Discrimination scheme for Fe-Mn deposits based on REY, HFSE and Th

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Marine Fe-Mn deposits can be distinguished based upon the type of aqueous fluid from which they precipitate and their specific setting: While hydrogenetic crusts slowly precipitate from ambient seawater and attain their constituents from this source, diagenetic nodules form within the sediment, with pore water as major source of elements. In the vicinity of hydrothermal vents, hydrothermal crusts precipitate from both hydrothermal fluid and seawater as possible source fluid. Variable concentrations of economically important elements characterize these groups. The individual groups can be separated using discrimination diagrams such as Ce/Ce^*_{SN} vs. Nd, Ce/Ce^*_{SN} vs. Y/Ho_{SN}, Nb vs. Ta, and Ce/Ce^*_{SN} vs. Th, Zr, Hf, Nb, Ta, which combine the effects of redox, growth rate and mineralogy on the trace metal content of Fe-Mn deposits. The redox-sensitive Ce, and HFSE and Th are continuously scavenged during crust growth, while the other REY are controlled by an exchange equilibrium. In contrast to REY, HFSE and Th are mainly scavenged from the Fe oxide phase relative to the Mn oxide phase, and together with the low mobility of these elements during diagenesis, this can be used to separate the individual groups. Hydrogenetic crusts display positive Ce anomalies, negative Y anomalies and high concentrations of REY, HFSE and Th, reflecting slow precipitation from seawater. Diagenetic nodules differ from hydrogenetic crusts and nodules as they display negative Ce anomalies at lower Nd concentrations, related to the low mobility of Ce^{4+} in sub-oxic porewaters. Seawater-dominated hydrothermal crusts differ from hydrogenetic crusts and diagenetic nodules as this is the only group which display positive Y anomalies, together with negative Ce anomalies and low Nd concentrations. This signature reflect the rapid scavening of REY from ambient seawater on hydrothermal oxide particles, without strong fractionation. In contrast to these hydrothermal crusts, hydrothermal Mn crusts which gained significant proportions of their REY content from the mantle via hydrothermal fluids (up to 30%, based on Nd isotopes), often cover the same regions as diagenetic nodules in Ce/Ce^*_{SN} vs. Y/Ho_{SN} and Ce/Ce^*_{SN} vs. Nd diagrams. Both groups can be further be separated in Ce/Ce^*_{SN} vs. Th and Nb vs. Ta diagrams.

Geochemical diversity and K-rich compositions found by the MSL APXS in Gale Crater, Mars

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Along the Curiosity rover's traverse toward Glenelg (through sol 102) the Alpha Particle X-ray Spectrometer (APXS) analysed four rocks and one soil. Microscopic images and compositions of unbrushed rock surfaces are consistent with 5-20% dust contamination. Nevertheless, the underlying characteristics of these rocks may still be discerned. As a group, they span nearly the entire range in FeO* and MnO of the Martian dataset. In addition, they are particularly enriched in volatile metals (K, Zn, Ge), and these elements do not correlate with Cl or S. One rock, Jake_Matijevic is notably alkaline and evolved; its composition is that of a nepheline-normative mugearite. The other three rocks plot in the basanite field of a TAS diagram, with high K_2O (up to 3.0%) and low SiO_2. These three rocks are otherwise SNC-like (high Fe and low Al). Three out of the four rocks (including Jake_Matijevic) plot along a line in variation diagrams, suggesting mixing of Fe-rich and Al-rich components, likely by sedimentary processes.

With only four rocks analyzed so far and ambiguity as to their geologic context (e.g. outcrop vs. float; igneous vs. sedimentary) additional measurements are needed to fully understand the region. It is nevertheless clear that Curiosity landed in a lithologically diverse, K-rich region of Mars.

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