Cu Targeting Methodology Review Process

Methodology

This document summarises the Copper target review process that was followed 4-9 Dec 2017 in Maun. An initial correlation matrix analysis (figure 1) confirmed that: 1) the elements selected for the multi-element analysis methodology were appropriate and relevant to this area and 2) that Sc was an appropriate normalising ratio for the data for this area.[i] All of the data and analyses to date[ii] were reviewed and it was further confirmed that the targeting approaches to date were appropriate and suitable for this area.

All the techniques employed previously involved the use of the full KGP dataset (with and without bedrock), regardless of thickness of sand and the underlying landform surface (see figure 2). To check and increase the contrast to improve possible target definitions, the geochemistry-depth profiles were examined for a number of elements over a number of holes. It was clear from all the multi-element data over all the randomly checked holes that values increased near the sand-calcrete bedrock interface (figure 3). The same trend is visible across the majority of the KGP holes.

One particular set of intervals at the interface was separated out from the overall dataset and defined as regolith. From this data elements showing good correlations were selected and used to calculate the regolith [average Cu x m x ppm] value as a means of comparing regional dispersion patterns as well as calculating the [total element value / meter] as an equivalent comparison for the KGP work to date. The bedrock altitude (used to model an isopach landform surface for the pre-Kalahari) and overburden thickness (contoured to help identify potential dispersion issues) values were also extracted from this regolth-specific dataset.

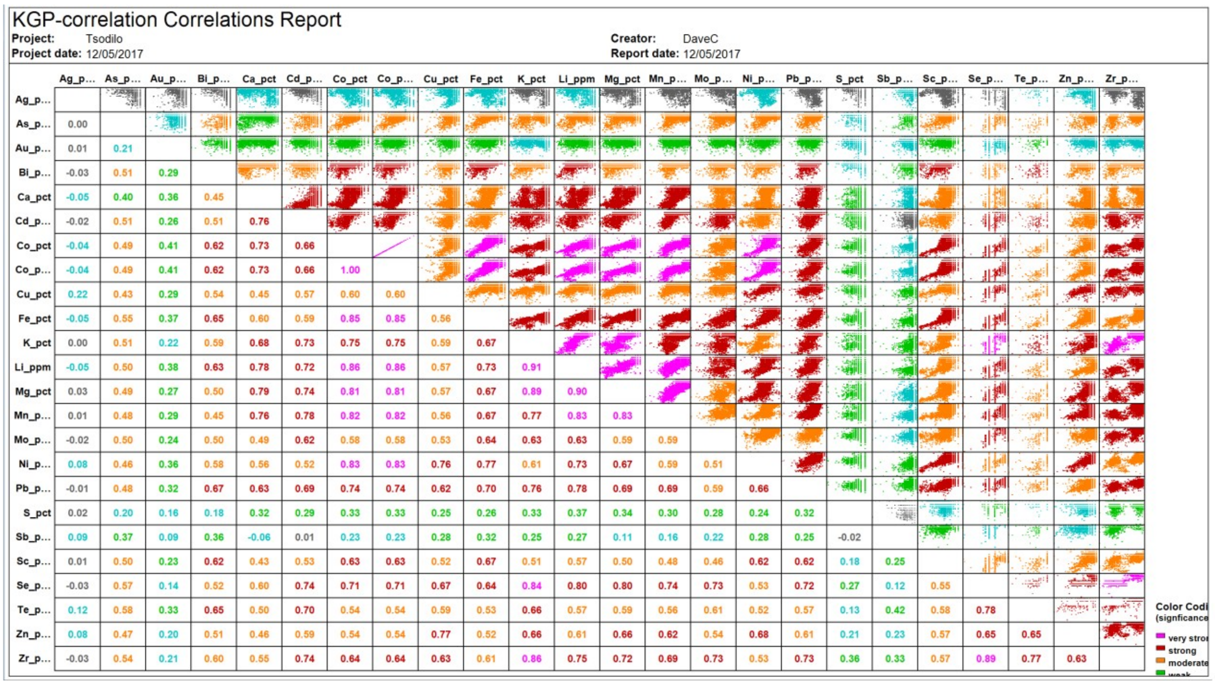


Figure 1 Correlation Matrix of selected elements.

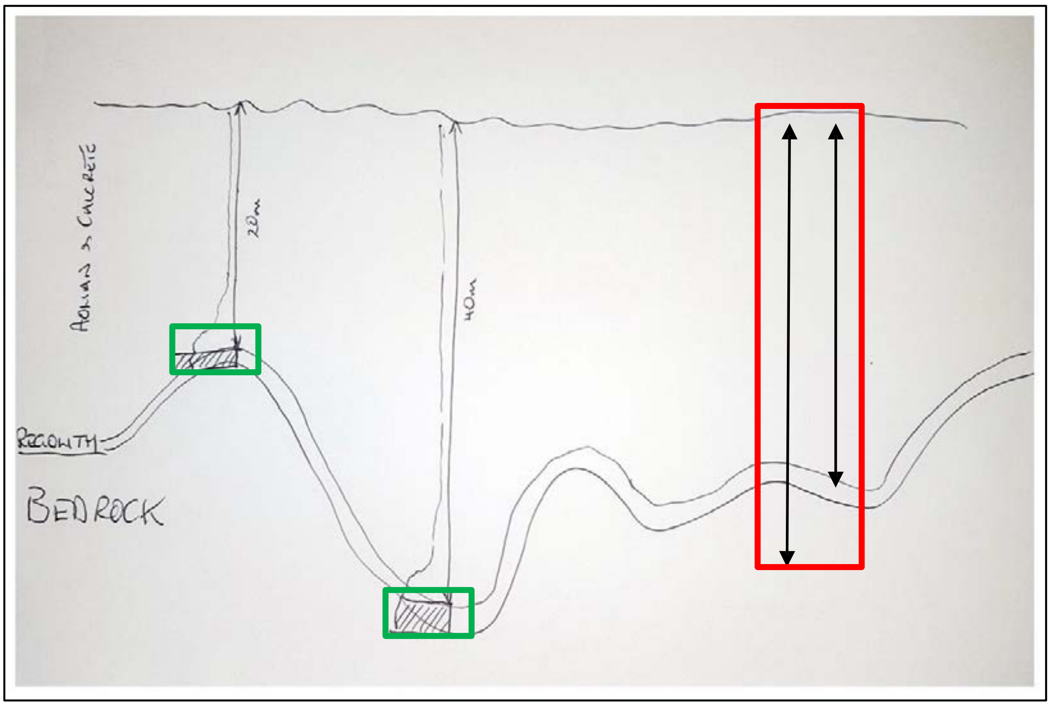


Figure 2 Schematic diagram showing the Regolith (left) in contrast to the whole KGP dataset (right) intervals analysed. The Regolith data analyses (green boxes) are based purely on the data at the regolith and exclude all assays above it. Previous KGP data analyses (red box) were based on the full KGP dataset with and without bedrock.

