



# African Mineral Standards

## Certificate of Analysis

### Uraniferous Alaskite Reference Material Goanikontes, Namibia

#### AMIS0085

Recommended Concentration and two "Between Laboratory"  
Standard Deviations

#### **Certified Concentrations\***

|                  |      |   |      |      |
|------------------|------|---|------|------|
| U (XRF)          | 266  | ± | 15.4 | ppm  |
| U (M/ICP)        | 263  | ± | 21   | ppm  |
| Specific Gravity | 2.66 | ± | 0.18 | g/cc |

#### **Major Element Certified Concentrations**

|                                       |       |   |       |   |
|---------------------------------------|-------|---|-------|---|
| Al <sub>2</sub> O <sub>3</sub> (XRF)  | 10.98 | ± | 0.26  | % |
| CaO (XRF)                             | 3.28  | ± | 0.09  | % |
| Cr <sub>2</sub> O <sub>3</sub> (XRF)  | 0.079 | ± | 0.008 | % |
| Fe <sub>2</sub> O <sub>3</sub> (XRF)  | 3.50  | ± | 0.12  | % |
| K <sub>2</sub> O (XRF)                | 4.69  | ± | 0.19  | % |
| MgO (XRF)                             | 1.75  | ± | 0.068 | % |
| Na <sub>2</sub> O (XRF)               | 1.73  | ± | 0.09  | % |
| P <sub>2</sub> O <sub>5</sub> (XRF)** | 0.071 | ± | 0.008 | % |
| S (M/ICP)                             | 0.354 | ± | 0.026 | % |
| SiO <sub>2</sub> (XRF)                | 70.58 | ± | 1.36  | % |
| TiO <sub>2</sub> (XRF)                | 0.21  | ± | 0.014 | % |

#### **Major Element Provisional Concentrations**

|           |       |       |   |
|-----------|-------|-------|---|
| LOI       | 2.540 | 0.56  | % |
| MnO (XRF) | 0.066 | 0.008 | % |

\* Or, by applying a chemical conversion factor of U x 1.1793 = U<sub>3</sub>O<sub>8</sub>  
U<sub>3</sub>O<sub>8</sub> by XRF: 314 ± 18.2 ppm  
U<sub>3</sub>O<sub>8</sub> by multi acid digestion: 310 ± 24.8 ppm

\*\*P<sub>2</sub>O<sub>5</sub> concentration corrected on 11 August 2011

**Intended use:** AMIS0085 is suitable for monitoring the accuracy of a single analysis of uraniferous alaskite ore. This material can be used for routine quality control by inserting within a batch of samples.

Additional geochemical data is presented for this material that will enable its use for method development and for the calibration of equipment. This comprises certified major element data (p1) and uncertified trace element data (Appendix).

The recommended mean and "Between Lab" standard deviations for this standard reflect the average results from the laboratories that participated in the round robin. Slight variations in analytical procedures between laboratories will reflect as slight biases to the recommended concentrations and this is acceptable. Good laboratories however will report results within the two standard deviation levels with a failure of <10 %.

**Origin of material:** This material was supplied by Bannerman Resources Ltd from their Goanikontes Project 30km east of Swakopmund in Namibia. This deposit represents one of the uraniferous alaskite occurrences first actively explored in the Namib Desert during the 1970's. The most significant of these deposits is Rössing Uranium, mined by Rio Tinto since the late 1970's.

The uranium is associated with Lower Palaeozoic age alaskite granites emplaced, predominantly along  $S_3$  foliation planes, into heavily folded biotite-amphibole-pyroxene schists of the lower Khan Formation. The term "alaskite" is applied locally to a leucocratic variety of granite, often with a pegmatitic texture.

The most abundant primary uranium mineral is uraninite, but betafite is also present. The uraninite is commonly associated with chloritised biotite in the alaskite. Titanium bearing oxides, ilmenite and magnetite are also present. Goanikites uranium deposit does not show any fundamental qualitative differences compared to the Rössing uranium deposit situated 40 km to the North East.

This deposit is described in detail in Mouillac, J.L., Valois, J-P. and Walgenwitz, F. (1986). *The Goanikontes uranium occurrence in South West Africa/Namibia*, in Mineral Deposits of Southern Africa, 1833-1843, Anhauser, C.R., and Maske, S. (Eds) (1986). Geol. Soc.S.Africa., Johannesburg.

**Mineral and chemical composition:**

The major element chemistry for this material has also been certified and is presented on p1 of this certificate. Additional uncertified trace element chemistry is set out in the Appendix.

**Appearance:** The material is a very fine powder. It is coloured a Light Grey (Corstor 5Y 7/1).

**Radioactivity:** Shipments of this material do not require special marking, labeling or placarding. AMIS0085 does contain U (3.3 Bq/g) and Th (0.06 Bq/g), but due to low activity concentrations it is classified as EXEMPT MATERIAL in terms of "Safety Standards Series No. TS-R-1: Regulations for the Safe Transport of Radioactive Material, International Atomic Energy Agency, 2005, para 403, Table 1".

**Method of preparation:** The material was crushed, dry-milled and air-classified to 100% <54um. Wet sieve particle size analysis of random samples confirmed the material was 100% <54um. It was then blended in a bi-conical mixer, systematically divided and then sealed into 1kg Laboratory Packs. Samples were randomly selected for homogeneity testing and third party analysis. Statistical analysis for the consensus test results were carried out by an independent statistician. Explorer Packs are subdivided from the Laboratory packs as required.

**Methods of analysis requested:**

1. Multi-acid digest, including HF, ICP- OES or ICP-MS. Multi element scan ( to include U ).
2. U XRF.
3. Majors ( Al<sub>2</sub>O<sub>3</sub>, CaO, Cr<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, MgO, MnO, Na<sub>2</sub>O, SiO<sub>2</sub>, TiO<sub>2</sub>. LOI. ) XRF fusion.
4. SG ( gas pycnometer ).

