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**OPEN FILE
REPORT
SERIES**

**LATERITE GEOCHEMISTRY
IN THE CSIRO-AGE DATABASE
FOR THE ALBANY-FRASER REGION**
(Collie, Dumbleyung, Mt. Barker, Pemberton sheets)

Volume 2 - Appendices

E.C. Grunsky

CRC LEME OPEN FILE REPORT 28

December 1998

(CSIRO Division of Exploration Geoscience Report 161R, 1991.
Second impression 1998)

CRC LEME is an unincorporated joint venture between The Australian National University, University of Canberra, Australian Geological Survey Organisation and CSIRO Exploration and Mining, established and supported under the Australian Government's Cooperative Research Centres Program.





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RESEARCH ARISING FROM CSIRO/AMIRA REGOLITH GEOCHEMISTRY PROJECTS 1987-1993

In 1987, CSIRO commenced a series of multi-client research projects in regolith geology and geochemistry which were sponsored by companies in the Australian mining industry, through the Australian Mineral Industries Research Association Limited (AMIRA). The initial research program, "Exploration for concealed gold deposits, Yilgarn Block, Western Australia" (1987-1993) had the aim of developing improved geological, geochemical and geophysical methods for mineral exploration that would facilitate the location of blind, buried or deeply weathered gold deposits. The program included the following projects:

P240: Laterite geochemistry for detecting concealed mineral deposits (1987-1991). Leader: Dr R.E. Smith.
Its scope was development of methods for sampling and interpretation of multi-element laterite geochemistry data and application of multi-element techniques to gold and polymetallic mineral exploration in weathered terrain. The project emphasised viewing laterite geochemical dispersion patterns in their regolith-landform context at local and district scales. It was supported by 30 companies.

P241: Gold and associated elements in the regolith - dispersion processes and implications for exploration (1987-1991). Leader: Dr C.R.M. Butt.

The project investigated the distribution of ore and indicator elements in the regolith. It included studies of the mineralogical and geochemical characteristics of weathered ore deposits and wall rocks, and the chemical controls on element dispersion and concentration during regolith evolution. This was to increase the effectiveness of geochemical exploration in weathered terrain through improved understanding of weathering processes. It was supported by 26 companies.

These projects represented "an opportunity for the mineral industry to participate in a multi-disciplinary program of geoscience research aimed at developing new geological, geochemical and geophysical methods for exploration in deeply weathered Archaean terrains". This initiative recognised the unique opportunities, created by exploration and open-cut mining, to conduct detailed studies of the weathered zone, with particular emphasis on the near-surface expression of gold mineralisation. The skills of existing and specially recruited research staff from the Floreat Park and North Ryde laboratories (of the then Divisions of Minerals and Geochemistry, and Mineral Physics and Mineralogy, subsequently Exploration Geoscience and later Exploration and Mining) were integrated to form a task force with expertise in geology, mineralogy, geochemistry and geophysics. Several staff participated in more than one project. Following completion of the original projects, two continuation projects were developed.

P240A: Geochemical exploration in complex lateritic environments of the Yilgarn Craton, Western Australia (1991-1993). Leaders: Drs R.E. Smith and R.R. Anand.

The approach of viewing geochemical dispersion within a well-controlled and well-understood regolith-landform and bedrock framework at detailed and district scales continued. In this extension, focus was particularly on areas of transported cover and on more complex lateritic environments typified by the Kalgoorlie regional study. This was supported by 17 companies.

P241A: Gold and associated elements in the regolith - dispersion processes and implications for exploration. Leader: Dr. C.R.M. Butt.

The significance of gold mobilisation under present-day conditions, particularly the important relationship with pedogenic carbonate, was investigated further. In addition, attention was focussed on the recognition of primary lithologies from their weathered equivalents. This project was supported by 14 companies.

Although the confidentiality periods of the research reports have expired, the last in December 1994, they have not been made public until now. Publishing the reports through the CRC LEME Report Series is seen as an appropriate means of doing this. By making available the results of the research and the authors' interpretations, it is hoped that the reports will provide source data for future research and be useful for teaching. CRC LEME acknowledges the Australian Mineral Industries Research Association and CSIRO Division of Exploration and Mining for authorisation to publish these reports. It is intended that publication of the reports will be a substantial additional factor in transferring technology to aid the Australian Mineral Industry.

This report (CRC LEME Open File Report 28) is a Second impression (second printing) of CSIRO, Division of Exploration Geoscience Restricted Report 161R, first issued in 1991, which formed part of the CSIRO/AMIRA Project P240.

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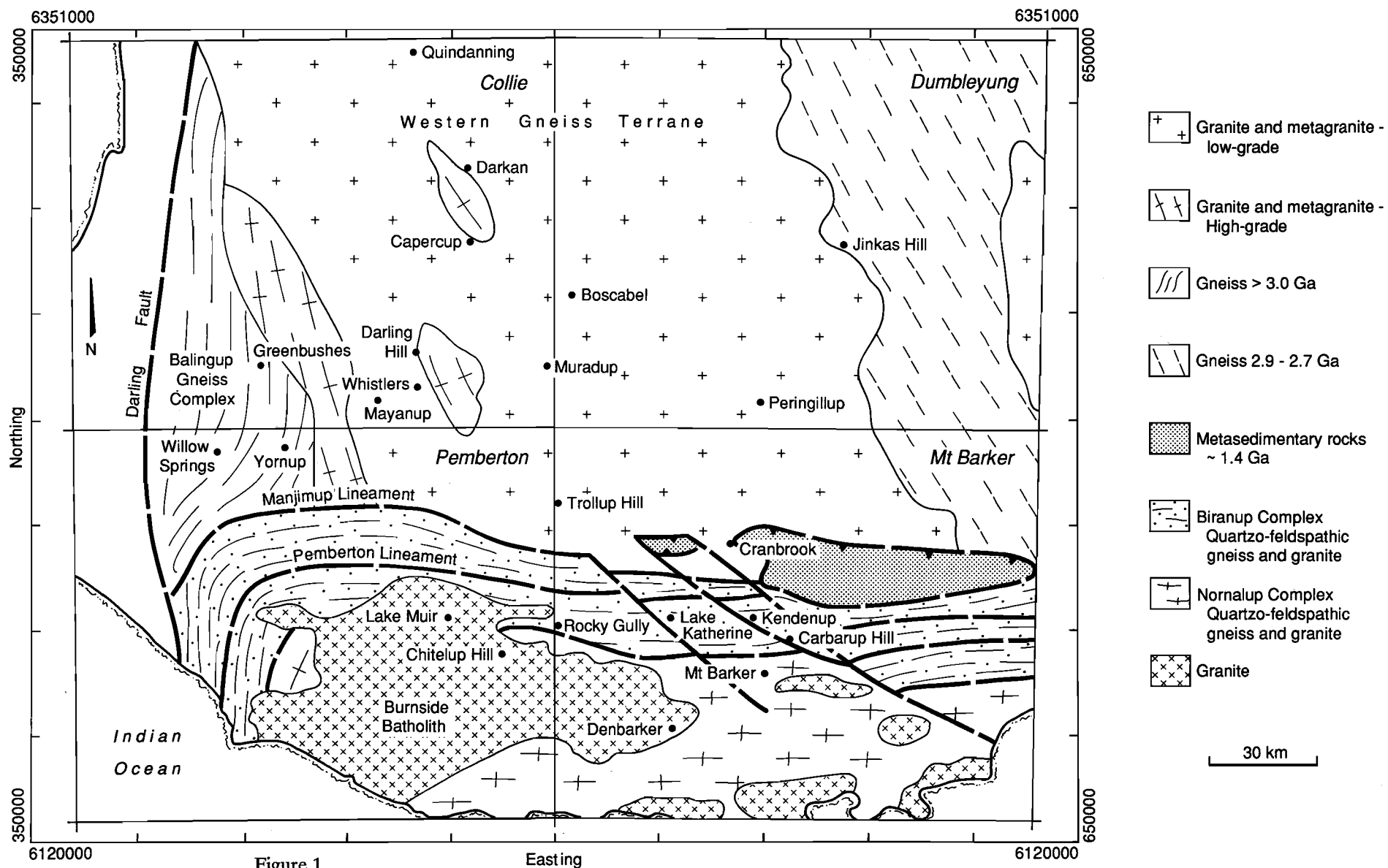
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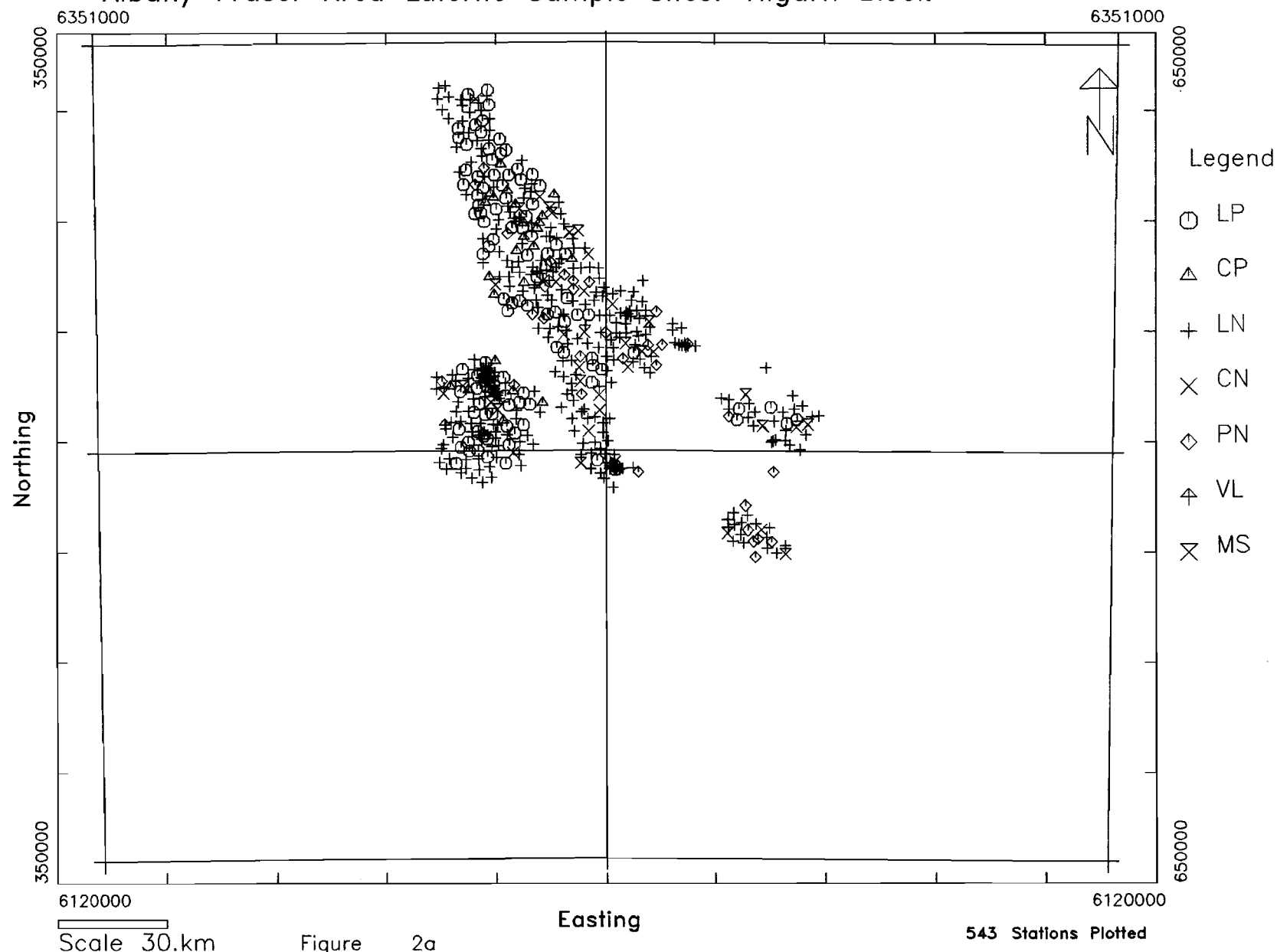
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Albany-Fraser Area Laterite Sample Sites: Yilgarn Block



Albany-Fraser Area Laterite Sample Sites: Albany Orogenic Belt

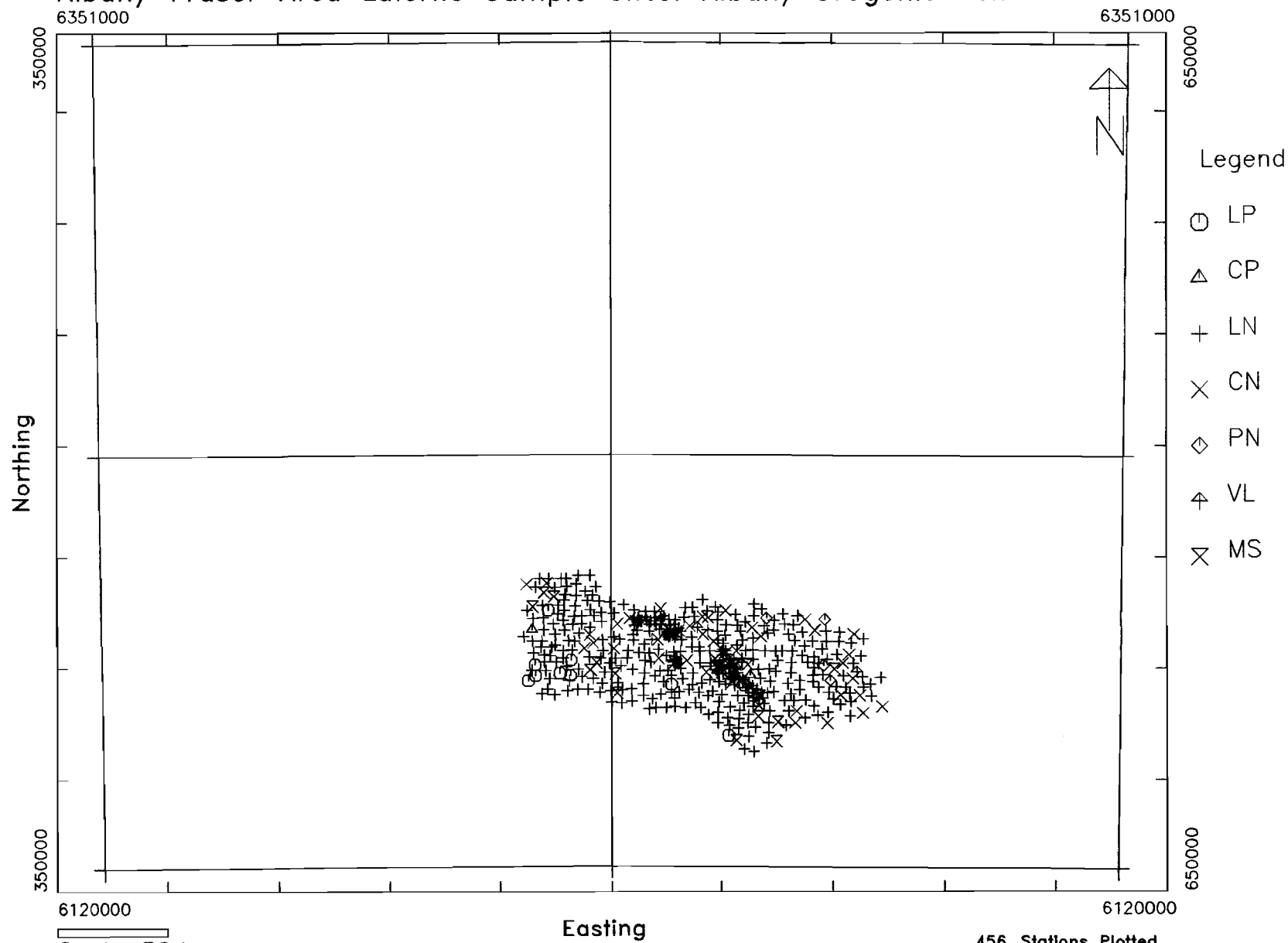
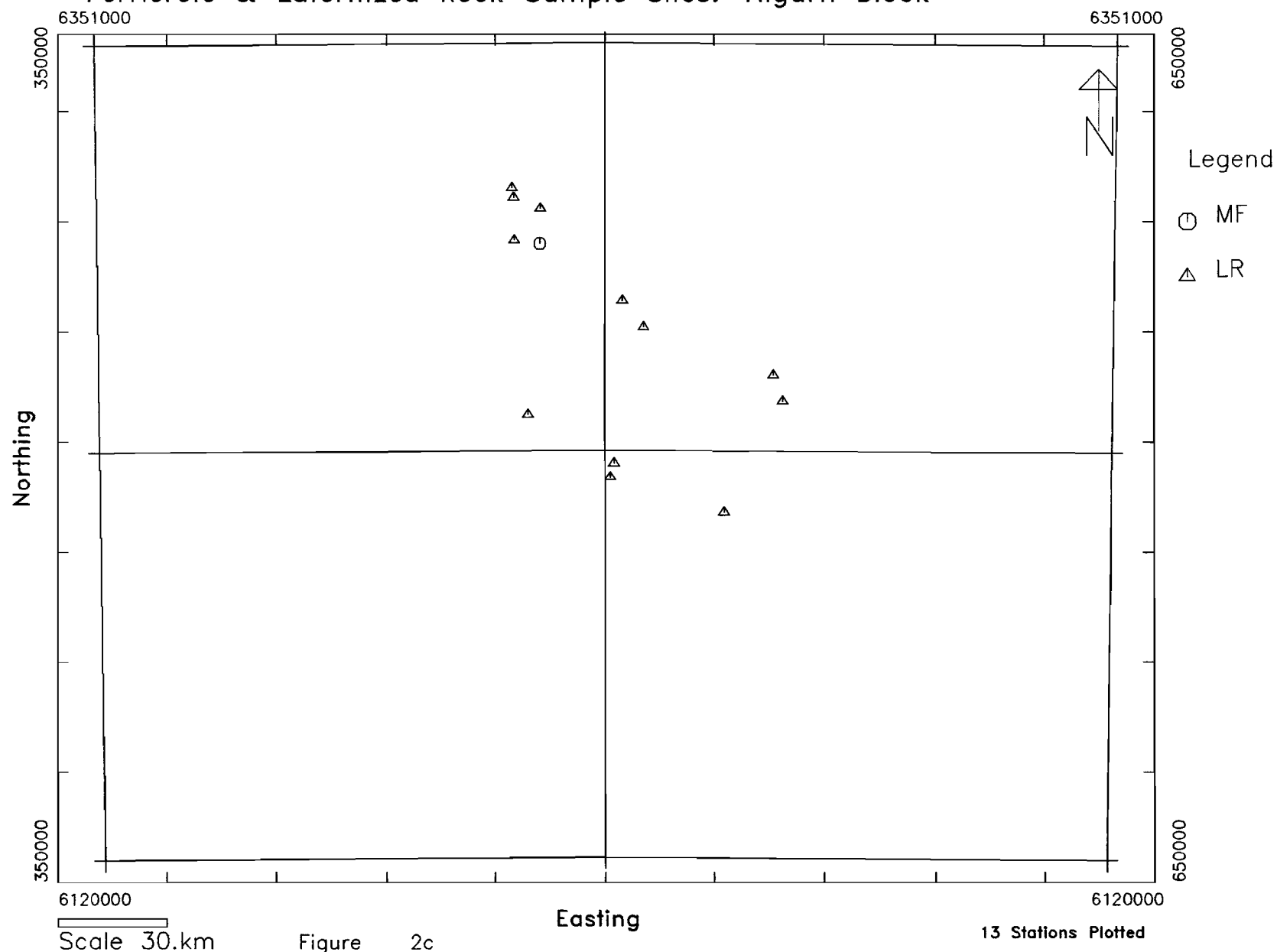
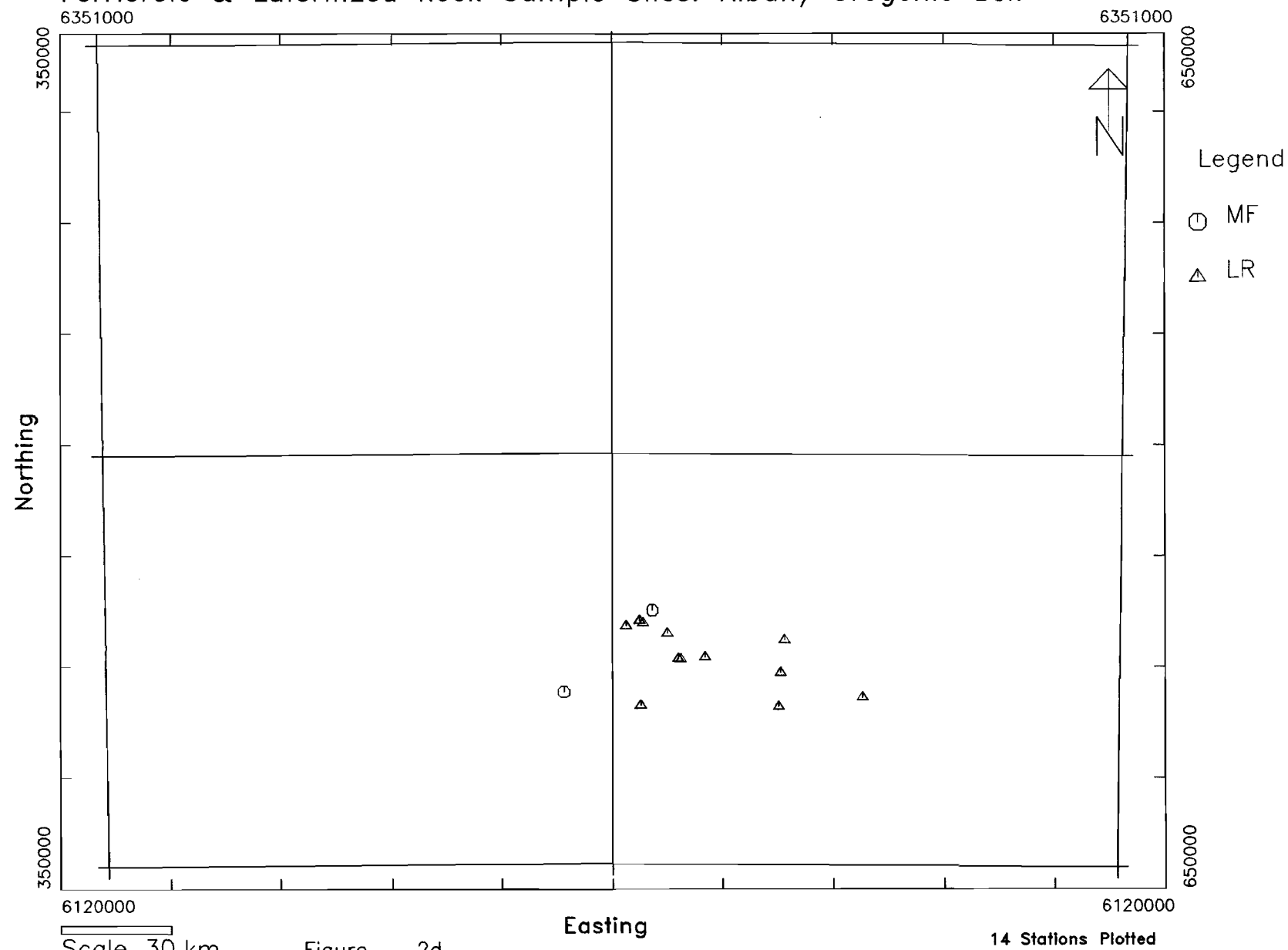


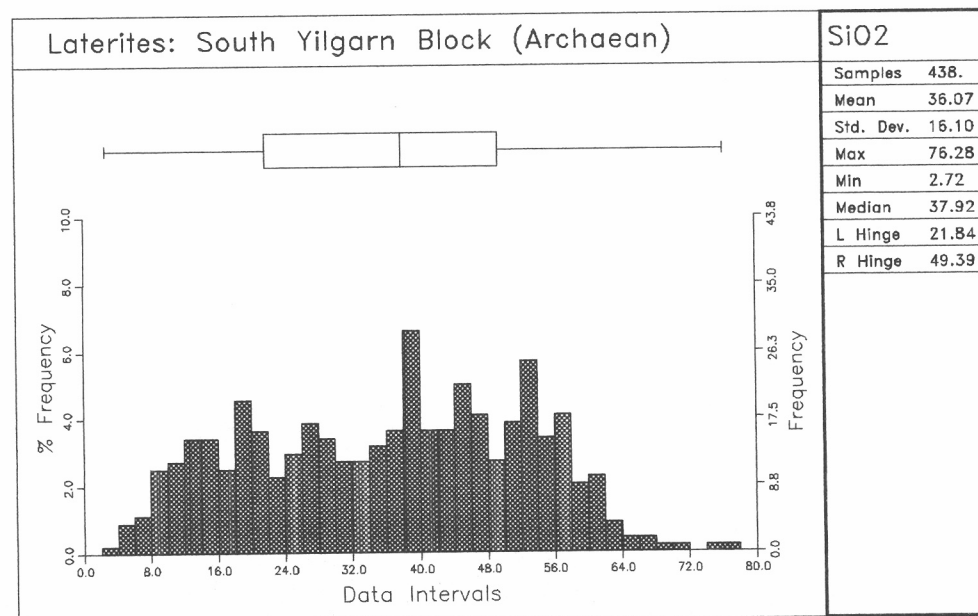
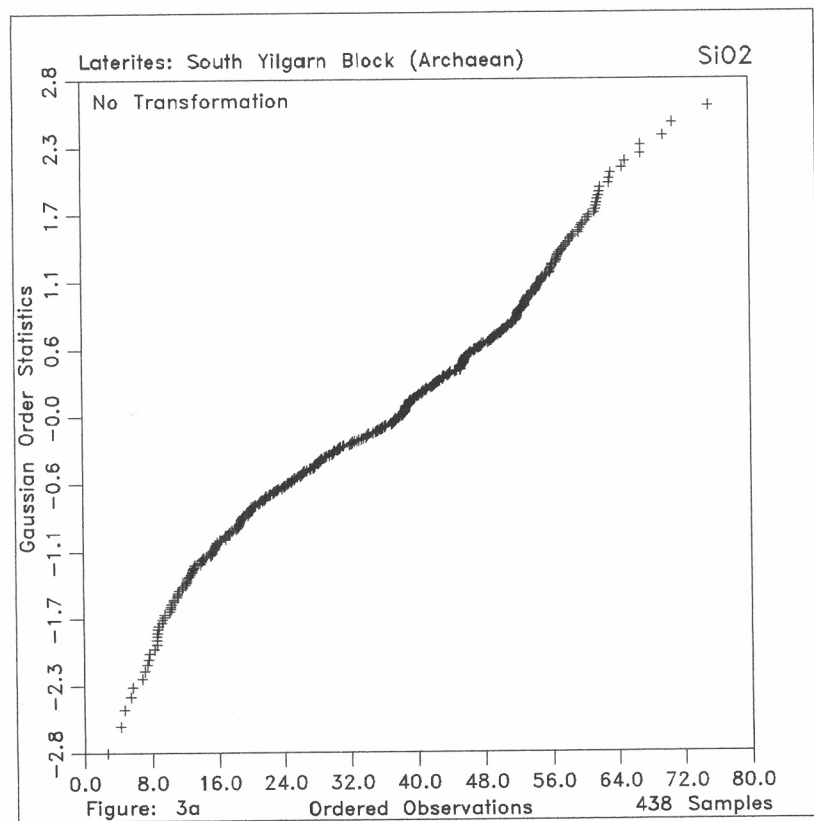
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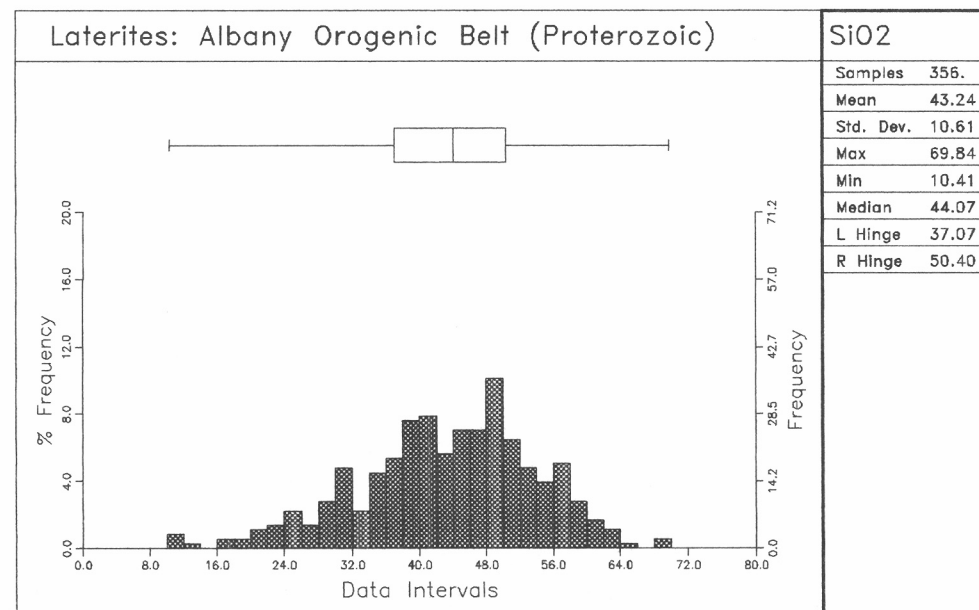
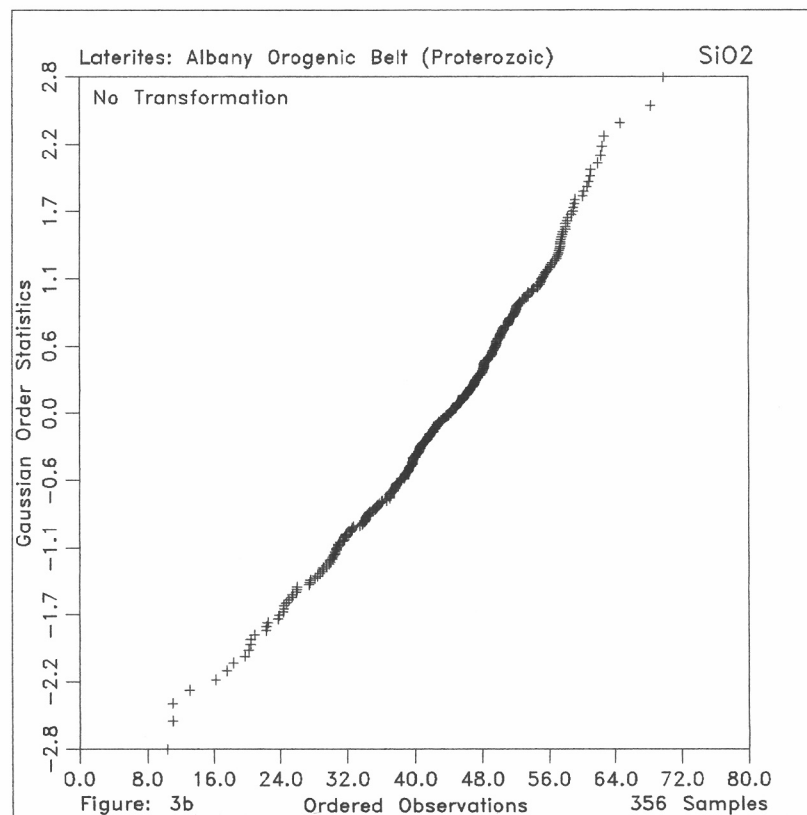
Ferricrete & Lateritized Rock Sample Sites: Yilgarn Block

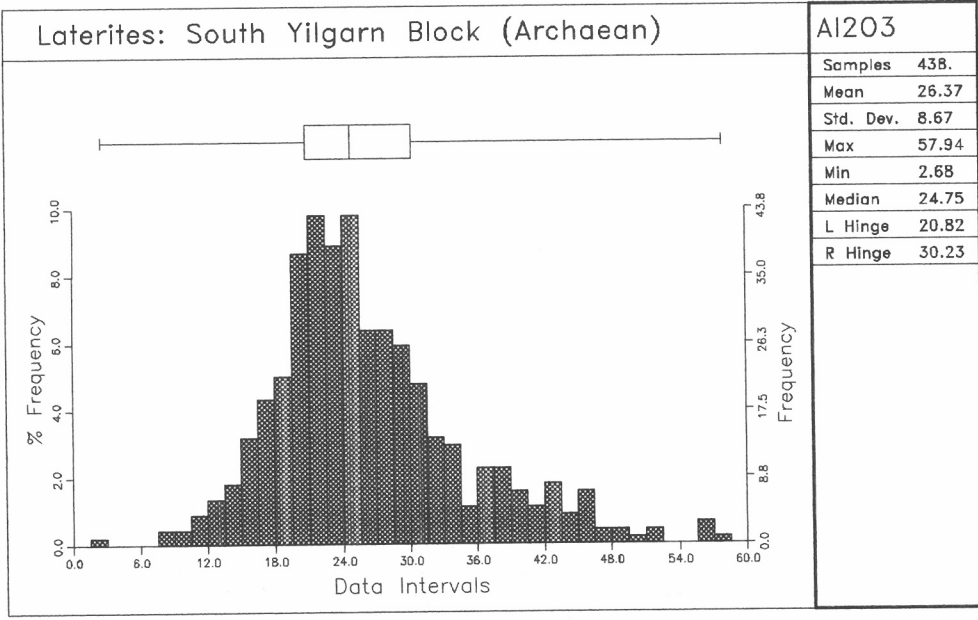
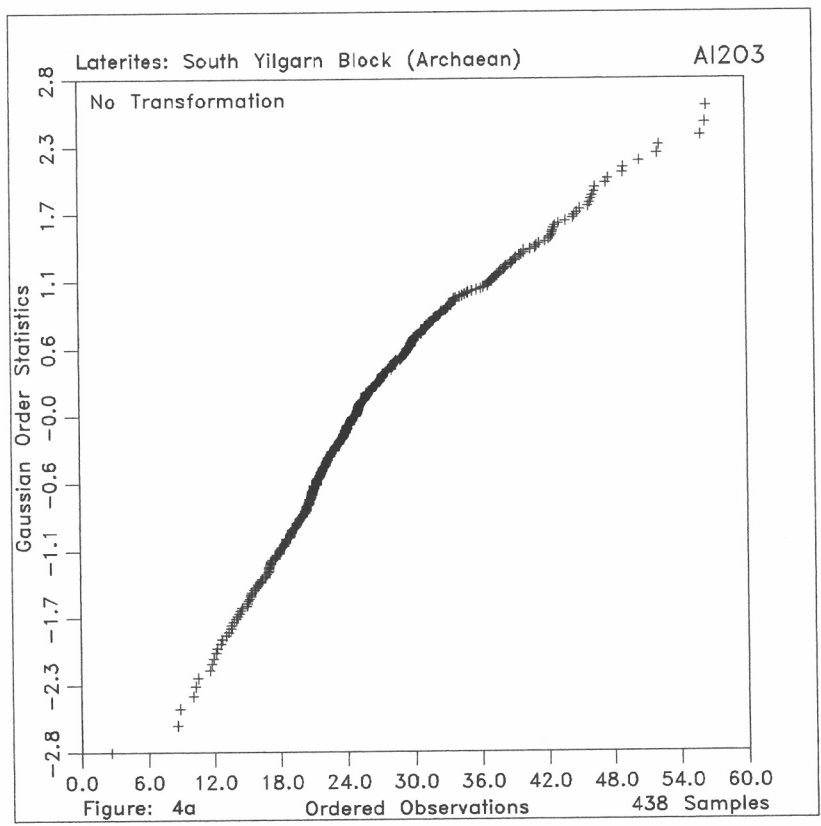


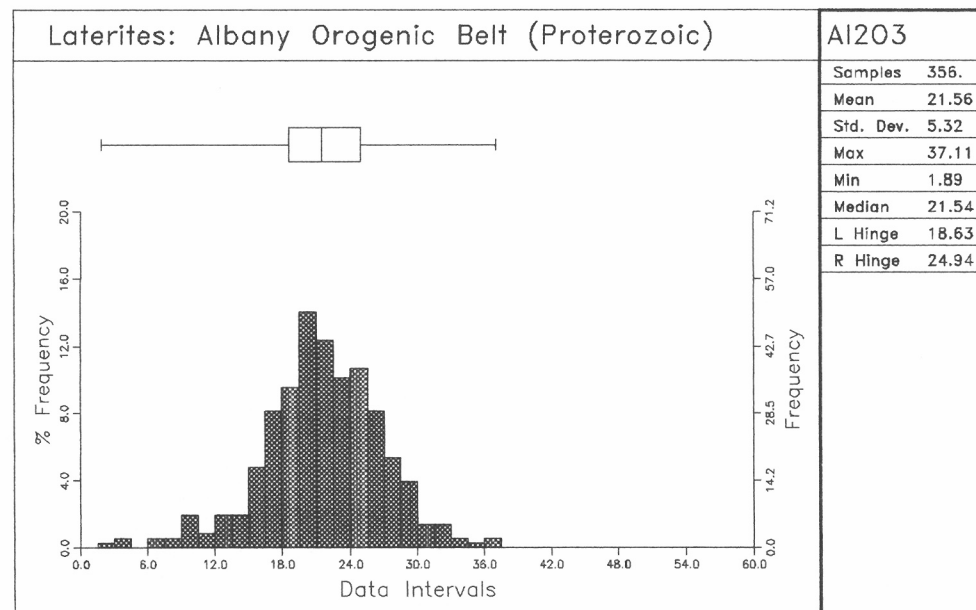
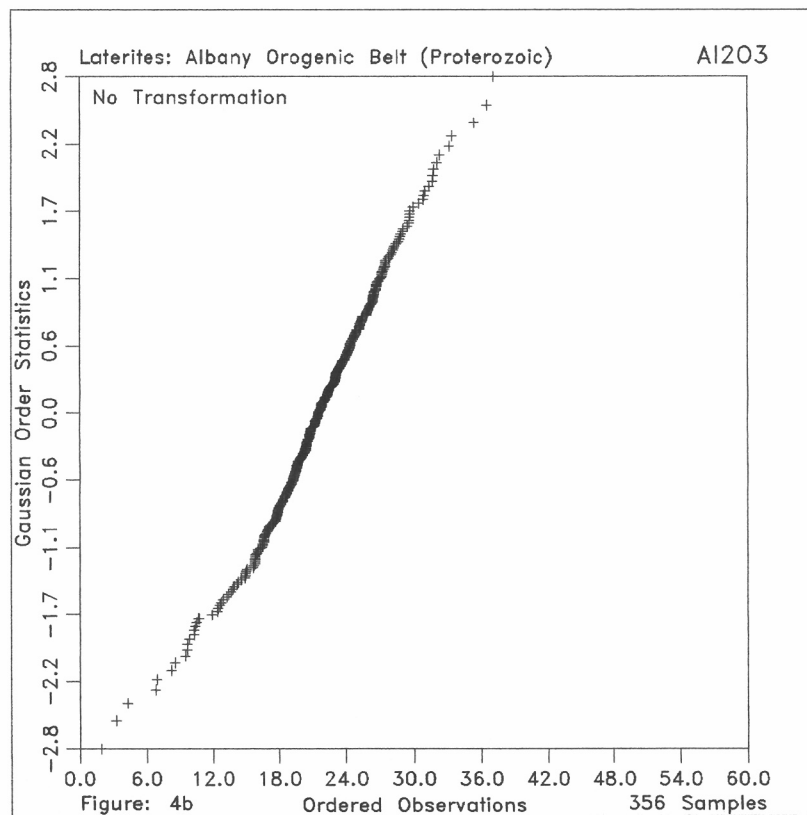
Ferricrete & Lateritized Rock Sample Sites: Albany Orogenic Belt

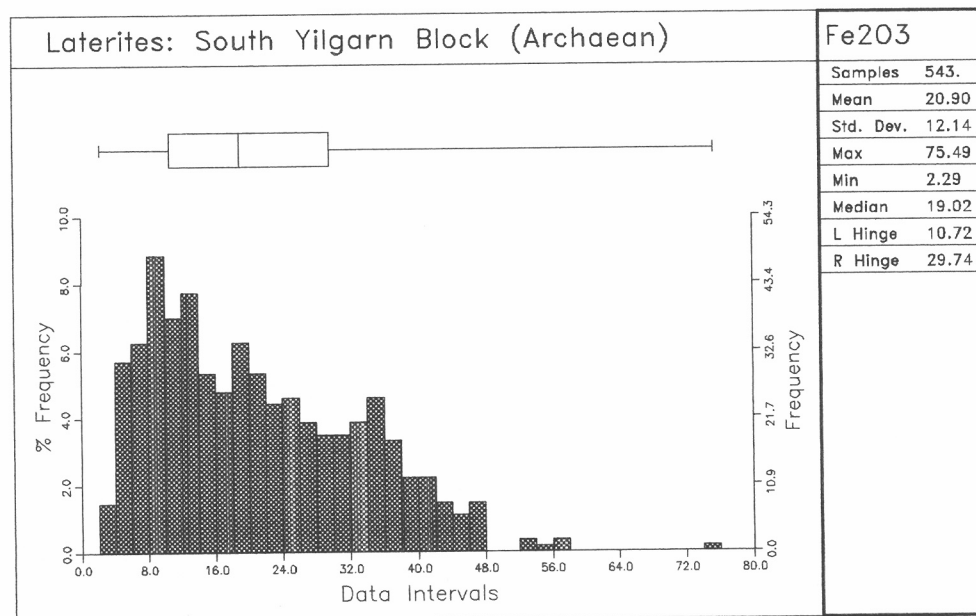
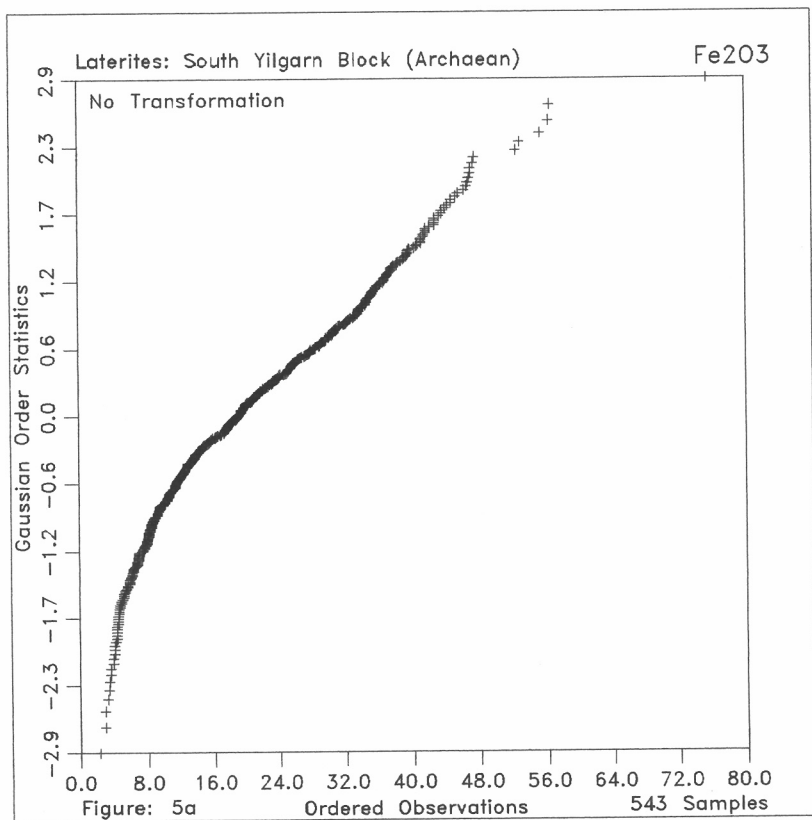


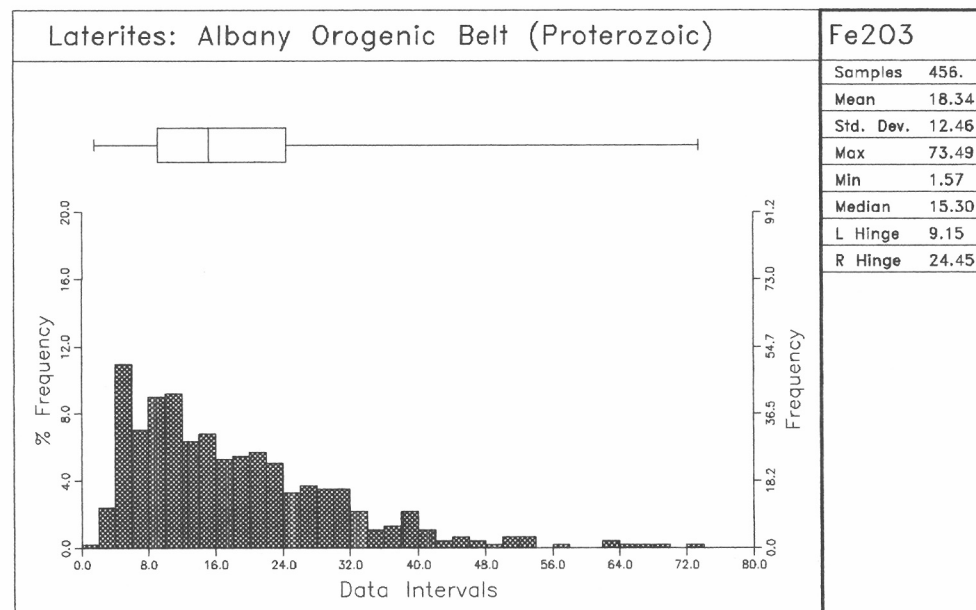
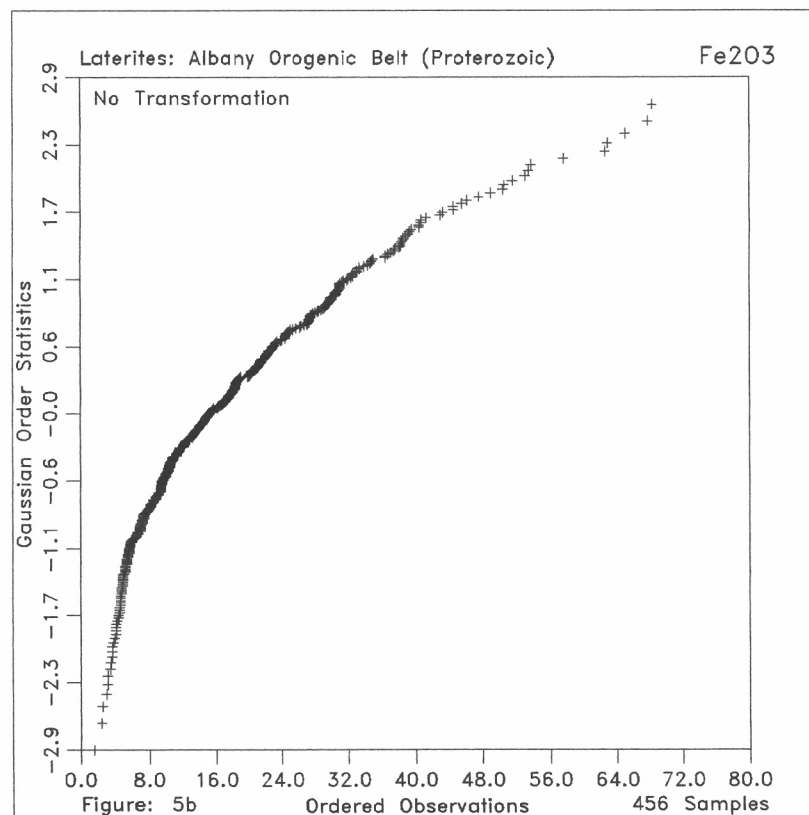


