Note on Geology and Radiometrics in the vicinity of Yiyintyi Drill Holes 11BLRC0174 to 11BLRC0176; Borroloola Project, NT

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SUMMARY

Three exploratory reverse circulation boreholes designed to test for unconformity-related uranium mineralized zones at the base of the Yiyintyi Sandstone near the north-eastern end of the Yiyintyi Range have not convincingly accounted for a nearby airborne radiometric anomaly, did not penetrate to the base of the Yiyintyi Sandstone, and did not intersect any significantly mineralized or altered zones. Data from a limited ground radiometric traverse suggests that above background radiation levels are associated with organic-rich soils in ephemeral marshes and salt pans along the foot of the Yiyintyi Range.

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INTRODUCTION

In late October to early November 2011, Sandfire Resources NL drilled three exploratory reverse circulation percussion drill holes (11BLRCs 0174 to 0176) to test a radiometric anomaly at the western foot of the north-eastern limb of the Yiyintyi Range in a location potentially favourable for unconformity-related uranium deposits.

This note records our observations and interpretations based on logging of the RC cuttings (PK) and a one and a half-day geological reconnaissance (WH) in early November, 2011.

GEOLOGICAL SETTING

The prospective area is located at the eastern edge of the Mesozoic-Cainozoic 'embayment' in the Yiyintyi Range, about 10 kilometres south southwest of Mount Young (Figure 1). The Yiyintyi Range in that vicinity is composed of pale pink to grey medium-grained quartz sandstone, generally moderately poorly sorted and in medium to thick diffuse planar bedforms. The beds dip (and almost certainly face) between 20° and 40° to the northeast (Figure 2 and Figure 10). The bedding strike trends vary locally between about 300° to 350°, not related to folding but apparently due to mega-scale cross bedding, which is not observable in individual beds (Figure 3). Their composition, texture and bedforms are perfectly consistent with the Yiyintyi Sandstone formation, as mapped by NTGS.

Silicified and locally hematite-stained monomict breccias, overprinted by stockworks of drusy quartz veinlets, exist in a northeast (040°) trending five to twenty-metre-wide fracture zone, prominent in outcrop and as a photo-linear feature (Figure 4, 5 & 10). This is presumably a fault zone, possibly of only minor rotational displacement: the bedding dips are gentler on the northwest side whereas the lithofacies and strike trends are similar on both s ides.

At the foot of the Range, in the vicinity of the drill hole collars, there is a 50-100-m-wide strip of discontinuous low outcrops of massive, non-sorted, clast supported, pebbly to coarse cobbly conglomerate, composed of well rounded to sub-angular clasts of pink medium-grained quartz sandstone in an interstitial matrix of well indurated, silica-cemented medium-grained quartz sandstone (Figure 6). The zone increases to about 400 metres wide to the south, where low escarpments reveal the coarse conglomerate as a basal layer of, and *horizontally* inter-stratified with, diffuse bedded to massive medium-grained pale pink to grey, locally pebbly, quartz sandstone (Figure 7, 8 & 10).
In hand specimens, this sandstone facies is compositionally and texturally similar to the average Yiyintyi Sandstone, and furthermore, the clasts in the conglomeratic facies are clearly derived from the Yiyintyi Sandstone in the adjacent Yiyintyi Range. This makes the two formations megascopically indistinguishable in reverse circulation drill cuttings. However, the horizontal layering in the broad southern outcrops, and the existence of sparse fossils (Figure 9), are incontrovertible evidence that the conglomerate-sandstone association unconformably overlies the moderately northeast dipping Yiyintyi Sandstone.

The preliminary total magnetic intensity image from a 2011 airborne survey indicates that the Yiyintyi Sandstone has significant magnetic susceptibility contrast to the adjacent alluvial 'embayment' (Figure 17). The broad magnetic gradient, extending at least 2 km west of the Yiyintyi outcrop, suggests a significant thickness of Yiyintyi Sandstone beneath this north-eastern limb of the Range, possibly shelving at moderate angle to the west beneath the Mesozoic and younger cover sediments.

Figure 1. Prospect location diagram *(adapted from Pietsch et al., 1993).*

Figure 2. Northeast dipping medium-diffuse-planar bedded medium grained Yiyintyi Sandstone, 575595E 8314215N.

Figure 3. Local strike variations of up to about 30° appear to be due to mega-scale cross bedding, which is not observable in individual beds; 575620E 8314155N.

Figure 4. Monomict breccias of angular sandstone clasts cemented by silicified locally hematite-stained comminuted sandstone, frequently overprinted by stockwork of drusy quartz veinlets, in a prominent northeast trending fracture zone in Yiyintyi Sandstone. Upper photo at 575440E 8314695N, lower photo at 575380E 8314625N.

Figure 5. Sparse drusy quartz veinlets are common in the sandstone within several tens of metres of the northeast trending fracture zone; e.g. this example 575420E 8314710N.

Figure 6. Specimen of conglomerate outcrop at 575380E 8314695N, between collars of drill holes 11BLRC0174 and 11BLRC 0175.

Figure 7. Horizontal bands of pebbly-cobbly conglomerate in diffusely thick-bedded sandstone at 57565E 8314025N, about 700 metres south of the drill holes.

Figure 8. Macro-photo of pebbly, pale pink medium grained quartz sandstone; 575635E 8314045N.

