Understanding Soanian archaeology from a holistic approach

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Certificate of Examination

This is to certify that the dissertation titled "Understanding Soanian archaeology from a holistic approach" submitted by Mr. Shubham Pal (Reg. No. MS13145) for the partial fulfilment of BS-MS dual degree programme of the Institute, has been examined by the thesis committee duly appointed by the Institute. The committee finds the work done by the candidate satisfactory and recommends that the report be accepted.

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Dated: April 20th, 2018

Declaration

The work presented in this dissertation has been carried out by me under the guidance of Dr. Parth R. Chauhan at the Indian Institute of Science Education and Research Mohali.

This work has not been submitted in part or in full for a degree, a diploma or a fellowship to any other university or institute. Whenever contributions of others are involved, every effort has been made to indicate this clearly, with due acknowledgment of collaborative research and discussions. This thesis is a bonafide record of original work done by me and all sources listed within have been detailed in the bibliography.

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Dated: April 20th, 2018

In my capacity as the supervisor of the candidate's project work, I certify that the above statements by the candidate are true to the best of my knowledge.

Dr. Parth R. Chauhan

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Contents

Abstract

The **Soanian** is a post- Acheulean archaeological adaptation in the Siwalik region of the Indian subcontinent. It was named after the Soan valley in Pakistan by H. de Terra and T.T. Paterson in the 1930s. Since then, numerous investigators have reported additional assemblages from different parts of the Siwalik zone including India and Nepal. Associated tool types occur variably with Acheulean assemblages, with proto-historic sites or exclusively. They also occur with Siwalik age fossils through geomorphological mixing. No exclusive Soanian evidence in well-stratified context has yet been excavated, dated or studied from multidisciplinary perspectives. The aim of this project was to try to address some issues associated with prevailing Soanian interpretations. Besides compilation of published data, surface assemblage from field surveys was analysed, a geological trench was excavated in post-Siwalik context, and experimental work was conducted to replicate the possible reduction sequences used by Soanian-producing hominins.

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Chapter 1: Siwalik Hills and the Soanian - Review

Introduction

Open-air Palaeolithic sites belonging to either the Acheulian (biface) or the Soanian (non-biface) lithic traditions (de Terra and Paterson, 1939; Sankalia, 1974; Chauhan, 2003) are the characteristics of the earliest prehistoric record in the Siwalik Hills or sub-Himalayan region of South Asia. Soanian artefacts were primarily manufactured on quartzite pebbles and cobbles, and assemblages generally comprise varying quantities of choppers, discoids, scrapers, cores, and numerous flake types, occurring in diverse typo-technological frequencies at individual sites (Paterson and Drummond, 1962). Dennell (1995) has stated that the Soanian as an industry or tradition per se, is inadequately defined to use it as a typological category. This is supported by the fact that Soanian tool types – especially choppers and simple flakes – are also found at regional Harappan/Chalcolithic sites. It has been almost eight decades of research on the Stone Age of the Siwalik Hills yet the chronological and technological frameworks have yet to be firmly established especially in the Indian region when observed in the light of work done in Pakistan and Nepal in the last 25 years. A lack of well-stratified sites in undisturbed dateable contexts can be one of the reasons despite the rich archaeological record of the Siwalik zones. Palaeolithic sites in The Siwalik zone are usually divided into two types – Acheulian and Soanian. In the early decades of Siwalik Palaeolithic research, the Soanian and Acheulean were seen as different yet contemporary cultural entities. Subsequent research, however, has demonstrated a chronological dichotomy where the Acheulean evidence is largely older. These respective sites encompass a diverse range of geographical, geological and cultural contexts, and despite numerous studies to understand the Siwalik Palaeolithic record many key issues mostly related to chronology, typology, contexts and cultural affinities are still far from being resolved. It is therefore imperative to review the earlier Palaeolithic research done in the region to put the results of this study into context (Chauhan, 2005).

Siwalik Hills

The Siwalik zone (Map 1) refers to the sub-Himalayan hills range that runs parallel to the Himalaya extending eastwards from northern Pakistan to Bhutan (Lycett, 2007). These hills caught the attention of the world when fossils of a Miocene ape were identified here in the late 1800s. They were then ascribed as the ancestors of modern humans owing to similarities in dental morphology but later identified as ape genus *Sivapithecus* (Andrews, 1983).

The Siwalik range has an average width of 24 km, and it reaches an elevation between 900 m and 1200 m. The majority of the sediments are located within the political boundaries of Pakistan, India, and Nepal, and become steeper and narrower, from west to east. The Main Frontal Thrust (Nakata, 1989; Lave and Avouac, 2000) separates the Siwalik Hills from the Indo-Gangetic plains to the south.

The Siwalik Hills were formed due to the tectonic uplifting of the fluvial sediments deposited by the rivers and streams flowing perpendicularly to the Lesser and Greater Himalayas. Ongoing erosion and tectonic activity has greatly affected the topography of the Siwalik zone, now comprised of hogback ridges, valleys of various orders, gullies, choes (seasonal streams), earth-pillars, rilled earth-buttresses of conglomerate formations, semicircular choe-divides, talus cones, colluvial cones, water-gaps, and choe terraces (Mukerji, 1976a). Associated badland features include predominantly sparse vegetation, steep slopes, high drainage density, and rapid erosion rates (Howard, 1994).

Siwalik sediments have been divided stratigraphically into three subgroups, subdivided into eight formations (from oldest to youngest):

- Kamlial (Lower Siwalik Subgroup);
- Chinji, Nagri, and Dhok Pathan (Middle Siwalik Subgroup);
- Tatrot, Pinjore/Pinjor, and Boulder Conglomerate formations (Upper Siwalik Subgroup).

Highly rolled pebbles, cobbles and boulders (mostly quartzite) also occur in the later stratified deposits and provided the raw material for making stone tools to the hominin populations living in the region. Apart from the Boulder Conglomerate Formation(BCF) of the Upper Siwalik subgroup these quartzite clasts are present in stream beds, in terrace sections and *duns* or intermontane valleys.

The Paleolithic sites on the Siwalik slopes are situated on or above sediments belonging to almost all the Siwalik formations. Most stratified evidence of hominin occupation, however, is found in the Upper Siwalik Formation (Dennell et al., 1988; Hurcombe, 2004) and post-Siwalik deposits (e.g., Stiles, 1978). Due to the dynamic geomorphological nature of the Siwalik landscape, Siwalik age vertebrate fossils and post-Siwalik age lithics are often mixed and found together in surface context.

In the scope of this review, we will focus on Palaeolithic localities in the Siwalik hills such as Soan valley, Pabbi hills and Potwar plateau in Pakistan; Chenab and Ravi valleys, Beas-Banganga and Kangra valleys, Markanda and Ghagghar valleys, Pinjore and Nalagarh duns, Aitbarapur (Mohapatra, 1979) and more recently found, Masol (Malasse,2016) in India; Dang and Deokhuri valleys, Tui valley in Nepal (see relevant citations in Table X).

The shape of Soanian research

The pioneers who first noted presence of lithic artefacts in the Siwalik zone were Wadia (1928) and K.R.U. Todd (Paterson and Drummond, 1962). However, de Terra and Paterson (1939; Map 3) made the first attempt to systematically understand their geological contexts and gave it the name *Soanian* (Hawkes et al, 1934; Movius, 1948), and suggested its origin in the Middle Pleistocene (see Dennell and Hurcombe, 1993; Dennell and Rendell, 1991). In Nepal (Map 5), Gudrun Corvinus has done most of the intensive Palaeolithic investigations within the last three decades, notably in the Dang and Deokhuri valleys (Corvinus, 1998, 2002). Researchers in the Indian Siwalik zone (e.g. Lal, 1956; Mohapatra, 1981; Karir, 1985) relied heavily on de Terra and Paterson's work (1939) for several decades. The work of W.D. Gill (1951) and then by Sankalia (1957) first cast doubts about de Terra and Paterson's interpretations which were subsequently disproved by the British Archaeological Mission to Pakistan in the 1980s. The Soan River 'terraces' as observed by de Terra and Paterson were proven to be erosional features rather than true river terraces (Rendell et al., 1989). Numerous prominent workers (e.g. Movius, 1948, 1957; Sen, 1957; Graziosi, 1964; Paterson and Drummond, 1962; Saroj, 1974; Jayaswal, 1982) have tried to establish classification schemes in the past but none of these schemes were standardized and failed to accommodate new tool-types from the Siwalik region. The works of Gaillard (1995, 1996), Karir (1985), and Krantz (1972) are the only exceptions which have considered basic concepts such as the processing sequence of Soanian cores or the technological differences in Soanian flakes. Chauhan (2006) also attempted to establish a chronological and classificatory framework for the Soanian. Recently, an Indo-French project (Malasse, 2016) reported controversial results of fossil bones with cut marks and extending the age of the paleoanthropological evidence – including lithics - to 2.6 Ma. Additionally, Soni and Soni (2007, 2017) have been working in the frontal zone of the Indian Siwalik zone and have suggested that the Soanian might have been contemporary to even the Late Harappan period, a debatable interpretation that requires further research. Both these studies require further research and better contextual and geochronological data as they may have been found in secondary context and erosional activities might have caused mixing of artefacts and/or fossils from different time periods.

Features of Palaeolithic sites in the Siwalik Hills

Palaeolithic sites in the Siwalik Hills have been generally assigned to either Soanian (Map 2) as the majority, or Acheulian. H. de Terra and T. T. Paterson reported both Soanian and Acheulian artefacts from the Soan valley in Pakistan which gave the name to Soanian industry (Terra and Paterson,1939). Though there have been sites such as Ror (Bhattacharya et al., 1981) in Kangra valley which are distinct from either one, it has been observed that miniature pebble side-scrapers bear morphological resemblance to Soanian choppers. Some well-known Siwalik Acheulian sites are Aitbarapur in India (Gaillard, 2008), Dina and Jalapur in Pakistan (Dennell, 1989), and Satpati and Gadari in Nepal (Corvinus, 1990). Major Soanian sites are Guler (Karir,1985) and Toka (Chauhan,2007) in India and Arjun-3 (Corvinus,1995) in Nepal – although the latter is not classified as Soanian by the researcher. Below, the compiled data is described according to specific attributes and features such as geographic distribution and topography, geological context, chronology and artefact density.

GEOGRAPHICAL DISTRIBUTION AND TOPOGRAPHY

Out of a total of 119 reported Palaeolithic sites in the region, 15 are in Pakistan, 100 in India and only 4 in Nepal as can be observed from the compilation of published data presented in Table 1. In Indian sites, 9 sites have been reported from Himalayan range in Jammu and Kashmir (Map 4) from the Liddar and Sind river valleys. Table 2 shows that only 11 Acheulian sites have been reported in Pakistan compared to 21 in India and 2 in Nepal. It is interesting to note that the Soanian and Acheulian evidences occur spatially together only at Chauntra in Pakistan; Such spatial overlap of both technologies has yet to be reported from India or Pakistan. It possible that both technologies might have been contemporary at one point in time, or partially overlapped, while occupying different ecological niches. Another possibility is that the Soanian post-dates the Acheulean and the Chauntra site represents either i) geomorphological mixing of the two or ii) the Soanian tools types there are actually part of the Acheulian assemblage. Indeed, simply choppers, cores and flakes are common in Acheulean assemblages elsewhere.

The majority of reported Acheulean and Soanian sites are concentrated in the western Siwalik zone (Maps 7-10), a pattern which should be expected as the region was once the hotspot of hominin research due to the multiple findings of *Sivapithecus* fossils. Also as a large number of other vertebrate fossils are found in this region, most of the researchers have continued to focus their efforts here. But owing to the difference in relief in the Pakistan Siwalik zone as compared to the Indian and Nepal Siwalik zones, most of the oldest sites have been reported from Pakistan, mostly in Soan valley and the Potwar region. On the other hand, the Indian Siwalik zone have a higher concentration of post-Siwalik sites. This is due to the widespread deposition of Plio-Pleistocene deposits in low-relief exposures in the Pakistan Siwalik zone as this region has experienced less frequent episodes of tectonic uplift and associated erosional regimes. In contrast, the Indian and Nepalese Siwalik zones have high-relief topography as they have been continuously uplifted since the Middle Pleistocene resulting in a lower number of Early Pleistocene sites than in Pakistan. With the exception of sites found in Nepal, the easternmost expanse of reported sites currently ceases at the banks of the river Yamuna. This has left a sizeable geographic gap in the Siwalik zone between the Yamuna river in India and the Sarada river in western Nepal and another gap east of Deokhuri valley in central Nepal. There are also some unique geographic pockets which may yield well-preserved archaeological assemblages, such as the Paonta *dun*. It is one of the few dun valleys which is small, relatively undisturbed and remaining to be surveyed. Although the Dehra *dun* is larger and more prominent, heavy development and industrial activities may have affected the regional archaeology and the preservation of primary context sites. It is notable that the suitable raw material type in this zone is dominated by white quartzite whereas in other zones it is orangish brown or yellow quartzite. Numerous tracts in the Nepal Siwaliks also remain to be surveyed and the efforts by G. Corvinus demonstrate the paleoanthropological potential of the region. The Nepal zone is especially relevant as it may link the eastern and western Siwalik Palaeolithic records and help explain whether specific Southeast Asian technologies such as the Hoabinhian or associated elements penetrated the Indian Siwalik zone or not.

GEOLOGICAL CONTEXTS

Almost all Palaeolithic sites in The entire Siwalik zone are found in the valleys along the river terraces formed by various rivers and streams flowing perpendicular to the hills and the frontal slopes of the sediments, but none appear to preserve primary stratified Palaeolithic sites excepting the ‘loess’ deposits reported by de Terra and Paterson (1939) in Pakistan. The difference though is that while the Pakistan Siwalik zone has sites in erosional terraces covered in loess deposits, that is not the case in India and Nepal. Perhaps future surveys in western Kashmir in areas adjoining the Potwar plateau may yield stratified sites in loess. Most sites in India and Nepal are found in fluvial terraces in the intermontane valleys locally knowns as d*uns* such as Pinjore and Nalagarh *duns* in India and the Dang and Deokhuri *duns* in Nepal. Interestingly, almost all of these valleys are of similar dimensions and features. Excepting the evidence from the Soan valley in Pakistan and a few other sites, most of the Acheulean sites are found on the frontal slopes of the Siwalik sediments which might suggest differential occupation of niche-environments by these populations. Also the lower relief in the Pakistan Siwalik zone has preserved the Plio-Pleistocene deposits much better than their steeper extension in India and Nepal where erosion has made an already difficult topography more challenging contextually. This is a major factor in the lack of provenance for almost all the Soanian sites as they have been found in secondary contexts where many a times sediments from different time periods and layers have mixed repeatedly resulting in the reporting of even Harappan potsherds coming out of the same horizon as the lithic artefacts. On the other hand, it is possible that at some sites, such evidences are truly contemporary and reflect diverse technological adaptations due to changing environmental conditions (Soni and Soni, 2017).

Since a majority of Soanian sites have been reported in India, the most common geological context they are found in is fluvial terraces formed by the streams and rivers flowing out of the Siwaliks and southwards towards the plains. A total of 75 sites have been reported from fluvial terrace contexts. Following it is the erosional terraces of the Pakistan sites as reported by de Terra and Paterson; fluvial context sites number 15 sites in Pakistan. Seven sites have been reported from the surface of the Pinjore Formation while 16 have been reported from the surface of the Tatrot Formation along with 1 from the Tatrot silts, possibly reworked. One site each has been reported from the Boulder Conglomerate Formation, basal alluvium, plains below the hills, post-Siwalik streambed and intersection of plains and frontal zone. Only 7 sites are known from the frontal slopes of Siwalik range. For the Acheulian sites, 21 sites have been reported from frontal slopes of the Siwalik zone in India, followed by 8 from erosional terraces and post-Siwalik loess, 1 each from a fluvial terrace and Upper Siwalik conglomerate in Pakistan and 2 in *dun* valley sediments in Nepal. Future efforts to locate primary context Soanian Palaeolithic sites can be addressed through remote sensing and GIS applications. Such methods may help identify pockets of intact post-Siwalik deposits (terrace or floodplain contexts) where dateable lithic assemblages may be preserved. Similar approaches can be applied in zones with loess deposits such as western Kashmir which preserves the extension of the Potwar plateau. It is important to distinguish between and keep apart the earliest Oldowan or Oldowan-like assemblages such as the Pabbi Hills material and the earliest Soanian evidence, for which no chronological evidence yet exists. In other words, both are different archaeological entities and probably technological unrelated to one another as they are techno-chronologically separated by the Siwalik Acheulean. Based on current evidence, the oldest Soanian evidence should – theoretically – be no older than the Middle Pleistocene and its origins may possibly be preserved the Boulder Conglomerate Formation.

PALAEOLITHIC CHRONOLOGY

Contextually, almost all Palaeolithic sites in the Siwalik zone can be broadly divided into two chronological categories – (Upper) Siwalik age and post-Siwalik age. Artefacts reported from the Siwalik age sites show signs that hominin activity took place in the region during the deposition of Siwalik sediments and before they were uplifted. Assemblages from this category has been variably dated to between 2.0 and 0.5 Ma like Riwat and Pabbi Hills in Pakistan although they are marginal in number, presumably due to lack of availability of raw material until the deposition of BCF, the lack of systematic surveys and/or the lack of geological preservation/exposure patterns. Also most of the reliably dated sites in South Asia have been reported to be younger than Lower Pleistocene (Chauhan, 2009). A lack of accurate knowledge of highly complex tectonic and sedimentation processes prevents recognition of syndepositional hominid occupation during BCF deposition which has been observed in cases of some sites attributed to be contemporary to it. On the other hand, there is reliable stratigraphic and geomorphic evidence available for post-Siwalik sites. Excepting some assemblages in Pakistan (e.g. Dennell et al. ,1988; 1993) and Nepal (e.g. Corvinus,1998; 2002), all these sites have been ascribed to the Soanian *culture*. Another major problem is the mixing of sediments due to the erosional processes which can be highlighted by the recent findings in Masol where apparently fossils bearing intentional cut marks estimated to be 2.6 million years old have been found along with some artefacts, mostly *simple* choppers (Malasse, 2016). Some of De Terra and Paterson’s occurrences of Acheulean and Soanian artefacts in shared contexts in the Soan terraces may also be a result of similar geomorphological processes.

