Geochemical Analyses Across the Boundary of the Jurassic Werner Formation and Louann Salt, Gulf of Mexico, USA

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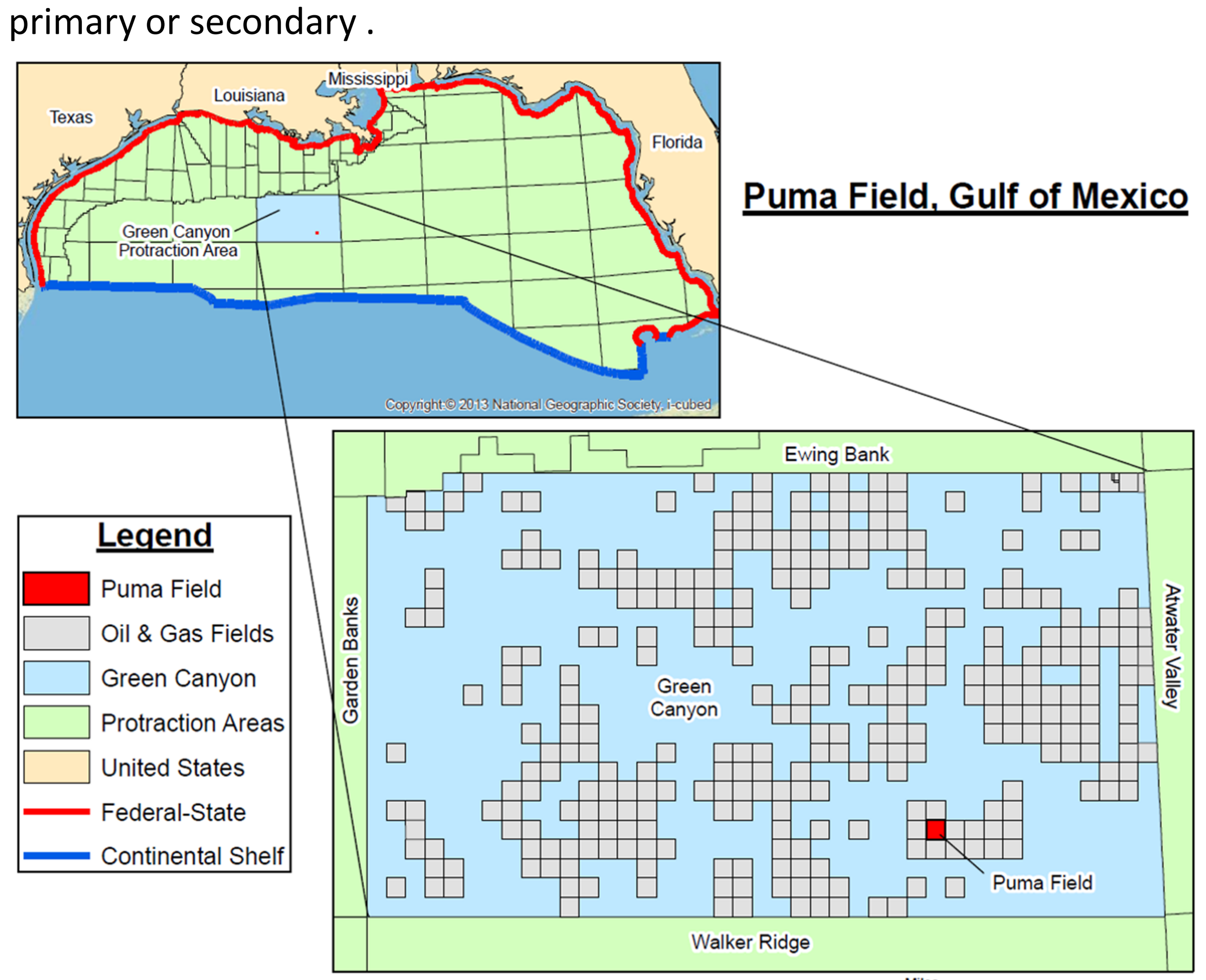
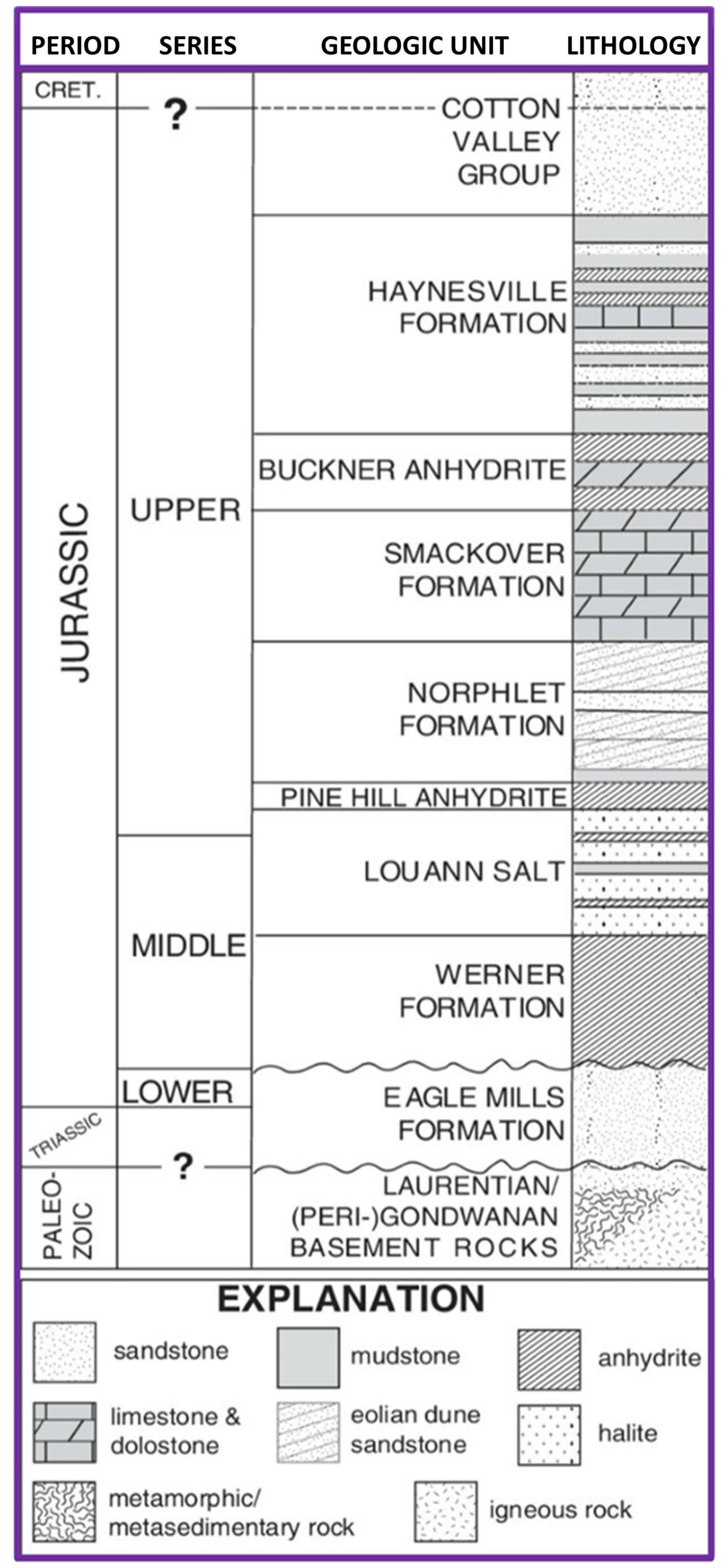
Abstract

