# Chemical Studies on the Ocean. (LIII)

## Chemical Studies of the Shallow-water Deposits. (9) On the Chemical Constituents of the Shallow-water Deposits along the Sea-coasts of Niigata, Yamagata and Akita Prefectures[1)]

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Laying emphasis on K determination, we have analysed 11 kinds of the deposits from the sea-coasts of Niigata, Yamagata and Akita prefectures, and found that the $K_2O$ content is considerably high in the two samples from the sea-coast of the Echigo Alluvial Plain, and comparing the average $K_2O$ value of all these samples with that of the deposits of Ishikawa and Toyama prefectures and that of Korean sands reported in the previous papers, we can see $K_2O$ % written in this report is slightly lower than that in the former and is near to that in the latter.

### INTRODUCTION

In the previous paper[2)], we have reported on the chemical composition of 8 kinds of the deposits from the sea-coast of Aichi prefecture. In this paper, the analytical results on 11 kinds of deposits from the sea-coasts of Niigata, Yamagata and Akita prefectures are described.

According to the investigations of the Fisheries Experiment Stations of these prefectures, the shallow-water deposits near the shoreline consist chiefly of sands, gravels and boulders, and the coastal sand dune has developed in many places.

### SAMPLES

Locality and date of sampling are shown in Table 1.

These samples are the deposits collected in the neighbourhood of the shoreline.

Sample 11 : grayish white sand containing many small gravels ; collected by T. Tachibana at the point about 3 km northeast of the estuary of the Ara River.

Sample 12 : blackish brown sand ; collected by S. Nakano at the point about 100 m southwest of the estuary of the Mae River.

Sample 13 : brown sand ; collected by I. Toyama at the sea-coast of Amaze.

Sample 14 : grayish white sand ; collected by I. Matsuda at the point about 2 km southwest of the estuary of the Shin River.

Sample 15 : grayish white sand ; collected by K. Watanabe at the point about 2 km northeast of the estuary of the Ochibori River.

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Table 1.

| Sample No. | Locality | Date |
|---|---|---|
| 11 | Shimoarahama, Yachihomura, Nakakubikigun, Niigataken | Aug. 13, 1947 |
| 12 | Kujiranami, Kashiwazakishi, Niigataken | Aug. 12, 1947 |
| 13 | Amaze, Izumozakimachi, Santōgun, Niigataken | Aug. 14, 1947 |
| 14 | Kawakami, Ikarashihama, Uchinomachi, Nishikambaragun, Niigataken | Aug. 10, 1947 |
| 15 | Muramatsuhama, Matsuzukamura, Kitakambaragun, Niigataken | Aug. 13, 1947 |
| 16 | Aburato, Kamomachi, Nishitagawagun, Yamagataken | Aug. 15, 1947 |
| 17 | Miyaumi, Nishiarasemura, Akuumigun, Yamagataken | Aug. 22, 1947 |
| 35 | Karasumori, Uchimichikawa, Michikawamura, Yurigun, Akitaken | Aug. 25, 1947 |
| 36 | Shimodeto, Tennōmura, Minamiakitagun, Akitaken | Aug. 27, 1947 |
| 37 | Minamihirasawa, Funagawaminatomachi, Minamiakitagun, Akitaken | Sept. 29, 1948 |
| 38 | Miyasawa, Katanishimura, Minamiakitagun, Akitaken | Aug. 7, 1947 |

Sample 16 : grayish sand containing shell fragments ; collected by K. Hida at the southern side of the Aburato-Bay.

Sample 17 : grayish white sand ; collected by K. Yoshimiya at the point about 2 km southwest of the estuary of the Nikkō River.

Sample 35 : grayish white sand ; collected by T. Mori at the point abut 300 m south of the estuary of the Kimigano River.

Sample 36 : brown sand ; collected by K. Sasaki at the sea-coast of Shimodeto.

Sample 37 : grayish white sand containing many shell fragments ; collected by T.

Table 2. Size composition of the deposits.

| Sample No. | Mesh[a] | | | | | | |
|---|---|---|---|---|---|---|---|
| | >8 | 14 | 28 | 48 | 100 | 200 | pan |
| | % | % | % | % | % | % | % |
| 11 | 40 | 29 | 4 | 15 | 11 | 1 | 0 |
| 12 | 0 | 1 | 69 | 30 | 0 | 0 | 0 |
| 13 | 0 | 0 | 0 | 2 | 80 | 18 | 0 |
| 14 | 0 | 1 | 13 | 20 | 56 | 10 | 0 |
| 15 | 0 | 4 | 7 | 21 | 63 | 4 | 1 |
| 16 | 0 | 1 | 18 | 66 | 11 | 3 | 1 |
| 17 | 13 | 48 | 38 | 1 | 0 | 0 | 0 |
| 35 | 5 | 25 | 55 | 14 | 1 | 0 | 0 |
| 36 | 0 | 0 | 0 | 4 | 73 | 23 | 0 |
| 37 | 9 | 14 | 24 | 18 | 25 | 10 | 0 |
| 38 | 0 | 3 | 26 | 15 | 41 | 15 | 0 |

[a] Tyler standard.

