V. Compiled Data of Chemical Compositions in Ice Cores Drilled at Mizuho Station

1) Measurements of sodium and magnesium

Neutron activation of nuclides can be applied to the measurement of sodium components at the ppb level in liquid samples by irradiating ^{23}Na with thermal neutron to form ^{24}Na, 1.37 and 2.75 MeV γ rays from which are counted. The detection limit of the element by this method is 0.5 ppb (2×10^{-8} mol·kg^{-1}) and the accuracy is $\pm5\%$ in relative error. Sodium concentration in Arctic and Antarctic snow strata has been found to be between 5 ppb (2.2×10^{-7} mol·kg^{-1}) and 40 ppb (17.4×10^{-7} mol·kg^{-1}) affected by yearly and seasonal atmospheric conditions.

Sodium and magnesium ions at such concentration level also can be quantitatively determined by atomic absorption method after application of successive freezing concentration to the samples, sodium ions being enriched in liquid phase but not in ice phase. The overall detection limit by this method is 0.5 ppb (2×10^{-8} mol·kg^{-1}) and the accuracy is $\pm10\%$ in relative error, sodium and magnesium components in fine particles such as volcanic ashes and clays being occluded. Table 1 gives measured concentrations of sodium and magnesium in JARE-12 cores, which were drilled at Mizuho Station (70°41.9′S, 44°19.9′E; 2230 m) in East Antarctica.

2) Measurements of mercury

A core sample containing $(0–20)\times10^{-12}$ kg of mercury, cut from Mizuho JARE-13 cores, was taken into a vessel and melted in the presence of potassium permanganate. Mercury ions are reduced with stannous chloride to form elementary mercury, which is under continuous supply of nitrogen gas collected on the surface of gold particles. Amalgamated mercury is then released as atomic mercury at 400°C. Mercury vapor is introduced into a quartz absorption cell

Table 1. Concentrations of Na and Mg in Mizuho JARE-12 cores.

Depth (m)	Sodium $\times10^{-6}$ mol·kg^{-1}	Magnesium $\times10^{-6}$ mol·kg^{-1}
18.84–18.89	13.70	0.86
19.23–19.33	2.09	0.12
26.45–26.60	2.35	0.41
27.42–27.55	2.48	0.29
28.82–28.93	15.60	1.81
33.09–33.13	4.65	2.75
34.60–34.70	6.78	3.13
39.92–40.06	37.30	5.14
45.00–45.12	1.44	1.52
49.87–49.97	7.39	2.30
59.85–59.96	0.48	0.08
60.86–60.95	0.22	0.12

(8 mm of diameter and 25 cm of length). Absorbance at 253.7 nm is measured. The precision (95% confidence) is within ±5% in relative error for 10 nm of mercury, detection limit being 1.5×10^{-13} kg. Most important is the flow-rate of nitrogen for amalgamation and release on and from the surface of gold particles. The heating temperature of gold particles for the release was kept exactly at 400°C for 90 seconds. Contaminations such as absorption of atmospheric mercury by samples, reagents, and vessels give serious error. The class 100 clean laboratory could eliminate such contaminations. The results of the measurements are given in Table 2.

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Table 2. Concentration of mercury in the Mizuho JARE-13 cores.

Depth (m)	Sample taken (kg)	Mercury $\times10^{-9}$ mol·kg^{-1}	Annual accumulation $\times10^{-7}$ mol·m^{-2}·yr^{-1}
4.0 – 4.1	0.093	0.043	0.045
6.0 – 6.1	0.107	0.109	0.110
8.0 – 8.1	0.195	0.065	0.065
10.0 – 10.1	0.121	0.074	0.070
12.0 – 12.1	0.207	0.013	0.015
15.37– 15.55	0.230	0.237	0.239
19.0 – 19.1	0.225	0.027	0.030
23.48– 23.66	0.230	0.244	0.244
28.38– 28.52	0.137	0.049	0.050
32.44– 32.62	0.128	0.029	0.030
36.26– 36.41	0.126	0.086	0.085
44.37– 44.52	0.227	0.014	0.009
64.52– 64.68	0.213	0.015	0.015
68.82– 68.97	0.275	0.006	0.005
72.49– 72.65	0.280	0.004	0.005
80.37– 80.53	0.253	0.005	0.005
92.40– 92.56	0.243	0.000	0.000
96.42– 96.57	0.125	0.000	0.000
100.70–100.85	0.135	0.013	0.015
106.43–106.70	0.261	0.010	0.009
116.54–116.70	0.196	0.008	0.002
128.49–128.64	0.246	0.007	0.005
132.50–132.66	0.172	0.000	0.000
136.70–136.87	0.332	0.010	0.009
140.55–140.70	0.246	0.009	0.009
144.54–144.70	0.221	0.008	0.009