Precise measurements of helium isotopes and noble gas abundance in cave dripping water in three selected caves in East Asia

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Paleo-temperature recorded in nature archives is a critical parameter to understand climate change in the past. With advantages of unique inert chemical characteristics and sensitive solubilities with temperature, dissolved noble gases in speleothem inclusion water were recently proposed to retrieve terrestrial temperature history. In order to accurately apply this newly-developed speleothem noble gas temperature (NGT) as a reliable proxy, a fundamental issue about behaviors of noble gases in the karst should be first clarified. This study developed a new system for analyzing helium isotopic ratios and noble gas abundances by mass spectrometric and quadrupole mass spectrometic technqiues with static mode and an ultrahigh vacuum purification line. $^{3}He/^{4}He$ measurements made on reference materials show the long-term 2-sigma external uncertainty of ±0.44%. Cave dripping water samples were collected from three selected caves, Shihua Cave in northern China, Furong Cave in southwestern, and Gyukusen Cave in an island located in the western Pacific. We found that helium isotopic ratios in the dripping water samples match air values. Only one exceptional dataset is observed in Furong cave. This isotopic offset could be attributed to a possible extra ^{4}He source in the cave. Our results indicate that elemental and isotopic signatures of noble gases from air can be generally preserved in the epikarst and support the fidelity of NGT techniques.