APPENDIX A2

MARATHON W HORIZON PLATINUM GROUP MINERALS STUDY
PETROGRAPHIC DESCRIPTIONS OF POLISHED THIN SECTIONS

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11AV-M08A Two Duck Lake pegmatitic gabbro **W Zone High Grade Marathon M-07-304, 11m**

Description: pegmatitic gabbro with coarse tabular plagioclase intergrown with fresh anhedral (more or less interstitial) clinopyroxene and minor slightly to strongly altered Ti-magnetite exsolving ilmenite lamellae. The assemblage contains ~4% sulphides in patches consisting of chalcopyrite-bornite in myrmekitic intergrowth interstitial to the major phases. There is also pure chalcopyrite without bornite, which contains remnants of pentlandite (now altered to millerite and UM1). Rare, fine-grained euhedral cobaltite occurs in the chalcopyrite-bornite as well as small white specs that could be PGMs. One 100µm gold/electrum grain was found in the bornite. Chalycopyrite± bornite have been remobilized into the clinopyroxene where it occurs as inclusion trails in emulsion texture. The sample is generally very fresh, but magnetite is slightly to strongly altered and there is a strong alteration zone around some of the sulphide patches, consisting of red-brown secondary biotite, green amphibole (actinol. hbl ?), bladed tremolite and extremely fine-grained Mg-chlorite, the latter in direct contact to plagioclase. A few clinopyroxene grains have been heavily altered by carbonate + amphibole or chlorite + clear titanite.

Plagioclase (55%) coarse (up to 10 mm long) subhedral to anhedral tabular grains with trace slight alteration (by calcite, chlorite)

Diopside (40%) very coarse (>12 mm) fresh, anhedral, pale brown grains with anhedral inclusions of red-brown biotite and inclusion trails of emulsion textured sulphides

Biotite (tr.) 1) fine-grained anhedral red-brown inclusions in clinopyroxene 2) red-brown secondary biotite overgrowing opaques (both chalcopyrite and magnetite); possibly both the same biotite

Hornblende (tr.) rare bluish green to olive green pleochroic, altering clinopyroxene and overgrowing opaques

Tremolite (tr.) medium grained colourless, acicular to bladed masses in alteration zone rimming opaques

Mg-Chlorite (0.5%) fine-grained very pale green alteration of plagioclase and as very, very fine-grained reaction rim around plagioclase against sulphides.

Carbonate (2%) fine-grained alteration of clinopyroxene

Apatite (tr.) medium grained anhedral to subhedral elongate grains interstitial to plagioclase, smaller euhedral to subhedral grains in alteration assemblage and intergrown with sulphides

Magnetite (0.5%) fine- to medium-grained subhedral slightly altered, rounded grains with coarse ilmenite exsolution lamellae and ilmenite rims against sulphides

Ilmenite (tr.) coarse exsolution lamellae in magnetite

Titanite (tr.) fine-grained colourless euhedral grains in clinopyroxene altered by carbonate

Chalcopyrite (3-4%) yellow reflectance, anhedral patches (≤6.5 mm) interstitial to primary silicates, some show myrmekitic intergrowth with bornite

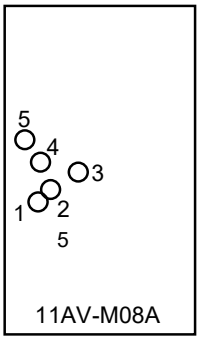
Bornite (1%) anhedral brick red in myrmekitic intergrowth with chalcopyrite

Millerite (tr.) fine-grained creamy yellow anisotropic bladed aggregates (after pentlandite ?) in chalcopyrite

Cobaltite (tr.) rare fine-grained euhedral creamy white isotropic grains in chalcopyrite

PGM ? (tr.) very fine-grained anhedral bright white refl. intergrown w. bornite

Gold (tr.) 100 µm long anhedral grain in bornite in circle



1) several euhedral to subhedral apatite grains in very, very fine-grained chlorite-tremolite alteration with minor chalcopyrite

2) small euh apatite intergrown with chalcopyrite in tremolite and larger between altered magnetite and chalcopyrite subhedral apatite in

