

APPENDIX

I COVERAGE OF REMOTE SENSING DATA

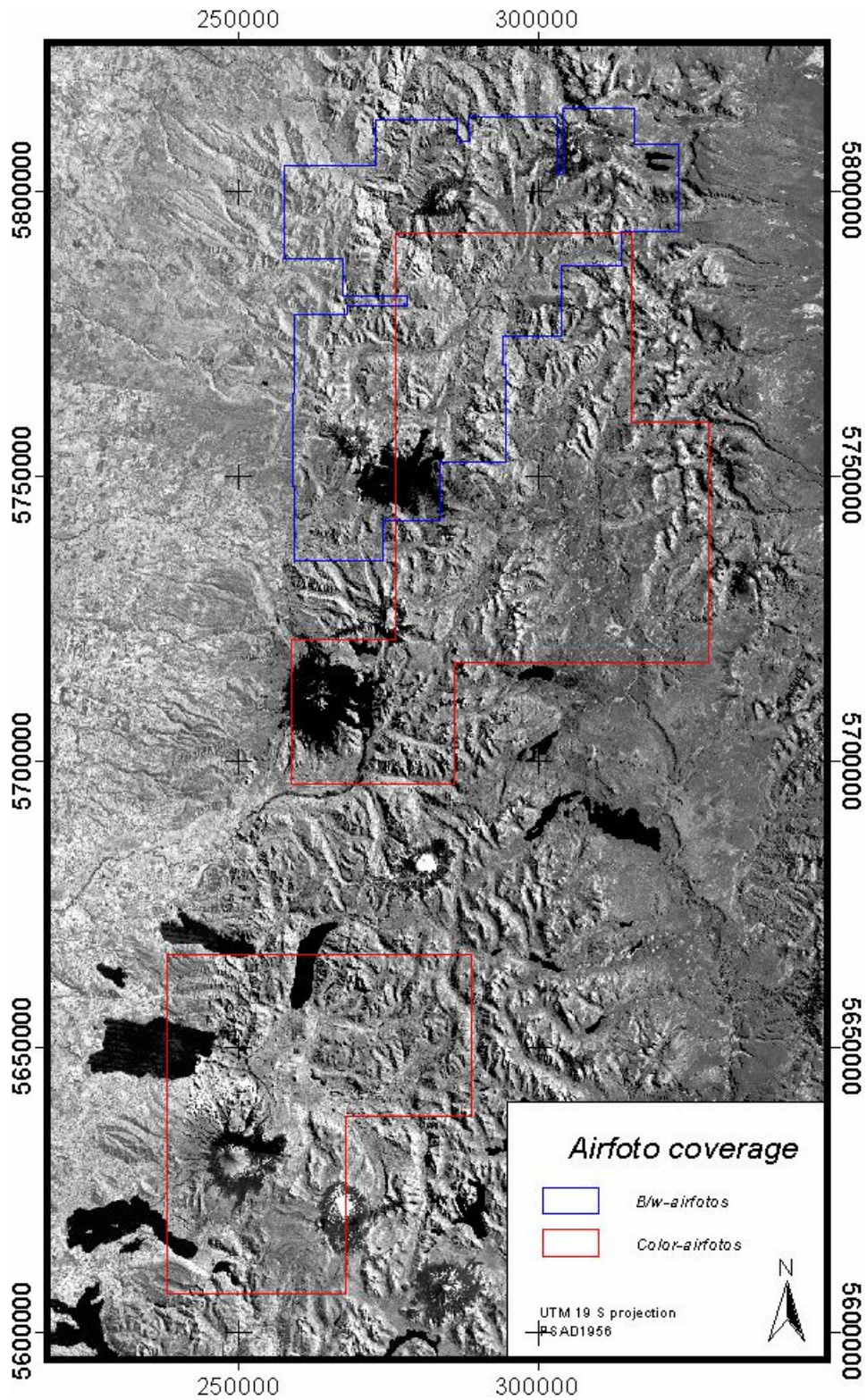


Fig. A1: Coverage of remote sensing data (UTM 19 S projection, PSAD 1956 ellipsoid).

