University of Groningen

Is there an 'aquatic' Neolithic?

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DOI:
[10.33612/diss.157185365](https://doi.org/10.33612/diss.157185365)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2021

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Bondetti, M. (2021). *Is there an 'aquatic' Neolithic? New insights from organic residue analysis of early Holocene pottery from European Russia and Siberia*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen. <https://doi.org/10.33612/diss.157185365>

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Is there an “Aquatic” Neolithic?

New insights from organic residue analysis of early Holocene pottery from European
Russia and Siberia

PhD thesis

to obtain the degree of PhD at the
University of Groningen
on the authority of the
Rector Magnificus C. Wijmenga
and in accordance with
the decision by the College of Deans.

and

to obtain the degree of PhD at the
University of York
on the authority of the
Vice-Chancellor and President Prof. Charlie Jeffery
and in the accordance with
the decision by the Dean of the York Graduate Research School

Double PhD degree

This thesis will be defended in public on

Monday 1 February 2021 at 14.30 hours

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**Is there an “Aquatic” Neolithic?
New insights from organic residue
analysis of early Holocene pottery from
European Russia and Siberia**

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University of York and University of Groningen

(Under a double doctoral degree programme)

Department of Archaeology

December 2019

*« Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so
that way we may fear less »*

Marie Skłodowska Curie

Abstract

English abstract

This thesis investigates the function of early Holocene hunter-gatherer ceramic vessels in northern Eurasia. It presents the first systematic application of organic residue analysis (ORA) to Early Neolithic pottery from European Russia and Siberia. During the early Holocene (ca. 9,700 to 5,000 cal BC) pottery was widely produced by hunter-gatherers across Eurasia. One existing theory suggests that the advent of pottery was linked to an intensification of aquatic resource exploitation; the so-called “Aquatic” Neolithic (Gibbs et al. 2017). This theory is supported by recent ORA of early pottery from eastern Asia and northern Europe, where lipid markers derived from aquatic resources were frequently encountered, absorbed in the pots themselves. One area neglected by ORA is the vast territory of what is now Russia where the arrival of pottery marks the start of the Neolithic period, predating agriculture by several thousand years. Despite its importance in defining the Neolithic in this region, little is known about how early pottery was used and what drove its adoption during the early Holocene. Here, ORA was applied to 417 samples, representing 314 ceramic vessels, recovered from three important early Neolithic sites: the East Siberian site of Gorelyi Les, and Rakushechny Yar and Zamostje 2 in the southern and northern part of European Russia respectively. Overall, the results generated by this thesis indicate much greater diversity in the use of early pottery than predicted from the “Aquatic” Neolithic theory. While aquatic products were indeed prevalent at many sites, lipids derived from terrestrial plants and animals were also common and, overall, the initial use of pottery seems to have varied according to the regional context. These results challenge the idea that the widespread adoption of pottery by Holocene Eurasian foragers was driven primarily by the need to process aquatic resources.

Samenvatting in het Nederlands

Dit proefschrift onderzoekt de functie van jager-verzamelaars aardewerk in Noord-Eurazië gedurende het vroeg Holoceen. Het omvat de eerste systematische toepassing van organische residu-analyse (ORA) op vroeg-Neolithisch aardewerk uit Europees Rusland en Siberië. Tijdens het vroeg Holoceen (ca. 9.700 tot 5.000 cal v. Chr.) werd aardewerk geproduceerd door jager-verzamelaars in heel Eurazië. Een bestaande theorie suggereert dat de eerste opkomst van aardewerk verband hield met een intensivering van de exploitatie van aquatische soorten: het zogenaamde "Aquatic Neolithic". Deze theorie wordt ondersteund door recente ORA van vroeg aardewerk uit Oost-Azië en Noord-Europa, waar zogeheten "biomarkers", afkomstig van aquatische bronnen, vaak werden aangetroffen, geabsorbeerd in het aardewerk zelf. Een gebied waar ORA nog niet eerder is toegepast is het uitgestrekte grondgebied van wat nu Rusland is. Hier markeert de komst van aardewerk het begin van het Neolithicum, dat hier duizenden jaren ouder is dan de landbouw. Ondanks het belang van aardewerk bij het definiëren van het Neolithicum in deze regio, is er weinig bekend over de functie, en waarom het in gebruik genomen werd tijdens het vroeg Holoceen. In dit onderzoek werd ORA toegepast op 417 monsters, die 300 aardewerken potten vertegenwoordigen, afkomstig van drie belangrijke vroeg Neolithische vindplaatsen: de Oost-Siberische vindplaats Gorelyi Les, en Rakushechny Yar en Zamostje 2 in respectievelijk het zuidelijke en noordelijke deel van Europees Rusland. Al met al duiden de resultaten van dit proefschrift op een veel grotere diversiteit in het gebruik van vroeg aardewerk dan voorspeld op basis van de "Aquatic Neolithic" theorie. Hoewel aquatische producten inderdaad op veel vindplaatsen prominent aanwezig waren, kwamen lipiden afkomstig van planten en landdieren ook veel voor in het aardewerk. Over het algemeen lijkt het aanvankelijke gebruik van aardewerk te variëren afhankelijk van de regionale context. Deze resultaten betwisten het idee dat de wijdverbreide adoptie van aardewerk door Holocene Euraziatische jager-verzamelaars voornamelijk werd gedreven door de noodzaak om aquatische soorten te verwerken.