Figure 9. A nine-centimetre-long fossil fragment, possibly of an ammonite, in pebbly sandstone at 575680E 8313960N. Haines et al. (1993) reported rare ammonites up to 60 centimetres diameter in the Cretaceous shallow marine transgressional sequence in the Mount Young sheet area.

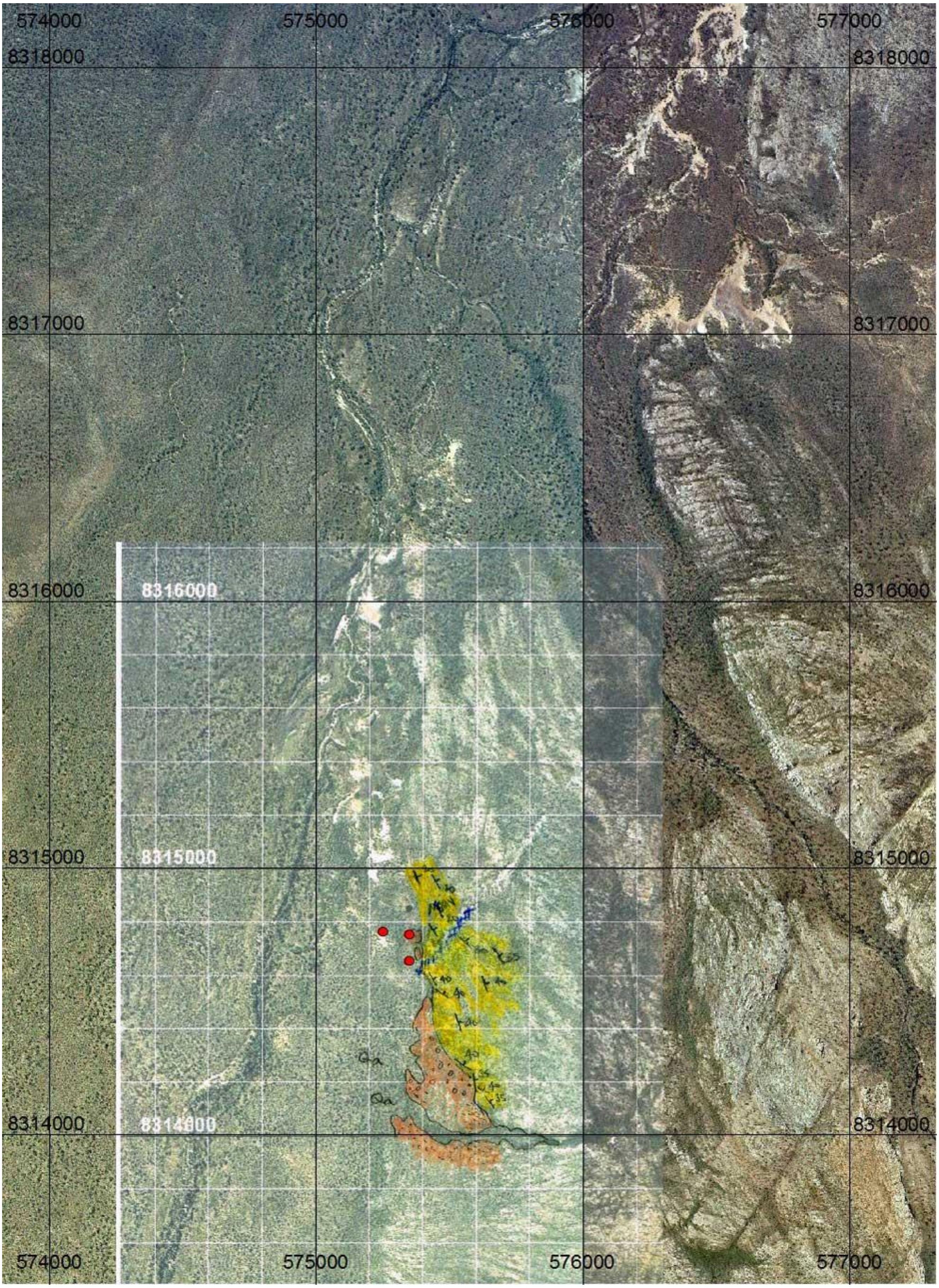


Figure 10. 1:20,000 scale ortho-photo image and geological sketch map of the prospect area showing the drill hole collars as red dots. North-easterly dipping Yiyintyi Sandstone occupies the yellow-shaded area; the pink-shaded area is flat lying conglomerate and sandstone, probably Mesozoic.

RADIOMETRICS & MAGNETICS

Preliminary processing of data from an airborne magnetic and radiometric survey flown in September 2011, indicated a chain of prominent bull's-eye uranium-channel anomalies[3], extending about three kilometres along the foot of the Range near the north-eastern tip of the Yiyintyi Range (Figure 14 & 15).

Photo-geological interpretation showed that the anomalous zones largely coincide with bare, probably saline, sandy or marshy patches between the foot of the Range and creeks draining north to the nearby tidal reach of the Limmen Bight River (cf. Figures 10 and 15). Nevertheless, Sandfire Resources NL regarded the spatial association with the edge of the Yiyintyi Range (that possibly represents the unconformity expected at the base of the Tawallah Group) and prominent photo-linear fault-zones as a potentially favourable structural and stratigraphic setting for unconformity-related uranium mineralization. Accordingly, Sandfire proposed to test the presumed Yiyintyi unconformity by drilling three 150-m-deep reverse circulation boreholes collared at the edge of the outcrop and inclined at -60° to the west[4] (results described below).

