The interpretation of bipolar knapping in African Stone Age studies

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Abstract

Bipolar knapping is presented as a case study for the interpretation of African Prehistory. Bipolar knapping was first thought of as a typological marker but, lately, it has been referred to as a technological marker. I challenge the idea that the technological change represented by bipolar knapping should be understood as a technological marker, because to do so is simply a translation of an outdated typological definition taken unconsciously from evolutionary schemes. Bipolar knapping, as with many other technological traits belonging to the Final Pleistocene, appears and disappears probably for different cultural and economic reasons. An example of Howiesons Poort bipolar knapping is presented here in order to highlight the prominance of this technique in the Middle Stone Age, notwithstanding its under-recognition in published lithic analyses.

Keywords

Bipolar knapping, technological marker, Middle and Later Stone Age

Introduction

Lately, the transition from the Middle Stone Age to the Later Stone Age has been interpreted as a technological change (e.g. Villa et al. 2012), thereby moving away from an older typological approach. This terminology: Early Stone Age (ESA), Middle Stone (MSA) and Later Stone Age (LSA), comes from the first half of the Twentieth Century, when prehistoric studies began in Southern Africa (Goodwin and Van Riet Lowe 1929). The origin of these terms comes from the perceived need to organize the Stone Age into typological-chronological phases. This tendency arose because, at the time, Prehistory was highly influenced by Geology. When these terms were created there was still a strong theoretical stream coming from a mixture of evolutionism and particularism in order to understand and organize Prehistory (Trigger 1989; Sheperd 2003). As a result, the Stone Age phases were distinguished by type fossils derived from the typological approach to analyzing lithics.

It seems that these old typological frameworks have now been replaced by technological ones. Indeed, since the 1990s technological studies have arisen in order to tackle the transition from Middle Stone Age to the Later Stone Age (see for example Clark 1999; Díez et al. 2009 or Eren et al. 2013, among many others).

Among the technological changes said to define the transition into the LSA is the appearance of bipolar knapping which is linked to strategies of microlithization, which has been one of the main traits used by many researchers to define the beginning of the LSA (Beaumont 1978; Deacon 1984; Mercader and Brooks 2001; Wadley 1993; among many others). It must be pointed out that for some researchers the mere appearance of this knapping strategy marks the beginning of the LSA (Beaumont

1978), whereas for others the LSA began when this knapping method was intensified after earlier beginnings (Villa et al. 2012; Eren et al. 2013); together with other major technological changes (d'Errico et al. 2012). However, the distinction between the MSA and the LSA seems quite arbitrary and imprecise, as was pointed out by several authors (Wadley 1993; Clark 1999; Díez et al. 2009; McBrearty & Brooks 2000).

In this paper I tackle the issue of how bipolar knapping has been theoretically interpreted in MSA and LSA studies. Here I challenge the idea that this technological change should be understood as a technological marker (understood as a boundary marker), because to do so is simply a translation of an outdated typological definition taken unconsciously from evolutionary schemes[1]. Because of this historiographic tendency, bipolar knapping has been under-theorized in MSA contexts. Instead of a technological marker, bipolar knapping, like any other technological feature, should be understood in its particular context and should be explained within an explicit theoretical context. The apparent simplicity and abundance of bipolar knapping, and the prolific and on occasion subjective opinions about it, make it a suitable topic of discussion on theoretical grounds. In addition to the theoretical discussion, I shall present and interpret a small assemblage containing bipolar knapping from a MSA context.

1 Here I refer to evolutionary schemes as linear perspectives and I do not refer to Foraging Theory or Behavioral Ecology approaches. The linear sequence of stages, ages and industries in southern Africa was not written from a behavioural ecological perspective, but from a cultural evolutionist one, see Mackay (2009) for a detail discussion.

Bipolar knapping: a definition

Bipolar knapping is a method in which the core is placed on an anvil and held with the bare hand. The rock is hit from above with a hammer held in the other hand, causing blanks to fly off from the top and also from the edge that is in direct contact with the anvil (Crabtree 1972).

Bipolar knapping has been recognized mainly from the identification of bipolar cores and a specific type of flake by-product; even the mechanical properties of this type of knapping have been clearly identified in comparison to other knapping methods (see Cotterel and Kamminga 1987). Nevertheless, the recognition of this knapping method has been highly controversial in prehistory, as it has been associated with the typological morphotypes splintered piece, scaled piece or *pièce esquillée* (Figure 1).

The main dilemma around the use of these names has been how to interpret them, because as mere typological categories they do not imply either functional or technological tasks (de la Peña 2011). Typologically, splintered pieces are quadrangular or rectangular lithic pieces which display splintering on two opposed edges or even on four edges. This splintering is what is recognized in European lithic technology literature as *écaillé* retouch (from the Laplace Typological system). Hayden (1980) was one of the first to call attention to the confusion regarding splintered pieces in North American and Western European archaeology. At this time they were being interpreted in two different ways: as wedges/chisels (intermediate pieces) and as bipolar cores. This debate has been particularly prolific in French

Upper Palaeolithic research, as well as in North American Paleoindian lithics studies (Le Brun Ricalens 2006; Shott 1999).

Numerous experimental works have been published in order to distinguish bipolar cores from intermediate pieces (wedges or chisels) that were thought to be used to work hard materials. De la Peña (2011) distinguished several qualitative characteristics in order to differentiate bipolar cores from wedges in an experimental program using fine grained flint. The use of wedges does not usually generate splintered retouch or *écaillé* retouch on the working edges. In contrast, bipolar knapping always produces symmetrical scars (or what is recognized typologically as *écaillé* retouch) on opposing edges. The edges will develop similar macroscopic characteristics because they are both in contact with the same type of material: stone. Other rocks, such as quartz, develop different qualitative characteristics (see Callahan 1987).The distinction between bipolar cores and intermediate pieces on quartz has been not tackled at all (in contrast to extensive work on cryptocrystalline material such as flint). In addition, for quartz on which removal scars are difficult to see, the distinction between freehand and bipolar knapping is not always clear from a qualitative point of view (see in this regard Díez-Martín et al. 2011 or de la Peña forthcoming paper).

The origins of bipolar knapping are early in the archaeological record. Moreover, a very similar technique has also been recognized as part of a chimpanzee strategy for nutcracking. Bipolar knapping was even used in the ESA (e.g. Díez-Martín et al. 2011). However, it must be stressed that this knapping method had a (sometimes) different purpose in later Prehistory and also ethnographical contexts. In early times it seems that this type of knapping was a straightforward method to produce flakes, meanwhile in MSA, LSA and recent times (based on ethnographic examples) bipolar knapping was (mainly) directed at the production of small flakes and bladelets (microliths), sometimes used hafted in compound tools (Flood 1980; Flenniken 1981), in some other cases they were still produced merely for obtaining flakes (White 1968; Sillitoe and Hardy 2003).

