Final response and future directions

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It is rare for authors to be able to read comments on their paper by leading colleagues and to have the chance to respond before its publication. We would like to thank the editor of *Antiquity* for providing this opportunity. The comments express both acceptance of, and doubts about, interconnectedness between the eastern Mediterranean and Scandinavia in the Bronze Age. Kaul's comments demonstrate a deep insight into how Nordic archaeology reveals this interconnectedness; that is clearly expressed in his latest publication on the topic in *Antiquity* (Kaul 2013). Moreover, both Kaul and Sognnes, who accept these interconnections, have an excellent understanding of Scandinavian Bronze Age rock art. In fact, most of the reviewers' comments express a positive attitude to the interpretation of the rock art images as possible representations of oxhide ingots.

Harding, on the other hand, has serious doubts about these connections. His general view on Bronze Age Scandinavian rock art (its repertoire of motifs, scale and quantity) however, does not allow for the complexity of the material. One of the present authors (Ling) has studied the generic frequency of images in rock art and has suggested chronologies based on ships (Ling 2008, 2013). While it is, of course, very important to recognise generic frequency in the material, this does not mean that material that occurs infrequently is irrelevant, as Harding seems to suggest. If we applied the same premise to the study of grave goods it would mean, for example, that if the normal repertoire of finds in Scandinavian Bronze Age graves were to consist only of swords and metal jewellery, then we must disregard glass beads and even Baltic amber when it appears, because they are infrequent and therefore outside the usual repertoire of grave goods. Scandinavian rock art is an important source material and some sites include over 200 figurative images; even if these are dominated by a few generic categories they also include unique images that we have not yet been able to interpret (see Coles 2000, 2005; Ling 2008, 2013). Moreover, the Baden-Württemberg oxhide ingot fragment that Harding observes is missing from the paper appears in the map in Figure 1 (above) rather than in the text.

We agree that one should be cautious when interpreting the meaning of motifs represented in rock art, but the resemblance to oxhide ingots of the images described in our paper is compelling; in fact, the Torsbo example shown in Figures 6 and 8 (above), was identified by a group of international researchers with a practical knowledge of copper oxhide ingots (Shelley Wachsmann, Fulvia Lo Schiavo and Alfredo Mederos, in addition to one of the present authors). Moreover, it would be quite a coincidence for these images to occur on

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the same rock panels as Bronze Age ships that can be dated to the same period as the ingots; one such image is represented on board a fourteenth century BC ship.

In terms of the interconnectedness of the eastern Mediterranean and Scandinavia during the relevant period, 1600–1500 BC, we agree with Brandherm and Kaul that crossing Continental Europe perhaps remains the most likely alternative, and we have indicated this on the map (Figure 1 above). The strong similarities between Carpathian and Scandinavian metalwork favour the hypothesis that the four Scandinavian copper alloys that match Cypriot ores from this phase (Table 1 above) were derived from Cypriot copper that was transported via the Danube to the Carpathian 'hot spot' and then onwards to the Nordic sphere. Or as Vandkilde puts it: "[t]he Carpathian Basin was a formidable cultural crucible sustained by the intersection of a number of networks which stemmed from Central and Northern Europe, the Aegean and the Pontic-Caspian Steppes" (Vandkilde 2014: 617). In our next research project, therefore, we are planning to test this hypothesis by analysing copper alloys from archaeological sites in Romania, Hungary and Slovakia which are dated to this period.

Knapp's comments indicate that, with reservations, he would be willing to believe that oxhide ingots were represented on rocks in Sweden. He questions, however, whether lead isotope analyses can be reliable indicators of the origin of metal. We do not claim that the consistency of lead isotope ratios found in a piece of metal to the ratios found in ores from a deposit alone prove that it originated in this deposit. There are many other conditions that need to be fulfilled to make such a claim (see Ling *et al.* 2014). It is true that the best use of lead isotope composition is 'exclusion' of an ore source, but it would be a scientific mistake not to attempt to suggest which of the known deposits might be sources of this metal. So even if it were true that ores from eastern Turkey have the same lead isotope composition as ores from the British Isles (as suggested by Knapp), one would be inclined to believe that artefacts with such compositions, if frequently found in Britain, originated from British, not Turkish ores. Pernicka emphasises this difficulty, but he also cites lead isotopes in interpreting the origin of metals (e.g. Pernicka 2010).

Hitherto, the evidence of interconnectedness, mobility and long-distance interactions between north and south in the Bronze Age have been based mostly on similarities in forms, decorations and designs. Many interesting proposals have been made. However, new scientific methods, including characterisation of archaeological amber using Fourier transform infrared spectrometry, lead isotope and chemical analyses of copper alloys, chemical analyses of glass beads, strontium and oxygen isotope analyses of skeletal remains, and aDNA analysis, challenge old ideas of mobility and interaction and clearly show that archaeologists in the past have underestimated long-distance connections in Bronze Age Europe. Today, therefore, we rely not only on parallels in form or decoration, but also the chemistry of the materials, which can give us a more complete picture of the flow of goods in the Bronze Age.

Our aim was to document the possibility of interconnections between the eastern Mediterranean and Scandinavia in the Bronze Age in terms of chemical and lead isotope compositions of bronzes and possible representations of oxhide ingots in Scandinavian rock art. Of course, much more research will be needed to be able to understand how such connections were organised and, as Brandherm stresses, much more material has to be interrogated. The article is a small component of a current research project and in the

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next few years we hope to have more results that can confirm, modify or disprove current paradigms relating to the metal trade in Northern Europe in the second millennium BC.

References

COLES, J.M. in association with B. GRÄSLUND. 2000. *Patterns in a rocky land: rock carvings in south-west Uppland, Sweden. Volume 1*. Uppsala: Department of Archaeology and Ancient History, Uppsala University.

COLES, J.M. 2005. *Shadows of a northern past: rock carvings of Bohuslän and Østfold*. Oxford: Oxbow.

KAUL, F. 2013. The Nordic razor and the Mycenaean lifestyle. *Antiquity* 87: 461–72.

LING, J. 2008. *Elevated rock art—towards a maritime understanding of Bronze Age rock art in northern Bohuslän, Sweden* (Gotarc Serie B; Gothenburg Archaeological Thesis 49). Gothenburg: Institutionen för Arkeologi.

– 2013. *Rock art and seascapes in Uppland*. Oxford: Oxbow.

LING, J., Z.A. STOS-GALE, L. GRANDIN, K. BILLSTRÖM, E. HJÄRTHNER-HOLDAR & P.-O. PERSSON. 2014. Moving metals II: provenancing Scandinavian Bronze Age artefacts by lead isotope and elemental analyses. *Journal of Archaeological Science* 41: 106–32. http://dx.doi.org/10.1016/j.jas.2013.07.018

PERNICKA, E. 2010. Archäometallurgische Untersuchungen am und zum Hortfund von Nebra, in H. Meller & F. Bertemes (ed.) *Der Griff nach den Sternen. Wie Europas Eliten zu Macht und Reichtum kamen, Internationales Symposium in Halle (Saale) 16–21. Februar 2005* (Tagungen des Landesmuseums für Vorgeschichte Halle Band 05/II): 719–34. Halle (Saale): Landesmuseums für Vorgeschichte Halle.

VANDKILDE, H. 2014. Breakthrough of the Nordic Bronze Age: transcultural warriorhood and a Carpathian crossroad in the sixteenth century BC. *European Journal of Archaeology* 17: 602–33. http://dx.doi.org/10.1179/1461957114Y.0000000064

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