GSA DATA REPOSITORY 2009169

SUPPLEMENTARY METHODS

Radiocarbon ages

The hyraceum samples with lab code "UBA" were pretreated with 2% HCl for 1 hr at room temperature to remove potential carbonate contamination and dried at 60^{o}C. They were then weighed into quartz tubes with an excess of CuO, sealed under vacuum and combusted to CO_2. The CO_2 was converted to graphite on an iron catalyst using the zinc reduction method (Slota et al., 1987). The $^{14}C/^{12}C$ and $^{13}C/^{12}C$ ratios and were measured by accelerator mass spectrometry (AMS) at the ^{14}CHRONO Centre, Queen's University Belfast.

Samples with lab code "A" were measured radiometrically with gas proportional counters (GPC) at the University of Arizona. These samples were dissolved in 1N HCl to remove carbonate. The solution was neutralized with dilute NaOH solution, and remaining organic matter was recovered as solid by evaporating the water in a drying oven at 90°C. The organic matter was burned, and the resulting CO_2 was purified and converted to benzene using techniques close to those outlined in Noakes et al. (1965) and Polach et al. (1973).

The radiocarbon age and one standard deviation were calculated using the Libby half-life of 5568 years following the conventions of Stuiver and Polach (1977). The ages were corrected for isotope fractionation using the AMS measured $\delta^{13}C$ (not given) which accounts for both natural and machine fractionation and calibrated with the SHCal04 curve (McCormac et al., 2004) or the IntCal04 calibration curve (Reimer et al., 2004) with an offset included for the Southern Hemisphere (McCormac et al., 2004) (Supplementary Table 1).

The age-depth curve shown in Supplementary Figure 1 is derived from linear interpolations between median probability calibration ages.

Data from the separate middens was combined at points of intersection based on calculated age and stable isotope values. Where significant overlap between the records existed, as in the case between

SPZ-1-3 and SPZ-1-5, preference was given to the record with the higher accumulation rate and resolution (Supplementary Figure 1).

Stable Isotopes

Isotope ratios of bulk midden samples were measured on a Thermo-Finnigan Delta-Plus XP isotope ratio mass spectrometer. Samples were combusted at 1020ºC and the carbon and nitrogen converted into CO_2 and N_2 in a Thermo Flash EA 1112 elemental analyser. Gases were introduced into the mass spectrometer in a stream of helium, via a Conflo interface. The standard deviation of repeated determinations of homogeneous material was less than 0.2 ‰ for both carbon and nitrogen. Carbon isotope results are expressed relative to Vienna PDB, nitrogen relative to atmospheric nitrogen.

References Cited

McCormac, F.G., Hogg, A.G., Blackwell, P.G., Buck, C.E., Higham, T.F.G., and Reimer, P.J., 2004, SHCal04 Southern Hemisphere Calibration, 0-11.0 Cal Kyr BP: Radiocarbon, v. 46, p. 1087-1092.

Noakes, J.E., Kim, S.M., and Stipp, J.J., 1965, Chemical and counting advances in low level scintillation age dating, Proceedings of the International Conference on Radiocarbon and Tritium Dating: Pullman, Washington, p. 68-92.

Polach, H., Gower, J., and Fraser, I., 1973, Synthesis of high-purity benzene for radiocarbon dating, *in* Rafter, T.A., and Grant-Taylor, T., eds., Proceedings of the 8th International ^{14}C Conference, Volume 1: Wellington, Royal Society of New Zealand, p. B36-B49.

Reimer, P.J., Baillie, M.G.L., Bard, E., Bayliss, A., Beck, J.W., Bertrand, C.J.H., Blackwell, P.G., Buck, C.E., Burr, G.S., Cutler, K.B., Damon, P.E., Edwards, R.L., Fairbanks, R.G., Friedrich, M., Guilderson, T.P., Hogg, A.G., Hughen, K.A., Kromer, B., McCormac, G., Manning, S., Ramsey, C.B., Reimer, R.W., Remmele, S., Southon, J.R., Stuiver, M., Talamo, S., Taylor, F.W., van der Plicht, J., and Weyhenmeyer, C.E., 2004, IntCal04 Terrestrial Radiocarbon Age Calibration, 0-26 Cal Kyr BP: Radiocarbon, v. 46, p. 1029-1058.

Slota, P.J., Jull, A.J.T., Linick, T.W., and Toolin, L.J., 1987, Preparation of small samples for ^{14}C accelerator targets by catalytic reduction of CO: Radiocarbon, v. 29, p. 303-306.

Stuiver, M., and Polach, H.A., 1977, Discussion: reporting of ^{14}C data.: Radiocarbon, v. 19, p. 355-363.

Table DR1. Radiocarbon ages and calibration information for the SPZ-1-2, SPZ-1-3 and SPZ-1-5 hyrax middens.

