Archaeological Discovery, 2026, 14(4), 253-287
https://www.scirp.org/journal/ad
ISSN Online: 2331-1967
ISSN Print: 2331-1959

Investigating Geometrical Granite Landscapes: A Comparative Framework, with Case Studies from California and Montana

Sam Osmanagich

Founder and Principal Investigator, Archaeological Park: Bosnian Pyramid of the Sun Foundation, Visoko, Bosnia and Herzegovina
Email: info@drsamosmanagich.com

How to cite this paper: Osmanagich, S. (2026). Investigating Geometrical Granite Landscapes: A Comparative Framework, with Case Studies from California and Montana. *Archaeological Discovery, 14,* 253-287.
https://doi.org/10.4236/ad.2026.144014

Received: August 3, 2026
Accepted: September 13, 2026
Published: September 16, 2026

Abstract

Granite terrain occasionally produces landforms that look built: planar faces, right-angle intersections, coursed or stacked blocks, stepped terraces, standing monoliths. Some of these forms, including planar faces and stepped profiles, are well explained by ordinary joint-controlled weathering; right-angle intersections are a weaker signal on their own, since orthogonal jointing occurs naturally in granite but the same geometry is also a hallmark of dressed masonry, which is why this paper treats no single feature as diagnostic of origin (Section 9). In a smaller number of cases, this kind of morphology occurs at sites with independent evidence of human modification. This paper proposes a general framework for telling these cases apart, and applies it to new case-study material from Three Rivers and Kirch Flat, California, and from previously documented localities in Montana. We define granite's relevant physical and mineralogical properties, state an explicit and deliberately narrow hypothesis expressed as testable, discriminating predictions, introduce an eight-category morphological typology (Types A-H) together with operational classification thresholds, and apply that typology across the California and Montana material and a wider set of comparanda: accepted anthropogenic granite construction (Sardinia, Great Zimbabwe, Osirion at Abydos, Mahabalipuram) and natural granite controls (Yosemite, Joshua Tree, City of Rocks, Dartmoor, Matobo Hills, Huangshan). We do not decide, for California or Montana, whether the documented features are natural or built; that question is left open and is the object of the phased research protocol proposed in Section 10. On the strength of the morphology alone, both localities belong in a coordinated program of future research, whatever that research eventually concludes about their origin.

Keywords

Granite Geomorphology, Megalithic Landscapes, Comparative Archaeology, Three Rivers, California, Montana Monoliths, Great Zimbabwe, Sardinia Nuraghe, Stone Spheres

1. Introduction

Granite terrain sometimes produces landforms that look built: planar faces, blocks meeting at right angles, stacked or balanced boulders, stepped profiles. Planar faces and stepped profiles are commonly explained by joint-controlled weathering, exfoliation, and spheroidal weathering acting on granite's natural three-dimensional jointing; right-angle intersections are a less reliable indicator on their own, since orthogonal jointing is itself a documented natural process in granite (Section 8.2) but the same geometry is equally characteristic of dressed masonry (Section 8.1), which is one reason this paper avoids treating any single feature as diagnostic. In a smaller number of cases, this kind of morphology turns up at sites with independent archaeological evidence of human modification. Telling the two apart, and knowing which cases actually deserve a closer look, is a real geomorphological and archaeological question—and is best approached not site by site but through a general, reusable framework.

This paper has two aims. The first is to document granite features at two localities near Three Rivers, California, and to summarize comparable material previously recorded in Montana. The second, broader aim is to place that documentation inside a framework—a stated hypothesis, a shared morphological typology, and a comparative set of accepted anthropogenic sites and natural controls—that could equally be applied to any other granite landscape a future researcher wants to evaluate. The California and Montana material is presented here as the first case study for that framework, not as its subject matter in isolation.

We are explicit about scope. This is not a claim that either locality preserves an ancient city, a pre-Ice Age civilization, or the work of any particular builders. Those are hypotheses that, at present, have no independent supporting evidence, and we exclude them from the analysis that follows. What is documented here are recurring, measurable morphological features. Whether those features originate from geological processes, from human activity, or from some combination of the two is the question a future systematic investigation should be designed to answer—not a conclusion this paper is in a position to reach.

2. Granite as a Geological and Archaeological Material

2.1. Mineralogy and Physical Properties

Granite is a coarse-grained intrusive igneous rock, typically composed of 20% - 60% quartz by volume together with alkali and plagioclase feldspar and smaller amounts of mica and accessory minerals (Deer et al., 1992). Its interlocking crystalline fabric gives it high compressive strength (commonly on the order of 100–250 MPa) and strong resistance to chemical and mechanical weathering compared with most sedimentary rocks, which is why granite landscapes tend to preserve joint-controlled and exfoliation-related landforms—domes, tors, sheeted faces—over very long timescales (Twidale, 1982; Twidale & Vidal Romaní, 2005). These same properties explain why granite is difficult to quarry and shape with simple tools, and why worked granite is treated in the archaeological literature as a marker of investment and skill wherever it occurs.

2.2. Quartz, Piezoelectricity, and the Limits of What It Explains

Quartz crystals are piezoelectric: mechanical stress applied along particular crystallographic axes generates a measurable electrical charge (Cady, 1946). Because granite typically contains a substantial quartz fraction, this property has motivated a body of geophysical and archaeophysical research into whether granite outcrops or granite monuments produce macroscopic electrical or resonance effects. We are careful here to keep two claims separate. It is correct, and well established, that individual quartz crystals are piezoelectric. It is a distinct and considerably less settled question whether a granite mass—an assemblage of randomly oriented quartz grains bonded with feldspar and mica—produces a coherent, measurable piezoelectric effect at the scale of an outcrop or a wall, and whether any such effect had archaeological or cultural significance. We treat that second question as open and do not rely on it anywhere in the analysis that follows.

2.3. Why Granite Recurs in Monumental Construction

Across very different cultures and periods, granite is a repeated choice for monumental and megalithic construction, from the Nuragic towers of Sardinia to the dry-stone walls of Great Zimbabwe to the transported capstones of the Dutch hunebedden. Plausible reasons include exceptional durability and weathering resistance, high compressive strength, local availability in granitic terrain, and the symbolic or prestige value of working a famously hard stone. We present these as candidate explanations to be weighed against the specific evidence at each site, not as an established or complete list, and we do not treat granite's durability or hardness as evidence, by itself, that any particular granite feature is anthropogenic.

3. Hypothesis

This paper works from a single, deliberately narrow hypothesis: certain granite landscapes display recurring geometrical morphologies whose origin—natural, anthropogenic, or mixed—is not yet established, and which therefore warrant systematic, multidisciplinary investigation. This hypothesis does not presuppose an anthropogenic origin, a chronology, or a builder population for any given site—those remain separate, downstream questions to be addressed only if and when the morphological and geological evidence at a specific locality warrants it. To make that hypothesis testable rather than merely plausible, we state it here as two competing, discriminating predictions, following standard practice in geoarchaeological equifinality studies:

H0—Natural-process prediction: if the observed geometries at a given locality result primarily from joint-controlled weathering, exfoliation, gravitational displacement, and surface erosion, then 1) planar surfaces and block boundaries should correlate statistically with the dominant regional joint sets measured independently of the questioned features; 2) the angles formed at block intersections should cluster around the natural fracture-orientation distribution for that pluton rather than around 90˚ specifically; 3) apparent courses, terraces, and block alignments should show limited dimensional regularity from one block to the next; and 4) no systematic tool marks, prepared bedding surfaces, transported or foreign blocks, artificial fill, or associated archaeological deposits should be present.

H1—Anthropogenic-modification prediction: if human modification contributed substantially to the morphology at a given locality, then selected features should instead exhibit systematic departures from the regional natural-joint model, including repeated dimensional regularity among blocks, sustained coursing or alignment that persists independently of the dominant local joint orientation, deliberately prepared or dressed contact surfaces, possible percussion or tool traces, blocks that have been transported or repositioned relative to their probable parent outcrop, and/or archaeological deposits or artifacts spatially associated with the structures.

