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Supplementary Materials for

The origins of cannabis smoking: Chemical residue evidence from the first millennium BCE in the Pamirs

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Table S1. Radiocarbon dates from the Jirzankal Cemetery.

Tomb	Material	Lab No.	$\delta^{13}C$ (‰)	AMS age (BP)	Calibrated age (cal. BP, ±2σ)
M1	Textile	Beta-354583	-19.6	2560±30	2750-2550[i]
M1	Wood	Beta-354584	-23.7	2510±30	2740-2470[i]
M10	Human bone	Beta-360538	-17.9	2450±30	2710-2360[i]
M11	Human bone	Beta-360540	-17.6	2390±30	2650-2360[i]
M12	Human bone	Beta-360543	-17.4	2390±30	2650-2350[i]
M14	Wood	Beta-360547	-23.3	2370±30	2460-2340[i]
M14	Wood	Beta-403048	-	2450±30	2710-2360[i]
M14	Wood	Beta-400296	-21.7	2570±30	2750-2700[ii]
M15	Wood	Beta-400297	-22.3	2430±30	2540-2355[ii]
M25	Human bone	Beta-403044	-17.3	2440±30	2705-2355[i]
M35	Wood	Beta-403051	-24.1	2410±30	2685-2350[i]
M49*	Wood	Beta-403053	-23.3	2490±30	2730-2460[i]

[i] Cited from ref. 44; [ii] cited from ref. 42; * the original tomb No. was M50.

Fig. S1. Ancient cannabis plant from tomb M231 (ca. 790–520 BCE) at the Jiayi Cemetery in Turpan, Xinjiang. (Photo Credit: Meng Ren, University of Chinese Academy of Sciences)

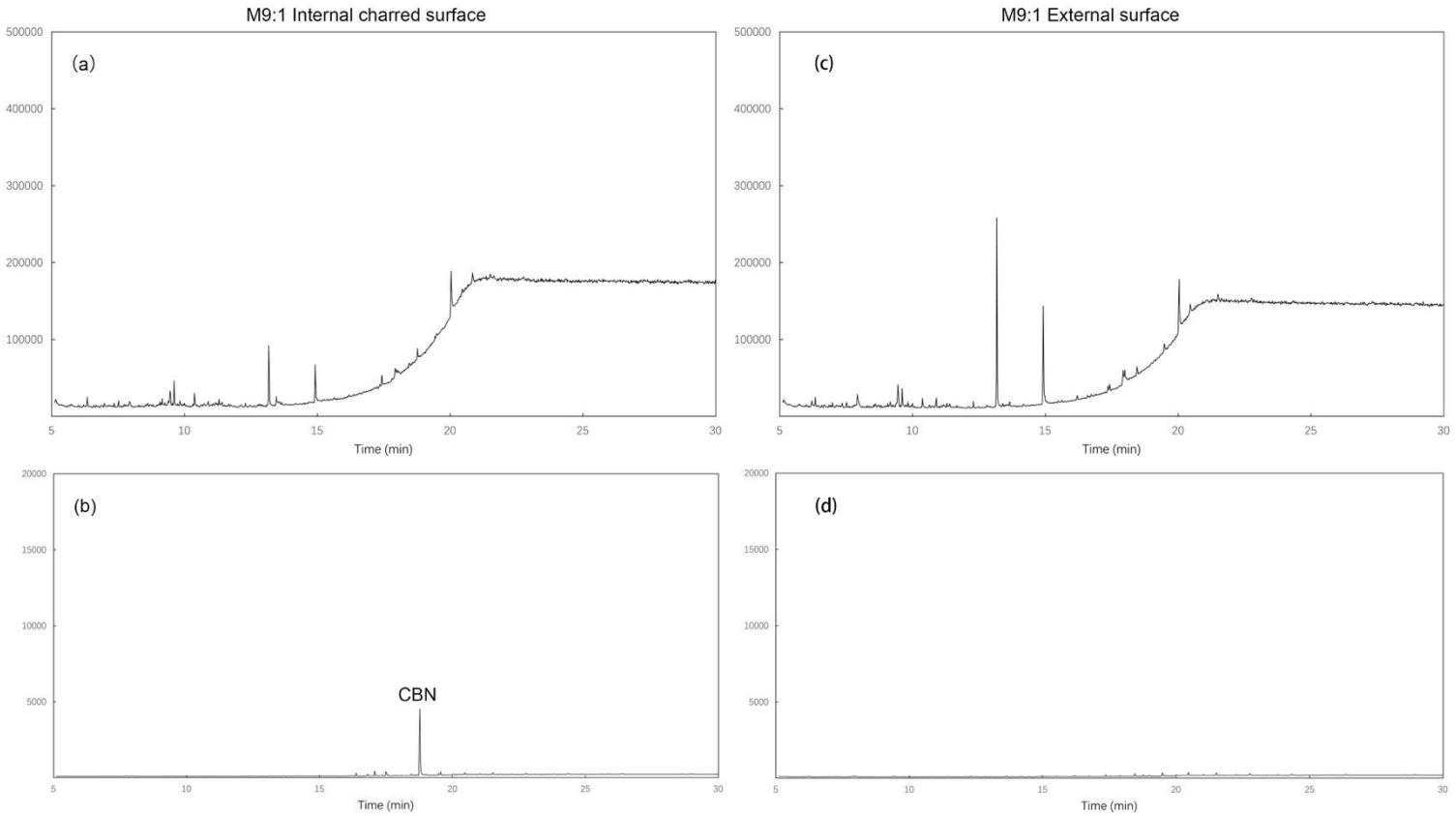

Fig. S2. Chromatograms of the wooden brazier M9:1 from the Jirzankal Cemetery. (a) Total ion current (TIC) chromatogram of the internal charred fragment of the wooden brazier M9:1 (labeled as 1I); (b) Chromatogram in select ion mode (SIM) of the internal charred fragment of the wooden brazier M9:1, showing cannabinol (CBN); (c) TIC chromatogram of the external fragment of the wooden brazier M9:1 (labeled as 1E); (d) SIM chromatogram of the external fragment of the wooden brazier M9:1.