3) two large elongate apatite grains interstitial to plagioclase and chalcopyrite-bornite containing gold inclusion, white PGMs in bornite between the apatite grains

4) euhedral elongate apatite (0.5 mm, fractured) in clinopyroxene

5) 1.4 mm anhedral apatite interstitial to plagioclase. and chalcopyrite-bornite-millerite

14AV-05A Coarse Olivine-Gabbro **W Horizon**

Description: abundant coarse, anhedral olivine is intergrown with anhedral clinopyroxene, red-brown biotite-phlogopite and abundant fresh, anhedral medium- to coarse-grained plagioclase and fine-grained euhedral apatite. Some of the olivine grains are marginally serpentinized (dark olive green) and surrounded by serpentine-tremolite-talc-magnetite-ilvaite-altered areas (possibly former orthopyroxene?). Interstices between primary minerals are filled with (secondary) green euhedral amphibole (actinolitic hornblende), pale green chlorite, and carbonate. Chlorite-serpentine alteration penetrates along cracks and veins into the feldspar. Minor Ti-magnetite is almost completely altered with ilmenite exsolution lamellae and intergrowths still preserved. Sulphides consist of small patches of chalcopyrite disseminated throughout and also infiltrating the alteration patches where it is typically intergrown with or surrounded by secondary magnetite. Chalcopyrite is intergrown with minor bornite containing inclusions zvyagintsevite, vysotskite, Rh-pentlandite and several small cream-coloured or white Pd-minerals including palladian gold.

Plagioclase (65%) medium- to coarse-grained, subhedral laths, partially invaded by chlorite alteration

Olivine (15%) medium to large anhedral grains, slightly marginally serpentinized with wide inclusion trails

Clinopyroxene (8%) fine- to medium-grained, brown, anhedral rounded to lobed grains, surrounding olivine

Orthopyroxene (tr.) medium-grained, anhedral, associated with olivine, completely replaced by serpentine-tremolite-talc-magnetite assemblage

Biotite-Phlogopite (1.5%) fine- to medium-grained, red-brown, anhedral, in interstices associated with green amphibole

Actinolitic Hornblende (1.5%) green euhedral bladed aggregates in chlorite-carbonate-filled interstices

Chlorite (3%) fine-grained pale green masses filling interstices and cracks and vein in feldspar

Serpentine (2%) a) dark olive green rims and veins in olivine; b) colourless to pale yellow parallel textured fibrous masses with grey ifc. replacing orthopyroxene ?

Talc ? (tr.) extremely fine-grained high ifc. flaky masses intergrown with magnetite in orthopyroxene pseudomorphs

Tremolite (2%) acicular parallel textured colourless masses intergrown with serpentine/talc-magnetite in pseudomorphs after orthopyroxene?

Carbonate (1%) colourless anhedral, monocrystalline fill of interstices together with chlorite, actinolite

Apatite (tr.) rare fine-grained euhedral in plagioclase

Ti-Magnetite (tr.) fine-grained anhedral grains intergrown with ilmenite, almost completely altered

Magnetite (tr.) fine granular secondary in orthopyroxene alteration patches, intergrown with chalcopyrite, ilvaite, tremolite-talc

Ilmenite (tr.) fine-grained, opaque, pinkish grey reflecting anhedral grains intergrown with magnetite

Ilvaite (tr.) dark brown barely translucent with distinctive bluish grey reflectance intergrown with tremolite-magnetite in alteration patches

Chalcopyrite (1%) yellow reflecting anhedral patches intergrown with pyrrhotite

Bornite (tr.) brick red to tan, anhedral intergrown with chalcopyrite

Pyrrhotite (tr.) rare, pinkish cream reflectance, intergrown with chalcopyrite

Pentlandite (tr.) as fine-grained cream-coloured inclusions in chalcopyrite

Vysotskite [(Pd,Ni)S](tr.) light creamy grey euhedral prismatic grains in aggregates

Zvyagintsevite [$Pd_3(Pb,Sn)$] fine-grained bright white, hard same appearance as isoferroplaltinum

