The function of tanged points from the Suyanggae site, Korea, and the Early Upper Palaeolithic

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1. Introduction

The purpose of the present article is three fold. First, it aims at establishment of a new methodology for lithic microwear analysis. Two major trends of use-wear analysis have been “the low power school” and “the high power school”. A new methodology is to combine “the mid power” approach to them toward a more synthetic method. Secondly, it aims at further clarification of the function of tanged points at the Suyanggae site, Locality VI, Korea. It will be a new addition to so-far published site reports with the mid power approach. Thirdly, it aims at further comparative research between Tohoku District of Japan (日本東北地方) and the Korean Peninsula on lithic artifacts from respective regions in terms of the emergence of modern human population arrivals.

Tohoku History Museum (東北歴史博物館) is a general historical museum established by Miyagi Prefectural government. It was founded in 1999, succeeding its former Prefectural museum of Tohoku Historical Material Museum (東北歴史資料館) which was founded in 1974. It is located in Tagajo City, neighboring the ancient fort site of the Tagajo castle (多賀城跡). The Tagajo castle was first built in A.D.724 according to the Tagajo Stele (多賀城碑). The castle area and accompanied Temple remains are designated as special historical relics by the Japanese government. The Tagajo site has maintained reputation as one of three distinctive historical relics of Japan, with the Dazaihu site in Kyushu and the Heijo capital palace site in Kinki District during the Ritsuryo system period around 8th century A.D. and after.

Tohoku History Museum announces its three missions in the society. The first mission includes its broad globally notified recognition of Tohoku District, as the Northeastern part of Japan. There are two reasons why this particular article is mainly in English. One is because of this mission. The other is the historical recognition by the first author as Director of a history museum, that the cooperative research results between institutions of Korea and Japan should be expressed in the common language, contemplating the 20th century international history in Asia, not to mention its details here. However, the general reader in Miyagi Prefecture may refer to the supplementary chapter in Japanese, which also explains research backgrounds for the specialized area of lithic use-wear analysis.

The current research was conducted based on the institutional agreement of research cooperation between Tohoku University, Department of Archaeology (TU hereafter), and the Institute of Korean Prehistory (IKP hereafter). The agreement was signed on August 4, 2017 by Professor Akoshima and President Lee, both being co-authors here. Figure 1 shows the scene of agreement ceremony at IKP. We desire the present article will further contribute to the mutual academic exchange between two countries.

Figure 1. Academic exchange agreement between Tohoku University and Institute of Korean Prehistory

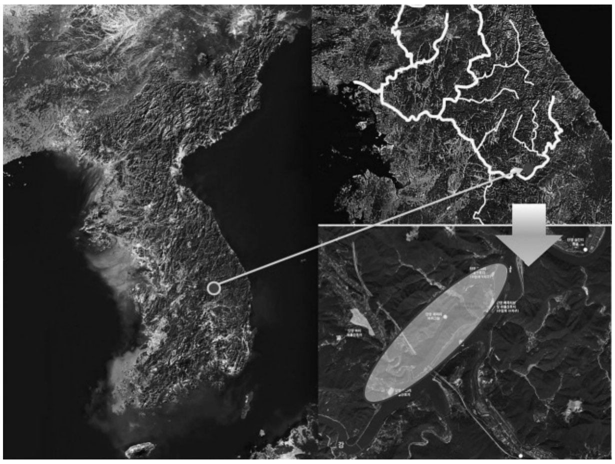

Figure 2. Location of the Suyanggae site (courtesy of IKP)

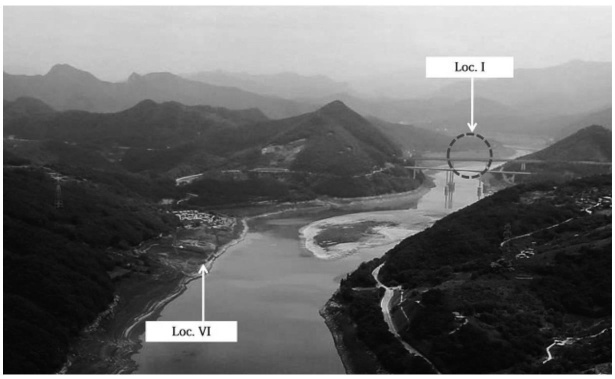

Figure 3. View of Locality I and Locality VI (courtesy of IKP)

2. Analytical procedures

(1) The Suyanggae site, Locality VI

The Suyanggae site is located at Aegok-ni and Hajin-ri, Jeokseong myeon, Danyang County, Chungbuk Province, Korea. The site is 125m to 132m above sea level (Figure 2, courtesy of IKP). The site has been very famous for a representative Palaeolithic site in the Korean Peninsula. Already 13 excavations were conducted at the site, since 1983 to 2015. From the 1st excavation to the 8th excavations, the research was conducted by the Chungbuk National University Museum. From the 9th to the 13th excavations, the research was conducted by Institute of Korean Prehistory. There are three different localities where the Palaeolithic cultural layers are identified, namely, Locality 1, Locality 3, and Locality 6 (Also writes Licality I, Locality III, Locality VI, Figure 3, courtesy of IKP).

The tanged points for the present analysis were excavated during the 11th campaign (2013), 12th campaign (2014 to 2015), and 13th campaign (2014 to 2015) conducted by IKP respectively. There are 4 cultural layers of the Palaeolithic period. There are abundant radiocarbon AMS data of charcoal samples from the site. The cultural layer 4 at the Suyanggae site, Locality VI was AMS dated to the period of the first portion of the Upper Palaeolithic age. Namely, averaged dates with 95.4% probability is, 41874-41254 cal BP (Lee, Yung-jo and Woo, et al. 2018, Lee, Kyong-woo 2019).

We had cooperative sessions in July, August, and September 2017, each for one week of analysis at IKP. The analytical results of these sessions were published in 2018 for the official site report by IKP (Lee, Yung-jo and Woo, et al. 2018). During the cooperative sessions, a total of 96 tanged points were examined for microwear analysis from Locality I and VI (cultural layers 3 and 4).

For the present paper, as was mentioned before, one week of cooperative session was conducted at IKP in September 2019. The tanged points are from Locality VI, cultural layer 4.

(2) Use-wear method

Functional interpretation of lithic artifacts has been a major focus of stone tool analysis ever since the late 19th century. Microwear analysis developed after 1970s when Keeley (1980) revealed that different worked materials produced various micro-polishes. For general reviews, refer to Akoshima (1989, 2010). There have been two dominant trends of microwear analysis. One is “the high power method” which mainly focuses on micro-polish developments. It is also often called as “Keeley method” and practiced mostly in Europe. Another is “the low power method” which mainly focuses on microflaking developments (Akoshima 1987). It was popular in the Processual Archaeology in America, as the method is suitable for relatively large sample sizes.

In Japan, Tohoku University Microwear Research Team (TUMRT hereafter) was among the first endeavors in this field of analytical method. The team was led by the late Professor Chosuke Serizawa and it has kept actual practices up to the present time with a large scale experimental reference collection. Application of TUMRT methodology has recently broadened to many sites around Tohoku District, Japanese Archipelago, and such foreign countries as Korea, China, Russia, Mongolia, Honduras and Guatemala, Ecuador, France, and U.S.A. (e.g., Akoshima 1995, Frison and Akoshima 1996, Kanomata 2011, Gunchinsuren and Kanomata et al. 2013, Akoshima and Kanomata 2015, Aoyama 2021). For recent trends, refer to Akoshima, ed. (2020). Cooperation with administrative sectors of cultural properties protection was widely practiced. For example, with Miyagi Prefecture Board of Education, Cultural Properties Protection Section（宮城県教育委員会文化財課、旧文化財保護課）, several cooperative researches have been practiced (Kanomata 2014, 2021, Kanomata et al, 2010, 2018) in the excavation reports including the Kajisawa site, Zao Township (鍛冶沢遺跡), the Kitakomatsu site, Osaki City (北小松遺跡), and the Nakazawa site, Ishinomaki City (中沢遺跡) which was for restoration projects after the Great East Japan Earthquake disaster.

Tohoku University method (TUMRT) has adopted both high power and low power methods together from the outset of its activity in 1976. By integrating the two different systems of analysis, not only reliability of interpretation increases, but also a wider application to actual variable situations became feasible. For example, the integrated method is applicable to situations where there is great variability in lithic raw materials, variations in the degree of surface alteration including patination phenomena.

For the analysis of the Suyanggae site materials in 2017, TUMRT strategy was fully applied as combination of high power and low power methods. The patination phenomena on shale materials at the Suyanggae site restricted full application of the high power method, but fortunately microflaking scars brought a certain level of meaningful results. Details of analytical results were published in the official site report by Institute of Korean Prehistory (Akoshima and Hong 2018b).

Subsequent to the site report publication, Akoshima attempted a new method for the same specimens, with the financial support by the Japanese government research funding (KAKENHI, grant-in-aid for scientific research). It is the “mid power method” using a digital microscope. Mid power means the magnifications around 100 times in order to focus on edge rounding and striations. By re-evaluating the original work by Sergei Semenov in Russia (Semenov 1964 in English), it was considered that phenomena of edge rounding and striations might be detected on the tanged points to bring new insights into this unique type of tools in the Korean Peninsula throughout the Upper Palaeolithic period. During the analytical sessions at IKP in 2017, we noticed a remarkable pattern of microwear around the tang part depression. Heavy to medium degrees of edge rounding were often observed on the notched depression parts of the tang area, irrespective of the functions of working edge parts. However, the actual method of use as IUZs (independent use zone by Vaughan 1985) was not necessarily clear for the tang portion. We postulated that the rounding phenomena along the tang may have been related to the hafting behavior by inhabitants at the site of Suyanggae.

