SOME OBSERVATIONS ON THE TREATMENT OF LAVENDER JADEITE

By John I. Koivula

The separation of naturally colored lavender jadeite from color-treated material is a problem that has long plagued gemologists. One theory is that the dying agents being used are of an organic nature. If this is true, they should break down at elevated temperatures and lose their coloring ability. Naturally colored lavender jadeite, however, should retain its color and not bleach on heating. To investigate this theory, the author sawed 42 different specimens of lavender jadeite in half. One half of each specimen was heated while the other half was retained as a color control. Those stones that bleached on heating showed a strong orange fluorescence to long-wave ultraviolet radiation before heating and a moderate bluish-purple X-ray fluorescence both before and after heating. The control halves of those stones that retained their color when heated to as high as 1000°C fluoresced a very weak brownish red when exposed to long-wave ultraviolet radiation and a strong reddish purple to pink when exposed to X-ray radiation both before and after heating.

ABOUT THE AUTHOR

Mr. Koivula is the senior staff gemologist in the Gem Identification Department of the Gem Trade Laboratory, Inc., Santa Monica, CA.

Acknowledgments: The author wishes to express his appreciation to Tino Hammid, of GIA Gem Media, for the photography in figures 2, 3, and 4; and to Susan Kingsbury, also of Gem Media, for the art in figure 5.

The problem of detecting color treatment or enhancement in lavender jadeite has plagued gemology for many years. Gemological laboratories receive a regular stream of rings, pendants, bracelets, and the like from various trade sources who ask that they determine whether the color is natural or treated. Thus far, the laboratories have had to respond that there are no known tests to detect color treatment in some lavender jades, so that the precise nature of the coloration in the gems in question must remain a mystery.

To study color in lavender jadeite, the researcher must first establish whether the sample specimens are of treated or natural color. However, the lack of a method to separate treated from naturally colored lavender jadeite has made it virtually impossible to obtain the control subjects of known color origin that would be required to carry out an accurate study of the problem.

One theory voiced repeatedly in the trade is that the dye(s) being used to enhance the color are organic in nature, at least one suspect being blueberry juice. If we assume that this theory has some merit and we apply the knowledge that organic compounds will break down at temperatures as low as 200°C to 300°C, it should be possible to detect organic dye treatments simply by heating the subject. Although this would have to be considered a destructive test and, as such, could not be used as a routine gemological procedure, it might be an effective method of obtaining study specimens of known coloration and thus could aid the search for other, nondestructive, methods of identifying color treatment.

In fact, during the routine identification of lavender jadeite over a period of several years, the author noted that some gems fluoresced bright orange when exposed to long-wave ultraviolet radiation while others did not. Intrigued by this variation in the long-wave fluorescence, the author tested 42 small specimens of lavender jadeite

Figure 2. The two color types of lavender jadeite noted by the author. The color-treated stone is on the left (GIA collection no. 3654), and the "natural" type with stable color is on the right (GIA collection no. 528).

from various sources. Of the original 42 samples, 28 showed a strong orange fluorescence to long-wave ultraviolet radiation, while the remaining 14 showed only a very weak brownish-red reaction to the long-wave lamp. A careful microscopic examination of all the test subjects revealed the existence of an unidentified coloring agent that could be seen concentrated in some of the tiny surface fractures of those jadeites that glowed orange to long-wave ultraviolet radiation (figure 1), but not in any of the others. Heat treatment of these specimens offered the opportunity to confirm these observations regarding the identification of the treated material.

HEATING TO OBTAIN CONTROL SAMPLES

To establish both control and study groups, the 42 different samples of various shades and tones of lavender jadeite discussed above were sawed in half with a thin-bladed diamond trim saw. The saw was lubricated and cooled with distilled water rather than a cutting oil to avoid introducing any organic contaminants into the somewhat porous surfaces of the samples. The specimens were then washed in clean distilled water and allowed to dry at room temperature. They were subsequently sorted by color into two basic groups: (A) those that showed a pinkish-purple color, like the stone on the left in figure 2; and (B) those that showed a bluish-purple color, like the stone on the right in figure 2. Using a Blue M Electric Company Lab-Heat muffle furnace (manufactured in Blue Island, Illinois) with a temperature range of 0°C to 1000°C, the author heated one sawed half of each of the 42 test specimens individually (for a total of 42 heating sessions) and retained the other half at room temperature as a control sample.

Figure 1. Dye concentrated in the tiny surface cracks of color-treated lavender jadeite. Oblique illumination, magnified 45×.

The heating atmosphere was air, and the temperature for heating ranged from a low of 220°C to the furnace maximum of 1000°C. The heating time ran from 30 minutes to eight hours. (The variation in temperature and heating time resulted from initial efforts to determine the amount of time and heat required to bleach the dyed material.) All 28 of the jadeites in the pinkish-purple color group (figure 2, left) lost this color when subjected to temperatures ranging from 220°C to 400°C for 30 minutes. The color that remained was a pale brownish to grayish white. This heat-induced color change is vividly illustrated in figure 3, which shows a sliced cabochon with the control half on the left and the heated half on the right.

No color change was detected in the 14 subjects in bluish-purple color group B after heating. The shortest run for this group was four hours and

Figure 3. An example of heat bleaching. The unheated control half is on the left, and the heat-bleached half of the same stone is on the right (GIA collection no. 3661).

Figure 4. The strong orange long-wave fluorescence of a color-treated lavender jadeite (GIA collection no. 3654).

the longest was eight, at a miximum temperature of 1000°C. It was concluded that these stones had not been organically dyed. Once the subjects were divided by color and reaction to heat into the two basic groups, they were then subjected to the more useful and practical nondestructive gemological tests of ultraviolet and X-ray fluorescence.

