

XRF ANALYSIS OF QUARTZ SANDS

Major and minor elements in quartz sands were determined by X-ray fluorescence analysis (XRF) with the sequential X-ray spectrometer in the application laboratory in Karlsruhe. The measuring conditions are listed on the next page.

For calibration certified clay standard samples were used (see copy). Fused beads (0.6 g sample and 6.0 g Spectromelt A12 = 66% $\text{Li}_2\text{B}_4\text{O}_7$ and 34% LiBO_2) had been prepared for XRF analysis.

Calibration curves and calibration data (correction models, standard deviation, absolute and relative deviation of standard samples) are presented for Fe_2O_3 , TiO_2 , SiO_2 , CaO , K_2O , Al_2O_3 , MgO and Na_2O .

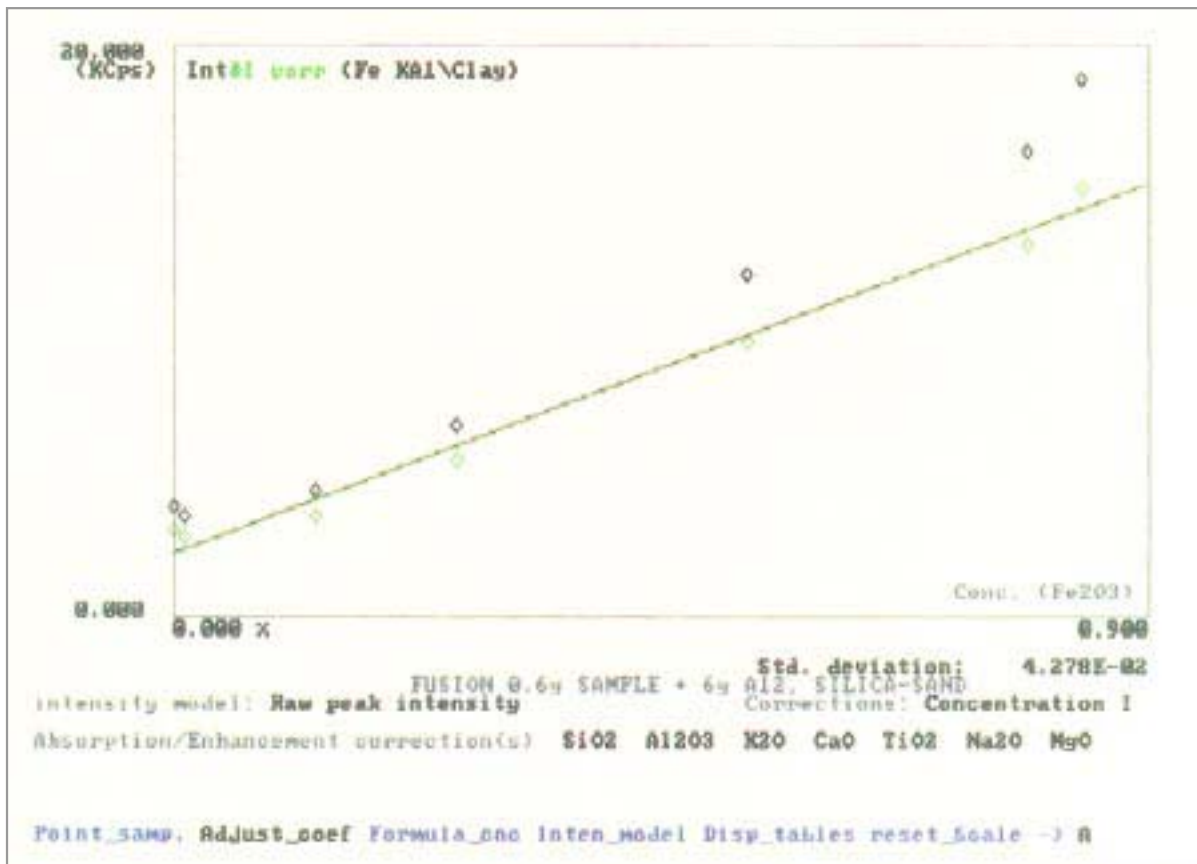


| --- Standards | Fe2O3 % | TiO2 % | SiO2 % | CaO % | K2O % | Al2O3 % |
|---------------|------------|-----------|-----------|----------|----------|------------|
| 1 FK | 0.261 | 0.058 | 88.20 | 0.110 | 4.230 | 6.180 |
| 2 139 | 0.840 | 0.530 | 82.41 | 0.140 | 0.510 | 13.800 |
| 3 BCS313-1 | 0.010 | 0.020 | 99.70 | 0.010 | 0.005 | 0.050 |
| 4 BCS314 | 0.530 | 0.190 | 96.20 | 1.810 | 0.090 | 0.770 |
| 5 BCS267A | 0.790 | 0.170 | 95.90 | 1.750 | 0.140 | 0.850 |
| 6 2CAS8FLI | 0.130 | 0.010 | 98.10 | 0.570 | 0.050 | 0.210 |
| 7 SIO2 | 0.000 | 0.000 | 99.99 | 0.000 | 0.000 | 0.000 |

| --- Standards | MgO % | Na2O % | CO2 % | Summe % |
|---------------|----------|-----------|----------|------------|
| 1 FK | 0.150 | 0.250 | 0.39 | 99.83 |
| 2 139 | 0.120 | 0.059 | 0.78 | 99.19 |
| 3 BCS313-1 | 0.001 | 0.005 | 0.10 | 99.90 |
| 4 BCS314 | 0.050 | 0.050 | 0.09 | 99.78 |
| 5 BCS267A | 0.060 | 0.060 | 0.00 | 99.72 |
| 6 2CAS8FLI | 0.020 | 0.050 | 0.01 | 99.15 |
| 7 SIO2 | 0.000 | 0.000 | 0.00 | 99.99 |

