

1 **Open Access publishing practice in Geochemistry: current state and**
2 **look to the future**

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24 **Abstract**

25 Open Access (OA) describes the free, unrestricted access to and re-use of research articles.
26 Recently, a new wave of interest, debate, and practice surrounding OA publishing has emerged. In
27 this paper, we provide a simple overview of the trends in OA practice in the broad field of
28 geochemistry. Characteristics of the approach such as whether or not an article processing charge
29 (APC) exists, what embargo periods or restrictions on self-archiving' policies are in place, and
30 whether or not the sharing of preprints is permitted are described. The majority of journals have
31 self-archiving policies that allow authors to share their peer reviewed work via green OA without
32 charge. The journals with the highest APC are typically those of the major commercial publishers,
33 rather than the geochemistry community themselves. Until the geochemistry community makes
34 the decision to move away from journal-based evaluation criteria, it is likely that such high costs
35 will continue to impose financial inequities upon research community. However, geochemists
36 could more widely choose legal self-archiving as an equitable and sustainable way to progress
37 communication of their research.

38

39 **Introduction**

40

41 The majority of published scientific papers are behind paywall, rendering them inaccessible to the
42 majority of the public (Tennant *et al.*, 2019). Since the end of the 1980s, members of the scholarly
43 community have been making various cases for wider public accessibility to published research,
44 referred to as Open Access (OA) (Suber, 2009). Scientific publishing is currently undergoing a
45 major transition (Lajtha, 2019; Watts *et al.*, 2019), with the change to OA representing a significant
46 shift in the financial models of major publishers, opening up diversity in publishing routes and

47 raising the issue of publishing ethics. It is critically important to ensure that scientists and their
48 institutions do not have to pay more to read and publish papers than they do currently.

49 As with all other scientific disciplines, there is a strong imperative for the geochemistry community
50 to ensure that the research it produces is widely accessible (Sparks, 2013; Chopin, 2018).
51 Geochemistry as a discipline includes the study of the chemical composition of the Earth and other
52 Solar System objects, and the geochemical processes that affect them (White, 2018; Holland and
53 Turekian, 2013). Geochemical concepts and/or principles underlie many Earth and environmental
54 processes, notably those relevant to human interaction with our planet from resource exploitation
55 to public health. Since such themes have important societal implications, it is even more crucial to
56 ensure widespread accessibility.

57 Open Access practices are increasing at a systemic level (Tennant *et al.*, 2019). The movement
58 around Plan S, a funder-led initiative launched in September 2018, aims to accelerate the full
59 transition towards OA. These initiatives have opened up discussions about the ability of journals
60 and research communities to appropriately and sustainably shift towards a dominantly OA model
61 (Lajhta, 2019). Geochemistry, like other scientific disciplines, now has a range of publishing
62 options available to authors operated by a range of universities, commercial publishers, and
63 societies, forming a complex publishing landscape (Tennant *et al.*, 2019).

64 As part of this transition, it is even more an imperative that individual research communities have
65 got a better understanding of the academic publishing landscape, and the options available to
66 researchers. Many of the professional societies active in this aspect are currently evaluating their
67 publishing strategies and models, and some are considering an increased role for OA publication
68 in their journals. Here we provide an overview and analysis of the current OA practices in
69 “geochemistry” journals. This evaluation is an intention to support further debate, raise awareness

70 and support decision making processes for the future development of the geochemistry community
71 (Chopin, 2018).

