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**Title of article** "Anomalously Young Volcanoes on Old Hot Spot Traces: I. Geology and Petrology of Cocos Island"

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## APPENDIX 1A. REPRESENTATIVE OLIVINE ANALYSES

| Sample Desc * | DV8 gms | DV8 pn rm | DV8 pn cr | DV8 pn rm | DV8 pn cr | PC4 gms | PC4 pn rm | PC4 pn cr |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 36.50 | 34.15 | 37.46 | 38.57 | 38.66 | 35.80 | 38.58 | 39.85 |
| FeO | 29.33 | 40.72 | 22.20 | 17.12 | 17.18 | 32.32 | 20.02 | 11.60 |
| MgO | 32.39 | 21.39 | 38.58 | 43.31 | 43.26 | 29.94 | 40.41 | 46.91 |
| CaO | 0.35 | 0.49 | 0.22 | 0.23 | 0.19 | 0.44 | 0.27 | 0.24 |
| NiO | 0.13 | 0.13 | 0.11 | 0.10 | 0.20 | 0.18 | 0.16 | 0.21 |
| $TiO_2$ | 0.14 | 0.09 | 0.04 | 0.06 | 0.06 | 0.14 | 0.11 | 0.01 |
| MnO | 0.75 | 2.08 | 0.40 | 0.31 | 0.32 | n.a. | 0.37 | 0.22 |
| Total | 99.59 | 98.97 | 99.01 | 99.70 | 99.87 | 98.85 | 99.92 | 99.04 |
| Number of ions on 4 oxygen bases: | | | | | | | | |
| Si | .992 | 1.000 | .988 | .985 | .986 | .993 | .995 | .997 |
| Fe | .667 | .997 | .489 | .365 | .366 | .750 | .432 | .243 |
| Mg | 1.313 | .993 | 1.516 | 1.648 | 1.644 | 1.238 | 1.554 | 1.749 |
| Ca | .010 | .013 | .006 | .006 | .005 | .013 | .007 | .007 |
| Ni | .003 | .003 | .002 | .002 | .004 | .004 | .003 | .004 |
| Ti | .003 | .002 | .001 | .001 | .001 | .003 | .002 | .000 |
| Mn | .017 | .052 | .009 | .007 | .007 | n.a. | .008 | .005 |
| Total | 3.004 | 2.989 | 3.012 | 3.014 | 3.013 | 3.000 | 3.002 | 3.003 |
| Molecular proportions: | | | | | | | | |
| Fo | 66.3 | 49.9 | 75.6 | 81.9 | 81.8 | 62.3 | 78.2 | 87.8 |
| Fa | 33.7 | 50.1 | 24.4 | 18.1 | 18.2 | 37.7 | 21.8 | 12.2 |

Note : Desc * = Description of phases analyzed (the same from Tables 1A to 1E): gms = groundmass; mpn = microphenocryst; pn = phenocryst; rm = rim; mt = mantle; cr = core; cl = clast; (oliv) = included in an olivine crystal; (cpx) = included in clinopyroxene crystal.

APPENDIX 1A. REPRESENTATIVE OLIVINE ANALYSES (continued)

| Sample Desc | PC75 gms | PC75 pn cr | PC30 gms | PC30 pn cr | E1 gms | PC8 gms | PC8 mpn rm | PC8 mpn cr |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 34.77 | 39.10 | 38.13 | 38.89 | 34.61 | 33.62 | 35.88 | 35.42 |
| FeO | 39.67 | 21.64 | 23.33 | 18.48 | 39.66 | 45.92 | 36.08 | 35.30 |
| MgO | 22.91 | 38.44 | 37.10 | 41.44 | 24.29 | 16.80 | 25.43 | 26.38 |
| CaO | 0.52 | 0.22 | 0.25 | 0.21 | 0.42 | 0.36 | 0.32 | 0.32 |
| NiO | n.a. | n.a. | 0.13 | 0.16 | 0.00 | 0.16 | 0.06 | 0.16 |
| $TiO_2$ | 0.20 | 0.06 | 0.06 | 0.04 | 0.07 | 0.10 | 0.10 | 0.07 |
| MnO | 1.11 | 0.42 | n.a. | n.a. | 1.30 | 2.48 | 1.89 | 1.81 |
| Total | 99.18 | 99.88 | 99.00 | 99.25 | 100.4 | 99.44 | 99.76 | 99.46 |
| Number of ions on 4 oxygen bases: | | | | | | | | |
| Si | 1.003 | 1.014 | 1.006 | 1.000 | .987 | 1.008 | 1.011 | .999 |
| Fe | .957 | .469 | .515 | .398 | .946 | 1.151 | .850 | .833 |
| Mg | .985 | 1.485 | 1.459 | 1.589 | 1.033 | .750 | 1.068 | 1.109 |
| Ca | .016 | .006 | .007 | .006 | .013 | .012 | .010 | .010 |
| Ni | n.a. | n.a. | .003 | .003 | .001 | .004 | .001 | .004 |
| Ti | .004 | .001 | .001 | .001 | .001 | .002 | .002 | .002 |
| Mn | .027 | .009 | n.a. | n.a. | .031 | .063 | .045 | .043 |
| Total | 2.992 | 2.985 | 2.990 | 2.996 | 3.012 | 2.990 | 2.986 | 2.999 |
| Molecular proportions: | | | | | | | | |
| Fo | 50.7 | 76.0 | 73.9 | 80.0 | 52.2 | 39.5 | 55.7 | 57.1 |
| Fa | 49.3 | 24.0 | 26.1 | 20.0 | 47.8 | 60.5 | 44.3 | 42.9 |

