Mapping Geochronological Data of Rock Formations Across the Southeast U.S.
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Abstract
The primary objective of this project is to map the geochronological data of various rocks across the south east based on location, age, geochemistry and type of geochronological analysis used (various radiometric isotope systems). Through this visualization, an understanding of the tectonic history of various rocks in this area can be obtained and through this, a determination of the distribution of Precambrian rocks across this area can be obtained. Secondly, the work of such an analysis will also allow for the discovery of various patterns amongst the rocks in this area, for example patterns which may exist in the rock types as well as in the progression in age of these rocks. This research also seeks to uncover the relationships which may exist between the Precambrian rocks of this area and the younger rocks which they are surrounded by, in order to determine if the geology and tectonic history of this area is more significantly grounded based on geochronology versus structural processes. Using GIS as a tool for analysis of geochronological data from the national USGS database effectively creates the advantage of examining tectonic events through the lens of time, thereby allowing for observation of the patterns which may exist between the rock types of various ages.

Methods

Results
Maps showing the calculated age estimate (in millions of years) of various rock formations in the Southeastern United States, based upon both K-Ar as well as U-Pb dating.

Discussion
The continent of North America was formed over billions of years, and various geologic processes still continue to shape it today. All of the mountain ranges across the globe were built millions of years ago during events called orogenies, which operated in repeated bursts of activity through time. The Grenville orogeny was a long-lived Mesoproterozoic mountain-building event that is associated with the assembly of the supercontinent Rodinia via the collision of 3 or 4 existing continents. It is this orogenic event (1000-980 Ma) that marks the beginning of the formation of the Appalachian Mountains we see today. Since the Grenville orogeny, the Appalachians have been shaped by many other periods/episodes of mountain building. In each of these various mountain building events that led to the formation of the Appalachians, beginning with the Grenville orogeny through to the Alleghanian orogeny, material has been recycled from the previous orogenic episode and used within the subsequent tectonic event. As such, it is expected that the rocks which exist in the Appalachians today contain Grenville-age material and younger. However, the premise of this research lies in the mystery which has arisen as a result of the presence of a set of rocks that are trapped within the Appalachians that pre-date the Grenville orogeny (fig 2).

An advancement in modern technology in recent years has allowed for the formation of a rapidly expanding geochronological database, which has thus led to significant advances in understanding the geochronology and tectonic evolution of various regions and the similarities and differences which may exist between them. These rocks of interest in this research (represented as the black areas on the map in figure 2) are essentially “two old”, their age suggests that they belong to the Precambrian, Mesoproterozoic era (~1,600-1,000 Ma) and thus could not have been incorporated in the Grenville orogeny. Results from this research indicate the presence of rocks of this era which is in general consistent with the locations of these Mesoproterozoic inliers proposed by Karlstrom et al (figure 2). The results also confirm the presence of a small amount of rocks which exceed 1600 Ma. Results from the comparison between these two dating techniques indicate that the U-Pb radiometric ages are generally older than the surrounding K-Ar ages, within a 20 mile radius.

Conclusion
Through the analysis of this data, I was able to look at tectonic events through the lens of time and observed the patterns which may exist between the rock types of various ages. Various geoprocessing tools such as the buffer tool were used to create a buffers around the area in the southeast with the highest concentration of Proterozoic inliers. Although the value of these geoprocessing has proven to be undisputed, further investigation of this geochronologic data in combination with sampling and observations in the field, will allow for the generation of a more comprehensive answer to the question of how and why these older rocks are present in this matrix of younger rocks in the Appalachians. This will in turn help to gain an understanding of the geologic history of the region, in an effort to answer the larger question of how and when different parts of North America formed.

References & Data Sources

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