

FINAL PERMIT REPORT

Final archaeological research excavation

Archaeological excavations at Lovedale, Free State Province: the 2021 season.

Permit number: 2862

SAHRIS Case ID: 13324

Authors: Michael Toffolo, Kristen Wroth, Maïlys Richard, Lloyd Rossouw

Date: 10 February 2022

SAHRA permit officers: Ragna Redelstorff and Philip Hine

Date of permit issue: 4 February 2019 (amended on 12 March 2020)

Expiry date of permit: 28 February 2022

Permit holder: Dr. Lloyd Rossouw (holder), National Museum Bloemfontein; Dr. Michael Toffolo (co-holder), Bordeaux Montaigne University, France

Permit to: Dr. Lloyd Rossouw (National Museum Bloemfontein) and Dr. Michael Toffolo (Bordeaux Montaigne University, France), in collaboration with Prof. Britt Bousman (Texas State University, USA), Prof. Daryl Codron (University of the Free State, South Africa), Prof. Christopher Miller (University of Tübingen, Germany)

Site name: Lovedale

Object ID: 129110

Executive summary

The site was excavated from 7 to 20 September 2021, using the same site grid established in 2019. The 2021 season was dedicated to the full excavation of Unit 8 in Area A, which was laid out in 2019 but not excavated, and to the opening and excavation of two additional squares in Area A, Unit 12 and Unit 13. Units were excavated by arbitrary levels 10 cm thick using pointing trowels, patches, and small picks due to the hardness of clay-rich layers, down to a depth of 50 cm below surface (except for Unit 12, 20 cm below surface). All levels were photographed and plotted. Unit 9, opened in 2019 in the gravel layer at the bottom of Area A, was expanded by 2 m² to recover additional faunal material for electron spin resonance dating. Artifacts, bones, and sediment samples were 3D-plotted using a total station and labeled using progressive numbers, whereas excavated sediments were sieved through a 4-mm mesh to recover small lithic flakes and bone chips. Artifacts were 3D-plotted and collected out of context at the bottom of the donga and at the top of Area A. At the end of the season, trenches were backfilled with sandbags. Based on the results of the 2019 and 2021 laboratory analyses, seven sedimentary units (SUs) were identified and described at the site. Sediments reflect different flow regimes of the Modder River and were accumulated mainly as overbank deposits, which underwent different degrees of pedogenesis (bioturbation, illuviation of clay minerals, precipitation of calcium carbonate, nucleation of iron-

manganese nodules). At least two hiatuses were observed in the sequence (missing soil A horizons), but their length is thought to be limited based on dating results. Phytolith analysis revealed that the sequence is dominated by C₃ grasses (temperate climate), except for the occupation layer, characterized by a spike in arid conditions as represented by short cells of C₄ grasses (arid climate). Most artifacts recovered were concentrated in excavation levels 3-4 (20-40 cm below surface) at the top of SU4 and within SU5, formed during a period of minor overbank deposition of the Modder, and show characteristic features of Middle Stone Age technology, although the reduction process is not known outside the Free State. Projectile points are the most distinctive formal tool and exhibit bifacial trimming of the base to facilitate hafting; these characteristics were observed at only a few contemporary sites in the region. A dating program based on optically stimulated luminescence (OSL) of quartz sand established the age range of the human occupation between 77,000±7,000 and 56,000±6,000 years ago. One OSL sample collected next to a projectile point at the base of the occupation layer produced the age range 77,000±7,000 to 69,000±7,000 years ago, which can be considered the earliest occupation at the site. Electron spin resonance dating coupled with uranium-series dating (ESR/U-series) of herbivore teeth recovered from the gravel layer produced a minimum age (caused by uranium leaching in tooth enamel) of 63,000±3,000 years ago (weighted mean), with the oldest sample dated to 68,000±15,000 years ago, in agreement with the OSL dates obtained from the overlying sedimentary units.