**Method of certification:** Twenty one laboratories were each given eight randomly selected packages of sample. The results from the nineteen laboratories that issued results timeously were used for the certification.

The mean and standard deviation for all data was calculated. Outliers were defined as samples beyond the mean  $\pm$  2 Standard Deviations from all data. These outliers were removed from the data and a new mean and standard deviation was determined.

Standards with an RSD of near or less than 5 % are then certified, RSD's of between near 5 % and 15 % are given Provisional Concentrations and limits, those with RSD's over 15 % are given Indicated Concentrations.

This method is different from that used to calculate the Confidence Interval shown on many Government-produced standards in that the actual "between-laboratory" standard deviation is used in the calculations. This produces upper and lower limits that reflect actual individual analyses rather than a grouped set of analyses. The limits can therefore be used to monitor accuracy from individual analyses, unlike the Certified Limits published on other standards which quote a Confidence Interval.

**Participating laboratories:** (Not in same order as in the table of assays)

1. ACME Analytical Laboratories Ltd., (Canada).
2. Activation Laboratories Ltd., (ActLabs, Ancaster, ON, Canada).
3. AGA - Vaal River Laboratory (South Africa).
4. ALS Chemex South Africa ( Pty ) Ltd.
5. ALS Chemex, (Perth, Australia).
6. ALS Chemex, (Vancouver, Canada).
7. Ammtec Ltd., (Western Australia).
8. Anglo Research (Crown Campus, South Africa).
9. Assayers Canada, (Vancouver).
10. Genalysis Laboratory Services ( Pty ) Ltd., (Australia).
11. Geoscience Laboratories, (Geo Labs, Sudbury, Canada).
12. Labtium Inc. ( Finland )
13. OMAC Laboratories (Ireland).
14. Pt Intertek Utama Services (Intertek, Indonesia)
15. Set Point Laboratories ( Pty ) Ltd (South Africa)
16. SGS Lakefield Research (Canada)
17. SGS Lakefield Research Africa ( Pty ) Ltd. (Joburg, South Africa)
18. SGS Welshpool (Australia).
19. Ultra Trace ( Pty ) Ltd. (Australia)

**Assay Data:** Data as received from the laboratories for the important certified elements listed on p1 is set out below. A proficiency report has been sent to the managers of the participating laboratories. Additional data from this round robin is available on request.

