Asian Archaeology (2020) 3:35–46
https://doi.org/10.1007/s41826-019-00028-9

ORIGINAL PAPER

Paleolithic Lithic Artifacts and Industries from Survey along the Muling River Basin, Heilongjiang, China

Zuowen Cui[1] · Quanjia Chen[1] · Youqian Li[2] · Wanbo Li[1] · Shituo Liu[1] · Tianxu Wei[1]

Received: 27 November 2018 / Accepted: 4 December 2019 / Published online: 26 February 2020

Abstract
From April to May, 2016, an archaeological survey for Paleolithic sites along the Muling River Basin was carried out jointly by a team from the School of Archaeology of Jilin University, the Institute of Cultural Relics and Archaeology of Heilongjiang Province, and local city and county Cultural Relics Administrative institutes. A total of 21 Paleolithic localities and 974 stone artifacts were found. This paper presents the results of this survey and a typological classification of the stone artifacts found in these localities, which are divided into different industry types (Flake, Blade, and Microblade) through their characteristics. Stratigraphic methods are used to speculate on the ages of the collected assemblages. Then, their functions are discussed through considerations of percussion technique, tool processing, and toolkits. Finally, they are compared with Paleolithic sites of the same age from surrounding areas.

Keywords Muling River Basin · Flake Industry · Blade Industry · Microblade Industry · Upper Paleolithic

1 Geographical location and general situation of the Muling River Basin

The Muling 穆棱 River is located in the southeastern part of Heilongjiang 黑龙江 Province. It originates on the north slope of the Wojiling 窝集岭 Mountains and flows into the Ussuri River crossing from southwest to northeast through five cities and counties, including Muling, Jixi 鸡西, Jidong 鸡东, Mishan 密山, and Hulin 虎林. The Muling River today is also known as the Mangniu 牤牛 River. In the Jin 金 Dynasty, it was called the Maolian 毛怜 River and the Mulingshui 穆棱水 River; in the Yuan 元 Dynasty, it was called the Moli 莫力 River; in the Ming 明 Dynasty, it was called Mailan 麦兰 River; in the early Qing 清 Dynasty, it was called the Mulun 木伦 River and the Muleng 木楞 River, and in the late Qing Dynasty, it was renamed the Muling River. The term muling in Manchu means "horse" or "herd-horses." The Muling River Basin was named for the horse ranches there when the area belonged to ancient Balhae.

The upper valley of the Muling River extends from its source to Sandaohe 三道河 Village in Xiachengzi 下城子 Township; the middle valley then reaches to the city of Mishan; and the remainder is the lower valley. The Muling River, beginning in 225 km of the southwest in Gonghe 共和 Township and the present-day Tuanjie 团结 Reservoir, flows northward from the Gonghe basin into the Quanyan 泉眼 River basin, then northwest into the Sancha 三岔 Plain, where the Dashitou 大石头 River and Xiaoshitou 小石头 River flow into the Muling River from the southwest. The river then passes Muling Town and continues to flow northeast into Xingyuan 兴源 Town, where the valley suddenly widens and the Liumao 柳毛 River joins it from the left side. There, the 2 km wide river valley features a series of many villages, such as Datun 大屯 and Xiwaizi 西崴子. From Xingyuan Town, it flows 18 km to Xiachengzi Town, and the tributary

✉ Zuowen Cui
623127286@qq.com

Quanjia Chen
466829887@qq.com

Youqian Li
254876879@qq.com

Wanbo Li
296875376@qq.com

Shituo Liu
1120459178@qq.com

Tianxu Wei
1095687739@qq.com

[1] School of Archaeology, Jilin University, Changchun 130012, China

[2] Institute of Cultural Relics and Archaeology of Heilongjiang Province, Harbin 150008, China

Maqiao 马桥 River joins it. Then, the river continues northward into Bamiantong 八面通 Town from the big bend at Sandaohe Village. Continuing north for 6.5 km, the Liangzi 亮子 River joins it on the right side (Muling xian zhi bian zuan wei yuan hui 1990). The Muling River then flows northeastward from Muling City to the Lishu 梨树 District of Jixi City, where two tributaries join it, the Jianchang 碱厂 River in the south of the district and the Fengshan 风山 River in the north. At Liumaodajing 柳毛大井 Village, the river flows eastward into Jixi City, where Muling River Park was constructed (Jixi shi di fang zhi bian zuan wei yuan hui 1996). It flows eastward through Jidong County, Mishan City, and Hulin City, and finally flows south of Hutou 虎头 Town into the Ussuri River (Fig. 1).

2 Identified Archaeology Stie Localities

2.1 Distribution of the localities

Twenty-one Paleolithic localities have been found and distributed in the administrative areas of Muling City and Jixi City in the Muling River Basin. Nineteen localities are in Muling City, including three localities in Gonghe Township, two localities in Muling Town, one locality in Xingyuan Town, four localities in Xiachengzi Town, one locality in Maqiaohe Town, six localities in Bamiantong Town, and two localities in Fulu 福禄 Township. Two localities in Jixi City are located in the Lishu District and Mashan 麻山 District (Fig. 2).

2.2 Locations of the localities

Jianchang Village Pishan Paleolithic Locality (44°05′26.10″ N, 130°11′41.77″E; 525 m asl) is located at the second terrace on the Western Bank of Jianchang Village, Gonghe Township, Muling City. The stone artifacts were collected in the plough layer (Chen et al., 2019a).

Shengli Beishan Paleolithic Locality (44°08′04.22"N, 130°11′13.31″E; 500 m asl) is buried in the second terrace on the Western Bank at Shengli Village, Gonghe Township. The stone artifacts were collected in the plough layer.

Dongshan Locality (44°09′20.55″N, 130°12′52.60″E; 503 m asl), where the stone artifacts were collected in the plough layer,

