YBRA UPLIFT

Issue 24 Annual Newsletter of the Yellowstone-Bighorn Research Association (www.ybra.org) 2018






Scenes from YBRA. *Top row*: (left) Kirk Johnson, director of the Smithsonian National Museum of Natural History, and Chace DeForest (wife, in hat) with kitchen crew from left to right, Chelsea French, Katheryn Fifarek, Tara Gates, Jeanette Reinhart, and Peggy Timm, and (right) California State Univ. - Long Beach field course at Clarks Fork Canyon. *Middle row*: (left) Linda Dutcher, Rick Dutcher and family at the dedication of the Dutcher dormitory on August 14, 2017, and (right) finished interior of dorm. *Bottom row*: (left) finished interior of lodge addition, (middle) YBRA booth at national GSA meeting, and (right) Phil Robertson receiving the Russ Dutcher award for outstanding service to YBRA.

Exploring New Initiatives

From the President,

I am pleased to report that YBRA continues to thrive and in 2017-18 accomplished several important goals involving improvements to the camp and the launching of new education initiatives. These efforts are central to our mission of Earth Science education and research, and promote our vision of enhancing the educational experience of faculty and students, expanding our outreach, and generating new revenue streams.

Physical improvements to the camp include the completion of the Dutcher dormitory and lodge addition, which served our students and staff for the first time this season. Both represent significant upgrades for the campus. The opening of the dormitory also allowed us to repurpose Dusenbury to a third study hall, a much needed capacity, while maintaining around 100 beds for clients. The shake roofs of the Heroy dormitory and F&M cabin were replaced with metal as part of our fire protection program, bringing the total completed to 8 buildings. The Library classroom was furnished with new tables, chairs, white boards, and a projection screen, and several cabins received new mattresses and other upgrades.

We had a very enthusiastic response to our fund-raising campaign for the construction of a faculty cabin to be named in honor of Bill Bonini. Impressively, over $56,000 was raised from 65 YBRA members and supporters in about 18 months. As of this writing, site excavation (between F&M and Thom), the foundation with floor joists, and offsite preparation of about half the whole log walls have been completed. The need for this type of facility has increased considerably in recent years as we routinely host three groups in camp simultaneously and sponsor symposia and professional workshops.

In 2017, about 335 people utilized YBRA facilities, a decrease of ~10 % over last year's record numbers. The total included 250 students and instructors from 7 universities and 55 researchers and crew members from the Bighorn Basin Paleontological Institute. Other visitors included Kirk Johnson and several board members of the Smithsonian National Museum of Natural History, the Jane Ferguson Wilderness Adventurers (promoting outdoor education for Red Lodge area youth), and several alumni, families, and volunteer workers. Student enrollments for 2018 are down significantly in several university courses, largely reflecting the cyclic nature of employment in the resource sector.

YBRA outreach activities in 2017 continue to make an impact at both the local and national levels. We hosted an Open House for the Red Lodge community, participated in the Red Lodge Fun Run for Charities sponsored by the Red Lodge Area Community Foundation, and held our 4th annual YBRA Alumni Day Symposium. Kirk Johnson, YBRA member and Sant Director of the Smithsonian National Museum of Natural History, was the keynote speaker for the event which was attended by over 80 people. At the national level, our booth at the GSA Conference in Seattle, WA attracted numerous alumni and supporters with over 50 new people signing up for the YBRA Uplift.

In 2017 and again this year, YBRA partnered with the Tippet Rise Art Center to lead geology tours for visitors at their +10,000 acre working ranch near Fishtail, MT. Tippet Rise (https://tippetrise.org/) hosts world class musicians and land sculpture artists to celebrate "the concept that art, music, architecture, and nature are inextricably linked in the human experience". I highly recommend a visit, if the opportunity arises.

As a result of recent strategy discussions, we launched two exciting education initiatives in 2017-18: 1) a YBRA Science Teacher Training workshop, and 2) professional short courses, FAST 101 and 102 (see http://www.ybra.org/fast/), that teach cutting-edge field applications in advanced photonics, imaging, and semi-autonomous aerial systems. The workshop will emphasize field based experiential learning, implementation of science standards, and provide recertification units or continuing education credits targeting middle and high school science teachers in SE Montana.

