Seasonal, Stable Isotope Variations in Grand Junction, CO During Three Consecutive La Niña Years

Miles Garrison

Abstract

Meteoric water (precipitation) has a $d^{18}O$ and $d^{2}H$ signature and when the two are correlated, a meteoric water line is the result. Typically, every 3 to 7 years La Niña is the dominant phase of the ENSO cycle in the Pacific Ocean. The occurrence of three consecutive La Niña years is rare, meaning there is limited research associated with a "triple-dip" phase of the ENSO phenomenon. This research studies climatic effects of La Niña and a "triple-dip" La Niña phase to determine if there are seasonal patterns recorded in $d^{18}O$ and $d^{2}H$ values of precipitation samples in Grand Junction, CO during any given season of each of the three consecutive La Niña years occurring in 2020, 2021, and 2022. This research will also determine the seasonal distribution of precipitation amounts in Grand Junction during the 2020-2022 period and compare isotopic values with amounts of seasonal precipitation. Lastly, this research will provide a comparison of seasonal amounts and seasonal isotopic averages to determine which types of storm systems (ex. tropical monsoon systems or Pacific NW systems) deliver the most and least amounts of precipitation to Grand Junction, CO and in which seasons the given precipitation is most and least abundant. Samples analyzed for this research will be collected from multiple locations in Grand Junction, CO. At these locations precipitation events are recorded and collected using a rain gauge, then they are sent to Western Colorado University in Gunnison, CO for analysis using cavity ring-down spectroscopy.

Origins of Dakota Formation White Sandstone at Lunch Loops Trail, Grand Junction, CO

Jackson Weber

Abstract

The Dakota Formation is a Cretaceous aged (145 Ma to 65 Ma ago (Hansen, 2023)) deposit that formed during the onset of the Western Interior Seaway transgression. The Western Interior Seaway transgression created littoral marine, lagoonal, estuarine and paludal environments of deposition. At Lunch Loops Trail in Grand Junction, Colorado there exists a white sandstone that sticks out in color from surrounding units. This white sandstone Dakota Formation unit, at locally observed outcrops, is overlain by carbonaceous shale. Comparing chemistry composition below and above this carbonaceous shale was completed using XRF chemistry analysis of counts (peak detection for elements directly related to concentration (photon electron) of that element within the sampling volume) of Si, Al, Ti, Fe, Mn, V, Cr, Ca, K. Results show a depletion of elements Al, Ti, Fe, Mn, V, Cr, Ca, K in the white sandstone below the carbonaceous shale compared to XRF chemistry counts of these elements in the beige sandstone above the carbonaceous shale. Si was greater below than above the carbonaceous shale in XRF chemistry count likely due to down profile movement of clay minerals associated with Si. XRF chemistry data supports mineral leaching of the white sandstone. Leaching from downward penetrating acidic (sulfate rich) solutions from oxidation of coal and carbonaceous shale. Leaching origins are further classified by either wave action of the transgressing sea oxidizing the peat unit that would later undergo diageneses and become the carbonaceous shale seen today; or leaching from drainage waters through the overlying carbonaceous shale.

Using $^{40}Ar/^{39}Ar$ detrital sanidine dating to identify the age and stratigraphy of the Goodenough unit in western Colorado

M.J. Winey

Abstract

The Goodenough unit is the informal name of sedimentary deposits that primarily occur within landslide blocks capped by Miocene basalt flows, and which overlie the Eocene Green River Formation on Grand Mesa. The Goodenough has been studied at several locations in the Grand Mesa area, including Military Park, Ward Creek, and Goodenough Reservoir. At these locations, the Goodenough is heterolithic, and includes pebbly sandstone, silty sandstone, multi-colored mudstone, tuffaceous sediment, stromatolites, and chert-bearing limestone. The abundance of mudstone and fine-grained sediments interfingering with coarse-grained sandstone and pebbly sandstone implies that the Goodenough unit was deposited in a fluvial-lacustrine depocenter. The volcaniclastic sediment suggests that there was active volcanism occurring during the deposition of the Goodenough. 40Ar/39Ar dating of detrital sanidine acquired from sand-rich units and a reworked tuff was used to provide the first radiometric age constraints for the Goodenough unit. These age constraints for the Goodenough will be compared to other Cenozoic stratigraphic units across Colorado to determine if the Goodenough is a unique stratigraphic unit or if it is like other coeval formations. The long-term potential significance of this project is to determine if the Goodenough accumulated due to continued post-Laramide subsidence and/or valley filling.

