Western Cave Conservancy

Protecting the West's Last Frontier

Vol 13 No 1 Winter 2020

Letter from the President

I'd like to thank everyone for all the support you've given the Western Cave Conservancy over the last year. We've been working hard to continue being worthy of your support.

Over the past year, we've been excited to finally get some recreational, trustee-based trips going in certain caves that were previously off-limits. We were also happy to see the return of cavers to Avalanche Cave, with the blessings of the Forest Service (no trustee required).

Of course, the discovery of WNS in California has been an unfortunate development (both for the health of the bats and the convenience of cavers); the WCC continues to endorse a Clean Gear Policy, even for the areas of the state in which there is not yet any suspicion of WNS. We hope Western cavers will continue to set a good example by following all the best practices for minimizing the possibility of human-related WNS expansion.

We have interesting plans for 2020 that we hope to be sharing with you soon, including a new-and-improved website, and some other things that weren't quite ready at press time… which is as good an excuse as any to remind you that there is an email list for all things WCC-related. Just visit https://tinyurl.com/wcc-announce to join!

As always, we'd love to hear your thoughts on all things related to the conservation of caves, and how the WCC can help everyone succeed at this goal. Please feel free to share them with me at steven@westerncaves.org.

Cave softly!

IN THIS ISSUE

The Ice Crawlers of Avalanche Caves

By Sean D. Schoville, Department of Entomology at the University of Wisconsin-Madison

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In February 2019 Marianne Russo was contacted by Sean Schoville, author of the following article. He had found a reference to the presence of these insects, called "ice crawlers", as having been observed in Avalanche Cave. This original siting of this species at Avalanche Cave was reported by Mother Lode Grotto member, Dave Cowan in the mid-1980's. It was this reported siting that Sean was following up on. He asked for her help in pinpointing the cave on the map. She re-contacted him recently to see if he was successful in locating more specimens. Unfortunately his plans for a trip in 2019 fell through and he will try again this spring to ski in while there is still snow on the ground. He was also interested in joining a trip to

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Editor Mark Bowers

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the cave later in the summer since the entrance may be blocked with snow until mid-summer. Perhaps we can look forward to further news about this interesting creature next year.

Cave environments often provide a home to an unusual collection of species, many of them rare and endemic to highly localized habitats. Caves provide cool, humid microenvironments that are relatively constant throughout the year, and despite the lack of light, these stable climatic conditions are beneficial to a variety of organisms. Among the oddities that frequent the darkness are a group of flightless insects, relatively large in size (0.5-1 inch in length), that climb the walls and live in the small spaces of rocky habitat that surround the cave interior.

These insects, known as ice crawlers, are unusual and extraordinarily rare, living only in mountain tops in alpine habitats and in caves throughout western North America. Ice crawlers (a name that suits their preference for cold temperatures and their habit of foraging on snow or ice) are known scientifically as the genus Grylloblatta, and make up their own insect order Grylloblattodea. Ice crawler populations seem to use both the cave ecosystems and surface habitats at different times throughout the year. At low elevation sites throughout northern California, ice crawlers are active on the surface when snow is present (December to March). They forage at nighttime, and they can be seen moving briskly on snow when most other insects would perish. Later in the season, the same population of ice crawlers can be found in the twilight or dark zones of caves as snow disappears and surface habitats warm in the summer. This suggests that they are most likely troglophiles (rather than cave obligate troglobites), and their anatomy also supports this classification. For example, their compound eyes remain well developed and adults are pigmented.

Adult male ice crawler in a lava tube at Lava Beds National Monument.
Photo Credit: Sean D. Schoville

