Grand Junction Geological Society, Annual Student Research Presentations
April 28 and 29, 2021
Via ZOOM Meeting (*link to ZOOM instructions*)

Wed April 28	Thurs April 29
Brycen Meyer	**Anja Riedel**
Alex Fenske	**Roan Hall**
Rhett Dacaug	**Anastasia Daniel**
Karlie Hadden	**Jarad Lavelle**
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Caden Anderson	**Zak Saint**
Frank Martinez	**Pedro Terres Illescas**

2021 GJGS Student Presentations, April Meeting

	Student	PresentationTitle	Abstract
Wed April 28 - 7 pm	Brycen Meyer	Study of the Provenance of the Paleocene/Cretaceous(?) Ohio Creek Formation in Colorado and the Dark Canyon Formation in Utah	There are several conglomeratic units that are found in the Colorado Plateau and Southern Rocky Mountains of eastern Utah and western Colorado that differ from other fluvial deposits found in the stratigraphic record of these areas. These units, the Ohio Creek Formation, and Dark Canyon Formation, are thought to record a tectonic uplift event that happened during the late Cretaceous or early Paleogene periods. Previous studies suggest that these units were deposited during the Paleocene, but the age estimates remain uncertain. Another key question is the provenance of the gravel clasts in these two units. A comparison of these two units and an analysis of their provenance will use existing and new detrital zircon data from these formations, which will be used to evaluate possible origins of the Ohio Creek Formation and the Dark Canyon Formation. This project will also try to determine if these units should be considered correlative.

Wed April 28 - 7:10 pm	Alexander Fenske	Pebble Compositions in the Paleocene/Cretaceous(?) Ohio Creek Conglomerate and Paleocene basal Wasatch Formation, Mesa, Colorado	The Ohio Creek Conglomerate is an enigmatic stratigraphic unit that straddles the K/T boundary in Western Colorado. One possible origin for the Ohio Creek is that it is part of the Mesaverde Group progradational succession that filled the Western Interior Seaway and set the stage for basement-involved tectonic events of the Laramide Orogeny. Mesa Verde Group sediments were deposited by east-flowing river systems during late Campanian to Paleocene(?) times. The Ohio Creek represents conglomerates and pebbly sandstones that overlie weathered sandstones and mudstones of the Mesaverde Group (Williams Fork Formation), which consist of 50 to 150 m of white to light buff-colored deposits. The white weathered portion of the Mesa Verde Group and the overlying Ohio Creek Conglomerate is overlain by the Paleocene Wasatch Formation, which includes a prominent basal conglomerate. All three units contain- scattered small chert pebbles although relatively large pebbles and cobbles are found in basal deposits of the Wasatch Formation. The distinctive colors and chert pebbles of these rocks have raised questions concerning whether or not these rocks represent separate stratigraphic units. The purpose of this study is to analyze the pebble composition of the Ohio Creek and basal Wasatch Formation to determine their origins.

Wed April 28 - 7:20 pm	Rhett Dacuag	Relationship of Joint Patterns and Structural Features of the Devil's Canyon Area, Colorado National Monument	The Uncompahgre Plateau is represented by a complex set of faults in the vicinity of Colorado National Monument (CNM) in Western Colorado. Large oblique strike-slip faults exist within Devil's and Flume canyon, on the northeastern side of the Uncompahgre Plateau. To understand the relationship between small-scale structures and larger faults within the area, this study will investigate the orientations of the stress fields acting on each structure. Using multiple strike and dip measurements, the overall strike and dip of each structure can be used to show the orientation of stress fields. Comparisons of individual structures' stress fields will then be used to see which structures were created by the same uplift event. Previous studies have found that faults along the Colorado Plateau display deformation kinematics that are consistent with two uplift periods: the Permo-Pennsylvanian Ancestral Rockies and the Late Cretaceous-Paleogene Laramide orogenies. This study will determine if the CNM structures were formed by either of the two uplift events or if they were caused by a different mechanism. If small-scale structures are related to the large faults within the Devil's Canyon area, the small structures will have strikes and dips that are similar to those observed along the large faults.

