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Trampled under foot: A quartz and chert human trampling experiment at the Cova del Parco rock shelter, Spain

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ABSTRACT

An assemblage of 500 (385 quartz and 115 chert) experimentally knapped artefacts, underwent human trampling over the course of two weeks by a team of 10–12 excavators wearing soft-soled shoes used while excavating in the rock shelter. Two zones of trampling were used: Zone 1, a high artefact density, low trampling intensity, and lower soil compaction and rockiness; and Zone 2, a low artefact density, high trampling intensity, higher soil compaction and rockiness. The primary questions were to understand the difference in fracture rates and types between the chert and quartz, and the difference between the zones of artefact density, trampling intensity, and soil density. The results have shown that significantly more quartz fractured and were damaged compared to chert, and for both materials there was significantly more breakage in the zone with the higher trampling intensity and higher soil compaction and rockiness. There was no discerned association between the original artefacts' size or weight and the occurrence of breakage of the quartz and chert artefacts, except for a very weak association for narrower and thinner quartz artefacts being more likely to break. Overall, there was relatively little horizontal or vertical movement of the artefacts over the two weeks, with the largest size ranges moving the most, but with no significant difference in the movement of artefacts amongst the smaller size ranges.

1. Introduction

In recent years, experimental approaches for trampling identification have grown in archaeological research (Macphail et al., 2004; Eren et al., 2010; Miller and Sievers, 2012) due to the need for a correct identification and interpretation of anthropogenic features where activities affecting the integrity of artefacts may have occurred. While numerous researchers have examined the fracture mechanics of quartz from the perspective of knapping (Callahan, 1987; Knutsson, 1988; Tallavaara et al., 2010; Driscoll, 2011a) and the effects of burning (Driscoll and Menuge, 2011), there has been little attention given to the effects of trampling. Although Pargeter (2011) has undertaken a trampling experiment with quartz, this experiment used a limited amount of quartz flakes and a limited time period of trampling, and a quarter of the flakes was buried at a depth of 10 cm, and therefore were not part of a surface trampling experiment.

In order to remedy this gap in our knowledge concerning the effects of trampling on quartz artefacts, a large-scale human trampling experiment was carried out over two weeks in 2013 at the Upper Palaeolithic rock shelter at Cova del Parco in the Iberian Pre-Pyrenees. In total, 500 artefacts were placed in two trampling zones – with 400 in one zone and 100 in the other – 3 m apart in areas of differing soil compaction and trampling intensity. The soil composition was investigated through soil micromorphology samples taken on the last day of the experiment. The two trampling zones are described as: Zone 1, a high artefact density, low trampling intensity, lower soil compaction and rockiness; and Zone 2, a low artefact density, high trampling intensity, higher soil compaction and rockiness. The principal questions for the experiment were:

1. What is the difference in fracture rate between quartz and chert, and what effect does artefact dimension/weight have on the fracture rate?

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2. What is the difference in fracture types, including edge damage and 'accidental retouch' between quartz and chert?
3. What is the difference between zones of different artefact density?
4. What is the difference between zones of trampling intensity?
5. What is the difference between zones of differing soil compaction?
6. What is the difference between zones in terms of the horizontal and vertical movement of artefacts, and what effect does the varying dimensions/weight of artefacts have on this movement?

2. Materials and methods

2.1. Selection of experimental artefacts

An assemblage of 500 experimentally knapped artefacts (hereafter artefacts) were selected for the trampling experiment, with 23% (n = 115) chert artefacts used as a baseline to analyse the quartz. The quartz is xenomorphic quartz (vein quartz), knapped by hard hammer percussion from river cobbles collected from the River Segre in the Pyrenees and the chert was nodular chert knapped by hard hammer percussion from the Aquitanian Formation, collected in Aragón, close to the confluence of the Segre and Ebro rivers. The experiment location of Cova del Parco is along the River Segre in the Pre-Pyrenees. The raw material was knapped and artefacts were selected from the debitage primarily based on the variable of maximum length, divided into six size ranges (Table 1). The divisions into groups provided a proportionally approximate match based on the artefact length for the variables of artefact material and for the two zones of trampling, with Zone 1 (see below) containing 80% of the artefacts.

The grouped artefacts were divided between the two zones randomly using SPSS 21.0 (IBM, 2012) random number generator, with no statistically significant differences for the means for the six variables tested between the two zones for the materials individually or combined (Tables 2 and 3). Ideally, the use of the chert artefacts as a control would include artefacts of similar dimensions, but this was only possible for the variables of length and width due to quartz knapping generally producing relatively thicker, and consequently heavier, flakes (see Driscoll, 2011a). While the means between the materials were not statistically significantly different for length, width, or length/width ratio, they were significantly different for thickness, weight, and width/thickness ratio (Table 4). Therefore, the analysis proceeded cognisant of the fact that the two materials differed significantly in terms of relative thickness and weight.

2.2. Trampling grids set-up

The artefacts were placed in two 1 m^2 zones 3 m apart, with the two zones devised to represent areas of differing density of artefacts: Zone 1 contained 400 artefacts and Zone 2 contained 100 (Fig. 1). The two zones also represented differences in trampling intensity, with Zone 1 placed in area of less traffic compared to Zone 2, and areas of differing slope and soil composition (see micromorphology, Section 2.4). Fig. 1 presents a schematic of the experiment area, showing that Zone 2 was placed in a more restricted space than Zone 1, which entailed a higher degree of traffic over it as it acted as a narrow corridor of movement at the excavation site. While the differences in intensity of trampling were not quantified, observations of how people used the space over the

Table 1
Distribution of artefacts by size range, material, and zone.

Material	Zone	Size range (based on max. length)						Total
		>=10 < 15 mm	>=15 < 20 mm	>=20 < 25 mm	>=25 < 30 mm	>=30 < 35 mm	>=35 < 40 mm	
Chert	Zone 1	22	22	23	11	7	7	92
	Zone 2	6	5	6	3	1	1	22
	Total	28	27	29	14	8	8	114
Quartz	Zone 1	77	77	76	38	20	20	308
	Zone 2	19	20	19	10	5	5	78
	Total	96	97	95	48	25	25	386
Total	Zone 1	99	99	99	49	27	27	400
	Zone 2	25	25	25	13	6	6	100
	Total	124	124	124	62	33	33	500

Table 2
Means for pre-trampling artefacts by material.

Material		Length	Width	Thickness	Weight	L/W ratio	W/T ratio
Chert	N	114	114	114	114	114	114
	Mean	21.31	14.08	3.75	1.20	1.58	4.08
	Median	20.50	13.75	3.50	0.77	1.50	3.94
	Std. Deviation	7.368	4.963	1.659	1.355	0.452	1.357
Quartz	N	386	386	386	386	386	386
	Mean	21.17	14.23	5.62	2.29	1.60	2.81
	Median	20.00	13.15	4.80	1.15	1.44	2.69
	Std. Deviation	7.097	5.741	2.872	3.123	0.522	1.019
Total	N	500	500	500	500	500	500
	Mean	21.20	14.19	5.19	2.04	1.59	3.10
	Median	20.20	13.30	4.50	0.99	1.45	2.93
	Std. Deviation	7.152	5.569	2.757	2.855	0.507	1.225

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