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Discrimination of Gossans and Ironstones from the Mount Isa Inlier

by
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for
XStrata Copper, Australia

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Supporting Excel Workbooks

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Summary

The chemical analyses of ferruginous surface rock samples from the Mount Isa Inlier can be successfully separated into true gossans and ferruginous materials derived from sulphide-poor or –free precursors by the use of simple multi-element discriminants.

The first discriminant, termed the "regional filter" is defined as:

RegFilter = (Cu+Zn+Pb)/100 + (Sb+Au)/10, or

RegFilter10 = RegFilter/1.5 (to produce threshold value of 10)

This discriminant has the potential to be applied outside the Mount Isa Inlier to highlight weathered materials that may have developed from a broad range of mineralisation styles (sediment-hosted Pb-Zn and Cu-Pb-Zn, and Cu and Cu-Au mineralisation).

The second discriminant, termed the "Isa filter" is defined as:

IsaFilter = (Cu+Pb)/100 + As/25 + Ag + (Sb+Au)/10

IsaFilter10 = IsaFilter/2 (to produce threshold value of 10)

This discriminant excludes Zn, and may therefore be appropriate for regions where extensive, low level Zn mineralisation, such as that posited for the Mount Isa district, produces a large number of distracting multi-element responses as measured by the "regional filter".

The discriminants are not intended for use as measures of sub-surface mineralisation potential. However, they appear to provide a robust measure of the likelihood that a specific sample of weathered outcrop developed from a mineralised and/or sulphidic precursor. The level of confidence in achieving a successful discrimination is in excess of 90%, but nominally less than 97%.

In common with a single element determinations of rock chip samples, a discriminant will only be as effective and representative of a given outcrop, or prospect, as the original sample is. Therefore, the discriminants require due caution in their application to rock chip data.

However, the issue of sample representativity is generally less critical for soil samples. Therefore, the discriminants could reveal previously unnoticed trends and metal associations in historical soil datasets.

A closer examination of the existing datasets, together with CRCLEME and CSIRO openfile data, would almost certainly result in modified discriminants that are sensitive to lateritic processes, unconformity-related metal enrichment or other styles of mineralisation (*e.g.*, seafloor hydrothermal).

Introduction and Data Sources

1. MIM Exploration Gossan Collection
   - Assembled between April 1991 and September 1993
   - Samples from 147 sites
   - Assays for 184 samples from 124 sites
   - Samples collected by several geologists
   - Chemical analyses completed by AMDEL
   - Physical collection and original field cards held by the Exploration Group of Xstrata Cu, Australia (Oban Rd., Mount Isa)
   - Root data file is an excel spreadsheet called khgossan
   - Rationale – to establish a database of Mount Isa Inlier gossan analyses to assist with the recognition of mineralisation, and variants thereof, in strongly weathered and iron-rich outcrop

2. Mount Isa District Ironstone Collection (MIMEX)
   - Assembled between July 1992 and September 1992
   - Samples from 69 sites
   - Assays for 102 samples from 69 sites
   - Samples collected by B Bradley (BSc Honours student), under supervision (K Hannan)
   - Chemical Analyses completed by AMDEL
   - Physical collection, original field cards, and detailed photographic slides held by the Exploration Group of Xstrata Cu, Australia (Oban Rd., Mount Isa)
   - Root data file is an excel spreadsheet called IsaDistrictFestones
   - Rationale – to sample all processed Fe anomalies as indicated by classification of satellite imagery covering the Mount Isa district.

Primary Classification of Sample Collections

The two collections of samples, corresponding to 286 chemical analyses, were carefully classified at several levels to enhance the presentation of the data in graphical form and to facilitate statistical analysis of different combinations of the resulting subgroups.

The combined datasets are summarised according to regional setting and sample site setting in the graphs of Figure 1 (next page). Thus, for example, 100 samples were collected from locations within the Western Succession (which excludes the Mount Isa district. Of the 100 Western Succession samples, 60 were classified as originating from a prospect, 29 from a location not named or considered to be a mineral prospect (hence the term "reconn"), and a further 10 from a recognised deposit (refer to the bottom right corner graph). In the case of samples from the Mount Isa district (upper right graph), the bar labelled as 'Mount Isa deposits' includes all gossan samples from Novit, Mount Isa Mine, Hilton and George Fisher.

MIMEX gossans and ironstones classified by regional setting ("other" means outside Mt Isa Inlier)

	# Levels	Count	# Missing
Deposit_Group, Total	14	286	0
Deposit_Group, East Succ	3	27	0
Deposit_Group, Isa District	3	150	0
Deposit_Group, Other	4	9	0
Deposit_Group, West Succ	6	100	0

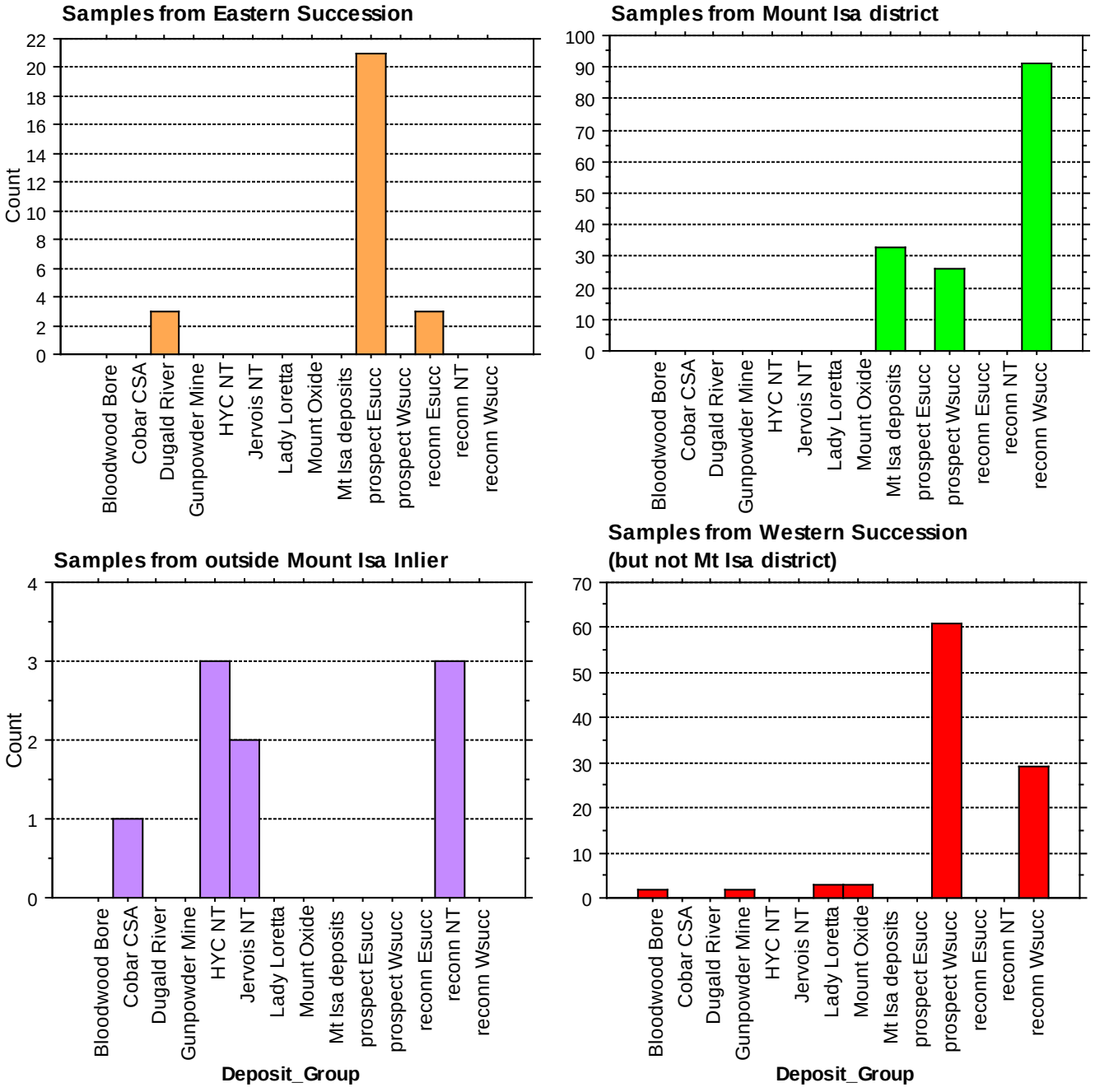


Figure 1

MIMEX gossans and ironstones classified by:

(1) regional setting – 4 subdivisions (4 graphs), and

(2) sample site setting (deposit, prospect, reconnaissance)

Detailed Classification of Individual Samples

The next level of classification differentiates gossans from rocks and ironstones, as determined from the original data files of the two collections, and after a detailed analysis of element associations and individual metal abundances. The finalised classifications are depicted in Figure 2.

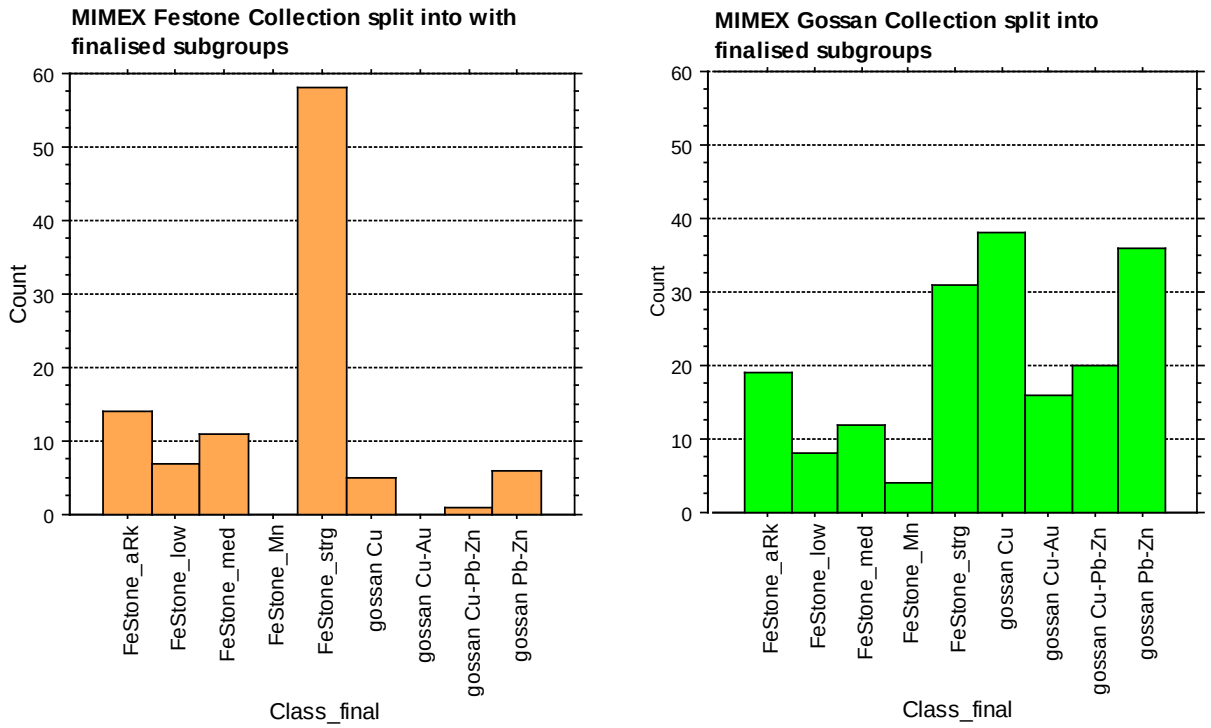
In the case of the MIMEX Gossan Collection, most samples were readily classified into one of 4 subgroups, *viz.*, Cu, Cu-Au, Pb-Zn, or Cu-Pb-Zn gossan, and the remaining samples were initially defined as ironstone. After an examination of the frequency distribution of iron content, expressed by the recorded or calculated Fe2O3T value, it was clear that the ironstone group could be conveniently subdivided at distinct population breaks, producing 4 subgroups:

- Festone_aRk: Fe2O3T < 10.3 wt.% (effectively a rock)
- Festone_low: Fe2O3T between 10.3 and 17.4 wt.% (effectively ferrugunised rock)
- Festone_med: Fe2O3T between 17.4% and 31.7% (original rock textures rare)
- Festone_stg: Fe2O3T > 31.7% (usually described as massive hematite)

All of the Mount Isa District Ironstone Collection samples were classified initially, and by definition, as ironstone. However, discontinuities in the frequency distribution of Fe2O3T were found to be similar to those of the Gossan Collection, and therefore subdivision into the same 4 subgroups was appropriate. A check of field descriptions, geographic locations, and subsequent data analysis revealed that several samples from this collection could be confidently re-classified as gossan (refer to left graph of Figure 2).

A few of the MIMEX Gossan Collection have extremely high Mn contents and were classified accordingly (Festone_Mn, Figure 2, right graph).

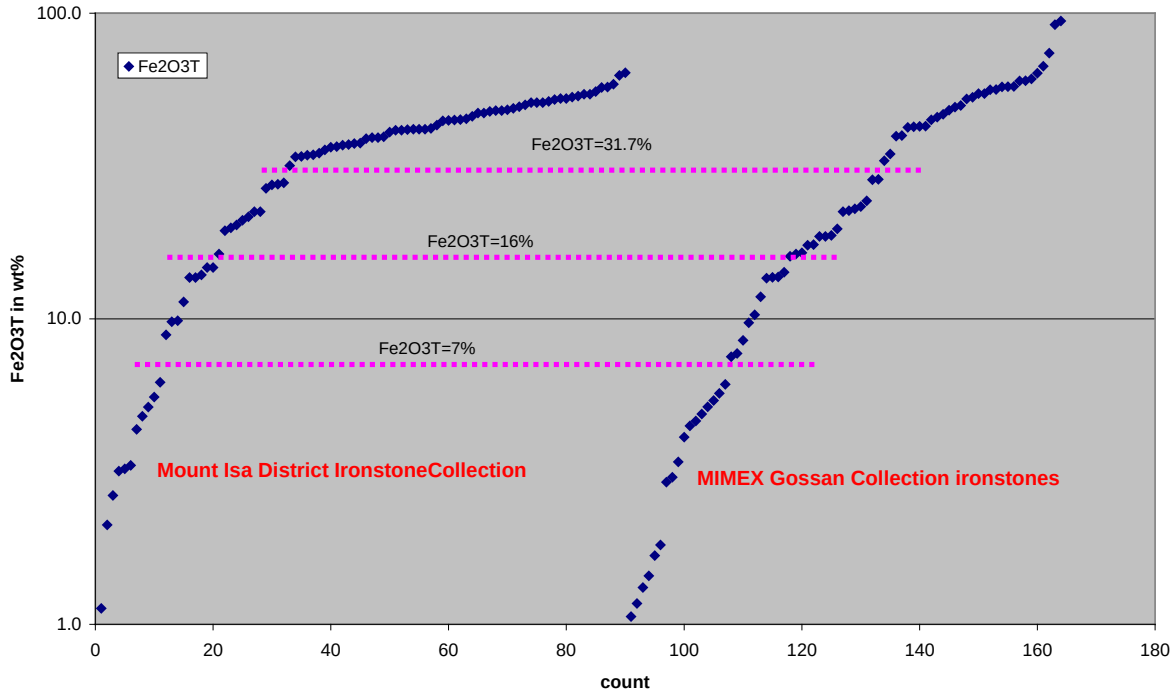
Figure 2



Subdivision of the ironstones was fundamental to assessing the relevance of Fe and Mn to the discriminate analysis. However, after sample reclassification, it is clear that slightly modified population breaks maybe applicable (Figure 3).

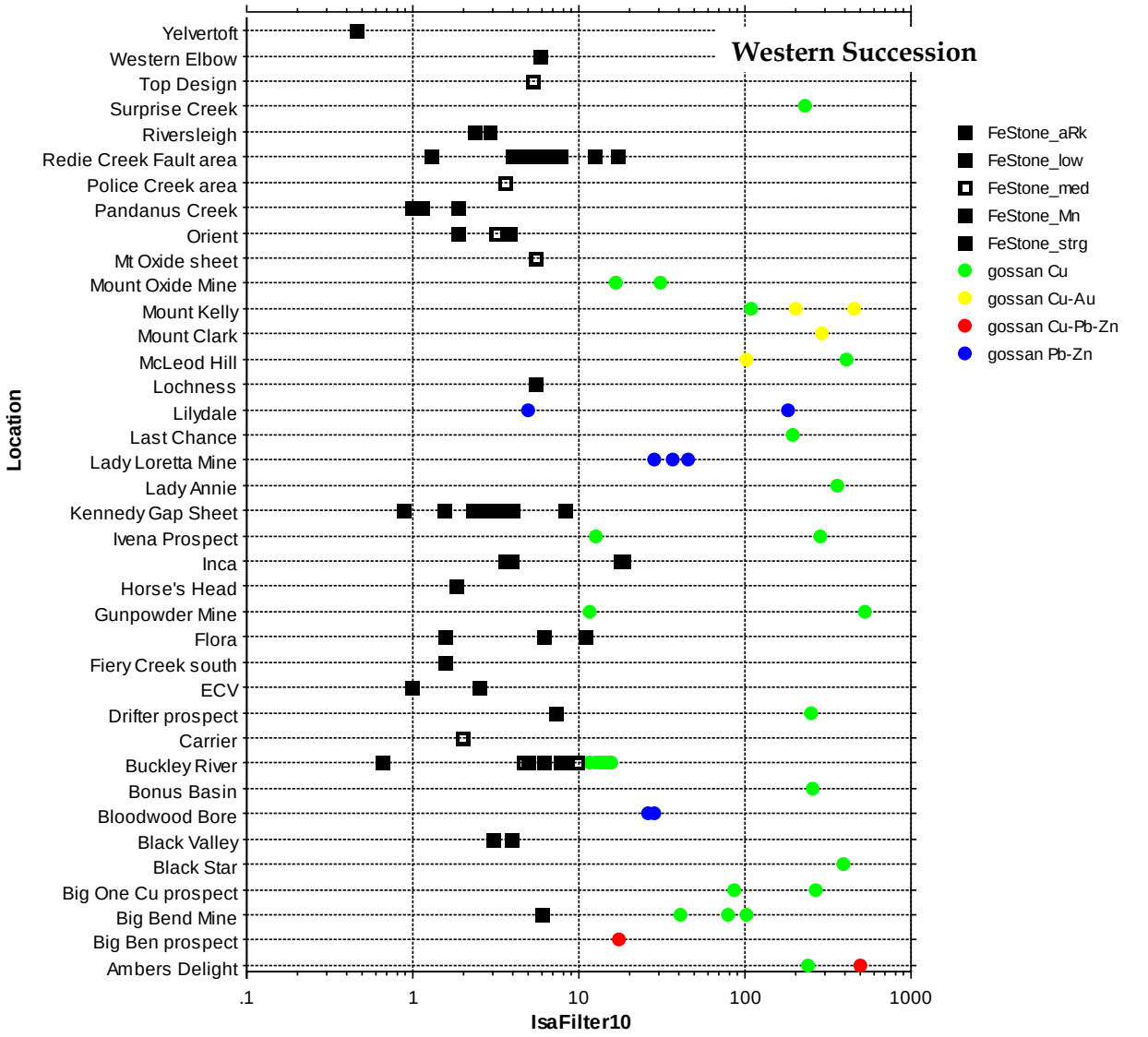
Figure 3

Frequency distribution of Fe2O3T in ironstones from the two rock collections. Discontinuities that define useful subdivisions are indicated at 7, 16 and 31.7%



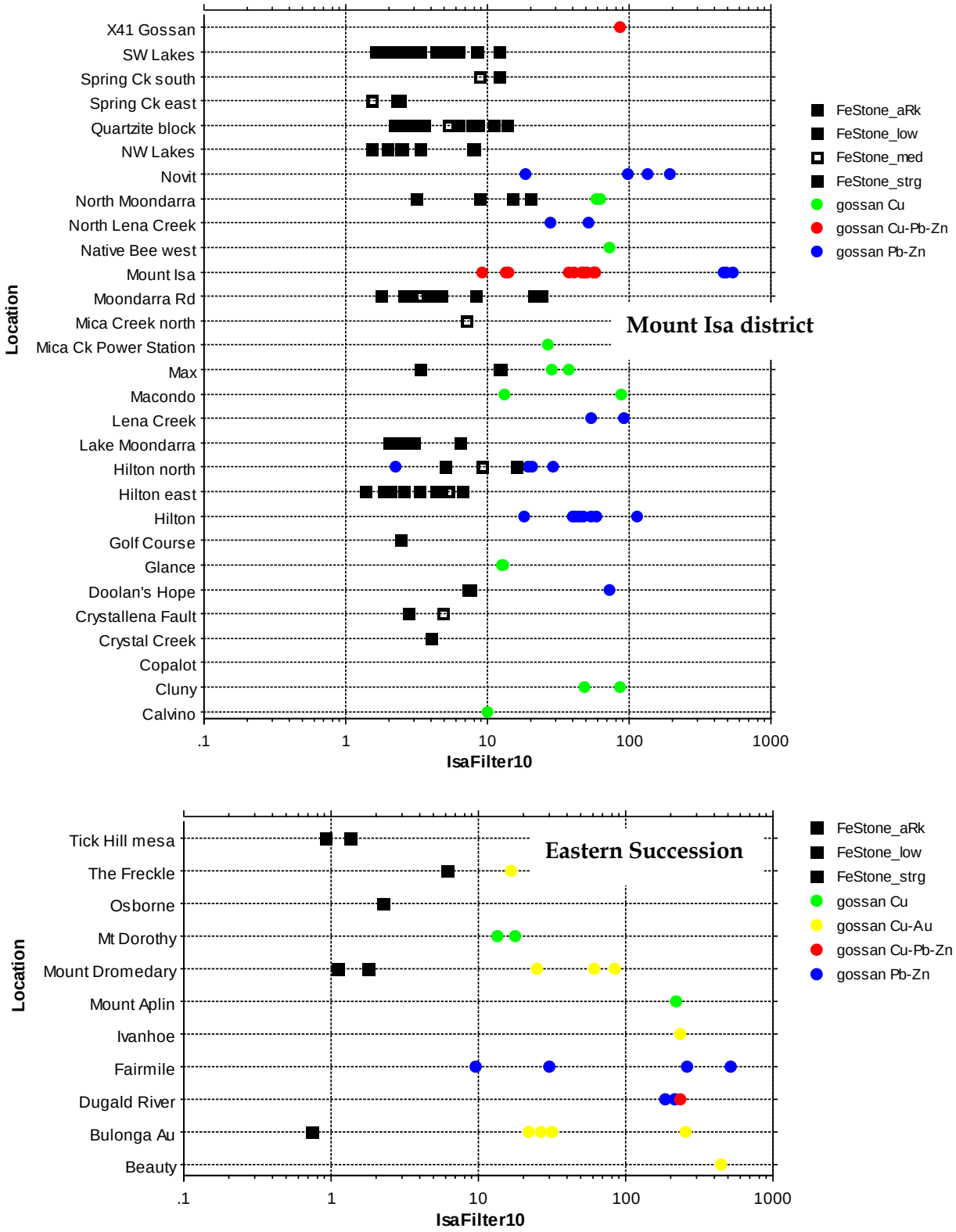
To complete this section, all samples are plotted according to location and "final_class" in Figure 4 (pages 7 and 8). Each graph provides a useful reference summary of the content and character of those portions of the Ironstone and Gossan collections from the Western Succession, Eastern Succession, Mount Isa district, and prospects and deposits outside the Mount Isa Inlier. The property depicted for each sample is **IsaFilter10**. This variable is derived from the Cu, Pb, As, Ag, Sb and Au analyses of each sample and is explained in detail on page 16. The filter was adjusted by a simple factor to ensure that the gossans and ironstone populations were effectively separated at a filter value of 10.

Figure 4: Samples from each locality, prospect, or deposit classified according to gossan type or ironstone subgroup



Other Australian prospects and deposits

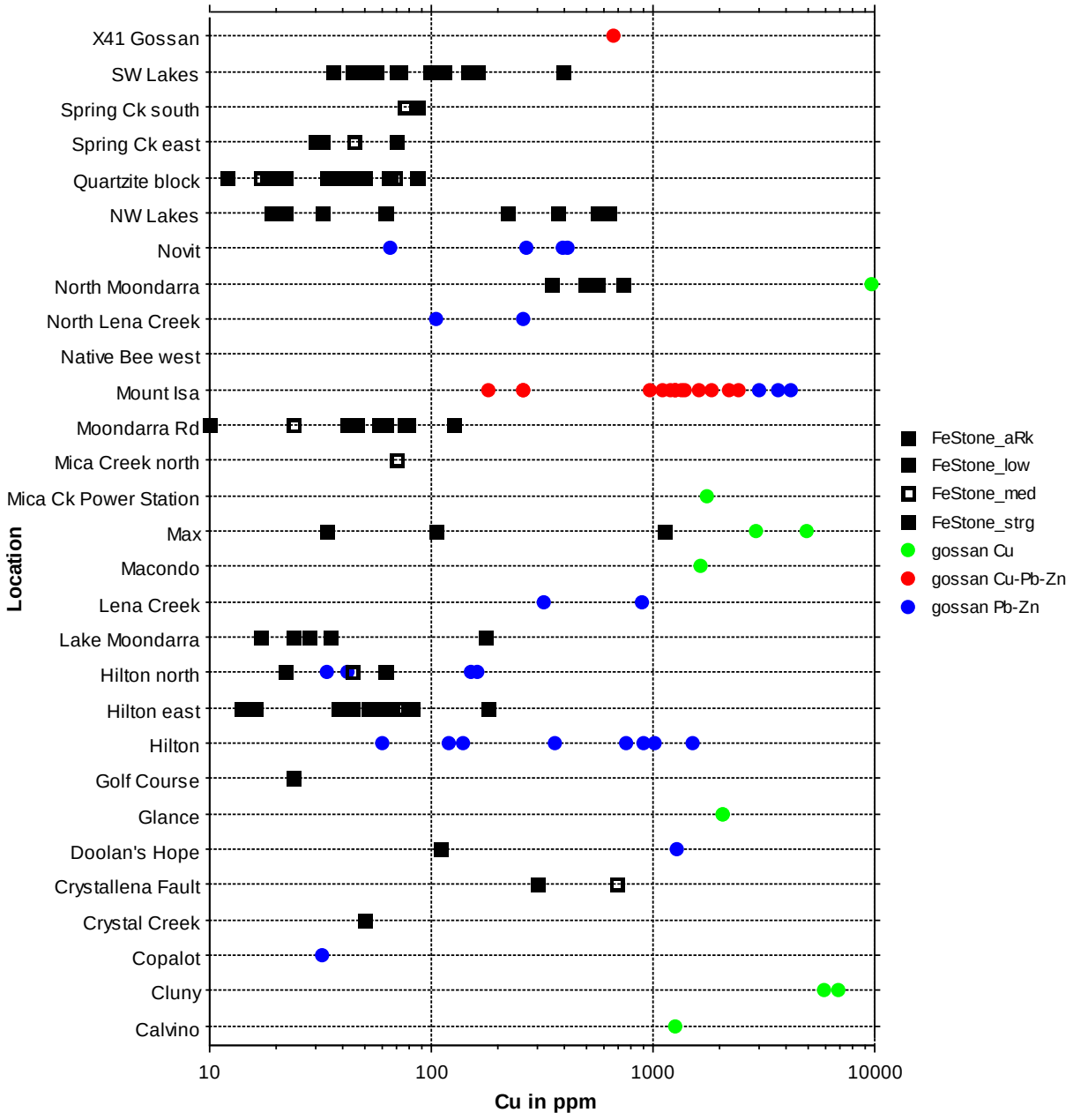
Figure 4 continued: **Samples from each locality, prospect, or deposit classified according to gossan type or ironstone subgroup**



Data Processing

The challenge of distinguishing a true gossan from ferruginous material derived from a sulphide-poor or –free precursor is illustrated in Figure 5. Here, the Cu content of all samples from the Mount Isa district are plotted in a similar manner to the equivalent classification plot of Figure 4 (*viz.* upper graph, page 8). Clearly, many samples classified as Pb-Zn gossan, and even some classified as Cu-Pb-Zn gossan, are indistinguishable from many ironstone samples, particularly in the 100-1000 ppm interval.

