Physical Properties of Suspended Dust in Iceland

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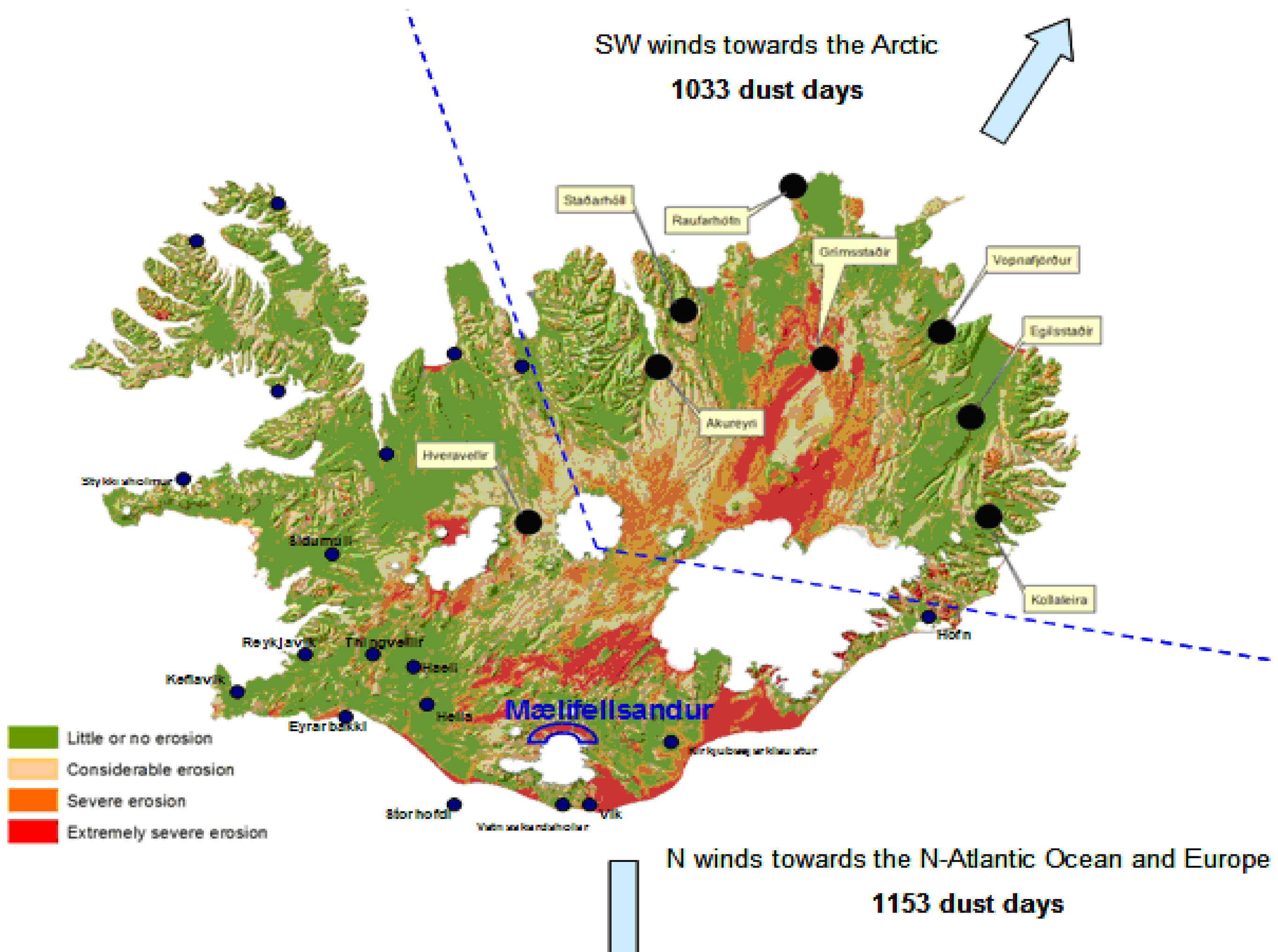

Fig. 1. A map of soil erosion and dust day frequency in Iceland. Location of the measurement site Mælifellssandur is marked in blue.

