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ORIGINAL ARTICLE

International disparities in open access practices in the earth sciences

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Abstract

Background: Open access (OA) implies free and unrestricted access to and re-use of research articles. Recently, OA publishing has seen a new wave of interest, debate, and practices surrounding that mode of publishing.

Objectives: To provide an overview of publication practices and to compare them among six countries across the world to stimulate further debate and to raise awareness about OA to facilitate decision-making on further development of OA practices in earth sciences.

Methods: The number of OA articles, their distribution among the six countries, and top ten journals publishing OA articles were identified using two databases, namely Scopus and the Web of Science, based mainly on the data for 2018.

Results: In 2018, only 24%–31% of the total number of articles indexed by either of the databases were OA articles. Six of the top ten earth sciences journals that publish OA articles were fully OA journals and four were hybrid journals. Fully OA journals were mostly published by emerging publishers and their article processing charges ranged from $1000 to $2200.

Conclusions: The rise in OA publishing has potential implications for researchers and tends to shift article-processing charges from organizations to individuals. Until the earth sciences community decides to move away from journal-based criteria to evaluate researchers, it is likely that such high costs will continue to maintain financial inequities within this research community, especially to the disadvantage of researchers from the least developed countries. However, earth scientists, by opting for legal self-archiving of their publications, could help to promote equitable and sustainable access to, and wider dissemination of, their work.

Keywords: article processing charges, geoscience, open science, predatory journals, preprints, repositories

Introduction

Scholarly journals are the primary vehicle for communicating research to other researchers and have traditionally been run by various societies and associations.[1] Some journals have remained independent and continue to be run by scholarly communities, whereas most have been gradually acquired by commercial publishers.[2] In choosing a journal for submitting their manuscripts, authors consider a number of factors: coverage by indexing services, readership, type of journal, the journal's Impact Factor (IF), language, type of article (a regular research article, a review article, a commentary, and so on), average time taken for peer review, reputation of the journal, and article-processing charges (APCs) or any other charges.

The digital age is also forcing scholarly publishing to undergo a major transformation. A decline in print versions, the high costs of journal subscriptions, and the increasing costs of publication are all spurring scientists to look for alternatives to the traditional scientific publishing.[3,4] In addition, according to STM (formerly the International Association of Scientific, Technical and Medical Publishers),[5] two-thirds of the scholarly literature produced in 2016 remains mostly inaccessible to the public because the work is hidden behind prohibitively expensive subscription paywalls. This constraint is driving the ever-increasing move to open access (OA), which, while generally slow, marks a significant shift in the financial models used by major publishers within a scientific, technical, and medical information publishing market that generated $25.7 billion in 2017. Open access has introduced greater diversity in publishing routes and highlighted major problems related to publishing ethics, such as copyright infringement and inappropriate expenditure of public funds. Ensuring that

researchers as authors and their institutions do not have to pay even more to read and publish papers than they currently do has become a critically important part of the OA transition.[6] Academic publishing through the OA route aims to make more scientific content accessible online and has been around in various forms for almost three decades. However, OA too often gets conflated with just one mechanism, namely the author-facing business model of APCs, whereby authors pay to cover the cost of publishing their papers,[7] which puts the already disadvantaged academics to even greater disadvantage. Indeed, Pourret *et al.*[7] highlight the different forms of OA, which are identified as gold, bronze, green, or diamond OA: neither green nor diamond OA involves APCs, and green OA corresponds to self-archiving by authors on their personal website or in an archive of near-final and peer-reviewed versions of their work. Trusted archives are usually preferable. Diamond OA denotes free (without any APCs) access to content from a journal's website. Gold OA involves APCs for immediate publishing access whereas bronze OA refers to free-to-read articles on the publisher's website but without any explicit open license, which potentially prohibits future re-use of the articles. These distinctions are critical, because APCs typically associated with OA publishing may put to disadvantage researchers from developing countries who do not have the funds to pay the APCs.[8] Retraction Watch (https://retractionwatch.com/2020/06/16/failure-fails-as-publisher-privileges-the-privileged/) recently highlighted the possibility that some publishers (MDPI, for example), by favouring the submissions of researchers from developed countries, privilege the privileged even more. This brief account of OA is important when one considers that the ultimate aim of publishing research is to disseminate information and describe advances in science for the good of society, especially in the increasingly important context of the United Nations Sustainable Development Goals,[9] and earth sciences – the focus of this paper – among other fields of science have been organized to solve local problems in dealing with the earth system.

