

# The Impact of Electronic Journals on Use of Print in Geology

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This study examines the use of geology journals at Washington State University (WSU), before and after electronic access was provided, to determine if the use of the print collection increased as in the previous studies at WSU of three other science disciplines. The number and source of articles cited by WSU geologists from 1998 to 2004 is also examined to determine the impact of electronic access on citation patterns. In light of inflation and package deals, librarians need to understand how faculty use journals. This analysis will assist librarians in better understanding journal usage to inform future serial purchasing decisions.



A previous study was published in 2004 that evaluated the impact of the availability of electronic journals (e-journals) on the use of print journals in Chemistry, Mechanical and Materials Engineering (MME), and Physics collections in the Owen Science and Engineering Library (Owen), Washington State University.<sup>1</sup> The study revealed that the use of all three collections increased with the advent of electronic access (e-access) to many of the titles. When comparing usage in 1998, when there was no e-access, to usage in 2001, the statistics showed that overall initial use of the print collections increased after e-access was added. After 2001, print use went into a steady decline.

Geologists have the reputation of being tied to the use of traditional resources as indicated by Julie Hallmark,<sup>2</sup> who wrote, “geologists...in contrast to chemists and

other scientists, use older literature and international publications to a greater extent. Thus, e-journals play a lesser role in their research.” To determine if this was true at WSU, the authors decided to analyze the data available for the years 1998 through 2004 to determine if there was an adherence to print or if geologists followed the pattern demonstrated by their colleagues in Chemistry, Engineering, and Physics.

## Context

Washington State University is a land-grant institution with eleven libraries on four campuses statewide. The Owen Library on the Pullman campus provides support to four thousand faculty and students with majors in the hard sciences, agriculture, and engineering as well as general undergraduate students in other majors.

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In this time of journal inflation and big deal packages, librarians need to understand how researchers are using journals. This analysis will assist librarians in better understanding journal usage with the goal of informing future serial purchasing decisions.

**Questions**

The previous WSU study revealed that the use of the print collection increased with the advent of e-journal access. These findings contradicted such previously published findings as Goodman’s<sup>3</sup> that “users will use anything in electronic format, even items of no apparent value, that would not be used in print, and would not be requested on interlibrary loan.” The authors wished to determine if the trend they had previously observed in Chemistry, MME, and Physics at WSU would hold for geology or if the patterns similar to those referred to by Goodman and also seen by DeGroot and Dorsch,<sup>4</sup> Morse and Clintworth,<sup>5</sup> and Rogers<sup>6</sup> at other institutions would assert themselves. Did Geology users change over to the e-format in 2002 as did those in Chemistry, MME, and Physics? To add to understanding use of the collection, the authors decided to analyze the citation patterns of geology faculty to determine if they demonstrated title-loyalty or if they were choosing titles found primarily in e-format.

**Methodology**

The authors compared the use of geology titles in 1998, before Owen had e-journals, to the use of the same titles in the years 2000–2004, when e-journals were available to WSU users and use statistics were available from publishers. Embargoed titles (those with time-delayed e-access) were not an issue; there were none in the subject area of the study.

Continuous use statistics for print journals had been kept in Owen between 1993 and early 2006.<sup>7</sup> Each reshelving of a current or bound volume, whether checked out or used in-house, counted as one use. Signs posted throughout the library asked

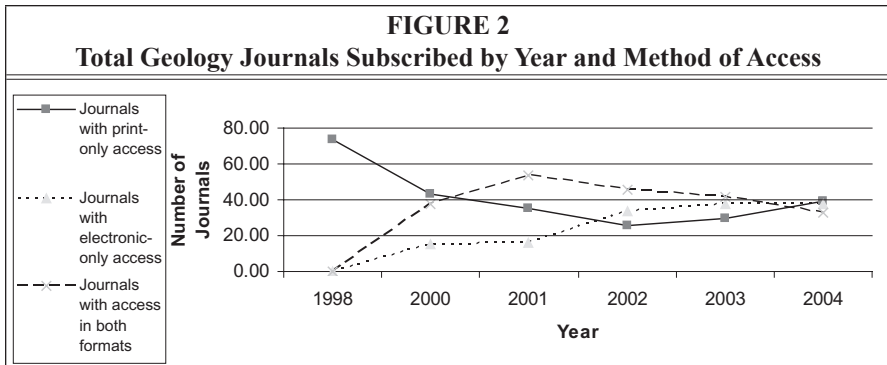
patrons not to reshelve items because a journal use study was being conducted. This had been going on so long that faculty had learned that reshelving of issues instead of leaving them out to be counted could result in the journal being cancelled in the next round of cancellations. It should be noted that Oliver Obst<sup>8</sup> calculates that this method underestimates actual usage by 15 to 33 percent.

