Atmos. Chem. Phys. Discuss., 11, C10093–C10097, 2011
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Individual particle analysis of aerosols collected under haze and non-haze conditions at a high-elevation mountain site in the North China plain" *by* W. J. Li et al.

Anonymous Referee #2

Received and published: 12 October 2011

General comments:

This study includes TEM analyses of individual particles that were collected at an elevated site in the North China Plain. As expected, polluted conditions were encountered most of the time, and haze layers contained mostly sulfate/organic mixed particles with additional refractory components such as soot, metals and fly ash. When air masses arrived from the Northwest, mineral particles were dominant. An interesting result is the quasi-periodic, mid-day formation of new particles. Particle growth occurred by the condensation of sulfate and organics and by coagulation with pollutants and mineral dust. I see as the main value of the paper that it provides a detailed, single-particle-

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based account of major particle types within haze layers in North China.

The paper appears to be publishable. However, shortcomings of the study include the following: 1) The claim that "ultrafine" soot and fly-ash particles played a role in particle nucleation appears to be unsubstantiated, since the TEM images show these anthropogenic particles to be much larger than the new particles as measured with the WPS and shown in Fig. 6. 2) The criteria for the distinction of particle types are unclear (see below), please provide more detail. 3) Writing and editorial inconsistencies need to be fixed (such as labeling of Figure 3, incomplete or grammatically incorrect sentences); these are listed below.

Minor comments:

Abstract: "Each fine refractory particle can enlarge the sulfate particles by 10–20 nm." Presumably, the fine refractory particles have a range of diameters that probably extends beyond 20 nm. I suggest to be less specific about the size change.

Page 22388, line 1-2 ..around the top of the planetary boundary layer... ..what types of aerosols...

Line 4: Either "significant" or "important", but not both

Line 7: Delete "extremely" (if "absent", then it cannot be "slightly" or "extremely")

Line 8: Delete "of"

Line 18: Move "size-dependent" before "chemical and physical properties.."

Paragraph starting at line 22: Please use either present or past tense consistently.

Page 22389, line 23: Used

Page 22390, line 10: Please do not use the word "scanned" because readers may confuse the technique with SEM. "obtained" would do.

Page 22391, line 20: Replace "these" with "the"

ACPD

11, C10093–C10097, 2011

Page 22392, line 2: Which day?

Line 6: "..suggesting that the conditions on the summit of Mt. Tai adequately represent the results of the important air pollution advective patterns..."

Lines 11-12: Please provide exact criteria for the distinction of different particle types. For example, how did you distinguish S-rich from Na/K-S/N? Did you use threshold values from EDS results? (For example, if Na exceeds 5 at%, then it is a Na-S particle instead of S-rich?)

Line 11: "internally mixed with organic matter.."

Line 14: Delete "other"

Line 20: "Minor K and Na occurs in most sulfates.." Does this statement refer to type-A or type-B S-rich particles? It seems to repeat the statement in lines 15-17.

Fig. 3 Labeling is absolutely confusing. Many panels are marked a) and b), and the captions do not seem to correspond to the labeling. Please label each of the 14 panels in an unambiguous way and provide clear captions.

Line 25: "We noticed that externally mixed soot.."

Page 22393, line 3: Which Fig. 3b? There are 7 of them.

Line 5: Delete "physical" – coagulation is always a physical process

Line 14: "were" instead of "have been frequently"

Lines 21-23. The sentence is incomplete, please rephrase.

Lines 21-25: Hard to follow in the lack of proper labels on Figure 3. "A similar coating on Ca-rich particles reported" – similar to what? Please rephrase.

Lines 25 and 29: In the lack of quantitative compositional information (EDS analysis of O and N can be qualitative at best) how did you identify Ca(NO3)2? Did you do electron diffraction? Same for NaNO3 (line 5 on next page).

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11, C10093–C10097, 2011

Page 22394, lines 6-10: "the products of heterogeneous chemical reactions of sea salt and halite from ground soil with acidic SO2 and HNO3 gases (Laskin et al., 2002)." "In this case, based on air mass back trajectories shown in Fig. 2 and on their rounded shape, the particles were likely from aged halite." Do you mean terrestrial halite? (Sea salt is also halite.)

Line 23: Replace "into" with "in"

Line 24 Replace "through" with "according to"

Where is Table S1?

Page 22395, line 18 "both the PM2.5 and water-soluble ionic concentrations on Mt. Tai are higher than on other mountaintops of similar altitude elsewhere in the world."

Line 22 Delete "ground"

Line 26 "..looked like on clear days.."

Page 22396, line 5: "New particle formation and growth events"

Lines 6-7: At what time of the day did new particle formation occur? It is not clear from the diagram in Figure 6.

Lines 12-13: "The result shows that aerosol particles through gaseous transformation greatly contributed into the top of PBL. The heights of air masses nearby the summit of Mt. Tai further display that most new particles were possible formed around 1000–2000m in the regional scale (Fig. 2).." Meaning unclear, please rephrase these two sentences.

Page 22397, lines 9-10: "..in the elevated air masses enough maintained new particle growth for more than 4 h.."

Line 12: "in" instead of "into" and "It is interesting to note"

Line 13: "may have enlarged"

ACPD

11, C10093–C10097, 2011

Interactive Comment

Line 18: "refractory" instead of "non-refractory"

Line 19: "whether" instead of "that"

Line 24: particles

Lines 25-29: "These mixing characteristics are direct evidence that the ultrafine aerosol particles from steel industries, coal-fired power plants, and vehicular emissions may participate in the initiation of particle nucleation through condensation and may contribute to their subsequent growth through coagulation in the upper atmosphere over the NCP." While I agree with the second part of the sentence, the claim that soot and fly-ash particles "may participate in the initiation of particle nucleation" is not supported by the TEM images in Fig. 7. The soot, metal and fly-ash particles appear to be several tens of nm large, whereas the new particles in Fig. 6 have diameters less than 10 nm.

Page 22398, line 8: replace "acids" with liquids"

line 11 downwind

line 14: in which sulfur acids or sulfates

line 17: delete "certain"

Page 22400, lines 18-22 Again, the nm-sized new particles are unlikely to be refractory anthropogenic particles. It is also not convincing that these particles "enlarge sulfate particles by 10-20 nm" – how was this calculated?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 22385, 2011.

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11, C10093–C10097, 2011