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Changing Trends and Rethinking Geoscience Education in the Context of a Global Crisis

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PRESIDENTIAL ADDRESS

Changing Trends and Rethinking Geoscience Education in the Context of a Global Crisis

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It is somewhat ironic that I am sitting down to compose this Geoscience Canada article one day after Joe Biden was declared the winner of the 2020 US election on the Biden-Harris ticket, and I won't deny that the result of a more forward-looking agenda in regards to safeguarding our planet has inspired me! Under normal circumstances this article would follow from my GAC Presidential address delivered at the annual GAC-MAC meeting in mid-May, but, needless to say, this year has been anything but normal. As it turns out, the annual CSPG-led Geoconvention, in which we, along with MAC, were partnered together with other professional geoscience societies, was significantly delayed and ultimately held in an online format in mid- to late-September. All normal GAC and MAC meeting-related functions, including luncheons, awards, ceremonies and keynote talks, were also postponed with the idea that we could have a double cohort in a future face-to-face (F2F) setting in London, Ontario (Western University), in May 2021.

The circumstances at GAC have been a microcosm of what is happening across society as a whole, with continuous adjustments, delays in plans and new systems put into operation as the situation continually changes and evolves. In short, the global pandemic, felt acutely in almost every region of the world, is forcing us to rethink the ways we do things. In spite of extreme tragedy, including thousands of lives lost, the results have been positive on several fronts. For example, in this time of crisis, many in mainstream society have recognized the need to address several fundamental and persistent problems facing humanity including, but not limited to, the current climate crisis, issues with poverty and the increasing divide between rich and poor, as well as underlying issues of inequity and systemic racism, awareness of which has been enhanced by events in the USA and the 'Black Lives Matter' movement. As global citizens, we all have a role to play in these issues, but as geoscientists we also need to realize our potential to assist in the area of the global climate crisis, an issue I will address toward the end of this article.

One of the areas that have been impacted most by the COVID-19 situation is education, both at the K–12 and college/university levels. At the time of lockdown, all teachers and university professors and instructors had to quickly (within the space of 2–3 weeks) navigate the transition to online teaching, with little or no preparation time. Course platforms were created, learning materials were amassed and distributed to students at short notice (in clever ways, maintaining distance), instructors got up to speed with online platforms such as Zoom and MS Teams. It was a crazy time during which our own Faculty Association urged its members to refer to these as 'emergency teaching measures', recognizing that they by no means approached the requirements of traditional 'distance education' delivery. In addition, while there was breathing room for additional preparation in the summer, serious concerns continue around adequate resources and time to continue to deliver effective online programs.

Speaking to our own discipline, the highly applied nature of geology, across both solid Earth and environmental fields, obviously presents significant challenges for teaching in an online format. There is also a genuine concern, among us all, for the outright loss of experiential (F2F) learning in practical sessions and laboratories. This being said, it has been encouraging to see the enormous spirit of collaboration among geoscience departments, as well as individual like-minded geoscience educators, across the country since the emergency began in mid-March. This underscores the important role of the Council of Chairs of Canadian Earth Science Departments (CCCESD), comprising geoscience heads from across the country, which has been in regular communication on its e-mail network since the pandemic began. Although I am no longer formally a head, as President and now Past-President of GAC, I have remained on this network, recognizing the important linkages it provides. An enormous range of topics has been discussed by this group, from delivery methods and related resources for specific sub-disciplines, to conferring on numbers of classes and protocols for F2F learning.

In April and May, and continuing into the summer, there was also a significant discussion and sharing of ideas on plans for geological field schools in various departments. My sense is that very few departments were able to offer traditional F2F field schools and that many had to improvise, opting for some combination of digital, map-based assignments, coupled with virtual field trips/excursions, or some hybrid of these activi-

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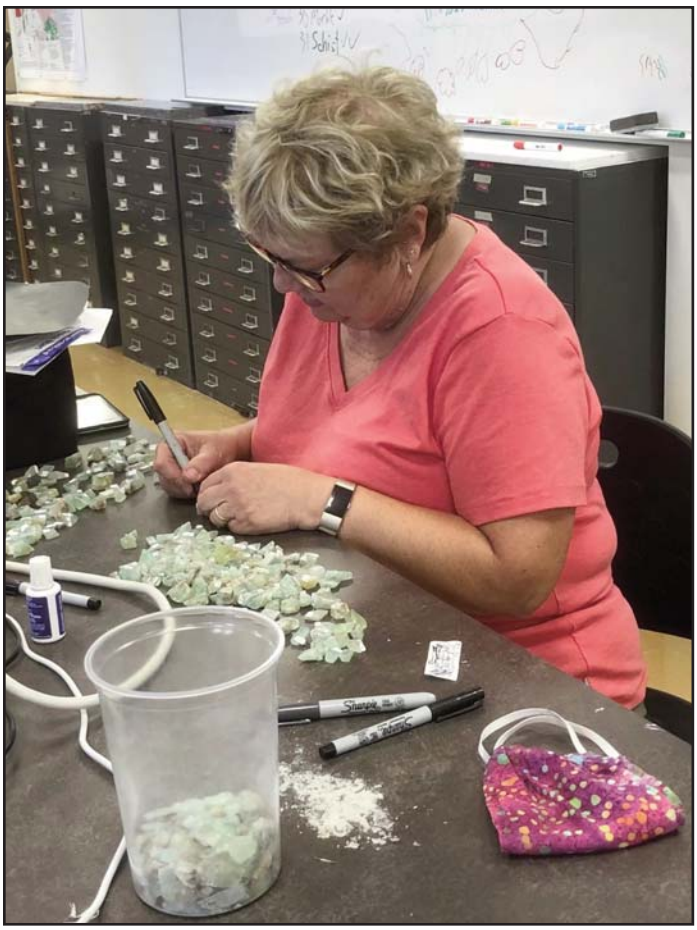

