Experimentation and technological analysis in the study of the rock carvings at the site of Hjemmeluft, Alta, Finnmark, Norway

*Marie Vourc'h**

Abstract - Experiments and technological analysis of the Hjemmeluft rock etchings
The experiment and the technological analysis hereby presented pertain my doctorate on prehistoric rock art in north Scandinavia. The technological analysis on the hammer of the Hjemmeluft site (Alta) has been carried out to give information on rock etchings and has allowed a better understanding of the historical processes of the site. Going beyond the technologies used and/or the possible chrono-cultural boundaries, the experiments allow a direct and deep study of the rock etching and to better understand the engravers' gestures and the ideas that moved them. The technological analysis is complementary to the study of rock etchings, facilitating more concrete dimensions because it's a gestural one enabling one to get a little bit closer to the prehistoric engravers.

Riassunto - Sperimentazione e analisi tecnologica delle incisioni rupestri di Hjemmeluft (Alta, distretto di Finnmark, Norvegia)
La sperimentazione e l'analisi tecnologica qui presentate fanno parte dalla mia tesi di dottorato sull'arte rupestre preistorica nel nord della Scandinavia. L'analisi tecnologica sulla martellina del sito di Hjemmeluft (Alta) è stata condotta allo scopo di fornire informazioni sulle incisioni rupestri e ha permesso una miglior comprensione dei processi istoriativi del sito. Al di là della ricerca sulle tecniche usate e/o degli eventuali confini crono-culturali, la sperimentazione permette di approfondire più direttamente lo studio delle incisioni rupestri e di comprendere meglio i gesti degli incisori e le idee che li hanno guidati. L'analisi tecnologica è complementare allo studio delle incisioni e permette di approcciare una dimensione più concreta perché gestuale e di avvicinarsi un po' di più agli esecutori preistorici.

Résumé - Expérimentation et analyse technologique des gravures rupestres du site de Hjemmeluft à Alta (Finnmark, Norvège).
L'expérimentation et l'analyse technologique présentées ici sont issues de ma thèse de doctorat qui porte sur l'art rupestre préhistorique dans le nord de la Scandinavie. L'analyse technologique des piquetages du site de Hjemmeluft à Alta a été menée dans un premier temps dans un but informatif, c'est-à-dire pour fournir des informations complémentaires sur les gravures piquetées du site et dans un second temps, afin de permettre une meilleure compréhension des procédés de gravures dans ce site. Au-delà de la recherche des techniques empruntées, et/ou d'une marque chrono-culturelle éventuelle, l'expérimentation permet d'accéder plus directement aux gravures préhistoriques, de mieux comprendre les gestes des graveurs, et de tenter d'approcher les idées directrices les ayant guidées. Couplée à l'analyse technologique, elle permet d'aborder une autre dimension des gravures, plus concrète car gestuelle, et de s'approcher ainsi un peu plus de ceux qui les ont produites.

***

Introduction

Alta (West Finnmark, Norway) is the most important rock art area in the north of Scandinavia. Hjemmeluft is situated at the end of the Altafjord (Figure 1); the site is well maintained thanks to the existence of a museum (opened in 1991) which is also used for study purposes (the site was put on the World Heritage List in 1985). The upkeep of many panels as well as the excellent preservation of the carvings in some areas provides optimal study conditions. Moreover, the site consists of more than 3,000 carvings made over a long period (from around 4200 BC to 200 AD) with five distinct production stages (Helskog 2000). Like all the pecked carvings, those from Hjemmeluft were made

* Marie Vourc'h
TRACES, CREAP - UMR 5608 CNRS
Maison de la Recherche
Université Toulouse II-Le Mirail 5 allées Antonio Machado 31058 Toulouse Cedex 9 France m_vourch@hotmail.com

by direct (thrown) and/or indirect (made with hammerstone) percussion. But as no technological analysis of the carvings has been made on this site yet, launching a study of this kind seemed very relevant.

The technological analysis of the carvings is not an end in itself. First, it will provide a better understanding of the carving process, and then it could be part of a transregional dimension, and as such, be used in comparison with other technological analysis on other sites from the region and nearby cultural areas (which has not yet been done).

The starting hypothesis for the carving processes is that various techniques reflecting various sorts of know-how may exist, depending on the period. These can still be seen today thanks to the analysis of the flake negatives. Indeed, when the engraver pecked the carvings, 'each hammerstone impact caused the removal of a few square millimetres of rock, leaving distinctive groove called flake negative' (Mens 2002). No significant differentiation (diachronic) may, however, be found, either because different techniques exist in a similar time period, or because the percussion techniques and the tools used to make the carvings did not significantly change with time.

Both the technological study and the experimentation aim to establish:

1. The type of rocks of the supposed tools the carvings were made with
2. The morphological characteristics of the tools used for the pecked carvings
3. The most likely techniques of percussion
4. Some possible diachronic changes on those previous three parameters on the site.

Means of analysis

The technological study of the carvings is based on the observation to the naked eye of the flake negatives. The general depth is calculated with a micrometric gauge.

