



Monica Powers

mcp319@lehigh.edu

Faculty Advisor: David Anastasio



Motivation

This research project centers around an attempt to recover Milancovitch cyclicity in lake sediments as a method of dating. Motivation for using this unique technique stems from the curiosity that Southern Spain was an ancient biped(hominin) occupation site, through which human ancestors passed on their migration route from Africa to Europe. Study for this project was conducted around an ancient lake in the Baza basin, which most likely acted as a center of settlement and habitation. At the archeological site Barranco León, an ancient tooth was recently found and believed to have belonged to one of these hominins. Based on relative dating of micromammal fossils, the tooth is predicted to be ~1.4 Ma. Results from this study will confirm this estimate and provide a better understanding of the region.



Figure 1. Reconstruction of ancient hominin

Background

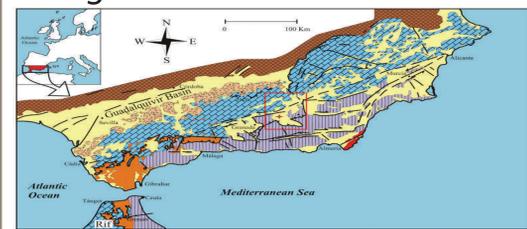
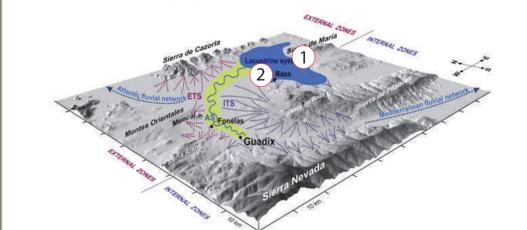


Figure 2. (above) Map of Southern Spain, focused on the region of study

Figure 3. (below) Reconstruction of Baza Lake system with section locations



Data collection for this project was conducted in the towns of Orce and Cortes de Baza, located in the square in Figure 2. The two sections, both roughly 60m in depth, are hypothesized to be located near the shoreline of the ancient Baza Lake. **Figure 3** depicts the lake, which spans over 4000km², and the external, internal, and axial systems that drove sediment movement. Based on the near-shore locations and evidence of paludal lake sediments, the environment was most likely a swampy wetland.

Methods

Sample collection was paced over a two-week period in late May 2017. At each section, outcrops were measure and sampled every 25cm. The first portion of data processing was conducted at the Centro Nacional de Investigación sobre la Evolución Humana (CENIEH) in Burgos, Spain. Sediment was dried, crushed, and packed into 1cm³ plastic boxes. Low-field bulk magnetic suseptibility, Anhyseric Remnant Magnetization(ARM), and Isotropic Remnant Magnetization(IRM) measurements were taken at the CENIEH. IRM acquisition curves were developed by placing samples in a series of increasing magnetic fields up to 2.8T. For ARM, samples were placed in a superconducting magnetometer where they were exposed to a 100mT AF field, followed by a 0.05mT DC field. For the additional IRM measurements on all samples, a field of 1T was applied on the samples, and then reversed with a -0.3T field. At Lehigh, data processing was performed on the measurements using MTM Fourier analysis. The series of tests ran in this RStudio Astrochron program led to conclusions on deposition rates and absolute ages.