72

73 **Methods**

74

75 We constructed a list of 56 journals in which geochemistry research is regularly published based
76 on the Scopus, Web of Science, Scimago and Sherpa/RoMEO databases. This list only includes
77 discipline-specific journals (where the word ‘geochemistry’ appears in the aims and scope of the
78 journal). Interdisciplinary “mega-journals”, interdisciplinary environmental journals and regional
79 journals were excluded, acknowledging the publication of geochemically focused studies in these
80 journals. The full dataset is provided in Supplementary Information. These methods appear to be
81 an adaptation of Tennant and Lomax (2019). Data included:

82 Journal name;

83 Year of first publication;

84 Journal policy on:

85 - sharing of preprints (version of a research paper typically shared prior to peer review
86 and publication in a journal);

87 - sharing of postprints (version of a research paper subsequent to peer review and, thus,
88 acceptance, but before any type-setting or copy-editing by the publisher);

89 - presence or absence of an embargo period;

90 - sharing of the publisher version (known as VOR, Version of Record of scholarly
91 research paper, after undergoing formatting by the publisher);

92 - option for gold OA exists (*i.e.* instant availability at the point of journal publication;
93 including hybrid OA);
94 Article processing charge (APC) for the gold OA option (zero denotes diamond OA);
95 Sherpa/RoMEO (<http://www.sherpa.ac.uk/romeoinfo.html>) colour status;
96 Journal impact factor in 2018;
97 Name of publisher.

98 It should be noted that Sherpa/RoMEO colour status is not related to the OA type (*i.e.* gold,
99 green...). For APC data, an average number of ten printed pages was considered for publishers
100 that use a page-based fee. Prices were converted to US\$ when necessary.

101

102 **Results and discussion**

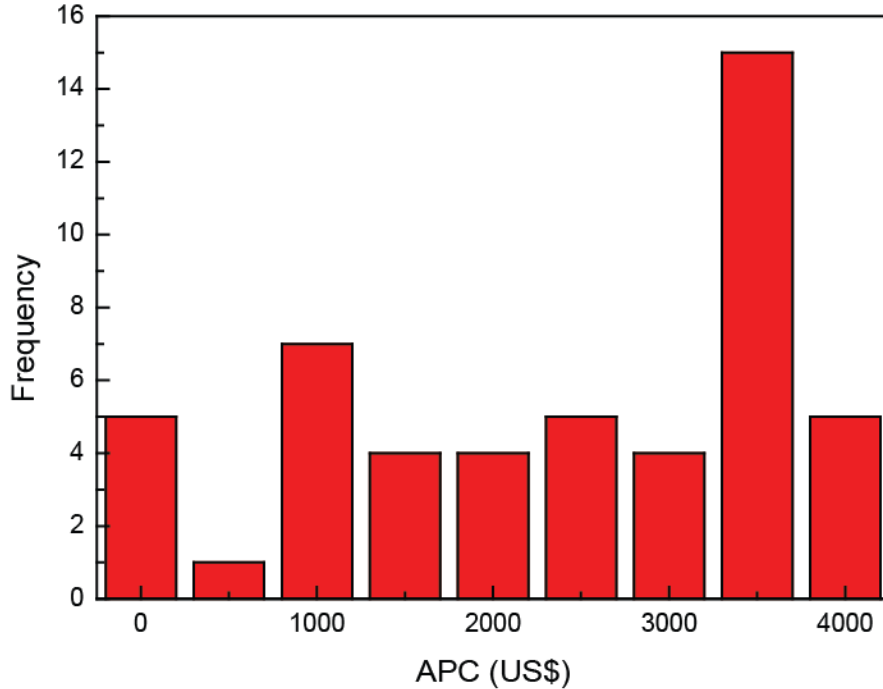
103 Historically, geochemists have published much of their work in journals edited by geochemistry-
104 related professional societies (Holland and Turekian, 2013). The first issue of *Geochimica et*
105 *Cosmochimica Acta* appeared in 1950. The *Geochemical Society* (GS) was founded in 1955 and
106 adopted *Geochimica et Cosmochimica Acta* as its official publication in 1957. The *International*
107 *Association of Geochemistry and Cosmochemistry* (IAGC) was founded in 1966, and its journal,
108 *Applied Geochemistry*, began publication in 1986. *Society for Environmental Geochemistry and*
109 *Health* was established in 1971 and *Environmental Geochemistry and Health* became the official
110 journal in 1981. *Chemical Geology* became the journal of the *European Association of*
111 *Geochemistry* (EAG), which was founded in 1995. Geochemistry has become a major force in the
112 *Geological Society of America* and in the *American Geophysical Union* (AGU) with titles like
113 *Geochemistry*, *Geophysics*, *Geosystems*. The titles listed above were originally owned by
114 professional societies that used to work with small editing companies. Most of these small

