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Forlagets navn rækker tilbage til Anders Sørensen Vedel. Han udgav i årene 1591–92 otte bøger, der var „Prentet paa Liliebierget udi Ribe". Om disse disse bogudgivelser og trykkeriet se By, marsk og geest 10, 1998.

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Indhold

Geochemical constraints on the provenance of Viking Age soapstone finds from Ribe, Denmark

By Tobias B. Skowronek and Riia M. Chmielowski

Steatite objects are regarded as one of the characteristic features of Viking Age material culture, present in both Atlantic settlements and the Scandinavian homelands. However, the provenance of steatite artefacts in these regions can be difficult to determine. Any resolution regarding the origin of steatite finds from precisely dated context such as in Ribe, Denmark can thus contribute to the understanding of the development of commerce and urbanization at the very beginning of the Viking period. Here, we present X-ray fluorescence (XRF) data for 20 steatite objects from Ribe phases F-I (790-850AD), one sample from nearby Okholm, and four samples from Hedeby and compare the data to steatite deposits in Norway and Sweden; in addition to steatite objects from other places such as Bergen and Kaupang. The results suggest, that Ribe initially sourced its soapstone from a quite limited number of deposits; one possible candidate being the deposits at Hisåsen near Fjaere in Agder, southern Norway. Over the course of the 9th century these imports were supplemented by other, possibly multiple sources. The small amount of soapstone data available from other emporia, together with methodological inconsistencies prevent us from drawing any further conclusions. However, the available data is consistent with the possibility of the deposit, that supplied Ribe in the late 8th and early 9th centuries; may also have supplied soapstone to Kaupang and Hedeby.

We want to express our gratitude towards Mette Højmark Søvsø, Morten Søvsø and Claus Feveile for giving us access to the steatite finds from the Ribe excavation ASR 9 as well as their valuable help with choosing individual samples. We furthermore appreciate the help of Tom Heldal and Gitte Hansen for sharing their XRF-databases of Norwegian steatite occurrences. Last but not least, we thank all of the anonymous reviewers for their comments.

Steatite, also known as soapstone or in Danish: fedtsten, has been a known material for Scandinavians since the Stone Age (Skølsvold

1961). During the Viking Age, the quarrying and working of steatite became major industries, due to the suitability of the material for all kinds of domestic needs (Jesch 2015). Steatite goods have therefore been found in great quantities at emporia like Hedeby and Ribe. Heid G. Resi was the first to look at the massive corpus of steatite finds from Hedeby (Resi 1979). Resi argued that these steatite finds must have come from either western Sweden or eastern Norway. The results of mass spectrometry and cluster analysis conducted by Björg E. Alfsen and Olav H. J. Christie (1979) supported this idea. Because of the huge amount of steatite found at Hedeby and the wide distribution of the latter in Denmark, Resi argued that Hedeby may have served as a distribution point for the whole of Denmark. However, this now seems to be a questionable conclusion.

The study of networks and nodal points in early Viking-age Scandinavia by Søren Sindbæk (2007) suggests that Hedeby may indeed have received commodities from western Sweden and from emporia like Kaupang in eastern Norway, but it seems unlikely that those commodities were also traded on to Ribe. It is more likely, that Ribe received its steatite directly from elsewhere in Norway, perhaps from Agder (especially the area around modern-day Grimstad) via the medieval port of Hesnessund (Schou 2007 & 2017) or from another source further north. The important questions surrounding the Ribe soapstone, relate to the degree in which this commodity was standardised and routinised. Did the steatite at Ribe come from only one region, or is there evidence of a variety of major deposits being represented? Do these origins follow known political boundaries? Were certain sources used only to produce vessels, whilst others were utilized especially in the production of pyrometallurgical equipment; such as moulds or tuyere? Exploring these questions will contribute to the understanding of the organization of the industry and the role which Ribe played in the development of commerce and urbanization at the start of the Viking period.

Therefore, the question of steatite provenance is quite pivotal for our point of research. However, the provenance of steatite is not easy to determine. As Richard Jones (2007) stated “steatite has been one of the most difficult materials of archaeological interest to characterise by physico-chemical methods of analysis with a view to identifying its origin”. Until now there have been several different approaches utilized to provenance steatite; from testing its magnetic susceptibility (Clelland 2005) to Strontium-Isotopy (Bray 1994) or the determination of Rare Earth Elements (REE’s) (Forster & Jones 2023). Promising results were achieved from the chemical characterization of accessory minerals inside the steatite matrix (Skowronek et al. 2020; Chmielowski 2024). Keulen et al., (2022) applied ^{147}Sm/^{144}Nd isotopy to steatite of Greenland; an approach with great potential. However, any methodology requires comparative data with the soapstone deposits, which could have been the source of the artefact; no matter if it is based on the geological age or chemical data of the soapstone mineralisation. There is no comprehensive database for the Scandinavian region that includes all deposits. Many Norwegian deposits, except for those in the south and east of the country, have been thoroughly mapped with XRF data (available from Norwegian Geological Survey (NGU)). Therefore, as that is one of the largest comparative data sets available, XRF analysis was chosen for this project.

Previous XRF steatite work

A major study by Hansen et al. (2017) on the provenance of vessels found in Bergen

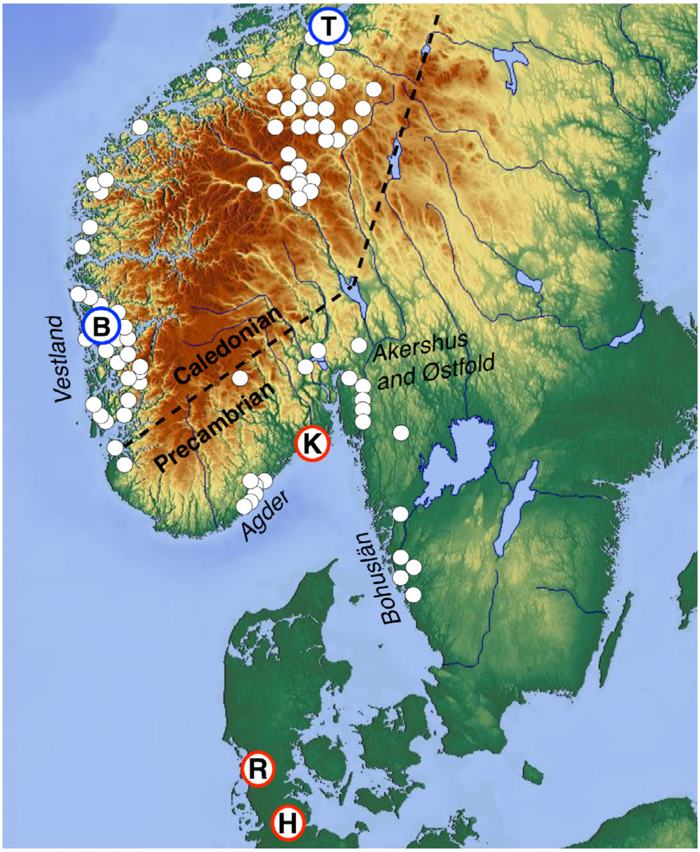

Fig. 1.