| --- Standards | Fe2O3 KCps | TiO2 KCps | SiO2 KCps | CaO KCps | K2O KCps | Al2O3 KCps |
|---------------|---------------|--------------|--------------|-------------|-------------|---------------|
| 1 FK | 6.5782 | 0.4237 | 238.0677 | 2.9427 | 69.2971 | 20.3433 |
| 2 139 | 18.7425 | 2.2050 | 218.1697 | 3.5045 | 9.9333 | 45.8387 |
| 3 BCS313-1 | 3.4406 | 0.2888 | 271.7857 | 1.7889 | 1.1813 | 0.7731 |
| 4 BCS314 | 11.9059 | 0.9633 | 260.7934 | 24.3904 | 2.4188 | 3.4815 |
| 5 BCS267A | 16.2167 | 0.8512 | 260.9279 | 22.9039 | 3.0686 | 3.4388 |
| 6 2CAS8FLI | 4.3044 | 0.2421 | 267.0242 | 8.7819 | 1.9339 | 1.7641 |
| 7 SIO2 | 3.7243 | 0.2225 | 272.8506 | 1.7360 | 1.0665 | 0.6329 |

| --- Standards | MgO KCps | Na2O KCps | CO2 KCps | Summe KCps |
|---------------|-------------|--------------|-------------|---------------|
| 1 FK | 0.2216 | 0.7477 | | |
| 2 139 | 0.2349 | 0.5462 | | |
| 3 BCS313-1 | 0.1111 | 0.4506 | | |
| 4 BCS314 | 0.1507 | 0.4945 | | |
| 5 BCS267A | 0.1413 | 0.5055 | | |
| 6 2CAS8FLI | 0.1272 | 0.5528 | | |
| 7 SIO2 | 0.1105 | 0.4455 | | |



Program file: SILICA-F.QAN
 Compound: Fe2O3

Std. deviation: 4.278E-02

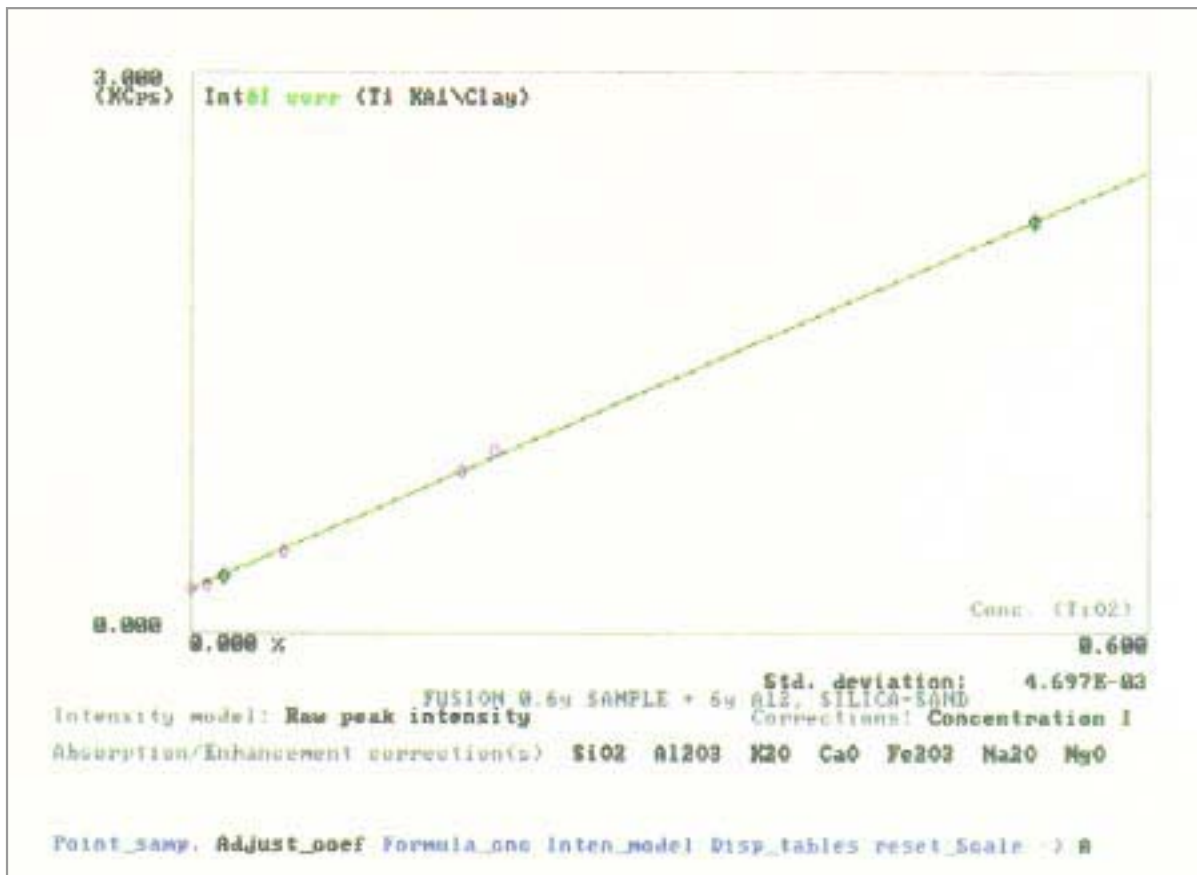
Net intensity model: Raw peak intensity
 Dead time correction is On

