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LORDSBURG, NEW MEXICO.

Grass Valley appears to represent shearing visible in a vertical section. Lordsburg, N.M., presumably of Laramide age, exhibits shearing visible in plan.

S.G.Lasky: Geology and Ore Deposits of the Lordsburg Mining District, New Mexico. USGS Bull. 885, 1938.

Rock Formations: Oldest to youngest.

Lower Cretaceous? Basalt.(a).Lower basalt.Base not exposed although 85 mine workings penetrated this formation vertically for 1050'.

Remarkably homogeneous thruout this thickness.Soft,jointed plus.

(b) Upper basalt. N side of district;once covered whole district, barely removed from higher hills. Max.thicknessleft is 300'. Tuff at base,with a few thin rhyo.flows.

(c) Intrusive breccias. Larger plugs, early blacl basalt brecc., later white rhyo.breccia. Smaller plugs, either one brother. Black breccia has fragments of Lower basalt cemented by other basalt. Frags.both these rocks in porphyritic basalt to f.g. breccia matrix.

These intrusive breccias noweher cut the Upper Basalt

(d) Intrusive rhyo. Last volcanic episode. Intrudes basalt and intrusive breccias. Outcrops thought to be remnants of volcanic necks.

Late Cret.or early Tertiary Intrusives.-(a) Porphyritic GD.Irregular stock intrudes all formations described. Main host for known ore deposits.

(b).GD porph.and aplite dikes.

(c) Qtz latite dikes.Long,narrow. Older than Miocene volcanics. Pe Post-mineral but were themselves later mineralized. (probably intramin).

(d) Felsite dikes. Post-veins but prob.pre-Miocene volcs.

Structure: Basalt flows probably flattish. Roof pendants show that N horn of crescent-shaped GD stock must be near original top of the massive. 500' eroded. Central, S parts eroded much deeper.

Spatial relation of faults to periphery of stock. Main group follows N horn. See sketch.

Faults.- Nearly all pre-mineral,and channels for ore solutions. Especially Anita-Atwood set have boldsiliceous outcrops. Since the fault sets originated at same time,this means E-W set was more permeable at a time when solutions were highly siliceous.(See below).

Four episodes intramineral faulting. Post-ore movement on all faults. Minerals accompanying each opening differed;hence position of openings formed during each stage of movement can be inferred from distibution of the different varietues of vein matter. In general openings produced during one stage of faulting were largely indepdnent of those produced during any preceding stage. But trunk openings held their positions. Dynamic ore control. Dunn, ore channels. Planes of post-ore faults coincide with those of the two preceding stages (4,5).

Direction and amount of movement at 85 Mine only.Horizontal,cumulative displacement 150', SE block (HW) moved SW,relatively.GD-basalt contact offset. Mullions horiz.,up to 1.5' deep 4' across. Bonney vein has deep horiz.mullions.

Anita-Atwood pattern suggests main members had horiz.movement. See AIME vol.144. This zone,along N side of N horn,contains principal volcanic vents of the district. Probable that both N horn and the faults are localized in a long -establised zone of weakness,and that the stock affected the localization of the faults only in having been a buttress against stresses,probably regional,that actually caused the faults. (Volcanic vents older than GD stock).

Ore Deposits.-Faults described mineralized nearly everywhere. Anology to Grass Valley: branches,some returnig, common. S.t. veins split as if fraying out,but onesplit strengthens farther on, becoming main vein. Or vein is taken up by another fissure somewhere in the wall. At many other places vein filling lies in overlapping simple fissures,

or crosses along a link from one fissure to a parallel one,main fissure continuing as tight or gougy barren stringers, Commonly two such gougy stringers pass into qtz.vein at their junction. Shown on plan and section.

P-M faulting, forming thick masses gouge and breccia found on all veins. Confined to ~~xkx~~ planes within and along vein walls.Displacement so nearly parallel to vein that continuity of ore not seriously interrupted.(Point outm difficulty where P-M fault slices across vein).

