# Chemical Studies on the Ocean. (LI)

## Chemical Studis of the Shallow-water Deposits. (7)[1]
## On the Chemical Constituents of the Shallow-water Deposits along the Sea-coasts of Ishikawa and Toyama Prefectures[2]

Masayoshi ISHIBASHI and Shunzō UEDA

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We collected 10 kinds of the samples at the sea-coasts of Ishikawa and Toyama prefectures and 9 kinds of them were analysed. It is found that they have nearly similar chemical composition except for two samples from the sea-coast of the Noto Peninsula, and the $K_2O$ content is comparatively high in all the samples.

### INTRODUCTION

On the chemical studies of the oceanic deposits, there are many works performed in Japan about the deep-sea deposits[3], but not so many about the shallow-water deposits[4]. This is mainly due to the difficulties of systematic researches on the shallow-water deposits, which are made up chiefly of materials carried by river-water from terrestrial regions and arranged with great diversity of the sedimentary facies according to the landforms, geology, sea-currents, etc. of its region. While, as previously reported[5], the shallow-water deposit from the Korean sea-coast was verified to be rich in Ra and K, and exceedingly effective as a sort of earth brought from another place for rice crop, so we came to carry out the researches on the deposits from the Japanese sea-coasts, as it is important and also interesting from the viewpoint of science as well as resources to investigate the chemical composition of the Japanese deposits and to compare it with the Korean.

In this paper, the analytical results of the 9 kinds of deposits collected at the sea-coasts of Ishikawa and Toyama prefectures are reported.

### SAMPLES

Locality and date of sampling are shown in Table 1.

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

Sample 1 : light brown sand ; collected at the point about 800 m northeast of the estuary of the Kakehashi River.

Sample 2 : brown sand ; collected along the shoreline of the sand dune near

* 石橋 雅義, 上田 俊三

Table 1.

| Sample No. | Locality | Date |
|---|---|---|
| 1 | Atakamachi, Komatsushi, Ishikawaken | Mar. 16, 1947 |
| 2 | Mukōawagasaki, Uchinadamura, Kahokugun, Ishikawaken | Mar. 19, 1947 |
| 3 | Takahama, Takahamamachi, Hakuigun, Ishikawaken | Mar. 20, 1947 |
| 4 | Ōkawa, Machinomachi, Fugeshigun, Ishikawaken | Mar. 17, 1947 |
| 5 | Fujinami, Sannamimura, Fugeshigun, Ishikawaken | Mar. 23, 1947 |
| 6 | Matto, Nanaoshi, Ishikawaken | Mar. 20, 1947 |
| 7 | Kubo, Kubomura, Himigun, Toyamaken | Mar. 20, 1947 |
| 8 | Ebie, Ebiemura, Imizugun, Toyamaken | Mar. 20, 1947 |
| 9 | Shimomurakimachi, Uozumachi, Shimoniikawagun, Toyamaken | Mar. 18, 1947 |
| 10 | Ikujimachi, Shimoniikawagun, Toyamaken | Mar. 18, 1947 |

Awagasaki.

Sample 3 : light brown sand ; collected at the point about 500 m south of the estuary of the Konmachi River.

Sample 4 : blackish sand containing comparatively many shell fragments and gravels ; collected at the point about 1.5 km northeast of the estuary of the Najimi River ; this coast is very rocky, and steep sea-cliff about 50 m high can be seen close to the shoreline.

Sample 5 : blackish sand containing comparatively many shell fragments ; collected at the sea-coast of Hetanohama ; the greater part of this coast is rocky.

Sample 6 : light grayish brown sand containing comparatively many shell fragments ; collected at the point about 200 m east of the estuary of the Akaura River.

Sample 7 : light brown sand ; collected at the point about 500 m southeast of the estuary of the Shin River.

Sample 8 : light grayish brown sand ; collected at the sea-coast of Ebie.

Sample 9 : light yellowish sand ; collected at the point about 1 km north of the estuary of the Kado River.

Sample 10 : small gravel (0.5~3 cm)*; collected at the point a little to the south of the Ikuji Cape.

