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

The following file is part of the Grover Heinrichs Mining Collection

**ACCESS STATEMENT**

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

**CONSTRAINTS STATEMENT**

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

**QUALITY STATEMENT**

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

XII C

Reprinted for private circulation from
THE JOURNAL OF GEOLOGY
Vol. 60, No. 3, May 1952
PRINTED IN U.S.A.

# MULTIPLE EMPLACEMENT OF THE IDAHO BATHOLITH[1]

ALFRED L. ANDERSON
Cornell University

## ABSTRACT

Manuscript received January 11, 1951.

These he believes to be related geneti-

XII C (Idaho Bath).

GSA Spec. Pap 82, 1964, p. 343

**Idaho Batholith**

ROSS, CLYDE P., *U. S. Geological Survey, Bldg. 25, Federal Center, Denver, Colo.*

# *Magmatic Source of Idaho Ores*

ALFRED L. ANDERSON
*Department of Geology*
*Cornell University*
*Ithaca, New York*

LANCASTER PRESS, INC., LANCASTER, PA.

With the writers compliments

# METALLOGENIC EPOCHS IN IDAHO.

ALFRED L. ANDERSON.

Reprinted from ECONOMIC GEOLOGY, Vol. 46, No. 6,
September–October, 1951

Reprinted from Economic Geology, Vol. 46, No. 6, September–October, 1951
Printed in U. S. A.

# METALLOGENIC EPOCHS IN IDAHO.

ALFRED L. ANDERSON.

ABSTRACT.

vol. 43, pp. 84–99, 1948.

# Some Features of the Idaho Batholith.

C.P.Ross: 16th Int.Geol.Cong.1933,369-383.

Central part of bath.invaded thick Belt serie s,argill.qtzites & their schist equival ents. Roof pendants. SE border bath.,thick Carb. strata;north of here,probably all of Paleo represented. Great geosyncline in Paleo just east of present bath. Comparable Mesoz.thicknesses in a trough 150 mi.E of bath. W shore of interior sea during most of Paleo coincided with present E exposed border of bath.,shown by types of seds, hence area of bath.has been positive since end of Algonkian.

Bath somewhat calcic qtz-monzonite,slight gneissoid texture. Quite uniform,thinks bath.intruded essentially as a unit.

Shell around bath.,esp.along roof,gneissic qtz.diorite;lit-par-lit injection into Belt;Paleo rks.intensley meta,but little injected. Qtz-mon z.of main mass usually cuts this shell. Intrusion of shell diorite took place under greater pressure than that of later, main mass. Shell,as corase grained as main mass, probably not chilled edge;more bas ic minerals may have tended to move toward re latively cold walls as wh whole mass slowly consolidated.Ore she ll may represent a relatively un-differentiated phase of parent magma,consolidated at early stage of in trusive process.

Bath had flat roof,outward-slopping, steep sides. Belt rocks in roof flexed,but less closely folded than Paleo rks on E flank,which ~~are~~ show close ly compre ssed,ove rturned and broken folds.Much of overturning is to NE,but near Bayhorse the major anticline,trending NE to N,in marked con trast to NW folds farther E,is flat on top and overturned fan-like on both flanks,as if pinched at depth. More open fold was pinched,possibly by E shove of E flank of bath against buttress on E.

This Bayhorse anticline may be N extension of major Wood River an-ticline. Latter a compound fold which trends N60W,broken by many thrusts N45W,parallel to trend of subordinate folds of the anticline.Displace-ment on the fold s and overturning of subordinate folds to NE.Thrusts moderately steep,disp.hundreds of thousands of ft.Related to the fol d-ing and very diff.from flat thrust plates of W Montana.

Wood River anticline and main,most W Bayhorse anticline lie along E borde r of bath and follow closely larger sinuosities of contact. Bath invaded after major part of folding but possibly before end of thru sting. Small stocks at Bayhorse, larger ones at Wood River,short dis-tances E of main bath;intrude previously folded rks also;some at Wood River rimmed by normal (synthetic) flts;some domed rocks. Some synthetic flts,800 O'displacement. At Wood Rive r,arching that produced the major anticline thought late,superimposed,as early result of igneous activi-ty,on old er,close folds. For fults surrounding stocks,2 likely hypothe-ses:(1 ) formed by stresses that dome intruded strata,during or just aft ter intrusion;(2) preexisting thrusts so tilted locally during the do-ming inc ident to intrusion as to reverse direction of dip.

Deformation decreases E of bath,folds trend N40W in contrast to N15 W adjoining bath.

Persistent upward tendencies of earth block now containing bath may be related to processes that finally brought about intrusion. The regional uplift that became pronounced early in Mesoplotz.

Look up petrographic structure, Idaho Bath. ✓
See: Geol. of NE part of Idaho Bath. etc. C.M. Langton - JG 43(35) 27-60.
Also: C.P. Ross - Some features of the Idaho bath. 16th Int. Geol. Congr. Rept., vol. 1 ('36) 369-385
Ump - USGS Bull 528 Lemhi Co. ✓

CENTRAL IDAHO. IDAHO BATHOLITH ETC.

Sources:

1. The gold and silver veins of Silver City, De Lamar and other mining districts in Idaho. W. Lindgren, 20th AR, USGS, 1898-9, Pt. III, 75-256. 40 mi. = 1" map accompanying this is basis for this synthesis.

2. Mining Districts of the Idaho Basin and the Boise Ridge, Idaho. Lindgren 18th AR USGS Pt. III, 1896-1897, 625-719.

3. Lindgren, 1900 AR USGS 107-187 (see)

4. Lingren & Drake USGS Folio 104, 1904. (see)

4A) Some gold deposits of the NW. F.C. Lincoln, EMJ 8-26-11 (De Lamar).

5. Preliminary account of the ore deposits of the Loon Creek (Casto) district, Idaho. J.B. Umpleby USGS Bull. 530, 1911(1913) 66-74.

6. Ge ology and Ore Deposits of the Casto Quad., Idaho. C.P. Ross: USGS Bul 1.854, 1934

7. Gold Veins of Sundry Areas in the Idaho Batholith. F.A. Thomson, EMJ-P 118(Oct. 1924), 533-540. (Elk City, Buffalo Hump etc.)

8. Ge ology and Ore Deposits of the Buffalo Hump District. R.H. Beckwith. Annals N.Y. Ac. Sci. XXX (1928) 263-296.

9. Lode Mining in the Quartzburg and Grimes Pass Porphyry Belt, Boise Basin, Idaho. E.L. Jones Jr. USGS Bull. 640(1916) 83-111.

10. The Lode Deposits in the Boise Basin, Idaho. C.P. Ross: EG 28(1933) 329-343.

11. Silver Mineralization in the Banner District, Idaho. EG A.L. Anderson & A.C. Rasor, EG 29('34) 371-387.

12. Some Lode Deposits in the NW part of the Boise Basin. C.P. Ross: USGS Bull. 846-D, 1934.

13. Geol. & ODs of Wood River Region. Umpleby et al., USGS Bull 814('30).

General Geology.-

Source(1): Idaho bath. Nevadan in age. Columbia River plateau lavas, 2000' thick, early Miocene. Batholith uniform composition and texture (moderately coarse; between GD and QM. Jointed, any attitude, but commonest N70E, dip N or S at 45-80°. This parallel to many veins. Differentiate dikes: GP (common everywhere) mainly N or NNW. Many other GP however strike E-W. The narro lamprophyres always strike E-W. GP really QP, qtz phenos in microxx GM. Followed by later qtz veins. Dior. por and qtz-dio. por. dikes common. Coarse GM. Main belt from Rock Creek (Willow Creek) ENE to Qtzburg & Grimes Pass.

Central Idaho area was a solid, competent block since early Tertiary, for a non-monolithic part of crust, faulted and dipplaced would not have yielded to pressure so uniformly as the vein-pattern in the bath. indicates

Basin & range structure S of Snake R. N-S lines. No uniform E-W vein system, as in bath., here. Owyhe e veins N-S.

Source (6): Idaho bath. QM cuts sharply into older seds, steep contacts; xenoliths. Intrusion caused or accompanied regional uplift; striking feature is ability to transgress and shatter the CR. Dimensions increase

Umpleby - Mackay region, Idaho, USGS PP 95 ('17) 1-123
Kirkham v. Igneous geol. of SW Idaho. JG 39(31) 43-77
✓ C.P. Ross: Mesoz. & Tert. granitic rks in Idaho. JG 36('28) 678-680

downward. Age of bath.end of Jurassic.

Source (7): I deal E-W section shows pronounced arching ~~xxxxx~~ with bath.as core.

Source (8): Thinks bath.late Cret.or early Tert.(After Umpleby,Geol. & ODs of Lemhi Co. ,Idaho:USG S Bull.528(1913) p.43). Concurs that magma made room for itself by displacing surrounding roc ks.

Additional Source: Structural Behavior of Igneous Rocks,Balk: (1) p. 68:Core massive,b orders foliated. Lindgren describes huge foliated gneissic plate terminating intrusive on E (A geological reconn.across the Bitte r-root range and Clea rwater Mts.in Montana & Idaho,USGS ~~Mxxx504(1912)~~ PP 27 ('04),20,21,42-51.) Foliation increases toward border,border dips 30°E. NNW of Hamilton,Mont. Balk saw g neissic layers intensly streaked by flow lines pitching 25° E d own dip of foliae. The 3000' wide gneissic plate trends N-S 100 mi.,swinging to S W,then W at S end. See G.H.Eldridge:Ge ol. reconn.across Idaho,USGS 16th A R pt II('95)225,249;A.L.Anderson:Geol.& mineral resources of region around Orofino, Id. Id.Bur.Mines & Geol. Pam. 35('30),17-19,28,29;Contact phenom.assoc.with Cassia bath.,Id .,JG 42('34) 381;C.H.Clapp:Geol. of portion of Rocky Mts.,Mont. Mont.Bur. Mines & Geol. Mem.4 (1932 ),18;F.A.Thompson & S.M.Ballard:Geol.& gold resources of N central Id . ,Id.Bur.Mines & Geol.Bull.7('24),32.

Ibid.p. 113: major structural unit of bath (apparently an arch) embraces several minor units.