Wed April 28 - 7:30 pm	Karlie Hadden	Preliminary Investigation of the Crustal and Upper Mantle Tomography of the Devil's Canyon Area in the Grand Valley of Western Colorado USA	This research supports the theory that the Uncompahgre Plateau represents uplifted fault blocks, allowing for magmatic intrusions. A recent ground-based magnetic survey conducted at a test site within the northeastern Uncompahgre Plateau has detected a localized high-magnetic anomaly that indicates possible iron- and magnesium-rich rocks. The anomaly may indicate one of two intrusion types: old Precambrian intrusions or younger Oligocene mafic intrusions. Seismic tomography maps—representing "fast" and "slow" seismic propagation velocity associated with different rock types—have been generated through the Incorporated Research Institutions in Seismology (IRIS), and are used in this research to elucidate the potential deep origin of the intrusions. The IRIS data is correlated with the high-magnetic anomaly to test existing hypotheses on the geologic history of the Uncompahgre Plateau and origins of magmatic intrusions. If the magnetic high represents a Precambrian intrusion, we do not expect any "signal" of this magmatism in the tomography data (since it occurred so long ago); however, if the intrusions are Oligocene in age there should be a remnant low-velocity signal from the heated region(s) where the intrusions may have been sourced. Results may indicate genesis of intrusions within similar uplifts of the Colorado Plateau and Rocky Mountain regions.

Wed April 28 - 7:40 pm	Devin Horvat	Identifying shallow unexposed features in basement rock through ground-based magnetic surveying in the vicinity of Devils Canyon, Grand Valley, western Colorado USA	Previous work along the northeastern slope of the Uncompahgre Plateau in Colorado indicate the likely presence of igneous intrusions. Intrusions that could be present include gabbro intrusions within Precambrian basement rock (during the Precambrian) or an Oligocene diorite porphyritic intrusion. Synchronous intrusive bodies of Precambrian or Oligocene age have been identified elsewhere in the Uncompahgre Plateau (Johnson, 1983; Trumbo, et al., 2016; Johnson, et al., 2016); thus, it is possible that more intrusive features may exist in the study area. New ground-based, high-resolution magnetic surveying may assist in improving constraints related to the geometry and location of undiscovered intrusions. Unfortunately, igneous intrusion may only be one viable explanation for magnetic anomalies within the study area, as fault-displaced basement rock may also cause a magnetic signature similar to an igneous intrusion (Bouligand et. al., 2016). We will apply the Peters Half-Slope method (Peters, 1949) to the newly acquired magnetic data to estimate the depth of the magnetic-anomaly source. From this, we will assess the likelihood that the observed anomaly is an igneous intrusion such as an up-flowing upper-mantle plume, and not a displaced fault block. Determining the type of subsurface structure may help further characterize uplift mechanics and possible surface structures associated with the anomalies as described by Casillas (2004) and Johnson

Wed April 28 - 7:50 pm	Caden Anderson	Polygonal Fractures in the Entrada Formation along the Northeastern Uncompahgre Plateau and Grand Valley Areas of Western Colorado	Polygonal fractures are 4-8 sided shapes that are found in both igneous and sedimentary rocks around the world. In this study, I am looking at the causation of shallow (0.1- 1 meter deep) polygonal fractures within eolian sandstones, specifically the Entrada Formation, in the Grand Junction, Fruita, and Glade Park areas. To do this, I looked at the stratification, homogeneity, and grain cementation in the polygons, as well as the amount of light that is absorbed by the polygons per day (diurnal heating). I found that the stratification, grain cementation, and homogeneity all affected the width, depth, and shape of the polygons, but the deciding factor for formation was the amount of light absorbed by the surface of the rock per day. I also disproved previously suggested methods for the formation of polygonal fractures, like freeze thaw action, desiccation (cracks formed before lithification), and compression induced buckling of sheeting joints. Finally, I compared the polygonal fractures seen in my study area to those found on other planets in our solar system, like Mars and Venus. This data is important because it show how depositional differences across a formation affect the appearance and erosional patterns of the rock's surface once it is exhumed.

Wed April 28 - 8 pm

Franklin Martinez	CO2 Sequestration as a Method of Decarbonization	Research highlights the importance of decarbonization and examines technological development of CO2 sequestration. CO2 sequestration efforts in the Colorado Plateau region will be studied in the context of previous studies conducted worldwide. Background knowledge of CO2 sequestration potential and methods associated with oil and gas production will be summarized along with method of decarbonization. The White Rim Sandstone in Utah has been highlighted as a potential site for carbon capture, utilization, and storage (CCUS) within the Colorado Plateau. Studies of this sandstone show potential new sites of CO2 sequestration given its favorable porosity and mineralogy. Samples of the White Rim Sandstone were analyzed for volumetric porosity and mineral content. Results suggest that the White Rim Sandstone has a CO2 sequestration potential capacity of up to 150 years, making this geologic unit a great candidate for a decarbonization site. Potential new zones within this region are of great importance as well. Further study of the Colorado Plateau and its carbon sequestration potential is important for developing CCUS technology in North America as well as for ongoing efforts by energy companies to decarbonize.