Riwat in Pakistan has been reported as the oldest South Asian Palaeolithic site with dates coming out to be 1.9-2.5 myr (Rendell, 1989). The Pabbi Hills evidence, also in Pakistan, has also been dated to 0.9-2.0 myr (Hurcrombe and Dennell, 1993). In all, 36 sites in India have been reported to fall in the age bracket of 0.2-0.7 myr old (Joshi, 1974). Soni and Soni (2009) have reported 8 sites in India and have suggested them to be less than 16 kyr old. Although site of Masol has been reported to be 2.6 myr (Malasse, 2016), the evidence is highly controversial due to the lack of a primary context and other methodological issues. Arjun-3 in Nepal has been reported to belong to the Middle Palaeolithic period and has been dated to a minimum age of 30 Ka (Zoller, 2000). Thus, as has been observed previously most of the sites remain undated and thus pose a major challenge to give a proper timeframe period to the Soanian. As a result, we are not able to understand its earliest manifestation, whether it overlaps with the Acheulean and the technological changes (if any) during its longevity.

Based on the above review of available published literature, the Soanian record is not continuous and there are many geographic and chronological gaps. Until primary context sites are dated on a more comprehensive temporal spectrum (from the Middle Pleistocene onwards), the current evidence suggests only intermittent occupation of the Siwalik zone. It is possible that the zone was not occupied on a continuous basis during the Palaeolithic due to the lack of raw material diversity and spatial abundance, intermittent tectonic activity, and formidable topographic barriers for north-south mobility. The topography may have also affected the density and diversity of fauna for subsistence purposes. The oldest Soanian evidence continues to remain elusive and its earliest technological classification may be questionable and difficult to pinpoint. For example, recent research has extended the Indian Middle Palaeolithic to 385 Ka (Akhilesh et al. 2017), which has important implications for the Soanian evidence as new methods have confirmed Mode 3 attributes (Lycett et al. 2007) in some assemblages.

ARTEFACT DENSITY

One of the major hurdles in establishing a reliable framework for Siwalik Palaeolithic sites, apart from most assemblages being in non-primary or surface contexts, is the low yield of most sites ranging from a few artefacts strewn across the landscape to a few hundred at most. The highest amount of artefacts yielded by a site is 4106 from the site of Toka in India reported by Chauhan (2005), followed by 1632 from Jd -6 also in India reported by Soni and

Soni (2007) and Arjun 3 in Nepal yielding 1354 artefacts (Corvinus, 1995). In Pakistan, the Pabbi Hills complex yielded the highest amount of artefacts numbering 600 (Rendell, 1989). Many sites have been reported with vague information about the precise number of artefacts. Additionally, a total of 13 sites have yielded only 1 artefact each.

A lack of vertebrate fossils contemporary with the lithic evidence has also contributed to lack of knowledge about palaeoecological conditions at the time of deposition. Most sites represent secondary mixing although investigators at Masol suggest that the lithics and fossils are contemporary. The Pabbi Hills lithics and fossil evidence also appears to come from the same sedimentary contexts and is probably contemporary but all of them come from surface contexts.

The Siwalik Hills zone is basically unsuitable for reliable or accurate information regarding original artefact densities. Depending on the age of any given Soanian site and unless exposed from burial recently, most original assemblages must have significantly decreased in number through various post-depositional processes. With the exception of unusually rich sites with several hundred or several thousand artefacts, artefact densities at most sites are relatively low ranging from find-spots of individual artifacts to one or two dozen lithic scattered across several hundred square meters and found at different elevations (i.e. high relief topography of the Siwalik Hills). In other words, a large number of smaller and/or or rounder specimens may have been washed away following strong seasonal rains or buried in secondary deposits including in the beds of the numerous seasonal streams. In that regard, Soanian assemblage compositions should to be viewed and interpreted cautiously and may not reflect an accurate picture of the original site setting, function and associated hominin group size.

Chapter 2: Field surveys and Geological trench at Toka

Field Surveys and Surface Collections

Surveys were conducted in the Siwalik zone in the Sirmaur District (Map 6) of Himachal Pradesh. The objective behind the surveys was to look for new sites yielding Soanian artefacts in better contextual integrity than known sites. To begin with, we identified locations by looking at topographic maps, Google Earth and other academic data such as published and unpublished resources, to better understand the chances of finding suitable sites. This helped us to realise that most of the earlier reported sites were situated near the streams and rivulets crisscrossing the Siwalik zone. Most of these streams flow parallel to the hills and then often cut perpendicularly creating small valleys. Then surveys were done accordingly to the targeted areas and surface collections were done at various locations. The collections include both artefacts and fossils apart from occasional pottery fragments all from the same surface context indicating possible mixing over time. A record of these fresh collections according to the sites has been provided in Table 2. Major sites found were Devni and Ujjal Majri (Sambhalwa) where majority of the artefacts were collected from surface contexts within spatially restricted areas. The collection was done on an exhaustive basis owing to low yield of sites combined with high erosional rates. This means that we tried to collect as many artefacts as we were able to identify in the field before they got washed away or reburied downslope towards the plains. Since none of the sites had *in situ* artefacts, we can safely assume that the sites are in secondary contexts and the artefacts might have been deposited there due to fluvial processes or surface wash/run off. This is consistent with most of the earlier research done as almost all known Soanian sites are in secondary contexts as discussed earlier. Although Dehra Gopipur in Kangra Valley was excavated by G.C. Mohapatra, the contextual integrity of the site is not clear and it is yet to be dated.

In the field survey collections (see Table 3), Ujjal Majri yielded 40 lithic artefacts and a single pottery fragment. We collected 13 lithic artefacts and 12 pottery fragments from Site 3 and 14 lithic artefacts only from Site 1. Devni yielded 12 lithic artefacts but the lowest collected were 7 lithic artefacts from Site 2. Site names were given according to the proximity to the nearest villages and if there were none, the sites or occurrences were numbered.

All these collections were surface collections from secondary context as they were found on the fluvial terraces formed by the minor Siwalik streams on top of the Tatrot formation.

Therefore, these assemblages can only be chronologically interpreted as provisionally post-Siwalik until older primary sites are identified and dated.

The compositions of these assemblages suggest they might have occupied an area further upstream with abundance of raw material, food and water. Though no site as a possible shelter has been reported from the study area, there is a possibility that we might be able to find such sites on surveying the interiors of the Siwalik range, areas which may have hollows within harder sediments, such as rock shelters elsewhere. Also it might be possible that the early humans might have occupied this area even during and after its uplift. As we found the artefacts from the eroded surface but the geological trench suggests that the artefact layer there might be between the cobble layer and Tatrot Formation.

Excavation

The location of the geological trench was on a hilltop near Toka village (Fig. 1) near Kala Amb town in Sirmaur District. The hilltop was a flat terrace and also a part of industrial zone. The terrace is composed of post-Siwalik fluvial sediments sitting directly above the sediments of Tatrot Formation of the Lower Siwalik subgroup. This area had been previously worked on by Dr. Parth Chauhan as a part of his doctoral research which was centred around this particular site and the immediate region. His work reports this site as the richest collection of Soanian lithic artefacts ever found. This was thus an important site and we wanted to revisit to get some geological samples to date the associated sedimentary context. In other words, dating the post-Siwalik terrace would provide minimum ages for the archaeological materials indirectly associated with these strata. The trench was ~placed at a distance of about 7 metres from a factory on the hilltop representing the uplifted post-Siwalik terrace of the Tirlokpur Nadi. The trench area was disturbed on the surface mostly due to industrial and plastic waste dumped over there. We chose a relatively clean patch of land and started a 2mX2m trench (Fig. 2) on it and the final depth reached was 1.90 m (Fig. 4). The trench was excavated to the top of the main gravel horizon which lies discomformably on the Tatrot Formation. The purpose of the trench was 1) to understand detailed stratigraphy of a post-Siwalik terrace deposit and 2) to collect sediment samples for OSL dating. The stratigraphy (Fig. 3) of the trench shows a modern cultural layer (dumped construction material like bricks, cement, plastics) in the topmost layer about 35 cm thick. It is then followed by a brown clay layer about 56 cm thick and also contains three fine layers of calcrete at depths of 45, 65 and 72 cm from the top. The third layer is sandy layer of about 60 cm thickness and changes colour from light brown to whitish as the particles become coarser with increase in depth. The fourth and final layer is of gravel around 39 cm thick. We could not excavate further due to adverse weather conditions and only scraped the walls to prepare for taking OSL samples (Fig. 5,6). The stratigraphy observed clearly shows a fluvial deposition pattern for the layers with finer sediments on top and coarser sediments on bottom. Unfortunately, the geological excavation did not yield any artefacts despite their occurrence on the surface around the site. This leads us to believe that artefacts must have been transported with the earliest sediment layers, i.e., the gravel layer in this case and/or originate further down. Future excavations should reveal the precise stratigraphic context of the artefacts directly above the Tatrot formation. It is expected that the artefacts most likely occur at the interface between the post-Siwalik and Upper Siwalik strata. This hypothesis is supported by the fact that the fine sediments did not yield any raw material and were homogenous for the most part. We then focussed on collecting sediment samples from the exposed layers which can then be further processed in the labs to get some estimates about the time of deposition these layers. On visiting the site one can observe that the stream flows besides it but almost 50 metres below the hilltop. This emphasises the rapid rate of uplift this region has witnessed in the past and is an ongoing phenomenon. The sediments could only have been deposited by the stream itself and so might have been uplifted later. This gives a relative idea that the artefacts may either belong to the period before the uplift of Siwalik sediments or during the earlier phase of uplift. This can tell us about the habitation pattern of the early humans in this area once the dates arrive.

For dating, we collected different samples for various analyses to better understand the geological processes and their timeline in this area.

SAMPLES COLLECTED

- Numerous calcrete nodules for stable isotope studies were collected from the clay layer at intervals of 5 cm (Fig. 7).
- 9 sediments samples were collected across all the layers (except cultural layer) for geomorphological studies with intervals of 10 cm (Fig. 8).
- 6 samples were collected for dating using Optically Stimulated Luminescence (OSL) technique (Fig. 9, 10). These are expected to be processed through collaboration at the Wadia Institute of Himalayan Geology, Dehra Dun.

Calcrete nodules are basically $CaCo_3$ and are formed under dry weather conditions. Presence of calcrete suggests a palaeo-surface exposed to drier conditions. These nodules can be used for stable isotope studies (C, N and O) to reconstruct past environmental conditions. They can also be dated using the electron spin resonance method and Uranium-series method. Such methods can give us a relative age estimate for the sediment layers in which these are found or the age of sediment burial. Radiometric dating or radioactive dating is a technique used to date materials such as rocks or carbon, in which trace radioactive impurities were selectively incorporated when they were formed. The method compares the abundance of a naturally occurring radioactive isotope within the material to the abundance of its decay products, which form at a known constant rate of decay. Among the best-known techniques are radiocarbon dating, potassium–argon dating, and various types of luminescence dating. The description of one of the luminescence methods to be applied at this site, is outlined below from Wikipedia (2018).

In physics, optically stimulated luminescence (OSL) is a method for measuring doses from ionizing radiation and makes use of electrons trapped between the valence and conduction bands in the crystalline structure of certain minerals (most commonly quartz and feldspar). The trapping sites are imperfections of the lattice — impurities or defects. The ionizing radiation produces electron-hole pairs: Electrons are in the conduction band and holes in the valence band. The electrons that have been excited to the conduction band may become entrapped in the electron or hole traps. Under stimulation of light the electrons may free themselves from the trap and get into the conduction band. From the conduction band they may recombine with holes trapped in hole traps. If the centre with the hole is a luminescence centre (radiative recombination centre) emission of light will occur. The photons are detected using photomultiplier tube. The signal from the tube is then used to calculate the dose that the material had absorbed.

To carry out OSL dating, mineral (quartz) grains have to be extracted from the sample. Most commonly these are so-called coarse grains of 100-200 μm or fine grains of 4-11 μm. Occasionally other grain sizes are used such as feldspar.

The difference between radiocarbon dating and OSL is that the former is used to date organic materials, while the latter is used to date minerals. Events that can be dated using OSL are, for example, the mineral's last exposure to sunlight. It is also used for dating the deposition of geological sediments after they have been transported by air (aeolian sediments) or rivers (fluvial sediments).

Chapter 3: Lab analysis of Archaeological specimens

A total of 86 artefacts were collected from multiple field visits in the Siwalik zone of the Sirmaur District. They were analysed using various quantitative and qualitative parameters in the lab for their identification and classification. A record of all the artefacts collected was made for analysis and future references.

Methodology

- All the artefacts were washed and brushed to remove any loose dirt or contaminant.
- They were then labelled and given IDs according to the site where they were collected from.
- Then they were measured on quantitative parameters on their metric size (length, width and thickness) and weight.
- Observations were made based on their qualitative parameters and all artefacts were classified into their respective types.
- Photography of all the collected artefacts was done.

Important Definitions

1. Toth's (1982, 1985) classification was applied on the flakes which were broadly classed under *Flakes and fragments* (debitage).

   i. Type I: Cortical platform, cortical dorsal surface (Fig. 12)

   ii. Type II: Cortical platform, partially cortical dorsal surface

   iii. Type III: Cortical platform, noncortical dorsal surface

   iv. Type IV: Noncortical platform, cortical dorsal surface

   v. Type V: Noncortical platform, partially cortical dorsal surface

   vi. Type VI: Noncortical platform, noncortical dorsal surface

   vii. Type VII: Indeterminate whole flake
2. Choppers: cores, usually made on waterworn or rolled cobbles with a flaked edge around part of their circumference.
3. Discoids: cores, usually made on flat cobbles or thick flakes, with a flaked edge around most or all of their circumference
4. Scrapers: pieces that have been retouched along a side edge or end edge.

Observations and Results

After the analysis of the data obtained from the artefacts, they were classified accordingly. The assemblage contains cores divided into two major types – discoids (Fig. 13) and non-discoids. The choppers (Fig. 11) which essentially start out as core in any Soanian assemblage were classified according to the location of flake scars and edges. Thus they were labelled first according to presence of flake scars - on only one side, i.e., unifacial, or both sides, i.e., bifacial. Then location of the edge was observed whether it was on only one margin or edge, i.e., unimarginal, or on both the margins or edges, i.e., bimarginal. Choppers were then finally labelled as either “side-” or “end-” choppers depending upon whether the edge is located on the usually longer ‘side’ of the clast or the shorter ‘end’. Other tool which was observed was scrapers made on either flakes (Fig. 15) or cores (Fig. 16) and were classified using the same criterion such as choppers. The flakes were classified based on the typology given by Nicholas Toth. Some important observations were made based upon factors such as presence of ‘backing’ on the flake (Fig. 17) or in many cases the orange slice like structure usually an indicator of bipolar technique.

Table 7, 9, 10, 11 and 12 respectively show the statistical values for lab analysis of the data in Table 4. The average length, width and thickness of the artefacts was 79.64 mm, 60.10 mm and 37.13 mm respectively while the standard deviation was 24.61 mm, 20.18 mm and 17.39 mm respectively for the entire collection. Devni assemblage has average measurements of 86.26 mm, 67.01 mm and 40.60 mmm respectively while the standard deviations are 23.27 mm, 19.50mm and 14.40 mm respectively. Site 1 assemblage shows average measurements of 76.12 mm, 57.90 mm and 31.91mm respectively and has standard deviations of 28.2 mm 24.03 mm and 18.43 mm respectively. Site 2 assemblage yielded average measurements of 85.21 mm, 63.32 mm and 37.59 mm respectively while the standard deviations were 23.49 mm, 25.61 mm and 17.23 mm respectively. Site 3 assemblage has average measurements of 78.26 mm, 60.10 mm and 33.93 mm respectively and standard deviations of 24.79 mm, 19.91 mm and 19.06 mm respectively. Average measurements of Ujjal Majri assemblage are 78.36 mm, 58.24 mm and 38.88 mm respectively and standard deviations of 24.55 mm, 18.51 mm and 17.61 mm respectively.

For the total data, maximum length, width and thicknesses are 132.15 mm, 105.98 mm and 79.12 mm respectively while minimum values are 3.92 mm, 20.18 mm and 7.96 mm respectively. For Devni assemblage, the maximum values are 126.16 mm, 101.98 mm and 56.38 mm respectively while minimum values are 59.88 mm, 36.32 mm and 17.86 mm respectively. Site 1 assemblage has maximum values of 121.48 mm, 92.04 mm and 66.58 mm respectively while the minimum values are 30.92 mm, 20.18 mm and 9.56 mm respectively. Site 2 assemblage yielded maximum values of 115.58 mm, 94.24 mm and 59.88 mm respectively and minimum values of 50.32 mm, 26.18 mm and 14.78 mm respectively. Site 3 assemblage has maximum values of 127.32 mm, 91.72 mm and 73.78 mm respectively while minimum values are 44.2 mm, 28.26 mm and 13.00 mm respectively. Lastly, Ujjal Majri assemblage has maximum values of 132.15 mm, 93.76 mm and 79.12 mm respectively and minimum values of 33.3 mm, 26.58 mm and 7.96 mm respectively.

Graph 9 shows that generally weight of the artefact keeps in line with its dimensions but will also vary depending upon the density of the artefact material. This suggests that they were trying to actively select for denser material which would make for more durable tools despite difficulty in knapping or reduction.

Similarly, Graph 10 demonstrates that the dimensions of cores and discoids are generally larger than that of flakes. Exceptions are the bigger flakes which have bigger dimensions than the average cores, as the former must have come from boulders. There are also cores of smaller dimensions which indicates lower availability of suitably big sized clasts to work with.

Graph 13 represents the morphological distribution of the assemblage where 15 artefacts are C/D shaped, followed by 13 which are elongated, 12 are squarish, 10 are triangular, 8 are roundish, 5 are completely angular, another 5 are discoidal, 3 each are pointed and almond shaped while 2 each are fan-shaped and amorphous. There was no blade-like artefact observed in the assemblage.

As shown in graph 14 majority of the artefacts, i.e., 51 are shades of Brown in colour. The next most dominant colour is Tan with 18 artefacts while the rest comprises 6 Burgundy, 2 Black, 6 Gray and 3 White artefacts. This shows the variety in the colour of the quartzite material available in this area.

