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GEOLOGY AND ORE DEPOSITS OF THE CUSTER MOUNTAIN AREA, CUSTER CO. IDAHO.

M.A. Thesis of Thor H. Kiilsgaard, UC Jan. 1949. Under Hulin. A.L. Anderson of Cornell suggested the problem and directed the field work.

References: J.B. Umpleby, Some Ore Deposits in NW Custer Co. USGS Bull. 539, 1913, 45-55.

C.P. Ross: Geology and Ore Deposits of the Bayhorse Region, Custer Co. Idaho. USGS Bull. 877, 1937, 49-58.

Ross: Ore Deposits in the Tertiary Lava in the Salmon River Mts., Idaho. Idaho Bur. Mines, Geol. Pamph. 25, 1927

Location.-Yankee Fork Mining District, NW Custer Co. Yankee Fork of Salmon R. Custer Mt. area along SE border of Yankee Fork Dist., just SE of old mining camp of Custer. Sections 10, 11, 14, 15, T12N, R15E Boise meridian; shown on Vhallis National Forest Map, US Foreset Service. Custer i2 12 mi. up Yankee Fork from Sunbeam, reached on US 93 from either Challis, County Seat, 45 mi. to the E, or from Hailey, 81 miles S.

Mt. summits 8500-9500', components of broad, gently undulating regional plateau, Idaho Peneplain. J.B. Umpleby: An old erosion surface in Idaho, its age and value as a datum plane. JG 20, 1912, 139-147. 3500' Salmon R. canyons.

Rock Formations.-Penn. Wood River, not exposed in Custer Mt. area, but in floor of Yankee Fork valley, 3 mi. S of Custer. Thin-bedded arg. qtzite to massive black carbonac. qtzite. Strike N, dip NW, 45° in S to 80° in N.

Idaho Batholith. No OCs in area, but along W side of Yankee Fork district, also in E part. Latter place it protrudes thru Challis volcs. one lobe SW to within 6 mi. of Custer area. QM.

Age narrowed down to post-Triassic, pre-Miocene. See C.P. Ross: Mesozoic and Tertiary granitic rocks in Idaho. JG 36, 1928, 692. Same, Some Features of the Idaho batholith, 16th Int. Geol. Congress Report, 1936, 382-383.

J.C. Reed, Geology & Ore Deposits of the Warren Mining Dist., Idaho Co. Idaho, Idaho Bureau of Mines & Geology' Pamph. 45, 1937, p. 8, thinks age upper Jurassic or lower Cretaceous. Why tie it in to Sierra Nevada?

Challis Volcanics. Overlie above basement. Dominant rocks of area Thick series of IB andesites, latites, tuffs and rhyolites. Together with Miocene porph. intrusions, only CR of area. C.P. Ross, Geology & Ore Deposits of Csto quadrangle, USGS Bull. 854, 1935, 28-34 gave units: lowest latite-andesite member; middle, partly IB tuffaceous member; upper Yankee Fork rhy. member (not in area)

N 35° E, dip 19° SE + tuffs to N50E, 12° SE

Tertiary Intrusives.- Mainly dikes, very small to 100' wide. All in 3 parallel belts, ENE, following channel way shear zones. These zones controlled mineralized areas of region. All showings within or adjac-

ent to these zones. N dike-shear zones buff color % oxid,alt.of CR, traced 12 mi. Middle zone poorly defined,small.S zone,has within it irreg.stock-like QM nass which intrides Challis volcanics & it itself is intruded by dacite porph.dikes.

Structure: Challis volcanics Oligocene(?);they were warped ;on SE,limb of SW projections of Ross's major (axis) NE arch. Faulting: most of faulting confined to the 3 ENE zones;on SE flank of the arch,and they roughly parallel regional trend of the structure. N70E. Faults within the zones not continuous and in places en echelon,oblique acrss belt. (N55 to 60E,while zone trends N80E ;c.f.Nolan Basin Range en echelon flts. Good comparison;try clay experiment). Master faults all normal, dip steep N (arch flat). In Custer Mt.area shear zone well-defined by strike of porph .(dacite) dikes,veins,and s.t. by faults exposed in mines. Near Lucky Boy mine zone nearly amile wide,traced for several miles. N dip of breaks in zone,50-70°.

Stress developed during crustal stretching of the arched areaexceeded ellastic limit of rocks and caused rupture. Ftactures have paralleled longit.axis of arch,dip;toward that axis;collapse of unsupported HW. The HW in riding over the FW has been subjected to stresses resolved into divergent and complx fractures,many filled with dikes and veins.

