Prehistoric artifacts of Mesoamerica, anthropological evidence of ET paleocontact.

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Abstract

This study provides a multi-analytical characterization of the Aztlan collection, an extensive assemblage of over 10,000 artifacts representing a previously lost material culture of Mesoamerica. Manufactured from sophisticated, low-temperature anthropogenic geopolymers, these specimens exhibit a level of material engineering previously unattuned to the regional prehistoric record. C14 AMS radiocarbon dating of organic inclusions within the ceramic matrix yields a chronological age of 8,570 ± 30 BP, establishing a definitive mid-Holocene provenance. The collection serves as a unique anthropological record of Extra-Terrestrial (ET) Paleocontact, evidenced by explicit iconographic narratives. While currently remaining non-accessioned by traditional institutional bodies, the sheer scale and empirical consistency of the Aztlan artifacts necessitate a fundamental re-evaluation of established prehistoric timelines and cultural origins.

Keywords: *Geopolymerization, Technosignatures, Paleocontact, Aztlan, Panspermia.*

Introduction

The subjects of this material science research are samples derived from the Aztlan collection, an extensive body of archaeological artifacts recovered from the Cerro del Toro mountains in the southern highlands of Jalisco, Mexico. While the collection currently remains non-accessioned by state or academic institutions, the empirical data presented herein provides a rigorous foundation for its formal recognition within the prehistoric record.

Historically, the collection has occupied a contentious space within Mexican archaeology. In 2001, the Instituto Nacional de Antropología e Historia (INAH) participated in the establishment of a museum in Ojuelos, Jalisco, to display and catalog these items. However, following the museum's closure in 2014, the INAH issued statements distancing the institution from the site, characterizing the artifacts as modern fabrications due to their unconventional iconographic depictions of Extra-Terrestrial (ET) Paleocontact.

These institutional conclusions, however, were rendered in the absence of comprehensive geochemical analyses or archaeological investigations. By labeling the assemblage as "illicit forgeries" based on visual inspection alone, a significant gap was created in the scientific literature regarding the artifacts' true complexity.

To address this void, an international consortium of independent organizations—including Nahua Ollin (Mexico), STARaztlan (Russia), and AETTri (USA)—has undertaken the task of rigorous laboratory investigation. The objective is to move beyond speculative archeological opinion and establish a forensic framework that distinguishes evidence of genuine antiquity from modern replication.

Modern forgeries are typically characterized by distinct technosignatures, such as high-speed rotary tool marks and petrochemical residues. Conversely, the complexities present within the Aztlan collection suggest a sophisticated, prehistoric engineering tradition.

While previously assumed to be modern forgeries carved from natural stone, microstructural analysis reveals a complex composition consistent with Low-Temperature Geopolymer Setting (LTGS) ceramics. This engineered matrix

frequently incorporates multi-component mosaics, inclusions of metal alloys and crystals.

The goal of this research is to investigate the geopolymer hypothesis as a primary indicator of authenticity. Most critically, we present evidence of internal permineralized root systems proliferating within the ceramic micro-voids—a biological process requiring undisturbed subterranean deposition over vast timescales. When coupled with AMS radiocarbon dating yielding 8,570 ± 30 BP horizon, the material evidence suggests that the Aztlan collection represents a sophisticated, lost material culture that challenges established anthropological frameworks.

Materials and Methods

1. Sample Selection and Preparation

The study group consists of n=13 representative specimens sourced from the Aztlan assemblage (Jalisco, Mexico). Specimens were selected for material diversity, ranging from monolithic geopolymer-like substrates to multi-component mosaic artifacts. To preserve integrity, samples were obtained via precision mechanical excision using high-carbon steel instruments in a controlled laboratory environment. Samples were mounted on aluminum stubs using conductive carbon adhesive; no sputter-coating or chemical pretreatments were applied to ensure the preservation of original chemical and isotopic signatures.

2. High-Resolution Micromorphology and Elemental Mapping

Microstructural imaging was performed using a Thermo Fisher Helios NanoLab 660 DualBeam SEM. The system was operated in low-vacuum mode to mitigate charging effects on the non-conductive geopolymer matrix while maintaining sub-nanometer resolution of internal microstructure and inclusions. Elemental characterization and mapping were conducted via the integrated EDS suite on the Helios 660 to quantify the weight percentages of the sample matrix. Initial morphological surveys were conducted using a Keyence VHX-7000 Series ultra-high resolution digital microscope.

3. Surface Technosignature and Radionuclide Analysis

To distinguish between ancient manufacturing and modern replication, surface textures were mapped using a Keyence VR-6000 3D Optical Profilometer. Non-contact profilometry at sub-micron resolution was utilized to detect the presence or absence of modern mechanical rotary-tool markers versus manual prehistoric tooling. Additionally, radionuclide signatures and isotopic consistency were evaluated using a Radiacode 103 gamma spectrometer to characterize the compositional nature of the anthropogenic geopolymers against known regional geological backgrounds.

4. Chronometric Dating

Radiocarbon measurements were conducted at the University of Georgia Center for Applied Isotope Studies (CAIS) utilizing a CAIS 0.5 MeV accelerator mass spectrometer. To isolate the organic fraction from the geopolymer matrix, samples were dried and treated with 1N HCl to ensure the complete removal of secondary carbonates. The cleaned organic residue was then combusted at 900°C in evacuated, sealed ampoules in the presence of CuO. The resulting CO2was cryogenically purified and catalytically reduced to graphite using the method of *Vogel et al. (1984)*. Graphite 14C/13C ratios were measured against Oxalic Acid I (NBS SRM 4990) standards. Stable isotope ratio mass spectrometry was utilized to measure 13C/12C ratios, expressed as δ13C relative to the PDB standard, to correct for natural isotopic fractionation. Uncalibrated radiocarbon dates were calculated in years Before Present (BP, where 0 BP = 1950 CE) using the Libby half-life of 5,568 years. The resulting age of 8,570 ± 50 BP (Sample MA-0014C; pMC 34.41 ± 0.21) provides a definitive mid-Holocene chronological anchor for the artifacts' manufacture.

Figure 1: *Archaeological sites of Cerro del Toro, Jalisco, Mexico.*

Figure 2: *Artifact A of the Aztlan research group. This artifact is a hallmark example of the complexities present within the greater Aztlan collection. This mosaic is a complex assemblage of unique materials, engraved upon with 3D relief illustration featuring ultra-fine (~30 micron) detail. Highly vitreous surfaces and variegated colors denote a ceramic-like composition. Notable depictions of symbolic motifs, ET beings, and UFO craft.*

Results and Discussion

During preliminary investigations of the material composition of artifact A, a transverse dissection of the artifact was executed. This process involved utilizing a wet tile saw to cut a precise incision along the horizontal axis of the multi-component mosaic artifact, aligning precisely with the seam between the mosaic tile surface (top) and the base surface (bottom). (Fig 3) This process was conducted with strict sterilization protocols under laboratory conditions to avoid sample contamination.

The dissection of artifact A revealed internal micro-voids throughout the internal body of the artifact, possessing well preserved, fossilized biological root systems as well as an embedded grass seed floret. (Fig 4) This artifact features curved through-holes at the periphery of the disc as it was likely an adornment. These through holes evidently served as points of entry for internal water migration allowing for biological propagation.

Morphological evidence from ultra-high magnification SEM imaging identifies a highland grass floret, specifically a member of the Poaceae family. Dimensional analysis indicates a spindle-shaped geometry with a length of approximately 4.2 mm and an aspect ratio of 3.8:1, diagnostic of the *Muhlenbergia* or *Agrostis* genus. This grass species is indigenous to the Jalisco southern highlands of which the artifact originates. Further taxonomic refinement identifies the species as *Muhlenbergia robusta* based on the isolated spacing of silicified micro-teeth, or scabrous hairs, measured at 35–50 µm along the vascular nerves. (Fig 7)

Alongside these roots, vibrant blue-translucent filaments were observed, originally suspected as modern contaminants but later identified as permineralized fungal hyphae. These hyphae exhibit a measured diameter of 10–25 µm and demonstrate a distinct septate morphology characteristic of soil-dwelling fungi. These fungal filaments likely formed a symbiotic mycorrhizal network within the rhizosphere, as evidenced by their coiling attachment and penetration of the lateral root hairs. The presence of these hyphae indicates a complex, localized permineralization process occurring within the artifact's internal micro-environment. (Fig 4, 6)

Figure 3: *Artifact A, transverse dissection.*

Figure 4: *Artifact A, permineralized root structures.*

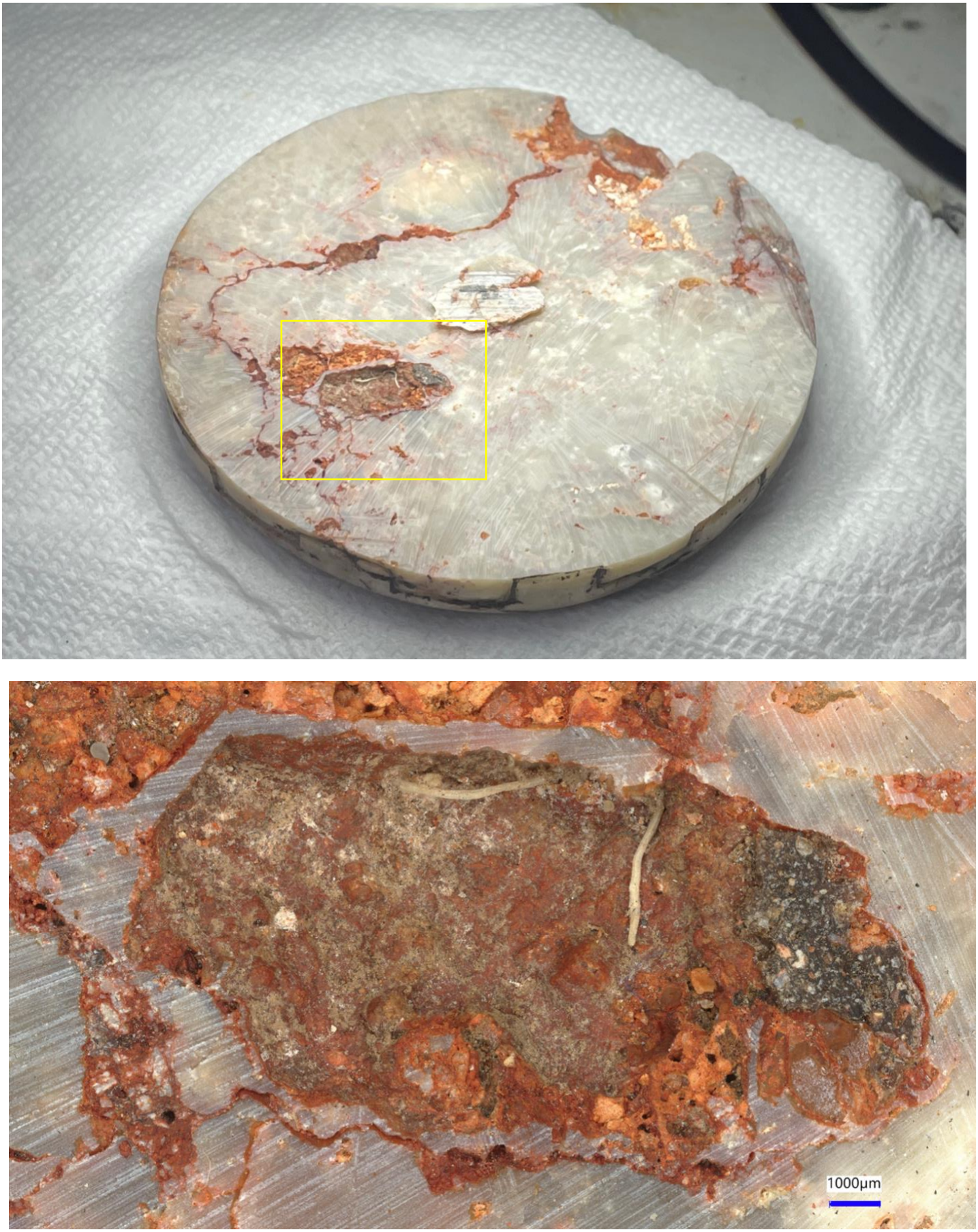


Figure 5: *Artifact A, internal micro-voids reveal permineralized root structures growing from within the artifact internal structure, including fungal hyphae and a seed floret.*

Figure 6: *Permineralized root and hyphae structures present with artifact A*

Figure 7: *Preserved seed floret discovered internally embedded within the mosaic composition of artifact A.*

Scanning Electron Microscopy (SEM) confirms the presence of a permineralized root system found within artifact A, featuring longitudinal vascular bundles of silicified xylem and phloem vessels. These vessels exhibit a honeycomb-like cortical architecture with vessel lumen diameters of 15–25 µm, aligning with the xeromorphic hydraulic profile of highland grasses. Energy Dispersive Spectroscopy (EDS) data provides quantitative support for this fossilization, showing that silicon (0.66 wt.%) and aluminum (0.34 wt.%) have physically integrated into the carbon-rich biological matrix through permineralization.

The high concentration of Carbon (76.33 wt.%) and Oxygen (22.66 wt.%) confirms a biological origin (cellulose or chitinous precursors) that has undergone significant chemical alteration. The Silicon and Aluminum maps show a distinct concentration of these elements following the exact path of the biological filament. This indicates that aluminosilicate minerals have effectively replaced the internal cellular structures, a delicate and authigenic process occurring over large timescales in situ within the internal micro-voids of artifact A.

The presence of a permineralized root system within the internal micro-voids of the mosaic composition of artifact A suggests a complex, multi-stage history that defies modern replication. For these delicate biological structures to transition from living tissue to a mineralized state, the artifact must have been subjected to a highly stable, mineral-saturated subterranean environment over a vast temporal horizon.

The migration of groundwater through the artifact's internal matrix likely activated dormant organic material, creating a localized micro-ecosystem protected from the external atmosphere. This isolation provided the necessary anaerobic conditions to prevent rapid decomposition, allowing for the slow, molecule-by-molecule replacement of organic cells with inorganic minerals. Such a transformation is not an instantaneous event but a secondary geological process that necessitates undisturbed burial for centuries, if not millennia. The structural integrity of the fossilized roots, interwoven with the artifact's internal components, demonstrates that this biological growth is intrinsic to the specimen's history rather than a superficial addition.

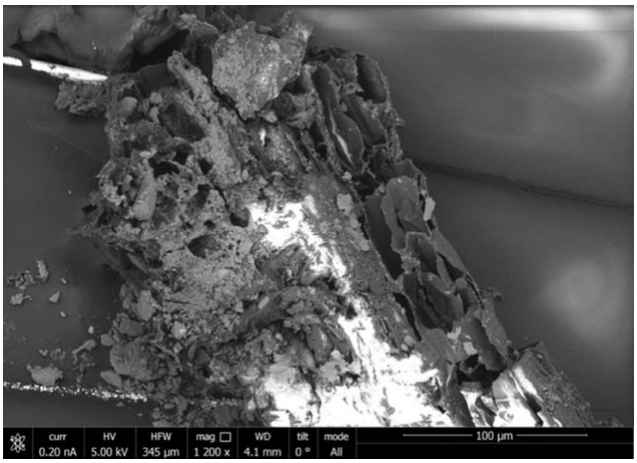
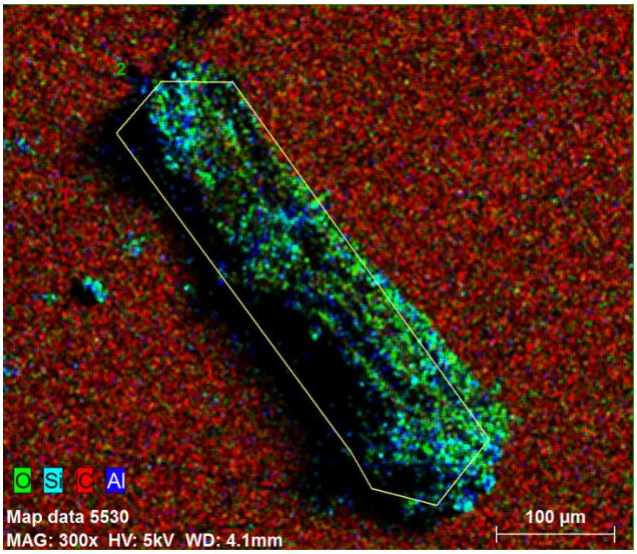


Figure 8: *SEM image of permineralized root structures discovered within the internal micro-voids of artifact A.*



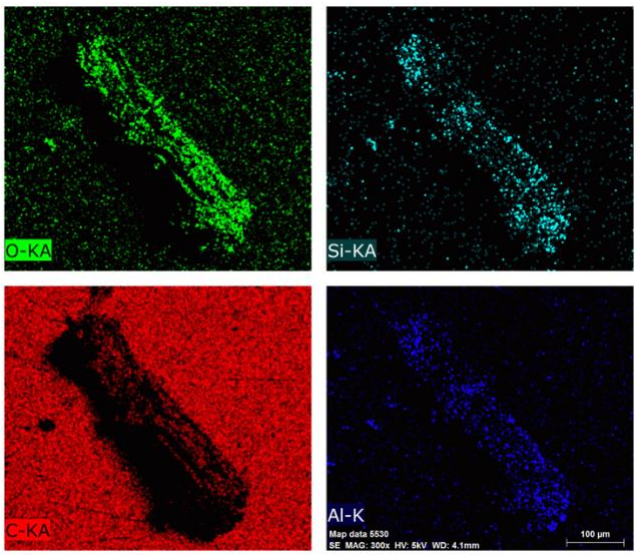


Figure 9: *EDS mapping of artifact A root sample.*

Figure 10: *Artifact B, front side.*

Figure 11: *Artifact B, back side.*

Artifact B of the Aztlan artifact research group is a mask-like pendant, featuring 3D sculptural elements including the prominent ET face upon the front side, as well as incredibly precise symbolic and illustrative surface engravings at the curved facial perimeter. (Fig 10) The back side of artifact A features a dimensionally complex, 3D relief engraving depicting a priest-like human figure in the presence of an extra-terrestrial being holding an infant. These beings are all encompassed inside of a rattlesnake illustration. (Fig 11)

Beyond the precise artistic elements exhibited on artifact B, the physical characteristics present upon the artifact's surface are insightful as to the nature of the material's composition. Specifically in regard to the glaze-like surface enamel, artifact B possesses a distinctly vitreous green surface with a definitive interfacial boundary and thickness relative to the internal, core material characterized by a red colored, ceramic-like composition. This surface enamel exhibited in artifact B is strikingly similar to the colors present in ancient Egyptian faience ceramic artifacts. Egyptian faience is one of the world's most ancient ceramic traditions, recognized for their distinct chemically engineered self-glazing behavior and famous "Egyptian blue" color.

The erosion patterns featured upon the front side of artifact B provide additional forensic signatures of a distinct chemical gradient inherent to the artifact's material composition. (Fig 12) These ceramic-like physical features present in artifact B are atypical of carved geological stone, as natural stone does not possess such a chemically variegated surface enamel unless chemically treated.

Figure 12: *Artifact B, surface enamel erosion detail. Material sample 1B location at upper periphery.*

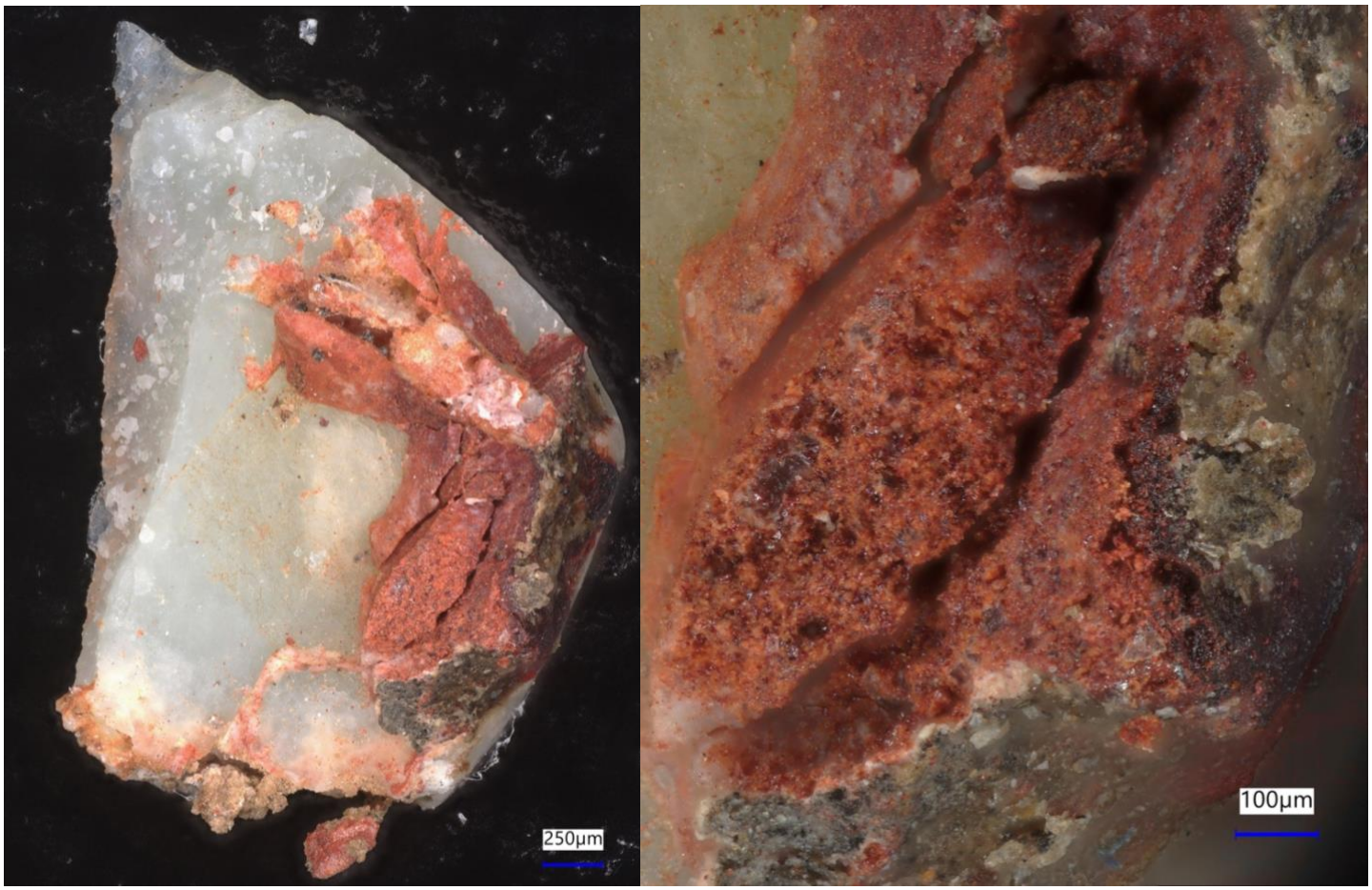


Figure 13: *Sample 1B, featuring both surface enamel and core material observed under optical microscopy.*

The macroscopic and microscopic morphological characteristics of sample 1B exhibit a compelling physical alignment with the Low Temperature Geopolymeric Setting (LTGS) framework established by the material science research of the Geopolymer Institute of France and Waltraud M Kriven of the University of Illinois. (Kriven, 2010, 2018, 2019) (Davidovits, 2017) (Davidovits et al., 1999) (Davidovits, J., & Davidovits, R. 2004)

The micrograph of sample 1B (Fig 13) reveals a chemically bonded heterogenous interface between a turquoise-green exterior enamel layer and a ferruginous red interior core, suggesting a low temperature covalent bonding process rather than a vitreous enamel formed through thermal fusion.

In the context of the LTGS framework, this low-bake enamel represents a departure from traditional ceramic glazing. While conventional enamels require temperatures exceeding 800°C to melt glass frits onto a substrate, geopolymer ceramics utilize chemical polymerization to achieve durability at temperatures between 20°C and 250°C. (Kriven, 2019)

Furthermore, the turquoise hue of the enamel observed in Figure 13 strongly correlates with the copper-phosphate chemistry identified in the *Djoser Faience* study of the Geopolymer Institute, where low-temperature processing (250C–350C) preserves specific chromophores that would otherwise transition at higher refractory temperatures. (Davidovits, J., & Davidovits, R. 2004)

This biphasic structure is similar to the experimentally validated low temperature self-glazing behavior of Egyptian Faience, where alkaline salts and soluble silicates migrate toward the surface through efflorescence during the clay's drying phase. Followed by thermally controlled low-temperature curing, this unique manufacturing technique eventually forms a richly colored vitreous surface enamel achieved at sub-vitrification temperatures. This non-refractory thermal processing, specifically in the context of LTGS represents the most likely technique of manufacture for the Aztlan artifacts, producing a chemically engineered organo-mineral composite at ambient to low temperatures. (20C - 250C) (Davidovits, 2017)

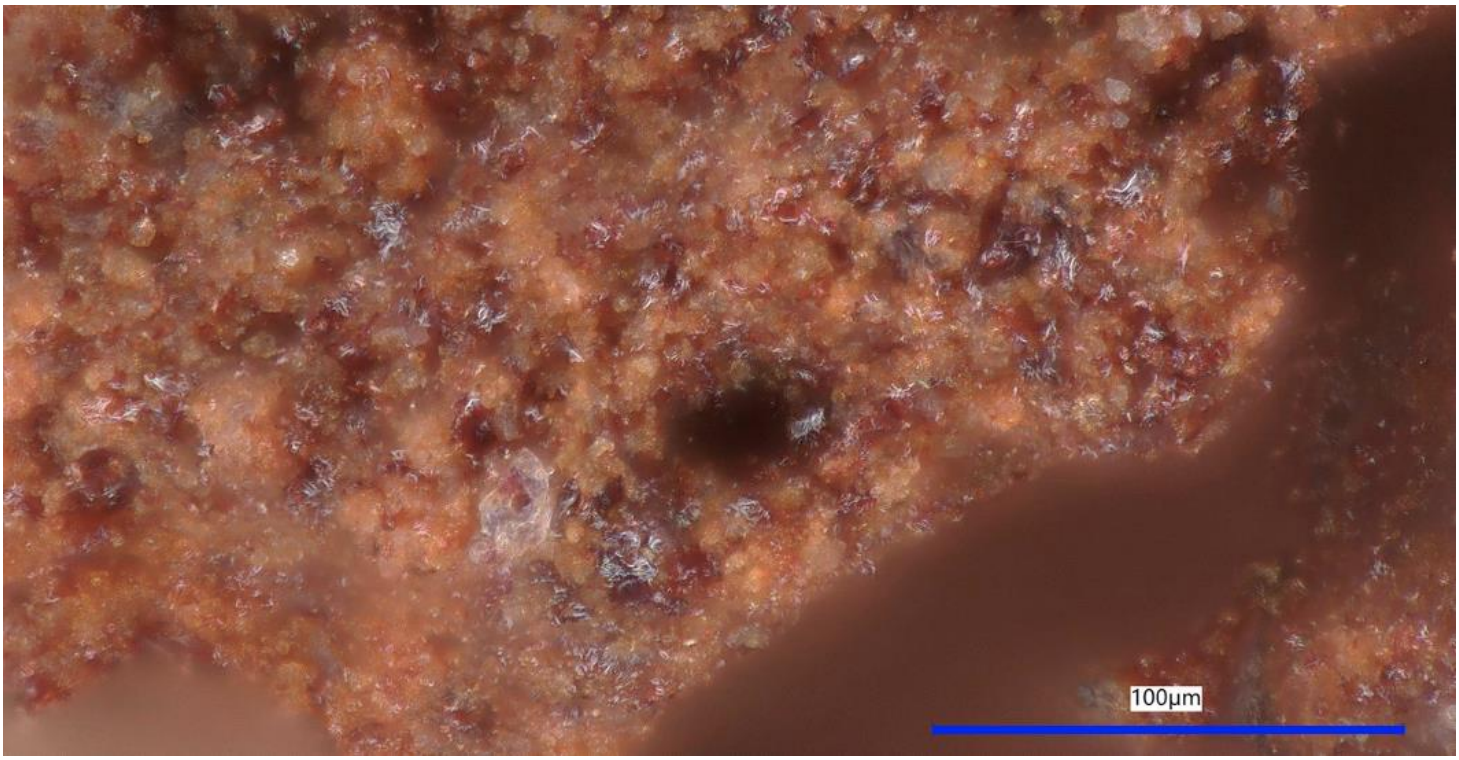


Figure 14: *Sample 1B, internal material composition, highly vitreous microstructure.*

The vivid red coloration of the internal material composition of sample 1B is highly indicative of a poly (ferro-sialate) geopolymer structure, as described by Davidovits (2020), where iron oxides such as hematite are substituted into the aluminosilicate network. The micro-texture of sample 1B appears dense and consolidated, lacking the porosity typically associated with high temperature kiln-fired terracotta.

