AM-88-393

FLuid infiltration through the Big Horse Limestone Member in the Notch Peak contact -metamorphic aureole, Utah

Labotka et al.

To be deposited: Tables A1-13

AMerican Mineralogist, 73, 11-12, 1302-1324

# Effects of Contact Metamorphism on the Chemistry of Calcareous Rocks in the Big Horse Limestone Member, Notch Peak, Utah

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Complete Tables of Mineral Analyses

Table A1. Microprobe Analyses of Calcite in Cycle 2 Limestones.

| Sample Number<br>Photo # - Grain #<br>Number of Analyses (n)/Grain | 14H-81<br>4-1<br>n=10 | 14H-81<br>4-2<br>n=14 | 14H-81<br>4-3<br>n=10 | 3H-38A<br>4-2<br>n=8 | 3H-38A<br>5-1<br>n=8 | 3H-38A<br>6-2<br>n=9 |
|---|---|---|---|---|---|---|
| Wt.% (±W)* | | | | | | |
| FeO | 0.08 (0.008) | 0.11 (0.01) | 0.11 (0.01) | 0.22 (0.01) | 0.15 (0.01) | 0.15 (0.009) |
| MnO | 0.00 | 0.00 | 0.00 | 0.03 (0.006) | 0.02 (0.002) | 0.01 (0.007) |
| MgO | 0.96 (0.17) | 1.85 (1.39) | 1.82 (1.25) | 1.80 (0.20) | 1.74 (0.11) | 1.82 (0.11) |
| CaO | 55.60 (0.42) | 53.81 (1.82) | 54.88 (1.72) | 54.40 (0.30) | 53.58 (0.36) | 53.87 (0.24) |
| $CO_2$ | 44.74 | 44.31 | 45.12 | 44.81 | 44.05 | 44.35 |
| **Total** | **101.39** | **100.08** | **101.93** | **101.26** | **99.54** | **100.19** |
| Mineral Formula/1 Cation | | | | | | |
| Fe (±W)* | 0.0012 (0.0001) | 0.0015 (0.0002) | 0.0011 (0.0002) | 0.0029 (0.0002) | 0.0020 (0.0002) | 0.0021 (0.0001) |
| Mn | 0.0000 | 0.0000 | 0.0000 | 0.0004 (0.00008) | 0.0003 (0.00003) | 0.0002 (0.00002) |
| Mg | 0.0235 (0.0042) | 0.0457 (0.0344) | 0.0441 (0.0304) | 0.0438 (0.0045) | 0.0431 (0.0049) | 0.0447 (0.0057) |
| Ca | 0.9753 (0.0074) | 0.9528 (0.0322) | 0.9545 (0.0298) | 0.9528 (0.0052) | 0.9545 (0.0064) | 0.9530 (0.0057) |
| **Total** | **1.0000** | **1.0000** | **1.0000** | **0.9999** | **0.9999** | **1.0000** |
| Fe/(Fe + Mg) | 0.049 | 0.032 | 0.024 | 0.062 | 0.044 | 0.045 |
| T°C (±2σ) | 400 (22) | 502 (114) | 496 (104) | 495 (17) | 492 (19) | 498 (22) |

Table A1. Continued (Page 2 of 6 Pages).

| Sample Number<br>Photo # - Grain #<br>Number of Analyses (n)/Grain | 16H-85<br>2-1<br>n=9 | 16H-85<br>2-2<br>n=8 | 16H-85<br>4-1<br>n=7 | 16H-85<br>4-2<br>n=4 | 18H-90<br>2-1A<br>n=10 | 18H-90<br>2-2<br>n=13 |
|---|---|---|---|---|---|---|
| Wt.% (± W)* | | | | | | |
| FeO | 0.12 (0.008) | 0.11 (0.006) | 0.17 (0.01) | 0.15 (0.008) | 0.10 (0.007) | 0.10 (0.005) |
| MnO | 0.02 (0.003) | 0.01 (0.001) | 0.00 | 0.00 | 0.02 (0.001) | 0.02 (0.001) |
| MgO | 2.00 (0.07) | 2.09 (0.13) | 2.03 (0.10) | 1.96 (0.09) | 1.70 (0.14) | 1.62 (0.10) |
| CaO | 52.86 (0.28) | 53.06 (0.46) | 53.42 (0.36) | 53.07 (0.68) | 54.28 (0.19) | 55.03 (0.22) |
| $CO_2$ | 43.75 | 44.00 | 44.24 | 43.88 | 44.53 | 45.02 |
| **Total** | **98.75** | **99.27** | **99.86** | **99.06** | **100.63** | **101.79** |
| Mineral Formula/1 Cation | | | | | | |
| Fe (± W)* | 0.0017 (0.0001) | 0.0015 (0.00008) | 0.0024 (0.0003) | 0.0022 (0.0001) | 0.0013 (0.00009) | 0.0014 (0.00006) |
| Mn | 0.0003 (0.00003) | 0.0002 (0.00001) | 0.0000 | 0.0000 | 0.0002 (0.00001) | 0.0003 (0.00002) |
| Mg | 0.0499 (0.0017) | 0.0519 (0.0033) | 0.0502 (0.0025) | 0.0487 (0.0021) | 0.0417 (0.0034) | 0.0392 (0.0022) |
| Ca | 0.9481 (0.0049) | 0.9465 (0.0078) | 0.9475 (0.0063) | 0.9451 (0.0121) | 0.9567 (0.0033) | 0.9591 (0.0038) |
| **Total** | **1.0000** | **1.0001** | **1.0001** | **1.0000** | **0.9999** | **1.0000** |
| Fe/(Fe + Mg) | 0.033 | 0.028 | 0.046 | 0.043 | 0.030 | 0.034 |
| T°C ($\pm 2\sigma$) | 518 (6) | 525 (12) | 519 (9) | 513 (8) | 486 (14) | 476 (9) |

Table A1. Continued (Page 3 of 6 Pages).

| Sample Number<br>Photo # - Grain #<br>Number of Analyses (n)/Grain | 20H-99<br>1-1<br>n=10 | 20H-99<br>1-2<br>n=9 | 20H-99<br>1-4<br>n=10 | 20H-99<br>3-1<br>n=7 | 8H-130<br>2-1<br>n=4 | 8H-130<br>3-1<br>n=5 |
|---|---|---|---|---|---|---|
| Wt.% (± W)* | | | | | | |
| FeO | 0.22 (0.06) | 0.16 (0.01) | 0.14 (0.007) | 0.15 (0.02) | 0.07 (0.006) | 0.07 (0.008) |
| MnO | 0.01 (0.0007) | 0.02 (0.001) | 0.00 | 0.01 (0.001) | 0.07 (0.02) | 0.10 (0.009) |
| MgO | 1.18 (0.14) | 1.60 (0.17) | 1.30 (0.12) | 1.20 (0.09) | 0.51 (0.03) | 0.52 (0.03) |
| CaO | 55.06 (0.35) | 54.37 (0.75) | 54.65 (0.16) | 54.38 (0.25) | 54.46 (0.52) | 55.22 (0.30) |
| $CO_2$ | 44.63 | 44.53 | 44.39 | 44.09 | 43.39 | 43.95 |
| **Total** | **101.10** | **100.68** | **100.48** | **99.83** | **98.50** | **99.86** |
| Mineral Formula/1 Cation | | | | | | |
| Fe (± W)* | 0.0030 (0.0008) | 0.0021 (0.0002) | 0.0020 (0.00008) | 0.0021 (0.0002) | 0.0010 (0.00009) | 0.0009 (0.00012) |
| Mn | 0.0001 (0.00001) | 0.0002 (0.00001) | 0.0000 | 0.0002 (0.00002) | 0.0011 (0.0002) | 0.0014 (0.00013) |
| Mg | 0.0287 (0.0033) | 0.0392 (0.0041) | 0.0320 (0.0030) | 0.0298 (0.0022) | 0.0129 (0.0009) | 0.0130 (0.0008) |
| Ca | 0.9682 (0.0062) | 0.9583 (0.0131) | 0.9660 (0.0029) | 0.9679 (0.0044) | 0.9850 (0.0095) | 0.9847 (0.0054) |
| **Total** | **1.0000** | **0.9999** | **1.0000** | **1.0000** | **1.0000** | **1.0000** |
| Fe/(Fe + Mg) | 0.095 | 0.051 | 0.059 | 0.066 | 0.072 | 0.065 |
| T°C (±2σ) | 428 (16) | 476 (17) | 444 (14) | 433 (11) | no dolomite | no dolomite |

Table A1. Continued (Page 4 of 6 Pages).

| Sample Number<br>Photo # - Grain #<br>Number of Analyses (n)/Grain | 5H-46<br>2-1<br>n=10 | 5H-46<br>2-2<br>n=10 | 5H-46<br>2-3<br>n=8 | 5H-46<br>4-1<br>n=8 | 5H-46<br>4-3<br>n=10 | 5H-46<br>4-5<br>n=10 |
|---|---|---|---|---|---|---|
| Wt.% (± W)* | | | | | | |
| FeO | 0.08 (0.003) | 0.09 (0.005) | 0.08 (0.005) | 0.09 (0.005) | 0.08 (0.006) | 0.08 (0.007) |
| MnO | 0.00 | 0.00 | 0.00 | 0.02 (0.002) | 0.00 | 0.00 |
| MgO | 1.36 (0.07) | 1.39 (0.06) | 1.25 (0.11) | 1.26 (0.05) | 1.30 (0.10) | 1.41 (0.05) |
| CaO | 53.85 (0.34) | 54.56 (0.44) | 53.92 (0.29) | 55.04 (0.25) | 54.66 (0.26) | 53.96 (0.25) |
| $CO_2$ | 43.79 | 44.38 | 43.73 | 44.63 | 44.36 | 43.93 |
| **Total** | **99.08** | **100.42** | **98.98** | **101.04** | **100.40** | **99.38** |
| Mineral Formula/1 Cation | | | | | | |
| Fe (± W)* | 0.0011 (0.00005) | 0.0012 (0.00006) | 0.0011 (0.00008) | 0.0012 (0.00007) | 0.0012 (0.00009) | 0.0011 (0.00008) |
| Mn | 0.0000 | 0.0000 | 0.0000 | 0.0002 (0.00003) | 0.0000 | 0.0000 |
| Mg | 0.0338 (0.0007) | 0.0341 (0.0014) | 0.0311 (0.0026) | 0.0308 (0.0012) | 0.0319 (0.0025) | 0.0351 (0.0014) |
| Ca | 0.9651 (0.0034) | 0.9647 (0.0079) | 0.9650 (0.0051) | 0.9678 (0.0044) | 0.9669 (0.0047) | 0.9637 (0.0045) |
| **Total** | **1.0000** | **1.0000** | **1.0000** | **1.0000** | **1.0000** | **0.9999** |
| Fe/(Fe + Mg) | 0.032 | 0.034 | 0.034 | 0.038 | 0.036 | 0.030 |
| T°C (±2σ) | 452 (3) | 453 (7) | 439 (13) | 438 (6) | 443 (12) | 458 (6) |

Table A1. Continued (Page 5 of 6 Pages).

