3.3. A CAUTIONARY TALE

Post-depositional processes affecting Stone Age sites in boreal forests, with examples from southern Norway

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BACKGROUND

Within the E18 Arendal–Tvedestrand project 38 sites were excavated during the period 2014–2016. Most of the sites are dated, through typology and shoreline displacement studies, to different parts of the Stone Age, with a majority presumed to belong to the Early Mesolithic (see chapters 2.2.1–2.2.7, this volume). The majority of these are, due to rapid regional shore displacement (Romundset, chapter 3.2, this volume) situated on high altitudes in forested areas removed from cultivated land. The sites excavated as part of the project have therefore rightly been promoted as being of great scientific value in that the shore displacement leads to fewer sites being palimpsests, thus giving a better chronological resolution. However, since one of the project's main goals is also to discuss issues relating to the internal organization of the sites (Mjærum & Lønaas 2014: 12; *cf.* Mjærum *et al.*, chapter 1.4, this volume), and since the prevailing excavation method has been directed toward this objective (Mjærum & Lønaas 2014: 13–14), this article is to be seen as a necessary reminder of source critical factors to be kept in mind. The article will also highlight some of the more striking examples of natural formation processes encountered within the project. Since the oldest of the sites within the project are believed to exceed an age of 11,000 years, various post-depositional processes have had ample time to act on the contexts investigated.

A quick glance is sufficient to indicate that most of the sites within the project can easily be characterized as undisturbed. For archaeologists, who tend to be anthropocentric in their outlook, this for the most part means a lack of obvious human impact, especially farming, in the forested zone. It is easy to get the impression that forested, uninhabited areas are pristine environments, thus forgetting that the forest has also been a cultural landscape for a long time (*cf.* Hennius *et al.* 2005: 112). Prehistoric (or historic) use of the forest zone can leave traces of high archaeological visibility, such as coal- or tar production, which require rather large structures. The solitary hearths primarily dated to the early Iron Age, which are commonly found during Stone Age excavations, are remains with a lower visibility. More worrying is the cultural impact that we do not recognize. None of the sites excavated was covered by primeval forest (Norw.: *urskog*), but by forest that has been chopped down on a regular basis. The ways in which related tree stump removal and regrowth preparation have affected the older cultural deposits remain unknown factors.

Even at a purely hypothetical site location, where humans could be argued to have had no impact, there are still a vast plethora of processes that affect buried Stone Age deposits. This is especially true of the sites in question, since none of them is believed to have been protected by rapid sediment accumulation of either cultural or natural origin. The sites are certainly affected by various chemical processes affecting the taphonomy of perishable materials, not least evidenced by the complete absence of bone material. These issues, however, are not dealt with in the following text, which will primarily focus on processes that would affect the distribution of lithic scatters or create features, such as pits, stone concentrations etc. This is something that should be an integral part of every archaeological undertaking, but which is made especially important by observations of natural processes "mimicking" cultural features at some of the excavated sites.

POST-DEPOSITIONAL PROCESSES – AN OVERVIEW

Podsolization

Podsolization is the main soil forming process in the investigated region (Jones *et al.* 2010: 59–60). The pedological process combines slow decomposition of the organic horizon (O-horizon) with continuous leaching, transporting destabilized iron and aluminium oxides down through the soil. This results in a white, leached horizon (E-horizon), overlaying an iron-rich reddish layer (B-horizon) on top of the parent material (Goldberg & Macphail 2006: 68–69; Jones *et al.* 2010: 29, 50). The rate at which a mature podzol would form in the region is thought to involve thousands of years (Sauer *et al*. 2008; *cf*. Barrett & Schaetzl 1993), and observations of podzols have been used within the project to argue that sites are undisturbed, albeit without discussion on depth variability (cf. Barrett & Schaetzl 1993: 51). Podsolization is included here because of its propensity to obliterate cultural organic accumulations (i.e. features) in the upper part of the soil.

Frost action

Frost action is a collective term for several physical processes related to the repeated freezing and thawing of soil (Bowers *et al*. 1983), and which has great potential for the redistribution of cultural deposits, both vertically and horizontally. Frost action can occur in any soil which regularly freezes and which has moisture content, making silty soils more affected (Johnson & Hansen 1974; Bockheim & Tarnocai 1998). This has the predominant effect of pushing larger objects towards the surface, while smaller objects tend to fall back into the voids thus created, resulting in a vertical size-related sorting (Johnson & Hansen 1974). In rare circumstances, this is easily detectable by what is referred to as *patterned ground* (Hilton 2003). The lack of this, however, does not imply that frost action has not been affecting sites. As has been shown, only under very exceptional circumstances do Stone Age sites in sandy deposits have a vertical find distribution that can be said to correspond to the original living floor (Johnson & Hansen 1974; Vermeersch & Bubel 1997). In Northern Europe, characterized by regular freezing and thawing of the soil, frost heaving can be argued to have affected any open air archaeological assemblage (Johnson & Hansen 1974). Frost action has more effect on objects closer to the surface than on those buried deeper, and is also related to the morphology of the objects (Johnson & Hansen 1974; Johnson *et al*. 1977), something which on occasions has been used to explain the sorting of different material categories (pottery, bone fragments and hazelnut shells) at different levels (Sundström *et al*. 2006: 38–40). The effects of seasonal freezing cycles have also been demonstrated to have a dramatic effect on the horizontal distribution of objects, with annual average movement rates of 2.5–10 cm (Bowers *et al*. 1983; Hilton 2003), although this is naturally modified in accordance with the frequency of freezing cycles (Hilton 2003). It is also interesting to note that this sorting is not biased towards a downslope movement of objects, possibly due to direction of needle ice collapse (Bowers *et al*. 1983). Simulations of long term frost action indicate that find concentrations would become increasingly dispersed horizontally over time (Bowers *et al*. 1983), something that might also be reflected in soil geochemistry, with redistribution taking place over several centuries (Couture *et al*. 2016).

