Potential of mineral waste from mines in Pakistan for carbon dioxide capture: considering the case of Baluchistan

Tasawar Ali Chandio[1*], Adnan Alam Awan[1], Simon Sadiq[1], and Usman Ali[1]

[1]*Geological Survey of Pakistan, Ministry of Energy (Petl. Div.), Govt. of Pakistan*

[*]*Email: tasawarali@gsp.gov.pk*

In the 21st century, environmental pollution has become a serious threat to biodiversity, human health, and the ecosystem. Particularly, anthropogenic activities significantly contribute to the release of CO_2 into the Earth's atmosphere, making atmospheric pollution due to CO_2 one of the grave concerns faced by humanity worldwide. Various sources trigger this, including the combustion of fossil fuels for electricity generation, transportation, industry, and other activities, releasing approximately 50 billion metric tons of global warming gases (GWG) annually. Additionally, mines (mineral exploration) are major contributors, both directly and indirectly. For example, BHP, an Australian multinational mining company, alone emitted over 3.4 Mt of GHG from iron and nickel mining sites in 2020. Moreover, mineral waste, often considered of less economic importance, accounts for approximately 2-6 Giga tons worldwide. Interestingly, it has significant potential for capturing CO_2 and sequestering it. Calcium, magnesium, and silicate rocks, in particular, are candidate materials for this purpose, which could have monumental environmental and economic benefits for the country. With particular reference to Pakistan, the Baluchistan province boasts plenty of mineral treasures that have stimulated the development of the mining industry, producing 1 Mt of mineral waste annually. This study employs several state-of-the-art techniques, including FTIR micro-spectroscopy with a powerful synchrotron source (IR beamline), to understand the CO_2 fixation process occurring in nature and to estimate the potential of natural minerals as CO_2 capturing and sequestration agents. Detailed X-ray fluorescence spectroscopy (XRF) was also carried out on numerous mineral waste samples collected from the Muslim Bagh District of Baluchistan, Pakistan. The analysis results of selected rocks and mineral wastes from the mines of Baluchistan showed promising trends in terms of CO_2 capture.