

Penn in the Alps

August 10-20, 2016

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Penn in the Alps 2016

In late August of this year, 13 Penn undergraduates with a multitude of backgrounds and interests traveled to the Alps with Dr. Reto Gieré and TA Philipp Sedlazeck. We learned how the mountains were intertwined with the culture of the inhabitants. Our exploration of the native habitat and culture touched on an examination of the Alpine ecosystems, including the wildlife, flora, geology and human habitation.

After full day hikes, 5-course dinners, and treacherous drives, the group achieved more than could be described in a syllabus or advert—a sense of family. This final report contains diary entries written by the students, detailing each day's activities and sharing some memories, in addition to the research papers that each student presented during the trip.

Sarah Haber

Trip Leaders



Dr. Reto Gieré

Most likely to be almost as good at drinking coffee as he is at teaching geology



Philipp Sedlazeck

"Most likely to see fire inside the mountains" – Ed Sheeran

Students



Claire Brundage
*Most likely to Nordic ski
to her job at NASA.*



Caleb Carter
*Most likely to use the
word "Huntsman"*



Hailey Dougherty
*Most likely to never
come home*



Sabrina Elkassas
*Most likely to wear leggings more
exciting than us after dinner*



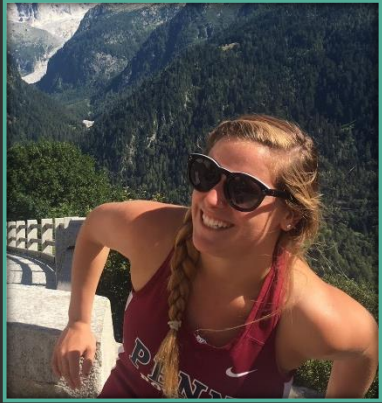
Shivali Govani
*Most likely to suggest
we take a group picture*



Sarah Haber
*Most likely to carry her
bodyweight in rocks*



Eryn Heintz
*Most likely to be the only
person to upload pictures to the
google drive*



Sarah Henry

Most likely to be simultaneously telling a story, braiding her hair, and climbing a mountain



Callie Holtermann

Most likely to sign her arrangement of sexyback while being assistant mountain goat



Dipak Kumar

Most likely to follow his heart



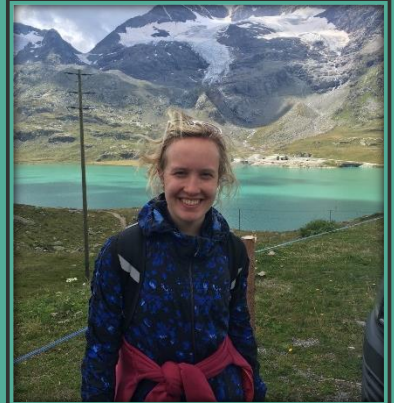
Sandra Loza-Avalos

*Most likely to say "wow," "fam," or "b*tch please!"*



Becca Richardson

Most likely to "have no room in her bag" but still carry a model of the Earth wherever she goes



Rita Wegner

Most likely to smuggle a marmot through customs

Lodging

August 10

1

Hotel California

Schifflande 18

CH-8001 Zürich, Switzerland

www.hotelcalifornia.ch/english

August 11

2

Albergo Vittoria

Piazza Della Chiesa 12

1-23024 Madesimo-Montespluga, Italy

www.passospluga.it

August 12

3

Hotel San Lorenzo

Via G. Garibaldi 3

1-23022 Chiavenna, Italy

<http://www.sanlorenzochiavenna.it/home.jsp>

August 13-14

4

Jugendherberge Cuntschett

Via de la Staziun 46

CH-7504 Pontresina, Switzerland

www.youthhostel.ch/de/hostels/pontresina

August 15

5

Berghaus Diavolezza

Diavolezza 1

CH-7504 Pontresina, Switzerland

<http://www.diavolezza.ch>

August 16-18

6

Albergo Chiareggio

I-23020 Chiesa Valmalenco-Chiareggio, Italy

www.hotelchiareggio.it/

August 19

7

Albergo Croce Federale

Viale Stazione 12A

CH-6500 Bellinzona, Switzerland

www.hotelcrocefederale.ch/index.php/en/

August 20

1

Hotel California

Schifflande 18

CH-8001 Zürich, Switzerland

www.hotelcalifornia.ch/english

Lodging Map

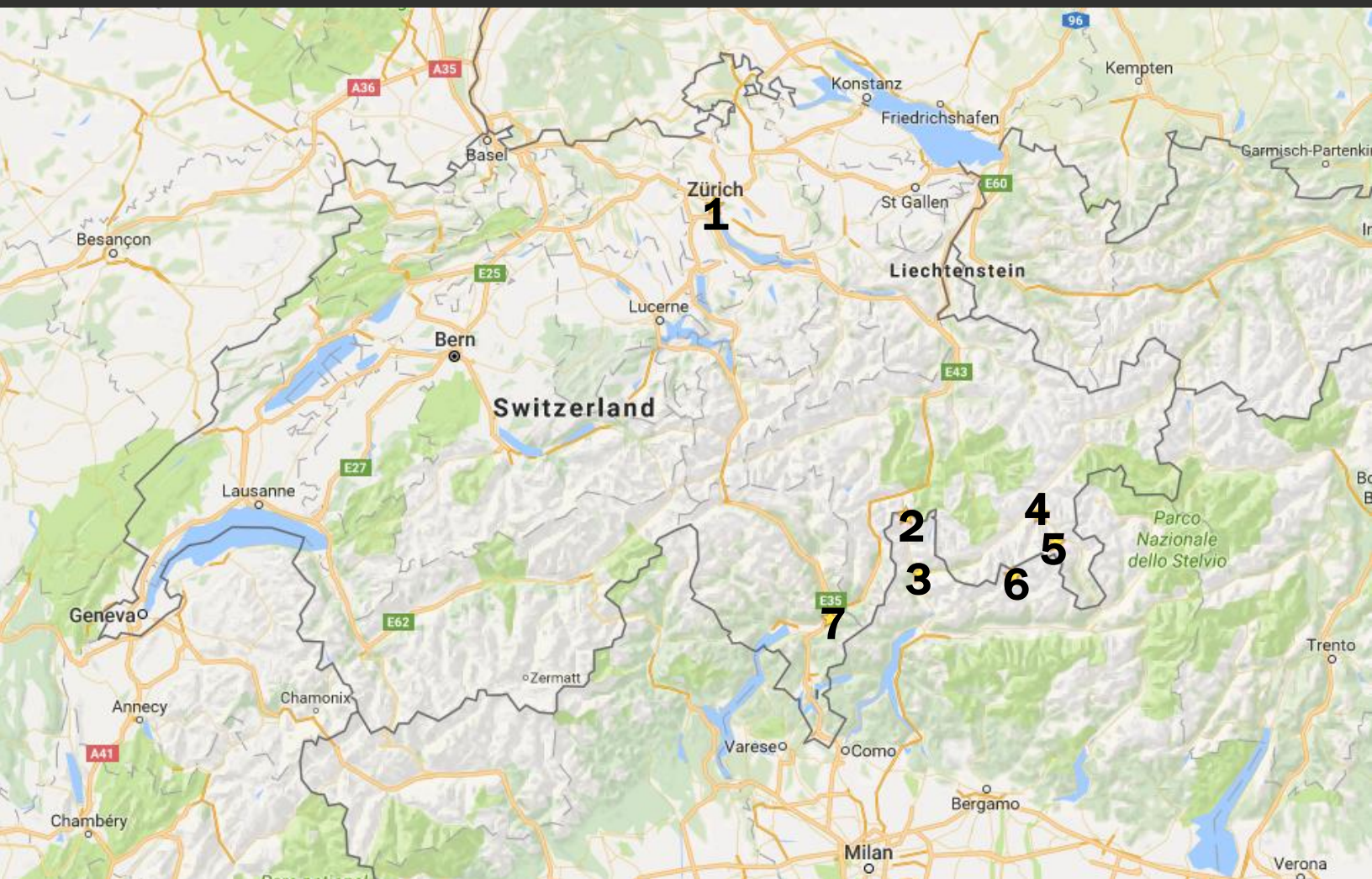


Figure 1: Map of Hotels

Diaries

Day 1 – 8/10/16

Sabrina Elkassas



Figure 2: Map of Zürich

- 1– Grossmünster Church
- 2– Swiss Federal Institute of Technology
- 3– Fraumünster Church
- 4– Bahnhofstrasse Street
- 5– St. Peter
- 6– Zürich Opera House

In Switzerland, also known by the Latin name “Confœderatio Helvetica,” there are urban hubs juxtaposing great mountains. On the first day of our trip, we explored Zürich, the largest city. It is known as one of the financial centers of the world, housing some of the world’s largest banks such as Credit Suisse and UBS, among others. The Limmat River, (Figure 3) sourcing from the beautiful glacially formed Lake Zürich (Figure 4), flows north through the middle of the city. The area where Zürich is now situated was once completely overtaken by immense glaciers, which created moraines, piles of debris to either side of the glacier, on one of which the city now sits.



Figure 3: Swans on the Limmat River



Figure 4: Lake Zürich on a cloudy day

We started our walk from the Hotel California (Figure 5). You can check out any time you like, but you can never leave. We walked to a lovely café by the Limmat River. In front of the café were street car tracks (Figure 6). They run throughout the whole city, and the trains even go all the way through the mountains! This efficient and widespread mode of transportation explains the lack of cars and narrow streets. As we were discussing the plans for the trip, two Zimmermann were spotted. These handy people have a distinct style of dress, as you can see in the picture below (Figure 7). They travel around the country with few belongings, looking for work repairing houses in exchange for room and board.



Figure 5: Hotel California



Figure 6: Some of the extensive street car tracks that run through Zürich



Figure 7: Zimmermann (along with Caleb and Dipak)

Here, we also discussed Switzerland's government and immigrant population. The area that would become Switzerland was ruled first by the Romans from 15 B.C. to about 300 C.E. Where present-day Zürich is located, they set up a camp and collected tolls on people traveling on the river. After the Romans, the tribes ruled, followed by Frankish kings, after whom the Habsburg family took rule. The Old Swiss Confederacy overthrew the family in the 15th century. From the 15th to the 17th century, trade guilds ruled because they were tired of the regime of the aristocrats. Since then, there is a parade once a year to celebrate the overthrow of the aristocracy. A huge pile of wood is created with a snowman on top. Explosives are placed in the head of the snowman, and the length of time that it takes for the head to explode is interpreted to tell the length of the summer.

Switzerland is known for its neutrality in the many wars that have occurred around it. Surprisingly, there is a large military compared to the amount of people living here. Military service used to be compulsory; in recent years the laws have changed and now one can choose between military and community service. The people make the decisions here in what is known as a direct democracy. To change legislation, the people must have a referendum, drafting a petition and getting 100,000 signatures. There are seven seats on the Federal Council, essentially the "presidents." Switzerland is not part of the European Union (EU). The people held a referendum against joining the EU and to keep their own currency. However, anyone in the EU can work in Switzerland, and vice versa. Immigrants make up about 25% of the population, with a larger influx in the past 100 years starting with Italian immigrants, then Spanish and Portuguese, followed by the people from the Balkans, Sri Lanka, and finally the Middle East.

After having this discussion, we started exploring Zürich! We passed two famous confectionaries – H. Schwarzenbach (Figures 8 and 9), known for its house-roasted coffee and imported sweets from all over the world, and Conditorei (Figures 10 and 11), a 15th century home owned by the same Schober family for five generations.



Figures 8 and 9: H. Schwarzenbach and some of the confections in the window.



Figures 10 and 11: Conditorei and the chocolate display inside

We then went to visit three cathedrals. The first was Grossmünster (Figure 12), which means “the great abbey.” It was a monastery before it became a church. Its story is quite unique. There were two martyrs, Felix and Regula (now the patron-saints of the city). They were decapitated in 286 C.E. and it was said that they picked up their heads and walked to the site of Grossmünster. Charlemagne’s horse supposedly found their graves, and Charlemagne then commissioned the construction of the church in 1100 C.E. This is why there is a large and brilliant statue of the ruler in the crypt, the oldest part of the church (Figure 13). Additionally, all of the paintings on the ceilings and walls are original (Figure 14).



Figure 12 (left): The Grossmünster

Figure 13 (right): The statue of Charlemagne in the crypt of Grossmünster



Figure 14 (left): The original ceiling of the crypt in Grossmünster

It is built in the Romanesque style, with rounded arches (Figure 15) and buttresses. Augusto Giacometti some of made the rich, colorful stained glass windows in the Cathedral (Figure 16). Giacometti’s family is from Stampa (Bregaglia) in the Alps, so we were foreshadowing some of what was to come on our trip! This church was the base for the Protestant reformation in Switzerland, as started by Zwingli. It was very special to be at the place where such an important historical movement took root. Then, we walked around the corner from the church and even saw Zwingli’s house (Figure 17)!

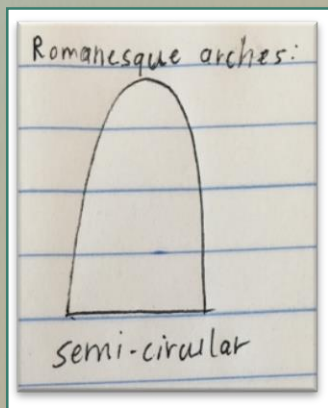


Figure 15: Romanesque arch shape



Figure 16: Stained glass windows in Grossmünster, fashioned by Jacometti's brother

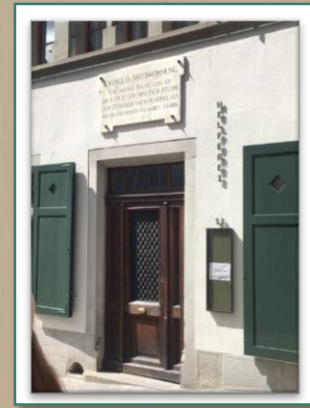


Figure 17: Zwingli's home in Zürich

Before visiting the other two churches, we meandered through the streets of Zürich, observing that there was no garbage anywhere on the ground. Also, there were small fountains on every street. We learned that these fountains have water clean enough to drink, and that there is no trash because Switzerland has a strict waste policy. People are extremely conscious of the environment and were pioneers in environmental initiatives. Basically, everything is recycled. Even the brown glass bottles are separated from the green glass bottles. Trash bags are very expensive, so people are discouraged from throwing away garbage without recycling. Regarding energy production, they use 0% coal, 60% hydropower, and 40% nuclear power. There are no landfills; instead, garbage is incinerated to produce energy, and then the ashes are mined for metals (gold, silver, brass, aluminum, iron, etc.). Although this does produce carbon emissions, it is no more than any other combustible source.

We then visited the Swiss Federal Institute of Technology (ETH). The federal government owns this German-speaking University (Figure 18). Students pay practically nothing to attend, since it is funded by tax money. In addition to getting education, students are also provided with health insurance and free passes for public transportation. There is also a second institution similar to ETH, except it is French-speaking and in Lausanne, near Lake Geneva. While we were walking up to the campus, we saw a stationary exercise bike locked to the bike bar. We all laughed because it was such a nonsensical sight (Figure 19). The university sits on top of a hill that overlooks all of Zürich, so we had an extraordinary view of the city (Figure 20)



Figure 18: ETH

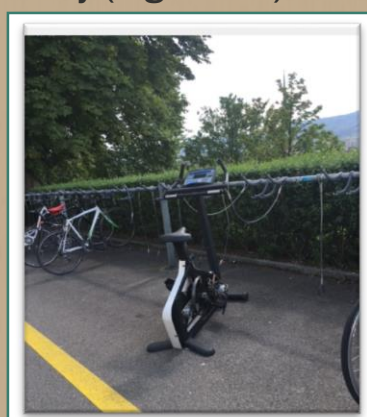


Figure 19: Nonsensical exercise bike

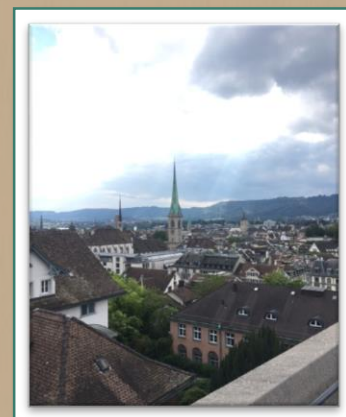


Figure 20: View of Zürich from ETH

Next, we went to Fraumünster Church (“abbey of the women”). In the 12th and 13th centuries, women owned and ruled the city from this tower. It possesses a large mechanical clock on its tower (Figure 21). The famous artist Marc Chagall made some of the stained glass windows in Fraumünster, which was an added extra onto an already beautiful church. It is built in the gothic style. It has pointed arches (Figure 22) instead of the rounded arches of the Romanesque style we saw in the Grossmünster. The organ has pipes from as small as 4cm long to as large as 10m long.

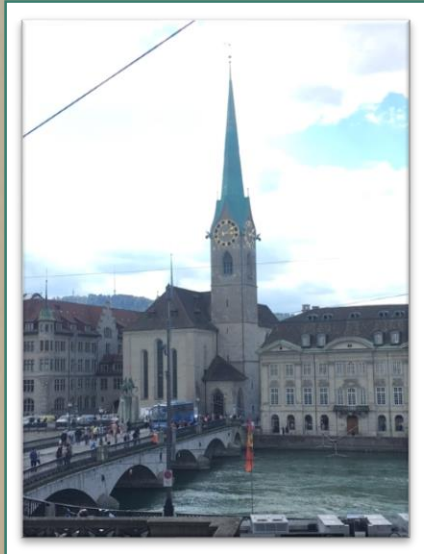


Figure 21: Fraumünster's clocktower

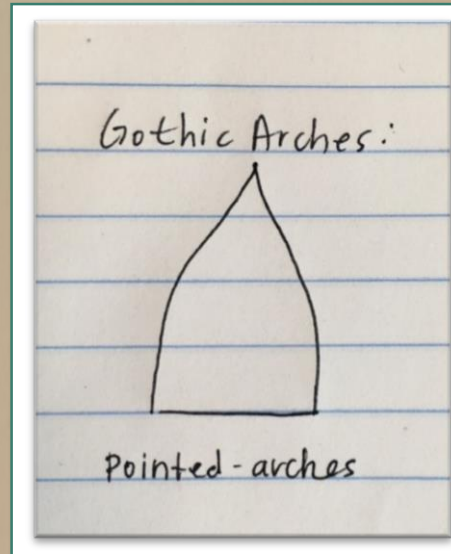


Figure 22: Gothic arch shape

From there we moved onto Bahnhofstrasse (“station street”), known as the most expensive street in Zürich. There are many designer stores (Figure 23) and bank headquarters. Additionally, there is the Sprüngli café, a famous, family owned chocolatier that has teamed up with Lindt (Figure 24). Finally, in their entire splendor, the flags of the cantons hang above the streets (Figure 25).



Figure 23: Chanel, a high-end designer brand, on Bahnhofstrasse



Figure 24: Sprüngli Café

Next, we went by the lake to find a statue of Ganymed (Figure 26). Here, we learned that the Swiss flag is the only square flag in the world. Most countries have rectangular flags. The Cross on the flag is also indicative of the organization of the Red Cross, which was created in Geneva. An interesting fact we learned was that all lifeguards in America sport the Swiss flag as a symbol that they are rescue personnel. This is a white cross on a red background but the correct symbol is a red cross on a white background.