Yaraku at the point about 100 m southwest of the southern breakwater of Funagawa-minato.

Sample 38: brown sand containing small amounts of shell fragments; collected by T. Ōta at the northern tombolo of Hachirō-gata.

The size composition of these deposits is shown in Table 2.

The geology of the land adjacent to the locations sampled is briefly as follows:

Sample 12 was collected at the sea-coast near Yoneyama which is chiefly composed of agglomerate, agglomerate-tuff and two-pyroxene-andesite; Samples 13, 16 and 37 were collected at the sea-coast of the land composed of Tertiary formations; the others, at the coast of Quaternary formations. Further, Tertiary formations are found relatively near the location where Sample 35 was collected. In the mountainous areas of these districts, Tertiary sedimentary rocks and volcanic rocks distribute widely, and small amounts of granites and Paleozoic formations are found there.

## EXPERIMENTAL PROCEDURE, RESULTS AND DISCUSSION

Experiments were carried out as described previously[3].

The analytical results of the air-dried samples are shown in Table 3. From this table we obtained the percentages of chemical constituents in the sea-salt-free samples dried at 105 ~ 110°C as shown in Table 4*.

In Table 4, it is noticeable that Samples 17 and 35 have different chemical com-

Table 3. Chemical composition of the deposits.

| Sample No. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 35 | 36 | 37 | 38 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | % | % | % | % |
| Drying loss | 0.78 | 0.50 | 0.59 | 1.00 | 0.34 | 0.87 | 0.28 | 0.78 | 1.59 | 1.67 | 1.20 |
| Ignition loss | 1.49 | 1.31 | 1.62 | 2.07 | 1.28 | 4.42 | 1.15 | 1.24 | 2.50 | 24.50 | 2.74 |
| $Fe_2O_3$ | 3.54 | 5.34 | 4.12 | 3.33 | 2.06 | 2.75 | 2.57 | 2.73 | 4.57 | 2.52 | 2.79 |
| $TiO_2$ | 0.43 | 0.57 | 0.48 | 0.45 | 0.34 | 0.46 | 0.37 | 0.43 | 0.53 | 0.44 | 0.51 |
| $Al_2O_3$ | 13.26 | 12.50 | 12.16 | 12.97 | 12.05 | 12.29 | 9.42 | 9.20 | 14.27 | 8.43 | 12.37 |
| MnO | 0.05 | 0.08 | 0.04 | 0.06 | 0.03 | 0.04 | 0.04 | 0.08 | 0.07 | 0.06 | 0.04 |
| CaO | 1.98 | 2.50 | 2.97 | 2.02 | 1.45 | 3.85 | 1.02 | 2.70 | 2.55 | 27.84 | 3.97 |
| MgO | 1.58 | 2.05 | 1.67 | 1.28 | 0.84 | 1.70 | 1.06 | 0.38 | 0.97 | 0.97 | 0.95 |
| $K_2O$ | 1.75 | 2.07 | 2.10 | 3.12 | 3.64 | 2.70 | 1.90 | 1.67 | 1.98 | 1.54 | 1.71 |
| $Na_2O$ | 3.15 | 2.34 | 2.56 | 3.07 | 3.08 | 3.28 | 2.19 | 2.28 | 2.97 | 1.92 | 2.81 |
| $SiO_2$ | 71.82 | 70.49 | 72.31 | 71.01 | 75.48 | 67.92 | 79.96 | 79.05 | 67.82 | 30.70 | 70.33 |
| $SO_3$ | 0.20 | 0.10 | 0.11 | 0.12 | 0.13 | 0.23 | 0.13 | 0.10 | 0.10 | 0.51 | 0.10 |
| Cl | 0.19 | 0.35 | 0.36 | 0.19 | 0.24 | 0.31 | 0.07 | 0.22 | 0.19 | 0.04 | 0.43 |
| $P_2O_5$ | 0.11 | 0.13 | 0.08 | 0.05 | 0.04 | 0.10 | 0.06 | 0.05 | 0.06 | 0.13 | 0.08 |
| $CO_2$ | — | — | — | — | — | 1.40 | — | — | — | 20.37 | 0.89 |
| N | n. d. | n. d. | n. d. | n. d. | n. d. | n. d. | n. d. | n. d. | n. d. | n. d. | n. d. |

* We performed this calculation on the basis of the same assumption as in the previous paper[1].