The Gulf of Mexico is a leading world-producer of hydrocarbons, even within its relatively short production period. This is due in part to the movement of the Louann Salt throughout the region, creating large-scale structural traps due to salt diapirs and domes. Although the Louann Salt is an important aspect of the hydrocarbon system in the Gulf of Mexico, without cores to observe relationships between the two timing of the movement and variations within this massive (upwards of 3,050 m [10,000 ft.]) are poorly understood due to the formation only existing in the subsurface. This study will look at the contact between the underlying Werner Formation and the Louann Salt to determine variations in depositional environment and composition across the boundary. Studying this transition will provide insight into environmental and oceanic changes that caused the different formations to be deposited across the Gulf of Mexico, and will provide industry with critical information on the formation during drilling that could help mitigate over-pressurized zones. This study specifically will help start the database of geochemical analyses of the lower contact, and describe the changes in the depositional environment between the Werner Anhydrite and the Louann Salt. X-ray fluorescence (XRF) and x-ray diffraction (XRD) were measured on cuttings from the Puma-5 well, Puma Field to determine mineralogy and elemental changes from the underlying Werner Formation into the Louann Salt. Results indicate that the Louann Salt is primarily pure halite, with zones of potassium and magnesium enrichment. There are areas of shales, clay inclusions and limestones throughout. The contact between the two formations is fairly abrupt, with inclusions of the other throughout. It is difficult to say if these are primary or secondary .