## APPENDIX 1B. REPRESENTATIVE PYROXENE ANALYSES

| Sample Desc | DV8 gms | DV8 pn rm | DV8 pn mt | DV8 pn cr | E62 gms | E62 pn cr | E15 gms | E15 pn rm | E15 pn cr |
|---|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 47.99 | 47.56 | 45.95 | 45.73 | 48.95 | 48.58 | 51.68 | 49.75 | 49.41 |
| $Al_2O_3$ | 5.58 | 6.22 | 8.47 | 8.83 | 4.91 | 5.57 | 2.80 | 1.91 | 2.35 |
| FeO* | 7.74 | 7.84 | 6.97 | 6.93 | 6.43 | 6.63 | 13.50 | 15.79 | 16.92 |
| MgO | 13.62 | 13.11 | 13.07 | 12.62 | 15.19 | 14.67 | 9.27 | 9.41 | 8.44 |
| CaO | 21.92 | 22.10 | 21.94 | 21.58 | 20.79 | 20.93 | 20.12 | 20.59 | 20.79 |
| $Na_2O$ | 0.47 | 0.49 | 0.56 | 0.52 | 0.38 | 0.57 | 0.95 | 0.44 | 0.60 |
| $TiO_2$ | 2.37 | 2.54 | 2.86 | 3.02 | 2.34 | 2.03 | n.a. | n.a. | n.a. |
| MnO | 0.19 | 0.16 | 0.17 | 0.20 | 0.18 | 0.14 | 99.71 | 0.58 | 0.57 |
| Total | 99.88 | 100.0 | 99.99 | 99.43 | 99.17 | 99.12 | 99.18 | 100.1 | 99.41 |
| $Fe_2O_3$† | 3.29 | 3.12 | 4.04 | 2.55 | 1.61 | 2.74 | 1.74 | 1.58 | 2.37 |
| Number of ions on 6 oxygen basis: | | | | | | | | | |
| Si | 1.772 | 1.732 | 1.682 | 1.657 | 1.751 | 1.789 | 1.906 | 1.926 | 1.873 |
| Al | .243 | .267 | .365 | .377 | .207 | .242 | .083 | .087 | .105 |
| $Fe^{2+}$ | .148 | .153 | .102 | .141 | .149 | .128 | .388 | .465 | .469 |
| $Fe^{3+}$ | .091 | .085 | .111 | .069 | .043 | .076 | .049 | .046 | .068 |
| Mg | .750 | .712 | .713 | .682 | .810 | .805 | .552 | .543 | .477 |
| Ca | .867 | .862 | .860 | .838 | .797 | .826 | .863 | .854 | .844 |
| Na | .034 | .035 | .040 | .037 | .026 | .041 | .053 | .033 | .044 |
| Ti | .066 | .070 | .079 | .082 | .063 | .056 | .021 | .021 | .027 |
| Mn | .006 | .005 | .005 | .006 | .005 | .004 | .018 | .019 | .022 |
| Total | 3.975 | 3.922 | 3.958 | 3.890 | 3.852 | 3.967 | 3.933 | 3.995 | 3.928 |
| Molecular proportions: | | | | | | | | | |
| En | 42.5 | 41.2 | 42.6 | 41.1 | 46.1 | 45.8 | 30.6 | 29.2 | 26.6 |
| Fs | 8.4 | 8.9 | 6.1 | 8.5 | 8.5 | 7.3 | 21.5 | 25.0 | 26.2 |
| Wo | 49.1 | 49.9 | 51.3 | 50.5 | 45.4 | 46.9 | 47.9 | 45.9 | 47.2 |

Notes: * = Measured total FeO
† = Calculated $Fe_2O_3$

APPENDIX 1B. REPRESENTATIVE PYROXENE ANALYSES (continued)

| Sample Desc | PC8 gms | PC8 pn rm | PC8 pn cr | RB43 gms | RB43 pn rm | RB43 pn cr | E64 gms | E64 gms |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 49.13 | 51.17 | 50.74 | 44.78 | 48.41 | 50.62 | 51.29 | 51.03 |
| $Al_2O_3$ | 4.88 | 2.26 | 1.54 | 7.66 | 4.71 | 2.60 | 1.91 | 1.70 |
| FeO* | 10.33 | 10.98 | 11.97 | 10.25 | 7.67 | 7.36 | 9.63 | 11.05 |
| MgO | 12.36 | 12.22 | 12.77 | 11.81 | 13.83 | 14.96 | 12.75 | 11.83 |
| CaO | 19.81 | 21.88 | 21.43 | 20.80 | 21.90 | 21.91 | 22.41 | 22.39 |
| $Na_2O$ | 0.66 | 0.54 | 0.51 | 0.79 | 0.44 | 0.43 | 0.59 | 0.61 |
| $TiO_2$ | n.a. | n.a. | n.a. | 4.34 | 1.99 | 1.23 | 0.74 | 0.64 |
| MnO | 0.67 | 0.47 | 0.71 | 0.26 | 0.20 | 0.26 | 0.48 | 0.51 |
| Total | 100.4 | 100.2 | 99.67 | 100.7 | 99.25 | 99.37 | 99.80 | 99.76 |
| $Fe_2O_3$† | 1.05 | 2.50 | 4.56 | 4.92 | 3.48 | 3.03 | 2.55 | 2.86 |
| Number of ions on 6 oxygen basis: | | | | | | | | |
| Si | 1.793 | 1.911 | 1.871 | 1.637 | 1.781 | 1.802 | 1.883 | 1.883 |
| Al | .210 | .099 | .076 | .330 | .204 | .109 | .083 | .074 |
| $Fe^{2+}$ | .286 | .273 | .243 | .178 | .140 | .138 | .225 | .261 |
| $Fe^{3+}$ | .029 | .070 | .127 | .135 | .096 | .081 | .071 | .079 |
| Mg | .672 | .680 | .702 | .644 | .764 | .794 | .698 | .651 |
| Ca | .775 | .876 | .847 | .815 | .863 | .836 | .882 | .885 |
| Na | .047 | .039 | .036 | .056 | .031 | .030 | .042 | .044 |
| Ti | .049 | .018 | .015 | .119 | .055 | .033 | .020 | .018 |
| Mn | .015 | .022 | .022 | .008 | .006 | .008 | .015 | .016 |
| Total | 3.875 | 3.989 | 3.931 | 3.922 | 3.941 | 3.830 | 3.918 | 3.911 |
| Molecular proportions: | | | | | | | | |
| En | 38.8 | 37.2 | 39.2 | 39.3 | 43.2 | 44.9 | 38.7 | 36.2 |
| Fs | 16.5 | 14.9 | 13.5 | 10.9 | 7.9 | 7.8 | 12.5 | 14.5 |
| Wo | 44.7 | 47.9 | 47.3 | 49.8 | 48.9 | 47.3 | 48.9 | 49.2 |