Geophysical and Geochemical Analysis of a Mafic Intrusion and Related Hydrothermal Deposits Northwestern Uncompahgre Plateau

Hailey Peters

Abstract

Ground magnetic surveys of the Uncompahgre Plateau of western Colorado have indicated a strong magnetic anomaly ranging from 49,800-52,000 nT in the Glade Park area. The magnetic anomaly is likely due to a concealed mafic pluton that intruded under the Laramide-aged Uncompahgre Plateau. Additional Bouguer gravity anomaly data indicates a dense mass under the crust in the same location as the magnetic anomaly showing a high of -180 mGals. This value is anomalously high compared to the rest of Colorado that is around -260 to -290 mGals. Interpolation of the magnetometer data was done using Petrel to determine the shape of the intrusions profile. The assumed depth of the intrusion is ~4 km done via gravity survey taken from (Casillas 2004).

Mafic intrusions under the Uncompahgre Plateau can provide heat sources for hydrothermal deposits that form along basement faults. Hydrothermal veins intruded through Mesozoic sedimentary rocks, from the Chinle Fm. through the Dakota Fm., have been found around the northwestern Uncompahgre Plateau in relation to other mafic intrusions. Ten quartzite samples from the Salt Wash Mbr. of the Jurassic Morrison Fm. in Glade Park have been taken for geochemical XRF analysis. Ten known hydrothermally altered quartzite samples from Devils Canyon have been analyzed using XRF as a base case for comparison. Elevated levels of trace elements Fe, Mg, Al, Ti, and K are enriched in hydrothermal fluids where the heat source of the system is that of a mafic intrusion. The average content of these mafic elements in the Glade Park quartzites resulted in 1969.32 ppm of Fe, 7822.4 ppm of Mg, 22541.97 ppm of Al, 9501.23 ppm of Ti, and 4710.94 ppm of K. These values greatly exceed that of a regular

quartzite which is close to 10 ppm per element. It can be interpreted that intrusive related hydrothermal activity has occurred during the geologic history of the Glade Park area.

Dotsero Volcano Magnetic Survey

Andrew Schmidt

Abstract

Dotsero Volcano, Colorado's youngest *phreatic maar* composed of basalt flows (*a'a*), welded tuff, and ash encircling an 800-meter elliptical crater, erupted 4,150 years ago. Three eruption phases are hypothesized: 1) quiescent fissure-fountaining, 2) catastrophic groundwater explosion, and 3) Strombolian ash discharge. Subsequent mass-wasting conceals vents except relict tabular structures. Basement-involved faults penetrate local evaporites; a diatreme likely formed within a salt-weld depression, funneling in groundwater from a now-beheaded tributary. Geothermal springs suggest heat sources remain. Speculation about Dotsero subsurface igneous geometry has not benefitted from modern technology; to this investigator's knowledge no ground-level magnetic surveys exist. Solidified iron-bearing magmas impart detectable anomalies upon Earth's magnetic field; field magnetometers detect changes in intensity when traversing the magnetic poles of a buried structure. 101 locations were sampled by walking magnetometer, producing a transect grid with 12 best-fit intensity curves parallel to Earth's magnetic field lines. Depths to uppermost magma encroachment were estimated using Peter Half Slope Method and first- and second-derivative maxima and inflection points. Coordinates were digitized in ArcGIS Pro, producing interpolated contour maps. Pluton depths are postulated at 45-to-145-meters. Shallow intrusions (2200-meter elevation) undergird the scoria cone and northeast-trending ridge. A flat tuffaceous structure (2000-meter elevation) may undergird the maar's southwest extreme.