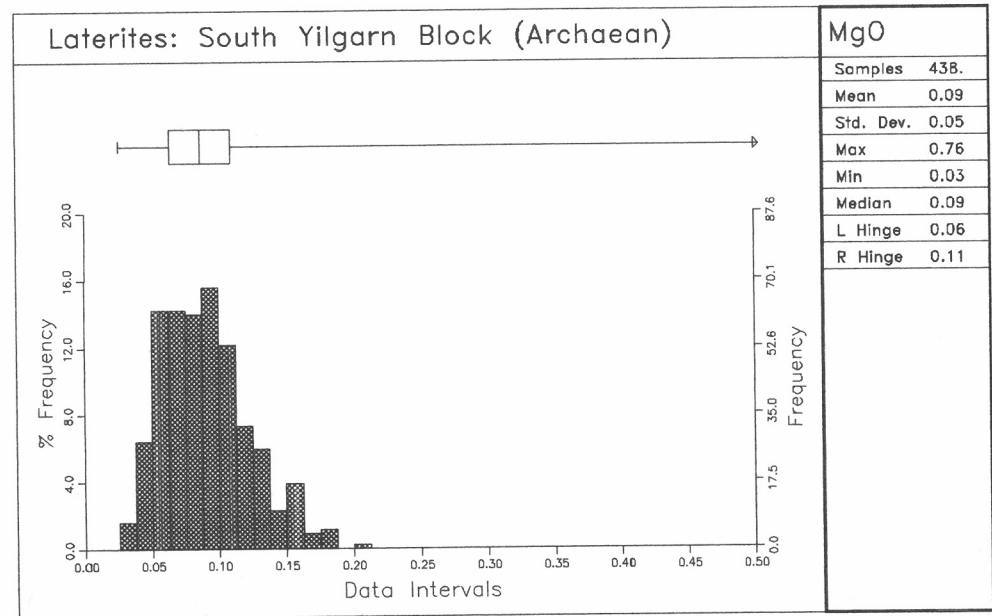
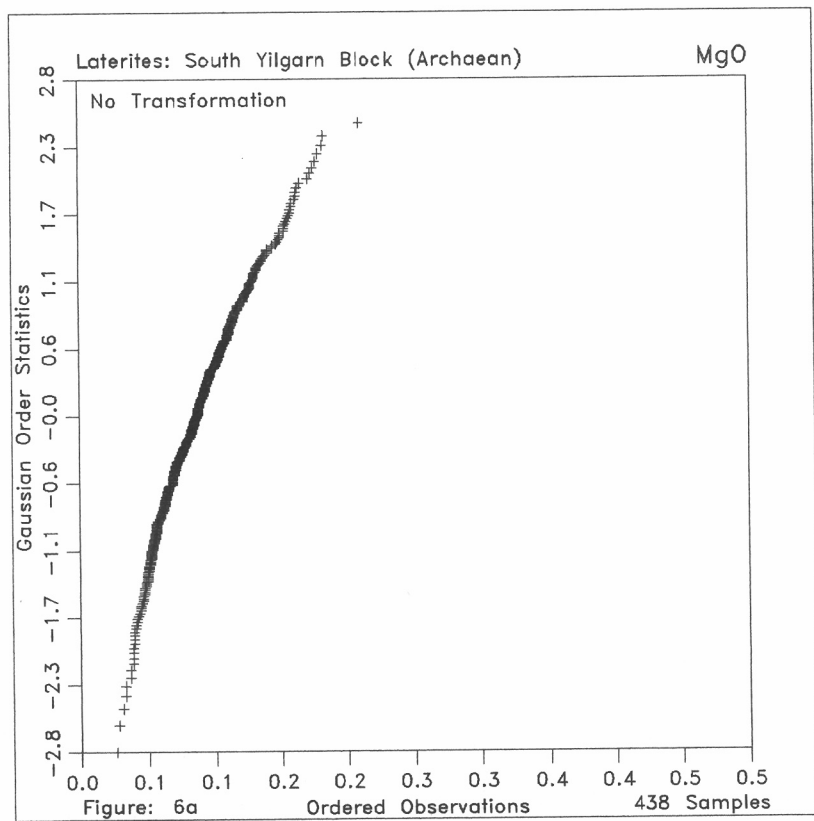


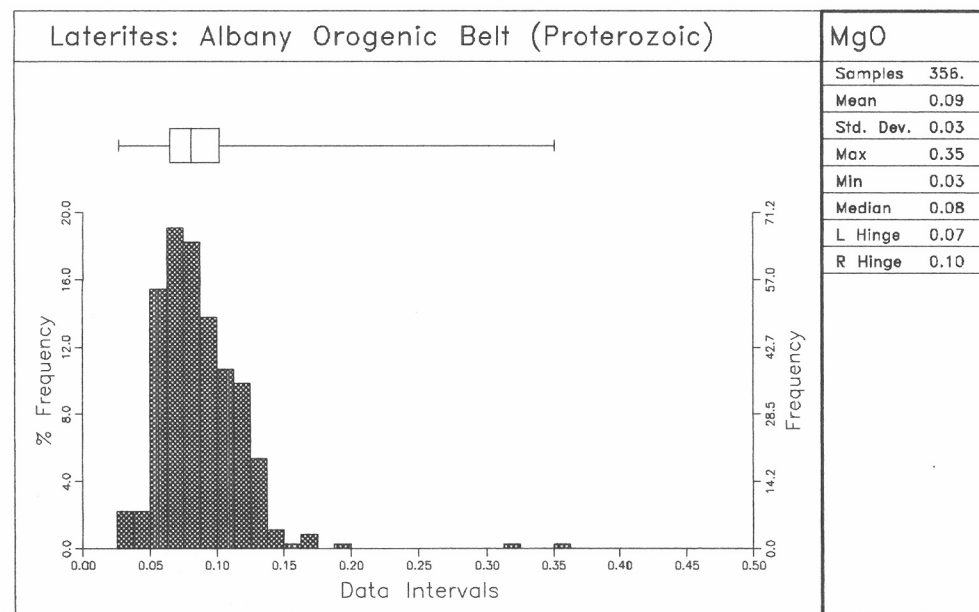
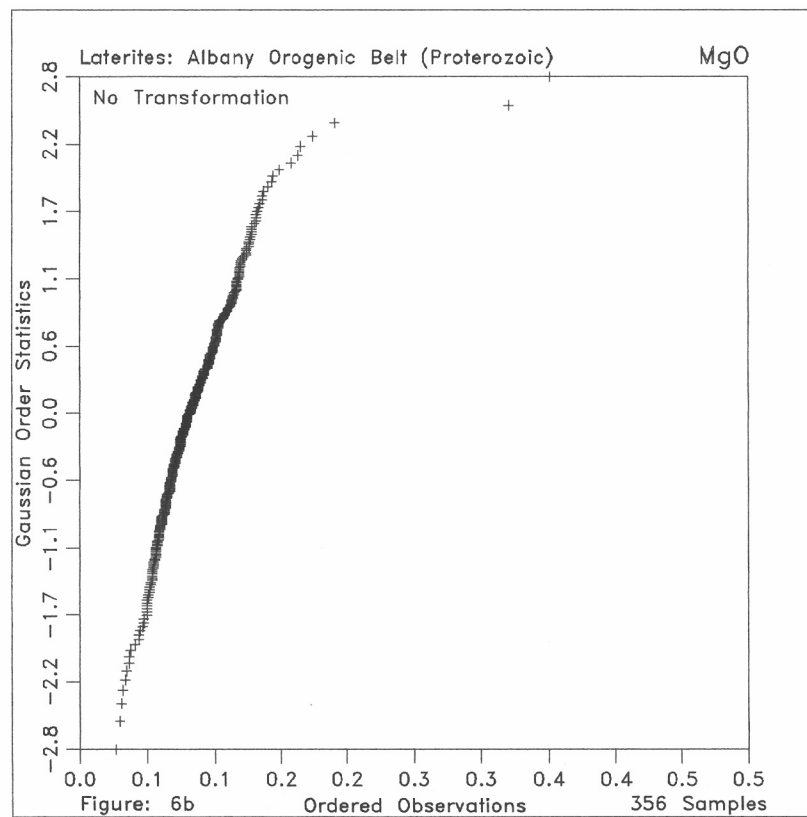


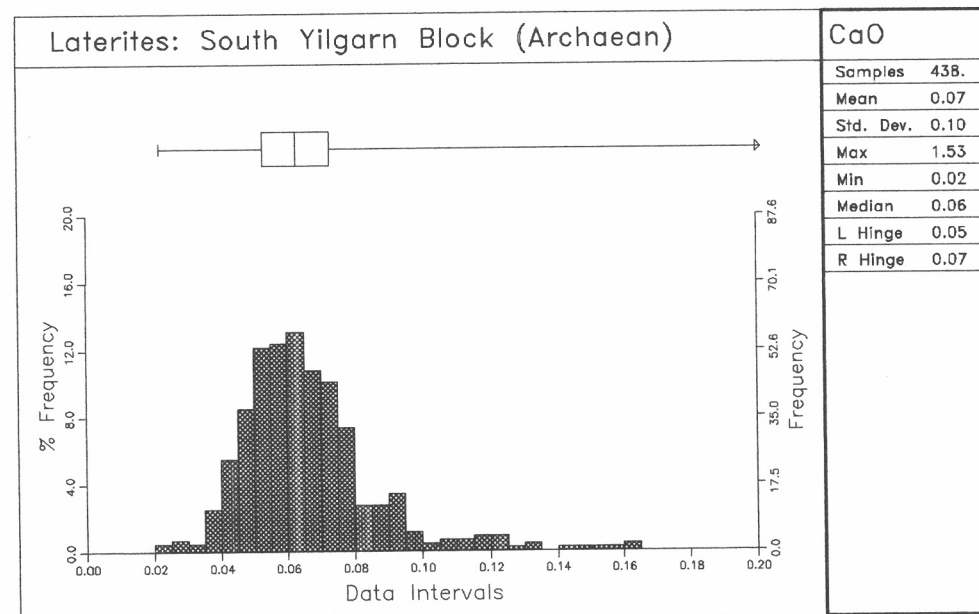
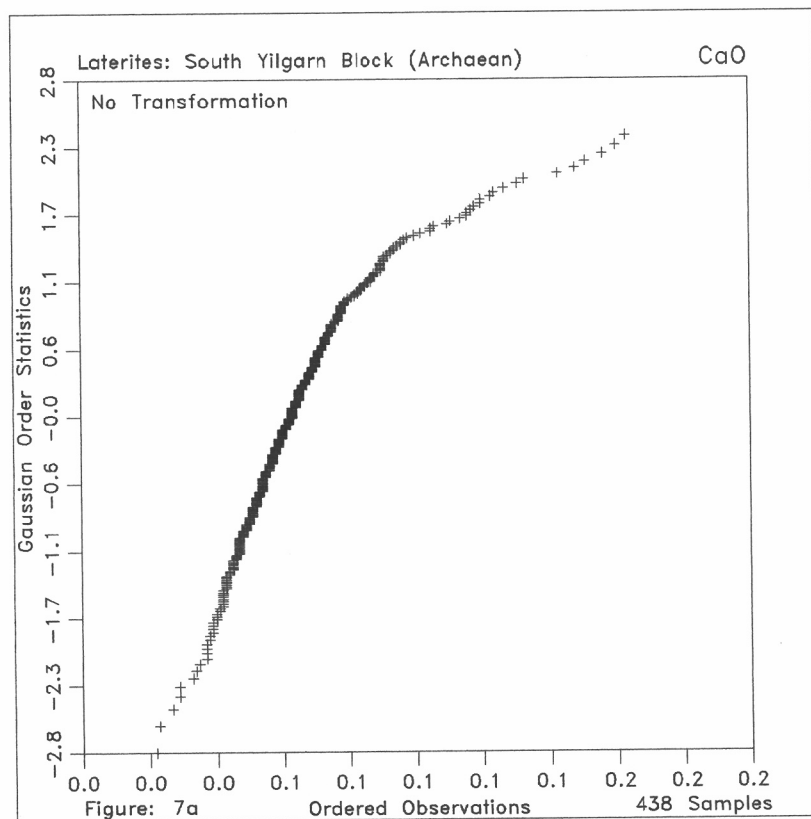


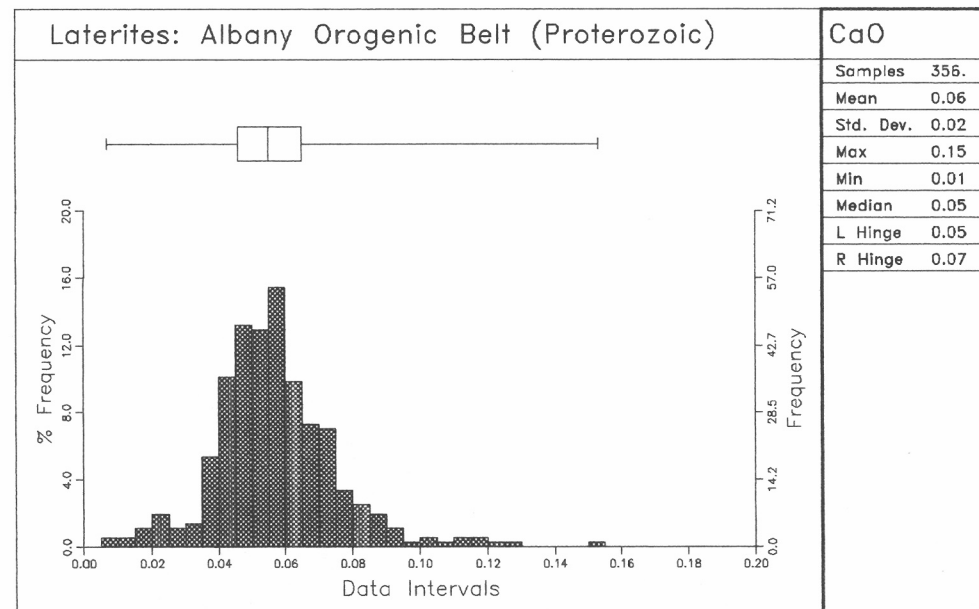
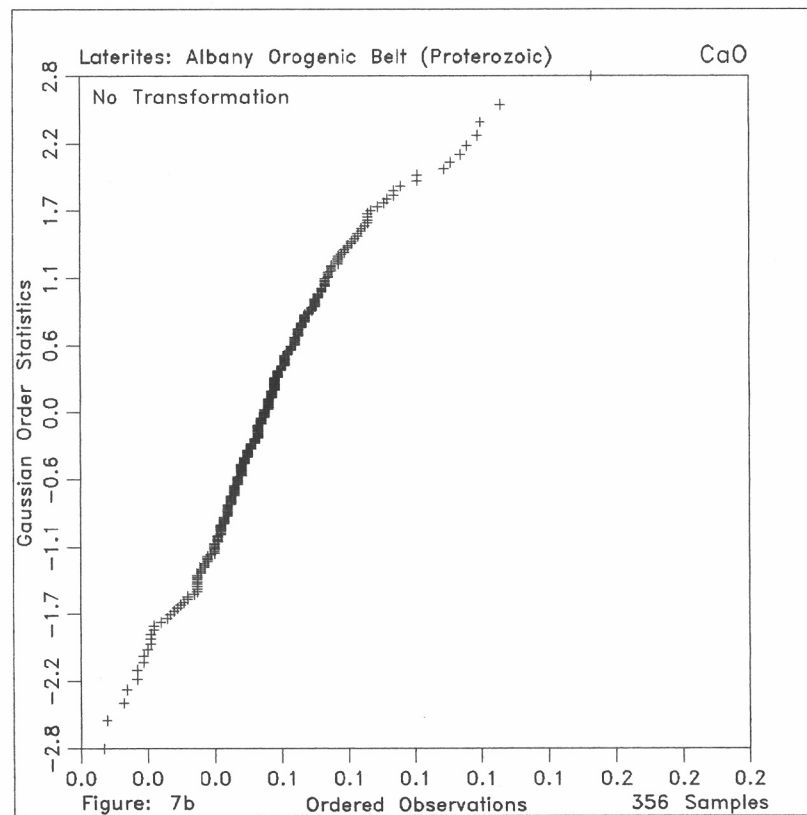


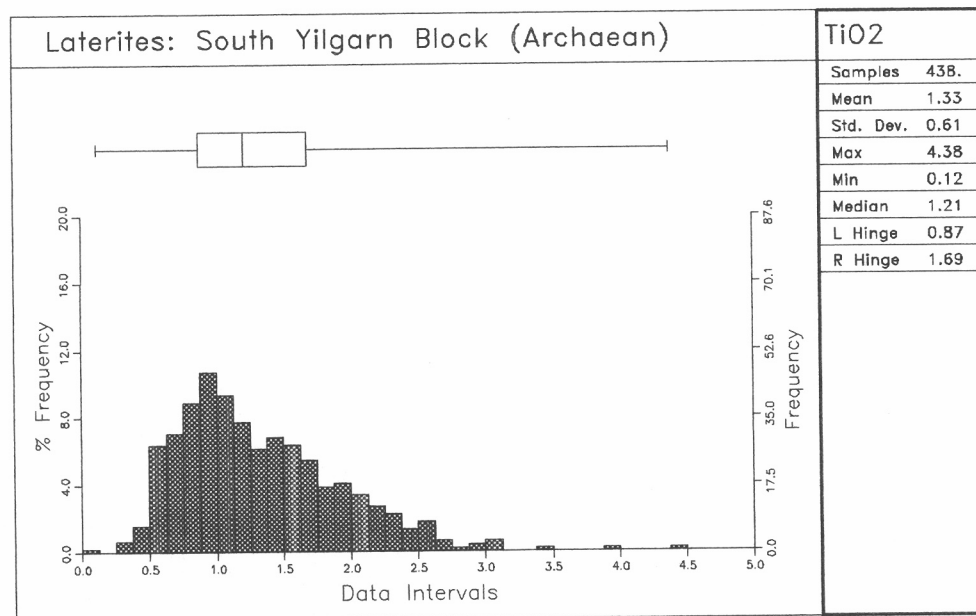
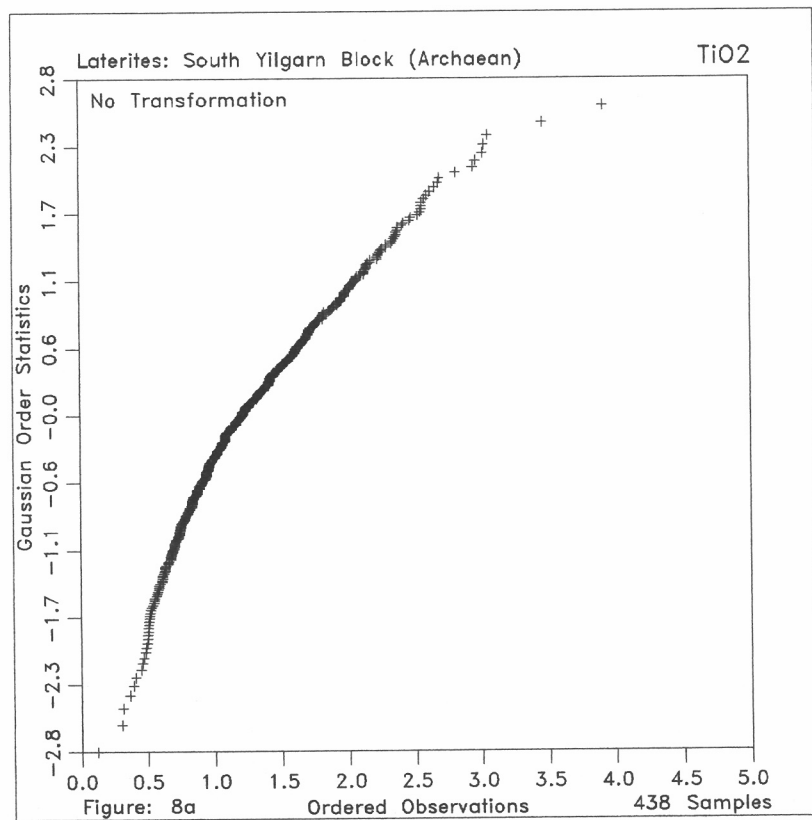


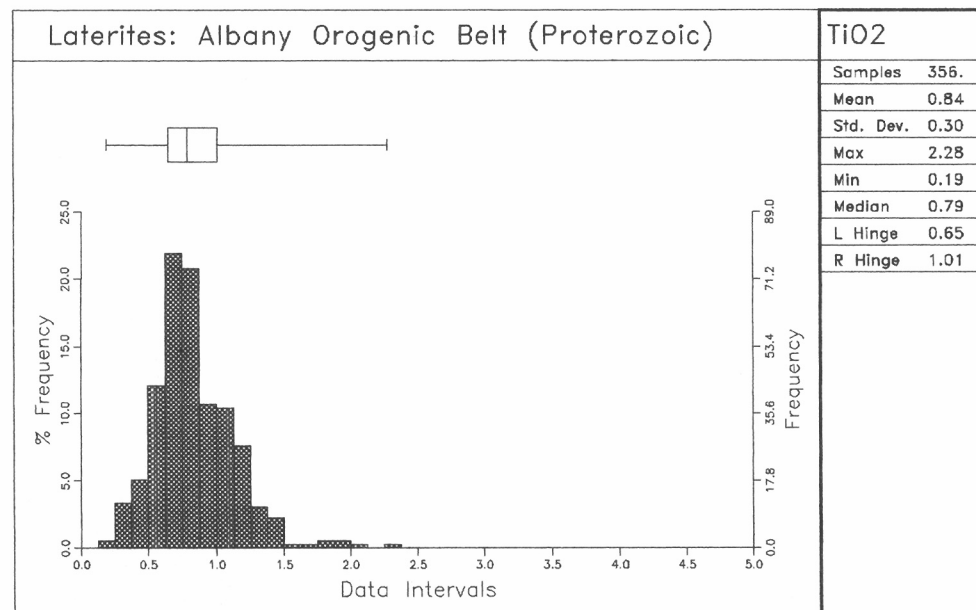
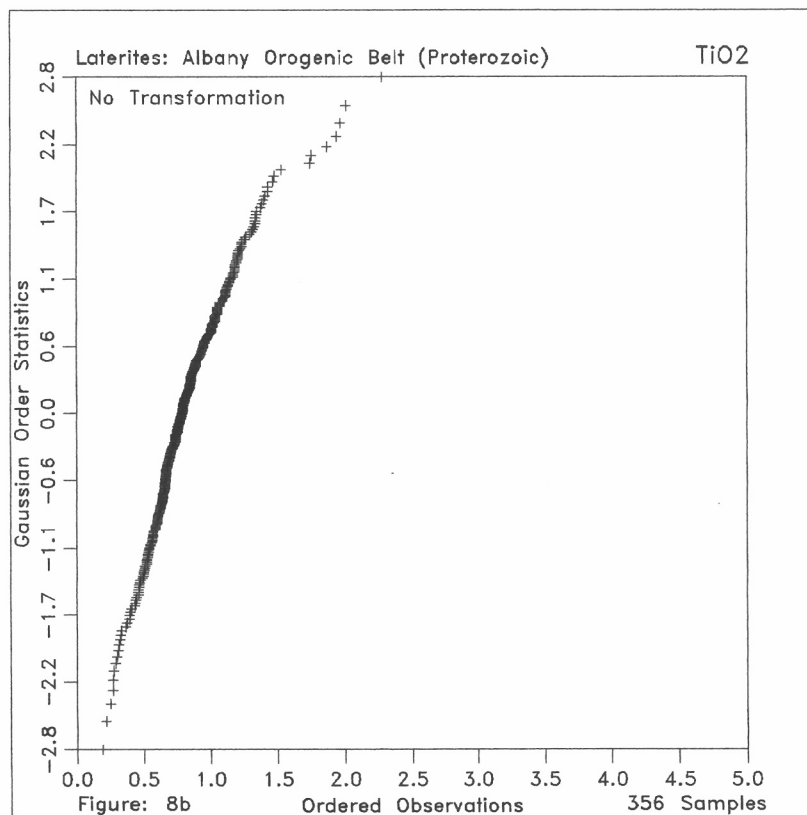


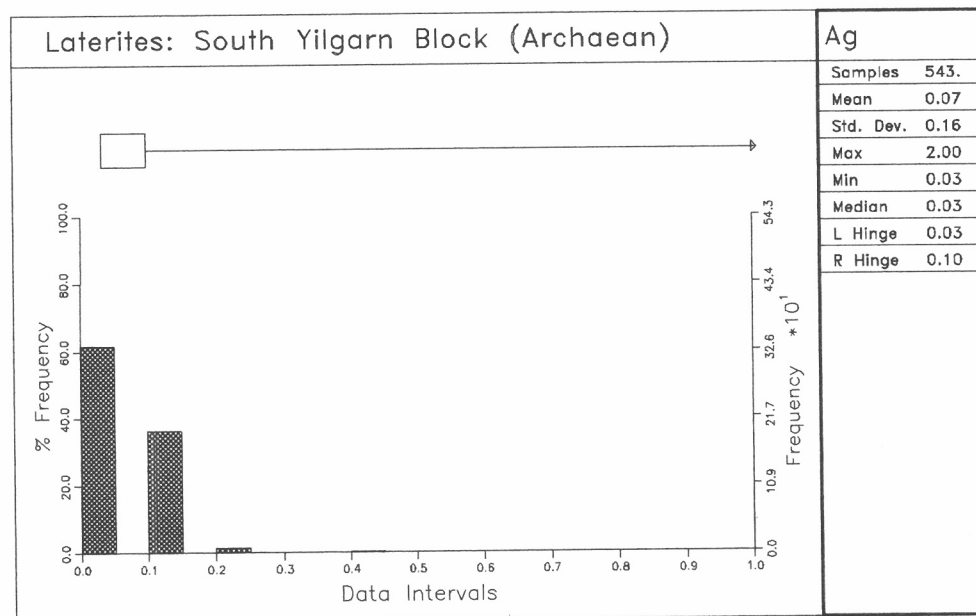
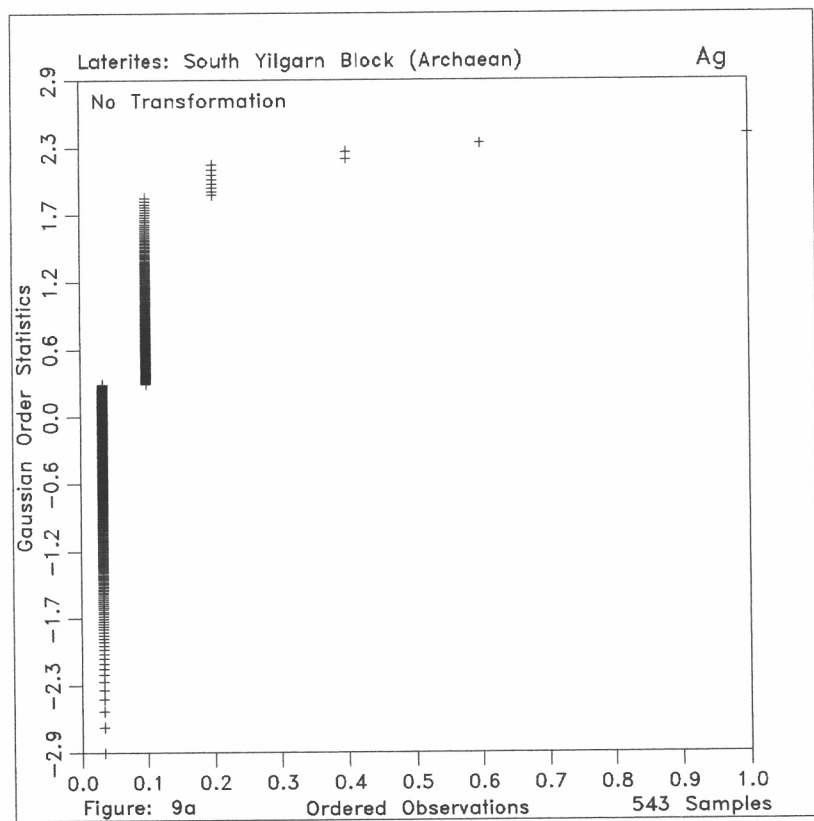


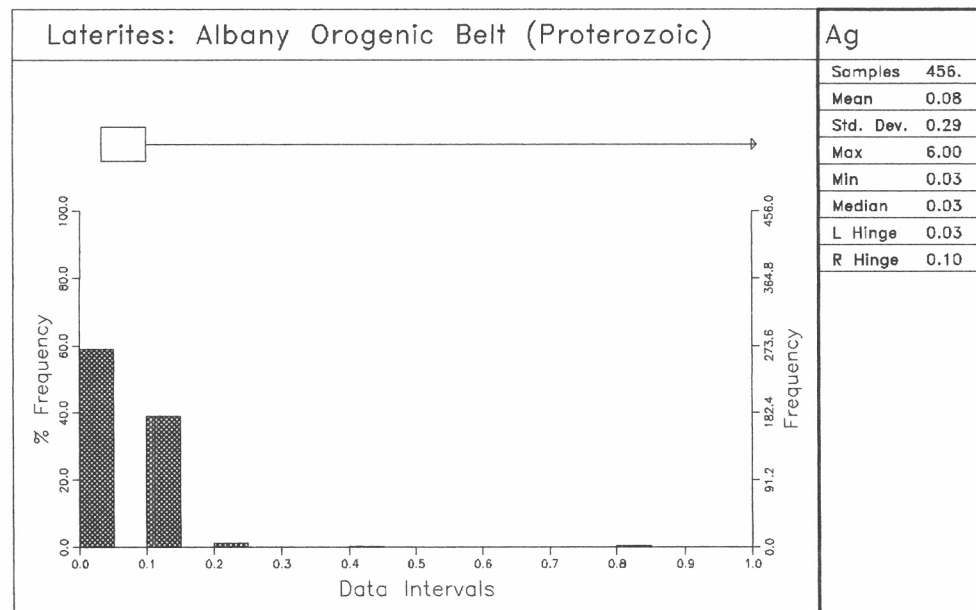
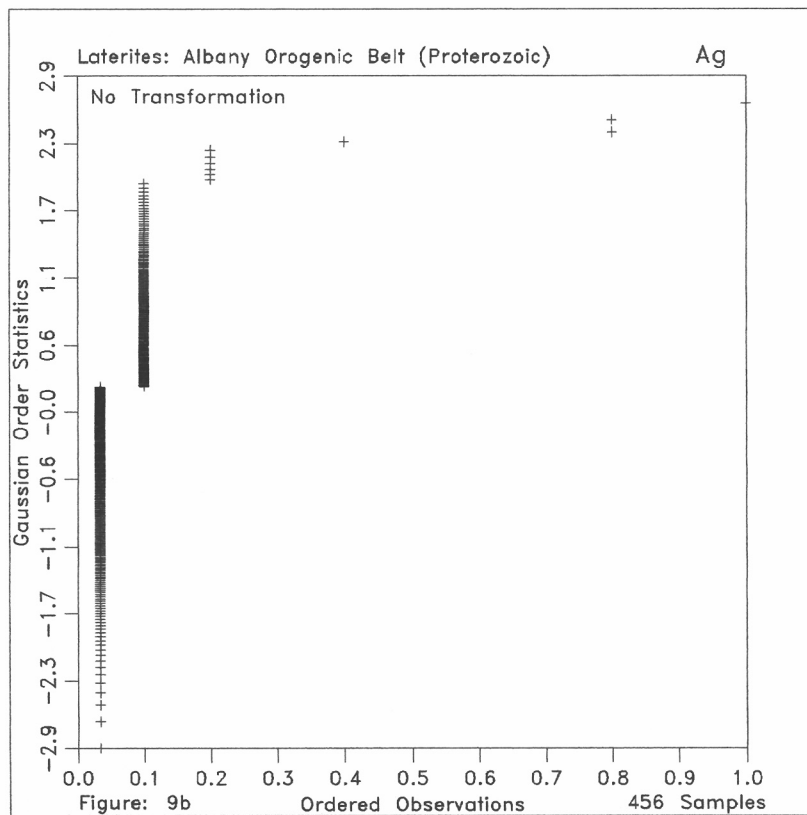


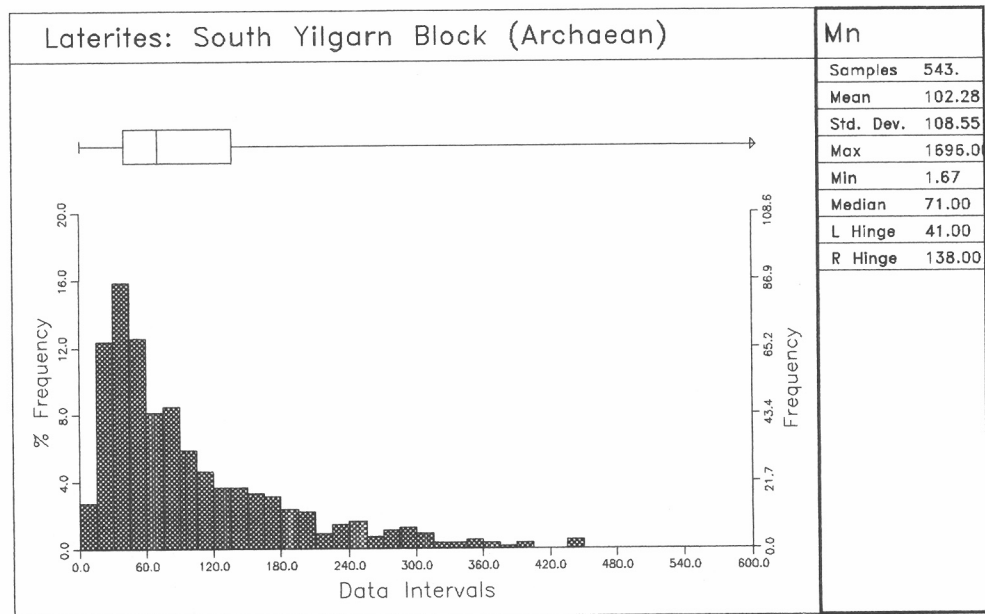
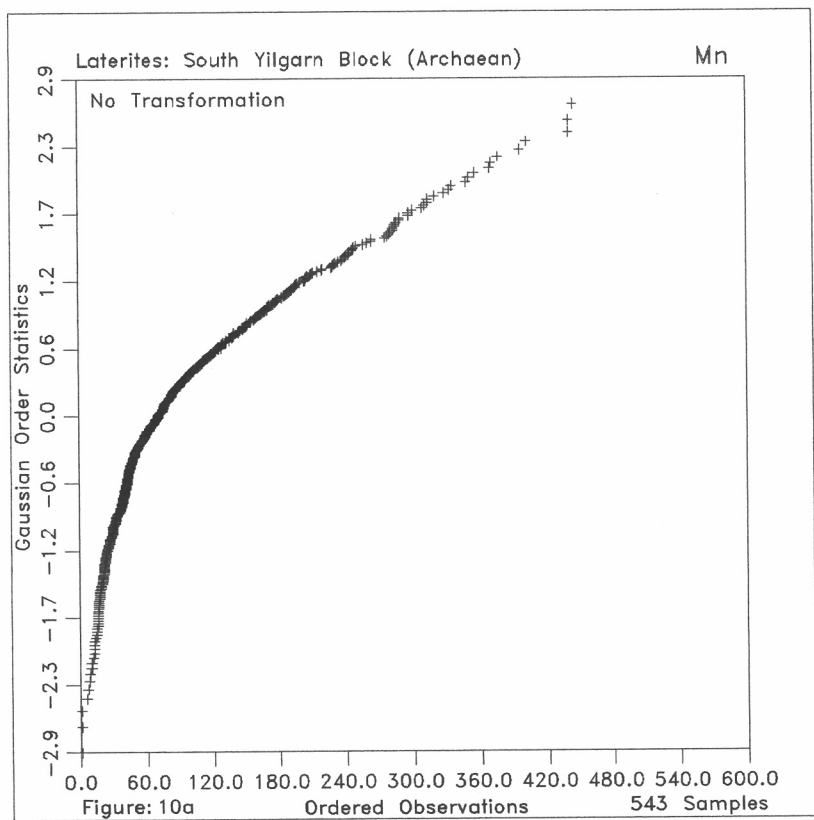


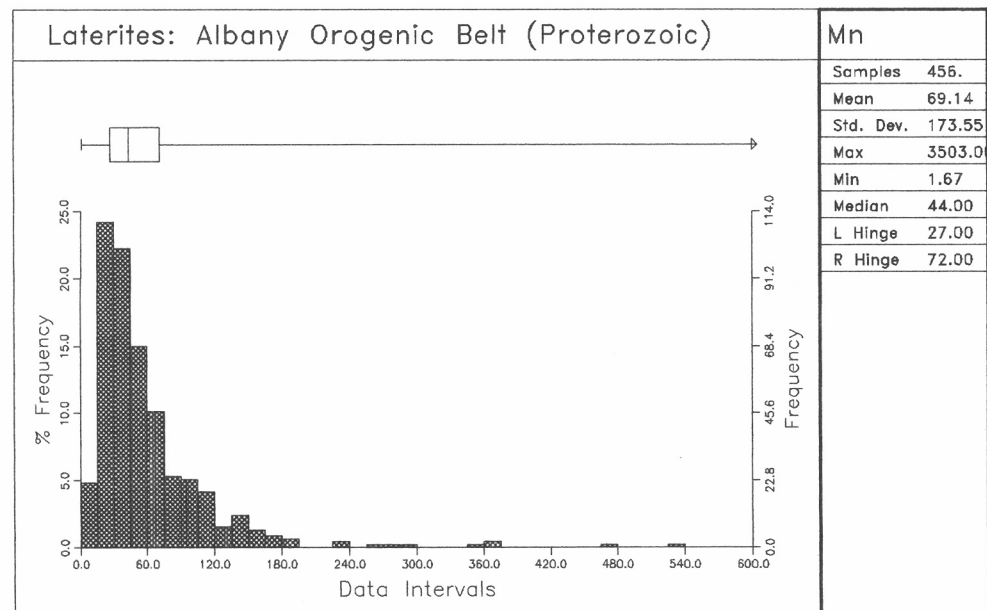
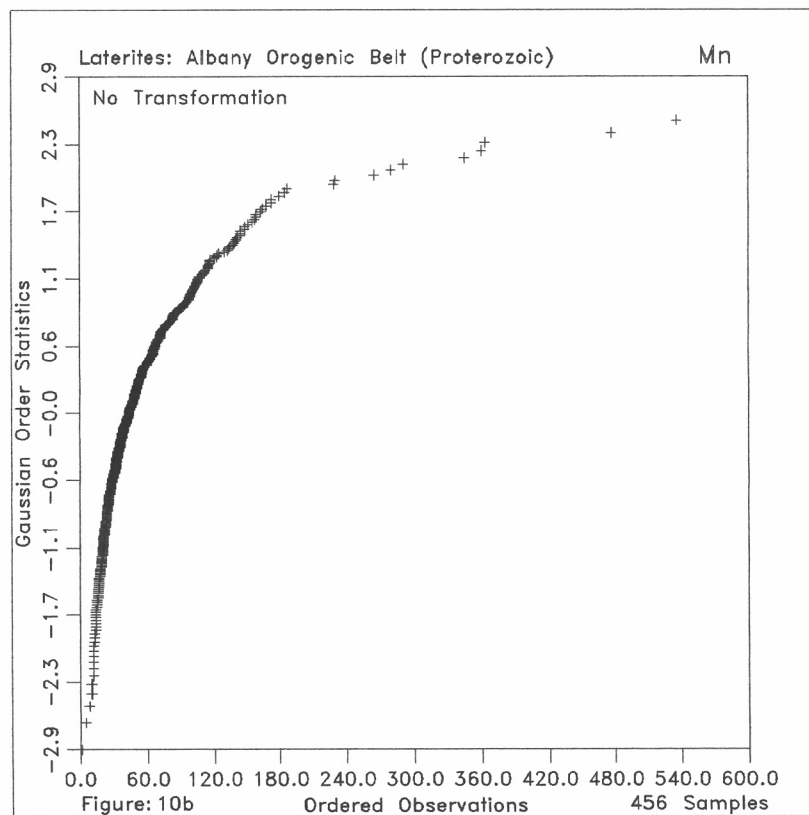


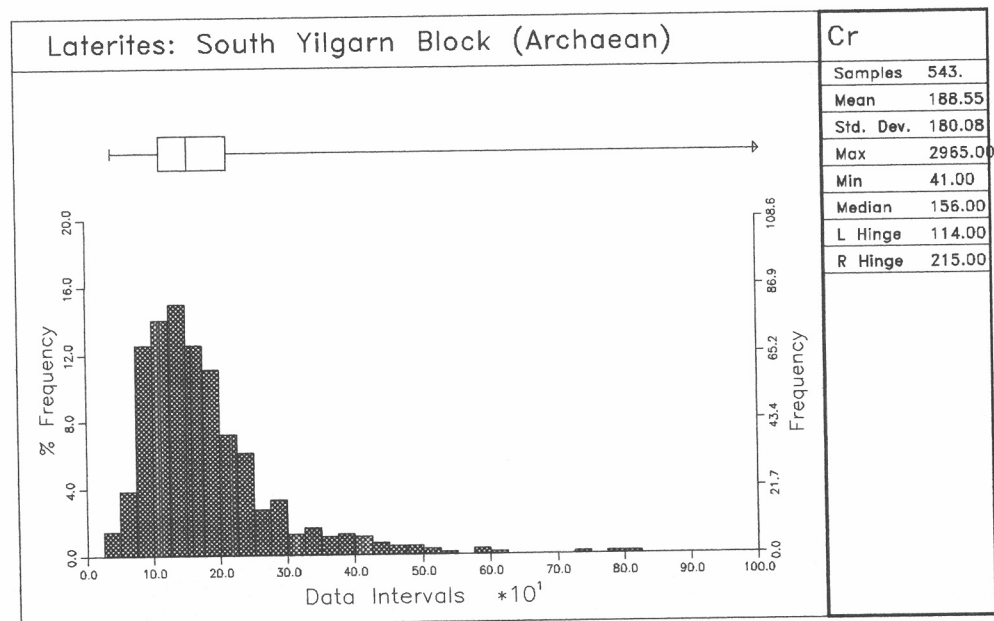
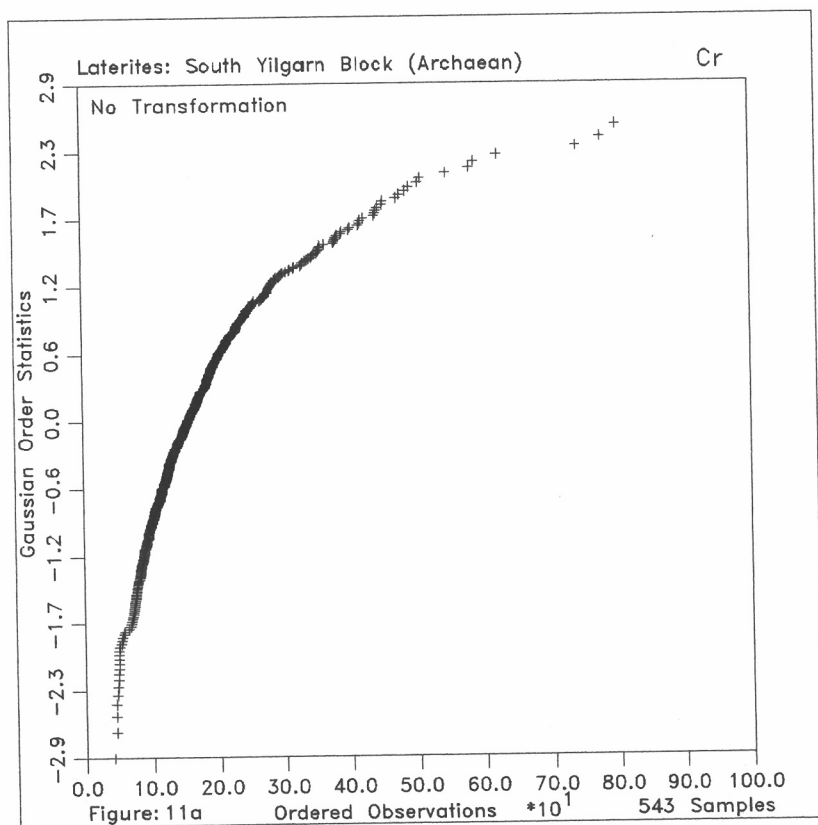


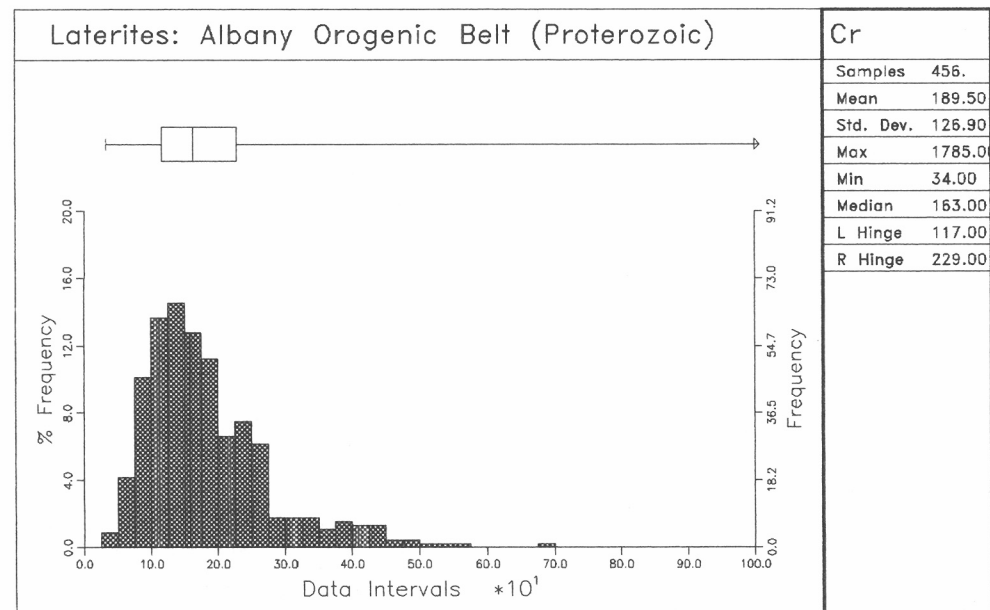
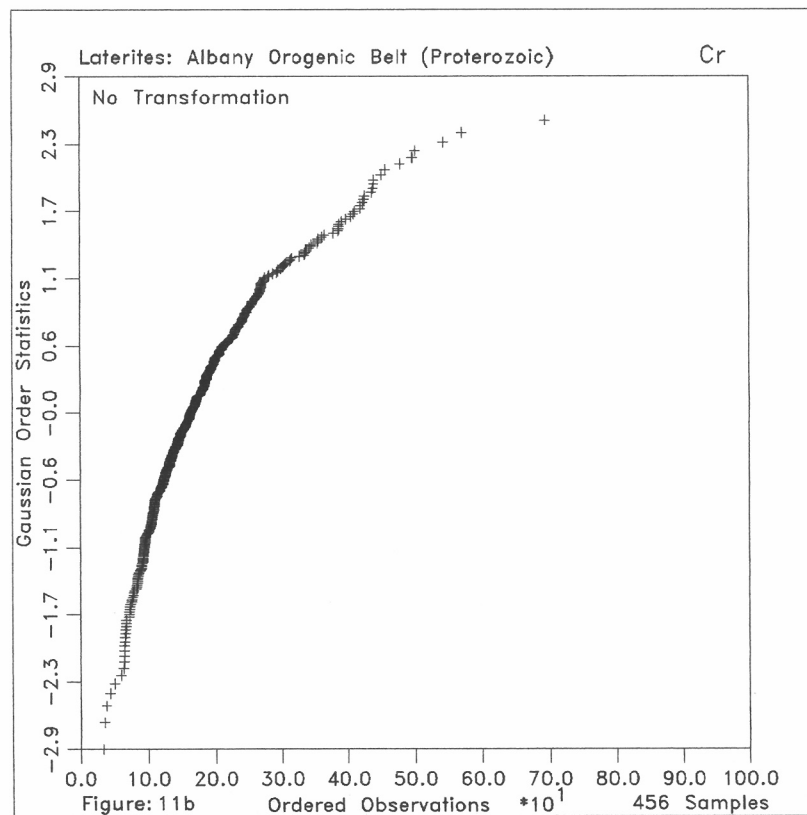


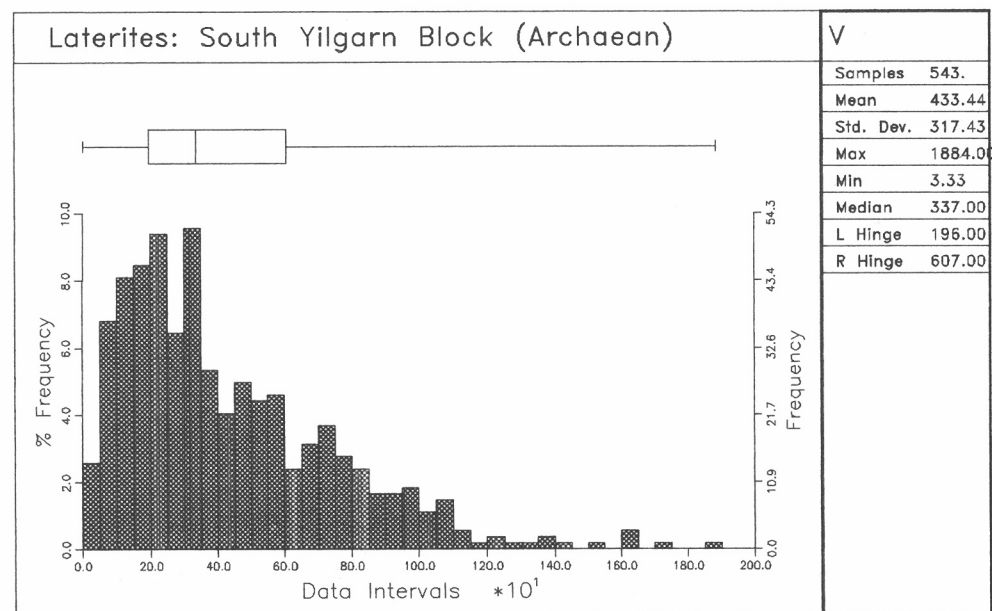
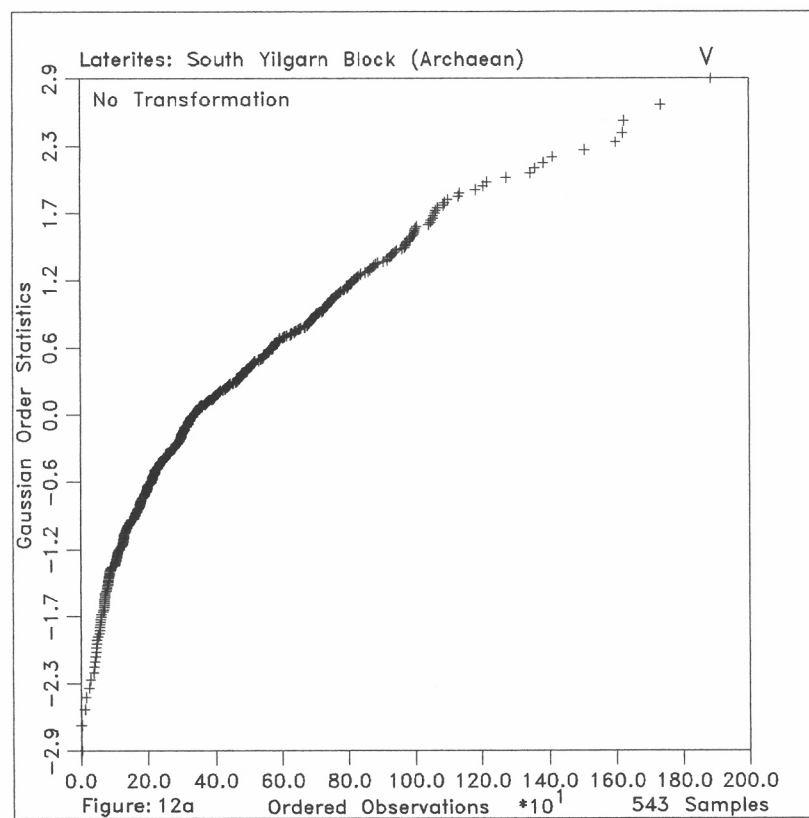


