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Characteristics of glacier surface weathering crust and light-absorbing particles, and their combined impact on glacier albedo at the Potanin Glacier, Mongolia

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By Sakai et al.

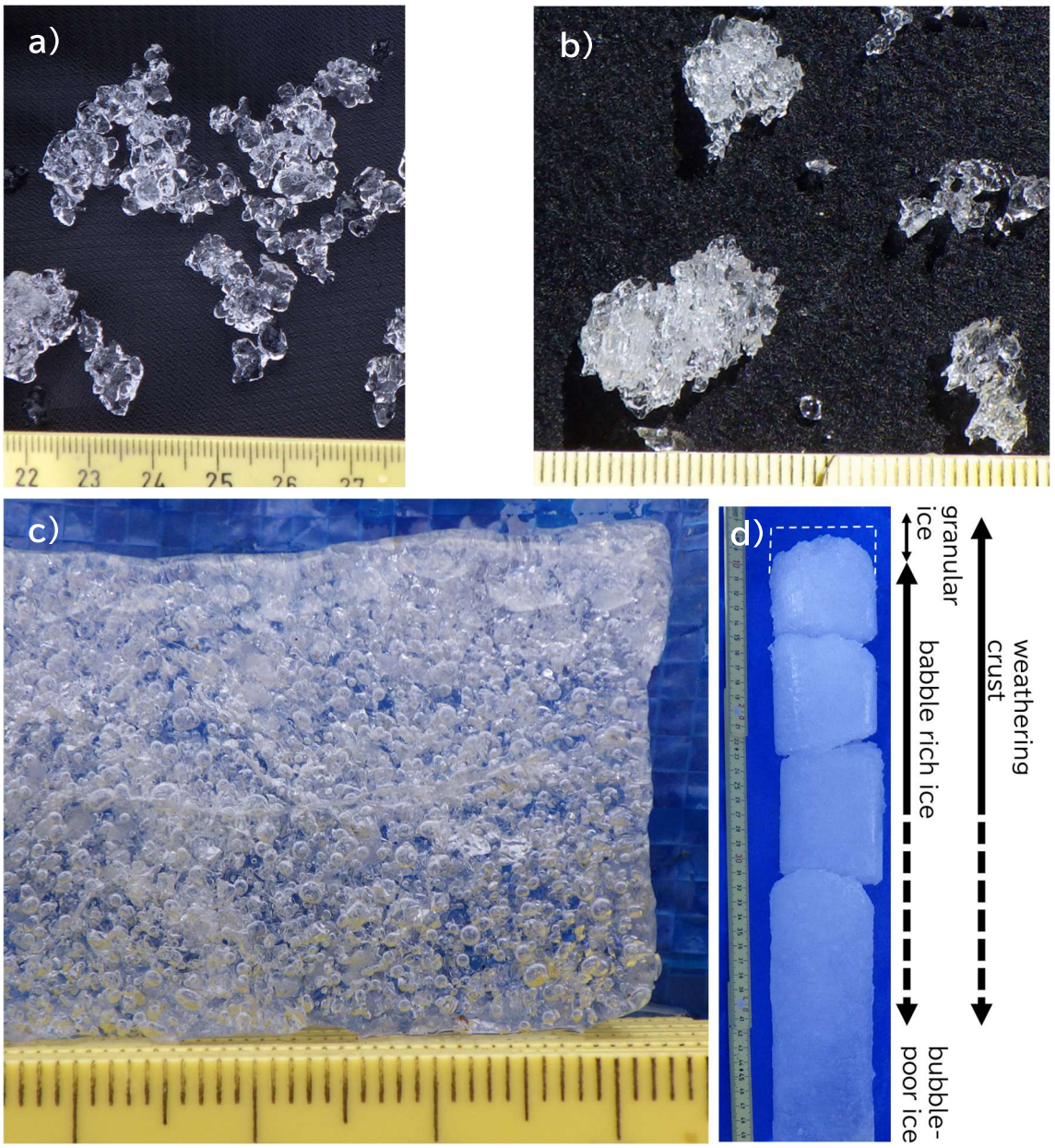

Figure S1 Examples of photographs of the weathering crust. a) Surface granular ice with rounded grains. b) Surface granular ice with angular grains. c) Sliced weathering crust just under the granular ice, showing a structure densely filled with air bubbles. Scale is indicated by the ruler (minimum length:1 mm) shown in the photograph. d) A core of weathering crust collected near ST2c on 30 August 2024. Because the fragile the granular ice layer disintegrates during ice coring with an ice auger and is not preserved in the recovered core, its original position is indicated by a white dashed line in the photograph.

