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SEPARATION OF FELDSPAR FROM QUARTZ BY FLOTATION

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ABSTRACT

Laboratory application of flotation to the separation of oligoclase feldspar from quartz yields good results. Quartz in excess of 3 percent remained in only two of the seventeen samples studied.

INTRODUCTION

Flotation separation of feldspars from quartz was first accomplished in 1936 (Ladoo and Meyers, 1951, p. 216) and has been used commercially for many years. For example, the feldspar plant at Kona, North Carolina produced from alaskite ore a pottery spar with a maximum amount of 5 percent quartz (Lutzen, 1953, Table 1). However, despite its proven success, flotation still is not used for routine mineral separations in the mineralogy laboratory, and has received scant, if any, attention in most mineralogy texts dealing with mineral separation.

The writer has found that flotation works admirably for separation of oligoclase from quartz where traditional methods fail because of overlapping densities and magnetic susceptibilities. After flotation, quartz in excess of 3 percent remained in only two of seventeen samples studied. (See Table 1.) This note is written therefore, to advertize the usefulness of flotation for mineral separation in the mineralogy laboratory and to demonstrate its applicability specifically toward the problem of separating oligoclase from quartz.

The techniques and procedures described herein are generally similar to those of Van Der Plas (1966), who treats specifically feldspar flotation. However, his treatment of the effectiveness of flotation separation is somewhat lean. Of two samples studied feldspar concentrates of 87 percent and 11 percent were achieved after one flotation operation. One suspects though, that these concentration percentages would be significantly improved with repetitious flotation operations.

EQUIPMENT AND REAGENTS

1. Flotation cell (3/4 liter capacity) with overflow lip and equipped with variable speed automatic stirrer.
2. Plastic tubing (1/4″ diameter) sufficiently long to supply air from the operator's mouth to the bottom of the flotation cell.
3. Conditioning agent—Conc. HF.
4. Collector agent—1% solution of Alamine (4-lauryl primary amine with 12 carbons).
5. Distilled H_2O.
6. A pH meter.

TABLE 1. QUARTZ PERCENTAGES IN OLIGOCLASE AFTER FLOTATION[a]

Sample Number	Wt. % Quartz
3702	1
3703	0.7
3706	12
3708	2
3712	1
3713	0.6
3714	0.4
3715	0.4
3716	24
3718, A, B, C	0.5, 0.6, 0.6, 0.7
3720	1
3722	2
3723	3
3724, A, B, C	0.8, 0.6, 0.6, 0.8
3727	0.7
3729	0.8
3731	0.8

[a] Percent quartz in oligoclase was estimated by comparing the intensity of the quartz X-ray reflection (100) or (101) to that in "standard" oligoclase samples containing quartz. Samples FD156 (#4) of Emmons (1953) with 19.2% quartz and 3705 PL (Herber, 1968) with 6.9% quartz were used as "standards." The percentage of quartz in each "standard" is calculated from the amount of excess SiO_2 calculated from the chemical analyses. X-ray intensities were estimated from peak heights measured in chart units on a strip-chart recording and a linear relationship was assumed between the lowest and highest intensities measured. The results in Table 1 represent an average value from one forward and one reverse scan. Samples 3718 and 3724 were run in quadruplicate. Most samples consisted of 1.0 g of −400 mesh powder pressed to a $\frac{3}{4}$-inch diameter disk-shaped pellet at 30,000 psi. Samples 3718 C and 3724 C consisted of .5 g.

PROCEDURE

The starting samples consisted mainly of crushed granitic rocks (30 to 40g) which were deslimed and sieved (smallest diameters 62 to 125 μm) with most of the magnetic fraction eliminated. After flotation the K-rich alkali feldspar fraction was separated from the plagioclase (and remaining quartz) fraction with heavy liquid (tetrobromoethane) of density 2.590±0.003 g/ml.

1. Pulping. Place dry sample in a 500 ml beaker which contains about 450 ml distilled water.

2. Conditioning. Add HF to the pulp until pH of 2.5 is reached and allow mixture to stand undisturbed for about 5 minutes. Wash the acidified pulp into the flotation cell with distilled water and condition further by stirring for a few seconds.