One access to a full-text article counted as one use for e-journals. E-journal use statistics are added to the database, in a separate field, as they become available. In this way, librarians can track changes in usage patterns for each title over a multiyear period. Here there also may be a problem of inflated numbers. According to Obst, redundant multiple e-accesses of between 20 and 28.2 percent have been reported. Instead of printing articles for future use, patrons may be going back to the Web site to view the full text time after time. While anecdotal evidence based on comments from our patrons suggests that Obst is correct, the authors do not have sufficient data necessary to alter our method of reporting uses. A full explanation of the journal use database and statistics collection process is available in Galbraith’s<sup>9</sup> 2002 article “Journal Retention Decisions Incorporating Use-Statistics as a Measure of Value.”

A total of 110 geology journals were evaluated in this study. For a journal to be included in the study for any given year, the WSU Libraries had to have an active subscription in either print or e-format. Titles that did not have an active subscription in a given year were subtracted from the base 110. Between 1998 and 2001, the number of geology titles in the Owen collection increased 41.9 percent due to package purchases and consortial agreements. (See figure 1.)

**FIGURE 1**  
**Total Number of Journals by Year**

1998	2000	2001	2002	2003	2004
74	96	105	106	110	110



By 2004, the last year of the study, the overall gain in number of titles was 67 percent. However, due to the shifting nature of packages and consortial agreements, the journal titles in the study varied from year to year until the number of titles began to stabilize in 2003.

Very little of this change was due to purchasing titles that were individually selected by librarians; most of the fluctuation came as a result of consortial and package purchases. During this period, due to budget cuts, the library cancelled long-standing geology titles. Low-use titles were targeted. The cancellations did not impact overall use of journals, as the data show use continued to increase. (See figure 3.) At times the cancelled titles were later picked up in consortial purchases. The titles changed often as the content of package deals changed.

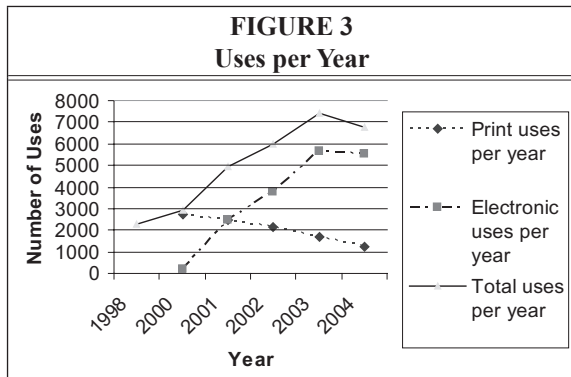
For the citation analysis, the authors mined data from *Science Citation Index* and the publication lists of the Department of Geology. WSU provided online access to *GeoRef*, the main geology database, for all the years of this study. In 2001 the libraries also instituted *ExLibris' SFX* link resolver software. The library expected that the ease of getting to e-journals from *GeoRef* via *SFX* would impact journal use and citation patterns. Unfortunately, due to failure of the statistics reporting software, the library

does not have statistics that would enable the authors to support or refute this expectation.

**Results and Discussion**

For this study the authors looked at titles in each of the format categories. (See figure 2.) The number of print journals peaked in 2001, as did the number of journals available in both formats. Interestingly, the number of journals with print-only access bottomed out in 2002 and then began to increase in number again. When packages changed or ceased, or a package subscription was dropped, the library lost access to electronic titles and more titles reverted to print-only, as can be seen in the “access in both formats” row.

