

Diamonds from Than Lwin River near Mong Hsu, Myanmar

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Introduction

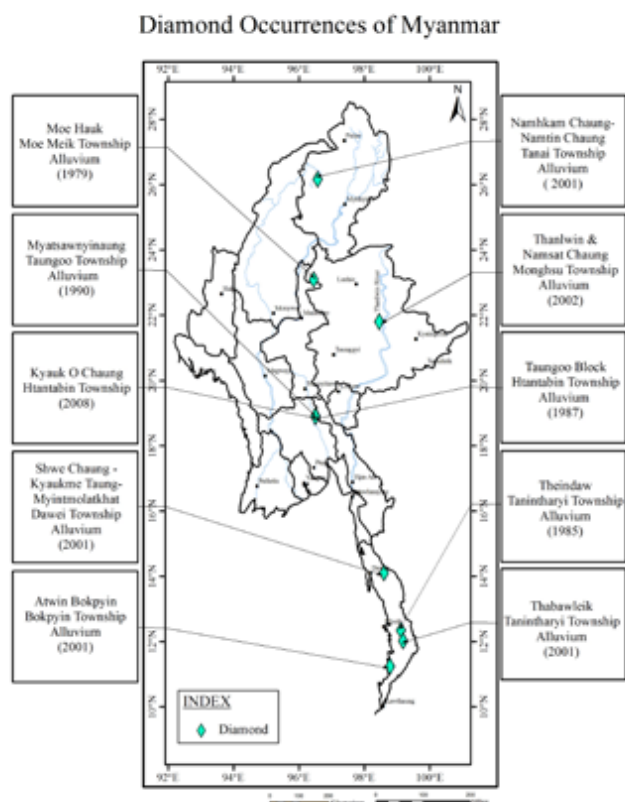
Sixteen rough diamonds were acquired in 2023 by co-author TTS from a gem dealer linked to Mong Hsu, Shan State, Myanmar. While diamonds have been reported in Myanmar, most are from limited alluvial deposits. Discoveries include Kyeindaw (1959), Mohaung near Momeik (1989), and tin mining areas in Kyaukmedaung (1981) and Myat-

sawnyinaung near Taungoo, both within the Mergui Group. (Griffin *et al.*, 2001; Win *et al.*, 2001; Kyaw Thu & Khin Zaw, 2017). In 1985, 3,000 alluvial diamonds, including a 10.3-carat stone, were recovered from Theindaw mine near Myeik. Between 1995–1998, small quantities of diamonds were found during gold panning along the Than Lwin River near towns including Tangyan, Pangsang, and Mong Hsu (21°51'22"N, 98°32'36"E) (Personal communication: Nyunt Htay & Ma Gjam). The sixteen diamonds used in this study originate from this locality. As noted by Griffin *et al.* (1998), Win *et al.* (2001), and Nyunt Htay (2012), Myanmar's diamonds are largely alluvial, with no confirmed primary sources to date.

Materials and Methods

Sixteen rough diamonds ranging from 0.18 to 1.02 carats (Fig. 2) exhibited various crystal habits, including octahedral, trisoctahedral, tetrahexahedral, macle, and rhombic dodecahedral forms. Surface and internal features were examined using a GIA binocular microscope and long-wave ultraviolet (LWUV) fluorescence. Raman spectra were collected with a Renishaw inVia™ confocal Raman microscope (532 nm, spectral range from 100 to 2000 cm⁻¹), while FTIR analysis was performed using a JASCO FT/IR-4X spectrometer (absorbance range 400–4000 cm⁻¹). These methods assessed structural integrity, surface alteration, and defect-related features.

Fig. 1. Various location of diamond deposits discovered in Myanmar over the years including the recent finding along Than Lwin river near Mong Hsu Township (map prepared by Thet Tin Nyunt, 2025)



Samples & Results

Microscopic Observations

Microscopic analysis revealed a variety of surface and internal features across the specimens. Notable observations included dark crystal inclusions, green and brown surface spots, percussion marks indicative of mechanical stress, hexagonal etch pits, trigons, and lamellar growth zoning. Green spots were especially prominent on some samples and suggested exposure to radioactive environments. Per-

cussion marks implied histories of plastic deformation and mechanical impact.

