Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.5615

The potential of in-situ mineral carbonation for the sequestration of CO_2 in the mineral deposits of Kazakhstan

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The World Bank reported that Kazakhstan belongs to one of the top 10 countries by CO_2 emissions per capita. Obligations set by the Paris Agreement required to find out solutions and implement them to properly reduce its CO_2 emissions in the atmosphere. Energy-intensive industrial facilities with a strong dependence on fossil fuels (coal-fired power plants, mining and metallurgical sector, oil and gas production) are the main sources of the carbon emissions. Besides existing technological applications, the country's wealth in minerals could give an additional opportunity to implement an effective in-situ mineral carbonation for the sequestration of CO_2 in the mineral deposits.

In this study, we assessed the potential of in-situ mineral carbonation in Kazakhstan mineral deposits for CO_2 sequestration. The calcium contents in phosphate mineral deposits of Malyi Karatau (KokJohn, Zhanatas) and Chilisai (Aktobe) reached ~43%, respectively. The highest content was observed in Sayak (Cu deposit) and Akshatau (W-Mo deposit) with the average concentration of calcite higher than ~55% in the form of apatite. Due to the geological and geochemical characteristics of different mineral deposits, diverse natural minerals have been used as raw materials for the carbonation processes. Because the apatite deposits with the high calcium content are widely distributed and easily found in the geological formations of Kazakhstan, the phosphate mineral could be a promising candidate material for the effective and proper mineral carbonation technologies in Kazakhstan. The numerical estimation using PHREEQC was conducted to characterize the carbonation reaction with minerals including the apatite from different deposits and to investigate the CO_2 sequestration potential. According to the preliminary estimation results, Kazakhstan mineral deposits can significantly contribute to the reduction of CO_2 emissions through the mineral carbonation.

This study was supported by the Research Grant of Nazarbayev University (091019CRP2106 and 021220FD1051).