

Quarrying in the Stone Age and Bronze Age in southern Norway studied as a socially situated phenomenon

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ABSTRACT

In this paper, a *chaîne opératoire* analysis of lithic extraction sites and direct lithic procurement form the point of departure. This study was originally part of a PhD project comprising a detailed examination and contextualization of 21 extraction sites located in southern Norway. The 21 sites are in different topographical settings and landscapes, in different geographical regions, and they provided people in the Mesolithic, Neolithic and Bronze Age with different types of rock. I build on the results from the original study of all the sites, but I will here emphasize only a few of them. To transcend the sites' physical differences and acquire information about procurement *practices*, I operate with an extended notion of what constitutes a quarry. Whereas estimates of the scale of quarrying and the duration of exploitation are important, tracing the occurrence of the extracted rock away from the quarries in different dated archaeological contexts is equally necessary in order to understand the character and value of the exploitation of the procurement sites.

Investigating lithic procurement from various angles, attempting to chart and visualize spatial and temporal variation in practices, different methods have been applied. An important aspect has been to establish an index of the intensity of exploitation. This enables a demonstration of a 'norm' and an 'extraordinary' manner of exploitation of quarries and other lithic procurement practices. Furthermore, lithic procurement studied as a chain of operations embeds a theoretical perspective where all practices are perceived as influenced and guided consciously or subconsciously by peoples' cultural choices, traditions and social habitus. Together with the dated and contextualized sites and procurement practices, this offers a frame for interpreting the results of my study; some practices are common cross-regionally, while others defined regions and/or time-periods. Quarry studies therefore have the potential to provide insights into developing social relations and social-political strategies. Indeed, interpreted in a wider cultural context, it seems that how, and from whom or where you obtained your rock mattered more than the type or the quality of the rock itself.

KEYWORDS

Prehistory, lithic procurement, *chaîne opératoire*, contextualization, relations

Introduction

Choices made in all kinds of practices, tasks or operations including lithic procurement are rooted in culturally transmitted knowledge. The exploitation of lithic raw material and quarry sites can therefore be regarded as expressions of social phenomena. Methods to investigate the character of exploitation are thus chosen accordingly. The argument of this paper is supported by the results from a recently conducted *chaîne opératoire* analysis of 21 procurement sites in southern Norway (fig. 1)¹. Shown in figure 1 are all the lithic extraction sites recorded in the national database for cultural heritage, recorded by archaeologists

¹ The compilation of information from examining and contextualising the sites, and the comparison of results, were undertaken during my PhD research (Nyland 2016a).

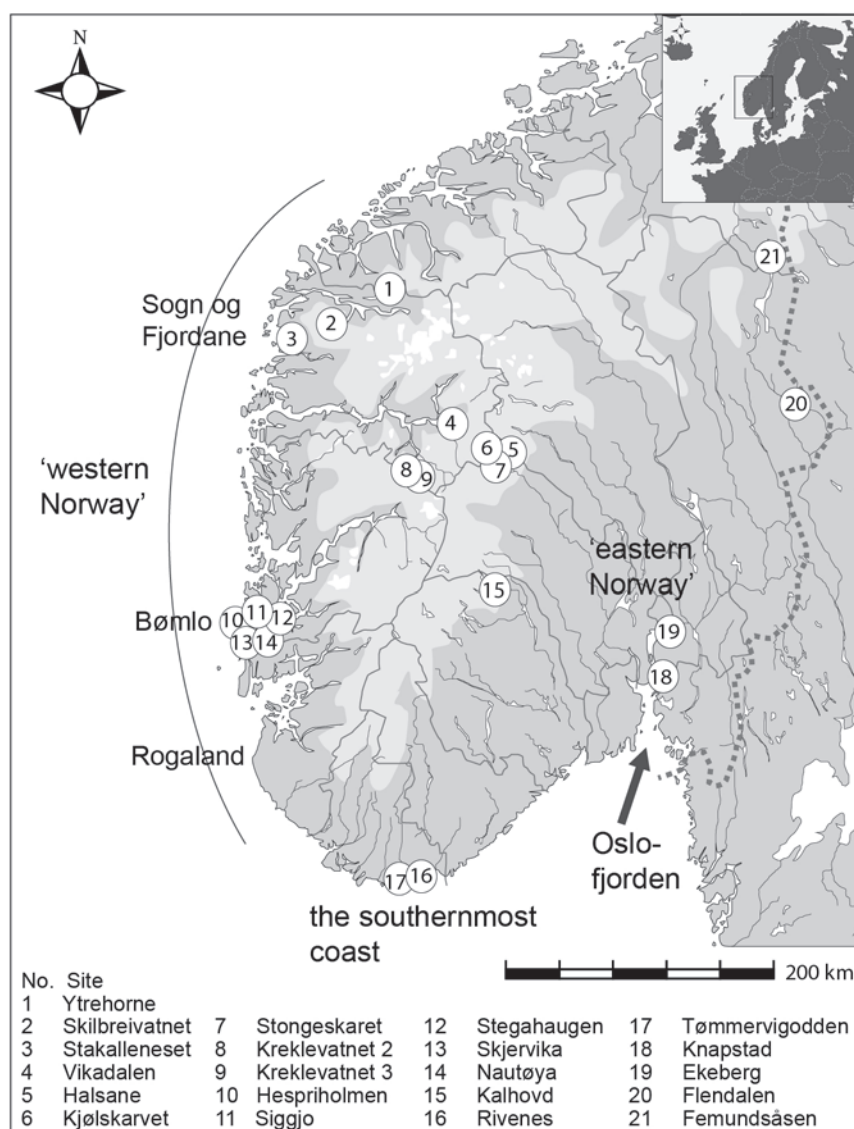


Fig 1. Map showing the location of 21 analyzed sites forming the empirical foundation for the present paper. Other place names and names of regions, mentioned in the text, are also shown on the map (figure by A.J. Nyland)

Обр. 1. Карта на 21 местонаходища на суровини, залежали в основата на настоящата статия. Картата включва и географските имена/местоположения, споменати в текста (автор А. Ниланд)

through various surveys over the last 100 years in southern Norway². Detailed archaeological investigations and analyses provided data to chart chronological and geographical variability between the lithic procurement sites, as well as the distribution of the quarried rock. The aim was to identify variation in lithic procurement practices and the character of the

² Quartz quarries were not included in my PhD research. Quartz was exploited throughout the Stone Age and Bronze Age in Norway, as well as in later periods. However, owing to the frequent and unpredictable fragmentation of quartz, it can be hard to identify prehistoric techniques at such quarries. Furthermore, chronologically demarcated tool types are rarely identifiable at such exploited sources, which would have made their dating problematic, as well as too time consuming for a PhD project.

exploitation of procurement sites. The sites fall into the chronological periods of the Mesolithic, Neolithic and Bronze Age. Only a few of them are presented in this paper.

A fundamental premise of this article is that direct lithic procurement is not a homogeneous phenomenon. There is an essential difference between quarrying and collecting rock. Furthermore, the reasons for the prehistoric choices of which rock deposits were exploited for tool production, should not only be sought in the pragmatic, functional realms. In ethnographic records, there are many examples of outcrops, natural places and rock sources that were pivotal in peoples' beliefs, mythical stories, sense of belonging and history (e.g. Gould 1978; Gould, Saggers 1985; Taçon 1991; Nuttall 1992; Taçon, Ouzman 2004). However, the challenge is to tie such ephemeral sentiments down in the archaeological record. Spatial and temporal variation in different aspects of lithic procurement practices indicate that certain extraction sites, procurement practices and selected rock types did play an important role in prehistoric societies (see also Pétrequin et al. 1998; 2015; Davies, Edmonds 2011). I argue that the character of exploitation of certain sites was significant even *beyond* being necessary raw material for tool production. That is, the manner in which places of procurement were used and reused, and the scale of rock distribution, appears to indicate that certain sites played a strategic part in socio-political strategies for either setting people apart or bringing people together. In the following, I will outline the approach supporting this interpretation, and expand on my arguments.

Demonstrating variation beyond physical differences

The challenge is to find a method that enables the distinguishing of differences beyond apparently physically diversified quarry sites and rock types. My aim has thus been to demonstrate a way to transcend general knowledge from sites varying in size, scale, rock type, landscape location and natural topography.