Ibid. Quotes Cla pp,opp.cit.above, re Belt Mts.,which extend from near Canadian borde r S to He le na and S W to Missoula.Individual ranges N-S trending tracts of Belt & Paleo strata,dip in general W;whole system cut by W-dipping thrusts.SW of general area is Boulder bath,beyond this,Id. bath. Folding & wedge -faulting preceded intrusion of the baths,but most of thrusting accomp. or follow ed that intrusion;baths made way for themselves partly by thrusting a side the ir confining walls.

Additional Source: C.P.Ross: Ore deps.of Idaho in relation to structure & historical geology. Lindgren vol.('33) 265-272. Two major events: (1) int rusion of Id.bath,assoc.diastrophism, late Meso;(2) mid-Tert.ign. activity. Ore deps.of (1) and (2). (Ross:Classif.of lode deps.of S-Central Id.EG,26('31)169-185).

History: Most of N and central Idaho Nof Snake R.covered in late Algonkian by shallow Belt se as-great thickness (bottom sinking) noq q tzite largely ARGILLACEOUS,SOME CALC.BEDS. Yowzah. Only mod.folded,but cut by faults, shear zones,some large displ . Paleo: Much of E Id.S of 45-30 inter mit.covered by somewhat deeper seas,now tens of tho sands of ft.of qtzites argillite s,dols,mbls.These Paleo seas rarely extended W into positive area now occupied by exposed portions of Idaho bath. Permian: intense vulcanism in part submarine,E Oregon,W and SE Id. Similar rocks in S-central Ida, probably the same. Most of Idaho has been dry land since Permian. North-central Idaho,which contains most imp. ODs,positive since early Paleo.But in SE Idaho over 25,000 ft.strata,in part marine,par contin.,dep.in Meso. (G.R.Mansfield: Geography,geology & min.resources of part of SE Id.USGS PP 152,1927.)

Probably starting in Jurassic,orogenic dist.,intrusion Id.batho. (refers to Anderson on Cassia bath.,late Cret.or early Tert.,Ida.bath, same age).

Many stocks between Idaho and Boulder baths;may cover in age interval between late Jur.-early Eocene. Older stocks might be nearer older Idaho bath;stocks from there E progressively younger. Accords with Lindgren's suggestion of E migration of batholithic intrusions in Cordillera( Igneous geology of the Cordillera and its problems: Problems of American geology, 260-263,1915). However, abundant Tert.effusions,small intrusions,in W Idaho..

In centra l Id.most intense deformation during intrusion of Id.bath; but farther E,just as intense near close of Cret;overthrusting persisted in Mont.at least into Eoc.(Mansfield,op.cit.,198-199,382-383). Thus suggestion of parade of deformations E thru late Mesoz.and early Tert..

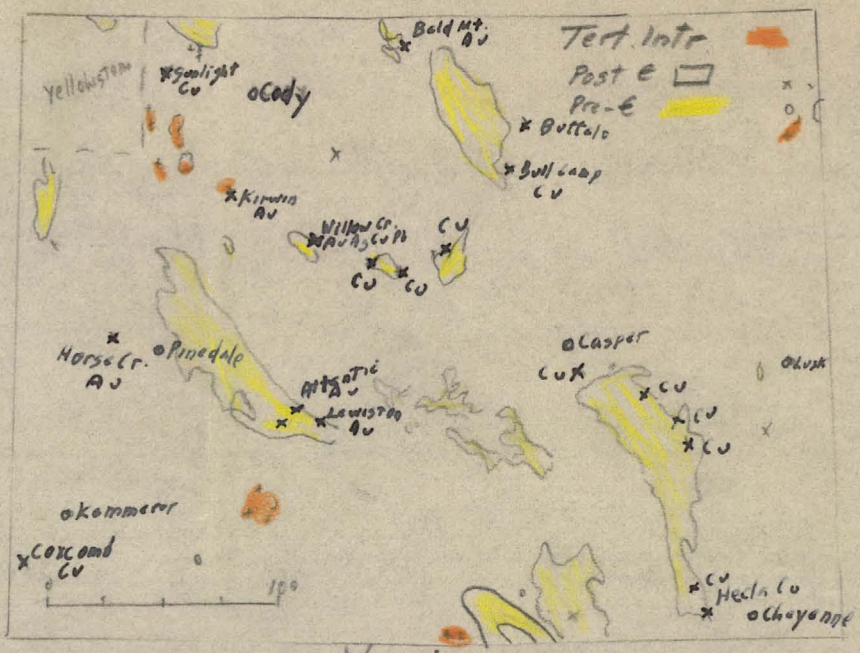
Large-scale vulcanism,Oligo or early Miocene after region deeply eroded, IM compos.lavas and pyroclast., mile thick;over most of the state. Called Challis volcs in S-central part.These flexed,broken,,and with older rocks intruded by sev.bodies granite whose axes follow structural lines in CR,and by many dikes,mostly granophyres. Erosion again,peneplain,successive effusions in Miocene (mostly in W,Columbia lavas),Pliocene,Pleistocene. The se mainly basalt,so,e rhy. In areas sites of subsidence in Tert..

Mineralization.

Meso: Within bath.and assoc.with related stocks deps.mainly Au;removed where deep erosion. Cu deps,mostly Mesoz. Related to igneous meta near Meso.intrusions. Most Pb-Ag lodes in shears zones in seds at varying distances, to many miles,from exposed gran.rks.

Te rt.: All related either to Mioc.granite and assoc.dike rks or to Cha llis volcanics. Related also to Miocene structures.

In S-Central Ida.,Chall is volcs.to broad anticlines,broken by many flts.,with Mioc.gran.in cores of the uplifts and genetically related to them.(Check on Ross:Geology & ODs of S-Central Idaho,USGS in preparation).


Tert. Intr.
Post ∈
Pre-∈
Yellowstone
Sunlight Cu
Cody
Bald Mt. Au
Buffalo
Bull Camp Cu
Kirwin Au
Willow Cr. Au As Cu Pb
Cu
Cu
Cu
Horse Cr. Au
Pinedale
Atlantic Au
Lewiston Au
Casper
Cu
Cu
Cu
Cu
Olustee
Kommerer
Coxcomb Cu
100
Cu
Hecla Cu
Cheyenne

Wyoming

# Geology & ODs of Lemhi Co., Id.

J. B. Umpleby USGS Bull. 528 (1913)

Seds – Algonk. Schist, bare, then qtzite alt. with sch. slate etc.

Broad elevation in Eocene – probably acc. intrusion of Idaho batholith.

Min – (1) Laramide & late (2) Mioc. or early Pliocene.

all deps. in (1) except small group Au–Ag veins

Nicholia – CR ls over mass t-g qtzite. Main tunnel & Viola mine crosses N-S anticline. W E

$PbCO_3$ ore in nearly flat "vein" 40 60°

in ls.

Spring Mt – CR late Paleo seds (ls) N15E 40° SE.

Highly folded. Pb Ag replacements along veins which ∥ qtz-dior. dikes that follow N15E strike.

Lemhi Vmin – Vein N20E 80NW. Ls N20E 45SE.

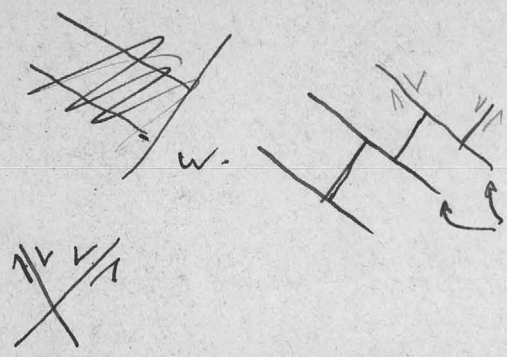
Pb–Ag.

VEINS = FAN JOINTS OR ANTITHETIC FLTS.

Texas Seds – Paleo strike N-S dip 45E Basal series t-g qtzite 2000'+. Є. Then 500' mass dol ls. Ord. Sil – 300' mass dol. ls. Dev? 200' +b blue & white dol ls. Then Miss

Lodes strike just E of N, dip W, usually > 45°. ~~∥ to strike of beds, but dip op~~ p. 94. "Thus the course of the veins is ∥ to the strike of the formations although their dip is opposite & steeper. This relation suggests that the fissures which the ores follow were formed when the rocks were folded into their present attitude, for it is apparent that fissures with dips toward the core of an uplift would result from the upbending of a great series of rocks with

resistant quartzite at the base & inelastic limestone above".




Bed fits out the veins: "in such a way as to indicate a settling toward the Lewis Valley [E] of successively overlying strata"! Obviously this aids the toppling-flow or elongation toward the low area E of the uplift. Not the cause effect, which may & probably does take place in tangential folding. CRITERION.

Synthetic set. not:

~~Vein~~ OD's - 15, comb. fissure filling; & repl. out along beds. Pb-Ag. Zn > 9%. Carbonates.
PM qtz-dun - pre dike. Dike strike N13E, probably dip [illegible]

Blue Wing District. N35W ~~N-S~~ anticl., algonk. seds. Qtzite slates & schists.
Vein fractures ∥ anticlinal axis. Sharp HW, post qtz crushing - Synthetic fits.

Bolsas in the case white qtz of Zn,Pb,vein
Tet., py, bitumite, PbS, molybd., cc, py. Rare general minerals.
Fissure filling.

~~Junction District~~ -

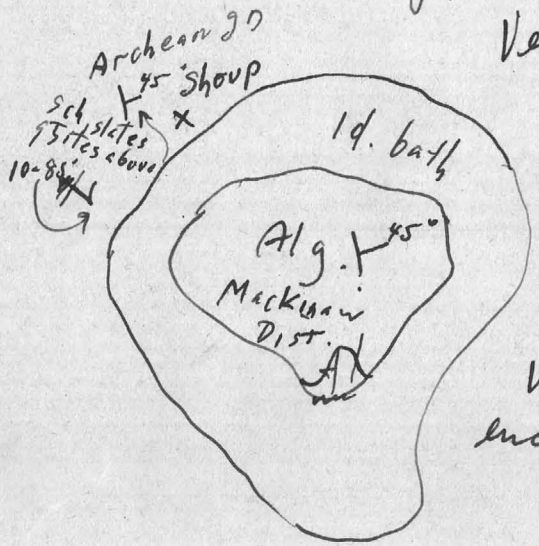
Gibbonsville Dist. - alg. qtzites, qtzitic slates & mica-slates
N20W 40-70E. Narrow E-W steep vein (>70° N or S) 1'±
Barite, py in case clear white qtz. Au assoc. with py. Shoots pitch E with dip of seds. Vein barren in pre-€ meta dia. sill, poor in qtzite, productive in black clay slate.

