

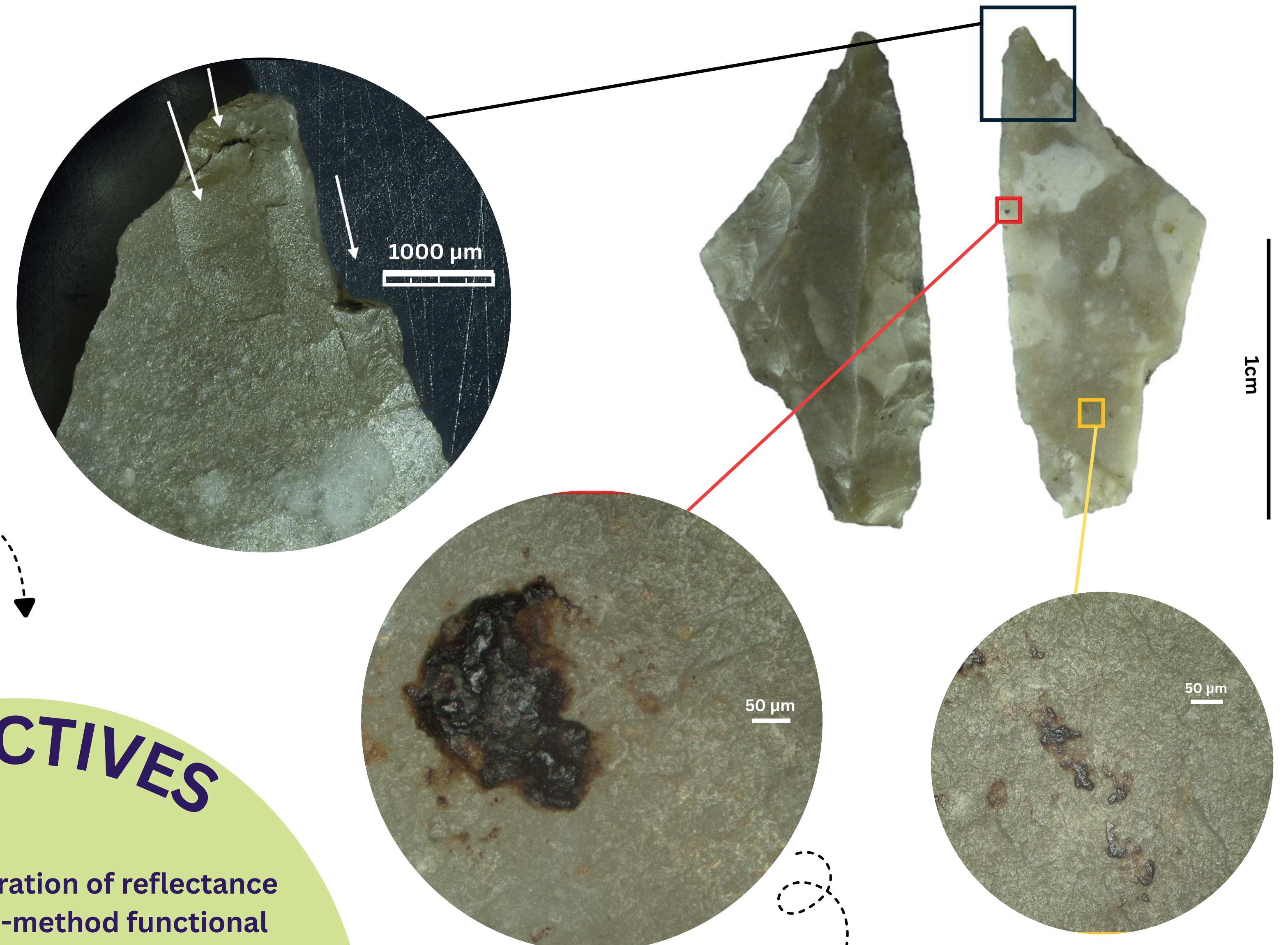
Integrating FTIR Spectroscopy into a Multi-Method Approach to Residue and Use-Wear Analysis of Stone Tools: Insights from Diepenbeek-Molenstraat