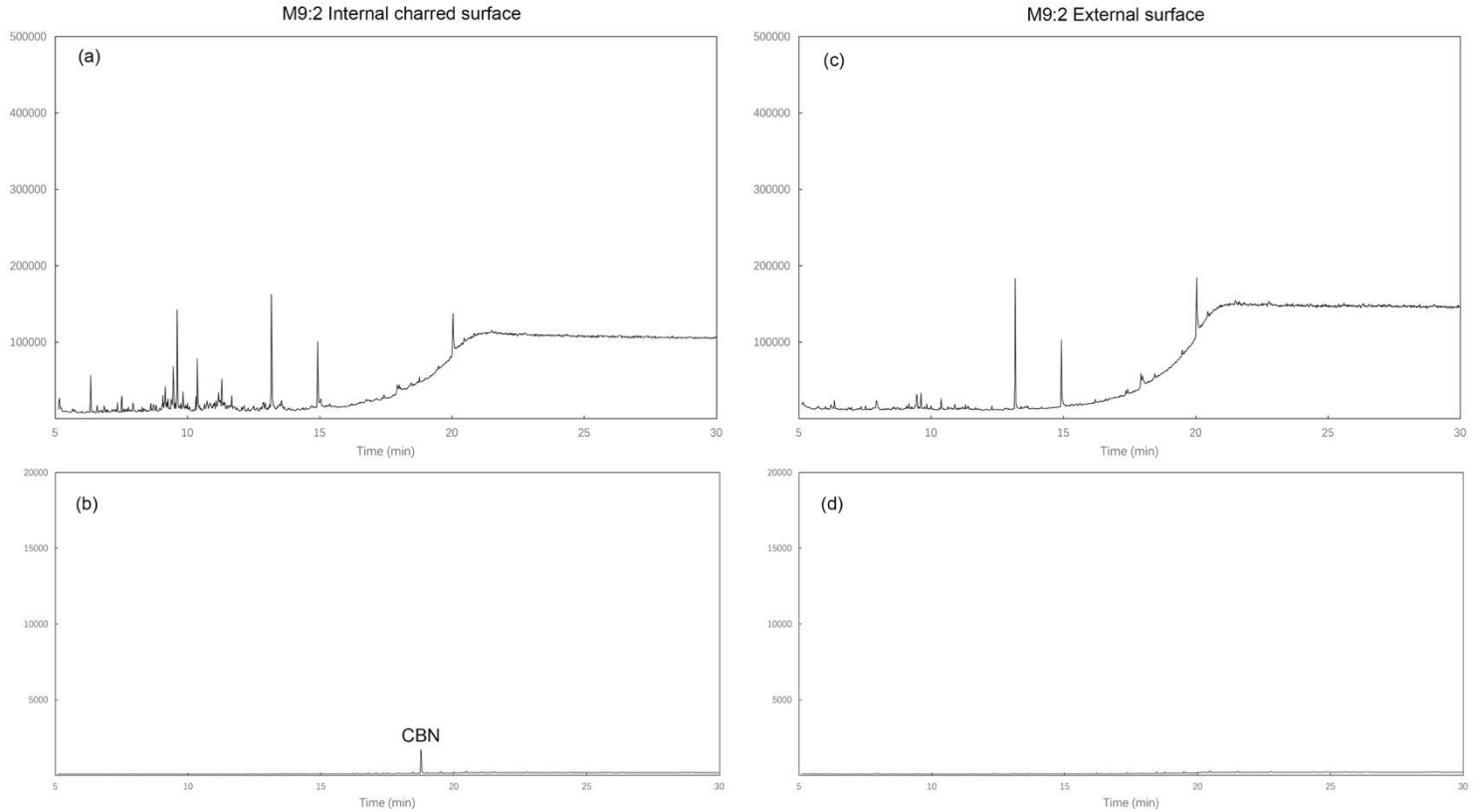

Fig. S3. Chromatograms of the wooden brazier M9:2 from the Jirzankal Cemetery. (a) TIC chromatogram of the internal charred fragment of the wooden brazier M9:2 (labeled as 2I); (b) SIM chromatogram of the internal charred fragment of the wooden brazier M9:2, showing cannabinol (CBN); (c) TIC chromatogram of the external fragment of the wooden brazier M9:2 (labeled as 2E); (d) SIM chromatogram of the external fragment of the wooden brazier M9:2.

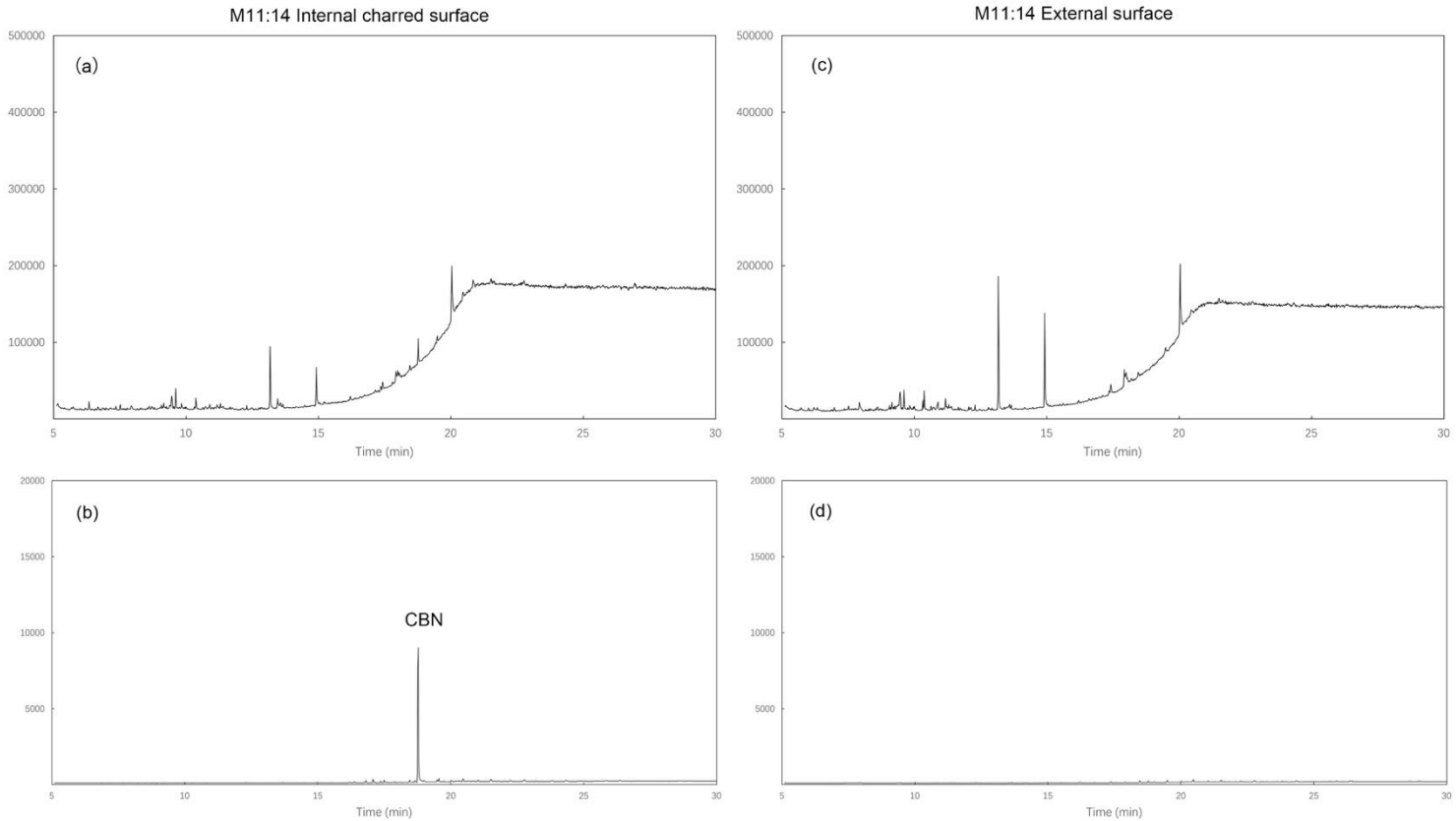

Fig. S4. Chromatograms of the wooden brazier M11:14 from the Jirzankal Cemetery. (a) TIC chromatogram of the internal charred fragment of the wooden brazier M11:14 (labeled as 3I); (b) SIM chromatogram of the internal charred fragment of the wooden brazier M11:14, showing cannabinol (CBN); (c) TIC chromatogram of the external fragment of the wooden brazier M11:14 (labeled as 3E); (d) SIM chromatogram of the external fragment of the wooden brazier M11:14.