The YBRA FAST courses will focus on field applications of Small Unmanned Aerial Systems (sUAS, or drones), Applied Photogrammetry, Lidar, and Hyperspectral Imaging for professionals and faculty. We are also exploring a potential partnership with UNAVCO (http://www.unavco.org/), a NSF-funded, university-governed consortium that facilitates geoscience research and education using geodesy. One important goal of both these efforts is to ultimately transfer knowledge, datasets, and technologies to our student groups.

Our fund-raising emphasis this year shifts to a ***Restore YBRA*** campaign that targets two high-priority deferred maintenance items - rebuilding the Howell Gulch access road and replacing the plumbing and fixtures in the Main Washhouse. Both have deteriorated to a point of creating serious maintenance issues and a negative impression for clients and visitors. Although not as exciting as a building project, addressing these problems is vital to our future success. Information for contributing to YBRA is on page 6 of this newsletter, included with the proxy ballot, and on our website, www.ybra.org. Please return the proxy ballot, dues, and, if possible, your donations by **October 31, 2018.**

YBRA is exploring new initiatives that will significantly enhance our ability to fulfill our field science education and research mission. It is our hope that these and other efforts will keep YBRA vital and sustainable for the next 82 years!

Richard Fifarek….
rhfifarek@gmail.com

2018 Camp Schedule

YBRA continues to be bolstered by 5 university geology field courses and the Bighorn Basin Paleontological Institute (formerly New Jersey State Museum) that have returned to camp for years, in some cases spanning decades. Moreover, word-of-mouth "advertising" and our GSA promotions have resulted in 4 new courses filling out the 2018 schedule, including California State Univ. - Long Beach, Univ. of Texas - San Antonio, Adelphi Univ., and Drexel Univ., as well as a Pennsylvania Teachers Training workshop. Although the ~June 1 to August 15 period is nearly full, we have had little success in utilizing camp from August 15 to September 15. Already we have had a new group inquiring about 2019.

MAY — JUNE

May 27-June 4: Montclair State Univ.
June 4-22: Univ. of Houston Geology Course I
June 6-16: Pennsylvania State Univ. Geology Course
June 17-30: Southern Illinois Univ. Geology Course
June 23-30: California State Univ-Long Beach Geology
June 24-30: Univ of Texas-San Antonio Geology Course

JULY

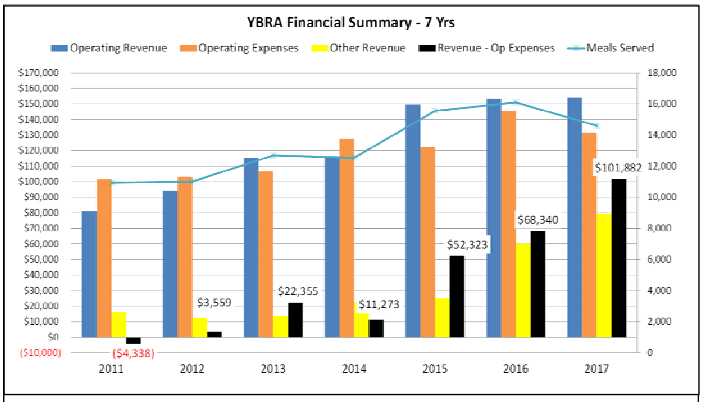
July 1: YBRA annual summer meeting
July 1-5: California State Univ.-Long Beach Geology
July 1-8: Southern Illinois Univ. Geology Course
July 7-31: Bighorn Basin Paleontological Group
July 7: Univ. of Houston Geology Course I
July 8-26: Univ. of Houston Geology Course II
July 22-31: Adelphi Univ.
July 23-31: Ohio Univ. Geology Course

AUGUST

August 1-11: Bighorn Basin Paleontological Group
August 1-3: Ohio Univ. Geology Course
August 11: Univ. of Houston Geology Course II
August 4-11: Drexel Univ. Geology Course
August 5-10: Pennsylvania Teachers Workshop
August 17: YBRA Charrette
August 18: YBRA Alumni Symposium & Open House