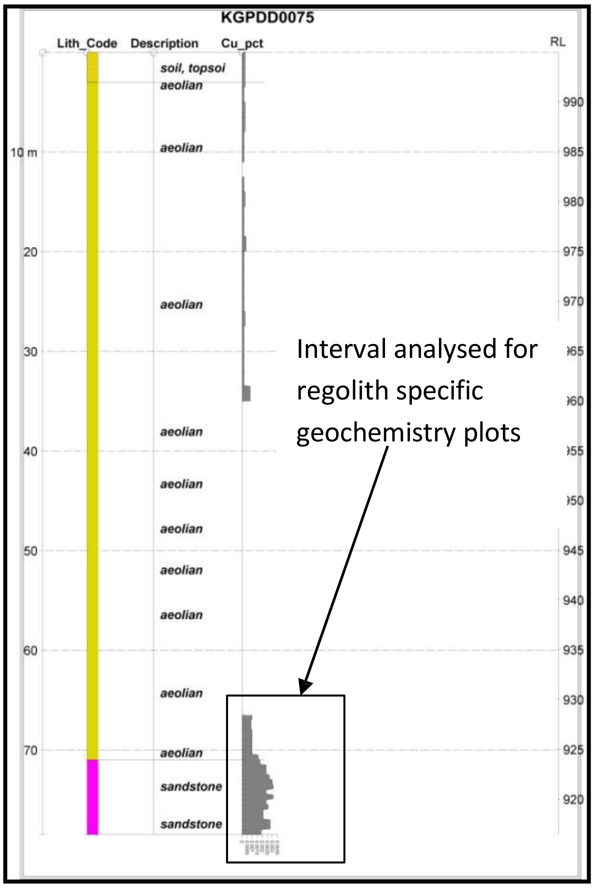


Figure 3 Geochemistry – Depth profile illustrating peaks in Cu geochemistry in sample KGPDD0075 at the regolith (overburden-bedrock) interface.

Isopach and Thickness maps

The Overburden Isopach map is overlain with the KGP Sc Ratio and KGP ratio targets in Figure 4 . In addition to this, 7 targets reintroduced from the KGP ratio target dataset are also shown[iii]. Targets on the higher areas in the isopach map are more promising targets as they are less likely to be enhanced by dispersion from other locations, whereas those in topographically low locations may be possibly be influenced by such factors.

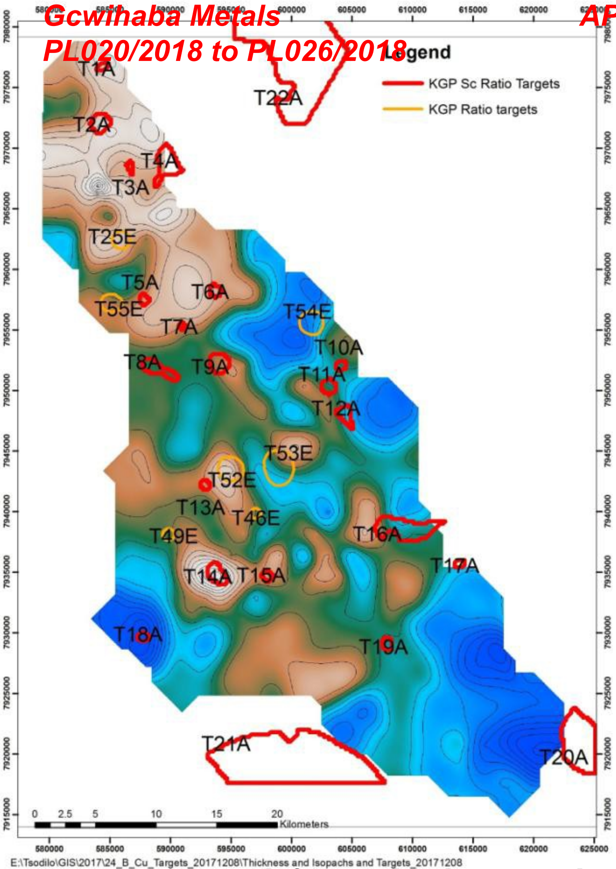
On the thickness map (figure5) not all the thick areas of overburden lie in topographic lows. In fact, many of the thicker areas actually lie on high ground. Equally ranking targets may be prioritised on the basis of the overburden thickness. A target on a thicker cover may be given a higher rank than a similar one on thinner cover. While thickness was incorporated in KGP and other ratio work, it was not done in a manner that recognised the Cu and other element spikes at the regolith in the geochemistry profile as discussed above. This could have led to over corrections (above deeper thicker locations) and a reduction in the anomaly size relative to anomalies with thinner cover because the bulk of the mineralisation is situated at the regolith. Two newly calculated variables “Regolith / m” and “Regolith Ratio” provide a way to gauge whether this is indeed the case.

Target re-evaluation and Preliminary conclusions

The data re-evaluation process enabled a number of targets previously pulled out from the initial KGP / overburden work to be reintroduced[iv]. These targets are designated “TE” and are those that were reintroduced from the first pass through the KGP data[v] as they show good correspondence with the regolith kicks. They included: T52E, T53E, T46E, T49E, T54E, T25E and T55E. Furthermore, the target priorities were reviewed using the four ranking scores:

- KGP Ratio
- Regolith / m (definition: Average Cu x m x ppm)
- Regolith Ratio (definition: Cu total/total thickness)
- KGP Sc Ratio

The top four targets were identified as follows: T1A, T15A, T19A and T54E. The KGP-regolith-assays (Cu x m x ppm) data is shown in figure 6 relative to the targets. The same dataset is shown relative to the Recce 2 (deep drill hole) dataset in figure 7a. There are a number of places where anomalies in the regolith index and the Recce2 contours match up well (near: TA9, TA15, TA16, TA19). In figure 7b the regolith data is compared to the previously defined KGP ratio (shallow drill hole) data. Many of the existing targets (T1A1 to TA19) line up with the KGP ratio anomalies and the higher regolith dataset values: TA1, TA25, TA55, TA15, and TA19 amongst others.



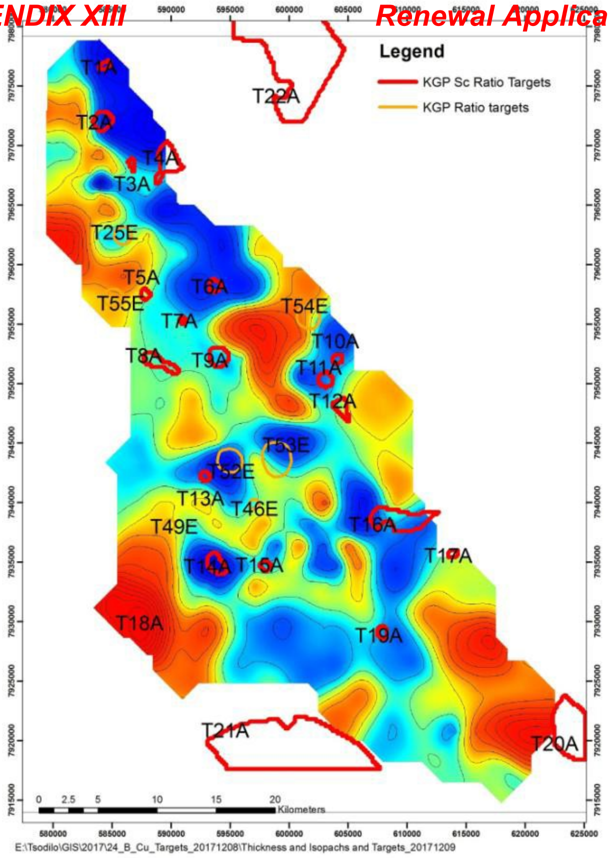
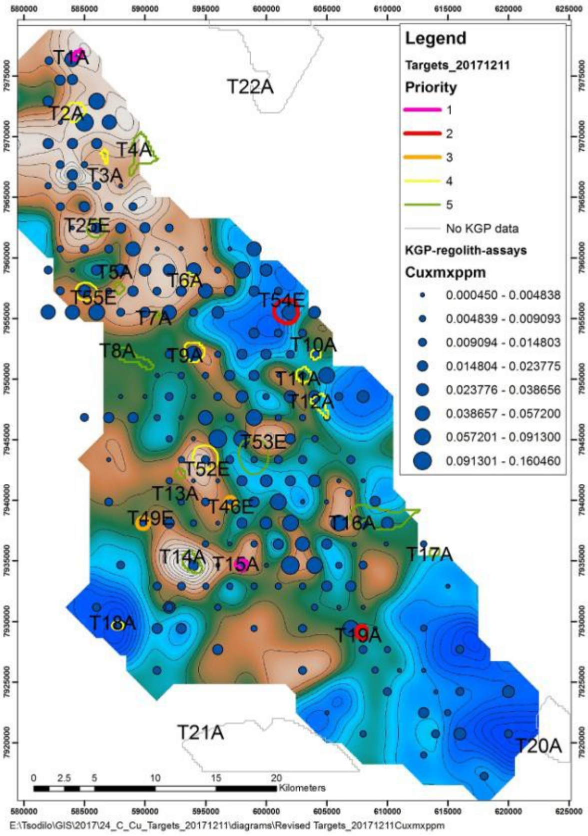


Figure 4 (top left) Overburden Isopach map showing KGP Sc Ratio and KGP ratio targets. Figure 5 (top right) Overburden thickness map showing KGP Sc Ratio and KGP ratio targets.



