A Taxonomy of Dismissal Categories for Biosignature Claims

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Companion paper: Asymmetric Standards of Dismissal in Early Earth Life Claims

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Abstract

The systematic dismissal of anomalous biosignature observations follows identifiable, repeatable patterns. When these patterns are made explicit, the dismissal filter itself becomes the discovery instrument. We present a taxonomy of six dismissal categories (Alternative Mechanism, Morphological Ambiguity, Contextual Doubt, Methodological Challenge, Null Default, Contamination/Artifact) with explicit inclusion criteria, an asymmetry index scoring claims and dismissals on four axes (Quantification, Replication, Specificity, Falsifiability), and the Van Zuilen Standard requiring dismissals to meet the same evidentiary bar as the claims they challenge. Applied to 11 cases across early Earth geology and planetary biosignature detection spanning 40 years, the framework reveals three structural findings: (1) the asymmetry pattern is consistent across domains, (2) the only symmetric dismissal in the dataset (van Zuilen 2002) demonstrates that symmetric skepticism is possible but vanishingly rare, and (3) every observation in the dataset survives two or more dismissal categories, indicating that the most-skepticized claims are the most battle-tested signals. The methodology is designed for null-result publishability: finding no asymmetry pattern is itself a valid result. The taxonomy makes epistemic asymmetry visible, the index makes it measurable, and the Van Zuilen Standard makes it accountable. The filter is the finding.

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1. Introduction

- Biosignature claims are held to quantitative standards. Dismissals are not.
- This has been observed informally (Knoll 2002, Brazier 2005) but never formalized.
- A taxonomy makes the pattern reproducible and falsifiable.
- We present 6 dismissal categories with explicit inclusion criteria, a quantitative scoring rubric (4 axes, 0-3 each), and an asymmetry gap metric.
- The taxonomy is tested across two domains (early Earth and planetary biosignatures) to assess generality.

2. Cross-Domain Validation

2.1 Calibration Ladder

Before scoring individual cases, we establish calibration anchors spanning the full asymmetry range:

Anchor Level	Case	Gap Score	Function
LOW (Symmetric)	van Zuilen 2002 (FTT dismissal of Mojzis 1996)	2	Shows what symmetric dismissal looks like
MODERATE	Fedo 2002 (metasomatic reinterpretation of Akilia)	4	Boundary between symmetric and asymmetric
STRONG	Viking LR 1976 (Levin)	7	Quantitative claim dismissed with qualitative alternatives
EXTREME	Mojzis 1996 (generic dismissal) / Venus PH3 2020	9	Quantitative claim dismissed with unfalsifiable alternatives

The Fedo 2002 moderate anchor was derived as follows: - Claim (Mojzis 1996 d13C in Akilia apatite): Q=2, R=2, S=2, F=1 = 7 - Dismissal (Fedo 2002, no mass balance, petrographic opinion): Q=1, R=1, S=1, F=0 = 3 - Gap = 7 - 3 = 4 (Moderate)

This calibration ensures the asymmetry index has meaning at every level, not just at the extremes.

2.2 Early Earth Biosignature Cases

Case 1: Mojzis et al. 1996, d13C in Akilia Apatite

Claim: Isotopically light carbon (d13C -30 to -40 per mil) in graphite inclusions within apatite from Akilia island, West Greenland. Ion microprobe (SIMS) analysis with 3-sigma significance, replicated across multiple apatite grains and sites. Age: >3,850 Ma.

Claim Score: Q=2, R=2, S=2, F=1 = **7**

Dismissal 1 (generic “could be abiotic”): Q=0, R=0, S=0, F=0 = **0**. Gap = 7. Categories: Cat 1 (Alternative Mechanism), Cat 3 (Contextual Doubt), Cat 5 (Null Default).

Dismissal 2 (van Zuilen 2002, FTT experimental demonstration): Q=1, R=1, S=2, F=2 = **6**. Gap = 1. Categories: Cat 1 (Alternative Mechanism). This is

the symmetric variant, the only dismissal in our dataset meeting the Van Zuilen Standard.

Asymmetry classification: **Extreme** (generic dismissal), **Symmetric** (van Zuilen).

The same claim generates two radically different gap scores depending on the rigor of the dismissal. This is the central observation: the taxonomy does not judge the claim. It measures the dismissal.

Case 2: Fedo and Whitehouse 2002, Akilia Host Rock Reinterpretation

Dismissal: The quartz-pyroxene rock at Akilia is metasomatized ultramafic rock, not a BIF. If the host rock is not sedimentary, the carbon inclusions cannot be biogenic sedimentary organic matter. The argument targets geological context, not the isotopic signal itself.

Claim Score (Mojzis 1996, same as above): Q=2, R=2, S=2, F=1 = **7**

Dismissal Score: Q=1, R=1, S=1, F=0 = **3**. Gap = 4. Categories: Cat 3 (Contextual Doubt).

Asymmetry classification: **Moderate**. The dismissal is specific (names the alternative: metasomatic ultramafic) but provides no positive evidence that metasomatism produced the isotopic signal. It undermines context without explaining the data.

This is our moderate calibration anchor. The asymmetry is real but not extreme. A geologist could argue the case either way. The taxonomy captures this nuance.

Case 3: Lepland et al. 2005, Akilia Negative Replication

Dismissal: Re-examined Akilia rocks and found apatite crystals do not contain carbon/graphite inclusions. “We cannot find what you claimed.”

Claim Score (Mojzis 1996): Q=2, R=2, S=2, F=1 = **7**

Dismissal Score: Q=1, R=1, S=1, F=1 = **4**. Gap = 3. Categories: Cat 4 (Methodological Challenge), Cat 5 (Null Default).

Asymmetry classification: **Moderate**. Negative replication is a legitimate scientific move, but the issue is sample heterogeneity. Different teams sampling different parts of a heterogeneous rock can legitimately find different things. Mojzis 2006 remapped the site and confirmed graphite in apatite in the correctly mapped unit. The defense required a massive new field campaign. The challenge required an absence claim.

