Mineralogy Gemological characteristics and chemical characteristics of Haüyne from Afghanistan

Kittika Lueangtrongkit [1], Ratthaphon Amphon[1] and Sutas Singbamroong[2]

[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand (kittikalueangtrongkit@gmail.com)

[2] Dubai Central Laboratory, Dubai, United Arab Emirates (sutas.singbamroong@gmail.com)



Figure 1 : Blue haüyne from Badakhshan, Aghanistan (Singbamroong, 2026)

Introduction

Haüyne (pronounced "how-een") is a rare feldspathoid mineral belonging to the sodalite group with the chemical formula $Na_3Ca(Si_3Al_3)O_{12}(SO_4)$. Gem-quality haüyne has only rarely entered the jewelry market because of its scarcity, small crystal size, and limited number of localities. Fine blue haüyne suitable for faceting was known almost exclusively from deposits in the Eifel region, Germany (Kiefert & Hänni, 2000). The recent discovery of gem-quality blue haüyne in Afghanistan, particularly in the Badakhshan region (Blumentritt and Notari, 2025) has gained significant attention in the gemological community. This new occurrence represents only the second major source of facetable haüyne worldwide, making it of considerable scientific and commercial interest. Afghan haüyne displays a distinctive dark violetish blue coloration, differing from the brighter, medium blue typically seen in German material. This research aims to establish comprehensive gemological and chemical characteristics of Afghan haüyne. Such characterization is crucial for its accurate identification and distinction from other blue gemstones like sapphire, tanzanite, benitoite, and even its German counterpart, thereby aiding in origin determination.

Material and Methods

Thirty faceted blue haüyne samples, weighing between 0.102 and 0.544 carats, were examined at the Department of Geological Sciences, Chiang Mai University, CIMO, Department of Mineral Resources (Figure 2). These samples were supplied by Mr. Hamza Ikram, a reputable Pakistani gem dealer who sourced the material from a miner in the Sar-e-Sang mining area of Badakhshan, Afghanistan. Standard gemological properties (color, transparency, refractive index, specific gravity, and fluorescence reaction) were recorded using standard equipment. A gemological microscope was utilized for microscopic examination to identify internal features such as inclusions and growth structures. To characterise the sample's spectroscopic and crystal chemistry, visible to near-infrared absorption properties were measured with a UV-Vis-NIR spectrophotometer, capturing spectra from 300 to 850 nm. A Raman microscope, equipped with a 785 nm diode laser, then performed Raman spectroscopy, covering the 300–1200 cm^{-1} spectral range. Finally, chemical composition was semi-quantitatively assessed using energy dispersive X-ray fluorescence (EDXRF) spectroscopy via a micro-XRF spectrometer.

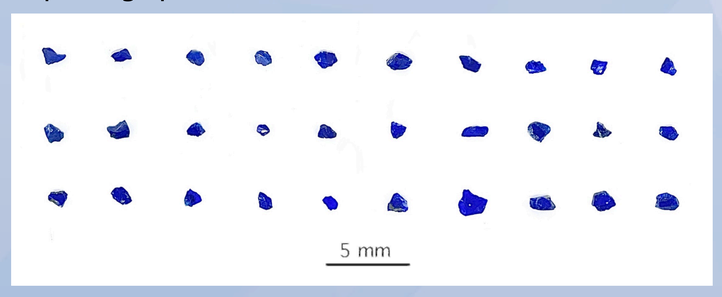


Figure 2 : shows the image of 30 haüyne samples from Aghanistan

Results and Discussion

Thirty haüyne samples were transparent to translucent and singly refractive, exhibiting refractive indices between 1.498 and 1.507. Hydrostatic specific gravity measurements ranged from 2.40 to 2.49. Most specimens showed inert to moderate orange fluorescence under long-wave UV (Fig.C and D), and were inert under short-wave UV. While these gemological parameters generally matched known haüyne characteristics, some specific gravity values were slightly lower than reported for German blue haüyne (2.46-2.48). Microscopic examination revealed fluid inclusions, partially healed fissures, and fractures (Fig.A and B).