It is against this background that we briefly discuss key differences in publication strategies between earth scientists from six countries across the world. More specifically, we discuss the differences in our experiences and understanding of access (OA versus paywall) and its scope, namely regional *versus* international.

Material and methods

Raw data were derived from two major indexing databases, namely Scopus and the Web of Science (WoS). Using both the databases, relevant information was extracted for 2018 and limited to affiliations from the six countries in which the authors of this paper work, namely China, France, Indonesia, South Africa, the United Kingdom, and the United States of America (Table 1). The total number of articles and that of OA articles covering the categories 'Geochemistry and Geophysics' and 'Geology' of the Web of Science and the 'Earth and Planetary Sciences' category from Scopus were counted. It should be noted that the same article can be counted more than once if the work was the result of international collaboration. We also selected the top ten earth-science journals (based on the number of articles published by them in the Scopus category 'Earth and Planetary Sciences') that also publish OA articles. For those ten journals, we counted the number of OA articles, calculated the proportion of OA articles to the total number of articles published, and also noted the status (fully OA or hybrid), the amount of APCs, the IF for 2019, and the name of the publisher (Table 2).

Results

In 2018, a total of 13,436 articles were published in the WoS category 'Geochemistry and Geophysics'; 30,189 in the category 'Geology'; and 106,246 in the Scopus category 'Earth and Planetary Sciences'. Of the total of all the three, only 24%–31% were OA, and the UK had the largest share (46%–54%) of the OA articles, much greater than that for any of the other five countries, with China accounting for the lowest share (18%–20%) (Table 1). Between the two databases, Scopus was ahead of WoS in terms of both absolute number and the proportion of OA articles.

Of the top ten journals that publish OA articles in earth sciences, six are fully OA and four are hybrid journals (Table 2). Fully OA journals are mostly published by either emerging publishers (MDPI[10] and Hindawi, for example) or long-time OA publishers (Copernicus Publications, which is the publishing arm of the European Geophysical Union, for example), and their APCs ranged from $1000 to $2200 and the journal IFs, from 1.298 to 5.414 (one of the journals was not indexed). The hybrid journals are published by the older or mainstream publishers including EDP Sciences, Wiley/AGU, Oxford/Royal Astronomical Society, and American Meteorological Society, and their APCs are much higher ($1100–$3035)–as are their journal IFs (4.580–6.209).

Table 1. Open-access publishing in earth sciences, by country

	Web of Science category						Scopus category		
	Geochemistry and Geophysics			Geology			Earth and Planetary Sciences		
Country	Total number of articles	Number of OA articles	Proportion of OA articles (%)	Total number of articles	Number of OA articles	Proportion of OA articles (%)	Total number of articles	Number of OA articles	Proportion of OA articles (%)
China	3,492	651	19	7,277	1,295	18	30,877	6,321	20
France	1,145	333	29	2,085	851	41	6,949	2,916	42
Indonesia	26	6	23	173	91	53	561	254	45
South Africa	134	26	19	415	81	20	1466	538	37
UK	1,063	574	54	2,545	1,618	64	9,749	4,516	46
USA	3,569	902	25	6,761	2,523	37	25,108	11,486	46
Total	13,436	3,271	24	30,189	9,369	31	106,241	33,135	31

Note: All data as accessed on 26 Feb. 2020.

