“Lithic Diversity, Population Change, and Mobility: Insights from the GRSLE Dataset”

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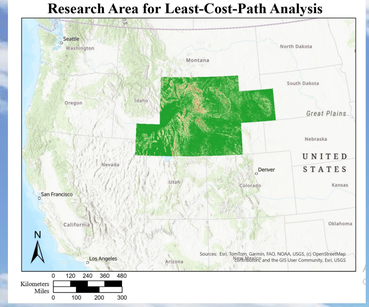
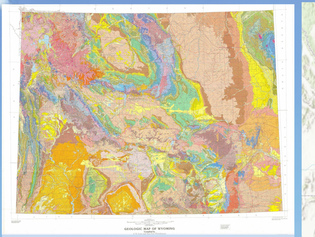
Drawing on more than 250,000 systematically recorded artifacts from the Greybull River Sustainable Landscape Ecology (GRSLE) Project, this study examines lithic raw material diversity across Paleoindian, Archaic, and Late Prehistoric periods in the Absaroka Mountains of northwestern Wyoming. Over 1,800 temporally diagnostic projectile points provide a framework for evaluating long-term trends in raw material use. Using ArcGIS and RStudio, we compare spatial and temporal distributions to assess how demographic change, mobility, and exchange shaped technological choices. Preliminary results suggest that shifts in population density influenced both the relative reliance on local stone and the scope of nonlocal materials present. These findings highlight the value of region, landscape scale approaches for exploring behavioral change, while also situation high-country assemblages in broader regional and interregional contents. By bridging systematic mountain datasets with comparative perspectives this project contributes to ongoing debates about mobility, interaction, and adaptation in the Greater Yellowstone Ecosystem.

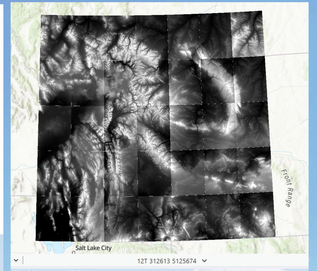
A Distance-Based Model for Tool Material Choice

Research Area for Least-Cost-Path Analysis





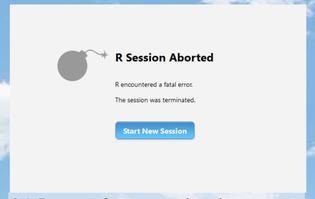
1. Locate Lithic Sources/Quarries and “central point” starting area. (1)(4)



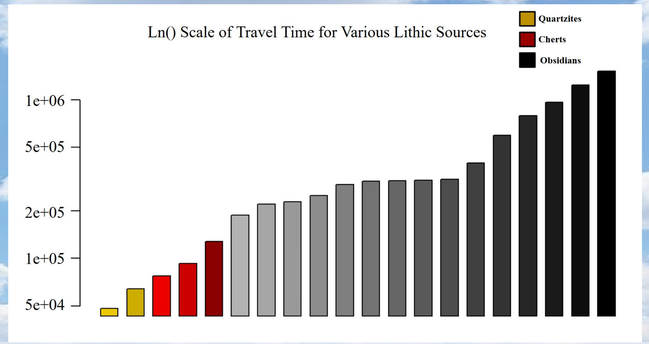
2. Collect DEM data and calculate slope.

$$v_{Lorentz} = c\left(\frac{1}{\pi b\left[1+\left(\frac{\theta-a}{b}\right)^2\right]}\right) + d + e\theta$$

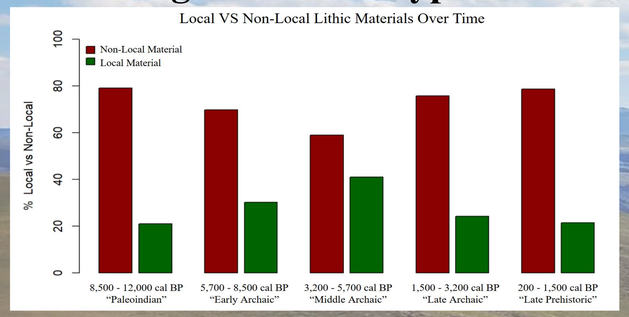
3. Calculate the velocity costsurface from slope. (4)



3.1. Run out of memory and crash computer. Repeat step 3.



Background and Hypothesis



“Local Material” in this case to refer to materials who are geologically sourceable from within the Absaroka Mountain Range. It is hypothesized that this trend is a result of decreasing intertribal mobility and increased establishments of trade for the people living in this region (7).

Expectations

- Higher population density → More intertribal contact → Higher cost of movement → Less access to Non-Local resources
- Higher population density → More intertribal contact → More Trade → Greater access to Non-Local resources
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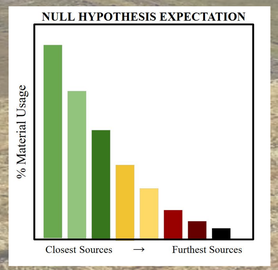
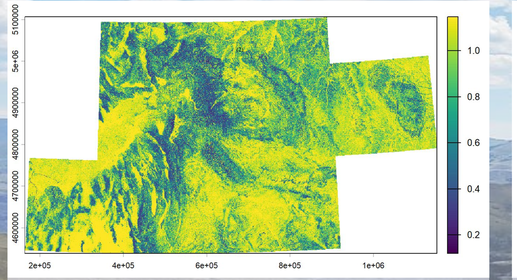
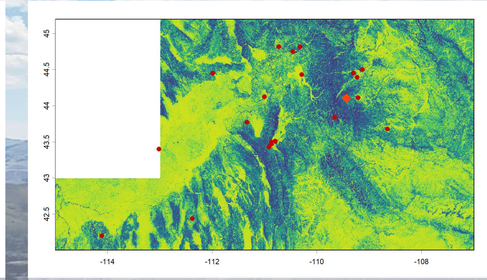
NULL Hypothesis

“Assuming all else is equal, there should be an inverse relationship in the distance to a lithic quarry and the amount it is used within a population.”

