Porosity Concerned Model of Weathering-rind Development

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A model of weathering-rind development was proposed based on the study of andesite cobbles sampled from a modern floodplain and four fluvial terraces (0 ka, 20 ka, 130 ka, 290 ka and 660 ka) in central Japan. The 0-ka rocks are not visibly weathered and the 20-ka rocks have a thin alteration layer. The 130-ka, 290-ka and 660-ka rocks have brown weathering rinds with a thickness of 3-6 mm. Weathering rinds are divided into two bands: the outer brown band experienced both oxidization and dissolution, whereas the inner band is characterised by the dissolution. The total thickness of the two bands, corresponding to a dissolved zone, is related to both rock porosity and time, while the thickness of the outer band or a oxidised zone is basically independent of porosity.

A model of weathering-rind development was proposed based on the study of andesite cobbles sampled from a modern floodplain and four fluvial terraces (0 ka, 20 ka, 130 ka, 290 ka and 660 ka) in central Japan. The time elapsed since the above ages are assumed as the weathering periods. The 0-ka rocks are not visibly weathered. The 20-ka rocks have an alteration layer with white or brown colours with a thickness of ca. 1 mm on their surface. The 130-ka, 290-ka and 660-ka rocks have brown weathering rinds with a thickness of 3-6 mm, which differ from fresh-looking interior with gray colour. Based on the measurements of chemical, physical and mechanical properties throughout from the rock surface to the interior, weathering rinds are divided into two bands. The outer brown band (Band A) contains abundant Fe due to the accumulation of ferric hydroxides: FeO(OH), Fe(OH)3 and Fe2O3. This band experienced both oxidization and dissolution. The inner band (Band B) is characterised by the dissolution of alkali/alkaline metals. The inner border of this band is located at the place where the amounts of CaO and Vickers' hardness numbers start decreasing with decreasing depth. Based on these observations, a growth model of weathering rinds in andesite rocks was proposed. The total thickness of the two bands (L(A+B)), corresponding to a dissolved zone, is related to both rock porosity (n) and time (t), whereas the thickness of the outer band (L(A)) or a oxidised zone is basically independent of porosity. Their relationships can be represented by diffusive equations: $L(A+B) = 0.3240(nt)^{1/2}$ and $L(A) = 0.1692t^{1/2}$.