THE APPLICATION OF GROUND BASED AND AIRBORNE RADIOMETRIC METHODS TO AID GEOLOGICAL MAPPING IN THE OLARY PROVINCE, SOUTH AUSTRALIA

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ABSTRACT

The Late Palaeoproterozoic Olary Domain, in the east of South Australia, has been extensively surveyed using airborne geophysical methods, including 256 channel radiometrics. This detailed data set over outcropping areas is potentially a valuable aid to geological mapping. Ground-based radiometric data was obtained along profiles through the eastern Weekeroo Inlier and Ninnerie Hill areas in order to relate radioelement concentrations to lithological units. The Weekeroo Inlier traverse sampled all stratigraphic units present in the Olary Domain. The Ninnerie Hill traverse sampled Early Mesoproterozoic granitoids, migmatites and host metasediments. Two acquisition styles were attempted when collecting the ground-based data, with continuous recording to provide results that better replicate the airborne data than discrete sampling. The discrete sampling method was found to be heavily influenced by single point anomalies and not representative of the lithological average.

Relative peaks and troughs on all three channels and total count data correspond well between the ground and airborne data. Correlation between the airborne data and the ground-based data was best for the K channel. For the Th channel the ground-based data was similar to the airborne data in wavelength and amplitude but was bulk shifted below the airborne data. The U channel data from the ground-based data detected the same anomalies as the airborne data but was an order of magnitude higher. The differences between the airborne and ground-based data could be due to errors in the calibration process that was performed for part of this project or due to the time difference in acquisition of the ground-based and airborne data.

Comparison of ground-based data with the geology of the survey areas revealed that radiometric data can provide useful lithological discrimination. Within the survey area some differences between metasediments, intrusive lithologies, and alteration types are determinable. The radiometric data can successfully differentiate between potasic and sodic granites. The low levels in all three measured radioelement channels can reflect occurrences of amphibolites. The data discriminates between pelites and psammites in that the pelites contain significantly higher levels of K, the difference between levels of Th and U are less extreme but are still discernable. As well as providing a mapping tool on the lithology scale, the interpretation of radiometric data can resolve sub-lithology scale variations.

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ABBREVIATIONS

MeV	million electron volts
PIRSA	Primary Industries and Resources South Australia
DGPS	Differential Global Positioning System
ppm	parts per million
U	uranium
Th	thorium
K	potassium
Bi	bismuth
BHEI	Broken Hill Exploration Initiative
RGB	red green blue multi component or ternary radiometric image
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Ma	million years ago
m	metres
km	kilometres
s	seconds

1 INTRODUCTION

While recent improvements in the acquisition and processing of airborne radiometric data have enabled the creation of impressive images, just how radioelement concentrations shown on the images correspond to surface geology remains somewhat unclear. By proving that a particular rock type has a characteristic radiometric signal, radiometric data can then be used as a geological mapping tool, not only in areas of poor mapping coverage but in areas where definition between rock types with a gradational contact may be subject to individual interpretation. By using the information from ground traverses, extrapolation along strike can be made from the control areas into regions only covered with airborne data.

This thesis aims to show that radiometrics is a useful geological mapping tool. Data from both airborne and ground-based acquisition methods are compared with geological information within the Olary Domain of South Australia. The Olary Domain is situated in the north east of South Australia, approximately 450 kilometres from Adelaide (Figure 1). The study area covers parts of the Curnamona and Olary 1:250,000 map sheets.

Airborne radiometric data used for this study was acquired in 1995, during the Broken Hill Exploration Initiative (BHEI), a joint program between the South Australian, New South Wales and Federal Governments. The ground radiometric data was collected specifically for this project and was acquired in conjunction with detailed geological information.

The 256 channel data acquired was converted into concentrations of potassium, and equivalent uranium and thorium by the application of stripping ratios determined during the calibration process conducted for the spectrometer used in this study. The values of these three radioelements where then related to both the airborne data and geological information.

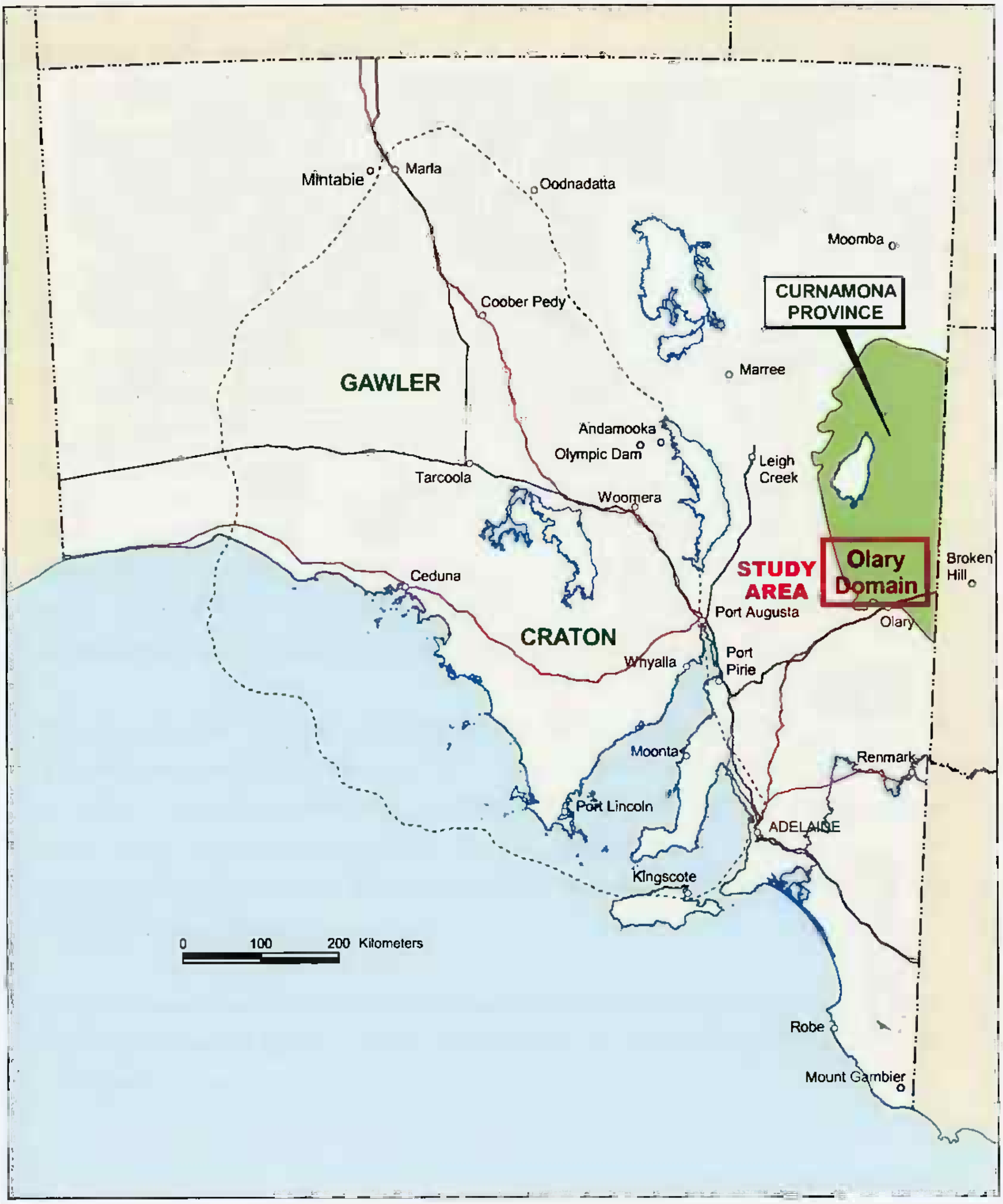

***Figure 1 :** Locality plan*

2 REGIONAL GEOLOGY

2.1 Regional Setting

The Palaeoproterozoic Olary and Broken Hill Domains comprise the Willyama Inliers, which in turn constitute part of the Curnamona Province. The Proterozoic Curnamona Province extends across eastern South Australia and western New South Wales (Figure 2, Ashley *et al.* 1998). Apart from the Willyama, Mount Painter and Mount Babbage Inliers the Proterozoic geology is largely obscured by younger sedimentary cover. Rock exposure occurs as a series of semi-isolated outcrops from the Olary Domain of South Australia into the Broken Hill Domain of New South Wales.

The nature and position of boundaries between the two domains has always been somewhat contentious, but appears to be best defined by distinctive gravity and magnetic characteristics (Ashley *et al.* 1997). However recent geological mapping by Crooks (pers. com.) indicates little difference in the tectonic and metamorphic history between the domains and that differences, therefore, reflect differences in early basin development.

The Olary Domain is largely composed of low to high grade, regionally metamorphosed and deformed late Palaeoproterozoic sedimentary, volcanic and intrusive rocks (Ashley *et al.* 1998). Early Mesoproterozoic granitoids extensively intrude the Palaeoproterozoic rocks. Low grade metasediments of the Neoproterozoic Adelaide Geosyncline unconformably overlie or are faulted against the Olary Domain rocks. There are sporadic Neoproterozoic mafic dykes

The total thickness of the Willyama Supergroup in the Olary Domain is unknown. Estimates from the Broken Hill Domain put the average thickness at 6-7 km (Willis *et al.* 1983 and Drexel *et al.* 1993).

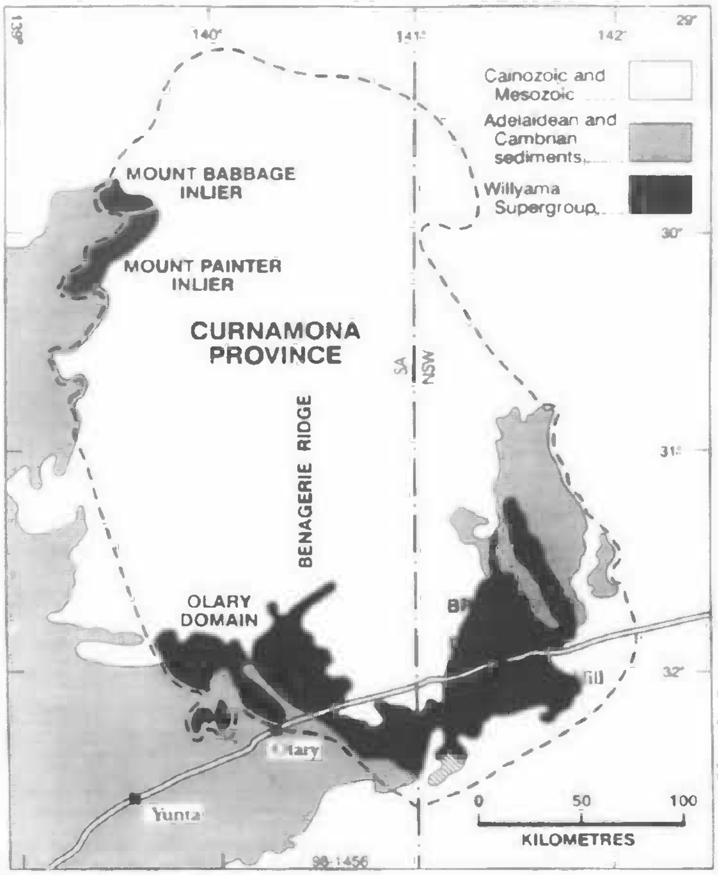

Figure 2. Extent of Curnamona Province (after Ashley et al. 1997).

2.2 Olary Domain Lithological Sequence

The five informal lithostratigraphic units identified in the Olary Domain change in general composition upwards from quartzofeldspathic through calcsilicate-rich to pelitic. Stratigraphic nomenclature of the Olary Domain is still subject to debate. However, for the context of this thesis, the stratigraphic terminology outlined in Ashley *et al.* (1997 and 1998) is used.

Composite Gneiss Suite

Although referred to as the basal unit of the Olary Domain, the 'Composite Gneiss Suite' is thought to represent a migmatised portion of the 'Quartzofeldspathic Suite' (Ashley *et al.* 1997). The gneiss is dominated by coarse grained and migmatitic quartz + feldspar + biotite ± sillimanite ± garnet gneiss.

Quartzofeldspathic Suite

The 'Quartzofeldspathic Suite' is extensive in the Olary Domain, and is dominated by massive to layered albitic quartzofeldspathic rocks, and psammopelitic schists grading to composite gneiss. The 'Quartzofeldspathic Suite' is further divided into the 'lower albite', 'middle schist' and 'upper albite', units. The latter may be equated with the feldspathic component of the 'Calcsilicate Suite' (see below).

Calcsilicate Suite

The 'Calcsilicate Suite' is not as continuous or as thick as the 'Quartzofeldspathic suite'. The 'Calcsilicate Suite' is characterised by massive, banded and finely laminated calcsilicate and feldspathic rocks, which are finer grained and better laminated than the quartzofeldspathic gneiss (Drexel *et al.*1993). Calcsilicate rocks are charactersied by actinolite, diopside and epidote.

Bimba Suite

The 'Bimba Suite' is laterally extensive although only up to 50 m thick. The unit contains metasiltstone interlayered with marble, laminated marble, albitic chert and calcsilicate gneiss and host to predominantly strataform pyritic sulphides.

Both the 'Quartzofeldspathic Suite' and 'Calcsilicate Suite' suite are magnetite prone whilst the overlying units are reduced. The difference in magnetic response exposes the sulphidic 'Bimba Suite' to mineral explorers even through thick cover.

Pelite Suite

The 'Pelite Suite' is widely distributed in the Olary Domain and is several hundreds of metres thick (Ashley *et al.* 1997). The unit is dominated by pelitic and psammopelitic schist, locally grading into thin psammites higher in the sequence.

Intrusive Rocks

Several types of felsic and mafic intrusives have been recognised in the Olary Domain. The felsic intrusives consist of A, I and S type granites, with ages ranging from 1720 to 1580 Ma. Amphibolites and metadiorite dykes are both concordant and discordant with host rocks.

3 RADIOMETRIC METHOD PRINCIPLES

3.1 Natural Sources of Radiation

The three naturally occurring elements with radioisotopes that produce gamma rays of sufficient energies to be detected by aerial surveying methods are: potassium (K), uranium (U), and thorium (Th). Average crustal abundances: are K – 2%, U – 2.7ppm, Th – 8.5ppm (Minty 1997). ^{40}K is the only radioactive isotope of K, and during the decay process releases a single gamma-ray photon of 1.46MeV. Uranium occurs naturally as the isotopes ^{235}U, ^{238}U and ^{234}U. The decay of these isotopes does not directly emit gamma-ray photons of detectable energy levels, however the decay of ^{214}Bi, a daughter product late in the ^{238}U decay series, does emit a detectable gamma-ray photon of 1.76MeV. Measurements of U using the 1.76 MeV gamma-ray determination are indicated by the term "gamma-equivalent uranium" or eU. The abundance of thorium is measured in a similar way. During the decay process of ^{232}Th, the isotope ^{208}Tl is produced, resulting in a gamma-ray of energy 2.62MeV, which is used to measure gamma-equivalent thorium (eTh).

3.2 Detection of Gamma Rays

The detection of gamma rays originating from near the Earth's surface is based on their incidence on a medium that converts the incident energy into an electrical pulse. Materials such as sodium iodide (NaI) can convert the gamma rays into a fluorescent photon pulse, which is detected and converted into a current pulse by a photomultiplier tube. Therefore the energy level of the incident gamma ray is directly proportional to the voltage of the pulse that is sent from the photomultiplier tube to the mulitichannel analyser. The energy range for modern spectrometers is in the range 0 - 3.0 MeV. Two hundred and fifty six channels are used over this range. Therefore a group of channels, or window, will relate to a particular energy range. Detecting crystals can be up to 48 litres in volume, for aerial surveys, whereas ground-based crystals are typically in the order of 0.35 litres in volume.

The three radioelements that are typically recorded, namely K, eU and eTh, have single energy levels as shown in Table 1, a window is used for each isotope. The energy loss of the gamma rays due to interaction with matter will result in a range of gamma ray energies rather than a concentrated photopeak.

Table 1 Energy levels of radio isotopes (after IAEA 1991).

Window Name	Isotope Used	Major Peak	Window Range (MeV)
Potassium	^{40}K	1.460	1.37-1.57
Uranium	^{214}Bi	1.765	1.66 -1.86
Thorium	^{208}Tl	2.614	2.41 – 2.81
Total Count			0.41 – 2.81

3.3 Calibration of Spectrometer

Gamma ray spectrometers must be calibrated to enable conversion from counts per second to radioelement concentrations. Calibration also determines the stripping constants that correct for Compton scattering. Compton scattering is the name used to describe a process whereby a single high energy gamma ray photon produces many lower energy photons by interaction with matter (Van Blaricom 1992). A photon given off by ^{208}Th can interact with the environment to produce two photons of energy characteristic of ^{214}Bi and ^{40}K. In order to determine concentrations of K or U the observed count rate must be corrected by an amount, which is proportional to the number of counts in the Th channel. Stripping constants are determined by recording multiple measurements over a set of calibration pads. The reduction of field data to concentrations allows comparison of data sets from one area to another, or as in the case of this study compare airborne and ground-based data.

3.4 Construction of a RGB Image

Airborne radiometric data is typically presented as a RGB (red green blue) image. A RGB image is a ternary image where one colour is used for each channel, red is for K, green is for Th and blue is for U. White areas on an image signify saturation due to relatively high, equivalent values of K, Th and U; black areas represent equivalent, but low, values. The range of colours produced and their relationship to the relative radioelements is shown in Figure 3. The combination of concentrations of the three main radioelement channels into a single image allows relative radioelement abundance relationships to be determined.

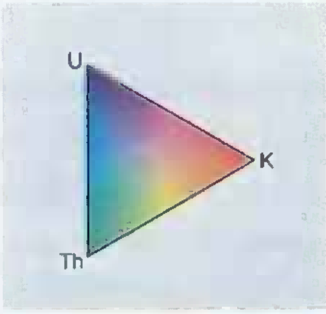

Figure 3. Red, green, blue (RGB) composite colour triangle used in the generation of the RGB images

3.5 Flight Height

The concentration of gamma rays decreases in an exponential fashion with distance away from the land surface due to the collision with other particles and subsequent energy loss. The amplitude of the gamma rays decreases by approximately one half for every 100m of height (IAEA 1991). Therefore at 120m there will only be about 35% of the ground level concentrations present. To determine a flying height correction factor a series of flights are made at increasing altitudes over a constant flight line. The airborne data used in the present project have been corrected for flying height.

4 METHODOLOGY

4.1 Calibration of Spectrometer and Description

An Exploranium GR320 spectrometer, utilising a 0.35 litres volume sodium iodide detection crystal, was used for the acquisition of all ground-based radiometric data. The GR320 spectrometer was set up to record 256 channels, in the range 0-3 MeV. Grasty *et al.* (1995) specifies that spectrometers require calibration every 12 months, therefore the spectrometer was calibrated prior to use. The reason for calibrating the spectrometer is that the spectra of the potassium, the uranium series and the thorium series overlap. Hence each chosen spectral window contains some signal from the other two elements. Correcting for this overlap is termed stripping. Stripping ratios are determined from readings taken over concrete pads of known radioelement concentrations.

The calibration pads used were situated at Whyalla airport and are owned by PIRSA. The pads were constructed in 1992 by CSIRO and concentrations for the four pads are shown in Table 2. The pads were in an unusable position at the airport, due the recent renovations. Hence they were, with considerable logistical problems, transported back to Adelaide and placed in storage where they are now more accessible. After consultation with Bruce Dickson (CSIRO, North Ryde, NSW) and Stephen Monkhouse (Exploranium, Canada), the spectrometer sensor was placed on top of each pad and multiple readings of 300 seconds duration where taken. These readings were then input into the software Explore, Version 4.6, and calibration constants were computed. Slight changes from the original values for the regions of interest (ROI's) were determined and these new values where then used during data acquisition at Olary.

Table 2. *Gamma-ray calibration pad concentrations for the PIRSA calibration pads*

Pad	K (%)	U (ppm)	Th (ppm)
Background	0.24±0.02	0.48±0.8	2.28±0.34
K	5.84±0.17	0.57±0.35	1.37±0.56
U	0.25±0.04	38.5±4.5	1.16±0.53
Th	0.19±0.06	4.5±0.33	103.2±5.6

4.2 Data Acquisition

When linked to a global positioning system (GPS) the spectrometer can, in real time, record digitally a position for each sample. A GPS signal is subject to an ambiguity imposed by the United States military. Position errors of up 100 metres result from the ambiguity. By differentially correcting the GPS signal positional errors can be reduced to sub meter levels. Despite considerable time spent ensuring that the spectrometer would interact with a differentially corrected global positioning system (DGPS), when in the field the position results obtained were not differentially corrected. The spectrometer communicates with the DGPS unit after each sample is recorded and a position is obtained and logged against the recorded spectrum. The spectrometer recorder is strapped to the chest of the operator and the sensor is carried in the hand, the DGPS unit is carried on the back of the operator (Figure 4).

The levels of atmospheric radon created by evaporation of moisture are particularly high in the early morning or late afternoon (Kennedy 1992). Therefore field work was only carried out in the middle of the day to avoid these times when background radiation levels are increased. When a traverse was conducted over multiple days, data acquisition was always started on the end point for the previous day. This was done to ensure that continuity between days was maintained and the influences of radon were detectable.

Figure 4. Operational configuration of the Exploranium GR320 spectrometer and Differential Global Positioning system.

Orientation of the ground survey lines were determined depending on the final outcome desired. The survey over the Ninnerie Hill area was designed to cover as much outcropping granite body as possible with minimal samples recorded over alluvium (Figure 5). The Weekeroo traverses were designed to sample a maximum number of outcropping units in the area. In addition the main traverse was designed to follow a flight line used during the airborne survey (Figure 6). Approximately 25 line kilometres were surveyed and 700 spectra recorded. All data are presented in Appendices 1 to 3.

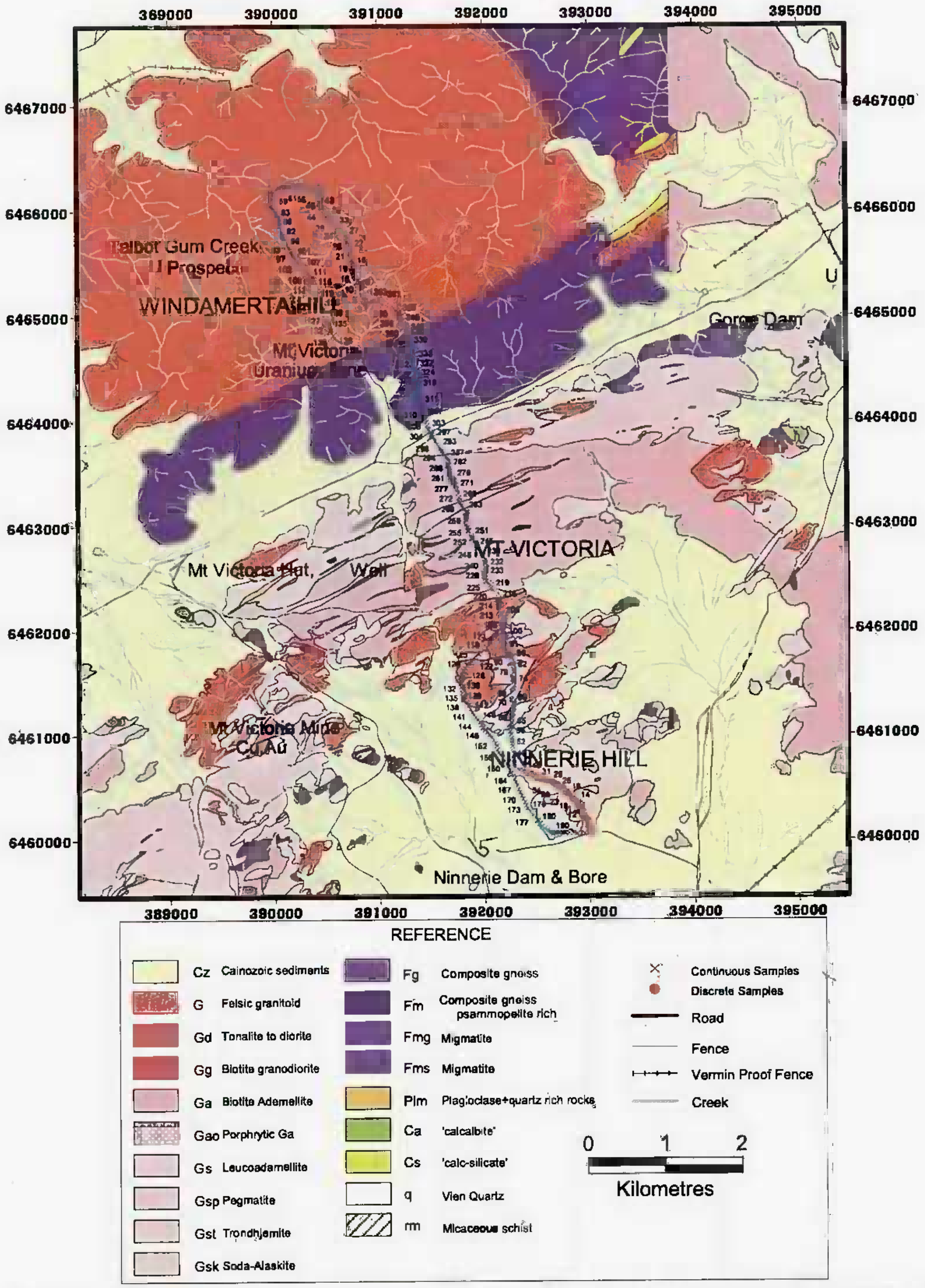

Figure 5. *Sample positions for the Ninnerie Hill Traverse. The red dots indicate the position of discrete samples and the blue crosses are continuous sample positions. (Geology after Laing 1995a)*

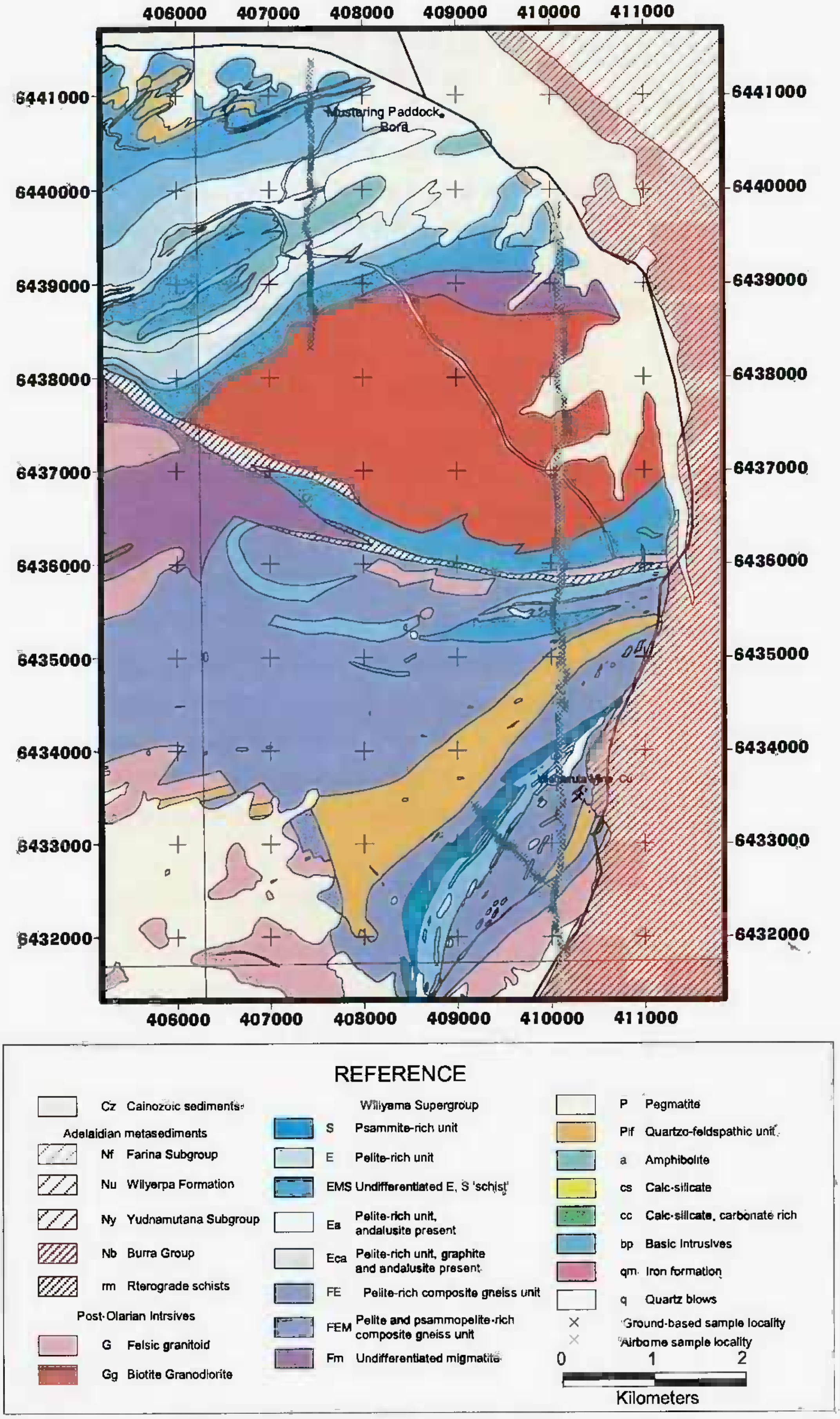

Figure 6. Sample locations for the Weekeroo Traverses. (Geology after Laing 1995b)

The elevation of the detector crystal above the ground was kept constant as much as practically possible. This was not a problem on flat ground. By way of adjustment when the terrain was sloping, the sensor was raised in an effort to maintain a constant sensor height. In regions of extreme slope, recording was not stopped but the positions noted for later inspection of the data. The reason that the sensor to ground orientation is important is because sloping surfaces exaggerate the gamma-radiation emanating from the rock when compared to a horizontal surface (Kennedy 1992), in a similar way to the attitude of a plane affecting the detector response in an airborne survey (Billings 1998).

4.3 Continuous Samples Vs. Discrete Samples.

Kennedy's (1992) guidelines for ground-truthing stipulate that ground radiometric data are recorded at discrete sample locations. In this discrete mode the spectrometer recordings are made whilst stationary at a single locality and the spectrometer is not recording while being transported from one sample locality to another. However, the spectrometer has the ability to record continually over a user specified time interval, sampling all the ground traversed during that time interval. A portion of the Ninnerie Hill Traverse was sampled using both the discrete and continuous methods to determine which method was most suitable in view of the project aims. For both methods an integration time of 30 s was used to acquire full 256 channel spectrum data. The distance between discrete mode samples approximated 40m. The average spacing between samples was approximately 30 m when operating the spectrometer in continuous mode.

4.4 Geological Log of Sites

A log of rock types versus sample number was kept along the profiles as the main objective of the study was to relate the radiometric signal to lithological units. A single discrete sample was recorded at outcrops that best represented the unit being traversed. Positions of the discrete samples where noted and removed from the traverse data during processing, as they did not represent a continuous section of the traverse. Care was taken to continue moving at an average velocity, until the current 30 s sampling period was complete when the recording was paused.

4.5 Processing and Interpretation

Concentrations of radioelements were calculated using the calibration values obtained during the calibration process. The processing software used was Explore, Version 4.6 provided by Exploranium. Position information was verified to ensure that the samples acquired were recorded along the planned traverse localities. All processing was done in the field to ensure that the data was of sufficient quality to enable later interpretation.

The data sets were displayed as either profiles or spatial plots to aid interpretation. The profiles were created as two dimensional plots; where the 'X' axis is the distance along the traverse in metres and the 'Y' axis is the radioelement abundance. The spatial plots display the location of the sample point in the correct geographical position, as a result the sample points can be overlaid on regional grids.

The Ninnerie Hill and Weekeroo areas vary in radioelement concentration (Figure 7). The Weekeroo area contains higher levels of U and Th and lower levels of K than the Ninnerie Hill area. Due to the different radioelement concentration levels between the two traverses, different scales for the relative low, moderate and high divisions were used during interpretation.