Most of the artefacts (45 in number) are flakes or flake tools, while 31 are cores or core tools and a further 6 are choppers and 4 are discoids (see graph 15). A detailed typological distribution can be observed in graph 16. A high number of primary flakes suggests that hominins might have used only a crude reduction sequence without much retouching similar to mode 1 technologies like Oldowan.

Thus the assemblage observed was not significantly different from what has been reported previously. The ‘chopper-chopping’ tools were similar in morphology as classified under Soanian technology. Even a pitted cobble fragment (Fig. 14) was observed which has been reported only recently elsewhere (see Soni and Soni, 2009). Thus, as was expected it would be safe to assume that this assemblage belongs to the general Soanian evidence found in this region. Vertebrate fossils and pottery fragments that have been found along with this assemblage are very common across the sites owing to the geomorphological complexities in this region.

Chapter 4: Experimental work and Implications for archaeological interpretations

In relation to the analysis of the field-collected lithic evidence, one question which is often asked is “How were Soanian artefacts made?” Therefore, one of the objective of the experimental analysis was to understand the techniques and reduction sequences that might have been used by the hominin populations making the Soanian tools. Due to various restrictions in this this study, we had to limit the replication to only few major types see in field assemblage.

For the planned experimental work, we collected raw material (quartzite cobbles and pebbles) from the bed of the Tirlokpur Nadi near Kala Amb in the Siwalik frontal zone. Then we measured and labelled the cobbles before proceeding to knap them to obtain different tool types. This was followed by simply selecting and producing a diagnostic end product such as a unifacial or unimarginal side-chopper, choosing a suitable cobble for it, choosing a suitable hammer stone (Fig. 18) and then trying to knap the cobble to the desired shape.

In this process I tried a few techniques –

- Direct percussion- The cobble is directly hit by a hammer to remove flakes and shape the edge.
- Hammer on anvil- The core is kept on an anvil and struck to remove the flakes.
- Bipolar- A pebble is kept on an anvil and is then hit by a hammer on the top to remove flakes or split the clast thus resulting in two *bipolar* forces of impact (Fig. 20).

Observations and Results

For making choppers and discoidal cores, the direct percussion technique was mostly used to obtain the results while occasionally using the hammer on anvil technique. The initial strikes required to get the first few flakes on the cobble took relatively more strikes than the subsequent removal of flakes. This might be due to non-availability of proper platforms on the core surface. This point was further stressed as a flatter cobble having a natural platform was relatively easier to work with. I found making unifacial choppers (Fig. 19, 21) relatively easier and faster when contrasted with a bifacial chopper (which was an unsuccessful one for me). Additionally, making a proper discoidal core (Fig. 22) resulted in only partial success as the removal of top flake after centripetal flaking proved difficult. The bipolar technique was used on smaller cobbles and resulted in nicely-split cobbles and typical ‘orange slice’ shaped flakes.

But there were some interesting and unintentional objects also observed during this process. Indeed, this represents one of the first formal attempts to replicate Soanian tool-types and the study demonstrated the potential of experimental archaeology in a regional context.

The ‘orange’ slice flakes which are usually associated with the bipolar technique were also obtained unintentionally while using direct percussion technique, although they were made accidently due to misplaced strikes on the striking platform. This can mean that not all such flakes in the field may be a result of the bipolar technique.

I also obtained two flake tools which comprised a triangular point-like flake and a backed knife-like flake which I retouched to get a proper edge though it was not intentional and did not expect to make them from the beginning. But as we have seen many backed knives in the field, this observation means that the hominins might be trying to completely utilize the raw material they had, given the fact that very little required quality might have been available. This was evident because most of the raw material available to us was of low quality as compared to the original artefacts from Toka and other sites. This stresses the fact that the hominins might have perfected a technique to actively select for raw material to use. Also, based on our observations, it is of little surprise that wasting was not an option as good material might not have been easy to come by.

So as a result I was able to replicate a total of five choppers, a partially successful discoid, and two flake tools.

I then weighed the core or the tool, the flakes and the collectible debitage together again to observe the loss in mass from the original. Not much mass was lost: in most cases it was not even one percent of the original and all of the cases had less than three percent loss in mass. This was also affected by our inability to collect all the debitage of that cobble. An interesting observation was that using a higher stool for sitting resulted in a lower spread of the debitage for me to collect. This was surprising to me as I expected a spread of debitage to be directly proportional to the height at which I was knapping the cobbles; which in turn was affected by the stool height. This, however, needs to be tested further by using a standard procedure and control over the height of knapping and associated factors.

Now a few other factors that can affect the outcome and efficiency of this experiment should be kept in mind. I consider myself a novice knapper and thus, it was expected to not all expected objectives. Once more experience and practice is gained, additional questions regarding the Soanian can be answered more accurately and consistently using experimental archaeological as a methodological tool.

Chapter 5: Conclusions and future directions

The review highlights some major elements of Soanian technology and associated hurdles which until now have prevented us from establishing a chronological framework for it. This has been a constant source of debate among researchers which are still trying to find out whether it preceded, was contemporary or succeeded the Acheulian technology in this region. There is also further debate on whether the Soanian is a mode 1 or mode 3 technology. Until now not much research has been done except for the new geometric morphometric analysis by Lycett (2007). This has put a big question mark on its placement in the 'technological evolutionary tree' of lithic technology in India.

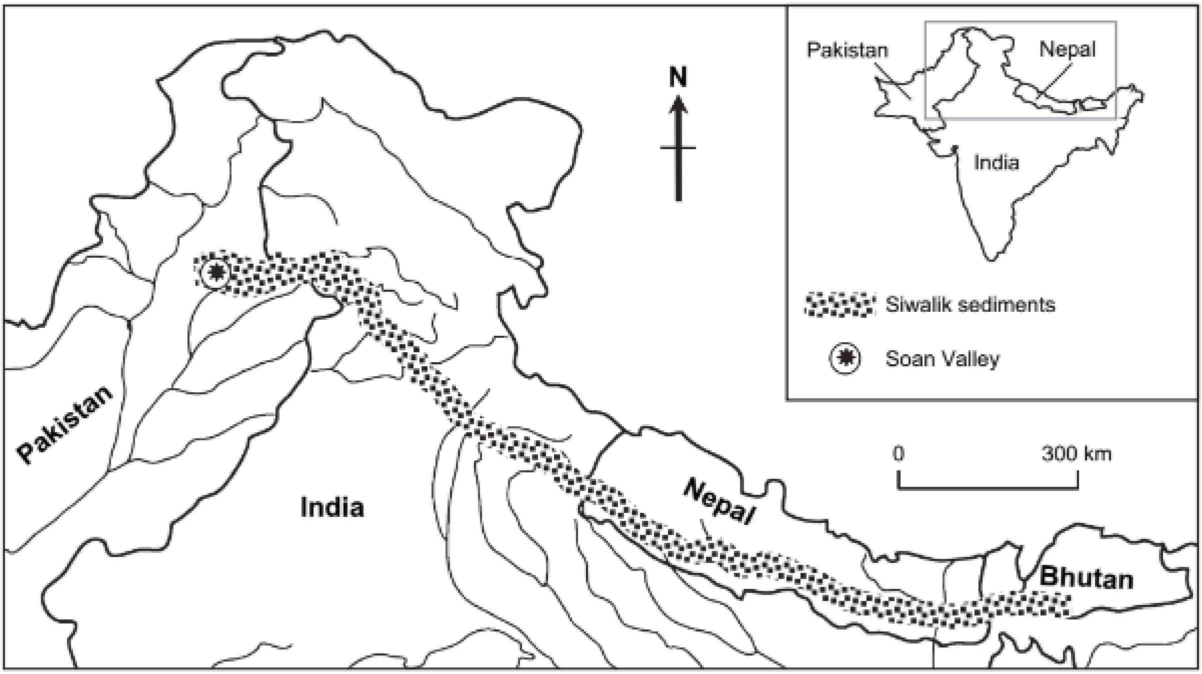
The review of the previous research also shows us that a large geographic gaps exists in the current research areas that have been studied. As discussed earlier these gaps, extending from the Yamuna River's right bank in Himachal Pradesh to the Dang valley in Nepal and thus mostly covering Uttarakhand and the western Nepal Siwalik zone and eastwards to Deokhuri valley in Nepal, have remained unexplored for the most part except for the prominent Neolithic evidence in north-eastern India. Of particular interest is the area of Uttarakhand Himalaya as Soanian artefacts have been found to the west and east of this zone. This warrants research in this area as this zone might yield dateable Soanian sites which has been lacking elsewhere. Another avenue to pursue in the future is recover faunal/floral material in association with Soanian assemblages for paleo environmental reconstructions as well as information about hominin subsistence patterns. Not a single Soanian site has been found in primary context and finding such a site would help us in settling many conceptual debates and specific research questions.

So for our field excavation our motivation was to get sediments that we can use to give a date bracket for the artefact bearing layer. Though we never reached the main layer, we collected sediments from the upper layers so that we can at least date the deposition of latter sediments and thus get a minimum age for the secondary deposition of the artefacts on the terrace. In addition, we can gain more comprehensive knowledge of post-Siwalik contexts and stratigraphic sequences. Currently, we are awaiting absolute dates from the samples we have collected which are being processed in a suitable lab. Reaching the Tatrot sediments below the gravel horizon at the site of Toka still requires more work and has to be pursued to complete our objectives. Hopefully, this planned work will be completed in the near future.

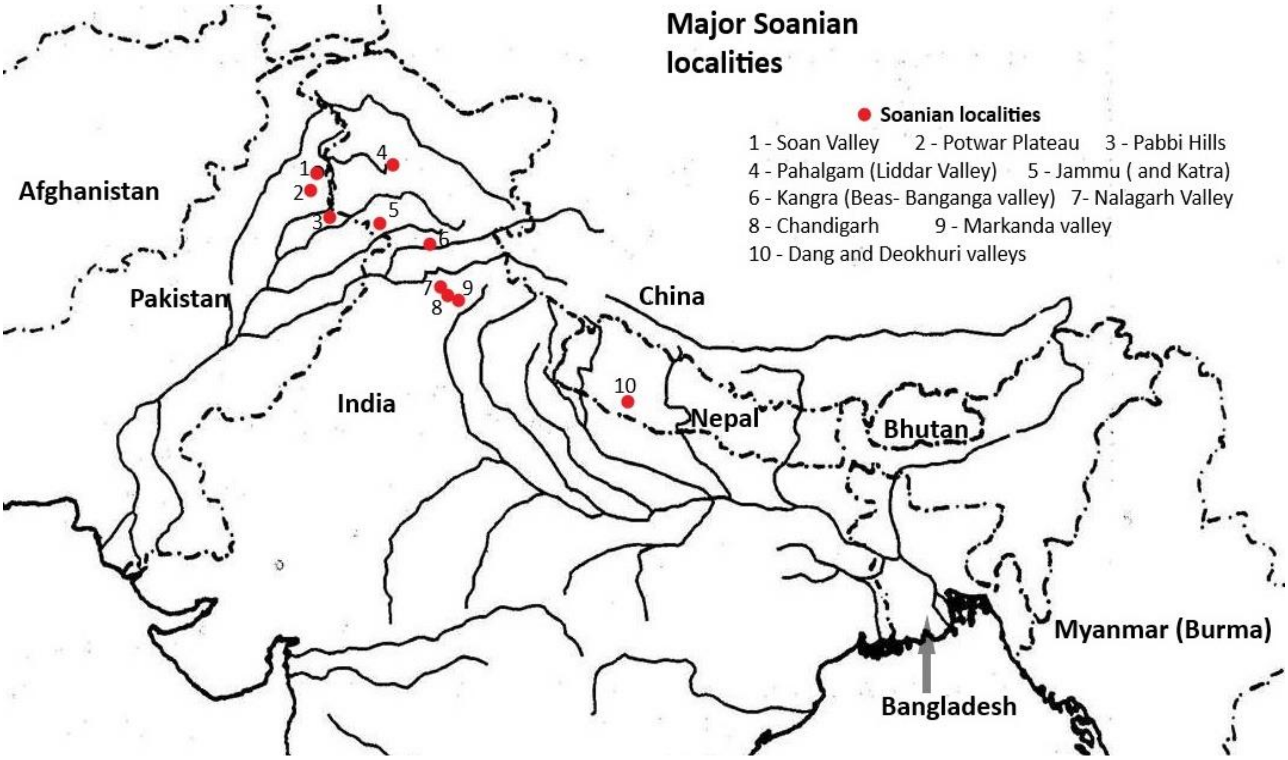
The artefacts collected by us from the field surveys comprise of typical Soanian evidence and covers almost all types of artefacts that have been reported even including a single instance of pitting on a cobble. Although these new sites were in the previously explored region, this has given me confidence and the necessary experience to fulfil the demands for further research in identifying sites in the unexplored areas. The variety of artefacts in the assemblage prompted us to try the experiment for the sequence behind their preparation that might have been used by early humans.

From the results of the experiment some interesting results were obtained which warrant a proper controlled study. Nevertheless, we slightly updated modified an earlier published flowchart (based on work by C. Gaillard, see fig. 23) to accommodate the current results in it to better suggest the modifications. Since this experiment did not deal with greater scope and due to time constraints, we had relaxed some of the controls. Though I must stress that an independent experimental analysis of Soanian lithics should be done with more participants of various degrees of expertise, a standard procedure for everyone and a tight control on other factors which can affect the process of knapping. This might give us better results regarding the reduction sequences and anomalies across the spectrum and help us to better understand the current and future Soanian assemblages from the field.

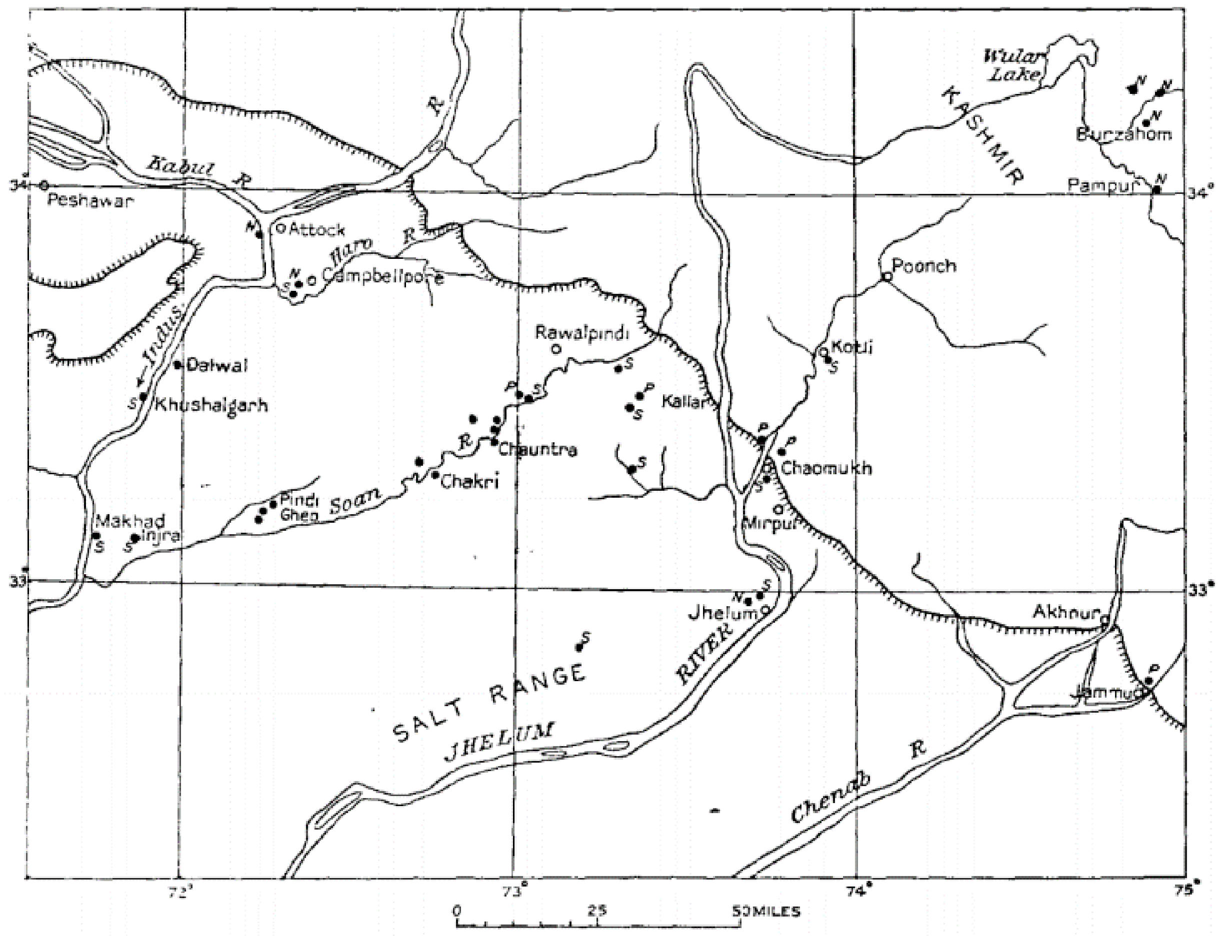
Appendix 1: Maps



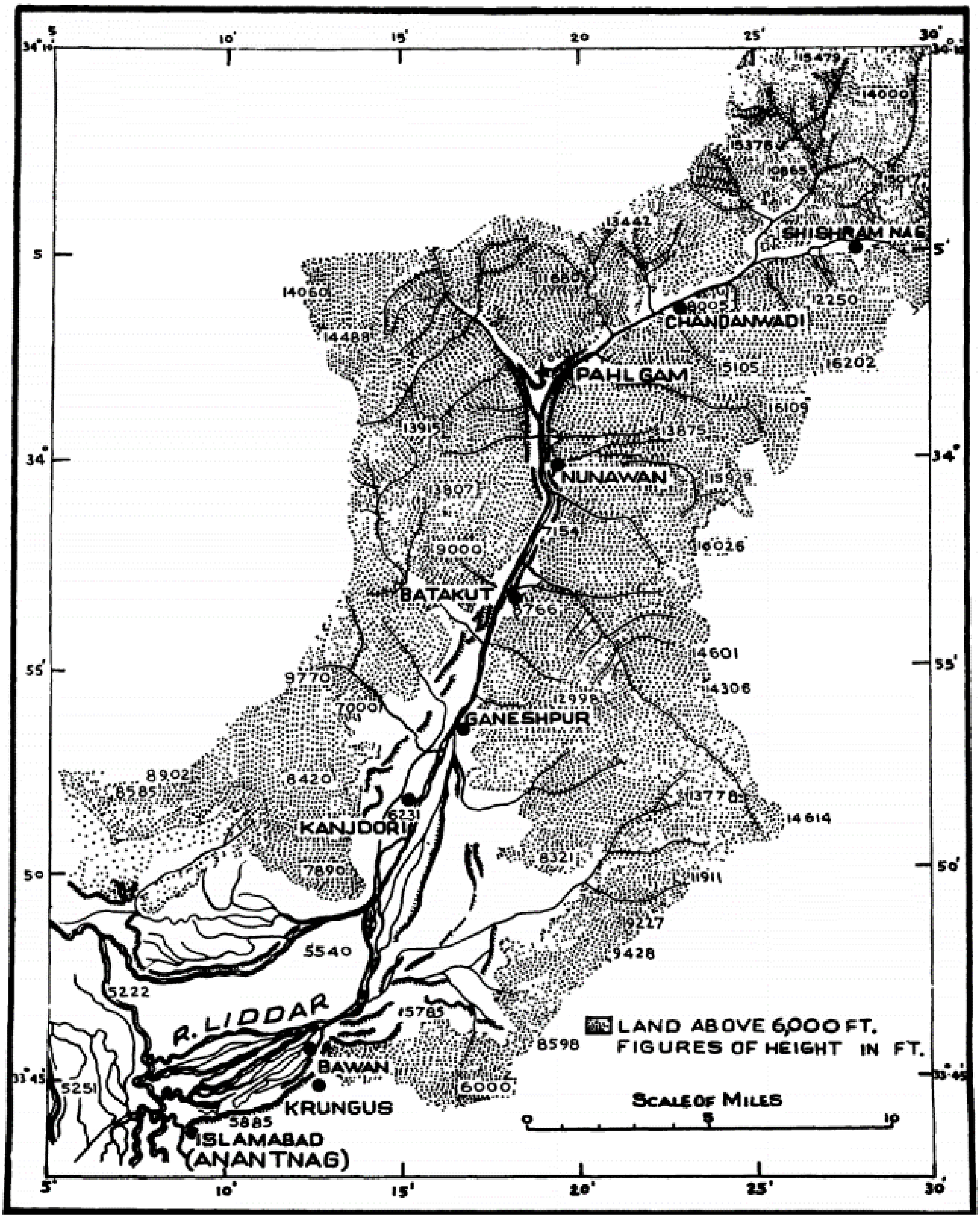
1 Map of Siwalik Hills (Source: Lycett, 2007)



