TOPICAL REVIEW – TEMATICKÁ SYNTÉZA

Far from home: Stroke-Ornamented Ware and grog temper in the Polish Lowlands

Daleko od domova: Vypíchaná keramika a příměs drcené keramiky v Polské nížině

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After the disappearance of the Linear Pottery culture (LBK) in the area now known as the Polish Lowlands, we observe a heterogeneous cultural situation. The Late Band Pottery culture (LBPC) and the Stroke-Ornamented Ware culture (SBK) are distinguished here. Generally, none of these communities used grog (ground potsherds, 'chamotte') as the main type of clay temper. However, there are exceptions to these production rules. In this article, the presented pottery materials from sites in the Polish Lowlands allow us to conclude that grog temper was important for some of these communities. An attempt to interpret the addition of fragments of other vessels to the pottery clay does not point to the technical advantages of the chamotte itself, but rather to its symbolic meaning – the use of fragments of burned vessels to produce new forms. A great deal of ethnographic data justifies this approach, which is sometimes used in archaeological interpretations. The proposed hypothesis allows us to consider an alternative concept of the origin of some post-LBK communities in the Polish Lowlands.

Late Band Pottery culture – Stroke-Ornamented Ware culture – Stichbandkeramik – grog temper – pottery technology

Po zániku kultury s lineární keramikou (LBK) v oblasti dnes známé jako Polská nížina pozorujeme heterogenní kulturní situaci. Je zde rozlišována pozdní kultura s lineární keramikou (LBPC) a kultura s vypíchanou keramikou (SBK). Obecně platí, že žádná z těchto komunit nepoužívala drcenou keramiku („šamot") jako hlavní typ keramické příměsi. Existují však výjimky z těchto výrobních pravidel. Keramický materiál z lokalit v Polské nížině prezentovaný v tomto článku umožňuje vyvodit závěr, že příměs drcené keramiky byla pro některé z těchto komunit důležitá. Pokus o interpretaci přidávání zlomků jiných nádob do hrnčířské hlíny nepoukazuje na technické přednosti samotného šamotu, ale spíše na jeho symbolický význam – využití zlomků vypálených nádob k výrobě nových forem. Četná etnografická data ospravedlňují tento přístup, který je někdy využíván i v archeologických interpretacích. Navržená hypotéza umožňuje uvažovat o alternativním pojetí vzniku některých post-LBK komunit v Polské nížině.

pozdní kultura s lineární keramikou – kultura s vypíchanou keramikou – Stichbandkeramik – šamotová příměs – technologie keramiky

Introduction

Pottery decorated with stroke ornament is found among the materials of communities that developed in what is now known as the Polish Lowlands after the disappearance of the Linear Pottery culture (LBK) around 5100 BC (*Whittle et al. 2022*). In the lowlands between the Vistula and Odra rivers, the excavated archaeological remains have no analogues outside this area. This largely indicates the emergence of a new cultural unit known as the Late Band Pottery culture (LBPC) (*Fig. 1*; *Czerniak 1980*; *Czerniak – Pyzel 2019*). The term is associated with a broader concept allowing the LBPC community to be derived

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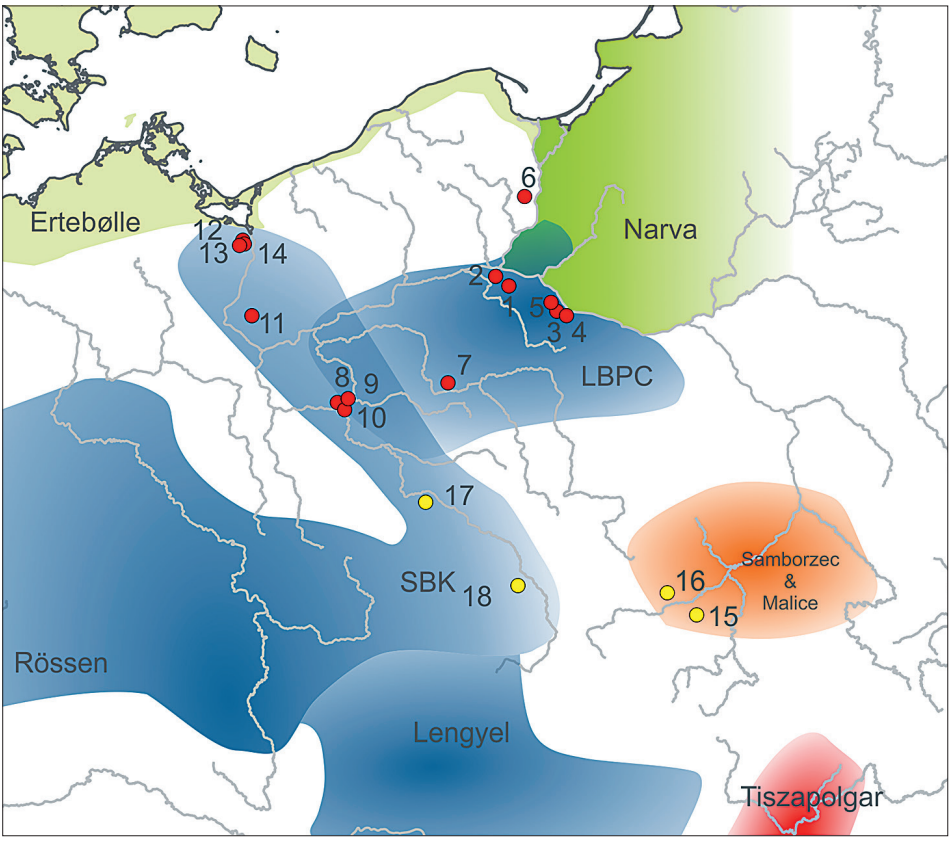

Fig. 1. North-central Europe around 4800–4500 BC. Sites mentioned in the text: Red points label SBK/LBPC sites: 1 – Węgierce 12; 2 – Gorzyce 38; 3 – Ludwinowo 7; 4 – Ludwinowo 6; 5 – Dubielewo 8; 6 – Barłożono 12; 7 – Kijewo 4; 8 – Święty Wojciech 7; 9 – Międzyrzecz 108; 10 – Międzyrzecz 11; 11 – Nowe Objezierze 22; 12 – Przylep 5; 13 – Szczecin-Gumieńce 17; 14 – Mierzyn 9. Yellow points label sites from outside the Polish Lowlands that have been radiocarbon dated: 15 – Targowisko 10–11; 16 – Kraków-Olszanica 2; 17 – Strachów 2; 18 – Racibórz Ocice 1 (based on *Czerniak 2012*; *Řídký et al. 2017*; *Czerniak – Pyzel 2019*).

from local LBK groups. The currently revealed chronological hiatus between the LBK and LBPC was likely caused by a crisis experienced by the first farmers communities that forced them to abandon permanent settlements and agriculture and instead base their existence on animal husbandry and temporary settlements. The result was the emergence of communities classified as the LBPC (*Czerniak – Pyzel 2019*, 62). The further stage of their development associated with the Brześć Kujawski culture (BKC) is characterised by renewed economic and settlement stabilisation appearing, among other ways, as multi-phase settlements featuring trapezoidal longhouses.