Subsets of the Olary Domain RGB image were produced for the Ninnerie Hill and Weekeroo areas (Figure 7). Spatial plots of the RGB subsets combined with the colour coded sample localities where used to extend interpretation away from the traverses.

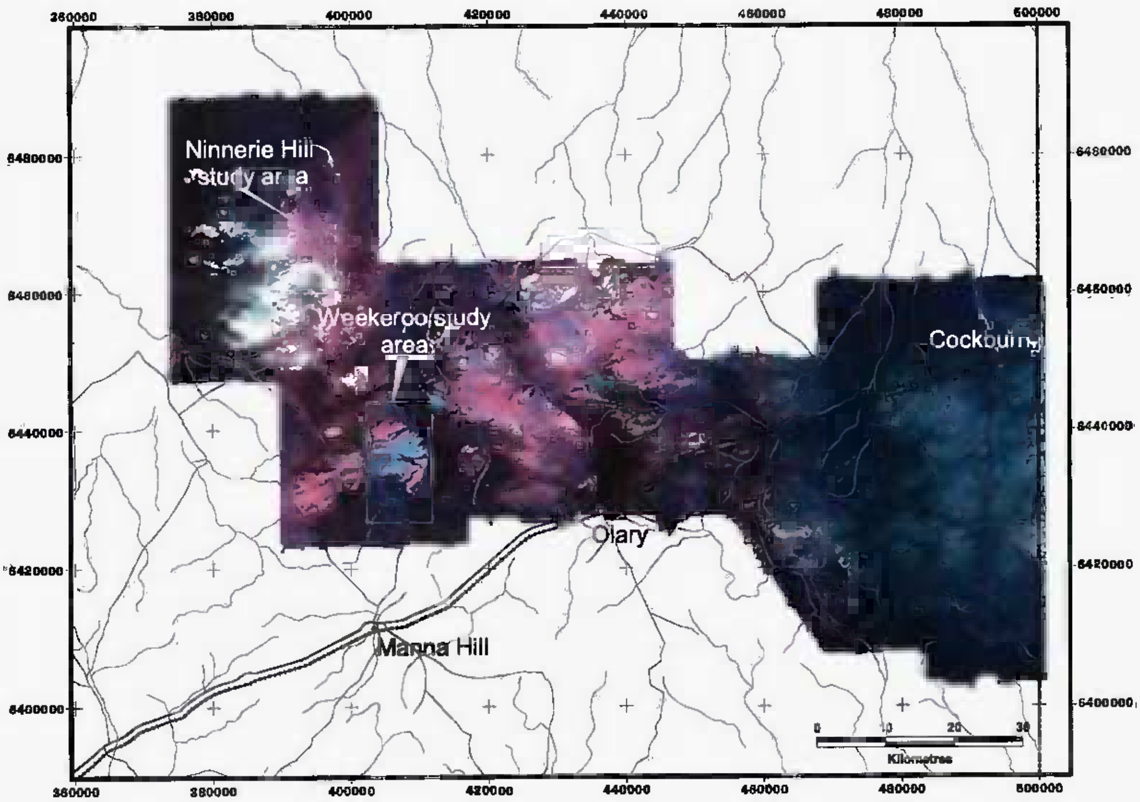

Figure 7. RGB image for the entire airborne data set, covering much of the outcropping Olary Domain rocks.

4.6 Airborne Data

The airborne data used were acquired in 1995 by World Geoscience Corporation, during the Broken Hill Exploration Initiative (BHEI) Primary Industries and Resources South Australia (PIRSA, formerly Mines and Energy South Australia (MESA)). Flight lines where 100 m apart, flying height was 60 m.

5 RESULTS

5.1 Comparison Of Acquisition Methods, Discrete vs. Continuous

The sample locations for the discrete and continuous acquisition methods, which were both applied over part of the Ninnerie Hill traverse, are shown in Figure 8. The results for the discrete and continuous methods are tabulated in Appendices 1 and 2 respectively. The data obtained for both methods are presented in graphical form for the K, Th and U channels (Figures 9,10,11). For both the discrete and continuous methods the data for all three channels is dominated by large single point anomalies. These single point anomalies make correlation between the continuous and discrete data sets difficult. A three point moving average smoothing function has been applied to the data to reduce the influence of the single point anomalies. The smoothed data are presented in graphical form for the K, Th and U channels (Figures 12,13,14).

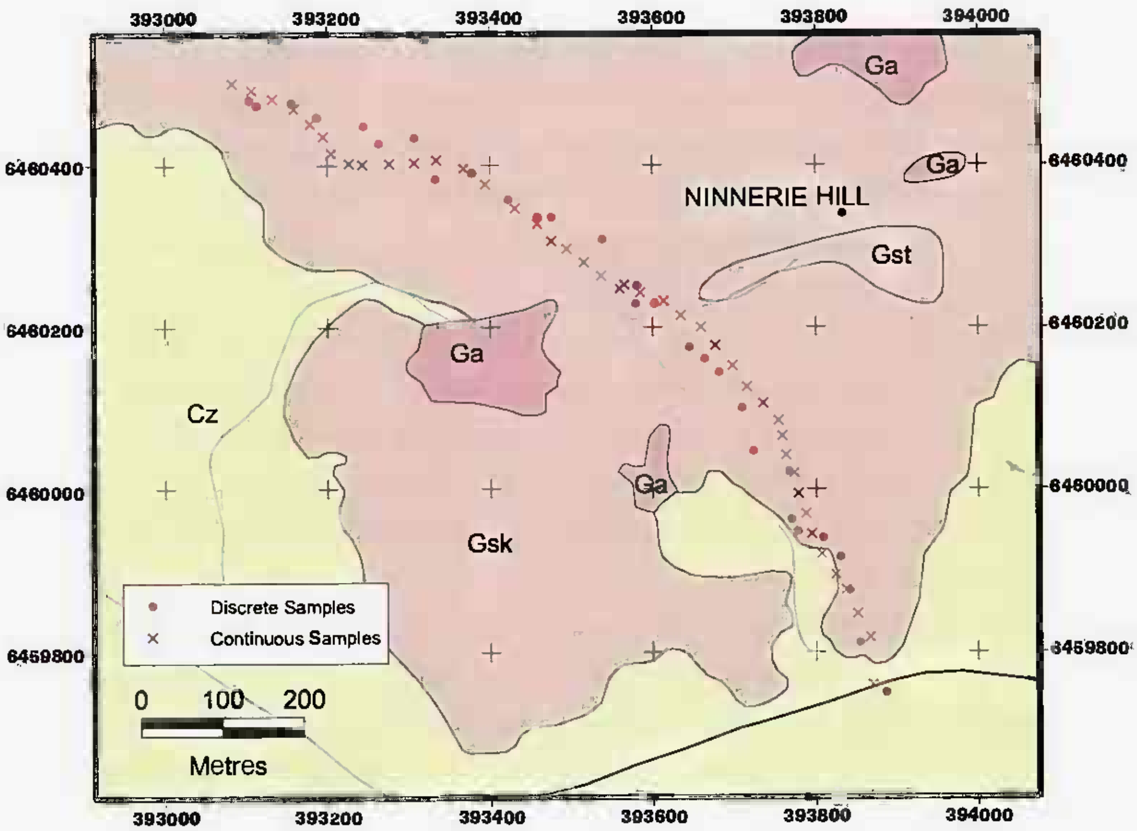

Figure 8. Sample locations for the acquisition method comparison at Ninnerie Hill. Cz–Cainozoic sediments, Ga–Biotite Ademellite, Gst–Trondhjemite, Gsk–Soda-Alaskite. For reference refer Figure 5.

The non-smoothed K data (Figure 9) is dominated by large single point anomalies in both the continuous and discrete data sets. However, by smoothing the data, (Figure 12) there is a clear correlation between the two methods. The broad wavelength anomaly at 6460050mN (Figure 12), although detected by both methods, is significantly wider in the discrete data compared to the continuous data.

The Th channel data in the non-smoothed form (Figure 10) contains many short wavelength high amplitude single sample anomalies, especially in the continuous data, but also in the discrete data. The data sets correlate better after smoothing (Figure 13). However there are two sections that differ. The first is an anomalous high at 6460050mN that is detected by the continuous method but not by the discrete method. The second is a large high at 6460350mN that can be seen in the discrete data but is recorded as a low by the continuous method.

The results for the uranium concentrations (Figure 11) show a strong correlation between the two acquisition methods. The two larger anomalies at approximately 6459950mN and 6460400mN are detected by both methods, although the wavelength and amplitude varies the features are represented in both data sets. The moderate high at 6460350mN in the discrete data represents part of the high at 6460400mN. This can be more clearly seen if the data is smoothed using a three point moving average (Figure 14).

Although every effort was made to follow the same path for both acquisition methods, this was not precisely achieved. The difference in position between the two methods was largely due to the test traverse not being clearly identified by markers. For a more rigorous comparison the traverse position should have been pegged before starting. The discrepancy in localities could also be in part due to the ambiguity of the GPS, which would be removed if a functional DGPS system were used. The anomaly at 6460050mN in the smoothed discrete K data is broader than for the same anomaly detected by the continuous acquisition method (Figure 11). Due to the limited position control, it is possible that the discrete acquisition method sampled a more extensive outcrop of the unit responsible for the elevated K values than the continuous acquisition method.

The discrete sampling method may not record an average radioelement concentration of the rock units sampled as the sampling points were not the average of a wide area but concentrated into one area of small radius. Features such as creeks, dykes and shear zones will greatly influence the discrete acquisition method but, due to their limited lateral extent, there will be little response from these features represented in the airborne data.

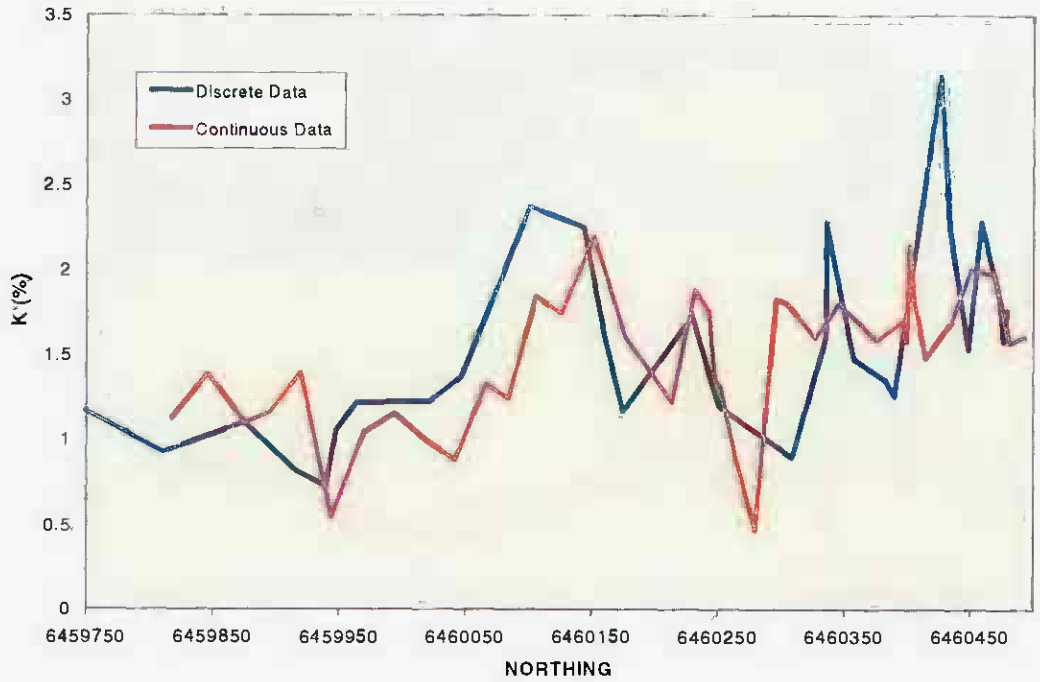

Figure 9. *Comparison between continuous and discrete sampling methods for the potassium channel.*

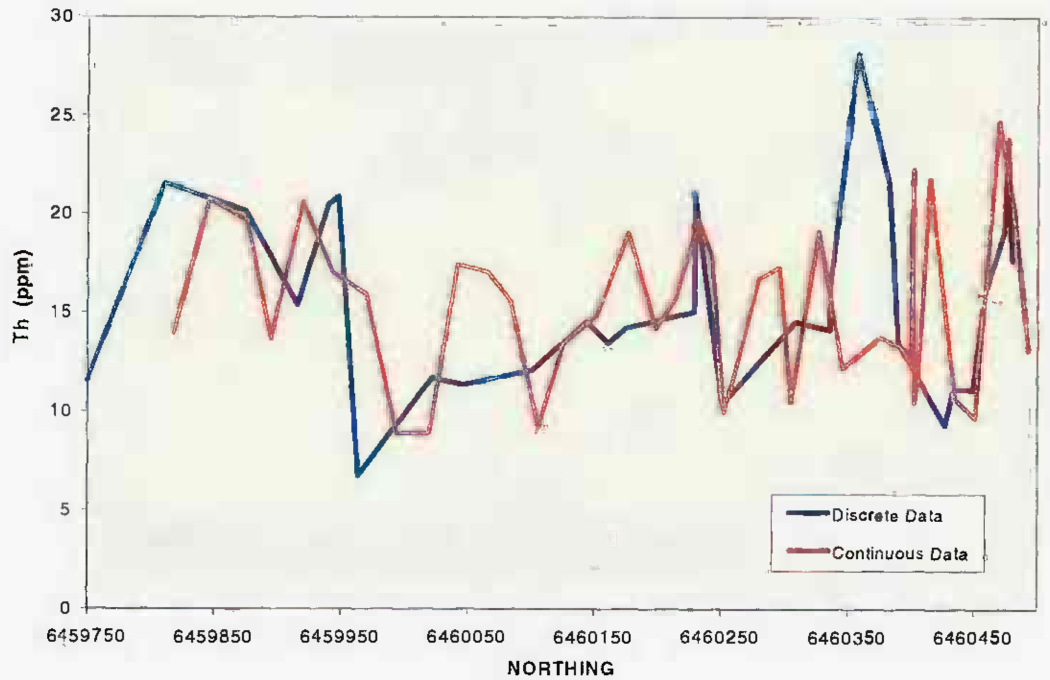

Figure 10. *Comparison between continuous and discrete sampling methods for the thorium channel.*

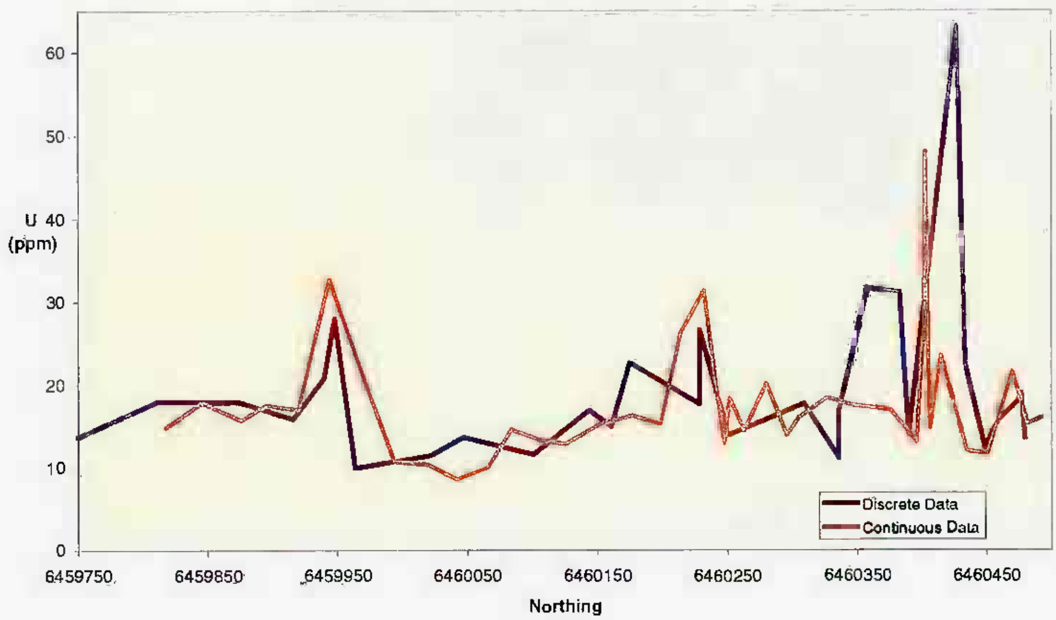

Figure 11. Comparison between continuous and discrete sampling methods for the uranium channel.

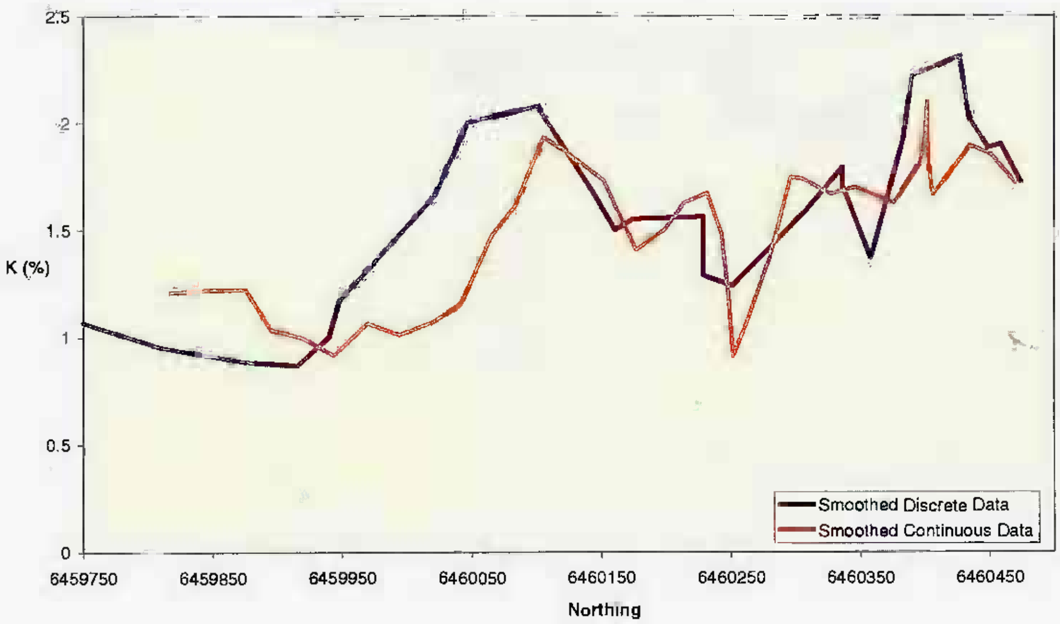

Figure 12. Comparison between continuous and discrete sampling methods for the potassium channel using a three point moving average to smooth the data.

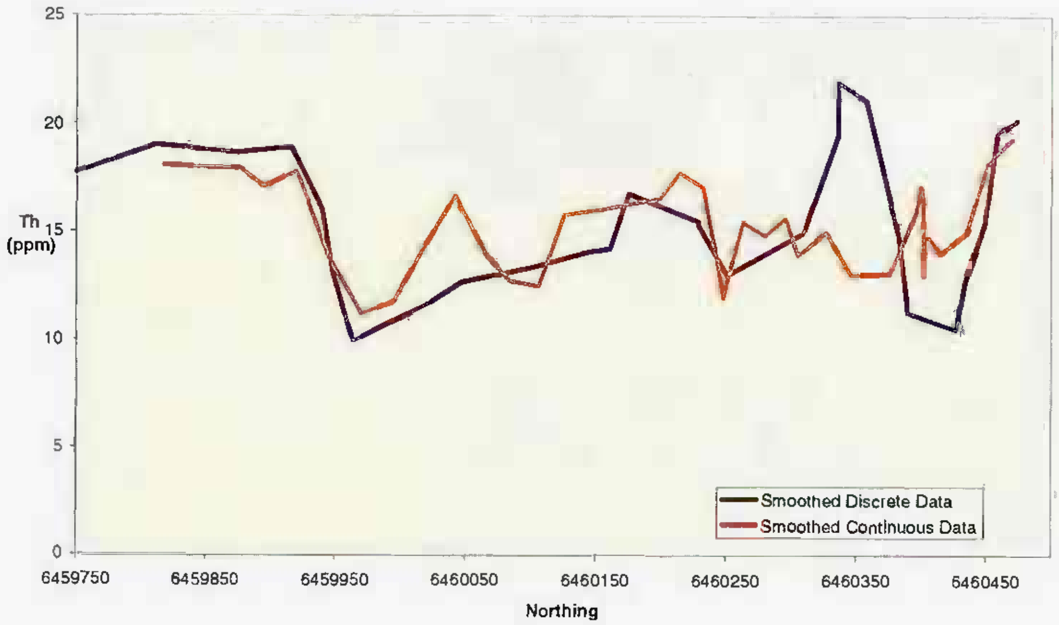

Figure 13. Comparison between continuous and discrete sampling methods for the thorium channel using a three point moving average to smooth the data.

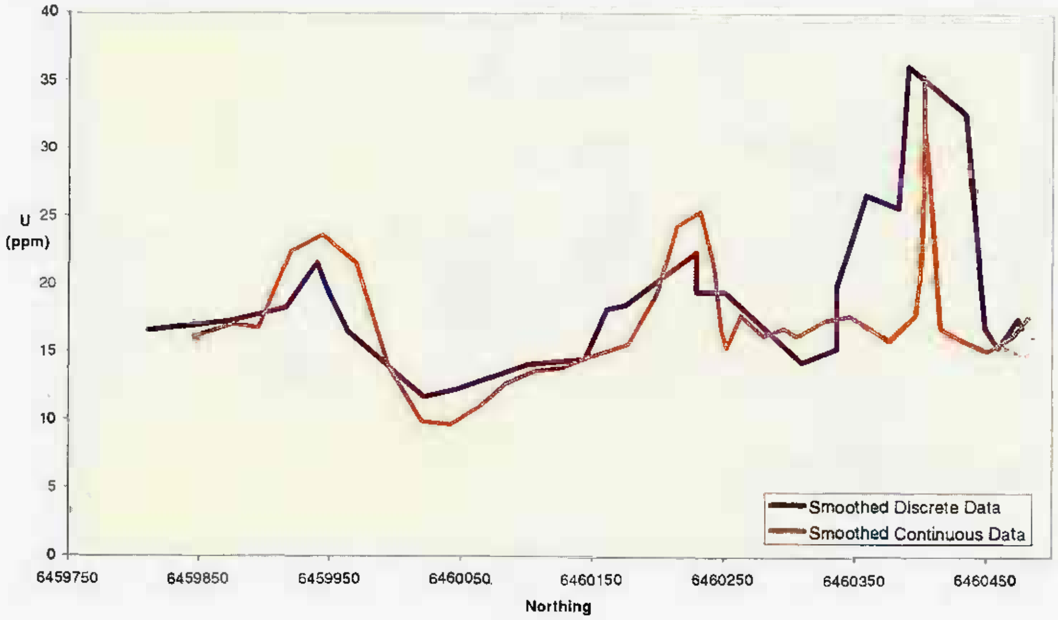

Figure 14. Comparison between continuous and discrete sampling methods for the uranium channel using a three point moving average to smooth the data.

5.2 Comparison Of Airborne And Ground-Based Radiometric Data

Plots of the airborne and ground-based data for K, Th and U along the Weekeroo Inlier traverse (Figures 15 to 17 respectively) show a strong correlation between the two acquisition methods. The best correlation is for the K values (Figure 15) where not only are the wavelength of anomalies similar, but the amplitude is also similar. For the Th values (Figure 16) the amplitude of the anomalies is similar, however baseline levels are different. The amplitude of the U anomalies (Figure 17) are much less for the airborne data compared to the ground-based data. The wavelength of anomalies for both the Th and U vales is similar. Possible origins of the differences in amplitude of Th and U values between the airborne and ground-based data are discussed in the following chapter.

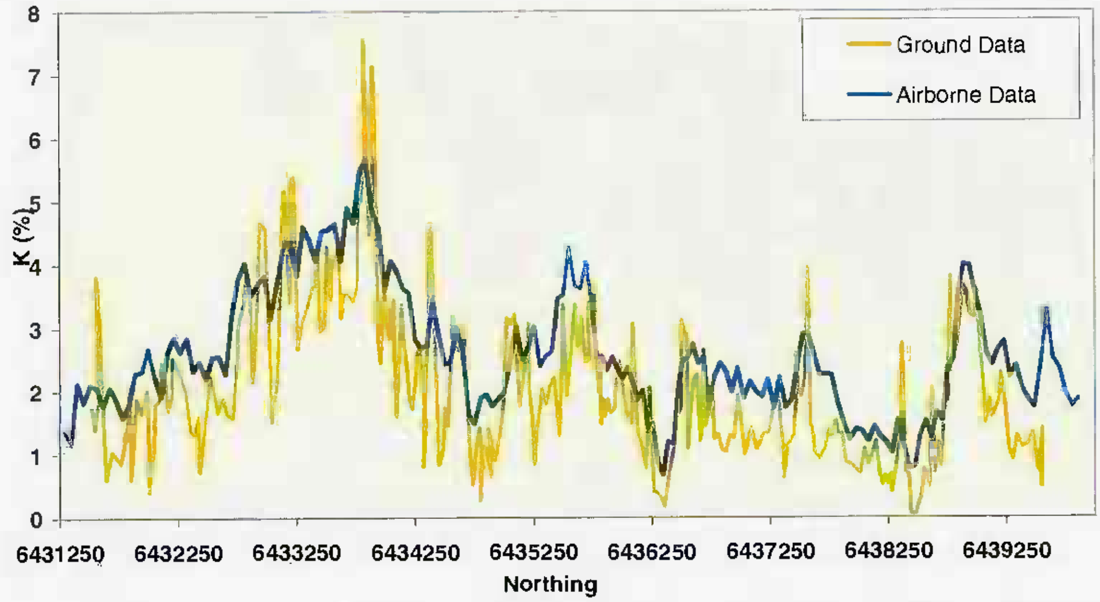

Figure 15. Comparison between airborne and ground-based data acquisition methods for the K window.

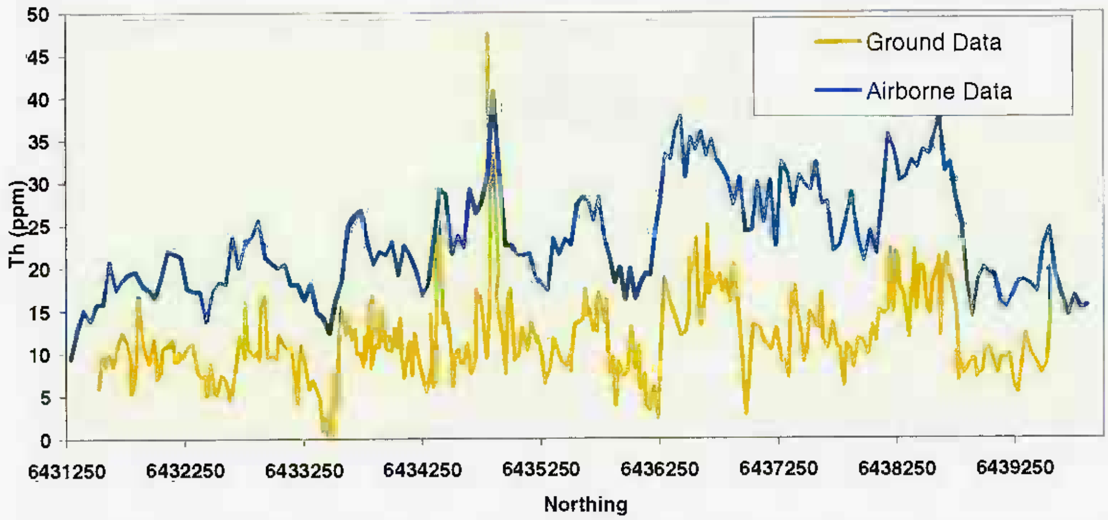

Figure 16. Comparison between airborne and ground-based data acquisition methods for the Th window.

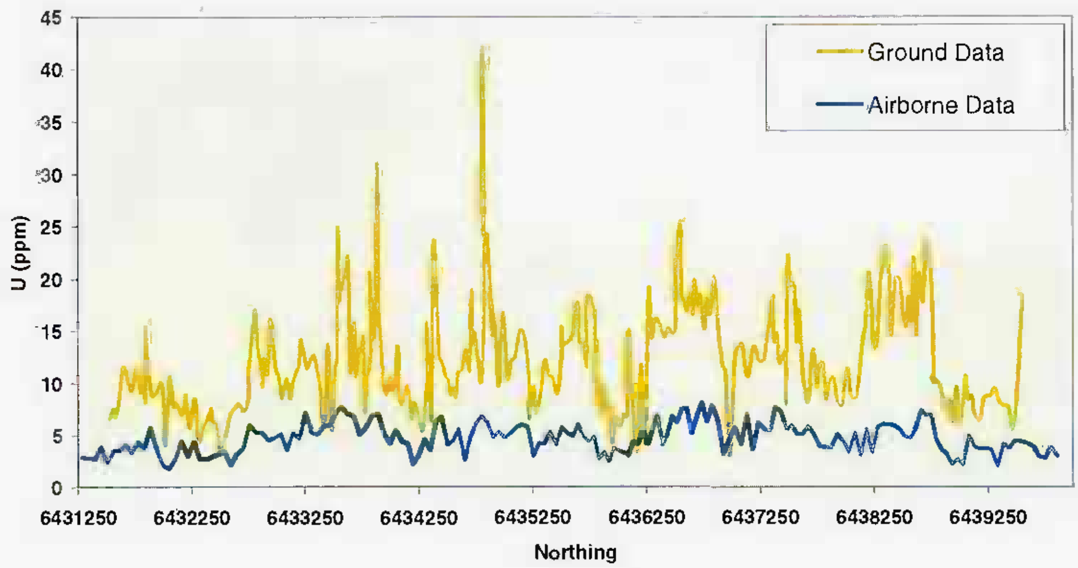

Figure 17. *Comparison between airborne and ground-based data acquisition methods for the U window.*

5.3 Ninnerie Hill Traverse

The acquisition sample positions for all points in the Ninnerie Hill traverse area in relation to the known geology are shown in Figure 5. Each blue cross represents a sample position acquired in continuous operation mode and the red circles represent a discrete sample position. The main traverse follows the planned northwest – southwest direction, except for a slight deviation near Ninnerie Hill it self, due to terrain difficulties. The two shorter loops on the western side of the main traverse were made while the operator was walking back to the vehicle. The southern of these two shorter loops, which crossed alluvium, was not used in any interpretation. The short northern loop was used only as an aid to regional interpretation, not as a guide to interpretation of lithologies, as no geological notes where made during these short additional traverses.

The final display for the main traverse is shown in Figure 18. The U and Th values are expressed in parts per million (ppm) whereas the K values are expressed as a percentage. The data as presented are hard to interpret due to the high frequency, noisy nature of the signal. To reduce the noise level the data was smoothed using a five point moving average (Figure 19). High frequency noise is removed by smoothing the data and thus the longer wavelength response can be interpreted. The source of the high frequency noise is believed to be the variable nature of the outcrop on the sub metre scale. Since the response of a rock type at the 100 metre plus is most suited to comparison with the airborne data, the longer wavelength response is used in the interpretation process.

The range of values has been divided into three zones termed, low, moderate and high to aid interpretation. The divisions are shown (Figure 19). In Figure 19 the geological log has been combined with the smoothed radioelement concentrations in order to facilitate analysis of the radioelement signal from the different lithologies. it is possible in this way to categorise a rock type based on the relative abundances of the three radioelements: a key aim of this project. The relative radioelement abundances are presented and discussed in the following chapter.

The airborne data and the ground-based data are correlated by posting scaled colour representations of the ground data over a RGB image of the airborne data. A separate plot is produced for K (Figure 20), Th (Figure 21) and U (Figure 22) where each ground-based sample point is coloured according to the signal level for that radioelement. The geology outlines from Figure 5 are also posted over the RGB images.

Three samples points are not shown In the three plots (Figures 20 to 22) for the Ninnerie Hill traverse. These points where recorded at the southern end of the short sub traverse in the vicinity of the Mt Victoria Uranium Mine (Figure 5). These points where omitted because the extremely high values recorded in all three windows around the old workings of the mine distorted the dynamic range of the remaining values. Values for these points (Samples 494-496) are listed in Appendix 2.