Figure 5: Cu abundances in ironstones and gossans from the Mount Isa district



In the search for a multivariate factor, or discriminant, to separate the two rock types, a much larger range of plots were generated to examine the relationships between individual metals and different classification variables. Three are included in this report to illustrate the process.

A critical finding early on was that Fe and/or Mn do not strongly control the multi-element signatures of ferruginous materials (gossan or not). Although there is some evidence for the "scavenging" of metal Fe-accumulation associated with weathering, it is clear that the process does not explain the chemical profile of most samples in the two collections, particularly at Fe2O3T levels in excess of about 10 wt%.

This important conclusion is illustrated in Figures 6 and 7. In these plots, samples of the MIMEX Gossan Collection are plotted from left to right according to their final rocktype classification, and within each subgroup the samples are ordered from lowest to highest Fe2O3T content. Cu and Pb, respectively, are recorded on the right-hand Y axis of Figures 6 and 7.

The potential of Cu to be used in any multi-element discriminant is clear in Figure 6, given that most Cu, Cu-Au and Cu-Pb-Zn gossan samples have much higher Cu levels than the ironstone subgroups. Similarly, the ability of Pb to highlight most of the Pb-Zn gossans at the expense of ironstones in figure 7, implies that Pb, too, must be considered for any discriminant. Both Figures clearly demonstrate a full range of iron content, expressed as Fe2O3T, within each ironstone and gossan subgroup.

Figure 6: Cu and Fe2O3T in samples of the MIMEX Gossan Collection

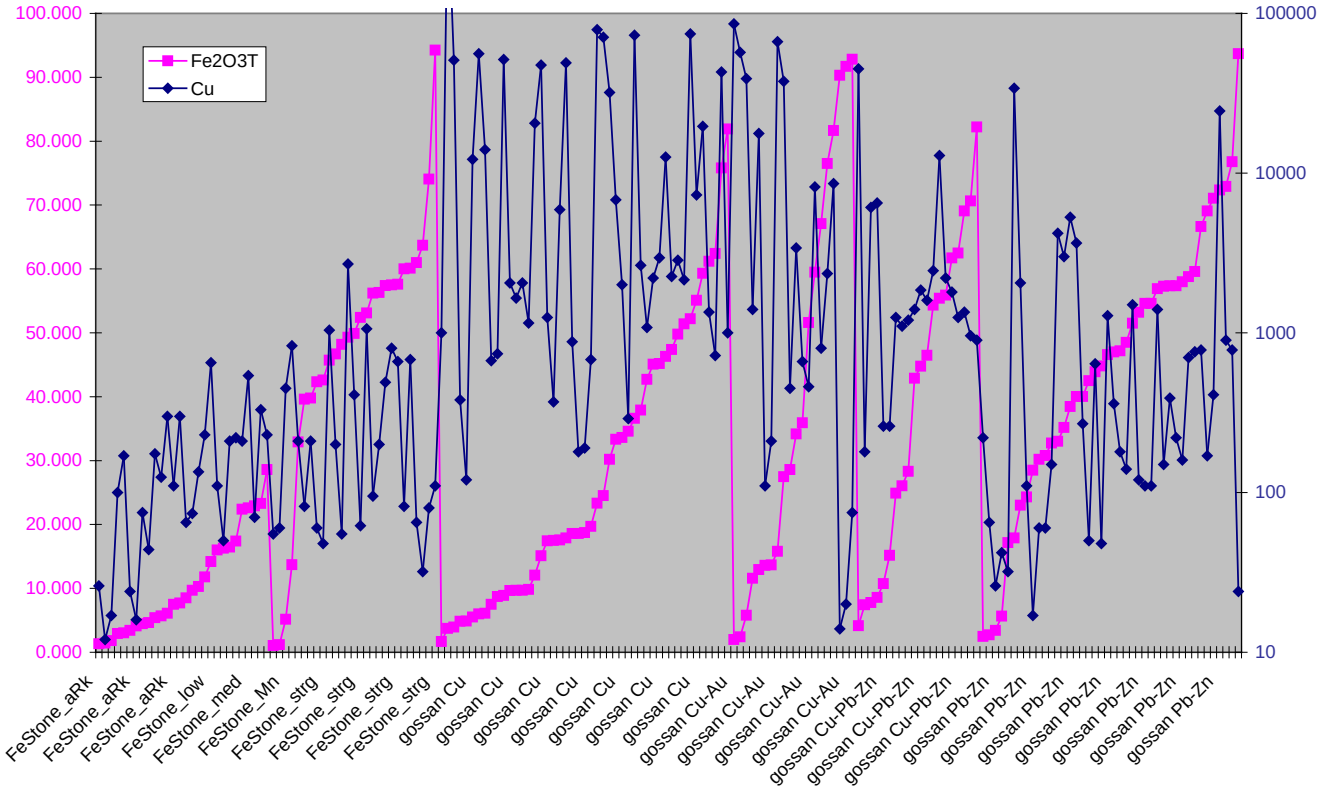
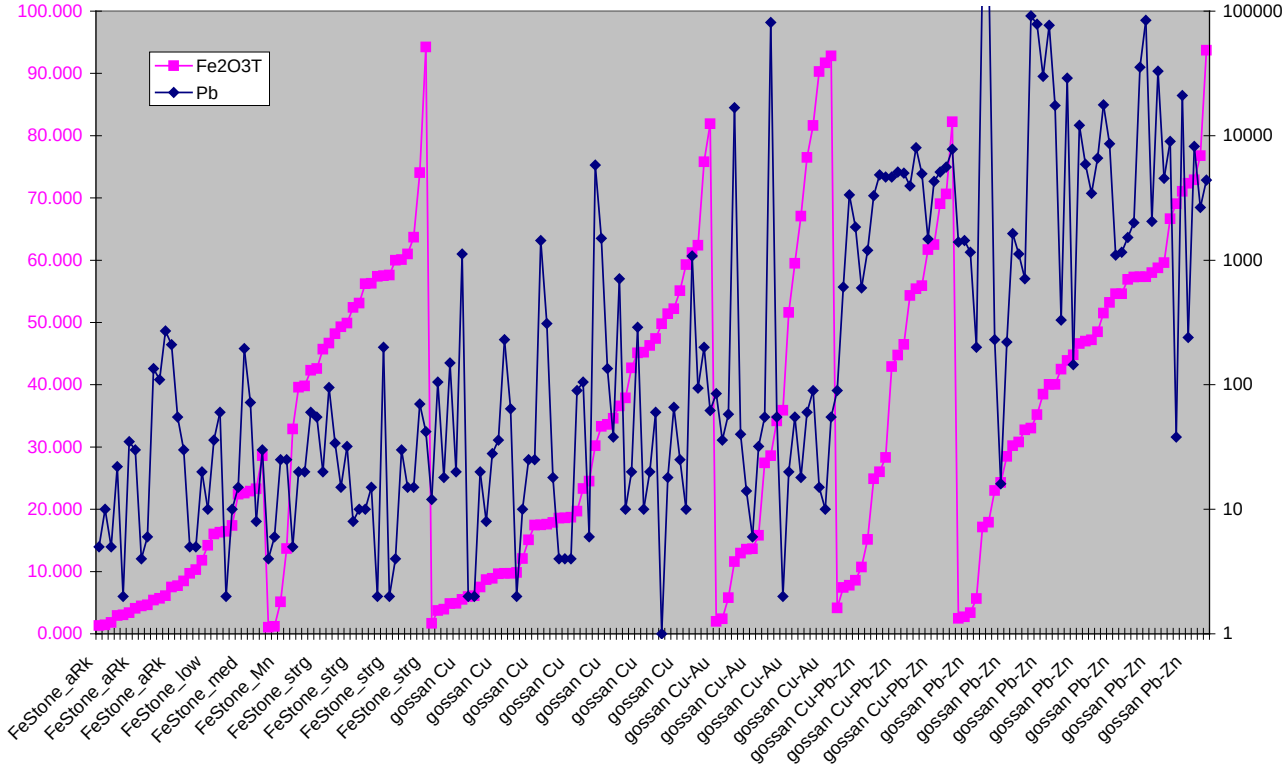
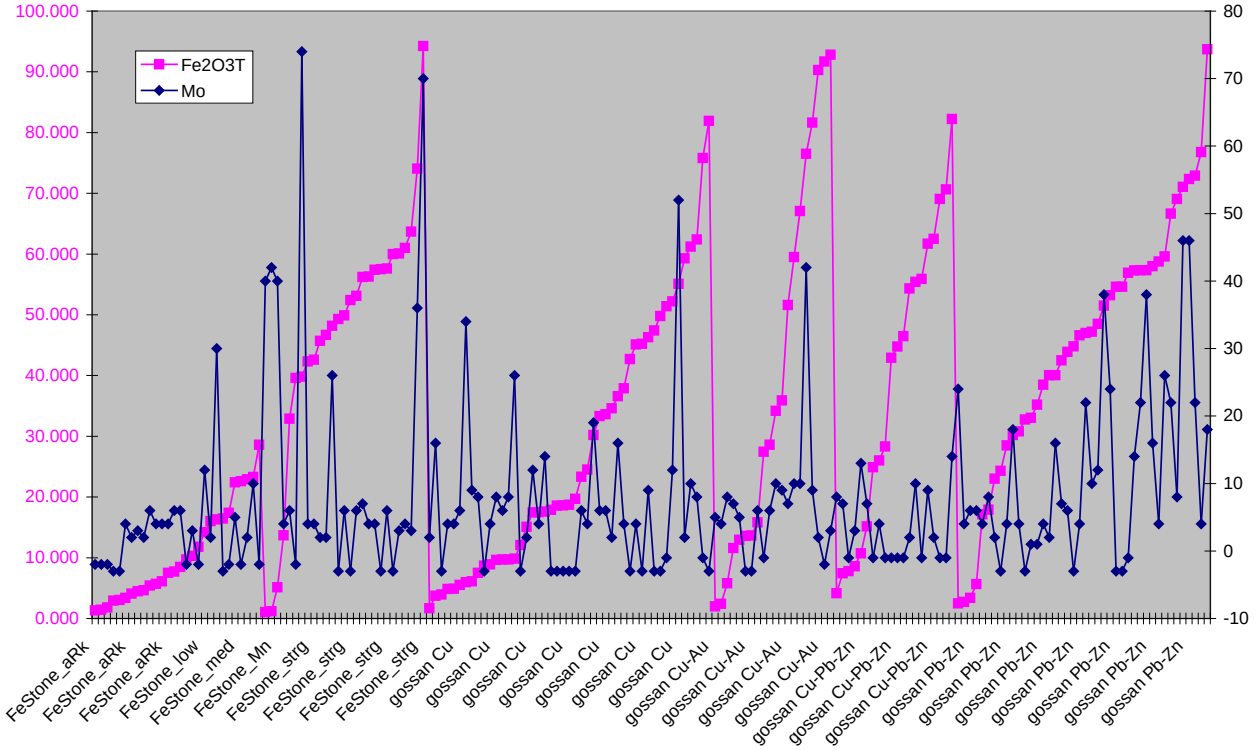


Figure 7: Pb and Fe2O3T in samples of the MIMEX Gossan Collection



By contrast, it was evident at an early stage that Mo has little potential to be used in a discriminant. Figure 8 illustrates how Mo levels do not occur at distinctive levels within any rocktype grouping.

Figure 8: Mo and Fe2O3T in samples of the MIMEX Gossan Collection



Identification of a Discriminant (filter)

The process described in the previous section was repeated for all elements, including the major oxides. The Excel workbook, KHGossanGraphs, contains the equivalent plots of Figures 6-8 for each element of the MIMEX Gossan collection. The workbook, AllData_Filters, has similar graphs for the combined MIMEX Gossan and Mount Isa District Ironstone collections.

First Pass – the Regional Filter

By then concentrating on elements with contrasting abundance distributions between different combinations of ironstone and gossan subgroups, factors were determined for each metal to ensure that distribution heterogeneities were preserved in equal contribution in derived variables, or discriminants. For example, Cu/100 + As/25 was found to combine the distribution characteristics of both metals in approximately equal proportion. Pb and Zn were found to require a similar factor to Cu (0.01), Sb and Au with (Au in ppb) a factor of 0.1, and Ag a factor of 1. Ultimately, the element factors reflect the range of abundances observed in the population distribution of each metal.

This systematic process, which amounts to a controlled and manual version of multivariate discriminant analysis, is preserved in the excel workbook, KHGossanFilter.

Ultimately, a combination of Cu, Zn, Pb, Au and Sb was found to effectively separate the gossans and ironstones of the gossan-dominated MIMEX Gossan Collection. The red-dashed line of Figure 9 corresponds to a CuPbZnSbAu factor value of 15. Careful examination suggests that there is a persistent break in the population distributions of each subgroup of gossans and ironstones in the vicinity of factor value 15. On checking the identity of the 4 ironstone-classified samples with factor values well above 15, three were found to be from the sporadically mineralised Redie Creek Fault area and the fourth from the Drifter prospect, several km north of the Lady Loretta deposit. These are well-known, albeit, problematic prospects.

Similarly, several of the gossan-classified samples that plot below factor level 15, were on closer examination found to be prospects with weak mineralisation like Carrier (Pb-Zn) or Bulonga (Au), or they were highly siliceous outcrops (silcrete within the Mount Isa and Hilton gossans). Such discrepancies are easily detected in the prospect plots of Appendix 1 and when cross-checked against the original field descriptions or photos.

A simple combination of Cu, Pb, Zn produces a similar effect to the CuPbZnSbAu factor, but not surprisingly, several of the Cu-Au gossans and some of the more strongly leached Cu gossans from the Western Succession (which retain Sb and/or Au) plot well within the ironstone-dominated field (Figure 10).

When other metals such as Ag or As are considered together with Cu, Pb, and Zn, the effect is to produce a less distinct separation between the ironstone and gossan-dominated populations. Thus, it was concluded that Cu, Pb, Zn, Sb and Au constitutes a "regional" discriminant, that distinguishes gossans with a broad range of mineralised precursors from ferruginous material derived from a sulphide free or, at most, a very weakly sulphidic precursor.

Figure 9: **MIMEX Gossan Collection samples plotted against Fe2O3T content and the factored sum of Cu, Pb, Zn, Sb and Au**

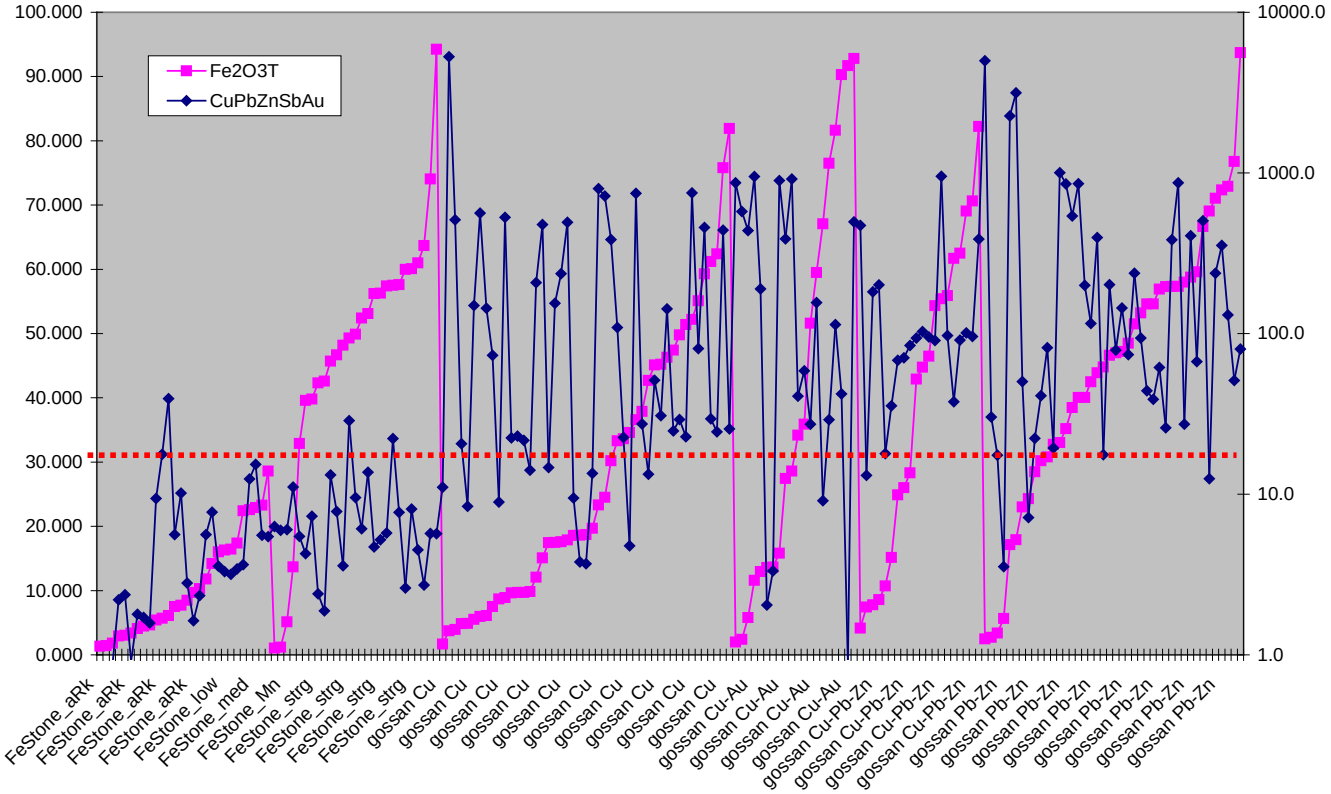
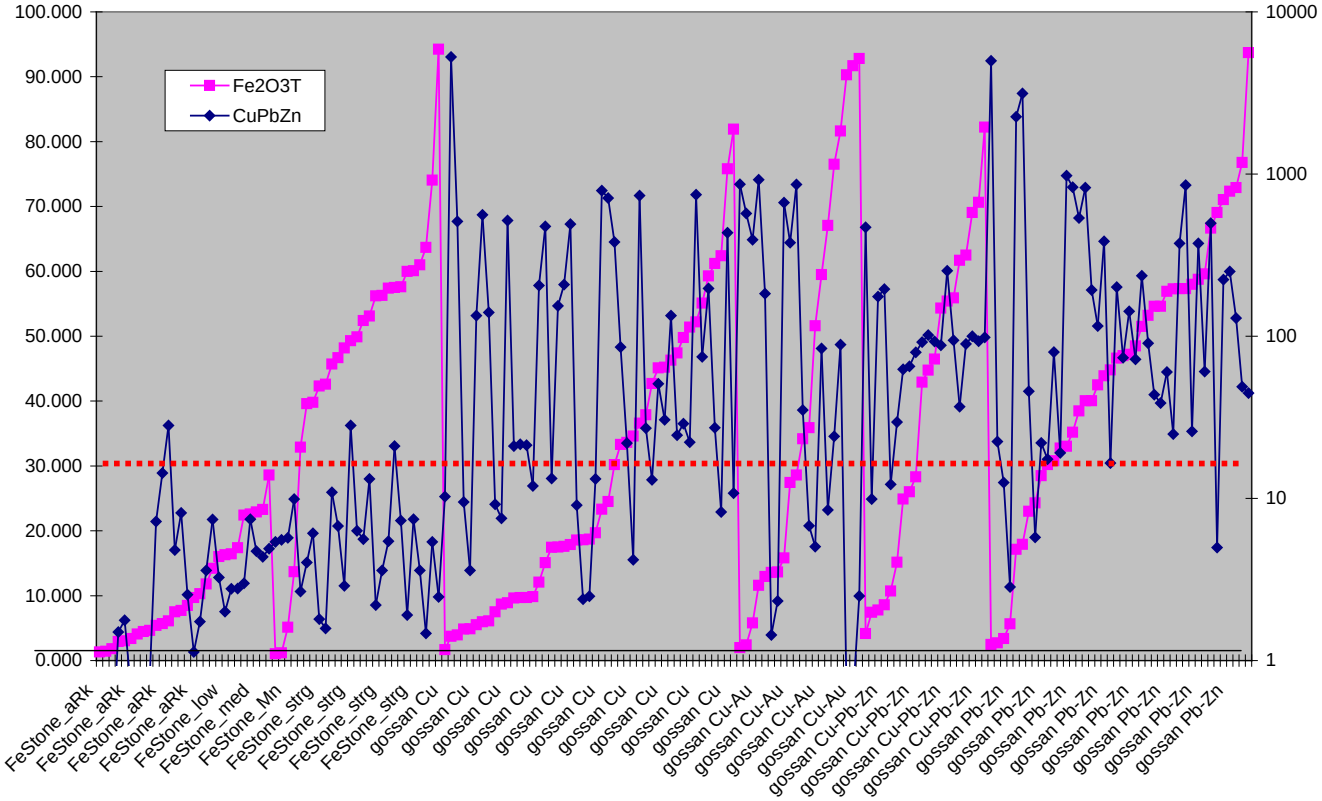


Figure 10: **MIMEX Gossan Collection samples plotted against Fe2O3T content and the factored sum of Cu, Pb, and Zn only**



When the "regional" discriminant (Cu-Pb-Zn-Sb-Au) was applied to the combined MIMEX Gossan and Mount Isa District Ironstone collections it was found that many of the ironstones from the Mount Isa district were factored as gossan, due to persistently high Zn contents. The results are displayed in upper graph of Figure 11, where the "regional" discriminant was adjusted to a threshold of 10 by dividing all factor values by 1.5. The gossans indicated on this plot represent re-classifications from ironstone. For comparison, the results for the MIMEX Gossan collection are presented again in the lower graph of Figure 11.

The Zn-rich character of the Mount Isa District samples compared with samples classified as ironstone in the MIMEX Gossan Collection is demonstrated in Figure 12 (upper). The lower graph emphasises that, unlike Zn, Cu levels in progressively higher Fe samples do not increase as they do in ironstone-classified samples from outside the Mount Isa district.

Rather than indicating a failure of the discriminant, it is probable that the classification of these Zn-rich samples as gossan is appropriate from the perspective of, say, a reconnaissance rock chip programme designed to detect evidence of large sediment-hosted base metal systems. It is argued that their Zn-rich (and Cu-poor) character must reflect the widespread, sulphidation and associated weak Zn-Fe mineralisation of the host original rock units. If they are simply products of "metal-scavenging" during weathering-related Fe-enrichment, then the Fe-Zn correlation observed in Mount Isa district samples should be evident in ironstone-classified samples of the MIMEX Gossan Collection. Furthermore, 2 elements normally associated with metal scavenging by hematite and goethite, V and Co, do not display a systematic enrichment in the higher Fe ironstone subgroups.

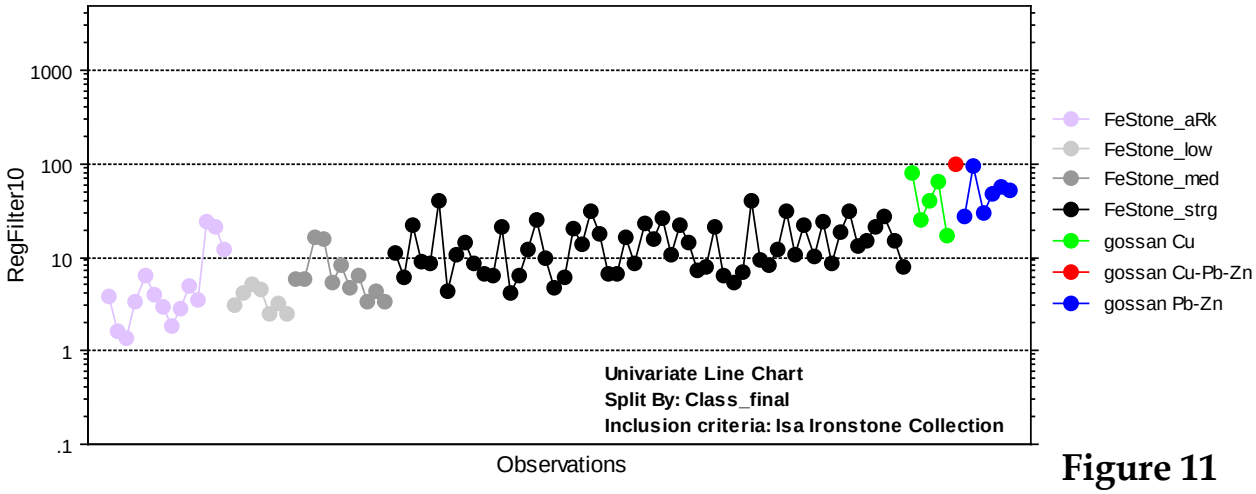


Figure 11

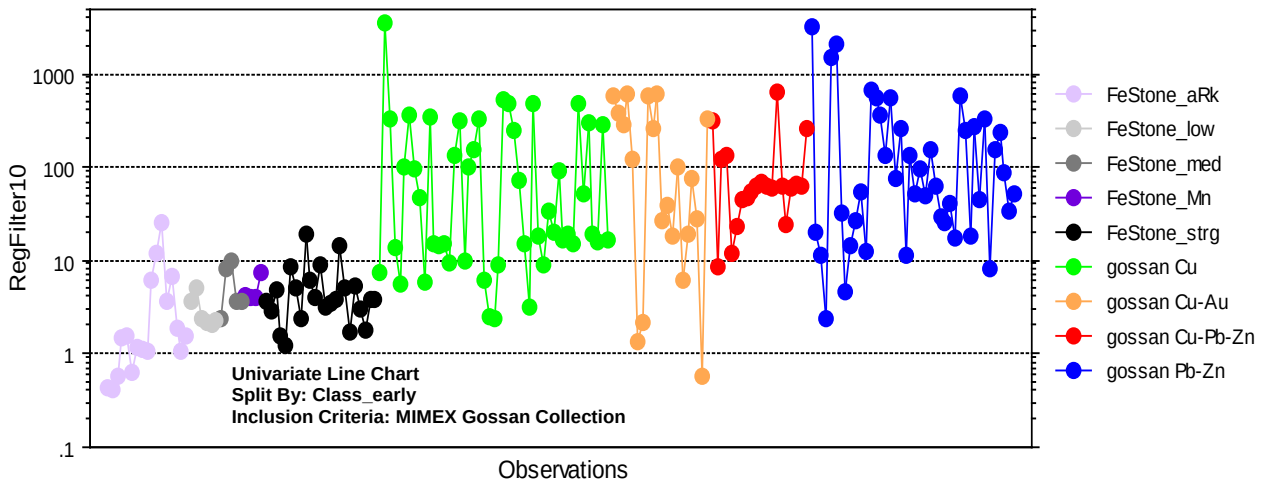


Figure 12: A comparison of Zn abundances in equivalent subgroups of the Ironstone and Gossan Collections