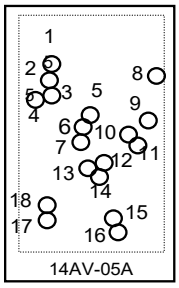
Keithconnite [$Pd_{3-x}Te$] dull cream

Isoferroplatinum [Pt_3Fe] bright white, hard rectangular or drop-shaped grains

Coldwellite [Pd_3Ag_2S] (tr.) very fine-grained creamy yellow inclusion in chalcopyrite

Palladian Gold (tr.) very fine-grained (≤25 μm), soft, bright cream, intergrown with chalcopyrite

Rh-pentlandite (tr.) very fine-grained, hard, very light creamy grey intergrown with chalcopyrite



1) palladian gold [**F348**] in tiny chlorite bleb (with Pd_3Te) in plagioclase adjacent to chalcopyrite-bornite patch with two bright zvyagintsevite inclusions; also two bright white reflecting anhedral bits between large apatite and biotite at rim

2) **F807**, triangular Rh-pentlandite intergrown with chalcopyrite in plagioclase between calcite and chlorite; also another tiny creamy white zvyagintsevite in chlorite veining plagioclase

3) rhomb shaped composite grain with creamy white bulk (zvyagintsevite) enclosing light grey Rh-sulphides and pyrrhotite-coloured keithconnite, as well as soft cream palladian gold; **F1408** palladian gold (soft, light cream) intergrown with ? at tip of extension along amphibole edge

4) large subhedral creamy white, hard isoferroplatinum and a tiny composite grain further in **F1419**: grey Rh-pentlandite intergrown with chalcopyrite on one side and inhomogeneous soft creamy white zvyagintsevite with even brighter wispy inclusion (only visible in BSE) on other side.

5) **F1718** - two bright white elongate bits in tremolite near rim, one is palladian gold, the other zvyagintsevite; also wispy light grey vysotskite integrown with magnetite and pinkish cream pyrrhotite? in tremolite alteration in centre of circle; Ge-bearing keithcponnite or törnroosite at edge of circle

6) tiny bright white rounded grain (isoferroplatinum) intergrown with tiny chalcopyrite in chlorite adjacent to small biotite; another less bright creamy white squarish grain near rim is **F1769** (unknown Rh-sulphide)

7) hard white euhedral grain of isoferroplatinum in edge of chalcopyrite, another off white/dull cream-coloured grain (coldwellite?) associated with chalcopyrite near edge

8) **F394** - tiny rounded bright light cream isoferroplatinum intergrown with palladian gold, zvyagintsevite and keithconnite associated with chalcopyrite in chlorite near tremolite

9) chalcopyrite intergrown with very pale tan bornite (non-stoichiometric ?) and chlorite rosettes

10) light gre**y** unknown Rh-sulphide [**F1800**] hosting white thin zvyagintsevite flakes and less bright solid grain included in chalcopyrite at edge of chlorite filled pocket in plagioclase; also two hard white square zvyagintsevite grains in bornite at edge

11) light grey oval keithconnite intergrown with white isoferroplatinum (containing rusty brown bornite inclusions) in chlorite adjacent to bornite with cream-coloured inclusion

12) white drop-shaped grain in bornite near edge

13) bornite with inclusions of light grey euhedral vystotskite (zoned to braggite) intergrown with poikilitic creamy white zvyagintsevite and digenite; squarish pentlandite in bornite

14) **F1976** dark cream-coloured keithconnite inclusion in pentlandite (almost same colour, with tiny inclusions of telargpalite (?); pentlandite intergrown with magnetite

15) small hard squarish creamy white zvyagintsevite at edge of chalcopyrite; isoferroplatinum at edge of circle

16) creamy white rounded isoferroplatinum grain in chalcopyrite in centre

17) creamy white zvyagintsevite veining pyrrhotite-coloured patch of Pd-As-tellurides intergrown with millerite and chalcopyrite; anhedral pale tan bornite bits and small coldwellite in chalcopyrite

18) creamy white drop-shaped isoferroplatinum grain in carbonate-hornblende outside chalcopyrite