The year 2001–2002 can be identified as the year that online offerings transitioned from the minority to the majority of the geology journal collection. The number of titles available in both print and e-formats dropped consistently after 2001.



2002 was the first year a preference for online access was reflected in a planned effort by WSU Libraries to cancel print journals in favor of online access. This was primarily the result of a need to stay within budget while avoiding a large cut in the number of journals available to WSU users.

A consortial purchase was not renewed for 2004, resulting in a reduction in the number of titles with e-access. The percentage of print journals subscribed to during the study period did not drop below 50 percent because WSU did not cancel print when archival rights were unavailable.

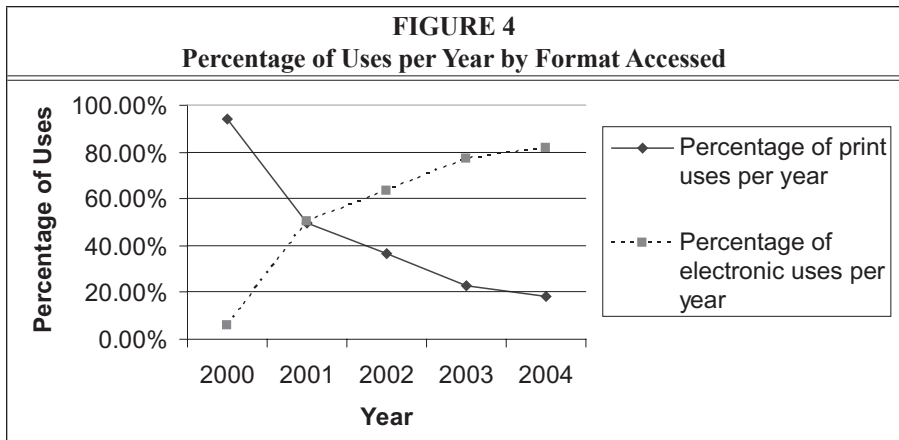
The first step in the study was to look at the total usage of all journals in each format. (See figure 3.) Similar to the findings of previous WSU studies of Chemistry, MME, and Physics, the use of the print journals increased after the e-format was introduced. Although total use of the print format dropped in 2001, it still was higher than use in 1998. By 2002, print use dropped below the 1998 level and continued to drop in each study year thereafter. E-formats rapidly gained in use, until 2004 when the use dropped three percent. (See figure 3.)

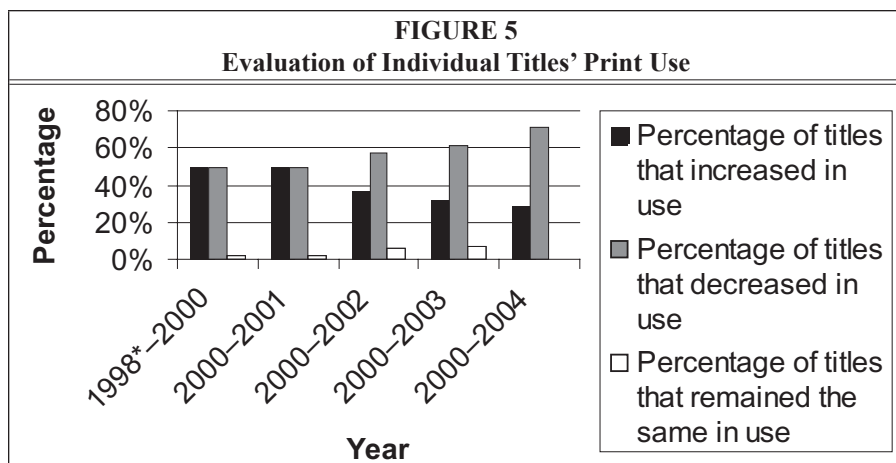
The drop of usage in both formats in 2004 may be attributed to the loss of three faculty members in the department, which was 20 percent of the faculty at that time. At the same time, there were 33 percent

fewer declared undergraduate majors in geology in 2004 than in 2003. A case study conducted by Ochola and Peterson-Lugo<sup>10</sup> found that in “a non-major lower level course, the students heavily used Internet resources (60% of their citations), while their use of library print and electronic resources was minimal.” On the other hand, “the students in the upper level GEO 3435 class produced bibliographies in which 86% of the research came from traditional library resources.” If Ochola and Peterson-Lugo’s conclusion is correct, the relatively small drop in e-use in 2004 may be explained by undergraduates using the Internet instead of e-journals.