Bioturbation

There are many animals, ranging from the very small to the very large, that dwell full-time or part-time buried in soil. This means that animals play an integral role in soil formation, to which they contribute in various ways. Among the more important ways, from an archaeological perspective, is their capacity to create mounds and voids, accelerate erosion, destroy or mix soil layers, and form new layers (Hole 1981).

A major player in connection to bioturbation is the earth worm (Stein 1983), of which there are several species in Fennoscandia (Terhivuo 1988). Earth worm density varies with different factors, soil acidity and organic soil content being among the most important (Goldberg & Macphail 2006: 69; Zenkova & Rapaport 2013); earth worms prefer dung, herbage and tree leaves in deciduous forests (Stein 1983). Some species of earth worm, especially the hardy *Dendrobaena octaedra* (surface-dwelling) and *Lumbricus rubellus* (a shallow burrower), are also present in the acidic environments of the coniferous forests (Rybalov & Kamayev 2012; Terhivuo 1988). In connection with this, it naturally has to be remembered that the coniferous forests dominating the Aust-Agder region today have not been present through the entire Holocene (Romundset, chapter 3.2, this volume; *cf*. Sørensen *et al*. 2014a), and the lush forests of the Atlantic period would have been a good habitat for deep-burrowing species, such as *Lumbricus terrestris* (Terhivuo 1988). Earth worm populations can therefore also be expected to have fluctuated. Experiments indicate that the primary reason for the relative absence of *Lumbricus terrestris* in acidic soil is not related to soil properties, but rather to the isolation of forested regions from cultural landscapes (Räty 2004).

Earth worms and ants are important causes of bioturbation at our latitude, with the earth worm capable of moving between 10 and 50 tonnes of soil per hectare per year, while ants move between 1 and 5 tonnes (Wilkinson *et al*. 2009). Stein (1983) calculated that a substantial midden site could have been completely digested by earth worms in just under 50 years. Earth worms number in the hundreds per square metre (Armour-Chelu & Andrews 1994; *cf*. Hole 1981). The effect on soil formation is dependent on the particular earth worm species (Frelich *et al*. 2006), but the predominant archaeologically relevant effect of earthworm activity is to cause objects to sink below the surface (Vermeersch & Bubel 1997:126). Experiments have shown that earth worms, while dragging litter into their burrows, can cause small objects to move 20 cm vertically and 15 cm horizontally over the course of a few months (Armour-Chelu & Andrews 1994), and the effect of earth worm activity has in fact been compared to that of ploughing (Frelich *et al*. 2006). An even more serious side effect is that bioturbation, caused by both fauna and flora, tends to cause soil to move horizontally downwards (*soil creep*) (Norman *et al*. 1995; Wilkinson *et al*. 2009). Other effects include the blurring of boundaries between strata, natural and cultural soils, and the alteration of botanical assemblages and soil chemistry (Stein 1983). Most earthworm and animal activity is concentrated in the top 30 cm (Boeck 1983; Vermeersch & Bubel 1997:127), but earth worms have been observed to burrow 6 m down under certain conditions (Stein 1983). Both termites (McBrearty 1990) and ants (Crombé *et al*. 2015) have been shown not only to rearrange the soil matrix and finds within it, but also to frequently create features that can easily be mistaken for hearths/pits.

Ranging in the same soil disturbance rate as earth worms are also small soil burrowing mammals (Hole 1981; Erlandson 1984; Boeck 1986). Erlandson (1984) argues that the gophers present in North America redistribute cultural material vertically at a rate of 5 % per century, creating bimodal find distributions over an archaeologically brief time. A similar detectable stratification process, though refined by a size-sorting (that interestingly is the opposite of the sorting that results from frost action) is argued by Boeck (1986), who also claims that the horizontal displacement is much less systematic. Though gophers are not present in Northern Europe, other burrowing mammals, such as badgers, moles (albeit not in Norway), foxes, rabbits, hares, mice and otters, are.

Dogs are another (semi-cultural) source of bioturbation, and are agents creating four different kinds of pit-like features that can be mistaken for man-made (O'Connell 1987: 79; Jeske & Kuznar 2001). It is not far-fetched to suggest that the Mesolithic sites excavated within the E18-project have been visited by dogs as well as people, given that the dog is domesticated and present in North Europe by that time (Savolainen *et al*. 2002; Thalmann *et al*. 2013; Jessen *et al*. 2015). Lacking bone material, this is impossible to verify, except through identification of dog made features at the sites. If the Mesolithic people of southern Norway had dogs, and if they furthermore had generalized refuse areas (containing all kinds of waste, including edible items), there is a great risk that the find scatters encountered archaeologically would have been affected by canine behavior. Canine digging creates a back fan with material scattering up to 7 metres (Jeske & Kuznar 2001).

