LETTER

The Zandmotor data do not resolve the question whether Middle Paleolithic birch tar making was complex or not

Patrick Schmidt[a,b,1], Maxime Rageot[a,c], Matthias Blessing[a], and Claudio Tennie[a]

Niekus et al. (1) present a find of Neanderthal birch tar from Zandmotor (The Netherlands), concluding that a cognitively complex underground production method was used. However, Schmidt et al. (2) recently showed that birch tar production can be simple [burning bark near stones: the condensation method (2)]. Two arguments are used by Niekus et al. (1) to claim that the Zandmotor tar was produced with a complex method: The efficiency of simpler techniques was too low, and their tar's composition indicates a complex technique. As we will argue, these arguments are invalid.

The Condensation Method's Efficiency

Producing 0.6 g of tar took 3 h with the condensation method (2), leading Niekus et al. (1) to calculate a 10-h production time for the Zandmotor tar. The experiment by Schmidt et al. (2) was done with one cobble to sequentially produce the tar. From the ~6:20-min video showing the process in Schmidt et al. (2), ~4:30 min correspond to bark burning and ~1:20 min to scraping off tar (i.e., the experimenter's full attention is required during one-third of time). One can use three cobbles simultaneously, or even more, if several people work together. As for the quantity of bark needed, up to 2,500 g can be harvested from a single living tree (3). If dead bark is used, 600 g of bark can be picked up from 80 m^2 (2). Thus, birch forests provide plenty of bark. These theoretical considerations on the efficiency of tar production techniques are problematic for making inferences about the likelihood that they were used in the past.

Zandmotor Tar Composition

Betulin, lupeol, and the absence of degradation markers in the Zandmotor tar would indicate production temperatures of ~350 to 400 °C (1), temperatures only reached with more complex production techniques (4). However, the condensation method also produces betulin and lupeol (2). Soft-heating degradation markers [lupa-2,20(29)-dien-28-ol; α-betuline I; lupa-2,20(29)-diene] form already <350 °C (3). Lupa-2,20(29)-dien-28-ol and lupa-2,20(29)-diene also form by postdepositional decay (5). No temperatures were published in Niekus et al. (1), and compositions of experimental tars produced in Kozowyk et al. (4) were not provided, i.e., we lack crucial data to compare the Zandmotor tar with experimental tar. Charcoal/mineral inclusions in the Zandmotor tar are said to indicate complex production (1). However, birch tar was kept and transported over long time periods in the past (3, 6). Tar is malleable and recyclable, and may result from several sessions [causing homogenization of inclusions during its life cycle—just as found by Niekus et al. (1)]. Thus, impurities cannot unambiguously be linked to specific production techniques.

Conclusion

Data presented in Niekus et al. (1) are explainable by different techniques and do not allow pinpointing of the complexity of Paleolithic tar making. We cannot rely on intuition or measures of effectiveness (1) to solve such debates. Contrary to what Niekus et al. (1) suggest, Schmidt et al. (2) never debate the degree of Neanderthal technological innovation—if anything, the conclusion of Schmidt et al. (2) is one of sophisticated innovativeness of Neanderthals. Schmidt et al. (2) merely show that Middle Paleolithic tar making must not necessarily be a complex process.

[a]Department of Early Prehistory and Quaternary Ecology, Eberhard Karls University of Tübingen, 72070 Tübingen, Germany; [b]Applied Mineralogy, Department of Geosciences, Eberhard Karls University of Tübingen, 72074 Tübingen, Germany; and [c]Department of Prehistory and Protohistory, Ludwig-Maximilians University Munich, 80539 Munich, Germany

Author contributions: P.S. and C.T. designed research; P.S. performed research; P.S. analyzed data; and P.S., M.R., M.B., and C.T. wrote the paper.

The authors declare no competing interest.

[1]To whom correspondence may be addressed. Email: patrick.schmidt@uni-tuebingen.de.

First published February 11, 2020.

1 M. J. L. T. Niekus *et al*., Middle Paleolithic complex technology and a Neandertal tar-backed tool from the Dutch North Sea. *Proc. Natl. Acad. Sci. U.S.A.* **116**, 22081–22087 (2019).

2 P. Schmidt *et al*., Birch tar production does not prove Neanderthal behavioral complexity. *Proc. Natl. Acad. Sci. U.S.A.* **116**, 17707–17711 (2019).

3 M. Rageot *et al*., Birch bark tar production: Experimental and biomolecular approaches to the study of a common and widely used prehistoric adhesive. *J. Archaeol. Method Theory* **26**, 276–312 (2019).

4 P. R. B. Kozowyk, M. Soressi, D. Pomstra, G. H. J. Langejans, Experimental methods for the Palaeolithic dry distillation of birch bark: Implications for the origin and development of Neandertal adhesive technology. *Sci. Rep.* **7**, 8033 (2017).

5 E. M. Aveling, C. I. Heron, Identification of birch bark tar at the Mesolithic site of Star Carr. *Anc. Biomol.* **2**, 69–80 (1998).

6 F. Sauter, J. Ulrich, A. Graf, W. Werther, K. Varmuza, Studies in organic archaeometry I: Identification of the prehistoric adhesive used by "Tyrolean Icemen" to fix his weapons. *ARKIVOC* **5**, 735–747 (2000).