In the Ninnerie Hill Traverse K values generally show a gradual steady increase from 1.5% at the start to approximately 6461800mN where the values plateau and alternate around 3.5%. The decrease of K values to the south is possibly due to either original compositional variation of the granite or metasomatitic activity. That Th and U values do not decrease to the south suggests that alteration is the reason for variation in K.

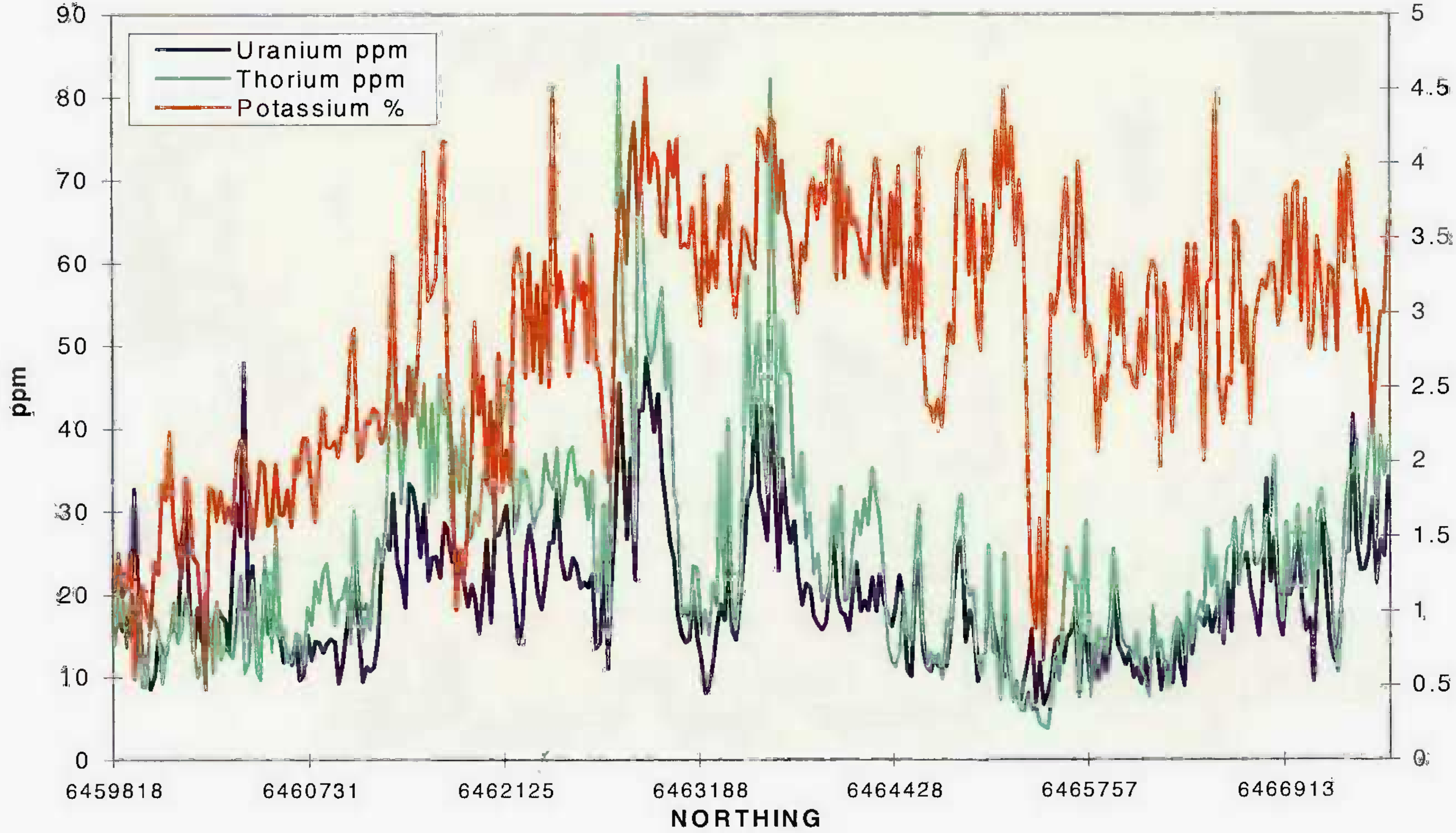

Figure 18. Graphical representation of potassium, thorium and uranium levels, non-smoothed, for the Ninnerie Hill traverse.

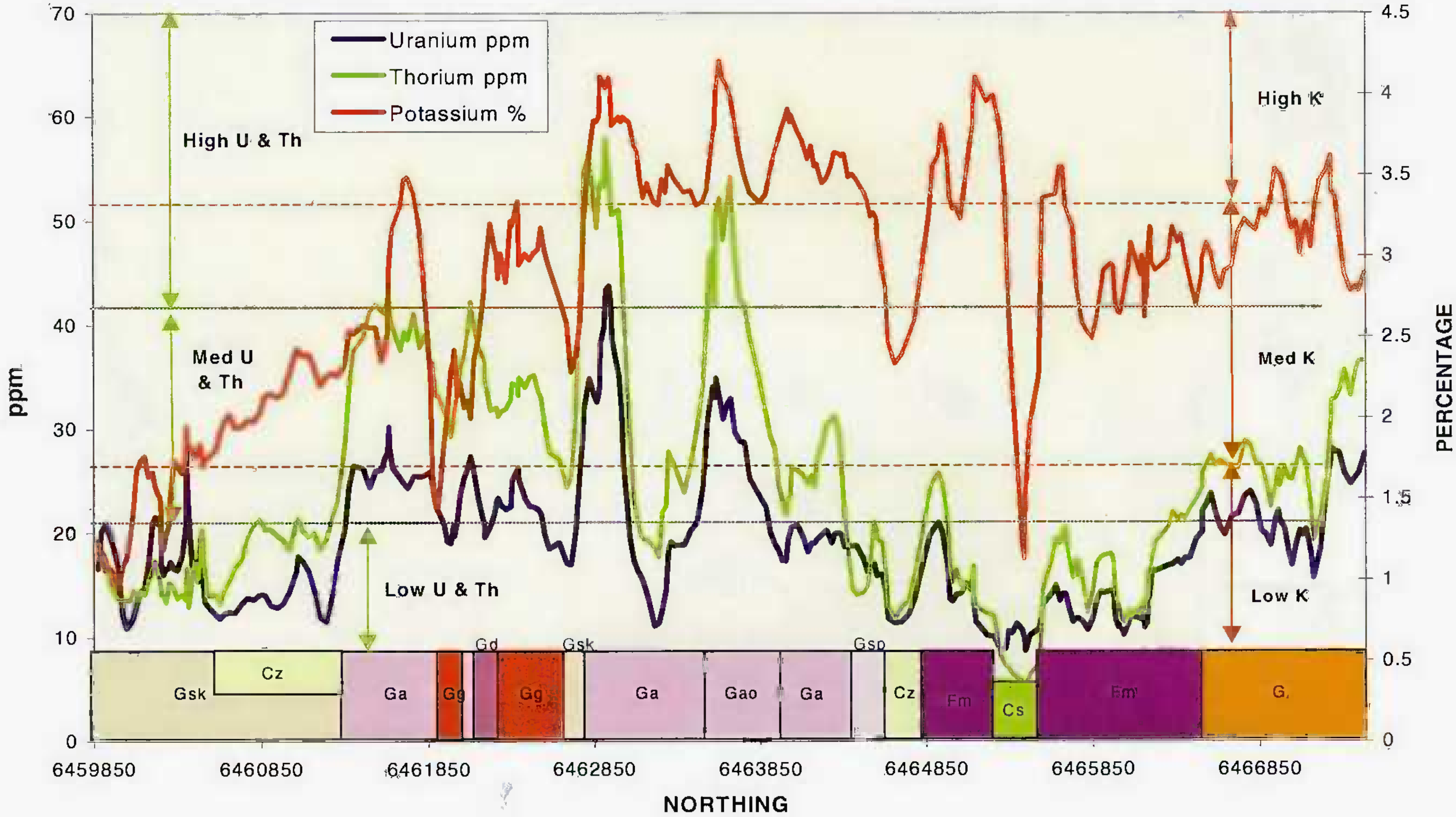

Figure 19. Graphical representation of potassium, thorium and uranium levels, smoothed, for the Ninnerie Hill traverse. Geological boundaries are derived from Laing (1995a) and the geological log recorded as part of this study.

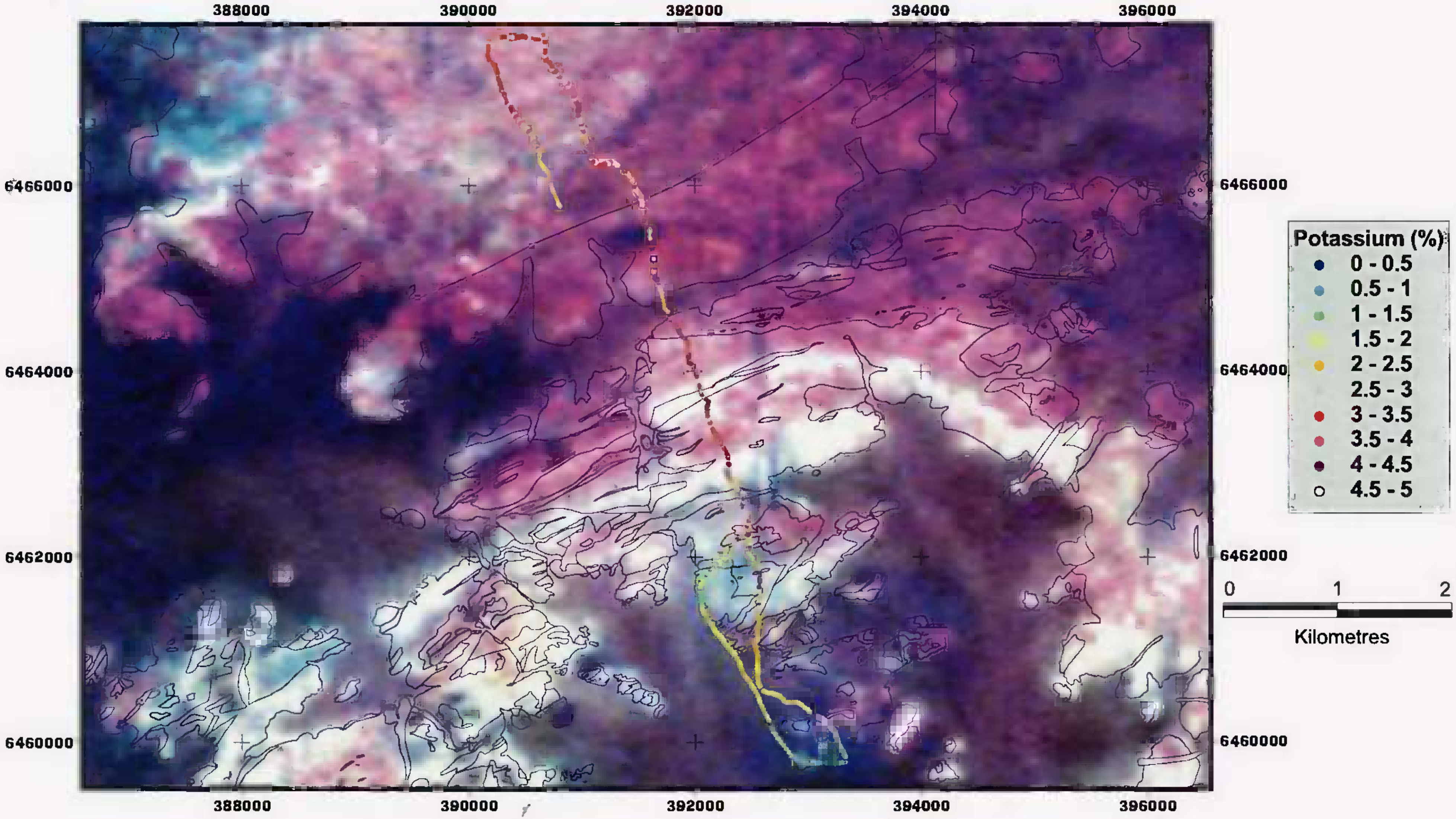

Figure 20. Spatial representation of potassium levels for the Ninnerie Hill Traverse overlain the airborne RGB image and geology outline (after Laing 1995a).

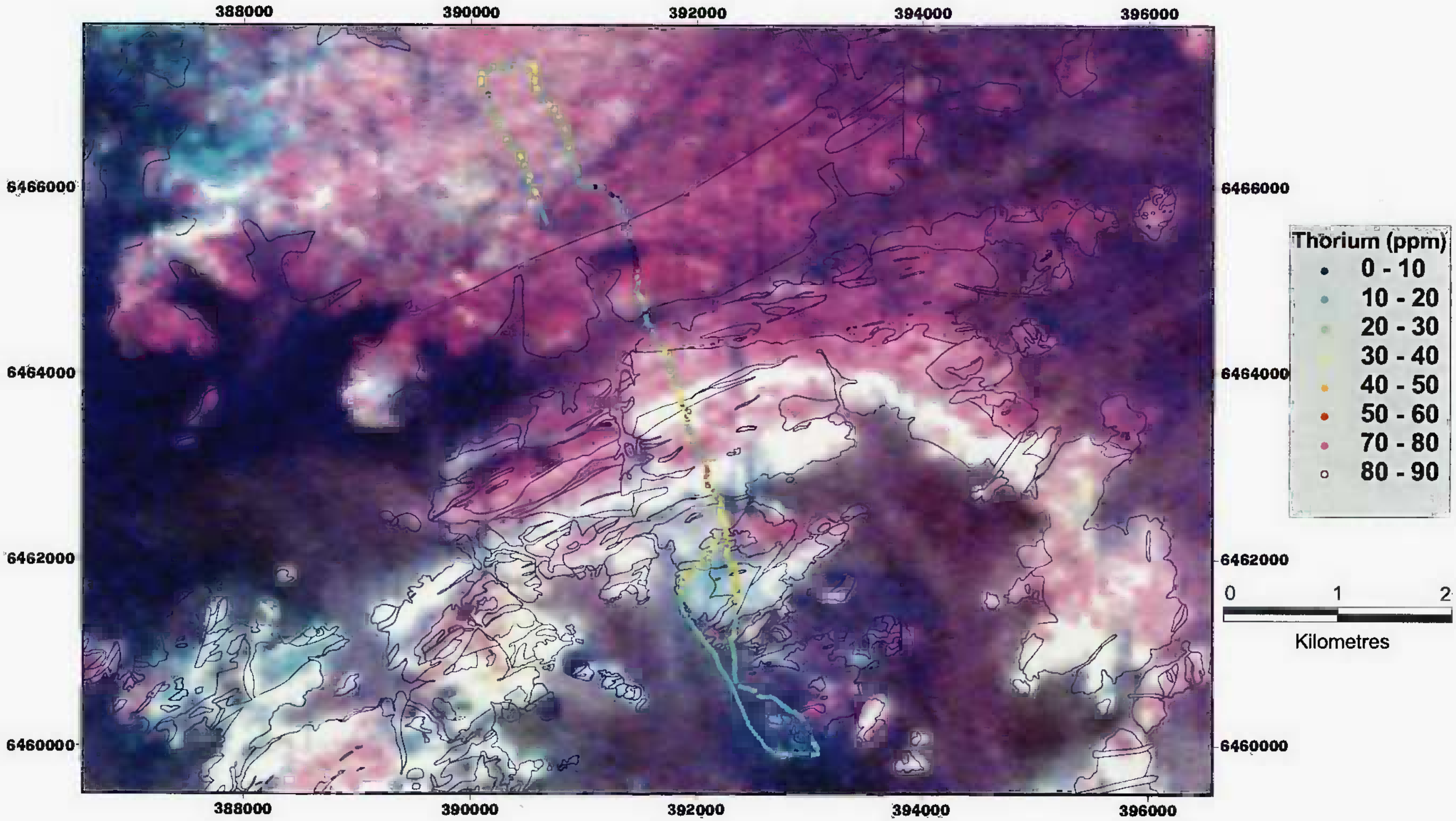

Figure 21. Spatial representation of thorium levels for the Ninnerie Hill Traverse overlain the airborne RGB image and geology outline (after Laing 1995a).

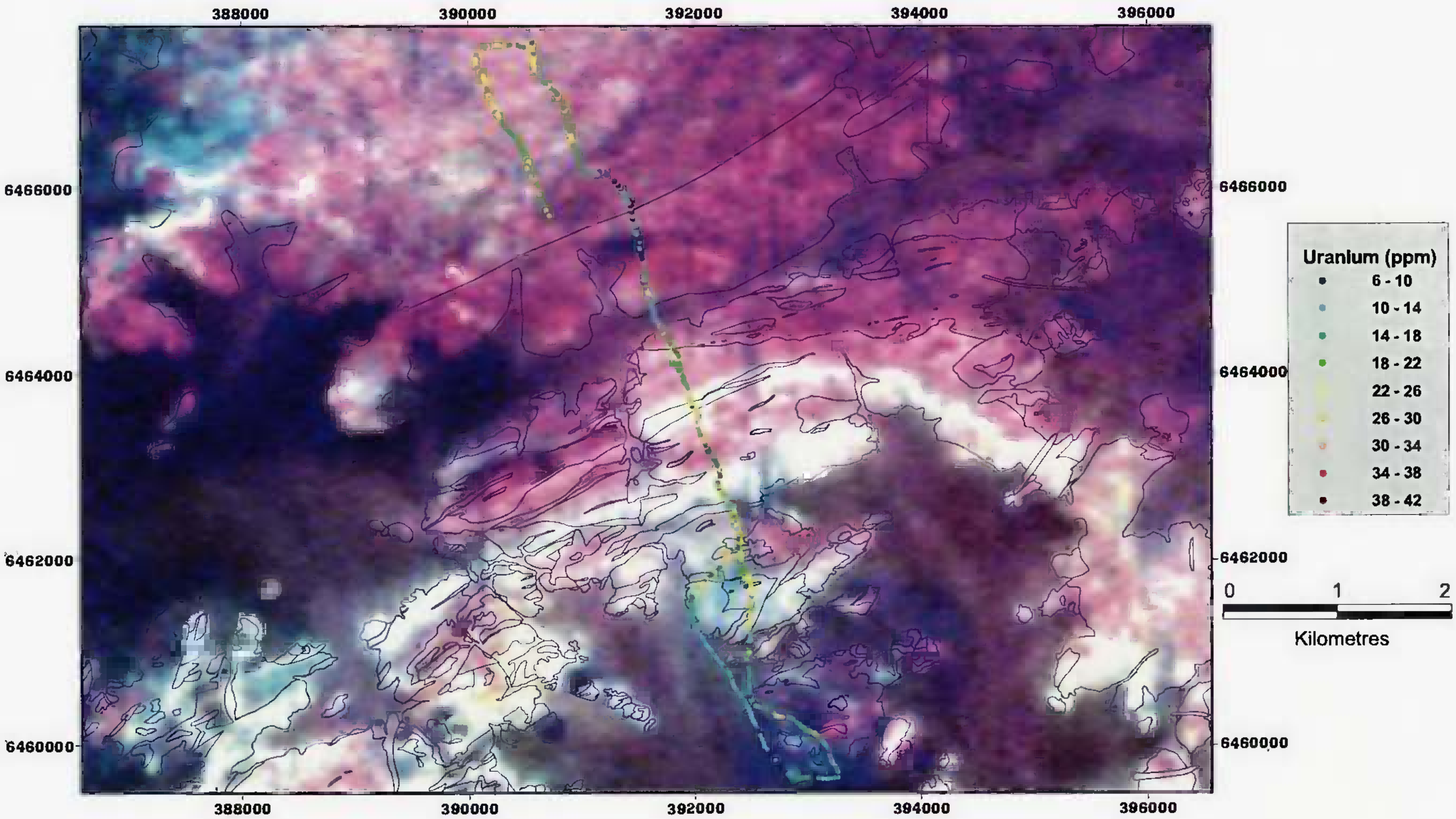

Figure 22. Spatial representation of uranium levels for the Ninnerie Hill Traverse overlain the airborne RGB image and geology outline (after Laing 1995a).

5.3 Weekeroo Inlier Traverses

Ground-based data acquisition over the Weekeroo Inlier traversed the majority of significant rock types. One traverse followed an airborne flight line in order that ground-based and airborne data could be directly compared. Final sample positions for the ground-based data are shown in Figure 6. In total 12.5 km of ground-based data was acquired resulting in 594 spectra (Appendix 3). Two sub traverses were conducted in conjunction with the main traverse, in order that all lithostratigraphic units be sampled (Figure 6).

Both profile and spatial plots where produced for the Weekeroo traverses. The non-smoothed profile for the main traverse (Figure 23) was smoothed by a five-point moving point average (Figure 24). Smoothing of the data reduced the presence of single sample anomalies enabling interpretation based on the longer wavelength anomalies.

Profiles for the northern sub traverse are shown in Figure 25 and for the southern sub traverse are shown in Figure 26. Both profiles in Figures 25 and 26 have been smoothed by the application of a five point moving average filter. When both a sub traverse and the main traverse transect a common rock unit similar radioelement concentrations are present. In the southern sub traverse (Figure 26) the high K levels associated with the psammopelitic schist recorded at approximately 6432980mN can also be detected on the main traverse at 6433800mN (Figure 26). In the vicinity of the 'Bimba Suite' an increase in Th and decrease in U can be observed on both the main and the southern sub traverses. Low K values associated with granites are consistent for both the northern sub traverse and the main traverse.

Further interpretation of the airborne data between the ground traverses was performed by posting colour coded symbols for each sample point over the RGB image for the Weekeroo area Separate plots for each of K, Th and U are shown in Figures 27 to 29 respectively.

Relative radioelement abundances for the rock types sampled were determined by combining the geological information recorded and the ground radiometric data in profile form (Figure 24). For purposes of interpretation the profile was divided up into regions based on the suite system then subdivided into major units within each suite (Figure 24). At the start of the main traverse samples were taken from Adelaidian Meta-sediments and the traverse ended sampling volcanics. However too few samples where recorded on suitable outcrop to establish a characteristic radiometric signal for these rock types.

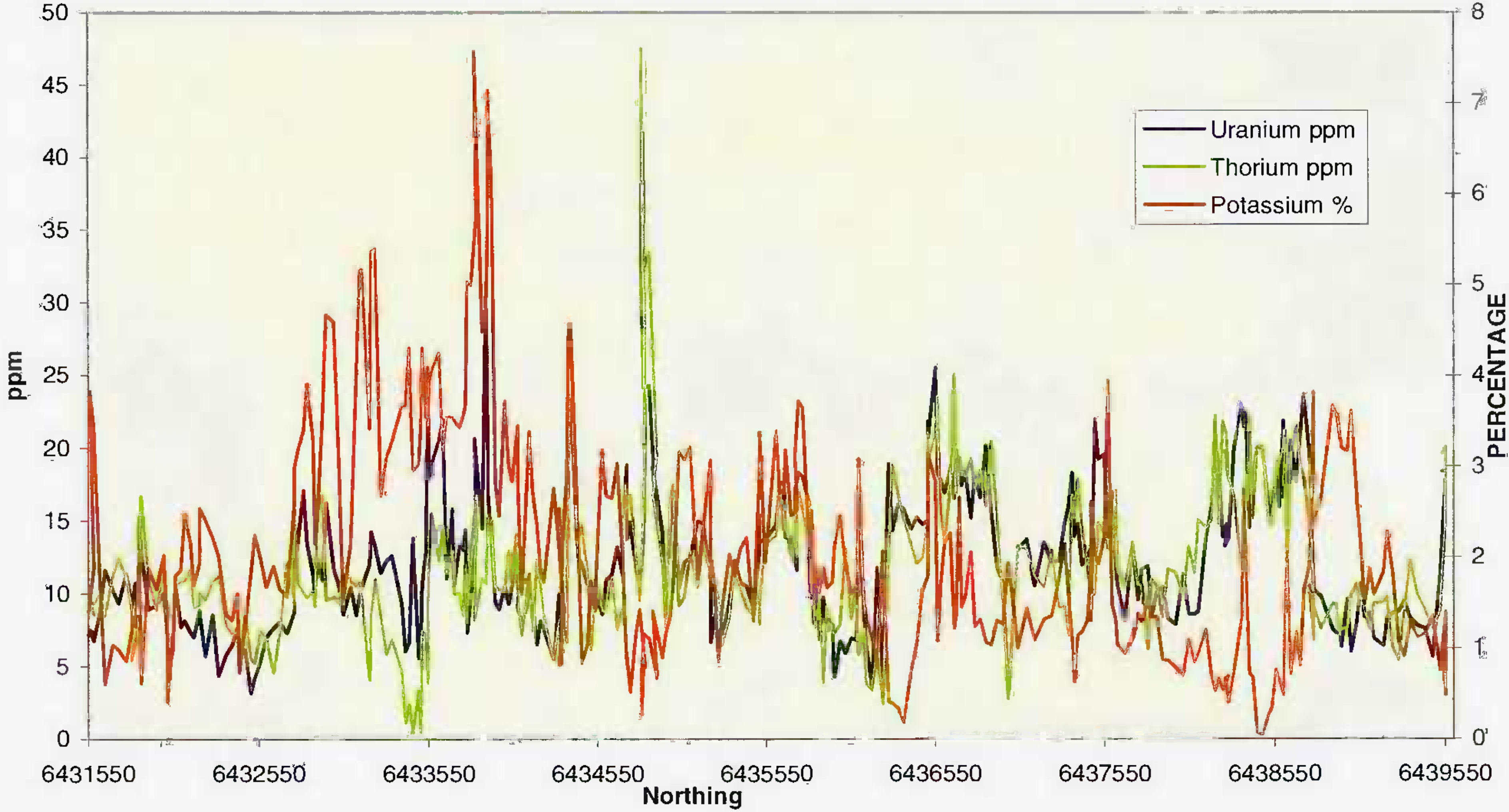

Figure 23. Graphical plots for K, Th and U values for the Weekeroo main traverse. Traverse direction is north-south. Non-smoothed data

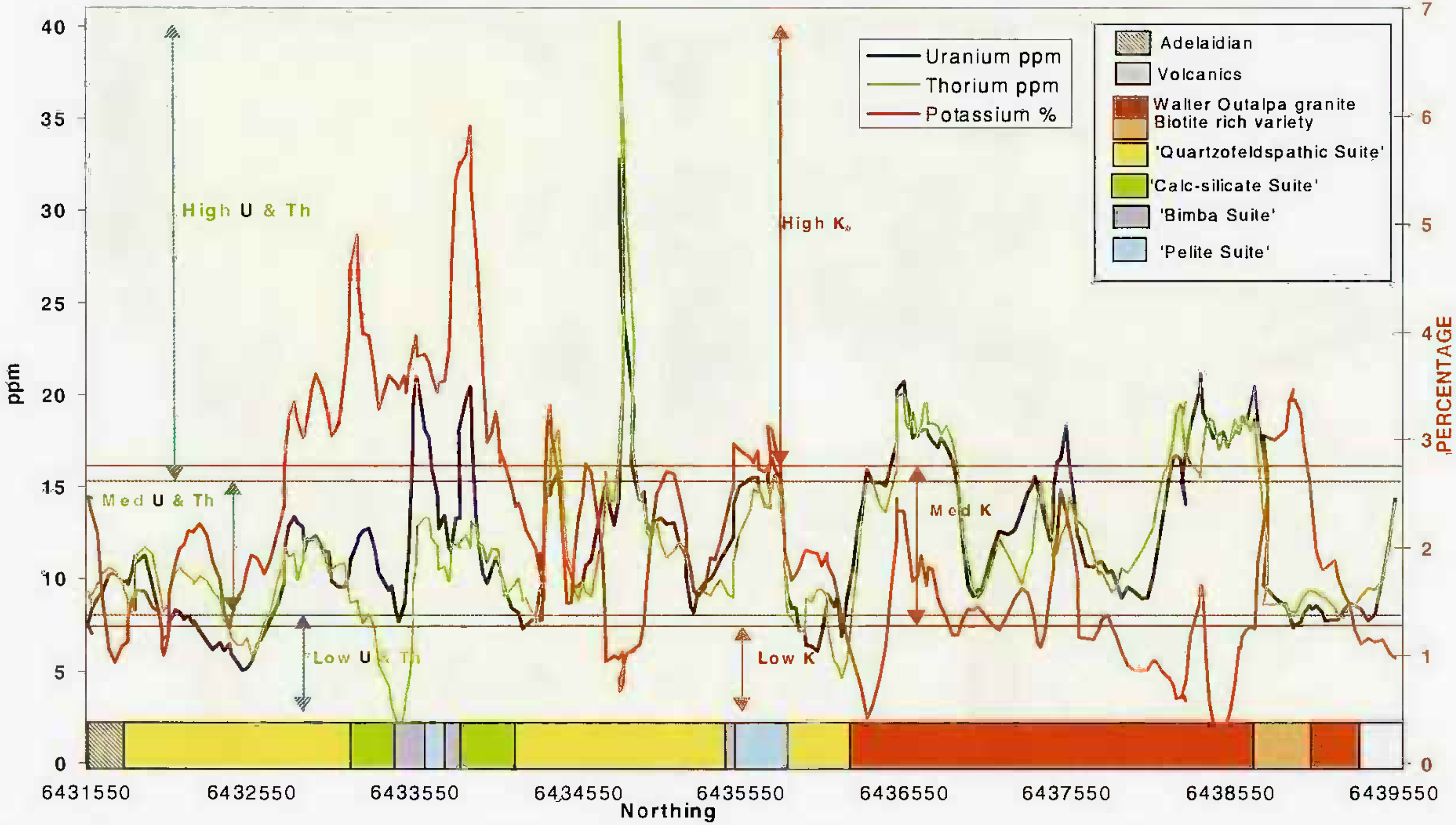

Figure 24. Graphical representation of potassium, thorium and uranium levels, smoothed, for the Weekeroo Inlier main traverse. Geological boundaries are derived from Laing (1995b), Brett (1998) Conor (pers. com.) and the geological log recorded as part of this study.

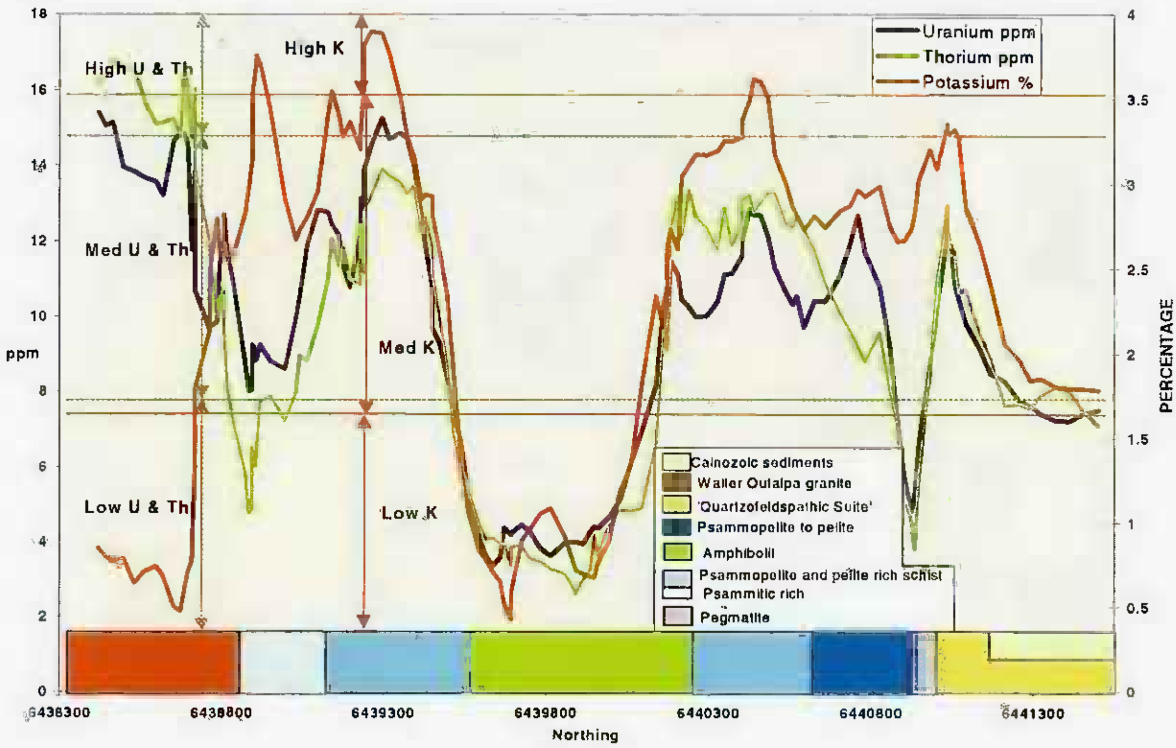

Figure 25. Graphical plots for K, Th and U values for the Weekeroo northern sub traverse. Traverse direction is north – south along line 407000mE. Smoothed data.