# APPENDIX 1C. REPRESENTATIVE FELDSPAR ANALYSES

| Sample Desc | DV8 gms | DV8 pn rm | DV8 pn mt | DV8 pn cr | E15 gms | E15 pn rm | E15 pn cr | PC8 pn rm | PC8 pn cr |
|---|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 60.82 | 54.43 | 47.91 | 48.89 | 65.04 | 59.87 | 59.11 | 62.48 | 65.22 |
| $Al_2O_3$ | 22.07 | 27.82 | 33.10 | 31.91 | 19.36 | 24.85 | 25.13 | 22.22 | 20.44 |
| FeO | 0.69 | 0.68 | 0.41 | 0.54 | 0.39 | 0.22 | 0.24 | 0.20 | 0.23 |
| MgO | 0.17 | 0.09 | 0.04 | 0.02 | 0.03 | 0.02 | 0.04 | 0.02 | 0.03 |
| CaO | 6.93 | 10.04 | 15.71 | 14.74 | 0.50 | 5.48 | 6.33 | 3.24 | 1.12 |
| $K_2O$ | 2.93 | 0.46 | 0.17 | 0.10 | 7.87 | 1.28 | 0.97 | 3.41 | 6.03 |
| $Na_2O$ | 5.94 | 5.41 | 2.38 | 2.99 | 6.07 | 7.87 | 7.44 | 7.54 | 6.86 |
| $TiO_2$ | n.a. | 0.14 | 0.10 | 0.13 | 0.05 | 0.03 | 0.07 | 0.04 | 0.05 |
| SrO | n.a. | 0.34 | 0.10 | 0.00 | 0.00 | 0.34 | 0.22 | 0.00 | 0.09 |
| Total | 99.59 | 99.41 | 99.92 | 99.37 | 99.31 | 99.96 | 99.55 | 99.15 | 100. |
| Number of ions on 8 oxygen basis: | | | | | | | | | |
| Si | 2.755 | 2.482 | 2.200 | 2.252 | 2.953 | 2.684 | 2.660 | 2.817 | 2.921 |
| Al | 1.178 | 1.495 | 1.792 | 1.735 | 1.036 | 1.313 | 1.333 | 1.181 | 1.079 |
| Fe | 0.026 | 0.026 | 0.016 | 0.021 | 0.015 | 0.008 | 0.009 | 0.007 | 0.009 |
| Mg | 0.012 | 0.006 | 0.003 | 0.001 | 0.002 | 0.001 | 0.003 | 0.001 | 0.002 |
| Ca | 0.342 | 0.490 | 0.773 | 0.727 | 0.024 | 0.263 | 0.305 | 0.156 | 0.054 |
| K | 0.168 | 0.027 | 0.010 | 0.006 | 0.456 | 0.073 | 0.056 | 0.196 | 0.345 |
| Na | 0.518 | 0.478 | 0.212 | 0.267 | 0.534 | 0.684 | 0.649 | 0.659 | 0.596 |
| Ti | n.a. | 0.005 | 0.003 | 0.004 | 0.002 | 0.001 | 0.002 | 0.001 | 0.002 |
| Sr | n.a. | 0.009 | 0.003 | 0.000 | 0.000 | 0.009 | 0.006 | 0.000 | 0.002 |
| Total | 4.999 | 5.018 | 5.011 | 5.013 | 5.022 | 5.037 | 5.023 | 5.019 | 5.008 |
| Molecular proportions: | | | | | | | | | |
| Ab | 50.4 | 48.0 | 21.3 | 26.7 | 52.7 | 67.1 | 64.3 | 65.2 | 59.9 |
| An | 33.3 | 49.2 | 77.7 | 72.7 | 2.4 | 25.8 | 30.2 | 15.4 | 5.4 |
| Or | 16.3 | 2.7 | 1.0 | 0.6 | 45.0 | 7.2 | 5.5 | 19.4 | 34.7 |

APPENDIX 1C. REPRESENTATIVE FELDSPAR ANALYSES (continued)

| Sample Desc | RB43 gms rm | RB43 gms cr | E37 gms | E37 pn cr | E10 gms | PC52 gms | E1 pn cr | E64 rm |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 53.71 | 53.07 | 65.48 | 64.81 | 58.98 | 61.49 | 54.16 | 59.59 |
| $Al_2O_3$ | 27.86 | 28.66 | 19.31 | 20.30 | 25.17 | 22.70 | 28.78 | 25.30 |
| FeO | 1.15 | 1.02 | 0.70 | 0.18 | 0.82 | 0.41 | 0.51 | 0.31 |
| MgO | 0.14 | 0.09 | 0.01 | 0.00 | 0.14 | 0.00 | 0.06 | 0.01 |
| CaO | 10.11 | 11.01 | 0.10 | 0.82 | 6.23 | 3.90 | 10.42 | 6.85 |
| $K_2O$ | 0.39 | 0.35 | 7.32 | 5.55 | 2.45 | 2.96 | 0.40 | 0.41 |
| $Na_2O$ | 5.57 | 5.17 | 7.06 | 8.43 | 6.12 | 7.62 | 5.45 | 7.41 |
| $TiO_2$ | 0.22 | 0.23 | n.a. | n.a. | n.a. | 0.15 | n.a. | 0.05 |
| SrO | 0.09 | 0.13 | n.a. | n.a. | n.a. | n.a. | n.a. | 0.08 |
| Total | 99.24 | 99.73 | 99.98 | 100. | 99.91 | 99.23 | 99.78 | 100. |
| Number of ions on 8 oxygen basis: | | | | | | | | |
| Si | 2.459 | 2.423 | 2.954 | 2.909 | 2.656 | 2.777 | 2.456 | 2.662 |
| Al | 1.503 | 1.542 | 1.027 | 1.074 | 1.337 | 1.208 | 1.538 | 1.332 |
| Fe | 0.044 | 0.039 | 0.026 | 0.007 | 0.031 | 0.016 | 0.019 | 0.011 |
| Mg | 0.010 | 0.006 | 0.001 | 0.000 | 0.010 | 0.000 | .004 | 0.001 |
| Ca | 0.496 | 0.539 | 0.005 | 0.040 | 0.301 | 0.189 | 0.507 | 0.328 |
| K | 0.023 | 0.020 | 0.422 | 0.318 | 0.141 | 0.170 | 0.023 | 0.023 |
| Na | 0.495 | 0.458 | 0.618 | 0.734 | 0.535 | 0.667 | 0.480 | 0.642 |
| Ti | 0.008 | 0.008 | n.a. | n.a. | n.a. | 0.005 | n.a. | 0.002 |
| Sr | 0.002 | 0.004 | n.a. | n.a. | n.a. | n.a. | n.a. | 0.002 |
| Total | 5.040 | 5.038 | 5.053 | 5.082 | 5.011 | 5.031 | 5.027 | 5.003 |
| Molecular proportions: | | | | | | | | |
| Ab | 48.8 | 45.0 | 59.2 | 67.3 | 54.8 | 65.0 | 47.5 | 64.7 |
| An | 48.9 | 53.0 | 0.5 | 3.6 | 30.8 | 18.4 | 50.2 | 33.0 |
| Or | 2.3 | 2.0 | 40.4 | 29.1 | 14.4 | 16.6 | 2.3 | 2.3 |

