Supplementary materials for

The Isotopic Characteristics, Sources, and Formation Pathways of Atmospheric Sulfate and Nitrate in the South China Sea

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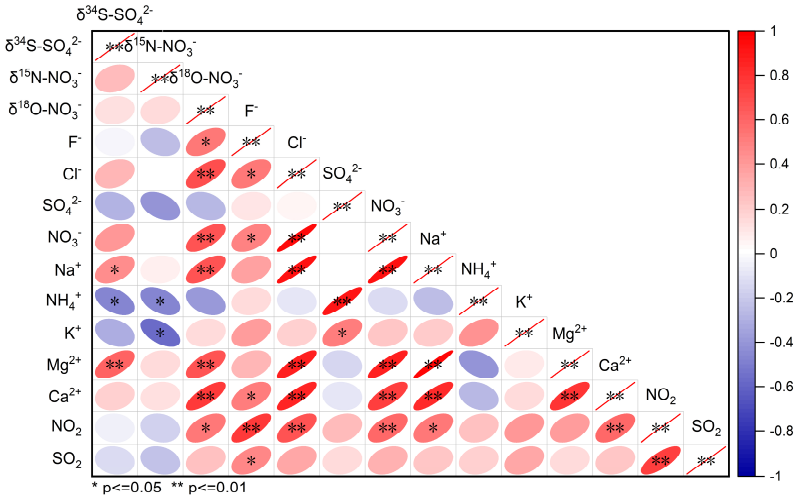


Figure S1. Correlation coefficients among major ions of $PM_{2.5}$ with gaseous pollutants and isotopes.

Table S1. Stable sulfur isotopic levels in sulfate aerosols

Regions	Sites	Acronym	Time	Site types	$\delta^{34}S\text{-}SO_4^{2-}$ (‰)	References
Arctic	Cruises		Jul. 2014	Polar zones	16.2 ± 2.6	Ghahreman et al., 2016
Antarctica	Dumont d'Urville	DDU	2011		17 ± 0.4	Ishino et al., 2019
Antarctica	Dome C	DC	2011		15.8 ± 0.5	
Antarctica	Atmospheric Research Observatory	ARO	2002 (SUM, AUT)		18.5 ± 1	Walters et al., 2019
Antarctica	Atmospheric Research Observatory	ARO	2002 (WIN, SPR)		14 ± 1	
Pacific	Cruises		Apr. 1988, Mar. 1989	Open oceans	15.6 ± 3.1	Calhoun et al., 1991
North Pacific	Hedo-misaki	HED	2014–2016		15.1 ± 1.5	Inomata et al., 2019
	Ogasawara	OGA	2014–2016		15.7 ± 3	
Atlantic	Cruises		Sep.–Oct. 2004		10.53 ± 3.23	Lin et al., 2012
South China Sea	Cruises		May.–Jun. 2021	Marginal seas	8.7 ± 1.8	**This study**
Sea of Japan	Rishiri	RIS	2014–2016		10.8 ± 1.4	Inomata et al., 2019
	Sadoseki-misaki	SAD	2014–2016		11.5 ± 1.4	
	Oki	OKI	2014–2016		13.2 ± 1.2	
Canada	Fraser Valley	FV	2001	Coastal cities	5.8 ± 1.9	Norman et al., 2006
Peru	Arequipa	AQP	2018		8.9 ± 5	Olson et al., 2021
Japan	Tsuruoka	TSU	1993–2003		5.7	Akata et al., 2010
North China	Lanzhou	LZ	Mar.–Jun. 2017	Inland cities	0.8	Wang et al., 2021
	Harbin	HRB			7.5	
	Shenyang	SY			6.5	
	Qingdao	QD			4.5	
	Shijiazhuang	SJZ			1.6	
	Tianjin	TJ			4.8	
	Beijing	BJ			6.5	
	Zhengzhou	ZZ			3.2	
	Taiyuan	TY			1.6	
South China	Wuhan	WH	Mar.–Jun. 2017	Inland cities	4.4	Wang et al., 2021
	Shanghai	SH			3.5	
	Nanjing	NJ			4.4	
	Chengdu	CD			5.7	
	Nanning	NN			0.2	
	Xiamen	XM			2.9	
	Guangzhou	GZ			2.6	
	Guiyang	GY			−2.7	