In order to further clarify the hypothesis that the tanged points were actually hafted, the cooperative session in September 2019 was devised. A new technique always requires some trials and errors. TUMRT had integrated high power and low power methods, but since 1970s we almost dropped the “Semenov method”, so to speak. We analyzed 13 specimens as pilot study in 2019 and made preparations for next cooperative sessions. Then the Covid-19 pandemic came in and our plans for March 2020 was cancelled, and still opportunities remain disappeared due to regulations on moving across the border. The pandemic still continues and we decide to publish the first results of our new integration of three methods, Low, Mid, High for the present paper.

A little before the pandemic in December 2019, we had valuable opportunities in China to explicate our new method of digital mid power analysis as Japan and Korea international team, at the 24th Suyanggae International Symposium “Zhoukoudian and Suyanggae” which was also held as the 90th anniversary of the first skull discovery of Beijing man (Akoshima, Woo, Hong, Otani, Lee, and Lee 2019).

In 2020, we had another opportunity to cooperate for the Korean Society of Museum Studies (韓国博物館学会) in the special issue for Suyanggae research. In the Journal, techniques and implications of the mid power method for Asian archaeological studies were explicated (Akoshima, Hong, Woo, Ahn 2020).

The methodology of TUMRT has been widely published and reference collections are open access publicized, domestically and internationally (e.g., Akoshima 1989, 2010, Frison and Akoshima 1996, Akoshima and Hong 2014, 2016, 2017b, 2018a). The reader may refer to the details there and we refrain from redundant repetition here.

For the low power analysis, a stereoscopic microscope of 30X (times) magnification (Vixen Microboy SL-30cs) was used. For the high power analysis, a metallurgical microscope (Olympus BH-FM) was used at magnifications of 50X, 100X, and 200X with incident light attachment. For the mid power analysis, a portable digital microscope (“Dino-lite”) was used at mainly 100X. No pre-treatment of the tool surface was necessary for either analysis.

3. Analytical results of tanged Points

(1) Description framework

The results of low power and high power analytical combination were already fully published in the official excavation report by IKP (Lee, Yung-jo and Woo, et al. 2018, a chapter by Akoshima and Hong), and it is not repeated here. The results of mid power from 13 specimens (9 with micro-photographs) are integrated with the previous results in the site report. The observation in 2019 concentrated on the tang portion of the tool, and some specimens were not necessarily analyzed for use method (for IUZs). Emphasis is laid on the retouched tang parts for detection of edge rounding and striations.

Somewhat summarized explanations of tool use interpretation are provided first and then explanations for the tang portion observation continue for the present paper.

Right and Left, Ventral and Dorsal

In the description, “right” or “left” denotes each side edge when the tool is viewed on the dorsal face, pointed tool tip up on the figure. So, “right lateral side” denotes left side edge on the ventral photo figure. This description is because both faces of the specific edge should be considered at the same time to make use-wear interpretation. For example, transverse motion will produce microflaking scars more on one face and less on the other face (e.g., Akoshima and Hong 2014, 2016).

Independent Use Zone

The concept of Independent Use Zone was devised by Vaughan (1985). It is abbreviated as “IUZ”. One tool is often utilized on its various edge portions (pointed end, proximal base, tip and a side, and so on). Each utilized portion is called IUZ. One IUZ includes both ventral face and dorsal face. IUZ is a unit of analysis for actual utilization, thus several different IUZs can be existent for a single tool. Different IUZs may indicate different episodes of tool use for the same tool piece. In the present method, microflaking scars, micro-polish surface, striations, and edge rounding are all observed together for the same IUZ, using three different microscopic devices. Interpretation of use is based on all of these traces.

Artifact numbers

The artifact number is the recording number during the excavation procedure. Actually they mean Suyanggae Locality VI, CL (Cultural Layer) 4. For example, 33928 means Loc.VI-4-33928. Subsequent three digit numbers are the one given in the excavation report in 2018. For tanged points, they are shown in the implement number table from p.810 to p.821 which also refer to illustrations and photographs. Tanged points are implement numbered between 824 and 888. They are in the table at page 820.

(2) Artifact number 33928

Artifact No.33928 (Figure 4 –excavation report figure 2, p.124) is tool list 825 in the final excavation report published by IKP. The tanged point is made of black shale with slightly banded texture. The rock type resembles andesite quality and coarse-grained. There are two IUZs.

Left lateral edge (part A) was used in transverse motion, with the ventral surface as its leading face. Worked materials were possibly of soft to medium hardness. The sharp unretouched lateral side retains microflaking scars toward the tip of the point. They are intermittent rectangular or scalar micro types on ventral face, and continuous scalar micro deep types on dorsal face. Clear striations are detected perpendicularly to the sharp edge on ventral face.

Right lateral edge (part B) was used in both transverse and longitudinal motions. Worked materials for the dorsally denticulated edge was probably mixed. Edge rounding is found on ventral face at projections overhang. Striations are detected both parallel and perpendicular to the edge with connections of micro-polish patches.

The proximal portion of both lateral edges (part C) exhibits rounding and crushing on the ventral surface. Base rounding are seen more on overhang portions than notched concavities. The base portion is interpreted as traces of haft related behavior. There is a modern break at the tip of the point tool.

(3) Artifact number 39356

Artifact No.39356 (Figure 4 –excavation report figure 9, p.128) is tool list 888 in the final excavation report published by IKP. This specimen is made of fine-grained black shale. It can be classified as a backed knife on blade. It has two IUZs.

Left lateral edge (part A) was used in transverse motions, the ventral surface of the tool as leading face. The worked materials probably include bone/antler, inferred from microwear polish patches of D1 type. Perpendicular striations are seen at retouched denticulated backing parts indicating transverse movements. The ventral face shows slight rounding of edges at retouch scars. Technologically the side was unifacially, dorsally retouched or notched, considered as lateral backing.

Right lateral edge (part C) was used in longitudinal motion, on worked materials of soft to medium hardness. Polish patches are found on elevated portions, but they are rough and bright, and difficult to classify by Tohoku Univ. categories. Microflaking scars of scalar, micro, deep type are found alternately continuous on both faces.

The base (part B) shows more intense traces of use on the proximal portion at the end. Technologically the base retouch was only partial and on alternated sides. There is rounding of edges on the initiation face of alternate retouch, especially heavy rounding at projection parts. But almost no rounding is detected in notch depression or base line parts. Possible hafting was inferred in the site report, but with the mid power observation this time, the tool is rather classified as a knife shaped tool with no haft.

(4) Artifact number 34144

Artifact No.34144 (Figure 5 –excavation report figure 17, p.132) is tool list 826 in the final excavation report published by IKP. It is reported in the Museum Studies in 2020 (figure 4) to show effective merits of the mid power method. The tanged point is made of fine-grained banded shale, patinated to whitish grey color. Low power observation could identify 2 IUZs.

The tip portion (part A) has traces of possible impact fracture as a projectile. Right lateral tip also shows microflaking scars of continuous, triangular, small, step type.

Right lateral unretouched side (part B) was possibly used in longitudinal motion on relatively soft materials. Sporadic microflaking scars of scalar, micro, deep type are seen on both faces partially alternating, suggesting parallel movements to the edge.

The base portion (part C) exhibits possible wear from haft related behavior. The base is dorsally notch retouched along both sides. Rounding is found on ventral overhang of notches for both sides. With mid power analysis, edge rounding and striations are more clearly observed. Striations vertical to the edge are also detected with mid power, so is heavy rounding. However, a lateral side (part B) is not found rounded with the same method nor are striations. Differences between the lateral side (B) and notched tang (C) is noteworthy for this piece, indicating effective merits of integrating 3 methods.

(5) Artifact number 34258

Artifact No.34258 (Figure 5 –excavation report figure 19, p.133) is tool list 827 in the final excavation report published by IKP. The tanged point is made of fine-grained banded shale, whose surface has been heavily patinated to grey color. Low power observation detected 3 IUZs. The tip part exhibits no clear impact traces.

Right lateral side, distal half (part A) is a dorsally denticulated edge. The part was inferred as utilized edge, but its motion or worked materials are un-identified. Some denticulated projections are rounded on ventral face and side face. Some striations are detected there. Right lateral, middle portion (part B) was probably used mainly in longitudinal motion. Microflaking scars are found to be continuous, mostly of scalar, micro, deep type, and often distribute alternating between ventral and dorsal faces. Also, rounding accompanies microflaking edge scars.

Left lateral side (part C) was also probably used mainly in longitudinal motion. Microflaking scars are found intermittently on ventral face. Along distal half they are trapezoidal, micro, step type, and along proximal half they are scalar, micro, deep type. On dorsal face microfaking scars are also found intermittently. They are scalar, tiny to micro, deep and stepped types. When the side is viewed from lateral direction, scars distribute alternatingly between two faces, suggesting parallel movement of the edge.

The base (part D) shows traces from hafting related behavior. Along the proximal tang depression, medium to heavy rounding, often with edge crushing, are detected with vertical (perpendicular to edge) striations. Heavy rounding is also found at the base tip and a corner with right lateral side. Namely projections along the tang are heavily rounded with striations. Here again, mid power method is an effective measure to identify some sorts of hafting behavior. This piece was well hafted, used on both lateral sides as knife, but probably was not projected as weapon.

(6) Artifact number 34627

Artifact No.34627 (Figure 6 –excavation report figure 22, p.134) is tool list 853 in the final excavation report published by IKP. It is reported in the Journal of Museum Studies in 2020 (figure 2) to show effective merits of the mid power method. The tanged point is made of banded shale of dark grey color with good surface conditions for high power observation. The point tip retains no wear traces of possible use.