SAHRIS object links

Lovedale: <https://sahris.sahra.org.za/sites/lovedale>

OSL samples: <https://sahris.sahra.org.za/objects/lov-dmv2019osl>

Sediment samples (2019): <https://sahris.sahra.org.za/objects/lov-dmv2019sediment>

Sediment samples (2021): <https://sahris.sahra.org.za/objects/lov-dmv2021sediment>

Bone samples (2019): <https://sahris.sahra.org.za/objects/lov-dmv2019bones>

Bone samples (2021): <https://sahris.sahra.org.za/objects/lov-dmv2021bones>

Export permit for OSL samples (2019): <https://sahris.sahra.org.za/cases/export-permit-2019-osl-samples-lovedale-and-damvlei>

Export permit for bone and sediment samples (2019): <https://sahris.sahra.org.za/cases/export-permit-2019-sediment-and-bone-samples-lovedale-and-damvlei>

Export permit for bone and sediment samples (2021): <https://sahris.sahra.org.za/cases/export-permit-2021-sediment-and-bone-samples-lovedale-and-damvlei>

Location details

Location name: Farm Lovedale 1844

GPS coordinates: 28°54'2.35"S 25°41'7.69"E

Nearest town: Dealesville

Local District: Petrusburg

Magisterial District: Petrusburg

Province: Free State

Approximate age of materials: sediments cover approximately the last 80,000 years, whereas artifacts are 77,000 to 56,000 years old; results are based on OSL dating of quartz sand and ESR/U-series of tooth enamel.

List of all participating researchers (2019 and 2021 seasons together)

- Dr. Michael Toffolo, Bordeaux Montaigne University (France): director of excavations, infrared spectroscopy analysis of bones.
- Dr. Kristen Wroth, University of Tübingen (Germany): excavation, registrar, phytolith analysis, sediment analysis using infrared spectroscopy and micromorphology.
- Prof. Britt Bousman, Texas State University (USA): excavation, site survey, lithic analysis.
- Dr. Chantal Tribolo, Centre National de la Recherche Scientifique (France): OSL dating.
- Dr. Lloyd Rossouw, National Museum Bloemfontein: excavation, phytolith analysis, curation of artifacts and faunal material.
- Mr. Isaac Thapo, National Museum Bloemfontein: excavation.
- Mr. Jacob Maine, National Museum Bloemfontein: excavation.
- Mr. Abel Dichakane, National Museum Bloemfontein: excavation.
- Dr. Liora Kolska Horwitz, Hebrew University of Jerusalem (Israel): faunal analysis.
- Dr. Maily's Richard, Centro Nacional de Investigación sobre la Evolución Humana (Spain): excavation, ESR/U-series dating.
- Prof. Daryl Codron, University of the Free State: stable isotopes analysis of tooth enamel.
- Prof. Christopher Miller, University of Tübingen (Germany): micromorphological analysis of sediments.

Curation of materials

Name of institution: Florisbad Quaternary Research Department, National Museum Bloemfontein

Name of curator: Dr. Lloyd Rossouw

Phone number of curator: 0842505992

Email address of curator: lloyd@nasmus.co.za

Institutional address: 36 Aliwal Street, 9300 Bloemfontein

Storage: lithics and faunal material are stored in ziplock plastic bags labeled with progressive numbers, which are kept in labeled carton boxes. Each number corresponds to specific spatial coordinates and Unit/Level numbers. Bulk sediment samples are stored in plastic vials. A

comprehensive list of all materials extracted from the excavation and their spatial coordinates is available in an Excel worksheet at the National Museum Bloemfontein, as well as fieldwork photos.

