

600192

THE ORE MINERALS  
OF THE  
MOUNT WASHINGTON  
COPPER MINE

70%  
Poor English

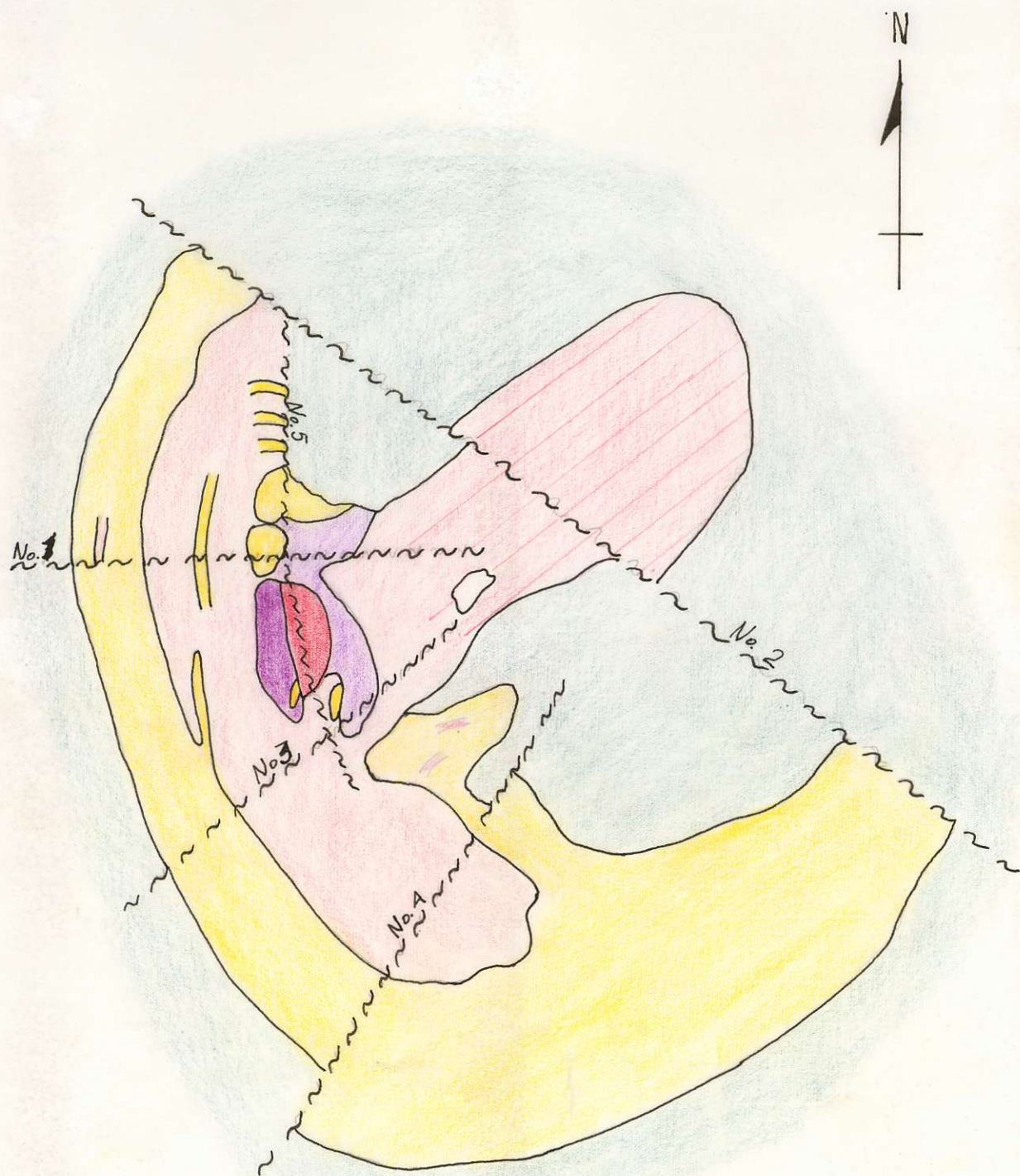
RMT  
May 3/66

## Resumé:







The Mt Washington Mine is located on Mt. Washington, about 15 miles northwest of Courtenay, Van. Is. Exploration was started in 1958, and production started in early 1965.

