

**2004 Spring Science Symposium Abstracts  
Geology and Environmental Science  
College of Science and Mathematics  
James Madison University**

Friday April 23, 2004, Taylor 405

**SEDIMENTOLOGY AND GEOMORPHOLOGY OF BLACKROCK BLOCK STREAM, SHENANDOAH NATIONAL PARK, VIRGINIA**

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Blackrock Summit, located in Shenandoah National Park in the Blue Ridge Mountains of central Virginia, is a tor composed of thick units of quartzite strata of the Harpers formation. The tor is highly fractured, producing spires that show downslope rotational movement. Block deposits extend downslope from this ridge top primarily on the northeast and western slopes of the mountain. The size and fabric of these boulders were examined to determine the mode of transport, and to provide insight into past climatic conditions. The specific site studied is located on the anti-dip slope on the northeastern side of the tor and is 50 m in length. The size of the blocks decreases with distance from the tor. The clasts near the top of the profile show a random orientation, suggesting movement by rockfall. Farther downslope the long axes of the boulders begin to show a northeasterly trend that parallels the slope. This trend continues to the bottom. The profile displays an undulating topography, and the blocks have an open framework that lack interstitial material. The western block field, examined in a previous study, shares similar features to the northeastern site; however, this slope has an extent of over 500m due to its location on the dip slope. Both profiles show a long-axis orientation that is predominantly downslope. The features and trends observed at Blackrock are indicative of periglacial processes described in the literature where ice acts as the main agent of transport.

**ASSESSING THE DEVELOPMENT OF TOWER KARST IN HA LONG BAY, VIET NAM**

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Karst topography manifests itself in a wide range of relief patterns in diverse climatic settings. This diversity has spawned numerous studies on the processes and conditions that must be present in order for a specific type of karst landform to exist. In particular, tower karst is easily identifiable by the narrow and jagged columnar-like towers that are surrounded by an otherwise flat terrain. During the initial stages of research, tower karst was believed to simply be advanced development of the rolling terrain found in doline karst. However, evidence of these two types of karst existing contiguously encouraged further investigation. Cumulative research has indicated several conditions that determine the type and style of development of karst topography. These conditions include 1) rainfall frequency and intensity, 2) existence of fault zones, 3) material and common minerals, 4) level of water table, 5) and relative geologic age. This paper will examine the presence and influence of these proposed conditions in the northern Viet Nam region of Ha Long Bay.

**THE MINERALIZING ENVIRONMENT OF THE BUCK HILL SYENITE, AUGUSTA COUNTY, VIRGINIA**

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Throughout the Valley and Ridge Province of Virginia and West Virginia are numerous Jurassic-Cretaceous age igneous intrusions cutting through the sedimentary country rock of Paleozoic clastics and carbonates. One such intrusion is the Buck Hill syenite; an approximately 0.3 x 0.1 kilometer, porphyritic nepheline syenite, located just north of Stokesville, VA on the 7 ½ minute, U.S.G.S., Stokesville quadrangle.

Vesicles within this high alkali - low silica igneous rock have yielded 20 different mineral species, both common and unusual. Several mineral species (synchysite-Ce, apatite) contain rare earth elements, while others (catapleiite, arfvedsonite) are enriched in zirconium. Niobium and Thorium bearing minerals have also been identified. A chemical/mineralogical similarity to the world famous syenite intrusion at Mont Saint Hilaire, Quebec,

Canada is undeniable.

Previous research on this location by JMU students Erin Raiter and Alyssa Saint John with help from Dr. Lance Kearns and Montana geologist Tom Tucker documented minerals that formed at this location with the use of X-ray diffraction and SEM/EDS analyses. Continued research, has provided verification of several additional mineral species along with a closer look at the chemistry of the known minerals. The paragenesis, or sequence of crystallization, was determined for the minerals from the Buck Hill syenite.