Over the last ten years, a general understanding of the relationships among ice-crawler species has emerged through the use of genetic data. Scientists have been using genetic research to reconstruct the relationships and evolutionary history of ice-crawler species, and have shown that they are excellent record keepers of how past glacial cycles have impacted local climate conditions throughout western North America. Several species of Grylloblatta are known from California, though the described species are geographically quite distant from Avalanche Caves. Grylloblatta washoa is known from alpine sites near Tahoe, and G. barberi is known from low elevation sites along the Feather River. Avalanche Caves, and nearby Sierra Buttes, host populations of ice crawlers that are poorly studied. Recently published genetic data suggest populations at Sierra Buttes are quite distinctive and may represent an undescribed species. Thus, it is of considerable interest to study populations from Avalanche Cave, to determine whether they represent a new endemic species. Additionally, experiments to determine the environmental sensitivity of ice crawlers to temperature and humidity are being employed to understand how changing environments might impact the conservation status of these rare species. Species of ice crawlers that occupy cave habitats rely on cool, humid microclimates, and snowfall during the winter to forage for resources, grow and develop. Thus, ongoing research is important to develop an understanding of how changing cave conditions and snowfall patterns might adversely impact populations of cold specialized species in the future.

REMEMBERING A PASSIONATE SUPPORTER OF THE WCC

Marianne Russo

Historical research and photos provided by Bruce Rogers

This coming spring it will have been two years since we lost the company of Gale Beach (NSS # 6725). I was heartbroken to hear of her passing when I got call from Jim Lakner, another great supporter of the WCC and a wonderful friend to both Gale and Ray Beach. I first met Gale and her husband Ray back in the mid -1980's, probably at a fall Regional or perhaps at a spring Speleo-ed. As the years passed, I could always count on seeing them at local caver events and national conventions. At virtually every national convention I attended I could be sure to see Gale working hard at the registration desk. She was a quintessential "volunteer", always ready to get in and help out wherever she could be useful. She was always to friendly and welcoming and really made me feel like I was part of the big "caving family". She and Ray were life long cavers, learning their skills on many of the Mother Lode caves I experienced for the first time when I started caving in the early 80's.

Gale was so enthusiastic when she learned that a group of cavers were starting a cave conservancy in the west. The Beach's, both Conservation Life members of the NSS, have been generous supporters of the NSS and its many worthwhile programs and projects. Seeing that a local conservancy could bring some of these same benefits to western caves and cavers, Gale encouraged us at every opportunity. She and Ray opened their home on several occasions when we needed a place for a board meeting and always showed up at annual public meetings and Regional presentations to lend their support.

Photo of Gail in her youth.
Photo Credit: Unkown

Gale and Ray became founding members of the WCC in 2003, and always gave generous annual donations. However, Gale was especially fond of Rippled Cave having visited it many times during her early years of caving, and when we put out the call for donations and loans to help pay for what is now known as the Weller Preserve (15 acres plus Rippled Cave), she and Ray came through in a very big way. They gifted the WCC with $10,000 and loaned us another $10,000. They, along with several other very generous long-time cavers made it possible for us to acquire this much-loved Mother Lode cave, which sees frequent visitation by central California grottos throughout the year.

As if that wasn't enough, and this is a special memory for me, I would periodically get "post-cards" from Gale, bearing little notes asking if we needed anything for the Preserve. When I say post-cards, I mean old fashioned picture cards that you could buy at gas stations or variety stores, that had place on the back

Gale & Ray Beach outside Wildcat Cave at the 1972 White Salmon, WA, NSS convention. Photo Credit: Unkown

for a short note on one side, the address and postage stamp on the other. Before the advent of smart phones, I guess these could be considered the original "text messages". Anyway, as a result of one of these cards, Gale and Ray ended up giving me the money for the four folding tables and 20 stacking chairs we have in the Weller Fieldhouse. These are used for meetings and classes that are held from time to time. They donated other materials when we needed them and were always encouraging us to make further improvements. I can say, truly, that we would have had a lot tougher time purchasing Rippled Cave and managing the preserve without the help of Gale and Ray.

And now, if you didn't have the opportunity to know Gale and Ray well, or actually go caving with them, here is a brief history of their caving lives:

2003 with Julia Graves (sis-in-law to Gale's younger brother Pat) & Ray — all supporting Beverage Appreciation Day… Photo credit: Unknown

Gale first became acquainted with cavers and caving in the early 1960's, when she was still a student at Stanford University. Her adventurous room-mate, Susan, discovered this interesting new club called the San Francisco Bay Chapter of the NSS. They

Gale perched on The Chockstone in the Scallop Room, Rippled Cave, Feb. 26, 1972. Photo credit: Unknown

attended a meeting and met a handsome young man, newly retired from the US Marine Corp. This fellow, one Ray Beach, was destined to play a major role in Gale's life. Apparently, in these early days, first time cavers such as Gale were blindfolded during the drive to their first cave. Until recent times, secrecy for cave locations was the mantra for all cavers. Today, of course, with GPS and the social networking, this is breaking down, although many hard-core caves are still very circumspect with what they share.