History: All known depoists discovered by 1877;1st finds several thousand dollars combined Au,Ag. Main epoch 1880-1900 Mining dormant 1905-1936 when Lucky Boy reopened;active until closed by L-208,1942, 1948, attempting to revive Lucky Boy mine.

Ore Deposits:Typical epithermal gold-silver.Wt of silver far outways that of Au. Galena Zns,tetrah.present but non-commercial. Within Custer Mt. shear zone,almost all dip N.Intense HT alt. Most pronounced adjacent to veins,but not uncommon where no lodes seen.

a. Immediately next to "mineralized" veins,zone of silicification; fg and cryptocrystalline qtz.migtaed away from main fracture planes,replaced older mins in CR.Qtz as tiny veinlets,scattered grains.

Contains adularia, chalcedony, qtz, calcite as gangue

b. Sericite zone,ill-defined. S.t. in contact with veins.s.t.well away.Sericite replaces plagiocalse and FMs. Bleaches rock.Soapy when wet dissem.py.

c. Propylitization:thruout entire shear zone,but best developed in outer areas,farthest from major veins.Chlorite from FMs calcite plus,py plus;CR stained brownishred fromoxid,py.

Mineralogy:Qtz gangue crystals vary fromcryspotcrystalline to 1" xx. Comb qtz.structure. Thin delicate banding parallel vein walls or concentric about drusy cavities. Silver sulpho-salts. Epithermal signs.

Veins qtz-cal.gangue,few inches to 3-4',rare 11'.Discontinuous on strike,few to several hundred ft.

Gangue:light qtz.,cryptocryst.to csely crystalline.Cal.,fairly large good xx;chalcedony;adularia,very fine. Ore:py,ccpy,ruby silver,specks free Au;megascopic. Ore is light-colored agregate of the various bague minerals with dark minute bands, dark irreg. blebs,and scattered sulphide grains,

mainly pyrite. The thin dark wavy sulphide bands cut all gangue minerals but they actually follow tiny qtz veinlets (Pachuca) or qtz-lined drusy cavities. Many of these tiny sulphide particles which give dark color to qtz.bands are various silver sulpho-salts,others too small to be resolved even under mike.

Crystallinity of ore esp.of qtz varies from very fine to very coarse implying varying speeds of deposition. Drusy qtz cavities often with contained sulphs. Druses resulted from early qtz.deposition that did not go to completion. Recurrent brecciation opened the druses.

The thin dark crustification banding concentric around the openings AND VUGS is not evidence of the entry of new minerals;the banding has resulted from the simultaneous deposition of qtz.& sulphides. In a typical banded zone earluest mineral deposited on vein wall was qtz,growing ouward from the wall.Later sulphide seeds started growing on the qtz with ionic substance diffusing in to the growing seeds.Meanwhile qtz continues to deposit;since it grows faster than the sulphide it gradually builds a band on the outwrd side. Once the qtz band exceeds the diffusion gradient of the growing sulphide seed it will be easier to re-seed a new band than to continue diffusion to the old one.Thus rapid qtz. deposition can account for the thin delicatebanding.

Ore Minerals:

Calcite	
Quartz	Replaced the calcite along clevage.
Adularia	
Pyrite	Dominant sulph;1 mm-.Druses,qtz veinlets
ZnS	Druses,tiny metasomes in qtz strgrs
PbS	Rare,replaced by later sulphs
Ccpy (insol. sulph. repl. a more sol)	Common,micros.grains replace ZnS
Tetr	Very rare
Miargy	Most abundant Ag min.;in qtz-lined cavities.
Pyrarg	
Stephi?	Abundant at Gan.Custer only.
Arg	
Electr	
Gold	As scattered blebs taking shape of enclosing xx.

Distribution of the Ore.-Fractures of Custer Mt.shear zone were channels,but they did not form continuous OBs. Ore in shoots,pockets. Environment of these high-grade Obs governed by (1)physico-chemical factors,(2) mechanical factors. Straight Hulin:

Ascending solutions nearing surface metal areas of lower T,P.With continued ascent boiling point reached,it being governed by T-P condition On boiling,latent heat removed and gas phase produced,accelerating upward movement of solutions.Rapid loos of heat from boiling,plus passage thru cooler-walled fractures caused solutions to become supersaturated with respect to minerl constituents held in sol.Deposition;range of mineral deposition short because as solscontinued to rise & boil they finally reached stage of wet-steam.No chance asyet for deposition- velocity too great.This stage marked upward limit of ore deposition.?Now removed by erosion.