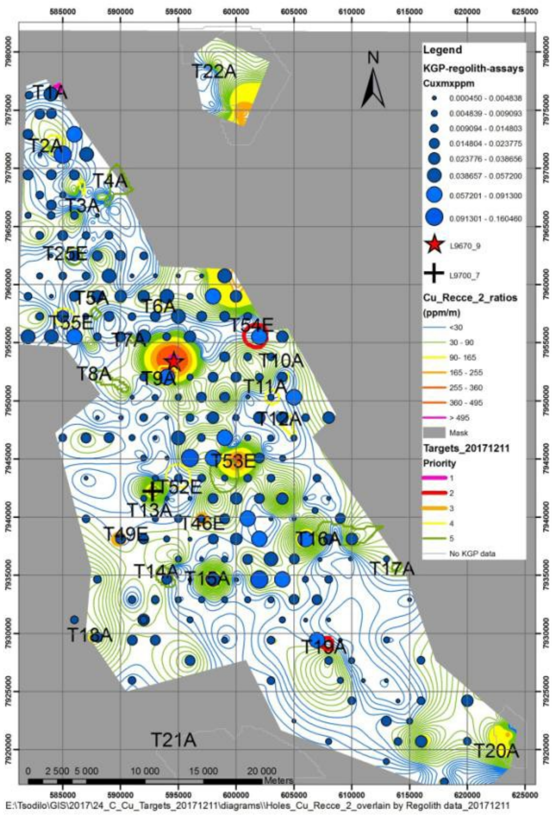


Figure 6 (top left) KGP-regolith-assays (Cu x m x ppm) data is shown relative to the revised targets and isopach map. Figure 7a (top right) KGP-regolith-assays (Cu x m xppm) data is shown relative to the revised targets and Recce2 (deep drill hole) data.

Geophysics & Geology

Form line work, remapping of faults, fractures and shears based on the geophysics is ongoing (Catterall, pers. com). The whole area is a series of tightly folded doubly plunging anticlines and synclines with some shears and thrusts (parallel and sub-parallel to the basin margins - identified from the existing geological mapping have and which truncate the lithologies sub-parallel to strike) as well as many later faults trending NW-SE (parallel and sub-parallel to the dyke trend) offsetting the lithologies.

The regolith data were examined in the context of the 1st, 2nd horizontal, tilt derivatives and other magnetic and EM data products (figures 8 – 10). When one reviews the superimposed KGP holes and Recce2 ratios and looks beyond the grid pattern, there are trends associated with the underlying geological trends. Due to the extent and gridded nature of the data it is difficult to relate everything back to the underlying geology because the scale of folding is too tight for the grid spacing. However that said, there appears to be a trend with both the KGP and Recce2 data on the west side of the northern basement high and on both the eastern side of the southern basement high (see red blocks) (see figure 11a and b). Correlations are suggested between magnetic features, EM features, faults and shears[vi] and the disposition of the anomalies. Several of the anomalies appear to be distributed along or adjacent to linear magnetic features (visible on the tilt derivative images) and NW-SE trending EM ridges (figures 8, 9 and 10). These associations indicate that it may be possible to link the elevated values to specific (mineralised) geological units. This relationship may be refined by more detailed structural mapping and a tighter soil sampling grid. The associations of Cu mineralisation with the drill hole data and logged geology has already been highlighted in the initial targeting methodology document (section 5: p40 to p42)[vii].

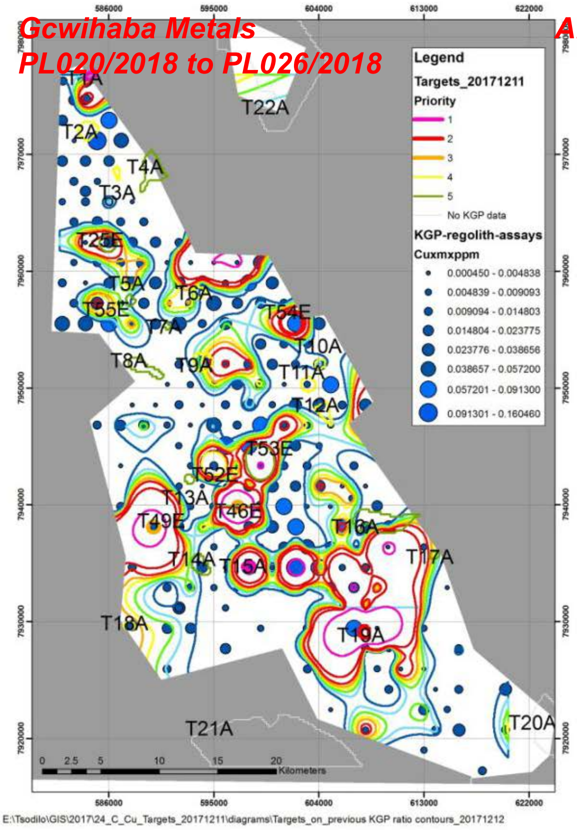
While in L9700/7 Cu mineralisation appears associated with amphibolite and amphibole gneiss, the FQM drill hole data show copper kicks associated with a wider range of lithologies above the basement gneiss (/MSCBQ), where gabbro is overlain by Mwashya bt-qtz-calcite schist to phyllite. Kicks are observed in the following lithologies: MSCB (schist - biotite), MSCBQ (schist - biotite quartz), SSH (shale), Amphibolite, SLS (limestone), SSHB (shale- black / carbonaceous) and (VBA) Mafic volcanics.

Synopsis of target areas

Area 5 is of primary interest as it contains T1A and T35E and overlies a major magnetic anomaly, but should be elongated and extended southwards to encompass T2 (which is currently not in an area). T1A is situated on a topographic high with thin cover and high rankings across the board.

Area 1 is the second highest ranking area as supported by various geochemical variables but it also sits on a marked geological boundary. Of the two targets in this area T15A seems far more interesting. T15A is situated at a lower altitude but is still topographically high with a moderate thickness and high values.

Area 10 is new proposed area that ranks third highest. It includes target T19A with the highest KGP ratio and one of the highest regolith values. It coincides with an interpreted fold



