

Abstract

This field study is located among the Southern San Juan Mountains in a high alpine environment. Three high elevation soil trenches were dug in order to extract information on sediment maturity and mineralogy of the research area. The water table in this zone is high and shares similar characteristics with the adjacent valley that can be classified as a fen. After collecting the soil samples for X-ray diffraction (XRD), it was recognized that an iron rich chlorite was present as well as quartz. The lack of organic material and clays suggest immature sediments. The blue coloration in the minimal clay content suggests anoxia. Collectively, this data alongside glacial striations carved into the Uncompahgre Quartzite Bedrock 1.25 Km north and 600 ft. higher in elevation suggests soils that could be classified as inceptisols. Less than .1 km from the study area alpine fens and lakes are present. Evidence derived from this field study suggests that previous soils were likely removed as a result of glacial activity during the Last Glacial Maximum. The swallets along the Northwestern fault boundary are an active draining mechanism and has likely been draining this valley since the last glacial maximum.

Introduction

- > 1.75 kms west of Snowdon Peak; 2.0 kms south of Molas Pass. Located in the southern San Juan Mountains of Colorado at an elevation of 11,165 ft. ± 10.
- > The study area is between the carbonates of the Hermosa Group and the Precambrian Uncompahgre quartzite and phyllite that lies above.
- > Chamosite was identified in the XRD data and is an alteration mineral originating through moderate metamorphism of iron rich deposits. Chamosite can be expressed as $(Fe_{2+}, Mg)_5Al_2Si_3O_{10}(OH)_8$ developing a 2:1 clay structure with a tri-octahedral structure.
- > Inceptisols are defined as young soils with limited clay mineral development. Inceptisols exhibit minimal horizon development and can be classified further into 6 subcategories. Given our high alpine environment our sub-order most directly correlates with Crycepts, which are Inceptisols of cold climates.
- > Research from an elevation of 10,636 feet indicate ice free conditions 13,500 ya. The study area sits roughly 500 ft. above this elevation and therefore would share a similar correlated age of deglaciation.
- > Swallets are karst-related features where dissolution has caused openings to form and allowing surface streams to disappear underground.
- > X-ray Diffraction is commonly used to identify unknown minerals or compounds in a given medium. Samples can be measured using a smear method or by powdering the sample.

Research Question

Since the last glacial maximum, has a glacial lake occupied the high-elevation study area?

