TWO NOTABLE COLOR-CHANGE GARNETS

By Carol M. Stockton

Two garnets exhibiting unusually strong changes of color are discussed. Changes in color appearance are observed to occur not only between different light sources but also between reflected and transmitted illumination from the same light source. The gemological properties and chemical compositions of these two stones are noted and compared.

In the course of the study on garnets currently being pursued by the GIA Department of Research, we have had the opportunity to examine many color-change garnets. Recently we were shown two exceptionally fine examples from East Africa that are worthy of special note. Both of these stones were in the form of water-worn pebbles; stone A weighs 5.72 ct and stone B weighs 3.50 ct and is one of the finest examples of alexandrite-like garnet we have seen. Both stones show change in color from diffuse daylight or fluorescent light to diffuse incandescent light. In addition, both stones change color depending on whether the light is transmitted through the specimen or reflected from its interior surface, an observation first made by D. V. Manson. Stone A changes from greenish-yellowish brown in transmitted fluorescent light (figure 1a, left) to purplish red in reflected fluorescent light (1b, left). In incandescent light, it changes from reddish orange in transmitted (1c, left) to red in reflected (1d, left) light. Stone B, with fluorescent illumination, is light bluish green in transmitted light (1a, right) and purple in reflected light (1b, right); in incandescent light, it changes from light red in transmitted (1c, right) to purplish red in reflected (1d, right) light.

It must be noted that the combination of the sensitivity of these stones to subtle changes in the wavelengths of lighting and the difficulty of accurately reproducing color on photographic film resulted in some anomalies between the appearance of these stones in this article and their natural appearance to the eye.

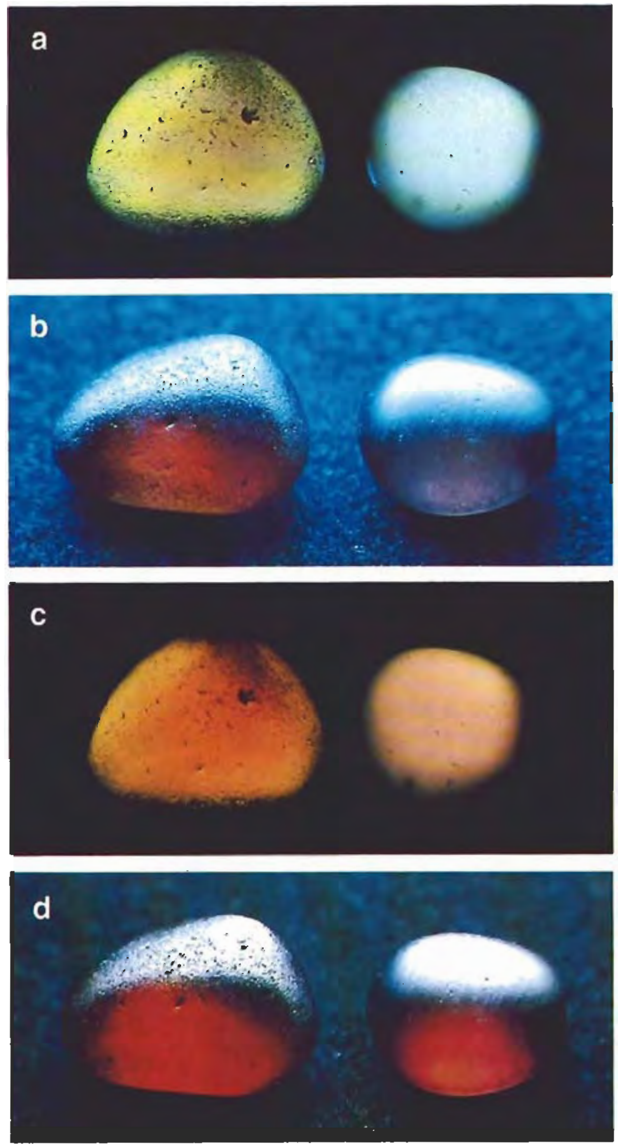

Figure 1. Color-change garnets A (left) and B (right) in transmitted fluorescent light (a), reflected fluorescent light (b), transmitted incandescent light (c), and reflected incandescent light (d).

The other properties of these stones are shown in table 1, and reveal some very interesting dif-

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TABLE 1. Data for the two color-change garnets.

