

Dear referee,

Many thanks for the time you have taken reading and commenting on this submission. Both reviews we have received are incredibly constructive and informative and we deeply appreciate the effort that has been put into them. We generally agree with the feedback and suggestions made in both reviews. We do feel that some of the suggestions are out of scope for this manuscript and its intended audience (people with no background to decolonising and similar concepts who are from a discipline heavily divorced from its human and social impact). This manuscript is designed as an introductory piece, and we understand that it often skirts around some complex arguments and concepts – and may feel lacking in depth to those who are familiar with the topics and concepts covered. Several of the suggestions made are things some of the authors (and other groups in the geosciences) are working towards and that we hope will be outputs in their own right. Reading these reviews has been hugely interesting and insightful, again we extend our thanks to the reviewers, hopefully our paths may cross again as we work towards a more inclusive, accessible and decolonised geology! In order to make our response more focused we have provided comment (in red) directly to each point:

My perspective on this ms is informed by my training in human geography, and most recently by my extensive work to write about decolonizing geography, including on physical geography. In this respect, I read the ms as an interested academic in a cognate discipline who has extensive knowledge of the decolonising debates generally.

Overall, the paper raises many important points about the presence of colonial legacies in geology's teaching, interpretive frameworks, and its canonisation of particular (western-endorsed) forms of knowledge. The ms is written in an accessible style in order to create a broad conversation, and without assuming any prior knowledge of decolonial issues. My main response is positive, although the ms could, I suggest, do more to draw out specific dimensions of the discipline's "colonial present" in more detail, as the discussion was at points rather general.

Colonial present was something we discussed in detail whilst putting the ms together. We did begin to write up a section focusing on it and it was quickly apparent that it would be a very significant section (a manuscript in its own right). It was felt that a large section on the colonial present in this ms may disengage the very individuals who we want to reach (decolonisation is uncomfortable and we need the discipline to understand that before those feelings create disengagement). There is current work being undertaken to look in more detail at the disciplines colonial past/collecting Indigenous geologies/outlining the colonial present (for example, several of the authors of this are part of a project that has received some funding for a project looking closer at the colonial present of the discipline).

p.1 "early modern" - be careful with this label which generally refers to the period 1492 to around 1700; so this ms's focus on the post-1700 period could more usefully be labelled as such. On the same page, "our civilization" is for many people a loaded term, both because it assumes a common heritage and the term has such strong associations with western societies. Perhaps "diverse world societies" would work?

Actioned – really interesting point about labeling of time periods (something geologists love doing!)

p.2, line 46: exploitation of mineral resources was undertaken by Spanish and Portuguese state-led colonisation and colonialism, from the early 16th century. line 50: these forms of knowledge may not have been 'academic' in the sense today, but they did establish a mindset that Europeans had the right to identify, extract and trade minerals, which were the foundations at a deeper level for later 'academic' study. Line 56: North European Empires (versus earlier southern European empires, including Spain and Portugal) - clarification required here. And it would be useful to explain to non-specialist readers what is meant here by "dominance of knowledge production" - what is described here is epistemology [note spelling; incorrectly spelled at end of ms] which then informs pedagogy (students tend to be inducted into the dominant epistemology, through a particular mode of teaching and learning ie pedagogy). Decolonising the curriculum entails questioning and reforming both epistemology (the interpretive frameworks, and domains of what is considered important knowledge) and pedagogy.

Can clarify on Empires. We avoided the use of non-specialist terminology as much as possible but we agree this would be a good place to expand on epistemology (and point the reader to the glossary), will also add pedagogy to the glossary.

p.3 line 69: provide a page number for Peake and Kobayashi. lines 73-75: in decolonising debates today, the emphasis has been on the colonial geopolitics (ie which world powers, which world scientific networks and associations) of knowledge production as a whole. It is this pattern of power and domination that then shapes which types of knowledge are deemed valuable enough to 'extract' or destroy. So I wondered if more could be said here about the norms, 'standards' (established in geology) and control of journals, and who decides what is valuable 'new' knowledge. Yes, journals as an example would be a useful addition here – and an example the target audience will be familiar with. Line 81: students 'learn' or 'engage with' (the term 'undertakes' is awkward). In this paragraph, the crucial point is that the curriculum is endorsed as the knowledge most worth passing on - if there is a very common set of truths found across all geology courses, then that can be termed the 'canon'. Deciding what goes in/stays out of the canon relates back to the power dynamics mentioned above. Could the ms give an example or two of geology's canon? Examples of what isn't canon might be easier? Social Justice - Ethics - human facing content - is often missing as it is dismissed as being outside of the discipline? Line 93: decolonising the curriculum is not solely concerned with repositioning theory then, but also crucially the content and - key, although underexamined in the ms currently - the interpretive frameworks used to explain and understand the content. Not too sure many geologists would be aware of interpretive frameworks, but I think a sentence around theory, content and pedagogy would be useful.