Bipolar knapping in Middle Stone Age contexts

Bipolar flaking has been previously reported in the MSA of Western, Eastern and Southern Africa (Mehlman 1977; Clark 1999; Harper 1994; Wurz 2000; de la Peña and Wadley 2014; Mackay 2009; Soriano et al. 2010; Wadley 1993). However, it is striking that it has received much more attention in LSA assemblages where it has been considered a paradigmatic marker for the LSA.

The reason for this imbalance is that even when it was recognized or cited in MSA assemblages, bipolar flaking still was treated ambiguously or even dismissed. In other words, other knapping methods, such as bifacial reduction or the so-called 'core prepared' methods (i.e. *Levallois* or discoidal), received more attention.

Nonetheless, in some MSA contexts, splintered pieces have been interpreted as bipolar cores. Mehlman (1977) recognized this form of knapping in East Africa several decades ago for the MSA at Nasera Rock (Tanzania). Later on, other studies confirmed the identification of bipolar knapping in detailed technological publications, particularly for Mumba (Tanzania) (Díez et al. 2009; Eren et al. 2013).

Soriano et al. (2010) pointed out how bipolar knapping was a major technological component of Ounjougou (Mali) in a chronocultural sequence extending over 100000 years and covering most of the regional 'Middle Palaeolithic'.

Harper (1994) noticed an increase in bladelet production and the use of the bipolar technique in the final MSA of Rose Cottage (South Africa). Clark (1999) stressed that bipolar knapping was not exclusively present in the LSA but that it may play a fundamental role in the behavioral trajectory towards more refined bladelet production in the southern african LSA record. Indeed, she understood that this technological choice was typical of the final MSA. In her technological study of the transition between the MSA and the LSA in South Africa she recognized bipolar knapping in the final MSA layer Ru from Rose Cottage (~26000BP). In addition she did a replication experiment in order to demonstrate that bipolar knapping can produce bladelets. Moreover, she interpreted the 1Wa lithic assemblage of Border Cave, formerly identified as Early LSA by Beaumont (1978), as more likely MSA, owing to the fact that bipolar knapping was present together with the presence of irregular cores, radial cores, facetted platforms and the absence of bladelet cores. The presence of bipolar knapping in this same layer has been recently used to support, on the contrary, the first manifestations of the LSA in Southern Africa (Villa et al. 2012).

Wurz (2000) mentions *outil écaillés* in the Howiesons Poort sequence of Klasies River Mouth (South Africa) from the Singer and Wymer 1967/8 excavations. Following Callahan (1987) she interpreted them as products of extended core reduction and not as tools.

Mackay (2009) pointed out that in Diepkloof (South Africa) bipolar cores are common in the >74, 70-65, 65-62 and 62-60 ka layers. Meanwhile at Klein Kliphuis (also in South Africa) bipolar cores are common between 62 to 60 ka Mackay (2009) explained the different frequencies in bipolar knapping for the MSA in ‘terms of the differences in the availability of flakeable stone at different sites’. In other words, his proposition is that sites with poorer access to stone have a higher prevalence of bipolar knapping, for example, Diepkloof.

In the following section I present a MSA case study of bipolar knapping in Southern Africa in order to add to this small synthesis of cases associated with the MSA.

The case of bipolar at Sibudu Cave

Sibudu is located approximately 40 km north of Durban (South Africa), and about 15 km inland of the Indian Ocean, on a steep cliff overlooking the uThongathi River. The shelter has a long occupation sequence with several layers and features corresponding to the MSA and Iron Age. Howiesons Poort occupations reported here come from six square metres (squares B4, B5, B6, C4, C5 and C6) of Wadley's excavations in the deep sounding. The layers associated with the Howiesons Poort are (from the base to the top): Pinkish Grey Sand (PGS), Grey Sand (GS), Dark Reddish Grey (DRG) and Grey Rocky (GR)

At Sibudu bipolar knapping has been emphasized in the Howiesons Poort layers. For the management of quartz in the layer GS, de la Peña and Wadley (2014) showed that bipolar knapping was systematically used as a recycling and microlithic strategy understood as an explosion in numbers of small flakes and bladelets (Flenniken 1981), in order to continue the exploitation of quartz after freehand percussion for bladelet production. Besides, bipolar maybe was also a solution dealing with quartz core geometry rather than size.

Moreover, in the rest of Sibudu's e Howiesons Poort layers (GR, DRG and PGS) it also seems that bipolar knapping was a recurrent strategy in order to continue the reduction of quartz, once the freehand method was impossible to apply because of the small size of the cores.

The analysis of cores[2] at Sibudu was guided by the following experimental observations with quartz bipolar knapping (de la Peña forthcoming):

•The hammered edge and the opposite edge become smooth and rectilinear. If the hammered side is rotated, the core becomes quadrangular or rectangular.

•The core rapidly becomes smaller as a result of knapping. In fact, bipolar knapping can be applied to extremely small cores (as small as 2 cm).

•Although the cores are not prepared in any way, a striking platform is automatically created as a result of the hammering process.

•The residual core shapes in quartz bipolar knapping are rectangular and quadrangular shapes.

In addition, some of the qualitative characteristics highlighted for freehand knapping with quartz appeared frequently, such as: bluntness of the hammered edge or fissuration of the overhang (Figure 2). On the contrary, bipolar knapping percussion produced other characteristics observed during freehand knapping with quartz, but in lower frequencies, such as: hinge and step terminations in cores and bipolar blanks, the predominance of rectangular-shaped scars, irregularity and heterometry in scars, and hinge and step scars in cascade.

[2] It has been proposed that the distinction between freehand and bipolar knapping for quartz is clearer on the cores than on the by-products (Jeske and Lurie 1993).

Following the experimental observations described above I identified 195 quartz cores with the same/similar scar pattern of bipolar reduction and 45 quartz cores same/similar scar pattern of freehand bladelet production (see de la Peña forthcoming for the freehand characteristics) (Figure 3 and 4).

The distinction between freehand and bipolar cores is also illustrated typometrically in Figure 5 by Length/Width ratio and in Figure 6 by the box-plots of length, breadth, thickness and weight by layer and comparing freehand and bipolar cores. Here I present the results only for GR, GS and PGS, as DRG had very few pieces (n=9). Furthermore, U Mann-Whitney and t-tests show how the distinction between bipolar and freehand cores is statistically significant for breadth, thickness and weight in the GS and PGS layers (see Table 1 for Shapiro Wilk normality test and Table 2 for the t test and U Mann-Whitney). The distinction between freehand and bipolar knapping is also clear when characteristics such as frequency of conchoidal negatives, fissuration of the overhang and bluntness of striking platform are compared (Figure 7).

