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K15-297 293.1-293.22m: SEMI-MASSIVE PYRITE-SPHALERITE-MINOR GALENA-MAGNETITE-TRACE CHALCOPYRITE (RARE SULFOSALTS, TETRAHEDRITE AND UNIDENTIFIED?) IN GANGUE OF CARBONATE-LOCAL QUARTZ-MINOR CHLORITE

Hand sample not supplied; etched offcut shows fine-grained, grey, crudely banded/laminated semi-massive sulfide composed mainly of pyrite and sphalerite in abundant carbonate gangue. The rock is distinctly magnetic, shows widespread but slow reaction to cold dilute HCl (except veins), and no stain for K-feldspar in the etched offcut. Modal mineralogy in polished thin section is roughly:

Gangue (60%)

Carbonate (mainly calcite/dolomite?)	85%
Quartz (mainly in central band/vein)	13%
Chlorite	2%

Ore (40%)

Pyrite	75%
Sphalerite	20%
Galena	2%
Magnetite	2%
Chalcopyrite	<1%
Sulfosalt1 (Pb-Sb, Bi or Ag?)	<1%
Sulfosalt2 (tetrahedrite?)	<1%

Gangue minerals are dominated by carbonate, forming sub- to rarely euhedral crystals mainly in the 0.5 mm (locally <0.1, or less commonly up to almost 1 mm) range. The carbonate species is difficult to be sure of due to the HF attack damaging the surface and making it less reactive; it may include calcite and dolomite (?). Minor quartz forms subhedral, mostly <0.5 mm crystals except in a central band/vein with irregular anhedra up to 1 mm, in aggregates to ~3 mm long. Most crystals are apparently relatively unstrained; even the larger ones show only mild undulose extinction with no sub-grain development or suturing of grain boundaries, but are locally cut by hairline fractures of chlorite (minute flakes <15 μm). Scattered coarse euhedral flakes of chlorite are randomly oriented, up to about 1 mm, with pale green pleochroism and length-slow, low to moderate birefringence suggestive of F:M slightly more than 0.5 (or it may replace relict biotite) There are also patches of the very fine-grained chlorite (minute flakes <15 μm) with pale yellow-brownish/greenish pleochroism and length-slow, but low, birefringence; similar material replaces magnetite along fractures.

Ore minerals are crudely arranged in bands or laminations mostly <2 mm thick but loosely aggregating to about 0.5 cm thick, highlighted by compositional variation (pyrite-rich, sphalerite-galena rich, or rarely carbonate-rich, minor chalcopyrite-sulfosalts bearing). Magnetite is widely scattered as subhedra <0.5 mm, mainly in sulfide-rich bands. Much pyrite occurs within what is almost a matrix of sphalerite and minor galena, and locally, fine sphalerite or galena is included in pyrite.

Pyrite forms generally cubic euhedra up to about 1 mm in diameter, locally aggregating to 2 mm. Sphalerite forms somewhat rounded sub- to rarely euhedral crystals mostly <0.75 mm in diameter but commonly in aggregates up to several mm thick, elongated in the plane of banding and intergrown with galena as irregular masses mostly <0.5 mm. Sphalerite shows medium red-brown colour suggestive of moderate Fe content, and only rarely contains chalcopyrite <50 μm. Most chalcopyrite occurs as subhedra <0.3 mm intergrown with sphalerite in the carbonate-rich band/vein. Sulfosalt forming stubby to elongate sub/euhedral crystals <0.5 mm long shows reflectance somewhat less than that of galena, with weak but distinct anisotropism from dark grey to medium grey under crossed polars. In plane light, it shows slightly olive-greenish tints compared to galena, and could be any one of a wide variety of Pb-Sb, Bi or Ag-bearing sulfosalts, only determinable by SEM or microprobe studies. A different sulfosalt (grey, apparently isotropic) forming subhedra <0.1 mm characteristically intergrown with chalcopyrite is likely tetrahedrite (?).

In summary, this is semi-massive pyrite-sphalerite-minor galena-magnetite-trace chalcopyrite (rare sulfosalts, tetrahedrite and unidentified?) in gangue of carbonate-local quartz-minor chlorite. Chalcopyrite and sulfosalts are mostly in a coarser, carbonate-quartz rich band.