#### PARASEQUENCES OF DIVERGENT CONTINENTAL MARGINS VERSUS THOSE FOUND ON CONTINENTAL CRATONS

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Because of a closer proximity to the world's oceans one would expect to find fuller, and more prevalent, better-developed full parasequences on divergent continental margins (DCM's) as opposed to those found on continental cratons. The parasequences on continental cratons should be incomplete and should be missing sequences like the low stand tracts that can be found on DCM's. This is a fact due to their farther proximity from the sea level changes, which deposit the parasequences found in the rocks. Indeed this is what was found, however, this phenomenon was studied at a greater depth to determine what degree these system tracts were missing from the sedimentary rock record of continental cratons. Basic conclusions about the relevance of parasequences on DCM's and continental cratons with respect to their proximity to the ocean and the differing depositional environment that they were both formed in were created. In order to perform this task, a theory had to be formulated from a "bottom-up" approach by looking at some specific localities and comparing them to the localities of a different environment. After this information was assimilated it was concluded in general that the farther the proximity of the worlds oceans the less developed the parasequences.

#### MEASURED VERSUS PREDICTED CRYSTAL SIZE DISTRIBUTION IN COMPUTER SIMULATED IGNEOUS TEXTURES WITH RANDOMLY ORIENTED CRYSTALS

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This research deals with the computer simulation of nucleation and growth of randomly oriented prisms (1:1:5). In this type of texture the cut effect of the thin section through the crystals show lengths and widths of crystals which are not their true lengths and widths. Nevertheless, our results show that good estimates of crystal size distribution (CSD) can be obtained from measurements of grain sizes in 2-dimensions. Thus it can be demonstrated that the ratio of the (nucleation rate constant)/(crystal growth constant) can be extracted from the slope of the CSD.

#### RESISTIVITY AND IP SURVEY OF MINES SURROUNDING THE CHANCELLORSVILLE BATTLEFIELD IRON FURNACE

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Hidden in the woods behind the remaining structure of an old iron furnace and the dilapidated foundations of the various structures of Chancellorsville Battlefield, VA lay many open pits. These pits are speculated by archaeologists to have been part of an iron mining industry that existed in the area during the time of the Civil War. Since these pits have been abandoned since the end of the war, there are no outcrops exposed. To assist archeological studies in determining what lay beneath the pits a resistivity and induced polarization (IP) survey was done. IP is an electrical method particularly useful for locating disseminated conductive minerals. Two lines were surveyed perpendicular to one another across one of these pits. By inducing a current into the ground we can then measure the resistivity and chargeability of the subsurface and generate a cross sectional model of the area surveyed by both forward modeling techniques and inversion. These methods were used resulting in a model demonstrating a distinct IP anomaly beneath the pits. This anomaly indicates a particularly conductive and IP-responsive body that is likely pyrite.

**ELECTRICAL PROPERTIES OF LEACH ORE, CRIPPLE CREEK MINE, COLORADO**  
**Gary Horton** and William Frangos, Department of Geology & Environmental Science

The Cripple Creek and Victor Gold Mining Company in Victor, Colorado is a leading gold producer in North America. The mine is an open pit/heap leach recovery facility where the ore is placed in an unconsolidated pile and treated with a dilute cyanide solution. The pregnant solution is then pumped to an adsorption facility for gold extraction. Annual recoveries of gold reach 65,000 oz/yr at a mine cutoff of 0.018 opt.

The intent of this project is twofold 1) to investigate saturation characteristics within the heap itself through the use of a series of Schlumberger soundings at locations with different solution saturation (e.g., fresh ore with no solution as opposed to fully leached rock), and 2) to perform laboratory spectral induced polarization studies on ore samples to determine electrical properties indicative of leaching conditions. Induced polarization, an indication of metallic and clay content, characterizes electrical energy storage. In spectral induced polarization a wide range of electrical frequencies are used, typically 0.01 to 500 Hz. If there is a characteristic difference in the electrical properties of saturated vs. unsaturated ores then these differences could be detected by surface measurements, revealing subsurface regions of under-saturation and insufficient leaching.

Findings indicate the competent, low-sulfide rock is highly resistive and has very low IP response. Discrimination between leached and fresh ore will require recognition of subtle differences.

