Redox reactions of $Fe_{II\text{-}III}$ oxyhydroxycarbonate minerals in gleysols, fougèrite, trébeurdenite and mössbauerite, and water denitrification

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Colour change from bluish-green to ochre in gleysols is due to redox reactions within $Fe_{II\text{-}III}$ oxyhydroxycarbonate, related to a green rust $Fe_{II\text{-}III}$ double layered hydroxide of general formula $Fe_{II6(1-x)}\ Fe_{III6x}\ (OH)_{2(7-3x)}\ O_{2(3x-1)}\ CO_3\ 3H_2O$. Minerals are named (i) fougérite for $Fe_{II4}\ Fe_{III2}\ (OH)_{12}\ CO_3 \bullet 3H_2O$ green rust $Fe_{II\text{-}III}$ hydroxycarbonate (ii) trébeurdenite for $Fe_{II2}\ Fe_{III4}\ (OH)_{10}\ O_2\ CO_3 \bullet 3H_2O$ $Fe_{II\text{-}III}$ oxyhydroxy- carbonate (iii) mössbauerite for $Fe_{III6}\ (OH)_8\ O_4\ CO_3 \bullet 3H_2O$ ferric oxyhydroxycarbonate at definite x values of 0.33, 0.67 and 1, respectively; the exceptional redox flexibility comes from toptotactic reactions as shown by XRD and TEM; the relative trivalent cation average ratio x extends from 0.33 to 1 by mixing minerals as shown by Mössbauer spectra (Fig. 1).

Figure not supplied.

Figure 1: Mössbauer spectra measured at 78 K of samples vs x (***a***) fougèrite; (***b***) trébeurdenite (***c***) mössbauerite

In samples extracted out of waterlogged gleys in a water table (Fougères), x varies between 0.33 and 0.67 by mixing fougèrite with trébeurdenite, whereas in those extracted from the schorre of a maritime marsh (Trébeurden), x varies between 0.67 and 1 by mixing trébeurdenite and mössbauerite, due to partial oxidation of the gley at low tide. This redox flexibility is responsible for water denitrification in water tables combined with anaerobic bacterial reduction.

Plume-ridge interaction: Constraints on melting dynamics from the Azores and Iceland

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Ocean Island Basalts (OIB) erupted in the vicinity of Mid-Ocean Ridges (MOR) provide important information on melting processes, melt movement and composition of the Earth´s mantle. In particular the major element, trace element and Sr-Nd-Pb isotope ratios allow for constraints on the distinct melting behaviour of enriched and depleted mantle sources, their along and across axis distribution and potential changes in melting depth and melting temperatures.

While the flow of melts into the Mid-Atlantic Ridge (MAR) in the Azores and Iceland has been the subject of several studies, both plumes exhibit active volcanism on the western side of the Mid-Atlantic Ridge away from the proposed plume locality. Such off-axis volcanism beneath the North-American plate is comparable for the two OIB settings in terms of trace element and isotopic source composition relative to the main plume centre. Incompatible trace element ratios of Nb/Zr, Ta/Hf and La/Sm are elevated by similar factors in the off-axis (western) lavas when compared to the lavas from the plume centre. We compare the melting dynamics (i.e. P-T conditions of basalt generation) underneath the Snaefelsness peninsula (Iceland) with those underneath Flores and Corvo islands (Azores); both examples of unusual off-axis and "off-plume" magmatism.

We demonstrate that Iceland and the Azores exhibit comparable excess temperatures, but that melting underneath the western Azores islands is initiated deeper. The sources in the Azores are more enriched and degrees of partial melting are slightly lower than compared to Snaefellsness. This implies that for both cases melting dynamics are largely controlled by the geochemical composition of the source and possibly lithosphere thickness rather than upwelling rate. The differences between eastern and western (i.e. plume related vs. "off-plume") sources may reflect different proportions of enriched melts during binary mixing with depleted MORB mantle (DMM) sources.