| Lab Code | U ppm (M/ICP) | U ppm (XRF) | Al2O3 % (XRF) | CaO % (XRF) | Cr2O3 % (XRF) | Fe2O3 % (XRF) | K2O % (XRF) | LOI % | MgO % (XRF) | MnO % (XRF) | Na2O % (XRF) | P2O5 % (XRF) | S % (M/ICP) | SG g/cc | SiO2 % (XRF) | TiO2 % (XRF) |
|----------|---------------|-------------|---------------|-------------|---------------|---------------|-------------|-------|-------------|-------------|--------------|--------------|-------------|---------|--------------|--------------|
| A        | 287           |             | 11.30         | 3.33        | 0.076         | 3.57          | 4.81        | 2.40  | 1.77        | 0.060       | 1.73         | 0.089        | 0.320       |         | 69.8         | 0.220        |
| A        | 278           |             | 11.13         | 3.30        | 0.075         | 3.60          | 4.76        | 2.70  | 1.75        | 0.060       | 1.71         | 0.060        | 0.320       |         | 69.8         | 0.210        |
| A        | 271           |             | 11.16         | 3.33        | 0.076         | 3.57          | 4.75        | 2.80  | 1.78        | 0.060       | 1.70         | 0.076        | 0.330       |         | 69.7         | 0.210        |
| A        | 274           |             | 11.01         | 3.30        | 0.075         | 3.62          | 4.68        | 2.80  | 1.75        | 0.060       | 1.67         | 0.094        | 0.310       |         | 69.8         | 0.210        |
| A        | 287           |             | 10.95         | 3.27        | 0.074         | 3.58          | 4.63        | 2.70  | 1.74        | 0.060       | 1.66         | 0.074        | 0.320       |         | 70.2         | 0.210        |
| A        | 284           |             | 11.21         | 3.27        | 0.075         | 3.50          | 4.78        | 2.70  | 1.73        | 0.060       | 1.72         | 0.084        | 0.330       |         | 69.7         | 0.210        |
| A        | 271           |             | 11.28         | 3.31        | 0.078         | 3.51          | 4.86        | 2.70  | 1.78        | 0.060       | 1.75         | 0.082        | 0.320       |         | 69.6         | 0.220        |
| A        | 272           |             | 11.20         | 3.33        | 0.075         | 3.56          | 4.84        | 2.20  | 1.75        | 0.060       | 1.73         | 0.069        | 0.320       |         | 70.2         | 0.210        |
| B        | 276           | 225         | 10.75         | 3.17        | 0.080         | 3.51          | 4.54        | 2.65  | 1.62        | 0.070       | 1.69         | 0.070        |             | 2.65    | 70.4         | 0.210        |
| B        | 276           | 231         | 10.98         | 3.15        | 0.080         | 3.53          | 4.57        | 2.67  | 1.66        | 0.070       | 1.71         | 0.070        |             | 2.66    | 70.0         | 0.210        |
| B        | 271           | 228         | 10.86         | 3.15        | 0.080         | 3.51          | 4.52        | 3.46  | 1.64        | 0.066       | 1.69         | 0.070        |             | 2.69    | 69.5         | 0.210        |
| B        | 270           | 240         | 10.85         | 3.12        | 0.070         | 3.50          | 4.65        | 3.39  | 1.59        | 0.068       | 1.69         | 0.060        |             | 2.71    | 69.4         | 0.200        |
| B        | 275           | 230         | 10.79         | 3.18        | 0.080         | 3.53          | 4.53        | 2.71  | 1.65        | 0.065       | 1.67         | 0.070        |             | 2.69    | 70.2         | 0.210        |
| B        | 271           | 245         | 10.77         | 3.17        | 0.080         | 3.55          | 4.52        | 2.69  | 1.64        | 0.071       | 1.68         | 0.070        |             | 2.71    | 70.1         | 0.210        |
| B        | 269           | 238         | 10.96         | 3.15        | 0.070         | 3.54          | 4.55        | 2.73  | 1.67        | 0.069       | 1.68         | 0.070        |             | 2.68    | 70.0         | 0.200        |
| B        | 275           | 228         | 10.76         | 3.21        | 0.080         | 3.53          | 4.58        | 2.74  | 1.63        | 0.067       | 1.69         | 0.070        |             | 2.67    | 70.2         | 0.210        |
| C        | 251           |             | 11.00         | 3.29        | 0.070         | 3.37          | 4.75        | 2.10  | 1.59        | 0.051       | 1.75         |              | 0.370       | 2.50    | 70.9         | 0.200        |
| C        | 242           |             | 11.10         | 3.27        | 0.072         | 3.39          | 4.77        | 1.85  | 1.58        | 0.053       | 1.75         |              | 0.360       | 2.54    | 71.0         | 0.200        |
| C        | 254           |             | 11.05         | 3.25        | 0.071         | 3.33          | 4.73        | 1.80  | 1.59        | 0.052       | 1.75         |              | 0.380       | 2.53    | 71.2         | 0.200        |
| C        | 254           |             | 10.90         | 3.26        | 0.073         | 3.35          | 4.75        | 2.19  | 1.58        | 0.052       | 1.75         |              | 0.380       | 2.52    | 71.0         | 0.200        |
| C        | 257           |             | 10.90         | 3.30        | 0.075         | 3.36          | 4.73        | 2.38  | 1.62        | 0.053       | 1.85         |              | 0.380       | 2.53    | 70.6         | 0.200        |
| C        | 249           |             | 11.00         | 3.31        | 0.077         | 3.42          | 4.76        | 1.86  | 1.58        | 0.053       | 1.75         |              | 0.370       | 2.57    | 71.1         | 0.210        |
| C        | 247           |             | 10.95         | 3.27        | 0.074         | 3.38          | 4.77        | 1.77  | 1.58        | 0.051       | 1.76         |              | 0.370       | 2.55    | 71.3         | 0.190        |
| C        | 250           |             | 11.00         | 3.28        | 0.077         | 3.31          | 4.74        | 1.92  | 1.56        | 0.051       | 1.74         |              | 0.370       | 2.50    | 71.2         | 0.200        |
| D        | 271           | 262         | 11.20         | 3.26        | 0.080         | 3.43          | 4.54        | 2.81  | 1.76        | 0.070       | 1.72         | 0.073        | 0.380       | 2.71    | 70.5         | 0.210        |
| D        | 257           | 264         | 11.23         | 3.24        | 0.080         | 3.45          | 4.55        | 2.79  | 1.76        | 0.070       | 1.72         | 0.073        | 0.360       | 2.65    | 70.6         | 0.210        |
| D        | 260           | 263         | 11.25         | 3.24        | 0.080         | 3.44          | 4.54        | 2.79  | 1.76        | 0.070       | 1.73         | 0.073        | 0.360       | 2.60    | 70.6         | 0.210        |
| D        | 259           | 264         | 11.20         | 3.24        | 0.080         | 3.45          | 4.55        | 2.81  | 1.76        | 0.070       | 1.73         | 0.073        | 0.350       | 2.56    | 70.6         | 0.210        |
| D        | 257           | 263         | 11.20         | 3.26        | 0.080         | 3.43          | 4.53        | 2.82  | 1.75        | 0.070       | 1.73         | 0.074        | 0.360       | 2.53    | 70.6         | 0.210        |
| D        | 259           | 261         | 11.18         | 3.24        | 0.080         | 3.44          | 4.55        | 2.80  | 1.76        | 0.070       | 1.73         | 0.073        | 0.360       | 2.41    | 70.5         | 0.210        |
| D        | 254           | 261         | 11.21         | 3.25        | 0.080         | 3.43          | 4.53        | 2.80  | 1.75        | 0.070       | 1.72         | 0.074        | 0.350       | 2.52    | 70.7         | 0.210        |
| D        | 251           | 263         | 11.19         | 3.24        | 0.080         | 3.45          | 4.55        | 2.84  | 1.76        | 0.070       | 1.73         | 0.074        | 0.350       | 2.48    | 70.5         | 0.210        |
| E        | 262           |             | 10.20         | 2.91        | 0.064         | 3.17          | 4.34        |       | 1.53        | 0.059       | 1.52         | 0.062        | 0.330       | 2.65    |              |              |
| E        | 260           |             | 10.96         | 3.13        | 0.061         | 3.42          | 4.24        |       | 1.64        | 0.063       | 1.63         | 0.066        | 0.350       | 2.62    |              |              |
| E        | 254           |             | 10.58         | 3.05        | 0.063         | 3.30          | 4.16        |       | 1.59        | 0.062       | 1.58         | 0.066        | 0.340       | 2.63    |              |              |
| E        | 260           |             | 10.26         | 2.95        | 0.061         | 3.22          | 4.17        |       | 1.54        | 0.060       | 1.54         | 0.062        | 0.330       | 2.57    |              |              |
| E        | 261           |             | 10.82         | 3.11        | 0.063         | 3.39          | 4.29        |       | 1.62        | 0.063       | 1.62         | 0.066        | 0.340       | 2.66    |              |              |