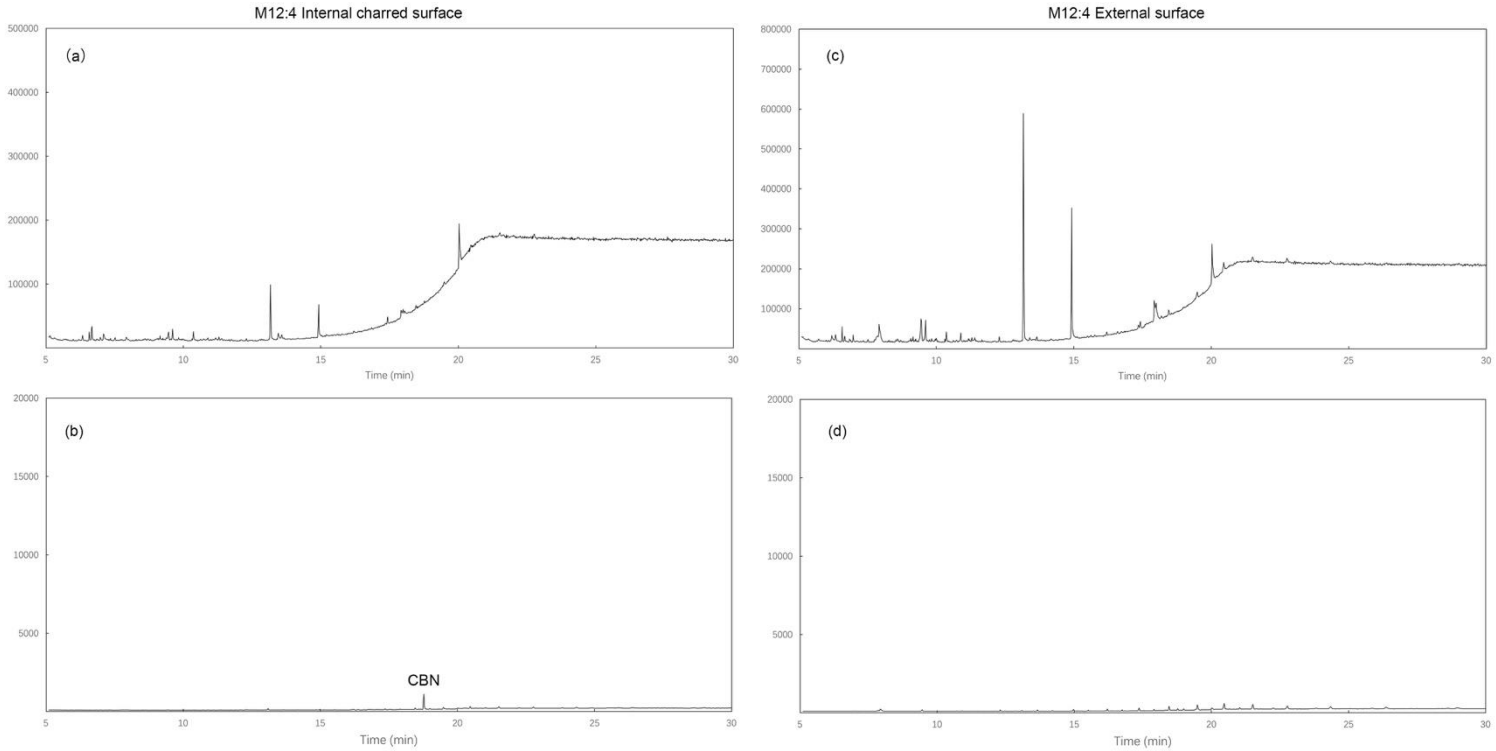

Fig. S5. Chromatograms of the wooden brazier M12:4 from the Jirzankal Cemetery. (a) TIC chromatogram of the internal charred fragment of the wooden brazier M12:4 (labeled as 4I); (b) SIM chromatogram of the internal charred fragment of the wooden brazier M12:4, showing cannabinol (CBN); (c) TIC chromatogram of the external fragment of the wooden brazier M12:4 (labeled as 4E); (d) SIM chromatogram of the external fragment of the wooden brazier M12:4.

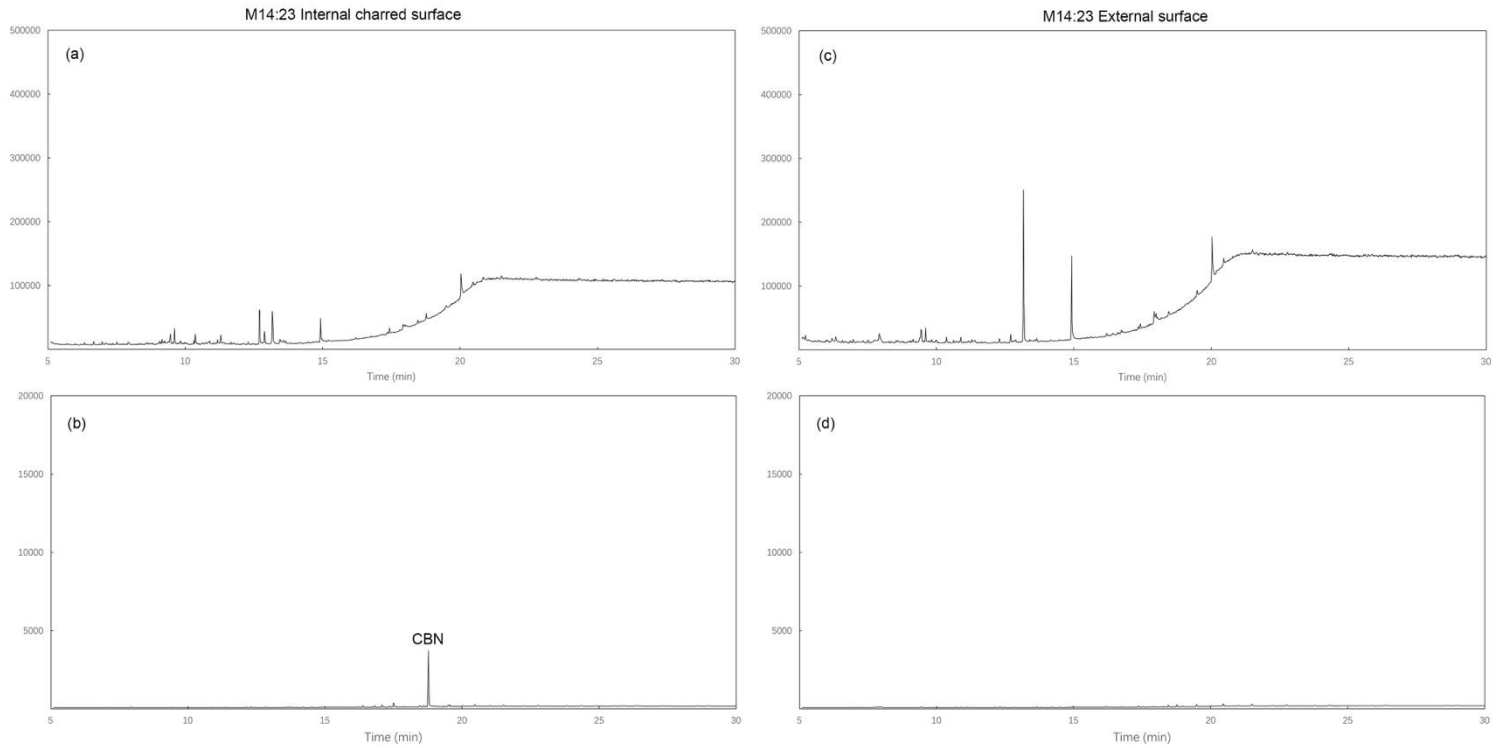

Fig. S6. Chromatograms of the wooden brazier M14:23 from the Jirzankal Cemetery. (a) TIC chromatogram of the internal charred fragment of the wooden brazier M14:23 (labeled as 5I); (b) SIM chromatogram of the internal charred fragment of the wooden brazier M14:23, showing cannabinol (CBN); (c) TIC chromatogram of the external fragment of wooden brazier M14:23 (labeled as 5E); (d) SIM chromatogram of the external fragment of the wooden brazier M14:23.

