

“Enriching Lives within Sedimentary Geology”: Evaluating SEPM’s Role in Diversity, Equity, and Inclusion

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Abstract

Innovative science benefits from diversity of thought and influence at all waypoints along the scientific journey, from early education to career-length contributions in research and mentorship. Scientific societies, like the Society for Sedimentary Geology (SEPM), steward their innovators and the direction of the science, thereby defining the societal impact and legacy of a discipline. They are uniquely positioned to promote the representation and success of all scientists, including those from minoritized groups or populations, through proactive advocacy, and inclusive mentorship, awards, and leadership. We introspectively review available records of SEPM membership, leadership, awardees, and editorial boards to identify areas for growth and begin a dialogue about how the society and its members can work together to better reflect our community. In the last decade, SEPM has seen a decline in membership, while representation and recognition of scientists from minoritized groups has remained low. Awards and honors have overwhelmingly gone to men, even in the last ten years, and very few women or people of color are in leadership roles. We provide recommendations for swift actions that SEPM and its members should undertake for the society to become a diverse, inclusive, and equitable environment where all scientists thrive. The systemic changes needed will take continuous effort, which *must be shared by all of us*, to build an enduring legacy that we can all be proud of.

Introduction

The mission of the Society for Sedimentary Geology (SEPM) is to “enrich the lives of professionals and students within sedimentary geology”. Amidst the swell of voices speaking out against discrimination in Science, Technology, Engineering and Mathematics (STEM), and the resultant loss of valuable, diverse talent at all career stages (Bernard & Cooperdock, 2018; Calma, 2020; Campbell, 2019; Dutt, 2019; Nature Editorial, 2020; Subbaraman, 2020), it is time for SEPM to assess whose lives the society is truly enriching. What is SEPM doing to increase diversity, equity and inclusion (DEI) in sedimentary geology? Do all scientists who share a love for the sedimentary record feel an *equal* sense of belonging within our scientific society? Are the achievements and contributions of all scientists, irrespective of their socio-economic class, disability status, race, or gender (for example), being fairly recognized?

Scientists’ contributions are customarily measured by their record of publications, service, mentorship, and awards; likewise, a measure of a scientific society’s professional relevance lies in its record of scientists represented in publications, leadership, membership, and award history. We review a few key SEPM records to identify areas for improvement. We would ideally synthesize these records to include self-reported gender, racial, ethnic, LGBTQ+, disability, and other legally protected statuses; however, this demographic data has never been collected.

Results reported below, assembled through personal knowledge, website information and personal pronouns used, are the authors’ best approximation of demographic trends in SEPM. This approach is fundamentally flawed, as each person that is a part of this synthesis has been categorized according to the authors’ perception, rather than their own self-reported identity (Rasmussen et al. 2019); *it risks the further disenfranchisement of individuals who are already marginalized*. For example, this approach does not include persons with non-binary gender, biracial, ethnic, and intersectional identities (Blevins and Mullen 2015; Quihuiz 2011; Harris 2013; Rasmussen et al. 2019). The existing data used in this study serves only as a starting point to begin a dialogue and identify areas where change is needed. The data treatment herein should not be used as a template for further demographic research within the society (Rasmussen et al. 2019). We emphasize that SEPM and its members *must* prioritize the collection and tracking of anonymous, *self-reported* demographic information that encompasses the diversity of our community and of human society as a whole.

Membership

SEPM is experiencing decreasing membership (Fig. 1). It is unclear what drives membership attrition, and additional data is needed to uncover the impetus behind the decline in SEPM professional memberships. Collected data are currently limited to gender (only binary options) and age, whereas data on race, ethnicity, LGBTQ+, and disability status has never been collected. Anonymous collection and transparent reporting of demographic information of the SEPM membership must be prioritized. The number of scientists from under-represented minorities (URM) in STEM who are joining, remaining with, or leaving SEPM are currently unconstrained. Career stages of professional members, not currently reported through society records, could provide insight into membership trends.

