

PAC Virtual Meeting March 2021 Findings

1. Congratulations on landing of Perseverance, upcoming launches of other missions

The PAC congratulates the Mars 2020 team and PSD on its successful landing of the rover, including spectacular footage of its descent and deployment. The PAC applauds the worldwide excitement over the landing and looks forward to the science that will come from the mission. Additionally, the PAC congratulates PSD's many mission teams for progressing toward launches despite the ongoing impacts of the global COVID crisis.

2. COVID mitigation efforts

The impact of COVID-19 on the planetary science community is an area of great concern to the PAC. We commend NASA's efforts to provide extensions and additional funding support to early career scientists in particular through the ROSES programs. We recommend that NASA look for additional opportunities to mitigate the negative effects of COVID on scientific productivity that can be implemented rapidly, including through joint activities with professional societies and other science agencies. Longer term, the PAC encourages NASA to find ways to assess the impact of COVID-19 on its planetary science objectives, employing the skills of social scientists as needed.

3. Infusing astrobiology expertise into mission teams and decisions

Astrobiology is a key component of NASA's scientific research portfolio, and astrobiology is frequently mentioned by NASA as a motivating factor in its choice of missions. The Astrobiology program, as well as its Research Coordination Networks, are a resource outside of the traditional Assessment Group structure that provides a different and critical perspective on questions regarding life detection and how to address them. The PAC encourages NASA to ensure that astrobiology scientists and researchers are incorporated into mission definition teams and science teams that determine driving requirements for relevant large missions such as MSR to ensure that astrobiology-related objectives are met. Specifically, the PAC recommends that NASA continue and expand efforts to involve a broad group of lab scientists who are experts in establishing biogenicity of ancient Earth samples in the coming years of the M2020 mission through continuing Participating Scientist Program calls and seeking community input in design of laboratories for sample return analysis. The PAC particularly encourages recruitment of scientists from underrepresented groups that may not have previously been funded by the NASA Mars program.

4. Concern about the cost of MSR and its impact on programmatic balance within PSD

MSR is estimated to cost \$4.7B while still in Phase A, and the project seeks to launch by 2026. This will drive a very steep funding profile that will result in severe pressure on other elements within PSD, including R&A and missions to study other destinations. The PAC is concerned that the large cost of MSR will impact programmatic balance, including other scientific priorities identified by the Decadal Survey. The narrow focus and significant cost of MSR - large compared to previous PSD flagship missions - is very likely to impact PSD's ability to undertake missions that address a wide range of other science questions. Particularly given that the majority of the costs associated with MSR are engineering related (see Finding 5), the potential

for impact to PSD's overall science program is high. The PAC recommends that PSD should look for ways to minimize the cost of MSR (identifying potential descopes) and/or reduce its annual cost impact by stretching out its schedule. Since it appears that many objectives of MSR and the Mars Ice Mapper mission overlap with those of HEOMD, PSD should investigate options for cost sharing.

5. Science involvement in planned Mars missions

a. Mars Ice Mapper

The PAC continues to be concerned about the need for science community involvement in the definition of the Mars Ice Mapper (MIM) mission. As stated in a previous PAC finding, for MIM to be successful, it must have clearly defined science objectives, and it would be best to openly compete any instruments that are to be incorporated beyond the radar. The PAC requests continued updates from NASA on its plans to initiate a mission definition team that incorporates members of the broader science community, consistent with MEPAG's Finding regarding using the Mars science community to ensure that the mission concept is able to achieve its stated science aims. If the objectives of MIM partially or primarily stem from human spaceflight needs, the PAC recommends that NASA should make efforts to share costs with HEOMD.

b. Mars Sample Return

The PAC is concerned about the potential lack of science involvement in elements of Mars Sample Return (MSR) beyond the Mars 2020 (M2020) rover. It was stated at the March 2021 PAC meeting that the elements of MSR outside of Perseverance have no science team. While it was asserted that a science team is not required because MSR components beyond M2020 merely retrieve samples selected by the Perseverance science team, science involvement throughout the entire MSR campaign is needed to determine threshold requirements, science costs of potential descopes, and mission success criteria. One can envision scenarios in which some segment of the sample return effort encounters an issue that could lead to failures to achieve its Level 1 requirements, and science input would be needed to determine an optimal response. In the absence of a separately competed, engaged science definition team, the Mars 2020 team are the de facto science team for MSR. However, the goals of MSR and Mars 2020 are not the same.