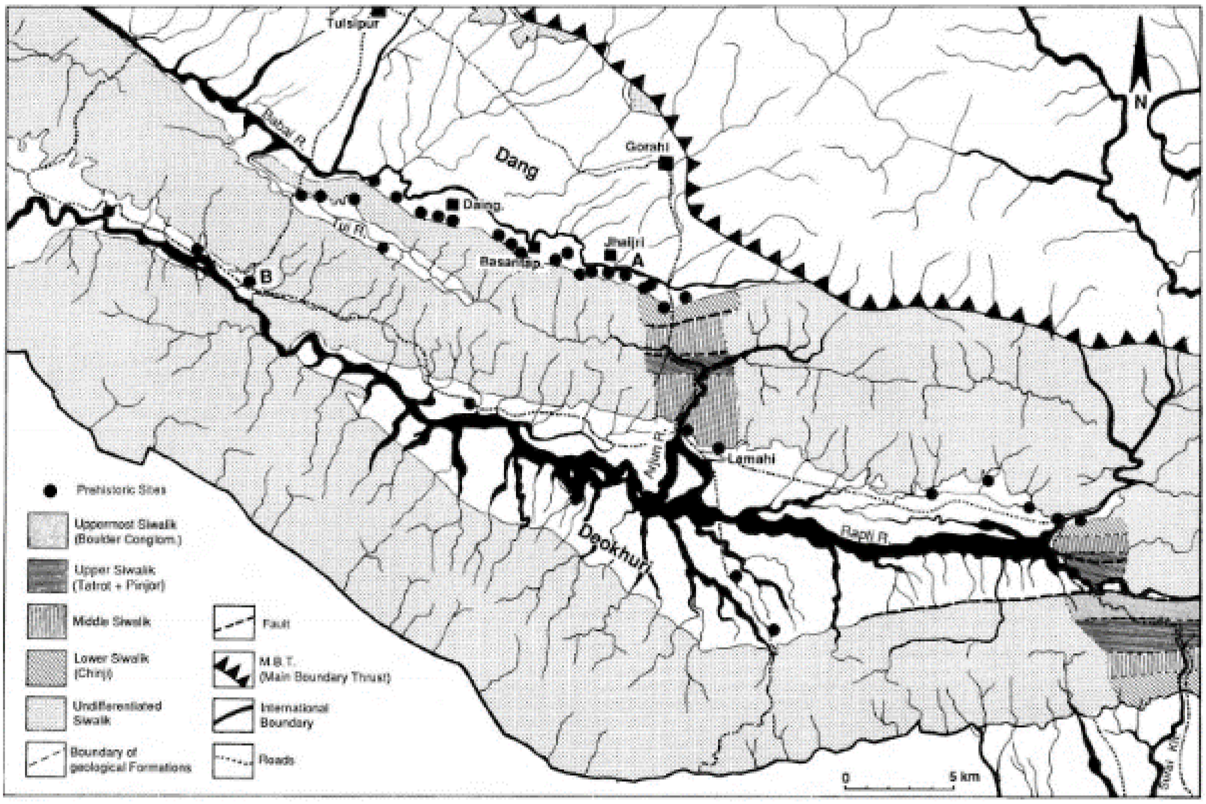
2 Map of Major Soanian Localities



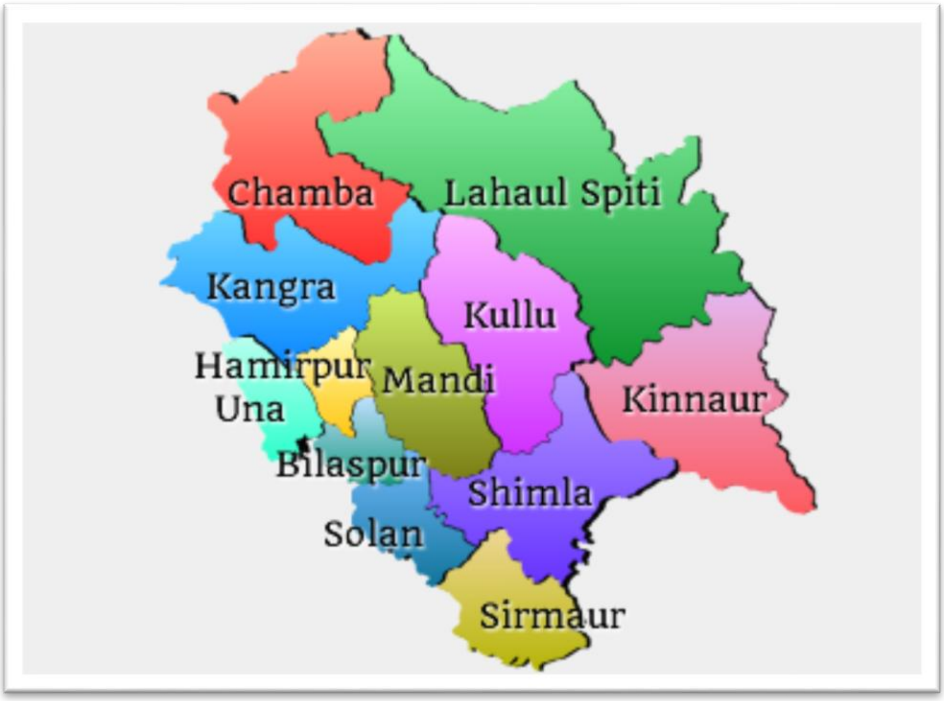
3 Map of Soan-valley sites in modern Pakistan (Source: De Terra and Paterson, 1939)



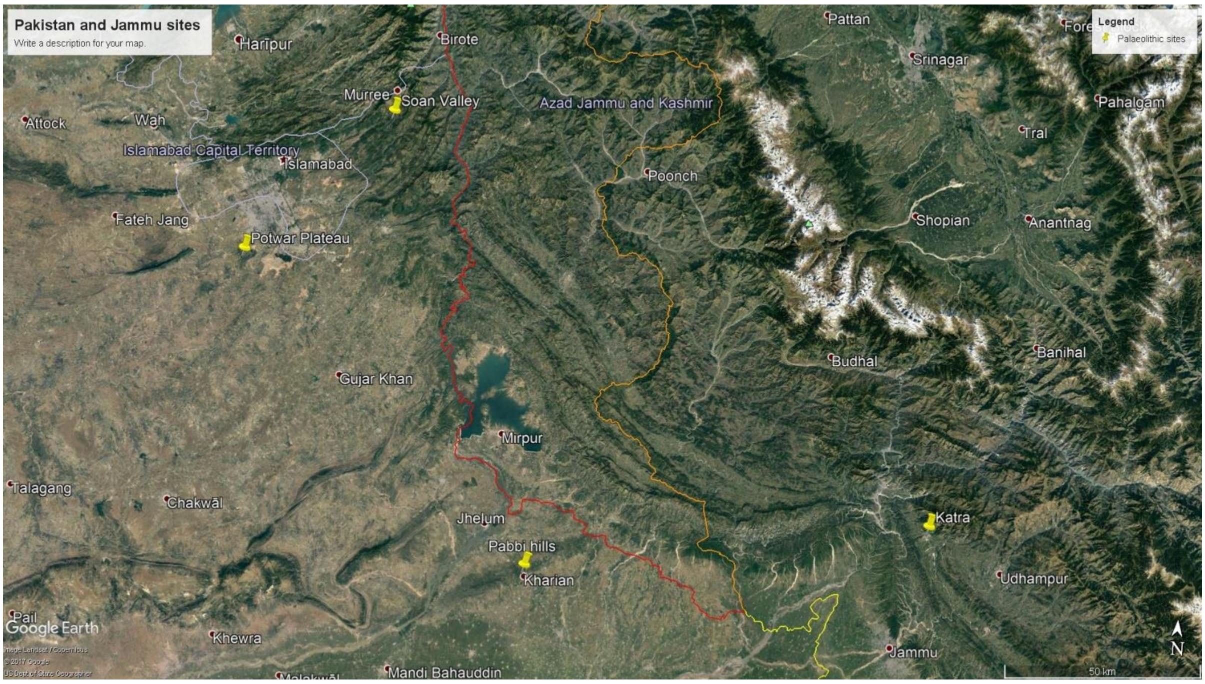
4 Map of sites in Liddar valley, Jammu and Kashmir (Source: Sankalia, 1971)



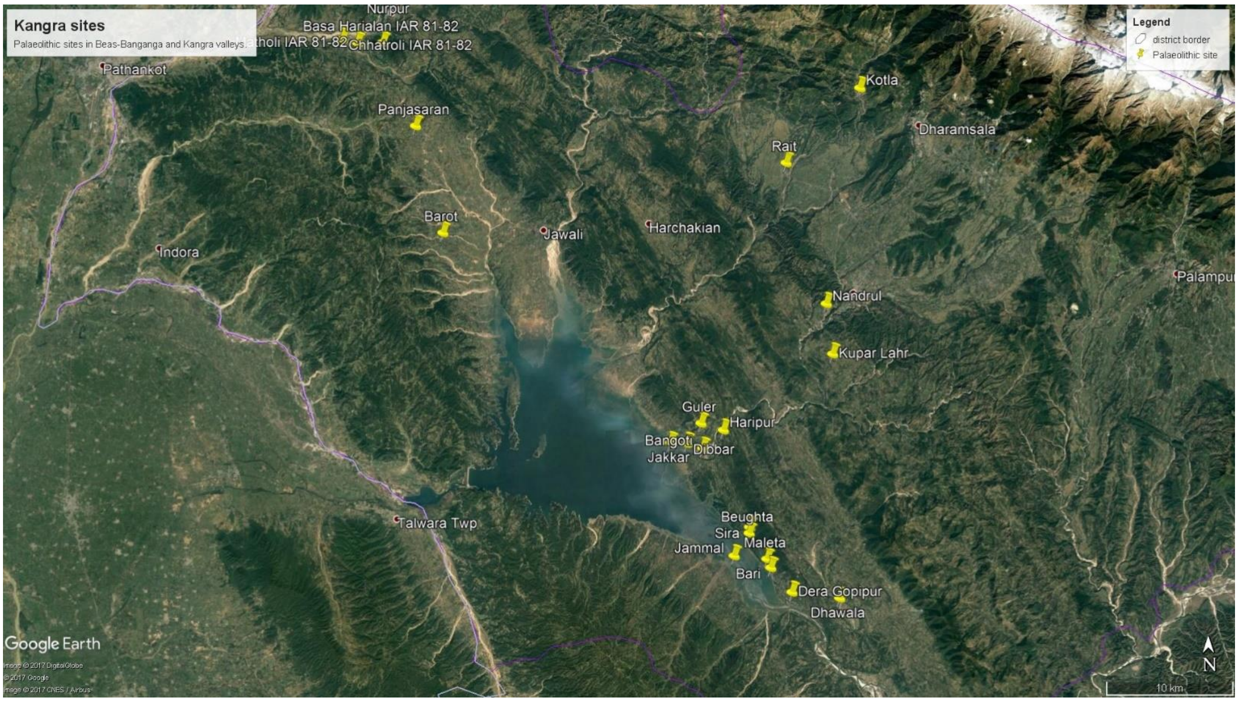
5 Map of sites in Dang and Deokhuri valleys in Nepal (Source: Corvinus, 1991)



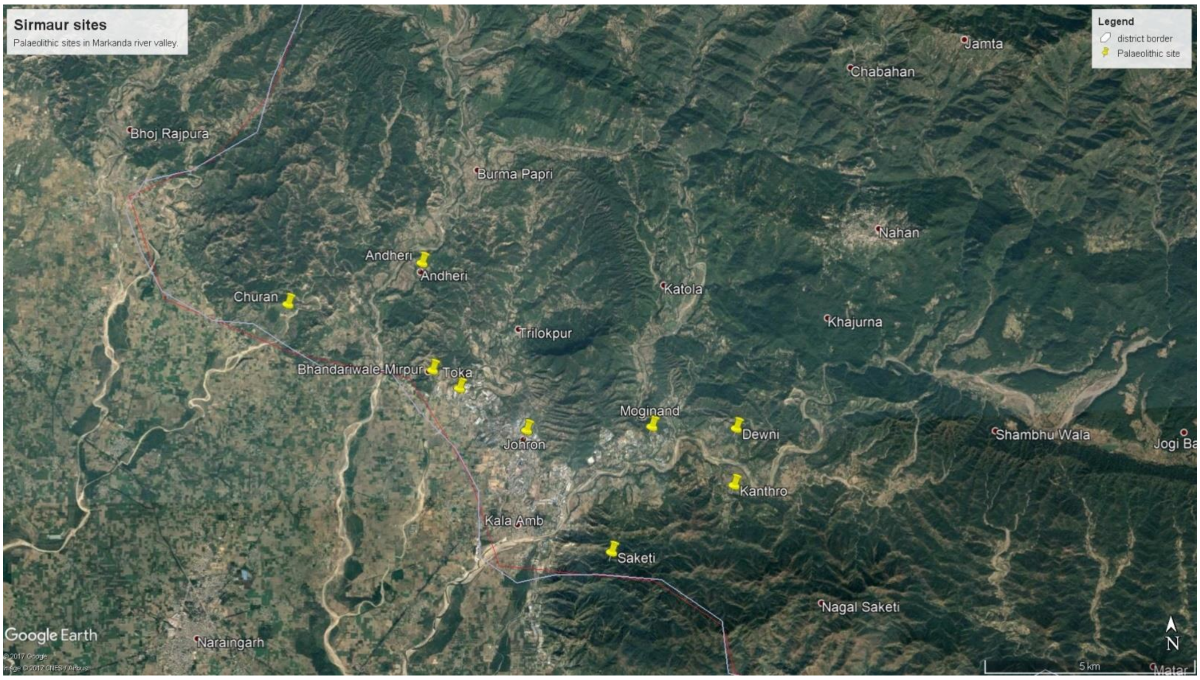
6 Map of Himachal Pradesh showing Project area - Sirmaur District



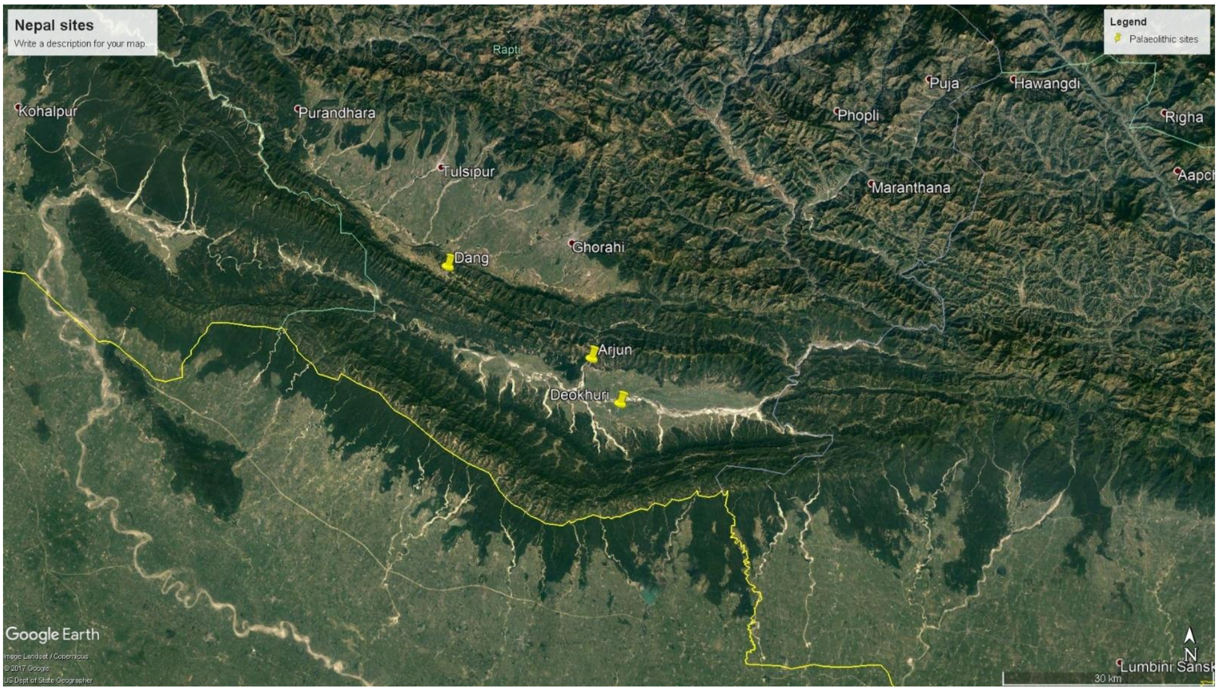
7 Map showing major Soanian sites in North Pakistan and Jammu and Kashmir, India