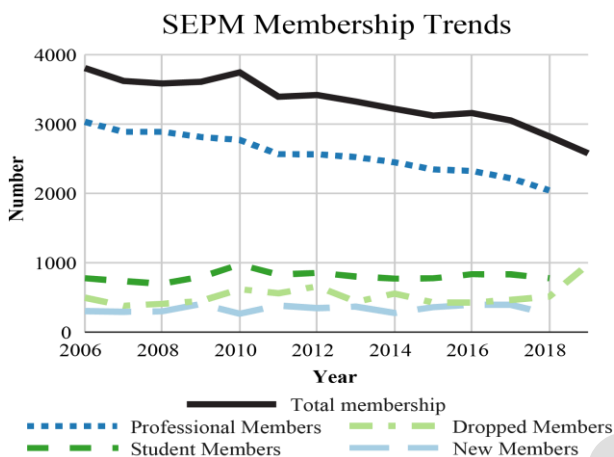


Figure 1: SEPM membership is decreasing, a trend primarily associated with declining professional membership. Dropped, new, and student memberships show a flat decadal trajectory; the number of dropped memberships remain consistently larger than new memberships. This suggests that SEPM is failing to recruit recent graduates at a rate matching dropped professional memberships. Data source: www.sepm.org/society-records.

Per the [membership registration portal](#) and the [society bylaws](#), to acquire voting membership, an applicant must (1) provide two professional references, and (2) have 3 years of experience beyond their bachelors' degree. Dues for voting and non-voting members are the same; the difference lies in applicants' professional networks. To first-generation scholars, scientists from developing nations, scientists not affiliated with top-tier research schools and anyone without a large network of colleagues, requiring references can be a barrier to participation (Dutt et al., 2016; Madera et al., 2009; Ward et al., 2018). Scientists will be unlikely to invest in a society where they cannot influence decisions. By contrast, the American Geophysical Union, a thriving scientific society, opens voting to all members. Furthermore, membership dues for recent graduates and scientists at under-funded institutions could be substantially reduced from current rates or subsidized by donors. Proactive recruitment of URM students at SEPM booths at minority-focused conferences (e.g. the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS)) and partnerships with organizations like the Geoscience Alliance would help diversify membership.

Leadership

For decades, the phrase “representation matters” has echoed where the decisions made impact communities (Powell, 2018). Per society records, 141 (73%) of 192 seats on the SEPM leadership council from 2007 to 2019 were occupied by men and 51 (27%) were occupied by women (Fig. 2); the ratio of men to women in different years ranged from 1.5 to 6. Councilors who presented as white held 180 (94%) of the council seats and 12 (6%) seats were held by members presenting as people of color; to our knowledge, a seat on the council has rarely been held by LGBTQ+ or Latinx scientists and has never been held by an Indigenous or Black scientist. We recommend that scientists with diverse identities are proactively recruited into SEPM leadership positions and that leadership opportunities for both students and professionals are expanded. Ensuring that all leadership positions (e.g., councils, committees,

editorial boards) are framed in the context of diversity, equity, and inclusion is essential for the future of this society. All leadership teams **must** be educated about issues that limit equity and demonstrate a commitment to removing bias from decision-making that affects SEPM, its members and the larger community of sedimentary geologists. All humans come with biases; the only way to eliminate the effects of these biases is to ensure that people with a range of perspectives are involved in all decision-making processes.

SEPM Leadership Council (2007 - 2019)

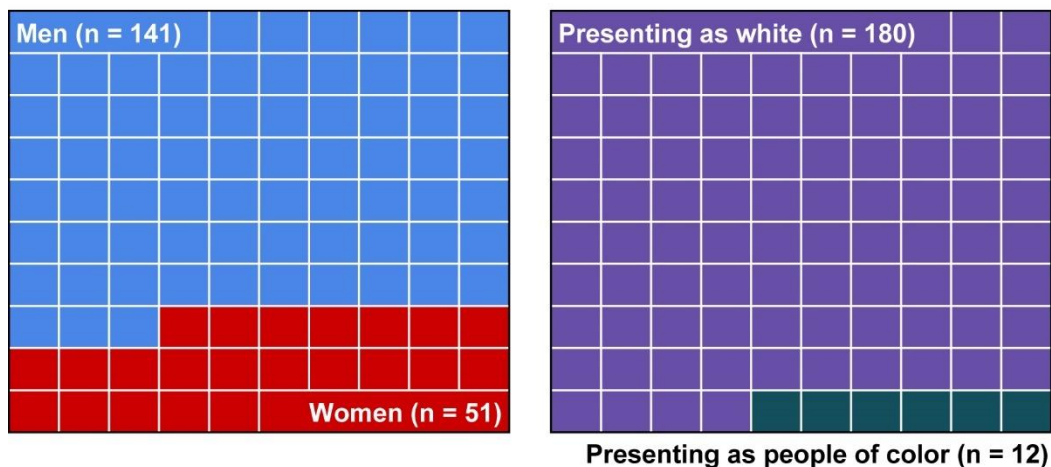


Figure 2: Demographics of SEPM Leadership councils from 2007 to 2019. Data source: www.sepm.org/society-records.