Indian Creek Distr. Av CK meta alg. Sh, SS, + 75% qtzite brittle slate. Meta but not crumpled.

Archean gneiss, pre-alg. Pre-€ dir. ass. with seds, late Ord. granite. Young GP.

Seds vary

Mineral Hill (Shoup) Antithetic flts. related to anticline.




Veins strike NE, dip SE. Independent of schist & bedding, corresponds to regional joints

Av ass. with py, in case qtz.

PbS ±, ZnS-, arsenop-.

Veins cut by GP dikes, but some are enclosed in gran.

Geology - Mining - Costs -
Talache, Idaho

Talache, Bonner Co., Idaho
Talache Mines, Inc. 6 1/2 mi. from RR. 65 mi. fr. Spokane to RR sta.

Vein dips 30-60°; 100' levels. Haulage Tunnel 4000'.
Narrow vein. C.R. shaly qtzite Vein traced 1/2 mi.
on surf. U.g. dev. 1700'. Width 0 - 1" - 6'.
Ave. width 16.5", ave. dip 45°. Gen. breaks clean
from walls. Faulted - normal - largest displ. 150',
minor disp. 25'. Rolls, slips, pinches & swells.
Tetrahedrite princ. ore., but siderite, pyr., chalco.,
sphal., gal. arsenop. Assays 12-20 oz Ag.
Ore reserves est. 110 000 T 0.09 oz au; 17.5 oz ag.
Pockets of rich ore - intersection small X-fissure
& vein on 700 - small bonanza 1000 oz Ag.

1200 or Tunnel level connects with 400 thro 3-comp.
raise - Center - rails, skip - man - Timber & supp.
Outside comps waste & ore-chutes; storage
battery haulage - 4000' to mill. Ore fall controlled
by arc gates at each level. (100' lev. interval)

Stope faces broken in 2 steps - first removes waste, sec. breaks vein. Carefd u.g. sorting. Waste used as fill; excess trammed to dump. Ground stands poorly; too narrow for ▢ sets; ordin. stulls & head boards with waste-filling. Low pitch at times calls for consid. mucking. Chutes at 33⅓' int.

Mining Costs - July '22 $6^{48}$/T.

Mill - Flotation - 150 T/day. Cost $120 mo.

Wood - corrug. g. I. sides & Roof. Flat site selected for compactness & labor-saving - 2 men nec. No grading, etc. Only 1 more elev. nec.

Transp. - 2½ T cars - S.B. locos; ore bin holds 500 T.

Milling Costs - Flotation - Concentration.

155 Tons a day, 1922 - $0^{93}$ ton. Heads at 15 oz Ags .07 oz Au., 0.58% Cu, 0.79% Pb, 2.00% Zn, 8.00 Fe.

Mesozoic & Tert. granitic Rocks in Idaho.
C. P. Ross. 5G 36 ('28) 673-693.

Id. bath - most of W, all S, much of E border - unused with Mesozoic (?) volcs. Rest on eroded surface of bath. Pre-Mioc.

Umpleby - ~~geol &~~ ODs in the Sawtooth □; Idaho
USGS Bull 580 ('15) SE end of bath, intrudes thick Paleo Seds. Post-Perm.

Ross: ODs in the Tert. lava in Salmon R.

Mts - Id. Bur. Mines & geol. Pam. 25 ('27)

Permian volcs. intruded.

Wallowa Mts - GD stock cuts rhs. possibly as young as Jurassic.

Original surface of bath., as shown by roof pendants, not far above present surface.

Smaller Bodies related to Idaho Bath: Wood River, Lemhi Co. 7 Devils, scattered exp., SW part of state. (Salmon City etc)
Loon Lake Pluton. ← Funnel shaped. C & R D M

Younger granite in Idaho - Salmon River Mts., Wood River. Casto □ Middle Fork of Salmon R. Pink granite - along axis of lava of Cont. colapse, involving intrusion of folding, genetically related Mioc. volcs. in many pts. Laccol

Permian & intruded along base of Permian volcs. - Tran guesses Chem S.T., penetrates Tert. Underneath this pink gran. complex - meta seds, mainly algonk., & gran. Supposed rel. to Id. Bath. Injection gneiss, both by Id bath & Pink gran. above, only 1 mi. thick. See K.T. Chamberlin

Pink gran. Mioc. possibly even Pliocene

30,000

(2)

EDWARD WISSER
MINING GEOLOGIST
533 CALL BUILDING
SAN FRANCISCO
TELEPHONE GARFIELD 4676

& T.A. Link – Theory of laterally spreading batholiths. J.G. 35 ('27) 319–354.

NW part, Wood River begin. Strata & dike. Dike cut Mioc. lava. Also Sawtooth II, W of this.

---

Montana – Barrell, Marysville Min. Dist., USGS BB57 (1907) oldest intrusion, latest Cret. or Tertiary prob. early Eoc. Marysville bath (9 ft dia) younger, but cuts only Belt.

Weed – Geol. & ODs Butte, USGS BP 74 ('12) shows Boulder bath intrudes Cret., & nearly Laramie strata involved in the folding, ass. with the intrusion. May be as late as Miocene.

Philipsburg (Calkins, Philpsb. Folio 196 ('15)) Cut Colorado (up to Cret.) overlain unconformably by beds not younger than Mioc.

Age of Id. Bath.

Bases Nevadan age largely on erosion of bath. prior to out-pouring of Mioc. volcs. This may have been long enough to corresp to Olig., Eoc. & part of Cret., so bath. may be at least as old as Cret.

Thinks sig. cover over bath. must have been great (in conflict with another source) Min. cover 1 mile (very small in rel. to 30,000 sq. mi. = area of Id. bath)

all this eroded & both partly alev. (latter slightly)
How much time to erode 1 mi. Belt 9 miles?
Following Ferguson, Allegheny Pl., Pocos estimates 100' per million years, time for 1 mi = 528 000 000 years.

Estimates of Length of Tert. & Cret. in millions of yrs.

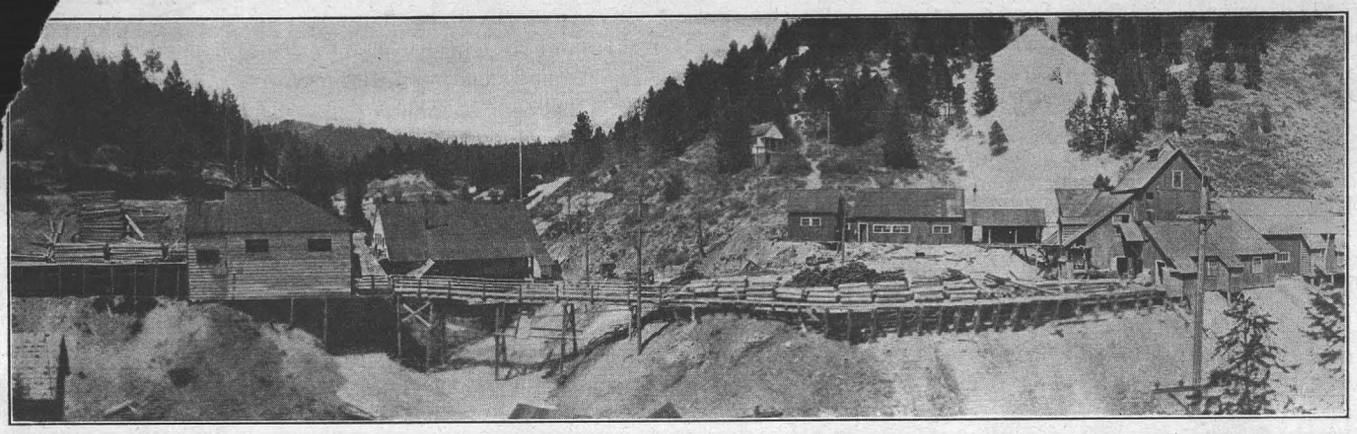
| Period | Barrell Max. | Barrell Min. | Period | Holmes By alleged successive cycles | Holmes From Radio-active minerals |
|---|---|---|---|---|---|
| Plioc. | 6 | 7.5 | Upper Tert | 30 | 35 |
| Mioc. | 12 | 14 | | | |
| Olig. | 16 | 16 | | | |
| Eocene | 20 | 26 | Lower Tert. | 30 | 25 |
| Upper Cret. | 40 | 50 | Upper Cret. | 30 | ---- |
| Lower " (Comanche) | 25 | 35 | Lower " | 30 | ---- |

J. Barrell – Rhythms & the Measurement of Geol. Time.
Bull. GSA 25 ('17) 884–885.
Arthur Holmes – The Age of the Earth (1927)
Time for erosion to get back to Cret.

Pink granite – only Idaho both. & lower Tert. volcs. which lie unconf. on Id. batholith.

EDWARD WISSER
MINING GEOLOGIST
533 CALL BUILDING
SAN FRANCISCO

TELEPHONE GArfield 4676



*View of Gold Hill Mine framing shed, stores, shops, and shafthouse*

# Ore Deposits of Gold Hill Mine, at Quartzburg, Idaho

## Geological Problems Many and Varied—Gold Hill Vein Considered Source of All Orebodies on Property—Present Workings Along Intersection of Fissures With Rhyolite-Porphyry Dike

BY A. J. MCDERMID

THE REGION known as the Boise Basin is in an intermontane valley about twenty-five miles long and fifteen miles wide and lies thirty miles northeast of Boise, Idaho. The history of the district, full of interesting, adventurous, and often tragic incidents, begins with the death, at the hands of Indians, of the leader of the party of prospectors who discovered gold placers in the valley in 1862. In a few months thereafter the district was thickly populated with miners, gamblers, and desperadoes. The first were attracted by the richness of the placers, while the others, no less hopeful of easy wealth, hoped to gain it by less honest and easier methods than mining. The camps were prosperous. Gold was easily won from the ground, and before the end of the century the district had produced approximately $60,000,000, all but about $4,000,000 of which came from the placers. The smaller amount was produced by lode mines.