## APPENDIX 1D. REPRESENTATIVE SPINEL ANALYSES

| Sample Description | PC4 (oliv) * | PC4 (oliv) | E10 (oliv) | E10 (oliv) | E10 (oliv) | E10 gms | E10 (oliv) | E10 (oliv) | E10 (oliv) |
|---|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 0.13 | 0.16 | 0.15 | 0.25 | 0.15 | 0.14 | 0.19 | 0.11 | 0.14 |
| $TiO_2$ | 1.90 | 2.40 | 13.79 | 2.90 | 13.64 | 3.43 | 3.58 | 12.25 | 2.93 |
| $Al_2O_3$ | 32.79 | 36.60 | 8.86 | 33.97 | 12.55 | 43.72 | 32.75 | 13.67 | 34.84 |
| $Cr_2O_3$ | 24.95 | 20.74 | 15.50 | 21.42 | 18.07 | 7.81 | 20.15 | 18.17 | 20.92 |
| FeO | 26.19 | 21.94 | 55.33 | 27.97 | 43.50 | 28.25 | 29.96 | 43.23 | 25.08 |
| MnO | 0.35 | 0.27 | 0.70 | 0.40 | 0.47 | 0.64 | 0.38 | 0.51 | 0.32 |
| MgO | 13.29 | 14.78 | 4.77 | 13.86 | 9.72 | 15.69 | 13.19 | 9.61 | 15.21 |
| CaO | 0.05 | 0.06 | 0.07 | 0.04 | 0.10 | 0.06 | 0.05 | 0.06 | 0.04 |
| Total | 99.65 | 96.95 | 99.17 | 100.8 | 98.20 | 99.74 | 100.3 | 97.61 | 99.48 |
| Calculated based on spinel stoichiometry: | | | | | | | | | |
| FeO | 18.41 | 21.33 | 42.37 | 23.45 | 32.24 | 21.38 | 29.96 | 31.90 | 20.51 |
| $Fe_2O_3$ | 8.65 | 0.68 | 14.41 | 5.02 | 12.52 | 7.64 | 7.64 | 12.60 | 5.08 |
| Molecular proportions: | | | | | | | | | |
| $Mg/(Mg + Fe^{2+})$ | 0.563 | 0.553 | 0.167 | 0.513 | 0.350 | 0.567 | 0.440 | 0.349 | 0.569 |
| $Cr/(Cr + Al)$ | 0.338 | 0.275 | 0.534 | 0.297 | 0.491 | 0.107 | 0.292 | 0.471 | 0.287 |
| $\frac{Fe^{3+}}{(Cr + Al + Fe^{3+})}$ | 0.100 | 0.008 | 0.326 | 0.062 | 0.245 | 0.091 | 0.095 | 0.237 | 0.062 |

## APPENDIX 1E. REPRESENTATIVE ILMENITE AND TITANOMAGNETITE ANALYSES

| Sample Desc | PC4 mpn | PC4 gms | PC4 (oliv) | PC4 gms | E10 gms | E10 gms | PC8 gms | PC8 gms |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 0.13 | 0.09 | 0.38 | 0.24 | 0.17 | 0.91 | 0.15 | 0.14 |
| $TiO_2$ | 49.75 | 51.05 | 53.28 | 49.89 | 50.11 | 48.96 | 49.18 | 48.92 |
| $Al_2O_3$ | 0.22 | 0.16 | 0.33 | 0.18 | 0.07 | 0.40 | 0.10 | 0.08 |
| $Cr_2O_3$ | 0.08 | 0.14 | 0.57 | 0.13 | 0.10 | 0.06 | 0.05 | 0.04 |
| FeO | 40.80 | 37.22 | 32.81 | 41.22 | 43.31 | 43.43 | 42.65 | 42.36 |
| MnO | 0.81 | 0.75 | 0.54 | 0.77 | 0.79 | 0.80 | 1.49 | 1.47 |
| MgO | 5.30 | 6.86 | 11.57 | 5.14 | 3.30 | 3.13 | 4.00 | 3.61 |
| CaO | 0.22 | 0.22 | 0.08 | 0.52 | 0.32 | 0.37 | 0.16 | 0.14 |
| Total | 97.31 | 96.49 | 99.56 | 98.09 | 98.17 | 98.06 | 97.78 | 96.76 |
| Calculated based on ilmenite stoichiometry: | | | | | | | | |
| FeO | 34.34 | 32.74 | 27.09 | 34.54 | 38.17 | 38.25 | 35.56 | 36.06 |
| $Fe_2O_3$ | 7.18 | 4.98 | 7.42 | 5.71 | 5.76 | 7.88 | 7.01 | |
| Calculated based on spinel stoichiometyry: | | | | | | | | |
| FeO | – | – | – | – | – | – | – | – |
| $Fe_2O_3$ | – | – | – | – | – | – | – | – |
| Calculated as proposed by Bowles (1977): | | | | | | | | |
| Ilm mole % | 91.6 | 93.8 | 89.9 | 91.7 | 94.0 | 92.8 | 90.9 | 92.0 |
| Hm mole % | 8.4 | 6.2 | 10.1 | 8.3 | 6.0 | 7.2 | 9.1 | 8.0 |

APPENDIX 1E. REPRESENTATIVE ILMENITE AND TITANOMAGNETITE ANALYSES (continued)

| Sample Desc | PC4 gms | PC4 gms | PC4 (cpx) | E10 (cpx) | PC8 (oliv) | PC8 (oliv) | PC8 gms | PC8 gms |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 0.39 | 0.17 | 0.35 | 4.37 | 0.28 | 0.16 | 0.20 | 0.21 |
| $TiO_2$ | 22.11 | 20.82 | 22.74 | 22.50 | 20.85 | 23.39 | 22.51 | 23.57 |
| $Al_2O_3$ | 2.63 | 4.11 | 2.10 | 1.57 | 1.44 | 0.59 | 0.21 | 0.67 |
| $Cr_2O_3$ | 3.26 | 6.37 | 0.18 | 0.11 | 0.08 | 0.06 | 0.07 | 0.06 |
| FeO | 61.78 | 57.63 | 63.95 | 59.03 | 65.98 | 66.87 | 69.14 | 67.02 |
| MnO | 0.78 | 0.71 | 0.85 | 0.56 | 1.15 | 1.39 | 1.54 | 1.42 |
| MgO | 4.22 | 5.44 | 3.41 | 2.24 | 0.15 | 1.72 | 1.04 | 1.13 |
| CaO | 0.13 | 0.11 | 0.25 | 2.27 | 0.15 | 0.37 | 0.07 | 0.23 |
| Total | 95.30 | 95.36 | 93.83 | 92.65 | 90.08 | 94.55 | 94.78 | 94.31 |
| Calculated based on ilmenite stoichiometry: | | | | | | | | |
| FeO | 11.87 | 8.37 | 13.61 | 17.99 | 17.46 | 16.28 | 16.98 | 17.92 |
| $Fe_2O_3$ | 55.47 | 54.75 | 55.95 | 45.61 | 53.96 | 56.23 | 57.97 | 54.57 |
| Calculated based on spinel stoichiometyry: | | | | | | | | |
| FeO | 46.93 | 41.55 | 50.70 | 57.67 | 47.51 | 53.74 | 52.52 | 54.46 |
| $Fe_2O_3$ | 16.51 | 17.87 | 14.72 | 1.51 | 20.53 | 14.59 | 18.48 | 13.96 |
| Calculated as proposed by Bowles (1977): | | | | | | | | |
| Ilm mole % | 65.7 | 65.3 | 66.7 | 72.9 | 66.8 | 66.8 | 63.8 | 69.0 |
| Hm mole % | 34.3 | 34.7 | 33.3 | 27.1 | 33.2 | 33.2 | 36.2 | 31.0 |

