangle map of Ransome shows how completely the two synclines match up. The Hedberg area is simply a disrupted segment of the major syncline, which, as shown above, is of pre-Cret age.

The nature of the disruption is shown by the stereogram and sections. Viewed looking NE and starting on the N, a strong uplift with SW axis is visible on Section 1. The Soudan fault was used as a synthetic fault, and the block of Martin between that and the Hedberg fault was shot high. The west limb of this arch lies west of the Quarry fault, and the Hedberg graben lies along the exact axis. The stereogram shows this bulge to have occurred in the very trough of the Copper Queen syncline-the anomoly in attitudes where the bulge begins is very marked.

Section 2: The apparent intensity of arching is less here; but the section runs ~~thru~~ close to the trough of the plunging syncline so that the arching force had to nullify first an original droop, hence actucal degree of up-arching may have been the same. The Martin is shot above the line of apparent arch by the Soudan fault. This section just cuts the N end of the Lovers Leap graben, discussed below.

Section 3. Same as 2; but Section C shpws arching appearing visible in NE section and stereogram shows this to be an arch trending NNW, either a branch of the Hedberg arch or one superimposed upon it. The Lovers Leap graben lies along the crest of this NNW arch.

Section 4. Also through the trough of the original ~~section~~ syncline, and shows disruption of the latter by the Lovers Leap arch and the Hedberg dropped keystone,

Section 5. Arching visble in this section is strong. Here the Lovers Leap graben changes to a pair of antithetic faults dipping W (west boundary fault turns over).

Looking NNW, Section C shows NW step-faults, synthetic, forming an uplift with NW axis. The steps lead up to the strong NW fault that butts on the Hedberg, then great drop, N side down at least 1500' (nearly twice as great as Quarry or Hedberg displacements; note on Sections 1,2, that Soudan fault has displacement nearly as great as Quarry or Hedberg, and hence fallacy to say Quarry bounds great dropped Copper Queen block: if no Hedberg disruption, the original plunging syncline would follow without interruption across Hedberg

area). The great NW fault mentioned indicates graben action in response to arching with NW axis.

Age of faults: 1. Bisbee West Zone, Dividend (Quarry, Hedberg etc. faults block on them). 2. NE faults, Quarry, Hedberg, Soudan etc. 3. NW faults that block on (2). NW graben. Dikes came in after (2) and probably in (3) epoch, which marks arching with NW axis.

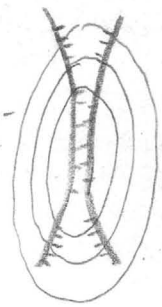
Probable geologic history:

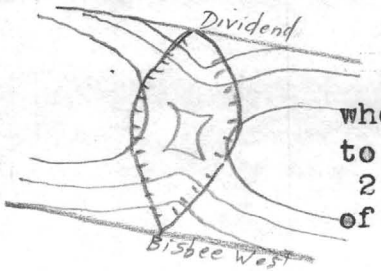
Pre-Cret. Folding of Paleozoics to give NW folds, Copper Queen syncline. Possibly some bed-thrusting. Then formation of ~~main Mule Mts.~~ NW uplift, ~~aided by major NW faults, Bisbee West, Dividend, very likely other Escabrosa ridge faults, White Tail Deer etc. Differentia uplift of blocks between these faults, such as~~ Main movement on Dividend (N side up). Stripping of Paleozics from N side of Dividend. Bisbee West movement, N side up (but much of latter movement may have occurred later). Erosion, but not peneplanation, for Glance cgl. formed in basins and is very coarse, even suggesting continued spotty uplift during this lart of the lower Cret. There may have been peneplanation however between close of Paleo and start of Cret. Probably Glance period marks start of Tertiary uplift, although there was a sag permitting deposition in shallow waters of higher Cret. ss, sh.ls etc.

