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MILLING OF KYANITE ROCK FROM NEAR POWELL, WISCONSIN

by

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Open-File Report 39-1
4 p.

1939

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SUMMARY

Though it is quite certain that this kyanite rock may be concentrated with flotation, its resistance to crushing points to methods using less fine crushing.

Providing exploration indicates an ore body of adequate size, and investigation shows that an operation here could compete profitably with operaters ~~ers~~ of similar nature in the Middle Atlantic and Southern states, it is recommended that either a wet or dry milling process be used contingent on availability and cost of water or electricity.

After preliminary crushing to about $\frac{1}{4}$", the wet method should consist of jigs for removal of the garnet and kyanite and the tailings to shaking tables to remove the biotite and muscovite. The kyanite could be separated from the garnet on a shaking table.

After crushing to pass $\frac{1}{4}$" in the dry process, the ore would be passed over a set of shaking screens, where the extreme fines are removed and discarded. The oversize is fed over three sets of electromagnetic rolls, where the garnet, biotite, and some muscovite are removed. The remaining material - kyanite, quartz, feldspar, and some muscovite - is passed through an electrostatic field and the kyanite removed.

REPORT ON MILLING OF KYANITE ORE

Because of the resistance to crushing of this rock, it would be necessary to conduct a careful screening test to determine the minimum crushing necessary to give maximum economic recovery.

This ore consists of a medium coarse-grained biotite schist with fairly uniform distribution of kyanite crystals. The schist is dominantly quartz, biotite, feldspar with garnet and kyanite disseminated throughout. This schist occurs in isolated outcrops about 2 miles southwest of Powell, Wisconsin, in sections 28, 29, 32, 33, T.42N., R.4E., Iron County. All the property is owned by the State of Wisconsin. The surface area of known ore consists of two separated outcrops; the dimensions of one was 345 feet by 210 feet; the other outcrop had maximum dimensions of 560 feet by 375 feet. There is a stream near the outcrops and a county trunk highway is close. The area is marshy with little relief, which condition will necessitate pumping in any operation.

This investigation was confined primarily to the possibility of concentrating the kyanite by flotation. This attempt was not entirely successful. Other investigations working on similar ores succeeded in concentrating the kyanite to about 98% recovery.

Recent trials (May 5, 1939) indicate that the successful flotation of this ore is approaching, though amounts of reagents successfully used on other kyanite schists do not show good recovery on this particular schist.

The list of reagents used by Coghill & Clemmer:

Reagent Used	Pounds per Ton Crude Ore		
	Rougher	Cleaner	Recleaner
Pine oil	0.08		
Oleic acid	0.32		
Sodium oleate	0.60		
Sodium hydroxide . . .	1.00	0.75	
Sodium silicate . . .		0.75	
Sulfuric acid			0.32

It seems evident now that the amounts of reagents for this ore will be similar to the above list.

Though the flotation of this ore is not as yet successful, there were several characteristics learned of the milling of the ore. It was found that the ore absorbed a great deal of water used in ball-mill grinding and necessitated a much heavier load of water to effect adequate grinding. About 450 gms. H_2O/500 gms. of ore is necessary. Sodium Hydroxide was found to be a definite activator of frothing. The more NaOH added, resulted in increased froth. The NaOH did not materially increase recovery of any of the minerals floated. Absence of NaOH, however, precludes any flotation worthy of the name. Variations of Oleic Acid seemed to indicate that smaller amounts enhanced the recovery of biotite. Increase of sodium oleate materially increased the flotation of the micas. About 4 lb/ton made a good recovery of the micas.

However, in the opinion of the writer, the additional crushing and reagents costs would not be warranted by the additional recovery of kyanite fines. Therefore, a mechanical type of concentration, in which less finely ground ore may be handled, is recommended. After being crushed in jaw-crusher, it is crushed through rolls set at about $\frac{1}{4}$". This ore was jigged and a very good bed of garnet and kyanite was formed with garnet on the bottom next to the screen. This concentrate may be readily separated on shaking tables due to the very different crystalline shapes of garnet and kyanite. The garnet is more or less spherical and the kyanite is long and bladed.

It is recommended that a battery of jigs be used to insure recovery of all of the kyanite and garnet. The final overflow from the jigs should be tabled, where the micas will be removed. The remaining quartz, feldspar, etc. would go to the tailings stacker.

The following method of concentration was not used with this ore due to lack of equipment. It is used by the Celo Mines, Inc. of Burnsville, N.C.

This method consists of selective screening through 4 Hummer vibrating screens. Each of the sized sections of ore is sent over 3 Johnson induction magnetic separators; the first pass removes most of the garnet and some of the biotite; the second, the rest of the garnet; and the last pass removes the rest of the biotite and much of the muscovite, leaving quartz, feldspar, kyanite, beryl, and remaining muscovite. A modified Huff type electrostatic separator concentrates the kyanite in recoveries up to 98%.

The above kyanite operations are chiefly working residual kyanite deposits. Therefore, the crushing costs are much smaller than would be the costs for this particular operation because of the resistance of this schist to crushing.

References

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