

# Variations of geothermometry and chemical-isotopic compositions of hot spring fluids in the Rehai geothermal field

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Geothermal variations, origins of carbon-bearing components and reservoir temperatures in the Rehai geothermal field (RGF) of Tengchong volcanic area (TVA), Yunnan Province, Southwestern China, are discussed on the basis of carbon isotope compositions, combined with helium isotope ratios and geothermal data from 1973 to 2000.  $\delta^{13}\text{C}$  values of  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{He}$  and travertine in the hot springs range from  $-7.6$  to  $-1.18$  per mil,  $-56.9$  to  $-19.48$  per mil,  $-6.7$  per mil to  $-4.2$  per mil,  $-6.4$  to  $-4.2$  per mil and  $-27.1$  to  $+0.6$  per mil, respectively. The carbon dioxide probably has a mantle/magma origin, but  $\text{CH}_4$  and  $\text{He}$  have multiple origins.  $\text{CO}_2$  and  $\text{He}$  in RGF thermal fluids are predominantly derived from igneous carbon dioxide, but other ions originate from rocks through which the fluids circulate. The  $\delta^{13}\text{C}$  values of  $\text{CO}_2$ , (aq) and (aq) illustrate that isotopic equilibriums between  $\text{CO}_2$  and (aq), and (aq) and between DIC and travertine were not achieved, and no carbon isotope fractionation between (aq) and (aq) of the hot springs in RGF was found. Using various geothermometers, temperatures of the geothermal reservoirs are estimated in a wide range from 69 to 450 degree centigrade that fluctuated from time to time. Contributions of mantle fluids and shallow crust fluids in Rehai geothermal field varied with time, which resulted in variations of chemical and isotopic compositions and reservoir temperatures.