Main localities and approximate steatite occurrences mentioned in the text. White dots: known steatite deposits. Red circles: Viking-age Emporia, R= Ribe, H= Hedeby, K= Kaupang. Blue circles: other important towns: B=Bergen, T=Trondheim. Broader region names in italics. The dotted line approximately divides between Precambrian and Caledonian bedrock. Steatite occurrences after Hansen & Storemyr 2017, 15.

and surrounding areas found that the XRF data of many soapstone deposits in Norway are chemically similar. However, their data shows that concentrations of trace elements such as Nickel (Ni), Cobalt (Co), Vanadium (V) or Zinc (Zn) form significant clusters that appear to be related to the precursor rock types which were metamorphosed to form the soapstone. Their results indicate that, in the region of Vestland in western Norway the steatite deposits can be divided into four groups. Each of these groups are related to a specific type and/or age of precursor rocks.

These geochemical observations regarding the characteristic elements' fractionations are probably not limited to the deposits in Vestland, but may characterize the behaviour of these elements in Norwegian soapstone mineralization in general. This is both useful and problematic for the discussion of the provenance of the Ribe steatite, as it makes assigning a quarry to an archaeological find impossible. Therefore, using a method of elimination could possibly lead to the identification of certain candidates for quarry districts. The data and data groups established by Hansen et al. will be compared with our results below, where we refer to them using the following letters and names: A) Precambrian Gabbroic, B) Precambrian Volcanic, C) Ophiolite or D) Melange rocks. (cf Hansen et al. 2017, 261-263). Since the dating of the finds and the deposits in Hansen et al. is not clear, we leave this out of the discussion and concentrate purely on the geological patterns.

Archaeological context

Ribe

The steatite analysed here was found in the excavation termed ASR 9 Posthuset (meaning Post Office) which was carried out from September 1990 to March 1991 at the Post Office on Sct. Nicolaj Gade in the town centre of modern Ribe (Feveile & Jensen 2006b, 119). Numerous previous excavations from 1973 onwards in the vicinity of the town centre (cf. Feveile & Jensen 2006a, 67) had revealed the existence of a marketplace from the 8th Century AD which was further substantiated by the 1990-1991 excavations. A phase system comprising the archaeological phases AA-J was established (Feveile & Jensen 2001) followed by an absolute chronology for the phasing (Feveile & Jensen 2006b: 128-130). The earliest steatite in ASR 9 occurs in the phase F which ranges from 790-800 in good accordance with the beginning of the Viking age, followed by phase G (800-820). Phases H and I have the same dating (820-850) and J relates to either the 12th or 13th Century AD. The total amount of steatite finds in ASR 9 was 46, but only 30 can safely be assigned to individual objects. 39 out of the 46 samples are considered stratigraphically secured. The amount of steatite finds is much higher in phases H/I (n=31) compared with the earlier phases F and G (n=7); while there is only a single object in J (Feveile & Jensen 2006b, 131). Recent excavations (SJM 3) in Ribe near the Post Office conducted in 2017-2018 have unearthed a total of 202 fragments, c. 8.5kg (Sindbæk & Barfod 2023, 91). It is thought, that until c. 860 most of the imported steatite does represent pyrometallurgical tools such as tuyère or casting moulds, while steatite vessels seem to have been imported only from the mid 9th Century (Sindbæk & Barfod 2023, 92). Due to some as yet unexplained circumstances, Ribe cannot be documented by archaeological sources, from the late 9th Century until the end of the 11th Century (Feveile & Jensen 2006a, 87).

Okholm

For this study, a single fragment of a soapstone from the Okholm excavation has been added. Okholm is an archaeological site located about 8 km southwest of Ribe. First investigated in the 1960s, extensive excavations were carried out in 1995-1996. These excavations revealed that Okholm consists of several pit houses from the 8th or 9th century, whose inventory is similar to that of Ribe in terms of the type of artifact assemblage. The soapstone fragment was found in pit house XVII, which contained some weaving stones and probably dates to the 9th century (Feveile, 2010).

Hedeby

The four steatite samples from Hedeby derive from the harbour excavation, that was carried out from c. 1900-1969. During that time a total of 3428 pieces, all together 3540kg of steatite were recovered from all find areas and from the surface of the semicircular rampart. The steatite finds were thoroughly analysed concerning their typology (Resi 1979), organic residues (Augdahl 1979) and provenance (Alfsen & Christie 1979). The majority of steatite finds in Hedeby were vessels with a more or less spherical base – probably intended for cooking (Resi 1979). The samples used for this study were supplied by Volker Hillberg of Museumsinsel Schloss Gottorf. Unfortunately, their find contexts were not recorded, which limits the chronological interpretation below. However, Resi suspected, that the majority of steatite imports must date from the 10th Century AD, interestingly the same period where Ribe (see above) seems to have completely vanished from the map.

Materials and Methods

A total of 20 steatite objects from Ribe were sampled, all deriving from excavation ASR 9 (Table 1). One sample deriving from ASR 583 Okholm was added. For the Ribe steatite, care has been taken to ensure that samples from strata F-J are represented. With the exception of phase J, at least two samples from each phase are represented.

From the excavation of the Viking age emporia of Hedeby, Germany four steatite objects have been sampled.