Table 2. Top ten journals in earth sciences (by number of articles indexed in Scopus)

	Open-access articles		Other information			
Journal	Number	%	Publishing model	Article-processing charges ($)	Impact Factor for 2019	Publisher
Remote Sensing	1,963	100%	Fully open access	CHF 2200	4.118	MDPI
Astronomy and Astrophysics	1,805	99%	Hybrid	3000	6.209	EDP Sciences
Atmospheric Chemistry and Physics	941	100%	Fully open access	1000	5.414	Copernicus/EGU
Geophysical Research Letters	700	48%	Hybrid	2500	4.580	Wiley/AGU
Monthly Notices of the Royal Astronomical Society	573	17%	Hybrid	3035	5.356	Oxford/Royal Astronomical Society
Minerals	556	100%	Fully open access	CHF 1800	2.380	MDPI
Shock and Vibration	504	100%	Fully open access	2200	1.298	Hindawi
Geosciences	450	100%	Fully open access	CHF 1200	—	MDPI
Journal of Climate	417	77%	Hybrid	1100	5.707	American Meteorological Society
Biogeosciences	416	100%	Fully open access	1000	3.480	Copernicus/EGU
Other journals	97,916	26%	—			
Total	106,241	31%	—			

Discussion

Open-access policy

Most of the papers in earth sciences from China were earlier published in hybrid journals.[11] This trend can be attributed to a historical incentive for researchers to publish in top journals (that is, journals with high IFs and placed in the first quartile as categorized by the Chinese Academy of Sciences) or, in other words, those that publish the mostreliable work.[12] In many cases, one of the easiest options for Chinese authors was to publish their research in a 'high-impact' predominantly English hybrid journal without paying the APCs and place their paper behind a paywall simply because they could not afford to pay the APCs. However, this policy changed in early 2020. China recently published a national-level policy to ban the use of journal-based metrics as assessment criteria for academic promotion and recruitment, which should in future give priority to innovation and significance of the representative achievements in solving practical problems.[11] Further, publication in a restrictive list of Chinese journals is being proposed as one of the prerequisites to apply for top national awards. A move away from high IF

journals to Chinese journals could be a real game changer, because Chinese researchers are prolific in publishing.[13] This policy is seen as a responsible first step in reforming the evaluation of research in China and may encourage other nations to adopt similar policies. Specifically, the new policy tackles perverse incentives that drive the 'publish or perish' culture that might be encouraging questionable research practices. Owing to the drive to address (local) practical problems in this new policy and the need to target a specific audience, more research will probably be published in Chinese national journals (*Acta Petrologica Sinica* and *Geology in China*, for example), the majority of which levy APCs and are fully OA by default and continue to feed the common misconception that to comply with OA, authors need to pay APCs. Indeed, there are toll-access journals – journals that are not OA – that have page charges and there are OA journals without any page charges or APCs.

Pourret *et al*.[4] maintain that publicly funded research in the United Kingdom has to be made available through OA in order to abide by the *UK Research and Innovation Policy*: UK research councils provide universities with a tranche of money specifically dedicated to cover the costs of gold OA publishing in the form of APCs. Each university then uses that tranche in whichever way it sees fit: some cover the cost of gold OA on a first-come, first-served basis, whereas others favour publications they believe will have a higher impact. Any publication not selected for gold OA (for example because it was not deemed impactful enough or because the money has run out) has to be published through the green OA route at no charge to its authors, and there is a general policy of self-archiving in order for works to be eligible for assessment in the UK's Research Excellence Framework. Some universities also have restrictions on publishing in hybrid journals because of their lower quality and relatively high costs. Currently the Joint Information Systems Committee (https://www.jisc.ac.uk) is negotiating national-level agreements with commercial publishers. These contracts involve donating millions of pounds of public money each year to sustain the dysfunctional commercial publishing sector while simultaneously neglecting to invest in open scholarly infrastructure and thus, although often termed 'transformative agreements', it can be argued that a more accurate term could be 'stagnation agreements'. This situation is being replicated in many countries around the world as they try to realign themselves with recent changes implied by Plan S.[14] The movement around Plan S (https://www.coalition-s.org), a funder-led initiative launched in September 2018, aims to accelerate full transition towards OA. These initiatives have opened up discussions on journals' and research communities' abilities to correctly and sustainably shift towards a dominantly OA model.[4] Leaders in the field of higher education in many countries including South Africa are looking to move to a European model.[15] One major consequence of Plan S in the UK is an increase in the number of OA publications with a shift from hybrid journals to fully OA journals.[16]

