Archaeology stinks!

Can we find ancient smells in the field?

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Olfaction has a significant role to play in human cognition and environmental adaptation. Smell taps into that part of the brain which controls our long-term memory, emotions, learning and behavioural capabilities (Engen 1982, 18–29, 97–110; Hamilakis 2002, 2010).

Field archaeology tends to only access visible and tangible material culture. The invisible has remained uncaptured and unchallenged. Questions about finding smell in the field have been raised but often dismissed (Bartosiewicz 2003, 175–195; Day 2013, 5). However, some archaeologists have been considering ways of finding smell in the field and are recognising smell as an important source material (Buckley et al 2001, 2007; Hardy 2018; Malik 2020).

Focusing on a ground-breaking technique, headspace sampling provides an innovative method of accessing ancient odour molecules for analysis. This method, used in conjunction with gas chromatography and mass spectrometry (GC-MS) processing, detects and identifies odour analytes (Hamm et al 2005).

As a 'tangible' primary source of evidence, the extrapolated data from this analysis can be used to more fully reconstruct past lived experiences by discussing the application of particular aromatic agents in broader sociocultural practices and our interpretations of these. Advances in scientific techniques can allow odour to be used as primary source evidence but can we excavate smell in commercial archaeology, and can we bring together multi-faceted engagement in past cultural contexts?

Considerations about which collection methods for odour compounds may be most useful, convenient, quick and easy to use, and least costly, are currently under investigation and full results will be shared in the new year. As part of a baseline olfactory reference point, soil samples for odour analysis have been collected from excavation and evaluation sites. Two methods for collection are being tested – finds bags (medium and small) and 20ml glass vials.

Finding smell in the field

Finding tangible evidence starts with the archaeologist collecting samples in the field. Samples can be collected from any environment, and any organic material remains are likely to have detectable odour compounds.

This need not be complicated, but rather innovative, by using existing methods of sampling incorporated into the daily routine of excavation and sample collection similar to those designed for small finds collections or environmental sampling in tins or 40L sample buckets. Essentially, what is required are containers that can be sealed and maintain inertia.

For tests in the lab, only small (between 5 to 10ml) amounts of soil are required. Placed into finds bags and glass vials, soil is taken from the excavated feature section and the natural; from evaluation sites: top, sub and natural soils. Collection is conducted using the finer point of a trowel or a small long-handled spoon for soil (utensils used for collecting other types of material remains will vary). Samples are taken as part of the recording process, thereby incurring little increase in time factor (no more than five minutes for sampling) and involving as little invasive activity as possible.

Different features and landscapes and various types of organic material may demand different methods of odour collection. For example, techniques for sedimentary sampling can be considered if gas-tight containers are used (Kibblewhite et al 2015, 249–263). A sealed Kubiena tin, an adsorbent 'trap' (Tenax) tube, or a Nalophan bag may also be used (Malik 2020).

Factors affecting sampling

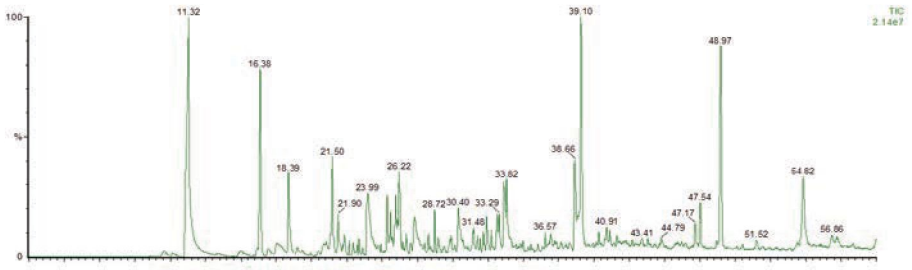
There are several factors to consider in collecting odour samples, apart from the containers used for sampling. These include the environmental impact of open and closed excavation sites, the time taken to collect samples and exposure to air before containment. Emission during collection could be an indication of degradation; the exudation from exposed soil would suggest that the odour compounds lying compacted within the soil are only emitted during disturbance.

Storage of collected samples may also pose problems for retention of odour molecules prior to lab analysis. For example, environmental exposure time in summer may require avoidance tactics (such as ice boxes) to reduce molecular degradation and maintain molecular inertia. The obvious answer is to freeze the contents to create inert molecules.

However, storing in conventional freezers has resulted in potential degradation occurring and crystallisation arising in samples collected in finds bags. A comparison test is being conducted whereby samples are not frozen to explore whether a headspace sampling technique would provide

similar results from molecules that have been allowed to remain active within the glass vial or finds bags.

Analysis in the lab will determine how these challenges may influence the final odour emanations and potentially how they compromise the samples, not only of soil but subsequent sampled material remains found within an excavated context.



(above) Example of what a graph looks like once the olfactory samples are put through the GC-MS process and turned into data. The peaks and troughs show the smell biomarkers. The peaks usually suggest what smelly compound is present. Further analysis using the software database shows the closest matches to what the odour compound might be.

Nevertheless, the presence of odour molecules in the archaeological record is still evident and samples collected by glass vial and finds bags will continue to be analysed – to discover how well odour compounds are retained and whether other strategies such as auguring should be considered – in order to determine the best sampling methods for use in the field.

The future of olfaction

Odour is integral and innate to human evolution and cognition. Smell, as a communicative process, actively enables material engagement and ontological development, informing our lived experience. Using an innovative technique that produces empirical data from *tangible* archaeological evidence permits us entry into previously unexplored sensorial sociocultural avenues that enable deeper, richer models of archaeological interpretation. But ultimately, the story of our past and finding ancient smells will, inevitably, largely depend on the research questions posed in the Written Scheme of Investigations and project designs, and begins with the field archaeologist excavating and collecting samples in the field.

Soil samples. Credit: Rose Malik

Rose Malik

Rose has been working as a commercial archaeologist since late 2018. She is currently researching odour sampling and analysis in the field for a PhD at Durham University, looking into developing a technique to find olfactory evidence from material remains.

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