Right lateral side is dorsally denticulated. On ventral face at notched depressions, only slight rounding is seen. This may have been traces from retouch. The edge is fresh sharp and virtually no microflaking is found. This edge was probably un-used.

Left lateral side shows virtually no wear traces under magnifications of 100X and 200X, suggesting no use. No rounding, no striations, no polish patches are detected.

With low power analysis, the base (part A) exhibits edge rounding, on ventral face (100X) at base retouch distal portion. However, the other side (right side) of the base is sharp, and shows no rounding. With mid power analysis, edge rounding with crushing and striations are clearly observed along the tanged depression on both sides, especially on the ventral face. The tanged point was denticulate retouched, prepared and hafted, but probably was not put to use.

(7) Artifact number 35602

Artifact No.35602 (Figure 6 –excavation report figure 24, p.135) is tool list 861 in the final excavation report published by IKP. The tanged point is made of medium grained shale. The break at the point tip is of snapped off type and not clear as DIF (diagnostic impact fracture). The tool was made from a thin blade as blank and both lateral sides are not retouched, retaining sharp edges. Low power observation could reconstruct its usage. There are 2 IUZs.

Right lateral side (part A) was probably used in longitudinal motion, on relatively soft worked materials. Microflaking scars are found with slight rounding of edge. The scars are mainly on ventral face in the middle portion of part A, while they are mainly on dorsal face in the distal and proximal portions of part A. Shapes of scars are variable, scalar, trapezoidal, triangle, both deep and stepped, micro sized. Their distribution is partially alternating.

Left lateral side (part B) was probably used in transverse motion, possibility is on relatively hard (medium to hard) worked materials. Its moving direction was the ventral face as its leading aspect. Microflaking scars of various shapes (trapezoidal, rectangular, scalar) and sizes (small to middle), some with stepped termination are found mainly on dorsal face. Striations in perpendicular direction are also found along part B edge on both faces, ventral and dorsal (observable at 30X), again suggesting transverse motion on relatively hard materials. Mid power observation did not detect edge rounding, but found perpendicular short striations.

Mid power observation found clear striations perpendicular to the edge along the tang. They are both long and short. There are also rounded edges on ventral concavities of tang notches which were retouched unifacially on both sides. At the tip of the tang, oblique direction striations are found on edge rounding. The base exhibits wear traces from hafting behavior.

(8) Artifact number 36801

Artifact No.36801 (Figure 7 –excavation report figure29, p.138) is tool list 830 in the final excavation report published by IKP.

The tanged point is made of medium grained shale but it is patinated. The base tang is pointed by retouch, while lateral sides of the tool remain sharp with no retouch. Two IUZs are recognized. Effective merits of mid power method are emphasized for this specimen.

Left lateral side (part B) was probably used in longitudinal motion. Along the sharp edge, microflaking scars of scalar, micro, deep type continuously distribute on both ventral and dorsal faces alternating. Right lateral side exhibits no clear use-wear traces with only sporadic microflaking scars.

The point tip (part C) exhibits possible wear traces as projectile use. There are 3 small burin-like fractures from the tip. There are also irregular angular chipping scars near the tip on the left lateral side (more distal portion than part B aforementioned). They need closer examination as DIF (diagnostic impact fracture) by Sano (2012) or not.

With low power method, the base partially shows heavy rounding on the concavity of base notch retouch (ventral to side face) at part A. However, with mid power method, a lot of microwear traces were found all around the tang portion as are shown in micro-photographs taken at 100X magnification. Traces are variable and more distinctive on the ventral surface. Mostly, there are perpendicular (sometimes oblique) striations on heavy rounding of edge. Some accompany edge crushing and/or nibbling. At the tip of the tang, heavy rounding and randomly running striations are found.

(9) Artifact number 37499

Artifact No.37499 (Figure 7 –excavation report figure 31, p.139) is tool list 832 in the final excavation report published by IKP.

The tanged point is made of medium-grained shale of banded texture, patinated to dark grey color. The point has 2 IUZs.

Left lateral side (part A) was used,. There is a possibility of varied (mixed) utilization. Microflaking scars are found on both dorsal and ventral faces. Their distribution is intermittent, and types are variable, mainly micro to small, scalar and trapezoidal.

Right lateral side (part B) of denticulated edge was also used. There is a possibility of relatively hard materials. On ventral face, varied degrees of rounding are found along the denticulate especially at projection parts. On dorsal face, microflaking analysis is difficult due to the denticulate retouch.

The base (part C) exhibits heavy rounding on ventral face along both left and right sides. Low power method found the rounding, but mid power method this time clarified the characteristics of these traces. They are shown in Figure 7 (bottom). There are perpendicular striations (sometimes parallel) dominantly on projection parts of tang retouch. Striations are on the rounded edge, often heavily rounded. The traces at the base are interpreted as hafting related behavior. This example again testifies the usefulness of mid power method.

(10) Artifact number 34087

Artifact No.34087 (Figure 8 –excavation report no figure) is tool list 847 in the final excavation report published by IKP.

This specimen is not reported in the use-wear section of site report (Akoshima and Hong 2018b), but it is introduced in the Journal of Museum Studies article as Figure 1 for an example of heavy edge rounding and striations along the tang portion (Akoshima, Hong, Woo, Ahn 2020, p.228). It is described here to reveal the efficacy of the “mid power method”.

On the ventral face along tanged edges (both right and left), a number of striations are found mainly in perpendicular direction. Some are deep and long. There are portions where striations cross in perpendicular and longitudinal directions (mixed orientation). Striations are formed on top of heavy (often extremely) rounding of the edge.

On the other hand, left lateral side of the tool shows relatively light (or slight) rounding. Striations are observed in mixed directions along the left lateral. A photo is shown at the corner of left lateral side and the end of tang notch (ventral). The sharp contrast of slight rounding on the lateral side and heavy rounding on the tang notch depression parts (part B) are notable.

Left lateral side (IUZ, A) exhibits slight rounding plus striations in various directions indicating mixed use orientation. Perpendicular striations are found more numerous than longitudinal ones. Microflaking scars are tiny and sporadic (at 100X). Worked materials are un-identified, motion was possibly mixed. Right lateral side exhibit no traces of use. The edge is naturally denticulated (not retouched) and remains sharp.

4. Tanged point function

The present analysis revealed some characteristics of the tanged point. Application of the new method, mid power analysis, contributed to the findings. As is explained for the individual specimen, a dominant trend emerged as to the function of tanged point. The majority of tanged points retains regular patterns at the base portion.

Heavy edge rounding is often observed along the depression parts of the tang. In the case of unifacial tang retouch, ventral surface exhibits heavier rounding. Rounding is more eminent at the projected portions of the secondary retouch platform. The tendency is eminent when the retouched edge represents somewhat denticulated form. On the other hand, the depression parts of the retouch which represent small concavity form in their shape, generally exhibit less degrees of rounding. Inside the secondary retouch scars, rounding is less frequently observed. Some examples show overlapping of edge rounding and microflaking, where microflaking scar parts show less degrees of rounding, compared to the neighboring edge parts.

The tip part of proximal tang also shows rounding phenomena as well as adjacent tip sides. This indicates that the very tip of the tang was also an integral part of the proximal tang rounding. On the other hand, distal portions apart from the end of the tang part (which are actually projectile point lateral side edge), are variable on a case by case basis. In other words, the lateral side edges are integral parts of a projectile shape and their usage was very variable. Thus, the functional diversity is represented in the group of tanged points for the lateral side edges. The diversity is shown as the individual functional interpretation of IUZs.

Striations exhibit other distinctive characteristics for most of analyzed pieces. The directions of striations are dominantly perpendicular (vertical) to the edge. There are some obliquely running cases and longitudinally running cases, but as a whole they are rather exceptional. The processes of producing perpendicularly running striations are yet unclear. We actually lack experimental experience about the hafting behavior of projectile point. However, the fact is the consistent pattern that perpendicular striations are abundant on rounded edges. Edge rounding and striations exist as sets. They are probably the result of one behavioral pattern of making hafted tool.

The mid power method is also suitable for observation of minute striations. Both rounding and striations can be observed better at the magnification of about 100X. The magnification is just between the examination paucity by either low power or high power. Here are major merits of using the mid power method, we would like to emphasize. Examination of specimens would be more time-consuming to use the third type equipment. However, the analysis certainly obtains effects of cross checking the results.

The present analysis revealed sharp contrasts between the uniformity in the microwear traces on the tang portion, and the diversity in the microwear traces along the lateral edges and/or the projectile point tips. In conclusion, the tang part uniformity is interpreted as the result of uniform transaction procedures by the inhabitants, irrespective of individual utilization of the tanged point as a tool.

Our hypothesis was that the microwear traces along and around the tang portion of points represent some sort of hafting behavior. The present analysis strengthened the probability of the hypothesis.

The present analysis even strengthened our original observation by low power and high power together. We had some examined cases with mid power analysis, besides tanged portions. They are explained in the individual cases, but generally mid power results are very confirmative to our previous results in 2017.

Lastly, we summarize the results of our analysis for the official site report here to ascertain the integrity of our methodology.