Figure 4,5,6. Sample prep. and lab equipment at the CENIEH

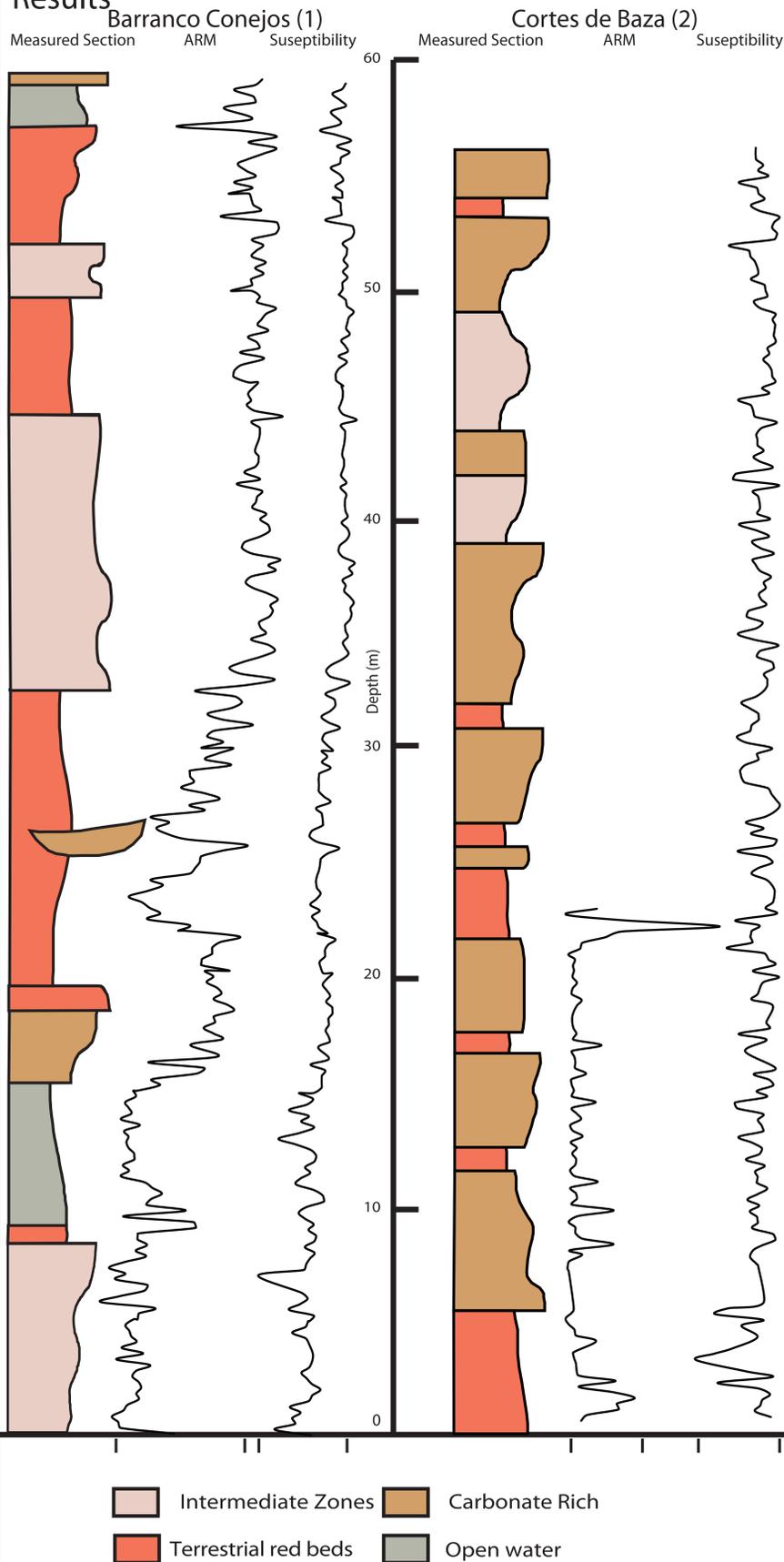
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Results



