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Observation on change of physico-chemical properties of crystalline rocks caused by freezing-thawing experiment

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Groundwater and surface water may be contaminated by a range of soluble chemical compounds in regions where rocks are weathered by freeze–thaw cycles. To reduce this type of pollution, which is particularly common in mining areas, the effects of freeze–thaw weathering need to be investigated to help determine how the rock is weathered and what chemical compounds result from the weathering. The physical conditions of a rock's surface generally change during freeze–thaw cycles, and voids on weathered surfaces tend to increase in number because of chemical dissolution of the minerals in the rock.

In this study, freeze–thaw experiments were performed using rock samples taken from near a mine. The physical changes in equally sized rock samples were observed during the experiment. To understand how chemical compounds were released during freeze–thaw cycles, powdered rock samples were added to distilled water and the chemical characteristics of the distilled water were determined. Information on physical changes in rocks can be used to understand how weathering affects the stability of cut slopes or tunnels, while the data from chemical analysis provide insights into the release of chemical species that can affect the surrounding natural environment.

We used physical and chemical (e.g. inductively coupled plasma–mass spectrometry) analysis methods to observe how the physical properties of the rocks and the chemical forms in a solution changed during a freeze–thaw experiment. The results show that the porosity and the dry density of the rock samples changed slightly during the experiment. The electrical conductivity and concentrations of chemical forms varied as the freeze–thaw cycle progressed. This study shows that weathering can be enhanced during freeze–thaw cycles and that groundwater is easily contaminated by the dissolved chemicals produced during this weathering.