A subsequent (post-drilling) reconnaissance ground-traverse along four east-west lines (8314775N, 8315250N, 8315700N and 8317100N) with an Exploranium GR-110 portable scintillometer indicated similar background radiation levels of about 40-50 counts per second (cps) over the Yiyintyi Sandstone outcrop, adjacent conglomerate, and sandy alluvial soils (Figure 16).

On the three southern lines, zones of one and a half up to eight times background levels are associated with clayey to peaty organic soils in ephemerally marshy 'black soil' areas, generally covered by *Melaleuca* (paperbark tree) or *Juncus* (pin rush) vegetation (Figure 11 & 12). The broad sandy bed of the main creek channel at near the western end of those lines has normal background radioactivity, which rule out the possibility that the airborne anomaly could have been caused by alluvial concentration of radioactive heavy minerals such as monazite and zircon.

On the northern line, 8317100N, the peak radiometric responses up to fifteen times background are related non-vegetated areas of exposed stony ferricrete, and salt-encrusted sandy ferricrete and pisolitic sand (Figure 13).

The extensive airborne-detected radiometric anomalies are thus clearly related to superficial zones of organic-rich peaty marsh soils, which can precipitate uranium by reduction reaction with oxidized surface water, and exposed areas of ferricrete, which commonly have higher than background radioactivity (e.g. Fisher and Sullivan, 1954). This near sea-level environment may also accumulate uranium by evaporation, or bacterial reduction of occasional seawater tidal surges.

Figure 11. Peaty organic soil (upper frame) formed in ephemerally marshy areas of *Juncus sp.* vegetation; e.g. at 575315E 8315005N.

Figure 12. Dry black soil swamp lined with *Melaleuca* (paperbark) radiometrically anomalous at ~130 cps; waypoint Yiy042: 575120E 8315250N.

[3] Magnitude with respect to background is unknown.
[4] Email from S.Oxenburgh to P.Lauricella & A.Hansen, 21/10/2011

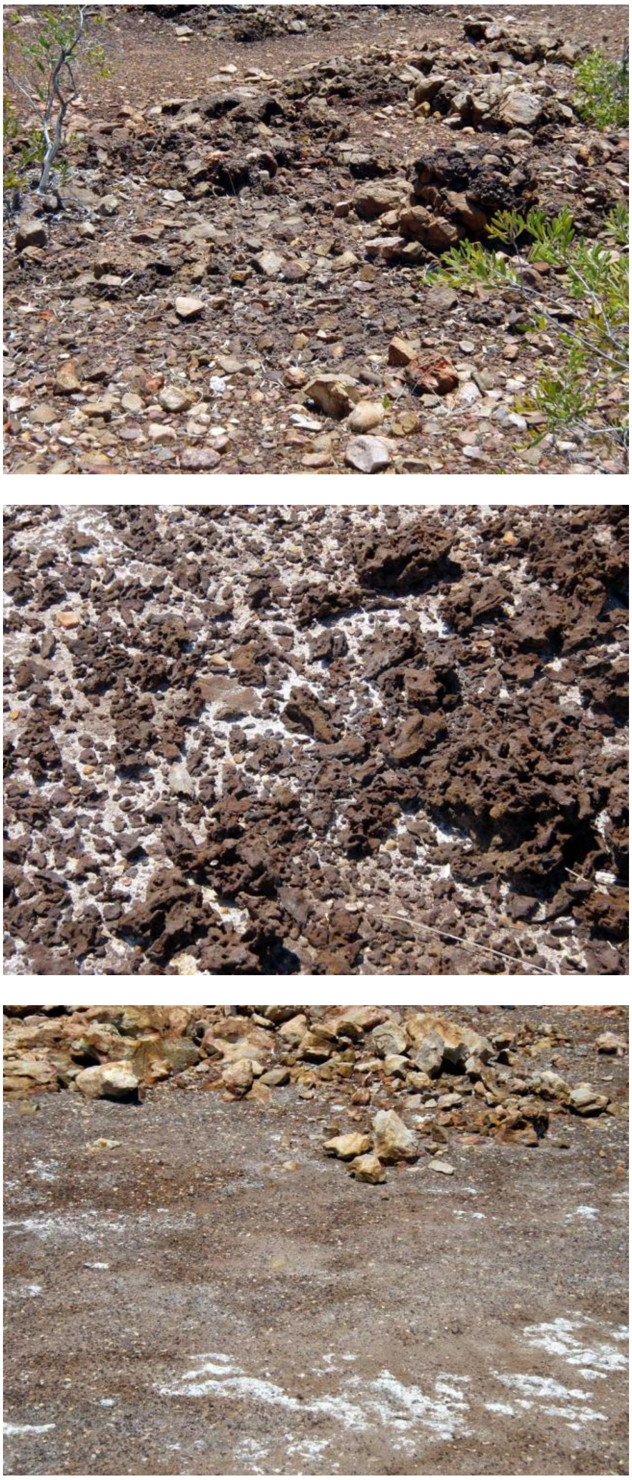


Figure 13. Non-vegetated areas of stony laterite (upper), salt-encrusted sandy ferricrete (middle) and salt-encrusted pisolitic sand (lower) spatially related to up to fifteen times background radioactivity on the 8317100N radiometric traverse.