Raman Spectroscopy

Raman spectroscopy revealed a dominant diamond peak at 1331 cm^{-1} across all specimens, confirming preservation of the crystalline diamond structure. Secondary peaks between 1442–1449 cm^{-1} were detected in several specimens, attributed to disordered carbon associated with surface-reaching inclusions or stress-altered regions. Additional features at 381 cm^{-1} and 1216 cm^{-1} (Fig. 4) observed near green surface spots suggest radiation-induced defects, while a 1419 cm^{-1} peak, found in diamonds with brown spots and percussion marks, reflects plastic deformation. Low-frequency peaks around 154 cm^{-1} (Fig. 5) were also recorded in some samples, indicating localized lattice stress or vibrational modes activated near inclusion zones (Pasteris & Wopenka, 1991; Nasdala *et al.*, 2004; Zaitsev, 2001; Fischer *et al.*, 2009; Smith & Dent, 2010).



Figure 2. Sixteen pieces of rough diamonds from Mong Hsu, Myanmar with size range from 0.18 ct to 1.02 cts, with total weight 7.86 carats. (Photo by Tay T.S.)

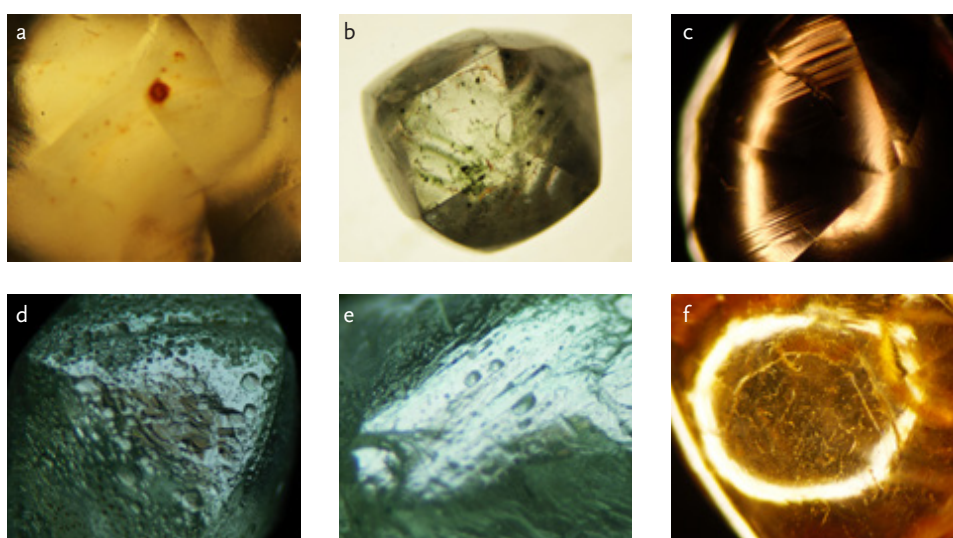


Fig. 3. Surface features of the 16 samples: (a) brown radiation spot (20x); (b) green radiation spots (20x); (c) lamellae growth marks (10x); (d) hexagonal growth marks (10x); (e) Etch marks (10x); (f) percussion marks (10x) (Microphotography by TTS).

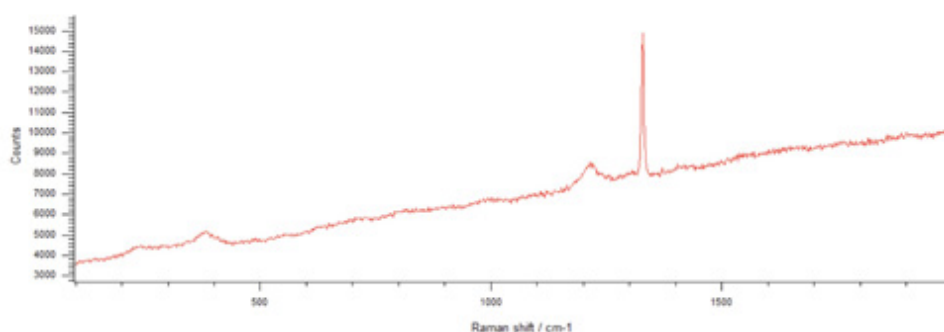


Fig. 4. Raman shift spectrum for specimen no. 11 showing peaks at 381 cm⁻¹, 1216 cm⁻¹, 1331 cm⁻¹