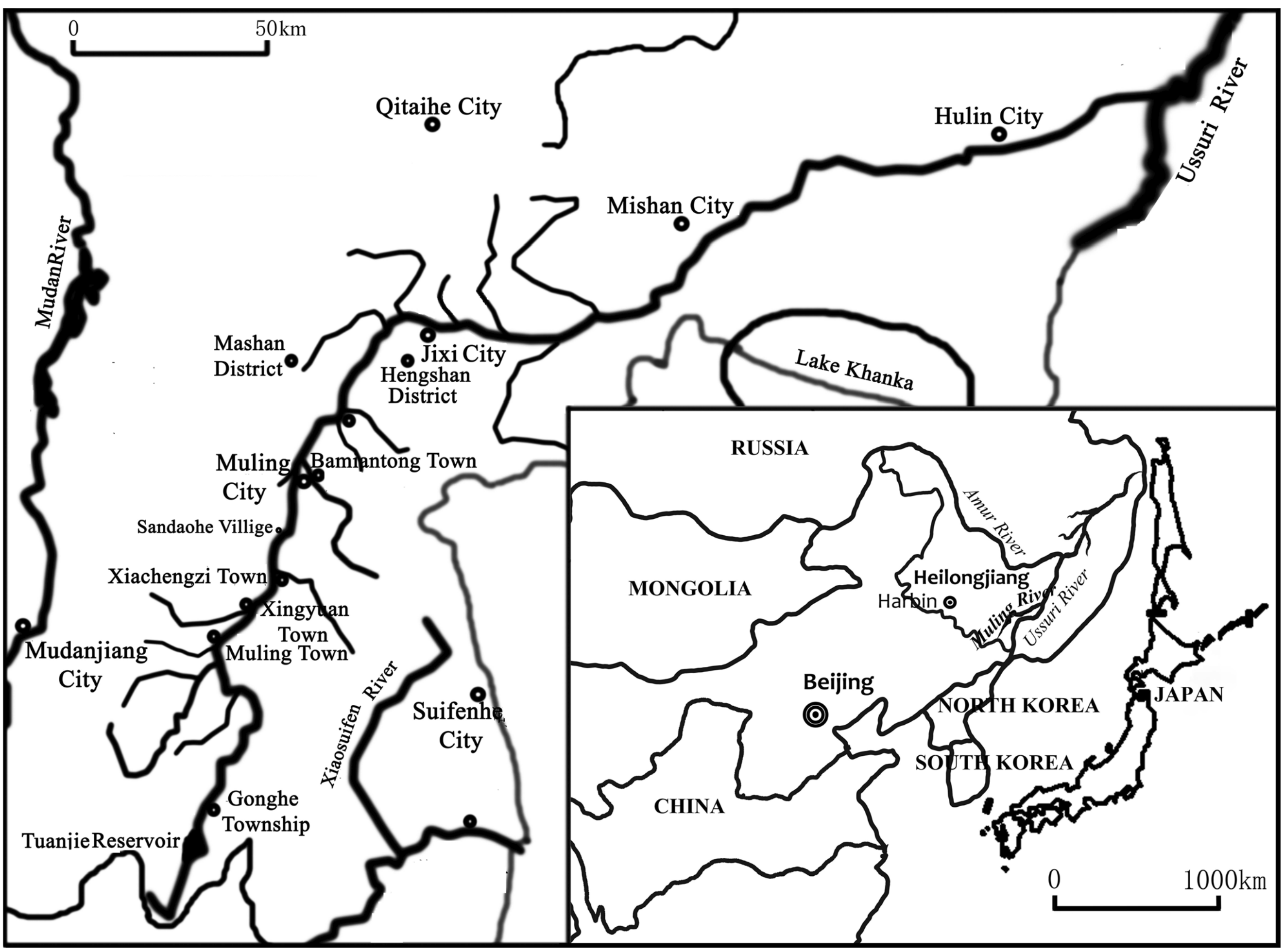

Fig. 1 Geography of the Muling River Basin

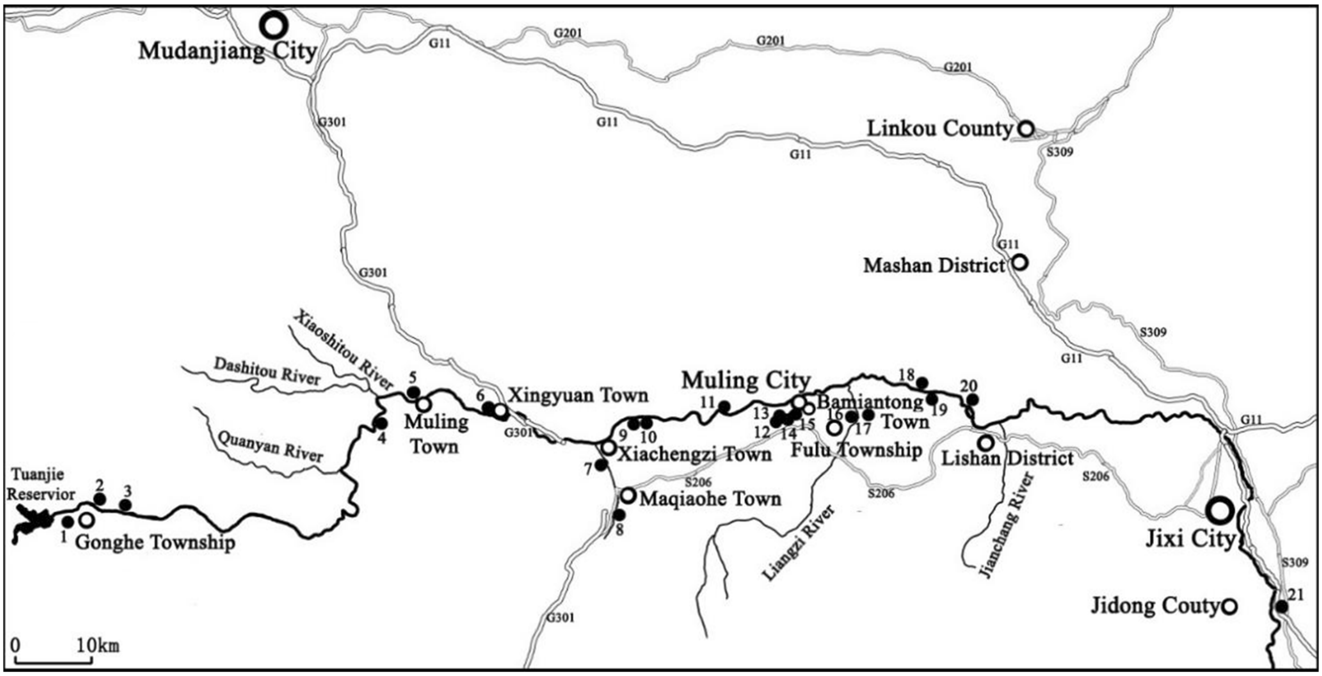

Fig. 2 Distribution map of Paleolithic localities in the Muling River valley. 1. Jianchang 碱厂 Village Pishan 劈山 Locality; 2. Shengli Beishan 胜利北山 Locality;3. Kaoshan Dongshan 靠山东山 Locality; 4. Bajiazi 八家子 locality; 5. Xigang 西岗 Village Locality;6. Xiaoxiwaizi Dongshan 小西崴子东山 Locality; 7. Dongnanshan 东南山 Locality;8. Zhengjiawaizi Dongshan 郑家崴子东山 Paleolithic Locality;9. Huojiawopeng Beishan 霍家窝棚北山 Locality; 10. Xinmin Nangang 新民南岗 Paleolithic Locality;11. Lishugou Nanshan梨树沟南山 Locality; 12. the First Locality; 13. the Second Locality;14. the Third Locality; 15. Hongtushan 红土山 Locality;16. Liangzi 亮子 River Nanshan 南山 Locality; 17. ErPaishan 二排山 Locality;18. Nangang 南岗 Locality; 19. Houshan 红土山 Locality;20. Dongshan 东山 Locality; 21. Xishan 西山 Site

is situated on the second terrace of the Muling River at Kaoshan Village, Gonghe Township, Muling City (Ni et al., 2017).

Bajiazi Locality (44°27′38.62″N, 130°15′33.39″E; 375 m asl) is located on the third terrace of the Western Bank of the Muling River, Muling Town, Muling City. The stone artifacts were collected in the plough layer.

Xigang Village Locality (44°30′52.74″N, 130°14′36.85″E; 414 m asl) is located at the third terrace on the Western Bank of the Muling River at Muling Town. The stone artifacts were collected in the plough layer.

Xiaoxiwaizi Dongshan Locality (44°34′59.85″N, 130°18′50.07″E; 430 m asl), where the stone artifacts were collected in the plough layer, is buried in the third terrace of the Muling River at Xingyuan Town (Li et al., 2018).

Dongnanshan Locality (44°40′39.51″N, 130°28′21.04″E; 355 m asl) is located on the second terrace of the Muling River at Xiachengzi Town. The stone artifacts were collected in the plough layer.

Zhengjiawaizi Dongshan Paleolithic Locality (44°40′01″N, 130°33′19″E; 370 m asl), where the stone artifacts were found in the yellow sub-clay layer, is situated at the second terrace at Xinzhan 新站 Villige, Maqiaohe 马桥河 Town (Shi et al., 2018).

Huojiawopeng Beishan Locality (44°43′38.55″N, 130°26′07.00″E; 338 m asl) is located on the third terrace on the eastern bank of the Muling River at Xiachengzi Town. The stone artifacts were collected in the plough layer.

Xinmin Nangang Paleolithic Locality (44°44′09.36″N, 130°26′07.15″E; 320 m asl) is situated at Xiachengzi Town. The stone artifacts were collected in the plough layer.

Lishugou Nanshan Locality (44°49′28.70″N, 130°28′37.90″E; 305 m asl), where the stone artifacts were collected in the plough layer, is buried in the second terrace of the east bank of the Muling River at Lishugou Village, Xiachengzi Town (Ni et al., 2018).

The First Locality (44°52′51.72″N, 130°31′44.10″E; 421 m asl) is located at the fourth terrace of the Muling River at Bamiantong Town. The stone artifacts were found in the plough layer and the yellow sub-clay layer (Chen et al., 2018a).

