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DEREVIANKO ET AL. 2000

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THE STRATIFIED CAVE SITE OF TSAGAAN AGUI IN THE GOBI ALTAI (MONGOLIA)*

Introduction

The territory of Mongolia is unique from the point of view of archaeological investigations. Geographically, the area is adjacent to several major centers of human settlement, suggesting the possibility of early occupation by human populations and the development of indigenous cultures during the Stone Age and later periods. The predominance in Mongolia of primarily arid and semi-arid environmental conditions during Pleistocene, as well as the region's high absolute elevation over the majority of the country, restricted active sedimentation processes that, in turn, affected the formation and preservation of archaeological sites. Studies of the southern Mongolian Paleolithic are hindered by the fact that the majority of known sites are deflated surface aggregates of artifacts. In order to understand the dynamics and absolute chronology of Paleolithic industries, it is necessary to study well-stratified sites. However, only a handful of such stratified sites has been recorded in Mongolia: namely the open-air sites on terraces of the Orkhon River (Derevianko, Nikolaiev, and Petrin, 1992) and the Tsagaan Agui and Chikhen Agui cave sites in the Gobi (Derevianko et al., 1996, 1998). Consequently, the stratified cave site of Tsagaan Agui (White Cave), with archaeological deposits dating from potentially more than 700,000 years ago to the recent historical period, is of crucial importance both for developmental studies of Stone Age cultures as well as paleoecological reconstructions for a significant portion of the Quaternary epoch.

Tsagaan Agui Cave lies at approximately North 44° 42' 43.3", East 101° 10' 13.4", in Bayan Hongor *aimaq* (province), about 40 kilometers northeast of the Bayan Lig *suum* (district or county) headquarters on the southern piedmont of the Gobi Altai massif, southwest of the Zuun Bogd Uul (or Baga Bogd Uul) mountain range (Fig. 1; 2; 3, *1*). Members of the Joint Soviet-Mongolian Historical-Cultural Expedition discovered the site in 1987 and in 1988 - 1989 the Soviet-Mongolian Stone Age Research Team (Derevianko and Petrin, 1995) conducted limited investigations at the site. From 1995 on, Tsagaan Agui Cave has been studied by the Joint Russian-Mongolian-American Archaeological Expedition (Derevianko et al., 1996, 1998).

The cave is situated with its entrance open to the southwest on the eastern wall of the largest canyon that bisects a small limestone range known as Tsagaan Tsakhir from northeast to southwest. The cave can be divided into five distinct sections: (a) the Entrance Terrace (or ramped entryway); (b) the Entrance Grotto (the narrowest part of the cave); (c) the Main Chamber; (d) the Inner Chamber; and (e) the Lower Grotto (Fig. 3, *2*).

Most lithic artifacts are produced on a local siliceous raw material that is abundant in heavily weathered outcrops some 50 meters above the cave's entrance. This raw material occurs in large blocks some 10 - 40 cm in size. A Paleolithic workshop has been recorded in the

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Fig. 1. A view of the limestone ridge called Tsagaan Tsakhir that contains Tsagaan Agui Cave.

immediate vicinity of these raw material outcrops. Blocks were apparently collected and reduced in situ. This siliceous raw material is a poor quality laminated flint formed during the diagenesis of the limestone ridge. The raw material displays numerous voids and large secondary crystal inclusions constituting up to 5 - 10% of the total volume and with an average dimension of around 10 mm.

Periods of sedimentation and paleoecology

Analyses of the Tsagaan Agui deposits (Fig. 4) have identified four distinct periods of sedimentation (Derevianko et al., 1998) (see Table).

The first and earliest period is associated with Strata 10 - 11 in the cave's entryway, Stratum 6 in the Lower Grotto, Strata 13 - 14 in the Entry Grotto, and Strata 12 - 13 of the Main Chamber and suggests a relatively warm and wet environment. The pollen of trees and shrubs (70 - 90%) dominates the palynological spectra associated with these strata. Among the trees, the pollen of spruce, pine, and arboreal species of birch dominate. Also, the pollen of broad-leafed species was identified including elm, hornbeam, maple, and lime. Among the grasses, solitary pollen grains of the Moraceae, *Lonicera* sp., and *Juglans* sp. were identified. This palynological evidence suggests a territory forested by mixed deciduous, broad-leafed, and coniferous species. The environmental conditions corresponding to these data would have been considerably more humid and warmer than at present with annual rainfall exceeding 400 - 500 mm and winter temperatures averaging above -18° Celsius. The presence of the pollen of *Ostrya* sp. and *Myrica* sp. in the spectra may suggest an age for this assemblage no later than the early Pleistocene, though redeposition of older fossil pollen grains in younger sediments should not be ruled out.

The paleomagnetic analysis of sediment samples taken from the lower portion of Stratum 11 in the cave's entryway (Gnibidenko, 1998) yielded evidence of reversed polarity suggesting

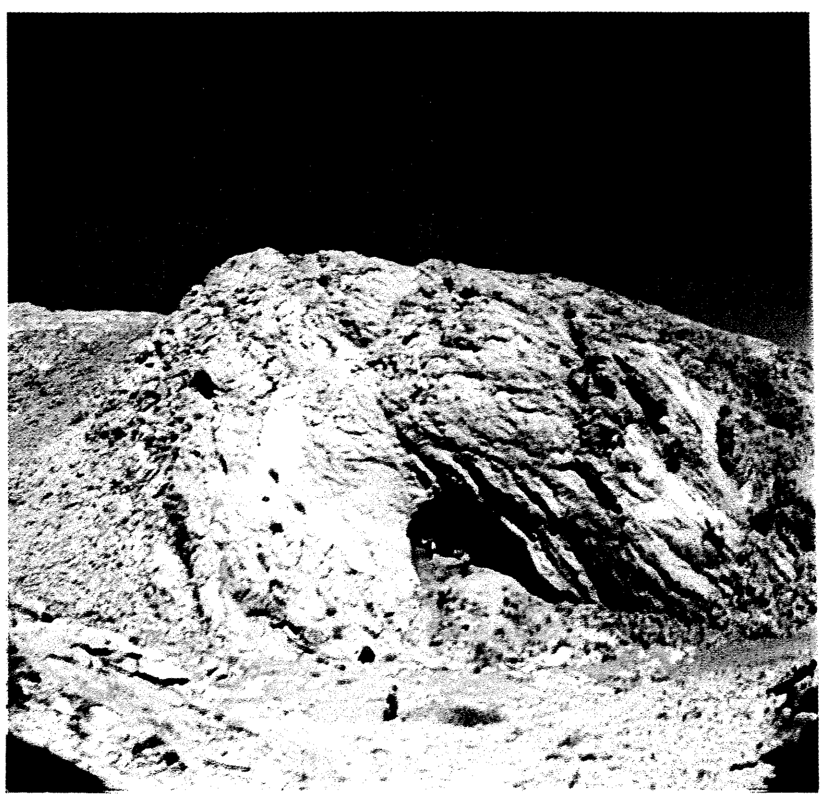


Fig. 2. Tsagaan Agui Cave.

an upper Matuyama [R] chron antiquity, i.e. somewhat older than 730 kyrs BP. A radio-thermoluminescence (RTL) date of 470 ± 117 kyrs BP (RTL-800) is available for Stratum 10 in the entryway zone. Another RTL date of 520 ± 130 kyrs BP (RTL-805) was obtained for Stratum 12 in the cave's Main Chamber. However, residual signal carry-over (Forman, 1989) from an extended period of sub-surface sediment transport within the cave system may mean that these RTL determinations greatly exceed the true age of the deposits.