14AV-06A coarse Gabbro **W Horizon**

Description: abundant fresh, anhedral medium- to coarse-grained plagioclase is intergrown with coarse anhedral clinopyroxene, green hornblende, fairly coarse subhedral to euhedral apatite, trace red-brown biotite-phlogopite, anhedral magnetite-ilmenite, and minor sulphides. An alteration assemblage consisting of carbonate (calcite/dolomite), pale brownish chlorite, clinozoisite and titanite has invaded interstices and caused considerable alteration of adjacent primary minerals, which in other areas appear fresh. Sulphides consist of patches of chalcopyrite in myrmekitic intergrowth bornite containing inclusions of millerite, maucherite, Pd-arsenides, kotulskite, sperrylite and several other very small cream-coloured or white UM.

Plagioclase (40%) coarse anhedral (≤7 mm long), only altered where affected by carbonate-chlorite alteration

Clinopyroxene (40%) coarse-grained, anhedral rounded pale brown grains mottled by red-brown biotite

Hornblende (8%) coarse, euhedral to anhedral, intense grassy green with inhomogeneous colour distribution (irregularly zoned), discoloured rims or overgrowths intergrown with sulphides

Carbonate (2-3%) colourless, anhedral, filling interstices, intergrown with chlorite, titanite, amphibole, altering primary silicates

Biotite-Phlogopite (1%) red-brown anhedral intergrown with opaques (magnetite-ilmenite) and fine-grained, anhedral mottling clinopyroxene

Chlorite (2%) fine-grained pale green to brown in aggregates intergrown with carbonate, as alteration around primary silicates; jeans blue interference colours

Titanite (tr.) almost colourless, fine-grained, euhedral high relief rhomb shaped grains in carbonate, amphibole and FeTi-oxides

Apatite (1%) clear, colourless, fine- to medium-grained (≤3.5 mm long) euhedral to subhedral grains intergrown with plagioclase, hornblende and sulphides

Ti-Magnetite (tr.) rare, fine-grained, anhedral interstitial to clinopyroxene, partly altered with resistant ilmenite exsolution lamellae

Chalcopyrite (3%) yellow reflecting anhedral patches in myrmekitic intergrowth with bornite, marginally intergrown with colourless amphibole or chlorite

Bornite (2%) in myrmekitic intergrowth with chalcopyrite, filling cracks and veins in silicates

Maucherite (tr.) large creamy white, slightly anisotropic host of PGMs and gold

Millerite (tr.) fine-grained dull cream (with bubbles on surface), strongly anisotropic (yellow-purple) , anhedral, intergrown with bornite in chalcopyrite

Isomeriteite (tr.) bright cream with yellowish tinge, rounded anhedral intergrown with UM2 in bornite, isotropic (beige) not millerite

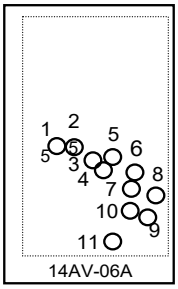
Menshikovite (tr.) bright creamy white, rounded anhedral intergrown with UM1 in bornite, anisotropic (beige-purplish) not millerite, up to 120 µm long

Kotulskite (tr.) fine-grained creamy with slight anisotropy (rose pink), hosting gold

Sperrylite (tr.) bright white, hard, anhedral, arsenide intergrown with chalcopyrite

Cobaltite (tr.) bright white, hard, euhedral, hosting gold

Hessite (tr.) very fine-grained anhedral dirty grey intergrown with UMs in chalcopyrite



1) millerite intergrown with bornite in chalcopyrite adjacent to coarse apatite

2) white elongate mertieite intergrown with grey hessite and bornite adjacent to hole in carbonate

3) isomertieite and menshikovite intergrown with each other and kotulskite (same colour but softer than isomertieite) at edge of bornite against chlorite; also minute hessite and ? red-brownish reflecting bornite?