Concentration correction model: Concentration I Regression weighting: Absolute
 Intensity at 100 % : 1440.055 KCps - Slope : 6.95456E-02 % / KCps
 Intensity at 0.0 % : +2.149 KCps - Offset:-0.14946 %

Absorption / Secondary emission corrections

| | | |
|-------|----------|---------|
| SiO2 | -0.21259 | (fixed) |
| Al2O3 | -0.23516 | (fixed) |
| K2O | 0.36546 | (fixed) |
| CaO | 0.36125 | (fixed) |
| TiO2 | 0.42794 | (fixed) |
| Na2O | -0.27600 | (fixed) |
| MgO | -0.24826 | (fixed) |

| --- Standard | Status | Measured KCps | Chemical % | Computed % | Deviation % | Rel. |
|--------------|--------|---------------|------------|------------|-------------|--------|
| 1 FK | | 6.5782 | 0.261 | 0.222 | -0.039 | -14.76 |
| 2 139 | | 18.7425 | 0.840 | 0.889 | 0.049 | 5.81 |
| 3 BCS313-1 | | 3.4406 | 0.010 | 0.039 | 0.029 | 291.06 |
| 4 BCS314 | | 11.9059 | 0.530 | 0.514 | -0.016 | -3.05 |
| 5 BCS267A | | 16.2167 | 0.790 | 0.754 | -0.036 | -4.51 |
| 6 2CAS8FLI | | 4.3044 | 0.130 | 0.088 | -0.042 | -32.35 |
| 7 SiO2 | | 3.7243 | 0.000 | 0.054 | 0.054 | |



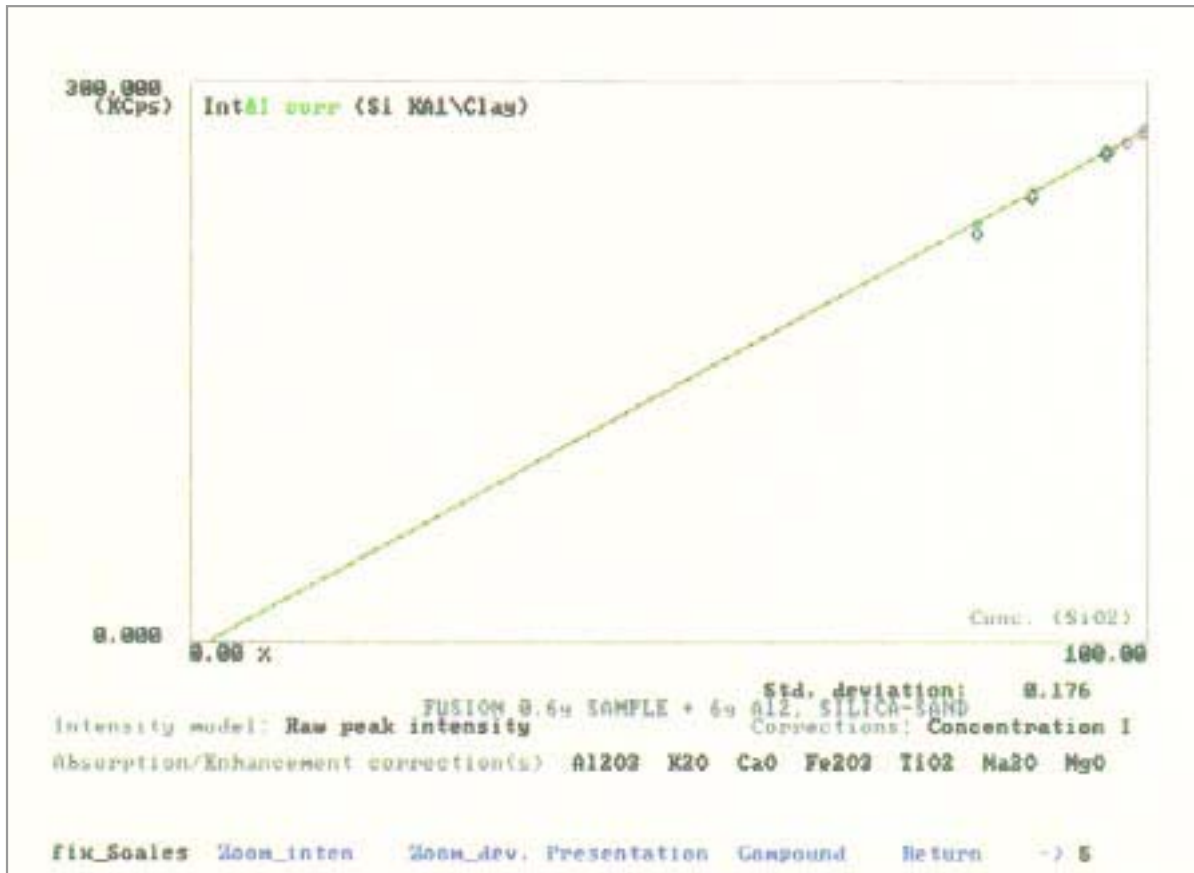
Program file: SILICA-F.QAN
Compound: TiO2