In the three main Howiesons Poort layers at Sibudu (GR, GS and PGS) quartz is the minority rock type knapped, but its exploitation was very pronounced because quartz cores were reduced to the limit of knapping reduction. This is interpreted as a strategy designed for microlithism and recycling. The recycling of the freehand cores into bipolar cores is supported not only because of the systematically smaller size of bipolar cores, but also because the percentage of cortex on bipolar cores is always smaller than on freehand cores (Figure 8). The by-products of bipolar knapping (small flakes and bladelets) were probably used hafted as microliths, just as they were in the LSA.

On the interpretation of Bipolar Knapping for African Stone Age Studies

Bipolar knapping has been used as a technological trait by which the beginning of the LSA can be recognised. This creates an interesting situation, because in eastern and southern African publications, bipolar knapping is regarded as an attribute of technological advancement or innovation. In other words, bipolar knapping is a highly economical way to produce microliths. Indeed, it is presented in the same "package" of other traits of putatively complex behaviour, such as: notched bones for notational purposes, wooden digging sticks, bone awls, and bone points (Ambrose 1998; Villa et al. 2012; d'Errico et al. 2012).It seems that its selection as a technological marker tacitly supports the hypothesis advocating change towards behavioural modernity in *Homo sapiens* at about 50Kya (Klein 1995). Paradoxically, in Upper Palaeolithic contexts of Western Europe, also related to *Homo sapiens*, this knapping technique has been repeatedly dismissed. Indeed, priority was always given to the hypothesis that splintered pieces are intermediate pieces to work hard materials. It seems that bipolar knapping, as a putatively simplistic procedure of knapping, does not fit the (European main stream) concept of complex hunter gatherers of the Upper Palaeolithic (Roebroeks and Corbey 2000). These different points of views around the same kind of knapping technique demonstrate that bipolar knapping has been evaluated in a highly arbitrary manner. In southern and eastern Africa it is viewed as a characteristic of *Homo sapiens* complexity by researchers who tacitly or implicitly seek a technological change between the MSA and the LSA. Meanwhile, in Early Upper Palaeolithic European contexts bipolar knapping is usually dismissed from discussions, or is barely quoted, because the technique does not look as complex as other technological strategies. Therefore, the same technological traits are dealt with in contradictory ways depending on their context and the research tradition of the analysts writing about the lithics[3].

The presence of a substantial quartz bipolar knapping tradition in Sibudu's Howiesons Poort makes it inappropriate to view bipolar knapping as a technological trait exclusively associated with the LSA. Indeed, bipolar knapping was formerly recognised in other African MSA contexts. Moreover, some authors have interpreted bipolar knapping as typical of MSA assemblages (Harper 1994; Clark 1999) and this highlights the inconsistency of using bipolar knapping as evidence for a LSA technology (Villa et al. 2012). This contradiction arises because the MSA and LSA distinction appears to be an artificial boundary and the traits that define the Ages are arbitrary (McBrearty and Brooks 2000; Díez-Martín et al. 2009; Wadley 1993).

It also seems paradoxical that when bipolar knapping strategies appear in East Africa (together with a range of other technological traits) it is considered the start of the LSA (Ambrose 1998). However, when bipolar knapping appears in Southern Africa in Howiesons Poort contexts, its appearance is treated as ephemeral (Villa et al. 2012). In other words, because this technological trait was not thought of as a classical MSA attribute its presence was glossed over even in previous works which demonstrate its presence. This approach seems to be a by-product of African historiography.

Furthermore, to use bipolar knapping as a 'technological marker' seems to be a conceptual development from previous typological proposals that used typological indicators as evolutionary markers. When Early, MSA and LSA were defined there was still a strong influence of Evolutionism in the archaeological discipline. It is

3 Saying this I admit the influence of the external history of Science, *sensu* Lakatos (1978).

striking that a new type of methodology, such as the *Chaîne Opératoire* or the reduction sequence approach, which has different objectives from the Evolutionary and Particularist theories of the beginning of the Twentieth Century, mainly to reconstruct the technical systems of past societies, still makes use of the same distinctions as the former models (Bar Yosef and Van Peer 2009). It would be more comprehensible for the way we name and understand the past (the terminologies) to change at the same time that the methodologies (and the theories behind them) change (Shea 2014).

To classify, and use, bipolar knapping as a 'technological marker' implies that there is a significant change in society because of the acquisition of that technology. In former times in the discipline of Prehistory, splintered pieces were regarded as an evolutionary/typological marker. If they are now considered to be a technological marker, we need to be told what is being marked and what the new theoretical approach is. In addition, calling bipolar knapping a technological marker implies that other technological changes and traits in the MSA will be ignored. However, I argue that this line of reasoning is made in some recent publications in an implicit, unconscious way.

Different technological solutions appear and disappear during the MSA and LSA and this does not necessarily mean either evolutionary advances or technological setbacks. The discontinuity in technological strategies has also been highlighted in the Middle Paleolithic contexts of the Middle East (Hovers & Belfer-Cohen 2006). In fact, the South African Howiesons Poort incorporates a number of technological and symbolic characteristics which have made it complicated to situate historiographically in the MSA (Pargerter 2014, Table 1). Technological change must be assessed in an appropriate context, and even if it is interpreted in a cultural evolutionist manner the theoretical underpinnings need to be specified.

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Table 1. Shapiro-Wilk normality tests by Sibudu Howiesons Poort layers for different parameters for Freehand and Bipolar cores. Cases which are not normal have been highlighted with an asterisk.

Shapiro-Wilk test									
		Length		Breadth		Thickness		Weight	
		Freehand	Bipolar	Freehand	Bipolar	Freehand	Bipolar	Freehand	Bipolar
Grey Rocky	W	x	0,936	x	0,9708	x	0,9298	x	0,8534
	p(normal)	x	0,07893	x	0,5827	x	0,05426	x	0,0008949*
Grey Sand	W	0.9568	0.9552	0.9555	0.9645	0.9621	0.9757	0.9126	0.8748
	p(normal)	0.512	0.00031*	0.4303	0.001955*	0.5588	0.1939	0.04631*	5.96E-09*
Pinkish Grey Sand	W	0,8895	0,8741	0,9409	0,9546	0,8946	0,9633	0,8097	0,8347
	p(normal)	0,2317	0,0006631*	0,6196	0,2411	0,2584	0,3592	0,0363*	0,0003752*

Table 2. Results of the statistical tests. Asterisk denotes statistical difference.