Data Analysis

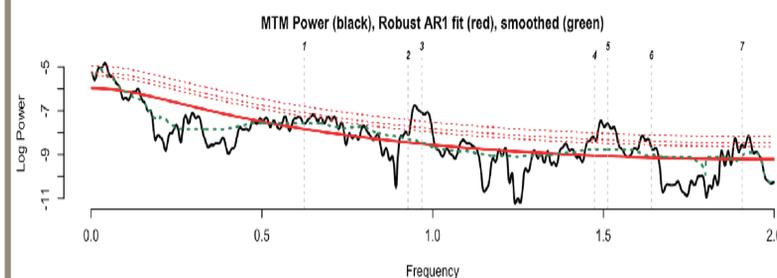


Figure 7. Barranco Conejos suseptibility astrochron power series

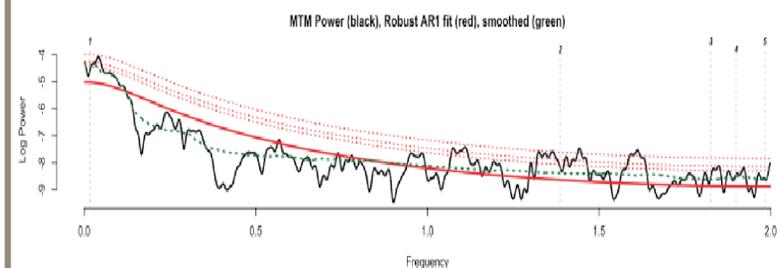


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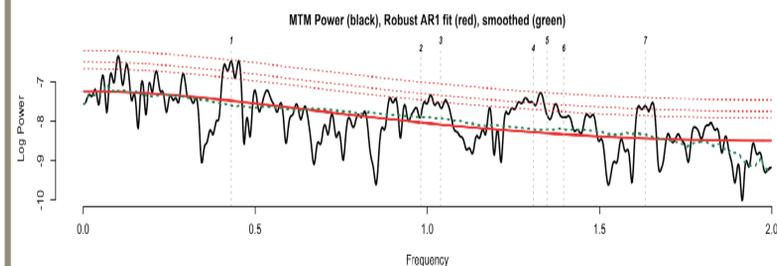


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The figures above show the time frequency analysis performed on each of the data sets. Each peak represents a possible frequency for sediment deposition rates. Peaks are defined based on their intensity above the 90th percentile. Each series peak(s) near or around a frequency of 1-1.5.

Conclusions

Based on the IRM acquisition curves, the samples contain a substantial amount of magnetite grains, proving that the sediments have internally recorded some kind of magnetic history. The cyclicity between 1m and 1.5m is consistent with the previous dating experiment using micromammals and with reversed polarity recovered from a nearby section. Because of the differences in the lithology and similarities in cyclicity, the results of this experiment must be independent of facies relationships. Further analysis in RStudio revealed a sedimentation rate of 7.34cm/1000 years for the Orce section using an eccentricity-tilt-precession function that focused the data in 1 to 2 million years. This concludes that the sections cover just over 800,000 years of time each, consistent with prior paleomagnetic results. ARM measurement on the Cortes de Baza samples is temporarily suspended due to cryogenic failure in the Lehigh paleomagnetic laboratory. Although the current conclusion does not provide an absolute age for these regions of the lake, new paleomagnetic results are expected in late September and, when combined with known data of the Olduvai chron, are expected to constrain the age of the Barranco Leon site.

Future Work

Aside from this dating, additional measurements will be taken to connect the data and make conclusions on the environment of the Baza Lake at a given point in time. These measurements will hopefully help to depict lake depth and size and also biological activity, such as the flora and fauna in and around the water. Overall, this information will help to complete the puzzle of ancient human migration based upon the climates they lived in and the resources they used.



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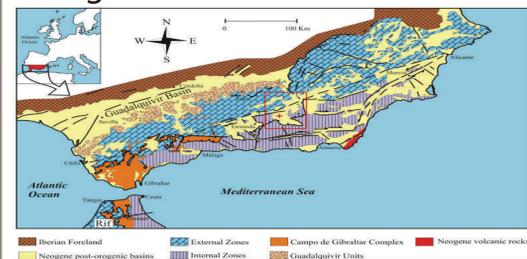


