

GSA Data Repository item 2004##**Appendix DR1****Varve counting protocol**

The outcrop was sampled using overlapping aluminium boxes. Tectonic activity has damaged the varves (up to a few centimetres) in some parts of the section (~20.8, 22.2, 24, 25.2, 26.2 cal. ka). Polished, and thin sections were prepared for the ~8.7m thick Massada section. All polished samples were photographed under reflected light (4 times magnification) revealing dark and light bands. However, the establishment of a clear winter (clastic) and overlying summer (aragonite) sequence is essential for accepting a dark and light couplet as a varve. This was done with detailed microscope examination of the thin sections. Each sub-lamina was (i) identified under the microscope as well as in the photograph, (ii) had its mineralogy studied to classify it as a clastic (winter) or aragonite (summer) deposit. The lateral extent and relationship with overlying and underlying sub-laminae was noted in every case to rule out spurious layers. Since sub-laminae were counted in both the photos and under the microscope, the entire section was counted twice. Damaged varves were identified and counted using a combination of detailed field photos and microscope observations. This enabled us to determine the length of the gaps but individual thickness measurements were not possible due to deformation of the varves. In order to overcome the problem of damaged varves, bins, rather than a running mean, have been used. To check the reproducibility of the approach, nearly a third of the samples (randomly selected) were rechecked under a microscope after a gap of several months and yielded a difference of <2%. However, repeat counting of selected damaged sections yielded higher errors of ~5%. In the time period under consideration (ca. 26.2-17.7 cal. ka) the estimated errors in the GISP2 core are ~2% (Meese et al., 1997).

Meese, D.A., Gow, A.J., Alley, R.B., Zielinski, G.A., Grootes, P.M., Ram, M., Taylor, K.C., Mayewski, P.A. and Bolzon, J.F., 1997, The Greenland Ice Sheet Project 2 depth-age scale: methods and results: *Journal of Geophysical Research*, v. C102, p. 26411-26423.