1. The results are inferences in terms of four dimensions. Namely, 1) used, unused or unknown, 2) which part of the artifact was used (IUZ), 3) for what kind of motions they were used, longitudinal, transverse, mixed, or un-identified, 4) on what type of worked materials they were used, soft, medium, hard, or more specific type such as bone/antler or wood.
2. Out of 96 tanged points from the Suyanggae site, 47 specimens were analyzed and the majority of them are suitable for use-wear analysis, irrespective of their rock type, or the degree of patination. However, surface conditions from the post depositional surface modification processes (also termed as PDSM) prevented from identification of microwear polish types in many cases.
3. The method of use exhibits diversity. The tanged points were not necessarily projectile weapons, but they were

utilized in a variety of tasks, such as cutting/sawing, scraping/whittling.

4. The tips of tanged points do not show traces as point projectiles in the majority of cases. Rather, lateral sides were often utilized as tool edges. Both right lateral edges and left lateral edges were utilized. In many cases, both sides were utilized, not only along the sharp side, but also the denticulated side and/or retouch blunting side. Some denticulated lateral sides were used in transverse motion of use. Some sharp lateral sides were used in both longitudinal and transverse motions.
5. The base of tanged points exhibits a particular clear pattern of microwear traces. The tanged points were hafted. (This point 5 result was strengthened with the present analysis).
6. Above observations are from about a half of the tanged points. They were selected as the result of initial screening process using very low magnifications of the hand lenses. If all specimens were examined with high power method, unused tools could possibly be identified as related to site structural and behavioral analysis.

(Akoshima and Hong 2018b, p.120-121).

All in all, the three different methods observe the same phenomena of edge damage in different scales of magnification and lighting. However, without using three devices, we are unable to obtain meaningful patterns of use-wear as a whole.

5. Conclusions

Theoretically, the processes of "Upper Palaeolithization", so to speak, have been one of the central themes in prehistoric archaeology today. The migration of modern Homo sapiens groups into East Asia is generally considered to have been the main factor leading to the transformation from the Middle Palaeolithic to the Upper Palaeolithic industries. Changes in lithic technology and typological composition have been the integral parts of the wide ranging cultural revolution which accompanied deepening of the "planning depth" on the part of the modern population. A conclusion of the present analysis is that the tanged point well represents the deepening planning depth in lithic technological complex in the middle part of the Korean Peninsula.

A remarkable finding is that the tanged points were evidently hafted implements. Methodologically, adoption of the "mid power approach" testified our original hypothesis in the official site report in 2018. It is notable that the hafting behavior was a prerequisite to making and using this class of tool. Some examples indicate that even if they were not utilized, the hafting was applied to the base part.

Also, their utilization episodes were quite variable, probably depending on the actual situations at various locations on the landscape. As is shown in the site report (2018) and additional mid power analysis here, lateral sides of tanged points were rather major working parts of the tool. The class of tool has been called "points", and general assumption is that their major function was that of the projectile weapon. Our analysis provides a different interpretation for utilization.

Modern human population at the Suyanggae site during the years between 41874 and 41252 calBP, produced tanged points in anticipation of future use as the composite tool. They were produced as composite tools with stone tip and haft shafts. The length of shafts or the raw material of them is yet unknown, but the composite tools were around their daily activities of various kinds including domestic activities in the migrating camp locations. It is possible that seasonal patterns of migration and planned subsistence activities were already established as modern hunter gatherers.

The overall lithic technology was basically relied on emergent blade or elongated flake techniques. At the Suyanggae site, Cultural Layer 4 which is the target of our present analysis, is dominated with the tanged point assemblage. It is also reasonable here to postulate that tanged "points" were in wide use for their daily life. The assemblage and technology transformed from Cultural Layer 4, to Cultural Layer 3, 2, and 1. The assemblage composition became more variable toward the top of the strata.

Here it may be pointed out that the function of tanged points also underwent a considerable degrees of transformation toward the Middle and Late parts of the Upper Palaeolithic period. Future analysis of the tanged points belonging to the later time periods will shed light on this problem. Already previous results are known from the use-wear analysis by Sano indicating the projectile usage of tanged points at the Jingeuneul site, Jinan-gun, along the Geum River. They point out a strong possibility of mechanically propelled weaponry (Lee, Gikil and Sano 2019).

Comparatively, implications of the present analysis to the archaeology of Tohoku District include also the emergence of modern human population into the Tohoku landscape. The time period is close to the Suyanggae CL4, as between 30000 and 38000 years ago, a number of sites are found and some were meticulously excavated. They include the Sasayamahara (笹山原) No.16 site in Fukushima Prefecture (e.g., Hong 2018), Jizoden(B) (地蔵田) site in Akita Prefecture (e.g., Kanda 2021, Kanomata 2011), and the Yakurai-san (薬莱山) No.17 site in Miyagi Prefecture (e.g., Hong 2021).

Lithic technology and assemblage composition are quite different from those in the Korean Peninsula. However, the research themes belong to the same category of prehistoric pursuit. Namely, the arrival of early modern human population and thereof emergence of revolutionary behavioral transformation from the pre-existent Middle Palaeolithic populations in the Japanese Archipelago (e.g., Yanagida and Akoshima 2015), need to be pursued. Generally, the period in Tohoku District belongs to the age division system of the Early Upper Palaeolithic. The period precedes the fall of the Aira Tanzawa pumice (AT) layer which is a wide-spread tephra throughout the Japanese Archipelago. Yanagida found a key stratum of "dark soil band layer" below the AT and established a chronological scheme in Tohoku District (Yanagida 2013).

During the EUP of Tohoku, distinctive blank production method of the Yonegamori technique (米ヶ森技法) which consecutively makes relatively round flakes with a positive scar on dorsal face. Elongated blanks to emergent blades were also produced. Trapeze artifacts (台形石器) and trapezoidal artifacts (台形様石器) are main typological components for the period, as well as knife shaped tools (ナイフ形石器). An important research domain should be the functional interpretation of thus classified tools. One viewpoint should be the question of hafting behavior and projectile utilization. Hand held tools or hafted tools are a fundamental division. There is also a related question about the meaning of secondary retouch. It is a question between secondary retouch to produce working edges, or secondary retouch to make tools more usable such as making back edges to hold. All these research topics necessitate the field of traceological analyses. Further in-depth functional studies in Tohoku District for the same time period as the present article would shed important light on the nature of the Early Upper Palaeolithic. Comparative studies on the period is urgently necessary for insights into the modern human behavior which presupposes much deeper planning depth than before.

Methodologically, it is demonstrated that the new technique of "mid power analysis" is an important addition to the "low power" and "high power" analyses. By combining three different techniques, much more reliable functional inferences become feasible. The combination also has strength for dealing with variations in samples, such as surface alteration, raw material diversity, site structure, and dichotomy of "curated" versus "expedient" type of tools.

Typologically, the type tool "tanged point" in Korean Peninsula has been related to the "flake point" (剥片尖頭器) tools especially in the Kyushu island. The assumption is based on geographical closeness and typological similarity. Temporally, there were abrupt influx of the almost identical tools after the eruption of the Aira caldera in Kagoshima Prefecture. The evidence supports the direct contact hypothesis.

However, we would like to point out that typologically similar artifacts are also existent in other regions including Tohoku District. Lee examined the "knife shaped tools" in Tohoku District and compared some specimens to Korean tanged points. His investigation revealed that some "knife shaped tools" can well be included in the category of "tanged points in Korea", although there are some differences such as the size of the blank blade (Lee, G. 2014).

In conclusion, the prehistory of Tohoku District must be interpreted in an explicitly comparative framework with the Asian continent, especially with adjacent regions such as the Korean Peninsula, the Chinese Northeastern provinces, the Sakhalin island, and the Russian Maritime region. Tohoku is not just Tohoku on its own isolation ever since the first inhabitants came in. The present paper in English takes a new perspective in Miyagi Prefecture archaeology (宮城県考古学の新視角).

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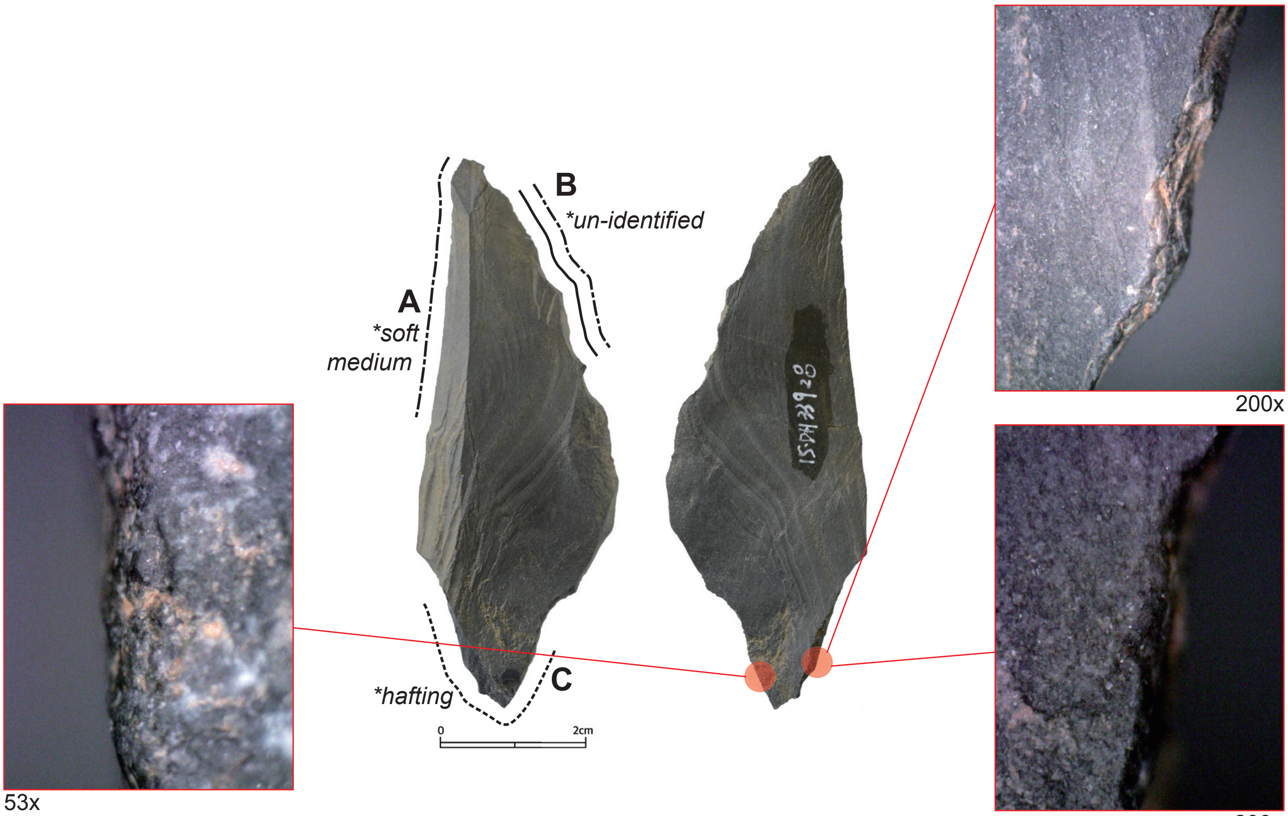
【付編】

