Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.33240

Tracing Subsurface Fluid Sources Using Li–Sr Isotopes in the Noto Peninsula Before the 2024 Major Earthquake

ZAHRA ZANDVKILI[1,2], TAKANORI KAGOSHIMA[3], TOMOAKI MORISHITA[4], YOSHIHIRO HIRAMATSU[4], MANATO AKISHIBA[5] AND YOSHIRO NISHIO[6]

[1]Fukushima university
[2]Kochi university
[3]University of Toyama
[4]Kanazawa University
[5]Tohoku university
[6]Kochi University

On 1 January 2024, a M7.6 earthquake struck the northern Noto Peninsula, Japan, following several years of intense earthquake swarm activity that has been interpreted to involve subsurface fluid migration. While noble gas studies suggest the possible involvement of deep-seated fluids, the geochemical origin and evolution of fluids circulating in the crust remain poorly constrained. Here we investigate lithium (Li) and strontium (Sr) isotope systematics of hot spring waters to evaluate the sources, water–rock interaction processes, and temporal variability of subsurface fluids in this non-volcanic back-arc setting.

A total of 62 water samples were collected between 2022 and 2024, including hot spring waters from nine sites and reference samples of river water and non-thermal shallow groundwater. Hot spring waters exhibit high Cl/Li weight ratios (2,860–23,800) and relatively high δ^7Li values (−2.1 to +19.9‰) compared with volcanic and slab-derived fluids reported from southwest Japan. Their $^{87}Sr/^{86}Sr$ ratios (0.7068–0.7090) cluster within a narrow range consistent with extensive interaction with crustal rocks. These geochemical characteristics indicate that the sampled hot spring waters do not record a dominant contribution from deep-seated fluids such as magmatic and/or slab-derived components.

Instead, the combined Li–Sr isotope systematics are most plausibly explained by mixing between crustal fluids and ancient seawater that infiltrated the crust during the Miocene opening of the Japan Sea and was subsequently modified during prolonged subsurface residence. Time-series observations at selected sites from 2022 to 2024 reveal short-term fluctuations in δ^7Li and Li/Sr ratios, suggesting transient changes in mixing proportions rather than episodic input of a distinct deep-fluid endmember.

Overall, this study provides new geochemical constraints on the origin and evolution of subsurface fluids beneath the Noto Peninsula and highlights the importance of long-term crustal fluid circulation and ancient seawater contributions in shaping fluid chemistry in seismically active non-volcanic regions.