

Mine Water Literature in ISI's Science Citation Index Expanded™

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Abstract. Scientists in most countries are assessed by the number of papers published in journals that are cited in the Science Citation index. This article reviews the mine water related entries in the Science Citation Index Expanded™ and discusses the results. Mine water relevant literature is spread over more than 900 journals, with 13 of them accounting for 25% of all relevant papers. No journal focused on mine water relevant issues can be found in the Index.

Key words: Science Citation Index; Thomson ISI; mine water research; mine water literature; Journal Impact Factor

Introduction

Scientists in most countries of the world are evaluated according to the journal impact factor (JIF) of the journals in which they publish. This factor is based on the number of citations in the "Science Citation Index" (SCI, Garfield 1999), a product maintained by Thomson ISI (Institute for Scientific Information) Corporation, which is a U.S. based information solution provider. Currently, the SCI lists about 3,700 of the world's leading scientific journals within a range of 100 disciplines and about 5,800 journals in the "Science Citation Index Expanded™". Each year, about 2,000 journals are evaluated, of which 10–12% are selected for the SCI. According to the journals' relevance in the scientific world, the ISI database is updated bi-weekly, but new journals are listed only after a three-year-evaluation period. The whole system is based on S.C. Bradford's findings in the 1930s that the most relevant scientific papers in each discipline can be found in less than 1,000 journals (Garfield 1979). ISI has evaluated those numbers in recent years and realized that 150 journals account for 50% of what is cited and 25% of what is published. Interestingly, 85% of all articles are published and cited in only 2,000 journals.

Because the SCI is based on those statistical numbers, small research areas may not be covered by the index, though Thomson ISI tries to incorporate enough journals to ensure a thorough coverage of all scientific fields. Nonetheless, the SCI is not all-inclusive (Garfield 1990). Scientific research areas less covered by the SCI are, for example, archaeology, mine surveying, and journals not published in English.

Several authors have criticised the use of publication activity, as documented by SCI and JIF, as selection criteria (e.g. Seglen 1997; Hecht et al. 1998; Opthof et al. 2002; Kaltenborn and Kuhn 2003), but this will not be further discussed here. This article investigates the relevant mine water related database entries in the Thomson ISI database, and provides an overview of the statistics that can be deduced from these entries. So far, no mine water related journal is listed in the SCI database.

Search Procedure

ISI's SCI Expanded database was searched at the end of January 2004 using the search term "(mine or mining) and water." This produced a list of 3,860 publications out of more than 33 million entries. A manual screening of the search results proved that by using this search term, most of the findings were relevant mine water literature, though some papers were more metallurgically biased. The search term "mine water" resulted in only 295 relevant papers and was therefore rejected. All the search results were downloaded and stored in a literature database for further evaluation (Kreutzer and Krohn 2003). An author, publication year, journal, and keywords list is being investigated statistically.

The same procedure was used for the GeoRef Database (American Geological Institute), resulting in 6,556 and 377 out of 2.57 million references related to geoscience journal articles, books, maps, conference papers, reports, and theses.

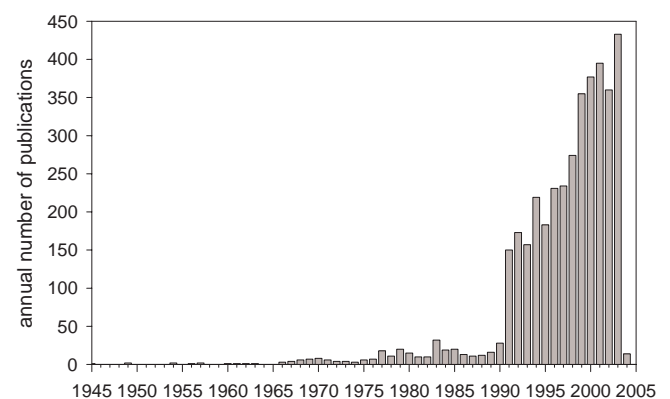


Figure 1. Annual numbers of mine water related papers in the SCI Expanded database between 1945 and 2004

ISI's search engine also provides a tool for searching within the citations of all its database entries. Therefore, in a second step, the number of citations for *Mine Water and the Environment* as well as the *Journal of the International Mine Water Association* was evaluated. As this part of the internet search engine does not provide full text search features, the abbreviation thesaurus for journal titles had to be evaluated first. ISI uses the abbreviations *Mine Water Env*, *J Int Mine Water Ass* and *J Mine Water* as well as some very similar abbreviations for IMWA's journals. This inconsistency is a result of the name change that occurred in 1991 and inconsistent citation practices by the authors.

