In: 2003. G. Füleky (Ed.) *Papers of the 1st International Conference on Archaeology and Soils.*
BAR International S1163, pp. 37-44.

AN OVERVIEW OF THE SPATIAL ARCHAEOLOGY OF THE GEELBEK DUNES, WESTERN CAPE, SOUTH AFRICA

Andrew W. Kandel[1], Peter Felix-Henningsen[2] and Nicholas J. Conard[1]

[1] Department of Early Prehistory and Quaternary Ecology
Institute of Pre- and Early History and Archaeology of the Middle Ages
University of Tübingen
Schloss Hohentübingen
D-72070 Tübingen, Germany
e-mail: Andrew-William.Kandel@uni-tuebingen.de
Nicholas.Conard@uni-tuebingen.de

[2] Institute of Soil Science and Soil Conservation
Justus-Liebig-University
Heinrich-Buff-Ring 26
D-35392 Giessen, Germany
e-mail: Peter.Felix-H@agrar.uni-giessen.de

INTRODUCTION

The Geelbek Dunes of the Western Cape Province (South Africa) cover an area of approximately 4 km^2 situated 90 km north of Cape Town in the West Coast National Park (Fig. 1). The deflation hollows located between the wind-blown, mobile sand dunes have long been recognized as a source of mammalian fossils and Stone Age artifacts. In 1998 a team from the Department of Early Prehistory and Quaternary Ecology of the University of Tübingen began fieldwork to systematically study archaeological occurrences in this active dune system (Conard et al. 1999). Over the course of the following field seasons from 1998 through 2001, the team spent over seven months in the field surveying the dunes, collecting samples of the faunal and artifactual remains, and excavating large areas. The team studied the geology and geomorphology of the dunes by excavating test pits, obtaining soil and organic samples for dating and other physical testing, measuring movement of the dunes, and setting up experiments to monitor the movement of objects placed in the dune system.

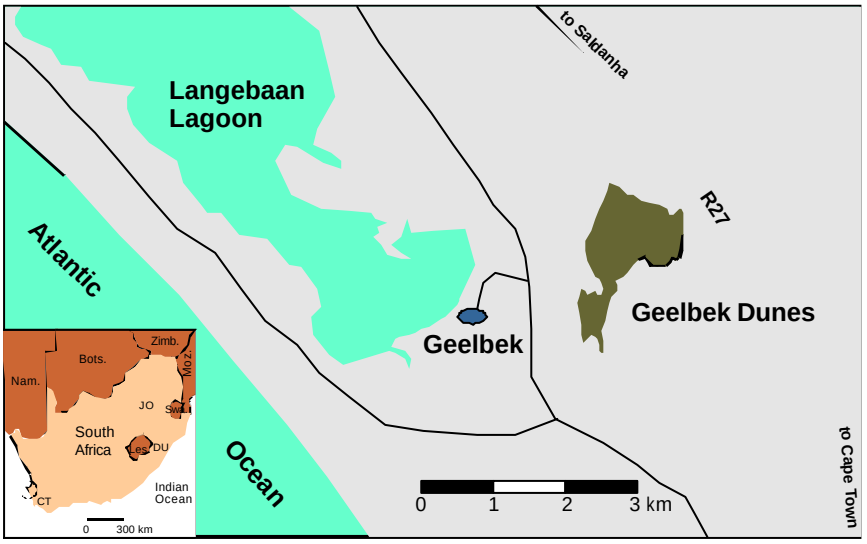

Figure 1. Geelbek. General site location map.

Archaeological research has typically favored well-stratified deposits at cave sites and rock shelter over poorly stratified, open-air sites. Thus, cave sites and rock shelters comprise a large portion of the archaeological record currently available from the Stone Age in South Africa. The differential preservation of archaeological remains further skews this perspective. Although it cannot be denied that cave sites and rock shelters represent key sources of archaeological data, they also present a somewhat biased image of the past. First, the location of these sites does not represent the actual distribution of hominid activities in ancient landscapes. Second, the internal spatial distribution of finds at these sites offers limited information, in that multiple occupations are preserved over a relatively small area. These two factors render the interpretation of the finds and features difficult.

The actual size of most Stone Age archaeological excavations in rock shelters or caves is much smaller than the area necessary to detect spatial patterning in open-air settlements of recent hunter-gatherer, according to ethnoarchaeological sources (Bartram et al. 1991, O'Connell 1987, Yellen 1977). At Geelbek, the detailed piece-plotting and refitting of finds recovered from surfaces in excess of 5000 m^2 has allowed us to address issues such as site type, spatial organization, subsistence dynamics and camp structure in open-air contexts from the Stone Age. These new data augment the existing datasets which often come from cave sites and rock shelters. In this paper, we describe the contribution of some of these open-air localities to the understanding of the paleoecology and archaeology of the Western Cape.