Integrating drone orthomosaic imagery and structure-from-motion 3D digital models with stratigraphic analysis of the Rabbit Valley paleontological area, Colorado, USA

William Myers

Abstract

Prospecting for undiscovered fossil specimens involves a wide array of tools and methods, that range from hiking and looking for clues on foot, to examining satellite imagery, and new ways to locate fossil localities continues to advance with technology. Previous paleontological studies have shown that drones can be used to create detailed orthomosaic maps that paleontologists can use to identify potential fossil sites with a higher degree of success. The Rabbit Valley Paleontological Site in western Colorado near the Utah border contains numerous fossil localities including the Mygatt-Moore Quarry. These localities are found in specific stratigraphic layers within mudstones of the Brushy Basin Member of the Morrison Formation, and the fossils at the quarries at Mygatt-Moore and the Cleveland-Lloyd Quarry have similar paleofauna. Data presented in this study intends to integrate orthomosaic drone imagery and 3D models of fossil sites with additional on-the-ground stratigraphic analysis of the fossil localities. The primary hypothesis to be analyzed in this study is that the use of drone data can improve prediction of future fossil discovery locations, and may be a useful tool for future paleontological exploration.

The fossil localities along the trail through time show distinct differences from the MMQ being sandstone localities. The sandstone outcrops along the Trail Through Time all show signs of being channel deposits. The drone data allowed me to trace these fossil beds for long distances which could be potential fossil hotspots in the future.

Application of Photogrammetry to Dinosaurian Trackways in the Cactus Park Area, Colorado

Laura A. Kleim

Abstract

The advent of photogrammetry as an accessible tool for geologic research has changed the way that ichnologists record and analyze data from fossil trackways. Digital elevation models (DEMs) allow for the creation of extremely accurate site maps and can reveal traces and biometric or biomechanical data that would have otherwise gone unrecognized.

There is an abundance of tracksites on the Colorado Plateau, and while some more unique or recently discovered tracksites have been analyzed via 3D modeling, many were described during the "dinosaur renaissance" of the 1970s and 1980s without the aid of modern technology. The recording of sites via photogrammetry is non-invasive, thorough, and allows for more detailed research to be conducted in the future, even by researchers who cannot easily go out into the field. This study aims to collect DEMs of dinosaurian trackways in the Cactus Park area, which will allow for new analysis of the sites, mainly through vertical exaggeration of said DEMs. This methodology can reveal new details of tracksites, up to and including entirely new trackways which were overlooked or uncertain in field observations.

Using d-spacing in Dolomite to Determine Iron Content with Applications to Green River Formation Rocks

Faith Urbin

Abstract

The Green River Formation is an Eocene lacustrine deposit and was deposited in several basins in Wyoming, Colorado, and Utah during the Laramide orogeny. The Parachute Creek Basin Member, Garden Gulch Member, and upper Douglass Creek Member, contains abundant oil-shale deposits within the Piceance Creek Basin in Colorado. The mineralogy consists of dolomite, ankerite, pyrite, dawsonite, calcite, quartz, K-feldspar, and Na-plagioclase (Cole, 1975). Using ten Green River Formation samples provided by Dr. Rex Cole, this project determined iron content in dolomite using X-ray fluorescence and X-ray diffraction, which allowed more detailed characterization of the dolomite in the samples originally studied by Dr. Cole. This technique required using the method of additions to create some iron-containing dolomite standards, applying internal standards to compare with dolomite samples containing unknown amounts of iron, and utilizing X-ray diffraction to determine the d-spacing of iron-bearing dolomite. With a more accurate technique, this creates an opportunity to expand understanding of the Green River Formation's mineralogy, depositional environments, and chemistry of the lakes. Results concluded standards were successful and correlation of d-spacing and iron content in dolomite requires more research to determine.