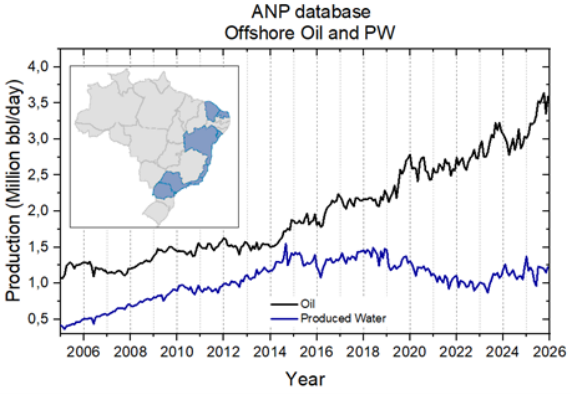
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Lithium in Pre-Salt Oilfield Brines: Geochemical Controls, Basin Evolution, and Resource Implications

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Lithium (Li) is a strategic material for the global energy transition, shaping the large expansion of batteries for electric vehicles, portable electronics, and grid-scale energy storage. Current Li supply is largely dominated by hard-rock mining and continental brines; however, these conventional routes face increasing challenges, including long production times, high water and energy consumption, environmental impacts, and a strong geographic concentration of resources. In this context, oilfield brines, also known as oil and gas produced water (PW), have emerged as a promising unconventional and complementary Li resource, with worldwide PW volumes projected to reach around 250 billion barrels per year by 2030/2035.

Compared with traditional lithium recovery via evaporation ponds, the development of advanced technologies, particularly Direct Lithium Extraction (DLE) processes, has enabled alternative approaches such as adsorption and ion exchange using Li-selective inorganic sorbents, membrane-based separations, solvent extraction, and electrochemical methods. Understanding the geochemical controls governing lithium enrichment in pre-salt oilfield brines is critical for assessing their resource potential and guiding extraction strategies, including shorter processing times, reduced land and freshwater requirements, higher selectivity, and the potential for integration with existing Oil & Gas infrastructure.

Although the use of PW involves significant technical challenges, its potential has been increasingly validated by pilot-scale and commercial DLE initiatives under development in the USA, Canada, and China. This scenario presents a novel and largely underexplored opportunity for Li extraction in Brazil, particularly considering that more than 80% of the country's oil production originates from offshore pre-salt fields. These extensive offshore basins host subsurface oilfield brines enriched with a range of dissolved metals, including lithium at concentrations of 50–500 mg/L, depending on the reservoir. Recent data from Brazil's National Agency of Petroleum, Natural Gas and Biofuels (ANP) indicate record levels of produced water, reinforcing the scale of this potential resource.

Here, we outline the challenges and the development of new Li-selective technologies from PW. This study highlights oilfield brines as an emerging component of the global lithium cycle and evaluates the geochemical controls governing lithium enrichment in deep sedimentary systems, with implications for both resource development and Earth-system lithium cycling.