Cretaceous shales, quartzites, agglomerates and tuffs overly Triassic basalts. Tertiary dacite porphyry and breccia intrude both units at a fairly high level. The later Mt Washington stock cuts and domes the entire sequence. Dykes, sills, and horizontal quartz veins cut the less resistant sediments and pass into the dacite porphyry and breccia. The main ore minerals were deposited in this contact region. The sandstone in this area is well fractured, bleached, and friable.

The porphyry and high level of emplacement is very similar in type to the large copper porphyry ores of the south western United States.



Legend

-  Qtz. Diorite + Qtz. Diorite Porphyry
-  Brecciated Qtz. Diorite Porphyry
-  Washington Breccia
-  Murray Breccia
-  L. Cret. Sediments
-  Volcanics - Andesites or Basalts

Geology of Mt. Washington  
(after Carson, 1960)

Scale: 1" = 3000'

~ ~ -- Fault

## Description of Hand Specimens

Most of the specimens are a light to medium grey color, and are covered with a coating of orange-red realgar and orpiment. The orpiment is present as a surface coating only, and is an alteration product of realgar. The realgar occurs as well-formed, short, prismatic crystals on the vein walls. These crystals were later covered by a thin layer of chalcedonic quartz, which, in turn, was covered by a thin layer of very fine, crystalline quartz. Megascopically, these masses appear like small stumps growing in the cavities and on vein walls.

(The) orpiment forms the coating on the chalky, friable quartz. This friable quartz is associated with the ore (B.C.M.M. Rep. 1961), and probably represents hydrothermal alteration by the ore fluids.

Large masses of chalcopyrite and well crystallized pyrite were deposited along with vein quartz at quite high temperatures. The evidence of fractures, though, shows that little pressure was contained in the rock



and deposition was therefore high level. The small, well crystallized cubes of pyrite are concentrated mainly in the chalcopyrite, but are also scattered in some of the dark, dense, quartz gangue.

## Microscopic Determinations

### Descriptions of Minerals

#### Chalcopyrite $CuFeS_2$

Extremely coarse and massive grains make up most of the polished sections. It is being replaced by the early quartz along many irregular fractures, while secondary quartz and realgar replace it along long, thin, well defined fractures.

#### Pyrite $FeS_2$

Very small (.1mm) to very large (20mm), well formed crystals of pyrite are usually enclosed in the chalcopyrite. It is always enclosed in a thin skin of quartz, which is slowly replacing it.

The larger grains can be seen to be com-

posed of a mosaic of differently oriented grains, which have slightly different reflecting abilities.

Tetrahedrite  $(\text{Cu}, \text{Zn}, \text{Fe}) \text{Sb}_4 \text{S}_{13}$

Some small grains of tetrahedrite can be seen associated with native arsenic and chalcopyrite. It shows excellent crystal faces when in contact with these two minerals, but has a ragged appearance where it is being replaced by quartz.

Microchem tests proved presence of Zn.

Arsenopyrite  $\text{FeAsS}$

A small grain of isotropic arsenopyrite was found associated with chalcopyrite and quartz. The isotropism is probably due to orientation. The arsenopyrite was identified by microchem tests and x-ray powder photographs.

Arsenic  $\text{As}$

This is a soft, well polished mineral of a light grey-buff color. It has a fine spherulitic texture. Pleochroism was not noted, but anisotropism is quite strong,

displaying light blue and green-grey colors. Under crossed nicols, the texture is a finegrained mosaic of plume and sheaf shaped grains, generally oriented <sup>normal</sup> to the colloform banding

