Can magnetic susceptibility data separate archaeological palimpsests? A case study from the Hess Creek site in interior Alaska with archaeological prospection implications

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Abstract
Magnetic Susceptibility (MS) is applied at a high latitude Interior Alaskan site. MS is implemented in breaking apart cultural palimpsests. MS acts as a proxy for assigning archaeological traditions and complexes. MS functions as a prospection tool for site excavation expansion.

Keywords
archaeological prospection; interior Alaska; magnetic susceptibility; palimpsests; post-depositional disturbance

Introduction

Archaeological sites containing palimpsests are found the world over; however, they are increasingly common in locations subjected to advanced disturbances, such as areas containing increased bioturbation, cryoturbation, and solifluction (Rapp and Hill 2006). In Interior Alaska, cryoturbation and solifluction are common factors in site disturbance, and they have likely led to differing interpretations regarding site chronology, occupation, and prehistoric landscape use strategies.

In 2021, Northern Land Use Research Alaska, LLC (NLURA) archaeologists conducted partial excavation of the Hess Creek Site (LIV-00001), located 113.5 km north of Fairbanks and 36 km south of the Yukon River, along the Dalton Highway in Interior Alaska (Fig. 1). The partial excavation of the Hess Creek Site was completed as a mitigative measure defined under a Memorandum of Agreement between the Alaska State Historic Preservation Officer and the Alaska Department of Transportation and Public Facilities for a new gravel source in support of road mainte nance and construction projects. While some portions of the Hess Creek Site displayed minimal disturbance, stratigraphic data and artifact provenance throughout most of the location suggest post-depositional displacement from both cryoturbation and solifluction, leading to the formation of a site-wide palimpsest of cultural materials. Additionally, diagnostic artifacts and radiocarbon-dated materials indicate that this location was used repeatedly, beginning in the Terminal Pleistocene up until the Late Holocene, with artifacts typically assigned to three or four chronologically distinct archaeological traditions and complexes.

Materials and methods

During the field effort, both field-based environmental and laboratory-controlled Magnetic Susceptibility (MS) techniques were used to collect additional proxy data that could be used to further separate the collective assemblage into chronologically controlled cultural zones. In all excavation units (EUs) or blocks excavated, samples were taken in a column within locations displaying the lowest degree of visually observed stratigraphic distur-

