Post-trip Report: **Mapping Late Devonian mass extinctions at the Hoshoot Shiveetiin Gol locality, Mongolia**

Olivia Paschall
Explorers Club Flag Expedition #112
Expedition dates: July 25-August 11, 2018
Location: Khovd Province, Mongolia
(photo, right): Expedition team with Explorers Club flag.

Field Team (field groups divided by scale of research: km, m, and cm-scale)

Team Member	Affiliation	Role
Dr. Ariunchimeg Yarinpil	Mongolian Palaeontological Centre, Mongolia	Regional mapping (km-scale) coordinator; bryozoan paleontology, regional fossil exploration and assessment
Otgonbaatar Dorjsuren	Gurvantalst Geologic Mapping , LLC, Mongolia	Regional mapping (km-scale)
Tumurchudor Choimbol	Gurvantalst Geologic Mapping , LLC, Mongolia	Regional mapping (km-scale)
Ganbayar Guunchinbat	Gurvantalst Geologic Mapping , LLC, Mongolia	Regional mapping (km-scale)
Otgonbayar Nerkhjav	Gurvantalst Geologic Mapping , LLC, Mongolia	Regional mapping (km-scale)
Dr. Sarah Carmichael	Appalachian State University, USA	Principal Investigator, local (m-scale) mapping of site, geochemical and mineralogical analysis
Olivia Paschall	Appalachian State University (student), USA	Local (m-scale) mapping of site, GMT topo map development, digital mapping
Dr. Sersmaa Gonchigdorj	Mongolian University of Science and Technology, Mongolia	Expedition coordinator; stratigraphy, (cm-scale) section description
Dr. Johnny Waters	Appalachian State University, USA	Co-Principal Investigator, paleontology of section (cm-scale)
Dr. Peter Königshof	Senckenberg Natural History Museum, Frankfurt, Germany	Stratigraphy, (cm-scale) section description, microfacies analysis, conodont biostratigraphy
Will Waters	ExxonMobil, USA	Site fossil assessment (cm-scale)
Allison Dombrowski	Appalachian State University (student), USA	(cm-scale) section description (assistant to Königshof and Gonchigdorj)

Travel/prep days:

Our journey to Mongolia began on July 25th, when we flew from Charlotte to Chicago. It was the first flight of four and the first day of six to reach our destination in rural, southwest Mongolia. Previously, the longest flight I had been on was about nine hours. The flight from Chicago to Beijing was just over *thirteen* hours, and it sure didn't help that our internal clocks were twelve hours off when we touched down. We took naps in the hot airport and six hours later we were boarding for Ulaanbaatar! We arrived late at night and were driven to our hotel by family members of Sersmaa, one of our Mongolian colleagues. My first taste of Mongolia was a few dried yogurt bites that Sersmaa's daughter Ariuka offered to us as a snack. They were sour tasting but surprisingly delicious. When we arrived at the "Ulaanbaatar Hotel," we were so exhausted that I had forgotten they told us that hot water would only be available at certain times during the day. Needless to say, I took a very cold and very fast shower around midnight before hitting the pillow.

The next morning we met with Seersma at her university, which was conveniently across the street from our hotel, and talked about the game plan for our field work. We discussed what needed to be done, what samples needed to be collected, and which people would be tackling the different tasks. After lunch, it was all I could do to stay awake; our extreme jet lag was kicking in. Allison definitely fell asleep at one point, and we were glad to take some naps after returning to our hotel. The next day we stopped at a dinosaur museum on the way to the airport.

It was inside a shopping mall complete with a food court, but their collection was more complete than any I had ever seen. Our final flight was from Ulaanbaatar to Khovd, which lasted about three hours. The last bit of the flight was very bumpy and we were all slightly queasy when we landed, but we were all very happy. Our first group photo (left) was on the tarmac before collecting our luggage in the very small Khovd International Airport. Our flying adventures were over but our driving adventures began shortly after. We ate dinner in Hovd and swiftly abandoned civilization, heading towards our field site. After a few hours, we stopped to camp for the night on the side of the road. We awoke to the sounds of yaks grunting outside our tents who were taking turns being milked by a local farmer. Warm sheep noodle soup was our breakfast, then we were off towards our permanent campsite. Another day of riding in the vans passed, half of which was on the bumpiest dirt roads I've ever experienced, and we arrived to our home for the next week (below).

