Rates and mechanism of weathering-rind development on andesite gravel in fluvial terrace deposits

5. Conclusions

Changes in several rock properties due to weathering were investigated and a growth model for the weathering rinds was constructed using andesite gravel in dated terrace deposits whose formative ages are 0 ka, 20 ka, 320 ka, 450 ka and 830 ka. The following conclusions can be drawn from the present study.

(1) Weathering rinds in andesite rocks mainly consists of two sub-zones with different rock properties: The outer one is *Zone A* with distinguishable brown colour, corresponding to the *brown layer*. The inner one is *Zone B*, which is a part of the *inner parts* with gray colour, but white layers were occasionally observed at the outermost part of Zone B.

(2) Zone A of 320-ka, 450-ka, and 830-ka rocks contains kaolin minerals, smectite, maghemite, and hematite and it has large values of L*, a* and b* colour indicators. The zone also has small contents of SiO_2, Al_2O_3, Sr and alkali/alkaline earth metals but large contents of H_2O, TiO_2, $FeO+Fe_2O_3$, V and Zr in bulk-chemical compositions. The pore volume and porosity for the zone are larger than those for the inner parts, whereas bulk density for the layers are smaller than that for the inner parts. The zone has very small rock hardness in terms of VHN values.

(3) The inner parts of the rocks consist of quartz, tridymite, plagioclase, pyroxene and magnetite. They have very small pore volume, the small porosity, relatively large density and large VHN values. Zone B is characterized by the depletion of alkali/alkaline earth metals especially Ca and Sr as well as decreased rock hardness.

(4) Chemical index of alteration (CIA) has the lowest decreasing rates with the progress of weathering. In contrast, VHN values decrease drastically during the early stage of weathering. These observations indicate that rock hardness decreases faster than chemical composition.

(5) Weathering rinds in andesite rocks are formed by the diffusive

development of the two zones. Zone A is subjected to both oxidation and dissolution, and Zone B is mainly subjected to dissolution. The total thickness of the two zones is related to both rock porosity and time, whereas the thickness of Zone A is independent on porosity.