She and Ray married in 1962, and she started her career in the admissions department of the San Francisco Children's Hospital. Gale was a very active caver between 1961 and the early

Gale in Menlo Park, CA 2016. Photo credit: Unknown

1980's, and along with Ray and other SFBC cavers did a remarkable amount of caving, many times under very tough conditions. In order to keep up with the "boys" and do all this caving, Gale quickly became vertically proficient. During this time, the standard rappel rig was double brake bars on two oval karabiners. A single steel chain link between them held the rig together, this was then attached to the seat harness with a locking karabiner. To climb back out, Gale used prusik knots which are tied on to the rope using a loop of cord with a smaller diameter than the main rope. Later, when they became available she switched to a set of Jumar ascenders, which were the standard when I started caving.

Besides going caving, she was active in grotto, region and national NSS activities. She was treasurer of the SFBC for decades, did a stint as the Western Region secretary/treasurer, helped edit the Cal Caver (now called the Western Caver), served as a member of the NSS Board of Governors and was for many years an active member of the NSS awards committee. Early on, she was assisted in the running of both the 1966 NSS Convention at Giant Forest in Sequoia N.P (the first truly western convention) and the later 1975 convention held at the Angels Camp, Frogtown fairgrounds in the California Mother Lode.

Gale and Ray participated in innumerable adventurous trips, not only to local California caves, but also exploring the great expanses of Nevada visiting caves and other features in the vast back country. The Beach's, along with Roger and Caroline Brown and our very own Bruce Rogers enjoyed amazing trips, usually associated around NSS Conventions, all around the U.S.

Bruce Rogers Surveying Shaft to Lower Tunnels: Credit Mike Davies

Stories are filled with tales of unexpected snow storms, flash floods, endless and confusing 4WD dirt roads, sodden tents and of course, fabulous camp dinners and adult beverages.

Gale was a very social person and for her the comradery of her fellow cavers was as important as the actual caving. She loved organizing gourmet meals on major trips and always appreciated a good party. Her social acumen and drive to organize and promote what she cared about led to her participation in "Speleo-politics", both on a local and national level, where she was very effective. Gale and Ray both had very successful careers which enabled them, in recent decades, to quietly be very generous donors to worthy caving projects such as the WCC and those associated with the NSS and affiliated organizations.

CLEAN GEAR POLICY – FIELD GUIDE

In keeping with the WCC Clean Gear Policy and in light of the presence of the WNS fungus in California, project managers and trustee leaders are expected to follow this guide to insure that at least a minimal effort has been made to protect our caves from contamination.

All trip organizers, whether they are project managers or trustees, must inform potential trip participants ahead of time that the WCC expects them to have clean gear before they will be allowed to enter any caves we control access to. If, in the case of Rippled Cave, grotto trip leaders vary, it is the responsibility of the Weller Preserve manager to inform leaders of this policy whenever they request access.

Project managers and trustees should always promote formal WNS Decontamination protocols. When informing potential participants of our policy, they should be given the link to our website where an electronic copy of our decontamination pamphlet can be found. Each project manager should have some of the paper pamphlets available to hand out at trustee meetings or at other times when it seems appropriate. [We need to make sure the place on our website where the decon info is located is SUPER EASY to find and download.]

At the SVR project we are requiring that the trustee tell potential participants that they need to follow decontamination protocols and they are requiring an email from each person confirming that they have done so. Do we want to expand this to our other caves? Lets discuss the pros and cons.

While it will be impossible to determine if gear has been truly decontaminated, it can be visually checked for visible signs of mud or dirt. Before cavers enter any of our caves, the trip leader should inspect the clothing, shoes, packs, helmets, gloves and any other gear. If there are stains, but no mud can be flaked off or dust shaken off, then it can be considered clean. For larger groups, the leader can designate another trusted caver or two, to assist with the inspection.