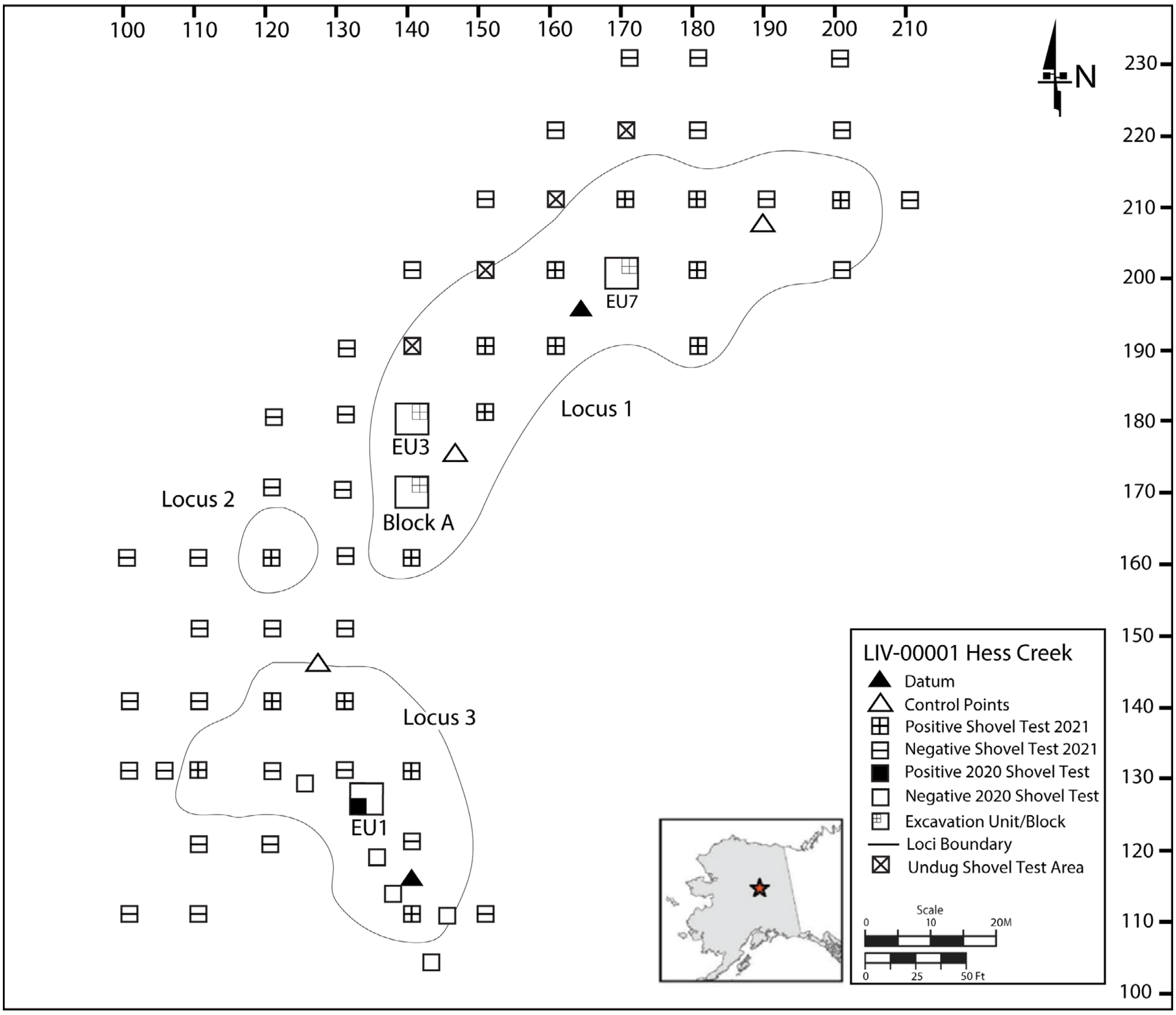

Fig. 1: Location of the Hess Creek Site (LIV-00001) detailing the excavation program across the site and observed loci.

bance. In the field, laboratory MS samples were acquired using five-centimeter-wide cubic boxes arranged vertically within the stratigraphic profile (Fig. 2). Prior to removing sample boxes from the walls of each EU or block, environmental MS was collected using a Bartington MS2E field unit with a MS3 meter and a Trimble Nomad field data logger equipped with Bartsoft software, which is designed to collect MS data directly in the field without additional sampling and processing. This data was taken approximately five centimeters away from, and parallel to, each column of cubic boxes. All samples were taken from the base of the root mat to the base of the excavation, which terminated on bedrock.

While results from the MS2E assembly were acquired directly in the field, laboratory samples needed to be transported and processed before data could be obtained. Data on laboratory MS samples was acquired using a Bartington MS3 meter with an MS2B laboratory-based unit. All samples were dried and placed in scalation vials prior to analysis. Low frequency and high frequency data was collected for each sample and frequency dependence percentages were calculated using Bartsoft software. Previous analyses conducted by Dalan (2006; 2008) show that both frequencies and calculations of percent dependence may provide information regarding cultural behavior at sites, with frequency dependence showing the highest degree of correlation with cultural alteration on the landscape.