Other countries such as Denmark and France (and most of the European countries) are having considerably more success by investing, through libraries, in green OA as part of their national policy.[7] This policy means that, to the largest possible extent, researchers and their institutes ensure that a peer-reviewed copy of a manuscript that is accepted for publication is uploaded to the appropriate institutional repositories whenever legally and technically possible.[7] In Denmark, a green OA policy has existed since 2016. This policy, as described above, does not constrain researchers in their choice of a publishing channel, because virtually all journals allow such uploading or even deposit articles automatically in appropriate repositories, after an embargo period, often on behalf of authors. At the moment, about 45% of the annual research output of Denmark is being uploaded into its universities' repositories (https://www.oaindikator.dk/en/), a share comparable to that of France: 49% of the research publications in France in 2018 are available as OA (including 'green' OA, not considered in our evaluation; https://ministeresuprecherche.github.io/bso/). Furthermore, some libraries in Denmark have allocated specific funds for paying APCs, albeit requiring that the corresponding manuscripts be made available through institutional repositories as well for the publications to qualify as green OA in the sense of the national policy.

Indonesia recently became the world leader for publishing research through OA, thanks largely to the efforts to index its journals in the Crossref registry.[17] However, this significant shift to OA scientific publishing is yet to change the way the Indonesian government evaluates staff performance and research impact.[18] The newest regulation on staff promotion in Indonesia, released in January 2020, continues to favour metric-based measurement of research output by giving a maximum score of 40 to articles published in journals with higher IFs but only 25 to those published in local journals. Publishing in journals with high IFs or in journals in the first quartile of the Scimago list is mandatory for being promoted to a professor. Currently all major universities in Indonesia not only pay the APCs but also offer other incentives for publishing in the so-called reputable journals (first-quartile journals). The way the Indonesian government allocates funding to higher education has been distorted as more money flows into the end-point of research and innovation rather than into constructing research infrastructure. In the long run, this policy does not create resilience in the local academic or research ecosystem. A similar phenomenon is seen in other nations such as India, a particularly relevant example because the country is planning to implement a one nation - one subscription plan.[19]

South Africa currently has no formal policies to publish OA. Although not linked directly to any policy, universities are known to pay APCs[20] but this monetary support is typically capped at less than $900. There is no stipulation that such support must be used for various types of OA or for publishing in hybrid journals, the only criterion being that the journal must be accredited by the South African Department of Higher Education, Science and Innovation. Unfortunately, some universities in South Africa pay a bonus to faculty members for publishing in the accredited journals (irrespective of whether they are predatory or OA). This incentive has resulted in some dubious publication practices.[21]

In USA, OA policies in the earth sciences community seem to be mixed. Gold OA is covered by some universities, typically those with sufficient resources, or whenever grants specifically budget for it. Additionally, some institutions, in conjunction with their subscription plans, have negotiated discounted APCs with society journals such as those published by AGU. These arrangements are viewed as beneficial to publishers,

institutions, and societies because the arrangements help to keep the subscriptions down. However, as evidenced by recent ongoing negotiations (since 2019) between Elsevier and the University of California system, such arrangements can be a sticking point and have resulted in the University of California unsubscribing Elsevier's journals and calling for faculty to withdraw from editorial boards of those journals. Major US societies such as AGU and the Geochemical Society host journals with hybrid OA options as well as full OA. Further, funding agencies such as the National Science Foundation require principal investigators to deposit papers arising from the work funded by its grants into a public-access repository (https://par.nsf.gov/).