Overview

Iceland is an active source of dust from glaciogenic and volcanic sediments. The frequency of dust days is <u>> 34 dust days annually</u> (Dagsson-Waldhauserova, 2013). Pioneer dust measurements of one of the most active dust sources (Mælifellsandur, Fig 1, 2) were conducted during high precipitation and low wind conditions on August 8th-18th, 2013.

We measured mass concentrations ($PM_{2.5}$ and PM_{10}), particle size distributions in size range 0.3-10μm and number concentrations. Instruments: TSI 8520 DustTrak Aerosol Monitors and TSI Optical Particle Sizer (OPS) 3330.

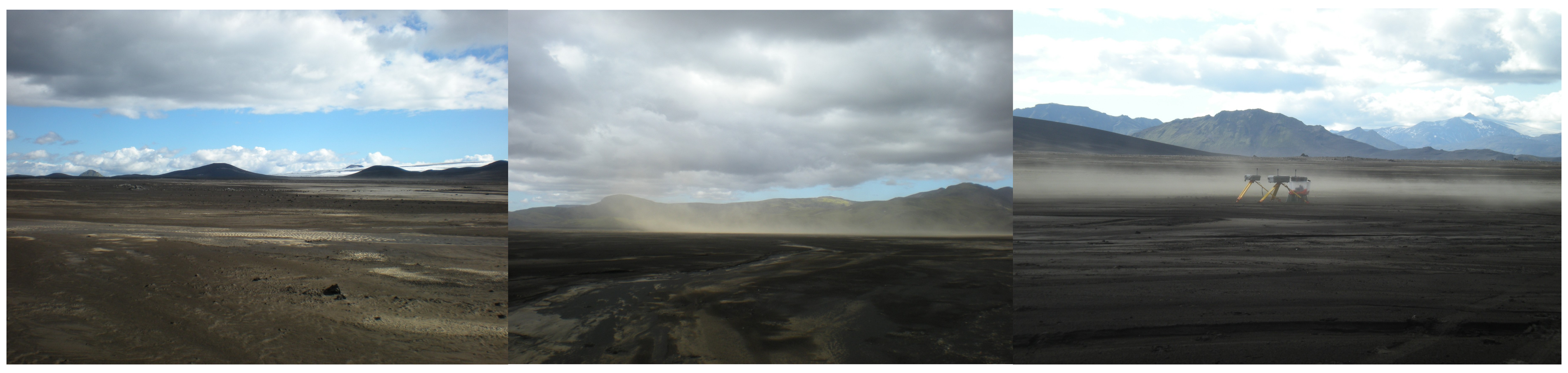

Fig. 2. Pictures from the measurements. Surface was exposed to sun for several hours before event (left). Surface heating resulted in cloud formation and suspension of dried silt particles (middle and right).

ATMOSPHERIC DUST MEASUREMENTS IN ICELAND (ADMI 2013)

ADMI took place during season of high precipitation (>70 mm), high relative humidity (>80%) and low wind speeds (0-4 m.s^{-1}). Surface heating mobilized wet silt particles in < 4 hours after the rain (Fig 2). **Particle Number Concentrations** (PNC) were well correlated with **Particle Mass Concentrations** (PMC) (Fig 3).

Max PNC_{10} reached 149,954 particles cm^{-3} min^{-1} and PMC_{10} was 1,757 μg m^{-3} min^{-1}.