Three Rivers, Kirch Flat, and the Montana localities are treated in this paper as candidate test cases for H0 and H1, not as confirmed instances of either. The present paper does not adjudicate between them; it documents morphology (Section 7) against a typology built to be scored under either prediction (Section 6) and proposes, in Section 10, the specific field, geological, and geophysical measurements—regional joint-orientation surveys, block-dimension statistics, tool-mark and petrographic analysis, and subsurface testing—required to evaluate H0 against H1 at each locality.

4. Regional Setting

4.1. Three Rivers and Kirch Flat, California

Three Rivers lies in the western foothills of the Sierra Nevada, Tulare County, California (approximate town center: 36.4386˚N, 118.8971˚W), at the boundary between the granitic batholith terrain of the range and the alluvial Central Valley. The Sierra Nevada batholith is composed predominantly of Mesozoic granitic rocks emplaced during subduction-related magmatism, subsequently exposed by uplift and erosion; the region is well known for granite domes, tors, and exfoliation features (e.g., in Yosemite and Sequoia-Kings Canyon National Parks, immediately to the north and east). Kirch Flat Campground (36.8791˚N, 119.1501˚W), approximately 54 km (33.5 miles) north-northwest of Three Rivers, along the Kings River, lies within the same granitic terrain and is treated here as a second, geologically comparable locality. Precise coordinates for the individual documented features within the Three Rivers site have not yet been recorded and are a priority for the field survey proposed in Section 10; a preliminary, non-georeferenced inventory of the individual features illustrated in Section 7 is provided there. The broader region also has a substantial and well-documented archaeological record of Native American occupation extending deep into California prehistory (Moratto, 1984).

4.2. Montana Localities (Monoliths)

Granite features previously documented in Montana include polygonal granite walls, dolmen-like arrangements of large slabs, balancing rocks, and standing monoliths at several independent localities, together with field measurements and orientation data collected during prior site visits. A full descriptive dataset comparable in detail to Section 7 below is being assembled and will be presented in a companion paper; here the Montana material is referenced only as comparative context. Because that feature-level dataset is not yet available in a form that supports a reproducible score, Montana is not scored against the Section 6 typology in the comparative table in Section 8.4; it is retained there, and here, as qualitative comparative material only.

5. Materials and Methods

Field documentation at the California localities consisted of repeated visits over an eighteen-month period, with photographic recording of individual features, their spatial context, and their relationship to surrounding vegetation, soil cover, and modern infrastructure (see Section 7.6). Photographs were taken with a handheld device; a subset is reproduced here as figures, selected for image clarity and for their value in illustrating specific, describable morphological characteristics (planarity, joint orientation, block proportions) rather than for narrative or interpretive effect. Photographs whose primary content was an interpretive claim (for example, images annotated to suggest facial or figural forms) were excluded from this dataset; that material may be discussed separately as a question of pattern perception, but it is not treated here as morphological evidence.

No systematic geodetic, geophysical, or remote-sensing survey has yet been carried out at either the California or the Montana localities. This is stated explicitly because it defines the limits of what this paper can claim: the observations below are descriptive and photographic, not measured in the sense of a georeferenced survey. Section 10 sets out the phased survey and analytical program needed to move beyond this preliminary stage.

Two further methodological limitations of the present preliminary dataset are stated explicitly here. First, the operational classification thresholds introduced in Section 6.2 were formulated after the photographic dataset in Section 7 had already been collected; because the underlying photographs were not taken with instruments capable of measuring the specified angular and dimensional tolerances, the Type A-H assignments given in Section 7 remain qualitative, by-eye classifications, and the thresholds introduced in Section 6.2 should be read as the operational standard for prospective field application in Section 10, Phase 1, not as a retroactive re-measurement of the current photographic sample. Second, the Type A-H classifications reported in this paper were assigned by a single observer (the author) from the photographic record. Independent classification of the same imagery by a second qualified observer, with inter-rater agreement reported (e.g., Cohen's κ), has not yet been carried out and is accordingly formalized as a required step of Phase 1 of the research agenda (Section 10) rather than claimed here.

6. A Morphological Typology for Granite Megalithic Landscapes

To make comparison across sites reproducible rather than impressionistic, we define eight morphological types. Any granite exposure, natural or anthropogenic, can in principle be scored for the presence or absence of each type; a single site typically shows several. The types describe geometry only and carry no implication of origin.

- **Type A—Planar faces:** broad, flat rock surfaces bounded by a single joint or exfoliation plane.
- **Type B—Orthogonal intersections:** two planar faces meeting at, or close to, a right angle.
- **Type C—Polygonal block arrangements:** blocks with three or more straight edges fitted against neighboring blocks.
- **Type D—Coursed walls:** laterally continuous, roughly horizontal rows of blocks separated by sub-parallel joints.
- **Type E—Stepped terraces:** two or more roughly planar levels connected by near-vertical risers.
- **Type F—Standing monoliths:** single blocks oriented with their long axis vertical or steeply inclined, isolated from other blocks.
- **Type G—Lintel structures:** a horizontal block resting across two or more supporting uprights, leaving open space beneath.
- **Type H—Balancing megaliths:** a block resting on a markedly smaller contact area than its own footprint, such that its stability is visually surprising.

6.1. A Provisional Complexity Score

The typology above is qualitative: a type is either present at a site or it is not. As a first step toward a quantitative treatment, we assign each type a provisional weight reflecting, approximately, how much co-ordinated effort or how improbable a natural weathering outcome it represents relative to the others—a single planar face is common and requires little explanation either way, while a lintel structure requires two or more separate blocks to be positioned in a specific load-bearing relationship. Table 1 lists the provisional weight assigned to each type. Summing the weights of the types present at a site gives a Morphological Complexity Index (MCI), reported for every site in the comparative table in Section 8.4.

Table 1. Provisional weights used to compute the Morphological Complexity Index (MCI) for each type (Section 6.1).

Type	A	B	C	D	E	F	G	H
Weight	1	1	2	3	3	2	4	3

These weights are provisional and are offered as a starting point for discussion, not as a validated metric: they are not derived from a probability model of natural joint-controlled weathering, and a defensible version would need to be calibrated against the natural-control sites in Section 8.2, ideally using the quantitative joint-frequency and orientation data proposed for Phase 2 of Section 10. The MCI is reported here only to make the qualitative comparison in Section 8.4 slightly more informative; it is not treated anywhere in this paper as evidence of anthropogenic origin, and a high score at Three Rivers or Montana carries the same evidentiary weight as a high score at Yosemite or Joshua Tree—none, until it is tested.

6.2. Operational Classification Thresholds

Table 2. Proposed operational thresholds for prospective classification of Types A-H (Section 6.2). Values are provisional pending calibration against the natural-control sites in Section 8.2.

Type	Operational criterion (provisional)
A—Planar face	Deviation from a fitted reference plane ≤5˚ across a measured area of ≥1 m^2.
B—Orthogonal intersection	Included angle between adjacent planar faces of 90˚ ± 10˚.
C—Polygonal block arrangement	≥3 blocks, each with ≥3 straight edges, in mutual contact with contact-surface gaps ≤5 cm.
D—Coursed wall	≥3 laterally adjacent blocks forming ≥2 m of continuous alignment, with course-axis deviation ≤10˚ from horizontal.
E—Stepped terrace	≥2 successive, approximately parallel tread surfaces (deviation ≤10˚ from horizontal) with riser heights ≥0.25 m.
F—Standing monolith	Single block with long-axis inclination ≥60˚ from horizontal, height-to-base ratio ≥1.5:1, isolated from contact with other comparably sized blocks.
G—Lintel structure	A block spanning ≥2 supporting uprights with an open void beneath of ≥0.2 m clearance.
H—Balancing megalith	Contact-surface area ≤20% of the resting block's footprint area, as estimated from orthogonal photographs or survey data.