韓国スヤンゲ遺跡スンベチルゲの機能と後期旧石器時代前半期

阿子島 香・洪 惠媛・禹 鍾允・李 隆助

東北地方の考古学・古代史は、東北地方内部で完結するものではなく、日本列島の各地はもとより、広く東アジアの中において考察されなければならない。本論は、そのような観点から、韓半島（朝鮮半島）と東北日本の比較を念頭に、後期旧石器時代の開始期すなわち現生人類が初めて両地域に渡来定着した時期の文化変化について、石器の使用痕分析という分野の研究を通して考察しようとするものである。

本論の課題である tanged point は、韓国語の茎（なかご）を有する突き刺す道具、「有茎刺突具」といった名称である。韓国の後期旧石器時代を通しての、代表的な石器器種という位置を有する。日本考古学での tanged point は、後期旧石器時代終末頃の「有舌尖頭器」を指すことが多いので注意が必要である。スンベチルゲは、日本考古学では「剥片尖頭器」という石器器種名が与えられて、特に九州後期旧石器時代での出土事例が、韓半島と比較されてきた研究史がある。一方で、日本考古学で「ナイフ形石器」という器種名で一括して総称されている石器の中にも、技術形態学的にスンベチルゲとして分類しても差し支えないような石器も含まれている。東北地方では、石刃石器群の中のナイフ形石器



* Worked materials

A, B, etc : IUZ(Independent Use Zone)

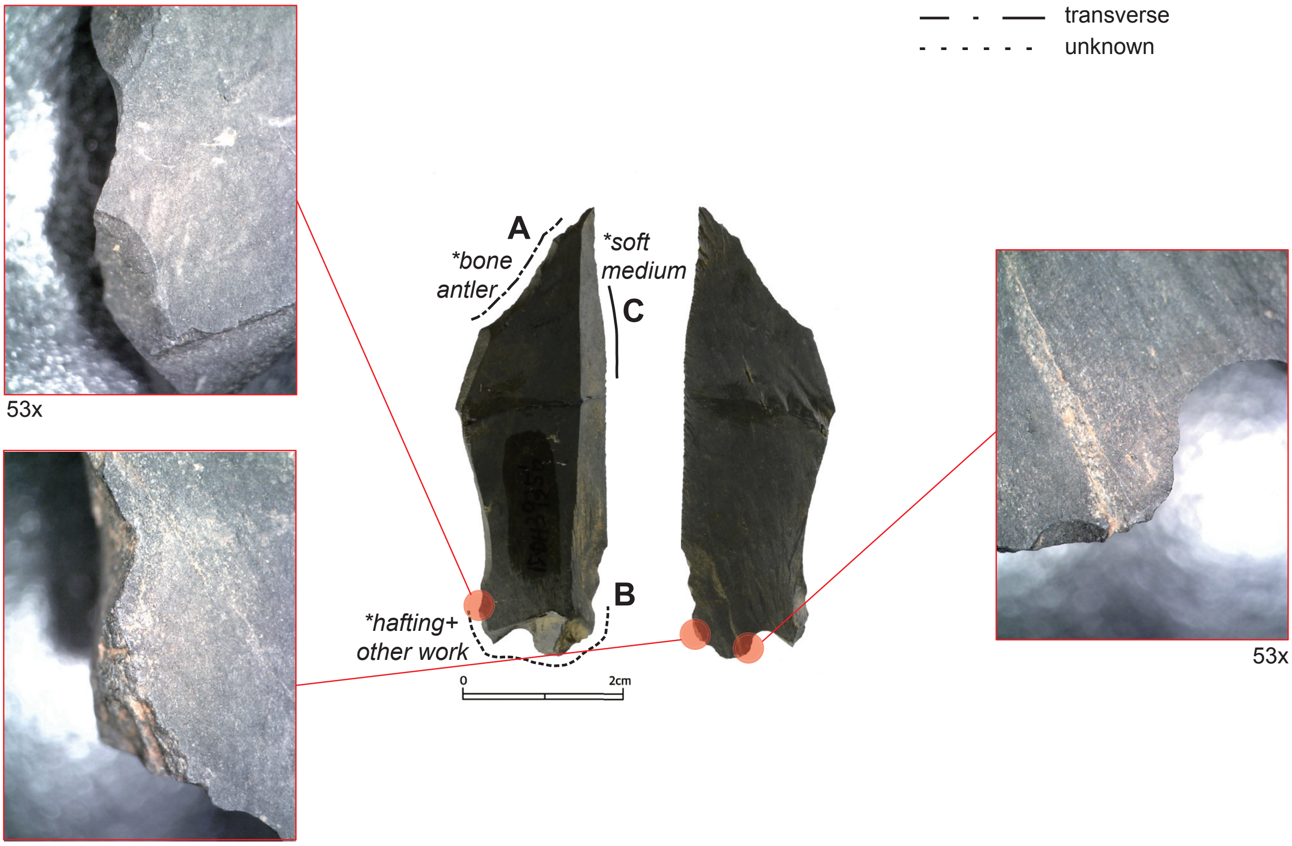
IUZ(photo area)

longitudinal

transverse

unknown

Artifact No. 33928.



Artifact No. 39356.

Figure 4. Artifact No. 33928, 39356.

