

V. Isaakidou *et al.* Changing Land Use and Political Economy at Neolithic and Bronze Age Knossos, Crete

TABLE S3. TUKEY POST-HOC ANALYSIS OF SIGNIFICANT ANOVA RESULTS FOR $\delta^{13}\text{C}$ AND $\delta^{15}\text{N}$ VALUES OF CEREAL AND PULSE GRAINS FROM NEOLITHIC AND BRONZE AGE KNOSSOS (SEE TABLE 3); P-VALUES > 0.05 ARE HIGHLIGHTED

Neolithic $\delta^{13}\text{C}$			
	Hulled barley	Free-threshing wheat	
Free-threshing wheat	0.0307		
Lentil	0.4784	0.0007	
Bronze Age $\delta^{13}\text{C}$			
	Celtic bean	Emmer	Hulled barley
Emmer	0.0004		
Hulled barley	0.0002	0.9999	
Winged vetchling	0.1331	0.0361	0.0084
LN $\delta^{13}\text{C}$			
	Free-threshing wheat	Hulled barley	
Hulled barley	0.1373		
Lentil	0.0082	0.2240	

TABLE S4. FREQUENCY OF SUCCESSFUL BONE COLLAGEN SAMPLES BY SPECIES (TOTAL COUNTS EXCLUDE SPECIMENS THAT FAILED DUE TO BAD ANALYTICAL ENVIRONMENT OR OTHER RUN ERRORS AND WERE NOT SUBSEQUENTLY RE-RUN DUE TO LACK OF EXTRA COLLAGEN): (A) NEOLITHIC AND BRONZE AGE; (B) BRONZE AGE PHASES (MAJOR FARMYARD ANIMALS [MFA] ONLY)

(a)	<i>Horse</i>		<i>Cattle</i>		<i>Pig</i>		<i>Sheep</i>		<i>Goat</i>		<i>Fallow deer</i>		<i>Dog</i>		<i>Badger</i>		<i>All</i>	
	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>
Neolithic	not present		43	25.6	78	52.6	137	65.0	68	70.6	not present		11	54.5	3	33.3	340	57.7
Bronze Age	1	100	47	72.3	51	80.4	104	87.5	79	89.9	16	100.0	5	100	2	100.0	305	85.6
<i>All</i>	<i>1</i>	<i>100</i>	<i>90</i>	<i>50.0</i>	<i>129</i>	<i>63.6</i>	<i>241</i>	<i>74.7</i>	<i>149</i>	<i>79.9</i>	<i>16</i>	<i>100.0</i>	<i>16</i>	<i>68.8</i>	<i>5</i>	<i>60.0</i>	<i>645</i>	<i>70.9</i>

(b)	<i>Cattle</i>		<i>Pig</i>		<i>Sheep</i>		<i>Goat</i>		<i>All MFA</i>	
	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>	<i>Total</i>	<i>% good</i>
Prepalatial	9	44.4	12	41.7	23	73.9	19	73.7	63	63.5
Late Prepalatial	7	71.4	6	66.7	14	78.6	8	87.5	35	77.1
Old Palace	3	100.0	6	100.0	10	80.0	4	75.0	23	87.0
New Palace	22	72.7	14	92.9	35	94.3	27	100.0	98	90.8
Final Palace	6	100.0	12	100.0	19	100.0	20	95.0	57	98.2
Postpalatial	not sampled		1	100.0	3	100.0	1	100.0	5	100.0

TABLE S5. TUKEY POST-HOC ANALYSIS OF SIGNIFICANT ANOVA RESULTS FOR $\delta^{13}\text{C}$ AND $\delta^{15}\text{N}$ VALUES OF ANIMAL BONE COLLAGEN FROM NEOLITHIC AND BRONZE AGE KNOSSOS (SEE TABLE 5); P-VALUES > 0.05 ARE HIGHLIGHTED

<i>Sheep $\delta^{15}\text{N}$</i>									
	<i>IN</i>	<i>EN</i>	<i>LN I</i>	<i>LN II</i>	<i>FN</i>	<i>PreP</i>	<i>LPreP</i>	<i>OP</i>	<i>NP</i>
EN	0.9977								
LN I	0.0056	0.1266							
LN II	0.9843	1.0000	0.0524						
FN	0.6244	0.9960	0.0930	0.9971					
PreP	0.2645	0.8712	0.8530	0.8442	0.9922				
LPreP	0.1227	0.6209	0.9997	0.5584	0.8581	0.9997			
OP	0.0006	0.0138	0.8227	0.0059	0.0127	0.1894	0.6437		
NP	0.1534	0.7847	0.7094	0.7048	0.9626	1.0000	0.9995	0.1178	
FP	0.0565	0.4774	0.9987	0.3653	0.6701	0.9990	1.0000	0.5085	0.9978

