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Open Access: what we can learn from articles published in geochemistry journals in 2018 and 2019

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Abstract

In this short communication, we look at Open Access (OA) practices in geochemistry based on articles published in 2018 and 2019 in a list of 56 journals and whether Article Processing Charge (APC) and Journal Impact Factor (JIF) drive publication or not. More than 40% of articles in 2018-2019 were published OA, and about 70% of them in fully OA journals with a mean APC of US$ 900 whereas the remaining were published in historical hybrid journals with higher APC of more than $US 1,800. A good correlation is observed between the number of OA articles published in hybrids journals and JIF whereas there is a positive relationship between the number of OA articles published in fully OA journals and APC. For OA articles published in hybrid journals (i.e. the majority of historical journals in geochemistry), it seems that the proportion of OA articles tends to increase in journals with higher JIF.

Keywords: Open Access; Open science; Article Processing Charge; Journal Impact Factor; Scholarly communication

1. Introduction

Throughout history, the scholarly community has increasingly made various cases for wider public access to published research, which in the early 2000s became known broadly as Open Access (OA). Over the last two decades, scholarly publishing has been undergoing a major and global transformation, with the move to system-wide OA marking a radical shift in the financial models of major publishers. This has opened up enormous diversity in publishing paths for authors, raising

further issues around publishing ethics. A key element of this transition is that virtually all stakeholders have recognised the importance of ensuring that researchers and their institutes should not have to pay even more to read articles than they already do [1], a total revenue across the English language Scientific, Technical and Medical publishing sectors estimated to be US$ 10 billion in 2017 [2].

As recently stated by Pourret et al. [3], OA too often gets conflated with just one way of achieving it: the author-facing business model of Article Processing Charges (APCs), whereby authors (or their institutions) pay a pre-specified fee to cover the cost of publishing. However, OA was already widespread many years before the advent of APCs, which became popular as OA became increasingly commercialised. When commercial publishers such as BioMed Central and PLOS demonstrated the feasibility of APC-based business models, the larger traditionally subscription-based publishing houses began to recognise OA more as a compliment, not a threat, to their business, and began to adopt it through 'transitional' hybrid journals. However, in their overview of OA practices in geochemistry, Pourret et al. [4] highlight some discrepancies with this seemingly dominant perspective. Critically, the majority of journals have self-archiving policies that allow authors to share their peer reviewed work via green OA routes and without charge (i.e., APC-free options). The journals with the highest APCs are typically those of the major commercial publishers, rather than journals from geochemical societies.

To our knowledge, no work has yet been reported on Article Processing Charge (APC) differences between fully-OA and hybrid journals (i.e., partial-OA) published by or for the geochemistry community. This work comes at an important time, as supra-national initiatives such as the mostly European funder-backed Plan S are seemingly showing a strong financial preference towards

APC-driven 'gold' OA models, while simultaneously seeming to neglect more equitable and financially sustainable 'green' and 'diamond' routes [5].

We present an overview of OA practices in geochemistry based on articles published in 2018 and 2019 and whether APC levels seem to correspond with authors OA publication preferences or not. We expect this analysis to be useful in helping the geochemistry community to make informed and sustainable choices in their future publishing activities, especially those elements of it which are publicly-funded and for which the geochemistry community has increasing responsibility.

2. Material and methods

The same method as described in Tennant and Lomax [6] for paleontology journals was used. The full dataset from Pourret et al. [4] was updated to include APC rates of open access articles and is available as Supplementary Information. Information for these APCs was sourced from Web of Science, Scopus and journals' web pages in January 2020.

