PREFACE

Salt Water Intrusion Meetings (SWIMs) have been held since 1968. The first one was convened by the late Professor Dr W. Richter, who invited some German, Dutch and Danish colleagues in his institute in Hanover, Germany, to discuss saltwater intrusion in coastal aquifers. He felt that the three countries might have similar problems in this field and that an exchange of experiences would be useful. After this meeting, it was decided that there should be a follow-up. This turned out to be a success, as is evidenced by the following list of previous meetings:

Previous SWIMs

1	Hanover, Germany	1968
2	Vogelenzang, the Netherlands	1970
3	Copenhagen, Denmark	1972
4	Ghent, Belgium	1974
5	Medmenham, UK	1977
6	Hanover, Germany	1979
7	Upsala, Sweden	1981
8	Bari, Italy	1983
9	Delft, Netherlands	1986
10	Ghent, Belgium	1988
11	Danzig, Poland	1990
12	Barcelona, Spain	1992
13	Cagliari, Italy	1994
14	Malmo, Sweden	1996
15	Ghent, Belgium	1998
16	Miedziezdroje, Poland	2000

The proceedings of the first informal meeting consisted of only a few pages in German. Successive meetings all had regular proceedings. The International Association of Hydrologists published 'Hydrogeology of salt water intrusion - A selection of SWIM papers'[1], also UNESCO devoted 2 publications to the matter in its series "Studies and Reports in Hydrology".

At this meeting, the 17th SWIM, we had a total of 65 abstracts, 10 of which were unfortunately withdrawn due to delay in projects and also lack of finances. Thanks to our sponsors, we have been able to support some Ph D students to attend the meeting. We have had 55 papers and posters from 14 countries. From outside Europe we welcomed the contributions from Turkey, Israel, Korea, Morocco, and the United States.

[1] De Breuck, W. (ed): **Hydrogeology of salt water intrusion** - *A selection of SWIM papers* 1991, 24 cm, 422 pp., ISBN: 3 922705 92 8 , Paperback ISBN: 3 922705 92 8

The papers have been subdivided in the following 8 topics:

Topic Country	NL	It	Es	US	B	D	UK	CH	Ru	Mo	IL	Sw	Tr	Kr	SUM
1. Basic understanding		1				2									3
2. Modelling	5		3	3	1	2		1	1	2		1			19
3. Hydrogeochemical and env. isotope studies	1	1	3								1		1	1	8
4. Study and Survey methods	1	1		1	1		1		1						6
5. Ecology								1							1
6. Salinization prevention, contr. and remediation	1			1	1		1								4
7. Impact of global weather and sea level rise	3														3
8. Regional studies	2	5	2		2										11
Grand Total	13	8	8	5	5	4	2	2	2	2	1	1	1	1	55

Looking at the distribution of the presentation and posters over the topics we see the prominence of modelling studies, with 19 contributions, which confirms a trend of the last 15 years or so. Taking topics three and four together, we see a sound contribution of studies that gather new field information to balance the models. Regional studies (topic 8) apply a mixture of research methods under practical circumstances; they are the proof of the pudding so to say and essential in understanding the often complicated field situation. Papers focusing on actually solving intrusion problems are crucial, but have often been a minority group. Therefore, we welcome papers in topic 6 very much as well as papers devoted to relatively new subjects such as ecology and the impact of global weather and sea level rise (topic 7).

During previous SWIMs, one might sometimes have got the impression that there exist two separate worlds: the one of the modellers with their computers and that of the geologists with their chemistry and isotopes. We must however, recognize that both are essential to gain the holistic understanding necessary to solve real-world problems. Hydrological models are now entering the geochemical world and vice versa. So we have started this SWIM with two short introductions, one on chemistry for modellers and one on modelling for chemists.

SWIMs have always maintained their informal character with contributions from well-known scientists mixed with young people giving their first presentation. The ambiance during the meetings of the last 34 years can be characterized as based on personal contacts and good discussions. There is no SWIM association or so, with memberships and fees; SWIM is carried by persons and institutions in various countries, which have confidence in it and see the usefulness of these meetings.

The importance of the study and tackling of saltwater intrusion problems still increases in most parts of the world. Even though the study of pollution plumes has been acquiring most research money, saltwater intrusion will prove to be more important in the end. This is because most people are living in fertile Delta areas where salinization threatens sustainability of agriculture and drinking water directly and on a much larger scale than direct aquifer pollution. Salinization manifests itself in the arid areas due to shortage of natural freshwater recharge, insufficient water resources management and agricultural practices causing for instance water logging, sometimes over vast areas.

Do we understand salt water phenomena? By 1900, the discovery of the now well-known Badon Ghyben-Herzberg principle, which shows how fresh water floats on the denser saltwater, meant a huge step forward in our understanding of fresh-saltwater phenomena and their interaction. Still this was only the beginning of our comprehension of the complicated natural situations that often characterize saltwater intrusion. This conference has shown a number of such situations. Also new and sophisticated techniques, both on the ground and through remote sensing were presented. It was demonstrated, that a whole series of different techniques and disciplines may be necessary to complete the often puzzling field situation. Curious phenomena are sometimes encountered as in wells in Spain when tide and fresh seaward groundwater flow come together. Concurrent mechanisms regarding the fate of the salt have been unravelled in the beautiful inland river system of the Okavanka Delta in Botswana, Africa, which ending in the Kalahari Desert has stayed fresh during the last 10000 years, creating a unique natural wealth. Such knowledge is necessary to prevent such vulnerable systems from being destroyed by ignorant developers, of which intriguing examples were given.