Figure 25: Flags of the cantons of Switzerland above Bahnhofstrasse



Figure 26: Statue of Ganymed on Lake Zürich



Figure 27: St. Peter

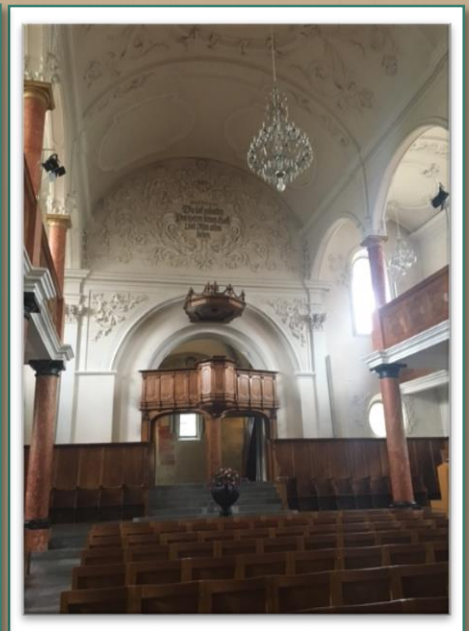


Figure 28: Baroque interior of St. Peter

Our last stop was St. Peter. It was the first baroque church after the reformation and also features the largest clock face on a church in all of Europe (Figure 27). Unlike the gothic and Romanesque churches that had characteristic arches, baroque style features opulence, intricate molding, and pastel colors, rather than a characteristic arch (Figure 28).



Figure 29: The Zürich Opera House

After finishing our enjoyable city tour, we had a delicious vegetarian dinner at Tibits, near the opera house (Figure 29). It was great meal to finish an excellent day! We all learned so much about the history, culture, architecture, government, energy policy, and society in Switzerland. I do not think we could have asked for a better start to our trip.

Day 2 –8/11/16

Callie Holtermann & Caleb Carter

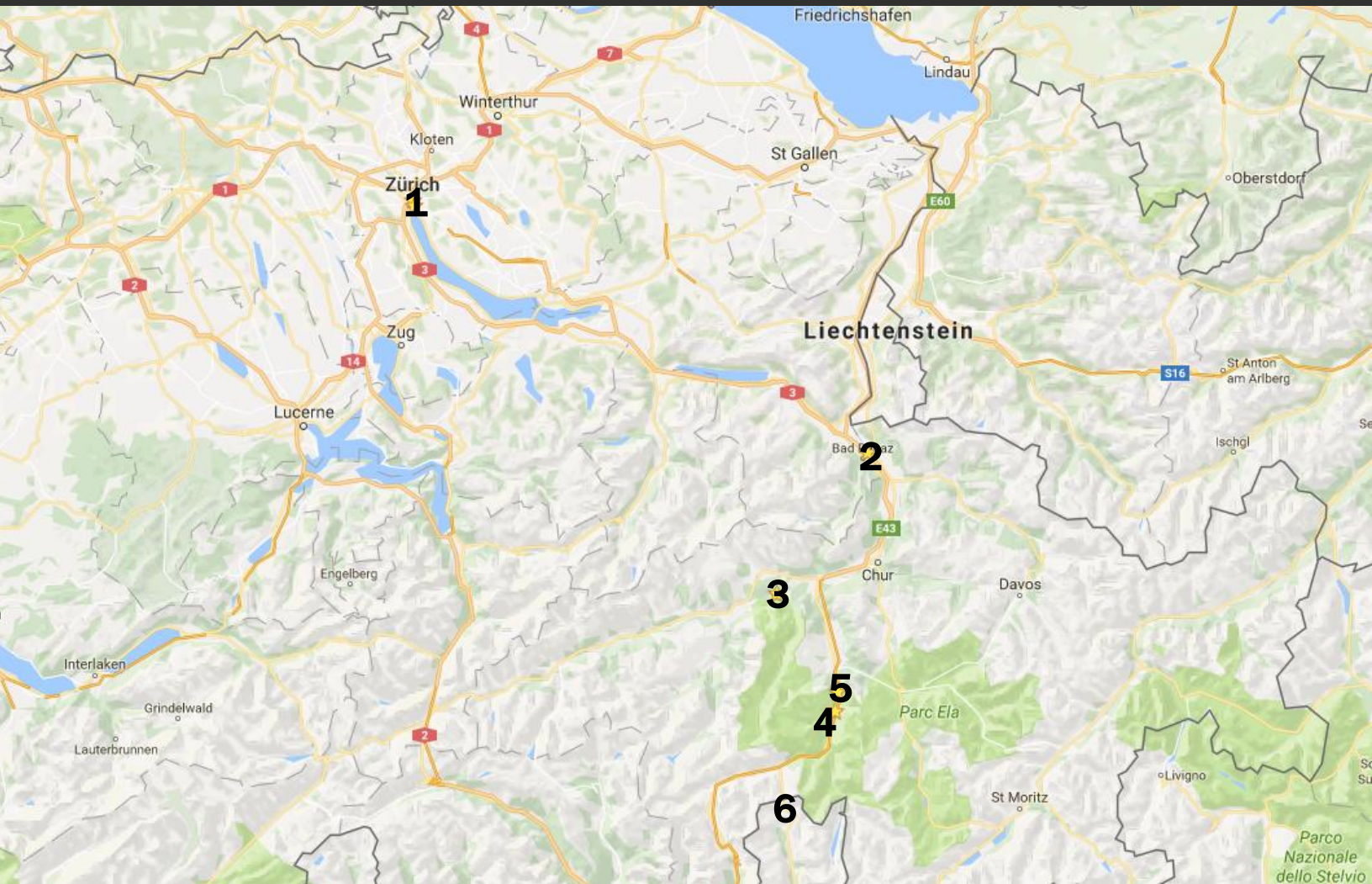


Figure 30: Map of Day 2

- 1– Hotel California
- 2– Marché Heidiland
- 3– Flims Landslide
- 4– St. Martin of Zillis
- 5– Viamala Gorge
- 6– Albergo Vittoria

Drive from Zurich and Heidiland (Caleb)

We spent our first night as classmates together at the Hotel California near the northern end of Lake Zurich. I was done-in from the previous day touring the city, and so sleep came more-or-less easily to me that night. In the morning, though, we left the hotel at 7:30 a.m., so the combination of jet lag and too little sleep made for a tough time waking up. My duffel bag, which had previously been neatly packed, became an almost random jumble of clothes, power converters, and hiking boots that suddenly seemed to take up twice as much space as before. (Small suitcase >> large duffel bag).



Figure 31: Opel's logo

After grabbing a quick shower and hauling my duffel bag downstairs, I met up with the rest of our crew in the hotel restaurant and had some of the best croissants I remember eating, along with coffee and an egg sunny-side-up. Impressively, our entire group was up, packed, and ready to go by the 7:30 departure time, but Reto and Philipp, who had emphasized the importance of being on time, arrived with the vans a bit later at around 7:40. A few of us had a bit of a laugh about this, and then we divided ourselves into two vans – one a white Volkswagen driven by Philipp and the other a silver “Opel” (Figure 31) driven by Reto. (According to Philipp, Opel is somewhat of a “people’s car” like Volkswagen). I got in the Volkswagen, along with Becca, Callie, Claire, Dipak, and Sarah, and this group became my bus crew for the rest of our trip.

From the hotel, we began our driving for the day by heading southeast along the southern side of Lake Zurich. As we drove along it, Philipp explained that the lake’s depth came because it was a glacial lake. Yesterday we learned it had originally been carved out during the last time the glaciers extended out into the Zurich area, and the U-shaped valley in which it resides is characteristic of such glacial valleys. The view was spectacular, and it was plain to see the amazing erosional power that glaciers could have. Our discussion then moved to the ubiquity of manual cars in Europe. None of us knew how to drive stick, and Philipp explained the value of being able to choose when to shift in mountainous regions – something we would come to appreciate more later on in the trip.

After about an hour of driving, we took a quick break at “Heidiland,” a large, themed convenience store and restaurant where we took a restroom break and ate snacks (Figure 32).



Figure 32: Heidiland

The restroom may have been the fanciest restroom I've ever used, and each person had to pay one Swiss Franc (roughly \$1) to use it. However, when you did so, you also received a coupon for one Franc off anything in the store, so only people who didn't buy anything from the store really had to pay for the restrooms.

After Heidiland, the terrain became more mountainous as we went further into the Swiss Alps. We began to drive along cliffs that were frighteningly steep at first, and soon the two-way roads were not wide enough for two cars side-by-side most of the way. When two cars came head to head, they had to find designated wider parts of the road where one car could pull to the side and let the other pass. This illustrated vividly how mountains acted as barriers between people and facilitated the development of separate cultures and languages in places that were otherwise relatively close together from a geographical perspective.

It was in this area that we made our first stop, where we hiked up for 5 minutes or so to a point overlooking the Vorderrhein ("front" Rhine) and the Flims landslide and pulled out our notebooks.

The Flims Landslide (Callie)

After a scenery-rich drive from Zurich, we stopped at an overlook that gave a stunning view of the Flims landslide. It was the first truly gorgeous view of the trip, and we reacted accordingly, taking about a thousand pictures and posting the good ones to Instagram (Figure 33).

Once we got over our initial shock, Reto gave us background on the Alps that allowed us to understand what we were seeing. He explained that the Alps are a mountain range that extend up from the Mediterranean, stretching across France, Switzerland, Austria, Turkey, Iran, then into the Himalayas, and finally Myanmar. Although some of these mountain ranges have different names, they all technically belong to the Alps because they formed in the same time frame. The highest Alps are in the west, which contains France's Mont Blanc, the tallest mountain in the range. The mountains get smaller as they extend eastward.

Reto also detailed the Alps' significance to the field of geology, which is considered to have been invented in the Alps. Many geologists come from the area, inspired by the intriguing mountains that surround them. In addition, the unique landscape has inspired many geological terms that are now used around the world.

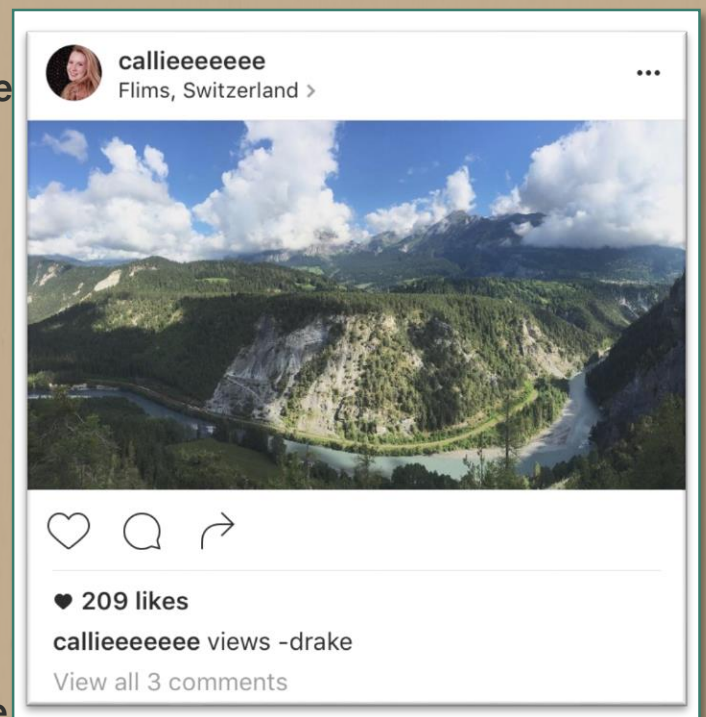


Figure 33: Flims Landslide



Figure 34: Rhine River

This unique landscape can be so brutal that most of the Swiss population lives in the lowlands. Switzerland borders Germany, France, Italy, Austria, and Lichtenstein (a small country through which we may or may not have driven on the way there – jury's still out on that). Although Zurich and Geneva are its most bustling cities, its capital is Bern, a preserved medieval town. Its two main rivers are the Rhine (Figure 34), which we could see, and the Rhone.

Now armed with crucial information regarding the country and its mountain range, we were ready to digest the geological marvel that lay before us. At 12 cubic kilometers the Flims landslide is the largest landslide in Europe. Ten

thousand years ago, when the Rhine glacier started its retreat, huge amounts of rocks broke off from a steep cliff. Today, those rocks are soft, pulverized by their fall thousands of years ago. Finding rocks like these in the lowlands is crucial for geologists – it helps them date when certain geological events happened. We also learned about the power of permafrost to shape an area. Areas of permafrost are permanently frozen, but thawed at the top. The landslide material deposited in the valley blocked the Rhine, which caused a lake. Water eventually broke through the natural dam because it was made of soft, unstable material. When the river broke through, it continued eroding the valley, doing so more effectively now that it was loaded with soft sediment.

That was just the part of the landslide that we could see! On the other side of the mountains was Flims, now a winter sport resort town. Flims is also made famous by its spectacular fault line, which has been carefully replicated by the American Museum of Natural History in New York. The landslide itself serves as a barrier between two languages: Romansh above, and German below.

More on the Landslide (Caleb)

Reto told us that the study of geology effectively began in the Alps, because people wanted to understand how their various features had formed. For this reason, many geology terms are actually derived from names of places in the Alps and their surrounding regions (such as the Jurassic period, which was named after the Jura Mountains West of Bern). With the field of geology, scientists were able to eventually

understand, for instance, that the Eastern parts of the Alps were lower in altitude than the Western portion of the Alps because of the way forces were distributed when the African and European plates originally collided. These forces were ultimately responsible for the creation of the Glarus Overthrust. At the thrust, 250 million year-old rock was thrust on top of 50 million year-old rock, creating a confusing situation in which older fossils are found above younger ones, causing headaches for early geologists.

The Flims Landslide, we learned, is a huge example of mass wasting in the Alps. It was destabilized by the receding of glaciers about 10,000 years ago, which caused massive quantities of rocks and the glacier's moraine to collapse into the valley and be smashed into soft, fine-grained rock. The landslide's 12 cubic kilometers of sediment is so big that it looked like simply another mountain to me before Reto pointed it out. Its size allowed it to act as an anthropological boundary as well, and in fact, the Flims Landslide was in part responsible for the separate development of Romansh- and German-speaking regions in the Swiss Alps.

The Vorderrhein here is highly effective at eroding the soft rock of the landslide, with apparent erosion rates of up to 20-25 mm per year compared to an average of around 1-2 mm per year in normal regions. From our vantage point, we were able to clearly see meanders in the river as it snaked through the valley and cut into the sides of the rock. We could also clearly see the red Glacier Express train as it carried tourists through the Alps.

After I briefly explained the theory behind meandering rivers to the group, we had the chance to hike down to the river and see one for ourselves. Walking downhill was much more difficult than we had imagined, and I spent a decent portion of the hike sliding downhill on my behind. At the bottom, we took out our food and sat down for lunch on the inside curve of a meander. The way back uphill was even more difficult, and I was completely exhausted after our 200 m ascent back to the vans.

St. Martin of Zillis (Callie)



Figure 35: Some of the ceiling tiles

Sarah Henry gave her presentation on St. Martin of Zillis, the beautifully preserved church that has been nicknamed the “Sistine of the Alps” thanks to its famous ceiling (Figure 35). Although the church was built in 831, the ceiling was not painted until 1100. It is divided into 153 panels, made up of 90 cm squares in a seventeen row, nine column array. The tiles depict humans, land and sea creatures, and angels. The tiles' content is strictly dependent on layout. The 48 border tiles depict mythical creatures, among them water animals as the painter had imagined them – basically land animals with scaly tails. The four corners contain angels with trumpets which represent the four directions of the wind. These were intended to remind people in church that judgment day was fast approaching.

The 105 inner tiles are less about decoration and more about exposition. Featured biblical scenes include the stories of the fish and of Saint Christopher, the patron saint of travel and children. Sarah then passed around a popular Saint Christopher necklace, which people often wear when travelling. The tiles on the back row of the ceiling depict the life of Saint Martin of Tours, a monk who was exiled from his father after his conversion to Christianity. Despite his humility and desire for a simple, pious life, he was more or less tricked into becoming the bishop of Tours.

The church (Figure 36) still functions during the warmer months, but is closed during the winter (save for Christmas Day). This is a part of the town's impressive effort to preserve the church's ceiling. The ceiling has been restored but never fully repainted. To have services in the winter would mean heating the church, a process that could damage the ceiling over time. The town's residents are proud of its Romanesque ceiling, as shown by the small but comprehensive museum we explored after the church. Overall, the visit gave me a better understanding of the intersections of culture, art, and religion in the Alps.



Figure 36: Outside of the Church

The Viamala Gorge (Caleb)



Figure 37: Viamala Gorge

Our next stop took us to the Viamala Gorge – the fastest but most treacherous path through the Alps between Switzerland and Italy. As we left our cars and crossed over the Wildener Bridge, the gorge was so jagged and deep that we could only rarely catch a glimpse of the Hinterrhein (“back” Rhine) stream below (Figure 37). Before this bridge was built in 1739, the path was even more difficult and seemed barely passable to me by any reasonable standard, especially with a horse or mule in tow.

The gorge itself was able to form partially because of the hardness of the surrounding rock and because the layering of the rock was perpendicular to the flow of the stream. Both of these features prevented the canyon walls from caving in and preserved the almost completely vertical walls. There are competing explanations for how the gorge formed. Some think that it was formed partially by a

glacier, due to the presence of huge boulders in the gorge which couldn't have been moved by a stream alone. However, the steepness of the gorge seems to only be formable by a stream. Reto told us that a likely explanation is that the stream was in place before the most recent ice age, and when the glaciers came in, it may have maintained its course as a subglacial stream, continuing to cut into the rock with higher pressure under the glacier. When the glacier melted, it then dropped the large boulders into the gorge.

Regardless of how it formed, the Viamala was a breathtaking sight (Figure 38). The strikingly blue water of the Rhine that ran through it and the staggeringly deep canyon it had created were unforgettable.

