



Comparison of geochemical characteristics between the basaltic red clay and Quaternary Red Clay in Hainan Island of tropical China

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Hainan Island is located in tropical China, with annual mean temperature 24 °C and annual mean precipitation 1639 mm, where the red clay and red weathering crusts are widely distributed. The island is also a volcanic zone during the Quaternary period, where basalts are commonly seen. A red clay profile derived from basalts, including red clay, semi-weathered basaltic rocks and Fe nodules, and a Quaternary Red Clay (QRC) profile, including uniform red clay (URC) and reticulate red clay (RRC), were selected in Lingao County, Hainan Island. Geochemical and magnetic characteristics of the profiles were studied. The contents of SiO₂, Al₂O₃ and Fe₂O₃ in the basaltic red clay were 322.75 mg g⁻¹, 269.22 mg g⁻¹ and 338.66 mg g⁻¹ on average; these of the semi-weathered basalts 366.84 mg g⁻¹, 248.25 mg g⁻¹ and 322.46 mg g⁻¹ on average; these of the Fe nodules 303.52 mg g⁻¹, 200.02 mg g⁻¹ and 434.91 mg g⁻¹ on average, respectively. For comparison, these of the URC were 620.94 mg g⁻¹, 171.91 mg g⁻¹ and 82.84 mg g⁻¹ on average, and the RRC were 658.49 mg g⁻¹, 181.60 mg g⁻¹ and 116.24 mg g⁻¹ on average, respectively. The content of free Fe (Fe₂O₃) of the basaltic red clay and Fe nodules was 114.16 mg g⁻¹ and 157.10 mg g⁻¹ on average, and that of the URC and RRC was only 31.37 mg g⁻¹ and 42.34 mg g⁻¹ on average, respectively. The basalts formed in volcanic eruptions were enriched in Fe but deficient in Si. The QRC in the island was mostly derived from alluvial sediments, which was enriched in Si and lower in Fe however. Fe content of the basaltic red clay was three times that of the QRC, and Si content of the former was only a half of the latter. The Fe nodules in the bottom of the basaltic red clay profile were formed through the leaching and re-precipitation of Fe during the intensive weathering of basalts under long-term high temperature and humid conditions. The content of total and free Fe in the Fe nodules were significantly higher than these of the parent rocks and red clay in the same profile. Magnetic susceptibility (χ) of the basaltic red clay attained $1093.07 \times 10^{-8} \text{m}^3 \text{kg}^{-1}$. χ of the URC was $37.64 \times 10^{-8} \text{m}^3 \text{kg}^{-1}$. That of the RRC, however, was significantly weakened, only $8.24 \times 10^{-8} \text{m}^3 \text{kg}^{-1}$. The basalts enriched in Fe contained high contents of magnetite and maghemite and presented strong magnetic signals. The QRC was generally lower in Fe content and weak in magnetic signals. Especially, the RRC was extremely weak in magnetic signals due to the dissolution of magnetic minerals caused by the fluctuations of groundwater levels. The red clay in Hainan Island was the final phase of chemical weathering and pedogenic processes. These red clay developed from the different parent materials, however, varied significantly in geochemical and magnetic characteristics. The distinguishment of the different red clay in the island was beneficial to plan agricultural regionalization better.

Keywords: Quaternary Red Clay; Basalts; Magnetic susceptibility; Weathering