APPENDIX 2. MAJOR AND TRACE ELEMENT CHEMISTRY OF COCOS ISLAND SAMPLES

| Sample<br>Unit | PC4<br>UVS | PC7<br>Trac | PC8<br>Trac | PC17<br>Pyro | PC19<br>UVS | PC23<br>UVS | PC30<br>UVS | PC43<br>UVS |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 46.14 | 61.77 | 59.47 | 51.34 | 48.43 | 50.16 | 49.04 | 50.21 |
| $TiO_2$ | 3.75 | 0.39 | 1.12 | 1.89 | 3.16 | 2.48 | 3.03 | 2.75 |
| $Al_2O_3$ | 17.75 | 18.77 | 18.64 | 18.86 | 17.92 | 18.23 | 17.99 | 16.93 |
| $Fe_2O_3$ | 10.45 | 4.33 | 5.54 | 8.25 | 9.97 | 8.66 | 9.71 | 10.20 |
| MnO | 0.15 | 0.15 | 0.13 | 0.12 | n.a. | 0.15 | 0.14 | 0.15 |
| MgO | 6.72 | 0.00 | 0.90 | 3.08 | 6.09 | 4.40 | 5.82 | 3.96 |
| CaO | 9.80 | 0.53 | 2.44 | 4.68 | 8.65 | 6.77 | 7.89 | 7.39 |
| $Na_2O$ | 2.50 | 5.91 | 5.65 | 3.63 | 3.94 | 3.78 | 3.61 | 3.57 |
| $K_2O$ | 0.93 | 5.56 | 5.01 | 2.55 | 1.65 | 2.08 | 1.73 | 2.58 |
| $P_2O_5$ | 0.81 | 0.09 | 0.41 | 0.74 | 0.58 | 0.75 | 0.75 | 1.06 |
| LOI | 1.20 | 1.41 | 0.83 | 3.18 | n.a. | 1.94 | 0.28 | 1.08 |
| Sum | 100.2 | 98.9 | 100.1 | 98.3 | 99.4 | 99.4 | 100.0 | 99.9 |
| | | | | | | | | |
| Sc | 23.8 | 8.6 | 8.9 | 10.5 | 18.14 | 12.9 | 15.5 | 14.6 |
| Cr | 128 | b.d. | b.d. | 19 | 105 | 28 | 76 | b.d. |
| Co | 37.1 | 0.6 | 5.1 | 14.4 | 31.0 | 21.6 | 30.5 | 20.8 |
| Ni | 110 | b.d. | b.d. | b.d. | 90 | b.d. | 80 | b.d |
| Rb | b.d. | 85 | 83 | 50 | 35 | 42 | 34 | 52 |
| Sr | 640 | b.d. | 230 | 530 | 640 | 1640 | 610 | 750 |
| Zr | 240 | 680 | 750 | 340 | 290 | 320 | 230 | 340 |
| Cs | 3.16 | 0.15 | 0.13 | 4.70 | .25 | 0.36 | 0.24 | 0.22 |
| Ba | 470 | 610 | 910 | 750 | 460 | 520 | 480 | 640 |
| La | 51.1 | 31.0 | 69.8 | 59.8 | 39.7 | 47.3 | 41.0 | 59.0 |
| Ce | 96 | 80 | 129 | 109 | 79 | 93 | 81 | 119 |
| Nd | 52 | 20 | 60 | 53 | 40 | 44 | 38 | 58 |
| Sm | 11.4 | 3.9 | 11.0 | 10.7 | 8.8 | 9.3 | 8.6 | 12.3 |
| Eu | 3.54 | 1.34 | 2.95 | 3.39 | 2.95 | 2.86 | 2.82 | 3.77 |
| Tb | 1.52 | 0.51 | 1.24 | 1.22 | 1.11 | 1.05 | 1.04 | 1.55 |
| Yb | 3.55 | 2.70 | 3.87 | 3.19 | 2.44 | 2.64 | 2.42 | 3.15 |
| Lu | 0.51 | 0.41 | 0.54 | 0.48 | 0.36 | 0.39 | 0.35 | 0.44 |
| Hf | 7.2 | 18.9 | 16.0 | 10.2 | 7.0 | 9.3 | 7.5 | 9.4 |
| Ta | 3.69 | 6.43 | 6.63 | 4.29 | 3.44 | 4.01 | 3.60 | 4.89 |
| Th | 4.39 | 10.81 | 10.79 | 6.25 | 4.37 | 5.75 | 4.68 | 6.81 |
| U | 0.9 | 2.7 | 1.0 | 1.7 | 1.1 | 1.2 | 1.1 | 1.8 |

Notes : (1) Major elements in weight % and trace elements in ppm. (2) All Fe expressed as $Fe_2O_3$. (3) b.d. = beyond detection limit. (4) n.a. = not analyzed (5) Relative uncertainties for $SiO_2$, $TiO_2$, $Al_2O_3$, $Fe_2O_3$, CaO and $Na_2O$ are generally better than 2%. Those for MnO, $K_2O$ and $P_2O_5$ vary from 2 to 5% whereas that for MgO varies from 2 to 10%. Relative uncertainties for La, Ce, Sm, Eu, Tb, Yb, Lu, and Hf are better than 2%. Relative uncertainties for the other trace elements vary from 2 to 20%, depending upon their concentrations (see also, Jacobs et al., 1977).

APPENDIX 2. MAJOR AND TRACE ELEMENT CHEMISTRY OF COCOS ISLAND SAMPLES (continued)