During this inspection the leader might take an opportunity to do a little education about the importance of not transferring organisms or pathogens from one cave to another.

ELECTRONIC NEWSLETTERS IN 2020!

Dear WCC Member:

The WCC Board of Directors has decided to switch to publishing an electronic newsletter as our default option, starting with the second issue of 2020.

Now if you are one of those people who still prefer receiving a paper copy, don't worry we are happy to oblige! However, you will need to let us know that you wish to continue getting paper newsletters.

To continue receiving paper copies, contact Marianne and let her know. You have three options:

Call her at: 916-663-2571 (you can leave a message if you want).

Email her at: mariannelrusso@gmail.com

Or send this sheet back by snail mail to:

Western Cave Conservancy, PO Box 230, Newcastle, CA 95658

Project report for White Moon Cave, CA

Cameron de Wet (cameron.de.wet@vanderbilt.edu) on behalf of the Oster Lab Group

Dept. of Earth and Environment Science

Vanderbilt University

We are using stalagmites collected from White Moon Cave to investigate climate changes in coastal California over the last ~10,000 years. Paleoclimatologists prefer to use stalagmites rather than other types of mineral cave deposits because of their simple, linear growth pattern. Variations in geochemical parameters of the calcite (CaCO3) within a stalagmite track changes in climate during the time that the stalagmite grew that are transmitted through water that seeps from the surface into the cave. Thus, stalagmites can be used as records of what

Figure 1. Vanderbilt undergraduate student Monica Xu samples dripwater in White Moon Cave in June 2019.

the climate was like in the past, in a similar way to how scientists study the chemistry of ice and air bubbles in ice cores. Over the last few decades, stalagmites have become increasingly important records of paleoclimate changes in continental settings.

Stalagmites are particularly valuable records of paleoclimate because of our ability to data individual layers within them with a high degree of precision using uranium-thorium (U-Th) disequilibrium dating techniques. This technique is based on the fact that, generally speaking, U ions are mobile in the soil and rock above the cave and can be transported to the stalagmite via seepage water, whereas Th ions are not. This means that any Th that we measure in the stalagmite layers is likely to have been sourced from the radioactive decay of the uranium ions, which occurs at a known rate. These measurements, allow us to generate an "age-model" that estimates the age versus depth relationship for the entire stalagmite and produce a record of chemical changes in the stalagmite with time.

We have collected U-Th ages for four stalagmites from White Moon Cave that indicate that these samples started growing in the cave between 6,000 and 10,000 years ago. Three of these stalagmites were found broken within the cave, likely due to blast damage associated with quarrying efforts. One stalagmite was collected in situ by Oster and her students in consultation with Bruce Rogers in 2013. These samples allow us to assess how climate in drought-sensitive coastal California has varied since the beginning of the most recent geologic epoch known as the Holocene, which began roughly 11,000 years ago. The ratio of oxygen isotopes (δ18O) in the stalagmites provides information about the temperature of the atmosphere when rain droplets condensed and fell above the cave, as well as the atmospheric circulation patterns that brought the rain to this region. The ratio of carbon isotopes (δ13C) tells us about the amount and types of vegetation that was growing above the cave in the past. Trace elements (e.g. magnesium or phosphorous) provide information about how wet the environment was and the rate at which rainwater infiltrated the ground above the cave. We also monitor these same geochemical signals in dripwater samples in the modern cave environment in order to better understand the system today. These cave monitoring efforts allow us to hone in on what aspects of climate system (e.g. temperature, annual rainfall, rainfall source) are driving the changes that we see preserved in the stalagmite. Together, these different geochemical proxies allow us to investigate specific questions about how California's climate has changed in the past, with an eye toward better understanding what to expect in the future.