K15-297 296.66-296.8m: MASSIVE PYRITE-SPHALERITE-MINOR CHALCOPYRITE-GALENA-ARSENOPYRITE-TRACE PYRRHOTITE-MAGNETITE (RARE SULFOSALT, TETRAHEDRITE?) IN GANGUE OF CARBONATE-QUARTZ-MINOR CHLORITE-SERICITE

Hand sample not supplied; etched offcut shows fine-grained, grey, crudely banded/laminated massive sulfide composed mainly of pyrite and sphalerite in abundant carbonate gangue. The rock is locally magnetic, shows widespread slow reaction to cold dilute HCl (where scratched), and no stain for K-feldspar in the etched offcut. Modal mineralogy in polished thin section is roughly:

Gangue (40%)

Carbonate (mainly dolomite?)	50%
Quartz (most abundant in remobilized band/veins)	47%
Chlorite	2%
Sericite/muscovite	1%

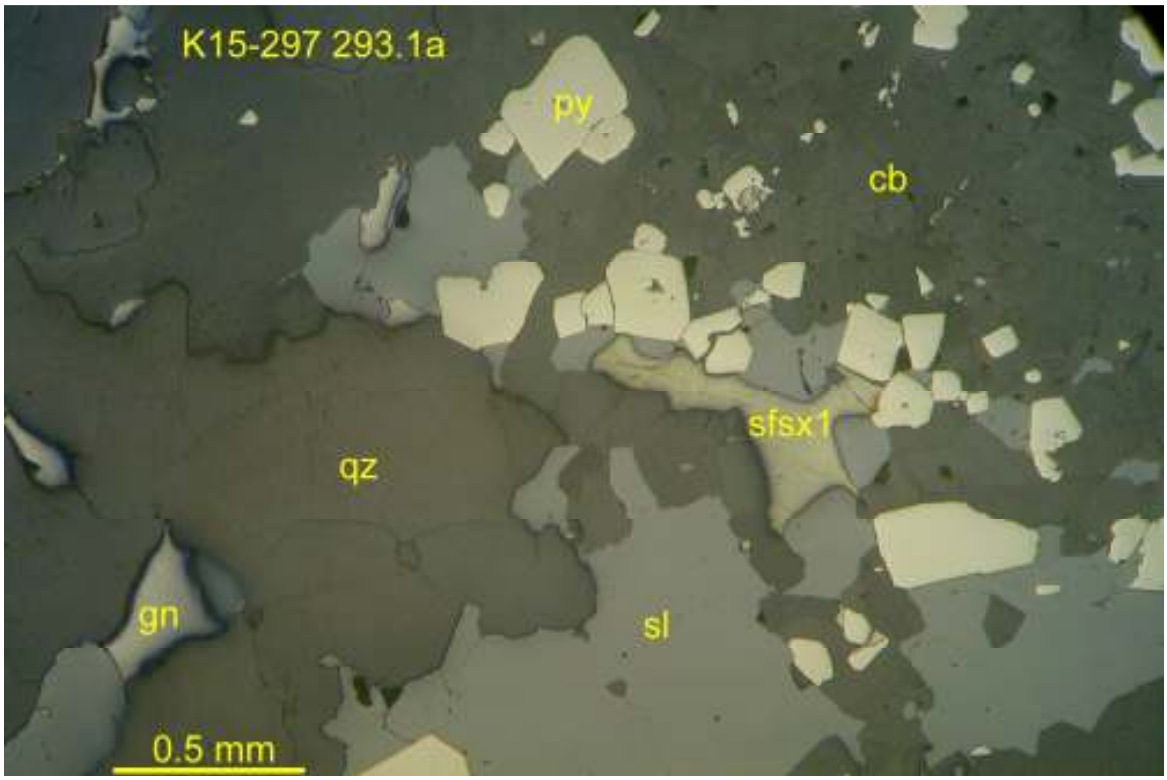
Ore (60%)

Pyrite	70%
Sphalerite	15%
Chalcopyrite	~5%
Galena	~5%
Arsenopyrite	3-5%
Pyrrhotite (locally partly altered to marcasite)	~1%
Magnetite (relict, partly altered to sphene?)	<1%
Sulfosalt (tetrahedrite?)	<1%