Specific information of the 2021 season

Responsible person 1 <i>Full name:</i> <i>Position/academic level:</i>	Dr. Michael Toffolo Associate researcher Bordeaux Montaigne University, France
Responsible person 2 <i>Full name:</i> <i>Position/academic level:</i>	Dr. Kristen Wroth Postdoctoral researcher University of Tübingen, Germany
Responsible person 3 <i>Full name:</i> <i>Position/academic level:</i>	Dr. Lloyd Rossouw Head of the Florisbad Quaternary Research Department National Museum Bloemfontein
Number of participants	6
Duration of field work	7-20 September 2021
Excavation equipment used (e.g., trowels, picks, chisels, total station, screen mesh sizes)	Pointing trowels, patches, and small picks were used for excavation; dentistry tools were used to uncover stone tools; pickaxes and shovels were used to clean profiles along exposed donga sections. All sediments were sieved through a 4 mm mesh. Excavation grid and units, artifacts, bones, sediment samples, and off-excavation surface finds were 3D-plotted using a total station.
Indication of volume excavated numbers or names of stratigraphic units removed, approximate volume excavated (estimated bucket count)	Two new excavation units (1x1 m), Unit 12 and Unit 13, were laid out and excavated by arbitrary levels 10 cm thick. Unit 12 was excavated down to 20 cm below surface, and we stopped at that point due to the lack of artifacts. Unit 13 was excavated down to 50 cm below surface. We completed the excavation of Unit 8, laid out in 2019, down to 50 cm below surface. We expanded by 2 m ² Unit 9, laid out in 2019 in the gravel layer at the bottom of Area A, to recover additional faunal material from a ~30 cm thick gravel bed (excavated as a single level).
Samples provide a list of all samples taken and what analysis is planned to be carried out. (e.g., charcoal samples taken for radio-carbon dating, samples and placement of scimitars for TL dating)	List of bulk sediment samples for infrared spectroscopy and magnetic susceptibility: LOV-SED-1 LOV-SED-2 LOV-SED-3 LOV-SED-4 LOV-SED-5 LOV-SED-6 LOV-SED-7 LOV-SED-8 LOV-SED-9 LOV-SED-10 LOV-SED-11 LOV-SED-12 LOV-SED-13 LOV-SED-14 LOV-SED-15 LOV-SED-16 LOV-SED-17 LOV-SED-18 List of intact block samples for micromorphology: LOV-MM-2021-1 LOV-MM-2021-2 LOV-MM-2021-3

	<p>List of faunal samples for infrared spectroscopy:</p> <p>LOV-1963 LOV-1986 LOV-1998</p> <p>List of teeth samples for ESR/U-series dating:</p> <p>LOV-2061 LOV-2062 LOV-2063</p>
Description of work/methodology excavation strategy, recording techniques used etc.	Units were excavated by arbitrary levels 10 cm thick, except for Unit 9 in the gravel layer (single 30-cm level). All level surfaces, artifacts and sediment samples were 3D-plotted using a total station. Level surfaces and sediment sample locations were photographed. All sediments were described according to texture, structure, inclusions, and color.

List of excavated artifacts and bones by Unit/Level. All artifacts are made of hornfels. Classification by type is not yet available, although artifacts from Level 1 can be classified as pertaining to the Later Stone Age, whereas artifacts from lower levels show characteristic features of Middle Stone Age (MSA) technology. Tools, cores, and debitage were recovered. The MSA projectile points, which are the most common formal tool in the assemblage, are divided in two groups based on their characteristics, called “Lovedale” points and triangular points, and clearly predate Howiesons Poort technology. Their relation to the contemporary Still Bay technology of the coast is unknown.

	Unit 8	Unit 12	Unit 13
Level 1	4	2	2
Level 2	3	1	1
Level 3	18	-	22
Level 4	8	-	25
Level 5	10	-	4

Unit 9 was excavated in one single level, 30 cm thick, and did not contain artifacts. However, teeth and bones were recovered for a total number of 6 items. Off-excavation surface lithics: 45.

Conclusions reached

Our research at the open-air MSA site of Lovedale situated on the Modder River addressed the lack of Marine Isotope Stage 4 (71,000-57,000 years ago) sites in the central interior of South Africa. Using sediment micromorphology, infrared spectroscopy of bones and sediments, phytolith and faunal analyses, as well as luminescence and electron spin resonance dating, we have reconstructed the evolution of paleoenvironments in this portion of the Modder River at specific points over the last ~80,000 years. Our results help contextualize human occupation and hunting strategies associated with a pre-Howiesons Poort technology that occurred in a wetland environment during a short-lived warm, dry period dated to ~70 ka. The lithic assemblage, including all stages of the lithic reduction process and dominated by distinctive projectile points that we call “Lovedale”, is consistent with a hunting preparation station on an exposed surface along the river. These results show that humans settled the grasslands of the central interior at the onset of MIS 4 and confirm the importance of wetlands in human subsistence strategies, especially in times of climatic stress.

Additional information



Figure 1. Map showing the location of Lovedale in the western Free State. The meandering green line running from east to west is the Modder River.



Figure 2. Aerial photo showing the location of the excavation site in the Lovedale donga. The grey line in the top-right corner is the Modder River.