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

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

Samples 1 and 2 were collected at the coastal front of the Kaga Alluvial Plain, the eastern hills of which are Tertiary and Diluvium. The main rivers which may affect these samples are R. Kakehashi, R. Tetori and R. Sai. R. Kakehashi runs

* This gravel is presumably originated from the Kurobe River and composed of clay-slate, sandstone, granite-gneiss, rhyolite, porphyry, porphyrite and serpentine, of which porphyry, porphyrite and serpentine are dominant and clay-slate is poor.

Table 2. Size composition of the deposits.

| Sample No. | Mesh[a] | | | | | | |
|---|---|---|---|---|---|---|---|
| | >8 | 14 | 28 | 48 | 100 | 200 | pan |
| | % | % | % | % | % | % | % |
| 1 | 0 | 1 | 12 | 53 | 33 | 1 | 0 |
| 2 | 0 | 3 | 82 | 14 | 1 | 0 | 0 |
| 3 | 0 | 0 | 0 | 2 | 58 | 40 | 0 |
| 4 | 21 | 30 | 41 | 8 | 0 | 0 | 0 |
| 5 | 0 | 2 | 30 | 52 | 13 | 3 | 0 |
| 6 | 0 | 7 | 43 | 26 | 13 | 11 | 0 |
| 7 | 0 | 0 | 1 | 27 | 52 | 20 | 0 |
| 8 | 0 | 0 | 29 | 70 | 1 | 0 | 0 |
| 9 | 0 | 0 | 3 | 66 | 29 | 2 | 0 |
| 10 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |

[a] Tyler standard.

mainly through the regions composed of Tertiary pyroclastic rocks and rhyolite ; R. Tetori, through Jurassic formations, gneisses, Tertiary pyroclastics and rhyolite ; and R. Sai, through andesite and Tertiary formations.

The Noto Peninsula where Samples 3, 4, 5 and 6 were collected, consists mainly of Tertiary sedimentary and volcanic rocks.

Samples 7, 8, 9 and 10 are the deposits from the Toyama-Bay. The plain bordering the bay is mainly Alluvium, its margin being Diluvium. As to the mountainous areas, the lower part surrounding the plain is composed of Tertiary rocks, and in their higher part gneisses, granites and the Mesozoic formations distribute.

## EXPERIMENTAL PROCEDURE, RESULTS AND DISCUSSION

Experiments were carried out mostly by the methods reported in the previous papers[6] and partly by those described in the works by J. W. Mellor and H. V. Thompson[7].

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**.

As obvious from Table 4, all the samples except 4, 5 and 6 which contain many shell fragments have approximately similar chemical composition. Further, recalculating the composition based on the shell fragments ($CaCO_3$)-free samples from Table 4***, though its tabulation is omitted here, we can see that only Samples 4 and 5

* Samples 10 was not analysed, because it is gravel.

** We performed this calculation on the same assumption as in the previous paper[8].

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

Table 3. Chemical compostion of the deposits.

| Sample No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | % | % |
| Drying loss | 0.28 | 0.34 | 0.64 | 0.70 | 2.51 | 0.44 | 0.49 | 0.25 | 0.27 |
| Ignition loss | 1.38 | 1.31 | 2.69 | 4.96 | 12.46 | 4.58 | 1.20 | 0.96 | 0.76 |
| $Fe_2O_3$ | 2.50 | 3.04 | 3.30 | 4.37 | 5.78 | 3.05 | 2.32 | 3.74 | 1.76 |
| $TiO_2$ | 0.36 | 0.42 | 0.34 | 0.60 | 0.47 | 0.33 | 0.31 | 0.37 | 0.29 |
| $Al_2O_3$ | 10.23 | 12.55 | 12.05 | 12.89 | 13.74 | 12.66 | 13.06 | 12.61 | 13.76 |
| MnO | 0.03 | 0.04 | 0.03 | 0.04 | 0.02 | 0.02 | 0.02 | 0.04 | 0.02 |
| CaO | 1.91 | 1.98 | 3.38 | 9.26 | 11.11 | 6.39 | 2.30 | 3.01 | 1.72 |
| MgO | 0.79 | 1.02 | 1.35 | 1.84 | 1.78 | 1.04 | 0.72 | 1.15 | 0.56 |
| $K_2O$ | 2.69 | 2.91 | 2.57 | 2.14 | 2.15 | 2.52 | 2.84 | 2.63 | 3.20 |
| $Na_2O$ | 2.75 | 3.12 | 2.17 | 2.39 | 2.99 | 2.67 | 2.24 | 3.43 | 3.50 |
| $SiO_2$ | 77.36 | 73.43 | 71.83 | 61.18 | 45.19 | 66.03 | 74.99 | 72.05 | 74.48 |
| $SO_3$ | 0.17 | 0.12 | 0.12 | 0.12 | 0.34 | 0.26 | 0.18 | 0.19 | 0.14 |
| Cl | 0.36 | 0.37 | 0.58 | 0.13 | 0.28 | 0.43 | 0.23 | 0.41 | 0.15 |
| $P_2O_5$ | 0.08 | 0.14 | 0.10 | 0.14 | 0.15 | 0.09 | 0.06 | 0.10 | 0.06 |
| $CO_2$ | 0.46 | — | 1.02 | 4.50 | 6.57 | 3.29 | — | — | 0.41 |
| N | — | — | 0.01 | 0.02 | 0.02 | — | 0.04 | 0.03 | 0.02 |