Micrographs of the sample (Fig 14) reveal an internally vitreous luster, demonstrating a high refractive index inherent to the sample's material composition. This microstructure is characteristic of a silicon rich, highly dense amorphous phase. No evidence of sintering necks nor grain growth inherent to high temperature kiln firing is visible at this scale. The microscopic visual evidence of sample 1B provides a strong qualitative foundation for the further EDS analytical characterization of this material as a low temperature geopolymer ceramic, specifically pointing toward a complex poly (ferro-sialate) chemistry. The elemental constituents of sample 1B mapped through EDS reveal a clear molecular architecture characteristic of geopolymer synthesis. (Fig 15)

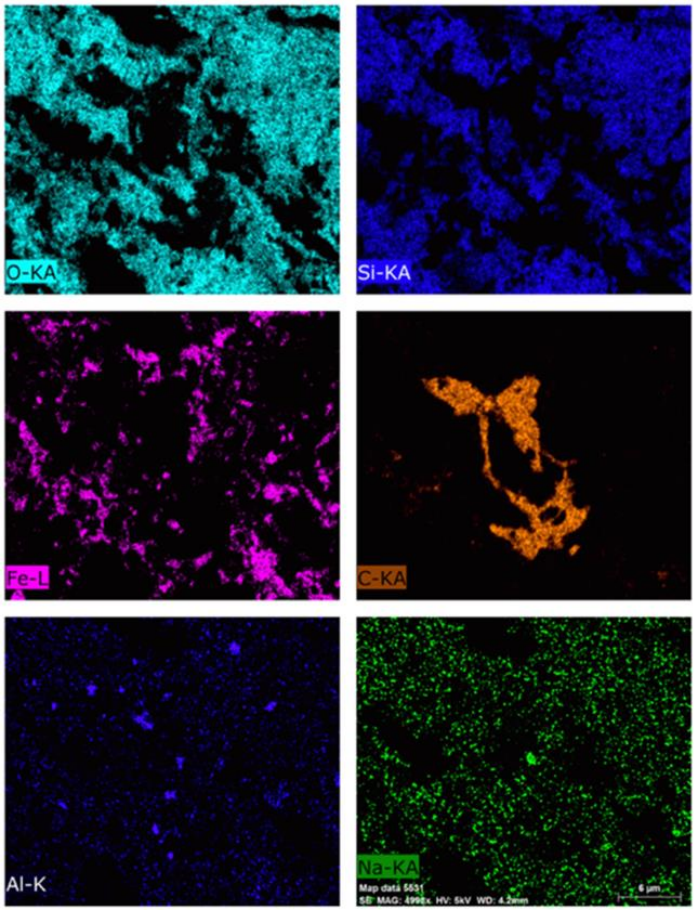


Figure 15: *Sample 1B, internal composition EDS elemental mapping. Notable Carbon morphology.*

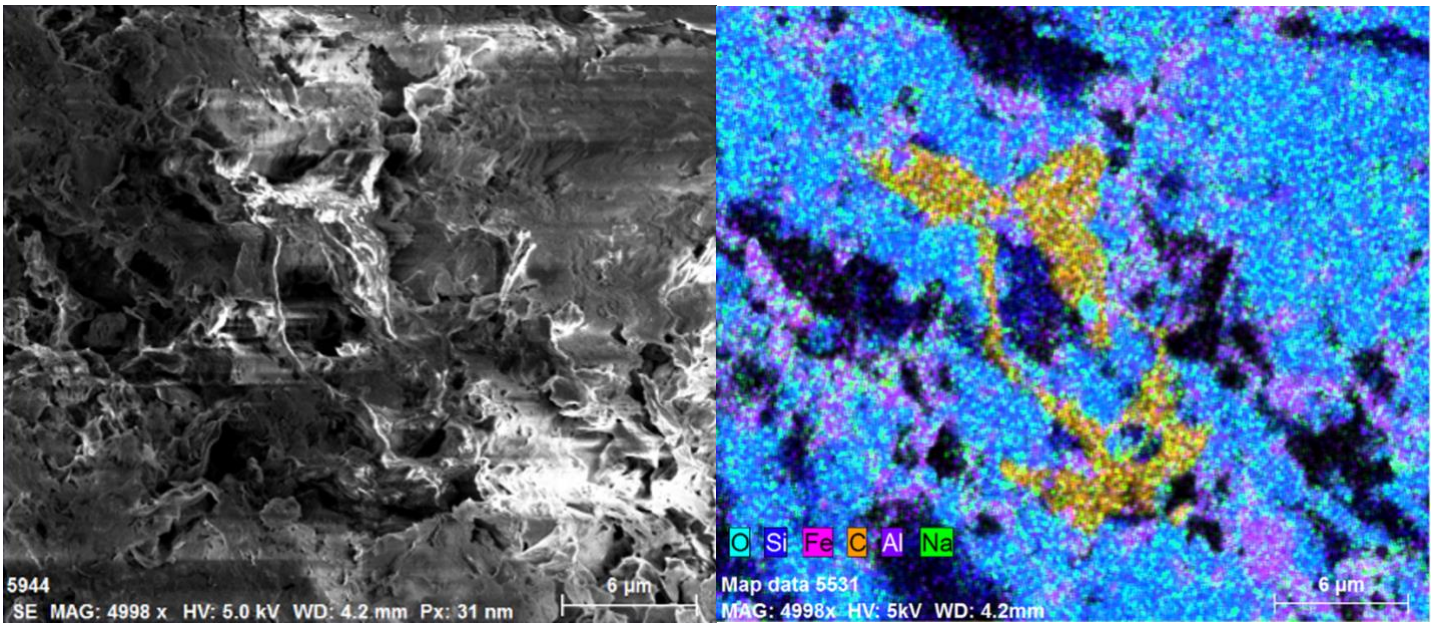


Figure 16: *Sample 1B, internal composition SEM and EDS mapping. Notable Carbon inclusion morphology.*

EDS mapping and stoichiometric data of sample 1B provide a chemical profile that strongly supports the LTGS characterization, specifically within the Poly(ferro-sialate) classification. The extremely low aluminum (0.58 at%) and high iron (10.20 at%) suggest that iron is not merely a pigment in this sample; it is the primary trivalent cation driving the geopolymerization. In a standard geopolymer, we look for an ideal stoichiometric ratio of Si/Al ≈ 1 to 3.

In sample 1B, the iron has effectively replaced aluminum. The Si/Fe ratio measured in sample 1A is 5.89. In geopolymer science, this suggests a Poly(ferro-siloxo) or Poly(ferro-multisiloxo) structure. This higher ratio typically results in a very stable and chemically resistant mineral polymer. (Fig 16, 17)

The Silicon (Si), Oxygen (O), Iron (Fe), and Sodium (Na) maps show a high degree of spatial correlation. (Fig 15) They overlap almost perfectly, illustrating a high degree of geopolymerization. This is the exact molecular architecture that defines a Poly ferro-sialate geopolymer classification. (J. Davidovits and R. Davidovits, 2020)

The significant sequestration of Carbon (C) (30.67at%) characterized by an internally embedded gum-like, non-diffuse morphology situated within with the Si−Fe−O atomic maps provides definitive evidence of a low temperature, sub-vitrification thermal history in regard to the material's manufacture. This abundantly present gum-like morphology observed throughout the EDS analyses of internal composition of sample 1B suggest a complex organo-mineral hybrid composite, similar to the microstructural geochemical evidence of internally embedded organic compounds discovered by the Geopolymer Institute in the ancient megalithic masonry of Tiwanaku, Bolivia. (Davidovits et al., 2019)

This preservation of a carbon throughout the internal microstructure of sample 1B is a distinct indicator of an organo-mineral synthesis, where geopolymerization is facilitated through carboxylic acid intermediaries. (Davidovits et al., 1982) In this specific setting, organic complexes such as oxalates and tartrates derived from plant extracts act as active dissolving agents to disaggregate mineral precursor materials.

The high carbon signature likely correlates to the residues of these biogenic acids present within sample 1B, which remain sequestered and preserved within the structure of the geopolymer ceramic. Because this process relies on low-temperature chemical polycondensation rather than thermal fusion, the organic carbon compounds do not oxidize or burn off, instead forming an integral part of the resulting geopolymer ceramic. Because organic materials typically begin to oxidize and vaporize between 400C and 600C, their abundant preservation observed within the microstructure of sample 1B is clear evidence that the material was synthesized at low temperatures, far below the threshold of traditional kiln firing, effectively preserving this organic material in situ.

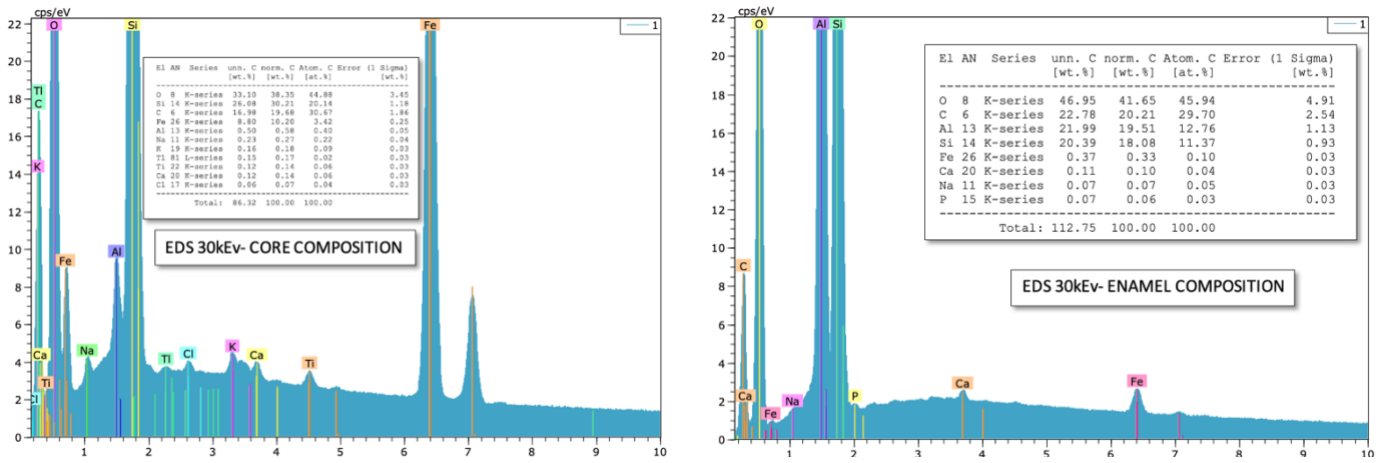


Figure 17: *Sample 1B compositional comparison of core vs surface enamel, 30 kEv EDS measurments.*

The calculated molar ratios derived from the EDS measurements of sample 1B reveal a sophisticated, multi-phase engineering strategy consistent with LTGS chemistry.

Analysis of the internal core at 30keV reveals a structural framework dominated by a poly (ferro-sialate) network, where iron functions as the primary trivalent network-former in the absence of significant aluminum. This core composition is characterized by an Si/Fe ratio of 5.89, confirming that the material's intrinsic red pigmentation is a result of this iron-silicate organo-mineral composite. (Fig 17, 18).

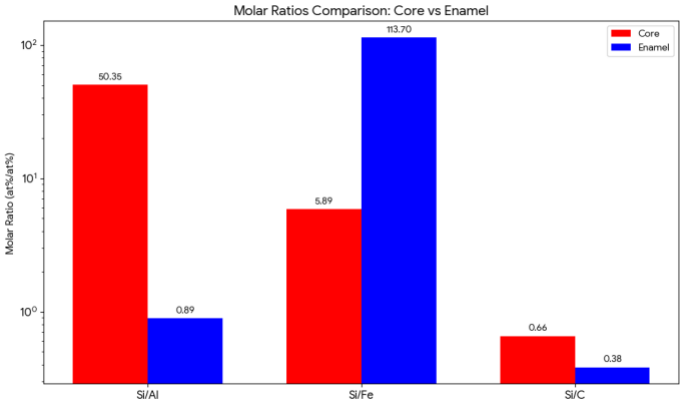


Figure 18: *Comparative molar ratios in sample 1B*

This chemical shift suggests that ancient artisans utilized iron-rich precursors as the primary reactive phase to achieve structural density of the artifact without requiring high-alumina clay.

In stark contrast, the surface enamel composition presents a Si/Al ratio of 0.89, marking a radical enrichment of aluminum and a near-total depletion of iron at the artifact's periphery. This inverse relationship between the core and the surface implies a controlled chemical migration process, where soluble aluminate species were drawn to the surface during the setting phase. The resulting enrichment facilitates the formation of a dense, protective aluminosilicate enamel that effectively mimics the vitreous properties of high temperature ceramic glazes.

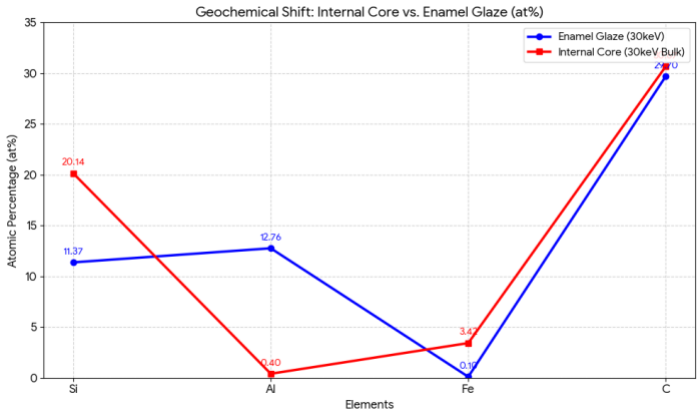


Figure 19: *Sample 1B material, geochemical shift*

Furthermore, the persistent and high atomic concentration of carbon, exceeding 30 at% in both areas, strongly supports the presence of an organo-mineral composite. (Fig 19) These organic constituents likely functioned as polyelectrolytes, regulating the pH and rheology of the geopolymer ceramic paste to prevent premature precipitation of the iron-silicate core. The significant divergence in Si/Fe and Si/Al ratios between the two regions demonstrates that the surface enamel is not a separate coating, but an engineered product of the material's own chemical constitution. The geochemical transition from a ferro-sialate core to an aluminosilicate surface serves as definitive evidence of an engineered chemical gradient designed for both structural integrity and environmental resistance.

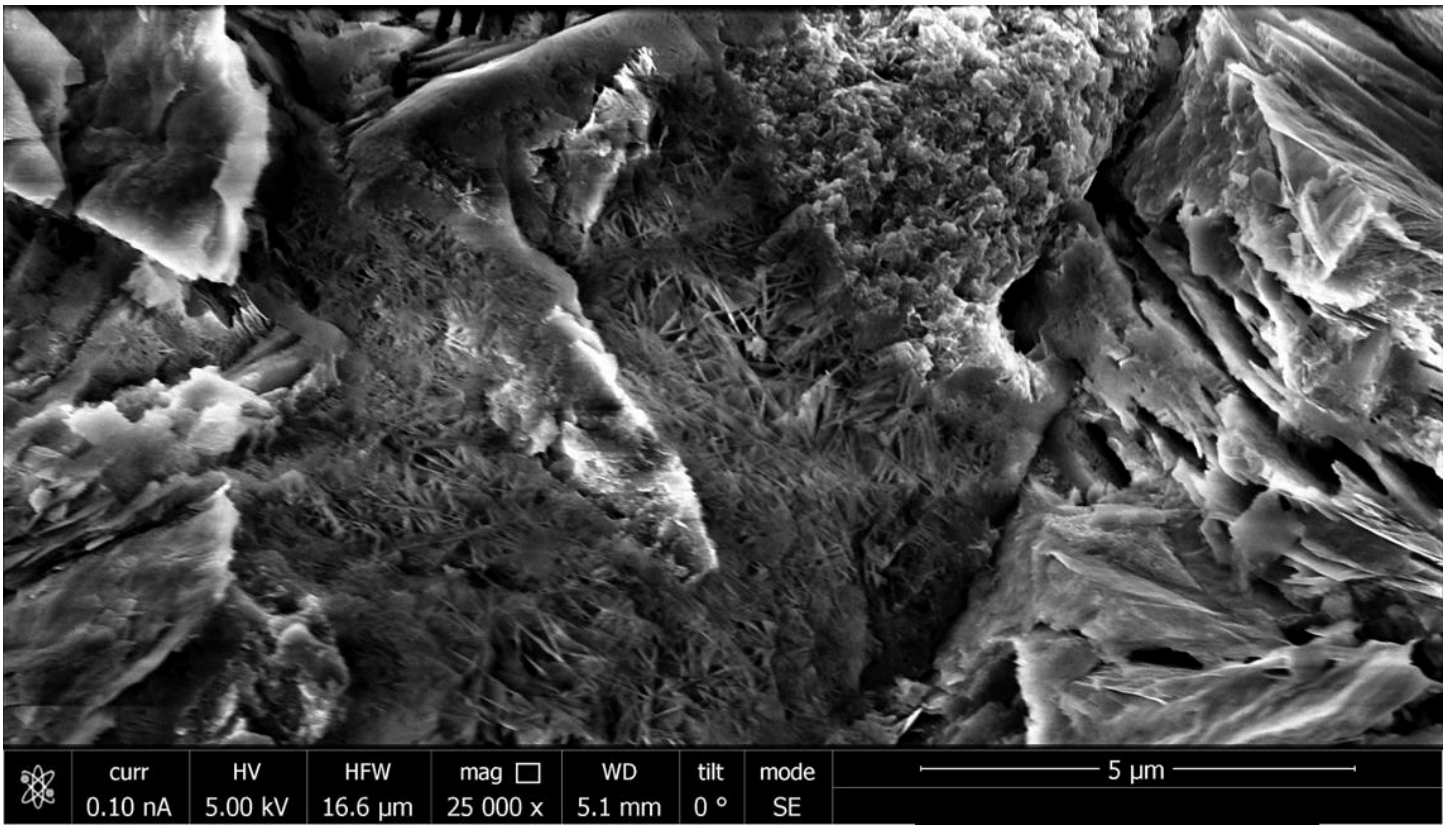


Figure 20: *Sample 1B core, SEM image. Nanoscale morphologies indicative of geopolymer synthesis in situ.*

The SEM micrograph of the sample 1B core provides a distinct visual representation of a complex hierarchical geochemical architecture that correlates exactly to key phases of nano-molecular geopolymer chemistry.

At the primary nano-scale structural level, the geopolymerization process initiates with the formation of discrete, nano particles identified as geopolymer micelles, which typically range from 5 to 30 nm in diameter (Davidovits, 2025).

Within the specific context of sample 1B, these primary GP micelle units have aggregated into the prominent globular quaternary structures visible in the top-right quadrant of the SEM image. (Fig 12) Sample 1B is composed of an average quantity of sodium at ~0.44 at% (Na). Sodium-based geopolymer nanoparticles are characteristically larger than their potassium-based counterparts, often presenting in the 30-60 nm range before further agglomeration. The presence of sodium content in sample 1B specifically influences the globular morphology of the quaternary clusters observed, as sodium ions lack the higher coordination efficiency of potassium, leading to the larger observed particulate diameters (Akono et al., 2025; Davidovits, 2025).

These micrometer-scale spherical colonies, approximately 1.1–2.5 µm in size, present within the top right quadrant of the SEM image represent the maturation of the poly(ferro-sialate) matrix, where the expulsion of water from the micellar interior has facilitated a dense, polymerized network (Davidovits, 2025). (Fig 20)

Interspersed within and extending beyond these GP micelle globular aggregates are distinct, linear, and cross-linked crystalline morphologies that characterize a secondary phase of molecular maturation in LTGS synthesis. These linear structures, observed in the reticulated network centrally located within figure 20, are identified as nano-zeolites, which nucleate from the amorphous geopolymer gel when the stoichiometric conditions and curing temperatures facilitate the final stage of geopolymerization, wherein long-range polymeric structures precipitate from the polycondensation phase. The presence of these interwoven zeolitic crystalline networks is distinctly indicative of a chemically engineered LTGS synthesis process where the inorganic matrix achieves high mechanical stability through chemically precipitated in-situ microstructural reinforcement.

The interaction between these inorganic formations and the high concentration of organic constituents (~30 at% Carbon) suggests a sophisticated organo-mineral template effect. The organic molecules, likely acting as polyelectrolytes, coated the precursor particles during the initial dissolution phase, thereby regulating the nucleation rate of the GP-micelles.

These organics occupy the inter-micellar voids, the nano-scale channels created during the expulsion of water, effectively acting as a compliant filler that prevents the micro-cracking typically associated with purely inorganic geopolymer systems (Davidovits, 2025) (Kriven et al., 2003)

The alignment of the zeolite phases in cross-hatched patterns suggests that the organic matrix served as a structural scaffold, guiding the growth of the mineral phases along favored electrochemical gradients. This synergy between the amorphous GP-micelle clusters and the crystalline zeolite laths, mediated by a pervasive organic phase, results in an organo-mineral composite material that mimics the structural durability of traditional kiln-fired ceramics without the need for extreme temperatures. Recent scientific observations of LTGS chemistry corroborate that such particulate morphologies are the hallmark of true geopolymer materials. (Davidovits, 2025) (Don-Kyun et al., 2018) (Kriven et al., 2003).

This nano-molecular arrangement demonstrates that the artifact was chemically ngineered at the molecular level to optimize density and environmental resistance. The persistent carbon signature throughout these regions suggests that the organic component was not a superficial additive but an integral part of the chemical synthesis, possibly serving to stabilize the iron-rich framework against oxidation. This integrated model provides a definitive explanation for the unique material properties of the artifact, properly characterizing it as a LTGS ceramic material.

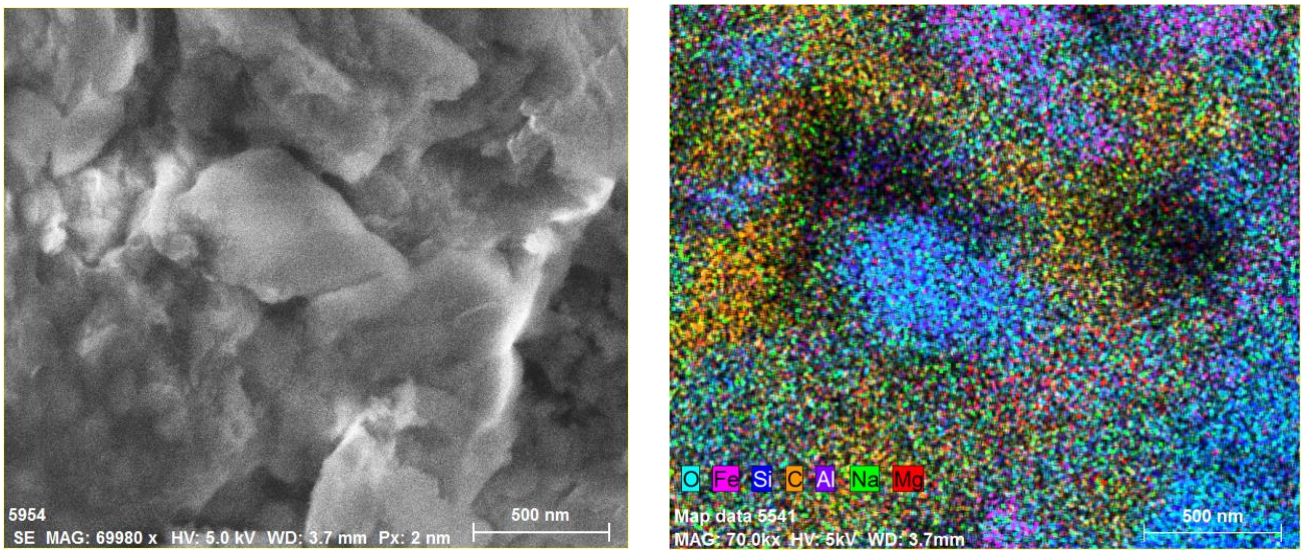


Figure 21: *Nanoscale SEM image and EDS mapping of sample 1B core composition.*

Interestingly, the Aztlan artifacts possess a unique internal green phosphorescence when exposed to high powered UV light. Additional EDS measurements of nanoscale structures within the internal composition of sample 1B reveal a diffusion of nanoparticulate carbon clusters within the poly(ferro-sialate) framework. (Fig 21, 22)

The identification of Carbon Quantum Dots (CQDs) within the microstructure of sample 1B is supported by current research into functional construction materials and hydrothermal carbonization of CQDs. In the LTGS framework, the exothermic polycondensation of the poly (ferro-sialate) network typically maintains a temperature range of 80C to 150C, providing the ideal hydrothermal environment for the carbonization of organic precursors into carbon fluorophores (CQDs) without the complete oxidation associated with high-temperature firing. (Zhao et al., 2024) This is achieved through the thermal pyrolysis of organic polymers, wherein the LTGS environment provides the ideal chemical potential to convert organic precursors into photoluminescent carbon clusters (Jiang et al., 2014).

