

Supplementary Material

Article title: Chemical elements recorded by *Quercus mongolica* Fisch. ex Ledeb tree rings reveal trends of pollution history in Harbin, China

Authors: Paula Ballikaya^{1,2,*}, Wenqi Song^{1,3}, Olivier Bachmann⁴, Marcel Guillong⁴, Xiaochun Wang³, Paolo Cherubini^{1,2,5}

¹ WSL, Swiss Federal Institute for Forest, Snow and Landscape Research, Zuercherstrasse 111, 8903, Birmensdorf, Switzerland

² Department of Geography, University of Zurich, 8057 Zurich, Switzerland

³ Key Laboratory of Sustainable Forest Ecosystem Management, Ministry of Education, School of Forestry, Northeast Forestry University, Harbin 150040, China

⁴ Institute of Geochemistry and Petrology, ETH, Clausiusstrasse 25, 8092, Zurich, Switzerland

⁵ Department of Forest and Conservation Sciences, Faculty of Forestry, University of British Columbia, 2004-2424 Main Mall, V6T 1Z4, Vancouver BC, Canada

The following Supplementary Material is available for this article:

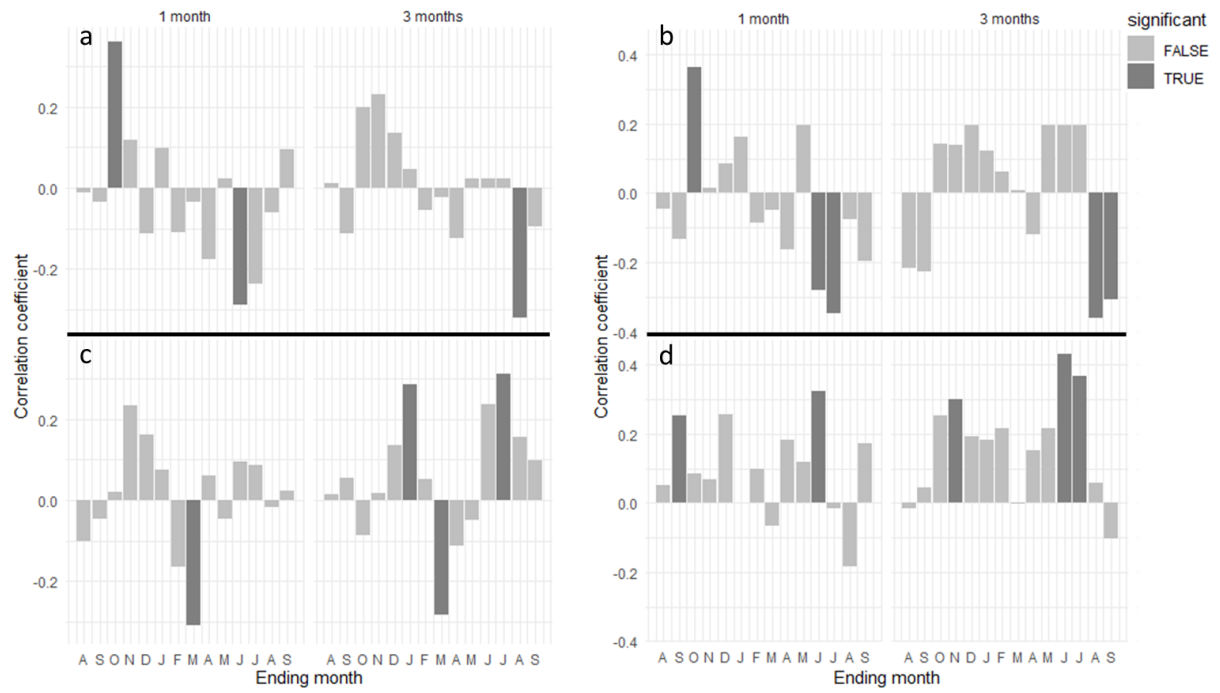


Figure S1. Monthly temperature (a, b) and precipitation (c, d) correlations with ring-width parameter from Mao'ershan (left) and Harbin (right). Both tree-ring and instrumental data have been 30-year spline detrended. Dark grey bars indicate significant correlations at $P \leq 0.05$.