The method used to record the negatives of percussion consists in making stampings on silk paper (Priuli 1984, Mens 2002). I used a thin paper (20 gr.) slightly plastified on the back side, which is set on the surface (humidified beforehand) and fixed with a special tape. A cloth is then pressed on the paper where the carvings lie. Small pieces of carbon paper are then scraped against the surface as for a standard rubbing (*frottage*). Best results are obtained on small surfaces (15×15 cm to A4 max.), since the piece of paper must not move.

Series of stampings have been made in this way at Hjemmeluft on carvings from various phases and various panels of a same phase in order to observe the changes of the flake negatives.

Experimentation has been carried out at the same time on the site, using direct percussion with and without haft and indirect percussion with stone and wood hammer. The results were then compared with the carvings of the site.

For now, the marks of percussion have only been observed by the naked eye, without being counted, analysed or measured in detail. In order to specify a flake negative, we follow the work of Mens (2002), who makes the distinction between three kinds of negatives according to their proportion length (l) and width (L): punctiform (rounded) negatives (ratio $l/L = 1$), slightly elongated ($1<l/L<2$) and elongated ($l/L>2$). The size of the negatives and the depth of the carving are also taken into account.

Rock surface and estimated tools

According to the geologist B. Holst, the rocks at Hjemmeluft show little colour, granular and structure variations; it is a very compact thin-grained meta-sandstone, rather homogeneous. The experiment has been done on the same type of rock, but belonging to isolated blocks at the water's edge, in the Bergbukten sector. No surface preparation was needed because the blocks were naturally polished.

No prehistoric tool has been identified as having been used for the making of the carvings, but when the carvings were discovered, fragments of chert and fine and coarse grained quartzite were found (Helskog 1988), in particular on the bottom of the panel Bergbukten 4B and in the peat covering the panel Bergbukten 4A (Helskog, pers. com.). This last panel is the best preserved and the most favourable for a technological study.

According to Helskog, the tools may have been left beneath the panels and could have been taken by the tides, seeing their closeness to the water (K. Helskog, pers.com.), or no tools have been recognised as such maybe because they did not fit with the idea we would have of them. The remains of the stock in the Alta museum did not allow us to identify possible hammerstones or intermediate tools. The rare remains discovered on the site in the dwelling areas and especially in the immediate surroundings of the carvings allow at least the formulation of some hypothesis on the nature (rock) of the hammerstone (quartzite or chert).

Because no types of tools could be identified, one of the aims of the experiment was therefore to test the performance of pebbles picked up from the shore without knapping them.

Experimentation and results

The hammerstones

Seven types of rocks have been tested, picked up from the foreshore: chert, quartz, jasper, a compact basaltic rock, a green stone (quartzite type), thick-grained quartzite and thin-grained quartzite (due to its rarity, the chert had been tested the previous year). A granitic rock as well as a sandstone sample were also tested but their effect on the sandstone slab was so trivial that they do not appear in the list.

The stones were chosen because of their shape (at least one angle, even if rounded) and their obvious handiness. They were not knapped (Figure 2A). No bone or metal percussor was tested as one of the aims of this experiment was to test the performance of the available material in the foreshore.

In order to find the best kind of stone, the stones were tested by direct percussion in a series of 2 minutes on a small slab (Figure 2B).

Two small rocks (less than 40 g) used as intermediary pieces were also tested: they crumbled too much to be used.

Stones nos. 5 (coarse-grained white/orangey/pinky quartzite, 317 g), 9 (green stone, 223 g) and 11 (dark red jasper mixed with fine grained purple quartzite, 172 g) showed the best results and were therefore used for experimenting on the types of percussion. Strangely enough the quartz flaked away a lot (probably because of the type of quartz on the foreshore: coarse granulometry and of little density); the chert (tested the previous year) also flaked away a lot with cutting fragment projections around. The best results were obtained with thin- and thick-grained quartzite (also jasper).

The accuracy of the lines depends on the shape, the size and the weight of the hammerstone. A hammerstone that is too large inhibits visualising the impact point. On the other hand, the hammerstone must not necessarily have a very pronounced head to allow good precision: a rounded shape is enough. A narrow head crumbles and breaks a lot faster. According to the results of my experimentation, the 'ideal' weight of the hammerstone seems to be located between 150 g and just under 400g. If the hammerstone is too light, the engraver must use more strength and if it is too heavy, the precision diminishes.

Techniques of percussion

Six reindeer were pecked by direct and indirect (hard hammerstone) percussion and by direct percussion with water addition (Table 1).

The direct hafted percussion was tested with a coarse-grained quartzite fixed (with a modern rope) to a curved haft in juniper (Figure 2A). The results were not surprising: the flake negatives were rather deep and made with little force, but the stone crumbled a lot and direct hafted percussion led to bad control over the impact point (even when holding the haft close to the stone), and this lack of precision tends to put this kind of percussion aside (at least at this site).