Results and Interpretation

First, the annual publication frequency was investigated and resulted in an interesting pattern. Between 1945 and 1990, only 305 mine water papers were listed in the ISI database, increasing thereafter from 150 in 1991 to 433 in 2003 (Figure 1). There is no clear reason for the increase from 1990 to 1991. Sixty different journals were reviewed by ISI between 1945 and 1991, with 30 of them only being reviewed in 1991 for the first time. Those 30 journals contain only 173 relevant papers for the period from 1945 to 2004, whereas the 30 journals that were reviewed before and after 1990 contain 1006 relevant papers. The reason for this increase between 1990 and 1991 can therefore not be seen in the ISI database itself, but must be seen as an indication of increasing interest in mine water issues by the scientific community.

Mine water relevant literature was published in 934 different journals, with 863 of them having published 10 or less relevant papers. Half of the papers were published in 62 journals, and 13 journals were responsible for 25% of the papers (Figure 2), having

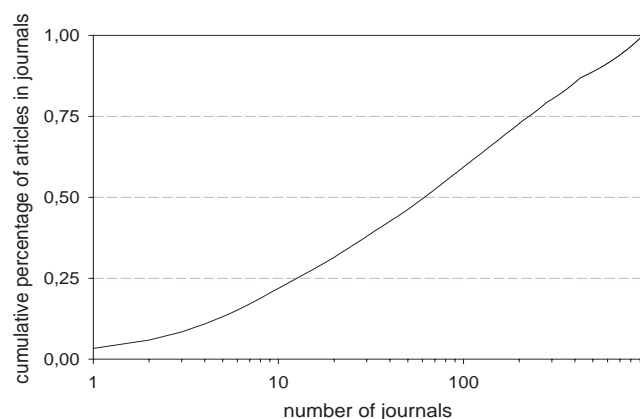


Figure 2. Cumulative percentage of articles published in the 934 journals with mine water related articles in the SCI Expanded between 1945 and 2004.

Table 1: 13 journals in the Science Citation Index that accounted for 25% of all mine water relevant papers published, the number of papers published between 1945 and 2004, and the journal's impact factor for the year 2002 (JIF). For comparison, *Mine Water and the Environment* is listed as well.

Journal Title	Articles	Impact
Environ. Geol.	129	0.390
Econ. Geol. Bull. Soc. Econ. Geol.	98	1.368
Sci. Total Environ.	97	1.396
Appl. Geochem.	96	1.320
Water Air Soil Pollut.	86	0.772
Environ. Sci. Technol.	78	2.707
J. Geochem. Explor.	74	0.318
Water Sci. Technol.	68	0.605
CIM Bull.	64	0.124
J. Environ. Qual.	53	1.155
Environ. Toxicol. Chem.	50	1.062
Hydrobiologia	46	0.659
Can. Geotech. J.	41	0.357
Mine Water and the Environment	264	–

published between 41 and 129 papers each. Currently, Environmental Geology is leading the ISI list with 129 papers between 1980 and 2004 (Table 1). A total of 264 papers were published by the International Mine Water Association in its journal.

An investigation of the key word list gives no clear trend in mine water research. 7748 different key words were used 39,034 times in SCI Expanded, 300 of them accounting for 50% of all key word listings in the mine water articles. Obviously, the key words 'water' (used in 23% of the papers), 'mine' (19%), 'drainage' (12%), 'mining' (10%), and 'acid' (8%) were the most common key words used (Table 2). 'Iron' (6%), 'copper' (5%), and 'lead' (3%) were the leading elements on the key word list, whereas 'coal' was used as a key word in 4% of the papers. Less than 1% of the papers dealt with alkaline mine water, while 15% addressed acid mine water (all acid and basic/alkaline entries used, e.g. 'acid-generating', 'acid-base-accounting', 'acid water'). Geochemistry, which has become increasingly important in *Mine Water and the Environment*, was a key word in 5% of the entries. Treatment technologies were addressed by only 2% of the entries. Although mine water pollution was key to 7% of the articles, and most pollution is associated with closed mines, abandoned or closed mines were cited as a key word in less than 1%.

