

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- STINSON, M. C. (1950), Mineralogy of the heavy minerals from some placers of central Idaho: Unpublished Master's Thesis, University of Idaho.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

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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.  $50^\circ$ ,  $\alpha$ , ca. 1.46;  $\gamma$ , 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  $\text{ZnSO}_4$  and  $\text{NaF}$  does not appear to have  $\text{ZnO}$  at first, but after decomposing to  $\text{ZnF}_2$  by heating, the product always contains  $\text{ZnO}$  formed by reaction with the water of hydration. Dehydration appears to take place in two stages, one between  $85^\circ$  and  $90^\circ$  C, the other at about  $100^\circ$  C. A satisfactory method of making  $\text{ZnF}_2$  is by heating the double salt,  $\text{NH}_4\text{F}\cdot\text{ZnF}_2$ , which is uniaxial, positive,  $\omega$ , 1.47;  $\epsilon$ , 1.481.  $\text{ZnF}_2\cdot 4\text{H}_2\text{O}$ , prepared as described above is soluble in  $\text{NH}_4\text{OH}$  solution, and impurities such as  $\text{ZnO}$  can be removed by filtration. Addition of  $\text{HF}$  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  $\text{HF}$  before the  $\text{NH}_4\text{OH}$  is completely neutralized. The crystalline precipitate is then filtered off, and the  $\text{NH}_4\text{F}$  driven off at a low heat, about  $150^\circ$  C.

Several double fluorides of the alkaline-earth metals with  $\text{ZnF}_2$  were prepared in this manner. All are uniaxial, and of low birefringence.

$\text{MgF}_2\cdot\text{ZnF}_2$  was prepared from  $\text{MgCO}_3$  and  $\text{ZnO}$ . A mixture of these compounds, mol ratio 1:1, was covered with an excess of  $\text{HF}$  and evaporated to dryness on a hot plate, then heated at  $200^\circ$  C for an hour to drive off the excess  $\text{HF}$ . The resulting product was a very fine white powder which appeared amorphous under the microscope. Some of the powder was heated to  $1200^\circ$  C in 45 minutes and held at  $1210^\circ$  C for 5 minutes. The charge cooled to a slightly bluish, flattened boule with bladed structure. The boule contained a little  $\text{ZnO}$  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  $1185^\circ$  C; it is uniaxial positive with  $\omega$ , ca. 1.40 and  $\epsilon$ , ca. 1.41. These low indices of refraction are surprising for they are so much nearer those of  $\text{MgF}_2$ ,  $\omega = 1.378$  and  $\epsilon = 1.350$ , than those of  $\text{ZnF}_2$ .

$\text{CaF}_2\cdot\text{ZnF}_2$  was prepared by direct fusion of a mixture of  $\text{CaF}_2$  and  $\text{ZnF}_2$  of mol. ratio 1:1 in a graphite crucible. The product was a single crystalline phase, except for a small amount of  $\text{ZnO}$ . Its melting point is  $796^\circ$  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  $\text{ZnO}$  and  $\text{SrCO}_3$  with an excess of  $\text{HF}$ . The resulting powder was heated to  $950^\circ$  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  $729^\circ$  C.

$\text{BaF}_2\cdot\text{ZnF}_2$  was prepared by mixing  $\text{BaCO}_3$  and  $\text{ZnF}$  in mol. ratio 1:1 and evaporating to dryness at  $120^\circ$  C with an excess of  $\text{HF}$ . The resulting powder was heated to  $1150^\circ$  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  $\text{MnCO}_3$  and  $\text{ZnF}_2$  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  $\text{ZnF}_2$  AND RELATED COMPOUNDS

Compound	Melting Point ° C.	Optical Character	2V	$\omega$ or $\alpha$	$\epsilon$ or $\gamma$	Biref.
$\text{ZnF}_2$	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

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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.<sup>1</sup> 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

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