Origin	ID-No.	Find.No.	Lab. No.	Ribe phase	Geological group
Ribe	200067090	ASR9x158	5826/23	J	Incomplete data
Ribe	200066946	ASR9x136	5827/23	I	III
Ribe	200066896	ASR9x022	5828/23	I	III
Ribe	200066697	ASR9x133	5830/23	I	II
Ribe	200066257	ASR9x155	5832/23	H/I	I
Ribe	200066253	ASR9x363	5833/23	H/I	I
Ribe	200066252	ASR9x165	5834/23	H/I	III
Ribe	200066189	ASR9x006	5835/23	H/I	III
Ribe	200065147	ASR9x441	5836/23	H	Incomplete data
Ribe	200065137	ASR9x018	5837/23	H	I
Ribe	200065018	ASR9x175	5838/23	H	III
Ribe	200064904	ASR9x050	5839/23	H	III
Ribe	200063825	ASR9x550	5840/23	G	Incomplete data
Ribe	200063822	ASR9x488	5841/23	G	II
Ribe	200063821	ASR9x491	5842/23	G	I
Ribe	200063812	ASR9x249	5843/23	G	I
Ribe	200062915	ASR9x487	5844/23	F	I
Ribe	200062425	ASR9x230	5845/23	F	I
Ribe	200054765	ASR9x477	5846/23	?	Incomplete data
Ribe	200054371	ASR9x478	5847/23	?	II
Okholm	200052164	ASR583x0160	5848/23		I
Hedeby	No number	No number	4197/19		I
Hedeby	No number	No number	4198/19		I
Hedeby	No number	No number	4199/19		I
Hedeby	No number	No number	4200/19		III

Table 1.

The sampled steatite objects from Ribe, Okholm and Hedeby.

The steatite artefacts have been sampled by cutting 1 cm^3 pieces. About 2 g of material was removed from these pieces using a Dremel with high-speed steel (HSS) attachments. The steatite powder was finely ground using wolfram-carbide ball mills for 20 minutes each. The fine steatite powder was then collected in glass tubes.

At the Institute for Geology, Mineralogy and Geophysics of the Ruhr-University Bochum the powder was pressed in tablets for main element analysis. Bunsen burners were used for the creation of glass melting-tablets which are necessary for trace element analysis. A wavelength dispersive Rigaku ZSX Primus IV X-ray fluorescence spectroscope was used to determine both main and trace elements. As less than two grams could be extracted from the samples with the numbers 5826/23, 5836/23, 5840/23 and 5846/23, these four could only be measured for main elements.

Interpretation of analytical results

The steatite analytical results are presented in table 2.

When the element combinations that were found to be useful for hinting at the rock-type from Hansen et al. (2017) (see above “previous XRF work”) are applied to the steatite of Ribe an interesting pattern emerges (Fig. 2). The Ribe steatite clusters in three groups. Table 1 shows which sample belongs to which geological group. These groups are in good accordance with the clustering of the different rock types discussed above. Ribe Group I and the sample from Okholm align well with Hansen et al’s (2017) data for gabbroic rock, while Group III may match either their Ophiolite or Melange host rocks. Group II does not align with any of these groups representing extraordinary pure steatites, which are commonly derived from metamorphosed sedimentary rocks such as carbonates (Schandl et al. 2002). These constraints on the geological provenance of the samples studied provide important information for a discussion of their geographical origin.

Fig. 2a.

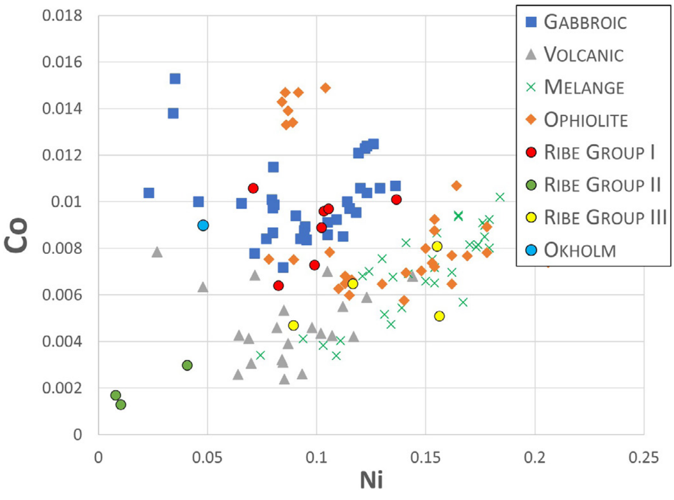

Fig. 2.

Binary plots for the amounts of Co, V, Ni and Fe_2O_3 in the Ribe steatite (circles) against those of steatite occurrences of different geological host rocks of Vestland (squares, diamonds, triangles and crosses). The chosen elements and oxides were found to be useful for distinguishing between geological host rocks by Hansen et al. (2017, 261263). A combined plot of Fe_2O_3/V vs Ni/Co divides best between Gabbroic and the three other kinds of bedrock. Note that group I Ribe steatites (red circles) and Okholm (blue circles) align well with gabbroic occurrences while group three aligns best with ophiolite or melange rocks.

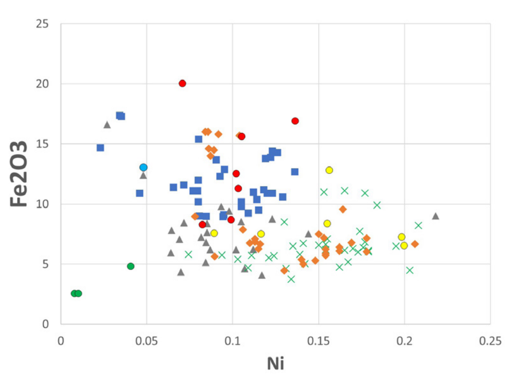

Fig. 2b.

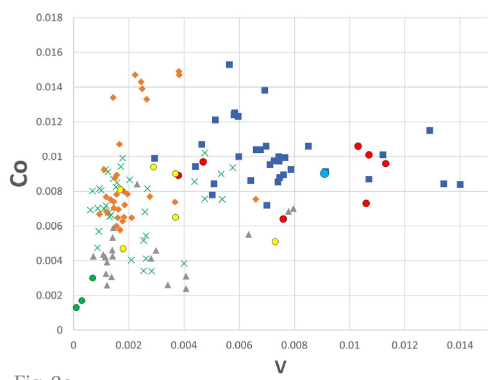

Fig. 2c.

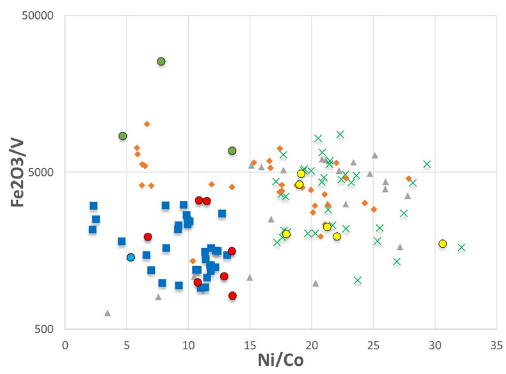

Fig. 2d.

