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## Effects of temperature and oxygen on $^{137}\text{Cs}$ desorption from bottom sediment of a dam lake

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### Abstract:

The temperature and oxygen environment play important roles in the desorption of  $^{137}\text{Cs}$  from freshwater lake sediment to lake water. In this study, 12 quarterly surveys were performed to measure the dissolved  $^{137}\text{Cs}$  concentration in surface and bottom lake water, the vertical distribution of water temperature, and the dissolved oxygen (DO) concentration at the upstream, midstream, and downstream sites of the Yokokawa Dam Lake in Fukushima Prefecture, Japan. Higher concentrations of dissolved  $^{137}\text{Cs}$  were detected in the bottom water than in the surface water, especially in the summer and midstream lake regions at depths of 8–21 m owing to higher temperatures, which activated the bacterial decomposition of organic matter, and anaerobization, which enhanced the  $\text{NH}_4^+$  in the pore water and  $^{137}\text{Cs}$  desorption from mineral particles. To compare the effects of anaerobization and increasing temperature on  $^{137}\text{Cs}$  desorption from sediment particles, intact sediment core samples were collected from the lake midstream and incubated for 1–14 days in a chamber under three controlled temperature and oxygen environment conditions: aerobic +10 °C; anaerobic +10 °C; and anaerobic +20 °C. The vertical distribution of  $^{137}\text{Cs}$  in the sediment pore water showed a similar profile as  $\text{NH}_4^+$  and  $\text{K}^+$ , and both the increased temperature and reduced DO concentration enhanced the  $^{137}\text{Cs}$  desorption. A comparison of the standard partial regression coefficients of temperature and DO concentration in the multiple regression equation for the  $^{137}\text{Cs}$  concentration in pore water shows that the reduction of DO from saturation to zero at the water–sediment interface accelerated the desorption of  $^{137}\text{Cs}$  more strongly than did the temperature rise from 10 to 20 °C. The experimental results show a nearly inverse proportional relationship between  $\text{NH}_4^+$  and the distribution coefficients of  $^{137}\text{Cs}$  after thermodynamic correction, except in the surface layer. These findings indicate that the  $^{137}\text{Cs}$  concentration in pore water can be explained by the temperature-dependent chemical distribution between the solid–aqueous phase and its equilibrium with  $\text{NH}_4^+$ .

Keywords: radiocesium, lake sediment, desorption, incubation test