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When supersaturation of ascending sols reached and depos.commenced xx deposited on fracture walls,at first small,due to quick chilling. With time walls became heated;with this equalization of T gradient between ascending sols.and fracture walls xx had more time to grow:larger. Recurrent faulting,4 th July.opened previously healed fractures,admitting fresh sols.Banding:chalcedony on vein walls.coarser qtz in center which in turn has chalcedony bands.

Bottom limit of ore grade mineraliz.? Lucky Boy,surface (8180') to lowest level,900, 7580;but from 700 down grade lessened;at 900 so low grade sinking abandoned.Width same. Gen.Custer,nor ore below 7200'. Below this bottom surface T too high.

Veins mostly follow consequent faults resulting from strains set up by movement along master faults.These ~~xxrikx~~ pre-mineral normal master faults strike ENE and dip N at moderate angles. Consequent faults in their HW,by "gravitational settling". These also in the main strike ENE, dip N;many however at oblique angles across the belt,but all dip N.

Imp

Within the local veins,shoots from several causes,among which are: change in strike and dip;intersectioj of 2 veins;subsequent movement along master faults which has permitted dilation and translation of the consequent fractures.

Lucky Boy: $2,200,000 Au-Ag,mainly from upper levels. Three veins, Calcite, A, Lucky Boy.All three qtz-cal.,ave.3' wide on 400,600;s.t. narrow to stringers,widen to 11'. The master faults here are the ABC and Badger. A is a vertical split off Lucky Boy. Structural control by ABC fault. ABC dips 54° NW,heavy gouge. Walls silicif.Banding in ore of Lucky Boy,Calcite veins persists right up to the fault surface,suggesting that IM slips within the fault have created dilation in the vein adjoining, "or have caused subsidence of vein HW thereby creating openings for ore deposition." On 400 L.B. shoot,west of ABC fault is 11' wide next the fault,tailing out to the W.At widest portion vein dips 74N. On 600,dip flattens to 66°,shoot narrows to 6';normal fault zigzag control. E shoots,workings mainly caved,but may have reached Badger flt.Probably in flted belock between ABC,Badger flts. NW rake of shoots,both W and E of ABC fault,shows structural control by that and probably the Badger flt.

Gen.Custer.$8,000,000. Dip slope,all ore exposed on surface. Where it passed down into gulch, NG. Upper part of exposed FW,most of ore from trough formed by swing of vein as shown.

Longview: Tunnel follows HW of well-defined fault.Small shoot.

4th July.-Sil.zones,dip steep N. Small qtz veins in zones.

Notes on Environment of OBs,Lucky Boy.Control by ABC and Badger flts. looks probable.

Lucky Boy: 400.600' west of ABC fault there is a stretch of 5' vein,splitting into 3 fingers at W end of workings;two of the 3 splits are strong where exposed farthest west;but the 3rd,followed farther,and also strong at its start,tails out to 8" so the others probably do likewise. The wide part of the main vein consists of

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parallel quartz and calcite stringers with few sulphides.

This barren lens tails out to the east,and for 40' the vein is almost non-existent where its course is crossed by a zone of small fractures ,NE,parallel to ABC and Badger flts. Smack E of this zone, against the easternmost fault,the vein is 3 or 4 ft.wide again,but barren. To the E it pinches and swells and in places shows brecciated inclusions of silic.andesite. 130' west of ABC fault vein started to widen radically-ore. 50' E of fault,same big width (stoped);caved beyond that.

Apparently nothing to indicate coming into ore on strike except widening of vein,and there is no consistent widening until the final one-ore comes in at the start of widening. 600 looks about the same as 400 except at one place at least,whole vein is calcite. Since author says ore associated with quartz,if the association is genetic as well as spatial,the quartz like the ore will probably peter out going down:all-calcite vein at depth.

Accompanying isopachs show local widening at ABC fault. Aside from this vein is pinching at depth and theline of pinch pitches to the E, that is,toward the ABC and Badger faults and toward the QMP major stock. The line of pitch is approximately normal to the ABC and Badger faults.

✓ Structure Analysis

Notes by E.W. Authors description of structural setting does not seem to take in all the facts,notably the peculiar SE belt of NW strikes of the veins, Gen.Custer to Black veins.Contains two main mines,Lucky Boy and Gen.Custer. Actual curving ,from NNW and of Mullan,E-W to NW, is probably significant.