Std. deviation: 4.697E-03

Net intensity model: Raw peak intensity
Dead time correction is On

Concentration correction model: Concentration I Regression weighting: Absolute
Intensity at 100 % : 373.418 KCps - Slope : 0.26795 % / KCps
Intensity at 0.0 % : +0.218 KCps - Offset:-5.83780E-02 %
Absorption / Secondary emission corrections
SiO2 -1.11860E-02 (fixed)
Al2O3 -3.31097E-02 (fixed)
K2O 0.64535 (fixed)
CaO 0.64117 (fixed)
Fe2O3 -4.55355E-02 (fixed)
Na2O -7.63076E-02 (fixed)
MgO -5.65715E-02 (fixed)

| Standard | Status | Measured KCps | Chemical % | Computed % | Deviation % | Rel. |
|------------|--------|------------------|---------------|---------------|----------------|--------|
| 1 FK | | 0.4237 | 0.058 | 0.057 | -0.001 | -1.83 |
| 2 139 | | 2.2050 | 0.530 | 0.526 | -0.004 | -0.66 |
| 3 BCS313-1 | | 0.2888 | 0.020 | 0.018 | -0.002 | -9.22 |
| 4 BCS314 | | 0.9633 | 0.190 | 0.200 | 0.010 | 5.25 |
| 5 BCS267A | | 0.8512 | 0.170 | 0.170 | 0.000 | -0.08 |
| 6 2CAS8FLI | | 0.2421 | 0.010 | 0.006 | -0.004 | -39.68 |
| 7 SiO2 | | 0.2225 | 0.000 | 0.001 | 0.001 | |



Program file: SILICA-F.QAN
 Compound: SiO2

Std. deviation: 0.176

Net intensity model: Raw peak intensity
 Dead time correction is On

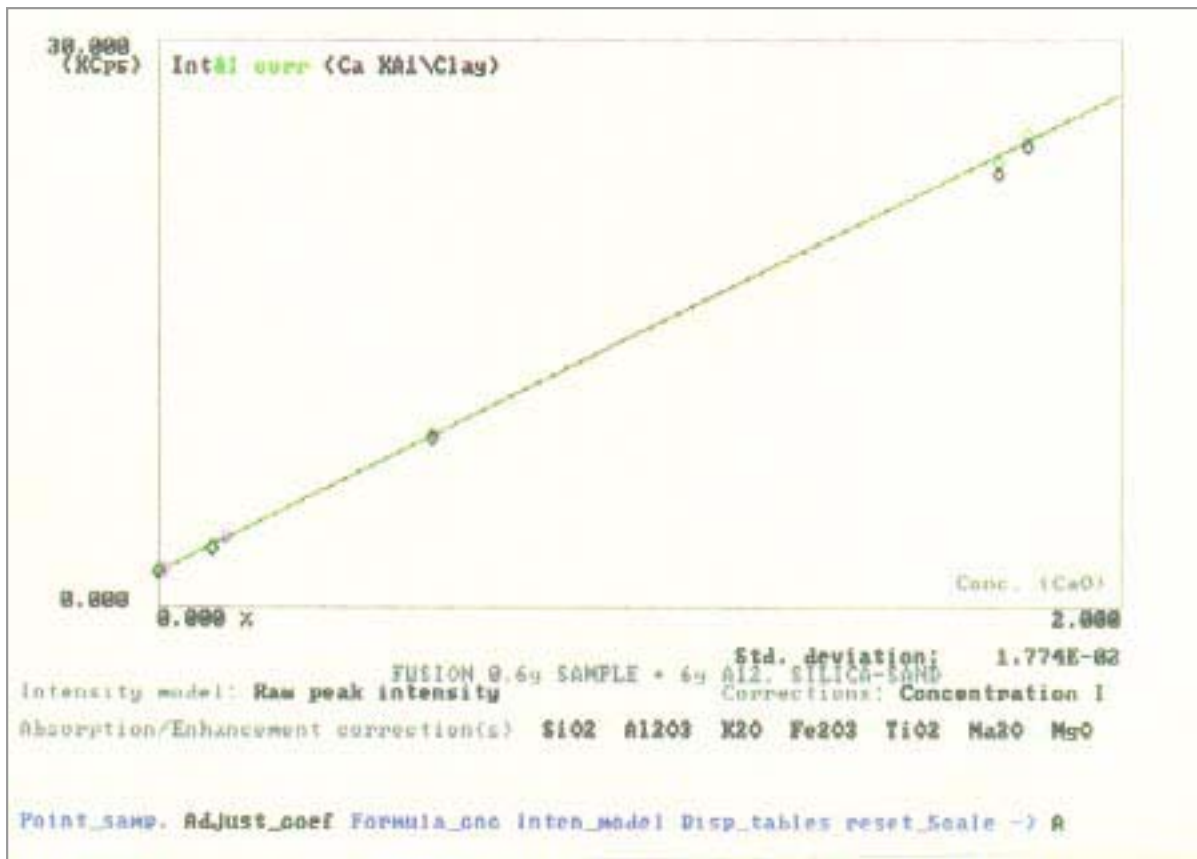
Concentration correction model: Concentration I Regression weighting: Absolute

Intensity at 100 % : 272.684 KCps - Slope : 0.35915 % / KCps
 Intensity at 0.0 % : -5.751 KCps - Offset: +2.0654 %