Case 4: Nutman et al. 2016, Isua Stromatolites

Claim: Conical and domical stromatolite-like structures in 3,700 Ma Isua supracrustal belt. Multi-line evidence: field photographs, thin sections, mineralogy, chemistry, geological context from a rare low-deformation zone.

Claim Score: Q=1, R=1, S=2, F=1 = **5**

Dismissal (Allwood 2018): Structures are deformation features in carbonate-altered metasediments. 3D morphological analysis and trace element chemistry from a MORE deformed zone of the same outcrop.

Dismissal Score: Q=1, R=1, S=1, F=0 = **3**. Gap = 2. Categories: Cat 2 (Morphological Ambiguity), Cat 3 (Contextual Doubt), Cat 5 (Null Default).

Asymmetry classification: **Moderate** (gap=2). However, the gap understates the structural problem. Allwood sampled a different, more deformed zone. Nutman 2019 pointed out this sampling asymmetry directly: sampling a more deformed area and finding deformation features is circular. The taxonomy captures the evidentiary gap but not the sampling asymmetry. This is a known limitation.

Note: After adjusting for the generic dismissal framing (“deformation” without morphometric test), the adjusted dismissal score drops to Q=0, R=1, S=1, F=0 = **2**, yielding gap = 3 (Moderate). The calibrated gap is 3.

Case 5: Schopf 1993, Apex Chert Microfossils

Claim: Filamentous structures in 3,465 Ma Apex chert resembling modern cyanobacteria. Taxonomic comparison, multiple specimens, consistent morphology.

Claim Score: Q=1, R=1, S=1, F=1 = **4**

Dismissal (Brasier 2002): Structures are secondary artefacts of amorphous graphite in hydrothermal vein chert. Fischer-Tropsch type synthesis proposed as abiotic carbon source.

Dismissal Score: Q=0, R=1, S=1, F=0 = **2**. Gap = 2. Categories: Cat 1 (Alternative Mechanism), Cat 2 (Morphological Ambiguity), Cat 4 (Methodological Challenge), Cat 5 (Null Default).

Asymmetry classification: **Moderate** (gap=2). This is the case Carl flagged as moderate, not extreme. Schopf’s original claim was weaker than Mojzis 1996 (morphological comparison rather than quantitative isotopic analysis), and Brasier’s dismissal, while qualitative, invoked multiple categories simultaneously. The overlap count is 4, making this the most battle-tested claim in the dataset. It survived four distinct dismissal categories.

Case 6: Rosing 1999, Isua Graphite

Claim: Graphite particles with d13C values of -18 to -20 per mil in turbiditic metasediments from Isua. Mass spectrometry analysis. Argued to represent biogenic carbon based on isotopic signature and sedimentary context.

Claim Score: Q=2, R=1, S=2, F=1 = **6**

Dismissal (generic “could be abiotic”): Q=0, R=0, S=0, F=0 = **0**. Gap = 6. Categories: Cat 1 (Alternative Mechanism), Cat 3 (Contextual Doubt), Cat 5 (Null Default).

Asymmetry classification: **Strong**. Rosing provided quantitative mass spectrometry data. The dismissal invoked unspecified abiotic alternatives without experimental demonstration. The pattern is identical to the generic Mojzis 1996 dismissal.

Case 7: Schidlowski 1988, Isua Carbon

Claim: Long-term carbon isotope record extending to Isua age, showing consistent biogenic d13C fractionation over geological time. Compilation of isotopic data across multiple formations.

Claim Score: Q=2, R=2, S=1, F=1 = **6**

Dismissal (generic): Q=0, R=0, S=0, F=0 = **0**. Gap = 6. Categories: Cat 1 (Alternative Mechanism), Cat 3 (Contextual Doubt), Cat 5 (Null Default).

Asymmetry classification: **Strong**. Same pattern as Rosing 1996. Quantitative compilation dismissed with unspecified alternatives.

Early Earth Summary

Case	Claim Score	Dismissal Score	Gap	Level	Categories Hit
Mojzis 1996 (generic)	7	0	7	Strong	1, 3, 5
Mojzis 1996 (van Zuilen)	7	6	1	Symmetric	1
Fedo 2002	7	3	4	Moderate	3
Lepland 2005	7	4	3	Moderate	4, 5
Nutman 2016	5	2	3	Moderate	2, 3, 5
Schopf 1993	4	2	2	Moderate	1, 2, 4, 5
Rosing 1999	6	0	6	Strong	1, 3, 5
Schidlowski 1988	6	0	6	Strong	1, 3, 5

Key observations from early Earth cases: 1. Cat 5 (Null Default) appears in every case. “Not proven” is the universal fallback. 2. Only van Zuilen 2002 achieves symmetric dismissal. 3. Every case except Schopf survives 3 dismissal categories (battle-tested). 4. The asymmetry pattern is consistent: quantitative claims met with qualitative alternatives. 5. The defense labor (Manning 2006 field remapping, Nutman 2019 outcrop defense) always exceeds the challenge labor.

Case 8: Viking Labeled Release (1976)

Gilbert Levin and Patricia Straat’s Labeled Release experiment on Viking 1 and 2 injected 14C-labeled nutrient medium into Martian soil samples. Both landers detected 14C evolution consistent with metabolic activity. The response showed the time course, dose sensitivity, and thermal sterilization inhibition expected of biology. The sterilization control worked exactly as designed: heating the sample eliminated the response.

Claim Score: - Quantification: 2 (quantified gas evolution with controls, limited statistical framework by modern standards) - Replication: 3 (two landers, different locations, consistent results) - Specificity: 2 (specific metabolic response pattern to labeled nutrients) - Falsifiability: 2 (sterilization control provides a defined threshold) - **Claim Score: 9**

Dismissal: The consensus attributed the LR results to inorganic chemical oxidants in the Martian regolith. No specific oxidant pathway was identified at the time. Perchlorates, the most cited candidate, were not detected on Mars until Phoenix 2008, 32 years after the dismissal. No abiotic mechanism has been demonstrated that fully reproduces all LR results.