Direct percussion

I realised during the experiment that direct percussion gives very different results according to the strength of percussion, and this parameter of gesture is hardly measurable. I therefore used the terms of 'strong percussion' and 'light percussion' to define two applications of force. The force used for strong percussion equals that used when hammering a nail into a hard material. The gesture is wide, the forearm rises quite a lot and the shocks occur every other second. The force used for light percussion is similar to slowly knocking at a door. The gesture is short and the forearm hardly rises because the shocks are so close to each other (about four repetitions a second). Strong percussion produces much deeper flake negatives, so that the amount of time of percussion is reduced. Light percussion produces clearly more superficial flake negatives and many impacts are needed to dig into the material. Moreover, this type of percussion may only be efficient on relatively soft material, sandstone here. But this type of percussion allows very good control over the line. The flake negatives are very characteristic: small and usually punctiform (rounded) (Figure 5).

Tool 5: The small reindeer (no. 1) had been pecked quickly by direct strong percussion (Figure 3).

The lines are very well marked, of variable width, and the flake negatives are diffuse and of various size and shape (Table 1).

Tool 9: The reindeer (no. 2) has been pecked quickly by direct strong percussion (Figure 4). The shape of the hammerstone and the use of its basal part required a strong angle towards the impact plane. It results in a high proportion of very elongated flake negatives. Some lines (especially the ventral line next to the foreleg) are very regular and quiet, similar to indirect percussion.

Tool 11: Reindeer no. 3 was pecked with strong and light direct percussion and by indirect percussion (Figure 5). The shape and hardness of the tool allow good control over the impact (whatever sort of percussion). In order to evaluate the degree of precision we can reach by direct percussion, an internal circular motif was added to the initial figure. The results were striking: as mentioned earlier, at this point of the experiment the precision needed to peck the circular motif forced me to diminish the strength of percussion. The rock erodes progressively after a while, and the digging is faster and faster. Besides the precision of this kind of percussion, the rendering is extremely sharp with very small negatives.

Direct percussion with water addition

Reindeer no. 4 was pecked with tool no. 11 by direct light percussion with water addition (Figure 6). The flake negatives are mostly small and equal the dry ones. Water addition seems neither to accelerate the digging of the rock nor to facilitate the pecking in any way. On the contrary, water and sandstone dust mix themselves together in a sort of paste which inhibits visualising the carving in progress. It is therefore necessary to rinse the pecked carving in order to see the line (instead of blowing when dry). This heavy and frequent rinsing of the carving in progress leads us to believe that if this practice was used, the rock surface must have been located next to the water. Because of the slope and the orientation of the carvings, the engraver(s) must have been situated on the bottom of the slope as they made the carvings. Then, if a big amount of water was added when carving, the engraver must have been wet (conceivable during summertime, in the middle of the day when it is warm, but inconceivable most of the time, even during the summer). For all those reasons, water addition seems very unlikely.

Indirect percussion

Tests of indirect percussion with a soft wooden juniper percussor were held, but the percussor was far too light to allow carving. These tests were therefore done with a hard granitic hammerstone of 401g with a flattened face.

Tool no. 5 and hard hammerstone: reindeer no. 5 was pecked in 12 minutes (Figure 7). Compared with the reindeer pecked by direct percussion with the same tool, the line was way less marked, there were fewer flake negatives, which were smaller and less deep. We may, however, point out that the line (especially of the croup and the back leg), very visible in the picture, is barely observable on the stamping. For a similar given strength, indirect percussion seems therefore less efficient for digging into the rock. Moreover, this type of percussion did not allow a bigger precision of the line, either because of the shape of the intermediate tool (tool no. 5), or because of the lack of practice of the experimenter. An intermediate tool with a well-marked point (even if rounded) is probably better, the attack angle being more important for indirect percussion than for direct percussion.

Tool no. 9 and hard hammerstone: reindeer no. 6 was pecked in 8 minutes (Figure 8). The edge and the angles of the basal part of tool no. 9 were used, the most efficient being the use of the angles. The flake negatives were consequently very heterogeneous: some (pecked with the edge) were almost imperceptible in stamping, whereas others (corresponding to the use of the tool's angles as active parts) (antlers, neck) were rather deep compared with the experimental negatives of the other reindeer. Several passages were necessary to get an efficient pecked carving. Besides, this type of percussion is not well adapted at all for the pecking of surfaces like head and neck. On the other hand, it allows one to get a regular line, with negatives well-lined up (not very visible individually).

Tool no. 11 and hard hammerstone: the figure (reindeer no. 3, Figure 5) was pecked in 15 minutes by direct percussion (already described above) and indirect percussion with hard hammerstone. The back and ventral lines as well as the foreleg of the reindeer were pecked by indirect percussion. The resulting lines were rather regular and of average depth. It is much more difficult to identify individual flake negatives with this type of percussion. On the whole, they seem slightly elongated and elongated (visible on the ventral line and the foreleg).

