

Workshop Description

The Tephra 2014 Workshop was convened 3-7 August, 2014, to discuss major developments, best practices, and future directions/needs in tephra studies from both volcanological and tephrochronological perspectives. By bringing together an international group of over 70 scientists with a variety of backgrounds who study tephra for different purposes, our hope was to enhance interdisciplinary collaboration and data sharing. To provide training, the workshop also incorporated hands-on sessions on optimal sample collection and treatment, dispersal modeling, and the use of databases. Volcanologists, tephrochronologists, archaeologists, paleoclimatologists, paleoecologists, paleolimnologists, petrologists, geochronologists, tectonophysicists, Quaternary scientists, atmospheric scientists, data managers, and others who work with tephra were represented.

During a day-long field trip, and three days of presentation and discussion, tephra scientists discussed challenges, opportunities and solutions in studies ranging from physical volcanology to archeology. A consensus-seeking session was held at the end of the meeting, in which the current state of the science and emergent issues were raised. Most of the discussion in the session revolved around formulating common best practices among the different scientific communities and establishing common data archiving and retrieval mechanisms. Best practices were discussed in terms of sample collection and laboratory treatment. It was felt that a starting point for ensuring some uniformity in collection and laboratory work was to develop data sheets or templates, in addition to a consensus document. Such data sheets would be constructed in such a way to allow scientists who might not be expert in one field to nevertheless collect and analyze data that would be of importance to scientists in another field. With respect to data archiving and retrieval, the discussion revolved in large part around databases, what is currently available, their use, and development of common standards for submission and data format.

Summary Documents

Summary documents resulting from the workshop can be found here:

<https://vhub.org/resources/3860/supportingdocs>

Field Trip

The meeting started on Day 1 with a field trip to Mount St. Helens on Monday, 3 August. This included two main tephra stops focusing on the major tephra-producing eruptions of the last ~16 kyr. Stop 1, Stratigraphy Viewpoint, has excellent exposures created by floods and lahars that swept down the Muddy River on May 18, 1980. The stratigraphy includes multiple layers of tephra, fall, flows & surges, and lahars. Tephra sets S, J, Y, P, B, W, and X are represented. Lunch was taken at Bear Meadows viewpoint near the location where Gary Rosenquist took his famous photographs of the initiation of the 1980 landslide and eruption. Stop 2 provided exposures of tephra deposits including 1980, layer T, set X, layer Wn, set B, set P, layer Yn, and set J. During the field trip, excellent discussions were had about the characteristics of proximal deposits and about tephra sampling and documentation. The field trip also served to

get participants better acquainted with one-another, setting the stage for the next three days of the workshop. Everyone was so enthusiastic and interested at the tephra stops that it was difficult to get participants back on the bus to move on.



[Field Trip Guidebook](#)

Scientific Presentations

Most of the meeting consisted of scientific talks and discussion. Links to these can be found here:

[Presentation and Discussion Videos](#)

[Presentation Posters](#)

Overview

Day 2 of the workshop opened with plenary talks by two of tephrochronology's great pioneers, John Westgate and Andrei Sarna-Wojcicki, who were together for the first time in many years. John spoke about "Tephra from creation to deposition" giving an overview of the process which result in tephra deposits as well as outlining synergies between tephrochronology, volcanology, and petrology. Andrei in his talk on "Development and application of tephra studies" provided a history including people, methods, and major discoveries.

Subsequent talks emphasized the need for common terminologies to aid collaboration & communication and the types of field data that all scientists working with tephra should collect and report. Other highlights include: advances in Antarctic tephrochronology; advances in Ar-dating of tephras; advances and best practices in tephra geochemistry (majors, traces, and isotopes); the discovery that the 860B cryptotephra in Europe originates from the White River eruption in Alaska thus establishing the potential for trans- Atlantic isochrons; and a note that lakes fed by large catchments may record eruptions even without receiving direct tephra fall. Gill Plunkett noted that the rapid expansion of cryptotephra studies has raised an important question: How many shards does it take for a cryptotephra to be an isochron?

Day 3 began with discussion of tephrostratigraphy and dating methods. This included talks on the extensive tephra record at Mono Lake, dating tephras by the glass fission-track method, the combination of paleomagnetic records and tephrochronology to improve our understanding of both, and a key lacustrine record of Icelandic tephras. These were followed by several talks and discussion of volcanological aspects of tephra studies from proximal to distal. This included a novel use of ground- penetrating radar in coarse proximal deposits and ash transport modeling using Ash3D. Eruption examples ranged from maars to rhyolitic Plinian. The day concluded with a session on methods of tephra correlation and applications of tephra isochrons. The application of statistical methods like PCA to tephra correlation was considered. Examples of long-distance correlation included the refining the extent of the younger Toba tuff and use of the Glacier Peak tephra to define a continent-spanning isochron. Such long-distance correlations also have potential to aid ash- dispersal studies of ash dispersal and are a great example of the potential for volcanologists and tephrochronologists to benefit from sharing data.

