Structural and Geochemical Characteristics of Limonite ore in Dela Sri Lanka

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Introduction

Limonite ($FeO.OH(H_2O)$) is hydrated, amorphous, and non-crystalline form of iron oxide. Limonite contains around 52.86% of iron. In Sri Lanka hydrated iron oxide is present as boulders, hill capping and near-surface deposits, classified as supergene deposits, around Dela-Noragolla (Jayawardena, 1984).

The objective of this research is to identify the chemical compositions, weathering grade, weathering pattern, decomposition, and provenance of Dela Limonite. There are only a limited number of detailed geochemical and mineralogical studies carried out up to date. Therefore, present research focuses on filling the gap in knowledge by identifying geochemistry with mineralogical characteristics of the limonite deposit.

Materials and Methods

Fresh limonite samples were collected in April, 2013. Each sample was homogeneously crushed. Fresh crushed samples were powdered using mortar and pestle and sieved into < 63 µm size.

FTIR analyses (Perkin Elmer 880) were carried out to identify the bonds in the samples in range from 400cm $^{-1}$ to 4000 cm $^{-1}$ wave number. The most representative limonite sample (SLDL 01) was analyzed at 25 °C room temperature, obtained with 2Th/Th radiation, operating at 40 kV, 30 mA and diffraction data were compared with references. XRF analysis was carried out using Brucker hand held XRF S1 TITAN instrument for forty (40) selected major and trace elements by having 0.4008 average errors.

Results and Discussions

FTIR analysis revealed several peaks (Figure 1) in 3570 cm $^{-1}$, 2360 cm $^{-1}$, 1420 cm $^{-1}$, 1350 cm $^{-1}$, 1100 cm $^{-1}$, and 800 cm $^{-1}$ wave numbers showing water group, P-H bond, organic sulfate, P=O and silicate iron (Coates, 2000; Stringfellow et al, 1993). In XRD analysis minerals were verified as limonite, goethite, quartz and hematite present in the deposit. Measured XRF data are summarized in Figure 2. By comparing with UCC value, it was clearly identified that the Fe_2O_3, P_2O_5, and MnO are enriched in this deposit (Figure 3). MgO, TiO_2, Cl, Co, and Ce slightly deviate from the UCC value. Al_2O_3, SiO_2, K_2O, CaO, S, V, Cr, Cu, Zn, Rb, Sr, Y, Sn have fewer amounts compared to the UCC value.

Less amounts of Al_2O_3, SiO_2, K_2O, and CaO represent that insignificant amount of feldspar. Low percentage of silica in the deposit revealed that the rock formation was in mafic environments. Having very fewer amount of S and Chalcophile elements trace elements represent that there is no sulphide mineral is a source to form this deposit.

Geochemically Ce, and Y are the traces, which were representing formation of apatite as a heavy mineral. By enrichment of P_2O_5, and fewer amount of Ca, Cl, OH, Ce and Y indicated that the apatite was present as a gangue mineral in this deposit.

Conclusions

The deposit is enriched with Fe_2O_3, MnO, and P_2O_5. Silica, S, trace elements and Chalcophile element were depleted in the deposit. P_2O_5 is present as apatite; a gangue mineral. High amount of the weathering and digestion occurred due to the climate condition of the area. Acidic environment has increased the weathering and digestion process. When the digestions happen limonite was transformed into laterite by leaching out other elements inside the deposit. The initial rock formation was in mafic or ultramafic source environments.

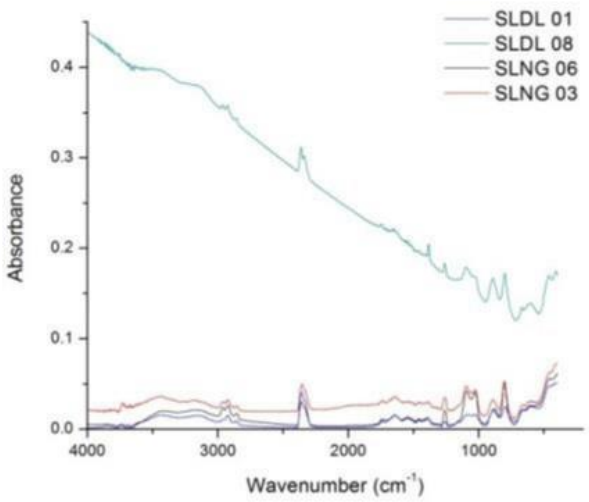

Figure 1. Analysed FTIR graphs of the limonite samples using Origin labfor SLDL 01, SLDL 08, SLNG 03, and SLNG 06

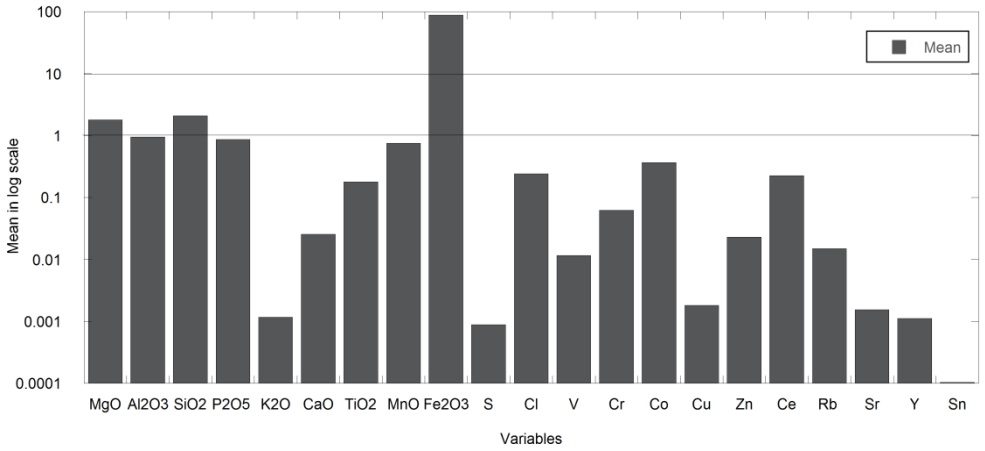

Figure 2. Measured mean XRF data in logarithm scale.

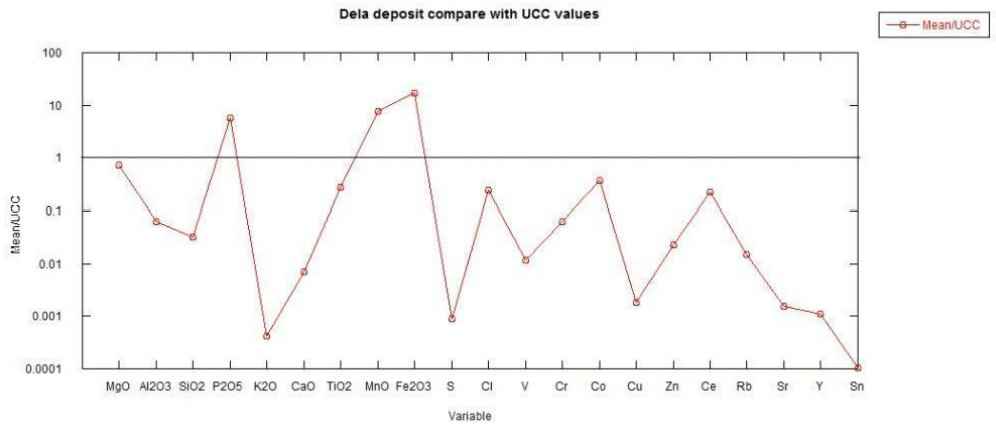

Figure 3. Dela deposit XRF mean values compare with UCC value.

References

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