Potential effects of soil moisture content on CO_2 triggered physicochemical properties of a shallow soil

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Carbon capture and storage (CCS) has been considered an effective strategy for meeting CO_2 emission reduction and its targets. However, potential CO_2 leakage from storage reservoirs is a major concern associated with this technology. Hence, we conducted a study to examine the effects of soil moisture content on CO_2 triggered physicochemical properties of a shallow soil with an emphasis on metal(loid)s mobilization. Soil samples for batch experiment were collected from an abandoned gold mine and characterized for various physicochemical properties. Batch experiment was conducted in a well-designed CO_2-glovebox (95% CO_2, 2% O_2) with different moisture contents (0%, 15 %, 27.5% w/w, and soil/water ratio of 1/10) and reaction times (2h, 1d, 10d, 20d, and 30d). A control experiment was conducted under the same conditions but open to the atmosphere. Results showed a significant decrease in soil pH in the early stage of the CO_2 exposure (2h), while it increased with both time and moisture content. Noteworthy, a positive correlation among CEC, moisture content, and decomposition of organic matter was observed in the CO_2-exposed samples. The continuous CO_2 exposure to the samples caused a meaningful mobilization of Fe (2.4%), Al (0.4%), Ca (27%), Mg (1%), Mn (49%), K (2%), Zn (7%), and Cd (3%) only in CO_2-exposed suspensions but not in those partially wet samples. Overall, our results demonstrated that elevated soil CO_2 can affect the soil chemistry even to unsaturated conditions and stressed to monitor simultaneously soil properties and metal mobilization.