Society Publications

Diversity promotes innovation from hypothesis through peer review and final publication (Hofstra et al., 2020; Powell, 2018). Personal identity impacts how we engage with our science (Apple et al., 2014; Semken, 2005; Smythe et al., 2020; Unsworth et al., 2012); it impacts how we approach a problem, and what we value, study, and write (Núñez et al., 2020; Ward et al., 2018). It influences how we select reviewers (Ross, 2017), how we review (Kaatz et al., 2014; Sordi & Meireles, 2019), and ultimately what makes its way through to publication (Chawla, 2019; Pico et al., n.d.). Diversity in the peer review and publishing process can help to eliminate bias (Fox & Paine, 2019).

SEPM's editorial teams are not diverse (Fig. 3). The team of 46 associate editors for the Journal of Sedimentary Research currently includes 39 (85%) men and 7 (15%) women; of these, 41 (89%) associate editors present as white and 5 (11%) present as scientists of color. The PALAOS team of 55 associate editors includes 40 (73%) men and 15 (27%) women; 54 (98%) of the team present as white and 1 (2%) presents as a scientist of color. Of the 58 editors of 20 SEPM special publications from 2009 - 2019, 48 (83%) were men and 10 (17%) were women; 53 (91%) editors present as white, 2 (3%) present as scientists of color. SEPM must take aggressive steps to include diverse identities in its editorial process to ensure equitable publication standards. Existing leadership must stay informed of and vigilant to sources of potential bias in editorial processes.

