

Crystallization of Cs- and Sr-bearing borosilicate glasses

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In order to establish one of the standards to estimate the stability of high-level waste glass, the crystallization of borosilicate glasses have been examined. Borosilicate glasses of 45 kinds of chemical compositions were previously synthesized. The starting glasses have been treated in an autoclave reactors at 200°C under vapor pressure of 15.4Mpa. The mineral species identified by powder X-ray diffraction technique are tridymite, quartz, K-feldspar, analcime($\text{NaAlSi}_2\text{O}_6 \cdot \text{H}_2\text{O}$), pollucite($\text{CsAlSi}_2\text{O}_6$), sealsite ($\text{NaBSi}_2\text{O}_5(\text{OH})_2$), strontium-zeolite($\text{SrAl}_6\text{Si}_{30}\text{O}_{72}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$), strontium-borosilicate($\text{SrB}_2\text{Si}_2\text{O}_8$), $\text{LiAlSi}_4\text{O}_{10} \cdot 2.5\text{H}_2\text{O}$, hectorite ($\text{Mg}, \text{Li})_3\text{Si}_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$, $\text{Li}_2\text{Si}_2\text{O}_5$, Li_2SiO_3 , $\text{Li}_2\text{Si}_2\text{O}_5 \cdot \text{H}_2\text{O}$, $\text{Li}_4\text{B}_2\text{O}_5$ and veatchite ($\text{SrB}_6\text{O}_{10} \cdot \text{H}_2\text{O}$). Most of mineral species belong to silicate group. Analcime-type zeolite is the most common of all products. The analcime-type zeolite includes variable ions. In particular, cesium(Cs), which has been applied for one of simulated radioactive elements in this present study, is trapped only in analcime-type zeolite. On the other hand, strontium(Sr), another simulated radioactive element, is included into some mineral species as well as analcime-type zeolite such as veatchite, Sr-zeolite, and strontium borosilicate. These results suggest that the chemical components of starting glasses should be controlled by provided radioactive elements like Sr and Cs. The investigation of the formation of analcime-type zeolite reveals the following two characteristics. 1) Formation of the zeolite always needs aluminium though boron and iron can replace partly aluminium of the tetrahedral site of the crystal system. 2) In addition to aluminium, sodium or cesium is indispensable for the formation of the zeolite.