Not all researchers of the Polish Lowlands accept the development of the LBPC and some of the local materials have been classified directly as the Stroke-Ornamented Ware culture (*Stichbandkeramik*, SBK, e.g. *Kulczycka-Leciejewiczowa 2006*; *Grygiel 2008*), which poses additional problems for interpretation. Current representations of the SBK and LBPC 'range' (*Řídký et al. 2017*, 580, fig. 1; *Czerniak – Pyzel 2019*) indicate that in

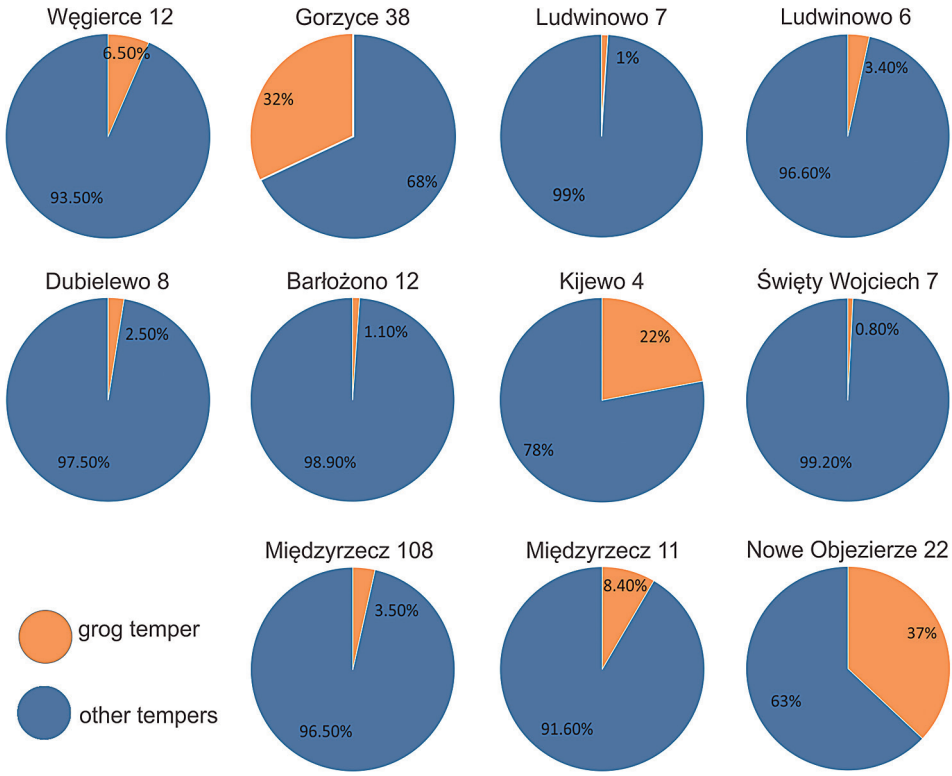

Fig. 2. LBPC/SBK sites featuring pottery with grog temper and its percentage share in pottery assemblages. For site locations see *Fig. 1*.

the Polish Lowlands, the paths of both communities, especially in the Odra Valley zone, actually ran very close and it is impossible to establish a clear border between them.

A much more distinct border during the Stroke-Ornamented Ware period can be drawn along the Vistula River. This demarcation is a reference to a broader hypothesis assuming that SBK communities in Central Europe were divided into specific zones differentiated by types of tempers used for pottery production (*Czerniak 1989*; *1994a*). The border of the proposed zones is thought to be located at the meridian course of the Danube River. The first zone, east of this section of the river, is characterised by the use of grog tempers (ground potsherds, 'chamotte'); the second zone, west of the Danube, is defined by the dominance of mineral tempers. Extending this border further north places it on the upper reaches of the Vistula, which, to the east of this section, was inhabited by communities that actually used grog temper. West of the Vistula up to its mouth, communities that added mineral tempers to the pottery clay were recorded. Therefore, according to this hypothesis, the area in which SBK and LBPC communities occurred belongs to the zone in which grog temper is of 'foreign' origin.

However, a recent analysis of materials from the LBPC site of Gorzyce located on the border of Kuyavia and Greater Poland revealed a significant share of pottery decorated with stroked ornament and made with grog temper (*Fig. 1*; *Fig. 2*; *Żurkiewicz et al. 2023*).

It also stimulated the search for further lowland analogies and aroused a discussion and interpretation of the procedure by which grog was added to vessels in the considered period of prehistory. This paper aims to review the LBPC/SBK sites from the Polish Lowlands where grog temper was identified as an addition to pottery decorated with stroke ornament and attempts to interpret this phenomenon.

Assemblages with grog temper in the Lowlands

The discussion on the presence of grog temper in pottery with stroked ornament in the Polish Lowlands began with discoveries from site 12 in Węgierce in the Kuyavia region of Poland (*Czerniak 1992*). A relatively small assemblage of pottery excavated from a clay pit was dated to the first phase of the LBPC. Of the 662 recorded pottery fragments (sherds), 43 (6.5% of the total) were classified into a new technological group: medium- and thick-walled pottery with a temper of fine sand and grog. Based on stylistic references (mainly 'stroked band' pottery), the author of the study argued that the materials were connected with the zone of Lower Silesia and the Czech Republic. The trace presence of 'chocolate' flint and grog in the ceramics from Węgierce is thought to be the result of contacts between the inhabitants of this settlement and Lesser Poland, perhaps with the Malice culture (MC) (*Czerniak 1992*, 46). In addition to the stylistic indications that the materials from Węgierce are from one of the earliest LBPC sites in the Lowlands area, a single radiocarbon date (Gd-2509 5860 ± 100 BP; *Czerniak 1994b*) is also available. Unfortunately, the date from an animal bone found in the clay pit described above is quite imprecise and marks the interval between 4988–4463 cal BC at 95.4% probability (*Tab. 1*).

Site no. 38 in Gorzyce is the newest on the list considered here and its recent excavation initiated the topic discussed in this article. In the complex of eight LBPC clay pits, 303 sherds from approximately 103 pottery vessels were documented (*Żurkiewicz et al. 2023*). The high frequency of decorated pottery (64%) is accompanied by the absolute dominance of the stroke technique performed on vessels with thin and medium-thick walls. The vast majority of vessels (up to 68%) were made with grog temper (*Fig. 3*).

Other sites in Kuyavia for which publications mention the presence of grog temper include Ludwinowo site 7, where pits, houses, and other LBPC household activity features were excavated (*Czerniak 2019*). Approximately 1% of LBPC pottery fragments from this site belong to technological groups containing grog. It is interesting that the custom of adding grog to ceramics is to a small extent visible also among the BKC – the successors of the LBPC at this site (*Czerniak 2019*, 162, tab. 3.3). A date obtained from a LBPC grave indicates the range of 4449–4330 cal BC (95.4%). An analysis of the stylistic attributes of this assemblage did not indicate any analogies outside Kuyavia.

In the same town, at Ludwinowo site 6 (*Czerniak 2017*, 213, tab. 2), the other LBPC settlement features were also excavated and included a pit house, a clay pit, and a 'special' feature (grave – cenotaph?). The assemblage excavated at the site includes 559 potsherds and eight flints. From this collection, approximately 19 sherds (3.4%) were made using sand with grog temper. The study did not identify any references to non-regional external styles of pottery decorated with stroked ornament.

In another Kuyavia settlement, at site 8 in Dubielewo, materials related to the LBPC and BKC were discovered. Graves (at least four features) and several household activity

