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THE DEVELOPMENT AND PERIODISATION OF WHITE SEA ROCK CARVINGS

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INTRODUCTION

The rock carvings of the White Sea of Northern Russia provide one of the most evocative sets of images in European and World prehistory.[1] Among numerous scenes of terrestrial and marine hunting created almost six thousands of years ago some of the first realistic depictions of humans have been carved, the magnificent quality of which stand them out from the European rock art. Carvings in this region form part of a wider rock art phenomenon that spans Scandinavia. Understanding the White Sea carvings is therefore essential for wider interpretation of prehistoric Scandinavian carvings and paintings (Fig. 1). Furthermore, since these realistic depictions of humans are unique for this region, their importance in more general terms transcends from archaeology to history of art as well as being significant for the study of the visual cognition.

Establishing the chronology of particular compositions or locations is essential for understanding any symbolic relationships between prehistoric fisher-gatherer-hunters and their landscapes, landscapes that served as archaeologically detectable sacred places. The aim of this paper is to propose a revised chronology for White Sea rock art by establishing the relative chronology of rock art panels for the Zalavruga site, and by reconsidering the chronological relationship between all other rock art complexes (Besovy Sledki, Erpin Pudas and Nameless Islands) located in the estuary of the Vig River, which flows into the White Sea.

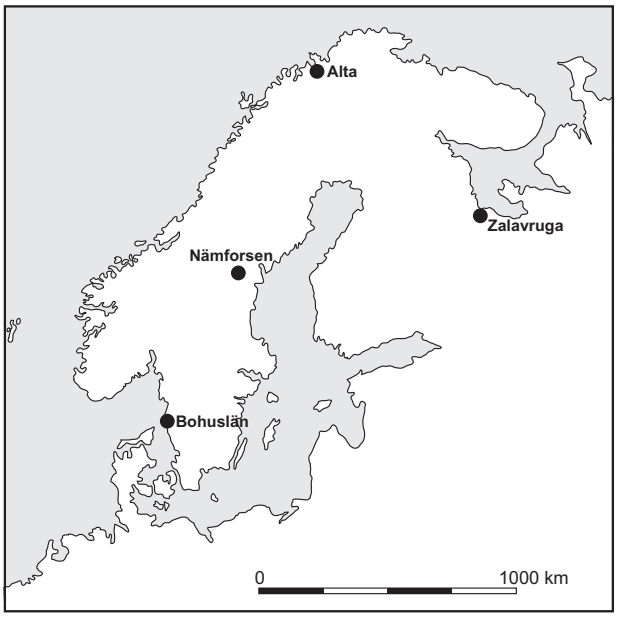

Fig. 1. Location of White Sea rock art.

WHITE SEA ROCK ART

The rock art of the White Sea (Fig. 2) was first recorded by A. M. Linevsky in 1926 when he discovered a complex of rock art at Besovy Sledki. Unfortunately, both parts of this complex are inaccessible today. The southern part is covered by a hydro-electric power station, and the northern part is under a purpose-built museum, designed to house the carvings *in situ*. However, the poor

1 Acknowledgements: This research was sponsored by the British Academy, the McDonald Institute for Archaeological Research and the Templeton Foundation. A number of team members have contributed to measuring the rocks and made this paper possible: M. Abbot, N. Challands, A. Challands, A. Clough, N. Reynolds, M. Sapwell and L. Ten Harkel . My special thanks goes to my Russian colleagues whose collaboration in this project cannot be underestimated in particular Dr N. Lubanova and Ms M. Shostakovich. I would like to thank Dr C. French and Dr S. Kaner for their insightful comments on this paper.

state of repair of the museum means it is unsafe to enter the building, and the rock art has been covered by sand, wood shavings, timber and floor coverings to protect it should the roof collapse. Linevski also recorded carvings at Erpin Pudas, the majority of which were discovered and documented by V.I. Ravdanikas in 1936 (Ravdanikas 1938). Ravdanikas had been conducting a survey of the region before the construction of the hydro-electric power station, and also discovered parts of the Zalavruga rock art complex, today known as Old Zalavruga. The majority of the surviving carvings in this location (New Zalavruga) were uncovered by a team directed by Savvateev between 1963 and 1968. Carvings on the Nameless Islands were discovered by the same team between 1963 and 1968 (Savvateev 1970).

METHODS OF ESTABLISHING A RELATIVE CHRONOLOGY OF ZALAVRUGA ROCK CARVINGS

In order to develop a chronology for dating of the White Sea rock carvings it was first necessary to build an internal chronology of the carvings at Zalavruga, the largest rock art complex in the area. This sequence was then related to the chronology of all location of the rock art compositions in the estuary of River Vig, tributary to White Sea; Besovy Sledki, Erpin Pudas, Nameless Islands, Zolotec and Zalavruga, so that the chronological relationships between particular carved rocks can be understood.

In our study over the last five years the largest complex of carved rock surfaces in the White Sea area has been re-recorded in a project designed in part to clarify the chronology of the rock carvings. An area of *c*. 8,500 m^2 was systematically documented and reconstructed in a virtual environment. During the recording new carvings were discovered and an area used as a quarry in the 1960s was identified, indicating the probable loss of carvings in this area (Fig. 3). A three-dimensional map of the whole area was created on to which all carvings were plotted.