Study area map provided by Brian Lesh: Geochemical and Well Log Analyses of the Louann Salt, Puma Field, Gulf of Mexico Basin. GeoGulf 2020

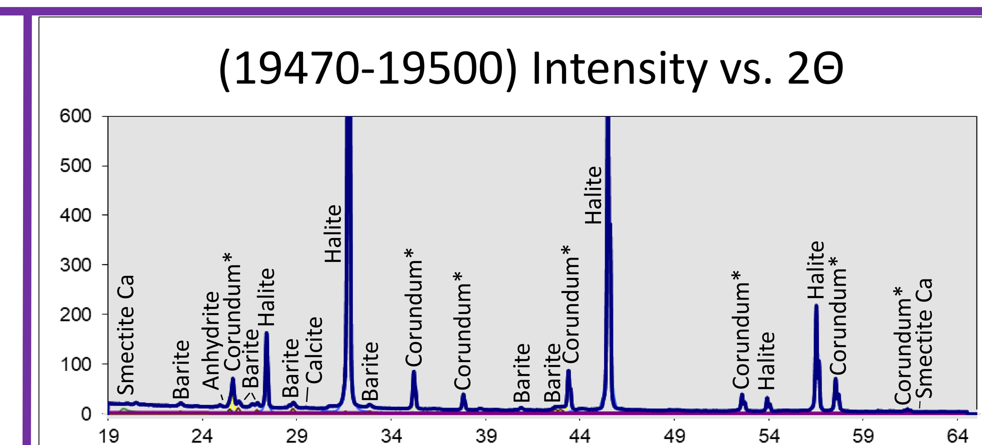


Column from Weislogel Et. Al., 2015

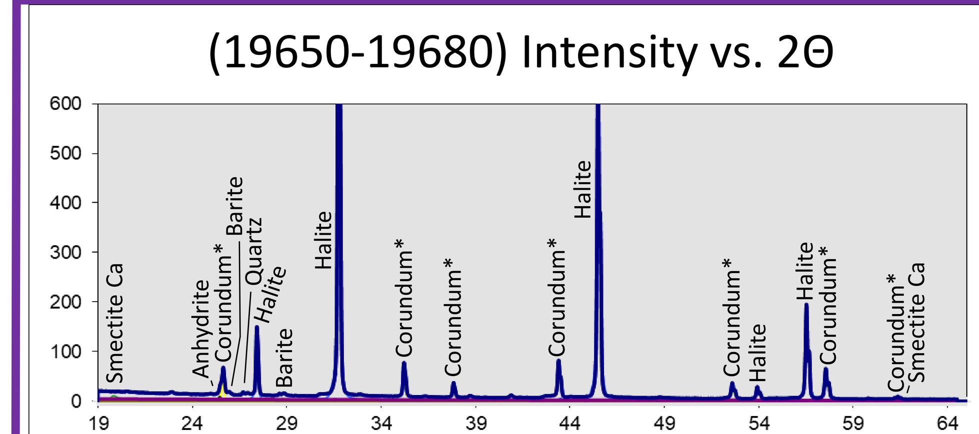
Geologic Setting

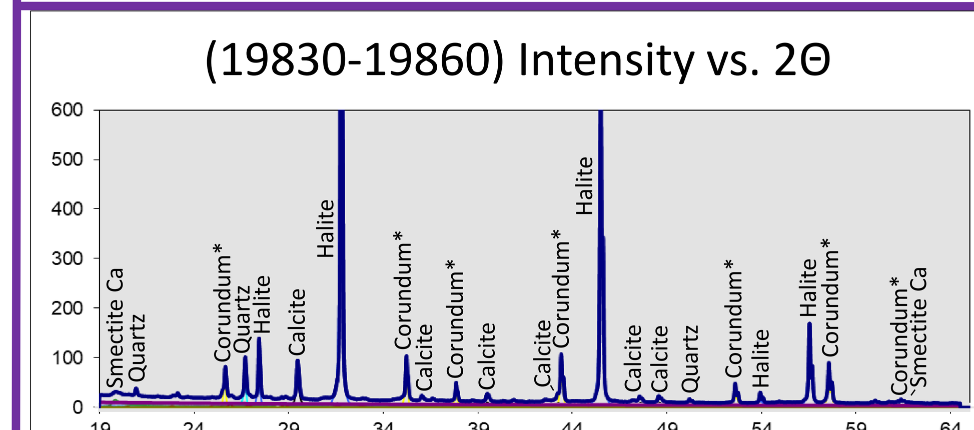
The Werner Formation from the Middle Jurassic consists of anhydrite, shale, sandstone, and conglomerate. The maximum thickness in the Mississippi interior salt basin is greater than 500 feet. This unit most likely formed by seawater ponding in subsidence zones in the