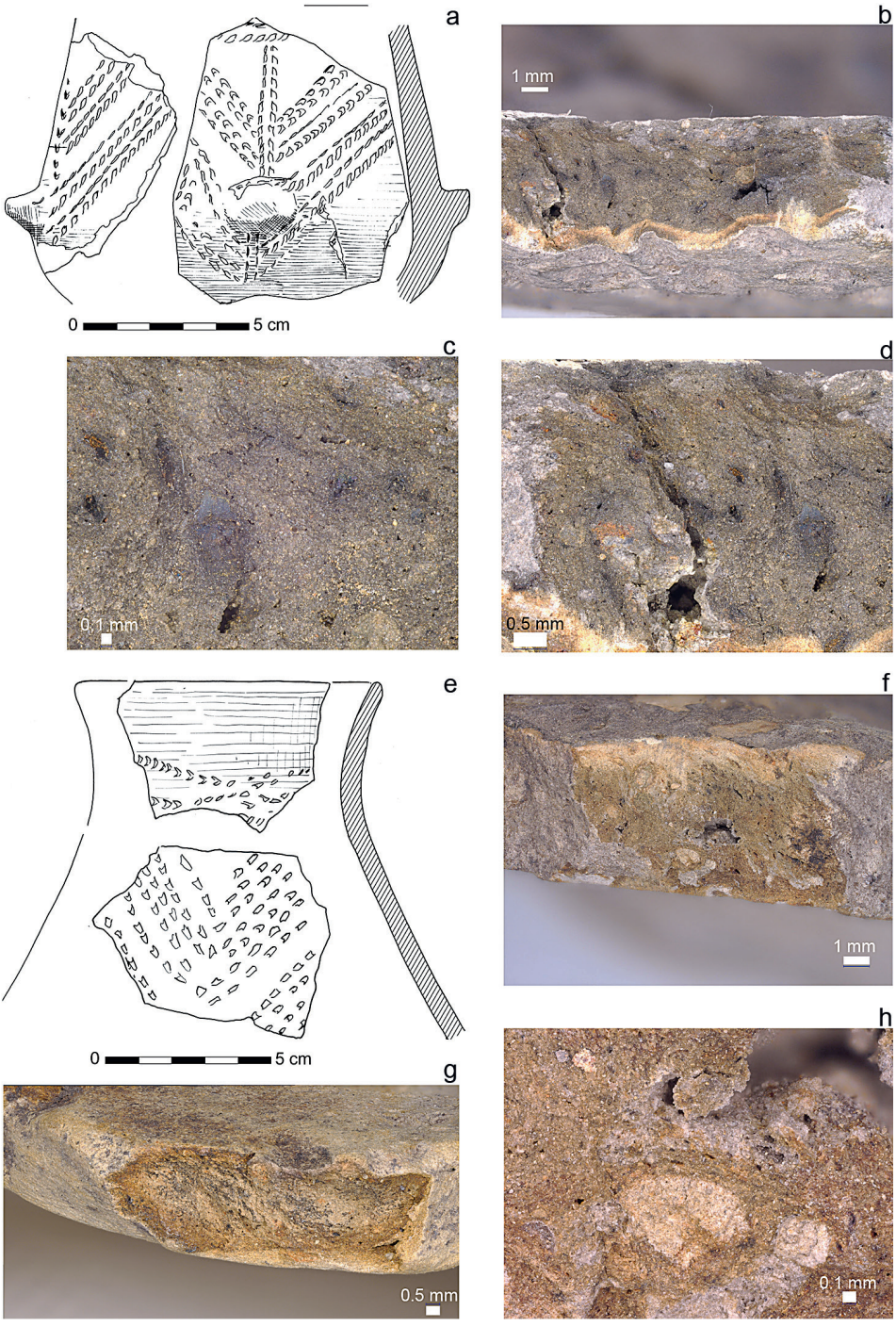

Fig. 3. LBPC pottery with grog temper. Gorzyce, site 38, Kuyavian-Pomeranian Voivodeship (drawn by E. Pawlak, photos by I. Sobkowiak-Tabaka).

#	Site	Lab. code	BP	Calibrated BC		Sample	References
				68.3% probability	95.4% probability		
1	Inowrocław Mątwy 5	Bln-1323	6000±120	5038 (61.8%) 4772 4762 (6.4%) 4726	5216 (95.4%) 4606	unidentified charcoal	*Czerniak – Kośko 1980*
2	Firlus 8	Gd-2429	6020±100	5045 (68.3%) 4790	5211 (95.4%) 4710	unidentified charcoal	*Kirkowski – Sosnowski 1994*
3	Nowe Objezierze 22	Poz-99611	5920±40	4837 (44.9%) 4774 4760 (23.4%) 4726	4928 (0.2%) 4925 4904 (95.2%) 4707	animal bone	*Czerniak et al. 2019; 2020*
4	Nowe Objezierze 22	Poz-99477	5890±40	4797 (68.3%) 4715	4889 (1.6%) 4870 4848 (93.3%) 4678 4630 (0.6%) 4622	animal bone	*Czerniak et al. 2019; 2020*
5	Nowe Objezierze 22	Poz-99478	5875±30	4785 (68.3%) 4716	4836 (4.5%) 4811 4805 (90.9%) 4681	animal bone	*Czerniak et al. 2019; 2020*
6	Białcz Stary 4	Gd-1753	5860±50	4795 (65.8%) 4678 4630 (2.5%) 4622	4843 (94.4%) 4591 4566 (1.0%) 4555	unidentified charcoal	*Czerniak et al. 2016*
7	Węgierce 12	Gd-2509	5860±100	4842 (66.8%) 4601 4563 (1.4%) 4556	4988 (1.2%) 4965 4956 (93.8%) 4493 4471 (0.5%) 4462	animal bone	*Czerniak et al. 2016*
8	Nowe Objezierze 22	Poz-99479	5850±40	4787 (68.3%) 4682	4834 (2.1%) 4814 4801 (92.7%) 4601 4564 (0.6%) 4556	animal bone	*Czerniak et al. 2019; 2020*
9	Nowe Objezierze 22	Poz-99612	5850±40	4787 (68.3%) 4682	4834 (2.1%) 4814 4801 (92.7%) 4601 4564 (0.6%) 4556	animal bone	*Czerniak et al. 2019; 2020*
10	Nowe Objezierze 22	Poz-99613	5840±40	4784 (20.9%) 4743 4733 (40.1%) 4674 4634 (7.3%) 4618	4796 (93.7%) 4587 4568 (1.7%) 4553	animal bone	*Czerniak et al. 2019; 2020*
11	Kraków Olszanica 2	Poz-77984	5830±40	4777 (8.1%) 4758 4727 (47.5%) 4654 4638 (12.7%) 4614	4792 (92.7%) 4585 4569 (2.7%) 4552	charcoal (*Quercus* sp.)	*Zastawny 2022*
12	Białcz Stary 4	Gd-2054	5820±80	4783 (11.3%) 4745 4731 (52.7%) 4586 4568 (4.3%) 4553	4881 (0.6%) 4871 4847 (94.0%) 4490 4474 (0.9%) 4460	unidentified charcoal	*Czerniak et al. 2016*
13	Targowisko 10–11	Poz-71637	5800±35	4711 (68.3%) 4611	4774 (1.3%) 4762 4726 (94.2%) 4544	charcoal (*Quercus* sp.)	*Zastawny 2022*
14	Nowe Objezierze 22	Poz-99476	5750±35	4672 (18.7%) 4635 4616 (49.6%) 4545	4698 (95.4%) 4500	animal bone	*Czerniak et al. 2019; 2020*
15	Strachów 2	Bln-3851	5730±80	4681 (66.5%) 4494 4469 (1.8%) 4463	4780 (2.0%) 4752 4729 (88.6%) 4441 4424 (4.8%) 4367	?	*Czarniak 2012*
16	Barłożno 12	Poz-17078	5720±40	4611 (68.3%) 4496	4681 (95.4%) 4457	?	*Felczak 2020*
17	Racibórz-Ocice 1	KN-1375	5690±55	4602 (14.4%) 4563 4556 (53.8%) 4453	4683 (89.9%) 4442 4422 (3.7%) 4395 4386 (1.8%) 4370	?	*Czarniak 2012*
18	Bodzia 1	Poz-43556	5580±40	4447 (9.2%) 4436 4429 (59.1%) 4363	4493 (6.0%) 4471 4461 (89.4%) 4345	animal bone	*Czerniak 2019*
19	Dubielewo 8	?	5580±60	4455 (68.3%) 4352	4541 (95.4%) 4335	human bone	*Siewiaryn-Mikulski 2015*
20	Janowice 2	Poz-83598	5560±40	4444 (24.4%) 4419 4402 (43.9%) 4355	4486 (1.3%) 4479 4456 (94.2%) 4340	animal bone	*Czerniak 2016*
21	Ludwinowo 7	Poz-31419	5525±35	4442 (20.9%) 4421 4396 (7.4%) 4385 4370 (39.9%) 4338	4449 (95.4%) 4330	human bone	*Czerniak 2019*

Tab. 1. Radiocarbon dates of LBPC and SBK sites from the Polish Lowlands compared with the earliest radiocarbon dates for assemblages with stroked ornament and grog temper from upland areas (red). Calibrated by the OxCal v.4.4 software (*Bronk Ramsey 2009*) using the IntCal20 calibration curve (*Reimer et al. 2020*).

features, including a clay pit, are connected with the LBPC stage. A detailed analysis of pottery technology carried out for the LBPC and the BKC (*Siewiaryn – Mikulski 2015*, 67, tab. 9) showed that out of 401 sherds, 10 were made using a temper of medium-grained grog and a very small amount of fine sand, mica and crushed stone. Single pottery fragments made using this technology also occur in other LBPC or BKC features. Within the stylistic analogies for the LBPC pottery, the authors emphasize clear attributes characteristic of the late horizon of the SBK (*Siewiaryn – Mikulski 2015*, 78). A radiocarbon date (5580 ± 60 BP) was obtained from the LBPC grave from this site (see *Fig. 4*; *Tab. 1*).