Study Area

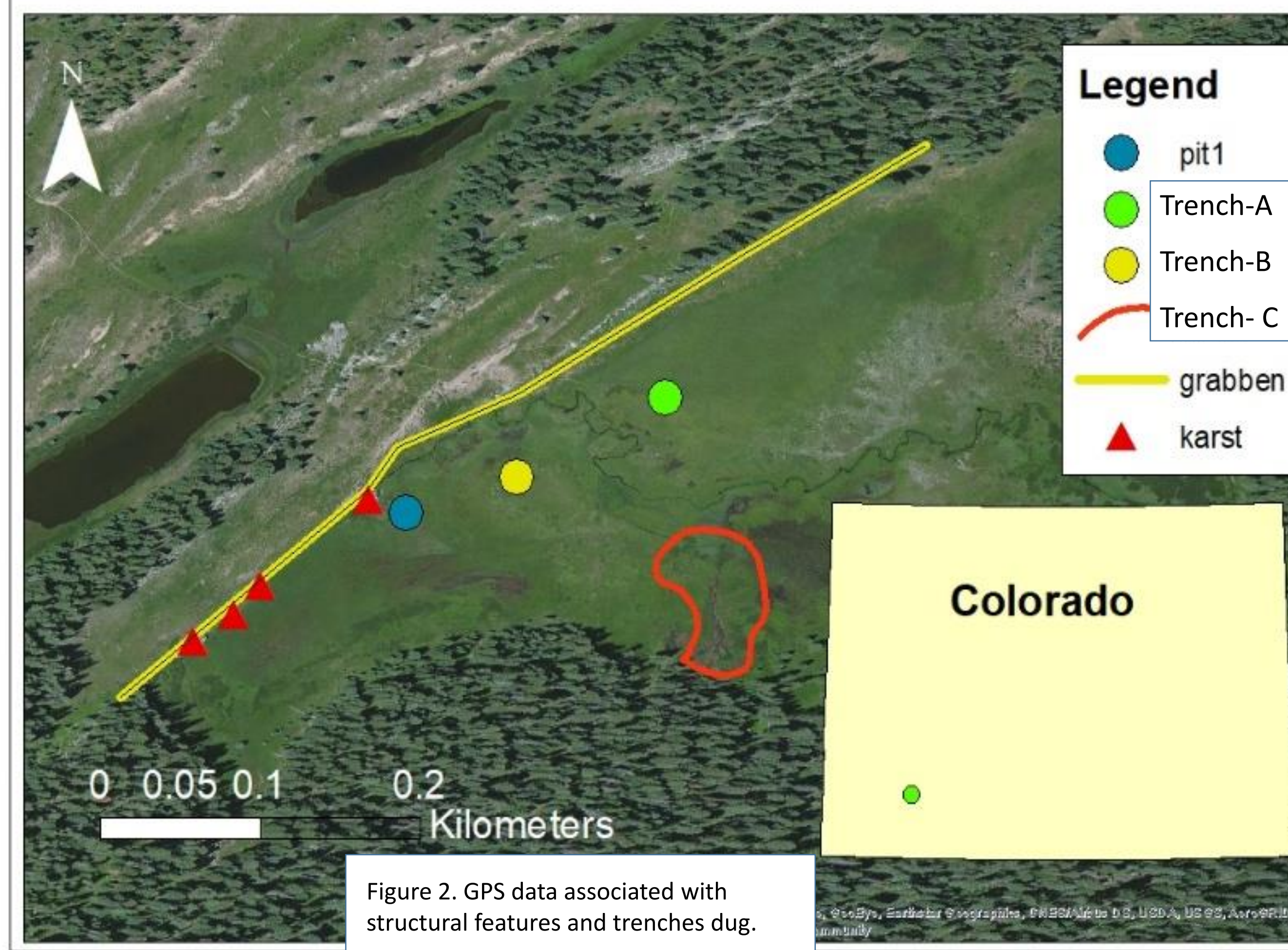


Figure 2. GPS data associated with structural features and trenches dug.

Background

The research area is an alpine environment connected to a karst system. The Hermosa Group is a bench forming unit alternating between siliclastic and carbonate rocks. Located at roughly 11,165 feet in the southern San Juan Mountains. A similar valley lies adjacent to the study area and has a lake environment closely resembling a fen. Given the similar conditions as our valley, it seemed likely a lake could have been present, yet evidence suggests otherwise. The topography and blue hues within the soil suggests cryoturbation, which is the mixing of soil horizons due to freeze thaw cycles. There is a structural constraint defined by a graben, oriented parallel to the long direction of our study area. We found bluish soils which are often a result of reduction due to high water table in anaerobic conditions. The water table was identified when digging 60 cm down in Trench-A, seen in Figure 3. The current classification that best defines our soils is an inceptisol, more specifically a crycept. Glaciers receded roughly 13,500 years ago, evidence of this can be identified from striations throughout our study area and two dating methods done close to the study area on growth bands within stalagmites. The U-series and isotopic data suggest the area was ice free complimented by carbon data that suggests oxidation of organic material on the sub-surface indicating ice free conditions as well (Kenny R., 2015). X-ray diffraction is a process that consists of a monochromatic wavelength, shot into a given medium, the wavelength deflects at certain angles given the d-spacing in the crystal lattice. As a medium is diffracted, depending on the angle of theta at which it is being shot, specific spikes represent the strongest chemical signatures within the sample.