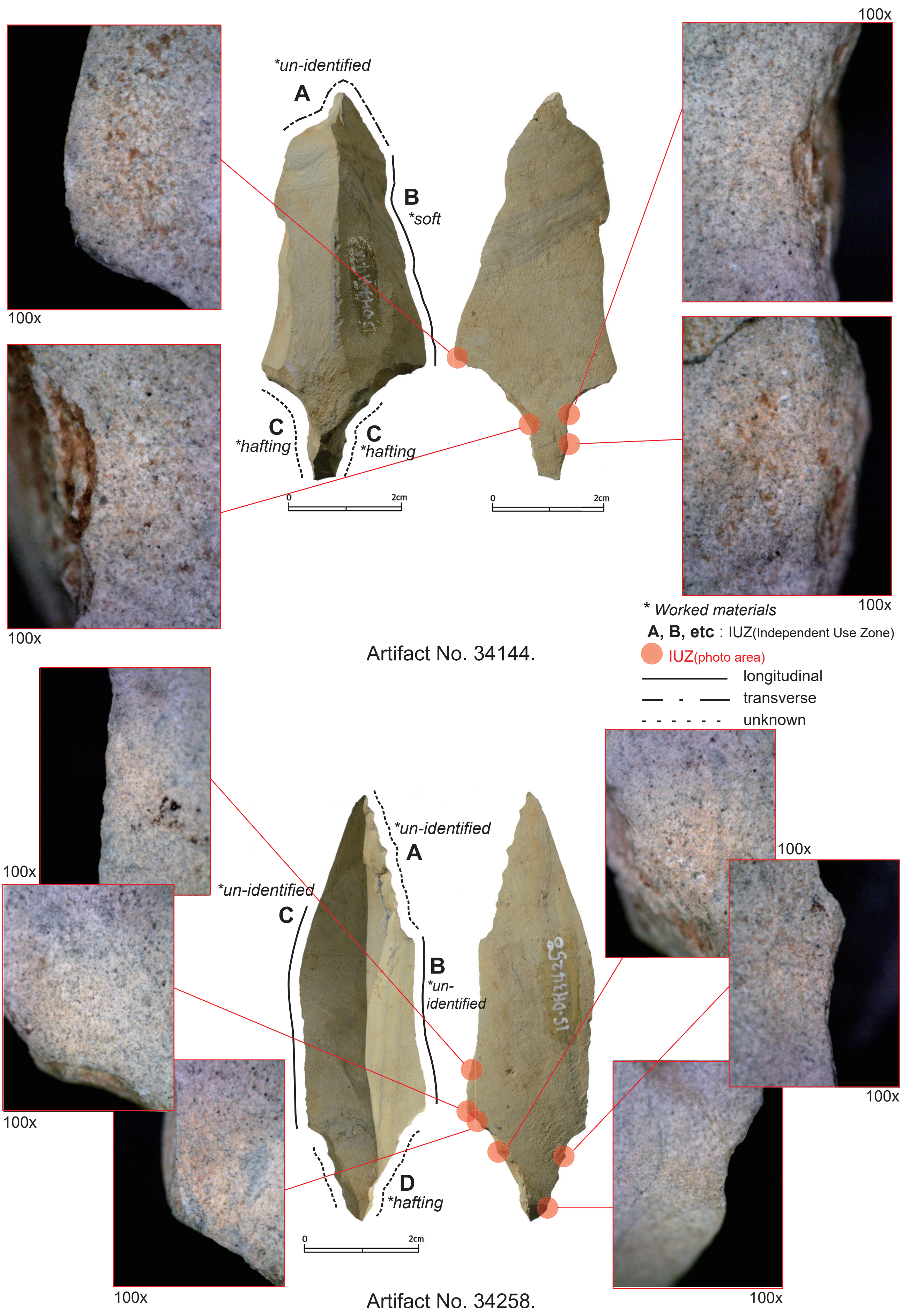
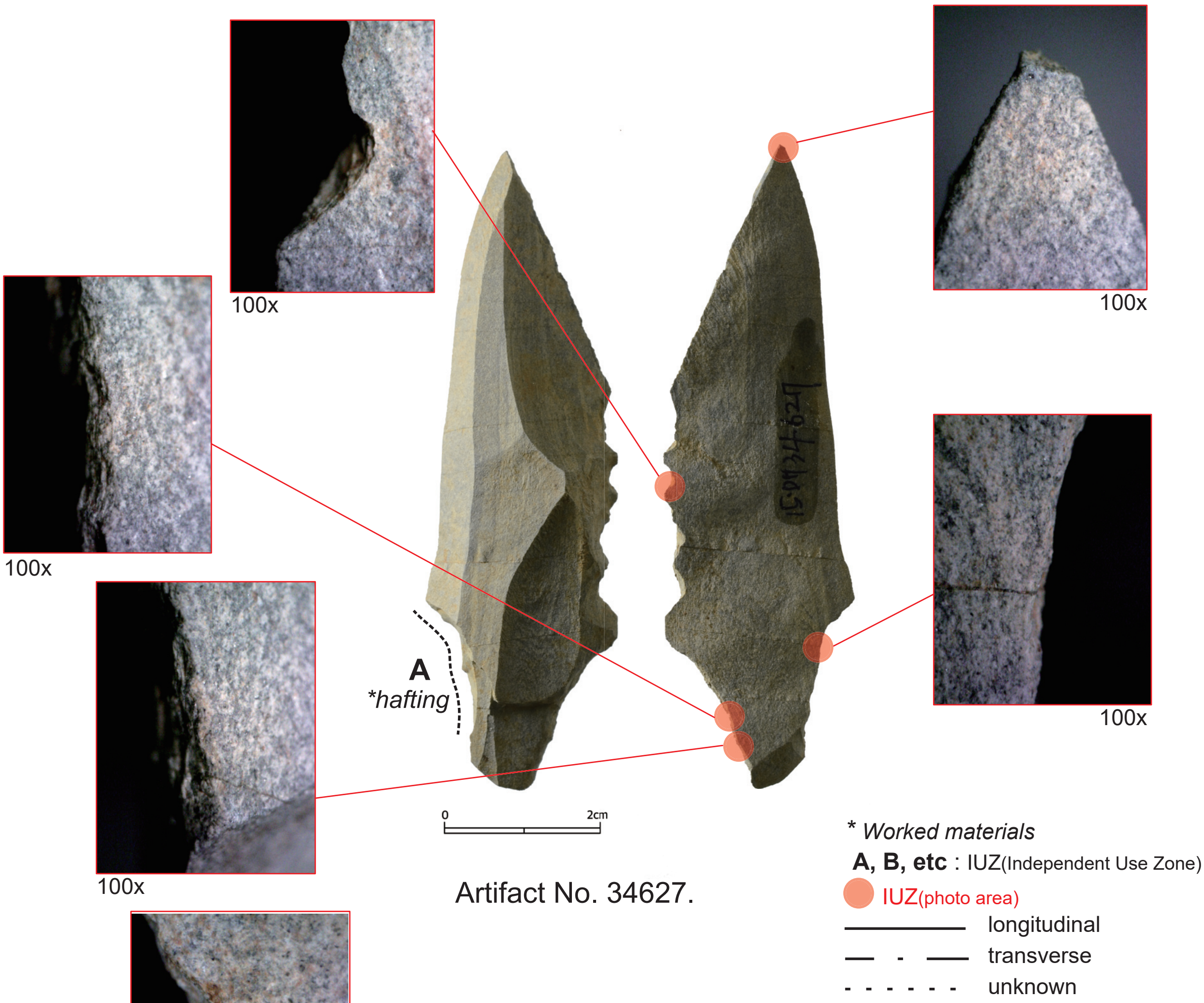
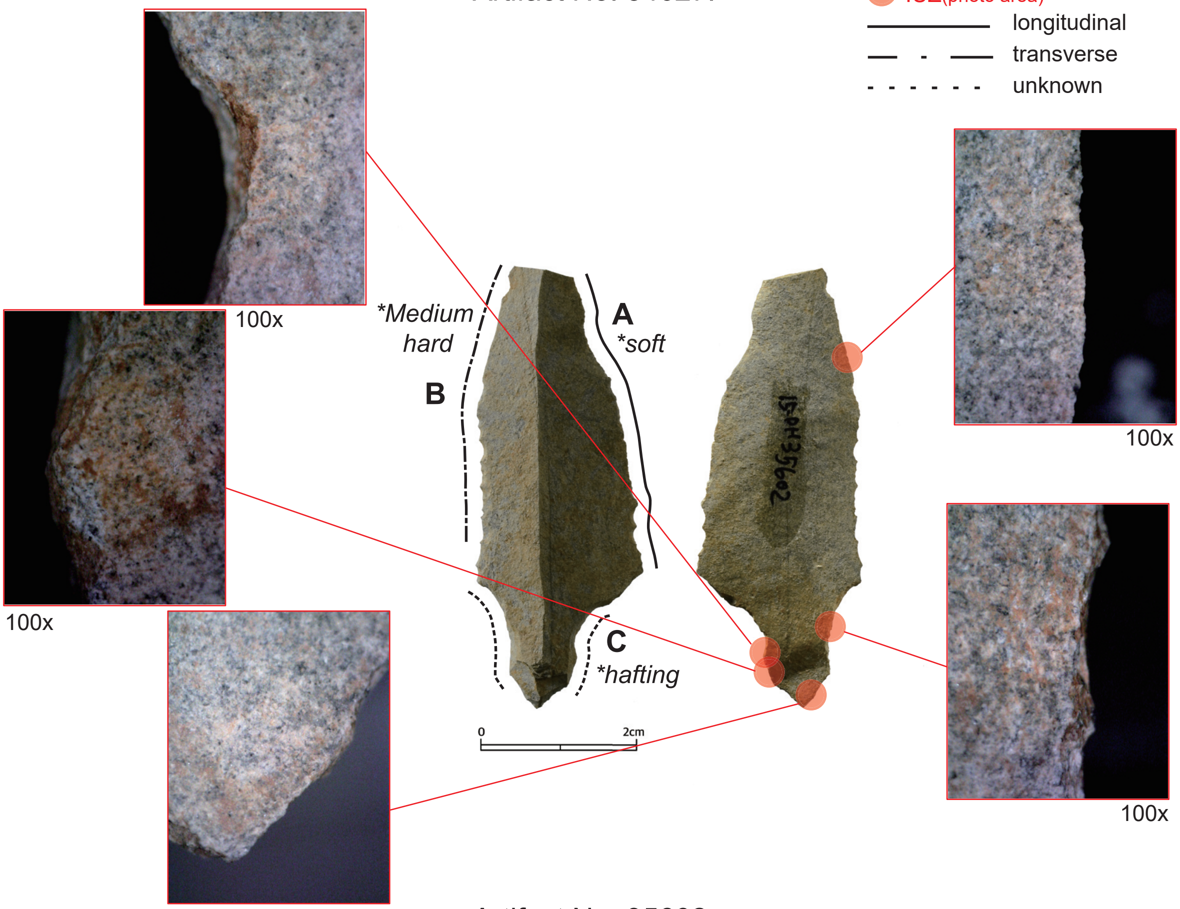


Figure 5. Artifact No. 34144, 34258.



Artifact No. 34627.



Artifact No. 35602.

Figure 6. Artifact No. 34627, 35602.