The Second Locality (44°52′51.72″N, 130°31′44.10″E; 346 m asl) is situated at the third terrace of the Muling River at Bamiantong Town. The stone artifacts were found in the yellow sub-clay layer.

The Third Locality (44°52′51.72″N, 130°31′44.10″E; 288 m asl) is located on the second terrace of Bamiantong Town. The stone artifacts were found in the yellow sub-clay layer (Chen et al., 2018b).

Hongtushan Locality (44°53′04.33″N, 130°31′47.77″E; 285 m asl), is located on the second terrace of the Muling River at Sipingshan 四平山 Village, Bamiantong Town. The stone artifacts were collected in the plough layer (Ni et al., 2018).

Liangzi River Nanshan Locality (44°96′17.61″N, 130°58′04.38″E; 266 m asl), where the stone artifacts were collected in the plough layer, is located at the second terrace of the south bank of the Liangzi River in Fulu Township (Ni et al., 2018).

ErPaishan Locality (44°57′58.06″N, 130°34′30.07″E; 270 m asl), is buried in the second terrace at Kangle 康乐 Village, Fulu Township; and the stone artifacts were found in the yellow sub-clay layer.

Nangang Locality (45°02′22.32″N, 130°34′38.15″E; 270 m asl) is located on the second terrace on the east bank of the Muling River in Xiuchi 秀池 Village, Bamiantong Town, Muling City. The stone artifacts were found in the yellow sub-clay layer.

Houshan Locality (45°02′58.08″N, 130°35′36.66″E; 260 m asl), whose stone artifacts were found in the yellow sub-clay layer, is situated at the east bank of the Muling River in Xiuchi Village, Bamiantong Town, Muling City.

Dongshan Locality (45°04′57.69″N, 130°38′00.63″E; 266 m asl) is buried in the second terrace on the north bank of the Muling River in Lishu District, Jixi City. The stone artifacts were found in the yellow sub-clay layer (Chen et al., 2017).

Xishan Site (45°18′13.27″N, 131°08′24.46″E; 209 m asl), where the stone artifacts were found in the yellow sub-clay layer, is located on the second terrace on the north bank of the Muling River in Shanhe Village, Jixi City (Chen et al., 2019a).

2.3 Topography and geological strata

The four-level Valley topography formed in the Muling River Basin is due to river action. The localities found were located on the second, third, and fourth terraces. There is one locality (the First Locality) on the fourth terrace; five localities on the third terrace (Xiaoxiwaizi Dongshan Locality, Dongnanshan Locality, Huojiawopeng Beishan Locality, Xinmin Nangang Locality, and the Third Locality); and the rest are on the second terrace (Jianchang Village Pishan Locality, Shengli Beishan Locality, Kaoshan Dongshan Locality, Bajiazi locality, Xigang Village Locality, Zhengjiawaizi Dongshan Paleolithic Locality, Lishugou Nanshan Locality, the Third Locality, Hongtushan Locality, Liangzi River Nanshan Locality, ErPaishan Locality, Nangang Locality, Houshan Locality, Dongshan Locality, and Xishan Site). Among all the localities, the stone artifacts were found in the plough layer and/or the yellow sub-clay layer under it. Eight localities had artifacts in the yellow sub-clay layer, while the rest had artifacts collected from the plough layer (Fig. 3).

3 Classification Standard

The classification of stone artificats in this paper is based on a standard typology established by one of the authors, Chen Quanjia, a professor of archaeology in the School of Archeaology of Jilin University. The classification is divided into cores, flakes, blades, blocky fragments, hammerstones, untilized flakes, and retouched tools(Chen, 2001) as follow:

Cores:
- Flake core:
  - Single-platform
  - Double-platform
  - Multi-platform
- Discoid
- Blade core:
  - Single-platform
  - Double-platform
- Microblade core:
  - Boat-shaped
  - Wedge-shaped

Flakes:
- Complete flake
- Proximal end
- Mesial part
- Distal end
- Left lateral end
- Right lateral end

Blades

Blocky fragments

Hammerstones

Untilized flakes

Retouched tools:
- Scraper
- End scraper
- Denticulate
- Drill
- Norch
- Burin
- Spear-shaped tool
- Adze-shaped tool
- Bifacial
- Chopper
- Handpick
- Point

4 Stone Industries and Their characteristics

Characteristics of the lithic artifacts from the 21 Paleolithic localities can be used to divide the localities into three types of stone artifact industries: the Flake Industry, the Blade Industry, and the Microblade Industry.

4.1 Classification and Characteristics of the Flake Industry

Flake industry lithics include 239 stone artifacts from 10 localities. These include 70 stone artifacts from the Kaoshan

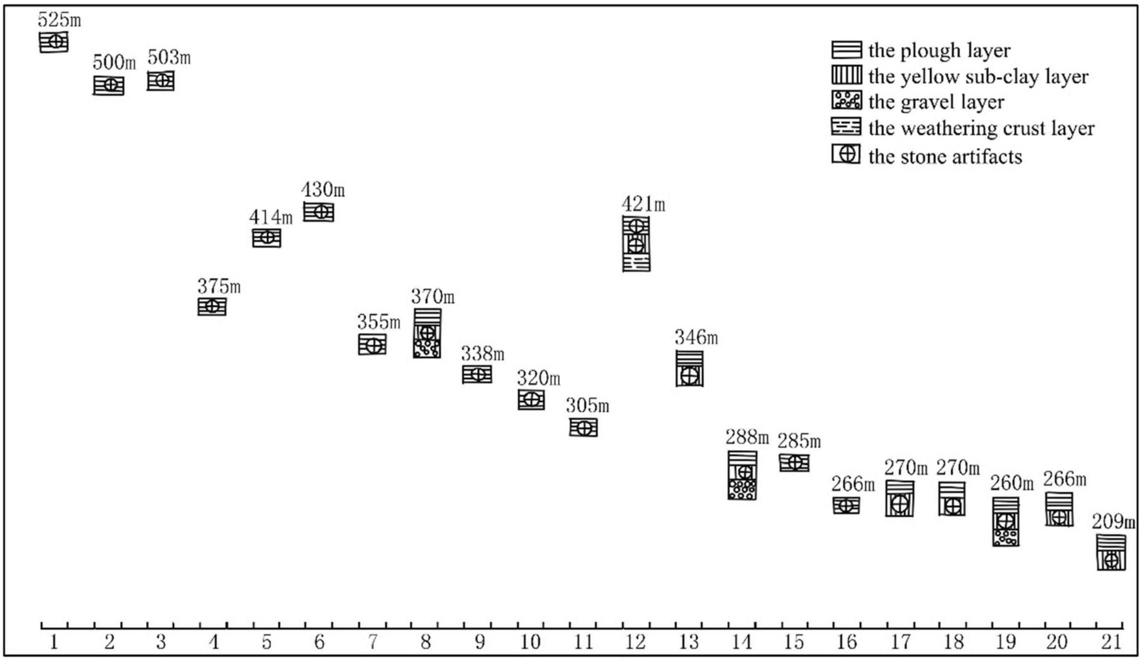

Fig. 3 Basic stratigraphic profile for each locality and their elevations in m asl.*X-axis* indicates the locality number given here, *y-axis* shows the altitude of the profile.1. Jianchang Village Pishan Locality; 2. Shengli Beishan Locality;3. Kaoshan Dongshan Locality; 4. Bajiazi locality; 5. Xigang Village Locality 6. Xiaoxiwaizi Dongshan Locality; 7. Dongnanshan Locality; 8. Zhengjiawaizi Dongshan Paleolithic Locality; 9. Huojiawopeng Beishan Locality; 10. Xinmin Nangang Paleolithic Locality; 11. Lishugou Nanshan Locality; 12. the First Locality; 13. the Second Locality; 14.the Third Locality; 15. Hongtushan Locality; 16. Liangzi River Nanshan Locality; 17. ErPaishan Locality; 18. Nangang Locality; 19. Houshan Locality; 20. Dongshan Locality; 21. Xishan Site