METHODS

Over the course of the systematic survey, 114 deflation hollows in the Geelbek Dunes were visited, their geological and archaeological characteristics described, and their locations measured with a GPS receiver. On the basis of these observations, 22 deflation hollows were chosen for further, more detailed investigation (Fig. 2). The selection of which localities to evaluate was based on several factors. Localities that were judged to be interesting from a specific archaeological or paleontological viewpoint were given higher preference over those less notable. Localities within a variety of geological contexts were chosen to obtain a sample of the different environments exposed between the dunes. Spatial distribution of the localities was considered in order to achieve a sample over the entire area of the dunes. Some localities with low find densities were purposely evaluated to gather as wide a spectrum as possible of the different situations. Finally, the time available for conducting the fieldwork was considered.

Within the 22 localities investigated, a Total Station efficiently and accurately piece-plotted and stored data on almost 30,000 individual finds. The Total Station consisted of a Leica laser theodolite used in conjunction with a Husky field computer and an operating program which was developed by Dibble and McPherron (1996). In addition to individual finds, the Total Station mapped the borders of geological units and measured the local and regional topography.

The majority of finds were found exposed on the surface, either deposited there or, more likely, projected onto that surface by deflation of the overlying strata. Only where geological conditions were favorable was it possible to unearth *in situ* archaeological materials. Systematic excavation was conducted in areas of high surface find densities in order to evaluate the efficiency of the recovery methods, to investigate the local geology and to improve the representation of smaller finds. Some lower density areas were also excavated for comparison.

In: 2003. G. Füleky (Ed.) *Papers of the 1st International Conference on Archaeology and Soils.*
BAR International S1163, pp. 37-44.

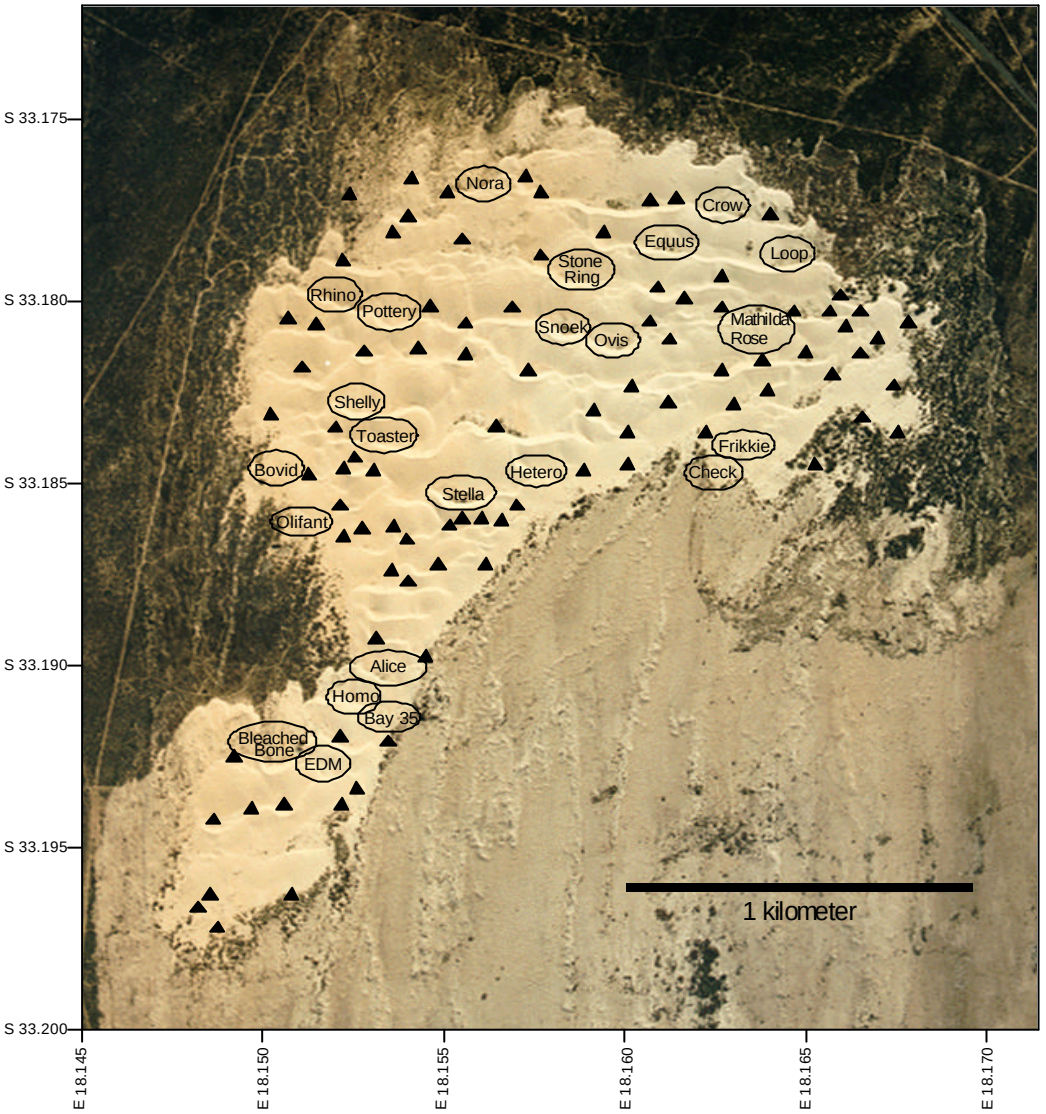

Figure 2. Geelbek. Map of the dunes showing the 22 localities investigated. The other 92 deflation hollows are marked by triangles.