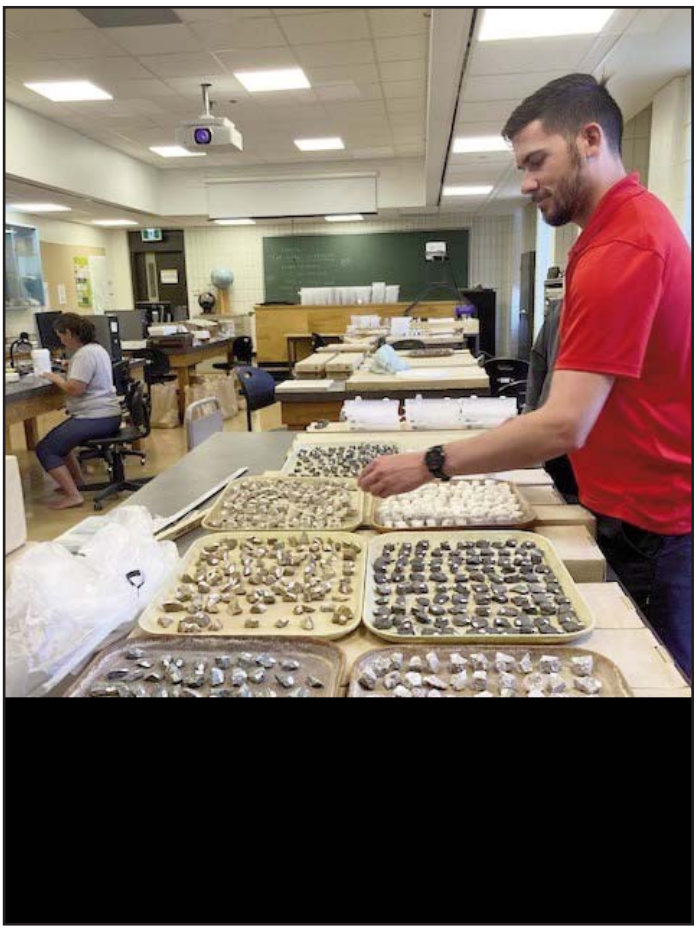

Students and staff from the Department of Geology, University of Regina, working diligently to prepare 'rock and mineral kits' to be distributed to students in the fall semester. To assist in remote teaching during the Pandemic, such kits have been created and provided to Geoscience students by most departments across the country this year. Photos courtesy of Janis Dale and Jeanette Roelofsen.

ties. In some cases, such as in my own department, some practical F2F sessions could be added into this mix, with appropriate protocols (masks, social distancing) in place. The incorporation of these new forms of technology-based learning has opened our minds to alternative modes of delivery of our geology curricula, and is sure to have some positive spin-offs, including addressing issues of inaccessibility, due to disability and/or prohibitive costs for some students. It was encouraging to see several sessions at the Geological Society of America annual meeting in Montreal (virtual platform), specifically devoted to teaching field geology by innovative, new (online/digital) methods. In short, the pandemic has sped up exploration of alternative teaching delivery methods, not just in our field classes, but in all the sub-disciplines (e.g. mineralogy, petrology, stratigraphy, structural geology, soils, glacial geology, etc.). We have also seen some highly professional remotely delivered seminar series springing up, sourced from both within and outside Canada, including those delivered by the Structural Geology and Tectonics (CTG) and Volcanic and Igneous Petrology (VIP) divisions of GAC; these have been particularly valuable for graduate student training.