YBRA Financial Summary for 2017

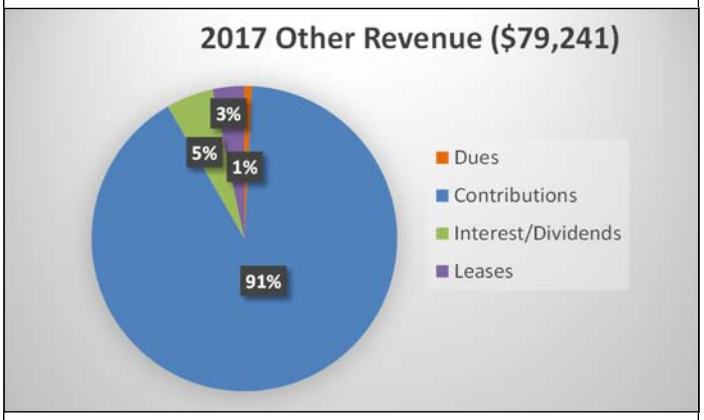
Financial data for the fiscal year ending May 31, 2018 shows that YBRA is in a sound and improving financial position and carries no debt. Operating revenues were near the record level (~$150K) of the previous two years whereas operating expenses averaged ~$133K for the same 3 year period (see bar chart). The ~10 percent margin of excess funds represents a substantial increase relative to margins from 2009 through 2014. This trend reflects the recent increases in the number of groups, enrollments, and camp rates and our ability to control costs, particularly those related to meals served. Operating revenues generally track the number of clients using our facilities and the total meals served in a season. In 2017, Jeanette and her staff prepared about 14,600 meals, an amazing figure, although it represents a ~9 % decrease of over 2016.



The student rate for room and board in 2017 was $35/day and this year is $37/day, which is still at the lower end of the range for several other field stations. We will continue to incrementally increase this rate over the next few years to a more average level.

The most dramatic change in our financial picture over the past 3 years has been a sharp increase in other revenue (see bar chart), which this year totaled over $79K. Most of these funds are designated and undesignated contributions from YBRA members and supporters (see pie chart). When operating expenses are deducted from total revenue (operating + other) we finished fiscal year 2017 with more than $102K (bar chart). The bulk of these excess funds were dedicated to building the Dutcher dormitory, lodge addition, and now the Bonini cabin. However, we were also able to address several maintenance items and replace 2 roofs with metal. Going forward, several major maintenance projects, including Howell Gulch road and the Main Washhouse, will be the focus of our fund-raising efforts and expenditures.

Clearly, our continued success is largely due the financial support from YBRA members, alumni and friends. On behalf of YBRA and the students we serve, **Thank You!**



YBRA People

Betsy Campen has resigned as YBRA Treasurer with her move from Billings, MT to South Carolina. This is a perfect opportunity to thank her for 35 years of enthusiastic service and we look forward to her continued support, albeit from a more distant locale.

Jen Baranovic is our new YBRA Membership and Marketing Director. She earned a MS degree in Geology at Southern Illinois University and previously worked for the Stillwater Mining Co. and currently is working part time for Retamco Operating Co. based in Red Lodge, MT. Jen brings brings a great deal of enthusiasm and considerable marketing skills to her position and already has made a major impact on our organization. Welcome Jen!

Dr. Emily Ward, YBRA councilor and associate professor at Rocky Mountain College (Billings, MT), is the winner of the 2017 Iris Totten Award presented by the National Association of Geoscience Teachers (NAGT). The award is designed to "promote research in geoscience education, geocognition, or related fields that investigate the ways in which people interact with, understand, and connect to Earth and Earth processes." Emily's research is interdisciplinary, combining geological sciences and the fields of cognitive science, educational psychology, and human geography. Presently, she is working with science educators, cultural experts, and tribal college faculty and staff on a National Science Foundation grant to develop valid and reliable place-based assessment for the geosciences. Congratulations Emily!

The Geological Society of America has chosen a team led by **Drs. Jinny Sisson and Alex Robinson** for the 2018 GSA/ExxonMobil Field Camp Excellence Award. This award recognizes the Univ. of Houston field course for teaching the fundamentals of field geology combined with diversity, safety awareness, and technical excellence. Over the last 10 years, ~450 UH students and 200 non-UH students have utilized the YBRA camp to study the geology of the Beartooth Mountains and Bighorn Basin. The $10,000 award will be used to improve the field education experience of future students. Congratulations UH directors and faculty!

UH field course at a stop in the Beartooth Mts.