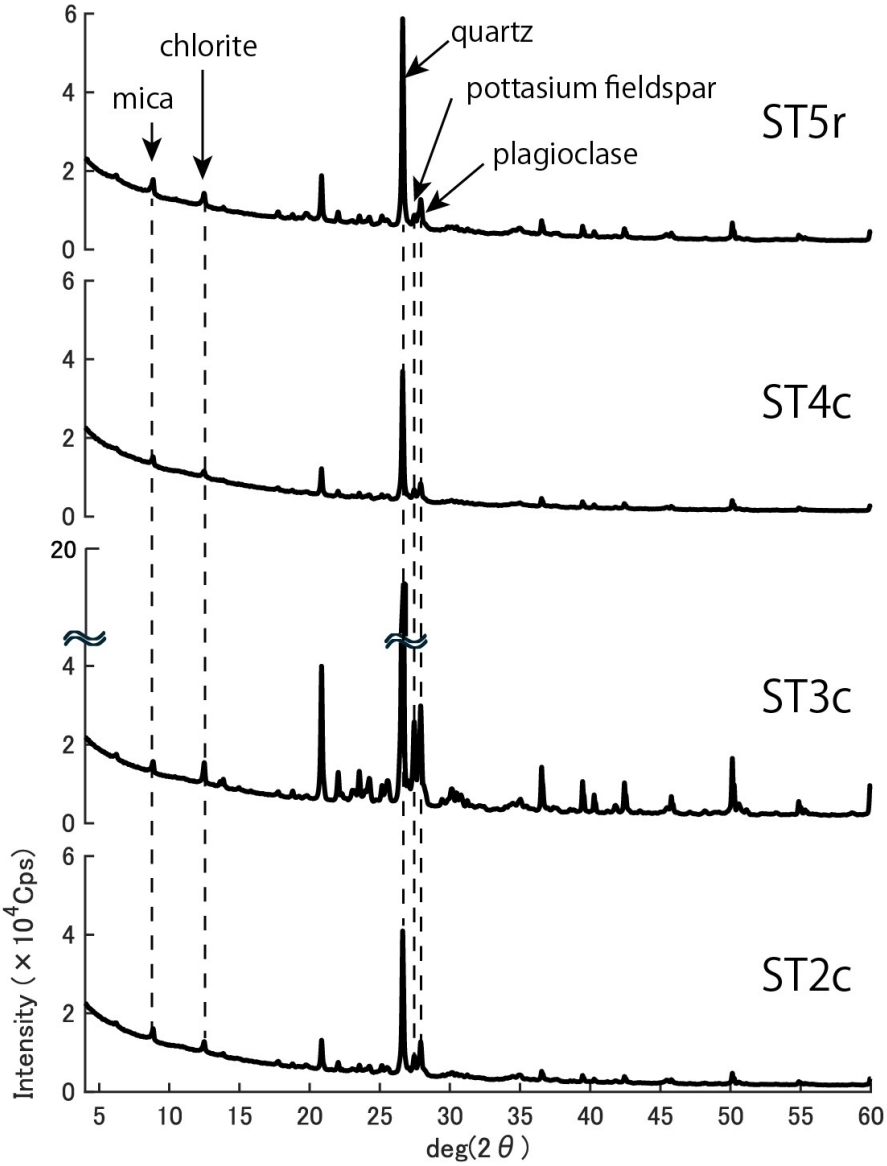

Figure S2 X-ray diffraction (XRD) spectra of minerals in particle at the Potanin Glacier surface.