Vein-filling.-Veins fissure fillings repeatedly reopned. While each reopening accompanied by distinct change in character of minerals deposited,so that there are shoots in whihc a particular variety of filling predominates,the mineral succession is similar to that of deposits in which depositio n was uninterrupted. This is an argument against the thesis, heldby some, that ore and gangue minerals came in together but that they separated out in the common paragenetic order observed. Here is a well-defined sequence chopped off by the end of the various periods of faulting. Only second stage yielded commercial ore,ccpy. Minor Cu, Pb, Au, Ag were deposited in later stages,but dilution caused by gangue minerals of these stages more than offset the gain. IMP.

Veins vuggy. Stages: (1) Tourmaline,calcite,sericite,chlorite,spec. All but tourmaline,spec.in wallsonly:usually early HT alteration. (2) Calcite;sericite in walls;py, ccpy,qtz.ZnS,PbS,barite,fluorite. (3) Qtz.(4) (5) (6) calcite. Minor qtz.,sulphides,barite.

Ave,grade primary ore,Emerald vein: 2.8% Cu.;1.23 oz.Ag.;0.111 oz. Au.Remarkably uniform,whole shoot;very roots of shoot the same.@1800(vert. range).

Vein tectonics: End of (1),veins sheeted and in part brecciated. (2) qtz,ccpy etc. End of (2)brecciation,distinct veins of third stage cutting earlier stuff. (3) Qtz plus.End of (3) brecciation. Etc.

Tectonic Analysis: Laramide active thrust from SW affected district: H.SchmittL Structural Association of Certain ~~Mineral~~ Metalliferous Deposits in SW US & NE Mexico. Trans.AIME 115,1935,Fig.6,p.41. Summary of the Geol. & Metallogenetic History of Arizona & N,Mexico.Ore Deposits Western States,1933, Fig.18 p.317 and p.321. Active shove toward NE;mechanics demand displacement on Anita-Atwood zone, N wide W or S side E.

Stage 1. Injection of GD and GD porph.dikes. Fig.1. Looks like conjugate sets of shear planes formed by simple compression. Roughly E-W set localized by zone of weakness marked by volcanic vents.This zone localized N horn of stock also,and N side of horn was probably quite straight in plan. Basalt fractured readily;the stock only failed gradually from its edges inward;it never did fail at its core.Hence the N contact developed a plane of marked structural discontinuity and weakness. But any actual differential movement along this surface had at this stage hardly commenced.Absence of feather joints along Anita-Atwwod zone. But the buttress was working as a cutting tool, however,shw shown by the west by north shear plane along NE side of S horn.Dikes could form in such shear planes because country as a whole had not lost competence,i.e. great planes of disruptive faulting hadnot yet commenced to function.

Fractures of Stage (1) were discontinuous in strike and probably in depth. Did not tap deep source of ore solutions. Cf Grass Valley crossings.

Stage 2. Ore period. Injection of qtz-latite dikes.Plate I. Extensive counterclockwise shearing now in progress along Anita-Atwood fault zone. Shove from SW utilized preexisting Anita-Atwood zone,which was oriented favprably as a locus of movement. Usually en echelon pattern a s explained for Grass Valley. Deformation of long narrow strip.Feather joint lacers between N and S components of the zone. Rotated

Feather joints form especially at echelon gaps in major shear planes

(Butte). The Emerald vein is the SW continuation of the zone of tension joints in the largest echelon gap of the Antia-Atwood zone. The strong stretching across the gap prolonged itself SW, cutting across the easily fractured GD horn. Emerald vein further localized by a partly covered intrusive ridge of GD between the N horn and the main mass.

The failing border of a buttress is a good place to hunt for ore. Baguio: s,t.ore just outside buttress,more often just inside. Reason: buttress edge is cracked affording solution channels,but at same time still relatively competent:it can support gaping fissures parallel to the direction of compression. Emerald fissure a major cross joint at the failing edge of a buttress,parallel to the direction of shove. Section shows that practically all qtz and ore confined to central GD block,and NE and SW contacts of GD are coextensive with corresponding sides of the ore shoot. Richest ore next the outward sloping SW contact;probably whole shoot localized by trapping,or by extra opening of brittle rock with soft rock to either side and above it (original top of GD only 500' above present surface,ore outcropped).