Dongshan Locality (flakes, blocky fragments, utilized flakes, and retouched tools [scrapers, notches, choppers, and adze-shaped tools]); 4 stone artifacts from the Bajiazi Locality (core, blocky fragment, utilized flake, and a drill); 7 stone artifacts from the Xigang Village Locality (cores, flakes, blocky fragments, scrapers, and burins); 46 artifacts from the Xinmin Nangang Paleolithic Locality (cores, flakes, blocky fragments, hammerstone, utilized flakes, and retouched tools [scrapers, notches, choppers, and points]); 6 stone artifacts from the Lishugou Nanshan Locality (retouched tools: scrapers, end scrapers, denticulates, and drill); 13 stone artifacts from the Second Locality (cores, blocky fragments, and retouched tools [scrapers, notches, and choppers]); 4 artifacts from the Hongtushan Locality (flakes, utilized flakes, and scrapers); 7 artifacts from the Liangzi River Nanshan Locality (cores, flakes, blocky fragments, utilized flakes, and retouched tools [scrapers and drills]); 28 stone artifacts from the Nangang Locality (cores, flakes, blocky fragments, utilized flakes, and retouched tools [scrapers, end scrapers, and denticulates]); and 54 lithic artifacts from the Houshan Locality (cores, flakes, blocky fragments, utilized flakes, and retouched tools [scrapers, denticulates, drills, spear-shaped tool, bifacials, and choppers]).

4.1.1 Flake Industry Classification

The Flake Industry stone artifacts include flake cores (single platform [n=5], double platform [n=5], and multi-platform [n=4]); flakes (complete flakes [n=25], proximal ends [n=19], mesial parts [n=5], distal ends [n=3], left lateral ends [n=2], and right lateral ends [n=2]); blocky fragments (n=20); hammerstone (n=1); utilized flakes (n=32); and retouched tools (scrapers [n=89], end scrapers [n=2], denticulates [n=3], drills [n=4], notches [n=5], burin [n=1], spear-shaped tool [n=1], bifacial [n=2], adze-shaped tool [n=1], point [n=1], and choppers [n=7]) (Fig. 4).

4.1.2 Flake Industry Characteristics

Lithic materials exploited at the localities were locally available from ancient riverbeds. There are 23 kinds of raw materials identified. Rhyolite and sandstone are main parts, accounting for 22.6% and 20.9% of the total. These are followed by flint, accounting for 10.1%. Quartzite, siliceous mudstone, argillaceous rock, breccia, basalt, obsidian, quartz, agate, siliceous rock, andesite, tuff, quartz sandstone, hornstone, granite and slate account for 6.7%, 5.4%, 5.1%, 4.2%, 3.3%, 2.9%, 2.5%, 2.2%, 1.7%, 1.3%, 1.3%, 0.8% and 0.8% respectively; while the siliceous limestone, limestone, rhyolite porphyry, gabbro and dacite accounted for only 0.4% each.

We divide the stone artifacts into four grades according to their maximum length: miniature (N≤20 mm), small (20<N≤50 mm), medium (50<N≤100 mm), and large (100<N≤200 mm) (Wei and Shuwen, 2013). Generally, small size is the most abundant, accounting for 65.3% of the total;

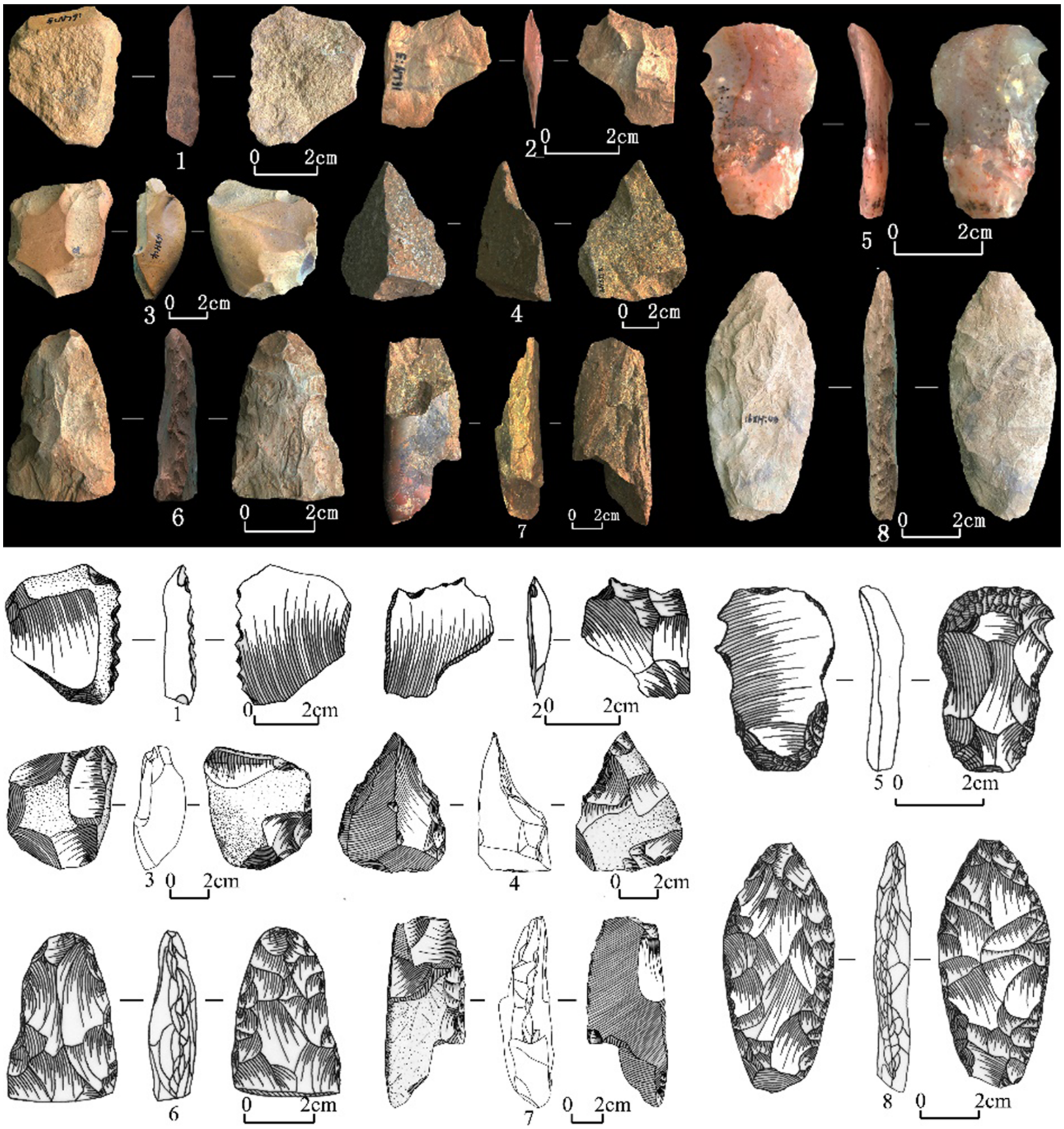

Fig. 4 Flake Industry lithics. 1. denticulate; 2. Drill; 3. flake core; 4. Notch; 5. end scraper; 6. Bifacial; 7. Chopper; 8. spear-shaped tool. 1, 2, 5. Lishugou Nanshan Locality; 3, 6, 7. 8. Houshan Locality; 4. the Second Locality

medium accounts for 26.8%; miniature accounts for 5.4%, while large is the least present, accounting for only 2.5%. It can be seen that small grade objects are the main part of the Flake Industry.

The proportion of hammerstones, utilized flakes and retouched tools is the highest, accounting for 61.9% of the total. Flakes account for 24.7%. Blocky fragments are less, accounting for 8%. Flake cores are least, accounting for only 5.4%. In the relevant tool assemblage, retouched tools are the most abundant, accounting for 77.7%; utilized flakes are few, accounting for 21.6%. Hammerstones are the least, accounting for only 0.7%.