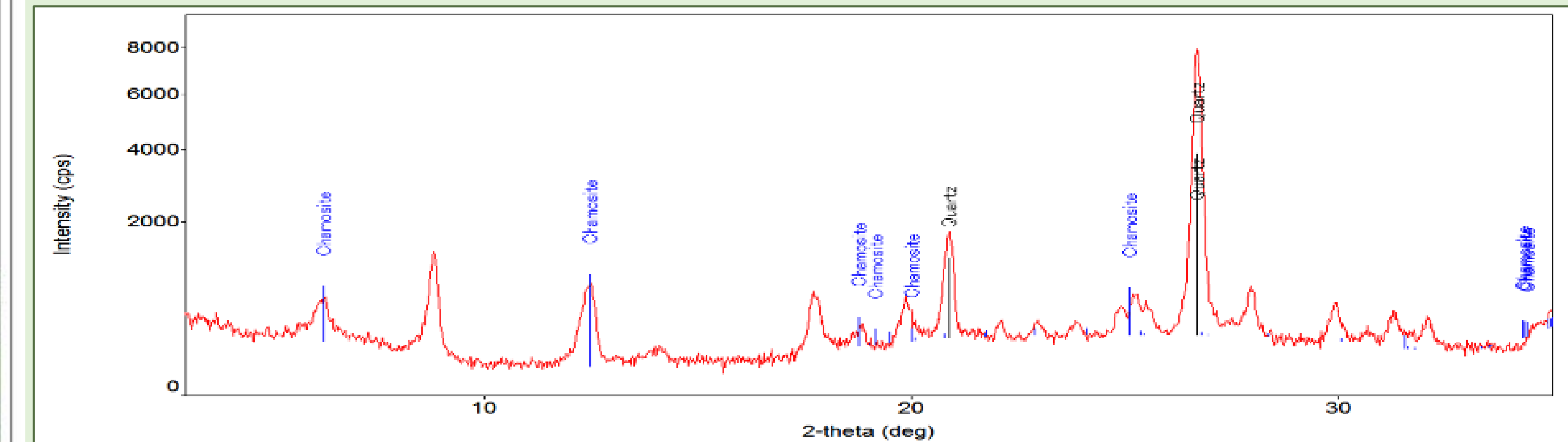


Figure 4. XRD data and correlated chemical signatures.



Figure 5. Shows trench 3 and where we collected samples for the XRD. Letters specify layers that correlate to fig three.

Figure 6. A photo of the study area facing the north-west aspect of Snowdon Peak.

