16-1 Geochemical analysis of acidulous medicinal waters (Carpathian Mountains, SE Poland) for finding new water rich in dissolved silica

Dariusz R. DOBRZYNSKI1), Lucyna RAJCHEL2)

1) Faculty of Geology, University of Warsaw, Warsaw, Poland
2) Faculty of Geology, Geophysics and Environmental Protection, AGH University of Science and Technology, Krakow, Poland

Silicon generates interest in ecology, biology and medicine due to the recognized role it plays in living organisms in controlling bio-available aluminium and its toxicity. In Poland, silicon is regarded as a desired component in balneotherapy, with threshold value for siliceous medicinal water of 70 mg/L H$_2$SiO$_3$ (~0.9 mM). In the Carpathians, mineral/medicinal waters occur in flysch rocks, in hundreds of sites where they are partly used for balneology. Most of these waters represent the acidulous (CO$_2$-rich) type. In contrast, only seven intakes are documented as sources of siliceous medicinal waters. Three main groups of acidulous waters occur in the Carpathians: 1) “simple” acidulous waters of HCO$_3$-Ca-Mg type (TDS=1-5 g/L), 2) waters of HCO$_3$-Cl-Na and Cl-HCO$_3$-Na types (TDS=10-30 g/L), and 3) waters from mixing of the above-mentioned types (Rajchel, 2012). Usually, high silicon concentration is found in thermal and/or alkaline groundwater. Unfortunately, Carpathian acidulous waters have low-enthalpy (T=6.4–20.3℃) and are slightly acidic or near-neutral (pH=5.2–7.7).

The presented geochemical study of water from 93 intakes throughout Polish Carpathian Mountains aimed at determining hydro-geochemical conditions conducive to finding new sites with Si-rich groundwater as viable source of medicinal water. It was reported that groundwater rich in silicic acid provide benefits in detoxifying body from aluminium and therapy of aluminium-related diseases (e.g. Exley et al., 2006). This study was focused on waters containing above 0.5 mM Si, suggested to be more effective in therapy (op.cit.). Silica-enriched groundwater is present in various geological-settings (Dobrzynski & Exley, 2010; Dobrzynski et al., 2012), but its therapeutic potential seems to be still underrated.

We found that silicon in concentrations above 0.5 mM occurs in mineral waters with ionic strength (I) of 0.02–0.3 M. The pH of Si-enriched waters varies between 5.8 and 6.6, which corresponds to free CO$_2$ content of 1600–3200 mg/L. The CO$_2$-mediated hydrolytic decay of silicate minerals is responsible for increased concentration of dissolved silicon. Geochemical modelling demonstrates that waters are close to chemical equilibrium with rock-forming feldspars. The prospective areas for finding new siliceous waters in Polish Carpathian Mountains are Poprad River Valley and Kroscienko-Szczawnica spas. The highest Si concentrations are expected to be found in groundwater which originate in the deeper part of the simple-acidulous water zone, and in geological structures where these waters mix with deeply-occurring chloride waters.
Keywords: Silicon, Acidulous water, Medicinal water, Carpathian Mountains, Poland

References
4) Rajchel L., 2012. Carbonated waters and waters containing carbon dioxide of the Polish Carpathians. AGH-UST, Krakow, Poland. 194 pp. [In Polish, English summary]