Mineralogical constraints in ore processing of Li-rich pegmatites

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In recent years, lithium (Li) demand is increasing. The main ores for Li are brines and also crystaline rocks rich on Li silicate minerals and/or phosphates. In Europe, there are some regions with good potencial for Li ore production; the most important deposits are granite pegmatites and greisens and the most important minerals are spodumene, petalite, lepidolite and zinwaldite.

Under the scope of project FAME (Flexible and Mobile Economic Processing Technologies), that focuses on improving processing technologies and to recover valuable materials from low grade and/or complex feedstock's ore, two European Li ores are being investigated: lepidolite from Gonçalo (1.2% Li_2O) (Portugal) and spodumene from Keliber (1% Li_2O) (Finland).

Froth flotation is the most suitable process to produce spodumene and lepidolite concentrates and it was tested in the two referred ores, after milling below 150µm for liberation purposes. During the processing of the two ores, it was not possible to maintain a Li_2O grade, close to the mineral stoichiometry, in the concentrates, even for low recoveries: for lepidolite, 3.9% Li_2O is the maximum grade obatined for 37% Li_2O recovery, remaining practically constant, even for high recoveries; spodumene flotation exhibits a maximum grade at 5.2% Li_2O under 35% recovery, which drops significantly to 2% Li_2O for 60% recovery.

At this point, it was necessary to find out a reasonable justification for these observations, from a mineralogical point of view. Studies on Gonçalo aplite-pegmatites reveal that fine lepidolite (0.5 to 2 mm) exhibits albite and quartz micro-inclusions (<100 µm). At Keliber, spodumene occurs in the form of poikilitic crystals with graphic and symplectic intergrowths with quartz which tends to be coarser (up to 250 µm long) and sub-angular in the centers of large spodumene crystals. However, these often grade into a symplectic intergrowth of minute and rounded vermicles, myrmekite-like, in spodumene at the contact with feldspar grains. These myrmekitic textures commonly grade into fibrous intergrowths of spodumene + quartz at the margins. The described mineral associations can be one of the reasons justifying low degrees of liberation of ore minerals.