Map of Preliminary Valorisation of the Major Groundwater Basins as cartographic representation of documentation of groundwater reservoirs, with establishing direction for further work and research

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A b s t r a c t. Preliminary valorisaion of the Major Groudwater Basins, including the assesment of groundwater useful properties, as well as necessity and order of protective measures *(Paczyński, 2003) is a research project undertaken by Polish Geological Institute at the request of the Minister of Environment. The PGI performed an assessment of the MGBs taking into account a wide range of aspects and with use of various documentations, results of studies, publications, archival and cartographic data. The two years hydrogeological research was cartographically summarized in the* Map of Preliminary Valorisation of the Major Groundwater Basins in 1 : 500,000 scale*, which is another step in documenting the Major Groundwater Basins. The valorisation revealed that most of the documented MGBs urgently require establishing protective zones and that there is an pressing necessity of implementing and designating "Strategic Groundwater Basins".*

Key words: *groundwater reservoirs, pollution resistance, Major Groudwater Basins, valorization*

The Polish Geological Institute (PGI) participated since the 1980s in creating the *Map of the Major Groundwater Basins of Poland needing special protection in 1 : 500,000 scale* (Kleczkowski, 1990), coordinated by the AGH University of Science and Technology in Cracow, preparing a study of future valorisation of groundwaters (Paczyński, 1988), and later was a contractor in updating the *Map of the Major Groundwater Basins of Poland in 1 : 500,000 scale* (Skrzypczyk, 2000–2004) and principal contractor of the *Hydrogeological Map of Poland in 1 : 50,000 scale* (Mapa, 1996–2004). At the request of the Minister of Environment, the PGI undertook the research project *Preliminary valorisation of the Major Groundwater Basins, including the assessment of groundwater useful properties, as well as necessity and order of protective measures* (Paczyński, 2003). The study was done in the Department of Hydrogeology and Engineering Geology PGI in 2002–2003, in cooperation with scientists from renowned geological universities. The two years hydrogeological research resulted in publishing the *Map of Preliminary Valorisation of the Major Groundwater Basins in 1 : 500,000 scale*, another cartographic study in overview scale, and thus another step in documenting the Major Groundwater Basins (Fig. 1).

Scope of work

When starting the work on this project, the PGI used the results of regional documentation studies on disposable resources of groundwaters, estimates of perspective groundwater reserves originally intended for water management purposes, 55 hydrogeological documentations of the Major Groundwater Basins (MGB) in 1 : 50,000 scale, *Hydrogeological Map of Poland in 1 : 50,000 scale,* as well as other studies and publications on this topic, especially those concerning water quality and hazards to the MGBs (Paczyński, 1994, 1995, 2002; Ulman-Bortnowska, 1995). Additionally, the work on timeline of studies on the MGBs, a document of the Ministry of Environment *Hydrogeological Policy of the Ministry* of 1994, and its later version, updated with help of PGI experts in 1998.

Within the main scope of the project, the Polish Geological Institute proposed an assessment of the MGBs according to their usefulness rank, degree of anthropogenic changes, pollution resistance, economic aspects of the protective recommendations and values of water usage fees. The assessment included evaluation of all MGBs documented in detail (1 : 50,000) and in overview scale (1 : 500,000).

The assessment of the MGBs was done in various ways. For those documented in detail, the evaluation involved, e.g., comparing predicted values (from overview studies) with actual data (detailed studies). Additional criteria were established for valorisation score and ranking of establishing protection zones. For those documented in overview scale, the evaluation was more in-depth, because the study not only suggested the sequence of their further documenting, but also their possible removal from the list.

Finally, the work on preliminary valorisation of the Major Groundwater Basins included:

- ❑ Evaluation of 125 Major Groundwater Basins (50 documented and 75 undocumented ones) scheduled for documenting their abundance, quality and strategic importance for water availability by the *Hydrogeological Policy of the Ministry*;
- ❑ Assessing the risk of pollution of the MGBs, related to current management, especially in their recharge areas. The work was based on existing hydrogeological documentations and cartographic materials;
- ❑ Proposing the order of further work on yet undocumented MGBs to be funded by the National Fund of Environmental Protection and Water Management.

The project led to a preliminary valorisation of the MGBs. The results were compared with values shown in the *Map of Areas of the Major Groundwater Basins (MGBs) in Poland Needing Special Protection in 1 : 500,000 scale* (Kleczkowski, 1990), four major criteria of recognizing an MGB were analysed in each case, the degree of risk to the groundwaters and urgency of establishing protective zones for documented groundwater basins were estimated.