Experiment		Tool no. 5	Tool no. 9	Tool no. 11		Tool no. 11
Direct percussion		Strong	Strong	Strong	Light	Light
		Reindeer 1	Reindeer 2	Reindeer 3		Reindeer 4
Time for percussion		5 min.	6 min.	15 min.		15 min.
Water addition		no	no	no		yes
Global morphology of flake negatives	punctiforms	×	×	×	×	×
	slightly elongated	×	×	×	×	×
	elongated	-	×	×	-	-
Min.. and max. width of the line (head excepted)		0.3–1.3 cm	0.15–1.1 cm	0.3–1.15 cm	0.4–0.7 cm	0.15–1 cm
Max. depth		0. 45 mm	0.35 mm	0.55 mm	0.25 mm	0.18 mm
Size of flake negatives	Min.	1.5 mm Ø	1.5×2.0 mm	2.0×2.5 mm	<1 mm Ø	<1 mm Ø
	Max.	4.5×6 mm	2×6 mm 3.5×5.5 mm	2.5×5.0 mm	1.5×2.0 mm	2.0×3.5 mm
Indirect percussion with hard hammerstone		Reindeer 5	Reindeer 6	Reindeer 3		
Time for percussion		12 min.	8 min.	15 min.		
Global morphology of flake negatives	punctiforms	×	×	-		
	slightly elongated	×	×	×		
	elongated	-	×	×		
Min. and max. width (head excepted)		0.15–0.8 cm		0.2–0.5 cm		
Max. depth		0.25 mm	0.45 mm	0.35 mm		
Size of flake negatives	Min.	1.0×1.5 mm	1.0×1.5 mm	1.0×2 mm		
	Max.	3.5×5.0 mm	3.0×4.5 mm	2.0×3.5 mm		

Tabl. 1. Table showing parameters and results of the pecked reindeers experimentation. (Tableau indiquant les paramètres et les résultats de l'expérimentation du piquetage des rennes).

Thanks to the experiment (Table 1), it is now possible to:

- postulate that tools were probably made out of quartzite or similar rock (green stone) and may have not been knapped;
- differentiate direct percussion from indirect percussion;
- differentiate a strong direct percussion from a light direct percussion;
- estimate the production time of a figure according to the type of percussion and the depth of the flake negatives;
- postulate the likelihood of the dry making of the carvings.

The comparison of the negatives and experimental lines with the pre-and proto-historic carvings of Hjemmeluft can currently allow analysing different gestural parameters used to peck figures and notice possible diachronic technological variations.

Comparison of the experimental carvings with those of Hjemmeluft

More than 100 stampings were made, on panels dating from chronological phases 1, 2, 3 (in Amtmannsnes) and 4 and 5 (Vourc'h, in press). Panels were chosen according to their dating and to the state of conservation of the rock and the engravings.

Phase 1 (4200–3300 BC)

The best preserved carvings are found in Bergbukten, especially on the panels of Bergbukten 4A, on surfaces rather horizontal and cleaned of mosses and lichens.

All carvings that have been stamped were most likely done by direct percussion; however, some of them seem to show a combination of both techniques of percussion, indirect percussion having mostly been used to peck the outline of the figures.

In Bergbukten 4A, we find several cases of this type of percussion combination, as follows.

Entirely pecked moose (Figure 9): the outline of the figures is extremely regular and well marked; Furthermore, the flake negatives of the outlines differ a lot from those of the inside of the figures: they are deeper, lined up and individually less distinguishable; in other words, they are characteristic of an indirect percussion.

The bear with her young (Figure 10): these three figures are particularly interesting; while the entire body of the bear seems to have been made by rather strong direct percussion (particularly the central part of the big bear, Figure 10A), the neck and especially the head include negatives of much smaller impacts, similar to light direct percussion (Figure 10B). The two small bears include rather small percussion negatives, but not as many as those of the mother bear's head. The line linking the ears to the tip of the muzzle is particularly clear, and the negatives are very small and regular, some overlapping others. This leads one to postulate the use of indirect percussion, at least in this place, with probably a way of pecking towards the end of the muzzle (from left to right); other marks located around the neck, the foreleg and the hindquarters also remind us of indirect percussion (alignment of the flake negatives). The difference between the rough and diffuse flake negatives of the central part of the animal (negative no. 1, Figure 10) and the tiny ones of its head (negative no. 2, Figure 10), seems to me to be due to a modification of the force applied during the percussion and the attack angle of the tool on the rock, rather than to the erosion of the hammer stone. If this reading of the flake negatives is right, it implies very special attention given to the head of the figure of the mother bear, implying close and light direct percussion. This particular treatment may also be observed on another mother bear figure (with its baby) in Ole Pedersen 8A. It would still be unwise to draw immediate conclusions of a symbolic order; on the one hand, the head is the anatomical part which best characterises the animal, and it seems therefore logical to treat it with more attention; on the other hand, this differential treatment is not systematically applied to bear carvings. However, for the carvings of phase 1, the outline (or a part of the outline) of the bear figures (and especially of adult bears) seems to have been pecked by indirect percussion.

The anthropomorphic figure on the left holding an elk head stick (Figure 11): the flake negatives of this figure are much smaller and shallower than those of the other anthropomorphic figure located on the right. This difference is especially interesting because both figures abreast are completely similar (from an iconographic point of view). Before experimentation, I thought it was due to wear on the tool, but a modification of the force of percussion (direct light/direct strong) seems to me currently more plausible. Both carvings could then have been made by two different engravers, or by one engraver having changed, for an unknown reason, his gestural parameters.