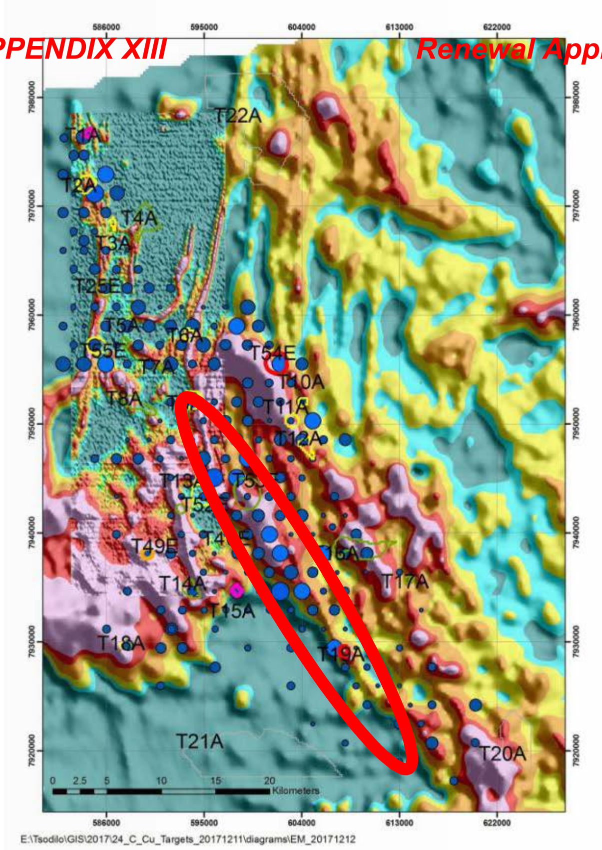
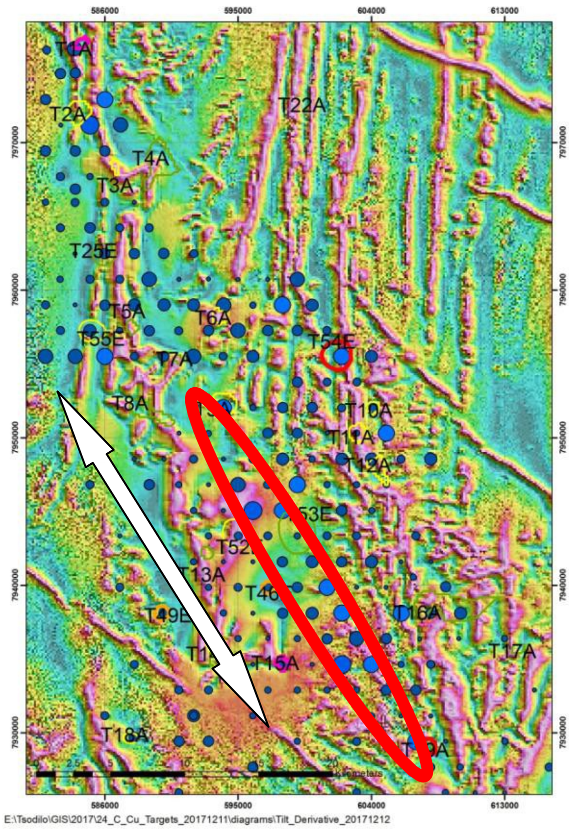


Figure 7b (top left) KGP-regolith-assays (Cu x m xppm) data is shown relative to targets and the KGP ratio data. Figure 8 (top right) KGP-regolith-assays data shown on EM. An association of high regolith values with NW-SE EM "ridges" is suggested.



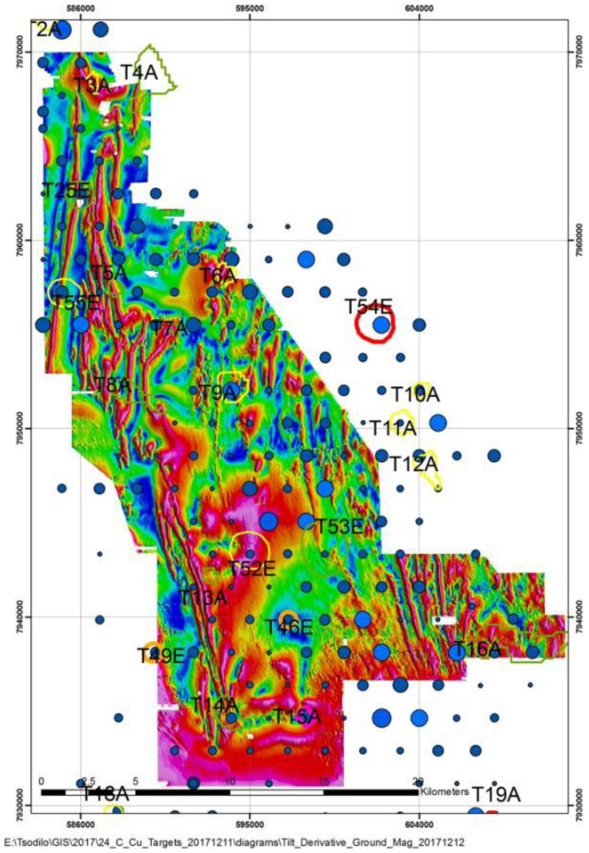


Figure 9 (top left) Revised target and KGP-regolith-assays data shown on Tilt derivative of Regional Mag. Figure 10 (top right) Revised target and KGP-regolith-assays data shown on Tilt derivative of Ground Mag.

closure in the magnetic data. It is situated on topographically lower ground with thin overburden and shows possible dispersion enhancement

Area 8 shows strong anomalies on the KGP and regolith values. Here one of the previously defined overburden targets has been reintroduced. It appears to sit on junction between a fold closure and a fault. T54E is situated on a topographically low, thick cover, may be enhanced by dispersion from T10

Area 6 ranks 5th in line and encompasses T52E and T46 which have very high Cu KGP and Cu/Sc ratio. In addition they appear to lie on the same magnetic feature. The area also includes T53E which exhibits the same anomalous Cu trends. Area 7 sits in an area of interference folds and contains T49 E which shows moderately anomalous scores across the board. The final target rankings and various indicator scores are listed in table 1.

Revised rankings compared with existing deep drilling

The revised target priorities are shown relative to the shallow (KGP) and deep drill holes (FQM & Tsodilo combined) in figures 12 and 13. Of the top 6 targets (scores 1 to 3), only one of these has been drilled: T19A. All other 5 top targets have the closest deep drill hole at a distance of approximately 1145m to 5953 m from the target centre. It should be noted T19A is topographically lower and has a thin overburden cover. These factors suggest possible dispersion enhancement in this area.

Two of the deep Tsodilo holes which showed the best Cu kicks (L9670_9 & L9700_7[viii],[ix]) were sited in generally good positions to target mineralisation close to the basement high and return Recce2 anomalies, as they should. However due to the KGP grid spacing neither of these holes are close to a KGP hole to provide a good enough indication. Also no account is taken of the sub-surface topography, the cover thickness or indeed what dispersion is taking place. The nearest other holes are all >2km distance, large enough to miss a mineable deposit within the Central Kalahari Copperbelt. L9670_9 shows promise as there are copper values down the hole with occasional spikes, possibly relating to veins or shears within the holes.

Recommendation

It is suggested that the work be followed up with carrying out the TerraLeach™ Partial Digest Geochemistry (TL1). The TL1 is an alkaline cyanide digest for gold and associated pathfinder elements such as copper. The methodology[x], sampling protocols[xi], detection limits and costs[xii] and other technique details are discussed in the Intertek, Genalysis Laboratory Services documentation[xiii]. Anomaly contrast when compared with conventional geochemistry is generally superior.

This technique should be carried out across the area around L9670/9 in a spacing and pattern similar to the distribution in figure 15. Lines should be approximately 2km long, spaced 500m apart and samples collected every 50m. This would allow one to compare surface results over the best anomaly to date with supporting drill hole information and provide more details across the basement into the Mwasha.