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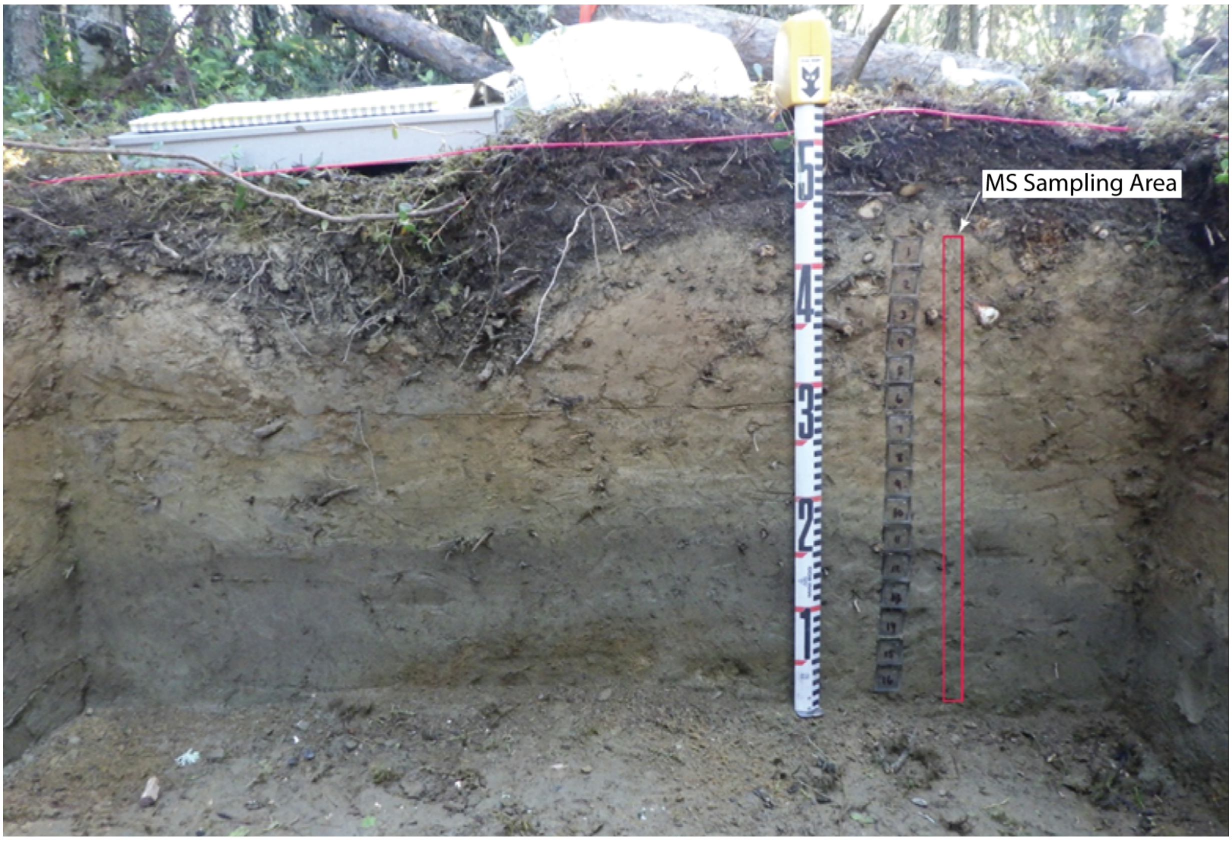

Fig. 2: Example of field and laboratory-based MS column sampling within EU3 and the Hess Creek Site (LIV-00001).

