The Vallerano Diamond from Ancient Rome: A Scientific Study

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Archaeological excavations during the 1990s at Vallerano, a municipality on Rome's southern periphery, uncovered a cemetery from the Roman empire. One tomb was that of a young woman, believed to be of Syrian origin. It contained a wealth of everyday objects and jewels, among them a gold and diamond ring. The diamond's gemological and spectroscopic properties were examined using portable instruments. Infrared spectroscopy indicated a type Ia diamond with evidence of B aggregates and probable A aggregates.

Excavations undertaken in 1993 in Vallerano, between the Via Pontina and Via Laurentina on Rome's southern outskirts, revealed a necropolis of 113 tombs (Bedini et al., 1995). One of these, Tomb 2, belonged to a young woman believed to be about 18 years old. Her marble sarcophagus contained a wealth of personal effects, an ivory doll, and finely crafted gold jewels set with gems (Bedini, 1995). The collection, whose richness is unusual among ancient Roman tombs, is on permanent exhibit at the National Roman Museum at Palazzo Massimo.

Of the artifacts, one is particularly noteworthy: a solid-band gold ring set with a rough octahedral diamond (figure 1). Its form corroborates Pliny the Elder's belief that the Romans valued diamonds above gold. The value of the Vallerano ring, the only known diamond-mounted ring in ancient Rome, is accentuated by its craftsmanship and simplicity of design.

One of the common objects discovered in the tomb was an oil lamp bearing the hallmark of Lucius Fabricius Masculus, active between 150 and 180 CE. This makes it possible to date the tomb to the reign of Marcus Aurelius. The richness of the Vallerano girl's tomb can be explained not so much by her family's wealth as by a particular ritual, most likely tied to religions of eastern origin. The material wealth and funeral rites of the Vallerano find, similar to those of other young Roman women such as Crepereia Tryphaena and the Grottarossa mummy (Bedini, 1995), can be linked to the Syrian community in ancient Rome. The Syrian enclave had its own religious, traditional, and commercial ties to Palmyra, a major caravan crossroad near the Euphrates River where luxury goods from the Persian Gulf and Arabia converged en route to Rome.

Among these were Indian diamonds that had been gathered on the Deccan altiplano, either from mines or in river gravels, as attested by both Pliny (Corso et al., 1988, Book 37) and Sanskrit literary sources (Chakraborti, 1966, pp. 244–245). These were objects of trade, along with other gems, spices, and luxury textiles. Pliny considered diamond the most precious of all stones, destined for kings and accordingly not meant for common use. Among the few archaeological specimens of diamond rings, this jewel is the only one whose chronological and social context is known (Marshall, 1968; Ogden, 1982).

In Brief

- Among the artifacts uncovered from ancient Roman tombs at Vallerano during the 1990s was a gold ring containing a rough diamond (approximately 0.15 ct).
- The ring can be linked to a young Syrian woman who died during the reign of Marcus Aurelius, making it the only Roman diamond jewel with a known background.
- Analyses conducted at the National Roman Museum point to a type Ia diamond with evidence of B aggregates and probable A aggregates.

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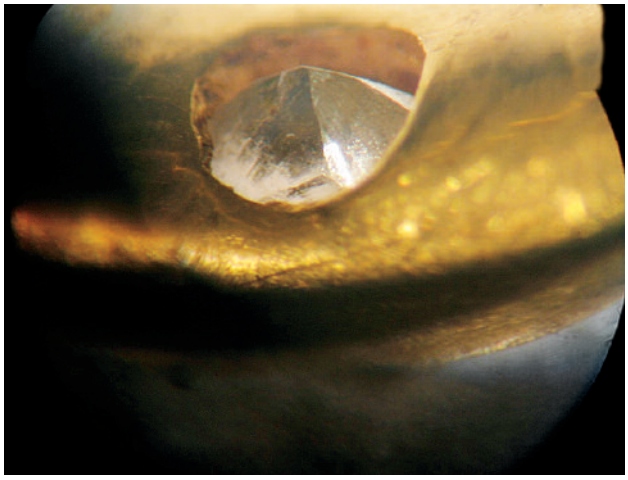
Figure 1. This gold and diamond ring, believed to belong to a young woman of Syrian origin, was discovered at the Vallerano site. The side view shows that the rough diamond was simply inserted into a central enlargement in the gold band. Photos by M. Letizia.