	Statistical test	U Mann-Whitney test	T-test
		p (same)	
Grey Sand	Length	0.07097	
	Breadth	2.721E-07*	
	Thickness		0.0057*
	Weight	5.97E-08*	
Pinkish Grey Sand	Length	0.0371	
	Breadth		0.85538
	Thickness		0.0062743*
	Weight	0.000157*	

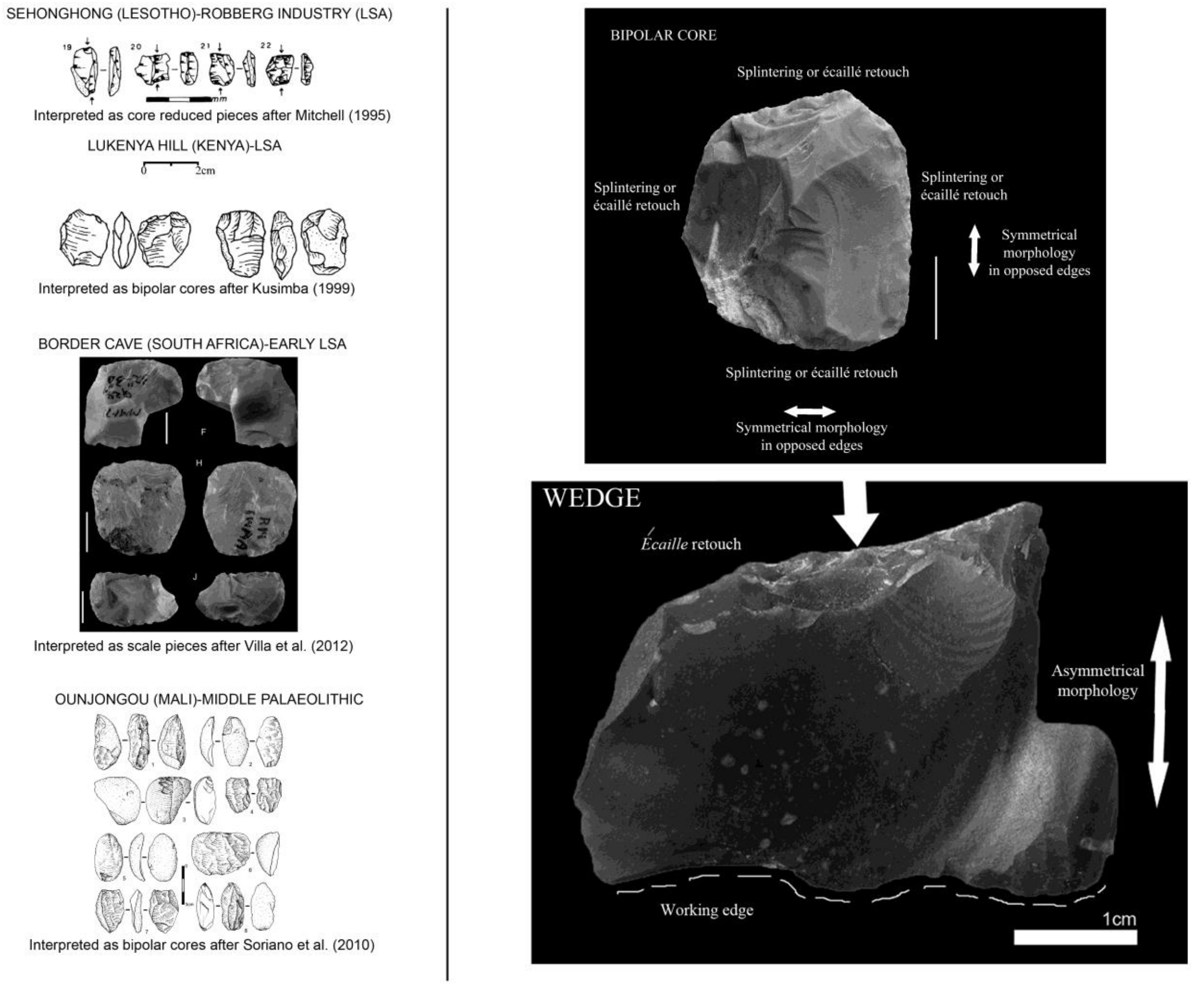


Figure 1. On the left different African examples of the identification of splintered pieces. On the right, the main differences highlighted in de la Peña (2011) in order to distinguish between an intermediate piece and a bipolar core.

