

Title : Mineralogy Gemological characteristics and chemical characteristics of Haüyne from Afghanistan

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Major : Gemology

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ABSTRACT

Haüyne is a rare and recently recognized gemstone species that was previously known only from deposits in Germany. However, a new source has now been discovered in Afghanistan. Therefore, this study investigates 30 haüyne gemstone samples from Afghanistan, focusing on their internal inclusions, chemical composition, and optical properties. The results indicate that the haüyne samples exhibit a purplish blue color with transparency ranging from transparent to translucent. The weights of the samples range from 0.102 to 0.544 carats. The specific gravity varies from 2.40 to 2.49, and the refractive indices are approximately 1.498 to 1.507. The samples show strong orange fluorescence under long-wave ultraviolet radiation and no fluorescence under short-wave ultraviolet radiation. The absorption spectra display a broad dark band in the range of 540–700 nm. Microscopic examination of the internal features reveals several types of inclusions, including feather inclusions, fluid inclusions, fracture inclusions, cloudy inclusions, and growth zoning. Color origin analysis using UV–Visible–Near Infrared spectrophotometry indicates absorption bands at approximately 410 nm, attributed to S_2^- species, and at around 600 nm,

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attributed to S_3^- species. Raman spectroscopic analysis shows prominent peaks at 442, 544, 578, 615, 639, and 1089 cm^{-1} , which are associated with S_3^- and are commonly observed in blue haüyne. The chemical composition of the samples was analyzed using X-ray fluorescence spectrometry (XRF). The results indicated that the samples consisted of 9.60 wt% sodium, 30.51 wt% oxygen, 0.07 wt% potassium, 3.34 wt% calcium, 8.35 wt% aluminum, 9.11 wt% silicon, 5.36 wt% sulfur, 0.02 wt% strontium, and 0.001 wt% arsenic. In summary, haüyne from Afghanistan exhibits distinct characteristics compared to that from Germany. The Afghan samples contain higher concentrations of S^{2-} and/or S^{3-} species than the German samples, resulting in differences in their Raman spectra. In addition, arsenic was detected in the Afghan haüyne samples but was not observed in the German samples.

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