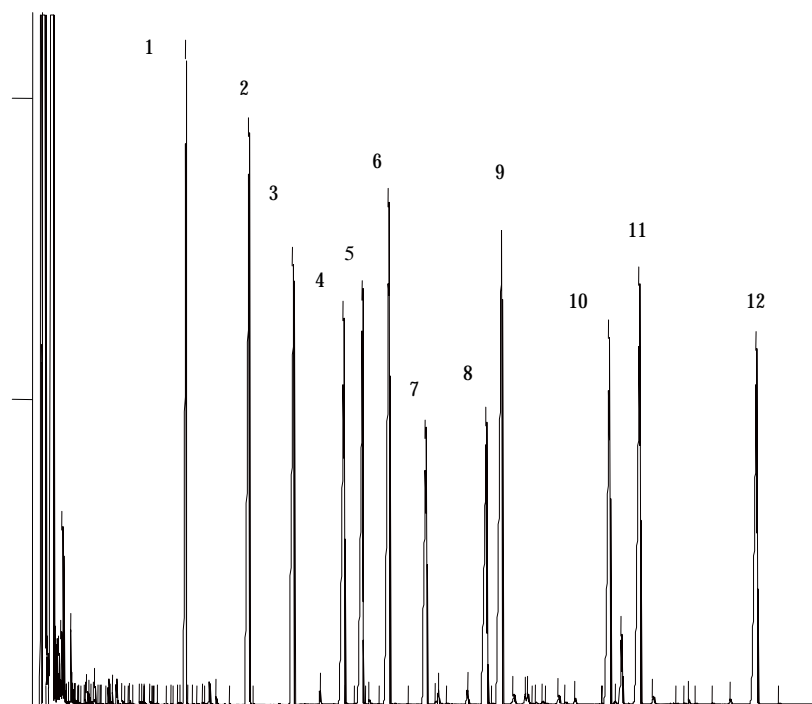


Supplementary Information Fig. 1 Flow diagram summarizing the analytical protocol.



Supplementary Information Fig. 2 The 12 Me₃Si-silylated phenols of the standard mixtures was analysed using the gas chromatograph with flame ionization detector (GC-FID). Peaks of each lignin phenol are numbered according to their elution times: 1) p-hydroxybenzaldehyde; 2) p-hydroxyacetophenone; 3) vanillin; 4) ethyl vanillin; 5) acetovanillone; 6) p-hydroxybenzoic acid; 7) syringaldehyde; 8) acetosyringone; 9) vanillic acid; 10) syringic acid; 11) p-coumaric acid; 12) ferulic acid.

Supplementary Information Table 1 Concentrations of lignin-derived phenols under different oxidation conditions

No	Lignin	Concentrations of lignin phenol detected from different CuO oxidation programs (mg/g)											
		170°C, 2 hrs			170°C, 3 hrs			155°C, 2 hrs			155°C, 3 hrs		
		1	2	Mean	1	2	mean	1	2	mean	1	2	Mean
1	p-hb	0.05	0.04	0.05±0.01	0.04	0.10	0.07±0.04	0.38	0.43	0.41±0.04	0.50	0.48	0.49±0.01
2	p-ha	0.37	0.26	0.32±0.08	0.31	0.86	0.59±0.39	0.39	0.48	0.44±0.06	0.43	0.40	0.42±0.02
3	Van	0.25	0.18	0.22±0.05	0.31	1.30	0.81±0.70	0.65	0.60	0.63±0.04	0.51	0.43	0.47±0.06
4	EV	0.22	0.22	0.22±0.00	0.22	0.22	0.22±0.00	0.23	0.23	0.23±0.00	0.22	0.22	0.22±0.00
5	Acetovan	0.30	0.25	0.28±0.04	0.40	0.60	0.50±0.14	0.39	0.49	0.44±0.07	0.43	0.41	0.42±0.01
6	p-hba	1.38	1.62	1.50±0.17	5.05	6.10	5.58±0.74	0.45	0.56	0.51±0.08	0.55	0.53	0.54±0.01
7	Syrin	0.30	0.17	0.24±0.09	0.03	0.06	0.05±0.02	0.84	0.60	0.72±0.17	1.57	1.50	1.54±0.05
8	Acetosyr	0.35	0.29	0.32±0.04	0.49	0.38	0.44±0.08	0.67	0.84	0.76±0.12	0.64	0.73	0.69±0.06
9	Va	1.62	1.39	1.51±0.16	4.02	9.98	7.00±4.21	0.58	0.72	0.65±0.10	0.89	0.88	0.89±0.01
10	Sa	2.26	1.93	2.10±0.23	5.22	9.48	7.35±3.01	0.99	1.16	1.08±0.12	1.01	1.23	1.12±0.16
11	p-cou	6.64	5.15	5.90±1.05	4.38	0.81	2.60±2.52	9.20	12.76	10.98±2.52	6.48	7.62	7.05±0.81
12	Fe	0.88	0.68	0.78±0.14	0.70	0.35	0.53±0.25	1.44	1.98	1.71±0.38	1.00	1.40	1.20±0.28

Abbreviations: p-hb, p-hydroxybenzaldehyde; p-ha, p-hydroxyacetophenone; Van, vanillin; EV, ethyl vanillin; Acetovan, acetovanillone; p-hba, p-hydroxybenzoic acid; Syrin, syringaldehyde; Acetosyr, acetosyringone; Va, vanillic acid; Sa, syringic acid; p-Cou, p-coumaric acid; Fe, ferulic acid.