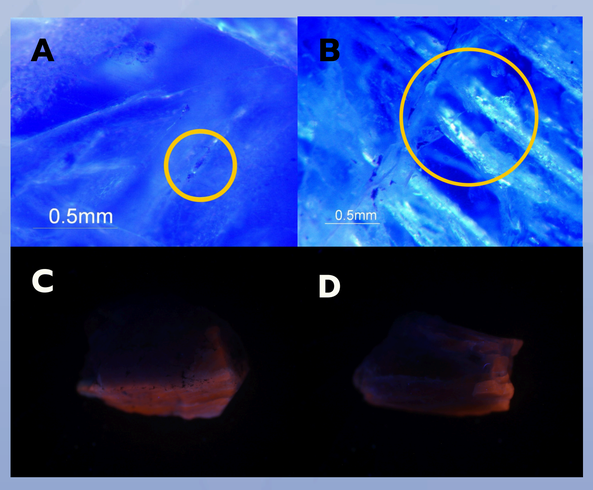


Figure 3 : shows the image of inclusion (Fig.A and B) and shows the image of long-wave UV (Fig.C and D) within the haüyne from Aghanistan

Spectrocopic features

UV-Vis-NIR absorption spectra displayed a strong band near 410 nm and a very strong, broad absorption centered at 600 nm (Figure 4). These spectral characteristics generated a blue transmission window (460–480 nm), directly corresponding to the samples' deep blue coloration. This absorption pattern significantly differed from that of German blue haüyne reference samples, which typically exhibit absorption bands at 380 and 600 nm, and a transmission window closer to 500 nm (Figure 4).

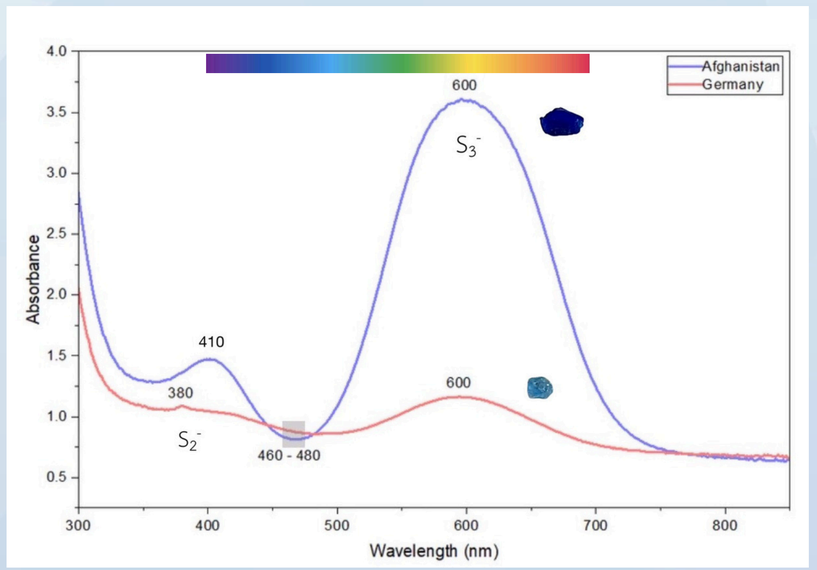


Figure 4 : UV-Vis-NIR absorption spectra of Haüyne from Afghanistan and Germany

Raman spectra of the blue haüyne revealed dominant peaks at 441, 547, and 988 cm^{-1}, consistent with reference spectra from the RRUFF database (Figure 5).