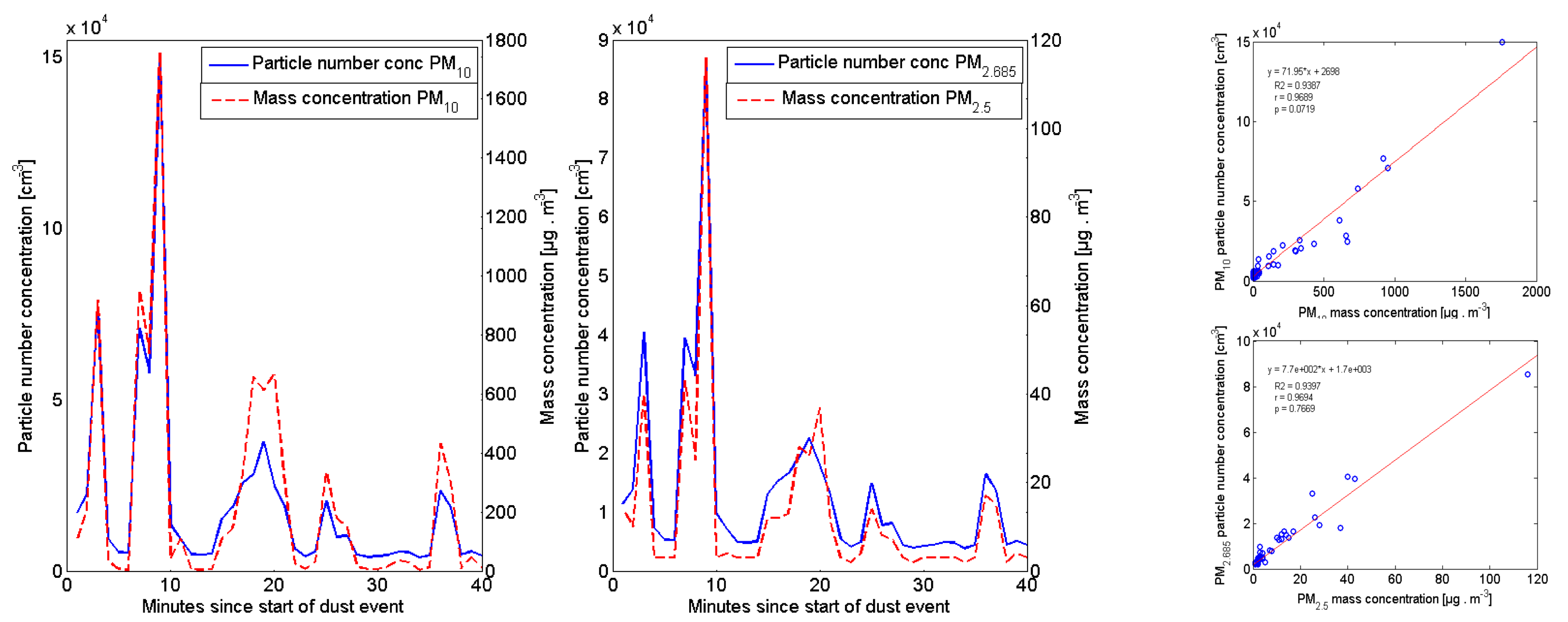

Fig. 3. LEFT: Particle number concentrations (blue) and mass concentrations (red) during the dust event. RIGHT: Correlations between particle number and mass concentrations of PM_{10} (above) and $PM_{2.5}$ (below).

Suspended dust was very fine: Highest number of particles was in size 300-370 nm!