ULTRAVIOLET FLUORESCENCE

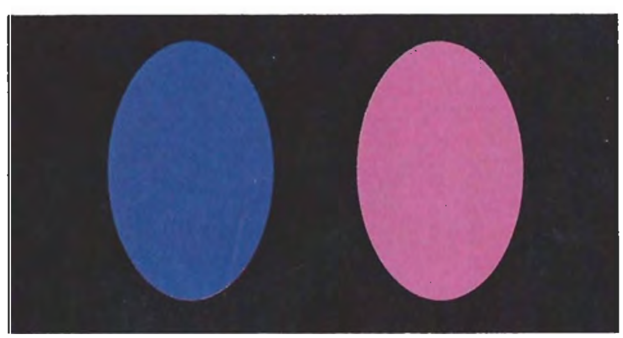
The 28 jadeites that had a pinkish-purple color before heating and lost their lavender color on heating showed a very interesting fluorescence to long-wave ultraviolet radiation. Before heating, the subjects exhibited a strong to very strong, bright orange fluorescence (figure 4). After heating, when the lavender color had been burned out, the strong orange fluorescence was gone as well, and the remaining fluorescence was a very weak brownish red. The short-wave fluorescence, both before and after heating, was a weak brownish orange to brownish red. The author studied the absorption spectrum of the strong orange long-wave fluorescence using a hand-held prism spectroscope, and found that only the yellow-green, yellow, orange, and red were passed, and all of the violet-blue and green were absorbed. The method used to examine the fluorescence spectrum for this study was rather crude. Perhaps if ultraviolet spectrophotometry were done, the points of absorption would be diagnostic of a particular organic dye.

Those 14 jadeites that showed a bluish-purple color initially and retained their color on heating showed a very weak brownish-red fluorescence to the long-wave and short-wave lamps both before and after heating.

X-RAY FLUORESCENCE

Using an X-ray fluorescence unit powered by 88 kilovolts, the author subjected all of the test specimens to X-rays both before and after heating. Those jadeites that bleached when exposed to the heat showed a moderate bluish-purple X-ray fluorescence both before and after heating (figure 5, left). The jadeites that retained their body color during heating showed a strong reddish purple to pink X-ray fluorescence (figure 5, right). In this

Figure 5. Artist's rendition of the X-ray fluorescence of the two types of lavender jadeite discussed here. On the left is the bluish purple of the heat-bleaching, treated stone. On the right is the "natural" type, showing a reddish-purple to pink fluorescence color.



case, the absorption spectrum of the reddish-purple to pink X-ray fluorescence color of the latter group was studied. This examination revealed a broad absorption band from 4900 Å to 5300 Å, a general overall haziness, and that the red was passed very strongly.

If the two types of lavender jadeite are placed side by side in the X-ray chamber, the difference in fluorescence is quite evident and the two stones can be easily separated. However, the small size of the circular X-ray fluorescence chamber well, which measures only 30 mm in diameter on its floor and 30 mm in depth, makes it virtually impossible to test large objects such as carvings by the X-ray fluorescence method.

CONCLUSION

Of the 42 specimens of lavender jadeite examined for this study, 28 bleached when exposed to heat in excess of 220°C for a maximum of 30 minutes. These same stones had a notable pinkish-purple color in their original state and fluoresced bright orange to long-wave ultraviolet radiation before they were exposed to the heat. All 28 stones also revealed dye in tiny cracks when examined under the microscope, and fluoresced a distinctive bluish purple when exposed to X-ray radiation.

In contrast, the remained 14 specimens did not bleach when heated to extreme temperatures (as high as 1000°C) and for as long as eight hours. In addition, these stones showed a bluish-purple color and a weak, brownish-red fluorescence to long-wave ultraviolet radiation both before and after exposure to heat. No dye was apparent when they were viewed under the microscope, and they fluoresced a distinctive reddish purple to pink in the X-ray unit. Although it is not feasible to heat every specimen to determine whether it is dyed, the results reported here suggest that a lavender jadeite that fluoresces strong orange to long-wave ultraviolet radiation is dyed, presumably with an organic compound. This conclusion can be confirmed if the orange-fluorescing stone reveals dye in its cracks when viewed under the microscope. If a stone with a color of unknown origin is exposed to X-ray fluorescence in conjunction with a lavender jadeite that is known to be dyed, and the unknown glows a distinct reddish purple to pink (as compared to the bluish purple of the treated stone), this writer feels that the unknown stone is *not* organically treated and the color may be natural.

At this time, we still have tackled only part of the problem, since it cannot be stated unequivocally that a stone that does not respond as described to long-wave ultraviolet or X-ray radiation is untreated. An inorganic dye or some other process may still be involved. However, the use of a combination of ultraviolet radiation, X-ray fluorescence, and microscopy (see table 1) should enable the gemologist to confirm that treatment has been used to enhance color in many cases.

TABLE 1. A comparison of "natural" color and treated lavender jadeite.

Type of lavender jadeite	Bleaches with heat?	Reaction to ultraviolet radiation	Reaction to X-ray fluorescence	Microscopy
"Natural" color	No	Long-wave, before and after heating: very weak brownish red Short-wave, before and after heating: very weak brownish red	Strong reddish purple to pink both before and after heating	No evidence of color concentration in surface cracks
Treated (dyed) color	Yes	Long-wave, before heating: strong to very strong orange Long-wave, after heating: very weak brownish red Short-wave, before and after heating: weak brownish orange to brownish red	Moderate bluish purple both before and after heating	Evidence of color concentration (dye) visible in micro surface cracks