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

| Sample No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | % | % |
| $Fe_2O_3$ | 2.52 | 3.07 | 3.36 | 4.41 | 5.96 | 3.09 | 2.34 | 3.78 | 1.77 |
| $TiO_2$ | 0.36 | 0.42 | 0.35 | 0.61 | 0.48 | 0.33 | 0.31 | 0.37 | 0.29 |
| $Al_2O_3$ | 10.33 | 12.68 | 12.26 | 13.01 | 14.17 | 12.82 | 13.18 | 12.74 | 13.83 |
| MnO | 0.03 | 0.04 | 0.03 | 0.04 | 0.02 | 0.02 | 0.02 | 0.04 | 0.02 |
| CaO | 1.92 | 1.99 | 3.42 | 9.35 | 11.45 | 6.46 | 2.31 | 3.03 | 1.73 |
| MgO | 0.76 | 0.99 | 1.31 | 1.85 | 1.80 | 1.00 | 0.70 | 1.11 | 0.54 |
| $K_2O$ | 2.71 | 2.93 | 2.60 | 2.16 | 2.21 | 2.54 | 2.86 | 2.65 | 3.22 |
| $Na_2O$ | 2.50 | 2.88 | 1.77 | 2.31 | 2.87 | 2.38 | 2.09 | 3.16 | 3.41 |
| $SiO_2$ | 78.09 | 74.18 | 73.06 | 61.76 | 46.60 | 66.85 | 75.68 | 72.77 | 74.88 |
| $SO_3$ | 0.13 | 0.08 | 0.05 | 0.10 | 0.32 | 0.21 | 0.15 | 0.14 | 0.12 |
| $P_2O_5$ | 0.08 | 0.14 | 0.10 | 0.14 | 0.15 | 0.09 | 0.06 | 0.10 | 0.06 |
| $CO_2$ | 0.46 | — | 1.04 | 4.54 | 6.77 | 3.33 | — | — | 0.41 |
| N | — | — | 0.01 | 0.02 | 0.02 | — | 0.04 | 0.03 | 0.02 |
| $Na_2O+K_2O$ | 5.21 | 5.81 | 4.37 | 4.47 | 5.08 | 4.92 | 4.95 | 5.81 | 6.63 |
| $K_2O/Na_2O$ | 1.08 | 1.02 | 1.47 | 0.94 | 0.77 | 1.07 | 1.37 | 0.84 | 0.94 |

have the different chemical composition from that of the others.

Namely, these two samples, having distinguishable appearences, are low in $SiO_2$ and comparatively high in $Fe_2O_3$, $Al_2O_3$, CaO, MgO, etc. So we can estimate that their original rocks may have been considerably different from those of the others.

Now, as for alkalies, it is seen from Table 4 that the $K_2O$ content is comparatively high in all the samples, being above 2 %. Namely, it ranges 2.16～3.22%, and its mean value amounts to 2.65 %, which is slightly higher than that of Korean sands, 2.39 %, shown in the previous paper[9]. The $Na_2O$ content is also above 2 % in most samples, therefore, the $Na_2O + K_2O$ content is considerably high in general, being above 4 % in all the samples. The average $Na_2O + K_2O$ content amounts to 5.25 % which is similar to that of previously reported Korean sands, 5.03 %.

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