Featured Article

Teaching Advanced Technology Applications in the Field

Dr. Colin Shaw, Assistant Research Professor, Geology Field Course Director and Undergraduate Scholars Program Director, Dept. of Earth Sciences, Montana State University, Bozeman, MT 59717-3480 colin.shaw1@montana.edu

A new generation of advanced sensor technology is bridging the gap between the physical and the digital worlds by allowing us to capture digital data describing the location, shape, appearance, and composition of real-world objects for computer analysis. These advanced sensors are enabling development of futuristic technologies like self-driving cars and autonomous robots. They also are revolutionizing field research in geology, environmental sciences, and ecology creating a demand for hands-on, field-based instruction to help students master field applications of these technologies. To address this demand, YBRA is launching a new initiative called FAST – Field Applications of Sensor Technology.

Teaching these new technologies in the field presents a host of technical and logistical challenges. Until recently, the task of introducing lidar and photogrammetry during field camp would have been truly daunting, but the advent of better instruments, user-friendly software, and the availability of teaching materials has made it possible to offer a rich and engaging introduction to these emerging field methods within the context of a traditional field camp project. The experience of the 2017 Montana State University field camp provides an instructive example of how to introduce applications of advanced sensor technologies into a field course.

Case Study: Montana State University Field Camp

In summer of 2017 MSU partnered with UNAVCO – the University Navstar Consortium – to offer a one-week module introducing field camp students to 3D reality capture using lidar and multi-view photogrammetry[1]. The scientific goal of the project was to quantify changes in the surface morphology of the Lone Peak Rock Glacier (LPRG) in Big Sky, Montana (Figure 1). This information is important for understanding the response of the glacier to climate change and forecasting impacts on the tourist economy of Big Sky Ski Resort.

Geologic Setting

The LPRG is one of at least 350 rock glaciers can be found in the mountains of southwest Montana (Florentine et al., 2014). Rock glaciers are thick bodies of ice covered by a carapace of rock debris and soil. Like their debris-poor relatives, rock glaciers flow continuously under the influence of gravity, but – insulated by their mantle of rock debris – they are less susceptible to the effects of a warming climate. Rock glaciers may soon be the last remnants of the extensive Pleistocene glaciers that once filled many high-mountain drainages in the northern Rocky Mountains; they provide a unique opportunity to study the dynamics of debris-rich ice flow and the cryobiology of ecosystems that thrive in, on, and

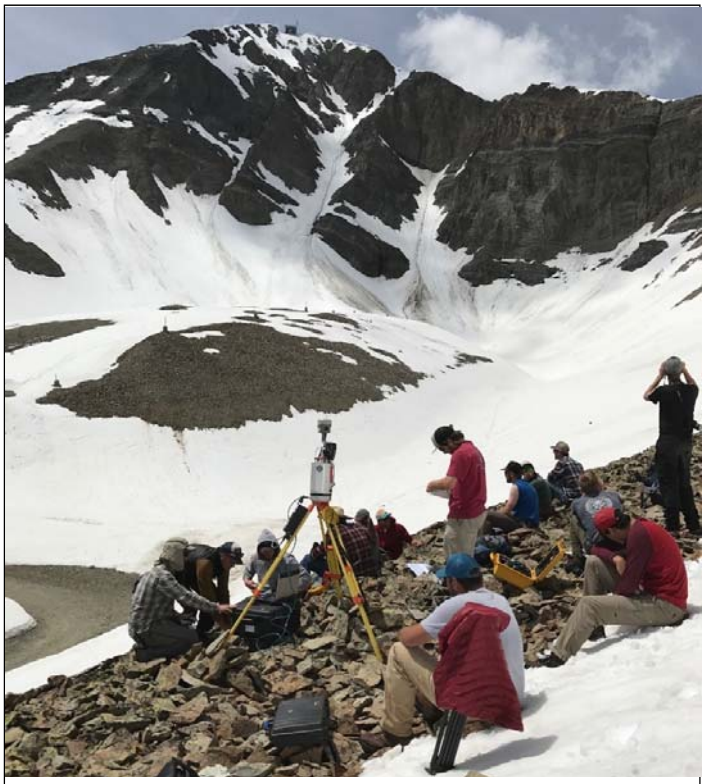


Figure 1: Students setting up a lidar scan of the Lone Peak Rock Glacier. Each student in the group is assigned a specific task and students rotate through different tasks during the course of the field day. The upper lobe of the glacier is visible immediately above the scanner with Lone Peak in the background.

around the glaciers.