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Acknowledgments

During my PhD, I had the pleasure and the chance to meet many amazing people from various backgrounds and origins who enriched me both scientifically and humanly and who deserve to be thanked for their support and/or involvement in this project.

I would like to begin by expressing my heartfelt thanks to my supervisors Oliver E. Craig and Peter Jordan for the trust they have placed in me and for giving me the opportunity to work on this project. I am deeply grateful to them for sharing their knowledge and advice. I consider myself extremely fortunate to have been able to work alongside them. Special thanks to Oliver for his unfailing enthusiasm and support during my research at York, but also for all the pleasant and convivial moments spent at scientific conferences, during the sampling campaigns, or simply enjoying a beer in the pub.

This research was undertaken with the support of the European Union EU Framework Programme for Research and Innovation Horizon 2020 under Marie Curie Actions, ArchSci2020 program (Grant Agreement No 676154). I am grateful to have been able to join this programme, which has given me the opportunity to live unforgettable experiences through numerous trips to many countries. This mobility programme also gave me the chance to discover and immerse myself in two different cultures, England and the Netherlands, which over the last 3 years have been my home. Through this programme I also have been lucky to meet many interesting and inspiring people. My first thoughts go to the ArchSci2020 students: Alison Harris, Anne-Marijn Snaaijer, Anne Katrine Runge, Aripekka Junno, Eden Slidel, Jack Dury, Jonas Niemann, Madison Llewellyn, Maiken Bro-Jørgensen, Mariana Muñoz-Rodríguez, Özge Demirci, Tatiana Feuerborn, Theis Jensen and Xénia Keighley who have been a kind of brothers-in-arms during these three years of the doctoral program like no other. They are all extraordinary people and I am very glad to have met them. I sincerely hope to have the opportunity to work with them in the near future.

Among them, I would like to especially thank Anne Katherine for her kindness and positive presence, as well as Jonas for his constant good mood and deep generosity. I am particularly delighted to have had the chance to spend more time with Jonas over the past year, even though he keeps saying that Italian cheeses are better than French cheeses. Whatever, no one is perfect!!! Their presence and support have been particularly precious during the last months of (difficult) writing. Finally, a warm thank you to Özge for his constant support during these three years. Thank you for all the cards you

sent me, always accompanied by beautiful words to give me more strength and energy, for all our discussions about our ability to complete the thesis, but also for all our travel plans together (there are already so many!!!). You are an incredible person and you will always keep a special place in my heart.

Beyond the ArchSci2020 program, my thoughts also go out to all my colleagues and friends at BioArCh and the Arctic Centre with whom I have spent a lot of time, whether in the lab, in the office or in various activities outside of work. They have been a sort of surrogate family during my three years in York and Groningen! I would like to thank them for all their kindness, support, assistance, advice and above all for their tolerance and patience in dealing with my chaotic English.

Among them, I would particularly like to extend my warmest and most sincere thanks to those who have made a real impact on these three years of doctoral studies, hoping that I will not forget anyone:

- Aurélie Manin, Léa Drieu and Brice Durand, my French team in York. Thanks also for all the crêpes (not forgetting the Nutella and Bananas), fondue and raclette parties, warming up the York nights!!! Aurélie and Brice I also owe you a great thank you for always offering me a place to sleep when I was "homeless".
- Miriam Cubas, my Lab partner, for her perpetual smile and her zest of life, bringing with her every day the sun that we miss so much in the NORTH, especially during the short winter days! Your presence and enthusiasm during my first year of thesis was fundamental to my well-being. Thank you also for letting me listen to my French music in the laboratory!!!
- Eirik Haug Røe for all the coffee breaks we spent together at the Arctic Centre, during which we dreamed and made plans about going skiing in Norway and France. I will never forget all our cycling adventures and giggles either.
- Giovanna Ganzarolli who has been an immeasurable support during my first months of adaptation in my new life in York. I really hope our paths will cross again.
- Matthew von Tersch who endured all my requests for which he always answered with a smile, even when it involved shovelling to bury and dig up my pottery. I was also honoured to work

alongside a great icon of English cinema!!! To that, one more thanks for your incredible “Secret Santa” gift from, I could not have asked for anything better.

- Marjolein Admiraal for his craziness and energy. She is an extraordinary and inspiring woman, full of talent and surprises. As a touch of madness brightens lives, I really hope to keep you by my side for as long as possible, ideally always accompanied by a glass of Côtes-du-Rhône!!! On top of being my friend, she has also been my official/non-official English proof-reader and my Dutch translator. For that, another big thank you.

- ALEX Lucquin for his unwavering support and for having been my personal psychologist during these three years of PhD. I am very grateful for your help, advice and especially your patience. You always made me feel welcome every time I came to your office with all my questions and concerns!!! You are probably one of the kindest people I have ever met. I would also like to take this opportunity to apologize for harassing you with all my questions!!! Unfortunately for you, I am not going to stop anytime soon, and you will probably have to endure me for a while yet!!!

