Supplementary Material

The following is a description of the method used to prepare samples for lead-210 by alpha spectrometry, following the ANSTO Environmental Radioactivity Measurement Centre (ERMC) Lead-210 dating sample preparation method. Approximately 0.2 g of ^{209}Po tracer was added to ~2 g of dried, homogenized sediment sample prior to the addition of 25 mL concentrated HNO_3 to digest organics, heated until evaporating close to dryness. ~20 mL of 30% H_2O_2 was added slowly and samples again heated until evaporated close to dryness. After cooling, 40 mL aqua-regia (10 mL conc. HNO_3 and 30 mL conc. HCl) was added and samples were placed on a hot plate under a watch glass to reflux overnight at ~60°C. Supernatant was separated from residue via centrifuge, using 6M HCl as a rinse, and the residue discarded. ~5 mL conc. HCl was added to the supernatant and heated to evaporate close to dryness, completing the digestion phase.

This was followed by application of the ERMC Polonium chemical isolation method (De Oliceria Goday 1983). 80 mL 0.04 M HCl was added to each sample while on a stirring hot plate, followed by 1 mL of 20 % ascorbic acid to reduce Fe(III) to Fe(II). 100 µL 1 M citric acid was added to complex trace iron and chromium, followed by 10 mg of Bi^{3+} holdback carrier to inhibit autodeposition of bismuth. The pH of each sample was adjusted to 1.5 with the addition of cresol red indicator and NH_4OH. 1 g of hydroxylammonium chloride was added and a silver disk holder floated in the solution for polonium deposition over at least 4 hours. Silver disks were removed and rinsed in distilled water and ethanol prior to polonium counting by alpha spectrometry.

Next the ERMC Radium chemical isolation procedure was applied to the samples (Golding 1961; Lim & Dave 1981; Lim, Dave & Cloutier 1989). Samples were added to 800 mL molecular filtered water and 20 mL conc. H_2SO_4 was added. 10 Ml 10mg/mL Pb^{2+} carrier was

added slowly via burette while the sample was stirred. Samples were covered and left overnight to allow Pb/Ba/Ra sulphate precipitate to flocculate. Supernatant was discarded, and 5 mL 0.2 M Na_5DTPA was added to the remaining residue along with thymol blue indicator to verify a sample pH of >9. Samples were mixed via vortex mixer and placed in a sonicator bath for 30 minutes. After the addition of two drops of methyl red indicator, samples were passed through a 0.45 μm disposable membrane filter. 2 mL of 1:1 acetic acid/water and 1 mL $BaSO_4$ seeding suspension (sonicated for 15 minutes prior) were simultaneously added to each sample before samples were refrigerated for at least 30 minutes. Refrigerated samples were poured through a smooth-surfaced Millipore "VV" membrane filter in a lock-seal Gelman filter apparatus and allowed to drain. Membrane filters were removed for radium counting by alpha spectrometry.

Table S1: Marura lead-210 dates, including modelled ages using a Constant Initial Concentration (CIC) model.

ANSTO Code	**ID**	**Unsupported ^{210}Pb decay corrected to 3-Oct-17**	**Calculated CIC ages (years before collection in 2015)**	**Mean calculated age from age-depth model (years cal BP)**
U526	MAR2 0-1m 0-1cm	25 ± 7		-50
U527	MAR2 0-1m 2-3cm	31 ± 5		-43
U528	MAR2 0-1m 6-7cm	31 ± 5		-27
U087	MAR2 0-1m 10-11cm	35 ± 5	47 ± 14	-12

U088	MAR2 0-1m 15-16cm	24 ± 4	69 ± 21	13
U089	MAR2 0-1m 20-21cm	9 ± 5	91 ± 28	55

Table S2: Marura AMS radiocarbon dates.

ANSTO Code	**ID**	**δ(^{13}C) per mil**	**% modern carbon**	**Conventional radiocarbon age**	**Mean calculated age from age-depth model**
			pM C 1σ error	**yrs BP**	**yrs cal BP**
OZW494	MAR2 0-1m 44-45cm	-23.7 ± 0.1	87.13 ± 0.31	1,105 ± 30	904
OZW495	MAR2 0-1m 72-73cm	-21.0 ± 0.1	84.42 ± 0.36	1,360 ± 35	1248
OZW496	MAR2 1-1.95m 44-45cm	-24.0 ± 0.2	77.41 ± 0.30	2,055 ± 35	1975
OZW497	MAR2 1-1.95m 84-85cm	-24.1 ± 0.1	72.77 ± 0.36	2,555 ± 40	2633
OZW498	MAR2 1.95-2.9m 44-45cm	-25.2 ± 0.1	64.40 ± 0.26	3,535 ± 35	3751
OZW499	MAR2 1.95-2.9m 84-85cm	-25.8 ± 0.3	59.63 ± 0.36	4,155 ± 50	4615