The 21 sites referred to in the Introduction differ greatly from one another. They are all open cast mines located in widely differing landscapes. They include exploited dykes on headlands in fjords, one large deposit on an islet on the exposed coastline, quarried outcrops, and narrow veins of suitable rock types located in the high mountains and river valleys. There are also exploited taluses in the forested interior (fig. 2). The rock types vary between fine-grained white and green quartzites, red jasper, bluish-grey rhyolite, white chalcedony, grey diabases and greenstone. Hence, the sites are sources of different types of rock, employed to make either adzes or blade and flake tools. All the sites have been archaeologically examined and/or surveyed, 14 of them by the present author³. Because the rock faces are normally very weathered, recognition of actual signs of human quarrying was possible at only a few of the sites. Instead, to recognize a quarry as a prehistoric site, traces of specific prehistoric lithic technologies were sought, and found, in the waste piles, the assemblages at workshops, and through rock from the source having been exploited at nearby settlement sites⁴. At the quarries and workshop sites, preforms for adzes or various lithic technologies, such as blade production or bifacial techniques, were observed. The

3 In addition to being presented in my PhD thesis, the excavations and surveys are all documented: reports are stored in the official archives at the Museum of Cultural History in Oslo, the University Museum in Bergen, and the Museum of Science in Trondheim.

4 A few 'quarries' were rejected or redefined after examination as these showed no signs of Stone Age activities either at the sites, or in their immediate surroundings. For obvious reasons, these are not included in the study.

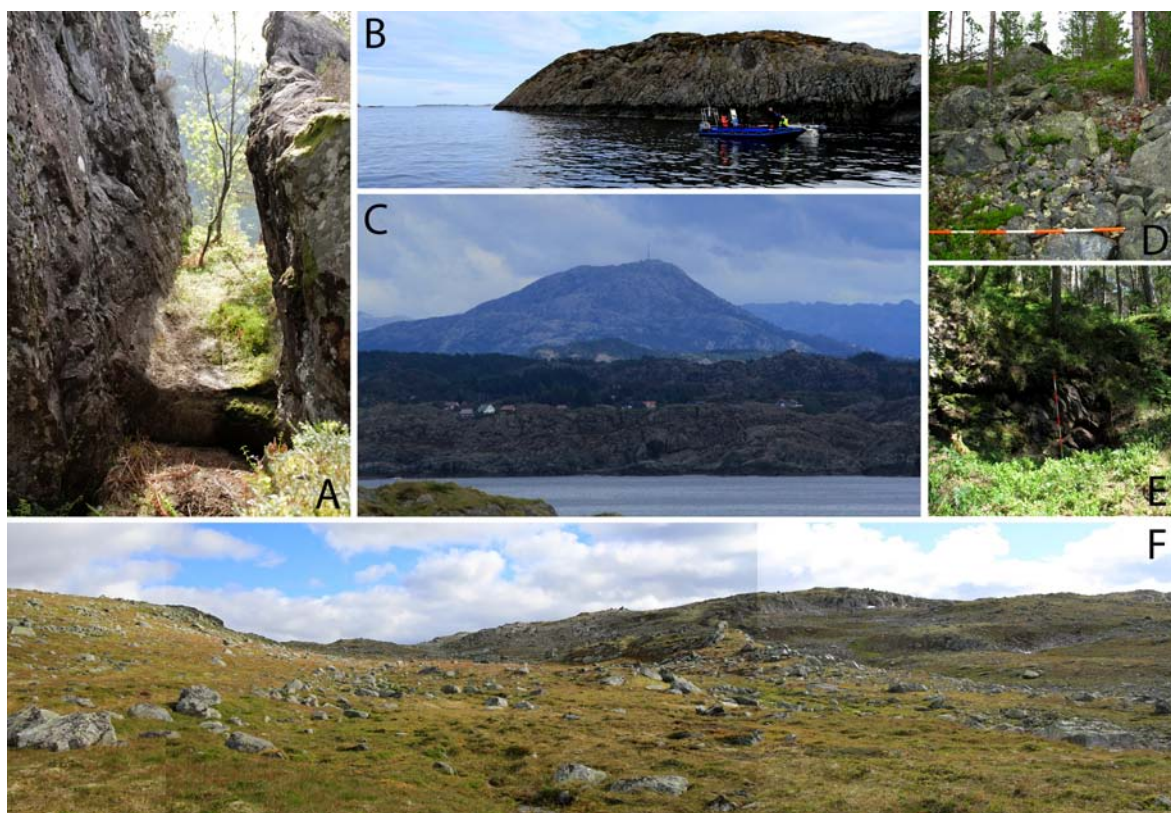


Fig. 2. Collage of quarry sites representing different landscape and topographical settings (numbers in parentheses refer to locations shown in fig. 1). A: Stakalleneset (3); B: Hespriholmen (10); C: Siggjo (11) (at the top of the mountain); D: Femundsåsen (21); E: Skjervika (13); F: Kjølskarvet (6) (the crag in the distance and outcrops/ boulders in the foreground (photos by A.J. Nyland)

Обр. 2. Колаж от кариери, представящи различни природни и топографски условия (номерата в скобите отговарят на обектите, маркирани на обр. 1). A: Stakalleneset (3); B: Hespriholmen (10); C: Siggjo (11) (на върха на планината); D: Femundsåsen (21); E: Skjervika (13); F: Kjølskarvet (6) (масив в далечината и морени на преден план (снимки А. Ниланд)

types of tools produced obviously also influenced the amount of waste and extraction, but as I will demonstrate, there are significant variations in the intensity of exploitation even beyond such aspects.

Different practices involved in lithic procurement

Comparing the results from my *chaîne opératoire* analysis of the 21 sites made certain relational ‘attributes’ of practices stand out. As expanded on in my PhD thesis and elsewhere (Nyland, in preparation), I divide the task of direct lithic procurement and quarrying into seven stages: 1: *Choice and preferences*. This investigative stage required a wider knowledge of which rock types were commonly used in the study area. The composition of the lithic assemblages reveals whether rock from one or several quarries dominated, or if collected beach flint found along the shore sufficed⁵. 2: *Location*. This is not

⁵ There are no naturally occurring primary flint deposits in Norway. Flint was still a popular rock type, as it could be collected as ice-transported nodules, which had arrived with melting icebergs after the Ice Age.

so much about geographical location, as it is about a site's social context. Quarrying, initial reduction of blocks and preform production often being the sole activities at quarry sites, are contrasted with the exploitation of rock deposits and lithic production at settlement sites. That is, being either a secluded and quarry-site-specific activity, or undertaken within the everyday sphere. 3: *Initial preparation*. This stage is identified through remains found in waste piles. For example, any charcoal from firewood burned at the greenstone quarry on Hespriholmen, a small islet in the sea, had to have been brought to the site. Hammer stones had to be brought to this quarry too (Alsaker 1987). 4: *Quarrying*. This stage is about the techniques that can be identified at the open-cast quarry sites. The three common techniques are direct hammering, wedging out blocks using natural cracks in the rock formation, and using fire to aid extraction. These techniques were used alone or in combination. 5: *Waste management*. As the Norwegian mines are all open cast, waste management such as refilling shafts as seen in British and Danish flint mines, is not found. Instead, one might look at the establishment of specialized workshops for initial production as a way to manage waste. The specialist sites kept waste separate from the household sphere, perhaps keeping rock from special sites away from people, or limiting the number of people who were allowed to have contact or acquire knowledge. 6: *Initial reduction*. this was to a lesser or greater degree undertaken at the quarries, at adjacent or detached workshop sites. 7: *Distribution*. what happened next to the quarried material? This stage requires a further understanding of the rock's distribution, the distance of transport from A to B, and the scale of exploitation. On this note, I will stress that I am not entering into a discussion of the many possible ways in which rock can change hands. Instead, I focus on the idea of *possessing rock from certain sites*. This desire may be due to a variety of sentiments: the rock's high quality, demonstration of access to a central site or a social nodal point assuring social position, rights to resources, or links to one's ancestors (see also Nyland 2016b; 2016c; 2017a). Accordingly, rock from such a site would be highly valuable.