Thurs April 29 - 7:00 pm	Anja Riedel	Remote Sensing Analysis of the Pine Gulch Fire, Mesa and Garfield Counties, Colorado	The destruction of forests due to fires causes extensive damage by inducing landslides, erosion, and desertification, as well as burning both community and living structures. The best way to mediate fire destruction, is to determine the patterns, triggers, and severity of forest fires. To stay ahead of both natural- and human-triggered forest fires, remote sensing techniques must be implemented at every stage of the fire prevention, fighting, and rehabilitation processes. Remote sensing is an important tool for fighting fires and mitigating burn damage in remote areas that are difficult to reach, or in which on-site research is prohibitively expensive to conduct. The ability to estimate the formation and behavior of fires in terms of predicting and combating them is invaluable because it saves time, money, and manpower. Landsat-8 and Sentinel-2 satellite images are commonly used in burn scar analyses for their accessibility and high quality. This research project will utilize Landsat-8 images and Envi analysis tools to conduct a burn intensity analysis of the 2020 Pine Gulch fire in Western Colorado, which was the largest fire in the history of the state at the time it occurred.

Thurs April 29 - 7:10 pm	Roan Hall	GIS Based Detection of Potential Landslide-Triggered Tsunamis in Prince William Sound, Alaska	With global warming there has been an increase in natural disasters worldwide that have produced many unforeseen consequences. In Arctic regions, one of these unforeseen consequences is tsunamis caused by de-buttressed slopes located adjacent to glaciers. As glaciers melt, slopes once supported by glacial ice are exposed and often end up undergoing mass wasting events. In regions where glaciers extend into water, however, the resulting mass wasting can displace enough water to create powerful tsunamis that can significantly affect local marine traffic and nearby communities. In 2015 a landslide-triggered tsunami occurred in Taan Fiord, Alaska. Study of this area using geographical information systems (GIS) and remote sensing data acquired before the event, detected slow slope movement using digital elevation models (DEMs). Several similar events could occur in Prince William Sound, a south-central region of the state which has a significant population and large amounts of marine traffic. Glacial bays are abundant in this region, several of which exhibit the same features necessary for landslide-triggered tsunamis to occur. This study aims to evaluate the Prince William Sound region for evidence of slow slope movement that might be indicators of future landslides and possible tsunamis.

Thurs April 29 - 7:20 pm	Anastasia Daniel	Comparison of arroyos along the eastern Book Cliffs, Colorado	Arroyos are flat-bottomed, near-vertical walled ephemeral channels that episodically incise, resulting in increased sediment yield downstream and impassable valleys that can disrupt various land use activities. The purpose of this research is to characterize arroyos of varying drainage basin size and steepness to determine their influence on arroyo morphology and stratigraphic complexity. The data will include three arroyos that drain the Book Cliffs northwest of Palisade, Colorado. The geometrical characteristics and stratigraphy of the lower reaches of each arroyo will be compared and an attempt will be made to explain similarities as well as differences. Characterization of the arroyos will use existing DEMs and Google Earth images. Measurements of drainage basin area, arroyo cross-sections, and longitudinal profiles as well as in-field observations will be used. The studied reaches will be at similar elevations so that reasonable comparisons can be made. Similarities and differences among the arroyos will be used to evaluate possible factors influencing arroyo development including climate, livestock grazing, and local differences in geology and relief. Additionally, this comparison may provide evidence for geomorphic thresholds specific to the study area such as those associated with gullying in other areas of the Piceance Basin.