On the whole, for phase 1, direct percussion therefore seems to have been predominantly used, most often with strong percussion; it was probably sometimes linked with indirect percussion, in order to refine the outline of some figures (mother bear figures and entirely pecked moose's figures), or to get rectitude of the lines. The small flake negatives interpreted as resulting from light direct percussion were only noticed in the sector of Bergbukten. On the measured engravings, the breadth of the pecked lines varies from about 0.2 cm (measured on the den of the bear of Bergbukten 7A) to 1.8 cm (measured on a fringed reticulated motif of Bergbukten 4A) (excluding entirely pecked motifs and zones). The depth of the lines varies between 0.4 mm and 1.85 mm. Figures are generally of rather reduced size; only a few moose and reindeer figures (in Bergbukten 4B and Bergheim 1) greatly exceed the average size of other figures.

Phase 2 (3300–1800 BC)

The carvings of this phase which were studied and stamped are in the sectors of Bergukten, Ole Pedersen and Apanes. Study of the flake negatives clearly points to a strong direct percussion in all cases.

Generally, lines are far wider (0.4–3.5 cm) and figures much broader than during phase 1 (especially in Apanes 1). The dimensions (8.5×6.5 mm max.) and depth (2.4 mm max.) of the flake negatives (which in most cases are also bigger than those of phase 1) could result from an augmented force of percussion, and/or a heavier hammerstone and/or a less pointed tool.

Phase 3(1800–900 BC)

Carvings dated from phase 3 are found in Amtmannsnes and in Storsteinen. On my last visit the Storsteinen's rock was covered for preservation. According to my previous visits, the carvings there seem to have been pecked by strong direct percussion (the granitic rock gives probably less freedom than the sandstone as to modes and degrees of application of the force of percussion). Lines are rather broad, and the flake negatives are partly eroded. Besides, the rock surface is way harder than in Hjemmeluft and the experiment having been led only on sandstone, the reference pecked carvings are not valid for this site.

On the other hand, a part of panel II in Amtmannsnes had been cleaned of mosses and lichens. Carvings were consequently much more visible than during my previous visits. The strong state of deterioration of the rock and of the carvings reduces, however, considerably the possibility of studying the flake negatives, the erosion having probably strongly enlarged the engraved lines. Given the breadth of the lines of studied figures (0.7–4.3 cm), it nonetheless seems that pecked carvings have been made by direct percussion.

Phases 4 and 5 (900–100 BC//100 BC–200 AD)

The carvings of phases 4 and 5 are located in Apana Gård (Hjemmeluft). All carvings of this sector seem to have been made by strong direct percussion, with some divergences. In some cases, the figures are pecked very deep and wide (like the fish of Apana Gård 5), in others cases (boat figures of Apana Gård 7 and 14) the figures give the impression of a greater freedom from an iconographic and technological point of view, with spaced out and diffuse flake negatives (Figure 12).

Conclusions

Technological analysis and experiment have shown a high probability of a quartzite hammerstone (coarse- or fine-grained, or any similar rock type) being used to peck the Hjemmeluft rock carvings. This study does not exclude the making of specific tools, but it shows that stones collected along the seashore and not been knapped are satisfying enough relative to the expected technical and stylistic requirements. Hammerstone morphology must of course be appropriate for the percussion type and required precision grade. Most of the rock carvings seem to have been made by strong direct (thrown) percussion.

Therefore, according to my experiments, standard hammerstone could weigh between 150g and 400g and have at least one point (even a rounded one). The depth variation between experimental and prehistoric flake negatives can be due to the strength variation between the experimenter (a woman in the 21st century) and the prehistoric engraver.

According to the study of percussion marks, the only diachronic technological variations that can be observed are a limited use of indirect and light direct percussion during the earlier phase. However, during the two last phases, especially during the last one, the immediate visual aim seems in a way to have prevailed over the continuity, as the flake negatives often are rather spaced out.

Indeed, experiments have shown a difference between the visual aspect of rock carving during its pecking and effective carving that can be seen by stamping. A very superficial carving that is hardly noticeable on stamping (or even imperceptible) is in return very visible on stone with a coloured contrast (white or pink on grey). Thus, a line can seem continuous while only few flake negatives are in reality pecked into the rock.

Technological analysis of pecked carvings does not stop here. A statistical analysis of flake negatives could indeed permit determining a characteristic signature percussion of one particular engraver. According to preliminary results and the conservation quality of the flake negatives, assuring stamping quality, such a study could probably be led successfully. Moreover, to complete this experiment, it would be necessary to test also metal hammerstones and to compare results with engravings from phases 4 and 5 (see also the work of E. Girya and E. Devlet in Russia). It introduces a particularly interesting and promising way forward for further studies.

Acknowledgements

I would like to address special thanks to E. Mens as well as to the wonderful team of Alta Museum which helped and supported me in this study.

Bibliography

Devlet E. et al. 2006. Rock Art of Chukotka: Pegtymel Petroglyphs, 8 pp., available on internet at <http://www.explorers.org/flag_reports/Flag_25_-_Stephanie_Zini_and_Alexander_Borodin.pdf>

Helskog K. 2000. 'Changing rock carvings – changing societies? A case from arctic Norway', Adoranten, Scandinavian Society for Prehistoric Art, Tanum, pp. 5–16.