SEPM Editorial Boards

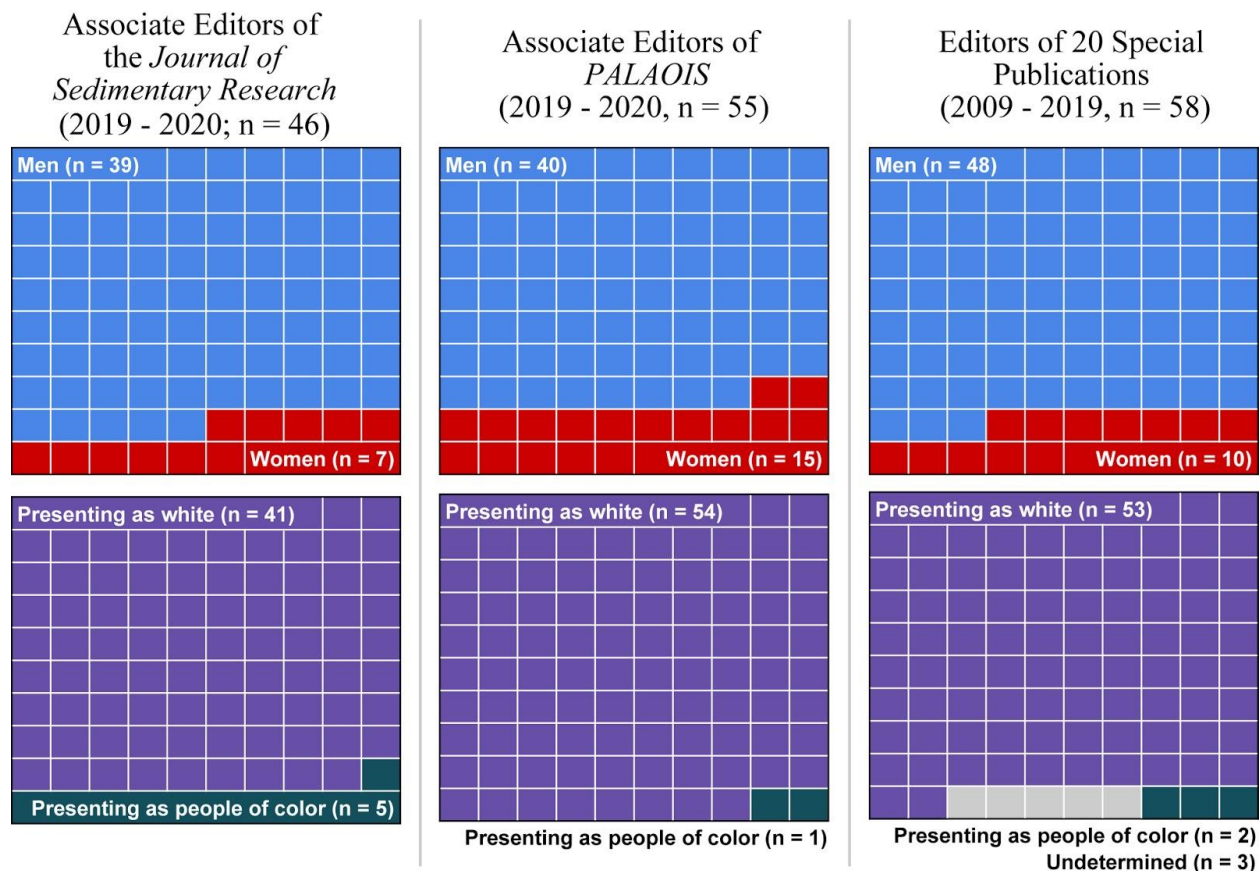


Figure 3: Recent demographics of editors on the two society journals, the *Journal of Sedimentary Research* (www.sepm.org/AE-Board) and *PALAIOIS* (<https://www.sepm.org/PALAIOS-Information>) in 2020, and SEPM Special Publications published between 2009 and 2019.

Double blind peer-review is a mechanism for eliminating bias, by reducing opportunities for nepotism (Cox & Montgomerie, 2019; Sordi & Meireles, 2019) and increasing submissions from female first authors (Budden et al., 2008; Pico et al., n.d.). Tomkins et al. (2017) showed that single-blind reviewing, which is what SEPM currently offers, significantly advantaged papers by well-established authors relative to the same papers when reviewed double-blind. Alternatively, open reviewing can eliminate potential bias, as the reviews are published alongside the manuscript (e.g., *Earth Surface Dynamics*).

Negative and fundamentally unhelpful reviews, lengthy review timelines, and rejections can create barriers to publishing. They slow the trajectory of early-career scientists, damp innovation, and can ultimately drive scholars out of STEM. We urge SEPM journals to consider prioritizing a mentoring approach over negative and unconstructive critique for papers that are first authored by students and early career scientists. Minimizing barriers to publishing is particularly important now, given the unequal impacts of the COVID-19 pandemic on submission rates (Times Higher Education, 2020; Myers et al., 2020).

Awards

SEPM awards eight distinct honors annually; all named awards honor white, male scientists. Of 337 awards since 1930, 309 (92%) awards recognized men and 28 (8%) recognized women (Fig. 4A, C). Gender ratios of awards in the last decade (2011-2020) improved slightly (Fig. 4 B, D); of 65 awards, 51 (78%) went to men and 14 (22%) went to women. Half of all awards to women were in the last 10 years. The Moore Medal is the only award with equal gender representation in the last decade; only 2 of 10 James Lee Wilson Awards to young scientists went to women, even though this is the demographic where female professional scientists are best represented (Bernard & Cooperdock, 2018). This review is not exhaustive; we encourage our readers to review the [list of past award-winners](#) to form their own assessment of diversity.

SEPM's future, and that of sedimentary geology, will be dictated by how and if we choose to remove explicit/implicit bias from our definition and recognition of outstanding contributions to our community. Inspecting the sources of bias in these award outcomes is an essential first step. Fully recognizing the talent and contributions of members who are not white and male is essential, if SEPM is to avoid becoming professionally irrelevant. Scientists' contributions to our discipline are not limited to their research but include committed mentoring, community service, and outreach; the required content of nomination and supporting letters should be changed to reflect that. Our awards nomination criteria ought to recognize the positive impacts made by individuals or teams on the field of sedimentary geology, especially from marginalized groups or scientists outside of the U.S.

assessment of diversity.