Among the many agents causing bioturbation, trees are undoubtedly, due to the size of their root system and their propensity to fall, one of the greatest disturbance factors. Apart from the fact that their roots continually transport soil both horizontally and vertically while growing, the effect of the tree fall/ tree throw is especially invasive on cultural deposits (Wood & Johnson 1978: 329). The result is a characteristic mound-pit feature (Wood & Johnson 1978: 328–329; Schaetzl 1990; Wilkinson *et al*. 2009), which can be visible on the surface for 2000 years (Norman *et al*. 1995: 20). The uprooting of a tree in sandy soils can affect a find distribution down to depths of -1 metre and within an area of 100–150 m^2. The frequency of tree fall varies chronologically and spatially, among other things relative to soil age, leading to older surfaces displaying a mix of weakly and well developed soils (Barrett & Schaetzl 1993: 51). This is a result of the fact that the pit feature has an increased rate of pedogenesis in relation to undisturbed soil, while the mound has a slower rate. The increase in the pit is due to a combination of greater water content, thicker organic horizons and greater insulation (Schaetzl 1990; *cf*. Nachtergale *et al*. 1997). Even though the morphology of mound-pit features and the resulting sediment transport are affected by the slope, the frequency of tree throws is not (Norman *et al*. 1995; Gallaway *et al*. 2009). Tree throw is one of the most ubiquitous post-depositional processes in many regions and is often identified during archaeological excavation. It will, however, be argued in this article that it is quite probable that many tree falls are never identified which casts considerable doubt on the validity of intra-site find distribution analyses. In the Aeolian landscapes of Western Europe, it has been calculated that one deep tree throw (-1 metre) occurs per hectare every 100 years (Vermeersch & Bubel 1997: 125). Potentially then, if the tree throws were evenly distributed, the entire area would be uprooted within the time frame of 10,000 years, virtually obliterating the vertical and horizontal patterns of cultural origin at a site predating that time frame. As stated almost 20 years ago, the large-scale impact of this process is yet to be evaluated (Vermeersch & Bubel 1997: 125). Some studies claim that nearly half the forest floor is covered by visible (i.e. comparatively recent) mound-pit features resulting from tree throw (Norman *et al*. 1995, with references).

Erosion

Many of the processes described above facilitate erosion, which is a major factor redistributing archaeological remains horizontally downwards (Rick 1976). Heavy rain can cause considerable horizontal movement of objects, especially downslope (*cf.* Gifford 1978: 93–94). Vegetation cover would help mitigate this process (Rick 1976), but when this is disrupted, for example through a tree throw, sediments and associated artefacts will start moving downwards.

CASE STUDIES – EXAMPLES OF DISTURBED SITES WITHIN THE E18 PROJECT

Case study 1: Kvastad A9 - pitfalls in pit feature genesis determination

During soil stripping at the site Kvastad A9, a feature (*Structure 1*) was uncovered, consisting of some 140 fist-sized stones, concentrated within an area of 0.7 x 1.2 m (see fig. 3.3.1). The feature was distinct against the virtually stone free sand that characterized the site. In the vicinity of the feature, flint blades of an Early Mesolithic character started to appear, which motivated a trench (14.25 m^2) to be opened up in connection with Structure 1. The excavation, in units of 50 x 50 x 10 m, revealed a small assemblage (204 finds) of Early Mesolithic blades, cores, tools and production waste, predominantly in flint (Darmark, chapter 2.2.4, this volume).

During excavation, the archaeologists noted that the soil matrix differed within the trench, ranging from loose, yellow sand, to a reddish brown, more compact and iron rich sand. Defining the borders between these was virtually impossible at upper levels, but became clearer at the bottom of the trench, at levels devoid of finds. At this stage, three pit-like features could be discerned, each of which was only partially within the trench. The pits were "surrounding" the former position of Structure 1, with one in the east (*Structure 5*), one in the south (*Structure 6*) and one in the west (*Structure 7*) (see fig. 3.3.1). It was presumed that the pits had been present at the upper levels as well, accounting for the heterogeneity experienced during excavation.

The structures were similar in appearance, in plan delimited by narrow diffuse bands of reddish-brown sand, encompassing an inner core of yellow fine sand. Patches of light grey sand, similar to the leached E-horizon of a podzol, and occasionally containing coal particles, were observed between the reddish outer perimeter and the inner core. As extrapolated from the parts visible within the trench, the structures were rounded and between 1–2 metres in diameter. The structures will be briefly described here.