Having investigated these stages at the 21 sites, some features were distinguishable. There is regional and chronological variation in whether initial reduction and preform production were undertaken at the extraction sites, at adjacent or at detached workshop sites. During the Middle and Late Mesolithic in western Norway, there seems to have been a desire to separate the activity of initial reduction of quarried rock for adze production from settlement sites. Indeed, most adze production, except for the stages of completion such as fine pecking and grinding, are found at detached workshop sites around two large adze quarries in western Norway: Stakalleneset and Hespriholmen (Olsen, Alsaker 1984). This deliberate seclusion of activity – keeping initial adze production away from settlement sites – contrasts with exploitation of rock deposits located at the settlement sites themselves. I named the latter practice on-site, or 'household', exploitation. Only a few such 'household sites' are recorded, and are a rare occurrence, given the hundreds of Stone Age sites that have been excavated. The household procurement sites in my study are found in the Late Mesolithic, located along the southern coast and in eastern Norway.

Another distinguishable feature was an extended 'intra-site organization'. However, this was detected at only one site, the Femundsåsen quartzite quarry in the eastern interior. This site was exploited from the Late Neolithic until the onset of the Early Iron Age. The site is a ca 2500 m² wide talus accumulation where large quartzite blocks were exploited. Within the Femundsåsen quartzite quarry, there are small demarcated areas of nodules reduced to similar sized blanks, ready for someone to choose one and carry it to the edge of the talus to establish 'working platforms' (see also Nyland 2016b). There may be extended organization

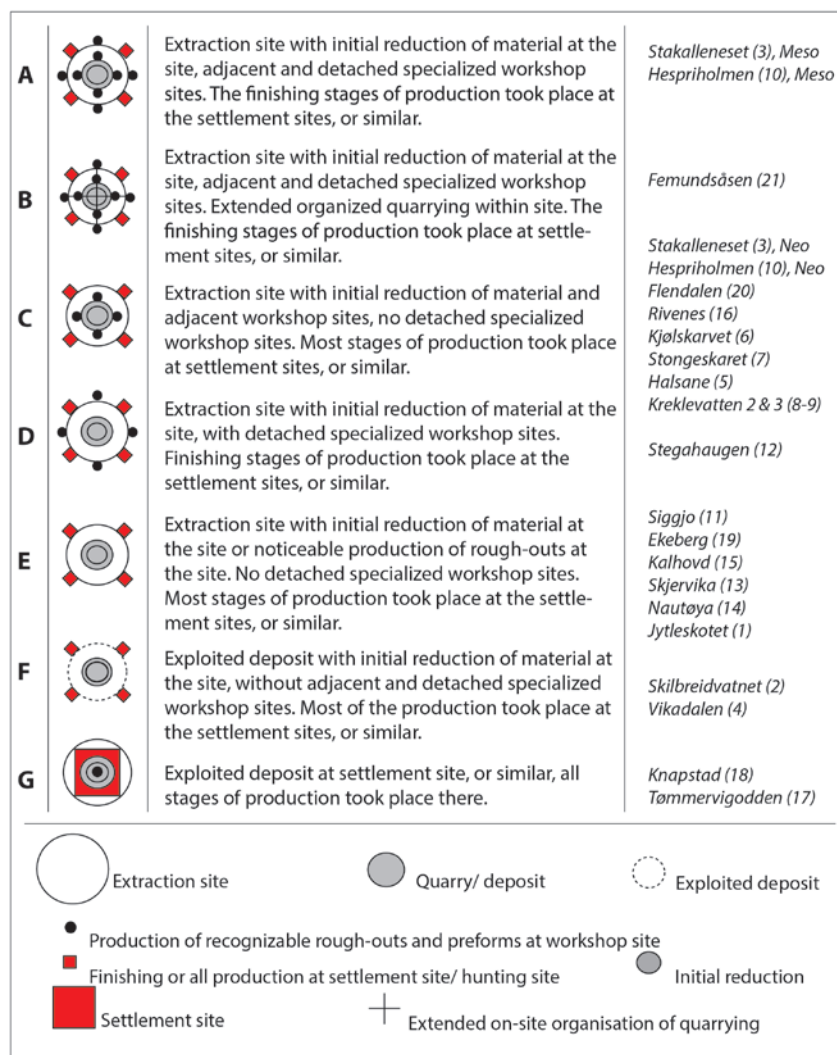


Fig 3. Models illustrating variation in the organization of direct lithic procurement. The models consist of the following components: 1) The white outer circle illustrates the extraction site's immediate boundary. This includes the topographically delimited deposit, waste piles and adjacent workshop sites; 2) The grey inner circle represents the initial on-site reduction of blocks that is found at each of the extraction sites; 3) The small black circles are indications of production of recognizable rough-outs or preforms. This took place either at adjacent workshop sites, within the extraction site, or at specialized workshop sites some distance away; 4) Red squares represent exploited deposits at settlement sites where all stages of procurement and production were undertaken; 5) The cross-marks indicate further internal organization of the quarrying

Обр. 3. Модели, илюстриращи разнообразие в организацията на пряк добив на каменни суровини. Моделите съдържат следните компоненти: 1) външният бял кръг е непосредствената граница на кариерата. Това включва топографски разграничени депозити, отпадъчни купчини и прилежащи работилници; 2) вътрешният сив кръг представлява първоначалното редуциране на скални блокове в рамките на кариерите; 3) малките черни кръгове показват производство на разпознаваеми заготовки или полу-фабрикати. Те се правени или в работилници в рамките на кариерите, или в съседни специализирани ателиета; 4) червените квадрати представляват суровини, експлоатирани в рамките на селища, където са документирани всички етапи на добив и производство; 5) кръстовете показват допълнителна вътрешна организация в кариерите

at other sites too, demarcated activity areas not detected due to limited archaeological excavations. However, the five other quartzite quarries exploited during the same period were in areas of similar vegetation or, rather, lack of vegetation. That is, the quarries, waste piles and layers were only partly covered by a thin cover of moss, reindeer lichen (*Cladonia rangiferina*) and scattered patches of turf.

Building on such key features representing differences of organizing direct lithic procurement, variation may be visualized as models (fig. 3). Obviously, models represent idealized situations. Furthermore, there may have been synchronous variations in practices that disappear when illustrated in this manner. That is, one may combine practices in a single model suggesting contemporaneity, but originally they were undertaken successively. To illustrate a dynamic and practical task by applying models is to freeze a living tradition, and to employ models is therefore a normative exercise. Therefore, models should be used cautiously. Furthermore, having attempted to create such models, I also identified aspects of the lithic procurement that the models did not accommodate – in particular regarding the sites' time-depth and variation in the intensity of exploitation.

Demonstrating variation in the duration of exploitation

Dating the duration of quarrying activity is challenging, but necessary for contextualization, to compare contemporary practices, the use and reuse of a site. To suggest a time-frame for activity at each of the 21 investigated sites, I combined several methods. From this, I established a tentative chronology of activity (fig. 4). The figure demonstrates time-depth of use as one distinguishable feature of only a few quarry sites. Reading from left to right, representing geographical location of the sites from west to east, one notices a difference between regions, a characteristic feature to which I will return shortly.

Returning first to the methods of dating the quarries, dateable charcoal mixed with waste and debris in the quarries was discovered at only four of the 21 quarries (Olsen 1981; Alsaker 1982; 1987; Olsen, Alsaker 1984). The lack of charcoal could be because fire as a quarrying technique was infrequent in southern Norway during the Stone Age. It could also be a result of poor preservation conditions, or rooted in fire being destructive for some rock types instead of securing usable blocks of rock. Neither is finding charcoal a guarantee of dating the whole period of quarrying activity. That is, the choice of technique probably varied over time. Thus, a charcoal layer can date one or two phases of activity, whereas in other periods perhaps either hammerstones or wedges sufficed. Moreover, fire may not have been used to loosen rock at all. At one site, the Flendalen jasper quarry⁶, fire had been used to clear the area of shrubs and heather, exposing large blocks of jasper scattered in front of the rock face.

Another problem is the relatively poor preservation conditions for organic material from the Stone Age in Norway. Therefore, coastal Stone Age sites are rarely sufficiently radiocarbon dated. Instead, a common dating method for Stone Age sites in Norway is to relate them to dated ancient shorelines (e.g. Kleppe 1985; Bjerck et al. 2008). In the Mesolithic, and most of the Neolithic, the inhabitants of the Norwegian coast were marine oriented and settled close to the shore. During and after deglaciation, isostatic movements caused major

⁶ The charcoal layer was dated by Egil Mikkelsen, but only presented in an archival report from an archaeological excavation (Mikkelsen 1984). It was also discussed by Ragnhild Sjurseike in her PhD thesis (Sjurseike 1994).

