



Foreword to the Special Issue on Pit Lakes: The Current State of Pit Lake Science

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As the last ice age came to an end, so did the last period of widespread lake formation. However, new lakes are currently being carved from the landscape as a result of open-cut mining. Relative to natural lakes, these new ‘pit lakes’ are not well-researched, and much of the research that exists is forever buried in industry reports and presentations. The fundamental reason that pit lakes are not prevalent in the primary scientific literature is that they are viewed as ‘industry problems,’ rather than inland waterbodies worthy of research. Despite this, the pit lake research that has taken place has led to cleaner water, safer catchments, and public recreational areas. But pit lakes have much more to offer the broader scientific community: they are perfect large-scale ‘laboratories’ in which to conduct scientific experiments and study ecological processes because they are essentially ‘de novo’ ecosystems. Therefore, the way to progress pit lake research is to make pit lakes known to the broader scientific community. Pit lakes are more than simply a ‘mine water’ issue.

The potential of pit lakes to act as test systems for fundamental scientific concepts has been largely unnoticed by the broader scientific community, despite the fact there are thousands of pit lakes that are now permanent features of the landscape, with more being planned. Pit lakes are the modern analogues of ancient crater lakes formed by volcanic activity or asteroid strikes and provide scientists the opportunity to study (for example) ecological succession at the landscape scale, without the constraints of paleolimnological data and laboratory inferences. As freshwater ecologists, we (the editors of this special issue) did not encounter the phrase ‘pit lake’ during our respective educations in Australia and the United States. This is puzzling, considering

that pit lakes are prevalent in both countries, occur in varying conditions, and mining is economically vital.

We have previously described the lack of pit lake research in the literature as resulting from insufficient collaboration between academia and the mining industry (Blanchette and Lund 2016). However, the deficit in research collaboration extends beyond the academia-industry nexus to include a lack of collaboration among scientific experts. Interdisciplinary and applied research often comes at great professional cost. Scientists who might find pit lakes interesting, such as ecologists and experts in DNA sequencing or material scientist engineers and biochemists speak different scientific ‘languages,’ which makes interdisciplinary collaboration time-consuming. Even more prohibitive is that the academic publishing and promotion system favours ever-increasing discipline specialisation. Further, when ecologists and environmental scientists step into the applied mining space, the ‘hit’ to one’s academic career can be profound in terms of the relative number and prestige of publications, despite the positive real-world impact of their research.

The struggles experienced by academics in the applied space mirror those working in industry and consulting. The ever-pressing requirements to report to government and regulatory bodies and address the problems with pit lakes on site take precedence over publications in accessible journals. The vast majority of pit lake work is conducted by industry and consultants, but this work is not entering the wider scientific literature because people do not have the time or permission to communicate their results. The upshot is that industry results are often not considered within a broader theoretical context. Pit lake research needs to harness the full spectrum of science to innovate, and it is currently failing to do so. For all the above reasons, pit lake research is struggling.

Despite many examples of local excellence in pit lake research and remediation, work occurring without a broader scientific and geographic thesis is holding back the field. However, we are beginning to tackle this problem with this

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special issue. Over the past three years of personally recruiting researchers from all sectors of industry and academia to partake in this special issue, we believe we have collated the best of what pit lake research currently has to offer. Collaboration between industry and academia and among specialists from different disciplines is the only way to push the idea of pit lakes as inland waterbodies, worthy of research, into the broader scientific community. When this idea becomes more mainstream, collaboration, innovation (and publication) should follow.

This special issue was edited by two freshwater ecologists with a special interest in mine water, and efforts were made to ensure that technical articles published in this issue were reviewed by at least one person ‘outside’ mine water. We invited reviewers well-regarded in the fields of limnology, vulcanology, engineering, and mathematics (among many others) who had never previously engaged with the journal. Each paper is an example of excellence not only within the discipline of mine water, but the broader scientific community. We also ensured that all submissions would be useful to the practitioner, containing information that could be put into practice ‘onsite’ at their pit lakes.

Finally, as freshwater ecologists specialising in the biology of rivers and lakes, it has been an honour to edit this

special issue on pit lakes. Neither of us began our careers with the intention of working in mine water, but interdisciplinary collaboration has been satisfying, stimulating, and very challenging. The culmination of our combined decades of research can be summarised thusly: pit lakes are ‘true lakes,’ even if they are artificial. Therefore, they are subject to the same principles and phenomena as natural lakes. The geologists, mine managers, hydrologists, pathologists, sociologists, biogeochemists, chemical engineers, and miners we have personally worked with have broadened our knowledge. Mining is also a community endeavour with a rich history, and we acknowledge the communities who welcome us and help us in the field. Therefore, this special issue is dedicated to our scientific colleagues and the mining communities, for their open minds and willingness to tackle challenges alongside us.

Reference

- Blanchette ML, Lund MA (2016) Pit lakes are a global legacy of mining: an integrated approach to achieving sustainable ecosystems and value for communities. *Curr Opin Environ Sustain* 23:28–34