

Long term temporal change of sulfur hexafluoride concentration in spring water at a forested headwater catchment

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We monitored the Sulfur hexafluoride (SF₆) concentration in the air, the spring and the groundwater to estimate the residence time of the water from April 2015 through May 2018 at a small forested headwater catchment underlain by granite in Fukushima, Japan. The SF₆ concentration in the air ranged from 9.2 pptv to 14 pptv, and it temporally increased with a gradient of 0.5 pptv/year.

Also, the SF₆ concentration in the spring water ranged from 3.5 fmol/L to 4.6 fmol/L during this period, corresponding to the concentration ranging from 9.9 pptv to 12.8 pptv in the air with increasing rate of 0.4 pptv/year based on Henry's equilibrium law between the air and the water. Thus, the temporal change of SF₆ concentration in the spring water shows the same trend as that of the air in the watershed with a time lag of a few years. In addition, the apparent SF₆ age in the spring ranged from 2 years to 7 years in the base flow condition except for the rainfall event periods. Therefore, the time lag of the temporal change in the SF₆ concentration between the air and the spring water.

Consequently, these results show that the groundwater flow in the watershed could be represented displacement piston flow model, and the temporal change pattern of SF_6 concentration in the air is conserved well in the groundwater within the watershed. Also, the SF_6 has a temporal information as two aspects, one is apparent age and the other is conservative temporal pattern such as stable isotopes.