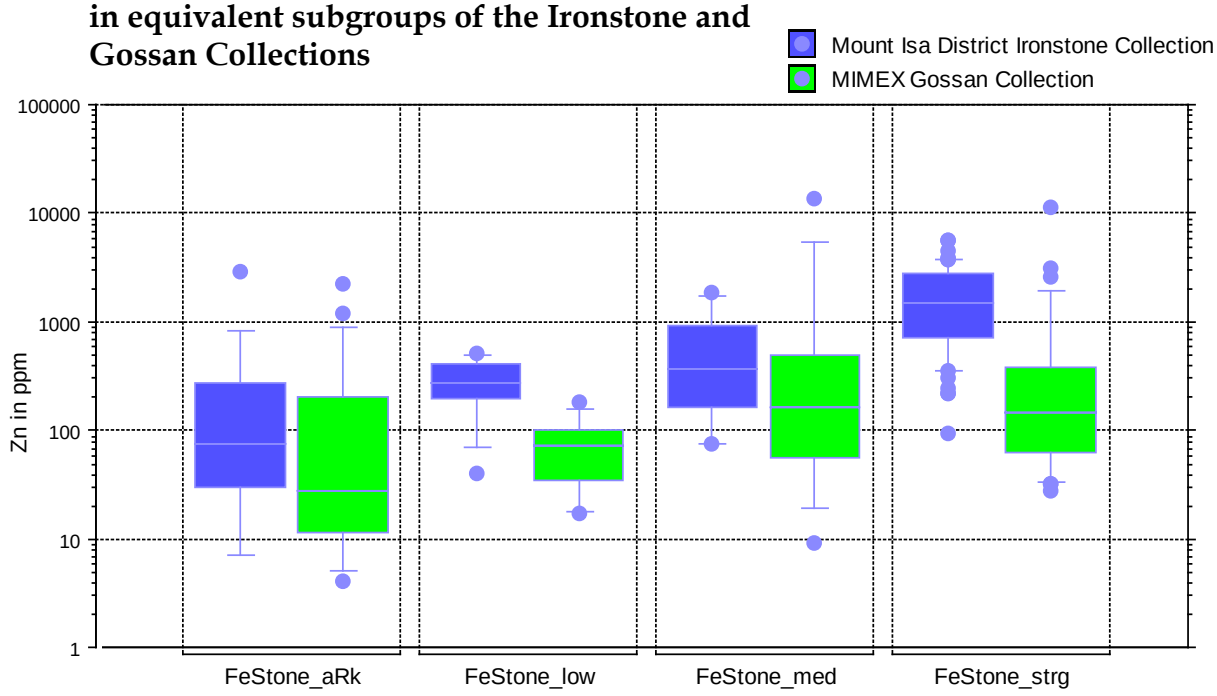
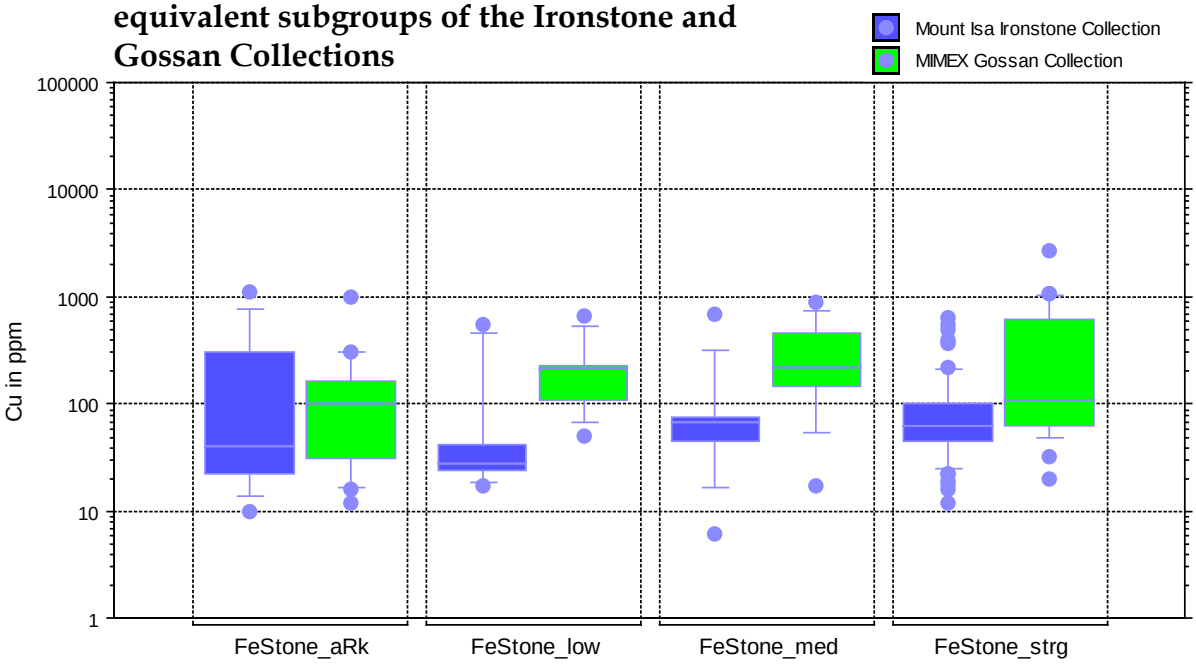


Figure 12: A comparison of Cu abundances in equivalent subgroups of the Ironstone and Gossan Collections



Second Pass – the IsaFilter

To account for the unusually Zn-rich character of ferruginous samples from Mount Isa Group rocks in the Mount Isa district, Zn was replaced in the "regional" discriminant by As and Ag to produce the the so-called IsaFilter. The results are depicted in Figure 13, which applies to all 286 samples of the present investigation. Clearly, this discriminant has depressed the "signal" of the chemically ambiguous Mount Isa district samples, whilst maintaining a clear discrimination of the full range of Mount Isa Inlier gossans (*cf.*, the black-filled circles with filter values of > 10 in the upper graph of Figure 11). Note, however, that Figure 13 represents the final product of the reclassification process. The locations and field descriptions were checked of samples that plotted on the "wrong" side of the filter threshold value of 10, and their classifications adjusted where judged appropriate. The number of samples reclassified from gossan to ironstone, and *vice versa*, can easily be tracked by comparing the detailed graphs of Figures 14 and 15.

Figure 13: All samples from the MIMEX Gossan and Mount Isa District Ironstone Collections plotted against their calculated IsaFilter value

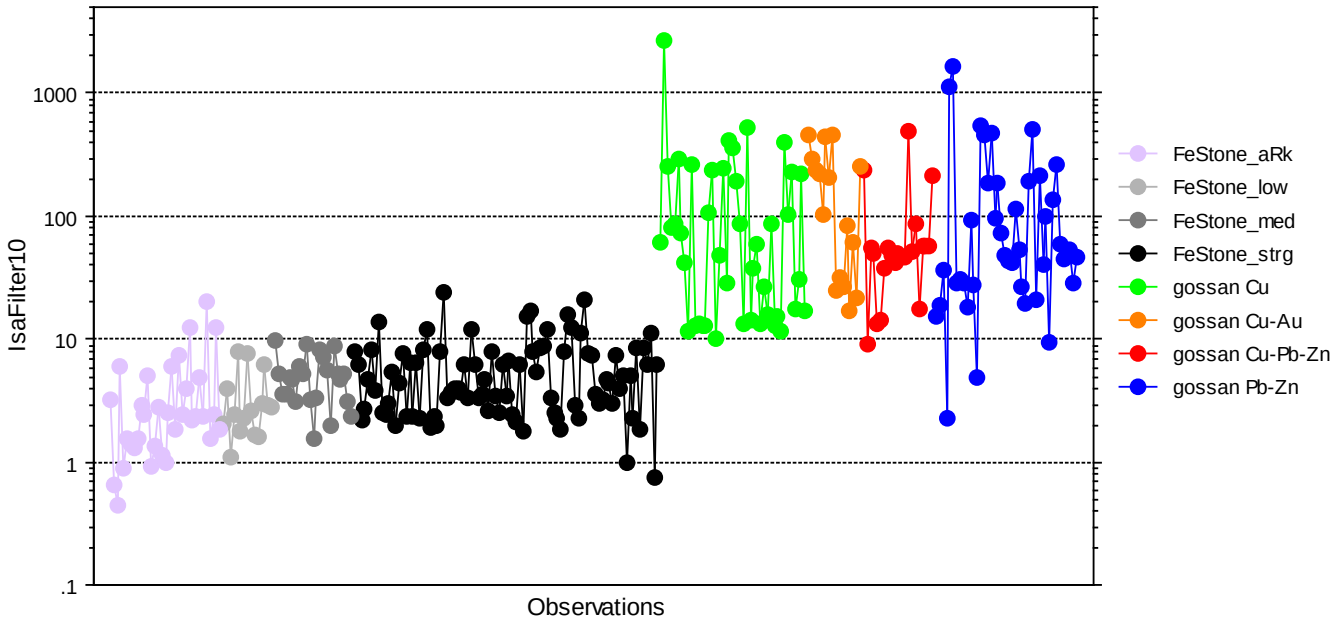
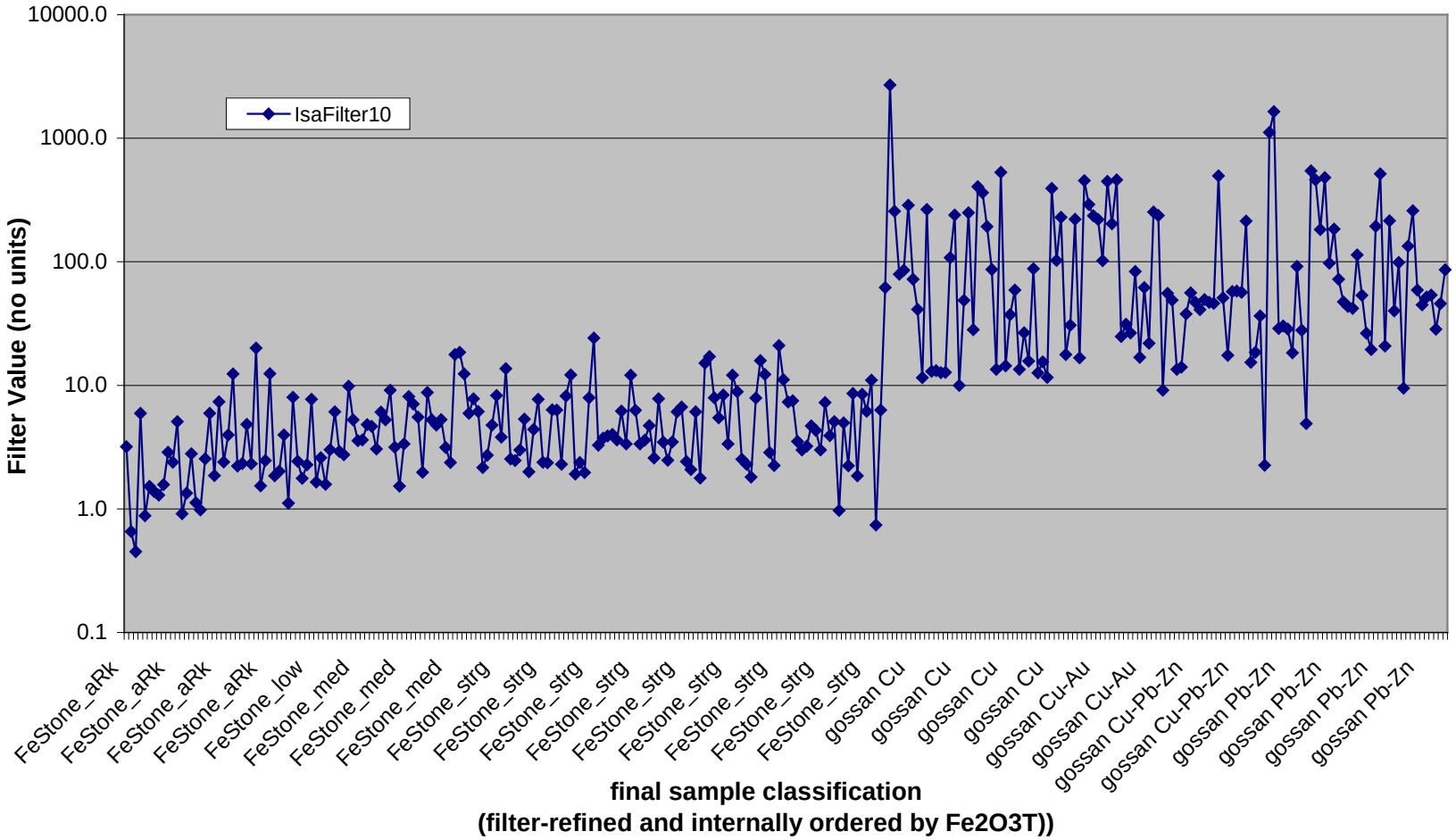
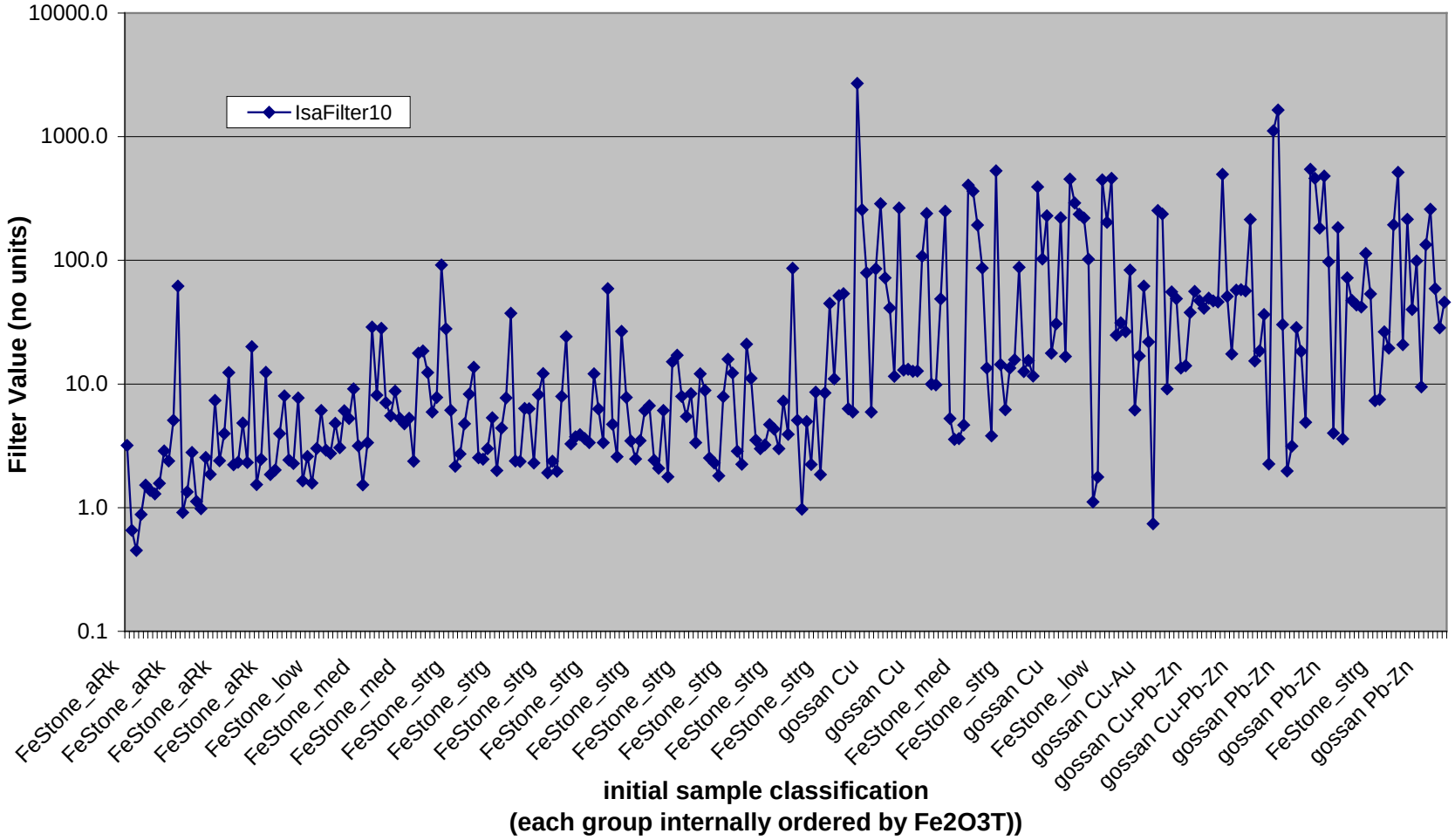


Figure 14 **Discrimination of gossans and ironstones by the IsaFilter**



IsaFilter = (Cu+Pb)/100 + As/25 + Ag + (Sb+Au)/10
IsaFilter10 = IsaFilter/2 (to produce threshold value of 10)

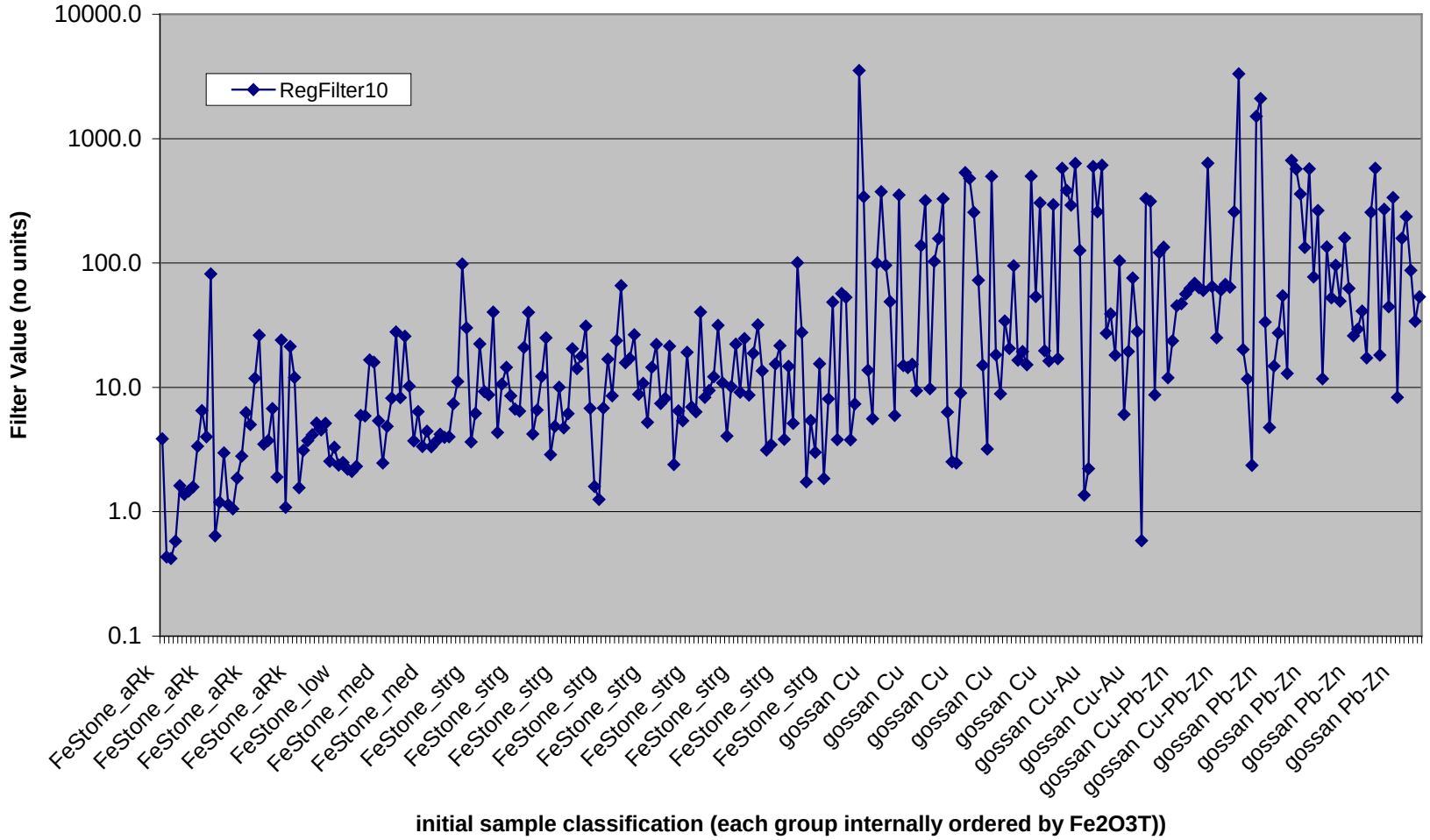
Figure 15 Discrimination of gossans and ironstones by the IsaFilter



19% of samples classified as ironstone (30/157) plot above isafilter threshold value of 10
19% of samples classified as gossan (24/129) plot below the threshold

After filter-assisted reclassification only 11% of ironstones and 4% of gossans plot above and below, respectively, the filter threshold value of 10 (refer to figure on previous page)

Figure 16 **Discrimination of gossans and ironstones by the Regional Filter**



RegFilter = (Cu+Zn+Pb)/100 + (Sb+Au)/10

RegFilter10 = RegFilter/1.5 (to produce threshold value of 10)

This graph is an extension of Figure 11, by including gossan samples

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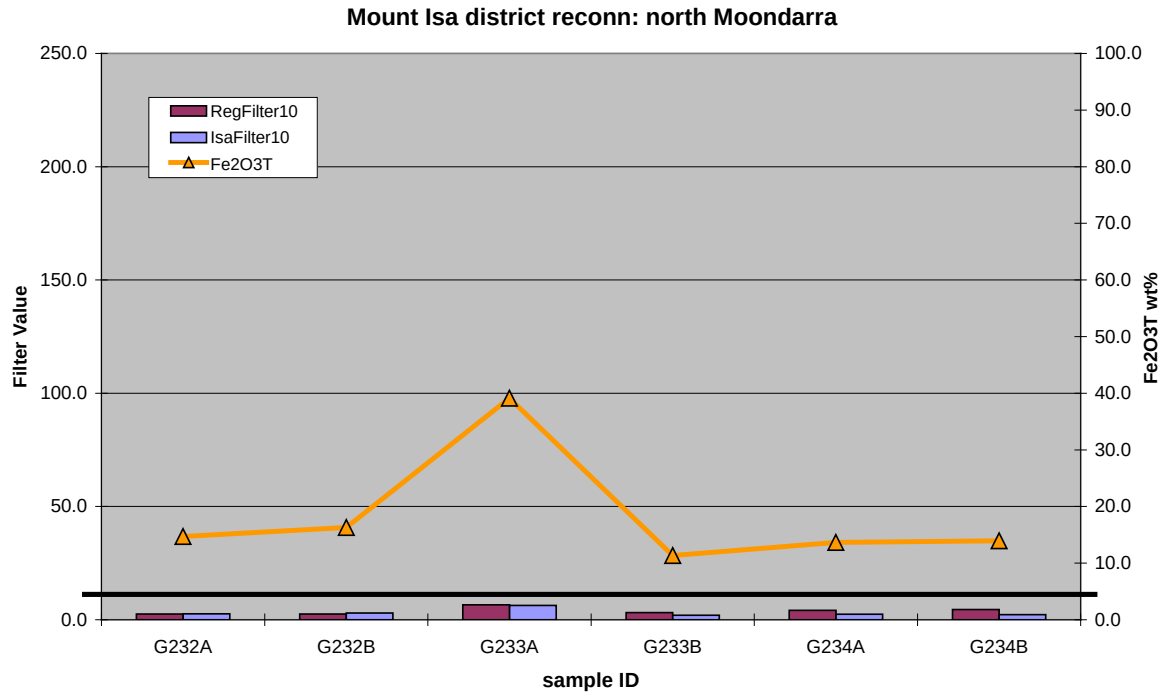
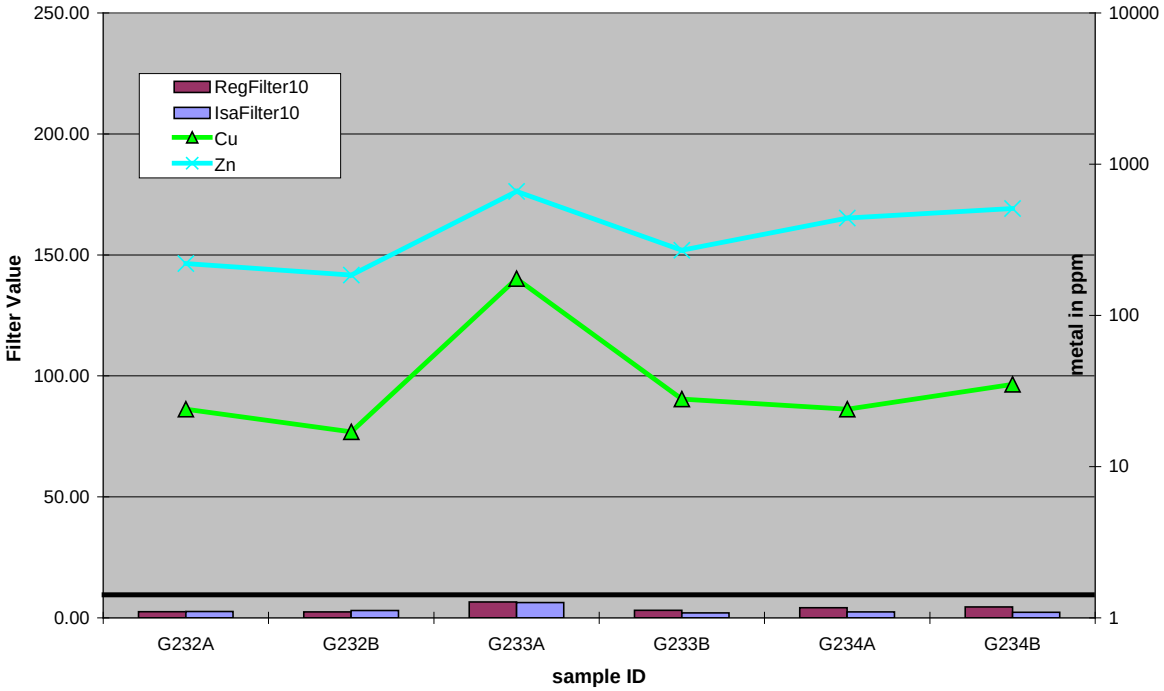

Mount Isa district reconn: north Moondarra
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G232A
G232B
G233A
G233B
G234A
G234B
sample ID


RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
250.00
200.00
150.00
100.00
50.00
0.00
10000
1000
100
10
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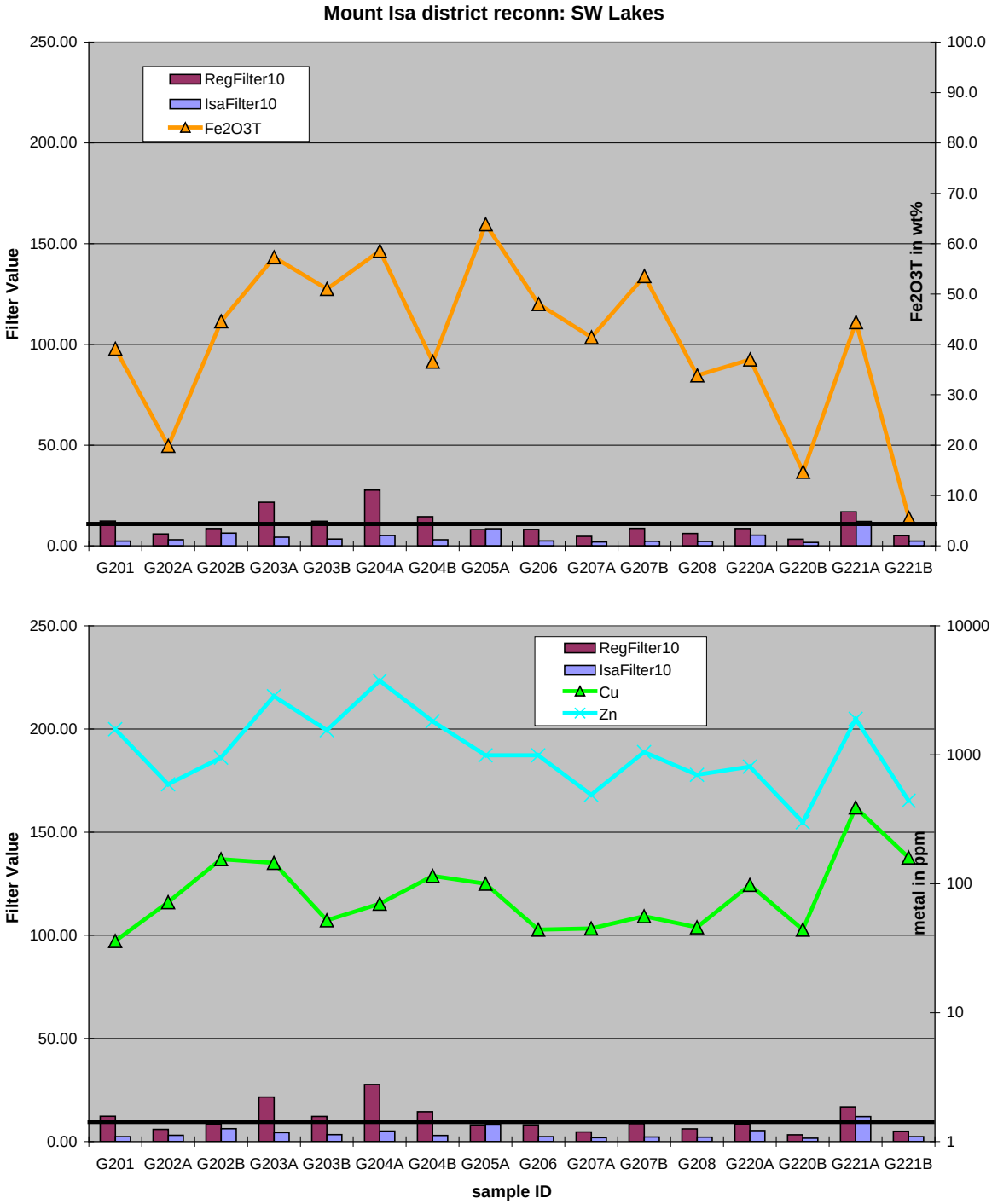
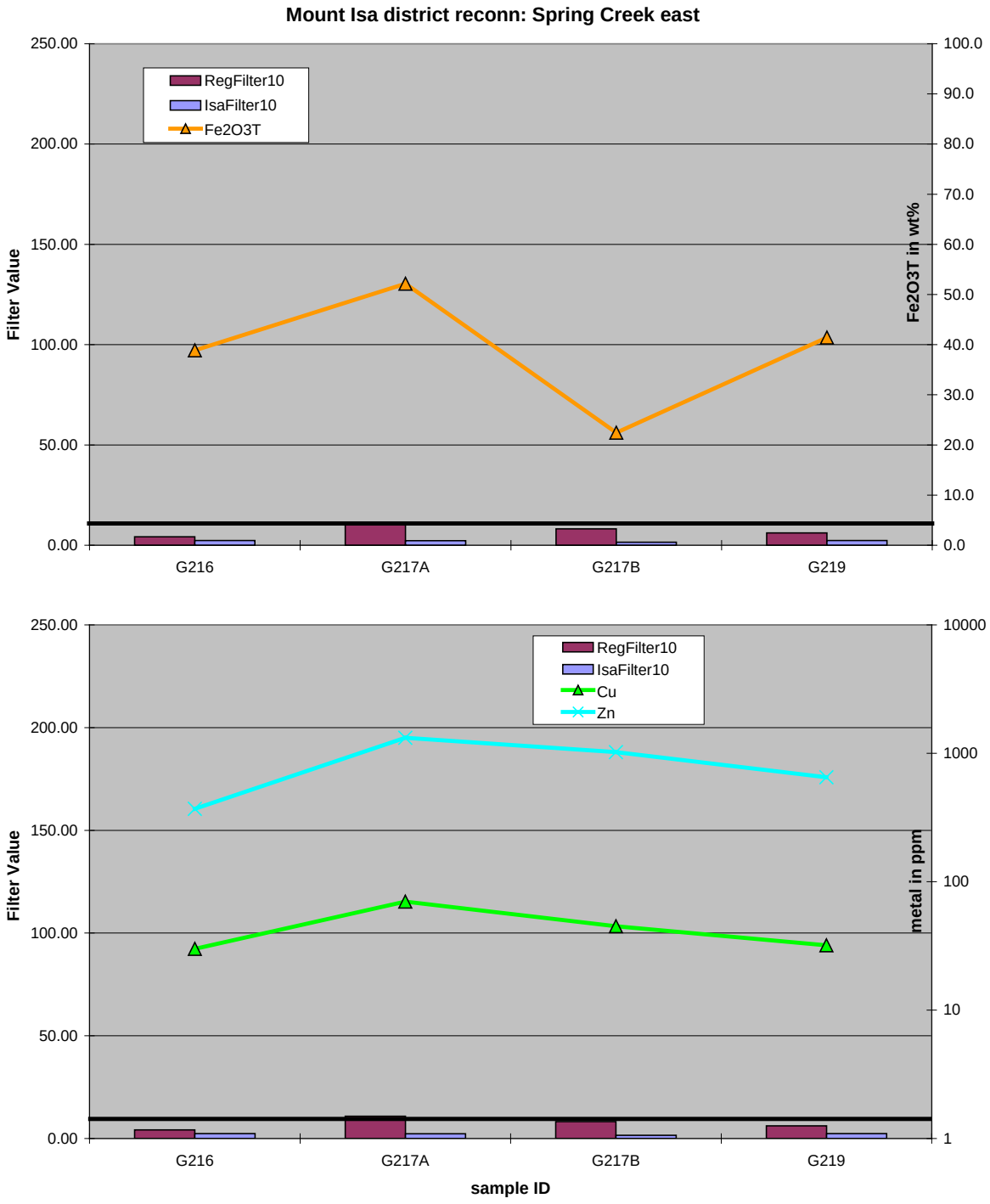
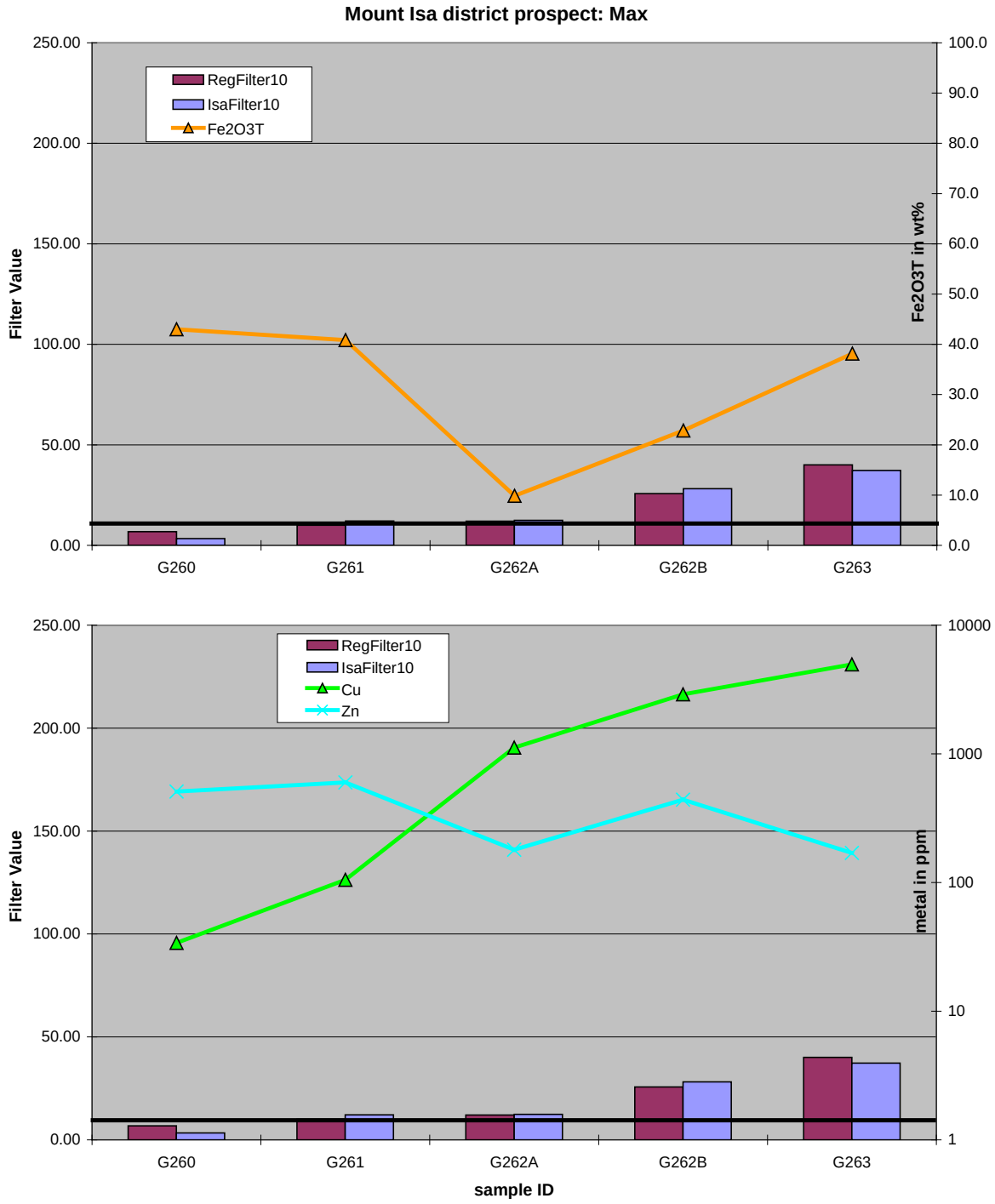
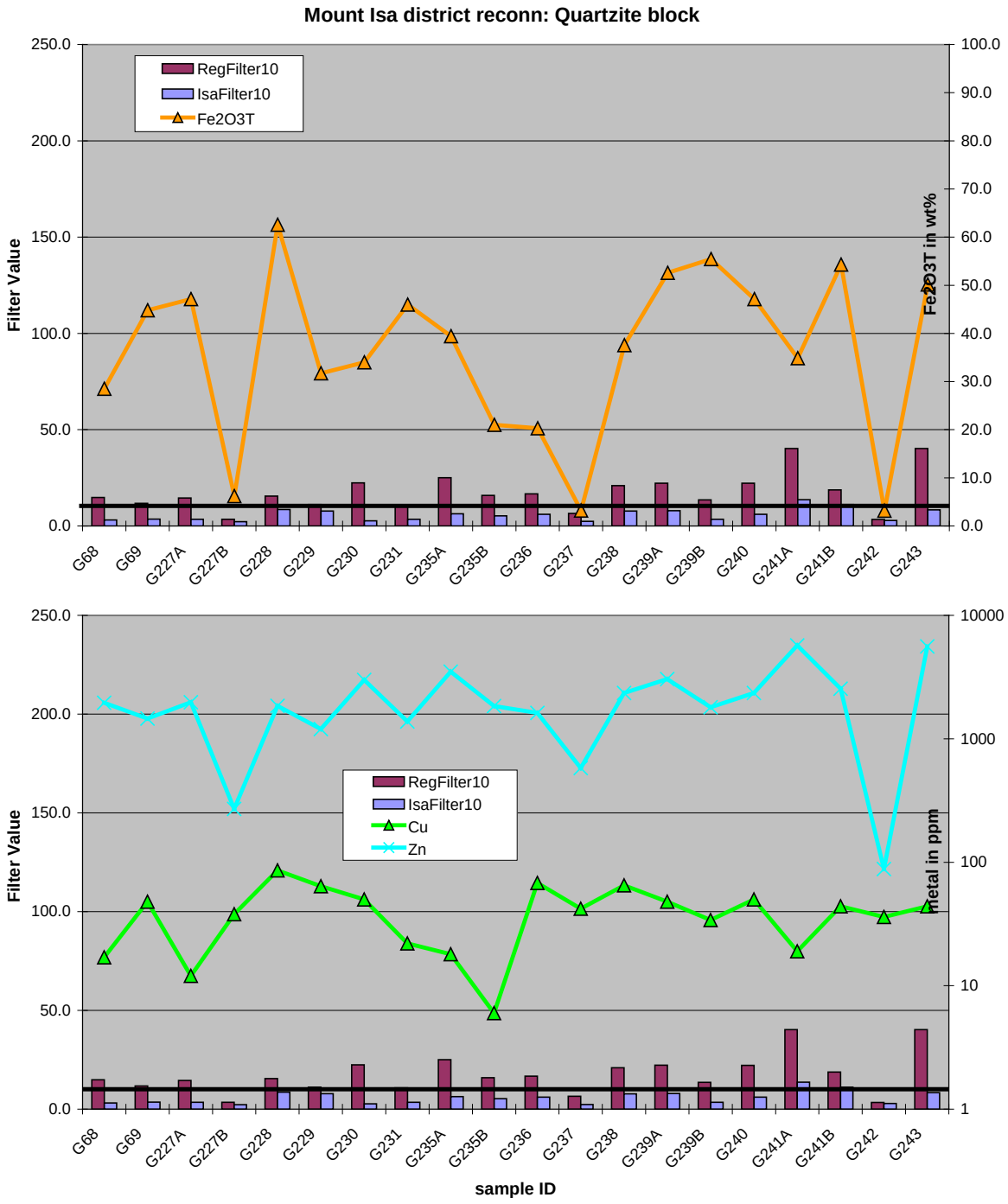
G232B
G233A
G233B
G234A
G234B
sample ID

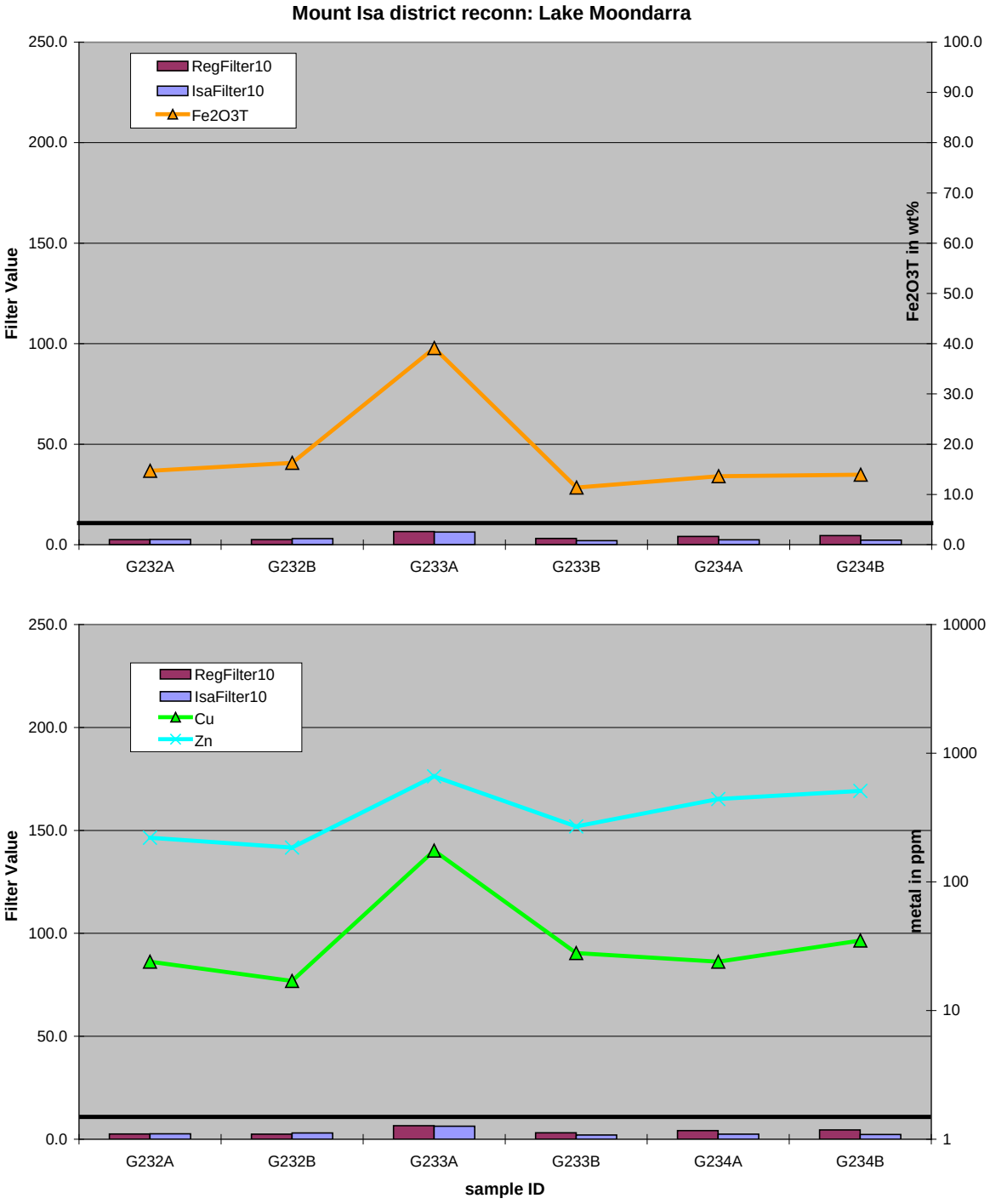

Mount Isa district reconn: SW Lakes
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.00
200.00
150.00
100.00
50.00
0.00
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G201 G202A G202B G203A G203B G204A G204B G205A G206 G207A G207B G208 G220A G220B G221A G221B
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

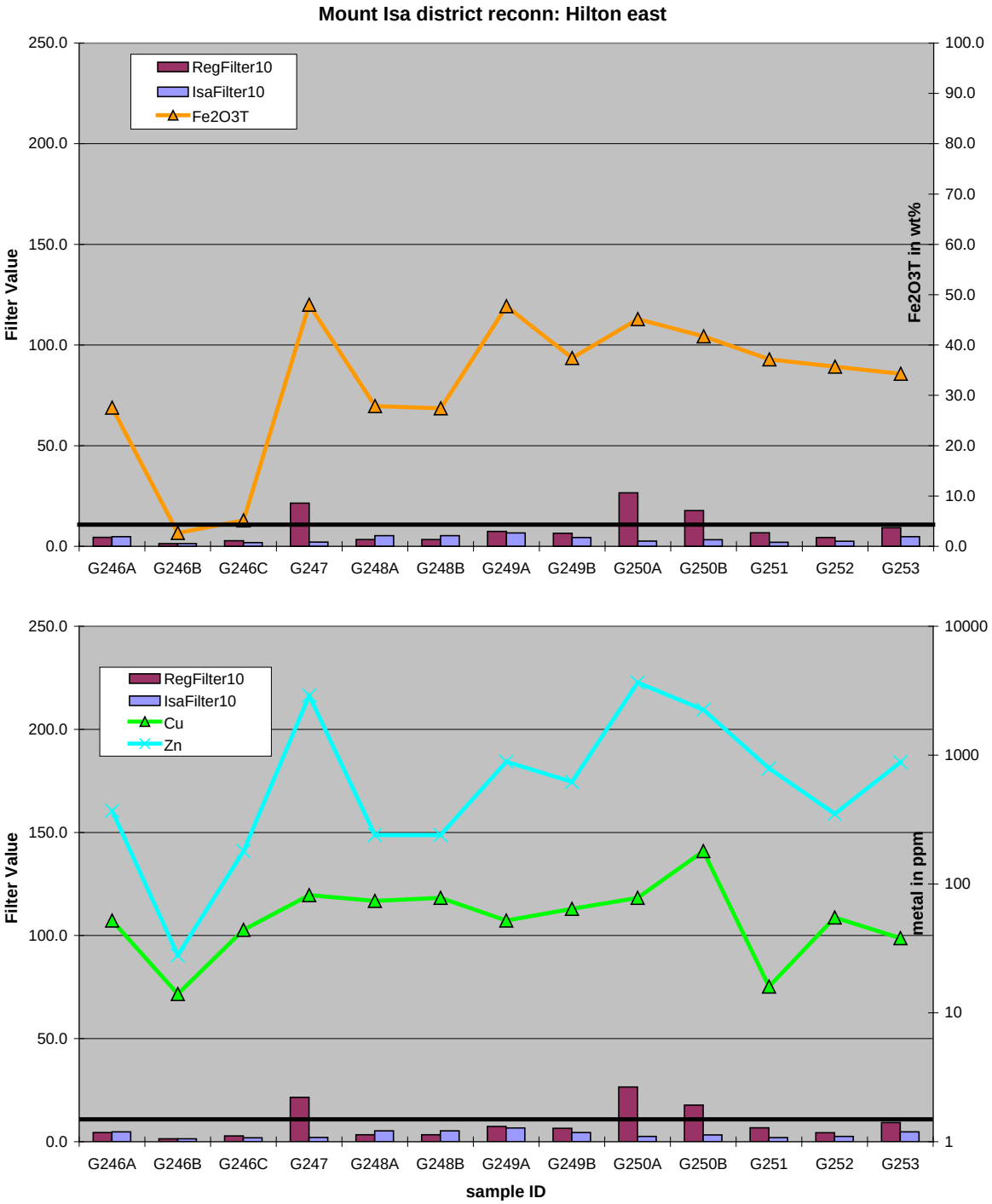

Mount Isa district reconn: Spring Creek east
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.00
200.00
150.00
100.00
50.00
0.00
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G216
G217A
G217B
G219
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

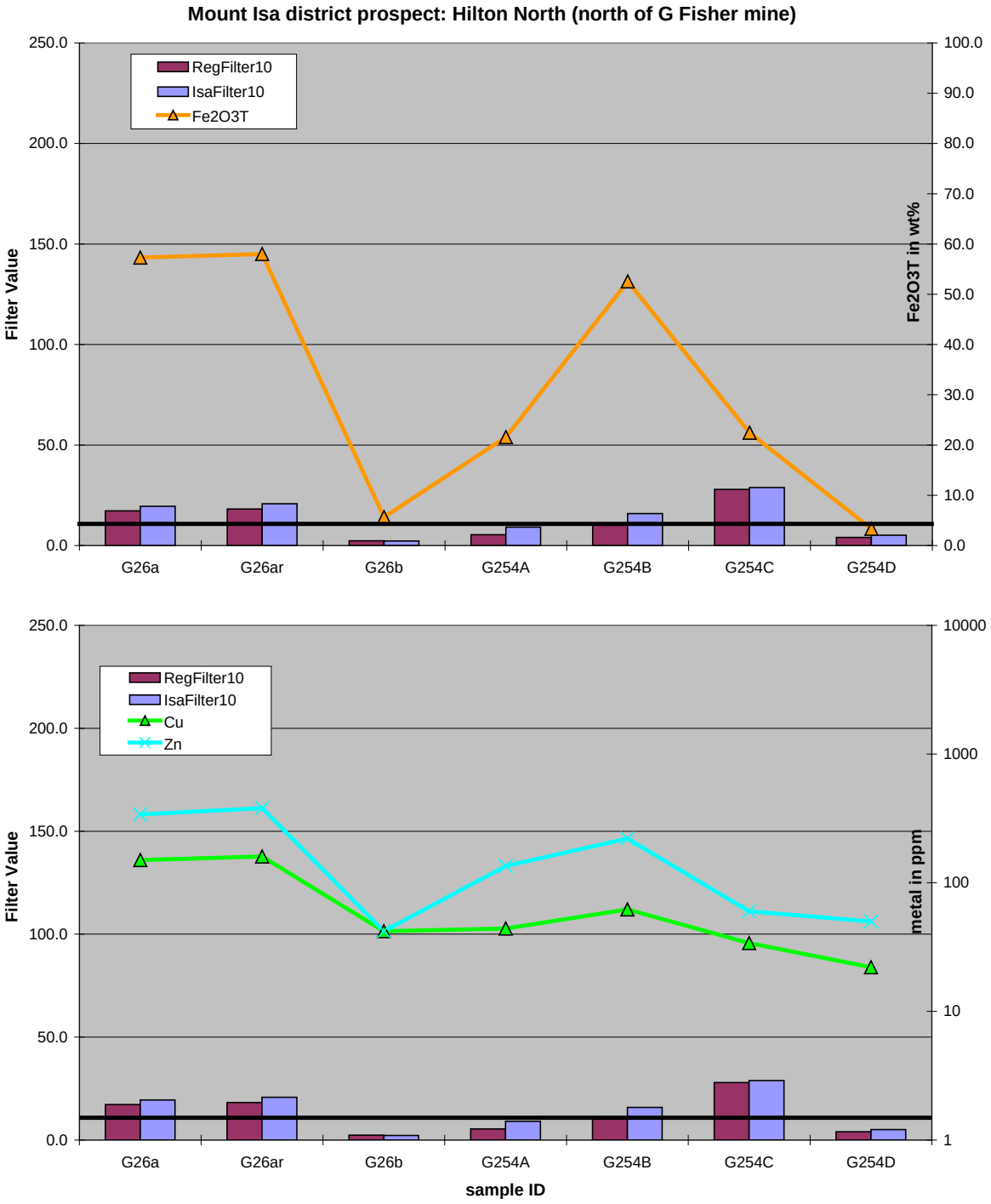

Mount Isa district reconn: NW Lakes
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.00
200.00
150.00
100.00
50.00
0.00
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G209
G210A
G210B
G211
G212
G213
G214
G215
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

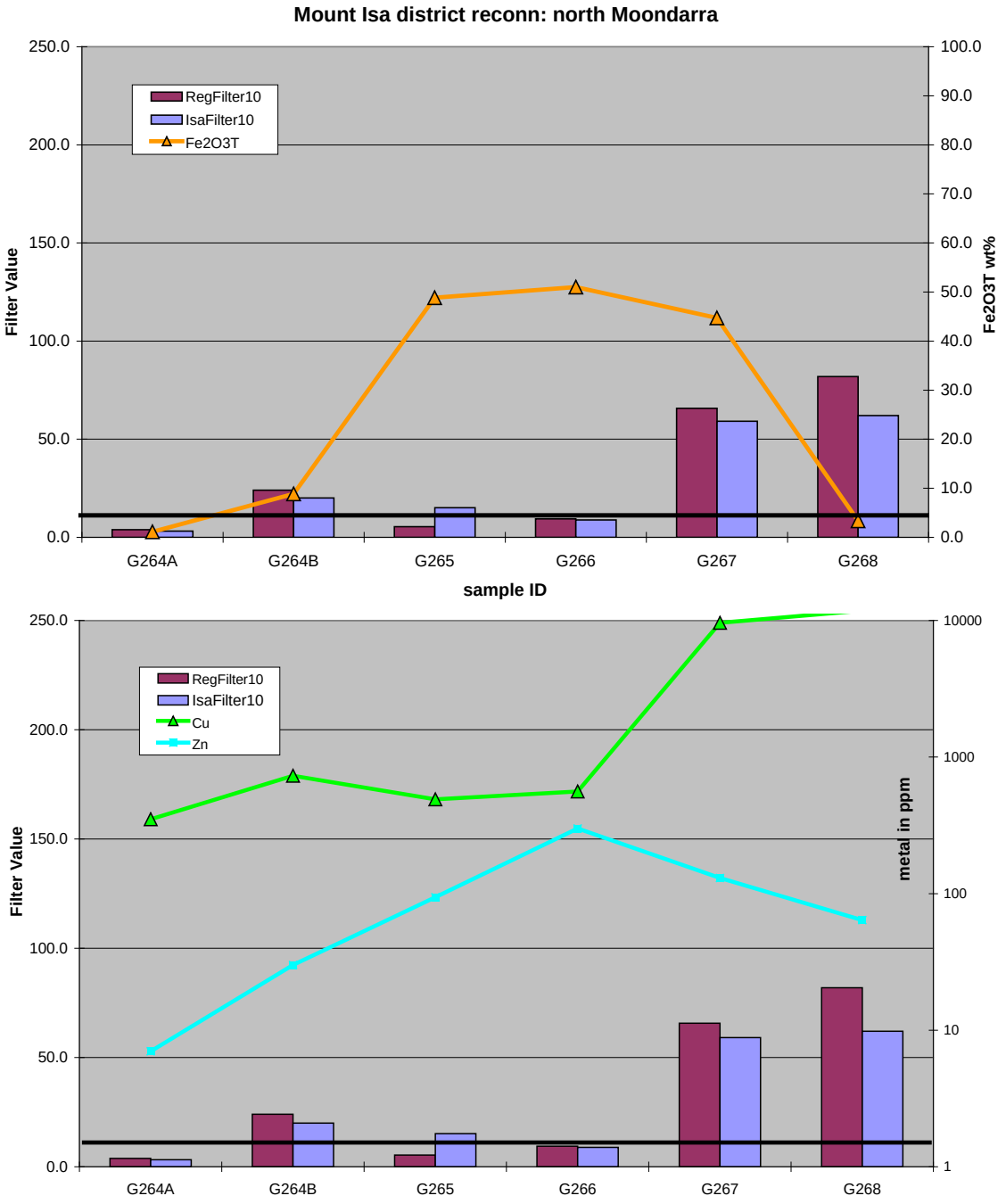

Mount Isa district prospect: Max
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.00
200.00
150.00
100.00
50.00
0.00
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G260
G261
G262A
G262B
G263
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