Etch tests :-  $H_2Cl_2$ ,  $KOH$ ,  $KCN$ ,  $HCl$  - neg

$FeCl_3$  - black stain

$HNO_3$  - dark grey to black stain

Microchem tests - Excellent for As and Sb

estim. Sb  $\approx$  5-10%

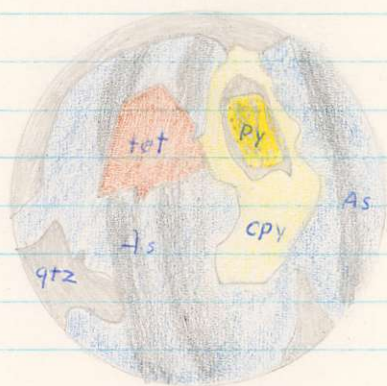
Realgar AsS

Grains of steel-blue realgar are usually associated with arsenic and always with the later quartz. It forms an inner coating on open vugs and is in turn coated by chalcedonic and then crystalline quartz. A deep, red internal reflection can be seen under crossed nicols

Minerals Present and Percentages

Mineral	Amount of Ore
Chalcopyrite	60%
Pyrite	18%
Realgar	10%
Arsenic	10%
Tetrahedrite	2%
Arsenopyrite	<1%

## Significant Textures & Paragenetic Sequence



X 100

Well crystallized pyrite was deposited in small to large grains from siliceous, iron rich solutions.

Addition of copper to the cooling solutions brought about the deposition of large quantities of chal-

copyrite over a long period of time. Much of the chalcopyrite was well crystallized, but later replaced by quartz. Introduction of minor quantities of antimony into the solutions caused the precipitation of very fine-grained and well formed crystals of tetrahedrite against the chalcopyrite.

After the copper and iron were depleted in the later stages of cooling, arsenic was introduced into the solutions. This was deposited, along with the remaining antimony, as zoned spherulites of antimony-rich arsenic. The decreasing cloudiness towards the rims of the spherulites of arsenic may be due to decreasing antimony



as the arsenic was deposited.

The pyrite probably acted as a chemical nucleus around which the other minerals deposited.

Replacement of chalcopyrite by quartz is preferential around crystals of pyrite, which are being replaced much slower. This is probably due to the very strong crystal lattice of pyrite and the much weaker one of chalcopyrite.



x 25

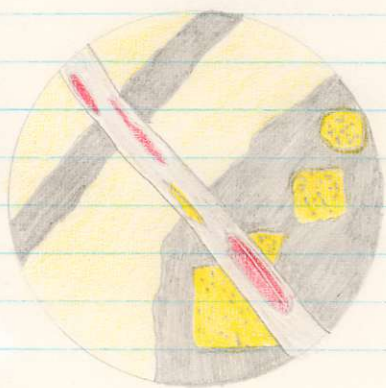
An early formed crystal of arsenopyrite is being replaced by later chalcopyrite, which is being replaced by still later quartz.



x 80

A definite preference of replacement is exhibited by quartz. Chalcopyrite (not shown here) is most susceptible, then, in order, are pyrite, arsenic and tetrahedrite. Preferred directions of replacement can

also be noticed. In arsenic, radial fractures and zonal Synerisis cracks are filled, while the  $\{001\}$  plane in pyrite is most susceptible.



x25

Several long, narrow, well-defined, filled fractures cut across entire specimens. The angular inclusions of chalcopyrite and split pyrite crystal suggest that these fissures were forced open.

This fracture-filling is associated with the deposition of realgar and the final two phases of quartz.

The amount of quartz supplied in this last period of deposition was very small, as the realgar in the vugs is coated by layers of chalcedonic and crystalline quartz only one-half m.m. thick.



