

## Direct emission of tritium to the ocean due to the Fukushima Daiichi nuclear disaster

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Tritium is one of nuclides emitted from the Fukushima Daiichi nuclear power plant (F1 NPP) due to its accident in 2011. However there are few reports on tritium in environmental water such as rain water [1], river water [2] and seawater [3] because tritium concentration in natural water is not so high compared to background water like cesium-137 or iodine-129 [3]. In order to trace tritium derived from F1 NPP and estimate how much tritium was released from the Fukushima nuclear disaster, we investigated tritium distributions in the ocean off the Fukushima area.

We collected seawater samples in the northwestern Pacific Ocean two months after the accident in May 2011. We measured tritium concentrations in collected samples using the helium-3 ingrowth method.

Higher <sup>3</sup>H concentrations were found close to the shore and lower concentrations were found offshore. The distribution of <sup>3</sup>H concentration was similar to that of <sup>137</sup>Cs concentration. There seems to be a correlation between <sup>3</sup>H and <sup>137</sup>Cs concentrations. This indicates that both radionuclides have the same origin, that is they came from the F1 NPP. The calculated <sup>3</sup>H/<sup>137</sup>Cs ratio from the correlation was similar to the production ratio of <sup>3</sup>H/<sup>137</sup>Cs in the broken reactors in the F1 NPP [4]. This indicates that observed radionuclides in seawater may have come from the F1 NPP with keeping the ratio that means no elemental fractionation. <sup>137</sup>Cs direct emission to the ocean has been estimated at about 3.5 PBq [5]. Multiplying this <sup>137</sup>Cs emission by observed <sup>3</sup>H/<sup>137</sup>Cs ratio may give tritium direct emission to the ocean from the F1 NPP.

[1] Matsumoto *et al.* (2013) *Sci. Tot. Env.*, **445-446**, 365-370. [2] Ueda *et al.* (2015) *J. Env. Radio.*, **146**, 102-109. [3] Povinec *et al.* (2013) *Biogeo.*, **10**, 5481-5496. [4] Nishihara *et al.* (2015) *J. Nuc. Sci. Tech.*, **52**, 301-307. [5] Tsumune *et al.* (2012) *J. Env. Radio.*, **111**, 100-108.