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Nitrogen fertilization increased loss risk of inorganic carbon from the calcareous soil

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There are two carbon pools in the calcareous soil, i.e. organic carbon (SOC) and inorganic carbon (SIC) pools. The inorganic C pool in soils of arid and semiarid areas is generally several times larger than the organic C pool. Calcareous soil covers more than 23% of global land. Calcareous soil is also one of main agricultural soils in China. Application of synthetic nitrogen (N) fertilizers increases rapidly during the past decades. Our concern is that whether soil acidification due to the application of N fertilizer affects the CO_2 emission from SIC pool of calcareous soil.
The effects of three N fertilizer types ($NH4NO_3$, KNO_3 and (NH4)2SO4) on CO_2 emission from calcareous soil were studied with closed-jar incubation method. To differentiate CO_2 emission from SOC and SIC pools, we used ignition to remove SOC. The CO_2 emission from the (NH4)2SO4 treatment was highest, followed by $NH4NO_3$ and KNO_3 treatments, whether the soils were ignited or not. Compared with control without addition N fertilizer, the average CO_2 release rate was 37%. Soil ignition significantly decreased CO_2 emission. A field trial was conducted to study the effects of adding N fertilizer and nitrification inhibitor (DCD) on CO_2 emission from the calcareous soil in Loess Plateau. The treatments included the control without adding of N fertilizer (N0), and two N fertilizer rates (N160, and N220) and their combination with DCD (N0, N160+DCD, and N220+DCD). The results showed that the application of N fertilizer significantly reduced the soil pH in comparison with the control (N0). The decrease rates of soil pH were less when N fertilizer was added with DCD. The CO_2 emission from different N fertilizer treatments was increased as the increases of N rate when no DCD was added. Compared with no fertilizer treatment (N0), the amount of CO_2 emission from N160 and N220 treatments were increased by 20.9% and 25.7%, respectively. When DCD was combined with the two N fertilizer rates, the CO_2 emission from the soil was decreased by 13.5% and 11.0%. It is indicated that soil acidification due to application of N fertilizer increases the loss risk of SIC from calcareous soil. Further study is needed to estimate and mitigate it.