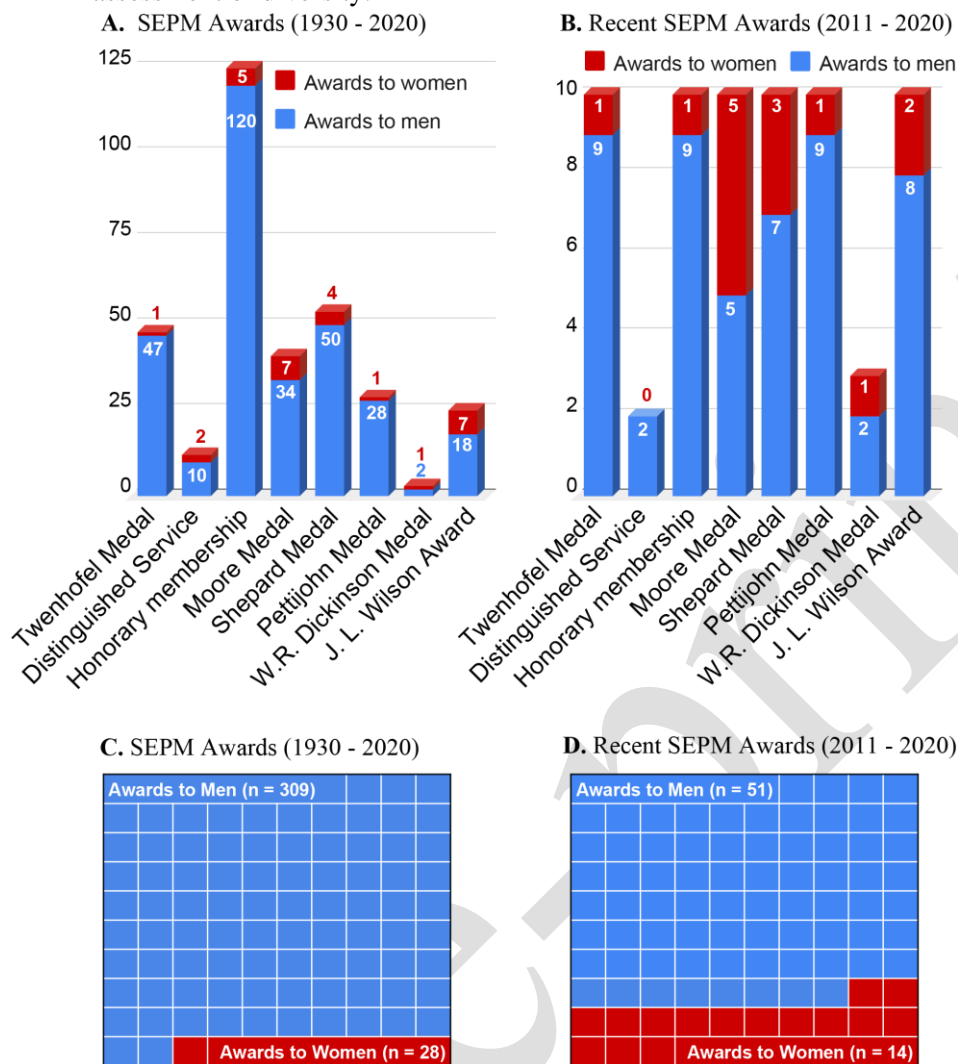


Figure 4: Gender breakdown in awards recipients (www.sepm.org/Past-Winners), including all award categories (A), award categories from the last ten years (B), all awards (C), and all awards for the past ten years (D). Note the order-of-magnitude differences in gender representation in some categories.

Requiring gender, racial, and ethnic representation on awards committees is a good start, and including URM students in committees could help relieve the service load on early- and mid-career URM scientists (Gewin, 2020). It is critical that we work together to ensure that URM scientists are nominated for awards (Hofstra et al., 2020). To bear out the value of a scientist's contributions as scholar *and* mentor, diversity among letter writers in terms of gender, race, ethnicity, and career-level should be viewed just as significant as letter content, and nomination letters should include the demographics of nominees' mentees *and* mentees' post-graduate successes. SEPM has adopted the practice of requesting "Professional conduct self-disclosure forms" for all nominees, but more must be done to ensure the top candidates for awards have been above reproach in all aspects of their professional lives over their entire

career. We recommend top nominees are vetted by cross-checking code of conduct reports with other societies and by contacting Title IX offices of institutions or employers (Wadman, 2017).

