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DISPUTATION TITLE:	**Carbonation reactions in ultramafic rocks:** experimental insights into physicochemical processes, microtexture evolution and reaction mechanisms

POPULAR SCIENTIFIC SUMMARY:

Interactions between CO_2-bearing fluids and silicate minerals commonly result in the formation of solid carbonates. Such carbonation reactions occur during weathering, hydrothermal alteration and metamorphism, playing a major role in the long-term global carbon cycle. Large carbonate deposits are often found in association with tectonically exposed ultramafic rocks, rich in the mineral olivine [$(Mg,Fe)_2SiO_4$].
Enhanced mineral carbonation using engineered processes has recently been proposed as a strategy for the safe and permanent storage of anthropogenic CO_2. Possible methods include *ex situ* mineral carbonation involving the transportation of mined feedstock material to concentrated sources of CO_2, such as fossil fuel–fired power plants, and *in situ* mineral carbonation, where CO_2-charged fluids would be directly injected into suitable rock formations.

The doctoral thesis explores the reaction mechanisms and physicochemical processes associated with the interaction of ultramafic rocks with CO_2-bearing fluids. The research done combines primarily experimental approaches with detailed microstructural and chemical investigations. Based on direct nanoscale observations of carbonation reactions, it is shown that the fluid composition at the solid-fluid interface, rather than the bulk fluid composition, is the most important factor during the carbonation process.

Carbonation experiments using samples of pristine ultramafic rocks demonstrate that carbonate precipitation in pore space may lead to a reduction in porosity, ultimately limiting the reaction progress. On the other hand, experiments on partially altered ultramafic rocks as well as natural observations indicate that the presence of olivine weathering products and serpentine [$Mg_3Si_2O_5(OH)_4$] veins is favourable for the carbonation progress.

The results of this dissertation have important implications for better understanding natural carbonation reactions, and may aid the optimization of engineered mineral carbonation as a strategy for mitigating anthropogenic CO_2 emissions.