Specifically, our lab has been using a speleothem from White Moon Cave that grew from ~8,600 until ~300 years ago (WMC1; fig. 2B) to investigate how rainfall rates in the region have changed in response to changes in global ocean and atmospheric circulation patterns. We have been focusing on an important climate event that occurred 8,200 years ago, known as the 8.2 ka event. The event is believed to have been caused by the catastrophic draining of large lakes of glacial meltwater that were situated near the present-day Great Lakes at the end of the last

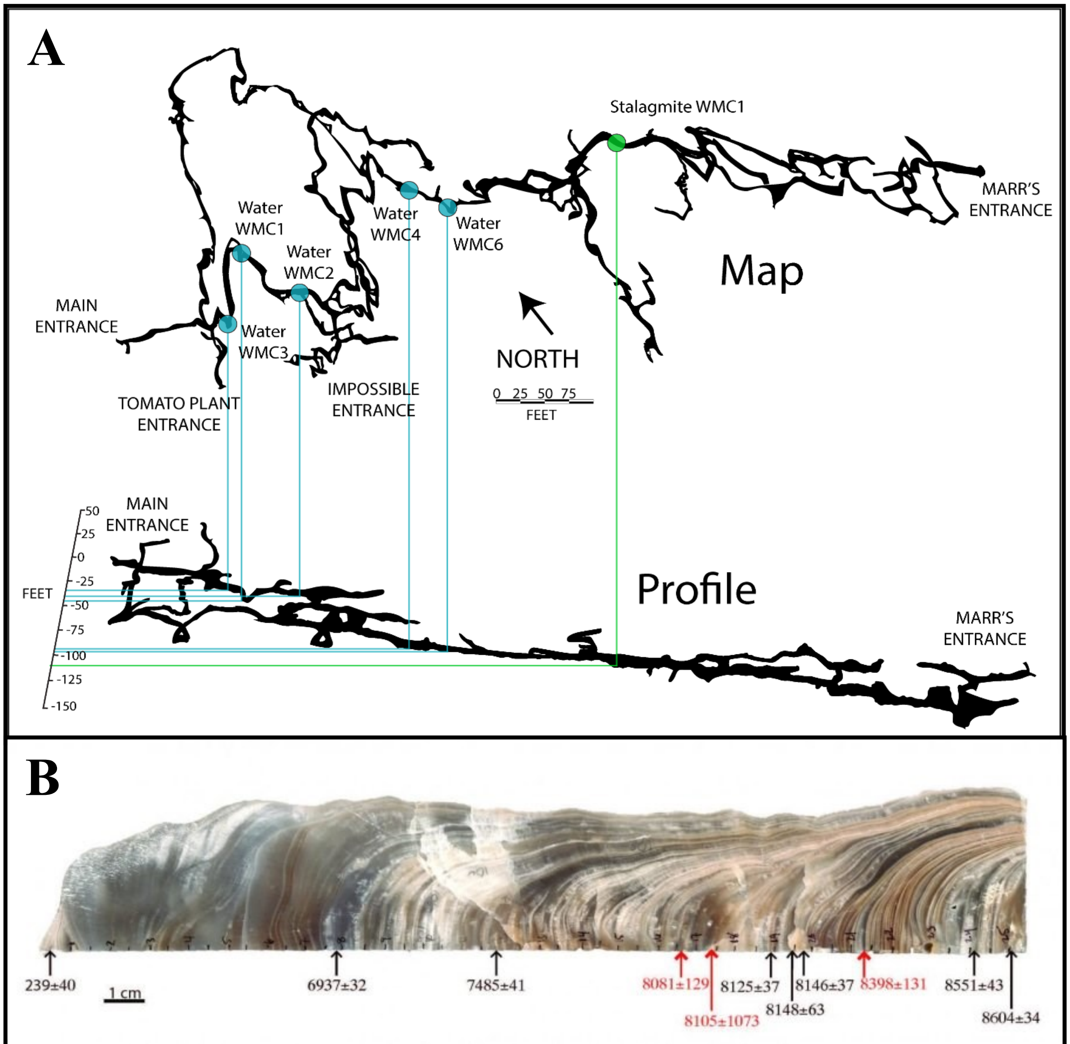

Figure 2. (A) WMC map and profile. Blue dots show water sampling locations from this study. Green dot shows approximate location of stalagmite WMC1 that was collected several years ago by a UCSC student. Main entrance is the modern entrance, which opens to the quarry wall. Map based on unpublished cartography by P. Bosted in 1986. **(B)** Quartered and polished stalagmite WMC1 with U/Th dates (cal. years before 1950) and 2 sigma errors from Os-

ice age. The drainage of this cold, fresh water into the North Atlantic appears to have caused a suppression of deep water formation that lasted for ~160 years. Paleoclimate records indicate that this suppression had ripple effects throughout the Earth's climate system, resulted in colder temperatures in the northern hemisphere, and changes to precipitation patterns around the globe. Paleoclimatologists have been particularly interested in the 8.2 ka event because continued influx of large volumes of meltwater from the Greenland ice sheet to the North Atlantic could lead to a similar disruption to ocean circulation in the coming decades/centuries.

