

List of Figures

Figure	Page
Fig. 1 Map of Nasuno-ga-hara, the study area.	75
Fig. 2 Geomorphic map of Nasuno-ga-hara. Stars (★) shows sampling sites, from Loc.1 to Loc. 10.	76
Fig. 3 Outcrop at Loc. 1, <i>Recent River Floodplain</i> (0-ka surface)	77
Fig. 4 Longitudinal profiles of riverbed and terraces.	78
Fig. 5 Outcrop at Loc. 3, <i>Lower Terrace I</i> (20-ka surface).	79
Fig. 6 Profiles of four terraces (a: 20-ka surface, b: 320-ka surface, c: 450-ka surface and d: 830-ka surface).	80
Fig. 7 Outcrop at Loc. 6, <i>Upper Terrace</i> (320-ka surface).	81
Fig. 8 Outcrop at Loc. 8, <i>Lower Hill</i> (450-ka surface).	82
Fig. 9 Outcrop at Loc. 10, <i>Upper Hill</i> (830-ka surface).	83
Fig. 10 Andesite rocks taken from 0-ka surface.	84
Fig. 11 Andesite rocks taken from 20-ka surface.	85
Fig. 12 Andesite rocks taken from 320-ka surface.	86
Fig. 13 Andesite rocks taken from 450-ka surface.	87
Fig. 14 Andesite rocks taken from 830-ka surface.	88
Fig. 15 Polarization micrographs of 0-ka rocks.	89
Fig. 16 Polarization micrographs of 20-ka rocks.	90
Fig. 17 Polarization micrographs of 320-ka rocks.	91
Fig. 18 Polarization micrographs of 450-ka rocks.	92
Fig. 19 Polarization micrographs of 830-ka rocks.	94
Fig. 20 X-ray diffractograms.	95
Fig. 21 Colour changes with depth in terms of L* a* b* colour-system values.	98

Figure	Page
Fig. 22 Visible spectra determined from colour measurement.	101
Fig. 23 PSD histograms of 0-ka rocks.	102
Fig. 24 PSD histograms of 20-ka rocks.	103
Fig. 25 PSD histograms of 320-ka rocks.	105
Fig. 26 PSD histograms of 450-ka rocks.	107
Fig. 27 PSD histograms of 830-ka rock.	111
Fig. 28 Relationship between chemical compositions for the brown layers and those of the inner parts.	112
Fig. 29 Relationship between the absolute weight in unit volume of chemical elements for the brown layers and those of the inner parts .	113
Fig. 30 Element-concentration maps for sample 450-B1 constructed by EPMA.	114
Fig. 31 Element-concentration maps for sample 830-A1 constructed by EPMA.	115
Fig. 32 Results of EPMA line analyses of Si, Fe and Ca (a: sample 450-B1, b: sample 450-B64).	116
Fig. 33 Chemical changes with depth from the rock surface (a: sample 20-B2, b: sample 20-B6, c: sample 450-B1, d: sample 450-B10, e: sample 450-B12, f: sample 450-B64).	117
Fig. 34 VHN-values versus depth from the rock surfaces for 0-ka rocks.	123
Fig. 35 VHN-values versus depth from the rock surfaces for 20-ka rocks.	124
Fig. 36 VHN-values versus depth from the rock surfaces for 320-ka rocks.	126
Fig. 37 VHN-values versus depth from the rock surfaces for 450-ka rocks.	127
Fig. 38 VHN-values versus depth from the rock surfaces for 830-ka rocks.	129

Figure	Page
Fig. 39 Changes in apparent thickness of weathering rinds with time.	130
Fig. 40 Changes in chemical composition with time.	131
Fig. 41 Changes in absolute weights in unit volume of chemical elements with time.	138
Fig. 42 Changes in chemical weathering indices with time.	145
Fig. 43 Relationships between time and pore volumes (V_α , V_β , V_γ , V_δ and V_t), $(V_\alpha+V_\beta)/V_t$ and $(V_\gamma+V_\delta)/V_t$.	147
Fig. 44 Changes in bulk density and porosity with time.	149
Fig. 45 Changes in VHN values with time.	150
Fig. 46 Changes in chemical, physical and mechanical properties with time.	151
Fig. 47 Differences in pore development between andesite and porous rhyolite.	152
Fig. 48 Variations of rock properties with depth (a: sample 20-B2, b: sample 20-B6, c: sample 450-B1, d: sample 450-B64).	153
Fig. 49 Summary of rock properties and weathered zones.	157
Fig. 50 Mechanism of the development of dissolution and oxidation zones.	158
Fig. 51 Definitions of the thickness of Zones A and B (a: dense rock, b: porous rock).	159
Fig. 52 Relationships between weathering time and thickness of Zones A and A+B.	160
Fig. 53 Relationships between L and $t^{1/2}$ (a: L_A , b: L_{A+B}).	161
Fig. 54 Relationships between L and $(n \cdot t)^{1/2}$ (a: L_A , b: L_{A+B}).	162
Fig. 55 A model for the development of oxidation zone (Zone A) and dissolution zones (Zone A+B) with the different porosity.	163