Meteorites in Cuba and the fragility of their institutional record

Meteoritos en Cuba y la fragilidad de su registro institucional

Yasmani Ceballos Izquierdo yasmaniceballos@gmail.com
https://orcid.org/0000-0001-5158-2547
Biblioteca Digital Cubana de Geociencias, Havana, Cuba

Abstract: Several attempts have been made in Cuba to update and consolidate the meteorite record. This paper highlights the lack of visual documentation, the absence of reference specimen identifiers, and the omission of bibliography and information on institutional repositories; coupled with an excessive reliance on single analytical techniques. It also incorporates an on-site verification work conducted at Havana Planetarium and the Museum of Natural History of Havana, in August 2025, which enabled direct comparison of the published information with the availability of physical specimens. These methodological shortcomings compromise the traceability, usage, and scientific validity of the information presented.

Keywords: Bacuranao, institutional collection, Mango Jobo, pseudometeorites

Resumen: En Cuba se han realizado varios intentos por actualizar y consolidar el registro de meteoritos. En este comentario se señaló: la falta de documentación visual, la ausencia de identificadores de ejemplares de referencia y la omisión de bibliografía e información sobre repositorios institucionales; unido a la dependencia excesiva de técnicas analíticas únicas. Asimismo, se incorporó trabajo de verificación *in situ* realizado en el Planetario de La Habana y en el Museo de Historia Natural de La Habana en agosto de 2025, el cual permitió contrastar directamente la información publicada con la disponibilidad de ejemplares físicos. Estas carencias metodológicas comprometen la trazabilidad, utilización y validez científica de la información presentada.

Palabras clave: Bacuranao, colección institucional, Mango Jobo, pseudometeoritos

Introduction

Cuban meteoritics has over a century of history marked by ambiguous reports, loss of specimens, misidentifications, and consecutive revisions (Ceballos-Izquierdo, 2019, 2022, 2024; Ceballos-Izquierdo *et al*., 2021, 2024a, 2024b and references therein). The article by Jaimez-Salgado *et al. (*2025) seeks to update the national record under the authority of the Institute of Geophysics and Astronomy (IGA); however, it does not provide significant novelties, as it merely repeats a list published in 2023.

The centerpiece of the most recent record update is the examination of fragments from the specimen known as Mango Jobo. They have historically been considered siderites, which is a classification that had already been ruled out in multiple previous studies (Ceballos-Izquierdo, 2022, 2024; Ceballos-Izquierdo *et al.,* 2021, 2024a, 2024b; Iturralde-Vinent, 2023). Jaimez-Salgado et al. (2025) reasserted none of the three fragments have a cosmic origin and, consequently, suggest a refinement of the institutional list to five meteorites. Their proposal as an attempt to achieve documentary order is valuable, yet it presents limitations regarding methodological design, scientific standardization, specimen documentation, results interpretation, transparency, and the very understanding of what an institutional record is.

Likewise, Iturralde-Vinent (2023) has offered significant comments on the record's previous version. Hence, this contribution examines these deficiencies in detail, aiming at providing concrete criteria for the future construction of an institutional record aligned with the Meteoritical Society's standards.

Materials and methods

The published literature on the institutional record of Cuban meteorites was subjected to a detailed documentary analysis, with special attention to publications by Jaimez-Salgado *et al.* (2023a, 2025). Primary sources and institutional documents were comparatively reviewed, assessing their coherence, traceability, and compliance with the Meteoritical Society's international standards. Furthermore, an on-site verification work —carried out in August 2025, at Havana Planetarium and the Museum of Natural History of Havana— was included to ascertain the whereabouts of fragments attributed to Mango Jobo specimen. During the visit to these institutions, physical and digital inventories were consulted; still, no fragments were found in the collections reviewed, and it was not possible to confirm their state of preservation.

Throughout the text, the term *meteor-wrong* (pseudometeorite) is used to refer to those specimens that, although resembling meteorites or historically mistaken as such, lack a cosmic origin, yet retain significant scientific value (Ceballos-Izquierdo *et al.,* 2024a).

Discussion

The work of Jaimez-Salgado *et al.* (2025) cannot be evaluated in isolation, but within the framework of a set of recent publications aimed at clarifying or reinterpreting the Cuban meteorite record. Both Iturralde-Vinent (2023) and Ceballos-Izquierdo (2024) have pointed out deficiencies in the way supposed Cuban meteorites are documented and published in the "institutional record." The pattern is detailed below.