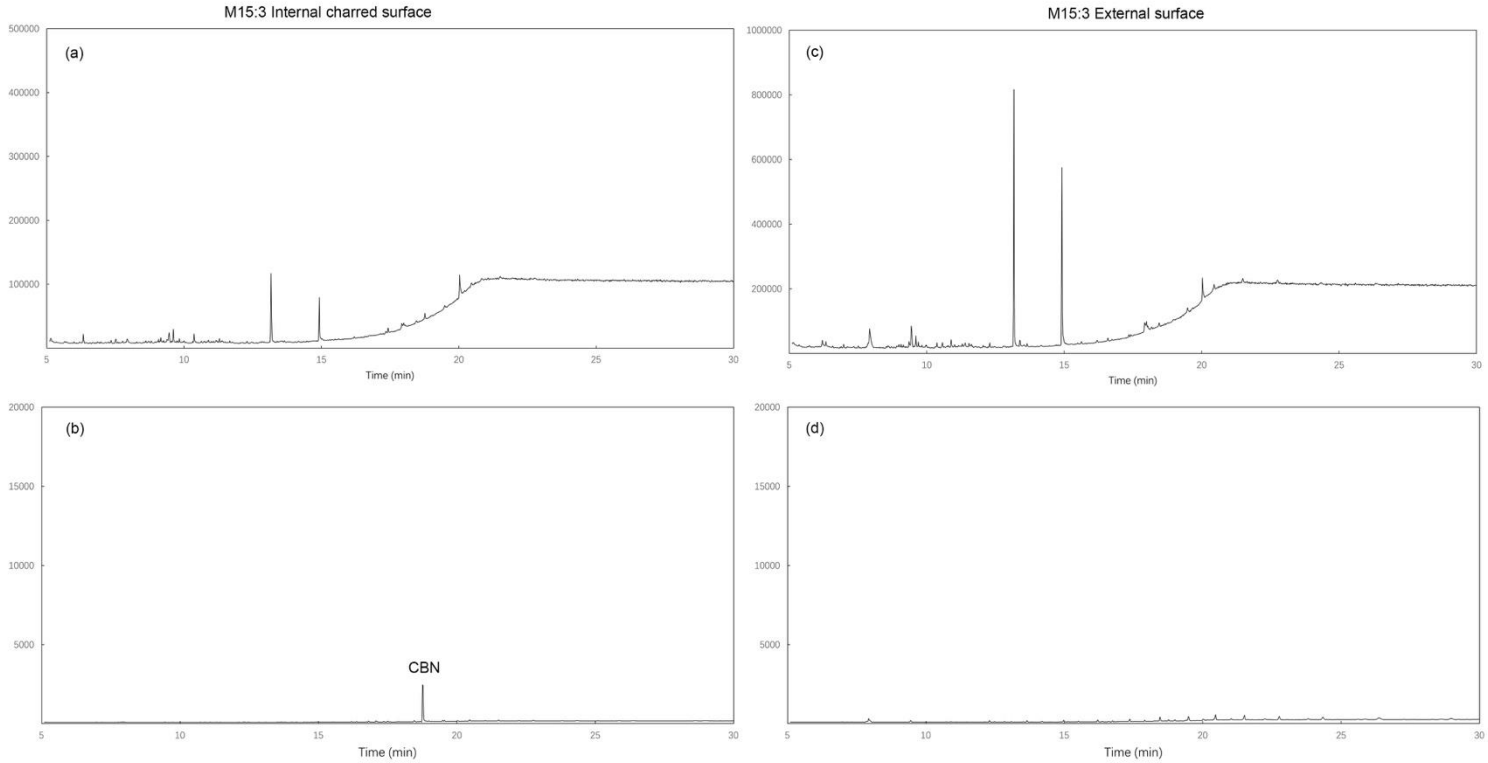

Fig. S7. Chromatograms of the wooden brazier M15:3 from the Jirzankal Cemetery. (a) TIC chromatogram of the internal charred fragment of the wooden brazier M15:3 (labeled as 6I); (b) SIM chromatogram of the internal charred fragment of the wooden brazier M15:3, showing cannabinol (CBN); (c) TIC chromatogram of the external fragment of the wooden brazier M15:3 (labeled as 6E); (d) SIM chromatogram of the external fragment of the wooden brazier M15:3.