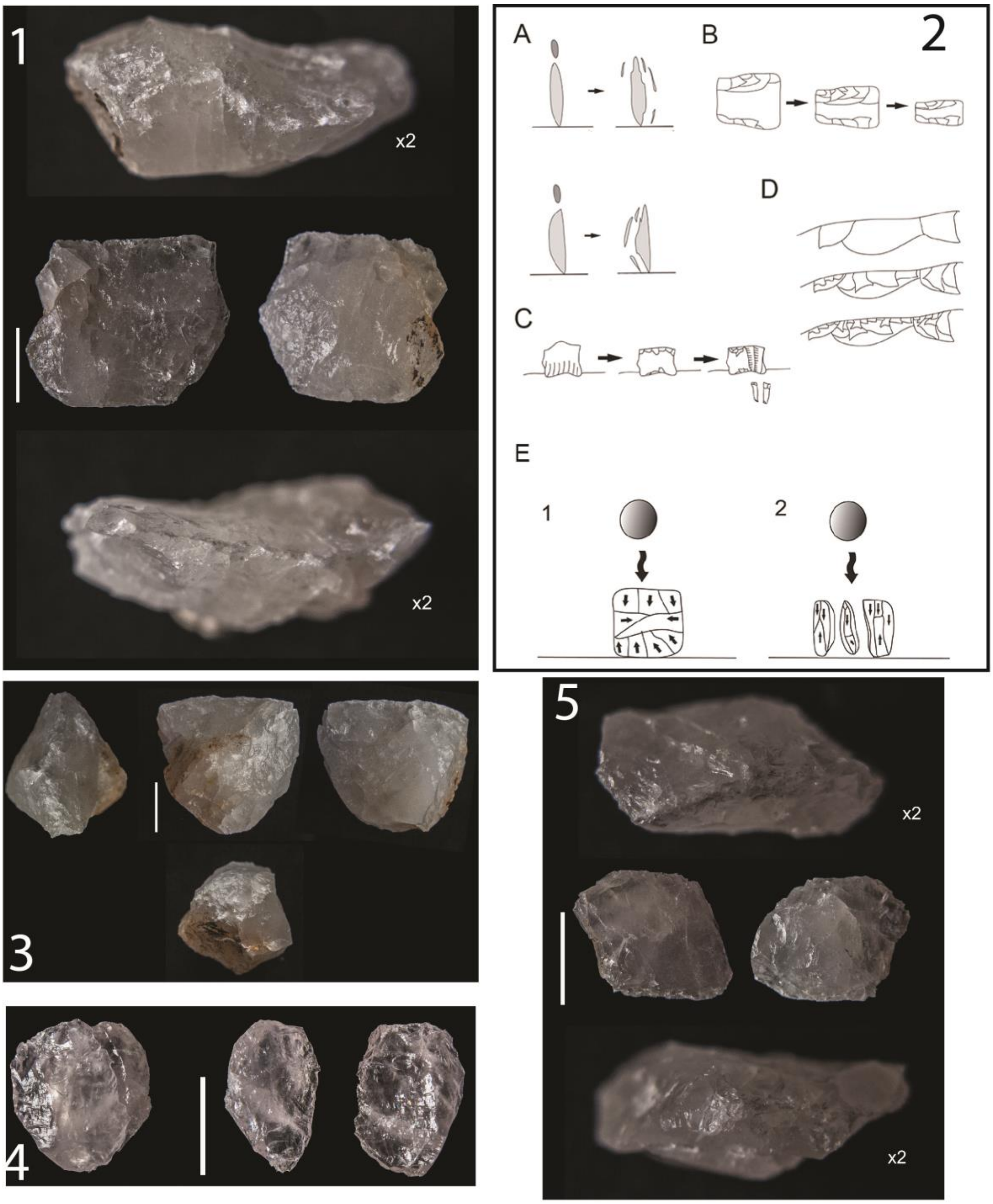


Figure 2. 1, 3 and 5 experimental quartz bipolar cores with quadrangular shapes and rectilinear edges. They also show bluntness of the hammered edge and the edge in direct contact with the anvil and fissuration of the overhang. 2. Some characteristics of flint bipolar knapping that also occur for quartz. A: (Above) Knapping process with symmetrical core. (Below) Knapping process with asymmetrical core B: Progressive reduction in core size. C: Involuntary production of striking platform. D: Overlapping of scars. E. The core split in two or more pieces. Modified from de la Peña (2011). 4. Bipolar core that split in two (like shown in 2.E2). On the left the two 'cores' refitted.

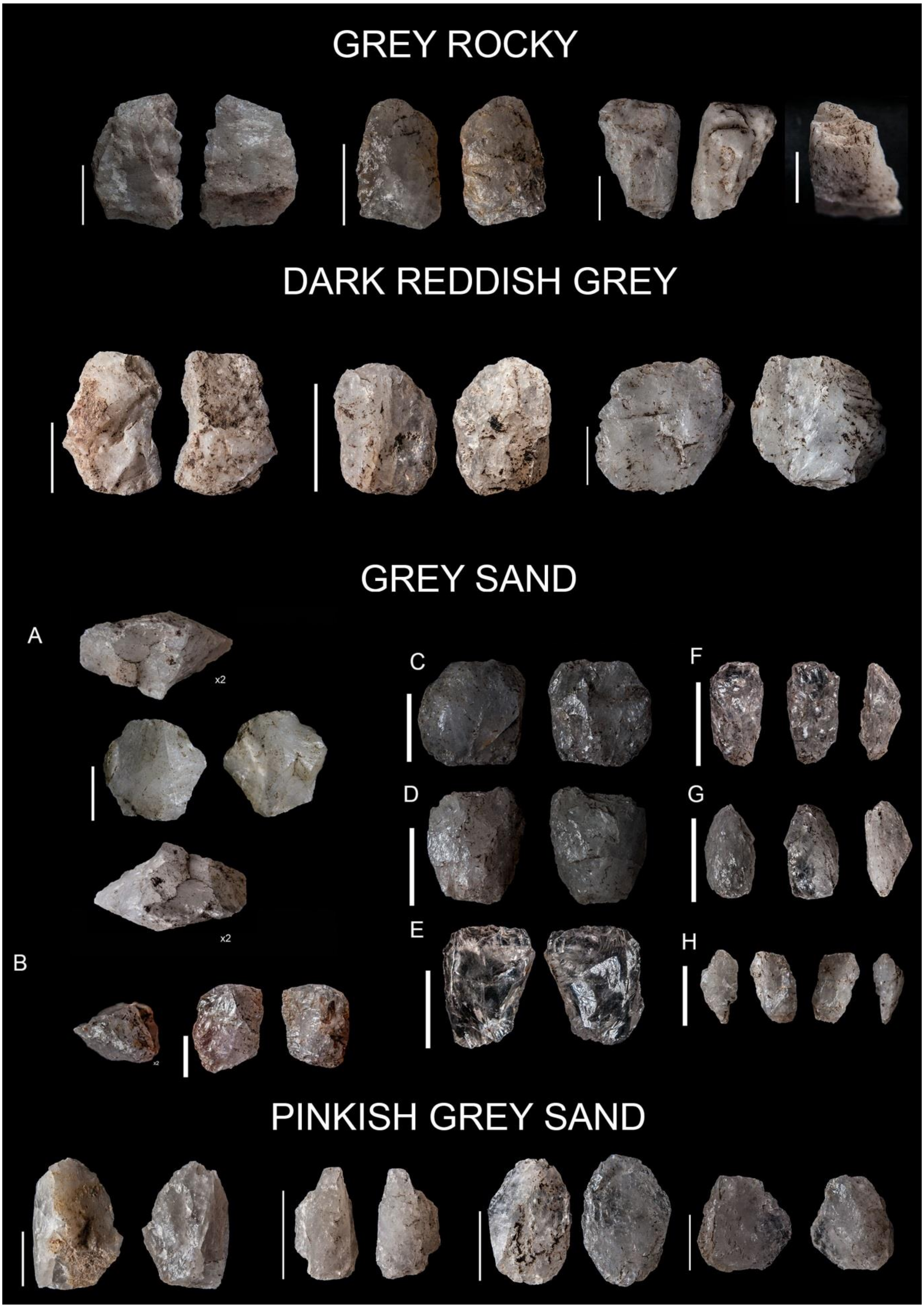


Figure 3. Sibudu quartz bipolar cores by layer showing the macroscopic characteristics highlighted in Figure 2.