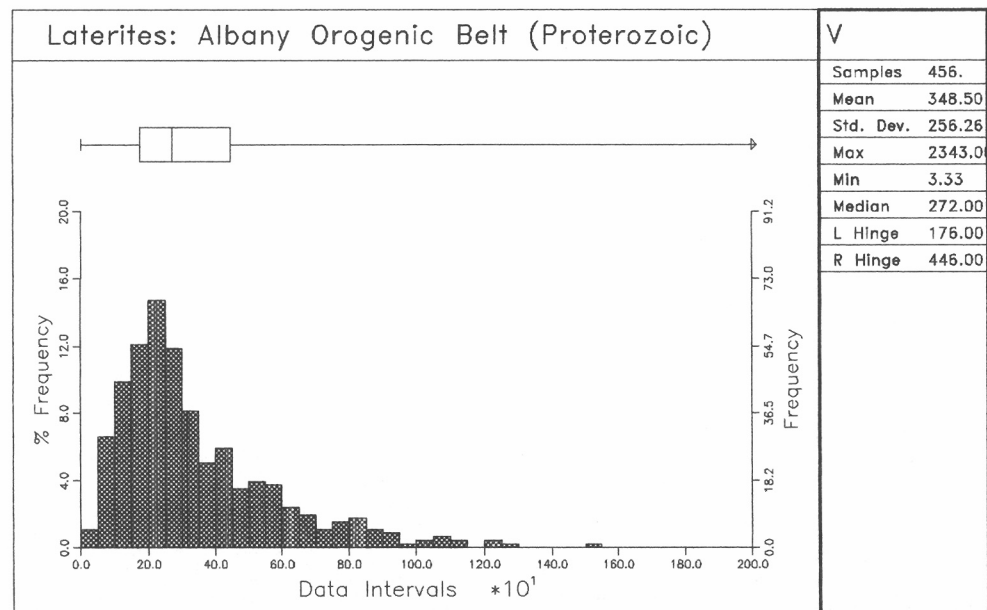
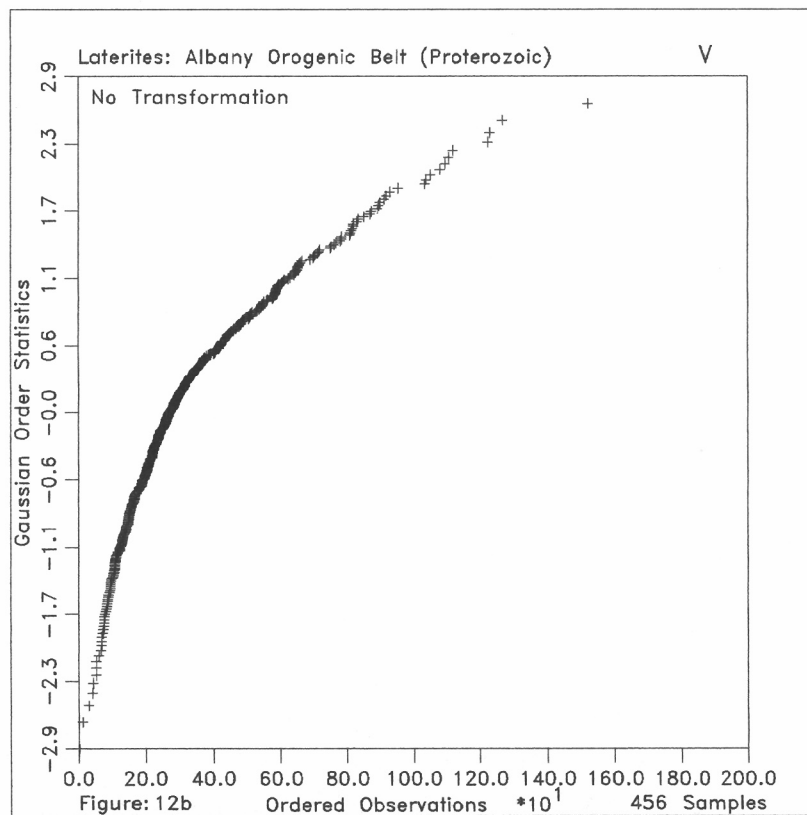


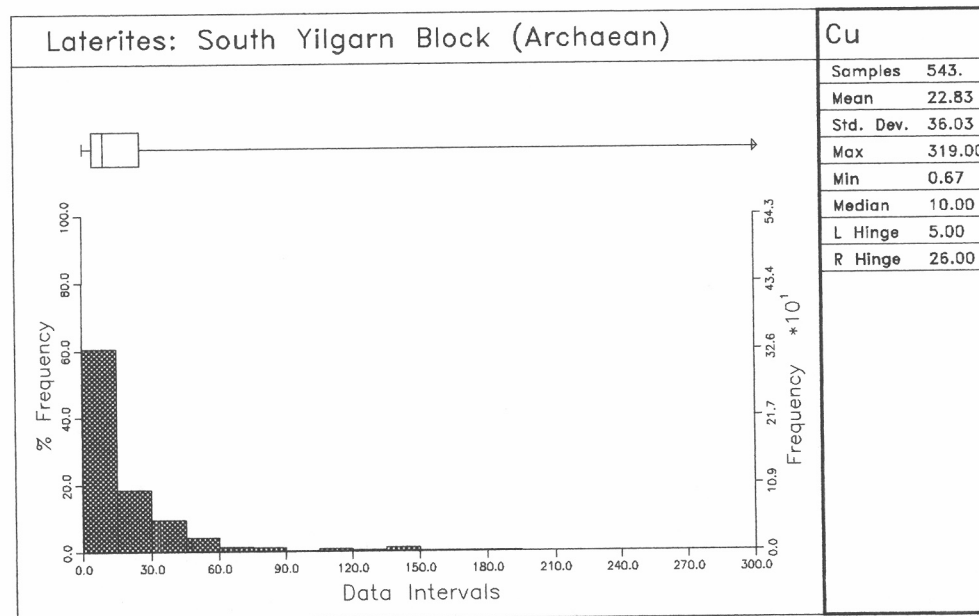
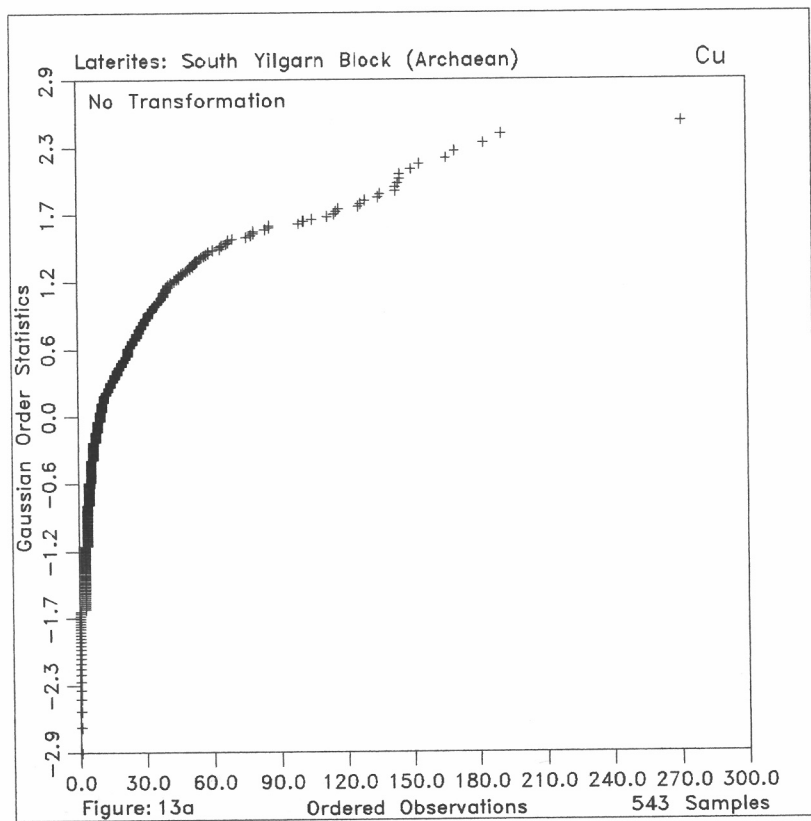


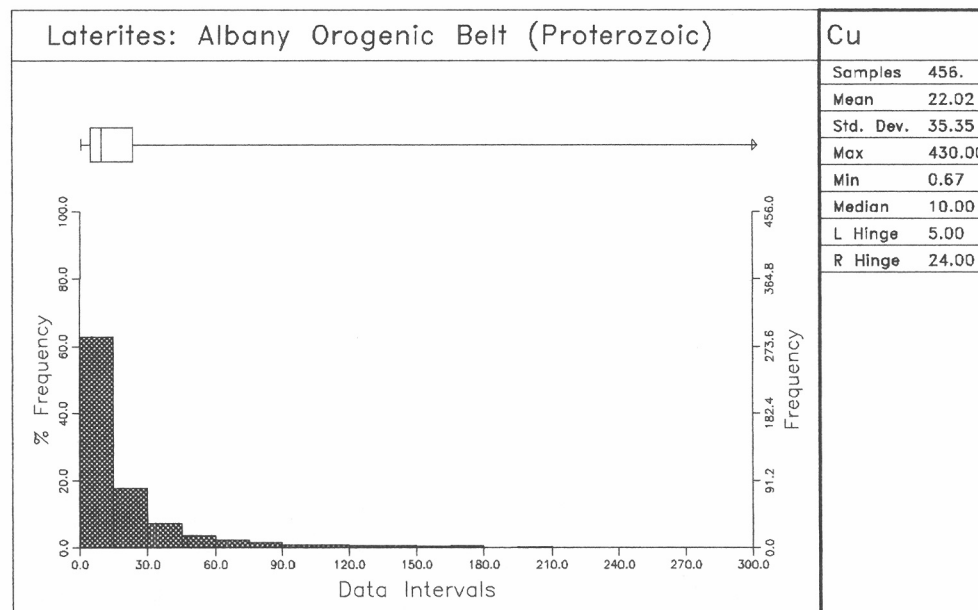
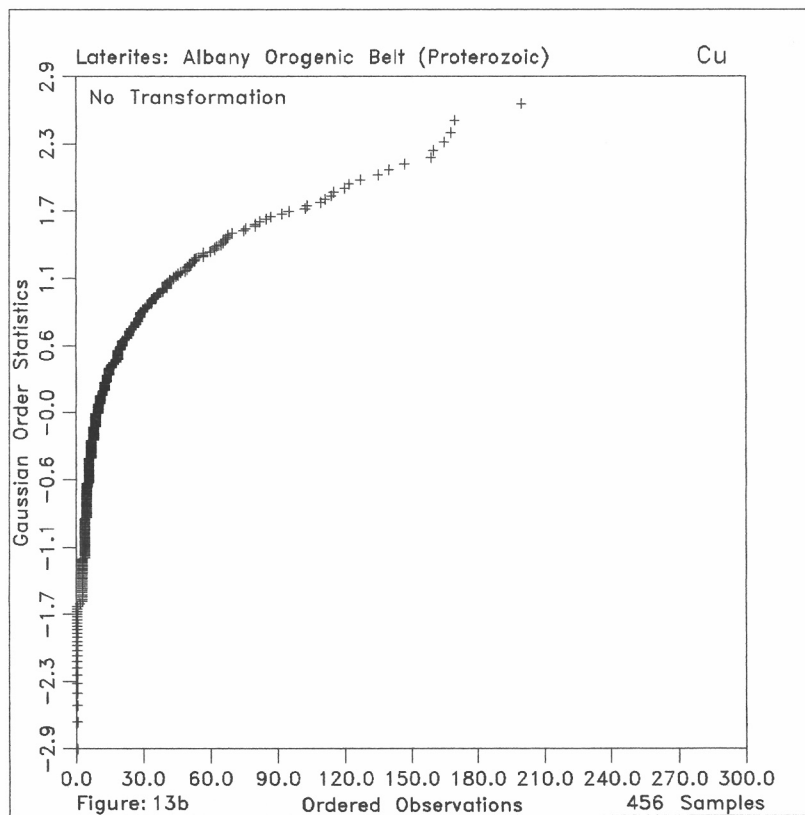


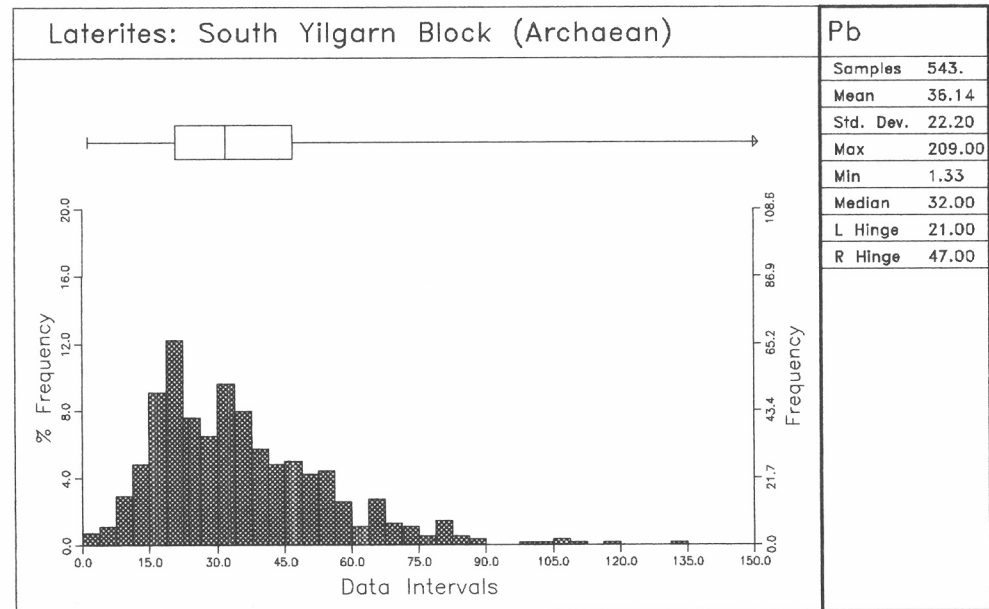
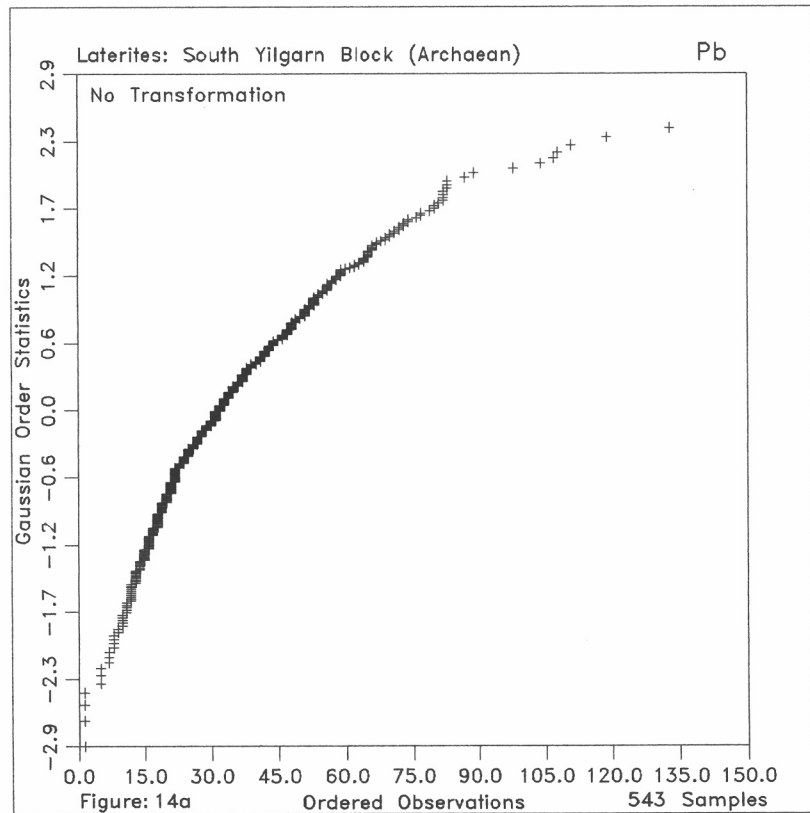


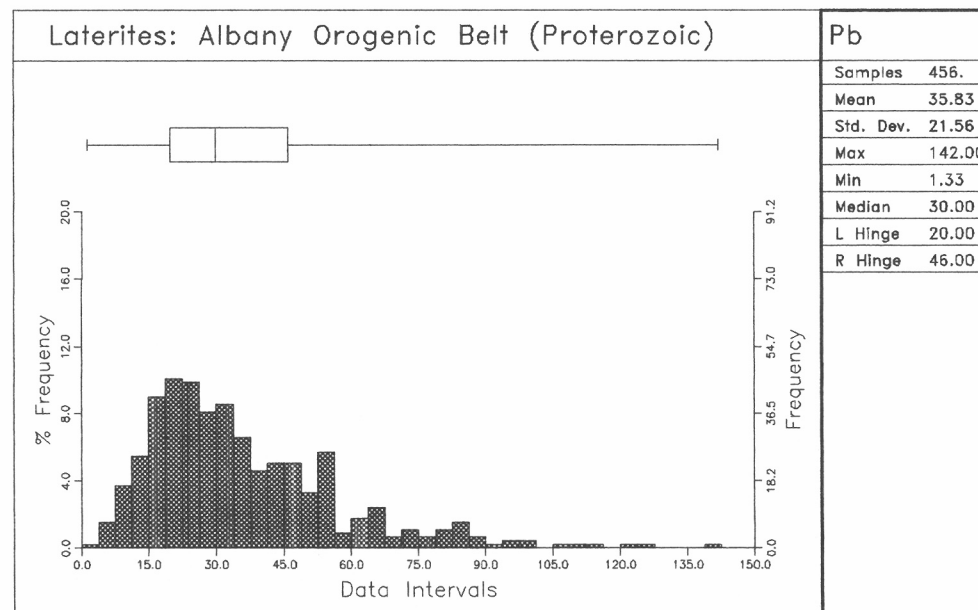
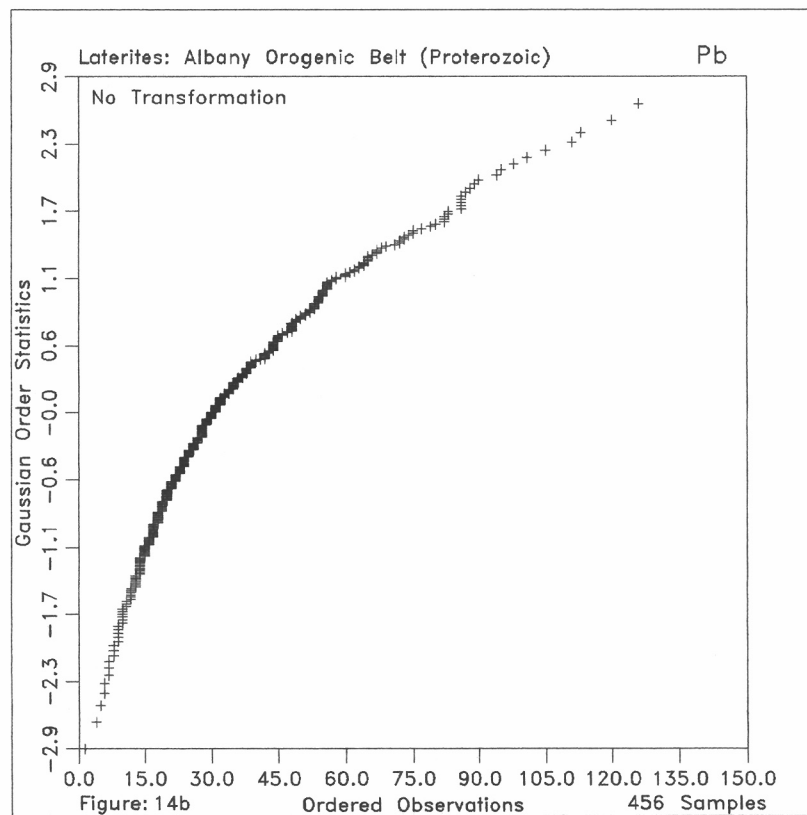


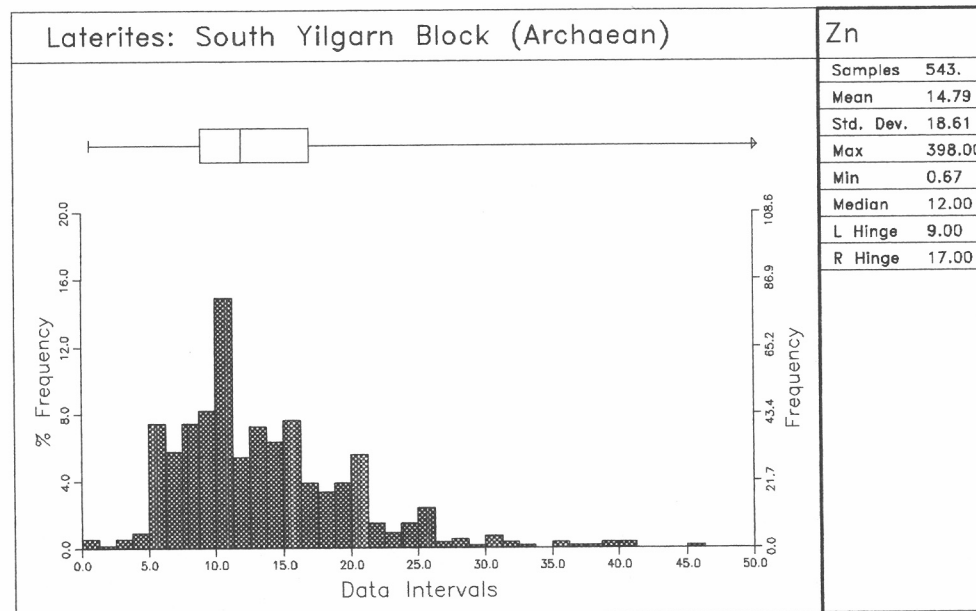
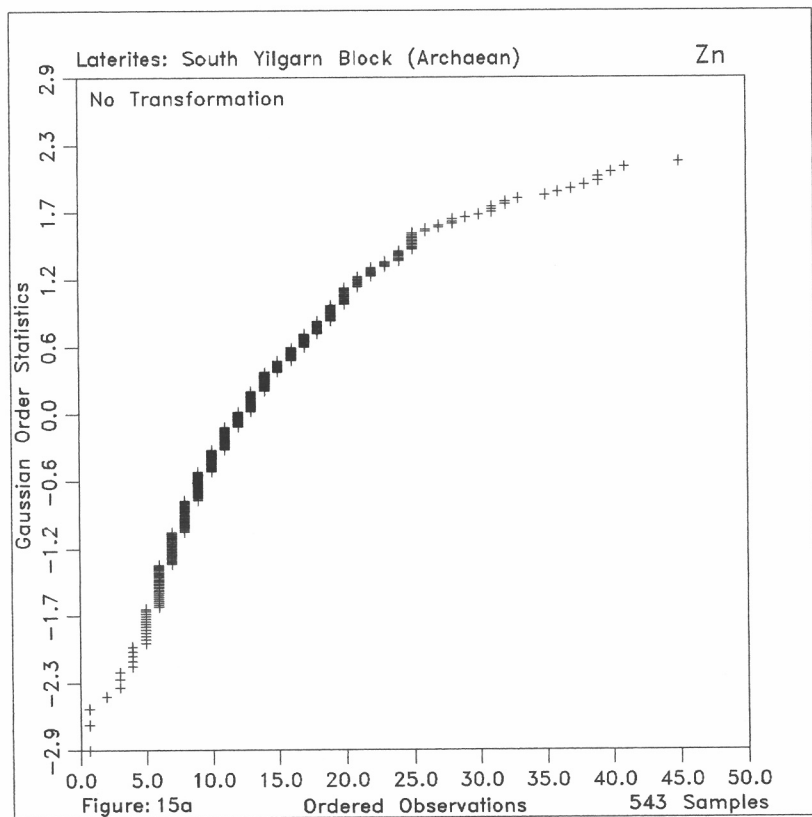


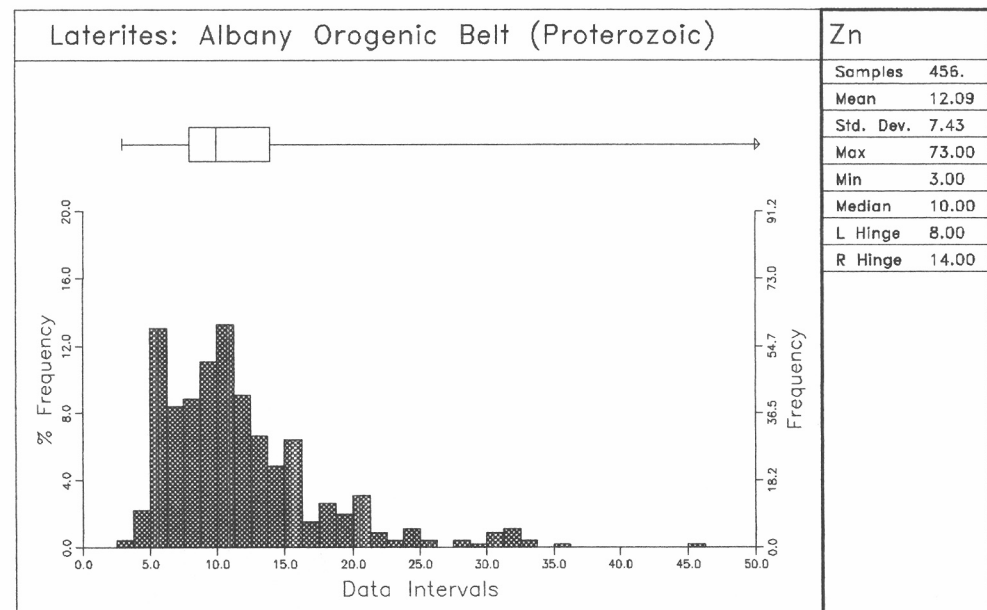
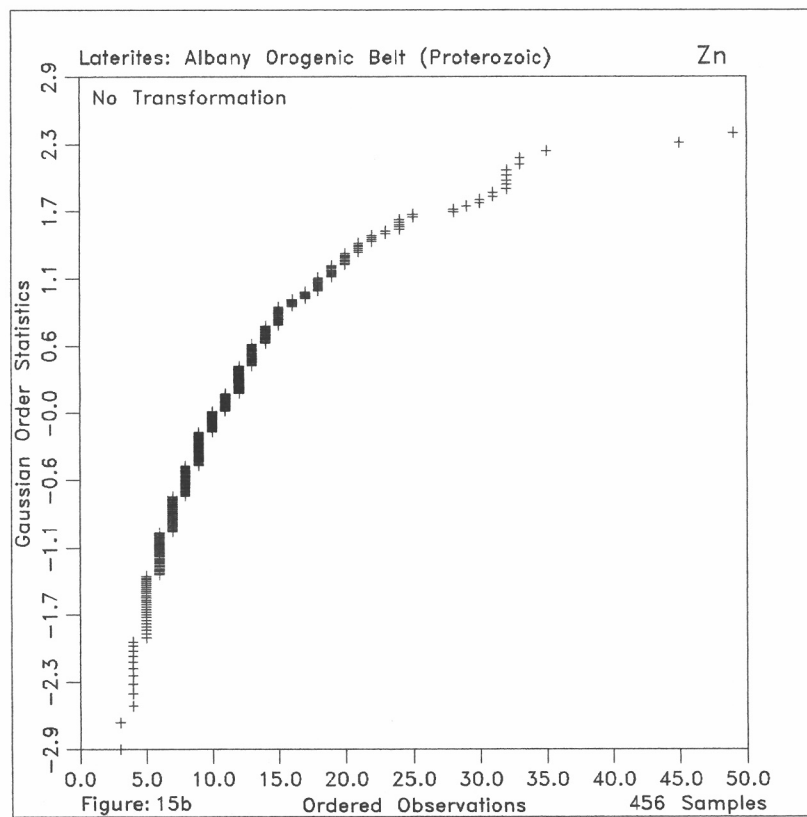


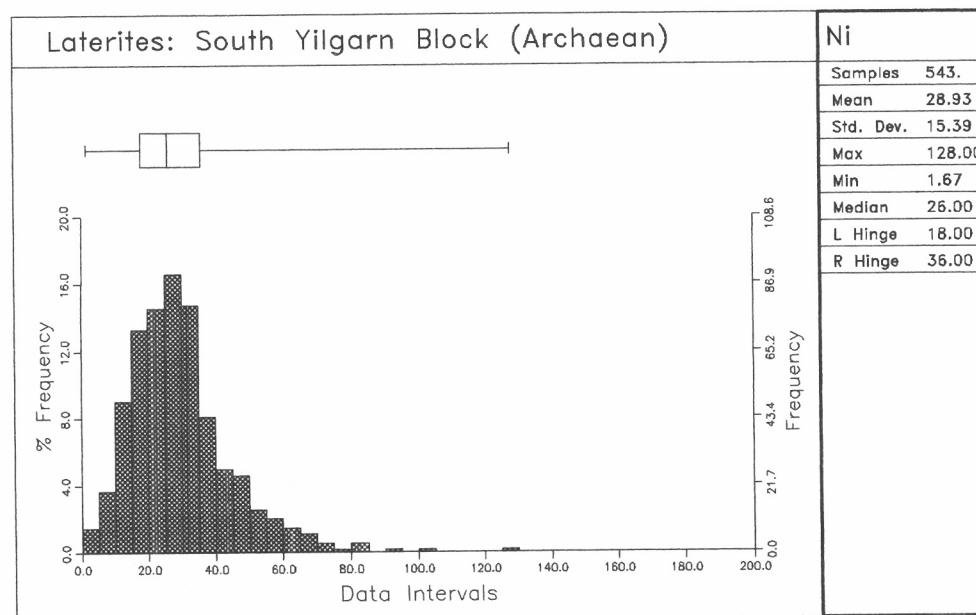
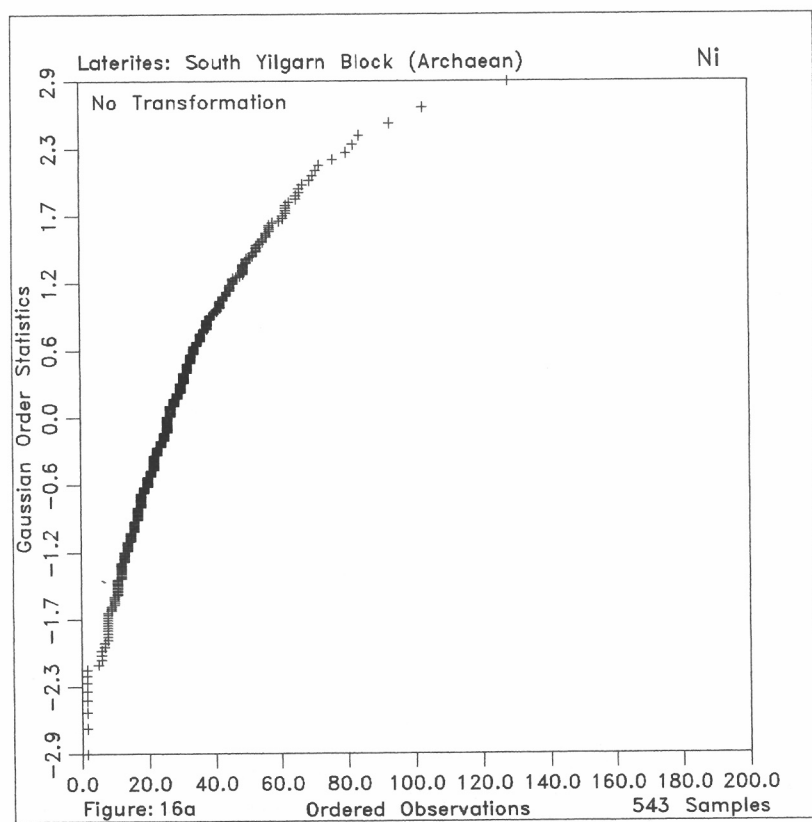


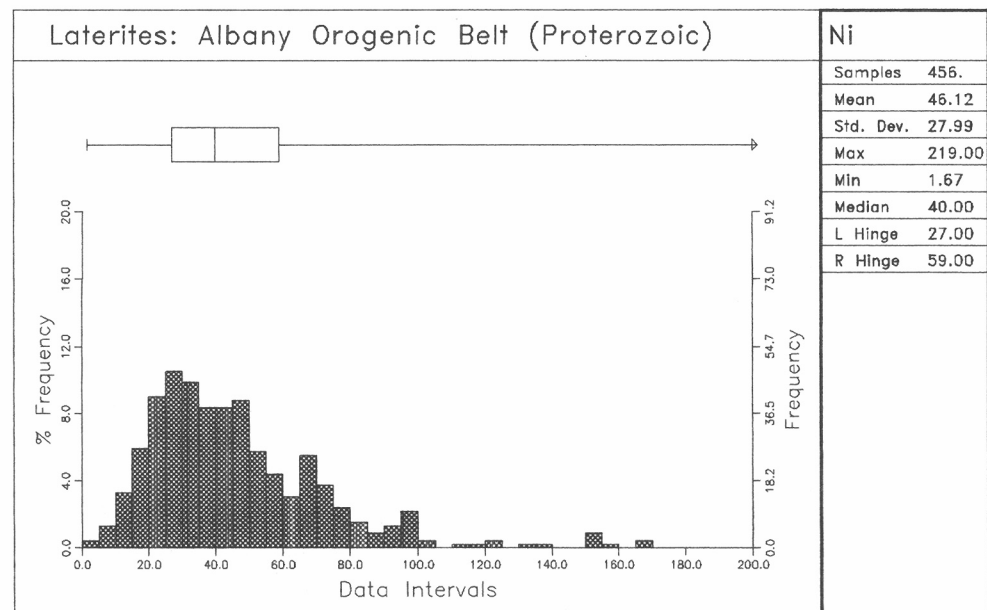
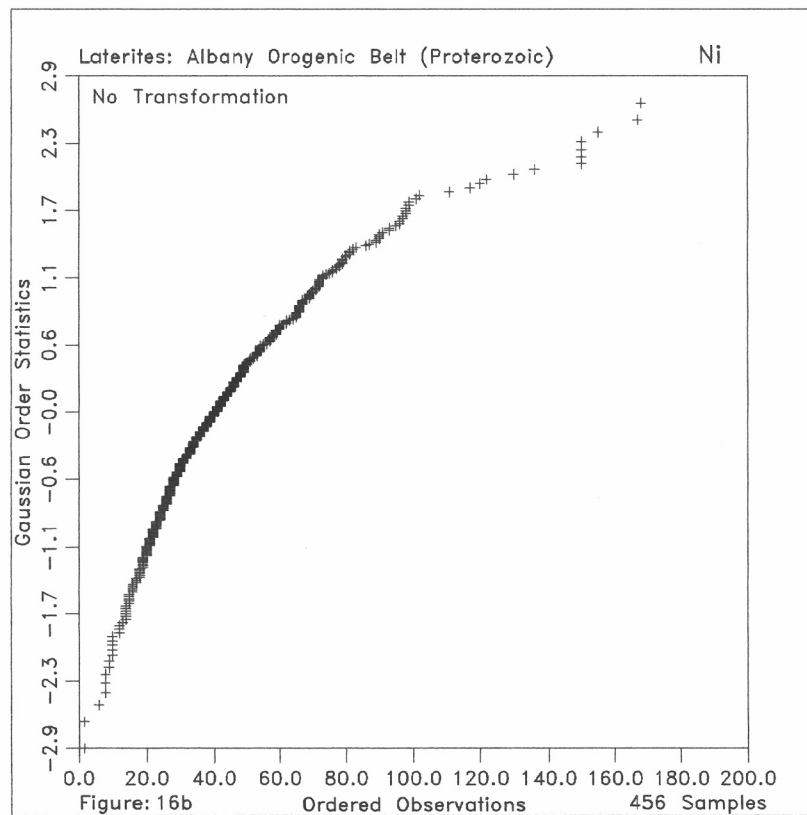


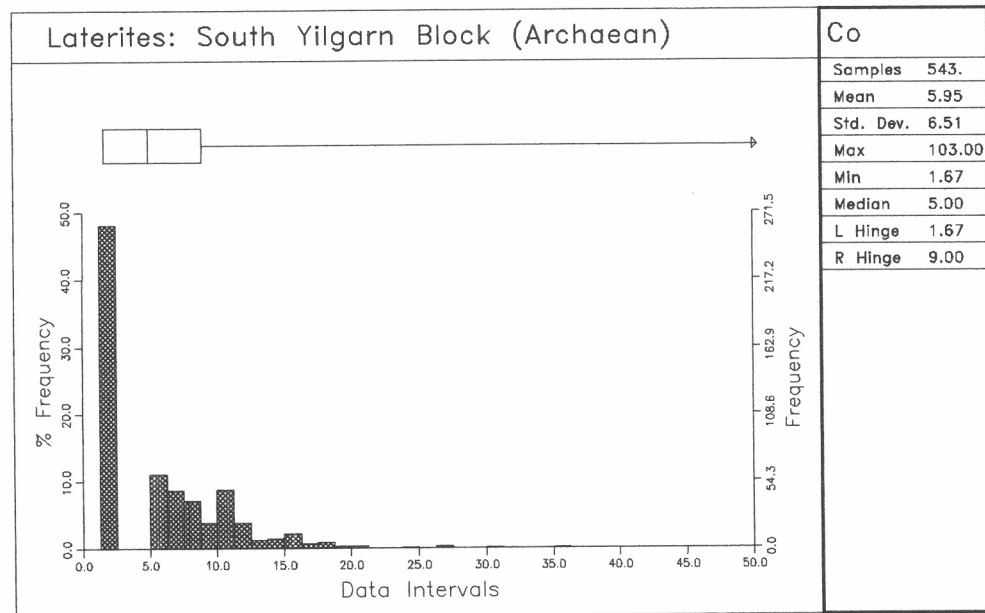
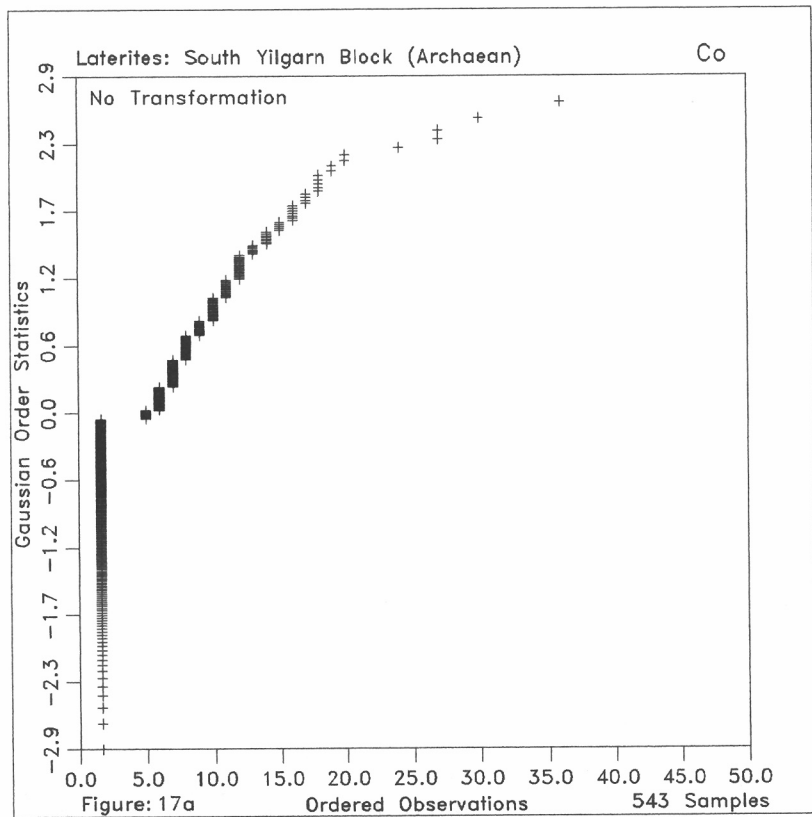


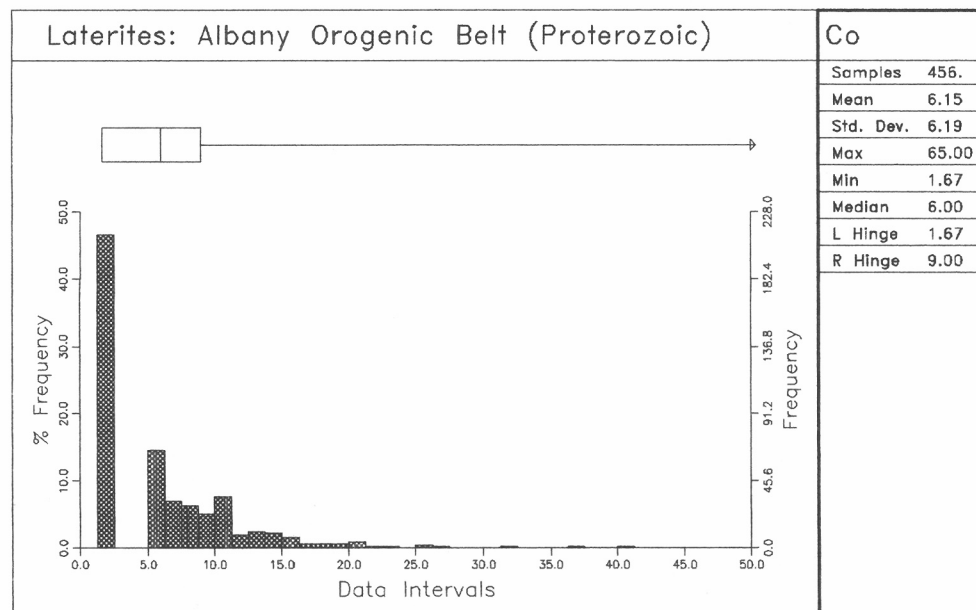
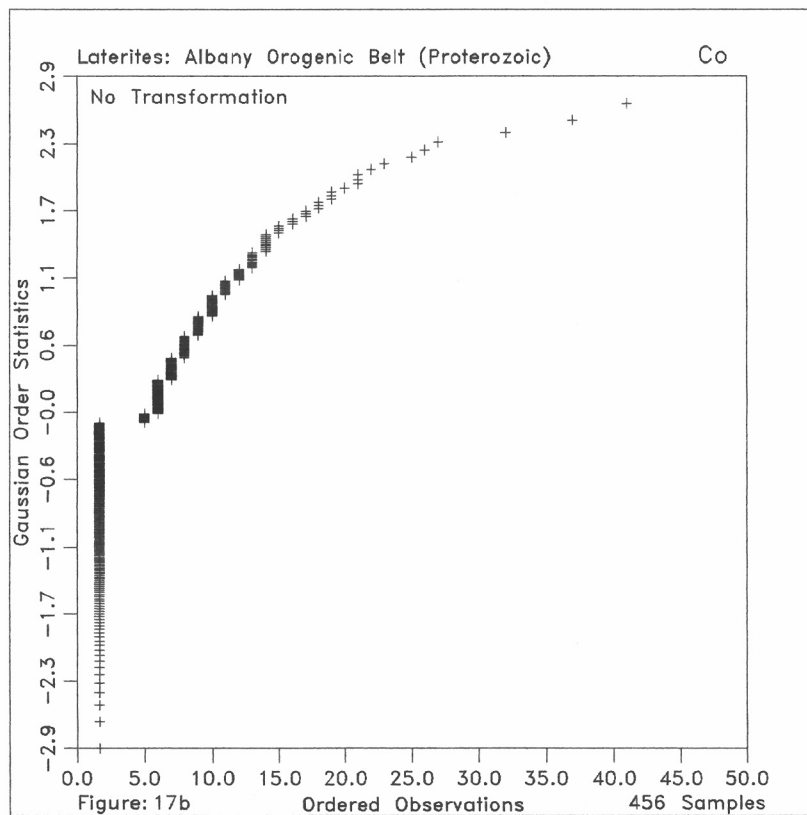


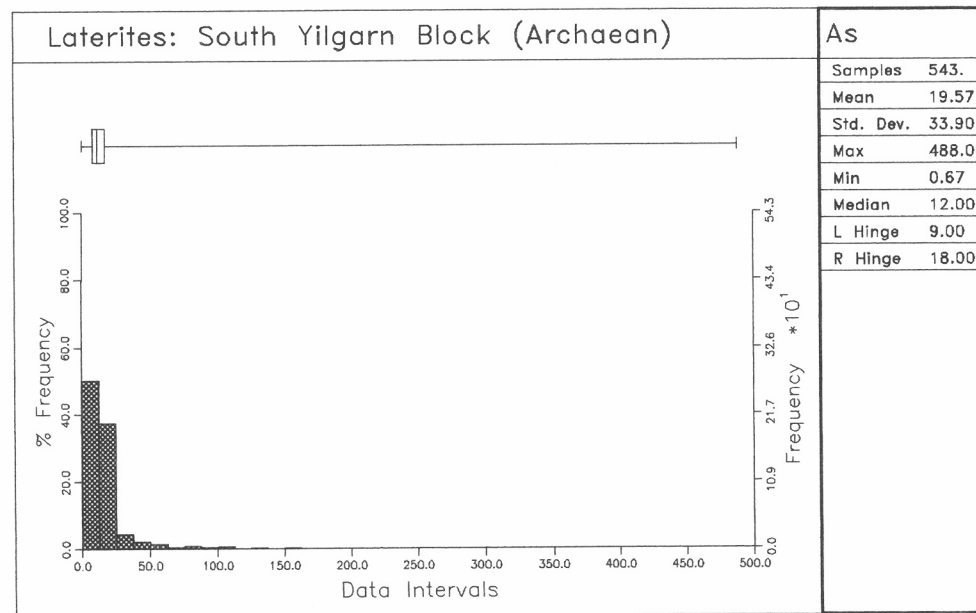
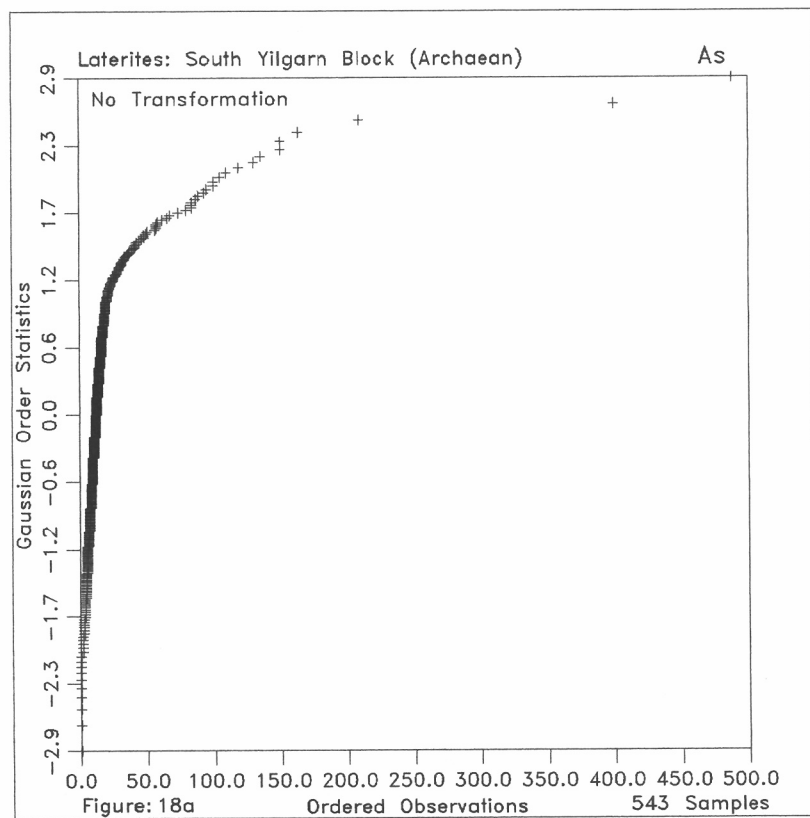