At present the placers are of minor importance compared with the underground mines. Considerable dredging has been done around Idaho City (Fig. 1), and there is a favorable area near Centerville that is as yet undredged. The chief activity, however, centers in the underground mines. Of these, the Gold Hill mine, at Quartzburg, is the most important. Since 1864 it has been continuously operated and is today the largest producer of gold in Idaho. Its total production to date is about $8,000,000, principally gold, with a very small proportion of silver. Gold is the principal metal mined in the district except around Banner (Fig. 1), where the ore is chiefly silver. In the vicinity of the Golden Age mine the gold is associated with lead and copper. I am not sufficiently familiar with all the mines of the Boise Basin to write a comprehensive article on the district, but I hope that the following remarks about the Gold Hill mine will be of some benefit to others engaged in mining in the district as well as to those in other localities who are interested in gold mining.

The most important geological feature of this mine is the Gold Hill vein, which is generally considered to be the source of all the orebodies in the mine. This vein is from 2 to 6 ft. wide. It strikes north 65 deg. east and dips slightly to the south. It is a member of the system of fissures which has been explored for several miles southwest and northeast of Quartzburg. For the first eleven years of the mine's operation surface workings of the Gold Hill vein and of the Last Chance (a vein parallel to the Gold Hill and 50 ft. north of it) yielded ore said to average $20 a ton. In that early day the ore was first broken fine enough for stamp milling by means of double-jacks. After it had been crushed in the stamp mills 60 or 70 per cent of the gold was recovered by means of amalgamating plates and the rest was allowed to go down the creek. The ore therefore, had to be of good grade to yield a profit.

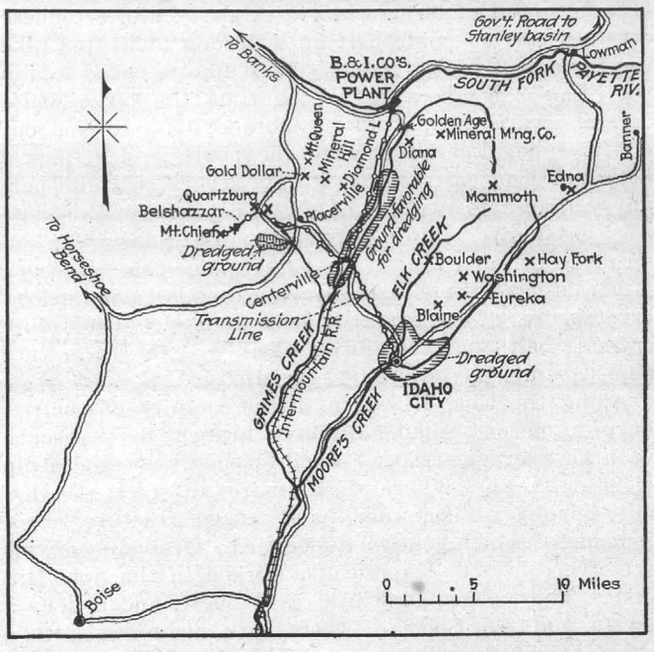



*Fig. 1. Map of Boise Basin*

The principal rock of the locality is an altered and fractured granite into which have been intruded dikes and chimneys of rhyolite porphyry and diorite porphyry. The general direction of these dikes is east and west and their most common width 40 ft. They dip about 80 deg. north as a rule. Sometimes at a junction of two dikes their combined width is from 100 to 200 ft. There is one rhyolite porphyry outcrop which is 300 ft. wide. Some of the dikes are lenticular in shape, and others have been found to extend with fairly uniform width for over 2,000 ft. One rhyolite-porphyry dike is cut by the Gold Hill vein (as in Fig. 2), so that in places there is from 10 to 20 ft. of rhyolite north

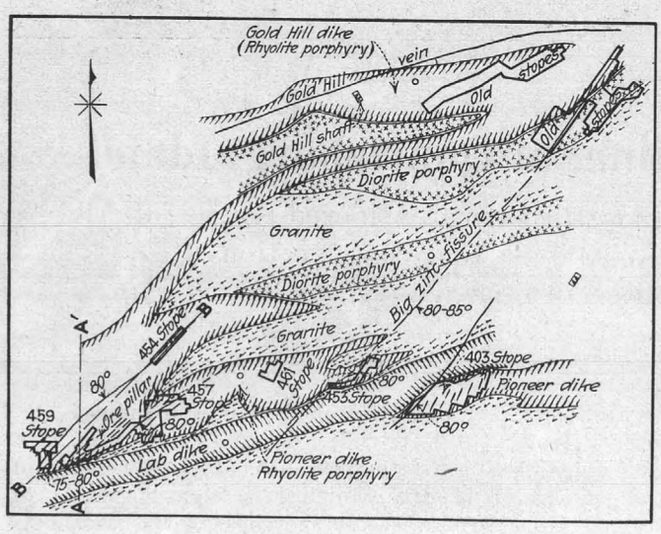



*Fig. 2. Plan showing geology and outline of stopes on 400 level of Gold Hill mine*

of the vein. Aside from this instance there is no evidence of there being any rhyolite porphyry north of the Gold Hill vein for at least 2,000 ft.

### Albite Formerly Mistaken for Labradorite

Paralleling the Gold Hill vein and 300 ft. south of it lies a dike whose most noticeable characteristic is the presence in it of large white crystals of albite. These crystals are commonly half an inch long and often take the form of Carlsbad twins. This dike is called locally the "Lab" dike because at one time the large white crystals were thought to be labradorite. It is about 40 ft. wide, dips slightly to the north and strikes a little north of east so that it cuts several rhyolite porphyry dikes at an acute angle. The rock in this dike was probably granite originally, but has been so strongly metamorphosed hydrothermally that the black minerals have disappeared, leaving the albite and quartz crystals in a fine-grained ground-mass. The albite crystals, although retaining their crystal form, are almost completely altered to sericite.

Along the Gold Hill vein in the vicinity of Quartzburg numerous smaller fissures branch to the south with an average strike of north 45 deg. east and a dip of 80 deg. east. Where these fissures intersect the rhyolite-porphyry dikes they have caused fracture zones, in some of which gold was deposited. Orebodies of this type were first discovered and worked in the Gold Hill dike. They varied in width up to 30 ft. and in length up to 150 ft. Some of them have been mined to a depth of 560 ft., which is as far as exploration has gone.

The orebodies being mined at present are those t occur along the intersections of fissures with the rhyo lite-porphyry dike, called the Pioneer dike. This dik shows the effects of much hydrothermal alteration and is leached in many places to a creamy white color. The rock is principally a fine ground-mass in which are scattered crystals of quartz and feldspar. The feldspar crystals are so completely altered to sericite that their exact original composition cannot be determined. In some places cubes of secondary pyrite have been formed as a result of the hydrothermal alteration. This dike shows the effect of hydrothermal alteration much more than does the Gold Hill dike. The former is softer, more leached, and contains more fissures than the latter. This alteration seems to have made the Pioneer dike more permeable for the ore-bearing solutions, as its orebodies are wider as a rule than those in the Gold Hill dike. Stopes in the more altered dike must be filled as soon as they are mined, whereas some stopes in the Gold Hill dike were not only left open but the timbers were removed after the ore had been extracted.

### Gold in Pioneer Dike Orebodies Found in Small Fissures

In the orebodies of the Pioneer dike the gold occu in small fissures varying in width from a knife blade to two inches. The porphyry is generally more leache and altered in the ore zones than elsewhere, and in the zones the seams are easy to follow. Where they pas into granite or into darker, less-altered porphyry they become so small and indefinite that they are soon lost. Generally, in each orebody there is one fissure which is larger and longer than the rest. It can be followed not only in the porphyry dikes but in the granite as well, in some cases for hundreds of feet (for example, the Big Zinc fissure of Fig. 2). The larger fissure rarely contains much of value. Evidently the ore-bearing solutions came up through the large fissure and penetrated out into the smaller fissures before they cooled sufficiently to deposit the gold. There are numerous small faults with displacements of a few inches at right angles to the ore fissures, but the faults contain no values.

The vein filling in the small fissures is chiefly quartz sprinkled with stibnite and pyrite. The larger fissures usually contain no stibnite, but pyrite is abundant and sometimes gouge is found in them. The gold is rarely visible, but is scattered through the stibnite in a finely divided state. It is not unusual to have a half-inch fissure, in which no gold can be seen, yield a sample which will assay over $5,000 per ton. In some of the seams there has been no movement along the strike since the ore was deposited, as the vein matter is not broken up. In others, there has been enough movement to powder the ore, but rarely enough to appreciably increase the width of the fissure.

### Samples Across Face of Drift Unreliable

It has not been found possible to take reliable samples across the face of a drift or the width of a stope, because the values are all concentrated in a few small seams, the adjacent country rock being valueless. The ore is followed by panning samples from the seams and by noting the character of the rock. Sphalerite is often present in the fissures near the end of an orebody, and is an indication of a decline in value of the vein in which it is found. Numerous pannings are necessary,

and small prospect drifts must frequently be driven from the sides of the stopes to determine the limits of the ore. The color of the porphyry is often no criterion, because there are sometimes found blocks of creamy white porphyry which ought to contain ore, but in which, unfortunately, no ore fissures exist. It sometimes happens that the values in one seam will continue past the main ore zone, and when this occurs a narrow cut-and-fill stope is used. The ore in these cases is better than average because in the narrow stope it is possible to mine less waste than in the wide stopes.

### Filled Square-Set Method Used

The rock is easy to break, and were it not for the lack of definite walls could probably be mined by a caving system. The method used is the filled square set. Under this system, barren ground can be left in place and much of the waste can be sorted out in the stopes and used for filling.

Since the Gold Hill vein was worked out, little ore has been found that did not lie in the rhyolite porphyry. In a few cases fissures in the granite, diorite porphyry, or the "Lab" dike have yielded ore, but as a rule the deposits were not of large extent, although some of them were very high grade.

