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title: **Chemical composition of groundwater of the pleistocene buried valleys in the area of selected sand pits in the Upper Silesia — Poland**

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The main purpose of the following research was the identification of processes and factors determining the chemical composition of groundwater from Pleistocene buried valleys in the area of sands extraction in the Upper Silesian region (southern Poland, fig. 1). Aquifers of Pleistocene structures under consideration are unconfined, built of sands and gravels of average thickness about 40 m, locally divided by silts and clays into two or three hydraulically connected layers, and underlaid mainly by low permeable deposits of Upper Carboniferous and Neogene. Groundwater in Pleistocene buried valleys in natural conditions is characterized by a low mineralization and good quality. Over 40 years of intensive mining drainage connected with the activity of Maczki-Bór, Kotlarnia and Kuźnica-Warężyńska sand pits has disturbed hydrodynamical conditions in the Pleistocene buried valleys, caused both longlasting lowering of the groundwater table (about 30 m at the maximum) and spreading of the depression cone. The character of the Biała Przemsza and Bierawka rivers was changed from gaining into losing. Nowadays, extraction of sands in the Upper Silesian region comes to an end. Kuźnica Warężyńska sand pit was changed into an artificial lake in 2006. The west part of Maczki-Bór sand pit is filled up with coal mining wastes and the east part of Maczki-Bór sand pit as well as the mining area of Kotlarnia sand pit are going to be flooded. The hydrodynamical changes described above as well as land use influence the quality of groundwater from the examined aquifers.

Processes and factors controlling the chemical composition of groundwater in the investigated Pleistocene aquifers were identified on the basis of an analysis of archival materials and data gathered during fieldwork and laboratory research carried out in years 2007–2009 as well as on the basis of results of geochemical modeling by using PHREEQC codes. The composition of groundwater in the examined area is strongly dependent on the anthropogenic factors such as changes of the groundwater level or pollution sources as well as on the geogenic factors such as the occurrence of pyrite and organic matter in the Pleistocene buried valleys. Increased SO_4^{2-} and Fe^{2+} concentrations and a slightly acidic pH (about 6.0) in groundwater from observation wells in the area of the depression cone of Maczki-Bór and Kotlarnia sand pits might suggest the occurrence of simultaneous processes of pyrite oxidation, calcite dissolution and gypsum precipitation (Kaźmierczak et al., 2009). On the other hand, the chemical composition of groundwater in the area of Kuźnica Warężyńska artificial lake is determined by processes initiated by an increasing level of the water table, e.g. gypsum dissolution, what results in equal molality of Ca^{2+} and SO_4^{2-} in groundwater (Jakóbczyk et al., 2009). Higher concentrations of Ni^{2+} (up to 0.112 mg/l) in groundwater from the area of the flooded sand pit Kuźnica Warężyńska than in groundwater from other pits (on average about 0.02 mg/l of Ni^{2+}) might suggest the occurrence of manganese oxides dissolution. During the aforementioned processes, elements such as Ni^{2+} and Cd^{2+} are released from deposits into groundwater. Saturation of groundwater in the area of all the investigated pits with respect to hematite and goethite can serve as evidence of precipitation of these minerals. The quality of groundwater in the Pleistocene buried valleys is greatly determined also by the presence of anthropogenic sources of pollutions, especially in the area of Maczki-Bór sand pit. Leakage from landfills, unsewered settlements and agricultural areas as well as polluted surface water of losing streams result in an increased mineralization of Pleistocene groundwater. TDS reaches up to about 6000 mg/l in the area of Maczki-Bór sand pit. Concentrations of many ions are also increased, e.g. SO_4^{2-} (up to 1850.0 mg/l) Cl^- (up to 2198.0 mg/l), Na^+ (up to 1846.0 mg/l), B^{3+} (up to 2.25 mg/l) and nitrogen compounds (NO_3^{2-} up to 57.25 mg/l and NH_4^+ up to 20.0 mg/l). The variability of the chemical composition of

groundwater from the Pleistocene buried valleys under research can be connected with overlapping impact of different factors and chemical processes in time and space.

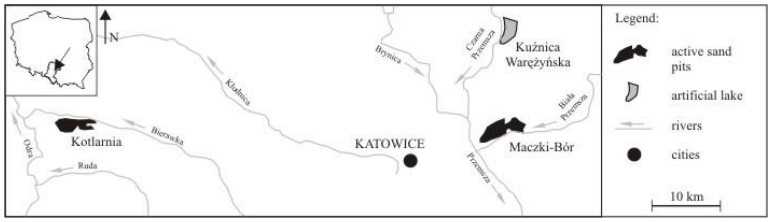

Figure 1. The location of open sand pits in the Upper Silesian region.

REFERENCES

Jakóbczyk S., Kowalczyk A., 2009: *Chemical composition of groundwater in the area of flooded sand pit Kuźnica Warężyńska in view of modeling investigations*. Biul. PIG, 463: 165–174.

Kaźmierczak J., Jakóbczyk S., Kowalczyk A., 2009: *Influence of anthropopressure on chemical composition of groundwaterin the Pleistocene aquifer in the area of Maczki-Bór open sand pit – geochemical modeling research*. Biul. PIG, 463: 231–240.

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