Further source assemblages come from the Starogard Lakeland slightly north of Kuyavia. At the Barłożno 12 site, a set of 12 sunken features and 1,973 potsherds were discovered (1,798 sherds from the sunken features). The description of the pottery analysis includes 988 fragments. The main type of temper in LBPC pottery at this site remains sand and crushed stone (*Felczak 2020*). Of the 202 isolated LBPC potsherds, 11 were identified as vessels made with a temper of sand and grog (*Felczak 2020*, 65–72, tab. 4). The presence of grog is also confirmed by mineralogical and petrographic analyses of the ceramic composition (*Rauba-Bukowska 2020*). Among the eight thin sections of LBPC pottery samples, grog temper was found in one – a fragment of the base of a thick-walled vessel (*Rauba-Bukowska 2020*, 216, tab. 2). In terms of stylistic features, O. Felczak clearly connects the Barłożno pottery with SBK assemblages from other regions of Poland. The influence of the Rössen culture is also mentioned for one of the vessels (*Felczak 2020*, 59).

Another site of interest can be found much further southwest of the previous settlement, in the Middle Warta River of central Greater Poland, where three LBPC sunken features were discovered at site 4 in Kijewo. Their attributes permit an interpretation as pits located along the walls of houses, even though there are no traces of the buildings themselves at this site (*Pawlak et al. 2008*, 191). A total of 466 potsherds were recorded, all within the features. From this collection, a relatively large number, 102 sherds (22%), were assigned to the technological group containing grog and fine sand (*Pawlak et al. 2008*, 245, tab. 5). According to the authors of that study, the materials from Kijewo are stylistically and technologically similar to the LBPC pottery from Kuyavia. The authors explain the exceptionally high frequency of pottery with stroked ornament by the intense connections of Greater Poland with the area of Lower Silesia and indirectly with the influence of SBK from phase IVb (according to *Zápotocká 1970*, 192). However, there is no interpretation of the fact that there was such a high frequency of ceramics with grog.

The remaining sites from the Polish Lowlands containing pottery with stroked ornament and grog temper come from the western border of the LBPC and SBK. They constitute a group of three points from the vicinity of Międzyrzecz (Lubuskie Voivodeship). The most complex remains related to the LBPC/SBK were discovered at the site of Święty Wojciech 7, but the available publication only presents an analysis of pottery (*Jankowska et al. 2014*). A total of 123 potsherds and 10 LBPC sunken features were discovered here. An organic temper and grog were noted only in one of the pottery fragments (the undecorated handle). The remains from this site were considered a manifestation of the short-term stay of the LBPC community along a route (north-south) concentrated in the Obra Basin. Based on the style of pottery ornament and vessel forms, as well as the occurrence of Rössen culture pottery in this area, the authors suggest chronological convergence with phase IV of the SBK in the Czech Republic (*Jankowska et al. 2014*, 67).

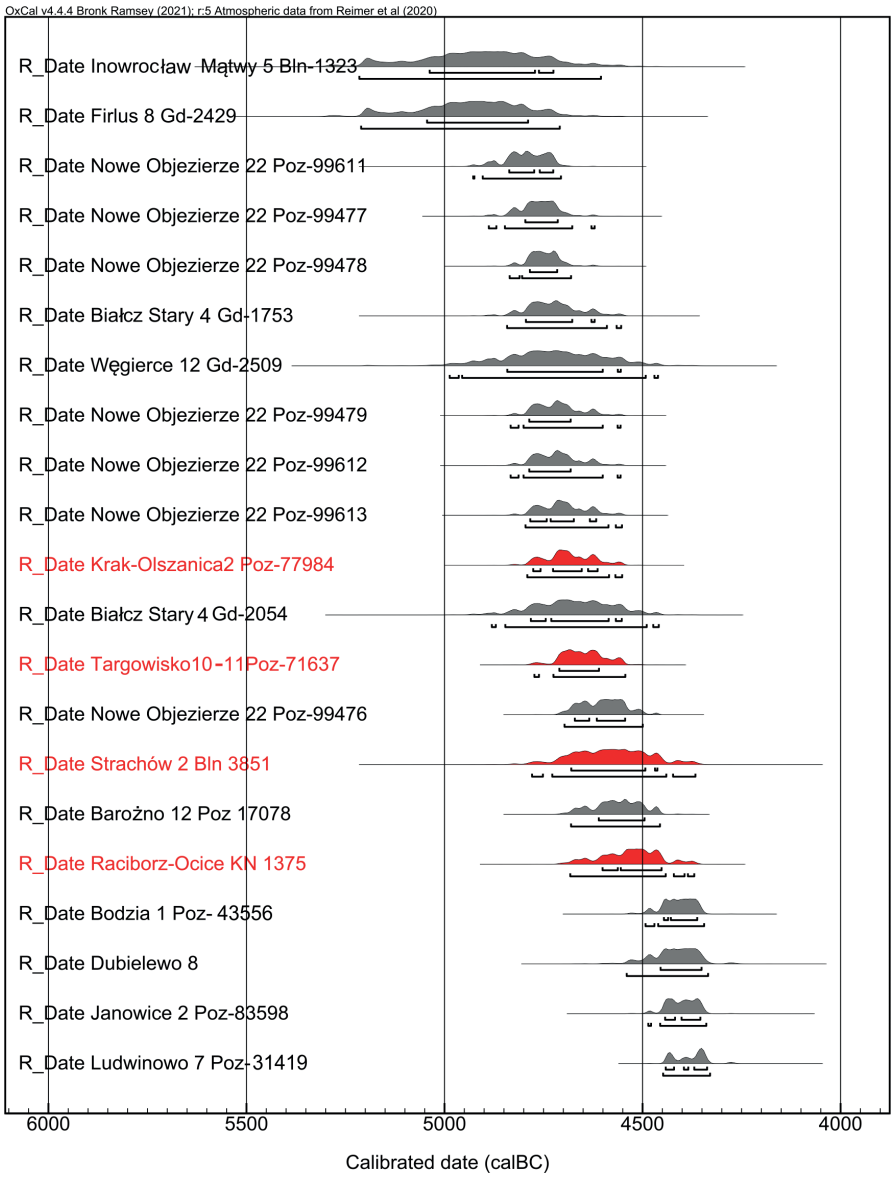

Fig. 4. Absolute dating of LBPC and SBK sites from the Polish Lowlands (grey) compared with the earliest radiocarbon dates for assemblages with stroked ornament and grog temper from upland areas (red). Calibrated by the OxCal v.4.4 software (*Bronk Ramsey 2009*) using the IntCal20 calibration curve (*Reimer et al. 2020*).