Absorption / Secondary emission corrections

| | | |
|-------|--------------|---------|
| Al2O3 | 0.16043 | (fixed) |
| K2O | -4.91130E-03 | (fixed) |
| CaO | 1.23427E-02 | (fixed) |
| Fe2O3 | 0.12407 | (fixed) |
| TiO2 | 3.77011E-02 | (fixed) |
| Na2O | 0.11385 | (fixed) |
| MgO | 0.13459 | (fixed) |

| Standard | Status | Measured KCps | Chemical % | Computed % | Deviation % | Rel. |
|------------|--------|------------------|---------------|---------------|----------------|-------|
| 1 FK | | 238.0677 | 88.20 | 88.47 | 0.27 | 0.31 |
| 2 139 | | 218.1697 | 82.41 | 82.27 | -0.14 | -0.17 |
| 3 BCS313-1 | | 271.7857 | 99.70 | 99.69 | -0.01 | -0.01 |
| 4 BCS314 | | 260.7934 | 96.20 | 95.95 | -0.25 | -0.26 |
| 5 BCS267A | | 260.9279 | 95.90 | 96.04 | 0.14 | 0.14 |
| 6 2CAS8FLI | | 267.0242 | 98.10 | 98.03 | -0.07 | -0.07 |
| 7 SIO2 | | 272.8506 | 99.99 | 100.06 | 0.07 | 0.07 |



Program file: SILICA-F.QAN
 Compound: CaO

Std. deviation: 1.774E-02

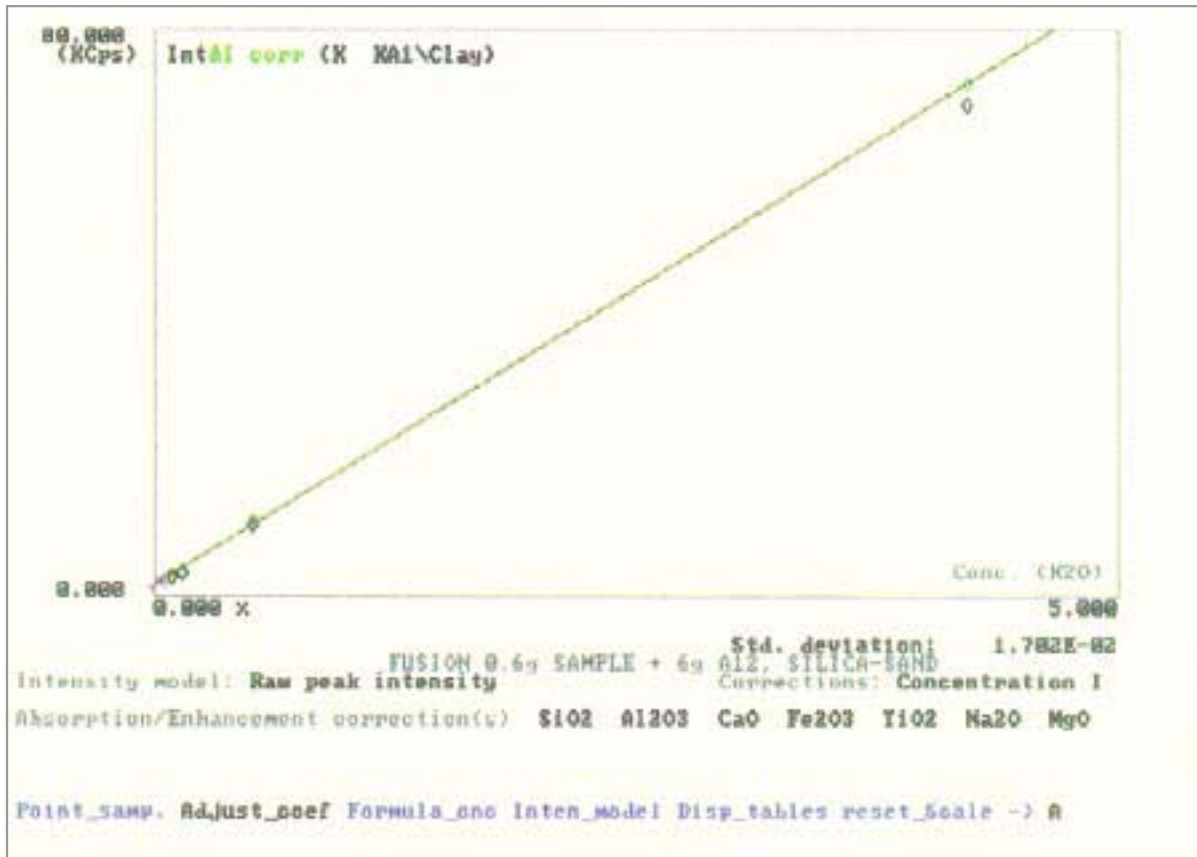
Net intensity model: Raw peak intensity
 Dead time correction is On

Concentration correction model: Concentration I Regression weighting: Absolute
 Intensity at 100 % : 1266.870 KCps - Slope : 7.90442E-02 % / KCps
 Intensity at 0.0 % : +1.754 KCps - Offset:-0.13865 %

Absorption / Secondary emission corrections

| | |
|-------|----------------------|
| SiO2 | 2.61748E-02 (fixed) |
| Al2O3 | 4.29929E-03 (fixed) |
| K2O | 0.67304 (fixed) |
| Fe2O3 | -3.24906E-02 (fixed) |
| TiO2 | -6.91732E-02 (fixed) |
| Na2O | -3.85672E-02 (fixed) |
| MgO | -1.94698E-02 (fixed) |

| --- Standard | Status | Measured KCps | Chemical % | Computed % | Deviation % | Rel. |
|--------------|--------|------------------|---------------|---------------|----------------|--------|
| 1 FK | | 2.9427 | 0.110 | 0.106 | -0.004 | -3.68 |
| 2 139 | | 3.5045 | 0.140 | 0.145 | 0.005 | 3.76 |
| 3 BCS313-1 | | 1.7889 | 0.010 | 0.006 | -0.004 | -35.51 |
| 4 BCS314 | | 24.3904 | 1.810 | 1.838 | 0.028 | 1.57 |
| 5 BCS267A | | 22.9039 | 1.750 | 1.718 | -0.032 | -1.81 |
| 6 2CAS8FLI | | 8.7819 | 0.570 | 0.574 | 0.004 | 0.62 |
| 7 SiO2 | | 1.7360 | 0.000 | 0.002 | 0.002 | |