The preliminary valorisation of yet undocumented MGBs was based on analysing new regional studies from the areas of particular MGBs and the *Hydrogeological Map of Poland in 1 : 50,000* scale, as well as the *Map of Areas of the Major Groundwater Basins (MGBs) in Poland Needing Special Protection in 1 : 500,000 scale* (Kleczkowski, 1990).

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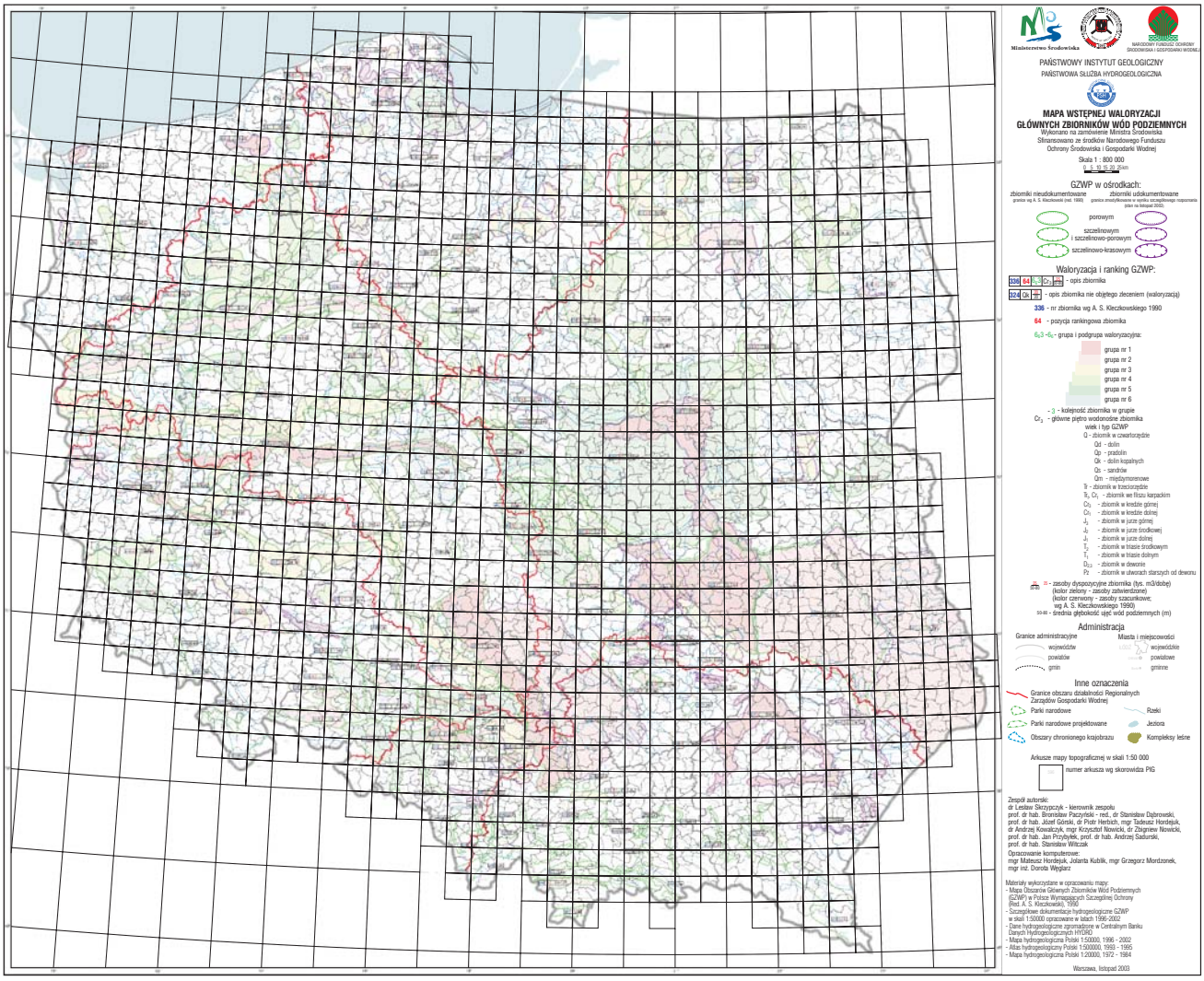

Fig. 1. The *Map of Preliminary Valorisation of the Major Groundwater Basins* presents the results of studies on valorisation and ranking of the Major Groundwater Basins of Poland

Methods

The study required analysing huge amount of hydrogeological documentations, archival and cartographic data. To organize these information, MGB charts were created to provide a comprehensive compilation of necessary data on each groundwater basin as a basis to performing the preliminary valorisation of the Major Groundwater Basins, group classification and lastly the ranking list of the MGBs. The original MGB chart layout was designed by a team led by Prof. J. Przybyłek and Prof. J. Górski from Poznań. The final information MGB chart layout, modified according to comments of the whole project team was the basis for compiling a digital database on the MGBs (currently as MS Access spreadsheets), with easy update options. The expanded version of an MGB chart includes additionally a methodic part on assessing water-bearing capacity of an MGB. This important add-on to the methodology of documenting the MGBs was provided by Prof. S. Witczak et al. (1999).

