CHEMISTRY OF MINERAL WATERS IN RELATION TO THE COMPOSITION OF SURROUNDING ROCKS

J. HANZLÍK, M. RENÉ

Institute of Rock Structure and Mechanics, Academy of Sciences of Czech Republic, V Holešovičkách 41, 182 09 Prague 8, Czech Republic

Chemical composition of natural waters depends both on their residence time within the Earth's crust and their interaction with the surrounding rocks. The geochemical interaction between water and its environment may last from several days to millions of years, depending on the physico–chemical diversity of the rock medium, hydrodynamic conditions and resulting different geochemical processes. Natural waters within the Bohemian Massif include mostly meteoric and lithogenic waters, i.e. constituents of the natural hydrogeologic cycle. However, there are also natural mineral waters, that represent a significant natural phenomenon, both by their chemical composition, gasification, and genesis. The origin and occurrence of such waters results from coincidence of conditions favourable for their formation in relation to the geological structure of the given region. Once formed, the chemical composition of water depends more or less on the type and chemical composition of the surrounding rocks. This relation is evident at the locality Prameny, where outflows of gaseous mineral waters are concentrated to a ENE–WSW trending fault zone, marked by occurrence of foliated amphibolites, serpentinite lenses and tremolite schists. Correlation analysis of the water chemistry was used for evaluation of sources of mineral contents of simple mineral waters from the Prameny area (Tab. 1).

	Na^+	K^+	Ca^{+2}	Mg^{+2}	Fe^{+2}	Cl^-	SO_4^{-2}	HCO_3^-
Na^+	1.00	0.43	0.76	0.66	0.12	0.46	-0.001	0.65
K^+		1.00	0.39	0.42	0.32	0.18	0.25	0.50
Ca^{+2}			1.00	0.85	0.16	0.55	0.44	0.82
Mg^{+2}				1.00	0.31	0.42	-0.25	0.91
Fe^{+2}					1.00	0.38	0.29	0.64
Cl^-						1.00	0.38	0.55
SO_4^{-2}							1.00	0.11
HCO_3^-								1.00

Tab. 1: Correlation analysis of the mineral waters from Prameny

Content of Fe is governed partly by the content of HCO_3^-, partly by the content of SO_4^{-2}. The Ca/Mg ratio in mineral waters is close to that in amphibolites (Tab. 2). The source of iron was presumably in pyrite, which forms locally pyritized zones in amphibolites. Comparing chemistry of mineral waters from nearby Prameny with that of the surrounding rocks, we can infer that the mineral waters acquired their chemical composition by elution of amphibolites and Mg-rich rocks (serpentinites). This is evident for the gaseous mineral water at Louka, which acquires its considerable magnesium content (110–140 mg/l) by leaching serpentinites or tremolite schists, as supported by similarity in Ca/Mg ratios of the waters and rocks (Tab. 2).

Rock	Ca/Mg (wt. %)	Outflows of mineral water	Ca/Mg mg/l
amphibolite	1.70	Prameny, borehole	1.34
		Prameny, reservoir	1.47
tremolite schist	0.33	Louka, borehole	0.22
serpentinite	0.02	Louka, borehole	0.10

Tab. 2: Relationship of Ca to Mg in rocks and mineral waters