XXIII Conference of PhD Students and Young Scientists

Interdisciplinary topics in Mining, Geology and Geomatics

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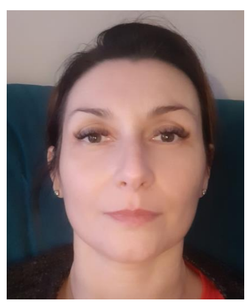
The BrineRIS Project – to discover hidden lithium resources in groundwater of Poland



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Introduction

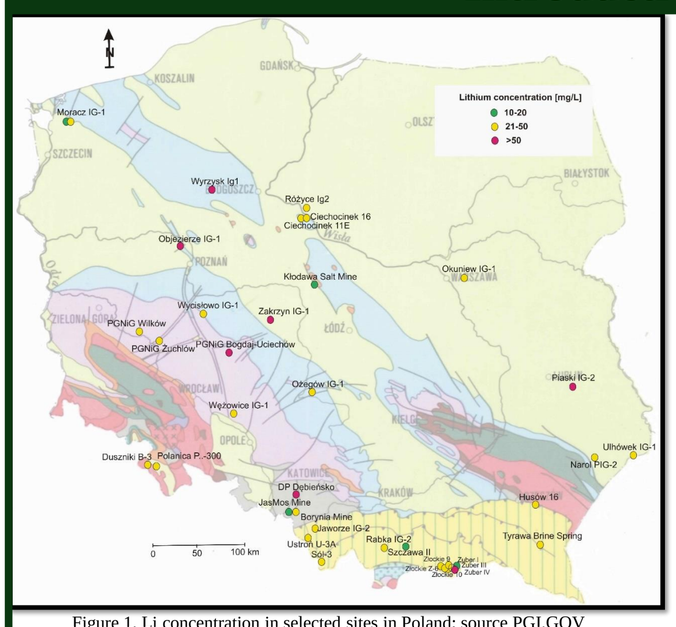

Figure 1. Li concentration in selected sites in Poland; source PGI.GOV

These research include Poland's hydrogeological database - the Central Hydrogeological Data Bank "HYDRO", the Database of Deep Boreholes "BOHYDRO", and the Mineral Groundwater Databank. In total, 510 sites were considered for the whole area of Poland. In 409 sites Li concentrations are over 1 mg/L, in 86 sites are over 10 mg/L, in 35 sites are over 20 mg/L, and in only 9 sites Li concentrations are over 50 mg/L.

The BrineRIS Project (Brines of RIS countries as a source of CRM and energy supply) aims to discover Li-enriched deep geothermal brines. The basis for selecting sampling sites was the Polish literature, which noted the high content of several elements in brine waters, mainly: potassium, magnesium, bromine, lithium (up to 100 mg/l) and iodine of Paleozoic, Mesozoic and Neogene aquifers. In addition, available public and archival databases in Poland and datasets from individual groundwater surveys were analyzed.

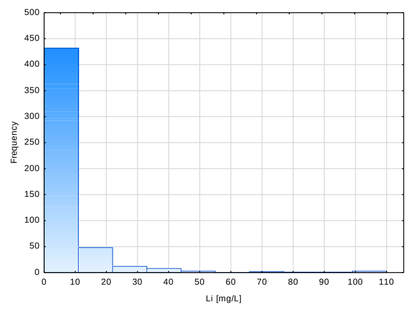

Figure 2. Lithium concentration distribution

Bogdaj-Uciechów-2

Figure 3. Bogdaj-Uciechów 2 well.

Water samples were taken from the Bogdaj-Uciechów-2 hydrocarbons well. The borehole of a depth of 1470 m was drilled in 1965. It is a part of the Bogdaj-Uciechów natural gas field, with primary recoverable reserves calculated as 15800 million m^3, of which 12339.22 million had been extracted by the end of 2016. The Bogdaj-Uciechów gas field is a conventional deposit locked in a structural-lithological trap. It is found in a series of quartz sandstones of the Rotliegend, a porous medium, and in the dolomite and dolomitic limestone series of the Zechstein limestone, a fractured-porous medium. The trap's saturating medium is nitrogenated, sulfur-free natural gas with a heat of combustion of 22.778 MJ/m^3. Bedding reservoir water, which was sampled, is sodium chloride brine with a mineralization of 260.8 g/L and an average density of 1,172 g/cm^3.