Field Days 1-4: Making a Geologic Map

We woke up to the bright sun on the morning of July 31st, ready to start our field work. The drive to the field site from camp was about 20 minutes and included driving through a small river. In 2012, this field site was found by a group of geologists whose van had flipped over. They explored the area for less than a day, but marked it as a potential future study site when they discovered Late Devonian fossils.

My primary research task in the field was to map the surrounding area of the field site called Hoshoot Shiveetiin Gol, where the stratigraphy was being recorded. A previous trip to this site in 2014 had yielded some samples that were used to find a radiometric age, but it was unknown how they related to the stratigraphic section. Are the units continuous so that the radiometric age can be used to date the stratigraphic section? Or is there a fault in between that obscures the relationship between the sections? It was my task to find out. The first half of the day I was dazed and confused, trying to acquaint myself with what the rocks looked like and how I was going to accomplish my task. Dr. Carmichael was my field partner, and once we established what rocks were around, we started mapping. We first followed the road and added it to the topography map; it would serve as a reference point for mapping the rock units.

The second day of field work, we began making our geologic map. We started near where the stratigraphy (cm-scale) group was working and described each rock unit in painstaking detail (one of my unit descriptions took up an entire page in my field notebook). We had to decide how we were dividing the rock units in order to map them, so there was a lot of discussion. We would say, for example, “These rocks are greener than those but they still have limestone lenses with fossils, so should we consider this a new unit or is it the same as the other one?” We recorded data for 30 stops; for each stop we recorded the unit or contact, any interesting features of the rock, and the orientation of bedding using our Brunton compasses. Geologically, Mongolia has a very complex depositional and deformation history, and our field site was no exception. The largest feature in the area is a large fold pointing northeast which

was obvious on the satellite image, but we were expecting to see many smaller folds and faults as we mapped with finer detail.

The third day, we discovered that some seemingly out-of-place pieces of rock were likely brought in by a very old, very large landslide. This was surely a relief because we had spent lots of time pondering why assorted rock fragments were in unusual locations. We continued recording data, and mid-morning I realized that my pants had ripped! I had been sitting on very sharp rocks, and my pants just couldn't handle it. I happened to be wearing my most durable pair of pants, though, so I ended up putting bright yellow duct tape over the holes and continuing my work. By the end of the third day, we had an almost complete picture of the structural geology of the area.

The fourth day, we completed the data-collection portion of the map, collecting about 20 final data points to fill in the spatial gaps. It was a great feeling to finally have collected all the data points we could. Now all that was left to do was sit down, interpret the structures, and fill in the areas where we couldn't take data, like where the modern river sediments or landslide deposit covered up the rock. To the left is a picture of me in the field while mapping.

Field Days 4-6: Matching up the section with other localities

Our next task was to see how another site called the "War Monument locality," matched up to the first site, Hoshoot Shiveetiin Gol. The War Monument locality was near our campsite, adjacent to a monument memorializing the fallen soldiers during a Kazakhstani invasion in 1948. Around midday on the fourth field day, we had completed map data collection, so we transferred our energy to the War Monument locality. We were trying to see if we could match up the rock units that we had just mapped over at Hoshoot Shiveetin Gol. We knew that in 2012 when they recorded the stratigraphy at the War Monument locality that they potentially did it upside down (thinking that the oldest rocks were the youngest rocks). We got a feel for the rocks but needed to consult the stratigraphic section they made to really assess if the section was recorded the proper way. So we returned to camp and consulted the previously-collected data.