GEOLOGY

Studying the geology of the Geelbek Dunes has been one of the key focal points of this project. Only through the detailed evaluation of the different paleoenvironmental settings of the past 200,000 years can the archaeological finds be placed in a meaningful context. Since a detailed account of the geological results is presented as an accompanying paper (Felix-Henningsen et al., 2002), they are summarized briefly here and in Figure 3.

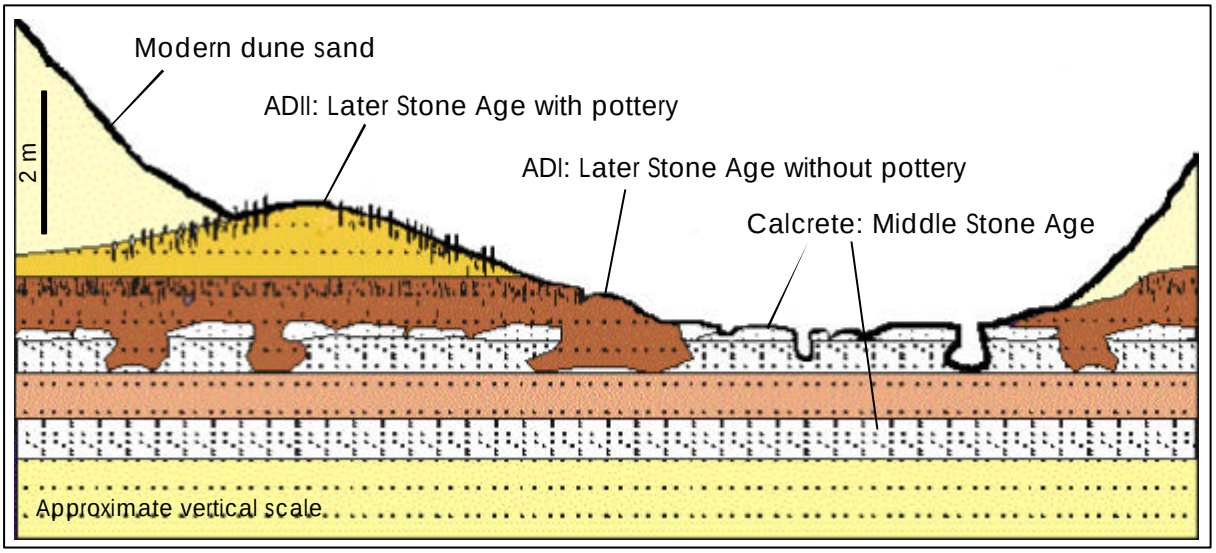

Figure 3. Geelbek. Geological cross-section of the stratigraphy of the dunes, depicting layers of calcrete, ADI, ADII and modern dune sand.

A calcrete substrate is found underlying the entire dune area and is exposed in most of the deflation bays throughout the dunes. Multiple layers of calcrete have been observed at localities such as Stella, Equus, Stone Ring and Rhino. These layers stem mostly from the Middle Stone Age, with U-series dates ranging between 200 and 22 ka BP. A layer of consolidated, dark brown sand overlies the calcrete layers, as seen at localities Nora, Snoek, Homo and Crow. This substrate, known as Ancient Dune I (ADI), formed during the pre-pottery Later Stone Age and has produced IRSL dates between 22 and 2 ka BP. Above the dark brown sand is a layer of yellow sand with calcareous rhizoliths (root casts) called Ancient Dune II (ADII), as seen at Bleached Bone, Pottery, Alice and Stone Ring. This layer is from the Later Stone Age with pottery and yielded IRSL dates from 2 ka BP to present. Finally, loose, wind-blown sand covers the entire sequence of deposits, offering changeable windows into the past.

ARCHAEOLOGICAL RESULTS

The Middle Stone Age

Absolute dates on calcrete from the localities Stella and Rhino provide evidence for the first securely dated archaeological and geological strata at Geelbek at about 150 and 65 ka BP (IRSL & U-Series). At these localities, occasional artifacts and scatters of numerous fossilized animal remains associated with calcrete are attributed to the MSA. Comparisons of finds and exposed geological units from these localities with those of other investigated deflation hollows in the dune field suggest that the MSA has a low-density, widespread distribution both inside and outside the dune field.

MSA peoples at Geelbek selected locally available, lithic raw materials for manufacturing artifacts. Little evidence for clear lithic scatters at MSA occurrences exists, which suggests that primary lithic reduction rarely occurred in the dunes. Rather, tools, cores and blanks were produced elsewhere and transported to Geelbek. Occurring in low density, ephemeral scatters, the finds from the MSA indicate a minimal pattern of activity or a low population density for this period.

Preliminary results of faunal and taphonomic analyses indicate the presence among the fossilized remains of several large mammalian species which became extinct at the end of the Pleistocene. These include the "giant" Cape zebra (*Equus capensis*), the long-horned buffalo (*Pelorovis antiquus*) and the "giant alcelaphine" (*Megalotragus priscus*). These and other species, such as eland (*Taurotragus oryx*), greater kudu (*Tragelaphus strepsiceros*), black hartebeest (*Connochaetes gnou*), black rhino (*Diceros bicornis*), African elephant (*Loxodonta africana*) and blue antelope (*Hippotragus leucophaeus*), are useful in reconstructing the environment at the time of deposition. The presence of these species suggests that grass played a more significant role in the regional vegetation than it does today. During this period when sea level was lower, the distance to the ocean was greater and grasslands covered the resulting coastal plain (Deacon 1982).

