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Direct Dating of Lithic Cuts Using Cosmogenic Nuclides: A Methodological Proposal to Establish the Construction Chronology of Megalithic Megastructures

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ABSTRACT

The chronology of megalithic megastructures is currently established through the analysis of organic matter — charcoal, bone, fibers — found in proximity to the constructions. This method dates the most recently documented human presence in the vicinity of a structure. It does not date the act of construction.

If a temporal gap existed between the moment of construction and the moment of documented occupation, current methods lack the capacity to detect it, as they implicitly assume the temporal identity of builder and occupant without independent verification.

This proposal introduces a fundamental operational distinction: dating the cut is dating the construction. The instant at which a stone surface is first exposed is the instant at which construction occurs. Both events are temporally identical and physically recordable.

Cosmogenic nuclide dating of lithic cut surfaces offers a method to establish that date directly. Beryllium-10 does not occur naturally in quartz. Its accumulation begins at the exact moment of surface exposure at a known and constant rate. The difference in ^{10}Be concentration between the cut surface of a megalithic block and equivalent uncut rock from the original quarry yields the date of the cut, independent of any associated organic evidence.

Aswan granite, the documented source of blocks in the principal Egyptian megastructures, contains approximately 30% quartz — a concentration adequate for this method.

The proposed protocol is reproducible, minimally invasive, falsifiable, and applicable to megalithic megastructures on any continent where materials with sufficient quartz content are available.

Keywords: cosmogenic nuclides, Beryllium-10, surface exposure dating, Aswan granite, megalithic structures, construction chronology, lithic cut dating, Accelerator Mass Spectrometry, archaeological chronology, quartz geochronology.

1. PROBLEM STATEMENT

The conventional archaeology establishes the chronology of megalithic megastructures through the analysis of organic matter — charcoal, bone, wood, fibers — found in proximity to the constructions. On this indirect evidence, the official chronology now accepted as definitive has been built.

This method dates the most recently documented human presence in the vicinity of a structure. It does not date the act of construction.

If a temporal distinction existed between the moment of construction and the moment of documented occupation, current methods have no capacity to detect it. They implicitly assume that builder and occupant are the same agent, without that assumption having been independently verified.

The question that current methods do not answer is: when was the stone cut?

Dating the cut is dating the construction. The instant at which a stone surface is first exposed is the instant at which construction occurs. Both events are temporally identical.

Cosmogenic nuclide dating of lithic cut surfaces offers a method to answer that question directly. An unexposed surface accumulates cosmogenic nuclides at zero rate. At the moment of the cut, that accumulation begins at a known, constant, and measurable rate. Comparing the ^{10}Be concentration in the cut surface of a megalithic block with the equivalent concentration in uncut rock from the original quarry yields the date of the cut.

Aswan granite, the documented source of blocks in the principal Egyptian megastructures, contains approximately 30% quartz — the mineral that traps ^{10}Be with precision adequate for this method.

This proposal does not invalidate existing methods within their legitimate domain. It proposes applying a different method to a different object: not the occupation, but the construction.

2. PHYSICAL BASIS

2.1 Cosmic rays and nuclide production

Earth receives constant bombardment from primary cosmic rays — high-energy particles, primarily protons and alpha particles. Upon interacting with the atmosphere, they produce a cascade of secondary particles that reach the Earth's surface.

When these secondary particles strike atoms in surface rock, they dislodge protons and neutrons from nuclei, producing new isotopes — cosmogenic nuclides. This process is called spallation.

The production rate is known, constant on a geological scale, and a function of measurable variables: geomagnetic latitude, altitude, and sky exposure geometry.

2.2 Beryllium-10 in quartz

Beryllium-10 (^{10}Be) does not occur naturally in quartz. Its only source in that mineral is cosmogenic spallation on oxygen and silicon within the crystal lattice.

Once produced, ^{10}Be becomes trapped within the regular crystal structure of quartz without possibility of migration. It accumulates progressively from the exact moment the surface is exposed.

Quartz is the ideal mineral for this method due to two concurrent properties: its crystal structure retains ^{10}Be without loss, and its chemical composition is sufficiently simple for production rate calculations to be precise.