A total of 8,766 authors contributed to the 3,860 articles, giving a mean of 2 authors per article. Out of those 8,766 authors, 60 are or were IMWA members. Of the 130 authors who published 5 or more papers, 7

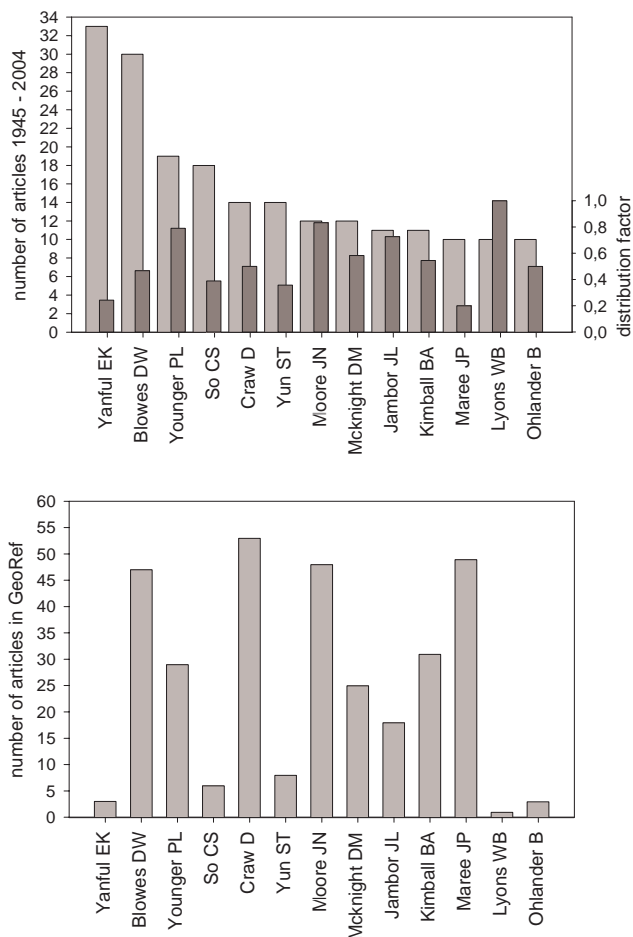


Figure 3. Top: number of articles of authors with more than nine papers in the SCI Extended database. The dark boxes give the distribution factor, which increases with the number of journals used by the author for publishing; bottom: number of articles of the same authors in GeoRef.

of them were IMWA members. E.K. Yanful leads the list with 33 entries published in 8 journals, whereas the second, D.W. Blowes, published his 30 papers in 14 journals and number three, P. L. Younger, published 19 papers in 15 journals (Figure 3 top). The relationship between published papers and number of different journals, designated a “distribution factor”, ranges between 0.2 and 1 for all authors with more than 10 papers. Assuming that this distribution factor is an indication of the quality of an author, and ranking the authors accordingly, gives highest honors to W.B. Lyons, J.N. Moore, and P.L. Younger (it should be mentioned that such a distribution factor can be manipulated by authors who desire to do so. In the case of the thirteen authors shown in Figure 3, this doesn’t seem to be the case, so the factor can be used for comparison reasons). 83 of the authors also published in *Mine Water and the Environment*, and 7 of them are included in the top 100 authors listed in the SCI mine water database. Those 83 authors

account for only 14% of all *Mine Water and the Environment* authors.

An interesting fact is that most of the leading researchers in the mine water field, be they IMWA members or not, can’t be found in the top ranks in SCI’s result list, but do appear on *Mine Water and the Environment*’s list and in the GeoRef database (Figure 3 bottom). This reflects the fact that mine water issues are not well covered by the SCI. It may also imply that researchers who are well known in this research field feel that they will not reach their desired audience by publishing in the journals that are in the SCI. Yet, because young researches are evaluated according to their publications in the SCI, it is important for them that a mine water journal be included in the SCI.