| Sample Number<br>Photo # - Grain #<br>Number of Analyses (n)/Grain | 7H-55<br>1-1<br>n=6 | 7H-55<br>3-1<br>n=9 | 7H-55<br>5-2<br>n=14 | 7H-55<br>5-4<br>n=10 | 7H-55<br>6-1<br>n=9 | 7H-55<br>6-2<br>n=10 |
|---|---|---|---|---|---|---|
| Wt.% (± W)* | | | | | | |
| FeO | 0.00 | 0.04 (0.002) | 0.06 (0.003) | 0.06 (0.005) | 0.06 (0.002) | 0.06 (0.002) |
| MnO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| MgO | 0.95 (0.05) | 0.99 (0.04) | 1.29 (0.05) | 1.29 (0.05) | 1.27 (0.06) | 1.28 (0.06) |
| CaO | 54.62 (0.24) | 54.03 (0.12) | 54.69 (0.17) | 55.32 (0.15) | 54.87 (0.19) | 53.89 (0.10) |
| $CO_2$ | 43.91 | 43.51 | 44.36 | 44.77 | 44.49 | 43.72 |
| **Total** | **99.48** | **98.57** | **100.40** | **101.36** | **100.69** | **98.95** |
| Mineral Formula/1 Cation | | | | | | |
| Fe (± W)* | 0.0000 | 0.0006 (0.00003) | 0.0008 (0.00005) | 0.0009 (0.00007) | 0.0008 (0.00003) | 0.0008 (0.00003) |
| Mn | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Mg | 0.0237 (0.0011) | 0.0247 (0.0009) | 0.0318 (0.0011) | 0.0295 (0.0011) | 0.0313 (0.0014) | 0.0319 (0.0015) |
| Ca | 0.9763 (0.0045) | 0.9747 (0.0021) | 0.9675 (0.0029) | 0.9696 (0.0027) | 0.9679 (0.0033) | 0.9673 (0.0018) |
| **Total** | **1.0000** | **1.0000** | **1.0001** | **1.0000** | **1.0000** | **1.0000** |
| Fe/(Fe + Mg) | 0.000 | 0.024 | 0.025 | 0.030 | 0.025 | 0.024 |
| T°C (±2σ) | 401[a] (6) | 407[a] (4) | 443 (5) | 431 (6) | 440 (7) | 443 (7) |

Table A1. Continued (Page 6 of 6 Pages).

| Sample Number | 23H-136 | 11H-116 | 11H-116 | 11H-116 | 12H-122 | 12H-122 |
|---|---|---|---|---|---|---|
| Photo # - Grain # | | 3-1 | 4-1 | 4-2 | 2-1 | 2-2 |
| Number of Analyses (n)/Grain | n=6 | n=4 | n=7 | n=4 | n=3 | n=4 |
| Wt.% (±W)* | | | | | | |
| FeO | 0.05 (0.006) | 0.16 (0.02) | 0.01 (0.002) | 0.06 (0.006) | 0.00 | 0.00 (0.007) |
| MnO | 0.01 (0.001) | 0.08 (0.02) | 0.01 (0.002) | 0.01 (0.002) | 0.00 | 0.00 |
| MgO | 0.91 (0.08) | 0.26 (0.05) | 0.39 (0.06) | 0.10 (0.007) | 0.26 (0.28) | 0.34 (0.14) |
| CaO | 54.38 (0.27) | 55.98 (1.03) | 55.89 (0.28) | 55.93 (0.38) | 56.43 (1.12) | 55.80 (0.73) |
| $CO_2$ | 43.70 | 44.36 | 44.29 | 44.05 | 44.57 | 44.16 |
| **Total** | **99.05** | **100.84** | **100.59** | **100.15** | **101.26** | **100.30** |
| Mineral Formula/1 Cation | | | | | | |
| Fe (±W)* | 0.0007 (0.00008) | 0.0022 (0.0003) | 0.0001 (0.00002) | 0.0008 (0.00008) | 0.0000 | 0.0001 (0.0001) |
| Mn | 0.0002 (0.00002) | 0.0011 (0.0003) | 0.0002 (0.00003) | 0.0002 (0.00007) | 0.0000 | 0.0000 |
| Mg | 0.0227 (0.0019) | 0.0063 (0.0013) | 0.0095 (0.0015) | 0.0023 (0.0002) | 0.0064 (0.0068) | 0.0084 (0.0034) |
| Ca | 0.9764 (0.0054) | 0.9904 (0.0181) | 0.9901 (0.0050 | 0.9967 (0.0068) | 0.9936 (0.0196) | 0.9915 (0.0131) |
| **Total** | **1.0000** | **1.0000** | **0.9999** | **1.0000** | **1.0000** | **1.0000** |
| Fe/(Fe + Mg) | 0.030 | 0.259 | 0.010 | 0.258 | 0.000 | 0.012 |
| T°C (±2 σ) | no dolomite | 260[b] (17) | 297[b] (15) | 187[b] (4) | 262[b] (69) | 286[b] (33) |

[a] No dolomite with 3 mm.
[b] MgO contents on these samples reflect sedimentary and/or diagenetic compositions and temperatures calculated are probably unreliable.
* See Appendix for calculation procedure.

Table A2. Microprobe Analyses Dolomite in Cycle 2 Limestones.

| Sample Number<br>Photo # - Grain #<br>Number of Analyses (n)/Grain | 14H-81<br>4-1<br>n=4 | 3H-38A<br>4-1<br>n=4 | 3H-38A<br>6-1<br>n=4 | 16H-85<br>1-1<br>n=4 | 16H-85<br>1-2<br>n=5 | 18H-90<br>1-1<br>n=4 |
|---|---|---|---|---|---|---|
| Wt.% (± W)* | | | | | | |
| FeO | 0.40 (0.02) | 0.71 (0.04) | 0.64 (0.04) | 0.87 (0.04) | 0.76 (0.06) | 0.82 (0.12) |
| MnO | 0.02 (0.005) | 0.01 (0.003) | 0.00 (0.003) | 0.04 (0.009) | 0.04 (0.004) | 0.06 (0.005) |
| MgO | 20.52 (0.28) | 20.70 (0.30) | 20.98 (0.32) | 20.63 (0.07) | 20.85 (0.33) | 20.74 (0.27) |
| CaO | 31.66 (0.48) | 30.50 (0.47) | 30.62 (0.57) | 30.68 (0.15) | 30.63 (0.20) | 30.82 (0.51) |
| $CO_2$ | 47.51 | 46.97 | 47.32 | 47.16 | 47.29 | 47.36 |
| **Total** | **100.11** | **98.89** | **99.56** | **99.38** | **99.57** | **99.80** |
| Mineral Formula/2 Cation | | | | | | |
| Fe (± W)* | 0.0104 (0.0005) | 0.0184 (0.0011) | 0.0165 (0.0009) | 0.0226 (0.0009) | 0.0197 (0.0016) | 0.0212 (0.0030) |
| Mn | 0.0006 (0.0001) | 0.0002 (0.00008) | 0.0001 (0.00005) | 0.0012 (0.00027) | 0.0011 (0.0001) | 0.0014 (0.0001) |
| Mg | 0.9430 (0.0130) | 0.9622 (0.0137) | 0.9678 (0.0149) | 0.9552 (0.0030) | 0.9625 (0.0015) | 0.9560 (0.0123) |
| Ca | 1.0460 (0.0158) | 1.0192 (0.0158) | 1.0156 (0.0189) | 1.0212 (0.0050) | 1.0166 (0.0067) | 1.0214 (0.0167) |
| **Total** | **2.0000** | **2.0000** | **2.0000** | **2.0002** | **1.9999** | **1.9999** |
| Fe/(Fe + Mg) | 0.011 | 0.019 | 0.017 | 0.023 | 0.020 | 0.022 |
| Ca/ Σ Cations | 0.523 | 0.510 | 0.508 | 0.511 | 0.508 | 0.511 |

Table A2. Continued (Page 2 of 3 Pages).

| Sample Number<br>Photo # - Grain #<br>Number of Analyses (n)/Grain | 18H-90<br>1-2<br>n=4 | 18H-90<br>1-3<br>n=4 | 20H-99<br>2-2<br>n=5 | 20H-99<br>3-1<br>n=4 | 5H-46<br>2-1<br>n=4 | 7H-55<br>6-1<br>n=3 |
|---|---|---|---|---|---|---|
| Wt.% (± W)* | | | | | | |
| FeO | 1.20 (0.12) | 0.74 (0.12) | 0.72 (0.05) | 0.65 (0.05) | 0.50 (0.08) | 0.41 (0.0065) |
| MnO | 0.06 (0.09) | 0.04 (0.005) | 0.03 (0.003) | 0.03 (0.005) | 0.03 (0.006) | 0.00 |
| MgO | 20.62 (0.30) | 20.70 (0.85) | 20.72 (0.48) | 20.65 (0.14) | 20.84 (0.08) | 21.05 (0.75) |
| CaO | 30.39 (0.51) | 30.65 (0.59) | 30.96 (0.57) | 30.66 (0.19) | 30.63 (0.35) | 30.42 (0.47) |
| $CO_2$ | 47.14 | 47.14 | 47.38 | 47.02 | 47.11 | 47.10 |
| **Total** | **99.41** | **99.27** | **99.81** | **99.01** | **99.11** | **98.98** |
| Mineral Formula/2 Cations | | | | | | |
| Fe (± W)* | 0.0312 (0.0031) | 0.0194 (0.0031) | 0.0187 (0.0012) | 0.0170 (0.0011) | 0.0130 (0.0020) | 0.0106 (0.00017) |
| Mn | 0.0016 (0.0001) | 0.0010 (0.00012) | 0.0008 (0.00009) | 0.0009 (0.0001) | 0.0008 (0.00015) | 0.0000 |
| Mg | 0.9552 (0.0138) | 0.9588 (0.0396) | 0.9549 (0.0221) | 0.9586 (0.0065) | 0.9656 (0.0036) | 0.9757 (0.0347) |
| Ca | 1.0120 (0.0170) | 1.0208 (0.0195) | 1.0257 (0.0190) | 1.0235 (0.0062) | 1.0205 (0.0115) | 1.0137 (0.0101) |
| **Total** | **2.0000** | **2.0000** | **2.0001** | **2.0000** | **1.9999** | **2.0000** |
| Fe/(Fe + Mg) | 0.032 | 0.020 | 0.019 | 0.017 | 0.013 | 0.011 |
| Ca/ Σ Cations | 0.506 | 0.510 | 0.513 | 0.512 | 0.510 | 0.507 |

Table A2. Continued (Page 3 of 3 Pages).

| Sample Number<br>Photo # - Grain #<br>Number of Analyses (n)/Grain | 11H-116<br>5-1[a]<br>n=1 | 12H-122<br>2-1[b]<br>n=3 | 12H-122<br>2-4[a]<br>n=3 | 12H-122<br>3-1[b]<br>n=6 |
|---|---|---|---|---|
| Wt.% (±W)* | | | | |
| FeO | 0.54 | 1.47 (0.33) | 0.22 (0.52) | 1.35 (0.24) |
| MnO | 0.00 | 0.04 (0.012) | 0.00 | 0.03 (0.003) |
| MgO | 19.70 | 19.19 (1.63) | 20.01 (3.35) | 19.35 (0.31) |
| CaO | 32.84 | 31.50 (1.42) | 32.44 (2.39) | 31.44 (0.25) |
| $CO_2$ | 47.61 | 46.60 | 47.43 | 46.65 |
| **Total** | **100.69** | **98.80** | **100.10** | **98.82** |
| Mineral Formula/2 Cations | | | | |
| Fe (±W)* | 0.0138 | 0.0387 (0.0086) | 0.0056 (0.0137) | 0.0355 (0.0063) |
| Mn | 0.0000 | 0.0010 (0.00028) | 0.0000 | 0.0006 (0.00007) |
| Mg | 0.9034 | 0.8992 (0.0762) | 0.9208 (0.1671) | 0.9058 (0.0144) |
| Ca | 1.0828 | 1.0610 (0.0477) | 1.0735 (0.0734) | 1.0581 (0.0085) |
| **Total** | **2.0000** | **1.9999** | **1.9999** | **2.0000** |
| Fe/(Fe + Mg) | 0.015 | 0.041 | 0.006 | 0.038 |
| Ca/ Σ Cations | 0.541 | 0.531 | 0.537 | 0.529 |

[a] Small euhedral grains (∿100 μm) replacing pelloids.
[b] Large euhedral grains (∿300-400 μm) replacing echinoids.
* See Appendix for calculation procedure.