<i>Goat $\delta^{15}\text{N}$ (excluding unweaned)</i>						
	<i>LN I</i>	<i>LN II</i>	<i>FN</i>	<i>PreP</i>	<i>LPreP</i>	<i>NP</i>
LN II	0.9996					
FN	0.9965	0.8967				
PreP	0.9140	0.6212	0.9754			
LPreP	0.2509	0.4357	0.0070	0.0027		
NP	0.0185	0.0447	0.0000	0.0000	0.9968	
FP	0.2129	0.4087	0.0002	0.0001	0.9998	0.8153

<i>LN I $\delta^{13}\text{C}$</i>		<i>FN $\delta^{13}\text{C}$</i>		<i>PreP $\delta^{13}\text{C}$</i>		
	<i>pig</i>	<i>goat</i>		<i>pig</i>	<i>goat</i>	
goat	0.002		goat	0.002	pig	0.037
sheep	0.980	0.001	sheep	0.990	0.0001	0.019 0.816

<i>NP $\delta^{13}\text{C}$</i>			<i>FP $\delta^{13}\text{C}$</i>			
	<i>cattle</i>	<i>goat</i>	<i>pig</i>		<i>cattle</i>	<i>goat</i>
goat	0.003			goat	0.388	
pig	0.528	0.250		pig	1.000	0.190
sheep	0.949	0.002	0.721	sheep	0.990	0.043 0.980

<i>NP $\delta^{15}\text{N}$</i>			<i>FP $\delta^{15}\text{N}$</i>			
	<i>cattle</i>	<i>goat</i>	<i>pig</i>		<i>cattle</i>	<i>goat</i>
goat	0.000			goat	0.19	
pig	0.763	0.000		pig	0.53	0.00
sheep	0.997	0.000	0.787	sheep	0.97	0.11 0.09

TABLE S6: SUMMARY STATISTICS FOR $\delta^{13}\text{C}$ AND $\delta^{15}\text{N}$ VALUES OF ANIMAL BONE COLLAGEN FROM NEOLITHIC AND BRONZE AGE KNOSSOS COMPARED WITH NEOLITHIC HALAI, MAKRIYALOS AND KOUPHOVOUNO AND WITH BRONZE AGE ARCHONTIKO, TOUMBA THESSALONIKIS AND MYCENAE

		$\delta^{13}\text{C}$				$\delta^{15}\text{N}$				
		<i>Min</i>	<i>Max</i>	<i>Average</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>Average</i>	<i>SD</i>	<i>N</i>
Halai	Cattle	-21.2	-13.5	-18.4	2.4	4.6	7.4	6.3	0.8	9
Neolithic	Sheep	-21.3	-16.2	-19.8	1.1	3.4	8.2	5.9	1	19
	Goat	-20.8	-18.7	-20.1	0.6	3	6.5	5.6	0.9	14
	Pig	-20.4	-19.3	-19.8	0.4	5.6	8.1	7	0.8	9
Makriyalos LN	Cattle	-21.3	-13.6	-16.8	2.2	3.1	6.5	4.9	1.0	22
	Sheep	-21.8	-17.2	-19.4	1.2	3.6	7.5	5.1	1.0	22
	Goat	-20.9	-18.3	-19.8	0.6	2.4	6.4	4.3	1.0	27
	Pig	-21.4	-20.2	-20.7	0.3	4.2	6.2	5.2	0.8	13
Kouphovouno MN & LN	Cattle	-21.1	-17.7	-20.4	0.9	2.7	8.4	4.8	1.2	15
	Sheep	-21.1	-19.6	-20.5	0.4	4.2	6.3	5.1	0.6	12
	Goat	-20.5	-19.7	-20.1	0.2	3.3	6.0	4.5	0.9	7
	Pig	-21.1	-19.1	-20.3	0.4	4.4	7.5	5.9	0.9	23
Archontiko late EBA-LBA	Cattle	-23.1	-11.4	-17.6	2.9	3.3	11.1	6.3	1.7	36
	Sheep	-21.4	-11.7	-19.4	2.1	3.6	9.0	5.8	1.2	19
	Pig	-21.5	-19.0	-20.3	0.6	4.3	8.9	6.7	1.2	38
Toumba Thessalonikis LBA	Cattle	-21.0	-10.1	-15.6	3.5	3.6	7.7	5.4	1.3	13
	Sheep	-21.0	-14.2	-18.9	1.2	5.3	8.8	6.8	1.1	36
	Goat	-20.6	-18.8	-19.5	0.4	3.8	8.8	5.3	1.2	33
	Pig	-20.9	-16.3	-19.6	1.0	5.3	9.9	7.6	1.0	26
Mycenae LBA	Cattle	-21	-18.8	-20.3	0.6	3.4	10	5.9	1.9	14
	Sheep	-21.7	-19.3	-20.6	0.5	3.8	8.3	5.3	1.1	32
	Goat	-21.8	-18.9	-20.6	0.7	3.2	10.7	5	1.6	22
	Pig	-21.2	-18.2	-20.2	0.8	3.9	10.4	6.4	1.9	15
Knossos Neolithic	Cattle	-21.1	-19.4	-20.5	0.5	4.5	6.9	5.2	0.7	11
	Sheep	-22.1	-19.5	-20.7	0.4	3.7	8.7	5.5	0.9	89
	Goat	-20.9	-16.7	-20.0	0.7	3.7	7.5	5.5	0.8	48
	Pig	-21.5	-19.4	-20.6	0.5	3.1	7.8	5.7	1.2	41
Knossos BA	Cattle	-21.3	-18.6	-20.5	0.6	3.6	7.5	5.3	0.9	34
	Sheep	-21.9	-17.4	-20.5	0.7	2.6	7.7	5.2	1.0	91
	Goat	-21.5	-16.2	-19.8	0.7	1.4	9.4	4.6	1.4	71
	Pig	-21.3	-18.9	-20.4	0.6	2.9	8.3	5.5	1.3	41