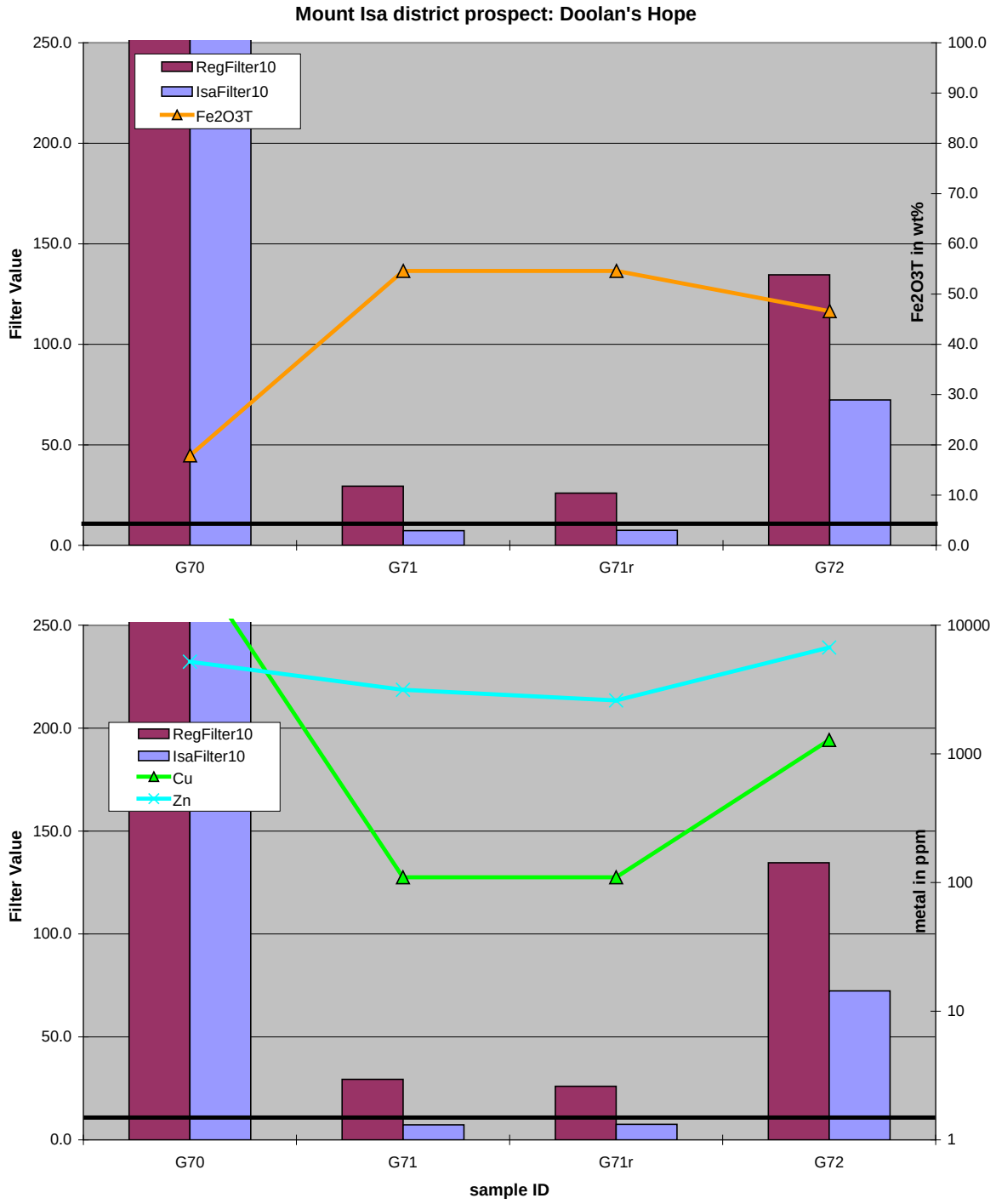

Mount Isa district reconn: Quartzite block
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G68
G69
G227A
G227B
G228
G229
G230
G231
G235A
G235B
G236
G237
G238
G239A
G239B
G240
G241A
G241B
G242
G243
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
Metal in ppm
10000
1000
100
10
1
sample ID

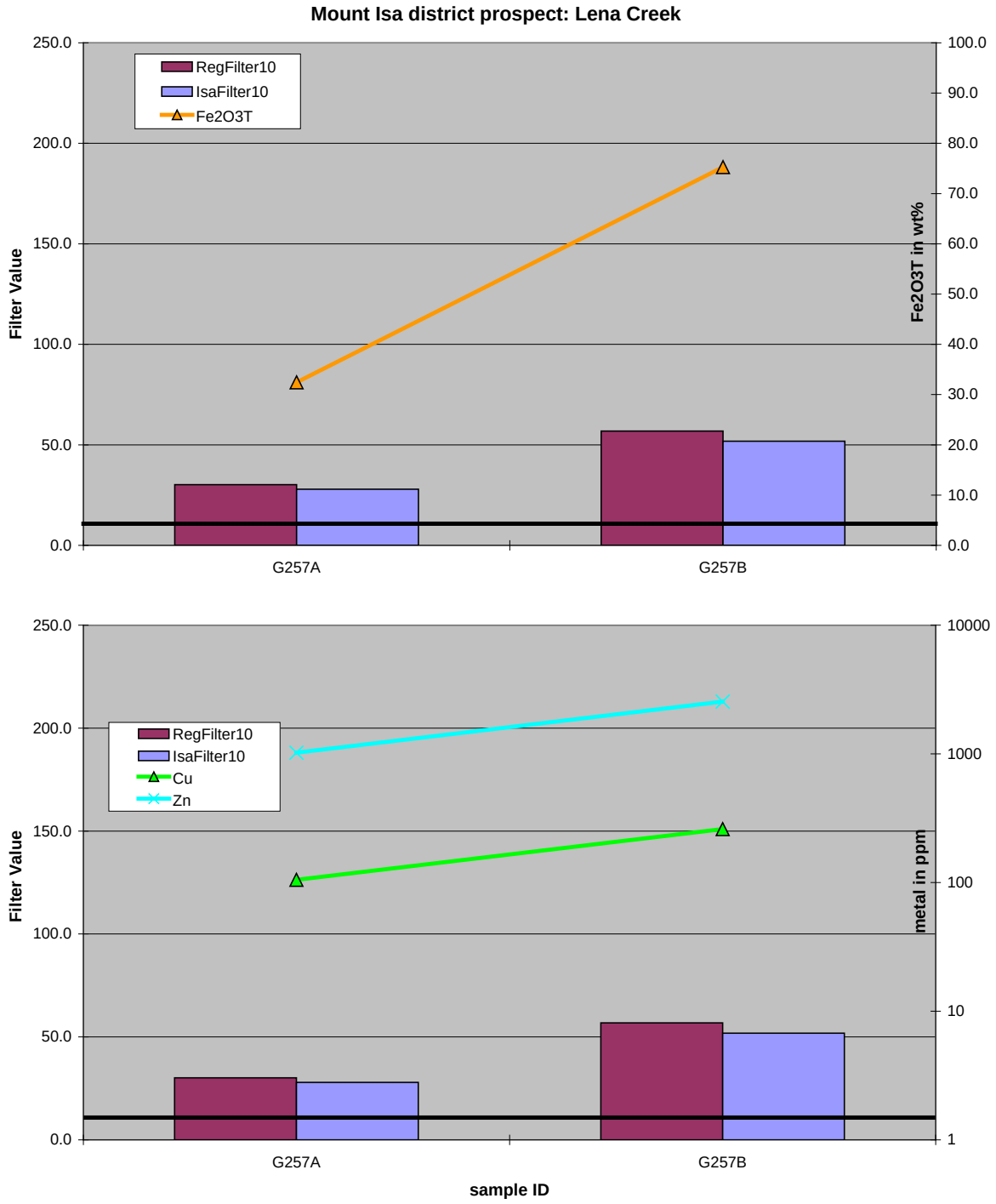

Mount Isa district reconn: Lake Moondarra
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G232A
G232B
G233A
G233B
G234A
G234B
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

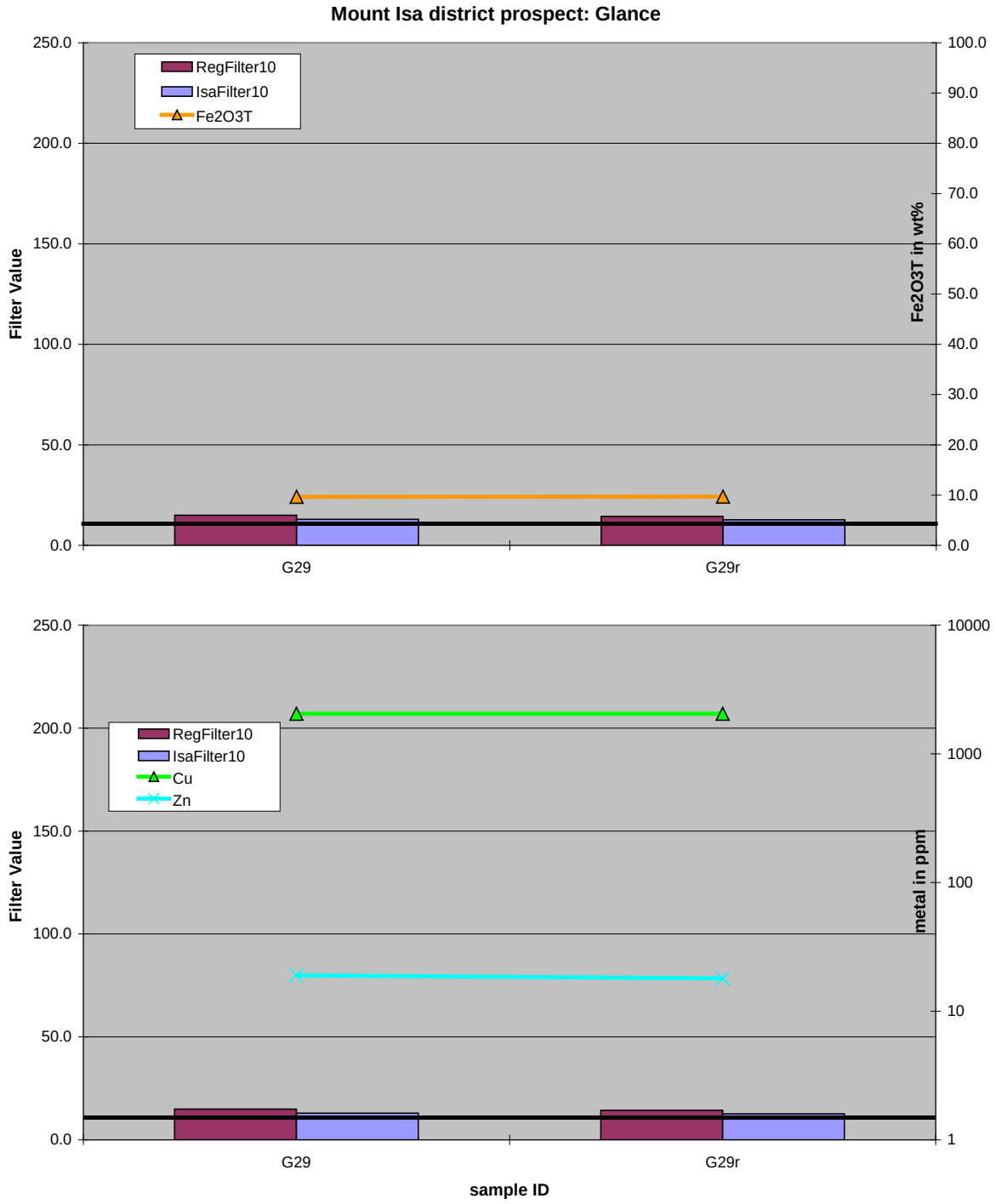

Mount Isa district reconn: Hilton east
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G246A
G246B
G246C
G247
G248A
G248B
G249A
G249B
G250A
G250B
G251
G252
G253
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

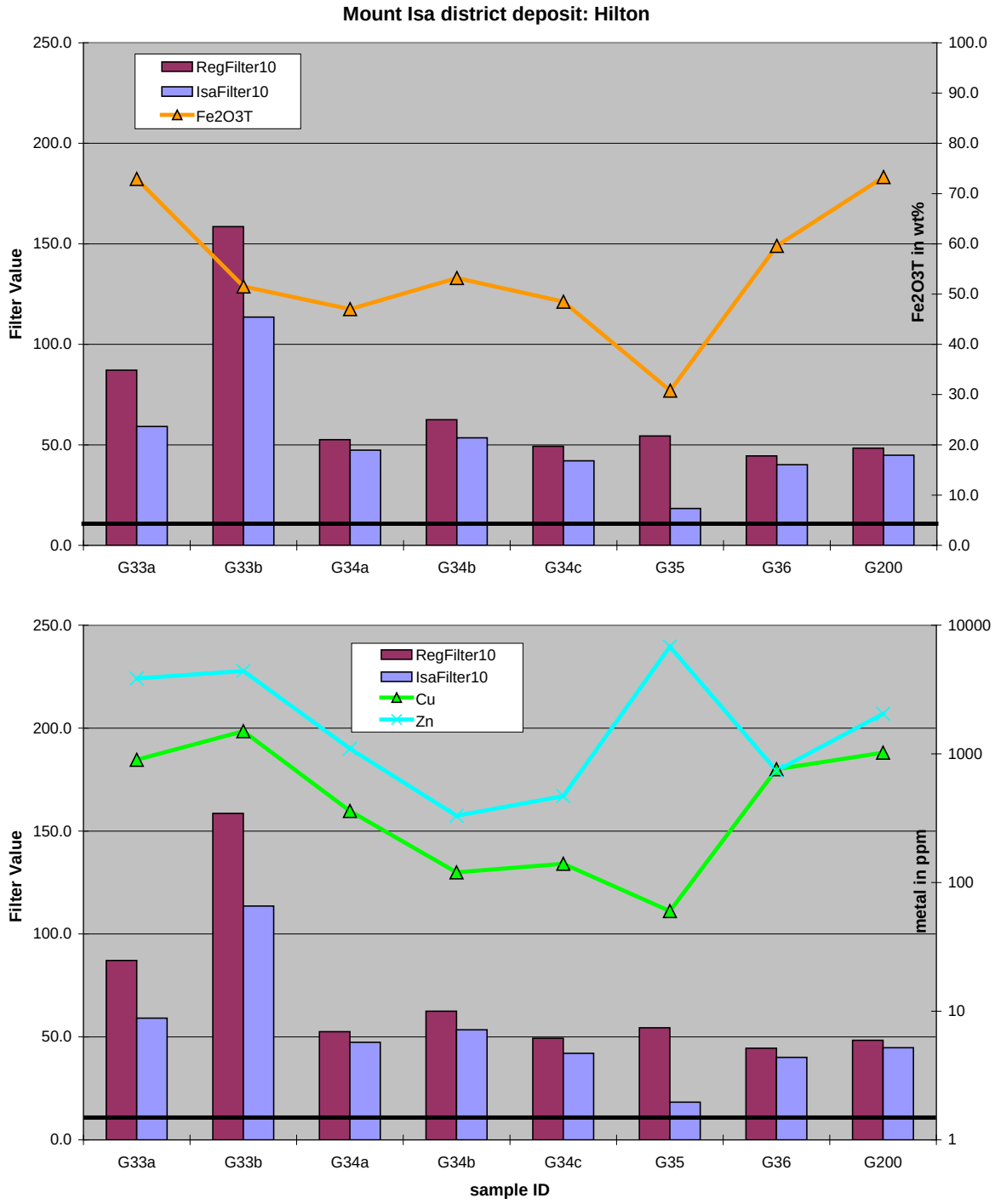

Mount Isa district prospect: Hilton North (north of G Fisher mine)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G26a
G26ar
G26b
G254A
G254B
G254C
G254D
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

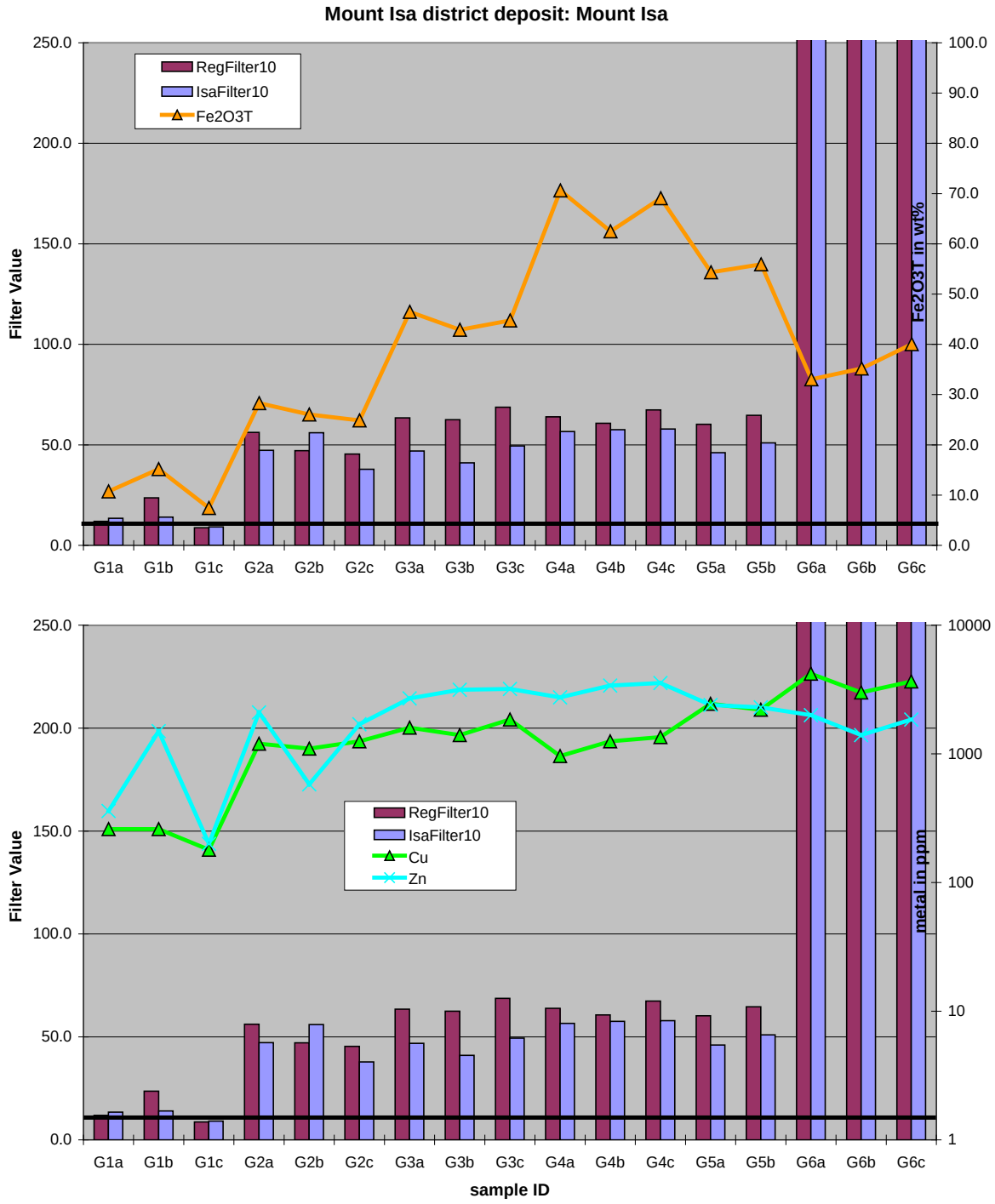

Mount Isa district reconn: north Moondarra
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T wt%
sample ID
G264A
G264B
G265
G266
G267
G268
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1

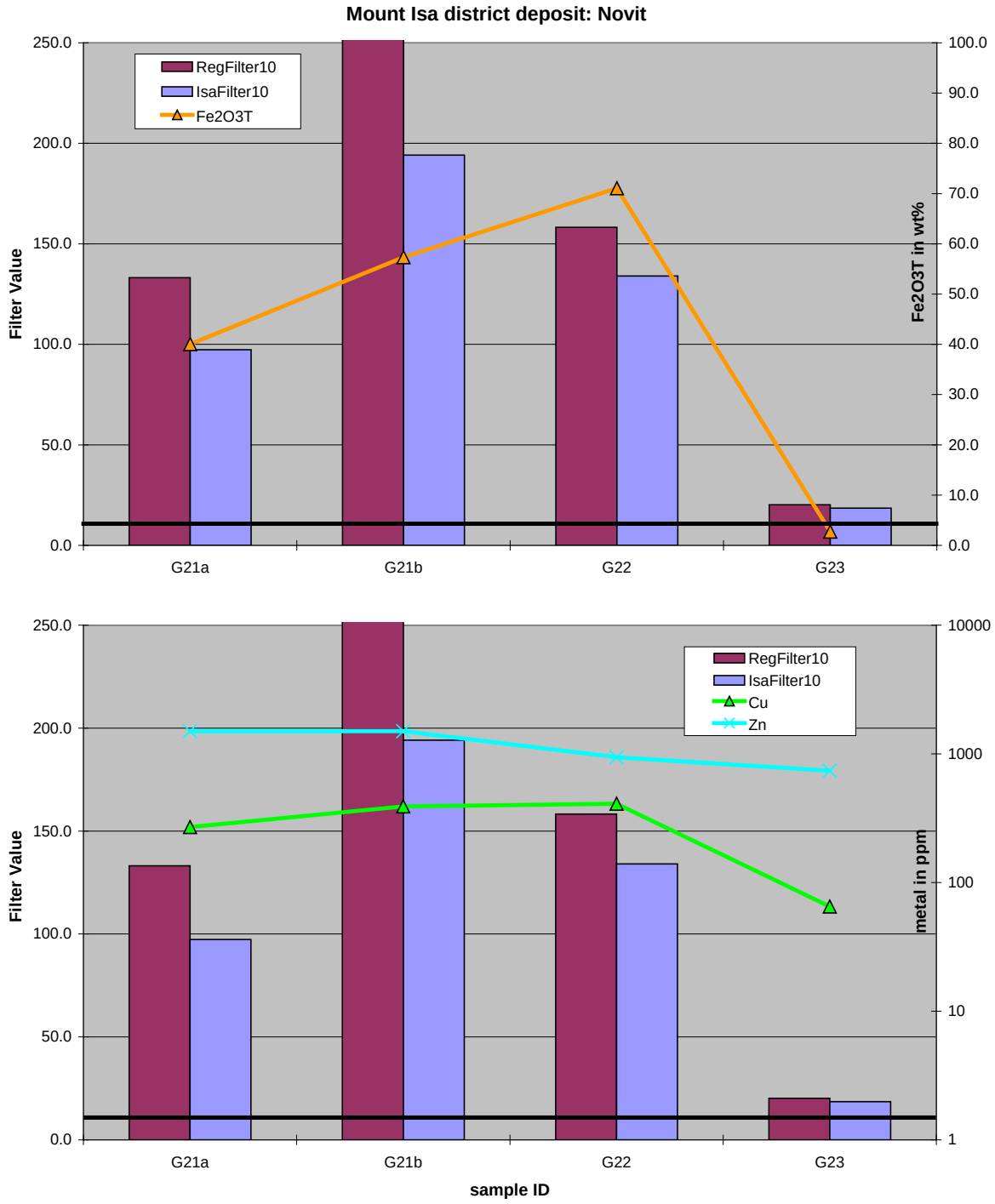

Mount Isa district prospect: Doolan's Hope
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G70
G71
G71r
G72
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

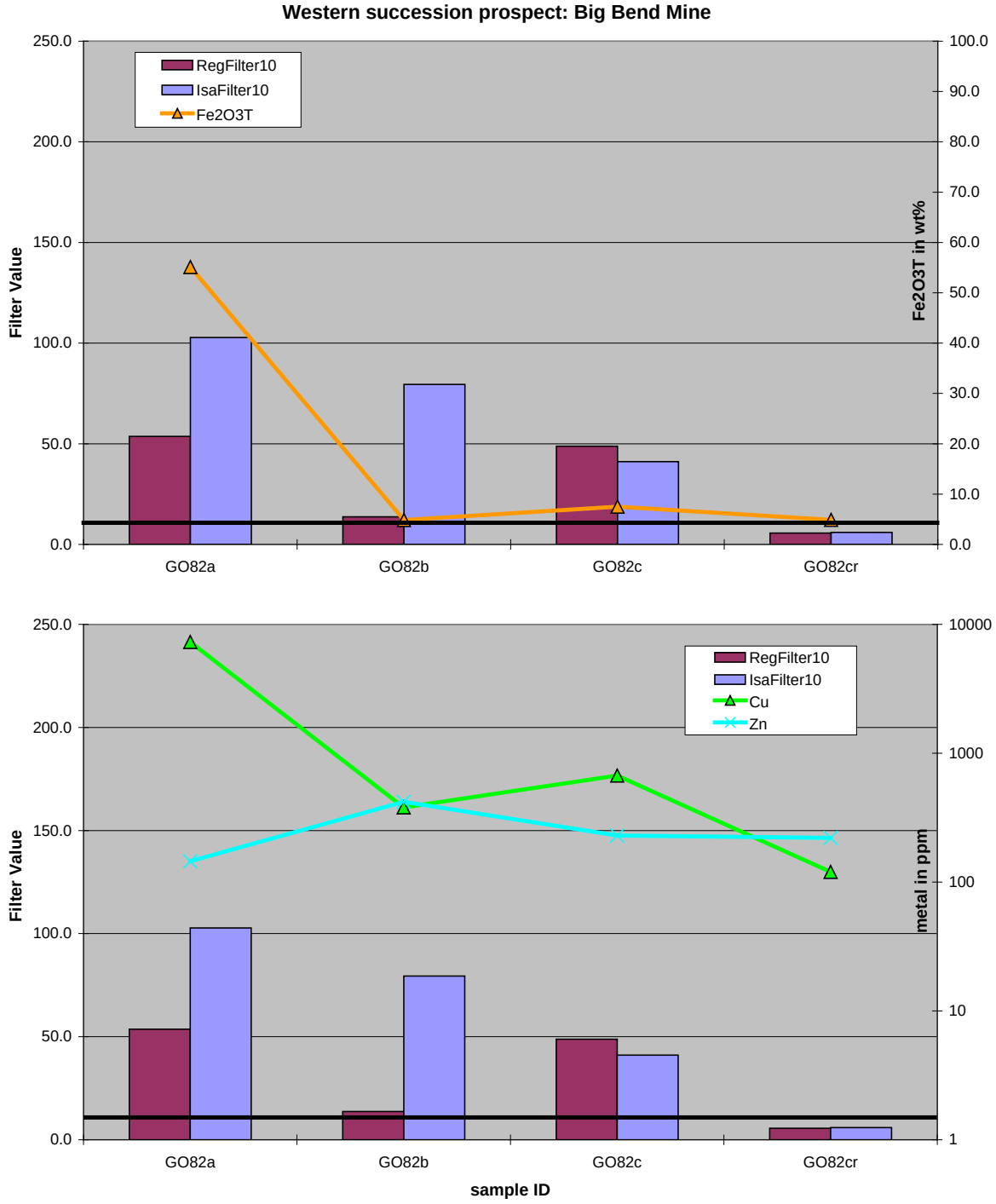

Mount Isa district prospect: Lena Creek
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G257A
G257B
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