The records of Strata 6 - 11 in the Main Chamber and Stratum 5 in the Lower Grotto represent the second period of sedimentation, perhaps best correlated with a cool, humid environment. The palynological record indicates the predominance of arboreal species including pine, birch, and spruce. Also the pollen of fir, elm, hornbeam, maple, oak, lime, and honeysuckle were noted. The sedimentation process is characterized by formation of lithological horizons with inclusions of sand and sandy loams impregnated with fine- to coarse-grained debris and alluvial pebbles. Ferrous stains are apparent throughout this sediment pack. The pollen spectra reveal occurrences of the pollen of *Typha* and the Cyperaceae, suggestive of the short-term presence of stagnant or slowly moving water in the cave. A RTL date of 450 ± 123 kyrs BP (RTL-803) was obtained from Stratum 11 in the Main Chamber.

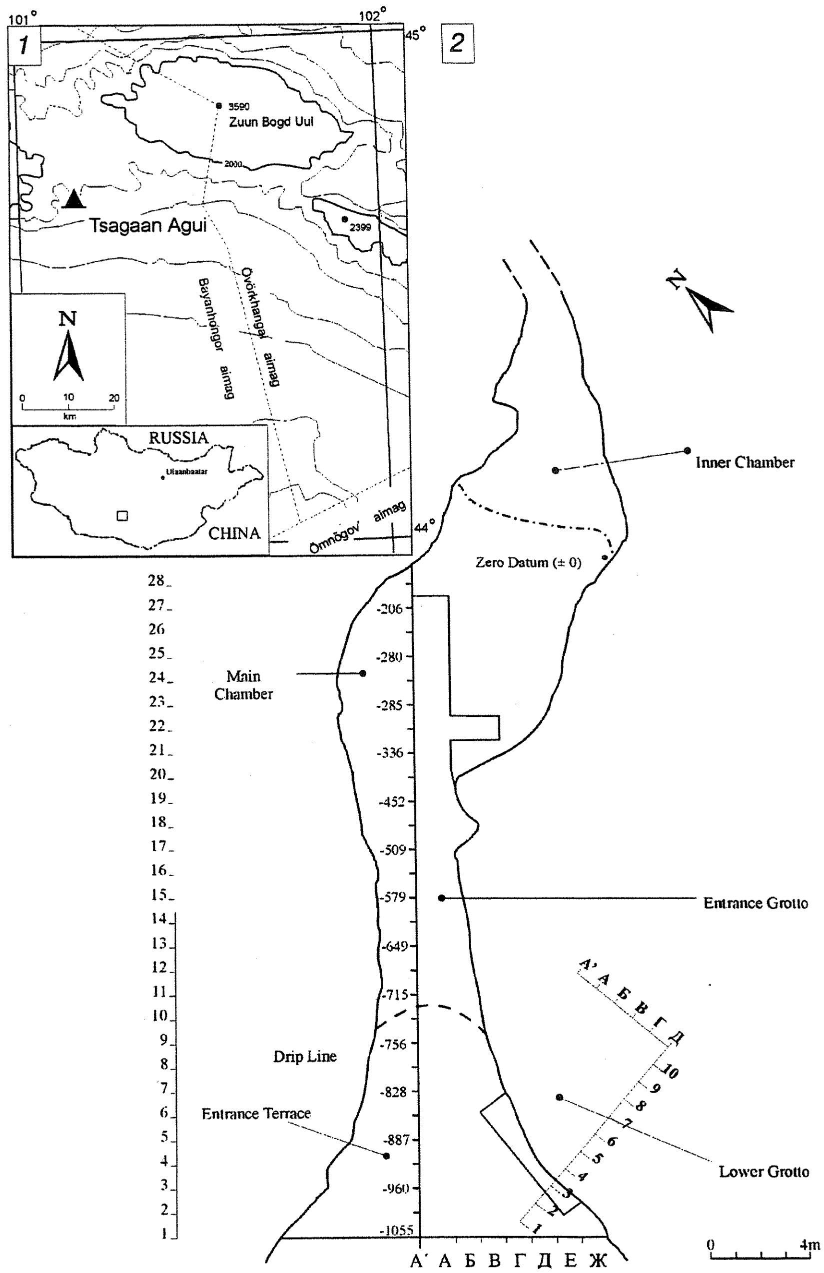


Fig. 3. Location (*1*) and plan view (*2*) of Tsagaan Agui Cave.

The third sedimentation cycle is represented by the lower portion of Stratum 4 and Stratum 5 in the entryway zone and by Strata 3 - 5 in the cave's Main Chamber. The data suggest gradual desiccation of the local ecology, together with a general cooling of the climate in comparison with that corresponding to the underlying horizons. The floral community was dominated by a steppe ecosystem; nonetheless a forest complex is also apparent. Mountain slopes were apparently forested by predominantly deciduous and coniferous species at this time.

The sporo-pollen spectra are characterized by the dominance of herbaceous and shrubby species. Within the arboreal/shrub group, small amounts of the pollen of *Picea, Pinus*, and *Betula* were identified, as well as solitary grains of the pollen of broad-leafed species. A RTL date of 227 ± 57 kyrs BP (RTL-804) is available for Stratum 5 in the Main Chamber while Stratum 4 (upper portion) of the Main Chamber is dated to between 46 ± 3 kyrs BP (early uptake) and 56 ± 4 kyrs BP (late uptake) by electron spin resonance (QT 40 and QT 41; Blackwell, personal communication). Radiocarbon age determinations allow dating of Stratum 3 to between 30,000 and 33,000 years BP. Note that Stratum 3 is not a depositional event, but a diagenetic event, specifically the formation of an occupation horizon on Stratum 4, which is lithologically identical to Stratum 2. Thus, while deposition rates may have slowed, they do not seem to have terminated. In addition, David Hyland's (personal communication) analyses of sediments from Chikhen Agui suggest slow but continuous deposition throughout the Last Glacial Maximum.

The record of the fourth sedimentation cycle (Stratum 2 in the entryway, the Entrance Grotto, and in the Main Chamber) reflects a considerably drier environmental condition. Eolian processes played the major role in the sedimentation regime. The sediments here contain a significant admixture of gravel, limestone debris, and calcite crystals that is suggestive of colluvial processes.

The gradual aridification trend initialized in Strata 4 - 5 continues through Stratum 2. A single ESR determination on an equid tooth places the age of lower Stratum 2 (or 2b) between 23 ± 2 kyrs BP (early uptake) and 25 ± 2 kyrs BP (late uptake) (Blackwell, personal communication). A depositional hiatus may be represented between approximately 22 - 18 kyrs BP (the Last Glacial maximum or Sartan Glacial), though we lack radiometric dates above Stratum 2b to confirm this hypothesis. Certainly, upper Stratum 2 (or 2a) resembles 2b lithologically, suggesting a resumption of similar depositional conditions. It is likely (given the character of the artifact assemblage) that Stratum 2a is terminal Pleistocene or, minimally, early Holocene in age.

The accumulation of the uppermost sedimentation layers in the cave (Stratum 1 of the Entrance Terrace, the Entrance Grotto, and the Main Chamber) occurred during the last few hundreds of years. The archaeological record here includes bronze artifacts of the historic Mongol period, an 11th century AD Chinese Northern Song Dynasty coin, ceramic Buddhist "tsa-tsa" votive objects, and birch bark fragments bearing Buddhist inscriptions. An absolute date of 931 ± 65 years BP was obtained for Stratum 1 through radiocarbon analysis.

