Mantle-derived helium along the Tancheng-Lujiang fault zone in eastern China

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Recent investigations revealed curtain anomalies of noble gases along some plate boundary strike-slip faults in the world. The Tancheng-Lujiang fault zone (TCLJF) is a large-scale fault zone with a trending of NNE-SSW and long distance for over 2400 km from the boundary between Russia and China in northern China to the Yangtze River in southern China. There are, many giant and damaged historical earthquakes, and also massive resource deposit formed along the TCLJF. As a result, the fault system has long been recognized as one of the main geological discontinuities of East Asia, and has attracted much attention from various viewpoints including mantle volatiles in recent years.

In order to obtain some information about the regional geology of each segment of the TCLJF, hot spring gas samples were collected from three regions, the Liaodong peninsula in the north, Tancheng County in the middle and Lujiang area in the south of the TCLJF and analysed for chemical and isotopic compositions. The results showed clear variations in He-C systems among these three regions. The $^{3}H/^{4}He$ ratios varied from 0.1 to 1.15Ra, indicating mantle-derived helium in the spring gases measured along the TCLJF. However, there is lack of mantle-derived CO_2 in the studied areas. Such different geochemical properties of hot spring gases were consistent with local geology surroundings, especially the local geothermal and tectonic features.