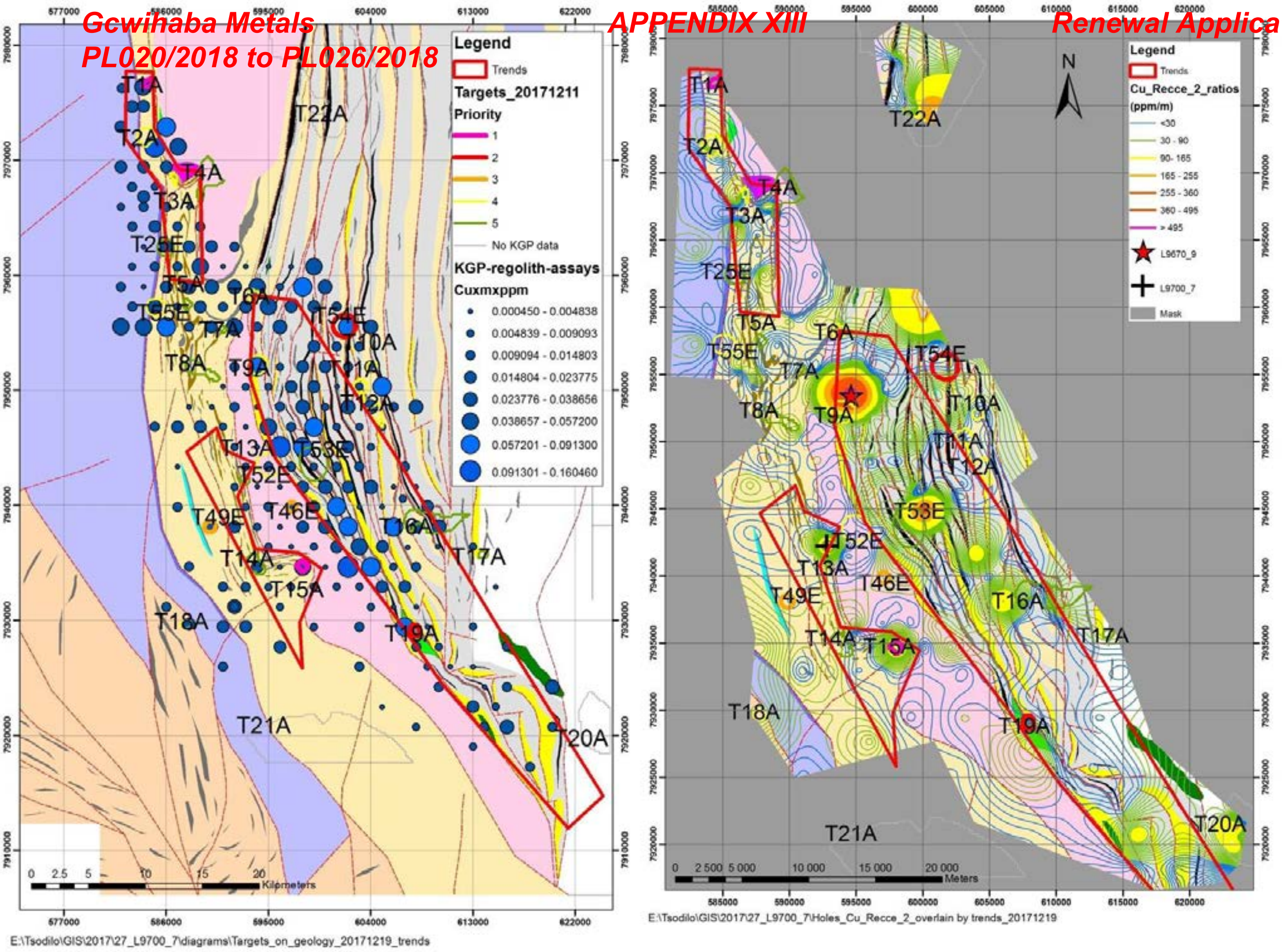


Figure 11a. (top left) Trends observed in the KGP-regolith-assays data shown on the geology. Figure 11 b.(top right) Trends observed in the Recce2 (right) Cu data over geology. Note the structural interpretation is disputable.

Table 1 Final indicator scores and revised target priority rankings.