As has been suggested above, the lowermost portion of the sedimentation sequence was accumulated under relatively humid environmental conditions. As a result, faunal remains were recovered only from the upper horizons, in particular from Strata 1 - 5 of the Main Chamber. The faunal assemblage is dominated by steppe and mountain mammalian species: kulan,

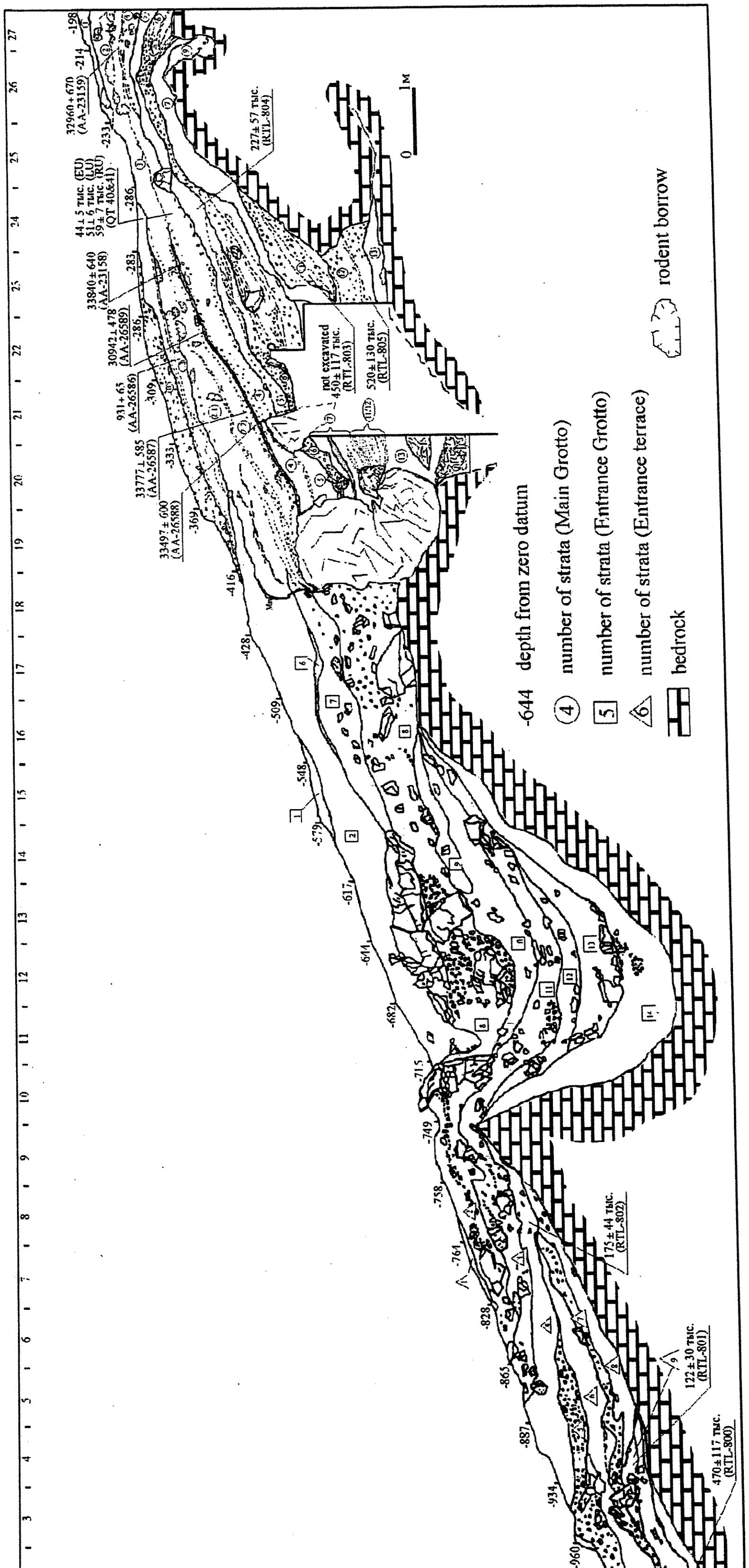


Fig. 4. Tsagaan Agui profile along the A' section with chronometric dates indicated.

Summary table of major sporo-pollen data, chronology, and paleoclimatic reconstructions for Tsagaan Agui Cave

Entryway Zone				Test Pit in the Main Chamber			
Stratum	Spore-pollen data	Climate	Dates	Stratum	Spore-pollen data	Climate	Dates
0	Semidesert-steppe landscapes	Modern; precipitation: 112 - 133 mm/year	–	0	Semidesert-steppe landscapes	Modern; precipitation: 112 - 133 mm/year	–
4 (upper portion)	Trees and shrubs (67%); significant increase in broadleaf species; abundant *Betulaceae* (up to 54%); *Chenopodiaceae* (36%); *Artemisia* sp. (8%); forest-steppe landscapes	Wetter and warmer than the previous period and at present	–		–	–	931 ± 65 BP (AA-26586)
4 (lower portion) 5	Grasses and shrubs (68 - 92%); *Chenopodiaceae* (up to 75%); *Compositae* (up to 21%); arboreal: *Pinus* sg. *Diploxylon* (up to 79%); broadleaf species are rare; steppe landscapes	Increasing aridity; some cooling compared with the previous period	175 ± 44 ka. (РТЛ-802)	2 3 4 5	Grasses (75%) dominated by *Gramineae*, *Compositae*, *Chenopodiaceae*, *Ephedra*, *Polygonaceae*; trees and shrubs: *Alnus*, *Fraxinus*, *Carpinus*, *Tilia*, *Picea*, *Pinus*, *Betula*; steppe landscapes with elements of forest associations	Cooler and much more arid than at the previous period	Stratum 3 32,960 ± 670 BP (AA-23159) 33,497 ± 600 BP (AA-26588) 33,777 ± 585 BP (AA-26587) 30,942 ± 478 BP (AA-26589) 33,840 ± 640 BP (AA-23158) Stratum 4 449 ± 6 ka.(EU) (QT 40 & 41) 57 ± 7 ka. (LU) (QT 40 & 41) 66 ± 9 ka. (RU) (QT 40 & 41) Stratum 5 227 ± 57 ka. (RTЛ - 804)
7 8	Grasses (72 - 98%); trees and shrubs: *Pinus* sg. *Diploxilon*, *Carpinus*, *Ostryopsis;* solitary seeds of broadleaf species; herbs and shrubs: *Compositae* (up to 85%), *Ephedra* (up to 21%), *Chenopodiaceae* (36%); steppe landscapes	Cooler and drier than previously; wetter and warmer than at present	–	6 11	Arboreal pollen is dominant: pine (up to 50%), spruce (up to 24%), birch (up to 55); broadleaf species: elm, hornbeam, maple, oak, lime; *Moraceae* and *Juglans*. The herbaceous group is dominated by *Compositae* and *Polygonaceae*; forest and forest-steppe landscapes	Cooler than the previous period, but wetter and warmer than present	450 ± 123 ka. (RTЛ - 803)
10 11	Trees and shrubs (67 -87%): *Carpinus* (up to 14%), *Fraxinus* (up to 14%), *Betula* sect. *Albae* (up to 18%); conifers : *Cedrus*, *Picea*, *Pinus*; broadleaf species: elm, hornbeam, maple, oak, lime; forest and forest-steppe landscapes	Wetter and warmer than present; precipitation: more than 400 - 500 mm/year	470 ± 117 ka. (РТЛ-800) Upper portion of the Matuyama chron >730 ka.	12 13	Trees and shrubs (75 - 90%); spruce (25%), pine (up to 35%), *Betulaceae* (up to 28%); broadleaf species: *Alnus* (up to 15%), *Carpinus* (up to 10%), *Ulmus* (up to 6%), *Corylus* (up to 8%), *Tilia* (up to 22%), *Juglans* and *Moraceae*; forest and forest-steppe landscapes	Wetter and warmer than present; precipitation: more than 400 - 500 mm/year	520 ± 130 ka. (RTЛ - 805)

dzeren, argali, and Siberian goat; all of which currently inhabit Mongolia. The Pleistocene horizons revealed rhinoceros (*Coelodonta antiquitatis*) bones, and those of cave hyenas and the chiru or Tibetan antelope (*Pantholops hodgsoni*). The latter occurs presently only on the Qinghai-Tibet Plateau (Schaller, 1998), but seems to have enjoyed an extended zoogeographic range, including Mongolia, during the Pleistocene.