(Post-Cret). Arching with NE axis in Hedberg area, formation of Hedberg graben. This coincides with probable start of intrusion. It will be shown below that this was large-scale arching, its effects extending east as far, probably, as the Mexican Canyon fault. Then arching with NNW axial plane (Lovers Leap graben), apparently an intermediate phases leading to arching along NW, forming the NW graben and longitudinal fissures up which came the NW dikes of Escabrosa ridge and elsewhere, probably the Sac Hill stock through tensional opening of the Dividend fault.

Some dikes however came in during the earlier NE arching: on quadrangle map witness the NE dikes north of the Hedberg area, in Pinal schist, both SW and NE of the Dividend fault, and the set N of Mt. Ballard. The distribution of these NE dikes implies a wider range of NE arching than implied above; but the Hedberg sections agree well enough with this, and show that at the Hedberg area the uplift starts to slope down to the SE; see Rove section from Int. Geol. Congress Guidebook.

Note on why Hedberg graben is pointed:





With free elongated dome, tensional graben faults are perp. to line of pull or stretching: along summit of anticline, and where latter plunges, they radiate out perp. to contours. Where a block is arched up between 2 preexisting faults, owing to free slipping of ends of arch along these faults uplift is easier at each end of the arch (where length of arch is so large that rocks cannot support themselves as a unit). Hence each end of arch may be considered a separate half-dome, with the sliced side along its bounding fault: hence graben pointed. This conception of mechanics may explain also "bowl", which may after all be supeimposed on the older syncline. Sagging between two loci of uplift.

Source Data:

Notes from BISBEE DISTRICT, ARIZONA; Olaf N. Rove, in Ore Deposits as related to Structural Features, 211–215.

NW Mule Mts. have axial core of Pinal schist intruded by pre-G granite; Paleo seds flank core on SW, Cret. form NE slope: broad anticline. "The southwestern flank is locally warped to form a crude syncline pitching NE against the Dividend fault." Note emphasis on the major uplift, lack of emphasis on the syncline.

Sac Hill stock-age uncertain. Minor igneous bodies: SE of Sac Hill, in the Sacramento mine area, great sill-like apophyses of GP seem to intrude along the lower contact of the Glance cgl. (see 1 mile to inch section). These contain important secondary sulph. OBs. Farther SE this mass becomes the Sac dike. Gardner area underlain by a large basin-like mass extensing from Sac Hill. In Lowell area large sill in Martin ls. Flat irreg. Shattuck dike caps ore. Irreg. dikes & sills localize ore in Czar-SW-Uncle Sam area. Igneous masses more abundant UG than on surface, but decrease in quantity and in importance as ore localizers away from Sac Hill.

Major Structural Features- Main movement (1500' plus, stratigraphic displacement) on Dividend pre-Comanchean, because Paleo seds eroded on NE side of fault, Cret. deposited directly on Pinal schist (Since erosion is in direct proportion to elevation above sea-level, this means that NE block went up in the absolute sense). Post-Comanchean folding produced the broad anticlinal structure of the Mule Mts with its local synclinal warpings. The massive Paleo seds on S side of Dividend underwent some block faulting, followed by thrusting from the SW during the folding period. Paleo now exposed was covered by several thousand ft. of Cret. Further normal faulting was accompanied by the intrusion of the porphyry stock, dikes, sills, followed by local fracturing and by the mineralization.

Structural Control.- All known ore on S side Dividend flt in down-dropped ls block 3 mi. E-W, 1.5 mi. N-S, bounded by Dividend, Escacado, White Tail Deer and Mexican Canyon flts. Block dropped 1000-2000'; is the W paer of a subordinate hook-shaped syncline on the major anti line of the Mule Mountains. Within this area 5 N-S fault zones with their associated shatter zones: Czar, Silver Bear, Cole-Nighthawk, Junction-Briggs & Denn-Campbell. 3/4 of known ore outside Sac Hill fringe ore is assoc. with these N-S fracture zones at their intersections with some other feature such as favorable ls horizon, dike, cross-fracture or sill. The SW-dipping Oliver flt zone (at least in part post- ore) most prominent cross-fracture.

Shattering of ls along pre-ore N-S faults main ore localizer: note ore pendants extending south from Dividend flt along (1) Czar, (2) Cole-Nighthawk, (3) Junction-Briggs & (4) Denn-Campbell.