Details of vein structure support tensional notion.(p.10). 1. First opening. Channel for spec.-tourmaline solutions along SW contact of GD block. Narrow channeo along NE contact also. Bigger channel to SW checks idea of active force from SW. 2. 2nd Opening. SW channel still functioned. Sporadic spots of wide qtz are strongly suggestive of squeezing open of a fissure. 3. 4th,5th (calcite) openings. SW contact still functioned as a channel,but NE contact now furnished an important channel as well. Calcite in general restricted to lower levels,where qtz, and ore are becoming sparse.This is a vein that bottoms in cal. Wtz sealed upper parts of vein against this reopening; movements becoming feebler,or rather,under beginning shearing movements. (Go to p.11).

After Stage 2 shearing movements probably started on 85 etc. Repeated tearing apart by compressive componen t of shove from SW weakand Emerald vein;tangential compoent finally overcame crookdness and lack of lubricating gouge along the Emerald,and shoves the N wall NE. But at start of this shearing movement Emerald vein put up vigorous ressistance so that a large feather joint formed as a branch (N75E qtz latite-felsit dike zone cutting across the district.(See Newhouse for reference here,introduction). The tendency for the ground to move differentially could not be denied

History of camp after this is one of continually decreasing rock competence in directions E-W and SW-NE. The shove from the SW produced from now on only strong horizontal fault movements and abundant PM gouge.

see p.14.

LORDSBURG, N.M. Brief Summary.Lasky, 1938.

Rock Formations.- Lower basalt.Kl? 1050'+.Soft,homogeneous,highly jointed.

Upper basalt. N side of district;once covered district.

Intrusive breccias: plugs,early basalt breccia,later whire rhyolite breccia.Smaller plugs,eiher one or the other. These itrueive breccias noweher cut upper badalt.

Intrusive rhyolite;intrudes basalt and breccias. Outcrops may be remnants of volcanic necks.

Late K or early T Intrusives: Porphyritic GD,stock,invades all above formations.

Dikes of GD porpyry and aplite.

Qtz latite dikes. Older than Miocene volcanics. Post-or intramineral.

Felsite di es.Post-veins but probably prepMiocene volcaniss.

Structure:Outcrop of stock crecent-shaped,horns to E. N horn near original top;central,south parts eroded deeper.

Spatial relation of faults to periphery of stock;strongest group follows N horn. Faults nearly all premineral.

4 episodes of in ramineral faulti g;mine als accompanyin each episode differed.

85 Mine,horiz.displacement,right-lateral,150'. Anita-Atwood zone, left-lateral.Wedge between moved E.

S rong p st-mneral faulting along all veins.

4 sages mineralization: (1) Calcite,sericite,calcite in walls.HT alteration. (2) Calcite,pyrite,Qtz.,ZnS,PbS,barite,fluorite. Emerald vein ave. 2.8% Cu,1.23 oz.Ag.,0.111 oz.Au. (3) Qtz.(4)(5); (6),calcite.

