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Characterization of individual ice residual particles by the single droplet freezing method: a case study in the Asian dust outflow region

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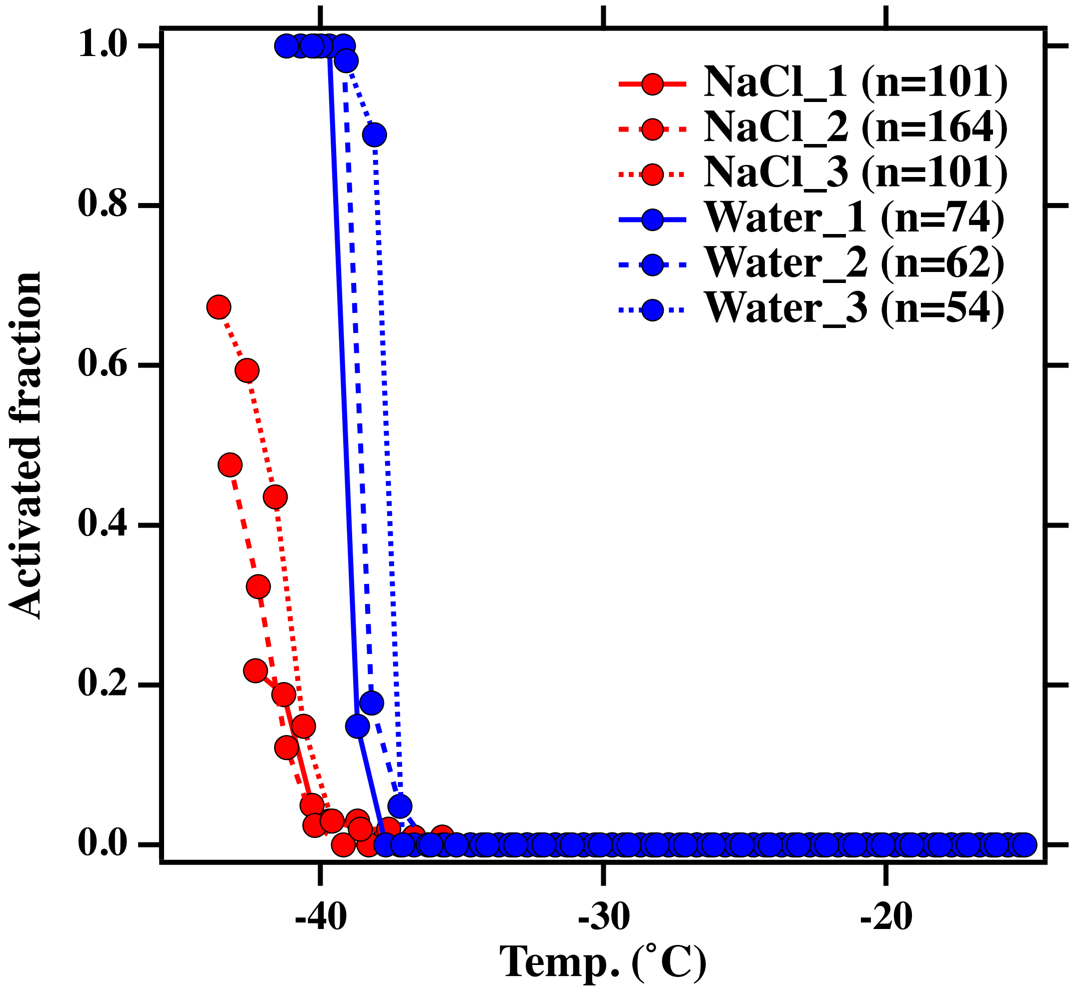

Figure S-1: Activated fractions of NaCl and pure water droplets. Three set of samples were tested for both NaCl and water. The number of particles and droplets observed under the microscope is shown as n.

The test NaCl particles were aerosolized by atomizing its solution (0.005g/ml) and collected on the substrate with an impactor. The pure water droplets were collected by spraying directly onto the substrate.

