In 2000, apart from Golianovo, a circle (single, diameter to 40 m) appeared also in the Lapas district. It is located to the northwest of the rondel in Golianovo, in a distance of 3 km, i.e. the same distance as the circle ditch in Velky Cetin, which lies to the southwest. In contrast to that ditch, a straight visual contact with the circle in bpas is not possible. Although we do not know the date of either of the two ditch structures, it is not to be excluded that they might belong to Lengyel culture. This may be confirmed in the future. In that case, its connection to the rondel in Golianovo could be supposed, which could fulfil a central function with regard to its size. It could undoubtedly contribute to further explanations of the function and position of circular ditch systems.

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Archaeological prospecting in fortified Great Plains villages: new insights through data fusion, visualization and testing

KENNETH L. KVAMME

In a five year research-oriented program based on geophysical surveys and related methods in the Great Plains of the Dakotas, many new insights and an increased understanding of the prehistoric and historic archaeology have been gained. These projects have employed broad area magnetic gradiometry and resistance survey techniques, EM survey methods (soil conductivity and magnetic susceptibility), together with more focused studies through resistivity tomography and ground penetrating radar (GPR). Aerial photography and centimeter-level mapping of surface microtopography have also been undertaken. In each study common themes have been: (1) use of multiple geophysical survey techniques, (2) use of GIS methods to co-register individual data layers and provide an efficient data management and integration system, (3) use of advanced image processing and data visualization tools, and (4) archaeologi..: cal testing of samples of anomalies for field identification or validation, frequently possible to achieve with a hand-held soil auger.

This research has been conducted for a variety of purposes, including the exploration of data fusion techniques (integrating multiple data sources) at a buried village "invisible" on the surface for the U.S. National Park Service, and a series of mappings of significant cultural features at sites in the North Dakota State Park system for the purpose of increasing tourism potential, particularly in preparation for the bicentennial (in 2004) of the Lewis and Clark Voyage ef Discovery (the primary event chat helped to open the Dakotas, and western North America, for settlement by Euro-Americans). Specific findings in several of the projects provide an indication of the content and promise of these projects. At the Whistling Elk site, in South Dakota, prior knowledge through a salvage excavation suggested an attack and rapid abandonment of this 14"' century village. The geophysical findings reveal more details with additional burned houses and a second village with its own fortification system within the wider village, suggesting a reoccupation and village contraction. An unusually large structure, interpreted as ceremoni:il, was also discovered.

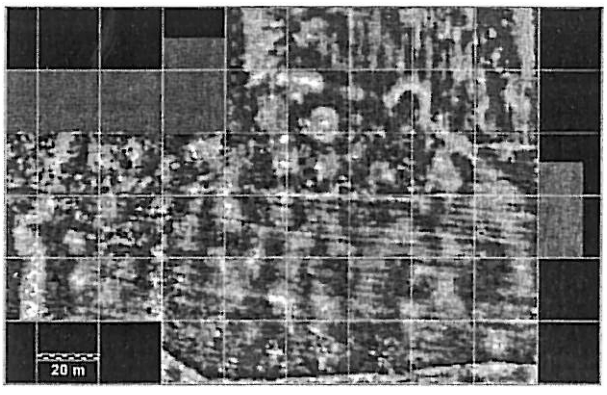


Figure 1: RCB color composite ef *11wg11etic, co11d1 ctivity, aud resisti11ity fi11di11gs, rcspcctiilcly, s/roiviug tlzc distributio11*ef */ro11scs aud Jortificatio11features withi11 vJ//listli11g Elk, a 14"' cc11111ry village* i11 *S0111/i Dakota, USA.*