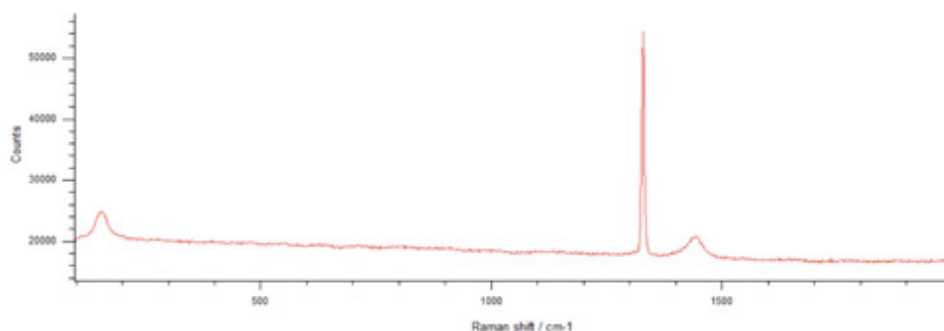


Fig. 5. Raman shift spectrum for specimen no. 6 showing peaks at 154 cm⁻¹, 1331 cm⁻¹, 1442 cm⁻¹

FTIR

FTIR spectroscopy confirmed that all diamond specimens are Type IaAB, characterized by absorption features at ~1004–1013 cm⁻¹ and 1170–1370 cm⁻¹, corresponding to A-aggregated and B-aggregated nitrogen defects. Additional absorptions near 3106–3215 cm⁻¹ indicate the presence of hydrogen-related defects. These results are consistent with prolonged high-temperature mantle residence, allowing nitrogen aggregation into stable forms, and suggest possible interaction with mantle fluids during or after formation (Boyd *et al.*, 1994; Woods, 1986).

Ultraviolet Light

Under long-wave UV light, most specimens exhibited weak to moderate fluorescence ranging from bluish white to chalky green, while almost all were inert under short-wave UV. Stronger fluorescence, as seen in samples 6, 7, and 9, may relate to nitrogen-related defects or localized structural distortion (Zaitsev, 2001). Specimens with green or brown radiation spots frequently displayed moderate blue fluorescence. Inert samples, including specimen 16, may

reflect low nitrogen concentrations or absence of optical defects (Boyd *et al.*, 1994). These observations support the natural origin and defect diversity among the Mong Hsu diamonds.

Discussion

Microscopy revealed features such as percussion marks, radiation spots, and resorption patterns. Under long-wave UV light, most diamonds fluoresced faint to moderate blue. Raman spectroscopy confirmed a stable diamond lattice (1331 cm⁻¹) with additional peaks (1442–1449, 1419, 381, 1216 cm⁻¹) indicating disordered carbon, plastic deformation, and radiation-related defects (Pasteris & Wopenka, 1991; Zaitsev, 2001). FTIR analysis identified all specimens as Type IaAB, showing A- and B-aggregated nitrogen and hydrogen-related defects (Boyd *et al.*, 1994; Woods, 1986), supporting a natural mantle origin with complex post-growth histories. A summary of results is given in Table 1 below.