| E        | 256           |             | 10.94         | 3.16        | 0.061         | 3.45          | 4.22        |       | 1.66        | 0.064       | 1.63         | 0.066        | 0.350       | 2.61    |              |              |
| E        | 260           |             | 11.11         | 3.20        | 0.059         | 3.49          | 4.05        |       | 1.67        | 0.065       | 1.66         | 0.066        | 0.350       | 2.59    |              |              |
| E        | 256           |             | 10.67         | 3.08        | 0.059         | 3.36          | 4.06        |       | 1.61        | 0.062       | 1.59         | 0.066        | 0.340       | 2.61    |              |              |
| F        | 259           |             | 10.80         | 3.50        | 0.096         | 3.62          | 4.92        | 2.32  | 1.72        | 0.071       |              |              |             |         | 67.4         | 0.199        |
| F        | 263           |             | 10.70         | 3.51        | 0.100         | 3.61          | 4.90        | 2.70  | 1.74        | 0.071       |              |              |             |         | 67.3         | 0.198        |
| F        | 253           |             | 10.50         | 3.39        | 0.095         | 3.51          | 4.72        | 2.40  | 1.65        | 0.068       |              |              |             |         | 65.3         | 0.192        |
| F        | 250           |             | 10.60         | 3.46        | 0.098         | 3.55          | 4.84        | 2.28  | 1.70        | 0.071       |              |              |             |         | 66.2         | 0.195        |
| F        | 255           |             | 11.00         | 3.62        | 0.099         | 3.67          | 4.97        | 2.18  | 1.75        | 0.071       |              |              |             |         | 68.7         | 0.203        |
| F        | 252           |             | 11.10         | 3.64        | 0.101         | 3.71          | 5.08        | 2.22  | 1.77        | 0.072       |              |              |             |         | 69.5         | 0.206        |
| F        | 246           |             | 11.90         | 3.83        | 0.106         | 3.96          | 5.36        | 2.26  | 1.88        | 0.078       |              |              |             |         | 70.7         | 0.218        |
| F        | 251           |             | 12.00         | 3.79        | 0.110         | 3.97          | 5.33        | 2.17  | 1.88        | 0.080       |              |              |             |         | 69.8         | 0.220        |
| G        |               | 264         |               |             |               |               |             | 2.09  |             |             |              |              |             | 2.91    |              |              |
| G        |               | 264         |               |             |               |               |             | 2.12  |             |             |              |              |             | 2.88    |              |              |
| G        |               | 263         |               |             |               |               |             | 2.12  |             |             |              |              |             | 2.89    |              |              |
| G        |               | 262         |               |             |               |               |             | 2.11  |             |             |              |              |             | 2.88    |              |              |
| G        |               | 260         |               |             |               |               |             | 2.10  |             |             |              |              |             | 2.89    |              |              |
| G        |               | 265         |               |             |               |               |             | 2.11  |             |             |              |              |             | 2.88    |              |              |
| G        |               | 265         |               |             |               |               |             | 2.12  |             |             |              |              |             | 2.88    |              |              |
| G        |               | 260         |               |             |               |               |             | 2.11  |             |             |              |              |             | 2.89    |              |              |
| H        |               | 243         |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| H        |               | 242         |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| H        |               | 240         |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| H        |               | 241         |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| H        |               | 243         |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| H        |               | 243         |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| H        |               | 242         |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| H        |               | 248         |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| I        | 251           |             | 11.29         | 3.41        | 0.080         | 3.75          | 4.89        | 3.07  | 1.83        | 0.070       | 1.72         | 0.080        | 0.360       |         | 68.3         |              |
| I        | 251           |             | 11.03         | 3.34        | 0.080         | 3.70          | 4.78        | 2.78  | 1.79        | 0.070       | 1.69         | 0.070        | 0.360       |         | 69.4         |              |
| I        | 248           |             | 11.15         | 3.35        | 0.120         | 3.82          | 4.88        | 4.30  | 1.78        | 0.070       | 1.83         | 0.090        | 0.340       |         | 67.6         |              |
| I        | 243           |             | 11.19         | 3.38        | 0.080         | 3.69          | 4.89        | 2.85  | 1.82        | 0.070       | 1.69         | 0.090        | 0.340       |         | 68.9         |              |
| I        | 250           |             | 11.18         | 3.39        | 0.100         | 3.65          | 4.86        | 2.63  | 1.85        | 0.070       | 1.67         | 0.080        | 0.360       |         | 69.4         |              |
| I        | 247           |             | 11.22         | 3.40        | 0.080         | 3.67          | 4.92        | 2.73  | 1.83        | 0.070       | 1.67         | 0.080        | 0.340       |         | 68.9         |              |
| I        | 244           |             | 10.80         | 3.22        | 0.080         | 3.52          | 4.73        | 3.42  | 1.72        | 0.070       | 1.76         | 0.090        | 0.340       |         | 69.1         |              |
| I        | 252           |             | 11.12         | 3.34        | 0.080         | 3.59          | 4.88        | 2.62  | 1.82        | 0.070       | 1.62         | 0.080        | 0.350       |         | 69.1         |              |
| J        | 253           | 250         | 10.94         | 3.24        | 0.076         | 3.45          | 4.73        | 2.57  | 1.76        | 0.063       | 1.78         | 0.071        | 0.347       | 2.83    | 71.0         | 0.210        |
| J        | 249           | 245         | 10.91         | 3.24        | 0.077         | 3.43          | 4.71        | 2.35  | 1.75        | 0.063       | 1.77         | 0.071        | 0.344       | 2.79    | 70.7         | 0.210        |
| J        | 253           | 251         | 10.92         | 3.25        | 0.076         | 3.46          | 4.71        | 2.59  | 1.76        | 0.063       | 1.77         | 0.073        | 0.342       | 2.77    | 71.0         | 0.210        |
| J        | 264           | 250         | 10.93         | 3.24        | 0.077         | 3.45          | 4.72        | 2.31  | 1.76        | 0.062       | 1.77         | 0.071        | 0.344       | 2.80    | 70.9         | 0.210        |
| J        | 258           | 252         | 10.91         | 3.25        | 0.077         | 3.45          | 4.72        | 2.32  | 1.76        | 0.062       | 1.77         | 0.071        | 0.345       | 2.82    | 70.8         | 0.210        |
| J        | 267           | 250         | 10.94         | 3.23        | 0.076         | 3.45          | 4.72        | 2.31  | 1.76        | 0.062       | 1.77         | 0.071        | 0.346       | 2.82    | 71.0         | 0.210        |
| J        | 250           | 252         | 10.86         | 3.25        | 0.076         | 3.46          | 4.70        | 2.26  | 1.76        | 0.065       | 1.78         | 0.071        | 0.341       | 2.79    | 70.8         | 0.210        |
| J        | 254           | 251         | 10.99         | 3.30        | 0.079         | 3.50          | 4.77        | 2.25  | 1.78        | 0.066       | 1.81         | 0.073        | 0.349       | 2.75    | 71.7         | 0.210        |