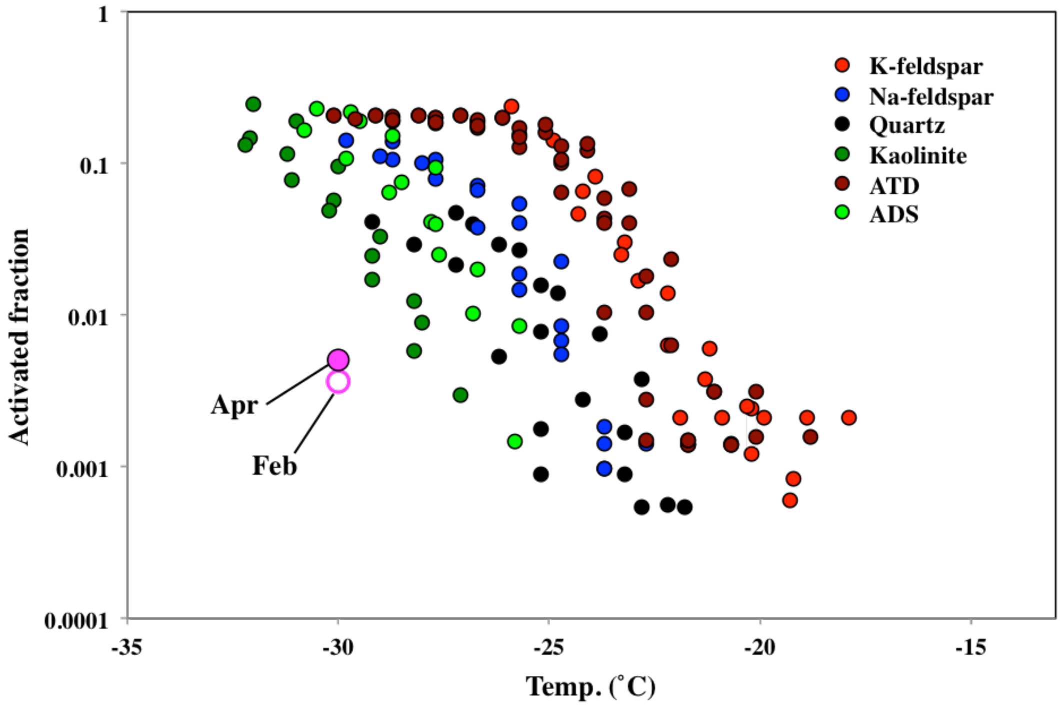

Figure S-2: Activated fractions of the reference mineral dust particles. Results of the atmospheric samples collected in February and April are also shown for comparison.

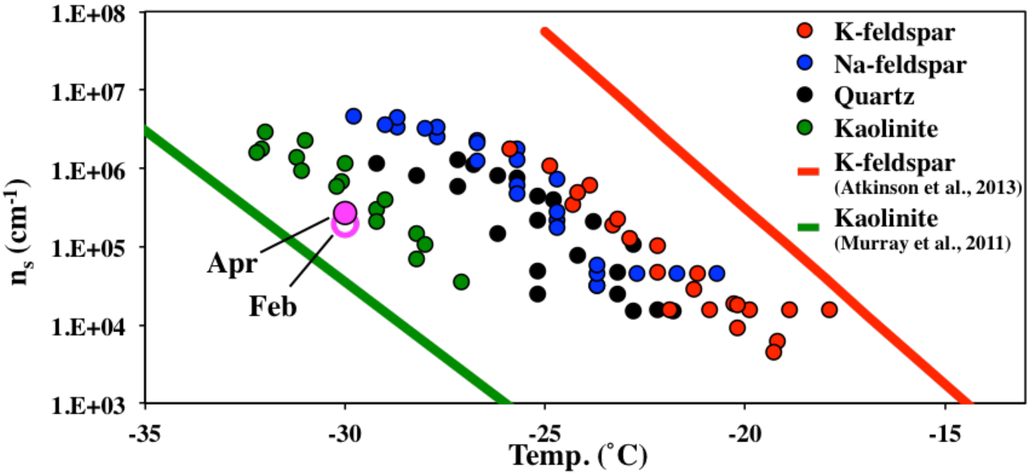

Figure S-3: the ice nucleation active site (INAS) densities for the reference single component mineral dust samples. These INAS densities were calculated from the activated fractions (Fig. S-1) and the averaged sphere equivalent surface areas obtained from the 2D silhouette of individual particles in the microscopic image.