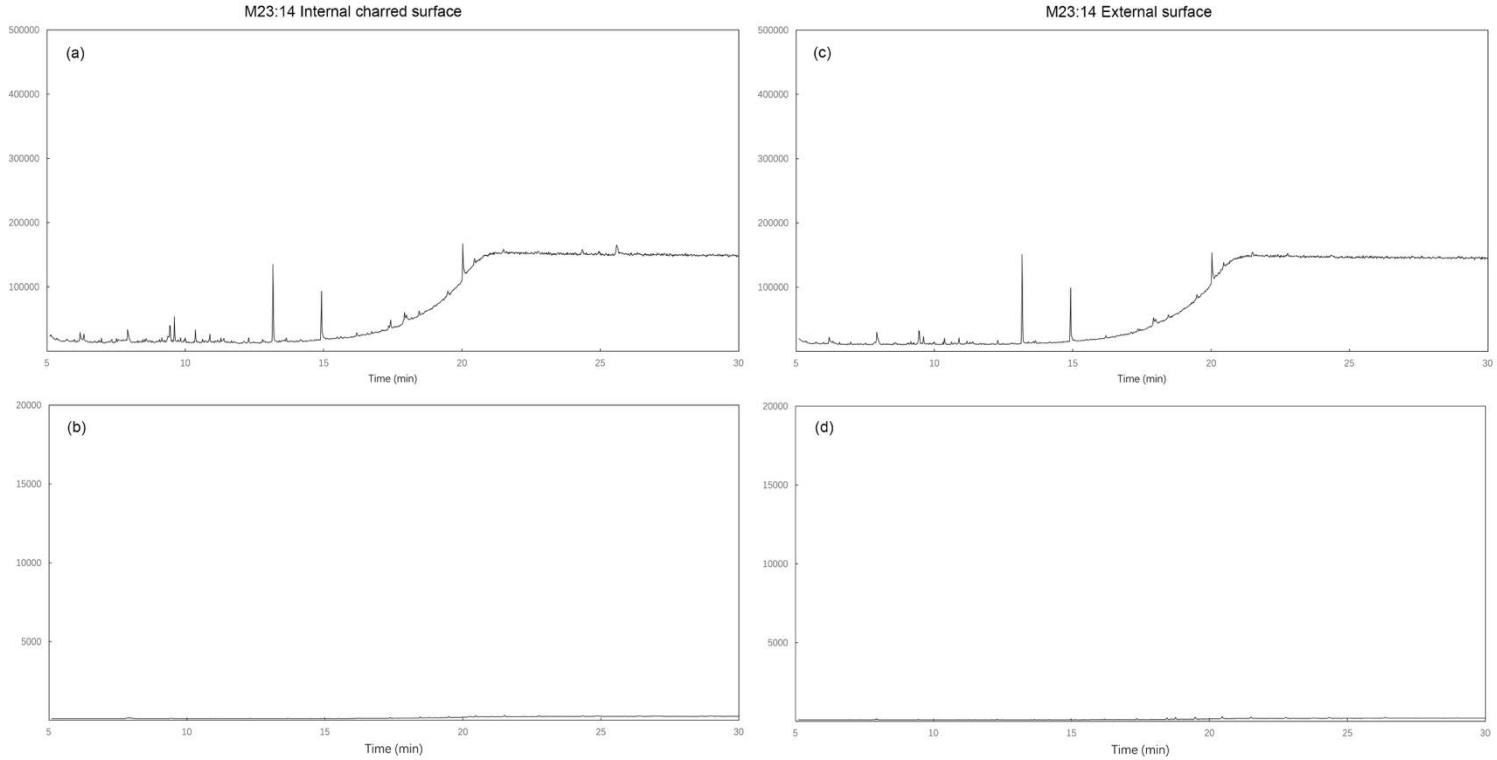

Fig. S8. Chromatograms of the wooden brazier M23:14 from the Jirzankal Cemetery. (a) TIC chromatogram of the internal charred fragment of the wooden brazier M23:14 (labeled as 7I); (b) SIM chromatogram of the internal charred fragment of the wooden brazier M23:14, without the detection of cannabinol (CBN); (c) TIC chromatogram of the external fragment of the wooden brazier M23:14 (labeled as 7E); (d) SIM chromatogram of the external fragment of the wooden brazier M23:14.

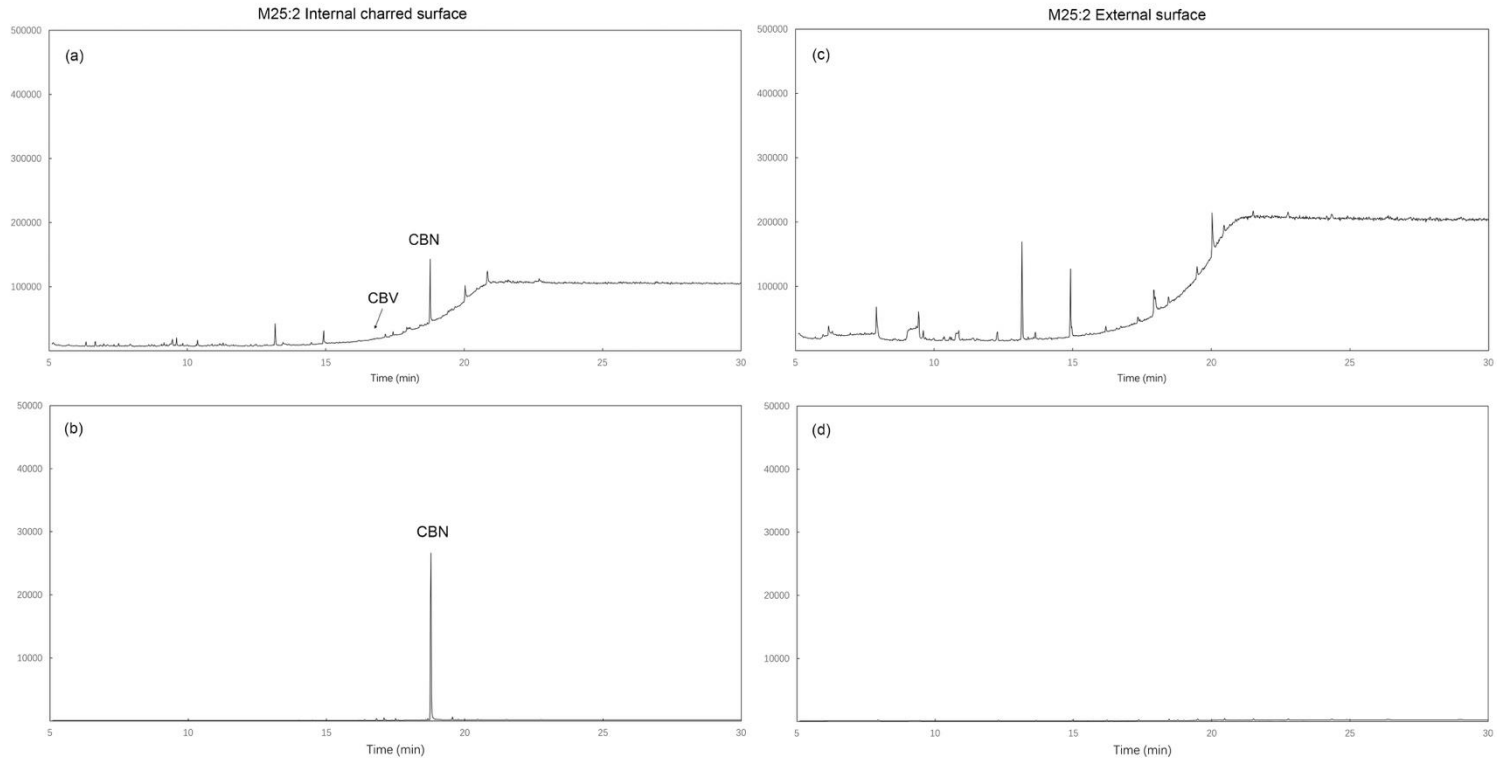

Fig. S9. Chromatograms of the wooden brazier M25:2 from the Jirzankal Cemetery. (a) TIC chromatogram of the internal charred fragment of the wooden brazier M25:2 (labeled as 8I); (b) SIM chromatogram of the internal charred fragment of the wooden brazier M25:2, showing cannabinol (CBN); (c) TIC chromatogram of the external fragment of the wooden brazier M25:2 (labeled as 8E); (d) SIM chromatogram of the external fragment of the wooden brazier M25:2.