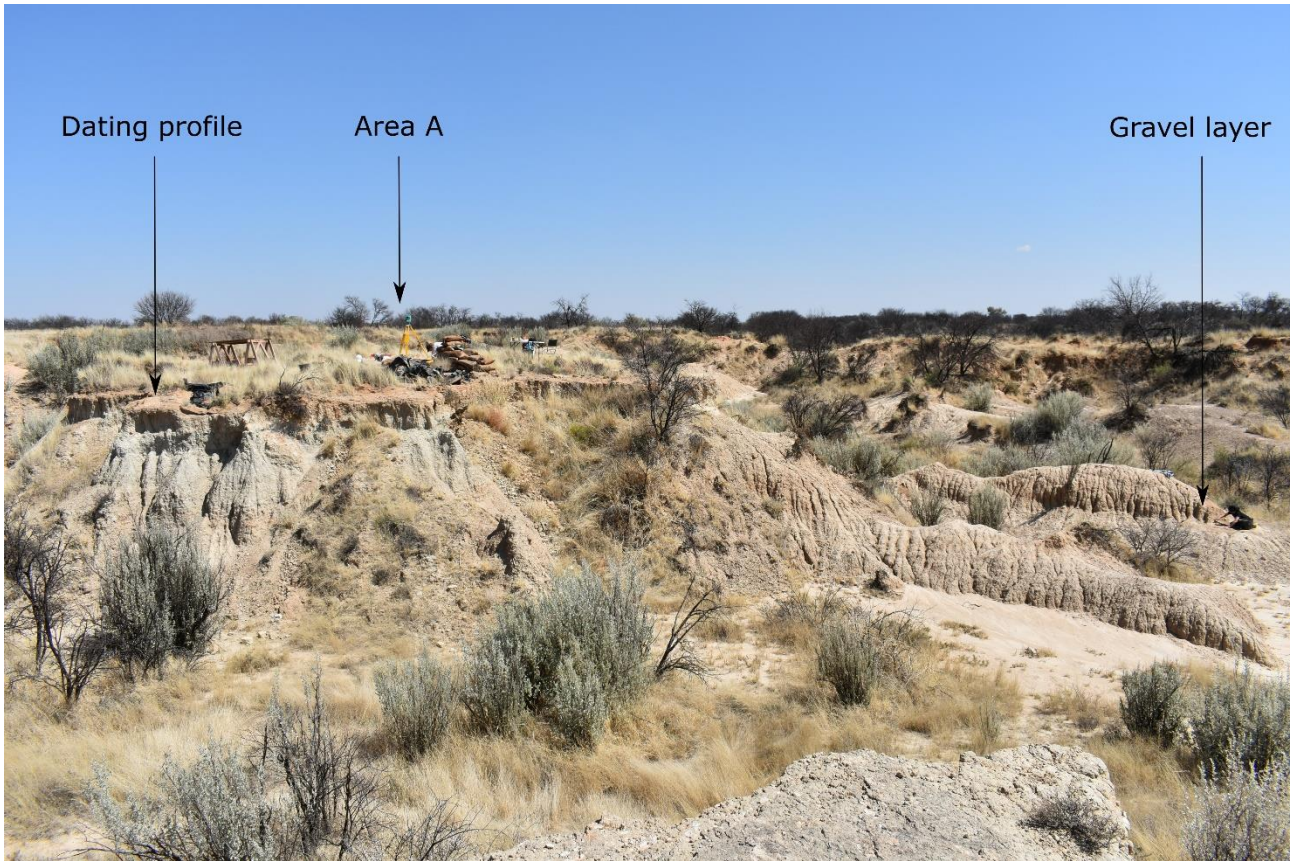


Figure 3. General view of the site, taken from the top of Area B.



Figure 4. Area A during excavation, 2021 season.



Figure 5. Unit 9 gravel layer during excavation, 2021 season. Note Area A at the top.



Figure 6. Photo of the east section of Unit 7 after excavation (2019). The shaded rectangle marks the excavation levels with the highest concentration of artifacts.