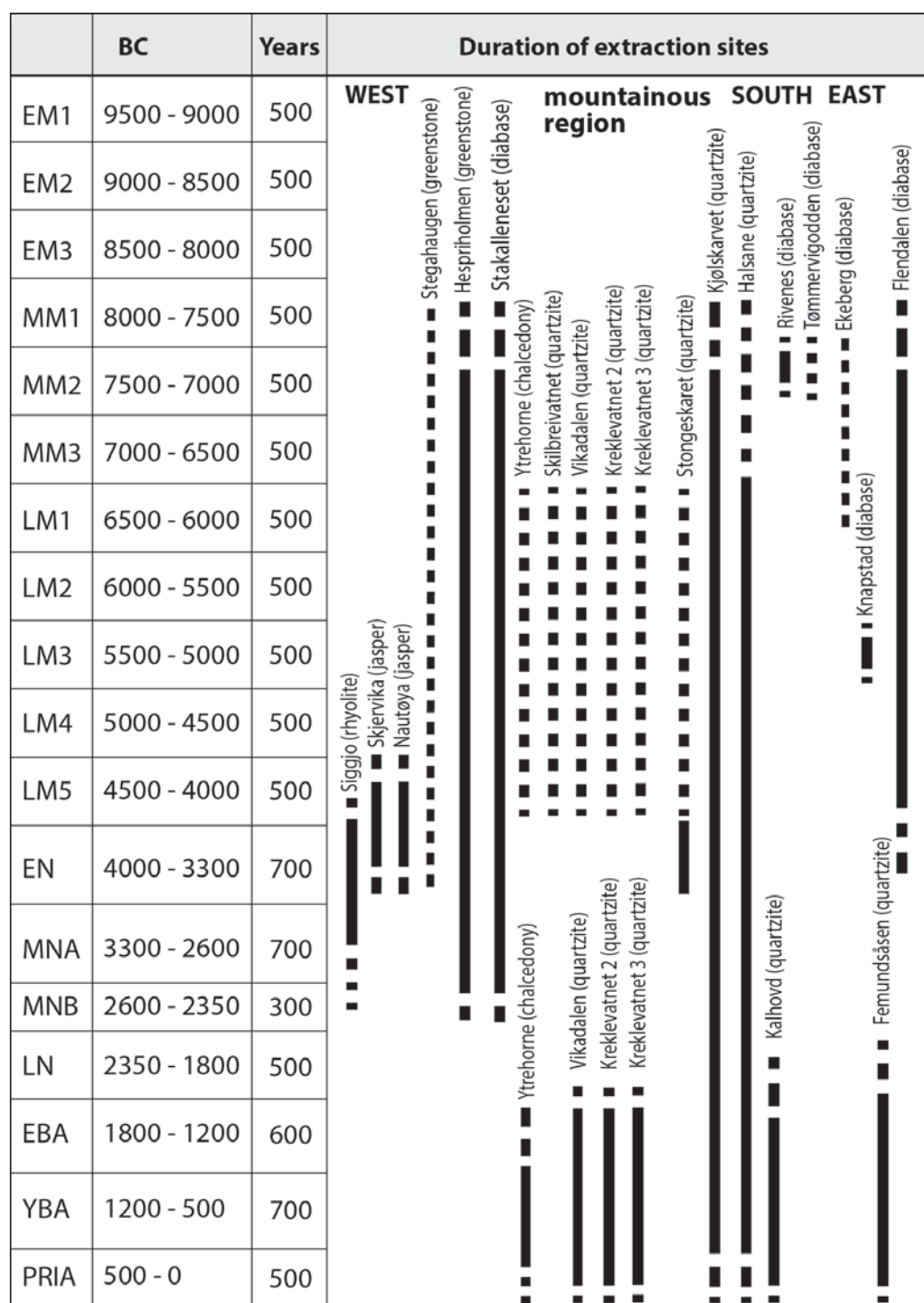


Fig 4. A tentative chronology of quarrying at 21 sites in Southern Norway. The abbreviations in the left columns mark the chronozones of the Stone and Bronze Age of southern Norway: Early (E), Middle (M) and Late (L) Mesolithic (M) and Neolithic (N), Early (E) and Late (L) Bronze Age (BA), as well as the Pre-Roman Iron Age (PRIA). Rock types are indicated in brackets

Обр. 4. Ориентировъчна хронология на местонаходищата в Южна Норвегия.

Съкращенията в лявата колона маркират хроно-зоните на неолита и бронзовата епоха в региона: ранен (E), среден (M), и късен (L) мезолит (M) и неолит (N), ранна (E) и късна (L) бронзова епоха (BA), както и желязна епоха (PRIA).

Видовете суровини са отбелязани в скоби

regressions, but also transgressions of the Norwegian coastline. The pace and curve of this process differs between regions. For example, at the coast of Vestfold County, west of the Oslo fjord, the marine limit was ca 160 m a.s.l. (Sørensen et al. 2014). Early Mesolithic sites have been found from between 125–195 m a.s.l., and the lithic assemblages reflect that the sites become younger, the lower in the relatively steep terrain they are located (e.g. Jaksland 2014). On the southwest coast in Rogaland County, the marine limit is around 30 metres at the coast, and the oldest Early Mesolithic sites are found around 15 m a.s.l. However, on the western coast, there was also a later transgression starting at the end of the Middle Mesolithic, covering older sites. Late Mesolithic sites and younger sites can therefore also be found on top of such beach ridges (Prøsch-Danielsen, Høgestøl 1995; Prøsch-Danielsen 2006; Skjelstad 2011). To date quarries and exploited deposits, relating quarries to ancient sea-levels proved to be of limited relevance. The method was applicable at only three sites since a deposit or specific rock source was not necessarily located close to the ancient shore. However, because the transgressing sea-level, a *terminus ante quem* could be determined for the three sites; Rivenes and Tømmervigodden on the southernmost coast, transgressed by the Late Middle Mesolithic, and partly Hespriholmen, on the southwestern coast. These sites were all ‘uncovered’ and ‘drowned’ by the sea. As for the first two sites on the southernmost coast, the sea level had not fallen sufficiently until after ground adzes ceased to be made.

The most useful method for dating activity at the procurement sites has therefore been typology. The knowledge of typological developments of lithic types and technology in southern Norway in the Mesolithic, Neolithic and part of the Bronze Age, is well developed (e.g. Bjerck 1986; Olsen 1992; Ballin 1999). Finding certain types of blade production/cores, bifacial pressure techniques, as well as preforms for characteristic adzes, can thus be used to deduce a general period of use. To examine material at sites of great time-depth is challenging due to the fragmented character of a quarried material and apparent post-depositional disturbances. Furthermore, because most quarry waste is non-chronologically diagnostic, it is important to include studies of assemblages at recorded and excavated workshops and settlement sites located near the quarries. That is, to investigate what became of the quarried rock is a way to gain insight into chronology. Hence, to operate with an extended notion of what constitutes a quarry, including the quarries’ waste piles, related workshops and settlement sites in the immediate vicinity of the procurement sites, is key. Although relations between quarries, workshops and settlement sites are mainly established through visual analyses of the rock, this is not too problematic. This is because the quarried rock types are relatively distinct, and the distances between source and examined sites were kept to a minimum.

Since several of the surrounding sites are excavated and radiocarbon dated, this aided the dating of the procurement sites. These sites showed contemporary use of raw materials from several quarries and sources. To look beyond the quarries themselves, into the use of the rock in varied archaeological contexts, is imperative in order to understand the social role of a particular quarry. Furthermore, the frequency of use of the different rock types at the settlement sites, as well as the range of their distribution, indicates tendencies in preferences and value assigned to different rock types. That such preferences vary within the same area over time indicates that this is not solely a question of availability.

