Development of ^{3}H-^{3}He groundwater dating method

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Residence time of groundwater is an important parameter to elucidate groundwater flow system. We are developing the ^{3}H-^{3}He method, which is one of dating methods to estimate groundwater residence time ranging from several months to 120 years. In regions where water circulation is relatively active like those in Japan, this method is useful because it is considered that there are few groundwater with residence time more than several thousand years. The best advantage of this method is that it is applicable to accurately determine an age of young water compared to other methods (CFC & SF_6method and ^{36}Cl method, etc.), because initial ^{3}H concentration is directly determined as the sum of ^{3}He and ^{3}H in the water at present, if the groundwater flow system has been a closed system for ^{3}He and ^{3}H until its discharge. The age determined by the ^{3}H analysis only requires an assumption of the initial ^{3}H concentration based on the record of the past precipitation, therefore it is difficult to determine unambiguous groundwater age (Mahara *et al.*, 1993). In the ^{3}H-^{3}He dating method,^{3}He concentration in a water sample is measured first by degassing of water in vacuum, and after a few months' storage, ^{3}He produced from the decay of ^{3}H in the sample is measured to determine^{3}H concentration at the time of degassing. Thus, how the water sample is well degassed during the first analysis and how leaking of ambient helium into the degassed water is suppressed are crucial to determine small amount of ^{3}H. We analyzed standard water samples provided by IAEA with known ^{3}H concentrations to evaluate accuracy and precision of our method. When we compared the ^{4}He concentrations of the samples analyzed just after degassing and those analyzed after storage for one month, the ^{4}He concentration was extremely large in the samples stored for one month. As this indicates that the air helium intruded into the degassed sample during storage, we examined various ways to seal the sample container to prevent intrusion. This presentation will discuss developing of this method and how it will be applied to groundwater study in the future.

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