Table A3. Microprobe Analyses of Talc in Cycle 2 Limestones.

| Sample Number | 3H-38A | 3H-38A | 16H-85 | 16H-85 | 18H-90 | 18H-90 | 5H-46 | 5H-46 | 7H-55 | 7H-55 |
|---|---|---|---|---|---|---|---|---|---|---|
| Photo # - Analysis # | 5-53 | 5-59 | 1-12 | 3-25 | 3-16 | 1-9 | 0-19A | 7-37 | 3-48 | 3-29 |
| $SiO_2$ | 60.30 | 61.09 | 60.77 | 61.12 | 61.49 | 60.90 | 61.89 | 60.93 | 60.90 | 61.33 |
| $Al_2O_3$ | 0.51 | 0.40 | 0.37 | 0.20 | 0.35 | 0.50 | 0.80 | 0.80 | 0.77 | 0.41 |
| $FeO_T$ | 1.09 | 1.05 | 0.96 | 1.02 | 1.48 | 1.14 | 0.68 | 0.73 | 0.79 | 0.75 |
| MgO | 29.95 | 30.63 | 31.06 | 31.08 | 30.69 | 30.73 | 31.28 | 30.87 | 30.69 | 30.75 |
| MnO | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| $TiO_2$ | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.01 | 0.00 | 0.00 |
| $Cr_2O_3$ | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CaO | 0.70 | 0.54 | 0.23 | 0.17 | 0.30 | 0.44 | 0.70 | 0.82 | 0.52 | 0.84 |
| $Na_2O$ | 0.07 | 0.10 | 0.08 | 0.09 | 0.00 | 0.12 | 0.10 | 0.05 | 0.10 | 0.04 |
| $K_2O$ | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| **Total** | **92.65** | **93.84** | **93.47** | **93.68** | **94.31** | **93.83** | **95.51** | **94.22** | **93.77** | **94.14** |
| Cations/11 Oxygens | | | | | | | | | | |
| Si | 3.951 | 3.950 | 3.941 | 3.954 | 3.958 | 3.940 | 3.928 | 3.923 | 3.936 | 3.950 |
| $^{IV}Al$ | 0.039 | 0.030 | 0.028 | 0.015 | 0.027 | 0.038 | 0.060 | 0.061 | 0.059 | 0.031 |
| **Total Tetahedral** | **3.990** | **3.980** | **3.969** | **3.969** | **3.985** | **3.978** | **3.988** | **3.984** | **3.995** | **3.981** |
| $^{VI}Al$ | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| $Fe^{2+}$ | 0.060 | 0.057 | 0.052 | 0.055 | 0.080 | 0.062 | 0.036 | 0.039 | 0.043 | 0.040 |
| Mg | 2.924 | 2.952 | 3.002 | 2.997 | 2.944 | 2.963 | 2.959 | 2.962 | 2.956 | 2.952 |
| Mn | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 |
| Ti | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.003 | 0.000 | 0.000 | 0.000 |
| Cr | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Total Octahedral** | **2.985** | **3.011** | **3.054** | **3.052** | **3.024** | **3.025** | **2.998** | **3.002** | **2.999** | **2.992** |
| Ca | 0.049 | 0.037 | 0.016 | 0.012 | 0.021 | 0.031 | 0.048 | 0.057 | 0.036 | 0.058 |
| Na | 0.009 | 0.013 | 0.010 | 0.011 | 0.000 | 0.015 | 0.012 | 0.006 | 0.013 | 0.005 |
| K | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.002 |
| **Total 'X'** | **0.059** | **0.051** | **0.026** | **0.023** | **0.021** | **0.046** | **0.061** | **0.063** | **0.049** | **0.065** |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.020 | 0.019 | 0.017 | 0.018 | 0.026 | 0.020 | 0.012 | 0.013 | 0.014 | 0.013 |

Table A4a. Microprobe Analyses of Chlorites in Cycle 2 Limestones.

| Sample Number | 14H-81 | 3H-38A | 16H-85 | 18H-90 | 5H-46 | 5H-46 | 23H-136 | 11H-116 | 11H-116 | 11H-116 |
|---|---|---|---|---|---|---|---|---|---|---|
| Photo # - Analysis # | 1-67 | 1-34 | 2-19 | 3-18 | 0-21A | 6-45 | 1-60 | 3-18 | 4-13 | 4-14 |
| $SiO_2$ | 32.39 | 32.43 | 30.61 | 31.72 | 29.29 | 28.68 | 32.83 | 28.62 | 28.88 | 28.82 |
| $Al_2O_3$ | 17.90 | 19.64 | 18.24 | 18.25 | 21.03 | 21.45 | 17.16 | 21.63 | 21.52 | 22.14 |
| $FeO_T$ | 1.16 | 2.75 | 1.84 | 3.57 | 1.82 | 2.06 | 1.76 | 2.52 | 2.06 | 2.53 |
| MgO | 32.03 | 30.46 | 34.95 | 33.57 | 33.58 | 32.80 | 29.84 | 31.85 | 32.34 | 31.43 |
| MnO | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.03 |
| $TiO_2$ | 1.12 | 0.04 | 0.02 | 0.03 | 0.00 | 0.03 | 0.25 | 0.04 | 0.01 | 0.01 |
| $Cr_2O_3$ | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 |
| CaO | 0.98 | 0.39 | 0.05 | 0.47 | 0.42 | 0.62 | 0.76 | 1.18 | 0.94 | 0.89 |
| $Na_2O$ | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 |
| $K_2O$ | 0.04 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.09 | 0.06 | 0.06 | 0.07 |
| **Total** | **85.65** | **85.71** | **85.71** | **87.61** | **86.15** | **85.65** | **82.79** | **85.92** | **85.81** | **85.93** |
| Cations/14 Oxygens | | | | | | | | | | |
| Si | 3.065 | 3.073 | 2.912 | 2.975 | 2.775 | 2.739 | 3.207 | 2.736 | 2.754 | 2.748 |
| $^{IV}Al$ | 0.935 | 0.927 | 1.088 | 1.025 | 1.225 | 1.261 | 0.793 | 1.264 | 1.246 | 1.252 |
| **Total Tetrahedral** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** |
| $^{VI}Al$ | 1.062 | 1.267 | 0.957 | 0.993 | 1.124 | 1.154 | 1.183 | 1.174 | 1.174 | 1.237 |
| $Fe^{2+}$ | 0.092 | 0.218 | 0.146 | 0.280 | 0.144 | 0.165 | 0.144 | 0.201 | 0.164 | 0.202 |
| Mg | 4.518 | 4.301 | 4.954 | 4.692 | 4.741 | 4.668 | 4.345 | 4.538 | 4.597 | 4.467 |
| Mn | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.000 | 0.002 |
| Ti | 0.080 | 0.003 | 0.003 | 0.002 | 0.000 | 0.002 | 0.018 | 0.003 | 0.001 | 0.001 |
| Cr | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 |
| **Total Octahedral** | **5.753** | **5.789** | **6.060** | **5.967** | **6.009** | **5.989** | **5.692** | **5.918** | **5.936** | **5.909** |
| Ca | 0.099 | 0.040 | 0.005 | 0.047 | 0.043 | 0.063 | 0.080 | 0.121 | 0.096 | 0.091 |
| Na | 0.004 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.015 | 0.000 | 0.000 | 0.000 |
| K | 0.005 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.011 | 0.007 | 0.007 | 0.009 |
| **Total 'X'** | **0.108** | **0.040** | **0.005** | **0.047** | **0.044** | **0.064** | **0.106** | **0.128** | **0.103** | **0.100** |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.020 | 0.048 | 0.029 | 0.056 | 0.030 | 0.034 | 0.032 | 0.042 | 0.034 | 0.043 |

Table A4b. Microprobe Analyses of Chlorites in Argillites.

| | 'Skarn' Station 10H | Cycle 2 Argillites | | | | | |
|---|---|---|---|---|---|---|---|
| Sample Number<br>Photo # - Analysis # | 10H-102<br>0-30 | 8H-59<br>1-16 | 5H-44<br>5-16A | 7H-54A<br>3-39 | 7H-54A<br>3-41 | 23H-135<br>3-8 | 23H-135<br>3-6 |
| $SiO_2$ | 28.39 | 29.67 | 30.28 | 26.87 | 28.31 | 27.30 | 27.09 |
| $Al_2O_3$ | 17.02 | 19.79 | 19.25 | 19.67 | 19.08 | 18.23 | 18.71 |
| $FeO_T$ | 32.34 | 11.37 | 13.27 | 18.61 | 15.13 | 20.74 | 20.41 |
| MgO | 6.25 | 23.11 | 23.23 | 19.14 | 22.44 | 19.01 | 19.03 |
| MnO | 0.68 | 0.05 | 0.20 | 0.10 | 0.06 | 0.16 | 0.16 |
| $TiO_2$ | 0.00 | 0.03 | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 |
| $Cr_2O_3$ | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| CaO | 0.30 | 0.21 | 0.19 | 0.36 | 0.10 | 0.33 | 0.34 |
| $Na_2O$ | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $K_2O$ | 0.08 | 0.39 | 0.26 | 0.01 | 0.03 | 0.00 | 0.00 |
| **Total** | **85.11** | **84.62** | **86.78** | **84.77** | **85.17** | **85.80** | **85.78** |
| Cations/14 Oxygens | | | | | | | |
| Si | 3.199 | 2.992 | 3.007 | 2.826 | 2.900 | 2.873 | 2.846 |
| $^{IV}Al$ | 0.801 | 1.008 | 0.993 | 1.174 | 1.100 | 1.127 | 1.154 |
| **Total Tetrahedral** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** |
| $^{VI}Al$ | 1.460 | 1.344 | 1.261 | 1.265 | 1.204 | 1.134 | 1.163 |
| $Fe^{2+}$ | 3.048 | 0.959 | 1.102 | 1.637 | 1.296 | 1.825 | 1.793 |
| Mg | 1.050 | 3.473 | 3.438 | 3.000 | 3.426 | 2.981 | 2.980 |
| Mn | 0.065 | 0.004 | 0.017 | 0.009 | 0.005 | 0.014 | 0.014 |
| Ti | 0.000 | 0.002 | 0.000 | 0.001 | 0.002 | 0.002 | 0.003 |
| Cr | 0.000 | 0.000 | 0.008 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Total Octahedral** | **5.623** | **5.786** | **5.826** | **5.912** | **5.933** | **5.956** | **5.953** |
| Ca | 0.036 | 0.023 | 0.020 | 0.041 | 0.011 | 0.037 | 0.038 |
| Na | 0.011 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| K | 0.012 | 0.050 | 0.033 | 0.001 | 0.004 | 0.000 | 0.000 |
| **Total 'X'** | **0.059** | **0.073** | **0.053** | **0.042** | **0.015** | **0.037** | **0.038** |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.744 | 0.216 | 0.243 | 0.353 | 0.274 | 0.380 | 0.376 |