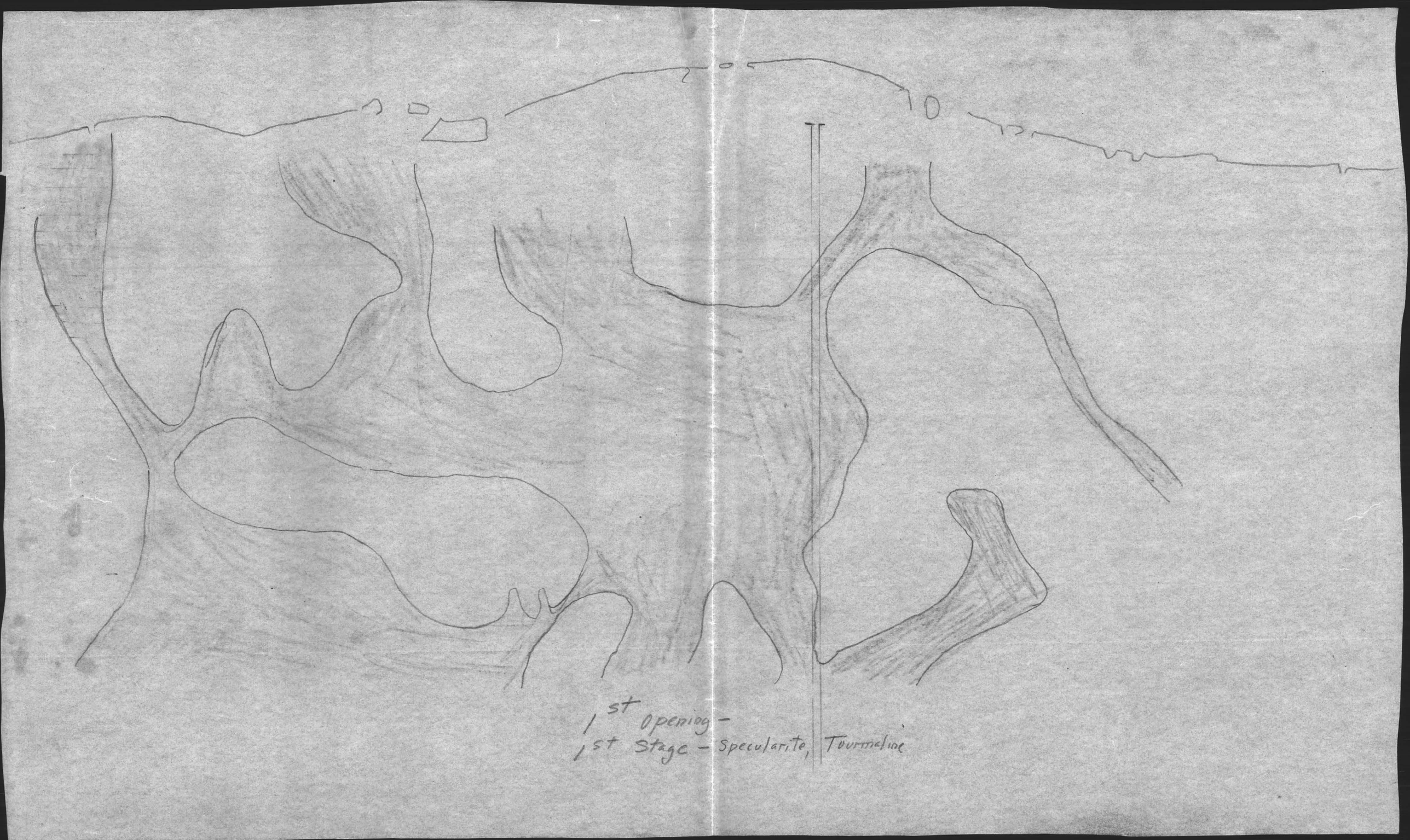
Tectoncis of veins: End of (1),veins sheeted,s.t. brecciated. Intruduction of (2). Endof (2).Veins of (30,qtz +,cut earlier minerals. Eend of (3),brecciation.Etc.

Tectonic Analysis:Stage 1: Intrusion of stock . Anita-Atwood zone marked by line of rhy volcan c vens,preexisting.This line of weakness localizee N horn of stock and the Anita-Atw od zone. Stock as cutting tool,but lit le or no horizontal move ent at the time, Fractures of Sta e (1) discontinuous.