Thurs April 29 - 7:30 pm	Jarad Lavelle	Using Structure From Motion Photogrammetry to Detect Motion of the West Salt Creek Landslide Headwall, Mesa County, Colorado	On May 25, 2014, a slope failure north flank of Grand Mesa created a 4.5 km-long rock avalanche in West Salt Creek valley, resulting in three fatalities. The avalanche was initiated by a large rotational slump failure which displaced fractured rocks and sent them down slope. Re-occurring headwall instability is a long-term threat in the area and GPS-based monitoring efforts have been insufficient to characterize headwall movement. Structure from motion (SfM) photogrammetry offers an accurate, low-cost, and effective means of characterizing changes in landform morphology over time. Investigations by the Colorado Geological Society indicated the headscarp continued to move as of September, 2015, but movements after 2015 have not been accurately determined. LiDAR data acquired in June, 2014 of the West Salt Creek area serves as the reference land surface against which estimates of movement subsequent to 2014 can be measured. A 3D (SfM) photogrammetry model based on drone (sUAS) imagery captured in September, 2020 will be compared to the LiDAR post-slide surface model, with the objective of detecting surface movement since the original slope failure in 2014. A better understanding of headwall movement since 2014 may lead to a better understanding of future movement.

Thurs April 29 - 7:40 pm	Lisa Van Kirk	Alkali-Silica Reaction Potential of Aggregates in Western Colorado: Application to Concrete	Concrete is a man-made material used in everyday construction to build our roads, bridges, building foundations and other projects. Identification of alkali-reactive aggregates is essential to mitigate harmful expansive reactions in concrete. Certain aggregates, when mixed with alkaline cement paste, produce Alkali-Aggregate Reactions (AAR) which may lead to expansive gel formation in concrete structures. Rapid expansion of these gels may eventually compromise the structural integrity of concrete structures. Past studies have shown certain mineralogic textures have larger effects on AAR than others. Because Colorado has variability in its geology, aggregates in the state should have variable reactivity. This study analyzes coarse concrete aggregate, from various aggregate pits located within Western Colorado. Mineralogy and textures of the aggregates are determined using ASTM C295, which is the Standard Guide for Petrographic Examination of Aggregates for Concrete. Third-party laboratory data from aggregate tests of ASTM C1260 and C1567, that characterize the reactivity of aggregates, will be compared with the aggregate sample petrography. Correlating data can provide future guidelines to mitigate concrete deterioration due to alkali-aggregate reactions.

Thurs April 29 - 7:50 pm	Zakary Saint	Determining if Trilobites are a Reliable Biostratigraphic Tool	Biostratigraphy plays a major role in determining the age relations of geologic units. Trilobites are believed to be a useful index fossil for this purpose due to their abundance, widespread distribution, and clearly defined period of existence. The purpose of this study is to use taphonomic data trilobite species to test their validity as a biostratigraphic tool. Data from well-known trilobite fossil sites located in Utah, New York, New Mexico, and Oklahoma will be compared. A secondary comparison will be made between trilobites found in the Colorado Peerless and Manitou formations that span the Late Cambrian Franconian (497 to 492 Ma) and the Ordovician (448.3 to 443.7 Ma) ages. Past work has shown there are trilobite fossils that are unique to certain regions and has also defined the unique morphological features of trilobite species with specific age ranges. These fossil species will be used as a means of evaluating the age of the rock formations at each locality. This study will seek to determine if the localities contain fossil data that is inconsistent with reported age estimates. Through studying previous work, it will be determined if trilobite biostratigraphy is truly a reliable tool for relative dating of geologic formations.

Thurs April 29 - 8:00 pm	Pedro Terres Illescas	Comparison of Zircon vs Zirconium in volcanic rocks within the Timber Mountain Oasis Valley Caldera Complex, Nevada.	The Miocene Timber Mountain "“ Oasis Valley Caldera Complex (TM-OV CC) started developing about 14 million years ago during a period where numerous eruptions, and caldera collapse events covered the land with pyroclastic rocks, tuffs, and lavas spanning a period of several million years. Rock samples collected from outcrops and borehole were analyzed previously and compile in databases that include information about sample lithology, stratigraphy, petrography, geochemistry, and geophysical properties. Two different-aged calderas within the TM-OV CC are evaluated: The Silent Canyon Caldera and the Timber Mountain Caldera. Specifically, rocks of the Belted Range Group (Tb), and Timber Mountain Group (Tm) will be evaluated. The chemistry of each of the stratigraphic unit differ in the amount of silica present: units are more silicic-rich as they get younger. Moreover, study reveals that the volumes of Zircon ($ZrSiO_4$) versus the abundance of Zirconium (Zr) differ as well between the calderas. The oldest caldera of the two calderas, the Timber Mountain Caldera has a higher concentration of zirconium. This difference suggests that the magma chemistry became more silicic over time to account for the increase in Zr.