The Section 6 definitions ("close to a right angle," "roughly horizontal rows," "roughly planar levels") are adequate for a first, descriptive pass but are not, on their own, reproducible between independent observers. To improve reproducibility, Table 2 sets out operational, provisional thresholds intended for prospective field application—that is, for use once the georeferenced measurement and photogrammetric survey proposed in Section 10, Phase 1, is under way. These thresholds are not applied retroactively to the existing photographic dataset in Section 7 (see Section 5); the Type assignments reported there remain qualitative. They are offered here so that future classification, by this author or by independent observers (Section 6.1; Section 10, Phase 1), can be checked against a stated, falsifiable standard rather than a verbal description alone.

7. Results: Documented Feature Types (California)

Observations are organized by feature type rather than by site, to facilitate comparison, and each subsection is labeled with the corresponding morphological type(s) from Section 6. For each type, representative examples from Three Rivers and Kirch Flat are illustrated. No claim of origin is attached to any individual feature; the descriptions are confined to observable geometry. Table 3 below consolidates the individual features illustrated in this section into a single, feature-by-feature inventory, cross-referenced to the relevant figures.

Table 3. Preliminary feature inventory, Three Rivers and Kirch Flat, California. Coordinates and dimensions were not recorded during the present preliminary, photographic documentation phase and are entered here as "not recorded" rather than estimated; both are scheduled for the Phase 1 field survey (Section 10).

ID	Locality	Figure(s)	Type(s)	Brief description	Coordinates/ dimensions	Observer/ campaign
TR-01	Three Rivers	1, 2	D, A	Coursed rectilinear wall exposure with planar joint-bounded courses	Not recorded; Phase 1 priority	Gary Bruce; 18-month campaign from Dec 2024
TR-02	Three Rivers	3	B, C	Two adjacent rectangular blocks separated by a narrow, near-parallel joint	Not recorded; Phase 1 priority	Gary Bruce; as above
TR-03	Three Rivers	4	C	Rounded-edge and elongated rectangular block pair on a common base	Not recorded; Phase 1 priority	Gary Bruce; as above
TR-04	Three Rivers	5, 6	E	Stepped structure with raised platform resembling a stair tread	Not recorded; Phase 1 priority	Gary Bruce; as above
TR-05	Three Rivers	7	F	Isolated standing angular monolith on hillside above main structure	Not recorded; Phase 1 priority	Gary Bruce; as above
TR-06	Three Rivers	8	D, E	Discontinuous stepped block alignment, broader hillside distribution	Not recorded; Phase 1 priority	Gary Bruce; as above

Continued

TR-07	Three Rivers	9	D	Additional coursed exposure, hillside distribution	Not recorded; Phase 1 priority	Gary Bruce; as above
TR-08 (context)	Three Rivers	11	Not typed (modern context feature)	Granite staircase adjacent to early 20th-century house	Not recorded	Gary Bruce; homeowner report
KF-01	Kirch Flat	10	E, D	Stepped, terrace-like granite feature, Kings River	Not recorded; Phase 1 priority	Gary Bruce; single comparative visit

7.1. Coursed Rectilinear Wall Segments (Type D, Type A)

At the Three Rivers locality, several rock exposures present as laterally continuous, roughly horizontal courses of rectangular to sub-rectangular blocks, separated by planar, near-vertical joint surfaces. Individual courses are traceable for several metres along strike. The exposure is shown in **Figure 1**, with a closer view of the joint planarity and course boundaries in **Figure 2** (feature TR-01, **Table 3**).

Figure 1. Coursed granite exposure showing laterally continuous, roughly rectangular blocks separated by planar joint surfaces, Three Rivers, California. Photograph: Gary Bruce.

Figure 2. Close-range view of the same exposure showing joint planarity and course boundaries. Photograph: Gary Bruce.

7.2. Paired and Adjacent Block Arrangements (Type B, Type C)

Several localities show two or more large blocks in direct lateral or vertical contact, with contact surfaces that are close to planar. In one example, two rectangular blocks stand side by side, separated by a narrow, near-parallel-sided gap (Figure 3; feature TR-02); in another, a rounded-edge block and an elongated rectangular block rest adjacent to one another on a common base (Figure 4; feature TR-03).

Figure 3. Two adjacent rectangular blocks separated by a narrow, near-parallel-sided joint, Three Rivers, California. Photograph: Gary Bruce.

Figure 4. A rounded-edge block and an elongated rectangular block resting adjacent to one another, Three Rivers, California. Photograph: Gary Bruce.

7.3. Stepped and Terrace-Like Structures (Type E)

The most visually striking feature documented is a stepped arrangement of large blocks rising in at least two levels, with a raised, roughly planar platform at one end resembling a stair tread (**Figure 5**, shown with a person for scale; feature TR-04). The feature is partially obscured by vegetation and by an overlying modern concrete water flume (Section 7.6). A closer view of the raised platform itself is given in **Figure 6**.

Figure 5. Stepped granite structure at Three Rivers, California, with a person for scale. Photograph: Gary Bruce.

Figure 6. Raised, roughly planar stone platform at one end of the stepped structure, resembling a stair tread. Photograph: Gary Bruce.

7.4. Standing Angular Monoliths and Hillside Distribution (Type F, Type D)

Away from the main stepped structure, the hillside above the Three Rivers campsite exposes numerous additional blocks and boulders, some standing as isolated angular monoliths (Figure 7; feature TR-05) and others forming discontinuous wall-like or terrace-like alignments over a broader area (Figure 8; feature TR-06).

Figure 7. Isolated standing angular granite block on the hillside above the main structure, Three Rivers, California. Photograph: Gary Bruce.

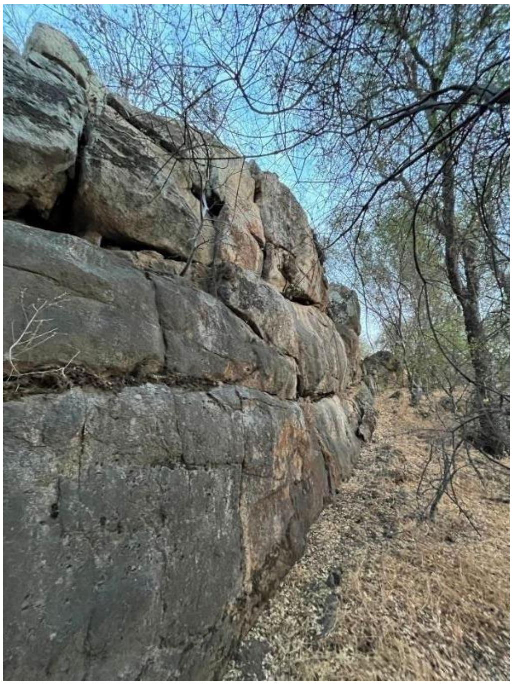

Figure 8. Discontinuous stepped alignment of blocks on the hillside, Three Rivers, California. Photograph: Gary Bruce.

An additional coursed exposure on the same hillside further illustrates the broader distribution of this morphology (Figure 9; feature TR-07).

Figure 9. Additional coursed exposure on the hillside, illustrating the broader distribution of similar morphologies (feature TR-07). Photograph: Gary Bruce.

7.5. Comparative Locality: Kirch Flat (Type E, Type D)

Similar stepped and terrace-like granite morphologies were documented approximately 54 km (33.5 miles) north-northwest of Three Rivers, at Kirch Flat Campground along the Kings River, within the same regional granitic terrain (Figure 10; feature KF-01).

Figure 10. Stepped terrace-like granite feature at Kirch Flat Campground, California, a locality approximately 54 km (33.5 mi) north-northwest of Three Rivers. Photograph: Gary Bruce.

7.6. Site Context: Modern Infrastructure and Historic-Era Modification

Two contextual observations bear directly on interpretation and are reported here rather than in the discussion, because they are themselves field observations. First, a nineteenth- to twentieth-century mining-era concrete water flume runs directly above the stepped structure at Three Rivers; portions of the flume are damaged and leak, and water runs across parts of the stone feature below. Second, a granite staircase adjacent to a house of early twentieth-century construction was documented at a separate location (Figure 11; feature TR-08); the homeowner reported uncovering it beneath vegetation, and its worked appearance differs in character from the surrounding informal landscaping.