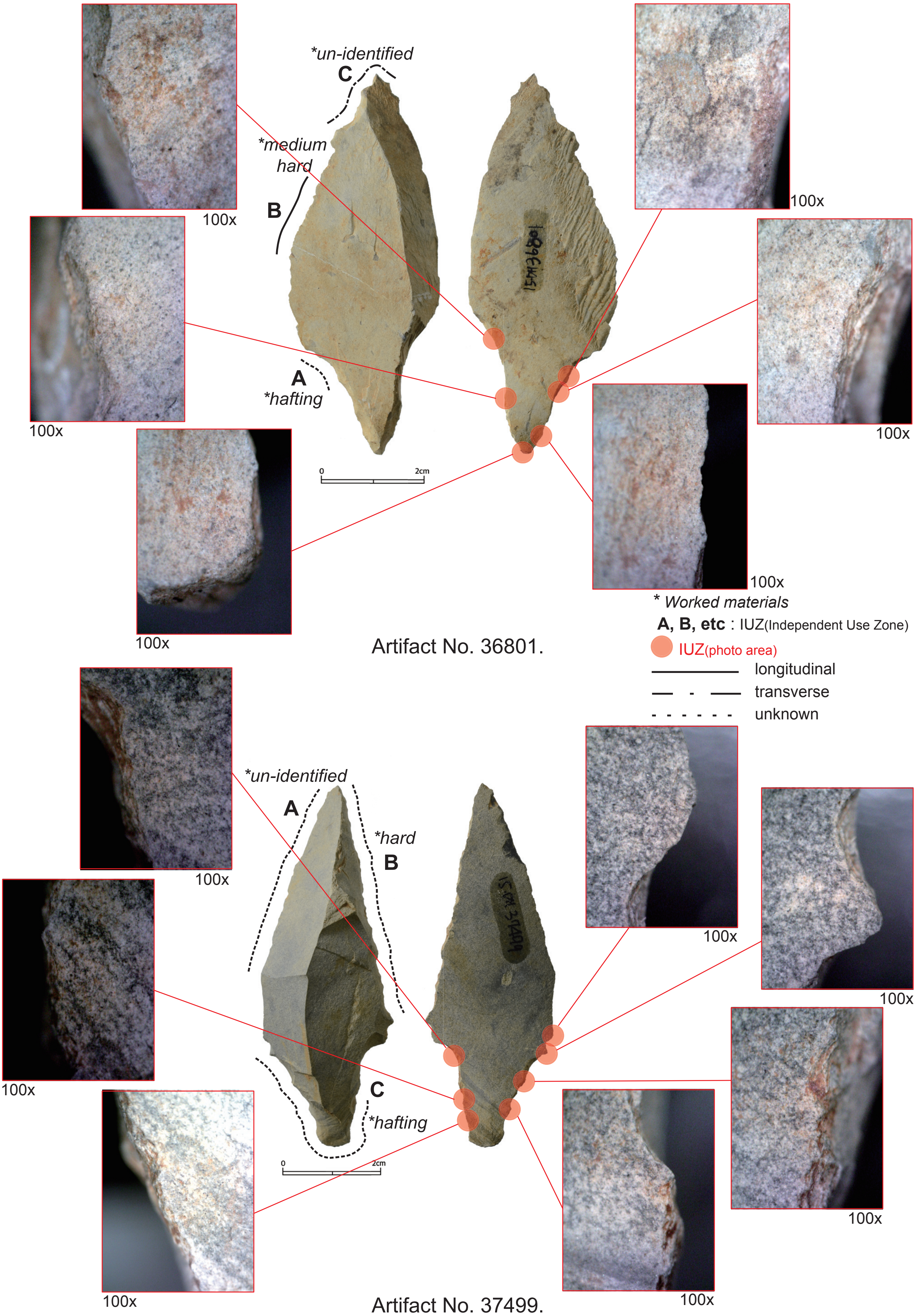


Figure 7. Artifact No. 36801, 37499.

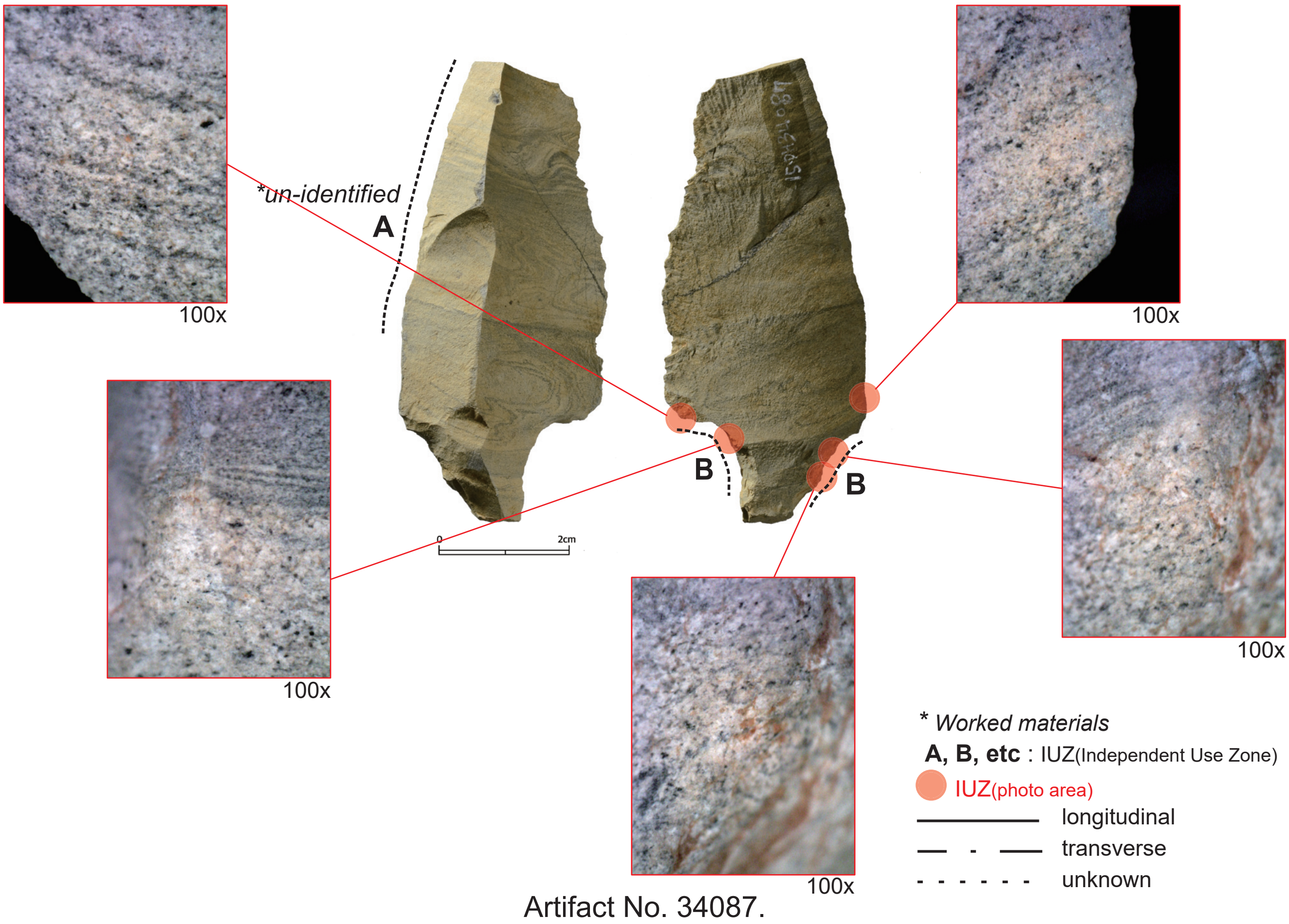


Figure 8. Artifact No. 34087.

に、韓半島のスンベチルゲと類似する出土事例もあり、比較研究が進められてきた（李起吉　2014）。東アジア各地での出土石器の比較研究は重要なことであるが、理論的には型式的、また技術形態的な類似と、機能における類似および相異とを、それぞれ別の次元として捉え分析していくことが必要であろう。

今回の使用痕分析は、韓国先史文化研究院と東北大学大学院文学研究科考古学研究室との研究協力協定（2017年 8 月 4 日締結）に基づいて、共同研究として実施することができた。2017 年 7 月、8 月、9 月、2018 年の発掘調査報告書準備と刊行、2019 年 9 月の各期間に、協力関係をもって研究を実施できたことは、両国間の友好と考古学学術交流にとっても、大きな意義を有する。その後も追加分析を予定していたが、コロナ禍により機会は失われたままである。本研究の枠組みの中心は、東北地方先史考古学との比較研究にあるので、まずこれまでの共同研究成果を総括し、今後の東北考古学への具体的展望を探ることとした。

スヤンゲ遺跡は、忠清北道丹陽郡に所在する、韓国を代表する旧石器遺跡として著名である。忠北大学校博物館、韓国先史文化研究院により、李隆助教授を中心に 1983 年から 2015 年まで、13 次に及ぶ発掘調査が実施されてきた。今回の分析は、2013 ～ 2015 年の第 11 次～第 13 次調査による、第 I 地区出土の 13 点、第Ⅵ地区第 3・第 4 文化層出土の 83 点、計 96 点を対象とした。使用痕分析では、石器の石材、製作技術、型式と組成、出土層位と空間分布などの背景情報を十分に考慮したうえで、最適な具体的分析手法を選択していくことが重要である。使用痕分析は、多大な時間を要する研究である。まず各種方法を試行し、スヤンゲ遺跡の石材の種類、石器表面の状態などを観察検討した。全点を、複数分析者（阿子島と洪）が独立に観察し、使用痕の可能性ある資料を選択し、一方で各種石材と表面状況に対しての、各法の効果を検討した。分析方法として、高倍率法と低倍率法を併用する手法が最適と判断された。高倍率法は、主として微小光沢面を観察し、低倍率法は主として微小剥離痕に着目する。線状痕と縁辺摩滅は、それぞれ倍率により観察できる現象が異なる。使用機器として、高倍率法はオリンパス BH-FM 金属顕微鏡（落射照明付き）により 50 倍から 200 倍、低倍率法は Vixen Microboy SL-30cs 実体顕微鏡により 30 倍で観察を行なった。報告書刊行後に、さらに新方法として中倍率法を導入し、デジタル顕微鏡を使用して、特にスンベチルゲの基部周辺の観察を約 100 倍で行なった。

対象資料のうち、47 点は使用痕分析に有望と判断され、詳細な観察を行なった。スヤンゲ遺跡の石材は多く

が「頁岩」（shale）と分類されており、日本東北地方の頁岩と類似する。しかし、現状の表面が灰色や灰褐色のような明色、また縞模様を有する石材では、高倍率下での微小光沢面があまり検出できないことが判明した。石器の欠損部分で確認されるが、もともと暗色の表面が風化進行した要因が考えられた。高倍率、低倍率ともに、東北大学使用痕研究チームによる参照実験資料が適用できると判断され、検出された痕跡の解釈を進めた。方法・基準資料の解説とデータは、阿子島（1989）、Akoshima (2010), Akoshima and Hong (2014, 2016, 2017a, 2017b, 2018a) を参照されたい。

