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**Abstract**

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# LUMINESCENCE SPECTRA OF DIAMONDS FROM THE "MIR" PIPE

*(Presented by Academician A. V. Shubnikov on 31 VIII 1960)*

It is known that the intensity of the glow of various diamond specimens under excitation by ultraviolet light with $\lambda 365$ mμ varies within very broad limits, and the color of the glow may vary from blue to yellow and orange. However, despite considerable changes in the intensity and color of the luminescence of individual specimens, it was believed that the luminescence spectrum of diamonds contains two components—the blue one (the 4152 Å line and a group of bands adjoining it) and the yellow-green one (the 5033 Å line and a series of accompanying bands), and that all changes in the intensity and color of the glow of individual specimens are explained by changes in the absolute and relative intensity of the blue and yellow-green systems of bands.

Earlier ([1]) we reported that, in studying the luminescence spectra of diamonds from domestic, chiefly Ural, deposits, it was found that in the glow spectra of different diamonds only the structure of the blue component remains unchanged, whereas in the yellow-green band significant variations are observed. This indicates a high sensitivity of the luminescence centers responsible for the yellow-green component to the influence of foreign impurities or of some other defects of the diamond lattice. Since it is unknown whether this difference in the structure of the yellow-green band is due to some geochemical features of the given deposit or to some other causes (the situation is also complicated by the fact that the general question of the nature of diamond luminescence has still not been resolved), it was of interest to study the glow spectra of diamonds from primary deposits.

The luminescence spectra of more than 100 diamonds from the "Mir" pipe were studied. Since, in selecting specimens for the investigation, diamonds were specially chosen in whose glow spectra there had to be a yellow-green band (from a large number of luminescent diamonds, specimens with orange, yellow, and whitish glow were selected), we naturally cannot draw any statistical conclusions about the content of diamonds with one or another glow in the "Mir" pipe.

The glow of the diamonds was excited by the light of an SVDSH-250 mercury-quartz lamp, passed through a UFS-3 light filter. The luminescence spectra of all diamonds were photographed with an ISP-51 spectrograph with a camera

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Fig. 1. Luminescence spectra of diamonds at 90°K (schematic)

Figure 1: Fig. 1. Luminescence spectra of diamonds at 90°K (schematic)

of focal length 270 mm. The glow spectra of 25 specimens were obtained on a spectrograph with a diffraction grating with a dispersion of $\sim 6$ Å/mm.

We have already noted that the structure of the blue component of the luminescence spectrum of different diamonds remains unchanged; therefore in Fig. 1, *a* –*e*, only the yellow-green components of the glow spectra of various diamonds are shown, obtained upon cooling the specimens to the temperature of boiling oxygen.

The yellow-green components of the luminescence spectra of only 3 diamonds consisted of the 5033 Å line and a system of adjoining bands with maxima–

maxima around 5120, 5216, 5290, 5370, and 5470 Å (see Fig. 1, *a*), i.e., they had the form coinciding with that reported in the literature ([2],[3]).

In the luminescence spectra of 70 samples, in addition to the band system adjacent to the 5033 Å line, there is also a band system around the 5108 Å line (Fig. 1, *b*). We previously reported on diamond luminescence spectra of the type shown in Fig. 1, *b* ([1]), and noted that the diversity in the intensity and color of the luminescence of diamonds from domestic deposits is in most cases due to changes in the absolute and relative intensity of

Fig. 1. Luminescence spectra of diamonds at 90°K (schematic)

the blue and yellow-green (of the type in Fig. 1, *b*) components of the spectrum; this was confirmed in the present case as well: in the luminescence spectra of 30 samples there was also a blue component of varying intensity, and their luminescence changed from sample to sample from light blue to yellow-green. In the luminescence spectra of 40 samples, under no exposures was it possible to detect the 4152 Å line or the blue component. In addition to the indicated lines 5033 and 5108 Å, in the luminescence spectra of some of these 70 diamonds there were narrow lines at 4906, 4958, and 4977 Å and a group of comparatively narrow bands with maxima around 5696, 5732, 5762, 5785, and 5818 Å (see Fig. 1, *b*).

The structure of the yellow-green band in the luminescence spectra of 30 diamonds had the form shown in Fig. 1, *v*. Here the most intense lines are located around 4891 and 5233 Å; in the spectra of some samples there are very weak narrow lines at 4906 and 5033 Å.

In the collection of diamonds we studied there are samples with inclusions that luminesce with a bright yellow-green color. The luminescence spectra of these diamond inclusions in diamond also have the form shown in Fig. 1, *v*.

The yellow-green component (Fig. 1, *g*) of the luminescence spectra of 5 diamonds consists of lines at 4966, 4976, 5018, 5033, 5050, 5067, 5108, 5180, 5188,

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and 5232 Å and of a group of comparatively narrow bands whose blackening maxima are located around 5696, 5732, 5762, 5785, and 5818 Å. The luminescence spectra of these samples also contain a blue component.

In the luminescence spectra of 3 samples (Fig. 1, *d*) the lines 4890, 4958, 4966, 4977, 5001, 5080, 5089, 5187, and 5230 Å, very weak bands around 5424, 5544, and 5608 Å, and a group of narrow bands around 5696, 5732, 5762, 5785, and 5818 Å were detected. The 4152 Å line and the blue component were not detected in the luminescence spectra of these diamonds.

In the luminescence spectrum of only one diamond, a very weak 4152 Å line and narrow bands around 5786, 5890, and 5998 Å were detected (see Fig. 1, *e*).

Since in Fig. 1 the luminescence spectra of diamonds are shown schematically, it is necessary to add that the spectra contain a continuous background.

In addition to the luminescence spectra of diamonds, the luminescence spectra of other minerals from the "Mir" pipe were studied. Only in the spectrum of zircon were two groups of narrow lines detected (Fig. 1, *zh*), located around 4845, 4860, 4872, 4890 Å and around 5704, 5707, 5717, 5748, 5760, 5763, 5776, 5793, and 5814 Å.

As already noted earlier ([1]), we have found considerable variations in the structure of the yellow-green band in the luminescence spectra of various diamonds. The nature of these changes, as well as the nature of diamond luminescence in general, is still unknown. A comparison of the luminescence spectra of diamonds presented in the present work and in work ([1]) makes it possible to suppose that certain geochemical features of primary diamond deposits affect the structure of the yellow-green luminescence band in such a way as to cause the appearance in the spectrum of a group of narrow bands located near 5696, 5732, 5762, 5785, 5818 Å, and of luminescence spectra of diamonds of the type shown in Fig. 1, *c*. To clarify the nature of diamond luminescence and the causes responsible for the diversity in the structure of the yellow-green band, further investigations are necessary.

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*Note: Figure translations are in progress. See original paper for figures.*

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