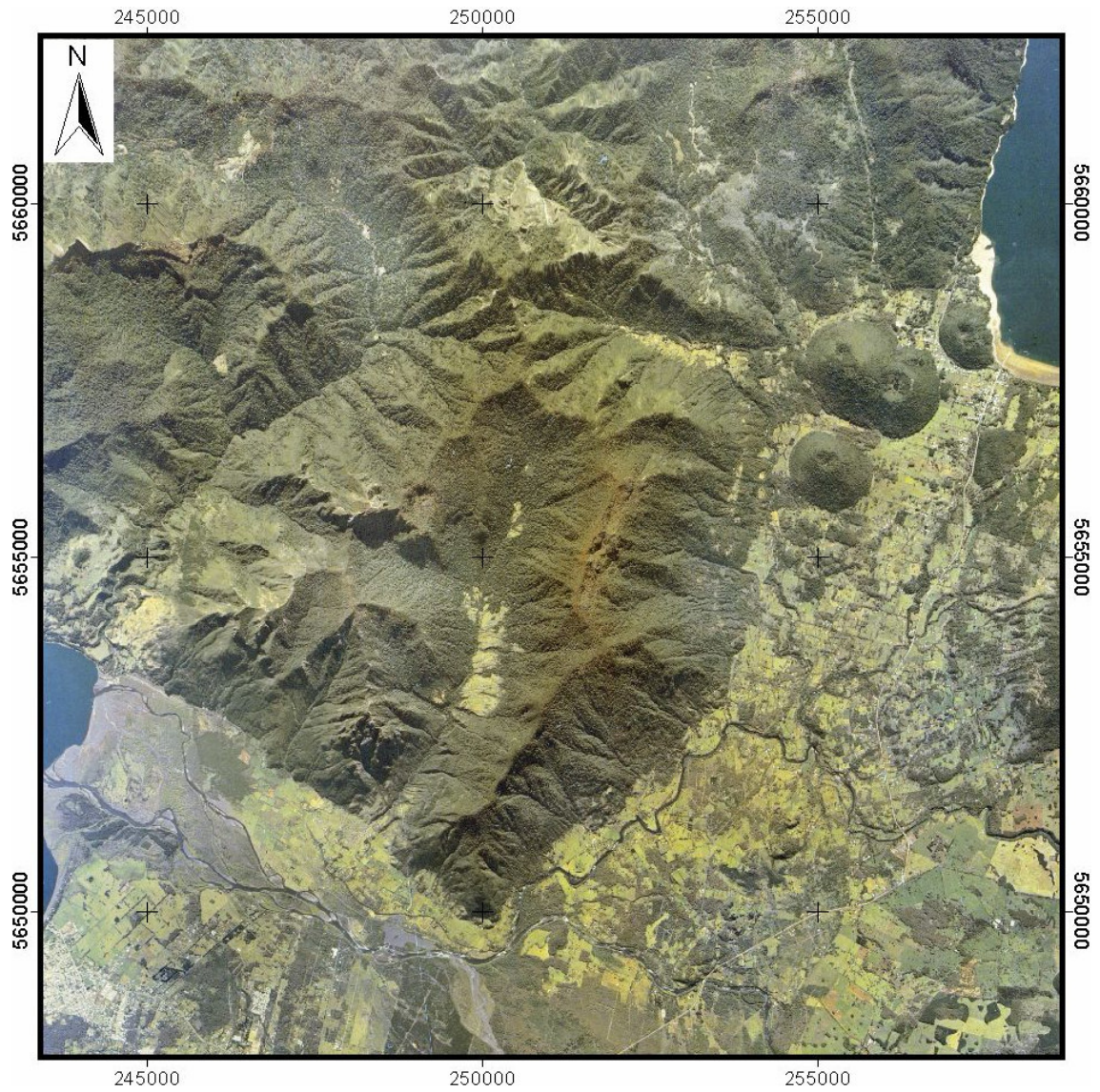


Fig. A2: Example of high resolution color air photo with 15 m ground resolution (Lago Caburga, 39°S, UTM 19 S projection, PSAD 1956 ellipsoid).

