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Relationship between mercury isotopes and earthquake in the Wenchuan Earthquake Fault Scientific Drilling Project Hole-1 (WFSD-1)

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Previous research on mercury and its isotopes mainly focuses on the ecology and the Earth's surface environment. Wenchuan Earthquake Fault Scientific Drilling Project (WFSD) provides us an opportunity to study the underground fault rocks of the Earth, and, for the first time, enables us to study the relationship between mercury and its isotopes in the fault zone and tectonic activity during the earthquake process, and whether the mercury isotopic characteristics in the different sections of the fault zone could be used to reveal the source of mercury and the processes of earthquake rupture.

Based on the WFSD, we first investigate the distribution of the total mercury (THg) from 600 m to 1035 m of the Wenchuan Earthquake Fault Scientific Drilling Project Hole-1 core (WFSD-1). The concentrations of THg in the fault gouge are significantly higher than the sandstone, shale, siltstone, and cataclasite in WFSD-1. The THg concentrations in the main seismic fault zone range from 9.9 to 73.5 ng/g while those under the main fault range from 20.5 to 36 ng/g. To determine the source of Hg, typical rocks from different depths were chosen for Hg isotope analysis. The results show that δ202Hg in the main seismic fault zone ranges from -0.11 ‰ to -2.68 ‰ and, below the seismic fault zone, δ202Hg are from -0.64 ‰ to -1.33 ‰Ṫhe seismic fault rocks are more enriched in THg and have a larger variation of δ202Hg compared to the other rocks. Mercury has different isotopic compositions and fractionation mechanisms in the fault zone, which were mainly affected by the earthquake and the fluid. The mercury isotope compositions reflected the fluid activities at the main fault zone. We demonstrate that mercury stable isotope ratios could serve as an effective tool for tracing mercury sources and monitoring and predicting earthquakes.