Transfer of Radiostrontium and Radioiodine from Seawater to Marine Organisms

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Abstract

In the safety review of the commercial spent nuclear fuel reprocessing plant in Rokkasho, a certain amount of radiostrontium is assumed to be discharged into the Pacific Ocean. In addition, radioiodine was discharged to the ocean during the final test of the plant using actual spent fuel in 2006-2008. In order to assess the realistic impact of those radionuclides to the public, it is important to understand the processes of their accumulation from seawater to marine organisms. In this research, from FY2016, the transfer rate of radiostrontium in seawater to bastard halibut (olive flounder: *Paralichthys olivaceus* Temminck et Schlegel) has been studied by using stable ^{86}Sr tracer instead of radiostrontium, while from FY 2018, it is planned to measure the transfer rate of radioiodine.

In FY 2016, we started exposure of one bastard halibut group, 284 d after hatching, to ^{86}Sr-enriched seawater with $^{86}Sr/^{88}Sr$ ratios of ~0.1495; we kept the fish at 15°C, giving then commercial bastard halibut feed (EP-4). The accumulation of ^{86}Sr in their muscle and bone was measured by using samples collected sequentially up to 112 d after the start of the exposure in FY2016. We continued the exposure experiment up to 553 d with sequential sampling and analysis in FY 2017. By using all data, we tentatively constructed a multi-compartment model for metabolism of Sr in bastard halibut, and confirmed that the model well simulated the measured data during the exposure period.

For validation and further tuning of the model, we planned an experiment for measuring excretion rate of ^{86}Sr from the bastard halibut, which had accumulated ^{86}Sr in advance of the experiment. We started exposure of two other groups of bastard halibut, 191 d and 276 d after hatching, to ^{86}Sr-enriched seawater with $^{86}Sr/^{88}Sr$ ratios of ~0.1495 in FY 2017, and kept them under similar conditions as mentioned in the second paragraph. The excretion experiment will be started in FY 2018.

An air-tight acrylic tank system, which had 8 L seawater and 20 L air, was constructed for the short term ^{125}I tracer experiment using bastard halibut and it was tested in the cold condition without the tracer. Water quality level, which does not affect the survival of bastard halibut, could be maintained for 10 days in the breeding density up to three fish per tank (5.85 g-fish weight L^{-1}-seawater) with non-feeding. The actual tracer experiment will be done using the developed system in FY 2018.

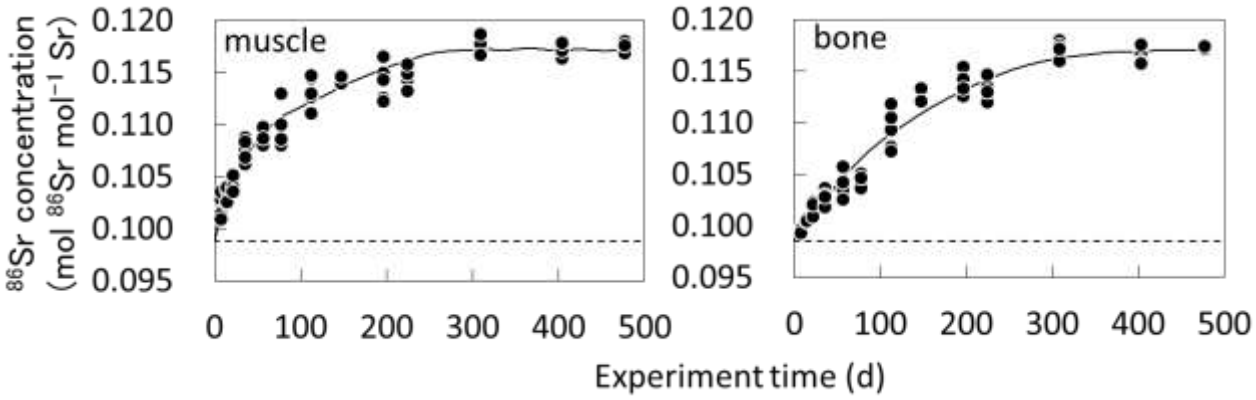

Fig. 1 Time dependency of ^{86}Sr concentration in the muscle and bone of bastard halibut (*Paralichthys olivaceus* Temminct et Schlegal) during exposure to ^{86}Sr-enriched seawater. Circles show measured values and the solid lines show values estimated by the metabolism model. The dotted lines are the background ^{86}Sr concentration in seawater.

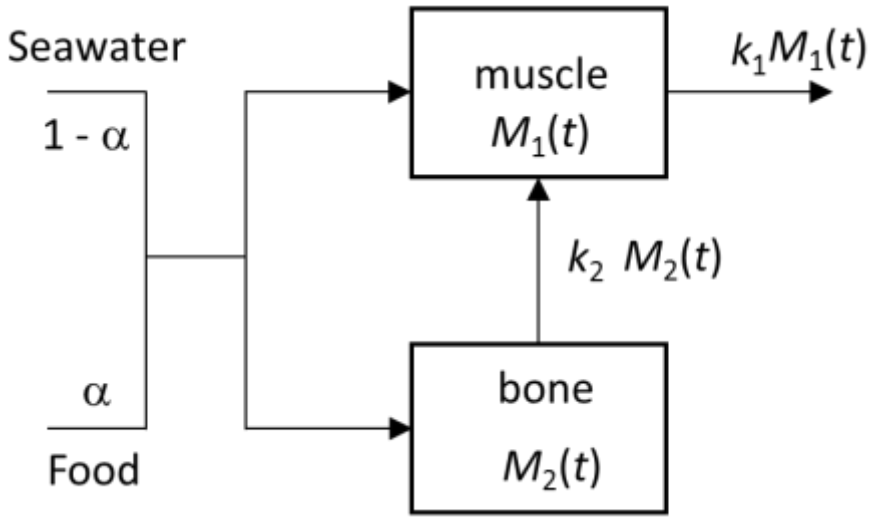

Fig. 2 Scheme of ^{86}Sr metabolism model in bastard halibut.

Table 1 Parameters of ^{86}Sr metabolism model in bastard halibut.

Parameter	Unit	Value	Confidence Interval of 95%
α		0.049	0.028 – 0.71
k_1	d^{-1}	0.037	0.029 – 0.046
k_2	d^{-1}	0.0017	0.0012 – 0.0021