The study contains evaluation and classification of MGBs with a valorisation method developed by Prof. B. Paczyński, with improvements added after analysis of the documentation materials.

Results

The results of preliminary valorisation and classification of the MGBs of Poland were presented as text descriptions, tables and maps. The effects are as follows:

1. Compiled were 125 basin charts; the basin charts form the basic documentation for further work on valorisation and group classification (thus expanding the information content of the MGB database within the HYDRO databank; Skrzypczyk, 2000–2004, 2005).

2. Two tabulated ranking lists:
   - ❏ Sequence of establishing protection for the 50 documented MGBs,
   - ❏ Sequence of documenting the other 75 MGBs.

3. Additional documents (ranking lists, necessary funding and preliminary schedule) were provided for the Appendix to the *Hydrogeological Policy of the Ministry* stating the Ministry plans for further documentation of the MGBs (Polityka, 1994).

4. The preliminary valorisation of the MGBs allowed update of the *Map of the Major Groundwater Basins in 1 : 500,000 scale.*

The MGB database has been updated with the ranking and valorisation results, and the MGB data documented in detailed scale. The valorisation revealed that most of the documented MGBs urgently requires establishing protective zones, thus confirming the generally correct order of documenting the MGBs assumed by the Ministry of Environment.

The study contains a preliminary proposition of detailed documentation (1 : 50,000) of other groundwater basins (an MGBs documentation schedule), together with a preliminary estimate of the costs. These documents can become Appendices to the *Hydrogeological Policy of the Ministry*, establishing the directions for further studies.

The studies were cartographically summarized in the *Map of Preliminary Valorisation of the Major Groundwater Basins in 1 : 500,000* (Fig. 1).

The first and second ranking groups of the documented reservoirs, requiring urgent establishing protective zones, contain 26 MGBs. This category includes aquifers not insulated from the surface pollution, with symptoms of anthropogenically changed chemistry of groundwaters, being the main source of water for local populations, intensely managed.

The third and fourth ranking groups of the documented reservoirs, requiring establishing protective zones in the next order, contain 17 MGBs. This category includes aquifers with good to moderate water quality, with no symptoms of anthropogenically changed chemistry of groundwaters, partly insulated from surface pollution, being the main source of water for local populations.

The fifth ranking groups of the documented reservoirs, requiring establishing protective zones in the third phase, contains 2 MGBs. This category includes aquifers with good to moderate water quality, well insulated from the surface pollution.

The sixth ranking groups of the documented reservoirs, requiring establishing protective zones in the fourth phase, contains 4 MGBs. This category includes aquifers of medium to low pollution resistance, with alternative water supplies for the population.

The first and second ranking groups of the undocumented reservoirs, requiring urgent completion of hydrogeological documentation in order to establish protective zones, contain 19 MGBs. This category includes aquifers not insulated from the surface pollution, prone to anthropogenic changes to chemistry of groundwaters, being the main collective source of water for local populations, intensely managed.

The third and fourth ranking groups of the undocumented reservoirs, requiring completion of hydrogeological documentation in the next order, contain 26 MGBs. This category includes aquifers partly insulated from surface pollution, with good to moderate water quality, being the main source of water for local populations.

The fifth ranking groups of the undocumented reservoirs, requiring completion of hydrogeological documentation in the third phase, contains 17 MGBs. This category includes aquifers well insulated from the surface pollution.

The sixth ranking groups of the undocumented reservoirs, requiring completion of hydrogeological documentation in the fourth phase, contains 5 MGBs. This category includes aquifers of medium to low pollution resistance, with alternative water supplies for the population.

An urgent task for the Polish hydrogeology is to begin work on implementing and designating "Strategic Groundwater Basins". From among the Major Groundwater Basins in Poland, there should be selected those with paramount importance for supplying water for people and economy, especially in emergency situations (disasters). For Regulations should be formulated concerning availability, usage and protection of the Strategic Groundwater Basins in normal and critical conditions. This is of great importance for enhancing the security of people and national economy in case of catastrophic events. An additional important element of this work is providing much better protection of resources and quality of selected most valuable groundwater reservoirs. This task should be undertaken as soon as possible by the national hydrogeological survey.

According to the EU policy, groundwaters are regarded as strategic reserves for the surface waters and should be protected as a whole. However, the current economic situation and available resources dictate concentrating efforts on those MGB recharge areas that are under highest risk of degradation.

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