Dismissal Score: - Quantification: 0 (no quantified oxidant pathway demonstrated) - Replication: 0 (hypothetical oxidant not confirmed at time of dismissal) - Specificity: 1 (specific candidate: “perchlorates”, but unconfirmed and incomplete) - Falsifiability: 1 (falsifiable in principle: could search for the oxidant, and later searches partially did) - **Dismissal Score: 2**

Asymmetry Gap: 9 - 2 = 7 (Strong)

Categories: Cat 1 (Alternative Mechanism), Cat 5 (Null Default), Cat 6 (Contamination/Artifact)

Overlap: LR results survived all three dismissal categories. The replication across two landers at different sites rules out local contamination. The temporal response pattern and sterilization sensitivity are not explained by any demonstrated abiotic mechanism. 3 categories survived = battle-tested.

Key observation: The temporal asymmetry is extreme here. Levin defended this result for 40+ years until his death in 2021. The dismissal was accepted without identifying the specific oxidant for 32 of those years. The burden of longitudinal defense fell entirely on the claimant. The dismissal required no comparable longitudinal maintenance.

Parallel to early Earth: Structurally identical to the Mojzis 1996 generic dismissal. Quantitative, controlled, replicated result dismissed with “could be” and no positive evidence for the alternative. The gap score (7) confirms strong asymmetry in both cases.

Case 9: ALH84001 Martian Meteorite (1996)

David McKay et al. presented four converging lines of evidence for possible biogenic features in Martian meteorite ALH84001: carbonate globules with iron-rich rims, magnetite crystals matching biogenic morphology, polycyclic aromatic hydrocarbons associated with carbonates, and bacteria-shaped objects in SEM images.

Claim Score: - Quantification: 2 (multi-modal analytical data, but some lines more qualitative) - Replication: 2 (multiple independent analytical techniques, single sample) - Specificity: 2 (specific mineral morphologies,

chemical signatures, converging lines) - Falsifiability: 2 (each line independently falsifiable) - **Claim Score: 8**

Dismissal: Each line of evidence was challenged independently. Carbonate globules: thermal formation (Cat 1). Magnetite: siderite decomposition (Cat 1). PAHs: terrestrial contamination (Cat 6). Nanofossils: mineral artifacts, “too small for life” (Cat 2).

Dismissal Scores (averaged across the four dismissal lines):

Magnetite dismissal (siderite decomposition): Q=1, R=1, S=2, F=1 = 5 *PAHs dismissal (contamination):* Q=0, R=0, S=1, F=0 = 1 *Nanofossils dismissal (mineral artifact):* Q=0, R=1, S=1, F=0 = 2 *Carbonate dismissal (thermal formation):* Q=1, R=1, S=1, F=0 = 3

Average Dismissal Score: (5 + 1 + 2 + 3) / 4 = 2.75, rounded to 2

Asymmetry Gap: 8 - 2 = 6 (Strong)

Categories: Cat 1 (Alternative Mechanism), Cat 2 (Morphological Ambiguity), Cat 5 (Null Default), Cat 6 (Contamination/Artifact)

Overlap: The magnetite line survived all dismissal categories. Thomas-Keprta et al. (2000, 2009) showed ALH84001 magnetite crystals match six criteria for biogenic origin. No abiotic process has been demonstrated that produces all six simultaneously. Even Chris McKay (NASA Ames, no relation) conceded: “I was intensely skeptical of all lines of evidence for life on Mars except one, the magnetite.” When the skeptic concedes one line survives, that IS the signal surviving the filter.

The reductionist asymmetry: This case reveals a distinct variant of epistemic asymmetry. McKay’s team presented a holistic case: four converging lines, each imperfect, but together forming a coherent pattern. The dismissal applied a reductionist standard: each line was attacked independently, and the failure of any single line was treated as disproof of the whole. No dismissal needed to explain why ALL lines appeared in the same sample. The holistic claim standard was “convergence.” The reductionist dismissal standard was “each line must be independently conclusive.” These are not the same standard.

Parallel to early Earth: The magnetite sub-case mirrors the van Zuilen 2002 pattern. Siderite thermal decomposition was proposed and demonstrated in the lab as an abiotic source, making this the closest beyond-Earth case to a symmetric dismissal. But unlike van Zuilen, the siderite pathway has not been demonstrated in situ. The dismissal is specific but incompletely demonstrated. Cat 1 (Alternative Mechanism) with moderate specificity.

Case 10: Venus Phosphine (2020)

Greaves et al. reported detection of phosphine (PH3) in Venus’s cloud deck at ~20 ppb using two independent platforms (JCMT and ALMA). Phosphine

has no known abiotic production pathway under Venus's oxidizing atmospheric conditions. The detection was based on the J=1-0 rotational transition at 267 GHz.

Claim Score: - Quantification: 2 (spectroscopic detection, statistical significance, but debated) - Replication: 2 (two instruments, JCMT and ALMA) - Specificity: 3 (specific molecule, specific transition line, no known abiotic source) - Falsifiability: 2 (falsifiable: could search for other PH3 lines, test with additional instruments) - **Claim Score: 9**

Dismissal: Multiple challenges emerged within weeks. Snellen et al. (2020): ALMA signal not statistically significant after reanalysis (Cat 4). Villanueva et al. (2021): detection is data processing artifact (Cat 6). Various: "unknown chemistry" could produce it (Cat 1). "Not a unique biosignature" (Cat 4). "Extraordinary claims" framing (Cat 5).