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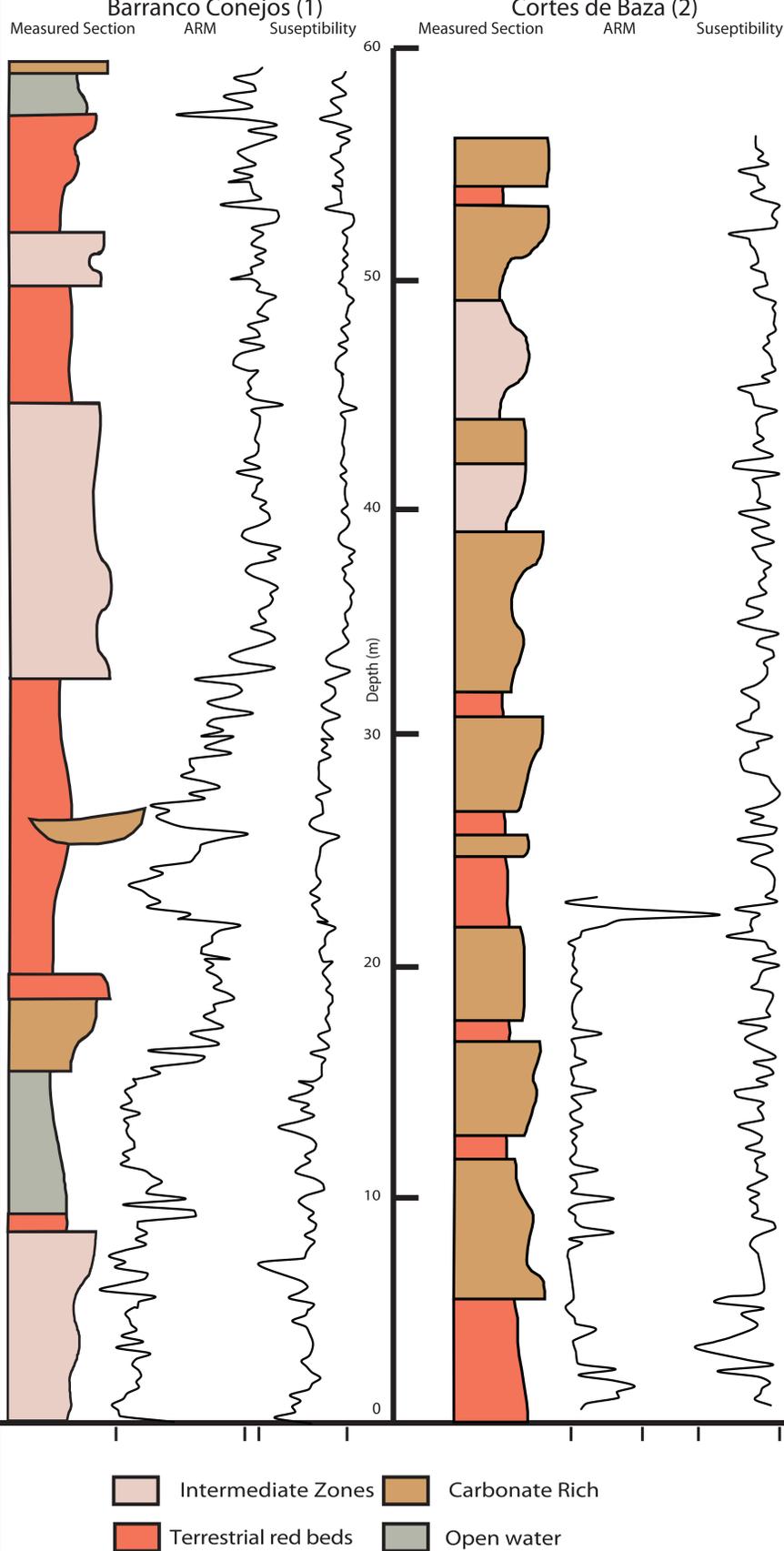
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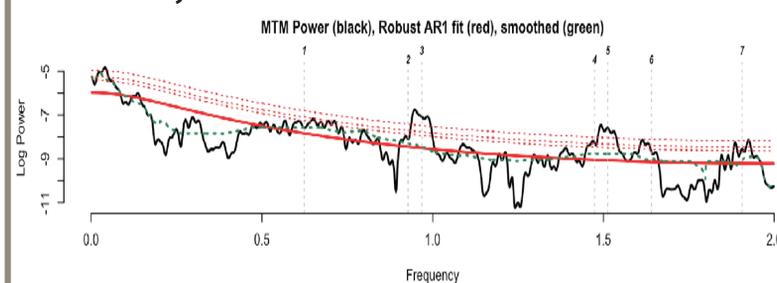