4) large bright white anisotropic menshikovite in bornite in hornblende

5) minute gold intergrown with bornite-digenite at edge of hornblende

6) millerite intergrown with bornite at edge of chalcopyrite intergrown with amphibole

7) hard, white ring-shaped sperrylite in chalcopyrite near rim; composite grain with greyish cream menshikovite with pale yellow kotulskite spots and light grey hollingworthite intergrown with chalcopyrite and bornite in centre of circle

8) electrum and hard white sperrylite in creamy maucherite in chalcopyrite intergrown with bornite and clinozoisite in plagioclase

9) gold associated with creamy kotulskitein chlorite-altered plagioclase intergrown with chalcopyrite-bornite

10) gold in centre of euhedral white cobaltite in chalcopyrite and soft creamy millerite in bornite-chalcopyrite further down

11) creamy white maucherite intergrown with bornite near apatite, more UMs in alt. plagioclase

12) oval composite grain with kotulskite intergrown with gold

13) inclusions of gold and kotulskite in large maucherite in chalcopyrite with myrmekitic bornite

14AV-06B coarse Olivine-Clinopyroxenite **W Horizon**

Description: abundant anhedral, coarse pale brown clinopyroxene is intergrown with coarse anhedral olivine and minor plagioclase. There are extensive alteration patches (after orthopyroxene or olivine?) surrounding olivine, consisting of extremely fine-grained serpentine/talc-tremolite, as well as dark brown serpentine-like alteration surrounding and veining the large olivine grains. Interstices between primary minerals are filled with conspicuously zoned red-brown to green euhedral hornblende with colourless tips intergrown with carbonate. Hornblende is overgrown by and partly replaced by colourless tremolite-actinolite. A few fine- to medium-grained rounded anhedral apatite grains and Ti-magnetite intergrown with ilmenite occur as minor minerals interstitial to the major primary minerals. Very small euhedral rounded Cr-spinel grains were found in clinopyroxene and alteration patches. However, most opaques in the alteration patches are secondary magnetite and diffuse chalcopyrite that has infiltrated the alteration assemblage. Larger patches of chalcopyrite ± bornite are intergrown with euhedral bladed amphibole (hornblende-actinolite). Also part of the ore assemblage are white to pale pinkish arsenides (interstitial to tremolite), pale creamy yellow millerite (at the edge of chalcopyrite) and rare gold/electrum.

Plagioclase (4%) coarse, subhedral to anhedral laths intergrown with clinopyroxene

Olivine (5%) coarse anhedral, veined, rimmed and partly replaced by dark brown alteration mineral

Clinopyroxene (70%) coarse-grained, anhedral rounded pale brown grains mottled by red-brown hornblende±biotite

Hornblende (5%) coarse, euhedral, zoned from red-brown cores to intense grassy green to blue-green rims with colourless tips (tremolite?), intergrown with carbonate in interstices between clinopyroxene

Carbonate (1%) colourless, anhedral, filling interstices, intergrown with amphibole

Biotite-Phlogopite (tr.) rare, red-brown anhedral mottling clinopyroxene

UM alteration (5%) deep red-brown alteration phase with chippy texture (lots of broken out bits) intergrown with secondary magnetite, replacing olivine (?)

Talc (1%) colourless, very fine-grained, micaceous masses replacing red-brown alteration, intergrown with magnetite and tremolite

Tremolite (2%) colourless, fine-grained, acicular to bladed forming tips of hornblende crystals and partly replacing hornblende, also as very fine-grained acicular masses intergrown with talc, secondary magnetite and sulphides/arsenides

Apatite (tr.) clear, colourless, fine-grained anhedral grains in interstices between clinopyroxene, plagioclase

Ti-Magnetite (tr.) fine-grained, anhedral interstitial to clinopyroxene, partly altered with resistant ilmenite exsolution lamellae

Ilvaite (1%) very dark brown, barely translucent bladed masses in alteration patches, intergrown with magnetite, talc, tremolite

Chalcopyrite (2%) yellow reflecting anhedral patches with inclusions of bornite, millerite; intergrowth with colourless amphibole

Bornite (tr.) in (myrmekitic) intergrowth with chalcopyrite, as discrete anhedral inclusions in silicates

Millerite (tr.) light creamy yellow (with bubbles on surface), strongly anisotropic (yellow-blue), anhedral, at edge of chalcopyrite

