Radionuclides and stable isotopes in mud-volcanic waters from southern Taiwan

IN-TIAN LIN[1*], CHIH-CHIEH SU[2] AND JUN-CHIN SHEN[1]

[1]Exploration and Development Research Institute, CPC, Taiwan *itlin@cpc.com.tw

[2]Institute of Oceanography, NTU, Taiwan

Terrestrial mud volcanoes are important gateways for deep fluids to migrate upward and as a window for studying fluid interaction at depth. Most of the mud volcanoes worldwide are associated with an active petroleum reservoir. The expelled gases deriving from the reservoirs are dominated by methane and carbon dioxide and are of early mature thermogenic origin. The supply of natural gas from mud volcanoes is commonly attributed to the migration of gas-bearing fluids from a deeper source area. However, the relative importance of these fluid sources is not well known.

Onshore mud volcanoes distributed along two major geological structures in southern Taiwan, the Chishan fault and the Gutingkeng anticline. Fluids sampled from 10 mud volcanoes, their chemical compositions, including hydrogen, oxygen, radon and radium isotopes were analyzed to evaluate possible sources.

The distribution of geochemical compositions in mud volcano fluids show patterns associated with their localities and geological settings. Generally, relative to seawater, the mud volcano fluids are depleted in Cl, Mg, SO_4, and are elevated in $\delta^{18}O$. However, the fluids of Chishan fault show the lower salinity, but with anomalously high $\delta^{18}O$ (4.3–7.0 ‰) and higher ^{222}Rn concentration, compare with the Gutingkeng anticline.

The expelled gases also demonstrate the different feature in these two regions. Carbon stable isotope analyzes of the methane provide evidence for thermogenic component ($\delta^{13}C$= -29.4~ -35.9‰) and microbial gas dominated ($\delta^{13}C$= -47.3~ -51.6‰) in the fluid reservoir for Chishan fault and Gutingkeng anticline, respectively.

According to results, gases from these mud volcanoes are predominantly methane enriched. The origins of hydrocarbon gases as inferred from carbon isotopic compositions range from microbial to thermally overmature sources. Mud volcano fluids in Taiwan originate at depth and their chemical compositions are controlled by the host rock. A simplified scenario involving mixing of the original sedimentary pore fluids (Gutingkeng anticline) and waters affected by clay dehydration released at depth (Chishan fault) , possibly due to different depth of water-rock interaction in the sources.