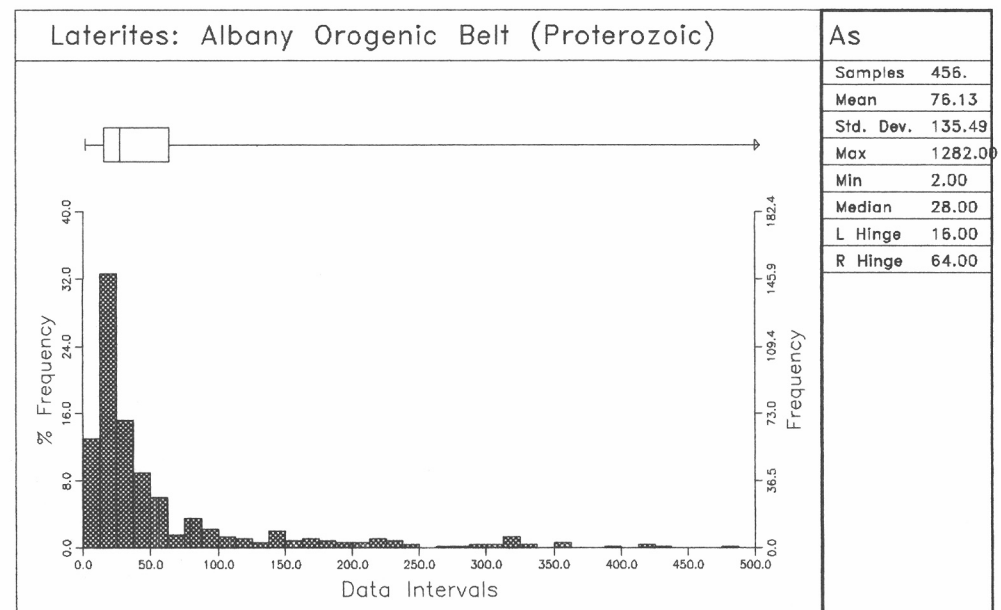
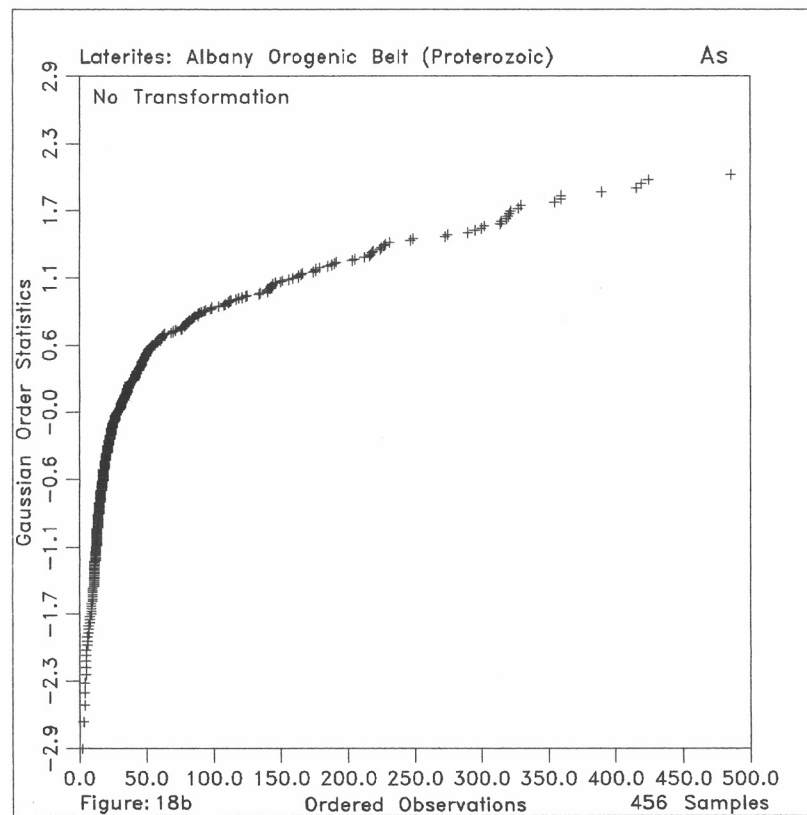


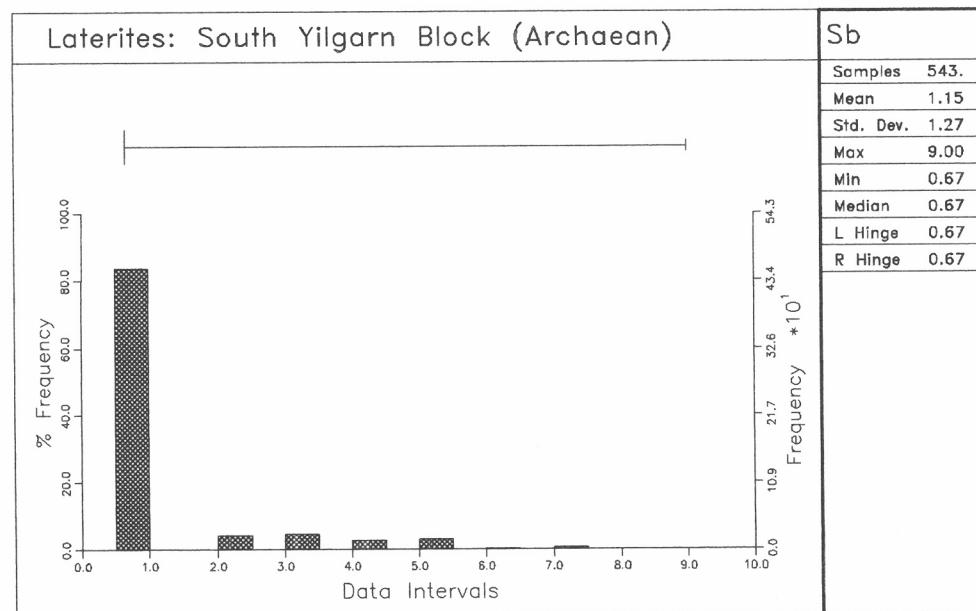
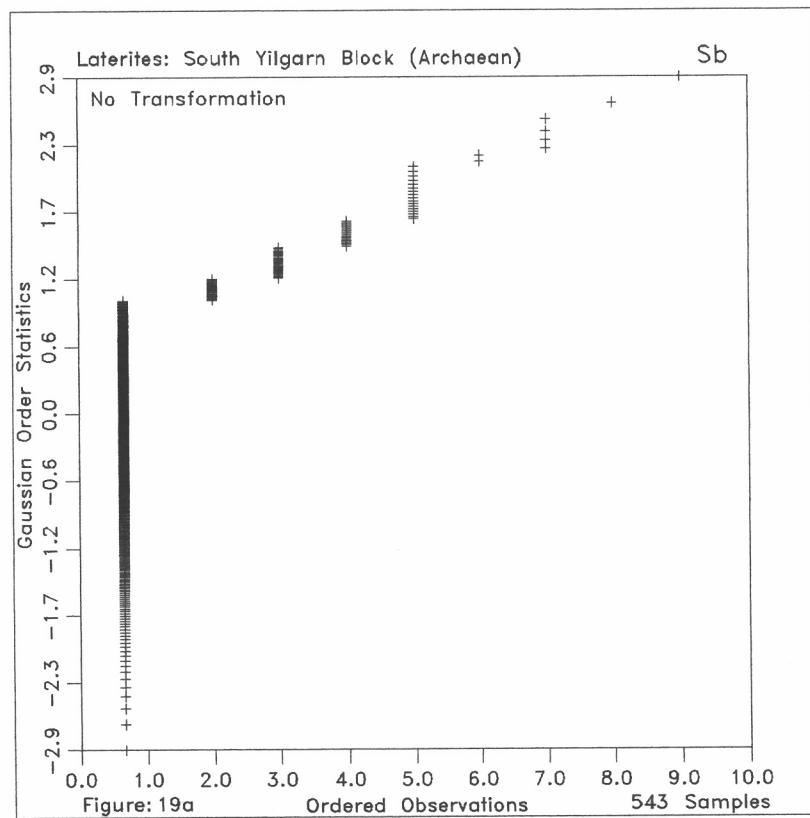


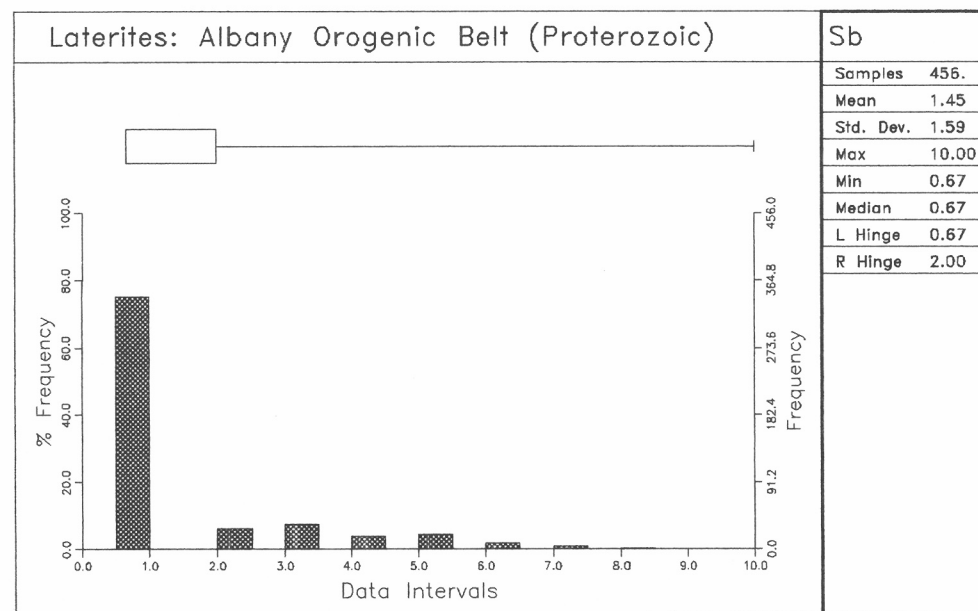
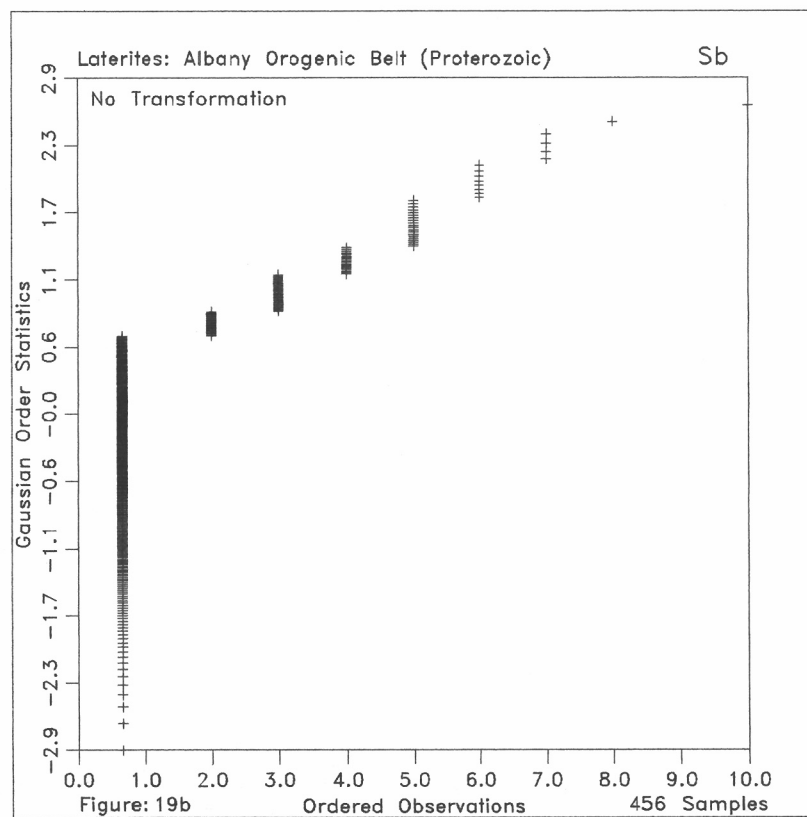


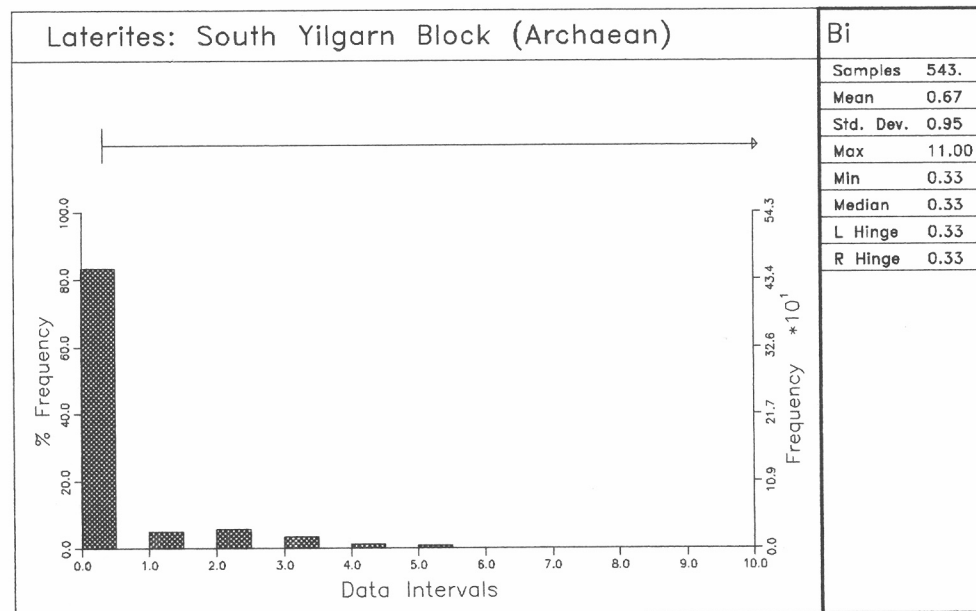
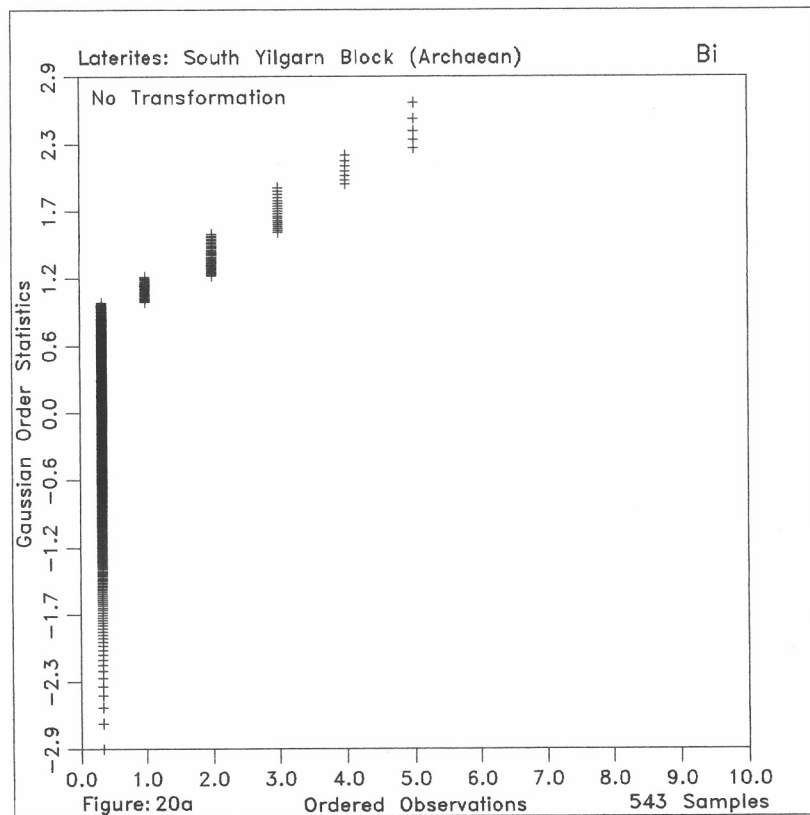


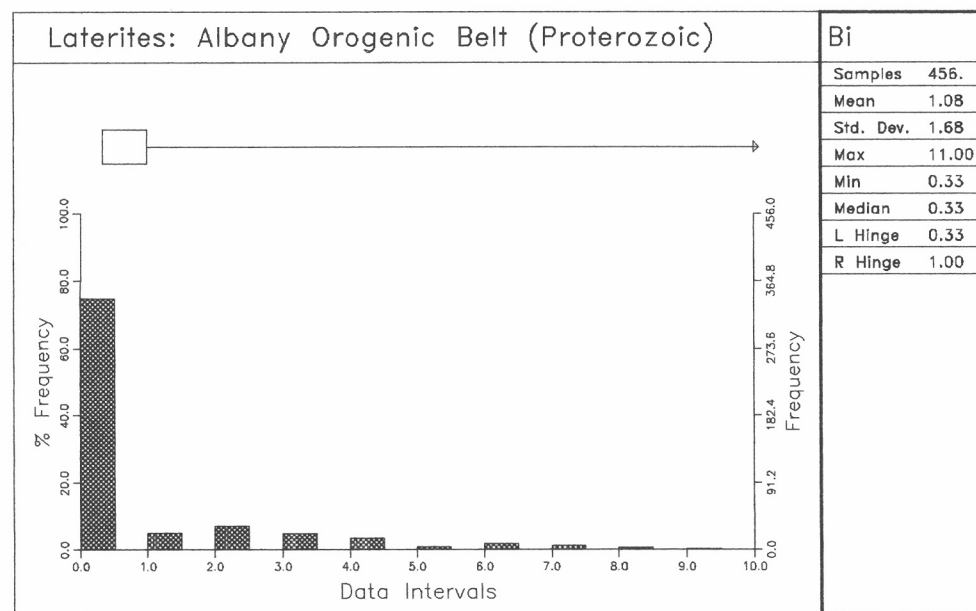
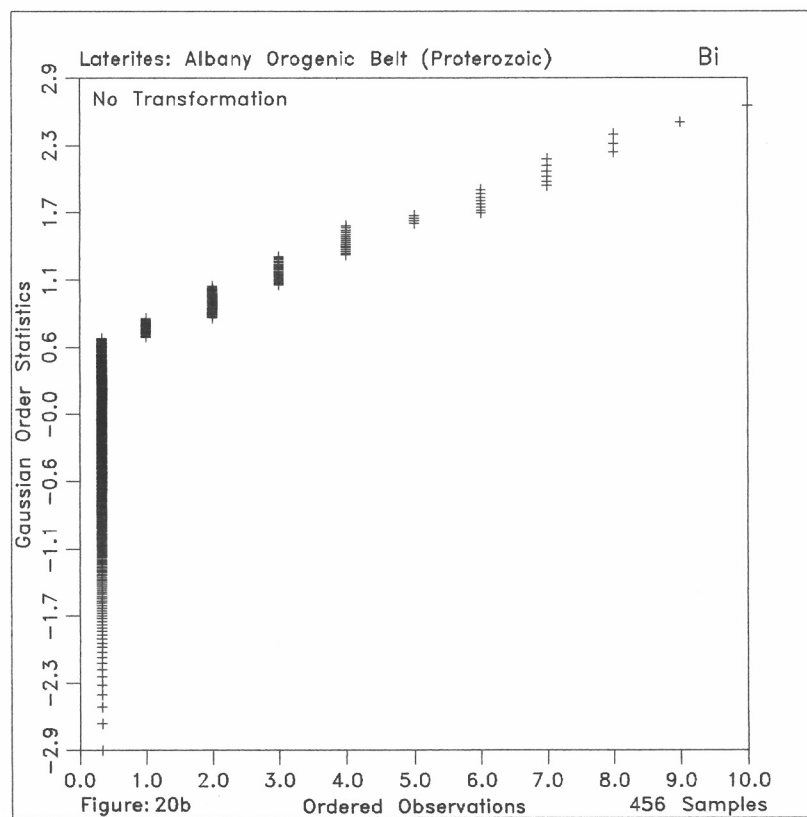


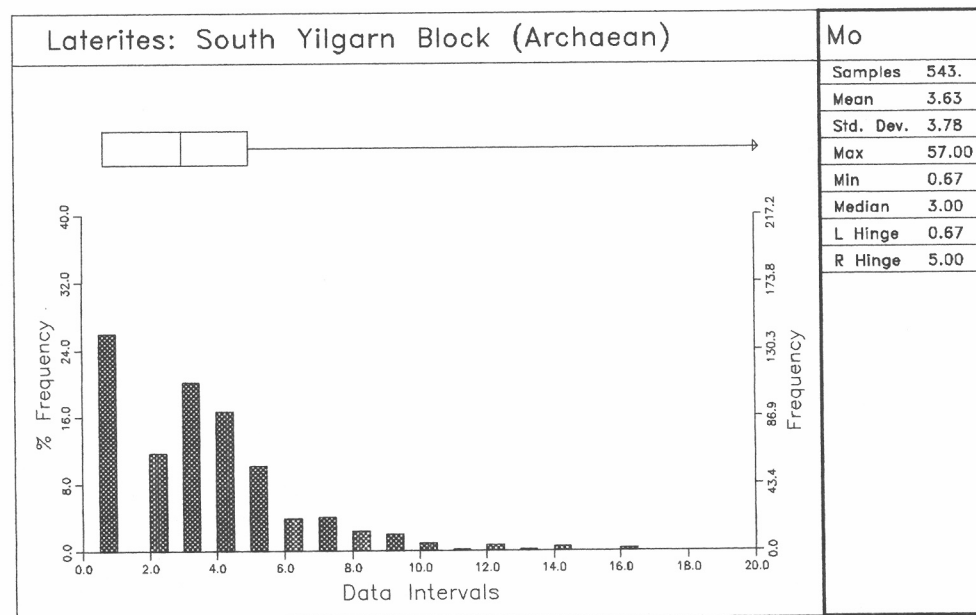
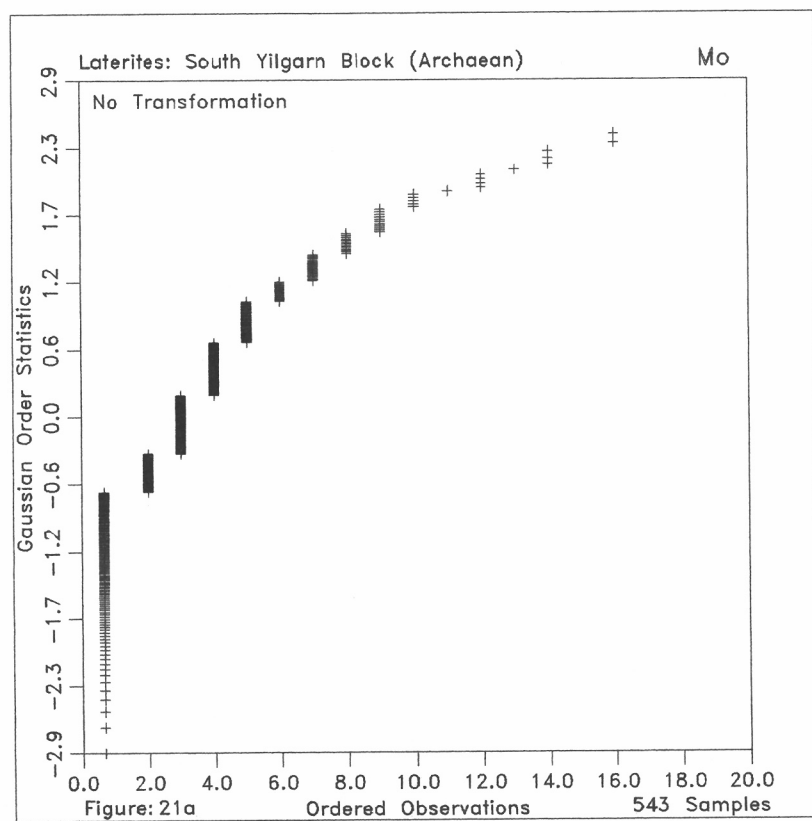


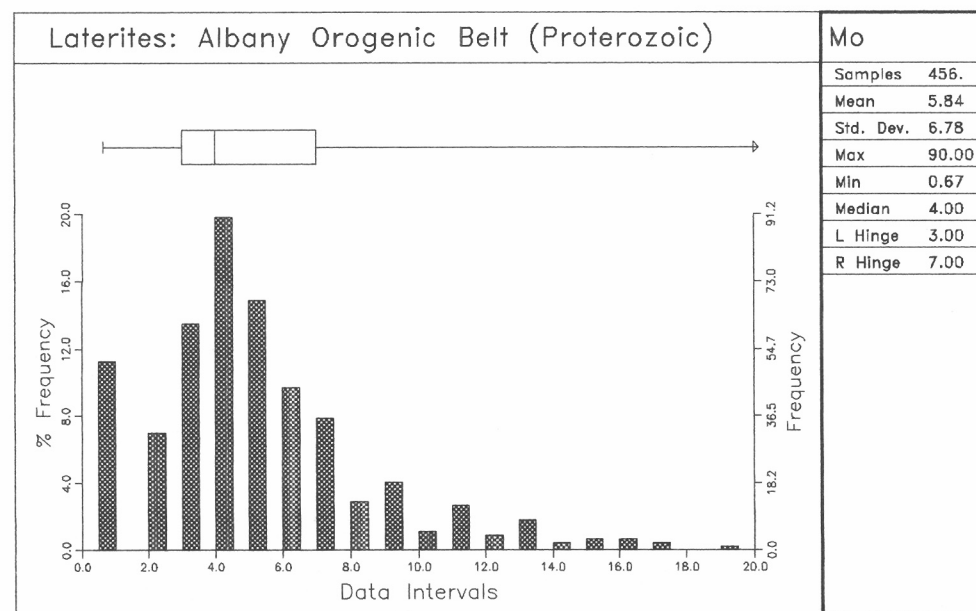
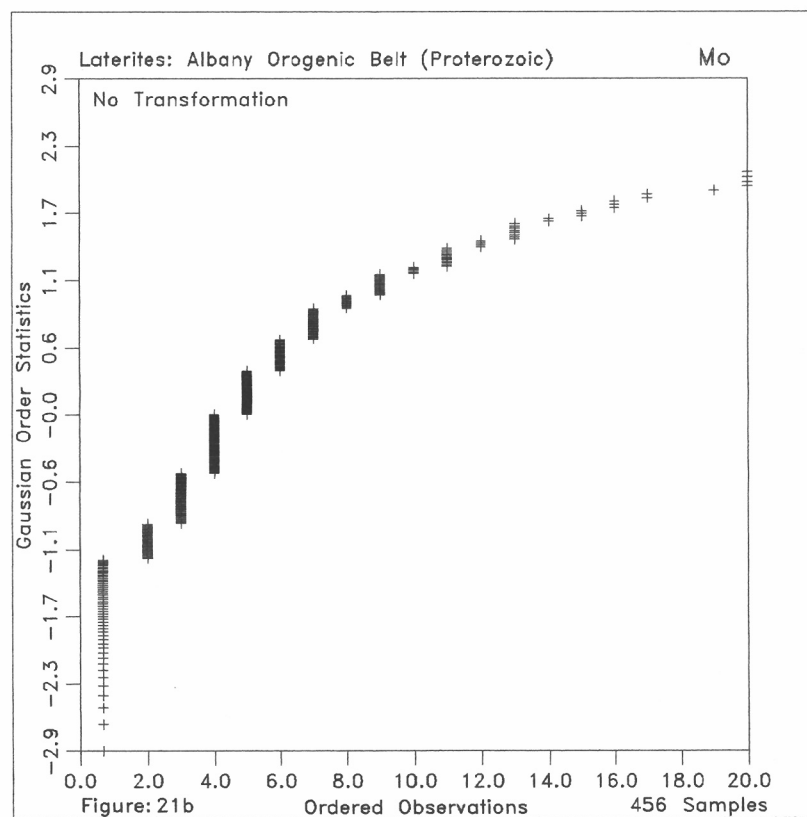


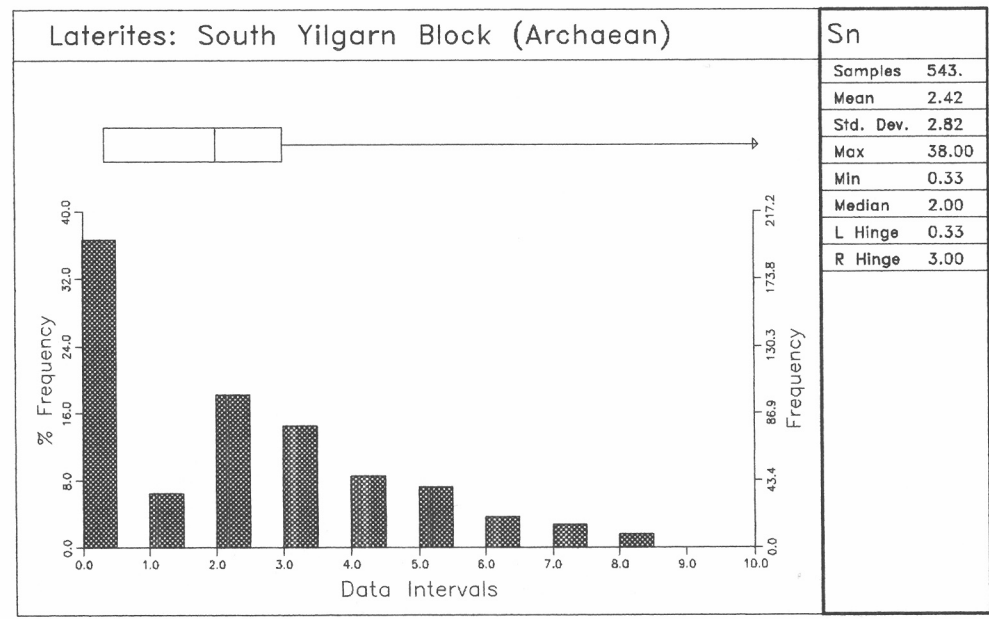
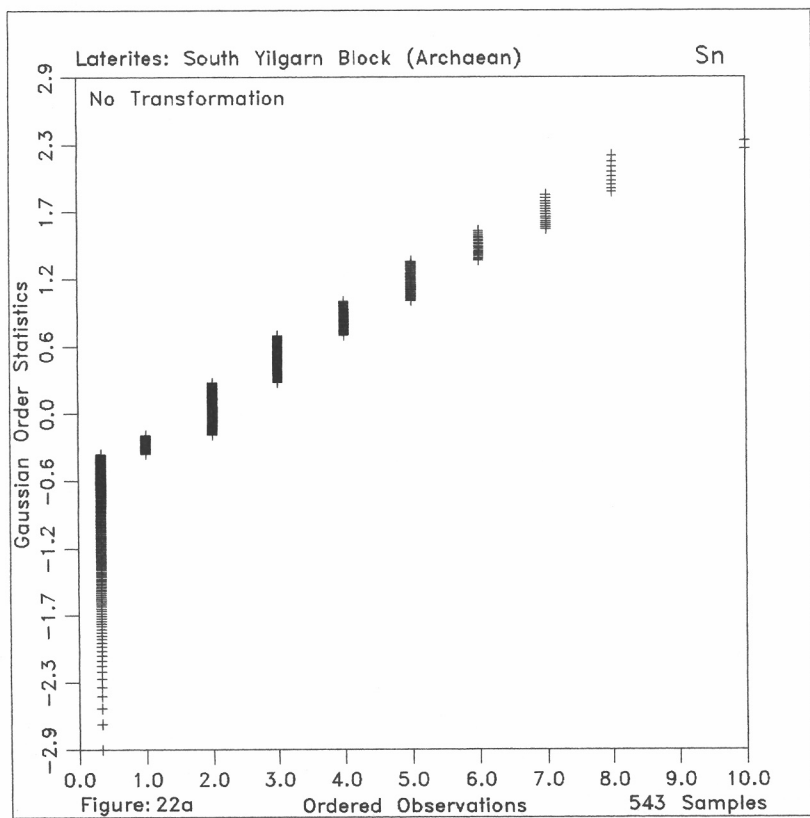


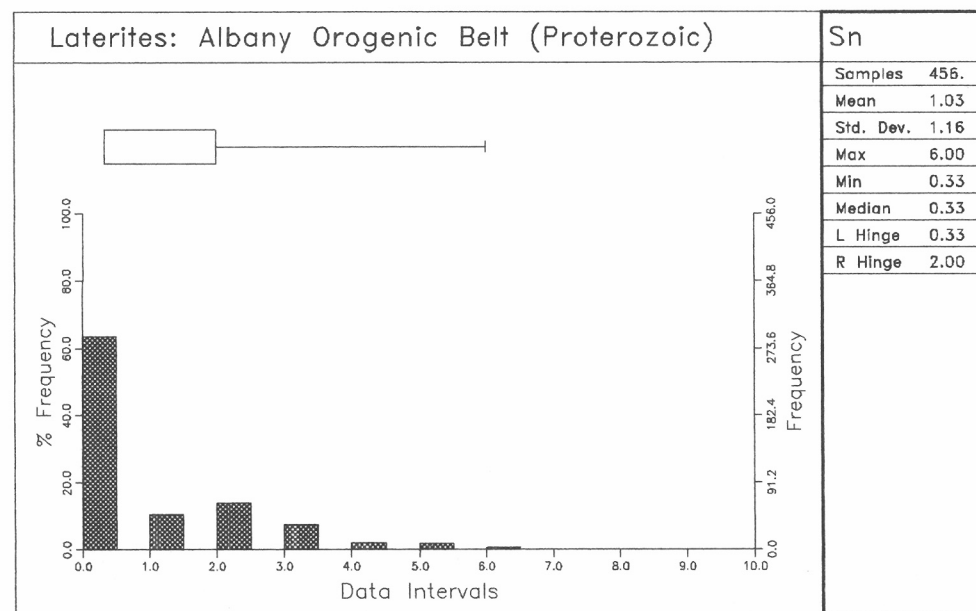
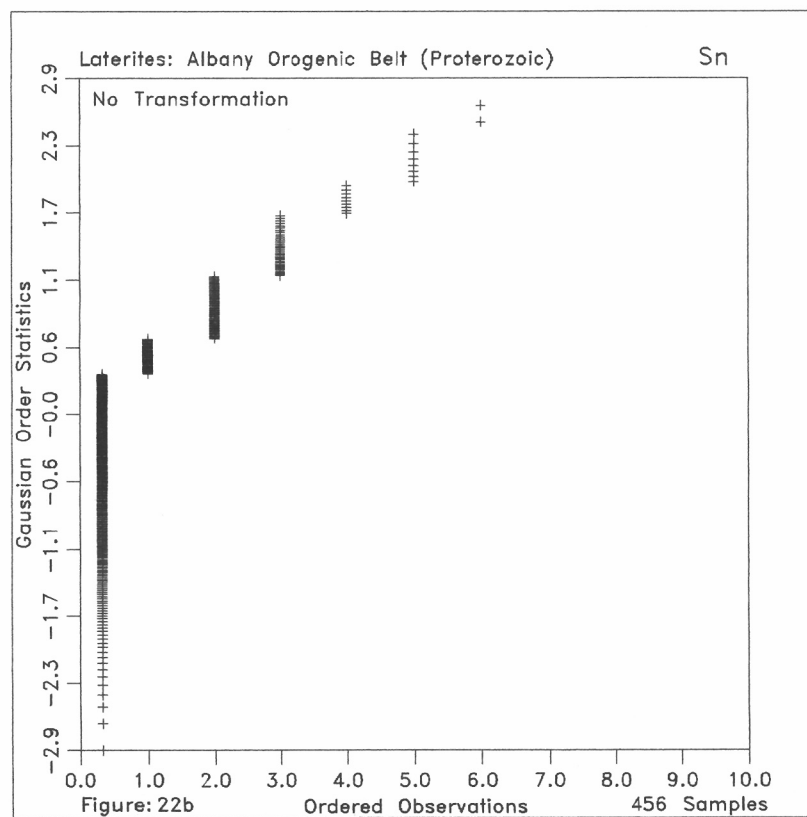


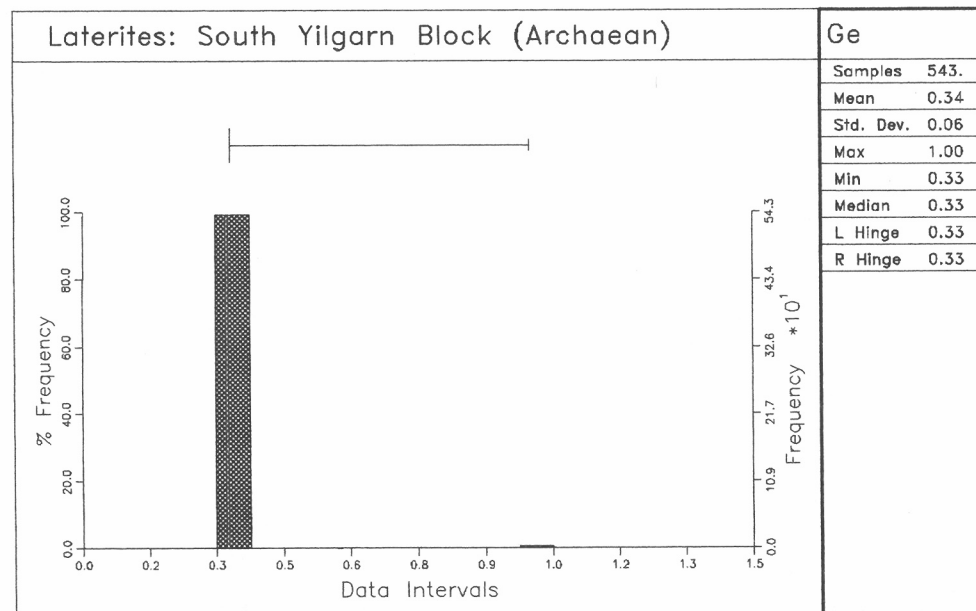
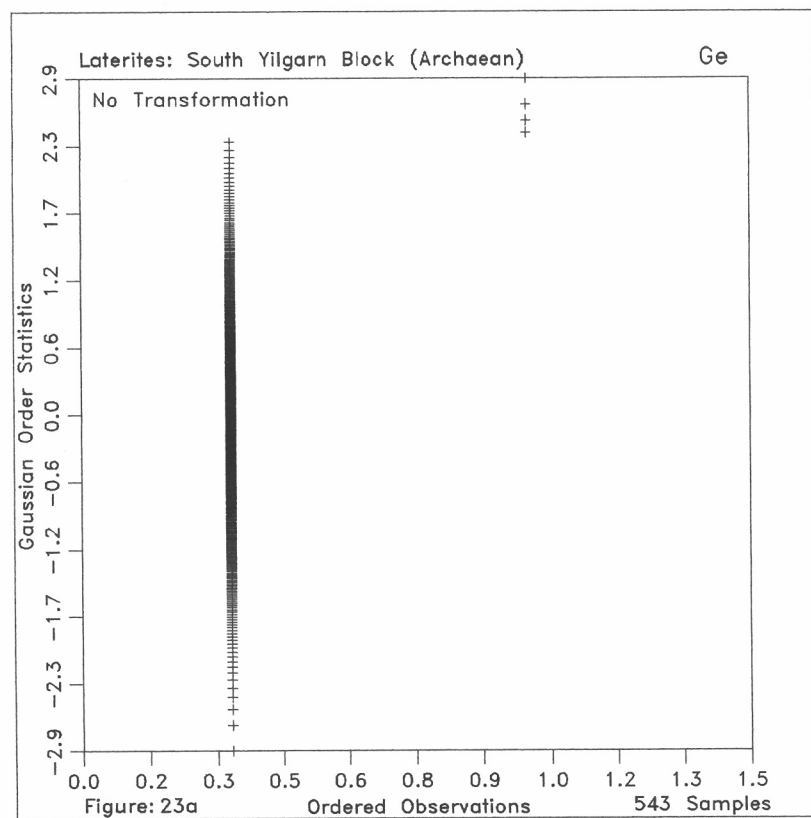


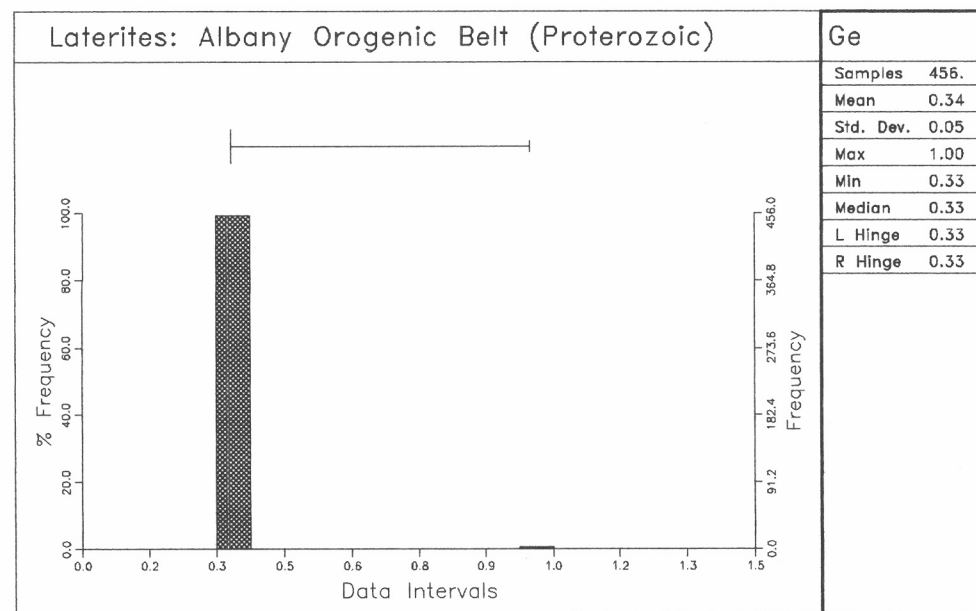
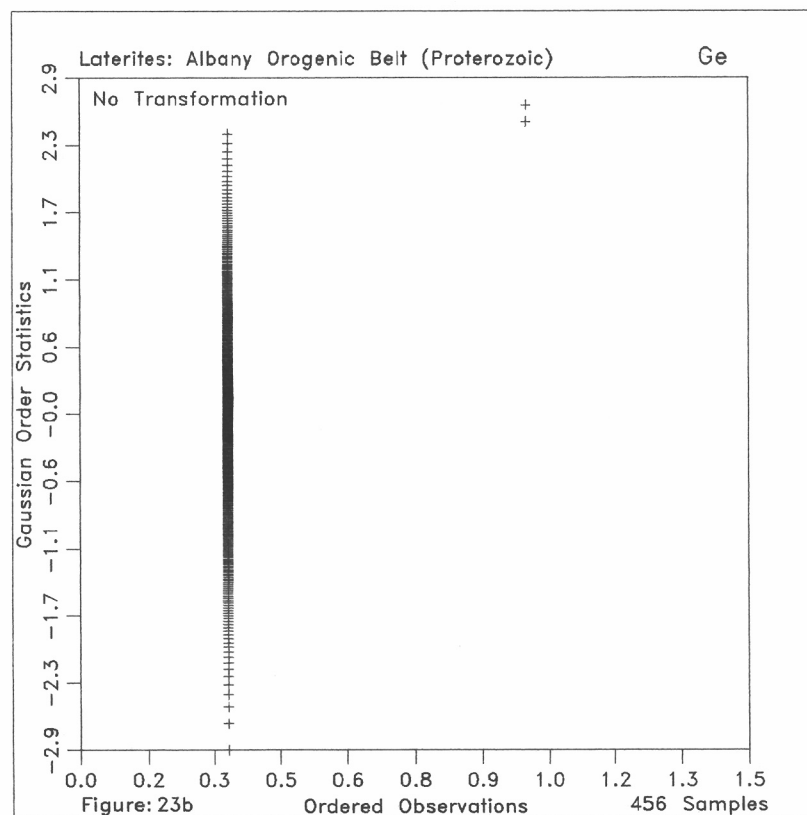


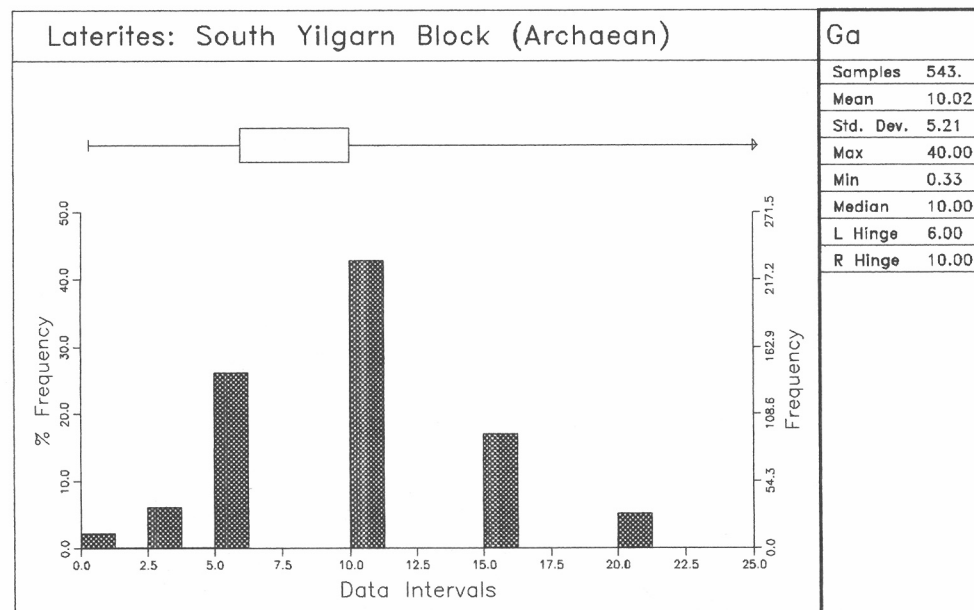
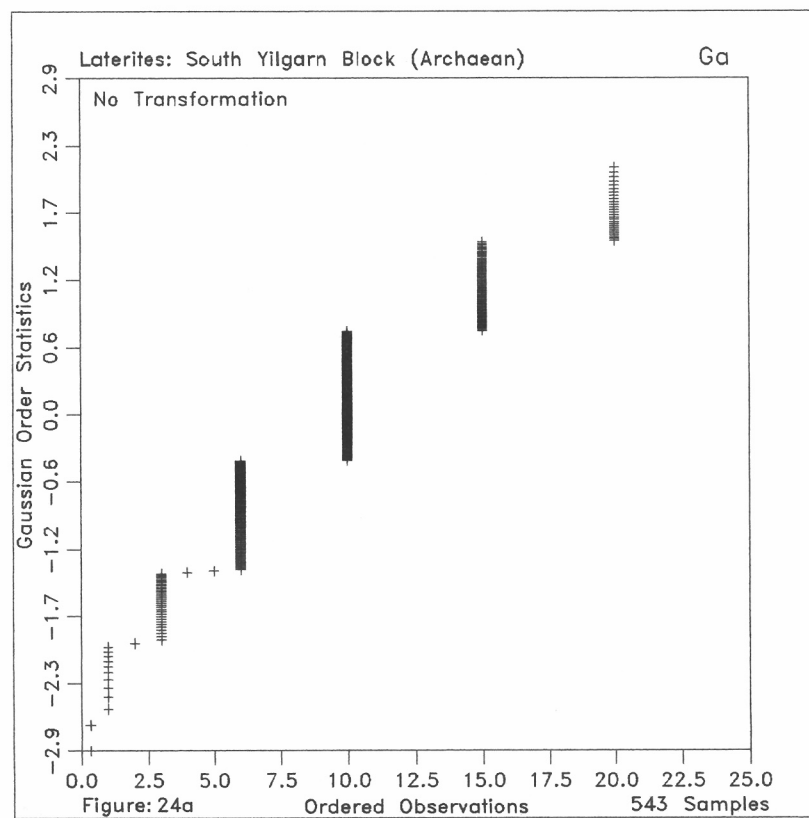


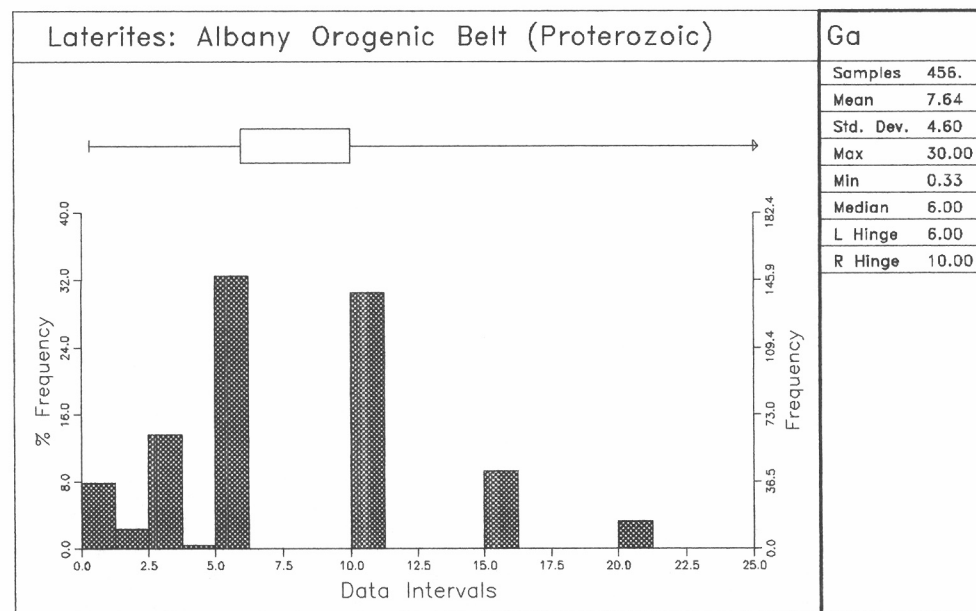
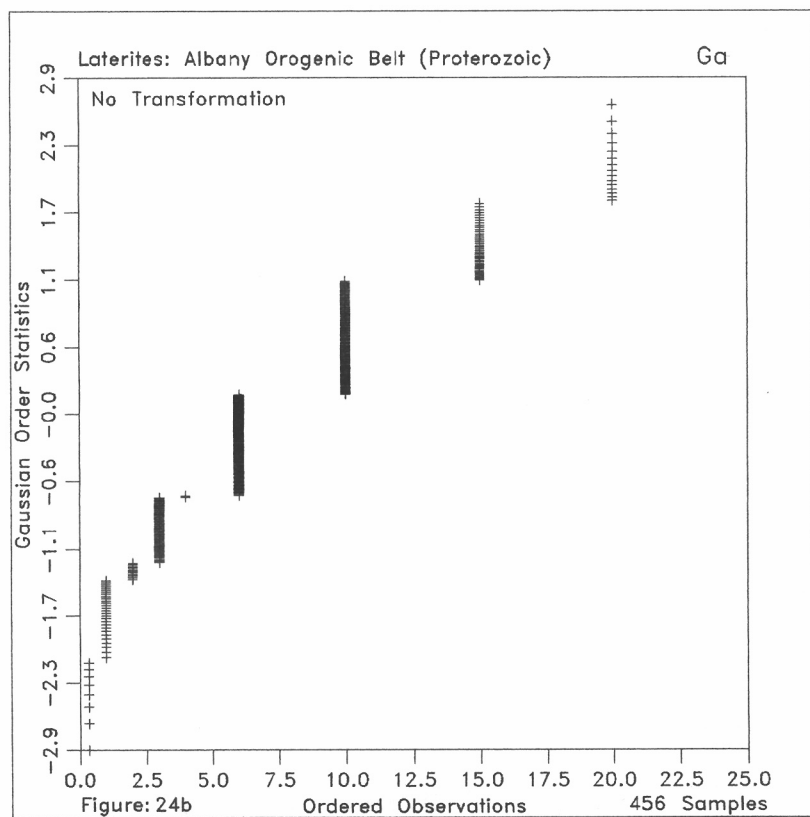