Table A5a. Microprobe Analyses of Phlogopite in Limestones.

| | Cycle 2 Limestones | | | | | | Cycle 5 Limestones |
|---|---|---|---|---|---|---|---|
| Sample Number | 14H-81 | 14H-81 | 14H-81 | 3H-38A | 5H-46 | 11H-116 | 8H-113 |
| Photo # - Analysis # | 1-63 | 1-65 | 1-13 | 2-51 | 7-41 | 3-22 | 1-53 |
| $SiO_2$ | 37.49 | 36.82 | 37.12 | 38.13 | 40.29 | 40.69 | 40.58 |
| $Al_2O_3$ | 17.82 | 18.19 | 18.08 | 18.02 | 14.74 | 17.17 | 13.08 |
| $FeO_T$ | 0.91 | 0.77 | 0.83 | 1.65 | 0.94 | 1.83 | 3.39 |
| MgO | 26.77 | 27.25 | 26.40 | 25.04 | 25.95 | 24.26 | 25.04 |
| MnO | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 |
| $TiO_2$ | 0.97 | 0.51 | 1.16 | 0.98 | 0.82 | 0.43 | 1.44 |
| $Cr_2O_3$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.01 | 0.04 |
| CaO | 0.89 | 0.94 | 0.32 | 0.50 | 1.04 | 0.99 | 0.81 |
| $Na_2O$ | 0.39 | 2.15 | 0.43 | 0.63 | 0.11 | 0.09 | 0.21 |
| $K_2O$ | 7.56 | 4.47 | 7.18 | 9.27 | 10.13 | 9.47 | 9.28 |
| **Total** | **92.80** | **91.10** | **91.52** | **94.22** | **94.06** | **94.96** | **93.88** |
| Cations/11 Oxygens | | | | | | | |
| Si | 2.665 | 2.634 | 2.663 | 2.700 | 2.858 | 2.846 | 2.905 |
| $^{IV}Al$ | 1.335 | 1.366 | 1.337 | 1.300 | 1.142 | 1.154 | 1.015 |
| **Total Tetrahedral** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** |
| $^{VI}Al$ | 0.158 | 0.168 | 0.192 | 0.204 | 0.091 | 0.261 | 0.009 |
| $Fe^{2+}$ | 0.054 | 0.046 | 0.050 | 0.098 | 0.056 | 0.107 | 0.203 |
| Mg | 2.836 | 2.905 | 2.823 | 2.642 | 2.743 | 2.528 | 2.672 |
| Mn | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 |
| Ti | 0.052 | 0.027 | 0.063 | 0.052 | 0.044 | 0.023 | 0.077 |
| Cr | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.001 | 0.002 |
| **Total Octahedral** | **3.100** | **3.146** | **3.128** | **2.996** | **2.937** | **2.921** | **2.964** |
| Ca | 0.068 | 0.072 | 0.025 | 0.038 | 0.079 | 0.074 | 0.062 |
| Na | 0.054 | 0.298 | 0.060 | 0.087 | 0.015 | 0.012 | 0.029 |
| K | 0.686 | 0.408 | 0.657 | 0.837 | 0.917 | 0.845 | 0.848 |
| **Total 'X'** | **0.808** | **0.778** | **0.742** | **0.962** | **1.011** | **0.931** | **0.939** |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.019 | 0.016 | 0.017 | 0.036 | 0.020 | 0.041 | 0.071 |

Table A5b. Microprobe Analyses of Micas in Argillites.

| | 'Intrusive' Station 10H | | Cycle 1 Argillites | | | | Cycle 2 Argillites | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number | BIO 10H-101 | BIO 10H-101 | BIO 23H-137 | BIO 23H-137 | BIO 11H-115 | MUS 11H-115 | BIO 8H-59 | BIO 8H-59 | BIO 5H-44 | BIO 7H-54A | BIO 7H-54A | BIO 23H-135 | MUS 11H-117 | MUS 12H-123 | MUS 12H-123 | MUS 12H-123 | MUS 12H-123 |
| Photo # - Analysis # | 1-45 | 1-47 | 2-16 | 2-23 | 1-9 | 3-11 | 4-16A | 5-22A | 1-54 | 4-13 | 2-44 | 1-27 | 2-48 | 1-31 | 1-33 | 2-45 | 3-51 |
| $SiO_2$ | 38.24 | 38.28 | 39.02 | 37.90 | 40.79 | 45.11 | 40.41 | 38.30 | 41.57 | 37.31 | 39.91 | 35.95 | 45.05 | 44.54 | 45.59 | 46.16 | 44.94 |
| $Al_2O_3$ | 12.66 | 12.87 | 16.35 | 14.80 | 17.34 | 34.65 | 13.16 | 14.34 | 12.29 | 17.24 | 12.64 | 16.48 | 34.31 | 34.20 | 30.59 | 34.52 | 33.07 |
| $FeO_T$ | 15.69 | 16.48 | 6.96 | 8.61 | 5.80 | 3.48 | 7.70 | 9.20 | 8.44 | 11.03 | 9.27 | 15.47 | 2.99 | 3.13 | 5.40 | 2.63 | 3.59 |
| MgO | 15.37 | 14.98 | 18.79 | 19.42 | 20.56 | 0.49 | 22.25 | 18.61 | 22.04 | 18.22 | 21.89 | 15.43 | 1.05 | 0.61 | 1.39 | 0.60 | 0.85 |
| MnO | 0.49 | 0.57 | 0.00 | 0.00 | 0.02 | 0.03 | 0.11 | 0.10 | 0.08 | 0.06 | 0.07 | 0.11 | 0.07 | 0.00 | 0.03 | 0.00 | 0.01 |
| $TiO_2$ | 2.87 | 3.06 | 0.95 | 1.61 | 0.41 | 0.51 | 0.50 | 0.68 | 0.19 | 0.81 | 0.32 | 1.03 | 0.61 | 0.87 | 0.80 | 0.22 | 0.41 |
| $Cr_2O_3$ | 0.00 | 0.00 | 0.03 | 0.04 | 0.02 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.05 | 0.04 | 0.03 | 0.02 | 0.03 | 0.00 | 0.02 |
| CaO | 0.00 | 0.00 | 0.44 | 0.20 | 0.49 | 0.36 | 0.07 | 0.08 | 0.10 | 0.11 | 0.09 | 0.24 | 0.26 | 0.80 | 0.66 | 0.18 | 0.88 |
| $Na_2O$ | 0.00 | 0.00 | 0.06 | 0.01 | 0.06 | 0.54 | 0.05 | 0.04 | 0.00 | 0.03 | 0.00 | 0.00 | 0.90 | 0.71 | 0.19 | 1.13 | 0.71 |
| $K_2O$ | 9.33 | 9.62 | 9.51 | 9.85 | 9.34 | 10.16 | 10.09 | 10.42 | 10.69 | 9.76 | 9.61 | 9.17 | 9.03 | 9.59 | 10.06 | 8.36 | 9.63 |
| **Total** | **94.65** | **95.86** | **92.11** | **92.44** | **94.83** | **95.33** | **94.42** | **91.78** | **95.40** | **94.57** | **93.85** | **93.92** | **94.30** | **94.47** | **94.70** | **93.80** | **94.11** |
| Cations/11 Oxygens | | | | | | | | | | | | | | | | | |
| Si | 2.889 | 2.871 | 2.884 | 2.834 | 2.896 | 3.038 | 2.941 | 2.900 | 3.007 | 2.752 | 2.939 | 2.732 | 3.045 | 3.023 | 3.126 | 3.107 | 3.069 |
| $^{IV}Al$ | 1.111 | 1.129 | 1.116 | 1.166 | 1.104 | 0.962 | 1.059 | 1.100 | 0.993 | 1.248 | 1.061 | 1.268 | 0.955 | 0.977 | 0.874 | 0.893 | 0.931 |
| **Total Tetrahedral** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** | **4.000** |
| $^{VI}Al$ | 0.017 | 0.009 | 0.309 | 0.139 | 0.347 | 1.789 | 0.070 | 0.180 | 0.055 | 0.251 | 0.036 | 0.208 | 1.779 | 1.759 | 1.599 | 1.847 | 1.732 |
| $Fe^{2+}$ | 0.992 | 1.034 | 0.430 | 0.539 | 0.344 | 0.196 | 0.473 | 0.583 | 0.511 | 0.680 | 0.571 | 0.983 | 0.169 | 0.178 | 0.310 | 0.148 | 0.205 |
| Mg | 1.731 | 1.675 | 2.070 | 2.164 | 2.176 | 0.049 | 2.413 | 2.100 | 2.376 | 2.003 | 2.402 | 1.747 | 0.106 | 0.062 | 0.142 | 0.060 | 0.087 |
| Mn | 0.031 | 0.036 | 0.000 | 0.000 | 0.001 | 0.002 | 0.007 | 0.006 | 0.005 | 0.004 | 0.004 | 0.007 | 0.004 | 0.000 | 0.002 | 0.000 | 0.001 |
| Ti | 0.163 | 0.173 | 0.053 | 0.091 | 0.022 | 0.026 | 0.027 | 0.039 | 0.010 | 0.045 | 0.018 | 0.059 | 0.031 | 0.044 | 0.041 | 0.011 | 0.021 |
| Cr | 0.000 | 0.000 | 0.002 | 0.002 | 0.001 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.003 | 0.002 | 0.002 | 0.001 | 0.002 | 0.000 | 0.001 |
| **Total Octahedral** | **2.934** | **2.927** | **2.864** | **2.935** | **2.891** | **2.062** | **2.991** | **2.909** | **2.957** | **2.983** | **3.034** | **2.961** | **2.091** | **2.044** | **2.096** | **2.066** | **2.047** |
| Ca | 0.000 | 0.000 | 0.035 | 0.016 | 0.037 | 0.026 | 0.006 | 0.006 | 0.008 | 0.009 | 0.007 | 0.020 | 0.019 | 0.058 | 0.049 | 0.013 | 0.064 |
| Na | 0.000 | 0.000 | 0.009 | 0.002 | 0.008 | 0.071 | 0.007 | 0.006 | 0.000 | 0.004 | 0.000 | 0.000 | 0.118 | 0.093 | 0.025 | 0.148 | 0.094 |
| K | 0.899 | 0.921 | 0.897 | 0.940 | 0.846 | 0.873 | 0.937 | 1.007 | 0.987 | 0.919 | 0.903 | 0.889 | 0.779 | 0.830 | 0.880 | 0.718 | 0.839 |
| **Total 'X'** | **0.899** | **0.921** | **0.941** | **0.958** | **0.891** | **0.970** | **0.950** | **1.019** | **0.995** | **0.932** | **0.910** | **0.909** | **0.916** | **0.981** | **0.954** | **0.879** | **0.997** |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.364 | 0.382 | 0.172 | 0.199 | 0.137 | | 0.164 | 0.217 | 0.177 | 0.253 | 0.192 | 0.360 | | | | | |
| $^{VI}Al/(\Sigma$ Octahedral) | | | | | | 0.868 | | | | | | | 0.851 | 0.861 | 0.763 | 0.894 | 0.846 |

BIO = Biotite. MUS = Muscovite.

