# Article Title: Understanding sources and processes using chemistry of fine and coarse particles simultaneously collected from different windward locations in N-NW India

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**Table S1** Average meteorological parameters during sampling periodover Bikaner (BKR), Jhunjhunu (JHJ) and New Delhi (DEL)

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Bikaner | Jhunjhunu | Delhi |
| Temp (ºC) | 35.7±3.9 | 35.6±4.6 | 35.0±5.0 |
| Dew Point (ºC) | 6.9±5.2 | 5.4±3.4 | 5.0±3.7 |
| Relative Humidity (%) | 18.7±8.3 | 16.6±6.3 | 16.7±6.6 |
| Wind speed (Km/h) | 14.9±6.2 | 16.5±5.5 | 9.5±4.3 |
| Planetary Boundary Layer(m) | 1138.5±1371.6 | 1566.0±1786.6 | 1304.6±1708.5 |

Source:National Oceanic Atmospheric Administration (NOAA); <http://www.arl.noaa.gov/HYSPLIT.php>

**Table S2** Data on repeat analysis of standard solution (R1 to R6) and randomly selected sample (S1 to S4) during water-soluble inorganic ion analysis in particle samples using Ion chromatograph

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ions | F¯ | Cl¯ | NO₃¯ | SO₄²¯ | Na⁺ | NH₄⁺ | K⁺ | Ca²⁺ | Mg²⁺ |
| Milti ions std (True value) | 1.00 | 2.50 | 5.00 | 5.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| R1 | 1.01 | 2.73 | 5.53 | 5.30 | 0.94 | 1.06 | 0.99 | 1.08 | 0.95 |
| R2 | 1.01 | 2.74 | 5.54 | 5.44 | 0.94 | 0.98 | 0.98 | 0.97 | 1.04 |
| R3 | 1.01 | 2.72 | 5.56 | 5.31 | 1.01 | 1.05 | 0.98 | 0.91 | 1.40 |
| R4 | 1.02 | 2.63 | 5.55 | 5.23 | 1.00 | 1.02 | 0.99 | 0.92 | 1.02 |
| Avg | 1.01 | 2.70 | 5.54 | 5.32 | 0.97 | 1.03 | 0.98 | 0.97 | 1.10 |
| Std | 0.00 | 0.04 | 0.01 | 0.07 | 0.03 | 0.03 | 0.01 | 0.07 | 0.17 |
| %RSD | 0.07 | 0.21 | 0.10 | 0.27 | 0.18 | 0.18 | 0.08 | 0.26 | 0.42 |
| %Accuracy | 102.00 | 105.20 | 110.92 | 104.60 | 100.30 | 102.00 | 98.60 | 91.60 | 102.00 |
| S1 | 0.25 | 8.07 | 12.81 | 25.59 | 7.86 | 1.00 | 3.52 | 11.40 | 1.46 |
| S2 | 0.26 | 8.09 | 12.85 | 25.70 | 7.87 | 1.03 | 3.53 | 11.33 | 1.55 |
| S3 | 0.24 | 8.06 | 12.84 | 25.60 | 7.85 | 1.02 | 3.52 | 11.23 | 1.54 |
| Aver | 0.25 | 8.07 | 12.83 | 25.63 | 7.86 | 1.01 | 3.52 | 11.32 | 1.52 |
| Std | 0.01 | 0.01 | 0.02 | 0.05 | 0.01 | 0.01 | 0.00 | 0.07 | 0.04 |
| %RSD | 0.09 | 0.11 | 0.13 | 0.22 | 0.09 | 0.11 | 0.06 | 0.26 | 0.20 |

\*Represent true value of soluble ions in E-Merck standards solution used for repeat analysis as R1…..R4; S1…S3 are repeat analysis of randomly selected samples ;Avg = Average; Std= Standard deviation; % RSD = % Relative standard deviation.