While concentrations of artifacts are rare, several concentrations containing the well-mineralized remains of large herbivores, some semi-articulated, have been documented from freshly weathered exposures in Rhino, Stella and Alice. Axial elements, particularly vertebrae, are the most common skeletal elements among the fossil assemblage. Poor surface preservation of the bones precludes the secure identification of cut marks, but other anthropogenic modifications, such as impact fracturing, do occur. Bones that have been chewed by carnivores, gnawed by rodents or burrowed by insects occur frequently.

At locality Equus,1268 fragments of ostrich eggshell (OES) greater than 15 mm were collected from an area of several hundred square meters. The total weight of the OES suggests that this scatter represents at least seven ostrich eggs. Forty-nine of the finds show evidence of human modification in the form of intentional percussion to create a single, rounded opening, some of which are of small diameter and others, large. One piece even preserves two separate, rounded openings. The bimodal distribution of small and large holes and the presence of one OES fragment with two holes suggest that the finds as a whole stem from two-holed water bottles. Preliminary results for a composite sample of the OES resulted in a 14C date in excess of 44 ka BP, placing these finds within the MSA. These data indicate that a cache of two-holed OES water containers was stored at this locality where MSA people probably camped for short periods.

The MSA of Southern Africa represents a period in prehistory in which anatomically modern humans evolved (Deacon & Deacon 1999). During the MSA, people obtained many behaviorally modern traits and likely represent the populations which left the African continent and moved into Asia, Europe and eventually the New World (McBrearty and Brooks 2000). Hominids at this time lived as hunter-gatherers in competition with other carnivores for both game and scavenging opportunities. During the MSA at Geelbek, when sea level was up to 100 meters lower than today (Deacon & Deacon 1999, Shackleton and Opdike 1973), the resulting broad coastal plain appears to represent a location from which mammalian resources were removed by carnivores and hominids and to which lithic resources were brought. Water was cached in OES water bottles for use during local forays. These observations indicate that the archaeological sites at Geelbek were part of a larger cultural landscape.

The pre-pottery Later Stone Age

Finds attributable to the LSA are more numerous than those from the MSA. Stone and bone tools, faunal remains with indications of human modification and bottles made from ostrich eggshell occur more frequently on ADI, although they are also documented on calcrete

surfaces alongside MSA assemblages,. The low frequency of diagnostic stone tools makes it more difficult to correlate these LSA occurrences to established chronologies from local cave and rock shelter sites. However, IRSL dates of the dark brown sand (ADI) suggest an age of 10 to 11 ka BP. Thus, a Terminal Pleistocene/Early Holocene age of the finds is also plausible, corresponding to the Albany Industry of Deacon (1982) and Deacon & Deacon (1999).

Several concentrations of stone tool debris have been documented. These are mostly fabricated on local raw materials, but also occasionally on imported, exotic raw materials. Core reduction methods during this period are dependent on the material used. Bladelets and their cores are common on fine-grained silcrete. Silcrete and quartz were used for the production of backed microliths. Scatters of coarser lithic material, such as quartzite and granitic rocks, indicate an expedient and opportunistic strategy for core reduction.

Faunal analyses are not yet complete for the LSA of ADI, but preliminary results indicate a faunal character similar to that of today. The LSA of Geelbek contains examples of distinct site types. LSA kill/butchery sites can be found at Geelbek, for example at Snoek where the mineralized remains of a butchered eland preserve cut-marks. These remains are spatially associated with over 30 backed microlithic tools and a scatter consisting of several, two-holed, water containers made from ostrich eggshell. At Crow, several bone link-shafts, which are used in composite arrows, have been recovered, thus establishing an association with hunting activities. Other localities preserve hearth features, which indicate places where people lived.

The LSA prior to the introduction of pottery was a period in which anatomically and behaviorally modern humans lived as hunters-gatherers. These populations are seen as direct descendents of the San (Bushmen) of Southern Africa. At Geelbek, hunting activities and occupation sites have been documented, suggesting that this area of the coastal plain played an important role in resource acquisition and was a place where hunter-gatherers lived.

The Later Stone Age with pottery

About 2000 years ago, pastoralists or herders called the Khoekhoen introduced both domestic stock and pottery into the Cape from the north and east. Interaction with existing hunter-gatherers took place, and this is reflected in the artifacts at these sites. At Geelbek, the numerous localities in which pre-pottery LSA sites are preserved differ from LSA occurrences with pottery in the abundance of the different classes of artifacts. In addition to LSA cultural debris, the LSA sites of the Geelbek Dunes with pottery also contain ostrich eggshell beads in all stages of production, concentrations of burned and unburned calcrete blocks, marine shell refuse and shell artifacts. These sites are documented in clear concentrations on ADII, and the spatial information from these sites suggests that these scatters preserve the remains of domestic camps.

