



# Flint knapping strategies at Cenjiawan, an Early Paleolithic site in the Nihewan Basin, North China



Ying Guan <sup>a,\*</sup>, Fa-Gang Wang <sup>b</sup>, Fei Xie <sup>b</sup>, Shu-Wen Pei <sup>a</sup>, Zhen-Yu Zhou <sup>c</sup>, Xing Gao <sup>a</sup>

<sup>a</sup> Key Laboratory of Vertebrate Evolution and Human Origins of Chinese Academy of Sciences, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing 100044, China

<sup>b</sup> Hebei Provincial Cultural Relics Research Institute, Shijiazhuang 050000, China

<sup>c</sup> Institute of Archaeology, Chinese Academy of Social Sciences, Beijing 100029, China

## ARTICLE INFO

### Article history:

Available online 26 July 2015

### Keywords:

Lower Paleolithic  
Stone working  
Nihewan Basin  
Refitting analysis

## ABSTRACT

Nihewan Basin is considered a vital region for the study of early human evolution, migration and behavioral variation in East Asia. Cenjiawan, dated to 1.1 Ma, is one of the Early Paleolithic sites in the basin, and yielded 1625 pieces of stone artifacts which provide significant information on early stone working techniques. The high proportion of small pieces suggests that Cenjiawan was not disturbed by natural agencies which would have removed the small debris away from the site area. Consequently, we were able to conduct refitting analysis to the whole lithic assemblage.

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## 1. Introduction

Nihewan Basin, (41°13'0"N, 114°40'E) in Hebei Province, North China contains one of the densest concentration of Early Pleistocene Palaeolithic sites outside Africa and has been investigated since the 1920s (Boule et al., 1928.; Dennell, 2009, 2013). It provides an important source of Paleolithic settlements and therefore early human occupation at high northern latitudes in Northeast Asia, thus serving as a vital region for the study of early human evolution and migration (Zhu et al., 2001, 2003, 2004, 2007; Liu et al., 2014). So far, the earliest site in the Nihewan Basin is considered to be Shangshazui (1.6–1.7 Ma) (Ao et al., 2013a,b) or Majuangou III (1.66–1.55 Ma) (Zhu et al., 2004). Other early sites include Xiaochangliang (1.36 Ma by Zhu et al., 2001; 1.26 or 1.48 Ma see Dennell, 2015), Xiantai (1.36 Ma) (Deng et al., 2006), Banshan (1.32 Ma) (Zhu et al., 2004; Liu et al., 2014), Feiliang (1.2 Ma) (Deng et al., 2007; Ao et al., 2012), Donggutuo (1.1 Ma) (Wang et al., 2005; Liu et al., 2013), Cenjiawan (1.1 Ma) (Wang et al., 2006), Huojiadi (1.0 Ma) (Liu et al., 2010) and Maliang (0.78 Ma) (Wang et al., 2005) (Ao et al., 2013a,b). Although no hominin skeletal remains have been found in the Nihewan Basin, these sites were probably created by *Homo erectus*, which is represented by a cranium from Lantian (Gongwangling) in the Loess Plateau south of Nihewan and which has recently been

re-dated to 1.63 Ma (Zhu et al., 2015), and a mandible, also of *H. erectus* from Lantian (Chenjiawo), dated to ca. 0.6 Ma (An and Ho, 1989).

These Early Palaeolithic sites at Nihewan are well studied and published in terms of their chronology (especially paleomagnetic dating), paleoenvironment and geology. Regarding their lithic assemblages, however, few specific case studies have been published in English academic journals or books. Keates (2010) published a paper about the evidence for the earliest Pleistocene hominin activity in the Nihewan Basin, and suggested that although the hard hammer percussion knapping method was always the dominant flaking technology, deliberate exploitation of high-quality stone and more developed core reduction could be observed in some relatively later sites in the basin such as Cenjiawan and Maliang from raw materials analysis and lithic refitting studies (Shen and Wei, 2004). This paper focuses on the stone knapping skills of the Cenjiawan occupants, which represent their “evolutionary adaptive behavior” (Shen and Wei, 2004, p. 297) in the Nihewan Basin, and provide indications of early hominin behaviors in Northern China.

## 2. Archaeological, geological and chronological background

The Cenjiawan site is located in Cenjiawan village in Yangyuan county (41°13'21"N, 114°40'17"E, 869.60 m above sea level) (Fig. 1). In 1984, an archaeological field survey was conducted by the Hebei Provincial Cultural Relics Research Institute in the Nihewan Basin, and the site was thus found, and named after the village. In 1986,

\* Corresponding author.

E-mail address: [guanying@ivpp.ac.cn](mailto:guanying@ivpp.ac.cn) (Y. Guan).

