Atmospheric
Chemistry
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Discussions

Interactive comment on "Magnetic signatures of natural and anthropogenic sources of urban dust aerosol" *by* Haijiao Liu et al.

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Reviewer #1 Specifically, authors used magnetic methods to quantify the magnetic particles, but they only measured χ and χfd. χ is affected by many factors, e.g., concentration, grain size, mineral types. The current study focused only on concentration without information of grain size and mineral types. I strongly encourage authors to provide a more comprehensive study on this issue.

Reply: Thanks for this comment. We conducted more magnetic measurements (see Method section, Lines 11-24 in Page 5 in the revised version). The temperature dependent susceptibility (χ-T), hyteresis loops and first-order reversal curves (FORC) were used to better constrain the grain size and types of magnetic minerals (see Figs. 1 and

2, Lines 10-22 in Page 6 and Lines 1-5 in Page 7 in the revised version).

χ-T is used to identify magnetic mineral composition. All the χ-T heating curves (Fig. 1a-f) are characterized by a major susceptibility decrease at 580 degrees Celsius, i.e. the Curie temperature of magnetite, which pinpoint magnetite as the major contributor to χ. All the samples are irreversible with cooling paths above heating trajectories due to the neoformation of magnetite (Jordanova et al., 2004; Kim et al., 2009). The χ-T heating curves of the vehicle exhausts displays a decreasing χ between 580 and 700 degrees Celsius (Fig. 1b), suggesting the presence of hematite.

All samples have similar slightly wasp-waisted hysteresis loops (Fig. 1g-l). Their magnetic saturation was generally reached at a magnetic field of about 300 mT. This is a clear indication of the predominance of low coercivity ferrimagnetic minerals in all samples.

The Day plot and FORC diagram are powerful methods to identify the domain state distribution of magnetic materials (Day et al., 1977; Dunlop 2002a, b; Pike et al., 1999; Roberts et al., 2000; Harrison et al., 2008). All the samples agree well with single-domain (SD) + multi-domain (MD) admixture curves in the pseudo-single-domain (PSD) range of the Day plot (Fig. 2a).

The FORC diagrams for street dust (Fig. 2d), and anthropogenic pollutant (Fig. 2e) have divergent contours that are characteristic of MD grains. The FORC diagram for natural surface sediments seems to be characteristic of PSD/MD behavior, whose outer contours display divergent pattern and inner contours are somewhat less divergent (Fig. 2a). The FORC distributions of atmospheric dustfall (Fig. 2b) appear to have a mixed set of contours. The outer contours have a divergent pattern that would be expected for MD particles, while the inner contours close about a central peak represent SD grains.

Day, R., Fuller, M., Schmidt, V.A.: Hysteresis properties of titanomagnetites: grain-size and compositional dependence. Phys Earth Planet Inter., 13, 260–267,1977

Dunlop, D. J.: Theory and application of the Day plot (Mrs/Ms versus Hcr/Hc) 1. The-oretical curves and tests using titanomagnetite data. J. Geophys. Res., 107, 2076, https://doi.org/10.1029/2001jb000486, 2002a.

Dunlop, D.J.: Theory and application of the Day plot (Mrs/Ms versus Hcr/Hc) 2. Ap-plication to data for rocks,sediments, and soils. J. Geophys. Res ., 107, 2057, https://doi.org/10.1029/2001jb000487, 2002b.

Harrison, R. J., Feinberg, J. M.: FORCinel: An improved algorithm for calculating first- order reversal curve distributions using locally weighted regression smoothing, Geochem. Geophys. Geosyst., 9, Q05016, https://doi.org/10.1029/2008GC001987, 2008.