| Sample<br>Unit | PC52<br>UVS | PC55<br>UVS | PC56<br>UVS | PC57<br>UVS | PC65<br>UVS | PC67<br>UVS | PC68<br>UVS | PC75<br>UVS |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 48.75 | 47.77 | 57.23 | 51.01 | 50.31 | 52.5 | 57.68 | 49.56 |
| $TiO_2$ | 2.78 | 3.27 | 1.51 | 2.55 | 2.98 | 1.82 | 1.22 | 2.66 |
| $Al_2O_3$ | 17.31 | 18.00 | 18.46 | 18.78 | 18.75 | 18.41 | 18.64 | 19.40 |
| $Fe_2O_3$ | 10.06 | 11.27 | 6.41 | 8.82 | 9.62 | 7.43 | 6.17 | 9.34 |
| MnO | 0.16 | 0.16 | 0.12 | 0.14 | 0.16 | 0.15 | 0.13 | 0.15 |
| MgO | 5.91 | 5.78 | 1.39 | 3.76 | 4.58 | 3.12 | 2.13 | 3.89 |
| CaO | 7.54 | 7.51 | 2.98 | 7.09 | 7.49 | 5.74 | 4.15 | 5.85 |
| $Na_2O$ | 3.63 | 3.03 | 5.25 | 4.04 | 3.76 | 4.37 | 5.78 | 3.50 |
| $K_2O$ | 1.89 | 1.68 | 4.21 | 2.13 | 1.90 | 2.86 | 3.39 | 2.18 |
| $P_2O_5$ | 0.81 | 0.80 | 0.75 | 0.80 | 0.80 | 0.76 | 0.45 | 0.79 |
| LOI | .57 | 1.35 | 1.35 | 0.60 | 0.48 | 2.11 | 0.12 | 2.02 |
| Sum | 99.4 | 100.6 | 99.6 | 99.7 | 100.8 | 99.3 | 99.9 | 99.3 |
| | | | | | | | | |
| Sc | 14.7 | 17.2 | 8.7 | 13.2 | 14.0 | 10.0 | 6.7 | 13.6 |
| Cr | 83 | 89 | 59 | 28 | 30 | 3 | 23 | 34 |
| Co | 31.1 | 35.6 | 10.1 | 20.8 | 25.7 | 13.7 | 9.25 | 22.3 |
| Ni | 100 | b.d. | b.d. | b.d. | b.d. | b.d. | b.d. | b.d. |
| Rb | 46 | 33 | 73 | 48 | 38 | 48 | 47 | 48 |
| Sr | 810 | 630 | 350 | 860 | 740 | 560 | 440 | 770 |
| Zr | 290 | 260 | 500 | 370 | 360 | 340 | 550 | 430 |
| Cs | 0.34 | 0.19 | 0.25 | 0.28 | 0.10 | 0.26 | 0.12 | 0.22 |
| Ba | 530 | 530 | 870 | 620 | 540 | 620 | 690 | 550 |
| La | 46.4 | 41.6 | 41.3 | 58.8 | 43.1 | 48.1 | 51.3 | 49.9 |
| Ce | 90 | 85 | 83 | 99 | 86 | 97 | 97 | 99 |
| Nd | 45 | 42 | 32 | 49 | 43 | 48 | 42 | 46 |
| Sm | 9.6 | 9.8 | 6.4 | 10.2 | 9.4 | 10.2 | 7.9 | 10.0 |
| Eu | 3.06 | 3.00 | 2.59 | 3.23 | 3.14 | 3.30 | 2.49 | 3.10 |
| Tb | 1.14 | 1.15 | 0.74 | 1.29 | 1.13 | 1.20 | 0.94 | 1.19 |
| Yb | 2.73 | 2.59 | 2.05 | 2.99 | 2.43 | 2.76 | 2.96 | 2.76 |
| Lu | 0.37 | 0.38 | 0.29 | 0.45 | 0.37 | 0.39 | 0.42 | 0.39 |
| Hf | 8.5 | 7.8 | 12.8 | 9.6 | 8.6 | 9.2 | 13.7 | 10.0 |
| Ta | 4.01 | 3.67 | 4.82 | 4.03 | 3.77 | 3.82 | 4.36 | 4.23 |
| Th | 5.41 | 4.80 | 7.85 | 5.85 | 4.98 | 5.22 | 7.87 | 6.16 |
| U | 1.5 | 1.1 | 2.4 | 1.6 | 0.6 | 1.2 | 1.5 | 1.4 |

APPENDIX 2. MAJOR AND TRACE ELEMENT CHEMISTRY OF COCOS ISLAND SAMPLES (continued)

| Sample<br>Unit | PC77<br>UVS | E1<br>UVS | E3<br>UVS | E10<br>LVS | E12<br>LVS | E15<br>LVS | E17<br>Dike | E26<br>Trac |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 51.59 | 54.67 | 49.24 | 46.75 | 46.54 | 58.13 | 46.12 | 56.06 |
| $TiO_2$ | 2.53 | 1.82 | 2.98 | 3.42 | 3.23 | 0.83 | 4.33 | 1.37 |
| $Al_2O_3$ | 17.99 | 18.52 | 17.92 | 15.99 | 17.39 | 18.36 | 17.85 | 20.33 |
| $Fe_2O_3$ | 9.38 | 7.66 | 9.19 | 9.98 | 9.82 | 6.10 | 9.87 | 6.29 |
| MnO | 0.16 | 0.16 | n.a. | 0.14 | 0.17 | 0.13 | 0.13 | 0.14 |
| MgO | 4.64 | 2.34 | 6.38 | 8.84 | 7.99 | 1.15 | 5.69 | 0.88 |
| CaO | 6.67 | 5.47 | 7.77 | 9.58 | 8.67 | 2.44 | 10.21 | 1.40 |
| $Na_2O$ | 4.21 | 4.81 | 4.07 | 3.10 | 2.66 | 5.10 | 2.59 | 4.71 |
| $K_2O$ | 2.36 | 3.14 | 1.88 | 1.10 | 1.53 | 4.99 | 0.91 | 5.04 |
| $P_2O_5$ | 0.73 | 0.72 | 0.49 | 0.72 | 0.76 | 0.25 | 0.88 | 0.48 |
| LOI | 0.00 | 0.48 | n.a. | 0.58 | 1.29 | 1.50 | 1.80 | 2.37 |
| Sum | 100.3 | 99.8 | 99.1 | 100.2 | 100.0 | 99.0 | 100.3 | 99.1 |
| | | | | | | | | |
| Sc | 12.7 | 11.3 | n.a. | 25.8 | 24.0 | 2.6 | 25.9 | 10.1 |
| Cr | 40 | b.d. | n.a. | 224 | 195 | b.d. | 116 | b.d. |
| Co | 24.8 | 11.6 | n.a. | 42.6 | 42.2 | 4.0 | 30.9 | 6.3 |
| Ni | b.d. | b.d. | n.a. | 140 | 140 | b.d. | 80 | b.d. |
| Rb | 46 | 62 | n.a. | 24 | 23 | 140 | 23 | 84 |
| Sr | 720 | 600 | n.a. | 630 | 580 | 360 | 770 | 210 |
| Zr | 340 | 460 | n.a. | 220 | 210 | 480 | 190 | 890 |
| Cs | 0.44 | 0.21 | n.a. | 6.89 | b.d. | 1.03 | 1.90 | 0.18 |
| Ba | 480 | 760 | n.a. | 420 | 610 | 1010 | 490 | 1320 |
| La | 52.8 | 58.8 | n.a. | 38.9 | 56.3 | 81.5 | 43.1 | 70.7 |
| Ce | 97 | 114 | n.a. | 79 | 100 | 138 | 86 | 127 |
| Nd | 43 | 54 | n.a. | 37 | 52 | 50 | 44 | 57 |
| Sm | 9.4 | 10.7 | n.a. | 8.2 | 10.7 | 9.3 | 9.5 | 10.9 |
| Eu | 2.89 | 3.50 | n.a. | 2.55 | 3.35 | 2.41 | 2.97 | 3.24 |
| Tb | 1.11 | 1.32 | n.a. | 0.96 | 1.36 | 1.15 | 1.12 | 1.22 |
| Yb | 2.87 | 3.17 | n.a. | 2.08 | 3.11 | 4.27 | 2.44 | 3.72 |
| Lu | 0.41 | 0.45 | n.a. | 0.30 | 0.43 | 0.66 | 0.35 | 0.53 |
| Hf | 10.3 | 12.6 | n.a. | 6.36 | 6.98 | 15.2 | 6.9 | 17.1 |
| Ta | 4.10 | 4.76 | n.a. | 3.67 | 3.89 | 7.51 | 4.20 | 6.62 |
| Th | 6.30 | 7.02 | n.a. | 4.54 | 5.23 | 16.39 | 4.83 | 10.86 |
| U | 1.7 | 1.6 | n.a. | 1.2 | 0.7 | 4.2 | 0.9 | 1.1 |