II GLACIERS OF THE STUDY AREA



Fig. A3: Glacier Grey (Parque Nacional Torres del Paine).

| Name | Latitude | Longitude | Base level (m) | Area (km ²) |
|---------------------------|----------|-----------|----------------|-------------------------|
| Nevados De Chillan | -36.87 | -71.38 | 2718.00 | 1.21 |
| Antuco | -37.40 | -71.37 | 2091.00 | 1.30 |
| Sierra Veluda | -37.45 | -71.42 | 2092.00 | 7.86 |
| Copahue | -37.85 | -71.17 | 2218.00 | 2.63 |
| Callaqui | -37.93 | -71.43 | 1864.00 | 3.48 |
| Sierra Nevada | -38.58 | -71.60 | 1928.00 | 4.35 |
| Llaima | -38.70 | -71.73 | 2127.00 | 0.41 |
| Sollipulli | -38.97 | -71.52 | 1834.00 | 10.15 |
| Quetrupillan I | -39.50 | -71.77 | 1727.00 | 5.95 |
| Mocho - Choshuenco | -39.93 | -72.03 | 1278.00 | 16.39 |
| Puyehue | -40.58 | -72.13 | 1810.00 | 1.63 |
| Osorno | -41.10 | -72.50 | 1261.00 | 3.73 |
| Tronador | -41.17 | -71.90 | 1138.00 | 38.72 |
| Yate | -41.78 | -72.38 | 1333.00 | 7.98 |
| Michinmahuida | -42.80 | -72.45 | 500.00 | 236.51 |
| Corcovado | -43.18 | -72.80 | 730.00 | 21.77 |
| Yanteles | -43.50 | -72.80 | 424.00 | 143.15 |

Tab. A1: Distribution of modern glaciers and snow fields in the study area as derived from analysis of Landsat TM image.

III VOLCANOES OF THE STUDY AREA

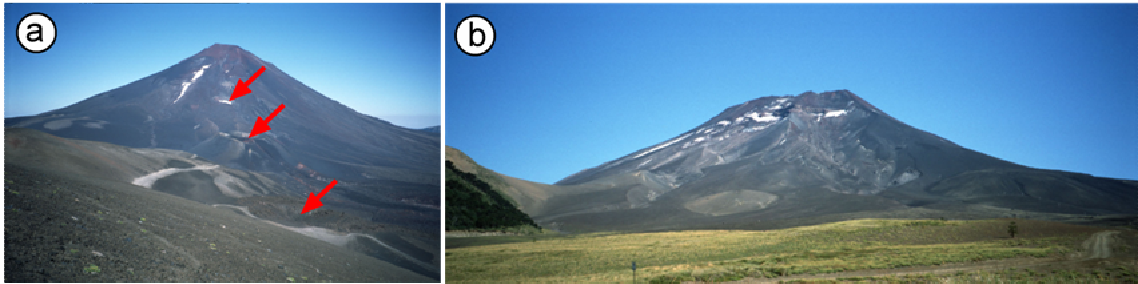


Fig. A4: Vn. Lonquimay as an example of a Holocene volcano elongated in a NE-SW direction. Pictures taken with orthogonal perspectives: (a) Polar N120°W (parasitic cones indicated by red arrows), (b) lateral N50°W.



Fig. A5: Normal fault cutting through recent ash deposits in the edifice of Vn. Llaima (38.5°S, UTM 19 S projection, PSAD 1956 ellipsoid).