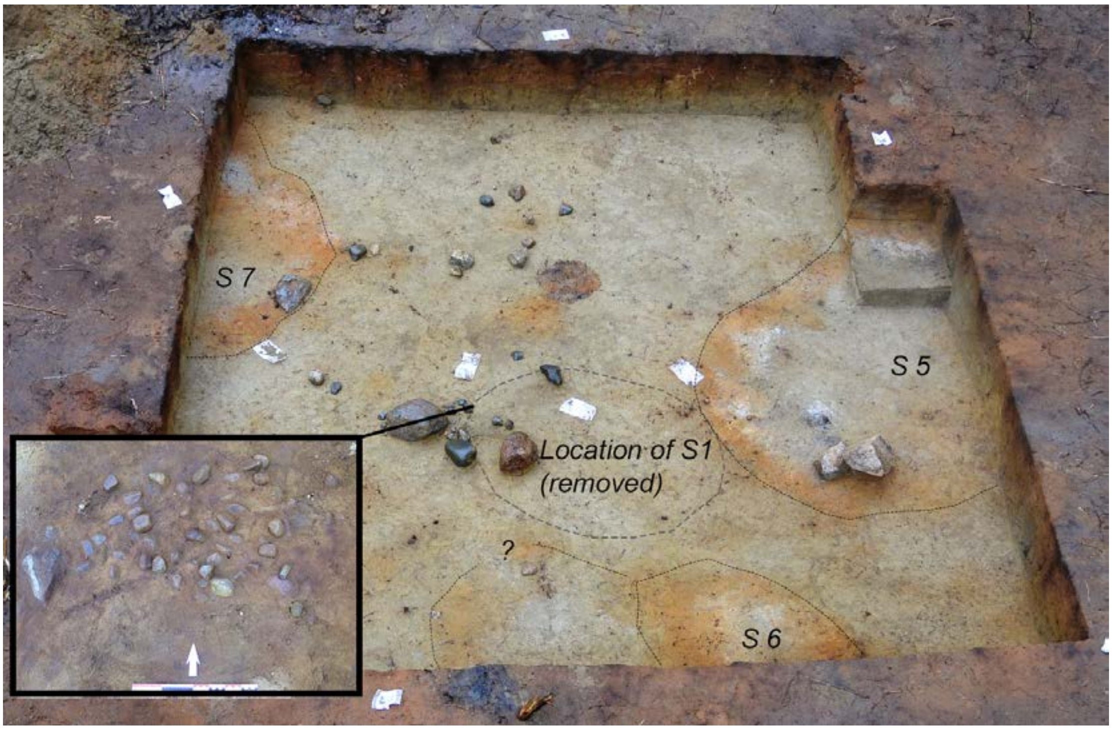

Figure 3.3.1: Kvastad A9. Plan view of the trench with Structures 5–7. The position of Structure 1 ('S1') is indicated, and a photo of Structure 1, as appearing on earlier levels, is included. Observe that the boundaries of Structures 5–7 have been highlighted. Ill.: K. Darmark / S. Viken / KHM.

Structure 5 was defined by a 20–30 cm wide band of reddish sand, separating the inner core from surrounding sand. In the western part of the feature, a patch of bleached grey sand separated the red sand from the inner yellow sand. In the southwestern part, two angular boulders were lying adjacent to each other, one of them endwise (see fig. 3.3.2). These turned out to be part one larger block, but the fitting sides were not facing each other, but were rotated in a way that gave the overall impression of deliberate structuration. In close proximity to these stones, a flint blade was found. Structure 5 was excavated contextually, and the different layers investigated separately. The youngest infill of yellow sand did not contain any finds, but in the red layer a few flints were found, among them a tanged arrowhead. The cut revealed a bowl-shaped, slightly pointed pit-like feature, with a maximum depth of 60–70 cm (see fig. 3.3.2). From the original surface level, the depth would have been close to 1 metre. At a later stage of investigation, Structure 5 turned out to be a circular feature, with a diameter of 2 metres.

Structure 6 was similar to Structure 5 in the presence of a red outer layer encircling a layer of yellow sand. However, it did not have patches of intermediate bleached sand. The structure was not investigated to the same extent as Structure 5 or 7, but the outline of the structure was judged at a later stage to be oval, and approximately 1.4 x 1.1 m. As indicated in fig. 3.3.1, it seems that the feature might continue even further to the west, as seen by patches of reddish sand. In connection to the southern perimeter of the feature, a standing stone was observed. This stone was rounded and not cracked, which was a difference in comparison to Structure 5.

Structure 7 was very similar to Structure 5 in the presence of red-brown sand, yellow sand and intermediate patches of bleached sand. Finds of flint were made within the structure (without the same contextual control as in Structure 5), and included an arrowhead. The depth and morphology of the pit was similar to Structure 5 (see fig. 3.3.2) and Structure 7 also had a larger boulder in connection to the northern perimeter. The shape of the feature was oval and the dimensions 3.4 x 1.4 m.

Early on, it was suggested, that the features displayed morphological similarities to traces of tree throws. They were of similar size, and contained a wide humic (though affected by podsolization) infill in combination with a thinner one (Langohr 1993; Dzięgielewski 2007). Certain observations merited a continued investigation of the features, however. One such was the suggested spatial relationship between Structure 1 and Structures 5–7, indicating a functional connection. The fist-sized rocks contained in structure 1 were morphologically similar to preferred boiling stones and Structures 5–7 could be argued to be remnants of boiling/food preparation pits, where either heat or deposited organic material could have contributed to the reddening of the soil (*cf.* Bokelmann 1981, 1989; Kubiak-Martens 2002; Thoms 2009; Holst 2010). Another observation in Structure 5 was that of two large angular stones in the perimeter of the structure, something that had parallels in Structures 6 and 7. The presence of arrowheads in both Structure 5 and 7 also seemed non-random and indicative of an anthropogenic structuration of the features.

It was reasoned that a presence of similar features outside the immediate vicinity of Structure 1 and the associated early Mesolithic finds would strengthen a view of the features as being of a natural origin. Therefore, the area was subjected to another soil stripping effort, with depths reaching down to the same -60/70 cm, at which Structures 5–7 first had been observed. This uncovered six more structures (8–11, 13–14) which shared morphological characteristics with the ones investigated earlier. The newly found structures were distributed all over the *c.* 200 m^2 area of deep investigation. A few of the newly found features were selected for partial excavation, treating them as if they were cultural objects. No finds were made in any of them, and the sections were by and large comparable to the ones witnessed in Structures 5 and 7. The disassociation of this type of feature from cultural artefacts in combination with their morphological similarity to known tree throws leads the excavator to believe that they are the result of floralturbation. Some unresolved questions remain, however. How did Structure 1, placed centrally between substantial tree throw pits retain its integrity? Why does it seem that the tree throws are spatially discrete, without obviously overlapping each other? Why did pits 5–7 have standing stones associated with them, in a relatively stone-free environment?

