Froth Flotation

This method is used to separate feldspar and mica from quartz. It is based on the froth flotation method developed at PRIME lab
http://www.physics.purdue.edu/primelab/MSL/froth_floatation.html.

- Grain size - typically 125-710um, but you should evaluate your sample and select a size that minimizes poly-mineral grains. We have successfully processed 63-125um. Quartz with attached feldspar or mica will float, in which case smaller is better.

- You can froth as much as 300 g in one bottle, otherwise split it into 2 bottles.

Preparation and pretreatment – 1% HF leach

- Record all information in the froth flotation log.

- Weigh the sample and record the weight. (Weigh it directly into a tared 2000 ml leaching bottle. Pour the sample in the hood to reduce dust inhalation and lab contamination.)

- Rinse the sample with DI-water to remove the dust.

- Take a small split (<1g) of the rinsed sample with a spatula and place it in a labeled petri dish for examination under the microscope. (It is easier to look at the minerals after the sample has been rinsed of dust.) Set the sample aside to describe while the sample is leaching.

- Add 1% HF solution to the jar filling it to approximately 2-3x the depth of the sample. Place it on the shaker table for 45–60 minutes. Do one sample at a time so the sample isn't sitting in the HF solution for too long. You can start the next sample leaching when you begin frothing the current sample.

- Meanwhile, describe the sample and record this in the log. Roughly estimate the % composition of quartz & feldspar and any other significant minerals. If you don't know the mineral at least describe color, luster, shape, etc.

Frothing Set Up

- Fill the 10-liter carboy next to the carbonator with the frothing solution: the final solution should contain 0.1ml/l glacial acetic acid and 0.1ml/l lauryl amine (surfactant).

- A concentrated solution is stored in the cabinet above the carbonator. Add 10 ml of concentrate per liter DI-water, and mix well. (This does not have to be precise.)

- Rinse off the carbonator tube before placing it into the frothing solution in the carboy. Make sure it's completely submerged. The solution will be sucked into the carbonator after it's been dispensed. Keep at least a few liters in the carboy so the carbonator does not suck up air.

- Hard open the CO_2 tank. It is pre-set to ~100 psi. (It should not exceed 100 psi)

- Plug in the carbonator. There is no on/off switch.

Frothing process

- After 45-60 minutes, decant the 1% HF solution from the sample into a labeled waste container. DO NOT rinse the sample.

- Keep the sample in the 2L-leaching bottle and add a few drops of mineral oil to the sample and swirl it around. All mineral oils seem to work – pine, eucalyptus, tea tree. (Do not use vegetable oils. Although they will work, they are impossible to clean up. Mineral oils are aromatic hydrocarbons and will evaporate, as opposed to vegetable oils that are long chain fatty acids.)

- Dispense some frothing solution onto the sample. Carefully swirl around the bottle at the same time. Decant the solution with the floating grains into a plastic collection jar or directly into a filter funnel hooked up to the pump. The first 2-3 additions might not work very well, but with each repetition the frothing will get "foamier" and more grains will float. The floating minerals will look clumpy, fluffy and bubbly and after a few repetitions of frothing and decanting, the sinking fraction and floating fraction will look distinct. If the frothing seems to slow down yet you can see there is still feldspar to remove, try adding more oil.

  (An easy granitic sample needs 5-10 repetitions. Usually the quartz looks more grayish than the feldspar. Note that usually granite has much more feldspar than quartz, so it is normal that the quartz fraction is smaller than the feldspar fraction. Use your original quartz % estimate as a guide, and if you are unsure take a spilt and check under the microscope before you finish!)

- When you think the separation is complete, take a split from the sinking/quartz fraction and check under the microscope to see if any feldspar remains. Difficult samples can be deceiving, so use this as a guide to check what your naked eye sees. Do not finish the sample without looking at this split, or you may quit too early.

Once the separation is complete…

- Take a tiny split from the floating fraction and record what is in it. Take note of any quartz that floated off with the feldspar fraction. It appears that very fine grain quartz can pour off with the floating fraction and in some cases where the quartz yields are small, it will be important to try and reduce this, or to recover it. Also, poly-mineral grains of quartz and feldspar will behave as feldspar and float.

- Finish filtering the floating fraction and collect the waste in a container. It is not hazardous waste but must still be collected. Use the proper label!

- Rinse the floating fraction in the filter with DI-water. Do not collect this in the waste. This can go directly into the sink. It is the rinse of an extremely dilute solution and safe.

Sinking and Floating Fractions

What you do next depends on what you want – Quartz, Feldspar or both.

Quartz Recovery:

- Rinse the sinking fraction with DI-water.
- Proceed to HF/HNO3 leaching (Quartz Preparation Method).
- Dry the rinsed floating fraction in the filter in the oven or in a hood.
- Once dry, transfer it to a plastic bag and weigh it. Record the weight and calculate the sinking fraction wt. (total wt. – floating wt.) and % sinking. If your original quartz estimate was good, it should be very close to the % sinking (assuming a clean separate).

Feldspar Recovery:

- If you want to process the feldspar fraction, after rinsing, transfer the feldspar to a leaching bottle.
- If you are not using the quartz, after rinsing it well, transfer it to a jar to dry in the oven. Once dry, record the dry weight and use that to calculate the floating weight and percent.

(If you are processing both the quartz and feldspar, you should still dry one of the fractions to obtain the percentages of sinking and floating.)

RECORD ALL WEIGHTS IN THE LOG!

Frothing Log - Descriptions and Weights:

Whole Rock:

- Mineral composition
- Approximate % Quartz, Feldspar, and other significant minerals
- Purity of grains, inclusions
- Grain size

Floating Fraction:

- Mineral composition – what else floated?
- How much, if any, quartz was lost to the floating fraction? And if there is quartz in the floating fraction, is it very fine grain quartz, or poly-mineral grains?

Sinking Fraction:

- Mineral composition – % quartz? Is it a clean separate?
- If there's Feldspar in it, try frothing it some more. Identify if it's Plagioclase (Na, Ca) or Orthoclase (K) feldspar. Na-feldspar does not float as well.

Record these Weights:

- Whole Rock (dry)
- Floating fraction (after it's dry)
- Sinking Fraction –calculated from the difference, or weigh directly (note which one).

Frothing Solution Recipe:

Reagents:

- Glacial Acetic Acid
- Dodecyclamine-98% (Lauryl Amine)

Make a Concentrated Solution:

- Fill a 1000 L bottle with 500 ml MQ H_20
- IN THE HOOD: Scoop ~10g Dodecyclamine-98% into the designated (tared) jar. Bring it to the balance with the lid on it.
- Add to the water.
- Add 10ml Glacial Acetic acid. (With the graduated cylinder)
- Fill to the 1000 ml line with MQ-H_2O.
- Allow it to dissolve overnight, but do not shake it. It will get very bubbly and frothy.

Filling the Carboy:

- You can use DI-water for the frothing solution.
- The carboy holds 10 L of solution (do not run it dry while frothing).
- Add 10 ml of the concentrate for every 100 ml DI- H_2O.