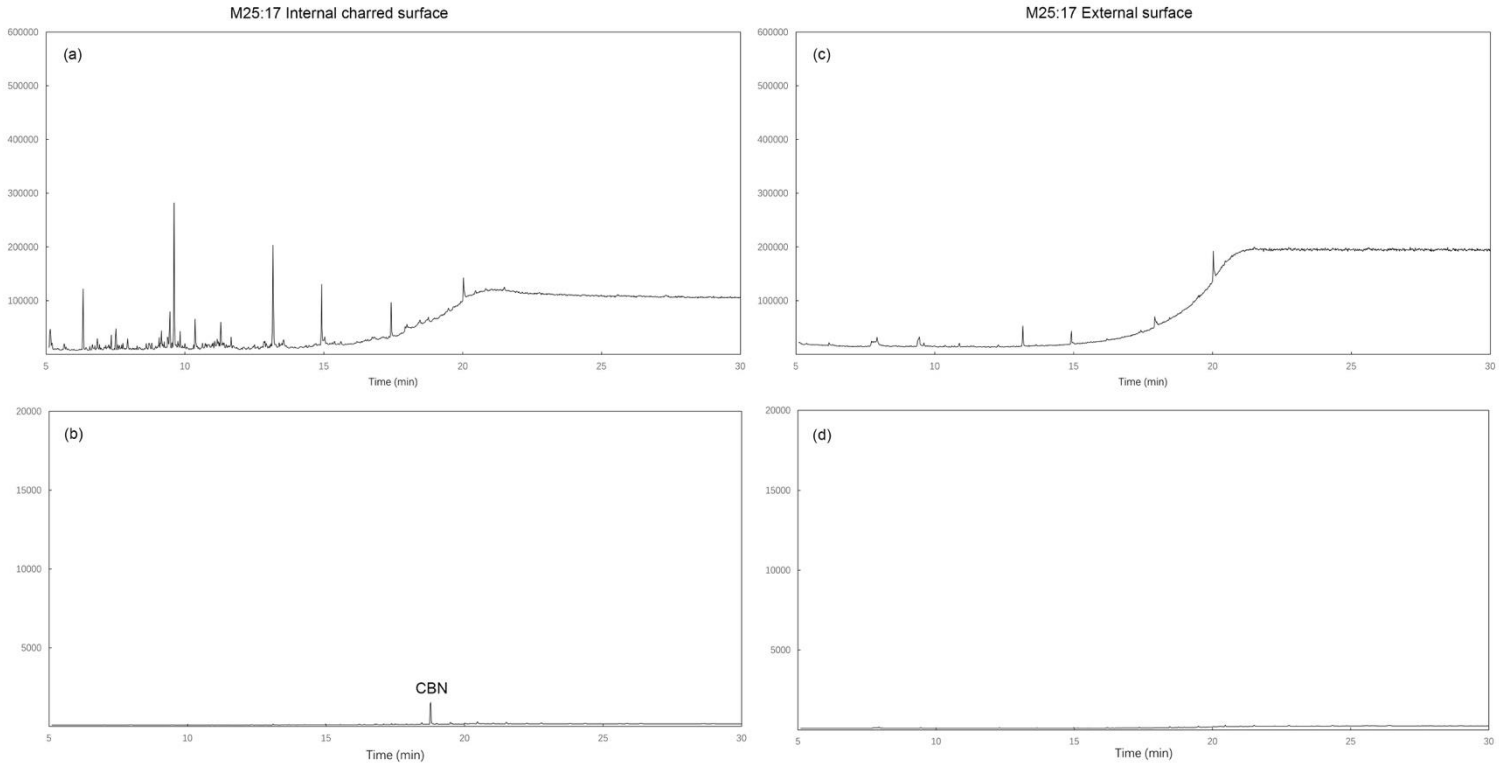

Fig. S10. Chromatograms of the wooden brazier M25:17 from the Jirzankal Cemetery. (a) TIC chromatogram of the internal charred fragment of the wooden brazier M25:17 (labeled as 9I); (b) SIM chromatogram of the internal charred fragment of the wooden brazier M25:17, showing cannabinol (CBN); (c) TIC chromatogram of the external fragment of the wooden brazier M25:17 (labeled as 9E); (d) SIM chromatogram of the external fragment of the wooden brazier M25:17.

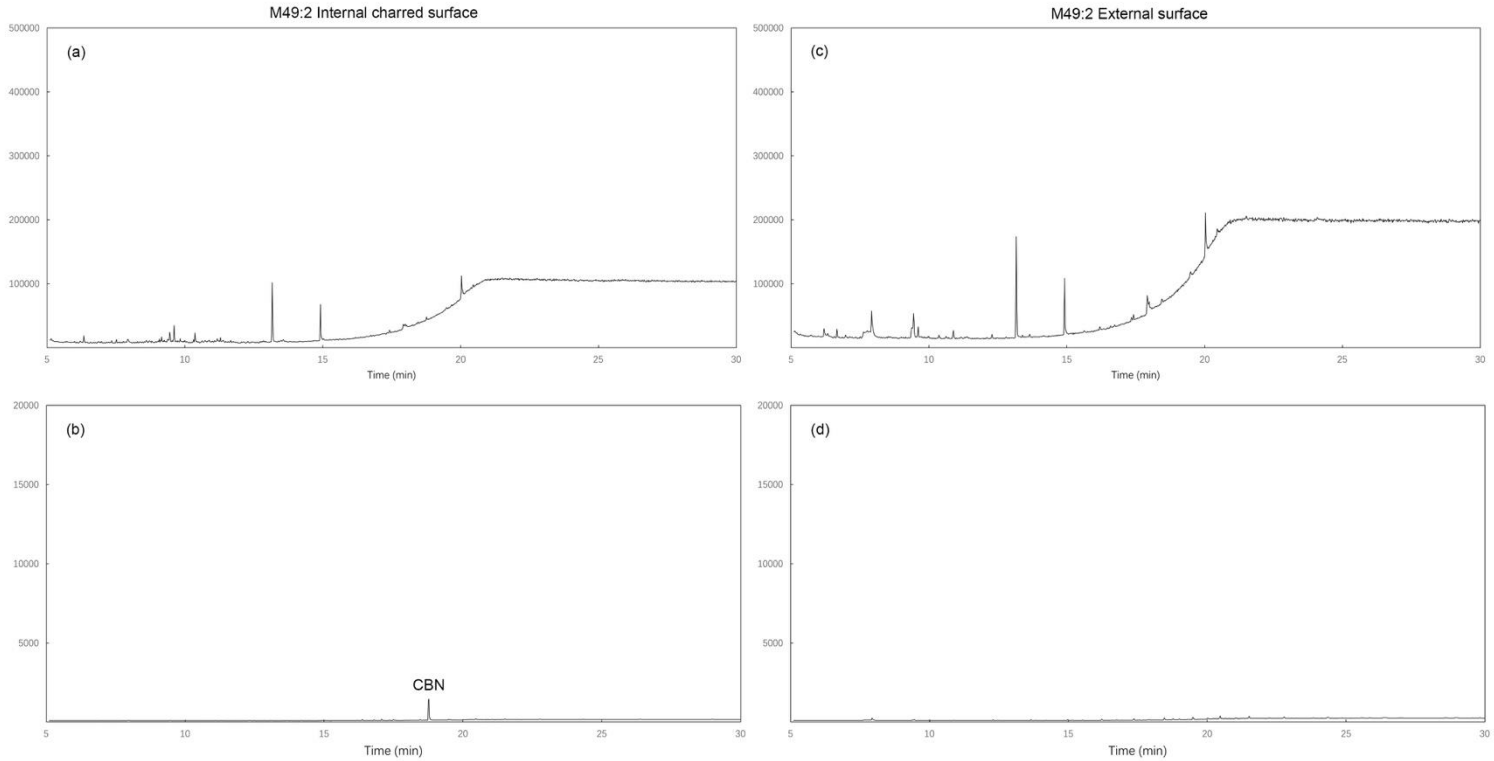

Fig. S11. Chromatograms of the wooden brazier M49:2 from the Jirzankal Cemetery. (a) TIC chromatogram of the internal charred fragment of the wooden brazier M49:2 (labeled as 10I); (b) SIM chromatogram of the internal charred fragment of the wooden brazier M49:2, showing cannabinol (CBN); (c) TIC chromatogram of the external fragment of the wooden brazier M49:2 (labeled as 10E); (d) SIM chromatogram of the external fragment of the wooden brazier M49:2.

