

Minor amounts of an unidentified amphibole, chlorite, muscovite, magnetite and martite are also present, the last three as inclusions in the corundum.

No well formed corundum crystals are present, many are irregular in shape and some have an almost tabular habit. The majority of the crystals have a linear orientation in the plane of the foliation of the schist.

The color of the crystals varies from light gray to buff. Crushed fragments are mainly clear, but very pale blue, lavender, and pink fragments are also present. The specific gravity of selected material, as determined with a pycnometer is low, 3.91, as compared with the specific gravity given by Ford (1932, p. 522); but well within the range of specific gravities presented by Barlow (1915, p. 123). The indices of refraction were not accurately determined. The identity of the material was confirmed by means of an x-ray pattern, by Dr. J. W. Gruner of the University of Minnesota.

This particular area can not be considered as a potential source of corundum; however, an examination of the thin belt of metamorphic rocks on the border of the Idaho batholith, 12 miles to the west, might be of interest.

REFERENCES

- BARLOW, A. E. (1915), Corundum, its occurrence, distribution, exploitation, and uses: *Geological Survey of Canada, Memoir 57*.
- FORD, W. E. (1932), Textbook of Mineralogy: 4th Ed.
- MINERAL RESOURCES OF THE UNITED STATES FOR 1906 (1907): *United States Geological Survey*.
- MINING WORLD (April 6, 1907), as quoted in Mineral Resources of the United States for 1906.
- SHANNON, E. V. (1926), The Minerals of Idaho: *United States National Museum, Bull. 131*.
- STINSON, M. C. (1950), Mineralogy of the heavy minerals from some placers of central Idaho: Unpublished Master's Thesis, University of Idaho.

DOUBLE FLUORIDES OF ZINC

EARL INGERSON AND GEORGE W. MOREY, *Geophysical Laboratory, Washington, D. C.*

The following observations were made in connection with work on the preparation of ZnF_2 and similar compounds for use as phosphors.

When ZnO or $ZnCO_3$ is dissolved in excess HF solution, it immediately precipitates $ZnF_2 \cdot 4H_2O$, which is biaxial, negative, 2V, ca. 50° , α , ca. 1.46; γ , ca. 1.47. The product usually contains some ZnO , probably because the material never has been entirely in solution. $ZnF_2 \cdot 4H_2O$ pre-

pared from solutions of ZnSO_4 and NaF does not appear to have ZnO at first, but after decomposing to ZnF_2 by heating, the product always contains ZnO formed by reaction with the water of hydration. Dehydration appears to take place in two stages, one between 85° and 90° C, the other at about 100° C. A satisfactory method of making ZnF_2 is by heating the double salt, $\text{NH}_4\text{F} \cdot \text{ZnF}_2$, which is uniaxial, positive, ω , 1.47; ϵ , 1.481. $\text{ZnF}_2 \cdot 4\text{H}_2\text{O}$, prepared as described above is soluble in NH_4OH solution, and impurities such as ZnO can be removed by filtration. Addition of HF precipitates the double fluoride. Most of the zinc is precipitated while the solution is still alkaline, and it is best to stop the addition of HF before the NH_4OH is completely neutralized. The crystalline precipitate is then filtered off, and the NH_4F driven off at a low heat, about 150° C.

Several double fluorides of the alkaline-earth metals with ZnF_2 were prepared in this manner. All are uniaxial, and of low birefringence.

$\text{MgF}_2 \cdot \text{ZnF}_2$ was prepared from MgCO_3 and ZnO . A mixture of these compounds, mol ratio 1:1, was covered with an excess of HF and evaporated to dryness on a hot plate, then heated at 200° C for an hour to drive off the excess HF . The resulting product was a very fine white powder which appeared amorphous under the microscope. Some of the powder was heated to 1200° C in 45 minutes and held at 1210° C for 5 minutes. The charge cooled to a slightly bluish, flattened boule with bladed structure. The boule contained a little ZnO and some isotropic crystals with index above 1.425, but most of it was relatively clear $\text{MgF}_2 \cdot \text{ZnF}_2$. This compound has a melting point of 1185° C; it is uniaxial positive with ω , ca. 1.40 and ϵ , ca. 1.41. These low indices of refraction are surprising for they are so much nearer those of MgF_2 , $\omega = 1.378$ and $\epsilon = 1.350$, than those of ZnF_2 .

