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Experimental and theoretical analysis of the physical properties of siliciclastic rocks under the influence of supercritical CO2 injection

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Introduction

The geological storage of carbon dioxide (CO_2) in hydrocarbon reservoirs, coal beds, and deep saline aquifers represents a promising strategy for mitigating climate change. Understanding the effects of this injection on different geological media is essential for improving monitoring methods, which are crucial for ensuring reservoir integrity and preventing possible leaks or structural damage over time. This work focuses on understanding and characterizing siliciclastic rocks before and after injection. Siliciclastic environments are commonly associated with sedimentary basins, which comprise a vast area of interest in the carbon storage process. We will make comparisons and analyses of the change in physical behavior of these rocks in response to saturation with supercritical CO_2.

Method and Theory

The injection of CO_2 into geological media occurs preferably in the supercritical phase, under which conditions it has a higher density, enabling the storage of larger quantities in a rock of the same volume. The injection of CO_2 into geological media is complex, and the behavior of the injected CO_2 is linked to a range of physical factors as well as chemical reactions that directly impact the behavior of the plume. Understanding the impact of this injection in certain environments allows for better adaptation of monitoring methods, which are fundamental and responsible for leakage, deterioration, and reservoir integrity over time.

This study investigates the behavior of siliciclastic rocks when subjected to CO_2 injection. The samples were characterized in the laboratory by measuring ultrasonic velocities, electrical resistivity, and conventional petrophysical analysis. Comparisons will be made between the samples before and after injection, together with a computational approach seeking to investigate possible relevant behaviors.

Results and Conclusions

The presence of supercritical CO^2 is expected to generate measurable variations in the physical properties of the samples, such as changes in electrical resistivity and variations in elastic parameters. The results obtained contributed to the knowledge of the impact of this injection on siliciclastic environments. These results may contribute to the formulation of more appropriate and efficient geophysical models for the environment, as well as provide data to improve the monitoring of carbon sequestration projects.