

Hydrogeochemical characteristics and origin of CO₂-rich mineral waters from Essentuki spa (Caucasian Mineral Waters region, Russia)

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The Caucasian mineral water (CMW) region is the unique natural object. Carbon dioxide mineral waters of various chemical composition and therapeutic properties were formed here. Essentuki mineral groundwater basin is located in the central part of this region and characterized by a wide variety of types of mineral water. Despite the almost 200-year history of the study of this area, the genesis of water and gas, the ways of migration of water flows and mechanisms of transformation of the chemical composition are still relevant and remain debatable. This is due to the complex geological and tectonic structure of the area, the presence of tectonic faults and zones of increased fracturing, hydrodynamic and hydrogeochemical conditions. The hydrogeology section of the area is represented by the monoclinical layers of Meso-Cenozoic aquifers going down towards the aquitards Proterozoic-Palaeozoic basement. The main area of groundwater recharge is the southern mountainous part and the basal complex. The area of transit and lateral outflow beyond the basin boundary is the northern and north-eastern regions. Faults and zones of increased tectonic fracture are areas of groundwater discharge. The volcanic laccolite peak plays an important role in the discharge of deep aquifers. The main feature of the Essentuki mineral water deposit is a gas-hydrogeochemical anomaly (inversion) of mineral waters. Mineral water of «Essentuki» type are salt-alkaline (sulfate-free) carbon, characterized by approximately equal content of bicarbonate and chlorine ions. Within the same aquifer, the mineral waters are characterized by different TDS (0,6-13 g/dm³), belong to different types, but have an identical salt composition. The temperature of mineral waters range from 10 to 70 °C and strongly depends on the depth and position of aquifers. As part of these research new data on the salt composition, as well as the isotopic characteristics of the water and gas phases of carbon dioxide mineral waters, the geothermal features of the formation of waters of the Essentuki area were obtained. Analytical and laboratory methods were used to identify general patterns and mechanisms of formation of these carbon dioxide mineral waters.

This study was supported by the Russian Science Foundation (RSF), project no. 21-77-00060.