APPENDIX 2. MAJOR AND TRACE ELEMENT CHEMISTRY OF COCOS ISLAND SAMPLES (continued)

| Sample<br>Unit | E29<br>Dike | E31<br>LVS | E37<br>Trac | E50<br>Dike | E53<br>LVS | E57<br>UVS | E58b<br>LVS | E59<br>LVS |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 50.36 | 48.74 | 62.94 | 53.36 | 49.66 | 50.53 | 50.84 | 56.78 |
| $TiO_2$ | 2.50 | 3.23 | 0.35 | 2.16 | 2.96 | 2.47 | 2.17 | 1.55 |
| $Al_2O_3$ | 16.93 | 17.51 | 18.20 | 17.22 | 18.28 | 17.96 | 18.78 | 19.20 |
| $Fe_2O_3$ | 9.53 | 9.41 | 3.98 | 8.13 | 9.10 | 9.01 | 8.12 | 7.55 |
| MnO | 0.15 | 0.16 | 0.13 | 0.14 | 0.14 | 0.16 | 0.14 | 0.07 |
| MgO | 5.49 | 5.59 | 0.05 | 3.36 | 5.10 | 4.41 | 3.37 | 0.65 |
| CaO | 6.53 | 8.39 | 0.41 | 5.00 | 7.52 | 6.84 | 6.94 | 2.99 |
| $Na_2O$ | 3.59 | 3.39 | 6.28 | 4.42 | 4.00 | 3.85 | 4.21 | 5.27 |
| $K_2O$ | 2.08 | 1.77 | 6.00 | 3.19 | 2.04 | 2.39 | 2.18 | 4.02 |
| $P_2O_5$ | 0.83 | 0.68 | 0.06 | 0.78 | 0.77 | 0.84 | 0.91 | 0.59 |
| LOI | 1.21 | 1.03 | 0.86 | 1.89 | 0.55 | 1.30 | 1.63 | 1.40 |
| Sum | 99.2 | 99.9 | 99.2 | 99.6 | 100.1 | 99.8 | 99.3 | 100.1 |
| | | | | | | | | |
| Sc | 13.3 | 19.7 | 9.4 | 9.2 | 14.5 | 12.5 | 12.2 | 9.6 |
| Cr | 55 | 95 | b.d. | b.d. | 40 | 25 | 7 | b.d. |
| Co | 27.0 | 29.1 | b.d. | 10.1 | 26.3 | 21.8 | 14.8 | 6.6 |
| Ni | b.d. | b.d. | b.d. | b.d. | b.d. | b.d. | b.d. | b.d. |
| Rb | 41 | 24 | 98 | 66 | 44 | 50 | 50 | 76 |
| Sr | 770 | 690 | b.d. | 480 | 890 | 690 | 660 | 430 |
| Zr | 280 | 270 | 850 | 450 | 270 | 350 | 460 | 660 |
| Cs | 0.21 | 3.45 | 0.28 | 0.63 | 0.34 | 0.33 | 0.51 | 0.34 |
| Ba | 590 | 530 | 460 | 630 | 470 | 530 | 620 | 760 |
| La | 45.1 | 49.7 | 19.9 | 62.0 | 43.7 | 50.7 | 51.2 | 56.7 |
| Ce | 90 | 98 | 74 | 126 | 85 | 101 | 104 | 112 |
| Nd | 44 | 46 | 13 | 64 | 43 | 48 | 51 | 51 |
| Sm | 9.3 | 9.3 | 2.7 | 12.5 | 9.3 | 9.9 | 10.6 | 9.8 |
| Eu | 2.83 | 2.92 | 1.02 | 3.65 | 3.03 | 3.18 | 3.46 | 3.33 |
| Tb | 1.06 | 1.10 | 0.42 | 1.51 | 1.08 | 1.19 | 1.25 | 1.14 |
| Yb | 2.47 | 2.57 | 2.79 | 3.55 | 2.57 | 2.62 | 2.90 | 3.10 |
| Lu | 0.38 | 0.36 | 0.43 | 0.51 | 0.35 | 0.38 | 0.42 | 0.43 |
| Hf | 8.6 | 8.7 | 19.6 | 11.3 | 8.4 | 9.7 | 10.2 | 14.5 |
| Ta | 4.15 | 4.37 | 6.30 | 5.58 | 3.78 | 4.22 | 4.16 | 5.61 |
| Th | 5.94 | 5.57 | 10.95 | 8.50 | 4.97 | 5.87 | 5.60 | 8.87 |
| U | 0.7 | 1.7 | 3.1 | 2.1 | 1.0 | 1.7 | 1.5 | 2.4 |

APPENDIX 2. MAJOR AND TRACE ELEMENT CHEMISTRY OF COCOS ISLAND SAMPLES (continued)