Mens E. 2002. ' L'affleurement partagé. Gestion du matériau mégalithique et chronologie de ses représentations gravées dans le Néolithique moyen armoricain', doctoral thesis, Université de Nantes, 3 vols (305, 279, 211 pp.).

Priuli A. 1984. Les gravures rupestres dans les Alpes, Glénat: Grenoble, 64 pp.

Vourc'h M. (in prep.) L'art rupestre préhistorique du nord de la Scandinavie, Eraul, 2011, Université de Liège, Liège.

Captions of figures. (Légende des figures) :

Fig. 1. Map of the Altafjord with indications of the different rock art sites and detail of the Hjemmeluft bay in Alta (modified after Helskog 1988).

(Carte du fjord d'Alta, indiquant l'emplacement des différents sites d'art rupestre et détail de la baie de Hjemmeluft à Alta.)

Fig. 2. A. Stones gathered up on the foreshore for the experimentation, hafted tool, hard and soft hammerstones ; B. Picture and stampings of preliminaries test with various types of rocks (1-10 tools) in order to choose the hammerstones for the experimentation (M. Vourc'h).

(A. Pierres ramassées sur l'estran pour l'expérimentation, outil emmanché, percuteur dur et tendre ; B. Photo et estampes des motifs piquetés en percussion directe avec différents types de pierres (outils 1-10) afin de choisir les percuteurs pour l'expérimentation. On peut voir notamment que les motifs piquetés à l'aide des outils 1, 6 et 7 sont très peu marqués à l'estampage, indiquant une faible profondeur des impacts.)

Fig. 3. Picture (A) and stamping (B) of reindeer 1, pecked by direct percussion with a coarse grained quartzite hammerstone (tool 5, 5 min. of percussion). The carving has been wet for the picture, the impact negatives being then more apparent (M. Vourc'h).

(Photo (A) et estampe (B) du renne 1, gravé par percussion directe avec un percuteur en quartzite à gros grains (outil 5, temps de percussion : 5 min.). La gravure a été mouillée pour la photo, les négatifs d'impacts étant alors plus visibles.)

Fig. 4. Picture (A) and stamping (B) of reindeer 2, pecked by direct percussion with a green stone hammerstone (tool 9, 6 min. of percussion) (M. Vourc'h).

(Photo et estampe du renne 2, gravé par percussion directe avec un percuteur en pierre verte (outil 9, temps de percussion : 6 min.).)

Fig. 5. Picture (A) and stamping (B) of reindeer 3 pecked by direct (light and strong) and indirect percussion (tool 11, time of percussion: 15 min) (M. Vourc'h).

(Photo (A) et estampe (B) du renne 3 gravé par percussion directe (forte et légère) et par percussion indirecte (outil 11, temps de percussion : 15 min.).)

Fig.6. Picture (A) and stamping (B) of reindeer 4, pecked by direct and light percussion with tool 11 and water addition (percussion time: 15 min.) (M. Vourc'h).

(Photo (A) et estampe (B) du renne 4 piqueté par percussion directe légère avec l'outil 11 et adjonction d'eau (temps de percussion : 15 min.).)

Fig. 7. Picture (A) and stamping (B) of reindeer 5, pecked by indirect percussion with hard hammerstone and tool 5 (percussion time: 12 min.) (M. Vourc'h).

(Photo (A) et estampe (B) du renne 5, gravé par percussion indirecte avec percuteur dur et outil 5 (temps de percussion : 12 min).)

Fig. 8. Picture (A) and stamping (B) of reindeer 6 pecked by indirect percussion and intermediate tool 9 (percussion time: 8 min.) (M. Vourc'h).

(Photo (A) et estampe (B) du renne 6 gravé par percussion indirecte avec percuteur dur et outil intermédiaire 9 (temps de percussion : 8 min.).)

Fig. 9. Detail stamping of mooses figures from Bergbukten 4A (M. Vourc'h).

(Estampe de figures d'élans du panneau Bergbukten 4A.)

Fig. 10. Stamping and detail of the pecked mother bear from Bergbukten 4A, showing the size difference between the flake negatives of the abdomen (6×4 mm, negative n°1) and those of the head (1,5×1 mm, negative n°2) (M. Vourc'h).

(Détail de l'estampe de l'ourse piquetée de Bergbukten 4A montrant la différence de taille des négatifs d'impact de l'abdomen (6×4 mm, négatif n° 1) et de la tête (1,5×1 mm, négatif n° 2) de l'animal gravé.)

Fig. 11. Stamping of two anthropomorphic figures from Bergbukten 4A, showing obvious pecking difference between the figure on the left (0,7 mm max. depth) and the one on the right (1, 85 mm max. depth) (M. Vourc'h).

(Estampe de deux figures anthropomorphes de Bergbukten 4A montrant des différences de percussion entre les deux figures).

Fig. 12. Stamping of the rowing boat of Apana Gård 14 (phase 5) (M. Vourc'h); the boat line formed by the flake negatives is here discontinuous. The carving clearly seems to have been made by (strong) direct percussion, probably very quickly (max. depth : 0,33 mm). The visual aspect obtained during the realisation of the figure must however have been rather divergent from the current rendering, notably with an uninterrupted line.