"In the Shattuck-Southwest area, flat thrust faults are known to cut out hundreds of feet of section, but in general the magnitude of the thrusts have not been solved. Some are mineralized and ore is localized in ad joining shattered ground; others are of unknwn age."

(p. 214)

In Uncle Sam-Shattuck area irreg.dikes and sills suggest they follow irreg.branching flts;they indicate local center of mineraliz. Ore localized between the fl at Shattuck & Wolverine dikes.These irregula rities, esp. where cut by sheeted ground of Czar flt.zone make imp. ore controls.

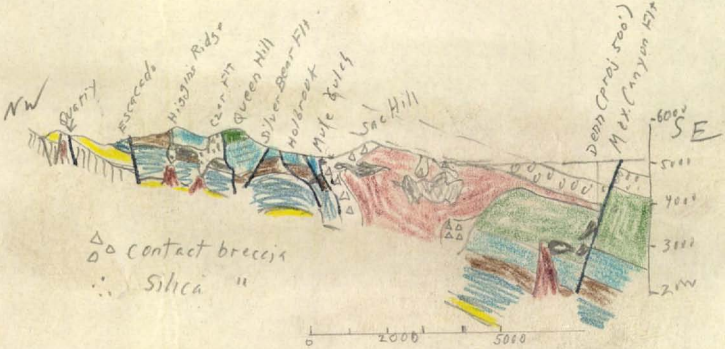
In Sacramento area ore localized in ls.embayments in the porph. dike,where they are cut by prominent sheeted zones. In Cole-Nighthawk zone ore assoc.with N-S fissure zones;widens out in certain horizons of lower Martin and upper Abrigo to form a replacement OB 900'long,20-30'thick and to 50' wide;original ls bedding preserved. Briggs ore the same .No porph. association.

Campbell ore in steep sheeted zone near a dike.

Ore Horizons.-Most of ore from upper third of Martin & lower 3rd of Escabrosa,esp.in Sac Hill area. Next in importance (farther S from Sac Hill) ate lower 3rd of Martin, upper fifth of Abrigo. Middle third of Martin somewhat shaly,folds and crumples rather than fractures under stress;localizes sills and flat thrusts;steep sheeted zones tend to dissipate in the shaly layer;ore localized under this semi-impervious layer. Thick massive lower 3rd of Escabrosa fractures readily.

Maximum stratigraphic ore range 2000' near Sac Hill;range decreases and horizon drops away from Sac Hill.

"The selection of the specific horizon appears to be due in part to the relatively thick-bedded character of the favorable horizons,as contrasted with the shaly middle Martin which probably was an important factor in intensifying the fracturing in the overlying and underlying important ore horizons." (p.215).


NW
Quarry
Escacado
Higgins Ridge
Czar Flt
Queen Hill
Silver Bear Flt
Holbrook
Mule Gulch
Sac Hill
Denn (proj 500')
Mex. Canyon Flt
SE
6000
5000
4000
3000
2000
contact breccia
Silica "
0
2000
5000

Rove's paper, the latest authoritative one (omitting the congealed Trischka) has many points in accordance with my conceptions, notably his emphasis on the Mule Mt. uplift, with the Copper Queen syncline nothing more than a warp on the SW flank. The Mule Mt. anticline is post Comanchean ; it was accompanied by thrusting from the SW during the folding period (Gold Hill thrust etc. The arching with NW trend was thus accompanied by strong confinement, even active shove, from the SW, which accounts for the Hedberg and other NE graben, and the many strong SW faults and fractures in the productive area; these fractures, on the SE limb of the arch, became antithetic faults, aiding the stretching, & syntheticfaults, aiding the uplift, as is well shown in the NW section reproduced by Rove). According to Rove, this fracturing & faulting was accompanied by the Sac Hill stock, dikes, sills etc., then more fracturing & the mineralization. The fact that best ore controls are not the SW faults, but sympathetic fissures in the respective fault zones, and the fact that the Big Shale in the Martin localizedore beneath along SW fractures that dissipate going up, in the shale, both point to vertical shove beneath the "Copper Queen syncline". That most of the local ore loci are downfaulted blocks does not militate against this notion, for fissures could be squeezed open extra-easily in blocks bounded by faults , through the gliding mechanics advanced above for the Hedberg graben.

