

Citizen Scientist Quartz Vein Investigation Produces Significant Findings



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SUMMARY

Milky quartz veins of all sizes are visible throughout the McDowell Sonoran Preserve (the Preserve) in Scottsdale, Arizona, and are commonly found in Arizona Proterozoic rocks. No research on milky quartz had been done locally and little was known about its formation, emplacement history, and geochemistry before this study.

Principal Investigator (PI) Brian Gootee of the Arizona Geological Survey (AZGS) worked with a volunteer team from the McDowell Sonoran Conservancy (the Conservancy), which manages the Preserve in partnership with the City of Scottsdale, to conduct detailed field research and mapping and to collect samples at two sites.



Citizen scientists collecting field data at Paraiso site.
Photo by Marianne Jensen

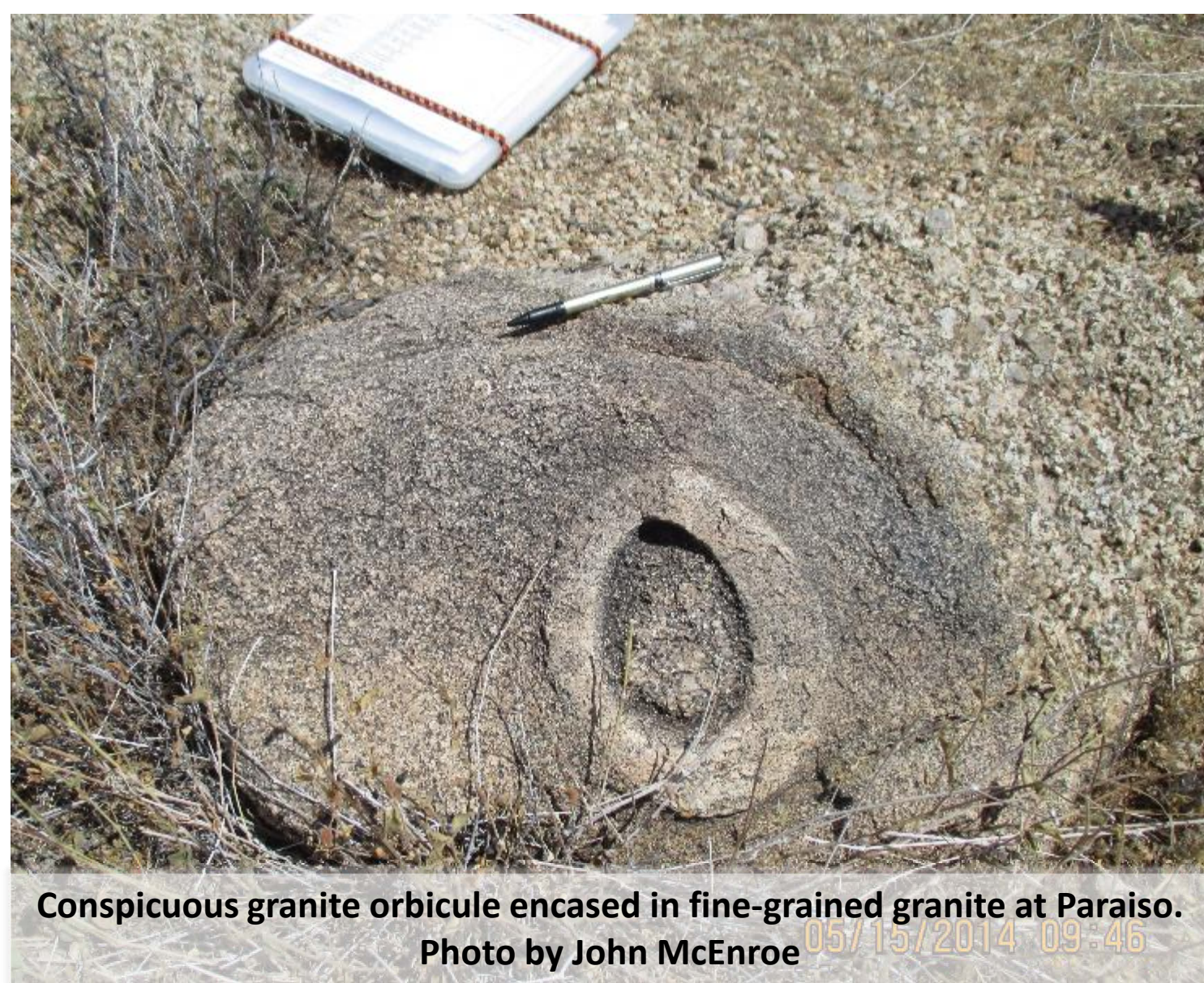


Sample collection at Fraesfield site.
Photo by Brian Gootee

Gootee analyzed the samples and, with citizen scientist project leader Daniel Gruber, summarized methodology, analyses, and interpretation in a report, including geologic maps, which was published by AZGS.