Of the 259 LBPC/SBK potsherds discovered at Międzyrzecz site 108, 37 were found in five sunken features (*Kaniewska – Sobucki 2006*, 138). The dominant type of temper added to LBPC/SBK ceramics was crushed stones. Grog was observed in only nine pottery fragments, constituting 3.5% of the collection (*Wierzbicki 2006*, 109). In the analysed

materials, the authors found numerous references to phase IV of the SBK from the Czech Republic, groups from the Elbe and Saale regions of this culture and to the Kuyavia LBPC groups (*Wierzbicki 2006*, 121).

At Międzyrzecz site 11, three sunken features were excavated: a pit house and two LBPC/SBK settlement pits (*Ciesielski – Gorczyca 2013*). A total of 391 pottery fragments were recovered, including 385 from the sunken features. The analysis of the pottery technology indicates that 33 sherds (8.2%) contain grog as the main temper. From the LBPC/SBK features, 309 fragments of daub containing grog were also recovered (*Ciesielski – Gorczyca 2013*, 20). The authors of the study suggest that these remains coincide with the late SBK phases (IV–IV/V) from the Czech Republic. They also indicate references to the areas of the Elbe and Saale, Lower Silesia and the Kuyavia LBPC and emphasise 'eastern influences' (LBPC) rather than western ones (Rössen culture) (*Ciesielski – Gorczyca 2013*, 20).

To summarise the cases presented above, it can be stated that the vast majority of stylistic attributes have references to SBK – usually in their classical versions (*Zápotocká 1970*). Sites near Międzyrzecz are *de facto* classified as SBK. It justifies an attempt to search the available studies of SBK assemblages from the Oder catchment area in terms of the presence of ceramics with grog.

The aforementioned sites from the vicinity of Międzyrzecz are a matter of the discussion regarding the occurrence of ceramics with grog temper and stroked decoration in the Odra Valley. Moving about 80 km in a straight line to the northwest, we stop in the immediate vicinity of the Odra Valley, at site 22 in Nowe Objezierze. The recent discovery of a unique form of a SBK rondel initiated intensive non-destructive research and excavations at this site. As indicated by the obtained series of radiocarbon dates, the rondel was established around 4850 BC and likely functioned for about 200 years (*Fig. 4*; *Czerniak et al. 2019*; *2020*). The significant fragmentation of ceramics obtained here mainly from the ditches of the rondel is emphasised, as are clear traces of damage on the shards related to erosion caused by their long exposure on the surface (rounded edges of fractures, poorly reconstructed forms of entire vessels). Of the 1331 fragments analysed, as many as 37% were classified into technological groups containing grog and grog with a mineral temper (*Czerniak et al. 2021*, 95).

At the mouth of the Oder River near Szczecin, approximately 60 km north of the site in Nowe Objezierze, we find further SBK sites where pottery with grog additions was identified (*Dziewanowski 2016*). In the opinion of the author of the study, stylistic attributes of the pottery refer to the late SBK influenced by the Rössen and Bischheim cultures.

A pit uncovered during the rescue excavation at the Przylep 5 site was probably a settlement pit. The excavated assemblage comprises a total of 183 potsherds as well as flint artefacts and animal teeth. Most of the vessels were beakers with stroked ornament with numerous analogies between the Elbe and the Vistula rivers (*Dziewanowski 2016*, 15). The ceramic technology is characterised by a significant amount of fine mineral dust and mica, with a trace amount of crushed stone. In one of the vessels decorated with a specific stroked ornament, chamotte was clearly visible.

An extensive settlement of post-LBK communities was identified at the Szczecin-Gumieńce 17 site (*Dziewanowski 2016*). Seven settlement features were examined here, from which 600 potsherds and 200 flints were recovered. In one of the features, which may have served as a pit house, 81 potsherds were identified, allowing for the reconstruction of the original vessels including stroke-decorated bowls, a decorated beaker and vessels

with Rössen culture decorative attributes. Their ceramic clays were based on a temper of fine grog and dusty crushed stone mineral, but vessels without the addition of grog were also recovered from this sunken feature. A few less characteristic vessel sherds with grog were also excavated in two other features at this site.

Finally, during rescue works carried out at site 9 in Mierzyn, three sunken features associated with post-LBK communities were discovered. In the settlement feature with a fireplace, at least 221 ceramic vessel sherds with fine grog additions were identified. In addition to vessels made using chamotte, there were also vessels with a temper of crushed stone and mica (*Dziewanowski 2016*, 23–28).

Summarising the sites and artefacts presented above, it can be stated that the mere discovery of grog temper is rarely accompanied by an attempt to interpret its presence. If performed, most analysts referred to the proposal of L. Czerniak, who considered this procedure as an inspiration coming from the MC (*Czerniak 1992*).

Assemblages with grog temper in the Uplands

In their home regions of the upper Oder Basin, the SBK community showed great attachment to the production of pottery using mineral tempers. This situation is indicated by classic studies on this culture (*Zápotocká 1970*, 4–9). Later analyses of SBK pottery focused mainly on the detailed classification of attributes describing stroked ornament (*Zápotocká 1978*). Also, recent studies of SBK materials more often address issues related to ornament rather than the technology of ceramic production (*Vondrovský et al. 2016*). Additionally, studies that describe ceramic technologies do not consider grog temper (*Novák et al. 2017*).

In Silesia, SBK assemblages are divided into two development phases. At the same time, the SBK and the early Lengyel-Polgar sphere also developed in the Silesian area (*Czarniak 2012*).

In K. Czarniak's monography on the communities of the later Danube sphere in Silesia, ceramic materials from 39 sites are considered in terms of the type of temper added. For phase I of the SBK, the author has information from 10 sites (*Czarniak 2012*, 48, tab. 1) and for phase II there is information from six sites (*Czarniak 2012*, 56, tab. 7). The author does not indicate even a trace amount of grog temper for any of these assemblages. However, researchers should be cautious when identifying grog with the unaided eye. Analyses of the petrographic composition of thin sections conducted using an electron microscope on SBK pottery from this region found two of the 13 samples from the Gniechowce 8 site to be tempered by grog (*Borowski et al. 2015*, 212).

Chamotte in this period in Silesia is visible in pottery associated with the Lengyel-Polgar sphere (phase Ia), as well as at sites originally identified as the MC, which was not separated by *Czarniak* (*2012*, 31). Grog can be considered the dominant temper in the earliest pottery associated with phase Ia of the Lengyel-Polgar sphere in Silesia since it was identified at three of four analysed sites (*Czarniak 2012*, 63, tab. 11) and it was considered a common or the dominant temper, present both in fine and coarse pottery. However, only two out of four analysed sites related to phase Ia show a small ('unique') presence of stroked ornament (*Czarniak 2012*, 64, tab. 13). The time horizon of this pottery in Silesia is determined by one radiocarbon date each from two sites (Strachów 2, pit 74, Bln-3851,

5730 ± 80 BP and Racibórz-Ocice, pit 9, KN-1375, 5690 ± 55 BP; see *Fig. 4*: probability distributions in red and *Tab. 1*). This is the period of approximately 4680–4450 BC, in which stroked ornament occasionally appeared on pottery with grog temper. The absolute chronology of phase Ia of the Lengyel-Polgar sphere in Silesia is assumed to be in the range of 4775–4650 cal BC (*Czarniak 2012*, 34, fig. 1), which does not coincide with the highest probability of dates from the aforementioned Silesian sites from this phase.

The situation changes slightly in the following Ib phase of the Lengyel-Polgar sphere (i.e. after c. 4450 BC). A much larger number of analysed sites are available (n=23), but grog as a temper in pottery was identified at only seven sites, and at two it occurred only in cooking pottery (*Czarniak 2012*, 72–73, tab. 21–23). It is also not the dominant temper anywhere in this phase. It often occurs only in one place, and in the remaining locations, its frequency has been described as sporadic or unique. At six of the seven sites where grog was recorded, pottery decorated with stroked ornament was also found. For phase Ib, we have evidence of this decoration on tableware for 40 sites (*Czarniak 2012*, 77–79, tab. 27–29). Stroked ornament was not observed at only three sites with very small pottery assemblages. Based on the concept of *Czerniak* (*1994a*, 6), the current interpretation is that the presence of grog in Silesian materials is a manifestation of contacts with the area of southeastern Poland, which is also evidenced by other attributes of this pottery (*Czarniak 2012*, 238).