調査報告書（韓国先史文化研究院刊行 2018）においては、石器 1 点ごとに個別に事実記載と解釈を述べた。使用痕分析の結果提示では、一覧表や記号化のような提示方法もあり得るが、今回のように石器の表面状態に多様性が認められ、検出痕跡と判定の確実さの程度にも多様さがある場合、一覧表のような記載をすれば逆に重要な情報を失わせる懸念が大きい。またスンベチルゲの形態や大きさ、調整加工の状態など、石器の型式学的・技術学的理解と、使用痕という機能論的情報を、一体的に理解していくことが重要と考えられる。使用痕分析では、確実に判断できる部分と、やや可能性にとどまる部分とが、ともに存在する。以下に英文報告書での結論を要約したい。

1）機能の解釈とは、観察事実と参照基準資料とによる、推論であること。石器が使用されたか非使用か、不明か。石器のどの部分が使用部位か、これは IUZ（independent use zone, 独立使用部分）として概念化できる。どのような動作に使用されたか、刃部に並行方向、直交方向、混在、不明。どのような加工対象物に使用されたか、軟らかい、中程度、硬い、あるいは特定の加工対象物の大別（骨角、木材のように）。

2）96 点のスンベチルゲのうち、分析した資料 47 点の多数から、何らかの使用に関する情報が得られた。石材の多様な種類や、表面の風化状況にもかかわらず、成果が得られた理由として、低倍率法と高倍率法とを併用したという方策がある。しかし埋没後の表面変化 (PDSM) のために、微小光沢の検出例が限られて、加工対象物の特定は限定的成果にとどまった。比較的に暗色の材質で表面変化が少ない石器に、微小光沢の残存が確認された。

3）スンベチルゲの使用方法は、多様性を示す。それは、必ずしも投射具としての槍先というわけではない。多くの種類の作業に用いられた。切断、鋸引き（双方向切断）、掻き取り、削り、などである。

4）多数の事例では、尖頭器先端部には投射具としての形跡は確認されなかった。むしろ、石器の側辺部が、作用刃部として機能した証拠が多かった。右側辺と左側辺の両方が使用されている。両側辺が使用されている場合、鋭利な縁辺（型式学的には刃部とされる）も、刃潰し加工や鋸歯縁加工が認められる対側辺も、その両方が使用されている事例もある。特に、鋸歯縁加工がある側辺部分には、刃部に直交方向の使用痕跡が認められることがある。鋭利な縁辺は、平行方向にも、直交方向にも使用されている。

5）スンベチルゲの基部には、明確なパターンが認められた。基部を形成する凹んだ部分に、摩滅が多く認められた。とくに、調整加工による凹み部分のオーバーハング（リタッチの打面側の縁）上に、顕著な摩滅がある事例が多かった。その摩滅は、石器の使用にまつわる結果であるか、製作上の形跡であるか（着柄のために縁辺をグラインドするなど）については、現状では断言できないが、何らかの「着柄行動」に起因するものと判断される。すなわち、スンベチルゲは、柄に装着されていた石器であったのだ。

調査報告書の刊行を準備するにあたって、我々の共同研究チームは、現在の世界学界での使用痕研究の中でも、高度な水準の分析を実施できたと考えている。しかしながら、未解決の課題もあり、新たな共同研究の可能性を求めて、報告書刊行後にさらに新しい分析方法開発を試行した（2019 年 9 月）。デジタル顕微鏡を使用した「中倍率法」の分析であり、一定の成果を得ることができた。本論の資料提示の内容である。この方法は、将来的に東北地方の石器分析にも応用が可能である。

石器使用痕分析には流派があって、各国の研究史とも関連している。たとえば、フランス、イギリス、日本では、高倍率法が重視されてきた。1970 年代にキーリーによって開発された方法なので、キーリー法とも呼ばれている。金属顕微鏡で微小光沢面を重点的に観察して、加工対象物の特定から、旧石器遺跡での人間活動の復元を目指す研究方向である。一方で、アメリカを中心に、低倍率法も発展している。実体顕微鏡で微小剥離痕を重点的に観察して、多数の資料観察結果を統計的に考察し、文化変化や人間集団の適応プロセスを解明しようとする研究方向である。1976 年からの東北大学使用痕研究チームは、故・芹沢長介名誉教授によって確立されたが、研究開始当時から、世界各国の研究動向を見て、高倍率法、低倍率法の両者を総合する方針を示された。同チームの分析方法は、韓国、中国、ロシア、モンゴル、アメリカ、フランス、ホンジュラス、グアテマラ、エクアドルなど、各時代の資料にも広く応用されてきた。宮城県内でも、県教委文化財課、関係市町村との連携が進められ、蔵王町鍛冶沢遺跡、大崎市北小松遺跡、石巻市中沢遺跡において応用がなされており、膨大な収蔵資料を有する東北歴史博物館においても、今後の進展も期待される。使用痕分析は標準的な石器研究法に含まれるもので、特殊な分野ではない。型式学、技術学、機能論は、石器研究の三大分野とも言える。

スヤンゲ遺跡の資料分析により、スンベチルゲの基部形態とその機能的な役割に関して、有力な仮説が得られ

た。より正確な解明のため、使用痕分析の新たな手法を試みたのが本論の意義である。低倍率は 30 倍、高倍率は 200 倍を中心に観察したのであったが、顕微鏡のタイプによる画像の特徴もあって、摩滅や線状痕の状況が十分に把握されない課題を残していた。研究史を振り返ると、1964 年に旧ソ連のセミョノフによって、使用痕分析の基礎が作られたころ、線状痕や摩滅の観察は重要な要素であり、100 倍前後の倍率を主にして検出されていた。このことは、彼の主著「先史時代の技術」(英訳 1964) でも論じられていたが、その後の使用痕研究の動向の中で、あまり重視されない流れとなっていた。高倍率法と低倍率法の「隙間」になってしまって、実際には存在する痕跡が十分に分析対象になっていないことが考えられた。

そこで、高倍率と低倍率の中間の倍率で、線状痕や摩滅を主として観察するために、いわば「中倍率法」を再評価して復活させたのである。微小剥離痕の状況も、中間倍率でとらえられ、製作に関する痕跡の分析にも有効と考えられる。使用機器は、米国製の比較的安価で可搬性にも優れたデジタル顕微鏡（Dino-Lite）で、Windows 7 上で画面観察した。セミョノフは、表面を炭素や金属でコーティングしたうえで斜光照明していたが、その必要はない。倍率ズームと内蔵照明の方向調整で、今回の目的には有効であった。

中倍率法で 13 点を観察した。基部、側辺、先端部を含めて、スンベチルゲ全体の観察も含めた。石器によって多様性があるが、全体的な傾向としては、基部の凹み部分の摩滅が顕著で、リタッチのオーバーハング部分がとくに摩滅している。鋸歯縁状に加工されている場合、凸部分が凹部分よりも摩滅している事例があった。基部に線状痕が検出されるのが通例で、縁辺に対して直交方向の場合が多い。基部に顕著な摩滅や線状痕が検出されても、石器の側辺（刃部）の状況とは、一致しない。両者は別である。これらの事実は、スンベチルゲの使用方法についての仮説を補強するものといえる。すなわち、スンベチルゲは柄に装着されて、そのうえで使用されたと考えられるのである。

しかし、基部の摩滅や線状痕が、製作から、着柄、使用に至る、どの段階で、どのような作用で痕跡となったのかは､今後の課題として残っている。製作時の加工具、リタッチの方法、着柄の時の固定方法、さまざまな使用、着柄部分の固着と動きなど、諸条件をコントロールした実験研究（ミドルレンジ研究）が必要である。

スヤンゲ遺跡の調査の中で、文化層による石器組成の相異が指摘されている。今回対象としたスンベチルゲは、下部の第 3 文化層、第 4 文化層に属しており、そのような編年的、通時的脈絡で、使用痕に表れている人間行動を解釈していく必要がある。下部の文化層において石器組成で多数を占めるスンベチルゲは、使い方としては多様な用途に供されて、しかも着柄を前提としていた石器であった可能性が高まった。すなわち、製作から使用までの工程段階をもつ、複合的な計画的道具使用の実例といえるだろう。ホモ・サピエンスが東アジアに渡来して、比較的初期の人類集団においてという脈絡で、韓半島でのスンベチルゲをめぐる行動が考察されるべきであろう。第 4 文化層の暦年較正年代は、41874-41254 calBP とされている。

この脈絡において、東北地方の後期旧石器時代前半期の研究との接点は、非常に大きく重要である。東北地方では、年代測定および「暗色帯」の下部と上部を基準に編年が進められており、台形石器、台形様石器、初現期の石刃、素材の連続剥離技法などを巡り、活発な研究が進められている。韓国など東アジアと、石器群の様相自体は相異するとしても、石器群が有する全体的構造の在り方に、ホモ・サピエンスの「現代人的行動」(Modern Human Behavior) を認識し、その比較研究を志向するべきである。今後の方向としては、型式学、技術学とともに、機能論を前提としての、石器群の「技術組織研究」(e.g., Binford 1983) の一層の進展が望まれる。現代人的行動としての「計画性の程度」(planning depth) を課題のひとつとした本研究が、そのために有意であることを希望して筆を擱く。