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| Name | Latitude | Longitude | Azimuth |
|--------------------------|----------|-----------|---------|
| Waile | -37.067 | -69.967 | 25 |
| Tromen | -37.133 | -69.850 | 50 |
| Tilhue | -37.267 | -69.933 | 25 |
| Antuco - Sierra Veluda | -37.425 | -71.392 | 45 |
| Copahue-Trocoman | -37.741 | -69.956 | 60 |
| Callaqui | -37.933 | -71.433 | 55 |
| Laguna Marinaqui | -38.267 | -71.100 | 40 |
| Lolco | -38.283 | -71.500 | 60 |
| Tolhuaca | -38.300 | -71.633 | 140 |
| La Holandesa | -38.308 | -71.533 | 60 |
| Cerro Canasto | -38.317 | -71.467 | 60 |
| Laguna Verde | -38.317 | -71.592 | 60 |
| Caracol | -38.350 | -71.683 | 60 |
| Lonquimay | -38.367 | -71.583 | 65 |
| Pino Solo | -38.508 | -70.750 | 90 |
| Sierra Nevada | -38.583 | -71.600 | 75 |
| Pino Hachado | -38.667 | -71.050 | 60 |
| Llaima | -38.700 | -71.733 | 50 |
| Meseta Del Arco | -38.817 | -71.083 | 60 |
| Sollipulli | -38.967 | -71.517 | - |
| Caburgua | -39.200 | -71.833 | 40 |
| Pichares | -39.233 | -71.700 | 20 |
| Redondo | -39.250 | -71.800 | 10 |
| Huelemolle | -39.317 | -71.833 | 15 |
| Villarica | -39.417 | -71.950 | 15 |
| Palguin | -39.417 | -71.950 | 60 |
| Quetrupillan II | -39.500 | -71.767 | 15 |
| Quetrupillan I | -39.500 | -71.767 | 45 |
| Lanin | -39.633 | -71.500 | - |
| Mocho - Choshuenco | -39.933 | -72.033 | 50 |
| Carran - Rininahue | -40.363 | -72.071 | 60 |
| Media Luna | -40.389 | -72.017 | 125 |
| Cordillera Nevada | -40.458 | -72.250 | - |
| Los Nirres | -40.500 | -72.017 | 60 |
| Cordon Caules | -40.500 | -72.250 | 130 |
| Mencheca | -40.542 | -72.042 | 70 |
| Pichi -Golgol | -40.561 | -72.017 | 50 |
| Puyehue | -40.583 | -72.133 | - |
| Fiucha | -40.717 | -72.233 | 55 |
| Antillanca-Casablanca | -40.783 | -72.183 | 55 |
| Puntiagudo | -40.983 | -72.267 | 55 |
| La Picada | -41.050 | -72.433 | 55 |
| Osorno | -41.100 | -72.500 | 55 |
| El Negrillar De Ensenada | -41.133 | -72.533 | 145 |
| Tronador | -41.167 | -71.900 | - |
| Pichilaguna | -41.183 | -72.267 | - |
| Cayutue | -41.283 | -72.283 | - |
| Calbuco | -41.333 | -72.617 | - |
| Cabeza De Vaca | -41.333 | -72.283 | - |
| La Vigueria | -41.383 | -72.333 | - |
| Rollizo | -41.433 | -72.317 | - |
| Pocoihuen | -41.500 | -72.333 | - |
| Yate | -41.783 | -72.383 | 155 |
| Hornopiren | -41.867 | -72.450 | 25 |
| Apagado | -41.883 | -72.617 | - |

Tab. A2: Volcanoes of the study area. Direction of elongation (if present) indicated (N---°E).

IV GEOMORPHOMETRIC DATA

| | Subarea 1 | Subarea 2 | Subarea 3 | Subarea 4 | Subarea 5 | Subarea 6 |
|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Latitude (°S) | 37 - 38 | 38 - 39 | 39 - 40 | 40 - 41 | 41 - 42 | 42 - 43 |
| Area (km²) | 8130 | 10870 | 7078 | 6336 | 8348 | 6440 |
| N | 3251858 | 4348042 | 2831178 | 2534482 | 3339156 | 2576101 |
| Resolution (m) | 50 | 50 | 50 | 50 | 50 | 50 |
| Max (m) | 3549 | 3089 | 3693 | 2443 | 3392 | 2396 |
| Min (m) | 225 | 228 | 89 | 75 | 0 | 0 |
| Mean (m) | 1185 | 1150 | 874 | 796 | 735 | 687 |
| E | 0.29 | 0.32 | 0.22 | 0.30 | 0.22 | 0.29 |
| Mean slope (°) | 14 | 11 | 14 | 11 | 18 | 19 |
| Surface ratio | 1.0557 | 1.0385 | 1.0559 | 1.0590 | 1.0939 | 1.1102 |