2.3 The difference between unexposed rock and cut surface

Rock uncut at quarry depth has a ^{10}Be concentration corresponding only to its prior geological exposure history. In the case of Aswan granite, practically zero in internal layers, given that it remained below the surface until its exposure through tectonic uplift.

At the moment of cutting, the new surface is exposed for the first time. ^{10}Be accumulation begins at that instant at a known rate.

The concentration difference between the cut surface of the block and the equivalent uncut rock at the original quarry is a direct function of the time elapsed since the cut. That difference is the construction date.

2.4 The fundamental equation

The relationship is:

$$t = N / P$$

Where:

- t = exposure time since the cut
- N = ^{10}Be concentration measured in the block surface
- P = local ^{10}Be production rate, calculated by latitude, altitude, and geometry

The global average production rate is approximately 4 to 5 atoms of ^{10}Be per gram of quartz per year, adjustable with precision for each specific site.

2.5 Why Aswan granite is the ideal material

Three concurrent properties make it optimal for this method:

- Contains approximately 30% quartz — sufficient concentration for reliable extraction and measurement
- Its quartz is coarse-grained with clear crystallization — visible to the naked eye, a required condition for reliable cosmogenic dating
- The original quarry in Aswan is documented and accessible — allowing reference samples to be obtained from uncut rock of the same geological body

3. EXPERIMENTAL PROTOCOL

3.1 Site and sample selection

Structure selection criteria

Megastructures will be selected that simultaneously satisfy:

- Documented use of Aswan granite verifiable mineralogically
- Original cut surfaces not exposed to subsequent intervention — no added cladding, no restoration, no modern abrasion
- Accessibility for sample extraction without significant structural damage

Priority candidate sites:

- King's Chamber, Great Pyramid of Khufu / Giza
- Valley Temple / Giza
- The Osireion / Abydos
- Burial chamber, Pyramid of Menkaure / Giza

Surface selection criteria

Within each structure, surfaces will be identified that:

- Correspond to the original cut — not subsequently re-cut or modified surfaces
- Have remained protected from continuous direct solar exposure to minimize temperature variables
- Are geometrically representative of the original cutting work

For each surface selected in the structure, the equivalent extraction point will be identified at the Aswan quarry — same geological body, approximately the same original outcrop depth.

3.2 Sample extraction

Two types of sample will be extracted per analysis point:

Sample A — Cut surface of the megalithic block

- Extraction of the first 2 to 3 centimeters of the cut surface
- Minimum required mass: 50 grams of pure quartz after processing
- Method: precision mechanical extraction without thermal contamination

Sample B — Reference rock at Aswan quarry

- Extraction from the interior of the unexposed granite body
- Same mass and processing as Sample A
- Purpose: establish the baseline ^{10}Be concentration prior to any exposure

The difference between Sample A and Sample B eliminates any pre-existing cosmogenic inheritance in the material, isolating exclusively the accumulation produced since the cut.

3.3 Sample processing

Quartz purification

- Mechanical crushing of the sample to a grain size fraction of 250 to 500 micrometers
- Selective chemical dissolution of feldspars and other minerals with dilute hydrofluoric acid
- Verification of resulting quartz purity by X-ray diffraction

Beryllium dissolution and extraction

- Total dissolution of purified quartz in concentrated hydrofluoric acid

- Addition of Beryllium-9 carrier of known concentration for calibration
- Chemical separation of Beryllium by ion-exchange columns
- Precipitation as Beryllium hydroxide and conversion to Beryllium oxide

Measurement

- Analysis by Accelerator Mass Spectrometry (AMS)
- AMS is the only method with sufficient sensitivity to measure ^{10}Be concentrations on the order of 10^5 to 10^8 atoms per gram of quartz
- Laboratories with adequate AMS capacity: SUERC (Scotland), PRIME Lab (Purdue, USA), ASTER (France), GFZ (Germany)

3.4 Exposure age calculation

With the measured concentrations, the following is applied:

$$t = (N_A - N_B) / P_{\text{local}}$$

Applied corrections include:

- Radioactive decay of ^{10}Be during the exposure period (half-life: 1.39 million years)
- Surface erosion rate if measurable
- Paleomagnetic variations affecting the historical production rate

3.5 Validation controls

- Minimum three independent samples per analyzed surface
- Minimum two independent surfaces per structure
- Blind analysis — the AMS laboratory does not receive information about the identity or location of samples until measurement is complete
- Cross-comparison between structures of the same system to verify internal chronological consistency

3.6 Variables controlled by the protocol

Variable	Control applied
Pre-existing cosmogenic inheritance	Subtraction of baseline concentration from quarry reference sample
Post-cut surface exposure	Selection of protected surfaces unexposed since original cutting
Local production rate variation	Site-specific calculation by latitude, altitude, and sky geometry
Sample contamination	Processing in certified laboratory under standard AMS protocol
Sample selection bias	Blind analysis and independent replicates

4. EXPECTED RESULTS AND IMPLICATIONS

4.1 Logical structure of possible results

The protocol produces a binary result in its first reading:

Scenario A — The dates obtained are consistent with conventional archaeological chronology.

Scenario B — The dates obtained are earlier than conventional archaeological chronology.

Both scenarios have scientific value. The protocol is not designed to confirm a prior hypothesis but to obtain a date that current chronology cannot produce through any existing method.

4.2 Scenario A — Consistency with conventional chronology

If ^{10}Be concentrations yield dates consistent with current official chronologies, the result:

- Validates conventional chronology for the first time through an independent method that directly dates construction
- Confirms that in these specific cases, builder and documented occupant are contemporaneous
- Establishes a methodological precedent applicable to other megalithic megastructures globally

This scenario does not invalidate the proposal. It strengthens it as an independent verification tool.

4.3 Scenario B — Earlier than conventional chronology

If ^{10}Be concentrations yield dates significantly earlier than official chronologies, the result establishes:

- A verifiable temporal gap between the moment of construction and the moment of documented occupation
- The existence of two temporally distinct events: construction and occupation
- The need to revise the authorship attribution that conventional archaeology has assigned to documented occupants

This scenario does not identify the original builder. It establishes only that the builder and the documented occupant are not the same temporal agent.

4.4 What the method cannot determine

With scientific precision, the protocol establishes its own limits:

- It does not identify who performed the cut
- It does not determine the technology used for the cut
- It does not establish the original function of the structure
- It does not prove or refute any hypothesis about the nature of the builder

It produces exclusively a date. The interpretation of that date corresponds to subsequent research.

4.5 Methodological implications independent of the result

Regardless of which scenario is confirmed, application of this protocol introduces a structural change in the archaeology of megastructures:

- Establishes the operational distinction between construction date and occupation date as methodologically separable and measurable categories
- Provides a direct dating method for the constructive act that does not depend on associated organic evidence
- Opens the possibility of applying the same protocol to megalithic megastructures on other continents — Sacsayhuamán, Puma Punku, Göbekli Tepe — where materials with sufficient quartz content exist

- If results from geographically distant structures produce mutually consistent dates, that chronological coherence would constitute evidence of constructive coordination at global scale in a period not yet identified

4.6 Falsifiability condition

The proposal satisfies the Popperian criterion of falsifiability: if the protocol applied to multiple structures and multiple surfaces consistently produces dates consistent with conventional chronology, the hypothesis of a temporal distinction between builder and occupant is refuted for those specific cases by the same method that could confirm it.

A method that can be refuted is a scientific method.

5. CLASSIFICATION AND DESTINATION

5.1 Document classification

This proposal constitutes a scientific methodological proposal with a clearly delimited problem, verifiable physical basis, reproducible experimental protocol, falsifiable results, and implications proportional to the evidence.

5.2 Recommended publication destination

Immediate preprint

- OSF Preprints — multidisciplinary, open access, citable from the day of publication
- EarthArXiv — specific to Earth sciences and geological dating

Target journals at medium term

- Quaternary Geochronology — leading publication in dating methods
- Journal of Archaeological Science — archaeology with rigorous scientific methodology
- Earth and Planetary Science Letters — for the geological component

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