



# Establishing an Ethic of Sampling for Future Generations of Geoscientists

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## ASSESSING THE ETHICS OF SAMPLING

The growing concerns about the ethics of geologic sampling are relevant to teaching, research, and our geoh heritage (Chan and Mogk, 2022). This paper examines our current culture and attitudes on ethics from sample collection to archiving, based on a community survey across multiple professional societies and geoscience disciplines, as well as a Geological Society of America (GSA) Connects 2022 Noontime Lecture Town Hall. Many helpful comments and suggestions from the geoscience community have helped move this process forward toward a consensus on the need for developing standards for ethical geologic sampling. The topic of sampling is complex and exposes values in conflict, with individual examples intimately tied to a particular question being asked; thus, one size does not fit all. Professional societies can provide a valuable service by having clearly stated guidelines for professional practice (e.g., as a requisite for publication), and by developing resources about sampling that can be easily accessed and imported into curricula for training future generations of geoscientists.

## SURVEY RESULTS

A survey made up of 46 questions was beta tested and refined prior to its release to multiple listservs of co-sponsor societies in August 2022, administered by GSA staff. We collected results ( $n = 810$ ) over a three-week open period for responses. All anonymous survey data (see Supplemental Material<sup>1</sup>) were aggregated so that no individuals could be identified. Nearly all questions had a full spectrum of choices, many

with optional comment boxes. The results are briefly summarized in the six categories (A–F) below and served as a springboard for discussion at the GSA Connects 2022 Noontime Lecture Town Hall in Denver, Colorado, USA.

### A. Participant Data

We received data in nearly all sectors of different demographic types, including from all represented subdisciplines across 47 countries (with U.S. emphasis). The majority of respondents were White males, reflecting the common demographic in geological sciences. In the broad range from students to professionals, 61% held Ph.D. degrees. About 65% of respondents were GSA members, 56% were American Geophysical Union (AGU) members, and 92% were affiliated with other societies, reflecting multiple society memberships.

### B. Sampling Practices

Sampling is a critical practice in the geosciences with a variety of purposes: 68% for research, 34% for industrial use, 23% for teaching, and 27% for outreach or other. Roughly half of the survey participants said that in hindsight, they might have sampled differently. Respondents noted the need for sample inventories and documentation, and the responsibility to develop comprehensive metadata, including how and where samples are collected, stored, and shared to optimize their utility by other researchers.

### C. Permissions and Permits

The vast majority of respondents seek appropriate permissions and permits for their sampling and mostly navigate without

problems. Some respondents commented on the value of inviting interaction with landowners, and others noted inconsistent rules between different federal agencies. Particularly in international work, respondents stressed the need for communication and collaboration with resident international colleagues and stakeholders, thereby also addressing the criticism of “helicopter or parachute science,” in which researchers from wealthier countries drop in and conduct research in emerging countries with little or no interaction with local scientists or community members (e.g., Stefanoudis et al., 2021). Respondents suggested that a website, or a panel of experienced expert mentors, should provide guidance and best practices for early-career workers who could use advice on getting started in certain international areas.

### D. Sampling Sampling Process

Most respondents (82%) always or mostly try to minimize their impact on the natural environment when sampling, but at least half (51%) felt that they might have over-sampled at times. About 74% of respondents have seen obvious sampling (on four or more occasions) by previous geoscientists. “Poor judgement” in sampling can have a negative impact on our discipline and the public perception of geoscientists (e.g., Sahagún, 2021). Survey participants indicated that >60% of samples were used for research, but ~16% of collected samples were never analyzed.

### Sample Fate

What is the ultimate fate of collected samples after the sampler’s retirement or

<sup>1</sup>Supplemental Material. Bar graphs showing responses to the GSA Survey on Ethics of Sampling and group discussion questions from GSA Connects 2022 Noontime Lecture Town Hall for the Culture and Ethics of Geologic Sampling. Please visit <https://doi.org/10.1130/GSAT.S.23528430> to access the supplemental material, and contact [editing@geosociety.org](mailto:editing@geosociety.org) with any questions.

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end of career? Although 27% think the majority of samples will go to a designated archive or other research or teaching collections (18%), 44% of the respondents either do not know where their samples will go or believe the majority will be discarded. This response stresses the need for examining other alternatives for repurposing or sharing samples, and/or finding appropriate archives, particularly where the samples have the proper locality and scientific documentation. In rare cases, with department closures, reorganization, or refocusing, there may be a loss of curation staff, and samples may be given low priority and/or simply tossed without time to investigate repurposing. Ethics of sample retention and curation are also important, particularly in a changing world where some original collection sites are no longer accessible for physical, social, or political reasons.

### **E. Training, Impact**

Given how important sampling is to our discipline, it is surprising that 63% of respondents have never had any formal training as students on sampling ethics. There is a strong consensus that students want and could use more training in values and ethics in their curriculum. Some students noted that they hear more about “leave no trace” through the outdoor recreation industry. Given how important outdoor interactions are to geologists, ethics training should be a high priority. Many indicated they would welcome resources and materials to help integrate ethics into the curriculum. 91% of respondents feel that sampling in very sensitive sites with strong geoheritage value or cultural and/or spiritual significance might warrant careful review of sampling plans and procedures.