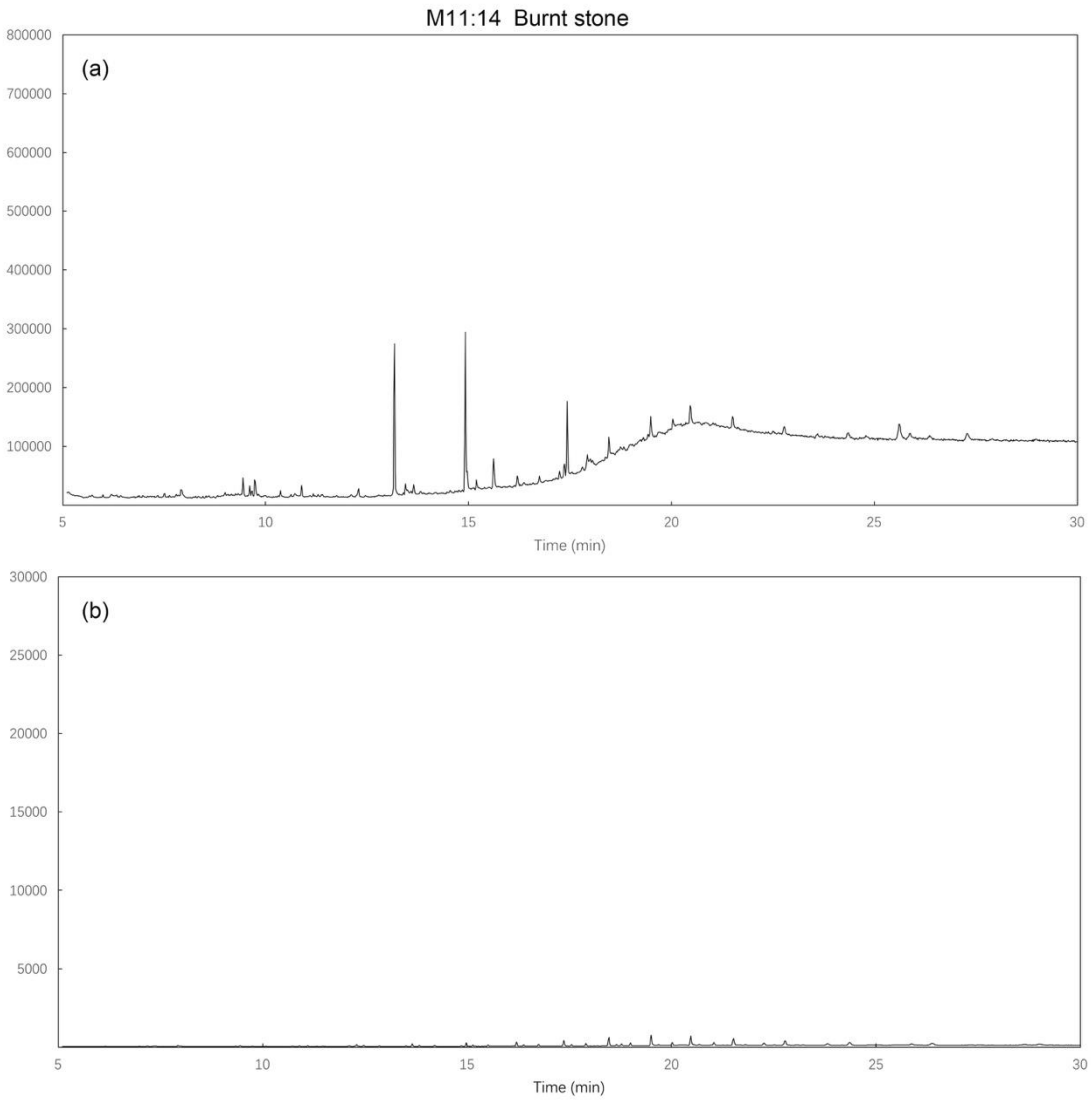

Fig. S12. Chromatograms of the burnt stone in the wooden brazier M11:14 from the Jirzankal Cemetery. (a) TIC chromatogram and (b) SIM chromatogram of the burnt stone (labeled as 11S) in the wooden brazier M11:14.

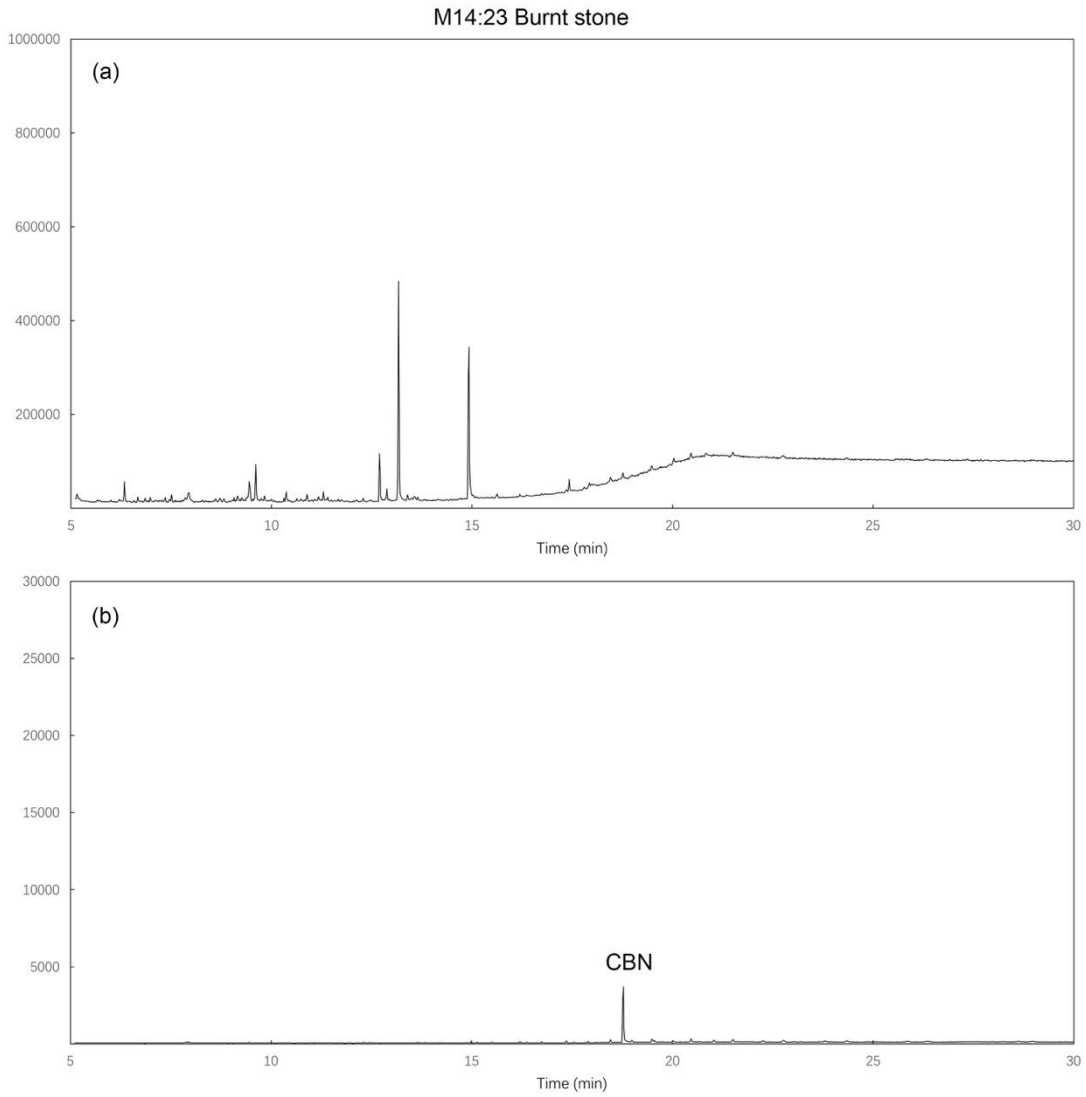

Fig. S13. Chromatograms of the burnt stone in the wooden brazier M14:23 from the Jirzankal Cemetery. (a) TIC chromatogram and (b) SIM chromatogram of the burnt stone (labeled as 12S) in the wooden brazier M14:23.