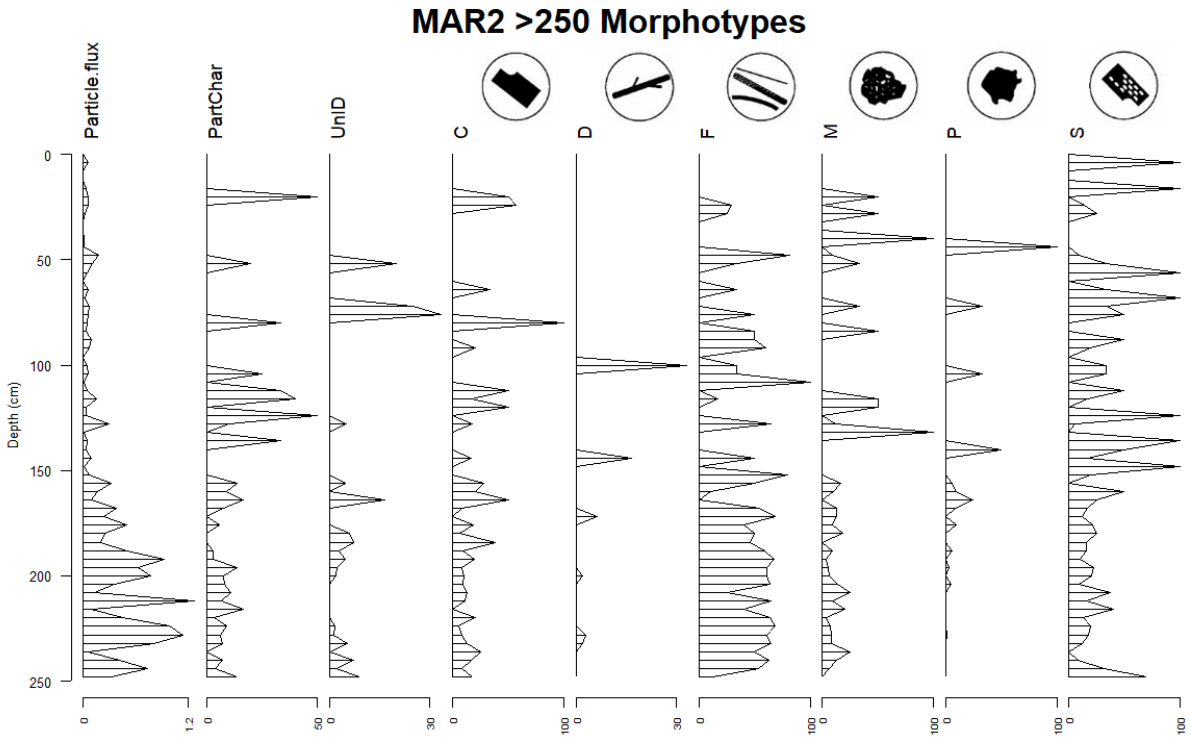

Figure S1: Morphotype data for Marura >250 µm charcoal (morphotype symbols after Enache and Cumming 2006, p.285). PartChar: partially charred particles, UnID: unidentified charcoal particles.