Grog temper in the Malice culture

Returning to the initial hypothesis presented in the introduction, which assumes the division of Central Europe into two technological zones for the production of pottery, the closest 'initial' area for chamotte technologies used by lowland LBPC communities is Lesser Poland. The influence of SBK in the area of Lesser Poland is represented by the Samborzec-Opatów Group (*Kaczanowska – Kozłowski 2006*). Its range is limited to the Sandomierz Upland and the vicinity of Kraków. Researchers of the origin of this group have debated whether it was closer to or further from the SBK itself (*Zápotocká 1970*; *Pavúk 1996*). Pottery decorated with stroked ornament, however, is made of clay with almost no temper (*Kaczanowska – Kozłowski 2006*, 25). Undecorated ceramics usually contain sand and fine grog, and occasionally fragments of flint.

The local chronology assumes the contemporary existence of the Samborzec-Opatów group and the MC (*Kadrow – Zakościelna 2000*). The chronological framework of the MC, based mainly on relative sequence (*Kadrow – Zakościelna 2000*), has only recently been supplemented with a larger series of radiocarbon dates, mainly for the areas near Kraków (*Zastawny 2022*). Within the time period of interest, the assemblages of the MC from the initial sections of its phase I seem to be important.

Phase Ia, generally dated to 4822–4717 cal BC (*Kadrow 2023*, 57), is defined by artefacts from the following sites: Rzeszów 20, Ćmielów 2, Targowisko 10–11, Modlnica 5, and Kraków-Olszanica 2 (*Kadrow 1990*; *Michalak-Ścibor 1994*; *Grabowska – Zastawny 2011*; *2014*; *Zastawny 2022*). Absolute dating of sites from the vicinity of Kraków (Targowisko and Kraków-Olszanica) indicates that this phase may have begun in this region around 4850 BC (*Fig. 4*; *Tab. 1*; *Zastawny 2022*).

Although there are no absolute dates for the vicinity of Rzeszów, at the Rzeszów 20 site, characterised by phases Ia and Ib MC, thin-walled beakers decorated with stroked

ornament were produced using a technology applied on roughly 27% of the entire assemblage – pottery clay tempered by very small fragments of ochre, and less often sand, grog, or clasts of unmixed clay (*Kadrow 1990*, 96). A production technology based on temper from large fragments (grains) of grog characterises thick-walled vessels at this site.

All MC vessels at the Ćmielów 2 site were made using three technological formulas. Only one of the technological groups contains sand as the dominant temper (21.4%, 471 vessel fragments) and is characteristic of the older MC phase. The remaining vessels (78%, 1,731 fragments) were made using grog temper (*Michalak-Ścibor 1994*).

Among the technological formulas used by the MC community at the Targowisko 10–11 sites, grog is found in only one technological group (*Grabowska – Zastawny 2014*, 280). It includes pottery clays with an average content of sand, a small amount of crushed stones, and numerous fragments of grog, often of considerable size. This formula was mostly used to produce thick-walled vessels. Only about 7% of the beakers, which are the only type of vessels with stroked ornament at this site, were made using grog temper (*Grabowska – Zastawny 2014*, 278, tab. 8a).

Only a very small amount of grog was found at the Modlnica 5 site (*Grabowska – Zastawny 2011*), where it constitutes approximately 1% of all distinguished types of tempers. Moreover, it was present only in biconical vessels – pottery with medium wall thickness that was not decorated with stroked ornament. However, the composition of the pottery of all types of vessels at this site included clasts of unmixed clay – dry fragments of clay (*Grabowska – Zastawny 2011*, 53 fig. 30). Pear-shaped beakers, the only type of vessels at this site that were decorated with a stroked ornament, were made using technologies comprising sand (48% of these vessels), clasts of unmixed clay (20%), crushed flint, stone (16%), and from clay without temper (16%).

Phase Ib (the classic MC) dated to 4703–4474 cal BC, is associated with the expansion of these communities. From the vicinity of Rzeszów and Sandomierz it stretches northeast to Lesser Poland, Upper Silesia, and Kuyavia, as well as Slovakia and Transcarpathian Ukraine (*Kadrow 2023*, 57; *Kadrow – Zakościelna 2000*, 245).

Some of the pottery assemblages from the sites described above (Rzeszów 20, Ćmielów 2) also characterise the late part of phase I. The standard of publication of other sites does not allow conclusions about the technology used to make the ceramics (Kraków-Olszanica 2, Targowisko 14–15, Rozbórz 20). On the other hand, publications of pottery from the site in Malice and Kraków Nowa Huta – Mogiła 48 seem to be helpful in tracing the types of tempers. In a very detailed, descriptive characterisation of finds from the eponymous site in Malice, grog cannot be found on the list of mentioned pottery tempers (*Kamieńska 1959*). Approximately 30% of all MC pottery from the Kraków Nowa Huta – Mogiła 48 site contains grog and approximately 50% contains grog and sand, but there is no analysis of what types of vessels they are, i.e. thin- or thick-walled (*Kaczanowska 1996*, 18, fig. 7). Nevertheless, most of the beakers and thin-walled amphorae are decorated with stroked ornament.

In summary, it can be noted that the materials of the MC show a close relationship between stroked ornament and thin-walled vessels such as beakers. As the main type of temper added to vessels decorated with stroked ornament, grog is no longer so distinct. We can demonstrate such a relationship to a significant extent only for three of the six MC sites discussed above.

Discussion

Exit zone?

In the MC, the earliest pottery with grog temper appears in the Rzeszów region and occurs there only in thick-walled vessels (*Kadrow – Rauba-Bukowska 2017*, 276). The time of its appearance can be approximately estimated at 5000/4900 BC (*Kadrow 2015*, 300). Previously, this type of temper occurred sporadically in the Lesser Poland Voivodeship in the LBK, with which the genesis of the MC is associated (*Kadrow – Rauba-Bukowska 2017*, 278, fig. 7). It was proposed that the spread of the MC resulted in the dissemination of grog temper to not only thick-walled but also in thin-walled vessels. The commonness of this temper was confirmed by microscopic examination of pottery fractures at the few sites of the classic MC phase in western Lesser Poland dating to 4800–4400 BC (*Kadrow – Rauba-Bukowska 2016*).

The MC communities are assumed to be the main factor that influenced the lowland LBPC groups. These relations might be responsible for the technological attributes used for LBPC pottery (Węgierce) or just stylistic attributes without the characteristic grog technology, always with clear stylistic influences identified with SBK. However, it is difficult to assess the state of the discussion on the most distant northern influences of the MC in the zone of the northern borders of the SBK (sites near Szczecin).

A characteristic feature appearing in the descriptions of MC pottery from Lesser Poland, which brings it closer to observations from the Lowlands, is the destruction of the outer surfaces of the walls of vessels decorated with stroked ornament (*Kaczanowska 1996*, 8; *Grabowska – Zastawny 2011*, 51; *Grabowska – Zastawny 2014*, 266). This has also been noted in the assessment of LBPC materials from the Gorzyce 38 site (*Fig. 5*) mentioned above (*Żurkiewicz et al. 2023*).

The most plausible inspirations for the use of grog at the LBPC sites from the Kuyavia and Greater Poland regions may be the influences from the MC in Lesser Poland. However, these impacts cannot be considered sufficient when trying to interpret the occurrence of grog at the settlements of this culture at the western (Międzyrzecz, Św. Wojciech) or northern (Barłożno) borders. These hypotheses can be completely refuted when applied to the origin of this procedure at SBK sites from the northern enclave (Nowe Objezierze and the vicinity of Szczecin). Perhaps it is worth considering the presence of grog itself from the perspective of its technical advantages and treating it as an ‘invention’, a technological innovation introduced at several different points in space, in a similar time horizon.