Kvastad A9 teaches us some important lessons. The first is obviously, that the remains of natural formation processes can display characteristics that are not easily dismissed as clearly natural even by a seasoned team of archaeologists. The second lesson is that tree throws can be very ubiquitous in the region, which is also believed to be a conclusion of more general relevance. The third, and maybe the most worrying lesson, is that the remains of ancient tree throws are very hard to discern, even when the potential for visibility is high. Due to podsolization, they can remain virtually invisible within the top 40–50 cm, which is considerably below the standard excavation depth for rescue archaeological excavations of Scandinavian Stone Age sites which are not superimposed by later layers (*cf*. Glørstad 2004a: 89–90; Biwall *et al*. 2007; Jaksland 2014: 24 and Sundström *et al*., chapter 1.5, this volume).

Case study 2: Sagene B2 – A hearth-pit-living floor complex debunked

Sagene B2 yielded two concentrations of finds of an Early Mesolithic affiliation, both containing numerous arrowheads of the single-edged and tanged varieties, micro burins, blades and flake axes. The southern concentration was larger and situated 1.5–2 metres above the smaller, northern one. In the northern part of the southern concentration, a cooking pit (Structure 1) with an associated scatter of fire-cracked rock was found (Structure 3), and dated to the Bronze Age (Darmark, chapter 2.2.1, this volume).

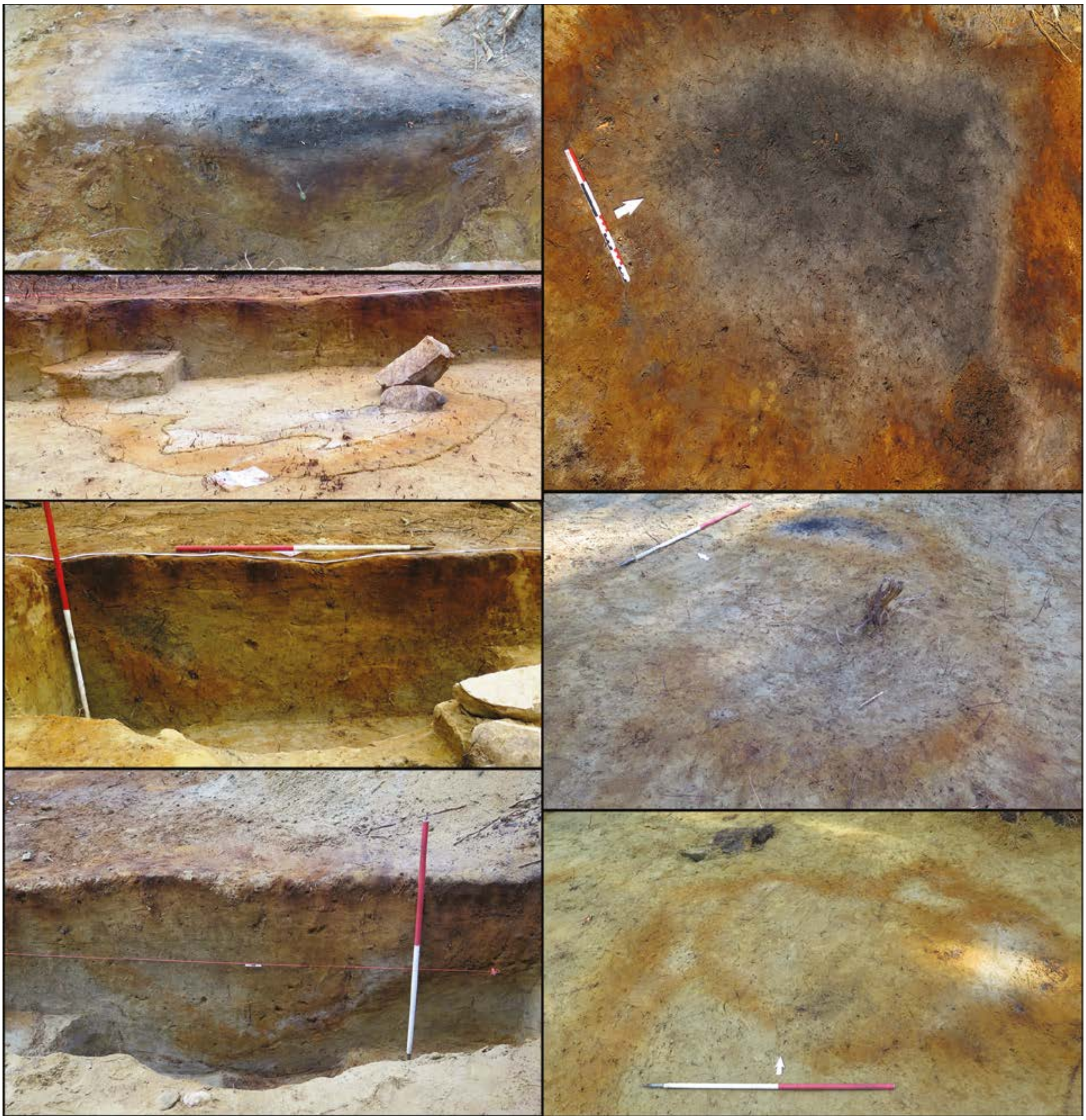

Figure 3.3.2: Kvastad A9. A selection of tree-throw structures, sectioned on the left and in plan view on the right. Top left is Structure 2, which appeared during the first soil removal at a depth of 20–30 cm. Middle left are two pictures of Structure 5, showing the section as well as the stone blocks in the perimeter. Bottom left is a section through Structure 7. Top right, Structure 2, middle right Structure 10, bottom right Structure 9, organized according to presumed age, based on the content of charcoal within the features. Ill.: K. Darmark / S. Viken / KHM.