Figure 11. Granite staircase adjacent to an early twentieth-century house, documented as site context rather than as a component of the main structure. Photograph: Gary Bruce.

These two observations matter for different reasons. The flume shows that at least part of the modern landscape immediately overlying the stepped structure is demonstrably anthropogenic and recent, which is relevant to any future discussion of surface exposure and possible erosional unroofing of the granite features below. The staircase shows that the boundary between clearly historic-era construction and the undated granite features is not always visually obvious in this landscape, which argues for caution in judging age or origin from appearance alone, in either direction.

8. Global Comparanda

This section situates the California and Montana material against two reference categories, following the typology defined in Section 6: sites with independently established anthropogenic granite construction, and sites where comparable morphology is produced by documented natural processes. A comparative summary table follows in Section 8.4 (Table 4).

8.1. Accepted Anthropogenic Granite Construction

8.1.1. Nuraghi, Menhirs, and Tomb of Giants—Sardinia, Italy (Type D, F, G)

The comparative approach adopted here builds on earlier anthropological work examining recurring technological and engineering characteristics of megalithic construction across geographically and culturally distinct sites (Osmanagich, 2025a). Sardinia's Nuragic megalithic tradition (Bronze Age, c. 18th-8th century BCE) provides an unambiguous anthropogenic granite reference: coursed dry-stone towers (nuraghi) with corbelled interior vaulting, single standing monoliths (menhirs), and chambered gallery graves (Tombe dei Giganti, "Tombs of the Giants"). These photographs were taken during a field visit to Sardinia in November 2020, illustrated in Figures 12-15.

Figure 12. Coursed and stacked granite boulders at a Nuragic site, Sardinia, Italy.

Figure 13. Standing granite menhir, Sardinia, Italy, shown for scale.

Figure 14. Entrance stele of a Tomb of the Giants (Tomba dei Giganti), a Nuragic chambered gallery grave, Sardinia, Italy.

Figure 15. Interior corbelled dry-stone construction inside a nuraghe, Sardinia, Italy, showing coursed masonry technique.

The nuraghi are useful comparanda specifically because the construction technique—coursed, roughly rectangular stone laid in horizontal courses with corbelling toward the interior—is independently documented and undisputed (Lilliu, 1988).

8.1.2. Great Zimbabwe (Type D)

Great Zimbabwe, in Masvingo Province, Zimbabwe (20˚16'S, 30˚56'E), is a UNESCO World Heritage Site built and occupied between the 11th and 15th centuries CE by ancestors of the Shona people (Pikirayi, 2001; Chirikure & Pikirayi, 2008). Its dry-stone granite walls, some reaching 11 m in height, are coursed without mortar and include the largest single ancient structure in sub-Saharan Africa south of the Sahara (**Figures 16-18**).

Great Zimbabwe is the strongest single comparandum in this paper for coursed dry-stone granite construction at landscape scale: the walls are unambiguously anthropogenic, the coursing technique is well documented, and the construction date is independently established.

Figure 16. Great Zimbabwe, Masvingo Province, Zimbabwe: coursed dry-stone granite wall of the Great Enclosure, with a person for scale.

Figure 17. Aerial view of the Great Enclosure at Great Zimbabwe, showing the curved coursed granite wall circuit.

Figure 18. Narrow passage between two parallel coursed granite walls, Great Zimbabwe.

8.1.3. Hunebedden—Drenthe, Netherlands (Type G, H)

The Netherlands preserves 54 hunebedden (megalithic chambered tombs), 52 in Friesland/Drenthe and 2 in Groningen, built by the Funnel Beaker Culture more than 5000 years ago from granite glacial erratics carried south from Scandinavia by ice-age glaciers (Bakker, 1992). Structurally each hunebed is a dolmen: smaller upright support stones (orthostats) carry larger, near-horizontal capstones. Hunebed D27, near Borger (52˚55'48''N, 6°47'51''E), is the largest in the country at 22.6 m long, with 26 supporting stones; it was first excavated in 1685 by Titia Brongersma. Hunebed D50, near Noord-Sleen (52˚47'46''N, 6˚47'14''E), retains a near-complete ring of 24 kerbstones around its passage (**Figures 19-21**).

The hunebedden raise a logistical question directly analogous to one a future study must ask about any anthropogenic component at Three Rivers or Kirch Flat: not only "is the block shaped", but "how, physically, could it have been moved and placed" by the society credited with it.

Figure 19. Hunebed D50, Noord-Sleen, Drenthe, Netherlands: granite capstones resting on upright support stones, with a person for scale.

Figure 20. Detail of capstone-to-orthostat contact, Hunebed D50, Noord-Sleen, Netherlands.

Figure 21. General view of a hunebed passage grave, Drenthe, Netherlands, showing the alternating pattern of upright and horizontal granite blocks.

8.1.4. Osirion, Abydos, Egypt (Quarrying, Transport, and Engineering Context)

The Osirion, a subterranean structure behind the Temple of Seti I at Abydos, is built from red granite quarried at Aswan, roughly 300 km to the south, together with quartzite (Klemm & Klemm, 2008). Its date is debated: it is conventionally associated with the adjoining temple, but its megalithic style and construction technique differ noticeably from typical New Kingdom architecture, and that association has been questioned. We take no position on the dating question here; it is not relevant to why the site is cited in this paper. Individual blocks are reported at up to roughly 60 tons; the photograph below, taken during a site visit, shows blocks in this range (Figure 22). Systematic survey of the Aswan granite quarries themselves—including the tool marks, extraction scars, and unfinished blocks left in situ—has been used elsewhere to distinguish ancient quarrying activity from natural rock breakdown (Kelany et al., 2009), a distinction directly relevant to the H1 prediction in Section 3.

Figure 22. Massive granite blocks in the Osirion, Abydos, Egypt, reported at up to roughly 60 tons.

Osirion is referenced here for its relevance to quarrying, long-distance transport, and construction logistics rather than to landscape morphology or chronology: it documents that granite blocks in the tens-of-tons range were quarried, moved roughly 300 km, and precisely fitted, which sets a concrete point of comparison for what is achievable without the lifting and transport equipment available today, independent of when the work was carried out.

8.1.5. Mahabalipuram, India (Type C, F—Contested Boundary between Natural Outcrop and Carving)

Mahabalipuram (Tamil Nadu, India) preserves seventh- and eighth-century CE monolithic rock-cut shrines and reliefs carved directly from granite outcrops, alongside unfinished and uncarved granite boulders in the same landscape. It is a useful comparandum precisely because it documents, at a single site, the full transition from unmodified granite outcrop to finished monument, which is the transition California and Montana observations are trying to evaluate (**Figure 23**).

8.1.6. Giza, Egypt (Accepted Anthropogenic Construction, Partly Granite)

Giza is included for completeness because it is frequently invoked in discussions of this kind, but it is a limited comparandum for landscape-scale granite morphology: the bulk of the visible structure is limestone, and granite use is confined to specific transported elements (Klemm & Klemm, 2008). Its greater relevance is to construction engineering and quarrying technique (Section 8.1.4) rather than to the block-and-terrace morphology documented at Three Rivers and Kirch Flat (**Figure 24**).

Figure 23. The Shore Temple, Mahabalipuram, Tamil Nadu, India: a granite structure carved and assembled directly on a coastal granite outcrop.

Figure 24. The Giza pyramid complex, Egypt (29.9792˚N, 31.1342˚E). Granite is confined to specific internal elements (e.g., the King's Chamber and relieving chambers of the Great Pyramid) and to elements quarried at Aswan; the visible superstructure is primarily limestone.

8.1.7. Akapana, Tiwanaku, Bolivia (Accepted Anthropogenic Construction, Partly Granite)

The Akapana pyramid at Tiwanaku, Bolivia, part of a broader ten-site comparative survey of pyramid engineering (Osmanagich, 2025c) and of the independently documented Tiwanaku monumental complex (Vranich, 2006), incorporates granite blocks alongside sandstone and andesite in its terraced construction. The photographs below, taken during a site visit, show fitted rectangular blocks with recessed joint-fittings characteristic of Tiwanaku masonry (**Figure 25**).