Grog – technical advantages

Adding temper significantly changes the original properties of the clay and largely determines the chemical, mineralogical, and petrological composition of the finished vessels (*Santacreu 2014*, 73–74). It also makes it easier to form a vessel by reducing the plasticity of the pottery mass and supports the control of the firing process. Tempers can be divided into several types: mineral (that may contain quartz), organic (plant fragments, bones, shells), and tempers of anthropogenic origin – grog (chamotte). Grog, unlike the previously mentioned tempers, which may be elements of a natural clay deposit or its accidental contamination, can almost always be considered an intentional admixture (*Ots 2008*). In this case,

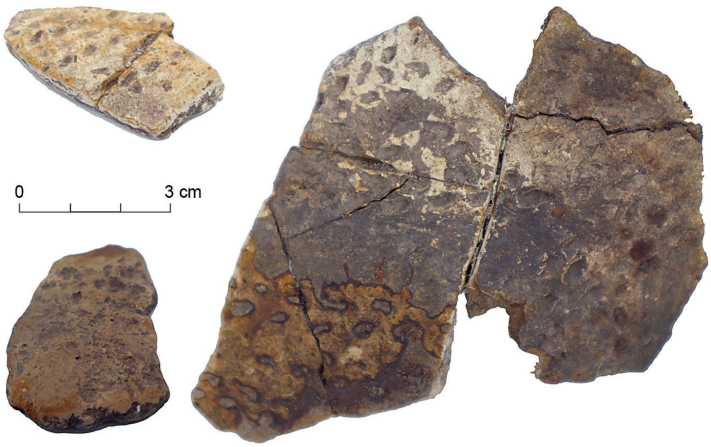

Fig. 5. Damage to the surface of the external walls of LBPC pottery with stroked ornament and with grog temper. Gorzyce, site 38, Kuyavian-Pomeranian Voivodeship (photo by D. Żurkiewicz).

it is important to distinguish fragments of ceramic vessels (grog) from clasts of unmixed clay, which could also be a kind of temper (*Cuomo di Caprio – Vaughn 1993*; *Whitbread 1986*, examples describing the MC above).

The use of grog, compared to the use of, for example, sand, requires several additional activities related to the preparation of such a temper. However, unlike rocks that require intensive grinding, grog requires less force for this activity. It is also more accessible within the manufacturer's immediate environment – it does not require knowledge of the local environment in terms of outcrops of suitable sand and rocks.

From a technical perspective, chamotte used as a temper seems to be a particularly advantageous solution due to its thermal expansion coefficient similar to clay. It prevents cracking of vessels during their firing and use, which involves gradual, continuous heating and cooling. However, this type of temper does not protect the vessels against sudden changes in temperature (thermal shock) unlike, for example, quartz, which allows for thermal expansion, or crushed stone, which significantly increases the durability of cooking vessels (*Santacreu 2014*, 154–155).

The functionalist approach assumes that the change in technological features is initiated by functional requirements or the discovery of a more optimal way to make a vessel (e.g. *Feathers 2003*; *Tite et al. 2001*). The addition of grog does not seem to be optimal from a functional point of view; it does not allow the creation of a vessel that would be most effective in use. In many of the aforementioned cases, chamotte was used as a temper for decorated vessels with thin walls, which are not connected with the functions of cooking vessels, so the advantages of the thermal properties of this temper would have little chance of being effective here. Instead, another cultural reason for including grog in pottery temper should be explored.

Grog – symbolic meaning

Many researchers emphasise the symbolic role of chamotte temper, referring to its universal meaning (*Chapman 2000*; *2022*) and highlighting the symbolic connotations of the cycles of life and death of people and artefacts (*Santacrue 2014*, 241). Artefacts can act as reminders of a previous home and family members left behind. Personal objects are also

associated with an individual's personality or 'soul' and may enhance the owner's sense of identity (*Sterner 1989*, 454). Another potentially important factor in pottery recycling is the creation of bonds with former family members and ancestors, which may have been particularly significant in the event of community or individual relocation. Pottery can be symbolically linked to an ancestral network (*Smith 1989*, 65), and vessels are recycled as grog to bring '*the spirit of the old pot in the new*' (*Pikirayi – Lindahl 2013*, 466).

These hypotheses are largely supported by ethnoarchaeological data looking for analogies for prehistoric counterparts in modern cultures, also in relation to the production of ceramic vessels (*Hegmon 2000*). These studies indicate the existence of a cross-cultural tradition related to the production of new objects from older ones. There are many ethnographic sources that record the use of grog as a temper in this context. In Ghana, for example, the Gurensi break the vessels (mainly bowls) of a dead woman and use their fragments as tempers for new products. In this way, they emphasise the relationship of the deceased with her family (*Smith 1989*, 61). Among the Sirak Bulahay and Kapiski tribes in Cameroon, fragments of a ceremonial vessel that was accidentally broken were brought to a blacksmith, who ground them up and gave them to his wife, a potter, for use in making a new container (*Sterner 1989*, 458). In some societies, recycling personal vessels maintains the connection with the deceased. For example, when someone dies, a piece from their personal pot is cut off, prepared as grog, and then used to make new pots. In this way, a bond is created between the deceased person and his or her family (*Smith 1989*, 61; *Sterner 1989*, 458). *Sterner* (*1989*, 454) stated that for Sirak potters in northern Cameroon, ceramic vessels communicate and attract ancestors to share family meals. This type of symbolism may be of greater value to people who have emigrated from their native community or territory.

The interpretation of chamotte temper described above was also used in an attempt to understand the local records of this ingredient in the ceramics of the Corded Ware culture (CWC) along its northern borders (Battle Axe culture – BAC). The earliest pottery of the BAC discovered in Sweden is made with grog temper. Over time, this temper becomes less common (*Larsson 2009*, 240). Moreover, early vessels were made according to more rigorous technological formulas than their later counterparts (*Larsson 2009*, 242). The author connects these treatments with the specific preferences of new arrivals who wanted to maintain contact with the traditions of their home areas and their ancestors by adding fragments of old used vessels. This procedure especially concerned vessels of particular importance – beakers. It could have been implemented based on the three explanations proposed here: 1) the tradition of '*This is how we make pottery*'; 2) a potentially functional solution – although adding even a very small amount of grog may not have actually had any empirical significance, the potters themselves may have been convinced of such importance; and 3) symbolic meaning as adding parts of old vessels, and thus their history of use makes a connection with the potters who created them (*Larsson 2009*, 353).

Beckerman's (*2015*) studies on the Corded Ware coastal community from the Netherlands indicate the possibility of distinguishing two groups of ceramic vessels – those containing crushed stone and those containing grog as the dominant tempers. The former type of temper and other morphological and ornamentation determinants characterise older ceramics, while the latter type comprises the later ones. The author rejects other ways of explaining these differences, i.e. those based on functional differences in vessels or social issues (*Beckerman 2015*, 173). This is related to the author's concept of the spread of CWC patterns in the northern Netherlands based mainly on diffusion among local Funnel

Beaker culture communities that used a temper of crushed stone (*Beckerman 2015*, 211). Only the stabilisation of the local CWC patterns led, in the later phase, to the adoption not only of the forms of vessels and decorations but also of a change in the technology of their production (i.e., grog admixture).

Analyses of 163 CWC potsherds from 24 archaeological sites in Finland, Sweden, and Estonia were aimed at detecting clusters related to its production and patterns corresponding to recycling, i.e. processing fragments of old vessels into grog temper (*Holmqvist 2021*). Microscopic and chemical analyses of the chamotte temper itself revealed that most of it was made from locally produced vessels, while a foreign origin of the chamotte temper in vessels produced in local centres was observed only for the earliest products related to the emergence of CWC in the analysed regions (*Holmqvist 2021*, 18). Based on these analyses, the route of the spread of the earliest CWC ceramics from Finland to Estonia and from Estonia to Sweden was reconstructed. According to the author, the sociocultural significance of this discovery proves the movement (migration) of pottery producers (probably women) to new areas. After identifying local clay deposits, the newcomers started local pottery production using the broken fragments of old vessels they had brought with them.