Assay Data (cont):

| Lab Code | U ppm (M/ICP) | U ppm (XRF) | Al2O3 % (XRF) | CaO % (XRF) | Cr2O3 % (XRF) | Fe2O3 % (XRF) | K2O % (XRF) | LOI % | MgO % (XRF) | MnO % (XRF) | Na2O % (XRF) | P2O5 % (XRF) | S % (M/ICP) | SG g/cc | SiO2 % (XRF) | TiO2 % (XRF) |
|----------|---------------|-------------|---------------|-------------|---------------|---------------|-------------|-------|-------------|-------------|--------------|--------------|-------------|---------|--------------|--------------|
| K        |               | 272         | 10.95         | 3.38        |               | 3.56          | 4.77        | 3.06  | 1.75        | 0.070       | 1.81         | 0.070        |             |         | 71.3         | 0.210        |
| K        |               | 270         | 11.02         | 3.36        |               | 3.58          | 4.78        | 3.03  | 1.77        | 0.070       | 1.80         | 0.070        |             |         | 71.7         | 0.210        |
| K        |               | 270         | 10.95         | 3.36        |               | 3.55          | 4.72        | 3.02  | 1.73        | 0.070       | 1.81         | 0.070        |             |         | 71.0         | 0.210        |
| K        |               | 262         | 10.93         | 3.37        |               | 3.57          | 4.72        | 3.35  | 1.73        | 0.070       | 1.80         | 0.070        |             |         | 71.3         | 0.210        |
| K        |               | 269         | 10.90         | 3.33        |               | 3.52          | 4.73        | 3.20  | 1.75        | 0.070       | 1.80         | 0.070        |             |         | 70.7         | 0.210        |
| K        |               | 258         | 10.94         | 3.33        |               | 3.57          | 4.71        | 3.18  | 1.75        | 0.070       | 1.78         | 0.070        |             |         | 71.4         | 0.210        |
| K        |               | 261         | 10.84         | 3.35        |               | 3.56          | 4.70        | 3.08  | 1.73        | 0.070       | 1.82         | 0.070        |             |         | 70.9         | 0.220        |
| K        |               | 267         | 10.92         | 3.38        |               | 3.55          | 4.73        | 3.24  | 1.76        | 0.070       | 1.80         | 0.070        |             |         | 71.2         | 0.210        |
| L        |               |             | 10.90         | 3.34        | 0.090         | 3.53          | 4.65        | 2.30  | 1.79        | 0.060       | 1.69         | 0.070        |             |         | 70.4         | 0.220        |
| L        |               |             | 10.80         | 3.31        | 0.080         | 3.48          | 4.65        | 2.30  | 1.75        | 0.060       | 1.63         | 0.070        |             |         | 70.2         | 0.220        |
| L        |               |             | 10.80         | 3.34        | 0.110         | 3.56          | 4.68        | 2.30  | 1.76        | 0.060       | 1.66         | 0.070        |             |         | 70.4         | 0.220        |
| L        |               |             | 10.80         | 3.32        | 0.080         | 3.48          | 4.63        | 2.30  | 1.76        | 0.060       | 1.66         | 0.060        |             |         | 70.0         | 0.210        |
| L        |               |             | 10.80         | 3.30        | 0.080         | 3.50          | 4.60        | 2.30  | 1.76        | 0.060       | 1.65         | 0.070        |             |         | 70.0         | 0.220        |
| L        |               |             | 10.80         | 3.31        | 0.080         | 3.49          | 4.64        | 2.30  | 1.76        | 0.060       | 1.66         | 0.060        |             |         | 70.0         | 0.220        |
| L        |               |             | 10.80         | 3.31        | 0.080         | 3.51          | 4.64        | 2.40  | 1.77        | 0.060       | 1.67         | 0.070        |             |         | 70.2         | 0.220        |
| L        |               |             | 10.90         | 3.36        | 0.080         | 3.51          | 4.68        | 2.40  | 1.79        | 0.060       | 1.67         | 0.070        |             |         | 70.5         | 0.220        |
| M        | 280           | 258         | 11.10         | 3.22        | 0.080         | 3.48          | 4.76        |       | 1.67        | 0.064       | 1.75         | 0.074        | 0.318       |         | 72.5         | 0.224        |
| M        | 279           | 252         | 11.10         | 3.22        | 0.079         | 3.49          | 4.76        |       | 1.68        | 0.064       | 1.76         | 0.071        | 0.328       |         | 72.4         | 0.223        |
| M        | 279           | 261         | 11.10         | 3.26        | 0.081         | 3.51          | 4.80        |       | 1.68        | 0.064       | 1.78         | 0.075        | 0.336       |         | 72.8         | 0.227        |
| M        | 276           | 259         | 11.20         | 3.25        | 0.079         | 3.50          | 4.81        |       | 1.69        | 0.065       | 1.80         | 0.072        | 0.330       |         | 72.8         | 0.219        |
| M        | 269           | 263         | 11.10         | 3.20        | 0.080         | 3.46          | 4.75        |       | 1.69        | 0.064       | 1.77         | 0.070        | 0.312       |         | 72.2         | 0.217        |
| M        | 273           | 260         | 11.10         | 3.22        | 0.080         | 3.47          | 4.76        |       | 1.68        | 0.063       | 1.78         | 0.073        | 0.313       |         | 72.4         | 0.222        |
| M        | 271           | 261         | 11.20         | 3.24        | 0.081         | 3.51          | 4.80        |       | 1.68        | 0.065       | 1.79         | 0.073        | 0.312       |         | 72.8         | 0.220        |
| M        | 280           | 262         | 11.10         | 3.22        | 0.079         | 3.48          | 4.75        |       | 1.68        | 0.064       | 1.76         | 0.071        | 0.313       |         | 72.4         | 0.220        |