gulf area. The evaporites formed from these saline lakes became what is known today as the Werner Formation.

Geologic setting modified from Mancini Et. At., 1990

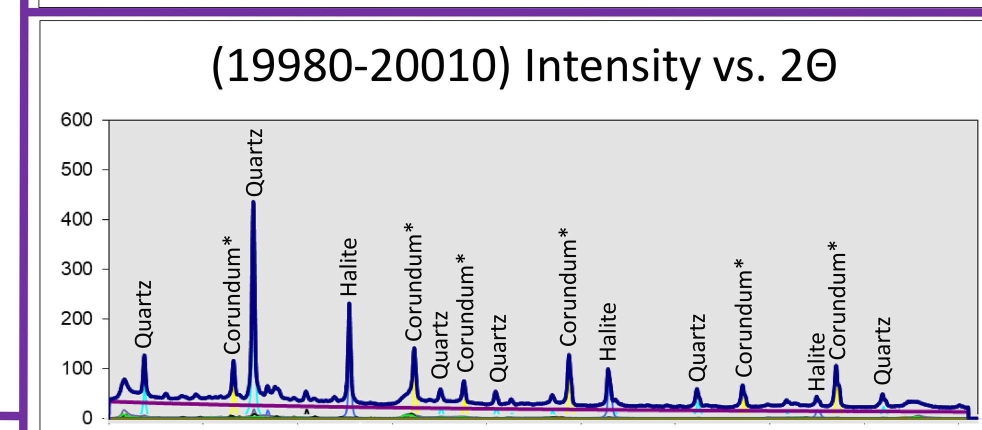


Various clay minerals such as Muscovite and Glauconite were identified in this sample between 5 and 15 two theta but are not shown.





Various clay minerals such as Muscovite, Smectite, Halloysite, and Illite were identified in this sample between 5 and 15 two theta but are not shown.



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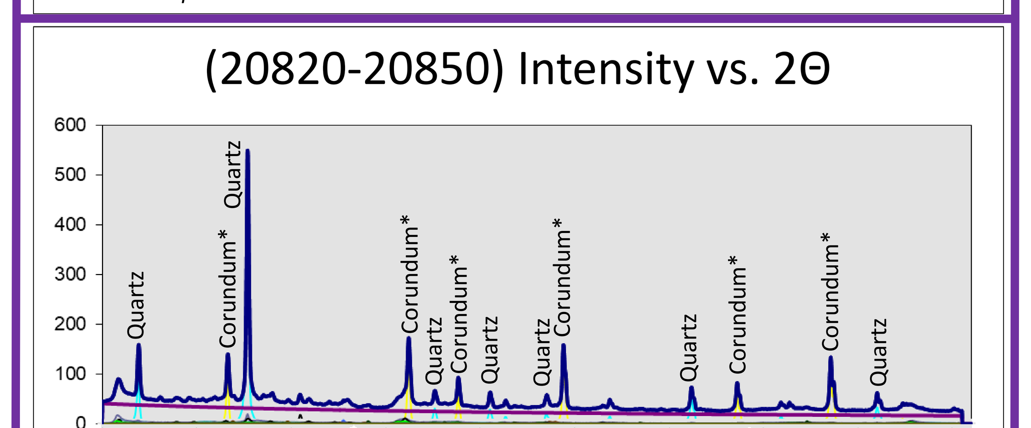