The available stratigraphic studies, palynological analyses (Simakova, 1998), paleopedological investigations (Dergacheva and Fedeneva, 1998), and zooarchaeological research (Baryshnikov, 1998) indicate that deposition of the majority of the cave's sediments took place under appreciably wetter and warmer environmental conditions than those which characterize the northern Gobi today. Throughout the stratigraphic sequence there is a trend toward gradual desiccation of the local ecology and the intensification of continental aspects of the climate as well as decreasing diversity in the floral community. Overall, environmental conditions seem to have been generally favorable for human habitation of the Gobi during significant periods throughout the Pleistocene.

Archaeological assemblages

The earliest archeological materials recovered from Tsagaan Agui Cave are associated with the first sedimentation cycle (Stratum 13 of the Entrance Grotto, Strata 12 and 13 of the Main Chamber). ***The primary reduction*** strategy is illustrated by several pebbles and rock fragments bearing scars of detachments, amorphous flakes removed from polyhedral cores, and debitage. Flake striking platforms are poorly defined. Most appear plain with only one showing some minor faceting.

The tool kit includes bifacially worked tools, combination tools, flakes, and retouched fragments. Particularly noteworthy are *the bifacially worked tools*. One such tool (Fig. 5, *3*) is irregular and triangular, having been fashioned on a massive rock. Both flaking faces of this tool are slightly convex and bear the negative scars of large detachments that were removed through additional trimming. The upper surface of the tool bears oblique, wide, natural backing, which represents residual flaking faces. The distal end opposite the back shows additional treatment through the removal of smaller spalls. The second tool in this series (Fig. 5, *4*), lenticular in cross-section, may be described as a proto-hand-axe or biface preform. Trimming was accomplished through the removal of large, wide spalls. The tool's back was further shaped with the aid of wide, transversely directed spalls. *The combination tools* (Fig. 5, *2*) were fashioned on large spalls and combine notched and scraper working edges. The notches were made on one of the lateral sides of the blank with the removal of a single regular spall and bear traces of additional fine marginal retouch. The scraper-like working edge was prepared along the opposite side of the tool with fine- and medium-faceted semi-abrupt dorsal retouch. *The flakes and retouched fragments* (Fig. 5, *1*) show secondary treatment that has not substantially modified the morphology of the blanks. The irregular semi-abrupt fine- and medium-faceted retouch on the dorsal faces of these implements was applied differentially depending on the morphology of the chosen blank.

In general, despite the small size of the available collection, the lithic industry associated with this sedimentation cycle in Tsagaan Agui bears characteristic early Paleolithic features evident in the techniques of retouch applied to striking platforms, as well as in the occurrence of diagnostic bifacially worked implements.

The collection of artifacts associated with layers accumulated during the second cycle of sedimentation (including archaeological horizon 3 of the terrace and in the Entrance Grotto, artifacts from the Lower Grotto, and artifacts associated with Strata 6 - 11 of the Main Chamber) is characterized by the archaic features and massiveness of the implements recovered. Some categories of artifacts yielding traces of ***primary reduction*** were identified in the Lower Grotto and in Strata 9 - 11 of the Main Chamber. They include various types of cores and core preforms, core-like fragments, blade spalls, flakes, fragments, and chips. Plain platforms dominate the residual striking platforms. Only a few retouched platforms were identified, and only one faceted platform was noted. The products of primary reduction demonstrate the prevalence of an irregular, or polyhedral, pattern of reduction. However, classical *Levallois flake cores*, as well as nuclei devoted to the production of elongated spalls were also noted. The Levallois flake cores are rounded with convex flaking surfaces prepared through centripetal removals and thoroughly prepared beveled striking platforms (Fig. 6, *1*). Cores for the removal of blade-like flakes are generally subtriangular in shape. Their convex flaking and back faces were prepared through centripetal removals and they exhibit striking platforms beveled by a single blow (Fig. 6, *4*). A few *robust prismatic double platform cores* (Fig. 7, *3*) were also noted. Such cores exhibit double striking platforms prepared through the removal of one wide spall and minimal additional treatment of the flaking hinges. Further reduction was executed from one of the platforms, while the opposing platform was used for rejuvenation. Usually no more than two or three blanks were removed from such cores. These blanks are elongated and subparallel. One *"proto-wedge-shaped" core* was noted (Fig. 6, *5*). The wedge-shaped form of the flaking face was determined by the natural form of the blank and does not show any additional working of the lateral sides. The wide, long ovoid striking platform is beveled to the back, having been prepared by the removal of large spalls. The blanks removed from such core are elongated and convergent. *Core-like* products are the most numerous. Usually a piece of raw material with a straight edge was selected for the production of such cores, with one straight edge serving as a directing "crest" (Fig. 6, *8 - 10*). Some specimens exhibit shaping of the flaking hinge prior to detachment of a spall. Such a strategy of blank production may have been dictated by the low quality of raw material available. Numerous imperfections and crystalline inclusions may have resulted in the frequent production of defective blanks. Consequently, any preparatory working of such cores might not have resulted in the generation of consistent, usable blanks. On the other hand, the archaic features of the cave's earliest archaeological complexes cannot be explained solely through reference to the low quality of the raw material employed. Several cores illustrate a rather systematic pattern in their preparation. Such cores were prepared on large spalls; their flaking faces were prepared on ventral faces or on massive lateral sides and/or distal ends of such spalls. Some prepared nuclei resemble Levallois cores, though the technique of their production shows traits particular to these cores alone.

Two major sub-categories of nuclei are distinguished: broad- and narrow-faced cores. Cores of the first subcategory have wide flake removal surfaces prepared on the ventral surfaces of massive spalls. Within this subcategory, a series of single platform cores, and single platform cores with additional preparation at their distal ends can be distinguished. Both varieties of cores were used for convergent spall removals. Both forms of nuclei bear faceted platforms and moderately prepared lateral sides. Both the pattern and the stage of preparation of such cores bear features similar to those noted for classic Levallois point cores (Bordes, 1980; Van Peer, 1992). They are also reminiscent of nuclei produced on Kombewa-type flakes that are characteristic of Acheulean industries recorded in Africa and in western Asia (Clark, 1970; Inizian et al., 1992, 57).

The narrow-faced cores, like those with broad flaking faces, were usually fashioned on massive flakes. Preparation of the flaking surface and parallel detachment of spalls was executed from the lateral sides and/or distal ends of blanks. Flaking from the narrow face of such cores was carried out from two opposing striking platforms. Occasionally, this strategy of core utilization resulted in the production of elongated micro-blanks.

