Green rust sodium/potassium sulfate

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Green rust (GR) is the generic name, which refers to a family of compounds consisting of brucite-like layers of Fe(II),Fe(III)-hydroxide. GR is a layered double hydroxide (LDH), also known as hydrotalcite-like materials (HLM). They have been identified in nature in soil taken from the redox boundary where groundwater is oxidised and they are important first solids during corrosion of iron in remediation barriers. The presence of Fe(II) in the brucite-like layer, makes GR very reactive towards redox sensitive elements, such as Cr, Se, Np and chlorinated solvents and pesticides. Understanding the GR system is thus interesting with regards to remediation techniques. It will also aid to better understand the redox processes taking place in the groundwater zone and to improve prediction of contaminant transport.

Previous studies have reported structurally bound water and anions in the interlayers, the thickness of which is assumed to be defined by the anion. Compounds with spherical or planar anions, such as Cl^- or CO_3^{2-}, produce similar X-ray diffraction (XRD) patterns and are known as Group 1 GR. Group 2 compounds incorporate three dimensional anions, such as tetrahedral SO_4^{2-}, and produce larger basal-plane spacings.

If we want to predict redox reactions and contaminant transport, it is important to know the structural parameters of the various GR types. GR_{SO4}, which is used in many studies, has not been characterised correctly in the past. We used several high resolution techniques including XRD, Mössbauer spectroscopy, ICP-AES and atomic force microscopy to investigate the GR_{SO4} compounds. We observed a difference in X-ray diffraction patterns depending on which monovalent cation was dominant during formation.

Within the last decade, two observations of naturally occurring sodium and sulphate-containing hydrotalcites have been described: nikischerite, $NaFe^{2+}_6Al_3(SO_4)_2(OH)_{18}•12H_2O$ and shigaite $NaAl_3Mn^{2+}_6(SO_4)_2(OH)_{18}•12H_2O$. We refined the structure for green rust sodium sulfate and potassium sulfate using the nikischerite structure as a basis. The calculations, as well as careful chemical analyses, clearly indicated presence of Na or K in the structure. Thus we present new chemical formulae and new crystal structures for $GR_{Na,SO4}$ and $GR_{K,SO4}$: $NaFe^{2+}_6Fe^{3+}_3(SO_4)_2(OH)_{18}•XH_2O$, P-3, a-axis = 9.520 Å, c-axis = 10.932 Å and $KFe^{2+}_{12}Fe^{3+}_6(SO_4)_{3.5}(OH)_{36}•XH_2O$ a-axis = 9.530 Å, c-axis = 11.183 Å.

A-type granite(?) of Late Jurassic age, western Utah, USA

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The Granite Peak Mountain intrusion of the Basin and Range portion of western Utah includes a distinctive, but poorly studied, beryl-muscovite granite that intrudes schistose and gneissic wall rocks. Based on the association with medium-grade metamorphic rock and the enrichment in Be, it has been hypothesized that the Granite Peak intrusion was Proterozoic in age—a time known to have A-type granites in this region. However, new U-Pb zircon ages acquired by laser ablation ICP-MS show that the intrusion is Late Jurassic (150 Ma). Late Jurassic plutons in the Basin and Range province are rare and the common Middle Jurassic granites of western United States are typical calc-alkalic plutonic rocks with strong subduction-zone affinities. Geochemically and mineralogically, the Granite Peak pluton is also enigmatic; it ranges from foliated hornblende (monzo)diorite to muscovite granite and is intruded by abundant beryl-bearing pegmatites. The most evolved granites are ferroan, high K, and enriched in Ga and HFS elements like typical A-type granites. However, unlike most A-type granites, the diorites and granodiorites are magnesian, $(FeO/(FeO + MgO) < 0.7)$ and titanite bearing. In addition, the granites are distinctly peraluminous and muscovite rich unlike most A-type granites. Moreover, the compositions of biotite in the granite (Fe/(Fe+Mg) ranges from 0.5 to 0.8 and total Al from 1.4 to 1.8 apfu) largely overlap with biotite compositions in strongly peraluminous (S-type) granites; P_2O_5 concentrations are atypically high and similar to S-type granites. The intrusion is strongly differentiated with progressive depletions of typically compatible elements like Sr, Ba, Eu, Ti, V, and P, but Y, U, Th, LREE and HREE also decline with evolution (as marked by increases in Si, Rb, Cs, Ga, and Pb). The trends suggest significant fractionation of REE-U-Th-Y-rich phases such as monazite, xenotime, zircon, and titanite. These paradoxical characteristics may imply that the Granite Peak Mountain intrusion evolved from an oxidized A-type magma that assimilated some of its metasedimentary wall rocks. The parental magmas may be part of a short-lived episode of anorogenic magmatism related to termination of subduction along the western margin of North America and to the emplacement of the Independence dike swarm into the transtensional boundary in eastern California.