		Isopach and thickness scores				KGP Ratio					Total	Regolith / m					Total	Regolith Ratio					Total	KGP Sc Ratio					Total		Priority
Target		Isopach	Isopach Score	Thickness	Combined	Cu	Co	Ni	Zn	Mo		Cu	Co	Ni	Zn	Mo		Cu /m	Co/m	Ni/m	Zn/m	Mo/m		Cu	Co	Ni	Zn	Mo			
T1A	Area 5	HIGH	3.0	2.5	5.5	4	7	8	6	7	32	6	7	8	1	7	29	1	1	6	1	1	10	3.5	6	8	6	6	29.5	Topographic high, thin cover, expect higher ranking	1
T2A		HIGH	3.0	3	6.0	1	3	1	4	1	10	7	3	5	7	6	28	2.5	1	1	1	1	6.5	1	3	1	1	1	7		4
T3A		HIGH	3.0	4	7.0	1	1	1	1	7	11	3	1	1	1	1	7	2.5	1	1	1	1	6.5	1	3	1	1	7	13		4
T4A		HIGH	3.0	3	6.0	1	1	1	2	4	9	2	1	1	1	1	6	1	1	1	1	1	5	6.5	6	7	1	6	26.5		5
T5A		MEDIUM	2.0	4	6.0	1.5	1	1	1	1	5.5	5	2	2	4	1	14	3	2	4	2	1	12	8	1	6	7	1	23		5
T6A		MEDIUM	2.0	3	5.0	1.5	3	6	5	4	19.5	7	4	7	4	6	28	4	2	5.5	2	4	17.5	3	1	6	4	1	15		4
T7A		MEDIUM	2.0	4	6.0	1	1	1	1	2	6	5	4	7	7	5	28	1	1	1	1	1	5	1	1	2	1	1	6		5
T8A		MEDIUM	2.0	4	6.0	1	4	3	1	1	10	1	1	1	1	1	5	1	1	1	1	1	5	1	5	1	1	1	9		5
T9A	Area 2	MEDIUM	2.0	4	6.0	4	4	2	3	3	16	7	6	6	7	8	34	5	5	5	4	6	25	1	1	1	1	1	5		4
T10A	Area 3	MEDIUM	2.0	3	5.0	1	1	1	7	3	13	5	3	3	6	3	20	1	1	1	1	1	5	5	3	6	6	6	26		4
T11A	Area 3	MEDIUM	2.0	3	5.0	1	1	1	5	8	16	2	3	1	1	8	15	3	2	1	1	8	15	1	4	1	2	8	16		4
T12A	Area 3	MEDIUM	2.0	4.5	6.5	1	3	1	4	2	11	6	7	6	3	7	29	1	2	1	1	2.5	7.5	5	4	6	7	5	27		4
T13A		MEDIUM	2.0	3	5.0	1	1	1	1	1	5	3	2	3	3.5	1	12.5	2.5	4.5	5.5	4	1	17.5	7	1	6	7.5	1	22.5		5
T14A	Area 1	HIGH	3.0	2.5	5.5	1	1	1	1	1	5	2	4	5	6	5	22	3	4	5	3	3	18	2	1	1	1	1	6		5
T15A	Area 1	HIGH	2.0	4	6.0	8	1	6	7	8	30	7	3	3	2	8	23	7	4	5	2	8	26	2	1	1	2	5	11	Topographically high , moderate thickness	1
T16A		MEDIUM	2.0	4	6.0	6	4	3	1	1	15	6	5	5	4	5	25	6	6	6	1	5	24	2	1	1	2	1	7		5
T17A		MEDIUM	2.0	4	6.0	4	8	6	5	3	26	2	1	1	1	1	6	3	2	2	1	1	9	2	2	1	1	2	8		5
T18A	Area 4	LOW	1.0	10	11.0	5	2	1	1	4	13	5	5	5	5	1	21	6	7	7	6	1	27	2	1	1	1	1	6		4
T19A		LOW	2.0	4	6.0	8	8	8	8	8	40	6	3	4	4	6.5	23.5	6	4	6	5	7	28	1	2	1	1	1	6	Topographically lower, thin overburden, possible dispersion enhancement	2
T52E	Area 6	HIGH	3.0	3	6.0	7	1	5	8	1	22	3	1	1	2	5	12	3	2	1	2	4	12	8	1	8	8	1	26		4
T53E	Area 6	MEDIUM	2.0	3	5.0	8	7	7	8	3	33	3	1	1	2	1	8	5	5	5	5	2	22	8	1	8	8	1	26		5
T48E	Area 6	MEDIUM	2.0	4	6.0	8	1	8	8	3	28	4	3	5	5	3	20	4	5	7	5	3	24	8	1	8	8	1	26	On a eastward facing topographic slope, with moderately thick cover.	3
T49E	Area 7	MEDIUM-LOW	2.5	4	6.5	8	1	7	8	2	26	5	1	3	5	3	17	4	3	4	4	3	18	8	1	7	8	1	25	On a southwesterly facing topographic slope with moderately thick cover.	3
T54E	Area 8	LOW	1.0	5	6.0	7	8	8	5	6	34	7	7	7	5	6	32	4	5	5	1	2	17	3	1	1	2	1	8	Topographically low , thick cover,may be enhanced by dispersion from T10	2
T25E	Area 9	HIGH	3.0	4	7.0	7	7	7	1	8	30	3	2	1	4	1	11	4	3	2	3	3	15	6	8	4.5	3	8	29.5		5
T55E	Area 9	MEDIUM	2.0	5	7.0	7	1	2	7	2	19	6	3	3	4	5	21	4	2	3	2	3	14	8	1	8	8	1	26		4
		Class factors:																													
		1.00			11						40						34						28						29.5		
		0.75			8.25						30						25.5						21						22.1		
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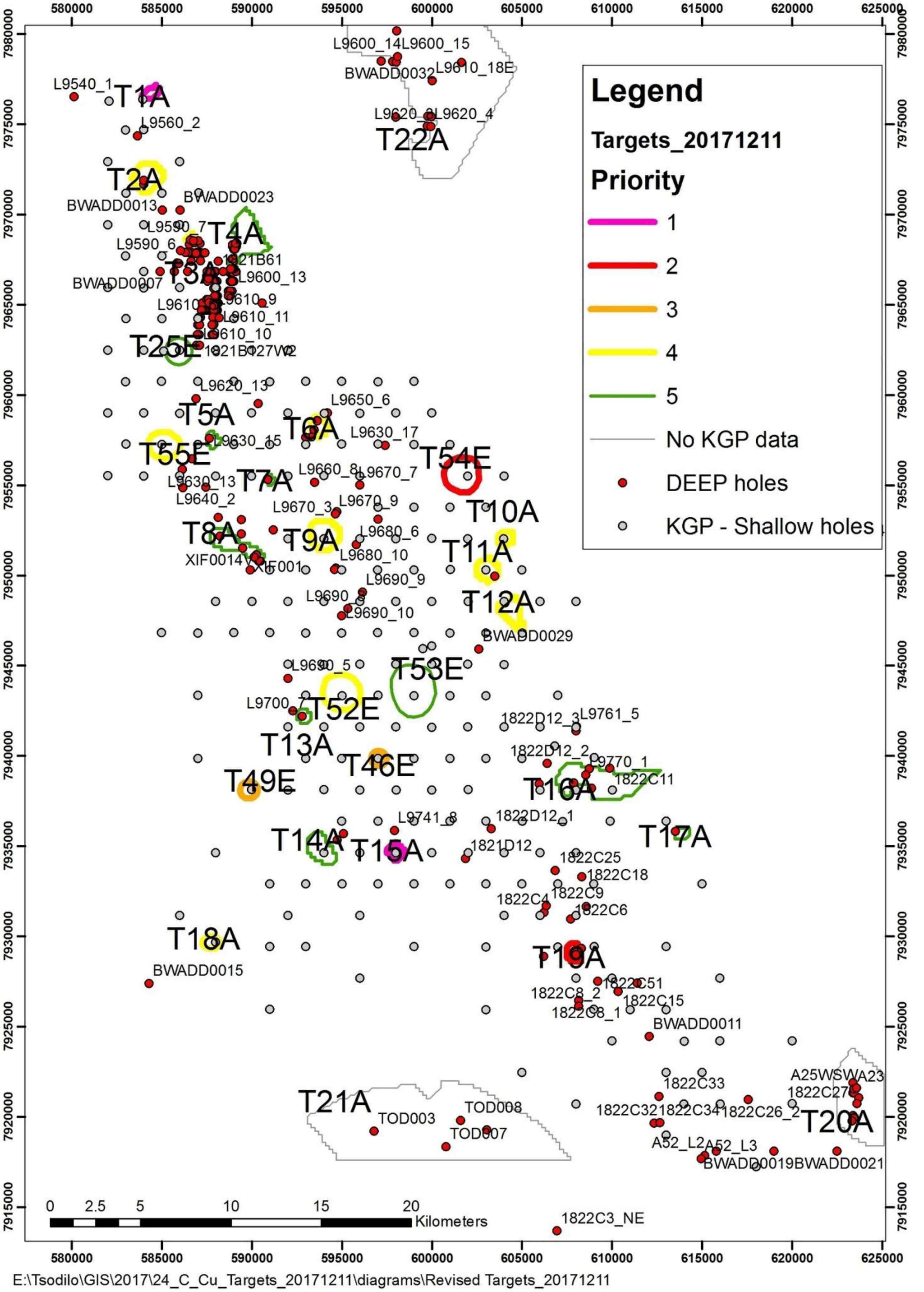

Figure 12 Revised target prioritization rankings relative to existing shallow and deep drill hole.

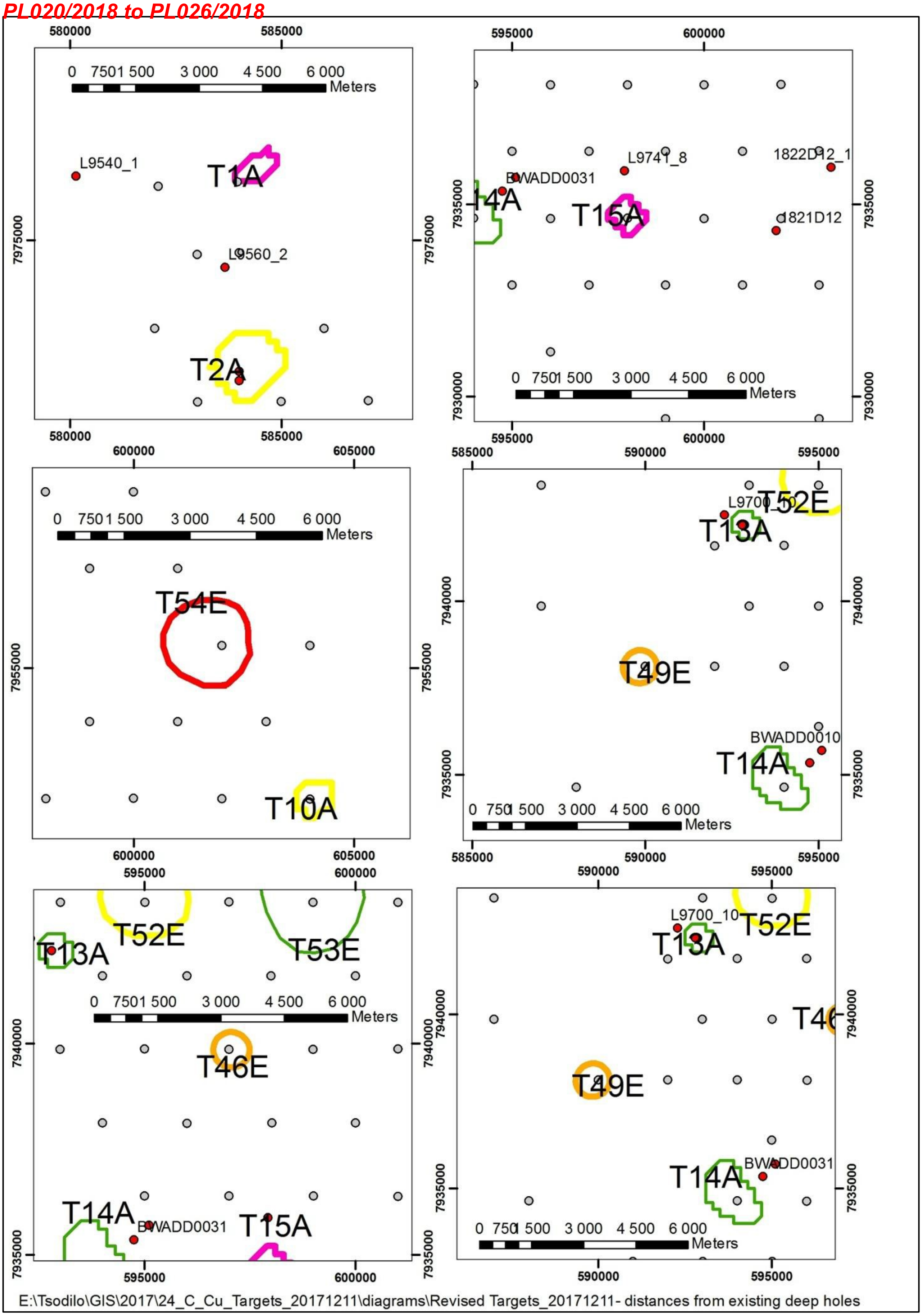

Figure 13 Closer views of prioritized targets relative to deep holes.