## Conclusions

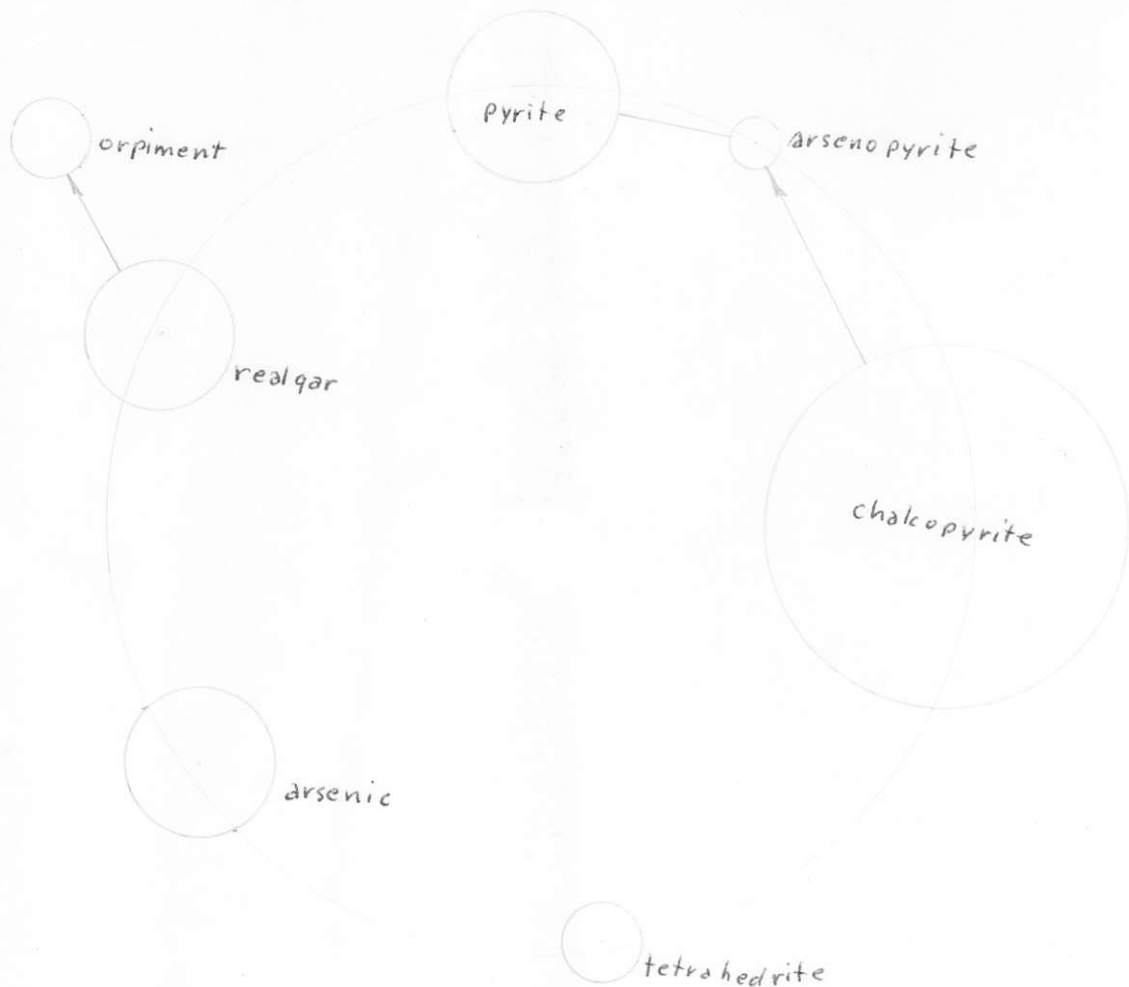
The acidic Tertiary intrusions were rich in metals, which, on cooling, were deposited in the sequential series described previously. The euhedral crystals formed on the walls of open fractures and vugs indicate an epithermal deposition at high level. High temperature is indicated by the presence of pyrite, arsenopyrite and chalcopyrite. For this reason, the deposit would more likely be termed xenothermal.

The later, high level, Mt Washington stock domed the volcanics and sediments. This probably caused the primary fracturing and the beginning of the quartz replacing the ore.

Later quartzitic dykes and conformable sills probably brought the arsenic minerals with them and caused some slight fracturing. Their associated hydrothermal solutions also bleached and broke up the existing quartzite beds to a

pale grey, friable material. The final remaining solution deposited the last two layers of chalcedonic ~~quartz~~ and finely crystalline quartz as a coating on all open fractures and vugs





van der Veen diagram illustrating  
 Paragenetic sequence and  
 Relative amounts of ore minerals at  
 Mt. Washington Copper Co.