



Investigation on the stability of FeCO_3 down to the core mantle boundary

Valerio Cerantola (1), Elena Bykova (), Catherine McCammon (), Marco Merlini (2), and Leonid Dubrovinsky ()

(1) Universität Bayreuth, Bayerisches Geoinstitut, Germany (valerio.cerantola@uni-bayreuth.de), (2) Università degli Studi di Milano, Italy

In the last century, the high intensification of CO_2 amount in the atmosphere together with the observed climate change have increasingly focused scientists' attention on the carbon cycle and its evolution at the Earth's surface. However, carbon is continuously transported from the surface into the deep Earth via subduction, mainly by means of carbonates. Fe-bearing carbonates (i.e. FeCO_3) in particular are potential carbon carrier down to the deep lower mantle, indeed the presence of iron influences the stability of this phase at high pressures and high temperatures (HPHT), partly due to the spin-pairing of Fe-d electrons. In this study we perform HPHT experiments on FeCO_3 in order to study its stability and eventually determine its decomposition products at the relative P and T conditions. Experiments were performed using synthetic FeCO_3 crystals in a laser-heated diamond anvil cell (DAC) at 100 GPa and $T > 1500$ K in order to generate the conditions prevailing in the Earth's lower mantle. X-Ray Single Crystal Diffraction (XRD) and Synchrotron Mössbauer Source (SMS) analyses were carried out at ESRF and APS synchrotron facilities. All samples were enriched in ^{57}Fe to ensure a strong signal for Mössbauer spectroscopy. At 100 GPa we observed the complete transformation of FeCO_3 into two new hp-carbonates, with Fe in different oxidation states depending on the heating temperatures and C in four-fold coordination with O. Laser heating at $T > 2000$ K generates a new phase with only Fe^{3+} in the structure: $\text{Fe}_4(\text{CO}_4)_3$. Laser heating at $1600 \text{ K} < T < 2000 \text{ K}$ triggers a different redox reaction, where half of the Fe atoms are in $2+$ and half in $3+$ valence states: $\text{Fe}^{(2)2+}\text{Fe}^{(2)3+}\text{C}_4\text{O}_{13}$. Mössbauer spectra confirm the XRD results by providing the exact amount of Fe-atoms in two different valence states. We assert Fe-rich carbonates can exist in regions down to the core mantle boundary, provided however the presence of an environment with relatively high $f\text{O}_2$ e.g. in the proximity of subducting slabs. The presentation will focus on our most recent results and discuss their implications for the carbon cycle in the deep Earth's interior.