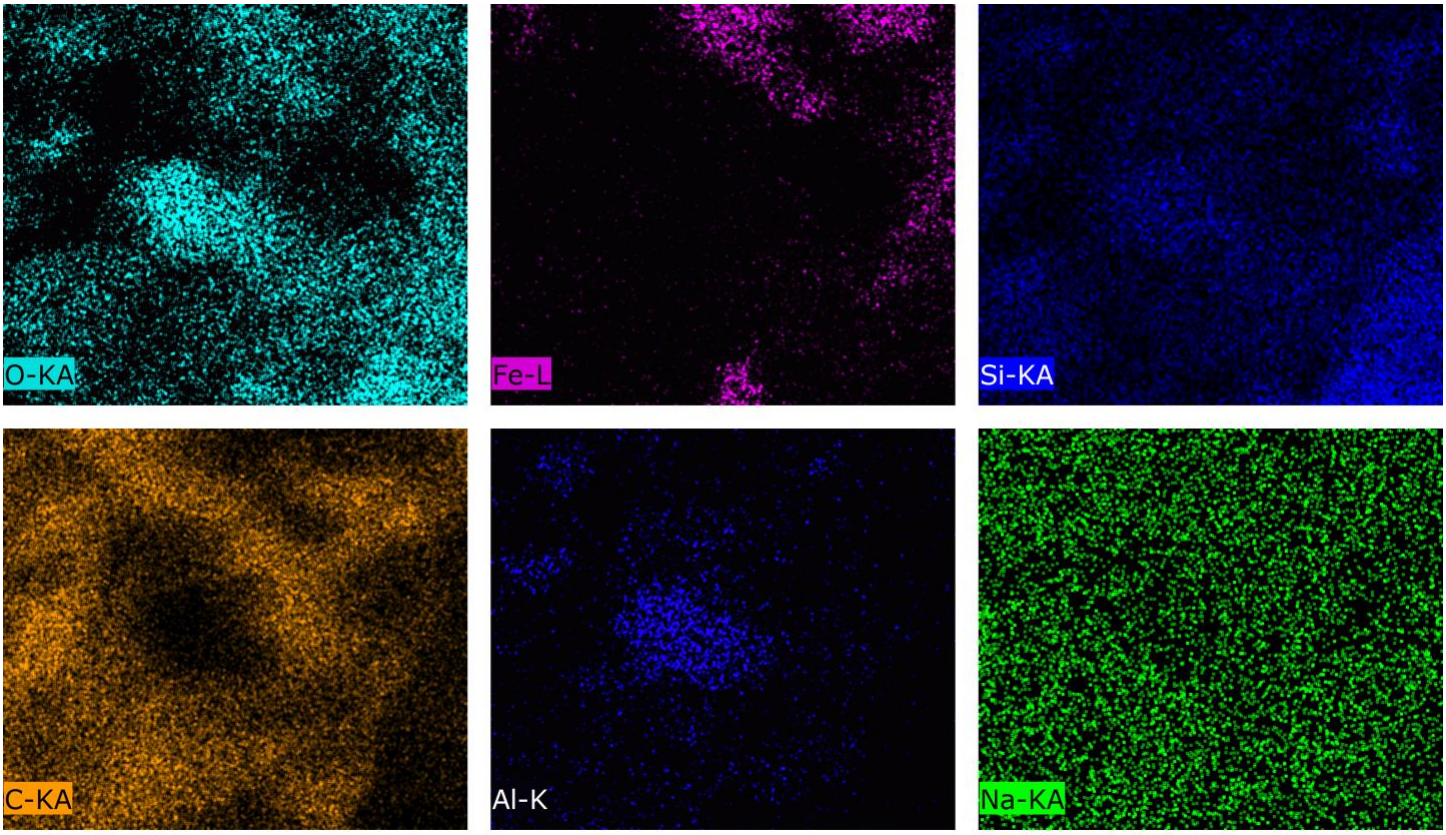


Figure 22: *Nanoscale EDS elemental mapping of sample 1B core composition.*

The observed optical shift in the Aztlan artifacts from green phosphorescence at 365 nm UV to yellow phosphorescence at 395 nm UV is a direct manifestation of the CQD quantum size effect, where smaller, more highly confined carbon dots exhibit higher energy transitions (shorter wavelengths) and larger dots or surface-oxidized clusters transition to lower energy emissions.

This excitation-dependent behavior suggests a polydisperse carbon distribution within the highly siliceous matrix of the artifact, where the silica (SiO_2) acts as a wide-bandgap dielectric host that prevents the quenching of the CQD's luminescence. (Ryu et al., 2023).

By stabilizing these CQDs within a rigid, highly siliceous inorganic framework, the compositional nature of the geopolymer ceramic prevents the aggregation-caused quenching that typically limits the optical performance of carbon-based fluorophores in less sophisticated systems (Dutta et al., 2024). The highly siliceous geopolymer matrix serves a dual role: it acts as a rigid host that prevents aggregation-caused quenching of the CQDs and as a transparent dielectric medium that facilitates the light-guiding properties essential for the artifact's voluminous phosphorescent glow.

The resulting organo-mineral composite effectively functions as a solid-state luminescent material, where the CQDs provide the electronic transitions and the siliceous geopolymer provides the structural and optical stability.

The characterization of the electronic transitions within sample 1B is grounded in the quantum mechanical behavior of zero-dimensional semiconductors, where the spatial confinement of electrons in sub-10 nm clusters induces a discrete splitting of energy levels (Liu et al., 2020). When the artifact is subjected to ultraviolet radiation, electrons undergo a transition from the ground state to a higher-energy conduction band, subsequently releasing photons as they relax to lower energy levels. The observed spectral shift from green to yellow phosphorescence under UV spectroscopy (365 nm vs. 395 nm) is a direct manifestation of this quantum size effect, indicating a polydisperse distribution of CQDs where transition energy is inversely proportional to particle diameter (Liu et al., 2020).

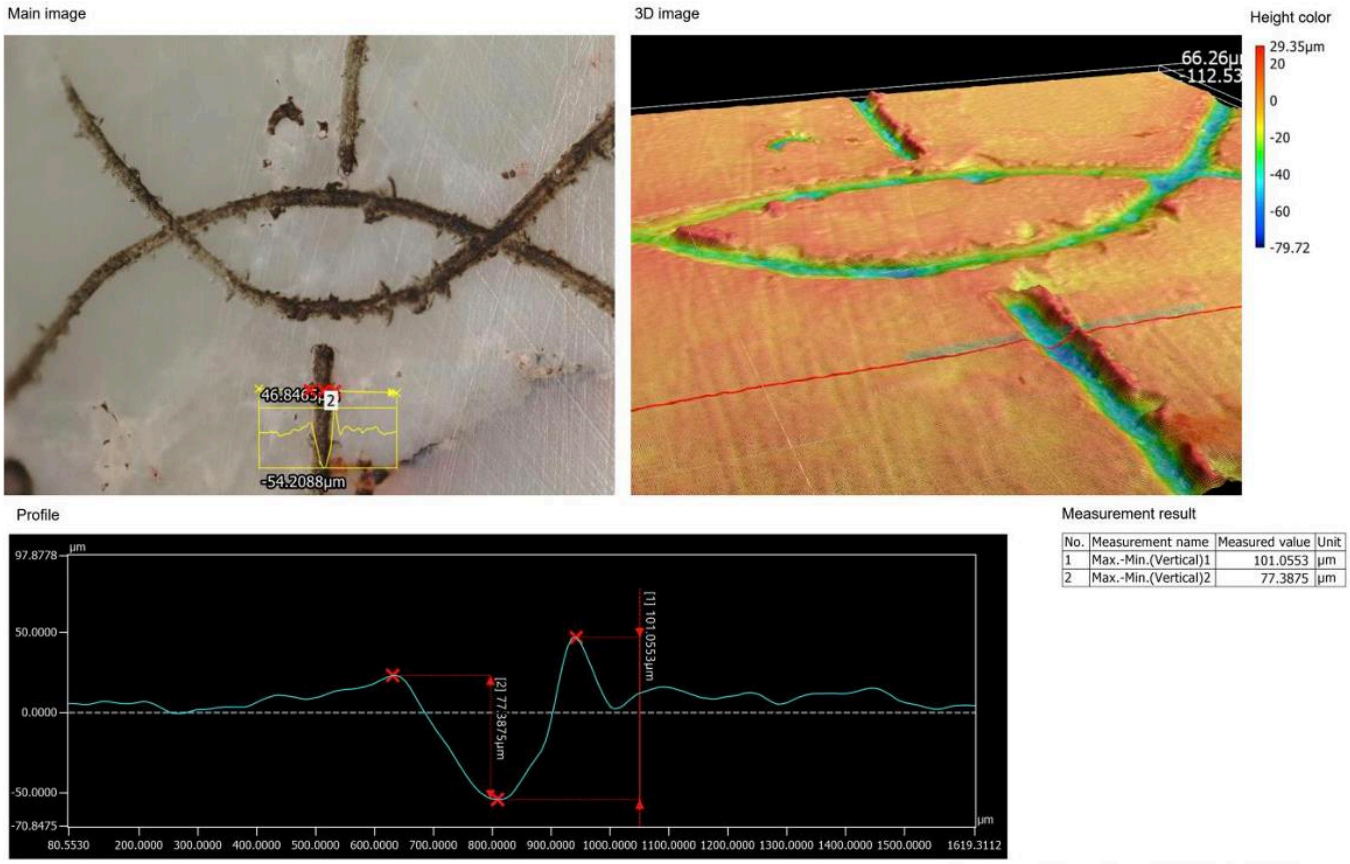


Figure 23: *Surface engravings of Artifact B analyzed through sub-micron resolution surface texture mapping.*

The high-resolution surface texture mapping of the engraved features on artifact B provides irrefutable evidence of a sophisticated, multi-stage low temperature manufacturing process. The topographic profile of the engraving is characterized by a central trough flanked by bilateral, elevated sidewall ridges, a morphology that serves as a diagnostic technosignature of material deformation occurring in a pliable soft state. (Fig 23, 24)

In the context of geopolymer rheology, this profile indicates that the engraving stylus was applied to the material during the gel stage of polycondensation. This specific physical state allowed the material to exhibit Bingham plastic behavior, wherein it possessed a defined yield stress sufficient to retain the geometry of the displaced volume without gravitational slumping.

The lateral sidewall ridges, or ploughing humps, demonstrate a continuous curvature from the original surface plane, indicating that material was redistributed through non-Newtonian fluid-like flow rather than removed via percussive fracturing or abrasive grinding. Had the artifact been engraved in a hardened or kiln-fired state, the interface would exhibit conchoidal scarring and micro-chipping; instead, the sidewall profile reveals a smooth, smear-like texture indicative of high-viscosity displacement. (Fig 24)

The extrapolated internal width of the groove (180 µm) and the maximum penetration depth (35 µm) constrain the stylus to a precision instrument with a tip radius of approximately 60 to 75 µm.

Given these dimensions and the observed striations within the trough, the stylus tool is highly consistent with an obsidian blade or a precision-knapped microlith. Obsidian, being a natural volcanic glass, can be flaked to achieve an edge radius significantly sharper than modern steel, allowing it to penetrate the semi-cured geopolymer material with minimal frictional resistance.

Following this soft-state engraving, the artifact likely underwent a final curing phase, where it was subjected to low-temperature thermal curing not exceeding 250C. This multi-stage manufacturing sequence including an engineered chemical synthesis, soft-state engraving, and low-temperature thermal maturation, explains the coexistence of abundant ultra-fine scale artistic detail and extreme material durability. The absence of thermal micro-cracking around the engraving further supports a curing temperature below the threshold of rapid steam evolution, typically exceeding 250C.

The preservation of the micron-scale engraving deposits indicates that the surface enamel achieved a high degree of hardness shortly after the tool's passage, locking the observed material plastic deformation into a fixed ceramic state. This signature effectively rules out modern mechanical engraving, which produces a kerf through abrasive material removal rather than the volumetric redistribution or material displacement observed in the topographic mapping of the engraving surface. The surface topography of artifact B serves as a powerful forensic indicator of the artifact's rheological state, confirming a multi-stage, low temperature manufacturing process.

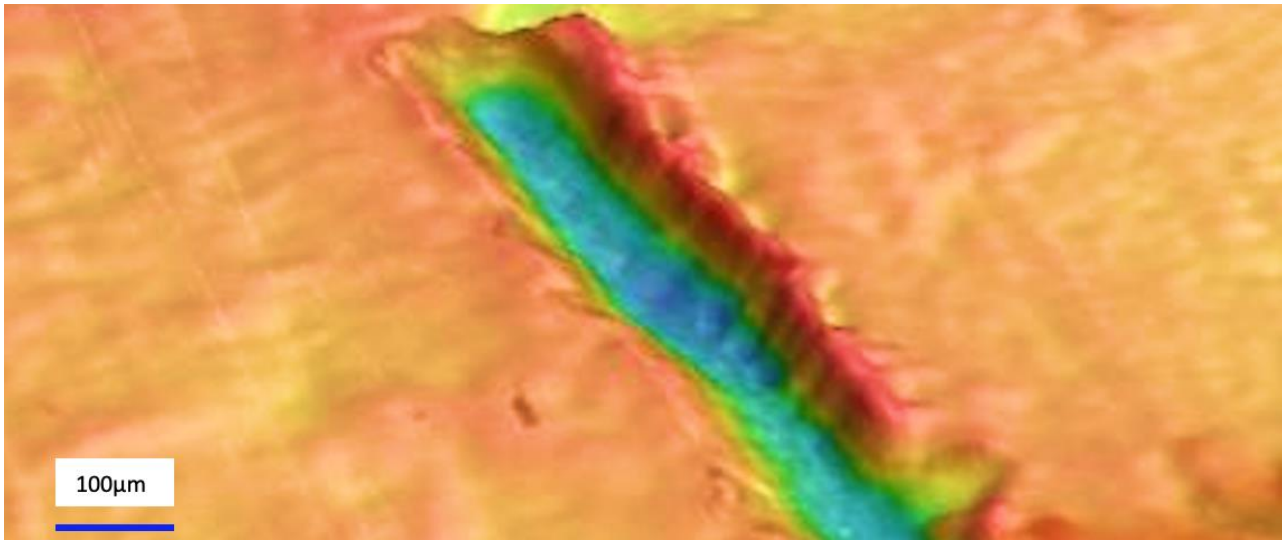


Figure 24: *Surface texture mapping, featuring pronounced material displacement ridges within the engraving.*

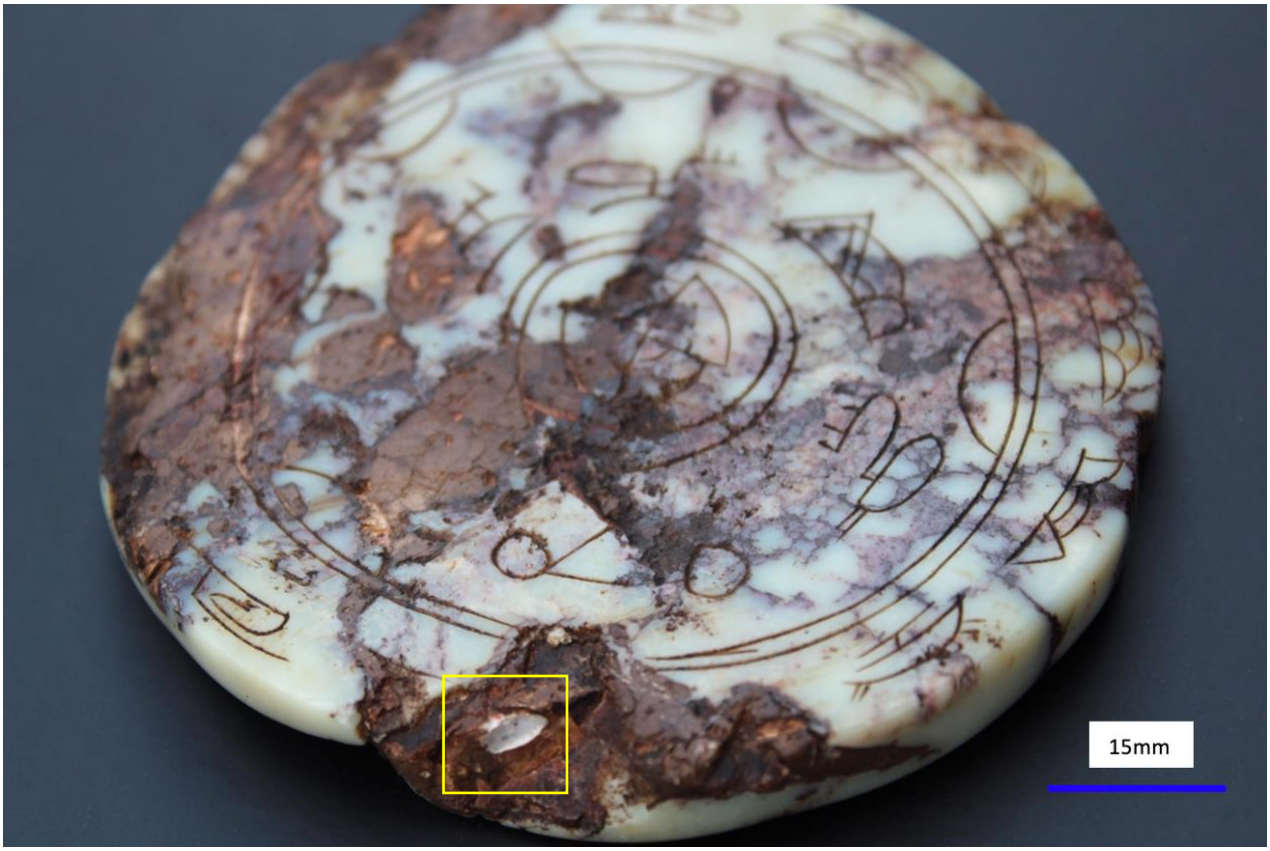


Figure 25: *Artifact C, front side. Material sample 1C location at lower periphery.*

Figure 26: *Artifact C, back side.*

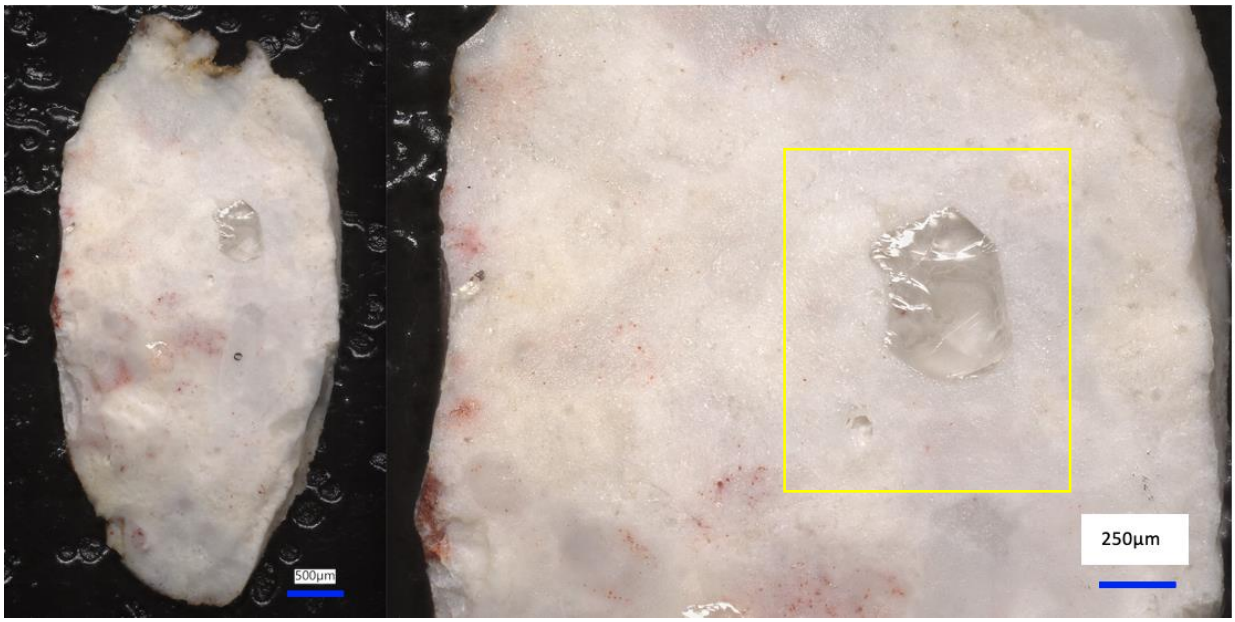


Figure 27: *Material sample 1C. Notably silica rich with glass inclusions, including an unreacted internal void.*

Elemental and stoichiometric analyses of sample 1C reveals another unique example of LTGS ceramic synthesis. This sample is characterized by a high-purity silica-rich geopolymeric internal matrix, notably featuring a micro-void of unreacted aluminosilicate precursor materials serving as primary evidence of their engineered chemical synthesis. (Fig 27, 28, 32)

Optical microscopy of the sample interior identifies a white, opaque, and highly vitrified matrix populated by sputtered red chromophores, likely iron-oxide (Fe2O3) micro-inclusions, which provide a marbleized aesthetic.

An additional prominent feature within sample 1C is a large, transparent glass inclusion. (Fig 27) The presence of microscopic glass inclusions within the geopolymeric matrix of sample 1C serves as further evidence of a low-temperature chemically precipitated manufacture of amorphous glass through a solution-gelation-dehydration process rather than high-thermal fusion. A common misconception is that such glass requires extreme heat for melting (>1000C). However, in the context of geopolymer science, this glass forms through evaporative polycondensation at very low temperatures (<250C).

As the artifact cures, the water within the alkaline silicate solution evaporates or is consumed by the hydration of the surrounding geopolymer gel. As the localized area of silicate solution becomes increasingly concentrated, these soluble silicates begin to bond and form amorphous *(Si-O-Si)* networks through polycondensation, eventually solidifying through evaporative dehydration into a hard, transparent vitreous mass at ambient or low temperatures (<250C). The sharp, angular morphology and conchoidal fracture patterns of the glass inclusion are characteristic of amorphous glass.

Adjacent to this prominent glass inclusion is a sub-surface air pocket, which serves as the primary site of focus for investigating the LTGS technosignatures of artifact C. (Fig 27) Comparative elemental analysis of sample 1C utilizes EDS measurements of the sample at varying regions of measurement to characterize the chemical transition from unreacted aluminosilicate precursors to the chemically synthesized geopolymer ceramic.

Within the internal matrix of sample 1C, the Si/Al molar ratio significantly exceeds stoichiometric expectations for natural clays, ranging from 5:1 to 9:1, indicating the presence of a highly siliceous, amorphous 3D network lacking a high aluminum content. (Fig 28) Conversely, measurements isolated within the semi-spherical internal micro-void reveals a sharp stoichiometric shift toward a Si/Al ratio of approximately 1:1, which aligns with the composition of kaolinitic clays (Al2Si2O5(OH)4) (Fig 28, 29) This in situ chemical disparity signifies an incomplete geopolymerization process where the reagent solution effectively dissolved the surrounding aluminosilicate source but failed to fully penetrate or react with the preserved aluminosilicates present within the micro-void.

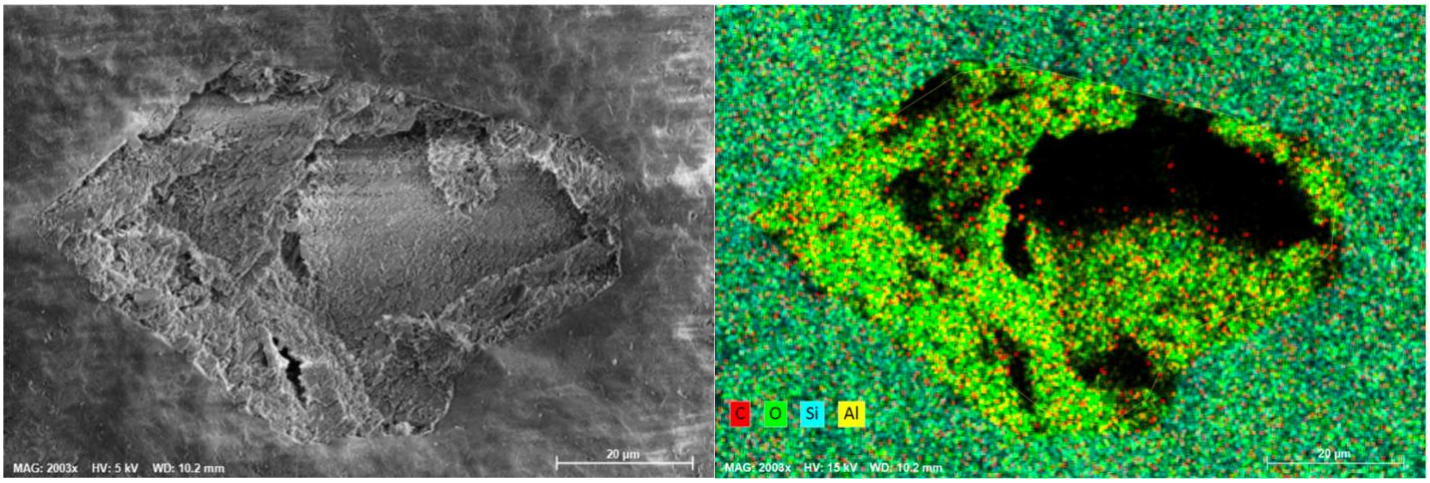


Figure 28: *Sample 1C, SEM and EDS mapping images of micro-void containing unreacted aluminosilicates.*

In the context of geopolymer science, this distinct chemical gradient between the internal matrix and the unreacted aluminosilicates present within the micro-void serves as definitive evidence of a LTGS synthesis rather than high-temperature vitrification from traditional ceramics or geological processes. (Davidovits, 2008) (Duxon et al., 2007)

The EDS elemental mapping corroborates these findings by demonstrating a high-intensity aluminum signal concentrated strictly within the unreacted micro-void location, contrasting sharply with the silicon-oxygen dominated signal of the surrounding internal matrix. (Fig 28, 30)

This elemental shift at the micro-void boundary represents the arrested reaction front, where the geopolymerization process was inhibited by localized thermodynamic or kinetic constraints. (Fig 30, 31) (Fernández-Jiménez et al., 2005) This comparative EDS compositional technique provides exact stoichiometric validation that artifact C is a product of LTGS synthesis, evidenced by the non-equilibrium state between the sample's internal geopolymer matrix and the unreacted mineral precursors present within the micro-void. (Fig 29)