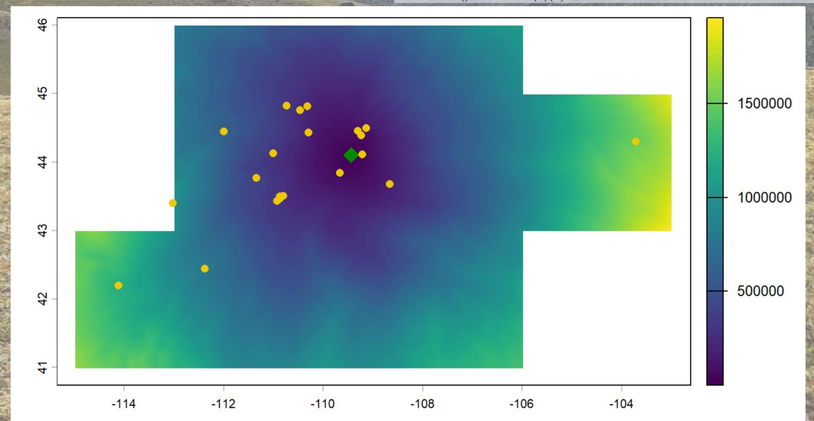




4. Transfer CostSurface to R, utilizing the “terra::rast()” function.(2)(5)



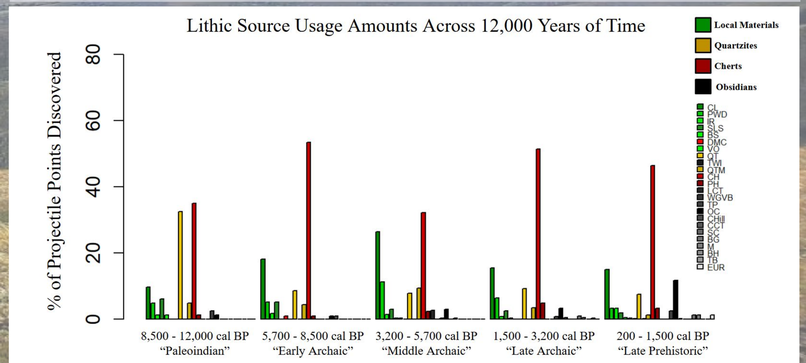
5. Transfer the Lithic source coordinates and starting point to R, utilizing the “terra::vect()” function. (2)(5)



6. Use the “terra::costDist()” function to perform the Least Cost Path analysis then extract the cell values of the quarry sites using “terra::extract()”. (2)

Results

- **Cherts are the most commonly used** resource despite taking ~3 days to travel to.
- **Quartzites are heavily prioritized in the Paleoindian** Lanceolate/Fluted tradition of projectile points, maintains a steady utility throughout other periods. *Potentially due to material durability? Perhaps specific use cases that require quartzite?*
- **Chalcedony contributes the most to the rise and fall of local material usage** from the PL → MA → LP. *Increased reliance may imply the limitation of mobility or the limitation of trade?*
- **Obsidian is extraordinary rare to see before the Late Prehistoric/Precontact**, the significant uptick in usage strongly suggests an increase in material accessibility during that time period. *Social/Group interaction changes? Reintroduction of the Horse? Post-contact trade networks? population shifts?*



Conclusion

We believe that this workflow has a great amount of potential to shape and expand how we interpret landscape-scale archaeological data. Through careful, long-term data collection projects like GRSLE, interesting questions regarding landscape use and mobility can be answered in order to better understand how Indigenous people lived on the vast American Continent.

Future research however, needs to be done, this experiment only shows a simplified model that doesn’t examine all known quarry sites for lithic material. More work will be needed to determine precise quarry locations and to establish more rigorous sourcing methods for non-XRF viable materials. **We only hope that this work has inspired you to think about (and potentially implement!) spatial analytics from a landscape scale into future site recording and research.**

Sources Cited:
(1)Craig Skinner, Jennyfer Skinner, Kathy Davis, and the rest of the team from sourcecatalog.com, the open database for Obsidian sourcing. (2.)Hijmans R (2025). _terra: Spatial Data Analysis_. doi:10.32614/CRAN.package.terra <https://doi.org/10.32614/CRAN.package.terra>. R package version 1.8-80, <https://CRAN.R-project.org/package=terra>. (3)J.D. Love, Ann Coe Christansen, “Geologic Map of Wyoming”, Department of Geology and Geophysics, University of Wyoming, https://www.uwyo.edu/geology/about/geology-map-wyoming.html (4) Michael J. Campbell, Philip E. Dennison, Bret W. Butler, Wesley G. Page, “Using crowdsourced fitness tracker data to model the relationship between slope and travel rates”, Applied Geography, Volume 106, 2019, Pages 93-107,ISSN 0143-6228, https://doi.org/10.1016/j.apgeog.2019.03.008. (5) R Core Team (2025). _R: A Language and Environment for Statistical Computing_. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>. (6) Reckin, Rachel & Todd, Lawrence. (2019). Refining chronology for surface collections: A new adaptation of morphological dichotomous keys for the Plains Typology and the Greater Yellowstone Ecosystem. Plains Anthropologist. 65. 1-29. 10.1080/00320447.2019.1611022.(7) Riley Hamada, Daniel Dalmas, Lawrence Todd, “Designing Research With Little Big Data: Lithic Material Studies in Northwestern Wyoming”, Plains Anthropological Society, http://grsle.org/Conferences/2025%20Posters/Hamada_et_al_PAC_2025_LithicMaterial.pdf

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