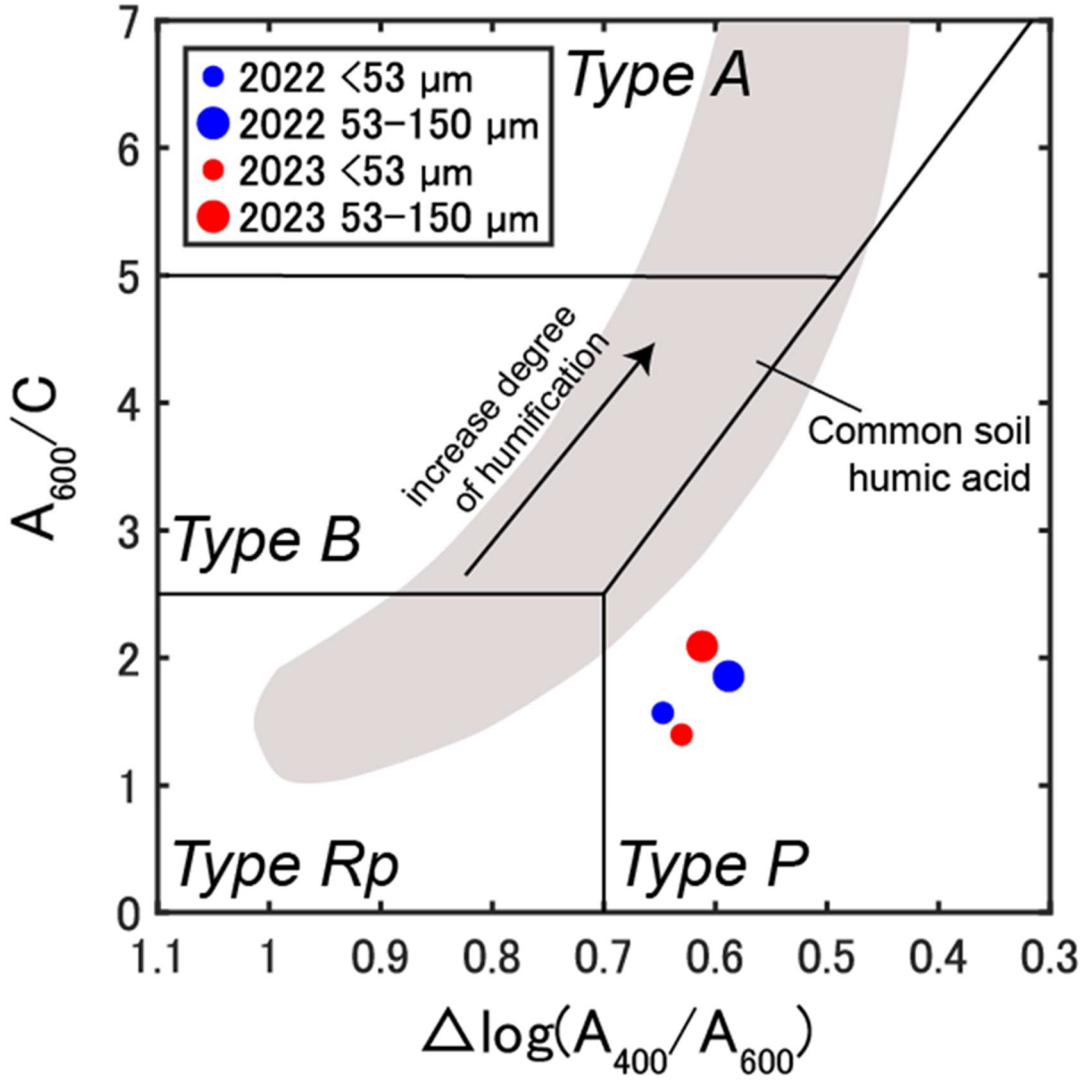

Figure S3 Diagram to classify types of humic acids including particles (Table 1) on the glacier using two methods of humic acid blackness (Δlog(A400/A600) and A600/C). Usually diagram can be classified as follows. Type A: Andosols or Andisols, Type B: Wet field, Type Rp : Peat, Type P: Podzols