Specific tools fashioned on elongated angular fragments or massive spalls dominate ***the tool kit***. Keeled, generally subparallel removals or burin-like spalls were detached from the convex face of the blank from its narrow end. The opposing flat face generally received additional flattening or backing. This category of tools, despite similar methods of blank preparation, can be classified into two subcategories according to how the working edges of such tools were fashioned. The first subcategory (see Fig. 7, *4*, *7 - 9*) is characterized by the formation of a sharply protruding working element (hence the classification of such tools as "spurs"). The second subcategory (see Fig. 7, *1*, *2*, *5*) includes tools, on which a narrow, straight working edge was fashioned. Another major category of tools is represented by *side-scrapers (racloirs)* fashioned on massive spalls or on fragments with the aid of scalar, large-faceted retouch (Fig. 8, *5*, *12*). Tools dominate the category of side -scrapers with transverse working edges retouched from the ventral faces. Also, a series of simple *notched denticulate* tools was identified, mostly fashioned on large spalls or fragments (Fig. 8, *4*). Simple *end-scrapers* (Fig. 8, *2*, *3*, *6*, *7*) form a separate category. These end-scrapers were fashioned on flakes; their working edges having been prepared by abrupt, small- and medium-faceted retouch on either the dorsal or ventral faces. So-called *"combination tools"* are uncommon in this assemblage (Fig. 8, *13*, *14*). Such

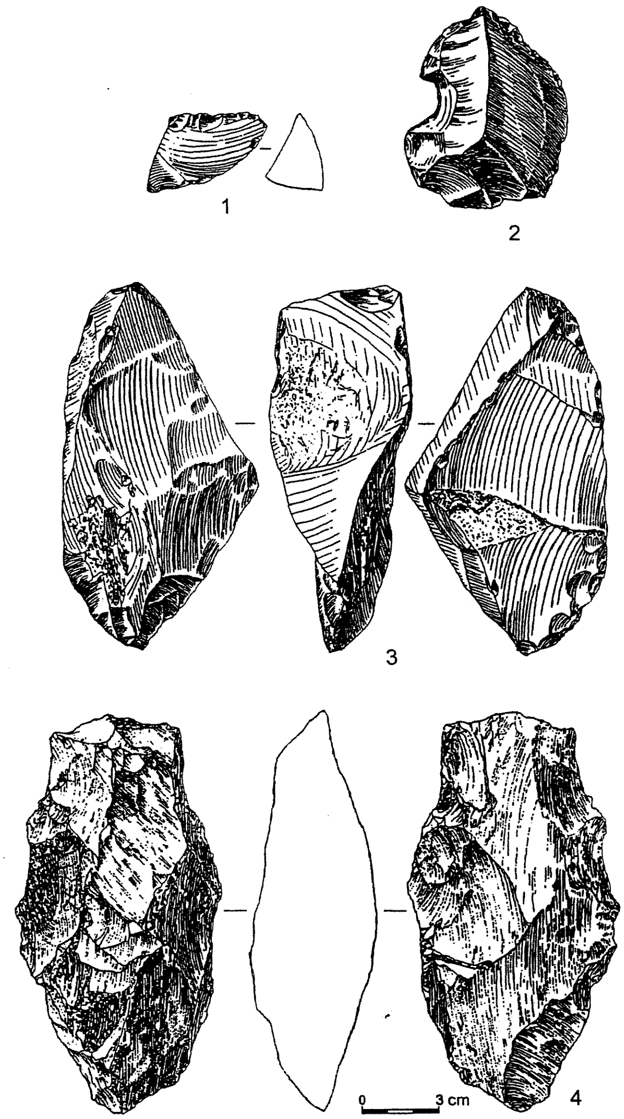


Fig. 5. Tsagaan Agui Cave.
Artifacts associated with sedimentation cycle 1.

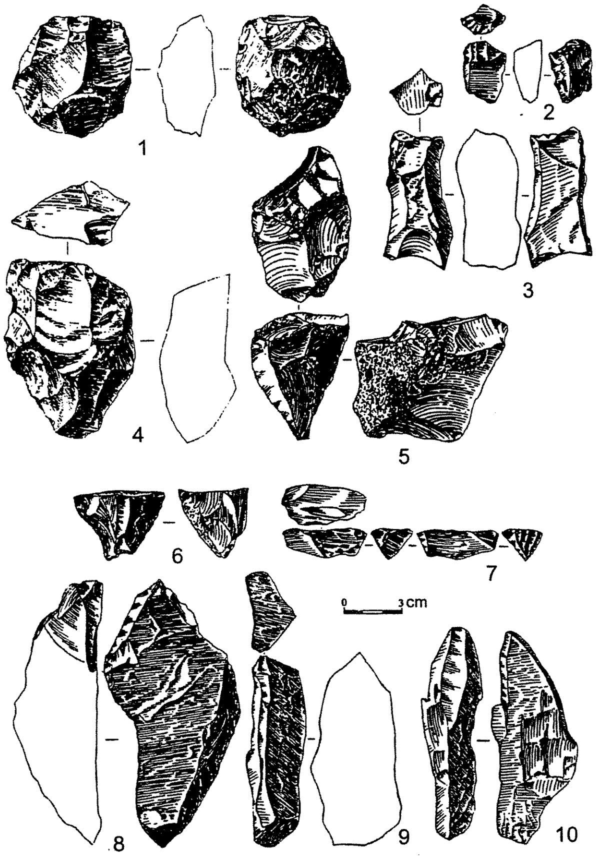


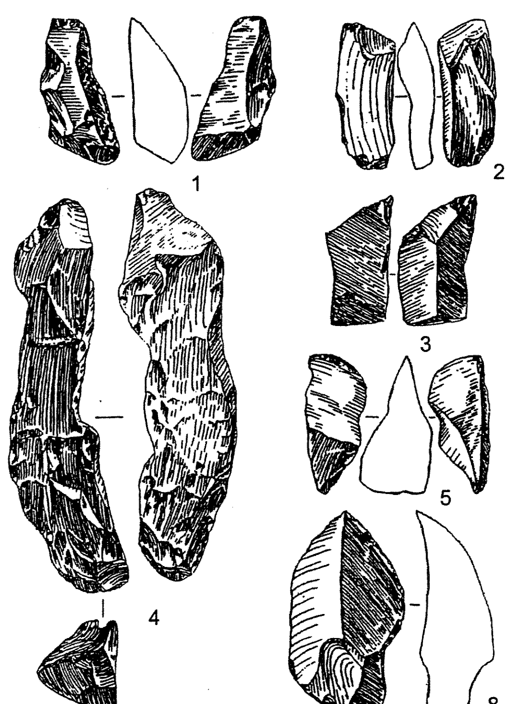
Fig. 6. Tsagaan Agui Cave. Artifacts associated with sedimentation cycle 2.

tools usually represent combination notches and scrapers. The notches were produced by the removal of a single spall and no additional treatment of the margins is noted. Scraper working edges were fashioned with small-faceted abrupt and semi-abrupt retouch.

The archaeological industry associated with the second cycle of sedimentation in the cave (archaeological horizon 3 in the entryway zone and in the Entrance Grotto, Strata 6 - 8 in the Main Chamber) illustrates features of ***primary reduction*** represented by core-like fragments, elongated spalls, flakes, and fragments. Some *core-like fragments* retain negative scars of elongated micro-blank removals on their faces (see Fig. 6, *2*, *6*, *7*). The discernible residual striking platforms are all plain.

The tool-kit includes specific tools similar to those described above (see Fig. 7, *3*, *6*). *Side-scrapers* are not numerous and all such tools were fashioned on short, massive flakes. This category includes backed transverse forms with working edges prepared on their dorsal faces (see Fig. 8, *9*). A solitary *notched denticulate* was also included in the tool kit. This tool was fashioned by the generation of simple notches without any additional trimming of the adjacent margins (see Fig. 8, *1*). Some *burin-like tools* were also recovered, though their typological features are not typical. Such tools were prepared on elongated blade-like flakes (see Fig. 8, *10*, *11*).

We conclude that the primary core reduction strategy noted within the industry associated with the second sedimentation cycle is characterized by a developed Levallois technology, the specific features of which are determined by the quality of raw material employed as well as by the early occurrence (already during the initial stage of this cycle) of proto-prismatic and proto-wedge-shaped core reduction strategies and by the presence of bladelet blank production during final stages of this cycle.