MATERIALS AND METHODS

The analyses were conducted at the National Roman Museum, using portable instruments. The stone was not removed from its fragile mounting, and in fact the researchers preferred leaving the stone in its supportive setting. Gemological examination was performed with a GIA Portalab equipped with a fiber-optic light and a binocular polarized microscope. Fluorescence was observed with long- and short-wave UV lamps. The diamond's infrared spectrum was collected with a Bruker Optics Alpha-R portable spectrometer with an external reflectance head covering a circular area of about 5 mm of diameter. The investigated spectral range was 7500–375 cm^{-1}, with a resolution of 4 cm^{-1} and 120 scans per acquisition (about two minutes).

Figure 2. The rough diamond in the ancient gold ring is seen here through the bottom of the mounting. Photo by D. Sali.



RESULTS AND DISCUSSION

The diamond measured 2.2 × 1.5 × 2.6 mm, corresponding to an estimated weight of 0.15 ct. The crystal had an adamantine surface luster and an octahedral form that was slightly rounded (figure 2). Trigons were not detected.

The diamond was inert to short-wave UV and fluoresced moderate blue to long-wave UV radiation. In neither case did the stone show phosphorescence. Magnification revealed a group of crystalline inclusions, the nature of which could not be determined due to the surface characteristics and the aforementioned precautions required in handling the ring.

Spectroscopic analyses of a number of points on the diamond provided reproducible spectra. Figure 3 shows the infrared spectrum in the 4000–375 cm^{-1} range, as no absorption occurred in the 7500–4000 cm^{-1} range. Absorptions were observed in the three-phonon spectral region (4000 to ~2800 cm^{-1}) at 3107 and 2786 cm^{-1}. The two absorptions had weak and very weak intensity, respectively, due to $C{=}CH_2$ group vibrations.

Moderate to weak absorptions at 2957, 2918, and 2851 cm^{-1} were attributed to CH_3 and CH_2 group stretching modes, likely due to grease contamination, as a thorough cleaning of the gem was avoided. The same molecular groups' bending mode was evident in a weak absorption at 1460 cm^{-1} (Iakoubovskii and Adriaenssens, 2002). Except for absorption due to atmospheric CO_2, no significant bands were observed in the two-phonon spectral region (Mendelssohn and Milledge, 1995).

The abundance of active absorptions in the one-photon spectral range at frequencies below the Raman threshold (1335 cm^{-1}) indicates the presence of nitrogen-impurity defects, leading to a classification of type Ia. Furthermore, the 1011 cm^{-1} absorption suggests the

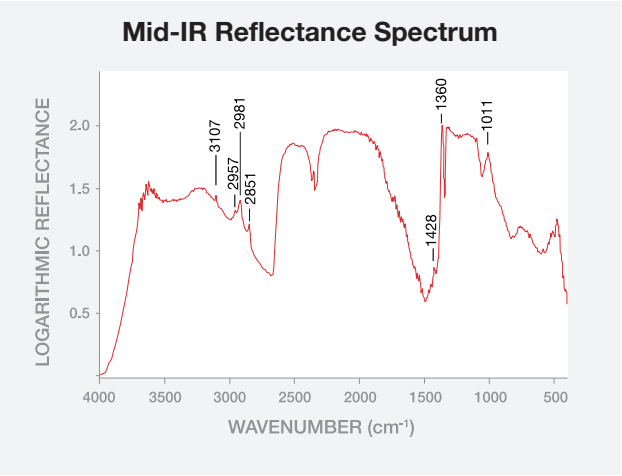


Figure 3. The Vallerano gem's FTIR spectrum classified it as a type Ia diamond.

presence of B aggregates (four atoms of nitrogen around a vacancy), and the intense narrow absorption at 1360 cm^{-1} shows the existence of platelet defects along (001) faces (Woods et al., 1993; Taran et al., 2006). A weak absorption at 1428 cm^{-1} could be attributed to N3 groups (Gaillou and Post, 2007).