Analysis of samples from one site provided evidence of several Proterozoic quartz formation events. The other site hosted pegmatite, cumulates, graphic granite, and orbicular granite near milky quartz.

The Conservancy volunteer team leveraged professional geologists' time to expand knowledge of an important geologic feature.



Conspicuous granite orbicule encased in fine-grained granite at Paraiso.
Photo by John McEnroe

For further information please see: Gootee, B.F. and Gruber, D.G., 2015, *Quartz vein investigation, McDowell Sonoran Preserve, Scottsdale, Maricopa County, Arizona. Arizona Geological Survey Open File Report, OFR-15-03, 69 p.*



Quartz Vein Report
QR Code

APPROACH

The volunteers, all citizen scientists from the McDowell Sonoran Conservancy Field Institute (the Field Institute), the research center of the Conservancy, worked with Gootee to examine milky quartz deposits in the Preserve. The project included:

- Reconnaissance mapping and evaluating a number of prominent milky quartz deposits to identify research candidates.
- Selecting two research sites from the candidates and mapping them in detail with associated measurements, observations, and sampling.
- Producing maps, reviewing collected data, and analyzing samples.
- Preparing a summary report.

Two sites, *Fraesfield* and *Paraiso*, were selected for detailed analysis. The *Fraesfield* site consisted of widely-spaced quartz units in a well-defined shear zone surrounded by bedrock. The *Paraiso* site was a group of large cylindrical milky quartz plugs with extensive mineralization, different from all other locations identified.



Field mapping by citizen scientists.
Photo by Marianne Jensen



PI Gootee selecting orbicular granite sample.
Photo by Marianne Jensen

The sites were mapped at large and small scales to delineate the extent, structure, and relationships between rock types and geologic units that encapsulated milky quartz features. Aerial balloon photography produced 3-D spatial data and detailed images using “structure from motion” processing.

Rock samples were collected from each site for thin-section petroscopic analysis by Gootee, with fluid-inclusion analytical support by Jim Reynolds. Samples were analyzed using a Geiger counter, shortwave UV lamp, and an X-ray fluorescence spectrometer.

When analysis, map preparation, and interpretation were complete, the project summary report was submitted to AZGS for peer review.