Particularly given the very large cost of MSR, clearly defined and carefully scoped Level 1 requirements, threshold requirements, and descope options for the non-M2020 elements of MSR are essential. These necessitate the input and peer review of multiple scientists from early stages of mission definition through operations. MSR represents such a large investment on the part of SMD that scientists must be involved throughout the sample return campaign to ensure its success, and must be in a position to influence decision making, which is beyond the scope of community meetings.

6. Planetary Defense and the NEO Surveyor mission

The PAC notes that there is strong community support for this mission, including from a recent National Academies study that concluded that a space-based infrared survey can rapidly accelerate progress toward the Congressionally mandated objective of finding more than 90% of large near-Earth objects and can determine their diameters, which current or future ground-based surveys cannot. The PAC encourages NASA to make a decision about moving the project out of formulation.

7. IDEA efforts in PSD

The PAC commends PSD for initiating an active inclusivity, diversity, equity, and accessibility (IDEA) effort in planetary science and appreciates the update on these efforts presented at the March 2021 meeting. The PAC was pleased to hear about the code of conduct that is being developed for NASA meetings and looks forward to hearing more about this in the future. The PAC recommends:

- That PSD continue to present regular IDEA-effort reports at future meetings to continue dialog on strategies for improving diversity and inclusivity within PSD.
- That we receive inputs from large community-driven IDEA efforts, including the cross-AG IDEA Working Group, and a selected subset of state-of-the-profession Decadal Survey white paper lead authors at future PAC meetings so that we can stay abreast of specific issues and work being done in this area.
- That NASA create a Chief Executive for IDEA, who is a member of the highest ranks of senior leadership at NASA. This practice, common now among large companies, helps to prioritize and implement IDEA-focused strategies, from and within the top leadership level.

8. R&A

The PAC appreciated the dialog with NASA, initiated with specific discussion questions posed regarding PSD's research and analysis (R&A) programs, and we look forward to continuing this dialog to understand the forces driving proposal pressure and increased proposal costs, which in turn lead to lower selection rates. The PAC recommends:

- That PSD make efforts to help R&A scale up when the PSD budget grows, and keep it constant if the PSD budget shrinks. We are extremely grateful that PSD's budget has grown substantially in recent years, but the PAC notes that the percentage of funding devoted to R&A has declined from roughly 15% to 8%. This greatly impacts NASA's ability to maximize the science return from its planetary missions, especially as the volume of available observation data increases.
- That NASA highlight the importance of the contributions of reviewers for its R&A programs at every opportunity when addressing the community, since quality reviews depend upon many scientists performing this community service. The PAC commends PSD for finding new ways to cultivate this culture of reviewing, for example by continuing to include an Executive Secretary role on panels, but other ideas would be welcome. The PAC recommends that NASA investigate ways of incentivizing reviewers where possible, including enabling appropriate compensation for the time needed to do the work (such as possibly allowing reviewer labor hours to be costed in its research grants).

- That NASA examine data on a Step 1/Step 2 triage process where possible, such as in other divisions where this has been tried previously, in an effort to decrease both total proposer and reviewer effort. As part of this process, NASA should estimate the fraction of proposals that would have to be triaged out to justify the resources required for the additional set of reviews and evaluate the potential for a reduced burden on the system via a simplified Step 1 process.
- That NASA should aim to issue calls for proposals every year where feasible, since reliability of calls is important to the community.
- That proposers be sent a reminder at approximately 6 months before the end of a grant to archive related publications in PubSpace.