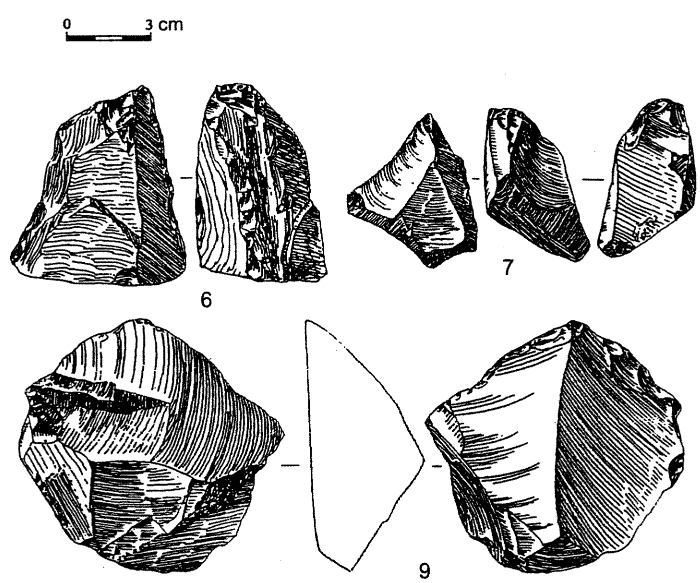


Fig. 7. Tsagaan Agui Cave. Artifacts associated with sedimentation cycle 2.

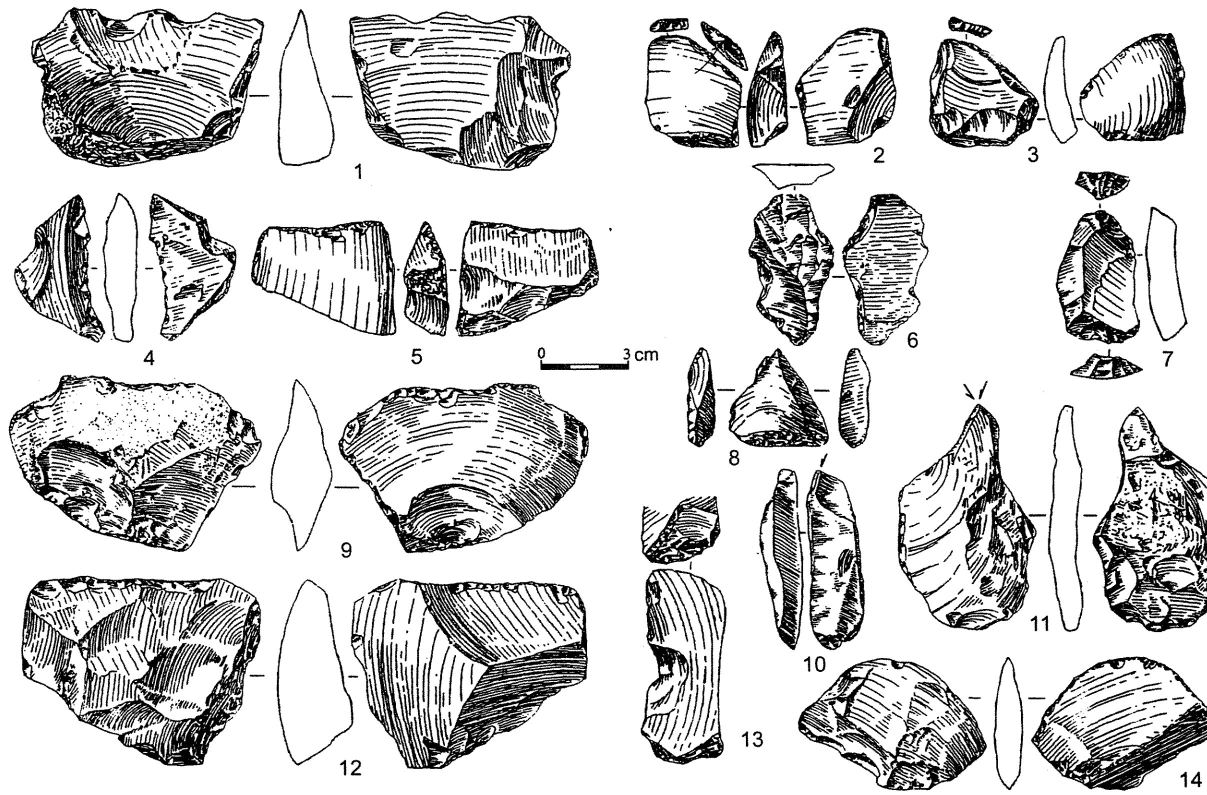


Fig. 8. Tsagaan Agui Cave. Artifacts associated with sedimentation cycle 2.

The tool kit is dominated by spur-like tools, side-scrapers of various morphologies, and notched denticulates. The secondary treatment of tools includes the removal of burin spalls. In general, the industry associated with the second cycle of sedimentation can be seen as developmentally related to the industry derived from underlying, earlier horizons.

The assemblage of artifacts associated with the third sedimentation cycle in Tsagaan Agui (archaeological horizon II of the entryway zone and the Entrance Grotto, Strata 3 - 5 of the Main Chamber) can be attributed to the late Middle Paleolithic/early Upper Paleolithic transition. ***The primary reduction*** traits of the industry associated with the initial period within the third sedimentation cycle (archaeological horizon II of the entryway zone and the Entrance Grotto, Strata 4 - 5 of the Main Chamber) are typified by Levallois-like flake cores, core preforms, core-like fragments, a proximal segment of a Levallois blade, flakes, and fragments. *The Levallois-like flake cores* (Fig. 9, *4*) are rounded with convex flaking faces on the distal ends and lateral sides prepared by the removal of centripetal spalls. The cores' convex back face was flaked longitudinally and transversely directed. The striking platforms are beveled toward the cores' back and were prepared by large scalar detachments. The blanks removed from such cores are short. A few *core-like fragments* display negative scars of bladelet removals, but no sign of preparation of either the striking platform or the flake removal surfaces. Plain platforms dominate those still classifiable. Only the Levallois blade exhibits a faceted striking platform (Fig. 10, *13*).

The tool kit is dominated by artifacts broadly similar to those described in association with the second sedimentation cycle (see Fig. 9, *3*, *5*, *6*). *Notches with natural backs* were also noted here (see Fig. 9, *1*). The small series of *longitudinal side-scrapers* was fashioned with abrupt, medium- and large-faceted dorsal retouch (see Fig. 10, *1*). Solitary examples of simple longitudinal *notched denticulates*, trimmed with large-faceted denticulated retouch (see Fig. 10, *2*, *8*), were noted within the tool kit as were *end-scrapers* made on flakes (see Fig. 10, *3*, *9*). The *combination tools* include scraper-like working edges with additional traces of trimming (see Fig. 10, *4*, *11*). *Blades* and *retouched flakes* (see Fig. 10, *6*, *7*, *12*, *13*) are also included in the tool kit.

The later period of the third sedimentation cycle at Tsagaan Agui (represented by *Stratum 3 in the Main Chamber*) is characterized by a developed Levallois strategy of core reduction. Both the linear Levallois method of flake production and the recurrent method of producing Levallois blades and elongated triangular blanks were noted. Both preforms and cores represent the former method. *The Levallois recurrent cores* (see Fig. 9, *2*) are sub-triangular in shape. Their flaking faces were prepared by longitudinally and transversally directed spalls resulting in convex distal and lateral margins. The backs of the nuclei were flattened by the removal of centripetal and transverse spalls. Striking platforms are significantly beveled toward the back of the core and are generally reshaped by the removal of a series of detachments directed both from the flaking face of the core and from its lateral margins. These cores exhibit thorough trimming of one lateral edge resulting in the formation of a crest. Usually, a series of three or four flakes were removed from such cores in each reduction stage. A set of *cores for the production of elongated bladelets* was also noted. Among those flakes with discernible striking platforms, those with plain platforms dominate. Faceted striking platforms (both plain and convex) were noted only within the category of Levallois blanks.