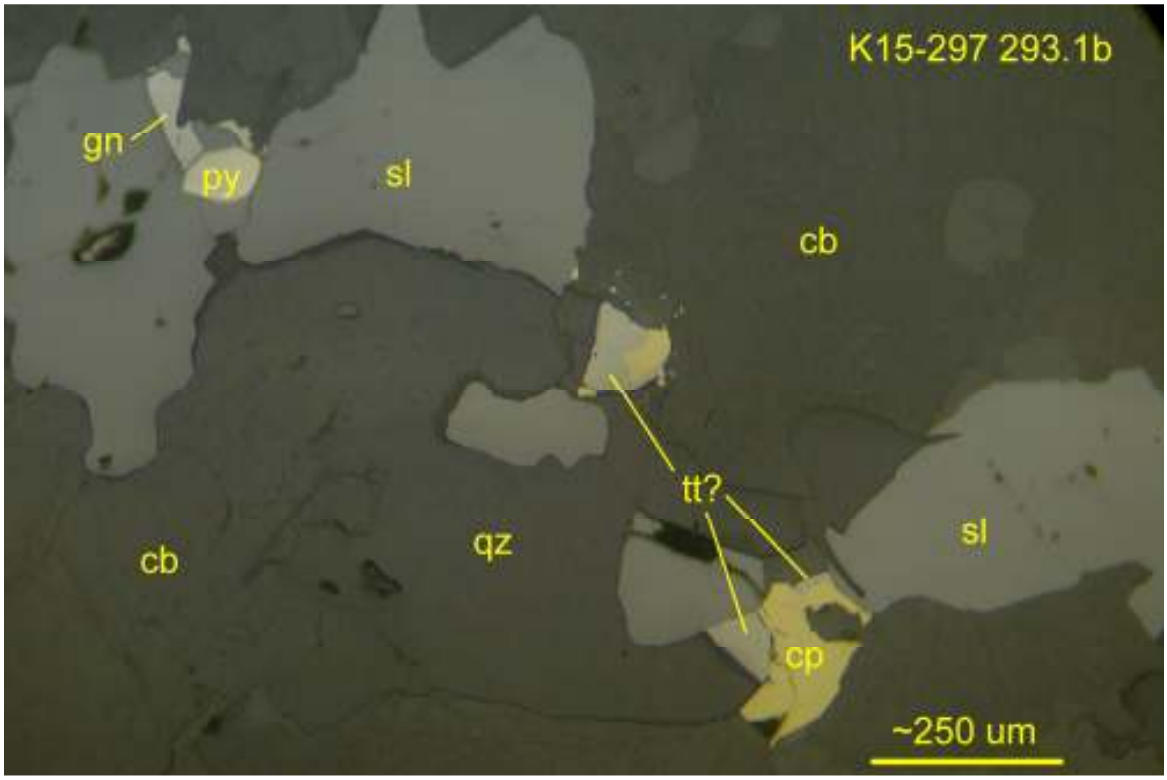
Gangue minerals are roughly equal proportions of carbonate (subhedral to ragged anhedral crystals mainly in the 0.5 to almost 1 mm range, likely mainly dolomite?) and quartz (subhedra to anhedra to 1.2 mm, aggregates to 2 mm). Most quartz crystals show only mild strain (indicated by only mild undulose extinction with no sub-grain development or suturing of grain boundaries) but locally show triple junctions indicative of annealing post-deformation. Scattered euhedral flakes of chlorite are randomly oriented, up to about 1 mm, with pale brownish green pleochroism and length-slow, low to moderate birefringence suggestive of F:M slightly more than 0.5 (may replace relict biotite?). There are also scattered flakes of sericite/muscovite (euhedral, <0.5 mm).