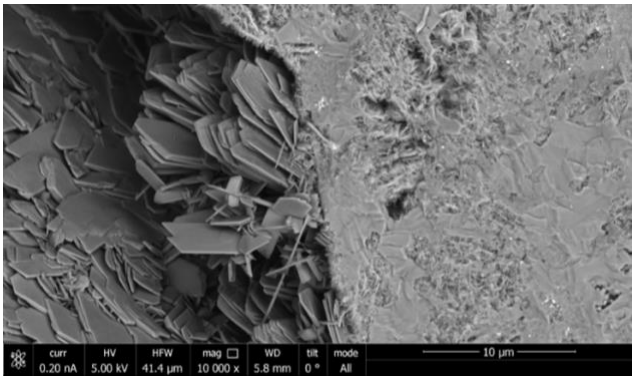


Figure 29: *Sample 1C, micro-void boundary.*

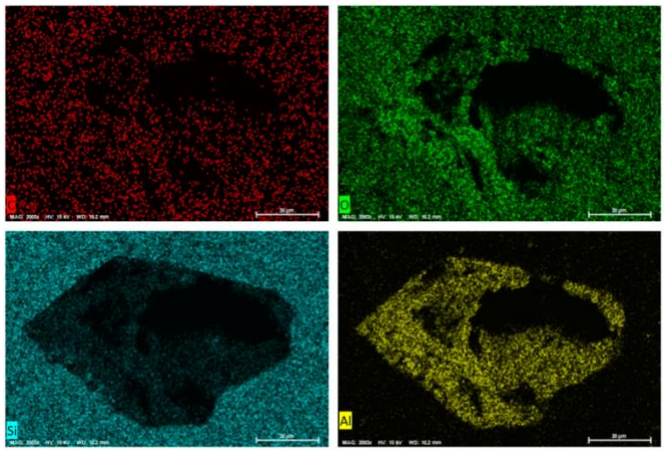


Figure 30: *Sample 1C, EDS mapping of micro-void.*

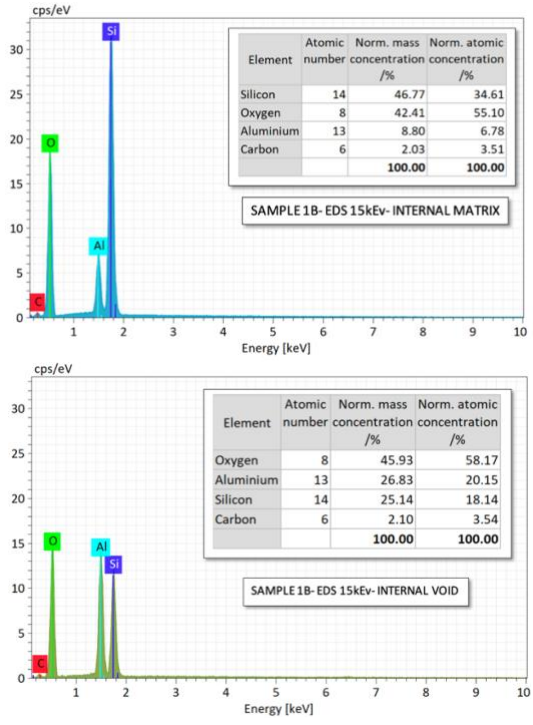


Figure 31: *Comparative EDS values in sample 1C.*

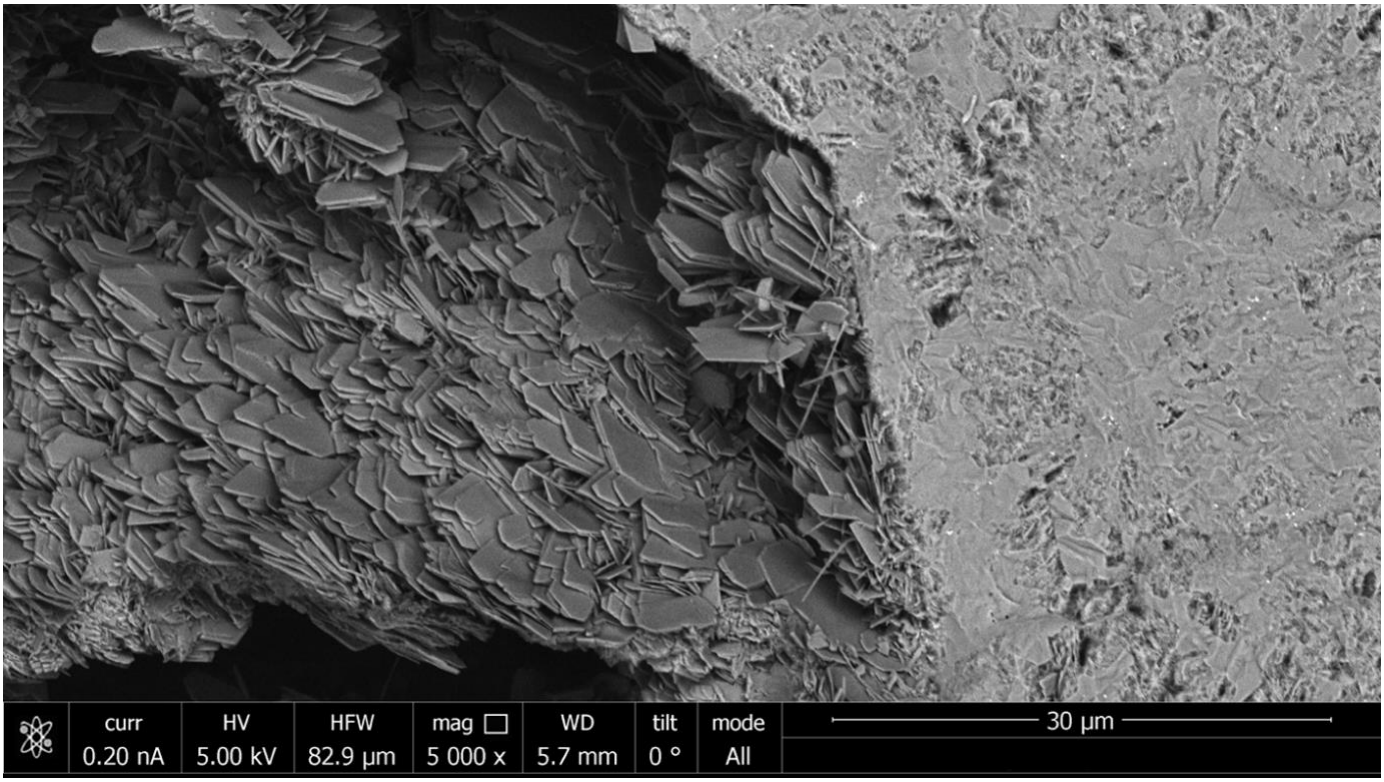


Figure 32: *SEM image of the internal void boundary featured in sample 1C, showing a transition from the geopolymeric matrix to the micro-void region of unreacted aluminosilicates, distinctly kaolinitic in morphology.*

High-resolution SEM imagery of sample 1C provides an unequivocal visual record of a geopolymerization process in situ, where the distinct interface between unreacted kaolinitic aluminosilicate precursors and an amorphous geopolymer matrix demonstrates an arrested reaction front. (Fig 29, 32)

The left half of the image reveals a dense cluster of pseudo-hexagonal platelets with a high aspect ratio, exhibiting the characteristic book-like stacking morphology of primary kaolinite ($Al_2Si_2O_5(OH)_4$). These platelets maintain sharp, angular geometries and pristine basal planes, suggesting that the localized chemical environment within the void did not achieve the thermodynamic threshold required for total mineral dissolution. (Fig 32)

In contrast, the right-hand sector transitions into a dense, glass like matrix that represents a fully reacted aluminosilicate network. This internal matrix lacks any discernible long-range crystalline order, a hallmark of the amorphous 3D framework produced by LTGS. (Davidovits, 2008) The physical envelopment of the platelet edges by the geopolymer matrix evidences the successful polycondensation of a silica-rich network that has mechanically interlocked with the remaining unreacted kaolinitic platelets. (Zhou et al., 2017)

Therefore, the correlation between the observed microscale morphologies and the previously analyzed Si/Al molar ratios provides a comprehensive characterization of sample 1C as a LTGS ceramic. (Fig 33, 34)

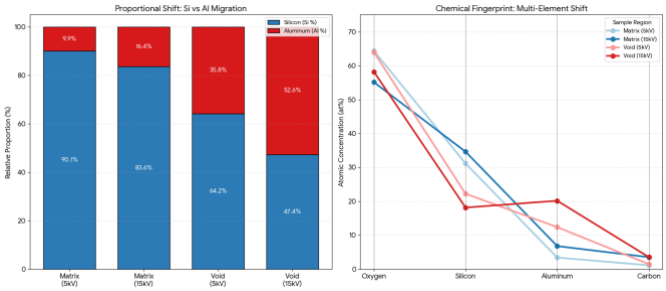


Figure 33: *Sample 1C, EDS comparative analysis.*

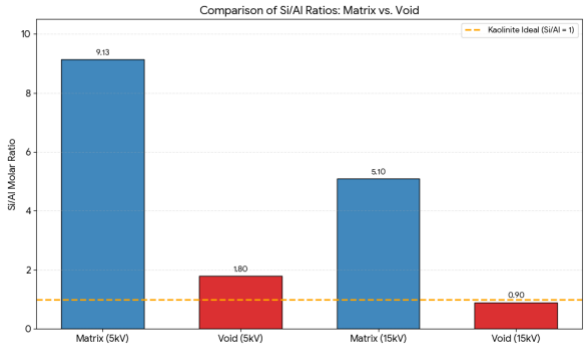


Figure 34: *Sample 1C, Molar ratio analysis.*

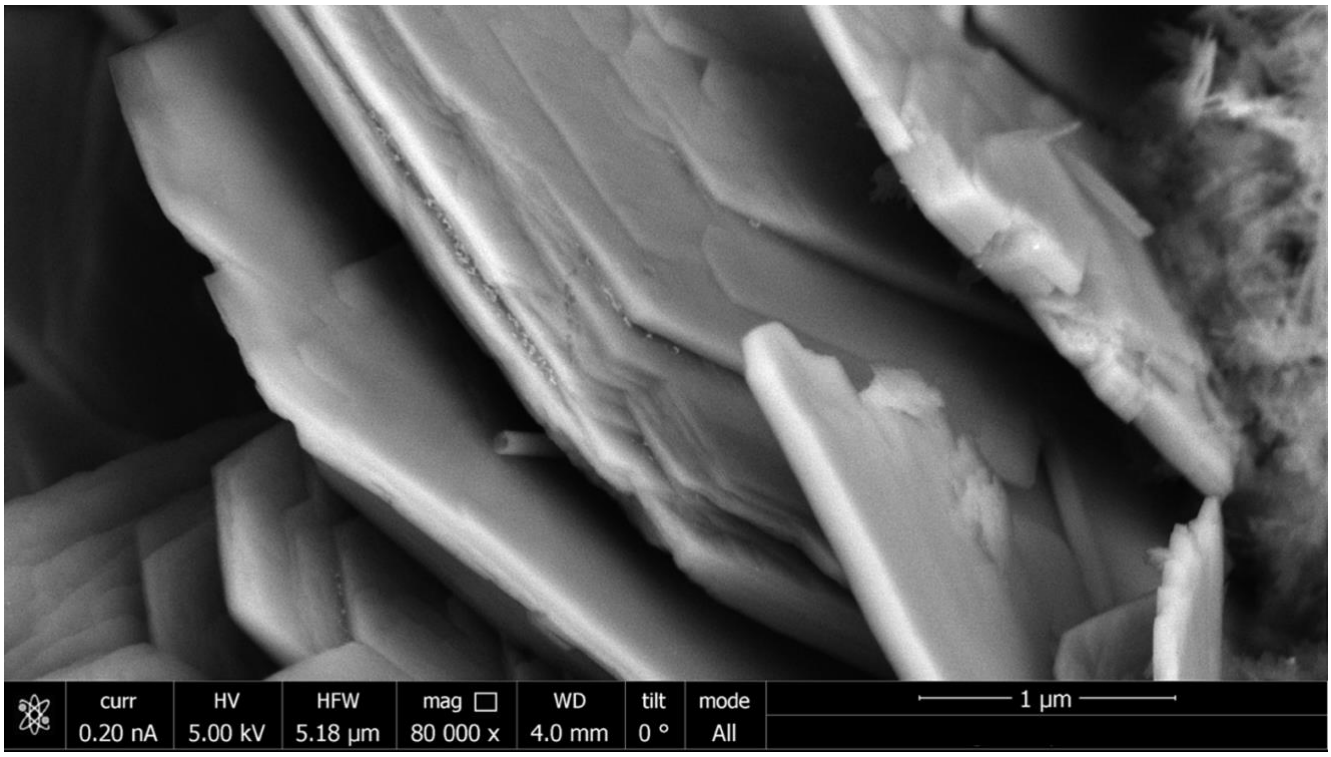


Figure 35: *SEM image of pseudo-hexagonal nano-platelets, identified as kaolinitic aluminosilicate precursors.*

The ultra-high-resolution SEM micrograph features nano-scale morphological details of the unreacted kaolinitic mineral precursors present within the internal micro-void of sample 1C. This image demonstrates the definitive morphologies of kaolinitic clays exhibited by the nanoscale crystalline layers of idiomorphic pseudo-hexagonal platelets. (Murray, 2000) (Fig 35)

These preserved, intricate lamellar structures exhibit remarkably sharp, well-defined edges and smooth basal planes, providing physical evidence that the kaolinitic mineral precursor has not undergone significant chemical dissolution. Because these kaolinitic structures are highly sensitive to both chemical dissolution and thermal dehydroxylation (>500C), their preservation within a dense, high-silica matrix serves as incontrovertible evidence of a kinetically arrested, low-temperature chemical synthesis. (Baccour et al., 2009)

The SEM micrograph of the internal geopolymer matrix reveals a complex network of acicular and reticulating nano-structures that are quintessential nanoscale morphological signatures of a highly reacted geopolymeric structure. (Lloyd et al., 2009) (Fig 36)

These linear morphologies correspond to the nascent precipitation of semi-crystalline zeolitic precursors that emerge during the polycondensation phase of geopolymerization (Davidovits, 2008). Unlike the pristine, unreacted kaolinitic platelets found in the internal micro-void, this reticulated and dendritic nanoscale morphology signifies a complete phase transformation, where the original aluminosilicate precursor has been entirely consumed and restructured into an amorphous poly (sialate) network forming a geopolymer ceramic. Consequently, the presence of these acicular proto-zeolite morphologies outside the micro-void confirms that the matrix has undergone geopolymerization and achieved structural maturity.

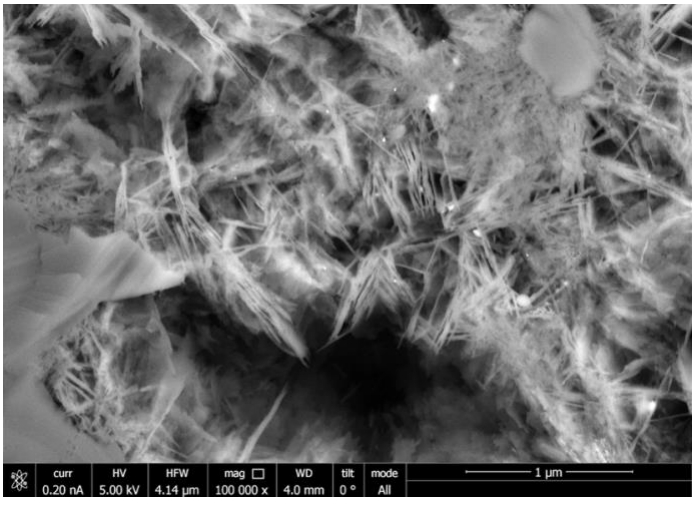


Figure 36: *SEM image of nanoscale geopolymeric morphologies present outside of the micro-void.*

Figure 37: *Artifact D, multi-component mosaic composite, front and back side.*

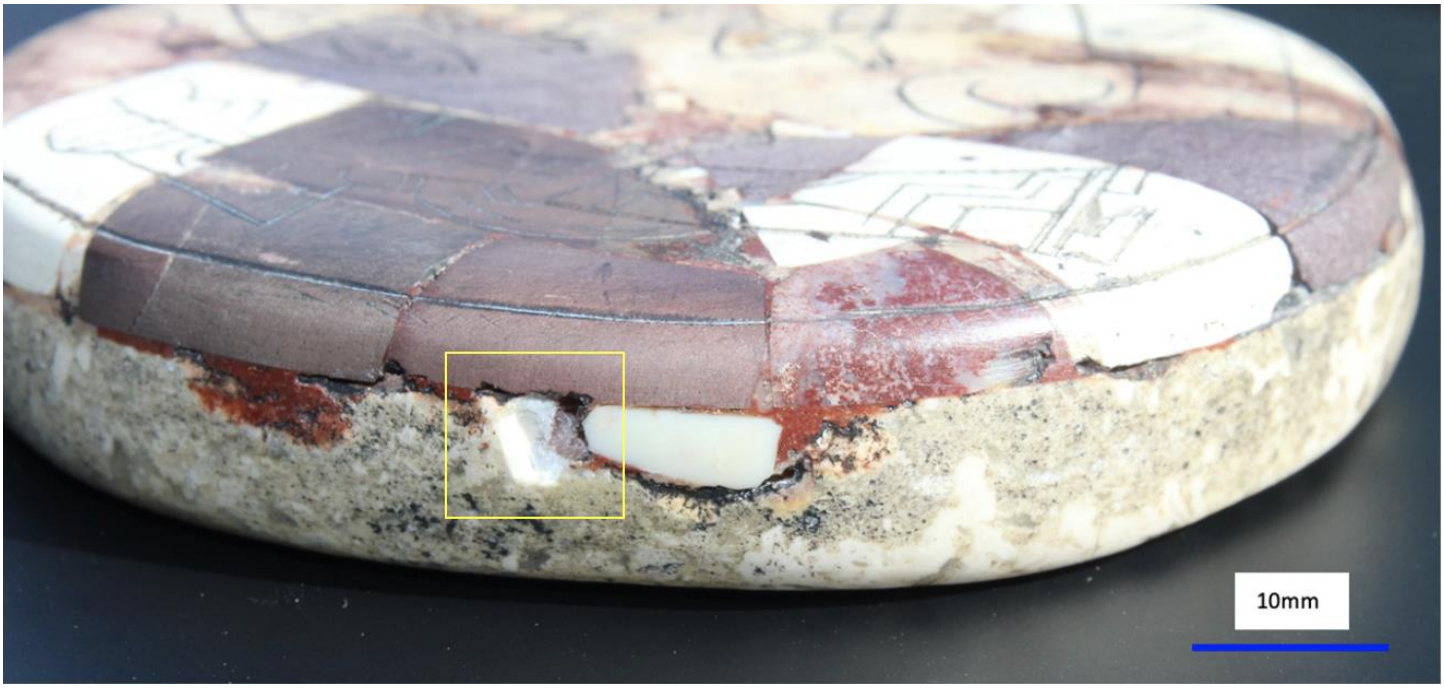


Figure 38: *Artifact D, periphery boundary of mosaic composite components, location of material sample 1D.*

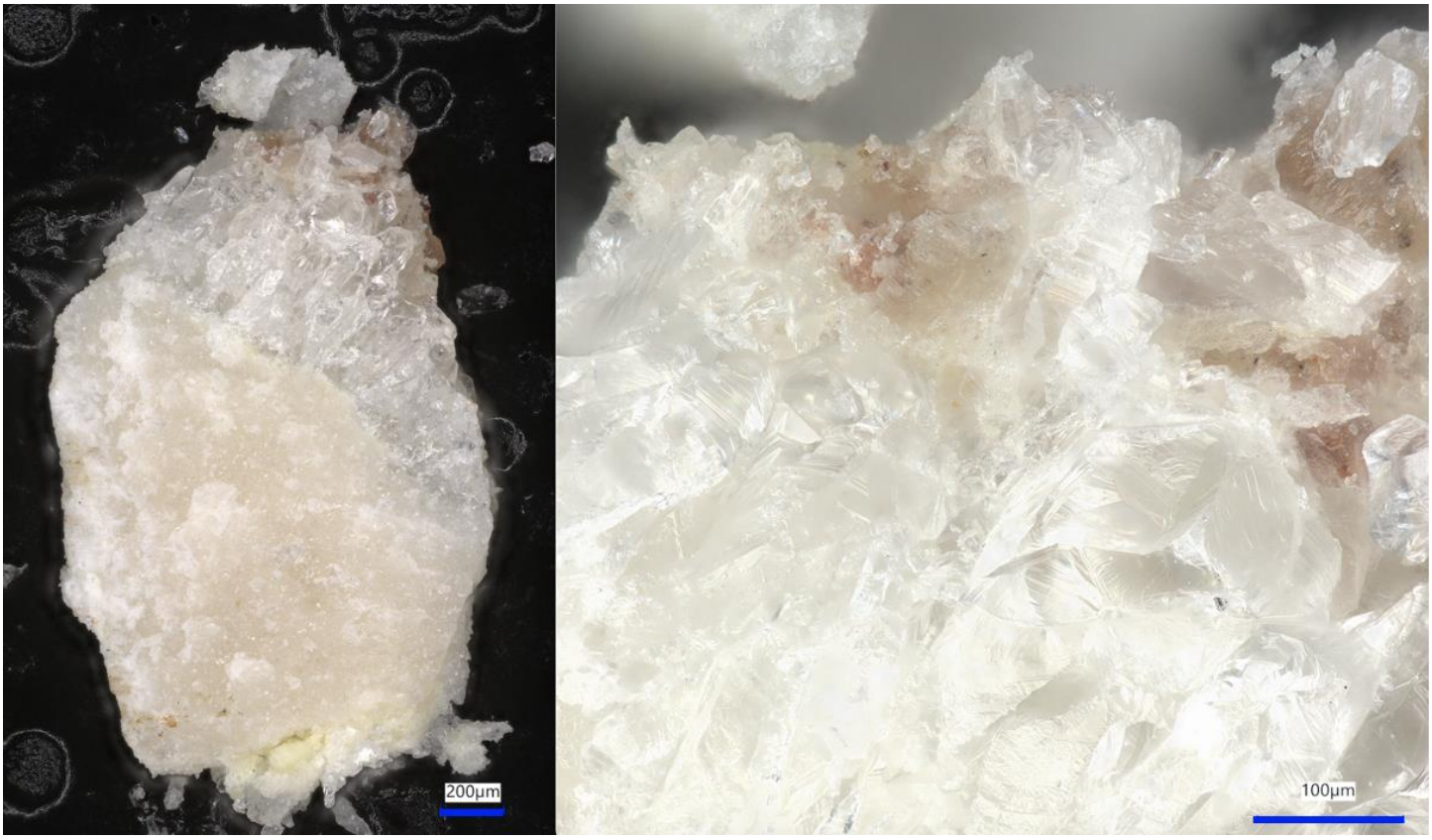


Figure 39: *Sample 1D observed under optical microscopy, exhibiting a highly siliceous compositional nature.*

Sample 1D from artifact D represents only a small fraction of the total materials present within the artifact available for compositional evaluation due to its complex mosaic form. This artifact represents a defining signature of the Aztlan collection wherein multiple material components are composed into a complex and precise mosaic design. (Fig 37, 38)

This unique style of fabrication is abundantly observed throughout the collection and represents a complex, multi-phase manufacturing operation while retaining the incredible micron-level surface engravings even across differing materials. (Fig 37) This mosaic type of artifact is not uncommon in the Aztlan collection, as many exist each being absolutely unique. Such mosaics are bound together by a red colored, resinous adhesive. This adhesive has been chemically analyzed via LC-MS, GC-MS, and C14 radiometric dating. (Fig 74)

The optical microscopy of sample 1D reveals a distinct vitreous luster and conchoidal fracturing patterns that deviate significantly from the microcrystalline or micritic textures typical of natural sedimentary limestone. (Folk, 1959) (Fig 39) These morphological features suggest the presence of a solidified amorphous network, facilitated by LTGS manufacture. The observed microstructure of sample 1D at this scale (100µm–200µm), precludes the interpretation of natural sedimentary limestone as these geologically formed materials characteristically possess biological remnants (micro-fossils) or geological structures like ooids. Sample 1D by comparison appears remarkably sterile and translucent in regard to the internal microstructure and is chemically dissimilar to natural limestone.

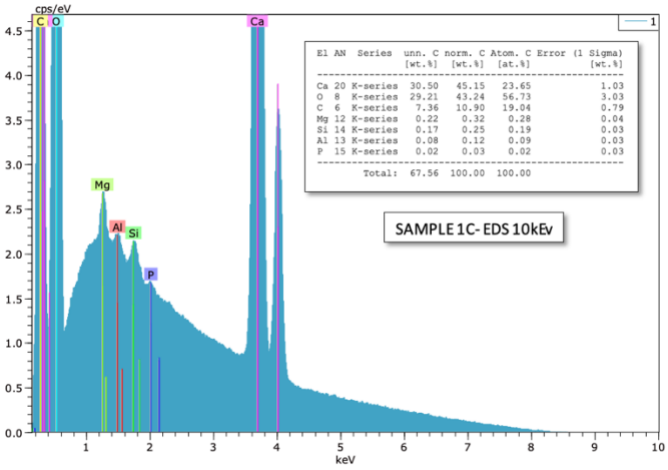


Figure 40: *Sample 1D, EDS analysis at 10kEv*

Quantitative EDS analysis indicates an elemental profile dominated by Calcium (23.65 at%), Oxygen (56.73 at%), and Carbon (19.04 at%), yielding a Ca:C molar ratio of 1.24:1. (Fig 40) This 24% stoichiometric excess of Calcium relative to Carbon is a diagnostic indicator of anthropogenic lime-based materials vs natural geologically formed calcite. Furthermore, the calculated Si:Al molar ratio of 2.11:1 aligns with the geopolymer framework of a poly(sialate-siloxo) network, supported by the standard metrics of molar ratios utilized for geopolymerization (Davidovits, 2008).

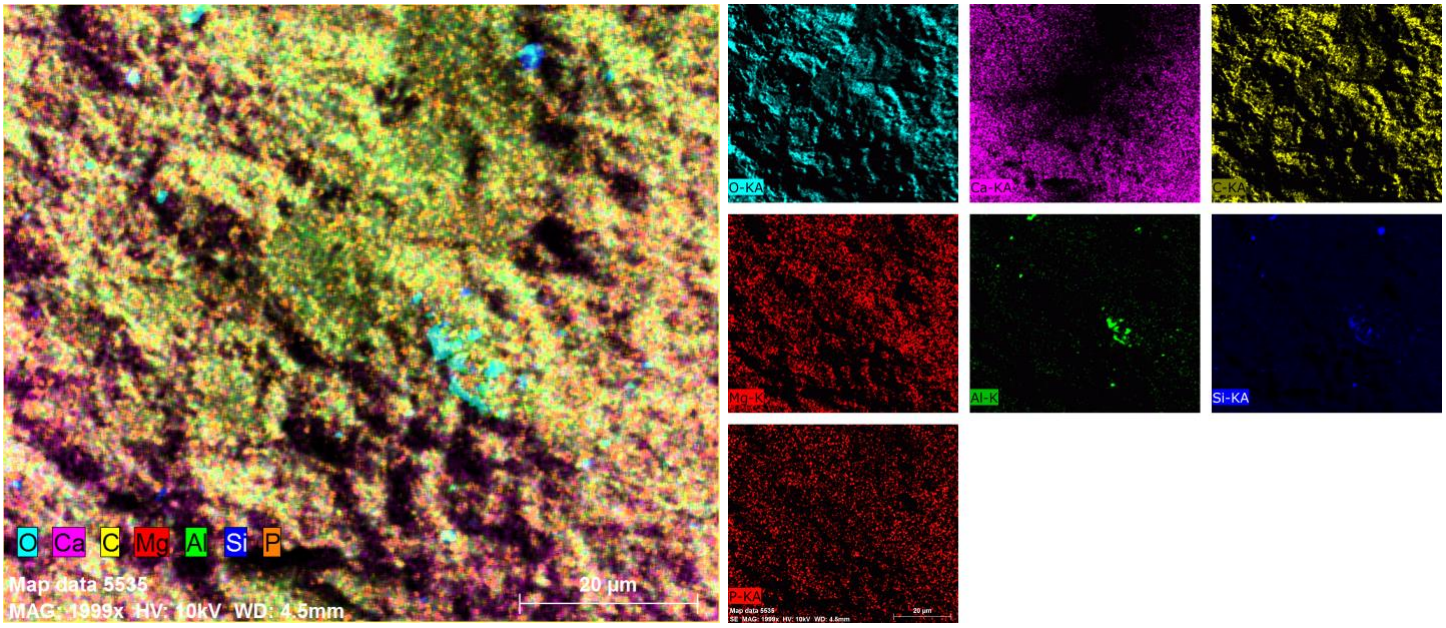


Figure 41: *Sample 1D, internal composition EDS elemental mapping.*

The EDS elemental mapping of sample 1D provides spatial confirmation of the material's chemically engineered origin, showing significant non-coincidence between Calcium and Carbon signals. (Fig 41) Evidenced by the Ca map (Magenta) vs. the C map (Yellow). The Calcium is relatively ubiquitous, yet the Carbon is selectively distributed. This compositional disparity indicates a non-equilibrium carbonation process. In an anthropogenic material made from slaked lime (Ca(OH)2), carbonation happens from the outside in as CO2 diffuses into the wet mix, occurring in ambient to low temperature curing. (Van Balen et al., 2005)

Moreover, the Blue (Si) and Green (Al) maps exhibit high spatial correlation, appearing as localized clusters rather than isolated mineral grains, which points to the deliberate addition of aluminosilicates to form a hybrid geopolymer composite material. The presence of trace Phosphorus (0.02 at%) and Magnesium (0.28 at%) dispersed within the matrix may represent the use of organic additives and mineral precursors, aligning with ancient Mesoamerican lime plaster technologies. (Bax, et al. 2019; Hansen et al., 2008).

