Further remarks on the electrostatic separation of minerals.

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IN a previous number of the Mineralogical Magazine (1909, vol. xv, p. 260), attention was called to a simple electrostatic method whereby, using a stick of sealing-wax and a copper plate, grains of minerals which have a metallic or sub-metallic lustre can generally be separated from those of the more transparent minerals, the former being attracted notwithstanding the fact that they are usually heavier than the latter.

One instance of the utility of this method of separation is that of proving the presence of a small amount of cassiterite grains in a large quantity of zircon. This condition of things is frequently met with in the non-magnetic residue yielded by separation with an electromagnet; for though, as is well known, ferriferous cassiterite is weakly magnetic, it is mostly found in the non-magnetic or practically non-magnetic residue, and in this respect it behaves much like rutile. However strong may be one's suspicion, as the result of observations with the microscope, that cassiterite is present in such a residue, it is as a rule desirable to settle the matter conclusively by chemical tests. But the amount of cassiterite mixed with the zircon may be so small that it is impossible to prove its presence by reduction with the blowpipe.

If, however, we apply the electrostatic method of separation, we find that the cassiterite, being a better conductor than zircon, is the more readily attracted; and in consequence of this fact we can obtain a cassiterite concentrate which yields tin by reduction with the blowpipe quite readily. The writer has been able to prove the presence of cassiterite in this easy manner on several occasions when it would have been difficult to do so without the aid of electrostatic separation.

Another instance in which the writer recently found it convenient to adopt electrostatic separation was in the isolation of a doubtful mineral from a mixture of wolframite and ilmenite occurring in a concentrate received at the Imperial Institute from the Federated Malay States, and stated to have been obtained at Tekka, Kinta, Perak.

The concentrate consisted of a mixture of heavy minerals, and was first submitted to magnetic separation, by means of which it was divided into four parts as indicated below. The column of figures on the right gives the approximate percentages as found by magnetic separation. The other column gives fuller results, obtained partly by chemical and partly by electrostatic means. These figures will serve to indicate more definitely the nature of the separation required.

		per cent.	per cent.
1. Highly magnetic	Magnetite	1·5	1·5
2. Moderately magnetic	Ilmenite	53·0	89·0
	Wolframite	35·0	
	Doubtful mineral	1·0	
3. Weakly magnetic	Monazite	3·5	9·5
	Tourmaline		
4. Practically non-magnetic	Rutile		
	Zircon		
	Pyrite		
	Quartz		
	Cassiterite	6·0	

The constituent of special interest was the doubtful mineral occurring in very small amount in the ilmenite-wolframite fraction. Its presence was not obvious to the unaided eye, but was evident enough when the material was examined microscopically. Its fairly high specific gravity, together with its optical character—uniaxial and positive, and the fact that it was magnetically more permeable than the monazite, suggested the probability that the mineral was xenotime; but it was considered desirable to prove the matter conclusively by isolating the mineral in sufficient quantity for chemical analysis. This was done by electrostatic separation, the possibility of which was promptly suggested by the fact that the supposed xenotime was light-coloured and fairly transparent, and presumably therefore a bad conductor, whereas the ilmenite and wolframite were known to be good conductors. By aid of the electrostatic method described below, about half a gram of the mineral was isolated in a fairly clean condition, and found by chemical analysis to consist essentially of yttrium phosphate, which established its identity as xenotime.

An alternative method of separation.

When, as in the cassiterite-zircon mixture to which we have referred, there is only a small amount of a good conductor mixed with a large amount of a bad conductor, it is advantageous to adopt the method of separation already described, using a somewhat flattened stick of sealing-wax (or its equivalent) and a copper plate.

If, however, as in the case of the above-mentioned mixture of ilmenite, wolframite, and xenotime, the amount of the bad conductor is very small, the method of using a stick of sealing-wax is rather tedious. Moreover, if one uses a large plate of ebonite instead, the separation does not succeed very well, owing to the difficulty of regulating the intensity of the charge on the plate of ebonite. Under these conditions it is preferable to attract the grains to a second copper plate which can be charged by a simple electrophorus or other such device.

This second copper plate should have one of its faces coated with a layer of shellac, which should be continued over the edge of the plate so as to form a narrow strip around the margin of the other face. At or near the edges of the shellac-covered face there should be insulating supports, which may conveniently be made of two narrow strips of glass cemented to the plate and coated with shellac.

The mixed grains are now placed on the naked copper plate, precaution being taken to have the plate and grains in a dry state. Over this the second plate is placed with its shellac-covered face downwards and in close proximity to the grains, contact being prevented by the insulating supports. The upper plate can then be charged by means of an electrophorus, and the conductors will be attracted to the shellac-covered face, to which they will adhere. The upper plate is then lifted, and the grains brushed off on to a sheet of paper. By a repetition of this operation a concentrate is obtained which consists chiefly of the bad conductor; and this can be finally cleaned as far as possible by the sealing-wax method, which offers fuller control.

By this method, the charge on the attracting plate can be regulated, and scattering of the grains largely avoided. Moreover, a large surface is presented to the mixture, and the separation is thus expedited. In isolating the xenotime from the mixture described above, two copper plates about 5 inches square were used.

We see, therefore, that electrostatic separation finds definite scope as a laboratory method in mineralogical work, especially as an adjunct to the electromagnet; and that this mode of separation can be applied to mixtures which it is either impracticable or undesirable to separate by the electromagnet or by heavy liquids.