8 Map showing major Soanian sites in Kangra District, Himachal Pradesh, India



9 Map showing major Soanian sites in Sirmaur District, Himachal Pradesh, India

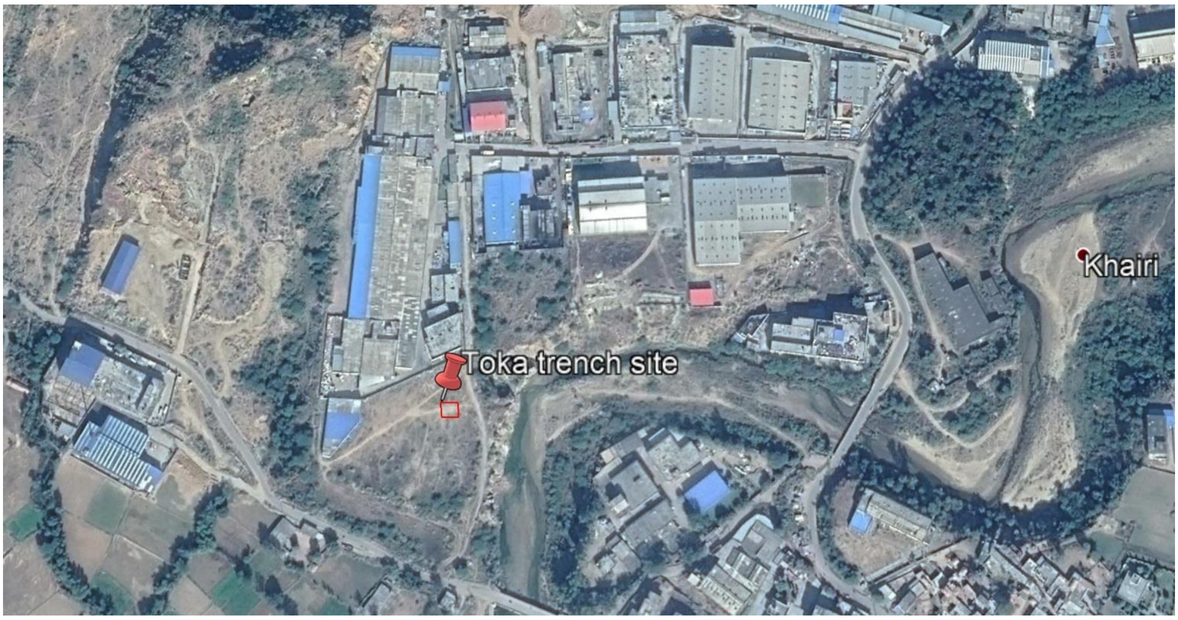


10 Map showing major Soanian sites in Nepal

Appendix 2: Figures and photographs

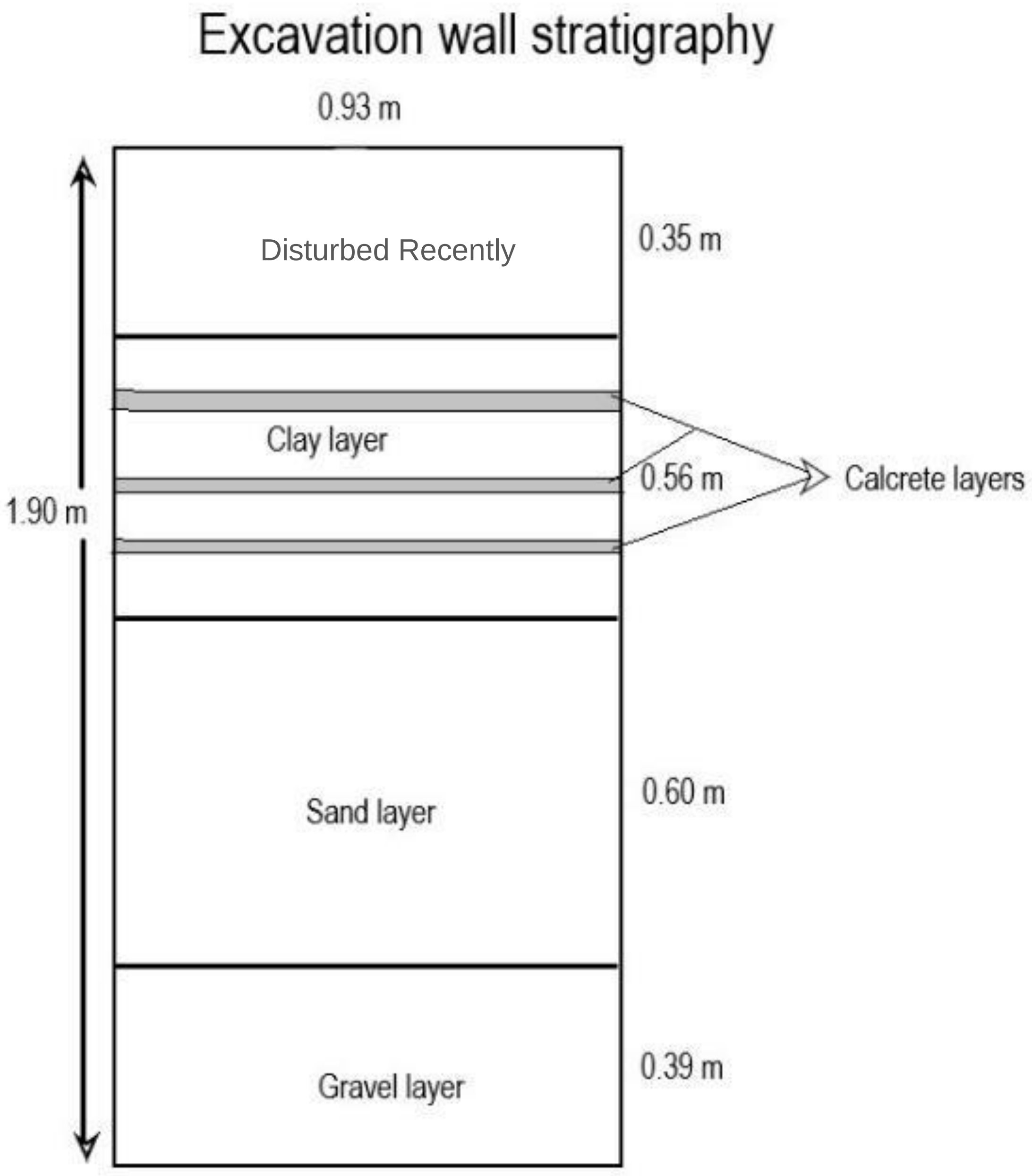
Excavation

1 Map showing Toka trench site



2 The 2X2 sq. m Trench, each section is 2X1 sq. m

3 Stratigraphy of the excavated section



4 The excavated section showing multiple sediment layers

5 Scraping the section wall

6 The trench after scraping

7 East wall of the trench showing cavities after calcrete collection

8 West wall after collection of geomorphological sediment samples

9 East wall showing OSL sample collection

10 Close up view of OSL sample collection

Quantitative and Qualitative analysis of the surface collection

11 UM 3: A bifacial side-chopper

12 DNI 2: A Toth type-I flake

13 S2 7: A discoidal core

14 S2 3: A pitted split cobble

15 S3 7: A unifacial end-scraper on a flake

16 S3 3: A core scraper

17 UM 22: A backed knife-like flake

Experimental Analysis

18 A used hammer stone showing pitting marks and a sample hammer stone

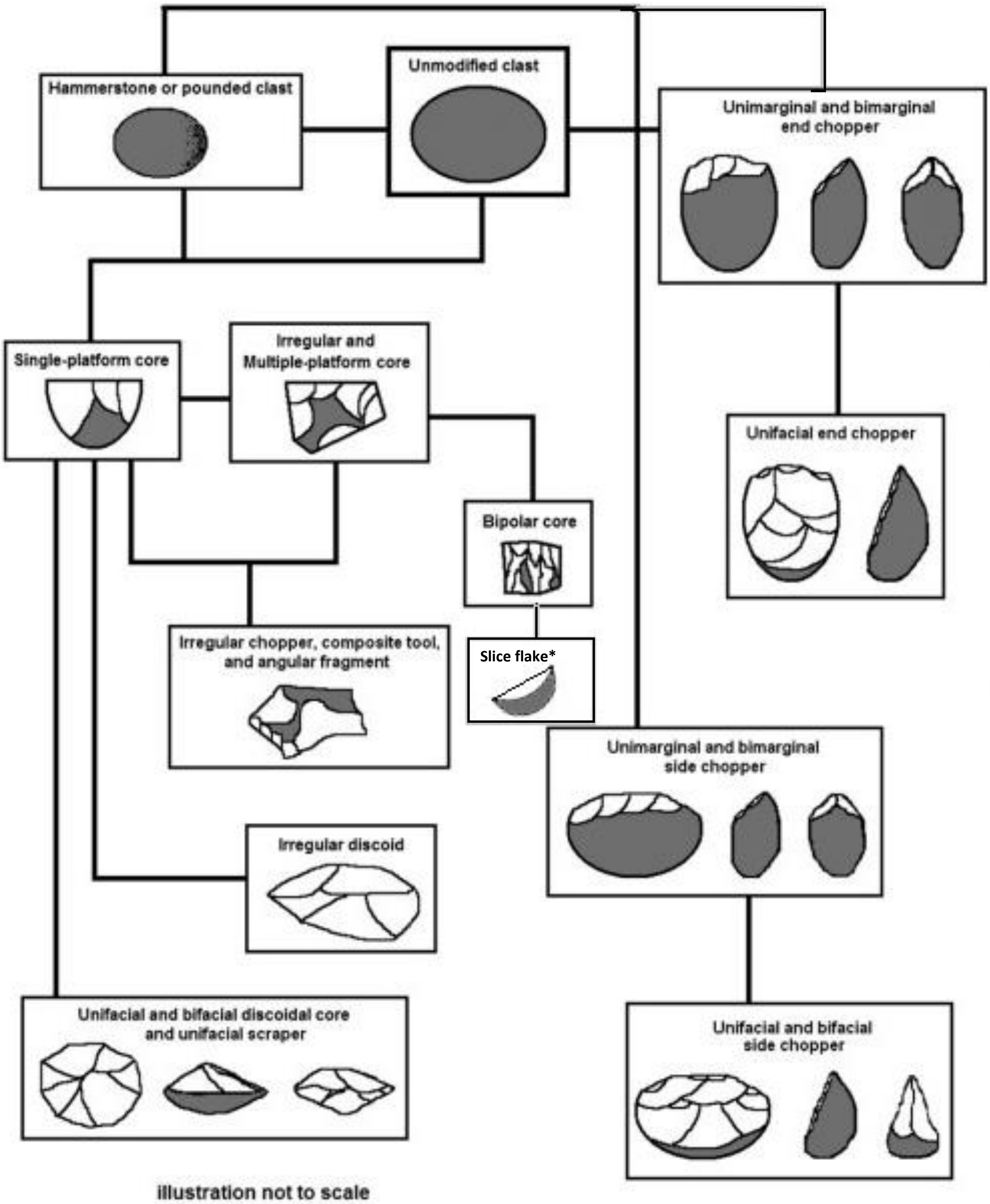
19 SC 56: A unifacial side chopper

20 SC 74: Split cobble using bipolar technique

21 SC 43: 2 Unifacial end-choppers from single clast

22 SC 42: A centripetally flaked core (unsuccesful discoid)

23 Modified flowchart for reduction sequence observed



*Generally observed during bipolar technique instead of the hard hammer direct percussion.

Appendix 3: Tables and graphs

1 Table of reported Soanian sites

Site	Location	Geographical context	Sedimentary context	Age	No. of Artefacts reported	Reported by
1) Pindi gheb	Northern Pakistan	Soan Valley	Erosional terraces covered by loess deposits	N.A.	115	Lt. K. R. U. Todd, 1930
2) Chauntra				N.A.	N.A.	Hawkes and Terra, 1934
3) Dalwal				N.A.	N.A.	Terra and Paterson, 1939
4) Khushalgarh				N.A.	N.A.	
5) Makhad				N.A.	N.A.	
6) Injra				N.A.	N.A.	
7) Gariala				N.A.	N.A.	
8) Chaomukh				N.A.	N.A.	
9) Kallar				N.A.	N.A.	
10) Adial				N.A.	N.A.	
11) Malakpur				N.A.	N.A.	
12) Guler	Kangra, Himachal	Beas - Banganga valley	Fluvial Terraces	N.A.	2	Pande, 1968

	Pradesh, India					
13) Islamabad (Anantnag)	Jammu and Kashmir, India	Liddar and Sind Valley - Himalayas	Fluvial Terraces	0.2 - 0.7 myr (Joshi,1974)	12	Sankalia, 1971
14) Kanjdori					N.A.	
15) Ganeshpur					N.A.	
16) Batakut					N.A.	
17) Nunawan					N.A.	
18) Chandanwadi					N.A.	
19) Shishram Nag					N.A.	
20) Pahalgam					N.A.	
21) Ghila Kalan	Northern Pakistan	Soan valley	Erosional terraces covered by loess deposits	N.A.	216	Johnson, 1972
22) Pahalgam	Jammu and Kashmir, India	Liddar and Sind Valley – Himalayas	Fluvial Terraces	0.2 - 0.7 myr (Joshi,1974)	10	Joshi, 1974
23) Jammu (16 sites)	Jammu and	Chenab and Ravi Valleys	Fluvial Terraces	0.2 - 0.7 myr (Joshi,1974)	900	Saroj, 1974

	Kashmir, India					
24) Nandrul	Kangra, Himachal Pradesh, India	Beas - Banganga valley	Fluvial Terraces	0.2 - 0.7 myr (Joshi,1974)	N.A.	Mohapatra, 1966; Sankalia, 1974
25) Guler					N.A.	
26) Haripur					N.A.	
27) Bangoti					N.A.	
28) Dera Gopipur					100 (Mohapatra, 1966)	
29) Dhawala					N.A.	
30) Jammal					N.A.	
31) Kotla					N.A.	
32) Panjasaran					N.A.	
33) Kupar Lahr					N.A.	
34) Hatli					N.A.	
35) Rait					N.A.	
36) Saketi					N.A.	
37) Basa Harialan					N.A.	
38) Chhatroli					N.A.	
39) Matholi					N.A.	
40) Dibbar					N.A.	
41) Jakkar					N.A.	
42) Sunneta					N.A.	

43) Nadauna					N.A.	
44) Bari					N.A.	
45) Maleta					N.A.	
46) Beughta					N.A.	
47) Sirha					N.A.	
48) Barot					N.A.	
49) Kheri	Nalagarh, Himachal Pradesh, India	Siwalik foothills	Pinjore formation	N.A.	45	Verma, 1975
50) Mullanpur	SAS Nagar, Punjab, India	Siwalik foothills	Boulder Conglomerate	N.A.	150	Sharma,1976
51) Ror	Kangra, Himachal Pradesh, India	Kangra valley	Fluvial Terraces	N.A.	N.A.	Bhattacharya et al., 1981
52) Dera Gopipur	Kangra, Himachal	Beas - Banganga valley	Fluvial Terraces	N.A.	3	Bhattacharya, 1981

	Pradesh, India					
53) Tilokpur	Sirmaur, Himachal Pradesh	Markanda Valley between Markanda and Yamuna rivers	Fluvial terraces in frontal zone	N.A.	N.A.	Verma and Srivastava, 1984
54) Moginand				N.A.	N.A.	
55) Kala Amb				N.A.	N.A.	
56) Saketi				N.A.	N.A.	
57) Bikramabad				N.A.	N.A.	
58) Bheron				N.A.	N.A.	
59) Kolar				N.A.	N.A.	
60) Kodewala				N.A.	N.A.	
61) Palhori				N.A.	N.A.	
62) Majra				N.A.	N.A.	
63) Dhoka				N.A.	N.A.	
64) Garibnath				N.A.	N.A.	
65) Dadhi	Nalagarh, Himachal Pradesh, India	Sirsa Valley	Fluvial Terraces	N.A.	176 (Mohaptra and Singh, 1979), 301 (Karir, 1985)	Sen, 1955; Mohaptra and Singh, 1979; Karir, 1985
66) Palasi				N.A.	N.A.	
67) Pirthan				N.A.	N.A.	
68) Beli				N.A.	N.A.	
69) Diawar				N.A.	N.A.	