BrineRIS laboratory tests proved a lithium content of 38,54 mg/L in borehole Bogdaj-Uciechów-2. The water in the borehole Bogdaj-Uciehców-2 contains mainly chloride (>50000 mg/L) and sulfate (308 mg/L) and its outflow temperature is 20,3°C and the pH =5,5.

Figure 4. Natural Gas Mine Bogdaj – Uciechów - Czeszów wchich is operating on the Bogdaj - Uciechów natural gas field; source pgnig.pl

Polanica Zdrój and Duszniki Zdrój

The sampling was conducted in the P-300a water wells in Polanica Zdrój and the B-3 in Duszniki Zdrój.

Figure 5. P-300a well in Polanica Zdrój

The borehole P-300a was drilled in 2000 to a depth of 271 m. Investigations carried out during drilling operations showed that in the hydrogeological profile of the borehole, there are two exploitable aquifers comprised of quartz-feldspar sandstones. The Middle Turonian aquifer contains mineral acidulous water type, with mineralization of 1.6 g/l and the yield of 8 to 16 m^3/h depending on the depression. Glauconitic sandstone of the Lower Turonian-Cenomanian aquifer contains 0.64% bicarbonate-calcium acidulous water and the wells yield oscillates around 13.0 m^3/h.

Figure 6. Sampling process

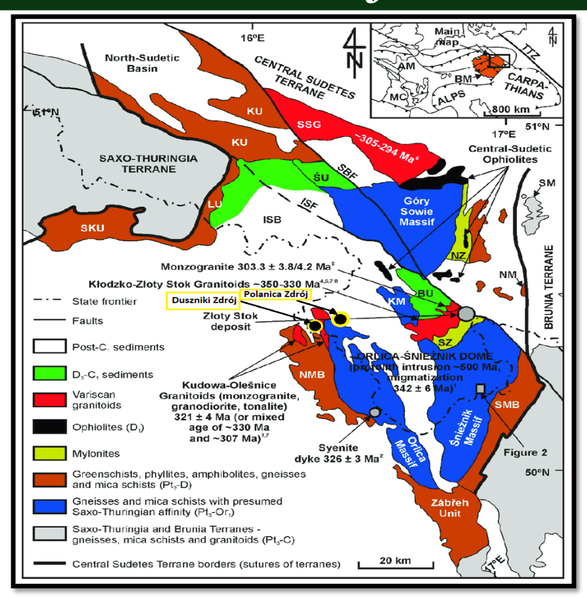

Figure 7. Geological map of the Sudetes with marked sampling points; source (Gil et al.. 2019).

Well B-3 is located in the area of peat meadows, between the spa and urban parts of Duszniki Zdrój, about 30 m from the intersection of the causeway and F. Chopin Avenue. It was drilled in 1970. The depth of this borehole is 96 m and it is cased along its entire length. A filter was installed in the section from 55.25 to 91.28 meters. It captured water occurring at a depth of 57.4 m. The exploited water is a 0.15% bicarbonate-calcium-magnesium radon CO2-enriched. The approved exploitation yeild is 0.18

Figure 8. The process of securing samples

BrineRIS laboratory tests showed a lithium content of 0.149 mg/L in borehole P-300a and 0.0074 mg/L in borehole B-3. Bicarbonate anions (1747.8 mg/L) and carbonate anions (1776.6 mg/L) are primarily present in the hole P-300a. at 18.6°C, the pH = 6.4. In borehole B-3, the bicarbonate (561.6 mg/L) and carbonate (570.7 mg/L) contents are much lower. The water temperature was 18.7 °C, and pH = 6.5.

More information on BrineRIS activities

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Conclusion

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Studies conducted in Duszniki Zdrój and Polanica Zdrój have not confirmed high lithium contents, however, in this case these wells are equally valuable sources of other elements. Lithium concentration of 38.5 mg/L was recorded in the water from the Bogdaj-Uciechów-2 borehole. This result is promising for the following laboratory tests of Li recovery.