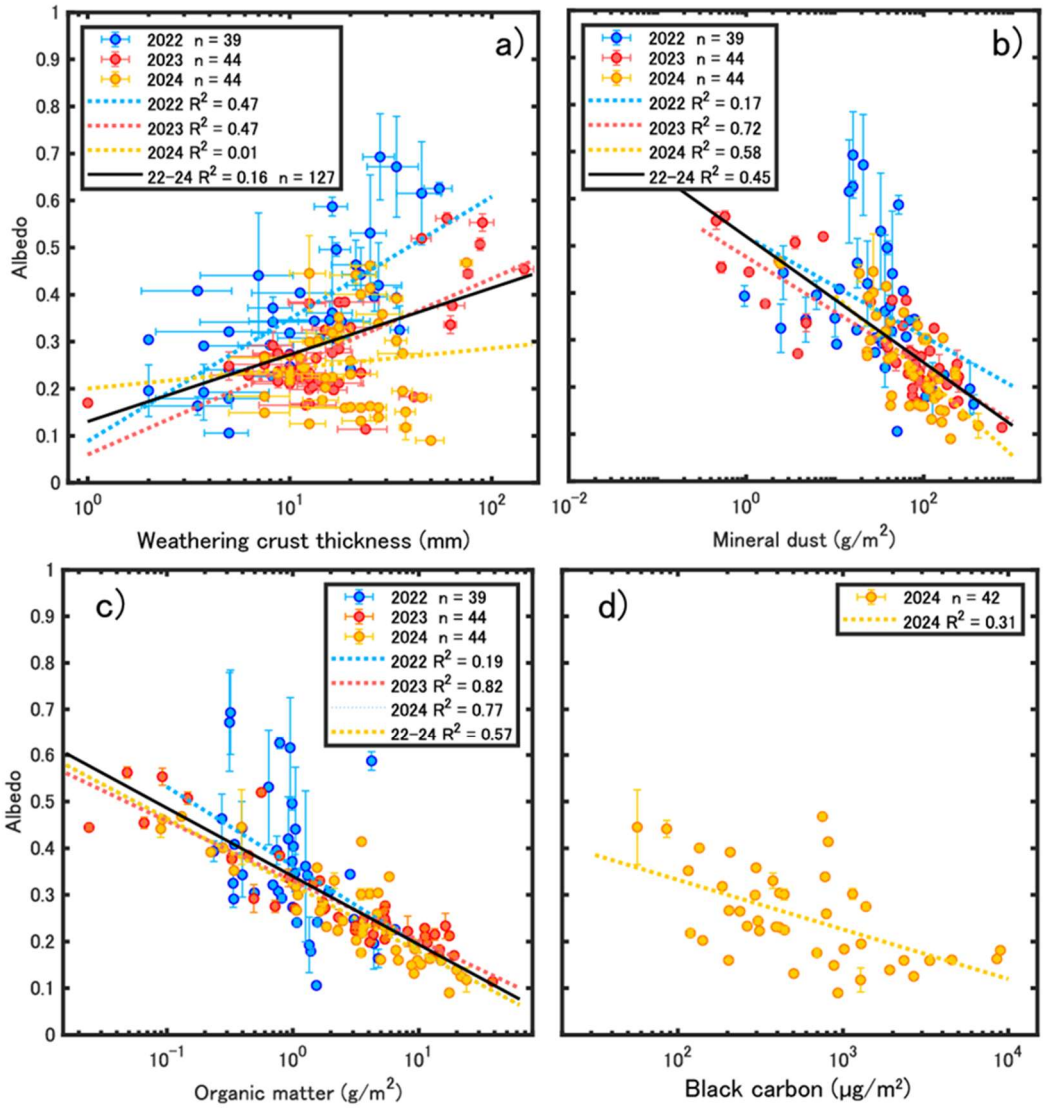

Figure S4 Year-by-year relationships for 2022, 2023, and 2024. Albedo vs GIT, b) Albedo vs MD, c) Albedo vs OM, d) Albedo vs BC.