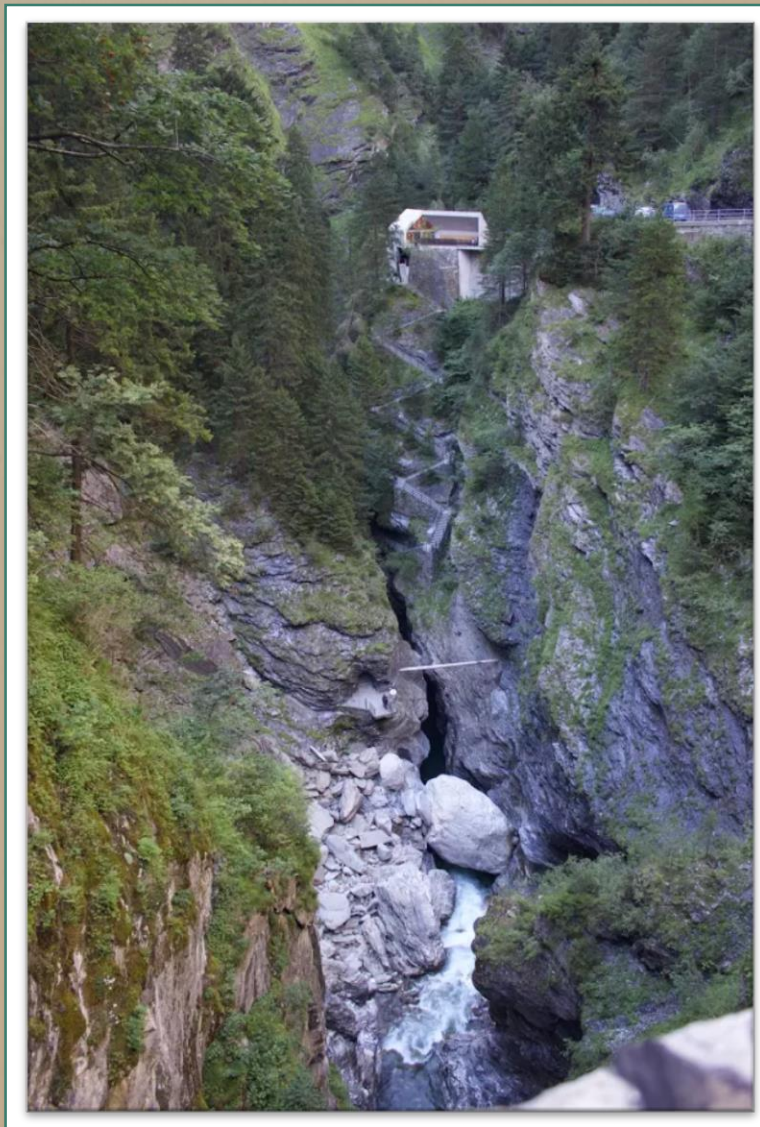


Figure 38: Viamala Canyon

Day 3 – 8/12/16

Dipak Kumar

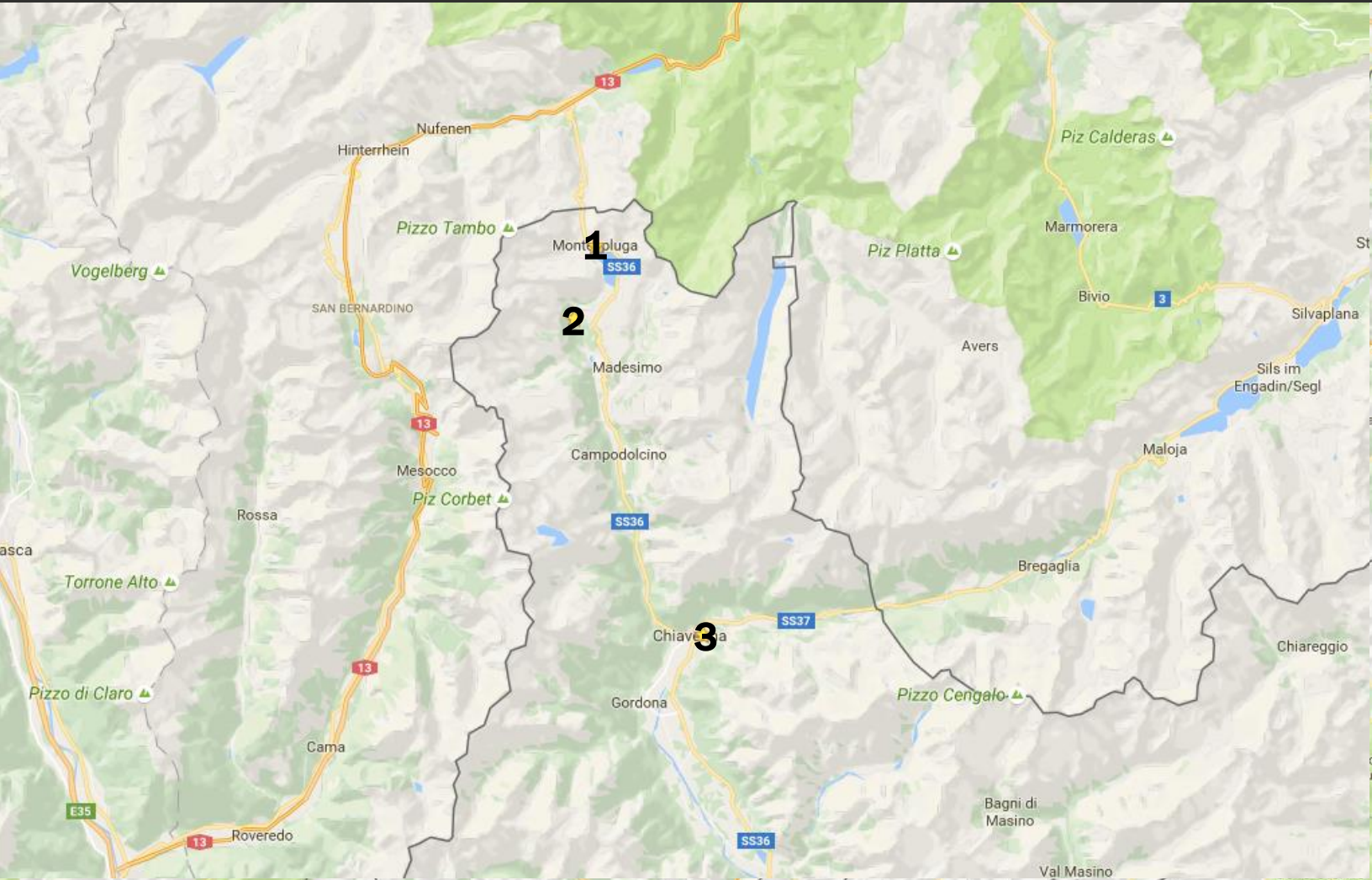


Figure 39: Map of Day 3

- 1– Albergo Vittoria
- 2– Cardinello Pass and Alpe Rasdegia
- 3– Hotel San Lorenzo

Activity Overview:

1. 8:00 a.m. through 9:00 a.m. - Breakfast of Croissants and yogurt at hotel Victoria, right across the border in Italy.
2. 9:00 a.m. through 12:00 p.m. – Hike down the Cardinello Pass (Sarah and Claire Give Presentations).
3. 12:00 p.m. through 12:45 p.m. – Lunch in the local village
4. 12:45 p.m. through 2:30 p.m. – Hike up the Cardinello Pass
5. 2:30 p.m. through 4:30 p.m. – Drive to Chiavenna
6. 4:30 p.m. through end of day – Explore Chiavenna

After a wonderful breakfast of croissants, coffee/tea, and yogurt at the hotel Victoria we found ourselves hiking down into the second of the two most difficult pieces of the Splügen, the Cardinello pass (Figure 40).



Figure 40: Cardinello Pass

Throughout this extensive trek there was much to admire, but no piece of the experience caught our attention more than the presence of the incredible marmot. As we continued down through the valley we heard its warning call to its fellow marmots, and its calls continued to narrate our descent (marmot in the red circle on top of rock in Figure 41). It helped that Phillip was quite the marmot whisperer.



Figure 41: Marmot sighting

We continued towards the bridge at the bottom of the valley. Along the way we were entertained by Callie and Caleb's lichen puns due to Callie's later presentation about the organism. I shall "lichen" those puns to the sound of someone scratching a chalkboard, but they were hilarious. Once we crossed the bridge at the bottom of the valley (Figure 42), the rest of the trek was smooth. We even met a man who was a computer scientist that told us about the herbs he was collecting in the area for health purposes. It was concerning though that he had only taken one class on the subject the day before we met him!

We paused a few minutes before our final destination, a village nestled in the corner of the pass called Alpe Rasdeglija, to hear Sarah Haber's presentation titled the History of Infrastructural Provision and Alpine Crossing that explored transportation in the Alps both past and contemporary. She divided her presentation into three distinct sections: military campaigns, commercial interests, and tourism. I was fascinated by one of these major military campaigns, the journey of Hannibal and his army through the Alps and the controversy surrounding which route he took (Figure 43). Reto added that his path was likely more clear at the time due to the lack of glaciers that exist today.

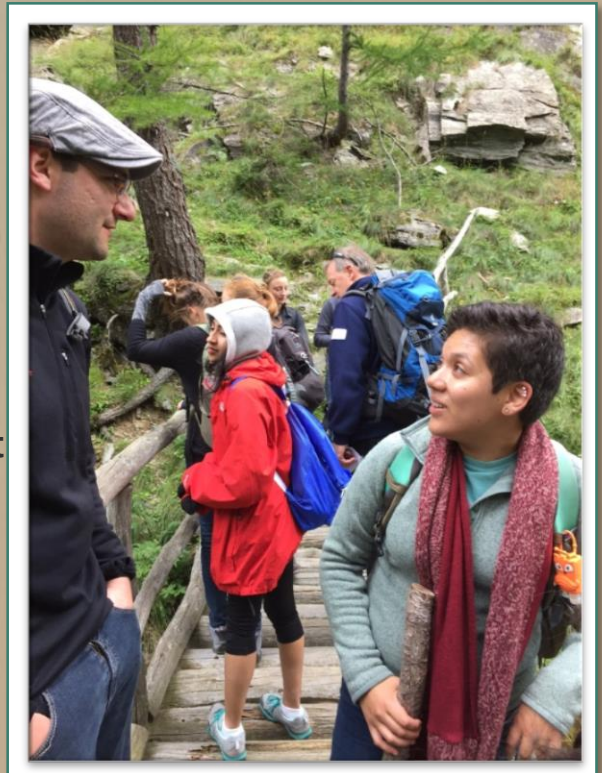


Figure 42: Bridge



Figure 43: Hannibal's potential route to Rome through the Alps

When Sarah's presentation concluded, Reto dove into greater detail about the pass. He informed us that the area was strategically important because it connected the lowlands in the south of the Alps to the lowlands in the North. As a result, another famous military tactician, Charlemagne, developed the transport infrastructure in the area. However, later with the creation of the Gotthard Tunnel, and the new larger tunnel, the area in which we were was no longer host to so much traffic.

We marched on, eventually encountering a herd of cows that were grazing just under the path to the village. I had never seen European cows before, and the bells around their neck fascinated me. As their clanging sound filled the air, all of us were in awe. Eventually many of us including Sarah Henry (after much convincing) went down to the cows and tried to pet them (Figure 44). Many discovered that their tongues are super rough, and we took some awesome photos.



Figure 44: Sarah greeting some Alpine cows

Then it was off to Alpe Rasdegliia for Claire's presentation. In a beautiful spot overlooking the valley and its glacial lake and right next to a church, Claire talked about agriculture and its evolution in the Alps. She might not have known it because she was facing us, but the locals were watching her too! This topic was interesting considering how difficult the climate and environment made alpine farming. She began with a quick overview of the history of the populations that had settled in the Alps. These peoples included the early Neolithic settlements and their famous pile-dwellings. It continued into the Celtic and Roman tribes. All of the history was excellent background for the heart of the presentation, alpiculture, farming in the Alps. Claire successfully illustrated the practices, challenges, innovations, and future of agriculture in the Alps. I was blown away at one piece of information in particular and that was that farmers in the Alps could not take advantage of many parts of the modernization of agriculture because of geography.

Consequently, a huge portion, as much as 90%, of the energy and time put into agriculture in the Alps consists of simply transporting goods! However, with the increasing availability of helicopters, the migration to more agriculturally viable areas in the Alps, and new innovations farming is still continuing and life is still very possible there. In fact as Claire was delivering this information, a man drove up with fresh fruit to give to the village people which to me was too coincidental not to mean something.

We then ate lunch in the same location (Figure 45). During lunch I was struck by the friendliness of everyone on the trip. People were exchanging knives, food, condiments, and colorful conversation, a trend that would continue for the rest of the trip. In that moment I knew that I was with a fantastic group of people.



Figure 45: Lunch in Alpe Rasdegliia

We finished lunch and began our trek back up the valley to our vans. During the first stage of the trek, back to the location of Sarah's presentation, Reto pointed out a large tree, a conifer, with needles and asked us what was special about it. It turns out that this particular tree is the only conifer in existence whose needles change color and drop off during the winter!

The journey continued and we handled the hike up a lot better than the previous day. I do not know if that was a result of just getting used to the exercise, or the many questions that were asked that allowed us to stop for a few seconds multiple times. The ultimate goal of those questions is a matter of personal opinion, but let us just say that everyone benefitted. When we were almost done, we ran into a group of mountain bikers that were attempting to ride down the narrow path we just navigated. I was incredulous at their daring, or dare I say insanity, but they looked like they were happy. Although, even after waiting a while, we never saw them exit

into the valley below. I guess we will never know if they made it out...Just kidding! I am sure they are fine. After working hard we were once again blessed with a breathtaking view and took a group photo (Figure 46).



Figure 46: Top of the Cardinello Pass

I thought we made great time, but if we had known what was waiting for us in the vans, I think we would have been even faster. Mrs. Giere made a delicious, soft, berry filled banana bread and Reto shared it with the entire group. Two whole loafs disappeared in a matter of minutes.

As we scarfed down the food, Reto attempted to frighten us with tales of the super windy road we were about to use to descend into Italy. We began driving but soon stopped because he even went so far as to pause right before the vans began the descent to take us to a walking spot where we could look out over the road. To his credit there were windy signs everywhere (Figure 47).

The descent did not begin well. Two cars were coming up as our two vans were coming down, and an angry Italian man (I don't know that he is Italian but I think it fits the story better) kept honking at Philipp to move even though there was no place to go. Reto pulled a three point turn on a windy road on the side of the mountain and was just able to squeeze past. Other than that instance though, it was not that bad. I heard later that my classmates in Reto's van were "not that impressed." Little did we know that the Italian village we were about to visit would floor us.



Figure 47: Windy Road Signs

Before we saw that Italian village though we made a quick geology pit stop at the bottom of the windy road to look at a landslide. A small township had been built around the huge rocks that dotted the landscape. Reto explained that the rocks had not been pulverized like the Flims landslide because they were not limestone, but nice, a metamorphic rocks. The immediate valley where the rocks fell from and we descended from was very steep making us question the safety of the village being there. Frost wedging had caused a landslide once, and it could probably do it again. With that happy thought we continued traveling, now noticing deciduous trees which only grow at a lower elevation all around us.

Previously I said that the Italian village that we would visit floored us. I still do not think those words do the village of Chiavenna justice. Chiavenna is everything that I dreamed Europe would be for the previous twenty years of my life before I got to finally go and I think many in the group felt the same. In fact at the end of the trip when recounting our favorite moments, this night in this village was at the top for many if not most of us. It was warm, a lot warmer than the environments in which we had been. The town was filled with life on this Friday night, and we were anxious to get out and explore. When Reto and Philipp gave us time to walk around, we were infused with the culture. Countless mom and pop shops dominated the streets, and the large square in the center of town was abuzz with activity. Accordion players played on the river that ran through the center of the village, buildings from many different centuries could be found in various nooks and crannies (Figure 48), and the people were so friendly and seemed to move at a pace that fostered enjoying life. Hailey even met an artist that used computers to create eye-catching interpretations of the Alps!



Figure 48: Exploring Chiavenna

The first thing we did as a group is pursue Gelato! The place we found had a variety of flavors, all delicious. As we destroyed the gelato, the smiles were clear on everyone's faces.

In my mind, there was no way this dessert could be topped by dinner, but fortunately it was. The place we went sat right on the edge of the mountain, so close that Reto informed us they used the rocks to cook much of the food we would later be having. Everything was enchanting, but nothing more so than the gnocchi we had. I looked down and started eating it, and when I finally looked up it was gone from everyone's plates. It was by far the best gnocchi I had ever had. Despite being so full, we could not help ourselves and ordered more dessert. Why would we not have tiramisu in Italy?

After dinner, Reto and Philipp led us on a walk through the city to witness Chiavenna at night (Figure 49). It was much needed to help the food go down. The city at night was energizing as well. Street singers infused the night with music, and countless young people were out.



Figure 49: Night Tour of Chiavenna

It was a perfect way to end the night, to what had been a long but fulfilling day.

Day 4 –8/13/16

Rita Wegner



Figure 50: Map of Day 4

- 1– Hotel San Lorenzo
- 2– Soglio
- 3– Bregaglia
- 4– Jugendherberge Cuntschett

We began the day in Chiavenna looking at the San Lorenzo monastery. There we saw a baptismal font, dated at 1156. The font was carved out of one rock, the Pietra Ollare. Many large monuments were made out of this kind of rock. The sculptors and designers used an iron pick and hammer to make such monuments. The specific baptismal font we examined displayed Romanesque 12th century artwork (Figure 51).

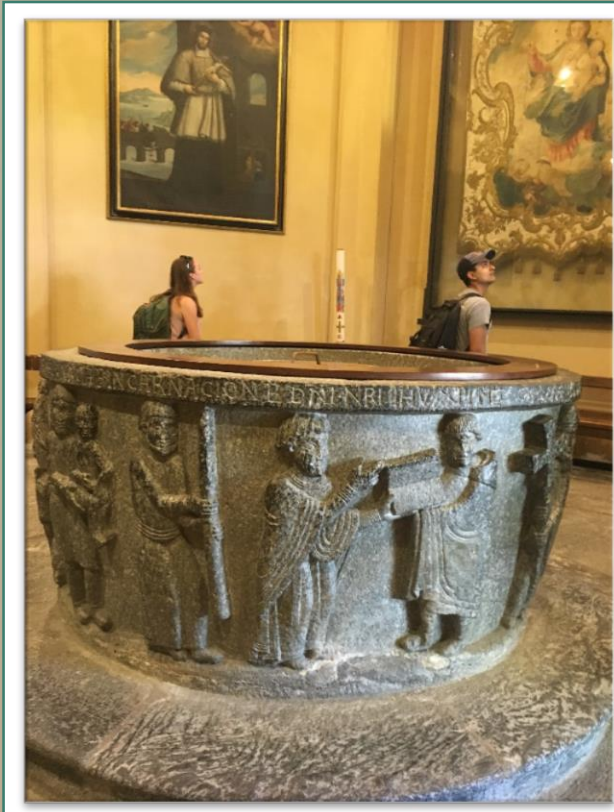


Figure 51: Baptismal font



Figure 52: Copper bowl used for baptism

This font displays the three classes: the horse represents the aristocracy, and the craftsmen represent the blacksmith, along with the tower and fancy buildings. The commoners were also displayed on the font.

After learning about the cultural significance of this monastery and the rock the font was made of, we discussed the geology of the Pietra Ollare. The rock, also known as soapstone, formed in the deep mantle, which made the rock soft when carving. It's found in the Alps and Himalayas, and Inuits also used the rock to make statutes. It was a very primitive way of carving. The Pietra Ollare of the baptismal font was mined in Italy, causing a local landslide on June 4, 1618.

Baptism is still performed here today. The bowl was made of pure copper, which is unique in Europe (Figure 52). To baptize the baby, the entire baby's body went into the water.

In the church, we saw soapstone pillars that were also carved out of one piece of rock, which were good examples of Baroque artwork. The church was built in the 17th century, and was a Catholic church, typical for Italy. It's a fairly wealthy community, so everything was made from the real stone, instead of the fake stone.

In the courtyard of this old monastery, we examined the structural columns made of soapstone. It was originally a mantle rock that became metamorphic. The soapstone structural column displays schistosity in orientation, which causes the rock not to slide. The alignment was horizontal, meaning the pillar was supported. This shows that the builders knew their rocks. We then learned how talc is a soft mineral, and makeup is made from it. The talc was found on these pillars (the white material), which is important for the cosmetic industry, and good for skin. The other mineral on the column is chlorite, and we found remnants of olivine. We also learned that collegiate means holy complex.

We next learned about the legend of Marmitte dei Giganti. This legend describes how giants cooked in potholes.

After all of that group learning, we split into small groups to examine the architecture of the arches. In addition to taking photos (Figure 53), we also sketched the arches (Figure 54), paying close attention to the years they were built.