The procedure of adding fragments of old vessels to a new prepared ceramic clay may refer to memory practices observed as far back as Neolithic communities from the Polish Lowlands (*Pyzel 2018*; *2019*). *Pyzel* (*2018*) refers this custom to the remains of settlements and, based on this, concludes that there was an attitude towards the past visible from the perspective of subsequent prehistoric communities. Typically, such practices are better understood within archaeological comparisons between cultures. In the case proposed here, we would be dealing with memory practices carried out within the same social group. Therefore, we obtain a much narrower time frame that was previously more difficult to capture based on, for example, stratigraphic or typological observations (*Pyzel 2018*, 144).

Earlier studies of the memory of the past had a long tradition, especially in English-speaking archaeology (e.g. *Bradley – Williams 1998*; *Bradley 2002*). They also concern the Neolithic period, but here they focus mainly on monumental structures (*Edmonds 1999*; more recently e.g. *Whittle et al. 2011*). Incorporating aspects related to ceramic vessels and their production in this trend could create a completely new field for researching this phenomenon.

The theory of memory practices among the Neolithic communities of Kuyavia can also be supported by stratigraphic and spatial relations of features, particularly at sites described above with the presence of stroke-ornamented and grog-tempered pottery. For example, at site 8 in Dubielewo, the densely placed BKC houses do not violate the ground plans of earlier LBK houses (*Pyzel 2018*, 165–168). At Ludwinowo site 6, the LBPC clay pit is a clear reference, as it is a continuation of an LBK clay pit (*Pyzel 2018*, 188). Furthermore, at Ludwinowo site 7, an LBPC grave was located in an existing feature that was probably an LBK well (*Pyzel 2018*, 191–193). In general, *Pyzel* (*2018*, 148) states that at almost all BKC sites in Kuyavia excavated to a large extent, there is enigmatic pottery of the earlier LBPC phase with more or less visible ‘stroked ornament’.

Chronological arguments

In light of current knowledge, it is difficult to consider the area of the Silesian SBK as the source from which the use of grog by the lowland SBK and LBPC communities orig-

inated. Currently, we have 17 radiocarbon dates from nine lowland LBPC and SBK archaeological sites (*Tab. 1*; *Żurkiewicz et al. 2023*). The modelled dates indicate that 'stroked band' pottery appeared in the lowland zone between 4876–4781 cal BC (68.3% probability) and disappeared around 4412–4331 cal BC (68.3% probability) (see *Żurkiewicz et al. 2023*, fig. 16). The proposed model indicates that the earliest dates from Silesia and Lesser Poland (Strachów, Racibórz-Ocice, Targowisko 10–11 and Kraków-Olszanica 2) are later than the beginnings of the appearance of pottery with stroked ornament in the Polish Lowlands (*Fig. 4*).

The time period in which the earliest MC pottery with stroked ornament appeared in the vicinity of Rzeszów is somewhat speculative, currently based only on relative chronology. It is also difficult to accept such a distant northern (e.g. around Szczecin) manifestation of MC influence recognised only through the type of pottery temper.

Conclusion

This paper presents a coherent and comprehensive explanation for the presence of grog tempers in ceramic vessel fragments from LBPC and SBK archaeological sites in the Polish Lowlands. The inclusion of older vessels as grog temper in the manufacture of subsequent vessels is interpreted as a means by which these communities maintained the memory of their past.

The custom of using chamotte as a temper with symbolic meaning and in symbolic quantities may have concerned more traditional or isolated LBPC communities. To a small extent, this custom could be continued in the next stage of stabilisation of those communities identified with the BKC. This is indicated by very preliminary findings of grog temper in potsherds from BKC sites (Broniewice 1, feature 2; Ludwinowo 7; Stawc 44; Brześć Kujawski 4; Boguszewo 43b, features 11 and 23; Rakowiec 22; *Bednarczyk et al. 1979*, 26–27, table 7a; *Grygiel 1986*, 288; *Kirkowski – Kukawka 1990*; *Dzierżanowska 2011*; *Czerniak 2019*, 162, table 3.2; *Kurzyk et al. 2019*) and suggests the continuity of such a procedure to an equally small extent (it was not common) in the next stage of the development of post-LBK communities in the Polish Lowlands.

Grog as an analytically important type of temper appears on the list of technological groups in the first attempt to describe them for the LBPC (*Bednarczyk et al. 1979*). It creates a technological group including crushed stone (white, grey, pink), grog, and mica. Indeed, *Bednarczyk et al.* (*1979*) point out the difficulties in identifying grog. In the next description of technological groups for the LBPC/BKC (*Czerniak 1980*), grog is no longer on the list of tempers but it reappeared after the analysis of the materials from Węgierce 12 (*Czerniak 1992*). However, this addition has not been disseminated as in the monographic publication (*Czerniak 1980*) and perhaps contributed to the reduced vigilance of later analysts of LBPC/BKC ceramics or the conscious elimination of this component as irrelevant for chronological considerations (e.g. *Kirkowski – Sosnowski 1994*, 119).

Currently, four sites are considered as the determinants of the earliest LBPC stage in the Polish Lowlands. The first is Węgierce 12 (*Czerniak 1992*), where grog was identified. According to *Czerniak* (*1992*, 66), this ceramic temper clearly represents the influence of SBK phase III/IVa (see also *Zápotocká 1970*), and the grog-tempering tradition originated from Lesser Poland. The next early context, feature 15 from Jankowo 4, represents the

influence of the Samborzec-Opatów group, although grog was not identified here (*Bednarczyk et al. 1979*). Next, materials from Inowrocław Mątwy 5 are thought to represent a significant share of Lengyel elements visible against the background of the forged style derived from the Rössen culture (*Czerniak – Kośko 1980*). Despite a detailed technological analysis, no grog was identified. Finally, the list ends with Konary site 20, which is associated with the influence of the MC, elements of SBK from phase IVb, and the Rössen culture. Here, a clear lack of grog temper can be observed (*Czerniak 1978*; *1980*), possibly indicating that only some of the earliest LBPC groups felt the need to maintain ties with the past by extending the 'life' of ceramic vessels through the addition of grog temper.

Perhaps this allows us to interpret at least some of these communities as groups of new migrants who arrived in foreign areas. Until recently, the origin of the LBPC was associated with the LBK communities that absorbed new waves of migrants and influences from other cultural centres (*Czerniak 1994b*, 60; *Czerniak 2012*, 155–156). Therefore, it was assumed that there would be continuous development of LBK communities that would gradually transform into the LBPC in the Polish Lowlands. Currently, new data indicating the relatively short duration of LBK communities in the Polish Lowlands and their disappearance around 5100 BC (*Whittle et al. 2022*) along with the possibility of the earliest dating of the origins of the LBPC to around 4800 BC (*Czerniak et al. 2016*) promote an alternative concept of the genesis of these latter communities. Thus, the hypothesis by *Grygiel* (*2004*, 631) is gaining credibility, as it assumes that the emigration of LBK communities from the Polish Lowlands to the Saale Basin was the result of unfavourable climate changes and the re-population of this zone of Europe by migrants from Lower Silesia representing the SBK.

In the technical aspect of the considerations presented here, the vigilance of researchers conducting a preliminary analysis of prehistoric ceramics seems to be particularly important. Many studies mention difficulties in identifying chamotte as a type of temper that may occur in various degrees of fragmentation. Additionally, this type of temper is easily confused with clasts of unmixed clay, which are also used as a type of temper. In the perspective of future research related to the identification of grog temper and the possibilities of its further analysis, the role of microscopic examination of selected batches of ceramic fragments seems to be important. It should also be mentioned that a certain pool of data could not be used in this study because the available publications did not contain a descriptive/analytical part regarding the production technology of vessels.

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