115 companies were then progressively acquired by major publishing companies (*e.g.*, *Geochimica et*
116 *Cosmochimica Acta* was historically published by Pergamon, but was purchased by Elsevier in
117 1991). In the meanwhile, European Geosciences Union (EGU) use the OA business model with
118 Copernicus but none of these titles focus on geochemistry exclusively until 2019.

119 The journals analyzed here mostly have a gold OA policy (49/56; 88%). In the case of
120 geochemistry this generally translates to an “author pays” model (45/49; 92%) (Lajtha, 2019).
121 Indeed, only five of the journals included in the database do not have APC. These journals
122 comprise two community-led initiatives from within professional societies (EAG and EGU), a
123 journal published by a university (Sapienza Università di Roma) and a journal published by
124 Elsevier and funded by China University of Geosciences (Beijing) and Peking University.

125 In the list of journals where OA is available, 45 apply an APC and 7 journals do not have a gold
126 OA option. The APCs range from 4,000 US\$ for journals such as *ACS Earth and Space Chemistry*
127 or *Elements* (owned by the American Chemical Society and jointly published by 17 participating
128 societies, including the *EAG* and the *GS*) to less than 1,000 US\$ for EGU journals published by
129 Copernicus (Fig 1). Amongst journals that charge APC, most of them charge between 2,500 US\$
130 and 4,000 US\$ per article (28) (Fig. 1), dominated by major commercial publishers, (Elsevier,
131 Springer Nature, and Wiley). The general state of the scholarly publishing industry can be
132 described as an oligopoly, with a few major actors dominating the scene (Larivière *et al.*, 2015).
133 Elsevier and Springer Nature publish the highest number of geochemistry journals (13 and 12,
134 respectively), followed by Wiley (5). Together, this represents around 55% of the total number of
135 geochemistry journals. The next largest publishers in terms of number of journals are the EAG (3
136 if *Elements* is included, which is jointly published by 17 societies) and Copernicus (4), followed

137 by Cambridge University Press (2), Schweizerbart (2), MDPI (2), Hindawi (2), and ten other
138 publishers (1 each).

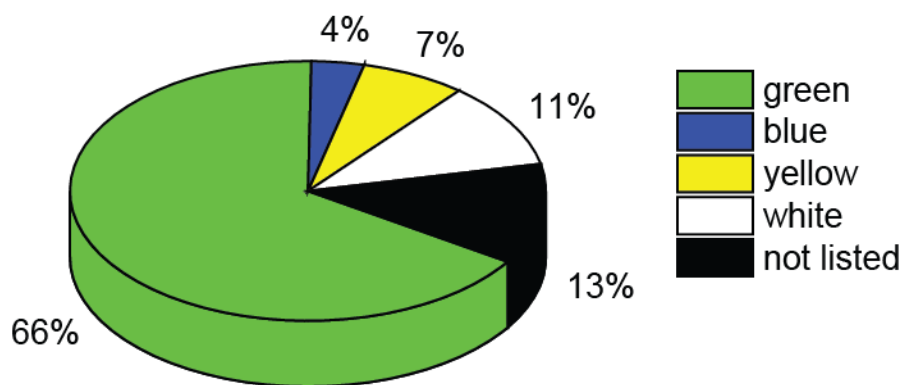


139
140 **Figure 1** APC distribution for all journals that have a gold OA option.