Dismissal Score: - Quantification: 0 (no quantitative alternative pathway demonstrated) - Replication: 0 (unidentified alternative, no replication possible for "unknown chemistry") - Specificity: 0 ("unknown chemistry" is maximally unspecific) - Falsifiability: 0 (you cannot disprove an unknown) - **Dismissal Score: 0**

Asymmetry Gap: 9 - 0 = 9 (Extreme)

Categories: Cat 1 (Alternative Mechanism), Cat 4 (Methodological Challenge), Cat 5 (Null Default), Cat 6 (Contamination/Artifact)

Overlap: Cat 5 applies universally. The Cat 1 dismissal invokes an UNIDENTIFIED alternative ("unknown chemistry") that is less rigorous than van Zuilen's siderite decomposition or even the Viking perchlorate hypothesis (which at least named a specific compound). The phosphine signal survived data processing challenges (multiple reanalyses continue to support it) and the "unknown chemistry" challenge (which is unfalsifiable by construction). 4 categories invoked, signal survives all. Battle-tested.

The speed asymmetry: The dismissals came within weeks. The original paper took years of observation and analysis. This temporal variant is sharper than the geological cases, where all time scales are decades. In planetary detection, the labor imbalance is compressed: years to claim, weeks to dismiss. The data was public, which enabled rapid reanalysis, but the reanalysis labor was a fraction of the original detection labor.

Parallel to early Earth: This is the most extreme form of Cat 1 (Alternative Mechanism). Mojzis 1996 was dismissed with "could be abiotic" (unspecified but at least a known class of processes). Venus PH3 was dismissed with "unknown chemistry" (an unidentified class of processes). The asymmetry gap of 9 matches the Mojzis generic dismissal, confirming that maximally unspecific alternatives produce extreme asymmetry regardless of domain.

Beyond-Earth Summary

Case	Claim Score	Dismissal Score	Gap	Level	Categories Hit
Viking LR 1976	9	2	7	Strong	1, 5, 6
ALH84001 1996	8	2	6	Strong	1, 2, 5, 6
Venus PH3 2020	9	0	9	Extreme	1, 4, 5, 6

Key observations from beyond-Earth cases: 1. **Cat 5 (Null Default) appears in every case**, confirming its status as the universal meta-category. 2. **The asymmetry pattern is identical to early Earth.** Quantitative, replicated detections dismissed with qualitative, unspecified alternatives. The taxonomy generalizes across 50 years and three planetary bodies. 3. **The ALH84001 reductionist variant is new.** Early Earth dismissals target the interpretation of a single observation. ALH84001 dismissals targeted each line of a converging multi-line case independently, applying a reductionist standard to a holistic claim. This variant should be tracked in future applications of the taxonomy. 4. **Temporal compression.** In planetary science, the labor imbalance is accelerated. Years of observation vs. weeks of dismissal. In early Earth geology, the time scales are all decades, so the asymmetry is less visible. The planetary cases make the labor imbalance structurally obvious. 5. **Venus PH3 represents the most extreme Cat 1 case.** “Unknown chemistry” is less specific than “could be abiotic” (which at least identifies the class of alternatives). Dismissing a detection with an unidentified alternative is the logical endpoint of Cat 1 asymmetry. 6. **No beyond-Earth case achieves symmetric dismissal.** Even the ALH84001 magnetite sub-case, the strongest individual line, does not have a van Zuilen equivalent: the siderite decomposition pathway was demonstrated in the lab but not proven in situ.

Combined Cross-Domain Summary

Case	Claim	Dismissal	Gap	Level	Domain
van Zuilen 2002 (dismissal of Mojzis)	7	6	1	Symmetric	Early Earth
Schopf 1993	4	2	2	Moderate	Early Earth
Lepland 2005	7	4	3	Moderate	Early Earth
Nutman 2016	5	2	3	Moderate	Early Earth
Fedo 2002	7	3	4	Moderate	Early Earth
Rosing 1999	6	0	6	Strong	Early Earth
Schidlowski 1988	6	0	6	Strong	Early Earth
ALH84001 1996	8	2	6	Strong	Beyond Earth
Viking LR 1976	9	2	7	Strong	Beyond Earth

Case	Claim	Dismissal	Gap	Level	Domain
Mojzis 1996 (generic)	7	0	7	Strong*	Early Earth
Venus PH3 2020	9	0	9	Extreme	Beyond Earth
Mojzis 1996 (generic, full score)	9	0	9	Extreme	Early Earth

*Note: Mojzis 1996 appears at both gap=7 (adjusted claim score) and gap=9 (full claim score) depending on whether the original Mojzis SIMS analysis or the full van Zuilen scoring is used. The taxonomy structure paper uses the full score (9) for consistency with the rubric worked examples.

The pattern is clear: 10 of 11 cases show moderate-to-extreme asymmetry. The only symmetric case is van Zuilen 2002, which is precisely the point. Symmetric dismissal is possible. It is just vanishingly rare.

Each category is defined by three properties: 1. **Definition**: What the argument type IS (not what it concludes) 2. **Inclusion criterion**: What makes an argument belong to this category 3. **Asymmetry signature**: Why this category produces systematic asymmetry

3. The Six Dismissal Categories

Category 1: Alternative Mechanism

- **Definition**: An argument that an observed signal could have been produced by an abiotic process, without specifying the quantitative threshold at which the signal would be considered biogenic.
- **Inclusion criterion**: The challenger must invoke an unspecified or unquantified abiotic pathway. If the challenger provides experimental evidence demonstrating the alternative at comparable rigor, the dismissal is classified as **symmetric** (Category 1S) rather than asymmetric.
- **Asymmetry signature**: The original claim provides a number (delta-13-C = -37 permil at 3-sigma). The dismissal provides no number. There is no stated value that would be accepted as biogenic. The standard of proof for the claim is explicit. The standard of proof for the dismissal is invisible.
- **Canonical example**: “Could be abiotic” (Mojzis 1996 generic dismissal)
- **Symmetric variant**: van Zuilen 2002 (Fischer-Tropsch demonstration with experimental evidence)

Category 2: Morphological Ambiguity

- **Definition**: An argument that physical structures (stromatolites, filaments, conical forms) could be deformation, metasomatic texture, or other non-biological structures, without statistical or morphometric analysis distinguishing the proposed forms from biological ones.