70) Malapada Choa				N.A.	N.A.	
71) Malpur				N.A.	N.A.	
72) Bhud				N.A.	N.A.	
73) Haripur				N.A.	N.A.	
74) Baddi				N.A.	N.A.	
75) Marrhanwala				N.A.	N.A.	
76) Dher Majra				N.A.	N.A.	
77) Arjun 3	Nepal	Deokhuri Dun	Fluvial terrace on Siwalik bedrock	Middle Palaeolithic	1354	Corvinus, 1985; 2002
78) Riwat	Northern Pakistan	Soan valley	Erosional terraces covered by loess deposits	1.9-2.5 myr (Johnson et al,1982; Raynolds and Johnson,1985)	23	Rendell, 1989
79) Potwar Plateau	Northern Pakistan	Potwar Plateau	Erosional terraces covered by loess deposits	N.A.	N.A.	Rendell, 1989

80) Pabbi hills	Northern Pakistan	Pabbi Hills	Erosional terraces covered by loess deposits	0.9-2.5 myr (Hurcrombe and Dennell, 1993)	600	Hurcrombe and Dennell,1993
81) Brakhuti	Nepal	Tui Valley	basal alluvium of cobble-boulder gravel below Babai formation	N.A.	N.A.	Corvinus, 1994
82) Katra	Jammu and Kashmir, India	Chenab and Tawi Valleys	Fluvial Terraces	0.2 - 0.7 myr (Joshi,1974)	50	Ganjoo et al., 1993-94
83) Gidhiniya	Nepal	Tui Valley	Fluvial terrace on Siwalik bedrock	N.A.	N.A.	Corvinus, 1995
84) Daingaon	Nepal	Tui Valley	Fluvial terrace on Siwalik bedrock	N.A.	N.A.	Corvinus, 1995
85) Chikni	Nalagarh, Himachal	Sirsa Valley	Fluvial Terraces	N.A.	N.A.	Sen, 1955; Mohaptra and

	Pradesh, India					Singh, 1979; Karir, 1997
86) Nadah	Sirmaur, Himachal Pradesh	Markanda Valley between Ghagghar and Markanda rivers	Pinjore surface	N.A.	1	Chauhan, 2005
87) Masumpura			Tatrot surface in frontal zone	N.A.	1	
88) Ganoli			plains south of Siwalik hills	N.A.	4	
89) Bhud			Tatrot surface in interior zone	N.A.	18	
90) Bhud II				N.A.	1	
91) Bhud III				N.A.	1	
92) Mandlar			Tatrot surface in frontal zone	N.A.	16	
93) Kundla				N.A.	1	
94) Churan			Post-Siwalik streambed in frontal zone	N.A.	2	
95) Bhandariwale Mirpur			Intersection of plains and frontal zone	N.A.	279	
96) Toka			Tatrot surface in frontal zone	N.A.	4106	
97) Johron				N.A.	1	

98) Bhudra			Tatrot surface in interior zone	N.A.	26	
99) Andheri			Tatrot surface near Markanda river	N.A.	4	
100) Moginand				N.A.	1	
101) Moginand II				N.A.	2	
102) Dewni				N.A.	3	
103) Dewni-Khadri				N.A.	1	
104) Dewni-Khadri II				N.A.	1	
105) Jainti Majri			Pinjore surface in frontal zone	N.A.	1	
106) Karor Uparli				N.A.	523	
107) Tandi Bara			Pinjore surface in interior zone	N.A.	1	
108) Gurha				N.A.	2	
109) Kuri				N.A.	1	
110) Saketi Fossil Park			Tatrot surface in interior zone	N.A.	1	
111) Ng-N	Punjab, India	Siwalik frontal range	Fluvial terrace	Younger than 16 kyr	76	Soni & Soni, 2007
112) Kudini					82	
113) G_R					526	
114) G_L					470	
115) Jd-6 (Jandori)					1632	

116)Piari Khad					245	
117)Masol (M1 – 12)	Punjab, India	Quranwala zone , Siwalik Frontal zone	Tatrot silts	2.6 myr	260	Malasse, 2016
118)Bara	Punjab, India	Siwalik frontal range	Fluvial terrace	Late Harapppan	N.A.	Soni & Soni, 2017
119)Dher Majra				4.8 – 11.3 kyr	N.A.	

2 Table of Acheulian sites in Siwalik Hills

S. No.	Site	Location	Geological Context	Chronology	Reported By
1.	Chauntra	North Pakistan	Erosional terraces on Siwalik formations and in post-Siwalik loess	N.A.	Terra and Paterson, 1939
2.	Ghariala				
3.	Balawal				
4.	MS163				
5.	Chak Sighu				
6.	Rawalpindi				
7.	Adiala				
8.	Chakri				
9.	Morgah		Terrace	N.A.	Pinford (?)
10.	Dina		Upper Siwalik gritstone/conglomerate	400 – 700 kyr	British Archaeological Mission to Pakistan, 1980s
11.	Jalapur				
12.	Kangar	India	Frontal slopes of Siwaliks	< 200 kyr	G. C. Mohapatra, 1970-80
13.	Jatwar				
14.	Kot				
15.	Lalwan				
16.	Sabaur				

17.	Palata				
18.	Babahar				
19.	Jhangrian				
20.	Ramanpur				
21.	Karura				
22.	Supalwan				
23.	Khanpur Kuhi				
24.	Garhi				
25.	Suna				
26.	Ghanaura				
27.	Saumundri				
28.	Aitbarapur				
29.	Tikhni				
30.	Daulatpur				
31.	Marawari				
32.	Chandikotla				
33.	Satpati	Nepal	Dun valley sediments	Late middle to early Pleistocene	G. Corvinus, 1980-90
34.	Gadari				

3 Table of Surface collections from Sirmaur surveys

Site	Artefact type	Artefact nos.
Ujjal Majri	Flakes / flake fragments	19
	Cores / core fragments	17
	Tools	4
	Pottery fragments	1
Devni	Flakes / flake fragments / flake tools	7
	Cores / core fragments	3
	Choppers / chopping tools	2
Site 1	Flakes / flake fragments	9
	Cores / core fragments	5
Site 2	Flakes / flake fragments	2
	Cores / core fragments	4
	Discoids	1
Site 3	Flakes / flake fragments	8
	Cores / core fragments	2
	Discoids	3
	Pottery fragments	12

4 Table of Metric dimensions and weight of collected specimens

Site	ID	Length (in mm)	Width (in mm)	Thickness (in mm)	Weight (in g)	Typology
Devni	DNI 1	67.92	64.3	56.38	289	Core
Devni	DNI 2	118.1	88.32	22.86	231	Flake
Devni	DNI 3	104.58	101.98	54.4	521	Core
Devni	DNI 4	126.16	75.9	52.78	455	Flake
Devni	DNI 5	102.6	84	52.34	365	Flake
Devni	DNI 6	90.74	66.78	40.08	265	Chopper
Devni	DNI 7	92.52	75.7	52.1	474	Flake
Devni	DNI 8	84.18	56.92	47.46	252	Flake
Devni	DNI 9	63.6	51.48	36.94	121	Chopper
Devni	DNI 10	64.2	62.76	36.02	212	Core
Devni	DNI 11	59.88	36.32	18	47	Flake
Devni	DNI 12	60.68	39.62	17.86	55	Flake
Site 1	S1 1	121.48	78.44	39.92	420	Flake
Site 1	S1 2	103.46	75.38	66.58	657	Core
Site 1	S1 3	103.18	92.04	49.52	541	Core
Site 1	S1 4	89.3	83.06	58.46	537	Core
Site 1	S1 5	89.48	84.08	31.74	252	Flake

Site 1	S1 6	107.18	67.6	28.4	230	Flake
Site 1	S1 7	66.02	54.44	29.5	142	Core
Site 1	S1 8	89.22	68.64	51	299	Core
Site 1	S1 9	71.18	42.08	17.1	45	Flake
Site 1	S1 10	56.72	55.44	18.32	50	Flake
Site 1	S1 11	49.86	20.18	20.52	31	Flake
Site 1	S1 12	42.24	32.7	14.88	25	Flake
Site 1	S1 13	30.92	27.16	11.2	6	Flake
Site 1	S1 14	45.52	29.32	9.56	14	Flake
Site 2	S2 1	86.94	72.1	59.88	428	Core
Site 2	S2 2	86.48	69.06	51.9	383	Core
Site 2	S2 3	84.92	50.9	24.62	122	Core
Site 2	S2 4	62	39.62	21.92	46	Flake
Site 2	S2 5	50.32	26.18	14.78	23	Flake
Site 2	S2 6	110.26	91.14	49.28	491	Core
Site 2	S2 7	115.58	94.24	40.72	540	Discoid
Site 3	S3 1	127.32	78.8	73.78	652	Core
Site 3	S3 2	93.26	81.94	58.3	511	Discoid
Site 3	S3 3	89.52	60.06	52.86	352	Core
Site 3	S3 4	93.4	70.24	35.1	238	Flake
Site 3	S3 5	96.38	55.2	34.12	208	Flake

Site 3	S3 6	73.44	72.78	27.5	192	Discoid
Site 3	S3 7	94.64	91.72	39.76	303	Flake
Site 3	S3 8	81.3	73.84	41.22	221	Discoid
Site 3	S3 9	49.58	47.7	13	30	Flake
Site 3	S3 10	77.2	43.32	19.84	62	Flake
Site 3	S3 11	50.96	45.38	13.64	34	Flake
Site 3	S3 12	46.18	32	16.3	20	Flake
Site 3	S3 13	44.2	28.26	15.74	15	Flake
Ujjal Majri	UM 1	100.18	85.6	73.2	821	Core
Ujjal Majri	UM 2	126.04	84.44	79.12	854	Core
Ujjal Majri	UM 3	132.15	90.39	60.4	758	Chopper
Ujjal Majri	UM 4	110.1	70.92	58.86	563	Chopper
Ujjal Majri	UM 5	96	90.32	34.72	445	Core
Ujjal Majri	UM 6	121.28	93.76	61.32	769	Core
Ujjal Majri	UM 7	100.1	72.06	50.92	378	Core
Ujjal Majri	UM 8	92.22	75.6	57.54	534	Core
Ujjal Majri	UM 9	95.72	81.08	51.18	457	Chopper
Ujjal Majri	UM 10	99.16	72.58	48.78	432	Chopper
Ujjal Majri	UM 11	88.4	63.84	62.26	319	Core
Ujjal Majri	UM 12	96.56	66.76	41.52	223	Flake
Ujjal Majri	UM 13	72.72	64.32	50.24	294	Core

Ujjal Majri	UM 14	93.38	73.26	43.76	292	Flake
Ujjal Majri	UM 15	96.12	77.52	28.3	197	Flake
Ujjal Majri	UM 16	82	65.66	60.8	330	Core
Ujjal Majri	UM 17	74.58	57.32	38.1	99	Flake
Ujjal Majri	UM 18	75.82	60.64	26.52	134	Flake
Ujjal Majri	UM 19	68.24	65.22	39.08	155	Core
Ujjal Majri	UM 20	92.42	53.94	39.86	202	Flake
Ujjal Majri	UM 21	67	51.16	47.46	130	Core
Ujjal Majri	UM 22	89.52	40.86	24.24	65	Flake
Ujjal Majri	UM 23	60.96	44.32	27.2	105	Flake
Ujjal Majri	UM 24	58.04	57.58	24.76	114	Flake
Ujjal Majri	UM 25	83.78	58.72	39.9	227	Core
Ujjal Majri	UM 26	71.42	43.24	43.4	144	Core
Ujjal Majri	UM 27	73.94	40.46	17.96	51	Flake
Ujjal Majri	UM 28	55.82	34.06	18.74	31	Flake
Ujjal Majri	UM 29	38.04	26.58	7.96	14	Flake
Ujjal Majri	UM 30	53	28.66	12.64	21	Flake
Ujjal Majri	UM 31	60.3	49.34	18.38	41	Flake
Ujjal Majri	UM 32	53.94	39.12	15.16	38	Flake
Ujjal Majri	UM 33	33.3	28.98	22.08	26	Core
Ujjal Majri	UM 34	52.02	44.8	27.34	54	Flake

Ujjal Majri	UM 35	41.9	39.64	17.82	28	Flake
Ujjal Majri	UM 36	56.98	47.56	28.84	96	Flake
Ujjal Majri	UM 37	42.06	33.14	21.58	35	Flake
Ujjal Majri	UM 38	65.74	59.26	51.18	186	Core
Ujjal Majri	UM 39	57.5	43.84	31.76	114	Core
Ujjal Majri	UM 40	106.12	53.08	50.48	395	Core

5 Table of Analytical attributes for all artefacts and associated codes

Colour			Sub types	
1	Tan		1	Borer
2	Burgundy		2	Single-sided scraper on flake
3	Black		3	Double sided scraper on flake
4	Gray		4	Convergent scraper on flake
5	White		5	Core scraper
6	Brown		6	Atypical Levallois
7	Purple		7	Core
			8	Pick
Hammerstones			9	Misc scraper
1	End hammerstones		10	Burin
2	Side hammerstones		11	Debitage/chunk
3	Miscellaneous utilized pieces		12	Non-artefact
			13	Indeterminate
Cores			14	Bipolar flake
4	Single-platform cores			
5	Multiple platform cores			
6	Irregular core		**Morphology**	
7	Levallois core		I	Blade or bladish

8	Bipolar core		II	Sub-spheroid
			III	Elliptical
Discoids			IV	Fan- Shaped
9	Discoidal core		V	C/D shaped
10	Unifacial discoidal scraper		VI	Amorphous
11	Bifacial discoidal core		VII	Squarish
12	Bifacial discoidal scraper		VIII	Triangular
13	Atypical Discoid		IX	Roundish
			X	Completely Angular
Choppers			XI	Pointed
14	Unimarginal End chopper		XII	Elongated
15	Unimarginal Side chopper		XIII	Discoidal
16	Bimarginal End chopper		XIV	Almond shaped
17	Bimarginal Side chopper			
18	Unifacial End chopper			
19	Unifacial Side chopper		**Qualities**	
20	Bifacial End chopper		P	Pitting
21	Bifacial Side chopper		S	Split cobble
22	Irregular chopper		B	Both
Flakes				
23	Toth type I		**Completeness**	

24	Toth type II		0	Whole
25	Toth type III		1	Siret (regular snap)
26	Toth type IV		2	Irregular break/snap
27	Toth type V		**Type of flaking**	
28	Toth type VI		0	Not applicable
29	Irregular flake		1	Sequential
			2	Step
			3	Both present
Degree of Retouch	0(no retouch) – 3(heavy retouch)		**Condition**	
Edge damage	0(no damage) – 3(severe damage)		1	Fresh
Edge wear	0(no wear) – 3(heavy wear or blunt)		2	Rolled
Patination	0(no patina) – 2(complete patina)		3	Weathered

6 Table of Qualitative analysis of surface lithic collection

ID	Colour	Morphology	Type	Subtype	Material	Qualities	Completeness	Flaking	Retouch	Edge Damage	Edge wear	Patination	Condition
DNI 1	6	X	5	7	Quartzite	NA	0	3	0	0	1	2	2
DNI 2	6	IX	23	2	Quartzite	NA	0	0	0	1	1	2	1
DNI 3	6	IV	6	7	Quartzite	NA	0	1	0	0	0	2	1
DNI 4	1	III	23	-	Quartzite	NA	0	0	0	0	1	1	1
DNI 5	6	VIII	23	2	Quartzite	NA	0	1	0	0	0	2	1
DNI 6	6	VI	19	-	Quartzite	NA	0	2	1	2	2	2	1
DNI 7	1	V	23	-	Quartzite	S	1	0	0	0	0	1	2
DNI 8	6	XII	26	-	Quartzite	NA	0	1	0	0	0	2	1
DNI 9	6	IX	14	-	Quartzite	NA	0	1	0	0	0	2	1
DNI 10	6	V	8	7	Quartzite	NA	0	1	0	0	0	2	1
DNI 11	6	V	23	11	Quartzite	S	2	0	0	0	0	1	1
DNI 12	6	XI	25	11	Quartzite	S	1	0	0	0	2	2	1
S1 1	6	XIV	23	2	Quartzite	S	1	1	0	0	0	2	1
S1 2	6	IX	6	7	Quartzite	NA	0	3	0	0	0	2	1
S1 3	6	XII	5	-	Quartzite	NA	0	2	0	0	0	2	1
S1 4	1	X	5	2	Quartzite	NA	0	3	0	0	0	1	1
S1 5	6	IX	23	2	Quartzite	NA	0	0	1	1	1	2	1

S1 6	6	XII	26	3	Quartzite	NA	0	1	0	0	2	2	2
S1 7	1	X	5	5	Quartzite	NA	0	1	0	1	1	2	1
S1 8	6	V	5	-	Quartzite	S	1	1	0	0	0	2	1
S1 9	6	V	23	14	Quartzite	NA	0	0	0	0	0	2	1
S1 10	6	IV	27	-	Quartzite	NA	0	0	0	0	0	2	1
S1 11	6	XII	26	11	Quartzite	NA	0	1	0	0	0	2	1
S1 12	1	VII	25	11	Quartzite	NA	0	0	0	0	0	2	1
S1 13	6	VIII	25	11	Quartzite	NA	0	0	0	0	0	2	1
S1 14	6	III	28	11	Quartzite	NA	0	0	0	0	1	0	2
S2 1	1	V	5	7	Quartzite	NA	0	3	0	0	0	2	1
S2 2	2	III	4	7	Quartzite	NA	0	2	0	0	0	1	1
S2 3	2	XII	8	7	Quartzite	B	1	1	0	0	0	2	1
S2 4	6	VIII	23	-	Quartzite	NA	0	0	0	0	0	1	1
S2 5	1	XII	25	-	Quartzite	NA	0	0		0	0	2	1
S2 6	6	XIII	4	7	Quartzite	NA	0	3	1	0	1	2	1
S2 7	6	XIII	10	-	Quartzite	NA	0	3	0	1	1	2	1
S3 1	1	VIII	6	2	Quartzite	S	1	3	0	0	0	2	1
S3 2	1	XIII	9	2	Quartzite	NA	0	3	0	2	1	1	1
S3 3	6	VI	5	5	Quartzite	NA	0	1	0	0	0	2	1
S3 4	6	III	24	-	Quartzite	NA	0	1	0	0	0	2	1
S3 5	6	VIII	24	-	Quartzite	NA	0	1	0	0	0	2	1