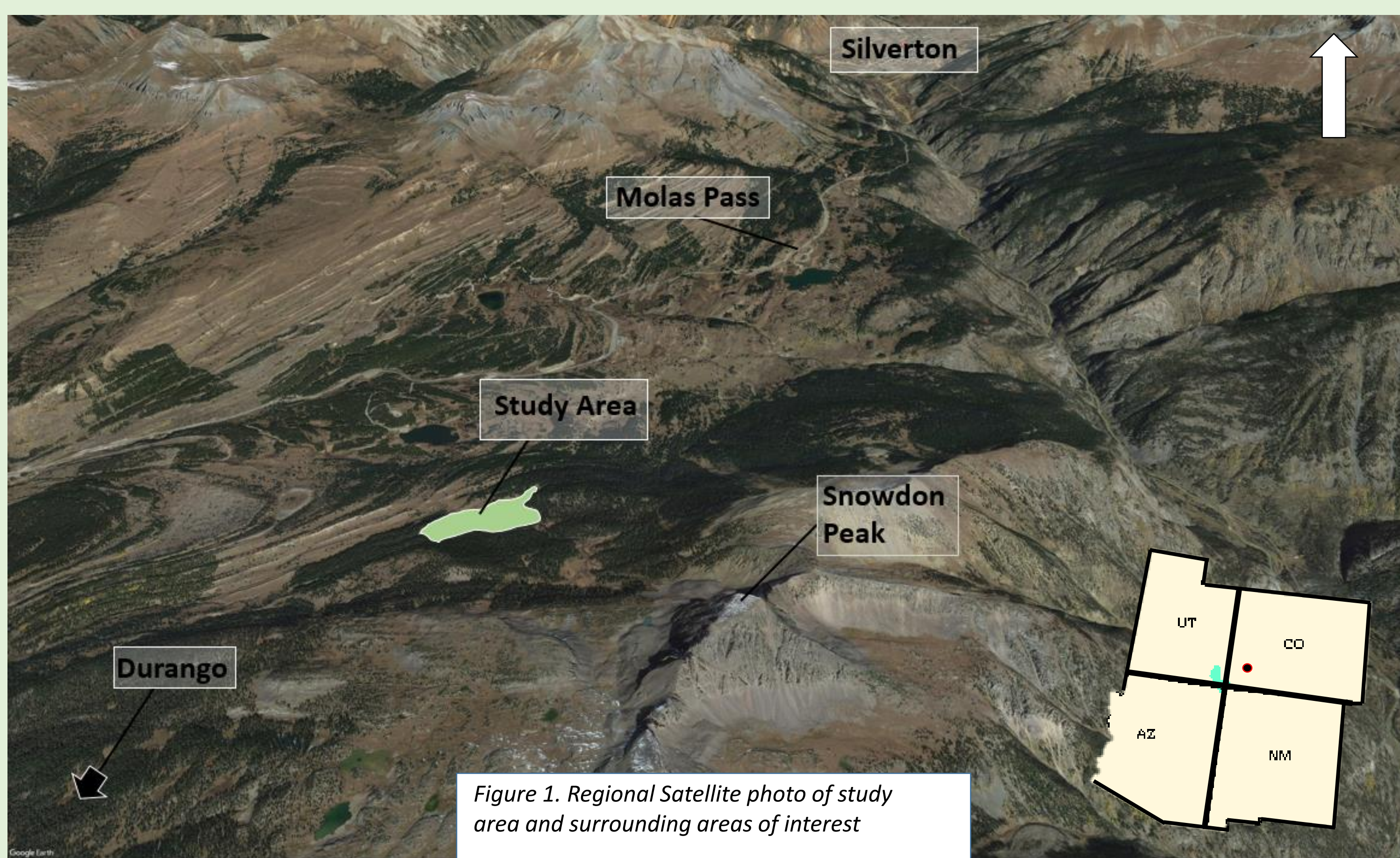