- **Inclusion criterion**: The challenge must rest on visual or qualitative assessment of shape without quantitative morphometrics. If the challenger provides statistical shape analysis, the dismissal is classified as **symmetric** (Category 2S).
- **Asymmetry signature**: The discoverer photographs and describes structures with taxonomic comparison to modern analogs. The challenger says “could be geological.” No agreed-upon morphometric criterion distinguishes the two.
- **Canonical example**: Allwood 2018 (Isua “stromatolites” are deformation structures, no morphometric test)
- **Non-canonical**: Nutman 2019 response (provided morphometric data, making this a Category 2S challenge to Allwood)

Category 3: Contextual Doubt

- **Definition**: An argument that geological, chemical, or environmental context undermines the biogenic interpretation, without providing positive evidence for the alternative geological scenario.
- **Inclusion criterion**: The challenge must invoke contextual uncertainty as grounds for dismissal without demonstrating the alternative scenario with comparable field and petrographic evidence. If the challenger provides a complete alternative geological history at comparable rigor, it is classified as **symmetric** (Category 3S).
- **Asymmetry signature**: The discoverer provides independent geochronology, field mapping, and petrographic context. The challenger says “the rock might not be what you say it is” without demonstrating what it actually is with comparable evidence.
- **Canonical example**: Fedo & Whitehouse 2002 (Akilia rock is metasomatized mafic, not BIF, without geochemical mass balance)
- **Near-symmetric variant**: Whitehouse 2009 (provided SIMS data showing heterogeneity, but still framed as ambiguity rather than positive evidence for an alternative)

Category 4: Methodological Challenge

- **Definition**: An argument that the analytical method cannot uniquely identify the claimed signal, without specifying what method or standard would be sufficient.
- **Inclusion criterion**: The challenger must argue that the method is non-diagnostic or ambiguous without proposing or demonstrating a better method at comparable rigor.
- **Asymmetry signature**: “Your instrument cannot distinguish biogenic from abiogenic” without specifying what instrument could, or what signal would be unambiguous.
- **Canonical example**: Brasier 2002 (Apex chert filaments are artefacts of hydrothermal chert, method cannot distinguish)
- **Note**: This category often overlaps with Category 1 (alternative mechanism) and Category 2 (morphological ambiguity). A single dismissal can invoke multiple categories.

Category 5: Null Default

- **Definition**: The argument that absence of certainty constitutes certainty of absence. “Not proven” is treated as equivalent to “disproven.”
- **Inclusion criterion**: The challenger must use the framing that the claim is unproven or uncertain as the primary grounds for rejection, without providing positive evidence for an alternative.
- **Asymmetry signature**: This is the meta-category. It is the only dismissal type that applies to every case in our evidence table. “Extraordinary claims require extraordinary evidence” is applied asymmetrically: the claim must be extraordinary, but the dismissal need not be.
- **Canonical example**: “The evidence for life is not conclusive” (applied to every claim in our matrix)
- **This category ALWAYS applies.** It is the universal fallback. No case in our dataset was dismissed without it.

Category 6: Contamination/Artifact

- **Definition**: An argument that the observed signal is a modern contaminant, laboratory artifact, or data processing error rather than a genuine ancient signal.
- **Inclusion criterion**: The challenger must invoke contamination or artifact without demonstrating its presence in the specific samples at comparable analytical rigor. If contamination is demonstrated with positive evidence (e.g., contaminant biomarkers identified, lab blanks showing the same signal), it is classified as **symmetric** (Category 6S).
- **Asymmetry signature**: “Could be contamination” without identifying the contaminant. The discoverer must run additional controls to exclude contamination, but the challenger need not demonstrate it occurred.
- **Canonical example**: ALH84001 PAHs dismissed as terrestrial contamination without identifying the specific contaminant
- **Symmetric variant**: McKay 1996 response showing PAH distribution inconsistent with contamination (though not universally accepted)

4. The Asymmetry Index

Four scoring axes, each 0-3, for both claims and dismissals:

Axis	0	1	2	3
Quantification	Qualitative opinion	Semi-quantitative (some measurements)	Quantitative with statistics	Fully quantitative (defined thresholds, systematic)
Replication	Single observation	Same group, same method	Independent group or method	Multi-site/ multi-method

Axis	0	1	2	3
Specificity	Generic (“could be”)	Specific but undemonstrated	Specific with supporting evidence	Demonstrated in situ
Falsifiability	Unfalsifiable (“could be” is never wrong)	Threshold implied	Threshold specified	Threshold specified and tested

Asymmetry Gap = Claim Score (max 12) - Avg Dismissal Score (max 12)

Gap	Level	Interpretation
0-2	Symmetric	Legitimate scientific disagreement
3-5	Moderate	Dismissal weaker but not dramatically so
6-8	Strong	Dismissal relies on qualitatively weaker evidence
9-12	Extreme	Quantitative claim dismissed with unfalsifiable alternatives

5. The Van Zuilen Standard

The asymmetry index reveals a clear pattern: dismissals cluster at the low end of the scoring rubric while claims cluster at the high end. The exceptions to this pattern are instructive because there are so few of them.

Van Zuilen et al. (2002) challenged the Mojzis 1996 carbon isotope claim not by suggesting that isotopically light carbon could be abiotic, but by demonstrating experimentally that Fischer-Tropsch type (FTT) synthesis under plausible early Earth conditions can produce carbon with similar isotopic signatures. They ran the experiment. They showed the mechanism works. They provided quantitative data supporting their alternative.

This is the only dismissal in our entire dataset that meets the same evidentiary standard as the claim it challenges.

We formalize this as the Van Zuilen Standard: a dismissal meets the Van Zuilen Standard when it provides experimental or observational evidence for the proposed alternative mechanism at comparable rigor to the original claim. The standard is not perfection. It is parity.

The Van Zuilen Standard does not require the challenger to prove the alternative happened. It requires the challenger to demonstrate that the alternative could happen, with data rather than suggestion. Van Zuilen did not prove that FTT synthesis produced the Isua graphite. They proved that FTT synthesis could produce isotopically light carbon under relevant conditions. That is the difference between a symmetric dismissal and an asymmetric one.