There was an increase in the use of geology serials over the seven-year period of study. This may be explained in part by the increase in computer literacy of the incoming student population. In addition, newly hired faculty members were younger and probably more comfortable with technology. Sathe et al<sup>11</sup> found, for example, “that certain categories of patrons, most notably faculty, prefer print journals over electronic, whereas most (medical) residents and fellows prefer electronic journals.”

A look at titles that had both print and e-access reveals that use of print increased immediately after the introduction of the electronic version, then slowly declined each year thereafter. It should be noted that use of the print version never





ceased. Over the years there is a confusing pattern of increased and decreased use of individual print-only titles. The authors could find no factor to account for this behavior. Yet those titles that were print-only throughout the period of the study maintained 70 percent of their year 2000 use level. Print-only title use had dropped, but not as precipitously as predicted by DeGroote and Dorsch,<sup>12</sup> Morse and Clintworth,<sup>13</sup> and Rogers.<sup>14</sup>

A perusal of the percentage of total use that each format represents may make it easier to see the change. (See figure 4.) By 2002, geology users demonstrated a clear preference for e-format. One question is, why did it take the faculty so long to adopt e-formats? Anecdotal evidence from the halls of library association meetings suggests that geologists are less likely to accept new formats. Hallmark's<sup>15</sup> writings also support this view.

Print use statistics showed a slow decline in print uses, but that is not the entire picture. (See figure 5.) When changes in print use are looked at title by title, a slightly different pattern emerges. Many titles exhibited an increase in use or a drop in use from year to year. Between 1998 and 2000, and again in 2000–2001, 49 percent of the print titles showed an increase in use and 49 percent of the titles showed a decrease in use, while 2 percent remained unchanged. Chemistry, MME,

and Physics titles exhibited a strong increase in print use of journals that were also available electronically. For geology, whether the title had an e-version or not had no effect.

Between 2001 and 2002, only 37 percent of the print titles had increases in use. By 2003, only 32 percent increased in use over 2002. By 2004, the final year of the study, there was an increase for 29 percent of the titles. Availability of an e-version made no difference which titles increased or decreased. At the same time, use of print titles in Chemistry increased 11 percent, MME increased 24 percent, and Physics increased 9 percent, for an average increase, for all three subject collections, of 14 percent between 2001 and 2003. The SFX link resolver had been in operation since fall 2001 and may have been a factor in the increase in use of print titles.

Although use of individual titles increased each year, no title increased in use every year. All titles increased in print use in at least two of the years. Some titles increased in as many as four individual years. In most cases, titles did not increase in use in consecutive years. A study of the individual titles that increased and decreased over the years also revealed no pattern related to e-format availability. Therefore, increase in use of an individual print journal was most likely related to some other feature such as content, qual-

ity of photographs and graphics, classes requiring students to investigate contents of particular titles, or perhaps ease of browsing back issues.

Were the new-to-WSU e-journals used? Most of the new e-titles acquired in packages and consortial deals made little impact on usage data. However, there were three new e-journals that consistently demonstrated impressive use. Obviously they are titles to which WSU should have been subscribing earlier (*Applied Geochemistry*, *Geomorphology*, and *Quaternary Science Reviews*).

### Citation Analysis

The authors were interested to see if citation analysis could provide insight into how the geologists were using their journals. According to Sathe et al,<sup>16</sup> "...our data regarding patrons' preference for and use of electronic journals for printing articles confirms the idea that patrons may limit their research to easily available electronic journals simply because of their convenience and regardless of whether other sources would better suit their information needs." At WSU a comparison was made of journals cited in 1998 and 2004. Geology faculty cited 46 percent more articles in 2004 than in 1998. Of the 771 journals cited, only 8 percent, or 61 journals, were in the WSU geology collection. Faculty members were using a large number of journals that were outside the sample or that WSU did not own. The 61 journals accounted for 37 percent of the total citations in 1998 and 38 percent of the total citations in 2004. The faculty was using our collection consistently.