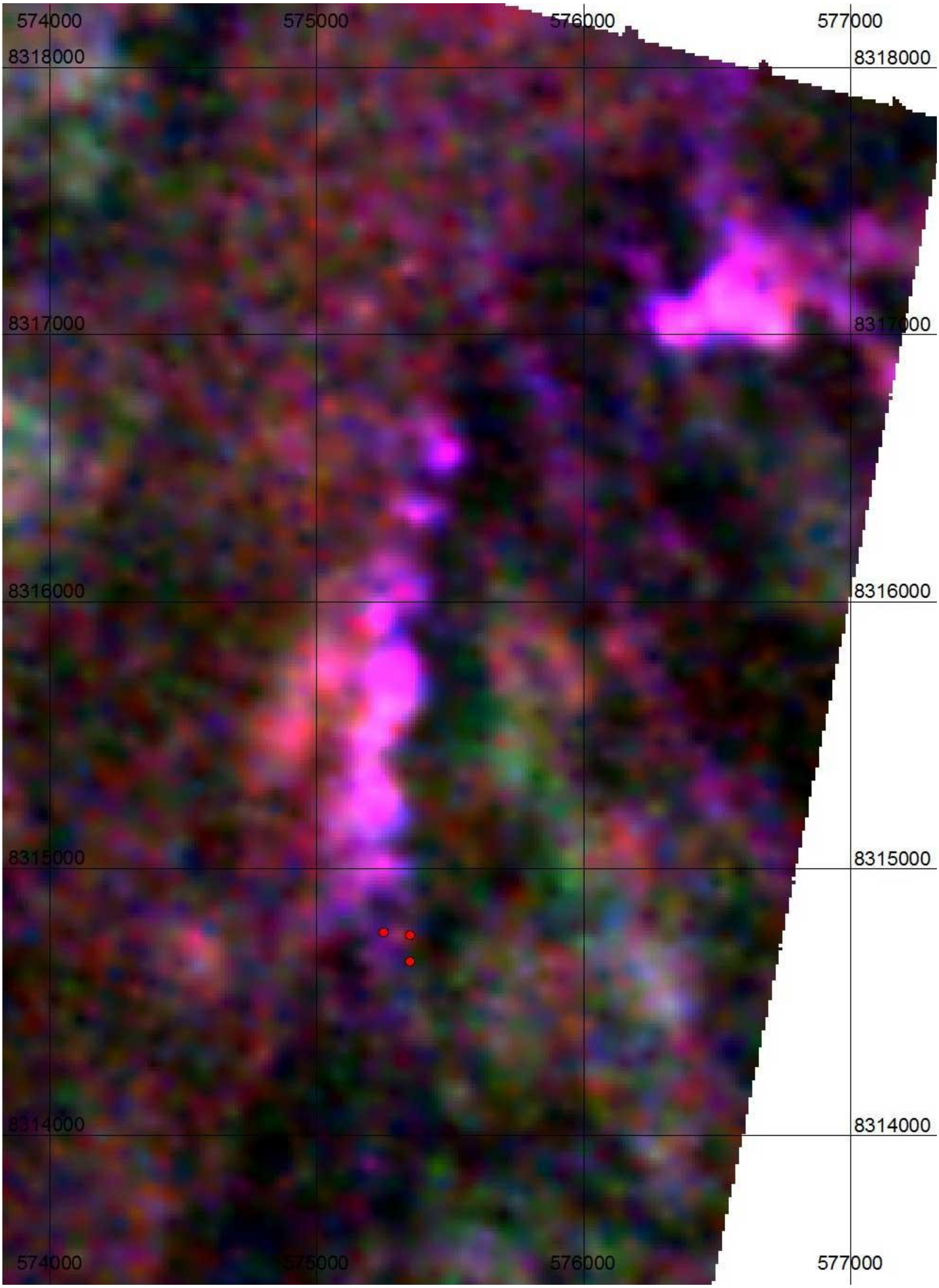


Figure 14. Radiometric K-U-Th (Red-Blue-Green) image of the same area and scale as Figure 10.