Tab. A3: Geomorphometric data of the study area.

V GEOTHERMOBAROMETRIC DATA

| ID | Easting | Northing | Rock | Age (Ma) | T (°C) | P (kbar) | Depth (km) | +/- |
|--------------|---------|----------|--------------|----------|--------|----------|------------|-----|
| LOF2-3 | 262500 | 5598000 | granodiorite | 112 | 704 | 2.3 | 8.6 | 2.1 |
| LOF4 | 257530 | 5598603 | orthogneiss | | 701 | 4.4 | 16.4 | 6.1 |
| LOF9 | 251421 | 5601334 | granite | 5.7 | 755 | 1.3 | 4.9 | 2.4 |
| LOF10 | 250979 | 5601745 | granite | 5.7 | 607 | 1.5 | 5.6 | 1.5 |
| LOF11 | 248271 | 5596619 | granodiorite | 184 | 711 | 2.5 | 9.4 | 1.7 |
| LOF12 | 259764 | 5599895 | granite | 103 | 498 | 3 | 11.1 | 3.5 |
| LOF13 | 259739 | 5598447 | granite | 103 | 465 | 3.5 | 12.8 | 1.8 |
| LOF15 | 257693 | 5593904 | granite | 110 | 634 | 3.1 | 11.3 | 1.9 |
| LOF49 | 258387 | 5598864 | orthogneiss | | 660 | 1.5 | 5.4 | 1.2 |
| LOF59 | 260231 | 5593934 | granite | 110 | 815 | 1.7 | 6.2 | 2.2 |
| LOF60 | 260426 | 5593855 | granite | 110 | 800 | 3.3 | 12.1 | 2.2 |
| LOF64 | 258060 | 5597855 | orthogneiss | | 638 | 3.3 | 12.2 | 3.0 |
| LOF73 | 257581 | 5582526 | granite | 180 | 720 | 1.1 | 4.1 | 2.2 |
| LOF77 | 270331 | 5592819 | granite | 108 | 760 | 2.3 | 8.5 | 3.3 |
| LOF78 | 269129 | 5593518 | granite | 108 | 771 | 2.7 | 10.0 | 2.6 |
| LOF79 | 267026 | 5593433 | granite | 108 | 752 | 2.8 | 10.3 | 4.1 |
| LOF89 | 264956 | 5601635 | granite | 92 | 756 | 2.2 | 8.1 | 1.8 |
| LOF93 | 260231 | 5593934 | granite | 110 | 755 | 3.3 | 12.2 | 2.2 |
| LOF95 | 258584 | 5607612 | granite | 97 | 696 | 3.4 | 12.7 | 2.1 |
| LOF98 | 262279 | 5587960 | granite | 110 | 749 | 2.6 | 9.7 | 1.1 |
| LOF101 | 245070 | 5550996 | granite | 180 | 710 | 2.9 | 10.7 | 2.3 |
| LOF104 | 244944 | 5550928 | granite | 15 | 767 | 1.6 | 5.8 | 2.2 |
| LOF105 | 246729 | 5546936 | granite | 180 | 726 | 2.4 | 9.0 | 2.2 |
| LOF108 | 257645 | 5595542 | orthogneiss | | 649 | 2.3 | 8.5 | 2.6 |
| LOF117 | 247184 | 5556036 | orthogneiss | | 592 | 2.2 | 8.0 | 1.4 |
| LOF118 | 247184 | 5556036 | orthogneiss | | 649 | 2.3 | 8.4 | 2.5 |
| LOF119 | 247184 | 5556036 | granite | 15 | 772 | 1.7 | 6.5 | 2.2 |
| LOF130 | 249671 | 5609495 | granite | 6.4 | 663 | 2.6 | 9.6 | 1.6 |