**Table S3** Data on repeat analysis of BHVO2 standards (R1 and R2) for major elements, and 1000 ppb multi-element standard (R1 and R2) for trace elements and a randomly selected digested samples (S1 to S3) using ICP-OES

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Standard | Al [ppm] | Ca [ppm] | Fe [ppm] | Ti [ppm] | Mn [ppm] | Ba [ppb] | Cd [ppb] | Co [ppb] | Cr [ppb] | Cu [ppb] | Pb [ppb] | Sr [ppb] | Zn [ppb] |
| True Value | 358.00 | 408.50 | 431.50 | 81.50 | 6.45 | 1000.00 | 1000.00 | 1000.00 | 1000.00 | 1000.00 | 1000.00 | 1000.00 | 1000.00 |
| BHVO-2 | 350.11 | 406.40 | 400.70 | 83.23 | 6.37 | 993.85 | 989.63 | 993.49 | 991.12 | 991.08 | 994.50 | 993.27 | 978.20 |
| R1 | 348.96 | 401.70 | 399.70 | 82.66 | 6.41 | 929.39 | 938.07 | 990.75 | 989.12 | 990.63 | 997.19 | 935.61 | 912.13 |
| R2 | 347.56 | 404.18 | 396.52 | 81.69 | 6.39 | 922.27 | 8.84.27 | 881.60 | 937.23 | 890.61 | 864.78 | 883.72 | 918.55 |
| Avg | 348.88 | 404.09 | 398.97 | 82.53 | 6.39 | 948.50 | 963.85 | 955.28 | 972.49 | 957.44 | 952.16 | 937.53 | 936.29 |
| Std | 1.04 | 1.92 | 1.78 | 0.64 | 0.02 | 32.20 | 25.78 | 52.11 | 24.95 | 47.26 | 61.79 | 44.74 | 29.75 |
| % Recovery | 97.45 | 98.92 | 92.46 | 101.26 | 99.07 | 94.85 | 96.39 | 95.53 | 97.25 | 95.74 | 95.22 | 93.75 | 93.63 |
| %RSD | 1.02 | 1.39 | 1.33 | 0.80 | 0.13 | 5.67 | 5.08 | 7.22 | 4.99 | 6.87 | 7.86 | 6.69 | 5.45 |
| S1\* | 582.10 | 306.09 | 296.60 | 23.65 | 1271.30 | 509.81 | 0.90 | 15.90 | 152.20 | 85.40 | 155.09 | 337.50 | 447.40 |
| S2\* | 560.75 | 280.29 | 288.42 | 21.40 | 1265.80 | 502.46 | 0.80 | 17.50 | 151.10 | 83.90 | 109.40 | 332.90 | 438.59 |
| S3\* | 562.80 | 298.60 | 299.30 | 24.20 | 1268.30 | 505.60 | 1.20 | 16.80 | 153.60 | 84.60 | 108.50 | 336.80 | 442.60 |
| Avg | 568.55 | 294.99 | 294.77 | 23.08 | 1268.47 | 505.96 | 0.97 | 16.73 | 152.30 | 84.63 | 124.33 | 335.73 | 442.86 |
| Std | 9.62 | 10.84 | 4.63 | 1.21 | 2.25 | 3.01 | 0.17 | 0.65 | 1.02 | 0.61 | 21.75 | 2.02 | 3.60 |
| %RSD | 3.10 | 3.29 | 2.15 | 1.10 | 1.50 | 1.74 | 0.41 | 0.81 | 1.01 | 0.78 | 4.66 | 1.42 | 1.90 |

Al, Ca, Fe, Mn, Ti were analyzed in USGS standard BHVO-2 and other elements in multi-element standard of E-Merck, Germany); \* S1, S2 and S3 represent repeat analysis of randomly selected digested sample. Avg = Average; Std= Staandard deviation; % RSD = % Relative standard deviation

**Table S4** Ratio of load, each WSII and ΣWSII between PM2.5 and PM2.5-10(PM2.5/PM2.5-10) collected during summer season at Bikaner (BKR), Jhunjhunu (JHJ) and New Delhi (DEL)

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | BKR | JHJ | DEL |
| Load | 3.0 | 5.5 | 3.5 |
| WSII | 3.0 | 3.1 | 2.8 |
| F- | 5.0 | 5.0 | 2.0 |
| Cl- | 1.7 | 1.3 | 1.8 |
| NO3- | 2.4 | 1.7 | 1.9 |
| SO42- | 5.4 | 8.2 | 7.4 |
| Na+ | 1.5 | 2.8 | 3.8 |
| NH4+ | 10.0 | 2.0 | 30.0 |
| K+ | 3.5 | 6.0 | 10.0 |
| Ca2+ | 3.3 | 2.6 | 3.7 |
| Mg2+ | 2.0 | 2.6 | 3.0 |

