

Study on carbon isotope effects at Kamchatka magmatic rocks and volcanic gases.

SERGEY ALEXANDER VOROPAEV¹, NATALIA MALIK²,
VYACHESLAV SEVASTYANOV³, NIKITA DUSHENKO⁴
AND OLGA KUZNETSOVA⁴

¹Vernadsky Institute of Geochemistry and Analytical Chemistry
(GEOKHI) RAS

²Institute of Volcanology and Seismology FE RAS

³Vernadsky Institute of Geochemistry and Analytical Chemistry
of Russian Academy of Sciences

⁴Vernadsky Institute of Geochemistry and Analytical Chemistry

Presenting Author: voropaev@geokhi.ru

Kamchatka' volcanism is convenient for studying the composition of deep mantle and crustal gases. Free gases of some thermal springs were collected in vacutainers by method of water displacement. We focused on the gas composition of Talovskiy and Verhneshchapinskiy hot springs. Talovskiy springs in the Nalychevo Valley between Avachinsky-Koryaksky and Zhupanovsky-Dzenzursky volcanic chains have a temperature 70 °C, chemical composition of gases, % vol: He-0.028, H₂-0.0011, O₂-9.7, N₂-39, Ar-0.49, CO₂-50, CH₄-0.55. Verhneshchapinskiy springs are located on the SE edge of the Central Kamchatka Depression, 7 km from the active Kizimen volcano. Their temperature is 52 °C, the chemical composition of the gas, % vol: He - < 0.003, H₂-0.003, O₂-3.3, N₂-19.5, Ar-0.22, CO₂-76.1, CH₄-0.0026.

The isotope analysis of the gases was carried out on a Delta Plus mass spectrometer with preliminary separation of the mixture on an HP 6890 gas chromatograph. The data is presented as values of $\delta^{13}\text{C}$ -deviations in % relative to the VPDB standard. The measurement error does not exceed 0.05%.

Table 1. ‰

Source	$\delta^{13}\text{C}_{\text{VPDB}} (\text{CH}_4)$
Talovskiy 1	- 25.91
Talovskiy 3	- 27.61
Verhneshchapinskiy 1	
Verhneshchapinskiy 2	

Under the assumption of thermodynamic equilibrium for the ¹³C and ¹²C isotope exchange reaction of methane and carbon dioxide, the Talovskiy gas separation coefficient corresponds to the equilibrium depth temperature of ~ 300-320°C. It is known, that if $\delta^{13}\text{C}$ (CO₂) more than -8‰, it is the inorganic origin. Mantle CO₂ typically has an isotopic composition of $\delta^{13}\text{C}$ between -9‰. Apparently, the carbon dioxide of the Verhneshchapinskiy springs is mainly of mantle origin with a small addition from the thermal decomposition of deep organic matter. Data on the carbon isotope composition of the gases of the Uzon volcano caldera, as well as the lavas of the Tolbachik and Klyuchevskoy volcanoes, have been obtained and will be presented in the report.

Work was supported by RFBR project 19-05-00554.