During the investigation, several features were investigated and dismissed. At the end, only three features (Structures 1, 3 and 5) were seen as cultural in origin and of these only one, consisting of an anomaly in the distribution of finds (Structure 5), is ascribed to the Early Mesolithic presence at the site. Two more features (Structures 2 and 4) were the subject of special scrutiny during the excavation and are of special interest for this chapter (for more information on the structures at Sagene B2 see chapter 2.2.1, this volume).

After the completion of layer 1 (10 cm) in the southern area, a combination of observations generated the hypothesis of a structure complex, elongated round in shape and roughly 5 x 4 m in size (see fig. 3.3.3). The observations leading to this idea were:

- *An indicated depression as seen by remaining bleached E-horizon, sharply delimited against surrounding B-horizon.*
- *The relationship between these shifts in soil color and feature Structure 4 (hearth) and Structure 2 (pit with Early Mesolithic finds), and Structure 3, a layer of fire-cracked rock.*
- *The presence of solitary larger boulders along the edges of the suggested structure*

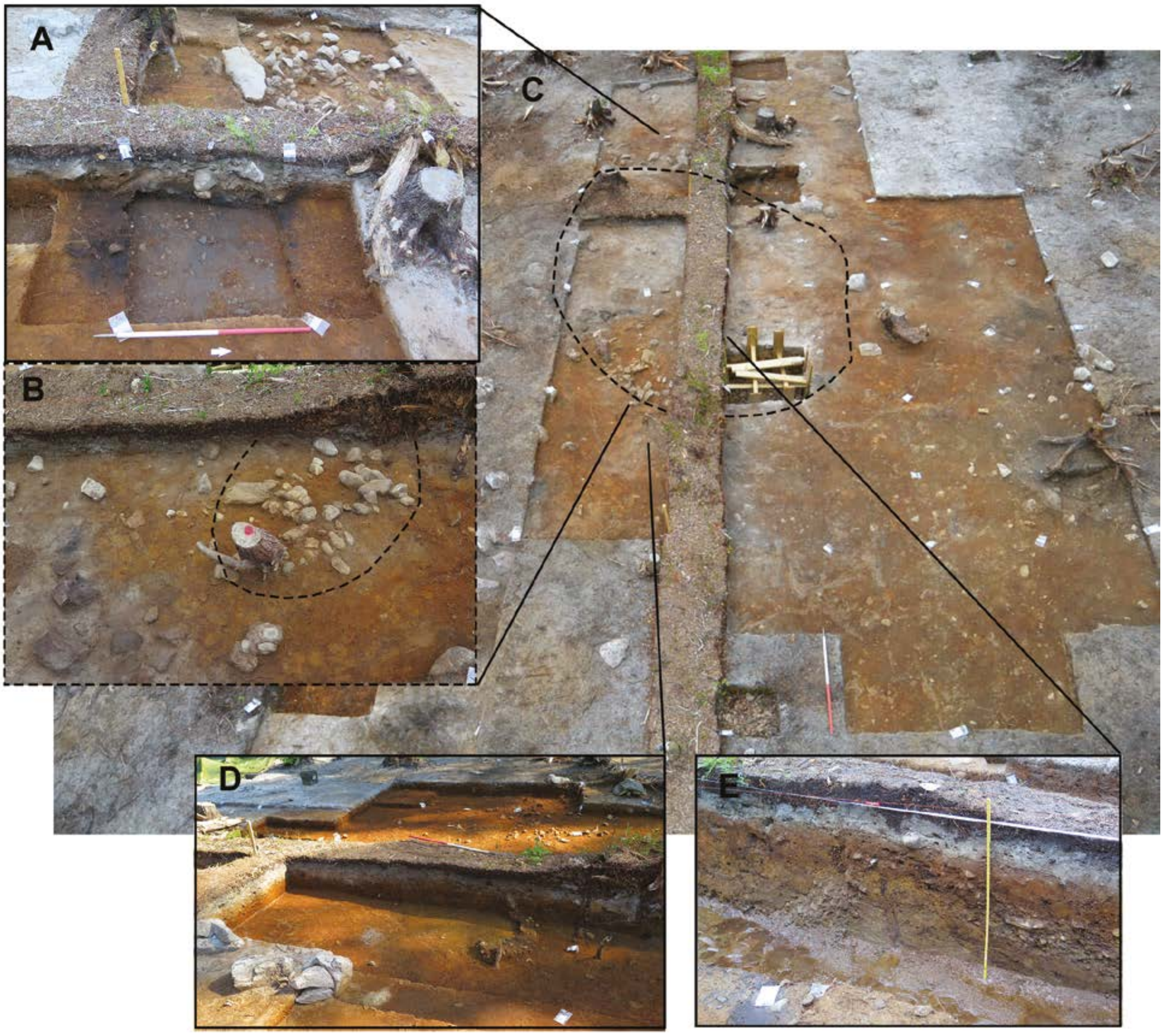

Figure 3.3.3: Sagene B2. Photographs of observations used to infer, and debunk, the existence of a "hut structure" at the site. A: The Bronze Age cooking pit in the foreground, with a fan of fire-cracked rock to the northwest. Notice the rather sharp limit with many stones north of the slab in the background, and few to the south. B: Structure 4 (A503080), presumed hearth, seen as a concentration of fire-cracked stones. C: Encircled area (possible hut structure) and locations of the discussed observations. D: Under Structure 4, a thin arch of stones was visible in the virtually stone-free sand. E: The section through Structure 2 (A501656) finally revealed the natural origin of the feature. Ill.: K. Darmark / S. Viken / KHM.