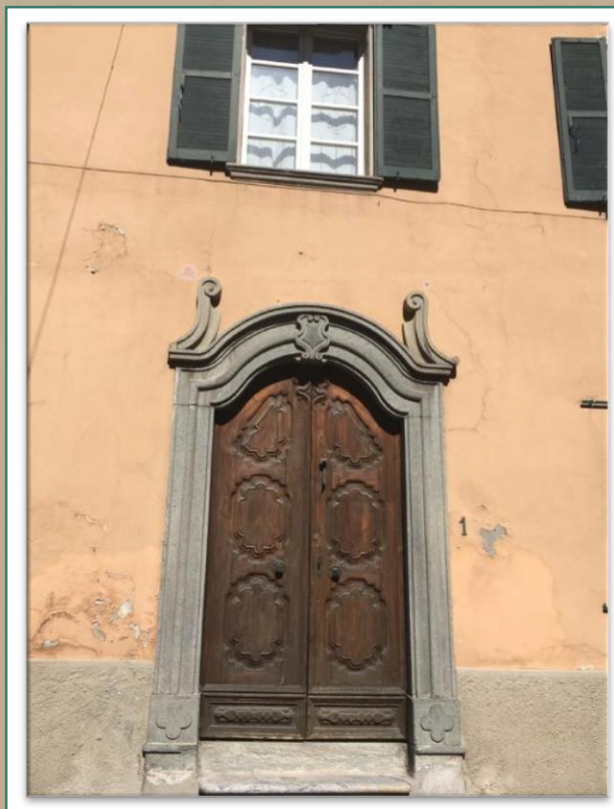


Figure 53: Arch in Chiavenna

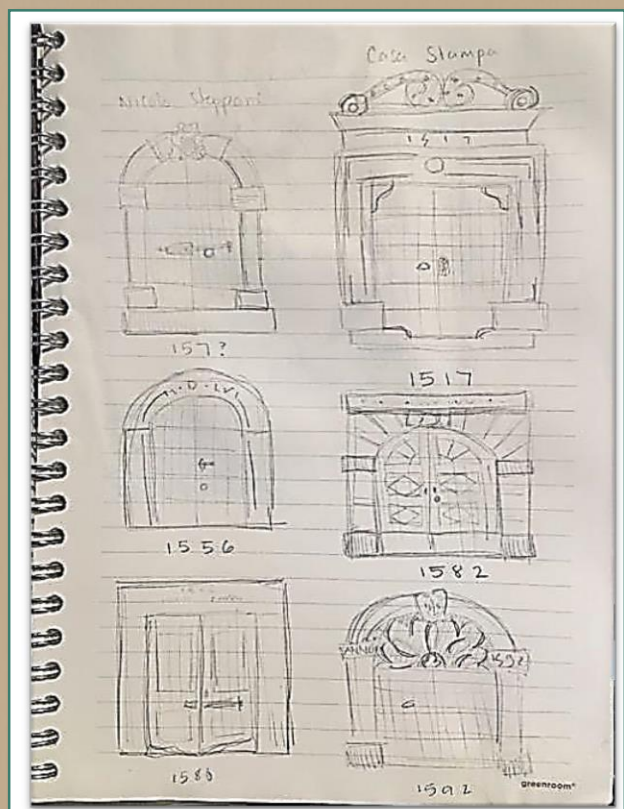


Figure 54: Callie's sketches of arches in Chiavenna

Ultimately, we saw many arches from the 1500s and 1600s. They were very ornate, and we saw many family coat of arms. We learned how many fancier buildings were built in the 17th century, however, the buildings were owned by Swiss families further up in the valley. These families got wealthy from trade. They made staircases out of stone. The Swiss influence of the village ended in 1814 after the Congress of Vienna, and then the mountain folk gave it back to Italy.

Afterwards, we learned about the history of Chiavenna as a transport hub. We learned how Rome conquered Chiavenna in the 15th century, and how Chiavenna's location, being north of Milano and near Chur made Chiavenna easy to access for mules and horses. We discussed how chariot marks are remaining in the city today, and how Romans used the pillars for mile markers.

After spending time in Chiavenna, we hit the road, and stopped in Soglio. A picture of the church we visited is below. At the church, we saw the natural stone floor made of Gneiss, a metamorphic granite. This rock was also used for the roofs. Looking around the village, we saw the high mountains made of granite as well, and examined the shiny mineral; mica. In this town, most people are farmers, growing potatoes, wheat, buckwheat, and some berries. They also farm a lot of livestock.

Afterwards, we stopped in a town called Bregaglia, where we saw an ancient torture mechanism (Figure 55).



Figure 55: Philipp demonstrating the ancient torture mechanism

When arriving in Pontresina, we took a train up the mountain to view the sunset, thus finishing our day.

Day 5 –8/14/16

Shivali Govani



Figure 56: Map of Day 5

- 1– Jugendherberge Cuntschett
- 2– Mottas Muragl
- 3– Chamanna Segantini
- 4– Alp Languard Ski Lift

This morning, our group woke up in the youth hostel in Pontresina, Switzerland, ready for our second hardest hike of the entire trip! I was especially excited because we had gotten a preview the night before when we took the cog railway up to watch the sunset and starry sky; I could tell this was going to be a challenging day. After breakfast at 7:30am, we drove to the cog railway and rode it roughly 700m up from Punt Muragl to Muottas Muragl. Figure 57 displays a map of our path. We started at Pontresina located on the right at 1805m above sea level and drove to the Punt Muragl Talstation on the left in the figure and this is located 1738m above sea level. We reached Muottas Muragl at 2456m above sea level on this crisp 49°F morning and saw a gorgeous view!

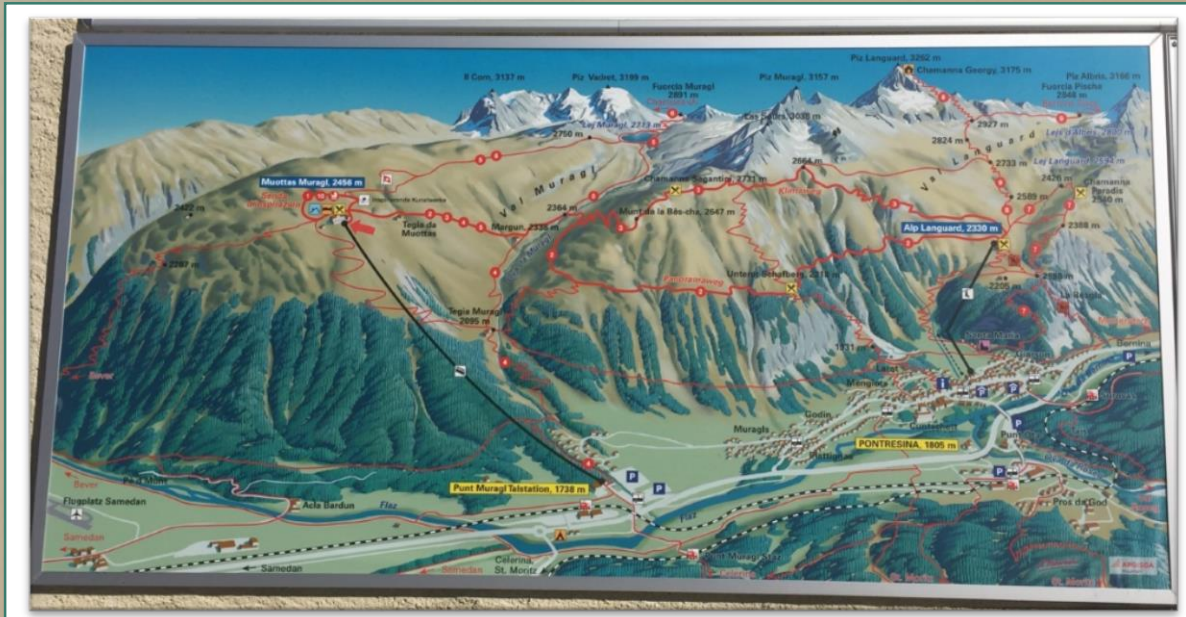


Figure 57: Map of the Day's Excursion

Muottas Muragl is located in the Upper Engadine. From the top, we saw views including St. Moritz, lakes of the Upper Engadine, Piz Palü, and Piz Bernina as seen in Figure 58. We learned about the changing demographics of travelers visiting the tourist destination, St. Moritz. Specifically, that it used to be a popular site for Russian tourists but has now become a more cost effective travel spot for Chinese tourists. The lake at St. Moritz is famous for sports like horse races in the winter when the snow is compressed on the ice, in addition to ski races and cross country skiing. Yesterday we saw kite surfing which is a popular water sport during the summer. The little body of water located on the left of the lake in Figure 58 was pointed out as a beautiful textbook example of a bog.

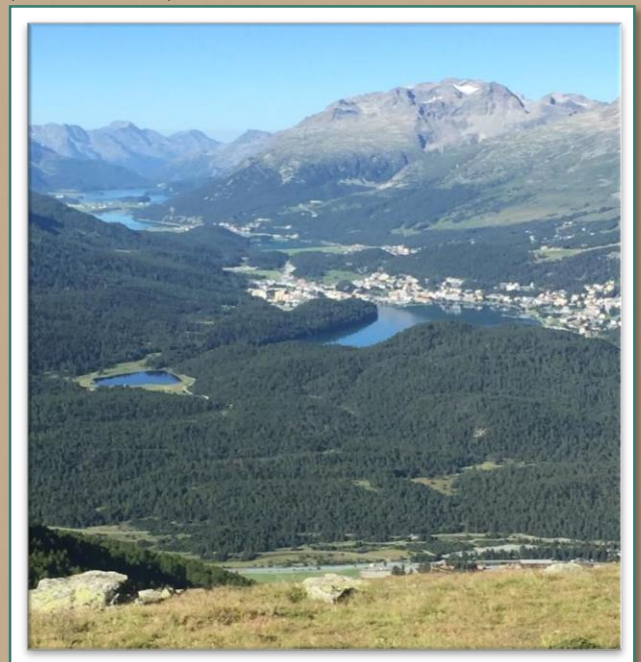


Figure 58: View from Muottas Muragl

A bog is an environment in which peat is formed, a soil-like substance that is a precursor to coal. We also learned that flora (especially flora located on the bottom of lakes) are an important indicator of climate change. Pollen specifically helps determine time. Additionally, we observed the very distinct tree line which was at very high altitude, about 3000m, because a lot of solar radiation reached the area. The special climate allowed for trees to grow at higher elevation. Forest sustainability was discussed and I was so surprised to hear that every tree that is cut down must be replaced by the exact same tree to replenish the population.

After taking in this view, Reto pointed out the trail we would take to go up Sheep Mountain which was personally a bit frightening but at the same time enthusing! The zigzag path in Figure 59 shows our path.



Figure 59: The Path up Sheep Mountain

After these lessons, we finally started our hike across the mountain shown in lines 5 and 6 in Figure 57 so we could get to the glacial lake. This was a dirt path, narrow, but smooth with some pebbles. On our way, we stopped to listen to Hailey's presentation on the Cultural Development Within the Natural Constraints of Alpine Topography. In addition to learning how an assortment of livelihoods, sports, and cultural activities resulted from the topography in the Alps (like mining in Austria or sled races in Davos), we learned about language barriers and divisions. I found this to be the most intriguing. It's not border lines that determine language differences, but rather topography. That is why in certain parts of Switzerland, citizens speak

Italian or vice versa! Reto gave us a personal anecdote on the historical referendum that made Romansh a national language and told us how his grandfather helped pioneer this decision. In this specific valley, we learned that Ladin Romansh is spoken and that printing school books is very costly because they must be printed in so many languages! Additionally, we ended up talking about the branding and labeling of goods and it was very interesting to learn that goods specific to an area or nation (like Feta cheese of Greece or Champagne) can only be called such names if they are made in that region. This was surprising because in America, we can buy “feta” cheese but it’s most likely not from Greece.

We also stopped to view the famous rock glacier from afar as shown in Figure 60 and learn about permafrost. For a substance to be characterized as permafrost, it must be frozen for at least 2 years. When we were given this lecture, we were on the south side of the ridge and sitting on permafrost! The north facing side has less solar irradiation and is thus always more extensively affected by permafrost. As seen in Figure 61, there are layers to permafrost. The top is the active layer where thawing and freezing continuously occur (more so in summer). The layer underneath is the actual frozen permafrost layer and the bottommost layer is surprisingly melted. Although it is insulated by compact ice, it is not frozen because it is closer to the center of the earth. For each km going down into the earth, the temperature increases by 30°C and this is called the geothermal gradient.



Figure 60: Rock Glacier

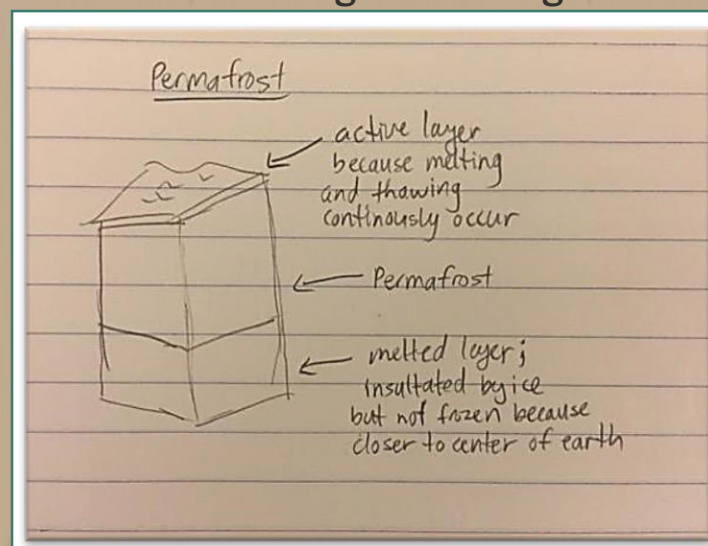


Figure 61: Permafrost Layers

We also learned about talus and other rock debris. Specifically, we learned how sand grains move down and that is by the phenomena shown in Figure 62. When water freezes, it lifts the grains perpendicular to the ground but once that melts, the sand grains no longer fall back to their original position but rather vertically down, displacing them.

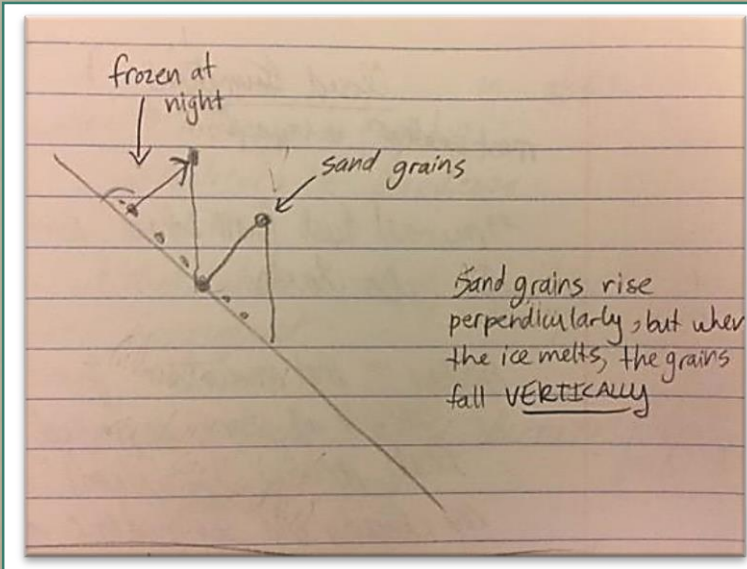


Figure 62: Movement of sand grains



Figure 63: Philipp and Caleb climbing talus

After this, we continued our walk and then finally reached the glacial lake. The weather was gorgeous by this point and many hikers and tourists were around us unlike on other hikes. At the lake, we sat and had a nice lunch. After eating, we made our way through the wide valley to get up close to the rock glacier. The path, or rather lack thereof, to get there was pretty difficult to maneuver in as we walked. There were medium to large pieces of dark talus and rock that we hiked around. Philip and Caleb even decided to climb a set of steep rock debris shown in Figure 63 while the rest of us observed. I don't think anyone else had the nerves to accomplish this feat! We saw the tongue of the glacier but noticed how there wasn't any ice visible and that is because it's permafrost. Ice is only present in the core of the rock glacier and we learned that the rock glacier we were looking at moves very slowly downhill.

Also during this part of the hike, we observed *Genziana* which is very famous to the Alpine area. Notice the intense blue color of this flower as shown in Figure 64.



Figure 64: Gentiana Flower

Moreover, during one portion of the hike, Reto and Phillip asked us to look closely and observe our surroundings to see if we could find something peculiar. After much scrutiny, we figured it out! There were little trees as shown in Figure 65 if you look very closely. This area that we approached was the tree line and the reason these trees were so tiny, was because the climate here is too harsh. Although they looked like baby trees, they were actually full size because that is as far the conditions allowed them to grow.



Figure 65: Tree Line

Finally, after walking through this valley and making observations, we started our ascent up Sheep Mountain. This was certainly the most strenuous hike of the trip for me. I pushed my body immensely and after many unbelievable views (like the one shown in Figure 66) and definitely tons of breaks, I made it! After getting to the top, which was 2731m above sea level, I had this incredible accomplished feeling that I'm sure my peers also experienced. It felt so amazing to know we were able to hike up about 900m. Comparing this to the little 300m hike we did the first day that left us exhausted, we proved just how far we'd come along on this journey. This is by far my greatest memory of the trip. I was so proud of myself and our group.

After a long break at the café on Top called Chamanna Segantini, we made our descent down Sheep Mountain. We stopped at the lift (Figure 67) and some group members decided to take this scenic ride while others split to take a longer hike to Pontresina. I was with the group that took the shorter steep path down with Reto (Figures 68 and 69). This path was much different than the ones so far in the trip in that it was woodsy. It was very beautiful and it reminded me of the Enchanted Forest, not that anyone knows what that is, but as far as Disney describes, it was the closest I ever felt to being in an enchanted place! The little streams and strangely shaped trees were very fascinating and the woodsy scent was much appreciated. Although Reto warned of its steepness, I didn't think it was bad at all! We made it back safely and Phillip picked us up and dropped us off at our hostel. After all our groups arrived, we had dinner, nice warm showers, and head off to bed! It was definitely a stressful day in terms of the arduous activity we engaged in, but despite that, incredibly rewarding and gratifying.