Importantly however, the impacts of this significant climate event have not been well characterized in western North America. Our work at White Moon Cave has been changing this. Stable isotope and trace element data from the White Moon Cave stalagmite point toward increased wetness and storminess in coastal California during the 8.2 kyr event, suggesting rapid changes in atmospheric circulation over the Pacific Ocean in response to freshwater input and cooling in the North Atlantic. These data were published in the journal Scientific Reports by Dr. Jessica Oster in 2017 and have raised interesting questions about how winter storms in coastal California may be influenced by climate changes around the globe.

We are now applying a new geochemical measurement to this stalagmite to attempt to generate quantitative reconstructions of precipitation change across the 8.2 ka event. The calcium isotope ratio in stalagmites (δ44/40Ca) responds to how much calcite has precipitated from seepage waters in the rock above a cave, which is ultimately a function of the amount of local precipitation. Most interpretations of paleoclimate proxies are limited to qualitative changes (e.g. more vs. less annual rainfall), but the calcium isotope proxy has been interpreted as a quantitative metric for past rainfall (e.g. increase in annual rainfall by 300 mm). Calcium isotopes represent an exciting new method of investigating rainfall variability in California during the 8.2 kyr event and beyond with a high degree of detail. To complement the δ44/40Ca data and explore variations in host rock dissolution, we are also developing a strontium isotope (87Sr/86Sr) record for WMC1. Speleothem87Sr/86Sr is an established qualitative proxy for water-rock-soil interactions above a cave and will serve as a valuable comparison for the δ44/40Ca data.

Our ongoing work in White Moon Cave is aimed at continued monitoring of oxygen and carbon isotopes and trace elements in cave drip waters during the summer and winter at multiple drip sites within the cave (see fig. 1A). Additionally, in order to use calcium isotopes to estimate specific rainfall rates in the past we must compare our stalagmite data with data from calcite that grew in the modern environment. In order to achieve this we install small glass plates underneath drip sites and allow trace amounts of calcite to precipitate on them. We then return to the cave after ~6 months to collect these plates and analyze the modern calcite. Ultimately, it is the comparison of this modern calcite and calcite from the stalagmite that allows us to estimate average annual rainfall from thousands of years ago.

Our lab has also been using a different stalagmite from White Moon Cave that grew from ~7,500 until ~3,000 years ago (WMC2) to develop new techniques for determining the ages of stalagmite layers. As noted above, stalagmites can be accurately and precisely dated at high precision using uranium-thorium disequilibrium dating methods, but this precision can be markedly reduced if the analyzed calcite is contaminated by other U- or Th-bearing mineral phases. Such contaminants can be difficult or impossible to visually identify using conventional microscopic approaches when they are below the speleothem surface, and