S3 6	6	XIII	13	7	Quartzite	NA	0	1	0	0	0	2	1
S3 7	1	VIII	23	2	Quartzite	NA	0	1	0	1	0	2	1
S3 8	2	XIII	9	7	Quartzite	NA	0	3	0	1	1	2	1
S3 9	5	VII	25	-	Quartzite	NA	0	0	0	0	0	2	1
S3 10	6	V	23	14	Quartzite	NA	0	0	0	0	0	2	1
S3 11	6	VII	28	-	Quartzite	NA	0	0	0	0	0	0	1
S3 12	6	XI	25	11	Quartzite	NA	0	0	0	0	0	2	1
S3 13	4	XII	26	12	Quartzite	S	1	0	0	0	0	2	1
UM 1	6	V	5	2	Quartzite	NA	0	1	0	0	0	2	1
UM 2	6	VII	4	7	Quartzite	S	1	1	0	0	0	2	1
UM 3	6	XIV	21	-	Quartzite	NA	0	1	0	0	1	2	1
UM 4	2	XII	14	-	Quartzite	S	1	1	0	0	1	2	1
UM 5	6	VII	4	7	Quartzite	S	2	3	0	0	1	1	1
UM 6	1	XII	4	7	Quartzite	NA	0	1	0	0	2	2	2
UM 7	6	VIII	5	7	Quartzite	S	1	1	0	0	0	2	1
UM 8	6	XII	4	7	Quartzite	NA	0	0	0	0	1	2	1
UM 9	1	XII	18	-	Quartzite	NA	0	2	1	0	1	2	1
UM 10	6	III	14	-	Quartzite	S	1	0	0	0	0	2	1
UM 11	1	VII	4	7	Quartzite	NA	0	2	0	0	0	2	1
UM 12	6	III	23	-	Quartzite	NA	0	1	0	0	0	2	1
UM 13	6	X	8	7	Quartzite	S	0	1	0	0	1	2	1

UM 14	6	VIII	27	-	Quartzite	NA	0	0	0	0	0	2	1
UM 15	6	XI	26	-	Quartzite	NA	0	1	0	0	0	2	1
UM 16	4	III	6	7	Quartzite	NA	0	3	0	0	1	2	1
UM 17	4	VIII	23	12	Quartzite	S	1	0	0	0	0	1	1
UM 18	2	IX	23	-	Quartzite	S	1	0	0	1	1	2	1
UM 19	4	X	4	7	Quartzite	NA	0	1	0	0	0	2	1
UM 20	6	X1	23	14	Quartzite	S	1	0	0	0	0	2	1
UM 21	6	VIII	4	7	Quartzite	S	2	2	0	0	0	2	1
UM 22	6	V	23	14	Quartzite	NA	0	0	0	0	0	2	1
UM 23	6	XIV	25	-	Quartzite	S	2	0	0	0	0	2	1
UM 24	6	V	23	-	Quartzite	S	1	0	0	0	0	2	1
UM 25	6	XII	4	7	Quartzite	NA	0	2	0	1	0	2	1
UM 26	2	V	4	7	Quartzite	NA	0	2	0	0	0	1	1
UM 27	4	XII	26	11	Quartzite	NA	0	0	0	0	0	1	1
UM 28	6	V	23	14	Quartzite	NA	0	0	0	0	0	2	1
UM 29	6	VII	25	11	Quartzite	NA	0	0	0	0	0	2	1
UM 30	1	V	23	14	Quartzite	S	1	0	0	0	0	2	1
UM 31	5	VII	28	11	Quartzite	NA	0	0	0	0	0	0	1
UM 32	1	VII	25	11	Sandstone	NA	0	0	0	0	1	2	1
UM 33	6	VII	4	-	Quartzite	S	2	0	0	0	0	2	1
UM 34	5	VII	28	11	Quartzite	NA	0	0	0	1	0	0	1

UM 35	1	IX	26	11	Quartzite	NA	0	0	0	0	0	1	1
UM 36	3	IX	23	12	Quartzite	S	1	0	0	0	0	0	1
UM 37	3	VII	26	12	Quartzite	NA	0	0	0	0	0	2	1
UM 38	1	V	8	7	Quartzite	NA	0	1	0	0	0	1	1
UM 39	4	III	4	7	Quartzite	NA	0	1	0	0	0	2	1
UM 40	1	V	8	7	Quartzite	S	0	1	0	0	0	1	1

7 Table of Statistics of measurements for each site

Mean and standard deviation	**Length (in mm)**	**Width (in mm)**	**Thickness (in mm)**	**Weight (in g)**
Mean (all sites)	79.64	60.10	37.13	250.90
Standard Deviation (all sites)	24.61	20.18	17.39	216.05
Mean (Devni)	86.26	67.01	40.60	273.92
Standard Deviation (Devni)	23.27	19.50	14.40	157.09
Mean (Site 1)	76.12	57.90	31.91	232.07
Standard Deviation (Site 1)	28.21	24.03	18.43	226.58
Mean (Site 2)	85.21	63.32	37.59	290.43
Standard Deviation (Site 2)	23.49	25.61	17.23	219.72
Mean (Site 3)	78.26	60.10	33.93	218.31
Standard Deviation (Site 3)	24.79	19.91	19.06	198.86
Mean (Ujjal Majri)	78.36	58.24	38.88	254.28
Standard Deviation (Ujjal Majri)	24.55	18.51	17.61	239.03
Maximum and minimum				
Data total Maximum	132.15	101.98	79.12	854
Data total Minimum	30.92	20.18	7.96	6
Devni maximum	126.16	101.98	56.38	521

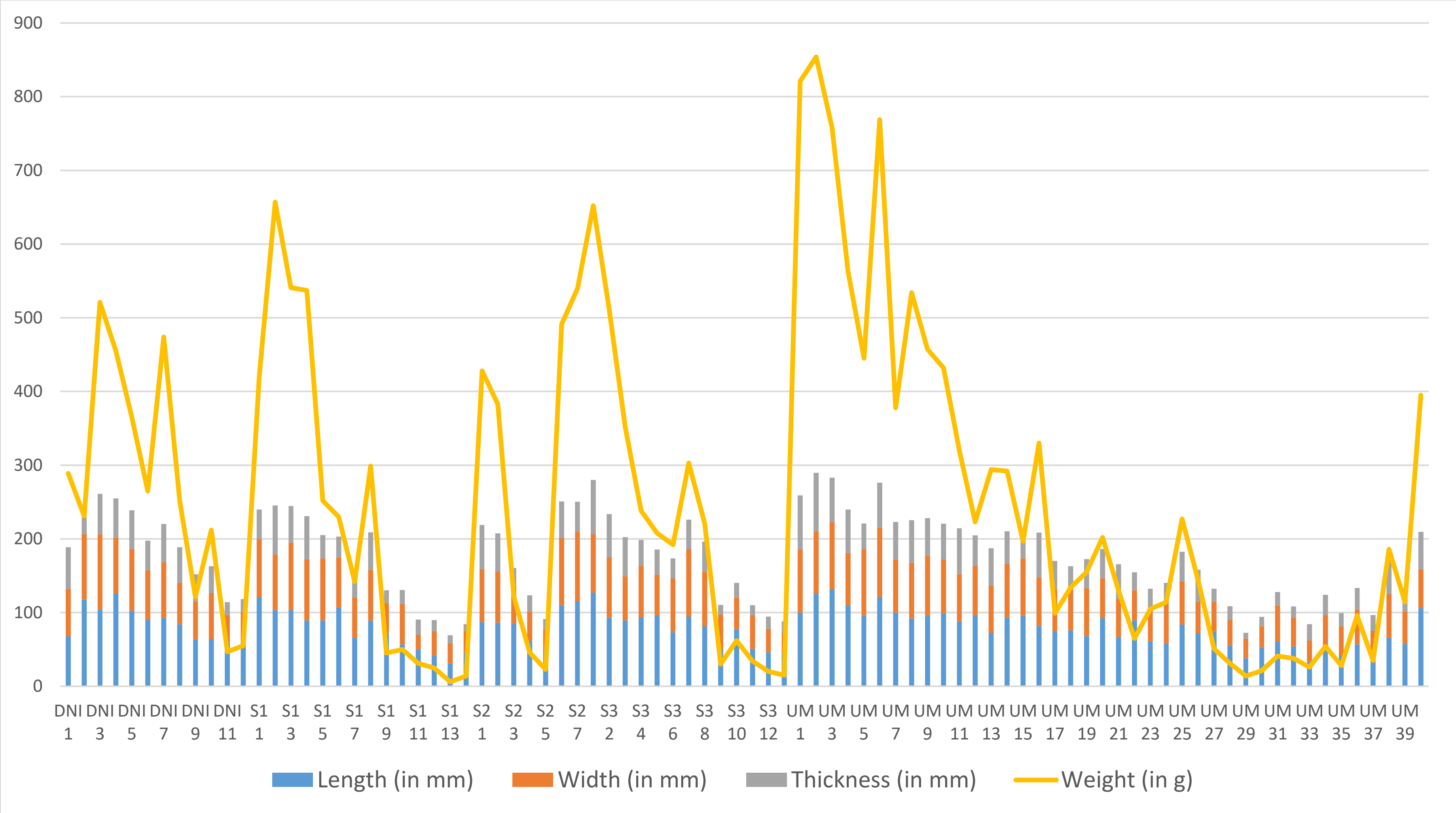
Devni minimum	59.88	36.32	17.86	47
Site 1 maximum	121.48	92.04	66.58	657
Site1 minimum	30.92	20.18	9.56	6
Site 2 maximum	115.58	94.24	59.88	540
Site 2 minimum	50.32	26.18	14.78	23
Site 3 maximum	127.32	91.72	73.78	652
Site 3 minimum	44.2	28.26	13	15
Ujjal Majri maximum	132.15	93.76	79.12	854
Ujjal Majri minimum	33.3	26.58	7.96	14

8 Table of Experimental lithic analysis

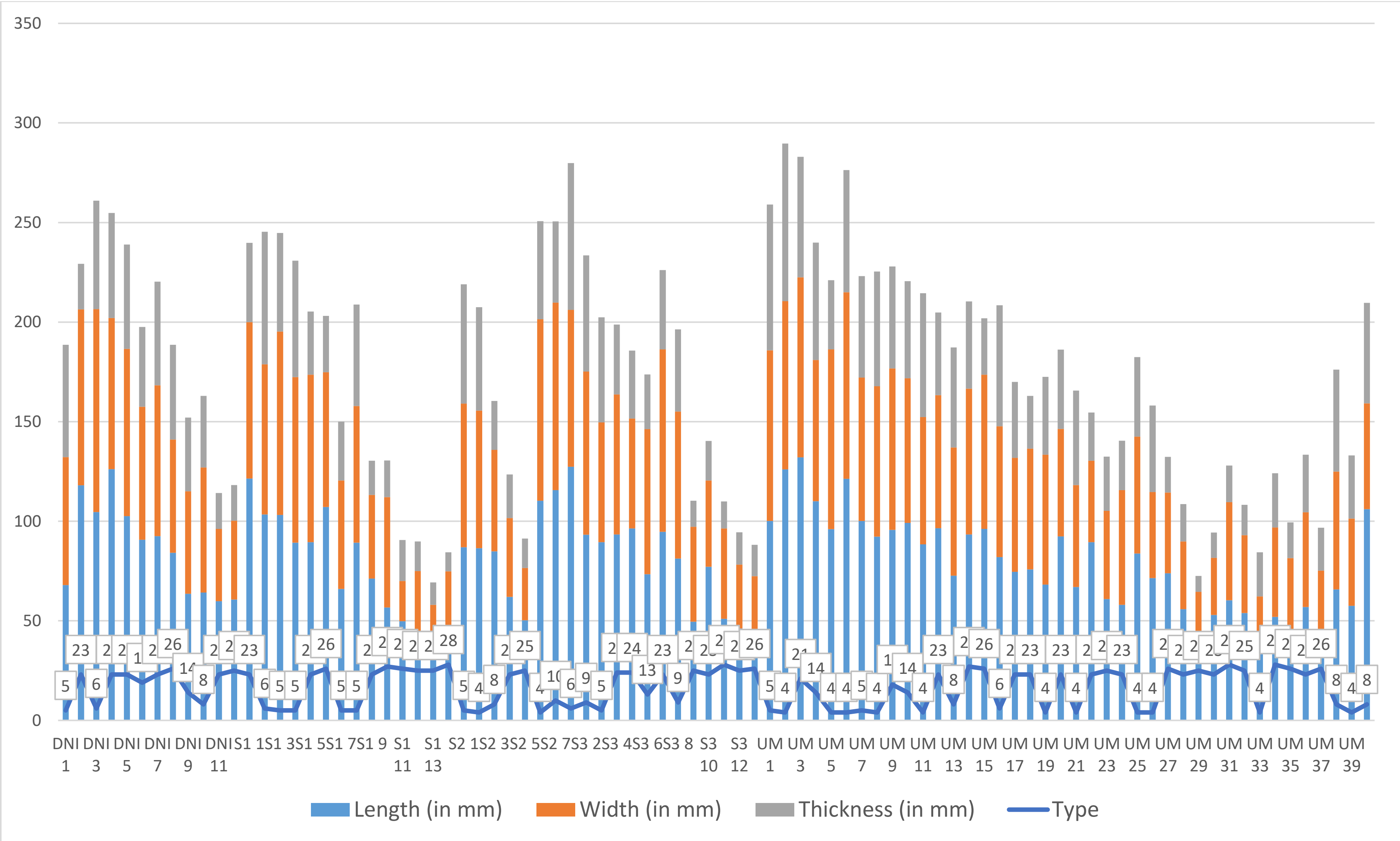
ID	Weight before knapping (in g)	Total Weight after knapping (in g)	Weight lost (in g)	% weight lost	Weight of artefact(s) (in g)	Artefact(s) made	Material quality (1 – coarsest 5 – finest)	Notes
SC 26	2010	1992	18	0.90	1614	Bifacial unimarginal side chopper (unsuccessful)	4	Was in use as hammer stone before the experiment began
SC 39	954	949	5	0.52	641	Bifacial unimarginal side chopper	3	Powdery material resulting in unusable edge
SC 41	1127	1104	23	2.04	501 core), 46(scraper), 25 (backed knife), 22 (point)	Core, flake scraper, backed knife, point (without notches)	3	Was in use as hammer stone before the experiment began
SC 42	1041	1039	2	0.19	706	Discoid core (unsuccessful)	3	

SC 43	1236	1231	5	0.40	459 (pointed), 448	2 Unifacial Unimarginal End choppers	4	Was in use as a hammer stone during the experiment and had split down the middle
SC 56	669	661	8	1.20	569	Unifacial unimarginal side chopper	3	Miniscule natural pits
SC 57	479	474	5	1.04	85	Exhausted core	2	
SC 58	585	579	6	1.03	143	Exhausted core	3	Banded material, lots of internal fractures
SC 74	239	234	5	2.09	135, 89	Bipolar flakes - 2	3	fine grained but powdery material

