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## Cr-bearing Green Spodumene from Northern Nigeria

During a buying trip to Nigeria in October 2017, rough stone dealer Farooq Hashmi obtained a few broken pieces of a green gem material that was sold to him as hiddenite. Its exact origin was not disclosed, but he was told it came from northern Nigeria.

Hashmi provided two of the pieces to author PK for faceting, and unfortunately the first stone cleaved during pre-forming of the pavilion. Cutting of the second stone yielded a 3.32 ct rectangular brilliant. Author PK has faceted numerous hiddenites from North Carolina, USA, and by comparison the material from Nigeria seemed harder, but it split much more easily along cleavages. During the cutting process, it was necessary to use nothing coarser than a worn-out 1,200 grit lap. Even so, the stone developed minor cleavage separations just from polishing the first crown main.

The faceted stone and cleaved preform were examined by authors CW and BW, together with three pieces of rough weighing 1.69–7.34 g (e.g. Figure 24) that Hashmi supplied. The faceted gem measured 9.98 × 7.21 × 5.48 mm, and the cleaved preform was incipiently polished for examination and weighed 5.62 ct. The stones were a pale, slightly bluish green and showed

strong pleochroism in bluish green, light green and pale greenish yellow. RIs of the faceted stone were 1.662–1.679 (birefringence = 0.017) and of the preform were 1.663–1.680 (also birefringence = 0.017). Hydrostatic SG values were 3.19 for the faceted stone and 3.20 for the largest piece of rough. The samples appeared pink with the Chelsea Colour Filter, and they fluoresced weak-to-moderate yellow to long-wave UV and were inert to short-wave UV radiation. These properties are comparable to those of Cr/V-bearing green spodumene from Afghanistan documented by Chadwick et al. (2007), except the Afghan material showed no UV fluorescence and yielded a somewhat higher SG value (3.25).

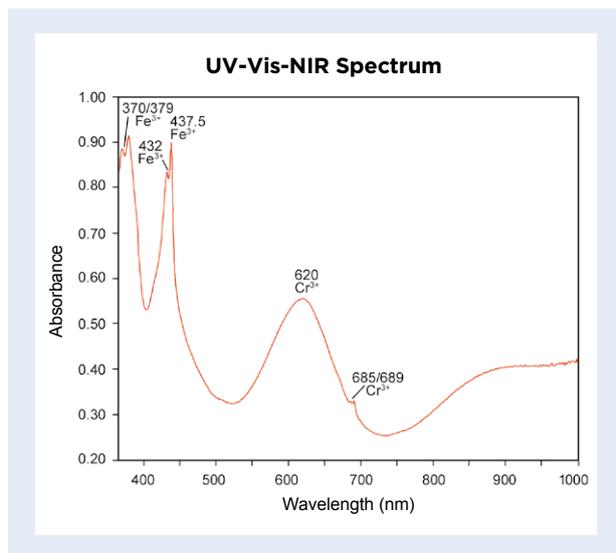
The rough and preformed Nigerian stones exhibited prominent cleavage faces and some conchoidal fractures; no natural crystal faces were present. Internal features consisted of parallel, rain-like, colourless solid inclusions and fluid trapped within cleavage fractures. The faceted stone contained prominent cleavage cracks and incipient fissures, as well as some very fine, parallel needles that were probably growth tubes.

To test the colour stability of the material, one of the rough pieces was placed in a window where it was subjected to direct sunlight. No fading was seen after a period of three days.

Raman spectroscopy with a GemmoRaman-532SG instrument confirmed the stones were spodumene. Ultraviolet-visible–near infrared (UV-Vis-NIR) spectroscopy of the faceted stone with a MAGI GemmoSphere instrument revealed sharp peaks at 685 and 689 nm due to  $Cr^{3+}$ , as well as strong features at 370 and 379 nm and at 432 and 437.5 nm (Figure 25) that are ascribed to  $Fe^{3+}$  (cf. Walker et al., 1997; Anderson and Payne, 1998). The green colouration corresponds to a transition window that is formed by the prominent band at 620 nm



**Figure 24:** This Cr-bearing spodumene is reportedly from northern Nigeria. The cut stone is 3.32 ct and the larger piece of rough weighs 7.34 g. Photo by Dean Brennan, Stone Group Laboratories.



**Figure 25:** UV-Vis-NIR spectroscopy of the faceted green Nigerian spodumene showed features due to  $\text{Cr}^{3+}$  and  $\text{Fe}^{3+}$ .

and another underlying band near 450 nm, both due to  $\text{Cr}^{3+}$ ; the latter feature is obscured by  $\text{Fe}^{3+}$  bands in the 430–440 nm region, which also contribute to the transmission window (and therefore the green colouration).

EDXRF spectroscopy with an Amptek X123-SDD spectrometer indicated prominent Fe and Mn, minor Cr, and traces of Ni, Zn and K. By comparison, the green Afghan spodumene documented by Chadwick et al. (2007) likewise contained  $\text{Fe} > \text{Mn} > \text{Cr}$ , as well as 59–72 ppm V.

Regarding the proper use of the term *hiddenite*, Chadwick et al. (2007) indicated ‘there is no consistent definition for this variety of spodumene. Although this term is typically used to refer to yellow-green to green Cr-bearing spodumene, it is unclear if the saturation of the green colour is important to the definition.’ These authors also mentioned that in addition to the classic locality at

Hiddenite, North Carolina, Cr-bearing spodumene is known from Brazil, India, Siberia and Afghanistan.

Although spodumene (kunzite) has previously been reported from northern Nigeria (Laurs, 2001), this is the first time that the green Cr-bearing variety has been documented from there.

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## Titanite (Sphene) from Zimbabwe

In early 2017, a new deposit of gem-quality titanite (sphene) was found in north-east Zimbabwe. According to Bill Larson (Pala International, Fallbrook, California, USA), the titanite comes from the Homestead mines in the Merewa area of Mutawatawa District in Mashonaland East Province. Although titanite has previously been reported from at least four Zimbabwean localities ([www.mindat.org/locentries.php?p=21891&m=3977](http://www.mindat.org/locentries.php?p=21891&m=3977)), none of them are located in this province. The stones were recovered as loose broken crystals in the soil. Shallow pits were dug with hand tools (e.g. Figure 26),

but the miners soon encountered bedrock, and titanite production ceased.

Larson obtained about 4.5 kg of rough material, of which 10% was of fine quality. Some large crystals were recovered (up to ~12 cm in maximum dimension), and many pieces of the titanite contained cuttable areas between fractures. Faceted stones have ranged up to 40 ct (Stone-Sundberg and Schumacher, 2018), with fine clean gems weighing up to 30 ct (see [www.palagems.com/gem-news-2017-11/#Sphene](http://www.palagems.com/gem-news-2017-11/#Sphene)). Several hundred carats have been faceted so far by Pala International, mostly as calibrated stones of 1–3 ct for sale through Jewelry Television. The colour