Figure 25. Akapana pyramid, Tiwanaku, Bolivia. (a) Fitted rectangular granite block with recessed joint-fittings. (b) A dressed rectangular block on the terrace surface. (c) Site signage showing the reconstructed stepped-pyramid plan. (d) Fitted blocks at a terrace corner.

Akapana is listed here as a further accepted anthropogenic comparandum for terraced (Type E) and coursed (Type D) granite-inclusive construction; a fuller treatment with site-specific morphological typing is a candidate for a future revision.

8.2. Natural Granite Controls

The following localities are widely documented in the geomorphological literature as natural granite landforms, without independent archaeological evidence of human modification (Twidale, 1982; Migoń, 2006). They are included to define the baseline against which any claim of anthropogenic origin at Three Rivers, Kirch Flat, or the Montana localities must be tested (**Figure 26**).

- **Yosemite National Park, California (Type A, E)**—granite domes and sheeted exfoliation faces produced by unloading and jointing (Twidale, 1982).
- **Joshua Tree National Park, California (Type B, C)**—blocky granite jointing and boulder piles from subsurface weathering along orthogonal joint sets.
- **City of Rocks National Reserve, Idaho (Type A, B, F)**—spires, domes, and orthogonal-jointed outcrops in the Almo pluton, a further Sierra-adjacent example of joint-controlled granite morphology at landscape scale.
- **Dartmoor, England (Type E)**—granite tors formed by differential weathering along joint-bounded corestones, frequently cited as the natural-process baseline for stepped granite outcrops (Twidale, 2002).
- **Matobo Hills, Zimbabwe (Type H)**—extensive granite balancing rocks, conventionally attributed to spheroidal weathering and subsequent removal of

surrounding grus.

- **Huangshan, China (Type F)—**natural granite peaks and pillars produced by joint-controlled erosion, frequently used as a visual comparandum for standing-monolith morphology (Twidale & Bourne, 2003).

A note on Matobo Hills specifically: the balancing-rock morphology there is treated in mainstream geomorphology as a settled natural-process case, and it is listed in that column in Section 8.4 on that basis. The author does not consider that classification closed for every individual formation at the site and regards at least some of them as open to discussion in the same sense as the California and Montana material; that view is personal, is not argued for in this paper, and does not change how Matobo Hills is used here—as the field's own natural-process reference case for Type H.

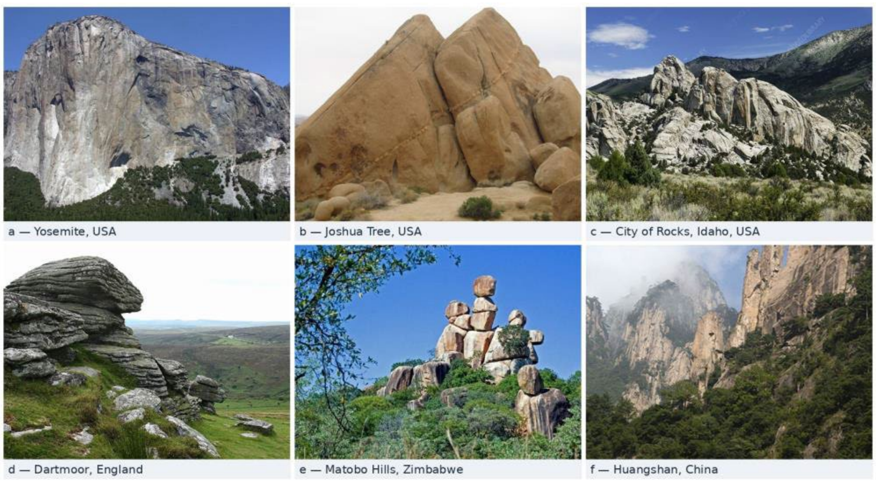

Figure 26. Natural granite reference landscapes. (a) Yosemite National Park, California—granite domes and sheeted exfoliation faces (Twidale, 1982). (b) Joshua Tree National Park, California—blocky granite jointing and boulder piles. (c) City of Rocks National Reserve, Idaho—jointed granite spires and outcrops of the Almo pluton. (d) Dartmoor, England—granite tors formed by differential weathering. (e) Matobo Hills, Zimbabwe—granite balancing rocks, conventionally attributed to spheroidal weathering; see note below. (f) Huangshan, China—granite peaks and pillars from joint-controlled erosion.

8.3. Questioned Sites: California and Montana

Three Rivers and Kirch Flat, California (Section 7), and the Montana localities (Section 4.2) are the two questioned sites evaluated in this paper. Neither is classified here as natural or anthropogenic; both are treated, on typological grounds alone, as candidates for the systematic investigation proposed in Section 10.

8.4. Comparative Summary Table

Table 4 below scores each site for the presence (✓) of each morphological type defined in Section 6, whether the site has independent archaeological evidence of human construction, and its provisional Morphological Complexity Index (MCI, Section 6.1). This is a qualitative first pass based on the material presented here and is intended to be replaced by quantitative feature counts once the survey work in Section 10 is complete; the MCI in particular is not evidence of origin (Section 6.1) and is included only as a compact summary of how many, and which, types co-occur at each site. Montana is not scored in this table: the feature-level dataset needed to support a reproducible score is being assembled for the companion paper referenced in Section 4.2, and Montana is accordingly retained here as qualitative comparative material only.

Table 4. Comparative summary of morphological types, independent archaeological status, and provisional MCI across the questioned, anthropogenic-control, and natural-control sites (Section 8.4).

Site	A	B	C	D	E	F	G	H	Independent archaeology	MCI
Three Rivers, CA	✓	✓	✓	✓	✓	✓			None (questioned)	12
Kirch Flat, CA				✓	✓				None (questioned)	6
Montana	*Not scored—feature-level dataset forthcoming* (*Section* 4.2)								None (questioned)	—
Sardinia				✓		✓	✓		Yes	9
Great Zimbabwe				✓					Yes	3
Hunebedden, Netherlands							✓	✓	Yes	7
Osirion, Abydos, Egypt			✓			✓			Yes (chronology debated)	7
Mahabalipuram, India			✓			✓			Yes	4
Giza, Egypt				✓					Yes	1
Akapana, Bolivia				✓	✓				Yes	6
Yosemite, CA	✓				✓				No (natural)	4
Joshua Tree, CA		✓	✓						No (natural)	3
City of Rocks, ID	✓	✓				✓			No (natural)	4
Dartmoor, England					✓				No (natural)	3
Matobo Hills, Zimbabwe								✓	No (natural)*	3
Huangshan, China						✓			No (natural)	2

Types: A = planar faces; B = orthogonal intersections; C = polygonal block arrangements; D = coursed walls; E = stepped terraces; F = standing monoliths; G = lintel structures; H = balancing megaliths. MCI = Morphological Complexity Index (Section 6.1), a provisional, non-evidentiary weighted sum. *See Section 8.2 for the author's personal reservation about the Matobo Hills classification, which does not change how the site is used in this table.

8.5. Granite Stone Spheres: A Related Global Phenomenon

A separate but related body of field documentation concerns near-spherical stone artifacts, some of them granite. These are a distinct morphological phenomenon from the eight types defined in Section 6 and are not treated as evidence for or against the origin of the Three Rivers or Kirch Flat material; they are noted here because several examples are specifically granite, as opposed to the volcanic, sandstone, or limestone spheres documented at other sites, and therefore fall within the material scope of this paper (**Figures 27-30**).

Figure 27. Polished granite sphere near the Hagia Sophia, Istanbul, Turkey.

Figure 28. Granite sphere near Šibenik, Croatia.

Figure 29. Granite sphere, Teočak, north-eastern Bosnia and Herzegovina.