(Estampe du bateau à rame d'Apana Gård 14 ; la ligne est ici discontinue, les négatifs d'impact assez espacés. La gravure a probablement été réalisée très rapidement par percussion directe (forte) (prof. max. : 0,33 mm). Mais l'aspect visuel obtenu lors de la réalisation de la gravure devait très certainement être assez divergent du rendu actuel, avec notamment un tracé continu).

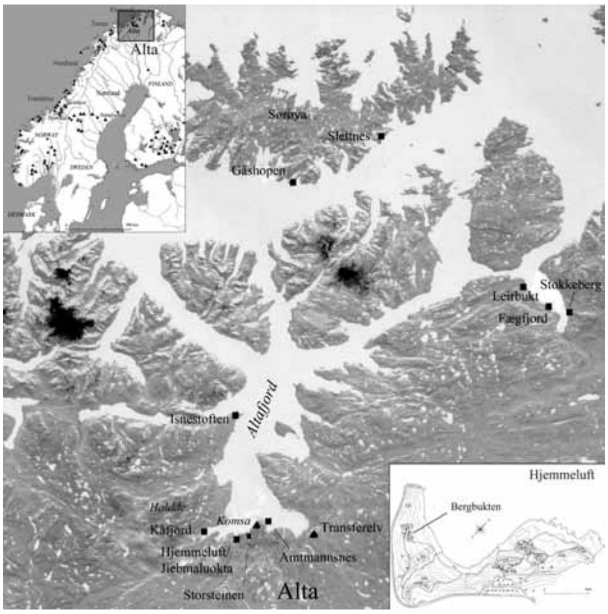

Fig. 1

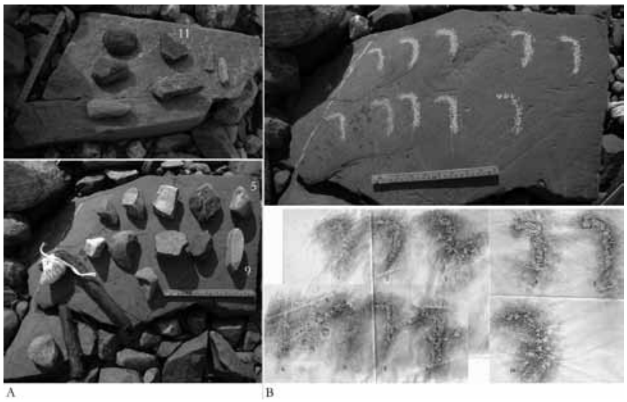