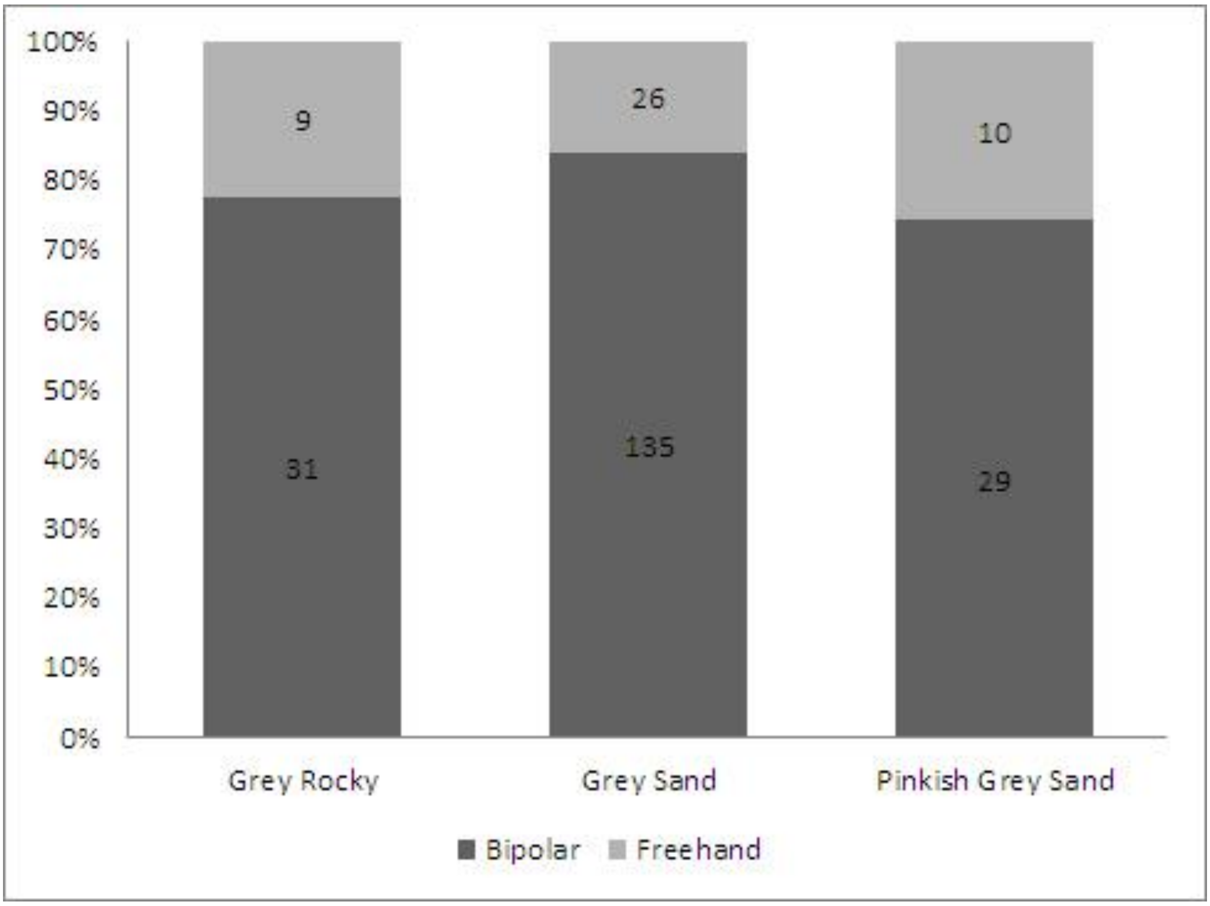


Figure 4. Percentage representation of freehand and bipolar cores for the three Howiesons Poort main layers in Sibudu Cave.

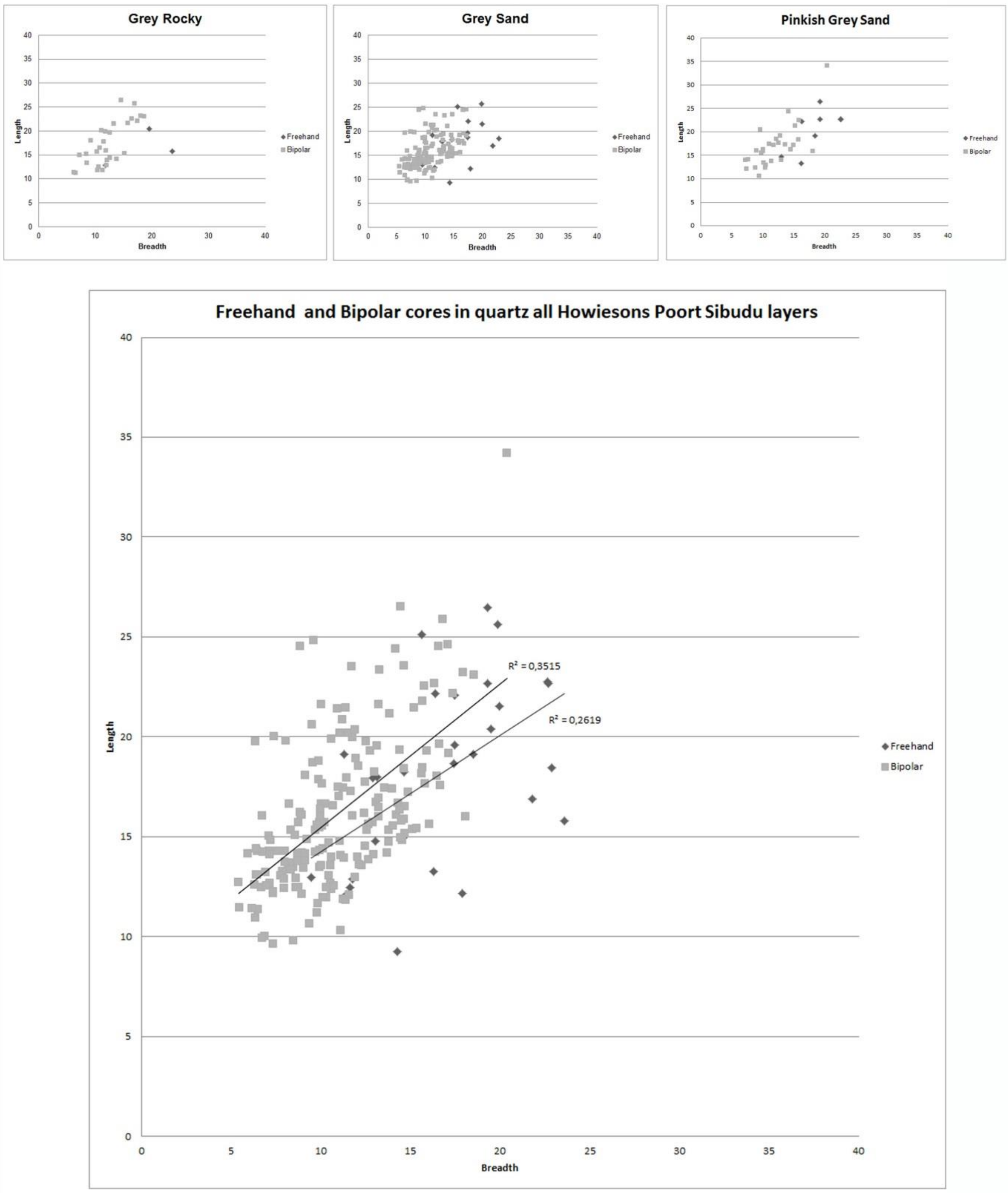


Figure 5. Scatterplot of the lengthening index of freehand and bipolar cores from layers GR, GS and PGS.

