Basic minerals for carbon dioxide sequestration: Potential and quantification

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Weathering of mafic and ultramafic rocks provided a significant sink for atmospheric CO_2. Subsequent carbonatization of alteration product of these rocks can constitute a promising solution for CO_2 sequestration.

In this study, basic minerals, olivine, anorthite and augite, constituents of basalts, were selected for their different cations chemical compositions. Their reactivity towards CO_2 in a supercritical state (150°C and 150 bar) was investigated in order to characterize their respective conditions of carbonatization. Dissolution of minerals and subsequent precipitation of carbonates with a net consumption of CO_2 were expected.

A quantified pure mineral phase (powders of 20-80µm), and CO_2 (as dried ice) were placed in closed-batch reactors (soft gold tubes) in presence of solutions. Different salinities, different ratios solution/solid (mineral phase) were investigated. Experiments were performed over a period from two weeks to three months.

Final solid products were quantified by Rock-Eval 6 technique, and identified using X-ray diffraction, Raman spectroscopy, electron microprobe and scanning electron microscopy. Gaseous compounds were quantified within a vacuum line equipped with a Toepler pump and identified by gas chromatography (GC). Carbon mass balances were calculated.

Olivine reacted amply with CO_2, trapping up to 56±1% (eqC of initial CO_2) as magnesite. Anorthite alteration produced calcite (11.2±0.1% to 15.4±0.1% eqC,). Only 2.1±0.1% to 3.6±0.1% (eqC) was trapped as siderite and calcite in the case of augite. Amorphous silica was observed in experiments conducted with olivine.

Solution/mineral ratios appeared as the primary control on the reaction, salinity acting as a second order parameter.

In our experimental conditions, olivine appeared as a good candidate for the CO_2 trapping into a geologic stable carbonate: magnesite. The possible use of mafic and ultramafic rocks for CO_2 sequestration will be discussed.

Mössbauer spectroscopy used for iron-oxide determination in banded iron formations: Implications for analyses on the Martian surface

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The iron oxide mineralogy in Precambrian banded iron formations (BIF) is complex due to their sedimentary, diagenetic and metamorphic/metasomatic history. Major debates concern the precursor minerals (carbonates, sulphides, oxides) of the presently observed oxides (hematite, magnetite, or goethite). The implication of micro-organisms during primary precipitation and secondary transformation, present as relict carbonaceous matter, are associated with BIFs [1]**.** Raman spectroscopy and TEM coupled with DRX on the ~2.9 Ga BIF from the Dhawar craton (South India) indicate that magnetite, the precursor oxide, is largely replaced by hematite and goethite. Preliminary Mössbauer spectroscopy analyses on separated silica and Fe-oxide laminae, carried out at 78 and 295 K at 10mm/s velocity confirm the presence of hematite, goethite and magnetite. However, one of the subspectra of magnetite is very similar to that of hematite at 295K. Consequently, these spectra seem superposed and contribution of both elements is difficult to decipher. Thus, the separation of the powdered ferrimagnetic fraction is necessary to clearly identify the presence of magnetite. These results are important as Mössbauer spectroscopy used on Fe-oxide samples from the Martian surface may lead to erroneous interpretations.

[1] B. Orberger, K. Hashizume, H. Soyama, R. Wirth, A. Hofmann, J.P. Gallien, C. Wagner. M. Jayananda. V. Rouchon. D.L. Pinti (2007) , Nitrogen and carbon in Archean iron formations. Archean Symposium, August, London, Ontario. Extended abstract.