The foregoing is true, in general, of all the orebodies in the Pioneer dike, but that does not mean that all the orebodies are exactly similar. Each one has characteristics peculiar to itself. In the orebody indicated by 454 stope in Fig. 2, three definite fissures have been mined from the 500 level to surface, and each fissure maintained its identity all the way up. In 453 stope the ore seams are indefinite. They die out in places or intersect other fissures or faults so that they cannot be traced far. The main fissure in this orebody is called the Big Zinc fissure. It is from a few inches to 3 ft. wide and contains masses of sphalerite often several feet in length. The vein matter of this fissure

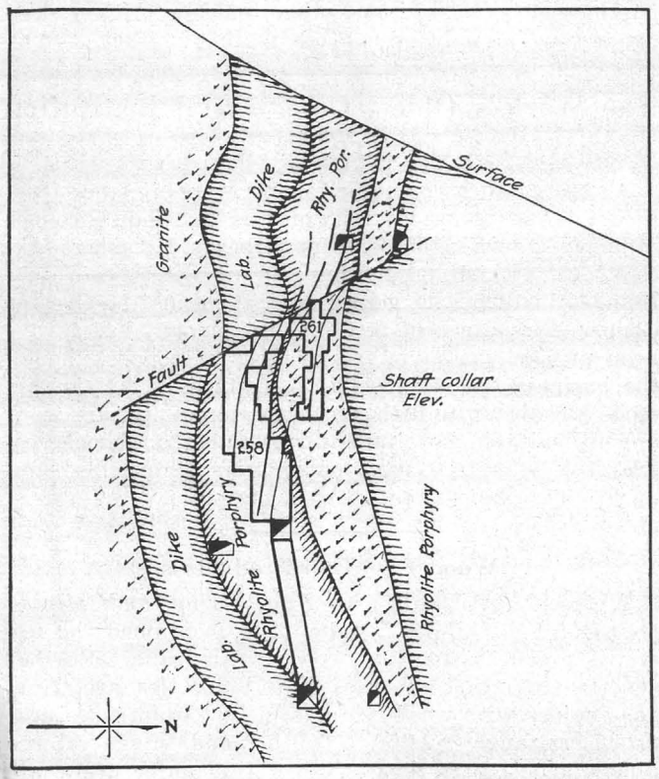



*Fig. 3. Vertical section "C," looking west*

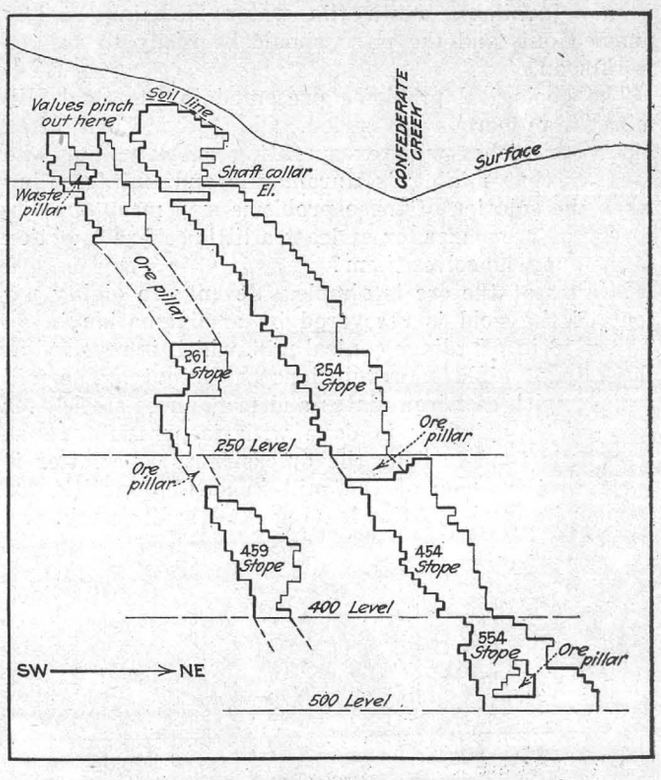



*Fig. 4. Vertical section "BB," looking northwest*

contains little of value, most of the gold being in the small seams of the fracture zones which lie adjacent to the big fissure in the rhyolite porphyry. In Section *C* (Fig. 3) is shown a section of a stope (No. 261) which lies wholly in granite. In 457 stope (Fig. 2) the large fissure contained better values than the small seams.

Section *BB* (Fig. 4) is a longitudinal section of the two orebodies indicated in Fig. 2 by stopes 459 and 454. The ore seams strike northeast and dip east, while the rhyolite porphyry dikes have an east-west strike and a north dip. As a result the orebodies trend to the northeast with depth. In order to show the limits of the two orebodies mentioned, throughout their depth in a vertical section, the stoping on either side of the plane of the section has been projected to the section.

### Effect of "Lab" Dike Not Understood

The part played by the "Lab" dike in the making of the ore is not as yet well understood. Solutions which emanated from this dike when it cut through the Pioneer dike are evidently responsible for the hydrothermal alteration of the rhyolite, because the leaching of the latter is always more pronounced near the "Lab" dike. The latter dike is probably not the source of the ore, as there is no general ore zone throughout the distance over which the two dikes are adjacent, but from the manner of its intersection with the Pioneer, it is inferred that the "Lab" dike was at least a fracturing agent and also acted as a dam, because some orebodies lie up against it (for example, 403 stope, Fig. 2). Exploration of the intersection of the "Lab" dike with the Gold Hill dike is contemplated, and this work will doubtless yield valuable information.

Development of the 600 level, to which the shaft was recently sunk, is being delayed on account of the destruction by fire of the hydro-electric plant at Grimes Pass. The mine partly filled with water, but as power

is now available again the water is being rapidly pumped out, and the mine should be ready to resume work soon.

The geological problems presented in the Gold Hill mine are numerous and varied. Old Mother Earth often hides her riches with exasperating subtlety, but who can say that mining is unromantic and uninteresting when the solution of these problems may mean the discovery of a bonanza, or at least a little self-satisfaction to the one who solves them?

Milling of the ore is simple. Seventy to eighty per cent of the gold is recovered by amalgamation in an 8-ft. x 18-in. Hardinge conical mill, which is revolved at the rate of eighteen revolutions per minute. The mill is lined with cast-iron plates and manganese-steel lifter bars. The grinding is done with jasper pebbles, as steel balls tend to flour the quicksilver. The latter is fed into the scoop of the mill in small quantities at regular intervals. After leaving the Hardinge mill, the

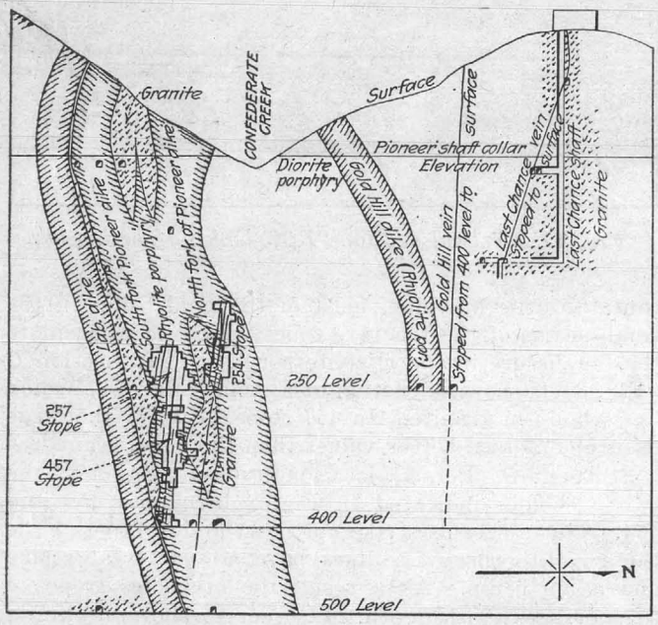



*Fig. 5. Vertical section "AA," looking west*

ore is passed over amalgamating plates and is then concentrated on four Overstrom Universal tables. The concentrates are ground to pass 100-mesh in cyanide solution in an 18-ft. x 4-ft. tube mill. The ground concentrates are agitated by air in Pachuca tanks. The pulp is then allowed to settle, the pregnant solution is decanted off, and, after being deprived of its gold in the zinc boxes, the effluent solution is run into barren-solution storage tanks. From 10 to 20 per cent of the gold is recovered in the cyanide plant, and the total extraction is from 90 to 95 per cent. The mill has a capacity of 175 tons or ore and the cyanide plant a capacity of ten tons of concentrates per twenty-four hours.

The Gold Hill company maintains a modern store in Quartzburg as well as a radiophone station. Hydroelectric power is abundant, and many of the buildings of the town are heated by electricity. Mining timber is plentiful and cheap.

The Boise Basin in general was well known as a gold-producing area before the war, and is again becoming a center of mining activity as a result of the decreasing cost of labor and supplies.

## Gold and Diamond Mining in South Africa on the Mend

According to a report from U. S. Trade Commissioner Perry J. Stevenson appearing in *Commerce Reports*, the gold mines of South Africa are making good progress. With the increase in output and the decrease in operation costs it is anticipated that within a short time this industry will be on its feet. The decrease in the cost of operation has injected a healthy confidence in this South African industry, as serious apprehension was entertained on account of the continued reduction in the premium on gold. The decreases in production costs have led many to the opinion that even if gold returns to its standard basis, namely, 85 shillings per fine ounce, the industry can still operate profitably. In July the gold production in the Transvaal amounted to 730,635 fine ounces and exceeded that for any month since July, 1920. Taking £4 11s. 9d. per ounce as a basis of valuation for gold, the July output is valued at £3,335,520. Gold production shows convincing signs of complete recuperation from the effects of the recent strike. Employment in the gold mines is on the increase. During the month of July 172,886 native laborers were employed as compared with 170,464 during June.

The final outcome of the approaching referendum, to be held next October, concerning the annexation of Rhodesia to the Union of South Africa, continues to be a point of much agitation throughout the Union. The South African press has dwelt quite extensively upon the advantages which Southern Rhodesia will acquire by annexation. These comprise extensive railway improvements, road construction, and lower taxation.

Diamond sales continue good, but there is little prospect of immediate resumption of general diamond mining. Reports from the Continent indicate that diamond stocks there are almost depleted, owing partially to the purchases of American and other tourists. Heavy shipments have already been made to that market.

## The World's Oldest Commercial Institution a Copper Company?

According to a recent newspaper clipping, the oldest industrial company in the world is a Swedish copper company known as Stora Kopparbergs Bergslags Aktiebolaget, which, according to its letterhead, was founded in 1225 A.D. Translated, it means the Greater Copper Mountain Mining Co. The company has always been primarily a miner and refiner of copper, though the business has extended into many lines. It is said to be strictly up to date in the matter of welfare work and to maintain hospitals, libraries, baths, schools, co-operative stores, recreational centers, children's summer country homes, and garden plats.

### Wood Fuel Gas Producers

A recent article in the *Engineering and Mining Journal* (Feb. 18, 1922, page 290) mentioned the use of gas producers burning wood in Australia. Further reports state that all classes of industries are using gas engines with wood fuel gas in that country. These producers range from 50 to 300 hp., and, in general, use billets about 2 ft. long. Several manufacturers are marketing equip[illegible] adapted for this work.