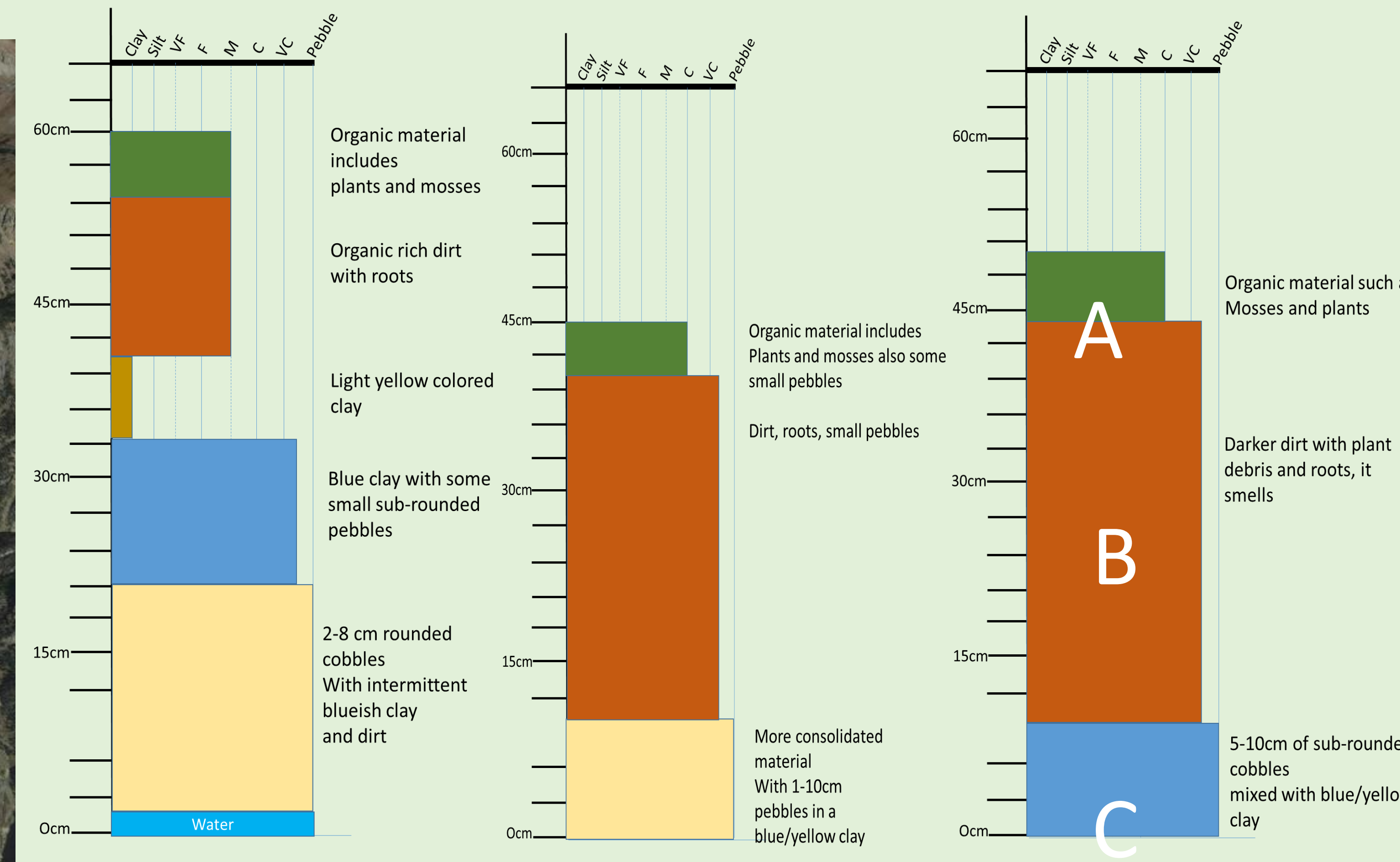