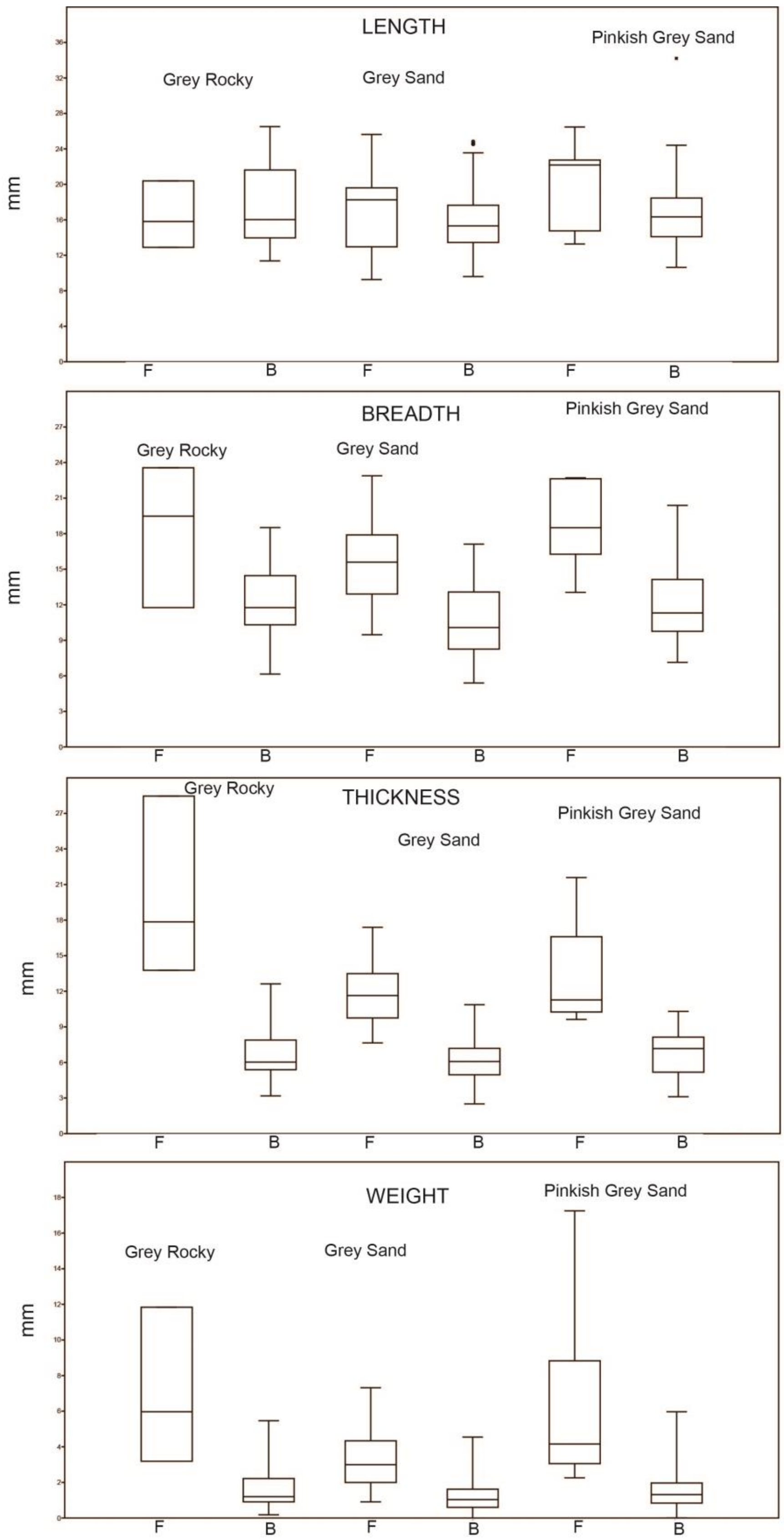
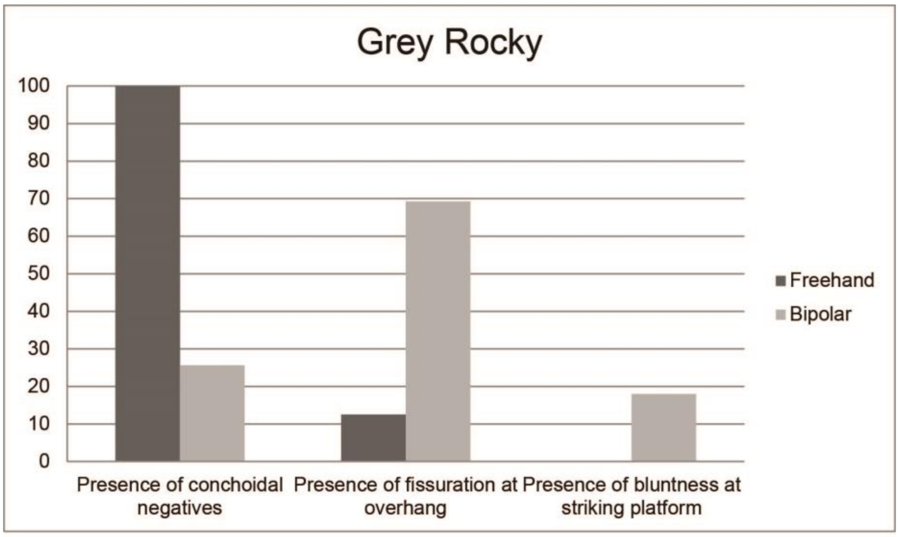
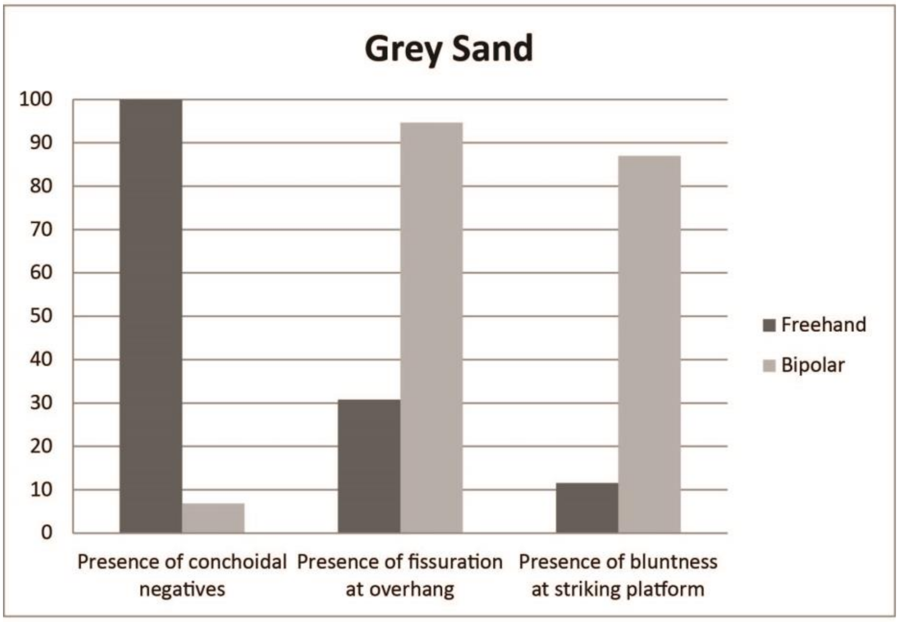