Typological dating is challenging and gives a fragmented result, but so does radiocarbon dating when trying to date a period of activity. My established chronology may well be lacking. Moreover, despite my suggested periods of exploitation, quarrying was not neces-

No.	Site	Extracted volume (m3)	Sum/ years (sequences)	Litre per year (Dm3)	Scale of activity
10	Hespriholmen	400	5700	70	Large
3	Stakalleneset	400	5700	70	Large
11	Siggjo	110	1900	60	Large
21	Femundsåsen	100	2300	44	Large
6	Kjølskarvet	100	8000	13	Large
20	Flendalen	40	4700	9	Large
19	Ekeberg	6	1000	6	Moderate
7	Stongeskaret	6	1200	5	Moderate
16	Rivenes	2.5	500	5	Moderate
9	Kreklevatnet 3	10	2800	4	Moderate
12	Stegahaugen	6	1700	4	Moderate
13	Skjervika	3	1200	3	Moderate
1	Ytrehorne	1	500	2	Moderate?
8	Kreklevatnet 2	5	2800	2	Moderate
14	Nautøya	2	1200	2	Moderate
5	Halsane	10	7000	> 1	Moderate
18	Knapstad	0.5	500	1	Small
4	Vikadalen	0.5	500	1	Small
15	Kalhovd	>0.5	2300	0.2	Small
2	Skilbreivatnet	>0.1	500	0.2	Small
17	Tømmervigodden	-	500(?)	-	Small (?)

Table 1. Estimates of age and scale of extraction at each of the sites

Таблица 1. Данни за периода на използване и мащаба на производство на всеки един от обектите

sarily a continuous, everyday event. Quarrying may well have had an episodic character, being an even undertaken once a year, or even less frequently. Even so, as the largest of the quarries persisted through deep time, this demonstrates that knowledge of these sites must have been maintained, kept alive in memories among the inhabitants of the area. As some of the sites over time had acquired large waste piles or deep scars in the quarried outcrops, the places became tangible proof of past times, past generations, even ancestral presence. Some of these sites come across as the most monumental and enduring of sites created by humans in the Norwegian Mesolithic and Neolithic. Besides the few large rock art sites, and grave mounds of later periods, there are no similar sized megaliths or other similar stone monuments in Norwegian prehistory. These humanly modified places could have been tangible traces of past generations, representing places of ancestral presence in the Mesolithic and Neolithic (Nyland 2016c; 2017).

Demonstrating variation in the intensity of exploitation

There are distinguishable scars on the outcrops that can be measured to give an impression of how much rock has been removed at only a handful of quarry sites. To estimate scale of quarrying, it has been important to document the thickness and extent of the waste piles and waste layers (table 1).

At three of the sites, extracted volumes had already been estimated during the initial investigations of archaeological excavations and surveys (Olsen, Alsaker 1984; Alsaker

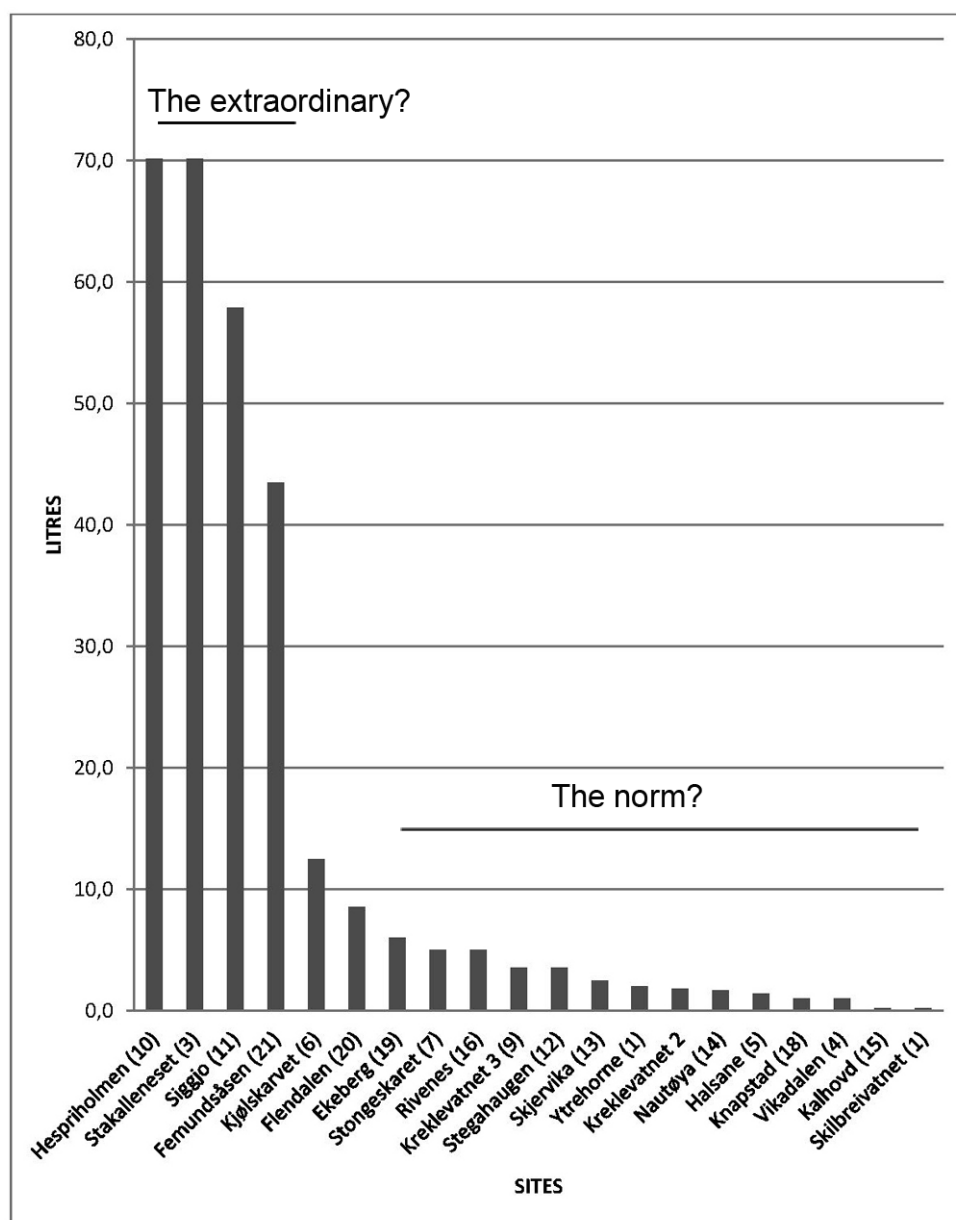


Fig. 5. Diagram showing the various intensity of exploitation, based on the numbers listed in Table 1

Обр. 5. Графика на различната интензивност на експлоатация, на основата на показателите в таблица 1

1987). The others were investigated by the present author. Even though the estimated volumes presented are rough estimates, it does give a point of departure for comparing the dimensions of the quarries and scale of the extraction. The sites have all been approached in a consistent manner with the intent to enable comparisons. The relation between the scale of extraction at each site and the estimated time-depth do give an indication of the intensity of quarrying and exploitation of each site (fig. 5). The estimates of waste volume are divided by the periods of use. Note that the number of years is not exact, but based on the duration of the periods (as shown in fig. 3).

The two adze quarries, Stakalleneset and Hespriholmen, located on the west coast, were massively quarried too, about 400 m³ each, but in relation to their time-depth, the activity is actually relatively modest. That is, they were revisited and exploited over 5000

years, starting after 8000 cal BC and ending around 2500 cal BC (Olsen, Alsaker 1984; Bergsvik, Olsen 2003). Two quartzite quarries (Kjølskarvet and Halsane), located in the mountainous regions about 1300 m. a.s.l., also show considerable time-depth. They were continuously in use from the Middle Mesolithic into the Pre-Roman Iron Age. However, these sites provided rock for blade and flake tools, and they are in a very different geographical area than the adze quarries at the coast. Quarries at such high altitudes were unavailable during winter, and any settlement in these areas is thought to be of another character than in the coastal, probably residential area. Yet, although the mountain quarries' time-depth is extraordinary, the scale of exploitation is such that it does not rate high on the intensity scale. The distribution is not as wide either. Nevertheless, located in areas for annual reindeer hunting, at the watershed between the western fjord landscape and eastern inland valleys, these sites may have been central in people's lives beyond being sources for available raw material.