These observations were also strengthened through the distribution of arrowheads, natural stone and fire-cracked rock, all of which could be argued to relate to the suggested complex (*i.e.* surrounding them).

The presumed structure was defined by having sharp E-horizon to B-horizon boundaries to the east and the west, which in the east coincided with solitary stones, and in the west with larger, boulders. In the north, the edge of the structure was defined by a row of stones, including a large slab (see fig. 3.3.3 A). A problematic circumstance was the position of the much younger cooking pit in the north-eastern section of the structure complex, itself intimately linked to the early Mesolithic find distribution.

Two features, Structure 4 (A503080) and Structure 2 (A501656), were situated in the southern part of the described area. Structure 4 was identified during the removal of layer 1, and consisted of a conspicuous concentration of fire cracked stone, ca 1 x 0.9 m, with stones around the perimeter creating a hollow center. The feature was lying on top of a reddish-brown layer (B-horizon), which seemed to interfere with the surrounding bleached sand (E-horizon), further augmenting the structured impression. The structure, which bears many similarities to hearths found on Stone Age sites, was cross-sectioned. No pit or divergent soil coloration was associated with the fire-cracked stones, and no coal was present. A soil sample, however, yielded small coal fragments, one of which was dated to the Early Neolithic.

Structure 2 was identified already during the sampling phase of the investigation, when one of the test pits yielded finds down to -80 cm, in comparison to the normal 30 cm in other test pits. The area around the pit belonged to the most find-rich areas at the site, and the anomaly itself contained lots of finds, with a clear peak at a depth of 60 cm. The anomaly was sectioned, revealing a sand-filled pit, cutting through a deeper lying gravel layer. For a long time, the stratigraphy and find content in the pit were viewed as a cultural feature. The combination of a deep pit (cache? storage pit?), and a hearth in the inner part of a possible hut structure, indicated by the factors above (shallow depression with deeper lying E-horizon, stones in perimeter and relation to find distribution), and an external concentration of fire cracked stones (outside refuse layer), seemed to make functional sense.

However, when the section trench was enlarged to the sides, it became obvious, that the gravel layer was part of the pit (see fig. 3.3.4). This layer derived from a layer higher up in the stratigraphy, which was discovered further to the north, and had fallen down, creating a lining along the northern cut of the pit. The same cut clearly disturbed the underlying natural fine sand. A downward slanting layer of gravelly sand was detected, situated intermediate between these layers. The shape of the layer strongly resembles a root cast, which would have mixed the layers mentioned above, also including fractions from the underlying parent material. Within the pit, 4–5 different stratigraphic units were defined based on subtle differences in texture and/or color. The pit clearly had a complex history of refills, which contrasted markedly against the relatively straightforward stratigraphy north of it. It is also notable, that the pit had been rendered "invisible" by podsolization in the upper 30 cm, with the exception of the existence of slightly deeper E-horizon material remaining in its vicinity.

That the pit Structure 2 is to be seen as a natural feature, belonging to the pit-mound feature typical of

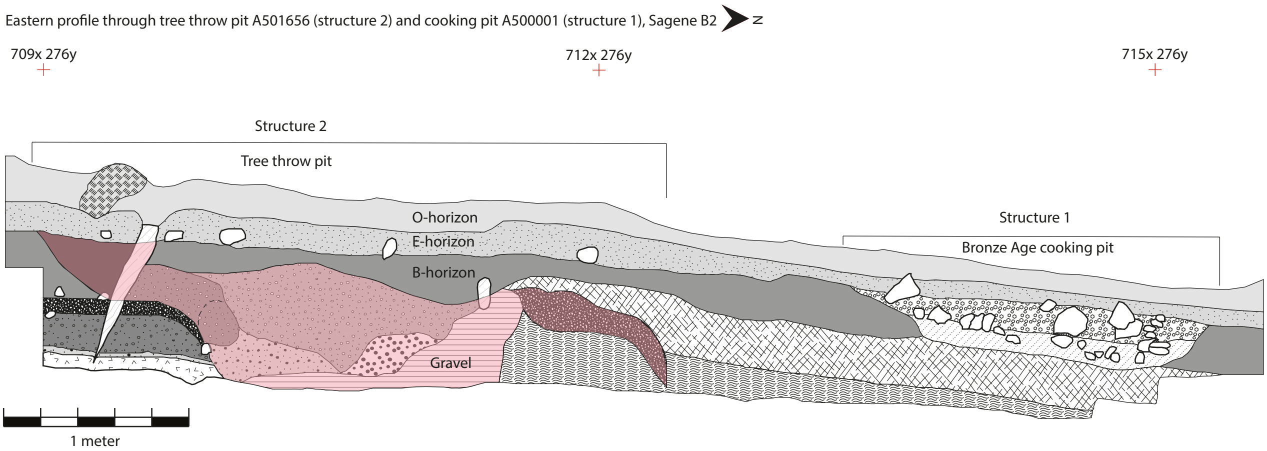

Figure 3.3.4: Sagene B2. Section drawing through Structure 2 (A501656, tree throw pit) and Structure 1 (A500001, cooking pit), showing the relatively undisturbed stratigraphy in the north in contrast to the complicated stratigraphy associated with the tree throw. Ill.: K. Darmark / KHM.