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INTRODUCTION

Reflectance-mode FTIR has become a powerful, non-destructive technique for reconstructing stone tool life cycles, from production and hafting to use and discard, through detailed residue and use-wear analysis. This study integrates reflectance FTIR with optical microscopy, SEM/EDS, and DHS-GC×GC-TOFMS to analyse Mesolithic lithics from Diepenbeek-Molenstraat (Belgium), a wetland site with exceptional organic preservation. By comparing spectra with established reference libraries, we demonstrate how reflectance FTIR enables identification of small residue deposits directly on tool surfaces, enhancing the reconstruction of tool use and maintenance.



OBJECTIVES

1. Assess the integration of reflectance FTIR within a multi-method functional framework
2. Understand residue preservation patterns in wetland environments
3. Evaluate FTIR sensitivity and reliability for detecting and identifying minute organic residues through comparison with known reference spectra collections

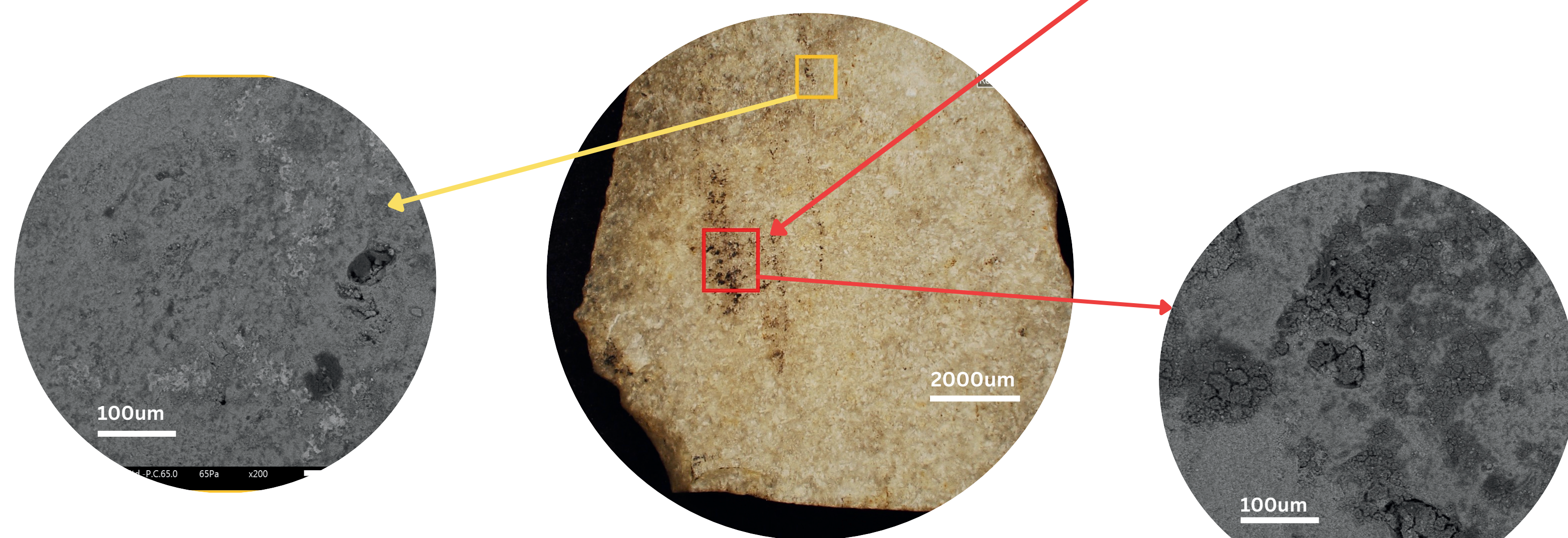
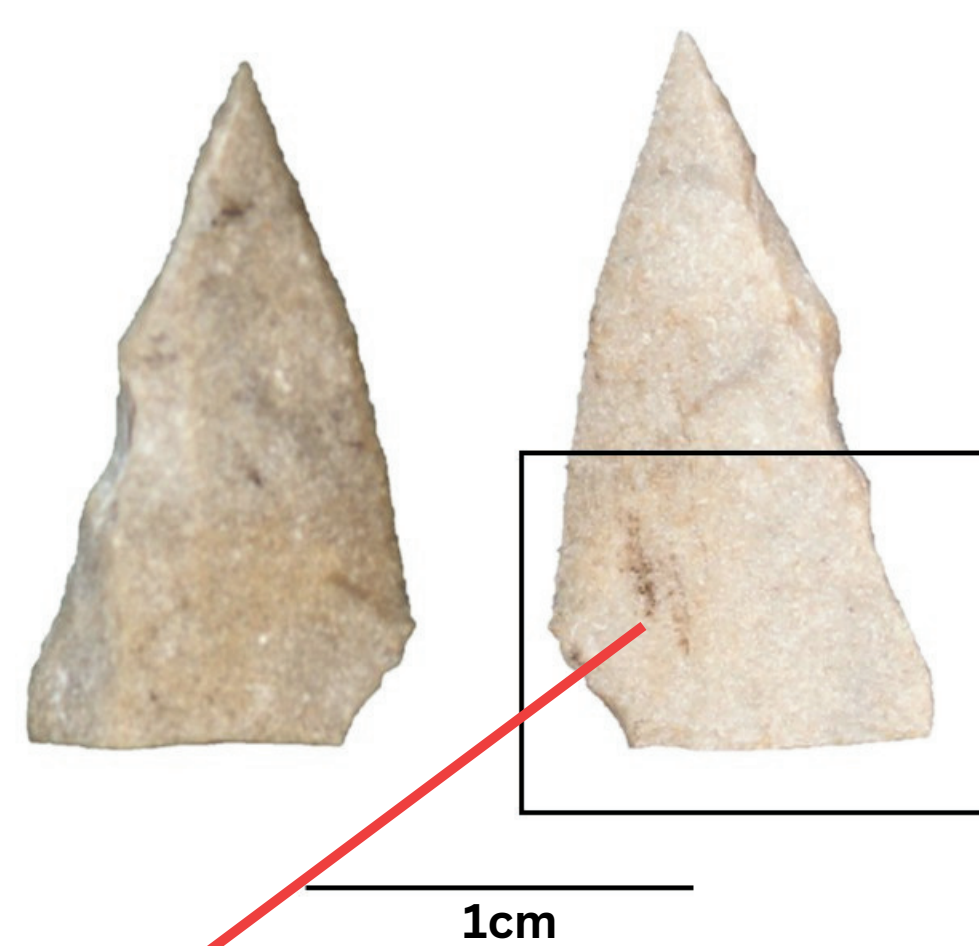
CHALLENGES