The morning of Day 4 consisted of a short session on tephra databases and catalogs followed by working groups and closing discussion. Anthony Newton demonstrated several new features of TephraBase designed to make the database a great tool, not just a repository. These include easier data entry, data versioning, the ability to define sub-populations within individual samples, various search tools, and the automatic generation of stratigraphic columns. Kerstin Lehnert summarized tephra- relevant data types within IEDA systems including samples, geochemistry, geochronology, petrology, and marine as well as the development of special portals to serve different research communities. Kerstin also discussed new journals designed specifically for publishing data. Kristi Wallace described the growing Alaska Tephra Database being developed by the USGS. This houses in one system an extensive array of information including details on samples, sample preparation & processing, physical characteristics, geochemistry, and ages.

The afternoon consisted of hands-on sessions. A session on dispersal modeling provided the opportunity to work with PUFFIN and Tephra2D. During a session on tephra in sediment cores, participants were able to get up close with some tephra-bearing marine and lake cores and try taking their own samples. The third session on contributing to open databases included demonstration of multiple systems and evolved into an extended discussion of data issues.

Break-out Working Group Presentations

On Thursday, 10:30—11:30, we broke up into working groups. Members of separate groups were chosen to ensure a mix of disciplines within each group. The organizers asked that each group consider preliminary questions that had been formulated, prioritize them, and discuss what to them are the three most important questions. In discussing the three most important questions, each group considered the challenges and opportunities represented, and possible solutions or paths forward. After this, from 11:30—12:00, we reconvened. Each group gave a brief presentation about their prioritized list, the three most important questions, and their proposed responses. The group presentations can be found [here](#):

[Working Group Presentations](#)

Recommendations from the break-out sessions

Summary of Major Themes

Two main themes resulted from the six-group breakout session. Both themes focus primarily on data issues.

Major Theme 1

There is a need for standardization of tephra field/core data collection, geochemical analysis, correlation, and data reporting. Everyone should be publishing supplementary data. What data is published may need to be discipline specific but starting with a skeleton common to everyone and a list of discipline-specific best practices would be helpful. Standardizing terminology (volcanic, sedimentary etc.) would facilitate data sharing. Best practices may address, for example, sample imaging, data visualization, dating, sample preparation, physical and chemical characterization, and reporting of uncertainties. The tephra community should produce best practice fact sheets, minimum requirements etc. These could be distributed via list-serves, web sites (Vhub), and conferences as well as sent to journals for use by editors and reviewers.

Major Theme 2

There is a great need for databases to facilitate information access across disciplines. Standardizing (see theme 1 above) is a first step toward greater use of databases. The community may work with new or existing trusted repositories. Interoperability between databases (e.g. regional databases feeding a global database or search interface) should aid progress. Databases need to be planned for the long haul (funded with staff to maintain), and there needs to be support for the large and critical task of getting decades of existing data into openly accessible systems. The community should also call for all new data sets to be contributed to such systems.

Further Recommendations

Metadata and documentation of data quality. The best practices on data reporting should list the minimum information that must be included for tephra samples (e.g. source location, collector &

date, type of sample, physical description, sampling technique, photographs/images, layer thickness, particle size, stratigraphic context, archival location, etc.). Full documentation and transparency facilitates data evaluation, facilitates quantification of uncertainties, and increases the possibility of replication (e.g. recollecting samples from the same original source). For analytical data, full documentation includes all methodology from sample collection to the final analytical results. Analytical data must also be accompanied by results from recognized reference materials obtained using the same procedures.

Existing IEDA templates for samples and geochemistry could serve as a starting point.

Correlation methods and uncertainties. There remains some lack of clarity about best practices in establishing tephra correlations and evaluating the uncertainties of such correlations, especially for ultra-distal cryptotephra deposits. One common, but not well-answered question is: What statistical techniques work best? In general, correlations supported by more information (stratigraphy, ages, geochemistry – i.e. multi-parameter approach) are likely to be more robust. Analytical uncertainties can be minimized by running unknown samples and potential correlatives consecutively during the same analytical session.

The Original List of Questions

[Questions to Address During the Workshop](#)

Acknowledgements

The workshop received financial support from the U.S. National Science Foundation (award 1443393), the UB Center for [GeoHazards](#) Studies, and from the International Quaternary Association (INQUA) through the International Focus Group on Tephrochronology and Volcanism (INTAV). Mike Cummings (Portland State) and Barb Catalano (U. Buffalo) provided a tremendous amount of logistical support without which this workshop would not have been such a great success. We also thank all of our attendees who contributed a great many ideas and much enthusiasm to the workshop's field trip, talks, posters, and discussions.