Locating Fossils:
Georeferencing and Mapping Invertebrates in the Western United States

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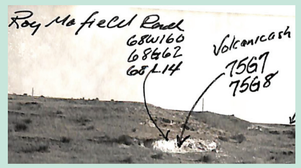
Introduction

The United States Geological Survey (USGS) houses over two million fossils within its Core Research Center in Lakewood, Colorado. In progress is a decade-long project to complete multiple fossil collection databases. We focused on enhancing the collections of USGS paleontologists John Hanley and Dr. William "Bill" Cobban by georeferencing and mapping fossil localities, the results of which will be uploaded to a publicly-accessible online database.

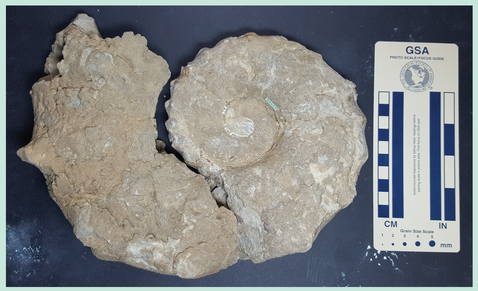
Baculites

Jess and Liz in the fossil bay



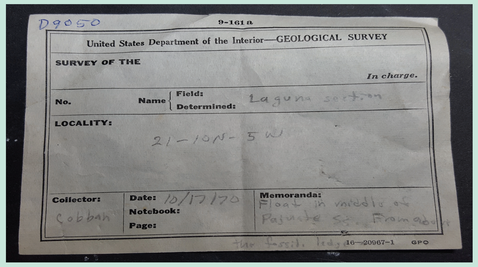
Field notes (Hanley, 1975)

Establishing Fossil Localities: Method Timeline



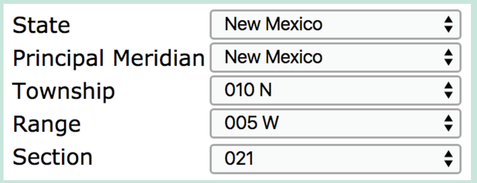
Plesiacanthoceras wyomingense

Step 1: This ammonite from the late Cretaceous period was discovered in New Mexico by Dr. Cobban, a renowned geologist, biostratigrapher, and paleontologist.



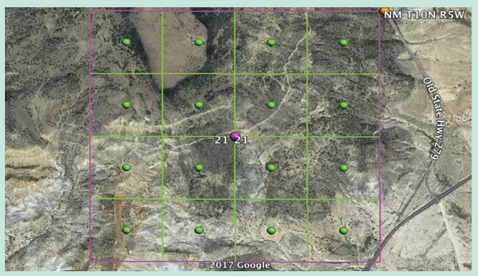
Locality slip

Step 2: The locality slip, which corresponds to this particular fossil, details where and when the fossil was discovered, and which collector found it.



www.earthpoint.us

Step 3: The state, township, range, and section from the locality slip are entered into Earthpoint, which displays the area via Google Earth.



Google Earth

Step 4: The .kml file created from Earthpoint is opened in Google Earth, displaying quartered subsections within the primary section. These subsections are then interpreted to plot a locality point that corresponds with a latitude and longitude.

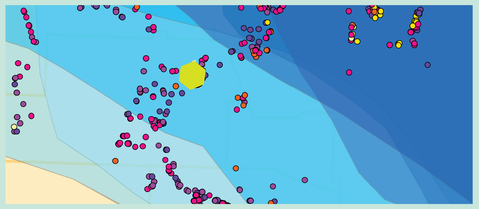
Dnum	Country	State	County	Era	Age_Period	Age_Stage	Age_Series_Substage	Age_Date_MY
9050	USA	New Mexico	Cibola	Mesozoic	Cretaceous	Cenomanian	Middle	94.84

Formation	Member	Lithology Notes	LocDescr
Dakota Sandstone	Paguate Tongue	Float from middle of Paguate sandstone Tongue of Dakota sandstone. Laguna measured section	NE1/4SE1/4 sec. 20 and SW1/4NW1/4 sec. 21, T. 10 N. R. 5 W.

Compiled Fauna	Index_Fossil	Collector	Date	EandR	Map	Lat	Long
Plesiacanthoceras wyomingense (Reagan), Plesiacanthoceras wyomingense	Plesiacanthoceras wyomingense	William A. Cobban	10/17/1970	OF-71-3D	Laguna	35.08	-107.39

USGS Database

Step 5: The latitude and longitude are entered into a spreadsheet.