| Sample<br>Unit | E60<br>Dike | E62<br>LVS | E64<br>Pyro | E68<br>Dike | E71<br>LVS | E73<br>UVS | RB16<br>Trac | RB41<br>UVS |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 50.52 | 42.58 | 45.81 | 50.59 | 48.95 | 50.49 | 61.71 | 47.44 |
| $TiO_2$ | 2.57 | 4.07 | 2.68 | 2.80 | 3.28 | 2.67 | 0.97 | 3.21 |
| $Al_2O_3$ | 17.07 | 18.58 | 20.09 | 16.68 | 17.93 | 17.23 | 20.29 | 17.49 |
| $Fe_2O_3$ | 9.39 | 10.35 | 8.13 | 9.47 | 9.55 | 9.75 | 3.77 | 11.14 |
| MnO | 0.26 | 0.21 | 0.22 | 0.13 | 0.16 | 0.16 | n.a. | 0.16 |
| MgO | 3.47 | 6.59 | 3.64 | 3.66 | 5.46 | 6.12 | 0.25 | 6.49 |
| CaO | 6.33 | 7.85 | 11.04 | 6.27 | 7.66 | 6.98 | 0.74 | 7.89 |
| $Na_2O$ | 3.73 | 1.75 | 3.75 | 3.60 | 3.34 | 4.13 | 6.03 | 3.23 |
| $K_2O$ | 2.76 | 1.41 | 1.51 | 2.76 | 2.14 | 2.08 | 5.66 | 1.62 |
| $P_2O_5$ | 0.97 | 0.92 | 1.01 | 1.08 | 0.72 | 0.78 | 0.14 | 0.81 |
| LOI | 1.98 | 5.17 | 2.95 | 2.02 | 1.02 | 0.00 | n.a. | 0.66 |
| Sum | 99.0 | 99.4 | 100.8 | 99.0 | 100.2 | 100.4 | 99.2 | 100.1 |
| | | | | | | | | |
| Sc | 13.6 | 27.2 | 16.2 | 14.2 | 20.1 | 14.1 | 3.4 | 17.3 |
| Cr | b.d. | 231 | 14 | b.d. | 102 | 104 | b.d. | 93 |
| Co | 20.4 | 47.1 | 18.7 | 17.3 | 28.7 | 29.7 | 1.3 | 35.4 |
| Ni | b.d. | 160 | b.d. | b.d. | 80 | 110 | b.d. | 100 |
| Rb | 57 | 195 | 173 | 51 | 50 | 45 | 92 | 34 |
| Sr | 560 | 390 | 860 | 530 | 650 | 710 | 100 | 690 |
| Zr | 350 | 240 | 220 | 280 | 350 | 280 | 660 | 290 |
| Cs | 0.50 | b.d. | 0.56 | 0.50 | 0.26 | 0.24 | 0.17 | 0.26 |
| Ba | 690 | 400 | 420 | 540 | 530 | 480 | 1200 | 430 |
| La | 64.7 | 38.6 | 46.1 | 57.5 | 51.9 | 47.6 | 81.6 | 42.8 |
| Ce | 129 | 77 | 95 | 117 | 105 | 94 | 149 | 85 |
| Nd | 65 | 36 | 47 | 60 | 48 | 43 | 70 | 44 |
| Sm | 12.9 | 8.3 | 10.1 | 12.3 | 9.8 | 9.3 | 12.5 | 9.6 |
| Eu | 3.82 | 2.67 | 3.11 | 3.73 | 3.11 | 2.88 | 4.48 | 3.00 |
| Tb | 1.51 | 1.03 | 1.15 | 1.43 | 1.17 | 1.15 | 1.55 | 1.19 |
| Yb | 3.72 | 2.13 | 2.40 | 3.09 | 2.69 | 2.76 | 4.72 | 2.52 |
| Lu | 0.50 | 0.30 | 0.35 | 0.43 | 0.38 | 0.38 | 0.67 | 0.38 |
| Hf | 10.0 | 6.3 | 6.0 | 9.1 | 9.2 | 8.7 | 14.9 | 7.9 |
| Ta | 5.01 | 3.68 | 3.70 | 4.83 | 4.64 | 4.25 | 6.24 | 3.61 |
| Th | 7.52 | 4.31 | 4.07 | 6.69 | 5.96 | 6.61 | 11.4 | 4.53 |
| U | 1.6 | 1.4 | 1.3 | 1.7 | 1.6 | 1.5 | 3.0 | 1.2 |

APPENDIX 2. MAJOR AND TRACE ELEMENT CHEMISTRY OF COCOS ISLAND SAMPLES (continued)

| Sample<br>Unit | RB42<br>Pyro | RB43<br>Pyro | RB45<br>UVS | RB52<br>UVS | RB54<br>UVS | DV8<br>LVS | DV21<br>UVS | DV45<br>UVS |
|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 49.52 | 50.15 | 51.55 | 49.09 | 48.54 | 46.14 | 58.39 | 58.90 |
| $TiO_2$ | 2.66 | 2.90 | 2.39 | 3.00 | 2.95 | 3.39 | 1.11 | 1.47 |
| $Al_2O_3$ | 18.47 | 16.67 | 18.51 | 18.16 | 18.24 | 17.40 | 18.47 | 19.36 |
| $Fe_2O_3$ | 9.27 | 10.39 | 8.95 | 9.38 | 9.64 | 10.80 | 6.08 | 6.21 |
| MnO | 0.15 | 0.20 | 0.15 | n.a. | 0.14 | 0.15 | n.a. | n.a. |
| MgO | 4.09 | 3.81 | 3.60 | 6.57 | 5.66 | 7.04 | 1.76 | 1.51 |
| CaO | 8.50 | 7.50 | 6.66 | 8.08 | 8.08 | 9.15 | 3.62 | 3.13 |
| $Na_2O$ | 3.80 | 3.78 | 4.33 | 3.41 | 3.63 | 2.94 | 5.64 | 5.36 |
| $K_2O$ | 2.35 | 2.74 | 2.44 | 1.59 | 1.66 | 1.68 | 4.05 | 4.66 |
| $P_2O_5$ | 0.67 | 1.12 | 0.71 | 0.46 | 0.73 | 0.84 | 0.32 | 0.42 |
| LOI | 0.61 | 0.54 | 0.32 | n.a. | 0.45 | 0.85 | n.a. | n.a. |
| Sum | 100.1 | 99.8 | 99.6 | 98.8 | 99.7 | 100.4 | 98.8 | 100.4 |
| | | | | | | | | |
| Sc | 15.3 | 15.8 | 12.8 | 16.1 | 15.4 | 20.21 | n.a. | 9.9 |
| Cr | 16 | b.d. | 35 | 106 | 78 | 91 | n.a. | b.d. |
| Co | 20.7 | 20.6 | 21.0 | 32.9 | 30.8 | 38.3 | n.a. | 6.6 |
| Ni | b.d. | b.d. | b.d. | 102 | 80 | 90 | n.a. | b.d. |
| Rb | 45 | 55 | 48 | 39 | 40 | 38 | n.a. | 80 |
| Sr | 740 | 680 | 670 | 800 | 810 | 690 | n.a. | 250 |
| Zr | 330 | 380 | 390 | 310 | 270 | 240 | n.a. | 610 |
| Cs | 0.39 | 0.46 | 0.33 | 0.22 | 1.60 | 0.46 | n.a. | 0.22 |
| Ba | 490 | 620 | 680 | 470 | 480 | 400 | n.a. | 1000 |
| La | 47.2 | 61.0 | 50.1 | 38.9 | 40.6 | 43.4 | n.a. | 68.2 |
| Ce | 96 | 126 | 96 | 77 | 80 | 91 | n.a. | 115 |
| Nd | 47 | 60 | 46 | 32 | 40 | 75 | n.a. | 52 |
| Sm | 10.0 | 13.4 | 9.8 | 8.4 | 8.5 | 9.6 | n.a. | 9.7 |
| Eu | 3.06 | 4.02 | 3.19 | 2.77 | 2.80 | 3.03 | n.a. | 3.04 |
| Tb | 1.19 | 1.60 | 1.26 | 1.04 | 1.04 | 1.12 | n.a. | 1.06 |
| Yb | 2.77 | 3.39 | 3.06 | 2.54 | 2.41 | 2.4 | n.a. | 3.51 |
| Lu | 0.39 | 0.48 | 0.44 | 0.36 | 0.34 | 0.33 | n.a. | 0.51 |
| Hf | 8.7 | 10.2 | 10.2 | 7.4 | 7.5 | 7.2 | n.a. | 14.8 |
| Ta | 4.21 | 5.10 | 3.95 | 3.49 | 3.63 | 3.69 | n.a. | 6.06 |
| Th | 6.08 | 7.15 | 5.67 | 4.49 | 4.57 | 4.59 | n.a. | 9.82 |
| U | 1.5 | 1.9 | 1.5 | 1.1 | 0.9 | 1.3 | n.a. | 1.7 |