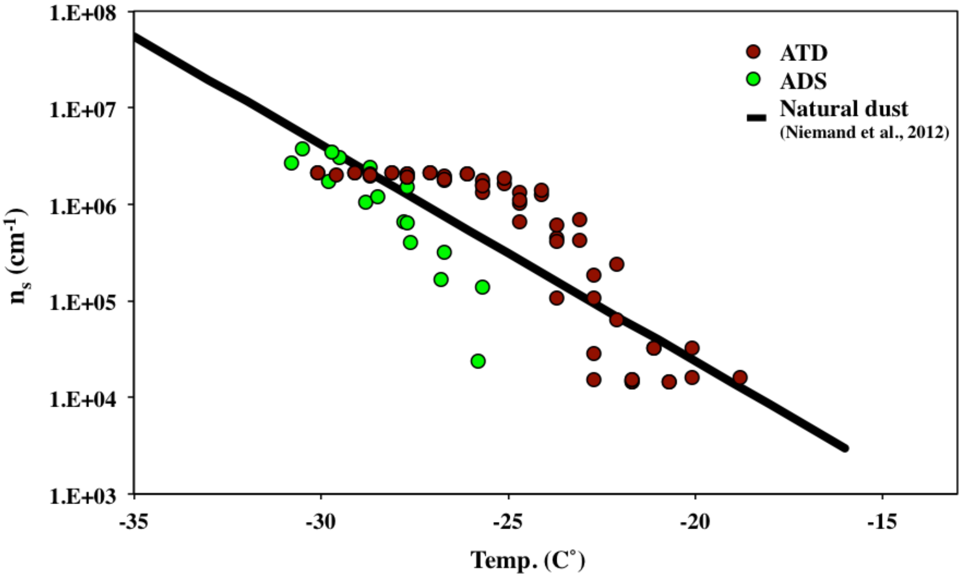

Figure S-4: the ice nucleation active site densities for Arizona Test Dust (ATD) and Asian Dust Source (ADS) particles.

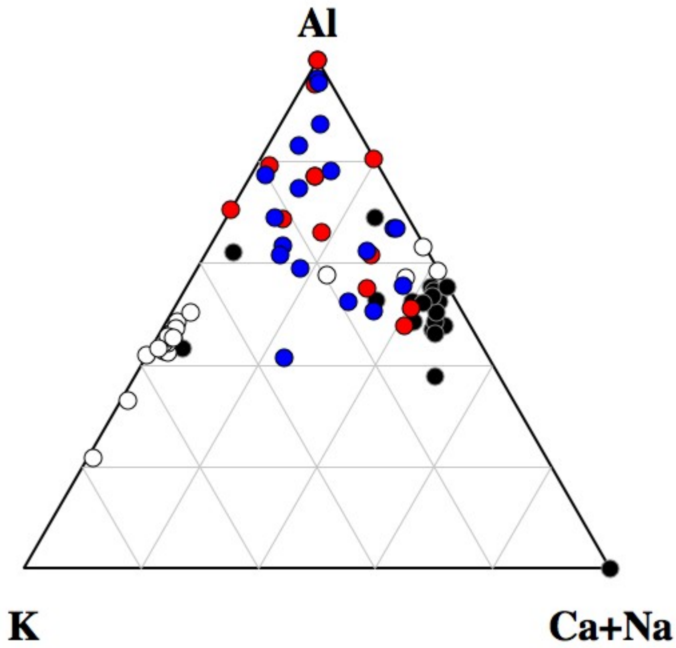

Figure S-5: Ternary diagram of Al-K-(Ca+Na) components, showing the compositions of mineral dust particles identified by SEM-EDX analysis. Data presented in relative atomic proportions. The circle symbols indicate non-active particles (red) and IN active particles (blue). Particles of single component Na-feldspar (black) and K-feldspar (white) are also shown for comparison.

Table S-1: The diameters and volumes of the particles before (dry) and after (wet) the condensational growth. Corresponding concentrations of the sample and test solute particles in the solution droplets are also shown. Here, D_{dry} and D_{wet} denote the circle equivalent diameters obtained from the 2D silhouette of the particles in the microscopic images taken before and after (at approximately -25 ˚C) the cooling experiment, respectively. The number of the particles observed by the microscope is shown as n. V_{dry} is the sphere equivalent volume calculated from the corresponding D_{dry}. V_{wet} was calculated by assuming droplets having contact angle of 110˚ relative to the substrate. The droplet volumetric growth factor GF was determined by the ratio of V_{wet} relative to $V_{dry.}$ By assuming following densities (sampled particles: 2.00 g/cm^3, NaCl: 2.16 g/cm^3, $Ca(NO_3)_2$: 2.36 g/cm^3), The calculated mass and molar concentrations of the droplet are shown in terms of m and M, respectively. The test solute particles of NaCl and $Ca(NO_3)_2$ were aerosolized by atomizing their solutions (0.005g/ml) and collected on the substrate with an impactor.

	Sampled particles (n = 144)	NaCl (n = 97)	$Ca(NO_3)_2$ (n = 102)
D_{dry} (μm)	3.9 ± 0.8	4.8 ± 1.4	4.0 ± 1.0
D_{wet} (μm)	9.2 ± 1.8	14.7 ± 4.7	12.9 ± 2.5
V_{dry} (μm^3)	4.4 ± 2.2	9.0 ± 7.6	4.9 ± 2.2
V_{wet} (μm^3)	156.9 ± 75.0	750.0 ± 677.0	429.2 ± 191.0
GF	43.9 ± 25.0	94.3 ± 55.7	123.7 ± 101.4
m (g/ml)	0.074 ± 0.112	0.029 ± 0.015	0.024 ± 0.009
M (mol/l)	-	0.49 ± 0.25	0.15 ± 0.05

References

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