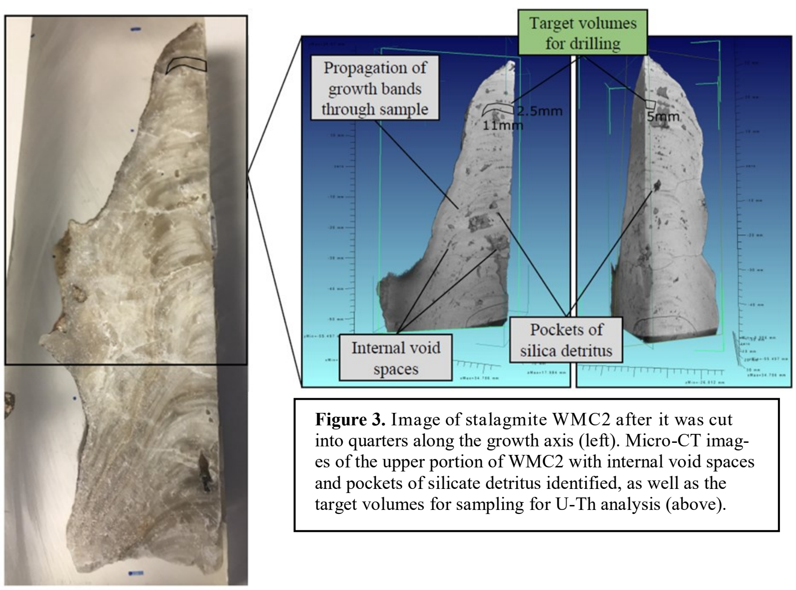

Figure 3. Image of stalagmite WMC2 after it was cut into quarters along the growth axis (left). Micro-CT images of the upper portion of WMC2 with internal void spaces and pockets of silicate detritus identified, as well as the target volumes for sampling for U-Th analysis (above).

may be accidentally incorporated into sub-samples, leading to unexpectedly large dating uncertainties.

In collaboration with a high school student from the School for Science and Math at Vanderbilt (SSMV), a partnership between Vanderbilt and Metro Nashville Public Schools, we have developed an approach to identify clean, dense calcite samples for U-Th dating using the micro-Computed Tomography (CT) machine at Vanderbilt that is minimally destructive to the stalagmite sample. Just like CAT scans in a doctor's office, the microCT machine uses X-rays to image density differences within a sample and construct a 3-D model of the internal structure of the stalagmite. We applied this new approach to WMC2, which contains mm-sized pockets of silicate detritus that greatly reduce the precision of U-Th ages. Because different minerals have different densities, this new approach allows us to detect these pockets of detritus below the surface of the stalagmite and then select volumes to sample for U-Th analyses that are free of contaminating minerals. Ultimately, we were able to improve the precision of the U-Th ages for WMC2 considerably. This method shows promise for optimizing the selection of material for U-Th or other proxy analysis and can thus improve paleoclimate records, especially in stalagmites with high concentrations of contaminating minerals.

We hope to continue working in White Moon Cave in collaboration with the Western Cave Conservancy. Future goals include developing paleoclimate records that cover the entirety of the last 10,000 years using all of the stalagmites we have collected from the cave. The development of these records takes time, and involves many different sampling and analytical techniques. The field effort is central to this work because understanding how modern climate change influences the cave provides the framework for interpreting the past changes we see in stalagmite geochemical records. We greatly appreciate the collaboration of Mike Davies and Bruce Rogers in providing guidance and support in the field. This work has been financially supported by the National Geographic Society, the National Science Foundation, and the Karst Waters Institute.

White Moon Cave publications:

Paper:

Oster, J.L., J., Sharp, W.D., Covey*, A.K., Gibson*, J., Rogers, B., Mix, H. (2017) Climate response to the 8.2 kyr event in Coastal California. Scientific Reports 7:3886.

Conference Abstracts (* denotes student author):

de Wet*, C., Erhardt, A.M., Marks, N.E., Sharp, W.D., Xu*, Y., Oster, J.L. (2019) Toward quantitative records of rainfall using speleothem Ca and Sr isotopes. PP44B-07. AGU Fall Meeting, 9-13 December (upcoming).

de Wet*, C., Erhardt, A., Sharp, W.D., Oster, J.L. (2018) Application of the speleothem calcium isotope paleo-rainfall proxy to the 8.2 ka event in coastal California. PP43E-1968. AGU Fall Meeting, Washington DC, 10-14 December.

Neal*, K., de Wet*, C., Sharp, W.D., Oster, J.L. (2018) Using microCT to improve 230Th/U dating of speleothems. PP23D-1506. AGU Fall Meeting, Washington DC, 10-14 December.

Covey*, A.K., Oster, J.L., Sharp, W.D. (2014) Coastal California climate response to the 8.2 kyr event: A high-resolution multiproxy speleothem study. GSA Abstracts with programs v. 46, no. 248070.

Oster, J.L., Covey*, A.K., Gibson*, J., Sharp, W.D. (2014) Speleothem-based evidence for the 8.2 kyr event on the California coast. Goldschmidt Conference, Sacramento, CA, 8-13 June.