Steatites of gabbroic origin (Group I and Okholm) can be found in a few places in Norway, and they are even rarer in Sweden. There is an occurrence in Vestland, from where the reference data originates. This is located within a limited geographical area, on the central part of the Hardangerfjord's eastern bank. However, it is unlikely that the Ribe group I and Okholm steatites originate from this deposit. On the one hand, Hansen et al. have shown in their study of over 100 soapstone vessels from Bergen, that these deposits were only of minor importance (Hansen et al., 2017, 288). On the other hand, it is not clear why this particular location located approx. 50 km down the Hardangerfjord should have been exploited when the surrounding area is teeming with soapstone deposits.

Some 500 km north in the southern Trøndelag area (former province Sør-Trøndelag) gabbroic steatite occurrences are common (cf. Fig. 1). The area south of Trondheim is of particular interest, as it has recently been suggested that whetstones from Ribe dating as early as the 8th century, may have originated from the region (Baug et al., 2019). Therefore, it is possible that other mineral raw materials were mined in the region in conjunction with the whetstone mining and shipped southwards together. There are several possible candidates in the region with the deposits of Klungen, Eidsli and Bakkaunet. However, the specimens from Group I and from Okholm cannot originate from these deposits, as the vanadium content of the Trøndelag soapstones is much higher than that of the Group I Ribe soapstones (Fig. 3). This is probably due to the younger age of the deposits in the Trøndelag region. There, the steatite originates from the Caledonian orogeny with Mesoproterozoic to Silurian ages (Slagstad et al., 2011, Fig. 1) As a relatively light element, vanadium is probably sensitive to fluid infiltration or other metamorphic

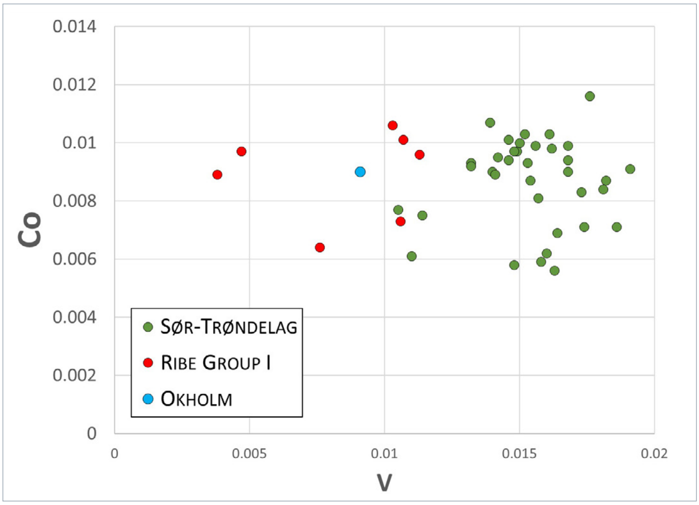

Fig. 3.

Co vs V for the Ribe group I steatite, the Okholm steatite and occurrences in the southern Trøndelag region. Although gabbroic rocks are common in the area, these do not match with the Ribe group I steatite and Okholm (cf. Fig. 2). This is likely due to the different age of the bedrock in the Trøndelag area, which is Caledonian (cf. Fig. 1). Thus, the Ribe group I and Okholm steatites are probably of Precambrian origin. Data for the Trøndelag occurrences from Tom Heldal NGU.

processes, which certainly occurred more frequently in the older Precambrian soapstone deposits than in the younger Caledonian ones. Therefore, a gabbroic soapstone of Precambrian age must have been quarried for the finds from Group I and the Okholm steatite, similar to the occurrence of the reference data from Vestland.

Other, more promising known occurrences of gabbroic steatite are located on the southernmost tip of the Norwegian peninsula in the region of Agder (cf. Fig. 1). Located in the modern-day municipality of Grimstad, along the river Nidelva and slightly west at Hisåsen lie large occurrences of steatite, worked in the Viking age and with waste heaps up to 8m high (Skjølsvold 1961, 59-64). Some of these deposits are of Precambrian gabbroic origin including the large ones at Hisåsen (Fig. 4).

Other steatite occurrences along the river Nidelva are probably not associated with the Gabbros but from isolated, more or less altered ultramafic pods. One of these deposits at Austre Vimme is extraordinarily low in trace elements and high in MgO and SiO_2 (Moree 1998, Tab. A2.3) more similar to Ribe group II steatites. This further points to the area around Hisåsen as a potential place of origin for the Ribe group I steatites. Intriguingly, steatite blocks or finished vessels could have been transported via the sea. Schou (2007:47) found an old ravine leading to a lake, the Blautetjønn and followed by another one, the Olstadtjønna and finally the Reddalsvannet. Although nowadays those lakes are not connected to each other, Skjelsvik (1996, 105) cites the report of Nicolaysen (1896, 230-231) who reports reaching the old workings at Hisåsen by boat. According to Skjelsvik the lakes in the area have been lowered indicating that in Nicolaysens time it was still possible to reach the quarries at Hisåsen from Grimstad. Recently, Tjorbjørn Schou demonstrated the importance of the steatite deposits in this region for participation in the trans-regional trade of the Viking Age (Schou 2007 & 2017). Schou suggests the exploitation of the steatite deposits on an industrial scale and links the emergence of regional elites to southern Scandinavian consumer markets. Leaving the nearby port of Hesnessund the steatite of this region could have also reached Ribe.