Fig. 2

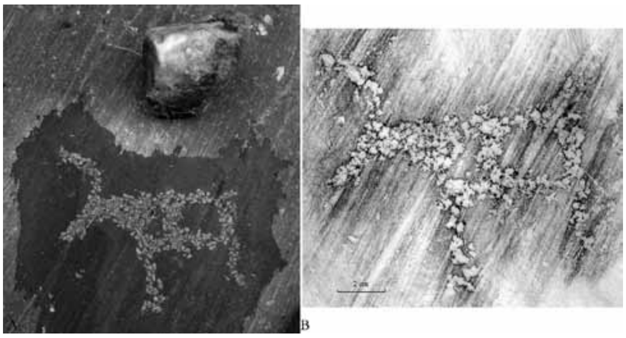

Fig. 3

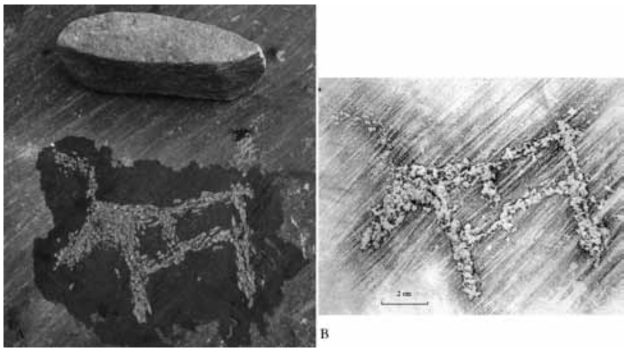

Fig. 4

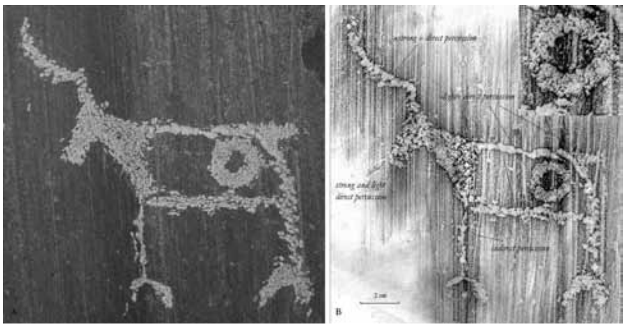

Fig. 5

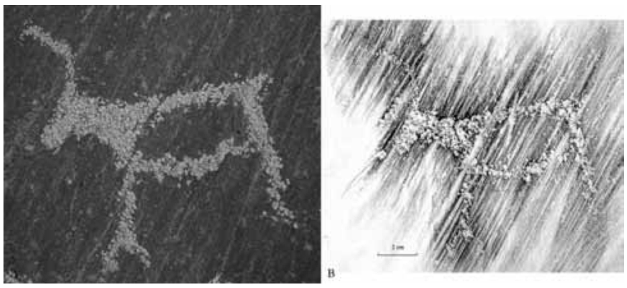

Fig. 6

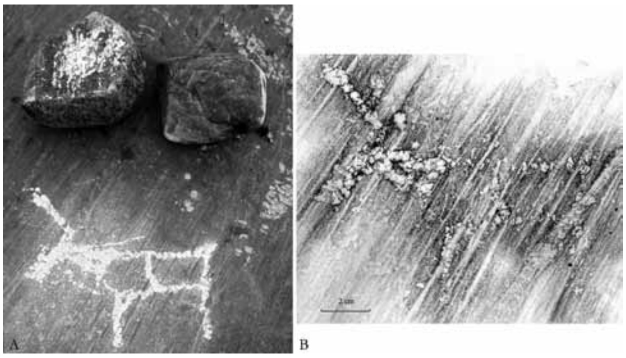

Fig. 7

Fig. 8

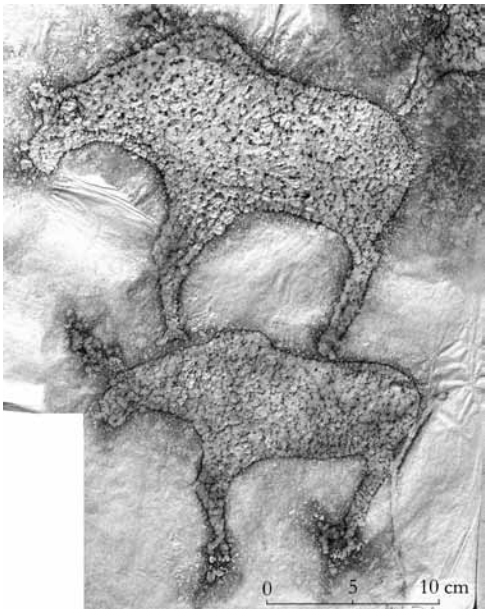

Fig. 9

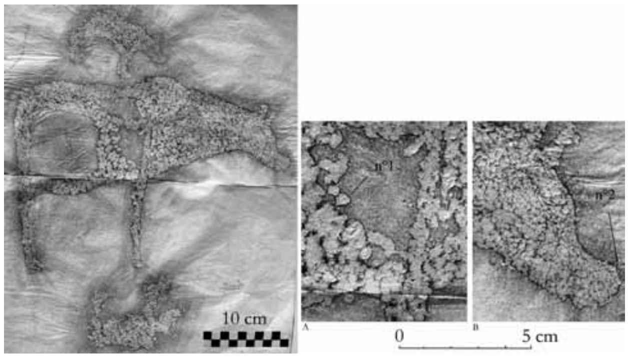

Fig. 10

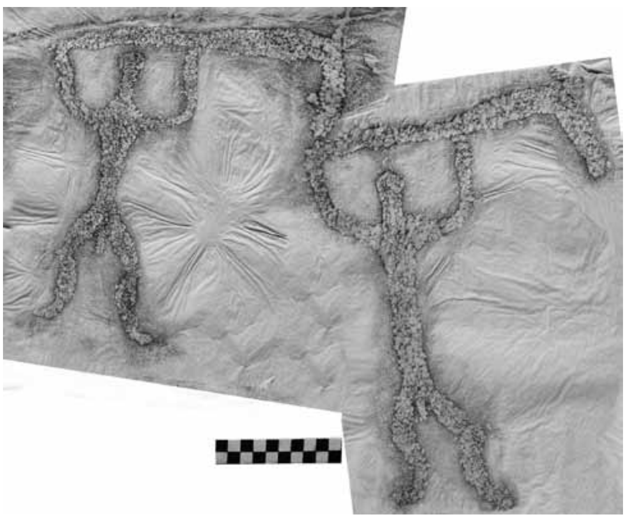

Fig. 11

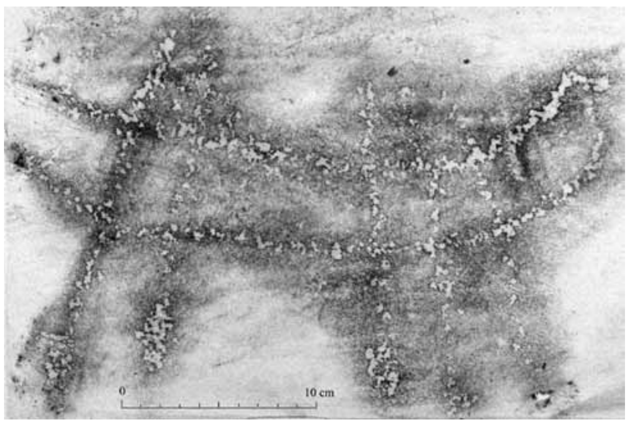

Fig. 12