Table A6a. Microprobe Analyses of Amphiboles in Limestones.

| | Cycle 2 Limestones | | | | | | | | | | | | Cycle 5 Limestone | Cycle 6 Limestone |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number<br>Photo # - Analysis # | 14H-81<br>1-5 | 14H-81<br>1-17 | 3H-38A<br>1-33 | 3H-38A<br>1-36 | 3H-38A<br>2-53 | 16H-85<br>1-5 | 16H-85<br>4-29 | 20H-99<br>4-29 | 5H-46<br>5-29 | 7H-55<br>4-5A | 23H-136<br>1-55 | 23H-136<br>2-63 | 8H-113<br>1-45 | 8H-114<br>1-43 |
| $SiO_2$ | 53.42 | 53.57 | 55.57 | 54.32 | 56.48 | 55.71 | 55.92 | 56.11 | 56.43 | 56.81 | 56.39 | 56.12 | 56.20 | 54.60 |
| $Al_2O_3$ | 3.31 | 3.52 | 4.53 | 2.92 | 1.26 | 1.81 | 2.73 | 1.40 | 1.27 | 1.99 | 1.44 | 2.41 | 0.69 | 2.35 |
| FeO | 0.43 | 0.29 | 0.60 | 1.01 | 0.89 | 1.06 | 0.94 | 0.93 | 0.00 | 0.45 | 0.88 | 0.97 | 2.19 | 7.66 |
| $Fe_2O_3$ | 0.30 | 0.37 | 0.71 | 0.00 | 0.36 | 0.00 | 0.25 | 0.00 | 0.81 | 0.00 | 0.61 | 0.17 | 0.00 | 0.00 |
| MgO | 23.85 | 23.71 | 23.65 | 22.64 | 23.68 | 23.96 | 23.51 | 23.69 | 23.88 | 23.47 | 23.16 | 22.98 | 22.65 | 17.98 |
| MnO | 0.00 | 0.03 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 | 0.03 | 0.00 | 0.01 | 0.02 | 0.00 | 0.07 | 0.11 |
| $TiO_2$ | 0.44 | 0.26 | 0.30 | 0.23 | 0.11 | 0.05 | 0.21 | 0.30 | 0.17 | 0.35 | 0.18 | 0.18 | 0.12 | 0.13 |
| $Cr_2O_3$ | 0.00 | 0.00 | 0.01 | 0.00 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 | 0.07 | 0.00 | 0.02 | 0.03 | 0.02 |
| CaO | 12.96 | 13.16 | 12.94 | 12.20 | 13.33 | 13.22 | 13.26 | 13.53 | 13.50 | 13.32 | 13.50 | 13.61 | 13.54 | 13.56 |
| $Na_2O$ | 1.51 | 1.57 | 0.61 | 0.80 | 0.50 | 1.04 | 0.62 | 0.62 | 0.27 | 0.43 | 0.19 | 0.30 | 0.35 | 0.10 |
| $K_2O$ | 0.07 | 0.07 | 0.04 | 0.04 | 0.03 | 0.05 | 0.04 | 0.08 | 0.08 | 0.09 | 0.05 | 0.05 | 0.09 | 0.09 |
| **Total** | **96.29** | **96.55** | **98.96** | **94.16** | **96.67** | **96.92** | **97.48** | **96.70** | **96.41** | **96.99** | **96.41** | **96.81** | **95.93** | **96.60** |
| Cations/23 Oxygen | | | | | | | | | | | | | | |
| Si | 7.447 | 7.448 | 7.490 | 7.683 | 7.797 | 7.695 | 7.659 | 7.755 | 7.788 | 7.784 | 7.802 | 7.732 | 7.863 | 7.773 |
| $^{IV}Al$ | 0.544 | 0.552 | 0.510 | 0.317 | 0.203 | 0.295 | 0.341 | 0.228 | 0.207 | 0.216 | 0.198 | 0.268 | 0.114 | 0.227 |
| **Total Tetrahedral** | **7.991** | **8.000** | **8.000** | **8.000** | **8.000** | **7.990** | **8.000** | **7.983** | **7.995** | **8.000** | **8.000** | **8.000** | **7.977** | **8.000** |
| $^{VI}Al$ | 0.000 | 0.024 | 0.210 | 0.170 | 0.002 | 0.000 | 0.100 | 0.000 | 0.000 | 0.106 | 0.037 | 0.123 | 0.000 | 0.168 |
| $Fe^{2+}$ | 0.051 | 0.034 | 0.067 | 0.119 | 0.103 | 0.123 | 0.108 | 0.108 | 0.000 | 0.052 | 0.101 | 0.112 | 0.256 | 0.912 |
| $Fe^{3+}$ | 0.031 | 0.038 | 0.073 | 0.000 | 0.037 | 0.000 | 0.025 | 0.000 | 0.084 | 0.000 | 0.063 | 0.017 | 0.000 | 0.000 |
| Mg | 4.955 | 4.912 | 4.751 | 4.773 | 4.872 | 4.932 | 4.799 | 4.880 | 4.912 | 4.793 | 4.776 | 4.718 | 4.723 | 3.815 |
| Mn | 0.000 | 0.004 | 0.000 | 0.000 | 0.001 | 0.002 | 0.000 | 0.004 | 0.000 | 0.001 | 0.002 | 0.000 | 0.008 | 0.013 |
| Ti | 0.046 | 0.027 | 0.030 | 0.024 | 0.011 | 0.005 | 0.022 | 0.031 | 0.018 | 0.036 | 0.019 | 0.019 | 0.013 | 0.014 |
| Cr | 0.000 | 0.000 | 0.001 | 0.000 | 0.002 | 0.000 | 0.000 | 0.001 | 0.000 | 0.008 | 0.000 | 0.002 | 0.003 | 0.002 |
| **Total Octahedral** | **5.083** | **5.039** | **5.132** | **5.086** | **5.028** | **5.062** | **5.054** | **5.024** | **5.014** | **4.996** | **4.998** | **4.991** | **5.003** | **4.925** |
| M4 Site | | | | | | | | | | | | | | |
| Octahedral | 0.083 | 0.039 | 0.132 | 0.086 | 0.028 | 0.062 | 0.054 | 0.024 | 0.014 | 0.000 | 0.000 | 0.000 | 0.003 | 0.000 |
| Ca | 1.936 | 1.960 | 1.869 | 1.849 | 1.972 | 1.957 | 1.946 | 2.004 | 1.997 | 1.956 | 2.002 | 2.009 | 2.030 | 2.069 |
| Na | 0.000 | 0.000 | 0.000 | 0.065 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.044 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Total** | **2.019** | **1.999** | **2.001** | **2.000** | **2.000** | **2.019** | **2.000** | **2.028** | **2.011** | **2.000** | **2.002** | **2.009** | **2.033** | **2.069** |
| A Site | | | | | | | | | | | | | | |
| Na | 0.408 | 0.423 | 0.159 | 0.155 | 0.134 | 0.279 | 0.165 | 0.166 | 0.072 | 0.070 | 0.051 | 0.080 | 0.095 | 0.027 |
| K | 0.012 | 0.012 | 0.007 | 0.007 | 0.005 | 0.009 | 0.007 | 0.014 | 0.014 | 0.016 | 0.009 | 0.009 | 0.016 | 0.016 |
| **Total** | **0.420** | **0.435** | **0.166** | **0.162** | **0.139** | **0.288** | **0.172** | **0.180** | **0.086** | **0.086** | **0.060** | **0.089** | **0.111** | **0.043** |
| %Quad | 57.94 | 56.44 | 74.49 | 83.78 | 86.09 | 71.27 | 82.84 | 81.97 | 89.67 | 89.21 | 90.12 | 86.57 | 88.90 | 88.66 |
| %'Others' | 42.06 | 43.56 | 25.51 | 16.22 | 13.91 | 28.73 | 17.16 | 18.03 | 10.33 | 10.79 | 9.88 | 13.43 | 11.10 | 11.34 |
| Breakdown of Quad | | | | | | | | | | | | | | |
| %Ca | 27.89 | 28.38 | 27.95 | 27.43 | 28.39 | 27.91 | 28.40 | 28.66 | 28.90 | 28.76 | 29.10 | 29.38 | 28.96 | 30.44 |
| %Mg | 71.38 | 71.13 | 71.05 | 70.80 | 70.14 | 70.35 | 70.03 | 69.80 | 71.10 | 70.48 | 69.43 | 68.99 | 67.38 | 56.14 |
| $\%Fe^{2+}$ | 0.73 | 0.49 | 1.01 | 1.77 | 1.48 | 1.75 | 1.57 | 1.54 | 0.00 | 0.76 | 1.47 | 1.63 | 3.66 | 13.42 |
| Breakdown of 'Others' | | | | | | | | | | | | | | |
| %A | 43.57 | 44.07 | 24.56 | 29.78 | 40.64 | 49.40 | 33.53 | 44.12 | 29.35 | 24.85 | 23.25 | 24.93 | 49.33 | 15.92 |
| %Na M4 | 0.00 | 0.00 | 0.00 | 11.95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12.72 | 0.00 | 0.00 | 0.00 | 0.00 |
| %Al4 | 56.43 | 55.93 | 75.44 | 58.27 | 59.36 | 50.60 | 66.47 | 55.88 | 70.65 | 62.43 | 76.74 | 75.07 | 50.66 | 84.07 |
| Best Name for 'Others' | ED | ED | PA | PA | MH | ED | PA | ED | MH | PA | MH | PA | ED | PA |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.011 | 0.007 | 0.014 | 0.024 | 0.021 | 0.024 | 0.022 | 0.022 | 0.000 | 0.011 | 0.021 | 0.023 | 0.051 | 0.19 |

ED = Edenite. PA = Pargasite. MH = Magnesium-rich Hastingsite, $Fe^{2+}/(Fe^{2+} + Mg) < 0.5$.