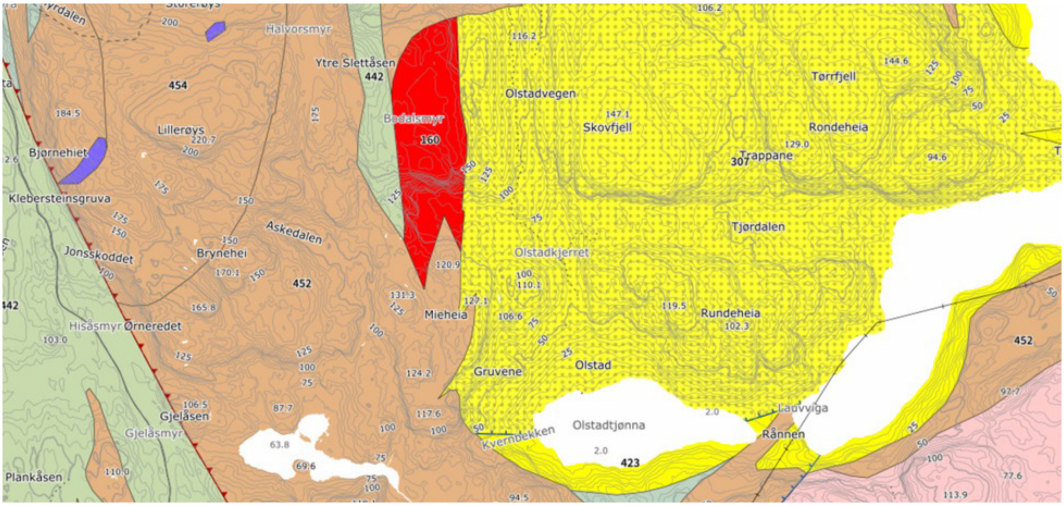

Fig. 4.

Geological map of the bedrock around Hisåsen, west of Grimstad in Agder, southern Norway (cf. Fig. 5 for the wider location). Note the two violet fields one of them termed "Klebersteingruva" (steatite quarry) both embedded in gabbroic rock (brown coloured area). Green: Gneiss, Red: Pegmatite, Yellow: Quartzite, Yellow grey dotted: Conglomerate with quartzite, Pink: Tonalite-Gneis From NGU-database: NGU.no

Unfortunately, no samples are available from any of these quarries as steatite rich deposit remain either unexcavated, are protected by Norwegian cultural heritage laws, or are buried under modern road constructions (cf. NGO, mineral ressources information sheets). However, based on the geochemical observations made here, these deposits are the most likely sources for the Ribe Group I and Okholm steatites.

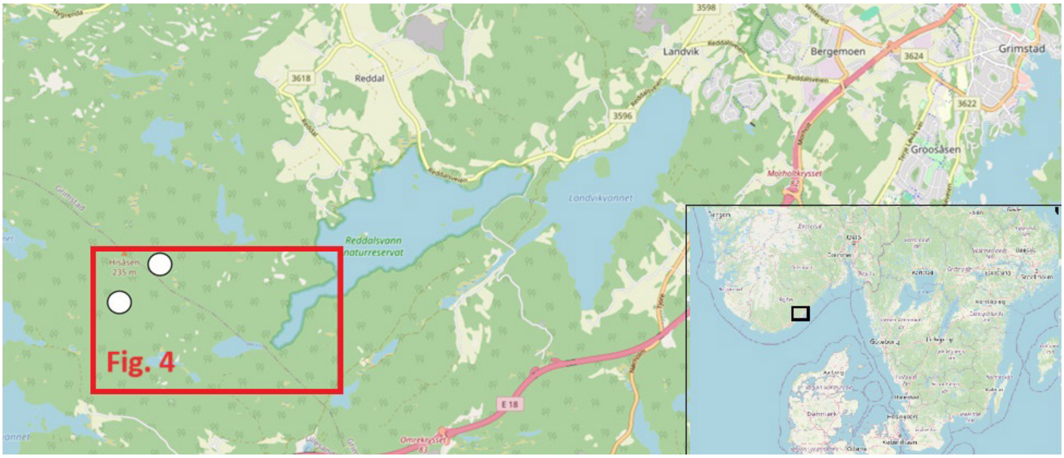

Fig. 5. Map of the Hisåsen area west of Grimstad in Agder, southern Norway. The red square indicates the outlines of Fig. 4. The white dots show where the two gabbroic quarries are located. Note the two small lakes inside the red square which are the Blautetjønn (western one) and the Olstadtjønna (eastern one) also visible in Fig. 4 (OpenStreetMap).

The steatites of group II do not fit with any known deposit from Norway. The Ribe Group II steatites cannot be easily traced back to their origin. This is because the extraordinary high purity of the group II steatites could represent a carbonate origin, which is scarce in the whole of Scandinavia (Storemyr & Heldal 2002, 360). It is more likely, that they have been quarried from lenses of higher quality (richer in talc) steatite within another outcrop, in which case it is unknown which host rock that might have been. The latter interpretation is suggested because, steatisation can sometimes affect the host rock in a manner that completely overprints some portions of source rock, leaving nothing but pure talc. Interestingly, at a place called Stølsfjell, about 12km east of Sandnes in Rogaland, there is a deposit that is carbonatic in origin and would produce a type of pure talc that occurs in the Group II steatites (Mortensen 1945). Another possibility, could be a Swedish origin, perhaps deriving from the volcanic basement rocks of the western coast in Bohuslän north of Gothenburg (cf. Fig. 1). As pointed out above, other occurrences such as the Vimme deposit in Agder contain very pure steatites as well.

The steatites of group III are in good accordance with what Hansen et al. (2017) have described as island arc/ophiolite and melange types (type C and D above). They were the main supplier for urban consumers in medieval Bergen (Hansen et al. 2017, 288). These rocks do not occur in Agder nor anywhere south of Stavanger as they are associated with ophiolites connected in the Caledonian mountain chain (cf. Fig. 1) (Pedersen et al. 1988). Thus, the group is likely not only from a different geological province but from a different geographical area. Ophiolitic and melange rock occurrences of steatite are common in the area between Bergen and Stavanger, in Trøndelag south of Trondheim in connection with the Løkken-Vassfjellet-Bymarka ophiolite and at several locations further north. While the overlap of data for these kinds of rocks prohibits any further provenance discussions, it is intriguing that those quarries that seem to be the major providers for medieval Bergen give the best matches for the group III steatites of Ribe. These quarries are located within an area of approx. 10 km radius around the Bjornafjorden some 30 km southeast of Bergen (cf. Jansen & Heldal 2017, 363).