Table S1. Examples of dendrochemical studies that investigated the trace metal concentration in different tree species across China.

Location	Tree species	Elements	Period	Method	References
Pearl River Delta, Guangdong Province	<i>Pinus massoniana</i>	S	1941-2002	-	[48]
Yixing, Jiangsu Province	<i>Ulmus pumila</i>	Cd, Cr, Cu, Ni, Pb, Zn	1977-2006	ICP-AES	[49]
Shenyang, Liaoning Province	<i>Pinus tabuliformis</i>	K, Ca, Mg, Mn, Cu, Zn, Al; Pb, Cd	1884-1996	ICP-AES; AAS	[50]
Yichun, Heilongjiang Province	<i>Larix gmelinii</i>	Pb, Cd, n, Cu, Mn	1987-2010	ICP-MS	[51]
Yangtze River Delta, Jiangsu Province	<i>Kalopanax septemlobus</i>	Pb, Zn	1960-2007	ICP-MS	[52]
Shanghai	<i>Cinnamomum camphora</i>	Cu, Zn, Pb, Cd	2004-2013	AAS	[53]
Xi'an, Shaanxi Province	<i>Toona sinensis</i> , <i>Firmiana simplex</i> ; <i>Populus bonatii</i> , <i>Ailanthus altissima</i>	Cd, Mn, P, Zn, Pb; Fe, Mn, Cu, Zn, Ni, Cr, Cd, Pb, Sn, Co, Hg, As and P	1991-2006; 1974-2009	ICP-MS and two-channel atomic fluorescence spectrometer; ICP-MS and ICP-AES	[54, 43]
Zhengzhou, Henan Province	<i>Cedrus deodara</i>	Cu, Zn, As, Cd, Hg, Pb	1980-2017	ICP-MS	[55]
Qinghai-Tibet Plateau, Qinghai province	<i>Picea crassifolia</i>	¹²⁷ I and ¹²⁹ I	1960-2015	ICP-MS	[56]
Fuzhou (Gu Mountain), Fujian Province	<i>Pinus massoniana</i>	Fe, Mn, Cu, Zn, Ni, Cr, Cd, Pb, Co, Sr	1848-2016	ICP-MS	[57]
Xikuangshan, Hunan Province	<i>Camptotheca acuminata</i> , <i>Camptotheca acuminata</i> , <i>Toona sinensis</i> , <i>Firmiana platanifolia</i> , <i>Melia azedarach</i> , <i>Cinnamomum camphora</i>	As, Ca, Pb, Sb, Zn	1949-2016	Laser Ablation-ICP-MS	[58]
Greater Hinggan Mountains, north-east China	<i>Larix gmelinii</i> , <i>Pinus sylvestris</i> var. <i>mongolica</i>	Hg	1940s-2014	atomic fluorescence spectrometry	[59]

Table S2. Spearman's correlation coefficients, calculated for the whole tree core, between elements in Mao'ershan and Harbin, that are significant at the 95% confidence level ($P < 0.05$), are provided in bold and italic.