| N        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| N        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| N        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| N        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| N        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| N        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| N        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| N        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| O        | 277           |             | 10.98         | 3.29        | 0.086         | 3.50          | 4.76        | 2.65  | 1.77        | 0.065       | 1.71         | 0.090        | 0.358       | 2.59    | 71.1         | 0.213        |
| O        | 281           |             | 10.87         | 3.27        | 0.082         | 3.47          | 4.76        | 2.75  | 1.76        | 0.065       | 1.71         | 0.053        | 0.368       | 2.57    | 71.1         | 0.211        |
| O        | 282           |             | 10.91         | 3.27        | 0.082         | 3.48          | 4.77        | 2.67  | 1.77        | 0.064       | 1.71         | 0.078        | 0.368       | 2.64    | 71.6         | 0.213        |
| O        | 278           |             | 10.96         | 3.29        | 0.081         | 3.47          | 4.77        | 2.75  | 1.75        | 0.064       | 1.72         | 0.126        | 0.362       | 2.63    | 71.2         | 0.213        |
| O        | 275           |             | 11.03         | 3.31        | 0.081         | 3.55          | 4.81        | 2.80  | 1.82        | 0.066       | 1.72         | 0.103        | 0.361       | 2.60    | 70.8         | 0.214        |
| O        | 272           |             | 11.03         | 3.30        | 0.082         | 3.53          | 4.78        | 2.73  | 1.79        | 0.064       | 1.71         | 0.072        | 0.362       | 2.56    | 70.8         | 0.213        |
| O        | 273           |             | 11.06         | 3.31        | 0.081         | 3.57          | 4.82        | 2.73  | 1.82        | 0.066       | 1.73         | 0.067        | 0.361       | 2.58    | 71.0         | 0.216        |
| O        | 279           |             | 10.82         | 3.22        | 0.081         | 3.47          | 4.72        | 2.86  | 1.75        | 0.064       | 1.70         | 0.078        | 0.359       | 2.60    | 69.9         | 0.210        |
| P        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| P        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| P        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| P        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| P        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| P        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| P        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| P        |               |             |               |             |               |               |             |       |             |             |              |              |             |         |              |              |
| Q        | 270           | 262         | 10.82         | 3.29        | 0.088         | 3.71          | 4.67        | 2.03  | 1.53        | 0.070       | 1.715        | 0.070        |             | 2.67    | 71.5         | 0.210        |
| Q        | 266           | 262         | 10.87         | 3.23        | 0.083         | 3.68          | 4.63        | 1.98  | 1.50        | 0.061       | 1.725        | 0.070        |             | 2.67    | 71.1         | 0.200        |
| Q        | 271           | 263         | 11.01         | 3.30        | 0.088         | 3.72          | 4.68        | 1.98  | 1.54        | 0.062       | 1.719        | 0.080        |             | 2.72    | 72.1         | 0.210        |
| Q        | 272           | 265         | 10.77         | 3.23        | 0.086         | 3.67          | 4.61        | 1.99  | 1.49        | 0.061       | 1.716        | 0.070        |             | 2.71    | 71.6         | 0.201        |
| Q        | 278           | 266         | 10.81         | 3.22        | 0.079         | 3.68          | 4.60        | 2.02  | 1.51        | 0.062       | 1.694        | 0.070        |             | 2.71    | 71.6         | 0.200        |
| Q        | 271           | 265         | 10.65         | 3.23        | 0.081         | 3.62          | 4.58        | 1.91  | 1.49        | 0.062       | 1.725        | 0.070        |             | 2.71    | 71.4         | 0.199        |
| Q        | 269           | 266         | 10.93         | 3.32        | 0.089         | 3.71          | 4.67        | 1.93  | 1.53        | 0.061       | 1.727        | 0.080        |             | 2.72    | 71.6         | 0.210        |
| Q        | 267           | 265         | 10.87         | 3.24        | 0.083         | 3.69          | 4.61        | 1.99  | 1.38        | 0.060       | 1.733        | 0.070        |             | 2.68    | 70.9         | 0.210        |
| R        | 263           | 274         | 10.90         | 3.25        | 0.080         | 3.50          | 4.68        | 2.37  | 1.73        | 0.070       | 1.770        |              | 0.362       |         | 70.7         | 0.210        |
| R        | 269           | 277         | 10.90         | 3.24        | 0.080         | 3.50          | 4.70        | 2.41  | 1.73        | 0.070       | 1.760        |              | 0.368       |         | 70.7         | 0.220        |
| R        | 261           | 274         | 10.90         | 3.25        | 0.080         | 3.51          | 4.70        | 2.40  | 1.73        | 0.070       | 1.780        |              | 0.363       |         | 70.7         | 0.220        |
| R        | 275           | 276         | 10.90         | 3.25        | 0.080         | 3.51          | 4.70        | 2.35  | 1.73        | 0.070       | 1.750        |              | 0.375       |         | 70.8         | 0.220        |
| R        | 262           | 272         | 10.90         | 3.24        | 0.080         | 3.49          | 4.70        | 2.43  | 1.73        | 0.070       | 1.760        |              | 0.366       |         | 70.7         | 0.220        |
| R        | 265           | 282         | 10.90         | 3.23        | 0.080         | 3.48          | 4.68        | 2.43  | 1.73        | 0.070       | 1.760        |              | 0.363       |         | 70.7         | 0.210        |