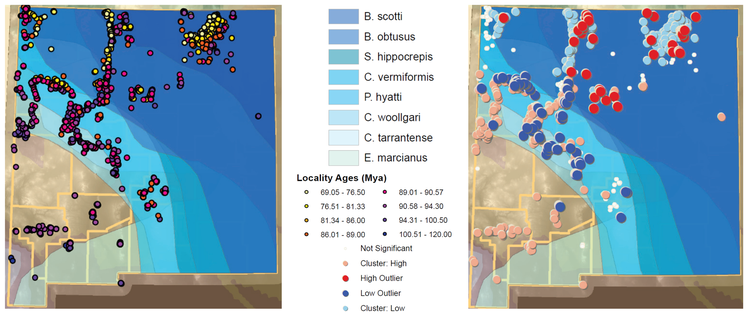


GIS map of fossil localities

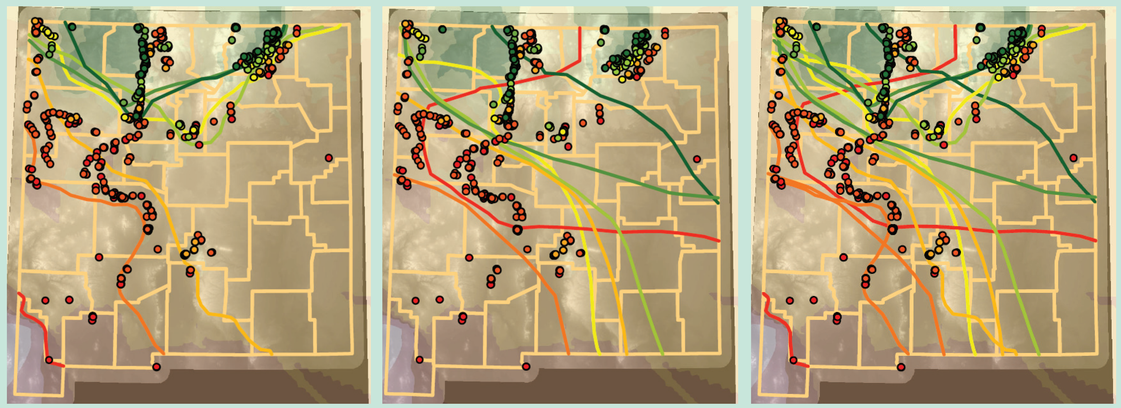
Step 6: The compiled data is mapped using ArcGIS.

Shoreline Mapping

As a case study, we used the fossil database to reconstruct Upper Cretaceous Western Interior Seaway shorelines and compared them to those predicted by paleontologist William Cobban. Were we able to reconstruct shorelines using fossil localities in a GIS? Cobban theorized partial shorelines based on marine invertebrate species and lithology from the Upper Cretaceous (Cobban, 1994). We compared these theorized shorelines with locality data, an interpolated surface of fossil ages, and a digital elevation model, to create maps depicting and analyzing the distribution of fossils and their relation to the theorized shorelines in New Mexico.



The distribution of fossil ages showed statistically significant high-value clusters in southern and southwestern New Mexico and low-value clusters in northern and northeastern New Mexico. The general trend of shorelines receding towards northeast New Mexico remains consistent between Cobban's theorized shorelines from the 1950s and our reconstructed shorelines. However, there is much variation that requires further exploration. This study shows the utility for mapping applications of the fossil database, where other questions may be explored.



From left to right: our shorelines, constructed from the fauna in locality records, an interpolated surface of fossil ages, and a digital elevation model; Cobban's reconstructed shorelines; a comparison of ours against Cobban's.

Database Application

Both the Cobban and Hanley collections contain a wealth of data to be used for current and future studies. In addition to shoreline mapping, potential projects include investigating climate changes throughout geologic periods. These results could be compared to current global climate trends to interpret future risks including rising sea levels, temperatures, and greenhouse gas emissions, and how they may impact the environment, population distribution, food scarcity, and more.

Didymoceras nebrascense

Future Work

The Smithsonian's U.S. National Museum of Natural History, which contains roughly 3,500 specimens from the USGS fossil collections, will eventually house the entire assemblage. Additionally, the corresponding databases will be published online in sections. This fall, the first 5,000 locality records will be made available, with the remaining 10,000 following shortly. Shapefiles are also being created to allow users to view this data in an online map platform, or to download it for any number of inquiries.

Acknowledgements

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