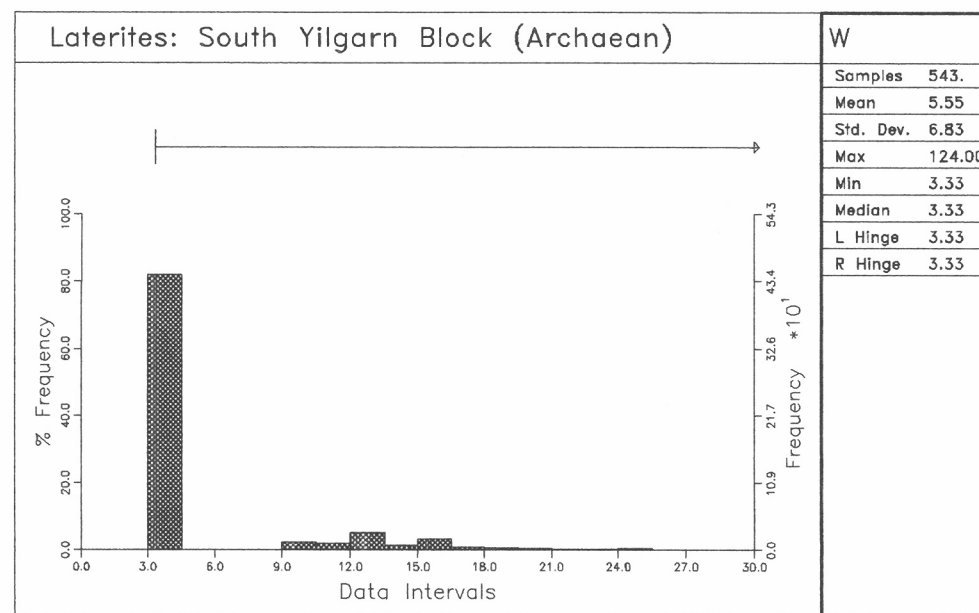
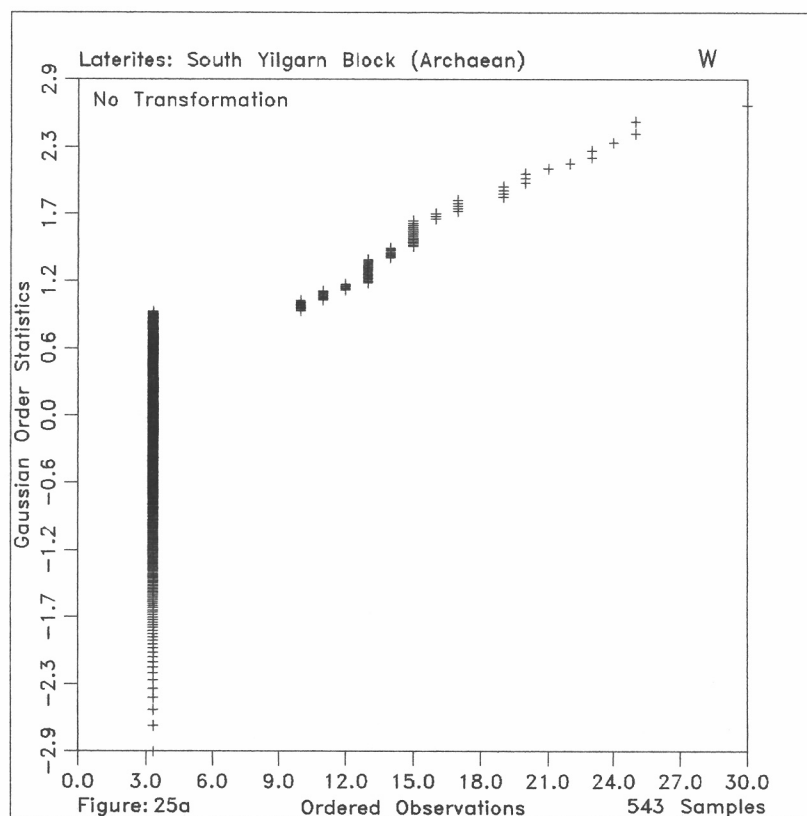


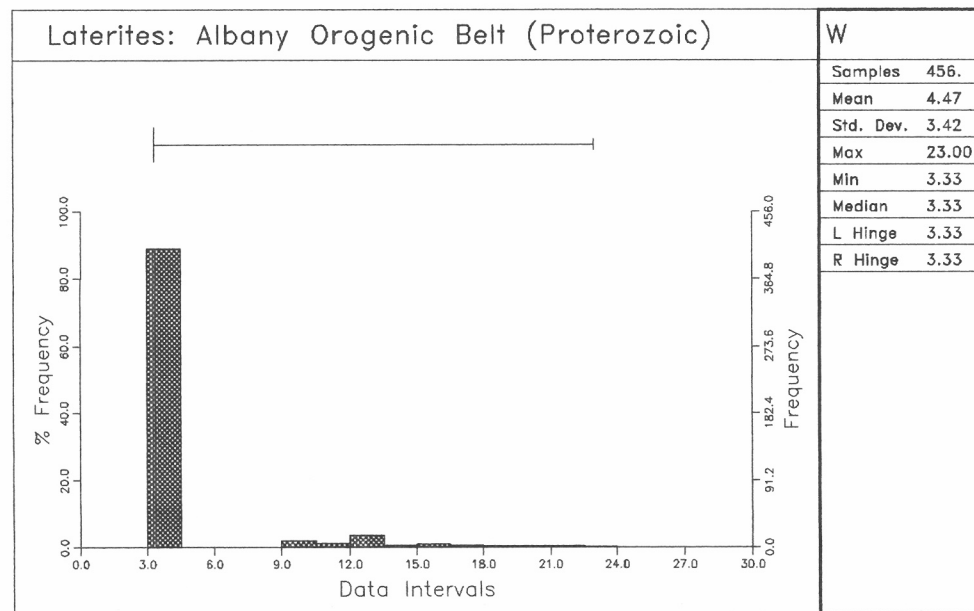
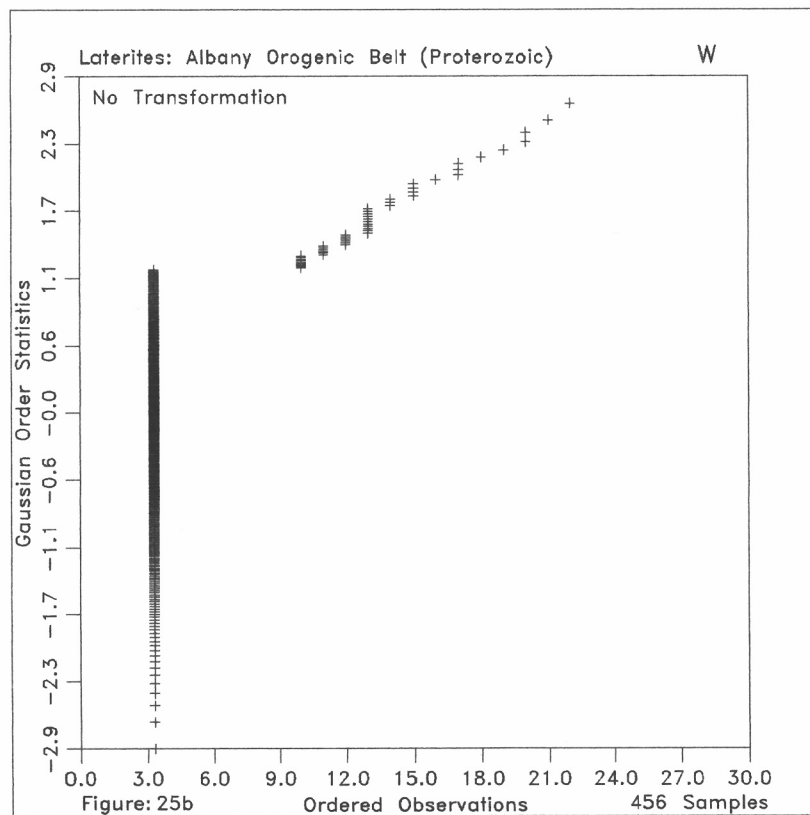


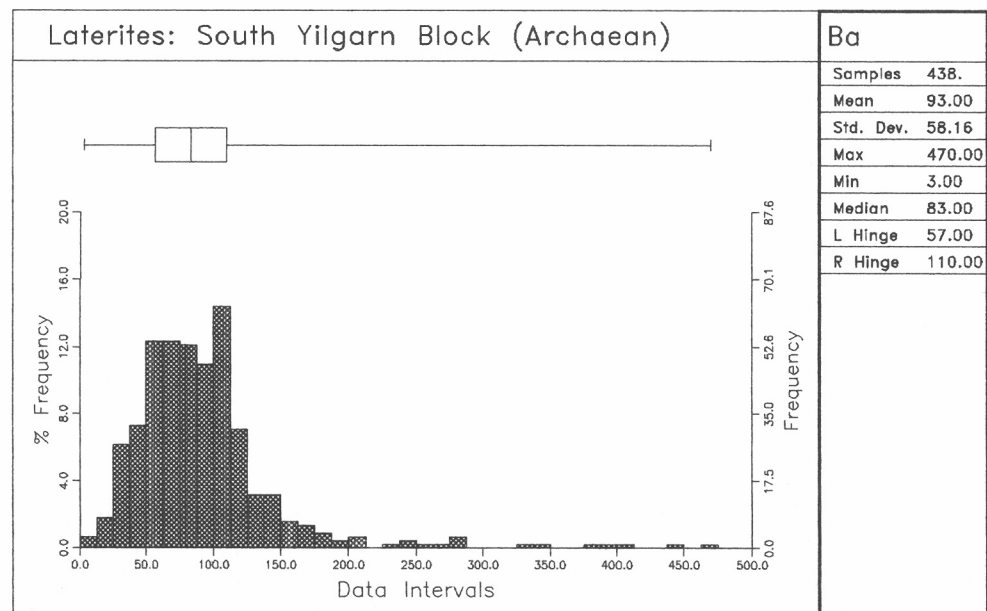
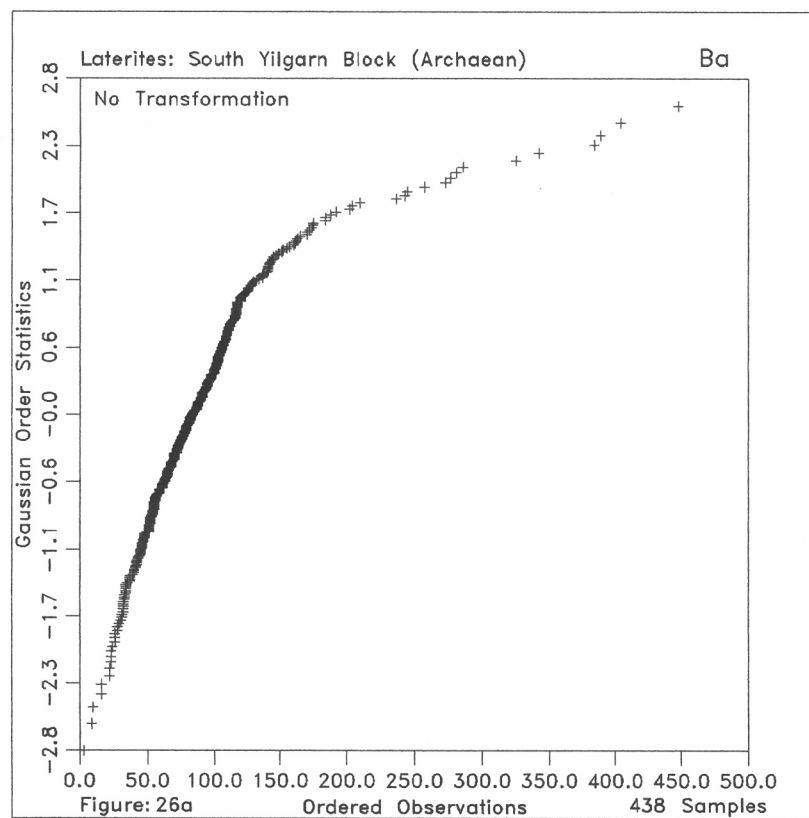


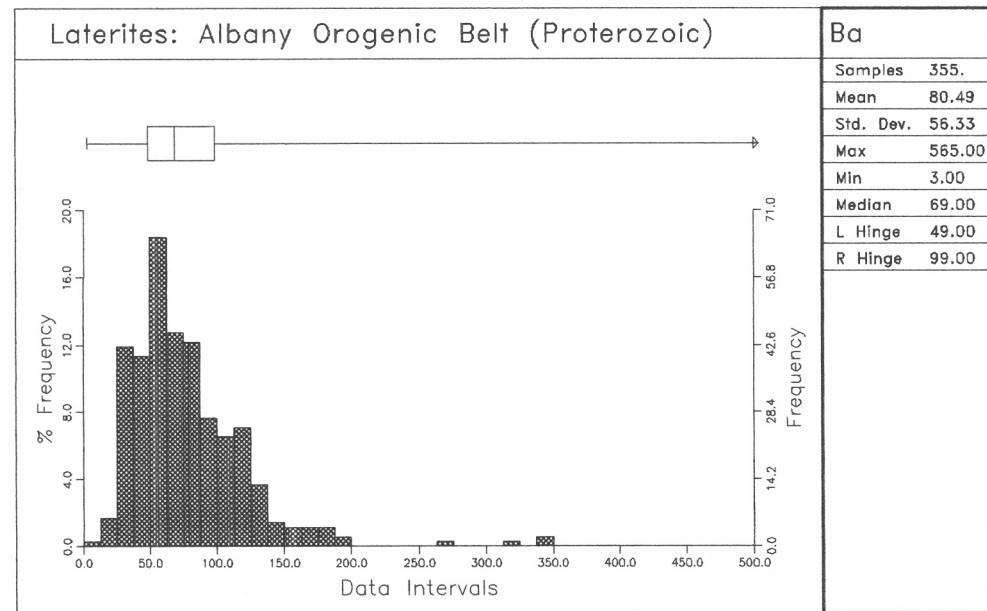
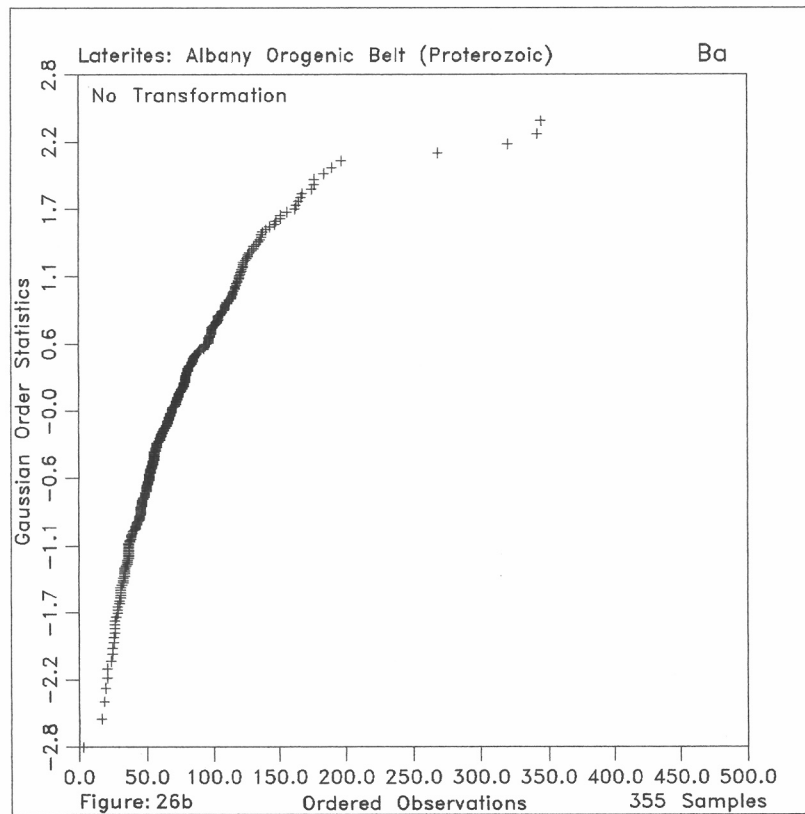


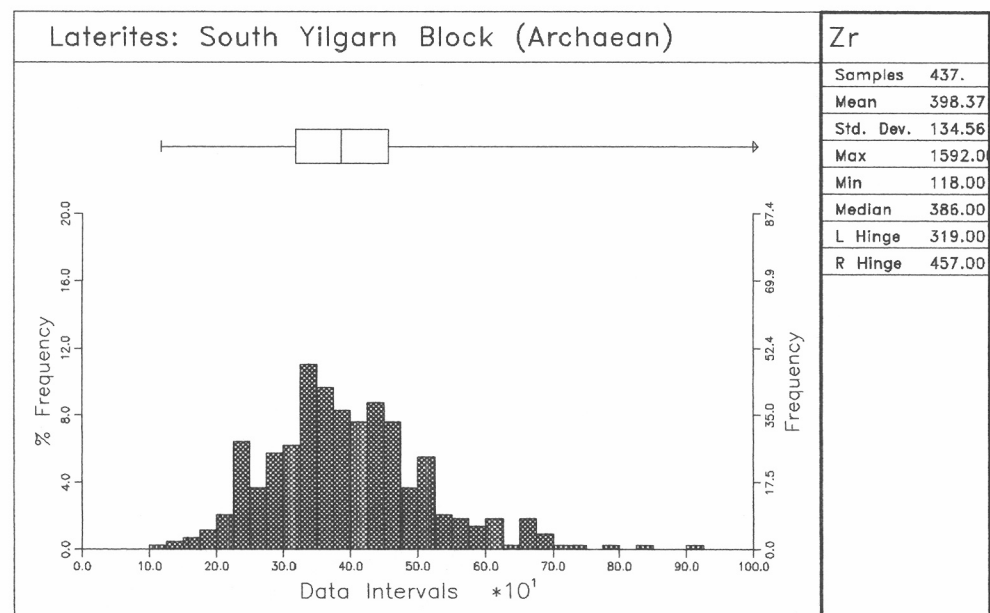
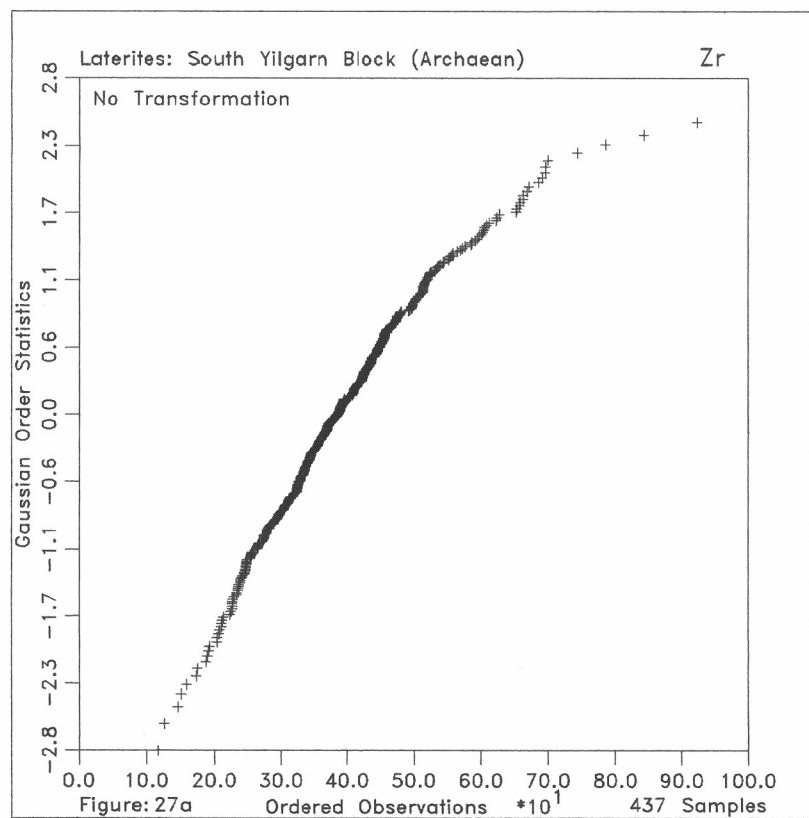


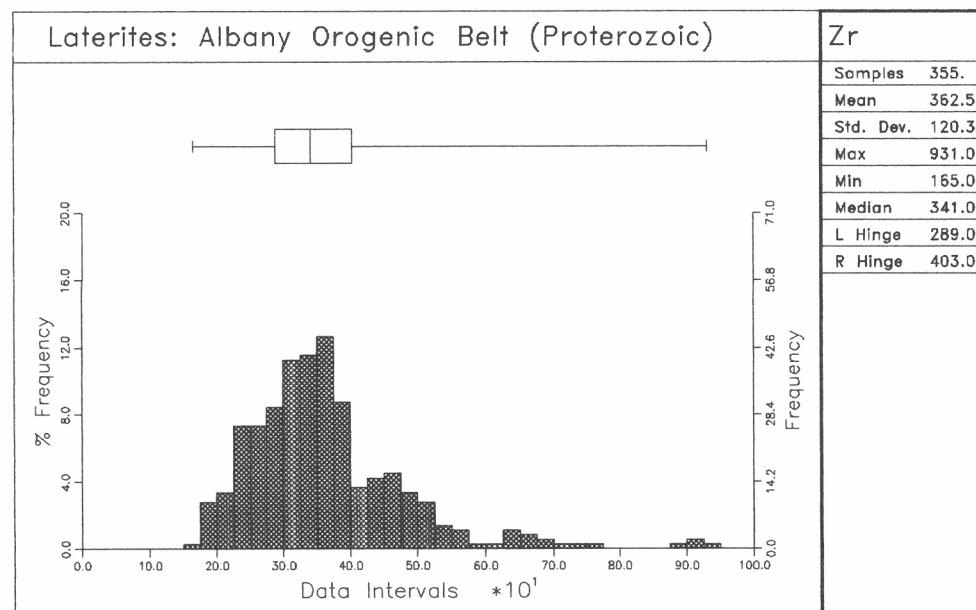
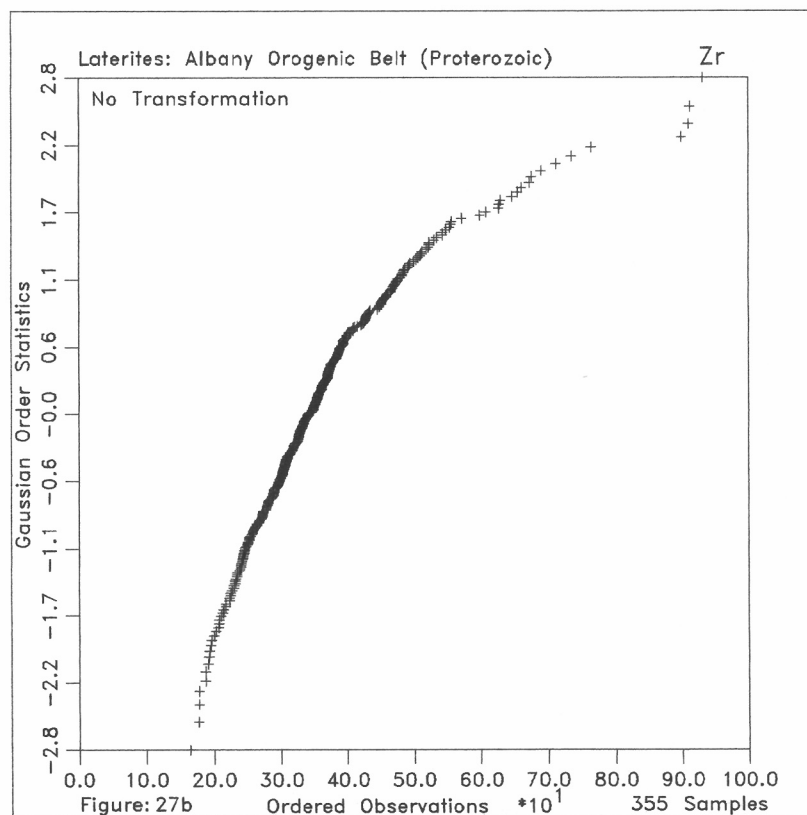


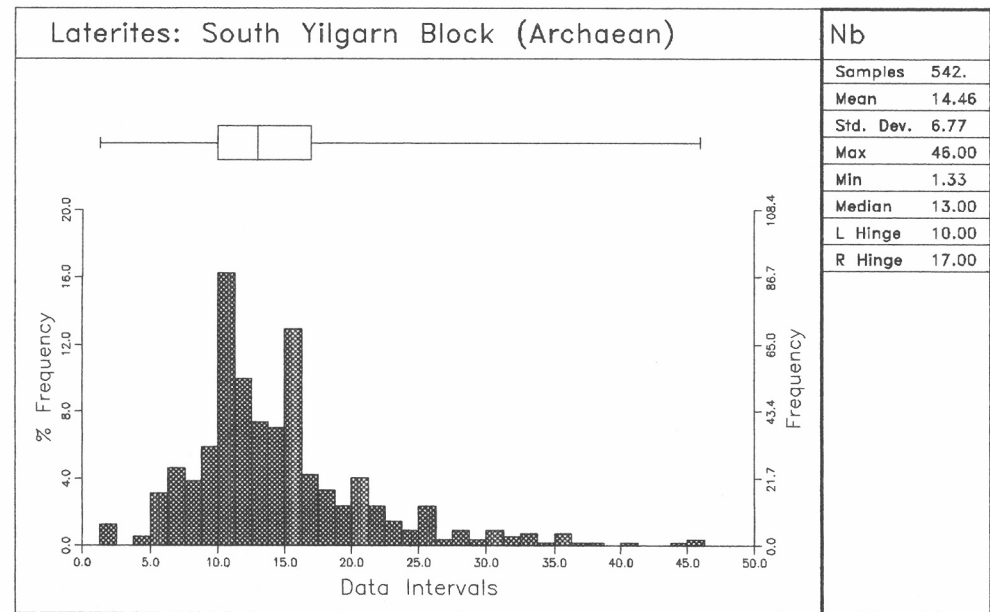
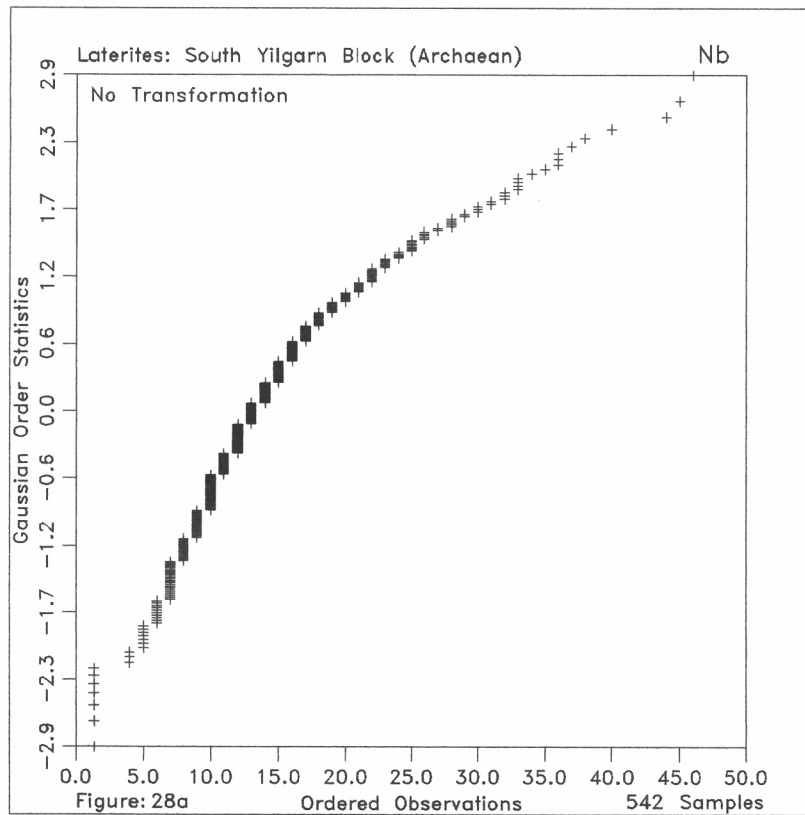


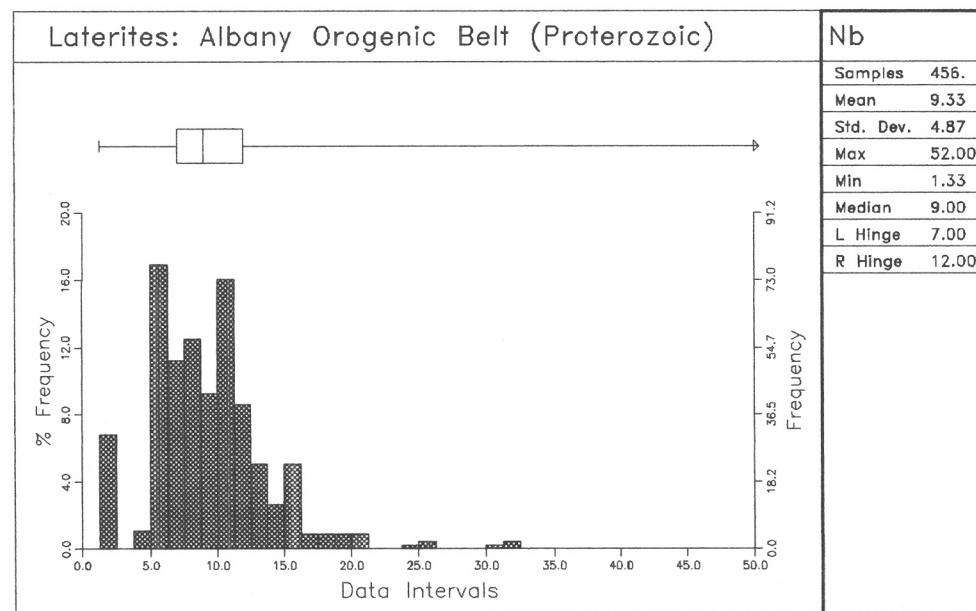
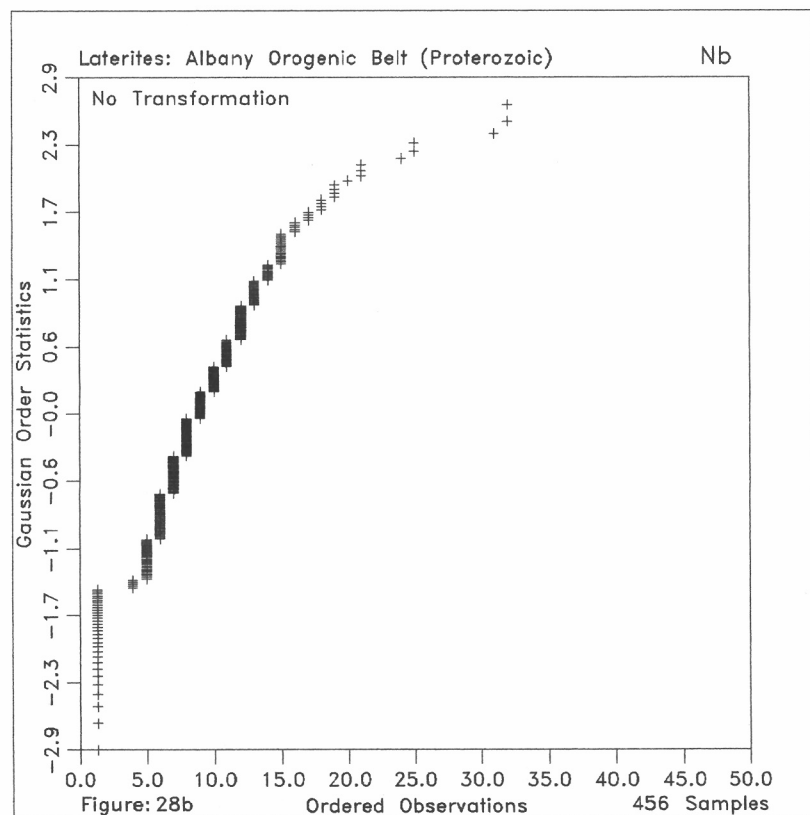


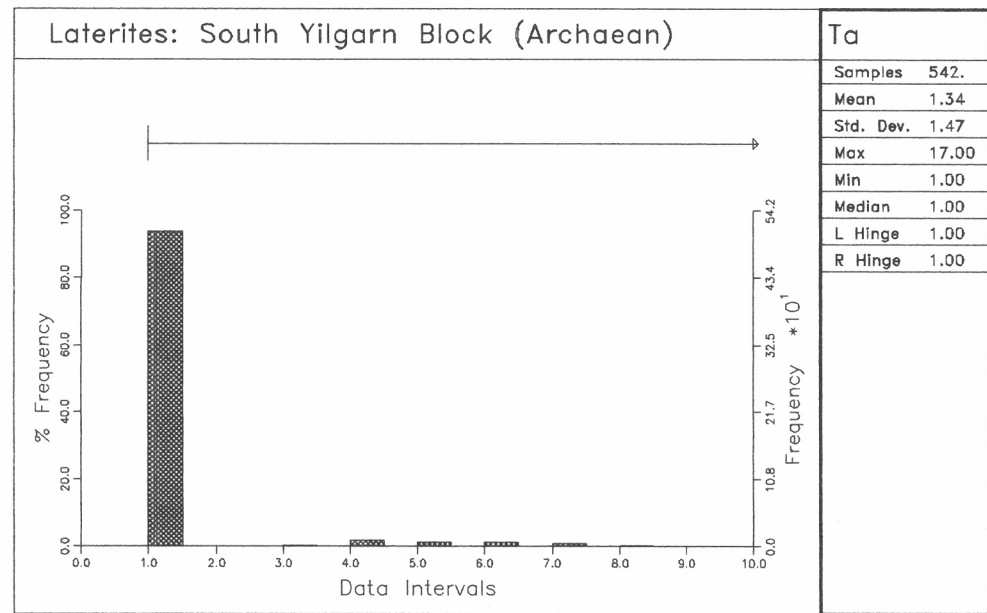
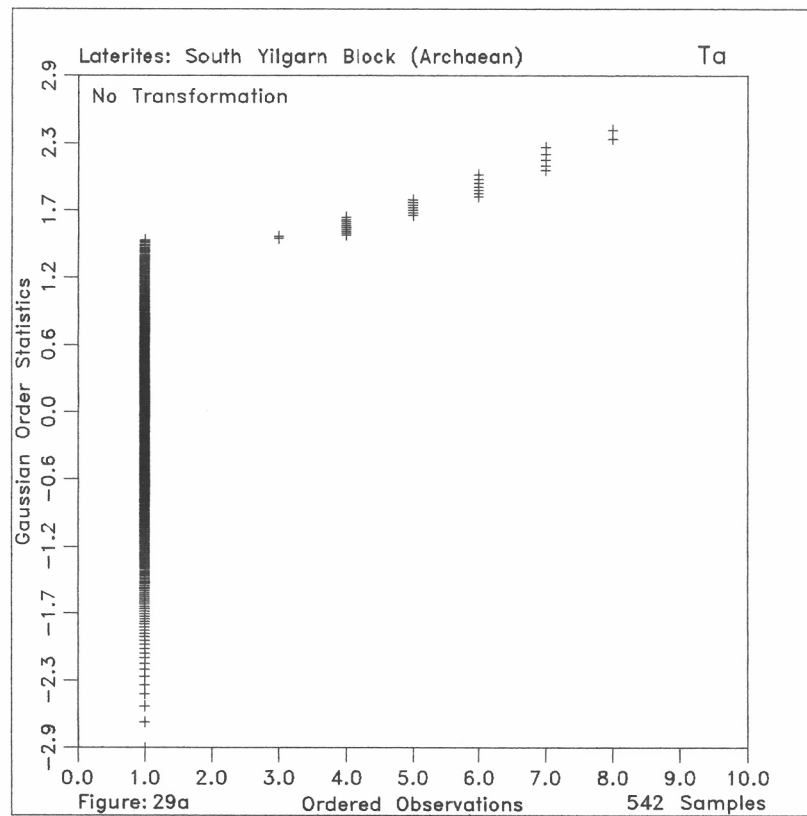


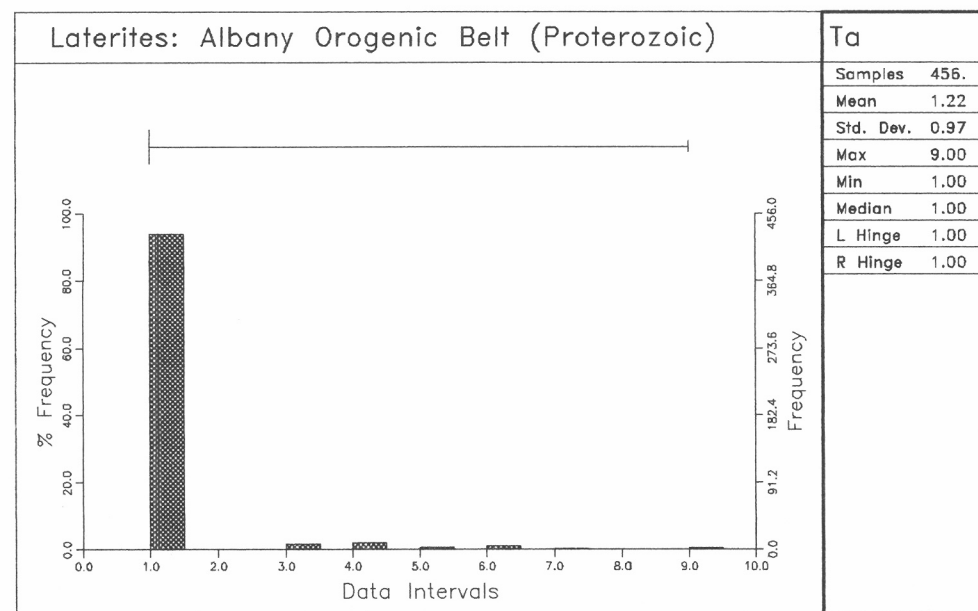
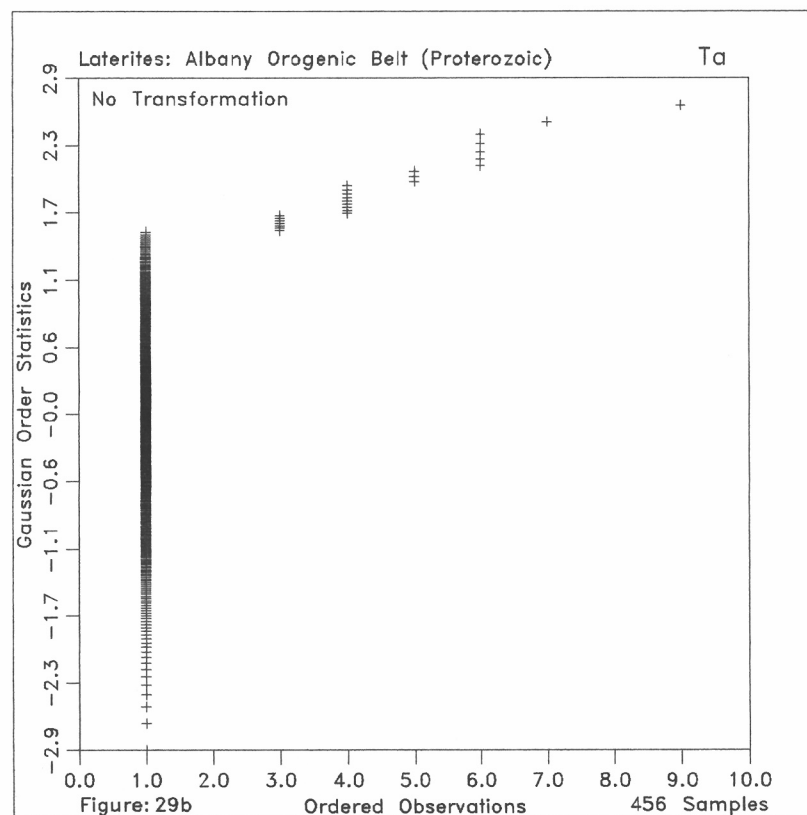


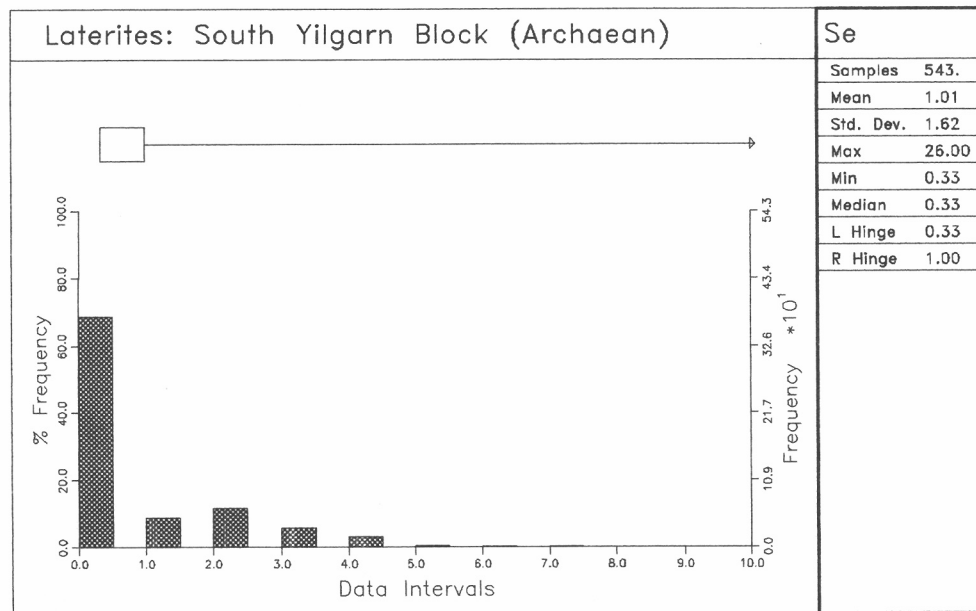
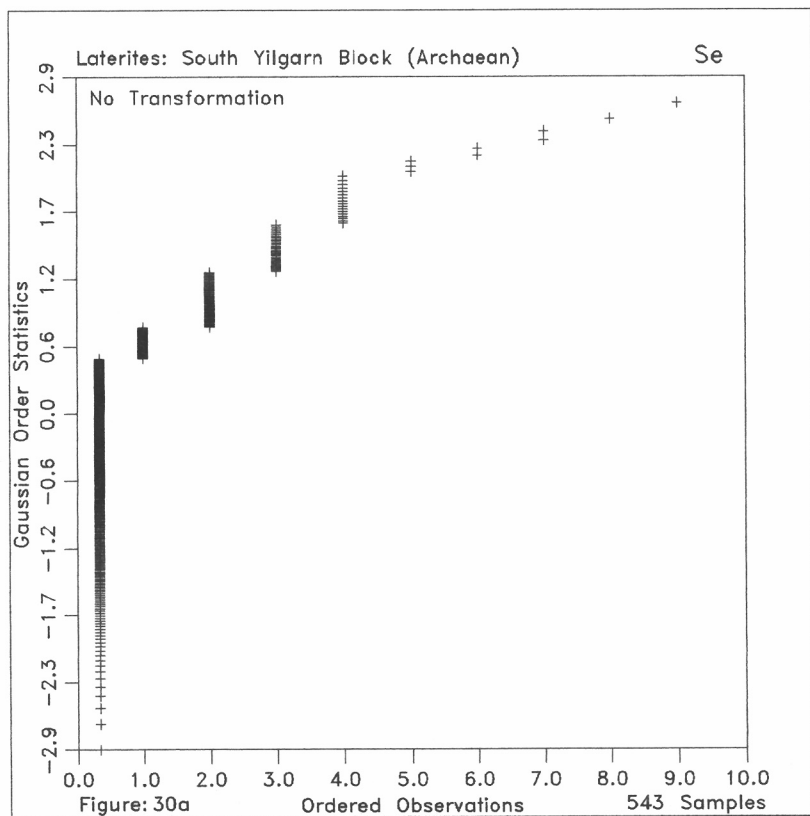


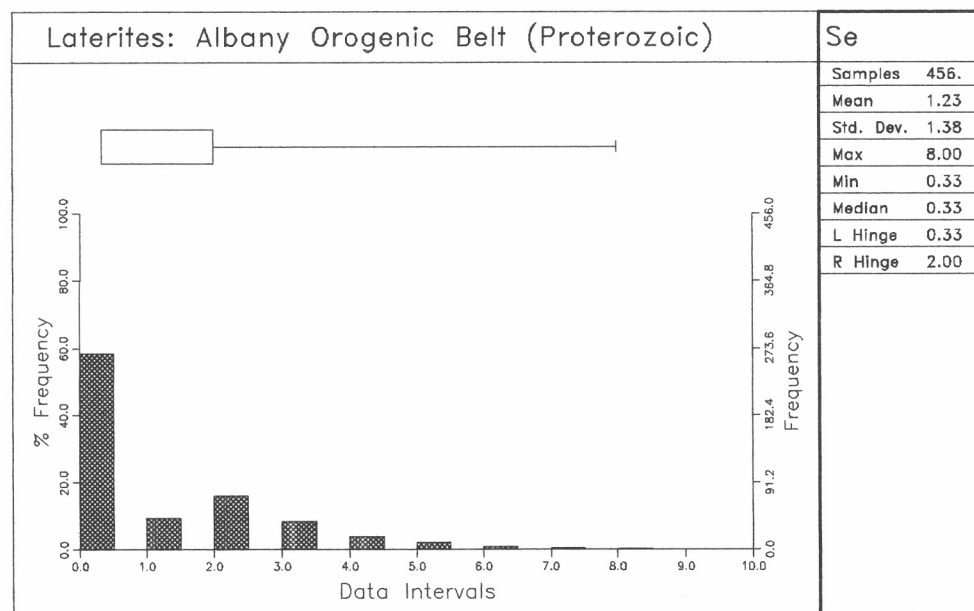
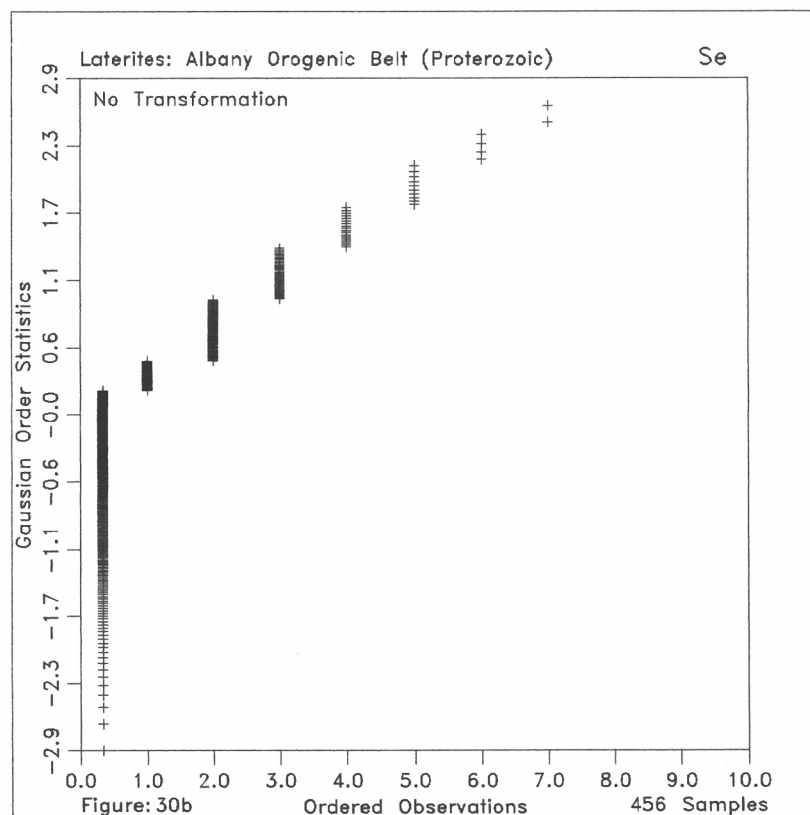