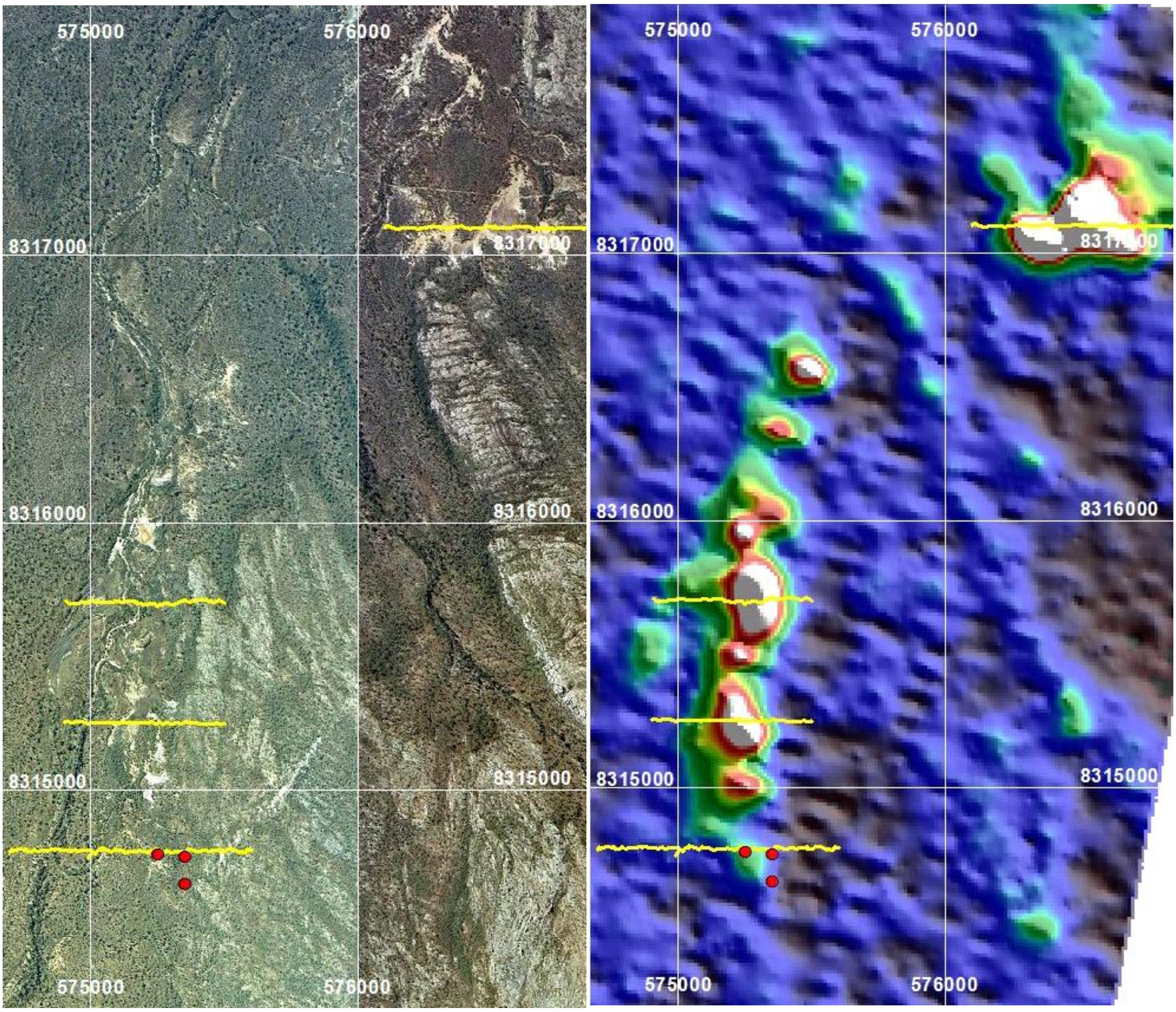


Figure 15. Orthophoto and radiometric Uranium-channel images showing locations of drill holes (red dots) and ground radiometric traverses (yellow), 1:25,000 scale, GDA.