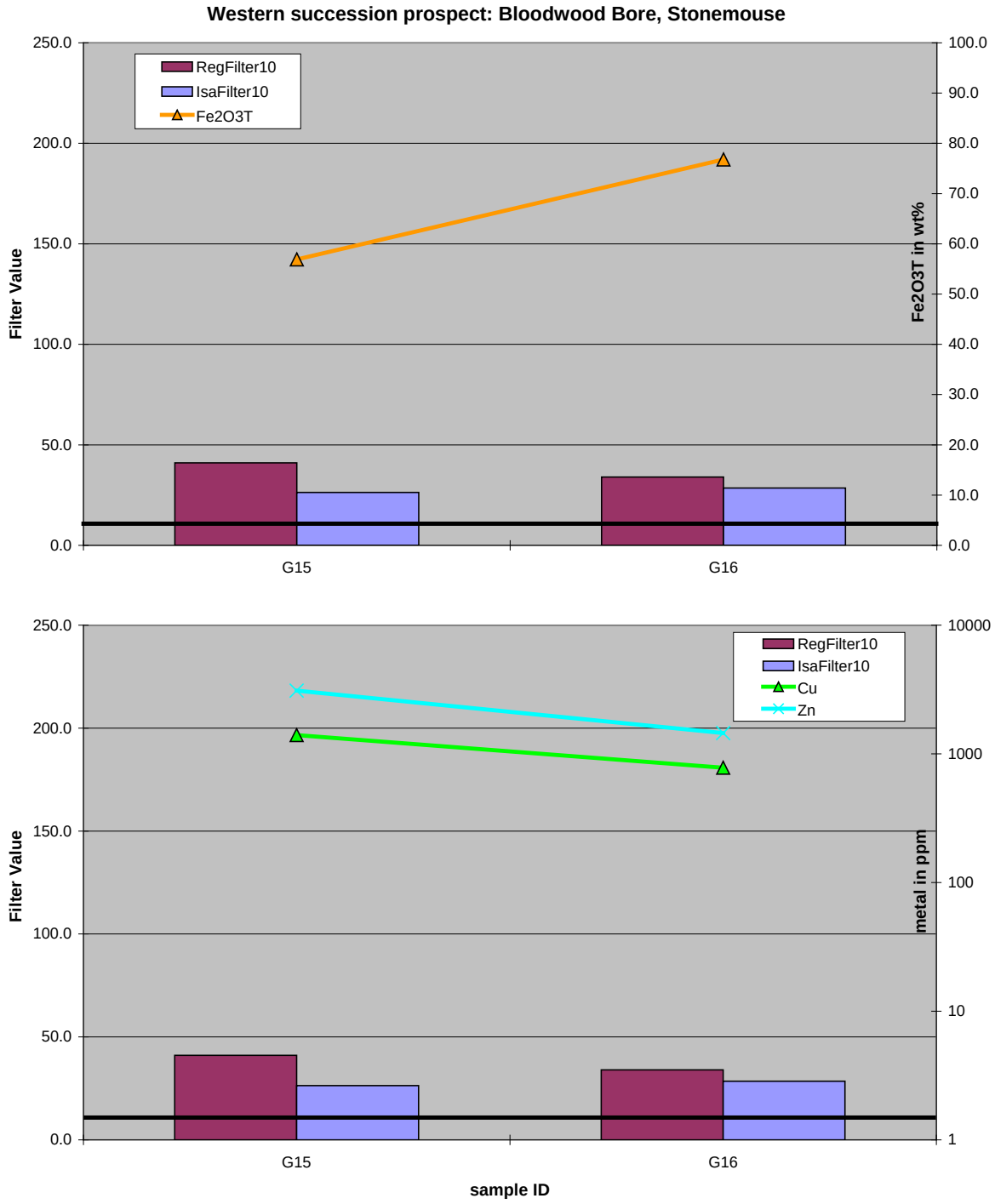

Mount Isa district prospect: Glance
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G29
G29r
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

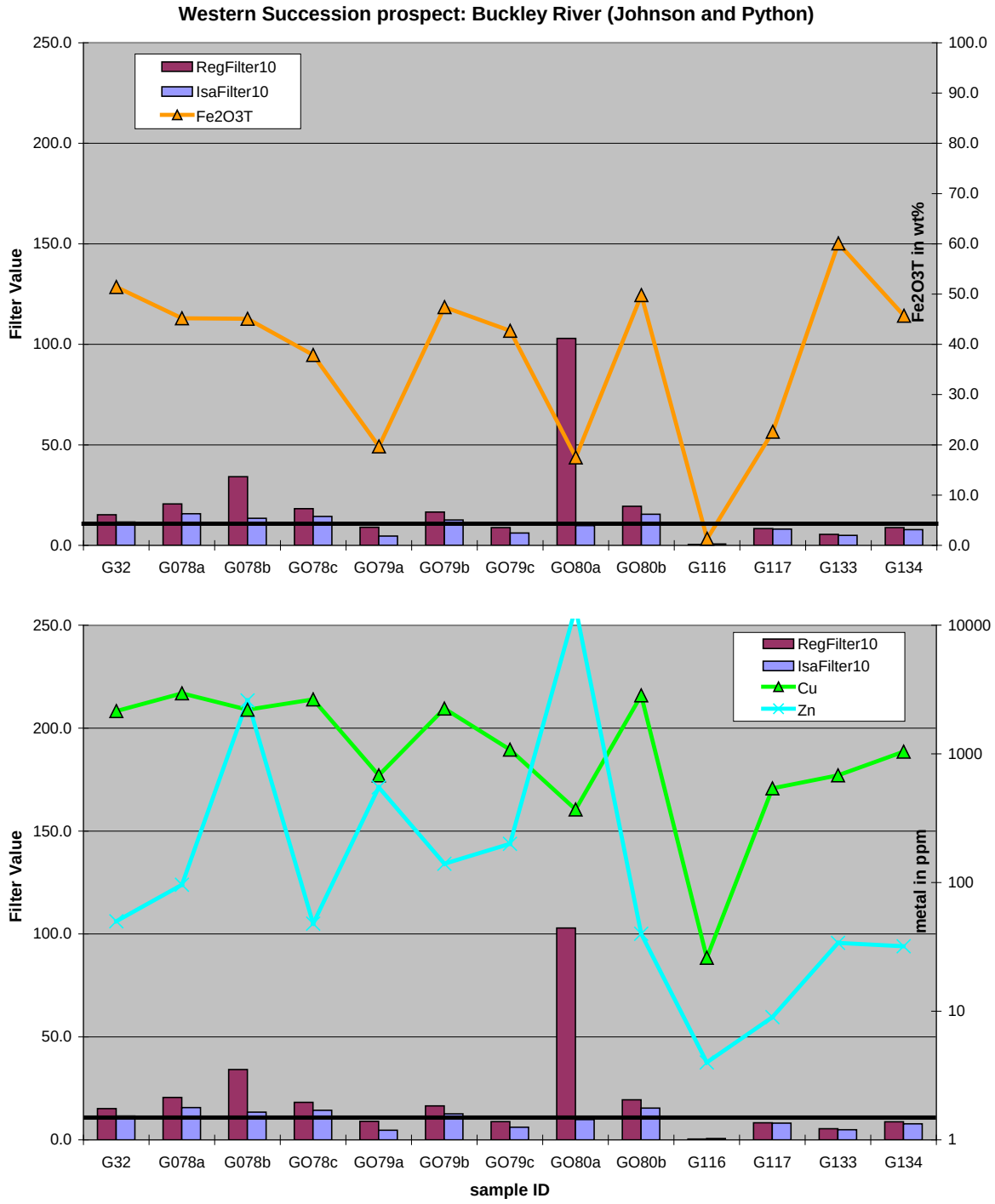

Mount Isa district deposit: Hilton
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G33a
G33b
G34a
G34b
G34c
G35
G36
G200
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

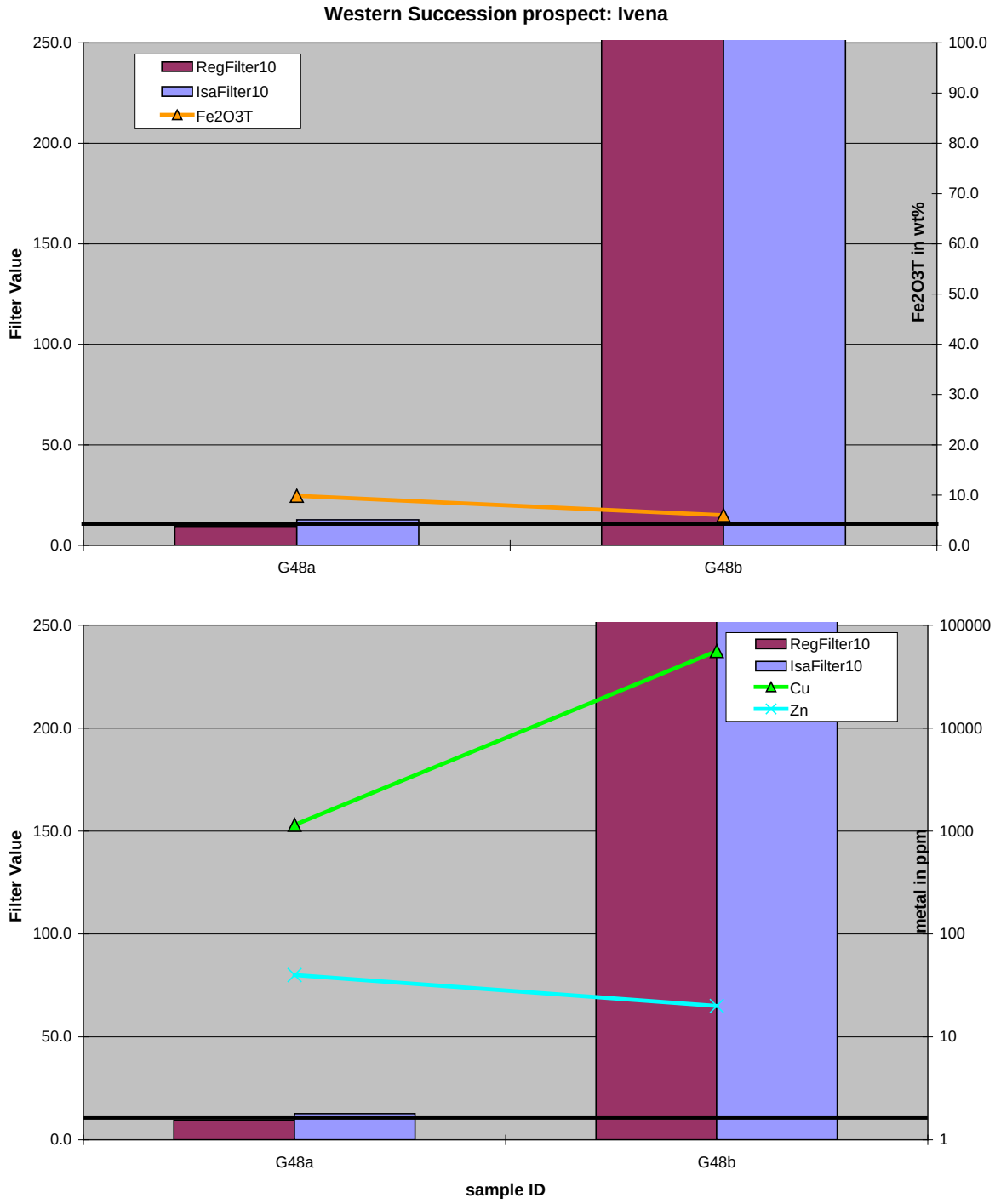

Mount Isa district deposit: Mount Isa
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G1a G1b G1c G2a G2b G2c G3a G3b G3c G4a G4b G4c G5a G5b G6a G6b G6c
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

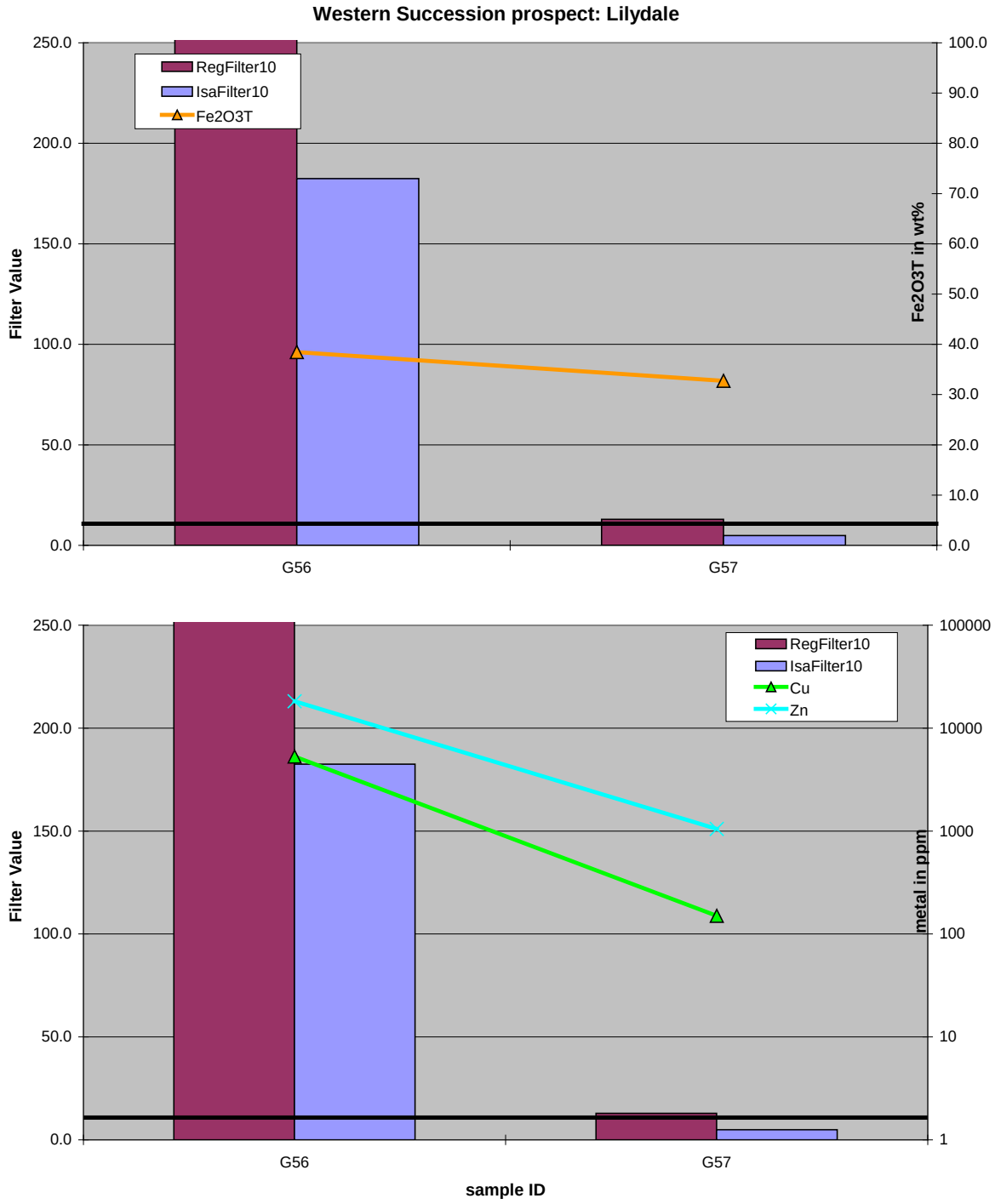

Mount Isa district deposit: Novit
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G21a
G21b
G22
G23
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

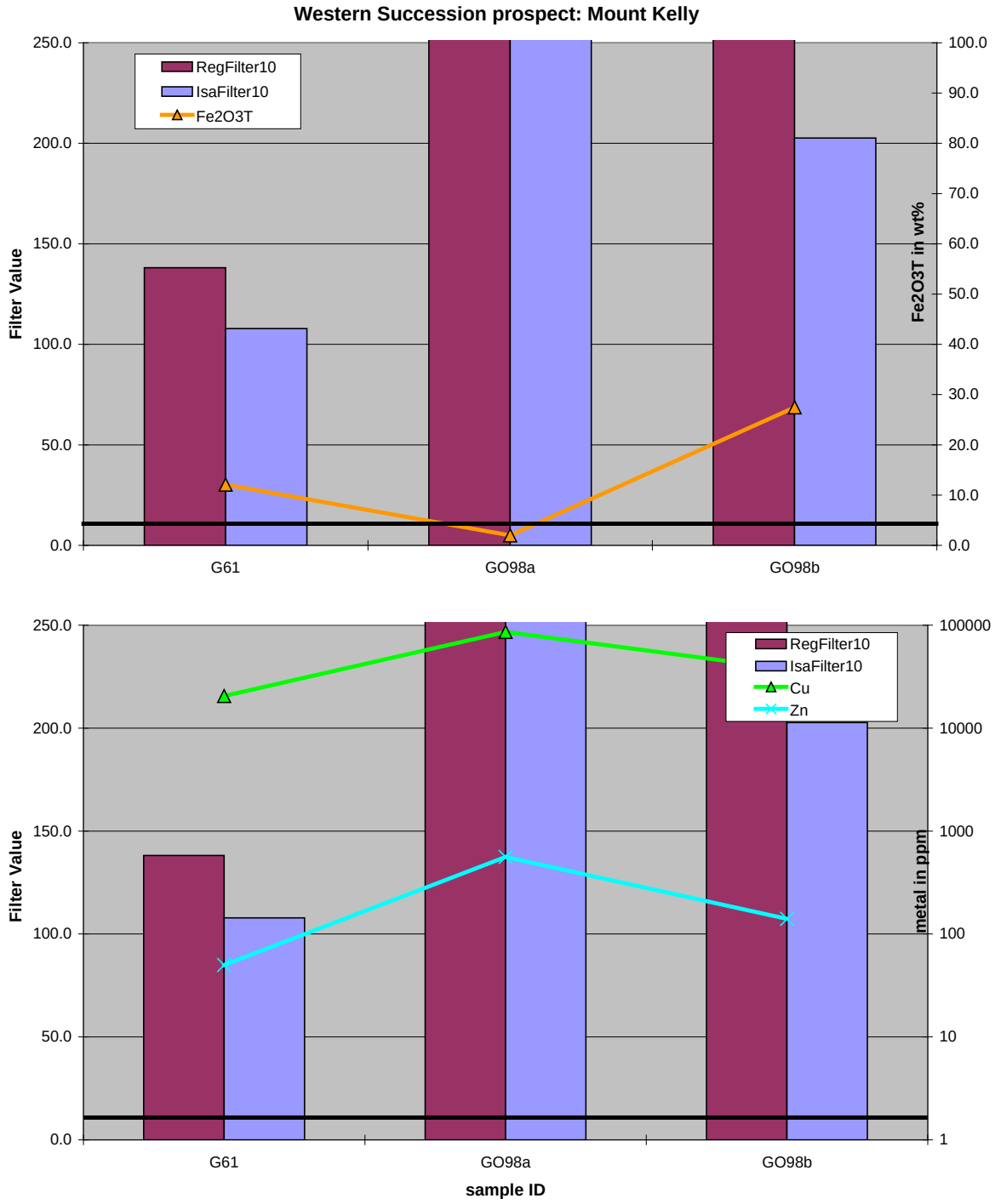

Western succession prospect: Big Bend Mine
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
GO82a
GO82b
GO82c
GO82cr
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

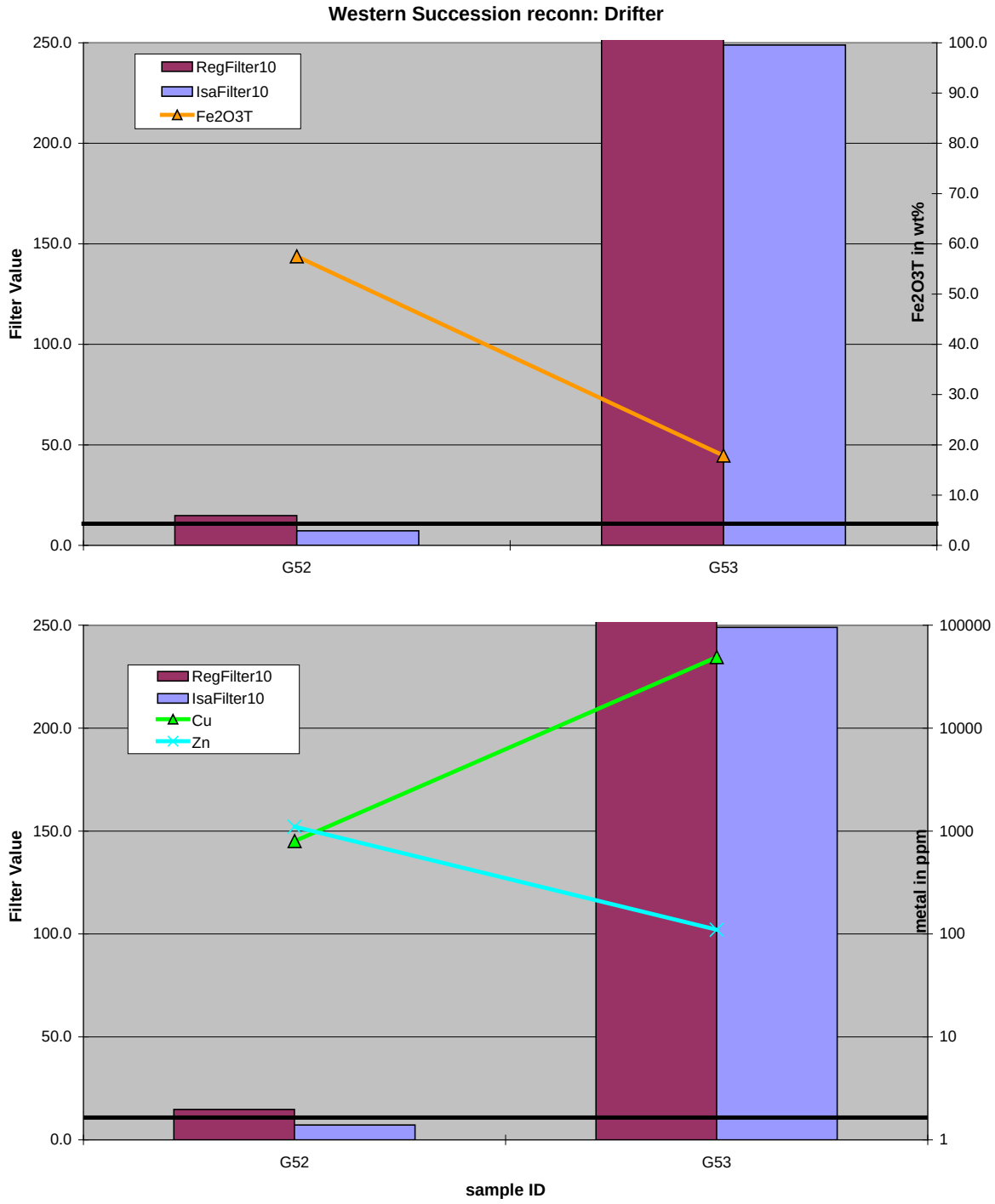

Western succession prospect: Bloodwood Bore, Stonemouse
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G15
G16
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

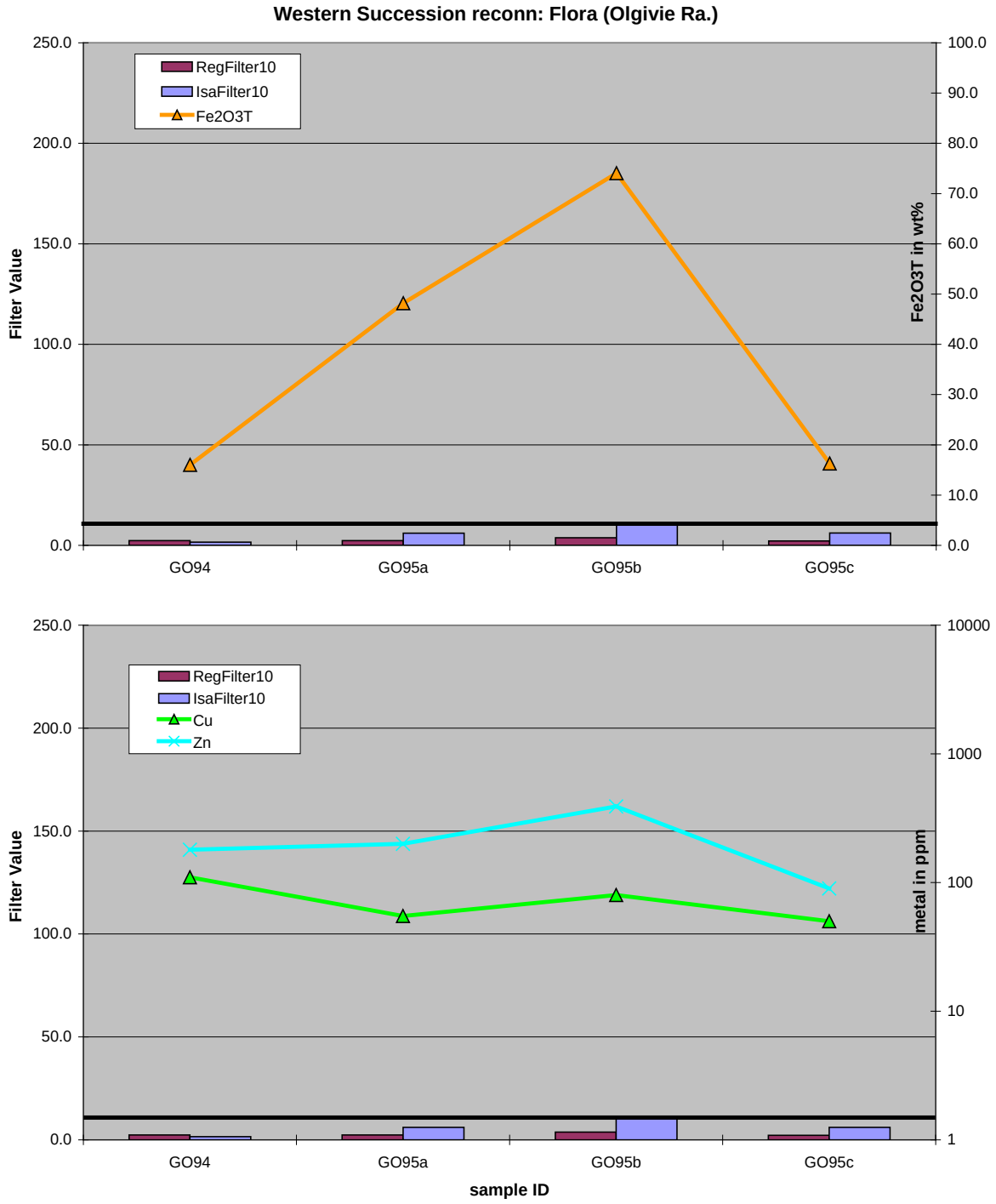

Western Succession prospect: Buckley River (Johnson and Python)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G32
G078a
G078b
GO78c
GO79a
GO79b
GO79c
GO80a
GO80b
G116
G117
G133
G134
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

