**Figure SM1:** Left, location of IOCG, IOA and porphyry deposits formed during the Upper Jurassic–Lower Cretaceous in the Atacama region (modified del Real et al.¹). Right, simplified geological map of the Candelaria-Punta del Cobre district with the main IOCG deposits (modified del Real et al.¹). Map was created by using Adobe Illustrator (v. 26.0.2)
Figure SM2: BSE images of actinolite grains analyzed by EPMA. The images show the different micro-textural types, including replacements (samples LD1687-4,-7 and-73), actinolite grains with core-to-rim chemical zoning and overgrowths (samples LD1687-16, -31, -42 and -53), chemically homogenous actinolite (samples LD1687-13, -31, -35, -63, -65 and -73), and aggregates of small actinolite crystals (samples LD1687-13, -35 and -70).
Continuation of figure SM2: BSE images of actinolite grains analyzed by EPMA. The images show the different microtextural types, including replacements (samples LD1687-4, -7 and -73), actinolite grains with core-to-rim chemical zoning and overgrowths (samples LD1687-16, -31, -42 and -53), chemically homogenous actinolite (samples LD1687-13, -31, -35, -63, -65 and -73), and aggregates of small actinolite crystals (samples LD1687-13, -35 and -70).
Figure SM3: Microphotographs of chalcopyrite and pyrite replacing magnetite from mineralized samples from the Candelaria district. Photo A corresponds to drill hole DH996 in the Santos deposit just east from the Candelaria deposit at a depth of 118.5 m from surface (Fig. SM1). The sample has chalcopyrite-pyrite disseminated and patchy mineralization with intense magnetite-biotite alteration and is hosted in the volcanic sedimentary unit of the Punta del Cobre Formation. Photo B corresponds to drill hole LE0011 south of the Candelaria open pit at a depth of 866.87 m from surface (Fig. SM1). The sample has chalcopyrite-pyrite disseminated with magnetite-feldspar-actinolite-biotite alteration and is hosted in the lower andesite unit of the Punta del Cobre Formation.
| Sample        | Depth from surface (m) | Host Rock               | Sample Description                                                                 | Actinolite description               |
|---------------|------------------------|-------------------------|------------------------------------------------------------------------------------|--------------------------------------|
| LD1687-4      | 55.4                   | Volcanic sedimentary Unit | Volcanic tuff highly altered with pink garnet alteration with a actinolite-chlorite-diopside-biotite-pyrite vein | euhedral actinolite with replacement textures |
| LD1687-7      | 91.6                   | Volcanic sedimentary Unit | Volcanic sediments replaced to intercalations of magnetite, actinolite, biotite with chalcopyrite, pyrrhotite and minor pyrite | Actinolite semi-prismatic euhedral grains |
| LD1687-13     | 203.65                 | Lower Andesite          | Lower andesite with quartz veinlets. Patches of pyrite with actinolite and surrounded by chalcopyrite-feldspar and quartz Brecciated lower andesite with intense pink feldspar alteration with epidote patches. Veins or patches of actinolite-magnetite and chalcopyrite-pyrite. Epidote patches. | Euhedral prismatic aggregates of actinolite |
| LD1687-16     | 247.65                 | Lower Andesite          | Lower Andesite with intense biotite alteration and magnetite and minor actinolite disseminated and in veins Breccia with andesite clasts and magnetite-pyrite-magnetite cement crosscut by pyrite-chalcopyrite-actinolite-magnetite veinlets | Euhedral bladed and prismatic cumulates of actinolite |
| LD1687-31     | 507.7                  | Lower Andesite          | Lower Andesite with intense magnetite alteration pervasively replacing the aphanitic matrix of the host rock. Magnetite-chalcopyrite-pyrite and actinolite-sulfide-magnetite-(albite halo) veins. | Euhedral prismatic actinolite grains |
| LD1687-35     | 585.12                 | Lower Andesite          | Lower Andesite with intense biotite alteration and magnetite and minor actinolite disseminated and in veins Breccia with andesite clasts and magnetite-pyrite-magnetite cement crosscut by pyrite-chalcopyrite-actinolite-magnetite veinlets | Euhedral prismatic actinolite grains |
| LD1687-42     | 685.7                  | Lower Andesite          | Lower Andesite with intense magnetite alteration pervasively replacing the aphanitic matrix of the host rock. Magnetite-chalcopyrite-pyrite and actinolite-sulfide-magnetite-(albite halo) veins. | Euhedral prismatic actinolite grains |
| LD1687-53     | 856.35                 | Lower Andesite          | Lower Andesite with intense magnetite alteration pervasively replacing the aphanitic matrix of the host rock. Magnetite-chalcopyrite-pyrite and actinolite-sulfide-magnetite-(albite halo) veins. | Euhedral prismatic actinolite grains |
| LD1687-63     | 1001.3                 | Lower Andesite          | Andesite breccia with pyrite-chlorite-actinolite patches and disseminated pyrite-magnetite. Volcanic rock with patches of albite-chlorite-actinolite and titanite alteration and disseminated magnetite-pyrite-epidote-feldspar-actinolite. | Euhedral prismatic actinolite grains |
| LD1687-65     | 1030.4                 | Lower Andesite          | Andesite breccia with pyrite-chlorite-actinolite patches and disseminated pyrite-magnetite. Volcanic rock with patches of albite-chlorite-actinolite and titanite alteration and disseminated magnetite-pyrite-epidote-feldspar-actinolite. | Euhedral prismatic actinolite grains |
| LD1687-70     | 1109.5                 | Lower Andesite          | Andesite with disseminated magnetite and actinolite aggregates. Andesite with disseminated magnetite and minor actinolite. Actinolite-magnetite veins with minor sulfides. | Aggregate of euhedral actinolite |
| LD1687-73     | 1132.1                 | Lower Andesite          | Andesite with disseminated magnetite and minor actinolite. Actinolite-magnetite veins with minor sulfides. | Aggregate of euhedral actinolite |