tree throws seems clear judging from the stratigraphy. The superimposition of hearth Structure 4 on top of the pit seemingly contradicts that. The solution to this enigma is either to see Structure 4 as part of the same event, *i.e.* fire-cracked stone that has accumulated in the mound section of the tree throw, or as a hearth of later date than the tree throw. It is tempting to see the fire cracked rock in Structure 4 as emanating from the Bronze Age cooking pit/refuse layer to the north, which has been laterally removed by the tree throw event. It is obvious, though, that the structure complex is related to factors not linked to the original deposition of finds during the Early Mesolithic. Most of the observations used to conjecture a "hut complex", apart from the two features discussed, can be easily explained using the tree throw model, which has created a central, relatively stone free area, a shallow depression visible through deeper lying E-horizon, and a relation to fire-cracked rock and finds.

DISCUSSION

Both case studies, Kvastad A9 and Sagene B2, illustrate how Stone Age sites have been affected by bioturbation in the form of tree throws. It has been argued, that the traces of these fossil natural events are not apparent in the top 30–50 cm, due to podsolization. It is shown, how these processes not only severely affect both vertical and horizontal find distributions, but can also create features that seem man-made. It is believed, that the features identified as tree throws at the two sites are only the most visible specimens and that there are unrecorded cases within the project. At both sites the features were identified through excavation deeper than normal and below the main find-bearing levels.

Scanning through the literature on the subject of post-depositional natural processes, though the overview is in no way exhaustive (for a more thorough overview, see Wood & Johnson 1978; Schiffer 1987), two things become clear. The first is that subject of post-depositional disturbance is linked to New Archaeology, and it is hard to find studies conducted after the mid 1980's. The second is that the picture of the processes at work is one of extreme complexity, where different factors act to sort the cultural deposits vertically and horizontally, sometimes in contradicting ways. The result is a severe blurring of discrete features, activity areas and strata. Maybe the complexity of the subject and its association with the natural sciences within a professional field which tends to reward spectacular finds/culturally stimulating interpretations rather than tedious falsification, has caused archaeology to move on. The question is, whether we are in the position to claim that we fulfill the ultimate condition that Gifford (1978: 98) stipulated necessary for it to be viable to have a focus on spatial aspects of human behavior within archaeology-that natural processes act upon the material consequences of activities conducted at the site in ways that preserve them? Or with the words of Bowers *et al*. (1983): "*Is our understanding of postdepositional process sufficient to enable us to make the quantum leap from an archaeological deposit to cultural reconstruction?*"

Within the project, some of the processes touched upon in this article have been observed. At Kvastad A1 (Stokke *et al*., chapter 2.2.5, this volume) and Kvastad A5-6 (Viken, chapter 2.2.7, this volume), it has been argued that finds have eroded horizontally downslope. At sites with stone-lined structures, interpreted as surface hearths such as at Sagene B1 and Hesthag C4 (Viken, chapters 2.2.3 and 2.3.1, this volume), it has been noted that the stones appear at 10–15 below the turf, indicating a downward transport of stones (*cf*. Glørstad 2004a: 89–90). This could possibly be accounted for with reference to for example effects of bioturbation. At Kvastad A7 (Darmark 2017a) and Kvastad A8 (Darmark 2017b), knapped stone was found scattered in very undistinct patterns, where it is difficult to imagine the cultural formation process behind the distribution and instead seem to conform to a view of continuous horizontal dispersal of finds. This is the pattern expected, if the blurring effect of many agents over thousands of years has been effective. At the same time, it is obvious, that several sites seem to have discrete find clusters, sometimes connected to structures. The issue with these, it is argued, is that it has to be explained how they are so well preserved. There are factors that could contribute to a better preservation. One is roof collapse (Hilton 2003; *cf*. Schiffer 1983: 691–692). If the finds have accumulated within a standing structure that has collapsed after abandonment, this creates a protective layer over the finds. Trampling (Gifford-Gonzalez *et al*. 1985; Vermeersch & Bubel 1997: 125) is a process that can rather rapidly compact an area and create a protective layer for the embedded artefacts, even though it simultaneously destroys them in part, and also affect their vertical and horizontal distribution. Both processes, and probably others, could be invoked to explain the relative integrity of certain find concentrations, but at the same time have other interpretative implications. Or maybe we are dealing with "false concentrations"? If finds move around in the matrix more or less "randomly", is it possible that there are microtopographical features that would work as find traps/collector nodes? The tree throw pit at Sagene B2 could certainly be a candidate for such, but it is conceivable that other kinds of natural and man-made features work in a similar way. It is suggested, that these misgivings should be addressed by shifts in standard methodology combined with efforts within large scale projects targeted at studying the effect of the processes behind the creation of Stone Age find distribution. What such methodological changes would include is a matter for a separate undertaking, but should at the minimal level entail stratigraphic studies below the podzol-horizon.