The extreme Ca:(Si+Al) ratio of 84.4:1 indicates that while the material is primarily a carbonate matrix, its structural integrity is likely augmented by a geopolymeric network. This hybrid binder system, often termed a calcium-modified geopolymer, allows for the low-temperature setting of a material that visually and chemically mimics natural stone.

The interdiffusion of Si and Al into the surrounding Ca matrix, as seen in the 20µm scale EDS maps, further confirms a chemical setting rather than a purely mechanical compaction of natural geological sediments. (Fig 41)

Based on the convergence of vitreous morphology, unnatural Ca:C ratios, and the localized Si:Al polysialate signature, it is evident that sample 1D is an anthropogenic, chemically engineered material consistent with LTGS manufacture.

Figure 42: *Artifact D exhibits a strong, persistent phosphorescence when stimulated by UV 365 nm.*

Like many artifacts of the Aztlan collection, artifact D exhibits a pronounced green phosphorescence under 365 nm UV light stimulation. (Fig 42) In such materials, the chemical and structural environment of the geopolymer matrix can facilitate the *in-situ* synthesis of carbon quantum dots (CQDs) from diffused organic precursors, which are then physically stabilized within the tridimensional framework (Teodore et al., 2019; Xiao et al., 2025).

This material rigidification and optical capacity achieved through LTGS manufacture is critical for the observed phosphorescent conditions within artifact D; as the amorphous aluminosilicate framework restricts the non-radiative vibrational relaxation of excited triplet states, effectively enabling an internal phosphorescence that manifests as a prolonged green afterglow. (Li et al., 2018; Mintz et al., 2019)

Furthermore, the dense mineral matrix provides essential protection from quenching by atmospheric oxygen, which would otherwise deactivate the long-lived triplet states necessary for a pronounced phosphorescent afterglow (Gong et al., 2019). The mechanics of this luminescence are fundamentally governed by quantum confinement, where the physical dimensions of the carbon clusters, typically below 10 nm, constrain the excitons and dictate the bandgap energy (Teodor et al., 2020). The subsequent optical shift to a yellow emission when stimulated with 395 nm UV is a diagnostic hallmark of excitation-dependent emission, a unique property of CQDs where the emission wavelength red-shifts as the excitation energy decreases. (Lim et al., 2015) This phenomenon arises because the lower-energy 395 nm photons preferentially excite larger carbon clusters or specific surface-state energy levels within the composite matrix (Xiao et al., 2025). Thus, sample 1D functions as a hybrid nano-composite material where the geopolymeric matrix preserves and enhances the quantum-scale optical properties of the embedded CQDs.

Such complex luminescence is fundamentally atypical of natural limestone, which generally exhibits simple fluorescence or weak phosphorescence limited to specific mineral activators like Manganese (Mn^{2+}) or rare-earth elements. Unlike the calcite found in nature, the anthropogenic calcium-hybrid geopolymer material present within sample 1D can exhibit significant atomic disorder and the presence of amorphous phases that act as hosts for these CQD optical centers. Natural geological formations lack the specific poly(sialate) network microstructure and the carbonized organic nanoclusters (CQDs) necessary to produce a correlated wavelength-dependent shift observed.

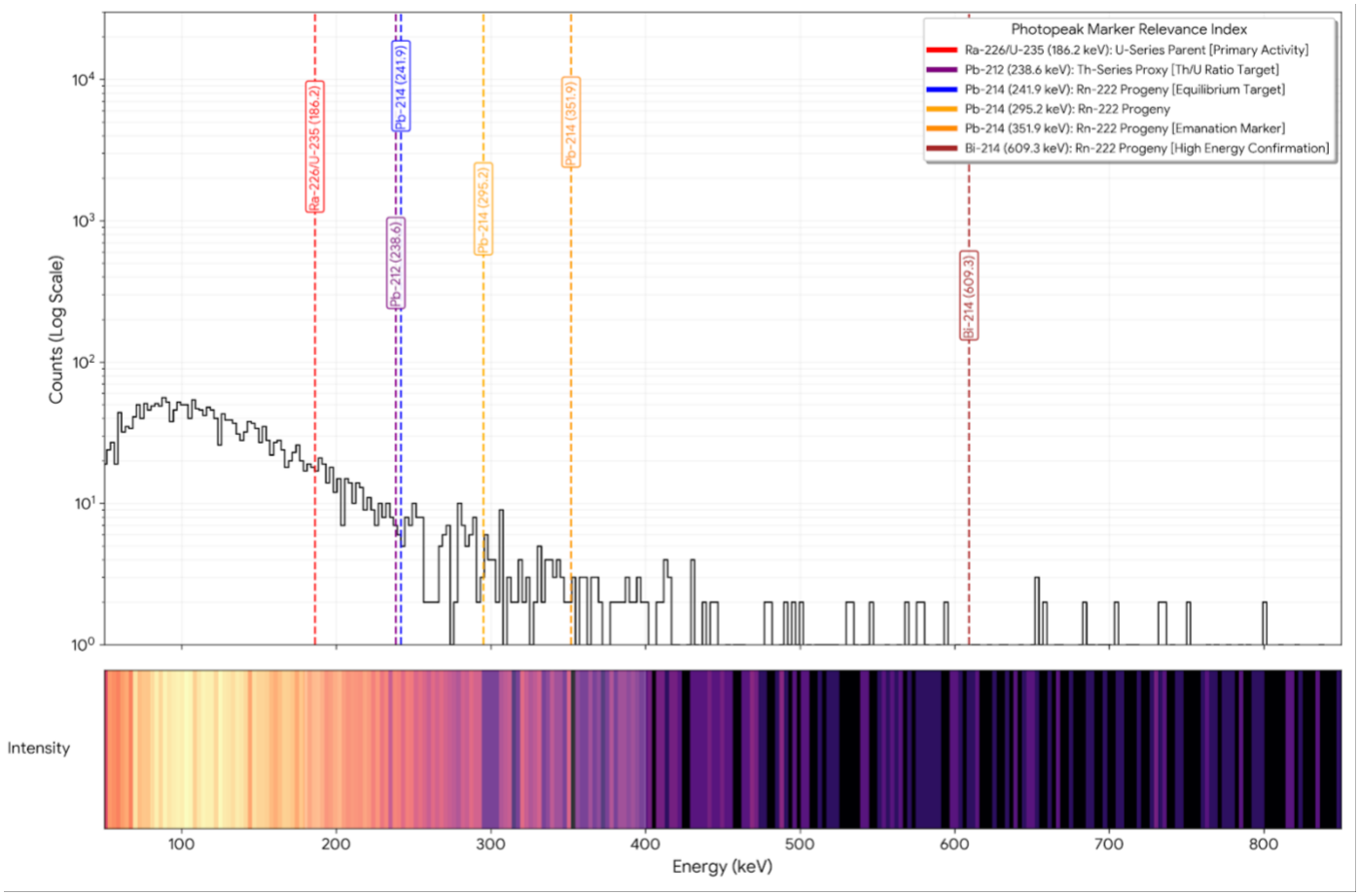


Figure 43: *Gamma spectroscopy material characterization of artifact D.*

The artifacts of the Aztlan collection are weakly radioactive. This mild radioactivity serves as a technosignature of their manufacture, explained in the context of a radionuclide concentration effect within their composition, wherein the selective mobilization of Uranium-238 radionuclides during the geopolymerization of volcanic aluminosilicates increases their relative Uranium-238 concentration within the LTGS ceramic. (Abdelouas, 2006; Kim et al., 2009; Langmuir, 1978)

The radiometric profile of artifact D, evidenced through gamma spectroscopy performed via a Radiacode 103, provides a definitive quantitative basis for identifying the material as a highly engineered anthropogenic composite rather than a natural geological specimen. (Fig 43)

Within the framework of the 238U decay series, secular equilibrium is established when the activity of short-lived progeny, such as 214Pb and 214Bi, becomes equal to the activity of the long-lived parent 226Ra. Secular equilibrium in sample 1D was assessed by comparing the activity of the long-lived parent isotope 226Ra with its short-lived progeny through high-resolution gamma spectroscopy. The primary parent activity was quantified using the 186.2 keV photopeak, which yielded a count-to-yield activity proxy of approximately 2331.19. In contrast, the progeny activities were derived from the 214Pb photopeaks at 241.9, 295.2, and 351.9 keV, resulting in a significantly lower average activity proxy of 490.94. This quantitative imbalance establishes a secular equilibrium ratio (R) of 0.2106, indicating that the progeny has achieved only 21.1% of the activity required for equilibrium. Such a low ratio demonstrates a severe state of radionuclide disequilibrium.

Such disequilibrium serves as a radiometric technosignature, proving that the material underwent a isotopic fractionation during the manufacturing process that separated mobile radionuclides from their parents. In natural, undisturbed stone, these isotopes would remain in a closed-system equilibrium (1:1).

Radon emanation is the kinetic process by which 222Rn atoms, produced via alpha decay of 226Ra, escape from the mineral lattice into the interstitial pore space through alpha-recoil and

diffusion. The radon emanation coefficient (E) calculated from the gamma spectroscopy data of artifact D, serves as a direct metric for the fraction of ^{222}Rn gas that migrates out of the solid matrix before decaying into measurable lead isotopes.

Calculated as the complement of the secular equilibrium ratio ($E=1-R$), the radon emanation coefficient for artifact D was determined to be 0.7894, or 78.94%. This finding implies that nearly four-fifths of the radon produced within the sample escapes into the surrounding environment, suggesting an exceptionally high internal surface area and interconnectivity. The calculation relies on the diagnostic contrast between the stable radium source at 186.2 keV and the depleted ^{214}Pb and ^{214}Bi daughters at 351.9 and 609.3 keV.

Ultimately, this high emanation rate is indicative of a mesoporous internal composition typical of an amorphous geopolymer composition rather than the naturally sealed crystalline matrices of primary geological formations. (Ivanovich & Harmon, 1992). This observed permeability is fundamentally inconsistent with the low emanation coefficients typically associated with natural limestone, which generally exhibit emanation values below 10%.

Consequently, these radiometric findings provide quantitative evidence of a microporous geopolymer matrix, reinforcing the hypothesis that sample 1D is a product of a low-temperature geopolymer setting rather than a primary geological formation.

To further characterize the provenance of sample 1D, the mass ratio of Thorium to Uranium was calculated using the ^{212}Pb proxy at 238.6 keV and the $^{226}Ra/^{235}U$ complex at 186.2 keV. The resulting activity ratio was transformed into a mass-based value by incorporating the specific activities of ^{232}Th and ^{238}U, yielding a final mass ratio of approximately 0.118. This value represents a significant deviation from the terrestrial crustal average, which typically ranges between 3.5and 4.0 in natural stone. (McLennan et al., 1990)

The calculation reflects a substantial enrichment of Uranium relative to Thorium, a geochemical anomaly often associated with industrial processing or the selection of specific mineral precursors. Consequently, the Th/U mass ratio provides compounding radiometric evidence that sample 1D is an anthropogenic composite with an engineered elemental profile.

Figure 44: *Artifact D, richly variegated material composition, with fine-detail anthropomorphic engravings.*

Figure 45: *Artifact E, front and back side. Anthropomorphic and zoomorphic details.*

Figure 46: *Artifact E, front side, ultra-fine detail (~30µm depth) surface engravings.*

Figure 47: *Artifact E micrograph, ultra-fine detail surface engravings with embedded efflorescence crystals.*

Artifact E provides additional evidence of unique LTGS ceramic materials present in the Aztlan collection. This artifact is characterized by a richly variegated material composition, glassy smooth surface, and ultra-fine detail 3D surface engravings. Interestingly, featuring several symbolic glyphs, anthropomorphic beings, and the presence of a UFO craft. (Fig 45, 46)

The presence of secondary mineral precipitates, occurring deep within the 30-micron deep surface engravings of artifact E provides evidence of a chemically active, geopolymeric substrate subjected to long-term geochemical maturation. (Fig 47, 48) These precipitates exhibit a distinct acicular morphology, characterized by radiating bundles of needle-like crystals measuring approximately 15 to 30 microns in length and 1 to 3 microns in diameter. This specific crystal habit is highly indicative of carbonation efflorescence, likely involving the precipitation of aragonite ($CaCO_3$). Unlike traditionally vitrified ceramics, which are chemically inert due to high-temperature phase changes, the LTGS ceramic matrix maintains a zeolitic, open-pore structure that facilitates the migration of soluble cations.

Over a period of extreme antiquity, seasonal moisture within the burial environment dissolved residual calcium and alkaline salts from the artifact's internal geopolymeric binder, transported through capillary action to the artifact's surface. Upon reaching the artifact's surface, these mineral precipitates encounter atmospheric or soil-derived CO_2.

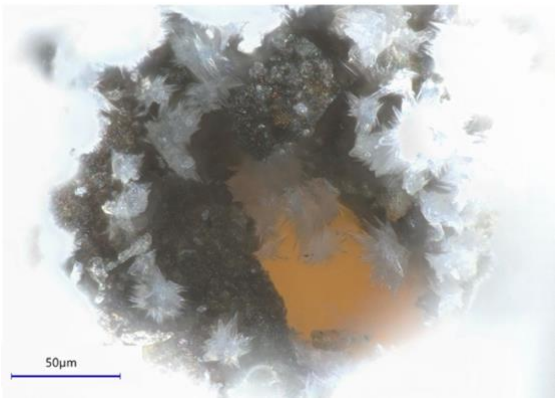


Figure 48: *Artifact E, efflorescence crystallization.*

The resulting carbonation efflorescence, occurring at the artifact's surface over large timescales allows for these abundant precipitates to form in situ. Such fine, acicular structures are physically incompatible with high-heat environments, as traditional firing would have both eliminated the necessary chemical precursors and caused significant shrinkage, distorting the ultra-fine surface features. The fact that these crystals grow directly from the internal micro-pores of the engraving confirms that the mineralization is an intrinsic byproduct of the material's internal chemistry rather than external contamination.

Furthermore, the microscopic scale of these formations, totally invisible to the naked eye, serves as a benchmark for authentic antiquity, representing centuries of gradual ionic diffusion. Consequently, these mineral precipitates act as a chemical fingerprint, definitively identifying artifact E as a sophisticated product of ancient geopolymerization.

Figure 49: *Artifact E, front side, ~30 µm engravings measured by high resolution surface texture mapping.*

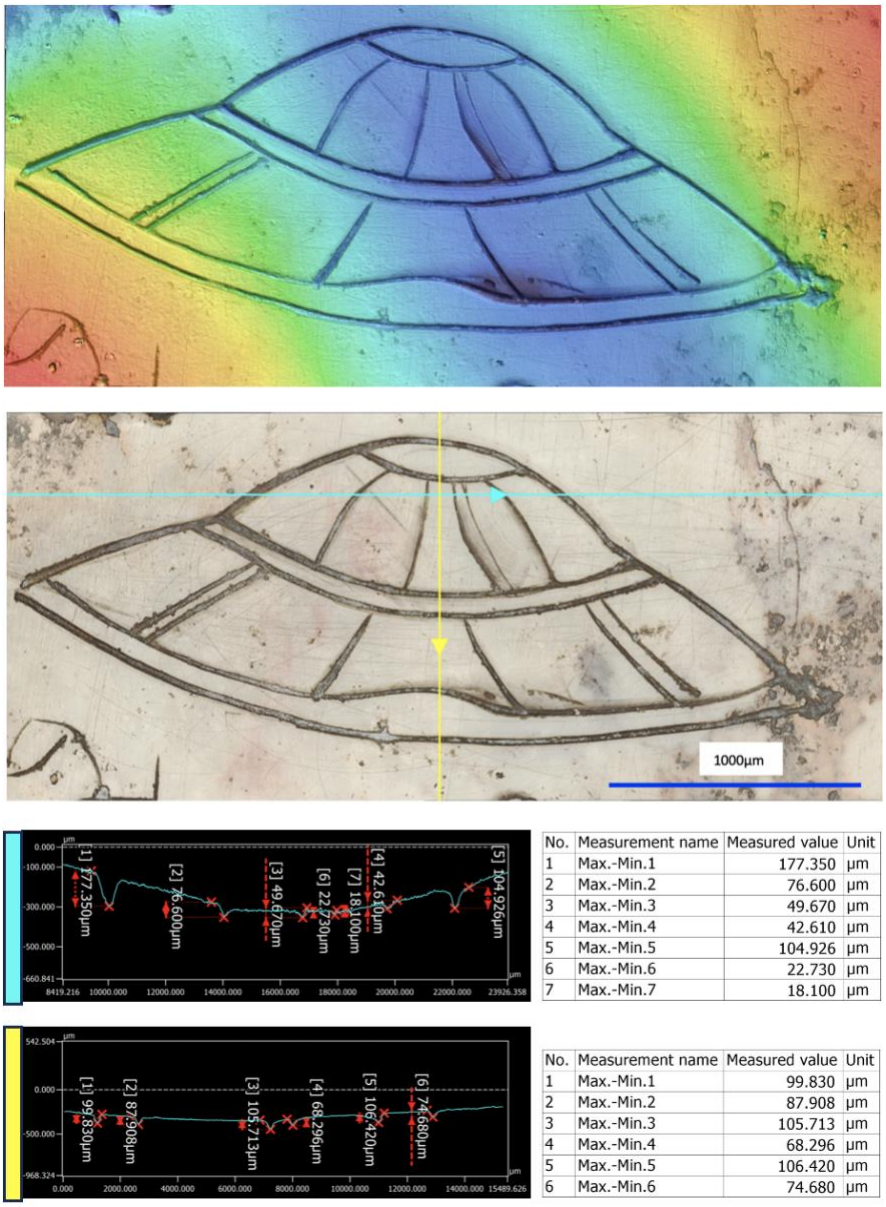
The high-resolution surface texture mapping of artifact E provides definitive physical evidence of a multi-phase manufacturing process characteristic of LTGS ceramic materials. The 3-D topographical data reveals that the symbolic engravings maintain an ultra-fine average depth of approximately 30 microns, a level of precision that exceeds the structural capacity of mechanical abrasion tooling on natural rock or traditionally fired, high-temperature ceramics. (Fig 49)

Critical to this analysis is the cross-sectional profile of the artifact's engravings, which consistently exhibits a "V" shape accompanied by distinct lateral material deposition, extending above the zero-datum surface plane. These ridges indicate a ploughing effect where the material was displaced outward rather than being mechanically extracted, a diagnostic feature of deformation within a Bingham-plastic medium. This forensic relic of the material's rheological behavior confirms that the engravings were executed while the geopolymeric material was in a soft or semi-plastic state likely occurring in the late polycondensation phase, prior to final low-temperature curing.

In this state, the aluminosilicate gel possesses a specific yield stress that allows for clean tool penetration while maintaining enough structural integrity to prevent the subsequent slumping of the fine detail surface engravings under low temperature curing. The absence of microscopic conchoidal fractures or abrasive striations within the engravings further suggests that the stylus tool parted a semi-plastic soft material rather than grinding through a solid mineral matrix.

Furthermore, the preservation of such minute detail is incompatible with high-heat vitrification, which typically induces significant volumetric shrinkage and distortion of surface microstructure at this ultra-fine scale. The fine detail structure of these engravings at the 30-micron scale supports the Davidovits model of soft mineralurgy, where chemical hardening (geopolymerization) replaces high-heat thermal fusion. (Davidovits, 1999; 2008)

Consequently, the topographical profiles act as a mechanical fingerprint of the artifact's initial geopolymeric viscosity. These findings characterize artifact E as a chemically engineered synthetic material that was engraved upon during its transition from a plastic gel to a solid LTGS ceramic. This complex surface engineering identifies the artifact as a sophisticated product of ancient geopolymerization, utilizing unique chemical rheology to achieve incredible precision engravings.



No.	Measurement name	Measured value	Unit
1	Max.-Min.1	177.350	µm
2	Max.-Min.2	76.600	µm
3	Max.-Min.3	49.670	µm
4	Max.-Min.4	42.610	µm
5	Max.-Min.5	104.926	µm
6	Max.-Min.6	22.730	µm
7	Max.-Min.7	18.100	µm

No.	Measurement name	Measured value	Unit
1	Max.-Min.1	99.830	µm
2	Max.-Min.2	87.908	µm
3	Max.-Min.3	105.713	µm
4	Max.-Min.4	68.296	µm
5	Max.-Min.5	106.420	µm
6	Max.-Min.6	74.680	µm

Figure 50: *Artifact E, UFO surface engraving.*

The high-resolution surface texture mapping of the UFO motif on artifact E provides further evidence of LTGS technosignatures, specifically in the context of a three-dimensional, sculptural relief material manipulation consistent with the polycondensation (gel) phase of a LTGS ceramic material. (Fig 50)

The topographical analysis reveals that the engraving is not merely a two-dimensional incision but a complex sculptural feature characterized by a controlled topographical gradient and intentional relief cuts to provide depth and detail to the UFO motif. These relief cuts, occurring at an ultra-fine scale, are evidenced by significant depth variations across the linear measurement paths, with peaks reaching between 105 and 106 microns planed surface junctions. The colorized topographical mapping identifies these regions as beveled gradients, where the transition from shallow edges to deep troughs creates a deliberate bas-relief effect that suggests the use of a variable-angle stylus tool engraving technique. This level of sculptural precision is mechanically improbable in natural stone or fired ceramics, where the removal of material through percussive or abrasive means would likely result in micro-fracturing marks or subsequent material deformation. Instead, the smooth, continuous engraving profiles and the lack of impact scarring indicate that the artisan engaged with a yielding, aluminosilicate gel during its critical polycondensation window.

In this semi-cured state, the material's high yield stress allowed the tool to be pressed deeper into the substrate to create shadows and structural thickness without causing the slumping or leveling of the surrounding micro-features. The variation in depth, spanning from 18 microns to over 100 microns, serves as a mechanical fingerprint of the tool's movement through a non-Newtonian fluid.

Furthermore, the preservation of such minute 3D detail confirms a low-temperature curing process, as the volumetric shrinkage associated with high-heat vitrification would have inevitably distorted the precise angularity of the relief cuts. This engineering feat suggests a sophisticated mastery of soft mineralurgy, where the physical properties of the geopolymer ceramic were manipulated to achieve a stone-like durability through subsequent low temperature final curing, finalizing the geopolymerization sequence within the material. The volumetric balance and material displacement observed in these topographical profiles provide an incontrovertible metric for plastic-phase fabrication. The ultra-fine UFO engraving characterizes artifact E as a chemically engineered composite that served as a medium for complex microscopic sculptural detail.