The numbering of the compositions here follows two systems: discoveries made prior to those during this research are referred to using the extant system of Roman numerals; new discoveries made during this research project are referred to using capital letters based on the sequence of discoveries. The original numbering system follows the sequence in which rocks were uncovered rather than the age of carvings. Hence the carvings discovered by Ravdanicas in 1936 are called Old Zalavruga, while the carvings of New Zalavruga are those uncovered by the Savvateev team in the 1960s. Rock art panels were exposed as vegetation was removed, moving from Old Zalavruga to New Zalavruga, and the original numbering system follows the sequence in which rocks were uncovered rather than the age of carvings. In the future we will transfer to a system of numbering images in accordance

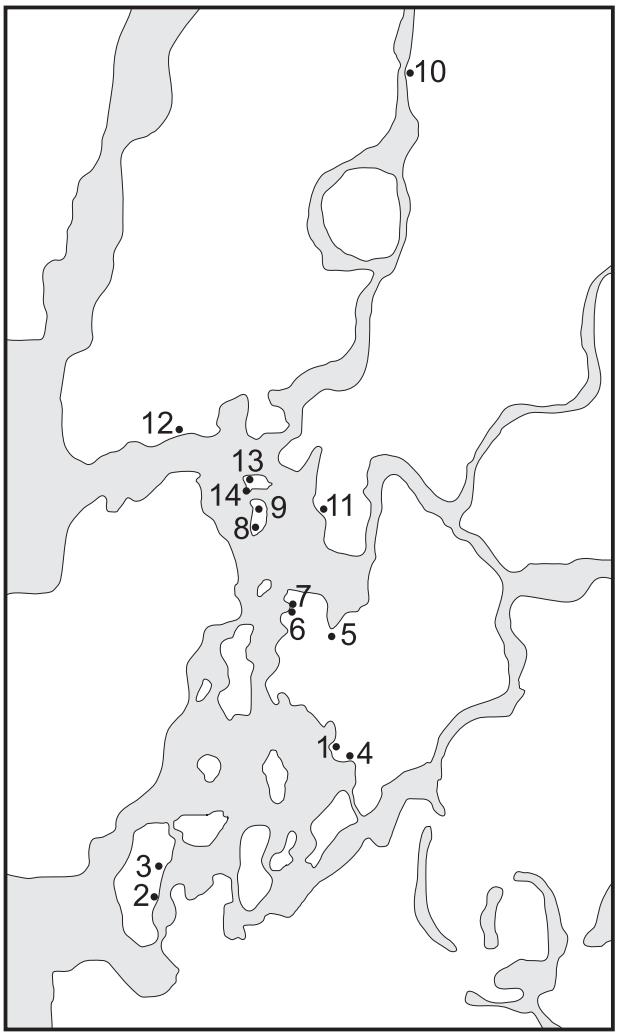

Fig. 2. Locations of rock art sites in White Sea region (Scale 1:10000 scale). 1 - Besovy Sledki South (S) , 2 - Besovy Sledki North (N), 3 - Erpin Pudas IV, 4 - Erpin Pudas III, Erpin Pudas II, 5 - Erpin Pudas II, 6 - Erpin Pudas I – South (S), 7 - Erpin Pudas I North (N), 8 - Nameless Islands I, 9 - Nameless Islands IV, 10 - Nameless Islands III, 11 - Nameless Islands II South (S), 12 - Nameless Islands II North (N), 13 – Zolatec, 14 – Zalavruga. Map constructed with a help of N. Lubanova.

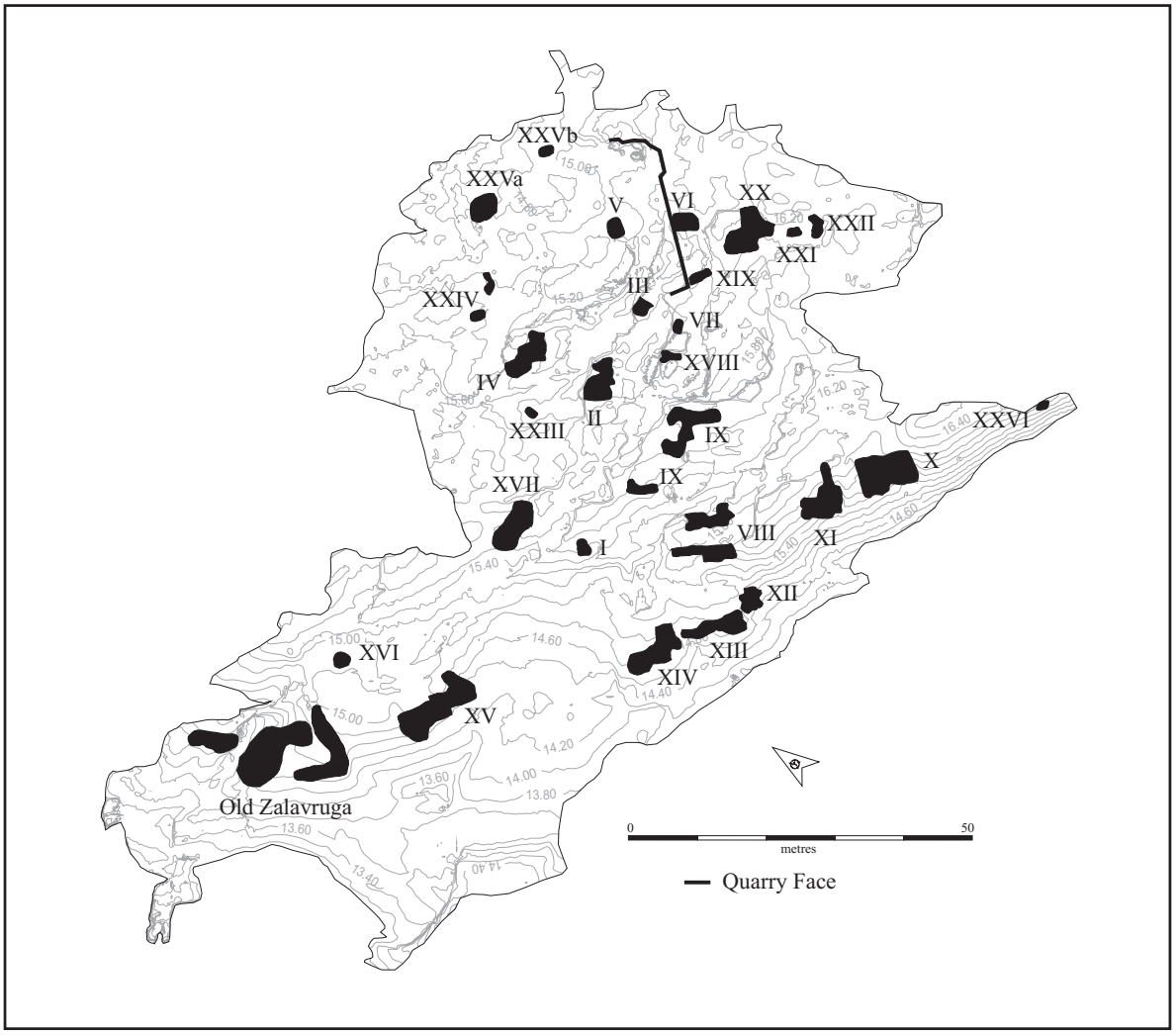

Fig. 3. Map showing locations of the various groups of carvings at Zalavruga (Map by Mr M. Abbot).

with the sequence in which they were carved. This will enable us to follow the development of the visual narrative as created by the prehistoric artists, rather than having our attention drawn to the sequence in which the rock art images were uncovered. This paper proposes a relative chronology for this rock art complex for the first time.