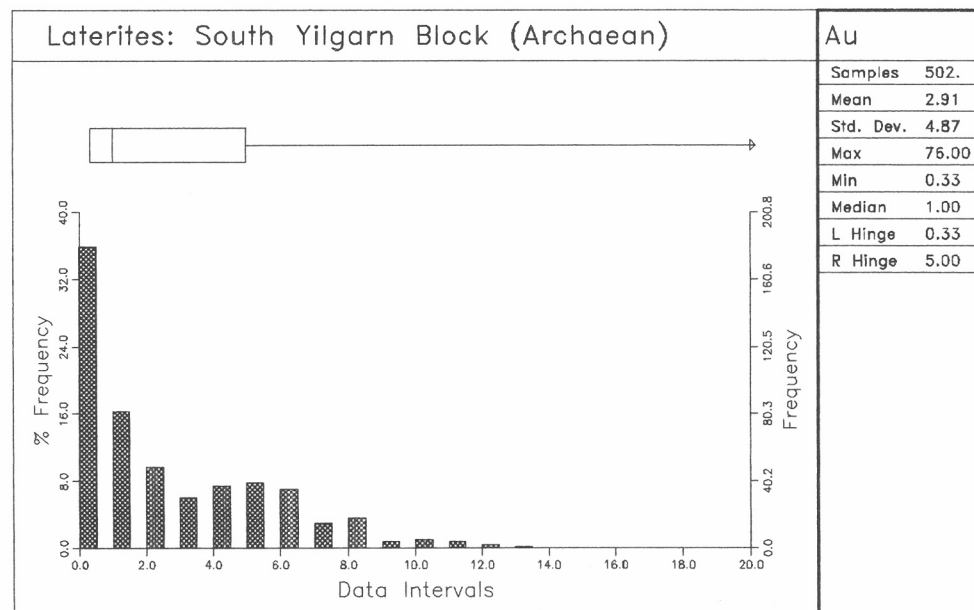
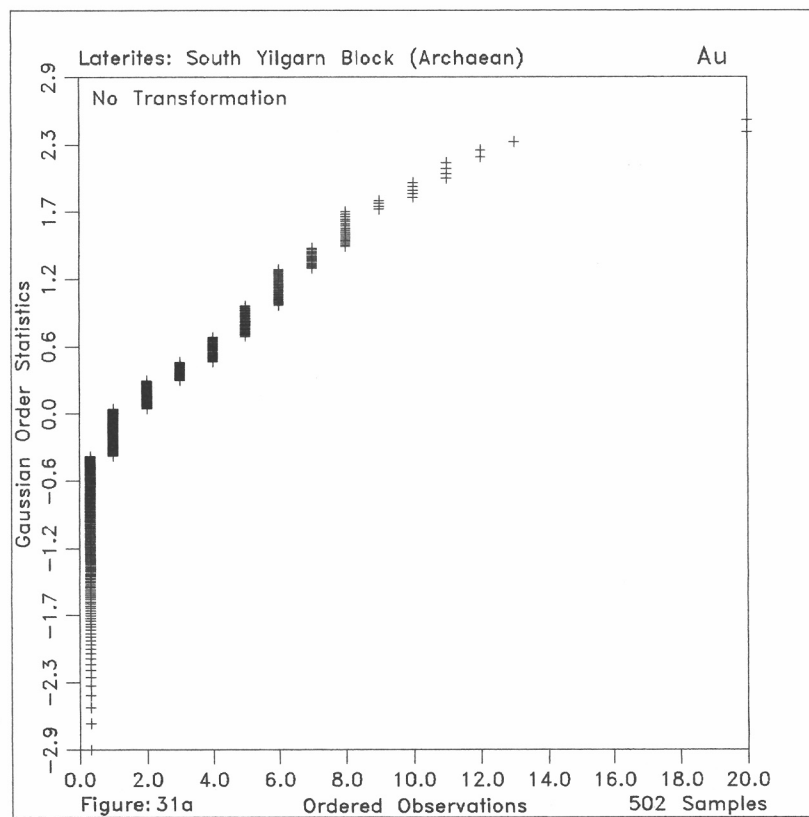


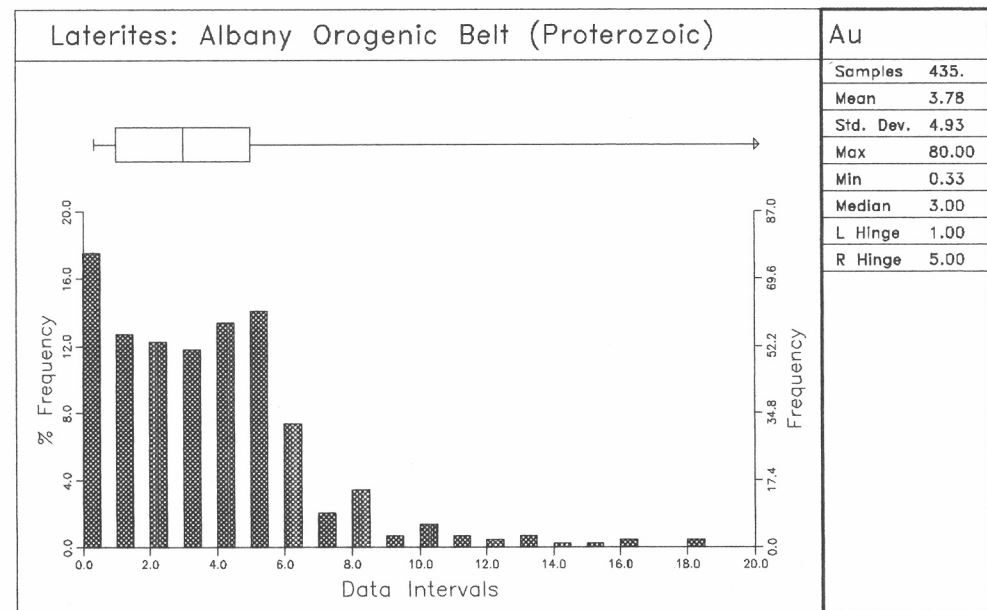
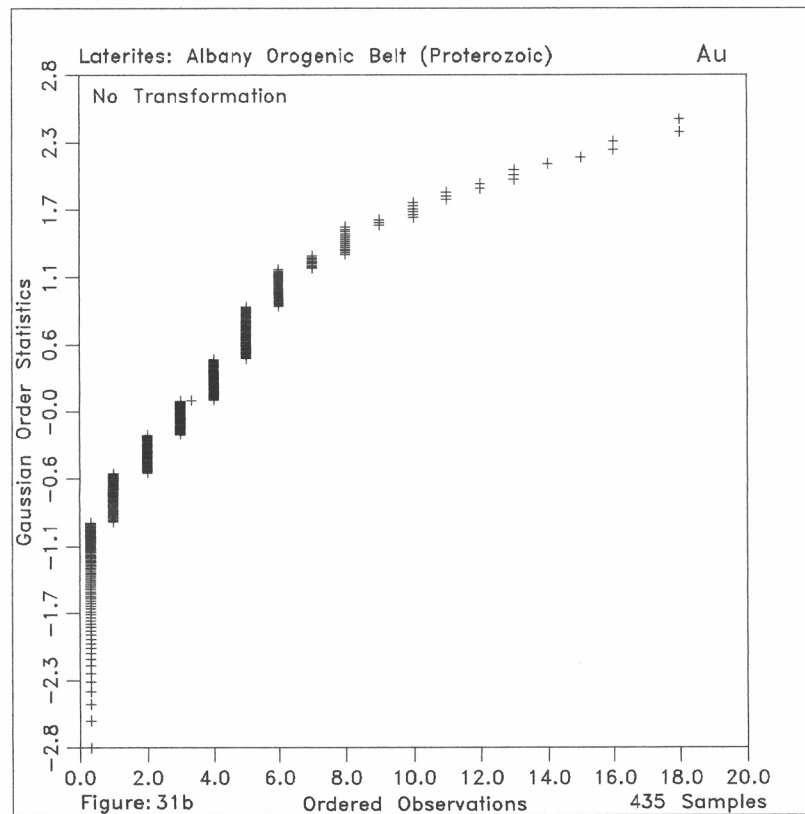












Albany-Fraser Laterites: Transformed Data

× Laterites: Albany Orogenic Belt
+ Laterites: Yilgarn Block

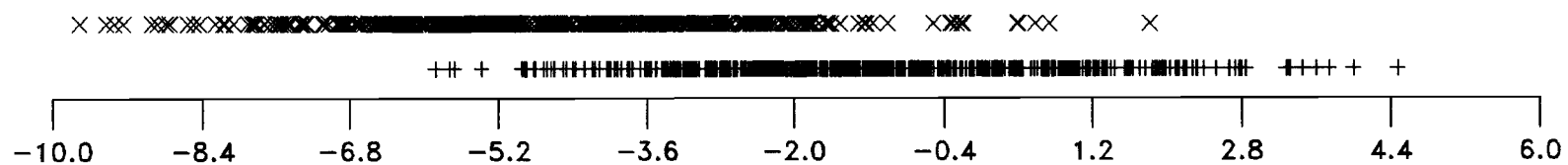
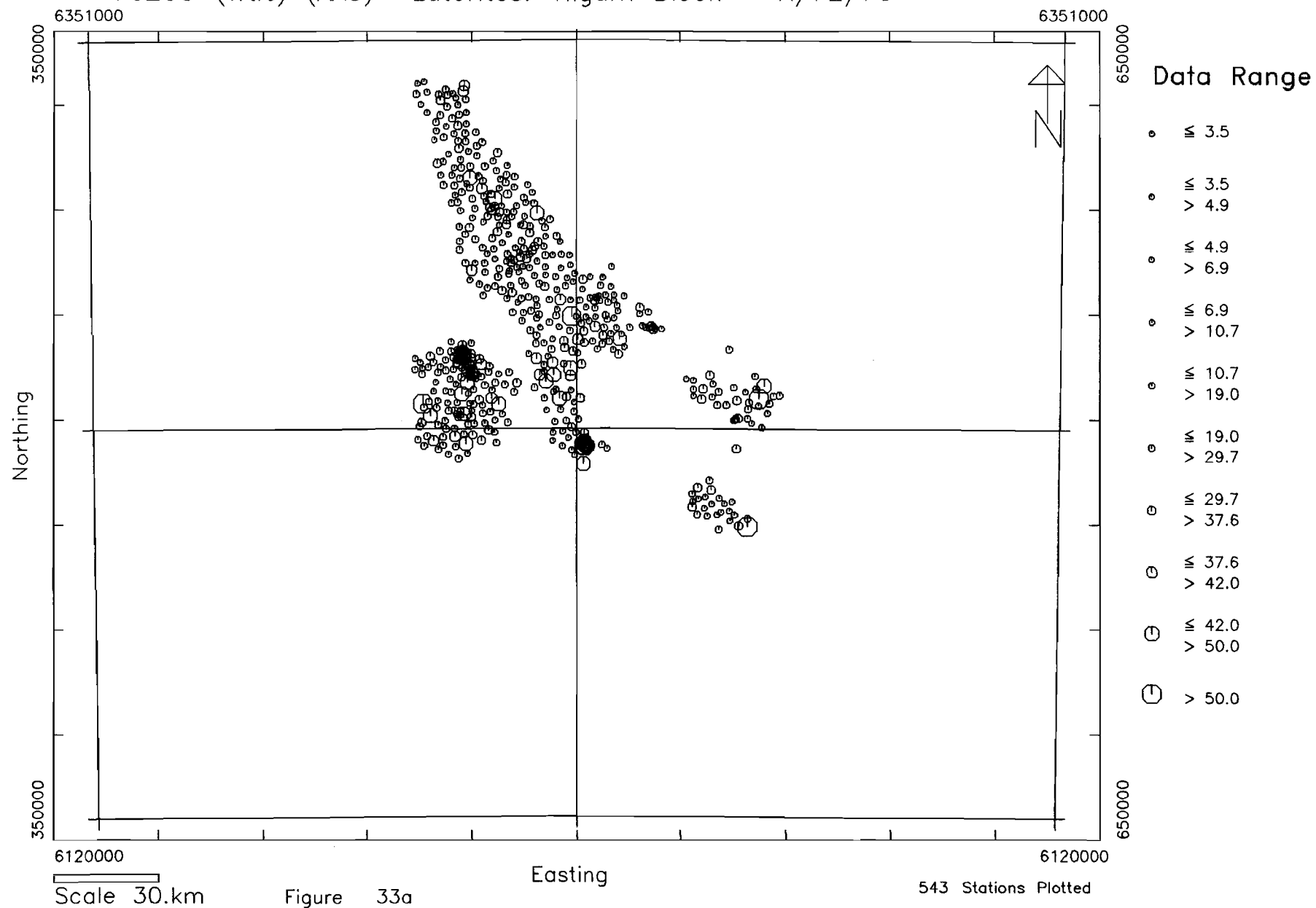


Figure 32

Discriminant Score

Fe2O3 (Wt%) (AAS) Laterites: Yilgarn Block R/F2/F3



Fe2O3 (Wt%) (AAS) Laterites: Albany Orogenic Belt R/F2/F3

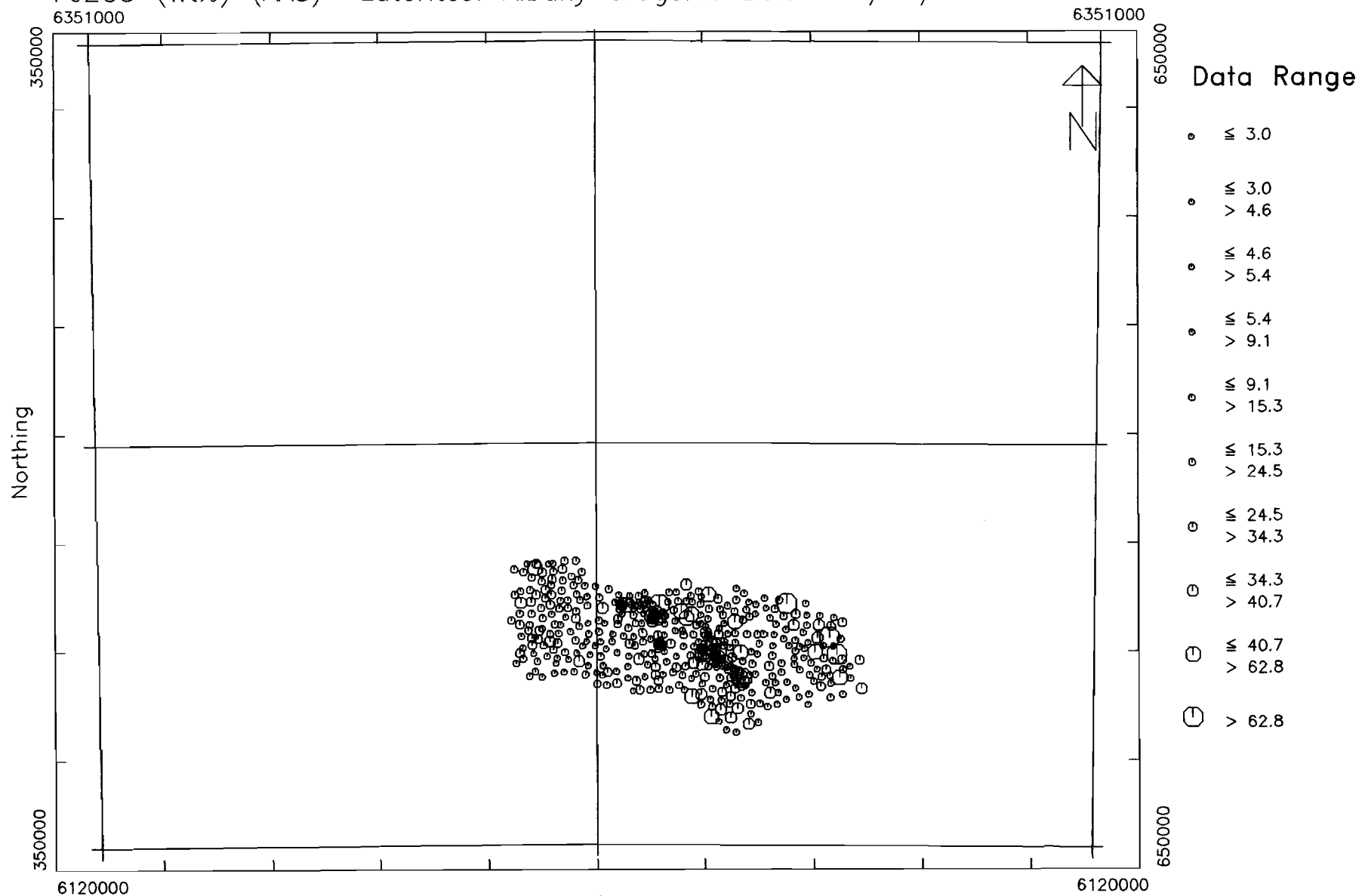
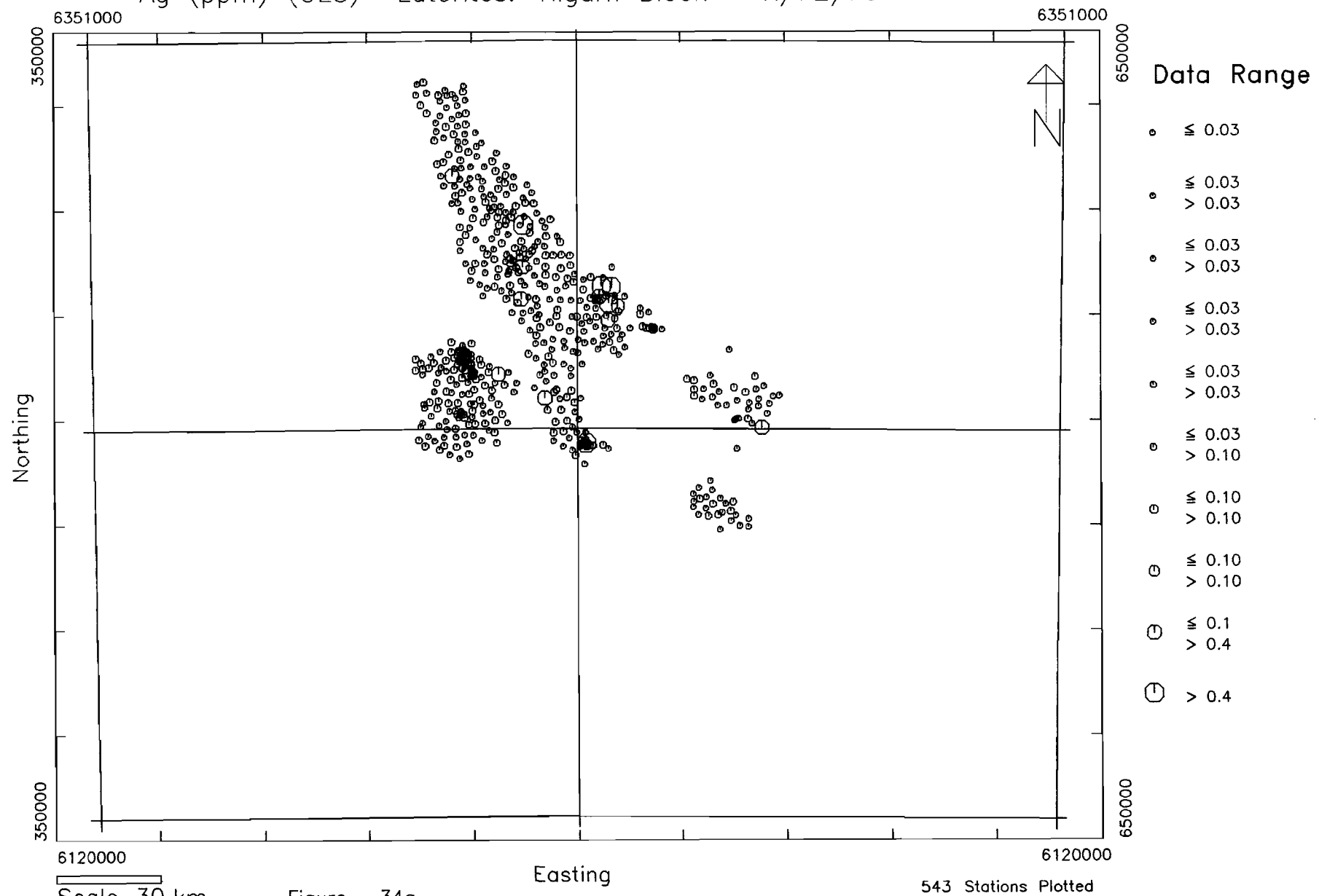
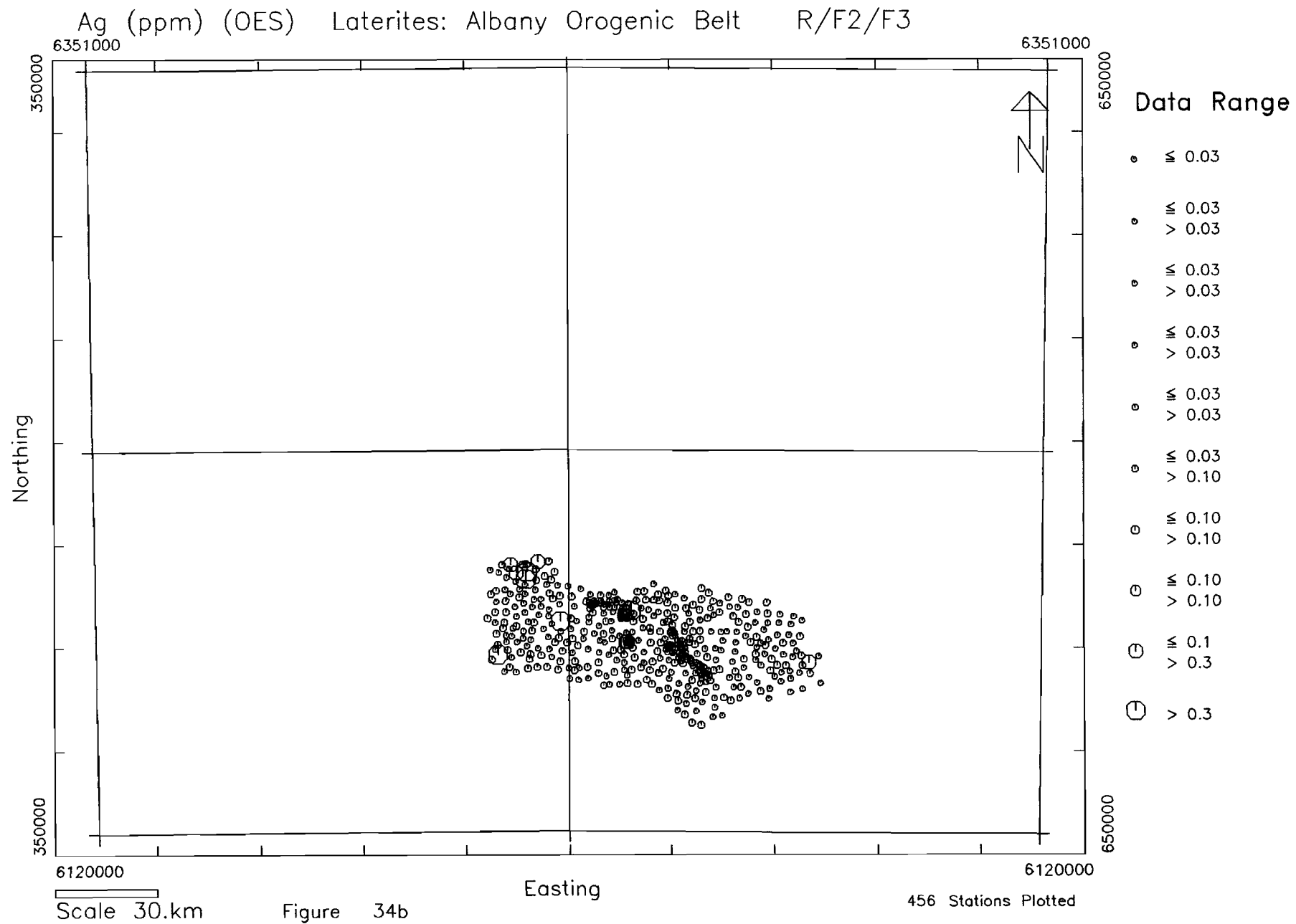


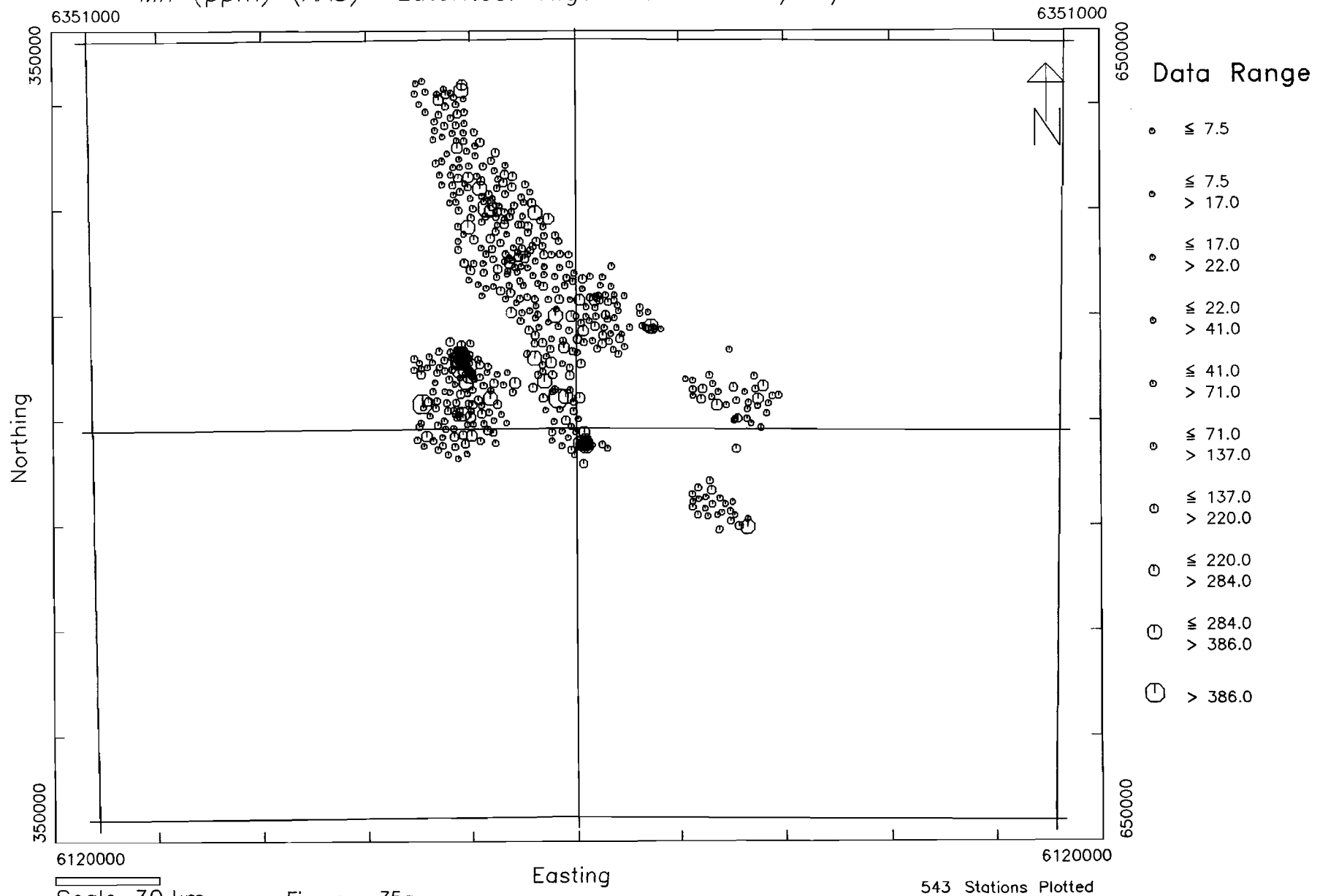
Figure 33b

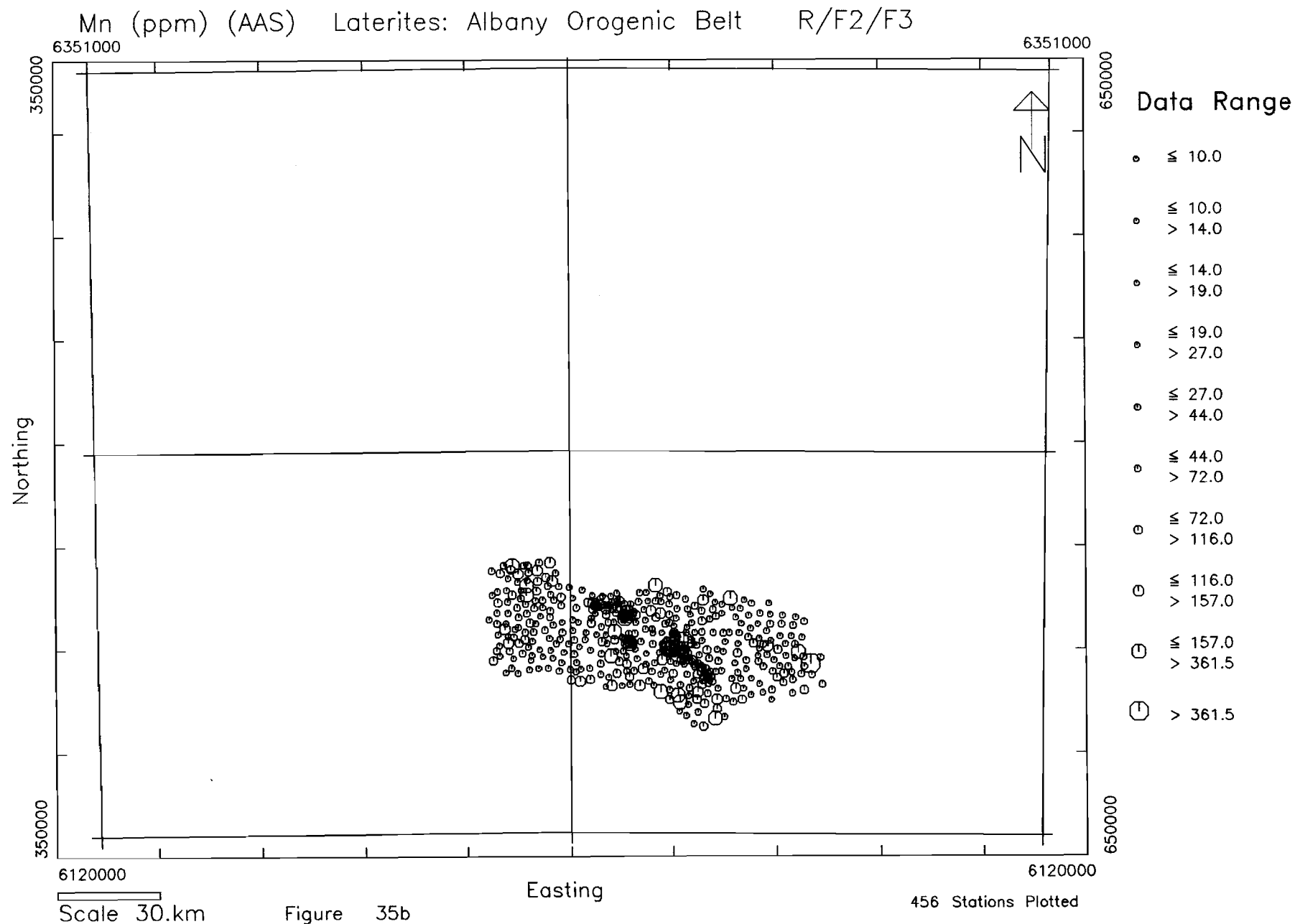
Ag (ppm) (OES) Laterites: Yilgarn Block R/F2/F3

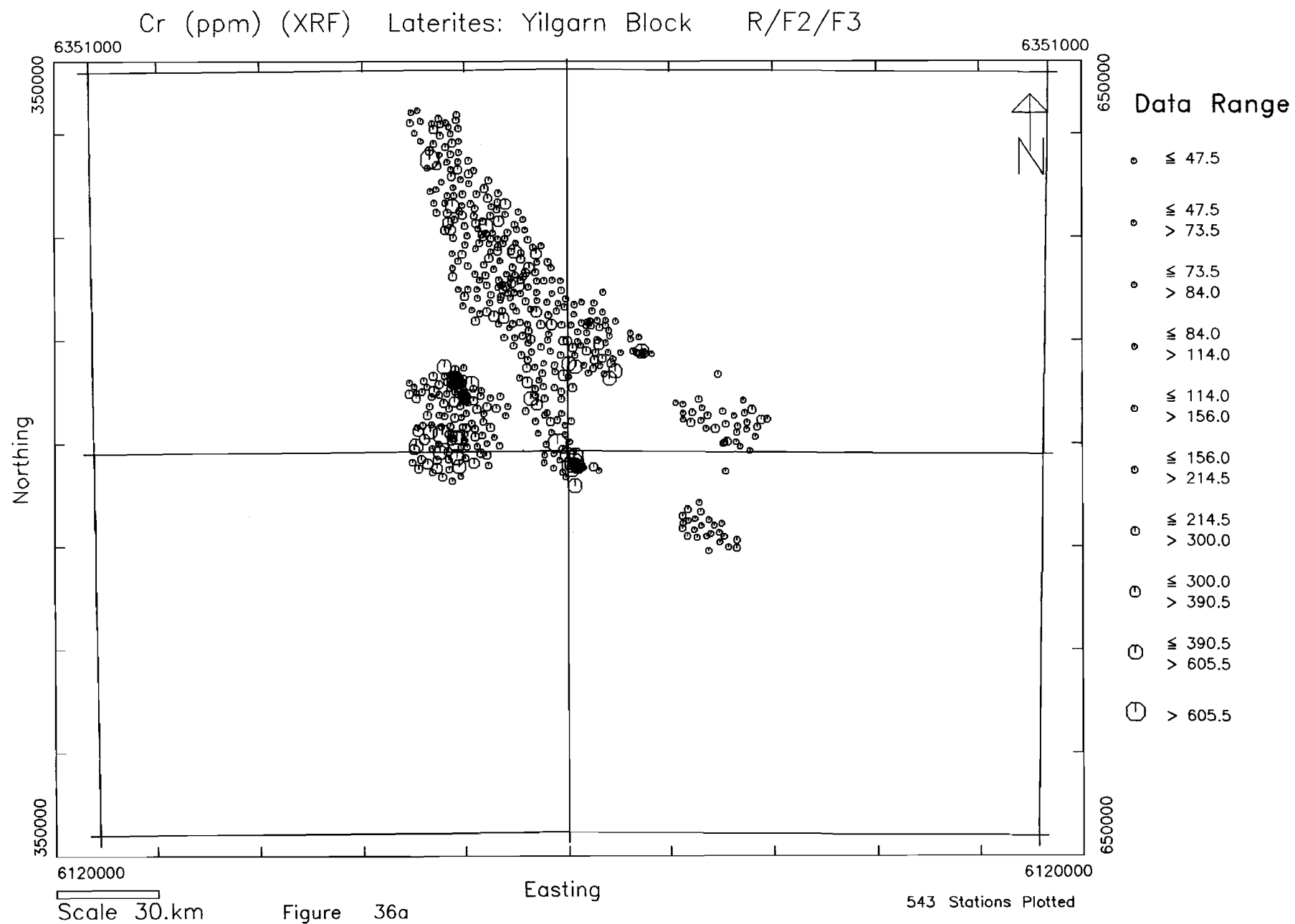


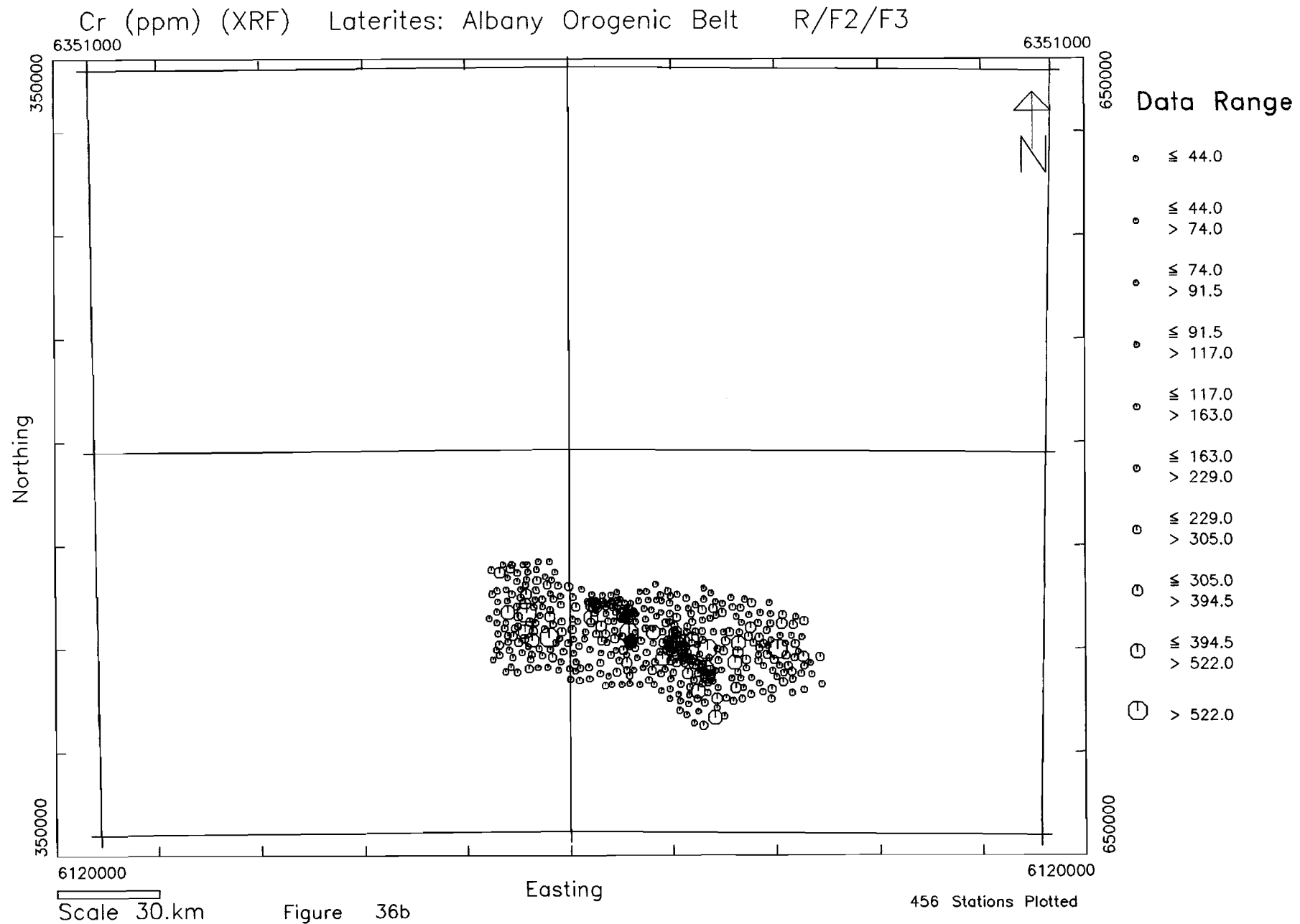


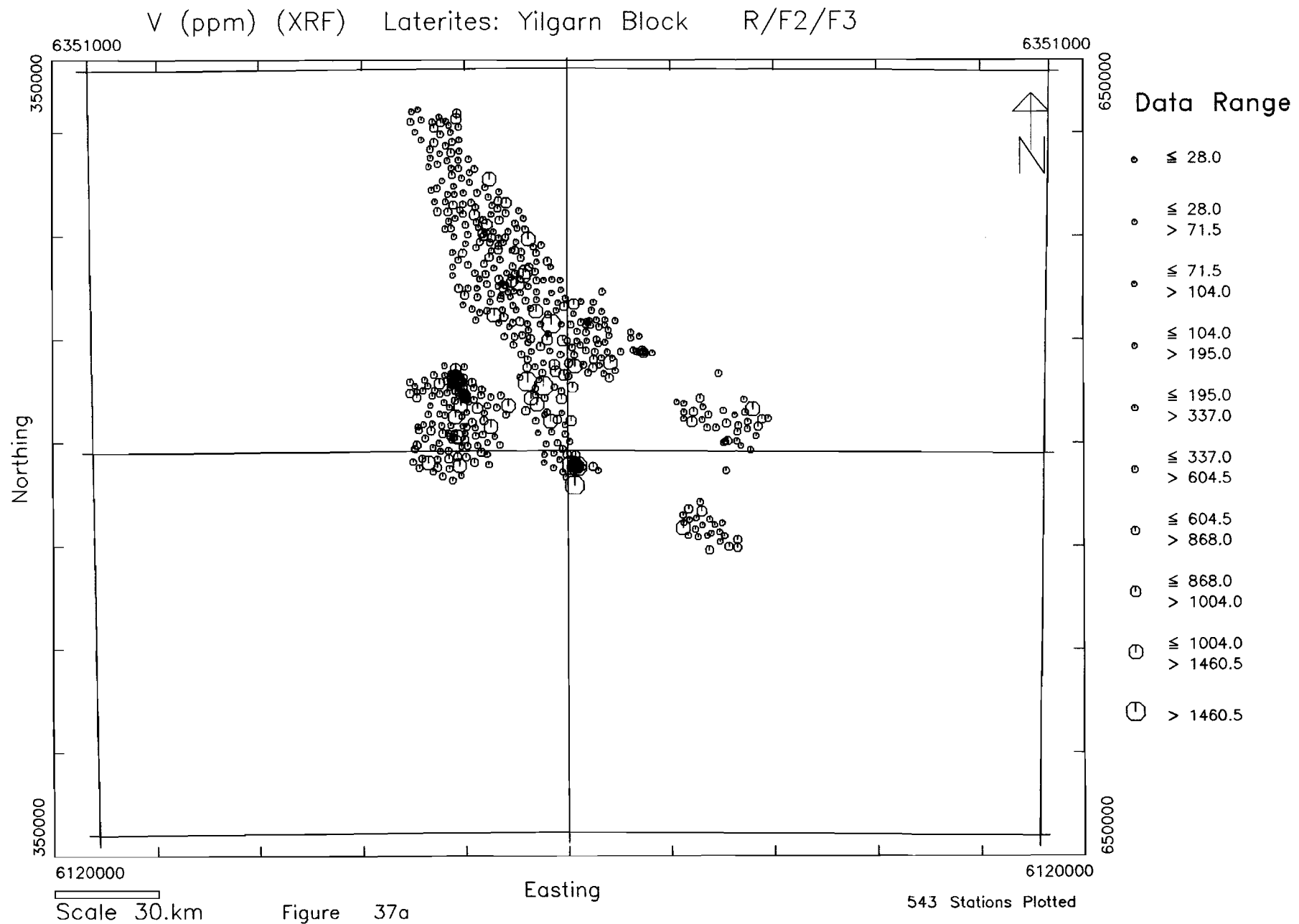
Mn (ppm) (AAS) Laterites: Yilgarn Block R/F2/F3