Lack of repositories and curation

As noted by Iturralde-Vinent (2023) and Ceballos-Izquierdo (2024), the absence of well-defined and publicly accessible repositories constitutes the greatest weakness within the Cuban institutional meteorite record. The records heretofore published provide no concrete information on the current deposit of specimens (meteorites or meteor-wrongs), their conservation status, the institution responsible for their custody, or inventory numbers guaranteeing their traceability. This omission not only prevents independent verification of results but also raises questions about the preservation of this national geological heritage and precludes any possibility of future scientific re-evaluations.

The last two publications on the institutional record (Jaimez-Salgado *et al.*, 2023a; 2025) have re-evaluated specimens already identified as meteor-wrongs, however, they do not document the movement and traceability of genuine meteorite samples, such as fragments from Viñales meteorite and Ramón de las Yaguas meteorite's main mass. A substantial advance in the record would be to formally document and illustrate the fragments preserved in the collections of various national institutions and museums, as well as the material from Viñales and Ramón de las Yaguas meteorites which are stored at IGA, and also the samples transferred from that institute to repositories abroad. Likewise, it would be valuable to have a formal publication designate Ramón de las Yaguas' main mass as the type specimen, with the corresponding assignment of a catalog number to guarantee its traceability.

As for meteor-wrongs, Mango Jobo case illustrates the problem: its fragments circulated through the Archaeology department of the former Academy of Sciences, the erstwhile National Museum of Natural History, the Havana Planetarium, the Museum of Natural History of Havana, and the Institute of Geophysics and Astronomy, with contradictory reports on their whereabouts. Rochette *et al.* (2024) analyzed one of them, but the material is no longer available at the museum (Iturralde-Vinent, 2023). These institutional transfers are not clarified by Jaimez-Salgado *et al.* (2025), leaving the traceability of the specimens unclear.

Mango Jobo's largest fragment was on display at Havana Planetarium until 2019, a fact verified by the author of this contribution. In 2021, after Ceballos-Izquierdo *et al.* (2021) questioned both its low density and alleged presence of Widmanstätten patterns, it was removed from the public exhibit and transferred to the IGA. Besides, Jaimez-Salgado (2023) mentioned that "nitric acid was recently applied" and admitted that the application of the reagent had caused severe corrosion of the piece. In addition, Jaimez-Salgado *et al.* (2023a) stated that the smaller fragment is the only one preserved, without providing details on the other fragments condition and chain of custody. To trace the three fragments whereabouts, the Museum of Natural History of Havana and Havana Planetarium were visited on August 30th, 2025, but no information was obtained regarding the presence of the larger and medium fragments.

To carry out scientific research, it is crucial each specimen has a unique and permanent identifier (Ceballos-Izquierdo, 2024). In this regard, and despite the institutional responsibility to curate and preserve materials, the current institutional records do not assign inventory numbers or identifiers to the three analyzed fragments and overlook their current location (Jaimez-Salgado *et al.*, 2023a; Jaimez-Salgado *et al.*, 2025). In the paper by Jaimez-Salgado *et al.* (2025), the specimens were identified only by their approximate weight, which is insufficient and risky: different fragments might be confused or lost, as practice has demonstrated. The critics made by Ceballos-Izquierdo (2024) to Rochette *et al.* (2024) for working with pieces lacking inventory numbers applies to the recent institutional update on Cuban meteorites.

Bibliographic omissions

The institutional records published so far incurred in the omission of crucial literature, although a greater effort to cite recent research is noted in the most recent institutional update (Jaimez-Salgado, 2025). As a result, a recount that does not acknowledge other aspects or the content of multiple scientific publications is presented as a definitive report. For instance, the information about Mango Jobo in Ceballos-Izquierdo (2022, 2024) and about Bacuranao in Rochette *et al.*

(2024) and Ceballos-Izquierdo (2024) is not discussed. Likewise, the first count of Cuban meteorites (Ceballos-Izquierdo, 2019) is ignored; this document, although being subsequently updated, represented the first formal dissemination of these data by the IGA, conferring upon it historical and methodological value.

In the specific case of Bacuranao, the omission is twofold: on one hand, scientific literature produced by national researchers is set aside; on the other, international bibliography addressing the consequences suffered by a meteorite after a prolonged period in a marine environment (e.g., Buchwald, 1977; Ceballos-Izquierdo *et al*., 2025) is ignored. The absence of this comparative framework leaves unexplored one of the most relevant hypotheses to evaluate this specimen´s true nature.