Global inequalities

The philosophy dominated by APCs has created a complex system and a hierarchy of financial privileges around OA publishing.[16] Gold OA is now mostly funded by institutions through 'read and publish' agreements or by direct support from agencies that fund research and in some cases by researchers themselves. The non-OA and green self-archiving routes are typically funded only by institutions and funding agencies (because there are no author-facing charges). If a researcher happens to be with an institution that can afford to pay both APCs and journal subscriptions, this does not seem to be a major hurdle: the cost is supported externally, and authors have no incentive to publish in less-expensive platforms that might be perceived as having a lower value. However, for other institutions (with lower budgets) and for researchers working in them, cost certainly remains an obstacle. Although many authors seem to equate OA with a specific form of business model (APC-driven gold OA), this is clearly erroneous, and the myth should be dispelled. In this situation, those researchers who can afford to publish in OA journals, particularly in those with a high IF and steep APCs, have an advantage over those who enjoy no such financial security and are restricted in their choice of journals owing to their inability to afford APCs. Given that it is now recognized that OA publishing tends to lead to increased 'impact' for researchers,[22] the inherent bias of the current APC-based OA publishing perpetuates this inequality through the 'Matthew effect' (the rich get richer and the poor get poorer). The switch from pay-to-read to pay-to-publish has left essentially the same people behind,[8] with some academics not having enough purchasing power (individually or through their institutions) for either option.[23]

Virtually everyone who might benefit from access to research has limited access to papers behind paywalls. Hedding[8] notes that for many countries it is extremely expensive for university libraries and non-academics to pay to access published scientific content, a problem even greater for financially poorer nations. Open access may conceptually address these shortcomings by providing greater access to readers, but that often simply shifts the financial burden to researchers. Moving towards OA creates inequalities between countries that have substantial financial resources and those that find it difficult to pay the often high APCs. That some countries have allowed the scholarly publishing system to essentially become a public financing machine for this inequity is a paradox and indicates horrendous mismanagement of relevant funding streams, failure to understand even basic market principles, and the diversion of public funds to protect the commercial sector. However, Indonesia has more than 1570 OA journals and ranks second, next only to the UK, in the Directory of Open Access Journals (DOAJ; https://doaj.org/). The majority, about 70%, of these journals do not levy APCs[24] and are funded by local universities and research institutions and published locally. Journals listed in the DOAJ mostly publish English-language articles but only represent one-sixth of the Indonesian journals listed in GARUDA, the country's national database (http://garuda.ristekdikti.go.id/), which currently indexes more than 1.1 million articles published in more than 9600 Indonesian journals maintained by more than 1600 publishers. Journals that charge only moderate APCs (*Indonesian Journal on Geoscience*, for example) are mostly the ones that are indexed by the indexing services and are considered to be of higher quality as a result. Regulations in Indonesia's higher education system give a higher score to articles published in journals and conference proceedings listed in Scopus, which lists only 47 Indonesian journals at present. However, even indexing services such as Scopus have been infiltrated by predatory journals,[21] which continue to threaten the credibility of current scholarship systems. Nevertheless, journals indexed by Scopus are now considered to be the elite journals in Indonesia. Either way, it is important to note the perplexing scenario in which the current Indonesian evaluation system seems explicitly designed to penalize Indonesian researchers who share and publish their work in Bahasa Indonesia (the Indonesian language) and Indonesian journals.

Access to global literature appears to be declining whereas it was expected to increase in the era of a globalizing world and the World Wide Web. For example, Hedding[8] notes that researchers, particularly students and non-academics (including policymakers), in many poor countries from the Global South have increasingly limited access to papers behind paywalls. Thus, the ultimate goal of OA publishing should be to make research more accessible to researchers, students, and non-academics.[8] Although from a different perspective, the push for the decolonization of research in South Africa has raised similar concerns.[25] Nordling[26] explains that decolonization is a movement to eliminate, or at least to minimize, the disproportionate legacy of white European thought and culture in education (including research) but notes later that decolonization is not well defined in the natural sciences and its relevance is even contested. Nevertheless, some South African researchers bemoan the lack of credit for publishing in local African journals.[27] This is even truer of other African countries (Democratic Republic of Congo, for example).[28] As highlighted for Indonesia and as OA voices from the Global South (especially Brazil and Mexico) have shown, green OA can be successful without capitulating to corporate publishers or expecting authors to pay high APCs.[29] Although more recognition could be given to African researchers publishing in African journals, the potential threat of predatory journals to African research communities is relatively high.[20] Therefore, although African researchers (and other researchers from the least developed countries) need to publish locally, this should be done while maintaining quality—the same problem faced by much of the rest of the world. To compound the problem in the case of the earth sciences community in Africa, very few local journals focus on earth sciences, for example the