Citizen scientists collecting data at Paraiso.
Photo by Marianne Jensen

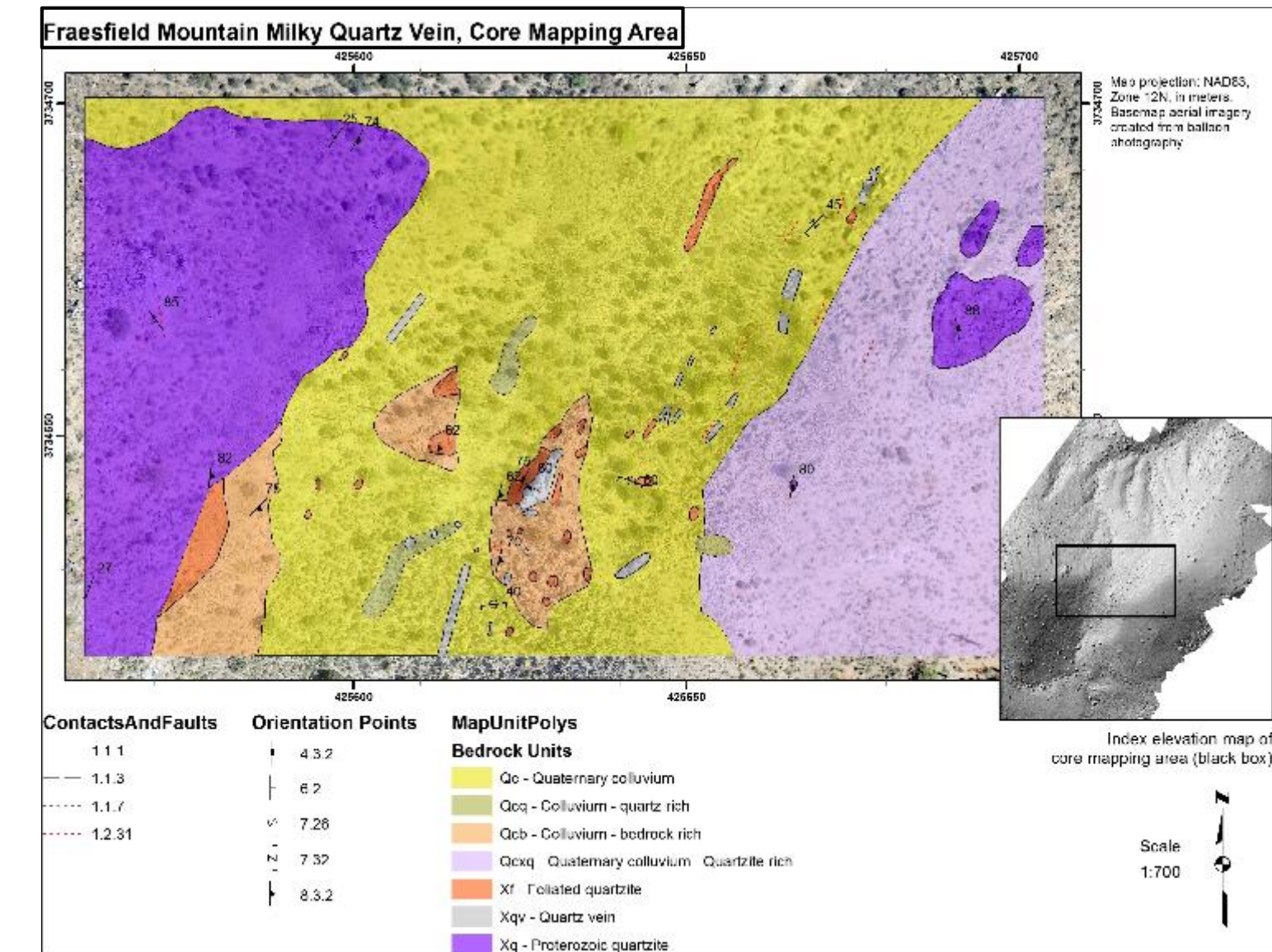
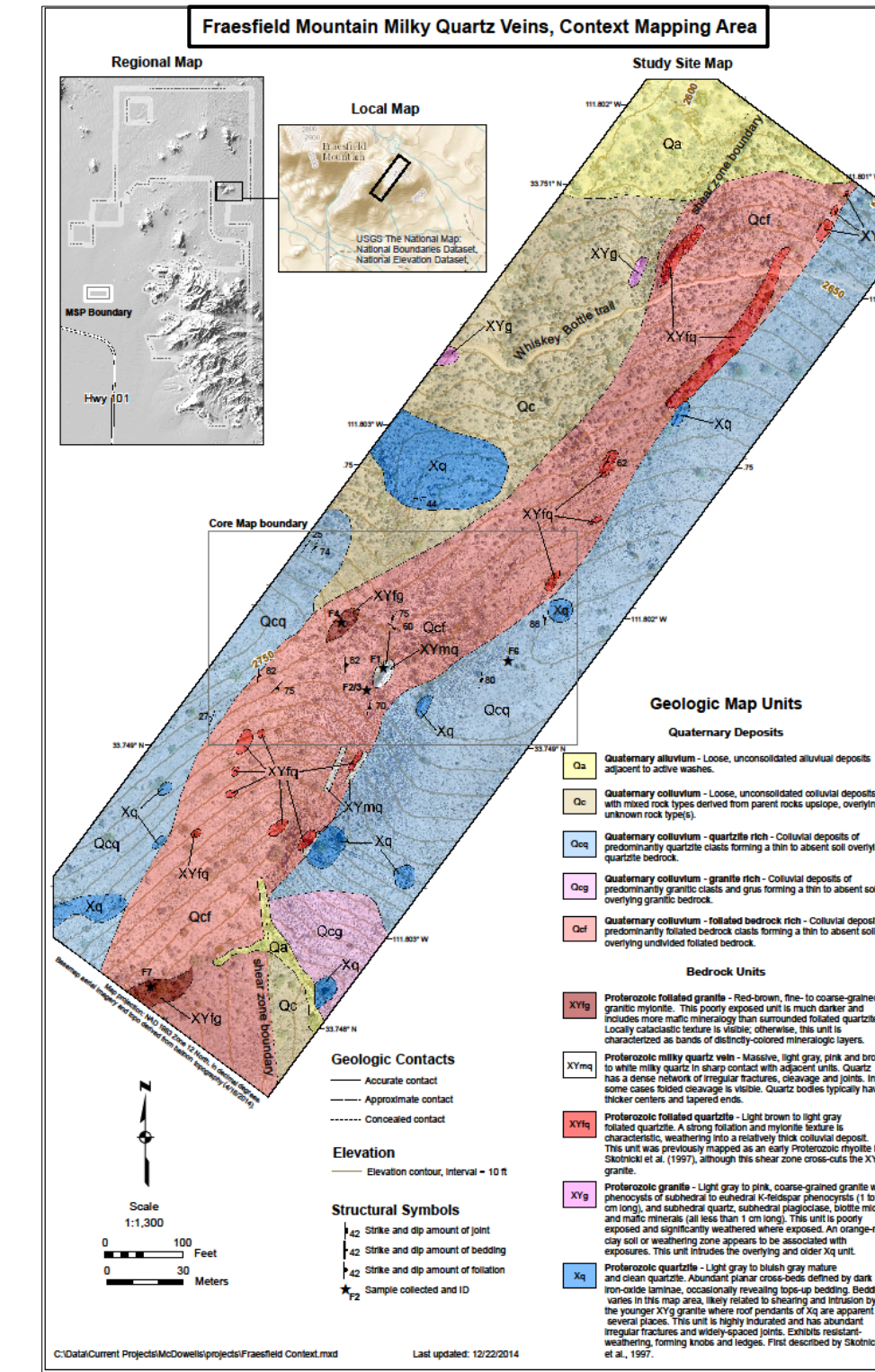