### **F. Actions for the Future**

Although requiring proof of sampling permits can be difficult and sometimes unrealistic, nearly 75% of respondents felt that publications should possibly require a sampling ethics statement. And, going forward, 79% of respondents indicated interest in development and access to teaching or resource materials on the ethics of sampling. Certain geoscience society journals are already implementing codes of publishing ethics and/or mandatory standards that include statements on sampling ethics. As an example on the ethics of fossil sampling, the Society of Vertebrate Paleontology has already developed an ethics code that specifically addresses sampling practices

(SVP, 2023), and that applies to all of their membership and those who publish in their journals or participate in their events. Similarly, the Geological Society of London (GSL, 2023) requires a statement regarding ethical sampling practices in their publications. Expansion of the GSA Code of Ethics & Professional Conduct (GSA, 2023a) to explicitly address ethical sampling practices is a positive action GSA can take to collaborate and provide resources to fill this clear need. GSA has begun to address the issue of sampling ethics and related open access to samples and data in their Ethical Guidelines for Publication (section 3.7, GSA, 2023b) and GSA Data Policy for Publications (paragraph 4, GSA, 2021), but these policies and position statements need to be revisited and strengthened.

## **TARGETED SUGGESTIONS**

Small groups at the GSA Connects 2022 Noontime Lecture Town Hall had spirited discussions targeting five topics (highlights below) that could affect how professional societies can respond.

### **1. On Resources**

Formal training on permitting and the ethics of sampling is highly desirable. Publications, webpages, or online resources with best practices would be useful across all sectors and subdisciplines. Also, checklists and resources for navigating permits and building relationships with land managers (government, tribal, and private) could be useful for many. A central webpage with a good search engine would be immediately relevant.

### **2. On Advice**

It is common to look to our professional societies for advice and professional guidance. Societies can help with information repositories and flow charts for developing field and sampling plans, a possible form or checklist for educational versus research activities, and an advisory board of experienced researchers that can recommend best practices at specific localities. Students may see or find themselves in situations that cause angst about sampling ethics. An advisory board or confidential mentoring could provide valuable advice on how to navigate such difficult situations.

### **3. On Formal Statements**

Position statements are mostly outward looking, but societies could look at internal

commitments to ethics and possibly bolster their existing codes of ethics. Even informal statements can have an impact. One example of a simple action to take would be reading a few sentences on ethics or distributing a code of conduct right at the start of professional or society-sponsored field trips.

### **4. On Publications**

“Leave no trace” should be the core of guiding practices on samples that comprise our published research, but stronger language as part of the journal publications could raise awareness and help train authors on the importance of sampling ethics. Legalities are difficult to enforce, but even strong aspirational statements can give authors pause to reflect on their sampling practices. Ethical statements commonly exist for research practices in other science disciplines (e.g., biological animal testing), and similar guidelines on sampling practices should be developed and universally applied to the geosciences as well.

### **5. On Archiving**

This is a long-term issue involving data standards, sharing provenance, and any archiving of information as well as physical specimens. Various sample registration systems (e.g., System for Earth Sample Registration, SESAR) are aimed at standard archival and retrievable sample information. Several state surveys, museums, and government agencies have local repositories for particular samples that relate to their mission. However, it is a familiar story to hear about samples going to the dumpster after a faculty member retires.

Questions surrounding sensitive lands include: Should some rocks be repatriated in cases where they were taken from areas with cultural or spiritual significance? What are the ethical obligations of long-term care or stewardship of samples under the original sampling agreement? What should be done if conditions or sensitivities change?

What is the responsibility of the investigator after they are done with a sample? In some cases, a rock swap for teaching may be used as an example of how samples can be repurposed. Even if full metadata (i.e., any descriptive data used for discovery and identification) is not available for samples to be of value to research, these may still be representative samples that are of value for teaching collections. Many samples collected for one research project can be repurposed to enable complementary and emerging new

lines of research. A similar exchange of available research samples may be warranted, and this would have the added benefit of expanding collaborative research opportunities across the geosciences.

Along with physical samples, the power of cyberinfrastructure could be both practical and powerful for archiving, such as providing a GIS layer of samples collected (tied to geographic coordinates) with all other informational metadata. However, maintaining database management systems can be very time consuming and expensive.

### GSA'S ROLE IN MOVING ETHICS FORWARD

Multiple societies cosponsored this survey on the ethics of sampling, highlighting a widespread need and desire for collaboration to raise the integrity of our discipline. GSA could be a leader in this area. More specifics on sampling ethics can both leverage and strengthen GSA's 2022 position statement on Responsible Geologic Fieldwork Practices (GSA, 2022), as well as GSA's Code of Ethics & Professional Conduct, Section 3.1 (GSA, 2023a). Ultimately, societies can create task forces and committees to set naming or metadata conventions, as well as garnering solid recommendations and sharable resources that can benefit the science and its society memberships. One new resource recently created from the work that went into this study is a Field Ethics and Sampling checklist decal or sticker that is currently freely available at all GSA meetings (Fig. 1). GSA has also started a website ([www.geosociety.org/fieldethics](http://www.geosociety.org/fieldethics)) for field ethics resources to go with this decal, and more resources will be added to this site over time.

Now is the opportune time for the geoscience community to continue open communication and involvement on the critical topic of sampling ethics, in order to guide and train future generations, and to both conserve and protect our geoheritage.

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Figure 1. New field ethics and sampling checklist sticker that is freely available at GSA meetings and is a quick and easy guide for conducting research in the field.