Submicroscopic Structure of Fe-Coatings on Quartz Grains in Tropical Environments

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Abstract: Formation of Fe-coatings or segregation at the expense of quartz grains is a common process in the tropical environment. Limited information is available about their internal structure at the submicroscopic level. The transmission electron microscope (TEM) and energy dispersive X-ray microprobe analyses (EDXRMA) techniques were used to identify the nature and arrangement of fundamental mineral particles within the Fe-coatings. Chemical and mineralogical studies showed that the coatings were composed of well-crystallized Fe-oxides, quartz and kaolinite. The EDXRMA analyses revealed the presence of linear concentrations (laminae) of nearly pure Fe oxide along the edges and the contact zone with quartz and within the coatings. Similar atomic proportions of Al and Si in several areas within the interior regions of coatings and the XRD pattern of the crushed coatings are supportive evidence for the presence of kaolinite. Under the TEM, the dense laminae (< 10 μm thick) consisted of elongated Fe-oxide particles (< 1.5 μm long and 0.2 μm thick) accommodated in subparallel arrangement. The interior areas had very high porosity and, in addition to Fe-oxides, contained other minerals: mainly kaolinite, quartz and isolated areas of Al-oxides. High amounts of ultramicroscopic pores (<0.5 μm) in the interior region suggested that dissolution of Fe-oxides occurred under reduced conditions, with subsequent reprecipitation of pure Fe-oxides in the laminae. Very low porosity and parallel arrangement of Fe-oxide particles (laminae) provided new surfaces (barrier) for Fe-accumulation when soil solutions provided new influxes of iron, thereby creating a thicker Fe-coating. The size and geometry of the ultramicroporosity were shown to play a significant role in the dissolution and precipitation of soil minerals, especially those involved in redox reactions.

Key Words: Electron Microscopy • Fe-coating • Fe-nodules • Fe-oxide Forms • Submicroscopic Structure • Ultrathin Sections • X-ray Microprobe Analysis

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