E.W. Notes from Ransome maps & Sections.- The sharing of the Cret. in the general Mule Mts. uplift, is obvious. Looks like Gold Hill thrust had been folded in the uplift. Patterm of NW faults in NW part of quadrangle is fan-shaped, and the faults are antithetic that belong to the fan, synthetic if they dip the other way. Good evidence for uplift.

Section B (mile to inch) shows excellently the nature of the uplift, NW trend, with Abrigo fault the bounding fault on the SW: Naco SW of Abrigo fault flat, Martin etc. NE of fault, humped up.

Summary.- Pre-Cretaceous folding rather gently folded the Paleozoics, forming Cu Queen syncline; Dividend fault formed at this time, and its major movement occurred. Peneplanation, laying down of Glance cgl and later Cret., on both sides Dividend fault; this involved sinking below sea-level. Post-Comanchean: general NW uplift, aided by major NW faults, Bisbee West, Abrigo etc. This major uplift from the start seems to have had a plunge to the SE, with the highest part in the Juniper Flat area. The geol. map of Arizona shows the Pinal schist plunging to the NW some 9 mi. NE of Bisbee. This map shows Paleo seds on the SW side of the schist, with Cret. on the NW. Likely that the pre-Cret Dividend fault is a regional feature, dropping down and preserving the Paleos. Cret. now stripped from this limb.

Then more local uplifts: (1) arching with NE axis, formation of Hedberg graben; (2) swinging of arching axis to NNW (Lovers Leap graben) and (3) NW arching again, formation of NW graben (post-Hedberg graben) and intrusion of NW post-Quarry fault dikes. Probably in connection with the phase of arching with NE axis, the Bisbee SW ore faults and fractures were formed, dipping NW toward Hedberg area. Arching between NW bounding faults. Possible upward shove of Sac. Hill plug, shown by SW radial fracture sets that governed WTD etc. ore.

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Copper Queen Hotel

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COOL THE YEAR 'ROUND

Bisbee, Arizona
"IT'S DIFFERENT"

Aug. 27, 1956

Visited Lavender Pit with W. K. Pincock, ore selection engineer ±. Present pit outlines limits of OB. Bottom will be at 4500' elev.

15000 T per day average 0.9%. Better at depth, ave. 1.12% (overall, I think)

~~Hea~~ Most of mineralization is pyrite quite a bit as cubes. ~~the~~ Cu_2S coatings make the ore. Grade of protore extremely low.

Ore very spotty, sort by shovel – make ore piles. Link it with breccia zones or pipes, very active present idea. One of the biggest, which I saw, is several hundred feet wide & seems to be elongated ∥ to Dividend flt. Latter may form the N wall of the zone, or zone may be S of flt. Apparently 1 or 2 more such breccias within the limits of the OB.

Pit will get the Sacto. block – caving ~~ore~~, which wouldn't cave. On SW porph.

ore seems to go clear to the l.s.

Hedberg - drilled several more holes, after mine, looked extremely promising but they passed thru a flat thrust which landed them in the wrong formation.

Nighthawk Area - Still use my report. Tobite - Tail Deer - Nighthawk & Boras ore zones hooking up. Have found plenty ore & is still extremely promising ground. Ore controls check.

Crude Zoning - E of Dallas 17 lbs. Pb & Zn fet. & Campbell country mined for 1 lb. Cu.

Breccia zones dike-like in places, & S.T. tend to follow NNE fracture pattern - but jump across, S.T. horizontal.

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Gossip.

Wm. G. Hogue, Co Q Geologist, visited Xmas Cimarron seems to be making a go of it.

Doug Tenney says Lewisohns trying to get together enough small properties at Helvetia to make a Co operation.

Jos. Linn is Consultant.