SD = one standard deviation (1σ)

TABLE S7: ESTIMATED RANGES OF $\delta^{13}\text{C}$ AND $\delta^{15}\text{N}$ VALUES FOR POTENTIAL CATEGORIES OF FORAGE AT NEOLITHIC–BRONZE AGE KNOSSOS

<i>Category of forage</i>	<i>Estimated ranges of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values</i>				
a. Neolithic and Bronze Age C ₃ cereal and pulse grain fodder	68% and 95% confidence ellipses estimated from $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of cereal and pulse grains from Neolithic and Bronze Age Knossos, respectively (see Table S1)				
b. Neolithic and Bronze Age cereal/pulse chaff fodder	-2.5‰ (cereal $\delta^{13}\text{C}$)/-1.5‰ (pulse $\delta^{13}\text{C}$) and -2.4‰ (cereal $\delta^{15}\text{N}$)/-0.5‰ (pulse $\delta^{15}\text{N}$) offsets from 68% and 95% confidence ellipses estimated for cereal and pulse grains from Neolithic and Bronze Age Knossos, respectively (above, a)				
c. Neolithic and Bronze Age stubble/fallow/(young cereal) pasture	-1.5‰ ($\delta^{13}\text{C}$) and -1.4‰ ($\delta^{15}\text{N}$) offsets from 68% and 95% confidence ellipses estimated for <i>cereal</i> grains from Neolithic and Bronze Age Knossos, respectively				
d. Neolithic-Bronze Age rough graze and browse on lowland central Crete	95% confidence ellipses estimated from mean wet- and dry-season $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values for annuals/forbs and shrubs/trees, respectively, at 500 mm mean annual rainfall extrapolated from Hartman (2008, appx A) using a linear regression model; reported $\delta^{13}\text{C}$ values corrected by +1.8‰ to allow for changing atmospheric $\delta^{13}\text{C}$ values:				
			<i>95% confidence interval</i>		
	<i>Annuals/forbs</i>	<i>Mean (‰)</i>	<i>Lower CI</i>	<i>Upper CI</i>	<i>Difference from mean</i>
	$\delta^{13}\text{C}$ (‰)	-27.69	-28.40	-26.99	0.71
	$\delta^{15}\text{N}$ (‰)	-0.73	-1.66	0.19	0.92
	<i>Shrubs/trees</i>	<i>Mean (‰)</i>	<i>Lower CI</i>	<i>Upper CI</i>	<i>Difference from mean</i>
	$\delta^{13}\text{C}$ (‰)	-26.38	-26.91	-25.86	0.53
	$\delta^{15}\text{N}$ (‰)	-1.36	-2.37	-0.36	1.01
e. Neolithic-Bronze Age summer rough graze on upland central Crete	+1.5‰ ($\delta^{13}\text{C}$) and -1.5‰ ($\delta^{15}\text{N}$) offsets from 95% confidence ellipse estimated for lowland rough graze on central Crete (above, d)				
f. Neolithic-Bronze Age lowland autumn-winter pannage	+3‰ ($\delta^{13}\text{C}$) and +2‰ ($\delta^{15}\text{N}$) offsets from 95% confidence ellipse estimated for lowland rough browse on central Crete (above, d)				
g. Neolithic-Bronze Age lowland C ₄ grain fodder	68% and 95% confidence ellipses estimated from $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of common millet grains from Bronze Age Archontiko and Toumba Thessalonikis (after Nitsch <i>et al.</i> 2017, 116–17 figs 4–5)				

