

Chapter 26: Sedimentological Characterisation of Units 1667, 1556, 1570 and 1568

by

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Purpose

A number of laterally extensive but archaeologically 'barren' sedimentary units are seen in several trench-sections, such as 780, 794 and 975. The origin of these units is unknown, but are thought to represent natural depositional processes across the site. In an attempt to define the frequency of events, and sediment sources, deposits comprising units 1568, 1570, 1556 and 1667 from Section 975 (= Section E-E¹, Fig. 20, top) were analysed for particle size and mineral magnetic properties. Particle size differences can define subtle changes within archaeological contexts, and explore the nature of sedimentation, whether chaotic, pulsed or uniform. Differences in mineral magnetic characteristics can also distinguish such contrasts, and can in certain conditions allow sediment sources to be identified.

Methods

From Section E-E¹, thirty five contiguous samples of approximately 5.0 cm thickness were sampled into plastic bags in the field. These spanned 175 of the c. 210 cm of sediment, and encompassed all of contexts 1570, 1556 and 1667, the lower 1/3 of context 1568, and included one sample from the calcarenite marl 'havera' bedrock (Sample 35). Boundaries between all contexts are visually well-defined except that between 1667 and 1556.

Subsequently, eleven samples of sediment from areas close to the archaeological site were taken from shallow natural exposures to serve as comparanda for the mineral magnetic measurements of 'on-site' sediments, to try to identify possible sediment sources. The locations of these samples are defined in Table 26.1.

Particle size distributions for the 35 samples were obtained by dry sieving, and plotted as % by weight. Mineral magnetic measurements (mineralogy, concentration and domain state) on the particle size fraction <63 µm were obtained by measuring hysteresis loops using a vibrating sample magnetometer.

Data were plotted on TILIA, and constrained cluster analysis using Edwards & Cavalli-Sforza's chord distance square-root transformation (CONISS) was undertaken on the sedimentological and saturation magnetisation data.

Table 26.1. Descriptions of the 11 natural exposures, and their resultant saturation magnetisation (concentration) values

<i>No. Description</i>	<i>Magnetic concentration (Am²kg⁻¹)</i>
1 topsoil from c. 60 cm depth in Plot 137, 30 cm above surface of Plot 159 - archaeological deposits suggest this point to be within the archaeological site.	0.108
2 topsoil from c. 75 cm depth in Plot 138E - also from within the archaeological site <i>sensu lato</i> .	0.131
3 alluvium/colluvium in cultivation terrace c. 4 m above stream bed.	0.144
4 alluvium/colluvium c. 2 m above surface of Plot 171, 1.3 m below that of Plot 160, c. 6 m above stream bed - deposit contains historic period sherds.	0.067
5 compact & homogenous marl bedrock.	0.011
6 Ash-rich sediment containing many sherds, probably part of the archaeological site.	0.118
7 alluvium/colluvium c. 6.5 m above stream bed.	0.076
8 alluvium/colluvium with pebbles from near base of modern stream channel.	0.070
9 alluvium/colluvium with many small pebbles in a recent terrace c. 5 m above stream bed.	0.050
10 alluvium/colluvium with many small pebbles in the same terrace as (9) but c. 4 m above stream bed.	0.078
11 colluvium 0.5 m above surface of Plot 175, 1.5 m below surface of Plot 174, c. 2 m above stream bed.	0.082

Results

Particle Size Distributions

The sediments are almost exclusively sands; generally <14% of material in each sample is silt & clay, and <9% is of fine gravel grade (Table 26.2). Within this quite narrow range, the sediments are poorly sorted. The particle size distributions of the sediments are remarkably uniform and there are few significant differences. The *havera* calcarenite is noticeably coarser. This unit and Samples 22 and 12-14 are distinguished on CONISS, predominantly on their coarseness. Equally strong is the clustering of Samples 1-7. These sediments are much finer than all other units, and group very tightly together on cumulative size distribution curves; sedimentologically, these represent the same sediment type.