Figure 66: View from Sheep Mountain



Figure 67: (Left) Alp
Languard Ski
Lift Going Down
Sheep Mountain



Figure 68: (Left)
Hike Down Sheep
Mountain I



Figure 69: Hike Down Sheep
Mountain II

Day 6 –8/15/16

Sarah Henry

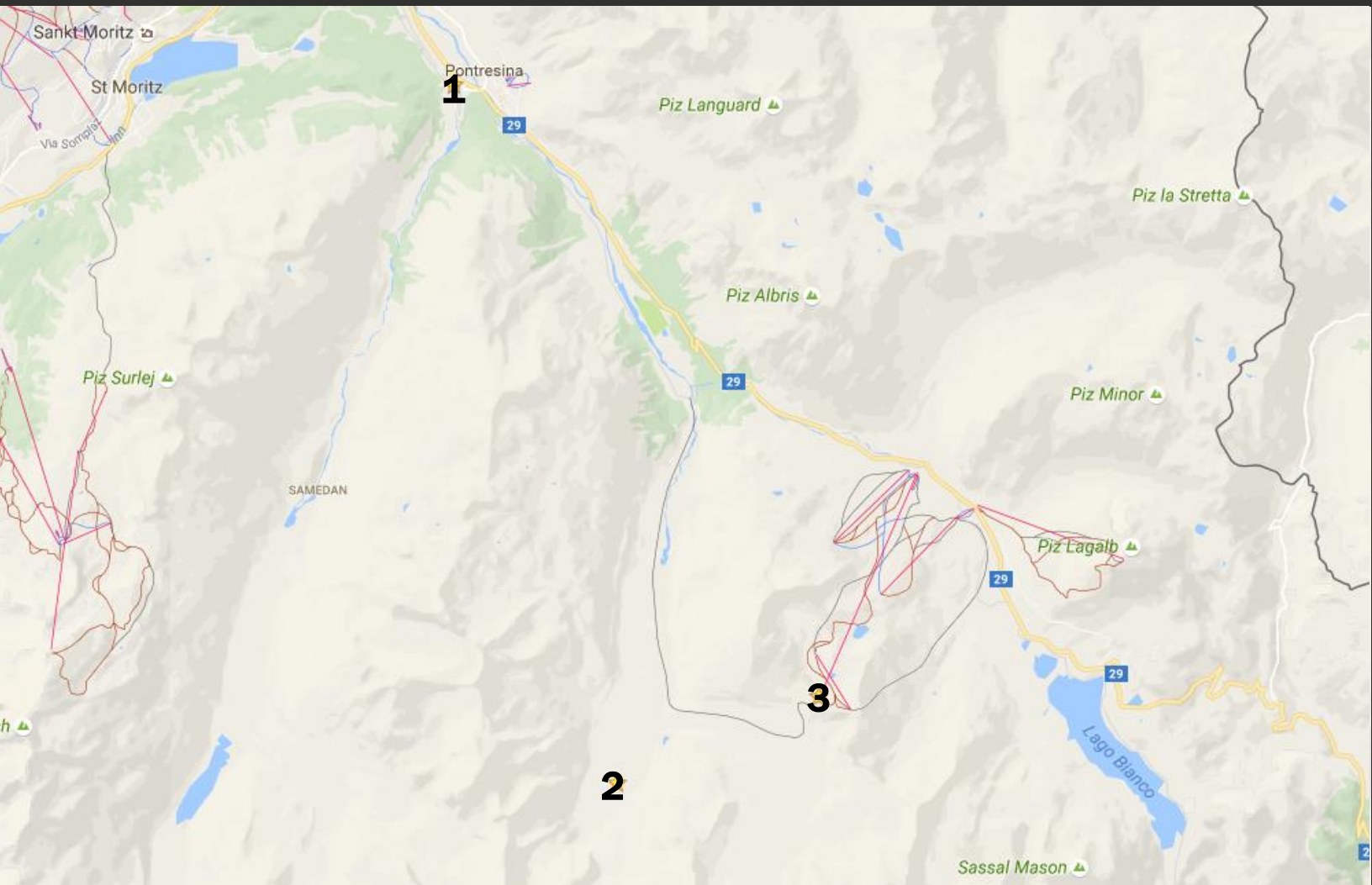


Figure 70: Map of Day 6

- 1– Jugendherberge Cuntschett
- 2– Morteratsch Glacier
- 3– Berghaus Diavolezza

Today we started our day in Puntraschigna (the Romanish version of Pontresina), a village approximately 2000 meters above sea level, where we learned about climate change, its effect on the Alps and the steps currently being taken to avoid catastrophe in the future. Next, we ventured to glacier Morteratsch to learn about glaciers by climbing on one after learning about the ice ages of Earth's past and present. Finally we headed to Diavolezza where we took a cable car to our accommodation for the night at approximately 3000 meters above sea level, where we learned about clouds and how to use them to predict the weather we will have.

In the morning we walked around the town and saw the key elements of a typical Swiss mountain village. Puntraschigna is a popular place for winter sports such as skiing as well as summer activities such as hiking. Despite the popularity of tourism, the town has maintained a large amount of its Swiss Alps charm. Often, the windows of houses here were small and pushed back with tilted sides to keep the house warm in the winter months, but still allow sunlight in, a common design in villages in this area, as seen in Figure 71.

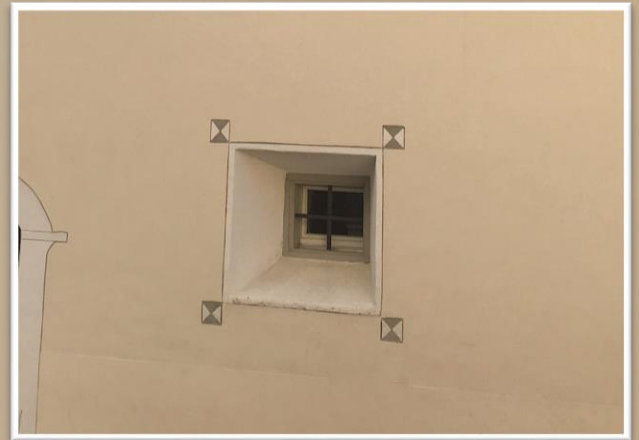


Figure 71: A classic window with tilted sides



Figure 72: A typical house with sgraffito

In addition, most houses in the area were decorated with sgraffito, drawings on the sides of the houses to decorate and personalize each house. The decorations on the sides often added to the beauty of the house, while saving money on real moldings around windows and on corners of the house. As you can see in Figure 72, the intricate designs give the illusion of blocks on the corner of the house and window moldings, when in reality they have been painted on.

While the sgraffito added beauty, there was also meaning behind the drawings on a house. Often on the houses was an ibex, the coat of arms of each family, the builder of the house, the owner of the house and the year it was built and renovated. This made each house unique as every family could decide how intricate the designs they wanted on their house. The ibex was an endangered animal but now, populations have recovered. As you can see in

Figure 73, the ibex was prevalent for the design of the houses in different ways, sometimes extremely elaborate (left) and sometimes slightly more plain (right).



Figure 73: Comparisons of two houses

The Ibex holds such tradition in this town because of its significance to the state that Puntraschigna is located in, Grisons. This state is diverse due to all the mountains in the area that keep the villages isolated from one another. Italian, Romanish and German are all spoken in this state. The coat of arms has an Ibex on it because of the prevalence of the Ibex in the state due to its mountainous terrain making it the ideal place for an ibex to live.

The coat of arms of a family is often extremely important to the tradition of family in these villages. It is passed down through many generations and is a great source of pride for each family. As you can see in Figure 74, the coat of arms is generally very intricate and involved the family name.



Figure 74: A family's coat of arms

I felt that the tour of Puntraschigna gave me insights to the appreciation that the families had for individuality in the 15th and 16th century when the houses were built as well as the pride of each family took in their name and their house. In my hometown, most the houses look very similar and most are made from brick. There is little self-expression on the outside the houses in my town so I appreciate the emphasis of self-expression in the Alps. Even when the houses are made

largely of the same materials, they manage to make each look different and unique.

Next, we heard from Sandra about climate change and how the Alps are being affected by it. This presentation really made me think about my own carbon footprint. The harsh effects that rising temperatures can have are terrifying and can change the Alps. The melting permafrost can lead to catastrophic damage. Sandra passed out a graph, pictured in Figure 75, which displays the rising carbon

dioxide levels. There was a specific increase during the industrial revolution as seen on the graph. I realized that global climate change is a serious problem and can certainly change the world as we know it.

After Sandra finished her presentation, we next listened to Shivali who gave us a lesson about the ice ages of the past and present. It was fitting that we were in front of the Morteratsch glacier.

We were next able to get the hands on experience of climbing the glacier and seeing the rate and which the ice was melting that afternoon. The most astonishing part of the glacier was the rate and which it is melting as of now. We had to walk past each marker that had a year of where the glacier had been. According to my measurements, the glacier is retreating at a rate of approximately 21 meters a year. I calculated this based on the last 190 years. This is an under-estimation as temperatures have risen more dramatically in the last 100 years. If the glacier continues to melt at its current speed it will be completely melted in 166 years, but if it melts at the max rate it has ever hit, the entire glacier will be melted in 65 years. There are many glaciers in the Alps that are having these issues and it can lead to massive problems down the road.

Our last activity of the day was taking the cable car up to Diavolezza, where we stayed 3000 meters above sea level. The views were beautiful, as seen in Figure 76, and it made me nervous for when the glacier melts and the Alps change due to the global climate change. This day really made me appreciate the beauty of the Alps and the terrifying thought that they could change forever if we aren't careful about keeping the environment beautiful. I have been working much harder to reduce my carbon footprint since this day and hope that I can one day be involved in programs that help to keep the environment beautiful.

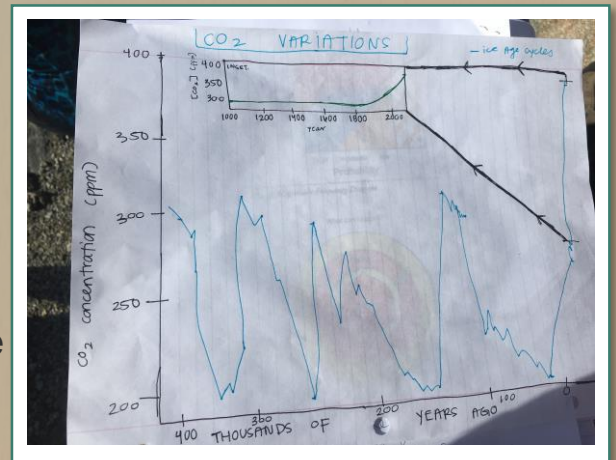


Figure 75: Carbon Dioxide Variations



Figure 76: View from Diavolezza

Day 7 –8/16/16

Sandra Loza-Avalos

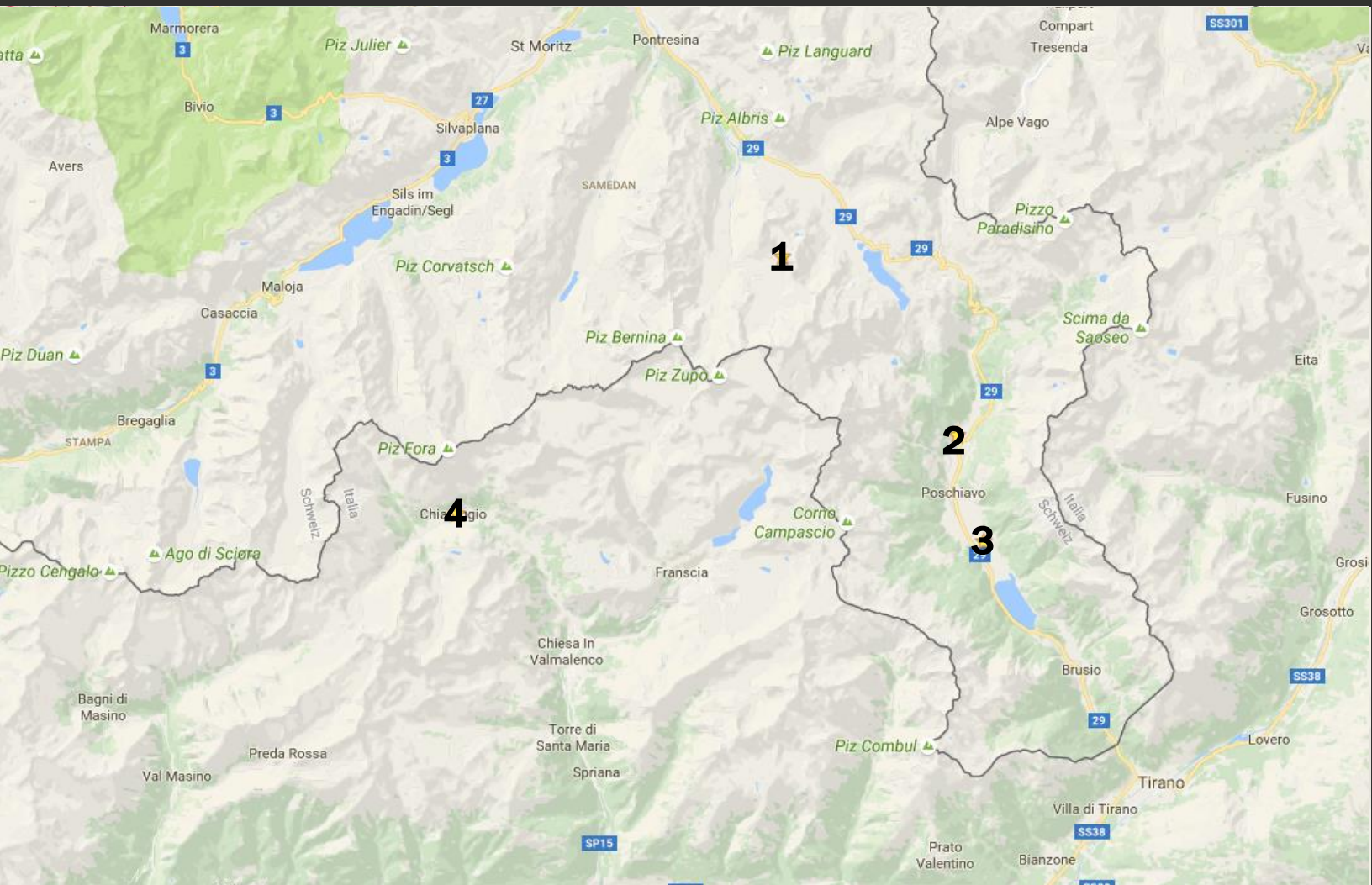


Figure 77: Map of Day 7

- 1– Berghaus Diavolezza
- 2– Cavaglia Glacier Garden
- 3– Poschiavo
- 4– Albergo Chiareggio

We were all woken from our slumber at 5:40 am by someone's alarm. I lay in bed, snuggled in my sleeping bag liner in the large room shared by all 15 of us, deciding that if I let the first few people get up and go about their business first, I would be able to salvage another few minutes of precious sleep. Eventually, I got up, dressed, and joined my classmates outside. We stood with anticipation, moving about the observation deck at the top of Diavolezza (at about 3000 meter elevation), waiting for the sun to peek out over the mountains. We all got amazing photos – I stayed out for about 40 minutes, the only thing leading me back in being my bladder and the thoughts of breakfast.

Swiss breakfasts so far were my favorite. I love Bircher muesli – oats, yogurt, milk, fruit, and nuts, all rolled into one – and this hotel did not disappoint. I ate a lot of Bircher muesli because we were going to descend about one kilometer down to the cable car base and back to our vans (because our cable car passes expired, and because why not?).

The descent was uneventful for 50 meters and then a huge patch of ice appeared. Some opted to take the “surfing on ice” approach, but I chose the “sliding down on my rear” approach. It was too early for such shenanigans! We had to cross another ice patch after another 50 meters (I was not amused), and perhaps 100 meters later a cliff lined with snow. A steep wall of snow to my left, a cliff-face to my right (Figure 78). At least the view was



Figure 78: Trek down the glacier

beautiful. This was one of the many times I realized the Alps were not created for humans with short legs such as myself – making the stretch from one carved-out footprint to another was very difficult! But at least the path had been marked for me, I suppose.

We stopped after this snow patch to discuss rock chemistry. I had just taken organic chemistry lab, and, although difficult, my inner nerd truly loved the reactions and learning about them. I was ready to apply my knowledge to geology. We discussed oxidation-reduction reactions occurring as the rocks were weathered, specifically in rocks with high iron sulfide content. Pyrite was the mineral found in these rocks – they were bronze-red in color due to the oxidation of the iron (essentially, the iron in them rusting). I learned the mineral pyrite was also called “Fool’s Gold;” we could see shiny, golden flecks in them. It was easy to see how a desperate miner could

confuse the pyrite for real gold! We also discussed the color given to minerals by certain oxidation states of chemicals – ferric ion gives minerals a red color (such as in pyrite), and ferrous ion gives them a green color.

The rocks were formed about 480 million years ago in the Paleozoic Era which is defined as the time period having occurred 570 to 245 million years ago. The surrounding mountains were much younger, formed from lava, and thereby being composed mainly of igneous rocks. We also looked out across to the mountains and valleys opposite us. They exhibited the typical u-shape given to them as a result of being carved from glaciers. We noted some v-shaped valleys, smaller and on the side of the u-shaped ones. These were fluvial valleys, having been carved out by rivers long after the ice had receded. There weren't many talus slopes, and the vegetation was lacking above the treeline. The rocks were also a paler color, almost white. If we squinted enough, we noticed bends in the rock and tilts – bends and tilts that were the same on a mountain across the valley from the one we stared at. They both had folds! The folds were formed when the Alps formed. The rock was cut in half via erosion due to the glacier. We were told the rock was of the sedimentary type, specifically limestone or dolomite, a special calcium magnesium carbonate. These lighter colored rocks were from the Triassic period, the oldest period of the Mesozoic. This is the period where the dinosaurs could be found in abundance, and dinosaur tracks are commonly found in those specific rock layers. Other things that are commonly found on these carbonated plants: edelweiss, a famous alpine flower. We made it down after about three hours of hiking (Figure 79). I ran once I saw a flat, open field – mostly because I had to use the restroom, but also because I was finally happy to see flat land again after our steep descent. We drove for ten minutes and stopped to have lunch overlooking a lake – not bad at all!



Figure 79: The group pauses to check out the cable car on its ascent- Diavolezza

We took a winding road to our next destination. We stopped in the middle of the road on an uphill, windy pass at one point because we noticed the other van smoking (oh no!) behind us. We had to make two trips to head up to the Glacier Garden, the executive decision being to leave the van on the side of the road to cool down. Talk about a morning full of activities! This Glacier Garden was in Cavaglia.

About ten years ago, a shepherd came
Across giant holes in the ground, with
smooth insides and small to large boulders
inside of them, also completely smoothed
and rounded. The legend said that these
were the pots giants had used to cook in.
These were actually potholes, caused by lots
of erosion. Glaciers, the rules of this
landscape, eroded the plain we were on.
Crevasses from the erosion and sheer force
of a giant glacier formed – the glaciers
would pull on rocks at steep inclines as they
moved, opening the crevasses deeply into
the ground. Bernoulli's Law states that water
flows faster through narrower openings. As
the crevasse increases in size slowly, the
water in the smallest portions of it flows
faster and faster. Water on its own, we
learned, wouldn't have been able to do this
on its own. The debris the glacier dragged
into the crevasse gave the water its erosive
power, like a powerful power-washing hose, to continue eroding along the edges of
the crevasse. The potholes could only have been created in these conditions – a
small incline for a glacier to climb up, and then a steep decline for the glacier to pull
on, with the help of gravity. The potholes we saw ranged from small to massive. A
person (or a few) could fit comfortably in the bottom of one (Figure 80).



Figure 80: Sabrina peers into one of the many potholes in the Glacier Garden

I was overwhelmed at this point by the vastness of the landscape, and the natural forces on Earth surrounding us. Glaciers had once towered over our heads here, and now, they had created these fun, interesting, amazing, smooth potholes? I literally had my breath taken for me as we stood at the top of the Glacier Garden, overlooking more u-shaped valleys.

Luckily by this point, the other van was deemed usable again, and we were able to continue to our next stop: the quaint town of Poschiavo, in the Italian speaking region of Switzerland. We stopped here for about an hour to decompress after the

day's activities, but not before stopping at an ossarium. I thought this would be some kind of museum honoring bears. However, an ossarium is actually a place where bones of the deceased are kept. We saw skulls on display in beautiful cupboards (Figure 81) – the ossarium was closed, so we were not able to investigate further, but persons would apparently be dug up from their final resting places and be placed in the ossarium to make space for more deceased.



Figure 81: View of the inside of the ossarium in Poschiavo

Aside from its interesting bone storage methods, Poschiavo had a gorgeously decorated church, with gold leaf included. The city had a specialty: sweets! Bakers and their families would emigrate from Poschiavo to other places in Europe with their secret recipes in tow, and make a fortune selling their goods. Many large, famous bakeries in Europe now have origins in the small town of Poschiavo. Unfortunately, those families stayed where the money was and only sent back money to Poschiavo – not the treats.

Despite the lack of specialty bakeries, a group of us sat in a coffee shop and tried a delicious forest berry cheesecake (Figure 82). It was special enough for us! The waitress decorated our cappuccino's with different art! We were glad for this moment's reprieve.