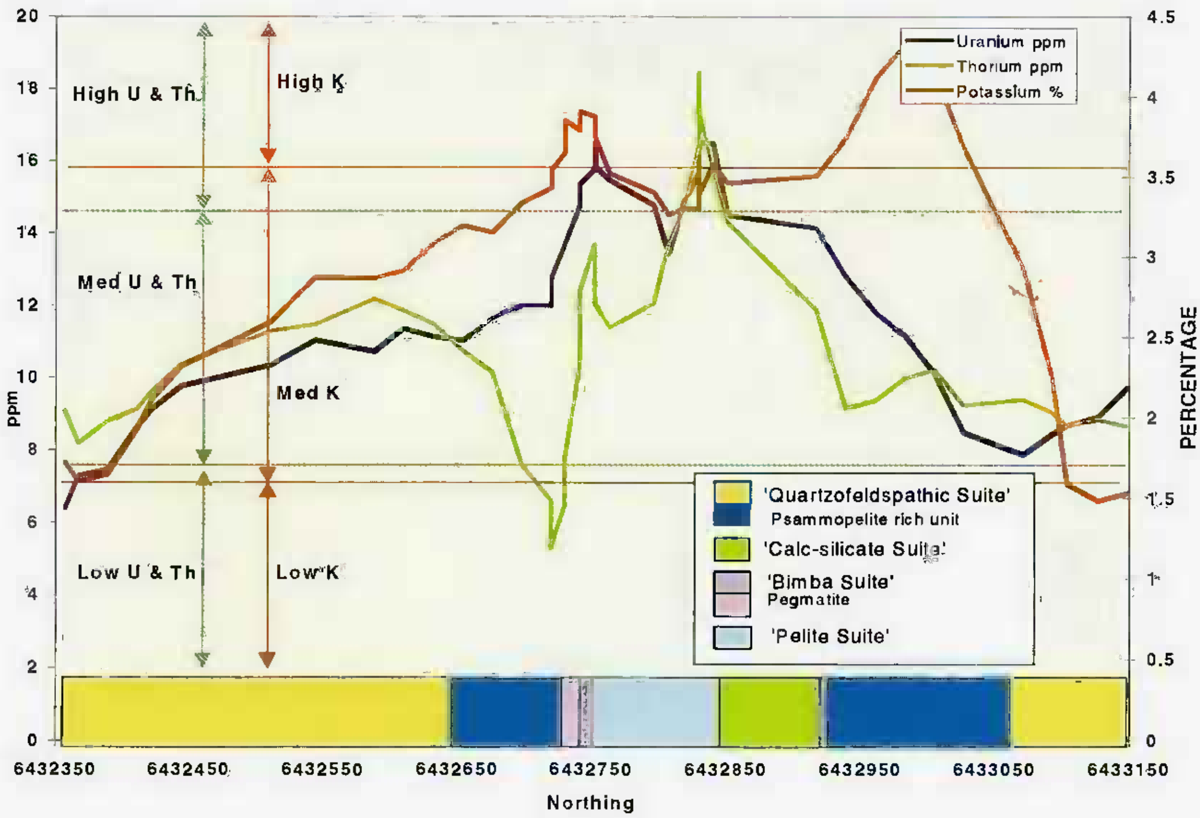

Figure 26. Graphical plots for K, Th and U values for the Weekeroo southern sub traverse. Traverse direction is northwest – southeast. Smoothed data

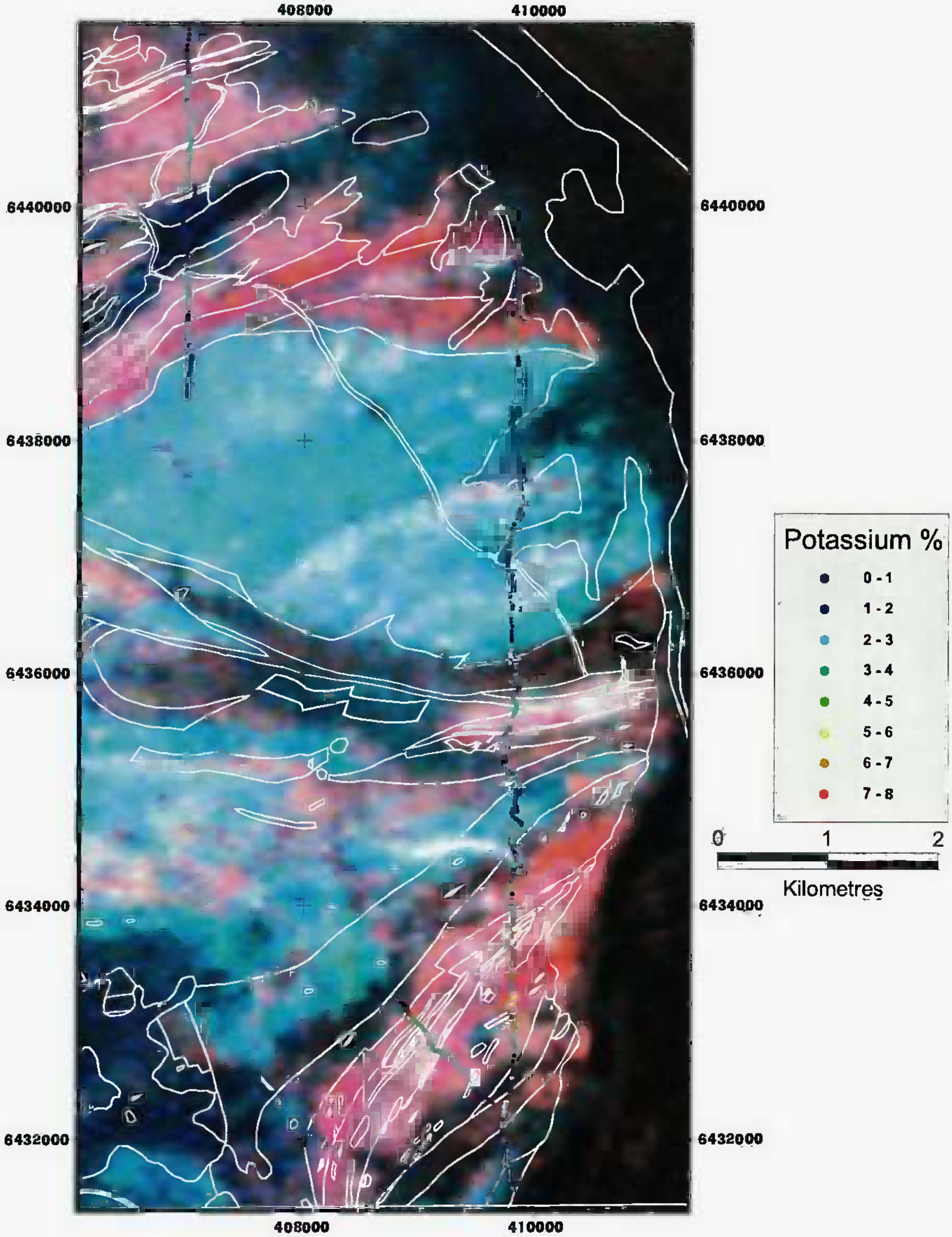

Figure 27. *Spatial representation of potassium levels for the Weekeroo Inlier traverse overlain the airborne RGB image and geology outline (after Laing 1995b).*

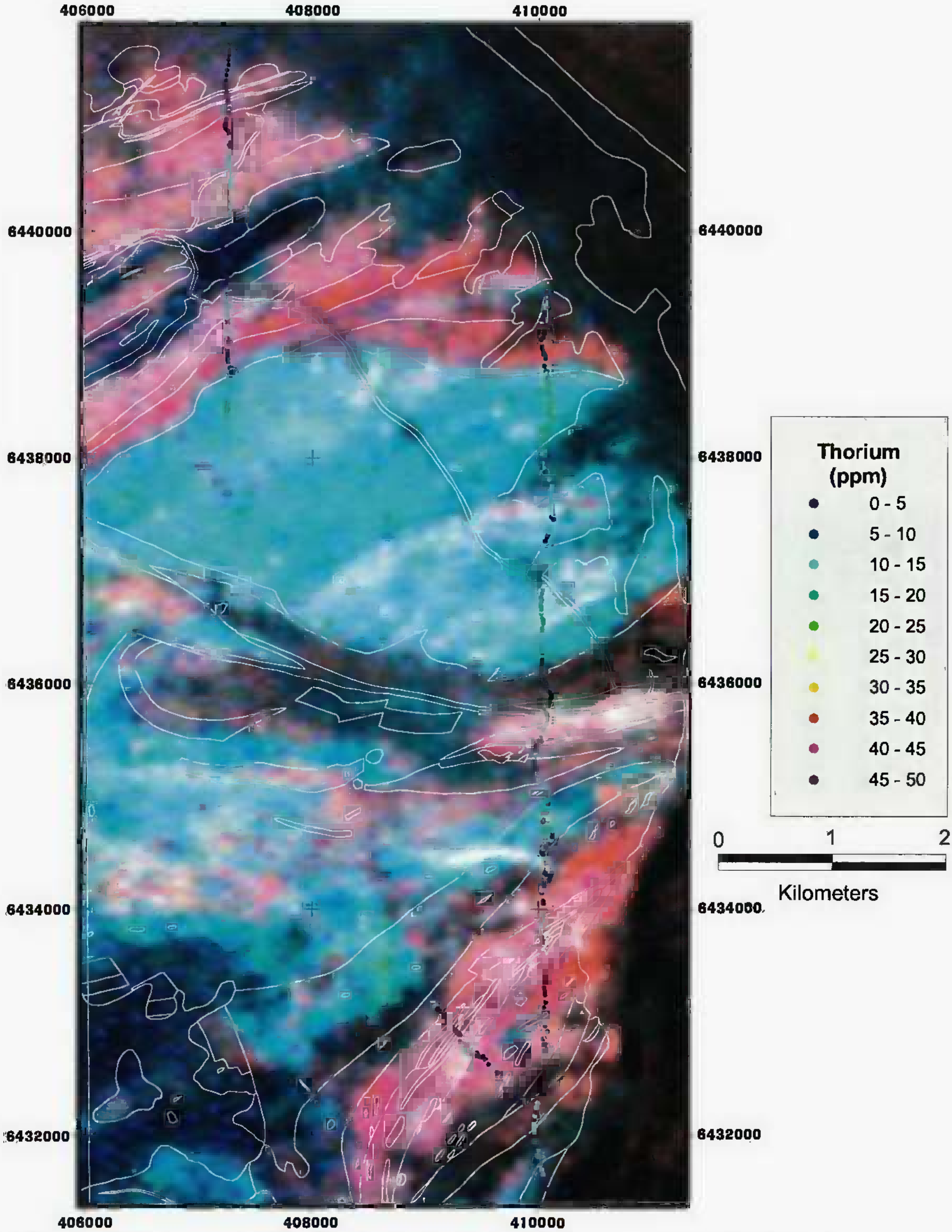

Figure 28. *Spatial representation of thorium levels for the Weekeroo Inlier traverse overlain the airborne RGB image and geology outline (after Laing 1995b)*

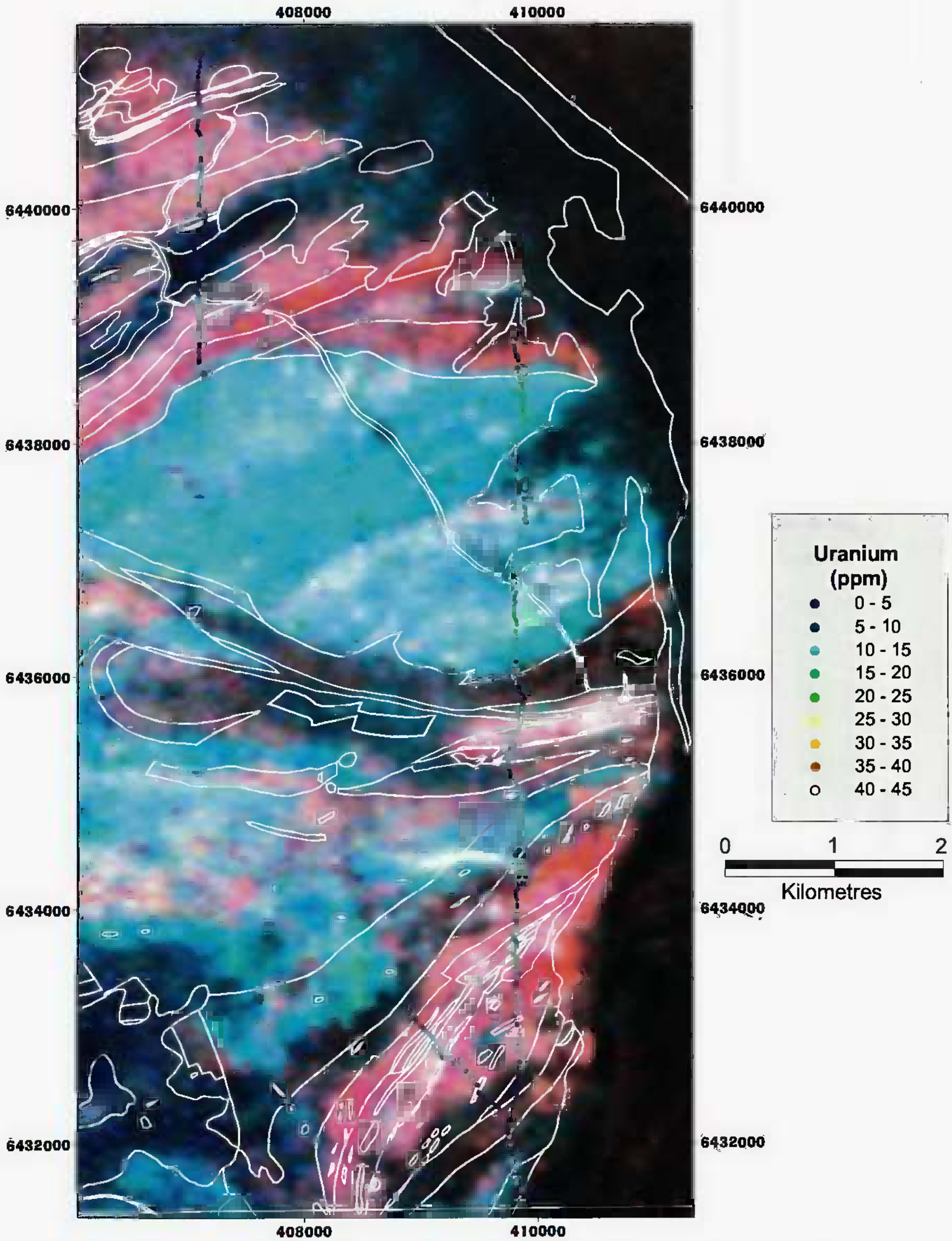

Figure 29. Spatial representation of uranium levels for the Weekeroo Inlier traverse overlain the airborne RGB image and geology outline (after Laing 1995b).

The geological compilation of Ashley *et al.* (1998) (Figure 30) better fits the radiometric data than does the earlier compilation by Laing (1995b) (Figures 27 to 29). Radiometric data supports the suggestion that the 'Composite Gneiss Suite' as mapped by Laing (1995b) may not be an individual "suite" but may form part of the 'Quartzofeldspathic Suite' (Conor, pers. com. 1999). Redefinition of lithological boundaries by Conor in Ashley *et al.* (1998) in the southern portion of the Weekeroo Inlier (Figure 30) and Brett (1998) in the northern portion of the Weekeroo Inlier were found to better match both the airborne and ground radiometric data. The differentiation into different rock types by Brett (1998) of the granitic body sampled in the north of the main traverse is confirmed by the ground-based radiometric data. The increase in mafic content near the northern margin of the Walter Outalpa granite is characterised by a rapid decrease in U and Th values simultaneous with a rise in K values at approximately 6438800mN on the main Weekeroo traverse (Figure 25).

Potassium values recorded along the main Weekeroo traverse (Figure 24) exhibit more variation than the K values for the Ninnerie Hill traverse (Figure 18). Variations in the K values are associated with lithological changes along the Weekeroo Traverse, whereas along the Ninnerie Hill traverse lithological changes are not marked by significant K abundance changes. Variation in K values along the Weekeroo Inlier traverse is due to meta-sediments, volcanics and granites being sampled whereas granites are predominantly sampled in the Ninnerie Hill traverse.

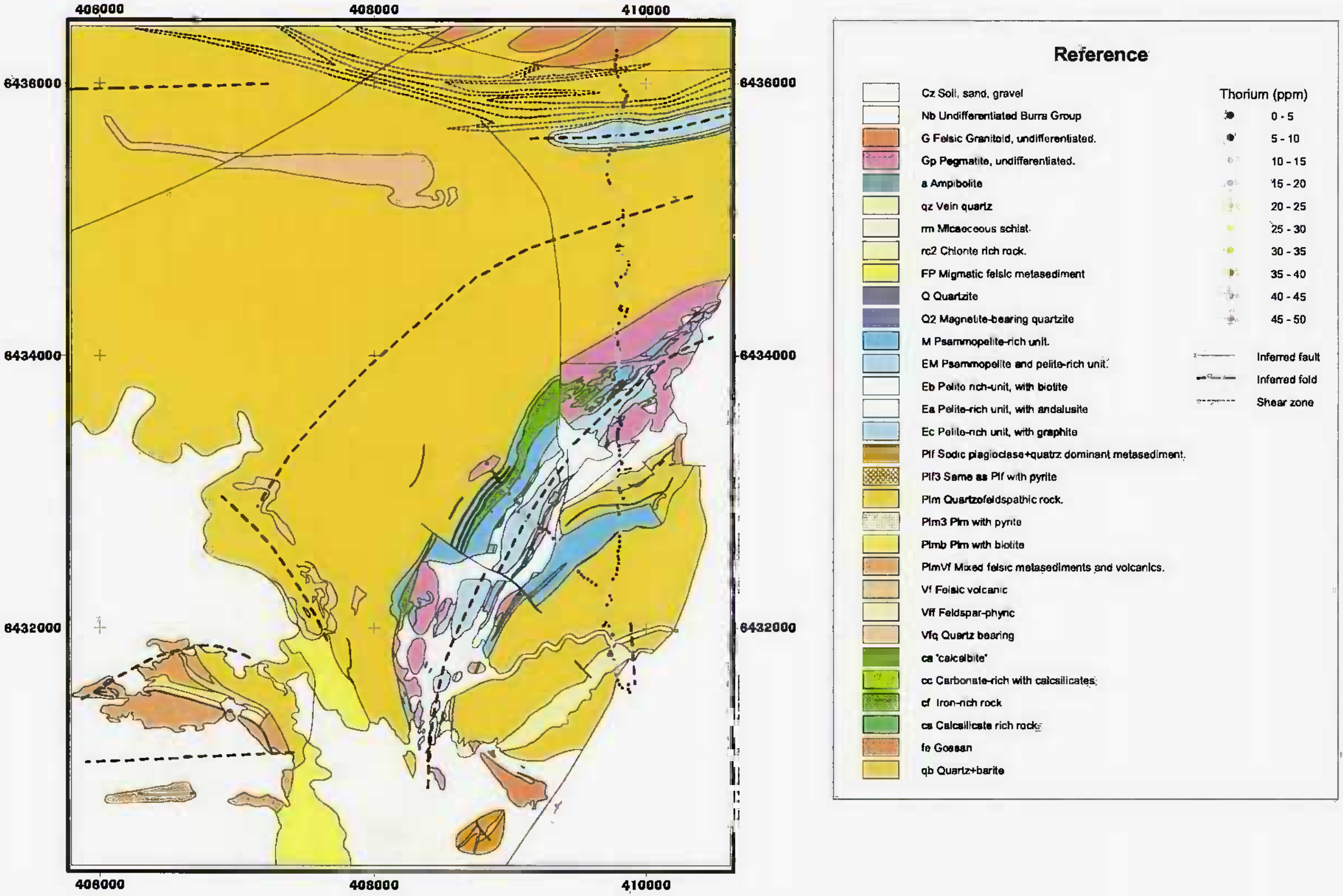

Figure 30. *Lithological mapping in the Walpuruta area, modified after Ashley et al. (1998). Position of sample localities is shown, samples are coloured according to Th concentration.*

6.0 DISCUSSION

6.1 Introduction

Two ground-based radiometric surveys were conducted in the Olay Domain, South Australia. The purpose of these surveys was to ground truth airborne radiometric data by correlation with logged lithological units and tie in with ground-based radiometric data.

6.2 Comparison Of Airborne and Ground-Based Radiometric Data

The direct comparison of airborne and ground-based radiometric data was achieved by conducting a ground-based traverse along a known flight line position. The results as previously presented show a strong correlation between the two data sets (Figures 15 – 17). The results indicate that overall a relative high in the airborne data corresponds to a relative high in the ground data although the values vary in amplitude. A possible reason for the difference in value ranges could lie in the calibration process. Calibration of the spectrometer is conducted by placing the sensor is on top of a series of concrete calibration pads and recording a five minute sample. The resultant spectrum is then used in the calculation of radioelement concentrations. The geometric correction factors used in the software are set for the sensor receiving maximum signal from the one metre square concrete block. However during field operations the sensor is raised approximately half a meter away from the source, therefore increasing the sampling area. Calculation and use of geometric correction factors for the sensor in the field operation configuration may reduce the baseline differences between the two data sets. After consultation with staff from both CSIRO (Commonwealth Scientific and Industrial Research Organisation) and Exploranium it was decided that the results obtained were the best that could be achieved within the scope of this study.

The average ground-based U concentration is approximately 12ppm and the average airborne U concentration is 5ppm. The four year difference between acquisition of the two data sets may explain the concentration level variations. The ground-based data was acquired during approximately the same month as the airborne data, in an effort to replicate the atmospheric conditions when the airborne data was acquired. The levels of atmospheric radon at both survey times are impossible to control. Atmospheric radon is detected in the uranium window and can affect U concentrations. Removal of radon from ground-based radiometric data can be done by recording a background sample over a large non-radioactive source, such as a lake. After consultation with Exploranium it was decided not to remove atmospheric radon as there are no lakes large enough in the Olary region to record a background sample from.

6.3 Ninnerie Hill Traverse

It is possible to observe diagnostic relationships for the lithologies in the Ninnerie Hill area from the combination of geological information and radioelement concentration (Figure 19). These relationships are presented in Table 3. The concentrations are in relative terms and care should be taken when extending interpretation beyond the survey area.

Table 3. *Relative radioelement concentrations for the Ninnerie Hill survey area.*

Rock type	Unit	K	Th	U
Intrusives				
Sodic Granite	Soda-Alaskite (Gsk)	Low-Moderate	Low-Moderate	Low - Moderate
Sodic Granite	Pegmatite (Alaskite) (Gsp)	Moderate–High	Low-Moderate	Low
Potassic Granite	Biotite Adamelite(Ga)	Moderate – High	Moderate-High	Low - Moderate
Potassic Granite	Biotite Granodiorite (Gg)	High	Moderate	Low - Moderate
Potassic Granite	Porphyritic Ga (Gao)	High	High	High
Intermediate	Tonalite to Diorite (Gd)	Moderate -High	Moderate	Moderate
Felsic Granitoid	Granitoid Undifferentiated (G)	Moderate–High	Moderate	Moderate
Metasediments				
Amphibolites	Calcsilicate rich (cs)	Low	Low	Low
'Quartzofeldspatic Suite'	Migmatite – Undifferentiated (Fm)	Moderate - High	Low-Moderate	Low
Surficial Sediments				
Cainozoic sediments	Soil, sand, clay. (Cz)	Low – Moderate	Low	Low

The two general types of granitoids sampled in the Ninnerie Hill area are termed sodic for albite rich granites and potassic for K-feldspar rich granites. Potassium concentrations for the sodic granites (Gsk and Gsp) are 1.5% and 2.4% respectively. The lithological units Gsk and Gsp are charcterised by low U and Th concentrations. The average U and Th concentrations range from 12-17 ppm for units.

A gradual increase in K concentration from 1.5% at approximately 6460500mN to 2.5% at approximately 6461350mN is due to the traverse sampling recent alluvial sediments, not outcrop (Figure 19). The potassium rich source material is potassic granites outcropping to the north of 6461350mN.

The potassic granites are harder to characterise due to their highly variable radioelement concentrations. The main diagnostic feature of the potassic granites is that their concentrations of K are much higher than those of the sodic granites. Uranium concentrations average 15 to 20ppm for the potassic granites, with the notable exception of the porphrytic variety of Ga (Gao) where the uranium concentrations peak at 30ppm. Thorium concentrations also are high for this porphrytic variety with peak values of 55ppm. Concentrations of all three radioelements for the lithological unit Ga are very variable which could imply that more varieties may be definable, other than the porhrytic variety. The biotite granodiorite (Gg) is characterised by high K values (3.0%), moderate Th values (35ppm) and low to moderate U vales (22-25ppm).

The undifferentiated granites (G) and migmatites (Fm) are too variable to characterise other than to say that the migmatites are low in U and Th (10-14ppm) and high in K (3.0%). The undifferentiated granites are discernable from the migmatites in that the concentration of U and Th increase to 20-25ppm. The K values (3.25%) for the granites is slightly higher than those of the migmatites. The transition from migmatites to granite can be detected as a change in colour in the RGB image for the Ninnerie Hill area (Figure 31). The intensity of the pink colour of the migmatites is decreased as the levels of U an Th increase. A linear northeast trending purple area at the contact between the granites and the migmatites reflects the position of a retrograde shear zone (Figure 31).

The amphibolites (cs) are characterised by very low concentrations of all three radioelements; K values of 1.1%, Th values of 6ppm and U values of 10ppm.

Results of this project show that positioning of geological boundaries as mapped can be improved with the use of radiometric data. Examples are observed in results for the Ninnerie Hill region. The first of these is the large high at 6463000mN (area A, Figure 31). This anomaly was detected in all three channels on both the ground-based and airborne data, but no significant lithological change was noted in the geological log. It is possible that the anomaly represents a subtle change to porphyritic biotite granite (Gao) since the radiometric signal matches a zone of Gao mapped to the north.

From both the data obtained as part of this project and the airborne survey it is possible to see that the radioelement concentration of the porphyritic biotite granite variety (Gao) is saturated in K, Th and U (area B, Figure 31). The saturated zone is represented by the colour white in the RGB image of the airborne data and the peak Th values in the ground data (Figure 31). The aerial extent of this saturated zone is greater that shown by Laing (1995a). From the results obtained a widening of the variety contacts in the north-south direction and extension to the east is possible. These results suggests that radiometric imagery and traversing will assist in depiction of certain lithological boundaries.

The soda-alaskite lithology (Gsk) is characterised by low to moderate levels of K, Th and U in the ground data that relates to a blue-grey colour on the RGB image of the airborne data (area C, Figure 31). In contrast to this is the biotite granite (Ga) to the north, which contains higher levels of K, Th and U is a white colour. The contact between these two lithologies is defined by a colour change in the RGB image does not conform to the contact position as defined by Laing (1995a). Based on the radiometric data the contact could possibly be repositioned to the north.

Geological mapping to the north of the creek, at 6465000mN has not been conducted in detail (Figure 31). Large areas are defined as either undifferentiated migmatite or granite. The airborne radiometrics and data obtained as part of this study show that refinement of the current mapping is possible. An outcrop just north of the creek that was found to be similar in outcrop and radio element concentration to the pegmatite (Gsp) south of the creek is one area that could be mapped in more detail (area D, Figure 31).

A previously unmapped calcsilicate unit was detected by the ground traverse. This unit is low in concentrations of all three radioelements and is characterised as a purple colour on the airborne RGB image (area E, Figure 31). It follows that airborne radiometric data can be used to map calcsilicate units, provided the units are of sufficient size to be distinguished from the air.

This work demonstrates that radiometric methods will provide a more concise, quicker and cheaper method of defining the transitional migmatite to granite boundary compared to conventional field mapping procedures When the main ground-based traverse crossed a retrograde shear zone at approximately 6466250mN the concentration of both Th and U increased from approximately 21ppm to 27ppm. The increase in both Th and U values can also be seen to the west where the short traverse crosses a zone of intense shearing associated with the Mt Victoria Uranium Mine. A line drawn through these two points coincides with a change in colour on the airborne RGB image (line F, Figure 31). A conclusion could be that the line as shown could mark the boundary position between the undifferentiated migmatite and granite.

6.4 Weekeroo Inlier Traverses

The same interpretation process as performed on the Ninnerie Hill data was conducted on the Weekeroo traverse data in order to produce a table of relative radioelement abundances for lithologies present along the traverses (Table 4).

In general the 'Quartzofeldspathic Suite' is characterised by low K values (approximate average 2%), reflecting the dominance of albite feldspar ($Na[AlSi_3O_8]$). Th and U are concurrent and range in the low to moderate categories (approximate average 12ppm).

Table 4. Relative radioelement abundances for lithostratigraphic units in the Eastern Weekeroo Inlier

		Radioelement	
Suite	K	Th	U
'quartzofeldspathic suite'	Low	Low-Moderate	Low-Moderate
'calcsilicate suite'	High	Low-Moderate	Low
'bimba suite'	Moderate	Moderate	Moderate
'pelite suite'	High	Moderate	Moderate
Intrusives			
Peraluminous granite	Moderate	Moderate-High	Moderate-high
Walter Outalapa granite	Low	Moderate-High	Moderate-High
Walter Outalapa granite-biotite rich variant	High	Low	Low
Amphibolite	Low	Low	Low

Transition to the 'calcsilicate suite' is characterised by an increase in K values, with some of the highest K values recorded in the traverse where peak values of 7.5% and average values of 4% were recorded. U values are generally elevated above those of Th, with average U values ranging from 12ppm to 14ppm and average Th values 7ppm to 12ppm. This result appears that which is to be expected. Regionally the 'Calcsilicate Suite' is characterised by fine grained albitic or calc-albitic rocks. The results of this survey confirm that, in the Weekeroo area, the "Calcsilicate Suite' is represented by pammopelitic (ie. Potassium-bearing mica-rich) lithologies.

The 'Bimba Suite' is distinguished by moderate U values (12ppm), moderate K values (2.25%), and moderate Th values (14ppm). Limited outcrop of the 'Bimba Suite' leads to difficulty in defining radioelment characteristics. The results appear abnormally high due to the proximity of the 'Pelite Suite'. The 'Pelite Suite' is characterised by high K values (2.8%), high U values (15ppm), and moderate to high Th values (13-15ppm).

A large anomaly exists in both the ground and airborne data at approximately 6434800mN (Figure 24). Peak high values for Th of 47.9ppm and for U of 41.7ppm and low K vales of 0.27% define the anomaly. The U and Th values are the highest concentrations along the traverse and are approximately double the average high values for the entire traverse. The anomaly is present in the airborne data and can be seen when the ground-based data is overlain (Figures 29 and 30). The geological log recorded for this study did not account for this anomaly. In relation to the same albitic unit to the south the only difference in the rocks in the anomalous region is that they are more massive. Due to positioning problems when the area was re-visited no explanation for the anomaly can be documented at present.