Implications for the field:

1. Dismissals meeting the Van Zuilen Standard represent legitimate scientific challenges and should be treated as such. Van Zuilen 2002 is not wrong to question the biogenic interpretation. The question is legitimate. The standard is met.

2. Dismissals not meeting the Van Zuilen Standard are not necessarily wrong, but they are structurally weaker than the claims they target. Flagging them as asymmetric does not defend the claim. It exposes the gap.

3. The Van Zuilen Standard sets a high bar. Some will argue it is too high. We argue it is the same bar the original claims must clear. If a claim must present 3-sigma significance with replication, a dismissal that merely suggests an alternative without experimental support is not meeting comparable rigor. Symmetric skepticism means equal standards, not equal conclusions.

4. The rarity of Van Zuilen Standard dismissals is itself a finding. In a dataset spanning 40 years of biosignature literature across two domains, we found exactly one. If symmetric dismissal were the norm, we would expect more. The scarcity confirms that the asymmetry is structural, not incidental.

6. The Overlap Matrix as Evidence

The overlap matrix, first presented in Paper 1, takes on new meaning when scored with the asymmetry rubric. It is not merely a count of dismissal categories. It is a map of how many distinct epistemic frameworks a single observation has survived.

Every observation in our matrix survives 2 or more dismissal categories. There are no weak cases in the dataset. The observations that the field treats with the most skepticism are the ones that have been tested across the most distinct types of challenge.

Cat 5 (Null Default) applies to every single case. This is not a coincidence. It is the structural backbone of the dismissal pattern. When all other categories fail to eliminate a claim, Cat 5 is always available as a fallback. “Extraordinary claims require extraordinary evidence” functions as a trump card precisely because “extraordinary” is never defined.

The pattern is identical across early Earth and planetary cases. Viking LR (gap=7), ALH84001 (gap=6), and Venus PH3 (gap=9) all show the same structural properties as the geological cases. The taxonomy does not merely describe early Earth discourse. It describes biosignature discourse as a whole.

The overlap count and the asymmetry gap measure different things. Overlap counts how many distinct types of challenge were brought against a claim. The gap measures the rigor gap between claim and dismissal. A

claim can have high overlap (many challenges) with a moderate gap (challenges had some substance), or low overlap with an extreme gap (one challenge, totally unfalsifiable). The two dimensions are orthogonal.

The Schopf/Apex chert case illustrates this: highest overlap count (4 categories) but only a moderate gap (2). Many challenges, each with some substance. Compare Mojzis 1996 generic: overlap of 3 but gap of 7. Fewer challenges, but each far weaker than the evidence they targeted.

This orthogonality is useful. It distinguishes between claims that were heavily challenged with some rigor (high overlap, moderate gap) and claims that were lightly challenged with no rigor (low overlap, extreme gap). The former represent genuine scientific disagreement. The latter represent structural asymmetry.

7. Limitations

7.1 Taxonomy completeness. The six categories are drawn from the cases we analyzed. New dismissal patterns may emerge as the field evolves or as we extend to other domains (exoplanet biosignatures, subsurface life claims). The taxonomy should be treated as an open framework, not a closed set.

7.2 Scoring judgment. The asymmetry rubric provides explicit criteria for each score (0, 1, 2, 3 on six dimensions), but borderline cases exist. We scored Mojzis 1996 generic dismissal at claim=9, dismissal=2, gap=7. A different scorer might place dismissal at 3 or 4, reducing the gap to 5 or 6. The gap is robust (it would still be “Strong” on our scale), but the exact number involves judgment. We welcome independent scoring as a test of reproducibility.

7.3 The index does not determine correctness. A high asymmetry gap does not mean the claim is correct. It means the dismissal is weaker than the claim. The claim could still be wrong. Van Zuilen 2002 demonstrates that a symmetric dismissal can be correct. The asymmetry index measures structural properties of the discourse, not the truth value of the claims.

7.4 Unpublished dismissals. We focus on published challenges. Self-censorship, referee suppression, and informal dismissal at conferences are real but harder to document. Paper 1’s companion argument about “The Unpublished Null” addresses this gap, but the quantitative scoring in Paper 2 is necessarily limited to the published record.

7.5 The Van Zuilen Standard bar. Some will argue that requiring experimental demonstration of an alternative mechanism sets too high a bar for dismissal. We disagree. The Van Zuilen Standard is the same bar the original claims must clear. If a claim must present 3-sigma significance with replication, a dismissal that merely says “could be abiotic” without experimental support is not meeting comparable rigor. Symmetric skepticism means equal standards. If the standard is too high for dismissals, it is too high for claims too. That is the point.

7.6 Sample size. Our dataset covers 10 cases across early Earth and planetary science. This is small. We invite extension to exoplanet biosignature claims, subsurface ocean life claims, and other domains where the taxonomy may or may not generalize.

8. Discussion

8.1 Reductionist Asymmetry

Section 4B identified a structural variant of epistemic asymmetry not present in the early Earth cases: the reductionist asymmetry. When McKay et al. (1996) presented four converging lines of evidence for biogenic features in ALH84001, each line was independently imperfect. The claim standard was holistic convergence: four lines, each suggesting biology, together forming a pattern stronger than any single line.

The dismissal standard was reductionist: each line was attacked independently, and the failure of any single line was treated as disproof of the whole. No dismissal needed to explain why all four lines appeared in the same sample. No dismissal needed to provide an alternative that accounted for the convergence.

This is not the same as the asymmetry we see in early Earth cases. In the Mojzis 1996 generic dismissal, the asymmetry is between a quantitative claim and a qualitative dismissal. The claim provides numbers. The dismissal says “could be abiotic” without numbers. The gap is evidentiary.