Flake cores are mainly single and double platform cores, while multi-platform cores are fewer. All blanks are chunks. Flaking technique is direct percussion, while the flaking method is mainly based on the reverse direction, and the turn direction is the second.

Flakes found are mainly complete flakes. Proximal ends are second, and other parts are fewer. All flakes are the result of percussion flaking.

In utilized flakes, single-edged are the most abundant, accounting for 84.4%; double-edged account for only 15.6%. The blanks are mainly complete flakes; the rest are second. Generally speaking, the ancient humans at this period have learned to use the sharp, lateral end to directly engage in production and process living materials.

Among retouched tools, scrapers are the most abundant, with others being few. Single-edged scrapers are the main type, followed by double-edged scrapers. The major blanks are flakes, followed by chunks. The main retouching technique is percussion technique, but there also exists examples of pressure technique. The retouch direction is mainly complex, followed by forward and reverse, with only few examples. Three different retouching purposes can be observed: retouched edge, shaping, or retouched handle. Through the analysis of different retouch parts, it can be learned that the ancient humans had different planning consciousness and the ability to overcome the difficult environment. Therefore, according to the different retouch positions, there are two retouch assemblages: 1. only retouching the edge without shaping or a handle; 2. retouching the edge or directly using the sharp edge with shaping or a handle. Statistical analysis shows that the second kind is much greater, while the first kind is relatively few.

4.2 Classification and Characteristics of the Blade Industry

There are 145 stone artifacts from 3 localities. Huojiawopeng Beishan Locality included 39 stone artifacts (cores, flakes, blades, blocky fragments, hammerstone, utilized flakes, and retouched tools [scrapers and choppers]. The Dongshan Locality included 84 stone artifacts comprised of cores, flakes, blades, blocky fragments, hammerstone, utilized flakes, and retouched tools (scrapers, denticulates, and drills). The Xishan Site had 22 stone artifacts, including cores, flakes, blocky fragments, utilized flakes, and retouched tools (scrapers, denticulate and choppers).

4.2.1 Blade Industry Classification

The stone artifacts of the Blade Industry include cores (flake cores [n=25) and blade core [n=1]), flakes (complete flakes [n=12], proximal ends [n=4], mesial parts [n=3], distal ends [n=7], left lateral ends [n=1], and right lateral ends [n=1]), blades (n=4), blocky fragments (n=20), hammerstones (n=2), utilized flakes (n=14), and retouched tools (scrapers [n=46], denticulates [n=2], drill [n=1], and choppers [n=2]) (Fig. 5).

4.2.2 Characteristics

Blade Industry lithics feature 18 kinds of raw materials, with chert (19.2%) and andesite (check that this is correct) (11%) being the main kinds. Obsidian, siliceous mudstone, rhyolite, quartzite, and slate follow these, accounting for 9.7%, 9%, 9%, 8.2%, and 7.6%, respectively. Agate, rhyolite porphyry, basalt, quartz sandstone, sandstone, tuff, chlorite, feldspar, and siliceous limestone account respectively for 4. 1%, 3.4%, 3.4%, 2.8%, 2.8%, 2.8%, 2.8%, 1.4% and 1.4%. Hornstone and dacite accounted only for 0.7% each.

Generally speaking, small size stone artifacts make up the majority, accounting for 52.4%; medium size is 33.1%; miniature is 11%; and large is least, accounting only for 3.5%. It can be observed that small size artifacts dominate the Blade Industry.

The percentage of hammerstones, utilized flakes, and retouched tools is the highest, accounting for 46.2% of the total. Flakes and cores are few, accounting respectively for 19.3% and 17.9%. Blocky fragments are 13.8%. Blades are the least, accounting for only 2.8%. In the tool assemblage, retouched tools are the most abundant, accounting for 76.1%; used flakes represent 20.9%; and hammerstones account for only 3%.

Cores include flake and blade cores. Flake cores are the main part, followed by blade cores. In flake cores, double platform cores are the most abundant, followed by singles platform cores; multi-platform cores are few. Blade core are double platform core. Blanks of all cores are chunks. Flaking technique is direct percussion. Flaking method is mainly based on the reverse direction, and the turn direction is the second. The flaking utilization rate is not high.

Flakes are mainly complete flakes with few of the other typological categories for flake parts. They are all resultant from percussion flaking.

All blades are percussion flaked, and they include proximal and distal ends.

Used flakes are mostly single-edged, followed by double-edged. Their blanks are mainly complete flakes.

In the retouched tools, scrapers are the most abundant, while others are few. Single-edged scrapers comprise the majority, followed by double-edged scrapers. The majority of the blanks for tool fabrication are flakes, while chunks are few. Percussion technique is dominant, but there exists pressure technique. The retouch direction is mainly forward, followed by complex, while reverse is few. According to our analysis of different retouch positions, using a retouched-edge or directly using the sharpened edge along with shaping or retouching a handle is the most common; retouched-edge alone without shaping or retouching a handle is fairly few.

4.3 Classification and Characteristics of the Microblake Industry

Microblade Industry artifacts include 596 stone artifacts from 8 localities. These include Jianchang Village Pishan Locality (126 stone artifacts, including cores, flakes, blocky fragments, utilized flakes, and the retouched tools [scrapers, notches, burins, denticulates, and end scrapers]); Shengli Beishan Locality (97 stone artifacts, which include cores, flakes,