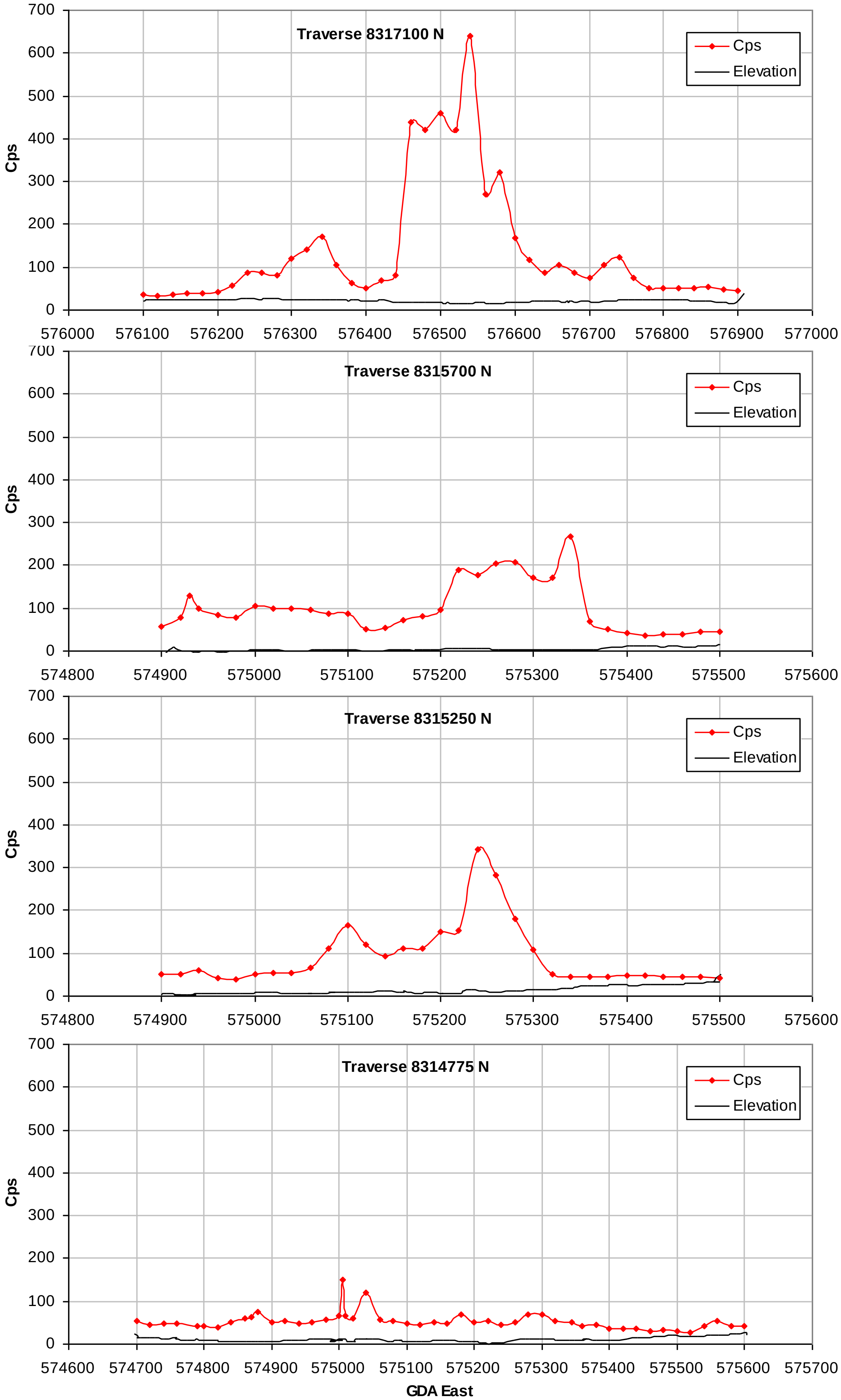


Figure 16. Radiometric profiles across the airborne-uranium-anomalous zones (cf. Figure 15). These radiometric data were acquired with an Exploranium GR-110 scintillometer held stationary at waist height with count rates integrated over 10 seconds, locations nominally determined by Garmin *etrex HCx* GPS receiver.

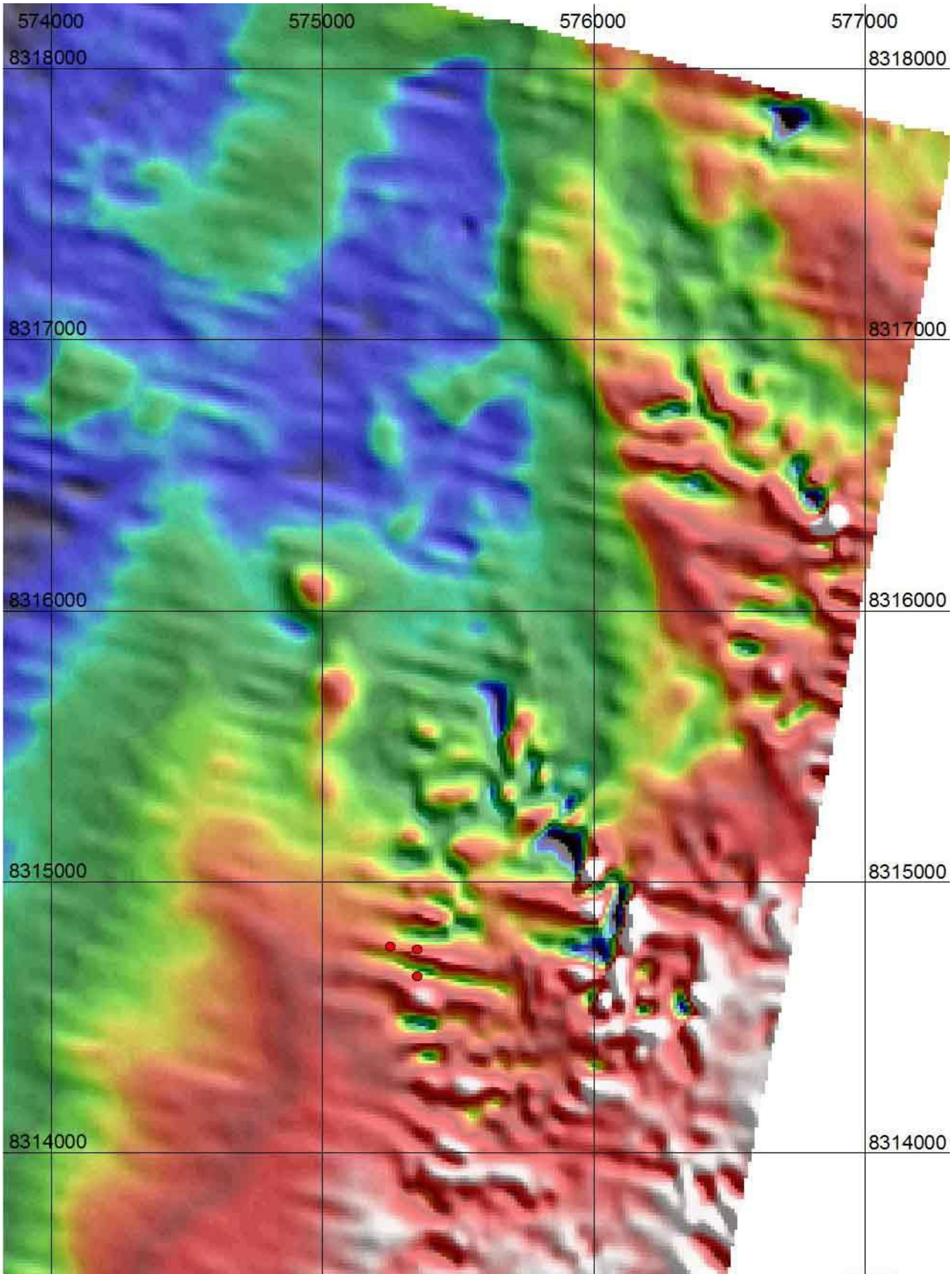


Figure 17. Total magnetic intensity image of the same area and scale as Figure 10.