| LOF131 | 248550 | 5624567 | granite | 10 | 656 | 2.4 | 9.0 | 2.7 |
| LOF133 | 271790 | 5640648 | granite | 10 | 730 | 1.1 | 4.0 | 2.1 |
| LOF134 | 286665 | 5645824 | granite | 94 | 656 | 2.1 | 7.7 | 1.0 |
| LOF137 | 270700 | 5805651 | granite | | 736 | 1.6 | 5.9 | 2.6 |
| LOF138 | 270480 | 5805271 | granite | | 729 | 1.8 | 6.7 | 3.5 |
| LOF140 | 274359 | 5865464 | granite | | 749 | 0.9 | 3.3 | 0.5 |
| LOF140 E.1 | 274359 | 5865464 | granite | | 761 | <1 | <3.0 | |
| LOF140 E.2 | 274359 | 5865464 | granite | | 703 | 1 | 3.7 | 2.2 |
| LOF140 E.3 | 274359 | 5865464 | granite | | 725 | 1 | 3.5 | 2.0 |
| LOF141 | 275843 | 5864690 | granite | | 754 | <1 | <3.0 | |
| LOF141x | 275843 | 5864690 | diorite | | 729 | <1 | <3.0 | |
| LOF142 | 275165 | 5876776 | granite | | 719 | 1 | 3.7 | 1.1 |
| LOF143 E.1 | 279550 | 5859736 | granite | | 766 | 1 | 3.7 | 1.7 |
| LOF143 E.2 | 279550 | 5859736 | granite | | 695 | 0.9 | 3.3 | 0.2 |
| LOF145 | 262515 | 5780277 | granodiorite | 58 | 736 | 0.9 | 3.3 | 0.6 |
| LOF146 | 259802 | 5785083 | granodiorite | 9.3 | 696 | 1 | 3.7 | |
| LOF148 | 287578 | 5727549 | tonalite | 82.7 | 722 | 1.2 | 4.4 | 1.1 |
| LOF148 P | 287578 | 5727549 | pegmatite | 82.7 | 767 | 1 | 3.8 | 2.2 |
| LOF149 | 287627 | 5725162 | tonalite | 82.7 | 750 | 0.9 | 3.3 | 1.3 |
| LOF150 | 292130 | 5716895 | granodiorite | 93.6 | 706 | 1.8 | 6.7 | 0.7 |
| LOF151 | 285214 | 5712806 | granite | 108 | 790 | 1.3 | 4.8 | 0.4 |
| LOF155 | 302755 | 5702654 | granite | 86 | 739 | 0.8 | 3.0 | 1.1 |
| LOF157 | 280382 | 5697123 | qtz-diorite | 10.7 | 730 | 1 | 3.7 | 2.2 |
| LOF157.2 E.1 | 274642 | 5696333 | monzogranite | 11.2 | 717 | 1.1 | 4.2 | 1.2 |
| LOF157.2 E.2 | 274642 | 5696333 | monzogranite | 11.2 | 721 | 1.1 | 4.0 | 2.2 |
| LOF157.2 E.3 | 274642 | 5696333 | monzogranite | 11.2 | 715 | 1 | 3.8 | 0.9 |
| LOF158 | 274642 | 5696333 | monzogranite | 11.2 | 736 | 1.4 | 5.2 | 1.0 |
| LOF159 | 250711 | 5690708 | monzogranite | 8.8 | 685 | <1 | <3.0 | |
| LOF160 | 266469 | 5738736 | granite | | 707 | <1 | <3.0 | |

Tab. A4: Al-in-hbl geothermobarometric data (after Seifert et al., in press). For details of the method see there.