Figure 82: The delicious cappuccino's and cheesecakes we had in Poschiavo

After our coffee break, we loaded up in the vans again, stopping one more time to buy groceries in a small Italian town about one town over from Sondrio. I got away with buying fruits and snacks for the next three days for only five Euros. What a deal! Why isn't America like this? After grocery shopping and somewhat fretting about the other van, we began our ascent to Chiareggio, our resting place for the day and for the next few days. With a lot of prayers and anxious glances back to the other van, we made it to Chiareggio! The hotel was gorgeous and was a lodge popular with geologists. At dinner, the best lasagna I have ever tasted (many agreed with me) was served as an appetizer. I was in heaven. The meat, cheese, and pasta... all cooked to perfection... it was what I needed after a long day such as today. Due to weather, the plans for tomorrow are up in the air, but I know a long rest is what I will definitely need first.

Day 8 –8/17/16

Hailey Dougherty

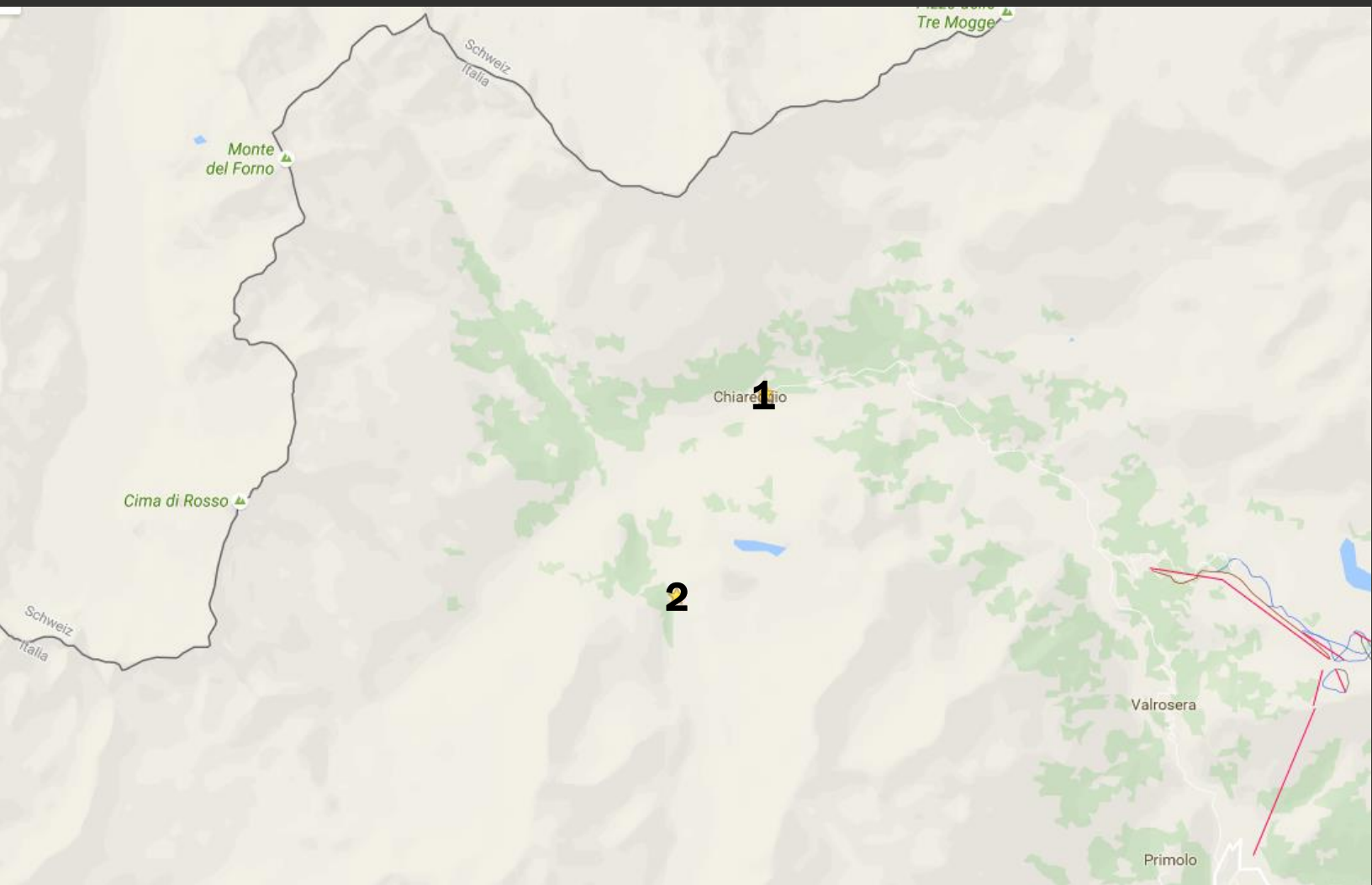


Figure 83: Map of Day 8

- 1– Berghaus Diavolezza
- 2– Riguglio Gerli

7AM: *Mattina*

Chiareggio is the highest village in the Malenco valley, which is located in the Sondrio province of Italy. After a long day of travel on the 16th of August, we had the pleasure of resting in a quaint, family-run Inn, Hotel Chiareggio (Figure 84), for a good night's rest. Morning woke me with the scent of freshly brewed Italian coffee, and the murmurs of waitresses and chefs, all of whom were scrabbling to accommodate our group of seventeen, much larger than their typical crowd of coupled hikers and family vacationers. Actually, backpackers and tourists are arguably the main reason that this hotel and village have endured to this day. Chiareggio, located at around 1,600 meters in altitude, is subject to harsh, cold, and snowy climates; the heavy snowfall restricts access to the village during winters, so home-inspections are completed by snowshoe. For this reason, the summer valleys surrounding Chiareggio attract curious and adventure-seeking travelers and researchers (including many geologists) to the region's slopes. Our class considered ourselves true Earth scientists that day as we headed out for a hike with interspersed lectures on culture, rocks, lichen, and streams, among others. We laced up our boots, packed our lunches, and took our last bites of breakfast, of course being mindful to limit our serving sizes of leftover cake from the previous night's dinner.



Figure 84: Hotel Chiareggio at sunrise

9AM: Serpentinite



Figure 85: Serpentinite in Valmalenco

It was apparent a short ten minutes into our hike that a greenish sheet silicate was shaping the landscape just above Chiareggio. We'd seen this stone earlier in the day in the floors of our hotel, and posing as the material for shingles on the roofs of our neighbors' homes. This metamorphic rock is known as serpentinite, or *serpentino* in Italian (Figure 85). The local economy is largely reliant upon the mining of serpentinite, not only for its benefit as an export, but also for its desirable properties, which support regional constructions. Serpentinite is used in many ways including roofing, sidewalks, flooring, and in kitchen counters, due to desirable schistosity and its resilient resistance against acids.

11AM: Alpine Fauna and Flora

Professor Gieré has a way of teaching that stresses the benefits of asking questions as a means to achieve understanding. He encourages students to seek out environmental clues, both large and small, which will enable answers to be found. Many of the Alpine flora (Figure 86) and fauna that we discovered in the region were indicator species and helped us to recognize historical climatic and geological information. I was particularly intrigued by the ability of map lichen to grow on rocks in such high altitudes (Figure 87). This is possible because lichen is a pioneer species. They typically do not have roots so they can grow in places with little to no soil. We learned that this species tends to grow in roughly circular dimensions, and that the largest lichen in diameter growing on a rock is, with very few exceptions, the oldest lichen present. Many researchers use this assumption to determine relative age of deposits and moraines, or to discover hints about historical glacial advances or retreats. We did not get to see it due to time limitations, but we were only a short walk away from the oldest tree in the Alps, which is 1,008 years old. Trees and vegetation in the Alps act as another proxy for geologic and glaciological clues. We discussed tree rings and tree cores and the importance of these features in discovering climatic patterns of the past.

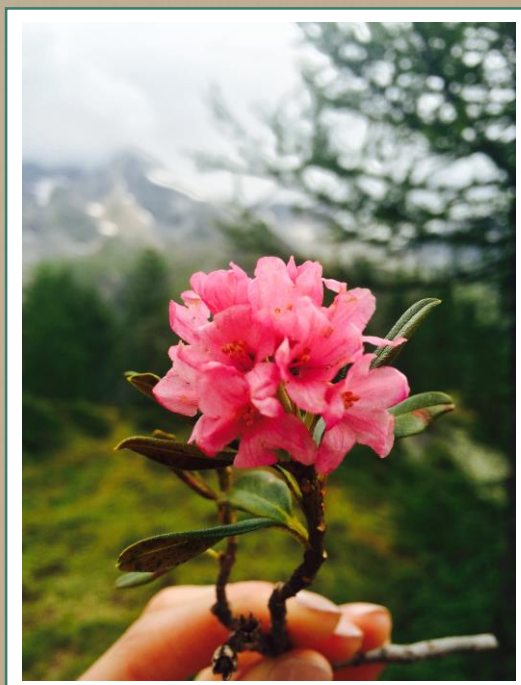


Figure 86: *Rhododendron ferrugineum* (Alpine Rose)

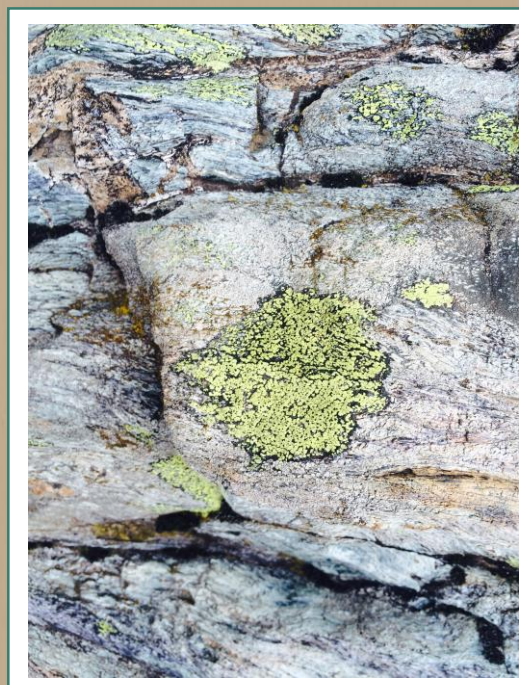


Figure 87: *Rhizocarpon geographicum* (Map Lichen)

2pm: High Alpine Culture

The afternoon called for a short break; a minute to sit back and observe the local people of the Alps and their way of life. But we were on a hiking trail in a high isolated valley... how would we gain insights if no one was present? To my own surprise, this would not be an issue at all. Even as we ascended to the highest

valleys we came across a variety of diverse individuals. We encountered a hikers accommodation cafe a short two miles from Chiarreggio and the space was bustling with a number of Italians, mostly families and couples, resting to reenergize with coffee or juice. We ourselves could not deny a fresh cup of Pesca offered to us by Professor Gieré (Figure 88). It was during this time of relaxation that I realized something extraordinary about the people surrounding us. These families out for a hike seemed to be entirely enthralled by the peaceful nature around them. There were numbers of people sprawled out on blankets, or sitting under sheer tents, staring at the sky and the mountains, and conversing just low enough as not to break the silence of the atmosphere. Sure, it was summer and many of these people were enjoying the holidays and their time off from work by completing a day excursion, but Professor Gieré reminded us that this was not an uncommon sight. He noted that the Italian people tend to love nature and education regarding the pursuit of its preservation. We noticed a variety of signs along the trails that were placed with the intention to educate the public about the history of the land around us (Figure 89). The taste of Pesca that afternoon made for the perfect metaphor for the Italian culture- the simultaneous *simplicity* and *richness* was heart-warming.



Figure 88: A moment of rest to enjoy Pesca Peach Juice at the Rigugio Gerli

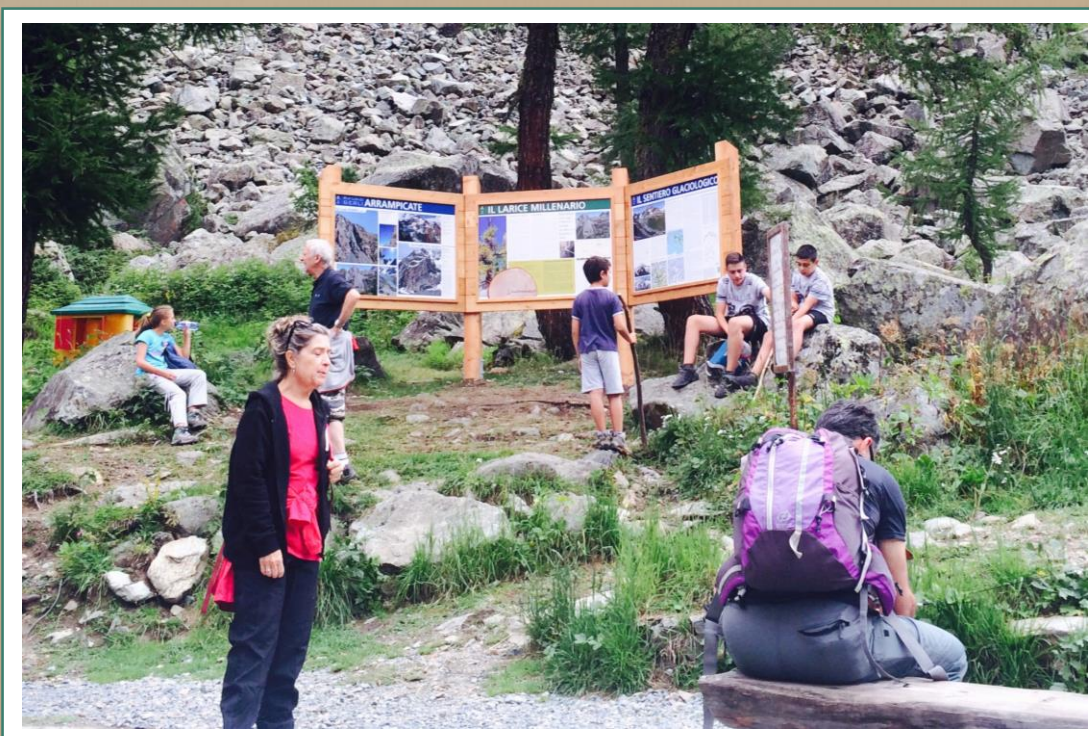


Figure 89: Italians resting along Valmalenco's hiking trails. Signs in the background discuss glacial history of the region

3pm: Alpine Transhumance

Arguably the most unforgettable experience of the day was being firsthand witnesses to the historical practice of Alpine transhumance. We hiked alongside cows, farmers, and herding dogs at work, as they traveled from one summer valley to the next (Figure 90). We first noticed the farmers after we were greeted by energetic pastoral dogs and we noticed smoke rising from above the nearest hill. These migratory farmers regularly abandon the lowlands after the end of each winter season, and they steer large herds up the mountains into high valleys. The land that the cows were grazing on belongs to the villages, and the villagers pay the farmers to bring all of their cows uphill. The farmers take shelter in old stone huts, which were built in this region using scavenged local stones and wood (Figure 91). I noticed one farmer climbing on top of a hut working to repair crooked shingles, for this would now become his new shelter for a few days, weather permitting. Migratory cattle farmers occupy Alpine huts for short durations each summer. Many Alpine huts are decaying and it is increasingly difficult to find people who know how to build these constructions and are willing to do so. We also saw horses as well, which the farmers use to transport food and supplies up the mountains. The cows that we encountered produce milk and cheese, very popular in Italian Alpine cuisine, which is sold to many of the lowland towns including Chiareggio. As we trekked downhill alongside the cattle, I was impressed by the abilities of these animals to navigate the steep and rocky slopes. The silence of the Alpine air was broken by the ring of cowbells, and the farmers' laughs, and I scrambled to photograph a life which was so familiar to them, but so exotic and new to me.



Figure 90: Herd dogs and farmers guide cattle through high Alpine valleys to take advantage of summer pastures

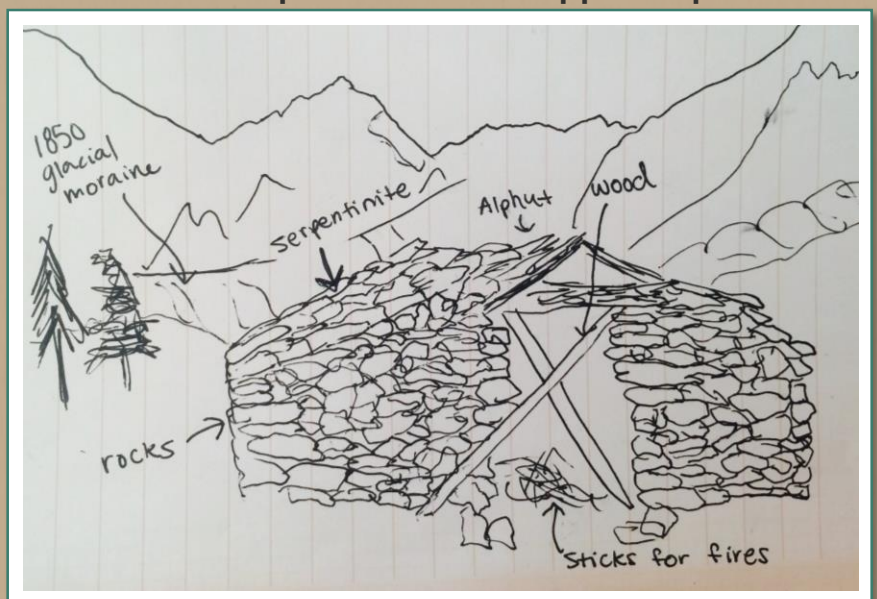


Figure 91: Sketch of an Alpine Hut in Valmalenco

8pm: A Taste of Italy

After an eventful day in Valmalenco I was more than ready to enjoy a restful evening and a delicious Italian dinner. My desires were met with soaring colors when Professor Gieré surprised the group with a wine and cheese social hour in the cellar of Hotel Chiareggio (Figure 92). The scene was perfect, as if from a movie I'd once seen before but only dreamt of living out. In a cool, stone room, we sipped some local wine (un po' di vino), and conversed with a young Italian girl who was born and raised in this small mountain village (one of the innkeeper's daughters). She even served us fresh cheese from the very cows we'd encountered earlier in the day. This girl soon became my friend and after dinner she told me stories of her life and her people. She was to go back to Milano at the end of the month to continue her studies at the University, but her heart has always been in Chiareggio, so she is dreading the day that she must return to the big city.

That evening I also got to know a few Italians who were vacationing for a few days in the high mountains. The language barrier between us was broken by our ability to share laughs and smiles during a game of cards. I am led to believe that the grandmother, Emilia Bavo, thoroughly enjoyed getting to know me, an energetic American girl, because she invited me to come stay at her home by Lake Como. Little does she know how much I've been inspired by the Italian high Alpine culture... I very well might show up at her door.