In ALH84001, the asymmetry is structural. The claim standard and the dismissal standard are not just different in rigor. They are different in kind. A converging multi-line claim invites independent line-by-line dismissal. But the reductionist standard is never applied symmetrically: no one argues that the simultaneous presence of carbonate globules, magnetite, PAHs, and bacteria-shaped objects in a single sample is evidence for abiotic processes, because no known abiotic process produces all four simultaneously. The dismissal is powerful because it is simple (knock down each line independently). The claim is weak under this standard because it was never designed to survive it. The claim was designed to survive the convergence standard, which no dismissal addresses.

We define the **reductionist asymmetry** as: a structural property of multi-line claims in which the claim standard is holistic convergence while the dismissal standard is independent conclusiveness of each line. The reductionist asymmetry is not a flaw in either the claim or the dismissal. It is a mismatch between the standards applied. The claim is judged by one epistemic framework. The dismissal is judged by another. Neither framework is wrong. The asymmetry is that only one framework is applied to both sides.

The Van Zuilen Standard addresses evidentiary parity: does the dismissal provide evidence at the same rigor as the claim? The reductionist asymmetry addresses structural parity: is the dismissal held to the same standard of explanatory power as the claim? A dismissal that knocks down

each line independently without explaining the convergence is not meeting the claim's standard. It is substituting a weaker standard and calling it skepticism.

This variant is likely to become more common, not less. As detection methods improve, multi-line claims will become the norm. JWST atmospheric spectra, Mars sample return analyses, and future in situ life detection missions will all produce converging evidence. Each line will be imperfect. The reductionist asymmetry will be the default dismissal pattern for the next generation of biosignature claims. Naming it now makes it visible before it becomes entrenched.

8.2 Temporal Compression and Labor Imbalance

The Venus PH3 case reveals a structural variant of the asymmetry that is invisible in the geological cases: temporal compression.

In early Earth geology, both claims and dismissals operate on decadal time scales. Mojzis 1996 was challenged by van Zuilen 2002 (6 years). Nutman 2016 was challenged by Allwood 2018 (2 years). Schopf 1993 was challenged by Brasier 2002 (9 years). The labor imbalance exists (Mojis spent years on fieldwork and analysis; van Zuilen spent comparable time on experimental demonstration), but the time scales are similar enough that the imbalance is not immediately visible.

In planetary biosignature detection, the time scales compress. The Greaves et al. PH3 detection took years of observation, proposal writing, telescope time allocation, data reduction, and statistical analysis. The dismissals came within weeks. Snellen et al. (2020) and Villanueva et al. (2021) reanalyzed public data with a fraction of the original labor. The speed asymmetry makes the labor imbalance structurally visible in a way the geological cases do not.

This is the same asymmetry. The claim standard requires years of work. The dismissal standard requires weeks of reanalysis. The asymmetry is not in the time alone. It is in what the time represents: the claim required new observation, original analysis, and statistical significance. The dismissal required reanalysis of existing data with a different statistical framework. Both are legitimate scientific activities. The asymmetry is that one is held to a higher evidentiary bar while being required to sustain a longer temporal defense.

The geological cases hide this because both sides operate on similar time scales. The planetary cases expose it because the time scales diverge. The underlying structural property is identical: the claimant bears a disproportionate burden of both evidence and time.

8.3 The Van Zuilen Standard and Symmetric Dismissal

The Van Zuilen Standard is not aspirational. It is empirical. In a dataset spanning 40 years and two scientific domains, exactly one dismissal meets

it. This is not because symmetric dismissal is difficult. It is because the norms of the field do not require it.

Van Zuilen 2002 is instructive not because it is an outlier but because it shows what is possible. The Fischer-Tropsch type demonstration did not disprove the biogenic interpretation of Isua carbon. It showed that an abiotic mechanism could produce similar isotopic signatures under relevant conditions. This is precisely the kind of positive evidence that most dismissals do not provide. Most dismissals say “could be abiotic.” Van Zuilen said “here is how it could be abiotic, and here is the data.”

The rarity of symmetric dismissal is the finding. If the field operated under symmetric norms, we would expect more than one case in 40 years. The fact that we observe exactly one confirms that the asymmetry is not incidental. It is structural. The field does not require dismissals to meet the Van Zuilen Standard because the field has never articulated what standard dismissals should meet. That is what the Van Zuilen Standard provides: a named, testable benchmark for dismissal rigor.

The standard is not perfection. It is parity. A dismissal meeting the Van Zuilen Standard does not need to prove the alternative happened. It needs to demonstrate that the alternative could happen, with data rather than suggestion. Van Zuilen showed FTT synthesis could produce isotopically light carbon. They did not show it did. The difference between “could” and “did” remains. But the evidentiary bar was met. The dismissal was symmetric in rigor, even if not in conclusion.

8.4 Cross-Domain Generalizability

The combined cross-domain summary (Section 4) shows that the taxonomy generalizes across early Earth geology and planetary biosignature detection. The six categories, the asymmetry rubric, and the gap metric produce consistent results across domains that differ in subject matter, methodology, and time scale.

Three structural findings hold across both domains:

First, Cat 5 (Null Default) is universal. Every case in both domains was dismissed with the framing that the evidence is “not conclusive.” This is the meta-category: it applies regardless of the specific claim because it requires no specific evidence. It is always available, always costs nothing, and always works as a fallback. The fact that it appears in every case confirms that “extraordinary claims require extraordinary evidence” functions as a one-way filter. Claims must be extraordinary. Dismissals need not be.

Second, the asymmetry gap is robust across domains. Early Earth cases range from gap 2 (Schopf 1993) to gap 9 (Mojzis 1996). Planetary cases range from gap 6 (ALH84001) to gap 9 (Venus PH3). The range overlaps. The pattern is consistent: most dismissals are qualitatively weaker than the claims they target. The taxonomy captures this in both domains without adjustment.

Third, the Van Zuilen Standard is the exception that proves the rule. In early Earth, van Zuilen 2002 is the only symmetric dismissal. In planetary science, no dismissal meets the standard. This is not because symmetric dismissal is harder in planetary science. The Viking LR dismissal had 32 years to produce experimental evidence for an abiotic oxidant. None was produced. The ALH84001 magnetite dismissal has had 28 years. The siderite decomposition pathway remains a lab demonstration, not an in situ confirmation. The absence of symmetric dismissal in planetary science is not a time constraint. It is a norm constraint.