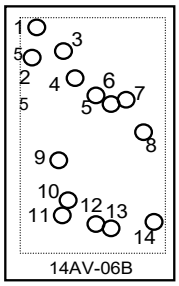
Maucherite (tr.) dull white, anisotropic intergrown with chalcopyrite, bornite interstitial to tremolite

Gold/Electrum (tr.) tiny (a few µm) spec surrounded by UM in chalcopyrite

Sperrylite (tr.) bright white, hard, subhedral, isotropic squarish grains intergrown with bornite

Moncheite (tr.) very fine-grained, very light grey anhedral intergrown with millerite in chalcopyrite

Menshikovite(tr.) creamy white, anhedral isotropic, same hardness as chalcopyrite, bornite



1) small, isometric, white, euhedral pentlandite crystals in ilvaite-magnetite alteration patch (photo 11)

2) kotulskite (intergrown with very light grey UM5) at edge of chalcopyrite with inclusions of bornite, sphalerite *Note: patches of old C-coating*

3) chalcopyrite intergrown with tremolite-talc in alteration patch; tiny round light yellow or cream kotulskite in chalcopyrite in centre *(obscured by ink splat*); sphalerite inclusion near edge of circle

4) creamy white maucherite intergrown with chalcopyrite and bornite (same hardness)

5) white and slightly pink tinged arsenide (menshikovite or majakite) intergrown with bornite and tremolite; F2089 tiny area where telargpalite (soft, light grey similar to hessite) is intergrown with maucherite and bornite

6) hard white anhedral sperrylite with bornite inclusion in biotite surrounded by bornite, Ti-magnetite, hornblende

7) two rhomb-shaped euhedral sperrylite grains in chalcopyrite near Ti-magnetite and one at edge of circle (opposite side)

8) white maucherite ± kotulskite and bornite intergrown with fine-grained tremolite-talc, blue bornite at top of circle

9) white arsenides (maucherite, menshikovite and sperrylite) and bornite, chalcopyrite intergrown with tremolite in pocket in clinopyroxene

10) blue Ag-chalcopyrite blob in clinopyroxene and bright white tiny round isoferroplartinum grain in biotite, and creamy white anhedral majakite grains in crack and intergrown with chalcopyrite-bornite

11) pentlandite intergrown with chalcopyrite and extremely small Rh-pentlandite specs at grain boundary (too small to probe) **F6218,** in red-brown hornblende in clinopyroxene

12) tiny electrum spec in pale yellow millerite in rim of chalcopyrite

13) electrum in light grey moncheite ($PtTe_2$) in chalcopyrite with bornite and millerite inclusions, white anhedral grain (Pd-As) in red-brown alteration UM

14) majakite intergrown with isomertieite in gangue

14AV-07A Coarse gabbro (mineralized) W Horizon

Description: very coarse anhedral clinopyroxene, orthopyroxene, olivine and plagioclase are intergrown with each other and minor but fairly coarse apatite. Fine-grained anhedral red-brown amphibole and biotite mottle clinopyroxene and red-brown biotite surrounds Fe-Ti-oxides. The olivine is rimmed and veined by dark olive green alteration (presumably serpentine?) and plagioclase is marginally altered by chlorite/tremolite and overprinted by trace clinozoisite. Coarse anhedral magnetite is associated with sulphides which form large anhedral patches and consist mainly of chalcopyrite intergrown with minor pentlandite remnants, millerite and coarse anhedral Ti-magnetite (± ilmenite). Several Pd- and Rh-minerals occur intergrown with millerite, pentlandite and chalcopyrite and in cracks in magnetite.