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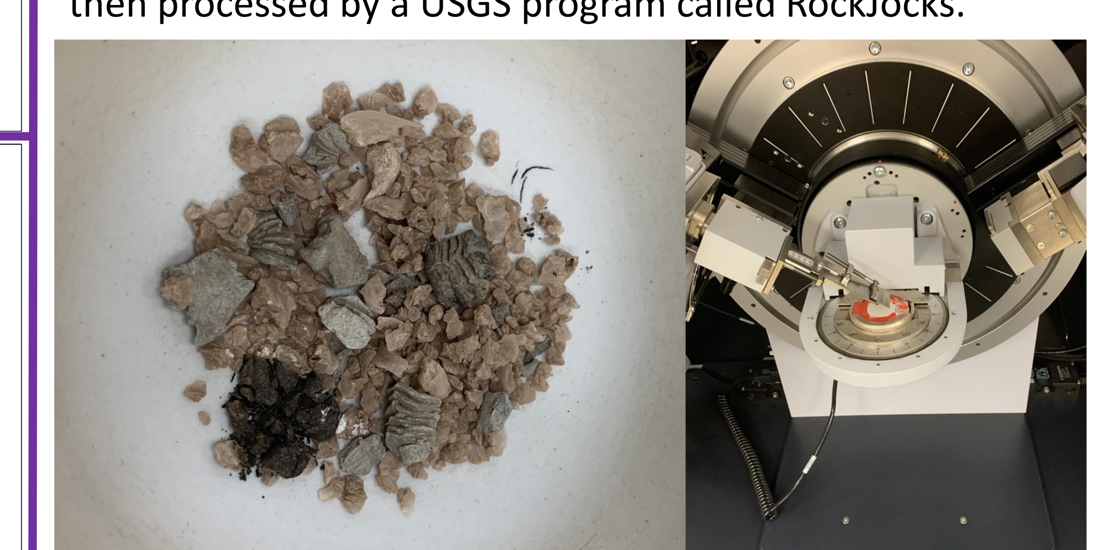
XRD Data

RockJocks produced the graphs you see to the left, which contain multiple peaks. These peaks represent minerals identified by the XRD machine. The graphs are arranged from the most shallow depth to the deepest depth, which helps visualize how the rock in the Werner Formation changes with depth. The shallower samples have much more halite, smectite, barite, and calcite than the deeper samples, and the deeper samples have much more quartz. **corundum was added as a reference marker, approximately 20% of each sample is corundum*.