Figure 1. Regional Satellite photo of study area and surrounding areas of interest

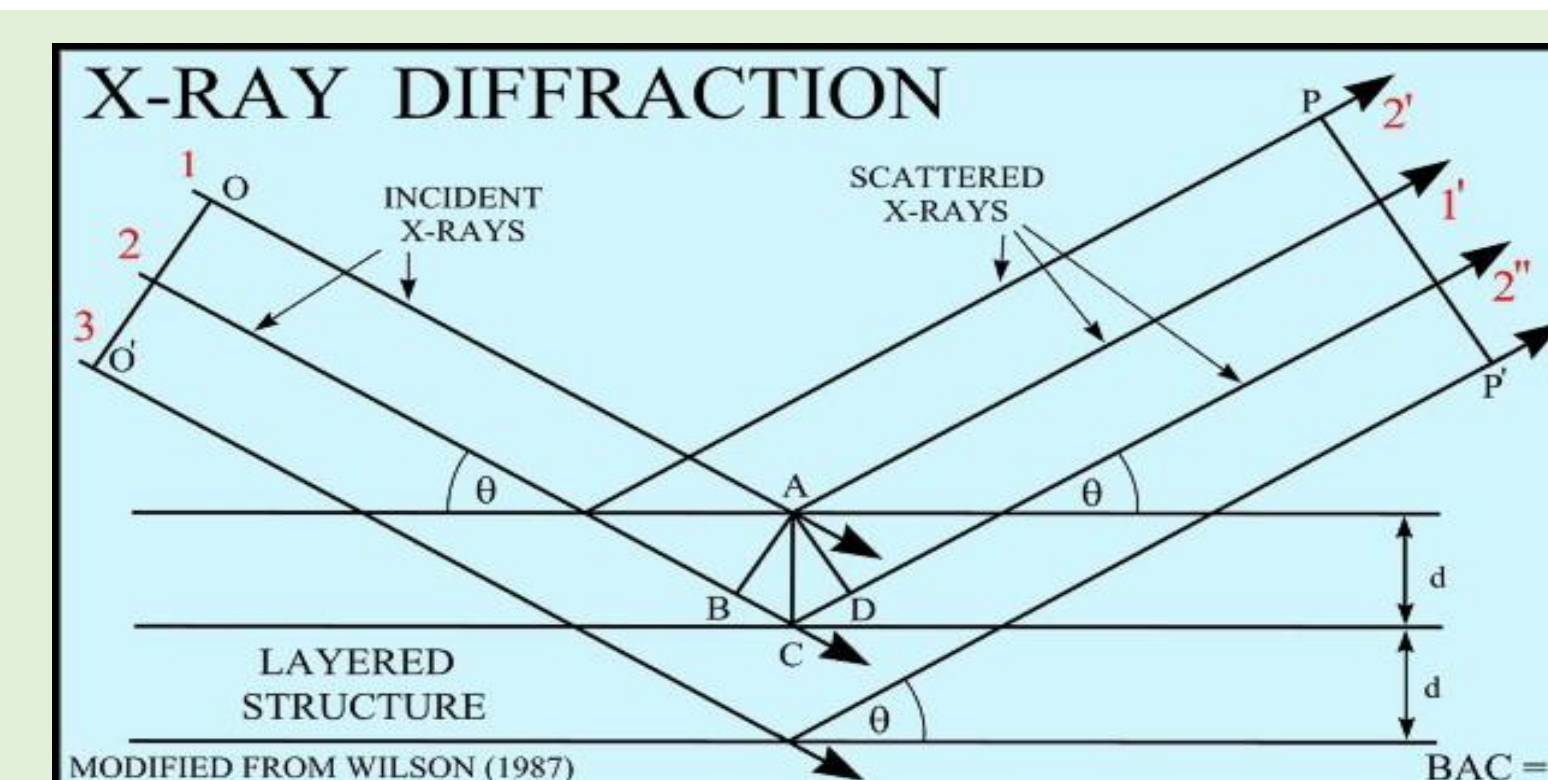


Trench-A

Trench-B

Trench-C

Figure 3. Soil profiles pertaining to the three soils trenches dug in study area



Methods

- Field work:**
- > Three soil trenches were measured, horizons were delineated, and locations were recorded with GPS.
 - > Each sample taken from Trench A was subdivided into three categories based upon the coloration and organic content.
- Soil samples:**
- > Soil Samples were dried; sieved to remove coarse particles.
 - > clay-sized fraction was extracted from a fluid column; placed on a glass slide.
- XRD:**
- > Glass slides with the clay-sized fraction were dried; analyzed for mineralogy using a smear technique.
 - > Samples were run to 30 theta using the XRD and data was analyzed using PDXL2 software.

Discussion

The soil samples show there has been reduction, given the blue shading most likely correlated to a high water table. There is no evidence of a paleo lake, we didn't see typical sediments that are consistent with lacustrine deposits such as continuous fine grain sediments (clay /fine grained silt) or varves. The clast from the middle and bottom layers point more to an alluvium likely from slope wash or spring floods. Granules were found throughout the study area and likely were transported by the high water table. The relative age of the soil in this area is young and the history of the area supports the age. First, the last of the glaciers receded from this relative elevation roughly 13,500 ya (Kenny, 2015); So, the glacier would have likely ripped all of the sediment out of this graben and allowed for young inceptisols to form. The formation of clays associated with well developed soils is minimal to none also suggesting younger sediment consistent with Inceptisols. Chamosite is an iron rich chlorite variety that is found in metamorphosed iron deposits.

References

- Guido, Z. S., Ward, D. J., and Anderson, R. S., 2007, Pacing the post-last glacial maximum demise of the Animas Valley Glacier and the San Juan Mountain ice cap, Colorado: Geology [Boulder], v. 35, no. 8, p. 739-742.
- Kenny R., 2015, stable isotope and speleothem chronology from a high alpine cave, southern San Juan Mountains: Evidence for deglaciation as early as 13.5ka.