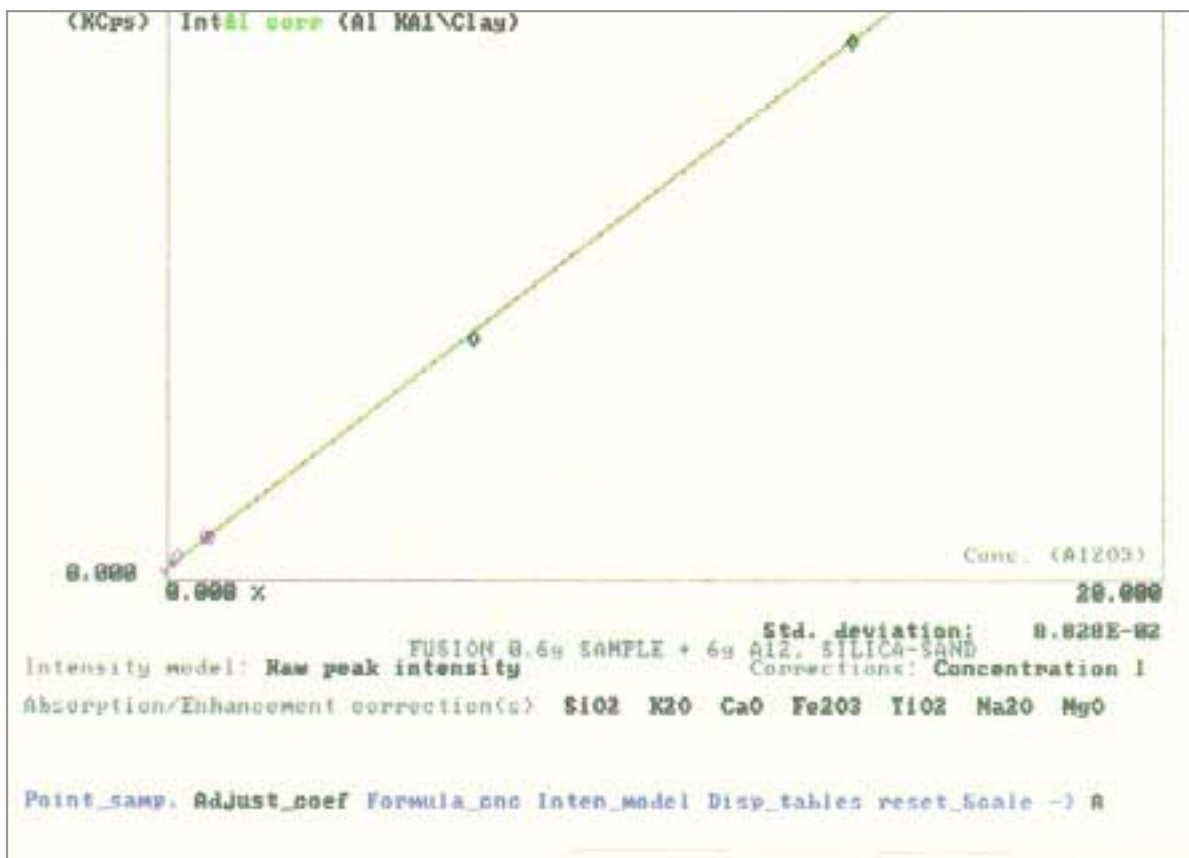
Program file: SILICA-F.QAN
 Compound: K2O

Std. deviation: 1.702E-02

Net intensity model: Raw peak intensity
 Dead time correction is On

Concentration correction model: Concentration I Regression weighting: Absolute
 Intensity at 100 % : 1679.575 KCps - Slope : 5.95802E-02 % / KCps
 Intensity at 0.0 % : +1.166 KCps - Offset:-6.94484E-02 %
 Absorption / Secondary emission corrections
 SiO2 4.44812E-02 (fixed)
 Al2O3 2.26297E-02 (fixed)
 CaO -6.43469E-02 (fixed)
 Fe2O3 -2.17990E-02 (fixed)
 TiO2 -7.03485E-02 (fixed)
 Na2O -2.03351E-02 (fixed)
 MgO -1.22940E-03 (fixed)

| --- Standard | Status | Measured KCps | Chemical % | Computed % | Deviation % | Rel. |
|--------------|--------|------------------|---------------|---------------|----------------|--------|
| 1 FK | | 69.2971 | 4.230 | 4.226 | -0.004 | -0.09 |
| 2 139 | | 9.9333 | 0.510 | 0.546 | 0.036 | 6.97 |
| 3 BCS313-1 | | 1.1813 | 0.005 | 0.004 | -0.001 | -18.91 |
| 4 BCS314 | | 2.4188 | 0.090 | 0.081 | -0.009 | -10.39 |
| 5 BCS267A | | 3.0686 | 0.140 | 0.121 | -0.019 | -13.60 |
| 6 2CAS8FLI | | 1.9339 | 0.050 | 0.051 | 0.001 | 1.52 |
| 7 SiO2 | | .10665 | 0.000 | -0.003 | -0.003 | |