 WSII = Water soluble inorganic ions

**Table S5** Percentage contributions of individual water-soluble inorganic ions (WSII) to ΣWSII in PM2.5 and PM2.5-10over Bikaner (BKR), Jhunjhunu (JHJ) and New Delhi (DEL)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | BKR |  | JHJ |  | DEL |  |
|  | PM2.5 | PM2.5-10 | PM2.5 | PM2.5-10 | PM2.5 | PM2.5-10 |
| %F- | 0.5±0.3(0.3-1.3) | 0.4±0.2(0.2-0.8) | 0.5±0.3(0.3-1.0) | 0.4±0.3(0.1-0.7) | 0.5±0.3(0.2-1.1) | 0.6±0.3(0.3-1.2) |
| %Cl- | 10.3±3.5(6.0-16.3) | 16.6±6.7(8.7-30.0) | 7.6±3.9(4.0-13.9) | 16.7±6.8(11.0-28.5) | 19.2±11.3(7.8-38.6) | 31.4±12.5(12.6-53.8) |
| %NO3- | 13.6±6.1(7.1-19.3) | 17.7±8.6(3.7-26.9) | 15.8±.4(11.0-19.2) | 29.5±4.2(22.4-33.4) | 20.4±17.2(4.7-62.3) | 36.9±17.9(8.3-62.1) |
| %SO42-total | 36.3±5.0(26.9-42.2) | 20.8±3.0(17.4-25.3) | 38.6±3.9(33.5-42.9) | 14.9±1.2(13.6-16.7) | 27.7±9.2(11.0-36.0) | 10.7±7.6(5.3-29.8) |
| %nss-SO42- | 33.9±5.2(22.8-39.7) | 15.6±3.5(8.8-20.3) | 37.2±4.1(32.0-41.9) | 12.9±1.3(11.3-15.0) | 26.1±8.7(10.4±34.5) | 9.6±7.1(4.8-27.8) |
| %NH4+ | 1.1±0.9(0.3-2.4) | 0.4±0.4(0.3-1.0) | 1.5±1.4(0.8-3.8) | 1.4±0.6(0.7-2.3) | 0.8±0.8(0.1-2.1) | 0.1±0.2(0.1-0.5) |
| %Na+ | 10.9±3.8(6.9-20.0) | 20.4±6.0(12.9-34.5) | 10.6±2.5(8.5-14.4) | 9.7±2.5(7.1-13.1) | 6.0±2.9(2.6-12.1) | 4.3±2.2(1.9-7.9) |
| %K+total | 5.4±1.9(2.8-8.2) | 4.5±2.6(2.9-8.9) | 5.2±1.7(2.9-7.7) | 3.7±0.9(2.3-4.8) | 7.7±3.0(3.0-11.6) | 2.3±1.8(0.9-7.0) |
| %nss-K+ | 5.0±1.9(2.4-7.8) | 3.8±2.3(2.4-8.0) | 4.8±1.8(2.4-7.4) | 3.4±1.0(1.8-4.5) | 7.5±3.0(2.9-11.3) | 2.2±1.7(0.8-6.7) |
| %Ca2+total | 19.7±5.6(15.0-30.6) | 16.5±3.7(11.5-23.1) | 18.1±3.7(13.9-23.5) | 21.4±5.6(14.7-28.8) | 16.0±8.3(3.3-27.3) | 12.3±7.6(6.4-28.5) |
| %nss-Ca2+ | 19.3±5.5(14.6-30.1) | 15.7±3.6(10.8-22.1) | 17.7±3.8(13.5-23.1) | 21.0±5.6(14.1-28.5) | 15.8±8.2(3.2-27.0) | 12.2±27.6(6.3-28.2) |
| %Mg2+ | 2.1±0.5(1.5-3.0) | 2.6±0.5(1.9-3.5) | 2.2±0.3(1.8-2.6) | 2.3±0.4(1.9-2.9) | 1.7±1.0(0.3-3.7) | 1.3±1.0(0.6-3.8) |

