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IMWA INSIGHTS

Michael Eckart 1959–2020

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Abstract
On July 25th, 2020, Dr. Michael Eckart, a passionate mining hydrogeologist and groundwater modeler, family man, friend, and colleague, lost his battle against an insidious cancer.

Education and Professional Career

Having grown up in the small town of Auerbach/Erzgebirge (Germany), Michael initially completed vocational training as a maintenance mechanic in uranium mining at SDAG Wismut in 1978. At the same time, he obtained his university entrance qualification. In 1981, Michael began a university degree in mining/civil engineering at the renowned TU Bergakademie Freiberg. In 1984 he was delegated to the MGRI Geological Research and Exploration Institute in Moscow, where he obtained a partial diploma in geotechnology and underground leaching of radioactive and rare metals. Two years later, he presented his diploma thesis on underground leaching, and in 1988, Michael obtained his doctorate from Freiberg University with a thesis on the development of models for transient, vertical-plane, two-phase flow.

In the same year, Michael started his professional career as a research assistant in Wismut's former Scientific and Technical Center. The political changes in 1989/90 led to the decommissioning of East German uranium mining, the subsequent foundation of Wismut GmbH, and thus the start of one of the world's largest environmental projects, the rehabilitation of the Saxon-Thuringian uranium mining. Between 1990 and 1993, Michael Eckart acted as deputy head of the newly formed engineering department and was responsible for the conceptual preparation of major remediation projects. With great dedication and success, he promoted the development and application of hydrogeological models for a wide variety of remediation tasks. In addition to fundamental conceptual questions, he oversaw the flooding of the most important East German uranium mine at Ronneburg and later the Dresden-Gittersee mine, which had been mined for uraniferous hard coal. Companions from this time remember the enthusiasm with which he electrified his social environment, but also his cheerfulness and life-affirming ease. With his broad, well-founded specialist knowledge and his strong communication skills, he knew how to convey the most complex hydrogeological facts clearly and comprehensibly to non-specialists like no other.

Michael developed a simulator for flow and reactive mass transport, called the *Boxmodel*, to predict the hydrodynamic and hydrochemical effects of mine water rise in large mine fields. The special feature of this numerical approach concerns the discretization of the mine itself. In contrast to the usual geohydraulic situation in hydrogeological media with a porous or fissured flow, mine cavities such as galleries, shafts, excavations or boreholes dominate the flow and lead to hydraulic short circuits in larger compartments over greater distances. The essential innovation in Michael's

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numerical approach consisted of dividing the porous medium into cells or elements only to the extent necessary from a hydrodynamic point of view. This approach means that within a numerical mine water model rock strata heavily penetrated by mine workings can be represented as one single element with a representative mine water level. At the same time, this approach enables a considerable reduction in the number of cells or elements of the numerical groundwater models. This precisely optimized spatial discretization makes it possible to cover mining areas of many hundreds to more than a thousand square kilometers in size and a vertical extent of many hundreds of meters within a single numerical model.

Driven by the vision of transferring his modelling concept to other mining areas, Michael decided against a management career in mine rehabilitation. Instead, in 1994, he switched to Geocontrol GmbH, for which he set up the company's Gera branch and worked as managing director from 1995 to 1999. Even after the takeover by Harress Pickel Consult GmbH, he continued to run the Gera office until 2002.

In 2003, Michael moved to today's DMT GmbH & Co. KG to create a large-scale mine water model for the entire area of the Emschermulde, in the Ruhr area. He worked as a specialist and manager in the hydrology and water management operational unit, both nationally and internationally, and succeeded in expanding the *Boxmodel* program system with a view to the special features of European hard coal mining.

In 2009, Michael was appointed as an expert for mine and groundwater in mining. His personal commitment, his always open manner, and not least, the model simulations themselves, convinced mining companies and technical authorities. Comprehensive mine water models were created within a few years for the German hard coal mining areas. Particularly noteworthy in this context are the Ruhr area, the Saarland, but also smaller areas, such as Oelsnitz, and later Ibbenbüren. In addition, mine water models were created for many European coalfields, such as Lorraine, Upper Silesia, and some Spanish and British mines.

However, Michael also applied the special flexibility of his model approach to very special and small-scale issues, such as the calculation of necessary escape times against ingressions of standing water from exhausted mine areas (the so-called goaf). Later, he expanded the *Boxmodel* concept to heat transport in mine water, which plays a decisive role in the assessment of mine water discharges into rivers. Michael's creativity as a programmer also made unusual model extensions possible. Against the background of intense debates about PCBs in mine water, the program system was expanded to include particle transport. In this way, it was not only possible to quantify the effects of mine flooding on PCB concentrations, which are mostly bound to suspended solids and transported in the mine water, but also to describe the effects of precipitation on the penetrability of galleries. Over time, further mine water models were created for the East Rand Basin in South Africa and Russian and Ukrainian regions.

Thus, the entire water balance, consisting of mine water, groundwater (e.g. in overburden aquifers), and surface water, with their flow speeds and balances was increasingly captured in a single joint model. The approaches developed for mine water issues were also transferred to the groundwater area for special tasks. In this context, reactive mass transport and heat transfer models are to be mentioned. The resulting software for mass transport was used under the name *Reacflow* for a number of relevant groundwater pollution cases, particularly in the Ruhr area. The software developed for heat transport in groundwater was specifically tailored under the name *Heatflow* for deep geothermal mine water problems with a special representation of very permeable fault systems. Several projects for the exploitation of geothermal energy have been optimized with *Heatflow*. The program systems *Boxmodel*, *Reacflow,* and *Heatflow* will all continue to be maintained and further developed at DMT.

The Private Michael

Michael's central purpose in life was his professional work, which challenged and fulfilled him. He worked tirelessly and excessively and was always his "own engine". His wife Dorothee kept him free of other tasks. At the same time, he shared his passions with her: skiing in his Ore Mountains–Vogtland homeland, extensive bike tours, and discovering nature while hiking and traveling. And Michael's contact with his fellow students lasted all his life; they met annually and kept mining traditions.

For his 40th birthday, he was given a dance class, and dancing became a pleasant pastime for him and his wife. And on the southern slope of their residential property, the Eckarts became winegrowers; with a good harvest, a good wine could be made from the red and white grapes.

It was the Eckarts' greatest luck to give their daughters, Annegret and Michaela, a sheltered childhood and to promote their education. On the other hand, Michael could only be a companion to his three grandchildren for a short time. When they are growing up, they will be told about their grandfather.

Michael lived in a health-conscious manner, took care of himself, and did sports. And yet he was unable to conquer the aggressive disease with which he was confronted on the last part of his life. Life-affirming as he was, he tried to enjoy the time he had left. Grateful for his many good moments and for the closeness to his dear Dorothee, who stayed by his side, he did not give up until the end.

In Michael Eckart, the professional world is losing a highly valued colleague and recognized expert with an excellent reputation who, with his work in the field of groundwater and mine water modeling, made a substantial contribution to the development of the companies for which he has worked for over three decades.

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