Unfortunately, the spectrum was saturated in the interval indicative of A aggregates (pairs of nitrogen ions dispersed in a regular pattern in the structure) between approximately 1350 and 1100 cm^{-1}; Hainschwang et al., 2006), either because of an elevated concentration of nitrogen or, more likely, the difficulty of positioning the diamond while attempting to analyze it. As a consequence, the existence of a type IaA component can only be hypothesized.

CONCLUSIONS

The discovery of a diamond ring makes the rich collection of the young woman buried in Vallerano Tomb 2 a unique find. The ring's simplicity in no way detracts from the importance of the jewel, which presents a series of questions regarding the context of ritual practices in which this and analogous burials of young females uncovered in and around Rome must be placed.

The presence of nitrogen impurities led to the conclusive identification of the gem as a type Ia diamond, with evidence of B aggregates. The elevated nitrogen content, as well as limitations imposed in handling such a rare object, are probably responsible for the saturation of absorptions in the one-phonon spectral region, so that the presence of A centers can only be reasonably inferred. The presence of hydrogen inclusions was revealed by analysis of the three-phonon spectral range.

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REFERENCES

Bedini A. (1995) *Mistero di una fanciulla. Ori e gioielli della Roma di Marco Aurelio da una nuova scoperta archeologica*. Skira Publishing, Rome.

Bedini A., Testa C., Catalano P. (1995) Roma. Un sepolcreto di epoca imperiale a Vallerano. Quaderni di archeologia etrusco-italica 23. *Archeologia Laziale XII*, Vol. 1, pp. 319–331.

Chakraborti H. (1966) *Trade and Commerce of Ancient India (c. 200 B.C.–c. 650 A.D.)*. Academic Publishers, Calcutta.

Corso A., Mugellesi R., Rosati G. (1988) *Plinio, La Storia Naturale, Libri 33–37*. Giulio Einaudi, Turin.

Gaillou E., Post J. (2007) An examination of the Napoleon Diamond Necklace. *G&G*, Vol. 43, No. 4, pp. 352–357, http://dx.doi.org/10.5741/GEMS.43.4.352.

Hainschwang T., Notari F., Fritsch E., Massi L. (2006) Natural, untreated diamonds showing A, B and C infrared absorptions ("ABC diamonds") and H2 absorption. *Diamond and Related Materials*, Vol. 15, No. 10, pp. 1555–1564, http://dx.doi.org/10.1016/j.diamond.2005.12.029.

Iakoubovskii K., Adriaenssens G.J. (2002) Optical characterization of natural Argyle diamonds. *Diamond and Related Materials*, Vol. 11, No. 1, pp. 125–131, http://dx.doi.org/10.1016/S0925-9635(01)00533-7.

Marshall F.H. (1968) *Catalogue of the Finger Rings, Greek, Etruscan and Roman, in the Departments of Antiquities, British Museum*. British Museum Press, London, pp. 127–129.

Mendelssohn M.J., Milledge H.J. (1995) Geologically significant information from routine analysis of the mid-infrared spectra of diamonds. *International Geology Review*, Vol. 37, No. 2, pp. 95–110, http://dx.doi.org/10.1080/00206819509465395.

Ogden J. (1982) *Jewellery of the Ancient World*. Rizzoli International Publications Inc., New York.

Taran M.N., Kvasnytsya V.M., Langer K., Ilchenko K.O. (2006) Infrared spectroscopy study of nitrogen centers in microdiamonds from Ukrainian Neogene placers. *European Journal of Mineralogy*, Vol. 18, No.1, pp. 71–81, http://dx.doi.org/10.1127/0935-1221/2006/0018-0071.

Woods G.S., Kiflawi I., Luyten W., Van Tendeloo G. (1993) Infrared spectra of type IaB diamonds. *Philosophical Magazine Letters*, Vol. 67, No. 6, pp. 405–411, http://dx.doi.org/10.1080/09500839308240950.