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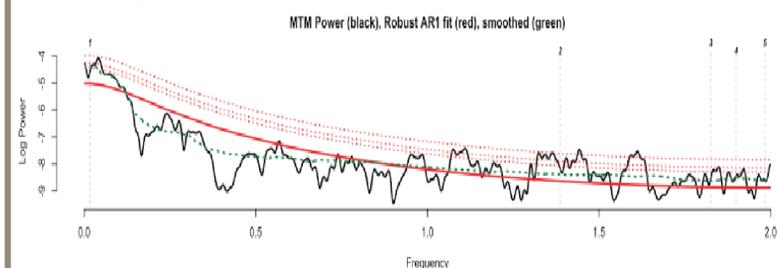


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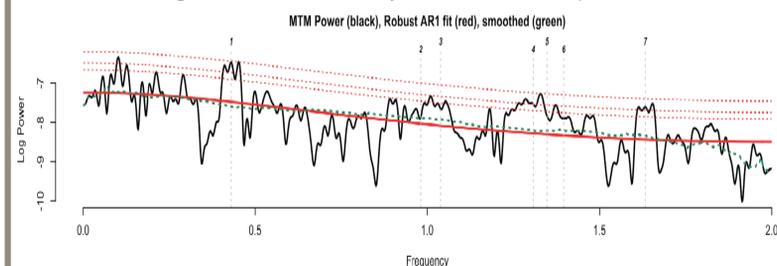


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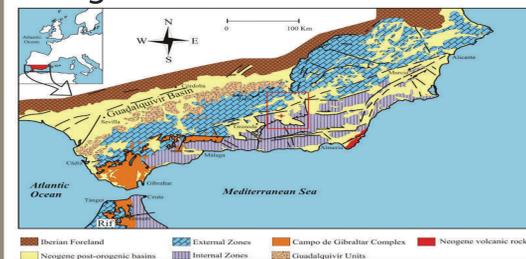
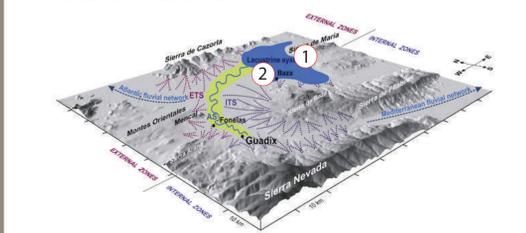