Figure 92: The Cellar of Hotel Chiareggio

11:59pm: Sleep

Day 9 –8/18/16

Eryn Heintz

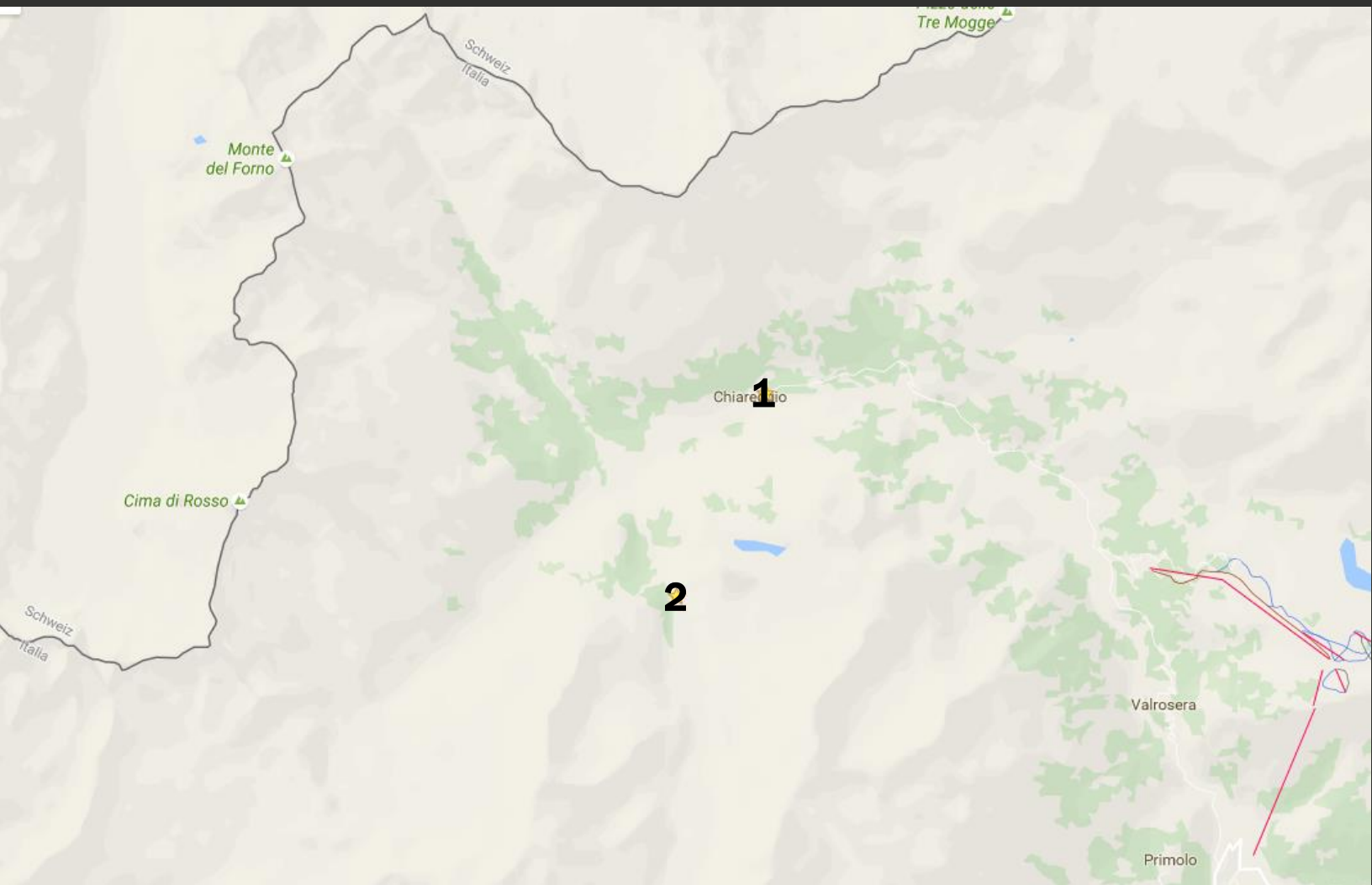


Figure 93: Map of Day 9

- 1– Albergo Chiareggio
- 2– Refugio del Grande Camerini

Our day began with breakfast in the adorable Albergo Chiareggio, where most of us stuffed ourselves with cake as fuel for our longest hike of the Trip (Figure 94). We set off after breakfast.



Figure 94: View at the beginning of the trail

Along the trail up the mountain, we stopped to hear Dipak's presentation on soils and Rita's on alpine animals, including everyone's favorite; the marmot. We also heard from Philipp about hunting restrictions in the Alps. In order to hunt in the Alps you have to buy a (very expensive) shot from a head hunter so that they can keep careful track of the animal populations. We also learned about golden eagles, a species that used to be protected. Today the Alps are fully saturated with the eagles, as they need 30 square miles of territory each to hunt. We also talked about bears in the Alps; they were hunted heavily in the past and the last one was shot early in the 20th century. Today the bears are beginning to repopulate the area, but the population is nowhere near restored.

We made one more stop before reaching the top of the mountain. We took our break by a stream and examined the rocks in the surrounding area. We worked in small groups to discuss, draw, and record what we saw (Figures 95, 96, and 97).



Figure 95: Sandra, Rita, Sabrina, and Sarah working hard to record observations about the nearby rocks



Figure 96: Sarah, Shivali, and Becca record their thoughts on the igneous intrusions

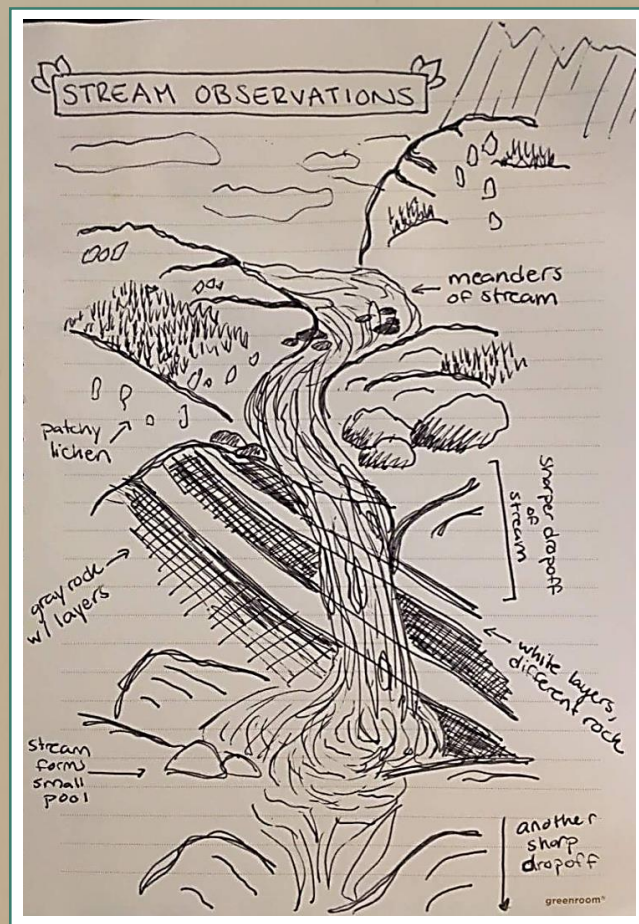


Figure 97: Callie's sketch of the area we observed

We observed that these igneous rocks resemble conglomerates, which typically contain rounded pebbles deposited by a river, and have a finer-grained matrix. We saw lots of rectangular silicate crystals of feldspar, which is a sign that a rock is igneous. We could also see xenoliths, or "foreign rocks" present close to the end of the igneous magma intrusion. There was also a clear example of a pluton (Figure 98); an igneous intrusion formed when masses of magma intruded through the Earth's crust.



Figure 98: Pluton with xenoliths

The igneous rocks we saw formed when the magma masses came through the Earth's crust about 30 million years ago. The magma cooled for a long period of time, about 5 million years, which created a weak zone during the time of the formation of the Alps.

Of course no Alpine hike would be complete without a visit from some cows, and we were joined by a group of them during our break. I couldn't resist a little photo shoot with them (Figure 99).



Figure 99: Friendly cows posing for this photo

Eventually we began the last stretch to the top of the mountain, finally reaching the hut at the peak where we enjoyed our well-deserved lunch with spectacular views (Figures 100 and 101).



Figure 100: View from the top of the mountain at Rifugio del Grande Camerini

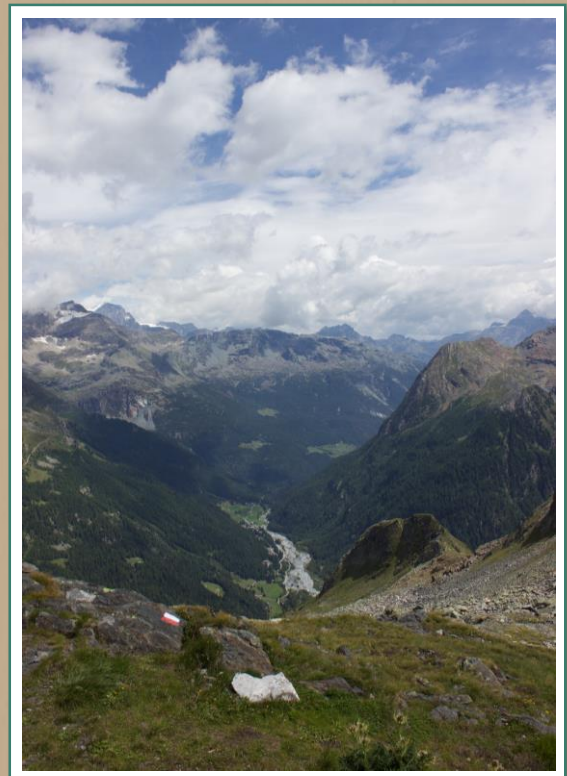


Figure 101: View looking at the valley below the mountain

When we were finally ready to make our way back down to Chiareggio, Reto told us there was a surprise for us. Everyone had thoroughly enjoyed the previous surprise, which had turned out to be a cheese and wine tasting so we were pretty excited. We came to find that this surprise was rock climbing down the side of a cliff. With help from Reto, Philipp, and a well-placed chain, we all made it down safely. Our group then split in search of aquamarine. While no one found aquamarine, we did find lots of samples of garnet and epidote, and tons of mid ocean ridge basalts.

We also saw a prime example of “twinning” in crystals (see Figure 102). These white rectangular feldspars form crystals with a line down the middle, separating a shiny half and a matte half. In igneous rocks larger crystals form first, and in this case the rocks came from the Bergell/Bregaglia intrusion.



Figure 102: Example of “twinning” in crystals

When we finally made it back to our hotel in Chiareggio we were rewarded with yet another incredible Italian dinner.

Day 10 –8/19/16

Becca Richardson

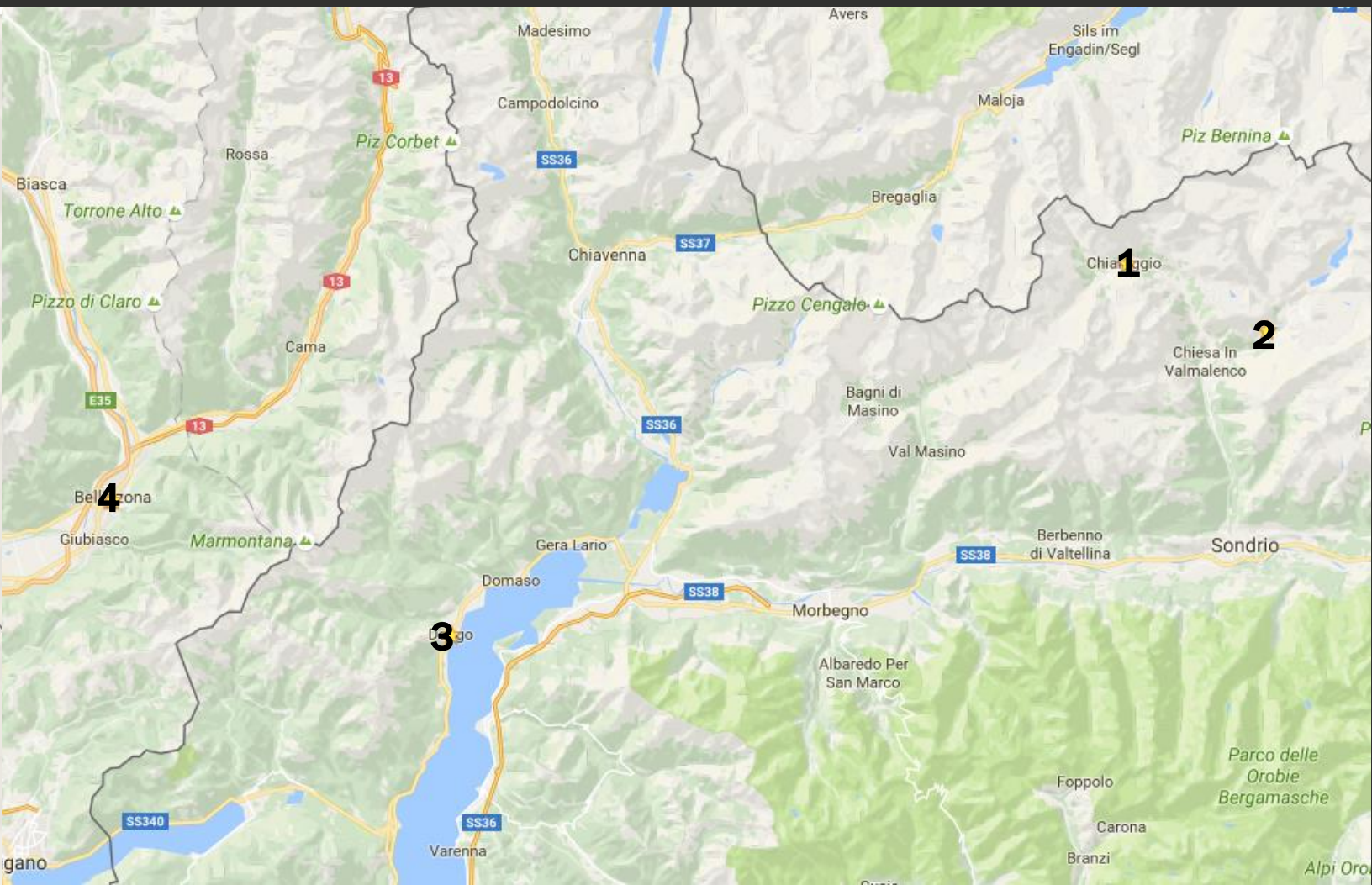


Figure 103: Map of Day 10

- 1– Albergo Chiareggio
- 2– Bagnada Mine
- 3– Lago di Como
- 4– Albergo Croce Federale

After another delicious breakfast at the hotel in Chiareggio, a remote Alpine town in Valmalenco, Italy, we began the day visiting a tribute to the Lenatti family- the gracious owners of our hotel. The Lenattis are prominent members of their community and this tribute highlighted several of their important contributions. The Lenatti family boasts four generations of male mountain guides. I found this to be particularly interesting since it is definitely a career far from those we normally consider, but is full of adventure and, sometimes, danger. One image I found to be especially striking was that of two men wrapped in aluminum blankets, sitting in a hole in the snow atop a mountain. After asking Reto for clarification, I realized that these men had most likely encountered a dangerous storm, and conditions were not safe to continue their trek. For me, this highlighted the difficulty of the mountain guide tradition, and gave me an even greater appreciation for what these four generations of men have done. However, the Lenatti legacy is uncertain. With only daughters now studying different pursuits at university, the Lenattis wonder what will happen to their hotel and the mountain guide tradition. We left this tribute with an even greater level of respect for our hotel owners, and began our drive to our next destination.

While on our drive, we passed through the village where the residents of Chiareggio move to in the winter. Philipp explained that Chiareggio is inaccessible in the winter due to extreme snowfall. If the residents want to check on their properties, they need to snowshoe up the mountain to gain access to the village. Reto recalled that one year, the snow was so heavy that the owners of our hotel had to hike to their property to remove snow from the roof, as it was so high that from the ground it reached the third floor, causing concern that the roof could not handle such weight. This made me realize just how much these people love their village and their community, as they battle difficult conditions in order to maintain their life in Valmalenco.

After a short drive, we arrived at the Bagnada Mine in Valmalenco (Figure 104). There, we met our guide Diego, and after a 20-minute walk uphill, we were introduced to Carmen, who gave us a tour of the mine. Although this was definitely the shortest hike of our trip, it was still extremely important. Many of us were out of breath and struggling, yet the miners who used to work in Val Malenco accessed the mine from lower in the village using an even steeper path with no guardrail and while carrying



Figure 104: The class inside the mine

tools. Some miners even hiked to work from the hills above, as they tended cows when they were not in the mine. This was our first indication that mining was certainly not an easy life - a lesson that would be reiterated throughout the day- particularly when we entered the mine and watched a few short videos that showed the early mornings, long walks, dangerous and difficult labor, and simple life that these miners lived. After gearing up with our hairnets and hard hats, we were ready to enter the mine.

We walked (or crouched for those who were tall) through a small tunnel, supported by wooden beams, until we entered a larger space. Carmen explained that this large space was unique to this type of mine. Coal and gold mines are traditionally composed of very small tunnels, with little room for workers to stand. This mine, used for talc, limestone, serpentinites, and quartz, was much larger (Figure 105). On a personal note, this was shocking to me. My grandfather worked in a coal mine, and was well over 6 feet, yet I was standing in a much larger mine, as a much smaller person, and was still feeling slightly claustrophobic and uncomfortable. As with many lessons throughout the day, I began to appreciate the difficulties my grandfather must have faced on a daily basis. However, we also learned about the religious protection that the miners were supposedly offered. In the entrance to the explosives room, there was a statue of St. Barbara- the protector of miners. It is customary to keep a statue of her in a mine.

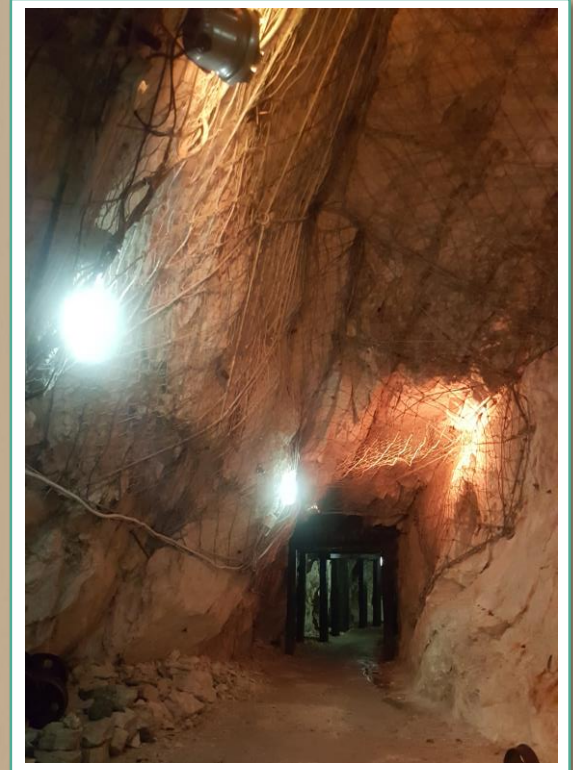


Figure 105: One of the larger tunnels leading into the mine

We also learned about the importance of this mine during the war. It was controlled by the Germans during the war; however, in contrast to much of Europe during this time, this town was able to escape certain hardships. Instead of enlisting in the military, men were expected to work the mine during this time. As such, they were able to avoid some of the fatalities and economic suffering that the war caused.

Next, we were given an explanation of the structure of the mine. The mine consists of 9 levels and has roughly two kilometers of tunnels. As visible in the map provided by Carmen in Figure 106. The left side of the mine consists of carbonates (including limestone and marble) that were formed during the Triassic period. To the right there are serpentinites, separated from the carbonates by a quartz vein. This quartz vein contained several crystals that were sold all over the world, particularly to

London and to its natural history museum. Throughout the carbonate side, there are veins containing talc, a hydrated magnesium silicate that is typically found in metamorphic rocks and is used in many products ranging from cosmetics to pharmaceuticals and from fillers to farming products. Talc is a secondary mineral, so its occurrence in the mine is a lucky coincidence in the region. Essentially, this vein was created due to a chemical reaction during the metamorphism of the mine when fluids entered. This was only possible due to the correct combination of relatively low temperatures and pressures. I found This information to be especially interesting; as it shows that the economic, and consequently social, fate of a region can be determined by the coincidences that result in natural resources. Just as a region can be negatively impacted by natural occurrences, this region was positively affected by the talc formation. Although mining is not the easiest life, it certainly helped to boost the economy in this region. In addition, the talc found in Bagnada is white, differing from the grey talc found in the currently active mines in Val Malenco. These talc veins were discovered in 1936 and were mined until 1987. As we walked around the mine, the separation between these veins and minerals was evident throughout.