Table 4. Chemical composition of the deposits on sea-salt-free and dry basis (calculated from Table 3).

| Sample No. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 35 | 36 | 37 | 38 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | % | % | % | % |
| $Fe_2O_3$ | 3.58 | 5.40 | 4.17 | 3.38 | 2.08 | 2.79 | 2.58 | 2.76 | 4.66 | 2.56 | 2.85 |
| $TiO_2$ | 0.43 | 0.58 | 0.49 | 0.46 | 0.34 | 0.47 | 0.37 | 0.44 | 0.54 | 0.45 | 0.52 |
| $Al_2O_3$ | 13.41 | 12.64 | 12.31 | 13.15 | 12.14 | 12.47 | 9.46 | 9.31 | 14.55 | 8.58 | 12.62 |
| MnO | 0.05 | 0.08 | 0.04 | 0.06 | 0.03 | 0.04 | 0.04 | 0.08 | 0.07 | 0.06 | 0.04 |
| CaO | 1.99 | 2.52 | 3.00 | 2.04 | 1.45 | 3.90 | 1.02 | 2.72 | 2.59 | 28.33 | 4.04 |
| MgO | 1.58 | 2.03 | 1.65 | 1.28 | 0.82 | 1.69 | 1.05 | 0.36 | 0.97 | 0.99 | 0.92 |
| $K_2O$ | 1.77 | 2.08 | 2.12 | 3.16 | 3.66 | 2.73 | 1.91 | 1.68 | 2.02 | 1.57 | 1.73 |
| $Na_2O$ | 3.04 | 2.10 | 2.32 | 2.97 | 2.92 | 3.09 | 2.15 | 2.15 | 2.89 | 1.92 | 2.54 |
| $SiO_2$ | 72.63 | 71.29 | 73.22 | 71.97 | 76.06 | 68.90 | 80.29 | 79.99 | 69.15 | 31.24 | 71.75 |
| $SO_3$ | 0.18 | 0.06 | 0.07 | 0.10 | 0.10 | 0.19 | 0.12 | 0.07 | 0.08 | 0.52 | 0.05 |
| $P_2O_5$ | 0.11 | 0.13 | 0.08 | 0.05 | 0.04 | 0.10 | 0.06 | 0.05 | 0.06 | 0.13 | 0.08 |
| $CO_2$ | — | — | — | — | — | 1.42 | — | — | — | 20.73 | 0.91 |
| N | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. |
| $Na_2O+K_2O$ | 4.81 | 4.18 | 4.44 | 6.13 | 6.58 | 5.82 | 4.06 | 3.83 | 4.91 | 3.49 | 4.27 |
| $K_2O/Na_2O$ | 0.58 | 0.99 | 0.91 | 1.06 | 1.25 | 0.88 | 0.89 | 0.78 | 0.70 | 0.82 | 0.68 |

position from others, being exceedingly high in $SiO_2$ and low in $Al_2O_3$ and the like. Further, it is seen that Sample 12 is comparatively high in $Fe_2O_3$ and MgO, and Sample 36 is so in $Fe_2O_3$ and $Al_2O_3$. Sample 37 which contains many shell fragments, has also a particularly different chemical composition, and we must recalculate the chemical composition on the shell fragments ($CaCO_3$)-free basis from Table 4. Obtained results* are as follows: $SiO_2$ 59.11 %, $Fe_2O_3$ 4.84%, $TiO_2$ 0.85 %, $Al_2O_3$ 16.23 %, etc. From these figures we can see that this sample consists of relatively different sand which is low in $SiO_2$ and comparatively high in $Fe_2O_3$, $TiO_2$, $Al_2O_3$, etc.

As for the $K_2O$ content in all the deposits, it ranges 1.57~3.66 %, being considerably high in Samples 14 and 15 which were collected at the sea-coast of the Echigo Alluvial Plain. The total average amounts to 2.22 % which is slightly lower than that of the sands from Ishikawa and Toyama prefectures, 2.65 %[3], and similar to that of Korean sands, 2.39 %[5].

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* In this recalculation, we assumed that shell fragments consist of $CaCO_3$ alone, and $CO_2$ in Table 4 results from shell fragments only.

us with many valuable samples.

## REFERENCES

(1) This investigation (9) (together with (8)) was presented at the 2nd Annual Meeting of the Chemical Society of Japan on April 2, 1949.
(2) M. Ishibashi and S. Ueda, This Bulletin, **34**, 122 (1956).
(3) M. Ishibashi and S. Ueda, This Bulletin, **34**, 117 (1956).
(4) M. Ishibashi and S. Ueda, This Bulletin, **33**, 165 (1955).
(5) M. Ishibashi and S. Ueda, This Bulletin, **33**, 170 (1955).