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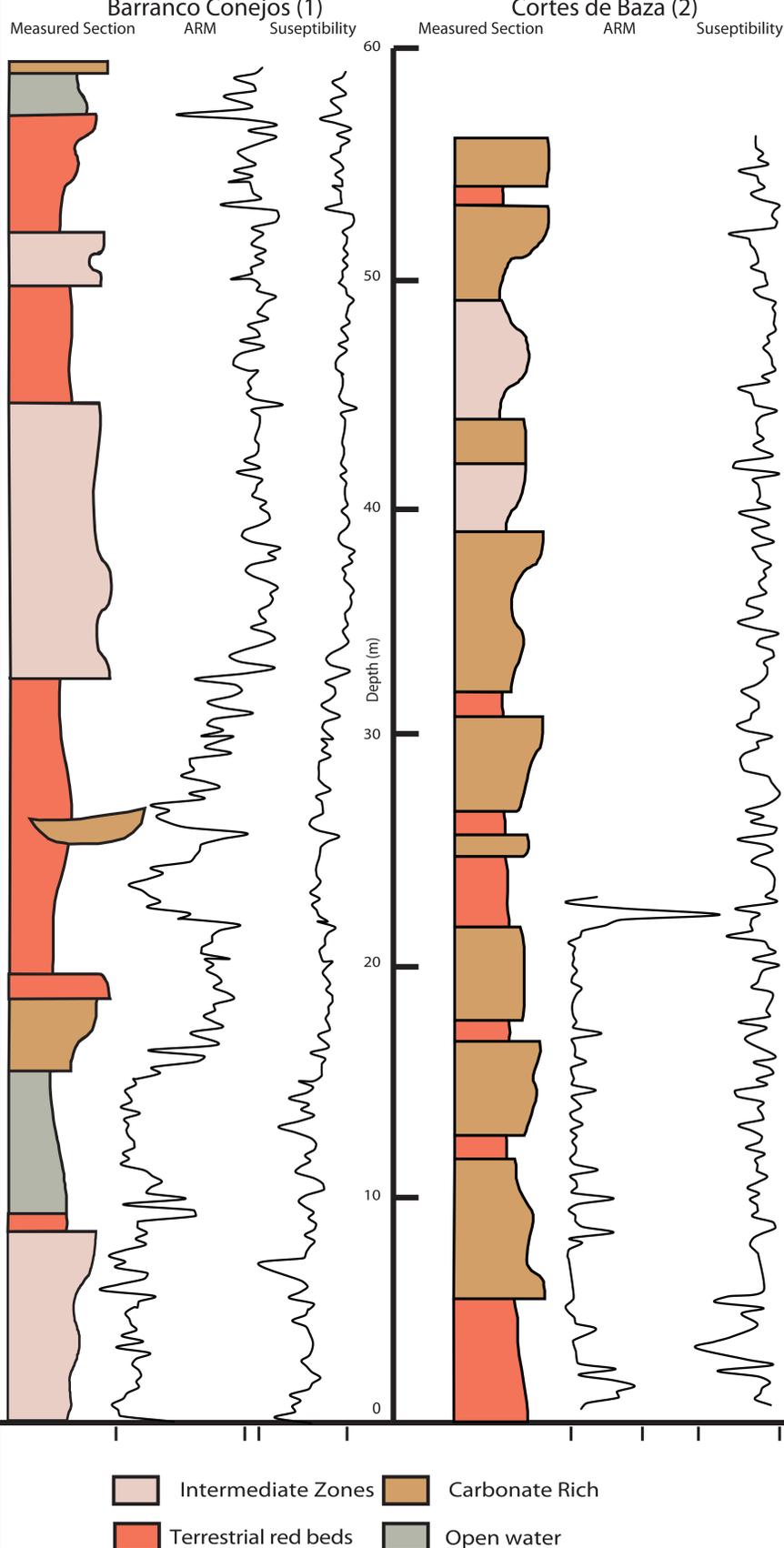
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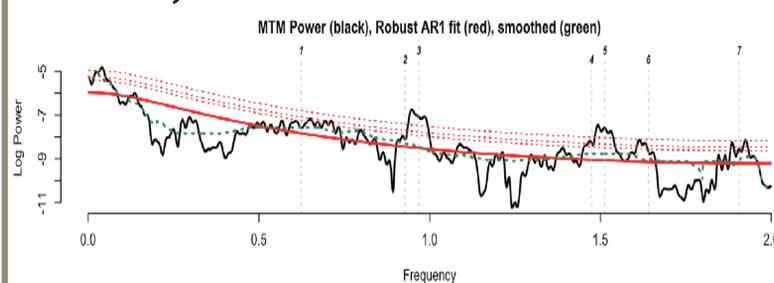


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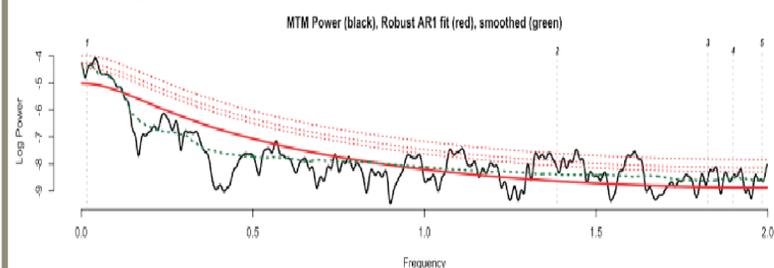


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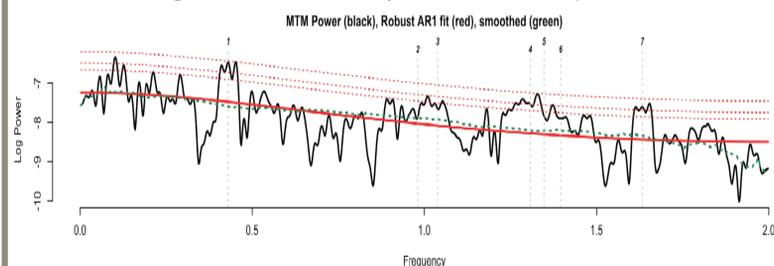


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