**SUPPLEMENTAL APPENDIX 1**

Initially, CIO results were often significantly younger than results from RICH and KIA, and inconsistent with the expected chronology of the Aarupgaard cemetery. Results from RICH and KIA were in good agreement with each other, and with the expected chronology, thus an anomaly was suspected in the CIO dating process, leading to offsets of 100-300 years. The anomaly was apparently unrelated to AMS measurement, as it occurred in measurements performed on both the previous HVEE AMS and the present Micadas system. Through laboratory testing at CIO and KIA, the source of the anomaly was identified as a contaminated batch of ‘Sulfix’ used in the period April 2017 - March 2018. The CIO laboratory protocol was updated following the test results, as described below.

**‘Sulfix’ contamination in CIO laboratory (April 2017 -March 2018)**

To test if differences in chemical pretreatment of CB could be responsible for the 14C age anomalies, where CIO results were often significantly younger than results from RICH and KIA, CB pretreated by KIA was sent to CIO, converted to CO2 and measured. Likewise, pretreated CB from CIO was converted to CO2 and measured at KIA. KIA results on CIO extracts fitted the high chronology indicated by results from samples extracted and dated at RICH and KIA, and were therefore older than CIO results on the same extracts, whereas CIO results on KIA extracts were younger than those previously obtained by KIA. It was therefore concluded that the anomaly was unrelated to differences in pretreatment.

Given that satisfactory results were obtained on organic standards, only CB samples appear to have been affected and the anomaly had to be related to the applied CB-method by the CIO lab.

Next, focus was put on development of CO2, as the carbon yield at CIO was only a third of that at KIA, regardless of where the samples were pretreated, due to the lower reaction temperature and probably also because of the use of H3PO4 solution with a high density; differences in carbon yield could have been associated with fractionation. Increasing CIO CO2 yields by increasing the reaction temperature did however not solve the 14C age anomalies.

While these tests were carried out at CIO, a relationship between the amount of CO2 developed and the 14C age anomaly became apparent; the lower the CO2 amount, the larger the anomaly. Younger carbon was added somewhere in the process, possibly when removing sulfur compounds. CIO has for a long time used ‘Sulfix’ (Waco, Japan), which consists of small grains composed of a mixture of Co3O4 (catalyst) and Ag2O. To test for a contamination from ‘Sulfix’, 14C-free CO2 was treated in the same way with ‘Sulfix’ as CO2 from CB samples, and measured by AMS. The results showed enhanced levels of 14C, demonstrating that the often younger CIO dates on CB since April 2017 were due to a (probably modern carbon) contamination of the ‘Sulfix’. As in April 2017 a new batch of Sulfix material (different lot number compared to the years before) was used, it might be that the contamination is related to this change. This will be further investigated.

For practical reasons CIO wishes to continue using ‘Sulfix’ and it was therefore investigated how to remove the contamination. Because the 14C level measured in the 14C-free-CO2 samples depended on the number of Sulfix grains used, it was decided to reduce the number of ‘Sulfix’ grains. Prior to use, the ‘Sulfix’ is heated in pure O2 (c.3 hr, 200°C) to oxidise any carbon. The gas is then evacuated and replaced by the sample CO2 which is again heated (min. 12 hr, 200°C) to allow sulfur compounds to react with the ‘Sulfix’. Results of this procedure for 14C-free background samples (GS-35; marble) indicate that the new ‘Sulfix’ purification method is successful at removing contamination. The same procedure was carried out for the unknown samples and results were consistent with expectations and measurements by the other laboratories.

CIO now verifies dating results by measuring reference material, replicate measurements and by measuring background material including the ‘Sulfix’ step. This case of CO2 contamination stresses the need for a full quality assurance strategy in all applied methods employed at AMS laboratories.