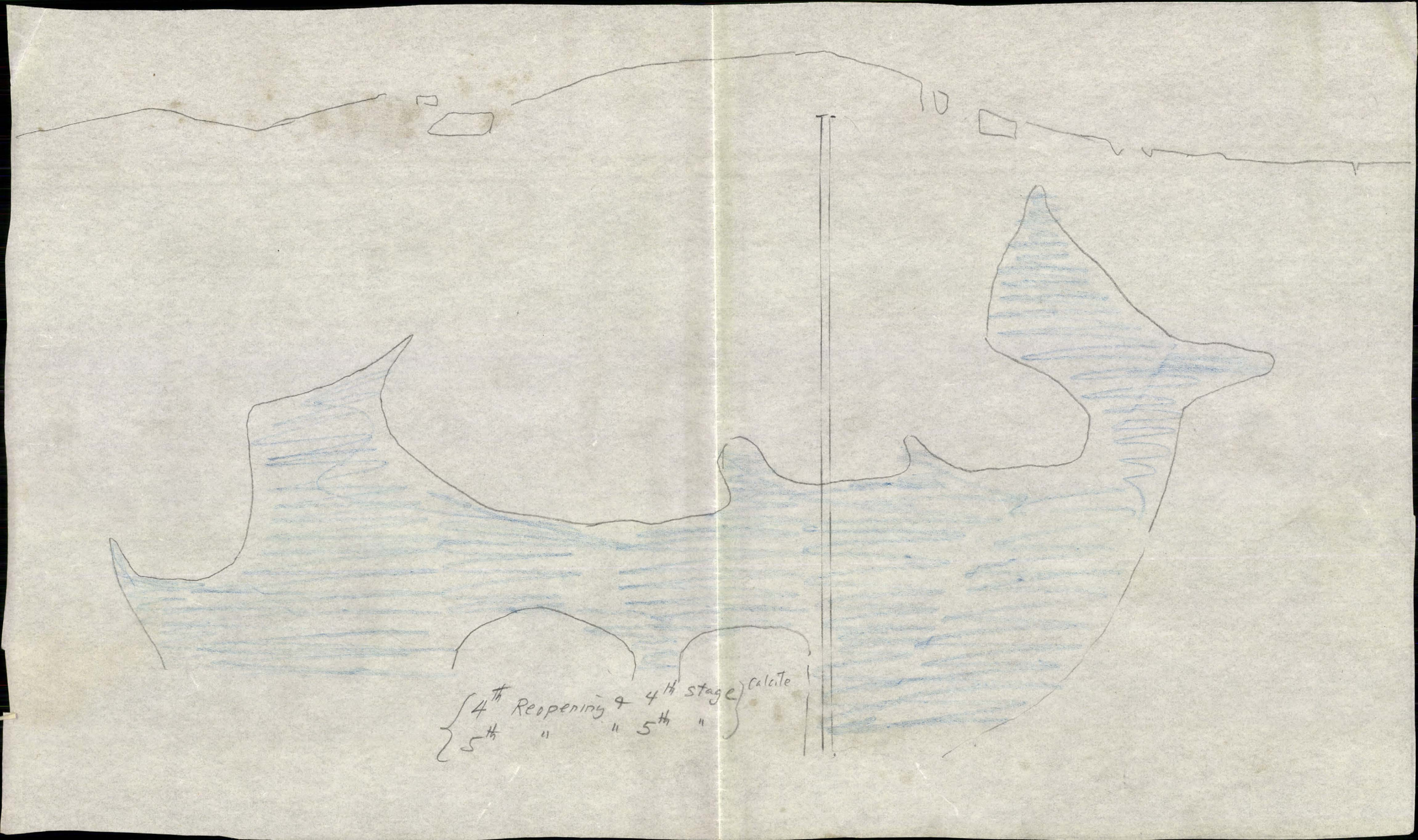
Staye 2.Ore period.Injection of qtz-latite dikes. Counterclockwise shearing along Anita-Atwwod zone. Fea her joint lacers between N and S faults. Rotated. Feather joints form especially at echelon gaps in ajor shear planes. Emerald vein the SW continuation of zone of feather joints in largest en echelon gap in Anita-Atwood zone. Originated also as a major cross joint parallel to direction of shove. Ore in brittle,competent GD.

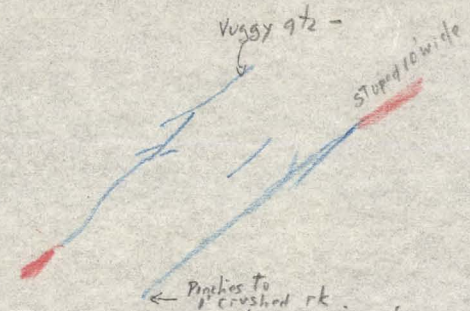
Afer Stage 2,shearing on Emarald,previo sly weakened. Post-mineral horiz ntal movement. Decreasing rock competence.

L961 Tectonic Map of U.S.shows no thrusting in the area.