The QMP stock has not apparently domed up the flows around it;it was therefore intruded before the major NE arching;this is confirmed by the fact that the dacite-porphyry dikes,in longitudinal fissures formed by the arching, cut the stock.The stock therefore stretched with the arching, as did the flows;but it probably did not stretch as much. Further, after its gaping fissures had been healed by dacite por. dikes,it apparently did not gape further.

The earlier fractures,as marked by faults,dikes,veins,are "regular", all N65E to E-W;the later fractures (presumably)are mainly"irregular", about N70 to N45W. Presumably therefore some factor entered the picture between the time of formation of thetwo systems. Logical factor would be the reinforced stock.

The WNW veins are plainly tension veins--QCB etc.,more so than the ENE ditto-4th July,silicified zone etc.Gen.Custer turns SE to make a tension vein,at the same time steepening in dip. The regular direction of stretching was NNW,perp.to axis of arch;stretching,at least after dike intrusion,was not intense;dikes largely healed the gaps. The later direction of stretching was NNE,or roughly parallel to the W contact of the stock.Note that the ABC and Badger faults, not far from parallel to this direction of stretching,are gougy faults,not breccia zones.

Along the W side of the stock,if the direction of stretching had remained NNW,the flows wouldhave been stretched into the stock,not possible since the stock was a buttress;hence direction of stretching was deflected SSW along the W edge of the stock. It might be asked why most of the WNW veins do not lie next the stock where stretching would be most intense. It seems likely that the stock may extend outward to the

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west at depth and that the ABC & Badger are marginal disruptive faults connected with this W margin. Where exposed, up in the lavas above the supposed westward bulge at depth of the stock, these faults may also have served as antithetic faults to aid the stretching; their course farther to the NE than the normal NNW faults and fissures having been conditioned by the stock. Suthour calls them the master faults; while they have not been traced very far on the surface owing to lack of markers, they plainly give the impression of great structural importance underground. They formed therefore in relation to the major arch with their attitude slightly changed by the buttress stock. Put another way, or as an alternative thought, these antithetic faults are later than the NNE dike-fissures; the latter were the first to form, when fissuring, not flow down the sides of the arch dominated; the master faults are later manifestations of flow, toppling etc.. The stock was reinforced by the dikes in it and became a buttress, defelcting the antithetic faults around its N edge. The ABC and Badger faults are regional faults locally deflected.

The WNW tension veins, on the other hand, are strictly local, related to the local stretching along the W side of the buttress.

During the arching movement of the flow rocks was upward and southward. The ABC fault is described as premineral, but it shows no vein-drag as might be expected in volcanic rocks (Sta. Ines vein, RDM). This is highly suggestive of "loose", tensional antithetic faulting. If the ABC fault was slightly permeable to the solutions (silicification etc.) it was there before the solutions entered, and therefore the vein fissure existed, at least in embryonic form, before the mineralization, and the displacement of that fissure had been accomplished by the antithetic faulting, before mineralization. What happened apparently during the mineralization was a squeezing open of the Lucky Boy and Calcite vein fissures, thru the arching & stretching. Such squeezing would have been at a maximum next the gougy ABC and Badger faults - Foepl effect, greater gliding. This effect would be even more pronounced between the ABC and Badger faults: double Foepl effect. This was probably solid ore. If the ABC and Badger faults had formed before the WNW tension fissures conditioned by the W side of the recently reinforced stock, antithetic movement on the ABC would cause the displacement on the Lucky Boy and Badger vein fissures, shortly after they formed or while they were forming; stretching between the two faults would be especially pronounced, so pronounced that it may well have been son concentrated between the two faults that no fissure formed E of the Badger, probably just above the W bulge of the tock at depth, as delimited by the marginal Badger fault. Free block faulting between faults, due to uplift and Foepl effect. Probably the main cause of widening of veins at cross-faults, rather than dilation due to slight movements on the fault.

Columbia fault at Goldfield, antithetic fault, does not penetrate the bed rock but is confined to the volcanic cover. Lucky Boy and Calcite veins pinch with depth: so do tenion fissures due to arching.