The two quarries that were 'intensively' exploited, that is massively exploited during short periods, are the Early Neolithic rhyolite quarry of Siggjo on the western coast, and the aforementioned Late Neolithic/Bronze Age quartzite quarry at Femundsåsen. Although sharing a characteristic type of exploitation, they belonged to different periods, and thus two different social settings. Moreover, the scale of distribution of the rock from these two sites differs. In this case, the distribution may represent varying value of the procured rock itself, as well as different use of the site from which the rock came from. In the Early Neolithic, the rhyolite was distributed to areas of already available high quality rock for making the same types of tools, whereas the quartzite of Femundsåsen was used intensively, but locally.

Practices defining geographical regions?

The different procurement sites in southern Norway seem to have been involved in different procurement practices and social systems. Charted chronological and spatial variation in scale, intensity, distribution and time-depth, all indicate different traditions and social practices involved in lithic procurement in the different regions. In a *chaîne opératoire* terminology, one may regard these as procurement *concepts* (e.g. Edmonds 1990; Lemonnier 1993; Soressi, Geneste 2011). A particular socially or culturally specific way of operating or performing a task, can also be viewed as a society's *modus operandi* (Bourdieu 1990). Regarding Stone and Bronze Age rock procurement in southern Norway, the continual exploitation of certain procurement sites, even if other sources of high quality rock were available, implies that some sites may have been entangled in social practices, traditions and perhaps even myths of ancestry. This continually enriched the procurement places with social significance. Consequently, each geographical region developed its own culturally situated way of procuring rock. The question remains, which social situation prompted the different responses or developments?

The sites discussed in this article, are mainly located in four geographical regions: the west coast, the eastern region, the southernmost coast, and the mountainous regions between eastern and western Norway. Although one may question its representability, the index diagram (fig. 4) displays variations in the intensity of exploitation of each site. It shows that *the norm* across the country seems to have been to quarry or otherwise exploit several deposits modestly and/or opportunistically, using the available sources where one lived or travelled. The result is that most of the sources and quarries appear relatively 'short lived', especially when compared with sites of extensive time-depth. The intensity index thereby

distinguishes sites that were *extraordinary*. Three of these were in western Norway: the two adze quarries of Hespriholmen and Stegahaugen, in continual use over 5500 years, and the rhyolite quarry atop Mt Siggjo, the large-scale exploitation of which and wide distribution of its material marked the onset of the Early Neolithic in the region.

In the forested inland plateaus of eastern Norway, relatively intense exploitation of the Flendalen jasper quarry continued throughout the Mesolithic. The material can be found at Mesolithic dated sites along river systems and lakes in the interior district surrounding it (Stene, Persson, Damlien 2010). However, at the onset of the Early Neolithic, around 4000 cal BC, the Flendalen site was abandoned. The abandonment can only be understood in light of its cultural-historical setting; that is, at the onset of the Early Neolithic there was incipient contact between the hunter-gatherers of eastern Norway and farming societies in southern Scandinavia (Scania and Denmark) (see Nyland 2016c). From this point on, the lithic assemblages at inland sites display less variation in lithic raw materials (e.g. Boaz 1998; Stene, Persson, Damlien 2010). Instead, flint – a coastal resource – was suddenly being transported into the interior region in larger volumes than earlier. The material culture also changed, including more elements of the farming societies of the south, for example, four-sided and polished flint axes produced in southern Scandinavia. Some of the imported axes were even reused as raw materials for blade and flake tools at the inland sites. High quality flint is also found in hoards, indicating added value given to imported flint. As mentioned, in my study I do not consider whether rock found far away from a quarry was directly procured, traded or exchanged, but stress how long distance distribution can express value given to certain rocks due to an idea of possessing rock from significant quarry sites. Accordingly, rock from certain sites or associated with specific people may have come to be been regarded as valuable, perhaps as ‘exotica’ originating from distant places, or from places related to sites of particular spiritual value, thereby becoming *pieces of places* (Bradley 2000). Furthermore, a certain rock type can also have gained value because of its association with specific groups of people, like flint accessible through contact with farming societies in a world of hunter-gatherers (Nyland 2016c).

Meanwhile, in western Norway, there is no similar orientation toward imported flint. Southern Scandinavian elements and impulses are less frequent. Instead, a sudden and intense exploitation of rhyolite from the summit of Mt Siggjo used to produce blade and flake tools started at around 4000 cal BC. The different pace of the ‘process of Neolithization’ in the two main regions of southern Norway at the time, is not only visible in practices related to lithic raw materials. It is also noticeable in varying incipient agricultural practices and the beginning of pottery making (Nyland 2016c, with references)⁷. Emphasizing the value of a certain rock type beyond its practical use may explain the two varying Neolithic trajectories that developed in western and eastern Norway, respectively. The archaeological record of western Norway shows fewer signs of integrating agricultural practices and artefacts than in the east. Although there are changes, for example in adze types and blade technology, the large adze quarries on the west coast, and the distribution patterns, endured into the Neolithic. The Mesolithic intensified quarrying had become an entangled social practice linking people to their region and their past. *Quarrying* was at the onset of the Neolithic still

7 In the east there are traces of the beginnings of livestock husbandry and incipient crop growing, frequent finds of imported polished flint axes and the erection of a handful of dolmens. In the west, there are very infrequently found sites with pottery and very few imported polished flint axes. Signs of agricultural practices (husbandry) continued until the Middle Neolithic.

a characteristic element of the inhabitants of the west coast. It seemed they quarried, even if they did not need to, and specific rock types were distributed into areas that were self-sufficient in raw materials. Why?

Ideas of significance related to place and practice at the Neolithic transition

When investigating whether rock, certain rock sources or quarrying itself had value beyond practical aspects, contextualization is required. Hence, distribution on local and regional scales should be examined and charted (e.g. Cummings 1979; Olsen, Alsaker 1984; Mandal, Cooney 1997; Pétrequin et al. 2015 – to name just a few examples of different provenance studies). Distribution of rock and the actual use of rock types at sites are part of examining lithic procurement practices. In the vicinity of Bømlo in the County Hordaland, I examined and quantified the raw material variation at 17 settlement sites near several contemporaneous exploited quarries: Nautøya and Skjervika jasper quarries, the Siggjo rhyolite quarry and Stegahaugen and Hespriholmen greenstone quarries (see also Nyland 2016c) (fig. 6) (table 2). Jasper, rhyolite, quartzite and flint collected from the beaches were all used to produce the same types of tools. Yet, while studying the on-site exploitation of these rock types at the sites, it became clear that jasper, even if the deposits were available and closely accessible, it was out-conquered by the other rock types. Indeed, jasper made up, in general, less than 2% of the assemblages. Hence, it looks like the inhabitants of this area did not really need to quarry jasper as they could easily find rock to replace it. The deposits did not even provide homogeneous rock; indeed, it is relatively poor knapping material. The jasper deposits themselves also display this small-scale quarrying; only about 2–3 cubic metres seem to have been extracted during their period of exploitation. Nevertheless, the inhabitants of this area still chose to quarry at these sites to obtain the characteristic red rock. Why?

As mentioned, the rhyolite quarry atop Mt Siggjo, on the island of Bømlo, was established at approximately 4000 cal BC. This ‘sugar top’ mountain is a sailing landmark in the region, and the view from the summit is exceptional. Except for extracting the characteristic dark bluish-grey rhyolite, criss-crossed with thin white veins, there are no other obvious resources to harvest on this mountain. Hence, the quarrying was planned and deliberate. It was not an embedded practice in Lewis Binford’s (1979) terms. Moreover, when fire was used to quarry, this would have been seen for miles as a beacon revealing the activity taking place at the top. The establishment of this quarry, and the wide dispersal of the ‘Siggjo-rhyolite’ is perceived as *the* chronological marker of the Mesolithic–Neolithic transition in western Norway. At coastal settlements all along the western coast, from Rogaland to Sogn og Fjordane, ‘Siggjo-rhyolite’ makes up between 30–60% of the lithic assemblages, sometimes up to 90% (Bergsvik 2006; Solheim 2007) (fig. 7). The distribution area covers districts that already had similar and accessible raw materials. The knapping qualities of rhyolite were no better than the various fine-grained and microcrystalline quartzites, flints or mylonites otherwise in use along the coast. So, what was so special about the rhyolite?