As is typical in the dunes, the majority of raw materials are local: quartz and quartz porphyry debitage predominate and indicate the primary, on-site production of stone tools. Lesser amounts of silcrete and quartzite flakes and tools had been made elsewhere and imported to Geelbek. On the basis of raw material composition and tool frequency, the pottery LSA of the dunes shares similarities with the numerous, coastal shell middens (Robertshaw 1979). Among the formal tools, scrapers are the most common, with grinding stones, occasional bored stones and backed microliths present in many of the assemblages. These tools suggest

not only that hunting took place here, but also domestic activities in which wood, plant and other organic materials were processed.

Preliminary analyses indicate that much of the fauna may be attributed to natural deaths and kills by small carnivores. The identified faunal remains include steenbok (*Raphicerus campestris*), Cape grysbok (*R. melanotis*), gray duiker (*Sylvicapra grimmia*), tortoise (*Chersina angulata*) and Cape hare (*Lepus capensis*). Many remains of small bovids carry traces of damage induced by non-human carnivores, and anthropogenic modifications are rare. However, it cannot be ruled out that carnivores, which further modified the assemblages, visited abandoned campsites. The absence of remains of domesticated animals at these sites suggests that hunter-gatherers, and not pastoralists, occupied the dunes.

The use of marine resources is clearly documented at Geelbek and establishes a clear link to both the lagoon and seashore. Marine shell is present at most of the localities, most notably Shelly, Check and Pottery. The black mussel (*Choromytilus meridionalis*) dominates the marine assemblages, followed by the white sand mussel (*Donax serra)* and limpets (*Patella* sp.) At Shelly and Toaster broken valves of *D. serra* have been consistently chipped along the broken edge to form simple scrapers. The remains of fish are less common. Of the analyzed fish remains, only 2 finds of the white sea catfish (*Galeichthys feliceps)* have been identified from Matilda Rose.

The presence of pottery at many localities reflects occupation by hunter-gatherers, pastoralists, or a combination of both. Fragments of pottery vessels are abundant at localities such as Toaster, Pottery, Stone Ring and Nora. Entire vessels from both Pottery and Stone Ring have been reconstructed. Pottery, or at least the ability to make it, was probably obtained from the pastoralists (Yates & Smith 1993). Thus, the trade of material goods and cultural exchange between the two groups were probably common.

Beads made from OES occur frequently at several localities in the dunes, for example Nora, Pottery and Toaster. Smaller, thin-walled beads overwhelmingly predominate over the larger variety. The size of ostrich eggshell beads has been used elsewhere to differentiate between hunter-gatherers and pastoralists (Yates 1995). The smaller bead size at Geelbek suggests that hunter-gatherers produced them. The production of both natural and blackened beads can be demonstrated at localities such as Nora and Pottery, where all stages from OES blanks to fully fashioned beads are present. This observation indicates that people lived at these places for longer durations.

Localities such as Pottery, Toaster and Equus preserve hearth features composed of concentrations of blackened blocks of calcrete. The concentric blackened calcrete is mostly fragmented into pieces under 10 cm with the largest individual blocks ranging up to 30 cm. This type of feature is interpreted as a roasting pit or platform (Avery 1974, Robertshaw 1979) and also supports that these localities served as places where people lived for longer durations.

At three localities, Homo, Hetero and Loop, small scatters of human remains have been identified. Current AMS 14C dates of these specimens give rough ages in the LSA with pottery. The bones appear to represent the remains of three disturbed burials of individuals who were probably interred near their area of discovery.

The pottery LSA on ADII represents a period in Southern Cape prehistory in which two populations of indigenous Africans, the San and Khoekhoen co-existed in the Cape. Finally,

historic artifacts attributable to the European settlers are present in small numbers on ADII and demonstrate that colonists also visited the dunes after they reached the Cape in 1652. For example, the provenience of three clay pipes was traced back to their European roots, glazed pottery sherds and glass fragments were examined, and metallic artifacts such as horseshoes and shell casings were collected in the dunes.

ASSOCIATED STUDIES

In additional to the archaeological field work, several associated studies were initiated in the fields of geology, experimental archaeology and geography. The geological investigation, including physical dating, clearly plays a crucial role in understanding the evolution of the Geelbek dune field. The results are summarized in this paper and presented in greater detail in an accompanying paper in this volume (Felix-Henningsen 2002).

Studies in experimental archaeology sought to duplicate the conditions necessary to recreate some of the various find types that were observed in the dunes. For example, fragments of ostrich eggshell were burned to achieve the different coloration of the OES beads by controlling the level of oxygen and organic materials present. Another experiment sought to fabricate OES beads in order to qualify which methods were most effective in making these ornaments. Calcrete was also burned in an attempt to duplicate the conditions necessary to blacken the blocks frequently observed in large concentrations in the field.