Sample	Midden	Measurement method	^{14}C age yr BP	1σ error	Calibration data	95.4 % (2s) cal age ranges	Relative area under distribution	Median probability (cal yr BP)
UBA-9426	SPZ-1-2	AMS	1.0703*	0.0022	Wellington	cal BP -7 to -8	1	-7
UBA-8994	SPZ-1-2	AMS	330	22	SHCal04	cal BP 303 -334	0.289938	392
						cal BP 360 - 446	0.710062	
UBA-8995	SPZ-1-2	AMS	992	19	SHCal04	cal BP 799 - 918	1	851
UBA-8996	SPZ-1-2	AMS	1399	31	SHCal04	cal BP 1180 - 1210	0.145369	1279
						cal BP 1226 - 1312	0.854631	
UBA-8997	SPZ-1-2	AMS	2370	24	SHCal04	cal BP 2181 - 2240	0.12994	2339
						cal BP 2303 - 2362	0.87006	
UBA-9427	SPZ-1-2	AMS	2974	20	SHCal04	cal BP 2963 - 3162	0.975315	3064
						cal BP 3188 - 3202	0.024685	
UBA-9001	SPZ-1-5	AMS	2852	33	SHCal04	cal BP 2790 - 2994	1	2898
UBA-9002	SPZ-1-5	AMS	3296	21	SHCal04	cal BP 3387 - 3490	0.818252	3455
						cal BP 3495 - 3511	0.040281	
						cal BP 3518 - 3556	0.141467	
UBA-8379	SPZ-1-5	AMS	3657	23	SHCal04	cal BP 3832 - 3984	0.997221	3908
						cal BP 4057 - 4060	0.002779	
UBA-9003	SPZ-1-5	AMS	4696	37	SHCal04	cal BP 5294 - 5474	0.968723	5402
						cal BP 5549 - 5574	0.031277	
A-14720.1	SPZ-1-5	GPC	6080	60	SHCal04	cal BP 6677 - 6708	0.018242	6870
						cal BP 6713 - 7019	0.962076	
						cal BP 7125 - 7151	0.019682	
UBA-8998	SPZ-1-3	AMS	4457	24	SHCal04	cal BP 4861 - 5053	0.968677	4965
						cal BP 5190 - 5213	0.030749	
						cal BP 5254 - 5255	0.000574	
UBA-9428	SPZ-1-3	AMS	6391	24	SHCal04	cal BP 7168 - 7325	0.984877	7266
						cal BP 7168 - 7325	0.015123	
UBA-8999	SPZ-1-3	AMS	6927	24	SHCal04	cal BP 7624 - 7644	0.041993	7700
						cal BP 7652 - 7788	0.958007	
UBA-8375	SPZ-1-3	AMS	7141	27	SHCal04	cal BP 7841 - 7974	1	7912
UBA-9429	SPZ-1-3	AMS	9240	26	SHCal04	cal BP 10244 - 10431	0.959657	10338
						cal BP 10463 - 10483	0.040343	
A-14718.1	SPZ-1-3	GPC	10596**	83.5	INTCAL04	cal BP 12246-12264	0.007267	12633
						cal BP 12375 - 12826	0.992733	

*F14C and F14C uncertainty

"**Adjusted for recommended SH offset of 56 +/- 24 (McCormac et al., 2004)"

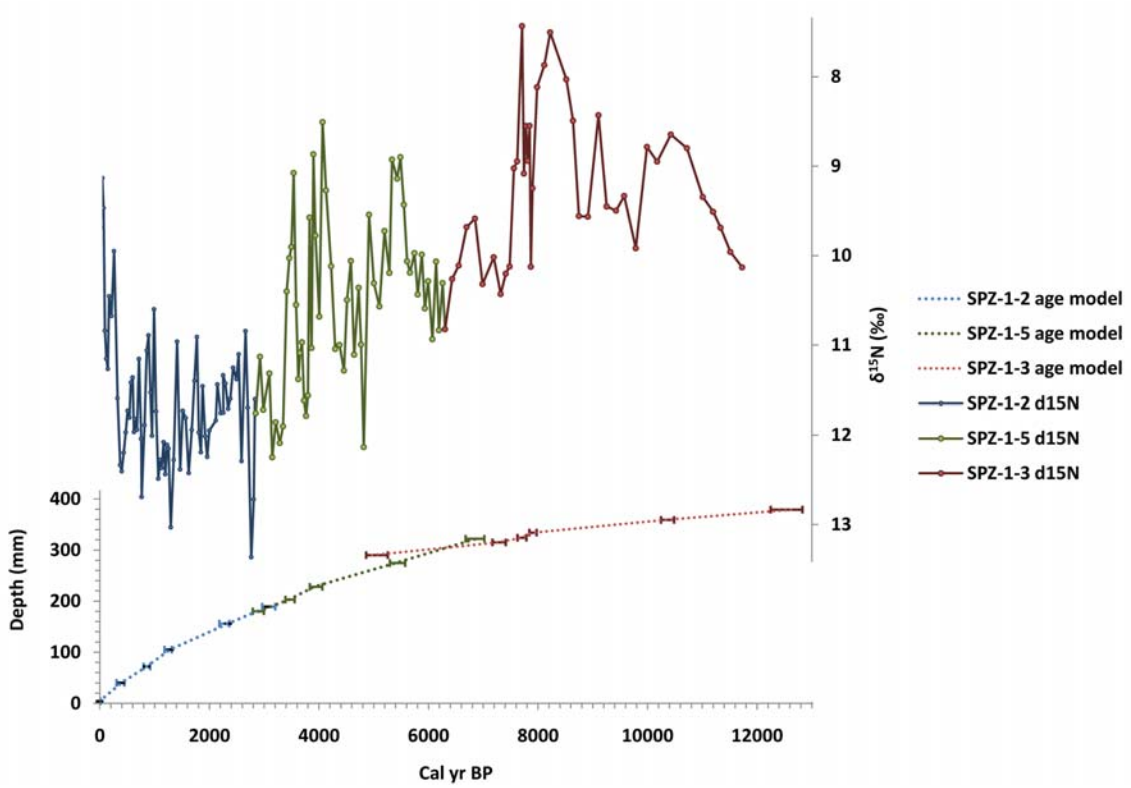

Figure DR1. $\delta^{15}N$ data and age-depth curves derived from radiocarbon ages for the SPZ-1-2, SPZ-1-3 and SPZ-1-5 hyrax middens.