Integration of PCA and clustering analysis with chemostratigraphy for improved lithofacies characterization in Southwest Texas

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Abstract. Chemostratigraphy has emerged as a powerful tool for understanding sedimentary rocks' depositional environments and anoxia levels. The analysis of chemical signals preserved in these rocks can help to reconstruct the changing conditions in the geological past and provide a complete understanding of the geological history of these formations. This information is essential for determining the stratigraphic and depositional environment and understanding the geological processes that have shaped the Earth's surface. However, with the vast amount of data that chemostratigraphic analysis generates, making sense of the patterns and trends can take time and effort. Principal Component Analysis (PCA) and clustering analysis provide valuable methods for reducing the complexity of the data and identifying meaningful patterns. Thirty wells and 2550 cuttings samples from the Eagle Ford were analyzed by a benchmark XRF in South Texas for the purpose of this study. By analyzing the anoxic geochemical proxies of the sedimentary rocks, it was possible to identify changes in the depositional environments and even correlate them with isotopic and organic chemical data on the occurrence of OAEs and hypersaline environments with some of the worldwide known Late Cretaceous and Eagle Ford Equivalent Source Rocks. Chemostratigraphic interpretations and PCA and clustering analyses identified meaningful patterns in the Eagle Ford Formation, providing valuable insights into the geological history of this formation, including identifying depositional sequences and recognizing variations in anoxia levels. These findings are essential for understanding the petroleum system in the Eagle Ford Formation and have implications for improving drilling, completion, production economics and other similar sedimentary rocks around the world.