The best-known stone spheres in the world, from the Diquís Delta region of Costa Rica, are carved from granodiorite rather than granite proper. Granodiorite is a coarse-grained intrusive igneous rock closely related to granite, distinguished mineralogically by a higher proportion of plagioclase relative to alkali feldspar; the two are often discussed together informally, but we keep the distinction explicit here for the same reason we do so elsewhere in this paper (Section 2.1). Over 300 Diquís spheres are documented, some exceeding 2 m in diameter.

Figure 30. Granodiorite spheres, Diquís Delta region, Costa Rica. (a) In situ, partially overgrown. (b) With a person for scale, showing near-perfect sphericity. (c) A museum display of spheres of varying diameters. (d) A sphere mounted for outdoor public display.

Spherical shaping raises a different question from the coursed and stepped morphologies documented in Section 7: a sphere is a much less probable outcome of joint-controlled weathering than a planar face or a right-angle intersection, which makes the natural-versus-anthropogenic question comparatively easier to test case by case (via petrography, internal fabric, and comparison with known spheroidal weathering products) even though it remains open at most individual sites. A fuller treatment of the granite and granodiorite examples in this catalogue, alongside the volcanic, sandstone, and limestone spheres documented elsewhere, is given in a separate study (Osmanagich, 2025b).

9. Discussion

Two baselines bear on how the morphologies documented in Section 7 should be read, and neither should be given priority over the other before the evidence is in. The first is geomorphological. Granite's characteristic orthogonal-to-oblique jointing (sheet joints, cross joints, and exfoliation joints) commonly produces rectilinear block geometry, and differential weathering along joint sets can produce stepped or terraced profiles without any human intervention; well-studied examples occur at Yosemite and Joshua Tree in California, at Dartmoor in England, and at Matobo Hills in Zimbabwe (Section 8.2). The second baseline is archaeological. Several of the world's clearest examples of anthropogenic granite construction—the cyclopean dry-stone walls of Great Zimbabwe, the nuraghi of Sardinia, the worked granite of Osirion at Abydos, and the rock-cut monuments of Mahabalipuram—demonstrate that granite is a workable and durable construction material, repeatedly chosen by very different cultures, capable of producing coursed, rectilinear, and carved forms closely comparable in general appearance to some of what is documented here (Section 8.1). Both baselines are real, both are well documented, and the Three Rivers, Kirch Flat, and Montana material has not yet been tested against either one with quantitative data. A discussion that leaned on the natural baseline alone would be as premature as one that leaned on the archaeological baseline alone; this paper deliberately keeps both open.

The comparative table in Section 8.4 (**Table 4**) makes this concrete: the questioned sites share individual types with both the natural-control column and the anthropogenic column, and no single type documented at Three Rivers, Kirch Flat, or Montana is, by itself, diagnostic of either origin. What would be diagnostic is a pattern—a consistent co-occurrence of types, a non-random spatial arrangement, or a match to the specific coursing or jointing signatures identified in Section 2 and Section 8—and detecting that pattern requires the quantitative survey data proposed in Section 10, not the qualitative table presented here. This is precisely what the H0/H1 predictions in Section 3 are designed to test: H0 predicts that block boundaries and angles will track the regional joint fabric and that dimensional regularity and tool traces will be absent, while H1 predicts systematic departures from that fabric together with prepared surfaces, transported blocks, or associated deposits. Neither prediction has yet been tested against instrument data at either locality. It is worth being explicit that the volume of material documented at both localities—repeated, independent occurrences of coursed, stepped, and paired block morphology across a wide hillside area at Three Rivers, and a comparably large photographic record from Montana—is itself part of what makes the hypothesis in Section 3 worth testing rather than dismissing outright; a single ambiguous outcrop would not.

The author's combined field experience with granite and other stone landscapes at Great Zimbabwe, at Aswan and Giza in Egypt, in Vietnam, in the United Kingdom, and previously in Montana provides a working comparative frame for this assessment, but it is not a substitute for the quantitative, site-specific analysis proposed in Section 10.

It is also worth stating plainly what is at stake in that future work. If Phases 2 - 4 of the research agenda in Section 10 were to establish an anthropogenic component at either locality, the questions that would follow are not academic footnotes but the central questions of the whole inquiry: who built it, when, by what methods, and why. This paper does not attempt to answer those questions, and it would be premature to do so on the morphological evidence alone; but the framework, typology, and phased protocol developed here are designed specifically to make it possible to ask them responsibly, with evidence, if and when the geological and archaeological baselines above are shown not to account for what has been documented.

Limitations

The present study is limited in ways that bear directly on how its conclusions should be read, and we set them out explicitly rather than leaving them implicit.

- **Incomplete exposure—**most of the documented features are partially buried, and their full extent below the current ground surface is unknown. Sections currently interpreted as isolated blocks or short wall segments may connect to larger structures, or may not; excavation is the only way to resolve this (Section 10, Phase 4).
- **Vegetation cover—**dense moss, leaf litter, and brush obscure joint surfaces and contact relationships at Three Rivers in particular, which limits how confidently individual joint planes can be traced or measured from photographs alone.
- **Absence of excavation—**nothing has been excavated at either the California or Montana localities. Every observation in Section 7 is a surface observation; subsurface stratigraphy, buried artifacts, and construction fill (if any) remain entirely unknown.
- **Absence of LiDAR—**no digital elevation model or LiDAR survey exists for either locality, so feature extent, precise dimensions, and site-wide spatial relationships cannot yet be measured quantitatively; the typology in Section 6 was applied by eye, from photographs.
- **Absence of GIS—**without georeferenced feature locations, the spatial-clustering and alignment questions raised in Section 9 cannot be tested statistically; the comparative table in Section 8.4 is a qualitative first pass for exactly this reason.
- **Absence of geophysical survey—**no ground-penetrating radar, resistivity, or magnetometry data exist for either locality, so the subsurface continuity of any feature, and any distinction between surface-exposed natural jointing and a buried anthropogenic structure, remains untested.
- **Absence of independent inter-observer classification—**the Type A-H assignments in Section 7 and Table 3 were made by a single observer. No second qualified observer has yet classified the same imagery independently, so no inter-rater reliability statistic (e.g., Cohen's κ) can yet be reported. This is formalized as a required task of Phase 1 in Section 10.

None of these limitations is fatal to the paper's argument, because the paper's argument does not depend on them: the claim is that the documented morphology justifies the investigation in Section 10, not that the investigation has already been carried out. But they do mean that every interpretive statement in this paper—about either the natural or the anthropogenic baseline—should be read as provisional pending exactly the data these limitations describe.

10. Proposed Research Agenda

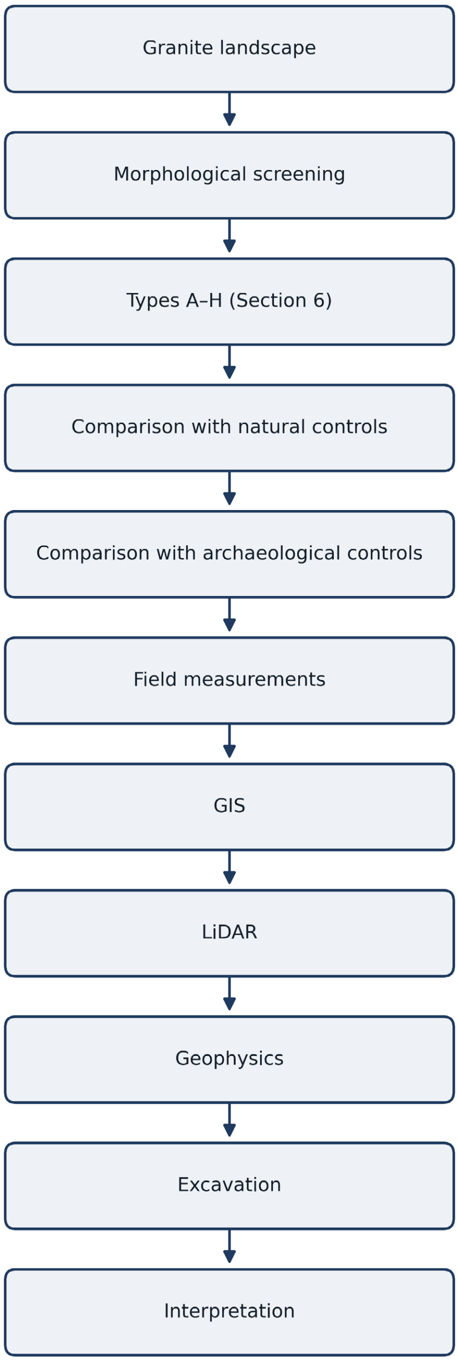

Figure 31. Proposed investigative sequence, from an unscreened granite landscape through morphological typing (Section 6), comparison against the natural and archaeological controls of Section 8, and the field, GIS, LiDAR, geophysical, and excavation stages of Section 10, to interpretation.