Figure 6. Box-plots of length, breadth, thickness and weight of quartz freehand and bipolar cores from layers GR, GS and PGS.





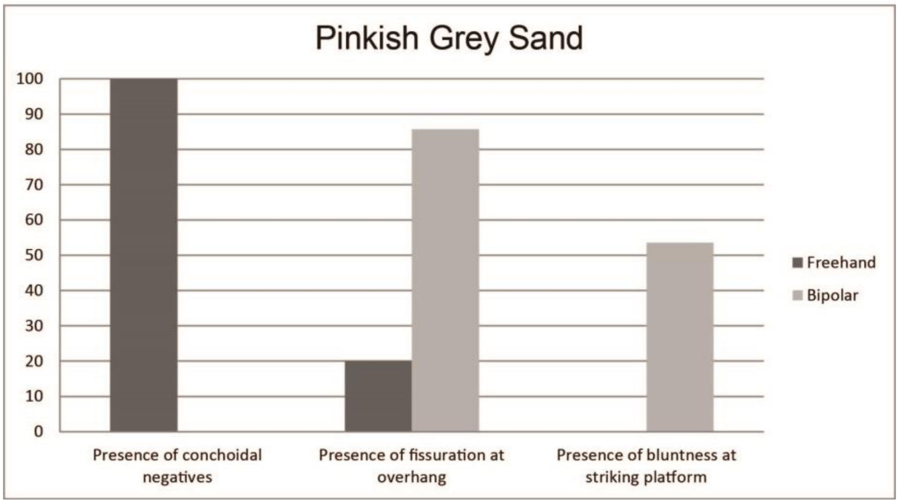


Figure 7. Percentage of conchoidal negatives, fissuration and bluntness of freehand and bipolar cores from layers GR, GS and PGS.

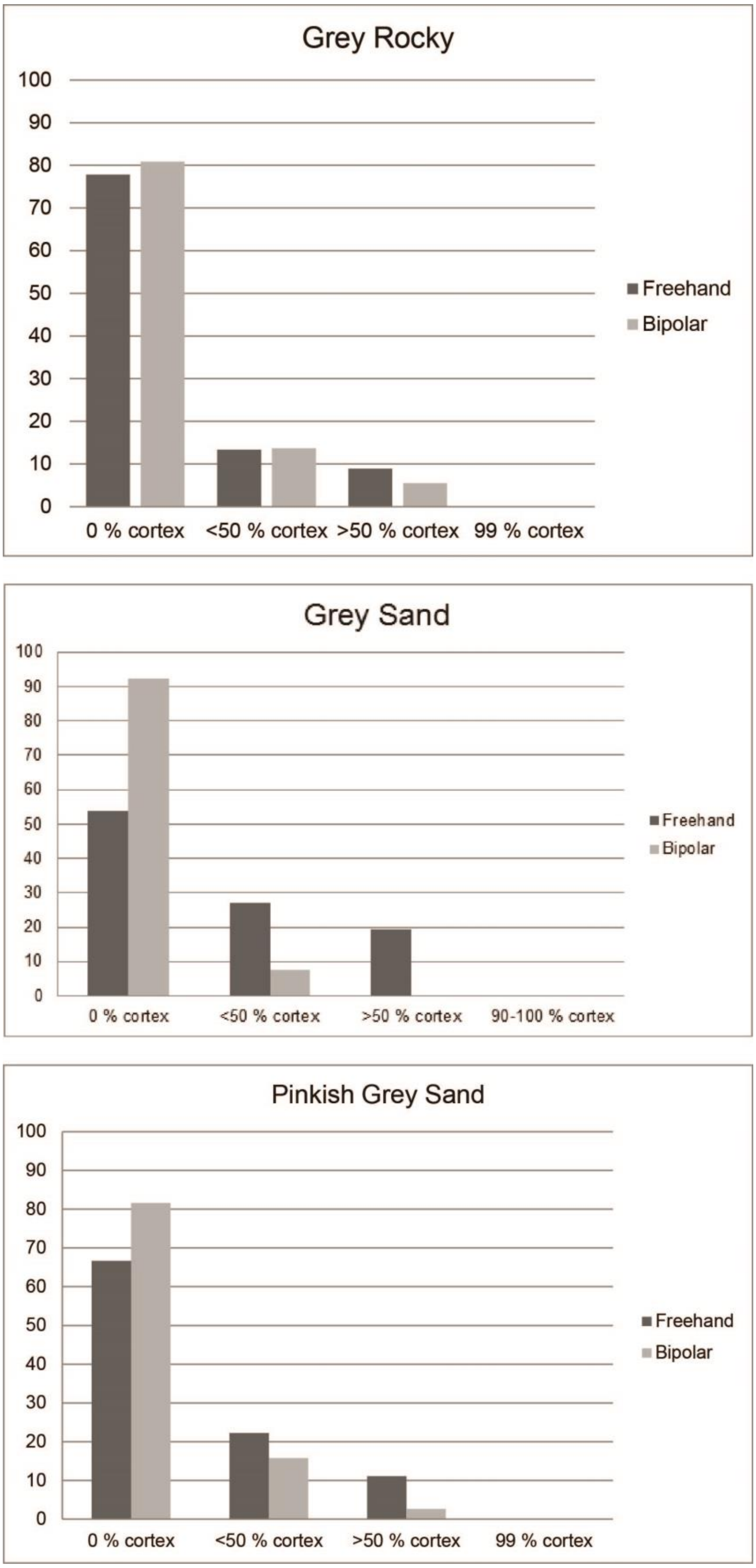


Figure 8. Percentage of cortex for quartz freehand and bipolar cores from layers GR, GS and PGS.