The use of Hespriholmen continued from the Mesolithic into the Neolithic, arguably intensifying during the Late Mesolithic (Olsen, Alsaker 1984; Bergsvik, Olsen 2003). Hence, for centuries, even millennia, the site had provided predictable sources for high quality rock. During the Early Neolithic, greenstone from Hespriholmen became less dominant, but



Fig. 6. Five quarries are located in close proximity to one another, on and around Bømlo. At the Mesolithic-Neolithic transition, ca 4000 cal BC, they were all in use simultaneously (figure by A.J. Nyland)

Обр. 6. Пет от карieri се намират в непосредствена близост на около остров Бомло. Те са едновременно използвани в периода на преход от мезолит към неолит (около 4000 BC) (автор А. Ниланд)

the site was still revisited and the rock widely distributed. Perhaps a collateral consequence of the persistent exploitation was that a significant place, where time was materialized and the activities of past generations made tangible, had been created. Over time, quarries displaying large scars might have come to be specifically valued places just because they were associated with ancestral presence? The continued use of Hespriholmen (and Stegahaugen) into the Neolithic may have been anchored in the hunter-gatherers' sense of obligation to their ancestors. Thus, the exploitation of the place was rooted in its entanglement in social and symbolic structures, having made quarrying a socially required practice (Nyland 2017). Thus, to the societies who knew and exploited the rock from these sites, the quarries may have represented places of practices and traditions linking the present population to their past. Within this, claims to territory and resources may have been embedded.

The five quarries were in use simultaneously. However, the distribution and use of the quarried rock from these sites differs greatly. Jasper from the two small jasper quarries was used very locally, on the islands surrounding the quarries. The dispersal of greenstone

Site name, location, island (Mus.no.)	Date	Sum finds (N= 100 %)	Sum flint / %	Sum Rhyolite / %	Sum quartz / %	Sum Quartzite / %	Sum jasper / %	From which jasper quarry? (visually identified)
112 Litla Skiftesvika, Spissøy (B15188)	MM-LM (+ LN /EBA)	6868	3624/ 53 %	3/ 0.04%	2469/ 36 %	113/ 1.6 %	19/ 0,3 %	Nautøya
60 Kjøttvika, Bømlo (B15217)	MM-LM	651	632/ 97 %	-	1/ 0.2 %	7/ 1.1 %	2/ 0.3 %	Nautøya (?)
20 Skatevika, Bømlo (B15187)	LM	9131	6499/ 71 %	22/ 0.2 %	1668/ 18 %	207/ 2.3 %	17/ 0.2 %	Nautøya (?)
12 Kjøttvika, Bømlo (B15179, B14571)	LM* + EN*	5916	3045/ 52 %	6/ 0.1 %	1856/ 31 %	89/ 1.5 %	128/ 2.7 %	Nautøya
13 Kjøttvika, Bømlo (B15180)	LM (+ MN)	4212	2238/ 53 %	12/ 0.3 %	1216/ 29 %	386/ 9 %	105/ 2.5 %	From Nautøya + Beach cobble
32 Kobbavågen, Spissøy (B15199)	(LM) + MNA *	5365	3949/ 74 %	76/ 1.4 %	769/ 14 %	245/ 4.6 %	6/ 0.1 %	Nautøya (?)
138 Jensavikdalen, Nautøy (B15395)	LM + EN	499	344/ 69 %	3/ 0.6 %	115/ 23 %	-	1/ 0.2 %	Nautøya
Mathisplassen, Finnås, Bømlo (B7537)	LM + EN	114	44/ 39 %	1/ 0.9 %	2/ 1.8 %	1/ 0.9 %	2/ 1.8 %	Nautøya (?) (Beach cobble?)
49 Grovikjamyro, Føyeno (B15210)	EN	4993	1898/ 38 %	2116/ 42 %	83/ 1.7 %	52/ 1 %	756/ 15 %	Nautøya
103 Kobbavågen, Spissøy (B15256)	EN-MNA	524	239/ 46 %	15/ 2.9 %	146/ 28 %	35/ 6.7 %	3/ 0.6 %	Not determinable
50 Nautøysundet, Føyeno (B15211)	Mesolithic + LN/BA	324	110/ 34 %	-	128/ 40 %	7/ 2.2 %	1/ 0.3 %	Undetermined
37 Kjøttvika/ Bømlo (B15201)	Neolithic/ Bronze Age*	2540	524/ 21 %	8/ 0.3 %	727/ 29 %	640/ 25 %	45/ 1.8 %	Nautøya (?) Beach cobble?
Bergeseide III, Berge, Bømlo (B13884)	LM	68	19/ 28 %	-	1/ 1.5 %	-	1/ 1.5 %	Skjervika
Lindal I, Berge, Bømlo (B13887)	LM-EN	78	48/ 62 %	15/ 19 %	2/ 2.6 %	2/ 2.6 %	2/ 2.6 %	Skjervika
Storemyr, Hovland, Bømlo (B12378-12380)	LM-EN-MN	14659	10420/ 71 %	664/ 4.5 %	2704/ 18 %	52/ 0.4 %	299/ 2 %	Skjervika
Nesjatræ, Vestvik, Finnås, Bømlo (B7700)	EN	864	130/ 15 %	47/ 5.4 %	4/ 0.5 %	3/ 0.3 %	4/ 0.5 %	Skjervika
Aurebetstjernet, Hovland, Bømlo (B8702)	EN	14	4/ 29 %	9/ 64 %	-	-	1/ 7 %	Skjervika

Table 2. List of different types of raw materials used in varying degrees at sites with jasper as part of the assemblages, surrounding the two small jasper quarries Nautøya and Skjervika. They are also in close proximity to Siggjo, Stegahaugen and Hespriholmen. N: all recorded lithic finds at each site. Some of the sites are radiocarbon dated (*). The rock types indicated are from the original catalogues (Kristoffersen, Warren, 2001)

Таблица 2. Различни видове суровини, използвани в различна степен на обекти, където ясписът е част от ансамблите. Тези обекти са разположени около две малки ясписови кариери – Наутоя и Шервика. Те също са в непосредствена близост до Сигхо, Стегахоуген и Хесприхолмен. N: всички намерени изделия от дадения обект. Някои от обектите имат радиовъглеродни дати (*). Посочените типове скали са взети от оригиналните каталози (по Kristoffersen, Warren, 2001)

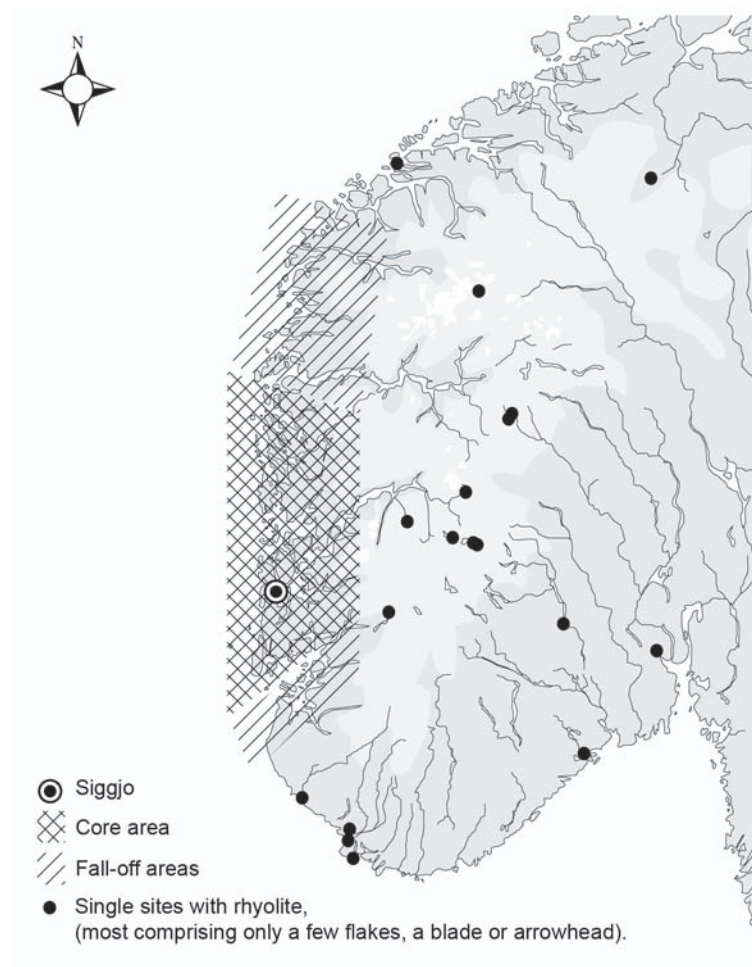


Figure 7. Distribution area of rhyolite on the west coast, based mainly on dispersal patterns established by Bergsvik (2006) and Solheim (2007), as well as my own PhD work (Nyland 2016a) (figure by A.J. Nyland, first published in Nyland, 2016c)