The LPRG is a large and active rock-covered glacier occupying the eastern cirque on Lone Peak – a late Cretaceous laccolith in the central Madison Range, south of Bozeman. The glacier lies on private land within Big Sky Ski Resort and the base station of the Lone Peak Tram is built *on* the glacier, presenting an interesting engineering and asset management problem. Students and faculty at Montana State University have been conducting research on the LPRG since at least the late 1960s. (Florentine et al., 2014; Florentine, 2011; Gardner, 2010; Goolsby, 1972; Montagne, 1971) and several MSU geography and geology classes use the glacier as an outdoor teaching laboratory.

The Technology

Lidar scanners measure the distance to objects or landscape features by measuring the time of flight of laser pulses emitted from a rotating scan head and reflected back to a sensor in the instrument. By scanning the beam across a wide field of view lidar scanners build up a three-dimensional model of the scan area. Ground-based, or terrestrial, scanners can measure the precise position of several points for each square centimeter of terrain that is visible from a scan position producing 'point cloud' datasets containing hundreds of millions of individual point measurements. The unparalleled resolution of lidar-derived topographic data highlights features that are far below the resolution of topographic maps and are invisible to the human eye providing new insights into geomorphic and structural questions.

Multi-view photogrammetry is a complimentary technique for producing point clouds with only a camera. the technique relies on advanced image processing to combine multiple overlapping photographs into a three-dimensional point cloud or surface model. Although much less accurate and precise than lidar, multi-view photogrammetry can provide useful datasets for geologic applications using any camera. Photogrammetry platforms range from hand-held mobile phone cameras to high pixel-count, drone-mounted cameras. Use of consumer-grade cameras and open-source processing software makes the cost of entry very low.

Outcomes: Scientific Results and Student Learning

During the 2017 field module, students worked in groups to capture high resolution three-dimensional data on the glacier morphology using a terrestrial lidar scanner and multi-view photogrammetry from mobile phone cameras. After combining the individual scans into a single data set each group created a detailed three-dimensional GIS model of the surface of the rock glacier. The students then compared their model to an aerial lidar scan of the same landscape collected in 2005 and calculated the change in elevation for the entire surface of the upper lobes of the glacier (Figure 2a). Project deliverables included a GIS map showing the magnitude of surface changes between 2005 and 2017, a detailed report summarizing student's interpretation of their data, and step-by-step instructions on how to run a lidar scanner to conduct a geomorphologic survey.

Despite a significant late-season snowpack (Figure 1) students were able to collect good data on exposed rock debris for critical parts of the upper lobes of the rock glacier. The data reveal a complex pattern of elevation increase along the frontal scarps of glacial lobes with a few areas of elevation decrease (Figure 2a). Lidar scan data of the Lone Peak Tramway base station confirms that the glacier is moving at a rate of over 25 cm/year for a net displacement of more than three meters between 2005 and 2017 (Figure 2b).

Assessment of project deliverables indicates that students achieved a basic mastery of lidar theory and methods during the five-day module while also learning about alpine geomorphology and rock-glacier flow dynamics. UNAVCO equipment, technical support, and teaching materials were essential to the success of the course. With support from the National Science Foundation, UNAVCO provides instruments and technicians/instructors for qualifying field courses. Costs are limited to instrument shipping and technician travel.

The experience of the 2017 MSU summer field camp lidar module on the Lone Peak Rock Glacier demonstrates that advanced technology can be successfully incorporated into undergraduate-level field courses.

