**Calibration of multiple tree-ring blocks and its implication on the debate of Minoan Eruption of Santorini around 17th-16th century BCE**

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**Supplementary Material:**

**Table S1**: Details of the Moving Average (MA) curve used in this study

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **Name of the MA curves** | **Number of years averaged** |
| 1. | 13\_year\_running\_average | 13 |
| 2. | 16\_year\_running\_average | 16 |
| 3. | 22\_year\_running\_average | 22 |
| 4. | 24\_year\_running\_average | 24 |
| 5. | 27\_year\_running\_average | 27 |
| 6. | 30\_year\_running\_average | 30 |

**Table S2:** OxCal script and output of two models used for benchmarking moving average calibration method

|  |  |
| --- | --- |
| **Moving average curve** | **Output** |
| **1. Ring count accurate**Plot() { D\_Sequence() { Curve("", "13\_year\_running\_average"); R\_Date("Sample-A", 3383, 11); Gap(24, 0); Curve("", "24\_year\_running\_average"); R\_Date("Sample-B", 3381, 11); Gap(22, 0); Curve("", "22\_year\_running\_average"); R\_Date("Sample-C", 3370, 14); Gap(13, 0); Curve("", "13\_year\_running\_average"); R\_Date("Sample-D", 3320, 21); }; }; |  |
| **2. Considering only sequence**Plot() { Sequence() { Boundary("S"); Curve("", "13\_year\_running\_average"); R\_Date("Sample-A", 3383, 11); Curve("", "24\_year\_running\_average"); R\_Date("Sample-B", 3381, 11); Curve("", "22\_year\_running\_average"); R\_Date("Sample-C", 3370, 14); Curve("", "13\_year\_running\_average"); R\_Date("Sample-D", 3320, 21); Boundary("E"); }; }; |  |

**Table S3:** OxCal script of four models described in Table 1 for calibration of olive branch radiocarbon ages (Friedrich et al., 2006)