141
142 The majority (84%) of journals in our database allow authors to share preprints of their articles
143 (47/56). Only 4 journals do not allow sharing article preprints (8%), all of which being professional
144 society-based journals. Five journals do not have an explicit preprint policy (6%). For postprints,
145 the situation is broadly similar. Forty-seven journals allow authors to share postprints (84%), and
146 only 4 explicitly prohibit postprint sharing (8%). Five journals do not have a clear postprint sharing
147 policy (8%). The 4 journals that prohibit sharing of postprints are the same that prohibit sharing of
148 preprints. Journals from the large commercial publishers (Elsevier, Springer Nature, Wiley) and
149 from most professional societies allow sharing of postprints. Earth scientists, including
150 geochemists, are in the top group to pursue green road to OA (Bjork et al., 2004). MDPI, which is

151 a purely OA publisher, publishes a few journals in Earth Sciences but does not have dedicated
 152 geochemical titles, although *Geosciences* has a Geochemistry section. Hindawi, another purely
 153 OA publisher, manages *Geofluids* and a geochemistry section in *Journal of Chemistry* (after
 154 withdrawing the *Journal of Geochemistry*). The AGU publishes several newly-established journals
 155 in OA and promotes the green road to OA in the geochemistry field via a number of well-
 156 established journals (*e.g.*, *Geochemistry*, *Geophysics*, *Geosystems*, *Journal of Geophysical*
 157 *Research-Solid Earth*). Authors in AGU subscription-based journals are granted general
 158 permission to deposit the final published citable VOR of the article six months after official
 159 publication (Van der Hilst and Hanson, 2013). Springer's portfolio of OA journals, Springer Open,
 160 also includes a number of geochemistry titles (including *Aquatic Geochemistry*, *Biogeochemistry*
 161 and *Environmental Geochemistry and Health*). The first transitions from subscription-based to
 162 full-OA journals have already taken place. In the 2000s, *Geochemical Transactions* moved toward
 163 full OA (Schoonen *et al.*, 2006). In 2012, the EAG released its new title *Geochemical Perspectives*,
 164 which was followed in 2015 by *Geochemical Perspectives Letters*. Finally, Elsevier launched its
 165 title *Results in Geochemistry* in the autumn of 2019.

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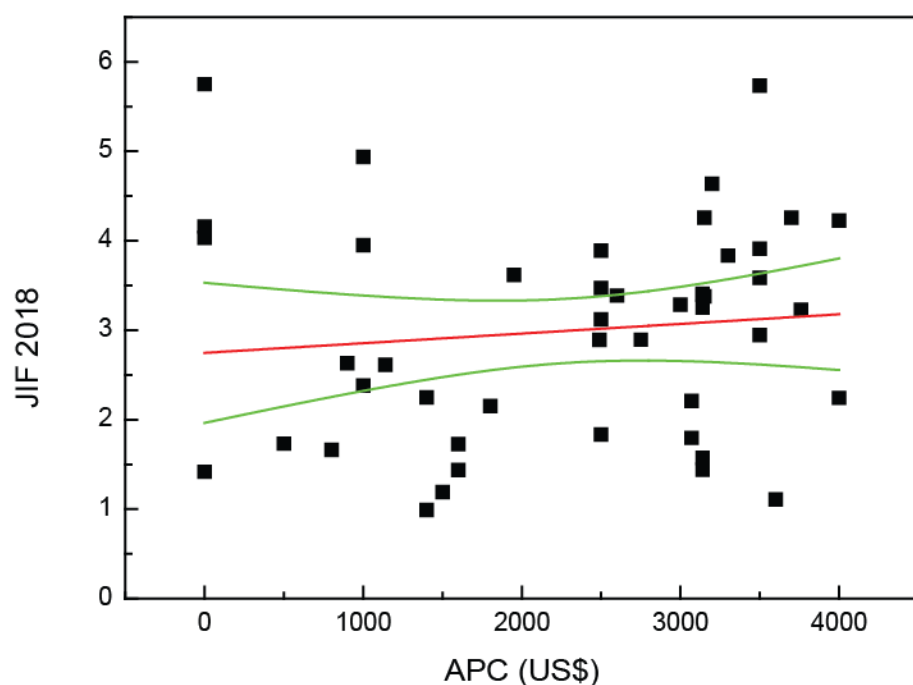


167

168 **Figure 2** SHERPA/RoMEO colours. Green indicates that preprints and postprints can be archived,
169 blue that postprints can be archived, yellow that preprints can be archived, and white that archiving
170 is not formally supported.