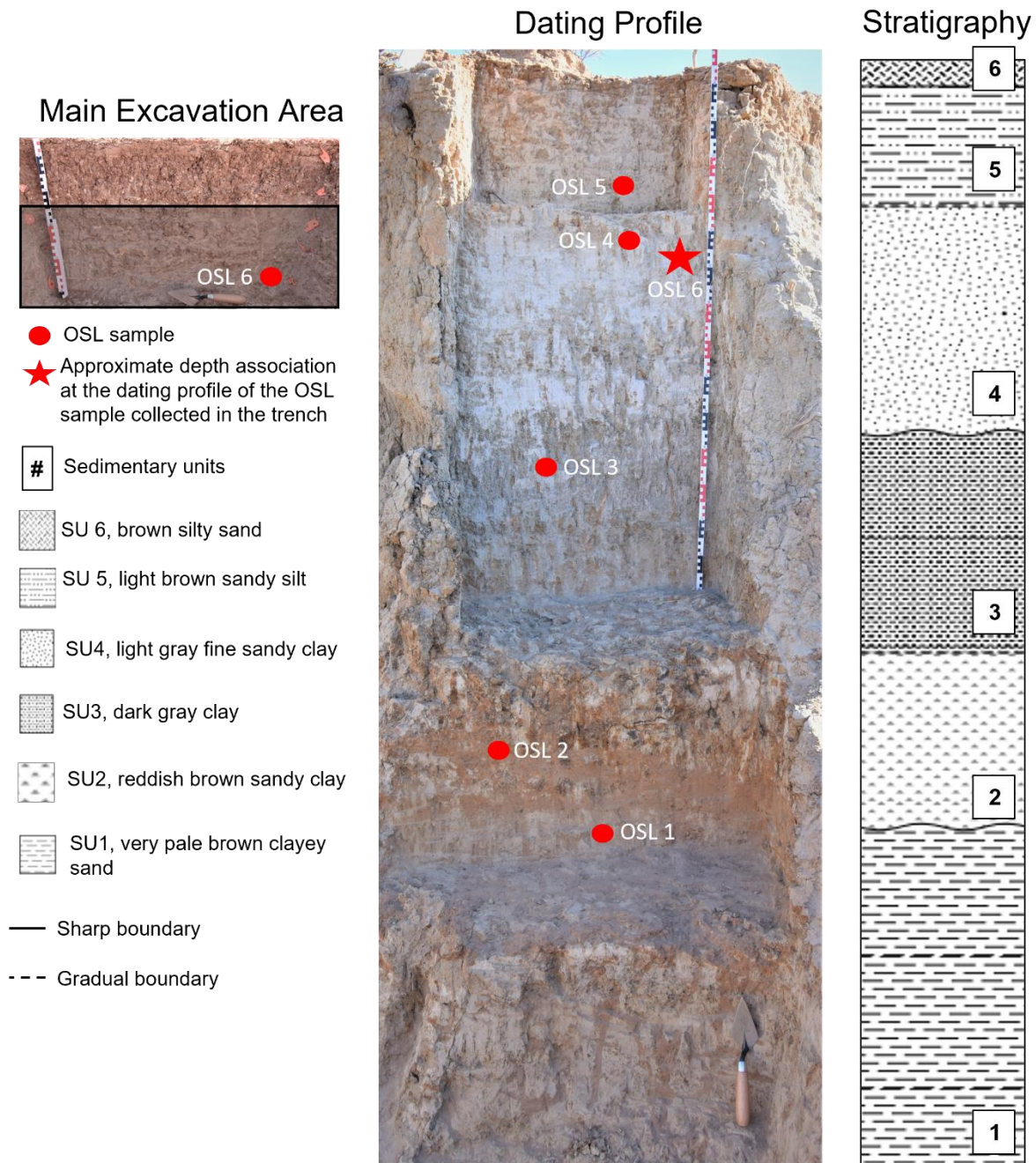


Figure 7. Photograph of the dating profile in the center. Red circles indicate the position of the OSL samples. The red star on the photograph indicates the equivalent depth of OSL sample collected from the main excavation area, shown in the image on the far left. The dark shaded rectangle on the image of the main excavation area indicates the zone from which archaeological material was recovered. On the right is a schematic depiction of the sedimentary units present in the dating profile with their numbers indicated in the squares on the far right.



Figure 8. Representative specimens of Lovedale points (a-c) and triangular points (d-f) found at Lovedale.

Publications

Detailed results appeared in the following publications:

Wroth K., Tribolo C., Bousman C. B., Kolska Horwitz L., Rossouw L., Miller C. E., Toffolo M. B., under revision. Human occupation of the semi-arid grasslands of South Africa during MIS 4: New archaeological and paleoecological evidence from Lovedale, Free State. *Quaternary Science Reviews* 283, 107455.