Sample no.	Weight (Carats)	Colour	Shape	Surface Features/ Inclusions	UV	Raman cm ⁻¹	FTIR Wave-length cm ⁻¹	Diamond Type
01	0.295	Very light greenish yellow	Octahedral	Semi-transparent; Curved percussion marks on surface	LW – Faint blue SW – inert (very faint orangy yellow)	1331	482, 1010, 1175, 1286, 1364, 3106, 3200	IaAB
02	0.294	Light yellow	Octahedral	Semi-transparent; Resorbed surface with curved per-cussion marks	LW – faint yellow SW – inert	1331	482, 1007, 1278, 1372, 2850, 2918, 3106, 3200	IaAB
03	0.349	Light yellow	Tris-octahedron	Transparent; Re-sorbed surface	LW – very faint yellow SW – inert	1331	481, 1007, 1172, 1284, 1367, 3106, 3195	IaAB
04	0.396	Light yellow	Tetra-hexahedron	Semi-transparent; Frosty surface; Brown radiation spots	LW – moderate bluish white SW – inert	1331	488, 1010, 1176, 1224, 1363, 3106, 3201	IaAB
05	0.613	Yellowish brown	Rhombo-dodecahedral	Transparent; Re-sorbed surface with curved percussion marks; Brown stains along growth zones	LW – faint yellowish green SW – inert	1331, 1419	485, 1013, 1177, 1287, 1363, 3192	IaAB
06	0.792	Yellow	Irregular/ Twinning	Transparent; Graining; Black included crystal	LW – strong yellowish-blue SW – inert	154, 1331, 1442	477, 1009, 1175, 1280, 1362, 3106, 3200	IaAB
07	1.018	Greenish yellow	Irregular	Transparent; Brown & green radiation spot inclusion; Re-sorbed surface with curved and rhombic percus-sion marks	LW – strong blue SW – inert	1331	480, 1009, 1171, 1281, 1362, 3107, 3215	IaAB
08	0.931	Brownish Yellow	Irregular	Semi-transparent; Black included crystals; Resorbed surface; Cube-shaped growth marks	LW – moderate yellowish blue SW – inert	156, 1331, 1449	488, 1010, 1174, 1280, 1362, 3106, 3203	IaAB
09	0.299	Yellowish Brown	Irregular	Transparent; Brown radiation spots; Resorbed surface;	LW – strong yellowish brown SW – inert	156, 1331, 1445	478, 1008, 1177, 1276, 1362, 3106, 3200	IaAB
10	0.636	Green	Irregular	Semi-transparent; Green radiation spots; Curved percussion marks; Shield-shaped growth marks	LW – moderate blue SW – inert	156, 1331, 1447	498, 1010, 1174, 1281, 1327, 1363, 3107, 3208	IaAB
11	0.525	Green	Dodecahedral	Transparent; Green radiation spots; Brown staining along fractures; Curved and rhom-bic percussion marks	LW – moderate blue SW – inert	381, 1216, 1331	1008, 1173, 1278, 1367, 3107, 3207	IaAB
12	0.473	Brown	Irregular	Semi-transparent; Curved percussion Marks; Resorbed surface	LW – moderate yellowish blue SW – inert	154, 1331, 1447	481, 1009, 1177, 1288, 1331, 1359, 3204	IaAB
13	0.234	Brown	Macle	Transparent; Re-sorbed surface; Rhombic percus-sion marks	LW – very faint blue SW – inert	1331, 1419	475, 1004, 1174, 1280, 1362, 3107, 3182	IaAB
14	0.287	Brown	Tetra-hexahedron	Transparent; Shield-shape; Resorbed surface and lamellae	LW – inert SW – inert	1331	474, 1006, 1185, 1280, 1362, 3186	IaAB
15	0.552	Green	Irregular	Semi-transparent; Hexagonal surface etch marks; Green radiation spots (also in fissures)	LW – moderate blue SW – inert	1331	480, 1010, 1183, 1288, 1362, 3106, 3208	IaAB
16	0.179	Colourless	Octahedral	Transparent; Octa-hedron growth marks	LW – inert SW – inert	1331	482, 1010, 1180, 1282, 1371, 3107, 3192	IaAB

Conclusions

The rough diamond specimens show evidence of natural radiation exposure, plastic deformation, and surface stress features, as revealed by microscopy, UV fluorescence, Raman, and FTIR spectroscopy. It is likely to be due to exposure to alpha radiation and regional metamorphism in the alluvial deposits. Radiation defects may be further confirmed with UV-Vis spectroscopy. Despite localized defects, the primary diamond lattice remains intact. These findings reflect a complex post-growth history involving deep

mantle conditions, transport-related stress, and surface alteration. Further advanced spectroscopic studies such as photoluminescence and cathodoluminescence could refine the understanding of these processes. The study of inclusions after polishing, may also potentially be useful in studying the origins of diamonds in the future, however, it may only remain as a useful information rather than giving definitive conclusions of a diamond's origin (Smith et al, 2022).

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