The tool kit includes *a retouched Levallois point*, both lateral margins of which exhibit intensive trimming with semi-abrupt dorsal retouch (see Fig. 10, *10*), and *a burin* which was fashioned on an elongated flake (see Fig. 10, *5*). It is noteworthy that the elongated Levallois point was fashioned on high-quality imported raw material.

As a whole, the lithic industry associated with the third sedimentation cycle can be attributed to the final stages of the Middle Paleolithic and the early Upper Paleolithic. A developed Levallois technology was primarily aimed at the production of blades and elongated, convergent flakes. In comparison with earlier assemblages, the technology of bladelet production is more developed and common. The tool kit comprises Middle Paleolithic tool types (especially side-scrapers and points) and notched denticulates as well as characteristic Upper Paleolithic tools (such as end-scrapers and burins), whose frequency increases throughout the assemblage. An additional important characteristic feature of this assemblage is the use of higher quality, presumably imported raw materials for the production of some artifacts.

As suggested above, the analyses of deposits in Tsagaan Agui cave suggest to some of us a gap in the sedimentation sequence, although alternative interpretations are also being explored. This hiatus may have occurred after deposition of the third sedimentation cycle. According to this perspective, artifacts recovered from deposits associated with the fourth sedimentation cycle (*archaeological horizon I of the entryway zone and Entrance Grotto, Stratum 2 of the Main Chamber*) differ significantly from those of the underlying assemblages. Here, some typologically definable tools were manufactured on high quality raw material, and the strategy of ***core reduction*** was aimed primarily at the production of *bladelets*. On the other hand, some of us regard the aggregate archaeological assemblage from Strata 2, 3, and 4 to be essentially homogeneous with Stratum 5 representing a transitional technology.

Tools with traces of trimming are diagnostic as are *scrapers* on flakes and *end-scrapers* on technical spalls. Also, *retouched blades*, *burin-like tools*, and *combination tools* exhibiting scraper-like working edges and traces of use-wear or notched working edges were identified. Bone implements were also encountered including a possible *awl* and *items of ornamentation* (beads and a pendant). This assemblage can be preliminarily associated with the final stages of the Pleistocene and early Holocene, but the relatively small sample size of the collection and the absence of directly associated absolute dates preclude precise age estimates of artifacts associated with the fourth sedimentation cycle.

The cultural remains recovered from the uppermost stratum in Tsagaan Agui (*Stratum 1 of the Main Chamber*) are attributed to only the past several hundreds of years. This conclusion is supported by available chronometric dates and the recovery of *a Chinese coin* dated to the Northern Song Shenzong regnal era (AD 1078 - 1085), *bronze artifacts* of the historic Mongol period, Buddhist *ceramic "tsa-tsa" votive objects*, and fragmentary birch bark texts.

Summary and discussion

Tsagaan Agui Cave represents one of the few well-stratified and well-dated Pleistocene archaeological sites now known in Mongolia. The cave's sediments contain cultural remains ranging from the Paleolithic to the later historic period. Analyses of these deposits suggest environmental conditions favorable for human habitation existed throughout greater part of the Pleistocene. Age estimates have been derived through paleomagnetic, radio-thermoluminescence, and radiocarbon techniques.

The techno-typological analysis of the industry associated with the lowermost horizons in the cave (mainly those of sedimentation cycles 1 and 2) reveal characteristic features similar to those reported from the earliest lithic complexes identified at Tsakhiurtyn Hondi (Flint Valley) in southern Mongolia (Derevianko et al., 1996, 1998; Zenin, 1996). The core reduction strategies in evidence at both sites are based on polyhedral reduction and Levallois-like technology adapted to the quantity, quality, and morphology of available raw material. Specific features of the Tsagaan Agui tool kit, such as the dominance of "spur-like tools", are also noted in the Flint Valley assemblages. Both the earliest lithic assemblages at Tsagaan Agui and the earliest surface complexes at Flint Valley include a notable series of Acheulean-like bifacial tools. Analyses of the artifacts from the lowermost chronometrically dated horizons of Tsagaan Agui Cave, as well as information derived from surface occurrences of artifacts (including Tsakhiurtyn Hondi, Mount Yarkh, and other sites in the southern Gobi) provide sufficient data to suggest the presence of a Levallois-Acheulean-like industry in Mongolia perhaps as early as 500 - 400 thousand years ago. We believe that such technologies may be present in Central Asia due to the in-migration of populations bearing a bifacial technology (Okladnikov,

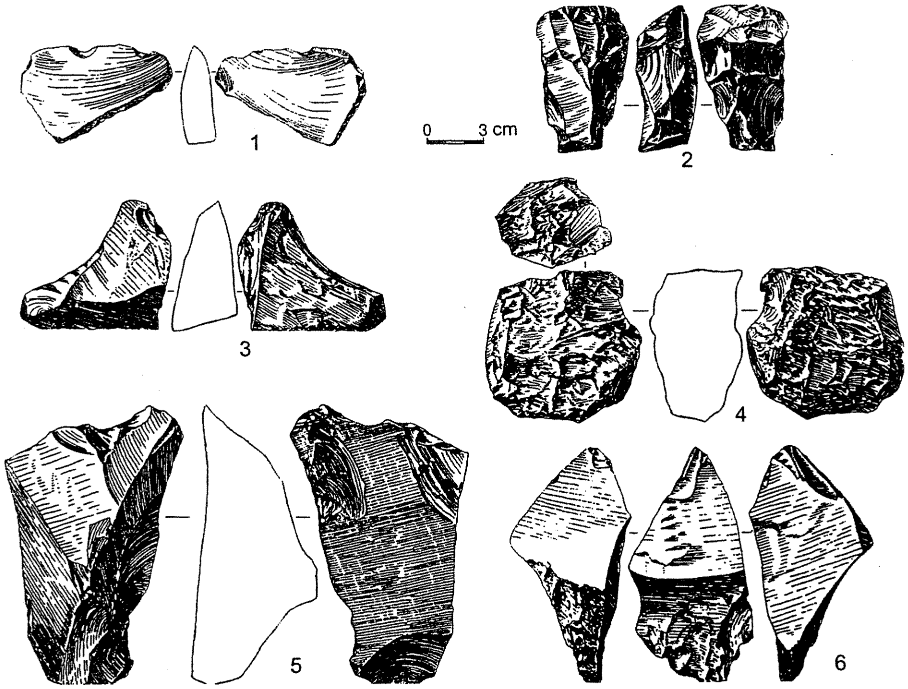


Fig. 9. Tsagaan Agui Cave. Artifacts associated with sedimentation cycle 3.

