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One Rupee Off-Metal Strike (OMS) of Shah Jahan I: A numismatic and historical study

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Abstract
This research paper investigates an unusual off-metal strike (OMS) one-rupee coin attributed to Mughal Emperor Shah Jahan I (reigned 1628-1658), integrating detailed technical numismatic analysis with broader historical interpretation. The study conducts a comparative assessment of the coin's metal composition, minting style, fabric, and die characteristics against standard silver rupees issued during Shah Jahan's reign. Using energy-dispersive X-ray fluorescence (EDXRF), the analysis identifies a heterogeneous metallic composition consisting of copper (52.09%), gold (5.56%), silver (4.47%), and cadmium (0.86%). Such an alloy significantly deviates from the established fineness of Mughal rupees and suggests the likelihood of non-standard minting conditions, experimental trial striking, or the use of repurposed metal blanks. In addition to the metallurgical findings, the paper contextualizes the OMS coin within Mughal minting conventions, regional production variability, and the administrative mechanisms governing currency circulation in the seventeenth century. The rarity of OMS coins attributed to major Mughal emperors, particularly Shah Jahan, underscores the importance of this specimen for advancing scholarship in South Asian numismatics. By combining scientific testing with historical evaluation, the study demonstrates how anomalous coins such as this OMS rupee offer valuable insights into mint experimentation, economic practices, and the complexities of Mughal monetary history.

Keywords: One rupee, OMS coin, Shah Jahan I, Mughal Emperor, numismatic

Introduction
The Mughal Empire, one of the most affluent and culturally sophisticated dynasties in South Asian history, reached its artistic and administrative apex under the rule of Shahab-ud-din Muhammad Khurram, better known as Shah Jahan I (1628-1658 CE). His reign represents a pinnacle of architectural achievement, aesthetic refinement, and imperial authority, reflected not only in monumental structures but also in the meticulously crafted coinage issued from numerous imperial mints [1, 2, 3]. Among these, the silver one-rupee coin functioned as both a principal medium of exchange and a powerful symbol of sovereignty, legitimacy, and minting excellence [4].

Shah Jahan's era is widely celebrated for its unparalleled contributions to Mughal art and architecture, epitomized by the construction of the Taj Mahal, the Red Fort, and a host of other grand edifices that continue to define the artistic landscape of the subcontinent [5, 6]. This aesthetic brilliance extended to the empire's numismatic tradition, where coins served not only as instruments of trade but also as symbols of sovereignty, craftsmanship, and regional minting practices. The coins of Shah Jahan's reign exhibit exceptional calligraphic precision, stylistic uniformity, and metallurgical consistency, characteristics that help modern scholars identify mint origins and chronological sequences with remarkable accuracy.

This study examines a highly unusual one-rupee specimen attributed to Shah Jahan I that departs from the standard metallic profile of Mughal rupees and is thus identified as an off-metal strike (OMS). Through a combination of metallurgical analysis, stylistic assessment, and comparative study against regular issues from established mints such as Agra, Delhi, Lahore, Surat, and Patna, the research aims to situate this anomalous coin within the broader context of Mughal monetary production [7, 8].

The numismatic literature on Mughal coinage, including foundational works provides essential frameworks for typological and die-style comparison, complemented by the

catalogues of the British Museum and the Indian Museum, Kolkata [9]. Recent applications of analytical techniques such as EDXRF and XRD further illuminate the technological sophistication of Mughal minting practices [10]. Despite the extensive documentation of Shah Jahan's silver rupees, authenticated off-metal strikes remain exceedingly rare. By incorporating evidence from mint regulations and historical accounts preserved in sources such as the Ain-i-Akbari and contemporary Persian chronicles, this study seeks to deepen our understanding of Mughal mint operations and the circumstances under which such atypical coins may have been produced [11].

Methodology

The present study integrates metrological examination, stylistic assessment, and scientific analysis to investigate the off-metal strike rupee attributed to Shah Jahan I. Initial visual inspection was conducted to document the overall appearance, surface characteristics, and preservation state of the specimen. Standard metrological measurements, including weight, diameter, and thickness were recorded using calibrated digital scales and precision calipers to ensure accuracy and comparability with established Mughal silver rupees.