**MEASURING THE GEOMETRY OF CURRENT FROM A WIRE USED AS A LINE SOURCE TRANSMITTER**  
**Jason Keener** and Will Frangos, Department of Geology & Environmental Science

Resistivity and induced polarization studies have always used point sources for transmitting current into the medium for ease of calculation. It may be advantageous to use a line source buried in the ground, instead of a point source for many surveys. Applications would range from running current down drill stems to transmitting from water pipes in the ground. The geometry of current out of a line source is largely unstudied, meaning that using a line source instead of a point source may produce bad data, artifacts, etc. A dual channel IP receiver was to measure the potential 1.2 cm away from each of two wires used as line sources to ascertain the distribution of uniaxial current flowing through a homogeneous medium of tap water. Areas of high and low conductivity can be simulated in the controlled environment, giving insight to the way current will behave when the line source is buried in a heterogeneous medium. The data show that differences in the surface resistance of the line source can affect the geometry of the current being transmitted. Variations in the surface resistance (due, for example, to fingerprints or corrosion) cause concentrations of the current into small segments of the wire serving as the line source. These disturbances were investigated by using electrical tape and metal clips to serve as non-conductive and conductive areas, respectively. Simulated non-conductive areas on the line sources show a marked decrease in voltages measured a short distance away, while simulated conductive areas show a large increase in the voltage measured.

**MAGNETIC SURVEY OF CATHERINE'S FURNACE SLAG PILE CHANCELLORSVILLE, VA**  
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The Catherine's Furnace slag pile is presently covered with leaves, debris, and even a road. The pile has been in existence long enough that it has become intertwined with the landscape of the area, even to the extent that mature trees are going on the pile. This situation makes accurate mapping of the slag nearly impossible without costly and very time consuming excavation or the use of a proton magnetometer.

The proton magnetometer was the preferred first choice for delineating the magnetic slag because time and money were a consideration. Data was collected on a 10m x 2m grid system. The grid shows magnetic response to coincide with slag in known areas. Interference from cultural features such as cars and metal culverts were noted on the grid.

The results of the study show that magnetic response appears to be an effective way to delineate the slag pile.

## THE CLASSIFICATION OF DINOSAUR EGGS BASED ON LITHOLOGICAL AND SHELL STRUCTURE ANALYSIS

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Eight dinosaur eggs were donated to the James Madison University geology department. Based on the information provided by the donor, they are assumed to have come from China or Mongolia. Analyses of the eggs consisted of a general dimensional analysis, MRI (magnetic resonance imaging) at a nearby hospital (Rockingham Memorial Hospital), examining the shell structure and the lithifying material with thin section analysis with a petrographic microscope, and cross-referencing the findings with studies on dinosaur eggs and lithologic units in China.

An initial analysis of the eggs', based on their dimensions, suggested that their parent was a Therizinosaur. This assessment was rejected based on analysis of the shell structure, which showed a dendrospherulitic structure. A Therizinosaur egg would have a ratite morphotype. Parents for eggs with dendrospherulitic structures are either sauropods or ornithopods. Further study with the lithology helped to narrow down the field.

Analysis of the surrounding matrix showed the lithifying material contained mud pebbles, angular and rounded quartz fragments, and clays. Because the eggs were found intact and were bought together, we can assume that the eggs were lithified in the nesting environment. The influence of the parent on the environment has to be taken into account, disturbing the sediments to make a nest and tracking in outside materials. Based on the sediments, we can assume that the environment was intermediate from a felsic sourceland, such as a meandering river downslope of a granitic sourceland.

A geologic atlas of China was referenced to see which units were known to contain dinosaur fossils of any kind. The lithology of these fossil bearing units were then compared with the lithology of the material attached to the eggs. Articles containing information on the fossils, paleoenvironment, and lithologic description were examined to see if the data obtained on the eggs and the lithifying material were similar. The unit that had the most similarities was the Nanxiong Formation (in the Jiangxi Province).

The unit contains dinosaur egg fragments and the unit is composed of coarse, red-purple sandstone with unsorted clasts of varying composition. The unit also contains evidence of mudflows. The depositional environment of this unit was suggested to be an ephemeric river. The Nanxiong Formation is a Late Cretaceous unit. Taking into the classification of the eggshell morphotype as dendrospherulitic and the age of the rock, the dinosaur that laid the eggs was probably an ornithopod. This conclusion is due to the fact that ornithopods were more prevalent than sauropods during the late Cretaceous. Also, an egg that was attributed to a hadrosaur was seen by one of the authors who noted its dimensions were similar to the donated eggs.