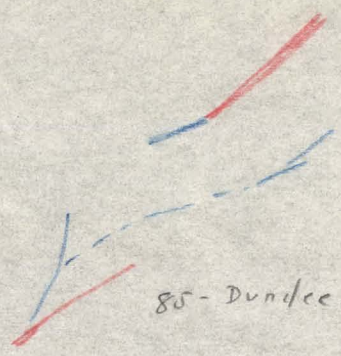


1st Opening –
1st Stage – Specularite, Tourmaline

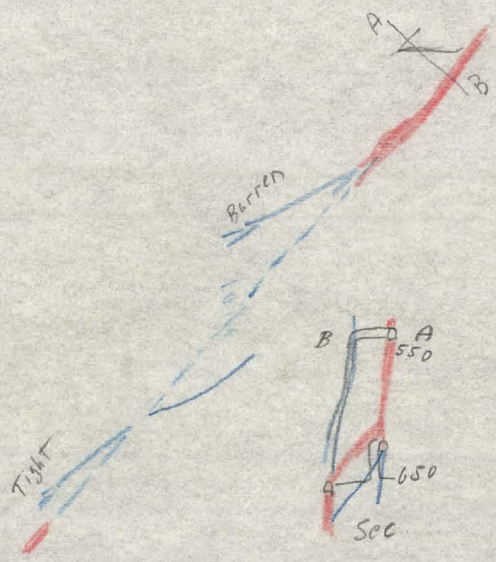

4th Reopening & 4th stage
5th " " 5th "
Calcite



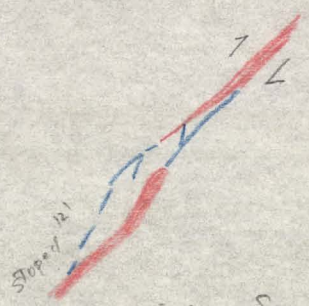
85 Mine, Dundee Sec. 200' Lev.



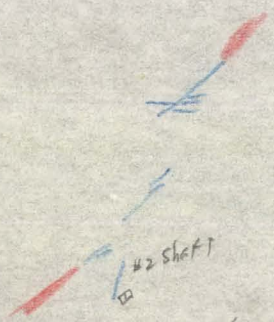
85 - Dundee - 1200' Lev.



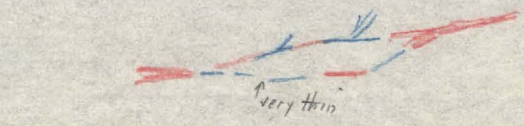
85, Emerald Sec. 650' Lev.



85 - Sim Crow Sec. 900' Lev.



Bonney Mine, 600' Lev.



Anita Mine - 500' Lev.

0 100 200

Details of Lordsburg Veins.

Rotation by plastic deformation, before fracturing
Anita-Atwood Shear zone orientation
Force
A
B
C
A'
B'
C'
Lee Peak
ANITA-ATWOOD SHEAR ZONE
Anita #3
Atwood
Waldo
Tioga
Nevada
Henry Clay Shaft
Old 85 Shaft
Emerald 85 Mine Shaft
Emerald Vein
Jim Crow Shaft
Bonnie #1
#3
Miners Chest
Vents for Upper Basalt
Felsite
Porphyritic Granodiorite
Basalt
1" = 2000'
Orientation for felsite dike period (Shearing along Emerald vein)
Supposed border of massive at shallow depth
Nellie Bly Mine
PLATE I
LORDSBURG
Structural Map

VERTICAL PROJECTION - 85 MINE
ore shoots show distribution of minerals of 2nd stage.

Active ground movement probably from SW-see. H. Schmitt, Structural Assiciations of certain Metalliferous Deposits in Southwestern U.S. & Northern Mexico, Tr. AIME vol. 115 (1935) fig. 6, p. 41
Also: Summary of the Geological & Metallogenetic History of Arizona & New Mexico, in Ore Deposits of the Western states, 1933, fig. 18 p. 317 & p. 321.

1. Granodiorite & GD-porph. dike fracture system. Normal shear pattern. Most dikes along antithetic set. Competence of rock ~~still~~ strong, except along Anita-Atwood zone, localized by volcanic vents - never competent here. Dikes may form in shear planes so long as rock competence is preserved. There was some competence at start of this period on Anita-Atwood zone, close to N end GD massive, for a small GD dike lies along it.
These dikes appear to have sealed their fissures, except along Anita Atwood zone.
The granodiorite buttress was strong, & the major fractures formed at this time occur on or away from its borders.

Fig. 1