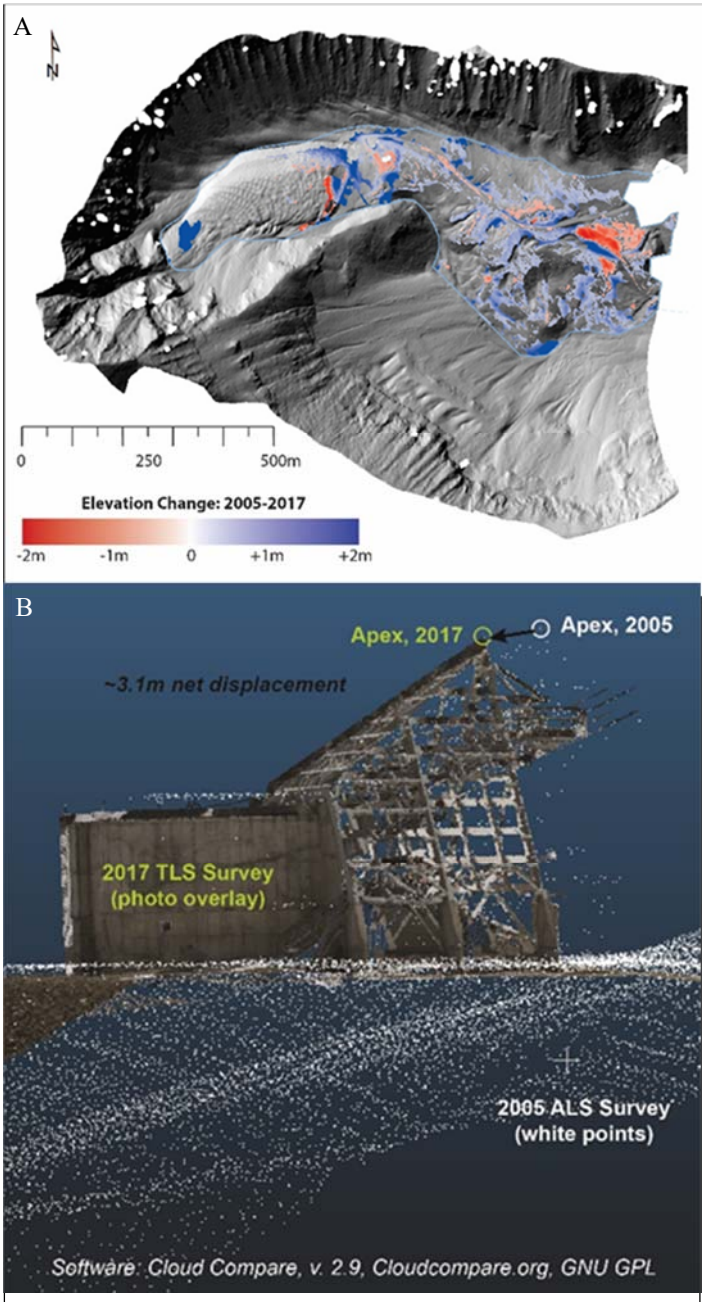


Figure 2: (A) Preliminary estimate of the change in elevation of points on the rock surface of the Lone Peak Rock Glacier (LPRG) between 2005 and 2017 overlaid on a grayscale shaded image constructed from the 2005 NCALM aerial lidar data. Snow cover was filtered out of the data set and areas outside of the study area boundary (solid blue line) were excluded from analysis. Areas shaded blue show an increase in elevation, areas shaded red show a decrease in elevation with the saturation of the color indicating the amount of elevation gain/loss. Evidence of resort operations can easily be seen in the data as linear red features and a prominent hairpin switchback. (B) Lidar scan data of the Lone Peak Tram base station. Data from the 2005 aerial survey is shown as white dots and data from the 2017 terrestrial survey is shown with a photographic overlay for clarity. It is possible to pick out the apex of the pyramidal base station in both datasets. By measuring the distance between this point in the two surveys, we can compute an approximate net displacement of about 3.1 m for the twelve-year period 2005-2017... or about 26cm/year. This is similar to the 31.5cm/year rate measured using GPS on the upper lobe of the glacier above the base station.

References

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Montagne, C., 1971, Quaternary and environmental geology of part of the West Fork Basin, Gallatin County, Montana, Montana State University - Bozeman, College of Letters & Science.

Contributing to YBRA

Contributions to YBRA are vital for sustaining our camp and operations, and fulfilling our mission supporting field science education and research. With your help we can continue to provide the exceptional study environment that thousands of students have experienced over the last 82 years. Donations in any amount can be made to YBRA and, if desired, directed toward several funds including these two high-priority projects:

1) "**Restore YBRA**", rebuilding the Howell Gulch Road and replacing plumbing and fixtures in the Main Washhouse, goal is $ 65,000, and

2) "**Metal Roofs**", replacing shake/shingle roofs on Thom and Rouse to minimize fire hazard; goal is $4,500.

Donations to YBRA can be made by:

1) Check, made out to **YBRA - (designate project or fund), and sent to Y.B.R.A., P. O. Box 20598, Billings, MT 59104-0598.**

2) Credit card, using the "**Donate**" button at the YBRA website, www.ybra.org.

3) Donating stocks; contact **Denny McGinnis (dbmcginnis@outlook.com)** for information.