Supplementary Information Table 2 Monthly concentrations of lignin-derived phenol parameters at different sampling locations in Loch Creran

(a) Sediment trap

Lignin parameters	Sampling dates												
	12.12.01	8.1.02	6.2.02	7.3.02	4.4.02	7.5.02	4.6.02	2.7.02	1.8.02	2.9.02	30.9.02	14.11.02	12.12.02
P (mg/g)	0.0838	0.0804	0.1094	0.1049	0.2269	0.1685	0.0736	0.2350	0.0646	0.0783	0.1276	0.0811	0.0579
V (mg/g)	0.1433	0.1468	0.1841	0.1857	0.1383	0.0605	0.0796	0.2050	0.0738	0.1131	0.1473	0.1371	0.0942
S (mg/g)	0.0939	0.0967	0.1176	0.1232	0.0789	0.0974	0.0853	0.1006	0.0543	0.0837	0.0943	0.0987	0.0685
C (mg/g)	0.0990	0.0917	0.1743	0.1494	0.0479	0.0273	0.0517	0.0604	0.0352	0.0659	0.1020	0.0824	0.0642
Total lignin (mg/g)	0.3362	0.3352	0.4760	0.4583	0.2651	0.1852	0.2166	0.3660	0.1633	0.2627	0.3436	0.3182	0.2269
S/V	0.6553	0.6587	0.6388	0.6634	0.5705	1.6100	1.0716	0.4907	0.7358	0.7401	0.6402	0.7199	0.7272
C/V	0.6909	0.6247	0.9468	0.8045	0.3465	0.4512	0.6495	0.2946	0.4740	0.5827	0.6925	0.6010	0.3631
(Ad/Al) _v	0.7555	0.9430	1.0132	1.0342	4.7459	1.1210	1.5059	7.6142	1.4564	1.1962	2.9852	1.4485	1.2796
(Ad/Al) _s	0.5093	0.6083	0.6283	0.6026	2.4872	3.0427	0.3170	5.0809	0.7371	0.5860	1.3012	0.6653	0.6532

P = p-hydroxyl phenols; V = vanillyl phenols; S = syringyl phenols; C = cinnamyl phenols; (Ad/Al)_v = ratio of vanillic acid to vanillin and (Ad/Al)_s = ratio of syringic acid to syringaldehyde.

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(b) LC1

Lignin parameters	Sampling dates and sediment depths															
	Creran head		LC1(8.1.02)	6.2.02	7.3.02	7.5.02	4.6.02		2.7.02	1.8.02	2.9.02		30.9.02	14.11.02	12.12.02	
	0-1cm	9-10cm	0-1cm	0-1cm	0-1cm	0-1cm	0-1cm	9-10cm	0-1cm	0-1cm	0-1cm	9-10cm	0-1cm	0-1cm	0-1cm	9-10cm
P (mg/g)	0.0128	0.0067	0.0824	0.0767	0.0591	0.0169	0.0665	0.0688	0.0545	0.0802	0.0923	0.0520	0.0324	0.0855	0.0722	0.0721
V (mg/g)	0.0269	0.0185	0.0853	0.0643	0.0755	0.0145	0.1097	0.0808	0.0685	0.0948	0.1148	0.0758	0.0881	0.1568	0.1205	0.1401
S (mg/g)	0.0086	0.0048	0.0586	0.0642	0.0498	0.0094	0.0732	0.0529	0.0451	0.0377	0.0648	0.0465	0.0705	0.0901	0.0754	0.0836
C (mg/g)	0.0329	0.0204	0.0734	0.0549	0.0746	0.0045	0.0892	0.0810	0.0692	0.0641	0.0908	0.0729	0.0711	0.0785	0.0760	0.0926
Total lignin (mg/g)	0.0684	0.0437	0.2173	0.1834	0.1999	0.0284	0.2721	0.2147	0.1828	0.1966	0.2704	0.1952	0.2297	0.3254	0.2719	0.3163
S/V	0.3197	0.2595	0.6870	0.9984	0.6596	0.6483	0.6673	0.6547	0.6584	0.3977	0.5645	0.6135	0.8002	0.5746	0.6257	0.5967
C/V	1.2230	1.1027	0.8605	0.8538	0.9881	0.3103	0.8131	1.0025	1.0102	0.6762	0.7909	0.9617	0.8070	0.5006	0.6307	0.6610
(Ad/Al)v	0.5918	0.4894	0.3919	0.7748	0.9355	0.5395	1.1571	0.9500	0.7689	0.3201	0.7195	0.8889	1.3470	1.1737	0.8185	0.8603
(Ad/Al)s	0.6579	1.4545	0.8549	0.3510	0.6239	0.6444	0.5659	0.6102	0.4679	2.9038	0.6188	0.6406	0.8934	0.7913	0.5863	0.5324