Ore minerals are crudely arranged in bands or laminations mostly <2 mm thick but loosely aggregating to about 0.7 cm thick, highlighted by compositional variation (pyrite-rich, commonly with a chalcopyrite matrix, or sphalerite-galena rich, alternating with gangue-rich bands). The latter have the appearance of remobilized sulfides/gangue, with coarser chalcopyrite (associated with pyrrhotite), sphalerite, and very minor sulfosalt intergrown with galena, plus local arsenopyrite. Magnetite (relict, apparently partly replaced by sphene?) is rare as subhedra <0.5 mm. Much pyrite occurs within a semi-matrix of sphalerite and minor galena or of chalcopyrite; locally, fine sphalerite or galena is included in pyrite. Pyrite forms generally cubic euhedra up to about 1 mm, but there are bands in which they average <0.1 mm (in a matrix of galena, sphalerite or chalcopyrite; these could represent relict primary sea-floor sulfides?). Sphalerite forms somewhat rounded sub- to rarely euhedral crystals mostly <0.75 mm but commonly in aggregates up to several mm long, elongated in the plane of banding and intergrown with galena as irregular masses mostly <0.5 mm. Sphalerite shows medium red-brown colour suggestive of moderate Fe content, and only rarely contains chalcopyrite <50 μm. Most chalcopyrite occurs as subhedra <0.3 mm (matrix to pyrite) or as masses to 0.75 mm containing pyrrhotite to 0.35 mm, intergrown with sphalerite in the remobilized bands/veins. Arsenopyrite occurs as either clusters of minute (<0.1 mm) euhedra or subhedra to 0.4 mm replacing margins of adjacent pyrite, apparently also associated with the margins of the remobilized band/vein. Sulfosalt forming sub/euhedra <0.15 mm is grey, apparently isotropic (likely tetrahedrite?) and intergrown with galena and sphalerite, also possibly associated with the remobilized band/veins.

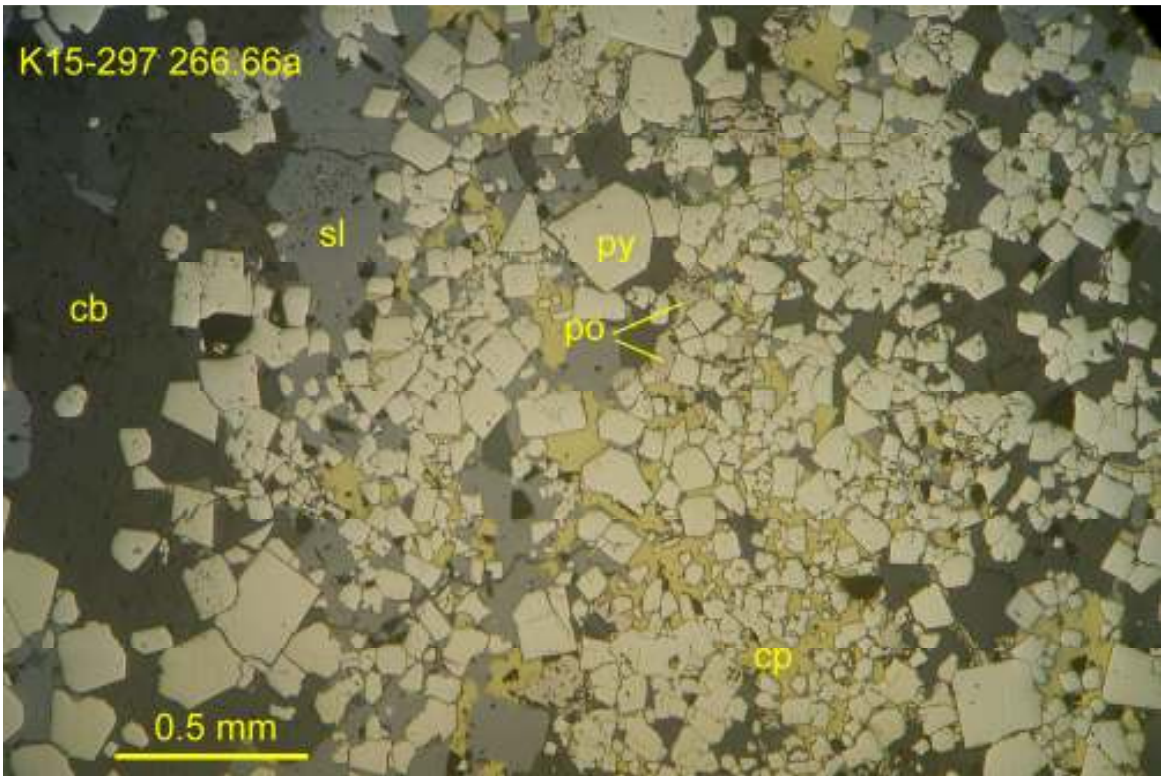
In summary, this is massive pyrite-sphalerite-minor chalcopyrite-galena-arsenopyrite-trace pyrrhotite-magnetite (rare sulfosalt, tetrahedrite?) in gangue of carbonate-quartz-minor chlorite-sericite. Arsenopyrite and sulfosalt may be mostly in remobilized carbonate-quartz rich bands.