APPENDIX

| ID | Easting | Northing | Rock | Age (Ma) | T (°C) | P (kbar) | Depth (km) | +/- |
|------------|---------|----------|--------------|----------|--------|----------|------------|-----|
| LOF161 E.1 | 249010 | 5703284 | granodiorite | 12.7 | 736 | <1 | <3.0 | |
| LOF161 E.2 | 249010 | 5703284 | granodiorite | 12.7 | 730 | <1 | <3.0 | |
| LOF166 E | 340451 | 5727187 | granite | | 700 | <1 | <3.0 | |
| LOF171 | 301359 | 5730235 | granite | 123.3 | 722 | 1.6 | 5.9 | 1.0 |
| LOF173 | 288075 | 5686235 | granite | 148 | 730 | 0.8 | 3.0 | 0.7 |
| LOF174 | 277384 | 5696650 | qtz-diorite | 11.2 | 729 | 1 | 3.7 | 1.0 |
| LOF202 | 281073 | 5627014 | diorite | 111 | 682 | 3.9 | 14.0 | 0.8 |
| LOF203 | 280219 | 5620506 | granite | 111 | 683 | 3.9 | 14.2 | 1.1 |
| LOF204 | 268713 | 5640534 | granite | | 627 | 5.1 | 20.6 | 0.7 |
| LOF206 | 262121 | 5666766 | granite | | 701 | 2 | 7.4 | 1.9 |
| LOF207 | 250719 | 5650091 | diorite | | 710 | 2.1 | 7.6 | 2.7 |
| LOF208 | 247139 | 5651604 | granite | | 683 | 1.9 | 7.0 | |
| LOF209 | 246640 | 5652135 | granite | | 669 | 1.8 | 6.7 | |
| LOF211 | 232068 | 5615456 | granite | 304.7 | 675 | 4.3 | 15.6 | |
| LOF213 | 228446 | 5595909 | granite | 142 | 693 | 1.6 | 5.9 | 1.2 |
| LOF215 | 231559 | 5593401 | diorite | | 662 | 2.9 | 10.4 | 2.2 |
| LOF217 | 223632 | 5578296 | granite | 296.7 | 667 | 5.5 | 20.0 | 4.8 |
| LOF219.1 | 221606 | 5398290 | granite | | 680 | 2.7 | 9.9 | 1.4 |
| LOF219.2 | 221606 | 5398290 | granite | | 688 | 2.1 | 7.5 | 3.3 |
| LOF220 | 221737 | 5399476 | granite | | 675 | 2.8 | 10.1 | 1.2 |
| LOF222.2 | 218160 | 5399158 | granite | | 671 | 3 | 11.0 | 1.0 |
| LOF223 | 220694 | 5398570 | granite | | 663 | 2.9 | 10.4 | 1.5 |
| LOF224 | 211032 | 5421721 | diorite | | 666 | 3.9 | 14.0 | 0.9 |
| LOF225 | 224190 | 5383923 | granite | 115 | 683 | 2.5 | 9.0 | 1.3 |
| LOF226 | 223157 | 5388740 | granite | | 688 | 2.8 | 10.1 | 0.9 |
| LOF227 | 225710 | 5397683 | granite | | 688 | 2.1 | 7.7 | 0.9 |
| LOF229 | 194998 | 5382248 | diorite | | 670 | 3.2 | 11.7 | 3.6 |
| LOF231 | 215530 | 5342389 | granite | | 685 | 1.9 | 6.9 | 1.5 |
| LOF232 | 215530 | 5342389 | granodiorite | 6.6 | 678 | 2.4 | 8.9 | 1.6 |
| LOF233 | 214161 | 5333489 | granodiorite | | 675 | 4.1 | 14.9 | 2.9 |
| LOF235 | 214831 | 5531281 | granite | 286 | 676 | 3 | 11.0 | 0.3 |
| LOF236 | 237315 | 5530228 | granite | 6.6 | 687 | 2.2 | 8.2 | 1.8 |
| LOF238 | 217321 | 5553170 | granite | 267 | 692 | 2.4 | 8.7 | 1.2 |
| PAN026 | 255033 | 5671509 | granite | 12 | 703 | 3.3 | 12.0 | 1.7 |
| PAN043 | 289825 | 5647040 | granite | | 711 | 2.2 | 8.0 | 0.8 |
| PAN044 | 289243 | 5657855 | granite | | 673 | 4.7 | 17.1 | 0.7 |
| PAN053 | 735311 | 5386289 | granite | | 672 | 3.7 | 13.4 | |
| PAN070 | 279162 | 5821070 | granite | | 708 | 1 | 3.5 | |
| PAN076 | 276322 | 5813256 | granite | | 701 | 3.2 | 11.7 | 1.1 |