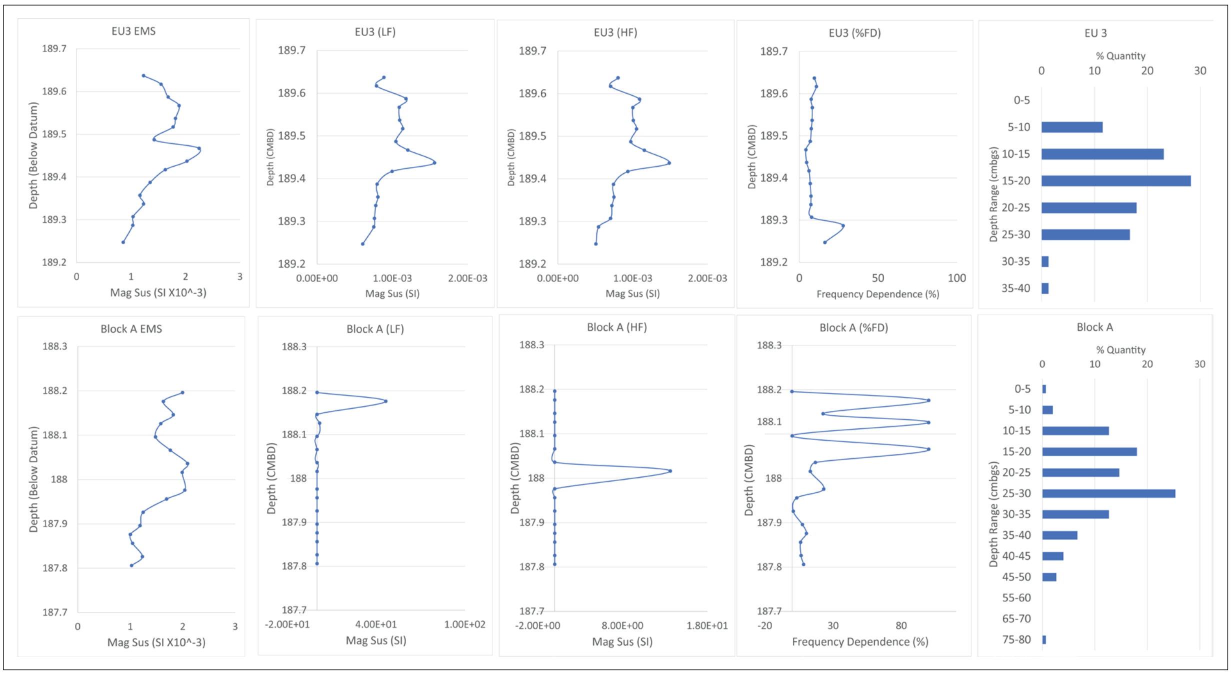

Fig. 3: MS results from EU3 and Block A from the Hess Creek Site (LIV-00001). EMS (Environmental Magnetic Susceptibility) indicates data collected with the MS2E field unit. All following data was collected from processed laboratory samples. Data on the far-right correlates to the percentage of artifacts recovered with five-centimeter excavation levels.

Results

MS data collected from several units at the site could not be properly parsed out due to advanced post-depositional alteration from colluvial forces, cryoturbation, and solifluction; however, results collected from the least visually perturbed sections of EU3 and Block A indicate that layers displaying increased quantities of artifacts with corresponding radiocarbon dates contained heightened MS values (Fig. 3).

Within EU3, an increase in MS values from 25 to 35 centimeters below ground surface (cmbgs) correlates with a larger excavated pit feature dating to 2515 to 2760 calendar years before present (cal BP). Frequency dependence also greatly increases in EU3 from 45 to 50 cmbgs, which is equivalent in depth with the base of the sampled pit feature.

Additionally, data obtained from Block A displays increased MS values throughout the stratigraphic column from 15 to 40 cmbgs alongside an increased quantity of artifacts and radiocarbon dates indicating occupation between 1405 and 1865 cal BP. A small increase in MS was also observed at the base of Block A from 50 to 55 cmbgs. This depth corresponds with the presence of a diagnostic Chindadn projectile point (associated with the Nenana Complex).

Discussion

Heightened MS values often displayed a strong correlation with archaeological layers at LIV-00001. Materials associated with high MS values in EU3 are associated with the Northern Archaic tradition, which spans from approximately 6,000 to 2,000 cal BP within this portion of Interior Alaska (Esdale 2008). Alternatively, higher MS values in Block A likely indicate repeated use of the site associated during the Athabascan tradition, which was present in the region between 2,000 cal BP and Anno Domini (AD) 1880 (Sheppard 2001). However, this pattern may also be the product of cryoturbation, which was visually present in these upper layers. The presence of high MS values at the base of Block A (associated Nenana Complex artifacts) indicates repeated use of the site beginning in the Terminal Pleistocene (between approximately 13,800 and 11,300 cal BP (Hoffecker 1983; Pearson 1997; Powers and Hoffecker 1989)).

Conclusion

Results from this study indicate that MS can be a powerful tool in parsing apart perturbed sites, especially when other proxy datasets are available for comparison. Since palimpsests are not uncommon in Alaska, the adoption of this technique is likely to yield additional informative results in the future and may be useful as a prospection technique for future excavation planning. This is demonstrated by the MS values obtained at the Hess Creek Site which indicate that expansion of both EU3 and Block A to the north and east directions would likely uncover more cultural material from the cultural zones described above.

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