p.4 line 100 the phrase "acknowledge colonial debts to knowledge creation" is awkward - arguably, it is a question of colonial legacies in knowledge creation. Actioned

p.5 line 140 One aspect requiring some more discussion is the unacknowledged influence of particular types of geologists relative to others in setting norms and criteria for excellence in a discipline - so it is a mindset and an awareness of the issues that need to change. The ms in this respect could perhaps delve more into the reasons why STEM subjects present their knowledge as 'neutral' and unaffected by social relations (again it's not a question of individuals but of society-wide 'commonsense'). This is important as decolonizing is not about just adding in Indigenous peoples and stirring; not least as the dividing line between Indigenous and STEM knowledges are context specific, blurred, contested and very difficult to fix. **Good point, we can add some discussion around this.** Lines 150-55: it would be very useful here to give an extended example to illustrate how an interpretation could be repositioned in a decolonising way - eg. from a first year undergraduate lecture, or topic that everyone learns in university; this would offer a specific set of resources as well as a sustained argument about how to decolonise [the paper does end with a list of recommendations, but these are not particularly engaged with the specifics of geology, which is what readers will presumably want to find here.] Since this page contains a considerable amount of repetition, a specific example would move the paper along strongly here. **There are plans for a much more detailed output that introduces exactly this, by introducing this as a separate output we would hope to be able to provide a much greater/detailed set of resources/case studies/methods/ideas.**

p.6 'colonised geology' : this subsection could usefully start with a line or two about the purpose of the historic overview - is this not taught in geology courses? **If it is taught on courses, it is rare! Certainly, in the UK – History of Geology modules are aligned to Earth (geological) history, rather than the history and origin of the subject itself.** Also, the discussion is very Anglo focused, and underplays the global nature of geology's history. I recommend looking at J A Secord 2018 chapter 'Global geology and the tectonics of empire', in Curry et al (eds) Worlds of Natural History. And A Bobbette and A Donovan (eds.) 2020 Political Geology. Springer. And Nicola Miller 2020 Chapter 7: Land and Territory, in her book Republics of Knowledge, Princeton University Press. These give a more international sense of how colonialism and geological knowledges interacted, drawing out German, Spanish and other trajectories. **Many thanks for these suggestions, we can work them in. Though Anglo focused is important as it seems to be predominantly Anglo activity that bought about the current canon (with other European nations working within this Anglo “framework”/set of knowledge).**

pp.6-7: this account tends to reinforce the idea that white European men are the problem (with a few notable exceptions); rather than this, how about talking about the type of exploration, the systems of validation, and institutional standards and circuits of knowledge production, by which core chronologies, typologies, international systems for verification etc etc were set up and - likely - continue to have a resounding influence today. In other words, structures not people. **This is an interesting point. We can certainly look to include more emphasis on the systems and procedures inherent in the past and present discipline. We do think**

that focusing on the human element is important in this manuscript, some geologists struggle to see the human impact of the discipline and of their own actions, showing the human element behind the structures created which persist into the present subject is important (discussions around core chronologies, typologies, circuits of knowledge production and systems of validation are likely to be out of place for the target audience?)

p.8 line 230: what are the global norms at play today? Could this discussion be more specific? Again, it's not just a question of random Indigenous peoples currently outside western institutions; decolonising implies a mindset in which a variety of knowledges - from farmers, women, Black, non-dominant religious groups etc etc - could pluralise and diversify what geology means. Another way to come at this question is to ask what is it that seems to make Indigenous knowledges so incompatible with 'global' geology? **We can expand on this – we have tried to emphasise the point that it's not a question of integrating indigenous peoples into western institutions with some of the examples used in the section pg6-7, and call attention to the fact that geological knowledge is plentiful outside of the present discipline canon. The idea of pluralising geology is interesting, this might be a useful way of talking about a discipline that isn't based on the current canon?**

line 236/38: on culture and science distinction: decolonial analysis highlights how non-western societies are said to have 'culture' while western societies have 'science'. **We can change our use of “cultural framework” here as this just emphasises its colonialism – and also explain non-western ‘culture’ vs western ‘science’.**

line 260-4: underscore the power of geologists relative to the legal provision for specific people and places; this reflects unequal power, not just geopolitics over national legislation, but crucially the role of political and economic elites and powerful groups, who ally themselves with western geologists (especially if it means foreign earnings from mineral wealth). Line 266: surely this is geology's "colonial present" (Gregory 2004) not its past? **Absolutely – should read present and decol actions needs to read in the future.**

p.10 line 306 the word is "willingness" **Actioned**

p.10-.11 - see Bryn Mawr college website for an extensive list of resources on the relationship between colonialism and geology, including links to Indigenous policy to establish ethical entry into and prospecting on Indigenous lands and territories.

<http://mineralogy.digital.brynmawr.edu/blog/geology-colonialism-reading-list/>

We are aware of this collection, some of the recourses will be impenetrable to some geologists (which is why we didn't include it) but we will add it to the suggested reading list – it is a very useful collection.

p.11 line 355: what does "more impactful" mean in this context? Could this be unpacked more.

line 361: on the Anthropocene, there is an emerging decolonising debate: see Davis H and Todd Z 2017 On the importance of a date, or decolonizing the Anthropocene. ACME 16(4):

761-80. And Slaymaker, O, Mulrennan, M and Catto N. 2020 Implications of the Anthropocene epoch in geomorphology, In Landscapes and Landforms in Eastern Canada. Springer.

It is probably best to avoid detailed debates around the Anthropocene here – lots of opinions in geology. It is interesting that it originated as a geological time period (and often referred to as such where it used) but most definitions do not use geological events to frame it.

p.13 spelling: epistemology, and epistemicide - you may be interested in Boaventura de Sousa Santos who has written extensively about epistemicide from a critical social science perspective. **Actioned**

It is great to see a glossary of terms given here! Another resource, in due course, will be S Radcliffe Decolonizing Geography: an introduction, Polity Press, Cambridge UK (published April 2022 in UK, May 2022 in North America).

Actioned, a resource from such a cognate discipline will be a useful addition.

Again, many thanks for this review and the effort put into it.