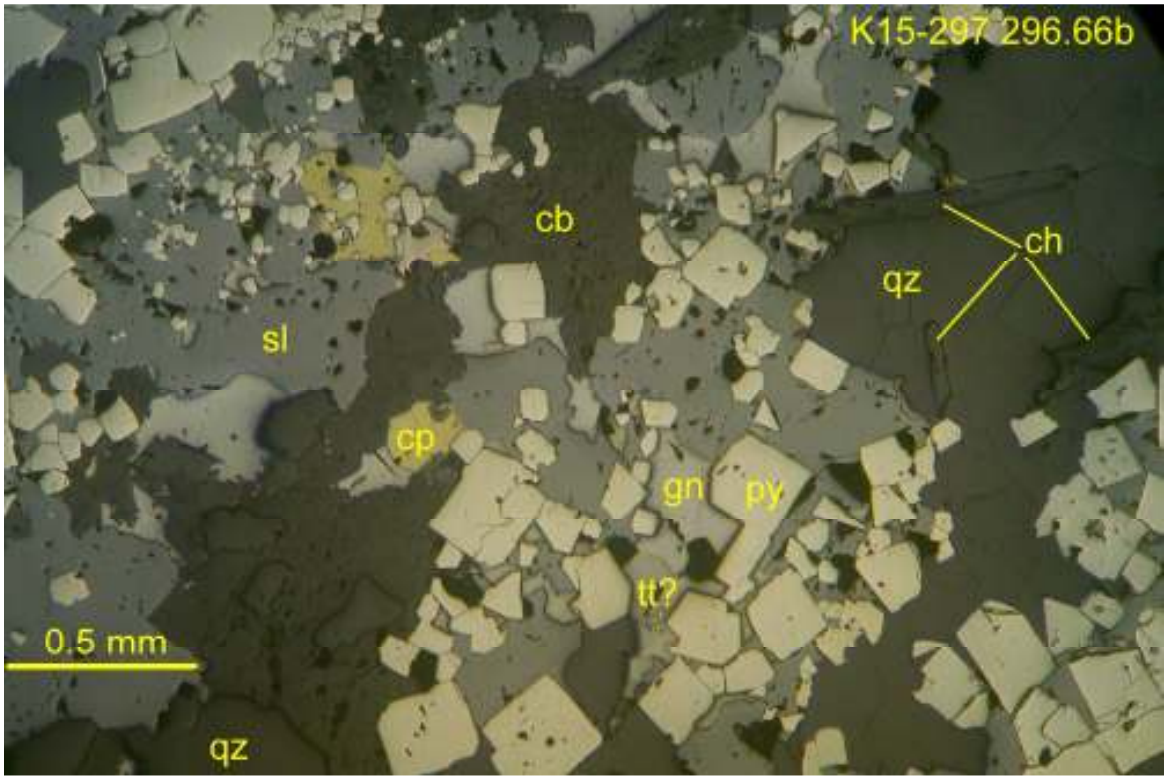
K15-297 293.1-293.22a: overview of coarse carbonate-rich band containing sphalerite, pyrite, minor galena and local sulfosalt 1 (slightly darker, with olive tint compared to galena) in gangues of carbonate and significant quartz. Reflected light, uncrossed polars, field of view ~3 mm wide.



K15-297 293.1-293.22b: detailed view to show grey, apparently isotropic sulfosalt 2 (possibly tetrahedrite?) intergrown with chalcopyrite associated with sphalerite, minor galena and pyrite, also closely associated with quartz in otherwise carbonate-rich gangue. Reflected light, uncrossed polars, field of view ~1.5 mm wide.



K15-297 296.66-296.8a: alternating pyrite-chalcopyrite or pyrite-sphalerite rich bands with gangue-rich (mainly carbonate) bands in fine-grained massive sulfides. Note minor pyrrhotite associated with chalcopyrite. Reflected light, uncrossed polars, field of view ~3 mm wide.



K15-297 296.66-296.8b: margin of possibly remobilized band with coarser chalcopyrite (±minor pyrrhotite), sphalerite, and galena (locally containing minor grey sulfosalt, possibly tetrahedrite, tt?), associated with coarser quartz, carbonate, and minor chlorite (ch) as euhedral flakes. Reflected light, uncrossed polars, field of view ~3 mm wide.