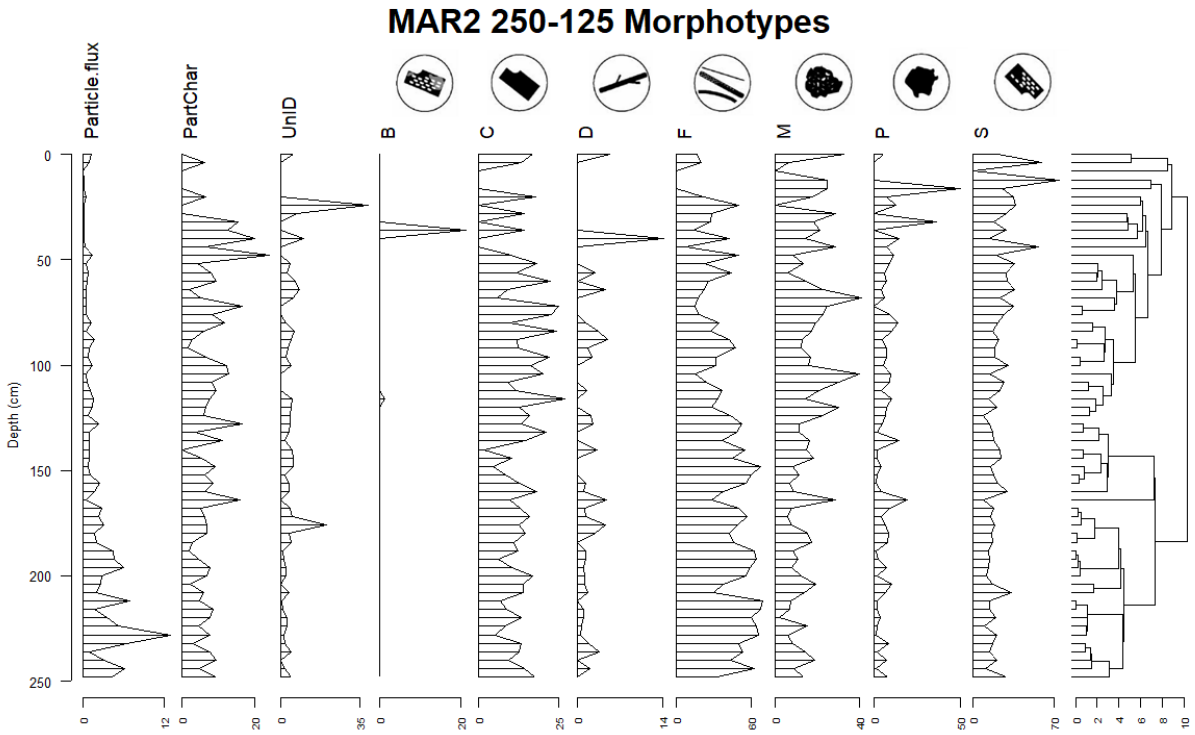

Figure S2: Morphotype data for Marura 250-125 µm charcoal (morphotype symbols after Enache and Cumming 2006, p.285). PartChar: partially charred particles, UnID: unidentified charcoal particles..

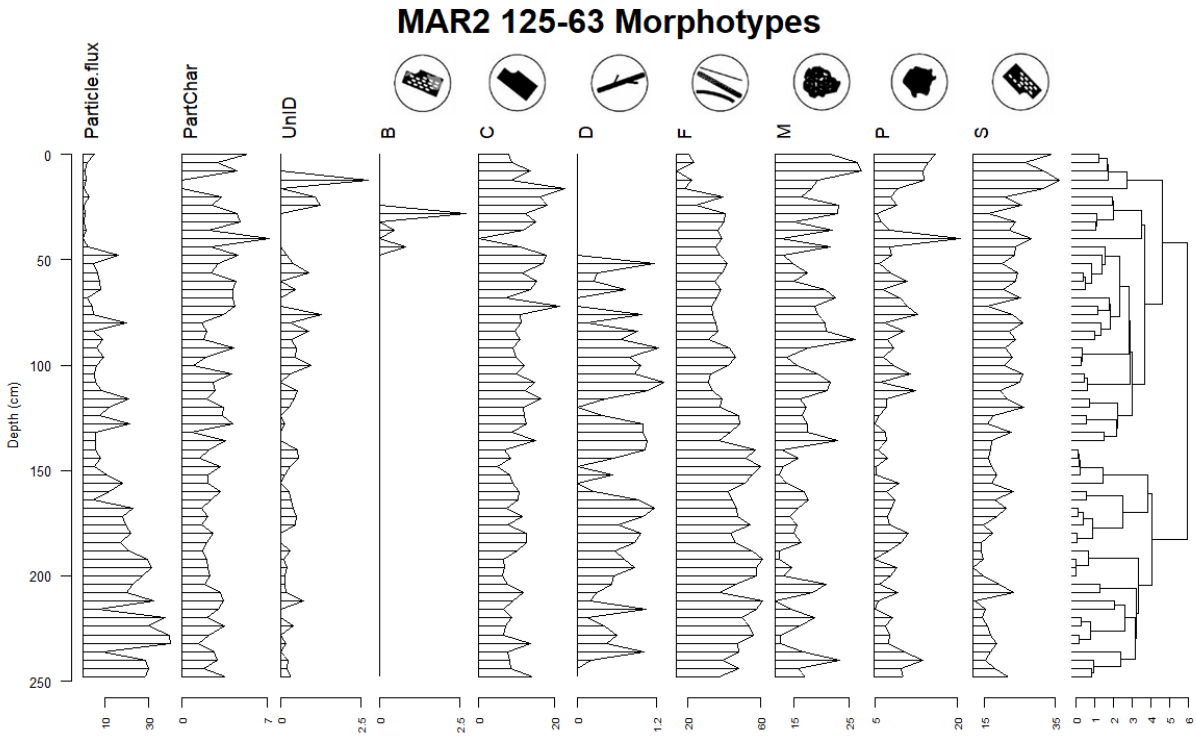

Figure S3: Morphotype data for Marura 125-63 µm charcoal (morphotype symbols after Enache and Cumming 2006, p.285). PartChar: partially charred particles, UnID: unidentified charcoal particles.