Laterite revisited: mode of formation

ABD. RASHID AHMAD & TEH GUAN HOE
Department of Geology, University of Malaya,
50603 Kuala Lumpur, Malaysia

During 1800 laterite was perceived as a rock. This idea persisted until the first quarter of the twentieth century. From then on laterite was accepted as iron precipitate and the accumulated material could be remobilized under different conditions, which affected its concentration. The formation of laterite is termed as laterization or lateritization. These terms are defined as the process which involves additions of iron with movement of dissolved Fe from elsewhere, in ferrous form with oxidation and precipitation to produce an iron oxide enriched material, leading to the formation of plinthite and ironstone. The mechanisms by which iron moves and is precipitated in the lateritization process are not clear and probably vary in different situations. This paper attempts to discuss these processes by introducing a systematic approach to the requirements leading to the understanding of the formation of laterites. A number of laterite samples were taken from the field representing what was thought to be the various stages of laterite formation from plinthite to ironstone. The colours of the materials constituting the samples were noted. Photographs of the samples were taken as whole or cross-section. Parts of the samples were cut for thin sectioning followed by petrographical analysis. Photomicrographs of selected features in the thin section were taken. The samples were also prepared for EPMA analyses. The results of this study indicate that a number of conditions have to be satisfied before the formation of laterite can be initiated. The transformation of ferrous to ferric iron and precipitation of ferric oxides and hydroxide started to occur at the aerobic-anaerobic interface. Zones of different porosity may contribute to the formation of aerobic-anaerobic interface across which Fe^{2+} must be transported either by flow or diffusion. The mechanisms for iron movement were suggested. Oxygen is the main oxidant in the redox reaction. There must also be a continuous supply of reductants (Fe^{2+}) for the growth of laterite and for the progressive development of plinthite to ironstone. The source of iron primarily originated outside the laterite body. Intermittent anaerobic conditions may develop in the laterite body and ferric iron is reduced back to ferrous form. It can move out and be deposited on the surfaces of vesicles and with time filling up the vesicles. Silicate minerals should be dissolved so that partial or total replacement by iron oxide could occur. Evidence of silica dissolution was given. The precipitation process may be controlled by simultaneous diffusion and oxidation reaction. The evidence for this is the occurrence of periodic precipitation also known as Liesegang banding phenomenon as detected by EPMA. As more and more iron oxide accumulates in the laterite body it becomes more compact and its porosity declines. The influence of water on the development of anaerobic condition becomes less significant. During drier periods and higher temperatures water is lost from the laterite body and it becomes hardened.