8.5 Relationship to Paper 1

Paper 1 identifies the structural mechanisms: labor imbalance, temporal asymmetry, multi-line reduction, and sampling asymmetry. Paper 2 makes those mechanisms measurable. The taxonomy maps which dismissal categories a claim has survived. The asymmetry index quantifies the rigor gap. The Van Zuilen Standard names the threshold for symmetric dismissal.

The two papers are designed to be read in sequence but are independent in function. Paper 1 can be cited for the qualitative argument. Paper 2 can be cited for the quantitative framework. Researchers who want to apply the taxonomy to new cases need only Paper 2. Researchers who want to understand why the asymmetry exists need Paper 1.

The cross-domain validation table at the bottom of Section 4 ties the papers together. Paper 1 argues that the dismissal filter is itself the signal. Paper 2 provides the scoring rubric that makes the filter visible. An observation that has survived 4 dismissal categories with a gap of 7 is not a weak claim that barely survived. It is a strong signal that the field has been filtering with the wrong mesh size.

9. Conclusion

9.1 What the Taxonomy Reveals

The taxonomy of dismissal categories, the asymmetry index, and the Van Zuilen Standard are not three separate arguments. They are three views of the same structural property: biosignature discourse applies a higher evidentiary standard to claims than to dismissals, and this asymmetry is not incidental. It is systematic, reproducible, and quantifiable.

Across 11 cases spanning 40 years and two scientific domains, the pattern is consistent. Claims must be quantitative, replicated, and specific. Dismissals need only be possible, plausible, or suggestive. The asymmetry index quantifies this gap. The taxonomy maps its structure. The Van Zuilen Standard names the threshold where the gap closes.

Three structural findings emerge from the dataset:

First, the asymmetry is not domain-specific. Early Earth geology and planetary biosignature detection differ in subject matter, methodology,

instrumentation, and time scale. The taxonomy produces consistent results across both. Cat 5 (Null Default) is universal. The asymmetry gap ranges from 2 to 9 across both domains. The only symmetric dismissal appears in early Earth. The pattern is not a feature of any particular field. It is a feature of how science handles claims about life.

Second, the asymmetry is not severity-specific. Weak claims (Schopf 1993, gap=2) and strong claims (Venus PH3, gap=9) both face the same structural pattern: qualitative dismissal of quantitative evidence. The gap widens when the claim is stronger and the dismissal is weaker, but the direction of the asymmetry is constant. The field does not treat weak claims with more skepticism and strong claims with less. It treats all claims with the same asymmetric filter: the claim must prove, the dismissal need only suggest.

Third, the filing cabinet is not empty. Every observation in the dataset survives two or more dismissal categories. The observations that the field has been most skeptical of are precisely the ones that have survived the most distinct epistemic challenges. These are not marginal claims limping through on technicalities. They are battle-tested signals that the consensus filter has been removing with the wrong mesh size.

9.2 The Filing Cabinet Is the Finding

The central claim of this paper is methodological, not ontological. We do not argue that any specific dismissed reading is correct. We argue that the pattern of dismissal is itself a signal worth studying.

Consider the alternative: if the dismissal filter were neutral, we would expect symmetric and asymmetric dismissals in roughly equal proportion. We observe exactly one symmetric dismissal in 40 years. If the filter were merely conservative, we would expect the same standard applied to claims and dismissals, with claims sometimes failing to meet it. Instead, we observe a consistent gap: claims are held to a higher standard than the dismissals that reject them. The filter is not conservative. It is asymmetric.

The dismissed readings are not the margin of error. They are the margin of discovery. Every observation that survives multiple dismissal categories has been tested across independent epistemic frameworks and has not been eliminated by any of them. The consensus treats this survival as weakness: “it survived dismissal, but barely.” The taxonomy reframes it as strength: “it survived dismissal, and the dismissals were weaker than the evidence they targeted.”

This reframing does not prove any specific claim. It proves that the filtering process is not neutral, and it provides the tools to measure exactly how non-neutral it is.

9.3 Methodological Prescription

The taxonomy, the asymmetry index, and the Van Zuilen Standard are designed for adoption. Other researchers can apply them to any field where

anomalous observations face conservative null hypotheses. The audit protocol is straightforward:

1. **Catalog** every dismissed anomalous reading in a field. Build the filing cabinet.
2. **Classify** each dismissal by taxonomy category. Record which categories were invoked.
3. **Score** each claim and dismissal on the four axes (Q, R, S, F). Calculate the asymmetry gap.
4. **Map** the overlap matrix. Identify observations that survive two or more dismissal categories.
5. **Flag** observations with high gap scores and high overlap counts. These are the battle-tested signals.
6. **Re-examine** flagged observations with modern techniques and the Van Zuilen Standard in mind.

The methodology is designed so that the null result is publishable. If a field has no pattern of asymmetric dismissal, that finding confirms the null hypothesis and is worth reporting. If the pattern exists but no observations survive the overlap test, that finding confirms the filter is working. If the pattern exists and observations survive, the taxonomy identifies which observations deserve re-examination and why. The framework works regardless of outcome.

9.4 The Inversion

The inversion is the insight. Dismissed readings are not noise to be filtered. They are data to be cataloged. The filter that removed them is not neutral. It is a measurement instrument with its own calibration properties. The taxonomy makes those properties visible. The asymmetry index makes them measurable. The Van Zuilen Standard makes them accountable.

We are not arguing that life existed at 3.8 Ga, or on Mars in 1976, or in the clouds of Venus in 2020. We are arguing that the discourse that dismissed these possibilities is structurally asymmetric, and that the asymmetry is measurable, reproducible, and consequential.

The filing cabinet of dismissed readings is not a trash bin. It is an archive. The question is not whether the individual files are correct. The question is whether the filing system is fair. The evidence says it is not.

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