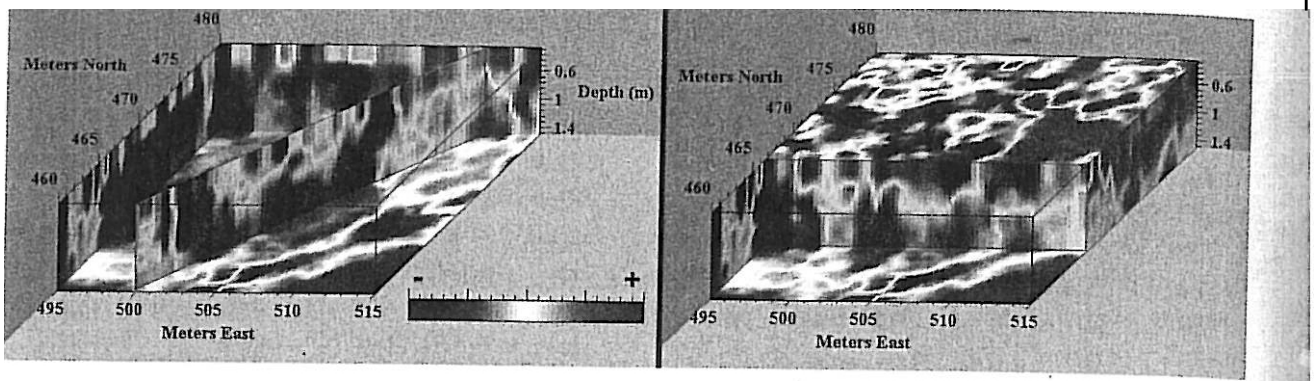


Figure 2: Resisti11ity 10111ograph)' met/rods applied co a 15'" ceit1ury house at Hiifl Village, North Dakota USA, slro111i11_!f lo111 resistivi1y above tire packed earth floor n11d high resistivity below it.

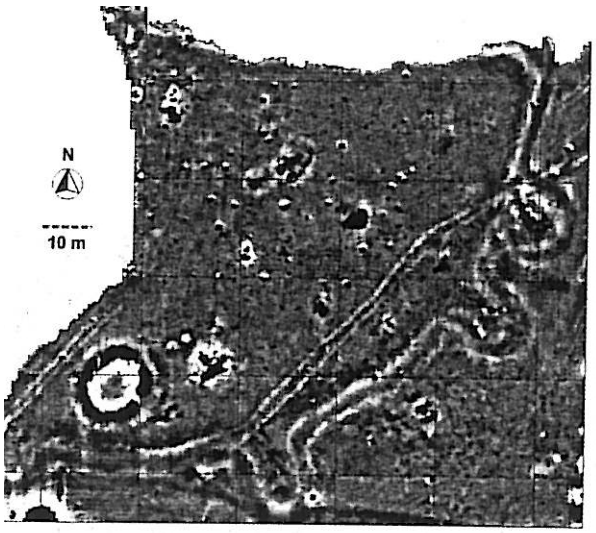


Figure 3: Mng11etic gmdio111etry image if tire early 1J'h ce11tury Me11okcn Village, North Dakota USA, showi,;g the fortifirn1io11 system with bastions, b11med houses, several trails, n11d n11 enrl11, circular, 111ifilled excavntio11.

At Huff, a mid-15th century village in Nore Dakot.1, a central plaza is clearly defined and its ritual significance is underscored by a lack of features within it. The consistent shapes, sizes, and internal organization of regularly spaced houses are emphasized, as is the volume of grain storage indicated by the tremendous number of bell-shaped pit features.

At Menoken, an AD 1200's village in North Dakota, burned houses, indications of house forn1, and an intra-village trail network arc obtained, as is inforn1ation about formation processes related to the fortification system.

At *Mitt11tn-h1111g-kuslr,* an ethnographic Mandan-Arikara village in North Dakota (occupied from about 1822-1861), a 400 m transect reveals numerous houses seen on the surf.ice (as shallow depressions) and in aerial photographs, but also new houses not seen and overlapping ones, suggesting the succession of occupation from Mandan to Arikara. That some houses have many iron artifacts, while others few, may point·to closer trade ties or interactions with nearby posts of the American fur trade.

At Fort Clark, an 1830-1860 fur trade post near *l\\lit111111-lm11g-k11sh,* five geophysical techniques reveal numerous details, particularly after data fusion, including stone foundations, floors, probable areas of burning, a dumping ground, and a Euro-American cemetery.

Many positive benefits have developed from this work. General mappings and identifications of significant cultural features have been achieved within these sites, providing greater underst.1nding of them together with important management and planning documentation.

Anomalies could frequently be culmrally identified with a high degree of accuracy based on their form, content, and spatial context within the geophysical imagery. Such ;momalies include houses, interior house features, grain storage bins, fortification ditches, bastion loops, trails, and village plazas. Archaeologic;al test excavations necessary for site interpretive programs could be placed exactly over anomalies of interest. New primary data has been acquired of great importance to Great Plains archaeology, including information about village layout, fortification systems, village size, the density and number of houses (and population by inference), recognition of aspects of warfare '(through fortifications and burned houses), and the volume of horticultural production (inferred by numbers of grain storage features).

North American archaeologists (generally na'ive about geophysical survey capabilities) have achieved a greater awareness of geophysical remote sensing and, thanks to our generally good results, these methods arc now viewed positively and are in greater demand, particularly in the Great Plains. Pare of the interpretive signage now in place in North Dakota archaeological state parks includes depictions of geophysical survey results, which serves to increase public awareness and support of these methods.