RC DRILLING RESULTS

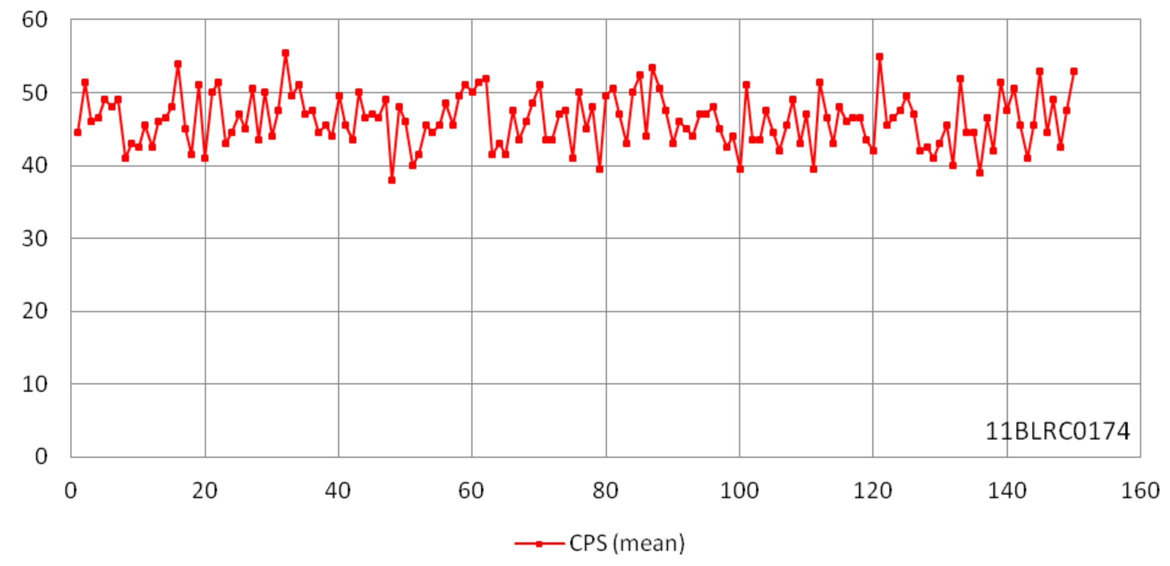
The drilling proposal initially planned for three holes inclined at -60° to the west from collars at 57350E along the edge of the Yiyintyi Sandstone outcrop, spaced at 100 metres apart between 8314650N and 8314850N. However, because the first two (southern and middle) holes did not penetrate to the base of the Yiyintyi Sandstone, the program was accordingly varied to place the third hole 100 m further west to improve the chance of intersecting that expected unconformity (Table 1).

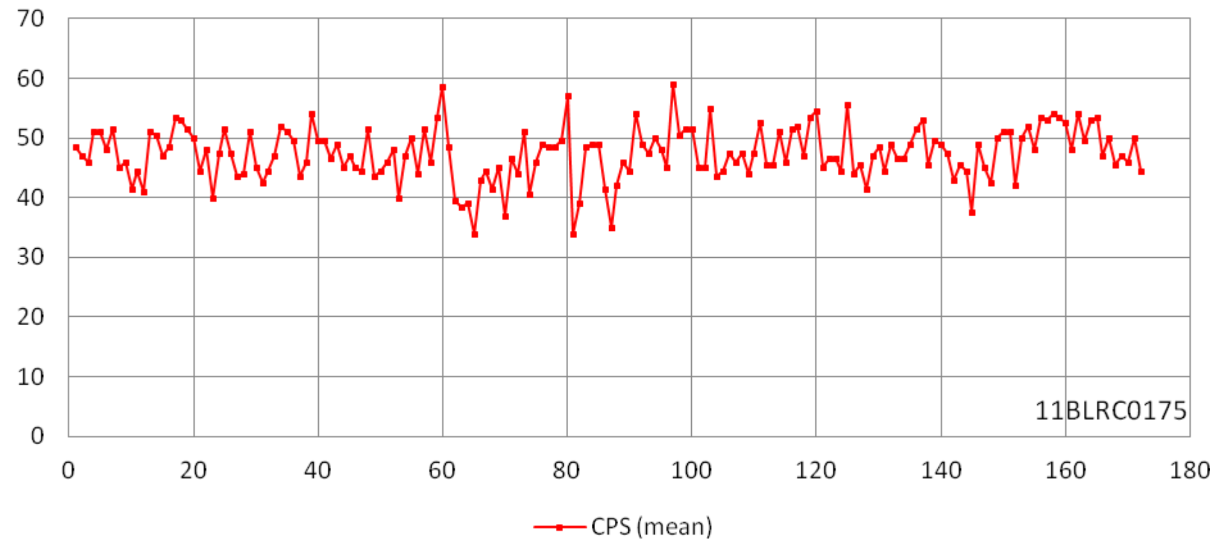
Table 1. Drill hole location data.