Nevertheless, most universities are critically underfunded to put the appropriate technological supports in place to effectively deliver online classes. There are also serious limitations for students, as much of this type of learning requires up-to-date computers (equipped with cameras and microphones), printing capabilities (e.g. for map-based applications), as well as reliable internet connections. Associated costs can prove prohibitive for some students, although are likely to improve over time; however, lack of access to reliable internet in rural areas continues to be a serious impediment, as recently recognized with the internet funding announcement (Nov. 10) by the Government of Canada. Software licensing can also be problematic for universities because of the often excessive and ever-increasing costs, although industry partnership has in some cases proven effective in this area. Regardless, even before the pandemic, Canadian universities appear to have been ill-equipped to invest in current, state-of-the-art equipment to facilitate teaching their Earth Science courses; in some cases, even the most basic items (e.g. petrographic microscopes) have been in short supply, and typically not replaced in a timely fashion.

Aside from this, as experienced Earth Scientists, we are aware of the serious shortcomings of lack of experiential learning in our discipline. Hands-on training has been and continues to be a critical component of academic programs in the

Earth Sciences and is virtually (no pun intended) impossible to replace. Most field-based researchers recognize that university field schools are a bare minimum on the road to becoming a fully-fledged field-oriented geoscientist. Student learning in university-based field courses is commonly augmented by on-the-job training over the summers with geological surveys, resource companies and environmental firms. With continuing concerns about COVID-19, these practical training opportunities have been severely curtailed. In short, we need to start thinking of creative ways to get the current cohort of geoscience students (2020–21 graduating class) up to speed with practical experience. As a first step, university departments may need to offer supplemental programming in the 2021 spring/summer or fall semesters that allows students to catch up on a range of practical skills. This could take the form of a 1–2 week long intensive course that covers practical aspects of all sub-disciplines that were impossible to teach F2F. This might include hands-on aspects of mineralogy, petrology (petrography and microscopic study), structural geology, stratigraphy and sedimentology, and environmental geology. If deemed feasible, in-class instruction could be accompanied by short (day or 1/2 day) field excursions to further advance practical know-how.

It is doubtful that universities will be able to make up entire (normal length) field schools, but I believe that such an intensive, hands-on week to augment skills that were largely taught online could be very helpful and go a long way toward improving student preparation. This academic program could possibly be paired with a collaborative effort between geological societies, universities (including their co-op programs), government organizations and environmental and resource companies to help get student job placements in the summer. All of this would have to be done under safe circumstances, of course, which will depend on how the virus situation progresses through 2021 and if vaccination programs have started up, etc. This being said, it would be prudent to start thinking and planning now.

All this stated, in order to appeal to a wider range of students and to increase equity and diversity within the geosciences, which is much needed, we need increasingly to be aware of other directions students can pursue to make meaningful contributions to our discipline. The COVID-19 pandemic may have fulfilled an important role in this regard, highlighting that there is room for non-field-based pursuits in the Earth Sciences and leading us to re-imagine classical modes of training. For example, we need to be open to the usefulness of new digitally-based lines of inquiry, including applications of modelling (3- and 4-D), artificial intelligence and quantum computing in the Earth Sciences. There are also avenues to pursue in the emerging areas of microanalysis and nanotechnology. Lastly and perhaps more importantly, we need to work toward incorporating 'indigenous ways of knowing' into our approaches to Earth Science education.

As mentioned at the beginning of this article, we are at a critical juncture in society today. The COVID-19 pandemic has accelerated the need to think 'outside the box' in order to find solutions to multiple pressing issues. As geoscientists, we are well-positioned to play a key role in helping to mitigate the current climate crisis. From the perspectives of Earth history and deep time, we have unique insights into the Earth system that place us in an excellent position not only to put recent anthropogenic effects on climate in context, and hence better understand them, but to play an active role in developing the needed mitigation measures. The transition to a carbon-free economy in the next 25–75 years will require specialized knowledge of Earth processes that can only be fostered by robust geoscience education programming. Highly qualified Earth Scientists will be needed to, among other things, evaluate sedimentary basins for geothermal potential, evaluate the extent and sustainability of groundwater aquifers and to explore for much sought after rare elements that underpin the electrical vehicle industries, not to mention those needed to support the rapidly growing tech and communications sectors!

The aforementioned are just a few of the wide-ranging applications that require expertise in the Earth Sciences, in conjunction with engineering. We must face the reality that while hydrocarbon resources will continue to be a component of the energy equation, they will be significantly reduced. The inevitable and much needed shift to renewable energy sources such as solar, geothermal and wind, some of these perhaps to be coupled locally with nuclear energy sources, will require the same fundamental skills in geoscience, just applied in somewhat different ways.

In closing, it is our obligation as geoscientists to bring attention to the important role we can play, both within the education system, particularly at the university level, and to the general public, in helping to understand and mitigate climate change. Presently, we also have an enormous obligation to make every effort to bring the current cohort of geoscience students through their degree programs successfully, and to ensure that supplemental programs are created to enhance their practical skills and augment their education. There is no better time to spread the word of the value of Earth Science education and to work on adjusting our academic programs to meet future needs. Now more than ever the world needs highly qualified geoscientists, and we need to be ready!

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