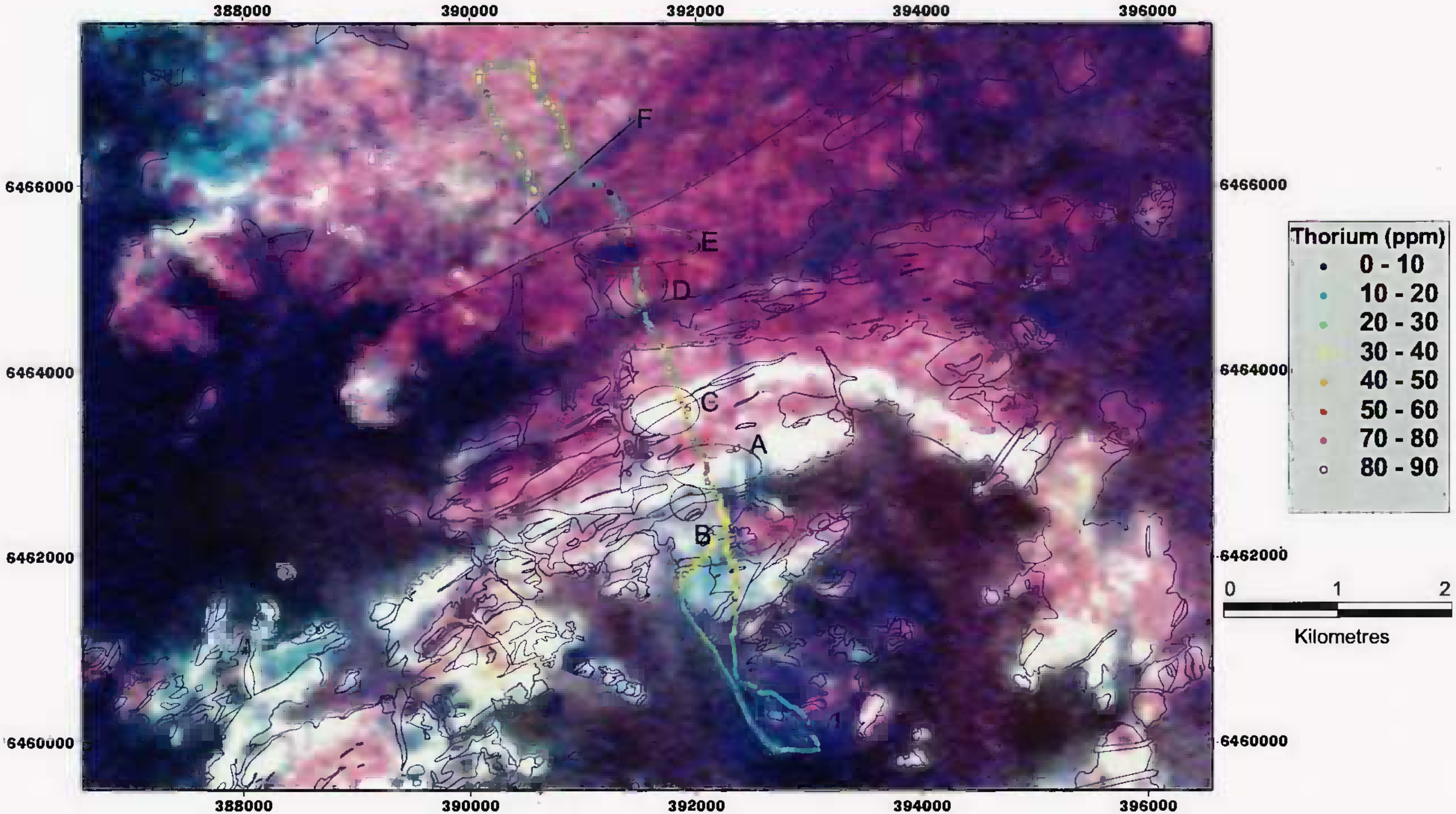

Figure 31. *Spatial representation of thorium levels for the Ninnerie Hill Traverse overlain the airborne RGB image and geology outline (after Laing 1995a). Areas A-F outline regions that this project has defined as requiring follow up work.*

7 CONCLUSIONS

Two ground-based traverses were conducted to acquire radiometric data over a series of meta-sedimentary and intrusive rocks within the Late Palaeoproterozoic Olary Domain. The correlation between airborne radiometric data, ground radiometric data and geology was a prime objective of this study. Ground-based traverses were completed at Ninnerie Hill and Weekeroo Inlier in order to assess the radiometric characteristics of meta-sediments, meta-volcanics and tectonites. The longest traverse at Weekeroo Inlier followed a flight line of the 1995 BHEI magnetic-radiometric survey in order to obtain a direct comparison between ground and airborne data sets.

A hand held portable gamma ray spectrometer (Exploranium GR320) was used for all ground-based acquisition. Position information from a global positioning system (GPS) unit was recorded concurrent with recording of radiometric data. The use of a differentially corrected GPS (DGPS) signal would have been preferred, however the configuration of the DGPS unit with the spectrometer proved to be incompatible. Calibration of the spectrometer was conducted using calibration pads owned by Primary Industries and Resources South Australia.

Two different methods of acquisition were tested, the discrete method and the continuous method. The discrete method involved sampling at a predefined spacing (approximately 40m). The continuous method recorded samples continuously at a fixed time interval. The continuous method proved to be the preferred method.

A high level of correlation between the airborne and ground-based radiometric data sets was achieved. The amplitude of anomalies for the K channel are similar for both data sets. The base line of the anomalies varied between the two data sets for both the U and Th channels. The discrepancy could be due to errors in the calibration process or due to a four year delay between acquisition of the two data sets. The high degree of correlation between the two data sets allowed geological interpretation to be extended away from the traverse locality to areas covered solely by airborne data.

Measurement of variation in radioelement concentration can identify individual geological units. Several lithologies were shown to have characteristic radioelement signatures. Another application of the radiometric method to geological mapping is the discrimination of rock types that are visually similar but differ in radioelement concentration. The radiometric data for the Ninnerie Hill area showed that the interpreted boundary between granite and migmatite was significantly incorrect. Thus this study demonstrated that important improvements can be made to geological maps with the use of radiometric data.

Commonly it is difficult, or even impossible to discriminate between sodic and potassic feldspars in the field. The Ninnerie Hill traverse showed that discrimination between sodic and potassic granites is possible using radiometric data. Moreover this discrimination can be applied to economic geology because it is possible to recognise zones of sodic or potassic alteration.

This study has proven the ability of ground-based radiometric methods to tie airborne radiometric data to the geology. Recommendations for future work are based on either applications of the data or modifications to the recording system. Modification of the recording system would involve reviewing the calibration process and incorporating a DGPS signal. Application of the data could involve investigation of anomalous areas such as the very large U and Th values recorded in the central region of the Weekeroo main traverse. Recording multiple readings on predefined outcrops could further refine lithological characterisation. The predefined outcrops could be based on either target lithologies or geochemical sample sites. Another extension of the study would be to conduct traverses over a sample locality for an extended time period to asses the noise component due to ephemeral sources present in radiometric data.

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APPENDIX 1

Discrete acquisition method data

NINNERIE HILL TRAVERSE DISCRETE DATA

Sample Number	Latitude	Longitude	Easting	Northing	Non-smoothed Data			Smoothed Data			Livetime
					U ppm	Th ppm	K %	U ppm	Th ppm	K %	
1	-31.5959	139.5260	393885	6459750	13.711	11.568	1.172				58.056
2	-31.5956	139.5258	393853	6459811	18.008	21.561	0.930	16.556	17.761	1.069	57.968
3	-31.5953	139.5257	393841	6459875	17.948	20.154	1.105	17.288	19.028	0.952	57.964
4	-31.5951	139.5257	393829	6459916	15.909	15.369	0.823	18.225	18.673	0.885	57.952
5	-31.5949	139.5255	393809	6459940	20.817	20.495	0.728	21.588	18.914	0.871	57.872
6	-31.5949	139.5253	393778	6459948	28.038	20.877	1.062	19.602	16.039	1.004	57.756
7	-31.5948	139.5253	393769	6459964	9.951	6.745	1.221	16.484	13.106	1.171	58.080
8	-31.5945	139.5253	393767	6460022	11.462	11.697	1.230	11.704	9.933	1.275	57.988
9	-31.5943	139.5250	393723	6460047	13.700	11.356	1.375	12.266	11.714	1.661	57.964
10	-31.5940	139.5249	393709	6460101	11.635	12.089	2.378	14.086	12.664	2.003	57.988
11	-31.5938	139.5247	393681	6460144	16.923	14.548	2.258	14.498	13.367	2.079	57.904
12	-31.5937	139.5246	393664	6460161	14.938	13.464	1.603	18.187	14.081	1.678	58.012
13	-31.5936	139.5245	393645	6460175	22.699	14.231	1.173	21.441	16.270	1.512	57.780
14	-31.5933	139.5242	393602	6460229	26.685	21.114	1.761	22.365	16.796	1.553	57.748
15	-31.5933	139.5241	393579	6460229	17.710	15.044	1.725	19.439	15.515	1.564	57.924
16	-31.5932	139.5241	393580	6460251	13.921	10.387	1.205	16.452	13.330	1.278	58.004
17	-31.5929	139.5238	393538	6460309	17.725	14.559	0.904	16.215	13.729	1.464	57.872
18	-31.5928	139.5234	393476	6460336	17.000	16.240	2.282	15.278	14.977	1.601	57.916
19	-31.5928	139.5233	393458	6460336	11.111	14.133	1.616	19.926	19.521	1.793	57.996
20	-31.5926	139.5231	393423	6460358	31.667	28.190	1.480	18.952	18.610	1.453	57.700
21	-31.5925	139.5228	393377	6460390	14.079	13.507	1.262	25.647	21.073	1.367	58.024
22	-31.5925	139.5226	393333	6460383	31.197	21.522	1.359	22.548	15.378	1.624	57.712
23	-31.5922	139.5224	393307	6460434	22.370	11.105	2.249	38.909	13.982	2.251	57.872
24	-31.5923	139.5221	393263	6460427	63.161	9.317	3.146	32.653	10.513	2.310	57.348
25	-31.5921	139.5220	393244	6460449	12.429	11.116	1.536	30.416	12.141	2.324	57.972
26	-31.5921	139.5216	393187	6460459	15.659	15.990	2.291	15.698	16.972	1.804	57.916
27	-31.5920	139.5214	393156	6460477	19.007	23.809	1.584	17.543	19.630	1.900	57.868
28	-31.5920	139.5212	393113	6460474	17.962	19.092	1.827	16.860	20.195	1.727	57.908
29	-31.5920	139.5211	393104	6460480	13.612	17.684	1.770				57.980

APPENDIX 2

Ninnerie Hill Traverse data

NINNERIE HILL TRAVERSE DATA

Sample Number	Latitude	Longitude	Easting	Northing	Non-smoothed Data			Smoothed Data			Livetime
					U ppm	Th ppm	K %	U ppm	Th ppm	K%	
1	-31.5956	139.5259	393866	6459818	14.836	13.940	1.133				29.00
2	-31.5954	139.5258	393851	6459846	17.884	20.742	1.392				28.96
3	-31.5953	139.5257	393837	6459876	15.726	19.632	1.105	16.597	17.711	1.240	28.94
4	-31.5952	139.5256	393824	6459895	17.490	13.686	1.167	20.185	18.326	1.122	28.96
5	-31.5950	139.5255	393807	6459920	17.051	20.553	1.400	20.807	17.364	1.052	28.98
6	-31.5949	139.5255	393795	6459944	32.772	17.015	0.545	19.808	15.212	1.064	28.90
7	-31.5948	139.5254	393788	6459970	20.996	15.933	1.046	18.387	14.252	1.029	28.94
8	-31.5946	139.5253	393778	6459994	10.731	8.872	1.161	16.699	13.626	0.927	29.04
9	-31.5945	139.5253	393773	6460020	10.384	8.885	0.995	12.151	13.638	1.084	29.05
10	-31.5944	139.5253	393763	6460042	8.613	17.423	0.886	10.880	13.564	1.125	29.02
11	-31.5942	139.5252	393759	6460066	10.031	17.077	1.334	11.398	13.632	1.262	29.01
12	-31.5941	139.5252	393753	6460084	14.642	15.562	1.247	11.897	14.544	1.413	28.97
13	-31.5940	139.5251	393735	6460106	13.318	9.215	1.849	13.222	14.029	1.676	29.04
14	-31.5939	139.5250	393715	6460126	12.879	13.444	1.749	14.476	14.429	1.731	29.00
15	-31.5938	139.5248	393697	6460152	15.243	14.846	2.203	14.602	14.160	1.759	28.96
16	-31.5936	139.5247	393677	6460177	16.300	19.079	1.609	17.192	15.456	1.635	28.99
17	-31.5935	139.5246	393658	6460199	15.271	14.216	1.387	20.891	16.715	1.663	28.95
18	-31.5934	139.5244	393634	6460214	26.269	15.697	1.227	21.552	17.318	1.576	28.89
19	-31.5933	139.5243	393613	6460232	31.371	19.739	1.890	21.978	15.496	1.519	28.85
20	-31.5933	139.5241	393584	6460243	18.549	17.860	1.768	21.528	15.386	1.514	28.93
21	-31.5932	139.5240	393565	6460252	18.429	9.970	1.323	19.175	14.725	1.456	28.91
22	-31.5932	139.5240	393559	6460248	13.025	13.665	1.362	16.945	14.122	1.173	28.95
23	-31.5932	139.5238	393537	6460263	14.502	12.392	0.937	16.025	14.011	1.186	28.98
24	-31.5931	139.5237	393515	6460280	20.219	16.723	0.477	15.556	14.120	1.283	28.94
25	-31.5930	139.5236	393494	6460296	13.949	17.304	1.831	16.644	15.216	1.331	28.93
26	-31.5929	139.5234	393475	6460305	16.085	10.516	1.808	17.256	15.177	1.506	28.96
27	-31.5928	139.5233	393458	6460327	18.463	19.145	1.604	16.608	14.590	1.729	28.95
28	-31.5927	139.5232	393430	6460346	17.565	12.196	1.808	16.447	13.758	1.703	28.96
29	-31.5925	139.5229	393394	6460376	16.979	13.788	1.595	16.194	14.045	1.704	28.98
30	-31.5924	139.5228	393367	6460396	13.144	13.144	1.700	22.110	12.309	1.803	29.00
31	-31.5924	139.5226	393334	6460406	14.817	11.954	1.811	24.805	13.196	1.850	28.97
32	-31.5924	139.5224	393307	6460403	48.043	10.463	2.100	26.047	12.910	1.848	28.74
33	-31.5924	139.5222	393276	6460402	31.043	16.629	2.045	28.833	14.741	1.938	28.87
34	-31.5924	139.5220	393244	6460400	23.186	12.362	1.583	30.574	16.706	1.874	28.96
35	-31.5924	139.5219	393227	6460402	27.074	22.299	2.152	23.377	16.743	1.793	28.88
36	-31.5923	139.5217	393205	6460415	23.525	21.778	1.488	19.497	15.352	1.785	28.90
37	-31.5922	139.5217	393195	6460435	12.056	10.646	1.697	19.179	17.814	1.864	29.00
38	-31.5921	139.5216	393179	6460451	11.644	9.676	2.006	16.827	17.400	1.749	29.02
39	-31.5920	139.5214	393159	6460470	21.598	24.672	1.978	15.333	15.666	1.773	28.90
40	-31.5919	139.5213	393133	6460482	15.311	20.226	1.575	16.120	19.357	1.831	28.99
41	-31.5919	139.5211	393107	6460493	16.056	13.107	1.610	16.718	20.389	1.760	28.97
42	-31.5918	139.5210	393083	6460502	15.993	29.103	1.986	14.762	18.631	1.695	28.98
43	-31.5918	139.5208	393050	6460503	14.635	14.835	1.652	14.252	16.962	1.742	28.96
44	-31.5918	139.5206	393019	6460513	11.814	15.881	1.649	13.348	16.735	1.733	29.02
45	-31.5917	139.5204	392991	6460524	12.765	11.881	1.814	13.098	13.985	1.741	29.03
46	-31.5914	139.5201	392948	6460580	11.535	11.976	1.565	12.103	14.039	1.796	29.03
47	-31.5913	139.5201	392940	6460601	14.742	15.350	2.026	11.819	13.192	1.898	29.04
48	-31.5911	139.5200	392930	6460628	9.661	15.106	1.923	12.286	14.515	1.967	29.00
49	-31.5910	139.5200	392928	6460659	10.390	11.646	2.160	12.412	15.399	2.018	29.04

50	-31.5908	139.5200	392926	6460690	15.104	18.498	2.161	12.338	16.654	1.932	28.98
51	-31.5906	139.5200	392929	6460731	12.162	16.394	1.819	13.249	17.453	1.940	29.01
52	-31.5904	139.5200	392925	6460767	14.375	21.627	1.596	13.788	19.653	1.979	29.00
53	-31.5902	139.5200	392925	6460801	14.213	19.097	1.964	13.588	20.721	1.967	28.97
54	-31.5900	139.5200	392924	6460837	13.085	22.649	2.357	14.091	21.363	2.022	28.99
55	-31.5898	139.5200	392923	6460870	14.107	23.836	2.100	14.078	20.328	2.132	28.97
56	-31.5897	139.5200	392923	6460903	14.676	19.607	2.095	13.104	20.378	2.145	28.95
57	-31.5894	139.5199	392914	6460942	14.310	16.450	2.145	12.839	19.774	2.120	29.04
58	-31.5892	139.5199	392904	6460978	9.340	19.347	2.029	13.236	19.420	2.141	28.98
59	-31.5890	139.5198	392894	6461016	11.764	19.633	2.233	14.365	18.329	2.266	29.00
60	-31.5888	139.5198	392889	6461058	16.090	22.066	2.203	16.390	21.093	2.416	28.98
61	-31.5888	139.5200	392921	6461069	20.323	14.149	2.721	17.796	21.371	2.413	28.90
62	-31.5886	139.5200	392922	6461094	24.432	30.272	2.897	17.344	20.313	2.376	28.89
63	-31.5884	139.5200	392920	6461130	16.371	20.736	2.011	16.382	19.681	2.391	28.94
64	-31.5882	139.5200	392925	6461166	9.503	14.342	2.050	14.482	20.009	2.298	29.03
65	-31.5880	139.5200	392930	6461202	11.279	18.908	2.275	11.853	18.367	2.191	28.99
66	-31.5878	139.5201	392939	6461239	10.827	15.787	2.259	11.443	19.576	2.254	29.04
67	-31.5876	139.5201	392941	6461275	11.285	22.064	2.359	14.165	21.566	2.269	28.98
68	-31.5875	139.5202	392947	6461305	14.319	26.780	2.329	17.439	23.185	2.251	28.91
69	-31.5872	139.5200	392916	6461349	23.116	24.292	2.122	20.354	28.342	2.327	28.87
70	-31.5871	139.5200	392916	6461374	27.647	26.999	2.187	24.536	33.984	2.531	28.85
71	-31.5870	139.5200	392922	6461400	25.404	41.574	2.637	26.452	37.480	2.517	28.78
72	-31.5866	139.5201	392937	6461460	32.194	50.275	3.381	26.223	38.822	2.571	28.73
73	-31.5864	139.5202	392945	6461499	23.897	44.261	2.256	24.384	41.315	2.555	28.82
74	-31.5863	139.5202	392952	6461532	21.970	31.003	2.393	25.984	42.009	2.556	28.88
75	-31.5861	139.5202	392947	6461569	18.455	39.462	2.108	26.077	41.379	2.342	28.88
76	-31.5859	139.5202	392944	6461591	33.401	45.042	2.641	27.226	41.120	2.408	28.73
77	-31.5858	139.5202	392949	6461613	32.662	47.129	2.310	27.753	42.465	2.526	28.76
78	-31.5859	139.5201	392932	6461605	29.641	42.965	2.588	30.238	43.666	2.921	28.78
79	-31.5858	139.5201	392939	6461621	24.605	37.726	2.983	27.900	40.634	3.009	28.80
80	-31.5857	139.5201	392940	6461635	30.881	45.467	4.082	26.269	39.816	3.172	28.74
81	-31.5854	139.5202	392949	6461683	21.709	29.881	3.082	25.257	37.562	3.302	28.81
82	-31.5853	139.5202	392952	6461704	24.511	43.041	3.125	24.743	39.325	3.470	28.79
83	-31.5852	139.5202	392945	6461727	24.578	31.694	3.237	24.297	38.588	3.482	28.82
84	-31.5850	139.5202	392947	6461765	22.035	46.542	3.823	25.519	41.084	3.382	28.79
85	-31.5848	139.5202	392944	6461798	28.649	41.781	4.144	25.421	37.848	3.171	28.73
86	-31.5846	139.5202	392941	6461832	27.822	42.365	2.579	25.240	37.977	2.804	28.78
87	-31.5845	139.5201	392928	6461864	24.018	26.856	2.070	25.899	36.234	2.241	28.83
88	-31.5843	139.5201	392927	6461895	23.674	32.343	1.405	24.485	36.430	1.655	28.82
89	-31.5844	139.5198	392878	6461875	25.334	37.827	1.009	22.643	33.198	1.455	28.87
90	-31.5842	139.5197	392870	6461911	21.575	42.760	1.214	22.088	33.250	1.448	28.84
91	-31.5840	139.5197	392865	6461945	18.615	26.203	1.575	21.243	32.787	1.755	28.94
92	-31.5839	139.5196	392848	6461964	21.241	27.114	2.037	19.218	30.879	2.017	28.86
93	-31.5838	139.5195	392840	6461985	19.450	30.032	2.942	19.026	29.247	2.289	28.87
94	-31.5837	139.5195	392831	6462000	15.208	28.288	2.318	20.631	30.727	2.344	28.88
95	-31.5837	139.5194	392826	6462008	20.618	34.600	2.575	19.719	31.716	2.417	28.86
96	-31.5836	139.5195	392829	6462024	26.641	33.601	1.851	21.275	33.520	2.133	28.87
97	-31.5835	139.5195	392829	6462042	16.681	32.060	2.402	23.688	35.783	2.215	28.90
98	-31.5834	139.5196	392845	6462064	27.229	39.054	1.519	25.339	37.127	2.060	28.84
99	-31.5833	139.5195	392840	6462085	27.273	39.601	2.728	26.154	39.219	2.105	28.75
100	-31.5831	139.5196	392849	6462105	28.873	41.320	1.802	27.390	42.198	1.994	28.81
101	-31.5830	139.5195	392840	6462125	30.717	44.062	2.076	24.759	40.290	2.377	28.81
102	-31.5829	139.5195	392832	6462153	22.860	46.953	1.846	22.650	39.390	2.487	28.81

103	-31.5827	139.5195	392827	6462191	14.071	29.515	3.435	20.748	36.611	2.790	28.96
104	-31.5825	139.5194	392820	6462224	16.731	35.099	3.276	17.131	31.065	3.089	28.86
105	-31.5827	139.5194	392815	6462188	19.360	27.428	3.315	15.708	26.149	3.442	28.91
106	-31.5828	139.5190	392761	6462173	12.632	16.332	3.572	16.174	25.759	3.491	28.98
107	-31.5828	139.5189	392737	6462168	15.744	22.370	3.613	18.375	25.491	3.469	28.88
108	-31.5828	139.5188	392720	6462165	16.402	27.565	3.680	19.873	25.298	3.432	28.87
109	-31.5829	139.5187	392706	6462148	27.735	33.760	3.164	22.802	29.499	3.204	28.79
110	-31.5830	139.5186	392692	6462133	26.853	26.463	3.130	24.910	32.332	3.051	28.80
111	-31.5831	139.5185	392677	6462118	27.277	37.335	2.435	26.391	33.355	2.861	28.83
112	-31.5832	139.5185	392675	6462094	26.285	36.536	2.848	26.411	33.389	2.687	28.76
113	-31.5833	139.5184	392668	6462070	23.808	32.680	2.727	24.538	35.242	2.581	28.88
114	-31.5835	139.5184	392663	6462046	27.834	33.931	2.296	23.128	35.146	2.425	28.76
115	-31.5838	139.5181	392617	6461984	17.488	35.729	2.598	22.667	36.578	2.216	28.85
116	-31.5839	139.5179	392591	6461955	20.228	36.856	1.656	20.355	32.569	2.294	28.88
117	-31.5841	139.5177	392560	6461933	23.976	43.694	1.805	17.716	30.144	2.385	28.80
118	-31.5842	139.5176	392535	6461911	12.251	12.637	3.117	17.902	30.321	2.252	29.01
119	-31.5842	139.5175	392526	6461904	14.639	21.806	2.747	17.114	29.000	2.372	28.93
120	-31.5843	139.5174	392507	6461896	18.415	36.612	1.935	18.256	29.819	2.539	28.84
121	-31.5843	139.5173	392488	6461882	16.288	30.251	2.257	22.681	39.809	2.355	28.89
122	-31.5844	139.5171	392467	6461865	29.685	47.790	2.639	25.499	44.305	2.117	28.74
123	-31.5845	139.5171	392453	6461844	34.380	62.587	2.199	26.783	45.841	1.959	28.71
124	-31.5847	139.5170	392441	6461818	28.728	44.282	1.555	29.685	48.278	1.840	28.76
125	-31.5847	139.5168	392410	6461805	24.835	44.294	1.143	29.567	46.597	1.532	28.81
126	-31.5849	139.5166	392384	6461779	30.797	42.435	1.666	27.167	42.412	1.400	28.80
127	-31.5851	139.5165	392362	6461740	29.097	39.388	1.096	25.641	40.272	1.435	28.80
128	-31.5853	139.5163	392341	6461706	22.378	41.661	1.539	24.901	37.299	1.574	28.84
129	-31.5855	139.5162	392320	6461671	21.096	33.581	1.732	22.005	35.505	1.520	28.92
130	-31.5857	139.5161	392308	6461631	21.138	29.430	1.840	18.998	32.526	1.566	28.89
131	-31.5859	139.5161	392309	6461587	16.317	33.465	1.391	18.154	29.965	1.542	28.96
132	-31.5861	139.5162	392314	6461549	14.062	24.492	1.328	16.702	29.166	1.493	29.00
133	-31.5863	139.5162	392319	6461514	18.159	28.858	1.420	15.830	27.202	1.407	28.93
134	-31.5865	139.5162	392329	6461481	13.832	29.587	1.487	16.077	25.398	1.431	28.92
135	-31.5867	139.5163	392331	6461443	16.781	19.607	1.409	16.678	24.997	1.492	28.88
136	-31.5869	139.5163	392332	6461401	17.553	24.448	1.512	15.704	23.853	1.613	28.96
137	-31.5872	139.5163	392344	6461359	17.067	22.484	1.632	15.970	21.898	1.737	28.89
138	-31.5873	139.5165	392376	6461324	13.285	23.139	2.027	15.249	22.434	1.762	28.96
139	-31.5876	139.5167	392402	6461286	15.166	19.813	2.108	14.689	21.036	1.880	28.96
140	-31.5878	139.5168	392426	6461245	13.174	22.287	1.530	13.804	20.067	1.914	28.97
141	-31.5880	139.5170	392445	6461206	14.753	17.457	2.102	13.824	19.679	1.843	29.02
142	-31.5882	139.5171	392467	6461173	12.644	17.639	1.801	13.364	20.603	1.795	29.02
143	-31.5883	139.5172	392490	6461145	13.385	21.197	1.676	13.684	22.098	1.819	29.02
144	-31.5885	139.5174	392515	6461117	12.865	24.437	1.864	13.904	23.582	1.728	28.99
145	-31.5886	139.5176	392541	6461090	14.775	29.758	1.655	13.762	25.082	1.817	28.94
146	-31.5888	139.5177	392563	6461060	15.852	24.879	1.647	13.746	26.039	1.841	28.99
147	-31.5890	139.5178	392581	6461027	11.933	25.140	2.243	13.777	25.208	1.888	28.96
148	-31.5891	139.5180	392603	6460996	13.307	25.980	1.796	14.054	23.449	1.922	28.96
149	-31.5893	139.5181	392630	6460967	13.017	20.283	2.098	13.843	22.014	1.989	28.98
150	-31.5895	139.5183	392659	6460934	16.163	20.964	1.828	14.053	21.597	1.804	28.98
151	-31.5896	139.5184	392678	6460915	14.797	17.701	1.981	14.441	19.829	1.769	29.02
152	-31.5898	139.5186	392706	6460875	12.981	23.057	1.315	14.654	19.275	1.745	28.98
153	-31.5900	139.5187	392725	6460834	15.245	17.141	1.624	14.161	19.168	1.789	28.93
154	-31.5902	139.5188	392738	6460798	14.086	17.514	1.979	13.546	18.667	1.849	29.02
155	-31.5904	139.5189	392749	6460760	13.697	20.426	2.047	13.256	17.458	2.025	29.03

156	-31.5906	139.5190	392764	6460724	11.722	15.197	2.282	13.179	17.308	2.083	29.00
157	-31.5908	139.5191	392784	6460691	11.531	17.013	2.191	12.855	18.083	2.108	29.04
158	-31.5910	139.5193	392812	6460660	14.857	16.391	1.917	12.966	17.761	2.064	29.00
159	-31.5912	139.5194	392836	6460625	12.468	21.390	2.101	13.960	17.534	1.912	28.97
160	-31.5914	139.5196	392861	6460586	14.254	18.814	1.828	14.285	17.745	1.763	28.97
161	-31.5916	139.5197	392885	6460551	16.690	14.064	1.524	13.587	18.869	1.837	28.99
162	-31.5918	139.5198	392904	6460515	13.156	18.067	1.446	13.342	17.944	1.809	29.01
163	-31.5920	139.5199	392919	6460478	11.369	22.010	2.286	12.769	17.997	1.816	29.02
164	-31.5921	139.5200	392937	6460443	11.242	16.765	1.960	11.558	18.392	1.892	29.02
165	-31.5924	139.5201	392950	6460404	11.387	19.081	1.863	11.482	18.729	2.011	29.02
166	-31.5926	139.5202	392966	6460364	10.637	16.038	1.904	11.736	17.787	1.836	29.02
167	-31.5928	139.5203	392984	6460325	12.775	19.748	2.043	11.338	17.193	1.813	29.02
168	-31.5930	139.5204	393003	6460286	12.640	17.300	1.406	11.410	17.025	1.743	29.06
169	-31.5932	139.5206	393020	6460247	9.251	13.799	1.847	11.651	16.934	1.630	29.07
170	-31.5934	139.5207	393039	6460206	11.750	18.237	1.516	11.803	15.593	1.491	28.99
171	-31.5936	139.5208	393059	6460167	11.842	15.584	1.337	11.591	15.101	1.503	29.00
172	-31.5939	139.5209	393077	6460123	13.532	13.043	1.350	12.471	14.635	1.415	29.03
173	-31.5941	139.5210	393087	6460088	11.580	14.840	1.465	12.068	14.103	1.437	29.01
174	-31.5943	139.5211	393112	6460054	13.649	11.470	1.406	11.609	13.733	1.449	29.04
175	-31.5945	139.5213	393141	6460013	9.736	15.577	1.630	11.674	13.620	1.430	29.01
176	-31.5947	139.5215	393171	6459978	9.550	13.736	1.394	11.338	13.646	1.375	29.02
177	-31.5949	139.5217	393202	6459941	13.854	12.477	1.255	10.116	13.567	1.416	29.03
178	-31.5951	139.5219	393231	6459905	9.903	14.968	1.189	9.825	12.854	1.357	29.03
179	-31.5953	139.5220	393255	6459867	7.538	11.076	1.614	9.764	13.218	1.337	29.08
180	-31.5955	139.5222	393279	6459831	8.278	12.015	1.332	9.222	13.529	1.308	29.06
181	-31.5956	139.5224	393310	6459807	9.246	15.554	1.295	9.992	14.503	1.317	29.06
182	-31.5957	139.5225	393339	6459788	11.144	14.032	1.109	12.038	17.315	1.176	29.06
183	-31.5958	139.5227	393365	6459771	13.756	19.841	1.237	13.467	18.365	1.151	28.96
184	-31.5959	139.5229	393389	6459758	17.765	25.135	0.908	15.014	19.416	1.164	28.96
185	-31.5959	139.5231	393419	6459748	15.422	17.265	1.209	17.036	23.587	1.209	29.03
186	-31.5959	139.5233	393454	6459750	16.984	20.806	1.357	17.543	23.958	1.209	28.99
187	-31.5959	139.5235	393487	6459754	21.252	34.886	1.333	16.248	21.534	1.269	28.87
188	-31.5959	139.5237	393523	6459759	16.293	21.697	1.237	15.035	21.714	1.289	28.93
189	-31.5959	139.5240	393564	6459755	11.288	13.014	1.211	13.763	20.796	1.269	29.00
190	-31.5959	139.5242	393606	6459755	9.359	18.169	1.306	11.814	16.627	1.252	29.04
191	-31.5959	139.5246	393656	6459752	10.624	16.217	1.259	10.676	14.688	1.247	29.02
192	-31.5960	139.5249	393703	6459747	11.508	14.040	1.248	10.787	14.678	1.257	29.00
193	-31.5960	139.5252	393750	6459745	10.602	12.001	1.214	11.696	14.114	1.238	29.09
194	-31.5960	139.5254	393795	6459748	11.842	12.964	1.257	12.383	13.398	1.147	29.00
195	-31.5959	139.5257	393835	6459756	13.905	15.347	1.213	15.089	17.528	1.410	29.01
196	-31.5959	139.5259	393870	6459760	14.059	12.637	0.805	18.636	21.602	1.847	29.07
197	-31.5824	139.5195	392829	6462249	25.037	34.691	2.561	21.285	24.628	2.118	28.84
198	-31.5823	139.5195	392838	6462260	28.337	32.372	3.399	22.529	27.554	2.512	28.82
199	-31.5822	139.5195	392834	6462271	25.089	28.094	2.611	23.363	31.197	2.857	28.86
200	-31.5822	139.5194	392812	6462284	20.123	29.974	3.183	22.709	31.658	3.013	28.89
201	-31.5820	139.5194	392824	6462319	18.227	30.852	2.531	22.294	31.958	2.833	28.91
202	-31.5818	139.5195	392835	6462346	21.767	36.996	3.340	23.799	33.878	2.919	28.82
203	-31.5818	139.5196	392842	6462355	26.266	33.874	2.500	24.662	33.757	2.938	28.75
204	-31.5816	139.5193	392804	6462391	32.609	37.695	3.040	26.283	34.126	3.334	28.80
205	-31.5816	139.5193	392808	6462391	24.440	29.370	3.277	26.317	33.263	3.259	28.80
206	-31.5816	139.5193	392804	6462390	26.334	32.693	4.512	25.469	33.899	3.273	28.85
207	-31.5816	139.5193	392795	6462396	21.934	32.685	2.964	23.839	33.932	3.238	28.85
208	-31.5814	139.5192	392777	6462434	22.029	37.054	2.574	23.677	34.677	3.257	28.88