Program file: SILICA-F.QAN
 Compound: Al2O3

Std. deviation: 8.827E-02

Net intensity model: Raw peak intensity
 Dead time correction is On

Concentration correction model: Concentration I Regression weighting: Absolute

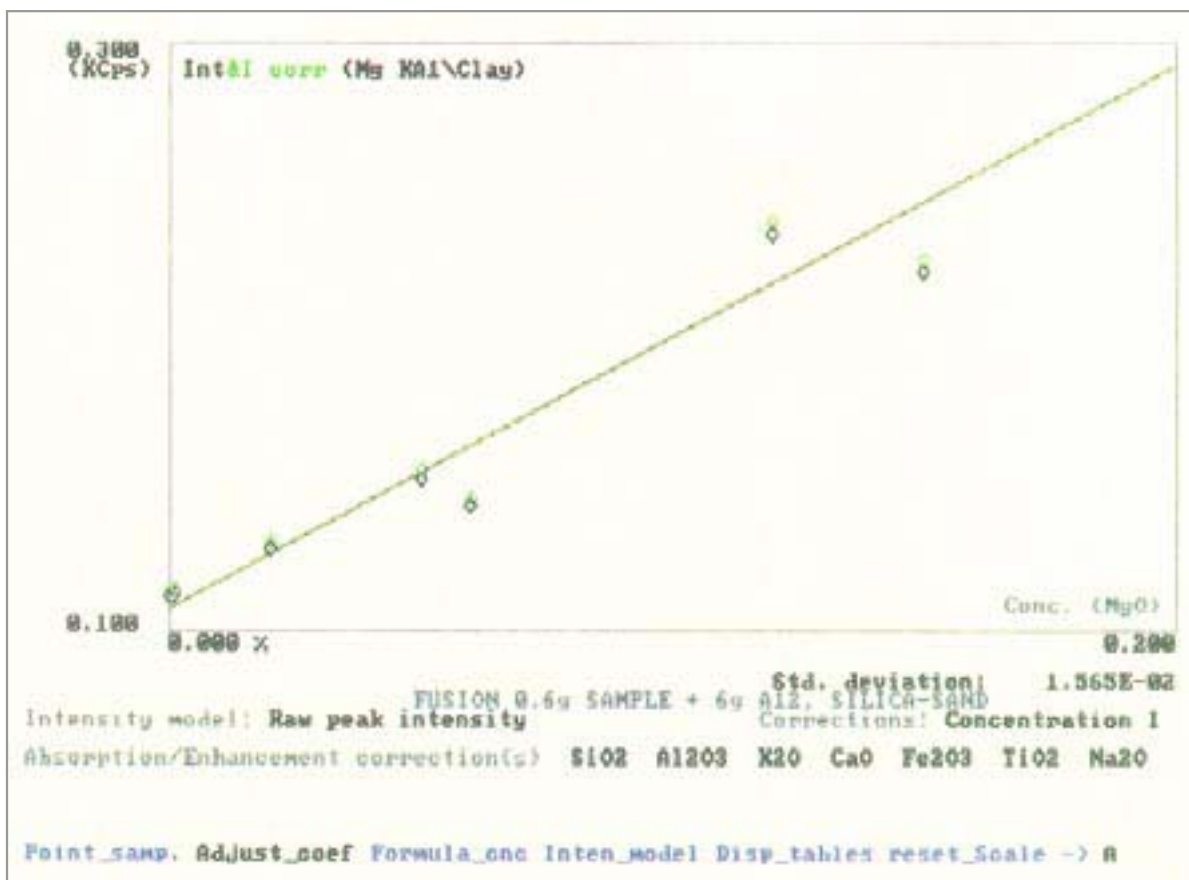
Intensity at 100 % : 328.842 KCps - Slope : 0.30478 % / KCps

Intensity at 0.0 % : +0.741 KCps - Offset:-0.22599 %

Absorption / Secondary emission corrections

| | | |
|-------|-------------|---------|
| SiO2 | 7.66465E-03 | (fixed) |
| K2O | 1.57565E-02 | (fixed) |
| CaO | 3.39124E-02 | (fixed) |
| Fe2O3 | 0.14838 | (fixed) |
| TiO2 | 6.02649E-02 | (fixed) |
| Na2O | 0.13820 | (fixed) |
| MgO | 0.15932 | (fixed) |

| --- Standard | Status | Measured KCps | Chemical % | Computed % | Deviation % | Rel. |
|--------------|--------|---------------|------------|------------|-------------|--------|
| 1 FK | | 20.3433 | 6.180 | 6.027 | -0.153 | -2.48 |
| 2 139 | | 45.8387 | 13.800 | 13.861 | 0.061 | 0.44 |
| 3 BCS313-1 | | 0.7731 | 0.050 | 0.011 | -0.039 | -77.10 |
| 4 BCS314 | | 3.4815 | 0.770 | 0.845 | 0.075 | 9.70 |
| 5 BCS267A | | 3.4388 | 0.850 | 0.832 | -0.018 | -2.12 |
| 6 2CAS8FLI | | 1.7641 | 0.210 | 0.316 | 0.106 | 50.46 |
| 7 SiO2 | | 0.6329 | 0.000 | -0.032 | -0.032 | |



