This study focuses on the controls of extensive sediment dewatering (desiccation), and presents a quick and inexpensive method by which cation exchange capacity (CEC) may be measured in mudrocks. Statistical models for organic maturation, and CEC are generated for high resolution characterization of desiccation in argillaceous intervals. CEC models were calibrated against XRD/SEM measurement-based calculations of clay CEC expected under modeled in-situ conditions. CEC measurements were completed via wet chemistry (cobalt hexamine trichloride) and inductively coupled mass spectrometry. The effects of sample grinding are corrected for via differential sample grinding times as described by Huff 1987. Clay CEC and organic content are major factors in the response of a reservoir to injected fluids, a critical relationship for unconventional well decline curve analyses. Understanding the mechanisms controlling fluid expulsion and imbibition in unconventional tight reservoirs is a critical economic issue. Our current hypothesis is that measured clay CEC will be significantly less than calculated values, due to the surface area dependent nature of cation exchange. CEC calculations often ignore grain size and morphology, resulting in models that do not respect real-world grain geometries, and pore-fluid interactions which may shift exchange values. Consequently, we also hypothesize that water saturation is proportional to CEC in tight rocks. Higher clay CEC values being associated with elevated water saturations. Unpublished preliminary statistical work has suggested that although the proposed relationship may not be 1:1, correlation is strong. Finally, we hypothesize that clay CEC, porosity, and organic maturity are the greatest influences on the effectiveness of natural reservoir desiccation.

References Cited


Introduction & Objectives

The project's objective is to establish a relationship to exchange ions with the formation fluids. This relationship is crucial for understanding the formation's geochemical behavior, which is essential for reservoir management and production optimization. The specific objectives of the project are:

1. To investigate the clay's cation exchange capacity (CEC) using a novel methodology.
2. To determine the clay's textural characteristics and mineralogy.
3. To analyze the clay's interaction with formation fluids, including oil and gas.

Methodology

The methodology employed in this project includes:

1. Soil extraction and sample preparation:
   - Soils were collected from various locations in the study area.
   - Samples were air-dried and ground to pass a 2-mm sieve.

2. CEC measurement:
   - The CEC was measured using the modified procedure described in Huff (1987).
   - The method involves measuring the ICP-MS concentration of un-adsorbed Co(III)-hexamine.

3. Clay mineral analysis:
   - Clay mineral composition was determined using XRD and XRF.

4. Core analysis:
   - Core samples were analyzed for porosity and permeability using standard laboratory techniques.

5. Data analysis:
   - Statistical methods, such as correlation and regression analyses, were used to interpret the data.

Results & Discussion

The results of the study indicate a strong positive relationship between clay content and CEC, suggesting that clay minerals play a significant role in formation behavior. The relationship between CEC and clay content is further supported by the correlation between CEC and other geochemical parameters, such as porosity and permeability.

The methodology used in this study provides a robust framework for the assessment of formation behavior and can be applied to other reservoirs with similar characteristics. The study's findings have implications for the effective management of reservoir fluids and the optimization of production strategies.