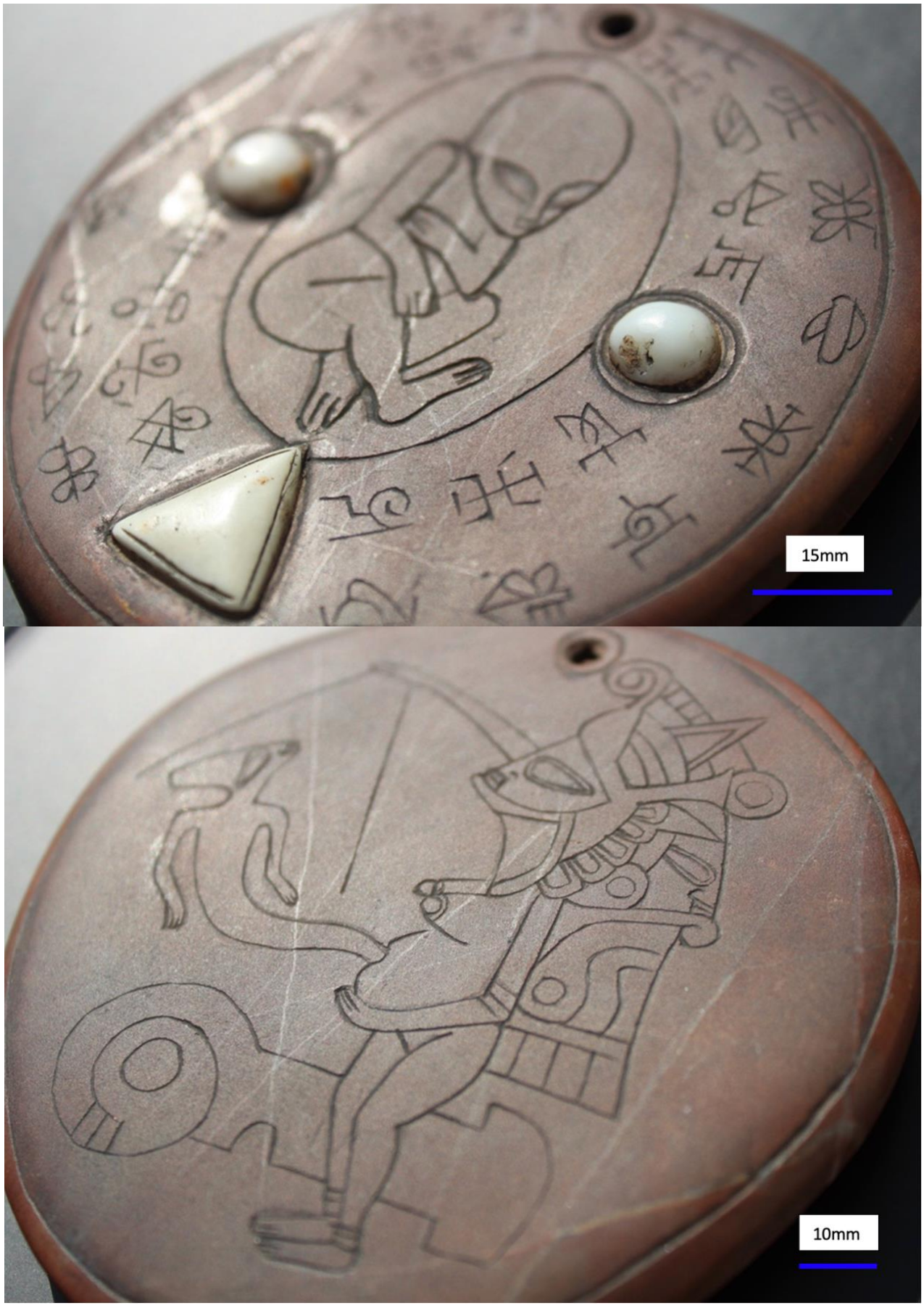


Figure 51: *Artifact F, front and back side. Ultra-fine surface engravings depicting ET hybridization.*

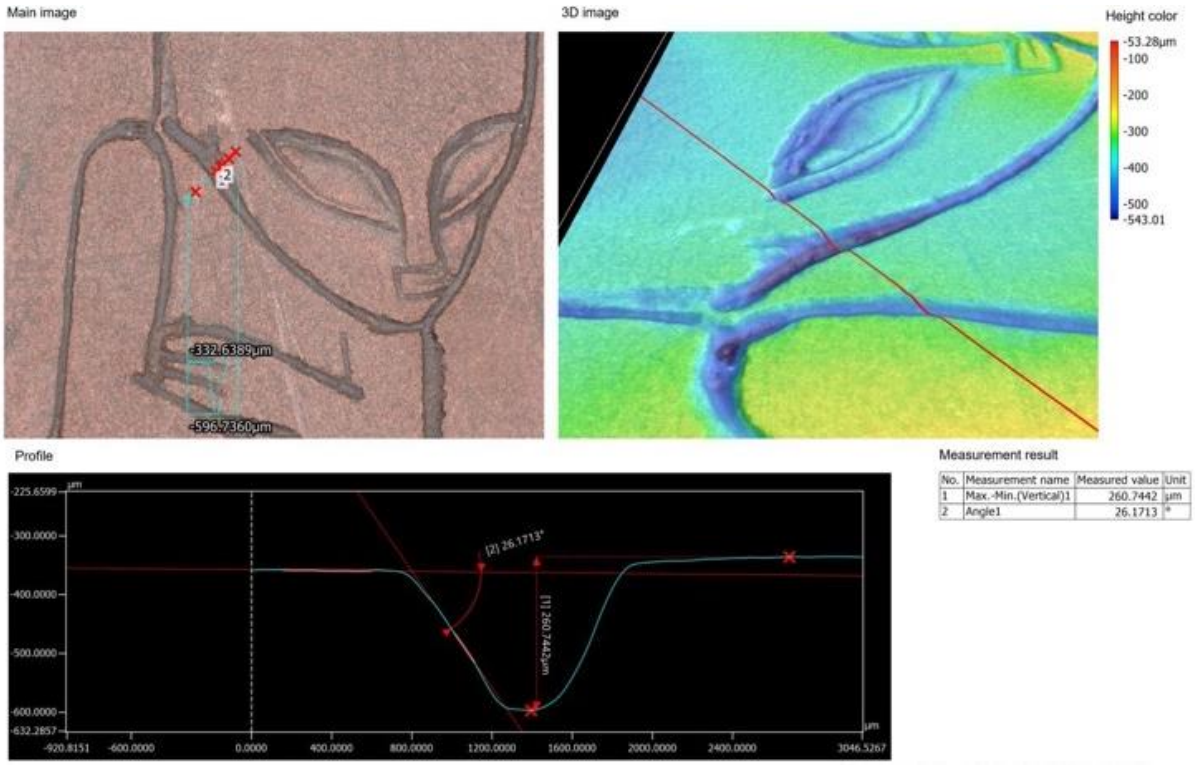


Figure 52: *Artifact F, surface engraving measured via high resolution surface texture mapping.*

Artifact F represents yet another unique LTGS ceramic material composition within the Aztlan collection. The high detail surface engravings of this artifact feature several symbolic glyphs, surrounding a small, ET being appearing in a fetus-like position. The back side of artifact E depicts a female being, extending her hand above her womb, with a connection to an ET being. This fine-detail illustration demonstrates the ET hybridization theme, abundant and definitive to the artifacts of the Aztlan collection. (Fig 51)

The high-resolution topographical analysis of artifact E provides additional evidence of controlled mechanical deformation within a Bingham-plastic medium, characteristic of the late polycondensation phase of a LTGS ceramic material. (Fig 52) High resolution surface texture mapping reveals an engraving depth of 260.74 µm, representing a tool-substrate interaction that maintains a remarkably consistent profile and sidewall angle of 26.17∘. The uniform smoothness of the engraving's sidewalls suggests that the tool parted a homogenous, viscous aluminosilicate gel as opposed to a process of mechanical abrasion into solid mineral matrix. Furthermore, this engraving's topographic profile demonstrates a distinct tool path, where displaced material has accumulated above the original surface datum. This volumetric displacement signature is a primary diagnostic for a LTGS ceramic, as the semi-cured material's surface behaves as a non-Newtonian fluid until the removal of the stylus.

The absence of microscopic conchoidal fractures or impact-induced striations within the engraving further invalidates a percussive or abrasive carving technique on a pre-existing stone surface. Instead, the stability of the 260.74 µm micro-features indicates a high yield stress inherent to the material during its polycondensation window, preventing the subsequent slumping of the engraved geometry. This precision is physically incompatible with traditional high-temperature firing, which would induce thermal stresses and volumetric shrinkage sufficient to distort such delicate micro-sculptural details. Consequently, the engraving acts as a mechanical record of the artifact's transition from a semi-plastic paste to a solid, chemically hardened poly(sialate) network.

This synthesis of depth and angular consistency identifies artifact F as a sophisticated product of ancient chemical engineering, where the rheological properties of the geopolymer were expertly exploited.

Figure 53: *Artifact G, multi-component artifact in the form of a sarcophagus featuring fine-detail engravings.*

Figure 54: *Artifact G, front and back side of the three components comprising the sarcophagus artifact.*

The structural analysis of artifact G, a three-part sarcophagus assemblage, provides a compelling case for the advanced application of LTGS technology in the production of complex cultural artifacts. The precise tolerances exhibited by the central figure as it nests within the lower sarcophagus box and lid indicate a level of fitment that is extremely unlikely to achieve through subtractive pre-industrial stone carving techniques, or modern tooling at this sub-millimeter scale which typically results in cumulative tool-offset errors. (Fig 53, 54)

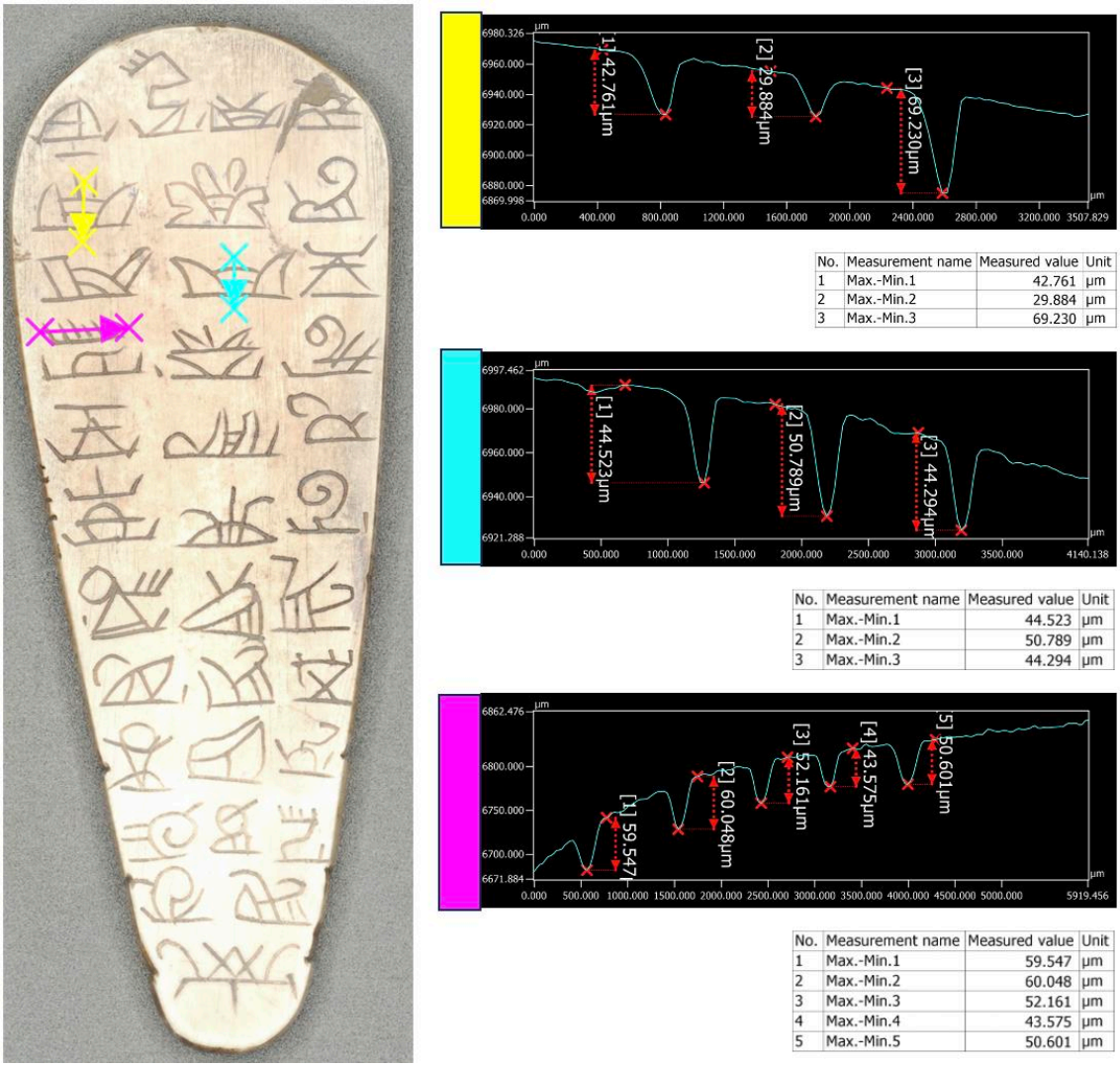
Instead, this high-precision assembly suggests a multi-phase production process where the components were formed against one another while in a semi-plastic phase, ensuring perfect dimensional complementarity. The complexity of the sarcophagus's internal geometry, featuring recessed chambers and stepped profiles, points toward a modular construction method where the central individual geopolymeric component was likely created primarily and therefore allowed for the sarcophagus enclosure to be subsequently form fitting.

The continuous pattern of mineral variegation observed across the lid and the base of the sarcophagus confirms that the components were fashioned from a single batch of geopolymeric ceramic, rather than disparate blocks of natural stone formed through percussive carving. Every facet of the three-part assemblage features ultra-fine 3D surface relief engravings that maintain a consistent micrometric depth. (Fig 53, 55)

The sharp, internal right-angles of the sarcophagus interior, combined with the lack of abrasive rounding or percussive bruising, characterize the manufacturing technique as additive or formative rather than subtractive. The material itself is fundamentally distinct from traditionally fired ceramics, as the compositional characteristics are entirely atypical of simple fired clay.

The absence of evidence in regard to thermal deformation or warping allows the tight-tolerance lid to maintain a flush seal with the base. This lack of volumetric shrinkage is a primary indicator of LTGS, where the poly(sialate) network cures at low temperatures through chemical cross-linking rather than thermal vitrification. Firing a complex, high-tolerance assemblage like the artifact G sarcophagus to 1,200◦C would result in 10%–15% volumetric shrinkage. This would inevitably warp the lid-to-box fitment and soften the 30-micron relief cuts into blurred indentations. Such profound craftsmanship, involving both three-dimensional sculptural relief and high-tolerance mechanical assembly, identifies artifact G as a masterpiece within the Aztlan collection and an astounding relic of ancient soft mineralurgy. The preservation of these features over millennia is a testament to the durability of the geopolymeric material. Ultimately, the assemblage of artifact G demonstrates a mastery of manufacture technique and precision engraving that defines the Aztlan collection.

Figure 55: *Artifact G, multi component assemblage in the form of a sarcophagus.*



No.	Measurement name	Measured value	Unit
1	Max.-Min.1	42.761	µm
2	Max.-Min.2	29.884	µm
3	Max.-Min.3	69.230	µm

No.	Measurement name	Measured value	Unit
1	Max.-Min.1	44.523	µm
2	Max.-Min.2	50.789	µm
3	Max.-Min.3	44.294	µm

No.	Measurement name	Measured value	Unit
1	Max.-Min.1	59.547	µm
2	Max.-Min.2	60.048	µm
3	Max.-Min.3	52.161	µm
4	Max.-Min.4	43.575	µm
5	Max.-Min.5	50.601	µm

Figure 56: *Artifact G, central sarcophagus component. Fine-detail surface engravings in the form of glyphs.*

The quantitative surface analysis of artifact G confirms a consistency of tooling execution that further validates the LTGS technosignatures of these ultra-fine symbolic engravings. (Fig 56) Across three distinct measurement paths, the data reveals a depth range of approximately 29.88 µm to 69.23 µm, demonstrating a level of micro-precision that necessitates specialized tooling and specific substrate rheology. To achieve such refined incisions without inducing structural failure or jagged edges, the artisan likely utilized an obsidian micro-stylus characterized by a high-aspect-ratio conical geometry and a polished, sub-100 µm tip.

The smooth, "V" shaped cross-sectional profiles observed in the datasets indicate that the material yielded through plastic flow rather than mechanical abrasion. In this state, the geopolymeric gel possesses sufficient cohesion to resist sticking to the tool, yet a low enough viscosity to be parted with minimal force. The presence of lateral material displacement at the engraving margins confirms a ploughing effect, where the volume of the stylus was accommodated by the surrounding paste without mass extraction.

Such extreme precision at the micron scale is functionally impossible on brittle, kiln-fired ceramics or natural stone, where percussive or abrasive forces would create microscopic conchoidal fractures and loss of detail. Furthermore, the stability of these depths across varying symbolic motifs suggests a controlled, uniform pressure application that exploited the consistent yield stress of the aluminosilicate network. This mechanical fingerprint identifies the engravings as an integral, semi-cured surface treatment rather than a post-hardening modification. The synthesis of these micro-topographical measurements characterizes artifact G as a product of sophisticated chemical engineering, where tool geometry and material timing were masterfully synchronized.

Figure 57: *Artifact H, demonstrating the masterfully minute craftsmanship exhibited in the Aztlan collection.*

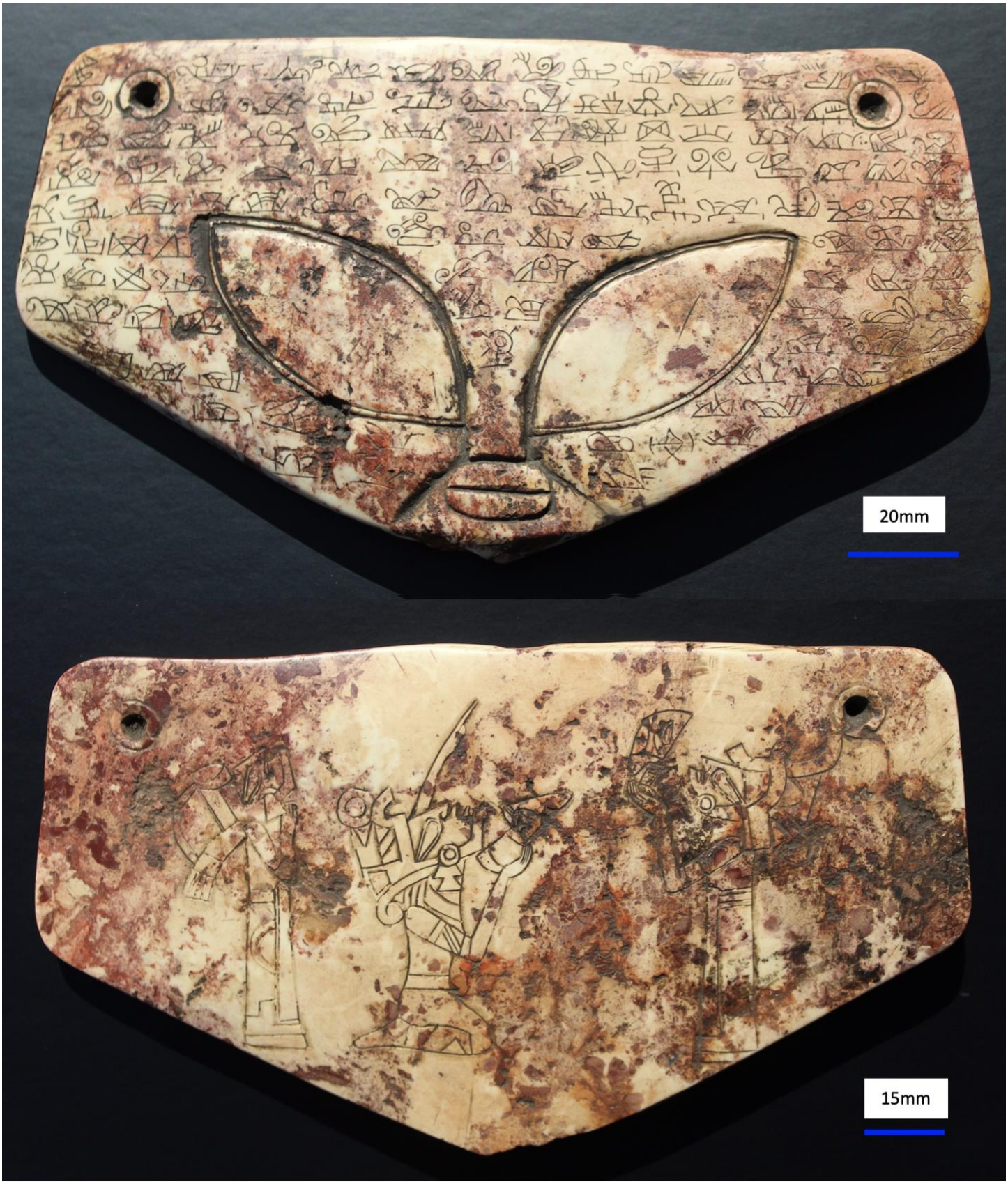


Figure 58: *Artifact I, front and back side. Fine-detail surface engravings featuring sophisticated written script as well as depictions of human figures in contact with ET hybrid offspring.*

Figure 59: *Artifact I, fine-detail surface engravings depicting the interaction of humans and ET hybrids.*

Figure 60: *Artifact J, small amulet featuring a semi-spherical metallurgical inlay.*

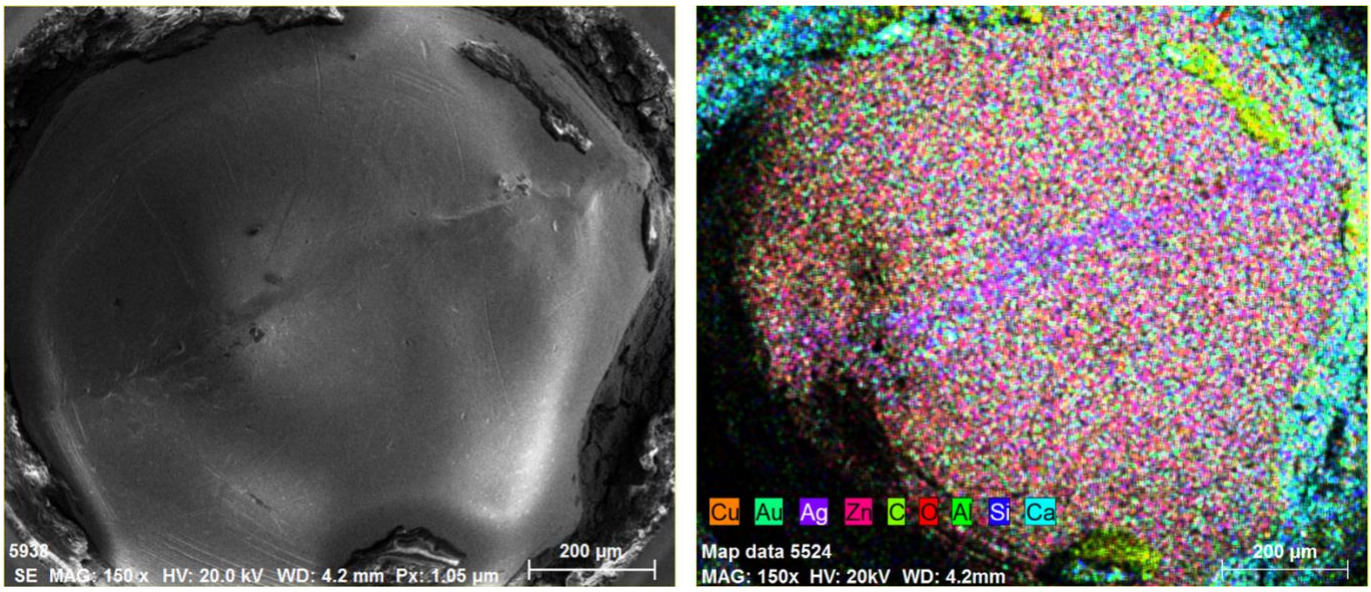
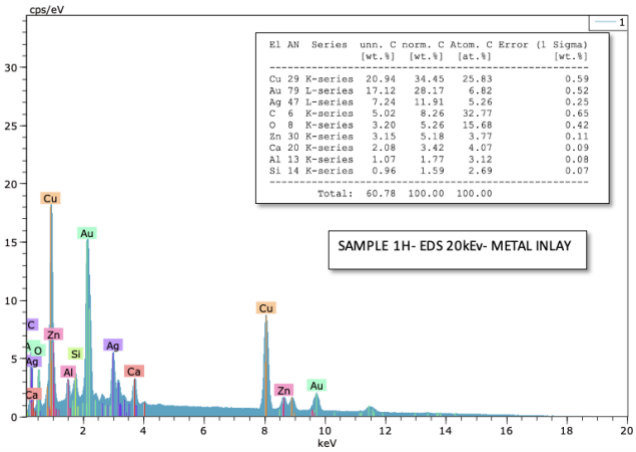


Figure 61: *Artifact J, SEM image and EDS mapping of inlayed metal alloy, sample 1J*

The EDS elemental analysis of the metal alloy inlays on artifact J reveals a signature of quaternary metallurgy that aligns precisely with the regional tradition of Tumbaga metallurgical alloy engineering. (Fig 60, 61)

The compositional analysis characterizes the alloy inlay as a primary Copper-Gold-Silver-Zinc (Cu−Au−Ag−Zn) system, where the 58.68 at% Cu to 15.31 at% Au ratio serves as a classic diagnostic for Tumbaga style metallurgical production. Historically, Mesoamerican smiths utilized the Au−Cu binary system to create synthetic gold that possessed superior mechanical hardness and a lower melting point than pure noble metals (Hosler, 1994). The inclusion of 17.19 at% Ag and 8.82 at% Zn indicates a highly evolved recipe designed to further depress the eutectic point, facilitating the casting of the small spherical alloy inlay observed in the SEM imagery. Zinc, often found in polymetallic ores of the Mexican highlands, likely acted as a deoxidizer, improving the fluidity of the melt and preventing porosity in the final inlay (Fig 62) (West, 1994).

The hemispherical ridgeline of Silver (Ag) identified in the EDS elemental mapping dataset is a profound metallurgical marker of liquation and surface segregation during the cooling phase. This phenomenon suggests that as the alloy solidified, the silver-rich phase was pushed toward the exterior boundary, a process often exploited by ancient smiths to enhance the visual luster of the object through subsequent chemical enrichment (Lechtman, 1984). (Fig 61)



El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (1 Sigma) [wt.%]
Cu	29	K-series	20.94	34.45	25.83	0.59
Au	79	L-series	17.12	28.17	6.82	0.52
Ag	47	L-series	7.24	11.91	5.26	0.25
C	6	K-series	5.02	8.26	32.77	0.65
O	8	K-series	3.20	5.26	15.68	0.42
Zn	30	K-series	3.15	5.18	3.77	0.11
Ca	20	K-series	2.08	3.42	4.07	0.09
Al	13	K-series	1.07	1.77	3.12	0.08
Si	14	K-series	0.96	1.59	2.69	0.07
Total:			60.78	100.00	100.00	

Figure 62: *Sample 1J, EDS compositional analysis*

Furthermore, the discovery of 32.77 at% Carbon in the periphery evidences the use of an organic adhesive, likely a stabilized plant resin, to bond the metal to the LTGS ceramic substrate. The presence of Calcium (Ca), Silicon (Si), and Aluminum (Al) within this adhesive zone suggests a hybrid organo-mineral mortar that ensured chemical adhesion between the metal and the ceramic. (Fig 63)

This cold-setting technique is consistent with the archaeological record of the Western Mexico and Maya regions, where multi-material assemblages were common (Hosler, 2009). The specific atomic proportions suggest a highly engineered metallurgical formulation that mimics the appearance of high-carat gold while utilizing more abundant copper reserves (Bray, 2002). This quaternary alloy formulation demonstrates a deep understanding of stoichiometry and thermodynamics, as the artisan successfully balanced four distinct elements to achieve a specific melting and aesthetic profile.