## EFFECTS OF PRECIPITATION IN THE NEAR SURFACE RESISTIVITY OF SOIL

**Lawrence Moller** and William Frangos, Department of Geology & Environmental Science

Shallow resistivity investigations have assumed increased importance with present interest in engineering and environmental studies. The purpose of this survey was to determine the effects—if any—that precipitation plays with respect to the near surface resistivity of soil. A location was selected for the survey and a set of nails, which would act as transmitting electrodes, were set in place. These nails were not to be moved in any way to ensure a control in the research. The electrodes were set up in a Schlumberger array, and data would be taken at weekly intervals. Precipitation amounts were tabulated and constantly recorded by the use of a rain gauge. After numerous weeks and surveys, acquired data yielded results that showed a positive correlation between rainfall amount and resulting resistivity. As precipitation increased, overall resistivity increased as well. The implications resulting from this survey prove to be quite significant with regard to geophysical data collection. Since precipitation affects the conductive characteristic of soil, care must be taken in comparisons between data taken at different times in an area.

## AN INVENTORY AND GEOMORPHIC PROCESSES OF BLOCK STREAMS OF PAINE RUN, SHENANDOAH NATIONAL PARK, VIRGINIA

**Melissa L. Orndorff** and L. Scott Eaton, Department of Geology & Environmental Science

This research was conducted on the block slopes located in the Paine Run drainage area of the Blue Ridge Mountains in Shenandoah National Park near Grottoes, Virginia. The study examines the characteristics of these block slopes. The blocks originate from the Harpers formation, a Cambrian quartzite, which shows trace fossils of *Skolithos*. The vast majority of these rocks are covered with lichens; therefore, these features are relatively stable and experience minimal movement during present climatic conditions. This region is thought to have had a minimal amount of vegetation during the last glacial maximum, as average July temperatures are estimated to have been 5-15° C colder than present day (Clark and Ciolkosz, 1988). This environment likely enhanced frost action, and accelerated physical weathering of exposed, non-vegetated bedrock.

A total of eight major block slopes were documented using aerial photography of 1:40 000 scale. The average area of the features is 0.014Km<sup>2</sup>, and range from respective lows and highs of 0 .0073 to 0.029Km<sup>2</sup>. The block slopes show an average slope of 20.4°, with a range of 11.0-29.2°. This average slope correlates with the findings of Clark and Ciolkosz (1988), where they noted a clustering of Appalachian block slopes between 20-25°. In Paine Run, these features are found evenly distributed between 1) East/North-Easterly and 2) Western facings, and their shapes are strongly elongate downslope. Future work will include examining the relationship between the structural geology of the basin with respect to location and development of these block slopes.

## THE PAST, PRESENT, AND FUTURE LOCATIONS OF THE STREAM OF MEADOW RUN, BLUE RIDGE MOUNTAINS, VIRGINIA

**Erin K. Peebles** and L. Scott Eaton, Department of Geology & Environmental Science

The stream of Meadow Run flows on the western flank of the Blue Ridge physiographic province near Grottoes, Virginia. The channel cuts through Pleistocene-Quaternary alluvial fans that are composed of saprolitized cobbles of Antietam Quartzite, the Shady dolomite, and deeply weathered fluvial deposits. The stream itself is an intermittent, multi-threaded channel that flows to the northwest, joining with the South River. The course of the channel is undergoing avulsions that are activating many rotational slides on the perimeter of alluvial fans that border the bank of the stream. These avulsions are activated when major flooding events occur. Each major hurricane that has occurred during the past several decades (e.g., hurricanes Camille (1969), Agnes (1972), Juan (1985), Fran (1996), and Isabel (2003)) has supplied enough energy through the system to activate the avulsions. Sequential air photos from the 1930s to present, Light Detection and Ranging (LIDAR) imaging, and field reconnaissance are being used to map the past and present channel locations. Predictions of the future locations of the stream are being developed from the headward migration of active knick points. These knick points are found in the avulsion on the southeast flank of the stream, giving evidence that the stream is changing its flow pattern as it tries to reach a point of equilibrium. Knick points are formed as more resistant rock or in this case trees that hold the sediment, erode away vertically and headward so that the stream can reach a graded long profile where the available energy of the river and the processes of the river are balanced. Bed load in the avulsions is also grading upward from flood plain silts and sands to channel pebbles and cobbles, providing further evidence for adjustments in the channel path. By acquiring insight into changes in channel evolutions we can begin to develop an understanding of how rivers respond to high energy conditions.