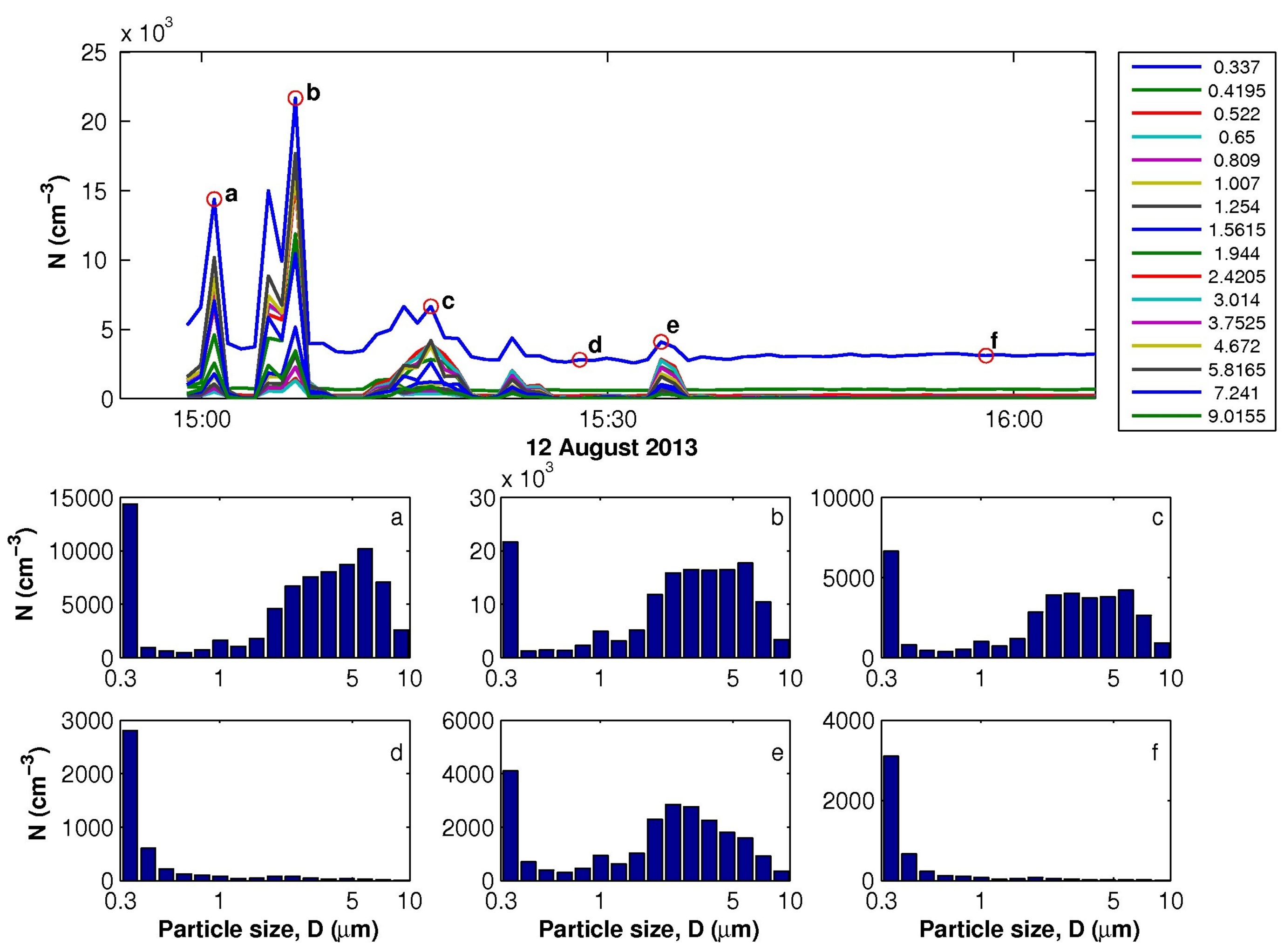

Fig. 4. Size distributions of dust particles in size range 0.3 μm to 10 μm determined from the dust peaks (a, b, c, e) and background number concentrations (d, f).

Mineralogical and geochemical analyses

Glaciogenic dust contains sharp-tipped shards with bubbles and 80% of the particulate matter is volcanic glass rich in heavy metals (Fig 5, Tab 1)

GLASS. CODE (average)	Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	TiO_2	FeO
Mælifellssandur, 2013	***3.2***	***4.9***	***14.2***	***42.5***	***0.9***	***11.5***	***5.6***	***17.0***
Eyjafjallajökull, 2010	3.9	1.4	17.6	62.5	1.8	6.0	0.8	5.7
Katla, 1918	3.1	4.8	13.1	48.2	0.8	9.7	4.8	15.1

Tab. 1. Chemical composition (average values) of the Mælifellssandur samples based on EDX analyses.