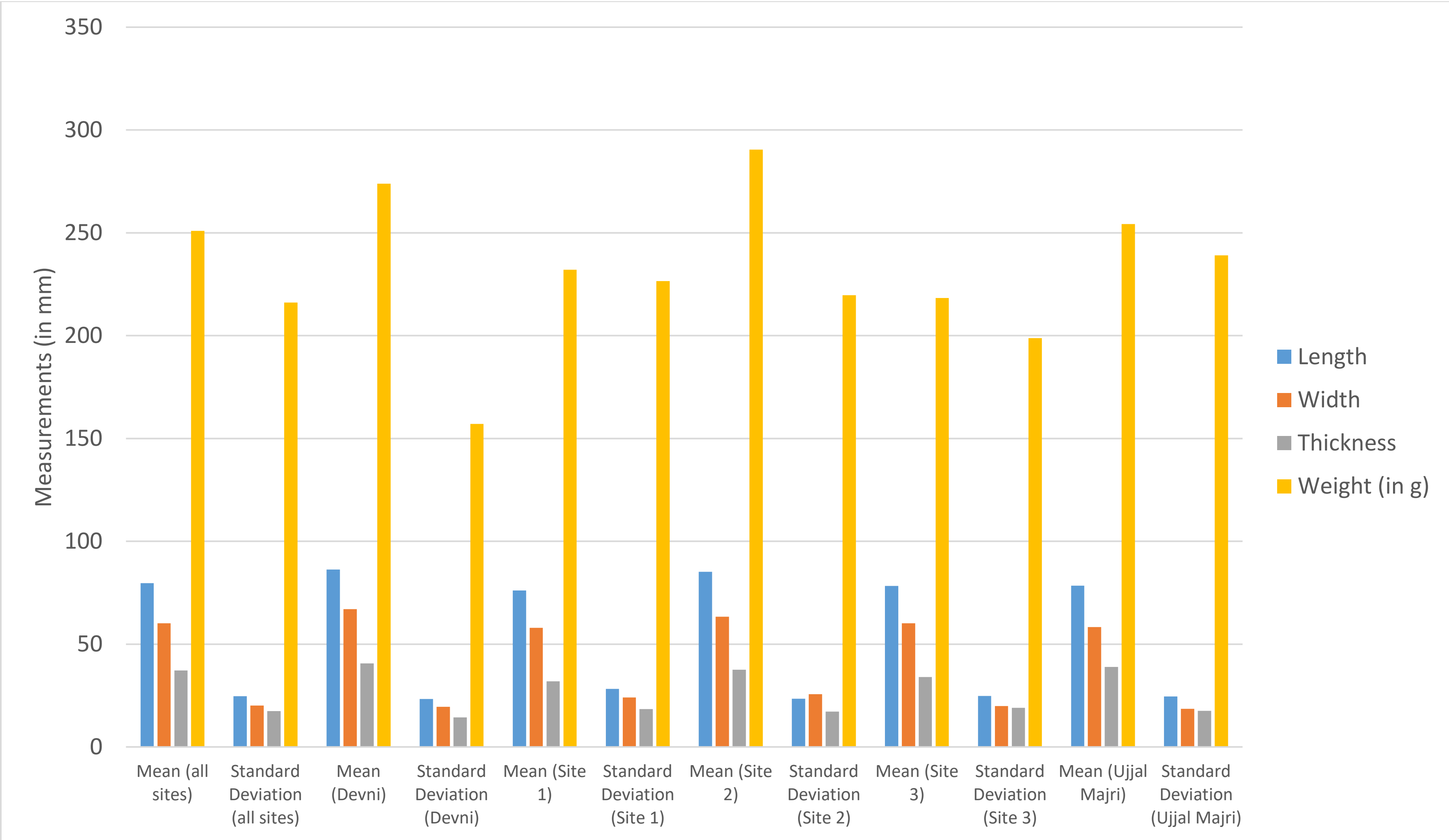
9 Graph of collection lithic analysis



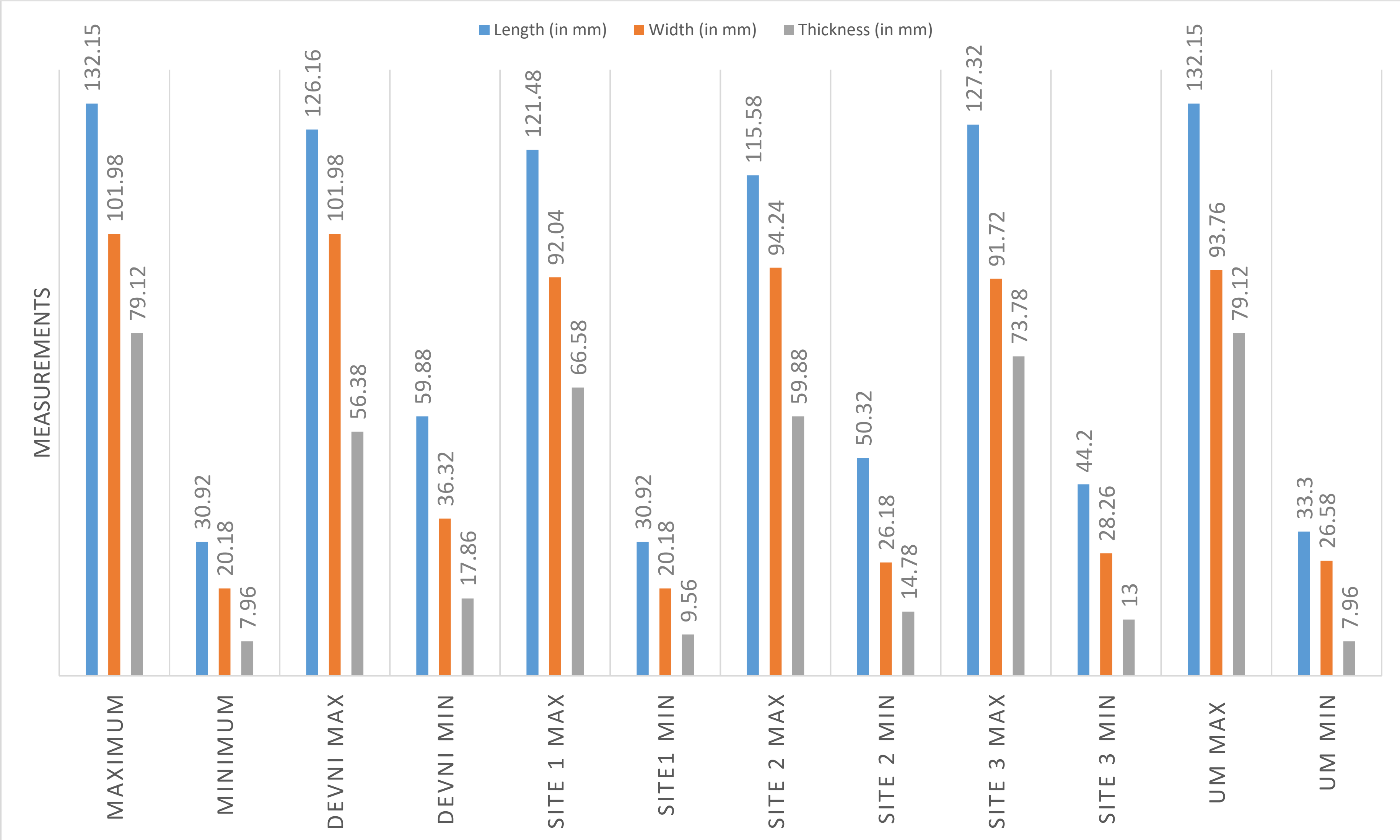
10 Graph of lithic dimensions and typology



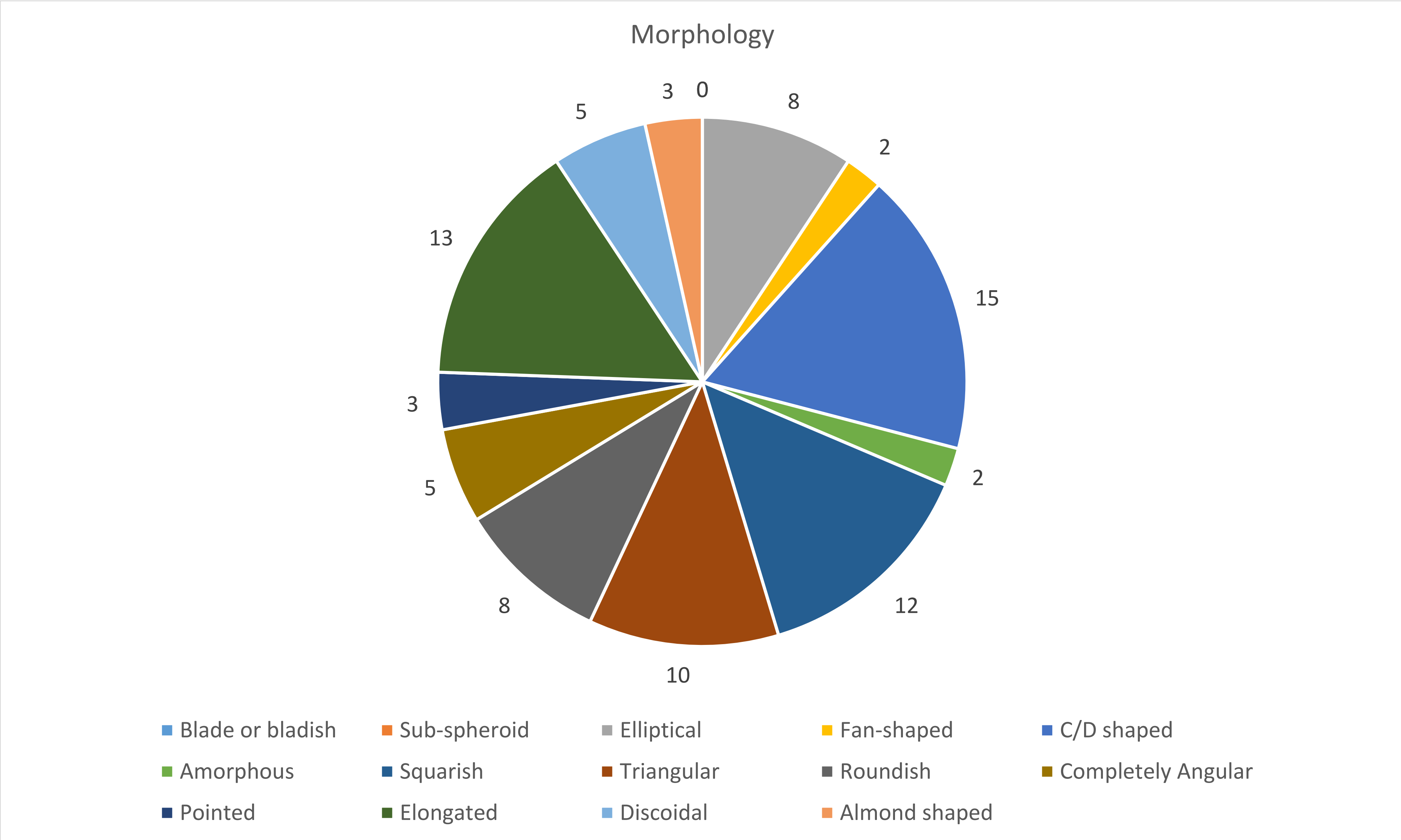
11 Graph of mean and standard deviation of the lithic assemblages



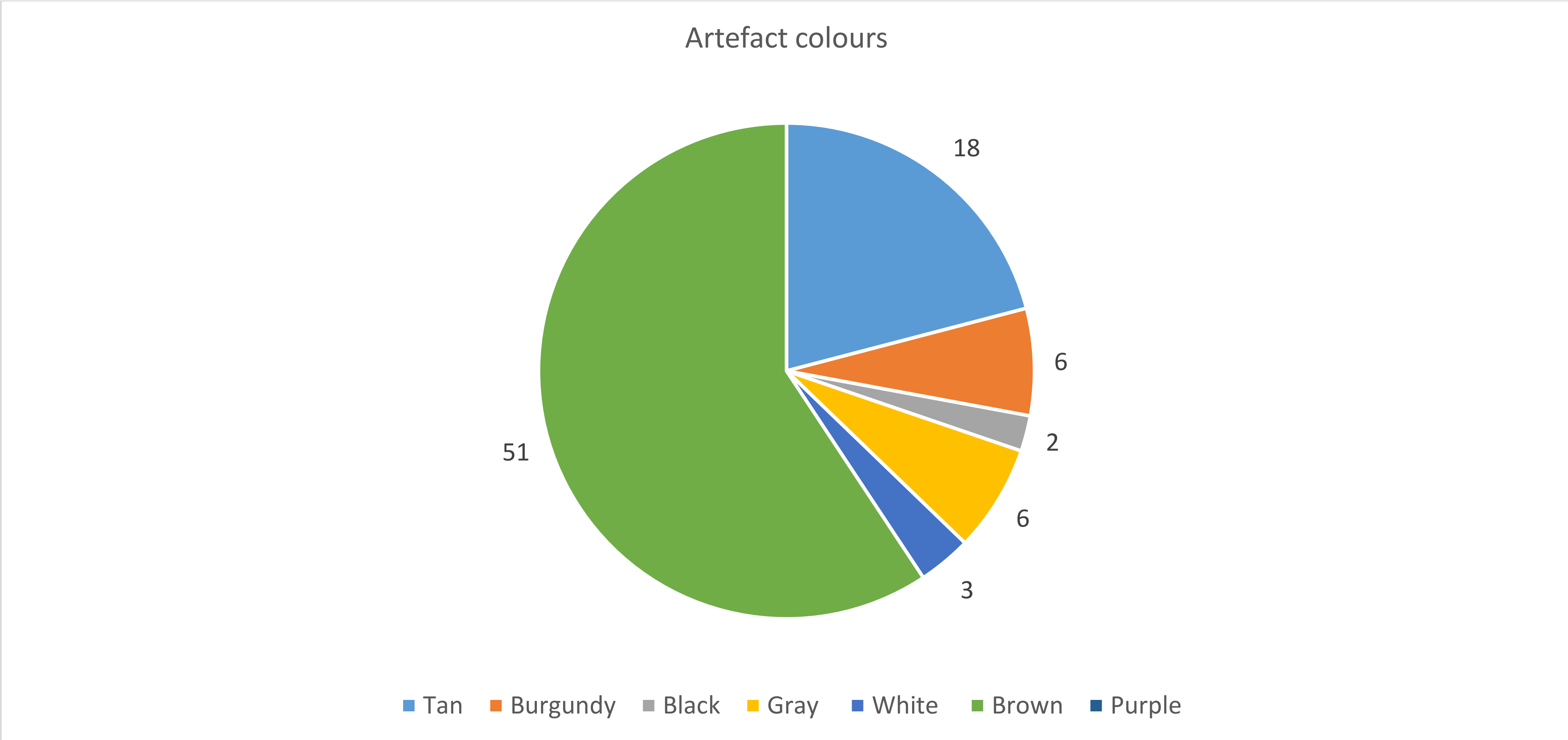
12 Graph of Plot of maximum and minimum values of the lithic assemblages



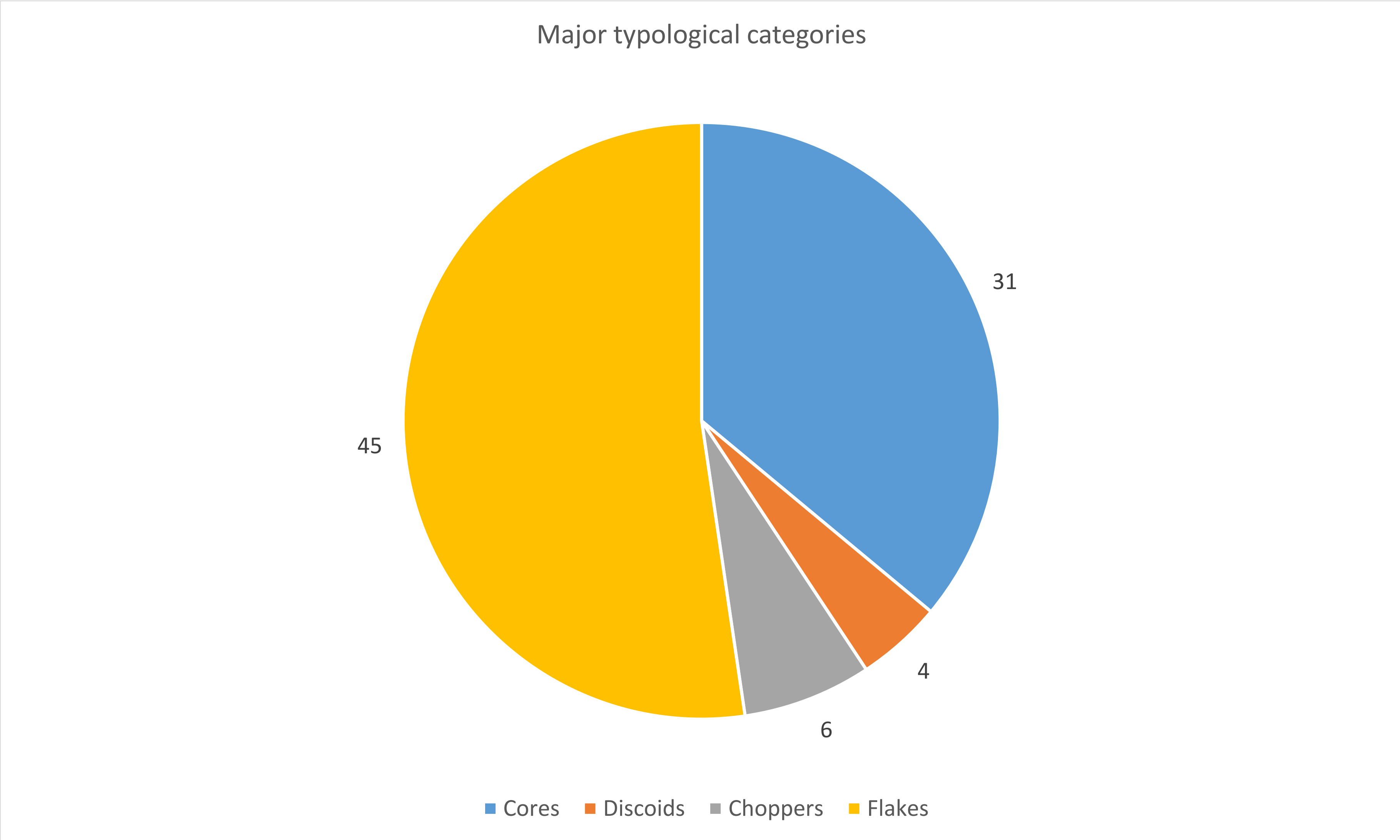
13 Graph of Morphological distribution of lithic assemblage



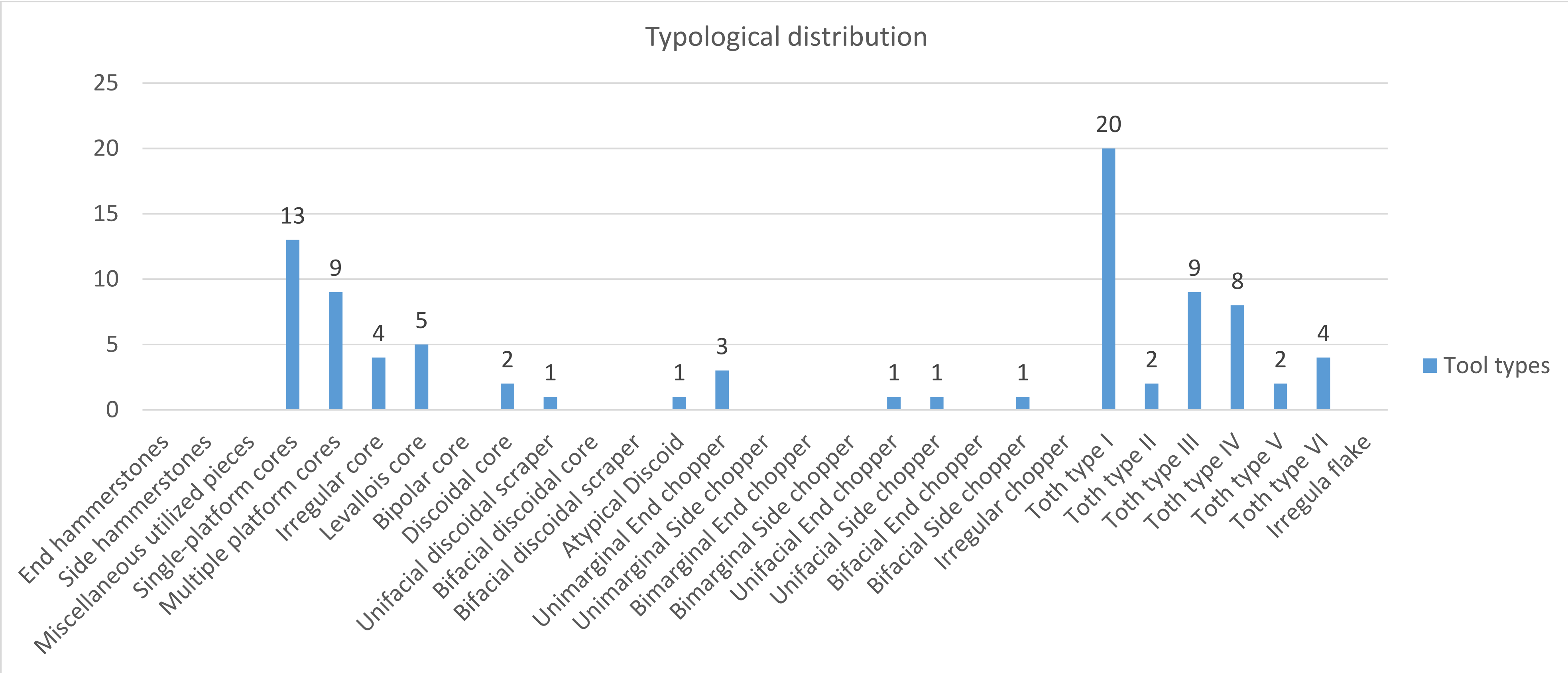
14 Graph of Colour-wise distribution of lithic assemblages



15 Graph of Major typological categories of lithic assemblages



16 Graph of Detailed typological distribution of lithic assemblage



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