Initially, Ceballos-Izquierdo (2024) and Ceballos-Izquierdo *et al.* (2024a) had considered Bacuranao's specimen as a meteor-wrong. In contrast, Jaimez-Salgado *et al.* (2023a) consider it an iron meteorite, later specified as a siderolite (mesosiderite), a controversial classification based on interpreting, on the base of the literature, the joint presence of chondrules and Widmanstätten patterns in the same specimen. Furthermore, Jaimez-Salgado *et al.* (2023a) allude "that it was tested with HNO_3 for Widmanstätten patterns" and later "confirmed in 1983 by the presence of chondrules and Widmanstätten patterns; the latter found in a test with HNO_3".

However, the original report by Segura-Soto (1983) does not indicate the application of nitric acid, nor the performance of such a test; it only mentioned the inspection of a polished section and a thin section. Regarding the Widmanstätten patterns, Segura-Soto (1983) only made an allusion: "the internal mass of the sample is completely composed of metallic minerals that in the polished section are revealed as kamacite, which, arranged in laminar bands, resemble the well-known Widmanstätten patterns".

This statement constitutes a morphological comparison, not a metallographic verification. It does not mean that such patterns were actually observed, and the published photographs do not allow them to be conclusively confirmed either. Over time, the original expression "resemble" was transformed by Jaimez-Salgado and collaborators into "confirmed," which is not recorded in the original report. Similar to Mango Jobo case, Jaimez-Salgado and collaborators maintain in their institutional record a specimen based on an interpretation that assumes the existence of Widmanstätten patterns that, in practice, cannot be verified.

Bacuranao specimen was found in a sandy seabed, on Bacuranao beach, Havana, in 1974 (Segura-Soto, 1983). Under such conditions, a metallic meteorite would be subjected to corrosion, sedimentation, and possible interactions with bacteria that could affect its integrity and composition over time. All these factors could even lead to the disintegration of the specimen (Buchwald, 1977; González-Toril *et al.,* 2005; Gronstal et al., 2009). Consequently, a meteorite found in a marine environment should exhibit clear signs of alteration, and its intact preservation, without visible evidence of corrosion, is highly unlikely.

Surprisingly, Segura-Soto (1983) reports no traces of alteration or corrosion products, which increases doubt about the material's true nature. It is described as black in color, with a submetallic luster and characteristics inconsistent with iron meteorites, such as the presence of lithic chondrules containing quartz and breunnerite. No information was provided on the mass, density, or repository of the specimen, leaving its existence in doubt. A small fragment was sent to the United States years ago, and the analyses performed indicated it was a basalt. Rochette *et al.* (2024) dismissed the meteoritic nature of a fragment preserved by Rojas-Consuegra attributed to Bacuranao; however, uncertainty persists as to whether the investigated fragment actually corresponded to the original material described by Segura-Soto (1983).

A datum originally reported by Segura-Soto (1983) is the magnetic susceptibility: 9000×10^{-6} CGS, a value incompatible with any known meteoritic range. Depending on the normalization used (mass or volume), the results in SI units fall well above or below the characteristic intervals for meteorites, being more consistent with industrial slag or terrestrial rocks enriched in magnetite. In both scenarios, the results clearly deviate from the ranges defined for meteorites; therefore, this magnetic susceptibility record constitutes a solid argument for ruling out the cosmic nature of the analyzed sample.

On the whole, the descriptive inconsistencies, absence of basic data, bibliographic contradictions, and the specimen's unknown whereabouts lead to the conclusion that Bacuranao should be considered a historical case of academic interest, but it lacks scientific validity to appear in an institutional or international meteorite record. The most consistent rationale would be to definitively exclude it from the institutional list, as its current inclusion seriously compromises the credibility of the Cuban record within the scientific community.

Accumulative effect of errors

The records on meteorites in Cuba have been criticized for the lack of visual documentation, cataloging and repositories, as well as the omission of literature and methodological weakness; which is consistent with previous reports from 2001 and 2007 (Iturralde-Vinent, 2023; Ceballos-Izquierdo, 2024). This reveals not only a specific deficiency but a fundamental problem in the way meteorites (or meteor-wrongs) are evaluated, investigated, and documented in scientific publications. Moreover, the almost exclusive reliance on XRD and XRF in the article by Jaimez-Salgado *et al*. (2025) is analogous to the 2001 and 2007 reports and the poorly detailed methodology in Ramón de las Yaguas meteorite analysis (Jaimez-Salgado *et al.,* 2023b). The cases of Boyeros, La Lisa, Güira de Melena, and Mango Jobo, identified as meteorites for decades by some of these techniques and later dismissed, demonstrate the fragility of the classifications.