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(c) LC0

Lignin parameters	Sampling dates and sediment depths				
	8.1.02 (0-1cm)	4.4.02 (0-1cm)	4.6.02 (0-1cm)	14.11.02 (0-1cm)	14.11.02 (9-10cm)
P (mg/g)	0.0934	0.1155	0.0716	0.0735	0.0729
V (mg/g)	0.1282	0.1696	0.1347	0.1427	0.1521
S (mg/g)	0.0782	0.1145	0.0930	0.0840	0.0887
C (mg/g)	0.0913	0.0830	0.1139	0.0928	0.0855
Total lignin (mg/g)	0.2977	0.3671	0.3416	0.3195	0.3263
S/V	0.6100	0.6751	0.6904	0.5886	0.5832
C/V	0.7123	0.4894	0.8456	0.6503	0.5621
(Ad/Al) _v	0.8593	1.3304	0.9269	0.8651	1.3551
(Ad/Al) _s	0.6366	0.9080	0.5345	0.5621	0.7481

(d) LC2

Lignin parameters	Sampling dates and sediment depths		
	4.4.02 (0-1cm)	2.9.02 (0-1cm)	2.9.02 (9-10cm)
P (mg/g)	0.0611	0.0382	0.0517
V (mg/g)	0.1193	0.0566	0.0686
S (mg/g)	0.0715	0.0248	0.0298
C (mg/g)	0.0481	0.0390	0.0603
Total lignin (mg/g)	0.2389	0.1204	0.1687
S/V	0.5993	0.4382	0.5802
C/V	0.4032	0.6890	0.8790
(Ad/Al) _v	1.3053	0.7083	0.8780
(Ad/Al) _s	0.8932	1.0638	0.6595

(e) LC3

Lignin parameters	Sampling dates and sediment depths		
	7.5.02 (0-1cm)	30.9.02 (0-1cm)	30.9.02 (9-10cm)
P (mg/g)	0.0154	0.0306	0.0353
V (mg/g)	0.0271	0.0381	0.0256
S (mg/g)	0.0105	0.0225	0.0133
C (mg/g)	0.0104	0.0193	0.0377
Total lignin (mg/g)	0.0480	0.0799	0.0766
S/V	0.3875	0.5906	0.5196
C/V	0.3838	0.5066	1.4727
(Ad/Al) _v	0.5526	1.5758	1.4324
(Ad/Al) _s	0.4909	1.5000	0.5846

(f) LC5

Lignin parameters	Sampling dates and sediment depths			
	6.2.02 (0-1cm)	2.7.02 (0-1cm)	12.12.02 (0-1cm)	12.12.02 (9-10cm)
P (mg/g)	0.0300	0.0628	0.0450	0.0362
V (mg/g)	0.0286	0.0874	0.0481	0.0212
S (mg/g)	0.0044	0.0557	0.0238	0.0082
C (mg/g)	0	0.0689	0.0353	0.0242
Total lignin (mg/g)	0.0330	0.2120	0.1072	0.0536
S/V	0.1538	0.6373	0.4948	0.3868
C/V	0	0.7883	0.7339	1.1415
(Ad/Al)v	0	0.9903	0.5611	0.5077
(Ad/Al)s	0.4194	0.5000	0.5042	0.6757

(g) LC6

Lignin parameters	Sampling dates and sediment depths			
	21.3.02 (0-1cm)	1.8.02 (0-1cm)	30.9.02 (0-1cm)	30.9.02 (9-10cm)
P (mg/g)	0.0147	0.0137	0.0280	0.0145
V (mg/g)	0.0188	0.0203	0.0265	0.0155
S (mg/g)	0.0111	0.0062	0.0073	0.0064
C (mg/g)	0.0069	0.0260	0.0353	0.0075
Total lignin (mg/g)	0.0368	0.0525	0.0691	0.0294
S/V	0.5904	0.3054	0.2755	0.4129
C/V	0.3670	1.2808	1.3321	0.4839
(Ad/Al)v	1.1129	0.6481	0.8235	0.9487
(Ad/Al)s	0.5091	0.8846	0.8750	1.4500

Note that the above concentrations are reported in the unit mg/g. The mean OC content of each location is 4.8% for LC0, 6.0% for the sediment trap samples, 4.0% for LC1, 3.1% for LC2, 1.8% for LC3, 2.3% for LC5 and 1.1% for LC6.