Geophysical Research Abstracts, Vol. 8, 06069, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06069


# "Emergency-groundwater-supply" by maar volcanoes in a natural disaster case? – A field data and flow modelling based study from the Gees Maar (West Eifel volcanic field, Germany)

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In the case of a natural disaster (flood, earth quake…) the drinking water supply for the affected citizens is very often in danger or affected, too. Typical scenarios are epidemic plagues by polluted regional aquifers. To save the water supply, alternative sources are needed. Like this study shows that quaternary maar volcanoes could be interesting for an "emergency-water-supply" in certain cases. 1. - Maars are very common worldwide and their genesis is linked on groundwater (phreatomagmatism). 2. - Because of their morphological and structural features, they could be great groundwater reservoirs. 3. - In contrast to the surrounding basement rocks maar structures could be separate and closed aquifers. 4. – Conditions of eruption products and the way of their deposition can lead to a good aquifer pollution protection.

The statements results from ground water exploration investigations on the Gees Maar volcano that is located 5 km in the east of the city Gerolstein (West Eifel, Germany). The first part of the project was focused on the volcano structure. Therefore borehole drilling and gravity and magnetic surveying and modelling were used. The Gees Maar has a near concentric shape. A tephra ring exists but the crater rim is eroded. The crater size was 900x600 m. The crater filling, thickness about 200 m, on top of the diatreme mostly consists of scoria and diatreme tephra. The minimum depth of the diatreme is 800 m. The surrounding rocks are Early Devonian shales and quarzites as well as Middle Devonian rocks.

Hydrological mapping pointed out an area of 0.42 $km^2$ for the crater filling deposits. The surface catchment area for the Gees Maar amounts to 1.34 $km^2$. The scoria deposits of the crater filling comply with a porous aquifer with high hydraulic conductivity ($10^{-3}$-$10^{-4}$ m/s). Volcanic deposits with lower hydraulic conductivity ($10^{-5}$-$10^{-7}$ m/s) cover it. But on the crater margin they have the same high conductivity values like the crater filling scoria deposits. Both units are in hydraulic contact.

Hydrogeological investigations detect a complete aquifer discharge on a single point spring within the margins range. Furthermore a low retention potential for the Devonian rocks was derived but the retention potential for the crater filling is exceptional high. The recharge process is the sum of the infiltration of the surrounded surface run off in the range of the crater margin, the infiltration from the Gees Bach stream and seepage water. The part of the surface run off is about 80 %. From this a groundwater production potential of 864 $m^3$/d was calculated. Additionally the Gees Maar structure allows producing the water by a single well, located on the northern side within the crater margin deposits.

An unrestricted use of the groundwater for drinking water was analysed. The relevant parameter falls short of the threshold values of the German drinking water regulations. So the Gees Maar has a great water resource management significance.

In the last step a numerical flow model will be created. Numerical maar volcano simulation under hydrolgeological aspects isn't known in the literature. The first answer to give is the possibility of modelling the structure in a numerical way. Finite element software will be used for this. If the simulation is successful the model will help for field data plausibility control. Finally a look on different hydrogeological scenarios follows which could be relevant in an "Emergency-groundwater-supply" case.

It seems to be possible that maar volcanoes could have a great hydrogeological potential. They could be an interesting alternative for regional aquifers, which are affected by natural disasters. In areas where maar volcanoes exist they can become important for strategic concepts for risk management.