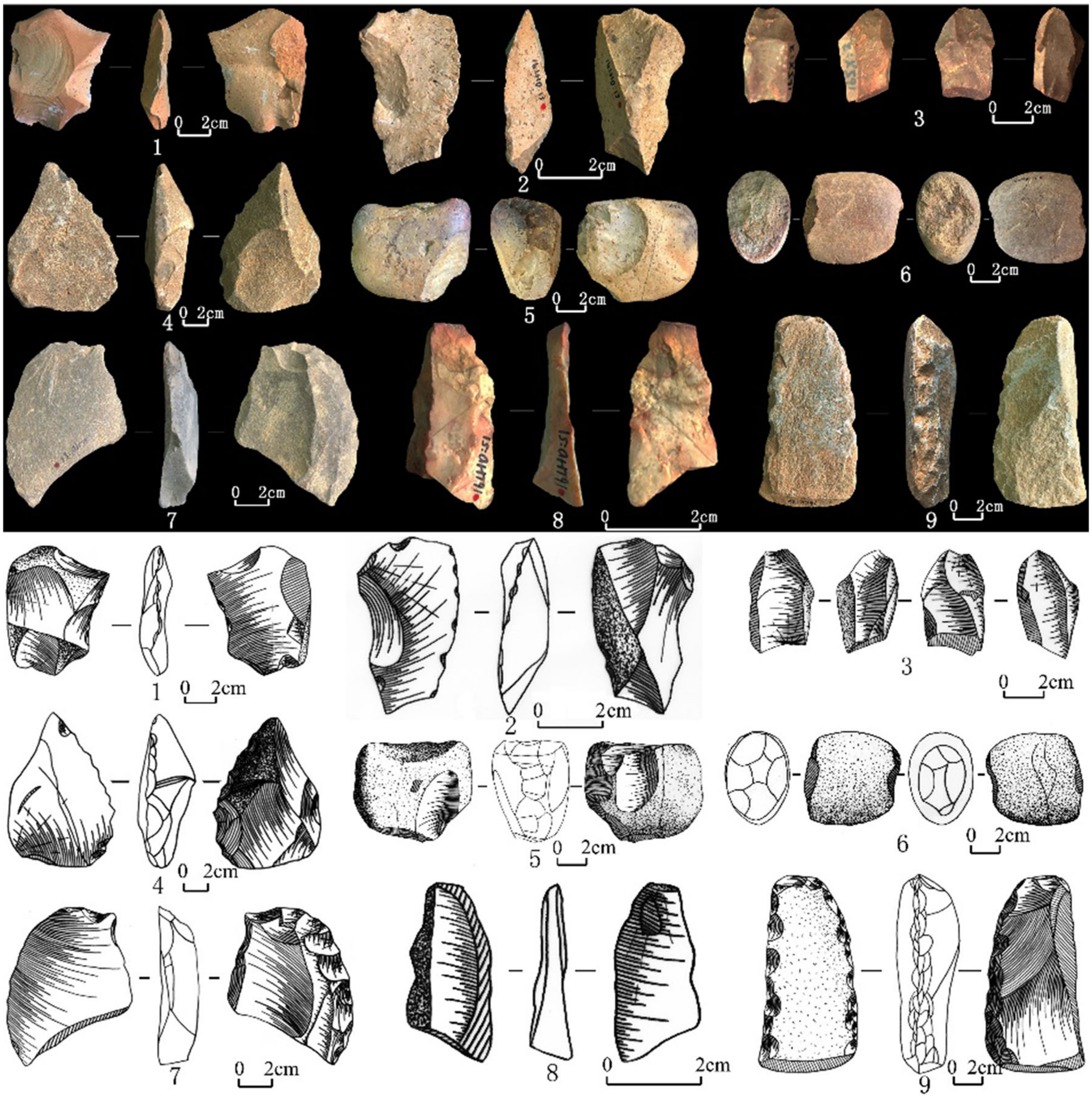

Fig. 5 Blade Industry lithics. 1. scraper; 2. utilized flake; 3. blade core; 4. Denticulate; 5. flake core; 6. Hammerstone; 7. Drill; 8. proximal end of blade; 9. Chopper. 1, 2, 6, 7, 8. Dongshan Locality; 3, 4, 5, 9. Xishan Site

blades, microblades, blocky fragments, utilized flakes, and retouched tools [scrapers, end scrapers, and bifacials]); Xiaoxiwaizi Dongshan Locality (35 stone artifacts, including cores, flakes, blocky fragments, utilized flakes, and retouched tools [scrapers, notches, choppers, and handpicks]); Dongnanshan Locality (48 stone artifacts, including cores, flakes, blocky fragments, utilized flakes, and retouched tools [scrapers and end scrapers]); Zhengjiawaizi Dongshan Paleolithic Locality (118 stone artifacts, including cores, flakes, blocky fragments, utilized flakes, and retouched tools [scrapers, notches, points, end scrapers, and bifacials]); Lishugou Nanshan First Locality (50 stone artifacts, including cores, flakes, blocky fragments, utilized flakes, and retouched tools [scrapers, denticulates, drills, adze-shaped tools, and choppers]); Lishugou Nanshan Third Locality (50 stone artifacts, including cores, flakes, blocky fragments, utilized flakes, and retouched tools [scrapers, denticulates, notches, and choppers]); and the Erpaishan Locality (72 stone artifacts, including cores, flakes, blocky fragments, hammerstone, utilized flakes and retouched tools [scrapers, drills, notches and choppers]).

4.3.1 Microblade Industry Classification

The stone artifacts include cores (flake cores [n=54], blade cores [n=4], and microblade cores [n=9]), flakes (complete flakes [n=73], proximal ends [n=31], mesial parts [n=15], distal ends [n=22], left lateral ends [n=3], and right lateral ends [n=2]), blade (n=1), microblades (n=3), blocky fragments (n=96), hammerstone (n=1), utilized flakes (n=57), and retouched tools (scrapers [n=175], end scrapers [n=9], denticulates [n=5], drills [n=6], notches [n=8], burins [n=2], adze-shaped tool [n=1], bifacial tools [n=10], handpicks [n=2], and choppers [n=7]) (Fig. 6).

4.3.2 Microblade Industry Characteristics

26 kinds of raw materials were found. Chert and limestone are the main raw materials, accounting respectively for 16.9% and 16.8% of the total. Obsidian comprises 11.7%; sandstone, siliceous mudstone, quartzite, basalt, rhyolite, quartz, and agate account respectively for 9.4%, 8.0%, 7.6%, 5.4%, 5.3%, 4.4%, and 3.7%. Andesite, rhyolite porphyry, hornstone, breccia, tuff, hornfels, quartz sandstone, and jade are few, accounting for 2.5%, 1.7%, 1.5%, 1.4%, 0.8%, 0.7%, 0.3% and 0.3%. Volcanic rocks, siliceous limestone, marble, volcanic breccia, mudstone, shale, slate, and silicified wood are only 0.2% each.

Most of the stone artifacts are small sized, accounting for 57.8% of the total. Medium sized represent 26.6%; miniature represent 10%; and large and giant are the least, accounting only for 5.4% and 0.2% respectively.

The types of stone artifacts are abundant. The proportion of hammerstones, utilized flakes, and retouched tools is the highest, accounting for 47.5% of the total. Flakes, blocky fragments, and cores are few, accounting respectively for 24.5%, 16.1%, and 11.2%. Microblades and blades are only 0.5% and 0.2%. In the tools' assemblage, the retouched tools are the most, accounting for 79.5%; utilized flakes are 20.1%; hammerstone is the least, accounting for only 0.4%.

Cores include flake, blade, and microblade cores. Flake cores are the majority, followed by microblade cores; blade cores are the least. In flake cores, single platform cores are the most, followed by double platform cores; multi-platform and discoid cores are few. The blanks are all chunks. Flaking method is the reverse direction and the turn direction. The flaking utilization rate is not high, so raw materials might be more sufficient. To a certain extent, the platform is not suitable to continue to flake and discard it. Among blade cores, single platform cores dominate, followed by double platform cores. The blanks of blade cores are chunks. Flaking technique is percussion flaking. The majority of the microblade cores are wedge shaped, followed by boat-bottom shaped cores. The blanks include both chunks and flakes. The platforms of flake blanks are all of the flake sections, and the raw material for all is high quality obsidian. The core platforms of chunk blanks are delicately retouched. It is known that ancient humans used the broken section of flakes or a repaired surface of a block blank as the platform for flaking microblades; the purpose of this may have been to obtain the most suitable microblades. The bodies of the microblade cores are delicately retouched, forming a keel on both sides. The microblades are produced using pressure technique.

Flakes are mainly complete flakes, with few of the other categories. They are all produced by direct percussion. Flake utilization is mainly on a single-edge, followed by double-edged, and the rest is few. Their blanks are mainly complete flakes. Generally speaking, the ancient humans during this period were skilled at using the sharp, lateral end to engage directly in production and processing organic materials.

The most abundant retouched tools are scrapers, with others being few in number. Single-edged scrapers are the majority, followed by double-edged scrapers; multi-edged scrapers are the fewest. The main blank for tool fabrication is flakes, followed by chunks. Blades and microblades are relatively few. Hammerstone percussion is the main reduction technique, but these is also pressure technique. The retouch direction is mainly forward, while complex and reverse direction are few. Analysis of the different retouch positions shows that a retouched edge or directly using the sharpened-edge together with shaping or a retouched handle is the most abundant; tools with only a retouched edge and no shaping or retouched handle are few.

5 Chronology

None of the 21 localities have yet been absolute dated. However, the age of the localities can be established through the geology, comparison of the stratigraphy, and by looking at the flaking techniques, tool assemblages, and analysis of the industry types.

First of all, according to the analysis of the accumulation age of the Quaternary strata in Heilongjiang Province, the yellow sub-clay layer belongs to the Upper Pleistocene (Heilongjiang sheng qu yu di ceng biao bian xie zu 1979), and so it should also belong to the Upper Paleolithic. Also, all of the lithic artifacts found in the 21 localities were chipped stone artifacts; there were no ground or polished stone objects or pottery found. There were also no cultural materials suitable for dating such as animal bones or carbonized plant materials discovered. The available geological, stratigraphic, and artifact evidence, however, suggests that the 21 localities in the Muling River valley belong to the Upper Paleolithic. It is well known that in China, the Small Flake Industry runs through the Paleolithic Age from the beginning to end; the Microblade Industry occurs during the Late Paleolithic Age; and the Blade Industry is a transitional stage between the Small Flake Industry and the Microblade Industry. As a result, the Flake Industry found in the Muling River Basin can at the moment be said to belong to the Early and Middle period of the Upper Paleolithic; the Blade Industry belongs to the Middle period of the Upper Paleolithic; and the Microblade Industry should belong to the Late period of the Upper Paleolithic.