3. Results and discussion

The first fully OA journal in Geochemistry was launched in 2000 (i.e. *Geochemical Transactions* [7]) and since then this number has regularly increased each year (Figure 1), with the last title launched in Autumn 2019 (i.e., *Results in Geochemistry*). Among the 56 considered here 15 journals are fully OA (i.e., publish 100% OA articles), 34 are hybrids (i.e., mixed) and 7 do not offer an OA option. In 2018, out of 9,326 articles, 3,765 (40.4%) were published as 'gold' OA, and in 2019, out of 9,196 articles, this proportion had increased slightly to 3,828 (41.6%). It must

be noted that these numbers are most likely an overestimation as we included the total number of articles for journals which have a Geochemistry section (e.g., journals like *Frontiers Earth Sciences*). Among these articles, 68.2% and 75.1% are published in fully OA journals, in 2018 and 2019, respectively. This overall proportion is comparable with 49% of the French 2018 annual research production being available as OA (including green OA, not considered in the present article; https://ministeresuprecherche.github.io/bso/) and 45% of the Danish annual research production being uploaded into universities' repositories (https://www.oaindikator.dk/en/) [3].

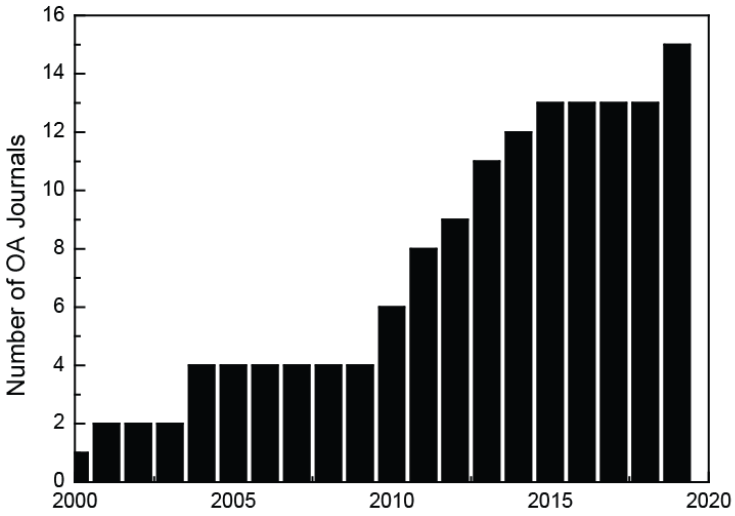

Figure 1 Evolution of the number of fully OA journals in geochemistry.

During the last two decades, journal publishing has significantly changed, with its dominance by learned societies being largely replaced by several big commercial publishers (*i.e., Elsevier, Springer Nature* and *Wiley*) [8, 9]. Major changes are now becoming more mainstream, including the increasingly widespread free access to articles [10], funded not by subscriptions but largely through APCs. While this was previously mostly done on a per-article basis, publishers have started offering 'transformative' agreements that tend to variably bundle subscriptions and

publication fees together at a much larger, often national, scale. This preference tends to increase the revenue-making capacity of the large commercial publishers, while simultaneously disadvantaging authors, institutes, and nations with relatively fewer financial privileges, as well as concentrating the publishing 'market' in the hands of a few players and at the expense of smaller or more innovative players [11]. In the context of the United Nations Sustainable Development Goals, more equitable alternatives are required for the communication of scholarship with wider society. This could include returning to earlier publishing models whereby research papers were not regarded or exploited as for-profit commodities, but instead as a public-serving good for the betterment of society [12].

Regardless of any potential waiver or discount systems in place (including through negotiations between universities and publishers), the total APC paid by the geochemistry community is estimated at US$ 7,029,260 in 2018 and US$ 6,944,140 in 2019. This is based on a mean value per article of US$ 1,867 in 2018 and US$ 1,814 in 2019 for the 49 journals selected (with a minimum of US$ 0 and a maximum of US$ 4,000). For fully OA journals, the total APC is estimated at US$ 3,308,500 (i.e., 47% of the estimated total) in 2018 and US$ 3,904,880 (i.e., 56% of the estimated total) in 2019. This is based on a mean value per article of US$ 879 in 2018 and US$ 1,025 in 2019 (with a minimum of US$ 0 and a maximum of US$ 2,490). Here, it must be noted that publishing in a fully OA journal is substantially cheaper than publishing in a hybrid journal, on average around half the cost for an equivalent output. In this context, *Results in Geochemistry* has proposed an APC of US$ 900. Such an APC is still high when compared with US$ 400 estimated by Grossmann and Brembs [13] for the true costs of article production, and there are cases where the production costs are 2 orders of magnitude even lower than this [14].