Table 2 Approximate distances from the centre of highest ranking revised targets to nearest deep drill holes.

Target	Nearest Holes	Approximate Distance (m)
T1A	L9540_1	4228
T1A	L9560_2	2450
T15A	L9741_8	1145
T15A	BWADD0031	3271
T15A	BWADD0010	3029
T54E	BWADD0022	5953
T54E	L9630_17	4469
T54E	L9670_7	5563
T54E	L9680_11	5243
T19A	1822C50	132
T19A	1822C7_1	470
T19A	1822C7_2	180
T19A	1822C5	1700
T19A	1822C6	1860
T19A	1822C51	1950
T46E	L9741_8	4068
T46E	BWADD0010	4508
T49E	L9700_10	5030
T49E	L9700_7	5130
T49E	BWADD0031	5680

Table 3 Deep drill hole values nearest centre of target T19A. (Highest of best values.)

HOLE_ID	Depth	SAMPLE_ID	BestFv_Cu_ppm	Technique
1822C27	127.60	1822C27_42	310	4AD_ICP_N
1822C27_2	237.40	1822C27/2_161	2600	ME-ICP61_N
1822C50	208.0	1822C50_125	1230	ME-ICP61_N
			BestFv_Co_ppm	
1822C27	99.60	1822C27_14	38.4	4AD_ICP_N
1822C27_2	176.40	1822C27/2_100	168	ME_MS81_ICP_MS_N
1822C50	352.60	1822C50_263	105.5	ME_MS81_ICP_MS_N
			BestFv_Ni_ppm	
1822C27	99.6	1822C27_14	186	4AD_ICP_N
1822C27_2	294.4	1822C27/2_218	375	ME-ICP61_N
1822C50	352.6	1822C50_263	795	ME-ICP61_N
			BestFv_Zn_ppm	
1822C27	99.60	1822C27_14	94.4	4AD_ICP_N
1822C27_2	161.40	1822C27/2_85	201	ME-ICP61_N
1822C50	102.60	1822C50_23	790	ME-ICP61_N
			BestFv_Mo_ppm	
1822C27	100.6	1822C27_15	8.82	4AD_ICP_N
1822C27_2	276.4	1822C27/2_200	6	ME-ICP61_N
1822C50	368.6	1822C50_279	55	ME-ICP61_N

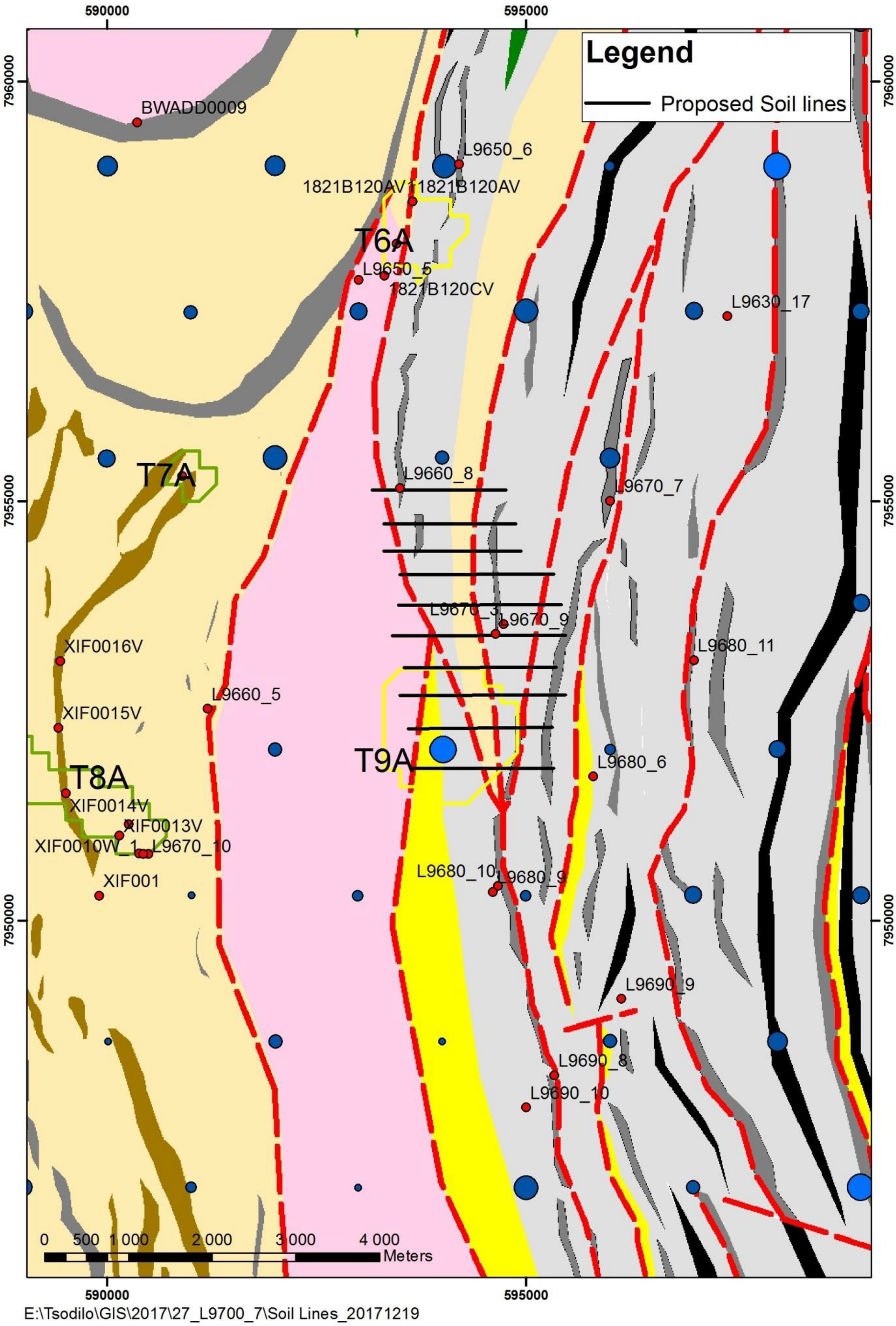

Figure 14 Proposed soil lines relative to targets and deep holes.

Gold targeting

Gold was also considered in the regolith data analysis process. Previous in-house work suggested correlations between Au targets and Cu targets[xiv]. The primary Au targets TA1 and TA2 are more closely associated with Cu targets T5A-T7A and T19A respectively figure 15. Some overlaps are visible between the Au + (As/2) Normalised targets and the medium to lower ranking Cu targets: Tn3 (T55E), Tn2(T9A), Tn4(T10A-T12A), Tn11(T52A), Tn10 (T14A) and Tn7 (T46E).