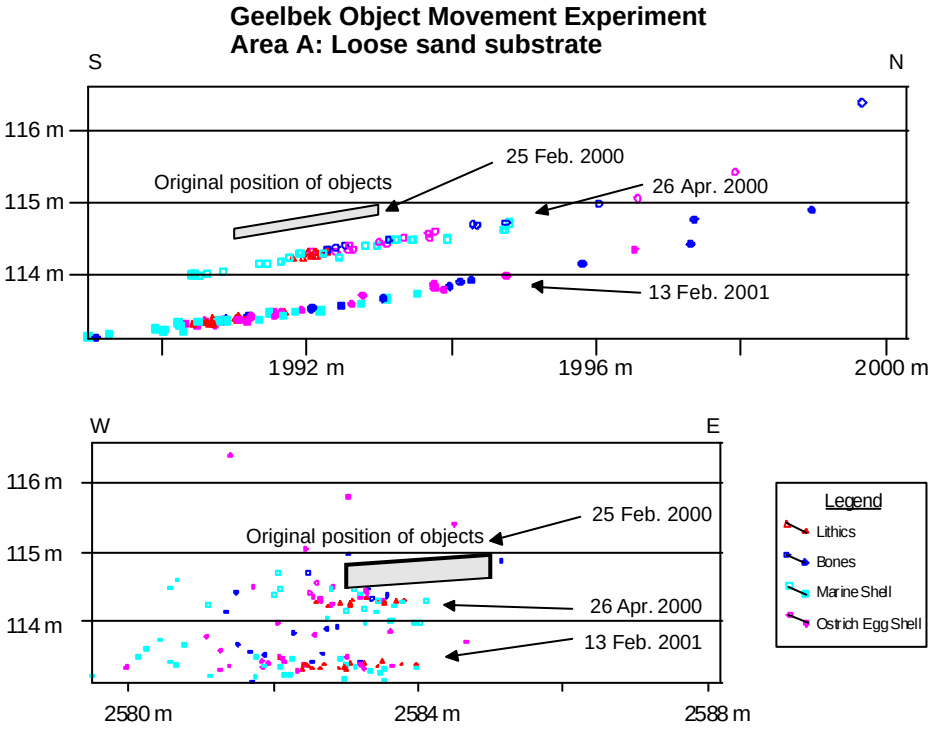

Figure 4. Geelbek. The cross-section of GOME, Area A shows that vertical deflation of approximately 1.5 m has occurred in just one year.

Another project in experimental archaeology, dubbed GOME (Geelbek Object Movement Experiment), involved placing several categories and shapes of objects on the different geological strata to monitor their subsequent movement over time. On 25 February, 2000, One hundred objects each were placed in 2m grids on loose sand, compact dark brown sand

(ADI) and on exposed calcrete. GOME has continued for 2 years with the results shedding insight into the way in which large-scale dune movements affect the taphonomy of these objects. The results confirm that deflation in these dunes occurs rapidly with the loss of 1.5 meters of dune sand documented in the first year (Fig. 4). Objects scatter not only in the predominant wind direction but are also strongly affected by the slope and stability of the surface on which they lay (Fig. 5). The shape and density of objects also plays a significant role in how far they move.