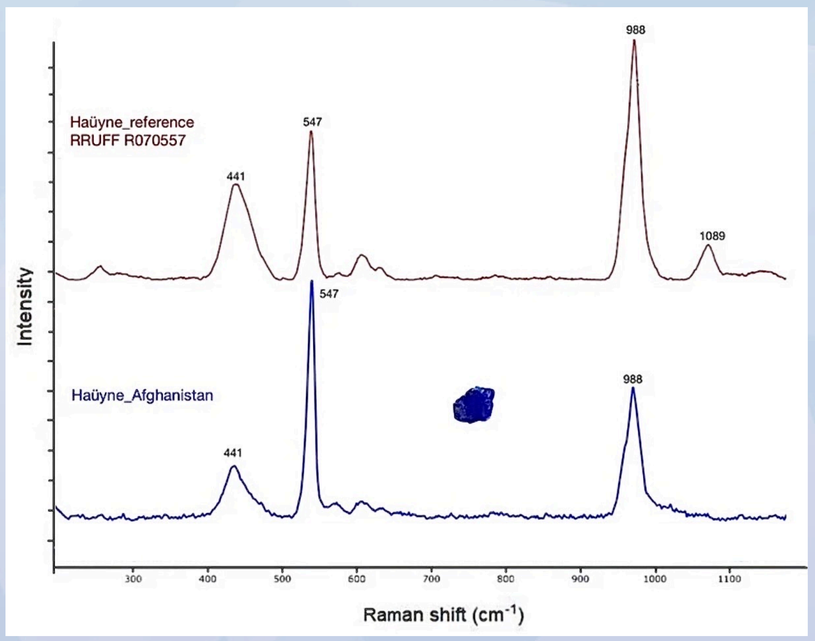


Figure 5 : Raman spectra of Haüyne from Afghanistan comparing with reference RRUFF database

Chemical composition

Table 1 : result of XRF chemical analysis of Haüyne from Afghanistan (all values quoted in wt% Oxide) Arsenic (As) was detected in the Afghan haüyne samples but was not found in the German samples (F.Blumentritt, 2025). However, the analytical results showed an arsenic content of only 0.001, which is extremely low. Therefore, it can be concluded that arsenic is not present in the Afghan haüyne samples as previously mentioned.

Na_2O	K_2O	CaO	Al_2O_3	SiO_2	SO_3	SrO
12.785	0.078	4.586	15.568	19.146	13.182	0.058

Conclusion

The recent discovery of gem-quality blue haüyne in Afghanistan marks a significant second major source worldwide. This Afghan haüyne displays a distinctive dark violetish blue color, differing from German material. It is singly refractive with R.I. 1.498-1.507 and S.G. 2.40-2.49. Key distinguishing features include a unique UV-Vis-NIR absorption spectrum (410 nm and 600 nm bands, 460-480 nm transmission window) that differs from German haüyne, and characteristic Raman spectra. These gemological and spectroscopic properties are crucial for its firm identification and differentiation from other blue gemstones and haüyne origins.

Acknowledgement

The authors gratefully acknowledge the financial support provided by the 50th Geological Antiversary Chiang Mai University and the Faculty of Science, Chiang Mai University. Special thanks are extended to Dr. Sutas Singhbamroong, an alumnus of first class of the Gemology Program, Faculty of Science, Chiang Mai University, for kindly providing the haüyne samples from Badakhshan, Afghanistan, used in this study. The authors also thank Sinakon Chimnakphant and the staff of the Department of Geological Sciences, Faculty of Science, Chiang Mai University, for facility support. Profound gratitude is expressed to the supervisor, Dr. Ratthaphon Amphon, for his invaluable supervision, encouragement, and critical reading of the manuscript.

Reference

- Kiefert, L. and Hänni, H.A., 2000, Gem-quality Haüyne from the eifel district , germany, *Gems & Gemology*, Vol. 36, No. 3, pp. 246-253
- Blumentritt, F. and Notari, F. 2025, Gem-quality Dark Blue Haüyne from Afghanistan, *The Journal of Gemmology*, 39(5), 426-427
- Farsang, S., Caracas,R., B.M. Adachi, T., Schnyder, C. and Zanacz, Z. 2023, S^{2-} and S^3 radicalsandthe S_4^{2-} polysulfide ion in lazurite, haüyne, and synthetic ultramarine blue revealed by resonance Raman spectroscopy, *American Mineralogist*, Vol. 108, pp. 2234–2243