CHEMICAL COMPOSITION OF SILICA SCALES DEPOSITED FROM GEOTHERMAL WATERS IN KYUSHU, JAPAN

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Silica scale from geothermal water is not pure silica, but contains various elements. In order to study a role of the elements on the deposition of silica scale, chemical compositions of geothermal water and silica scale were examined. The geothermal water and silica scale samples were collected from four geothermal fields in Kyushu, Japan.

The geothermal water was sampled in polyethylene bottle. To obtain silica scale sample whose history was clear, thin titanium plates were immersed in the geothermal water for 1 - 4.5 months. Silica scale deposited on the plate, growing cylindrically around the plate. After the silica scale samples were taken out of the geothermal water, they were immediately washed with distilled deionized water and methanol, and then were air-dried for a month. The silica scale samples were pulverized and ground into powder with agate mortor.

RESULTS AND DISCUSSION

The chemical composition of the geothermal waters was similar among all the samples. They were typically neutral and sodium chloride type, and contain large amount of silicic acid. The total silicic acid concentration was in the range 444 - 983 ppm (SiO_2). Aluminium was in the concentration range 0.22 - 1.34 ppm (Al). For iron, the concentration was lower except some geothermal waters.

The silica scale samples were almost X-ray amorphous, but some samples showed reflections of minerals such as α-quartz, iron oxides and sulfides. From the chemical compositions of geothermal water and silica scale, concentration factors (CF) of each element were calculated.

$$CF = ([Element]/[Si])_{scale}/([Element]/[Si])_{water}$$

[ ]: molar or molal concentration. If the CF value of a certain element is larger than unity, it indicates that the element is concentrated in the silica scale. The concentration factors showed that in all the samples aluminium and iron were so concentrated, and in some samples magnesium and manganese were concentrated. Based on the chemical composition, silica scale samples could be divided into four types as follows.

Type I : The main components are H_2O and SiO_2 and sum of Ig. loss and SiO_2 is larger than 95 %. Color; white - gray. Hardness; intermidiate between Type II and IV.

Type II : The iron content (as Fe_2O_3) is larger than 10 %. Color; black. Hardness; very hard.

Type III : The aluminium and iron contents are relatively high and nearly equal in amount. Color; gray. Hardness; relatively soft.

Type IV : The aluminium content is high, while iron content is relatively low. Color; white - brown. Hardness; relatively soft.

It seems that chemical composition of silica scale does not necessarily depend on that of geothermal water.