Scientists at all career levels often treat junior colleagues with far less respect than they do their peers or senior scientists. Members of one or more marginalized group(s) (Charleston et al., 2014; Crenshaw, 1990; Doshi, 2020; Gutiérrez y Muhs et al., 2012) are particularly vulnerable to bullying, harassment, discrimination, and abuse (Geocognition, 2019). For example, the work-place experience of a female scientist of color might be drastically different from that of her white male or female colleagues (Doshi 2020; Gutiérrez y Muhs et al., 2012; NASEM, 2018; Sharon & Cheney, 2020; Skachkova, 2007). It can take scientists years to recover from bullying and to get their careers on track, if they do not choose to leave their field of study entirely (Goodboy et al., 2015; Martin et al., 2015; NASEM, 2018; Poole, 2016; Twale & De Luca, 2008). By implementing the measures outlined above, SEPM will set the highest standard of ethical professional conduct for its members and ensure that its most vulnerable members know their welfare and long-term success are valued as highly as the research contributions of senior colleagues.

Conferences, Workshops, and Field Trips

Positive conference experiences build community. Quality educational and social events for students are investments in the future of the discipline. Friendships forged, shared adventure, and trust developed at conferences or on field trips engenders a sense of belonging that can last for a lifetime, span disciplines, and nurture creativity. Conversely, exclusion, harassment and exposure to unsafe behavior or spaces can cause scientists and members of their networks to permanently disengage from the community. Emphasizing *inclusivity* at conferences, workshops, and field experiences will foster a culture in which future cohorts of diverse talent are encouraged to thrive; such events attract groups invested in supporting and retaining diverse talent. Invited and accepted speakers at conferences must include scientists with diverse identities (Ford et al., 2019). Need-based rebates on membership and conference registration for faculty and students at two year colleges, small graduate programs, and Minority Serving Institutions will ensure broader participation of URM students and scientists, and create a diverse recruitment pool for institutions and companies present at these conferences.

Normalizing remote presentations promotes participation of scientists who find travel challenging, including immigrants, parents of young children, people who do not feel safe at a conference venue, and anyone with cultural or religious obligations or special needs which prohibit travel. In the wake of the COVID-19 pandemic, when most of us have adapted rapidly to remote conferencing technology, this is a manageable goal. Even before COVID-19, international travel was colored by uncertainty for immigrant or overseas-based scientists (Reardon, 2017a, 2017b). Potential delays in acquiring a visa can result in scientists choosing not to attend a conference. Scientists on work visas routinely avoid leaving the United States for fear of being barred from re-entry (Reardon, 2017b). U.S. work visas are usually valid for one to three years; while able to work in the U.S. with renewed paperwork, scientists must budget time (six weeks or more) and expenses (e.g., consulate fees, travel, room and board) to acquire a visa sticker at a U.S. consulate in order to re-enter the country after international travel. Faced with the possibility of endangering their current job by traveling internationally, most immigrant scientists choose not to travel. This can have measurable impacts on career trajectories (Kelsky, 2019; Morello & Reardon, 2017; Skachkova, 2007).

Field experiences are an integral part of sedimentary geology, yet access to and comfort/safety associated with participation in field opportunities is not equal (Carabajal et al., 2017). A fundamental part of including junior scientists with diverse identities in field-based educational programs is recognizing that LGBTQ+, Black, Latinx, Indigenous, Asian, and Middle Eastern colleagues are less safe in many environments (Clancy et al., 2014, 2017; Nelson et al., 2017). To guard against negative experiences, which can be particularly consequential for URM scientists, we must raise awareness of differences in backgrounds and experiences, and potential hostile behaviors, bias, and discrimination. We must develop guidelines for respectful behavior, and use SEPM reporting and enforcement mechanisms put in place with the [Code of Conduct](#). Field trip protocols must be designed to ensure all participants' safety and the [Code of Conduct](#) must be clearly shared and agreed to before fieldtrips begin (Gries, 2019; St. John et al., 2016; Williams et al., 2017). Furthermore, mitigating the financial burden of these experiences will demolish a fundamental barrier to participation of students with diverse identities and backgrounds.