At the moment, it remains eminently unclear why such vast differences appear, and what such an excess of money is being spent on, which represents billions of dollars of taxpayer money being spent each year. Pourret [12] recently asked what is the surplus money being used for? Is it used for real for-profit or redistribution within research communities (fee waivers for low-income countries, conference sponsorship, and student grants when journal associated with learned societies…)? In addition, according to the Directory of Open Access Journals (DOAJ; https://doaj.org/), around 71% of fully OA journals do not levy APCs; which is proportionally much higher than the case for the Geochemistry sector (i.e., 4/15, ca. 27%). However, perhaps counter-intuitively, most articles published OA are published in journals with APCs (e.g., for the geochemistry journals considered in our study 96% in 2018 and 95% in 2019) as already highlighted by Crawford [15]. The highest APCs are typically those leveraged by the large commercial publishers (see Pourret et al. [4] for details relevant to geochemistry), which extract profit margins in excess of 20-30% annually.

As illustrated in Figure 2a, there is a strong positive relationship (Pearson's r=0.42226) between the number of OA articles published in hybrids journals and Journal Impact Factor (JIF) whereas none exists for fully OA journals (Pearson's r=-0.19917). Conversely (Figure 2b), there is a positive relationship (Pearson's r=0.34942) between the number of OA articles published in fully OA journals and the APC whilst smaller for hybrid journals (Pearson's r=0.13932).

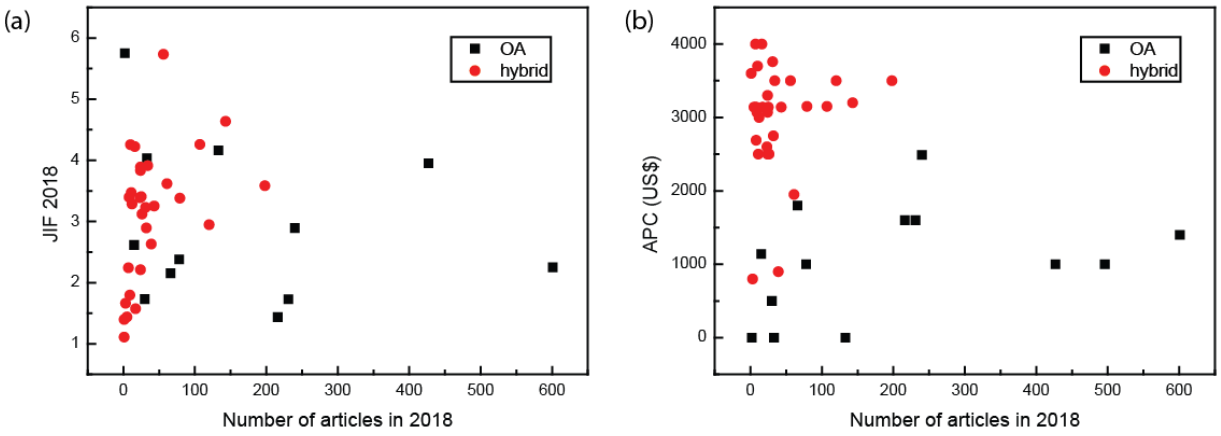

Figure 2 Number of Gold OA articles in 2018 as a function of (a) JIF 2018 and (b) APC (US$).

If we look further at the details, OA articles published in hybrid journals (i.e. the majority of historical journals in geochemistry), it seems that the proportion of OA articles tends to increase in journals with higher JIF (Figure 3a; Pearson's r=0.4136). A similar relationship is less apparent with APCs (Figure 3b; Pearson's r=0.3356).

