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Serpentinites as an option for CO_2 capture: the role of precursor minerals

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Serpentinites can act as natural geological accumulators for CO_2. These rocks are produced from the transformation of ultramafic igneous rocks, which largely consist of clinopyroxene, orthopyroxene, olivine and a member of the spinel group, along with accessory minerals. As a result of metamorphism, the original minerals are variably transformed to serpentine-group minerals $\pm$ chlorite $\pm$ amphibole; but they can be transformed as well into carbonates, either dolomite or calcite, or magnesian calcite. We have found both cases in serpentinites from different ultramafic massifs: Cabo Ortegal, in Spain, and Rajasthan, in India. Studied serpentinites from Cabo Ortegal are totally transformed to lizardite, and only fractures are filled by carbonate, mainly dolomite. However, in rocks from Rajasthan, we find that the primary minerals can be transformed either to serpentine (antigorite + chrysotile) or to carbonate (calcite or magnesian calcite). Serpentinites that are not transformed into carbonates could be used to accumulate CO_2, through the same type of transformation that other rocks have undergone during their carbonatization. We demonstrate that there is neither gain nor loss of Ca during carbonatization, and the CO_2 is basically retained as $CaCO_3$. Therefore, the CO_2 circulating in the seawater was trapped by complexing with the Ca contained in the minerals of the seafloor. A study of serpentinites that have not yet undergone carbonatization can provide a clue for the use of these rocks as carbon dioxide sequestration in terms of reducing carbon dioxide of anthropogenic origin.