## AN ANALYSIS OF THE USEFULNESS AND EFFECTIVENESS OF MAPPING THE AVERAGE HIGH TIDE LINE OF A BARRIER ISLAND FOR LONG TERM RESEARCH BY WALKING AND USING GPS AND GIS TECHNIQUES ON HOG ISLAND, VIRGINIA

**Curt Smith** and Stanley Ulanski, Department of Geology & Environmental Science

This research thrived to analyze the usefulness and effectiveness of mapping a barrier island on foot using modern GPS and GIS techniques. Hog Island, within the Virginia Coast Reserve on Virginia's Eastern Shore, was chosen to accomplish these goals because of its pristine nature and accessibility with permission from the University of

Virginia's Long Term Ecological Research laboratory in Oyster, Virginia. The significant inland movements of this island are ideal for beginning a long-term detailed study.

It was determined that by using a hand-held GPS unit Hog Island could be mapped on foot. The average high tide line was chosen as the ideal path because of its accessibility and definitive characteristics. The line on the ocean side of the island followed rack lines. The line on the lagoon side of the island followed marsh grasses that grow along the high tide line. The island was walked multiple times to determine variability in collecting the data.

All GPS data was then entered into a GIS application where all lines around the island were averaged. After finalizing and averaging the average high tide line, it was determined that the island was mapped with 3-5 meters of error on the front side of the island and with 5-20 meters of error on the backside. This proved to be only as effective and useful as had previous methods of mapping barrier island movement.

#### MEASURED VERSUS PREDICTED CRYSTAL SIZE DISTRIBUTION IN COMPUTER SIMULATED IGNEOUS TEXTURES WITH PREFERRED ORIENTATIONS OF CRYSTALS

**Krista C. Stevens** and R.V Amenta, Department of Geology & Environmental Science

Crystallization experiments with artificial magmas cannot produce the textures found in natural igneous rocks, so our approach is to see what can be learned about texture development by computer modeling of crystallization. This research deals with the computer simulation of nucleation and growth of aligned prisms (1:1:5). This type of texture is ideal for validating the results of our computer model because the true widths and lengths of the crystals can be measured from 2-dimensional slices or thin sections. Results show a close correspondence between the measured CSD and the actual one.

#### PHOTOGRAPHIC CREATION OF A NEW MICRO-MINERAL SECTION FOR THE JAMES MADISON UNIVERSITY'S MINERAL MUSEUM WEBSITE

**Emilie Scheels Stup**, Lance E. Kearns and Steve J. Baedke, Department of Geology & Environmental Science

The purpose of this project was to create a permanent photographic record of micro mineral specimens for public access. This web page was created to compliment the publicly popular, existing mineral museum website recently updated by Mary Sutherland. The micro minerals used in this project, included specimens from the Phillip R. Cosminski Micro-mineral Collection and the James Madison University micro – mineral collection. Together, these collections contain several thousands of fine specimens.

These tiny minerals were photographed to create a collection of quality images that would be of aesthetic as well as scientific value to students of mineralogy and the general public. Completion of the project required background research in microphotography techniques, the use of single lens reflex and digital cameras, photography software, and web page creation and modification. Mineral photos selected for use on this web site were acquired using a Canon EOS D60 digital, single lens reflex camera adapted to a Meiji RZ stereo zoom, tri-ocular microscope. Color corrected, fiber optic illumination was used.

#### AN INVESTIGATION OF SELECTED DAVIDSON SOIL PROFILES AT THE MOUNT PLEASANT SITE, AT MONTPELIER AS INDICATORS OF LAND USE DURING THE COLONIAL PERIOD