| R        | 266           | 273         | 10.90         | 3.26        | 0.080         | 3.51          | 4.69        | 2.34  | 1.73        | 0.070       | 1.760        |              | 0.360       |         | 70.7         | 0.220        |
| R        | 260           | 278         | 10.90         | 3.25        | 0.080         | 3.49          | 4.68        | 2.33  | 1.74        | 0.070       | 1.770        |              | 0.363       |         | 70.7         | 0.220        |
| S        | 290           | 11.10       | 3.34          | 0.080       |               | 3.58          | 4.69        | 2.76  | 1.79        | 0.080       | 1.790        | 0.070        |             | 2.64    | 71.1         | 0.210        |
| S        | 290           | 11.00       | 3.30          | 0.080       |               | 3.52          | 4.64        | 2.80  | 1.75        | 0.070       | 1.780        | 0.070        |             | 2.64    | 70.7         | 0.210        |
| S        | 300           | 11.00       | 3.32          | 0.080       |               | 3.57          | 4.69        | 2.76  | 1.76        | 0.070       | 1.790        | 0.070        |             | 2.63    | 71.1         | 0.220        |
| S        | 290           | 11.00       | 3.30          | 0.080       |               | 3.51          | 4.68        | 2.80  | 1.77        | 0.070       | 1.790        | 0.080        |             | 2.64    | 70.7         | 0.210        |
| S        | 290           | 11.00       | 3.31          | 0.080       |               | 3.55          | 4.71        | 2.84  | 1.76        | 0.070       | 1.800        | 0.070        |             | 2.64    | 71.1         | 0.220        |
| S        | 290           | 11.00       | 3.31          | 0.080       |               | 3.53          | 4.72        | 2.81  | 1.77        | 0.070       | 1.790        | 0.080        |             | 2.66    | 71.1         | 0.210        |
| S        | 290           | 10.90       | 3.29          | 0.080       |               | 3.50          | 4.61        | 2.84  | 1.76        | 0.070       | 1.780        | 0.070        |             | 2.64    | 70.0         | 0.210        |
| S        | 290           | 11.00       | 3.30          | 0.080       |               | 3.52          | 4.56        | 2.84  | 1.77        | 0.070       | 1.770        | 0.080        |             | 2.65    | 70.8         | 0.210        |
| T        | 257           | 274         | 10.60         | 3.24        | 0.070         | 3.43          | 4.51        | 2.95  | 1.70        | 0.070       | 1.690        | 0.070        |             | 2.7     | 69.8         | 0.200        |
| T        | 263           | 274         | 10.70         | 3.24        | 0.060         | 3.42          | 4.50        | 2.93  | 1.69        | 0.060       | 1.660        | 0.070        |             | 2.67    | 69.1         | 0.210        |
| T        | 259           | 276         | 10.80         | 3.29        | 0.070         | 3.52          | 4.57        | 2.95  | 1.74        | 0.060       | 1.680        | 0.070        |             | 2.66    | 70.3         | 0.220        |
| T        | 250           | 275         | 10.70         | 3.15        | 0.090         | 3.36          | 4.45        | 2.94  | 1.71        | 0.070       | 1.690        | 0.070        |             | 2.69    | 68.4         | 0.200        |
| T        | 261           | 275         | 10.80         | 3.24        | 0.070         | 3.44          | 4.50        | 2.89  | 1.71        | 0.060       | 1.700        | 0.070        |             | 2.67    | 69.6         | 0.220        |
| T        | 265           | 275         | 10.50         | 3.25        | 0.070         | 3.49          | 4.52        | 2.88  | 1.72        | 0.070       | 1.640        | 0.060        |             | 2.69    | 69.6         | 0.220        |
| T        | 272           | 274         | 10.70         | 3.24        | 0.070         | 3.42          | 4.51        | 2.92  | 1.67        | 0.060       | 1.640        | 0.070        |             | 2.67    | 69.8         | 0.210        |
| T        | 275           | 275         | 10.30         | 3.10        | 0.070         | 3.34          | 4.39        | 2.93  | 1.66        | 0.060       | 1.610        | 0.070        |             | 2.69    | 67.3         | 0.190        |
| U        | 233           | 270         | 11.00         | 3.30        | 0.085         | 3.50          | 4.73        | 2.25  | 1.75        | 0.070       | 1.710        |              | 0.340       | 2.78    | 71.0         | 0.220        |
| U        | 230           | 270         | 11.00         | 3.30        | 0.080         | 3.50          | 4.73        | 2.23  | 1.75        | 0.070       | 1.710        |              | 0.345       | 2.81    | 71.0         | 0.220        |
| U        | 227           | 270         | 11.10         | 3.31        | 0.079         | 3.51          | 4.74        | 2.20  | 1.75        | 0.070       | 1.730        |              | 0.330       | 2.76    | 71.0         | 0.220        |
| U        | 230           | 270         | 11.00         | 3.30        | 0.077         | 3.49          | 4.74        | 2.19  | 1.75        | 0.070       | 1.710        |              | 0.350       | 2.79    | 71.0         | 0.220        |
| U        | 227           | 280         | 11.00         | 3.30        | 0.077         | 3.50          | 4.74        | 2.22  | 1.76        | 0.070       | 1.720        |              | 0.340       | 2.8     | 71.0         | 0.220        |
| U        | 233           | 280         | 11.00         | 3.30        | 0.079         | 3.49          | 4.73        | 2.18  | 1.75        | 0.070       | 1.720        |              | 0.345       | 2.83    | 71.0         | 0.220        |
| U        | 229           | 270         | 11.00         | 3.31        | 0.080         | 3.50          | 4.73        | 2.17  | 1.75        | 0.070       | 1.710        |              | 0.335       | 2.78    | 71.0         | 0.220        |
| U        | 226           | 270         | 11.00         | 3.32        | 0.078         | 3.51          | 4.74        | 2.20  | 1.74        | 0.070       | 1.700        |              | 0.340       | 2.79    | 71.0         | 0.220        |