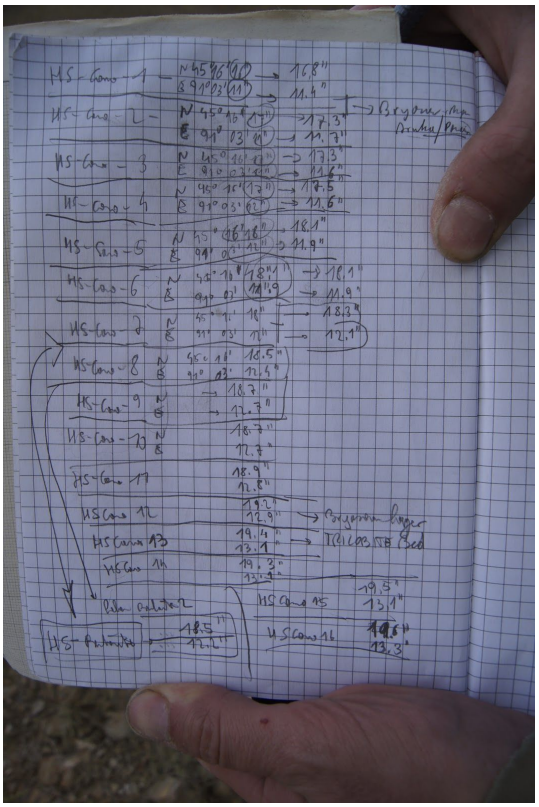
On day five, we woke up to wind and rain. I had just done “laundry” (in the river) the night before so all my clothes were hanging on my tent, getting soaked with rain. The Mongolian km-scale mappers (Otgonbaatar, Tumurchudor, Ganbayar, and Otgonbayar) were going out in the land cruiser cars (taking the vans would have been too dangerous) so Dr. Carmichael, Will, and I decided to accompany them. The long drive to the first site was perilous; I remember our car sliding sideways on the fresh mud at one point. We got stuck a few times, too. We made several stops throughout the day. At the first stop, we collected dacite (a type of volcanic rock) samples that could be used for radiometric dating. At a few other stops, we looked for fossils to determine when the rocks were deposited in geologic time (the rocks are only helpful to us if the fossils are Late Devonian). At the last site, we found about a dozen in-tact crinoid fossils, which Will was excited about.

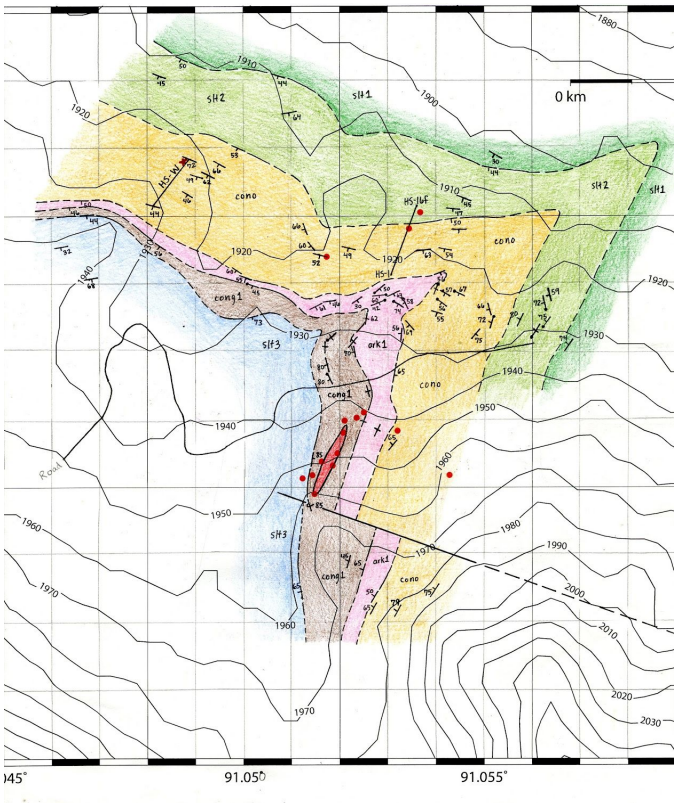
Since we had consulted the stratigraphic column that was put together in 2012, we returned to the War Monument Locality on the sixth day and rectified the stratigraphic section with our mapped stratigraphy from Hoshoot Shiveetin Gol. It had indeed been recorded upside down, which made it confusing to envision with the numbering system going the wrong way. Soon after we arrived back at camp, the other team who was still working on detailed stratigraphy at Hoshoot Shiveetin Gol returned with one very sick member of the team. Allison had been throwing up since right after lunch, and she was *very* sick. She could hold conversations in between bouts of vomiting, and we concluded that it was a combination of sun poisoning and food poisoning that hit her all at once. She was down for the count and spent the next few days recovering, with just enough time to feel sufficiently healthy before our very long return journey.