A Call to Action

Scientists who belong to racial, ethnic, LGBTQ+, and gender minorities are more likely to encounter negative and traumatic experiences than their majority-identifying colleagues (Clancy et al., 2017). URM scientists are disproportionately taking on the labor to enact meaningful change to the system, using time that could otherwise be directed towards innovation and career development (Di Roma Howley, 2020; Gewin, 2020; Jimenez et al., 2019). Often, URM scientists do this knowing that their careers, the stability of their personal lives, and the contributions of those who come after, hinge upon changing the system. ***They are doing this because they have no choice.***

Given the data presented here, SEPM can and must do better to remake this scientific society into one where every sediment and fossil loving scientist, regardless of personal identity, can thrive. We envision a society that reflects, supports, and increases the diversity of our field, and that recognizes that diverse identities are the scaffold of innovative science (Hofstra et al., 2020). Membership in this society should immediately mark every scientist as part of a forward-thinking group of individuals eager to use their skills and knowledge in service of Earth's most urgent problems and invest in the foundational research and education initiatives that build capacity for future generations and the problems they must solve. We want educators to be eager to bring students from all backgrounds, especially their URM students, to conferences and educational programs organized by SEPM, knowing their students are physically safe and protected from discrimination, harassment, and exclusion, and that their ideas and identities are valued in these spaces. We envision an SEPM where ***all scientists*** make room for historically silenced perspectives, and ***share the workload*** required for system-wide change.

Scientific societies can be transformative in creating equitable work environments and mitigating cultural injustices (NASEM, 2018). SEPM has recently implemented a [Code of Professional Conduct](#) and created channels for investigation of code violations; but more work is needed. To build upon existing efforts, we provide evidence-based, actionable recommendations to improve recruitment, retention, and advancement of URM scientists/students within SEPM and sedimentary geology:

1. Establish a continuous, annual survey of self-reported SEPM member demographics, including new and dropped memberships. Understanding who has been recruited and retained must be prioritized in order to characterize SEPM's status with respect to inclusion. Analyze and report these data to the society membership annually.

2. Ensure that all members, including students, have voting rights.
3. Ensure that the recently written [SEPM professional code of conduct](#) is agreed to by members, and all persons attending SEPM sponsored events; ensure that violators of the code are expelled from the society and barred from future events, as is within the society's purview.
4. Support victims of code violations (if they are willing), by following up and reporting code violations to the perpetrators' employers and funding agencies.
5. Facilitate need-based rebates in society membership and conference registration.
6. Ensure diverse identities are represented at speaking engagements at all SEPM sponsored events and facilitate broader participation through remote presentation options.
7. Ensure all student-focused events are scaffolded upon a principle of proactive inclusion of diverse identities. Actively recruit students from URM groups through partnerships with initiatives like the Geoscience Alliance, Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS), GeoLatinas, National Association of Black Geoscientists (NABG), American Indian Science and Engineering Society (AISES), Society of Latinxs/Hispanics in Earth and Space Science (SOLESS), The International Association for Geoscience Diversity (IAGD), 500 Women Scientists, and 500 Queer Scientists.
8. Ensure representation of diverse identities on award nomination lists, named awards, leadership councils, organization committees, awards committees, and editorial boards.
9. Evaluate sources of bias within the awards nomination process, formalize content requirements for nominations and support letters, and ensure nominees are above reproach in all aspects of their professional lives. Track and continually review the self-reported, anonymous demographic information of nominees, awardees, and nominators to ensure society awards are representative of the demographics of the field.
10. Appoint one or more DEI Councilor(s) and/or external consultants to oversee society efforts while emphasizing that DEI labor is not solely their responsibility. Moreover, ensure that *all* leadership work is framed in the context of inclusion and equity. Expand leadership opportunities.
11. Collect and continually review journal data, including accepted and rejected manuscripts, and the demographics of associated authors (i.e. first author career stage, gender, LGBTQ+ status, ethnicity, race and disability status), reviewers, and editors. Promote mentorship during the peer-review process, especially for junior scientists. Ensure that all editors are educated and vigilant to implicit bias in the peer review process (e.g., through annual anti-bias training), and proactively work to eliminate it.