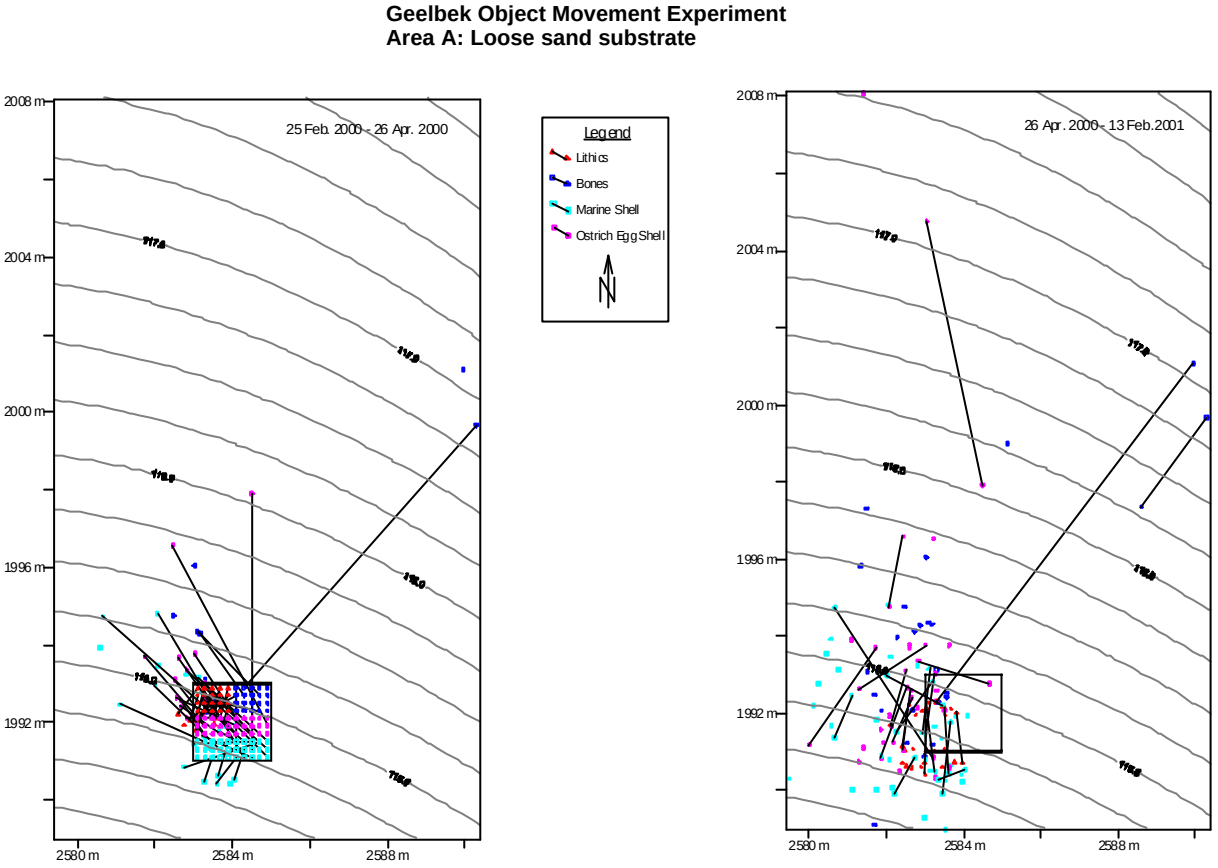

Figure 5. Geelbek. The plan of GOME, Area A demonstrates how artifacts generally moved downhill (westwards and southwards), despite the prevailing wind direction from the south.

In a geographical experiment to monitor large-scale movement of the dunes, the outlines of several of the deflation hollows were measured annually. In this way, the track of the dunes has been monitored. The rate in which the dunes migrate and expose new surfaces in the Geelbek system is not uniform and varies greatly depending on the specific setting Over the course of the project some of the deflation hollows in the Geelbek Dunes have been observed to move a maximum of 25 meters in one year, with an estimated average of about 10 meters per year (Fig. 6).

While the deflation bays moved northwards, the external boundaries remained stable over the course of the project. At the edge of the dune field, vegetation hindered the movement of the dunes, and the basic topographic structures remained fixed. Sand tended to accumulate slowly, as evinced by the gradual burial of fixed measuring stakes.

In: 2003. G. Füleky (Ed.) *Papers of the 1st International Conference on Archaeology and Soils.*
BAR International S1163, pp. 37-44.