On the basis of the preliminary documentation above, the author proposes that Three Rivers and Kirch Flat (California), together with the previously documented Montana localities, be treated as candidate sites for a coordinated, multidisciplinary research program, regardless of what that program ultimately concludes about origin. The program is organized into four phases; later phases depend on the results of earlier ones and are not intended to run in parallel with them. The overall investigative sequence, from an unscreened granite landscape through the four phases below to interpretation, is summarized in **Figure 31**.

Phase 1—Documentation

- Precise GPS/GNSS location of every documented feature, tied to a common geodetic datum across California and Montana localities
- UAV (drone) photogrammetry and orthophoto production for each locality
- Digital elevation modelling (DEM) and, where feasible, airborne or terrestrial LiDAR (Opitz & Cowley, 2013)
- Blinded, independent classification of the Section 7 imagery (and of new Phase 1 imagery) by two or more qualified observers against the operational thresholds in **Table 2** (Section 6.2), with inter-rater agreement reported (e.g., Cohen's κ), directly addressing the single-observer limitation noted in Section 9.1
- Regional structural-geological joint survey (orientation, spacing, frequency) independent of the questioned features, to serve as the natural-process baseline required to evaluate H0 in Section 3

Phase 2—Geology

- Petrographic sampling and analysis to characterize granite composition and weathering state
- Structural-geological mapping of regional joint sets for direct comparison with on-site block geometry
- Schmidt hammer rebound testing and other weathering-rind analyses to estimate relative surface exposure age

Phase 3—Geophysics

- Ground-penetrating radar (GPR) to test for subsurface continuity of features beneath sediment cover (Conyers, 2013)
- Electrical resistivity tomography (ERT) across suspected feature boundaries
- Magnetometry survey where soil and geology permit

Phase 4—Archaeology

- Targeted excavation at features flagged by Phases 1 - 3 as departing from the natural baseline
- Absolute dating of any datable material recovered (e.g., cosmogenic exposure dating of exposed rock surfaces, radiocarbon dating of any associated organic material)
- Systematic artifact recovery and cataloguing, should excavation proceed

GIS-based spatial analysis of feature distribution, clustering, and alignments, and consistent application of the morphological typology in Section 6 across all four phases, run throughout rather than as a separate step. A three-paper structure is envisaged: 1) the present preliminary field documentation and framework; 2) a GIS- and statistics-based spatial and orientation analysis once Phase 1 survey data are available; and 3) a geological-versus-anthropogenic origin assessment incorporating Phases 2 - 4, set against the natural and anthropogenic controls defined in Section 8.

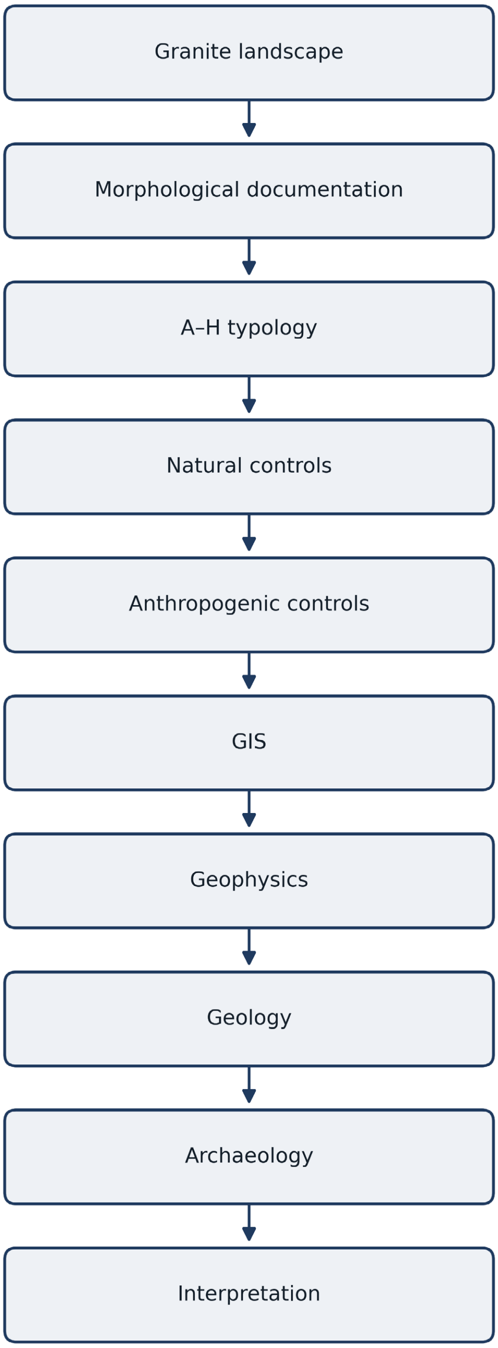

Figure 32. The evaluative workflow proposed in this paper: from an unclassified granite landscape, through morphological documentation and the A-H typology, comparison against natural and anthropogenic controls, and the GIS, geophysics, geology, and archaeology phases of Section 10, to an evidence-based interpretation.

No statistical analysis is included in this paper; the typology in Section 6 and the table in Section 8.4 are qualitative. Once Phase 1 survey data exist, the same framework extends naturally to a quantitative treatment: frequency distributions of each morphological type per site, joint azimuth and spacing statistics compared against the regional structural-geological baseline (following the discontinuity-survey methodology of Priest, 1993), block-dimension and orientation statistics, GIS-based cluster analysis of feature locations, tests of spatial autocorrelation, and Monte Carlo simulation to estimate the probability that an observed spatial pattern could arise from unmodified joint-controlled weathering alone. This is flagged here as the intended subject of Paper 2, not attempted in the present framework paper. **Figure 32** summarizes the full evaluative workflow proposed in this paper, from an unclassified granite landscape to an evidence-based interpretation.

11. Conclusions

Repeated field documentation at Three Rivers and Kirch Flat, California, has produced a substantial photographic record of recurring geometrical granite morphologies—coursed rectilinear exposures, paired blocks, stepped terrace-like structures, and standing monoliths—distributed across a broad hillside area. Comparable morphologies have previously been documented at localities in Montana. Placed against the typology, comparative table, and natural and anthropogenic controls developed in Sections 6 - 8, these recurring forms fall within a range that requires the phased, quantitative investigation proposed in Section 10 before any statement can be made about their origin; this paper does not attempt to make that determination. On the strength of the documented morphology alone, we conclude that both the California and Montana localities warrant systematic, multidisciplinary investigation, and that they merit inclusion, on that basis, in a coordinated future research program applying the same framework to any other granite landscape a future researcher wishes to evaluate.

The principal contribution of this paper, though, is not the interpretation of the California or Montana localities themselves. It is the introduction of a transferable methodological framework—a stated, testable hypothesis (Section 3), an eight-category morphological typology with operational classification thresholds (Sections 6, 6.2), a comparative table set against defined natural and anthropogenic controls, and a phased investigative protocol—for evaluating geometrically organized granite landscapes anywhere in the world. Three Rivers, Kirch Flat, and Montana are this framework's first case study, not its limit; the same typology and protocol apply equally to any granite landscape whose morphology raises the question this paper asks.

