Response to Nowell and Horstwood (2009)

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ABSTRACT

Here we respond to the comment by Nowell and Horstwood (2009) written in response to our 2008 paper where we presented the first results of the application of laser ablation strontium isotope analysis to a fossil hominin. Although we are pleased that the paper has attracted so much interest, including from researchers outside the field such as Nowell and Horstwood, we completely disagree with the two main arguments of their comment. Namely, we reject the notion that they can recalibrate our data using different methods and (non matrix-matched) standards determined in a different laboratory, and that is simply irresponsible to advocate the further development of this method for rare and important hominin samples through drilling rather than the almost non-destructive method of laser ablation that we presented in our paper.

We thank the authors for their interest in our paper, and their comprehensive treatment of our data, as well as their detailed arguments about the merits of laser ablation vs. drilling hominin teeth for analyses such as these. We are pleased that researchers from other disciplines are engaging with our data. We are also encouraged that Nowell and Horstwood are not arguing against the validity of our, or any, laser ablation strontium data on fossil teeth, but instead simply disagree with us on the method of calibrating, or correcting, the values to make them comparable to solution values. We argue below that the calibration we used, and indeed currently use now, is the more valid calibration method as it uses matrix-matched standards, namely tooth enamel, and not the poorly matched geological standards such as apatites that Nowell and Horstwood use. We also disagree with their arguments that micro-drilling of hominin teeth should be the only way forward with this area of research. While we agree that micro-drilling has the potential to provide strontium isotopic data from geologic samples free of the potential pitfalls associated with laser ablation analyses (Vroon et al., 2008), it is still a highly specialized and technically difficult technique that has yet to be applied, and therefore is far from being ‘the most appropriate method for the Sr isotopic analysis of rare and important hominid [sic] fossils’ (Nowell and Horstwood, 2009).

The main argument that Nowell and Horstwood make for the need to recalibrate our data is that when they attempt to undertake laser ablation strontium analysis they have quite a large offset between their laser ablation and solution values. We, in a recent paper, carefully examined this using a suite of rodent teeth which we measured in two laboratories (Leipzig and Cape Town) and found we had much less of an offset and that our methods of laser ablation produce accurate results (Copeland et al., 2008). The difference in results is likely to be the choice of standards used, as we have argued that it is necessary to matrix match the standards to the sample, especially in the case of biological materials such as dental enamel. Nowell and Horstwood instead use non-analogous geological apatite samples, which is a common mistake made when working with isotopic analysis of biological archaeological materials such as bone and teeth (bioapatite is not the same as apatite!).

In our laboratory we now use three enamel samples with known (i.e. determined through solution MC-ICP-MS and TIMS measurements) strontium concentration and isotope ratios. Indeed this move from one or two enamel standards to three is largely based on a recent paper by one of the authors (Horstwood et al., 2008). In routinely measuring three enamel standards at the same time as we measure our unknown sample we have found that the correction we need to make to our measurements is actually quite small, as reported in Copeland et al. (2008), and indeed very similar to the correction we made using the two teeth as we originally reported in our paper. It is also worth pointing out the rather absurd notion that...
Nowell and Horstwood can, without the original data, retroactively re-calculate our results using calibration factors derived from their studies in their laboratories, based on poorly matched reference samples, is incongruous with their argument against our data. Therefore, we see no reason whatsoever to change the results reported in our original paper, and stand by them as published.

The main goal of our paper was to demonstrate the advantages of laser ablation strontium for precious, and rare hominin fossils, where drilling teeth is simply not possible (Note: we only measured a ‘single’ Neanderthal tooth from the site – as it is, so far, the only published Neanderthal tooth from Greece!). Of course we realise the advantages of traditional drilling and solution chemistry methods, and indeed use these methods routinely in our laboratory for Holocene materials. However, it is simply not possible to use these methods on rare fossils, which is clearly something that the authors of this response have no experience with. Indeed, we feel it is irresponsible to damage rare and irreplaceable teeth through the use of an unproven technique (i.e. micro-drilling) when there is a much less destructive method of laser ablation. We agree that the accuracy and precision of the laser ablation method is lower than that of the more destructive solution methods, but believe that this is the only way to proceed with this analysis to preserve these fossils for future researchers. We are continuously working on refining our methods, and are confident that laser ablation methods will continue to improve and will one day match the level of solution methods.

So, although we are pleased in the interest that Nowell and Horstwood have shown in our research, we are disappointed with the polemic tone of the paper, which largely seems to be a platform for arguing the merits of TIMS vs. laser ablation strontium analysis of dental enamel. Therefore, although it is important to debate the merits of this relatively new method in this journal, and to discuss the appropriate methods of presenting and calibrating the resulting data, we completely disagree with the recalculation of our original data and stand by our original results, and the use of relatively non-destructive laser ablation methods to explore hominin mobility and movements.

References