We also learned a great deal about the historical significance of the Bagnada mine. “Anomia Cave di Amianto” discovered this mine in the late 1920s. This company obtained the first mining license for Bagnada in 1936, and continued to intensely mine the Bagnada for 50 years until the 1980s. Although technology has radically altered the mining industry, the museum allowed us to understand the historical significance of the mine and how it operated in the past. When the mine first opened, everything was dug by hand with shovels and picks. The miners carried the minerals up and down the “stairs” (inclines made using debris) and put them into train cars supported with wood and pushed them by hand out of the mine (Figure 107). If carrying rocks from below, they would use cranes that could be pulled by hand to raise

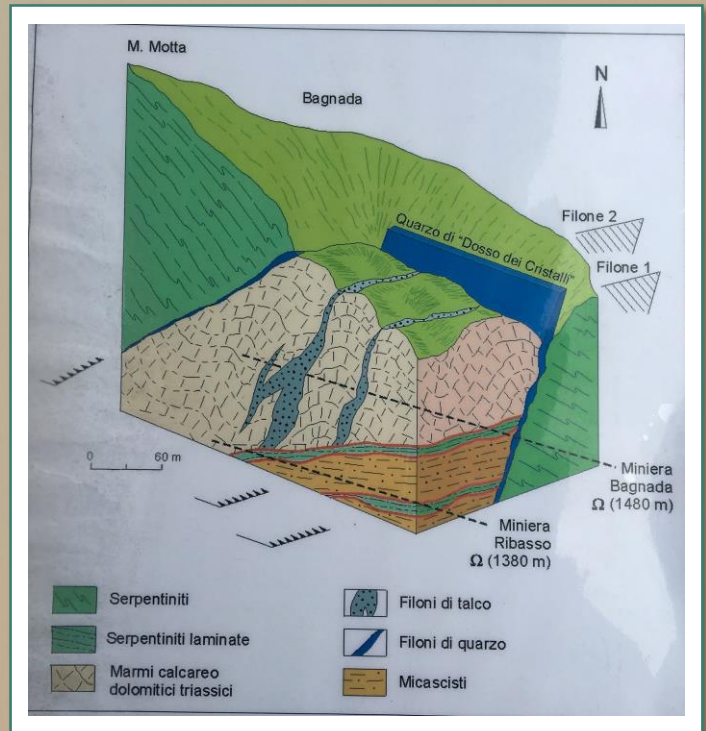


Figure 106: Mineral map showing the locations of various minerals in the Bagnada Mine



Figure 107: Old wood-based train car used by miners

the rocks. The train cars were quickly improved and were made from steel instead of wood (Figure 108).

Further improvements included the introduction of chutes in the mines so that workers could drop minerals down the chutes into the train cars instead of having to carry them down the stairs. One significant contribution was the introduction of compressed air drills in 1947 (Figure 109). However, these drills had several drawbacks. For example, they created a significant amount of dust, which was later resolved when a new model was created that added water to cool the drill and minimize dust. They also were difficult for workers to use because they created a heavy vibration that made them hard to maneuver and were extremely loud. To the left of the compressed air drill pictured in Figure 98 is a French lamp, another important innovation for the mine. It functioned from a chemical reaction, replacing the unreliable fossil fuels that were previously used.

Consequently, explosives were introduced to mining to resolve some of these issues. We visited the room where explosives were stored, the driest room in the mine, to learn more. The explosives were all normalized so that when detonated, the flame moved along the cord at a rate of $\frac{1}{2}$ meters per minute. The most dangerous part of using explosives was attaching the detonator to the cord. When setting off the explosives, the miners created 15- 20 holes in each tunnel area so that they could control the explosion. At the center was a cone shaped hole where the dynamite was loaded and from which the waves would spread according to physics. The explosives were timed so that they would begin in the center and move to the sides. Several safety precautions were also taken with the introduction of explosives. They designed the tunnels so that if there was an explosion at one end of the mine, it would not be able to travel to the other end. The miners also stored the dynamite far from the detonators as an additional safety measure. However, aside from safety concerns, explosives had additional drawbacks. They created a massive amount of dust throughout the mine, so the miners set the explosives off at the end of the day before going home for the



Figure 108: The more durable and reliable steel-based train cars

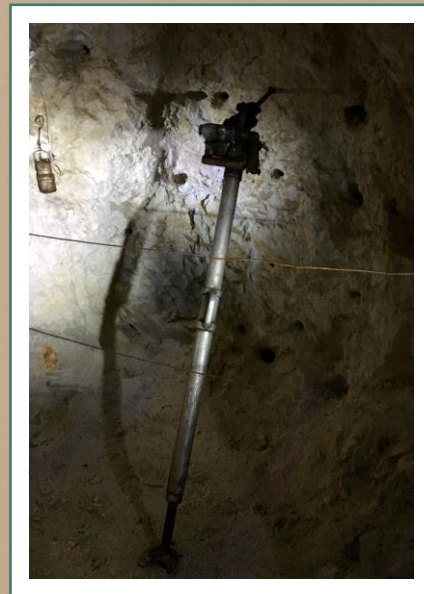


Figure 109: Compressed air drill and French Lamp

evening so that the dust would settle before the next morning. Learning about these mining innovations helped us to better appreciate the difficulties of this industry.

Ultimately, this mine was shut down when it was no longer profitable. However, in doing so many emergency exits were installed and thieves and gem experts used these exits to sneak into the mine to search for gems. It is estimated that some of the most precious gems in the mine left through these exits before the mine became a museum.

Although this mine is no longer in use, mining is still extremely critical to the region. The mine across the valley that is still functional is the third largest worldwide for talc and is the largest in Europe with the most tunnels. As a result, the economic prosperity and livelihood of the region continue to rely on mining.

After our walk around the mine, we visited the museum to learn more. We saw several artifacts from the mine along with tools used to make products out of the materials sourced from the mine. For example, we saw the device used to create pots from the talc. One rock could make five or six pots, as they fit inside of each other like “Russian dolls” according to Reto. Another item I found particularly intriguing in the museum was the sample of asbestos. We always hear about how dangerous asbestos is, so it was interesting to hear about how it helped support the economy in Val Malenco and about its variety of uses. It was used to make paper, bags, fire suits (since it cannot burn), thermal insulators, and even brake pads. The rock had hair-like fibers coming off of it, so it was definitely different than I expected and than the other rocks we saw throughout the trip. We also learned that green garnets can be found in asbestos, which I found ironic since asbestos is now frequently considered a dangerous and worthless material, yet it can contain a valuable gem. From the video we watched in the mine, we also learned that women collected asbestos at the top of the mine and they carried the asbestos in baskets on their backs down to the village every day, as pictured in Figure 110. Typically, I do not associate women with mining, so it was very interesting to see that they also experienced this difficult labor. The museum enhanced our understanding of the lessons we learned in the mine.



Figure 110: Women collecting asbestos in their backpacks

After the mine, we made a quick stop for lunch at a park and continued on the road. We broke up the drive from Val Malenco to Bellinzona with a stop for gelato at the Lago di Como. As one of the most famous and well-known destinations on our trip, I was extremely excited to see this lake in person. Driving through the various towns that border the lake, the magnitude of this lake was obvious. It stretched for several miles, but was not as wide as I expected. This finding is supported by Figure 111, a map of the lake that is shaped like an inverted “Y”. I was curious and decided to read more about the lake. I found that Lake Como is a glacial lake with an area of over 146 square kilometers. It is the third largest lake in Italy, and with a depth of 400 meters, Lake Como is one of the deepest lakes in Europe. One of the most surprising things to me on this trip and in learning about geology was how much glaciers have shaped our landscapes. Whenever people discussed ice ages I always imagined them as something in the past that has not drastically impacted my life, yet without ice ages and glaciers, many of the beautiful landscapes and natural resources we take for granted would not exist.



Figure 111: Map of Lake Como showing the “Y” shape

After another drive and a delicious pizza dinner, we embarked on our last visit of the day: a trip to the Castelgrande in Bellinzona – a UNESCO World Heritage Site. As the oldest of three castles, built in the 12th century and finished in the 15th century, Castelgrande was built as the beginning of a fortress so that the Italians could not pass in the midst of a war between the tribes in Switzerland and the Italians. It was beautiful to see the three castles lit up at night (Figure 112), but more importantly, as with many lessons throughout this trip, it made me realize just how much the geology of the region shaped the history and culture. The mountains functioned as a barrier throughout history, making it difficult for Switzerland to be conquered; however, certain places were vulnerable where there were valleys or entrances to the Alps. Bellinzona was one of these places and, consequently, it required the castles to be built as a fortress for protection. Without this particular alpine landscape, these castles would most likely not be built and Bellinzona would not have the rich culture it does today. This particular day was rich in geology, history, and culture, and made me realize how, although different disciplines, these components all have a large impact on one another.



Figure 112: Tower of Castelgrande at night

Day 11 – 8/20/16

Claire Brundage

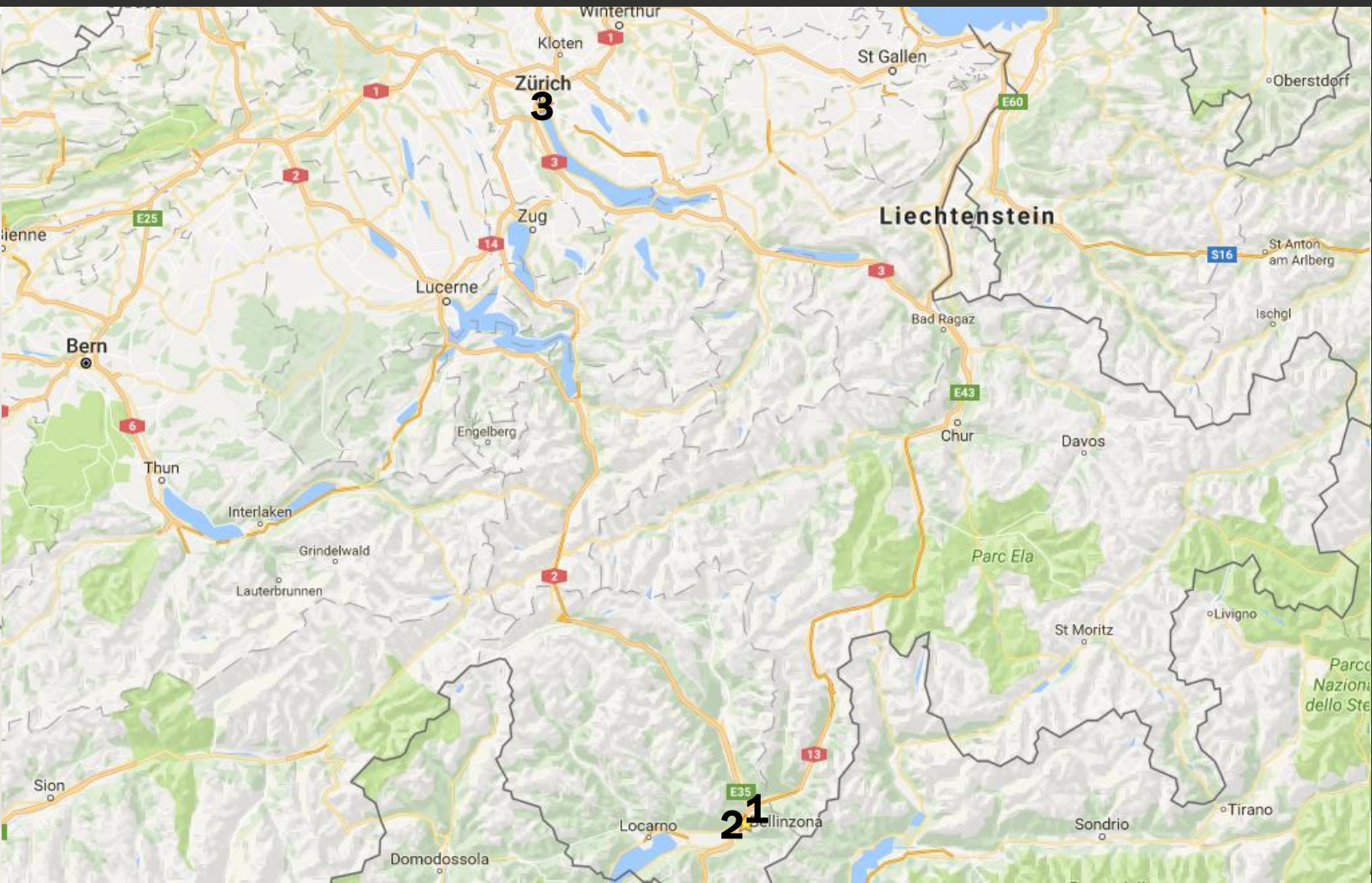


Figure 113: Map of Day 11

- 1– Albergo Croce Federale
- 2– Monte Bello Castle
- 3– Hotel California



Figure 114: Castle Grande, Bellinzona

We spent the last day of the trip in Bellinzona Switzerland. Our first stop of the day was at the Monte Bello Castle, one of three castles in this valley (Figure 114, 116). Inside the outer wall the group took fun pictures before sitting down on the grass to hear the final presentation by Eryn. In her presentation, Eryn discussed how paleontologists and geologists derive paleoenvironmental conditions from rocks and fossils. She began by explaining the six primary types

of fossils. This included petrified Fossils such as the traditional dinosaur fossils, molds, casts such as the remains from the volcanic explosion in Pompeii, carbon films, trace fossils such as fossilized footprints, and preserved remains in materials such as amber. Fossils help scientists understand properties of the Earth's environment

From tens of hundreds of millions of years ago. The fossil record extends past any historical records and even the capabilities of carbon dating, which only reaches back ~24,000 years. Paleontologists often use relative dating to determine the significance and time period of a fossil (Figure 115). The diagram above gives an example of a situation where two different fossils (stars and hearts) are seen in different layers of sedimentary rock. The distribution of the fossils may indicate that the star went extinct before the time period of the top layer but as we discussed during and after the presentation, this could have also been caused by



Figure 115: Relative Dating



Figure 116: The group at Monte Bello Castle

environmental changes, making this an unclear conclusion. I thought that this was a simple yet compelling example of the challenges of working with relative dating of fossils. In addition to relative dating Eryn taught the group about the process of fossil formation categories of sediment sorting in different water systems. I thought that it was interesting to learn that the

largest fossilized dinosaur footprint was found in the Alps at 3300 meters from 210 millions years ago. During the Triassic period, when the footprint was made it was on the tropical coast of the African continent (Figure 117). Since then the African plate has shifted up and rotated, colliding with the Eurasian continent. It was in this collision that the Alps were formed.



Figure 117: The continental arrangement during the Triassic period

After the presentation we discussed the significance of the three castles we saw in Bellinzona. Castle Grande, the lowest in the valley, was built beginning in the 13th century and was finished in the 15th century. Monte Bello Castle was built in a similar time period slightly higher in the valley (Figure 118). Sasso Corbaro, the smallest of the castles was built around 1500 situated a few hundred meters above the lowest castle. During this period

there was a wall running between the castles, perpendicular to the river. The position of Bellinzona in the valley south of the Gotthard pass made the city an important strategic position, especially after the opening of the pass in the 13th century. There was constant traffic through the valley, putting those in control of the fortifications in the powerful position of being able to tax anything passing through their gates. Control of the fortified valley and castles was fought over by Swiss tribes and Italians from Milan. This has lead to the heavy Italian influence in the region where Italian is still the predominant language. Although Switzerland was founded in 1291, it wasn't until 1500 that Bellinzona and the castles became part of the country.

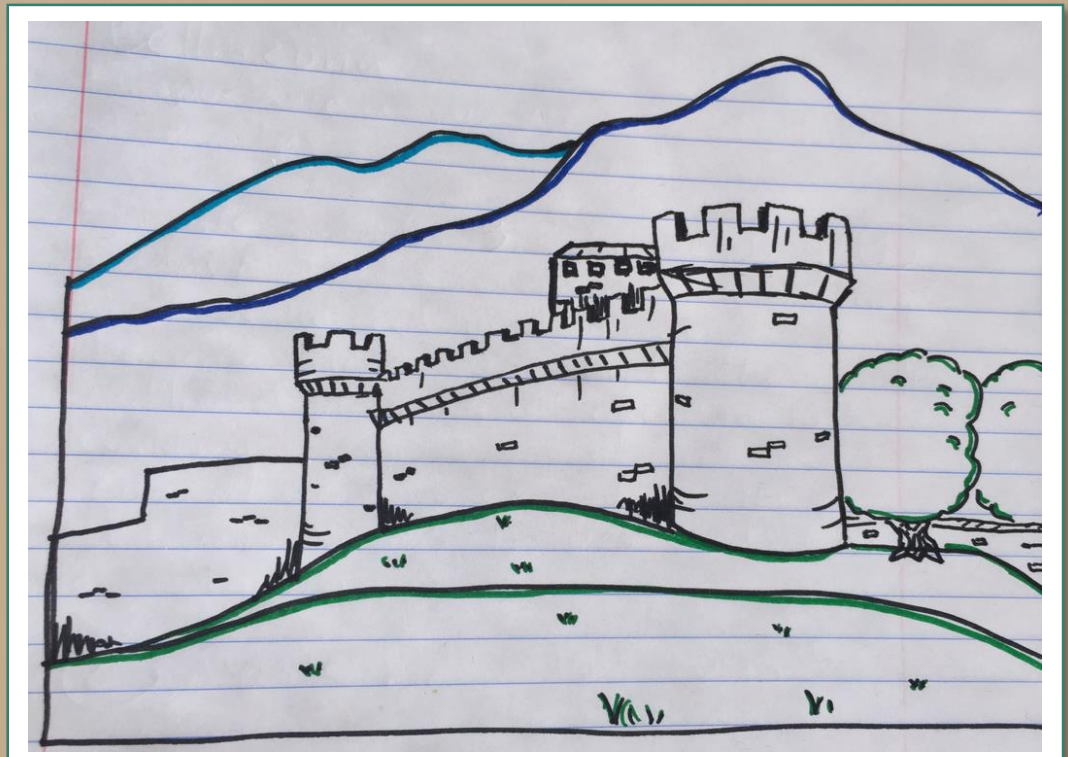


Figure 118: Claire's sketch of Monte Bello Castle

In the afternoon we explored the town of Bellinzona. In small groups we went into shops, restaurants and walked through the street market. The street market had

booths selling clothing, crafts, jewelry, and food such as local meats and cheeses (Figure 119). The market was also quite crowded (Figure 120). It ran through the pedestrian area of the town and attracted many shoppers.



Figure 119: A cheese stand at the street market in Bellinzona



Figure 120: The street market in Bellinzona

I was part of the group which took the train back to Zurich. We were all struck by how clean and efficient the train system was (Figures 121 and 122). It made sense after seeing this why rail travel is so popular in Europe. The trip back to Zurich was fast and comfortable. As we began our travels home we were able to look out and see the mountains, lakes and tunnels that we had spent the past two weeks studying flash by our windows for the last time.



Figure 121: The train station in Bellinzona



Figure 122: The train from Bellinzona to Zurich