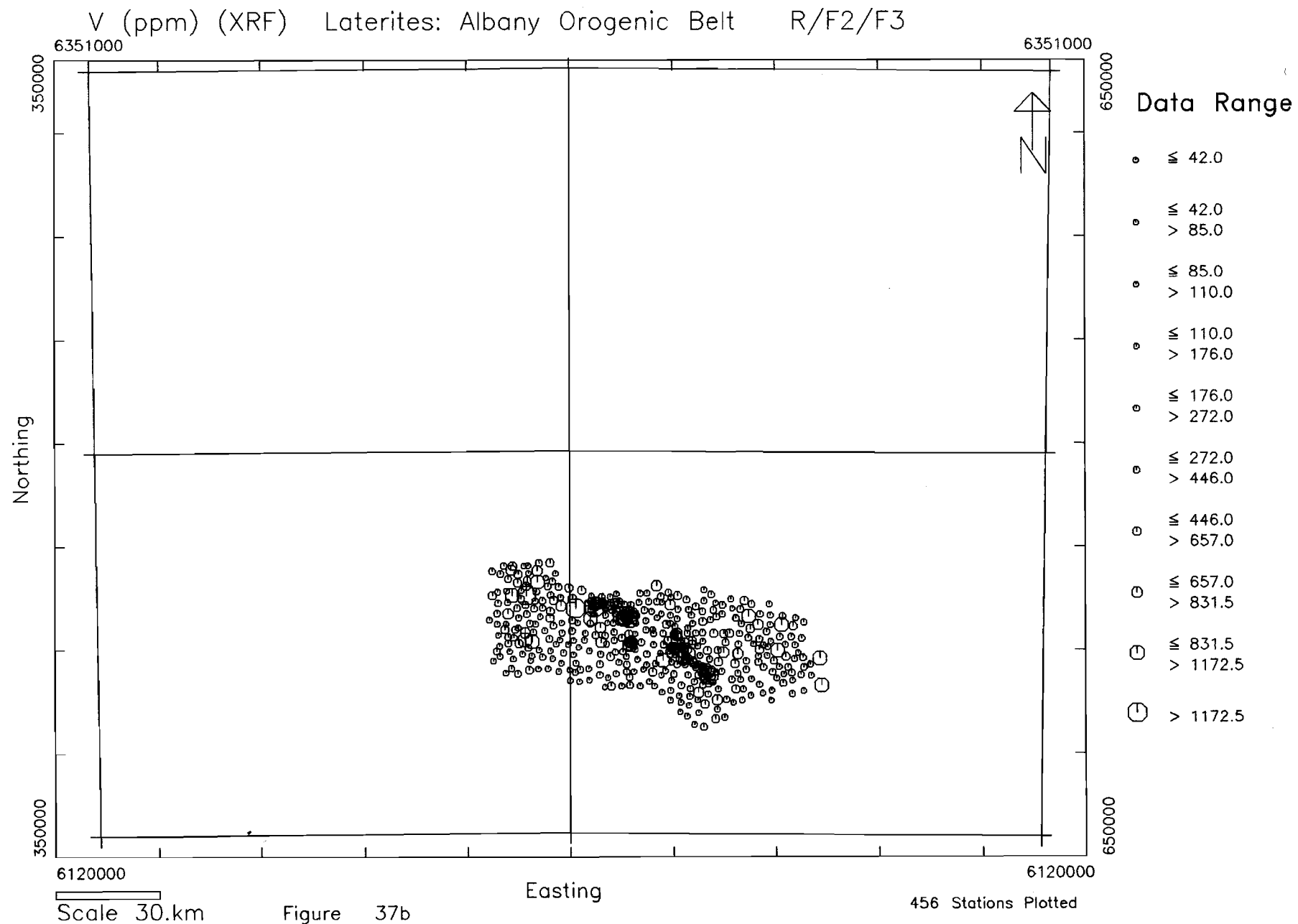


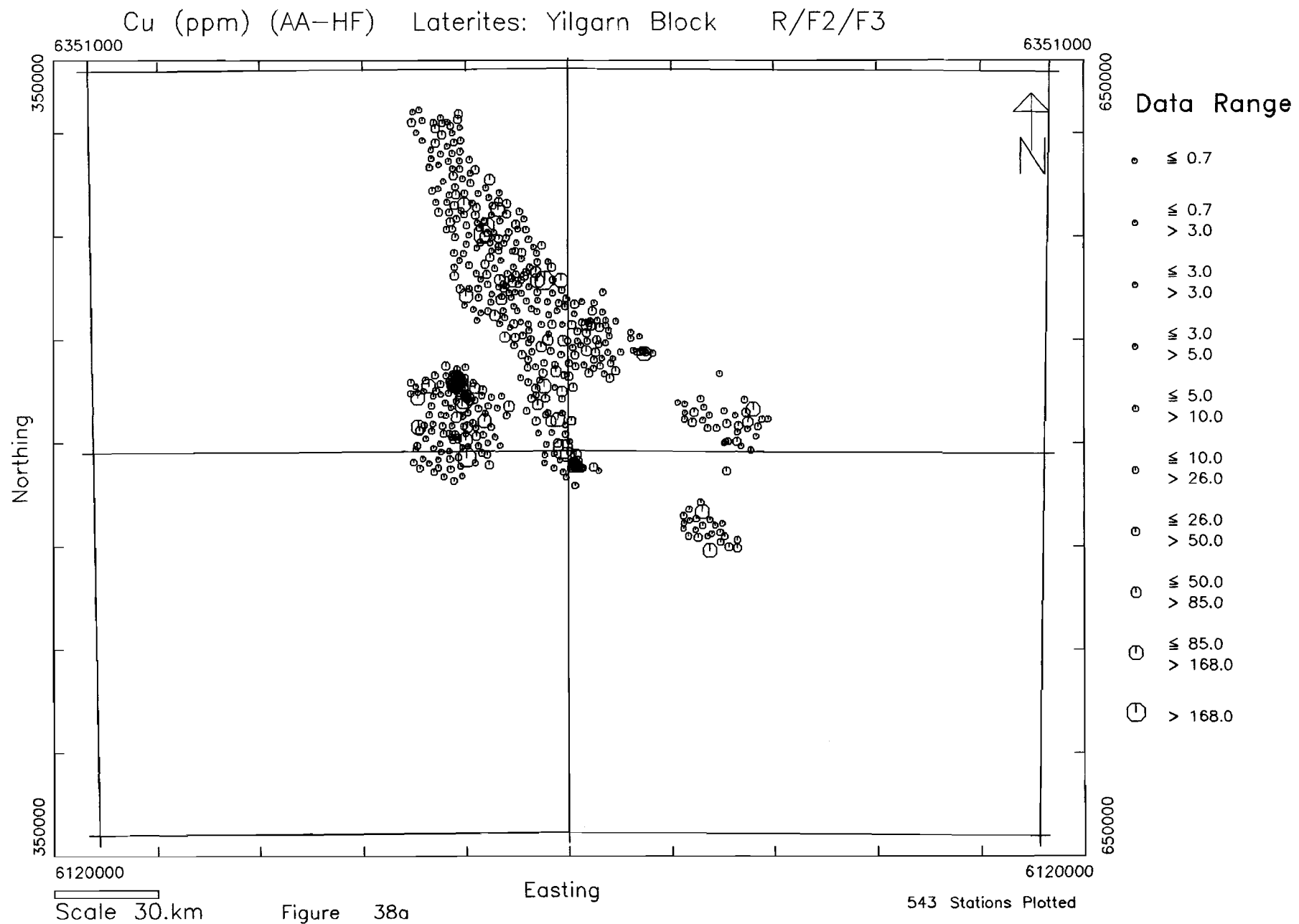


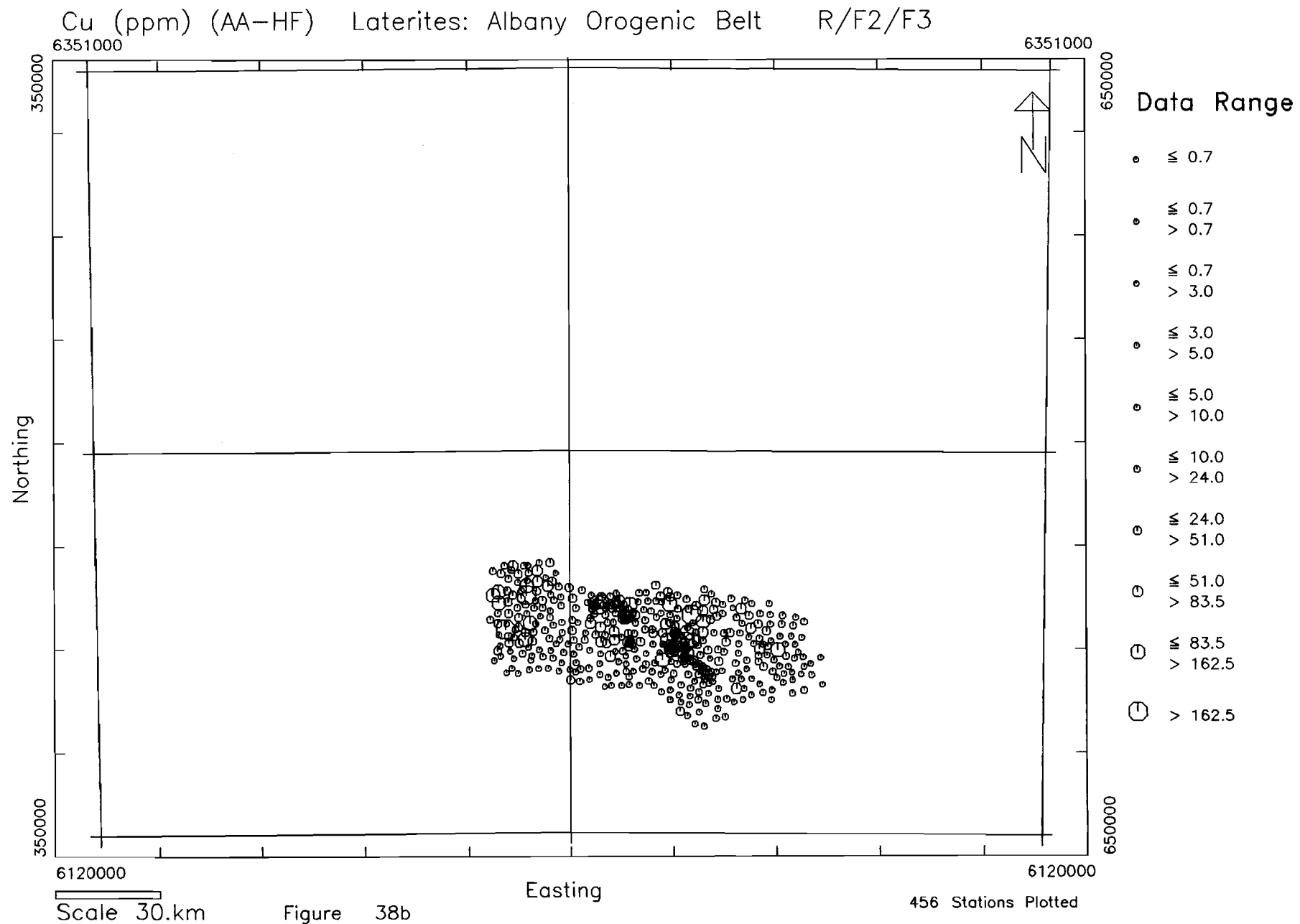


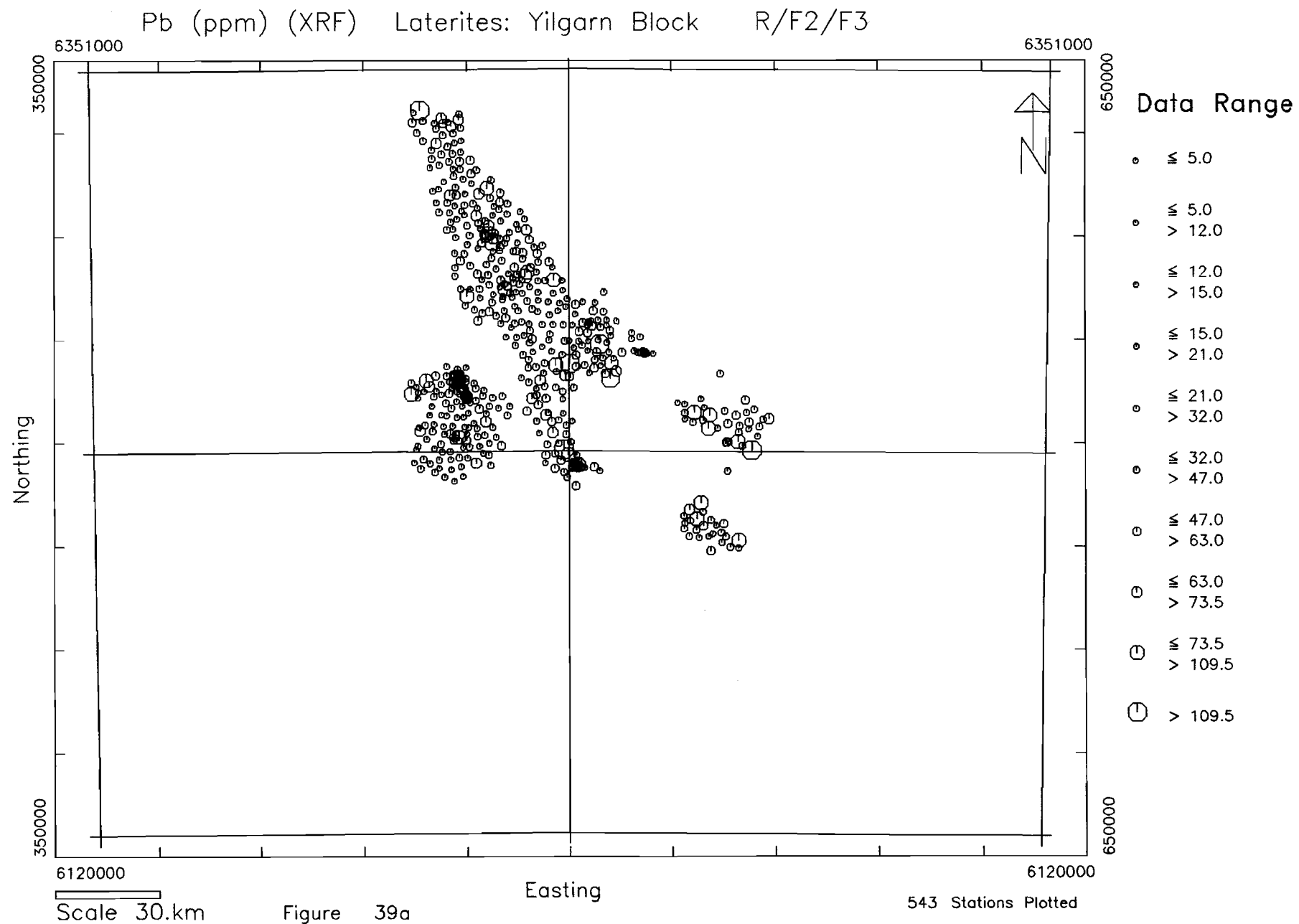


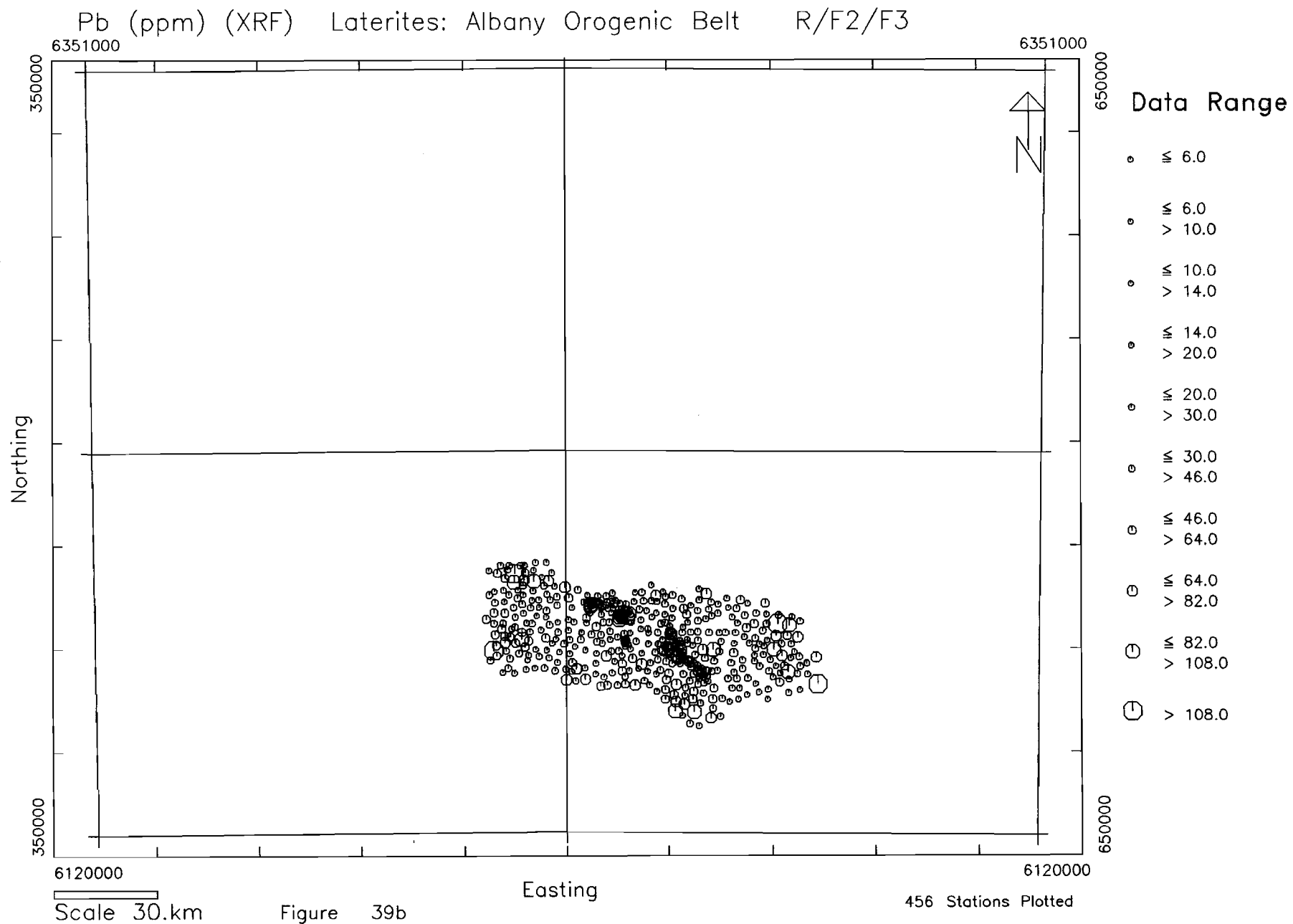


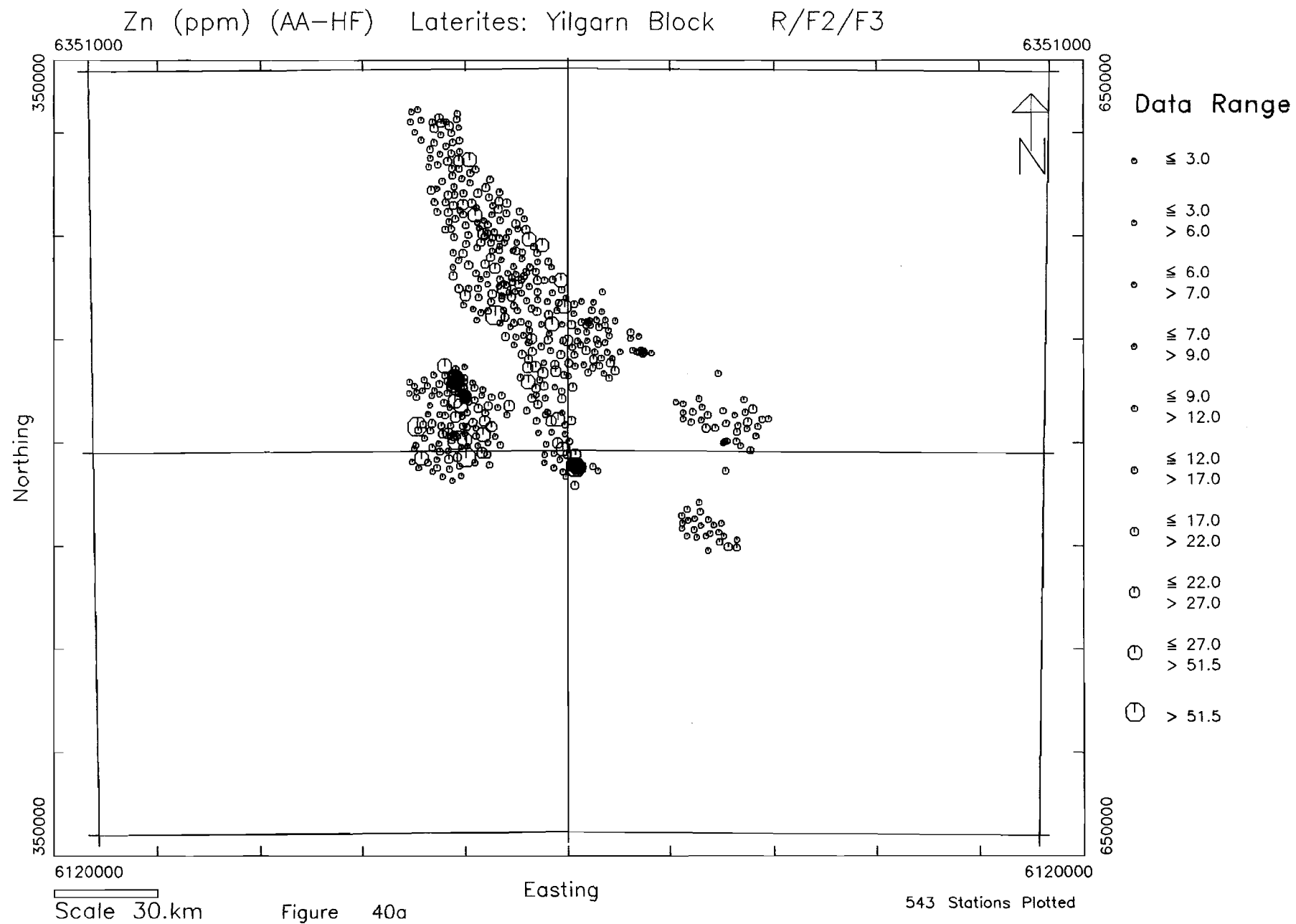


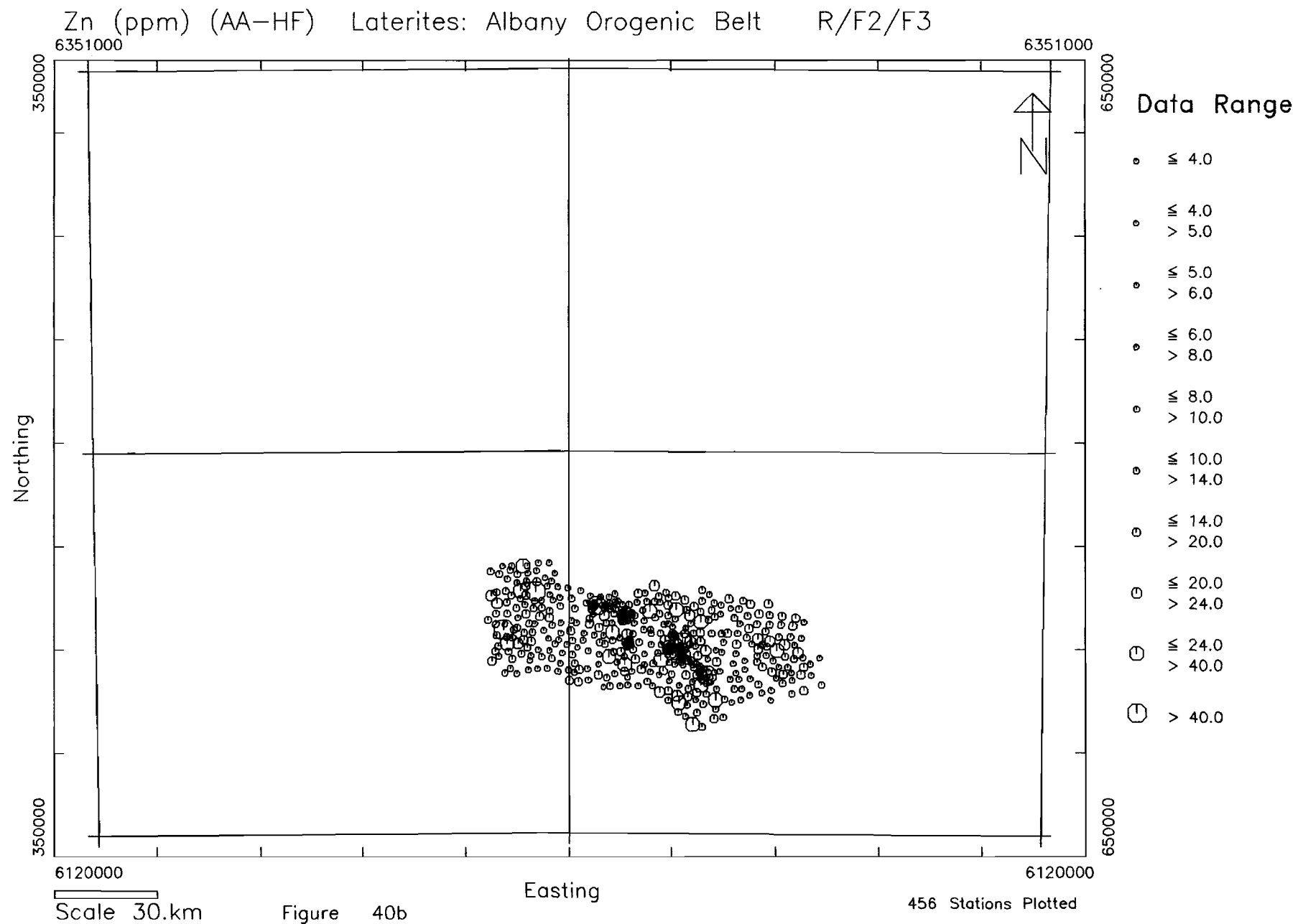




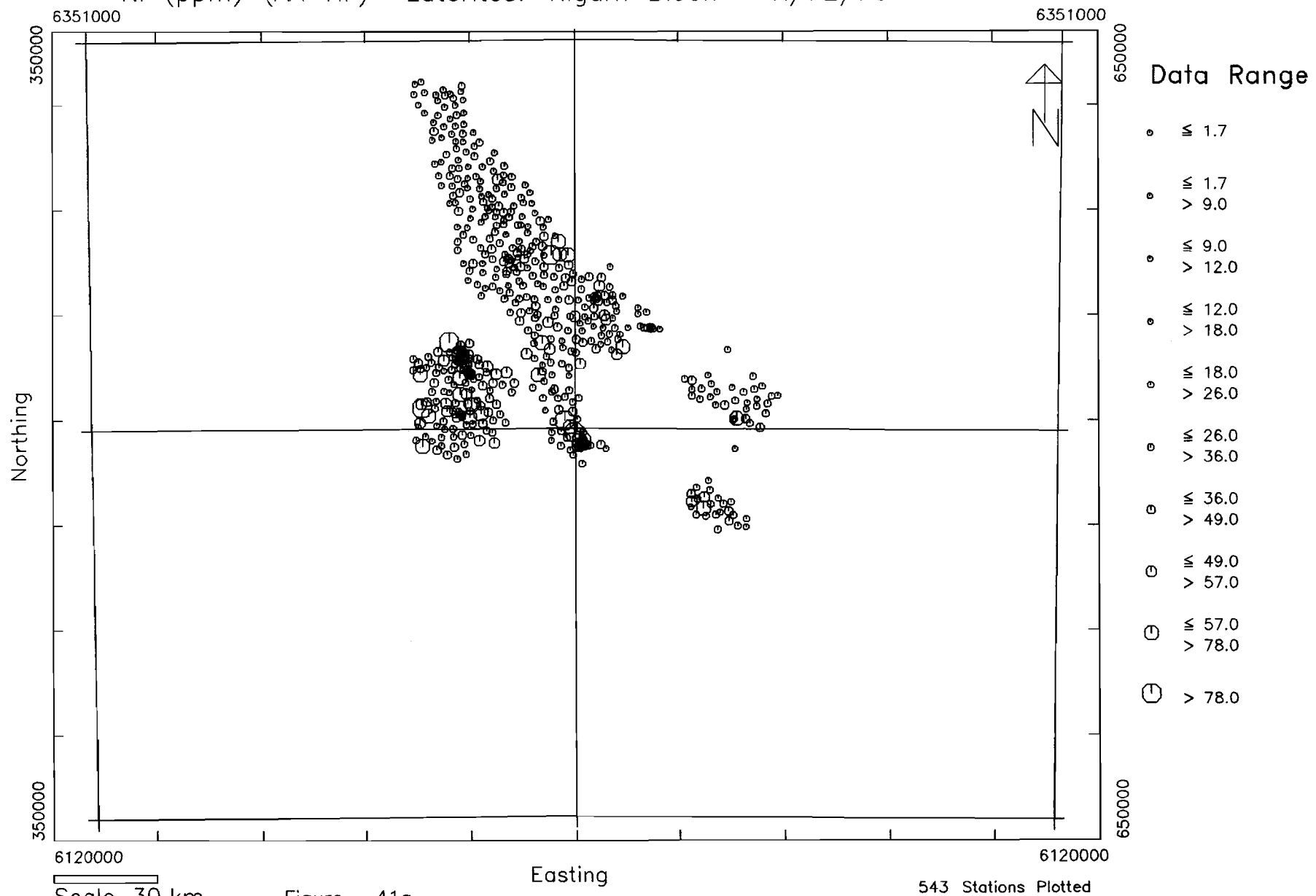


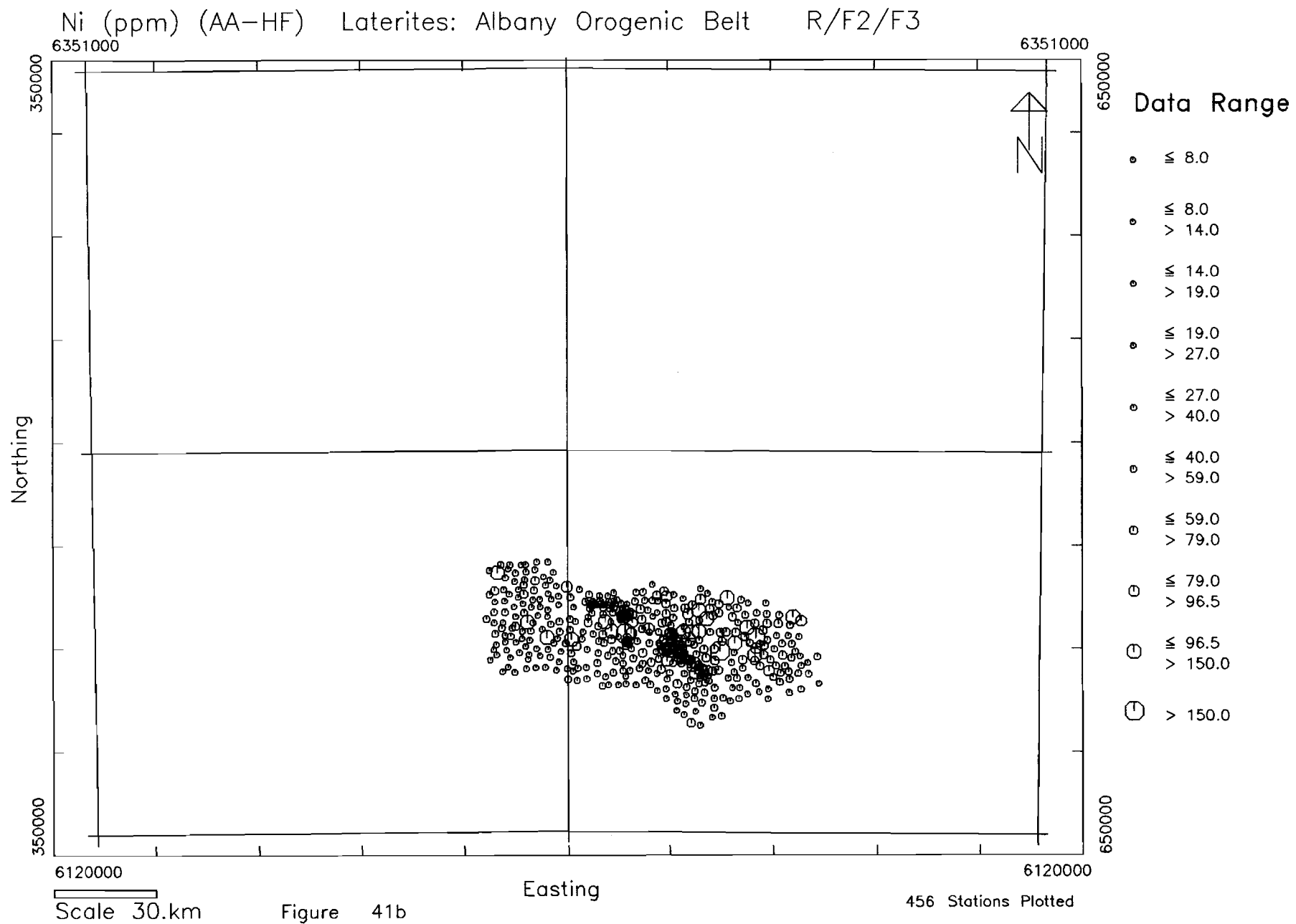


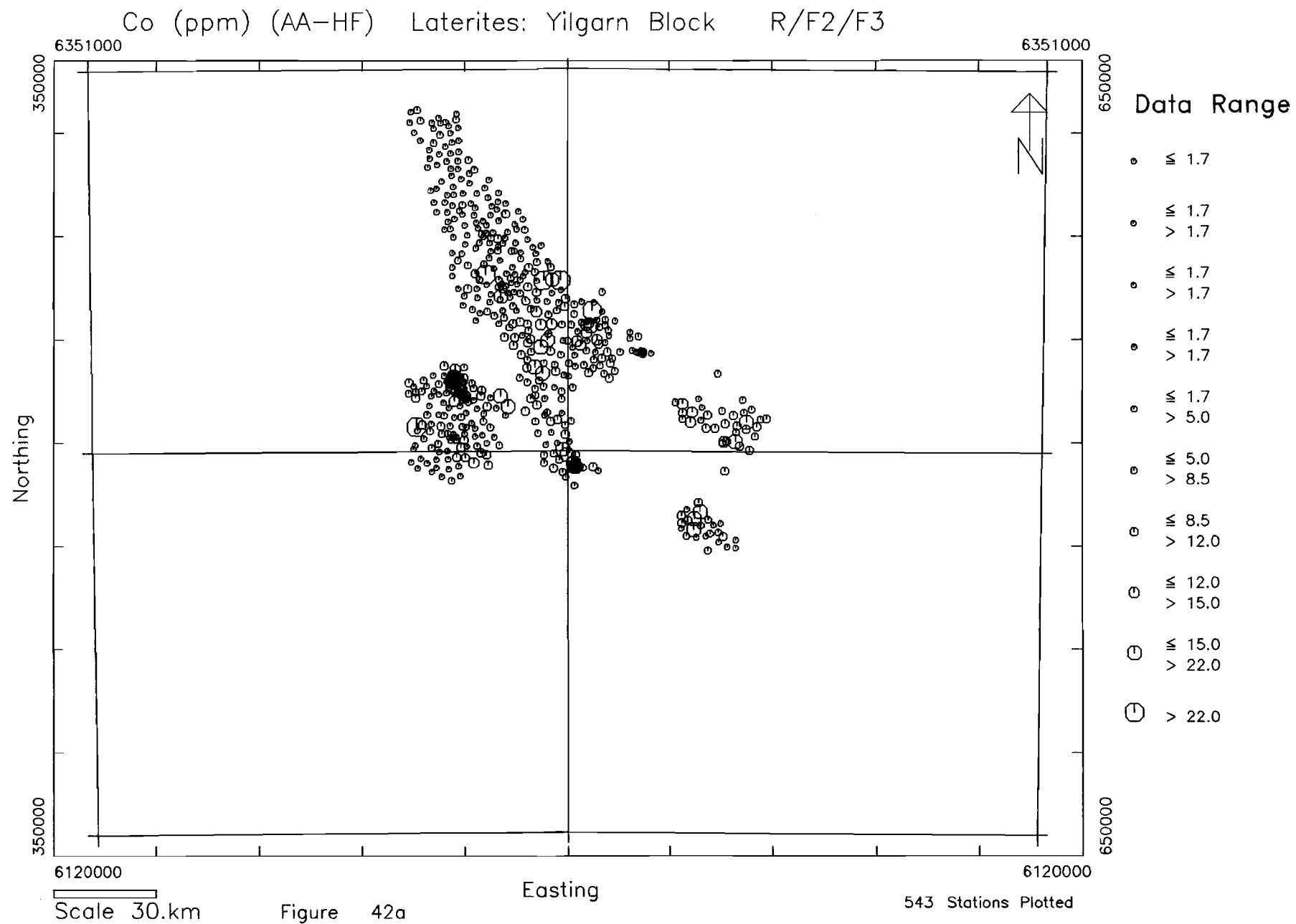


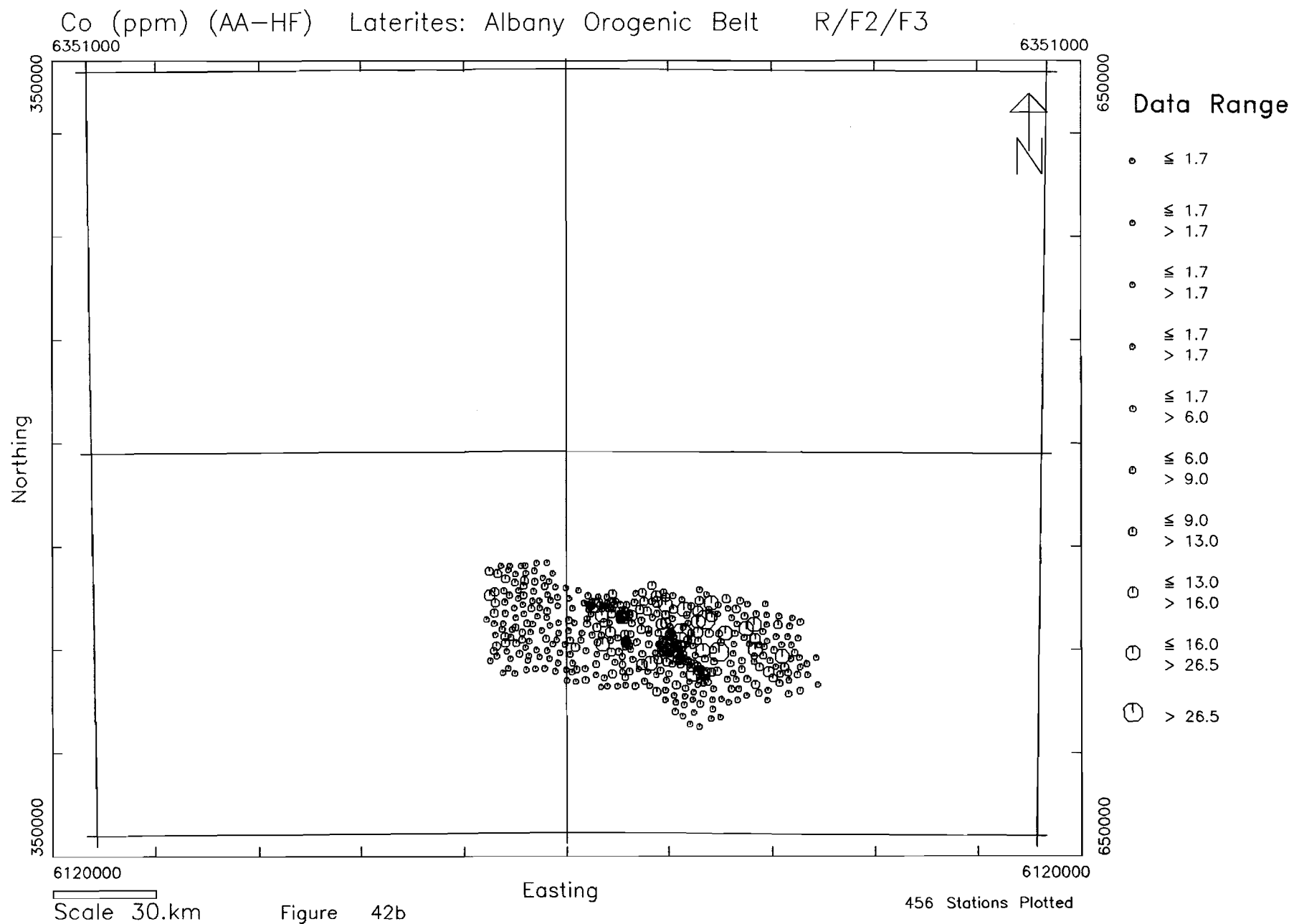


Ni (ppm) (AA-HF) Laterites: Yilgarn Block R/F2/F3

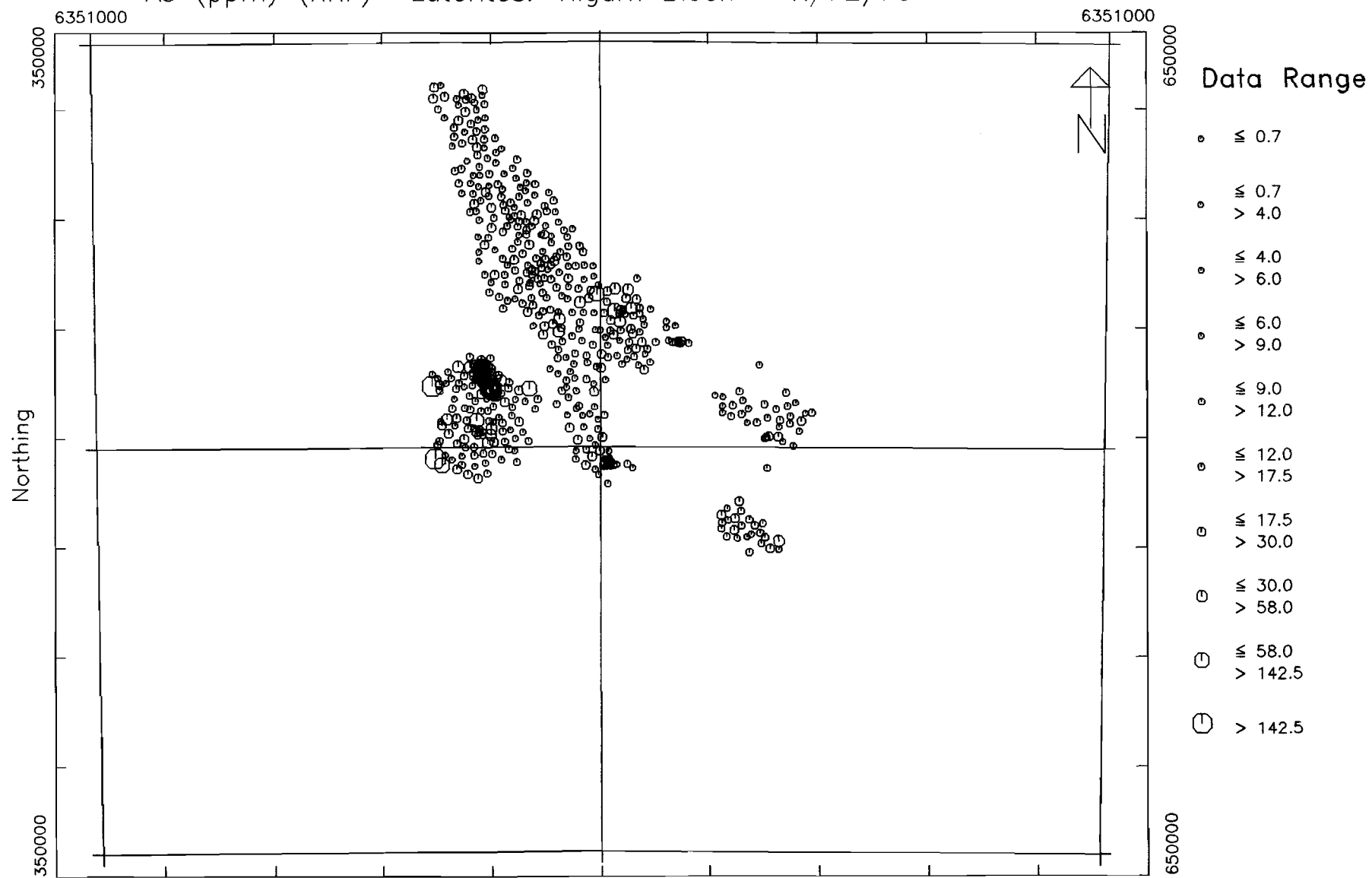




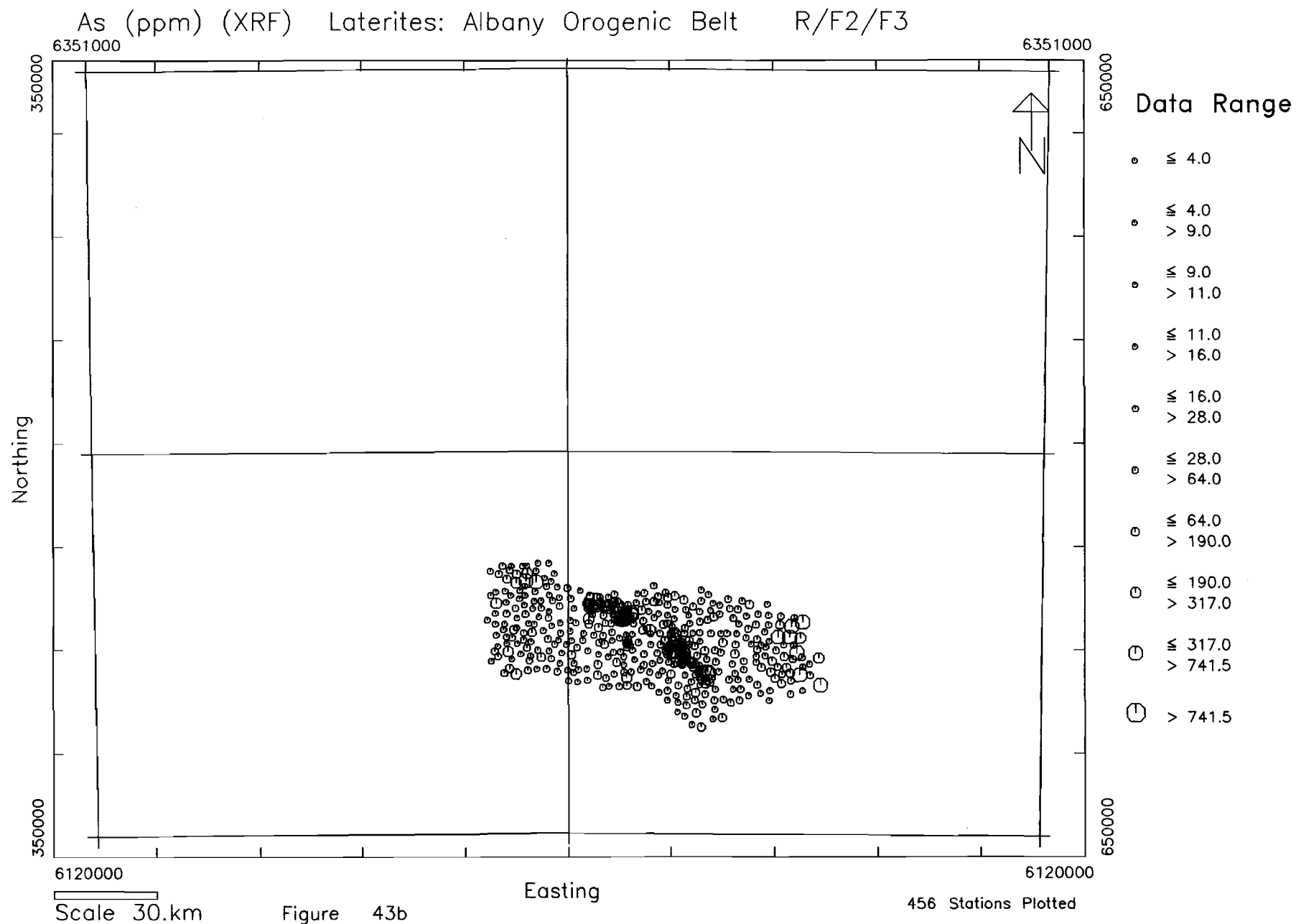




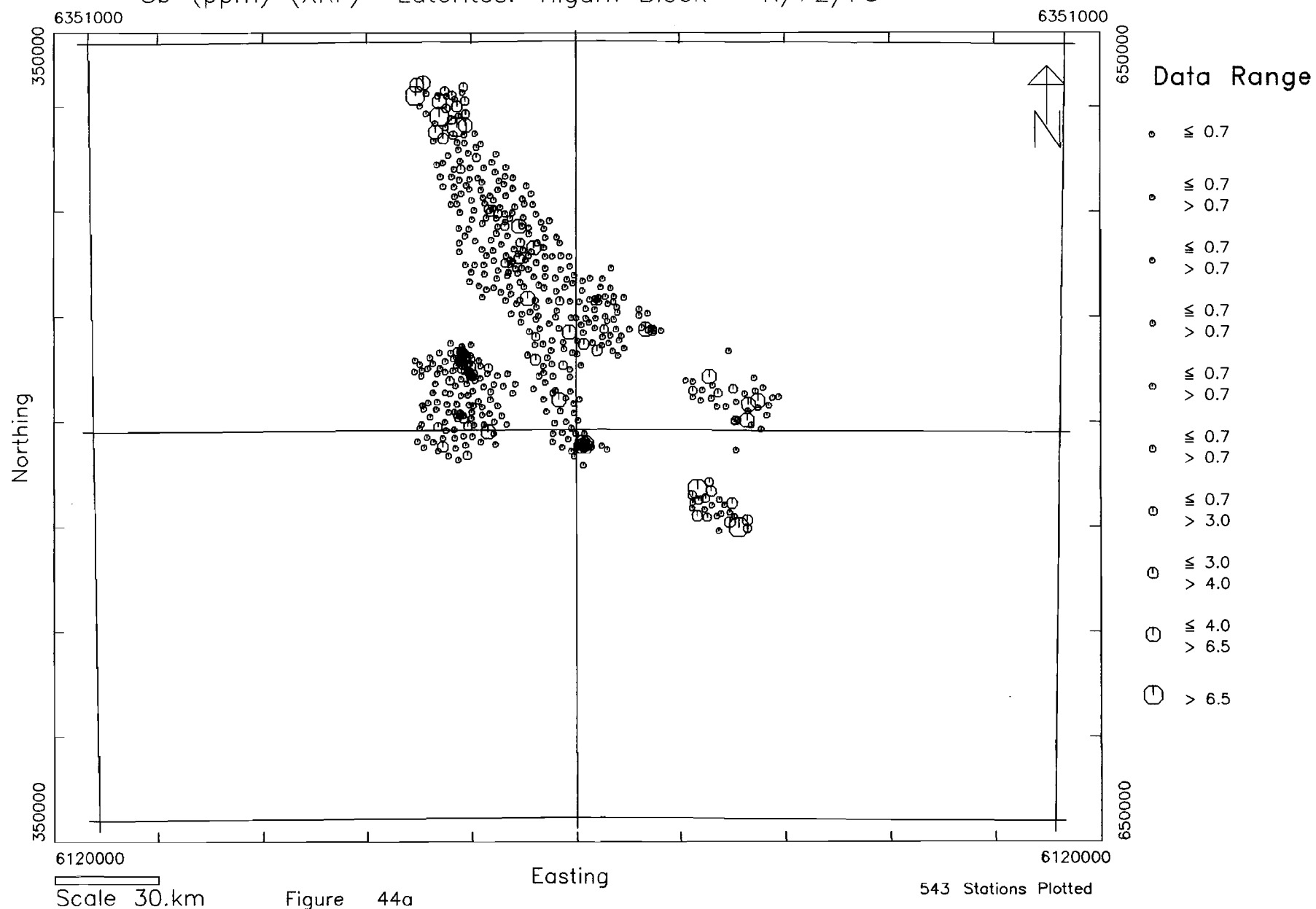
As (ppm) (XRF) Laterites: Yilgarn Block R/F2/F3