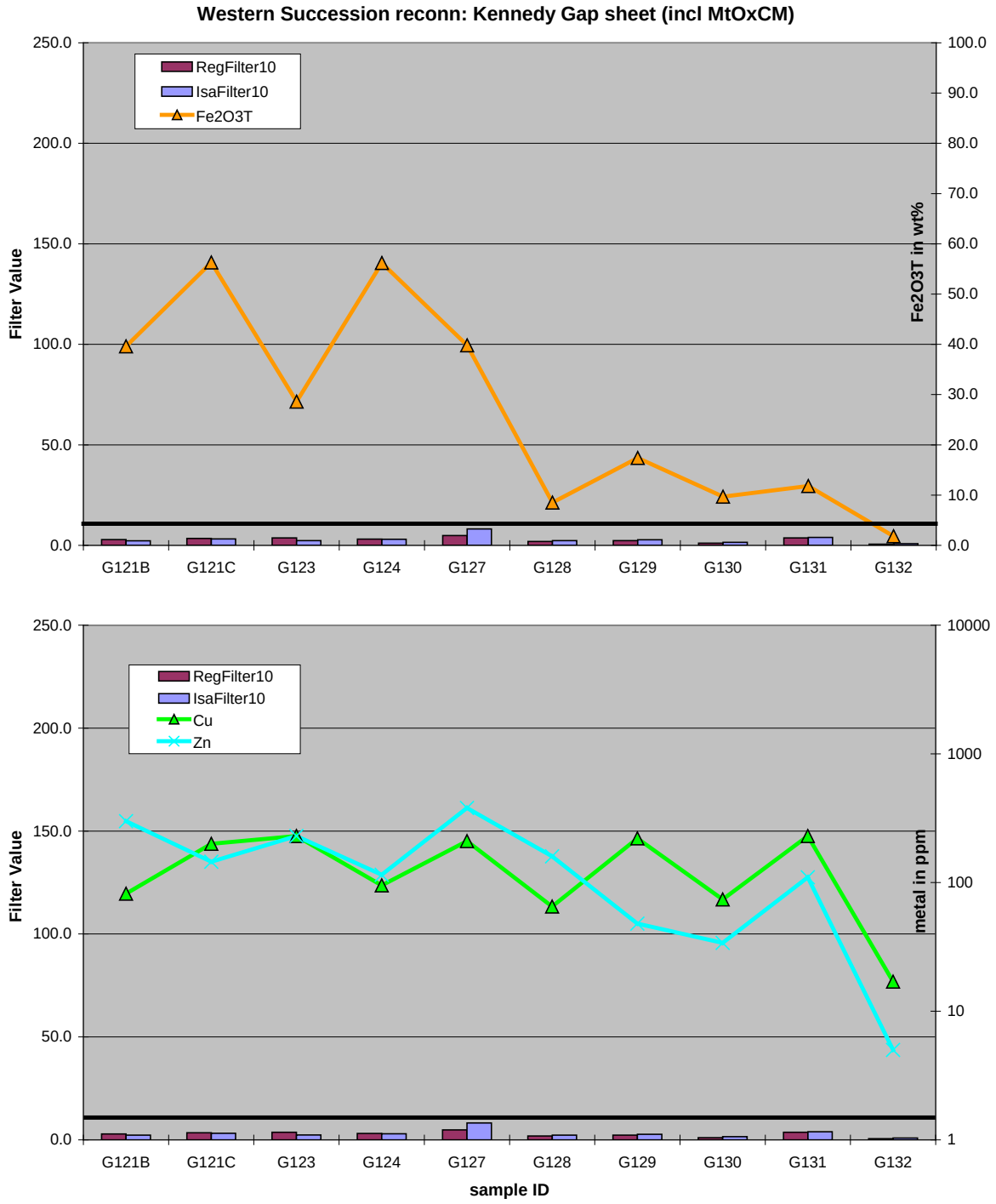

Western Succession prospect: Ivena
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G48a
G48b
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
100000
10000
1000
100
10
1
G48a
G48b
sample ID

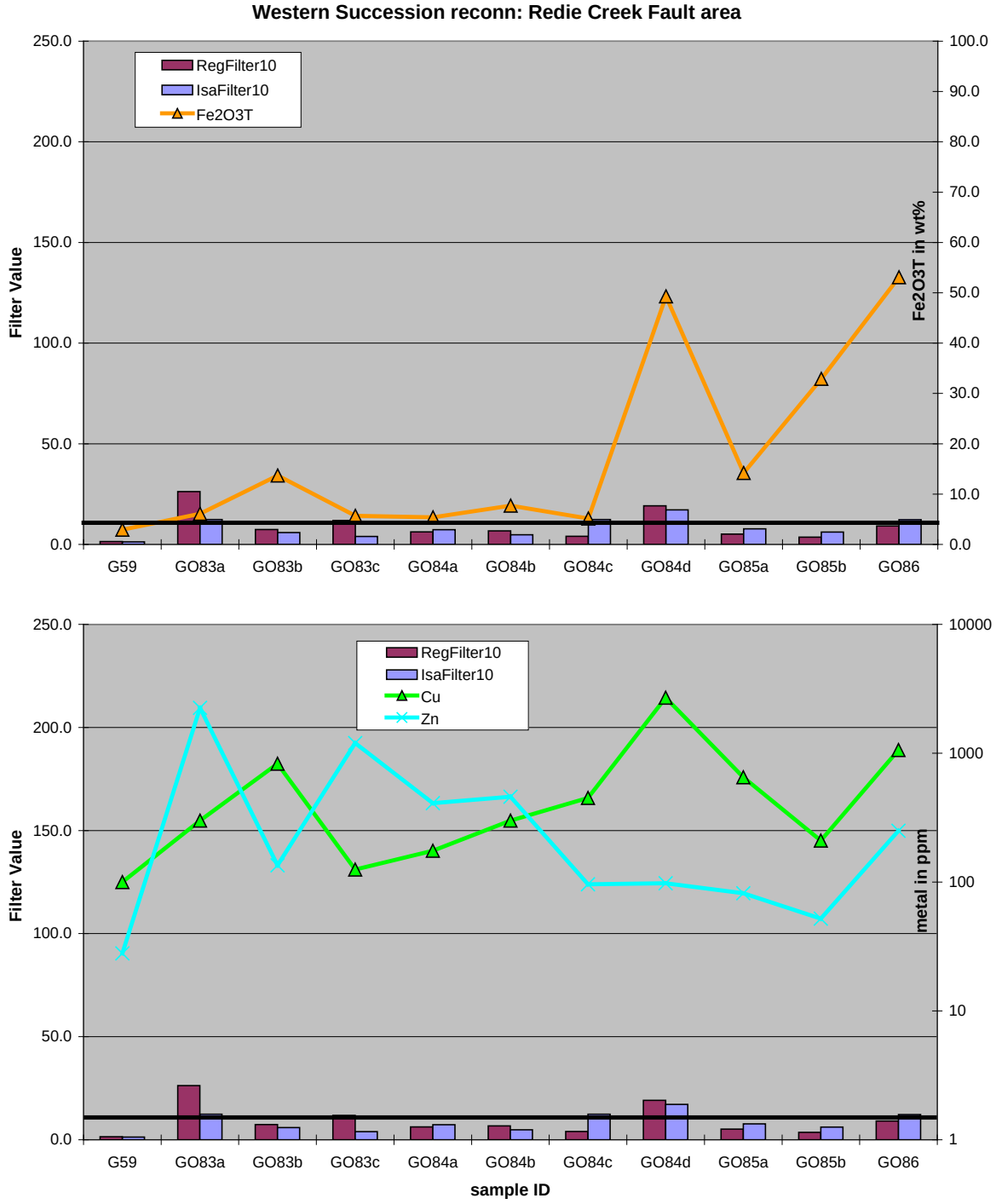

Western Succession prospect: Lilydale
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G56
G57
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
250.0
200.0
150.0
100.0
50.0
0.0
100000
10000
1000
100
10
1
G56
G57
sample ID

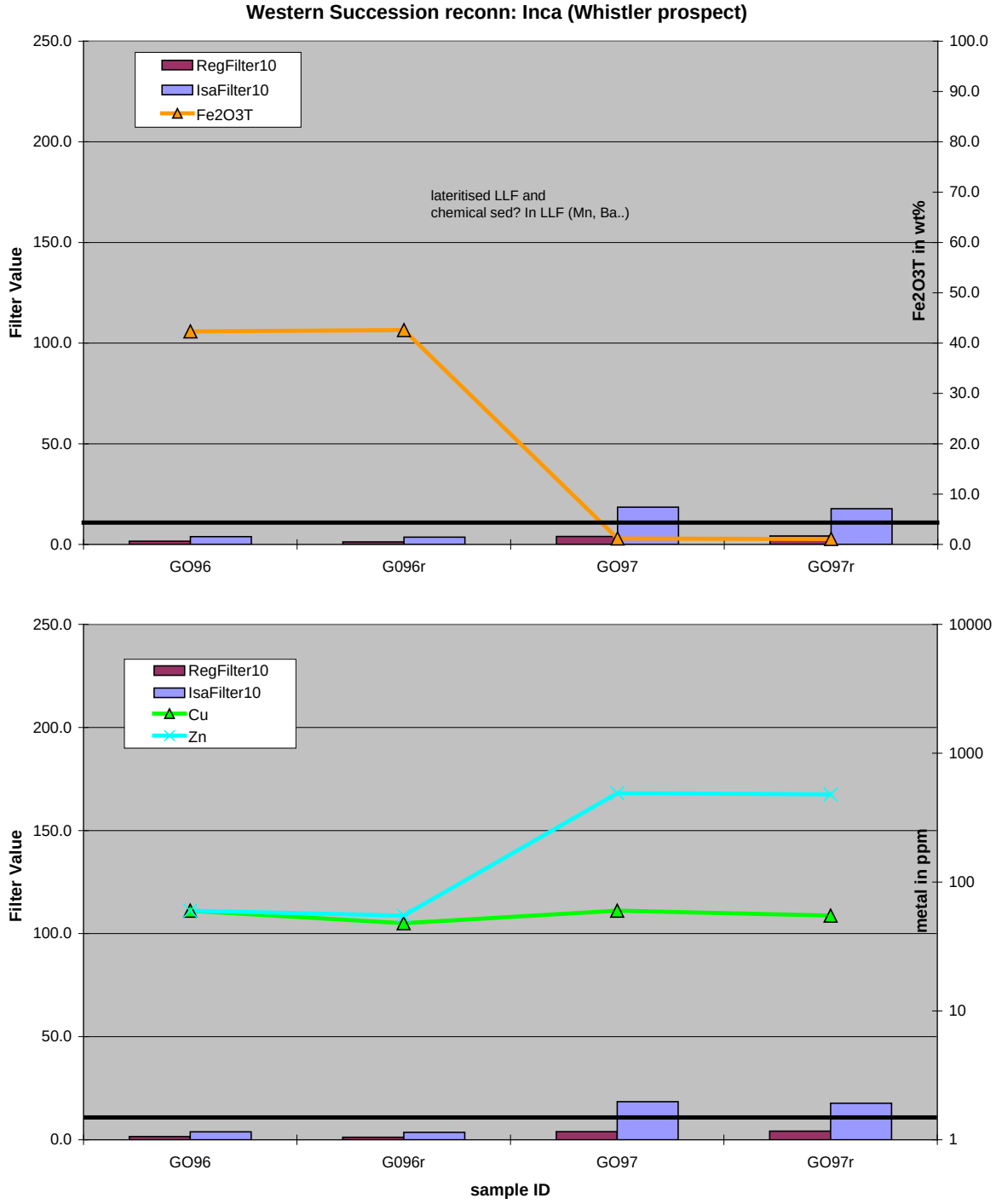

Western Succession prospect: Mount Kelly
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G61
GO98a
GO98b
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
100000
10000
1000
100
10
1
G61
GO98a
GO98b
sample ID

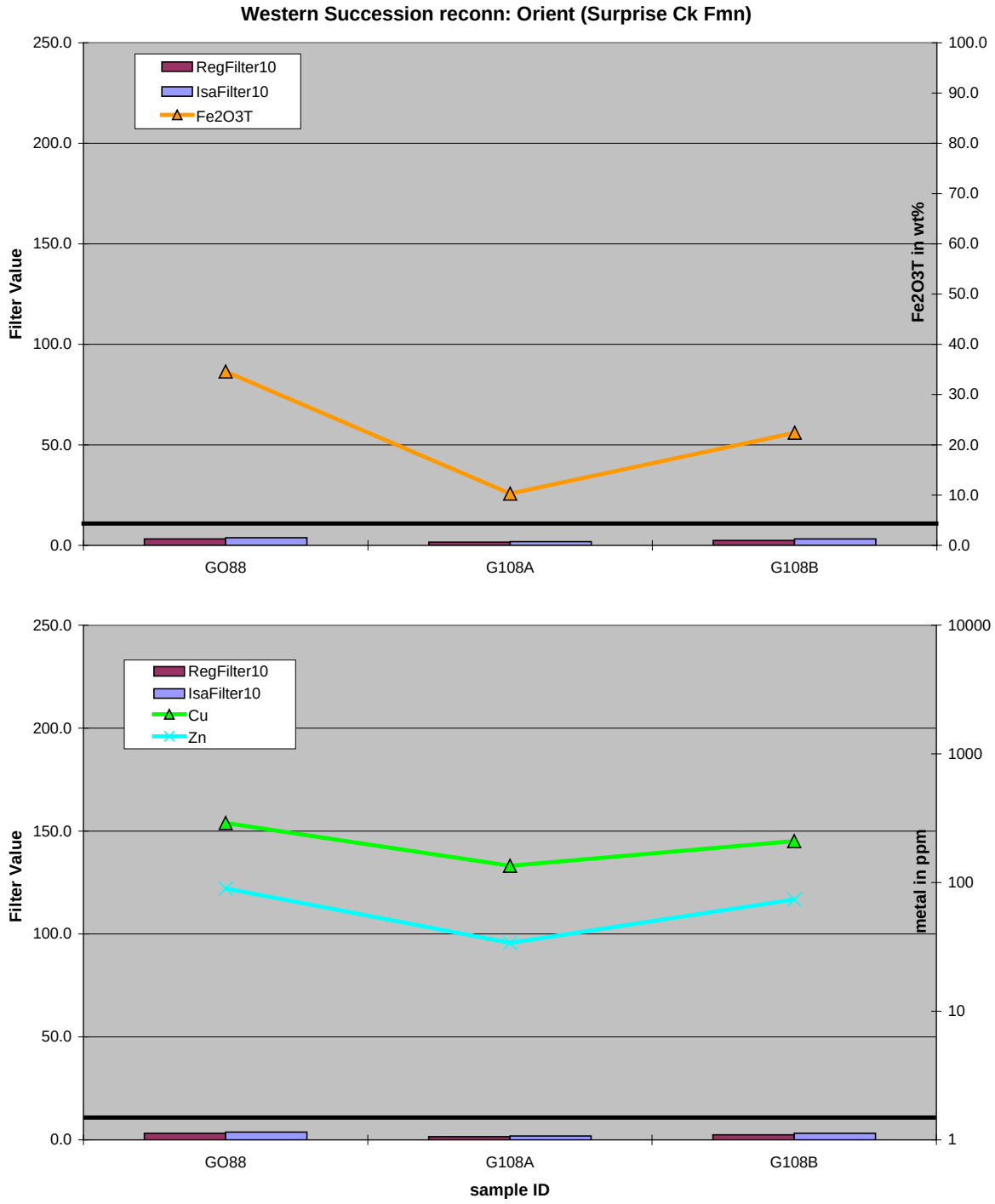

Western Succession reconn: Drifter
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G52
G53
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
100000
10000
1000
100
10
1
G52
G53
sample ID

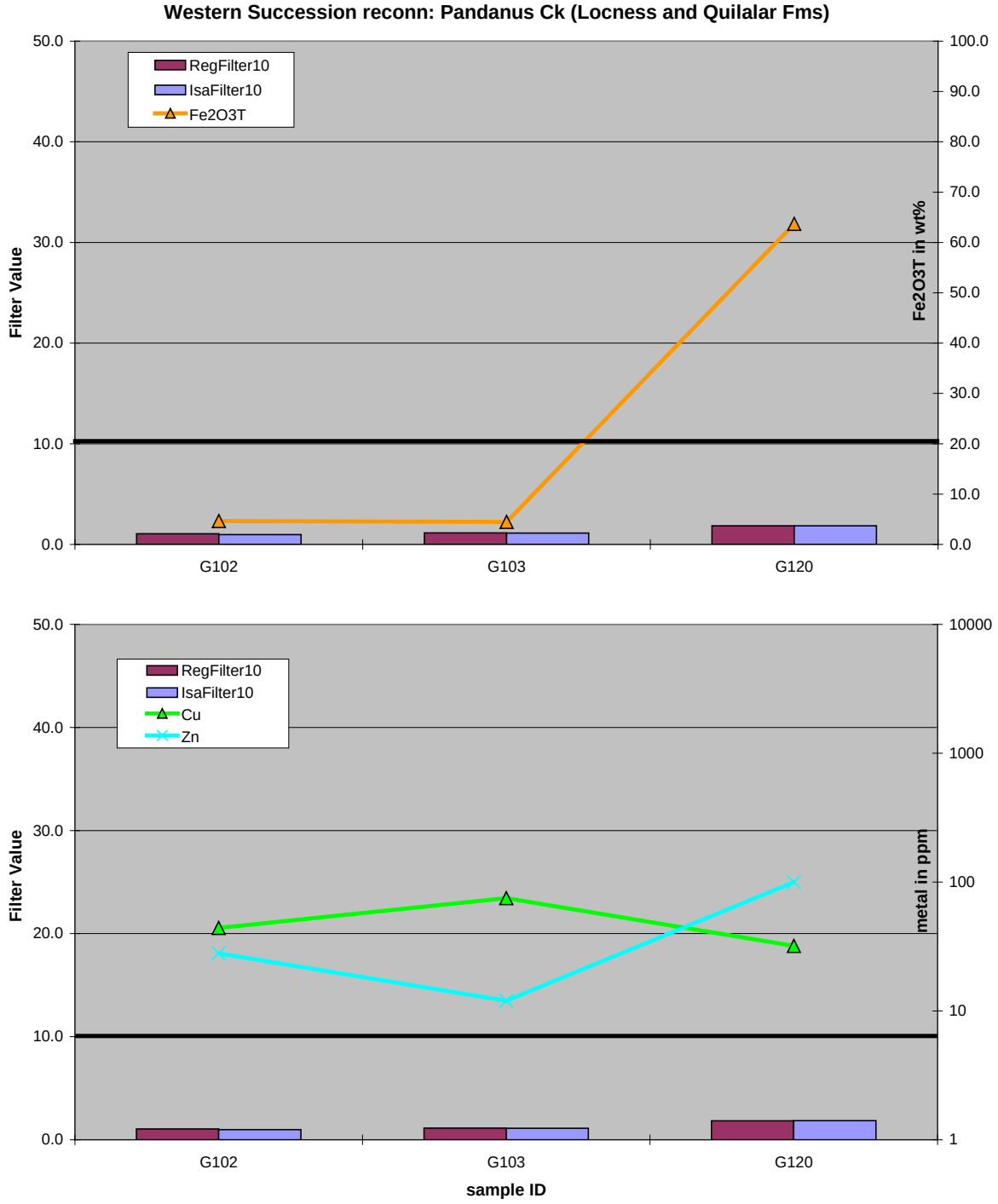

Western Succession reconn: Flora (Olgivie Ra.)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
GO94
GO95a
GO95b
GO95c
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

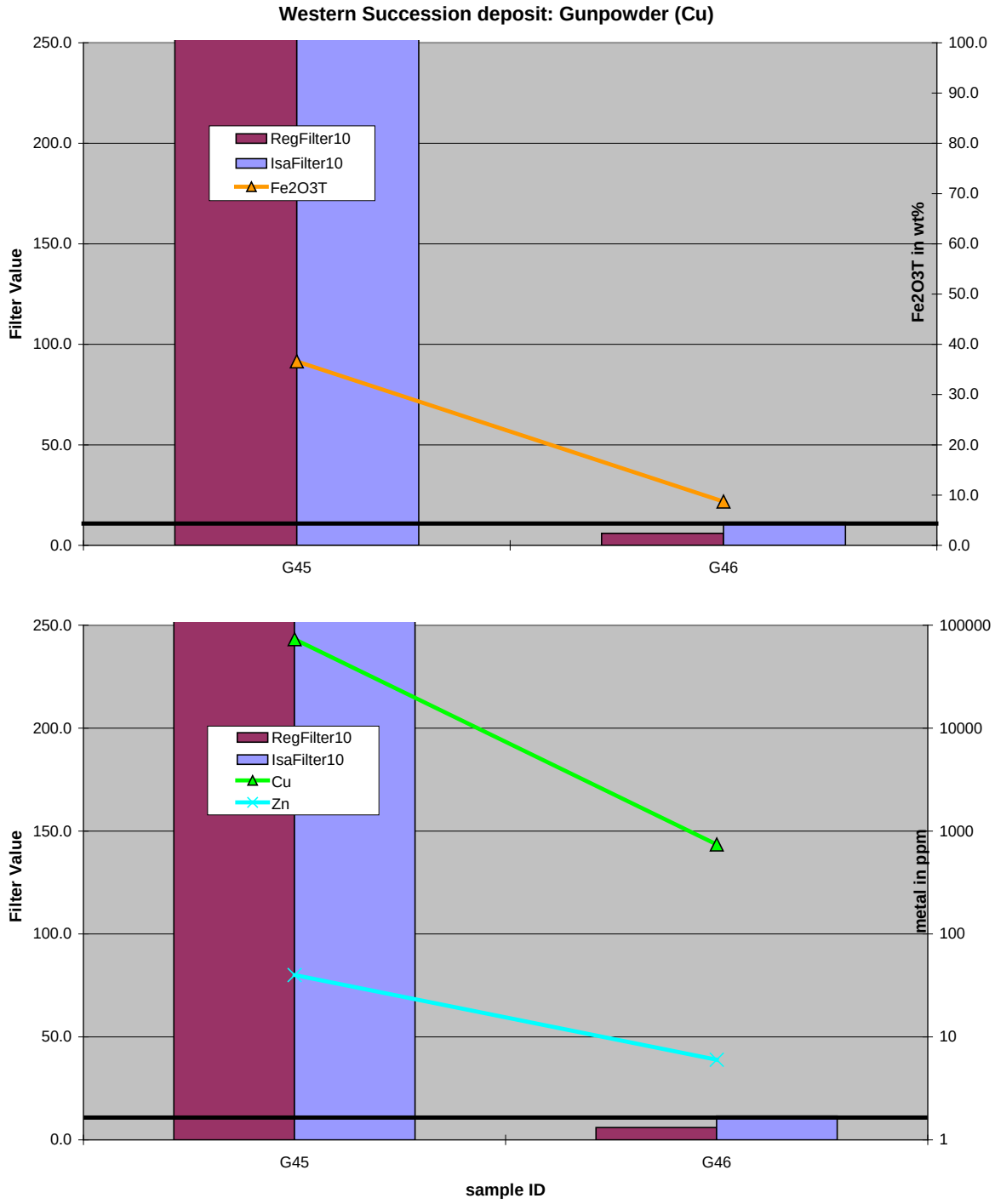

Western Succession reconn: Kennedy Gap sheet (incl MtOxCM)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G121B
G121C
G123
G124
G127
G128
G129
G130
G131
G132
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
250.0
200.0
150.0
100.0
50.0
0.0
10000
1000
100
10
1
G121B
G121C
G123
G124
G127
G128
G129
G130
G131
G132
sample ID

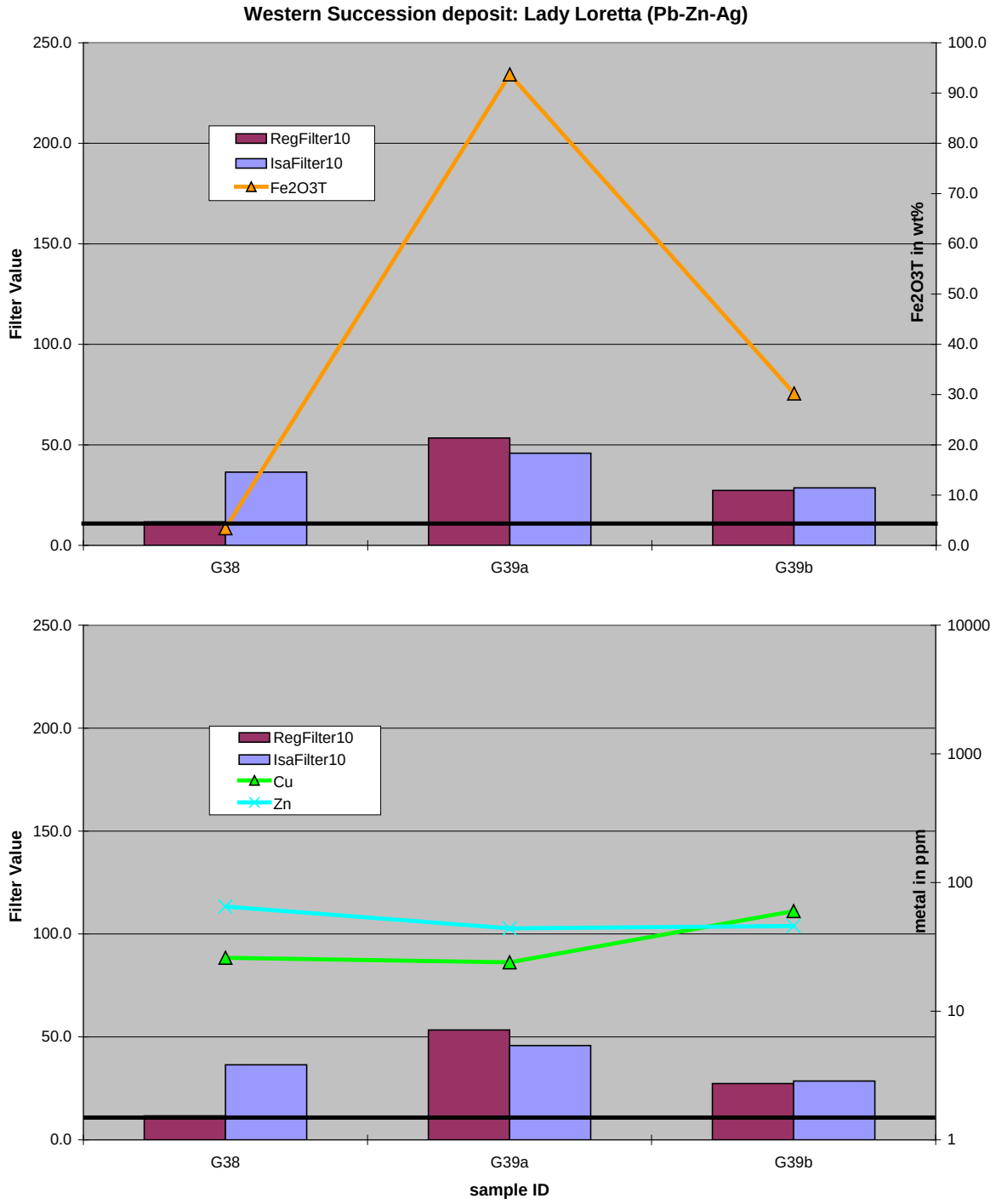

Western Succession reconn: Redie Creek Fault area
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G59
GO83a
GO83b
GO83c
GO84a
GO84b
GO84c
GO84d
GO85a
GO85b
GO86
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