Elemental analysis was performed using Energy Dispersive X-ray Fluorescence (EDXRF) spectroscopy [12]. This non-destructive technique provided quantitative data on the percentage composition of constituent metals, enabling evaluation of the alloy in relation to known standards for Mughal coinage. The readings were replicated to ensure consistency and to minimize instrumental error. Stylistic features, including calligraphy, die engraving, and mint marks, were examined under magnification using a stereomicroscope. These attributes were compared with authenticated examples attributed to the Patna Mint and other contemporary mints as documented in major numismatic catalogues and reference works. Particular attention was given to dies, legends, and mint-specific engraving conventions.

To contextualize the findings, the study incorporated historical and archival research. Primary Persian chronicles, administrative documents to understand the minting practices, metallurgical controls, and circulation patterns of Mughal currency during Shah Jahan's reign. Secondary historical studies provided additional interpretative frameworks, allowing for a comprehensive assessment of the specimen within its broader numismatic and historical milieu.

Discussion and Analysis

The off-metal strike (OMS) coin attributed to Shah Jahan I demonstrates notable stylistic congruence with authenticated Patna Mint rupees, particularly in calligraphic execution, die alignment, and overall fabric [13]. The coin is shown in below figure 1.

Fig 1: OMS One Rupee of Shah Jahan I

These parallels suggest that the dies used for this specimen were likely prepared for regular silver issues. However, the elemental profile revealed through EDXRF analysis, 52.09% copper, 5.56% gold, 4.47% silver, and 0.86% cadmium, places the coin well outside the normative fineness parameters of Mughal silver rupees, which typically maintain a high silver content with consistent purity standards. Metal composition with corresponding colour codes obtained from the machine is shown in figure 2 below. This pronounced deviation raises important questions regarding the minting context of the specimen.

Element	Content	Intensity	Color
Cu	52.09%	3763.02	
Au	5.56%	224.74	
Ag	4.47%	418.69	
Cd	0.86%	62.94	

Fig 2: Metal Composition

Several plausible explanations emerge. One possibility is that the coin represents a deliberate mint trial or experimental strike, conducted to test flan quality, die performance, or the suitability of alternative alloys. Mughal mints are historically known to undertake such experiments during periods of fluctuating metal availability, transitions in bullion supply routes, or administrative adjustments related to mint relocation. The overwhelmingly high copper proportion strongly supports the hypothesis that the flan was not intended for standard circulation but served as a surrogate metal blank for trial striking.

Energy Dispersive X-ray Fluorescence (EDXRF) spectroscopy has emerged as a critical tool for non-destructive analysis of historical coins. The mixed metal profile of the Shah Jahan OMS coin points to recycled or repurposed material sources, likely derived from the melting of scrap utensils, ornaments, or lower-grade coinage. The inclusion of cadmium, albeit in trace amounts, is particularly noteworthy. This element was rarely documented in Mughal metallurgy but may have entered through contamination or experimental alloying. Historical accounts, such as those in the Ain-i-Akbari and the Shah Jahan Nama, confirm that Mughal metallurgists possessed advanced smelting and refining capabilities, capable of producing high-purity silver and gold [14, 15, 16]. However, experimentation with alloy ratios was not uncommon, especially in mints like Patna and Lahore that were exposed to diverse trade inputs. The presence of gold traces could indicate an attempt to achieve a specific hue or luster, aligning with Mughal aesthetic sensibilities where visual brilliance was intertwined with symbolic imperial power.

The presence of detectable gold and cadmium, although in small quantities, further suggests the likelihood of recycled metal inputs or contamination from previously used crucibles and refining tools. Such traces are consistent with metallurgical practices in which leftover fragments of mixed metals were occasionally melted to produce test blanks. Taken together, the stylistic continuity with Patna dies and the anomalous composition underscore the interpretation of this coin as a rare example of Mughal mint experimentation rather than a circulation issue, offering valuable insights into technical flexibility within seventeenth-century mint operations.