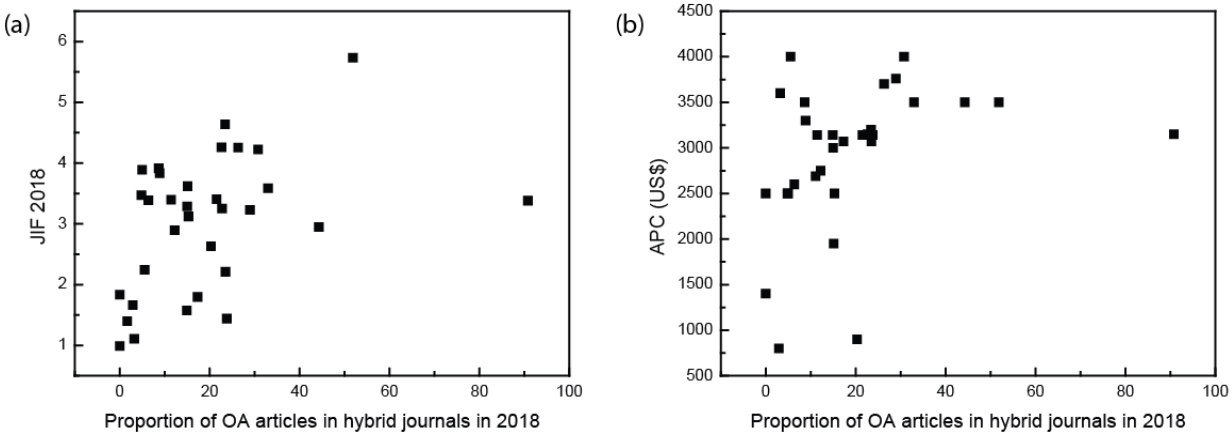

Figure 3 Proportion of Gold OA articles in hybrid journals in 2018 as a function of (a) JIF and (b) APC (US$).

In this OA transitional phase, publishing becomes more difficult when an APC-based system is imposed upon authors indiscriminately (i.e. via mandates or policies) and without appropriate and commensurate financial support. Thus, the APC-driven elements of OA can restrain journal choice for those individuals who want to or have to publish OA, but have restricted funding, if this is considered to be the only potential pathway to achieving OA and conforming to relevant OA policies. This comes in addition to existing constraints often imposed upon researchers through publication-based evaluation systems. Consequently, the only option for some researchers for having their research specifically published in a high impact journal, without paying APC, is to place their paper behind a subscription paywall. To make it worse, those researchers commonly don't have enough knowledge about copyrights, copyrights transfer agreement, and how to make their non-OA works publicly accessible legally.

This APC-dominated philosophy has created a complex system and hierarchy of financial privilege around OA [3]. In this scheme, a first group of researchers can afford to publish in OA journals, and especially those which charge high JIF that charge high APCs. A second group which does not benefit from such financial security, undergoes a forced restriction in choice imposed by their inability to afford APCs. Eventually, a third group can be considered, researchers that do not mind making their work OA stating that it is not their "job" (https://ministeresuprecherche.github.io/bso/). Future research should investigate the impact that constraints around APCs have had on publication choices for researchers from different demographics, and the potential impact this can have on the visibility and re-use of geochemistry research. Given that we know OA leads to increased success and 'impact' for researchers [16], the present way in which OA discriminates based on existing privilege only perpetuates this through

the 'Matthew Effect', ultimately reinforcing the journal-coupled prestige economy that currently governs so much of our global research systems.

As illustrated in Figure 4, Gold OA is mostly funded by institutions through 'Read and Publish' agreements or funding agencies, and in some cases researchers themselves. The non-OA and Green routes are typically only funded by institutions and funding agencies. If we are within an institution that can afford to pay both APC and journal subscriptions, it does not seem to be a big issue; but for other institutions (with lower budgets) and for individuals, it is.