Table A6b. Microprobe Analyses of Amphiboles in Argillites.

| | 'Intrusion' | 'Skarn' | Cycle 1 Argillite | | | | | | | Cycle 2 Argillite | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Number | 10H-101 | 10H-102 | 5H-47 | 5H-47 | 5H-47 | 7H-56 | 7H-56 | 23H-137 | 23H-137 | 7H-54A | 7H-54A | 23H-135 | 23H-135 |
| Photo # - Analysis # | 1-41 | 1-17 | 1-60 | 2-36 | 3-53 | 1-7 | 3-23 | 1-7 | 4-31 | 4-6 | 4-9 | 3-59 | 3-62 |
| $SiO_2$ | 50.47 | 45.17 | 55.24 | 55.29 | 55.48 | 54.45 | 54.82 | 52.29 | 55.03 | 52.98 | 54.82 | 52.37 | 51.86 |
| $Al_2O_3$ | 3.76 | 5.75 | 1.39 | 3.42 | 2.57 | 2.90 | 2.44 | 2.81 | 4.19 | 3.74 | 1.91 | 2.55 | 4.05 |
| FeO | 12.76 | 27.15 | 6.68 | 5.88 | 4.66 | 4.92 | 6.16 | 3.33 | 5.65 | 6.51 | 6.75 | 13.91 | 13.86 |
| $Fe_2O_3$ | 0.00 | 2.20 | 1.20 | 2.18 | 1.17 | 1.90 | 1.14 | 2.46 | 0.00 | 0.27 | 0.00 | 0.20 | 1.36 |
| MgO | 15.58 | 3.55 | 19.42 | 20.00 | 21.03 | 19.85 | 19.76 | 19.89 | 19.71 | 18.98 | 19.35 | 14.70 | 14.11 |
| MnO | 1.01 | 1.40 | 0.03 | 0.05 | 0.00 | 0.02 | 0.01 | 0.06 | 0.03 | 0.09 | 0.08 | 0.28 | 0.24 |
| $TiO_2$ | 0.42 | 0.22 | 0.01 | 0.03 | 0.01 | 0.10 | 0.09 | 0.18 | 0.16 | 0.21 | 0.07 | 0.15 | 0.13 |
| $Cr_2O_3$ | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.04 | 0.05 | 0.08 | 0.02 | 0.01 | 0.00 | 0.02 | 0.05 |
| CaO | 11.48 | 11.03 | 13.10 | 12.71 | 13.03 | 13.31 | 12.96 | 12.76 | 12.81 | 12.82 | 12.47 | 11.90 | 12.18 |
| $Na_2O$ | 1.50 | 0.63 | 0.12 | 0.11 | 0.28 | 0.23 | 0.31 | 0.20 | 0.13 | 0.52 | 0.21 | 0.26 | 0.31 |
| $K_2O$ | 0.46 | 0.60 | 0.16 | 0.12 | 0.32 | 0.13 | 0.12 | 0.20 | 0.22 | 0.33 | 0.21 | 0.28 | 0.18 |
| **Total** | **97.44** | **97.70** | **97.37** | **99.79** | **98.55** | **97.85** | **97.86** | **94.26** | **97.95** | **96.47** | **95.87** | **96.62** | **98.33** |
| Cations/23 Oxygens | | | | | | | | | | | | | |
| Si | 7.393 | 7.149 | 7.788 | 7.583 | 7.663 | 7.606 | 7.674 | 7.556 | 7.632 | 7.547 | 7.813 | 7.688 | 7.503 |
| $^{IV}Al$ | 0.607 | 0.851 | 0.212 | 0.417 | 0.337 | 0.394 | 0.326 | 0.444 | 0.368 | 0.453 | 0.187 | 0.312 | 0.497 |
| **Total Tetrahedral** | **8.000** | **8.000** | **8.000** | **8.000** | **8.000** | **8.000** | **8.000** | **8.000** | **8.000** | **8.000** | **8.000** | **8.000** | **8.000** |
| $^{VI}Al$ | 0.042 | 0.222 | 0.019 | 0.136 | 0.082 | 0.084 | 0.076 | 0.035 | 0.317 | 0.175 | 0.134 | 0.129 | 0.194 |
| $Fe^{2+}$ | 1.563 | 3.594 | 0.788 | 0.675 | 0.538 | 0.575 | 0.721 | 0.402 | 0.655 | 0.776 | 0.805 | 1.708 | 1.678 |
| $Fe^{3+}$ | 0.000 | 0.262 | 0.127 | 0.224 | 0.122 | 0.199 | 0.120 | 0.267 | 0.000 | 0.029 | 0.000 | 0.022 | 0.148 |
| Mg | 3.401 | 0.837 | 4.080 | 4.088 | 4.329 | 4.132 | 4.122 | 4.284 | 4.074 | 4.029 | 4.110 | 3.216 | 3.043 |
| Mn | 0.125 | 0.188 | 0.004 | 0.006 | 0.000 | 0.002 | 0.001 | 0.007 | 0.004 | 0.011 | 0.010 | 0.035 | 0.029 |
| Ti | 0.046 | 0.026 | 0.001 | 0.003 | 0.001 | 0.011 | 0.009 | 0.020 | 0.017 | 0.022 | 0.008 | 0.017 | 0.014 |
| Cr | 0.000 | 0.000 | 0.002 | 0.000 | 0.000 | 0.004 | 0.006 | 0.009 | 0.002 | 0.001 | 0.000 | 0.002 | 0.006 |
| **Total Octahedral** | **5.177** | **5.129** | **5.021** | **5.132** | **5.072** | **5.007** | **5.055** | **5.024** | **5.069** | **5.043** | **5.067** | **5.129** | **5.112** |
| M4 Site | | | | | | | | | | | | | |
| Octahedral | 0.177 | 0.129 | 0.021 | 0.132 | 0.072 | 0.007 | 0.055 | 0.024 | 0.069 | 0.043 | 0.067 | 0.129 | 0.112 |
| Ca | 1.802 | 1.871 | 1.979 | 1.868 | 1.929 | 1.992 | 1.944 | 1.976 | 1.904 | 1.957 | 1.904 | 1.872 | 1.888 |
| Na | 0.020 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.029 | 0.000 | 0.029 | 0.000 | 0.000 |
| **Total** | **1.999** | **2.000** | **2.000** | **2.000** | **2.001** | **1.999** | **1.999** | **2.000** | **2.002** | **2.000** | **2.000** | **2.001** | **2.000** |
| A Site | | | | | | | | | | | | | |
| Na | 0.406 | 0.193 | 0.033 | 0.029 | 0.075 | 0.062 | 0.084 | 0.056 | 0.006 | 0.144 | 0.029 | 0.074 | 0.087 |
| K | 0.086 | 0.121 | 0.029 | 0.021 | 0.056 | 0.023 | 0.021 | 0.037 | 0.039 | 0.060 | 0.038 | 0.052 | 0.033 |
| **Total** | **0.492** | **0.314** | **0.062** | **0.050** | **0.131** | **0.085** | **0.105** | **0.093** | **0.045** | **0.204** | **0.067** | **0.126** | **0.120** |
| %Quad | 50.79 | 57.47 | 89.39 | 79.15 | 83.16 | 80.30 | 83.68 | 77.82 | 81.57 | 77.32 | 90.67 | 84.38 | 75.16 |
| %'Others' | 49.21 | 42.53 | 10.61 | 20.85 | 16.84 | 19.70 | 16.32 | 22.18 | 18.43 | 22.68 | 9.33 | 15.62 | 24.84 |
| Breakdown of Quad | | | | | | | | | | | | | |
| %Ca | 26.63 | 29.68 | 28.90 | 28.17 | 28.38 | 29.74 | 28.64 | 29.66 | 28.70 | 28.94 | 27.93 | 27.54 | 28.57 |
| %Mg | 50.27 | 13.29 | 59.59 | 61.65 | 63.70 | 61.68 | 60.73 | 64.30 | 61.42 | 59.59 | 60.27 | 47.32 | 46.04 |
| %Fe | 23.10 | 57.03 | 11.50 | 10.18 | 7.92 | 8.58 | 10.63 | 6.04 | 9.88 | 11.48 | 11.80 | 25.13 | 25.39 |
| Breakdown of 'Others' | | | | | | | | | | | | | |
| %A | 43.97 | 26.95 | 22.62 | 10.71 | 27.99 | 17.75 | 24.36 | 17.32 | 10.38 | 31.05 | 23.67 | 28.77 | 19.45 |
| %Na M4 | 1.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.55 | 0.00 | 10.25 | 0.00 | 0.00 |
| %Al4 | 54.24 | 73.05 | 77.37 | 89.29 | 72.01 | 82.25 | 75.64 | 82.68 | 83.07 | 68.95 | 66.07 | 71.23 | 80.55 |
| Best Name for 'Others' | ED | H | MH | TS | MH | MH | MH | MH | TS | PA | PA | PA | PA |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.315 | 0.811 | 0.162 | 0.142 | 0.111 | 0.122 | 0.149 | 0.086 | 0.139 | 0.161 | 0.164 | 0.347 | 0.355 |

ED = Edenite. H = Hastingsite, $Fe^{2+}/(Fe^{2+} + Mg) > 0.5$. MH = Magnesium-rich Hastingsite, $Fe^{2+}/(Fe^{2+} + Mg) < 0.5$. PA = Pargasite. TS = Tschermakite.

Table A7a. Microprobe Analyses of Pyroxenes in Limestones.

| | Cycle 2 Limestone | | | | Cycle 6 Limestone | |
|---|---|---|---|---|---|---|
| Sample Number | 18H-90 | 8H-130 | 8H-130 | 8H-130 | 8H-114 | 8H-114 |
| Photo # - Analysis # | 2-20 | 2-5 | 2-6 | 4-23 | 1-32 | 1-41 |
| $SiO_2$ | 54.59 | 54.40 | 54.15 | 53.96 | 53.45 | 53.99 |
| $Al_2O_3$ | 1.07 | 0.54 | 0.59 | 1.05 | 0.15 | 0.18 |
| FeO | 0.00 | 1.99 | 1.53 | 0.33 | 6.49 | 4.60 |
| $Fe_2O_3$ | 0.91 | 0.34 | 0.00 | 0.81 | 0.00 | 0.00 |
| MgO | 18.01 | 16.83 | 16.78 | 17.19 | 13.53 | 14.90 |
| MnO | 0.03 | 0.17 | 0.09 | 0.07 | 0.18 | 0.11 |
| $TiO_2$ | 0.14 | 0.06 | 0.07 | 0.07 | 0.00 | 0.00 |
| $Cr_2O_3$ | 0.00 | 0.04 | 0.07 | 0.01 | 0.00 | 0.02 |
| CaO | 25.72 | 25.39 | 24.97 | 25.72 | 25.40 | 25.84 |
| $Na_2O$ | 0.33 | 0.09 | 0.10 | 0.13 | 0.06 | 0.00 |
| **Total** | **100.80** | **99.85** | **99.35** | **99.34** | **99.26** | **99.64** |
| Cations/6 Oxygens | | | | | | |
| Si | 1.961 | 1.985 | 1.996 | 1.969 | 2.002 | 1.998 |
| $^{IV}Al$ | 0.039 | 0.015 | 0.004 | 0.031 | 0.000 | 0.002 |
| **Total Tetrahedral** | **2.000** | **2.000** | **2.000** | **2.000** | **2.002** | **2.000** |
| $^{VI}Al$ | 0.006 | 0.008 | 0.022 | 0.014 | 0.007 | 0.006 |
| $Fe^{2+}$ | 0.000 | 0.061 | 0.047 | 0.010 | 0.203 | 0.142 |
| $Fe^{3+}$ | 0.025 | 0.009 | 0.000 | 0.022 | 0.000 | 0.000 |
| Mg | 0.964 | 0.915 | 0.922 | 0.935 | 0.755 | 0.822 |
| Mn | 0.001 | 0.005 | 0.003 | 0.002 | 0.006 | 0.003 |
| Ti | 0.004 | 0.002 | 0.002 | 0.002 | 0.000 | 0.000 |
| Cr | 0.000 | 0.001 | 0.002 | 0.000 | 0.000 | 0.001 |
| **Total Octahedral** | **1.000** | **1.001** | **0.998** | **0.985** | **0.971** | **0.974** |
| Ca | 0.990 | 0.993 | 0.986 | 1.006 | 1.019 | 1.024 |
| Na | 0.023 | 0.006 | 0.007 | 0.009 | 0.004 | 0.000 |
| **Total Cations** | **4.013** | **4.000** | **3.991** | **4.000** | **3.996** | **3.998** |
| %Quad | 96.07 | 97.99 | 97.40 | 96.16 | 99.34 | 99.39 |
| %'Others' | 3.93 | 2.01 | 2.60 | 3.84 | 0.66 | 0.61 |
| Breakdown of Quad | | | | | | |
| %Ca | 50.66 | 50.43 | 50.44 | 51.56 | 51.54 | 51.52 |
| %Mg | 49.34 | 46.49 | 47.15 | 47.93 | 38.18 | 41.32 |
| $\%Fe^{2+}$ | 0.00 | 3.09 | 2.41 | 0.51 | 10.28 | 7.16 |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.000 | 0.063 | 0.049 | 0.011 | 0.211 | 0.147 |