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The summer of 2004 will mark the tenth year of archaeological excavations at the Mount Pleasant site, home of James Madison's grandparents, located on the grounds of James Madison's Montpelier plantation. Archaeologists and geologists have recently attempted to determine the impact of anthropogenic activities, like building construction and agricultural practices, on the Davidson soil series; a Paleudult, which underlies the majority of the grounds at Montpelier. The purpose of the research described here was to quantify relationships between an undisturbed Davidson profile and four disturbed profiles nearby, collected along a hill slope at Mount Pleasant, and one disturbed profile located at the foot of the aforementioned hill slope. A total of forty-nine samples were collected using auger and pit methods. The investigation involved analyzing the grain size distribution and

identifying the mineralogy and morphology of selected sand fractions of all samples collected. Even in the field the soils were seen to vary significantly. The undisturbed profile conformed closely with the description published by the U.S. Department of Agriculture for the Davidson Series. The four profiles sampled on the Mount Pleasant hillside all displayed significant erosion related to tobacco and food crop cultivation and building construction. The single disturbed profile sampled at the base of the Mount Pleasant hillside that lies in a gentle topographic swale may have undergone erosion as a consequence of cultivation, but the evidence strongly suggests an area of significant sediment deposition. Comparisons of field observations, grain size distributions and sand characteristics are yielding valuable information concerning the history of soil erosion and deposition at the Mount Pleasant site. Montpelier's resident archaeologist and his staff will utilize the results of this study in ongoing efforts to evaluate historical land use patterns and practices at Montpelier.

#### **REACTIVATION OF SLOPE FAILURES ALONG MEADOW RUN, SHENANDOAH VALLEY, VIRGINIA**

**Eric J. Turner** and L. Scott Eaton, Department of Geology & Environmental Science

Meadow Run is one of numerous gravel bed rivers that drain from the western slopes of the Blue Ridge Mountains into the Shenandoah Valley of Virginia. The arrival of Hurricane Isabel on September 18-19, 2003 brought 174 mm of rain within 24 h, and caused moderate flooding. Two previously studied slope failures in this basin were reactivated during the hurricane. The lower third of the original slope failure was removed by high flows in Meadow Run, thus destabilizing the upper slope. In the 3 months following Hurricane Isabel, multiple pulses of block movement have coincided with periods of significant rain and snowfall. These recurrent slope failures are triggered by undercutting of steep fan edges (~20 m thick) by lateral migration of the mainstem river. The objective of our investigation is to quantify processes and rates of block movement on the reactivated surfaces. The most prominent reactivated slope failure is an earth slump, and consists of unconsolidated saprolitized alluvial- and debris-flow material. The rate of movement of these blocks continues to be measured. One detached block has moved a total of ~2.5 m from its initial position from several rainfall events. New tension cracks continue to form, serving as conduits for surface water to infiltrate and reach the failure plane, thus increasing pore pressure and the likelihood of slope movement. Recent measurements indicate that movement has accelerated due to the snow and ice storm of December 4-5, 2003, along with additional freeze-thaw processes. New scarps uphill are propagating upslope, with a possibility of reaching the main headscarp of the older slope failure. The water that frequently seeps or ponds in the lower third of the slide suggests that the failure plane also behaves as an aquiclude, minimizing infiltration and perpetuating the saturated conditions of the slide material. Field evidence suggests that slope failure by recurrent movement may be common in this landscape. Several intact, yet abandoned stream channels, combined with evidence of incipient stream piracy suggest Meadow Run frequently avulses, eroding the fans at multiple sites over time. This activity indicates that fan edges are susceptible to erosion by the mainstem river.

#### **VIRGINIA PRECIPITATION AND IT'S REGIONS: EMPHASIS ON THE SHENANDOAH VALLEY**

**Erin Webber** and Stanley Ulanski, Department of Geology & Environmental Science

The purposes of this research is to collect the liquid precipitation data for the Shenandoah Valley and surrounding areas all over the state of Virginia and compare and contrast the highs and lows over an extended period of time and then relate those values to the regions they were produced in. Data has been obtained through the Virginia climatology database and that data has been calculated using statistical means. The mean average data for each individual month of each year, from 1950 through 2003 has been measured. The data will be measured to find if there is significance in finding that there are droughts every 6-8 years in comparison to maximum rainfall occurring within 2 years after a significant lack of precipitation. My main focus is to define all five regions of Virginia geographically and determine the precipitation patterns on a yearly and monthly basis. This data will produce results that help to define each region with respect to it's location and weather pattern; however, because Harrisonburg is home to James Madison University and is located in the Shenandoah Valley, much attention will be on this region and it's distinctive weather which has much to do with the rain shadow effect and the ridges to either side of the valley.