**Table S6** Average pH, neutralization factors and molar ratios of selected water-soluble inorganic ions in PM2.5 and PM2.5-10over Bikaner (BKR), Jhunjhunu (JHJ) and New Delhi (DEL)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **BKR** | **JHJ** | **DEL** |
|  | **PM2.5** | **PM2.5-10** | **PM2.5** | **PM2.5-10** | **PM2.5** | **PM2.5-10** |
| pH | 6.29±0.24 | 6.57±0.24 | 6.30±0.14 | 6.78±0.15 | 6.11±0.19 | 6.45±0.16 |
| NF-NH4+ | 0.06±0.04 | 0.03±0.03 | 0.08±0.07 | 0.10±0.03 | 0.06±0.05 | 0.01±0.01 |
| NF-K+ | 0.15±0.08 | 0.18±0.1 | 0.12±0.03 | 0.12±0.02 | 0.26±0.08 | 0.15±0.03 |
| NF-Ca2+ | 1.12±0.61 | 1.21±0.34 | 0.87±0.21 | 1.36±0.30 | 0.96±0.29 | 1.60±0.56 |
| NF-Mg2+ | 0.20±0.1 | 0.32±0.09 | 0.17±0.03 | 0.25±0.04 | 0.16±0.06 | 0.27±0.1 |
| NO3-/SO42- | 0.28±0.11 | 0.65±0.30 | 0.32±0.07 | 1.54±0.21 | 0.38±0.07 | 0.87±0.35 |
| NH4+/SO42- | 0.70±0.06 | 0.05±0.05 | 0.10±0.08 | 0.25±0.07 | 0.08±0.07 | 0.02±0.02 |
| NH4+/NO3- | 0.25±0.2 | 0.07±0.07 | 0.33±0.33 | 0.16±0.04 | 0.22±0.19 | 0.03±0.02 |
| Ca2+/SO42- | 1.38±0.6 | 1.96±0.53 | 1.15±0.30 | 3.49±0.96 | 1.36±0.44 | 2.91±0.91 |
| Ca2+/NO3- | 4.62±3.25 | 3.56±1.55 | 3.71±0.99 | 2.24±0.43 | 3.45±0.83 | 5.44±6.9 |

Neutralization factors (NF) calculated in meqL-1

**Table S7** Average concentrations of carbon fractions (in µgm-3 units) in PM2.5 over PM2.5 over Bikaner (BKR), Jhunjhunu (JHJ) and New Delhi (DEL)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Site |  | OC1 | OC2 | OC3 | OC4 | EC1 | EC2 | EC3 | OP |
| BKR |  | 0.004 (0.02) | 1.75(13.7) | 4.18(31.32) | 4.74(35.32) | 0.91(7.14) | 0.60(4.78) | 0.10(0.82) | 0.58(6.8) |
| JHJ |  | 0.001 (0.01) | 1.1(12.6) | 2.49(25.14) | 2.29(23.8) | 0.97(9.9) | 0.38(4.47) | 0.06(0.7) | 1.66(23.25) |
| DEL |  | 0.22 (1.3) | 4.49(12.24) | 8.38(22.09) | 6.43(16.85) | 7.31(19.5) | 0.79(2.14) | 0.17(0.5) | 8.68(26.2) |

Value inside the bracket represents percentage contribution of each fraction to total carbon (TC)

**Table S8** Elemental concentrations (in ngm-3 units) in water-soluble residue of PM2.5 and PM2.5-10 collected during summer season over Bikaner (BKR), Jhunjhunu (JHJ) and New Delhi (DEL).