Table A7b. Microprobe Analyses of Pyroxenes in Cycle 1 Argillites.

| Sample Number | 14H-80 | 14H-80 | 14H-80 | 3H-36 | 3H-36 | 3H-36 | 3H-36 | 3H-36 | 3H-36 | 3H-37 | 3H-37 | 3H-37 | 3H-37 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Photo # - Analysis # | 3-4 | 5-16 | 5-18 | 1-4 | 1-8 | 2-27 | 2-31 | 3-37 | 4-40 | 1-19 | 3-36 | 4-45 | 5-14 |
| Layer Type | A | A | A | A | A | A | A | A | W | W | A | W | A |
| $SiO_2$ | 52.27 | 52.54 | 52.50 | 51.51 | 51.78 | 53.09 | 51.96 | 52.45 | 52.62 | 52.94 | 53.04 | 53.44 | 54.51 |
| $Al_2O_3$ | 0.70 | 1.44 | 0.67 | 0.45 | 0.23 | 0.90 | 0.42 | 0.40 | 1.16 | 1.04 | 0.31 | 1.51 | 0.56 |
| FeO | 11.15 | 10.94 | 9.63 | 13.09 | 11.43 | 5.38 | 12.08 | 11.30 | 7.70 | 6.66 | 8.27 | 5.08 | 7.34 |
| $Fe_2O_3$ | 0.00 | 0.48 | 0.76 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.96 | 0.00 | 0.00 | 0.00 |
| MgO | 11.15 | 11.20 | 11.93 | 9.80 | 10.51 | 14.52 | 10.29 | 10.84 | 12.72 | 13.53 | 12.71 | 14.49 | 13.38 |
| MnO | 0.17 | 0.18 | 0.17 | 0.42 | 0.15 | 0.02 | 0.21 | 0.18 | 0.29 | 0.07 | 0.25 | 0.08 | 0.08 |
| $TiO_2$ | 0.02 | 0.09 | 0.01 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.03 | 0.05 |
| $Cr_2O_3$ | 0.01 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.02 | 0.00 |
| CaO | 23.36 | 24.44 | 24.58 | 23.89 | 24.04 | 24.40 | 23.72 | 23.80 | 23.98 | 24.58 | 24.57 | 23.30 | 25.71 |
| $Na_2O$ | 0.14 | 0.11 | 0.05 | 0.00 | 0.00 | 0.08 | 0.00 | 0.07 | 0.33 | 0.21 | 0.05 | 0.40 | 0.05 |
| **Total** | **99.97** | **101.45** | **100.30** | **99.38** | **98.14** | **98.45** | **98.68** | **99.12** | **99.03** | **100.03** | **99.23** | **98.35** | **101.68** |
| Cations/6 Oxygens | | | | | | | | | | | | | |
| Si | 1.997 | 1.963 | 1.976 | 1.987 | 2.003 | 1.988 | 2.002 | 2.004 | 1.983 | 1.971 | 2.000 | 1.993 | 1.996 |
| $^{IV}Al$ | 0.003 | 0.037 | 0.024 | 0.013 | 0.000 | 0.012 | 0.000 | 0.000 | 0.017 | 0.029 | 0.000 | 0.007 | 0.004 |
| **Total Tetrahedral** | **2.000** | **2.000** | **2.000** | **2.000** | **2.003** | **2.000** | **2.002** | **2.004** | **2.000** | **2.000** | **2.000** | **2.000** | **2.000** |
| $^{VI}Al$ | 0.028 | 0.026 | 0.006 | 0.007 | 0.010 | 0.028 | 0.019 | 0.018 | 0.035 | 0.016 | 0.014 | 0.059 | 0.021 |
| $Fe^{2+}$ | 0.356 | 0.342 | 0.303 | 0.422 | 0.370 | 0.168 | 0.389 | 0.361 | 0.243 | 0.207 | 0.261 | 0.158 | 0.225 |
| $Fe^{3+}$ | 0.000 | 0.013 | 0.021 | 0.006 | 0.000 | 0.000 | 0.000 | 0.000 | 0.006 | 0.027 | 0.000 | 0.000 | 0.000 |
| Mg | 0.635 | 0.624 | 0.669 | 0.563 | 0.606 | 0.810 | 0.591 | 0.617 | 0.714 | 0.751 | 0.714 | 0.805 | 0.730 |
| Mn | 0.006 | 0.006 | 0.005 | 0.014 | 0.005 | 0.001 | 0.007 | 0.006 | 0.009 | 0.002 | 0.008 | 0.003 | 0.002 |
| Ti | 0.001 | 0.003 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 |
| Cr | 0.000 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 | 0.000 |
| **Total Octahedral** | **1.026** | **1.015** | **1.004** | **1.012** | **0.991** | **1.008** | **1.006** | **1.002** | **1.007** | **1.004** | **0.998** | **1.027** | **0.979** |
| Ca | 0.956 | 0.978 | 0.991 | 0.987 | 0.997 | 0.979 | 0.979 | 0.978 | 0.968 | 0.980 | 0.993 | 0.931 | 1.009 |
| Na | 0.010 | 0.008 | 0.004 | 0.000 | 0.000 | 0.006 | 0.000 | 0.005 | 0.024 | 0.015 | 0.004 | 0.029 | 0.004 |
| **Total Cations** | **3.992** | **4.001** | **3.999** | **3.999** | **3.991** | **3.993** | **3.987** | **3.986** | **3.999** | **3.999** | **3.995** | **3.987** | **3.992** |
| %Quad | 97.09 | 95.71 | 97.26 | 98.66 | 98.95 | 97.06 | 98.09 | 98.20 | 95.89 | 95.58 | 98.53 | 93.92 | 97.81 |
| %'Others' | 2.91 | 4.29 | 2.76 | 1.34 | 1.05 | 2.94 | 1.91 | 1.80 | 4.11 | 4.42 | 1.47 | 6.08 | 2.19 |
| Breakdown of Quad | | | | | | | | | | | | | |
| %Ca | 49.11 | 50.33 | 50.48 | 50.04 | 50.53 | 50.01 | 49.98 | 49.98 | 50.29 | 50.58 | 50.45 | 49.14 | 51.37 |
| %Mg | 32.60 | 32.08 | 34.08 | 28.55 | 30.72 | 41.39 | 30.16 | 31.56 | 37.10 | 38.72 | 36.30 | 42.50 | 37.18 |
| $\%Fe^{2+}$ | 18.29 | 17.59 | 15.44 | 21.41 | 18.75 | 8.61 | 19.87 | 18.46 | 12.61 | 10.70 | 13.25 | 8.36 | 11.45 |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.359 | 0.354 | 0.312 | 0.432 | 0.379 | 0.172 | 0.397 | 0.369 | 0.254 | 0.216 | 0.268 | 0.164 | 0.236 |