Megacrystic feldspar cast and remnant at Paraiso.
Photo by Marianne Jensen

RESULTS

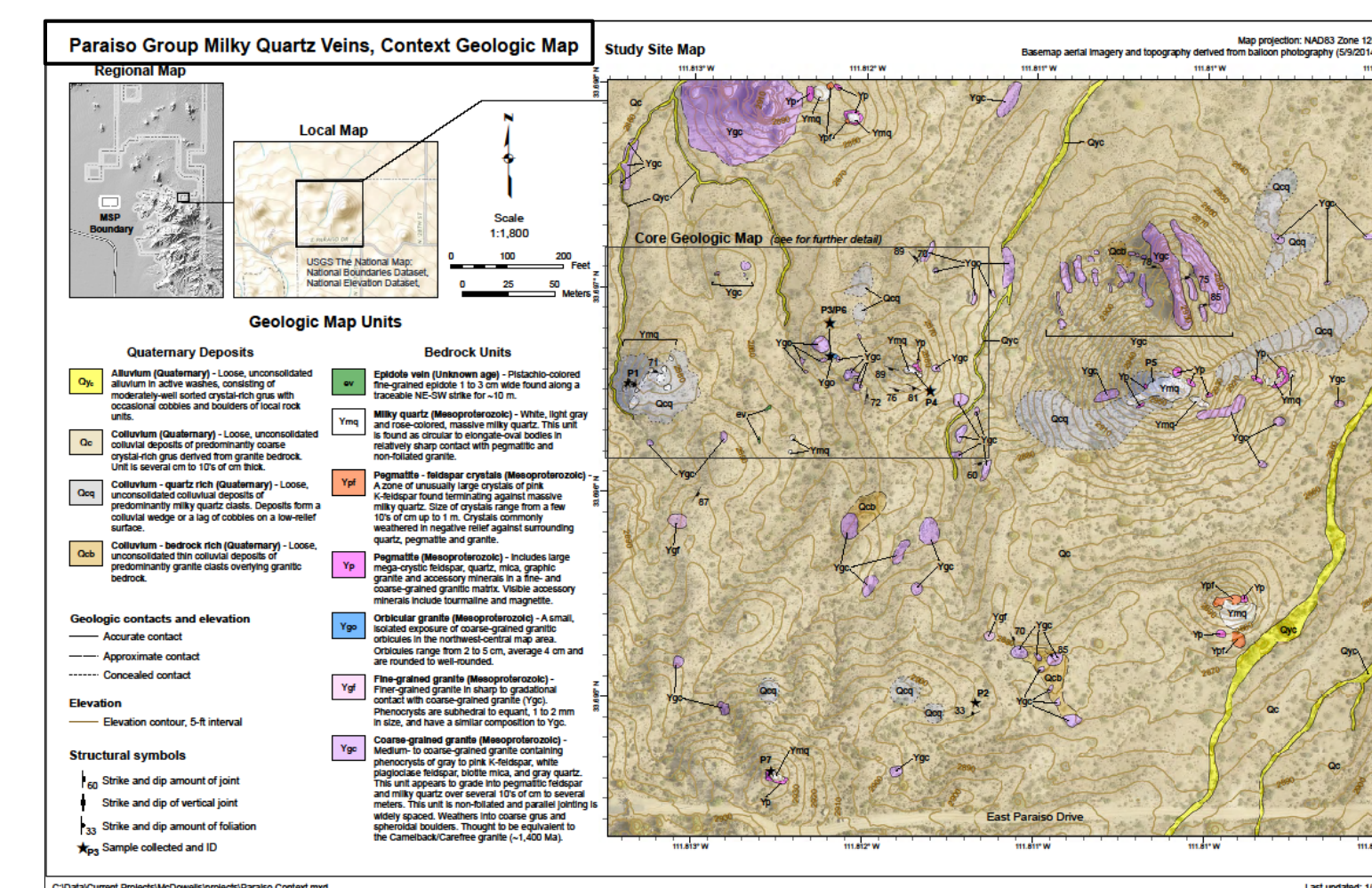
At the *Fraesfield* site, meteoric water trapped in local sandstone prior to the Mazatzal Orogeny c. 1700 – 1600 Ma was the likely source of fluids for the original formation of milky quartz there. The geology is represented by three events:

- During end-stage sandstone metamorphism c. 1600 Ma, hydrothermal conditions likely supported formation of non-deformed but discontinuous tabular or oblate quartz veins.
- The Carefree Granite intrusion c. 1425 Ma again produced hydrothermal conditions suitable for continued formation of quartz veins in both granite and quartzite.
- The existing rocks deformed along a narrow shear zone associated with c. 1400 Ma magmatism or the c. 1100 Ma Grenville Orogeny. Quartz veins and minerals underwent several periods of recrystallization, micro-fracturing, and fluid inclusion producing complex structures.

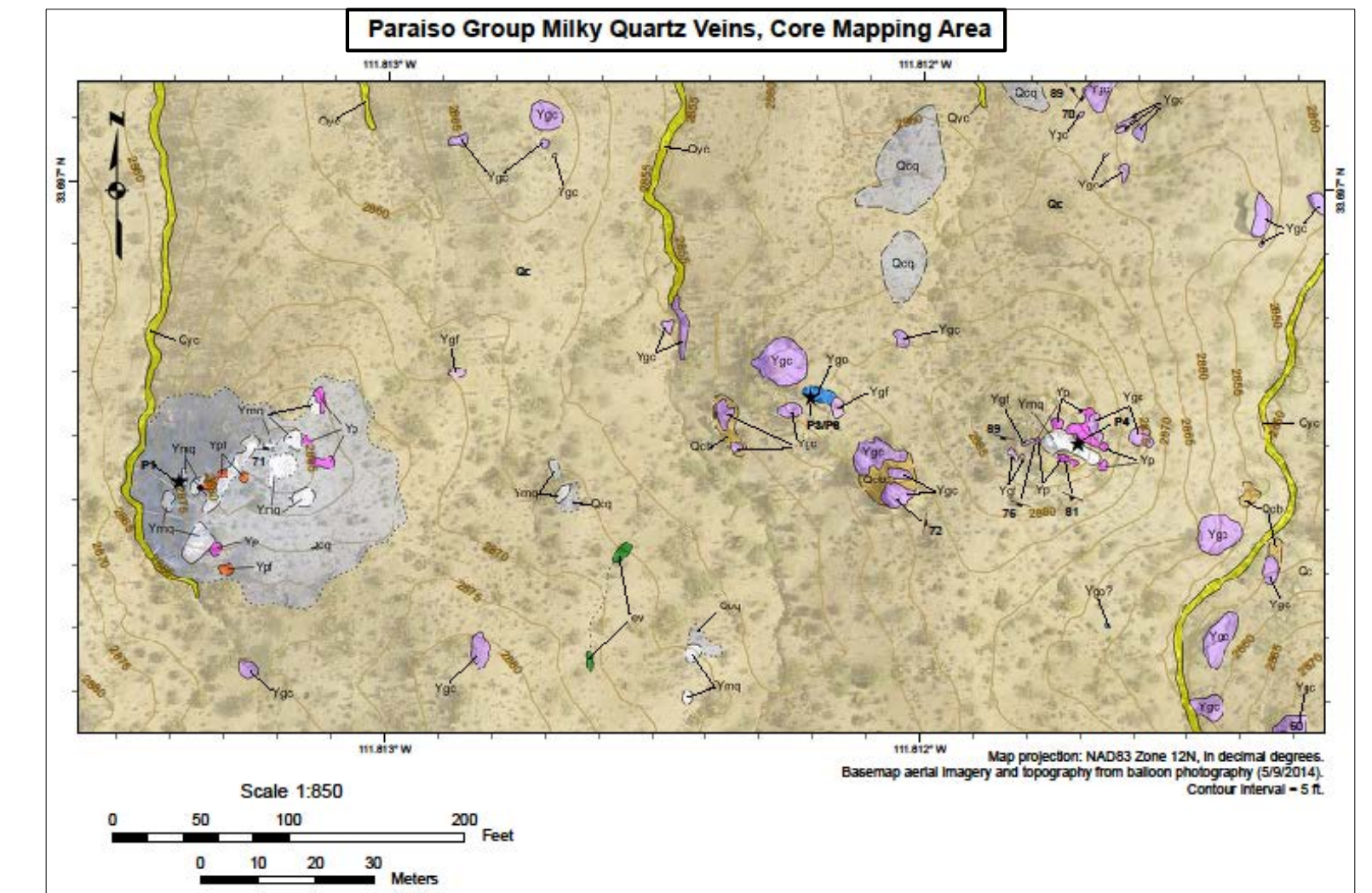


At the *Paraiso* site the main bedrock units are isolated hills and knobs of:

- Coarse-grained granite
- Massive milky quartz veins encircled in megacrystic pegmatites and graphic granite with cylindrical, conic or elliptical shapes.
- Granitic pegmatite with coarse to gigantic feldspar crystals and/or graphic granite. The pegmatite is likely late-stage, well-insulated crystallization at the margin of a fractionated granite batholith emplaced c. 1425 Ma.



RESULTS (continued)



Orbicular granite and cumulates were found at *Paraiso* and interpreted to have formed from circulating fluids during late-stage batholith formation before pegmatite and milky quartz formation.

We interpret the pegmatites and milky quartz cores to represent the final stages of crystallization of the Carefree Granite.

Based on the analysis and interpretation of both sites, quartz veins in the Preserve may have formed in several events over an approximately 550 million year period from the Mazatzal Orogeny metamorphism c. 1650 Ma, through the Carefree Granite plutonism c. 1400 Ma, to the Grenville Orogeny tectonism c. 1100 Ma.

SIGNIFICANCE

This investigation was conceived, planned, and managed by Field Institute citizen scientists with oversight by Gootee. The volunteer project team spent over 600 hours doing data collection, mapping, and data analysis. Gootee and Gruber prepared the report. Findings include:

- The *Paraiso* site provides a unique opportunity to study all stages of the Carefree Granite magma crystallization. The diverse geology was identified by citizen scientists, who recognized its significance.
- Citizen scientists noted the first orbicular granite and the first granite pegmatite associated with orbicular granite and cumulates in the area.
- The work at the *Fraesfield* site provided additional constraints on the date of shearing in the McDowell Mountains and perhaps regionally.
- Results indicate local milky quartz in Proterozoic rock likely formed in a wide range of environments between 1650 and 1100 Ma.

This project clearly demonstrates the ability of trained citizen scientists to undertake large-scale projects and make significant contributions to scientific research.



Tourmaline crystals in milky quartz.
Photo by Ralph Lipfert



PI Gootee with Field Institute staff and volunteers.
Photo by Marianne Jensen

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Geologic maps are by Brian F. Gootee and Daniel G. Gruber. All photographs are as noted.