Of the titles that were print-only in both years, 41 percent decreased in citation level, while 41 percent increased and 18 percent remained the same. Faculty members were not abandoning titles just because they were not available in e-format. Among the 710 titles cited that were not in the WSU geology collection were journals from such subject fields as agriculture, biology, chemistry, microbiology, pharmacology, physics, and zoology.

Together this indicates a trend toward increased interdisciplinary research and that, with the adoption of electronic access, the breadth of titles being cited increased tremendously.

Of the WSU titles owned in dual format, 20 percent decreased in the number of times they were cited. Eighty percent either increased in citations or remained steady. This was a 21 percent higher gain than print-only titles, suggesting that electronically available titles had gained acceptance among geology faculty.

The study also looked at which titles were most frequently cited by WSU geologists. Of the 38 titles that were cited ten or more times in 1998, 79 percent of them continued to be cited ten or more times in 2004. All those that dropped in citation level had e-formats. In 2004, 59 titles were cited ten or more times. This is an increase of 55 percent over 1998. Twenty-nine titles increased to this citation level when compared to 1998. One-fifth of those titles that rose to this level of citation in 2004 were print only. This suggests that format was not the driving force for Geology patrons. This contradicted Tenopir's<sup>17</sup> report of librarians' suppositions that "when [patrons] begin to rely on electronic full texts, they often don't bother to check print journal stacks" and that "most patrons will select the digital versions, even if a particular title or article is not best for their needs."

### Conclusions

As expected, after geology e-journals became established, use of e-titles far outstripped the use of print titles. This does not mean, however, that print became obsolete, as indicated by Goodman<sup>18</sup> and Sathe et al.<sup>19</sup> As with the previous WSU studies of Chemistry, MME, and Physics, initially the use of the print collection increased with the advent of e-journal access. The study shows that the changes in the use of individual titles are research driven. By 2001, geology users were using print and e-formats equally. This differs from the previous WSU study in which, by 2001, Chemistry uses of print

had dropped to 25 percent, MME had dropped to 40 percent, and Physics had dropped to 33 percent.

Geology print use in 2002 was virtually the same as that of 1998, but electronic usage had increased dramatically to become the dominant format. Use data for 2003 shows that print use declined to 23 percent. However, the second WSU study conducted by Brady et al.<sup>20</sup> of Chemistry, MME, and Physics showed more dramatic drops in print use by 2003, with Chemistry at 5 percent, MME at 13 percent, and Physics at 4 percent. Use of the geology print collection did not decline as dramatically over the same period.

As geology users became more familiar and comfortable with e-access, there was an increase in the total citations in the papers they authored. Total use of the collection in 2004 increased 295.5 percent over 1998 use, while the number of citations increased 46 percent. The method of library research changed, which led to an overall increase in the number of citations, individual articles, and titles appearing in their publications.

All WSU geology titles were indexed in *GeoRef* both before and throughout the study period. In the year 2001 our link resolver became truly functional. This combination increased visibility of both print and e-formats in the library's collection and made direct access to electronic titles easier. If a title was not available electronically, the link resolver permitted the patron to search the online catalog to determine if WSU owned the print version. This was a major contributor to the increased use of the collection. When a journal was not owned by WSU, placing an interlibrary loan request was also facilitated through the SFX link resolver. This contributed to the large percentage of geologist-cited journals that WSU did not own or were outside the study sample.

Citation analysis showed that the majority of titles WSU faculty members

cited were not in the WSU geology collection. Eight percent of the titles (61 titles) cited were in the WSU geology collection, and these 8 percent accounted for over one-third of the citations. These 61 titles increased or decreased in citation level with no relationship to the format available. WSU Geology faculty exhibited title-loyalty by citing in 2004 the same titles that were cited most often in 1998. The faculty members were using titles that suited their research needs, not just those titles available electronically.