$\text{CaF}_2 \cdot \text{ZnF}_2$ was prepared by direct fusion of a mixture of CaF_2 and ZnF_2 of mol. ratio 1:1 in a graphite crucible. The product was a single crystalline phase, except for a small amount of ZnO . Its melting point is 796° C. This compound is uniaxial negative, with $\omega = 1.465$ and $\epsilon = 1.455$.

$\text{SrF}_2 \cdot \text{ZnF}_2$ was prepared by treating a mixture of ZnO and SrCO_3 with an excess of HF . The resulting powder was heated to 950° C for 2 hours in a graphite crucible. This compound resembles $\text{BaF}_2 \cdot \text{ZnF}_2$ in appearance but is not quite so platy. It differs only slightly in optical properties from the calcium compound, being also uniaxial negative, mean index = 1.455. Its melting point is 729° C.

$\text{BaF}_2 \cdot \text{ZnF}_2$ was prepared by mixing BaCO_3 and ZnF in mol. ratio 1:1 and evaporating to dryness at 120° C with an excess of HF . The resulting powder was heated to 1150° C for 20 minutes in a graphite crucible. On slow cooling the melt crystallized to a single crystalline platy (almost

micaceous) phase. The melting point of this compound is 790° C. It is uniaxial negative with a mean index of about 1.544. Its birefringence is less than that of quartz, probably near 0.004.

$\text{MnF}_2 \cdot \text{ZnF}_2$ was prepared by treating a mixture of MnCO_3 and ZnF_2 of the proper stoichiometric proportions with an excess of HF, evaporating to dryness and fusing the resulting powder in a graphite crucible at 1000° C. A single phase results, uniaxial positive, $\omega = 1.487$, $\epsilon = 1.517$; m.p. = 897° C.

A double compound, $\text{ZnF}_2 \cdot \text{ZnCl}_2$, was made by fusing together the two components. It melts at 685° C, is biaxial, positive, $2V = 70^\circ$; mean index, ca. 1.70, birefringence less than quartz.

The properties of the compounds, the preparations of which are described above, are assembled in the accompanying table.

PROPERTIES OF ZnF_2 AND RELATED COMPOUNDS

Compound	Melting Point ° C.	Optical Character	2V	ω or α	ϵ or γ	Biref.
ZnF_2	872	Uniaxial+	—	1.510	1.526	.016
$\text{ZnF}_2 \cdot 4\text{H}_2\text{O}$	d. < 100	Biaxial —	$50^\circ \pm$	1.46	1.47	.010
$\text{NH}_4\text{F} \cdot \text{ZnF}_2$	d. < 150	Uniaxial+	—	1.47	1.481	.011
$\text{MgF}_2 \cdot \text{ZnF}_2$	1185	Uniaxial+	—	1.40	1.41	.010
$\text{CaF}_2 \cdot \text{ZnF}_2$	796	Uniaxial—	—	1.465	1.455	.010
$\text{SrF}_2 \cdot \text{ZnF}_2$	729	Uniaxial—	—	mean index	1.455	< .009
$\text{BaF}_2 \cdot \text{ZnF}_2$	790	Uniaxial—	—	mean index	1.544	.004 ±
$\text{MnF}_2 \cdot \text{ZnF}_2$	897	Uniaxial+	—	1.487	1.517	.030
$\text{ZnF}_2 \cdot \text{ZnCl}_2$	689	Biaxial +	$70^\circ \pm$	mean index	1.70	< .009

DETECTION OF FLUORITE IN SANDS WITH ZIRCONIUM-ALIZARIN SOLUTION

ROBERT M. GROGAN, *Illinois State Geological Survey*.*

The presence of grains of fluorite in natural sands or other assemblages of loose mineral fragments may be readily detected with the aid of a zirconium-alizarin test solution described by Feigl.¹ The technique described here was adapted and used recently in the examination of soil samples taken from above known or suspected fluor spar veins in the fluor spar mining district of southern Illinois. The purpose of this study

* Published by permission of the Chief, Illinois State Geological Survey, Urbana, Illinois. Since May 1, 1951 the author has been employed as Geologist, Development Department, E. I. du Pont de Nemours and Co., Inc., Wilmington, Delaware.

¹ Feigl, Fritz (1937), Qualitative analysis by spot tests, 161-163.