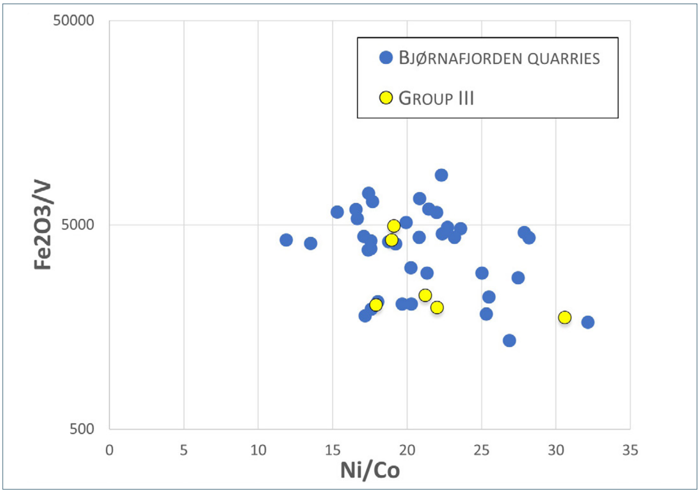

Fig. 6.

Fe_2O_3/V vs Ni/Co for the group III steatites from Ribe in comparison with those quarries that supplied Viking-age and Medieval Bergen. Although most ophiolithic and mélange rocks will plot somewhere in the field, it is not unlikely that these are the source of the Ribe group III steatites. Data for the Bjørnafjorden quarries from Tom Heldal, NGU.

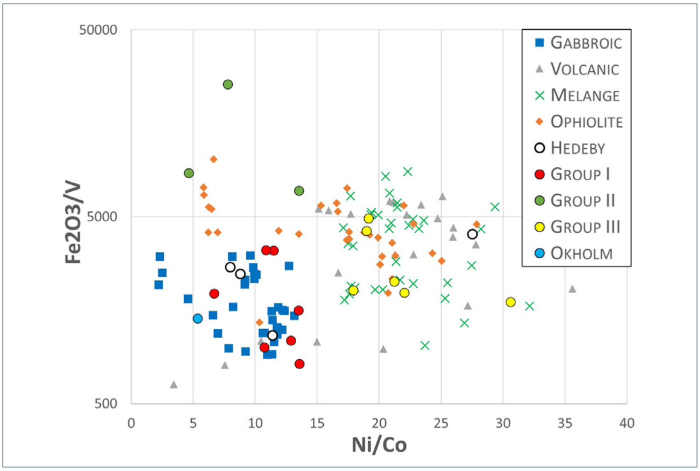

Fig. 7.

Fe$_2$O$_3$/V vs Ni/Co for the samples from the Viking-age Emporia of Hedeby in northern Germany (white circles). Three out of four samples plot together with the Ribe group I steatites and the gabbroic occurrences.

The four samples from Hedeby show a similar pattern to those from Ribe (see table 2). Three of the samples (Hedeby group I) plot together with those from Ribe group I, while another sample (Hedeby group II) is more in line with Group III but is somewhat of an outlier. It is likely that the Hedeby group I samples are from the same geographic location as the Ribe group I, that is the occurrences of Agder (see above) while the Hedeby group II sample is of unknown origin. The four samples were part of the second author's Master's Thesis in Archaeology at Durham University, which compared the four samples to occurrences in Sweden by means of Laser-Ablation ICP-MS and found no correlation to any of their examined Swedish or central Norwegian quarries, leaving the possibility open that they could derive from southern Norway (Chmielowski 2024).

Interestingly, steatite objects of 9th Century Kaupang, analysed by Jones et al. (2006) appear to come from a single source too (cf. Baug 2011, 334). The ICP-MS Rare Earth Element Analysis of Jones et al suggests that this source is not the volcanic basement rocks of Akershus and Østfold (cf. Fig. 1). The REE pattern of the Kaupang material analysed by Jones et al (2006, Fig. 3) is comparable to those of Precambrian gabbroic rocks (cf. Hansen et al. 2017, 268), such as those occurring at Agder and which also match with group I Ribe and Okholm steatites. It is unfortunate that there is no XRF data for the Kaupang material for comparison. Schou (2017: 148) suspected before that Kaupang may have received its steatite from Agder. With occurrences at Akershus and Østfold excluded, the geographically nearest sources for Kaupang would be Agder and then western Sweden (Bohuslän-region). Ribe was undoubtedly one of Kaupang's most crucial gateways to the southern North Sea region (for further evidence, see the numerous articles in Skre 2011). Given that Kaupang was founded around 800, which was roughly the same time as the first steatite appeared in Ribe, it is reasonable to assume that Kaupang supplied Ribe with steatite (Baug et al. 2019, 64).

If, in addition to the chemical composition of the samples, their dating, obtained from the confirmed stratigraphic context of Ribe, is considered, some noteworthy patterns emerge (cf table 1). Group I (probably from

Agder) contain samples from early phases (F and G c.790-820) as well as later ones (H and I. c. 820-850) while group III (possibly from the occurrences around the Bjørnafjorden near Bergen) contains only specimen from these later phases. This must mean that Ribe initially sourced its steatite from the Precambrian gabbroic occurrences of Fjaere, while steatite from more distant deposits (ophiolitic sources) also reached the emporia from 820 onwards.

Concluding remarks

Due to the limited number of analysed samples, the methodological problems discussed above, the lack of comparable data for quarries, as well as finds from other Emporia such as Hedeby and Kaupang; only tentative suggestions for possible sources can be put forward. However, the data does permit the following suggested scenario: From the end of the 8th century, Ribe received its steatite from Fjaere in Agder, southern Norway. It is possible that the demand from Southern Scandinavian could also indicate why the region around Fjaere eventually developed a soapstone industry as Schou (2017, 150) describes. This industry, could then have found further customers in the 9th century with the establishment of Kaupang as a trading centre, possibly even supplying Hedeby afterwards. As early as 820 AD, however, the exclusivity of supplies from Agder was supplemented by other, more distant sources. Although imports from Agder continued, new connections, possibly to Vestland in western Norway, seem to have been established. Baug et al (2019, 6364) argue that a similar pattern of raw material sourcing can be observed in the whetstone trade. Ribe received whetstones mostly from Mostadmarka in Trøndelag. From 820 onwards whetstones from Eidsborg in Telemark supplemented the demand. After Baug et al, this is possibly due to the increased traffic between Kaupang and Ribe during this period. However, as Kaupang itself possibly sourced its steatite from Agder, this may not apply to the soapstone trade. It is more likely that the non-ferrous metal art practised in Ribe (Orfanou et al., 2021) and its widespread consumption in Vestland, which can be surmised from the work of Brinch Madsen (1984, 96, Fig. 141), contributed to the stimulation of the soapstone trade from this region. Finally, the fact that several soapstone sources were used over the period of only a few decades is in itself an indication of the complex trading patterns that can be observed in Viking Age Ribe.