| Sample Number | 16H-84 | 16H-84 | 16H-84 | 16H-48 | 16H-84 | 18H-89 | 18H-89 | 18H-89 | 18H-89 | 18H-89 | 18H-89 | 20H-98 | 20H-98 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Photo # - Analysis # | 0-29 | 2-46 | 5-22 | 6-15 | 7-20 | 1-31 | 1-32 | 2-35 | 3-46 | 4-52 | 4-53 | 1-7 | 4-33 |
| Layer Type | A | A | W | W | A | A | A | W | C | W | W | A | A |
| $SiO_2$ | 51.60 | 51.23 | 52.45 | 52.04 | 51.58 | 51.96 | 52.50 | 52.71 | 53.24 | 52.57 | 52.30 | 52.36 | 53.06 |
| $Al_2O_3$ | 0.27 | 0.57 | 0.83 | 0.93 | 0.14 | 1.49 | 0.41 | 0.43 | 0.23 | 1.22 | 0.49 | 0.15 | 0.13 |
| FeO | 9.97 | 10.52 | 10.59 | 9.01 | 12.51 | 8.83 | 8.15 | 7.30 | 7.71 | 3.97 | 8.03 | 11.26 | 10.43 |
| $Fe_2O_3$ | 0.80 | 1.05 | 1.97 | 1.63 | 0.27 | 0.00 | 0.90 | 1.11 | 0.44 | 2.88 | 1.10 | 0.24 | 0.00 |
| MgO | 11.08 | 10.70 | 10.27 | 11.72 | 10.55 | 11.99 | 12.95 | 13.29 | 13.74 | 14.47 | 12.79 | 11.31 | 11.54 |
| MnO | 0.31 | 0.18 | 0.25 | 0.19 | 0.26 | 0.08 | 0.13 | 0.10 | 0.15 | 0.13 | 0.11 | 0.33 | 0.25 |
| $TiO_2$ | 0.03 | 0.04 | 0.00 | 0.07 | 0.02 | 0.05 | 0.01 | 0.00 | 0.00 | 0.03 | 0.02 | 0.00 | 0.00 |
| $Cr_2O_3$ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| CaO | 24.23 | 24.44 | 24.86 | 24.91 | 23.33 | 24.22 | 24.09 | 24.45 | 25.35 | 24.60 | 24.70 | 24.34 | 24.44 |
| $Na_2O$ | 0.17 | 0.09 | 0.37 | 0.12 | 0.05 | 0.07 | 0.12 | 0.17 | 0.03 | 0.40 | 0.15 | 0.00 | 0.00 |
| **Total** | **98.38** | **98.82** | **101.59** | **100.61** | **98.71** | **98.69** | **99.26** | **99.56** | **100.89** | **100.27** | **99.70** | **99.99** | **99.85** |
| Cation/6 Oxygens | | | | | | | | | | | | | |
| Si | 1.986 | 1.972 | 1.967 | 1.956 | 1.994 | 1.974 | 1.982 | 1.979 | 1.976 | 1.943 | 1.971 | 1.991 | 2.006 |
| $^{IV}Al$ | 0.012 | 0.026 | 0.033 | 0.041 | 0.006 | 0.026 | 0.018 | 0.019 | 0.010 | 0.053 | 0.022 | 0.007 | 0.000 |
| **Total Tetrahedral** | **1.998** | **1.998** | **2.000** | **1.997** | **2.000** | **2.000** | **2.000** | **1.998** | **1.986** | **1.996** | **1.993** | **1.998** | **2.006** |
| $^{VI}Al$ | 0.000 | 0.000 | 0.004 | 0.000 | 0.001 | 0.040 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.006 |
| $Fe^{2+}$ | 0.321 | 0.339 | 0.332 | 0.283 | 0.404 | 0.280 | 0.257 | 0.229 | 0.239 | 0.123 | 0.253 | 0.358 | 0.330 |
| $Fe^{3+}$ | 0.023 | 0.030 | 0.056 | 0.046 | 0.008 | 0.000 | 0.025 | 0.031 | 0.012 | 0.080 | 0.031 | 0.007 | 0.000 |
| Mg | 0.636 | 0.614 | 0.574 | 0.657 | 0.608 | 0.679 | 0.729 | 0.744 | 0.760 | 0.797 | 0.718 | 0.641 | 0.650 |
| Mn | 0.010 | 0.006 | 0.008 | 0.006 | 0.009 | 0.003 | 0.004 | 0.003 | 0.005 | 0.004 | 0.004 | 0.011 | 0.008 |
| Ti | 0.001 | 0.001 | 0.000 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 |
| Cr | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| **Total Octahedral** | **0.991** | **0.990** | **0.974** | **0.994** | **1.031** | **1.003** | **1.016** | **1.007** | **1.016** | **1.005** | **1.007** | **1.017** | **0.994** |
| Ca | 1.001 | 1.008 | 0.999 | 1.003 | 0.966 | 0.986 | 0.975 | 0.984 | 1.009 | 0.974 | 0.997 | 0.991 | 0.990 |
| Na | 0.013 | 0.007 | 0.027 | 0.009 | 0.004 | 0.005 | 0.009 | 0.012 | 0.002 | 0.029 | 0.011 | 0.000 | 0.000 |
| **Total Cations** | **4.003** | **4.003** | **4.000** | **4.003** | **4.001** | **3.994** | **4.000** | **4.001** | **4.013** | **4.004** | **4.008** | **4.006** | **3.990** |
| %Quad | 97.59 | 96.86 | 94.03 | 95.20 | 99.10 | 95.83 | 97.38 | 96.86 | 98.78 | 91.90 | 96.78 | 99.33 | 99.42 |
| %'Others' | 2.41 | 3.14 | 5.97 | 4.80 | 0.90 | 4.17 | 2.62 | 3.14 | 1.22 | 8.10 | 3.22 | 0.67 | 0.58 |
| Breakdown of Quad | | | | | | | | | | | | | |
| %Ca | 51.09 | 51.42 | 52.43 | 51.64 | 48.84 | 50.68 | 49.70 | 50.28 | 50.22 | 51.44 | 50.66 | 49.82 | 50.26 |
| %Mg | 32.50 | 31.31 | 30.13 | 33.79 | 30.72 | 34.90 | 37.16 | 38.01 | 37.86 | 42.09 | 36.49 | 32.20 | 33.00 |
| $\%Fe^{2+}$ | 16.41 | 17.27 | 17.44 | 14.57 | 20.44 | 14.42 | 13.13 | 11.72 | 11.92 | 6.47 | 12.85 | 17.99 | 16.74 |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.335 | 0.356 | 0.366 | 0.301 | 0.399 | 0.292 | 0.261 | 0.235 | 0.239 | 0.134 | 0.261 | 0.358 | 0.337 |

| Sample Number | 8H-129 | 8H-129 | 8H-129 | 8H-129 | 8H-129 | 8H-129 | 8H-129 | 5H-47 | 5H-47 | 5H-47 | 5H-47 | 5H-47 | 7H-56 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Photo # - Analysis # | 1-11 | 1-12 | 2-19 | 4-48 | 4-50 | 5-12 | 5-17 | 1-59 | 2-37 | 3-27 | 4-26 | 4-30 | 3-27 |
| Layer Type | A | A | A | C | C | C | C | A+C | A+C | A+C | A+C | A+C | C |
| $SiO_2$ | 54.58 | 53.93 | 53.60 | 54.25 | 54.91 | 53.65 | 52.11 | 53.85 | 52.90 | 53.24 | 53.95 | 53.67 | 53.78 |
| $Al_2O_3$ | 0.15 | 0.25 | 0.28 | 0.24 | 0.30 | 0.76 | 0.44 | 0.13 | 0.58 | 0.86 | 1.23 | 0.14 | 1.02 |
| FeO | 4.48 | 5.01 | 4.92 | 6.86 | 5.70 | 4.88 | 7.55 | 5.54 | 7.18 | 5.44 | 4.87 | 5.82 | 6.14 |
| $Fe_2O_3$ | 0.00 | 0.00 | 0.43 | 0.45 | 0.00 | 0.86 | 0.84 | 0.18 | 0.00 | 0.86 | 1.14 | 0.00 | 0.00 |
| MgO | 15.37 | 14.76 | 14.84 | 13.88 | 14.73 | 15.28 | 12.66 | 15.26 | 13.07 | 14.37 | 15.66 | 14.80 | 14.77 |
| MnO | 0.09 | 0.07 | 0.18 | 0.14 | 0.13 | 0.02 | 0.13 | 0.05 | 0.14 | 0.08 | 0.00 | 0.10 | 0.08 |
| $TiO_2$ | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.02 | 0.02 | 0.00 | 0.04 | 0.03 | 0.03 | 0.05 | 0.07 |
| $Cr_2O_3$ | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 | 0.00 | 0.02 | 0.07 | 0.03 |
| CaO | 25.43 | 25.53 | 25.52 | 25.72 | 25.90 | 24.90 | 24.72 | 24.63 | 24.36 | 25.12 | 24.72 | 24.41 | 24.44 |
| $Na_2O$ | 0.01 | 0.01 | 0.01 | 0.04 | 0.07 | 0.03 | 0.09 | 0.01 | 0.01 | 0.08 | 0.02 | 0.14 | 0.11 |
| **Total** | **100.11** | **99.56** | **99.80** | **101.59** | **101.74** | **100.40** | **98.57** | **99.66** | **98.30** | **100.08** | **101.61** | **99.20** | **100.45** |
| Cations/6 Oxygens | | | | | | | | | | | | | |
| Si | 2.004 | 1.998 | 1.986 | 1.990 | 1.997 | 1.972 | 1.981 | 1.995 | 2.001 | 1.971 | 1.958 | 2.000 | 1.979 |
| $^{IV}Al$ | 0.000 | 0.002 | 0.012 | 0.010 | 0.003 | 0.028 | 0.019 | 0.005 | 0.000 | 0.029 | 0.042 | 0.000 | 0.021 |
| **Total Tetrahedral** | **2.004** | **2.000** | **1.998** | **2.000** | **2.000** | **2.000** | **2.000** | **2.000** | **2.000** | **2.000** | **2.000** | **2.000** | **2.000** |
| $^{VI}Al$ | 0.006 | 0.009 | 0.000 | 0.000 | 0.010 | 0.005 | 0.000 | 0.001 | 0.026 | 0.009 | 0.010 | 0.006 | 0.024 |
| $Fe^{2+}$ | 0.138 | 0.155 | 0.152 | 0.210 | 0.173 | 0.150 | 0.240 | 0.172 | 0.227 | 0.169 | 0.148 | 0.181 | 0.189 |
| $Fe^{3+}$ | 0.000 | 0.000 | 0.012 | 0.013 | 0.000 | 0.024 | 0.024 | 0.005 | 0.000 | 0.024 | 0.031 | 0.000 | 0.000 |
| Mg | 0.841 | 0.815 | 0.819 | 0.759 | 0.798 | 0.837 | 0.717 | 0.843 | 0.737 | 0.793 | 0.847 | 0.822 | 0.810 |
| Mn | 0.003 | 0.002 | 0.006 | 0.004 | 0.004 | 0.001 | 0.004 | 0.002 | 0.004 | 0.003 | 0.000 | 0.003 | 0.002 |
| Ti | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 |
| Cr | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.001 | 0.002 | 0.001 |
| **Total Octahedral** | **0.988** | **0.981** | **0.989** | **0.986** | **0.985** | **1.018** | **0.986** | **1.023** | **0.996** | **0.999** | **1.038** | **1.015** | **1.028** |
| Ca | 1.000 | 1.014 | 1.013 | 1.011 | 1.009 | 0.981 | 1.007 | 0.978 | 0.987 | 0.997 | 0.961 | 0.974 | 0.964 |
| Na | 0.001 | 0.001 | 0.001 | 0.003 | 0.005 | 0.002 | 0.007 | 0.001 | 0.001 | 0.006 | 0.001 | 0.010 | 0.008 |
| **Total Cations** | **3.993** | **3.996** | **4.001** | **4.000** | **3.999** | **4.001** | **4.000** | **4.002** | **3.985** | **4.002** | **4.000** | **3.999** | **4.000** |
| %Quad | 99.35 | 99.06 | 98.73 | 98.71 | 99.04 | 97.06 | 97.47 | 99.42 | 97.24 | 96.63 | 95.71 | 98.99 | 97.34 |
| %'Others' | 0.65 | 0.94 | 1.27 | 1.29 | 0.96 | 2.94 | 2.53 | 0.58 | 2.76 | 3.37 | 4.29 | 1.01 | 2.66 |
| Breakdown of Quad | | | | | | | | | | | | | |
| %Ca | 50.55 | 51.09 | 51.04 | 51.05 | 50.95 | 49.84 | 51.27 | 49.08 | 50.60 | 50.90 | 49.15 | 49.28 | 49.10 |
| %Mg | 42.50 | 41.08 | 41.28 | 38.32 | 40.30 | 42.54 | 36.52 | 42.30 | 37.76 | 40.50 | 43.30 | 41.55 | 41.27 |
| $\%Fe^{2+}$ | 6.95 | 7.83 | 7.68 | 10.63 | 8.75 | 7.62 | 12.21 | 8.62 | 11.64 | 8.61 | 7.55 | 9.17 | 9.63 |
| $Fe^{2+}/(Fe^{2+} + Mg)$ | 0.141 | 0.160 | 0.157 | 0.217 | 0.180 | 0.152 | 0.250 | 0.169 | 0.235 | 0.176 | 0.149 | 0.180 | 0.189 |

A = Argillite Layer = Diopside + Felspars. C = Calcite-rich Layer. W = Wollastonite-rich Layer.