# Geochemical indicators and correspondence to GPR signals in a typical red soil Critical Zone

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The subsurface architecture of the Earth's Critical Zone (CZ) is formed mainly by geological and geomorphological processes and it is the fundamental control of hydrological and biogeochemical processes in CZ. To illustrate CZ structure geophysical methods such as GPR are often used. Interpretation of GPR signals involves mainly physical parameters determining soil dielectric constant such as particle size and water content. However, the formation of soil and saprolite zone properties is greatly depended on weathering and soil development which can be characterized by a series of geochemical indices. In a typical red soil CZ developed on the Quaternary red clay underlied by Cretaceous sandstone located in the subtropical south China, homogeneous red clay layer, the plinthite layer, the mixed quaternary materials and weathered sandstone saprolite as well as the solid rock make a complete horizon sequence. Though varied by thickness and depth with landforms and land uses, this sequence can be geochemically differentiated by indicators like CIA and $\tau$ (mass transfer coefficient) and we found that GPR signals could match much of the changes in the geochemical features. For example, the CIA values were larger than 89% within the topmost layer (homogeneous red clay) and rapidly declined downwards. The interpreted GPR results in terms of thicknesses and interfaces for different layers were well consistent with borehole logs. Actually physical properties such as clay fraction and porosity are considered as a result of weathering and soil formation so in turn correspond to geochemical indices. It is helpful to combine geochemical indicators with geophysical information to better interprete and understand the architecture of a CZ and, provide quantitative description of CZ structure for further modeling requirements.

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