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Inspiring Groundwater

IAH2021 **Book of Abstracts**

Former studies about underground karst rivers, recharge areas, and flood events are combined with recent remote sensing data first time of the whole karst area. This set of data is evaluated by using a geographic information system (GIS) to identify recharge areas of low vulnerability and to detect possible access points to related karst storages. This study will build the foundation for a concept of a sufficient and sustainable water supply for the future in Gunung Kidul.

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Impact Of Climate Changes On Water Supply In Wallonia

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Wallonia presents favorable water resources. Groundwater withdrawals provide 75% of pipe-borne water and surface water the other 25%. They are amply sufficient to answer to the needs of population, industry and agriculture. Furthermore, the water network allows the large export towards Brussels and Flanders.

Water reserves rely closely on the local geological structure ; limestone and chalk formations provide around 75% of the groundwater production, the remaining comes from less productive aquifers. Therefore, water stress can locally and temporaly appear, resulting from a high water demand added to limited storage capacity of the aquifer.

Regular rains refill aquifers essentially during winter, when water is not used by vegetation. More the winter refill is good, lower the risks for water supply will be during the rest of the year. This refill also defines the water availablily in the reservoir dams, although these can still take advantage of later precipitations.

Nowadays, water use during dry periods is not always in adequacy with water production, particularly as a result of climate change. Indeed, first the available water is becoming lower due to winter recharges less long and more intense precipitations and secondly summers becoming longer and warmer. Moreover, dimensions of the current distribution network can't follow consumption peaks due to heat waves. Drought is closely monitored for several years in Wallonia. All water stakeholders periodically gather in the CRC-W to discuss about the evolution of water ressources and make decisions about management and communication towards the public. Dealing with recurring droughts in Belgium is part of the Regional Scheme of Water Ressources, mission mandated by the Government to the SWDE to distribute quality water in abundance across the country. Thus, research is undertaken to lead wisely the territorial development, highly depending of the local available water ressource and to increase the performance of the public infrastructure by reducing water leaks and connecting public operators networks. Moreover solutions are studied to help the agricultural sector to face drought by finding alternative water ressources.

Alongside, drought has led the Government and water producers to study by modelisation the evolution of the Walloon groundwater bodies in order to predict the measures to carry in order to preserve them. Regularisation of boreholes and water uses prioritisation have to be established to avoid overexploitation of aquifers during low-water periods. Finally, cooperation between neighbouring states for a sustainable management of the cross-border groundwater bodies is required.

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Hydrogeological Characterization Of Crystalline Bedrock Using Borehole Magnetic Resonance At A Mining Development Site, Northern Finland

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The Borehole Magnetic Resonance (BMR) method was tested for measuring porosity and estimating groundwater flow

parameters required for hydrogeological modelling in a crystalline rock setting at the Sakatti Ni-Cu-PGE mining project site in Northern Finland. The characterization of hydraulic properties of deep bedrock, shallow fractured bedrock, surficial deposits as well as groundwater and surface water flow patterns and interactions between them is informative already during ore prospecting phase. Although BMR is widely used for determining storage and flow properties in sedimentary rocks forming hydrocarbon reservoirs, there have been few studies in basement rocks as described here.

The BMR method allows the detection of water in the subsurface by applied electromagnetic fields in a continuous manner with decimetre-scale measurements along the boreholes. The measured response is inverted to give a continuous distribution of relaxation time T2 which is a direct measure of the amount of water, or pore volume. This can further be divided into bound water and free water using specific cut-off values for each lithology, which can then be used to calculate estimates of hydraulic conductivity.

The Sakatti Cu-Ni-PGE deposit, located several hundred meters below the Natura2000-protected Viiankiaapa mire, displays complex and heterogeneous subsurface geology, hydrogeology and deformational history. The BMR data was acquired from six drillholes in order to obtain specific information about the structural heterogeneity and free water content within the depth interval of 50 to 360m, and thus estimations of the local flow parameters. Other available survey data, such as natural gamma ray, acoustic image data, core logging and packer tests were compared with the BMR data in order to compare and calibrate the groundwater flow parameters calculated based on these measurements. The initial results indicate that BMR is a suitable tool for studying lithologically and hydrogeologically heterogeneous fractured crystalline rocks. Flow parameters derived from the measured T2 distributions vary significantly throughout the intervals. In this crystalline bedrock setting, independently from the lithological composition, the measured intervals locally display relatively high hydraulic conductivities, and may be correlated to the more intensely fractured and/or brecciated zones. In addition, BMR may reduce more time-consuming methods such as packer tests or replace them altogether in regions where borehole conditions prevent the likelihood of successful testing. Furthermore, the BMR log provides continuous data over fractured crystalline basement rocks. This will include questions dealing with interactions between surface water, shallow groundwater as well as groundwater in fractured and weathered bedrock.

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Coping With The Risk Of Salinisation In The Zwin Area

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The Zwin area is a nature reserve on the Dutch-Belgian border. The area is a remnant of a tidal inlet through which the medieval city of Bruges was connected. However, from the late 13th century onwards, the channel was affected by silting up progressively which led to the decline of the thriving city economy.

The silting up of the Zwin area remains a problem. To counteract this, the area has been enlarged in 2016-2019 with an extra 110 hectares surrounded by a new dyke. However, the flooding of the enlarged area with seawater would almost certainly cause saline seepage in the adjacent polder area. To cope with this risk of salinisation, a dual barrier system was designed just behind the dyke. It consists of two ditches with different purposes: the ditch closest to the dyke serves as a drainage channel and captures saline seepage coming from the tidal area. This “saline ditch” is pumped to lower the water level and the pumped water is discharged in the nature area. The second ditch, further away from the dike, serves the purpose of infiltrating fresh water into the aquifer. This “freshwater ditch” is fed by the upstream Polder drainage system and maintained at a higher water level. The combination of both ditches forms a hydrological barrier and prevents salinisation of the agricultural land surrounding the Zwin area.

However, due to the heterogeneity of the aquifer, this shallow barrier isn't sufficient to counter deeper saline groundwater flow.