Incomplete references

Poor or mixed signals

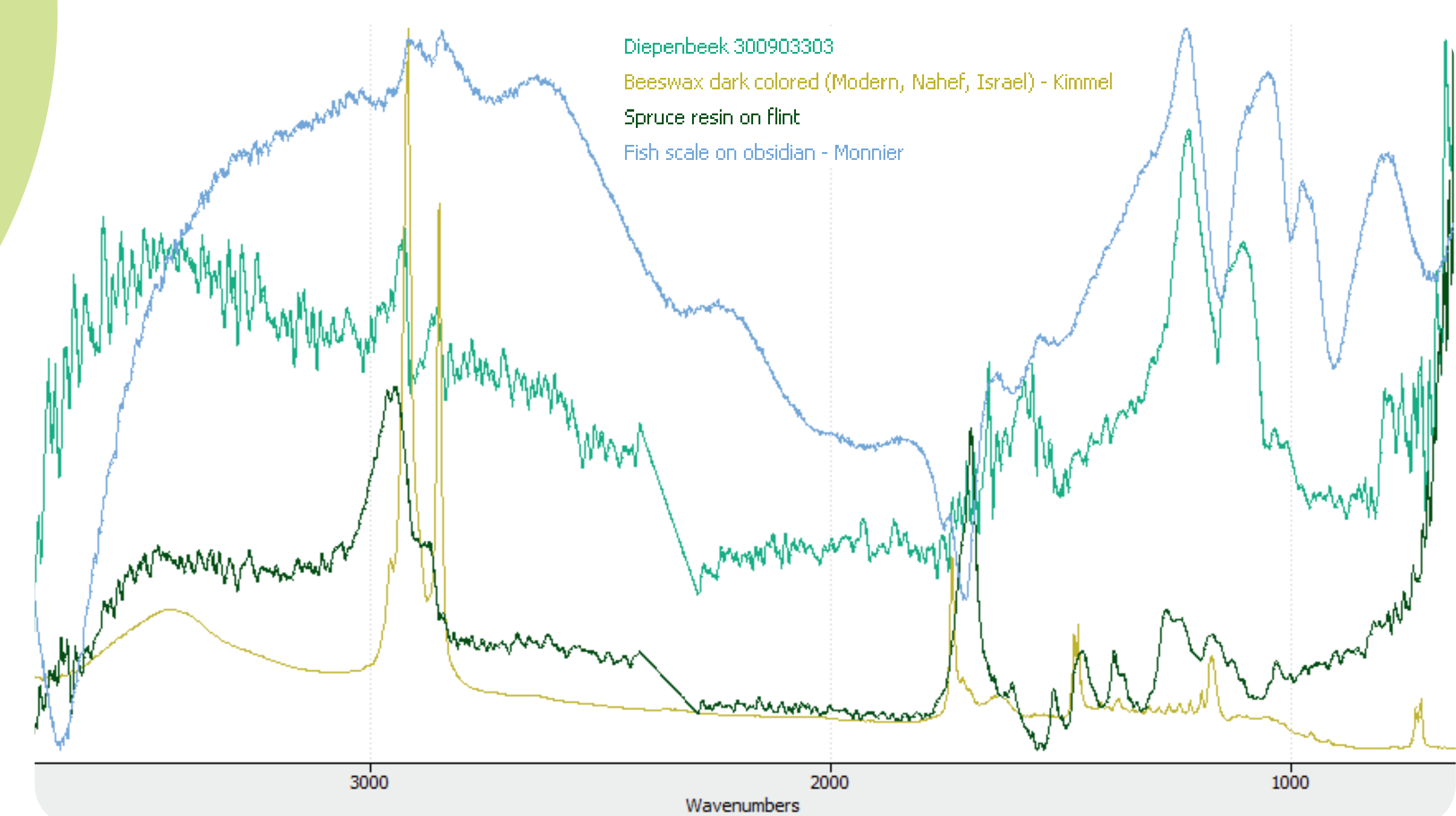
No standard protocols

Diagenesis



CONCLUSIONS

- Reflectance FTIR provides highly sensitive, non-destructive residue detection, even for small deposits on lithic surfaces
- Multi-method integration strengthens functional interpretations of Mesolithic stone tool use
- Comparison with established reference spectra collections increases analytical precision and interpretive confidence
- Comprehensive spectral reference databases are essential for maximising the analytical and interpretive potential of reflectance FTIR in archaeological residue studies



RESULTS

- Reflectance FTIR identified microscopic residue deposits directly on tool surfaces that were not always visible under optical magnification
- Integration with use-wear analysis clarified tool function
- Correspond most likely to spruce resin/beeswax mixtures, identified on five projectile points on their hafted parts
- Detection of uncommon residues, including fish scales, confirmed through spectral comparison with reference collections