Author's Note

The chapters above are written in a deliberately neutral, evidentiary register: they document morphology, state a testable hypothesis, and propose a research protocol, without asserting an origin for the California or Montana material. That restraint is a scientific choice, not a personal one, and it is the reason this paper stands a chance of being taken seriously by geologists and archaeologists who have no reason to trust an unsupported claim. I want to be equally clear about where I stand personally, separately from what the paper itself claims. Having reviewed thousands of photographs from Three Rivers, Kirch Flat, and the Montana localities, and having spent decades in the field at unquestionably anthropogenic granite sites elsewhere in the world, my own assessment is that the volume, consistency, and recurrence of the geometry documented at both localities favor an anthropogenic origin, and quite possibly one more technically accomplished than is currently assumed for either region. That is my opinion, not a finding of this paper, and it is not a substitute for the Phase 1-4 investigation proposed in Section 10—which remains the only process that can actually settle the question. If that investigation eventually supports an anthropogenic component at either site, the questions that will matter most are not whether, but who built it, when, by what methods, and why. I raise them here, briefly and by name, so the reader knows what motivates this research program, even though this paper does not attempt to answer them.

Acknowledgements

I thank Gary Bruce for eighteen months of field documentation at Three Rivers and Kirch Flat, California, and for the photographs reproduced in Section 7 of this paper, without which this preliminary study would not have been possible; his field account and these photographs were first published on the Foundation's website (Archaeological Park: Bosnian Pyramid of the Sun Foundation, 2025, Ancient city in California, https://piramidasunca.ba/en/ancient-city-in-california/). I also thank Julie Ryder for guiding fieldwork at the Montana localities referenced in this paper and for her decade of independent documentation of granite features across that state.

Data and Photograph Selection Note

The Three Rivers and Kirch Flat photographs reproduced in Section 7 were originally published, together with Gary Bruce's field account, on the Foundation's website (see Acknowledgments). Figures reproduced in this paper were selected from that larger photographic archive on the basis of image clarity and their value in illustrating describable morphological features. Photographs whose framing emphasized interpretive or figural readings (for example, purported facial or figural resemblances, or annotated "pyramid-shaped mountain" overlays) were not included in this dataset; they may warrant separate treatment as a question of pattern perception but are not offered here as morphological evidence. A comparable, image-based selection from the Montana archive has not yet been completed and is proposed as a next step (see Section 10).

Most of the remaining photographs in this paper are from the author's personal archive, taken during site visits to Bolivia, the Netherlands, Costa Rica, Bosnia and Herzegovina, Croatia, Egypt, and Montana. The natural-control photographs in Section 8.2 (Yosemite, Joshua Tree, City of Rocks, Dartmoor, Matobo Hills, Huangshan) and the Mahabalipuram photograph in Section 8.1.5 are sourced from Wikimedia Commons under open licenses.

Statement on the Use of AI

Portions of this manuscript—structural organization, drafting and editing of text, image selection from field archives, and formatting of citations—were prepared with the assistance of an AI language model (Claude, Anthropic) under the direction and review of the author. All factual claims, source citations, and interpretive statements were reviewed by the author, who takes full responsibility for the content, accuracy, and conclusions of this paper.

Data Availability Statement

The data supporting the findings of this study consist of field photographs, observational records, and published comparative sources. Additional documentation is available from the corresponding author upon reasonable request.

Author Contributions

Conceptualization, methodology, investigation, comparative analysis, writing—original draft preparation, writing—review and editing, visualization, and supervision: Sam Osmanagich, Ph.D.

Conflicts of Interest

The author is the Founder and Principal Investigator of the Archaeological Park: Bosnian Pyramid of the Sun Foundation. This affiliation did not influence the collection, analysis, or interpretation of the data presented in this study.

References

Bakker, J. A. (1992). *The Dutch Hunebedden: Megalithic Tombs of the Funnel Beaker Culture*. Berghahn Books.

Cady, W. G. (1946). *Piezoelectricity: An Introduction to the Theory and Applications of Electromechanical Phenomena in Crystals*. McGraw-Hill.

Chirikure, S., & Pikirayi, I. (2008). Inside and Outside the Dry Stone Walls: Revisiting the Material Culture of Great Zimbabwe. *Antiquity, 82,* 976-993. https://doi.org/10.1017/s0003598x00097726

Conyers, L. B. (2013). *Ground-Penetrating Radar for Archaeology* (3rd ed.). Alta-Mira Press. https://doi.org/10.5771/9780759123502

Deer, W. A., Howie, R. A., & Zussman, J. (1992). *An Introduction to the Rock-Forming Minerals* (2nd ed.). Longman.

Kelany, A., Negem, M., Tohami, A., & Heldal, T. (2009). Granite Quarry Survey in the Aswan Region, Egypt: Shedding New Light on Ancient Quarrying. In N. Abu-Jaber, E. G. Bloxam, P. Degryse, & T. Heldal (Eds.), *QuarryScapes: Ancient Stone Quarry Land-*

scapes in the Eastern Mediterranean (Geological Survey of Norway Special Publication 12, pp. 87-98). Geological Survey of Norway.

Klemm, R., & Klemm, D. (2008). *Stones and Quarries in Ancient Egypt*. British Museum Press.

Lilliu, G. (1988). *La civiltà dei Sardi: Dal paleolitico all'età dei nuraghi* (3rd ed.). Nuova ERI.

Migoń, P. (2006). *Granite Landscapes of the World*. Oxford University Press. https://doi.org/10.1093/oso/9780199273683.003.0018

Moratto, M. J. (1984). *California Archaeology*. Academic Press.

Opitz, R. S., & Cowley, D. C. (2013). *Interpreting Archaeological Topography: 3D Data, Visualisation and Observation*. Oxbow Books. https://doi.org/10.2307/j.ctvh1dqdz

Osmanagich, S. (2025a). Inherited or Forgotten Knowledge: An Anthropological Inquiry into Global Megalithic Mastery. *Global Journal of Anthropology and Contemporary Societies, 1,* 1-15. https://doi.org/10.5281/ZENODO.17746868

Osmanagich, S. (2025b). The Global Phenomenon of Stone Spheres: New Findings from Zavidovići, Bosnia-Herzegovina and Implications for Prehistoric Technological Knowledge-Featuring the World's Largest Stone Sphere. *Journal of Environmental Science, Sustainability, and Green Innovation, 1,* 1-12. https://doi.org/10.20944/preprints202505.0721.v1

Osmanagich, S. (2025c). Megalithic Pyramid Engineering: A Comparative Study of Scale, Material Use, and Structural Complexity across Ancient Civilizations. *Annals of Civil Engineering and Management, 2,* 1-15. https://doi.org/10.33140/acem.02.02.02

Pikirayi, I. (2001). *The Zimbabwe Culture: Origins and Decline of Southern Zambezian States.* AltaMira Press. https://doi.org/10.5040/9798216417873

Priest, S. D. (1993). *Discontinuity Analysis for Rock Engineering*. Chapman & Hall. https://doi.org/10.1007/978-94-011-1498-1

Twidale, C. R. (1982). *Granite Landforms*. Elsevier. https://doi.org/10.1016/b978-0-444-42116-6.50012-2

Twidale, C. R. (2002). The Two-Stage Concept of Landform and Landscape Development Involving Etching: Origin, Development and Implications of an Idea. *Earth-Science Reviews, 57,* 37-74. https://doi.org/10.1016/s0012-8252(01)00059-9

Twidale, C. R., & Bourne, J. A. (2003). Origin and Inversion of Fluting in Granitic Rocks. *Australian Journal of Earth Sciences, 50,* 543-552. https://doi.org/10.1046/j.1440-0952.2003.01009.x

Twidale, C. R., & Vidal Romaní, J. R. (2005). *Landforms and Geology of Granite Terrains*. Balkema. https://doi.org/10.1201/9781439833704

Vranich, A. (2006). The Construction and Reconstruction of Ritual Space at Tiwanaku, Bolivia (A.D. 500-1000). *Journal of Field Archaeology, 31,* 121-136. https://doi.org/10.1179/009346906791071990