TABLE S8. THE MEAN AND STANDARD DEVIATION OF THE $\delta^{13}\text{C}$ AND $\delta^{15}\text{N}$ VALUES OF STANDARDS IN EACH CARBON AND NITROGEN ISOTOPE RUN

<i>Plant remains</i>										
<i>Run file</i>	<i>Alanine</i>	<i>Alanine sd</i>	<i>CAFF</i>	<i>CAFF sd</i>	<i>C6</i>	<i>C6 sd</i>	<i>C7</i>	<i>C7 sd</i>	<i>N2</i>	<i>N2 sd</i>
$\delta^{13}\text{C}$ (‰)										
150206B	-26.91	0.09	n/a	n/a	-10.18	0.06	-31.70	0.13	n/a	n/a
150207A	-26.83	0.54	n/a	n/a	-10.05	0.37	-31.42	0.44	n/a	n/a
151208	-27.11	0.05	n/a	n/a	-10.37	0.08	-31.79	0.09	n/a	n/a
$\delta^{15}\text{N}$ (‰)										
150324B	-1.57	0.06	-3.11	0.06	n/a	n/a	n/a	n/a	20.54	0.08
150327B	-1.57	0.17	-3.17	0.19	n/a	n/a	n/a	n/a	20.35	0.28
151209B	-1.59	0.21	1.28	0.18	n/a	n/a	n/a	n/a	20.53	0.14
<i>Animal bone collagen</i>										
<i>Run file</i>	<i>Alanine</i>	<i>Alanine sd</i>	<i>CAFF</i>	<i>CAFF sd</i>	<i>SEAL</i>	<i>SEAL sd</i>				
$\delta^{13}\text{C}$ (‰)										
150209A	-26.85	0.12	-34.62	0.18	-13.26	0.19				
150209B	-26.93	0.10	-34.69	0.09	-13.23	0.07				
151016	-27.13	0.02	-27.71	0.02	-13.38	0.08				
151019	-27.12	0.02	-27.74	0.04	-13.44	0.03				
151019B	-27.11	0.04	-27.70	0.08	-13.37	0.03				
151019C	-27.13	0.05	-27.71	0.02	-13.38	0.03				
151020A	-27.10	0.03	-27.78	0.12	-13.51	0.11				
151020B	-27.12	0.07	-27.75	0.04	-13.38	0.10				
151020C	-27.20	0.06	-27.72	0.02	-13.47	0.09				
151021A	-27.08	0.04	-27.68	0.10	-13.38	0.03				
151021B	-27.10	0.02	-27.59	0.20	-13.22	0.14				
151207	-27.11	0.05	-27.71	0.06	-12.38	0.09				
151207B	-27.13	0.05	-27.70	0.03	-12.39	0.05				
160210B	-27.08	0.05	-27.68	0.04	-12.36	0.04				
160211	-27.13	0.11	-27.71	0.02	-12.36	0.05				
160212	-27.10	0.03	-27.72	0.04	-12.44	0.08				
160212B	-27.08	0.03	-27.71	0.03	-12.41	0.06				
$\delta^{15}\text{N}$ (‰)										
150209A	-1.69	0.20	-2.66	0.28	16.89	0.21				
150209B	-1.59	0.15	-2.65	0.09	16.97	0.25				
151016	-1.60	0.05	0.89	0.17	17.39	0.11				
151019	-1.56	0.03	0.85	0.06	17.27	0.05				
151019B	-1.69	0.34	0.83	0.06	17.31	0.10				
151019C	-1.52	0.07	0.87	0.09	17.35	0.08				
151020A	-1.56	0.07	0.97	0.15	17.45	0.19				
151020B	-1.59	0.06	0.82	0.06	17.33	0.04				
151020C	-1.54	0.06	0.87	0.04	17.31	0.09				
151021A	-1.52	0.06	0.95	0.11	17.40	0.07				
151021B	-1.53	0.05	1.04	0.04	17.41	0.20				
151207	-1.52	0.08	0.92	0.11	16.25	0.08				
151207B	-1.47	0.06	0.93	0.05	16.15	0.12				
160210B	-1.53	0.05	1.14	0.05	16.35	0.03				
160211	-1.47	0.07	1.18	0.03	16.33	0.03				
160212	-1.53	0.06	0.93	0.02	16.40	0.05				
160212B	-1.56	0.06	1.00	0.06	16.33	0.07				