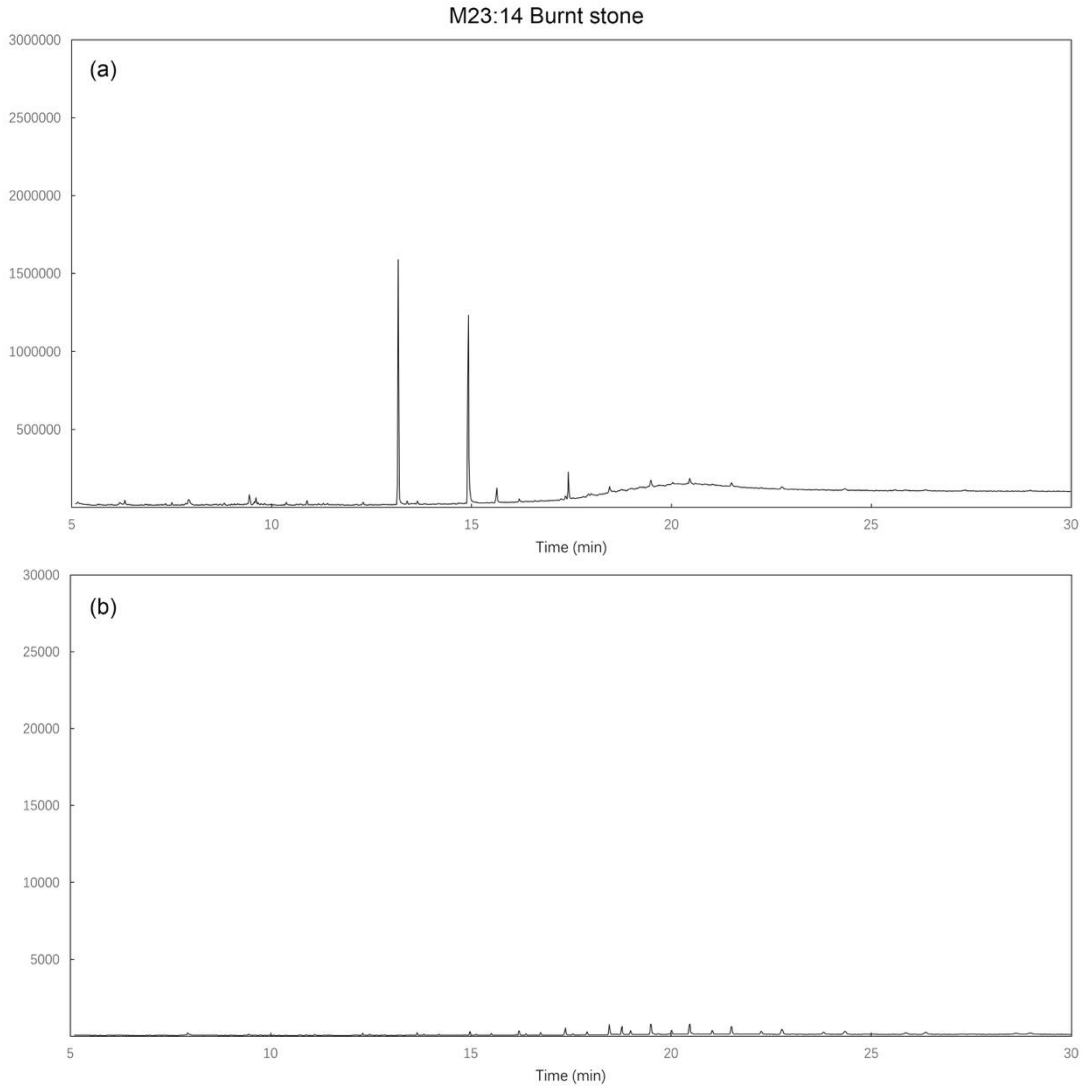

Fig. S14. Chromatograms of the burnt stone in the wooden brazier M23:14 from the Jirzankal Cemetery. (a) TIC chromatogram and (b) SIM chromatogram of the burnt stone (labeled as 13S) in the wooden brazier M23:14.

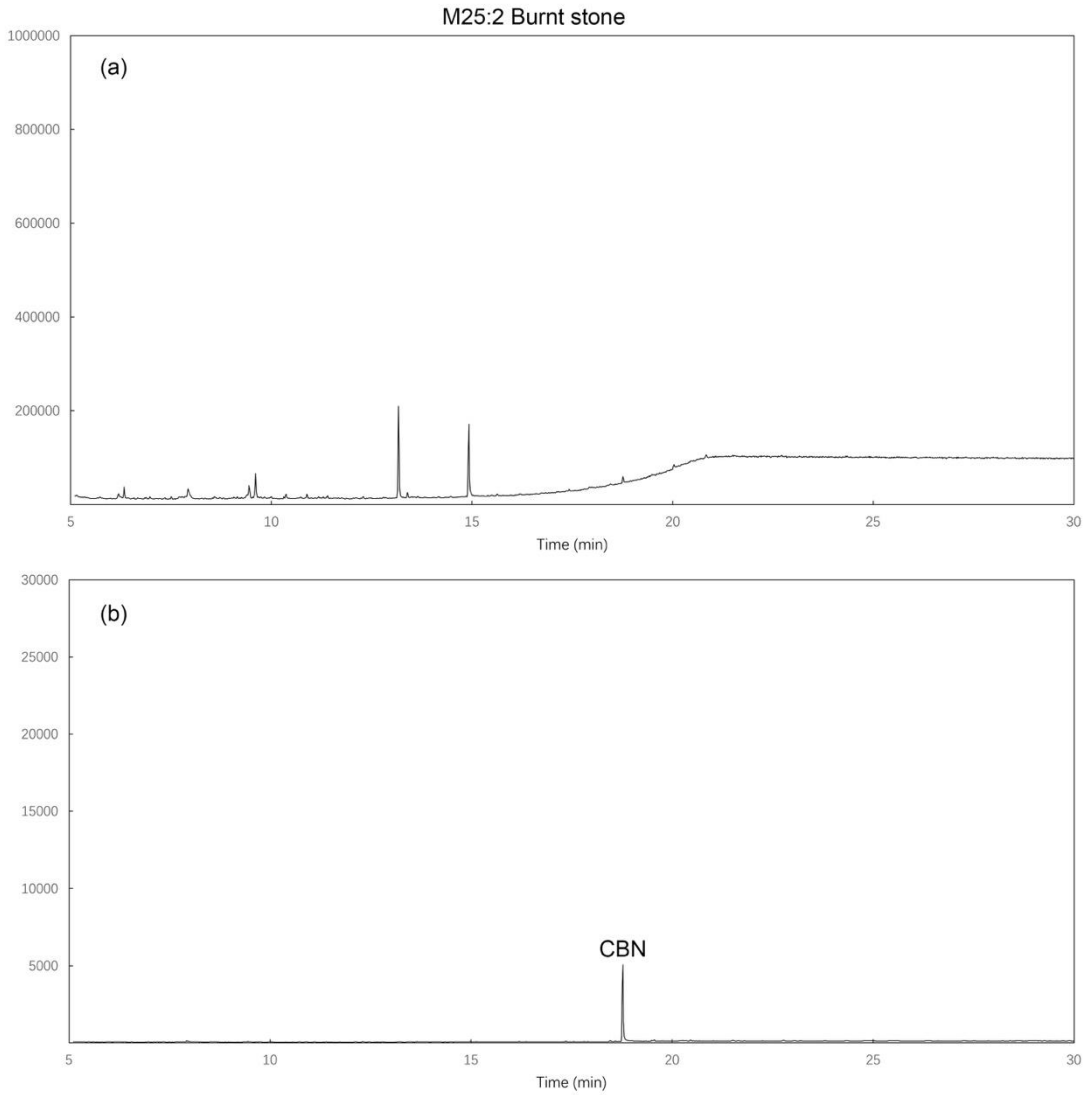

Fig. S15. Chromatograms of the burnt stone in the wooden brazier M25:2 from the Jirzankal Cemetery. (a) TIC chromatogram and (b) SIM chromatogram of the burnt stone (labeled as 14S) in the wooden brazier M25:2.