Table 26.2. Mean percentages of particle size distributions (n = 35)

Particle Size	Type	% by weight
<0.063 mm	silt + clay	14.01
0.063 - 0.212 mm	fine sand	25.50
0.212 - 0.5 mm	medium sand	19.99
0.5 - 2.0 mm	coarse sand	32.00
> 2.0 mm	fine gravel	8.27

Mineral magnetic measurements

Hysteresis loops of the 35 samples are all very similar in shape, suggesting a uniform mineralogy, and all suggest that the magnetic remanence carrier was pseudo-single domain ferrite, e.g., magnetite or maghemite. Differences between samples are seen only in the saturation magnetisation (the height of the hysteresis loop), which reflects concentration of magnetic minerals. The *havara* bedrock gives the weakest signal, and Samples 1-10 (Contexts 1570 and 1568) yield by far the strongest signals. Samples 1-5 are significantly stronger within this group. Magnetic concentrations in the samples are comparable with those obtained for archaeological soils from limestones in Italy (Tite and Linington 1986). It is possible that the magnetic signal is generated by topsoil enhancement (le Borgne 1955) through the conversion of weakly antiferromagnetic minerals (haematite or goethite) to strongly magnetic ferrimagnetic minerals (magnetite or maghemite). Two processes can account for such enhancement; fermentation, through decay of organic matter in reducing conditions and subsequent oxidation, and perhaps more important in archaeological contexts, burning, which induces anaerobic conditions during the fire but allows oxidation following the fire. This signal might imply that eroding topsoils were the source of sediment in Units 1570 and 1558, or that these units represent pedogenically altered sediment in a depositional hiatus.

Cluster analysis

The results of the cluster analysis suggest that the majority of archaeological contexts are not related to sedimentary units. Although the boundary between Units 1667 and 1556 is identified on CONISS, Unit 1667 is subdivided into three parts on slight differences in particle size distribution. There is, however, a consistent increase in the fine sand (>2 mm) fraction through this context, from very low values immediately above bedrock, and reaching a peak in Sample 22. Samples 21 to 8 are grouped together in an unconstrained cluster analysis, but are separated stratigraphically by the comparatively sand-rich Samples 12-14. Sample 8 is distinguished by its low clay content. Samples 7-1 are very similar, although they occur in two archaeological contexts, 1558 and 1570.

From these data, it can be suggested that sediment

deposition was not instantaneous, but occurred as phases. Three such phases are recognised (Samples 34-22, 21-8, 7-1), the latter two separated by thin bands of coarser sediment. Fining-up sequences such as can be generated on the waning stages of water-lain flows are not apparent. Indeed, trends within units are confined to the weakly exhibited coarsening-up sequence within the earliest unit, Unit 1667. Other units appear internally uniform.

Sediment sourcing

The eleven samples from localities around the archaeological site (Table 26.1) were analysed by measuring hysteresis loops (above). Ten samples are closely comparable, and only Locality 5 differs, in mineralogy, being dominated by paramagnetic minerals. Locality 5 is a sample from the *havara* bedrock, and the low magnetic concentrations (Table 26.1) conform with those from the same source in Section E-E¹. Magnetic concentrations of sediments at these localities range from 0.144 to 0.011 Am²kg⁻¹. The samples from Section E-E¹ are all within this range. Within this range, however, samples of topsoil (Localities 1 and 2) have higher concentrations, though not significantly higher, with values >0.10 Am²kg⁻¹, whereas six of the seven alluvial/colluvial localities have tightly clustered values of 0.05-0.08 Am²kg⁻¹ (mean of 0.070). This range is very close to those seen in archaeological contexts 1667-1568 and may infer similar sources.

Discussion

What is clear from both particle size and mineral magnetic studies is that the sediments preserved in these trench sections were not derived solely from exposed calcarenitic *havara* bedrock, but from some other source/s and by some transporting mechanism. Even those units with cumulative particle size distributions comparable with bedrock have different mineral magnetic concentrations. However, neither the origin or the sources of sediment have been clearly defined from this work. Particle size cannot adequately distinguish between colluvial and alluvial sources, although the poor sorting tends to suggest a colluvial origin. Other diagnostic data, such as internal bedding, are unobtainable. The mineral magnetic studies tend to suggest that two sources or processes contributed to the accumulating sediments. Units 1667-1556 may derive from either colluvium or alluvium; discrimination between these two different sources is hampered by the necessary vagueness in description of the natural exposures (Table 26.1), and because the identification of sediment sources, and the quantification of proportions of sediment from differing sources, require there to be strong differences in the magnetic mineralogy or domain state, which are not clearly demonstrable for the eleven 'source' localities analysed here. The failure may not be in the technique, but in the field-sampling, in not ad-

addressing the need to establish the full variability in source materials from areas at some distance and depth from the archaeological site.

Units 1570 and 1558 are distinguished by much higher magnetic concentrations (and slightly finer mean particle sizes, and may be induced through pedogenic changes in aerated topsoils (cf. le Borgne 1955). This might imply one of two sources for these contexts; either the erosion of topsoils, or the pedogenesis of underlying sediments.

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