DOI: 10.1016/j.quascirev.2022.107455

Richard, M., Pons-Branchu, E., Carmieli, R., Kaplan-Ashiri, I., Alvari Gallo, A.I., Ricci, G., Caneve, L., Wroth, K., Dapigny, A., Tribolo, C., Boaretto, E., Toffolo, M.B., under revision. Investigating the effect of diagenesis on ESR dating of Middle Stone Age tooth samples from the open-air site of Lovedale, Free State, South Africa. *Quaternary Geochronology* 69, 101269.

DOI: 10.1016/j.quageo.2022.101269

A manuscript with the full analysis of the lithic assemblage will be submitted for publication later in 2022.

Report for permanent export permits of OSL samples, sediment samples, and faunal samples, including destructive analyses

Permit number: 2975 (OSL 2019), 2999 (fauna and sediment 2019), 3346 (fauna and sediment 2021)

SAHRIS Case ID: 14053 (OSL 2019), 14170 (fauna and sediment 2019), 17124 (fauna and sediment 2021)

Authors: Michael Toffolo, Kristen Wroth, Chantal Tribolo, Maïlys Richard, Lloyd Rossouw

Date: 14 September 2022

SAHRA permit officers: Ragna Redelstorff and Philip Hine

Date of permit issue: 16 July 2019 (2975), 5 September 2019 (2999), 26 October 2021 (3346)

Expiry date of permit: 31 July 2020 (2975; extended to 31 October 2022 by permit officer), 30 September 2020 (2999; extended to 31 October 2022 by permit officer), 31 October 2022 (3346)

Permit holder: Dr. Lloyd Rossouw (holder), National Museum Bloemfontein; Dr. Michael Toffolo (co-holder), Bordeaux Montaigne University, France

Permit to: 2975 to Dr. Lloyd Rossouw (National Museum Bloemfontein), Dr. Michael Toffolo (Bordeaux Montaigne University, France), and Dr. Chantal Tribolo (CNRS-Bordeaux Montaigne University, France); 2999 to Dr. Lloyd Rossouw (National Museum Bloemfontein), Dr. Michael Toffolo (Bordeaux Montaigne University, France), and Dr. Kristen Wroth (University of Tübingen, Germany); 3346 to Dr. Lloyd Rossouw (National Museum Bloemfontein), Dr. Michael Toffolo (Bordeaux Montaigne University, France), and Dr. Maïlys Richard (CENIEH, Spain).

Site name: Lovedale (object ID 129110)

Object ID: 63949 (2019 sediment), 63950 (2019 fauna), 63668 (2019 OSL), 71848 (2021 sediment), 71849 (2021 fauna).

Results

The samples reached the designed research institutions as planned and were not moved further. Detailed descriptions of the sampling strategy, the analytical methods used in the study of the exported samples, as well as detailed results of these analyses and their interpretation, can be found in the publications listed above. In summary, OSL samples provided a chronological framework for the human occupation at the site, which occurred between ~77-56 ka. Bones and teeth analyzed by infrared spectroscopy revealed that faunal preservation at the site is variable, especially at the bottom of the stratigraphic sequence, and that bones should have been preserved within the artifact-bearing layer. Their absence from this layer is likely due to the fact that they were not deposited there in the first instance. In addition, infrared spectroscopy, Raman spectroscopy, cathodoluminescence, and laser-induced fluorescence analyses helped identify teeth affected by uranium leaching, which is a problem for electron spin resonance dating of tooth enamel. This method provided ages that are in agreement with OSL ages and helped constraining the entire stratigraphic sequence to the last 80,000 years. Infrared spectroscopy also revealed that freshwater mollusk shells from the bottom of the sequence are not suitable for isotopic analyses due to recrystallization of aragonite, and helped characterizing sediments at the site. In particular, the large

amount of clay minerals in the artifact-bearing layer is consistent with low-energy water deposition in an overbank environment. This was confirmed by the analysis of micromorphology thin sections, which showed that the stratigraphic sequence is the result of alluvial sedimentation under different flow regimes of the Modder River. Human occupation took place on an exposed land surface close to the river bank. Finally, the analysis of phytoliths extracted from sediments revealed that the site was occupied during a particularly dry period, at least locally, based on the large number of saddle morphotypes, produced by arid-adapted Chloridoid grasses.