209	-31.5812	139.5191	392761	6462459	24.457	37.858	2.861	22.578	34.982	2.972	28.90
210	-31.5811	139.5190	392760	6462487	23.633	33.095	3.375	22.491	35.201	3.019	28.84
211	-31.5809	139.5190	392759	6462511	20.838	34.215	3.084	22.266	33.600	3.039	28.78
212	-31.5809	139.5191	392765	6462528	21.498	33.781	3.201	21.869	33.004	3.171	28.88
213	-31.5807	139.5192	392776	6462550	20.902	29.048	2.672	19.834	30.464	3.030	28.88
214	-31.5806	139.5191	392771	6462576	22.474	34.880	3.521	18.495	27.730	2.933	28.79
215	-31.5803	139.5191	392767	6462636	13.458	20.398	2.670	19.082	27.135	2.743	28.86
216	-31.5800	139.5187	392702	6462683	14.141	20.542	2.599	17.098	24.321	2.582	28.91
217	-31.5799	139.5186	392683	6462708	24.433	30.806	2.254	16.991	25.332	2.280	28.81
218	-31.5797	139.5185	392677	6462738	10.984	14.983	1.868	20.221	31.348	2.379	28.96
219	-31.5796	139.5184	392651	6462765	21.936	39.930	2.009	26.488	43.995	2.598	28.84
220	-31.5795	139.5182	392625	6462779	29.610	50.481	3.167	28.787	48.186	2.911	28.75
221	-31.5794	139.5181	392615	6462788	45.474	83.774	3.694	31.926	54.551	3.202	28.54
222	-31.5793	139.5181	392608	6462820	35.928	51.764	3.815	34.828	56.506	3.610	28.60
223	-31.5791	139.5181	392601	6462848	26.683	46.807	3.327	33.256	51.723	3.832	28.78
224	-31.5790	139.5180	392598	6462865	36.444	49.705	4.048	32.596	49.313	3.826	28.70
225	-31.5789	139.5180	392593	6462881	21.750	26.565	4.276	33.850	52.711	3.858	28.86
226	-31.5789	139.5180	392595	6462887	42.175	71.725	3.662	38.233	53.613	4.107	28.61
227	-31.5788	139.5182	392618	6462910	42.200	68.751	3.977	39.753	53.261	4.073	28.55
228	-31.5787	139.5182	392619	6462920	48.595	51.320	4.572	43.330	57.885	4.031	28.61
229	-31.5786	139.5182	392623	6462938	44.044	47.941	3.878	43.723	54.290	4.101	28.64
230	-31.5786	139.5182	392623	6462951	39.637	49.690	4.068	42.181	51.952	4.015	28.67
231	-31.5785	139.5181	392609	6462956	44.141	53.751	4.011	38.627	50.627	3.803	28.65
232	-31.5783	139.5181	392611	6462998	34.487	57.057	3.548	35.089	51.075	3.857	28.66
233	-31.5782	139.5181	392610	6463015	30.825	44.695	3.510	32.004	47.607	3.825	28.69
234	-31.5782	139.5181	392601	6463025	26.356	50.182	4.147	26.739	42.930	3.856	28.74
235	-31.5780	139.5181	392607	6463045	24.209	32.351	3.911	22.882	34.992	3.833	28.82
236	-31.5779	139.5180	392591	6463064	17.819	30.366	4.164	19.574	29.707	3.824	28.87
237	-31.5778	139.5180	392584	6463089	15.202	17.368	3.434	17.229	23.007	3.682	28.95
238	-31.5777	139.5179	392569	6463108	14.283	18.270	3.464	16.457	21.227	3.641	28.93
239	-31.5776	139.5178	392557	6463128	14.630	16.679	3.434	15.843	19.789	3.460	28.90
240	-31.5775	139.5177	392545	6463147	20.350	23.452	3.710	15.209	19.372	3.355	28.90
241	-31.5774	139.5176	392528	6463168	14.747	23.177	3.258	13.953	19.351	3.447	28.92
242	-31.5773	139.5175	392514	6463188	12.032	15.282	2.909	12.799	19.034	3.388	28.94
243	-31.5771	139.5174	392500	6463212	8.006	18.165	3.924	11.110	18.619	3.329	28.98
244	-31.5770	139.5174	392488	6463238	8.859	15.091	3.138	11.402	17.689	3.310	29.00
245	-31.5769	139.5173	392476	6463258	11.903	21.378	3.416	12.757	21.989	3.472	28.95
246	-31.5768	139.5172	392468	6463280	16.208	18.530	3.164	14.546	22.593	3.387	28.96
247	-31.5767	139.5172	392456	6463296	18.809	36.781	3.719	18.428	27.820	3.557	28.86
248	-31.5766	139.5171	392449	6463312	16.949	21.186	3.498	19.151	27.218	3.519	28.87
249	-31.5765	139.5171	392442	6463328	28.271	41.223	3.988	18.813	26.678	3.479	28.76
250	-31.5762	139.5169	392413	6463392	15.520	18.371	3.225	18.892	23.919	3.389	28.93
251	-31.5759	139.5168	392396	6463431	14.514	15.826	2.965	20.271	26.610	3.403	28.92
252	-31.5757	139.5167	392385	6463467	19.207	22.990	3.267	20.954	30.036	3.308	28.90
253	-31.5756	139.5167	392381	6463503	23.845	34.638	3.571	24.462	34.210	3.334	28.87
254	-31.5754	139.5167	392386	6463530	31.685	58.352	3.512	30.286	40.516	3.400	28.68
255	-31.5753	139.5167	392381	6463550	33.060	39.243	3.356	32.862	46.430	3.593	28.81
256	-31.5752	139.5167	392376	6463564	43.634	47.357	3.295	34.059	47.083	3.715	28.65
257	-31.5752	139.5167	392380	6463577	32.088	52.562	4.231	33.018	41.853	3.815	28.70
258	-31.5751	139.5168	392397	6463583	29.827	37.901	4.180	34.887	50.437	4.004	28.78
259	-31.5750	139.5168	392396	6463606	26.483	32.204	4.014	32.805	52.206	4.200	28.75
260	-31.5749	139.5168	392399	6463625	42.405	82.159	4.299	30.967	48.195	4.087	28.60
261	-31.5748	139.5166	392366	6463647	33.222	56.203	4.276	32.273	51.202	4.055	28.67

262	-31.5746	139.5165	392341	6463672	22.897	32.511	3.667	32.923	54.185	3.985	28.77
263	-31.5745	139.5164	392324	6463696	36.358	52.934	4.018	29.695	47.023	3.836	28.67
264	-31.5743	139.5163	392312	6463726	29.733	47.121	3.664	28.821	42.303	3.634	28.74
265	-31.5742	139.5162	392303	6463755	26.263	46.347	3.554	28.709	41.967	3.499	28.78
266	-31.5740	139.5162	392300	6463787	28.851	32.604	3.267	25.185	38.787	3.390	28.79
267	-31.5737	139.5161	392287	6463845	22.340	30.827	2.994	23.510	34.707	3.327	28.84
268	-31.5735	139.5161	392278	6463884	18.736	37.036	3.470	22.428	31.400	3.376	28.84
269	-31.5733	139.5160	392267	6463909	21.360	26.723	3.350	20.130	29.377	3.503	28.88
270	-31.5732	139.5159	392256	6463937	20.853	29.810	3.798	18.940	28.195	3.630	28.80
271	-31.5731	139.5158	392239	6463961	17.360	22.491	3.905	18.344	24.632	3.710	28.89
272	-31.5730	139.5158	392234	6463981	16.389	24.913	3.627	17.392	23.278	3.785	28.89
273	-31.5728	139.5158	392238	6464003	15.756	19.225	3.870	17.338	21.651	3.854	28.92
274	-31.5728	139.5158	392225	6464017	16.600	19.952	3.726	19.438	23.300	3.904	28.85
275	-31.5727	139.5156	392205	6464030	20.587	21.675	4.140	20.110	23.428	3.821	28.87
276	-31.5726	139.5155	392187	6464038	27.858	30.733	4.156	20.538	26.171	3.869	28.78
277	-31.5725	139.5155	392188	6464074	19.750	25.556	3.215	20.719	26.025	3.771	28.89
278	-31.5723	139.5155	392186	6464105	17.897	32.937	4.110	19.729	25.640	3.710	28.90
279	-31.5721	139.5155	392186	6464138	17.503	19.223	3.232	18.190	24.655	3.595	28.91
280	-31.5720	139.5154	392175	6464160	15.639	19.754	3.835	19.020	25.537	3.678	28.92
281	-31.5719	139.5154	392166	6464179	20.161	25.807	3.584	19.036	24.372	3.553	28.91
282	-31.5718	139.5154	392170	6464191	23.900	29.967	3.629	19.377	26.811	3.566	28.83
283	-31.5716	139.5155	392182	6464225	17.974	27.108	3.483	19.867	28.528	3.446	28.87
284	-31.5715	139.5154	392165	6464251	19.211	31.419	3.296	20.233	30.408	3.473	28.87
285	-31.5713	139.5153	392153	6464280	18.087	28.338	3.235	19.057	30.795	3.554	28.91
286	-31.5712	139.5152	392127	6464298	21.992	35.209	3.720	19.942	31.235	3.635	28.80
287	-31.5711	139.5151	392112	6464322	18.022	31.903	4.036	19.983	29.542	3.629	28.87
288	-31.5710	139.5150	392098	6464340	22.398	29.308	3.889	19.841	26.668	3.613	28.88
289	-31.5709	139.5149	392093	6464357	19.415	22.954	3.264	18.682	21.992	3.629	28.92
290	-31.5708	139.5148	392078	6464383	17.379	13.968	3.159	18.751	17.861	3.485	28.94
291	-31.5707	139.5147	392059	6464403	16.197	11.826	3.798	18.736	14.611	3.503	28.93
292	-31.5705	139.5146	392043	6464428	18.363	11.249	3.315	18.805	14.081	3.471	28.98
293	-31.5703	139.5145	392017	6464472	22.326	13.057	3.979	17.500	14.309	3.397	28.90
294	-31.5702	139.5144	392001	6464494	19.758	20.303	3.106	16.282	14.842	3.338	28.88
295	-31.5701	139.5143	391988	6464515	10.857	15.111	2.788	16.771	17.499	3.241	28.97
296	-31.5700	139.5142	391977	6464533	10.104	14.488	3.502	17.143	21.036	3.265	28.99
297	-31.5699	139.5142	391970	6464552	20.810	24.536	2.832	15.867	20.154	3.223	28.97
298	-31.5698	139.5142	391978	6464554	24.188	30.740	4.100	15.923	19.402	3.141	28.87
299	-31.5697	139.5141	391963	6464583	13.377	15.895	2.896	16.037	19.091	2.915	28.99
300	-31.5696	139.5140	391940	6464604	11.138	11.351	2.379	14.372	16.578	2.801	29.01
301	-31.5695	139.5139	391924	6464620	10.671	12.934	2.368	11.803	13.007	2.464	29.07
302	-31.5693	139.5139	391922	6464660	12.485	11.971	2.261	11.397	11.777	2.330	29.02
303	-31.5690	139.5138	391915	6464701	11.342	12.884	2.416	11.434	12.878	2.383	29.04
304	-31.5688	139.5138	391902	6464743	11.351	9.747	2.228	12.207	13.502	2.495	29.00
305	-31.5686	139.5137	391897	6464781	11.319	16.856	2.643	13.731	16.152	2.601	29.00
306	-31.5684	139.5136	391880	6464822	14.539	16.051	2.927	16.593	19.595	2.903	28.97
307	-31.5681	139.5135	391858	6464869	20.106	25.220	2.791	19.689	24.055	3.261	28.87
308	-31.5680	139.5135	391866	6464891	25.648	30.099	3.924	20.276	25.025	3.550	28.82
309	-31.5678	139.5134	391848	6464924	26.834	32.050	4.017	20.984	25.799	3.614	28.85
310	-31.5677	139.5133	391829	6464946	14.252	21.707	4.091	20.143	24.854	3.806	28.99
311	-31.5675	139.5132	391813	6464977	18.081	19.920	3.244	16.915	21.313	3.616	28.95
312	-31.5675	139.5131	391798	6464991	15.899	20.495	3.754	13.683	16.929	3.361	28.93
313	-31.5674	139.5132	391810	6465008	9.509	12.393	2.976	13.462	15.272	3.287	28.99
314	-31.5673	139.5132	391814	6465030	10.674	10.128	2.739	14.076	16.467	3.294	29.04

315	-31.5671	139.5133	391821	6465058	13.149	13.424	3.720	14.195	14.971	3.225	28.97
316	-31.5669	139.5133	391830	6465088	21.148	25.895	3.283	13.827	13.929	3.369	28.94
317	-31.5668	139.5133	391821	6465113	16.495	13.015	3.406	14.548	14.468	3.665	29.00
318	-31.5667	139.5132	391816	6465135	7.671	7.182	3.697	15.253	16.776	3.821	29.02
319	-31.5667	139.5132	391808	6465134	14.278	12.827	4.216	13.290	14.160	3.936	29.01
320	-31.5666	139.5132	391813	6465146	16.676	24.960	4.501	11.504	12.958	4.104	28.93
321	-31.5663	139.5132	391817	6465215	11.334	12.818	3.861	11.485	13.421	4.054	29.03
322	-31.5660	139.5132	391802	6465256	7.563	7.002	4.243	10.069	12.045	3.989	29.03
323	-31.5658	139.5131	391794	6465296	7.576	9.497	3.450	8.699	8.228	3.787	29.06
324	-31.5657	139.5131	391797	6465326	7.196	5.947	3.890	8.904	7.261	3.384	29.04
325	-31.5656	139.5131	391785	6465342	9.826	5.875	3.492	10.557	7.058	2.754	29.06
326	-31.5654	139.5130	391775	6465364	12.361	7.987	1.845	10.427	6.430	2.241	29.10
327	-31.5653	139.5129	391765	6465392	15.824	5.987	1.094	10.318	6.045	1.596	29.02
328	-31.5651	139.5129	391765	6465425	6.926	6.353	0.882	10.698	5.749	1.221	29.09
329	-31.5650	139.5129	391762	6465445	6.653	4.022	0.665	9.820	4.893	1.124	29.02
330	-31.5650	139.5130	391772	6465439	11.727	4.397	1.619	8.679	5.168	1.529	29.02
331	-31.5649	139.5130	391772	6465472	7.971	3.706	1.358	10.169	6.431	1.949	29.06
332	-31.5646	139.5128	391736	6465527	10.115	7.363	3.119	11.808	7.528	2.447	29.05
333	-31.5645	139.5127	391724	6465539	14.381	12.667	2.984	11.794	10.254	2.846	28.99
334	-31.5644	139.5126	391716	6465549	14.845	9.505	3.154	13.147	14.631	3.354	28.99
335	-31.5641	139.5127	391726	6465604	11.660	18.030	3.615	14.194	17.518	3.370	28.94
336	-31.5640	139.5126	391716	6465628	14.736	25.589	3.901	14.973	19.378	3.374	28.95
337	-31.5639	139.5126	391715	6465652	15.348	21.797	3.199	13.523	19.028	3.545	28.92
338	-31.5638	139.5126	391706	6465671	18.278	21.971	3.003	14.206	19.907	3.545	28.94
339	-31.5637	139.5125	391697	6465685	7.592	7.752	4.008	14.171	20.565	3.305	29.02
340	-31.5636	139.5125	391694	6465704	15.076	22.427	3.615	12.816	17.708	3.246	28.89
341	-31.5635	139.5125	391689	6465729	14.561	28.878	2.699	11.460	15.688	3.179	28.93
342	-31.5633	139.5125	391691	6465757	8.576	7.509	2.906	11.841	17.319	2.790	29.01
343	-31.5632	139.5124	391678	6465787	11.495	11.874	2.667	11.546	15.628	2.581	29.01
344	-31.5630	139.5124	391676	6465818	9.498	15.905	2.061	10.717	12.398	2.523	29.04
345	-31.5628	139.5123	391661	6465848	13.598	13.974	2.574	11.740	14.379	2.487	29.04
346	-31.5627	139.5122	391642	6465873	10.419	12.726	2.407	13.519	17.097	2.611	29.03
347	-31.5626	139.5120	391618	6465897	13.688	17.414	2.729	14.402	17.710	2.768	28.98
348	-31.5624	139.5119	391604	6465917	20.394	25.466	3.286	14.247	17.855	2.906	28.92
349	-31.5622	139.5119	391603	6465961	13.911	18.968	2.847	14.452	18.054	2.951	28.99
350	-31.5621	139.5119	391593	6465972	12.823	14.703	3.262	14.350	17.275	2.934	28.98
351	-31.5621	139.5118	391585	6465981	11.444	13.717	2.630	12.258	14.581	2.780	28.98
352	-31.5621	139.5118	391584	6465987	13.181	13.518	2.644	11.690	13.841	2.708	29.02
353	-31.5620	139.5118	391579	6466002	9.931	11.998	2.515	10.961	13.071	2.647	29.05
354	-31.5619	139.5117	391565	6466014	11.069	15.267	2.490	11.110	12.317	2.637	29.05
355	-31.5618	139.5116	391545	6466035	9.179	10.854	2.955	10.216	11.119	2.754	29.00
356	-31.5616	139.5115	391529	6466066	12.188	9.949	2.581	9.908	11.606	2.644	29.04
357	-31.5616	139.5113	391507	6466079	8.711	7.530	3.229	9.552	11.426	2.585	29.04
358	-31.5612	139.5108	391426	6466153	8.390	14.428	1.966	9.936	12.525	2.530	29.06
359	-31.5611	139.5106	391396	6466170	9.290	14.368	2.197	9.280	13.080	2.631	29.06
360	-31.5610	139.5105	391375	6466178	11.099	16.352	2.678	9.833	13.277	2.577	29.02
361	-31.5610	139.5103	391350	6466178	8.910	12.722	3.083	10.519	12.720	2.822	29.01
362	-31.5611	139.5102	391328	6466163	11.474	8.515	2.960	11.389	12.507	3.038	29.02
363	-31.5611	139.5100	391296	6466160	11.822	11.645	3.191	12.352	12.957	3.170	29.01
364	-31.5612	139.5098	391266	6466148	13.640	13.302	3.278	13.727	13.855	3.110	29.00
365	-31.5612	139.5096	391237	6466137	15.913	18.604	3.338	13.987	14.978	3.095	28.93
366	-31.5610	139.5094	391195	6466175	15.784	17.212	2.785	15.513	16.682	3.148	28.97
367	-31.5609	139.5093	391178	6466198	12.777	14.127	2.880	16.210	17.403	3.183	28.99

368	-31.5609	139.5091	391161	6466189	19.451	20.165	3.456	16.449	17.519	3.113	28.82
369	-31.5609	139.5091	391152	6466204	17.126	16.910	3.454	16.533	17.649	2.957	28.95
370	-31.5608	139.5090	391143	6466225	17.107	19.183	2.989	17.681	20.375	3.020	28.98
371	-31.5603	139.5090	391141	6466302	16.203	17.861	2.003	16.871	20.542	2.974	28.95
372	-31.5602	139.5090	391136	6466328	18.518	27.755	3.197	16.986	22.036	3.179	28.92
373	-31.5600	139.5090	391131	6466358	15.401	20.999	3.226	17.443	21.248	3.080	28.93
374	-31.5599	139.5089	391124	6466380	17.700	24.381	4.480	17.000	21.776	3.130	28.87
375	-31.5598	139.5088	391098	6466402	19.393	15.243	2.494	17.570	21.333	3.003	28.94
376	-31.5596	139.5086	391079	6466430	13.987	20.500	2.251	17.585	22.306	2.861	28.93
377	-31.5594	139.5086	391073	6466469	21.370	25.543	2.565	19.444	23.256	2.686	28.91
378	-31.5592	139.5085	391056	6466504	15.473	25.863	2.515	20.094	24.425	2.899	28.94
379	-31.5592	139.5085	391059	6466504	26.998	29.131	3.606	22.105	25.808	2.980	28.81
380	-31.5591	139.5085	391053	6466530	22.640	21.089	3.558	22.830	26.640	3.075	28.91
381	-31.5590	139.5085	391048	6466556	24.043	27.413	2.656	23.815	27.585	3.021	28.87
382	-31.5588	139.5084	391039	6466582	24.994	29.702	3.038	22.029	26.477	2.885	28.89
383	-31.5586	139.5084	391033	6466613	20.397	30.592	2.249	20.493	26.994	2.794	28.90
384	-31.5585	139.5083	391027	6466640	18.072	23.589	2.922	19.838	26.542	2.906	28.90
385	-31.5583	139.5082	391007	6466681	14.958	23.673	3.104	21.615	26.480	2.928	28.90
386	-31.5581	139.5082	390999	6466720	20.768	25.152	3.217	21.848	26.224	3.142	28.93
387	-31.5579	139.5083	391014	6466759	33.880	29.392	3.149	23.582	28.842	3.223	28.82
388	-31.5577	139.5082	391004	6466792	21.564	29.312	3.318	23.993	28.370	3.185	28.89
389	-31.5575	139.5081	390982	6466825	26.740	36.681	3.328	22.832	26.708	3.155	28.86
390	-31.5573	139.5080	390969	6466858	17.014	21.313	2.912	20.196	26.571	3.282	28.93
391	-31.5572	139.5079	390961	6466886	14.961	16.841	3.069	19.864	24.920	3.243	28.92
392	-31.5570	139.5079	390964	6466913	20.700	28.707	3.783	18.804	22.525	3.342	28.86
393	-31.5569	139.5079	390950	6466941	19.905	21.057	3.123	21.227	24.410	3.534	28.91
394	-31.5568	139.5078	390935	6466960	21.438	24.709	3.823	22.165	26.091	3.508	28.85
395	-31.5567	139.5076	390914	6466968	29.129	30.736	3.874	21.124	24.504	3.504	28.85
396	-31.5566	139.5076	390905	6466994	19.650	25.245	2.939	20.565	26.339	3.428	28.92
397	-31.5564	139.5075	390890	6467020	15.497	20.775	3.759	18.165	25.187	3.239	28.96
398	-31.5563	139.5073	390866	6467040	17.108	30.229	2.747	16.933	25.144	3.165	28.89
399	-31.5562	139.5071	390831	6467067	9.443	18.952	2.878	18.988	26.627	3.216	28.94
400	-31.5561	139.5070	390811	6467089	22.966	30.519	3.504	20.236	28.107	3.013	28.88
401	-31.5560	139.5069	390790	6467106	29.929	32.658	3.189	19.786	27.221	3.125	28.86
402	-31.5559	139.5067	390773	6467125	21.733	28.179	2.744	20.368	26.650	3.205	28.88
403	-31.5557	139.5067	390758	6467152	14.858	25.796	3.308	18.088	22.661	3.052	28.92
404	-31.5556	139.5065	390740	6467168	12.356	16.101	3.278	15.672	19.302	3.204	28.91
405	-31.5556	139.5064	390725	6467180	11.563	10.572	2.740	16.293	19.664	3.321	29.00
406	-31.5554	139.5064	390725	6467207	17.848	15.862	3.949	21.647	21.475	3.376	28.93
407	-31.5552	139.5063	390697	6467246	24.838	29.992	3.331	24.203	25.140	3.528	28.92
408	-31.5550	139.5062	390682	6467274	41.631	34.847	3.583	27.140	30.743	3.617	28.70
409	-31.5551	139.5060	390659	6467273	25.137	34.430	4.037	28.144	32.770	3.399	28.77
410	-31.5549	139.5060	390656	6467298	26.247	38.586	3.185	27.775	32.921	3.362	28.84
411	-31.5548	139.5060	390646	6467320	22.866	25.997	2.861	24.438	33.492	3.252	28.86
412	-31.5546	139.5060	390648	6467353	22.993	30.745	3.145	25.725	35.638	2.881	28.86
413	-31.5544	139.5060	390652	6467390	24.945	37.703	3.031	24.728	33.204	2.780	28.80
414	-31.5542	139.5060	390659	6467423	31.577	45.160	2.184	25.448	35.823	2.808	28.74
415	-31.5542	139.5060	390652	6467437	21.258	26.413	2.681	25.777	36.526	2.779	28.86
416	-31.5540	139.5060	390649	6467473	26.466	39.094	3.001	27.602	36.567	2.894	28.82
417	-31.5537	139.5060	390644	6467516	24.639	34.259	2.997	26.848	35.819	3.203	28.84
418	-31.5536	139.5059	390631	6467547	34.069	37.908	3.607	25.489	35.648	3.326	28.78
419	-31.5538	139.5056	390584	6467495	27.806	41.421	3.732	23.672	33.423	3.455	28.81
420	-31.5538	139.5054	390549	6467502	14.466	25.561	3.292	22.120	30.726	3.405	28.93

421	-31.5538	139.5051	390511	6467509	17.377	27.967	3.645	20.359	27.999	3.349	28.88
422	-31.5537	139.5049	390473	6467523	16.881	20.772	2.749	18.355	24.028	3.290	28.94
423	-31.5537	139.5046	390438	6467523	25.266	24.273	3.325	19.503	22.484	3.240	28.82
424	-31.5537	139.5044	390405	6467526	17.783	21.566	3.439	21.393	21.757	3.155	28.93
425	-31.5537	139.5042	390372	6467520	20.209	17.844	3.043	23.320	22.138	3.115	28.94
426	-31.5537	139.5040	390336	6467519	26.826	24.331	3.218	22.907	21.425	3.022	28.85
427	-31.5537	139.5038	390300	6467519	26.514	22.676	2.550	23.909	21.873	2.799	28.88
428	-31.5537	139.5036	390275	6467525	23.205	20.709	2.857	25.281	23.738	2.792	28.87
429	-31.5537	139.5035	390249	6467524	22.790	23.806	2.326	24.222	24.267	2.809	28.90
430	-31.5537	139.5033	390220	6467523	27.071	27.167	3.006	23.410	27.372	2.939	28.85
431	-31.5537	139.5031	390188	6467518	21.532	26.979	3.308	22.239	28.683	2.852	28.87
432	-31.5537	139.5029	390164	6467517	22.453	38.198	3.199	21.025	27.436	2.821	28.84
433	-31.5537	139.5028	390140	6467511	17.349	27.265	2.419	21.451	25.749	2.646	28.90
434	-31.5539	139.5026	390121	6467486	16.719	17.573	2.172	22.561	27.899	2.563	28.94
435	-31.5540	139.5025	390103	6467462	29.201	18.729	2.133	22.263	27.559	2.573	28.80
436	-31.5541	139.5022	390047	6467444	27.083	37.729	2.894	26.993	30.486	2.710	28.80
437	-31.5542	139.5021	390042	6467425	20.964	36.499	3.248	28.362	34.343	2.973	28.85
438	-31.5543	139.5021	390042	6467400	40.996	41.899	3.103	27.453	36.887	3.305	28.75
439	-31.5544	139.5021	390038	6467380	23.565	36.860	3.490	26.471	35.630	3.424	28.80
440	-31.5546	139.5021	390034	6467352	24.656	31.447	3.791	26.085	33.614	3.405	28.86
441	-31.5548	139.5021	390033	6467319	22.175	31.443	3.487	22.679	30.057	3.534	28.83
442	-31.5550	139.5021	390046	6467281	19.033	26.417	3.153	21.275	26.767	3.578	28.88
443	-31.5551	139.5023	390073	6467253	23.967	24.116	3.751	18.839	24.050	3.444	28.91
444	-31.5552	139.5024	390091	6467239	16.543	20.409	3.708	20.333	19.633	3.424	28.94
445	-31.5553	139.5025	390108	6467224	12.477	17.867	3.122	21.036	19.454	3.408	28.96
446	-31.5554	139.5026	390116	6467209	29.648	9.358	3.385	20.854	18.229	3.492	28.83
447	-31.5555	139.5026	390121	6467189	22.546	25.518	3.076	22.504	19.664	3.607	28.88
448	-31.5556	139.5027	390129	6467165	23.057	17.994	4.168	25.400	21.763	3.740	28.89
449	-31.5558	139.5027	390139	6467135	24.793	27.585	4.285	22.446	24.846	3.737	28.84
450	-31.5560	139.5027	390140	6467099	26.956	28.361	3.784	22.014	23.428	3.793	28.82
451	-31.5562	139.5028	390152	6467062	14.878	24.772	3.372	21.810	25.796	3.634	28.90
452	-31.5564	139.5029	390162	6467023	20.387	18.428	3.359	21.545	25.480	3.411	28.89
453	-31.5565	139.5029	390175	6466997	22.036	29.835	3.373	20.474	25.610	3.310	28.86
454	-31.5566	139.5030	390180	6466975	23.471	26.002	3.168	23.902	27.513	3.455	28.84
455	-31.5567	139.5030	390185	6466958	21.597	29.015	3.278	26.330	33.307	3.579	28.92
456	-31.5568	139.5030	390184	6466946	32.019	34.285	4.099	26.844	32.381	3.729	28.74
457	-31.5569	139.5031	390193	6466933	32.526	47.396	3.978	28.033	32.743	3.798	28.74
458	-31.5570	139.5032	390211	6466908	24.607	25.207	4.122	28.158	34.509	3.910	28.85
459	-31.5571	139.5032	390223	6466881	29.415	27.814	3.512	25.856	33.271	3.721	28.81
460	-31.5573	139.5033	390230	6466853	22.224	37.842	3.839	23.975	29.033	3.492	28.79
461	-31.5575	139.5034	390243	6466819	20.509	28.094	3.152	24.054	29.579	3.279	28.89
462	-31.5576	139.5035	390269	6466793	23.121	26.209	2.835	23.515	29.269	3.384	28.88
463	-31.5578	139.5036	390285	6466768	25.002	27.937	3.056	22.131	25.629	3.238	28.83
464	-31.5579	139.5037	390295	6466742	26.718	26.264	4.039	22.025	26.211	3.131	28.87
465	-31.5580	139.5038	390310	6466718	15.307	19.642	3.106	20.772	26.409	3.250	28.99
466	-31.5582	139.5039	390324	6466694	19.975	31.003	2.620	19.661	25.325	3.087	28.86
467	-31.5583	139.5040	390339	6466668	16.857	27.198	3.429	17.299	23.533	2.861	28.89
468	-31.5584	139.5041	390358	6466644	19.447	22.520	2.242	17.246	24.330	2.852	28.96
469	-31.5586	139.5042	390376	6466619	14.907	17.304	2.907	16.170	23.809	2.914	28.99
470	-31.5587	139.5043	390394	6466597	15.044	23.626	3.060	16.298	23.235	2.704	28.94
471	-31.5588	139.5044	390413	6466580	14.593	28.394	2.934	15.561	22.970	2.851	28.92
472	-31.5589	139.5046	390436	6466561	17.497	24.331	2.378	16.891	26.845	2.948	28.94
473	-31.5590	139.5047	390460	6466539	15.763	21.197	2.974	18.194	28.478	2.815	28.92

