Supporting Information for

Oxidative Potential by $PM_{2.5}$ in the North China Plain: Generation of Hydroxyl Radical

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Text S1. Sampling and chemical analyses.

During the CAREBEIJING-NCP campaign (Campaign of Air Pollution Research in Megacity Beijing and North China Plain), ambient $PM_{2.5}$ samples were collected in an urban (Beijing) and suburban (Wangdu) site in NCP from 9th June to 8th July, 2014 (Figure S1). The Beijing site was located on the rooftop of a building in the campus of Peking University in Beijing, which was approximately 20 m above ground level with no obvious emission sources around except two major roads (200 m to the east and 600 m to the south). The Wangdu site was located on the top of two containers in Wangdu County, Baoding, Hebei Province, which was about 4 m above ground level and surrounded by farmland. And it is around 150 km away from Beijing and 90 km away from Shijiazhuang, which is a typical industry city in China.

The 23-h $PM_{2.5}$ samples were collected using an eight-channel low-volume sampler (SUPER SASS, Metone, USA, 6.7 L/min) in Beijing site, typically starting from 9:00 a.m. and ending at 8:00 a.m. the next day. A four-channel sampler (TH-16A, Tianhong, China, 16.7 L/min) was applied to collected $PM_{2.5}$ samples at the Wangdu site with daytime (from 8:00 a.m. to 5:30 p.m.) and nighttime (from 6:00 p.m. to 7:30 a.m. the next day) samples. Filter blanks were collected at the beginning, middle and end of the campaign. For each 23-h sampling, two Teflon filters (47 mm diameter, pore size 2 μm, Pall) and two quartz filters were collected. Before sampling, quartz filters were baked for 5.5 h at 550 °C. Teflon filters were weighted before sampling and re-weighted after sampling using a microbalance (Mettler Toledo) with the sensitivity of 0.00004 g to determine the mass concentration of $PM_{2.5}$. After sampling, the samples were stored at

-18 °C freezer prior to gravimetric and chemical analysis.

A punch of 2.27 cm^2 from each quartz filter was analyzed for organic carbon (OC) and element carbon (EC) using the offline mode of the online instrument of ECOC analyzer by the Sunset Laboratory (Model-4 Semi-Continuous Carbon Aerosol Analyzer). A 1/2 piece of each Teflon filter was put into a glass beaker, and 10 mL of de-ionized water (18.2 ΩM) was added. After a 30 min ultrasonic extraction at room temperature, it was filtered by a syringe filter, and analyzed by ion chromatography (ICS-2000 and ICS-2500, DIONEX) for water-soluble inorganic ions (Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, NO_3^-, and SO_4^{2-}). The remaining 1/2 piece of each Teflon filter was put in a digestion tank and a mixture of 4.5 mL HNO_3, 1.5 mL HCL, and 0.2 mL HF was added to digest the sample at 190 ℃ for 40 min. After digesting and cooling, the solution was diluted to 10 mL with de-ionized water. A total 23 elements (Al, Fe, Mn, Ti, Co, Cr, Ni, Cu, Pb, Zn, Cd, V, As, Se, Mo, and Co) was analyzed by inductively coupled plasma-mass spectrometry (ICP-MS).

Table S1. Average concentration of chemical species in $PM_{2.5}$ under different pollution levels, and the relative contribution of species to increased $PM_{2.5}$ from clean days to heavily polluted days in Beijing and Wangdu.

Species	*Conc. (μg/m³) in clean days*[a]		*Conc. (μg/m³) in heavily polluted days*		*Contribution to increased $PM_{2.5}$*[b]	
	Beijing	**Wangdu**	**Beijing**	**Wangdu**	**Beijing**	**Wangdu**
Fe	0.183	0.500	0.271	0.423	0.12%	/
Cu	0.005	0.015	0.020	0.028	0.02%	0.02%
Mn	0.012	0.020	0.022	0.028	0.01%	0.01%
Other metals	0.19	1.50	0.40	1.65	0.29%	0.21%
OC	6.2	9.0	8.0	11.6	2.46%	3.71%
EC	1.1	1.7	1.2	1.7	0.14%	/
SO_4^{2-}, NO_3^-, and NH_4^+	7.7	10.3	66.3	68.4	80.0%	83.1%

Notes:

[a]Clean days and heavily polluted days refer to days with daily average $PM_{2.5}$ concentration less than 35 μg/m^3 and above 75 μg/m^3, respectively.

[b]The relative contribution of increased mass of each species in the increased mass of $PM_{2.5}$ from clean days to heavily polluted days.

Table S2. The average $PM_{2.5}$ mass concentration (μg/m^3) and ·OH production (ng/μg·$PM_{2.5}$) under different pollution levels in Beijing and Wangdu.

	$PM_{2.5}$ (μg/m^3)		·OH (ng/μg·$PM_{2.5}$)	
	Beijing	**Wangdu**	**Beijing**	**Wangdu**
Average	51.4±31.5	70.5±37.4	1.11±0.41	1.01±0.43
Clean days	19.2±5.8	27.4±4.0	1.62±0.11	1.48±0.51
Lightly polluted days	50.8±8.7	54.3±9.8	0.99±0.20	1.04±0.29
Heavily polluted days	92.5±15.3	110.2±23.2	0.68±0.12	0.73±0.18

Notes: Clean days, lightly polluted days, and heavily polluted days refer to days with daily average $PM_{2.5}$ concentration less than 35 μg/m^3, between 35 and 75 μg/m^3, and above 75 μg/m^3, respectively.

Figure S1. Location of the sampling sites in the North China Plain. The map is created using ArcGIS for Desktop 10, with the base map from the National Geomatics Center of China (http://ngcc.sbsm.gov.cn/).

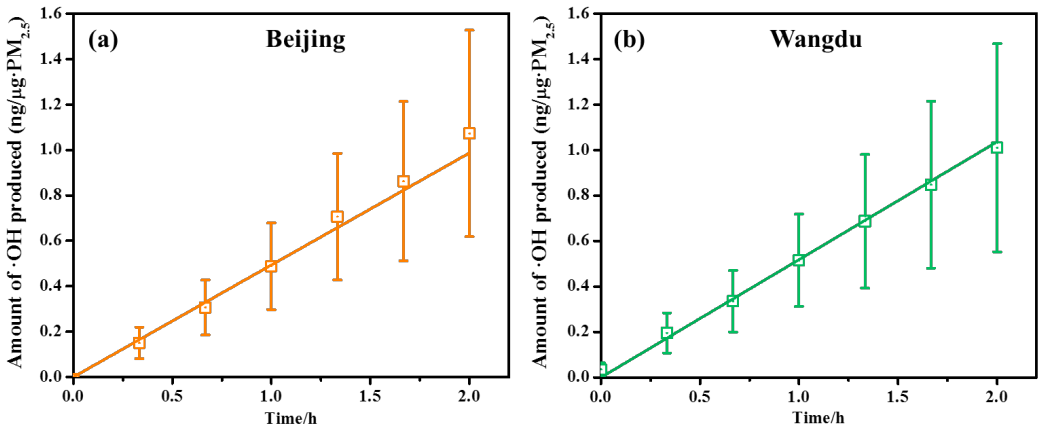

Figure S2. The formation of ·OH by $PM_{2.5}$ in a SLF solution as a function of extraction time (a: Beijing, b: Wangdu). The boundary of the box plot presents one standard deviation, and the square is the mean value.