

Peer-reviewed Conference Contribution

# Lithium Prospectivity in the Northeast German and Thuringian Basins

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Over the years many boreholes have been drilled into the Northeast German Basin (NEGB) in pursuit of the exploration of hydrocarbons. As well as gaining important information regarding petrophysical and geophysical data, legacy boreholes also provide information regarding total dissolved solids in formation water, which sometimes includes lithium concentrations. With the rapid increase in demand for electric vehicles in combination with EU net-zero targets, lithium is a vital component of the future of the energy industry as it transitions away from fossil fuel dependence.

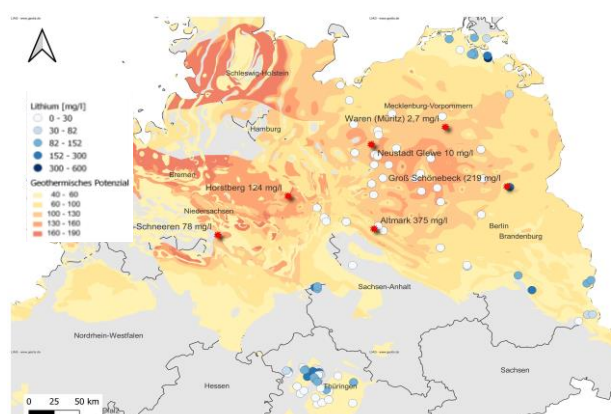
So, where can we find lithium, how much of it is there, and where does it come from? After extracting lithium content data from formation water trace element data, we can answer two of these questions. The data gathered [1] is from boreholes drilled in the NEGB (in the states of Brandenburg, Mecklenburg-Vorpommern, and Sachsen-Anhalt) and the Thuringian Basin. The Northeast German Basin makes up the eastern part of the North German Basin, which, in turn, is part of the Southern Permian Basin. It is located between the Baltic Shield to the north and the Variscan belt to the south [2]. The basin contains up to 12km of Phanerozoic strata [2], the evolution of which began with Late Carboniferous/Early Permian (Stephanian/Autunian) volcanism [3, 4, 5, 6]. In the NEGB increased concentrations of lithium can be found within the Zechstein Staßfurt Carbonate (Ca2) and the Rotliegend. In Brandenburg the highest values of 230 mg/L can be found in the geothermal well doublet Groß Schönebeck which was drilled into sedimentary Rotliegend and Permo-Carboniferous volcanics. Comparable values (190 mg/L) can be found in formation water samples of the Ca2 in the well Lübben 103. In Mecklenburg-Vorpommern, lithium contents of 600 mg/L were encountered in the Rotliegend of the well Gristow 7, with lithium contents in the Ca2 of the nearby well Gristow 6h2 reaching 300 mg/L. The Reinkenhagen field (which targeted the hydrocarbons of the Ca2) has several wells which exhibit lithium contents in the Ca2 of up to 140 mg/L. In Sachsen-Anhalt elevated lithium values are limited to the Ca2. The Fallstein field, originally drilled for the exploration of hydrocarbons, encountered lithium contents of up to 189 mg/L. Spatial distribution of the lithium data can be seen in Figure 1 along with current geothermal projects. Also displayed are areas of proven and suspected geothermal potential.

The Thuringian Basin is located between the Harz Mountains and the Thuringian Forest Mountains, the formation of which was part of the intramontane subsidence zone of the Variscan mountains [7]. The trough shaped sedimentation area of the basin was formed in the early Mesozoic [8]. In Thuringia, as in Sachsen-Anhalt, elevated lithium values are limited to the Ca2. The fields of Kirchheilingen, Langensalza, and Mühlhausen all have multiple wells which show lithium contents of up to 200 mg/L.

The source of lithium in formation water is not well understood and therefore cannot be clearly defined. A case study in Thuringia focusing on Zechstein salts in Gorleben and Morleben made the assumption that lithium content in the salt brines were leached from phyllosilicate bearing units (T4, A3, Ca3, T3) in the Zechstein [9]. Other sources discussed include relict metamorphic brines and organic compounds. A different study focusing on Rotliegend Ca-Cl brines in the

North German Basin found that brines rich in lithium originated from the leaching of lithium rich mica in the Lower Rotliegend (volcanics) [10]. If lithium accumulation in formation waters is related to Permo/Carboniferous rocks, it is possible that deep faults may have acted as conduits for lithium rich brines to migrate into overlying formations [11]. This may be a plausible theory as this dataset shows that elevated lithium contents in the Ca<sub>2</sub> can be found within the carbonate margin facies in areas through which major faults run. This is especially evident on the northern basin margin.

Ultimately the data compiled from both basins will be used to perform a lithium in place analysis.



**Figure 1: Geographical distribution of lithium data with current geothermal projects and geothermal potential (modified after Alms et al., 2022).**

#### Contributor statement

Alicia Groeneweg: Data Curation, Investigation, Visualisation, Writing – Original Draft; Manfred Heinelt: Investigation, Visualisation, Writing – Review and Edit; Katharina Alms: Conceptualisation, Data Curation, Investigation, Project Administration, Supervision, Visualisation, Writing – Review and Edit

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