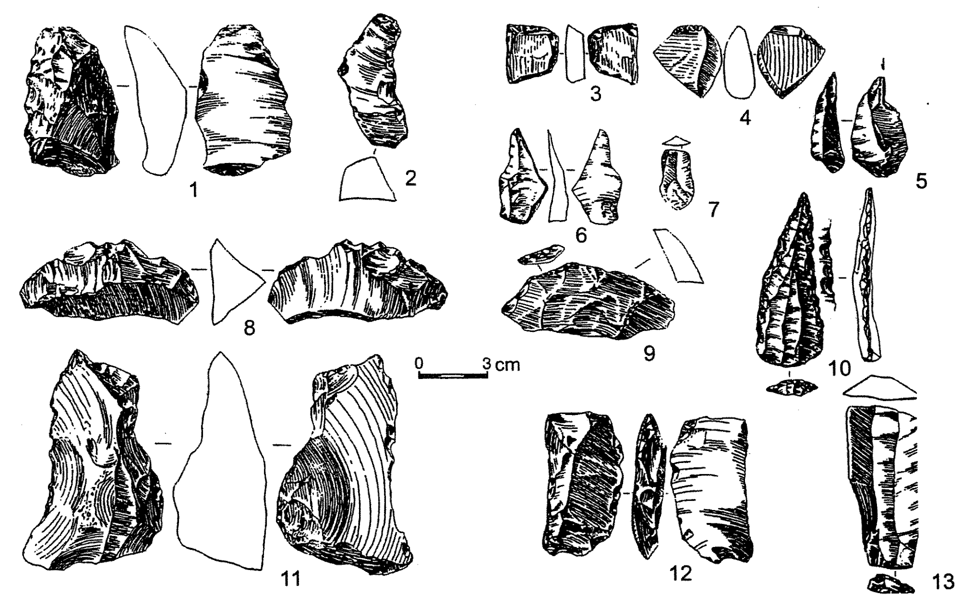


Fig. 10. Tsagaan Agui Cave. Artifacts associated with sedimentation cycle 3.

1986; Derevianko, 1990). The bearers of this Levallois-Acheulean-like tradition may have migrated east from central Kazakhstan (i.e., the Lake Balkash region) to southern Mongolia by moving through the so-called "Junggar Gates" on the current Kazakh-Chinese frontier, then further east and southeast along the natural corridor flanking the ranges of the Mongolian and Gobi Altai massifs.

A.G. Medoev (1982) first identified the presence of Acheulean-like tool types in early Paleolithic assemblages in Kazakhstan, particularly on the Mangyshlak Peninsula. Kh.A. Alpysbaev (1979) also recorded bifacial tools in early Paleolithic assemblages recovered from the Tanirkazgan, Borykazgan, and Kemer sites in the Karatau mountains of southern Kazakhstan. Thus, a Levallois-Acheulean continuum of development in Kazakhstan during the Early and Middle Pleistocene seems well grounded, bearing in mind the broad spatial distribution of the relevant industries. This inference is also supported by results achieved by recent joint Kazakh-Russian expeditions in central and southern Kazakhstan at sites such as Semizbugu and Kyzyltau 1 (Derevianko et al., 1993; Derevianko, Taimagambetov, Bekseitov, et al., 1996, 1998; Derevianko, Petrin, Taimagambetov et al., 1997). A new series of early Paleolithic sites yielding Acheulean-like bifacial tools has been discovered recently on the Mangyshlak Peninsula, of which the Onezhek localities investigated by Taimagambetov (1996) and Mangyshlak Locus 11 discovered east of Novy Usen by the Joint Kazakhstan-Russian Expedition in 1998 warrant special mention. Also, sites associated with a tradition of bifacially worked tools are reported from areas of western Turkmenistan contiguous with Kazakhstan, including the Yangadja II and Kara Tenghir localities on the Krasnovodsk Peninsula (Okladnikov, 1953, 1966; Abramova, 1984; Vishnyatsky, 1996).

The early assemblages of Tsagaan Agui demonstrate several characteristic features in common with North Chinese Paleolithic sites of the so-called Kehe-Dingcun "large flake" tradition (Wu and Olsen, 1985; Jia and Huang, 1991; Kuchera, 1996). The sites attributed to this developmental continuum exhibit a strategy of primary reduction that is characterized by a polyhedral pattern of flaking. The majority of tools of this tradition were fashioned on massive amorphous spalls through irregular retouch. The tool kit includes large numbers of scrapers of various sorts, burin-like implements, and tools with pronounced pointed ends, called *jianzhuangqi* in Chinese (Okladnikov and Abramova, 1994). The Dingcun industries include large bifaces, or handaxes, which have engendered considerable debate over the "Western" origin of the Dingcun handaxes and pointed tools (Okladnikov, 1972). The regional occurrence of such tools led to the proposition that there existed a zone of "Western influence" in the Chinese Paleolithic located in the mountains of the Loess Plateau in Shanxi and the Ordos (Hetao) Region within the Great Bend of the Yellow River. This facies was commonly correlated chronologically with European Levallois-Mousterian sites as well as with sites yielding Mousterian-like technologies in Inner Asia, Kazakhstan, and the Altai (Larichev, 1977).

With the discovery of a series of archaeological sites including Xihoudu, Lantian, Donggutuo, and Xiaochangliang, among others, the earliest human occupation of north China has been shifted back to the Early Pleistocene (Schick and Dong, 1993; Huang et al., 1995; Olsen, 1997), and the hypothetical Western origin of the Dingcun tradition has undergone significant revision. Studies of the earliest Paleolithic sites in China, including Lantian, Zhoukoudian Locality 13, and Kehe, have revealed that the tool kit includes bifacially worked implements (commonly referred to as handaxes and cleavers) and that bifacial reduction is a characteristic aspect tool manufacture. Thus, the origin of bifacial reduction strategies in the Dingcun assemblages can be most parsimoniously traced back as an autochthonous development attributed to the Early Pleistocene (Larichev, 1985). Some researchers trace the origin of Levallois-like technologies in China to local traditions as well (Liubin, 1970; Okladnikov and Abramova, 1994).

While the present authors support the hypothesis of the autochthonous origin of the Chinese Paleolithic, we believe it unwise to limit that perspective to a reconstruction of the Chinese Lower and Middle Paleolithic that suggests it was insular or isolated from "outside" influences. Detectable "Western" influence (apparently entering China from Mongolian territory) is clear, especially during the later Paleolithic, with the limited florescence of the Levallois technique and occurrences of Mousterian-like forms in associated tool kits. Consequently, the study of Early and Middle Paleolithic sites in south and east Mongolia, as well as their chronological attribution, allows inferences as to the evolutionary development of Paleolithic cultures in Central and East Asia and on the role of multidirectional migrations and autochthonous development in the configuration of their unique characteristics.

Despite the small sample sizes of collections associated with deposits of sedimentation cycle 3 at Tsagaan Agui, it can be confidently stated that Upper Paleolithic industries there are derived primarily from local Middle Paleolithic Levallois-like complexes. Both techno-typological indices and chronology suggest the late Mousterian and early Upper Paleolithic industries in Tsagaan Agui may reasonably be attributed to the "Orog Nuur" (Orok Nor) Levallois-Mousterian trajectory which is apparently unique to Mongolia (Derevianko and Petrin, 1990) and can be dated to between 40 - 30 thousand years ago (characteristic sites include Orok Nor 1 and 2, Orkhon 1, the jasper assemblages found on the northeastern face of the Arts Bogd Uul range, and Upper Paleolithic materials from Flint Valley and Chikhen Agui). Comparisons with industries from a broader territorial context reveal that the late Paleolithic assemblage of Tsagaan Agui cave displays many features in common with the so-called Kara-Bom Group in southern Siberia and northern Mongolia (Derevianko, Petrin, Rybin, and Chevalkov, 1998), as well as with those reported from North China, especially Shuidonggou and Sjara-osso-gol (Wu and Olsen, 1985; Yamanaka, 1995).

We remain cautious about our interpretations of the Tsagaan Agui chronostratigraphy. While long, presumably unbroken sequences of deposition are represented, the Last Glacial Maximum is a possible hiatus. Undoubtedly, the chronology needs to be refined, and detailed correlations of lithological horizons in the entryway zone with those defined inside the cave's Main Chamber need to be undertaken. Nonetheless, typological schemes based on the stratified Paleolithic assemblages at Tsagaan Agui make it possible to synthesize into a coherent chronological and typological system a large volume of archaeological data gathered in Mongolia and adjacent regions during the past two decades.

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