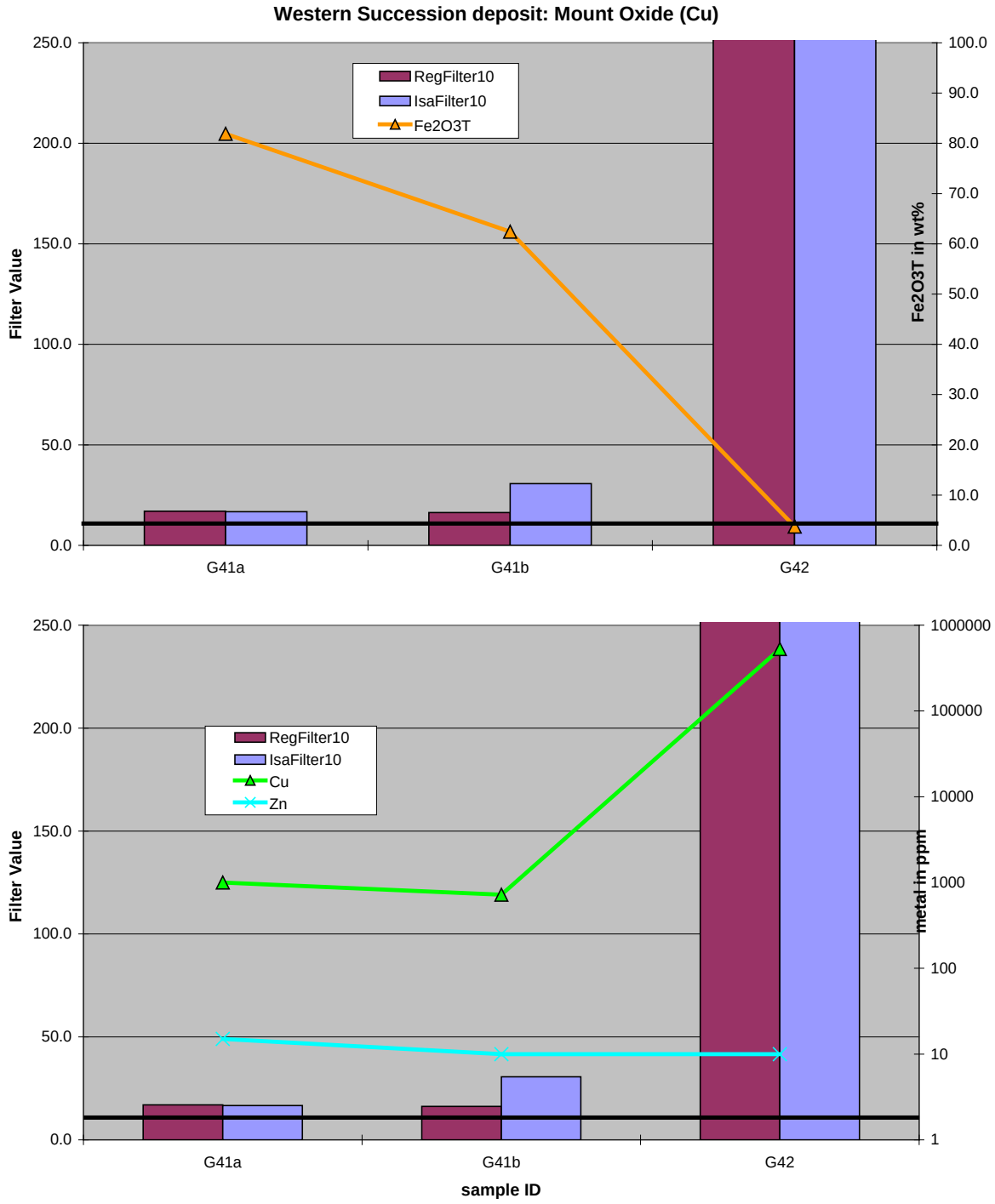

Western Succession reconn: Inca (Whistler prospect)
RegFilter10
IsaFilter10
Fe2O3T
lateritised LLF and
chemical sed? In LLF (Mn, Ba..)
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
GO96
G096r
GO97
GO97r
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

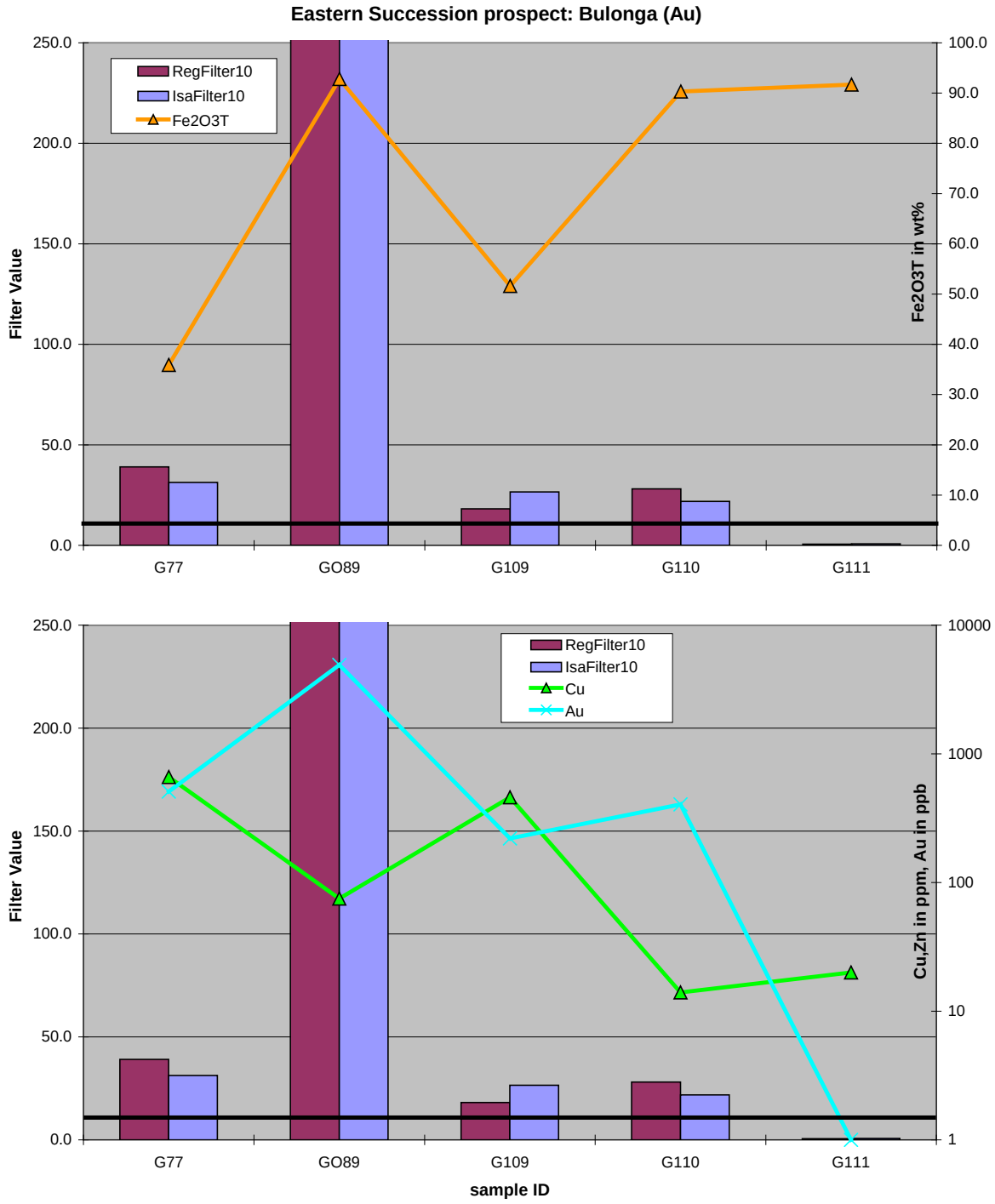

Western Succession reconn: Orient (Surprise Ck Fmn)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
GO88
G108A
G108B
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

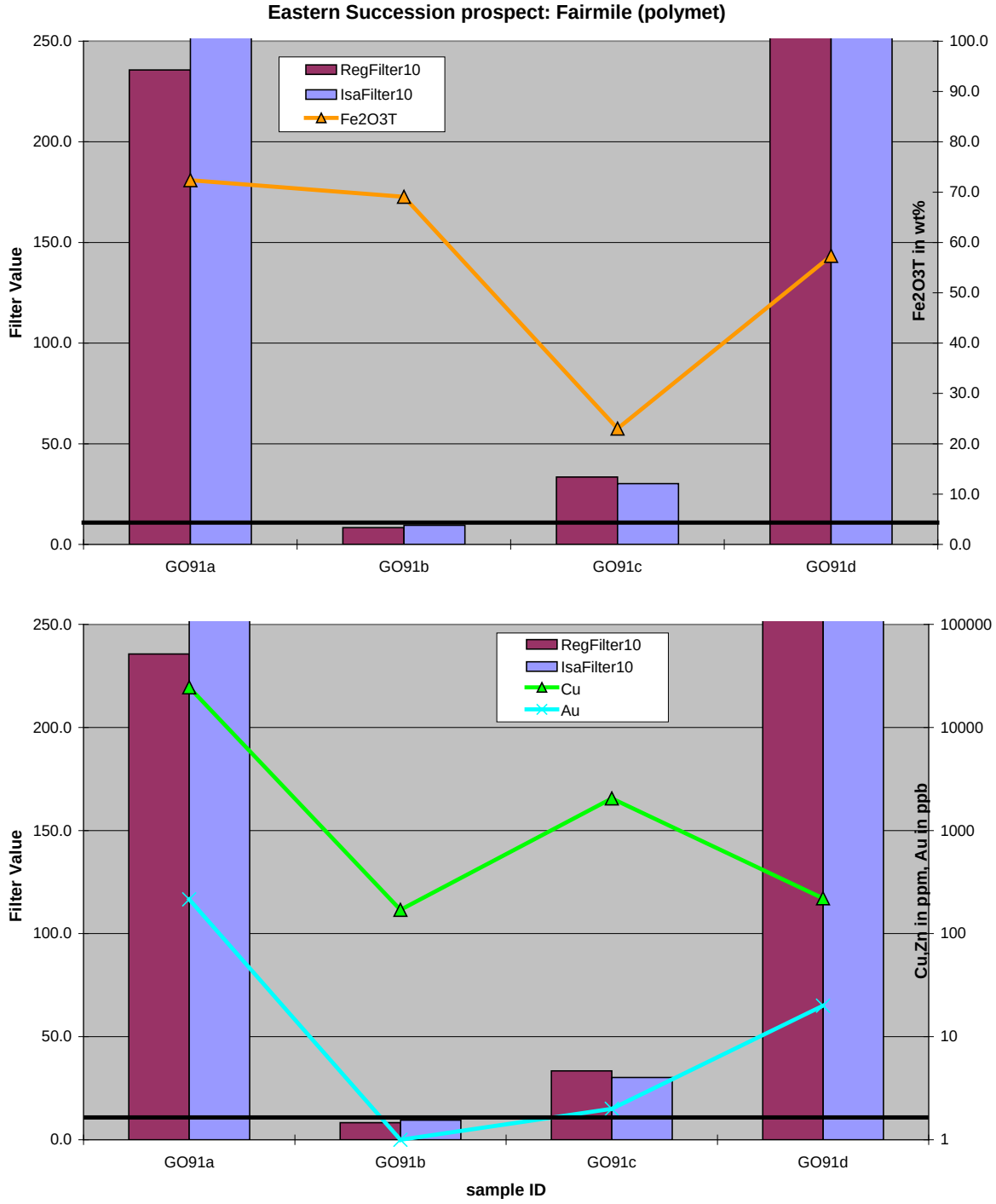

Western Succession reconn: Pandanus Ck (Locness and Quilalar Fms)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
50.0
40.0
30.0
20.0
10.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G102
G103
G120
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
10000
1000
100
10
1
sample ID

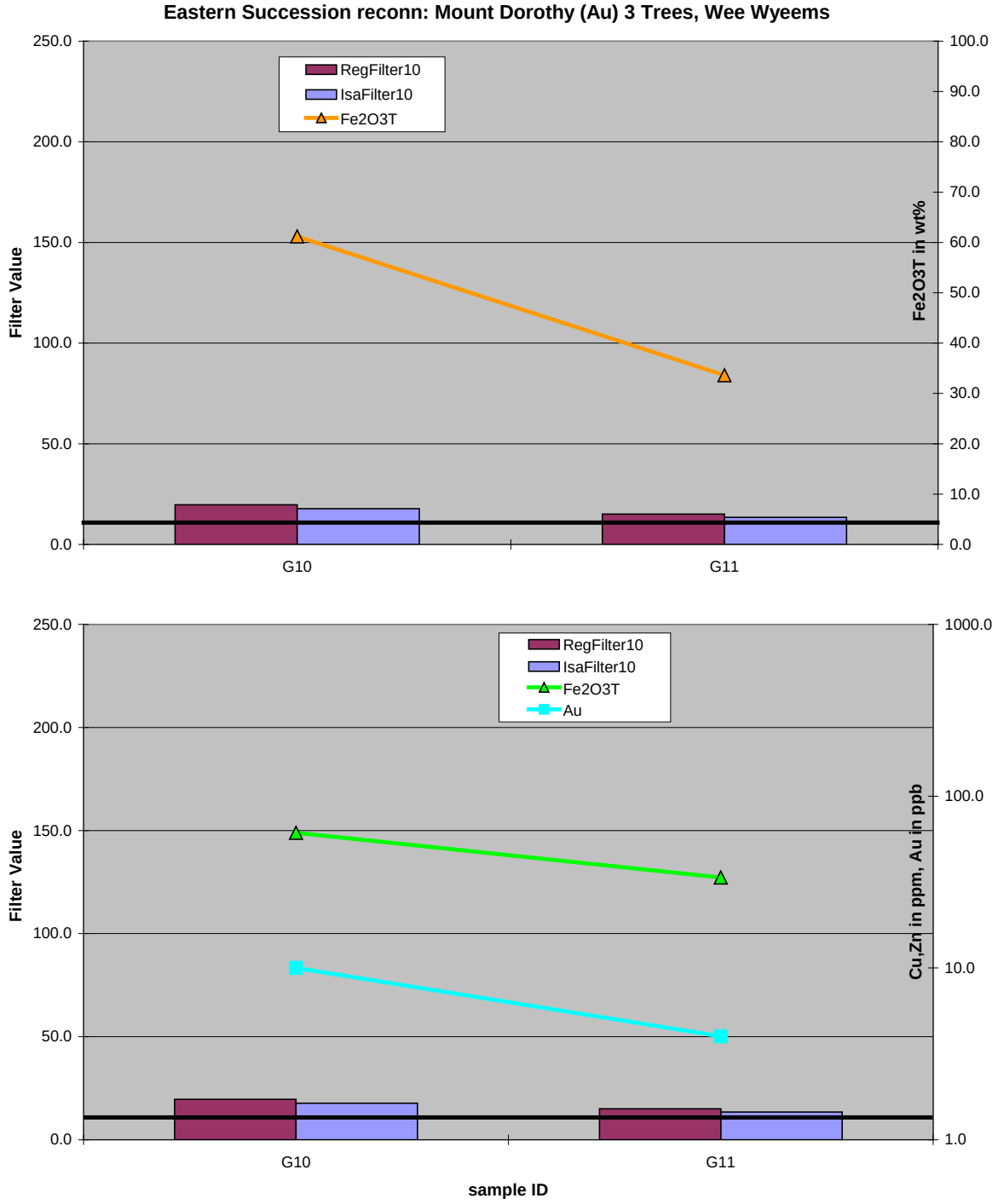

Western Succession deposit: Gunpowder (Cu)
Filter Value
Fe2O3T in wt%
RegFilter10
IsaFilter10
Fe2O3T
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G45
G46
Filter Value
metal in ppm
RegFilter10
IsaFilter10
Cu
Zn
250.0
200.0
150.0
100.0
50.0
0.0
100000
10000
1000
100
10
1
G45
G46
sample ID

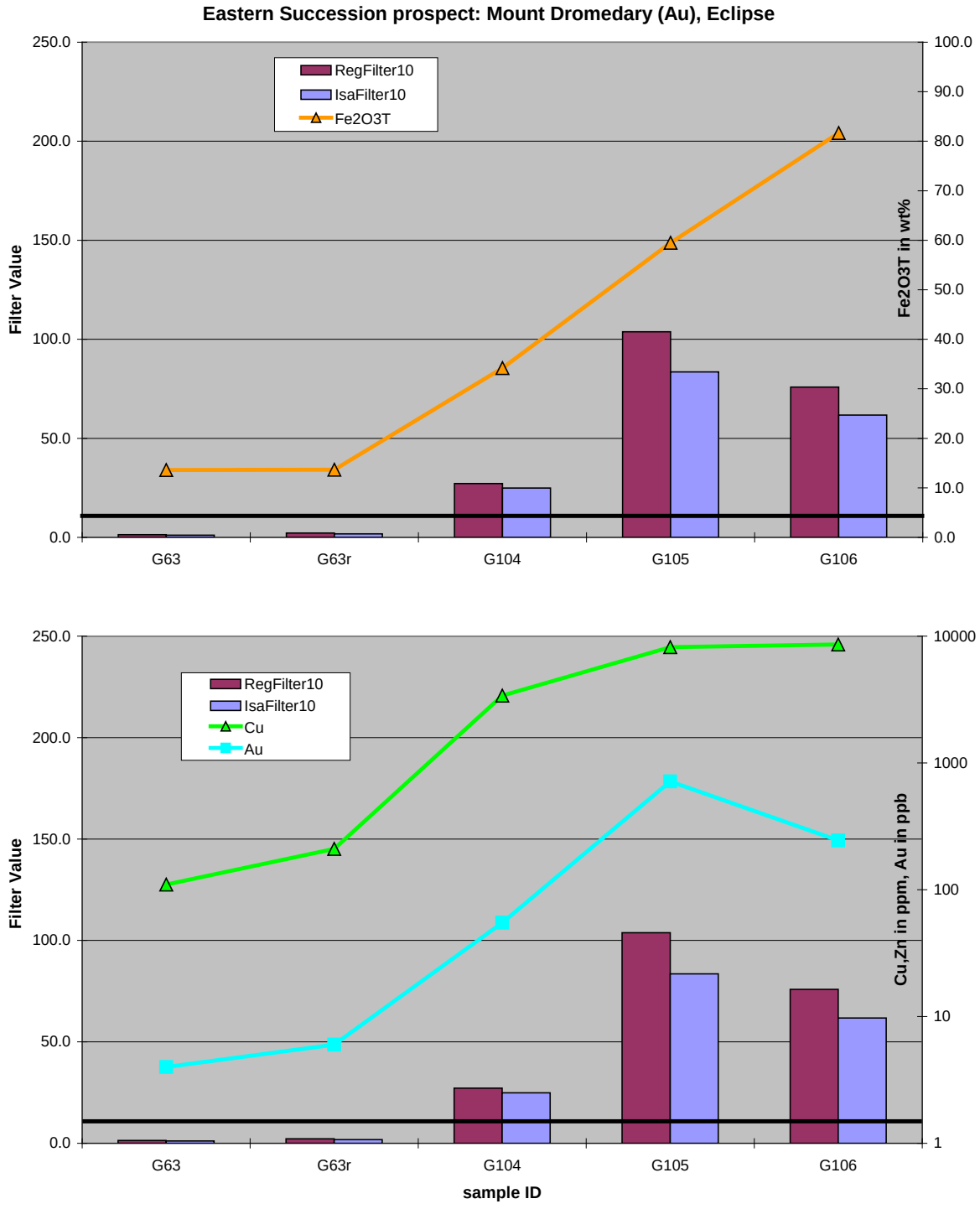

Western Succession deposit: Lady Loretta (Pb-Zn-Ag)
Filter Value
Fe2O3T in wt%
RegFilter10
IsaFilter10
Fe2O3T
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G38
G39a
G39b
Filter Value
metal in ppm
RegFilter10
IsaFilter10
Cu
Zn
10000
1000
100
10
1
G38
G39a
G39b
sample ID

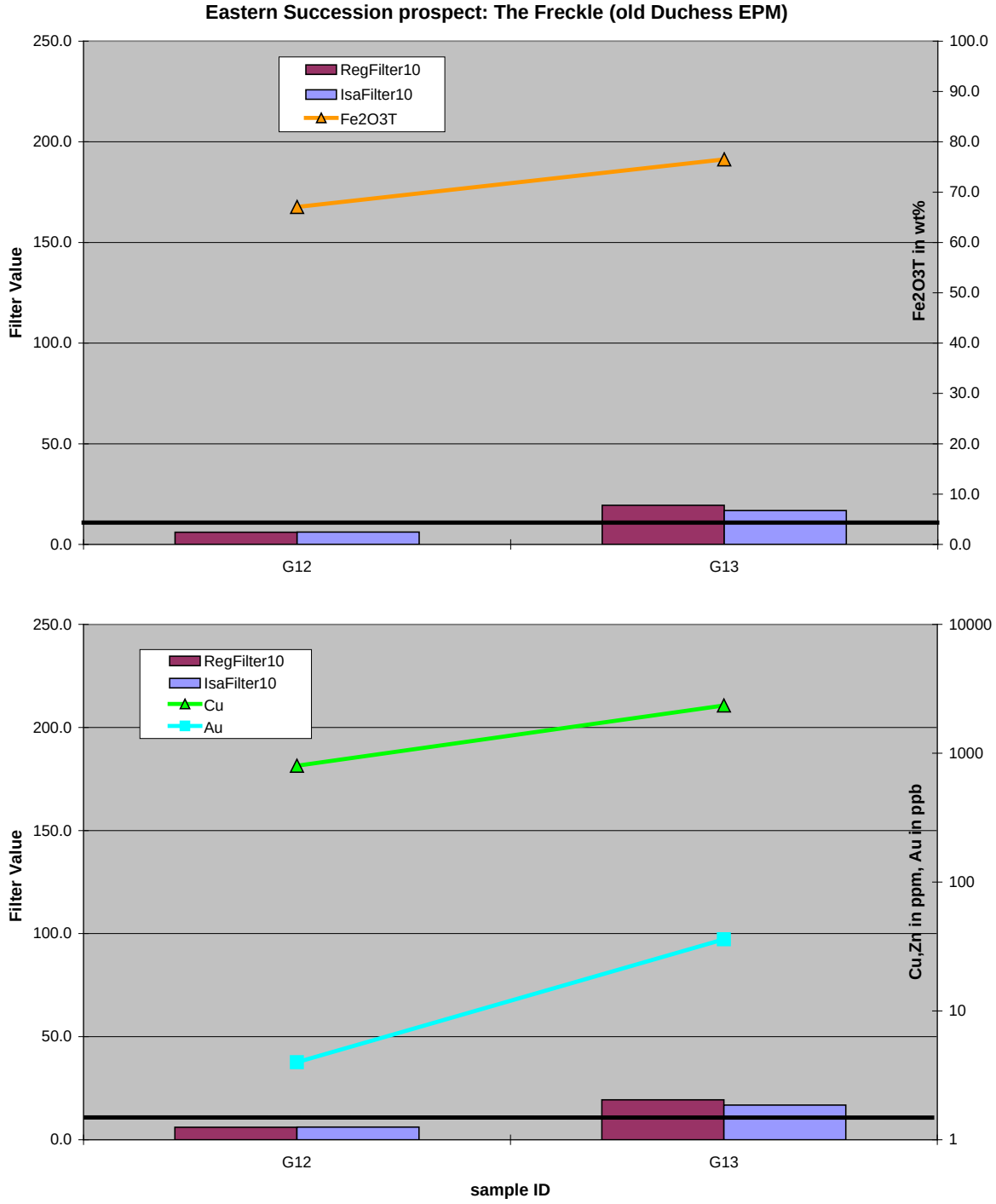

Western Succession deposit: Mount Oxide (Cu)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G41a
G41b
G42
RegFilter10
IsaFilter10
Cu
Zn
Filter Value
metal in ppm
1000000
100000
10000
1000
100
10
1
G41a
G41b
G42
sample ID

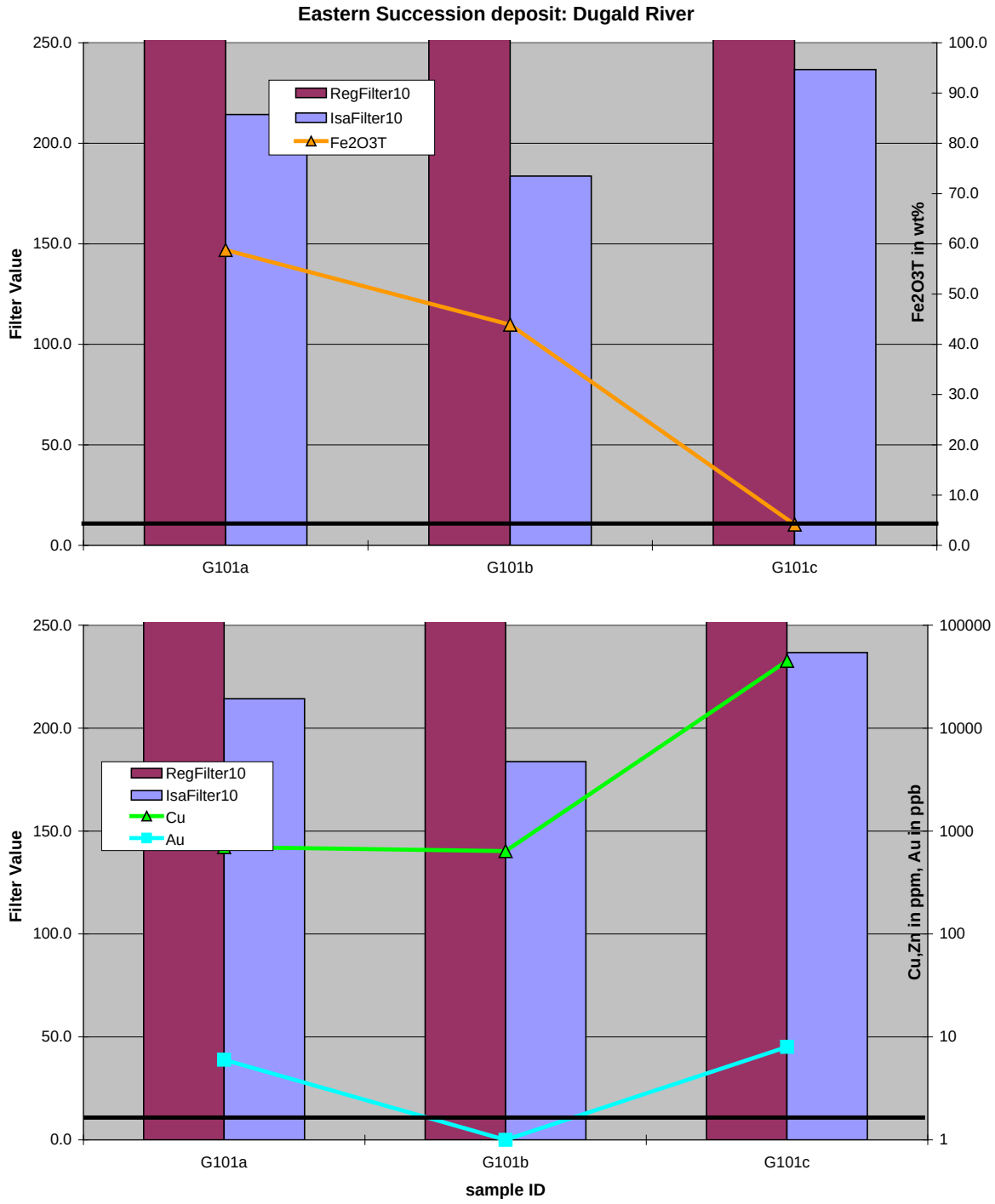

Eastern Succession prospect: Bulonga (Au)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G77
GO89
G109
G110
G111
RegFilter10
IsaFilter10
Cu
Au
Filter Value
Cu,Zn in ppm, Au in ppb
10000
1000
100
10
1
sample ID


Eastern Succession prospect: Fairmile (polymet)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
GO91a
GO91b
GO91c
GO91d
RegFilter10
IsaFilter10
Cu
Au
Filter Value
Cu,Zn in ppm, Au in ppb
250.0
200.0
150.0
100.0
50.0
0.0
100000
10000
1000
100
10
1
GO91a
GO91b
GO91c
GO91d
sample ID


Eastern Succession reconn: Mount Dorothy (Au) 3 Trees, Wee Wyeems
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G10
G11
RegFilter10
IsaFilter10
Fe2O3T
Au
Filter Value
Cu,Zn in ppm, Au in ppb
250.0
200.0
150.0
100.0
50.0
0.0
1000.0
100.0
10.0
1.0
G10
G11
sample ID


Eastern Succession prospect: Mount Dromedary (Au), Eclipse
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G63
G63r
G104
G105
G106
RegFilter10
IsaFilter10
Cu
Au
Filter Value
Cu,Zn in ppm, Au in ppb
10000
1000
100
10
1
sample ID


Eastern Succession prospect: The Freckle (old Duchess EPM)
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G12
G13
RegFilter10
IsaFilter10
Cu
Au
Filter Value
Cu,Zn in ppm, Au in ppb
10000
1000
100
10
1
sample ID


Eastern Succession deposit: Dugald River
RegFilter10
IsaFilter10
Fe2O3T
Filter Value
Fe2O3T in wt%
250.0
200.0
150.0
100.0
50.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
G101a
G101b
G101c
RegFilter10
IsaFilter10
Cu
Au
Filter Value
Cu,Zn in ppm, Au in ppb
250.0
200.0
150.0
100.0
50.0
0.0
100000
10000
1000
100
10
1
G101a
G101b
G101c
sample ID