Conclusions about the use of geophysical survey methods, their advantages and shortcomings, and the nature of features they are able co detect in Great Plains contexts, may also be drawn from these studies. Primary among these is the usual success of magnetic and resistance survey methods at these kinds of sites. While the former usually allows definition of trails, house features like hearths, burned roof support post,, and grain storage features, the latter tends to clearly define house outlines and exterior fortification ditches as well as trails. Part of ths-.success of these methods is due to their ability to cover large areas **in** relatively short spans of time. Although the speed, large-area coverage, and high sampling density of magnetic gradiomctry surveys is well-known, it is also possible to conduct rapid resistance surveys of very large areas at high spacial resolution (i.e., 50 x 50 cm) through the use of four simultaneous twin-probe readings taken in parallel at these shallow sites. Electrical resistivity and soil conductivity methods, while theoretically related, tend to produce results with enough new information (owing to very different sensing technologies) to warrant both techniques when possible. Three-dimensional visualization, including the use of animations, of multiple-depth resistivity data (resistivity tomography) and GPR output through time-slicing methods can also add important insights about the nature of complex deposits such as chose that occur in the vicinity of prehistoric houses.

Advances in 3D visualization of georadar data

jiiRG LECKEBUSCH, RONNY PEIKERT, MARKUS HAUSER

Ground penetrating radar or GPR provides full three-dimensional information of the sub-surface and is therefore an excellent prospection method for archaeology. Unfortunately, it is not as easy to extract the three-dimensional information from this data as it is for other geophysical prospection methods. The conventional display of profiles or rime-/depth slices only represents a two-dimensional view of a selected portion of the complete dataset. If appropriate geophysical processing is applied, the whole data cube can be visualised by calculating the iso-surface for a user-selected level. The iso-surfaces are regarded as a representation of the buried structures. This will give a complete view

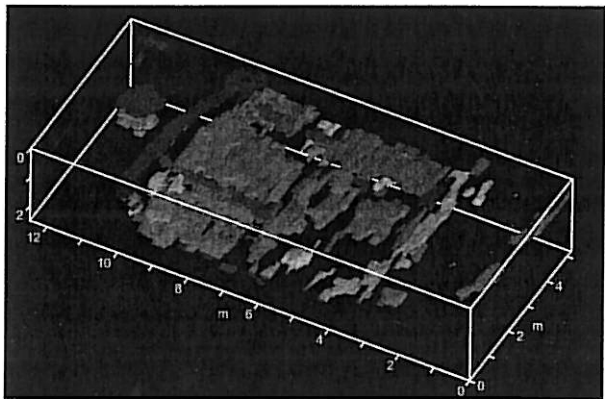


Fig11re 2: After a11 isos111face has been calc11lated, the vol11mes are colo11r-coded and a tltreslwlcl is applied to remove small vol11mes of less sig11ificm1ce.

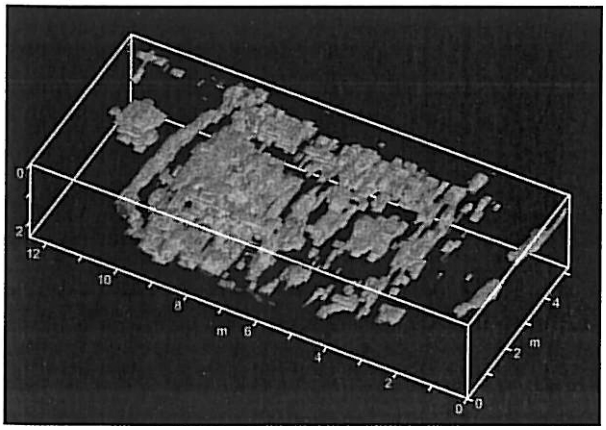
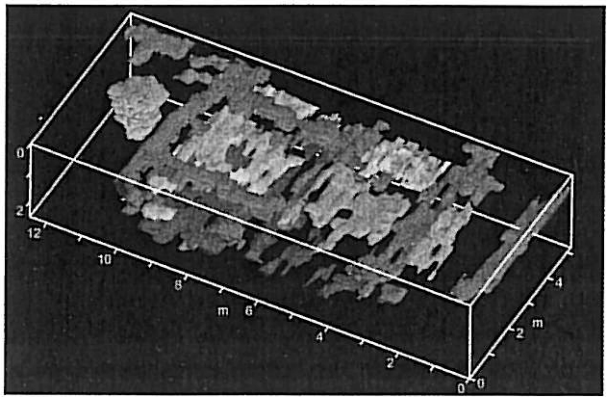


Fig11re 1: Tliree-di111ensio1wl 11irnalizatio11of gro1111d pe11etrati11g radar data. lsosurface represe11tatio11 of a small portiorr of a palace from the romarr to11111 A11g11sta Rm,rica (A11gst) i11 S11itzerla11d.



Figme 3: By 11si11,elocal iso-lc11e/s to tire data ofJig11rc 1, a 11111c/1 heller image ca11 be achie11cd, rcpresentiug the 1111e geometry more precisely.