Thus at one spot we found sodium nitrate:

| | Per cent |
|---|---|
| At the surface | 1.54 |
| Two feet below the surface | 0.16 |
| Two and a half feet below the surface | 0.19 |

The chlorides and nitrates of sodium on these volcanic rocks, both in the Topoc area and near West Well, appear thus to owe their origin to moisture impregnated with these salts being sucked up by the heat; on evaporating, the saline material is left as a white coating on the rock. Such salts are very soluble in water, and it is only in protected places that they accumulate. The salts were probably primarily derived from the lake shales, which are adjacent.

In the Topoc area, near West Wall, south of Parker in Arizona, and at many other points, there are extensive layers of a greenish shale in the lake-beds, and these shales nearly always give a reaction for sodium nitrate. These beds are much cut up by gulches and the surface is usually crusted over by a mud formed by the slacking of the shale during rains. This crust (*A*) usually gives a reaction for nitrates and other salts, but, immediately under it, there is frequently a white layer (*B*) richer in soda and lime salts. Frequently layer *B* is wanting. Finally, resting on the undisturbed shale is a third layer

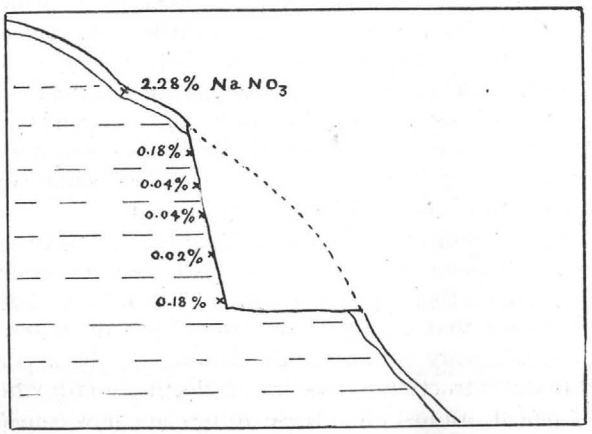



*Fig. 3.*

(*C*) from 3 to 12 in. thick, composed of broken bits of shale, and this lower layer usually shows a strong reaction for sodium nitrate.

Fig. 2 illustrates three layers, conforming to the general slope of which they form a part.

If now we cut through these surface deposits into the undisturbed underlying shale, we find usually a sudden decrease in the content of salts, and conclude that the larger content of salts in the surface layers is due to leaching by the rain-water from the shale, which breaks and slacks when wet. These salts are then re-deposited immediately under the mud crust in layers *B* and *C*, as shown in Fig. 2.

The decrease in the sodium nitrate content is illustrated in Fig. 3.

In the Topoc area, the shale showed a larger content of sodium nitrate than at the other points, as indicated by the following analyses by James W. Howson:

| Number. | Per cent Sodium Nitrate. |
|---|---|
| 1 | 1.90 |
| 2 | 3.23 |
| 3 | 0.76 |
| 4 | 4.08 |
| 10 | 3.80 |
| 11 | 2.19 |
| 12 | 1.14 |

In the deposits south of Parker on the Arizona side of the river, three different layers (Fig. 4) of greenish shale gave reactions for sodium nitrate, but the lowest layer was richest (1.96%) in this salt and this layer was reddish in color.

Finding no deposits of any commercial value in the volcanic and shale series, we proceeded south to Vivet Eye, where material of a better grade was promised.

Riverside Peak lies at the west border of the Colorado River Indian reservation. About a mile to the southwest and forming part of the same general ridge, is a peak locally known as Vivet Eye. In ascending this peak from the Colorado river, one passes first over limestone and dolomite beds probably of Paleozoic age; next over a series of green schists; then comes the limestone that forms the summit of Vivet Eye. These three terranes have a general north-south strike and dip at a steep angle.

The zone of green schist is largely obscured by fragments of schist that have been cemented by a porous deposit of carbonate of lime resembling travertine, mixed with varying amounts of white salts. This cemented material, evidently of recent origin, is sometimes 20 ft. or more in thickness. The travertine evidently owes its origin to the action of surface waters on the adjacent limestone, and the salts were presumably derived from former lake-beds now largely eroded by capillary attraction acting during a long space of time; waters impregnated with salts drawn from below, and evaporating re-

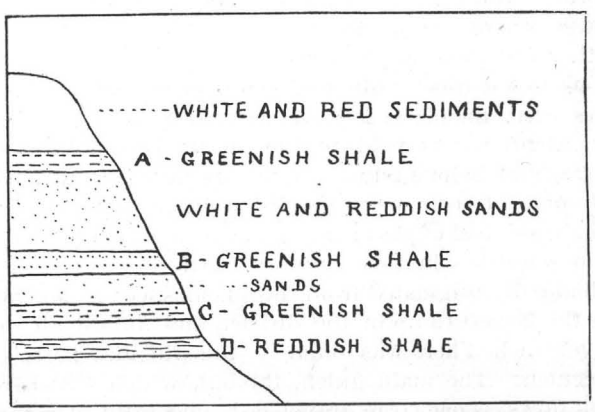



*Fig. 4.*

main at the surface, impregnating the porous breccia-mass of schist fragments and travertine. This deposit would thus be similar in origin to the efflorescence deposits of the volcanic rocks, but the conditions at Vivet Eye being more favorable, a greater accumulation of the salts has taken place.

A number of cuts were made in the cement-breccia of Vivet Eye, and here also the content of sodium nitrate was found rapidly to diminish with depth. At some points, however, nearly pure deposits of white salts a foot or more thick, were observed, and subsequent analyses showed several salts were present, including sodium sulphate, sodium chloride, calcium chloride, magnesium sulphate, potassium sulphate, potassium nitrate, and sodium nitrate. In one sample, 7.8% sodium nitrate was found, and in another 14.4%. The total acreage of the Vivet Eye nitrate deposits may equal 10 square miles or more, and this was the most promising of all the deposits seen. Nothing at all comparable to the Chile deposits was anywhere observed, nor is it to be expected.

The Chile deposits that are most profitable appear to have been formed by surface waters from the Andes percolating down to the plains between the Andes and the Coast range, and depositing there their salt contents. In the plains there is no rain and no run off, and hence the salts once deposited are preserved. In the Colorado basin, there are occasional rains, and the lake-beds drain into the Colorado river, which probably yearly *decreases* the total quantity of nitrates and other soluble salts in the basin.

## The Murray Gold Belt, Idaho.

Written for the MINING AND SCIENTIFIC PRESS
By THEO. L. LAMMERS.

Murray, in Shoshone county, Idaho, is, I believe, the oldest camp in the Cœur d'Alene, and it was formerly wholly devoted to gold mining. There are today several lead-silver mines in the vicinity, but these are all later locations and east of the gold belt. In several of the gulches southwest of Murray, between Murray and Wallace, there are a number of gold veins. In the vicinity of Osborne, on the Oregon Railroad & Navigation Co.'s line between Wallace and Wardner, the same formation with the same gold-bearing veins is found, also with a number of old locations. I had the opportunity recently of examining these veins at different places; and it appears to me that a large sheet of gold-bearing quartz extends from a little northeast of Murray to some distance southwest of Osborne; thus extending in a direction a little east of north for about 25 miles, with a width of probably 8 to 10 miles. To be sure, between Pony gulch and Osborne, a distance of about 12 miles, I have not examined the formations; in this territory there are no prospects or locations, as far as I know. But there is every reason to suppose that the formation extends unbroken through this distance, although lying deeper. And if there are no gold prospects in this distance, neither are there any silver-lead prospects, which latter belong to a distinctly different and later formation.

As usual, the placer deposits were first worked before any attention was paid to the quartz veins. Around Murray and Delta a number of placers have been worked, and some of them have yielded well; in fact, there is still a good deal of placer mining on a small scale in the various gulches in this territory. All this gravel has undoubtedly originated from the quartz sheets. Murray was the largest camp in the district, and almost all the gravel washed here was found on the hillsides north of the gulch. The main gulch, through which Pritchard creek flows, is one large gravel bed, generally of rather low value, and mainly near, or on, the bedrock; but in a few instances some richer pockets appear to have been worked by sinking and driving.

This main gulch would appear to have been created by a fault, with considerable throw, which I, however, have made no effort to determine; the south side of the gulch is steep, in places precipitous, and the gold-bearing quartz blankets crop out along the hillside at an elevation of about 500 ft. On the north side of the gulch, which is much less steep, the veins crop out 300 ft. above the creek.

I am speaking of a quartz sheet, but there are really two or three sheets with a vertical distance between them of from 30 to 50 ft. These sheets lie sometimes almost horizontal, sometimes with a dip a little south of west. I think the steepest dip observed at any place is about 45°. The underlying formation is a quartzite, in which lies one, possibly two, quartz sheets; on the quartzite lies another, and this is again covered by an old metamorphic schist. The quartz sheets are thus only visible where deeper gulches have been cut in the mountains either by faulting, or denudation, or both.

The formation, including the quartz deposits, has been extensively faulted. Frequent dikes of trachyte, a few feet thick, penetrate the country with a nearly vertical dip; these dikes, running about NW-SE, have all faulted the quartz sheets, causing steps of from one to five and six feet, ascending going west, descending toward the east. Some faults have been much bigger; thus in Pony gulch I observed a vein, about 15 ft. wide, with a strike of N 55° W, dip 82° northeast, which cuts through the quartz blankets, raising the easterly side nearly 300 ft. above the westerly. These trachyte dikes and veins, cutting and faulting the quartz sheets, apparently belong to the later vein formation, to which belong the great silver-lead bearing lodes of this district. Indeed, similar dikes occur, generally cutting through the silver-lead veins, although not faulting them, and, I think, almost invariably in the close vicinity of orebodies, a fact that points to these dikes as the ore-makers, or closely associated with the silver-lead ores.

As to the origin of these quartz sheets, I am not at all clear. Their large extent would seem to argue against any igneous nature, or as created by deposition in a fissure or by replacement. And in various places they certainly give the impression of being of sedimentary origin. I have seen quartz deposits in vein form in limestone, evidently by chemical replacement, where I have found what appeared to be the original fissure, nearly perpendicular, through which the mineral-bearing solutions probably ascended. But I have observed nothing of the kind in this case. On the other hand, in at least one place, in the Golden Chest mine at Murray, there is a comparatively rich ore-shoot, in which the gangue contains scheelite—a fact that suggests an igneous origin.