3. Flotation. With the automatic stirrer on slow speed, supply air orally through a tube to the bottom of the flotation cell and simultaneously add the collector agent (Alamine) drop by drop until a thick froth is obtained. As flotation occurs, the feldspar-laden froth flows over the lip of the cell and is collected in a dish or beaker. Continue adding Alamine and distilled water to maintain the froth overflow until it no longer feels gritty.

4. Wash flotation cell free of the tails (material which does not float, mostly quartz in this study) and store or discard them. Decant and discard the scum from the wet feldspar concentrate.

5. The procedure is repeated several times for each sample (5 times in this study). For repeat runs, Step 1 is deleted and conditioning is started directly by adding about 450 ml HF with pH 2.5 to the wet feldspar concentrate.

Note: It is probably better procedure to wash the acidified pulp into the flotation cell (Step 2) and maintain the froth overflow (Step 3) using HF with pH 2.5 instead of distilled water. Excessive amounts of distilled water significantly change the pH so that quartz is not depressed effectively and selectivity is lost.

RESULTS AND DISCUSSION

Table 1 shows the effectiveness of separating feldspar (oligoclase) from quartz. Quartz in excess of an estimated 3 percent remained in only two of the seventeen samples floated even though thin sections showed significantly higher amounts of quartz in the hand specimens. Estimates of modal quartz in the rock specimens ranged from 10 to 45 percent as calculated from weight percents of the different mineral fractions. Excess or deficient SiO_2 calculated from the chemical analyses of the oligoclase samples is in good agreement with quartz percentages estimated by X-ray diffraction.

Samples 3720, 3722, 3723, 3706, and 3716 contained 0.6, 1.8, 2.2, 9.7, and 21.4 percent excess silica respectively. For the remaining 12 samples the amount of deficient silica averaged about three percent of that required by the An content. Thus flotation-separation of quartz from oligoclase was performed successfully on 15 of the 17 samples. Ineffective separation for samples 3706 and 3716 probably resulted from improper pH control. Starting pH's of 2.7 and 3.0, and final pH's of 4.2 and 3.8 were recorded for samples 3706 and 3716 respectively. Starting pH's for the other samples ranged from 2.2 to 2.6 and final pH's ranged from 2.2 to 3.6. Maximum selectivity is probably achieved by controlling the pH at 2.5.

It should be noted that some particulars of sample preparation pertinent to a larger feldspar study promoted or may have been necessary for successful quartz separation. Prior to flotation, the samples had been crushed, screened and deslimed, and consisted almost entirely of quartz and feldspars. Consequently, fresh grain surfaces, a narrow size range, and simple mineralogy were assured. If these conditions are not met the flotation procedure described herein may not necessarily be successfully applied. For example, mineral grains in soils, sediments, or even disaggregated sedimentary rocks are commonly afflicted with oxide, carbonaceous, or grime coatings of some type which belie the true chemical composition of the mineral surface. Grain surface chemistry is critical to successful flotation and the reader is referred to the metallurgical literature for help in resolving specific problems.

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PUMPELLYITE OF DEUTERIC ORIGIN: A COMMENT

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At the close of their informative note on the occurrence of pumpellyite in cavities of altered syenite from the Prospect intrusion near Sydney, New South Wales, Raam *et al.* (1969) write:

"We are unaware of any previously published account of pumpellyite occurring in a high-level intrusive or volcanic rock that has not been subject to deep burial or geothermal activity. However, the Prospect occurrence appears to represent a clear example of deuteric pumpellyite."

It may be of interest, therefore, to note that pumpellyite has been found lining vesicles in Triassic basalt at Summit, New Jersey (Mason, 1960). In these vesicles it occurs as light to dark blue-green fibrous crusts, up to 1 mm thick; in some of the vesicles the pumpellyite has been followed by prehnite, analcime, and chlorite, in that order of deposition. I commented "It is probably not uncommon in the trap rocks, but could be easily misidentified as chlorite". This occurrence, like that at Prospect, appears to be a clear example of deuteric pumpellyite.

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