Hole	East	North	Incl.	Azi	Depth m
11BLRC0174	575349	8314650	-60	270	150
11BLRC0175	575350	8314756	-60	270	172
11BLRC0176	575254	8314763	-60	270	120

Drilling ceased in all three holes without reaching the base of the Yiyintyi Sandstone. The three drill holes were dominated by highly indurated grey-pink quartz sandstones. As previously mentioned the Yiyintyi Sandstone is virtually indistinguishable from the Mesozoic cover in chip samples. Kaolinite alteration in hole 11BLRC0176 possibly indicates the base of cover extends to at least 23m depth. It was noted that whilst drilling the collar for this hole there was an organic earthy smell from 1-7m. Figure 18 shows there is a marginally elevated count rate at the start of hole 11BLRC0176 estimated at 1.5 times background levels. This is consistent with the increase in radiation levels associated with marshy zones of organic-rich soils that were highlighted by the ground-traverses.

As of 25th November 2011 we are still awaiting the results from the assays.





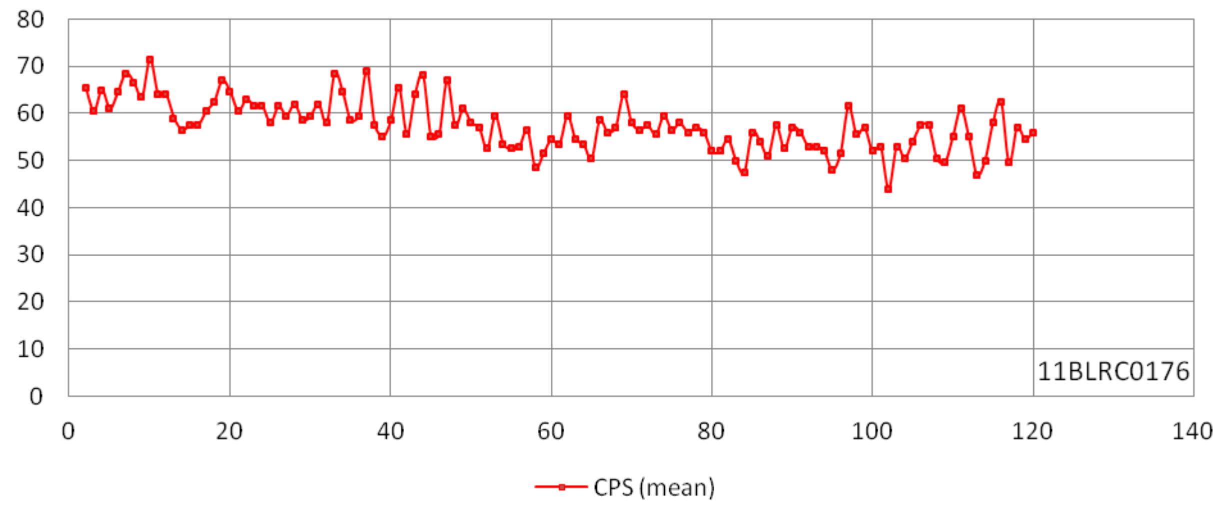


Figure 18. Radiometric response of RC cuttings from holes 11BLRC0174-6. These radiometric data were acquired with an Exploranium GR-110 scintillometer held stationary above each pile for 10 seconds with count rates integrated over 1 second. The highest and lowest count over this interval was recorded in order to provide the mean response.

CONCLUSIONS

- The north-eastern Yiyintyi radiometric anomaly may be attributable to reduction of uranium from oxidized surface waters, and possibly marine tidal surges, by organic-rich peaty and lateritic soils in low-lying marshy areas around the foot of the Range.
- A flat-lying sequence of sparsely fossiliferous, probably Mesozoic siliciclastic conglomerate and sandstone laps unconformably onto parts of the western foot of the Yiyintyi Range. Drill holes 11BLRC0174 and 11BLRC0175 were collared in this formation but its local thickness remains uncertain because of the difficulty of megascopically distinguishing the Proterozoic and Mesozoic sandstones in reverse circulation drill cuttings.
- Our (inexpert) assessment of the airborne-survey total magnetic intensity image suggests the Yiyintyi Sandstone has significantly higher magnetic susceptibility than whatever occupies the adjacent embayment in the Yiyintyi Range, that it has significant thickness beneath the Range, and that its upper surface may dip at a moderate angle to the west beneath the Mesozoic to Quaternary cover sediments. Two-dimensional modelling should easily resolve the orientation of the western edge of the Yiyintyi Sandstone in this area.
- Three reverse circulation bore holes designed to test for unconformity-related uranium mineralized zones at the base of the Yiyintyi Sandstone failed to penetrate to the base of that formation. Megascopic logging of the drill cuttings did not recognize significantly mineralized or altered zones.
- Scintillometer and geochemical analytical data from the drill hole samples indicate background levels of uranium and other trace elements throughout
- Limited surface mapping and two brief exploration drilling campaigns have so far failed to elucidate the nature of the base of the Yiyintyi Sandstone, nor its underlying basement. Reconnaissance ground radiometric traverses and geomorphic mapping suggest the anomalous zones are related to surficial processes. The conceptual target of unconformity-related uranium deposits thus remains largely unsubstantiated apart from the time-stratigraphic equivalence of the Tawallah and Katherine River Groups.

REFERENCES

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