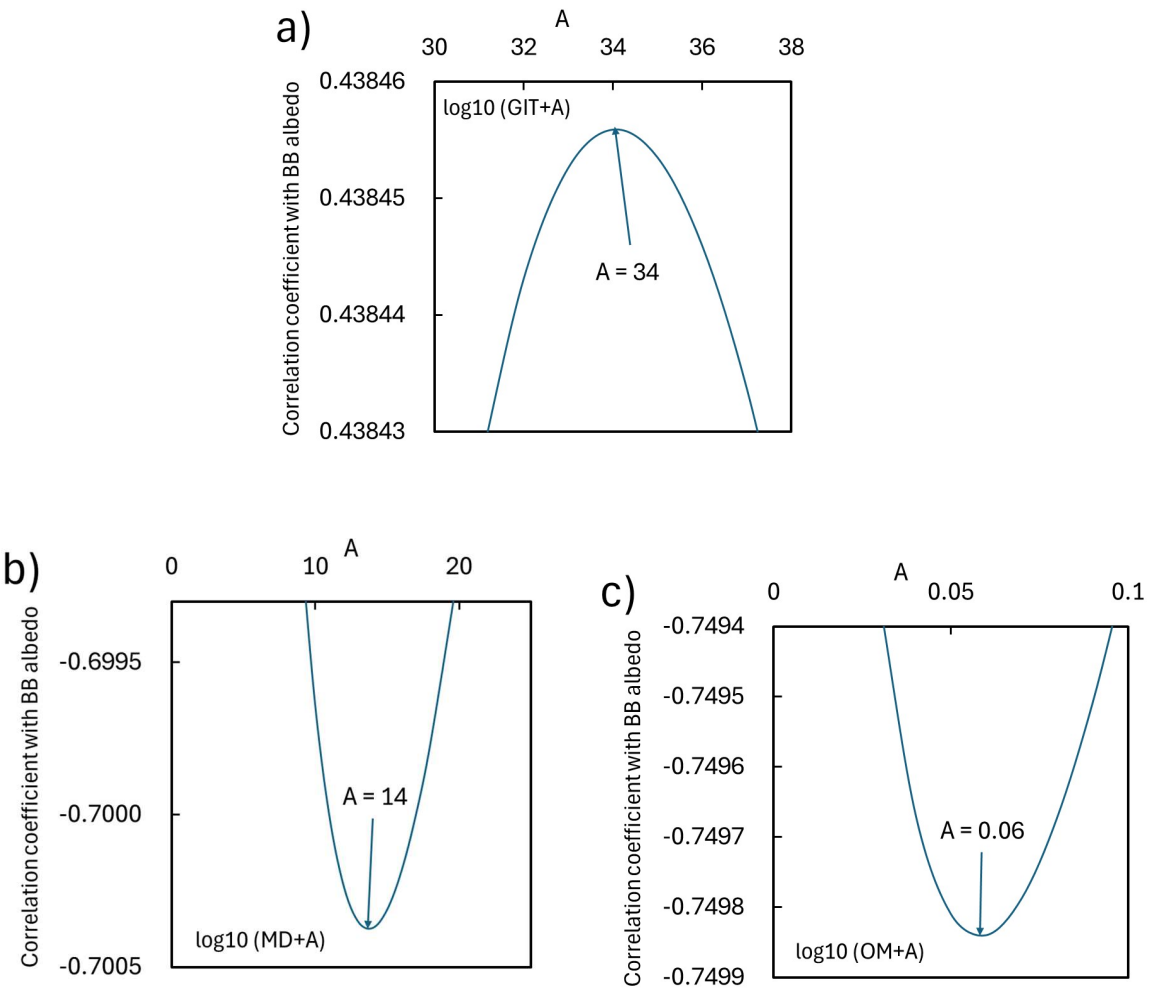

Figure S5 The constant A for each explanatory variable in the multiple regression analysis was chosen to maximize the absolute value of the correlation coefficient with BB albedo. The y-axis shows the correlation coefficient between BB albedo and log 10 (X+A), where *X* is each explanatory variable and A is a constant specific to each variable. (a) X= GIT, (b) X= MD, and (c) X= OM.

Table S1 Summary of physical condition of granular ice layer and amount of LAPs in the layer. Those spectral albedo of the surface granular ice and the underlying ice are shown in Fig. 6.

		a) dark	b) clean
Granular ice	thickness (mm)	12	34
Granular ice	ice density (kg/m^3)	338	264
Granular ice	particle diameter (mm)	4.8±2.3 (n = 100)	4.8±2.2 (n = 74)
Black carbon in granular ice layer	(μg m^{-2})	306	208
Mineral dust in granular ice layer	(g m^{-2})	68	24
Organic matter in granular ice layer	(g m^{-2})	2.5	0.22