The relative chronology and the sequence of carving, i.e. which group was carved first and which later, was established by monitoring the morphology of the rock surface. This in turn allowed us to follow the expansion of carvings and changes in the visual narrative through time, through which we documented the transformation of symbolic expression captured in the visual narrative of the rock art at Zalavruga.

TOWARDS A NEW RELATIVE CHRONOLOGY

Since all the carvings were carved into one particular rock outcrop, I suggest, albeit in the most general terms, that all carvings are related to each other despite their spatial and chronological distance. Further, the rock outcrop itself embodies an archaeologically detectable symbolic relationship between the carvers and the carved rock (Janik et al. 2007), expressed in three ways. The first is that the act of carving infused the carvings with the power of the rock. The second is that the rock was considered to gain spiritual powers by placing the carvings on it. The third is a combination of the first two, reinforcing the power of the rock and the carvings at the same time. These inter-

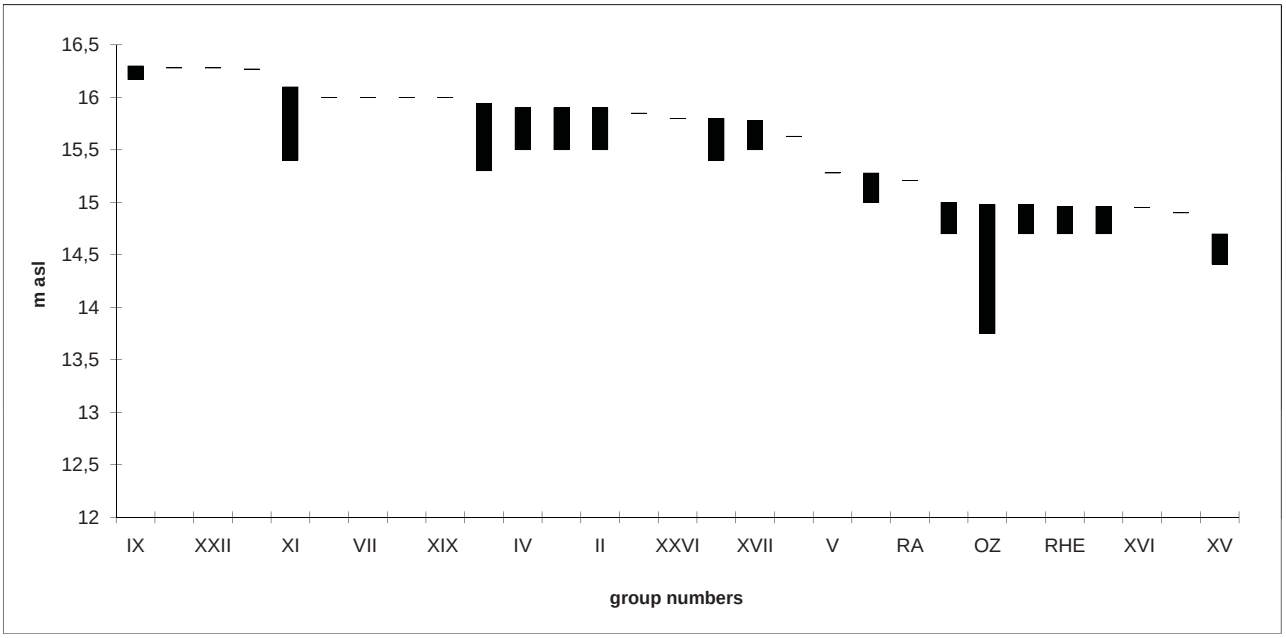

Fig. 4. Locations of rock art groups according to the elevation (meters above sea water level) at Zalavruga (New Zalavruga is divided into numerical and alphabetical groups while Old Zalavruga is defined as OZ).

pretations can be used to support the contention that this rock art related to beliefs and rituals of North European fisher-gatherer-hunters.

A process of transgression and regression of water, relating to isostatic movement of Scandinavia, resulting in the uplift of the land surface, in turn lead to the lowering of water levels in the White Sea and Vig River, thus exposing the rock surface above the water level, making it available to the carvers. At first the rock surface was not signified by being carved, so it is not known if this area had a sacred relationship with local communities of fisher-gatherer-hunters pre-dating the first carvings. It is possible, though, that the symbolic importance of the site began at this period. When the water level fell the exposed rock become the 'canvas' for the creation of a visual narrative, that is archaeologically identified as the oldest by its elevation, being the highest among the carved rock surfaces (Fig. 4).

The archaeologically measurable sacred relationship between the local prehistoric communities and the rock itself began with the creation of groups IX, XX, XXI and XXII. Part of group XI could have been carved in that period, as the previously mentioned groups or elements of them reach this particular elevation and formed part of the next phase of carvings which include groups VI, VII, XVIII and XIX. Group XI persisted through the two subsequent phases, and two locations within this group were identified as belonging to this phase by Savvateev. Next were carved groups X, IV, VIII, II, III, XXVI, I, XVII, XXIII. Groups V, XXIV and RA followed, after which were carved groups XIII, part of Old Zalavruga, XIV, RHE, XII and XVI, XXV followed by group XV and another part of Old Zalavruga. Finally, the rest of the Old Zalavruga carvings were created, after which the water level started to rise and the carvings were covered by alluvial sands and rising water.