The mineralization of the quartz sheets consists principally of pyrite and arseno-pyrite, with free gold; there is only a little silver. Chalcopyrite and galena occur sparingly. The mineralization in the vertical vein on Pony gulch, mentioned as cutting and faulting the quartz sheets, is entirely different, for it consists, in the outcrop, of heavy iron and manganese oxides, containing gold and silver, and showing galena in depth.

Along Pritchard creek, close to Murray, and between Murray and Delta, a number of mines have been opened and worked on these quartz sheets. They have all been pocket mines, that is, they have been opened on some higher-grade body of ore, and the mining has been confined to the extraction of this ore, neglecting any further development; almost all of these mines are now considered as worked out. I believe there is only one of them in operation, namely, the Golden Chest mine. There is, however, some prospecting being done on several claims. One of these, the Pilot, caused excitement about a year ago by suddenly disclosing a very rich shoot or lens, with ore running several thousand dollars per ton. Owing to various business arrangements, no serious development followed upon this discovery.

Most of these old mines have been equipped with small stamp-mills and, I presume on account of high expenses, they have had to confine themselves to high-grade ore. The mining seems to have been confined to extracting this high-grade stuff, neglecting development work. But it is doubtful whether these mines really are worked out. The high-grade lenses, to be sure, have been extracted; but there is gold all through this quartz deposit, and while certainly parts of it are too poor to be mined profitably, still, where I have examined and sampled it, the deposit would seem capable of furnishing a large tonnage of pay-ore, of low grade. What might be considered pay-ore would, of course, vary according to the operating expenses. Some claims on this deposit could certainly be mined at a minimum expense.

The Golden Chest mine, the most developed property in the district, shows bodies of good ore, which will probably average from $10 to $12 per ton in gold; this does not include the high-grade material. Twenty-five samples from various openings on the upper quartz sheet in another locality, where the deposit lies nearly flat, gave me an average value of $8.90 per ton in gold; and three samples from higher-grade lenses gave an average of $64 per ton. At the same time, samples could be

taken from these same openings that yielded only one or two dollars per ton. Evidently, part of the deposit would thus be too low-grade to admit of profitable extraction; probably one-fifth or one-fourth. At the same time, workings might at any time open up bodies of high-grade ore. While the quartz everywhere contains some gold, the metal appears to be concentrated in zones or lenses. As far as I have been able to observe, there are no special signs or indications to show when and where this concentration may be found, nor to indicate the end or limit of it. While the trachyte dikes seem to have some connection with the orebodies in the silver-lead veins, in these quartz sheets they do not appear to have any connection or bearing on the value of the ore, as is only natural, seeing that the dikes are of a much later formation. I would say, however, that it would hardly be profitable to work this deposit only for the high-grade bodies which might be encountered, and that to work the deposit as a whole profitably, it would be necessary to have conditions fairly favorable to cheap mining, with such equipment and openings as to be able to extract a large tonnage.

About two miles west of Osborne, on the north side of the valley through which flows the south fork of the Cœur d'Alene river (the O. R. & N. railroad follows this river up to Wallace), is located the Evolution mine, one of the old gold locations. This mine is opened on the same quartz sheets, which here show the same character, the same mineralization, and are similarly cut and faulted by trachyte dikes. The mine has been worked only by 'fits and starts,' and has not, as far as I know, made any production worth mention. Opposite this mine, on the south side of the valley, I have seen the outcrops of two of these quartz sheets. They have been prospected a little, and opened by inclines 50 to 60 ft. deep. The deposit here also dips southwesterly at an angle of 15 to 20°; the sheets are also cut and faulted by narrow trachyte dikes, so that raises have been made from the inclines to catch the continuation of the deposit.

The mineralization of the quartz here is virtually the same as in the Murray district; but in one place I found more galena than it usually carries, getting about 30% lead in one sample. H. S. Auerbach, the manager of the Golden Chest mine, tells me, however, that in one of the ore-shoots in that mine he finds considerable galena.

The thickness of the upper sheet is here from five to six feet. This is probably a little more than the average thickness, which I should estimate at about four feet; I have seen it in places only one or two feet thick, swelling to eight or nine feet.

While my investigations of this deposit have not been detailed, it appeared to me to be of considerable interest, both geologically and from the point of view of the miner.

---

COAL MINING IN ENGLAND.—The almost unexampled high prices of coal in Great Britain since last autumn, caused by the great demand due to the general prosperity and the severe winter, have led to work upon disused collieries and the prospecting for and opening of new ones. At several points about Nottingham new borings are being made, but the greatest activity in the district is in Lincolnshire. That county has hitherto produced no coal worth mentioning, though a belief has long existed that coal underlay it, and a recent report of the Royal Commission on Coal Supplies confirmed the belief as a fact. In a dozen different places new shafts are being sunk in Lincolnshire, and in several cases coal has been reached. The borings are generally to the depth of 600 to 900 yd. Some grades of house coal have recently declined a shilling (24 cents) per ton to the consumer, in comparison with midwinter prices. But this change occurs every spring. Coals for raising steam are, on the contrary, firm in price, and predictions are heard that they will yet further advance, possibly as much as $1 per ton.

---

## Immigration Bureaus.

A recent railroad accident in California, in which more than a score of Italian laborers were killed and many badly injured, developed a rather curious phase of the labor problem. It was remarked by many people that the laborers were from Eastern points, more than half having come from New York, and were on their way to a mine in this State, where their services had been engaged through one of the Eastern employment bureaus. While the alien labor laws prohibit the employment of foreigners or the promise of work, which amounts to the same thing, before the immigrants have landed, the immigration authorities take good care that our future citizens are well looked after when once they arrive. They take the trouble to see that those who are not welcomed by relatives or friends are put under the charge of men who make it their business to find work of suitable kind, so as to prevent them from becoming a public charge. Of course, these men do not perform this duty gratuitously, but it is a fact that in serving their own interests they manage to take good care of the many thousands who come to us each week unable to speak our language and who would otherwise be the prey of sharpers, who frequent the water-fronts of all the large seaports. The employment bureaus, as businesses conducted for this purpose are called, being in such close touch with the immigration commissioners, are frequently the means of ridding us of many undesirable foreigners, who have escaped from the crews of vessels without having been passed on by the proper authorities. Almost invariably such foreigners are detained and subsequently deported.

For a number of years many mines in the East have had laborers supplied to them by the employment bureaus, and have nothing but good to say of the system. The Delaware & Hudson, through the Southern Immigration Bureau of New York City, is among the large mine-owners that have benefited by the careful selection of men trained to pick out the foreigners best suited for various kinds of work. In the past two years these agencies have extended their field of work and they now send every month many hundreds of laborers to work in the mining camps of the West.

---

IN ITS simplest form, a caisson is an iron cylinder somewhat bell-shaped, open at its lower extremity and closed by sliding doors at its upper. Leading out of the upper part on one side is a chamber called an air-lock which is separated from the interior of the caisson by an iron door, and also from the outside by similar means. It is through this air-lock that the men enter and leave the caisson. Between the sliding doors at the upper part, or movable ceiling of the caisson, and the roof is a chamber or space known as the material lock, through which the buckets filled with soil are passed. When placed in position, the bell-shaped expansion of the caisson rests upon the bed of the river, and atmospheric air under pressure is pumped in. This by displacing the water enables the men to work in a pneumatic chamber wherein they are dependent for the air they breathe upon that delivered into the caisson by pipes from an engine, and as the surplus of air escapes by the bottom of the caisson ventilation is by this means effectively secured.

## Treatment of Matte from the Cyanide Mill.

Written for the MINING AND SCIENTIFIC PRESS
By A. E. DRUCKER.

It may be of interest to some to know of a quick and complete way in which to extract the metals from a rich matte as obtained at a cyanide clean-up. It often happens that the yield from this source adds considerably to the month's bullion.

Sulphur, the matte-forming element, comes from the zinc sulphate ($ZnSO_4$) remaining with the precipitate after acid treatment. The amount of $ZnSO_4$ present will depend, of course, upon the number of water-washes used in the final acid treatment. The more the precipitate is washed, the less will be the matte formed on a gold button. I believe that in our case (treatment of concentrate) it is possible at times for extremely fine material to escape from the filters, to be carried in suspension to the zinc-boxes where it is bound to remain with the other precipitate. The amount, however, is exceedingly small. If such be the case after treatment with acid, ferrous sulphate ($FeSO_4$) will be contained in solution, while free sulphur separates out with the precipitate according to the reaction:

$$FeS_2 + H_2SO_4 = FeSO_4 + H_2S + S$$

There is a possibility then, unless a complete roast is given to the acid-treated precipitate, of sulphur being present as a matte-forming material upon melting the final precipitate. The amount of sulphur obtained from this source to form matte will in all probability be slight. Experiments now point to the fact that the amount of matte obtained on a gold button depends principally upon two things, namely, the completeness of the final water-washes after acid treatment and the extent to which the final roast has been carried (whether merely a drying of the precipitate or a complete roast).

The matte that I am treating contains zinc, lead, iron, gold, and silver. When using the zinc-lead couple for precipitation, the presence of lead in the matte, if the gold slime is acid-treated and then smelted in a graphite pot, is practically inevitable. Lead in the matte may also be due partly to the dissolving (by the cyanide solution) of lead salts from oxidized concentrate followed by the precipitation of lead on the zinc. It may originate from the lead acetate used in some solutions. There are two sources by which iron may enter the matte, either by iron pyrite collecting in the zinc-boxes and finally appearing in the acid-treated precipitate as $FeSO_4$, or by some iron scale gathered from the roasting-pan with the gold precipitate. Zinc seems to enter the matte in considerable amount, especially when the acid-treated slime contains some undissolved zinc or has been only partly roasted, so as to contain zinc sulphate.

I believe that a small amount of matte on a button is desirable, for the slag above will, as a general rule, assay less in silver, especially when the matte contains lead. No nitre is used by us to keep down the matte upon fusion of the slime in crucibles. Its damage to the pots amounts to more than the cost of treatment of the additional matte. Previously to using my present method of reduction, we certainly did not welcome the presence of any considerable amount of matte at a clean-up, since the old method of treating small quantities with nitre or scrap iron was slow and incomplete. It is not safe to allow any amount of this rich matte to accumulate (it assays about $20 per lb.) and for that reason the best plan is to treat it immediately at the end of the clean-up, melting the bullion with the gold buttons into bars.