The spherical geometry of the alloy inlay, likely formed via granulation or water-casting, highlights a standardized production of decorative components (Reichel-Dolmatoff, 1988). The synthesis of the Cu–Au–Ag–Zn chemistry and the organo-mineral bonding zone characterizes these artifacts as premier examples of pre-Columbian chemical engineering. These findings solidify the collection's origin within a metallurgical tradition that valued the alchemical transformation of base metals into sacred, gold-like substances (Hosler, 1995)

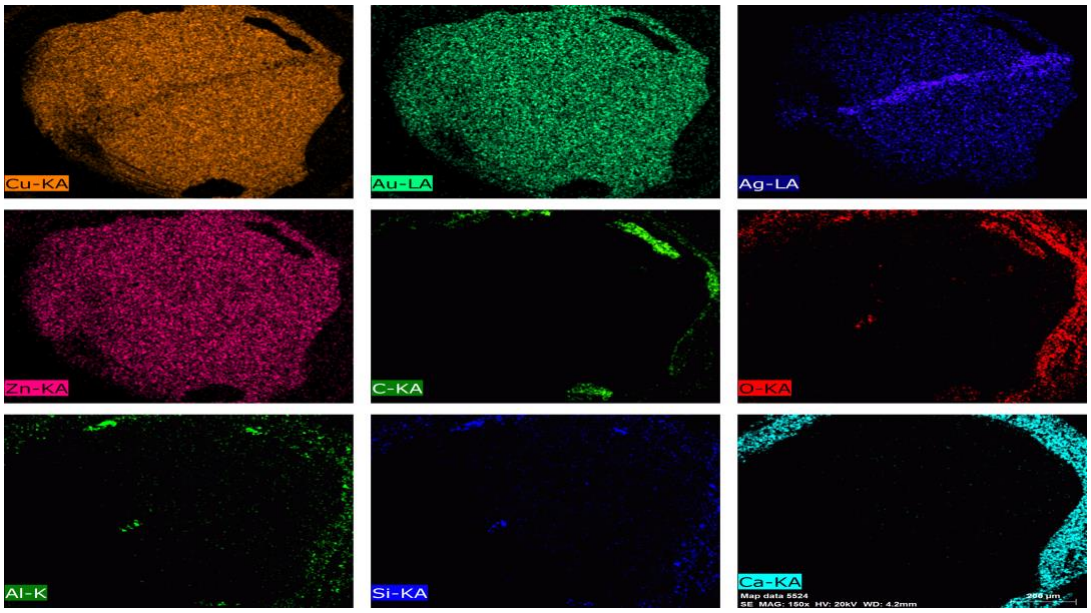


Figure 63: *Sample 1J, EDS elemental mapping of metal alloy inlay and surrounding adhesive material.*

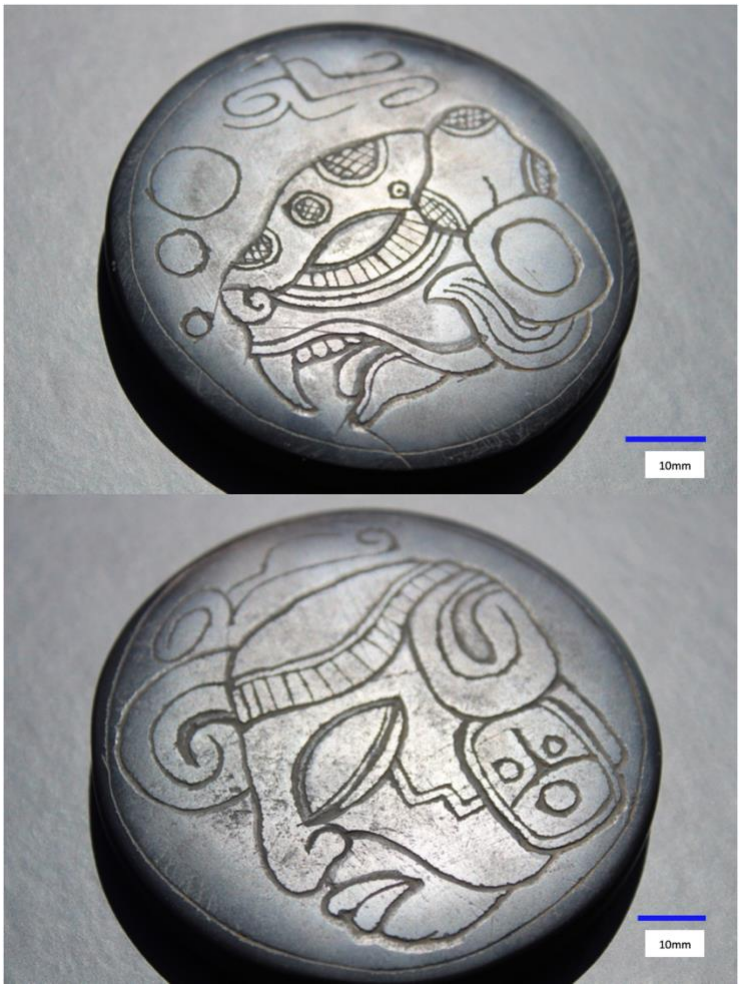


Figure 64: *Artifact K, front and back side.*

Artifact K represents a specific type of LTGS ceramic material found abundantly within the classifications of the Aztlan collection. This type of material is characterized by its deep, jet-black surface color. Many hundreds of artifacts within the Aztlan collection exhibit this deep black color upon their surface, with examples of certain artifacts possessing color gradients from absolute black, fading into brown and beige as the surface enamel degrades. (Fig 64)

Interestingly, artifact K exhibits this characteristic deep black surface color, similar to the deep black color found in the Bucchero Nero ceramics of the Etruscan civilization. Research conducted by the Geopolymer Institute concludes that the process of manufacturing the Bucchero Nero ceramics can be achieved at low temperatures through chemically engineered techniques. (Davidovits et al., 1999)

The production of Bucchero Nero via Low Temperature Geopolymeric Setting represents a sophisticated chemical engineering process in antiquity where the transition from natural clay to a rock-hard ceramic occurs through low temperature geopolymerization rather than high-temperature sintering.

In this process, the engineered addition of an alkali, triggers the dissolvement of the aluminosilicate layers within the clay. This dissolvement facilitates the formation of a three-dimensional poly(sialate) network, which provides the ceramic its structural integrity at temperatures significantly below the traditional vitrification point. According to the research by Joseph Davidovits, the distinctive black coloration is achieved through the thermal migration of organo-mineral complexes toward the surface of the artifact. These complexes, which are inherently present in certain ferruginous or carbon-rich clays, undergo a specialized carbonization process that is optimized at approximately 450C to 550C.

Artifact K exhibits a lustrous, deep-black finish and a dense surface texture that aligns closely with the material characteristics of LTGS-produced Bucchero Nero ceramics.

The uniformity of the black hue across the disc-shaped geometry suggests a controlled reduction environment coupled with the controlled internal migration of carbonaceous matter within the geopolymer ceramic during optimized curing temperatures.

Because the firing temperature of the Etruscan ceramics remains under the 500C threshold, the material retains a unique zeolitic chemical signature, characterized by the presence of chemically bound water within the molecular pores. This zeolitic structure acts as a stabilizing matrix for the black organo-mineral phases, preventing their total oxidation which would typically occur in high-temperature kilns.

This alignment supports the hypothesis that the deep black artifacts of the Aztlan collection did not undergo traditional high temperature sintering, which would have likely altered the iron oxides to a reddish-brown hematite. Instead, the more likely LTGS process preserved the reduced, carbon-rich state of the mineral matrix, resulting in the stone-like and waterproof nature of the artifact. Therefore, artifact K serves as a testament to the efficacy of ancient chemical engineering in creating high-performance ceramics at remarkably low thermal energy levels.

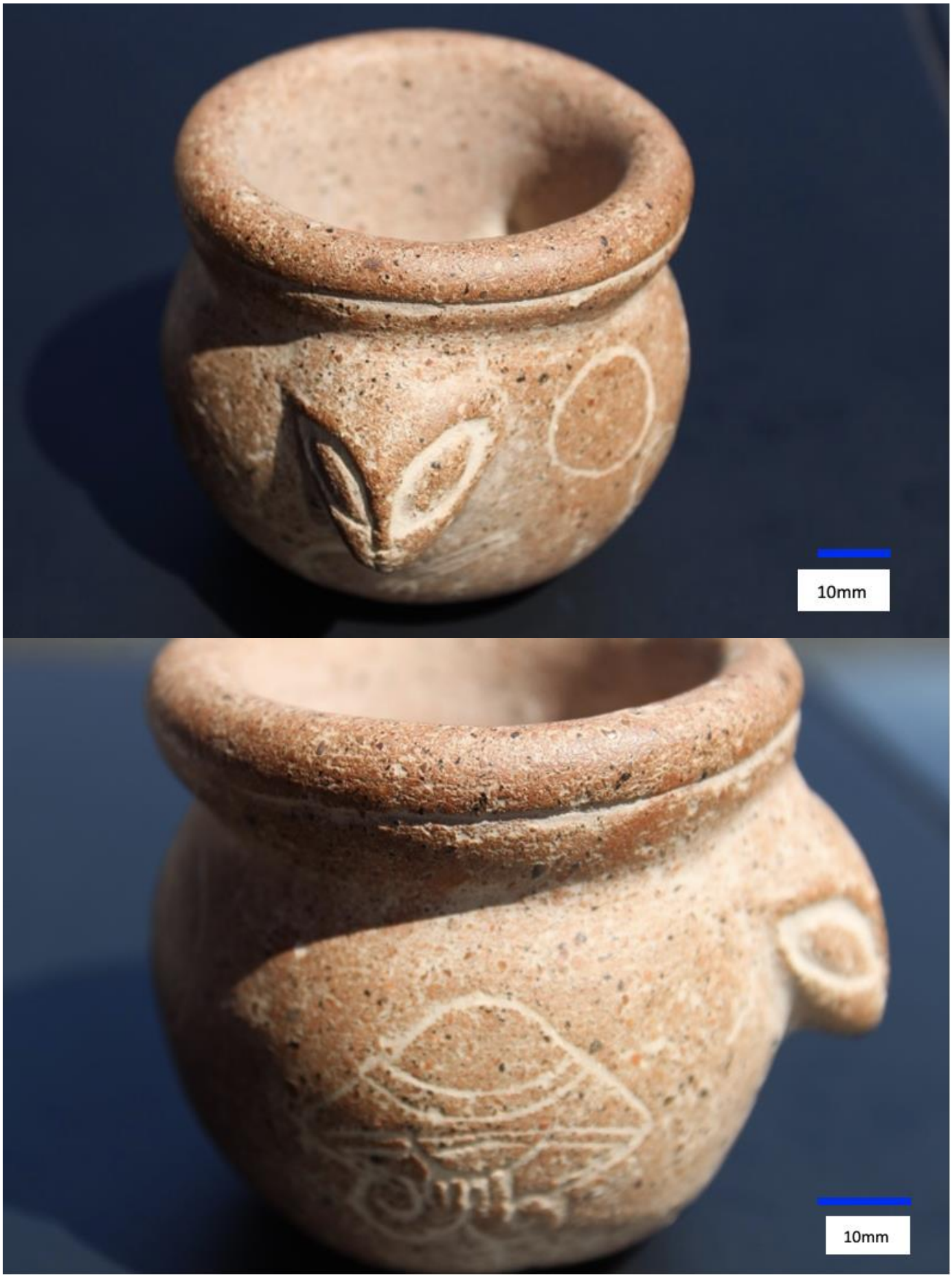


Figure 65: *Artifact L, small bowl vessel featuring a uniquely heterogenous material composition.*

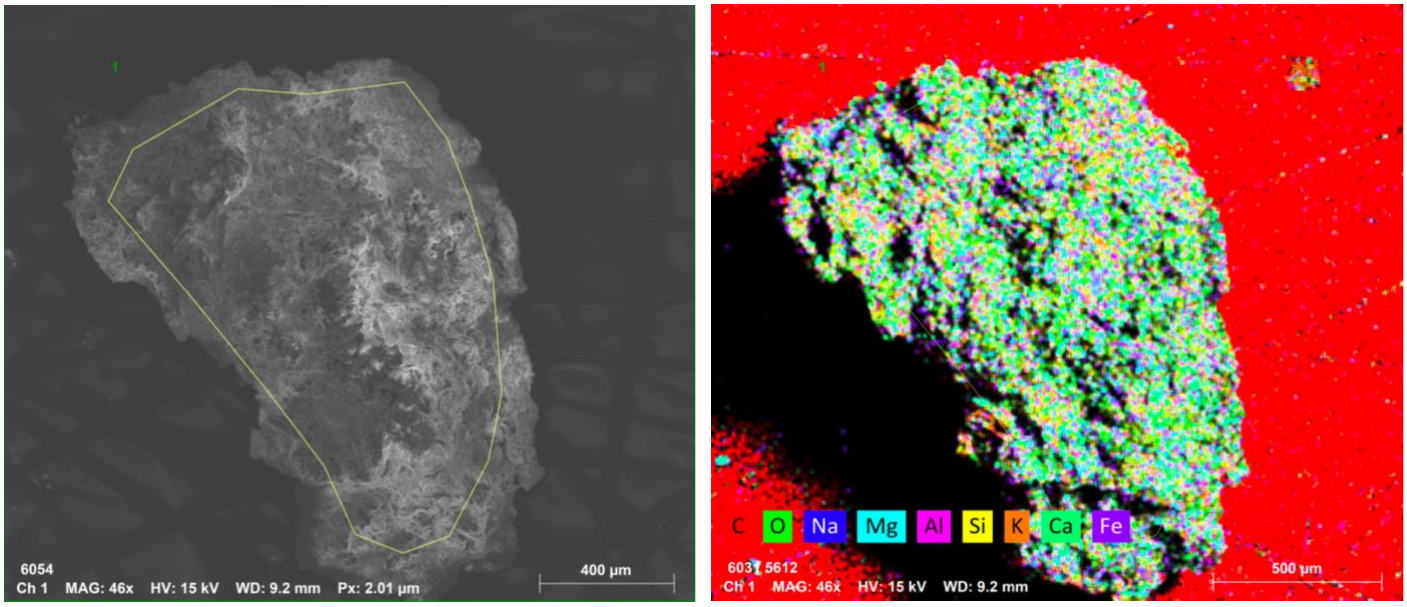


Figure 66: *Sample 1L, SEM image and EDS elemental mapping of internal composition.*

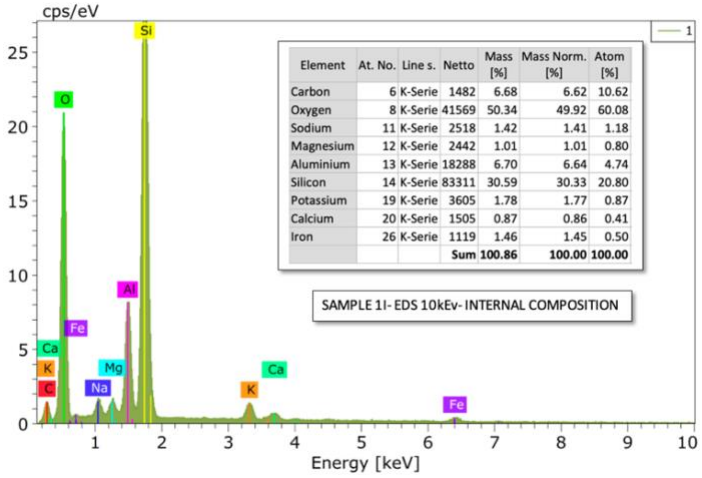


Figure 67: *Sample 1L, EDS internal composition.*

The characterization of the artifact L as a product LTGS technology is supported by a multi-modal analysis of its physical, spectral, and elemental properties. (Fig 65, 66, 67)

Visually, the artifact exhibits a heterogeneous macro-structure featuring atypical, large mineral grain sizes embedded within a fine-grained matrix, a morphology that contradicts traditional high-temperature ceramic processing where such inclusions would typically induce catastrophic thermal failure.

This physical evidence is corroborated by EDS data, which yields a Silicon to Aluminum (Si/Al) molar ratio of approximately 4.39. While a pure geopolymeric binder typically exhibits a ratio between 2.0 and 3.0, this elevated value indicates a composite material where an aluminosilicate binder is heavily reinforced by inert quartz (SiO_2) aggregates. The detection of an abnormally high carbon content of 10.62 at% is highly diagnostic, as organic carbon is typically oxidized and expelled in traditional kilns; its preservation here points toward a low-temperature firing threshold, likely below 250C.

The presence of significant alkali content, specifically Sodium and Potassium (Na+K), serves as evidence of the chemical reagent required to dissolve aluminosilicates and initiate the geopolymerization process. Furthermore, the calculated molar ratio of $(Ca+Mg+Na+K)/Al \approx 0.69$ highlights a sophisticated charge-balancing and structural reinforcement mechanism. In this geopolymeric arrangement, divalent cations such as Calcium (Ca) and Magnesium (Mg) act as critical molecular bridges, cross-linking the poly(sialate) chains to provide mechanical strength and water resistance without the need for high-temperature vitrification.

EDS mapping further validates this soft mineralurgy evidence by showing a distinct heterogeneous phase distribution where Aluminum and Alkalis are concentrated in the matrix surrounding sharp-edged Silicon islands. These sharp elemental boundaries indicate a lack of inter-diffusion and glass-phase formation, demonstrating the vessel never reached the temperatures required for traditional ceramic fusion. The significant spatial overlap of Silicon, Aluminum, and Oxygen within the binder regions confirms the formation of a complex aluminosilicate network rather than

simple dehydrated clay. (Fig 68) The reddish-brown coloration of the vessel suggests that this chemical synthesis occurred in an open-air, oxidizing environment, allowing iron within the matrix to oxidize while the geopolymeric bonds stabilized the structure. Artifact L serves as another unique example of the versatile capacity of LTGS technology to produce durable, stone-like vessels under varying environmental conditions and chemical formulations. Ultimately, the integration of the Si/Al molar ratio, high carbon retention, specific cation-to-aluminum ratios, and segregated elemental mapping provides an incontrovertible chemical fingerprint of ancient geopolymerization within artifact L.

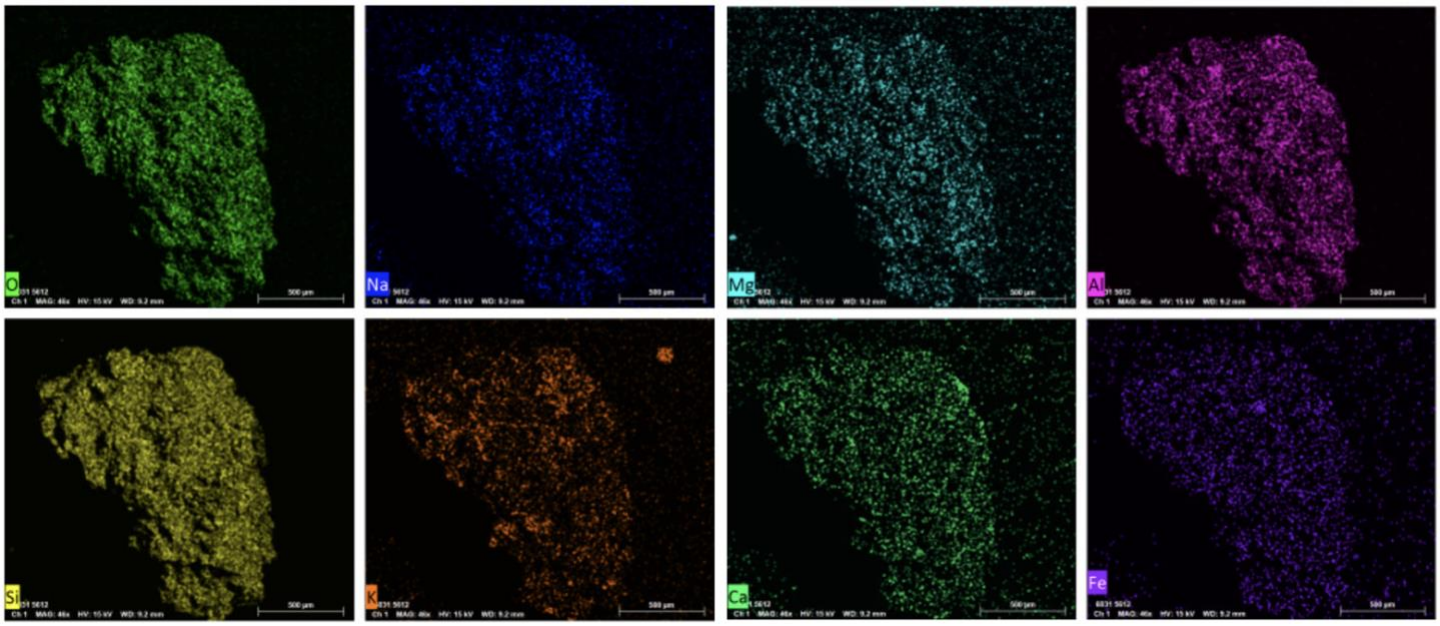


Figure 68: *Sample 1L, EDS elemental mapping of internal composition.*

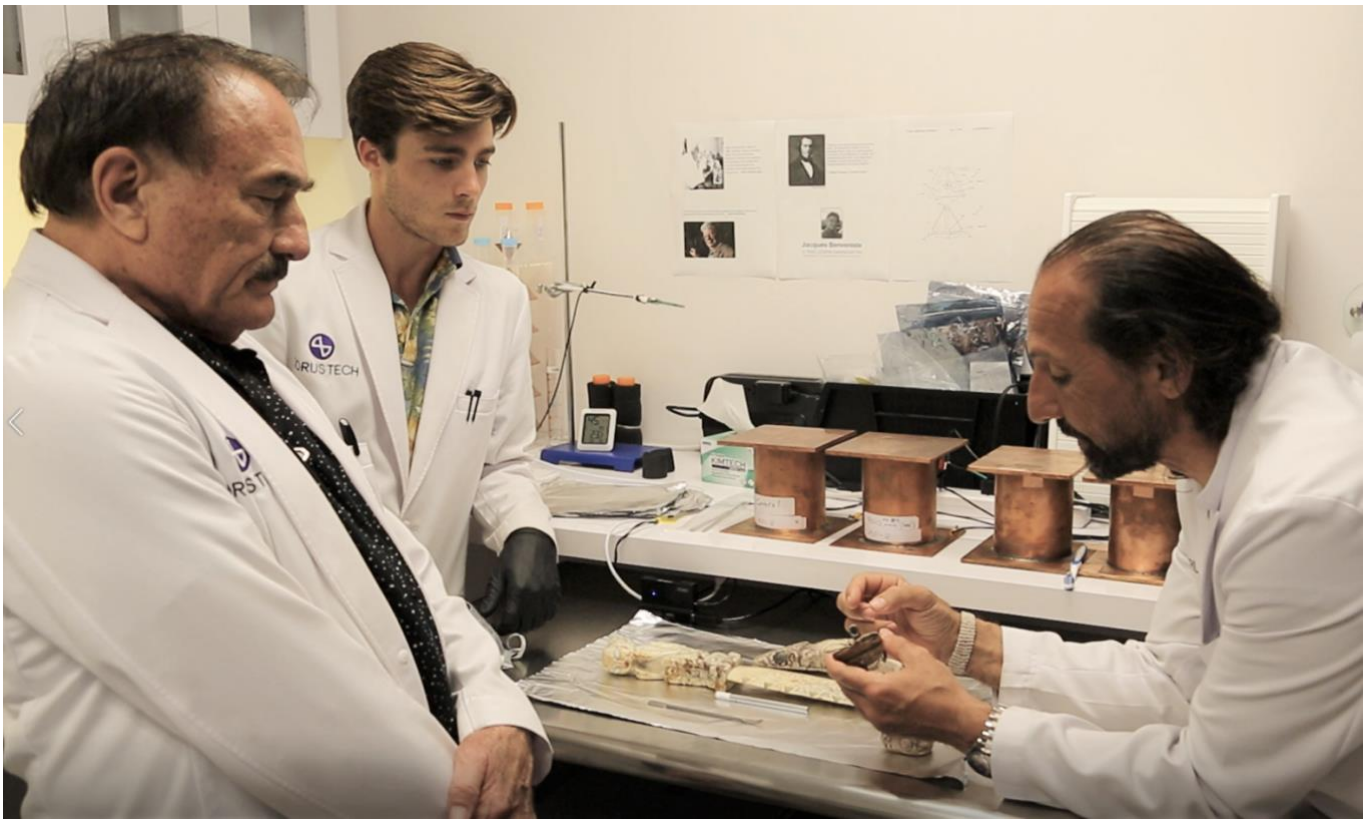


Figure 69: *Preliminary laboratory research of a select group of artifacts of the Aztlan collection.*

During preliminary investigations of the Aztlan artifact collection in 2019, laboratory research was conducted on a select group of four artifacts, each selected due to their possession of a distinct resinous adhesive bonding agent. To establish a chronological and chemical profile of these adhesive materials, the resinous adhesives were sampled under stringent sterile laboratory conditions to prevent modern contaminant interference. (Fig 69)

Chemical characterization was executed via Liquid Chromatography-Mass Spectrometry (LC-MS) and Gas Chromatography-Mass Spectrometry (GC-MS), techniques utilized to isolate and identify the specific molecular markers of the organic binder. The mass spectrometric data identified the substance as a tree-sap-derived exudate, aligning with historically established ethno-botanical practices involving the extraction and processing of resins known in early Mesoamerican cultural horizons. The preservation of these resinous adhesives is particularly significant, as it further suggests the artifacts were not subjected to extreme high-temperature firing protocols that would have otherwise volatilized or degraded the complex hydrocarbon chains of the adhesive resin.

Parallel to the chemical analysis, the chronological framework of the artifacts was determined through Accelerator Mass Spectrometry (AMS) C14 radiometric dating of the adhesive samples. The resulting chronometric data provide a preliminary baseline for the date of manufacture for these artifacts, yielding an average calculated date of approximately 8,570 years Before Present (BP). These findings suggest a profound antiquity for the Aztlan collection and indicate a highly developed understanding of organic chemistry and material science engineering during the Early Holocene.

The convergence of the LC-MS and GC-MS data with the AMS C14 results provides a preliminary, multi-proxy validation of the artifact's antiquity, placing the Aztlan collection within a crucial transitional period of the Early Holocene. Such a high degree of resin preservation across nearly nine millennia implies that the mortar-like adhesive material of the Aztlan artifacts may have included significant aluminosilicate additives, sequestering the organic material within the resinous adhesive from oxidative and microbial degradation. (Fig 72, 74)

Figure 70: *Artifact M, identified as sample MA-0010. Adhesive sample extracted from underneath the inlay.*

Figure 71: *Artifact N, identified as MA-0014. Adhesive sample extracted at the junction of blade and handle.*

The University of Georgia

Center for Applied Isotope Studies

RADIOCARBON ANALYSIS REPORT

March 19, 2019

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San Clemente, CA 92673

Dear Mr. Millar

Enclosed please find the results of ^{14}C Radiocarbon AMS analyses and Stable Isotope Ratio $\delta^{13}C$ analyses for the samples received by our laboratory on March 11, 2019.

UGAMS#	Sample ID	Material	$\delta^{13}C$,‰	$\delta^{15}N$,‰	^{14}C age, years BP	±	pMC	±
40917	MA-0010	organics	-25.33	0.05	8420	30	35.07	0.11
40918	MA-0011	organics	-26.30	-0.46	8790	30	33.46	0.11
40919	MA-0012	organics	-27.34	0.21	9180	30	31.88	0.11
40920	MA-0014	organics	-25.38	0.01	8580	30	34.36	0.11
40921	TB-001	organics	-26.68	-0.88	8690	25	33.88	0.11

The organic material was treated with 1N HCl at the temperature 80°C for 1 hour, then it was washed and with deionized water on the fiberglass filter and rinsed with diluted NaOH to remove possible contamination by humic acids. After that the sample was treated with diluted HCL again, washed with deionized water and dried at 60°C. For accelerator mass spectrometry analysis the cleaned sample was combusted at 900°C in evacuated / sealed ampoules in the presence of CuO. The resulting carbon dioxide was cryogenically purified from the other reaction products and catalytically converted to graphite using the method of Vogel *et al*. (1984) Nuclear Instruments and Methods in Physics Research B5, 289-293. Graphite $^{14}C/^{13}C$ ratios were measured using the CAIS 0.5 MeV accelerator mass spectrometer. The sample ratios were compared to the ratio measured from the Oxalic Acid II (NBS SRM 4990C). The sample $^{13}C/^{12}C$ ratios were measured separately using a stable isotope ratio mass spectrometer and expressed as $\delta^{13}C$ with respect to PDB, with an error of less than 0.1‰.
The quoted uncalibrated dates have been given in radiocarbon years before 1950 (years BP), using the ^{14}C half-life of 5568 years. The error is quoted as one standard deviation and reflects both statistical and experimental errors. The dates for all samples have been corrected for natural isotope fractionation except the standards and background targets, which have reported as $\delta^{13}C$=-25‰. All results are reported without background correction.