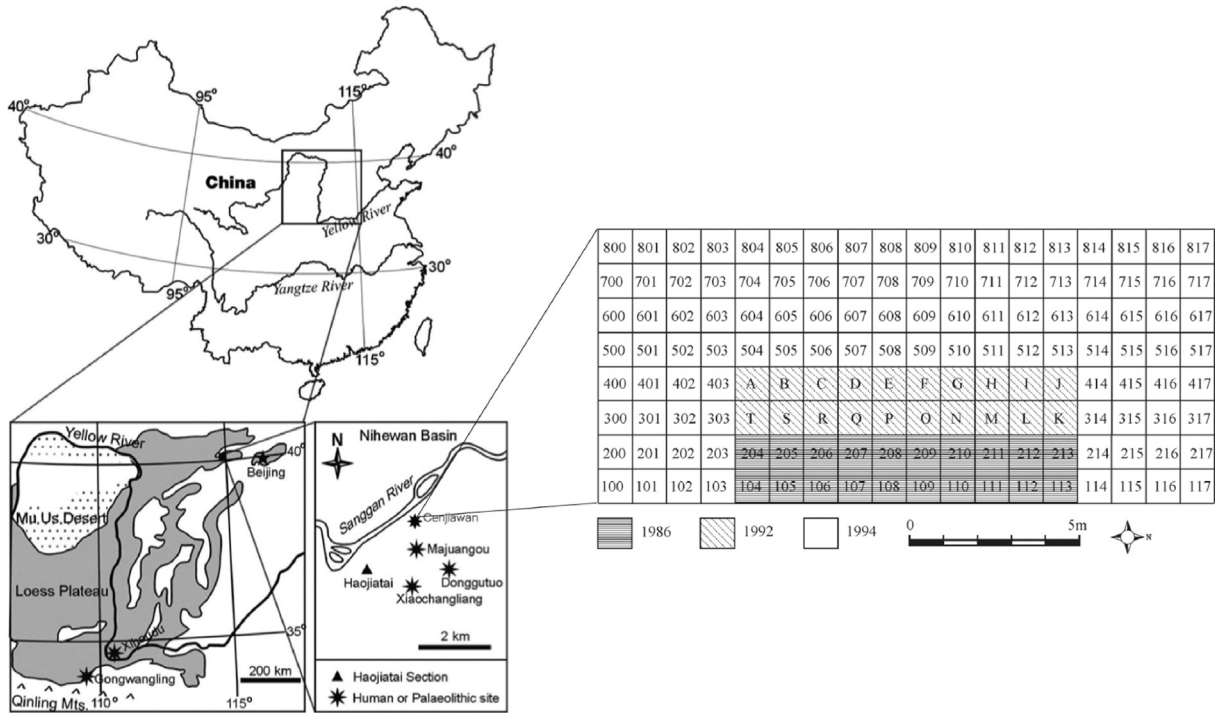


Fig. 1. Location of the main sites in Nihewan Basin (Zhu et al., 2004) and the excavation areas of 1986, 1992 and 1994 in Cenjiawan site, based on (Xie et al., 2006).

1992 and 1994, systematic archaeological excavations were conducted by Hebei Provincial Cultural Relics Research Institute, and 1625 pieces of stone artifacts were unearthed in the 144 m<sup>2</sup> excavation area (Fig. 1). Hundreds of animal fossils were associated with the artifacts, although very poorly preserved. The identifiable specimens indicate the presence of birds, *Equus przewalskyi*, and *Elephantids* sp. indet.

The Nihewan Basin is a downfaulted basin, which is located in the mountains of the northwestern part of Hebei province. This basin is filled with several hundred meters of late Cenozoic lacustrine strata, intercalated with layers of fluvial sediments at the margin (Barbour et al., 1926; Zhu et al., 2004; Wang et al., 2006). There have been numerous studies of the lacustrine and fluvial deposits in the basin and these will not be elaborated on here. Cenjiawan lies within the Nihewan Formation in the fourth river terrace, and about 1 m beneath the thick brown sand (TBS) layer (this layer is recognized as a reference sediment linking deposits among many archaeological sites) (Fig. 2).

In 2006, a paleomagnetic chronological study of the Cenjiawan site was conducted. Rock magnetic and magnetostratigraphic investigations indicated that the dominant magnetic mineral and remanence carrier contained in the sediments is magnetite. While hematite co-exists with magnetite in some portions of the Cenjiawan sequence, characteristic remanent magnetizations are carried by both magnetite and hematite. Measurements of anisotropy of magnetic susceptibility confirm that the Cenjiawan sequence has preserved its original sedimentary features and is suitable for magnetostratigraphic study. Paleomagnetic results indicate that the Cenjiawan site was formed shortly after the Punaruu normal event, which is dated at about 1.1 Ma (Wang et al., 2005, 2006; Zhu et al., 2007).

### 3. Lithic assemblage

Table 1 shows the number of stone artifacts from the Cenjiawan site in three excavation seasons. The area excavated in 1986 was the

most productive area, with a density of 44.84 pieces per m<sup>2</sup>, followed by that excavated in 1992 with 24.3/m<sup>2</sup>. In 1986, the 3-D coordinates were not collected during the field work, and therefore the horizontal and vertical distributions of excavated specimens are not available. The 20 m<sup>2</sup> area excavated in 1992 is shown in Fig. 3, which indicates that the most of the specimens were from trenches N, O, P, and Q, and also shows their vertical and horizontal distribution. The areas excavated in 1986 and 1992 are therefore considered to include the central part of the archaeological horizon. The area excavated in 1994 is thought to lie at its margins, and debris and chunks dominate the specimens. Through refitting analysis, the artifacts from 1994 have been attached to individual refitting groups, without typological and technological observations.

Table 1  
Excavated specimens in three excavation seasons.

	Area range	Core	Flake	Stone tool	Debris and unclassifiable	Total
1986	20 m <sup>2</sup>	23	97	26	751	897
1992	20 m <sup>2</sup>	13	81	7	385	486
1994	104 m <sup>2</sup>	242				242
Total	144 m <sup>2</sup>	/	/	/	/	1625

Debris and unclassifiable specimens (<20 mm in size) are dominant (82.02%), followed by flakes (12.85%), in the material excavated in 1986 and 1992. Cores and tools account for only 2.6% and 2.38% respectively (Fig. 4). According to Field (1999) and Schick (1987a,b), an undisturbed lithic assemblage should contain 60–70% of flaking debris <20 mm in size. Although minor depositional and post-depositional disturbances may have occurred, the high proportion of small-sized pieces suggests that the Cenjiawan site was not disturbed by natural agencies which would have removed the small debris away from the site area.

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