The titles included in the geology collection for any given year are impacted by large or "big deal" package purchases. Access to an increased number of titles through package deals should not necessarily influence subject specialists in supporting purchases. If the titles included in the big package deals are not those being used by faculty they may not be worth the expense or the support of the subject specialists. A periodic review of faculty citation patterns could have significant impact on purchasing decisions. However, if providing an increased breadth of offerings is a deciding factor, these big deals, with increased title selection, may be a favorable option and more likely to be supported by subject specialists.

### Future Directions for Research

Additional research needs to be undertaken to determine how journal cancellation affects interlibrary loan. The authors also wonder if different disciplinary "citation half lives" affect print use. An analysis of the impact of research-intensive courses on collection use should yield useful information for future collection cancellation decisions. The authors also speculate that personal subscriptions to journals, especially professional society publications, may have increased since 1998, which would impact the use level of the library's collections.

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### Notes

1. Tammy R. Siebenberg, Betty Galbraith, and Eileen E. Brady, "Print Versus Electronic Journal Use in Three Sci/Tech Disciplines: What's Going on Here?" *College and Research Libraries* 65, no. 5

(Sept. 2004): 427–38.

2. Julie Hallmark, "Access and Retrieval of Recent Journal Articles: A Comparative Study of Chemists and Geoscientists," *Issues in Science and Technology Librarianship* (Summer 2004). Available online at <http://istl.org/04-summer/article1.html>.

3. David Goodman, "A Year Without Print at Princeton, and What We Plan Next," *Learned Publishing* 15, no. 1 (Janu. 2002): 43–50.

4. Sandra L. Degroote and Josephine L. Dorsch, "Online Journals: Impact on Print Journal Usage," *Bulletin of the Medical Library Association* 84, no. 4 (Oct. 2001): 372–78.

5. David H. Morse and William A. Clintworth, "Comparing Patterns of Print and Electronic Journal Use in an Academic Health Science Library," *Issues in Science and Technology Librarianship* (Fall 2000). Available online at [www.library.ucsb.edu/istl/00-fall/refereed.html](http://www.library.ucsb.edu/istl/00-fall/refereed.html).

6. Sally A. Rogers, "Electronic Journal Usage at Ohio State University," *College & Research Libraries* 62, no. 1 (Jan. 2001): 25–34.

7. The practice was reinstated for all journals with active paper subscriptions after a few months when a new procedure was developed.

8. Oliver Obst, "Patterns and Costs of Printed and Online Journal Usage," *Health Information and Libraries Journal* 20, no. 1 (Mar. 2003): 22–32.

9. Betty Galbraith, "Journal Retention Decisions Incorporating Use-Statistics as a Measure of Value," *Collection Management* 27, no. 1 (2002): 79–90.

10. John N. Ochola and Billie R. Peterson-Lugo, "Collaboration Between the Library and Classroom Faculty in the Assessment of Student Research Needs: A Case-Study with Geology Undergraduates," *Collection Management* 28, no. 4 (2003): 79–94.

11. Nila A. Sathe, Jennifer L. Grady, and Nunzia B. Giuse, "Print Versus Electronic Journals: A Preliminary Investigation into the Effect of Journal Format on Research Processes," *Journal of the Medical Library Association* 90, no. 2 (2002): 235–43.

12. DeGroote and Dorsch, "Online Journals."

13. Morse and Clintworth, "Comparing Patterns of Print and Electronic Journal Use in an Academic Health Science Library."

14. Rogers, "Electronic Journal Usage at Ohio State University."

15. Hallmark, "Access and Retrieval of Recent Journal Articles."

16. Sathe, Grady, and Giuse, "Print Versus Electronic Journals."

17. Carol Tenopir, "Should We Cancel Print?" *Library Journal* 124, no. 14 (Sept. 1, 1999): 138, 142.

18. Goodman, "A Year Without Print at Princeton, and What We Plan Next."

19. Sathe, Grady, and Giuse, "Print Versus Electronic Journals."

20. Eileen E. Brady, Sarah K. McCord, and Betty Galbraith, "Print versus Electronic Journal Use in Three Sci/Tech Disciplines: The Cultural Shift in Process," *College and Research Libraries* 67, no. 4 (July 2006): 354–63.