The interplay between amorphous, nanocrystalline and crystalline materials in weathering processes

JURAJ MAJZLAN[1], FELIX Y. AMOAKO[1] AND MARTIN ŠTEVKO[2]

[1]Institute of Geosciences, Burgweg 11, Friedrich-Schiller University, D–07749 Jena, Germany

[2]Department of Mineralogy and Petrology, Faculty of Natural Sciences, Comenius University, 6 Mlynska dolina G, SK-842 15 Bratislava, Slovakia

Amorphous and nanocrystalline phases, so-called mineraloids, play a special role in weathering processes. They are metastable, persist for some time, and convert to other phases or dissolve in aqueous solutions. Yet, we are increasingly finding that even well crystalline secondary minerals which may have precipitated directly from the aqueous solution, had a transient amorphous precursor.

In a Medieval Jacob adit in Ľubietová (Slovakia), massive amounts of langite, $Cu_4(SO_4)(OH)_6{\cdot}2H_2O$, are precipitating. The sky-blue, milimeter-sizes euhedral crystals do not form directly from the water contaminated by copper. Instead, that water is covered by a layer of copper-rich gel, visually comparable to blue ice. This gel then slowly transforms into langite, although other Cu sulfate minerals are predicted to be thermodynamically more stable. We are currently applying spectroscopic techniques to understand the local structure of this gel.

In the dumps in Kutná Hora (Czech Republic), the mineral bukovskýite, $Fe_2(AsO_4)(SO_4)(OH){\cdot}9H_2O$, is abundant. A detailed investigation with microtechniques showed that bukovskýite forms by slow recrystallization of solid silicate gels. These gels span the entire range of chemical compositions from silicate-rich to arsenate-rich.

At the Chyžné (Slovakia) site, we encounter a range of ferric arsenate minerals which formed by weathering of the arsenopyrite-containing waste. They contain Fe, As, and traces of other cations. Yet, the stalactites found there are made of an amorphous ferric arsenate-phosphate, although the rocks are not particularly rich in phosphorus. At this site, the biological contribution to the formation of the amorphous materials seems to predominate and dictate what will form and persist. We believe that the role and importance of amorphous and nanocrystalline materials in the nature is still underestimated and deserves more attention.