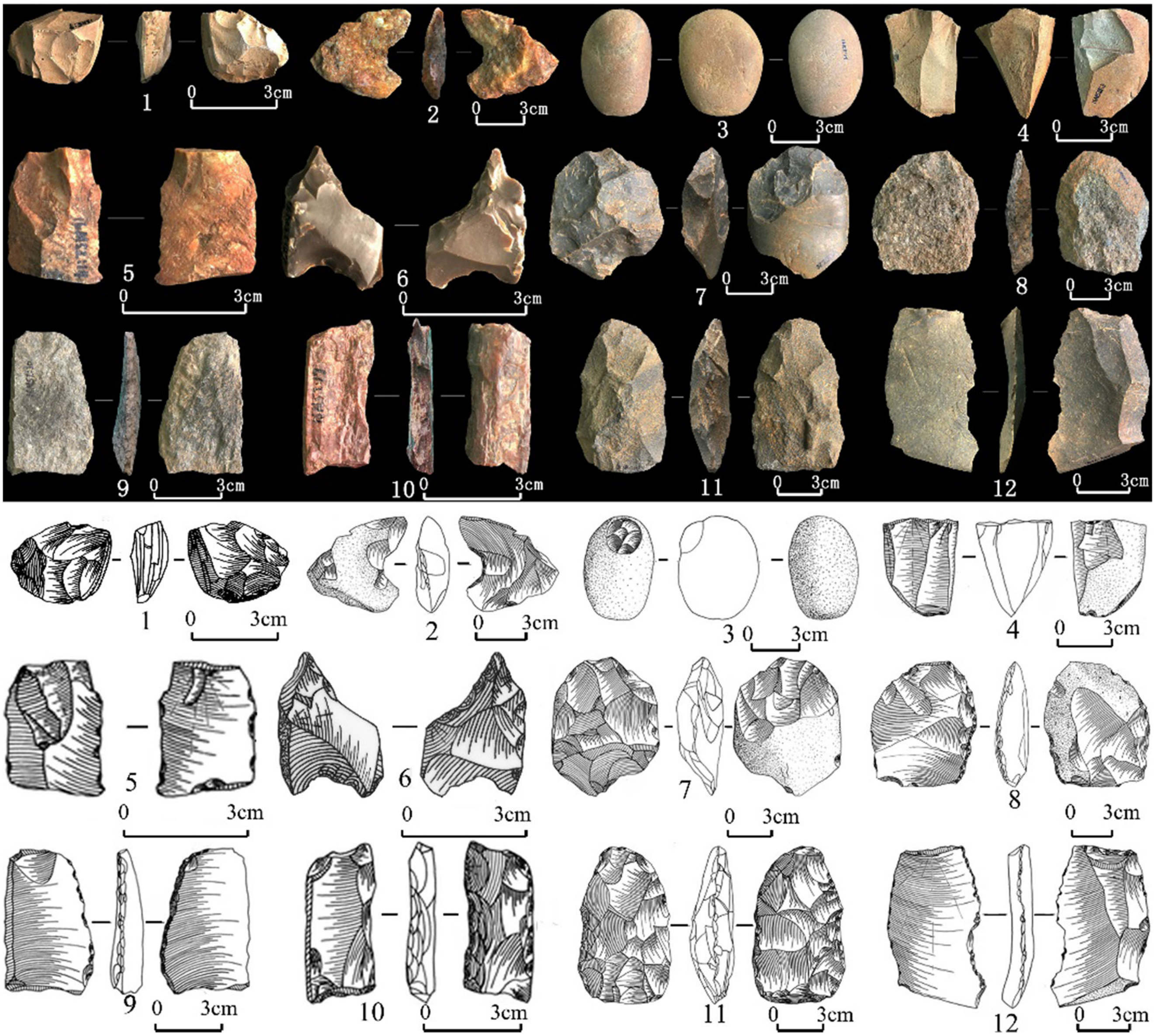

Fig. 6 Microblade Industry lithics. 1. microblade core; 2. notch; 3. hammerstone; 4. blade core; 5, 9, 10. scraper; 6. drill; 7. discoid core; 8. chopper; 11. adze-shaped tool; 12. denticulate. 1, 3. Erpaishan Locality; 2, 4, 8. the Third Locality; 5, 6, 7, 9, 10, 11, 12. the First Locality

6 Characteristics of the Localities

From the analysis of the surrounding geographic environment, the Paleolithic localities found in the Muling River Basin are situated on the second, third, and fourth terrace of the Muling River, which is rich in aquatic resources. It is not only suitable to ancient humans for production activities, but also suitable for long-term production and life.

Raw materials were locally available from the ancient riverbed. Hammer percussion technique and retouch technique were used to obtain the flakes, blades, microblades, and retouched tools. The appearance of blades and blade cores not only proves the existence of the Blade Industry, but also provides reliable basic materials for supporting that the Blade Industry may be the transitional stage between the Small Flake Industry and the Microblade Industry. Through the retouching and selective retouch of the stone tools, we can learn about the manufacturer's mind-set and the pre-supposed tool function and mode of usage. Through analyzing the tool assemblages found in Muling River Basin, we can see that the ancient humans adapted to local conditions through percussion and retouch techniques that allowed them to produce suitable tools. The assemblages also show that the subsisted by mainly hunting but also had a lifeway that included a gathering economy.

7 Comparative Analysis

Previously, some scholars divided the Upper Paleolithic localities in Northeast China into three industrial types: the Flake-based Small Tool Industry, the Pebble Tool Industry, and the Microblade- (or Blade-) based Micro-tool Industry (Chen, 1998). The three types of Paleolithic industries discovered in the Muling River Basin can be compared with those in Northeast China as follows. First, the Flake Industry in the Muling River Basin is also mainly small-sized, followed by medium-sized. The source of the raw materials is mainly from the local riverbed. The technology of flaking is mainly the hammering technique. Stone artifact types are cores, flakes, blocky fragments, utilized flakes, and retouched tools. The tool assemblage includes mainly scrapers, followed by drills and choppers. Retouch technique is mainly based on hammering percussion, while the direction of retouch is mainly complex direction, followed by forward. Generally speaking, the Flake Industry appears basically similar to that of the small stone artifacts industry represented by the Jinniushan 金牛山 Locality (Jinniushan lian he fa jue dui 1978). However, the Muling Basin flake industry also has its own unique aspects, such as there being no bipolar technique or anvil percussion, only hammering. The related tool assemblage in both areas includes utilized flakes and retouched tools such as scraper, denticulate, notch, burin, and spear-shaped tool.

Comparing the Muling Basin Blade Industry to that at the Shibazhan 十八站 Paleolithic Locality (Zhang Xiaoling et al. 2006), the source of the raw materials in both areas is from the riverbed, and the technology of flaking is the hammer technique. Stone artifact types in both areas include cores, flakes, blades, blocky fragments, utilized flakes, and retouched tools. The tool assemblages include mainly scrapers, followed by denticulates, drills, and choppers. Retouch technique employs hammering percussion. On the whole, the industrial characteristics between Muling and Shibazhan are similar, but the Muling Basin has its own unique characteristics, especially the use of obsidian. We suggest that the Flake Industry and Blade Industry in the Muling River Basin should belong to the Flake-Based Small Tool Industry.

If we compare the Microblade Industry from Muling with the Microblade-based Micro-tool Industry represented by the microliths from Dabasu 大布苏 (Dong Zhuan 1989), they are similar. The lithic raw materials are also based on local materials. Due to the natural geological conditions, a large number of high qualities obsidian were not found, but there is still a certain proportion of obsidian. The flaking technology is mainly hammering percussion, but there also is some indirect percussion present. The artifacts types include flake cores, blade cores, microblade cores, flakes, blades, microblades, chunks, utilized flakes, and retouched tools, among which scrapers, choppers, and burins are the major types. Therefore, we suggest that the Microblade Industry in the Muling River Basin can belong to the Microblade-based Micro-tool Industry.