Olivine (8%) coarse anhedral, veined, rimmed and marginally replaced by dark olive alteration mineral

Clinopyroxene (46%) coarse-grained, anhedral rounded pale brown grains mottled by red-brown hornblende± biotite

Plagioclase (26%) coarse, anhedral laths intergrown with clinopyroxene, olivine

Hornblende (tr.) very fine-grained, anhedral, red-brown to tan, mottling clinopyroxene

Biotite-Phlogopite (tr.) rare, red-brown anhedral mottling clinopyroxene and rimming Ti-magnetite/ilmenite

Tremolite (tr.) very fine-grained, colourless felted acicular aggregates in alteration pockets interstitial to primary silicates

Clinozoisite (tr.) very fine-grained, colourless, anhedral, overprinting plagioclase

Serpentine (tr) deep olive alteration rimming and veining olivine

Chlorite (tr) colourless to pale green, fuzzy alteration rimming and veining silicates

Apatite (1%) clear, colourless, medium-grained euhedral grains intergrown with primary silicates

Ti-Magnetite + Ilmenite (13%) medium- to coarse-grained, lobed, anhedral, with ilmenite exsolution lamellae intergrown with ilmenite and chalcopyrite

Magnetite (tr.) secondary rimming and veining chalcopyrite

Chalcopyrite (5%) yellow reflecting anhedral patches with inclusions of pentlandite, millerite; intergrown with coarse magnetite

Bornite (tr.) in (myrmekitic) intergrowth with chalcopyrite, as discrete anhedral inclusions in silicates

Millerite (tr.) light creamy yellow (with bubbles on surface), strongly anisotropic (yellow-blue), anhedral, at edge of chalcopyrite

Pentlandite (tr.) partly resorbed cream-coloured remnants in chalcopyrite

Palladian gold (tr.) very fine-grained, soft, cream, tiny (a few µm) spec intergrown with isoferroplatinum in chalcopyrite, also in cracks in magnetite

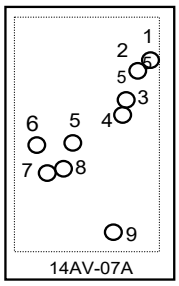
Coldwellite (tr.) soft, light grey myrmekitic intergrown with millerite in chalcopyrite

unknown Rh-FeNiCu-sulphide (tr.) light greyish cream lamella in chalcopyrite

Isoferroplatinum (tr.) bright white, hard, euhedral, isotropic grains in chalcopyrite

Pd-Te (tr.) very fine-grained, very light creamy grey anhedral intergrown with millerite in chalcopyrite

UM6 (tr.) creamy white, anhedral isotropic, same hardness as chalcopyrite, bornite



1) white isoferroplatinum intergrown with palladian gold, cuprian palladian gold and bornite, chalcopyrite at edge of large magnetite; pentlandite remnants in chalcopyrite (**F114)**

2) soft, light grey myrmekitic coldwellite intergrown with millerite (**F337**)

3) euhedral isoferroplatinum with adjacent light creamy grey keithconnite in chalcopyrite

4) secondary magnetite rimming pentlandite remnants in chalcopyrite and chalcopyrite itself; tiny coldwellite and larger sphalerite inclusions in chalcopyrite

5) light grey RhFeNiCu-sulphide lamellae (**F1905**) in chalcopyrite as well as rectangular light cream-coloured grain (stillwaterite; **F1905**) with hard light grey inclusions at other end of same chalcopyrite; also hessite in millerite in other inclusion in large plagioclase (**F1910**)

6) light grey mineral (vysotskite) intergrown with acicular millerite at edge of chalcopyrite

7) zvyagintsevite in chalcopyrite-millerite-polydymite at edge of large magnetite

8) Pd-gold and Rh-minerals in crack in magnetite emanating from coarse euh pentlandite rimmed by sec. magnetite in chalcopyrite

9) pentlandite and creamy white ? in bornite-chalcopyrite; UMs in smaller chalcopyrite-bornite closer to coarse magnetite

14AV-08 Mineralized Olivine Gabbro **W Horizon**

Description: abundant coarse, subhedral rounded plagioclase is intergrown with oikocrystic clinopyroxene, anhedral olivine and coarse Ti-magnetite in ophitic texture. Olivine is comparatively fresh but rimmed and veined by dark olive green serpentine and a necklace of secondary magnetite in talc/tremolite. Also present are extensive alteration patches (after clinopyroxene?) filled with green chlorite, talc ? and felted green actinolite surrounding red-brown remnants of primary biotite-phlogopite, and trace calcite. Trace anhedral epidote overprints altered plagioclase, that is veined by chlorite-actinolite. Minor chalcopyrite patches occur associated with magnetite and interstitial to and to a lesser degree in plagioclase. Myrmekitic intergrowth of chalcopyrite and magnetite with plagioclase and of titanite with plagioclase can be found in some areas.