Up to now, articles from IMWA’s journals or proceedings are cited only 37 times by papers in the SCI. Eleven of those citations refer to the *International Journal of Mine Water*, 9 to *Mine Water and the Environment*, and the others to IMWA’s proceedings (Table 3). Unfortunately, authors refer to the journals in different ways; therefore, the journal may be cited more often, but can’t be found in the SCI database. Reference lists of older articles published in this journal testify to this; the journal is cited as *Inter. J. of Mine Water*, *Int. Jour. Mine Water*, *Int. J. Mine Water*, *International Journal of Mine Water*, etc.

Conclusions

Though the Science Citation Index lists 3,860 mine water related papers in 934 journals between 1945 and 2004, only 14% of all authors ever having published in *Mine Water and the Environment* or *The International Mine Water Association Journal* are also included in the SCI. Comparing the number of journals with mine water relevant papers and the total number of papers published, 50% of the mine water literature covered by the SCI is currently distributed in 62 different journals. Scientists working in this field therefore would have to be aware of the articles published in all of those journals. Furthermore, there is currently no journal in the SCI specialising in mine water related subjects; the journals accounting for 25% of the articles published focus on the environment, water, geochemistry, or geotechnology.

Researchers working in the mine water field who are assessed by their impact factor are currently forced to write in journals that are less focused on mine water issues. Albeit this spreads the information to people who are not actively involved in mine water research, the knowledge is dispersed over too many different journals for researchers who wish to keep informed and communicate with others in their field.

Table 2: The 35 most frequently used key words in the SCI Expanded out of 7,749 used by the investigated papers accounted for 20% of all key words. Total number of key word entries: 39,034.

Key word	number	% of words	% of papers
Water	897	2.3%	23.2%
Mine	724	1.9%	18.8%
Drainage	453	1.2%	11.7%
mining	386	1.0%	10.0%
acid	308	0.8%	8.0%
metals	264	0.7%	6.8%
oxidation	253	0.6%	6.6%
sediments	252	0.6%	6.5%
pollution	247	0.6%	6.4%
iron	242	0.6%	6.3%
river	242	0.6%	6.3%
soil	218	0.6%	5.6%
tailings	215	0.6%	5.6%
metal	190	0.5%	4.9%
copper	179	0.5%	4.6%
groundwater	169	0.4%	4.4%
toxicity	161	0.4%	4.2%
waters	160	0.4%	4.1%
heavy	154	0.4%	4.0%
transport	152	0.4%	3.9%
sediment	148	0.4%	3.8%
geochemistry	147	0.4%	3.8%
soils	144	0.4%	3.7%
sulfate	141	0.4%	3.7%
coal	137	0.4%	3.5%
quality	136	0.3%	3.5%
adsorption	135	0.3%	3.5%
chemistry	135	0.3%	3.5%
contamination	134	0.3%	3.5%
reduction	130	0.3%	3.4%
bacteria	128	0.3%	3.3%
lead	128	0.3%	3.3%
isotope	127	0.3%	3.3%
mercury	127	0.3%	3.3%
stream	125	0.3%	3.2%

Furthermore, within the research area, the JIF misrepresents researchers who strive to publish their work where it will be read by mine water researchers and practitioners.

Last, but not at least, the SCI lists no journals specialising in mine water issues. Comparing the papers published clarifies that *Mine Water and the Environment* is the only journal that focuses on mine water related issues. Researchers publishing in other journals should therefore cite literature in *Mine Water and the Environment* to increase the journal's impact factor and its potential for being included in the Science Citation Index. Furthermore, if abbreviated, the journal's incarnations should be cited as *Mine Water Env* and *Int J Mine Water*.

Table 3: IMWA journal entries in the ISI Database that are cited by papers in the database

Hits	Cited Author	Volume	Page	Year
1	Koschorrek M	21	137	2002
1	Aslibekian O	20	73	2001
1	Pigati E	18	45	1999
1	Helling C	17	41	1998
1	Kesseru Z	16	67	1997
1	Indraratna B	14	71	1995
1	Banks D	13	35	1994
1	Hawkins JW	11	37	1992
1	Doepker RD	10	29	1991
2	Awbery HG	7	9	1988
1	Kaden S	4	1	1985
1	Motyka J	4	1	1985
1	Singh RN	3	1	1984
2	Fawcett RJ	3	33	1984
1	Henderson RM	3	41	1984
4	Aston TRC	2	1	1983
1	Lloyd JW	2	1	1983
1	Holton MC	2	33	1983
2	Atkins AS	1	31	1982
1	Rawat NS	2	29	1982

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