Table S2. Concentration and stable isotopic levels in nitrate aerosols

Regions	Sites	Seasons	Site types	NO_3^- (mg/m³)	$\delta^{15}N$ (‰)	$\delta^{18}O$ (‰)	References
West Pacific Ocean	Cruises	Winter	Open oceans	0.2 ± 0.2	−5.0 ± 3.5	72.3 ± 6.5	Kamezaki et al., 2019
West Pacific Ocean	Cruises	Winter			1.2 ± 1.5	55.9 ± 5.8	Jiang et al., 2021
SCS	Yongxing Island	Winter	Marginal seas	3.1 ± 0.8	1.2 ± 1.2	93.5 ± 1.0	Xiao et al., 2015
SCS	Dongsha Island	Winter			−4.5 ± 1.1	78.1 ± 1.1	Yang et al., 2014
South Korea	Uljin	Winter			8.2 ± 0.9	88.0 ± 1.4	Kim et al., 2019
Singapore	NTU	Winter	Coastal cities		−2.2 ± 0.2	57.0 ± 0.3	Li et al., 2020
China	Tianjin	Winter		20.5 ± 20.5	11.1 ± 5.9	86.7 ± 10.0	Zhang et al., 2022
	Hangzhou	Winter		21.0 ± 14.3	9.8 ± 3.2	84.8 ± 6.1	Fan et al., 2023
	Guangzhou	Winter		2.7 ± 0.6	9.5 ± 0.3	66.9 ± 3.0	Xi et al., 2023
	Shanghai	Winter		20.5 ± 15.6	7.2 ± 3.4	88.3 ± 12.1	Huang et al., 2024
China	Wuhan	Winter	Inland cities	33.3 ± 5.3	6.5 ± 1.3	93.7 ± 3.0	Deng et al., 2024
	Chengdu	Winter		27.2 ± 11.6	4.9 ± 4.3	98.8 ± 7.4	Zong et al., 2020
	Nanchang	Winter		16.2 ± 4.2	6.9 ± 0.6	86.7 ± 3.2	Luo et al., 2020
	Shijiazhuang	Winter		18.4 ± 13.9	14.1 ± 2.6	94.2 ± 4.8	Luo et al., 2021
West Pacific Ocean	Cruises	Summer	Open oceans	0.1 ± 0.1	−2.3 ± 4.1	70.7 ± 2.5	Kamezaki et al., 2019
East Indian Ocean	Cruises	Mar. - May.			0.9 ± 0.3	62.1 ± 5.8	Jiang et al., 2021
South China Sea	Cruises	May. - Jun.	Marginal seas	0.2 ± 0.4	−0.9 ± 2.4	52.3 ± 7.3	**This study**
South China Sea	Cruises	Summer		0.1 ± 0.1	4.9± 6.4	65.6 ± 12.1	Xiao et al., 2015
Yongxing Island	Yongxing Island	Summer		1.6 ± 0.4	0.3 ± 0.6	67.0 ± 8.1	Xiao et al., 2015
Dongsha Island	Dongsha Island	Summer			1.6	31.9	Yang et al., 2014
South Korea	Uljin	Winter			1.6 ± 0.7	69.8 ± 3.2	Kim et al., 2019
Singapore	NTU	Summer	Coastal cities		−0.4 ± 1.4	57.0 ± 2.0	Li et al., 2020
China	Tianjin	Summer		4.0 ± 2.3	5.9 ± 2.8	58.3 ± 8.9	Zhang et al., 2022
	Hangzhou	Summer		3.4 ± 6.6	5.9 ± 6.0	54.0 ± 6.4	Fan et al., 2023
	Guangzhou	Summer		0.6 ± 0.0	7.1 ± 0.3	58.4 ± 2.4	Xi et al., 2023
	Shanghai	Summer		1.8 ± 2.2	1.9 ± 6.1	63.3 ± 9.4	Huang et al., 2024
China	Wuhan	Summer	Inland cities	5.0 ± 3.4	3.8 ± 2.4	65.5 ± 2.1	Deng et al., 2024
	Chengdu	Summer		6.8 ± 4.6	1.3 ± 4.3	67.0 ± 7.9	Zong et al., 2020
	Nanchang	Summer		1.8 ± 0.5	2.5 ± 0.2	60.5 ± 2.7	Luo et al., 2020
	Shijiazhuang	Summer		9.4 ± 5.9	1.4 ± 2.2	67.5 ± 3.4	Luo et al., 2021

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