Program file: SILICA-F.QAN
 Compound: MgO

Std. deviation: 1.565E-02

Net intensity model: Raw peak intensity
 Dead time correction is On

Concentration correction model: Concentration I Regression weighting: Absolute

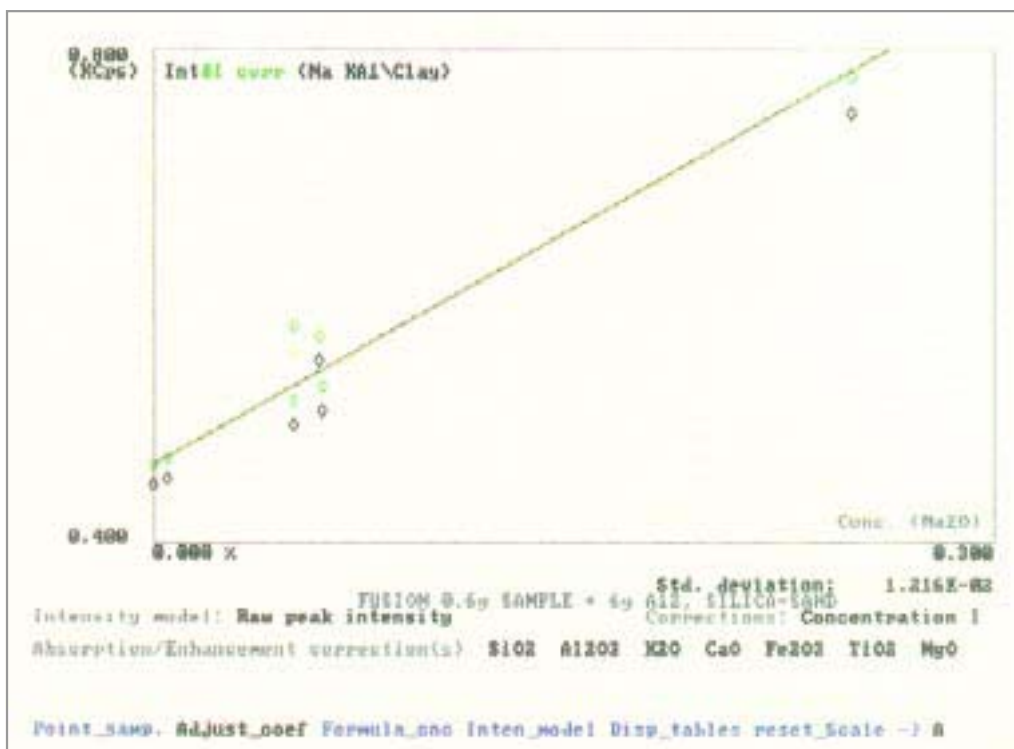
Intensity at 100 % : 92.721 KCps - Slope : 1.0797 % / KCps

Intensity at 0.0 % : +0.106 KCps - Offset:-0.11497 %

Absorption / Secondary emission corrections

| | |
|--------------------------------|---------------------|
| SiO ₂ | 1.68574E-02 (fixed) |
| Al ₂ O ₃ | 9.30298E-03 (fixed) |
| K ₂ O | 3.45588E-02 (fixed) |
| CaO | 5.32197E-02 (fixed) |
| Fe ₂ O ₃ | 0.16995 (fixed) |
| TiO ₂ | 8.03013E-02 (fixed) |
| Na ₂ O | 0.15942 (fixed) |

| Standard | Status | Measured KCps | Chemical % | Computed % | Deviation % | Rel. |
|--------------------|--------|---------------|------------|------------|-------------|--------|
| 1 FK | | 0.2216 | 0.150 | 0.129 | -0.021 | -14.25 |
| 2 139 | | 0.2349 | 0.120 | 0.143 | 0.023 | 19.24 |
| 3 BCS313-1 | | 0.1111 | 0.001 | 0.007 | 0.006 | 601.44 |
| 4 BCS314 | | 0.1507 | 0.050 | 0.051 | 0.001 | 1.50 |
| 5 BCS267A | | 0.1413 | 0.060 | 0.040 | -0.020 | -32.55 |
| 6 2CAS8FLI | | 0.1272 | 0.020 | 0.025 | 0.005 | 23.50 |
| 7 SiO ₂ | | 0.1105 | 0.000 | 0.006 | 0.006 | |



Program file: SILICA-F.QAN
Compound: Na2O

Std. deviation: 1.216E-02

Net intensity model: Raw peak intensity
Dead time correction is On

Concentration correction model: Concentration I Regression weighting: Absolute

Intensity at 100 % : 128.580 KCps - Slope : 0.78053 % / KCps
Intensity at 0.0 % : +0.462 KCps - Offset:-0.36040 %

Absorption / Secondary emission corrections

| | |
|-------|---------------------|
| SiO2 | 3.80210E-02 (fixed) |
| Al2O3 | 2.95287E-02 (fixed) |
| K2O | 6.22833E-02 (fixed) |
| CaO | 8.18321E-02 (fixed) |
| Fe2O3 | 0.20153 (fixed) |
| TiO2 | 0.10982 (fixed) |
| MgO | 1.83698E-02 (fixed) |

| Standard | Status | Measured KCps | Chemical % | Computed % | Deviation % | Rel. |
|------------|--------|---------------|------------|------------|-------------|--------|
| 1 FK | | 0.7477 | 0.250 | 0.246 | -0.004 | -1.68 |
| 2 139 | | 0.5462 | 0.059 | 0.082 | 0.023 | 39.31 |
| 3 BCS313-1 | | 0.4506 | 0.005 | 0.005 | 0.000 | -6.97 |
| 4 BCS314 | | 0.4945 | 0.050 | 0.041 | -0.009 | -18.27 |
| 5 BCS267A | | 0.5055 | 0.060 | 0.050 | -0.010 | -16.71 |
| 6 2CAS8FLI | UN | 0.5528 | 0.050 | 0.088 | 0.038 | 75.09 |
| 7 SiO2 | | 0.4455 | 0.000 | 0.001 | 0.001 | |

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