Do you or your *company* shop on Amazon.com? If so, you can donate 0.5 % of the purchase price for most items to YBRA at no extra cost. Simply go to smile.amazon.com (note this is not amazon.com) from the web browser on your computer or mobile device, log on to your amazon account, and choose YBRA as your designated charity.

Thank you for your continued support!

YBRA Alumni Day Symposium 2018 Agenda

Saturday, August 18

1:00 – 1:20 pm	**Richard Fifarek, YBRA President** *Introductions & YBRA's Legacy*
1:20 – 2:00pm	**Jefferson Hungerford**, *Keynote Speaker,* **Geologist, National Park Service** *Monitoring the Yellowstone Volcano*
2:00 – 2:30 pm	**Beth Pratt-Sitaula, Education and Community Engagement specialist, UNAVCO** *Teaching geodetic methods in geoscience field courses*
2:30 – 3:00 pm	**Daniel W. Hughes, Head of Exploration, Thyssen Petroleum** *Applied geophysics and the legacy of Princeton Prof. Bill Bonini*
3:00 – 3:30 pm	*Coffee Break*
3:30 – 4:00 pm	**Dan Seifert, Assistant Forest Geologist, USDA Forest Service, Red Lodge, MT** *Forest Service & BLM cave resources*
4:00 – 4:30 pm	**John Marjerison, Chief Engineer, Stillwater Mining Co.** *Mining the Stillwater Platinum-Palladium deposit*
4:30 – 4:45 pm	**Tyler Krutzfeldt** *Wrap-up, Questions & Answers*
4:45 – 6:00 pm	Bighorn Beverages

YBRA Who's Who?

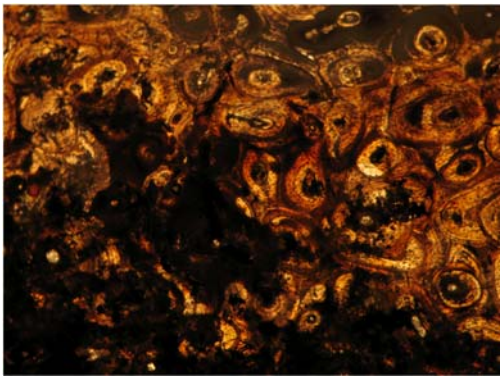
Note: Jinny Sisson usually submits to the Uplift a review of a geology themed book. However, this year she and her son, Alex, thought his research project on bone material collected at YBRA would be of interest to readers.

Comparative Histology: My 7th grade science fair project
By Alex Maze

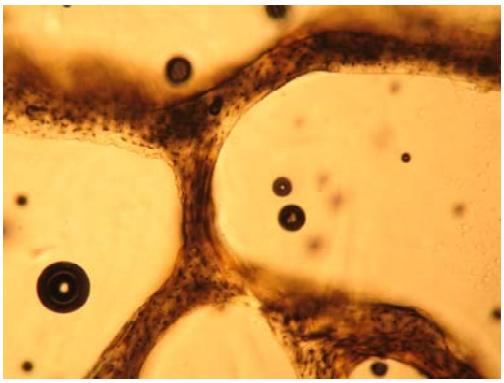
My project started when I found a large mammal rib bone and two dinosaur rib bones left behind by students at YBRA. This was after I had gone to the Museum of the Rockies and had visited their histology lab. So, when I found the bones I knew I could use them for my science fair project; I wanted to answer this question: How does bone density compare between dinosaurs and modern large mammals? In my study, I made thin sections of the rib bones and looked at them using a polarized light microscope. My hypothesis was that dinosaur bones are like bird bones.

Here are my conclusions: first is that dinosaurs have large bones, but they have more spongy bone then compact bone. This is probably because they were bigger creatures and needed lighter bones to walk around. Second, I found that the compact bone is thicker on the outside of the dinosaur rib than the inside. This would give the rib bone more strength and protect the dinosaur's organs. My large mammal rib bone has more marrow than the dinosaur rib bones possibly because they needed more nutrients.

Finally, my data shows that dinosaur bones have lots of small holes that are wider spaced in their spongy bone then the large mammal spongy bone. This supports the hypothesis that birds are decedents of dinosaurs. I also discovered there were small flakes of native copper in the larger dinosaur bone.



Middle of Dinosaur rib bone at 200x. This shows that there was very compact spongy bone.



Polarized light view of the spongy bone in large mammal rib at 100x. This shows the marrow as well as air bubbles (round circles).

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ATTN: Proxy Enclosed