Journal of African Earth Science published by Elsevier with virtually unaffordable OA options for African researchers. These inequalities have led to inequities. Indeed, according to the DOAJ, approximately 71% of fully OA journals do not levy APCs but that seems to apply to only a few journals in earth sciences (*Geochemical Perspectives Letters* and *Volcanica*, for example). The bias inherent within the current APC-based OA publishing perpetuates the inequality through the Matthew effect, ultimately reinforcing the journal-coupled prestige economy that currently governs our global research systems.[16]

We are well aware that our study has some limitations: our analysis was limited to only one year (given the dynamic nature of the data, especially on APCs); that we considered only six countries (although they contributed 64%–70% of the articles and 69%–79% of the OA articles); and that we chose only two databases (although the most important ones). However, we do maintain that our findings offer some valuable insights.

Conclusion

Although being mindful of the major disparities described above, the most important thing is to conduct research and disseminate its findings as widely as possible. We therefore call for greater unification of the global earth sciences community to focus on non-profit and community-driven solutions for OA publishing and open science (the EarthArXiv, for example). Indeed, the migration of EarthArXiv to new infrastructure as a result of an emerging collaboration with California Digital Library is a good opportunity to further highlight the need for not-for-profit and community-driven infrastructure for preprint repositories. It is time to return the sovereignty of research in earth sciences to those who perform it and to those who need it—as reflected by the earth sciences community, it is essential to continue the ongoing discussion on the 'bibliodiversity' manifesto.

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Authorship contributions

OP prepared the manuscript with contributions from all co-authors.

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References

1 Fyfe A, Coate K, Curry S, Lawson S, Moxham N, Røstvik CM. Untangling academic publishing: a history of the relationship between commercial interests, academic prestige and the circulation of research. *Zenodo*. 2017; 10.5281/zenodo.546100.

2 Larivière V, Haustein S, Mongeon P. The oligopoly of academic publishers in the digital era. *Plos One*. 2015;10 (6):e0127502. doi:10.1371/journal.pone.0127502.

3 Tennant JP, Crane H, Crick T, Davila J, Enkhbayar A, Havemann J, Kramer B, Martin R, Masuzzo P, Nobes A. Ten hot topics around scholarly publishing. *Publications*. 2019:7:(2)34.

4 Pourret O, Hursthouse A, Irawan DE, Johannesson K, Liu H, Poujol M, Tartèse R, van Hullebusch ED, Wiche O. Open access publishing practice in geochemistry: overview of current state and look to the future. Heliyon. 2020;6 (3):e03551. doi:10.1016/j.heliyon.2020.e03551.

5 Johnson R, Watkinson A, Mabe M. *The STM report: an overview of scientific and scholarly publishing*, 5th ed. International Association of Scientific, Technical and Medical Publishers: The Hague, The Netherlands, 2018; p. 214.

6 Tennant J, Waldner F, Jacques D, Masuzzo P, Collister L, Hartgerink C. The academic, economic and societal impacts of open access: an evidence-based review. *F1000Research*. 2016;5: 632. doi:10.12688/f1000research.8460.3.

7 Pourret O, Irawan DE, Tennant JP, Wien C, Dorch BF. Comments on "Factors affecting global flow of scientific knowledge in environmental sciences" by Sonne et al. (2020). *Science of the Total Environment*. 2020;*721*:136454. doi:10.1016/j.scitotenv.2019.136454.

8 Hedding DW. Comments on "Factors affecting global flow of scientific knowledge in environmental sciences" by Sonne et al. (2020). *Science of the Total Environment*. 2020; *705* 135933. doi:10.1016/j.scitotenv.2019.135933.

9 Le Blanc D, Towards integration at last? The sustainable development goals as a network of targets. Sustainable Development. 2015;23 (3):176–187. doi:10.1002/sd.1582.

10 Okagbue HI, Teixeira da Silva J, Anake T. Exploring the relationship between journal indexing and article processing charges of journals published by MDPI, the Multidisciplinary Digital Publishing Institute. *European Science Editing*. 2020; 46: e54523. doi:10.3897/ese.2020.e54523.