References

Chen, Quanjia 陈全家. 1998. Jiu shi qi shi dai kao gu 旧石器时代考古 (Paleolithic Archaeology). In Zhang Boquan 张博泉, and Wei Cuncheng 魏存成 (eds.), *Dongbei gu dai min zu·kao gu yu jiang yu* 东北古代民族· 古与疆域 (Ancient Nationalities, Archaeology and Territory in Northeast China), pp.171-197. Changchun: Jilin da xue chu ban she 长春:吉林大学出版社.

Chen, Quanjia 陈全家. 2001. Jilin Zhenlai Dandai Dakanzi fa xian de jiu shi qi 吉林镇赉丹岱大坎子发现的旧石器 (Paleolithic artificials unearthed at Dakanzi, Dandai, Zhenlai, Jilin). *Bei fang wen wu* 北方文物 2001. 02:1-7.

Chen, Quanjia陈全家, Li Youqian 李有骞, Cui Zuowen 崔祚文, and Ni Chunye 倪春野. 2017. Jixi Lishu Hekou Dongshan di dian fa xian de jiu shi qi 鸡西梨树河口东山地点发现的旧石器 (Paleolithic artifects of Dongshan locality from Hekou, Lishu, Jixi). *Wen wu chun qiu* 文物春秋 2017. 02: 37-45.

Chen, Quanjia 陈全家, Cui Zuowen 崔祚文, Li Youqian 李有骞, and Ni Chunye 倪春野. 2018a. Bamiantong Sipingshan di yi di dian fa xian de jiu shi qi yan jiu 八面通四平山第一地点发现的旧石器研究 (Research on Paleolithic artifacts of the first locality in Sipingshan, Bamiantong). *Bian jiang kao gu yan jiu* 边疆考古研究 2018. 22: 1-15.

Chen, Quanjia 陈全家, Cui Zuowen 崔祚文, Li Youqian 李有骞, and Ni Chunye 倪春野. 2018b. Muling Bamiantong Sipingshan di san di dian fa xian de jiu shi qi 穆棱八面通四平山第三地点发现的旧石器 (Paleolithic artifects of the third locality in Sipingshan, Bamiantong, Muling). *Wen wu chun qiu* 文物春秋 2018. 02: 21-29.

Chen, Quanjia陈全家, Cui Zuowen 崔祚文, Li Youqian 李有骞, and Chang Zhiqiang 常志强. 2019a. Heilongjiang Jixi Hada Shanhe Xishan di dian fa xian de jiu shi qi 黑龙江鸡西哈达山河西山地点发现的旧石器 (Paleolithic artifacts found in Xishan Site, Shanhe, Hada, Jixi City, Heilongjiang). *Bei fang wen wu* 北方文物 2019. 02: 3-8.

Chen, Quanjia 陈全家, Li Wanbo 李万博, Li Youqian 李有骞, and Ni Chunye 倪春野. 2019b. Muling Jianchang Pishan jiu shi qi di dian de shi qi yan jiu 穆棱碱场劈山旧石器地点的石器研究 (Research on stone artificials of Jianchang Pishan Paleolithic locality in Muling City). *Hua xia kao gu* 华夏考古 2019.04: 60-71.

Dong, Zhuan 董祝安. 1989. Dabusu de xi shi qi 大布苏的细石器 (Microliths from Dabusu). *Ren lei xue xue bao* 人类学学报 1989 (01): 49–58.

Heilongjiang sheng qu yu di ceng biao bian xie zu 黑龙江省区域地层表编写组. 1979. Dongbei di qu qu yu di ceng biao 东北地区区域地层表 (Northeast Regional Stratigraphic Table). In *Heilongjiang sheng fen ce* 黑龙江省分册 (Heilongjiang Provincial volume). Beijing: Di zhi chu ban she 北京:地质出版社.

Jinniushan lian he fa jue dui 金牛山联合发掘队. 1978. Liaoning Yingkou Jinniushan jiu shi qi wen hua de yan jiu 辽宁营口金牛山旧石器文化的研究 (Study of Paleolithic Culture in Jinniu site, Yingkou, Liaoning). *Gu ji zhui dong wu yu gu ren lei* 古脊椎动物与古人类1978.16(02): 129-136.

Jixi shi di fang zhi bian zuan wei yuan hui 鸡西市地方志编纂委员会. 1996. Jixi zhi (shang juan) 鸡西志(上卷) (Jixi gazetteer, vol. 1). Beijing: Fang zhi chu ban she 北京:方志出版社

Li, Youqian李有骞, Chen Quanjia 陈全家, Zhu Yixin 朱艺欣, and Ni Chunye 倪春野. 2018. Muling Xingyuan zhen Xiaoxiwaizi Dongshan jiu shi qi di dian diao cha jian bao 穆棱兴源镇小西崴子东山旧石器地点调查简报 (A Survey of Dongshan Paleolithic locality of Xiaoxiwaizi, Xingyuan Town, Muling City). In Dong wei 董为 (editor), *Di shi liu jie zhongguo gu ji zhui dong wu xue xue shu nian hui lun wen ji*, 第十六届中国古脊椎动物学学术年会论文集 (Preceeding of the sixteenth annual Meeting of the Chinese Society of Vertebrate Paleontology), pp. 217-228. Beijing: Hai yang chu ban she 北京:海洋出版社.

Muling xian zhi bian zuan wei yuan hui 穆棱县志编纂委员会. 1990. Muling xian zhi 穆棱县志(Muling County gazetteer). Beijing: Zhongguo wen shi chu ban she 北京:中国文史出版社.

Ni, Chunye 倪春野, Chen Quanjia 陈全家, Li Youqian 李有骞, and Lin Sen 林森. 2017. Heilongjiang Muling shi Kaoshan Dongshan jiu shi qi di dian shi zhi pin yan jiu 黑龙江穆棱市靠山东山旧石器地点石制品研究 (Research on stone artificials from Dongshan Paleolithic locality in Kaoshan Villige, Muling City, Heilongjiang). *Bei fang wen wu* 北方文物 2017. 04: 3-8.

Ni, Chunye 倪春野, Chen Quanjia 陈全家, Cui Zuowen 崔祚文, and Li Youqian 李有骞. 2018. Muling shi fa xian de san chu jiu shi qi 穆棱市发现的三处旧石器 (Three discovered Paleolithic localities in Muling City). *Bei fang wen wu* 北方文物 2018.03: 3-8.

Shi, Jing 石晶, Li Youqian 李有骞, Chen Quanjia 陈全家, , and Ni Chunye 倪春野. 2018. Heilongjiang Muling Zhengjiawaizi Dongshan jiu shi qi di dian de fa xian yu yan jiu 黑龙江穆棱郑家崴子东山旧石器地点的发现与研究 (Discovery and research on Dongshan Paleolithic locality of Zhengjiawaizi, Muling, Heilongjiang), *Bian jiang kao gu yan jiu* 边疆考古研究 2018.24: 41-51.

Wei, Qi 卫奇, and Pei Shuwen 裴树文. 2013. Shi pian yan jiu 石片研究 (A study of flakes). *Ren lei xue xue bao* 人类学学报 2013.04: 454-469.

Zhang, Xiaoling 张晓凌, Yu Huili 于汇历, and Gao Xing 高星. 2006. Heilongjiang Shibazhan yi zhi de xin cai liao yu nian dai 黑龙江十八站遗址的新材料与年代 (New materials and dates of Shibazhan Paleolithic locality, Heilongjian Province). *Ren lei xue xue bao* 人类学学报 2006.02: 115-128.

Note: This paper presents the mid-term research results of our “Key Research Base of Humanities and Social Sciences, Ministry of Education” project [Grant No. 16JJD780008].