Tab. A4: Al-in-hbl geothermobarometric data (continued).

VI WHOLE ROCK CHEMICAL DATA

| | | LOF41 | LOF44 | LOF84 | LOF53 | LOF56 | LOF76 | LOF19 |
|------------------------------------|-----|-----------|-----------|-----------|----------|----------|----------|---------|
| | | Migmatite | Migmatite | Migmatite | Mylonite | Mylonite | Phyllite | Diorite |
| SiO₂ | % | 71.7 | 76.8 | 76.3 | 53.1 | 64.5 | 57.2 | 50.1 |
| TiO₂ | % | 0.71 | 0.53 | 0.62 | 1.17 | 0.83 | 0.88 | 1.03 |
| Al₂O₃ | % | 12.8 | 10.8 | 11.0 | 21.0 | 15.9 | 19.5 | 21.5 |
| Fe₂O₃ | % | 4.32 | 3.04 | 3.50 | 9.14 | 6.09 | 8.34 | 7.88 |
| MnO | % | 0.07 | 0.08 | 0.05 | 0.11 | 0.07 | 0.07 | 0.10 |
| MgO | % | 1.52 | 1.15 | 1.24 | 3.12 | 1.94 | 2.41 | 3.12 |
| CaO | % | 2.24 | 1.05 | 2.01 | 3.92 | 2.51 | 0.77 | 5.43 |
| Na₂O | % | 3.10 | 2.18 | 2.50 | 3.69 | 4.11 | 0.85 | 3.77 |
| K₂O | % | 1.41 | 2.14 | 1.42 | 2.22 | 1.67 | 4.17 | 3.13 |
| P₂O₅ | % | 0.12 | 0.13 | 0.12 | 0.16 | 0.17 | 0.25 | 0.50 |
| H₂O | % | 1.97 | 1.72 | 0.92 | 2.40 | 1.62 | 4.34 | 2.53 |
| CO₂ | % | 0.08 | 0.10 | 0.08 | 0.09 | 0.23 | 1.43 | 0.29 |
| Sum | | 100.1 | 99.7 | 99.8 | 100.2 | 99.7 | 100.2 | 99.3 |
| Rb | ppm | 54 | 73 | 62 | 105 | 60 | 168 | 118 |
| Sr | ppm | 139 | 68 | 231 | 255 | 234 | 62 | 907 |
| Y | ppm | 33 | 29 | 27 | 39 | 39 | 40 | 9 |
| Zr | ppm | 276 | 292 | 295 | 218 | 205 | 138 | 380 |
| Nb | ppm | 13 | 15 | 10 | 18 | 13 | 19 | 13 |
| Ba | ppm | 308 | 412 | 402 | 556 | 561 | 612 | 1618 |
| Cr | ppm | 47 | 39 | 73 | 110 | 43 | 103 | 36 |
| Ni | ppm | 23 | <10 | 31 | 53 | 25 | 49 | 25 |
| Zn | ppm | 64 | 37 | 49 | 111 | 65 | 86 | 86 |
| V | ppm | 69 | 51 | 62 | 221 | 132 | 159 | 220 |

Tab. A5: Whole rock chemical data of samples of the Liquiñe area (produced by X-ray fluorescence analysis at GFZ Potsdam).