Implementation of these practices, accountability assessment, and further revision of policy should be a formal, iterative process (NASEM, 2020). ***SEPM must make a commitment to continuously set goals, track changes implemented, measure their success, and transparently report this data to its membership. These recommendations are only the first steps towards positive evolution of the SEPM.***

There are many reasons to look back on our history and feel discouraged that so little has changed or be immobilized by the scale of systemic change needed. But we are geoscientists; we work every day to imagine abstract environments and ecosystems that do not exist today. In our imaginations we walk on the ocean floor or on the surface of planets and moons we will never visit. Who better to transcend the bounds of space and time, to imagine and build a different and kinder world in which our history does not dictate our future, and those who come after us do not have to resist inequity in order to practice their craft? We understand the relevance of long-term trends; more importantly, we know how profound an

impact human intervention can have. Imagine how rapidly we could change the status quo, if we **all** committed to doing the work needed to make SEPM, our society, a place where all sedimentary geologists belong, are supported to innovate, and are respected and safe. We want **this** to be SEPM's enduring legacy; it would be one we could all be proud of.

Acknowledgements

The authors would like to thank Howard Harper and Mike Blum for offering historical perspectives on SEPM and for feedback on an early version of this work. The lead-authors acknowledge NSF grants [EAR-2005439](#), [EAR-2029803](#) and [EAR-1855209](#) for providing the opportunity to do this work.

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Pre-print

Data Repository for “Enriching Lives within Sedimentary Geology”: Evaluating SEPM’s Role in Diversity, Equity, and Inclusion by Fernandes et al.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Professional Members	3027	2883	2883	2809	2767	2562	2560	2520	2445	2342	2320	2216	2040	
Student Members	775	733	697	795	972	827	854	800	770	775	834	832	777	
Total membership	3802	3616	3580	3604	3739	3389	3414	3320	3215	3117	3154	3048	2817	2575
New Members	302	293	299	407	264	383	344	367	274	360	394	394	259	
Dropped Members	495	380	408	448	619	559	658	437	554	426	426	464	511	978

Source: <https://www.sepm.org/society-records>

	Total	Men	Women	Percentage of councilors who were men	Percentage of councilors who were women	Councilors presenting as white	Councilors presenting as people of color	Percentage of councilors presenting as white	Percentage of councilors presenting as people of color
Leadership Councils (2007 - 2019)	192	141	51	73	27	180	12	94	6

Source: <https://www.sepm.org/society-records>

Data Repository Table 3: SEPM Journal Editorial Boards and Special Publication Editors									
	Total	Men	Women	Percentage of editors who were men	Percentage of editors who were women	Editors presenting as white	Editors presenting as people of color	Percentage of editors presenting as white	Percentage of editors presenting as people of color
Associate Editors of Journal of Sedimentary Research (2019 - 2020)	46	39	7	85	15	41	5	89	11
Associate Editors of Palaios (2019 - 2020)	55	40	15	73	27	54	1	98	2
Editors of 20 Special Publications (2009 - 2019)	58	48	10	83	17	53	2	91	3
Sources: https://www.sepm.org/AE-Board ; https://www.sepm.org/PALAIOS-Information									

	First award	Last award	Number of awards	Awards to men	Awards to women	Percentage of awardess who were men	Percentage of awardess who were women
Twenhofel Medal	1973	2020	48	47	1	98	2
Distinguished Service	1997	2013	12	10	2	83	17
Honorary membership	1930	2020	125	120	5	96	4
Moore Medal	1980	2020	41	34	7	83	17
Shepard Medal	1967	2020	54	50	4	93	7
Pettijohn Medal	1992	2020	29	28	1	97	3
William R. Dickinson Medal	2018	2020	3	2	1	67	33
James Lee Wilson Award	1996	2020	25	18	7	72	28
All awards	1930	2020	337	309	28	92	8

Source: <https://www.sepm.org/Past-Winners>

	Number of awards	Awards to men	Awards to women	Percentage of awardees who were men	Percentage of awardees who were women
Twenhofel Medal	10	9	1	90	10
Distinguished Service	2	2	0	100	0
Honorary membership	10	9	1	90	10
Moore Medal	10	5	5	50	50
Shepard Medal	10	7	3	70	30
Pettijohn Medal	10	9	1	90	10
William R. Dickinson Medal	3	2	1	67	33
James Lee Wilson Award	10	8	2	80	20
All awards	65	51	14	78	22

Source: <https://www.sepm.org/Past-Winners>