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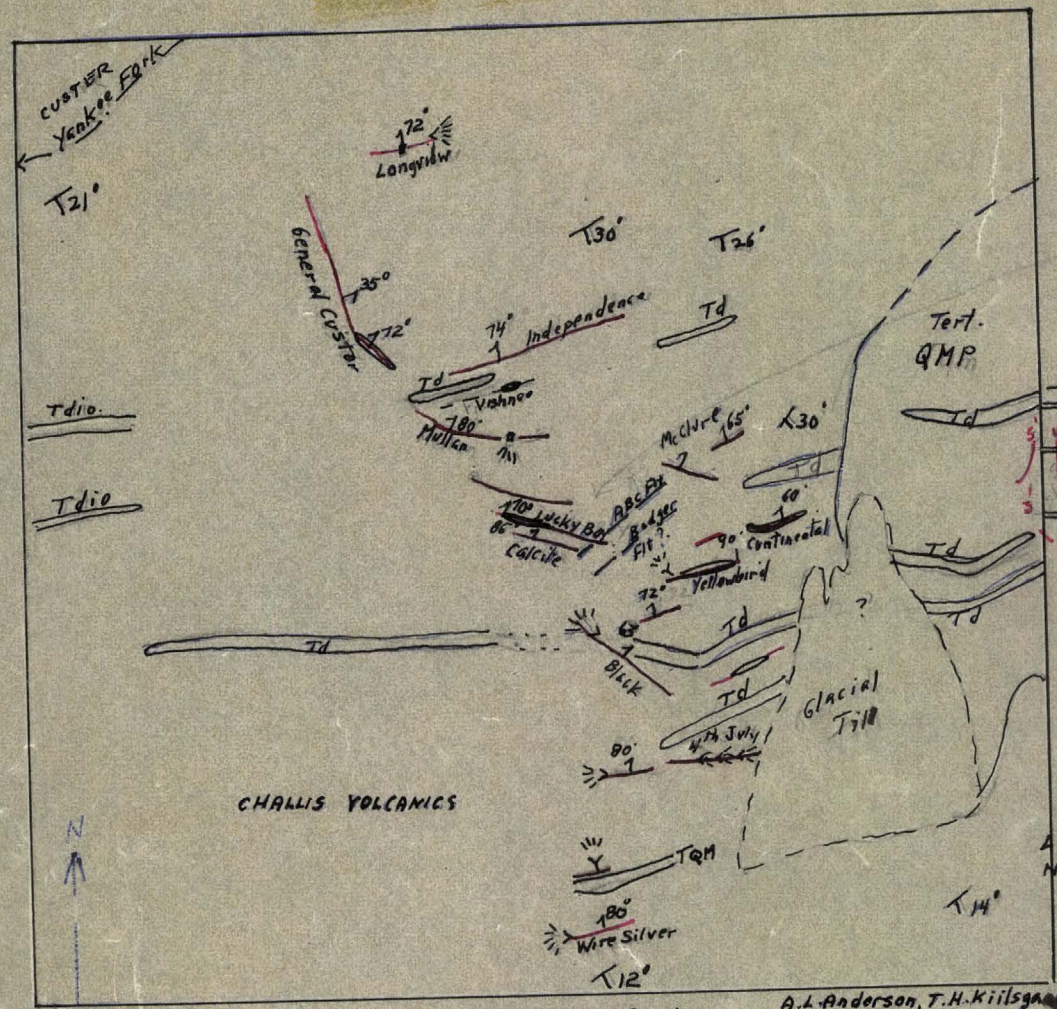

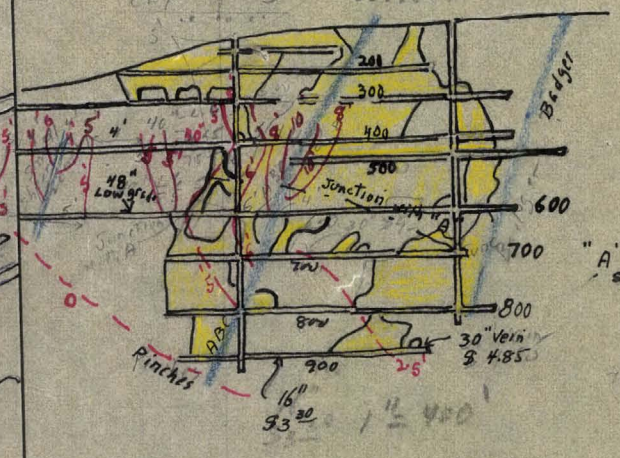

CUSTER MT. AREA, IDAHO
Scale: 1" = 2000'

A.L. Anderson, T.H. Kiilsgaard

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