Beautiful examples of research progress were also given in the field of quantitative modelling of geohydrochemistry changing the constitution of the water downstream along flow paths. Geohydrochemistry tells us what is going on, while radioactive dating uncovers the origin of water and how long processes have been going on. Clearly, hydrologists should no longer go without this chemical branch of our discipline. Further progress was for instance demonstrated by now explaining the physics of Rn and Ra data already presented at the SWIM meeting in Bari 1983.

Not only the modelling has progressed, the ways in which models are applied has evolved as well. Models are not just used to accurately represent complicated real-world situations encountered in the field, they are now also used to test the plausibility of hypotheses and to carry out worst-case and best-case analyses. Reality checking was a word heard several times during the meeting. It was shown how an alternative conceptual departure point combined with a large-scale model that only contains the major geologic and hydrologic features of an area, changed the public and official attitude with respect to optimal long-term waste storage localities in Sweden. Models are one of the very few ways to deal with the lack of old data needed to explain current situations. They are now used to simulate historic developments in an effort to explain current situations. These models are further improved by taking the age of the water and the chemical quality into account. The latter should be stimulated as much as we can.

Saltwater intrusion models are still very complex when it comes to simulating the details of the transition zone between fresh and salt water in regional scale models. We have seen developments to deal with that better, such as moving and multigrid methods. We have also seen improved user interfaces and even an expert system, which may eventually guide us to the right model.

An important point in this field of hydrogeology is the very limited number of analytical solutions to verify our codes. We have seen examples to solve that by means of physical models such as the Swiss nuclear magnetic box.

In the end, we need sufficient data. In dealing with intrusion or chemical changes in our models, the amount of data necessary may be tenfold compared to ordinary groundwater flow models. This is where geophysics comes in. Also some elegant examples of physical field methods were presented. Impressive was the airborne method demonstrated to map subsurface salinity distribution of thousand km^2 of the Everglades, to a depth of 60 m in just five days, thus providing an invaluable amount of space filling information.

Last but not least these methods have to be incorporated into field studies. Those trying to solve field problems are faced with an overwhelming and ever more sophisticated set of data and tools to choose from or to combine: heads, isotopes, chemistry, geophysics, seismics, gravity, models of different physical and chemical complexity. To be good hydrogeologists we have to become acquainted with a broad set of methods. Then we can decide when and where to apply these methods and when and where we should get help from related fields of science to create holistic instead of partial solutions. We need the solutions, because salinization of groundwater is getting even more urgent now we start facing climate change and seawater rise. Artificial recharge may be one of the solutions.

It was pointed out several times during this SWIM that, next to the technical solutions, we should focus our attention also on conveying concrete results to managers and politicians, because they are the ones who finally take the decisions, which should be based on sound underlying study results.

As with every SWIM a two-day excursion was organized immediately following the formal meeting. While during the 1986 SWIM in Delft the dunes along the North Sea and the southern province of Zeeland were visited, this time the focus was on the provinces of South-Holland, North Holland, Friesland and Flevoland (the latter consisting entirely of recent polders reclaimed from the former inland sea ‘Zuiderzee’). We first visited the Rijnland Water Authorities responsible for the management of the most densely populated part of the country, most of which lies below sea level. In managing the surface water, Rijnland also has to deal with saltwater seepage into its water system. The large IJmuiden sluices responsible for discharge of excess water of large part of the two provinces onto the North Sea was visited extensively. How polders were created and kept dry in the seventeenth century was shown further on in North-Holland. Next a stop was made on the 30 km long Afsluitdijk (finished in 1930), which separates the former inland sea "Zuiderzee" -which is now the fresh ‘IJssel Lake’- from

the North Sea. After a pleasant evening in Leeuwarden, capital of the province of Friesland, we enjoyed a large part of the sunny Frisian landscape the next morning, until we dove 6 m below sea level onto the floor of the Northeast Polder to see its water management system and have a last lunch together on the former island Schokland. The afternoon was closed with a visit to the nearby new inflatable rubber dam, which has to protect a large part of the province of Overijssel against flooding by high river runoffs combined with sea level rise feared for the near future. By 6 p.m. most participants said goodbye at Schiphol Airport after which the bus brought the rest of us back to Delft. It was a pleasant two-day trip, clarifying the extensive and complicated man-made managed water systems unique to The Netherlands and which it needs to maintain and develop, to survive.

We regretted very much the absence of Prof. Jan van Dam, one of the founding fathers of the SWIM who has been a driving force after the meetings since the very first one in 1968. He really looked forward to this one and hoped very much to attend it, but his health did not permit so.

I'm very thankful for all contributions and discussions, which made this 17th SWIM a success. I thank the scientific committee for its important preparatory work and Vincent Post and Gualbert Oude Essink, for their introductory lessons ‘Chemistry for Modellers’ and ‘Modelling for Chemists’ which have been much appreciated. I also thank my colleagues of the organizing committee for all work making the meeting happen and so well organizing the two-day excursion. Finally, I like to thank Prof. Emilio Custodio for his offer to organize the next Saltwater Intrusion Meeting in 2004 in Spain and Prof. Giovanni Barrocu for his offer to be host of the meeting in 2006 in Italy.

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