It is very difficult to estimate the distribution of particular types of depictions between and within phases, since some groups, e.g. XI, spans three phases. Preliminary observations suggest that the largest number of images is found in phase 3, while the smallest number was carved in phase 4. An interesting picture emerges of the variations of the choices made as to what and what not to depict within any particular phase, and comparison with other phases suggests a number of 'odd-one-outs'. The birds and elk do not follow the overall patterns within the phases. In phase 2, while the number of images of animals decreases with some animals not being depicted at all, except the white whale which stays the same as in the first phase, the number of birds depicted increases

Fig. 5. Old Zalavruga, black - as recorded by Ravdanikas, grey – new carvings recorded by Lubanova (redrawn by M. Sapwell after N. Lubanova 2007).

dramatically. The reverse occurs in phase 3: the number of birds drops while the number of all other images increases, making this phase the richest in terms of animal imagery. The same trend can be seen in the numbers of elk in phase 6: their numbers increase from the previous phase, while all other categories of images decline or disappear altogether. I suggest therefore that the importance of the meaning of birds in phases 2 and 3, and of elk in phase 6, is greater that of other depictions. Some depictions disappear altogether during some phases and increase dramatically in the others: e.g. bear is absent in phase 2 but takes the most prominent place in phase 3. Images of bears are most often absent, followed by birds and reindeer.

Looking at the chronological variation in imagery at Zalavruga, boats are the most important. Their number is not strongly correlated with the number of whales carved, which indicates that boats were of significance beyond marine hunting, as vehicles for people travelling from place to the other for trade or other social reasons. Terrestrial creatures, elk, reindeer and bear, outnumber marine species (whale). Among birds with one exception, only water birds are carved, becoming scarce or absent in later phases. What is depicted, changes with time, creating a new visual narrative capturing symbolic reality represented in rock art of Zalavruga.

New discoveries in recent years have been made primarily in the region of Old Zalavruga, and span the three last phases (5, 6, and 7), suggesting that new images were carved over the earlier carvings. The account of these discoveries presented by Lubanova does not allow us to establish their chronological relationships (Lubanova 2007, 130), and since no elevations are provided it is difficult to assess their chronological relationships (Fig. 5). The rock

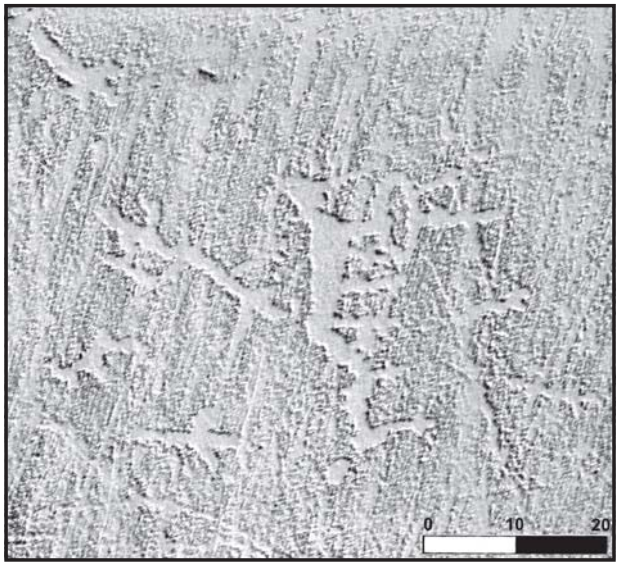

Fig. 6. Fragment of Old Zalavruga composition showing a person with number of arrows embedded in the most possibly his body and number of arrows 'flying' around.

surfaces at Old Zalavruga are probably the most exposed to weathering, reflected in the destruction of the thin layer of the rock surface. Furthermore, the overlapping carvings extend across different elevations of the rock surface, creating the need to establish precise relationships between them and the compositions of which they are a part. To document this in a fixed way, we plan to conduct further research to establish this relationship in the future and so the carvings of Old Zalavruga are not included in the current discussion of chronological variation within the carved images.

Among the clearly visible images, the carvings recorded by Ravdanikas, and defined as large compositions, belong to phases 5 and 6. Large elks, boats and rows of marching elks are the dominant images (Fig. 6). We know that this composition overlaps earlier carvings. Phase 7 comprises a small composition of carvings and some scattered carvings on the opposite rock. These images are among the most striking, depicting scenes of a man pierced by number of arrows: we can see the flying arrows aimed at him (Fig. 6). In addition, there is an image of three skiers with rucksacks on their backs carved alongside scenes of terrestrial and marine hunting. Although the precise details remain to be confirmed, it seems that this composition overlaps, at its highest point, a newly discovered carving of a boat, apparently built with a frame covered by leather.

CHRONOLOGY OF WHITE SEA CARVINGS

The beginning of White Sea rock carvings has up to now been dated on the basis of the style of pottery found in the vicinity of the Besovy Sledki carvings, while the ending is related to the carvings of Old Zalavruga rocks and end around the middle of the third quarter of 2nd millennium BC, which he relates to the Eneolithic and early Bronze Age (Savvateev 1970, 129f.). This chronology, based on pottery styles, is generally accepted in the literature, with the one exception of Deviatova's (1976) publication based on geomorphological changes in the land and water landscapes due to isostatic movements of the White Sea. Deriatova relates the creation of the rock art to the exposure above water of different terraces and rock outcrops along the Vig River. These terraces are related to two climatic periods: the first, the Atlantic period between 7800-7600BP and 4800-4700BP (6648-6604 calBC - 6464-6437 calBC and 3641-3536 calBC – 3520-3378 calBC), saw land exposure reach from 26.5-19.5 m asl; the second, the Sub-Boreal period between 4800-4700BP and 2800 BP (3641-3536 calBC – 3520-3378 calBC and 998-914 calBC), saw water levels drop from 19 m asl to 13.5 m asl, exposing the rocks previously covered by water. Informed by this geomorphological work and the detailed elevation measurements for each carving composition, in what follows, I propose a revised archaeological chronology for the rock art is proposed.

