Final report

DAAD Alumni expert seminar • October, 5 – 9, 2009 • Windhoek, Namibia

From 5 - 9 October 2009 an expert seminar on "Mining and Water" was held at the Auditorium of the Geological Survey of Namibia, Ministry of Mines and Energy (GSN), and University of Namibia (UNAM), Windhoek, Namibia. The expert seminar "Mining and Water" in Namibia was jointly organized by the Technische Universität Bergakademie Freiberg (TUBAF) and the University of Namibia.

The expert seminar focused on concrete problems on the topic mining and water. Mining and water is closely linked for certain reasons: in many countries groundwater has to be pumped from the subsurface in order to run a mine. This is true for both open pit mines and deep mines. Often huge amount of water pumped from the underground cannot be used and is spilled into rivers. However, at the end of the mining activities there is a deficit of groundwater which might take years and decades until pre-mining groundwater conditions are reached. In many cases pre-mining conditions even do not occur at all due to severe alteration of the hydraulic conditions. In semiarid and arid regions with very deep groundwater levels there is no need to lower the groundwater level, however, water is needed for dust control, milling and ore processing and thus fighting for water may occur between mining, irrigation and drinking water needs. On the other side acid mine drainage (AMD) is a common problem in mining areas with sulphide minerals and probably the biggest mining related problem worldwide since AMD causes not only low pH and high sulphate concentrations but as well increased concentrations of toxic trace elements like arsenic, cadmium, mercury and others. But AMD is not the only chemical problem related to mining and water: most of the world's gold is recovered with cyanide and due to sometimes poor techniques cyanide is released to the environment. Roughly 12 million artisanal miners worldwide constitute one of the largest sectors of the mining industry and huge environmental problems, since more than 250 tons of mercury are emitted annually from artisanal gold mines contaminating humans, soils, and water bodies.

The total attendance to the expert seminar, taking into account presenters (funded and non-funded) as well as passive participants including students and employees of the Geological Survey of Namibia, was 56 people.

Participants	
Participants, funded	10
Participants, others	2
Participants (GSN)	22
Participants (students UNAM)	22
Σ	56

Opening, talks and discussions were performed at the Ministry of Mines and Energy, and the short courses in the facilities of the University of Namibia. The opening speech was given by Prof. Lazarus Hangula, Vice Chancellor from the University of Namibia, followed by a plenary lecture of Dr. G. Schneider (Geological Survey of Namibia - GSN), under the title “Past and future tasks of the geological survey of Namibia”.

A total of 13 presentations, from five thematic areas, were presented. Multiple use of water – described by the Example Aguas Claras Pit Lake was presented during the first session. The second session dealt with mining and mine water management. Current results from projects and activities in South Africa (gold mining), Nigeria (Barite mining), Uranium mining and lignite mining (Germany) have been discussed. Special problems related to artisanal mining were reported by participants from Nigeria and Mozambique (Session III). Social aspects and environmental laws with respect to mining have been considered in Session IV. Session V dealt with groundwater management in different regions of Africa. Presented talks ranged from water development and management in the Kilimanjaro region, groundwater dynamics in the Naukluft Nappe Complex and the Nama Group in the Naukluft area of Namibia, as well as Groundwater pollution assessment in Palestine.

Following the talks discussions took place with all attendees participating actively.

Discussion about artisanal mining

Examples of artisanal mining / small scale mining were reported from participants from Nigeria (barite), Brasil (gold), Mozambique (gold), and South Africa (gold). If artisanal mining is going for gold in many places mercury is used and thus soil and water is heavily polluted. Obviously the artisanal miners are not trained in any procedures how to protect themselves and how it is possible to at least minimize the emission of mercury to the environment or using chemical-free method to recover gold. In many cases little or no interest from governmental authorities to improve or investigate the situation of the artisanal miners is recognized. All participants agreed that banning artisanal mining will cause huge socio-economical problems in the perspective countries or (which is more likely) would be impossible to be achieved. Participants of the workshop furthermore agreed that NGO´s would probably be best option to train the small-scale miners and to introduce non-chemical gold recovery methods such as low price, man driven centrifuges and gravitational sorting techniques.

The topics remediation and use of closed mine sites and in-situ-leaching were discussed only briefly because the common interest was with the topic artisanal mining.

Following 3 days presentations, 2 short courses were given. One short course dealt with geochemical modeling using the PHREEQC for Windows environment. After some basic theoretical principles the participants learnt how to navigate PHREEQC and perform simple tasks like calculation of electrical balance error, modeling of species distribution, saturation indices, and interpretation of results. Furthermore the influence of different parameters on the solution composition, e.g temperature, presence of gas phases (e.g. different CO_2 partial pressure in soil gas under open and closed system conditions) were taken into account. Different options were shown: enrichment effects in solutions

due to evaporation, mixing of waters, remediation measures like modeling the treatment of water by means of open or closed venting respectively adding limestone or dolomite.

Geochemical modeling using the reactive 3d groundwater model **PHAST** was the topic of the second short course. PHAST is a program for simulating groundwater flow, solute transport, and multicomponent reactions. The participants did some preliminary exercises by means of the graphical user interface WPHAST to get a basic understanding of the mode of operation of PHAST.

Water management was a big issue during the expert seminar. Windhoek, the capital of Namibia, is situated in one of the driest regions in the world und possesses no natural surface bodies in vicinity for potable water production. To handle the amount of 21 million m³ potable water per year, Windhoek water supply is based on three sources of water: Dam water (Omatako Dam, Swakkoport Dam and Van Bach Dam), groundwater, and reclamation water from treatment plants. This aspects were covered during a **field trip** visiting the waste water treatment plant and the New Goreangab Water Reclamation Plant (NGWRP) which is the first plant of this size worldwide providing potable water from pretreated waste water.

The conference proceedings are published under Merkel, B. & Schipek, M. (eds.) (2009): Mining and Water - Proceedings, DAAD Alumni expert seminar, October, 5 – 9, 2009. Wissenschaftliche Mitteilungen, 41, Institut für Geologie, Freiberg. The Proceedings consist of 13 contributions on 70 pages and is also available under http://www.geo.tu-freiberg.de/fog/FOG_Vol_24.pdf online.

The response of the seminar participants was very positive praising the good organization and the overall quality of the presentations and topics presented.

Participants of the DAAD Alumni expert seminar

Short Course Modeling with PHREEQC

Short Course Modeling with PHREEQC

Field Trip: Waste water treatment plant

Field Trip: Waste water treatment plant

Field Trip: Goreangab Water Reclamation Plant

Field Trip: Goreangab Water Reclamation Plant