|  |  |  |  |
| --- | --- | --- | --- |
|  | BKR | JHJ | DEL |
|  | PM2.5 | PM2.5-10 | PM2.5 | PM2.5-10 | PM2.5 | PM2.5-10 |
| Al \* | 33.0±12.1(19.9-56.2) | 25.4±27.6(12.0-97.9) | 31.7±18.1(13.5-53.2) | 19.2±6.9(10.2-28.3) | 34.3±34.8(9.7-124.2) | 14.1±6.2(6.4-25.5) |
| Ca \* | 19.5±12.6(11.2-51.8) | 14.3±25.1(4.2-81.2) | 15.4±7.9(7.0-27.6) | 3.7±1.1(2.4-5.3) | 27.8±22.8(10.9-74.3) | 9.6±5.3(5.6-19.3) |
| Fe \* | 6.4±4.0(3.1-15.8) | 5.3±9.4(1.4-30.4) | 6.5±4.5(2.4-12.7) | 2.8±0.9(1.7-3.9) | 15.1±14.3(3.4-43.0) | 4.7±3.2(2.6-12.4) |
| Ti \* | 0.8±0.4(0.5-1.9) | 0.7±1.0(0.2-3.5) | 0.7±0.5(0.3-1.5) | 0.4±0.1(0.3-0.5) | 0.6±0.4(0.1-1.8) | 1.9±1.0(0.4-4.2) |
| Mn \*  | 0.2±0.1(0.1-0.5) | 0.2±0.2(0.04-0.9) | 0.2±0.1(0.05-0.3) | 0.06±0.02(0.04-0.09) | 0.3±0.03(0.1-1.2) | 0.1±0.1(0.05-0.4) |
| Ba  | 156.0±76.2(78.4-360.1) | 69.7±51.3(32.1-191.2) | 119.3±69.7(46.3-206.8) | 35.1±20.6(6.4-57.2) | 347.1±437.1(40.4-1453.4) | 116.4±68.4(47.2-234.8) |
| Cd  | 1.0±2.2(0.1-7.4) | 0.3±0.4(0.1-1.4) | 0.7±0.4(0.3-1.3) | 0.2±0.2(0.02-0.7) | 2.2±1.6(0.03-4.8) | 0.2±0.1(0.1-0.6) |
| Co  | 1.4±1.0(0.1-3.8) | 1.0±0.7(0.5-2.8) | 1.8±1.7(0.2-3.7) | 0.6±0.5(0.01-1.3) | 5.2±8.2(0.5-25.6) | 1.5±1.1(0.7-3.6) |
| Cr  | 34.1±20.9(10.2-88.4) | 21.3±18.3(9.8-65.6) | 37.3±19.3(16.5-60.5) | 12.5±6.5(3.9-20.7) | 84.2±97.2(14.3-315.4) | 28.7±18.5(14.4-64.5) |
| Cu  | 15.4±10.4(5.4-38.5) | 6.1±5.3(3.1-19.2) | 19.5±11.9(9.8-38.9) | 6.1±3.4(2.2-11.3) | 67.8±78.4(11.8-267.6) | 15.3±5.8(6.8-22.7) |
| Pb | 11.8±7.4(4.2-26.8) | 1.8±1.8(0.6-6.3) | 20.1±16.0(7.6-45.6) | 4.1±2.0(1.7-6.3) | 232.4±211.9(2.4-685.7) | 23.5±20.8(5.1-69.5) |
| Sr | 98.4±29.9(57.2-168.6) | 30.7±23.9(16.3-88.9) | 51.9±32.2(20.1-92.6) | 16.8±9.8(2.7-28.4) | 128.5±185.3(11.3-595.8) | 43.2±28.5(19.5-96.8) |
| Zn  | 39.3±19.1(18.5-81.1) | 26.2±16.9(12.1-64.8) | 51.4±20.8(28.5-81.7) | 17.9±4.8(11.3-22.9) | 211.8±202.3(1.9-652.7) | 64.7±34.9(25.8-110.6) |

\*µg m-3; minimum and maximum concentrations are provided in bracket with each element

**Table S9** Coefficient of Divergence (CD$) in between sites for PM2.5 and PM2.5-10 during summer time

|  |  |  |  |
| --- | --- | --- | --- |
|  | BKR-JHJ | BKR-DEL | JHJ-DEL |
| PM2.5\* | 0.21 | 0.45 | 0.48 |
| PM2.5\*\* | 0.20 | 0.41 | 0.43 |
| PM2.5-10\*\* | 0.38 | 0.50 | 0.60 |
| PM2.5\*\*\* | 0.21 | 0.51 | 0.53 |
| PM2.5-10\*\*\*\* | 0.34 | 0.42 | 0.52 |

\*CD is calculated for F-, Cl-, NO3-, SO42-, Na+, NH4+, K+, Ca2+, Mg2+ OC and EC

\*\* CD is calculated for F-, Cl-, NO3-, SO42-, Na+, NH4+, K+, Ca2+, Mg2+
\*\*\* CD is calculated for F-, Cl-, NO3-, SO42-, Na+, NH4+, K+, Ca2+, Mg2+,Al,Ca,Fe,Ti,Mn,Ba,Cd,Co,Cr,Cu,Pb,Sr,Zn,OC and EC

\*\*\*\* CD is calculated for F-, Cl-, NO3-, SO42-, Na+, NH4+, K+, Ca2+, Mg2+ Al,Ca,Fe,Ti,Mn,Ba,Cd,Co,Cr,Cu,Pb,Sr,Zn

$: The coefficient of divergence (CD) among different sets of two sampling sites was calculated following the equation:

CDmn = $\sqrt{\frac{1}{p}}\sum\_{i=1}^{p} (\frac{X\_{im}-X\_{in}}{X\_{im}+X\_{in}})^{2}$

Where m and n represent two sampling sites, Xim and Xin represent the average concentration of chemical constituent i at site m and n, respectively. P is the total number of chemical constituents considered while calculating the CD. The near to zero value of CD indicate homogeneity in the chemical constituents of particles over two sites and the values of CD approaching unity would indicate heterogeneity.CD can be used for short-term or long-term measurements over spatial distributed sampling sites (Shen et al., 2011).