Geomorphological dating relies on the isostatic movement of Scandinavia, in this case the White Sea. Since the Vig River is a tributary of the White Sea, it is subject to the same process related to changes in water levels. The rock out-crops with rock art images located in the estuary of the river were affected by changes in water level, providing an independent record for dating the rock art. This method has already been used successfully in dating other Scandinavian rock art.

GEOMORPHOLOGY AND ISOSTATIC PROCESS

Detailed research in the Baltic and Scandinavia has shown that there are significant local differences in the isostatic process, and we have to pay close attention to the local context (Hafsten 1983, Ling 2005, Sogness 2003, Seitsonen 2005, Svendsen et al. 2004). The local water transgressions and regressions outside general land uplift

also happened in the White Sea and the Kola Peninsula (Kaplin & Selivanov 2004, fig. 5). It can be seen in the estuary of the Vig River where it resulted in the exposure of rock surfaces that could be carved. Later, due to the re-transgression of water levels, the rock art was covered by alluvial sand and water. In the region of the White Sea, including the estuary of Vig River, during the period of the creation of the rock art, it has been estimated that, on the basis of the uplift of Kola Peninsula there was an average ambient water level drop of between 5 and 5.5 mm per (Olyunina 2007). This is, however, somewhat misleading since different parts of Scandinavia can rise at different speeds. 'At the Gulf of Bothnia the land uplift was always faster than the rise in sea level, while at the west coast of Norway at least one transgression took place, during which the sea rose faster than the land and much land was submerged (Hafsten 1983)' (Sognnes 2003, 191). When generalising about land uplift in the Holocene we have to pay close attention to local circumstances. To contextualise the isostatic movements in the region of the Vig River estuary, ^{14}C dates and rock elevations are useful, which show water level fluctuations between within the dates (Fig. 7) 3700BP and 3600BP (2140 calBC and 1910 calBC). This may represent a transitional period in rock carvings, as from this time water levels started to rise and the rocks became covered by water and alluvial sand (Devyatova 1976).

In this way we are able to assess the approximate date of when any rock was exposed and thus the date of its possible carving. The collection and processing of detailed elevation data for all known compositions allowed us to sequence the development of rock art in the White Sea region (Fig. 8). This detailed data permitted much greater precision than previous assessments of relative heights of the rock carvings, to the extent that five different independent locations within the Erpin Pudas complex were distinguished, where previously they had all been lumped together as one group and dated to the same period, before 5th millennium BP (Savvateev 1970, 49). Further new discoveries made in recent years by Lubanova have been includes into Erpin Pudas I and divided into old location as Southern group and the new carvings as Northern group. Through detailed recording it was possible to recognise the five concentrations of carvings and to date each autonomously, while reconstructing the specific sequences of the creation of rock art in the estuary of the Vig River (Fig. 9).

Name	Elevation m asl	No-cal dates bp	Sample No	Calibrated date 95.4 % probability
Erpin Pudas site	21.5	2040 ± 60	TA 418	210 BC - 80 AD
Erpin Pudas site	21.8	2410 ± 60	TA 446	670 BC – 390 BC
Zolotec X site	14.4 – 15.5	3300 ± 60	TA 390	1700 BC – 1440 BC
Zalavruga IV site	19.4 - 20	3700 ± 100	TA 797	2500 BC – 1750 BC
Zolotec VI site	18.5 - 18.8	3780 ± 150	TA 801	2650 BC – 1750 BC
Zalavruga IV site	19.4 - 20	3810 ± 50	TA 794	2460 BC – 2130 BC
Zolotec IX site	16	3990 ± 60	TA 789	2700 BC – 2250 BC
Zolotec VI site	18.3 – 18.6	4150 ± 80	TA 793	2900 BC – 2560 BC
Zalavruga IV site	19.4 - 20	4430 ± 80	TA 392	3350 BC – 2910 BC
New Zalavruga rock art	15.3	4010 + 70	GIN 130	2900 BC - 2250 BC
Besovy Sledki rock art	19.5 - 20	4495 ± 60	TA 471	3370 BC – 3010 BC
Zolotec VI site	18	4620 + 60	TA 391	3650 BC – 3100 BC
Zalavruga I site	16.3	4775 + 70	TA 393	3670 BC – 3370 BC
Besovy Sledki rock art	19.5 - 21	5000 + 60	TA 431	3950 BC – 3660 BC
Zolotec VI site	17.8	5160 + 150	TA 421	4350 BC – 3650 BC
Besovy Sledki rock art	19.5 - 21	5180 + 60	TA 522	4080 BC – 3890 BC
Erpin Pudas site	23.7	5240 + 50	TA 795	4180 BC – 3960 BC
Erpin Pudas site	23.5	5460 + 80	TA 800	4460 BC – 4220 BC
Erpin Pudas site	21.5	5825 + 80	TA 413	4850 BC – 4480 BC
Erpin Pudas site	23	5860 + 100	TA 472	4990 BC – 4490 BC
Erpin Pudas site	23.2	5990 + 100	TA 799	5250 BC – 4600 BC
Erpin Pudas site	23.5	6510 + 120	TA 344	5660 BC – 5220 BC

Fig. 7. 14C dating of particular elevations (Savvateev et al, 1978). All dates in this paper have been calibrated by the author using OxCal v3.10 (Bronk Ramsey 2005).

Map no	Site	Highest elevation m asl	Lowest elevation m asl
1	Erpin Pudas III	20.38	19.83
2	Besovy Sledki S	20.00	19.00
3	Besovy Sledki N	20.00	19.00
4	Erpin Pudas IV	19.49	19.20
5	Erpin Pudas II	18.30	18.10
6	Erpin Pudas I S	17.75	17.50
7	Erpin Pudas I N	16.96	16.90
8	Nameless Islands IV	16.93	16.27
9	Nameless Islands III	16.45	15.28
10	Zalavruga	16.3	13.75
11	Nameless Islands I	15.72	15.62
12	Zolatec	15.75	14.63
13	Nameless Islands II N	15.11	14.87
14	Nameless Islands II S	14.55	14.52

Fig. 8. Highest and lowest elevations of particular rock art locations in the White Sea rock art region.

