Colourless to Near-colourless Diopside from Canada and Kenya

Diopside, a calcium-magnesium clinopyroxene ($CaMgSi_2O_6$) and Mg-rich end-member of the diopside-hedenbergite series (Deer et al., 2013), is rather unusual as a gem material. It is commonly greenish brown (mostly due to iron impurities) to dark brown (typically as cabochons displaying asterism), but its most attractive gem variety is emerald-green Cr-diopside from Russia.

Gem-quality colourless to near-colourless (thus chemically rather pure) diopside has been described from the Mogok Stone Tract in Myanmar (Themelis, 2008), Tanzania (Milisenda and Wehr, 2009) and Kenya (Renfro and Shen, 2012), in rather small sizes (generally <2 ct). These gems reportedly formed in contact-metamorphosed Ca-rich sediments (e.g. skarns) and silica-enriched marbles (Themelis, 2008; Deer et al., 2013).

Recently the author had the opportunity to examine five samples of colourless diopside from an additional locality—Canada—and compare them to some from Kenya (e.g. Figure 12). The samples were supplied by gem dealer Brad Payne (The Gem Trader, Cave Creek, Arizona, USA). He obtained the Canadian samples at the 2014 Tucson gem shows in Arizona, USA, from Brad Wilson (Coast-to-Coast Rare Stones International, Kingston, Ontario, Canada). Wilson stated that the gems were cut from old rough material that was mined more than 20 years ago in Cawood, Quebec. He had around 20–30 carats of cut stones in the 0.25–1.5 ct range. The Kenyan samples were selected by Payne at the 2010 Tucson gem shows from approximately 100–200 faceted pieces that mostly weighed less than 0.50 ct (larger stones were rather included).

Analysed for this report were two stones from Canada (0.64–0.91 ct) that were absolutely colourless, and three samples from Kenya (0.13–0.25 ct) that were very pale yellow. Raman analyses of all five samples revealed spectra that perfectly matched our diopside references. The properties measured for one sample each from Canada (0.91 ct) and Kenya (0.25 ct) fit well with reported values in the literature (Deer et al., 2013): RIs of 1.667–1.695 and 1.670–1.695, birefringence of 0.028 and 0.025, and hydrostatic SG of 3.28 and 3.30, respectively. The properties obtained for the Kenyan sample were consistent with those reported by Renfro and Shen (2012). The EDXRF chemical compositions of the two samples showed slight differences in Fe content (0.24 wt.% FeO in the colourless Canadian diopside and 0.40 wt.% FeO in the very pale yellow Kenyan sample; Table I). The Canadian diopside contained a marked concentration of Na (2.23 wt.% Na_2O), but this element was below the detection limit in the Kenyan sample.

Figure 12: Studied for this report were these three near-colourless diopsides from Kenya (0.25, 0.24 and 0.13 ct from left to right) and two colourless diopsides from Canada (0.91 and 0.64 ct). The slightly higher Fe concentration in the samples from Kenya is responsible for their very pale yellow colour. Photo © M. S. Krzemnicki, SSEF.

*Table I: Chemical composition of the analysed diopside samples.**

Location	Kenya	Canada
Weight (ct)	0.25	0.91
Colour	Very pale yellow	Colourless
Long-wave UV	Inert	Orange
Oxide (wt.%)		
SiO_2	47.4	47.0
TiO_2	0.11	0.08
MgO	22.9	23.3
MnO	0.01	0.05
FeO	0.40	0.24
CaO	28.7	26.7
Na_2O	nd	2.23
K_2O	0.08	0.07
Total	**99.6**	**99.7**

* V and Cr were analyzed for, but not detected. Abbreviation: nd = not detected.

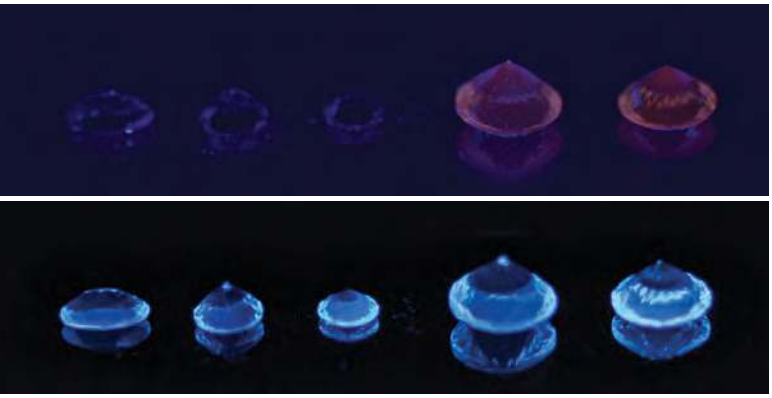

Figure 13: The three samples from Kenya (left side) and the two larger diopsides from Canada (right side) are shown under long-wave (top image) and short-wave (bottom image) UV radiation. The orange reaction of the Canadian diopsides under long-wave UV is quite marked. Photos © M. S. Krzemnicki, SSEF.

Microscopically, all five investigated samples contained a few tiny fluid inclusions and partially healed fissures ('fingerprints'). One of the Canadian specimens additionally had some slightly curved hollow tubes. All samples showed a characteristic strong doubling effect under the microscope due to their high birefringence.

Interestingly, the studied diopsides from these two different localities showed distinctly different reactions to long-wave UV radiation (Figure 13). The samples from Canada exhibited a distinct orange reaction, whereas those from Kenya were inert. This difference in fluorescence was also noted in their PL spectra (taken with 514 nm laser excitation); the sample from Canada had a distinct and broad PL band centred at about 580 nm (Figure 14). When exposed to short-wave UV radiation, all of the samples showed an equally bluish white reaction. This observation of varying UV reactions for diopside has been previously reported in the literature (Henkel, 1988–1989). In this case, however, this property allows a quick separation of these diopsides from Kenya and Canada. Nevertheless, not all Kenyan diopside shows the same fluorescence: the colourless samples studied by Renfro and Shen (2012) fluoresced a strong chalky greenish yellow to short-wave UV radiation and were inert to long-wave UV.

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Figure 14: PL spectra (using 514 nm laser excitation) of two selected diopsides from Kenya and Canada show distinct differences. The Canadian diopside has a strong PL band (at about 580 nm), whereas the sample from Kenya exhibits only very weak PL emission.