Plagioclase (60%) coarse, subhedral to anhedral laths intergrown with clinopyroxene, ol, magnetite

Olivine (5%) coarse anhedral, veined, rimmed and partly replaced by olive brown serpentine, and talc + magnetite

Clinopyroxene (20%) coarse-grained, anhedral rounded pale brown grains mottled by red-brown hornblende± biotite

Biotite-Phlogopite (0.5%) deep red-brown anhedral in alteration patches (probably primary relicts)

Talc (tr.) colourless, very fine-grained, micaceous masses surrounding serpentine alteration around olivine, intergrown with secondary magnetite, chalcopyrite

Actinolite (5%) colourless to blue-green, fine-grained, acicular forming felted masses in alteration patches

Epidote (tr.) fine-grained colourless medium-relief anhedral aggregates overprinting plagioclase

Apatite (tr.) clear, colourless, fine-grained anhedral grains in interstices between clinopyroxene, plagioclase

Carbonate (tr.) colourless, anhedral, in cracks in plagioclase

Ti-Magnetite (5%) coarse-grained, anhedral lobed, enclosing plagioclase, partly altered with more resistant ilmenite exsolution lamellae

Chalcopyrite (1%) yellow reflecting anhedral patches with inclusions of bornite, millerite; intergrowth with colourless amphibole

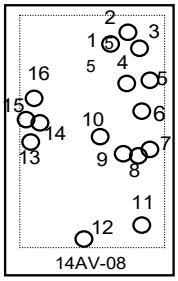
Pentlandite ?? (tr.) light creamy yellow isotropic, anhedral, at edge of chalcopyrite

Ag-pentlandite (tr.) pale rose brown inclusions in chalcopyrite

Isoferroplatinum or sperrylite (tr.) bright white, hard, subhedral, isotropic squarish grains intergrown with chalcopyrite

UM5 (tr.) very fine-grained, very light grey anhedral intergrown with chalcopyrite

UM6 (tr.) soft, creamy white, anhedral isotropic, same hardness as chalcopyrite, bornite



1) suspicious sulphides in inclusion trails in coarse magnetite *(not analyzed, too small)*

2) cream Rh-pentlandite and pyrrhotite inclusions in chalcopyrite in ilmenite in coarse anh magnetite

3) composite grain with light grey ferrorhodsite and white zvyagintsevite bracketing palladian gold and keithconnite, together with folded chalcopyrite in biotite; dark cream jig-saw-shaped grain at bottom is Pd-Te;

4) creamy yellow Pd-rich pentlandite in chalcopyrite (almost same colour)

5) Ag-pentlandite in chalcopyrite at left and Ag-chalcopyrite in chalcopyrite at right, pentlandite in between in actinolite

6) mottled cream grain of keithconnite at end of pentlandite (same colour) at end of chalcopyrite surrounded. by biotite-phlogopite

7) clausthalite in epidote-altered plagioclase

8) chalcopyrite and creamy white zvyagintsevite intergrown with grey laflammeite and gold in gangue (actinolite)

9) bright white zvyaginstevite grain in actinolite in centre surrounded by chalcopyrite

10) tiny composite grain in olivine w. very bright little zvyagintsevite spots in light grey Rh-FeNi-Cu-sulphide intergrown with chalcopyrite

11) small round composite grain in chlorite-altered plagioclase

12) dull cream and lighter cream grains (pyrrhotite and pentlandite) intergrown with sec. magnetite in tremolite alteration halo

13) white elongate zvyagintsevite in chalcopyrite (photo 3)

14) light grey laflammeite and bright cream zvyagintsevite at rim of chalcopyrite with chalcopyrite-speckeld sphalerite; tiny creamy white UM(s) in other chalcopyrite

15) chalcopyrite and soft bright cream zvyagintsevite intergrown with palladian gold and pentlanidte interstitial to tremolite

16) suspicious very tiny white spec in chalcopyrite and sec. magnetite in myrmekitic intergrowth with serpentine