The preliminary results presented here have provided an insight into the steatite trade of Viking-age Ribe. It should help to stimulate research into the trade in steatite and other raw materials in and between other Viking Age emporia such as Birka, Hedeby and Kaupang, about whose trading patterns no conclusions can yet be drawn, on the basis of the available data.

Lab.No	5826/23	5827/23	5828/23	5830/23	5832/23	5833/23	5834/23	5835/23	5836/23
Sum	96,116	93,28	95,67	94,59	95,06	95,21	96,26	87,43	93,891
SiO_2	58,57	56,43	56,16	60,87	54,92	44,97	57,61	47,13	47,39
TiO_2	0,02	0,02	0,03	0,01	0,22	0,31	0,04	0,03	0,27
Al_2O_3	0,77	0,77	0,59	0,31	3,63	3,80	1,86	0,76	7,67
Fe_2O_3	7,95	6,53	8,36	4,83	8,29	20,04	7,56	7,50	9,23
MnO	0,276	0,093	0,102	0,094	0,163	0,197	0,152	0,123	0,131
MgO	25,55	26,11	26,08	27,90	22,45	23,65	27,77	29,39	24,55
CaO	1,63	0,66	0,93	0,21	3,97	2,13	0,50	2,36	4,08
Na_2O	0,46	0,01	0,26	0,00	0,09	0,00	0,00	0,00	0,38
K_2O	0,15	0,09	0,65	0,05	1,21	0,04	0,54	0,00	0,06
P_2O_5	0,740	2,567	2,509	0,312	0,120	0,072	0,224	0,138	0,130
Ba	n.d.	0,0174	0,0159	0,0033	0,0062	0,0022	0,0061	0,0017	n.d.
Ce	n.d.	0,0046	0,0030	0,0042	0,0029	0,0053	0,0040	0,0049	n.d.
Co	n.d.	0,0094	0,0081	0,0030	0,0064	0,0106	0,0047	0,0065	n.d.
Cr	n.d.	0,5050	0,0992	0,1052	0,2265	0,0560	0,1242	0,3100	n.d.
Cs	n.d.	0,0004	0,0004	0,0004	0,0003	0,0002	0,0004	0,0004	n.d.
Cu	n.d.	0,0008	0,0008	0,0018	0,0006	0,0017	0,0005	0,0043	n.d.
Ga	n.d.	0,0003	0,0004	0,0004	0,0005	0,0003	0,0006	0,0004	n.d.
Hf	n.d.	0,0001	0,0002	0,0002	0,0002	0,0001	0,0000	0,0002	n.d.
La	n.d.	0,0000	0,0001	0,0007	0,0009	0,0001	0,0000	0,0005	n.d.
Mo	n.d.	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002	n.d.
Nb	n.d.	0,0001	0,0002	0,0002	0,0004	0,0006	0,0004	0,0001	n.d.
Nd	n.d.	0,0012	0,0009	0,0012	0,0011	0,0018	0,0012	0,0014	n.d.
Ni	n.d.	0,1996	0,1550	0,0406	0,0824	0,0708	0,0892	0,1165	n.d.
Pb	n.d.	0,0012	0,0126	0,0440	0,0002	0,0049	0,0338	0,0044	n.d.
Rb	n.d.	0,0000	0,0004	0,0000	0,0109	0,0006	0,0038	0,0000	n.d.
Sc	n.d.	0,0007	0,0007	0,0008	0,0008	0,0008	0,0007	0,0007	n.d.
Sn	n.d.	0,0003	0,0003	0,0002	0,0005	0,0008	0,0003	0,0005	n.d.
Sr	n.d.	0,0132	0,0123	0,0024	0,0028	0,0015	0,0019	0,0092	n.d.
Ta	n.d.	0,0013	0,0011	0,0000	0,0010	0,0009	0,0011	0,0010	n.d.
Th	n.d.	0,0000	0,0000	0,0000	0,0003	0,0000	0,0000	0,0001	n.d.
U	n.d.	0,0003	0,0002	0,0000	0,0002	0,0004	0,0000	0,0001	n.d.
V	n.d.	0,0029	0,0017	0,0007	0,0076	0,0103	0,0018	0,0037	n.d.
W	n.d.	0,0000	0,0000	0,0000	0,0002	0,0006	0,0001	0,0001	n.d.
Y	n.d.	0,0003	0,0004	0,0002	0,0005	0,0011	0,0005	0,0002	n.d.
Zn	n.d.	0,0227	0,0224	0,0162	0,0095	0,0085	0,0157	0,0089	n.d.
Zr	n.d.	0,0003	0,0006	0,0003	0,0022	0,0022	0,0005	0,0003	n.d.

Table 2.

XRF data for the studied steatites from Ribe, Okholm and /Hedeby. Compare with Table 1 to see which individual steatite object relates to which geological group and chronological phase.