**Availability:** This product is available in Laboratory Packs containing 1kg of material or in Explorer Packs containing client specified weights of material from 50g up to 250g. Laboratory Packs are sealed bottles delivered in sealed foil pouches. Explorer Packs contain material in standard geochem envelopes placed into foil pouches that are nitrogen flushed and vacuum sealed.

**Legal notice:** This certificate and the reference material described in it have been prepared with due care and attention. However AMIS, Set Point Technology (Pty) Ltd, Mike McWha, Dr Barry Smee and Smee and Associates Ltd; accept no liability for any decisions or actions taken following the use of the reference material.

17 July 2008

**Certifying officers:**



**African Mineral Standards:** \_\_\_\_\_

**Mike McWha**  
BSc (Hons), FGSSA, MSAIMM, Pr.Sci.Nat



**Geochemist:** \_\_\_\_\_

**Barry W. Smee**  
BSc, PhD, P.Geo, (B.C.)

## APPENDIX

Additional useful trace element results were provided by seventeen laboratories. Summary statistics are provided below. This data has not been certified.

| AMIS0085 Trace Elements |         | ppm (%) | 2SD  | RSD%  | n   |
|-------------------------|---------|---------|------|-------|-----|
| Ag                      | (M/ICP) | 0.34    | 0.19 | 27.70 | 52  |
| Al (%)                  | (M/ICP) | 5.70    | 0.30 | 2.64  | 74  |
| As                      | (M/ICP) | 70.0    | 10.5 | 7.49  | 91  |
| Ba                      | (M/ICP) | 346     | 31   | 4.55  | 122 |
| Be                      | (M/ICP) | 2.31    | 0.40 | 8.66  | 94  |
| Bi                      | (M/ICP) | 0.42    | 0.05 | 6.13  | 76  |
| Ca (%)                  | (M/ICP) | 2.31    | 0.13 | 2.72  | 83  |
| Cd                      | (M/ICP) | 0.20    | 0.11 | 28.44 | 70  |
| Ce                      | (M/ICP) | 70.7    | 7.4  | 5.25  | 101 |
| Co                      | (M/ICP) | 23.9    | 2.4  | 5.02  | 119 |
| Cr                      | (M/ICP) | 444     | 106  | 11.89 | 96  |
| Cs                      | (M/ICP) | 4.29    | 0.41 | 4.81  | 81  |
| Cu                      | (M/ICP) | 428     | 36   | 4.16  | 116 |
| Dy                      | (M/ICP) | 8.65    | 2.27 | 13.14 | 56  |
| Er                      | (M/ICP) | 6.40    | 2.34 | 18.25 | 48  |
| Eu                      | (M/ICP) | 0.96    | 0.06 | 3.26  | 45  |
| Fe (%)                  | (M/ICP) | 2.47    | 0.19 | 3.86  | 100 |
| Ga                      | (M/ICP) | 13.7    | 1.5  | 5.31  | 87  |
| Gd                      | (M/ICP) | 6.54    | 0.88 | 6.73  | 55  |
| Hf                      | (M/ICP) | 2.45    | 0.80 | 16.27 | 64  |
| Ho                      | (M/ICP) | 1.91    | 0.72 | 18.85 | 56  |
| In                      | (M/ICP) | 0.04    | 0.01 | 12.51 | 44  |
| K %                     | (M/ICP) | 3.80    | 0.29 | 3.87  | 77  |
| La                      | (M/ICP) | 37.0    | 3.1  | 4.18  | 100 |
| Li                      | (M/ICP) | 19.1    | 2.7  | 7.03  | 109 |
| Lu                      | (M/ICP) | 0.78    | 0.29 | 18.44 | 39  |
| Mg (%)                  | (M/ICP) | 1.03    | 0.07 | 3.34  | 92  |
| Mn (%)                  | (M/ICP) | 509     | 38   | 3.70  | 90  |
| Mo                      | (M/ICP) | 3.93    | 0.75 | 9.59  | 109 |
| Na                      | (M/ICP) | 1.26    | 0.08 | 3.20  | 91  |
| Nb                      | (M/ICP) | 10.1    | 2.0  | 9.86  | 86  |
| Nd                      | (M/ICP) | 28.3    | 2.2  | 3.97  | 47  |
| Ni                      | (M/ICP) | 69.0    | 5.9  | 4.24  | 107 |
| P                       | (M/ICP) | 297     | 38   | 6.32  | 69  |
| Pb                      | (M/ICP) | 117     | 15   | 6.25  | 109 |
| Pr                      | (M/ICP) | 7.93    | 1.04 | 6.58  | 54  |
| Rb                      | (M/ICP) | 222     | 28   | 6.34  | 84  |
| Sb                      | (M/ICP) | 10.4    | 2.4  | 11.66 | 97  |
| Sc                      | (M/ICP) | 4.72    | 0.85 | 9.03  | 78  |
| Sm                      | (M/ICP) | 6.25    | 0.79 | 6.33  | 46  |
| Sn                      | (M/ICP) | 3.10    | 0.21 | 3.40  | 74  |
| Sr                      | (M/ICP) | 102     | 7    | 3.22  | 109 |
| Ta                      | (M/ICP) | 1.41    | 0.41 | 14.74 | 72  |
| Tb                      | (M/ICP) | 1.24    | 0.25 | 9.92  | 56  |
| Te                      | (M/ICP) | 0.21    | 0.04 | 10.64 | 31  |
| Th                      | (M/ICP) | 53.4    | 5.6  | 5.24  | 87  |
| Ti                      | (M/ICP) | 1208    | 141  | 5.84  | 86  |
| Tl                      | (M/ICP) | 1.03    | 0.12 | 5.70  | 69  |
| Tm                      | (M/ICP) | 0.98    | 0.46 | 23.76 | 48  |
| V                       | (M/ICP) | 29.0    | 5.8  | 10.02 | 99  |
| W                       | (M/ICP) | 1.57    | 0.32 | 10.11 | 75  |
| Y                       | (M/ICP) | 42.3    | 10.4 | 12.31 | 95  |
| Yb                      | (M/ICP) | 5.82    | 2.08 | 17.90 | 56  |
| Zn                      | (M/ICP) | 93.9    | 10.3 | 5.49  | 108 |
| Zr                      | (M/ICP) | 64.3    | 19.6 | 15.23 | 86  |