Properties	Stone A	Stone B
Gemological		
Refractive index	1.773	1.763
Specific gravity	3.98	3.89
Spectra (nm)		
Absorption bands	504.5	505.5
	692.5	694.0
Maximum transmission	526.0	505.5
	676.0	683.0→
Maximum absorption	←450.0	450.0
	563.0	573.5
Oxide composition (%)		
MgO	2.25	9.03
CaO	7.83	7.10
MnO	25.59	19.09
FeO	5.12	3.06
Al_2O_3	21.33	21.55
V_2O_3	0.15	0.38
Cr_2O_3	0.23	0.66
SiO_2	38.04	39.80
TiO_2	0.20	0.07
End-member composition (%)		
Schorlomite	0	0.16
Andradite	0	0.91
$Mn_3V_2Si_3O_{12}$	0.55	1.38
Uvarovite	0.71	2.07
Pyrope	7.51	30.11
Spessartite	59.02	43.16
Grossular	20.33	16.22
Almandite	11.83	6.37

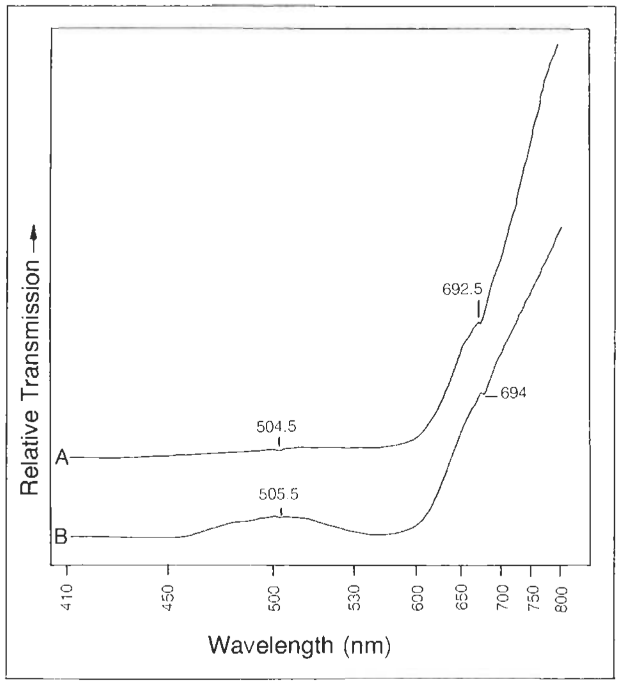

Figure 2. Graphs of the absorption spectra of garnets A and B.

ferences and similarities. Both stones have significant amounts of V_2O_3 and Cr_2O_3, which translate to $Mn_3V_2Si_3O_{12}$* and $Ca_3Cr_2Si_3O_{12}$ (uvarovite), but stone B contains considerably more of these two components. Both garnets contain more spessartite than any other end member. Both also have unusually high amounts of grossular for stones that would otherwise be considered members of the subgroup pyralspite. However, the two garnets differ markedly in pyrope and almandite content. Stone A has more almandite than pyrope, but stone B has considerably more of the latter. The lower refractive index and specific gravity obtained for stone B undoubtedly result from the high pyrope and lower spessartite and almandite contents of this sample.

With the use of the hand spectroscope, we observed complete absorption at the short wavelength end of the spectrum up to about 445 nm, as well as a definite thin band of absorption at about 690 nm, probably associated with the presence of chromium. Stone A, but not stone B, also shows a strong absorption band at 500 nm. Use of the spectrophotometer enabled us to locate these bands more accurately (figure 2). The general shape of both spectral curves resembles those observed elsewhere (Schmetzer et al., 1980). Maximum absorption occurs in two areas: (1) extending from about 450 nm to the short wavelength end of the visible spectrum; and (2) at around 560 to 575 nm between two major regions of transmission, one centered around 500 to 530 nm and the other increasing in transmission from about 670 nm to the long wavelength end of the visible spectrum. This pattern has been observed in the past with color-change garnets that were primarily pyropes in composition, whereas these two stones contain more spessartite than any other component.

These unusual two stones will also be included in a thorough study of color-change garnets to be presented at a later date.

**Technically speaking, $Mn_3V_2Si_3O_{12}$ is not an end member, as it has never been observed to comprise more than 50% of any naturally occurring garnet, but for convenience of description we use it as though it were a garnet end-member composition.*

REFERENCE

Schmetzer K., Bank H., Gübelin E. (1980) The alexandrite effect in minerals: chrysoberyl, garnet, corundum, fluorite. *Neues Jahrbuch für Mineralogie Abhundlangen,* Vol. 138, pp. 147–164.