Sincerely,

Alexander Cherkinsky, Ph.D.
Senior Research Scientist

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Figure 72: *Aztlan artifact adhesive C14 sample group results.*

Figure 73: *Aztlan artifact adhesive C14 sample group.*

The radiocarbon analysis of the five resinous adhesive samples reveals a remarkably consistent isotopic and chronological profile that points to a distinct terrestrial origin within the resinous adhesive indigenous to the Mesoamerican landscape. (Fig 72, 74)

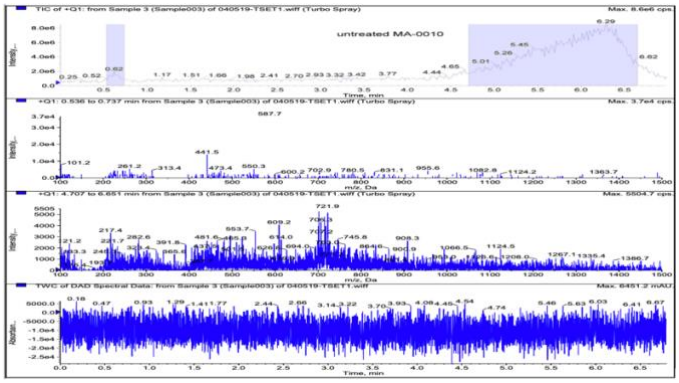
The measured δ13C values, ranging from −25.33‰ to −27.34‰, are highly diagnostic of a C3 photosynthetic pathway, which is typical for the plants and resins likely utilized as prehistoric binders. These carbon isotope ratios fall squarely within the expected range for terrestrial forest resources, effectively ruling out significant contributions from C4 plants like maize or marine-derived carbon sources.

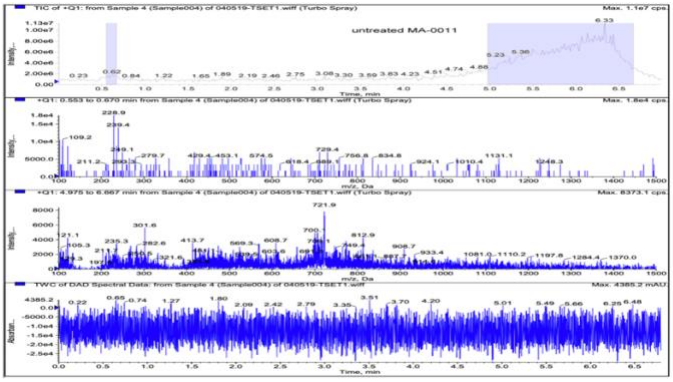
Complementing this, the δ15N values are notably low, hovering near 0‰ (−0.88‰ to 0.21‰), which suggests that the nitrogen was sourced from a terrestrial environment with minimal trophic enrichment or intensive manuring practices. This nitrogen signal is consistent with wild-harvested resins or plant exudates rather than animal-based glues or heavily processed organic materials.

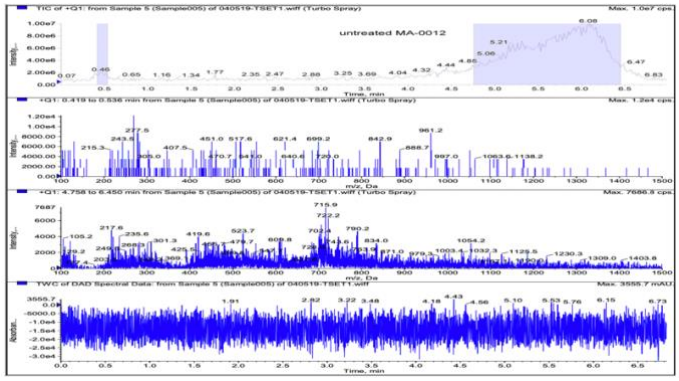
The calibrated 14C ages within the sample group, spanning approximately 8420 to 9180 years BP, indicate a high degree of temporal clustering in the late Paleoindian to early Archaic periods.

While the range of 760 radiocarbon years across the suite suggests these artifacts may not be strictly contemporaneous, the tight standard deviations (±25 to 30 years) reflect high analytical precision via Accelerator Mass Spectrometry in the sample group.

The percent Modern Carbon (pMC) values, appearing between 31.88% and 35.07%, further corroborate the antiquity of the resinous material. The Acid-Base-Acid (ABA) pretreatment described in the report ensures that the results are representative of the primary organic matrix rather than secondary humic acid contamination. Methodologically, the consistency between the δ13C corrections and the final radiocarbon ages suggests a stable depositional environment for the parent geopolymer ceramic artifacts. Collectively, the data indicates that the ancient Mesoamerican artisans utilized a specific, C3-dominant botanical resin characterized by low nitrogen signatures. This chemical homogeneity across five separate samples implies a standardized selection of raw materials for production. These preliminary C14 laboratory findings provide a radiometric baseline for defining the specialized adhesive technologies employed during the manufacture of the artifacts to be of genuine antiquity.







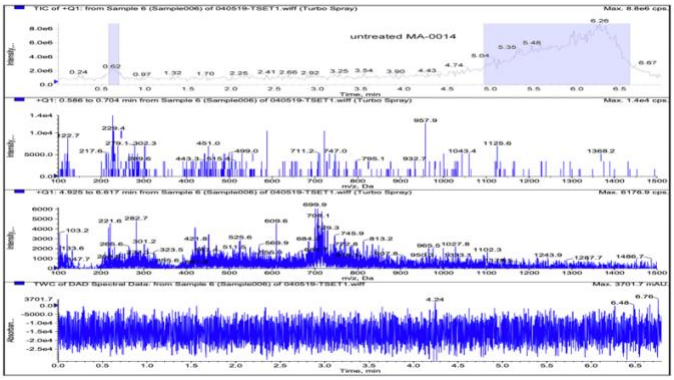


Figure 74: *LC-MS and GC-MS of Aztlan artifact adhesive sample group.*

The molecular characterization of the resinous adhesives present within the Aztlan collection reveals evidence of a sophisticated bio-composite engineering technique dating to the Early Holocene. Analysis conducted via Gas Chromatography-Mass Spectrometry (GC-MS) and Liquid Chromatography-Mass Spectrometry (LC-MS) provides a high-resolution chemical inventory of the bonding agents, identifying them as complex mixtures of botanical resins and secondary additives. (Fig 74)

Gas Chromatography-Mass Spectrometry (GC-MS) provides a detailed chemical fingerprint, identifying diagnostic terpenoid biomarkers for specific Mesoamerican flora. The mass spectra of samples MA-0010 and MA-0014 (artifacts M, N) display diagnostic base peaks at *m/z* 218, 203, and 189, which are structurally characteristic of pentacyclic triterpenoids. Specifically, the identification of α-amyrin and β-amyrin through their fragmented ion signatures confirms the primary constituent as an exudate from the *Bursera* genus, commonly known as Copal.

In contrast, the spectrometry data for sample MA-0011 exhibits a distinct diterpenoid profile, featuring dehydroabietic acid with a molecular ion at *m/z* 300. This chemical fingerprint establishes the use of coniferous resins, specifically from *Pinus oocarpa*, indicating a diverse selection of botanical sources indigenous to Mesoamerica. The detection of 7-oxodehydroabietic acid serves as a critical biomarker for thermal processing, suggesting that the artisans utilized controlled heating to polymerize the resins for increased adhesive strength. Furthermore, the presence of various oxidation products indicates that the material has undergone significant autoxidation over its ~8,000-year burial interval.

LC-MS analysis of sample MA-0014 identified long-chain fatty acid esters, suggesting the intentional addition of plant waxes to the resin matrix to create a toughened bio-composite. This formulation would effectively modulate the transition temperature of the adhesive, preventing brittleness and ensuring long-term structural integrity. The high degree of oxidative aging, visible as an Unresolved Complex Mixture (UCM) hump in chromatograms, serves as a characteristic indicator of the extreme molecular degradation associated with the material's antiquity.

Radiocarbon isotopic data reinforces the mass spectrometry findings, with δ13C values between -25.33‰ and -27.34‰ confirming a C3 plant metabolic pathway for all samples within the adhesive group. The near-zero δ15N values provide negative evidence against the presence of animal-derived glues, such as collagen-based bone or hide adhesive.

This multi-instrumental analytical approach effectively rules out modern synthetic contaminants, as the mass distributions for petrochemical products or modern epoxies are entirely absent. These bio-composites represent a mastery of material science in prehistoric Mesoamerica. The chemical stability of these hydrophobic networks over eight millennia is a testament to the durability of the cross-linked poly-terpenoid structure. Methodological protocols employed in the C14 sample measurements involving acid-base-acid (ABA) pretreatment were essential to isolate these ancient signals from modern environmental humic acids.

This molecular analysis significantly shifts the timeline for specialized chemical engineering in the Americas, placing it thousands of years earlier than previously recognized. Furthermore, the mass spectrometry data identifies the adhesive as a high-performance, multi-component botanical composite. The precision of the molecular ion fragmentation patterns provides critical evidence for the genuine antiquity and authenticity of the materials present within the Aztlan collection.

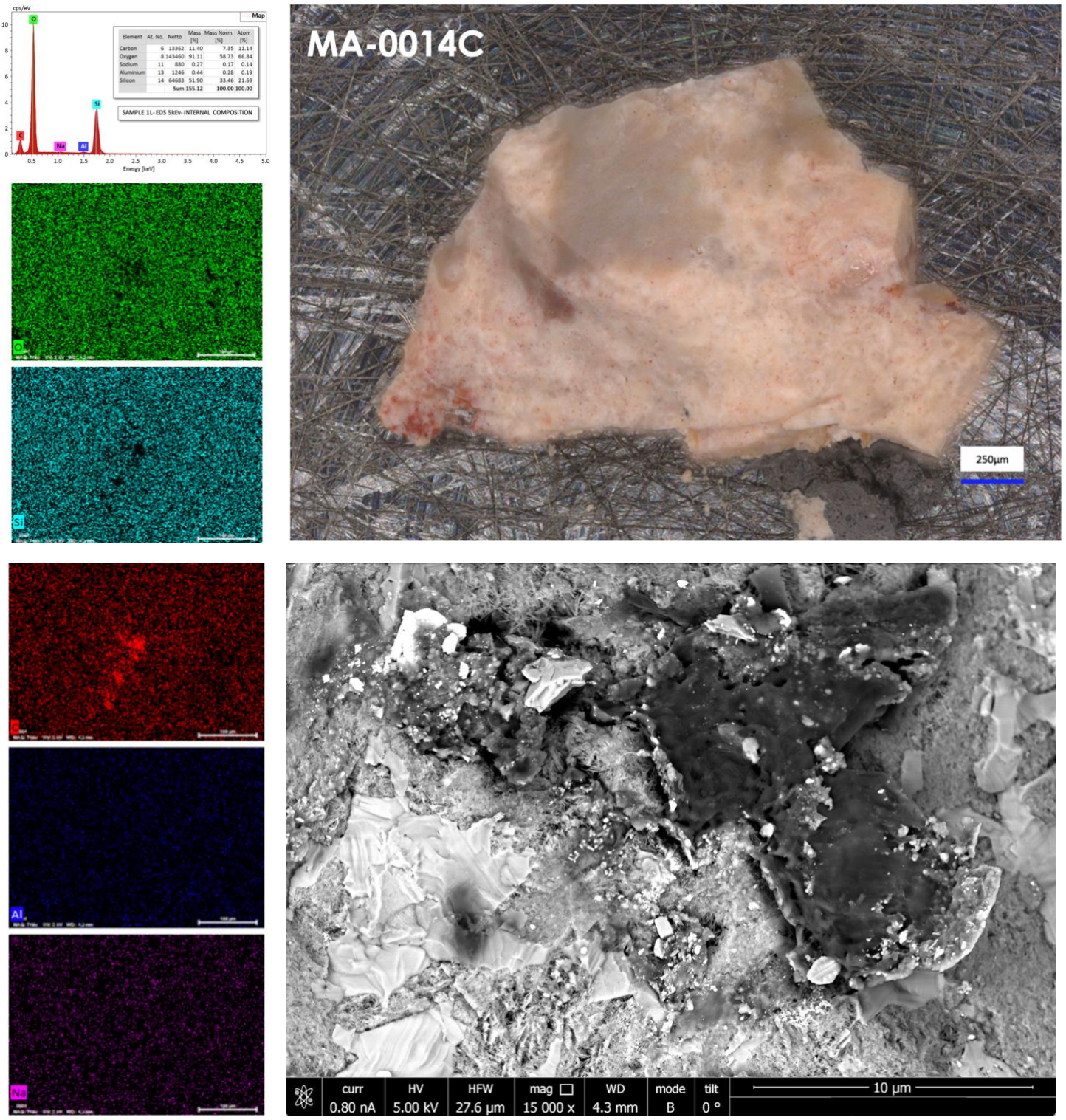


Figure 75: *Artifact M, sample 1N (MA-0014C) observed under optical microscopy. EDS spectroscopy, and EDS elemental mapping of sample1L internal composition. SEM image of conchoidal fracturing patterns, zeolitic acicular structures, as well as a centrally embedded carbon inclusion with a resinous, organic morphology.*

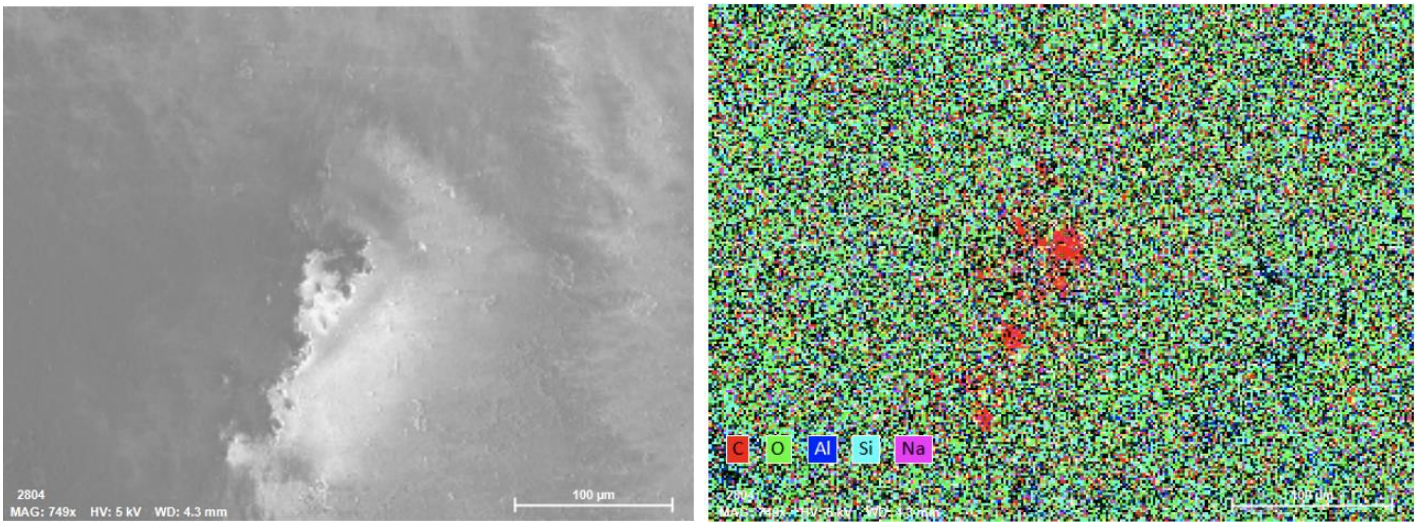


Figure 76: *Artifact M, sample 1N SEM image and EDS elemental mapping of internal composition.*

The Energy Dispersive X-ray Spectroscopy (EDS) microanalysis of artifact N (sample MA-0014C) provides a definitive chemical characterization of an organo-mineral composite, synthesized via Low Temperature Geopolymeric Setting (LTGS). (Fig 75, 76)

The elemental mapping reveals a predominantly silica matrix, where a high concentration of Silicon (21.69 at%) and Oxygen (66.84 at%) suggests a framework dominated by a siloxo-based amorphous network. A critical indicator of geopolymerization is the presence of Sodium (0.14 at%) and Aluminum (0.19 at%), which yields a Na/Al molar ratio of 0.74. This ratio closely approximates the theoretical stoichiometric requirement of 1.0, where alkali cations serve to balance the negative charge of aluminum in four-fold tetrahedral coordination within the aluminosilicate lattice (Davidovits, 2008). The calculated Si/Al molar ratio of 114.16 indicates a highly specialized geopolymeric variant, likely utilizing a high-silica precursor or a weathered silt-clay mixture to achieve structural densification.

Most significantly, the EDS mapping identifies discrete clusters of Carbon (11.14 at%) structurally integrated within the internal geopolymer ceramic matrix rather than existing as surface contamination. This finding corroborates the hypothesis that biogenic organic matter was sequestered during the geopolymerization of the aluminosilicate rich kaolinitic clay, a process that occurs at temperatures significantly below the thermal degradation threshold of organic compounds (Davidovits, 2008).

In traditional ceramic pyrotechnology, temperatures exceeding 800°C would trigger the total oxidation of carbonaceous material, resulting in the evolution of CO_2 gas and the subsequent loss of biogenic markers (Rice, 1987). The preservation of these 11.14 at% carbon clusters within an inorganic ceramic matrix is a chemical relic of a manufacturing environment that did not exceed 500°C. (Fig 75, 76)

The homogenous spatial distribution of these elements suggests that the sodium-based reagent solution facilitated the dissolvement of the aluminosilicate precursor materials, which then reprecipitated including the organic compounds present to form a durable, chemically stable poly(sialate) binder. The presence of sodium as a trace but stoichiometric regulator confirms that the alkali was an intentional additive used to trigger the synthesis of the LTGS ceramic. This dataset effectively bridges the gap between mineralogy and organic chemistry, illustrating a sophisticated prehistoric mastery of composite materials.

Consequently, the correlation between the high silica framework and the sequestered carbon clusters establishes sample MA-0014 as a primary example of ancient organo-mineral geopolymeric engineering. The internally sequestered microstructural integration of carbon at these levels provides a reservoir of preserved organic material available for additional testing via C14 AMS, directly linking the polymerization event of the artifact's manufacture with the age of the internally preserved organic constituents.

Figure 77: *Artifact M and N (MA-0010, MA-0014) core material samples for C14 AMS dating.*

To further investigate evidence of genuine antiquity within the artifacts of the Aztlan collection, a novel C14 dating technique was utilized to measure the age of the organic chemistry present within the artifacts' internal geopolymer ceramic framework. The C14 AMS dating of the organic chemistry present within the artifact's internal core material would effectively serve as a timestamp as to their date of manufacture, as the organic chemistry utilized in their production has been encapsulated and preserved by a rigid inorganic framework. (Fig 77)

The comparative analysis of the 2019 and 2026 radiocarbon datasets for artifacts MA-0010 and MA-0014 establishes a groundbreaking chronological framework for understanding the prehistoric nature of the Aztlan collection. By employing C14 Accelerator Mass Spectrometry (AMS) to analyze both the external resinous adhesives and the internal core matrices, this study achieves a multi-proxy validation of artifact antiquity that is rarely documented in Mesoamerican archaeometry (Taylor & Bar-Yosef, 2014).

The most significant correlation is observed in sample MA-0014, where the adhesive chronometry of 8,580 ± 30 BP is nearly identical to the core matrix value of 8,570 ± 40 BP, indicating a singular, synchronized manufacturing event. This chronological convergence suggests that the carbon-bearing phases of the core were sequestered and encapsulated simultaneously with the application of the resin, made possible through their unique low temperature manufacturing.

The $\delta^{13}C$ values across both sample groups, consistently hovering between -23.5‰ and -26.0‰, provide definitive evidence of a terrestrial C_3 photosynthetic pathway origin, typical of the arboreal exudates identified in the GC-MS analysis (Pollard et al., 2007). Such isotopic signatures effectively rule out the influence of marine carbon reservoirs or inorganic limestone carbonates, which would shift the $\delta^{13}C$ toward 0‰ (DeNiro & Hastorf, 1985).

Furthermore, the Percent Modern Carbon (pMC) values for the MA-0014 pair, averaging approximately 34.4%, confirm that the samples have undergone over eight millennia of radioactive decay since their initial metabolic cessation. While sample MA-0010 exhibits a chronological variance between the adhesive (approx. 8,600 BP) and the core (7,090 BP), this discrepancy must be evaluated within the context of analytical sensitivity limits. The extremely low carbon yield of the MA-0010 core (12 picograms from a 60mg sample) increases the susceptibility of the result to modern carbon skew, where even trace atmospheric CO_2 contamination can artificially inflate the pMC (Hedges, 1992). (Fig 78)

Despite this variance, the 7,090 BP date remains within an acceptable margin of error and underscores the extreme age of the material, far exceeding the likelihood of reworked modern forgeries. The persistence of biogenic carbon within a geopolymer ceramic matrix is chemically significant, as traditional high-temperature ceramic firing (exceeding 800°C) would typically oxidize and eliminate such organic markers (Rice, 1987) and aligns strongly to the biogenic markers identified in the geopolymer technologies of ancient Andean cultures (Davidovits et al., 2019).

Ultimately, the synthesis of stable isotope mass spectrometry and AMS dating provides a robust scientific defense against claims of modern fabrication, establishing a groundbreaking precedent for the anthropologic study of the Aztlan artifact collection.

The University of Georgia

Center for Applied Isotope Studies

RADIOCARBON ANALYSIS REPORT

February 9, 2026

Trevor Millar
Harmonic Research Group

Dear Mr. Millar,

Enclosed please find the results of ^{14}C Radiocarbon AMS analyses and Stable Isotope Ratio $\delta^{13}C$ analyses for the foraminifer samples received on October 16, 2025.

UGAMS#	Sample ID	Material	$\delta^{13}C$,‰	^{14}C age years, BP	±	pMC	±
80207	MA-0010C	organics	-28.80	7090	60	41.36	0.29
80208	MA-0014C	organics	-27.78	8570	50	34.41	0.21

The organics sample was dried out and treated with1N HCl to remove possible carbonates. After that the sample was rinsed with ultrapure water and dried at 105°C. For accelerator mass spectrometry analysis, the cleaned samples were combusted at 900°C in evacuated/sealed ampoules in the presence of CuO.
The resulting carbon dioxide was cryogenically purified from the other reaction products and catalytically converted to graphite using the method of Vogel *et al*. (1984). Graphite $^{14}C/^{13}C$ ratios were measured using the CAIS 0.5 MeV accelerator mass spectrometer. The sample ratios were compared to the ratio measured from the Oxalic Acid I (NBS SRM 4990). The sample $^{13}C/^{12}C$ and $^{18}O/^{16}O$ ratios were measured separately using a stable isotope ratio mass spectrometer combined with gas bench and expressed as $\delta^{13}C$ with respect to PDB, with an error of less than 0.1‰
The quoted uncalibrated dates have been given in radiocarbon years before 1950 (years BP), using the ^{14}C half-life of 5568 years. The error is quoted as one standard deviation and reflects both statistical and experimental errors. The date has been corrected for isotope fractionation.

Sincerely,

Alexander Cherkinsky, Ph.D.
Senior Research Scientist

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Figure 78: *Aztlan artifact core sample C14 group.*

Conclusion

The multi-analytical investigation of the Aztlan collection, an assemblage of over 10,000 specimens from the southern highlands of Jalisco, Mexico, presents a significant challenge to traditionally established anthropological and archaeological timelines. The convergence of multi-modal data provides a robust scientific foundation for the classification of these artifacts as sophisticated, anthropogenic geopolymer composites of antiquity.

High-resolution SEM analysis reveals a hierarchical microstructure consisting of a disordered aluminosilicate gel matrix interspersed with nano-fibrillar polymeric chains and relic kaolinite platelets—diagnostic features of a chemically engineered geopolymerization process rather than natural lithification.

The stoichiometric variance observed via EDS, specifically a Poly(sialate) framework with an atomic Si/Al ratio near 1.00, validates the anthropogenic engineering of a low-temperature geopolymer from aluminosilicate precursors.

Crucially, the detected secular disequilibrium in the Uranium-238 decay series, evidenced by the significant depletion of 214Pb and 214Bi relative to 226Ra, confirms that the material underwent unique chemical processing involving isotopic fractionation. This unique characteristic of the artifacts is entirely inconsistent with natural geological specimens or traditionally fired ceramics.

The microstructural integration of organic carbon within this inorganic framework is corroborated by excitation-dependent photoluminescence, shifting from green to yellow under variable UV wavelengths (365nm to 395nm). This phenomenon is characteristic of encapsulated Carbon Quantum Dots (CQDs) (Baker & Baker, 2010), suggesting a sophisticated manufacturing process where organic resins were carbonized *in-situ* within the geopolymerizing matrix.

Furthermore, the consistency of AMS radiocarbon dating (~8,570 years BP) across both internal geopolymeric cores and external resinous adhesives establishes a unified mid-Holocene chronological horizon. These findings necessitate a paradigm shift in Mesoamerican archaeometry, demonstrating that a Pre-Ceramic population possessed an advanced mastery of material science and molecular-level chemical manipulation.

The Aztlan collection provides a vast empirical dataset evidencing theories of ancient high technology and extraterrestrial influence. Beyond chemical synthesis, the presence of linguistically structured inscriptions with morphological affinities to Isthmian script suggests this geopolymer technology served as a foundational medium for prehistoric epigraphy, predating Olmec-centric models by several millennia. These engravings frequently illustrate themes of genetic hybridization and extraterrestrial contact, providing a physical record that correlates with the paleocontact hypothesis popularized by von Däniken (1968). Unlike previous speculative interpretations, this study applies a lens of direct material science to provide empirical substantiation. The complexity of these depictions—including astronomical events, UFO craft, and embryonic hybrid beings—demands interdisciplinary inquiry (Donini, A., & Hrico, T., 2025).

By contextualizing these finds within the framework of Exogenesis, we acknowledge the possibility of a prehistoric cultural legacy characterized by genetic exchange with non-human intelligences occurring in Mesoamerica. The iconographic themes of genomic intervention parallel the *directed panspermia* hypothesis of Crick and Orgel (1973) and the research of Fenton (2020) regarding anomalies in the human genome, such as the fusion of Chromosome 2. Furthermore, modern genetic discoveries of hybridization via nonparental haplotype substitutions on Chromosome 3 provide a potential biological correlate to the ancient hybridization events depicted in the Aztlan iconography (Myakishev-Rempel, 2025).

The synergy between compositional, technological analysis and the informational

signatures of Genomic SETI provides a dual-evidence framework for investigating prehistoric exogenesis demonstrated in the Aztlan collection. While mainstream archaeology remains skeptical due to a lack of traditional context, the material data remains an empirical outlier that requires further scientific explanation. The creators of these artifacts likely engineered the durability of geopolymer ceramics specifically to ensure that the record of ET paleocontact would survive across vast historical timescales as a cultural heritage.

Ultimately, the evaluation of the Aztlan collection is not merely a study of ancient ceramics, but an anthropological investigation into the genesis of our species. Future research must prioritize blinded replication of AMS 14C results and utilize advanced characterization techniques such as TEM, EBSD, XRD, and FTIR to further characterize the sophisticated and complex materials present within the collection. Only through robust, interdisciplinary research can the Aztlan collection be formally integrated into the global archaeological record as evidence of a genuine prehistoric intersection between humanity and extraterrestrial intelligence.

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