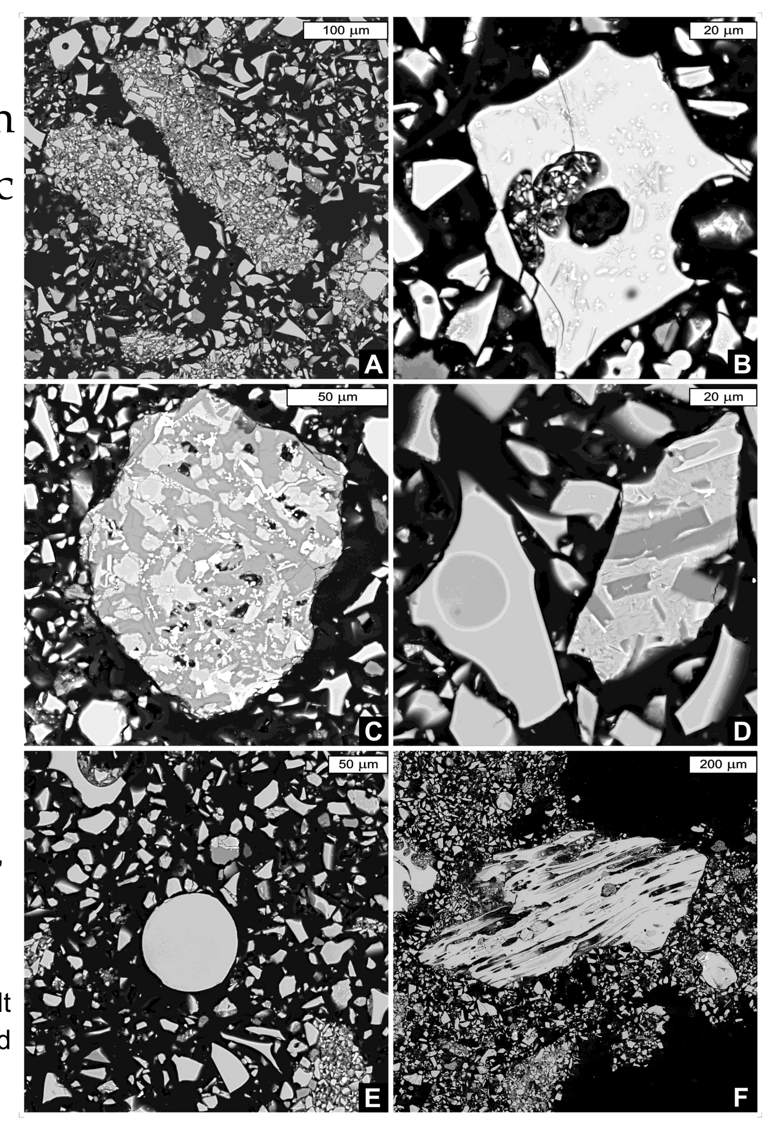

Fig. 5. The BSE images (back-scattered-electron) of the sample.

A – friable lumps of sub-millimetre sizes with the smallest glass particles. Dense packing, adhesion, and the presence of slightly developed (amorphous, crystallite dotted) meniscus and pendant cements (precipitated solutes). B – large shard of blocky glass containing small An-rich plagioclase laths (grey) and pyroxene and spinel crystals (relatively bright). The shard contains irregular voids/bubbles, selectively filled by the finest glass-silt fraction. Fractures in glass are fresh and still can expand. C – large clast with crystallized plagioclases (grey) and pyroxenes (bright). The brightest dots are Fe- and Ti-rich minerals, particularly the skeleton crystals of ulvospinel. D – pure homogeneous glass shard with a bubble (left) and a rare clast which consists of Na-rich anorthite (dark), altered augitic mass with amphiboles and zeolites (intermediate tones, structured), and an unusual hopper-shaped olivine (brighter, in upper right corner). E – uncommon spherical glass grain, with very slight initial crystallite

Conclusions

***Iceland is one of the largest and most active high-latitude cold dust sources.**

***Glaciog. dust is very fine with high number of close-to-ultrafine particles (300 nm).**

***About 80% of the dust is blackish volcanic glass rich in heavy metals.**

***Dust contains sharp-tipped shards with bubbles which allows rapid suspension of the particles.**

***Dust can be suspended during moist and low wind conditions.**

Detailed information:

Dagsson-Waldhauserova P., **Olafsson H., Arnalds O., Skrabalova L., Sigurdardottir G. M., Branis M., von Lowis of Menar S., Thorsteinsson T., Carlsen H. K., Jonsdottir I., 2014. Physical properties of suspended dust during moist and low wind conditions in Iceland. *Icelandic Agricultural Sciences*. Accepted.**

References

Pavla Dagsson-Waldhauserová, Haraldur Ólafsson, and Ólafur Arnalds. 2013. Long-term variability of dust-storms in Iceland. Geophysical Research Abstracts Vol. 15, EGU2013-11578-1.

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