|  |  |  |
| --- | --- | --- |
| **IntCal13** | **IntCal20** | **Moving average curve** |
| **1. Ring count accurate**Plot() { Curve("IntCal13"); D\_Sequence() { R\_Date("Hd-23599-24426 1-13", 3383, 11); Gap(18.5); R\_Date("Hd-23587 14-37", 3372, 12); Gap(23); R\_Date("Hd-23589 38-59", 3349, 12); Gap(17.5); R\_Date("Hd-23588-24402 60-72", 3331, 10); Gap(6.5, 0); Last("outermost ring"); }; }; | **1. Ring count accurate**Plot() { D\_Sequence() { R\_Date("Hd-23599-24426 1-13", 3383, 11); Gap(18.5); R\_Date("Hd-23587 14-37", 3372, 12); Gap(23); R\_Date("Hd-23589 38-59", 3349, 12); Gap(17.5); R\_Date("Hd-23588-24402 60-72", 3331, 10); Gap(6.5, 0); Last("outermost ring"); }; }; | **1. Ring count accurate**Plot() { D\_Sequence() { Curve("", "13\_year\_running\_average"); R\_Date("Hd-23599-24426", 3383, 11); Gap(24, 0); Curve("", "24\_year\_running\_average"); R\_Date("Hd-23587", 3372, 12); Gap(22, 0); Curve("", "22\_year\_running\_average"); R\_Date("Hd-23589", 3349, 12); Gap(13, 0); Curve("", "13\_year\_running\_average"); R\_Date("Hd-23588-24402", 3331, 10); }; }; |
| **2. Ring count is increased by 25%, and gap uncertainty set to 25% of section count**Plot() { Curve("IntCal13"); V\_Sequence() { R\_Date("Hd-23599-24426 1-13", 3383, 11); Gap(23,6); R\_Date("Hd-23587 14-37", 3372, 12); Gap(29,7); R\_Date("Hd-23589 38-59", 3349, 12); Gap(22,5); R\_Date("Hd-23588-24402 60-72", 3331, 10); }; }; | **2. Ring count is increased by 25%, and gap uncertainty set to 25% of section count**Plot() { V\_Sequence() { R\_Date("Hd-23599-24426 1-13", 3383, 11); Gap(23,6); R\_Date("Hd-23587 14-37", 3372, 12); Gap(29,7); R\_Date("Hd-23589 38-59", 3349, 12); Gap(22,5); R\_Date("Hd-23588-24402 60-72", 3331, 10); }; }; | **2. Ring count is increased by 25%, and gap uncertainty set to 25% of section count**Options(){Resolution=4;};Plot() { V\_Sequence() { Curve("", "16\_year\_running\_average"); R\_Date("Hd-23599-24426", 3383, 11); Gap(30,7); Curve("", "30\_year\_running\_average"); R\_Date("Hd-23587", 3372, 12); Gap(27,7); Curve("", "27\_year\_running\_average"); R\_Date("Hd-23589", 3349, 12); Gap(16,4); Curve("", "16\_year\_running\_average"); R\_Date("Hd-23588-24402", 3331, 10); }; }; |
| **3. Considering only sequence**Plot() { Curve("IntCal13"); Sequence() { Boundary("S"); R\_Date("innermost section",3383,11); R\_Date("second section",3372,12); R\_Date("third section",3349,12); R\_Date("outermost section",3331,10); Boundary("E"); }; }; | **3. Considering only sequence**Plot() { Sequence() { Boundary("S"); R\_Date("innermost section",3383,11); R\_Date("second section",3372,12); R\_Date("third section",3349,12); R\_Date("outermost section",3331,10); Boundary("E"); }; }; | **3. Considering only sequence**Plot() { Sequence() { Boundary("S"); Curve("", "13\_year\_running\_average"); R\_Date("Hd-23599-24426", 3383, 11); Curve("", "24\_year\_running\_average"); R\_Date("Hd-23587", 3372, 12); Curve("", "22\_year\_running\_average"); R\_Date("Hd-23589", 3349, 12); Curve("", "13\_year\_running\_average"); R\_Date("Hd-23588-24402", 3331, 10); Boundary("E"); }; }; |
| **4. Considering only sequence (with 8 year offset as per Manning et al 2020)**Plot() { Curve("IntCal13"); Delta\_R("8 14C year offset test",8,0); Sequence("Friedrich et al. 2006 Olive as Sequence Only") { Boundary("Start"); Sequence() { R\_Date( "Hd-23599-24426 'rings' 1-13", 3383, 11); R\_Date( "Hd-23587 'rings' 14-37", 3372, 12); R\_Date( "Hd-23589 'rings' 38-59", 3349, 12); R\_Date( "Hd-23588-24402 'rings' 60-72", 3331, 10); }; Boundary("End"); }; }; | **4. Considering only sequence (with 8 year offset as per Manning et al 2020)**Plot( ) { Delta\_R("8 14C year offset test",8,0); Sequence("Friedrich et al. 2006 Olive as Sequence Only") { Boundary("Start"); Sequence() { R\_Date( "Hd-23599-24426 'rings' 1-13", 3383, 11); R\_Date( "Hd-23587 'rings' 14-37", 3372, 12); R\_Date( "Hd-23589 'rings' 38-59", 3349, 12); R\_Date( "Hd-23588-24402 'rings' 60-72", 3331, 10); }; Boundary("End"); }; }; | **4. Considering only sequence (with 8 year offset as per Manning et al 2020)**Plot( ) { Sequence() { Boundary("Start"); Curve("", "13\_year\_running\_average"); Delta\_R("a",8,0); R\_Date( "Hd-23599-24426 'rings' 1-13", 3383, 11); Curve("", "24\_year\_running\_average"); Delta\_R("b",8,0); R\_Date( "Hd-23587 'rings' 14-37", 3372, 12); Curve("", "22\_year\_running\_average"); Delta\_R("c",8,0); R\_Date( "Hd-23589 'rings' 38-59", 3349, 12); Curve("", "13\_year\_running\_average"); Delta\_R("d",8,0); R\_Date( "Hd-23588-24402 'rings' 60-72", 3331, 10); Boundary("End"); }; }; |



Figure S1: Calibration of radiocarbon age 3331 ± 10 yr BP using (a) smoothen IntCal20 curve with a 13 year moving average in CALIB and (b) 13 year moving average curve constructed in this study

(a)

(b)

Figure S2: Calibration result of average radiocarbon age obtained from short-lived plant material from VDL in Santorini using IntCal20 curve (a) without any offset value, and (b) with an offset value of 8 years