171
172 Overall, 49/56 journals (88%) have an entry in SHERPA/RoMEO, among which 37 are “green”,
173 2 “blue”, 4 “yellow”, 6 “white” (Fig. 2).

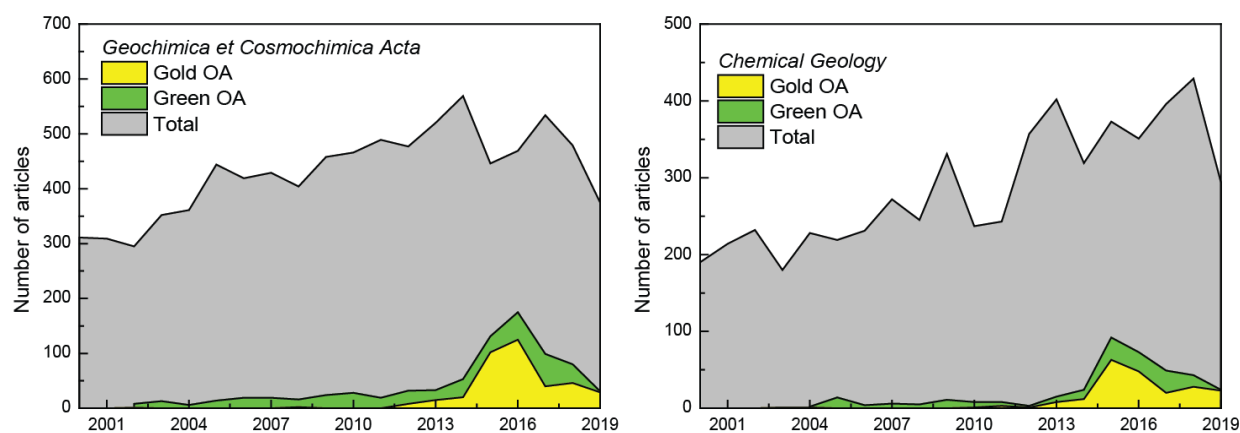
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176 **Figure 3** JIF as a function of APC (Pearson’s $r=0.1079$; red line corresponds to the linear fit,
177 whereas green lines correspond to the 95% intervals.

178
179 Most geochemistry journals have a journal impact factor (JIF) between 2 and 5 (Fig. 3). Outliers
180 to this range include monographs (*Geochemical Perspectives*), book series (*Reviews in Mineralogy*
181 & *Geochemistry*), as well as review journals (*Elements*), which tend to inherently accrue more

182 citations and are often considered to be of higher impact. The relationship between JIF and APCs
 183 does not show any evident correlation (Fig. 3). Only three journals with a JIF above 4 do not charge
 184 an APC, *Geochemical Perspective*, *Geochemical Perspective Letters*, and *Geosciences Frontiers*.
 185



186
 187 **Figure 4** Evolution of OA distribution for articles published between 2000 and 2019* in (a)
 188 *Geochimica et Cosmochimica Acta* and (b) *Chemical Geology* (data accessed July 2019 from
 189 Scopus for gold OA and total, and @unpaywall for green OA). *year 2019 is incomplete.