A number of the Au targets overlap well with the Au x m x ppm KGP regolith assays ratio: Tn15(TA1), Tn3, Tn13, Tn2, Tn4, Tn11 and Tn16 (TA4). Many of the Cu targets also show a good correspondence with higher Au x m x ppm KGP regolith assays ratios: T25E, T55E, T54E followed by: T2A, T9A - T12A, T52E, T46E, T49E,T14A and T15A.

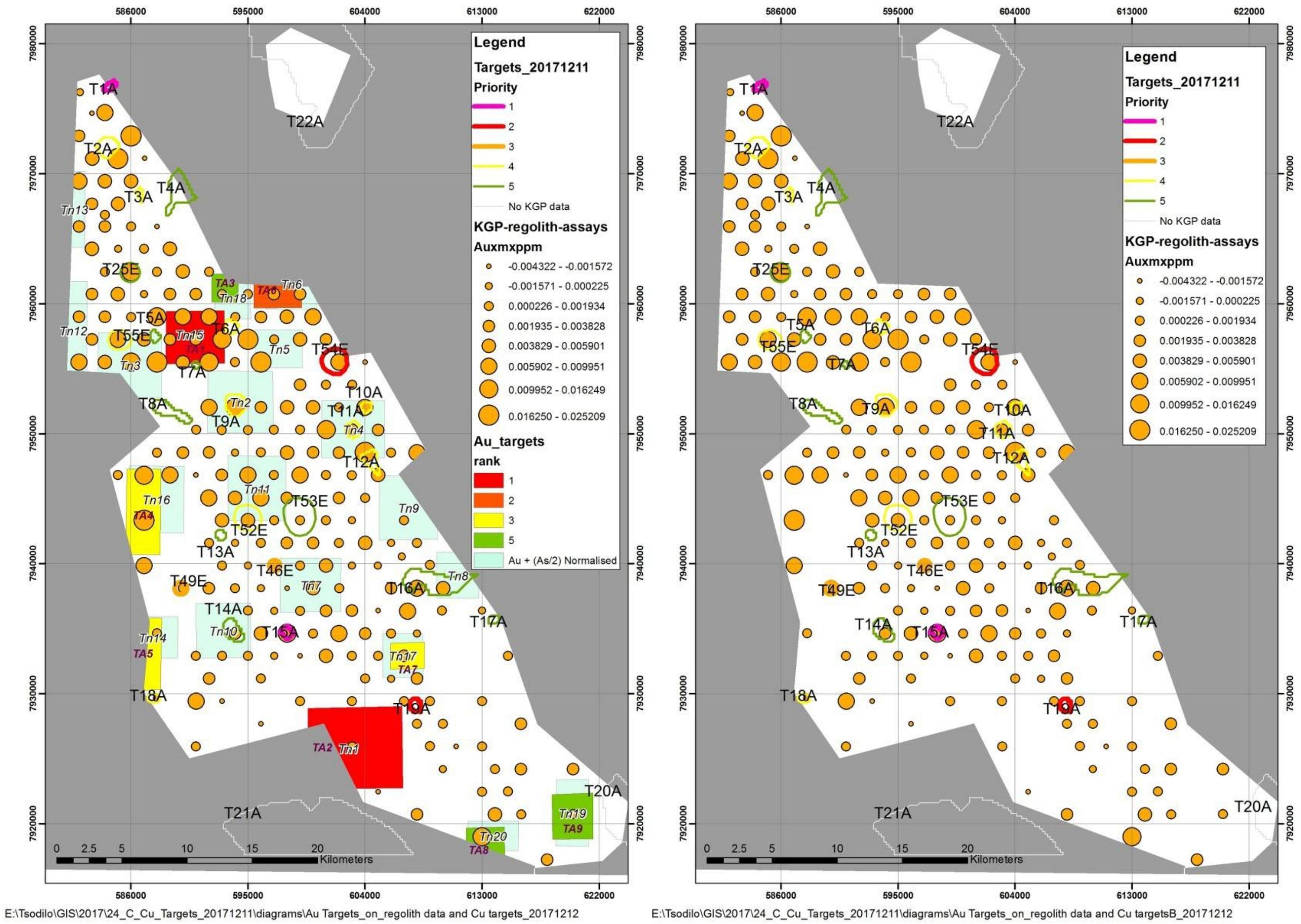

Figure 15 Comparisons of Cu and Au targets with Au x m x ppm KGP ratio data.

[i] First Quantum utilised Scandium based on their experience in Zambia, but it was considered necessary to check if the same approach would be relevant for this area.
[ii] Cu_Targets_Methodology_2017_04_05+JB[2];
[iii] The KGP Sc ratio targets excluded bedrock values and were determined using maxima values (referred to as Sc_Ratio_Cu_Ni_Co_Mo_Zn_Mn_sum_Target_A). This is the feature that has been used to delineate the latest target boundaries in 2017. The 7 additional targets mentioned here were initially defined during the first analysis of the KGP data (previously referred to as Ov_Cu_Ni_Co_Zn_Mn_Mo_Targets_A).
[iv] Copper Targets NW Ngamiland Tsodilo 2016_12_16_IM
[v] Copper Targets NW Ngamiland Tsodilo 2016_12_16_IM, Section 5, Table 5.4 (Listing of A and B type target boundaries generated from geochemical control contours) Last field KGP derived targets.T54E and T55E were also subsequently derived from the KGP ratio dataset.
[vi] Note the current FQM shears are disputable and may need remodelling.
[vii] Copper Targets NW Ngamiland Tsodilo 2016_12_16_IM, Section 5 p40 to 42 illustrates for the Tsodilo and FQM data separately in which of the drilled and logged lithologies the copper is concentrated.
[viii] High Cu XRF readings indicate that the highest values are associated with amphibolite (with quartz veins) (4000ppm) and Amphibole Gneiss (1250ppm) in L970/7. These XRF values are supported by lab assay results 10000 - 24100 - ppm in the Amphibolite.
[ix] Mineralisation in L9700/7 occurs in zones confined the 110m - 120m interval. A 10cm zone at 116.7m shows an average 3-4%Cu but can go up to 10-15%Cu on the red hematite blebs. (Lesego Kgotlhang, 11 November 2010). L9700/7 is associated with amphibolite and shearing and also displays overlapping kicks in Cu, Ni, Ag, S, Bi and Fe.
[x] TerraLeach™ technology is designed to remove the "mobile ion" component from soil with a view to detecting metal dispersion from a buried ore-body. Analysis is done using ICP-MS. "Mobile ions" refers to ions which have migrated into the weathering zone and which are only weakly or loosely attached to the surfaces of soil particles. These ions have the ability to disperse through un-mineralised rock possibly by micro-bubble, vapour, ground-water flow, capillary rise or electrochemical processes. The technique therefore has the capacity to indicate buried mineralisation. Anomaly contrast when compared with conventional geochemistry is generally superior. Samples are normally collected in the top 10cms of the soil profile.
[xi] Sites should be uncontaminated and undisturbed. Recently arrived wind borne sand, surface organic material and charcoal should be avoided. Dispersed ions are inferred to accumulate significantly within the top 10 cms of the soil profile. Minimum sample weights for individual samples can be as low as 10gms and up to 200gms. A nominal minus 1mm (minus 20 #) screened sample is generally appropriate.
[xii] Detection limit for Copper: 0.02ppm. Pricing: TerraLeach (TL1): / ICP first element: $20.00, / secondary instrument first element $8.50, / per additional ICP element $1.00
[xiii] Intertek Genalysis: "SAMPLING PROTOCOLS FOR "TERRA LEACH TM" PARTIAL DIGESTS" Intertek, Genalysis: "Laboratory Services: Schedule of Services & Charges 2016 Australia"
[xiv] Gold targeting methodology14Jul2017_2; Martinez_2017_Comparison+of+Gold+and+Copper+targets+18+July2[3]

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