The analysis of the One Rupee Off-Metal Strike (OMS) attributed to Shah Jahan I demands a deeper examination of the metallurgical, numismatic, and socio-economic contexts that framed its production. The discovery of an OMS specimen is not only significant for numismatists but also for historians and material scientists seeking to understand the broader mechanisms of Mughal mint technology and experimentation. The EDXRF composition, indicating dominant copper with minor traces of gold, silver, and cadmium, raises several hypotheses. One plausible interpretation is that the coin represents a trial strike, conducted to test die integrity, engraving quality, or mechanical pressure during minting. Mughal mints, particularly under Shah Jahan, were known to operate with a combination of manual hammer striking and screw-press techniques, often adjusted to improve imprint precision. Such trials were sometimes conducted on copper flans before employing silver or gold, given the higher value and scarcity of noble metals.

From a typological perspective, the inscriptions conform to the orthodox pattern of Shah Jahan's coins, with the emperor's titles on the obverse and the mint name and regnal year on the reverse. The calligraphy style closely aligns with known Patna issues, supporting the attribution. The precision of engraving and die alignment further supports its authenticity as a mint product rather than a contemporary counterfeit. Historical sources indicate that the Patna Mint was active throughout Shah Jahan's reign, producing silver rupees for eastern provinces, often distinguished by refined floral motifs. The discovery of an OMS coin from this mint adds new evidence to the range of metallic experimentation within the Mughal monetary system.

Shah Jahan's reign marked the consolidation of Mughal authority and an efflorescence of cultural achievement [17, 18]. Coinage served not merely as an economic instrument but as a medium of imperial propaganda [19]. His coins bore titles emphasizing divine sanction, such as 'Sahib-e-Qiran Sani' (Second Lord of the Auspicious Conjunction), asserting cosmic legitimacy. The standardization of coin weights and purity reflected administrative efficiency, while the aesthetic calligraphy mirrored the architectural symmetry of Mughal art. The OMS coin must be understood within this milieu of artistic perfection and technical mastery, yet it also reveals the occasional practical variations inherent to the large-scale minting operations of the empire.

From an administrative standpoint, the production of an OMS coin suggests the operational flexibility within the Mughal mint system. Each mint was overseen by a hierarchy of officials, including the Darogha (superintendent), the Amin (assessor), and the Taksal masters responsible for die engraving and striking supervision. A copper-based off-metal strike could have been authorized for technical testing or as an in-house sample for die approval. Economically, this practice reflects the Mughal state's concern with metal conservation, efficiency, and quality control. During the mid-seventeenth century, fluctuations in silver inflows from foreign trade, particularly from European merchants, may have led to temporary shortages that necessitated adaptive mint practices. The OMS coin thus embodies both a technical and administrative adaptation, bridging art and economy within the Mughal state apparatus.

Conclusion

The one-rupee off-metal strike attributed to Shah Jahan I stands as a rare and valuable artifact of Mughal numismatic history. Its atypical metal composition, coupled with stylistic consistency, demonstrates both technological experimentation and the operational complexity of Mughal minting practices. By bridging metallurgical data and historical context, this study enhances our understanding of how Mughal coinage functioned as both a fiscal and artistic expression of imperial identity. Future research integrating advanced compositional mapping, die-link studies, and comparative analysis of regional mints could further illuminate the dynamics of minting variability in early modern South Asia. The One Rupee Off-Metal Strike (OMS) of Shah Jahan I is a multidimensional artifact that transcends its immediate materiality. It encapsulates the technological ingenuity, administrative sophistication, and artistic excellence of Mughal India. By integrating metallurgical analysis with historical documentation, this study positions the OMS coin as a tangible intersection of

science, art, and governance. Its anomalous composition provides valuable insights into Mughal experimentation with alloys, their quality assurance protocols, and the extent of administrative oversight. The comparison with other off-metal issues across the Mughal and Sultanate periods reveals an enduring tradition of mint-level innovation, often driven by necessity or creative exploration. The coin's significance thus lies not merely in its rarity but in its capacity to illuminate the complex systems that sustained the Mughal Empire's economic and cultural grandeur. Future studies employing isotopic analysis, die-link mapping, and computational modeling of metal flow could further refine our understanding of OMS coins within the broader framework of South Asian numismatic heritage.

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