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Clay mineralogical evolution as a function of acidic leaching conditions: implications for alteration pathways on Mars' surface

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Combined satellite and in-situ measurements of Mars surface have detected mineral assemblages suggesting processes for which Earth analogues exist. One of these cases is represented by aluminous clay-sulphate assemblages, which suggest alteration by acidic fluids.
The Riotinto mining district (SW Spain) provides an Earth analogue for such Martian processes. The parent rocks belong to an Upper Palaeozoic (Late Famennian-Tournaisian) volcano-sedimentary complex including siliciclastic sediments and mafic and felsic volcanics, all of which underwent hydrothermal alteration.The oxidation of an extensive pyrite-rich orebody provided extreme to mild acidic fluxes that leached the surrounding rocks for over 20 million years (1).
Samples from several locations in the Riotinto area show a range of clay products: vermiculite, smectite, possibly halloysite, and kaolinite with a wide range of crystal order. Jarosite and iron oxides appear in the most intensely leached areas.
The different alteration products are due to the nature of the original rocks and the conditions in which low-pH leaching took place. Both mineral assemblages and spectral features of clay minerals from Riotinto can be used to interpret acidic alteration on Mars' surface.

(1) Essalhi et al., 2011. Mineralium Deposita 46, 981–999.