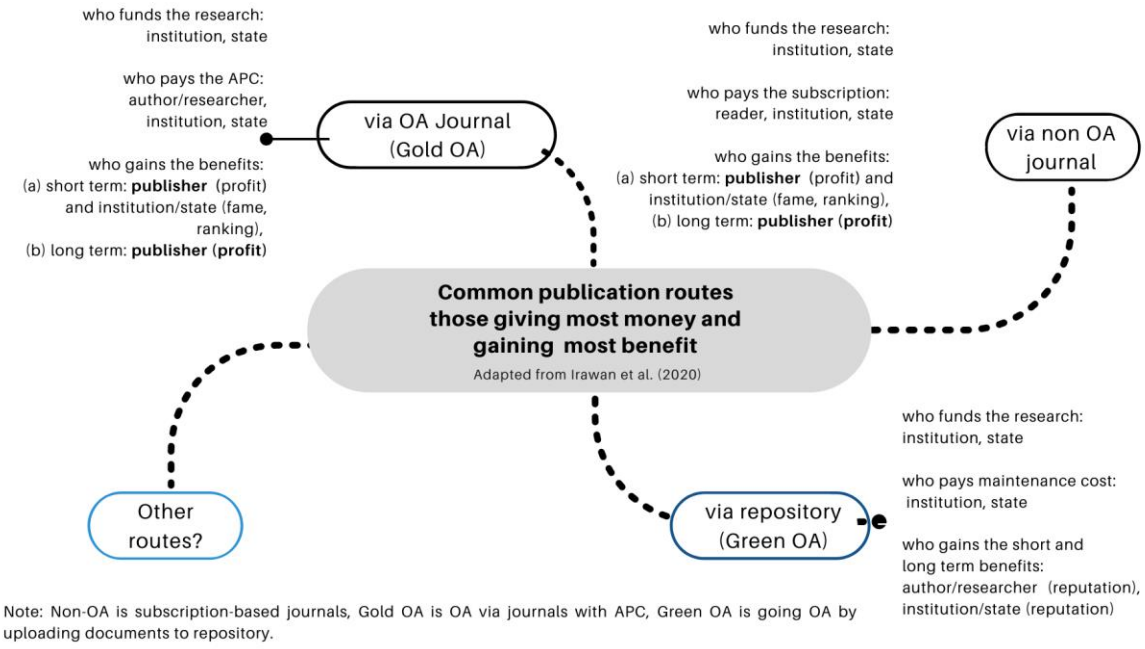

Figure 4 The academic publication route: a schematic representation of OA decision steps highlighting financial burden and benefit/reward for different stakeholders (adapted from Irawan et al. [17]).

To help resolve this inequity, there is a clear role for self-archiving of peer reviewed and accepted manuscripts (*i.e.*, postprints), the green way, in parallel to traditional journal publication. The green OA route is cost-free for authors, and in terms of time usually is only a matter of minutes to share articles online [18]. Often, it seems that awareness and understanding of green OA are the biggest barriers to more frequently engage with this practice. To pursue green OA, numerous stable, long-term platforms are available such as institutional repositories and collaborative tools such as EarthArXiv (https://eartharxiv.org/) for preprints. The latter is unfortunately still not well known and thus not often used in geochemistry [4, 19], and its future sustainability remains uncertain. Evidently, the current APC model imposed by many geochemistry journals can have deleterious effects on researchers who have no funding especially from lower income countries who are tempted to publish in predatory journals that proposed lower APC [20].

Overall, journals need to clearly clarify their preprint/peer review policy [21], the datasets needs to be clearly FAIR as Wilkinson et al. [22] proposed. It is evident that FAIR data is already in action in the Earth Sciences community [23] and Geochemistry community [24], but further engagement is required to make sure that this is being done as effectively as possible.

Eventually, as highlighted by Mellor et al. [25] it results in "*Conflict between Open Access and Open Science" and "APCs are a key part of the problem, preprints are a key part of the solution*". We need to engage for open science, open source, OA is part of it, starting by preprint and FAIR data availability.

CRediT authorship contribution statement

Olivier Pourret: Conceptualization, Data Curation, Formal Analysis, Visualization, Writing Original draft, Writing - review & editing. Dasapta Erwin Irawan: Data Curation, Visualization, Writing - review & editing. Jonathan P. Tennant: Writing Original draft, Writing - review & editing. Andrew Hursthouse, Eric D. van Hullebusch: Writing - review & editing.

Declaration of competing interest

No potential conflicts of interest are reported by the authors.

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