Mao'ershan	Mg	Al	Si	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Sr	Tl	Pb	Bi
Mg	-																		
Al	0.28	-																	
Si	-0.53	-0.33	-																
S	0.63	0.50	-0.50	-															
K	-0.06	-0.41	0.08	-0.03	-														
Ca	0.49	0.25	0.01	0.42	-0.05	-													
Ti	-0.25	0.51	-0.03	0.13	0.10	-0.07	-												
Cr	-0.46	0.17	-0.06	0.15	0.37	-0.52	0.47	-											
Mn	0.86	0.36	-0.55	0.85	-0.14	0.39	-0.15	-0.13	-										
Fe	-0.50	-0.06	0.17	-0.21	0.65	-0.57	0.39	0.80	-0.45	-									
Co	0.18	0.18	-0.48	0.59	0.51	0.02	0.31	0.62	0.40	0.43	-								
Ni	0.59	0.48	-0.74	0.78	0.00	0.33	0.28	0.12	0.73	-0.17	0.75	-							
Cu	0.52	0.45	-0.27	0.76	-0.03	0.16	-0.05	0.20	0.71	-0.02	0.52	0.59	-						
Zn	0.71	0.57	-0.56	0.78	-0.23	0.29	0.14	-0.01	0.80	-0.25	0.50	0.81	0.68	-					
As	-0.17	0.32	0.10	-0.08	0.42	-0.02	0.43	0.39	-0.20	0.54	0.22	-0.01	0.03	-0.29	-				
Sr	0.41	0.16	-0.04	0.59	0.01	0.89	-0.19	-0.27	0.50	-0.47	0.27	0.43	0.36	0.33	-0.06	-			
Tl	-0.65	-0.44	0.70	-0.73	0.45	-0.20	-0.11	0.13	-0.80	0.55	-0.26	-0.74	-0.43	-0.80	0.42	-0.24	-		
Pb	0.13	0.84	-0.40	0.48	-0.46	-0.06	0.65	0.37	0.36	-0.01	0.30	0.56	0.36	0.59	0.17	-0.04	-0.62	-	
Bi	-0.03	0.79	-0.07	0.24	-0.12	0.01	0.68	0.41	0.06	0.33	0.35	0.39	0.39	0.33	0.63	-0.01	-0.08	0.75	-
Harbin	Mg	Al	Si	S	K	Ca	Ti	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Sr	Tl	Pb	Bi
Mg	-																		
Al	0.17	-																	
Si	-0.80	-0.25	-																
S	0.49	0.51	-0.51	-															
K	-0.36	-0.36	0.62	-0.83	-														
Ca	0.55	0.17	-0.17	0.45	-0.09	-													
Ti	0.01	0.64	0.03	0.38	-0.17	0.15	-												
Cr	-0.06	0.43	0.05	0.06	-0.01	-0.08	0.52	-											
Mn	0.71	0.53	-0.74	0.75	-0.69	0.41	0.51	0.41	-										
Fe	-0.25	0.22	0.21	-0.22	0.21	-0.11	0.29	0.91	0.15	-									
Co	0.27	0.75	-0.40	0.58	-0.58	0.04	0.62	0.70	0.76	0.47	-								
Ni	0.78	0.50	-0.67	0.62	-0.36	0.48	0.43	0.31	0.82	0.11	0.62	-							
Cu	-0.01	0.38	-0.05	0.20	-0.08	-0.01	0.34	0.78	0.34	0.76	0.71	0.45	-						
Zn	0.48	0.57	-0.55	0.72	-0.59	0.20	0.39	0.60	0.82	0.35	0.85	0.75	0.68	-					
As	0.57	0.31	-0.51	0.67	-0.59	0.63	0.07	-0.02	0.59	-0.17	0.35	0.38	0.08	0.43	-				
Sr	0.24	0.06	0.12	0.31	-0.01	0.90	0.13	-0.20	0.14	-0.16	-0.15	0.17	-0.15	-0.10	0.54	-			
Tl	-0.39	-0.22	0.53	-0.76	0.93	-0.01	-0.13	0.06	-0.59	0.32	-0.48	-0.30	0.01	-0.47	-0.54	0.01	-		
Pb	-0.49	0.29	0.48	-0.36	0.54	0.14	0.29	0.22	-0.31	0.41	-0.04	-0.17	0.26	-0.25	-0.17	0.26	0.71	-	
Bi	-0.45	0.26	0.40	-0.19	0.29	0.01	0.49	0.08	-0.21	0.22	0.06	-0.04	0.23	-0.29	-0.25	0.22	0.34	0.76	-