Table SM1: Sample location and description. Drill hole LD1687, located in near the center of the Candelaria mine pit. UTM coordinates are east 73430 and north 55991; elevation 474 m a.s.l.; an azimuth of 244° and a dip of -60°.
Table SM2: EPMA results, detection limits, actinolite textures and Fe#

| Actinolite texture | N  | Fe# [wt.%] | Si [wt.%] | Al [wt.%] | Fe [wt.%] | Mn [wt.%] | Ti [wt.%] | Mg [wt.%] | Ca [wt.%] | Na [wt.%] | K [wt.%] | Cl [wt.%] |
|-------------------|----|------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Core              | 76 | 0.31       | 24.57    | 1.71     | 9.54     | 0.18     | 0.15     | 9.59     | 8.92     | 0.21     | 0.11     | 0.04     |
| Rim               | 68 | 0.42       | 23.92    | 1.36     | 12.58    | 0.29     | 0.08     | 7.95     | 8.78     | 0.21     | 0.09     | 0.04     |
| Replacement Early | 21 | 0.68       | 23.4     | 1.06     | 20.22    | 1.14     | 0.18     | 4.00     | 8.28     | 0.17     | 0.19     | 0.22     |
| Replacement Late  | 19 | 0.85       | 17.66    | 5.87     | 22.20    | 1.28     | 0.11     | 1.52     | 8.12     | 0.38     | 2.09     | 2.52     |
| Cumulate          | 67 | 0.38       | 24.55    | 1.59     | 11.42    | 0.17     | 0.17     | 8.41     | 8.82     | 0.26     | 0.12     | 0.10     |
| Homogeneous       | 194| 0.34       | 23.89    | 2.19     | 10.45    | 0.23     | 0.16     | 9.01     | 8.84     | 0.24     | 0.18     | 0.06     |

N= number of analyses

Table SM3: Median results for major elements analyzed by EPMA and Fe# calculations for each texture described for the actinolite grains used in this study

| Actinolite Type          | Fe#  | Si [wt.%] | Ti [wt.%] | Al [wt.%] | Fe [wt.%] | Mn [wt.%] | Mg [wt.%] | Ca [wt.%] | Na [wt.%] | K [wt.%] | Cl [wt.%] | F [wt.%] |
|--------------------------|------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Lower Fe# (0.48-0.19)    |      |          |          |          |          |          |          |          |          |          |          |          |
| Min-max                  | 0.48 | 21.4-26.4| bdl-0.59 | 0.1-0.41 | 7.24-14.24| 0.066-1.065| 6.78-11.09| 7.08-9.35| 0.012-0.57| 0.007-0.36| bdl-0.75| bdl-0.27 |
| Median                   | 0.33 | 24.2     | 0.11     | 1.98     | 10.38    | 0.22     | 9.1      | 8.3      | 0.22     | 0.14     | 0.05     | 0.07     |
| N/bdl                    | 365/0| 365/0    | 322/43   | 365/0    | 365/0    | 365/0    | 365/0    | 365/0    | 365/0    | 23/342   | 105/260  |
| Higher Fe# (0.91-0.48)   |      |          |          |          |          |          |          |          |          |          |          |          |
| Min-max                  | 0.91 | 16.42-22.35| 0.006-0.38| 0.174-7.29| 14.23-24.57| 0.21-0.172| 1.03-6.79| 7.7-15.9| 0.026-0.93| 0.01-2.88| bdl-3.54| bdl-0.147|
| Median                   | 0.48 | 22.4     | 0.09     | 2.02     | 20.26    | 0.49     | 3.9      | 8.4      | 0.28     | 0.24     | 0.22     | 0.05     |
| N/bdl                    | 860/0| 860/0    | 860/0    | 860/0    | 860/0    | 860/0    | 860/0    | 860/0    | 860/0    | 797/47   | 53/30    |

N=number of analyses, bdl= number of analyses below detection limit

Table SM4: Range of results and median values for major elements obtained by EPMA analysis of the actinolite grains used for this study separated by Fe# cluster.
References Supplemental Material

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