Shen, Z., Cao, J., Liu, S., Zhu, C., Wang, X., Zhang, T., Xu, H., Hu, T., 2011. Chemical composition of PM10 and PM2.5 collected at ground level and 100 meters during a strong winter-time pollution episode in Xi'an, China. J. Air Waste Manage. 61, 1150-1159.

**Table S10** Enrichment ratios (ER) of elements in PM2.5 and PM2.5-10 collected during summer season over Bikaner (BKR), Jhunjhunu (JHJ) and New Delhi (DEL)

|  |  |  |  |
| --- | --- | --- | --- |
|  | BKR | JHJ | DEL |
|  | PM2.5 | PM2.5-10 | PM2.5 | PM2.5-10 | PM2.5 | PM2.5-10 |
|  | Aver | Std | Aver | Std | Aver | Std | Aver | Std | Aver | Std | Aver | Std |
| **Ca** | **1.79** | **0.79** | **1.13** | **0.45** | **1.38** | **0.27** | **0.57** | **0.20** | **3.45** | **4.88** | **1.86** | **0.49** |
| Fe | 0.43 | 0.15 | 0.35 | 0.15 | 0.45 | 0.09 | 0.35 | 0.11 | 1.63 | 2.61 | 0.76 | 0.27 |
| Ti | 0.66 | 0.19 | 0.57 | 0.17 | 0.05 | 0.01 | 0.04 | 0.01 | 1.06 | 0.43 | 1.03 | 0.36 |
| Mn | 0.79 | 0.29 | 0.63 | 0.28 | 0.59 | 0.10 | 0.42 | 0.14 | 0.97 | 0.68 | 1.15 | 0.57 |
| Ba  | 2.67 | 1.49 | 0.55 | 0.27 | 1.53 | 0.21 | 0.27 | 0.14 | 4.83 | 4.36 | 1.23 | 0.39 |
| Cd  | 0.37 | 1.13 | 0.00 | 0.01 | 0.05 | 0.02 | 0.01 | 0.01 | 0.18 | 0.16 | 0.01 | 0.03 |
| Co  | 1.04 | 0.49 | 0.42 | 0.21 | 1.04 | 0.57 | 0.25 | 0.21 | 3.02 | 3.21 | 0.82 | 0.31 |
| **Cr**  | **8.14** | **2.35** | **2.28** | **0.65** | **7.77** | **0.90** | **1.53** | **0.70** | **17.85** | **14.31** | **4.57** | **1.25** |
| **Cu**  | **10.63** | **21.92** | **0.96** | **0.36** | **5.84** | **1.76** | **1.10** | **0.69** | **20.00** | **12.26** | **3.78** | **1.30** |
| **Pb** | **5.10** | **2.92** | **0.40** | **0.46** | **7.93** | **4.29** | **0.43** | **0.55** | **87.52** | **73.64** | **7.61** | **7.13** |
| Sr | 2.82 | 1.80 | 0.38 | 0.20 | 1.03 | 0.11 | 0.21 | 0.13 | 2.41 | 2.01 | 0.71 | 0.25 |
| **Zn**  | **3.77** | **1.05** | **1.62** | **0.70** | **5.94** | **2.08** | **1.25** | **0.79** | **21.52** | **17.98** | **5.39** | **2.51** |

ER = (CXs/Als)/(CXC/AlC), where CXs and CXC are the concentration of element X in the sample and upper continental crust (UCC), respectively. Similarly Als and AlC represent the concentration of Al in the sample and UCC, respectively; UCC values are taken from McLennan, 2001

McLennan, S.M., 2001 Relationships between the trace element composition of sedimentary rocks and upper continental crust. Geochem. Geophy. Geosyst. 2, 1525-2027.

**Fig. S1** Ratio of water-soluble inorganic ions (WSII) between PM2.5 and PM2.5-10 (PM2.5/PM2.5-10) at (BKR), Jhunjhunu (JHJ) and New Delhi (DEL)

**Fig. S2.** Pie charts showing average percentage makeup of ΣWSII in PM2.5 and PM2.5-10during summer season over Bikaner (BKR), Jhunjhunu (JHJ) and New Delhi (DEL)

**Fig. S3.** Percentage contributions of carbon fraction to total carbon in PM2.5 over Bikaner (BKR), Jhunjhunu (JHJ) and New Delhi (DEL)