190
 191 In 2018, among top hybrid and historical journals with APC, only 9% of *Chemical Geology* and
 192 14% of *Geochimica et Cosmochimica Acta* papers, respectively, were available as gold OA. The
 193 distribution of articles published in *Geochimica et Cosmochimica Acta* show that their country of
 194 origin are 56% from the USA, 11% from Germany, 10% from France, and 10% from the UK. Gold
 195 OA articles originate 66% from the USA, 37% from the UK, and 16% from France. In comparison,
 196 33% of the articles published in *Chemical Geology* originate from the USA, 16% from France, and
 197 14% from Germany. For gold OA articles published in *Chemical Geology*, 57% originate from the
 198 USA, 27% from the UK, and 20% from Germany. Green OA is mostly available on dedicated

199 repositories such as *HAL* (*i.e.* French repository <https://hal.archives-ouvertes.fr>) where 42% of
200 green OA articles for *Geochimica et Cosmochimica Acta* and 23% of green OA articles for
201 *Chemical Geology* are archived. Gold OA publishing peaked in 2015 and 2016 for *Geochimica et*
202 *Cosmochimica Acta* (23% and 27%, respectively) and for *Chemical Geology* (17% and 14%,
203 respectively). Similarly, green OA publishing peaked between 2015 and 2017 in *Geochimica and*
204 *Cosmochimica Acta* (7%, 11%, and 11%, respectively) and *Chemical Geology* (8%, 7%, and 7%,
205 respectively) (Fig. 4).

206 As scientific publishing continues to transition from the traditional pay-walled model to OA, it is
207 likely that increasingly individual researchers will face difficulties addressing the APC system,
208 regardless of any potential waiver or discount systems in place. Thus, the APC-driven elements of
209 OA generally restrains journal choice available for those individuals who want to, or have to,
210 publish OA articles, but have restricted funding. In many cases, one of the only options is to publish
211 their research in a high impact journal without paying the APC and place their paper behind a
212 paywall. Overall, the APC-dominated philosophy has created a complex system around OA. This
213 scheme seems to broadly the research community into two groups of those that can afford to
214 publish in OA journals, and especially in those that charge high APC, and those that do not benefit
215 from such financial resource and are forced to publish behind the paywall. It would be interesting
216 for future research to investigate the impact that APC-related constraints have had on publication
217 choices for researchers, and the potential impact this can have on the visibility and re-use of
218 geochemical research.

219 Eventually, there is a clear role for self-archiving of peer reviewed accepted manuscripts
220 (postprint), the green way, in parallel to traditional journal publication. Indeed in some countries
221 the policy of making research available to the wider public (the tax payer, ultimately funding the

222 research) has essentially established institutional archives to do this. The Green OA approach is
223 cost-free for authors and to pursue green OA, numerous platforms are available such as
224 institutional repositories and collaborative tools (*e.g.*, EarthArXiv <https://eartharxiv.org/>; Earth
225 and Space Sciences Open Archive, <https://essoar.org/>) for preprints. Preprint model is
226 unfortunately still confidential in geochemistry. Another area of concern is that the current APC
227 model has an additional restriction on research from developing countries, where the fees for OA
228 are beyond reach, driving to lower or no cost options of the “predatory journals” (Beall, 2012).
229 The proliferation in opportunities to publish scientific research as OA articles in these journals
230 where lack of support from scientific societies and un-validated review processes and “for profit”
231 approach with little apparent consideration of what is published. This questions the long term
232 future of peer review and the ethics of publishing. We acknowledge that there is a good level of
233 debate on this topic between professional and learned societies and academic publishers. We
234 encourage the geochemical community to be active and engage in the debate and actions,
235 prioritizing clear, transparent and robust peer review and visibility of our work.

236

237 **Concluding remarks**

238

239 In the context of the rapid evolution of scientific publishing models, it seems necessary to draw
240 attention to the situation of hybrid journals, which include the majority of traditional historical
241 journals in geochemistry. Plan S (<https://www.coalition-s.org>, among others) recommends
242 supporting fully open access publications and, therefore, excludes hybrid journals. It formally
243 discourages researchers and institutions from having to pay additional fees in a subscription-based
244 journal and asks us not to support a model that introduces “double-dipping”. It is indeed possible

245 to publish in a hybrid journal without paying APC and to disseminate its manuscript in open
246 archives on a repository. On the website of the journal, the article will be accessible only to
247 subscribers, and it will be accessible to all on the open archive (the green way).

248

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