474	-31.5592	139.5049	390481	6466512	21.559	36.675	3.396	19.287	27.975	2.663	28.88
475	-31.5593	139.5050	390499	6466484	21.556	31.790	2.394	18.825	26.723	2.765	28.91
476	-31.5595	139.5051	390513	6466454	20.058	25.880	2.173	19.900	29.029	2.779	28.92
477	-31.5596	139.5051	390523	6466424	15.190	18.072	2.889	18.657	25.498	2.531	28.97
478	-31.5598	139.5052	390535	6466401	21.139	32.725	3.044	17.795	23.649	2.576	28.90
479	-31.5599	139.5053	390547	6466375	15.344	19.024	2.156	18.784	23.218	2.781	28.94
480	-31.5601	139.5054	390565	6466346	17.244	22.546	2.617	19.239	23.650	2.790	28.95
481	-31.5602	139.5054	390571	6466327	25.003	23.725	3.199	19.843	24.944	2.632	28.86
482	-31.5603	139.5055	390581	6466307	17.467	20.233	2.932	21.784	27.696	2.644	28.92
483	-31.5604	139.5055	390593	6466292	24.158	39.192	2.258	22.499	28.307	2.665	28.85
484	-31.5604	139.5056	390596	6466275	25.046	32.785	2.212	22.040	29.950	2.428	28.85
485	-31.5606	139.5055	390584	6466250	20.823	25.602	2.725	24.410	30.705	2.337	28.93
486	-31.5607	139.5055	390580	6466222	22.707	31.940	2.011	22.884	26.326	2.232	28.86
487	-31.5609	139.5055	390587	6466194	29.313	24.005	2.479	23.124	23.876	2.168	28.82
488	-31.5610	139.5056	390601	6466169	16.529	17.296	1.732	32.395	25.497	2.020	28.91
489	-31.5612	139.5057	390622	6466141	26.250	20.536	1.892	33.243	25.173	2.155	28.86
490	-31.5613	139.5059	390647	6466115	67.177	33.709	1.985	31.402	26.087	2.130	28.58
491	-31.5615	139.5060	390667	6466084	26.947	30.322	2.686	31.928	28.270	2.294	28.82
492	-31.5616	139.5061	390686	6466055	20.107	28.574	2.356	85.018	27.968	2.723	28.87
493	-31.5618	139.5062	390700	6466029	19.161	28.208	2.550	398.788	20.442	4.809	28.84
494	-31.5619	139.5062	390696	6466015	291.696	19.024	4.039	439.124	17.768	4.920	27.30
495	-31.5619	139.5062	390702	6466015	1636.028	-3.920	#####	440.371	15.653	4.937	21.88
496	-31.5621	139.5063	390720	6465980	228.627	16.956	3.243	440.163	13.516	4.963	27.66
497	-31.5623	139.5063	390717	6465937	26.343	17.996	2.440	384.367	13.429	4.722	28.82
498	-31.5625	139.5064	390729	6465900	18.119	17.526	2.682	60.714	17.759	2.690	28.90
499	-31.5627	139.5065	390740	6465866	12.718	18.586	2.834	18.165	17.005	2.478	28.97
500	-31.5629	139.5065	390754	6465832	17.764	17.730	2.250	17.309	16.277	2.393	28.95
501	-31.5630	139.5066	390769	6465800	15.880	13.185	2.183	17.007	14.861	2.218	29.00
502	-31.5632	139.5067	390778	6465772	22.062	14.358	2.014	19.002	13.052	1.987	28.97
503	-31.5634	139.5068	390793	6465739	16.612	10.446	1.812				29.00
504	-31.5635	139.5069	390814	6465709	22.693	9.539	1.676				28.98

APPENDIX 3

Weekeroo Inlier traverses data

WEEKEROO INLIER MAIN TRAVERSE DATA

Sample Number	Latitude	Longitude	Easting	Northing	Non-smoothed Data			Smoothed Data			Livetime
					U ppm	Th ppm	K %	U ppm	Th ppm	K%	
1	-32.2493	140.0433	6431528	409878	6.569	5.971	1.744				29.13
2	-32.2490	140.0433	6431550	409868	7.188	9.515	1.396				29.10
3	-32.2488	140.0432	6431583	409868	7.353	8.524	1.881	7.071	8.572	2.454	29.08
4	-32.2490	140.0427	6431561	409821	7.498	9.545	3.822	7.486	9.365	2.462	29.08
5	-32.2488	140.0426	6431583	409802	6.744	9.306	3.424	8.365	9.148	2.303	29.10
6	-32.2485	140.0425	6431616	409792	8.645	9.934	1.785	8.938	9.694	2.135	29.10
7	-32.2482	140.0424	6431649	409782	11.586	8.434	0.605	9.303	10.259	1.567	29.08
8	-32.2478	140.0425	6431693	409791	10.217	11.254	1.039	10.229	10.614	1.055	29.05
9	-32.2474	140.0423	6431727	409782	9.325	12.369	0.983	10.325	10.379	0.936	29.08
10	-32.2470	140.0422	6431771	409762	11.371	11.077	0.861	9.828	9.772	1.087	29.12
11	-32.2468	140.0420	6431804	409743	9.128	8.760	1.192	9.920	8.828	1.128	29.11
12	-32.2467	140.0417	6431804	409724	9.099	5.401	1.357	9.705	8.255	1.345	29.11
13	-32.2465	140.0419	6431826	409734	10.680	6.533	1.245	10.490	8.156	1.537	29.07
14	-32.2464	140.0419	6431848	409743	8.248	9.503	2.071	11.247	9.740	1.421	29.07
15	-32.2463	140.0420	6431848	409743	15.297	10.583	1.820	11.206	10.858	1.525	29.00
16	-32.2462	140.0420	6431859	409743	12.909	16.678	0.613	10.909	11.318	1.605	29.01
17	-32.2458	140.0421	6431904	409752	8.895	10.994	1.875	11.268	11.750	1.596	29.02
18	-32.2455	140.0420	6431948	409751	9.194	8.833	1.648	9.626	11.369	1.438	29.05
19	-32.2451	140.0418	6431992	409732	10.045	11.661	2.024	7.981	9.440	1.397	29.05
20	-32.2449	140.0417	6432014	409723	7.086	8.682	1.030	7.038	8.669	1.182	29.14
21	-32.2449	140.0414	6432014	409685	4.684	7.034	0.407	6.716	8.474	1.050	29.14
22	-32.2447	140.0415	6432025	409694	4.179	7.136	0.804	6.839	8.242	1.006	29.14
23	-32.2445	140.0416	6432047	409703	7.585	7.857	0.987	6.969	8.673	1.171	29.10
24	-32.2444	140.0416	6432059	409713	10.662	10.504	1.801	7.656	9.440	1.582	29.10
25	-32.2442	140.0417	6432092	409712	7.733	10.835	1.853	8.295	10.350	1.853	29.06
26	-32.2439	140.0416	6432114	409712	8.121	10.870	2.462	8.180	10.591	1.994	29.07
27	-32.2437	140.0416	6432147	409712	7.375	11.686	2.161	7.820	10.328	2.021	29.08
28	-32.2434	140.0417	6432169	409712	7.008	9.060	1.691	7.999	10.172	2.158	29.07
29	-32.2432	140.0419	6432203	409740	8.863	9.191	1.938	7.518	9.908	2.147	28.98
30	-32.2431	140.0417	6432203	409721	8.630	10.054	2.538	7.750	9.730	2.157	29.04
31	-32.2428	140.0418	6432236	409730	5.716	9.550	2.406	7.221	10.160	2.222	29.07
32	-32.2425	140.0419	6432280	409730	8.534	10.796	2.213	6.612	9.886	2.109	29.06
33	-32.2421	140.0420	6432314	409739	4.364	11.211	2.015	6.181	9.322	1.863	29.06
34	-32.2418	140.0421	6432358	409757	5.816	7.820	1.374	6.568	8.894	1.703	29.14
35	-32.2415	140.0423	6432392	409776	6.474	7.234	1.309	6.123	7.754	1.407	29.10
36	-32.2412	140.0424	6432425	409785	7.650	7.410	1.603	6.479	7.278	1.255	29.10
37	-32.2411	140.0424	6432436	409785	6.313	5.095	0.733	5.946	6.827	1.343	29.09
38	-32.2407	140.0425	6432470	409794	6.143	8.832	1.256	5.497	6.429	1.531	29.08
39	-32.2405	140.0426	6432503	409794	3.149	5.564	1.817	5.036	6.436	1.608	29.11
40	-32.2403	140.0425	6432525	409793	4.230	5.246	2.245	5.174	6.810	1.795	29.11
41	-32.2400	140.0426	6432558	409793	5.347	7.444	1.987	5.471	5.960	1.924	29.09
42	-32.2397	140.0426	6432592	409802	7.003	6.965	1.672	6.449	6.271	1.892	29.10
43	-32.2393	140.0426	6432636	409802	7.626	4.582	1.900	7.066	7.649	1.755	29.12
44	-32.2389	140.0426	6432669	409802	8.039	7.116	1.653	7.746	8.066	1.877	29.10
45	-32.2385	140.0427	6432714	409811	7.313	12.137	1.565	8.604	9.895	2.137	29.08
46	-32.2382	140.0428	6432758	409820	8.748	9.529	2.593	9.824	11.108	2.394	29.04
47	-32.2381	140.0429	6432758	409820	11.296	16.111	2.977	11.640	11.702	2.741	29.01
48	-32.2379	140.0428	6432780	409819	13.725	10.649	3.183	12.872	11.220	3.207	29.04
49	-32.2377	140.0427	6432813	409810	17.117	10.084	3.388	13.379	11.342	3.347	28.98

50	-32.2374	140.0426	6432835	409800	13.473	9.725	3.897	13.047	9.945	3.181	29.04
51	-32.2372	140.0426	6432869	409790	11.284	10.143	3.289	12.790	10.893	3.013	29.02
52	-32.2370	140.0425	6432880	409790	9.637	9.122	2.147	11.550	12.226	3.039	29.02
53	-32.2369	140.0427	6432891	409809	12.439	15.391	2.343	12.102	12.196	3.192	29.00
54	-32.2367	140.0429	6432924	409818	10.915	16.747	3.517	12.173	12.118	3.452	29.01
55	-32.2364	140.0430	6432947	409827	16.236	9.577	4.666	12.350	12.169	3.607	28.94
56	-32.2361	140.0428	6432991	409808	11.640	9.754	4.587	11.573	11.541	3.445	29.02
57	-32.2358	140.0426	6433024	409798	10.519	9.374	2.923	11.478	10.361	3.173	29.07
58	-32.2355	140.0425	6433046	409789	8.557	12.252	1.532	9.930	10.547	3.027	29.10
59	-32.2352	140.0424	6433090	409770	10.437	10.848	2.157	9.605	10.755	3.141	29.07
60	-32.2348	140.0424	6433123	409769	8.497	10.506	3.936	9.593	10.822	3.590	29.06
61	-32.2346	140.0424	6433146	409778	10.012	10.794	5.157	10.285	9.187	3.966	28.99
62	-32.2346	140.0427	6433157	409797	10.459	9.709	5.169	11.049	8.727	4.608	28.98
63	-32.2342	140.0428	6433201	409816	12.018	4.076	3.409	11.991	8.828	4.900	29.04
64	-32.2341	140.0429	6433212	409816	14.258	8.550	5.368	12.277	8.364	4.403	28.98
65	-32.2339	140.0429	6433235	409825	13.209	11.011	5.396	12.636	7.590	3.988	29.00
66	-32.2336	140.0428	6433268	409806	11.440	8.477	2.673	12.753	8.149	3.959	29.03
67	-32.2333	140.0427	6433301	409805	12.259	5.838	3.092	11.755	7.372	3.617	29.02
68	-32.2330	140.0426	6433334	409796	12.602	6.869	3.266	10.320	5.386	3.270	29.02
69	-32.2325	140.0425	6433390	409786	9.265	4.664	3.656	9.371	4.170	3.597	29.00
70	-32.2323	140.0426	6433412	409786	6.033	1.082	3.664	9.675	3.090	3.568	29.06
71	-32.2321	140.0426	6433434	409785	6.697	2.399	4.306	8.270	2.395	3.519	29.06
72	-32.2318	140.0427	6433456	409795	13.775	0.438	2.950	7.705	1.558	3.466	29.05
73	-32.2316	140.0428	6433490	409813	5.579	3.392	3.020	8.611	2.836	3.593	29.06
74	-32.2315	140.0428	6433501	409813	6.439	0.481	3.389	9.852	3.783	3.439	29.08
75	-32.2314	140.0428	6433512	409803	10.567	7.471	4.300	11.619	4.467	3.668	29.05
76	-32.2312	140.0427	6433534	409803	12.899	7.132	3.536	15.476	5.652	3.755	29.03
77	-32.2310	140.0426	6433545	409794	22.610	3.860	4.094	17.779	8.096	3.865	28.93
78	-32.2311	140.0426	6433545	409784	24.865	9.316	3.455	19.444	9.700	3.816	28.90
79	-32.2309	140.0425	6433556	409784	17.955	12.699	3.941	20.977	10.715	3.959	28.95
80	-32.2309	140.0425	6433567	409784	18.891	15.494	4.051	20.857	12.853	3.774	28.95
81	-32.2305	140.0427	6433611	409793	20.565	12.204	4.253	18.094	13.295	3.791	28.95
82	-32.2302	140.0425	6433633	409784	22.009	14.550	3.169	17.671	13.330	3.711	28.91
83	-32.2300	140.0423	6433655	409755	11.052	11.526	3.539	16.015	12.230	3.602	28.98
84	-32.2298	140.0422	6433689	409755	15.836	12.875	3.541	14.558	11.782	3.437	28.94
85	-32.2296	140.0422	6433700	409755	10.610	9.995	3.509	12.750	10.561	3.516	28.99
86	-32.2293	140.0426	6433733	409783	13.283	9.964	3.428	13.416	10.647	3.541	28.99
87	-32.2292	140.0426	6433755	409782	12.968	8.444	3.565	11.714	9.920	3.839	29.00
88	-32.2290	140.0425	6433767	409782	14.384	11.958	3.661	11.621	10.541	4.135	29.02
89	-32.2290	140.0424	6433778	409773	7.327	9.239	5.032	11.765	11.893	4.601	28.97
90	-32.2287	140.0423	6433800	409763	10.144	13.098	4.987	13.305	11.842	5.402	29.02
91	-32.2285	140.0422	6433833	409744	14.000	16.726	5.762	13.330	11.658	5.565	28.99
92	-32.2285	140.0423	6433822	409754	20.671	8.190	7.569	18.064	11.947	5.509	28.91
93	-32.2282	140.0427	6433866	409791	14.508	11.038	4.473	19.829	12.366	5.632	28.94
94	-32.2280	140.0427	6433889	409800	30.996	10.684	4.754	20.417	11.722	5.906	28.88
95	-32.2279	140.0426	6433900	409791	18.972	15.190	5.600	18.951	13.089	5.625	28.90
96	-32.2278	140.0427	6433900	409791	16.939	13.507	7.134	17.936	12.989	5.298	28.90
97	-32.2277	140.0427	6433922	409800	13.341	15.025	6.165	13.517	12.909	4.838	28.98
98	-32.2275	140.0427	6433944	409790	9.433	10.540	2.835	11.833	11.924	4.461	29.02
99	-32.2272	140.0427	6433966	409790	8.898	10.281	2.456	10.301	11.807	3.638	29.03
100	-32.2270	140.0426	6433999	409790	10.554	10.265	3.716	9.747	10.937	2.971	29.05
101	-32.2268	140.0427	6434022	409790	9.279	12.926	3.017	10.558	11.652	3.061	29.03
102	-32.2266	140.0426	6434044	409789	10.572	10.671	2.832	11.184	11.669	3.259	29.04

103	-32.2264	140.0426	6434066	409789	13.488	14.118	3.284	10.869	11.519	3.072	28.97
104	-32.2263	140.0427	6434077	409789	12.030	10.364	3.445	10.598	10.358	2.788	28.98
105	-32.2262	140.0427	6434077	409789	8.975	9.516	2.785	10.437	10.498	2.898	29.08
106	-32.2261	140.0427	6434099	409789	7.926	7.123	1.595	9.559	9.159	2.786	29.09
107	-32.2256	140.0426	6434144	409788	9.770	11.370	3.380	8.457	9.551	2.568	29.00
108	-32.2255	140.0426	6434166	409779	9.096	7.423	2.723	8.286	9.755	2.384	29.04
109	-32.2253	140.0425	6434188	409779	6.521	12.322	2.358	8.213	10.027	2.409	29.08
110	-32.2250	140.0426	6434210	409778	8.120	10.538	1.864	7.346	8.845	2.285	29.05
111	-32.2248	140.0427	6434232	409797	7.557	8.484	1.722	7.536	8.962	2.165	29.08
112	-32.2244	140.0433	6434288	409844	5.436	5.457	2.761	7.922	7.697	1.990	29.07
113	-32.2241	140.0434	6434321	409853	10.048	8.008	2.120	9.464	8.503	1.779	29.10
114	-32.2239	140.0434	6434344	409862	8.448	5.999	1.482	9.937	8.900	1.599	29.14
115	-32.2240	140.0429	6434321	409806	15.832	14.567	0.811	11.405	9.390	1.328	29.02
116	-32.2240	140.0430	6434332	409815	9.919	10.469	0.823	11.354	9.242	1.338	29.06
117	-32.2239	140.0429	6434332	409815	12.780	7.906	1.403	11.006	9.372	1.617	29.04
118	-32.2238	140.0429	6434343	409805	9.793	7.269	2.173	11.901	11.062	2.366	29.07
119	-32.2237	140.0429	6434365	409815	6.708	6.650	2.878	14.625	14.394	3.120	29.04
120	-32.2236	140.0430	6434377	409824	20.306	23.015	4.553	14.568	15.524	3.314	28.93
121	-32.2234	140.0431	6434388	409824	23.536	27.132	4.591	15.021	17.010	3.047	28.93
122	-32.2231	140.0429	6434432	409814	12.498	13.556	2.372	15.811	18.027	2.679	29.01
123	-32.2228	140.0429	6434454	409814	12.055	14.699	0.839	13.809	14.648	2.116	29.03
124	-32.2226	140.0428	6434487	409795	10.658	11.735	1.041	10.868	11.197	1.488	29.04
125	-32.2224	140.0426	6434509	409785	10.298	6.118	1.737	10.287	10.575	1.487	29.06
126	-32.2222	140.0425	6434531	409776	8.833	9.875	1.449	9.585	9.406	1.955	29.08
127	-32.2219	140.0427	6434554	409785	9.589	10.446	2.367	9.639	8.814	2.282	29.06
128	-32.2217	140.0430	6434576	409813	8.547	8.855	3.179	9.845	9.810	2.464	29.01
129	-32.2215	140.0432	6434598	409841	10.930	8.776	2.679	10.717	9.349	2.780	29.08
130	-32.2212	140.0434	6434632	409859	11.324	11.099	2.645	11.038	9.098	2.690	29.02
131	-32.2210	140.0435	6434665	409869	13.192	7.570	3.030	12.721	10.814	2.316	28.99
132	-32.2207	140.0435	6434699	409868	11.197	9.188	1.916	14.304	12.234	1.945	29.03
133	-32.2205	140.0435	6434710	409868	16.959	17.435	1.309	14.789	13.286	1.601	28.94
134	-32.2204	140.0433	6434721	409849	18.846	15.879	0.826	15.137	15.116	1.099	28.92
135	-32.2205	140.0433	6434721	409849	13.753	16.357	0.926	15.282	15.863	0.951	29.03
136	-32.2203	140.0430	6434742	409821	14.930	16.723	0.518	13.908	14.273	0.974	29.00
137	-32.2200	140.0428	6434775	409792	11.924	12.922	1.176	12.938	14.265	1.001	29.04
138	-32.2197	140.0427	6434798	409783	10.089	9.483	1.424	14.241	16.556	0.974	29.08
139	-32.2196	140.0427	6434820	409792	13.997	15.839	0.961	19.593	20.575	1.038	28.99
140	-32.2195	140.0428	6434831	409792	20.268	27.816	0.792	24.756	25.710	0.859	28.88
141	-32.2195	140.0428	6434820	409792	41.686	36.818	0.839	28.463	33.313	0.712	28.73
142	-32.2196	140.0428	6434809	409801	37.738	38.596	0.277	32.054	39.372	0.669	28.82
143	-32.2197	140.0430	6434809	409811	28.624	47.497	0.688	32.828	40.243	0.742	28.82
144	-32.2197	140.0432	6434809	409830	31.955	46.132	0.748	29.349	39.571	0.795	28.80
145	-32.2195	140.0431	6434820	409830	24.137	32.174	1.160	24.732	35.742	0.874	28.89
146	-32.2193	140.0431	6434853	409820	24.290	33.457	1.104	22.754	29.592	1.019	28.89
147	-32.2188	140.0430	6434898	409810	14.655	19.447	0.671	19.229	22.793	1.050	28.92
148	-32.2190	140.0430	6434875	409810	18.734	16.747	1.412	16.339	17.892	1.050	28.93
149	-32.2186	140.0430	6434931	409819	14.330	12.140	0.901	14.328	14.473	1.096	28.99
150	-32.2183	140.0431	6434953	409828	9.684	7.667	1.161	14.731	14.086	1.305	29.08
151	-32.2181	140.0431	6434975	409819	14.235	16.362	1.337	13.066	12.574	1.656	29.03
152	-32.2179	140.0431	6434997	409819	16.670	17.516	1.716	12.638	12.097	2.089	28.95
153	-32.2177	140.0431	6435031	409828	10.411	9.185	3.162	13.185	13.141	2.499	28.99
154	-32.2173	140.0432	6435064	409827	12.188	9.755	3.068	13.338	11.935	2.584	29.03
155	-32.2170	140.0430	6435097	409818	12.421	12.888	3.211	12.973	11.145	2.704	29.02

156	-32.2167	140.0428	6435141	409789	15.001	10.332	1.764	13.079	11.549	2.684	29.04
157	-32.2163	140.0425	6435174	409760	14.846	13.566	2.314	11.972	12.000	2.478	29.01
158	-32.2159	140.0422	6435218	409732	10.938	11.203	3.065	11.142	11.576	2.171	29.00
159	-32.2160	140.0422	6435218	409732	6.656	12.012	2.036	10.071	11.452	1.986	29.06
160	-32.2158	140.0421	6435241	409732	8.268	10.765	1.674	8.519	10.019	1.806	29.04
161	-32.2156	140.0421	6435263	409731	9.644	9.712	0.843	8.220	9.444	1.600	29.08
162	-32.2153	140.0421	6435285	409722	7.087	6.402	1.412	9.345	9.377	1.553	29.10
163	-32.2150	140.0420	6435329	409712	9.444	8.326	2.034	9.845	9.283	1.637	29.08
164	-32.2147	140.0420	6435362	409712	12.281	11.679	1.802	10.017	9.145	1.912	29.01
165	-32.2144	140.0420	6435396	409721	10.769	10.293	2.094	10.396	9.572	1.888	29.04
166	-32.2141	140.0421	6435429	409720	10.501	9.023	2.216	11.094	9.942	2.071	29.07
167	-32.2137	140.0422	6435473	409729	8.984	8.537	1.295	11.718	9.183	2.344	29.08
168	-32.2133	140.0423	6435507	409748	12.936	10.179	2.948	12.280	9.000	2.598	29.04
169	-32.2133	140.0423	6435507	409739	15.402	7.883	3.168	12.930	9.866	2.543	28.98
170	-32.2134	140.0425	6435507	409767	13.577	9.379	3.365	14.073	10.959	2.960	29.05
171	-32.2131	140.0425	6435540	409767	13.752	13.353	1.937	14.989	12.429	2.912	29.04
172	-32.2125	140.0428	6435607	409785	14.699	13.999	3.384	15.457	13.726	2.828	28.98
173	-32.2123	140.0429	6435629	409794	17.515	17.529	2.706	15.521	14.868	2.791	28.99
174	-32.2121	140.0429	6435651	409803	17.739	14.368	2.748	15.545	14.725	2.895	29.00
175	-32.2119	140.0431	6435663	409813	13.901	15.093	3.178	14.925	14.925	2.722	28.99
176	-32.2116	140.0431	6435696	409822	13.873	12.636	2.460	13.995	13.923	2.707	29.02
177	-32.2114	140.0431	6435729	409821	11.598	15.001	2.516	13.860	14.103	2.779	28.97
178	-32.2113	140.0431	6435729	409821	12.865	12.517	2.631	14.741	14.502	2.888	28.99
179	-32.2114	140.0432	6435718	409822	17.063	15.270	3.110	15.576	15.137	3.124	29.00
180	-32.2112	140.0432	6435740	409821	18.307	17.085	3.721	16.571	14.872	3.091	28.94
181	-32.2111	140.0430	6435762	409812	18.049	15.813	3.643	16.028	15.641	2.962	28.91
182	-32.2108	140.0429	6435795	409793	16.569	13.673	2.353	15.436	14.628	2.764	28.97
183	-32.2106	140.0429	6435806	409792	10.153	16.363	1.984	13.945	13.328	2.521	29.01
184	-32.2106	140.0430	6435818	409811	14.103	10.206	2.117	11.927	12.054	2.089	29.05
185	-32.2105	140.0431	6435818	409821	10.851	10.583	2.511	10.673	10.858	1.995	29.08
186	-32.2104	140.0432	6435829	409830	7.960	9.445	1.480	10.020	9.501	1.920	29.10
187	-32.2103	140.0433	6435840	409830	10.297	7.691	1.885	9.143	8.231	1.872	29.10
188	-32.2101	140.0434	6435862	409839	6.887	9.582	1.606	8.460	7.914	1.703	29.08
189	-32.2099	140.0434	6435885	409848	9.722	3.853	1.877	8.447	7.508	1.751	29.05
190	-32.2097	140.0435	6435907	409858	7.433	9.001	1.666	7.252	7.431	1.795	29.10
191	-32.2095	140.0435	6435940	409848	7.893	7.413	1.723	7.215	7.092	1.965	29.06
192	-32.2093	140.0432	6435951	409829	4.322	7.306	2.105	6.448	8.948	1.976	29.09
193	-32.2091	140.0431	6435984	409810	6.707	7.888	2.456	6.347	8.799	1.963	29.08
194	-32.2088	140.0430	6436017	409809	5.883	13.133	1.933	6.134	9.493	1.952	29.04
195	-32.2085	140.0429	6436050	409790	6.929	8.254	1.597	7.038	9.487	1.829	29.14
196	-32.2082	140.0427	6436083	409771	6.828	10.885	1.669	8.726	9.067	1.951	29.11
197	-32.2081	140.0427	6436084	409781	8.843	7.274	1.488	9.221	7.959	1.872	29.08
198	-32.2080	140.0426	6436094	409762	15.148	5.790	3.068	9.141	7.076	1.819	29.04
199	-32.2078	140.0427	6436128	409771	8.356	7.592	1.538	8.502	5.569	1.712	29.08
200	-32.2077	140.0427	6436139	409771	6.530	3.840	1.334	9.088	5.333	1.571	29.14
201	-32.2073	140.0427	6436172	409770	3.633	3.347	1.129	6.913	4.645	1.371	29.08
202	-32.2071	140.0427	6436205	409779	11.774	6.094	0.787	9.024	5.600	1.147	29.08
203	-32.2067	140.0427	6436239	409779	4.270	2.354	2.069	10.588	8.599	0.960	29.13
204	-32.2065	140.0427	6436272	409779	18.914	12.365	0.416	13.089	11.289	0.802	29.02
205	-32.2062	140.0428	6436294	409779	14.348	18.835	0.399	13.899	13.126	0.680	29.03
206	-32.2059	140.0427	6436327	409778	16.139	16.799	0.338	15.939	15.336	0.418	29.05
207	-32.2056	140.0428	6436361	409778	15.826	15.276	0.180	15.200	15.276	0.547	29.00
208	-32.2053	140.0428	6436405	409787	14.466	13.402	0.756	15.289	13.999	0.793	29.01