Methodology

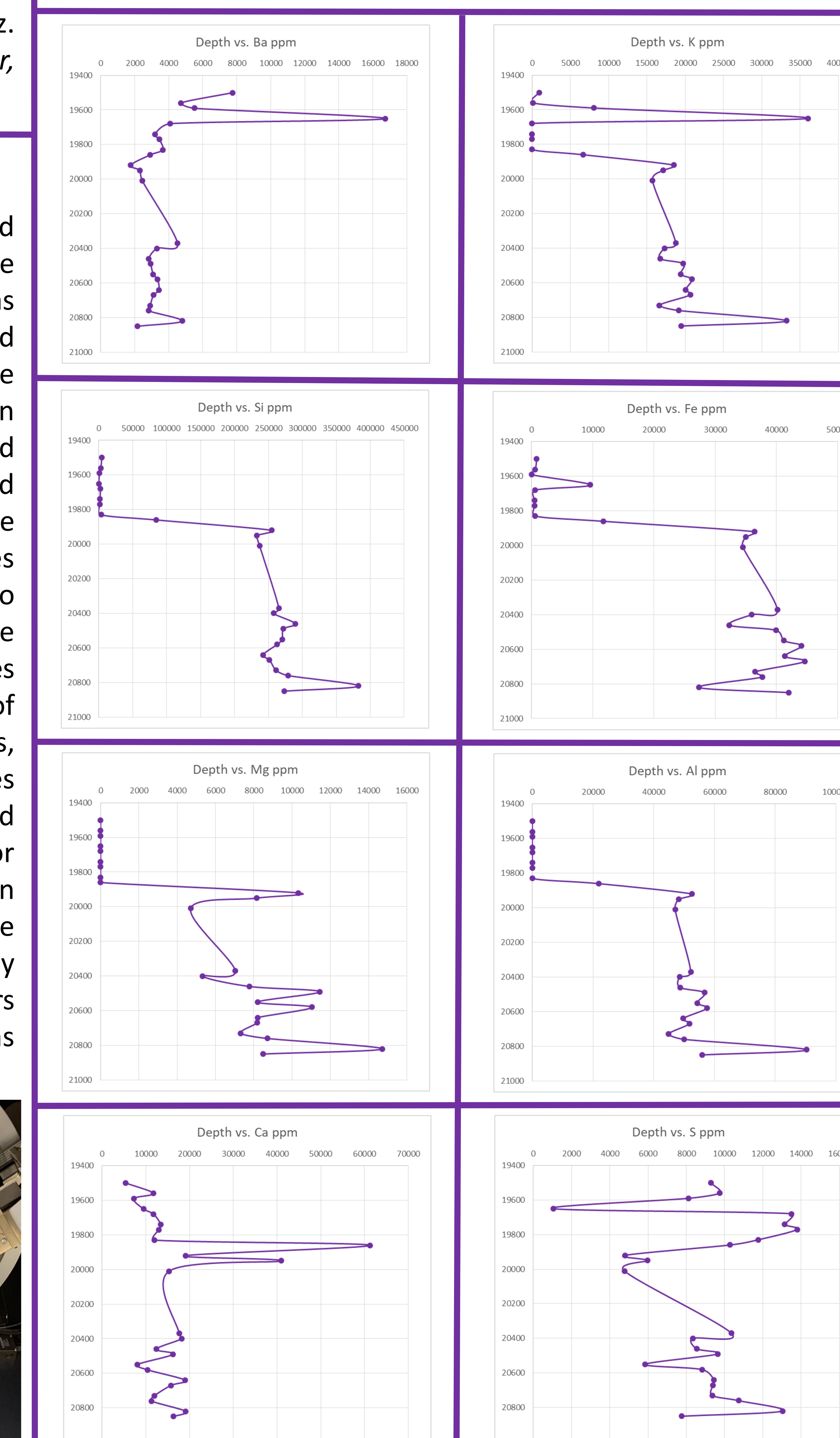
This process started out by taking each sample and grinding it down with a mortar and pestle until it was able to pass through a 250 micron sieve. Once this was accomplished, small amounts of each sample were loaded into XRF sample holders. Each sample was scanned for five minutes each, and the data was transferred from the Niton XL3t GOLDD+ XRF analyzer into Excel. Graphs for selected ions were created in Excel. Five samples were selected from the already processed XRF samples to further analyze with XRD. Approximately 2g from each of the five samples were taken, and roughly 0.5g of corundum was added to each of them as a reference point in the data. The sample and corundum mixtures were milled by agate millstones down to 3 – 4 microns. The samples were flushed out of the milling container with isopropyl alcohol into beakers, then placed in a drying oven overnight. The dried samples were placed into test tubes with 0.5mL of hexane and three scintillating beads, and then shaken vigorously for ten minutes each. Finally, the samples were once again passed through a 250 micron sieve, and loaded into a side loading dish for the XRD. The samples were analyzed by the Bruker D8 Advanced XRD for approximately two hours each. The data was transferred to Excel, and the data was then processed by a USGS program called RockJocks.



Pictured above is a sample before processing dark clast is ~1.5cm (left) and a sample about to be analyzed by the XRD machine (right) (red disk is ~7cm)

XRF Data

The XRF data was taken directly from the Niton XL3t GOLDD+ and placed into Excel to create the graphs seen below. Correlations can be seen between the presence of certain elements in the XRF data and mineral assemblages in the XRD data. For instance aluminum, magnesium, iron and silicon are very sparse in the upper samples that contain mostly salts, while the lower clay samples have an abundance of these ions.



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