Обр. 7. Разпространение на риолита по западното крайбрежие, основаващо се на работите на Bergsvik (2006) и Solheim (2007), както и на споменатата по-горе докторантска дисертация на автора (Nyland 2016a) (карта изготвена от А. Ниланд, публикувана за пръв път в Nyland, 2016c)

and diabase from Hespriholmen and Stakalleneset, respectively, has supported a division of the west coast into two large social territories (Olsen, Alsaker 1984), whereas the frequent distribution of Siggjo rhyolite marks social relations and networks encompassing the full extent of the west coast. Considering this, even the small-scale quarrying, such as at the jasper quarries, undertaken even if there was no apparent need for it, may be understood; to quarry was an expressive act, communicating identity. That is, the idea of quarrying at selected places, and the idea of *possessing rock from specific sites* – were characteristic cultural features of the western region of southern Norway. Hence, quarrying, even small scale and ‘unnecessary’, echoed the persistent tradition of quarrying adze materials at Hespriholmen. The importance of quarrying was emphasized through the establishment of the quarry at the summit of Mt Siggjo (see also Nyland 2016c).

From this perspective, it seems quarrying in the Bømlo area had taken on a signifi-

cance of its own. As such, the Early Neolithic maintenance of the quarrying tradition indicates peoples' historicity. The inhabitants of the west coast used the past in their present. *To quarry* reified peoples' sense of belonging, probably also their territorial claims. As I see it, this practice of almost demonstrative quarrying must be understood as related to the first encounters on the west coast with impulses from the Neolithic farming-based societies in the southeast. To the hunter-gatherers in the west, to quarry and use rhyolite from Siggjo was a deliberate choice, to actively maintain the *status quo* in the face of external impulses, signalling through using rock who belonged to a group, and who did not (see Nyland 2016c).

Final comments

Each quarry and lithic procurement site had special features, and each was important to the people exploiting it. Some of the sites discussed in this article have earlier been classified as 'special', that is, having added value or significance due to their location in the landscape (Bradley 2000; Lødøen 2010). However, I find that such a classification is often more based on our contemporary societies' ideas of places in the landscape being remote, or access to them being 'risky'. In my mind, a site's value is not necessarily linked to a site's topography, nor the geological properties of the different rock types. Studies of rocks' mechanical properties have shown that it was not automatically our concepts of the rocks' high quality that caused rock to be transported far away (Bradley et al. 1992). Furthermore, given that rock types discussed in this paper were also used at 'ordinary' settlement sites, it may well be that it is not even the archaeological contexts that automatically indicate contemporary value. Through my studies, I have found that to demonstrate quarry sites' extraordinary character and their value to contemporaneous societies, investigating and comparing a wide range of aspects and elements involved in lithic procurement is necessary. In this paper, I have suggested a way to compare duration, scale, rock distribution, intensity and other 'attributes' of quarrying practices. With this, tendencies in regional and chronological variability in the organization of lithic procurement practices and quarrying emerged.

When interpreted in a wider social, cultural and historical context, the variation in lithic procurement practices can give insight into regional developments. For example, the manner in which different quarries and rock types were exploited at the Mesolithic–Neolithic transition, indicates that certain quarries had been intertwined in social networks in the western and eastern region, respectively (Nyland 2017). These regions display two different trajectories toward the agricultural transformation during the Neolithic in southern Norway (see, for example, Nyland 2016c). Entering the Late Neolithic and Bronze Age, the social setting had changed from a relatively mobile hunter-gatherer-fisher lifestyle, to a more-or-less settled farming society. Accordingly, the social status and impact of quarries and rock had probably undergone a consequential change too. From the onset of the Bronze Age, lithic tools are less dominant in the archaeological record. Moreover, in this period, quarries had competition from man-made monuments such as large burial mounds. Still, as the quarries at Femundsåsen and the mountainous areas demonstrate, this did not mean that rock quarrying had ceased. Indeed, they may still have been significant social arenas or assets in an increasingly hierarchical society exploiting all available resources in different landscapes (Nyland 2016b).

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Добиването на каменни суровини през неолита и бронзовата епоха в Норвегия, изучавано като социален феномен

Астрид Ниланд

(резюме)

Добиването на каменни суровини включва няколко дейности, които са ръководени и съзнателно или несъзнателно повлияни от културните традиции на даденото общество и неговия социален хабитус (habitus). Това превръща добиването на суровини в социален феномен. Оттук следва, че изучаването на процеса би могло да бъде полезно в изследвания за създаването на социални връзки и социо-политически стратегии.

Статията представя резултатите от докторска дисертация, където са сравнени 21 местонаходища/кариери на различни видове скали, разположени в различна географска среда в Южна Норвегия. Обектите датират от мезолита, неолита, бронзовата

и дори началото на ранната желязна епоха (8000–300 пр. Хр.). Въпросът за добиването на каменни суровини е разгледан в светлината на концепцията за *chaîne opératoire*. Става дума за подход, който обръща особено внимание на контекстуализацията и практиките, свързани с производството на кремъчни изделия. Обектите се различават помежду си, въпреки че всичките са от типа отворени мини. Топографски те са разположени на: диги, намиращи се на носове на фиорди; малък остров, недалеч от бреговата линия; кариерни разкрития; вени на подходящи скални породи, разположени в най-високите части на планините или в речни долини; сипеи в залесената вътрешност на страната. Типовете скали варират между различни по цвят фини кварцити, яспис, риолит, халцедон, диабаз и диорит. Тези скали са използвани за направата на тесли, пластини или оръдия на отломъци. Всички тези разлики представляват сериозно предизвикателство за намирането на метод, който би могъл да анализира спецификите/разликите, а не просто да констатира разнообразието на кариерите и типовете скали. Целта на тази статия е да представи един нов подход, който не е фокусиран върху различията, свързани с кариерите (мащаб, видове скали, местоположение и природен релеф), а дискутира различните дейности, обединени в термина 'практики'.

Този подход включва изследването на археологически материали, произхождащи от кариери, работилници и селища, намиращи се в околността на каменните местонаходища. Изчислени са продължителността на експлоатация и обемът на производство на всеки проучван обект. Сравняването на резултатите, установяването на модели и индекс на интензивността на експлоатация демонстрират пространствени и времеви разлики в практиките за добиване на каменни суровини. Друг важен аспект на настоящото изследване е опитът да се датира периодът на експлоатация на различните обекти. Това позволява обектите да бъдат поставени в съответен контекст и да се установи дали едновременно експлоатирани кариери и видове суровини са използвани по различен начин.

Аспектите на изследването дават възможност да се изясни ролята и значението на определени кариери, на практиките за добив на суровина и на някои видове скали от специфични кариери. Всяка кариера и добив на практика има специфични характеристики, които вероятно са били от значение за хората, които са ги експлоатирани. Сравнението между различните обекти и практики показва, че вероятната норма е била прагматично използване на много местни източници. По-широко сравнение, обаче, показва, че някои обекти са били 'необикновени'. Сравнението между тяхното времетраене, обем на производство, разпространение на суровината и други атрибути на добивните практики (например, наличието на специализирани работилници), очертава тенденции в регионалното и хронологично разнообразие в организацията на снабдяване със суровини. Някои практики са всеобщо валидни, докато други са специфични за даден район и/или период – напр. използването на кариери през средния и късен мезолит, и особено в началото на неолита в Западна Норвегия, се отличава значително от това в Източна Норвегия. В по-широк културен и социален контекст изглежда, че понякога как, от кого или откъде е добита дадена суровина, има по-голямо значение от вида или качеството на самата скала. Следователно, видени в по-широк социален, културен и исторически контекст, промените в практиките на снабдяване с каменни суровини дават представа за особеностите и тенденциите в регионалното развитие.