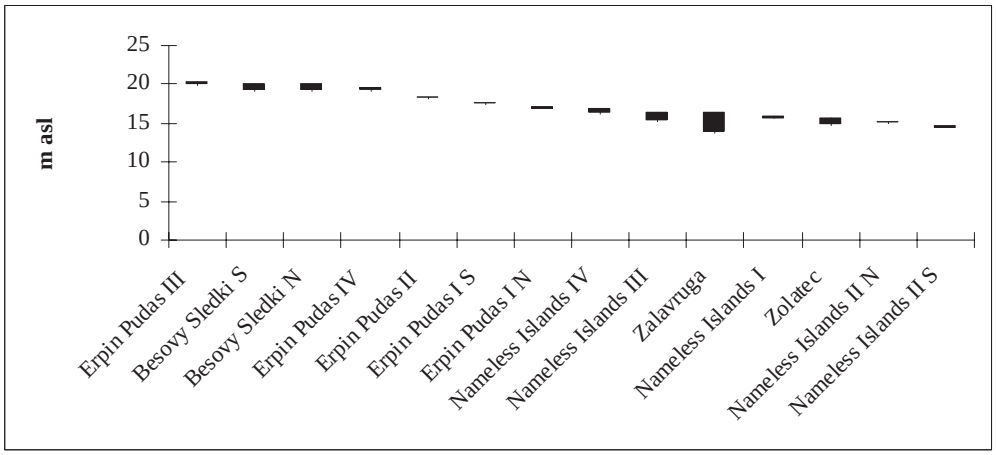

Fig. 9. Locations of particular rock art complexes according to elevation (meters above sea level).

Phase	Highest elevation	Lowest elevation	Non cal dating bp	Cal dating 95.4%
1	16.3	16.17	4775 - 4718	3590BC (84.8%) 3520BC – 3430BC (48.1%) 3380BC
2	16	16	4645	3500/3430 BC (80.3%)
3	16.1	15.3	4688 - 4340	3460BC (65.6%) 3370BC – 2940BC (79.9%) 2900BC
4	15.28	15	4331 - 4210	2930BC (95.4%) 2900BC - 2890BC (67.3%) 2860BC
5	15	14.7	4210 - 4079	2890BC (67.3%) 2860BC – 2630BC (88.6%) 2570BC
6	14.7	14.41	4079 - 3952	2630BC (88.6%) 2570BC – 2480BC (95.4%) 2460BC
7	14.41	13.75	3952 - 3666	2480BC (95.4%) 2460BC – 2130BC (50.2%) 2080BC

Fig. 10. Proposed dates for phasing of rock art at Zalavruga.

CORRELATION WITH THE RADIOCARBON DATA

Correlating these results with ^{14}C dates, it is possible say that the first rock was carved at the location of Erpin Pudas III, dated as early as 5825 ± 80 BP (TA 413) (4850/4480 calBC), and certainly before 5160 ± 150 BP (TA 421) (4350/3650 calBC). Deviatova (1976) suggested that hearths found nearby were used at this time, although the period between carving the rock and occupation could have been relatively short since this part of the rock surface was periodically flooded, a finding confirmed by the geomorphological analysis of the hearths located by the carved rock. The hearths are located one above another, indicating that Erpin Pudas III was seasonally occupied: she proposes that the hearths might have been used at the same time as the rock art was being created. Looking at the plan, however, the rock art is covered by sand, and the hearths are located in this sand above the carved rock surface (Deviatova 1976, 29, fig. 10). Such dating places Erpin Pudas III in the 4th millennium. BC, and much earlier than the dating proposed by Savvateev, who states that 'the rock art also does not go beyond the 3rd millennium BC' (Savvateev 1970, 49).

The Biesovy Sledki carvings (20 - 19 m asl) are located on the island of Shoyrukshin. Savvateev dates them as contemporary with early Neolithic comb-pit pottery dated to between 3rd and 2nd millennia BC (Savvateev 1970, 130). The elevations, however, could not be established precisely, since both compositions are inaccessible, one covered by the construction of the hydroelectric power station and the second by the viewing pavilion. The pavilion is in such a bad state of repair that the rock art had to be protected from falling masonry by layers of sand, sawdust, timber and carpets. The only measurement it was possible to obtain, thanks to the good will and permit from the local authorities to enter the pavilion, supports the elevation proposed by Savvateev. This elevation makes Biesovy Sledki South and North the second oldest rock art complexes among the White Sea carvings.

The subsequent carved locations were carved Erpin Pudas IV followed by Erpin Pudas II, both of which can be dated to before 5160 ± 150 BP (TA 522). Erpin Pudas I South, Erpin Pudas I North, Nameless Island IV and II were all carved before 4775 ± 70 BP (TA 393) (3670/3370 calBC), the date correlated with the elevation of 16.3 m asl. Next were the carvings of Zalavruga, Nameless Island I, Zolotec, Nameless Island II North and Nameless Islands II South. Carving of the rocks at the lowest elevation at Zalavruga must have finished by beginning of the marine transgression, by 3700BP – 3600BP (2140 – 1910 calBC).

Zalavruga is the rock art complex carved over the longest period of time in the White Sea. Its date, according to archaeological literature is correlated with to the presence of rhombus-and-pit ceramic recovered from elevated areas of the Zalavruga-1 settlement (Lubanova 2007, Tarasov & Marashkin 2002, Savvateev 1970). This is based on ^{14}C dates from charcoal recovered from the cultural layer from above the carved rock surface at Zalavruga 1, and pottery fragments related to the rhombic-pit pottery type. The cultural layer of this site is, however, divided from the carved rock surface by a layer of alluvial sand which is crucial to dating the rock art. The Zalavruga rock art carvings were dated first by Savvateev. He based his dates on the isostatic movements of the Vig River and the presence of settlements located close by, at a similar elevation to Zalavruga 1. He dates the Zalavruga rock art complex to the 'middle of third quarter of 2nd millennium BC related to Eneolithic and early Bronze Age' (Savvateev 1970, 129). Such a date constrains the creation of the rock art to a very short period of time around 1750BC – 1500BC (2200/2135 calBC – 1890/1770 calBC). Savvateev subsequently suggested that Zalavruga 1 dated to the 'middle of 2nd millennium BC', representing the earliest stage of the rock art chronology. The Zalavruga rock art complex is usually understood as being the youngest art from the Vig River estuary, and therefore the dating of this complex provides a *terminus ante quem* for all the White Sea carvings.