Potassium cyanide acts as a powerful reducing and desulphurizing flux, and for this reason it was used for decomposing the matte. Our particular matte is unusually high-grade, assaying as much as $45,000 per ton. It contains zinc, lead, and iron as sulphides, besides the precious metals. At the monthly clean-up about 800 lb. precipitate is obtained, producing nearly 3,000 oz. bullion, and from the treatment of this we obtain from 30 to 40 lb. matte. The amount varies from month to month. The method of treatment for the matte is as follows:

The matte, borax, and cyanide are put separately through a small rock-breaker and crushed fine. Borax and cyanide are used as fluxes and are put with the matte into three No. 60 graphite pots in the following proportions and order: There are alternate layers of borax, matte, and cyanide throughout, until the pot is full, and finally covered with borax. The crucibles are now put into the furnace and a white heat maintained for two or three hours. As a rule, it takes a little over two hours with a good hot furnace. It can be seen when the action is complete, for the charge will subside and the bubbling cease. The action and burning of the sulphur will be violent at the end of the first hour. Also the slag will become quite thick when the action is complete, being removed with a skimmer; this is necessary before pouring the contents of the crucible into a conical mold. If an excess of cyanide be used, it will be found just above the gold button and can be broken off by a blow with a hammer. The matte will now be entirely decomposed, leaving only a light porous slag and the gold button.

This method shows an extraction of 85 to 94% of the total value of the original matte, depending upon the richness of the material treated.

## The Prospector.

**Enquiries sent to this department are answered free of charge, if submitted by subscribers who are not in arrears. The full name and post-office address of the sender must be given, otherwise no answer will be made. Those who are not subscribers must accompany their questions with a fee of $3 for each question. No assays are made.**

A specimen of Schist was sent by J. F. S., of Crackerjack, California.

The rock sent by O. H. F. H., of Bodfish, Cal., is a Sillimanite Schist.

The black sand sent from Cedarville, Cal., is specular Hematite, with some Magnetite. It would have no value as a placer deposit.

O. B. A., of Tenabo, Nev., sends: No. 1, Calcite; No. 2, Dacite, stained with Copper; No. 3, banded Opal, stained with Copper; No. 4, Turquois; No. 5, Chlorite and Epidote; No. 6, Pyrite, Sphalerite, Quartz, and Stibnite.

The specimens marked P., Mina, Nev., are: No. 1, Slate; No. 2, Epidote; No. 3, Quartzite; No. 4, Quartz-Porphyry; No. 5, Sandstone, No. 6, Rhyolite; No. 7, weathered Andesite; No. 8, Andesite; No. 9, black Quartzite.

A. B., of Medical Springs, Colo., sends: No. 1, weathered Granite; No. 2, Epidote and Quartz stained with Limonite; No. 3, Diorite-Porphyry; No. 4, Feldspar-Porphyry; No. 5, Pegmatite-Granite; No. 6, crystalline Limestone.

B. R., of Hawthorne, Nev., sends: No. 1, Granite, with black speckled Hornblende; No. 2, Granite-Gneiss; No. 3, Barite and Quartz, stained with Malachite and Azurite; No. 4, Aplite Granite; No. 5, Chrysocolla; No. 6, altered Diorite; No. 7, impure Limestone.

The character of the ore changes down about 300' - change from an ore body chiefly carg. PbS to one chiefly ~~auriferous~~ argentiferous Cu-gold-silver ore, poorer than the zone above due to admixture of barren pyrite.

---

3. Replacement Deposits.

They are merely portions of the lodes where the walls have been replaced by minerals.

---

## Idaho Deposits.

Central Idaho. - Area of granite 100 mi. wide, from Snake River plains northward. Granite intrusive into Carbonif. rocks on E & W, so it is post-Carbonif.; it is traversed by many fissures striking N 70 E, dip SE 45-80

A biotite granite; many dikes running thru it - aplite, pegmatite, granite-, diorite-porphyry, lamprophyres granite porphyries are very common. lampro. dikes are small & inconspicuous but numerous. Qtz. veins are often accompany the lamprs - of later age than the ~~gran~~ lamprs.

Carb. Rocks - ss, ls., slates, sh, schists, quartzites, andesitic flows, rhy. flows

Columbia Lava - Sheets of basalt 20-150' thick, aggeg. 2000' - 4000'. Some rhy. Miocene. Not poured out by volcanoes

3/21/17

Idaho Cont.

The remarkable thing about the lava flow is the absence of volcanoes. (Cascade volcanoes perched on lava.) The lava must have been very fluid to travel over such low grades. Very little ashes. The lavas have a flat domed structure, indicating that they came from great vents such as Kilauea rather than volcanoes of the Vesuvius type. Lava of Miocene age.

Basins with large bodies of water were formed after the lava flow, & lake deposits 1000' thick have been formed — ss - clay - ls. Volcanic activity was then resumed, & the beds were covered by basalt. Snake River. Pliocene.

The bottom of the great lava flow can be seen, & the surface can be seen to have been rather rough, by no means a peneplain.

The lavas are much thicker ~~th~~ in some places than in others due to depression of the original surface.

## Ores of Central & W Idaho.

Many Cu - Ag - qtz filled fissure veins in the granite. Fissure veins also in the Carb. near the granite contact, but they are irregularly Sh. & Ag - PbS, Zn, Cu bearing veins, diff. from granite veins.

Veins in volcanic rocks.

The veins in the pre-volcanics do not form a well-defined belt. Prevailing strike is E-W, esp. N of Snake. Fissures coincident with the jointing system.

These fissures are supposed to be due to compressive stresses, & if so are conjugate.

The fissure veins outcrop on the surface of the pre-volcanics, & their outcrops pass under the mantle of lava. Pre-volcanic veins.

There are many faults S of the Snake River, trending N-S (Basin Range system of faults) The veins are Trend N-S & traverse the Columbia lavas, & ∴ belong to a distinct period from the pre-Miocene veins above.

<u>Wood River</u> or <u>Haley dist</u>. Near E margin of granite mass. Carboniff. ss., ls. sh. congl. have been closely compressed together & have been invaded by the granite. Relations similar to S. Nev. Some lake beds; outlying remnants of lavas (1000') covering outcrops of veins, but no veins in the lavas.

Fissure veins carrying Ag-PbS ores in sed. rks; much of the gangue is Siderite. Chief ore is PbS with a little $Zn_2S$ & Tetrahedrite.

50% Pb
50-100 oz Ag } successful mines.
# 2-5 Au

There are some similar veins in the granite, but most of these carry chiefly Chalcop., pyrrh., qtz-gange, & free Au.

The veins occur in 2 belts on two sides of an isolated mass of granite in the carb. rks.

Much of the mass is qtz-diorite (E side)

Belt on E & one on W (granite facies)

The ore-chutes are very irregular, from a few feet to 100's.

The deposits are apparently independant of the kind of rock they occur in, to some extent at least. This would tend toward a belief in ascending sols.

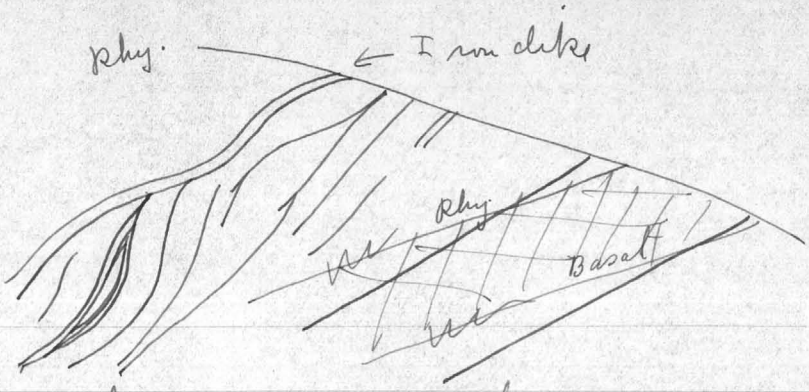
Some veins show ribbon structure & crustification. Portions of the veins are replacements of the walls; this occurs chiefly in the granite & qutz d. Seldom in shales etc.

---

<u>Delamar</u> - Silver City. W. border of granite, where lavas come up over it. Original surface under lavas was of high relief. Granite traversed by pegmatite dikes; some of these are nearly all qutz, but are barren. Basalt, diabase, rhy., granite pphy. dikes also. Lavas resting on granite. Pliocene lavas above. The region is fissured, & some of these follow the dikes.

| | |
|---|---|
| Rhyolite | 1000' |
| Basalt | 2000' |
| Granite | |

Sols. dep. Au-Ag. veins in these fissures at Delamar. The veins are all in the rhyolite. Latter is kaolinized, & impregnated with moncasite & pyrite; also silicified. An "iron dike" traverses the rhyolite here - a zone of compact greenish-gray clay studded with $FeS_2$, 50' thick, dips 39° SE. It is a fault gouge & profoundly influences the ore. The veins are only in the vicinity of this dike.




The croppings of these veins are not traceable to surface, & when found show no rich ore.

Gangue — a white laminated quartz - a pseudomorph of a cleavage mineral which as disappeared.

This proves 2 periods of mineralization

1. Calcite & barite deposition
2. Advent of siliceous sols.

The vein quartz is distinct from the rhyolite even when the latter is silicified.

Ore — Free gold chiefly; rarely visible.
$FeS_2$
Ag.

Considerable Ag in kaolinized rhy. of walls, but seldom Au.

The Ag deps. are close under the iron dike. "Silver stopes" running $400 a ton when mined.

Cerag
Ag
Pyargyrite

Ore shoots commonly 6' wide, in places 30'. 200' long

Ratio Ag - Au was 1-1 in value, Ag greater in wt.

## Flora de Mt.

The veins in the basalt are narrow than those in the rhyolite. In the granite, the veins follow basaltic dikes on one side or another.

The veins often show a ribbon structure. Fissures are long & straight. The assay end of the ore is the same in the rhy., basalt or granite, but the quantity of ore is greatest in granite

less in rhy.

least in basalt

## War Eagle Mt.

Veins narrow, gangue is qtz with calcite, siderite.

gold, argent., chalcop., pyrang.,

Gold > in value, Ag > in weight