209	-32.2050	140.0427	6436438	409777	15.223	12.067	1.063	15.063	13.649	1.084	28.99
210	-32.2046	140.0427	6436472	409777	14.790	12.449	1.627	16.260	14.813	1.630	28.98
211	-32.2044	140.0427	6436505	409777	15.011	15.052	1.793	17.464	15.959	2.105	29.00
212	-32.2043	140.0428	6436505	409777	21.807	21.095	2.910	19.518	17.699	2.460	28.90
213	-32.2044	140.0428	6436505	409777	20.486	19.133	3.135	20.227	19.914	2.352	28.95
214	-32.2040	140.0428	6436549	409786	25.496	20.764	2.834	20.783	20.073	2.339	28.82
215	-32.2038	140.0428	6436560	409786	18.334	23.526	1.090	19.809	18.525	2.189	28.96
216	-32.2037	140.0428	6436582	409786	17.790	15.848	1.728	19.430	18.175	2.015	28.92
217	-32.2034	140.0427	6436605	409776	16.941	13.354	2.156	17.638	19.032	1.691	28.96
218	-32.2032	140.0426	6436638	409766	18.589	17.384	2.267	17.946	17.702	1.744	28.95
219	-32.2030	140.0426	6436660	409766	16.540	25.046	1.216	18.039	18.395	1.930	28.96
220	-32.2029	140.0427	6436671	409766	19.874	16.876	1.351	18.131	19.413	1.788	28.94
221	-32.2027	140.0426	6436693	409766	18.251	19.314	2.656	18.103	19.552	1.648	28.94
222	-32.2026	140.0427	6436704	409766	17.400	18.443	1.451	17.829	18.402	1.816	28.96
223	-32.2024	140.0427	6436726	409765	18.449	18.081	1.565	17.463	18.488	1.794	28.97
224	-32.2021	140.0427	6436760	409775	15.172	19.297	2.056	17.131	18.321	1.526	28.94
225	-32.2018	140.0427	6436782	409765	18.044	17.307	1.241	17.686	17.826	1.449	28.95
226	-32.2015	140.0428	6436815	409774	16.590	18.476	1.316	17.128	18.293	1.344	29.01
227	-32.2012	140.0429	6436848	409783	20.173	15.971	1.067	16.469	17.491	1.194	29.02
228	-32.2009	140.0425	6436881	409745	15.660	20.412	1.038	15.008	15.911	1.198	28.95
229	-32.2006	140.0424	6436915	409745	11.877	15.292	1.308	12.314	12.761	1.321	29.04
230	-32.2003	140.0424	6436948	409745	10.741	9.407	1.264	9.636	10.860	1.430	29.04
231	-32.2001	140.0425	6436981	409754	3.118	2.724	1.930	9.102	9.437	1.423	29.08
232	-32.1999	140.0426	6437003	409754	6.784	6.463	1.612	9.478	8.985	1.449	29.09
233	-32.1996	140.0426	6437037	409763	12.990	13.301	1.004	9.440	9.348	1.414	29.06
234	-32.1991	140.0426	6437092	409762	13.758	13.029	1.437	11.522	10.888	1.292	29.04
235	-32.1986	140.0427	6437137	409771	10.548	11.223	1.086	12.598	12.180	1.240	29.06
236	-32.1982	140.0427	6437192	409771	13.530	10.425	1.319	12.452	11.329	1.392	29.04
237	-32.1977	140.0429	6437236	409780	12.163	12.922	1.352	12.678	10.542	1.534	29.04
238	-32.1974	140.0430	6437281	409798	12.261	9.045	1.768	13.766	9.713	1.626	29.06
239	-32.1971	140.0432	6437314	409817	14.888	9.095	2.145	14.714	10.980	1.586	29.02
240	-32.1969	140.0434	6437337	409826	15.989	7.079	1.547	15.071	11.448	1.442	29.00
241	-32.1966	140.0435	6437359	409835	18.268	16.761	1.118	15.574	13.213	1.316	28.93
242	-32.1965	140.0434	6437370	409835	13.948	15.259	0.630	14.988	14.338	1.124	29.02
243	-32.1964	140.0436	6437392	409854	14.777	17.871	1.140	14.313	15.291	1.075	28.99
244	-32.1961	140.0437	6437415	409854	11.957	14.722	1.183	13.269	13.736	1.222	29.08
245	-32.1958	140.0437	6437448	409863	12.616	11.844	1.303	12.109	12.655	1.617	29.00
246	-32.1956	140.0439	6437470	409881	13.048	8.984	1.854	13.537	11.068	1.796	29.03
247	-32.1956	140.0438	6437470	409872	8.148	9.856	2.604	14.995	11.102	1.943	29.04
248	-32.1954	140.0437	6437492	409853	21.918	9.934	2.035	16.380	11.555	2.127	28.96
249	-32.1952	140.0438	6437514	409872	19.244	14.891	1.920	16.547	12.380	2.545	28.99
250	-32.1949	140.0438	6437548	409862	19.543	14.108	2.222	18.320	13.004	2.321	29.00
251	-32.1947	140.0438	6437570	409862	13.884	13.112	3.945	16.364	14.433	2.177	28.98
252	-32.1946	140.0438	6437592	409861	17.012	12.975	1.483	14.649	13.804	2.001	29.00
253	-32.1944	140.0437	6437614	409852	12.139	17.080	1.314	12.365	13.064	1.744	29.06
254	-32.1942	140.0436	6437625	409852	10.666	11.743	1.042	12.243	13.150	1.179	29.02
255	-32.1938	140.0437	6437669	409851	8.126	10.407	0.936	10.754	12.677	1.158	29.08
256	-32.1935	140.0437	6437714	409851	13.275	13.546	1.117	10.656	11.381	1.153	29.06
257	-32.1932	140.0437	6437747	409860	9.562	10.607	1.381	10.898	10.271	1.251	29.00
258	-32.1929	140.0438	6437769	409860	11.653	10.602	1.290	10.954	10.386	1.331	29.08
259	-32.1927	140.0437	6437803	409860	11.873	6.195	1.529	10.316	9.781	1.374	29.03
260	-32.1924	140.0435	6437825	409840	8.405	10.980	1.336	10.499	9.326	1.272	29.01
261	-32.1922	140.0432	6437858	409802	10.086	10.524	1.335	9.824	9.543	1.187	29.05

262	-32.1919	140.0431	6437891	409802	10.476	8.332	0.872	9.025	10.592	1.038	29.06
263	-32.1915	140.0429	6437924	409783	8.281	11.687	0.862	9.609	10.353	0.911	29.07
264	-32.1912	140.0429	6437968	409773	7.877	11.437	0.787	9.320	10.900	0.862	29.12
265	-32.1908	140.0429	6438012	409773	11.326	9.783	0.701	8.935	11.512	0.856	29.07
266	-32.1904	140.0429	6438046	409773	8.638	13.259	1.090	9.036	12.186	0.872	29.04
267	-32.1901	140.0430	6438079	409782	8.551	11.394	0.843	10.227	12.809	0.957	29.07
268	-32.1899	140.0430	6438101	409781	8.785	15.055	0.940	11.146	13.863	0.950	29.03
269	-32.1896	140.0430	6438146	409781	13.836	14.552	1.211	13.515	15.650	0.837	29.04
270	-32.1892	140.0430	6438179	409781	15.920	15.057	0.666	15.540	16.329	0.802	29.02
271	-32.1890	140.0430	6438201	409790	20.481	22.195	0.523	16.559	17.679	0.721	28.95
272	-32.1888	140.0431	6438223	409790	18.677	14.787	0.668	16.734	18.957	0.603	28.99
273	-32.1886	140.0430	6438245	409780	13.881	21.803	0.539	16.502	19.516	0.610	29.00
274	-32.1884	140.0429	6438267	409771	14.713	20.942	0.621	15.054	19.035	0.638	29.00
275	-32.1883	140.0428	6438278	409770	14.759	17.851	0.697	14.078	19.646	0.585	28.94
276	-32.1886	140.0433	6438257	409818	13.241	19.793	0.665	15.276	18.635	0.628	29.00
277	-32.1883	140.0435	6438279	409836	13.798	17.841	0.404	16.947	16.813	0.771	29.04
278	-32.1880	140.0436	6438312	409846	19.868	16.748	0.755	18.277	16.258	1.181	29.02
279	-32.1877	140.0438	6438357	409855	23.072	11.831	1.333	20.112	15.797	1.462	28.93
280	-32.1876	140.0438	6438368	409864	21.406	15.075	2.750	21.142	15.509	1.659	28.92
281	-32.1875	140.0438	6438379	409864	22.417	17.491	2.068	20.072	16.569	1.652	28.94
282	-32.1873	140.0437	6438390	409845	18.947	16.402	1.389	19.005	17.231	1.522	29.02
283	-32.1872	140.0437	6438401	409845	14.518	22.047	0.720	18.725	18.235	0.985	28.96
284	-32.1870	140.0437	6438423	409845	17.736	15.139	0.681	18.241	18.755	0.580	29.01
285	-32.1868	140.0437	6438445	409844	20.006	20.098	0.065	17.685	18.525	0.354	28.94
286	-32.1866	140.0437	6438479	409854	19.999	20.090	0.045	17.856	17.033	0.278	28.95
287	-32.1862	140.0437	6438512	409844	16.165	15.253	0.257	17.952	17.661	0.294	29.00
288	-32.1860	140.0437	6438534	409844	15.374	14.585	0.341	17.132	17.488	0.409	28.96
289	-32.1858	140.0438	6438556	409853	18.216	18.279	0.764	17.509	17.454	0.498	28.94
290	-32.1856	140.0438	6438579	409853	15.907	19.231	0.639	18.056	18.643	0.736	29.02
291	-32.1855	140.0436	6438601	409843	21.884	19.924	0.487	17.883	18.128	1.078	28.98
292	-32.1853	140.0437	6438612	409843	18.900	21.196	1.451	18.339	18.391	1.067	28.92
293	-32.1852	140.0436	6438623	409833	14.507	12.012	2.050	18.696	18.847	1.175	28.98
294	-32.1850	140.0435	6438645	409833	20.499	19.591	0.710	18.512	18.672	1.240	28.96
295	-32.1848	140.0435	6438678	409833	17.690	21.513	1.177	19.454	18.048	1.275	28.96
296	-32.1846	140.0434	6438700	409823	20.964	19.048	0.813	20.478	18.668	1.248	28.94
297	-32.1843	140.0434	6438722	409823	23.611	18.076	1.624	18.545	16.642	1.867	28.96
298	-32.1840	140.0434	6438756	409813	19.629	15.114	1.915	17.004	13.704	2.198	28.99
299	-32.1839	140.0433	6438778	409804	10.832	9.460	3.809	14.914	11.910	2.481	29.06
300	-32.1839	140.0433	6438778	409813	9.986	6.825	2.832	12.149	9.814	2.689	29.03
301	-32.1840	140.0433	6438756	409813	10.510	10.077	2.226	9.736	8.649	3.040	29.04
302	-32.1835	140.0431	6438822	409794	9.787	7.593	2.662	9.033	8.613	2.995	29.07
303	-32.1828	140.0433	6438889	409803	7.564	9.292	3.670	8.493	8.679	3.088	28.98
304	-32.1826	140.0433	6438911	409803	7.317	9.281	3.583	8.053	8.292	3.357	29.06
305	-32.1825	140.0432	6438933	409793	7.285	7.153	3.298	7.365	8.273	3.465	29.08
306	-32.1825	140.0431	6438922	409784	8.313	8.144	3.573	7.779	7.952	3.363	29.02
307	-32.1824	140.0431	6438944	409783	6.346	7.498	3.202	7.518	8.086	3.370	29.09
308	-32.1821	140.0430	6438977	409774	9.634	7.686	3.161	7.679	8.784	3.245	29.03
309	-32.1818	140.0429	6438999	409773	6.011	9.948	3.617	8.148	9.112	2.968	29.04
310	-32.1816	140.0429	6439032	409764	8.092	10.643	2.672	8.559	9.388	2.624	29.06
311	-32.1813	140.0429	6439054	409764	10.660	9.784	2.187	8.374	9.369	2.366	29.07
312	-32.1811	140.0430	6439077	409782	8.397	8.878	1.482	8.562	9.244	1.960	29.10
313	-32.1809	140.0431	6439110	409791	8.713	7.593	1.869	8.227	8.995	1.793	29.10
314	-32.1806	140.0431	6439132	409791	6.946	9.320	1.591	7.760	8.994	1.813	29.06

WEEKEROO SOUTHERN SUB-TRAVERSE

Sample Number	Latitude	Longitude	Easting	Northing	Non-smoothed Data			Smoothed Data			Livetime
					U ppm	Th ppm	K %	U ppm	Th ppm	K%	
141	-32.23403	140.03235	408826	6433204	10.297	4.5533	1.773				29.088
142	-32.23430	140.03257	408845	6433171	8.4529	10.51	1.94				29.06
143	-32.23452	140.03273	408864	6433149	10.361	9.715	1.439	9.72	8.649	1.533	29.08
144	-32.23473	140.03292	408883	6433127	11.427	9.042	1.015	8.907	8.832	1.484	29.04
145	-32.23492	140.03308	408893	6433104	8.0627	9.4261	1.497	8.677	8.66	1.588	29.124
146	-32.23507	140.03318	408903	6433093	6.2328	5.4696	1.529	8.431	9.036	2.249	29.084
147	-32.23520	140.03328	408912	6433071	7.3034	9.6495	2.461	7.868	9.394	2.933	29.076
148	-32.23567	140.03365	408950	6433027	9.1296	11.595	4.741	8.475	9.225	3.682	29.04
149	-32.23585	140.03387	408969	6433005	8.6121	10.832	4.439	10.11	10.21	4.146	29.028
150	-32.23605	140.03407	408988	6432983	11.097	8.5801	5.241	11.15	9.977	4.327	29.052
151	-32.23622	140.03430	409017	6432961	14.414	10.418	3.848	11.79	9.361	4.116	29.004
152	-32.23642	140.03450	409036	6432939	12.498	8.458	3.367	12.79	9.156	3.741	29.028
153	-32.23662	140.03470	409055	6432917	12.31	8.5176	3.684	14.13	11.87	3.505	29.032
154	-32.23727	140.03472	409056	6432851	13.621	9.8077	2.564	14.49	14.29	3.461	29.012
157	-32.23735	140.03515	409093	6432840	17.824	22.137	4.062	16.47	15.73	3.575	28.964
155	-32.23747	140.03510	409093	6432829	16.203	22.532	3.628	16.5	17.38	3.389	28.94
156	-32.23743	140.03517	409093	6432829	22.416	15.656	3.937	16.47	18.44	3.524	28.912
158	-32.23740	140.03520	409103	6432829	12.433	16.765	2.756	15.66	16.51	3.3	28.984
159	-32.23753	140.03517	409094	6432818	13.457	15.133	3.237	14.87	14.7	3.301	29.016
160	-32.23768	140.03527	409103	6432807	13.773	12.462	2.941	13.4	13.75	3.264	28.992
161	-32.23775	140.03538	409113	6432796	12.264	13.506	3.637	14.78	12.05	3.403	28.972
162	-32.23800	140.03547	409122	6432763	15.063	10.863	3.75	15.45	11.37	3.521	28.996
167	-32.23815	140.03633	409207	6432753	19.318	8.293	3.45	15.8	11.99	3.729	28.98
163	-32.23813	140.03558	409132	6432752	16.837	11.745	3.829	16.5	12.03	3.757	28.968
164	-32.23815	140.03573	409151	6432752	15.515	15.551	3.981	16.42	12.98	3.777	28.992
165	-32.23818	140.03590	409170	6432752	15.788	13.681	3.776	15.76	13.68	3.878	28.964
166	-32.23822	140.03605	409179	6432741	14.621	15.622	3.848	15.35	12.37	3.907	29
168	-32.23822	140.03627	409198	6432741	16.053	11.819	3.955	14.76	10.27	3.788	29.02
169	-32.23830	140.03632	409207	6432730	14.772	5.1745	3.974	13.68	7.724	3.853	28.996
170	-32.23838	140.03645	409217	6432730	12.563	5.0607	3.385	13.67	6.449	3.647	29.028
171	-32.23840	140.03667	409236	6432720	10.411	0.9443	4.102	12.76	5.331	3.544	29.016
172	-32.23847	140.03692	409264	6432720	14.56	9.2465	2.817	11.98	6.597	3.43	28.944
173	-32.23867	140.03710	409283	6432698	11.477	6.2291	3.441	12.01	7.576	3.337	29.016
174	-32.23885	140.03732	409302	6432676	10.913	11.505	3.407	11.64	10.15	3.154	29.016
175	-32.23907	140.03745	409312	6432654	12.677	9.9561	2.917	11.02	10.73	3.194	29.004
176	-32.23925	140.03772	409340	6432632	8.5817	13.8	3.189	11.13	11.49	3.085	29.036
177	-32.23943	140.03800	409369	6432610	11.465	12.171	3.017	11.35	11.86	2.915	29.036
178	-32.23965	140.03825	409388	6432588	11.992	10.001	2.895	10.72	12.18	2.868	29.064
179	-32.24003	140.03857	409416	6432544	12.024	13.367	2.556	11.03	11.46	2.871	29.016
180	-32.24035	140.03873	409436	6432511	9.5158	11.545	2.682	10.35	11.29	2.595	29.044
181	-32.24097	140.03893	409455	6432444	10.173	10.239	3.205	9.771	10.37	2.319	29.048
182	-32.24113	140.03920	409483	6432422	8.0264	11.281	1.636	9.125	9.624	2.112	29.096
183	-32.24128	140.03943	409502	6432411	9.1153	5.4201	1.515	8.625	9.129	1.928	29.108
184	-32.24145	140.03965	409521	6432389	8.7926	9.6361	1.522	7.459	8.796	1.648	29.064
185	-32.24160	140.03985	409540	6432367	7.0158	9.07	1.76	7.281	8.183	1.605	29.068
186	-32.24177	140.04013	409569	6432357	4.3454	8.5716	1.806	6.387	9.076	1.721	29.076
187	-32.24198	140.04042	409597	6432335	7.1369	8.2193	1.421				29.104
188	-32.24218	140.04072	409626	6432313	4.6458	9.882	2.095				29.072

WEEKEROO NORTHERN SUB-TRAVERSE

Sample Number	Latitude	Longitude	Easting	Northing	Non-smoothed Data			Smoothed Data			Livetime
					U ppm	Th ppm	K %	U ppm	Th ppm	K%	
1	-32.15832	140.01395	407016	6441579	7.9754	6.8534	1.654				29.128
2	-32.15865	140.01393	407016	6441546	7.8405	5.5951	1.81				29.096
3	-32.15905	140.01388	407007	6441502	7.7255	6.1222	1.765	7.506	7.085	1.784	29.096
4	-32.15945	140.01380	407007	6441457	7.5503	7.9543	1.687	7.41	7.462	1.793	29.092
5	-32.15985	140.01373	406998	6441413	6.439	8.8987	2.003	7.213	8.005	1.794	29.076
6	-32.16023	140.01363	406989	6441369	7.4938	8.7414	1.698	7.237	8.109	1.807	29.096
7	-32.16060	140.01362	406990	6441324	6.8569	8.3084	1.818	7.395	7.89	1.852	29.080
8	-32.16095	140.01362	406990	6441291	7.8457	6.6442	1.829	7.612	7.552	1.844	29.076
9	-32.16127	140.01360	406990	6441258	8.3386	6.8578	1.91	7.757	7.66	1.964	29.096
10	-32.16163	140.01367	406991	6441213	7.525	7.2103	1.962	8.269	7.618	2.057	29.096
11	-32.16202	140.01370	407001	6441169	8.2204	9.2778	2.302	8.48	8.897	2.411	29.060
12	-32.16238	140.01372	407001	6441136	9.4132	8.0982	2.283	9.123	9.536	2.64	29.088
13	-32.16278	140.01393	407020	6441092	8.9009	13.039	3.601	9.814	10.7	2.869	29.032
14	-32.16295	140.01395	407020	6441070	11.558	10.054	3.052	10.48	10.63	3.273	29.096
15	-32.16308	140.01387	407011	6441058	10.977	13.012	3.109	10.86	11.73	3.323	29.044
18	-32.16313	140.01340	406973	6441047	14.875	18.069	4.318	11.88	11.62	3.301	28.912
16	-32.16327	140.01385	407011	6441036	11.527	8.9661	2.537	12.06	12.73	3.291	29.048
17	-32.16322	140.01342	406973	6441036	11.354	13.559	3.489	12.26	12.92	3.352	29.016
19	-32.16352	140.01358	406983	6441003	12.566	11.017	3.003	10.15	10.92	3.092	29.020
20	-32.16378	140.01362	406993	6440981	9.0622	6.4748	3.416	8.637	8.459	3.202	29.032
21	-32.16403	140.01358	406984	6440947	2.8945	5.4917	3.015	6.604	5.582	3.025	29.088
22	-32.16410	140.01352	406984	6440936	3.7898	1.2423	3.088	5.294	3.813	2.84	29.060
23	-32.16428	140.01347	406974	6440925	4.7078	3.6821	2.605	4.821	4.578	2.736	29.108
24	-32.16442	140.01358	406984	6440903	6.0152	2.1725	2.077	5.73	5.205	2.669	29.128
25	-32.16468	140.01377	407003	6440881	6.6989	10.302	2.896	7.314	7.077	2.665	29.048
26	-32.16487	140.01385	407013	6440859	7.44	8.6242	2.68	9.16	8.045	2.75	29.068
27	-32.16518	140.01390	407023	6440826	11.709	10.603	3.066	10.78	9.576	2.987	28.996
28	-32.16550	140.01392	407023	6440781	13.938	8.5237	3.029	11.7	8.792	2.927	29.028
29	-32.16575	140.01388	407014	6440759	14.106	9.8274	3.265	12.69	9.217	2.966	29.064
30	-32.16597	140.01393	407023	6440737	11.31	6.3806	2.594	11.95	9.593	2.876	29.076
31	-32.16628	140.01390	407024	6440704	12.381	10.75	2.876	11.08	10.1	2.842	29.040
32	-32.16660	140.01387	407015	6440659	8.036	12.482	2.616	10.39	10.89	2.745	29.028
33	-32.16693	140.01388	407015	6440626	9.545	11.055	2.859	10.41	11.72	2.815	29.016
34	-32.16723	140.01388	407015	6440593	10.68	13.8	2.78	9.712	12.32	2.732	29.012
36	-32.16743	140.01383	407015	6440571	8.892	13.748	2.943	10.53	12.67	2.815	29.012
35	-32.16753	140.01390	407025	6440560	11.406	10.534	2.461	10.31	12.38	2.861	29.048
37	-32.16773	140.01390	407025	6440537	11.029	12.742	3.034	10.66	12.47	3.009	29.032
38	-32.16802	140.01380	407016	6440504	10.648	12.522	3.087	11.3	13.27	3.174	29.044
39	-32.16828	140.01378	407007	6440482	11.308	12.788	3.519	12.12	13.27	3.511	29.008
40	-32.16847	140.01380	407016	6440460	14.608	14.559	3.768	12.68	13.02	3.603	29.016
41	-32.16860	140.01375	407007	6440438	13.01	13.734	4.147	12.69	12.76	3.62	29.012
42	-32.16878	140.01373	407007	6440426	13.819	11.471	3.492	12.84	13.19	3.495	29.020
43	-32.16892	140.01375	407008	6440404	10.729	11.237	3.175	12.04	13.11	3.382	29.008
44	-32.16893	140.01383	407017	6440404	12.044	14.961	2.891	11.62	12.46	3.278	29.040
45	-32.16922	140.01370	407008	6440371	10.575	14.15	3.207	11.14	11.88	3.252	28.972
46	-32.16943	140.01367	406999	6440349	10.942	10.49	3.626	11.12	12.87	3.255	29.008
47	-32.16968	140.01367	406999	6440327	11.397	8.5673	3.363	10.39	11.79	3.198	29.044
48	-32.16998	140.01363	406999	6440293	10.633	16.162	3.19	10.01	12.34	3.171	29.088
49	-32.17027	140.01360	406999	6440260	8.4186	9.5617	2.604	9.987	12.65	3.177	29.048

Sample Number	Latitude	Longitude	Easting	Northing	Non-smoothed Data			Smoothed Data			Livetime
					U ppm	Th ppm	K %	U ppm	Th ppm	K%	
50	-32.17047	140.01360	407000	6440238	8.6661	16.897	3.073	10.24	13.35	3.112	29.052
51	-32.17062	140.01360	407000	6440216	10.822	12.062	3.656	10.45	12.12	3.047	29.032
52	-32.17077	140.01362	407000	6440205	12.677	12.054	3.04	11.11	13.18	2.616	29.020
53	-32.17090	140.01360	407000	6440182	11.674	10.043	2.861	11.47	12.31	2.734	29.032
56	-32.17107	140.01425	407057	6440172	7.4693	5.4464	0.452	9.238	9.096	2.632	29.140
54	-32.17100	140.01367	407000	6440171	11.732	14.82	3.663	10.8	10.99	2.324	29.064
55	-32.17110	140.01375	407010	6440160	10.447	12.566	3.142	10.19	9.494	2.162	29.012
57	-32.17138	140.01420	407057	6440139	9.6194	4.5925	1.503	8.156	6.593	2.343	29.072
58	-32.17173	140.01420	407058	6440094	6.9231	8.0549	2.053	6.93	4.886	1.806	29.132
59	-32.17203	140.01415	407048	6440061	6.3221	2.3066	1.354	6.1	4.827	1.344	29.124
60	-32.17235	140.01407	407039	6440028	4.3177	4.0291	0.976	5.105	4.851	1.184	29.120
61	-32.17267	140.01393	407030	6439994	3.3169	5.1526	0.833	4.643	4.448	0.886	29.136
63	-32.17297	140.01333	406974	6439960	4.6093	6.0413	0.705	4.359	3.618	0.758	29.132
62	-32.17302	140.01397	407031	6439950	4.647	4.7126	0.561	4.4	4.197	0.678	29.160
64	-32.17313	140.01323	406965	6439938	5.1069	1.0471	0.716	4.284	3.261	0.681	29.164
65	-32.17333	140.01323	406965	6439916	4.1173	1.1349	0.576	3.941	2.992	0.699	29.136
66	-32.17358	140.01320	406965	6439894	2.9389	3.3707	0.846	3.995	2.62	0.716	29.156
67	-32.17388	140.01315	406956	6439861	2.9343	3.3654	0.797	3.981	3.114	0.911	29.152
68	-32.17423	140.01322	406966	6439816	4.8777	4.1827	0.644	3.628	3.278	1.085	29.144
69	-32.17452	140.01318	406957	6439783	5.0364	3.5178	1.692	3.821	3.462	1.054	29.176
70	-32.17480	140.01307	406948	6439750	2.3509	1.951	1.446	4.28	3.558	0.959	29.164
71	-32.17508	140.01295	406938	6439727	3.904	4.2931	0.691	4.454	3.892	0.895	29.132
72	-32.17532	140.01295	406939	6439694	5.2302	3.8471	0.321	4.23	3.879	0.595	29.124
74	-32.17535	140.01337	406976	6439694	3.9142	3.4558	0.324	4.179	3.354	0.428	29.184
73	-32.17550	140.01310	406958	6439672	5.7507	5.8501	0.195	4.365	3.947	0.521	29.152
75	-32.17562	140.01333	406977	6439661	3.024	2.2899	0.61	3.58	3.954	0.651	29.172
76	-32.17582	140.01330	406977	6439639	2.9745	1.3275	1.153	3.347	4.09	0.706	29.168
77	-32.17608	140.01347	406986	6439617	2.238	6.8449	0.971	3.618	4.072	0.781	29.132
78	-32.17625	140.01355	406996	6439595	4.5861	6.5341	0.599	4.082	4.448	0.831	29.192
79	-32.17650	140.01363	407006	6439562	5.2659	3.3625	0.573	5.351	5.39	1.068	29.084
80	-32.17677	140.01367	407006	6439540	5.3456	4.1706	0.859	6.609	6.035	1.392	29.096
81	-32.17693	140.01335	406978	6439517	9.3204	6.0357	2.338	7.515	6.845	1.87	29.072
82	-32.17715	140.01335	406978	6439495	8.5275	10.073	2.588	8.434	8.793	2.358	29.040
83	-32.17738	140.01345	406988	6439473	9.1133	10.584	2.993	9.276	9.935	2.604	29.044
84	-32.17753	140.01355	406997	6439451	9.8612	13.099	3.014	9.678	11.12	2.811	29.080
85	-32.17755	140.01350	406997	6439451	9.5561	9.8853	2.085	10.73	11.81	2.928	29.076
86	-32.17775	140.01350	406998	6439429	11.33	11.961	3.373	11.88	12.63	2.938	29.056
87	-32.17785	140.01350	406998	6439417	13.781	13.522	3.173	12.65	12.24	2.911	29.020
88	-32.17803	140.01353	406998	6439395	14.885	14.665	3.046	13.94	13.45	3.153	29.072
89	-32.17820	140.01355	406998	6439373	13.713	11.152	2.876	14.71	13.23	3.285	28.996
90	-32.17842	140.01357	406998	6439351	15.984	15.928	3.299	14.84	13.56	3.506	29.004
91	-32.17875	140.01360	407008	6439318	15.189	10.876	4.032	14.7	13.72	3.769	29.020
92	-32.17898	140.01367	407008	6439296	14.44	15.165	4.277	15.25	13.89	3.885	29.016
93	-32.17925	140.01375	407018	6439262	14.195	15.487	4.361	14.52	13.19	3.898	28.976
94	-32.17947	140.01375	407018	6439240	16.435	12.018	3.457	13.88	12.76	3.816	28.932
97	-32.17942	140.01358	406999	6439240	10.637	13.364	3.36	11.18	11.24	3.57	29.000
95	-32.17957	140.01370	407018	6439229	12.355	12.427	3.622	13.12	12.4	3.305	29.016
96	-32.17955	140.01358	406999	6439229	11.963	8.7264	3.05	12.2	10.84	3.204	29.048
98	-32.17983	140.01353	407000	6439196	9.6307	7.6791	3.036	10.75	10.99	3.362	29.004
99	-32.18003	140.01355	407000	6439174	11.301	14.021	2.951	11.32	11.83	3.278	29.008
100	-32.18013	140.01358	407000	6439163	10.239	11.167	4.153	12.15	11.33	3.405	28.980

Sample Number	Latitude	Longitude	Easting	Northing	Non-smoothed Data			Smoothed Data			Livetime
					U ppm	Th ppm	K %	U ppm	Th ppm	K%	
101	-32.18032	140.01358	407000	6439140	14.77	12.9	3.202	12.43	12.05	3.546	29.020
102	-32.18048	140.01363	407010	6439129	14.812	10.859	3.685	12.76	10.94	3.41	29.044
103	-32.18073	140.01360	407010	6439096	11.011	11.286	3.737	12.82	9.726	2.953	28.996
104	-32.18107	140.01353	407001	6439063	12.963	8.51	2.271	11.85	8.815	2.804	29.076
105	-32.18127	140.01350	407001	6439041	10.546	5.0744	1.868	10.53	8.943	2.732	29.028
106	-32.18133	140.01355	407001	6439030	9.9406	8.344	2.459	9.959	7.947	2.671	29.036
107	-32.18165	140.01358	407002	6438996	8.213	11.499	3.324	8.597	7.234	2.912	29.056
108	-32.18203	140.01358	407002	6438952	8.1305	6.3097	3.433	8.807	7.883	3.426	29.048
109	-32.18232	140.01355	407002	6438919	6.1552	4.9426	3.475	9.233	7.735	3.708	29.120
111	-32.18243	140.01352	407002	6438908	12.071	7.6038	4.441	8.826	6.22	3.758	29.012
112	-32.18245	140.01355	407002	6438908	8.2824	5.3034	3.866	9.018	6.023	3.71	29.064
110	-32.18253	140.01355	407002	6438896	11.593	8.3216	3.575	9.247	6.496	3.536	29.020
113	-32.18250	140.01357	407002	6438896	6.0289	4.9303	3.196	8.069	4.894	3.15	29.068
114	-32.18260	140.01353	407003	6438885	7.1143	3.956	2.605	8	4.763	2.995	29.076
115	-32.18275	140.01358	407003	6438874	6.8457	2.6746	2.507	8.754	5.859	2.832	29.032
116	-32.18302	140.01368	407012	6438841	11.729	6.952	3.09	10.65	7.044	2.608	28.976
117	-32.18322	140.01367	407013	6438819	12.053	10.782	2.763	11.73	8.072	2.547	29.012
118	-32.18335	140.01365	407013	6438808	15.487	10.857	2.073	12.69	9.601	2.648	29.004
119	-32.18335	140.01375	407022	6438808	12.548	9.0952	2.301	11.99	10.66	2.651	29.032
120	-32.18340	140.01380	407032	6438797	11.623	10.317	3.013	11.62	10.53	2.604	29.060
121	-32.18357	140.01390	407041	6438786	8.2358	12.239	3.105	9.854	10.06	2.793	29.080
122	-32.18373	140.01397	407041	6438764	10.215	10.149	2.525	9.709	11.6	2.486	29.040
123	-32.18372	140.01400	407051	6438764	6.6489	8.4803	3.02	9.621	11.93	2.142	29.100
124	-32.18418	140.01385	407032	6438719	11.822	16.8	0.768	10.68	13.87	1.791	29.032
126	-32.18415	140.01388	407032	6438719	13.533	21.957	1.293	14.03	16.02	1.363	28.972
125	-32.18422	140.01397	407042	6438708	11.181	11.981	1.35	11.77	14.7	0.774	29.040
127	-32.18433	140.01382	407033	6438697	15.651	14.297	0.382	14.51	15.92	0.706	28.968
128	-32.18445	140.01382	407033	6438686	17.939	15.083	0.078	14.83	16.71	0.604	28.936
129	-32.18455	140.01378	407023	6438675	14.265	16.259	0.429	14.87	14.74	0.479	29.000
130	-32.18477	140.01373	407024	6438653	12.772	15.941	0.781	14.64	15.23	0.506	28.996
131	-32.18502	140.01375	407024	6438620	13.725	12.141	0.724	13.19	15.14	0.689	29.068
132	-32.18523	140.01372	407024	6438597	14.475	16.75	0.52	13.56	15.1	0.742	29.032
133	-32.18550	140.01368	407015	6438564	10.711	14.608	0.99	13.68	15.66	0.714	29.012
134	-32.18580	140.01358	407006	6438531	16.135	16.076	0.692	13.84	16.53	0.647	29.032
135	-32.18612	140.01353	407006	6438497	13.337	18.715	0.646	13.95	16.59	0.793	29.028
136	-32.18643	140.01348	406997	6438464	14.546	16.5	0.385	15.13	16.78	0.772	28.976
137	-32.18667	140.01350	407007	6438442	15.042	17.047	1.254	15.04	16.33	0.8	29.032
138	-32.18688	140.01345	406997	6438420	16.61	15.547	0.883	15.41	16.2	0.853	29.004
139	-32.18712	140.01343	406998	6438386	15.685	13.816	0.831				28.992
140	-32.18720	140.01345	406998	6438375	15.17	18.106	0.909				28.928