OTHER CHRONOLOGIES

Russian archaeologists normally give priority to chronology based on pottery rather than radiocarbon dating or isostatic movement which is problematic for dating rock art (e.g. Tarasov & Murashkin 2002). Tarasov and Murashkin's article summarises how the dating of the rock art of Zalavruga is understood. The pottery found in the cultural layer at a higher elevation at Zalavruga 1 is dated to the beginning of the 5th millennium BP. 'The lower one is associated with the rock carvings of New Zalavruga' (Tarasov & Murashkin 2002, 44). Pottery found on the lower elevation of the same site has been defined as asbestos-tempered and porous pottery and is dated to the

second half of the 5th millennium BP.

On the basis of different pottery types, Tarasov and Murashikin conclude that Zalavruga 1 was occupied during the Eneolithic period, and that the occupation was divided into two phases, the earlier linked with rhombic-pit pottery, and the later with asbestos-tempered and porous pottery. They also argue that the settlement was created after the transgression of the Vig River, 'when alluvial sands buried rock carvings' (Tarasov & Murashkin 2002, 44). These interpretations of the dating of Zalavruga 1 and the chronology of the Vig River rock art in general remain difficult to understand due to inconsistencies in the argument.

First, although the rhombic-pit pottery is associated with a date of ^{14}C 4775 ± 70 BP (TA 393) (3670/3370 calBC) at an elevation 16.3 m asl, Tarasov and Murashikin date it to the beginning of 5th millennium BP. I suggest that this date indicates the second part of the first half of 5th millennium rather than the first part. Secondly, the second date from this site, obtained from an elevation of 15.3 m asl, 4010 ± 70 BP (GIN 130) (2900/2250 calBC), indicates the end of 5th millennium BP rather than the middle or second half. Third, there is no distinction between cultural layers other than pottery styles. Fourth, there is a layer of alluvial sand dividing the cultural layers at Zalavruga 1 from the carved rock surface, indicating that the rock art was created before either of these dates. Therefore the rock art should be dated earlier than 4775 ± 70 BP (TA 393) (3670/3370 calBC) and earlier than 4010 ± 70 BP (GIN 130) (2900/2250 calBC), so that the occupation of both sites took place after carving the rocks, or perhaps pottery was washed on to the rocks already covered by alluvial sand or had been moved by colluvial process from above Zalavruga 4 site, what could explain the lack of water abrasions on the pottery.

DISCUSSION

To solve the problem of dating the youngest carvings at White Sea and thus the dating of the Zalavruga rock art complex, I have turned to a method well established in Scandinavia for dating rock art, based on the isostatic movements of the White Sea coast.

Our research has shown that the Old and New Zalavruga images began to be carved at an elevation of 16.3 m asl, finishing at 13.75 m asl. Since we know that the rocks at Zalavruga began to be carved sometime after their exposure, and as we have not found carvings higher than 16.3 m asl (Fig. 3), we focus on the lowest elevation of the rock to be carved. Deviatova (1976: 107) argues that around 3700BP (2140/2030 calBC) the water levels in Vig River started to rise, ending approximately 3600BP (1980/1910 calBC), resulting in the submerging of the whole Zalavruga rock art complex.

Using isostatic movement is an accepted way of dating rock art, but the method gives approximate rather than definite dates. For example, if 16.3 m asl reflects a date of 4775 ± 70 BP (3670/3370 calBC), and if carvings at 13.75 m asl were created around 3700BP (2140/2030 calBC), then we can calculate that over some 1075 non-calibrated radiocarbon years the water level dropped by 2.55 metres, or an average ambient water level drop of 2.3 mm per year.

Based on these calculations, it is possible to suggest that the first phase of the creation of rock art at the Zalavruga complex was relatively short around 57 years, associated with an elevation of 0.13m asl. The second phase, comprising carvings in various locations but all at 16m asl is dated to 4645BP (3500/3430 calBC). The second phase also marked the beginning of the carving of group XI, which continues into the third phase, associated with elevations of 16.1m asl to 15.3m asl, dated to *c*. 4651BP till *c*. 4375BP (3460/3370-2940/2900 calBC). The fourth phase, between 15.28m asl and 15m asl, dates from 4367BP to 4255BP (2930/2900-2890/2860 calBC). The fifth phase, between 15m asl to 14.7m asl, dates from 4255BP to c 4135BP (2890/2860-2630/2570 calBC). The sixth phase, between 14.7m asl and 14.41 m asl dates from 4135BP to 4019BP (2630/2570-2480/2460 calBC). The seventh and final phase, between 14.41m asl and 13.75 m asl, dates from 4019BP to 3755BP (2480/2460-2130/2080 calBC).

The Zalavruga rock art complex was created over the longest period of time of any of the White Sea rock art sites, and on the basis of calculations presented above I argue that the most likely date for the start of the carvings was between the 5th and 4th millennia before the present (Fig.10). The chronology proposed here extends Savvateev's proposed dating from the 'Middle and Late Neolithic (second half of 3rd millennium and start of 2nd millennium BC)' (Savvateev 1977, 132), and places the start and end of the archaeologically detectable symbolic relationship between fisher-gatherer-hunter communities and these particular locations in their landscape at Zala-

vruga some 500 years earlier and 500 later than accepted in most recent literature.

