GLY 4200C
LAB EXERCISE 9

PHOSPHATES, VANADATES, ARSENATES, TUNGSTATES, and MOLYBDATES

Phosphates, Vanadates, and Arsenates

These groups contain tetrahedral anionic groups PO_4^{3-}, VO_4^{3-}, or AsO_4^{3-}, respectively. All of these groups are tetrahedral, with a pentavalent (5+) cation. Phosphorous, vanadium, and arsenic may substitute for each other in the anionic groups. There are a large number of minerals in these groups but most are quite rare.

The most important mineral in these groups is apatite, which occurs in three varieties, fluor-, chlor-, and hydroxylapatite. These are indistinguishable in hand specimen. Uranium occurs in many phosphate group minerals, making them radioactive. The mining of phosphate ores often releases radioactivity into the environment. Houses built on or around phosphate gangue material may be plagued by high radon concentrations as a result.

Examine the following specimens:

Phosphates

APATITE	$Ca_5(PO_4)_3(F,Cl,OH)$
Pyromorphite	$Pb_5(PO_4)_3Cl$
Autenite	$Ca(UO_2)_2(PO_4)_2\cdot 10\text{-}12H_2O$
Variscite	$Al(PO_4)\cdot 2H_2O$
Turquoise	$CuAl_6(PO_4)_2(OH)_2\cdot 4H_2O$
Wavelite	$Al_3(PO_4)_2(OH)_3\cdot 5H_2O$
AMBLYGONITE	$LiAlFPO_4$
Monazite	$(Ce,La,Y,Th)PO_4$

Vanadates

Vanadinite	$Pb_5(VO_4)_3Cl$
Carnotite	$K_2(UO_2)_2(VO_4)_2\cdot 3H_2O$
Tyuyamunite	$Ca(UO_2)_2(VO_4)_2\cdot 5\text{-}8\frac{1}{2}\ H_2O$

Arsenate

*Erythite	$Co_3(AsO_4)_2\cdot 8H_2O$

* REFERENCE SPECIMEN - DO NOT TEST!

Tungstates and Molybdates

Tungsten and molybdenum ions both have a theoretical charge of 6+ and the same size (due to the lanthanide contraction of the tungsten ion). Because of the large size of these ions, the anionic groups are distorted square planar rather than tetrahedral. These groups often exhibit at least partial solid solution, as between powellite ($CaMoO_4$) and scheelite ($CaWO_4$). In primary TUNGSTATES, the minerals are nearly free of molybdenum. Secondary minerals usually contain solid solution mixtures of tungsten and molybdenum. Extensive solid solution involving both cations and anionic groups is common. Properties thus vary between those listed for the end members.

Scheelite is an example of a mineral which is usually fluorescent. It can be located in ores by this property.

Examine the following specimens:

SCHEELITE	$CaWO_4$
WULFENITE	$PbMoO_4$
HUEBNERITE	$MnWO_4$ (end member of the wolframite series)
FERBERITE	$FeWO_4$ (end member of the wolframite series)

Note: Specimens shown are probably a mixture of HUEBNERITE (brown) and FERBERITE ($FeWO_4$, black).

Reference material in text

Klein, Chapter 17, pp. 405-406 and 425-433 has information concerning the minerals in this lab. These pages should be consulted while doing this laboratory exercise.

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