11 Mallapaty S. China bans cash rewards for publishing papers. Nature. 2020;579 (7797): 18. doi:10.1038/d41586-020-00574-8.

12 Brembs B. Prestigious science journals struggle to reach even average reliability. *Frontiers in Human Neuroscience.* 2018;12: 37. doi:10.3389/fnhum.2018.00037.

13 Tollefson J. China declared world's largest producer of scientific articles. *Nature*. 2018;553 (7689):390. doi:10.1038/d41586-018-00927-4.

14 Tennant J. How can we achieve a fully open future? *SocArXiv* 2020. doi:10.31235/osf.io/9kjwp.

15 Paterson M. New publishing model pins hopes on 'unity of purpose'. 2020; https://www.universityworldnews.com/post.php?story=20200414133107475.

16 Pourret O, Irawan DE, Tennant JP, Hursthouse A, van Hullebusch ED. The growth of open access publishing in geochemistry. *Results in Geochemistry*. 2020;100001. doi:10.1016/j.ringeo.2020.100001.

17 Van Noorden R. Indonesia tops open-access publishing charts. *Nature*. 2019; doi:10.1038/d41586-019-01536-5.

18 Irawan DE, Priadi B, Muharlisiani LT, Onie S, Rusnalasari ZD. Indonesia publishes the most open-access journals in the world: what it means for local research. *The Conversation*. 2020; https://theconversation.com/indonesia-publishes-the-most-open-access-journals-in-the-world-what-it-means-for-local-research-147421.

19 Irawan DE, Abraham J, Zein RA, Gutam S. India's plan to pay journal subscription fees for all its citizen may end up making science harder to access. *The Conversation*. 2020; https://theconversation.com/indias-plan-to-pay-journal-subscription-fees-for-all-its-citizen-may-end-up-making-science-harder-to-access-147444.

20 Mouton J, Valentine A. The extent of South African authored articles in predatory journals. *South African Journal of Science.* 2017;113 (7/8): 1-9. doi:10.17159/sajs.2017/20170010.

21 Hedding DW. Payouts push professors towards predatory journals. *Nature*. 2019; 565 (7739): 267. doi:10.1038/d41586-019-00120-1.

22 McKiernan EC, Bourne PE, Brown CT, Buck S, Kenall A, Lin J, McDougall D, Nosek BA, Ram K, Soderberg CK, Spies JR, Thaney K, Updegrove A, Woo KH, Yarkoni T. How open science helps researchers succeed. *eLife*. 2016; 7 (5): e16800. doi:10.7554/eLife.16800.

23 Ross-Hellauer T, Fessl A, Klebel T. Open science: who is left behind? LSE Impact Blog. 2020. https://blogs.lse.ac.uk/impactofsocialsciences/2020/10/23/open-science-who-is-left-behind/.

24 Irawan DE, Abraham J, Multazam MT, Rachmi CN, Mulyaningsih I, Viridi S, Mukti RR, Djamal M, Puradimaja DJ. Era baru publikasi di Indonesia: status jurnal open access di Directory of Open Access Journal (DOAJ). *Berkala Ilmu Perpustakaan dan Informasi,* 2018;14:133–147 (in Bahasa Indonesia).

25 Breetzke GD, Hedding DW. The changing and challenging research landscape in South Africa. *Studies in Higher Education*. 2019; 45 (11): 2245-2259. doi:10.1080/03075079.2019.1602758.

26 Nordling L. How decolonization could reshape South African science. *Nature*. 2018;554:159–162. doi:10.1038/d41586-018-01696-w.

27 North MA, Hastie WW, Hoyer L. Out of Africa: the underrepresentation of African authors in high-impact geoscience literature. *Earth-Science Reviews*.2020; 103262. doi:10.1016/j.earscirev.2020.103262.

28 Sooryamoorthy R. The production of science in Africa: an analysis of publications in the science disciplines, 2000–2015. *Scientometrics*. 2018;115 (1):317–349. doi:10.1007/s11192-018-2675-0.

29 Scherlen A. Building bridges for social justice in global publishing: seeking the Mexican perspective. *The Serials Librarian*. 2020; 78 (1-4): 112-116. doi:10.1080/0361526X.2020.1731858.