Furthermore, excavations at Zalavruga 4, between 20m and 19.4m asl two cultural layers were discovered and dated by ^{14}C analysis of charcoal samples. The upper layer was dated to 3700 ± 100 BP (TA – 797) (2500/1750 calBC) and the lower level to 3810 ± 50 BP (TA 794) (2460/2130 calBC). In both layers the same types of pottery were found: asbestos-tempered pottery, comb pottery with plant temper, different styles of pit-comb pottery, and rhombic-pit pottery, as dated by Savateev to the Early Metal Period (the Metal Period covers both the Bronze Age and Iron Age). These pottery types have been used to argue for an Eneolithic date for Zalavruga-1 settlement (Tarasov & Murashkin 2002, Lubanova 2007). I suggest that the chronology of pottery styles should be treated with caution in dating rock art carvings. Indeed in this case, the same types of pottery are associated with different radiocarbon dates, suggesting a further shortcoming in the pottery style-based approach.

LOCATION

The same method can be used to propose approximate dates for other carvings. The elevation of 21.5m asl is dated to 5825 ± 80 BP (TA 413) and 17.8m asl to 5160 ± 150 BP (TA 421). This suggests that the water transgression average ambient water lever drop of 5.6 mm per year was faster than in the following period and closer to the estimates for the Kola Peninsula (Olyunina 2007). These figures allow us to propose dates for the first rock art composition at Erpin Pudas III of between 5625BP to 5527BP 94495/4445-4370/4340 calBC). This average ambient water lever drop lasts through Erpin Pudas II, III, IV and Besovy Sledki. Dates for the next four locations (Erpin Pudas Ia and Ib, Nameless Island IV and III) can be proposed on the basis of radiocarbon dates for further elevations: 17. 8m asl 5160 ± 150 BP (TA 421) and 16.3m asl 4775 ± 70 BP (TA 393). In this period the average ambient water lever drop is estimated at 3.9 mm per year, showing that the isostatic movement had slowed down. The dates for Nameless Island III were calculated using an average ambient water level drop of 3.9 mm for the elevation of 16.3m asl, below which average ambient water level drop of 2.3 mm per year was used, as at Zalavruga. The same figures are used to calculate dates for the remaining rock art locations. The carvings of Zolotec are dated later than those at Nameless Island due to a height difference of only 3 mm. In addition, the carvings at Zolotec finish later, indicating that more of the rock surface was exposed. This new chronology for the White Sea rock art allows us for the first time to assess the development of particular complexes of carvings (Fig.11).

The carvings of Erpin Pudas III were the first to be carved, followed by the carvings of Besovy Sledki. Their creation overlaps, which I suggest indicates their being part of the first horizon of carvings in the White Sea region, the tangible record of a symbolic relationship between the islands of the Vig River estuary and the prehistoric communities which inhabited it (Fig. 3). As water levels became lower, fisher-gatherer-hunter groups began to signify other landscape locations that emerged from the water, following a general pattern northwards towards the sea. The carvings of Zalavruga are located closest to

Site	non cal bp dates	cal BC 95.4% dates
Erpin Pudas III	5625 - 5527	4495BC (85.4%) 4445BC - 4370BC (91.4%) 4340BC
Bes Sledki	5557 - 5379	4405BC (51.5%) 4350BC - 4265BC (60.4%) 4230BC
Erpin Pudas IV	5459 - 5414	4345BC (69.8%) 4320BC – 4330BC (95.4%) 4255BC
Erpin Pudas II	5254 - 5218	4070BC (84.3%) 3990BC – 4045BC (95.4%) 3980BC
Erpin Pudas I S	5147 - 5083	3975BC (95.4%) 3950BC – 3880BC (77.6%) 3800BC
Erpin Pudas I N	4945 - 4929	3715BC (66.3%) 3690BC – 3710BC (95.4%) 3655BC
Nameless Island IV	4937 - 4768	3715BC (69.3%) 3690BC – 3600BC (63.1%) 3550BC
Nameless Island III	4814 - 4332	3560BC (50.0%) 3530BC – 2930BC (94.1%) 2900BC
Zalavruga	4775 - 3666	3590BC (84.8%) 3520 BC – 2130BC (50.2%) 2080BC
Nameless Island I	4523 - 4479	3220BC (40.2%) 3170BC – 3330BC (69.7%) 3210BC
Zolatec	4539 - 4049	3360BC (39.1%) 3330BC – 2530BC (52.9%) 2490BC
Nameless Island II N	4258 - 4153	2900BC (95.4%) 2880BC – 2780BC (67.9%) 2670BC
Nameless Island II S	4014 - 4001	2575BC (76.0%) 2510BC – 2570BC (68.8%) 2520BC

Fig.11. Table showing the correlation between rock art elevations defined in meters above the sea water level, and estimated dates for their creation.

the sea, and were created over a much longer period of time than the others, estimated at some 1100 years, generating the largest complex of rock carvings in the White Sea region. At the time as the rock art at Zalavruga was being created, other locations were also being signified by rock art, including Nameless Island I, II N and S, and Zolotec. All of these different rock art locations represent new, archaeologically visible, symbolic relationships between local communities and the natural landscape of the Vig River estuary, the inlet to the White Sea.

The chronology of White Sea rock art proposed here begins in the 6th BP and lasts into the 4th millennium BP, namely the Early Bronze Age. The changes in imagery over the millennia reflect the creative dynamism within the visual narratives of the White Sea rock carvings. Notable are the lack of boat images in Erpin Pudas I South, one of few rock art complexes that could be accessed by foot in prehistory.

CONCLUSIONS

The chronology of the White Sea rock carvings, and the chronological relationships between them, as established in this paper, allow us to better understand the symbolic relationship between prehistoric fisher-gatherer-hunters and their landscape. The archaeologically detectable signification of the natural landscape in the estuary of the Vig River contributes to a better understanding of this important but relatively unknown region of Scandinavian rock art.

The carving of the White Sea petroglyphs took place later than in other parts of Scandinavia such as Norway where we can trace carvings from the Middle Mesolithic around 8800 BP. At this time, however, the Vig River estuary was still inundated, and carving of the rocks started just after water levels dropped, marking the beginning of the archaeologically detectable relationship between the landscape and those who inhabited it. Although this relationship did not end in the Bronze Age when the water levels rose and the rock surfaces became covered by sand and water, the expression of the relationship altered, becoming archaeologically untraceable.

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