Thank you all very much, you are all my heart.

I also owe a great thank you to all my co-authors, for the discussions and collaboration during the project, without whom this work would not have been possible.

Last, but not least I would like to deeply thank Matthieu Junca for supporting me, for many years now, in this unusual project of working with archaeological material. I will always be very thankful to him for always letting me pursue my aspirations and ambitions, even at the price of many sacrifices. I would also like to thank him for his patience and for always finding the right words to restore my confidence, which so often leaves me. Finally, I would like to express my gratitude to my family whose love and positive support over the years has been a constant force. I would particularly like to thank my parents who have always encouraged and pushed me to continue to seek out the profession that I am passionate about and that makes me happy to wake up each morning. I also thank them for teaching me that work is essential to achieving one's goals.

Author's declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References. The work carried out as part of this thesis has resulted in the following publications:

Manon Bondetti, Sofia Scott (Chirkova), Alexandre Lucquin, John Meadows, Olga Lozovskaya, Ekaterina Dolbunova, Peter Jordan, Oliver E. Craig (2020). Fruits, fish and the introduction of pottery in the Eastern European plain: Lipid residue analysis of ceramic vessels from Zamostje 2. *Quaternary International* 541, 104–114.

Manon Bondetti, Erin Scott, Blandine Courel, Alexandre Lucquin, Shinya Shoda, Jasmine Lundy, Catalina Labra-Odde, Léa Drieu, Oliver E. Craig. Investigating the formation and diagnostic value of ω -(o-alkylphenyl)alkanoic acids in ancient pottery. *Archaeometry* - *Submitted*.

Manon Bondetti, Alexandre Lucquin, Nikolai A. Savel'ev, Andrzej W. Weber, Andrzej, Oliver E. Craig, Peter Jordan. Resource-Processing, Early Pottery and the Emergence of Kitoi Culture in Cis Baikal: Insights from Lipid Residue Analysis of an Early Neolithic Ceramic Assemblage from the Gorelyi Les Habitation Site, Eastern Siberia. *Archaeological Research in Asia* - *Submitted*.

The following paper is in the process of being prepared for submission:

Manon Bondetti, Lara González Carretero, Ekaterina Dolbunova, Krista McGrath, Sam Presslee, Alexandre Lucquin, Viktor Tsybriy, Andrey Mazurkevich, Andrey Tsybriy, Peter Jordan, John Meadows, Oliver E. Craig. On the boundary of the “hunter-gatherer” and agricultural “Neolithic”: subsistence and culinary practices at the site of Rakushechny Yar in the Lower Don. Being submitted to *Archaeological and Anthropological Sciences*.

Manon Bondetti

Abbreviations

‰: per mille

%C: % Carbon

%N: % Nitrogen

ACL: average chain length

APAA: ω -(o-alkylphenyl)alkanoic acids

AR: alkylresorcinols

BC: before Christ

BP: before present (by convention, the year 1950 is used as the commencement date)

BSTFA: N,O-Bis(trimethylsilyl)trifluoroacetamide

C_x:_y: fatty acid with x carbon atoms and y unsaturation

C_x: linear alkane with x carbon atoms

Ca.: circa

Cal.: calibrated ¹⁴C dates on the calendar years

C:N: carbon-nitrogen ratio

CPI: carbon preference index

DAG: diacylglycerol

DHA: dehydroxyabiatic acid

DHYAs: dihydroxy fatty acids

DMDS: dimethyl disulfide

EA-IRMS: elemental analyser-isotope ratio mass spectrometry

EN: Early Neolithic

ESI: electrospray ionization

GC-MS: gas chromatography-mass spectrometry

GC-C-IMRS: gas chromatography-combustion-isotopic ratio mass spectrometry

GC-Q-ToF-MS: gas chromatography-quadrupole-time-of-flight mass spectrometry

HCL: hydrochloric acid

HPLC: high performance liquid chromatography

IFAs: isoprenoid fatty acids

K_x: linear alkanone with x carbon atoms

L: litre

m/z: mass to charge ratio

MAG: diacylglycerol

MALDI: matrix assisted laser desorption ionisation

MN: Middle Neolithic

µg: microgram

mg: milligram

MS: mass spectrometry

PCA: principal component analysis

pH: a logarithmic scale for expressing the acidity or alkalinity of solution

PUFAs: polyunsaturated fatty acids

P/S ratio: palmitic/stearic ratio

PTME: pentacyclic triterpene methyl ether

SEM: scanning electron microscopy

SRR: 3S,7R,11R,15-phytanic

RRR: 3S,7R,11R,15-phytanic

RY: Rakushechny Yar

Tx: triacylglycerol with x carbon atoms

TAG: Triacylglycerol

TFA: trifluoroacetic acid

TMTD: 4,8,12-trimethyltridecanoic acid

ToF: time of flight

UFA: unsaturated fatty acid

UPLC-HRMS: high-performance liquid chromatography–atmospheric pressure chemical ionization-mass spectrometry

v/v: volume per volume

Wx: wax ester with x carbon atoms