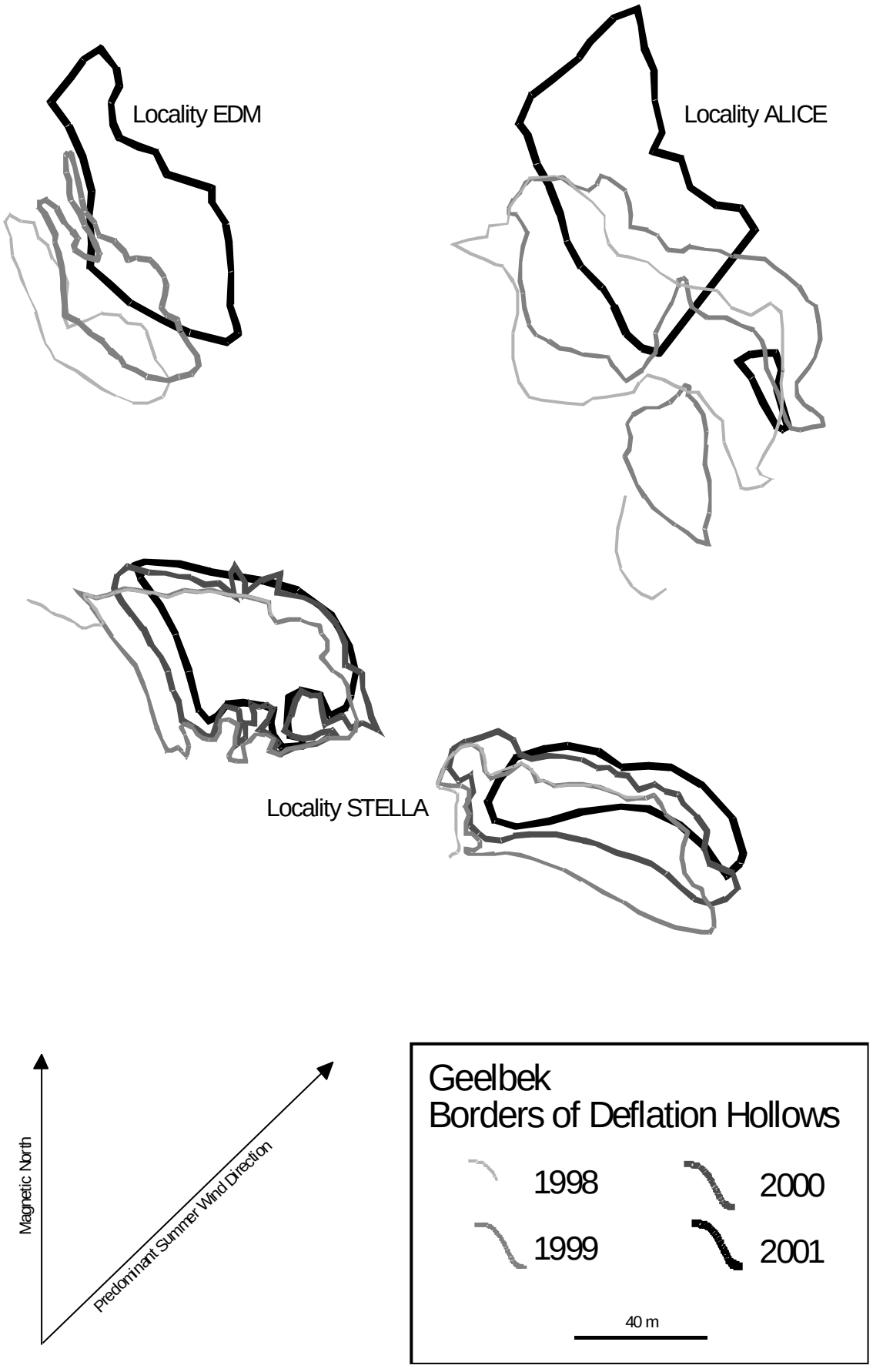

Figure 6. Geelbek. Schematized plan of localities EDM, Alice and Stella, showing relative movement of the dunes from 1998 through 2001.

CONCLUSIONS

Fieldwork and analyses of finds from Geelbek show the critical link between archaeology and soil science in prehistoric research. Open-air localities provide an important, source of information on paleoecology, Stone Age behavior, settlement, and landscape use when studied using interdisciplinary methods. Data from archaeological and pedological work at Geelbek contribute to the archaeological and ecological record of the region and allow us to correlate locally observed phenomena with the broader regional history. Differences in find frequencies and distributions are the result of geological, as well as cultural processes. Thus, this information represents a significant resource regarding prehistoric site formation and taphonomy and provides new insight into diverse aspects of past behavior including subsistence practices, raw material economy and landscape use.

ACKNOWLEDGEMENTS

Without financial support from the German Science Foundation (*Deutsche Forschungsgemeinschaft*) this project would not have been possible. Further logistical assistance from Iziko-Cape Town (South African Museums) has also helped us to achieve our goals. The staff at West Coast National Park has generously supported the work at Geelbek. Many students from the University of Tübingen and the University of Cape Town have also contributed their hard work to the Geelbek project. Particular thanks are due many colleagues for their support of the work at Geelbek, including G. Avery, J. Compton, J. Deacon, M. Leslie, J. Parkington, D. Roberts and S. Woodborne. Specific thanks are owed to M. Malina, T. Prindiville and T. Tonner for their significant contributions to this paper.

REFERENCES

Avery, G. 1974. Open station shell midden sites and associated features from the Pearly Beach area, south-western Cape. *South African Archaeological Bulletin* **29**:104-14.

Bartram, L. E., E. M. Kroll and H. T. Bunn. 1991. Variability in camp structure and bone food refuse patterning at Kua San Hunter-Gatherer camps. *In* The Interpretation of Archaeological Spatial Patterning, ed. E. M. K. and T. D. Price, pp. 77-143. New York: Plenum Press.

Conard, N. J., T. J. Prindiville and A. W. Kandel. 1999. The 1998 fieldwork on the Stone Age archaeology and palaeoecology of the Geelbek Dunes, West Coast National Park, South Africa. *Southern African Field Archaeology* **8**:35-45.

Deacon, J. 1982. The Later Stone Age in the Southern Cape. Doctoral Thesis: University of Cape Town.

Deacon, H. and J. Deacon.1999. Human Beginnings in South Africa: Uncovering the Secrets of the Stone Age. Cape Town: David Philip Publishers.

Dibble, H. L. and S. P. McPherron. 1996. A Multimedia Companion to the Middle Paleolithic site of Combe-Capelle Bas (France). CD-ROM. University of Pennsylvania.

Felix-Henningsen, P., A. W. Kandel and N. J. Conard. 2002. The significance of calcretes and paleosols on ancient dunes of the Western Cape, South Africa, as stratigraphic markers and paleoenvironmental indicators. *In* Title of this Volume, ed. G. Füleky. Proceedings of the 1st International Conference on Soils and Archaeology, Százhalombatta, Hungary, 30 May-3 June, 2001.

McBrearty, S. and A. S. Brooks. 2000. The revolution that wasn't: A new interpretation of the origin of modern human behavior. *Journal of Human Evolution* **39**:453-563.

O'Connell, J. F. 1987. Alyawara site structure and its archaeological implications. *American Antiquity* **52**:74-108.

Robertshaw, P. T. 1979. Excavations at Duiker Eiland, Vredenburg District, Cape Province. *Annals of the Cape Provincial Museums* **1(1)**:1-26.

Shakleton N. J. and N. D. Opdike. 1973. Oxygen isotope and paleomagnetic stratigraphy of equatorial Pacific core V28-238: oxygen isotope temperatures and ice volume on a 10^6-year scale. *Quaternary Research* **3**:39-55.

Yates, R. 1995. Appendix B: Report on the analysis of ostrich eggshell beads from Geduld. *Southern African Archaeological Bulletin* **50**:17-20.

Yates, R. and A. Smith 1993. Ideology and hunter/herder archaeology in the South Western Cape. *Southern African Field Archaeology* **2**:96-104.

Yellen, J. E. 1977. Archaeologcial Approaches to the Present: Models for Reconstructing the Past. New York: Academic Press.