The table is continued on the next page

Lab.No	5837/23	5838/23	5839/23	5840/23	5841/23	5842/23	5843/23	5844/23	5845/23
Sum	95,36	85,53	91,98	94,425	94,29	93,83	90,29	89,93	87,77
SiO_2	52,57	44,07	50,97	61,13	61,99	44,51	44,68	41,77	38,24
TiO_2	0,33	0,02	0,14	0,08	0,06	0,48	0,06	0,62	0,07
Al_2O_3	5,20	1,00	2,69	0,64	0,53	7,48	1,77	6,28	1,74
Fe_2O_3	8,69	7,26	12,82	2,47	2,56	16,90	12,53	11,31	15,62
MnO	0,115	0,075	0,039	0,005	0,004	0,188	0,127	0,158	0,119
MgO	23,17	32,09	23,30	29,60	29,10	21,93	24,47	22,38	26,95
CaO	1,97	0,50	0,64	0,03	0,00	1,87	5,21	7,13	3,39
Na_2O	0,13	0,00	0,00	0,42	0,02	0,04	0,00	0,02	0,00
K_2O	3,11	0,01	0,25	0,00	0,00	0,09	0,10	0,01	0,04
P_2O_5	0,070	0,507	1,131	0,050	0,028	0,340	1,342	0,250	1,604
Ba	0,0096	0,0024	0,0402	n.d.	0,0000	0,0027	0,0052	0,0018	0,0057
Ce	0,0021	0,0061	0,0056	n.d.	0,0050	0,0051	0,0040	0,0107	0,0087
Co	0,0073	0,0090	0,0051	n.d.	0,0013	0,0101	0,0089	0,0096	0,0097
Cr	0,4030	0,2638	0,3576	n.d.	0,0012	0,1130	0,2464	0,2024	0,3227
Cs	0,0000	0,0004	0,0003	n.d.	0,0005	0,0003	0,0004	0,0004	0,0003
Cu	0,0025	0,0036	0,0064	n.d.	0,0012	0,0081	0,0043	0,0022	0,0119
Ga	0,0008	0,0003	0,0006	n.d.	0,0005	0,0004	0,0003	0,0003	0,0000
Hf	0,0000	0,0001	0,0002	n.d.	0,0000	0,0003	0,0000	0,0002	0,0003
La	0,0022	0,0000	0,0000	n.d.	0,0000	0,0006	0,0000	0,0000	0,0000
Mo	0,0002	0,0002	0,0002	n.d.	0,0002	0,0002	0,0002	0,0002	0,0002
Nb	0,0004	0,0001	0,0002	n.d.	0,0000	0,0004	0,0002	0,0005	0,0000
Nd	0,0006	0,0017	0,0015	n.d.	0,0014	0,0017	0,0012	0,0032	0,0025
Ni	0,0990	0,1982	0,1561	n.d.	0,0101	0,1364	0,1021	0,1032	0,1053
Pb	0,0013	0,0042	0,0066	n.d.	0,0006	0,0006	0,0025	0,0006	0,0026
Rb	0,0275	0,0000	0,0006	n.d.	0,0000	0,0025	0,0004	0,0000	0,0000
Sc	0,0008	0,0007	0,0007	n.d.	0,0008	0,0008	0,0007	0,0006	0,0007
Sn	0,0004	0,0002	0,0007	n.d.	0,0001	0,0007	0,0005	0,0008	0,0007
Sr	0,0022	0,0036	0,0079	n.d.	0,0004	0,0031	0,0102	0,0081	0,0140
Ta	0,0011	0,0010	0,0012	n.d.	0,0000	0,0011	0,0009	0,0008	0,0007
Th	0,0001	0,0000	0,0000	n.d.	0,0000	0,0003	0,0001	0,0000	0,0000
U	0,0001	0,0001	0,0001	n.d.	0,0001	0,0002	0,0002	0,0004	0,0001
V	0,0106	0,0037	0,0073	n.d.	0,0001	0,0107	0,0038	0,0113	0,0047
W	0,0000	0,0000	0,0006	n.d.	0,0000	0,0003	0,0005	0,0000	0,0001
Y	0,0003	0,0004	0,0002	n.d.	0,0004	0,0007	0,0004	0,0008	0,0004
Zn	0,0149	0,0093	0,0380	n.d.	0,0007	0,0138	0,0208	0,0081	0,0210
Zr	0,0016	0,0004	0,0010	n.d.	0,0003	0,0054	0,0006	0,0043	0,0010

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Lab.No	5846/23	5847/23	5848/23	4197/19	4198/19	4199/19	4200/19
Sum	96,166	94,15	91,65	88,49	93,72	90,85	95,28
SiO_2	61,55	62,08	43,41	39,60	45,44	41,15	60,75
TiO_2	0,05	0,05	0,34	0,23	0,23	0,37	0,01
Al_2O_3	0,43	0,52	5,79	7,89	4,27	8,09	0,29
Fe_2O_3	4,47	2,57	13,04	13,76	17,84	11,14	5,26
MnO	0,006	0,003	0,171	0,146	0,113	0,146	0,116
MgO	29,28	28,90	25,89	25,25	25,56	25,06	28,10
CaO	0,00	0,01	2,86	1,17	0,19	4,53	0,75
Na_2O	0,36	0,00	0,00	0,00	0,00	0,17	0,00
K_2O	0,00	0,00	0,02	0,02	0,00	0,12	0,00
P_2O_5	0,020	0,020	0,131	0,419	0,081	0,073	0,006
Ba	n.d.	0,0009	0,0016	0,0060	0,0011	0,0015	0,0001
Ce	n.d.	0,0051	0,0044	0,0057	0,0057	0,0049	0,0038
Co	n.d.	0,0017	0,0090	0,0148	0,0095	0,0109	0,0083
Cr	n.d.	0,0012	0,1536	0,1247	0,0328	0,1971	0,1547
Cs	n.d.	0,0005	0,0003	0,0003	0,0003	0,0003	0,0004
Cu	n.d.	0,0022	0,0007	0,0006	0,0000	0,0037	0,0003
Ga	n.d.	0,0000	0,0000	0,0007	0,0004	0,0007	0,0003
Hf	n.d.	0,0000	0,0001	0,0000	0,0000	0,0003	0,0002
La	n.d.	0,0004	0,0003	0,0000	0,0000	0,0005	0,0000
Mo	n.d.	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002
Nb	n.d.	0,0000	0,0002	0,0003	0,0001	0,0004	0,0002
Nd	n.d.	0,0017	0,0016	0,0018	0,0016	0,0016	0,0013
Ni	n.d.	0,0079	0,0480	0,1180	0,0836	0,1240	0,2284
Pb	n.d.	0,0003	0,0005	0,0003	0,0003	0,0005	0,2730
Rb	n.d.	0,0000	0,0000	0,0001	0,0002	0,0003	0,0000
Sc	n.d.	0,0008	0,0008	0,0007	0,0007	0,0007	0,0007
Sn	n.d.	0,0001	0,0005	0,0004	0,0007	0,0005	0,0002
Sr	n.d.	0,0006	0,0041	0,0026	0,0011	0,0062	0,0006
Ta	n.d.	0,0007	0,0007	0,0010	0,0008	0,0011	0,0012
Th	n.d.	0,0001	0,0003	0,0002	0,0002	0,0002	0,0000
U	n.d.	0,0000	0,0003	0,0002	0,0003	0,0002	0,0000
V	n.d.	0,0003	0,0091	0,0051	0,0072	0,0096	0,0013
W	n.d.	0,0000	0,0003	0,0003	0,0002	0,0003	0,0000
Y	n.d.	0,0004	0,0007	0,0003	0,0002	0,0008	0,0001
Zn	n.d.	0,0007	0,0089	0,0118	0,0075	0,0074	0,0119
Zr	n.d.	0,0003	0,0041	0,0027	0,0020	0,0033	0,0003

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