In the specific case of Mango Jobo, the institutional records in 2023 and 2025 restate that the smaller fragment might correspond to an H-type ordinary chondrite. To confirm this hypothesis, they rely on XRD and XRF, overlooking the most direct and consistent procedure: basic microscopic observation and the search for chondrules, an essential diagnostic feature in this group of meteorites. 2023a and 2025 records do not mention Mango Jobo fragments´ basic aspects such as density, irregular shape, absence of fusion crust or regmaglypts, nor the presence of internal cavities and voids—characteristics that, by themselves, suffice to conclusively reject the meteoritic nature of this material, without needing to apply additional tests.

In addition, there is a lack of interpretation of the high cristobalite peaks detected in the XRD analyses. Cristobalites are not compatible with H-type ordinary chondrites and has been interpreted in Ceballos-Izquierdo (2022) as evidence against a meteoritic origin. In the case of Bacuranao, the 2025 update confirms results from 1983 as definitive while disregarding the direct re-evaluation of the material using modern methods and the critical reading of the original report.

The manner in which the information is presented so far shows a deficient level of detail to meet the usual standards for describing a scientific specimen. In the list by Jaimez-Salgado *et al.* (2025), the repository for Las Canas meteorite is only described as a museum in the United States; information supplemented by internet links without specifying the institution's name nor citing the original bibliographic reference that introduced the specimen (Ceballos-Izquierdo *et al.,* 2021). Bacuranao case is classified, on insufficient evidence, as a stony-iron meteorite (mesosiderite).

Another element to consider is the incorrect use of the preposition "*de*" (of) in the names of three meteorites (Meteorito de Santa Isabel de las Lajas, Meteorito de Viñales, Meteorito de Ramón de las Yaguas), contravening international nomenclature rules, according to which, for example, "Viñales meteorite" should be used.

Primary omissions are noticed in the specimen's characterization: it is not mentioned that Santa Isabel de las Lajas meteorite corresponds to an L-type ordinary chondrite, nor are the impact and weathering degrees of Viñales and Ramón de las Yaguas meteorites indicated. Finally, confusion is introduced from the very article's abstract by stating "a total of five meteorites confirmed to date, from an initial list supposedly of ten, of which three were seen to fall by witnesses and another two…". This poses the question: where was this list of ten specimens published? Furthermore, a factual inconsistency arises as Ceballos-Izquierdo *et al.* (2021) designated Las Canas meteorite as a "fall," because it was found after the fireball was sighted, meaning there would be four meteorites seen to fall in Cuba, not three. Likewise, the correct date corresponding to Mango Jobo finding is 1938.

The latest 2025 record uses an erroneous formulation when referring to "mass spectrometry by X-ray fluorescence" (a non-existent technique). The correct term would be X-ray Fluorescence (XRF), while Mass Spectrometry (MS) constitutes a different technique, which in geochemical and meteoritic fields is usually associated to coupling with inductively coupled plasma (ICP-MS, *Inductively Coupled Plasma Mass Spectrometry*), used to determine trace elements and isotopic ratios with high precision.

Conclusions

The institutional record of meteorites in Cuba has not yet reached the necessary standards to be considered updated and reliable. The consequences of these practices are critical: a) Cuban meteorites continue to lack a reliable, verifiable, and accessible institutional record; b) the scientific community perceives a deficit of transparency and accuracy in publications on these institutional records, projecting an image of superficiality in national meteorite evaluation; c) the island's meteorite and meteor-wrong samples heritage remains vulnerable to loss, misinterpretation, future re-evaluations, or even disappearance.

The international scientific community is guided by the Meteoritical Bulletin Database, which does require repositories, numbering, photos, and peer review. Until Cuba adopts these standards, its

institutional record will be reduced to an administrative exercise, with no real impact on scientific research. The current context, however, offers an opportunity to establish more rigorous protocols, improve traceability, and consolidate a Cuban meteorite record that meets international quality and accessibility criteria, benefiting both national research and international collaboration.

Recommendations

To reverse this situation, it is recommended to:

1. Designate an institutional collection with public access, a digital catalog, and museographic standards.

2. Assign unique identifiers to each specimen scientifically relevant, whether it is a meteorite or not.

3. Publish high-resolution diagnostic images with scales and annotations in any future "institutional update," clearly indicating each specimen's repository.

4. Implement a multidisciplinary approach combining various analytical techniques.

5. Include comprehensive bibliography, acknowledging previous contributions and international literature on meteorite weathering, alteration and classification, avoiding purely local or institutional biases.

6. Align nomenclature, descriptions, and acceptance criteria with the Meteoritical Society's standards.

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