Field Days 7-8: Polishing the Map and Final Touches

I accompanied the stratigraphy team for the first half of the seventh field day while they finished their data collection. I mostly looked for fossils, and I did end up finding a long rugose coral that I “expertly” excavated in seven pieces and glued back together at camp. The rest of the fieldwork wes spent primarily bookkeeping. The stratigraphy (cm-scale) team was making lists of all the samples they had taken, the mappers were finishing their km-scale mapping project, and I was making my final version of our m-scale field map. We also spent a while posing for photos that Felix (our photographer) set up, one of which was a group photo with all the m-scale and km-scale mappers.

I spent all afternoon of day 7 hunched over an 11”x17” map, painstakingly recording every single strike and dip (bedding orientation) measurement we had taken in the field. Then, matching up all the unit contacts we had observed and ensuring that they make geologic sense. This task might sound tedious and monotonous, but it’s actually the sort of thing I love. It was very satisfying to complete. We had gone from a disorganized, hurried list of points that were recorded in 2012 (below, left) to a detailed geologic map of the area (below, right), giving us a full picture of the local geology.





The last day in the field was fairly relaxing. We had accomplished all that we needed to with a day to spare! So we took our time eating breakfast and mid-morning I went for a hike with Will to a peak adjacent to our campsite. From the top, we could see a long extent of the river dotted with trees. We could also see the Chinese border to the southwest, which is denoted by the highest ridge in the area. That evening, our last evening in the field, we had a traditional Mongolian barbeque feast for dinner. They heated up rocks over a “flaming pile of dung” as Dr. Carmichael put it, then steamed some water with the hot rocks which cooked the sheep meat. Some of the parts of the animal were indistinguishable- I suspect I had some ribs and a piece of the sheep’s neck. It was, however, very delicious. Ganbayar poured us all a little bit of vodka (even for Allison although she was still too sick to drink it) and we made a few toasts celebrating a successful expedition. It was a great finale to a wonderful week in the field.

Return Journey:

The journey back to the States was a long one. Longer than the trip *to* our field site, or so it seemed. When we arrive back in Khovd after an entire day of driving (which included

seeing many herds of camels, see above), we were ecstatic to have toilets and running water. I felt defeated when I realized the water in our shower didn't work, because I had been waiting for a real shower for so long! I washed my face and went to bed, hoping to shower in the morning (it did end up working in the morning for some reason). The next morning, we ate breakfast and headed to the airport. We arrived at an empty airport. It turns out the ticket vendor had mistakenly told us that the flight left at 1:00 pm when really it left at 5:00 pm. So we killed an extra few hours playing card games and eating lunch. We arrive in Ulaanbaatar late at night, and Allison and I were too exhausted to attend a late dinner with the others. The next day we were free to explore the city, so we went shopping. We went to the "State Department Store," which is not run by the government despite its name. We had fun looking at all the souvenirs, and we bought some for ourselves, family, and friends. We flew the next morning from Ulaanbaatar to Beijing, then Beijing to Chicago. Our flight to Chicago arrived ten minutes *after* we departed, because of the drastic time change as we flew east. That was the longest ten minutes of my life! (More like twelve hours *plus* ten minutes). Our last flight from Chicago to Charlotte, North Carolina concluded our adventures. I was met with open arms; my parents couldn't wait to hear all about my adventures and I couldn't wait to tell them.

Conclusions:

When I first started college, my friend told me about their geology professor discussing a student that got to travel to Mongolia for their research. *You can do that as a student? I want to do that,* I thought. It was the first time I truly realized that many opportunities are open to me as an undergraduate, if I apply myself. Four years later and that student, travelling to Mongolia for research, is me. I've been so fortunate to be part of this experience and it has taught me so much about the research process. I loved working with international collaborators and hope to continue working with people all over the world, as an aspiring future academic. I have learned to be more confident in my mapping and research skills, because I felt like an important and essential contributor to the project. My experience mapping Late Devonian mass extinctions has made me a better traveller, collaborator, and overall scientist which is something from which I will benefit for the rest of my life.