Jordanova, D., Hoffmann, V., and Febr, K. T.: Mineralmagnetic characterization of an-thropogenic magnetic phases in the Danube river sediments (Bulgarian part), Earth planet. Sci. Lett., 30, 71–89, https://doi.org/10.1016/S0012-821X(04)00074- 3, 2004.
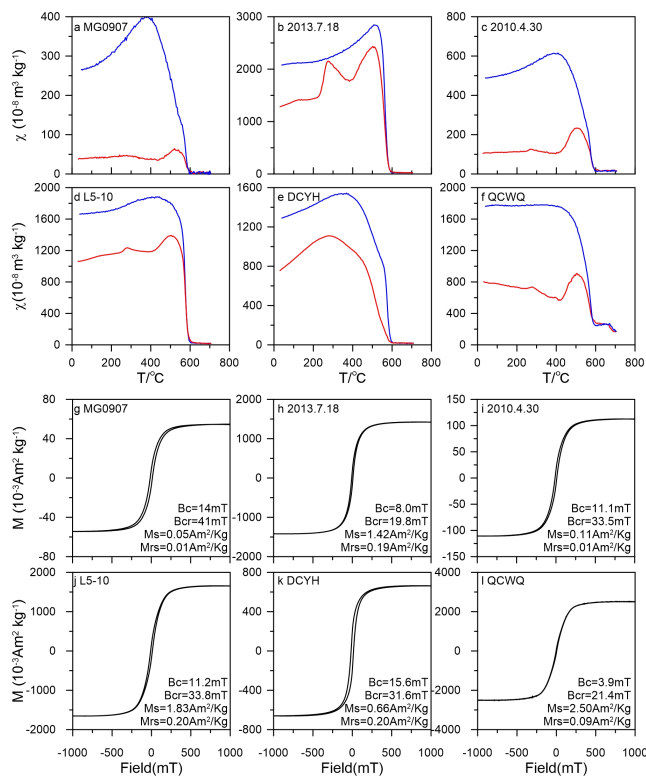
Kim, W., Doh, S. J., and Yu, Y. J.: Anthropogenic contribution of mag-netic particulates in urban roadside dust, Atmos. Environ., 43, 3137-3144, https://doi.org/10.1016/j.atmosenv.2009.02.056, 2009.

Please also note the supplement to this comment:
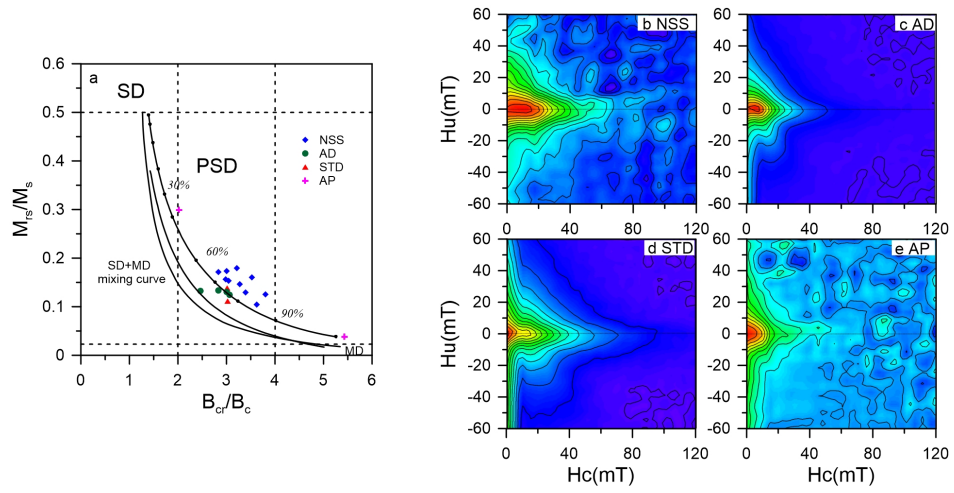https://www.atmos-chem-phys-discuss.net/acp-2018-452/acp-2018-452-AC1-supplement.pdf

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Fig. 1. χ-T heating (red line) and cooling (blue line) curves (a-f) and magnetic hysteresis loops (g-l) of representative samples.

Fig. 2. (a) Day-plot of the ratios Mrs/Ms and Bcr/Bc for representative samples from NSS, AD, STD, and AP; (b-e) FORC diagrams for representative samples of NSS, AD, STD, and AP.

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