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Space-time variation of gas composition and isotopes in groundwater of Fujinomiya area in central Japan

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Mt. Fuji erupted in 1707, a few months after the Nankai Megathrust Earthquake in Japan. As the Nankai Trough is overdue for another earthquake and considering the recent destructive earthquakes in adjacent areas such as the 2024 Noto earthquake, it is worth monitoring possible deep fluid activity under Mt. Fuji. Magmatic fluids and gases travel faster along preferential gas pathways, such as faults, than through the aquifers in sedimentary basins. The Fujikawa-Kako fault zone in Fujinomiya city, central Japan, is a suitable candidate location for observing changes in gas geochemistry (i.e., concentrations and isotope composition) related to tectonic activities such as volcanic eruptions and earthquakes. We collected water and gas samples at several sampling points in the area. Preliminary results show that N_2 is the dominant gas in all the sites, combined with low O_2 and high CO_2 concentrations, which is a typical signature of groundwater in Japan. N_2/Ar ratios are well within the range of air and air-saturated water. The $^{3}He/^{4}He$ ratios vary from 0.99 Ra (air-saturated water) to 4.9 Ra (significant mantle influence), while it is constant at the same place over time. $^{40}Ar/^{36}Ar$ ratios are similar to the air value of 295.5, suggesting a small contribution of deep fluids in the samples. The $d^{13}C$ values of CO_2 vary from -17‰ to -27‰, while the $d^{15}N$ values of N_2 are ranging between -4.2‰ +0.4‰. The regular sampling campaigns were complemented by on-site continuous gas monitoring with a portable mass spectrometer system using GE-MIMS technology. Such a system was set up at a location where mantle fluids are known to rise from the deep lithosphere. The acquired data show us the baseline values for groundwaters in the area and it is crucial that we continue our observations to timely detect possible imminent changes in the volcanic system.