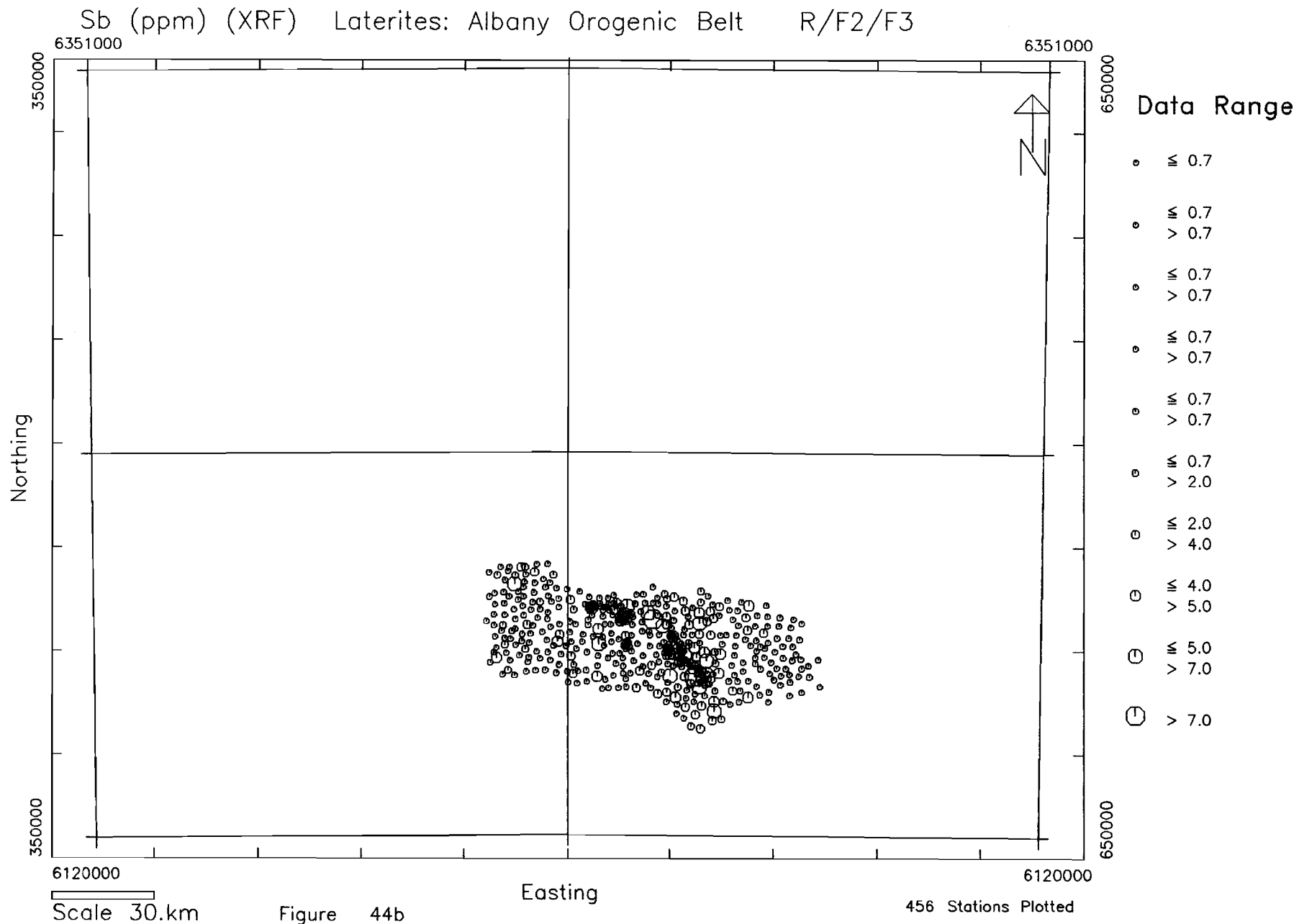


Scale 30.km Figure 43a 543 Stations Plotted

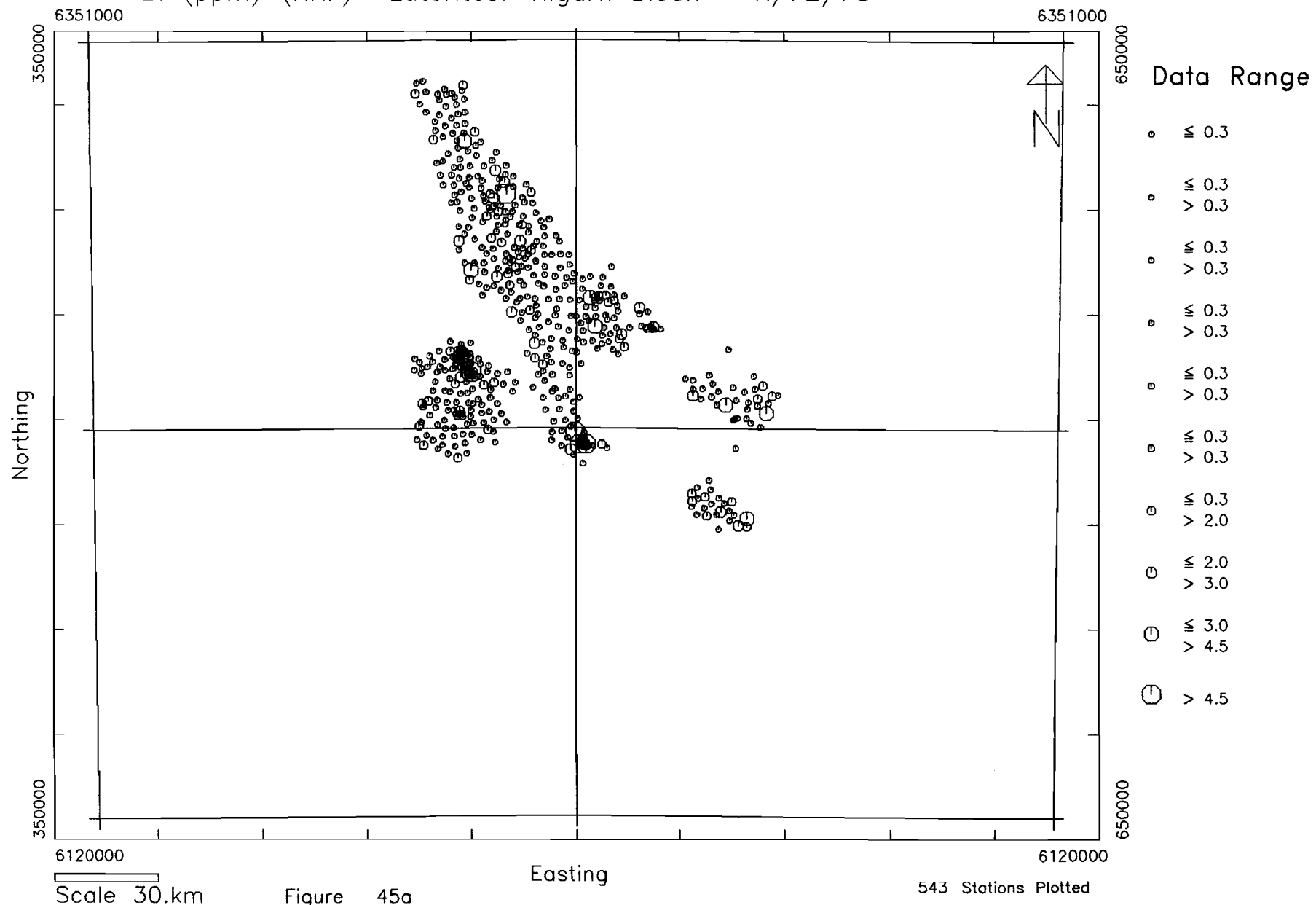


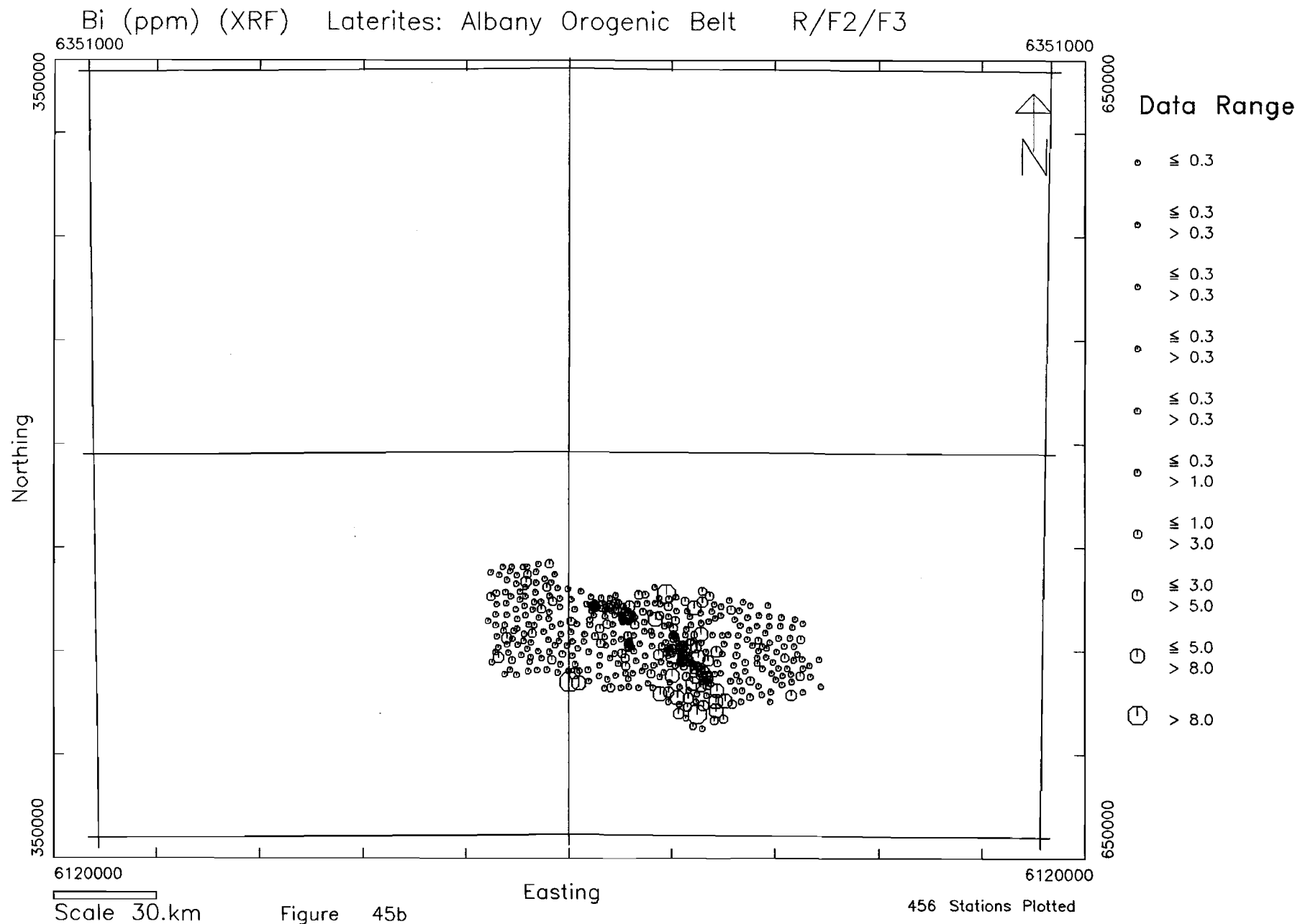
Sb (ppm) (XRF) Laterites: Yilgarn Block R/F2/F3

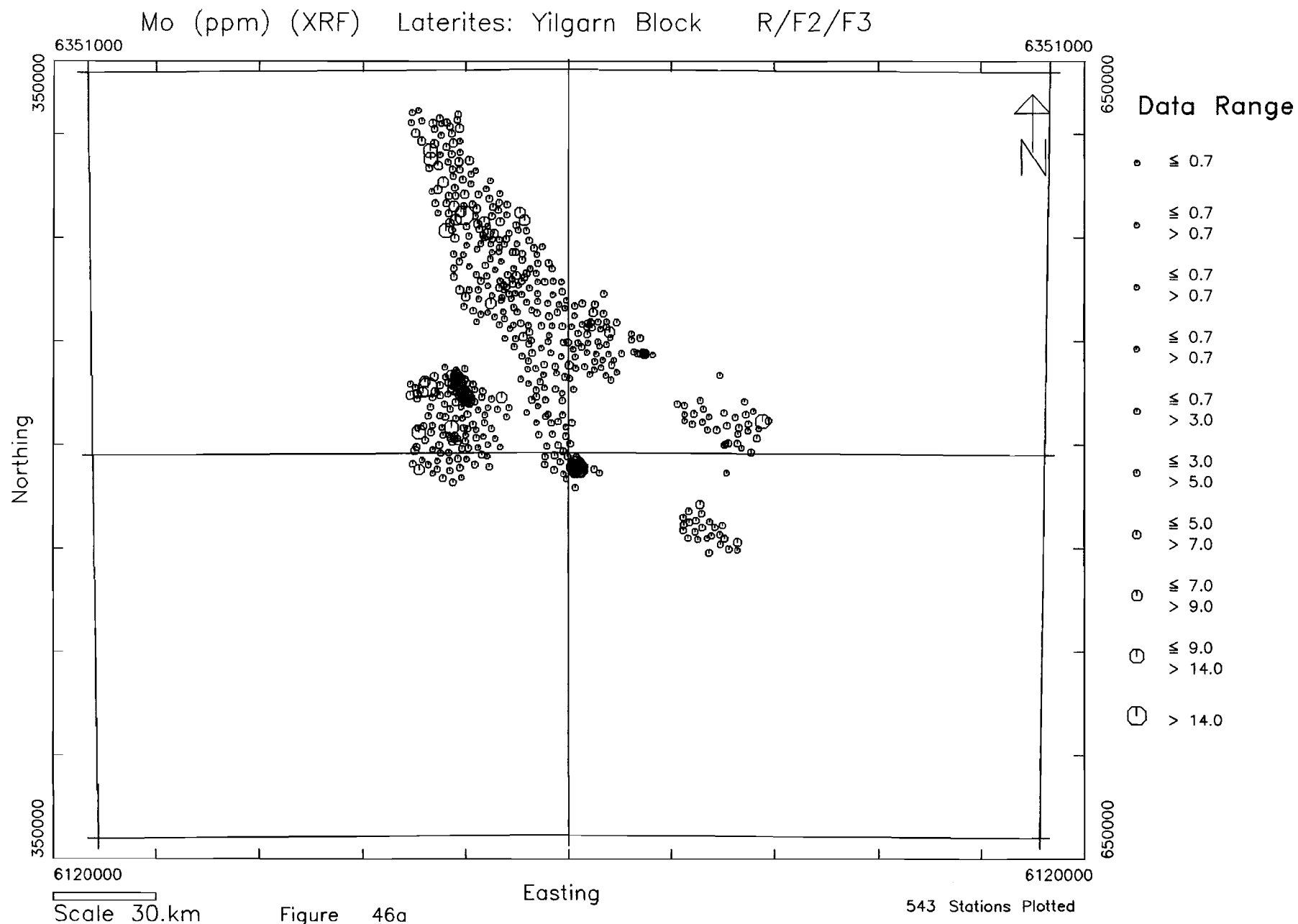


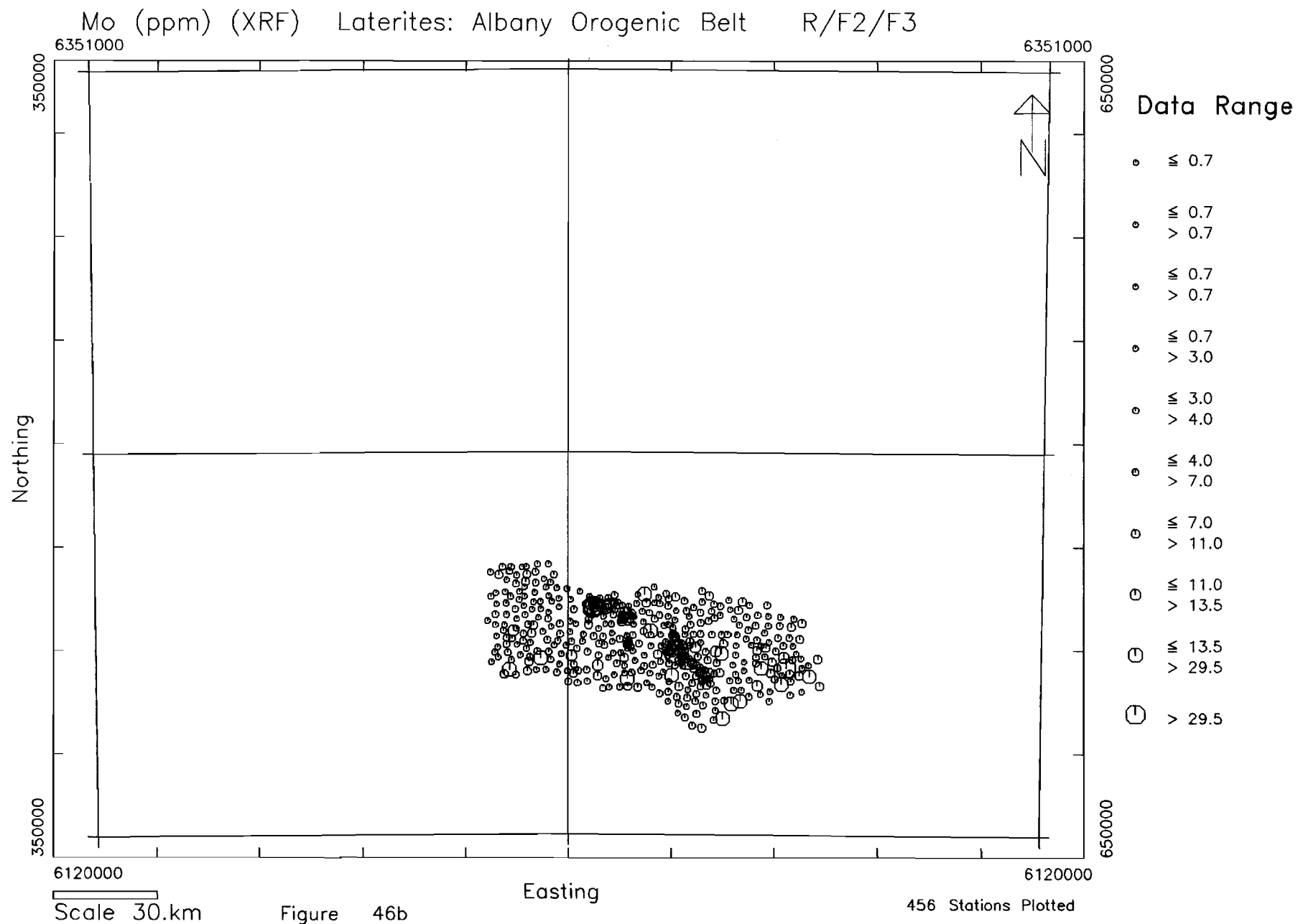


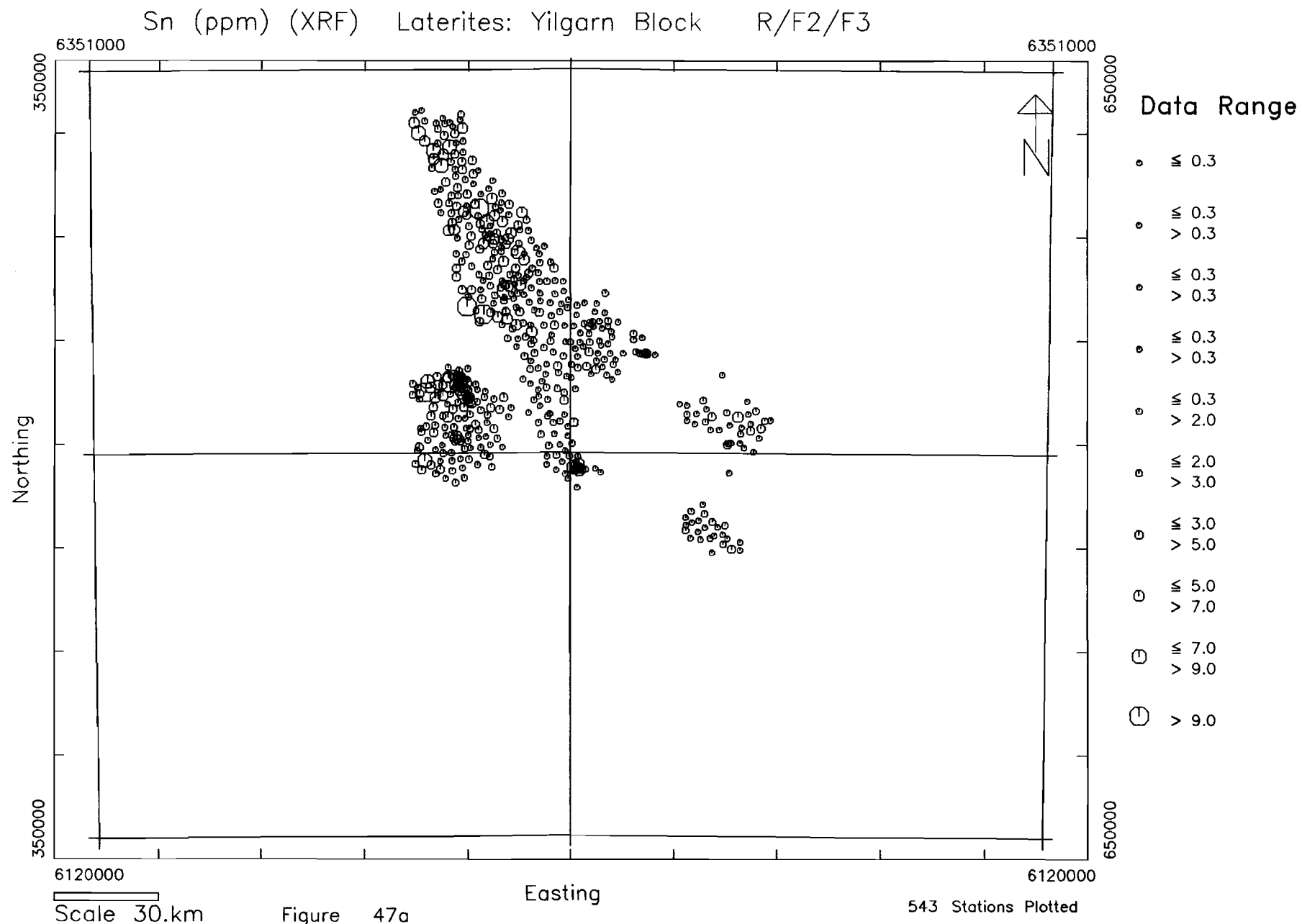
Bi (ppm) (XRF) Laterites: Yilgarn Block R/F2/F3



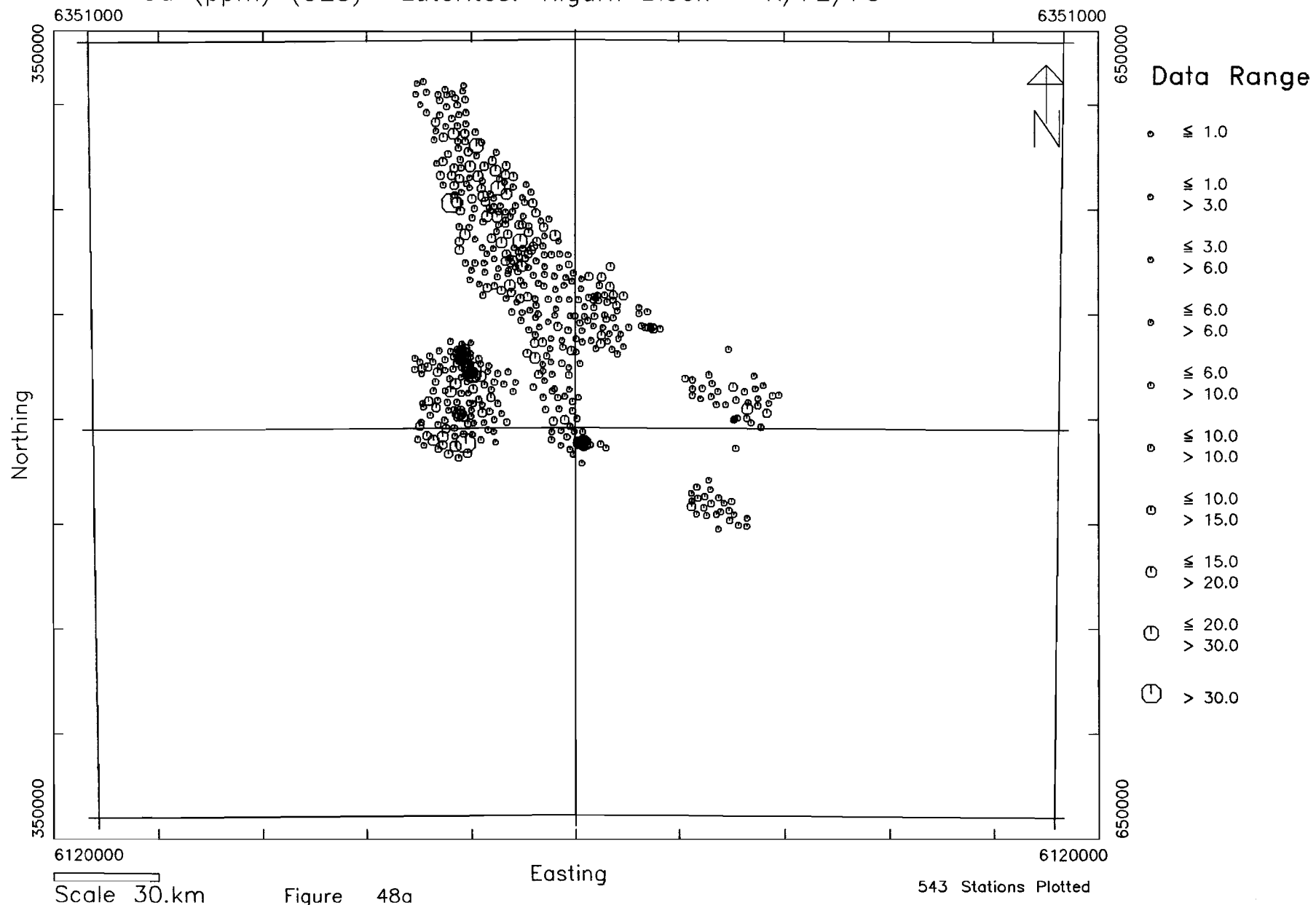


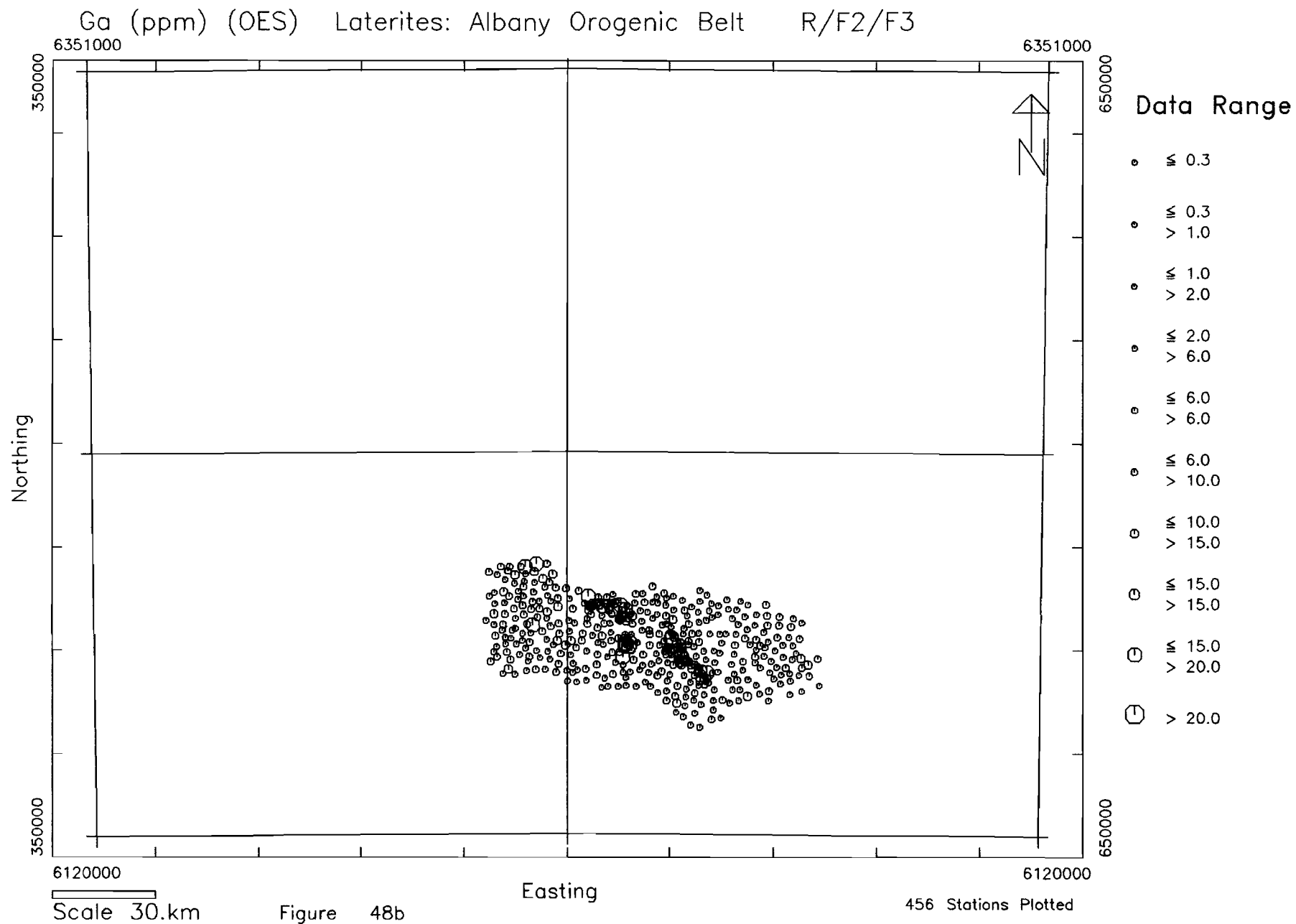




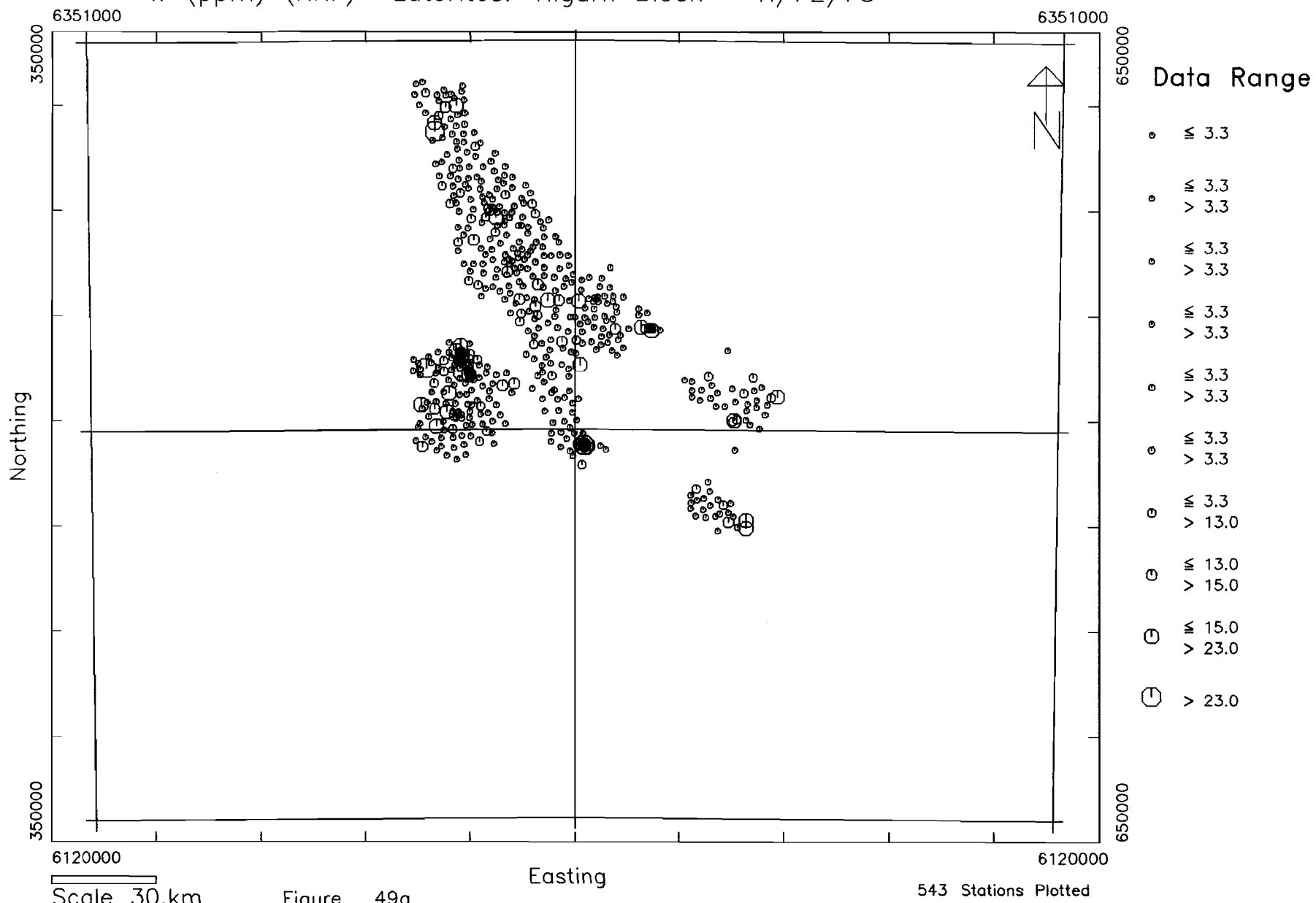


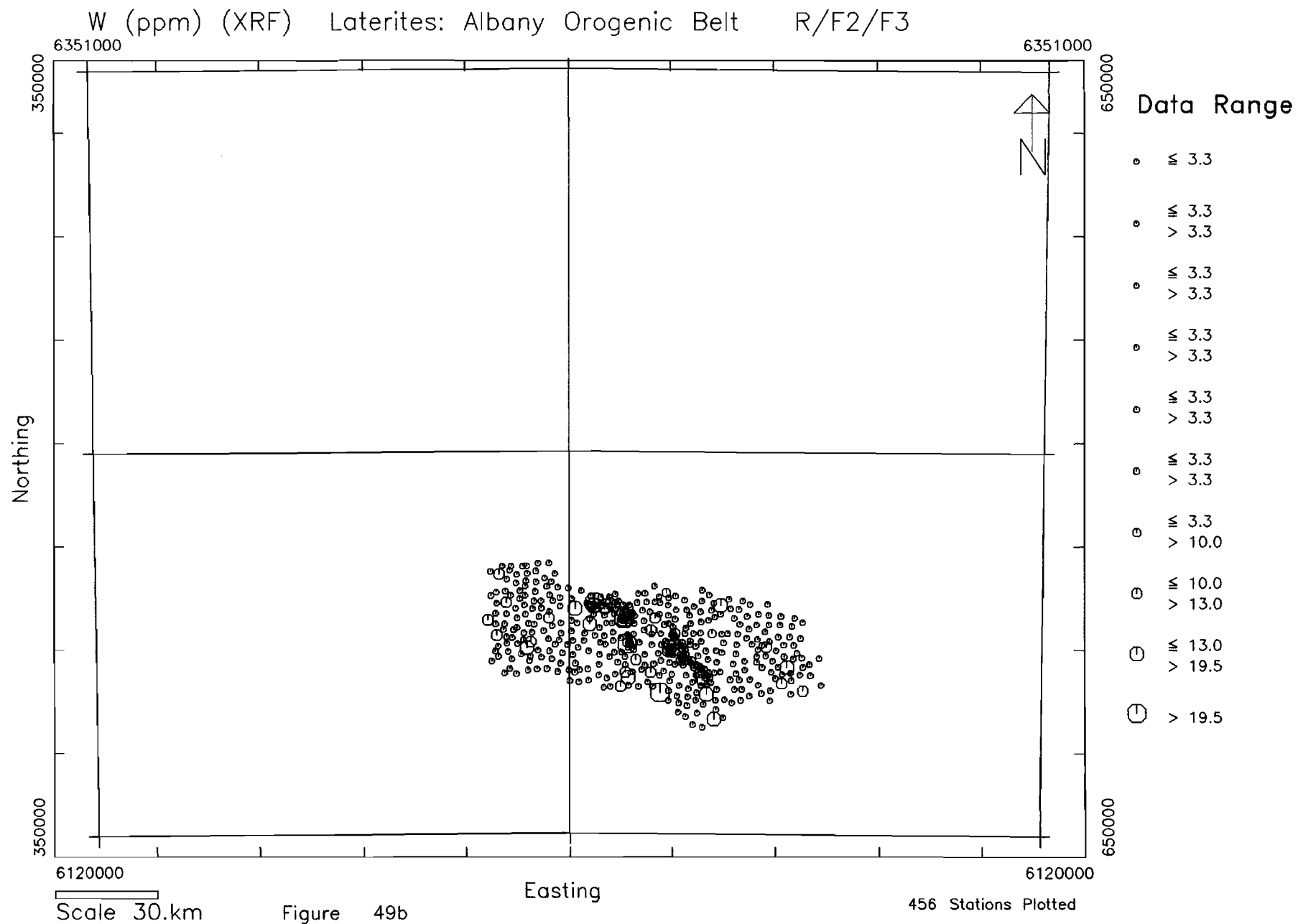
Ga (ppm) (OES) Laterites: Yilgarn Block R/F2/F3

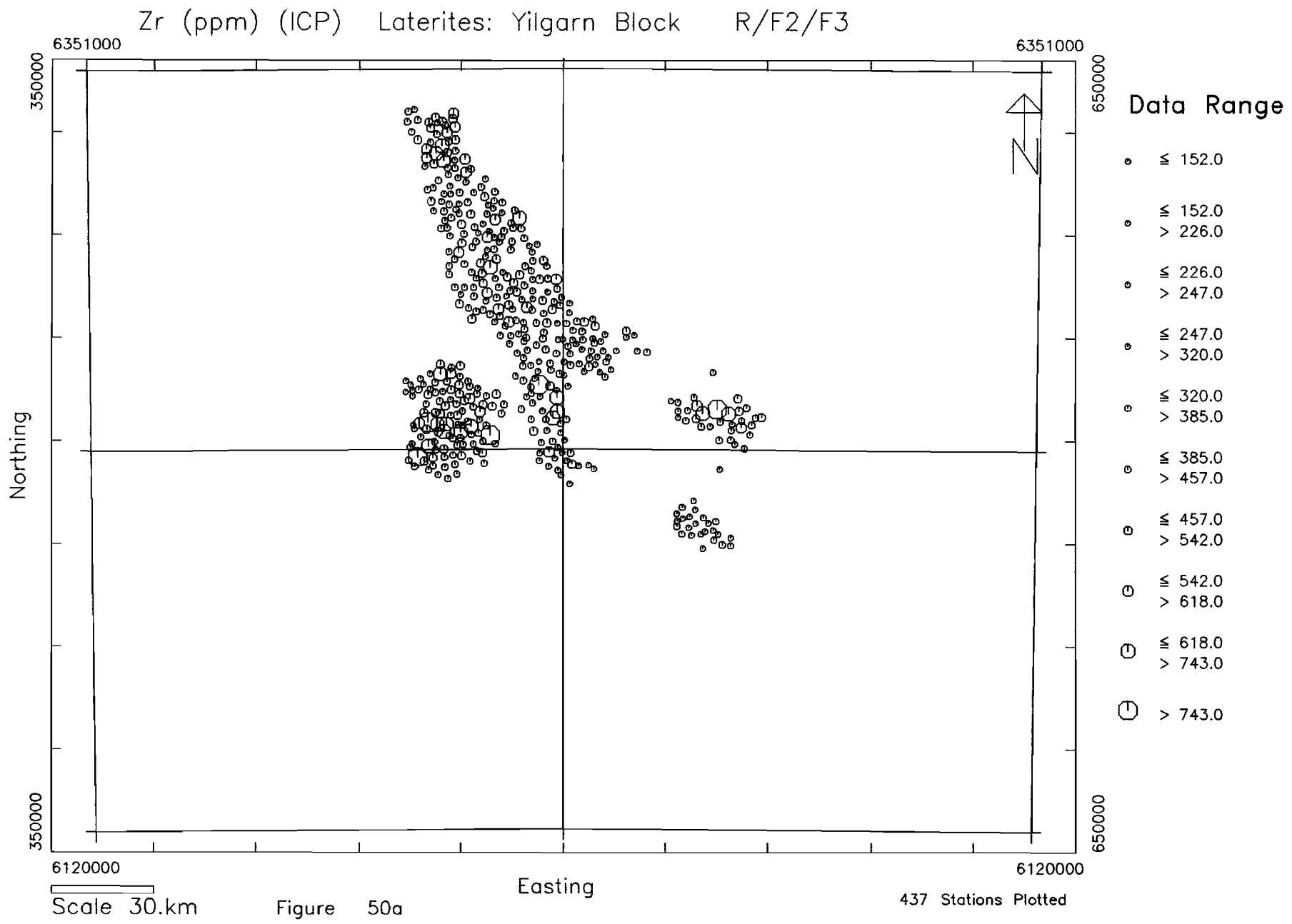


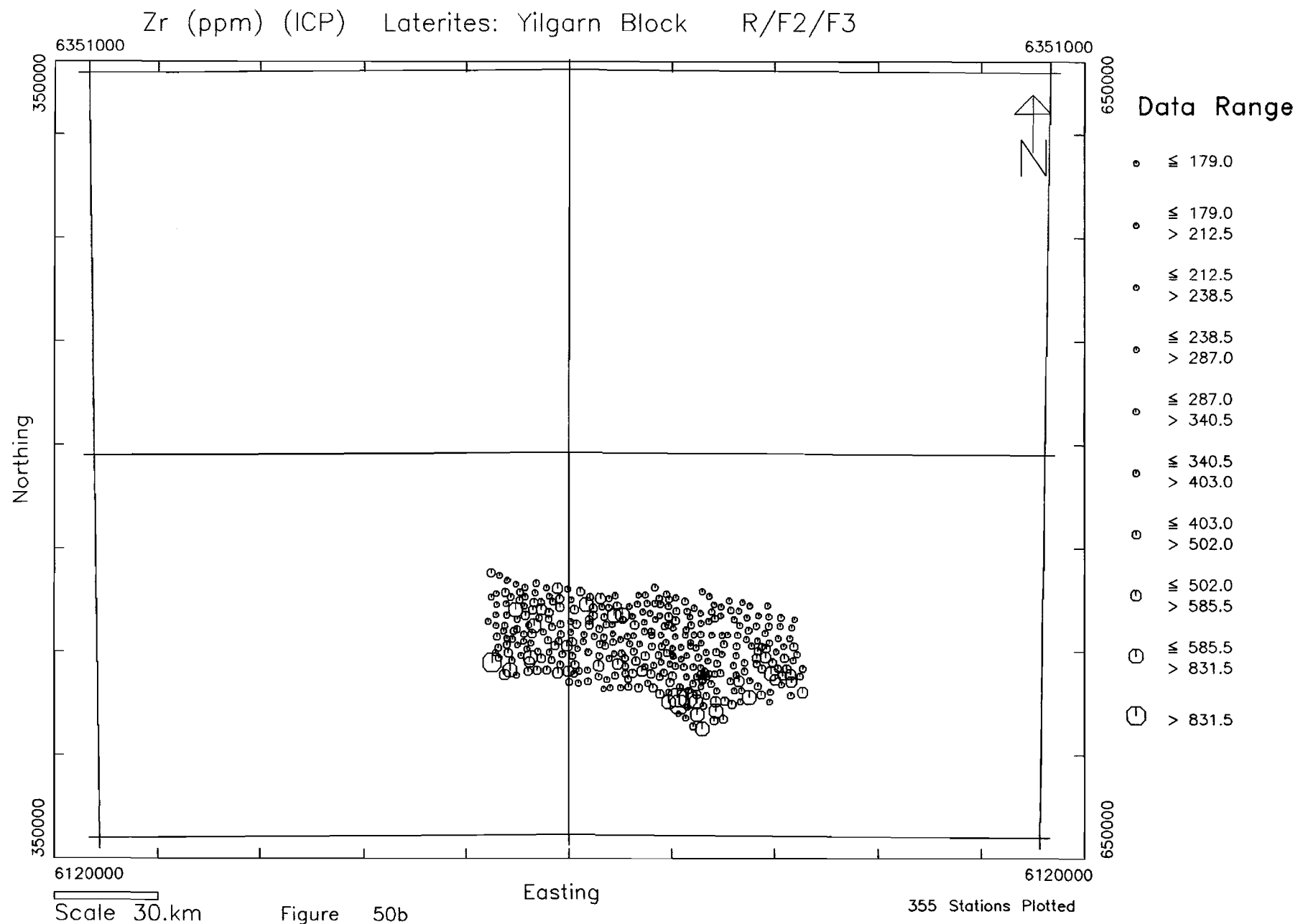


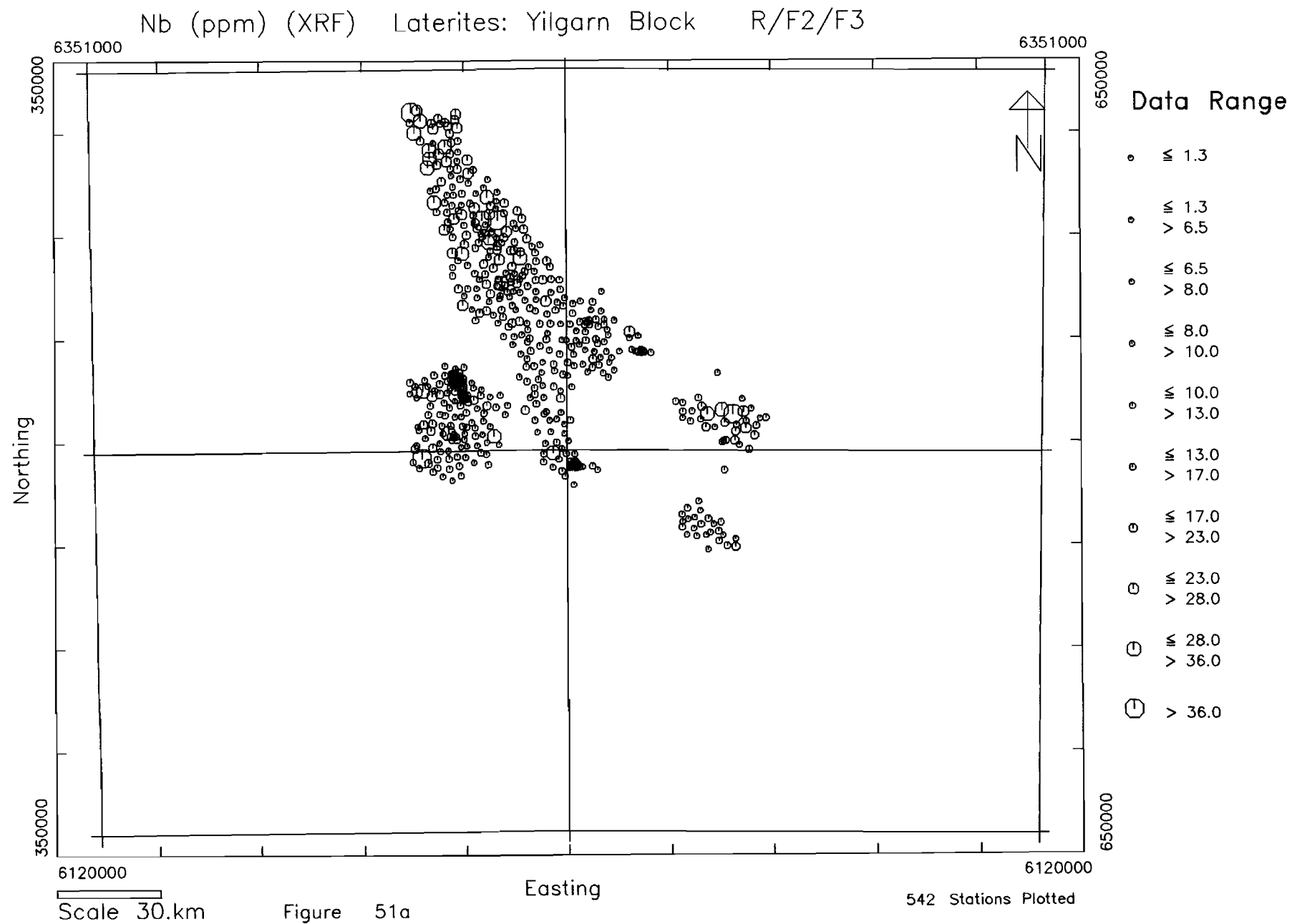
W (ppm) (XRF) Laterites: Yilgarn Block R/F2/F3

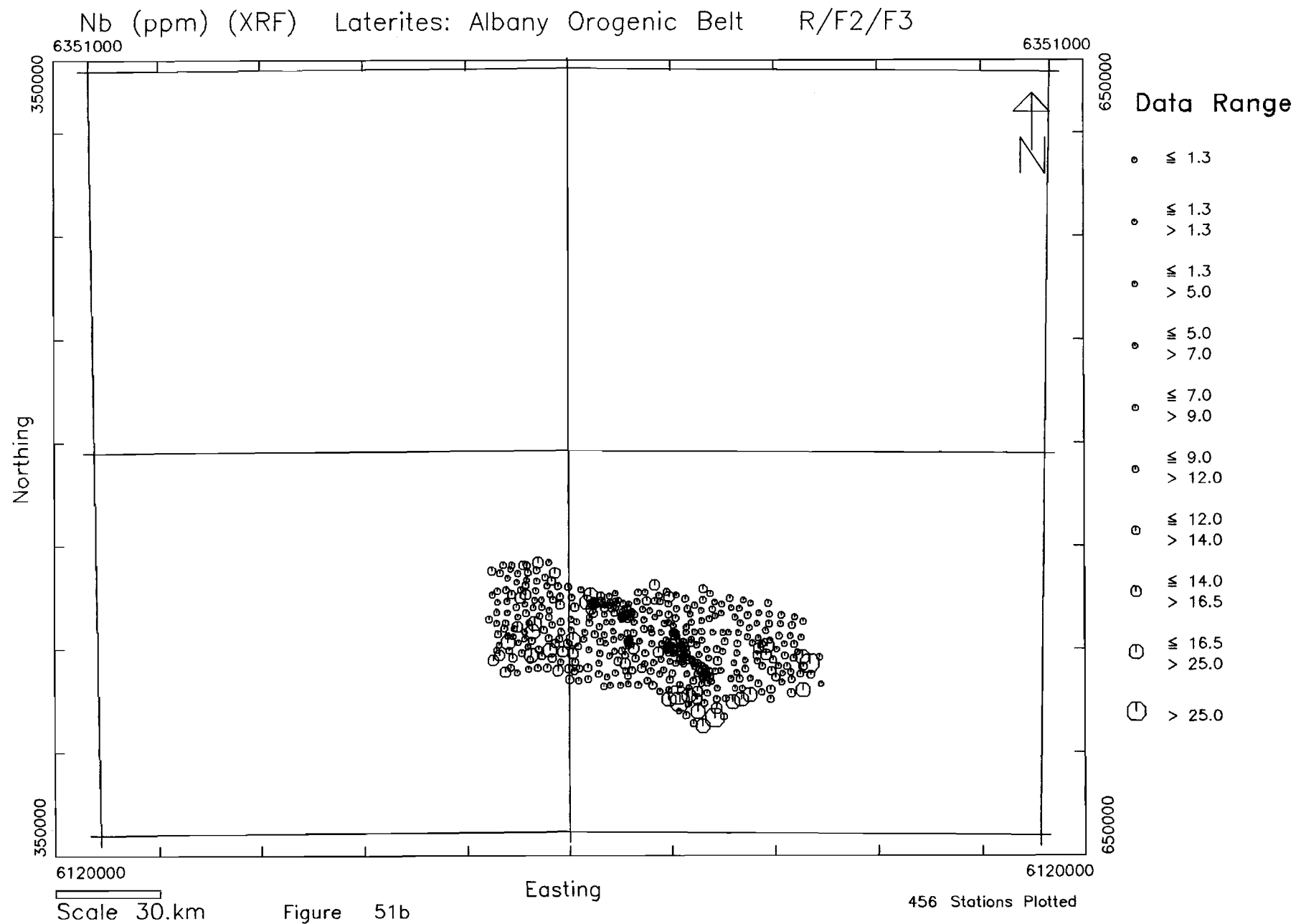




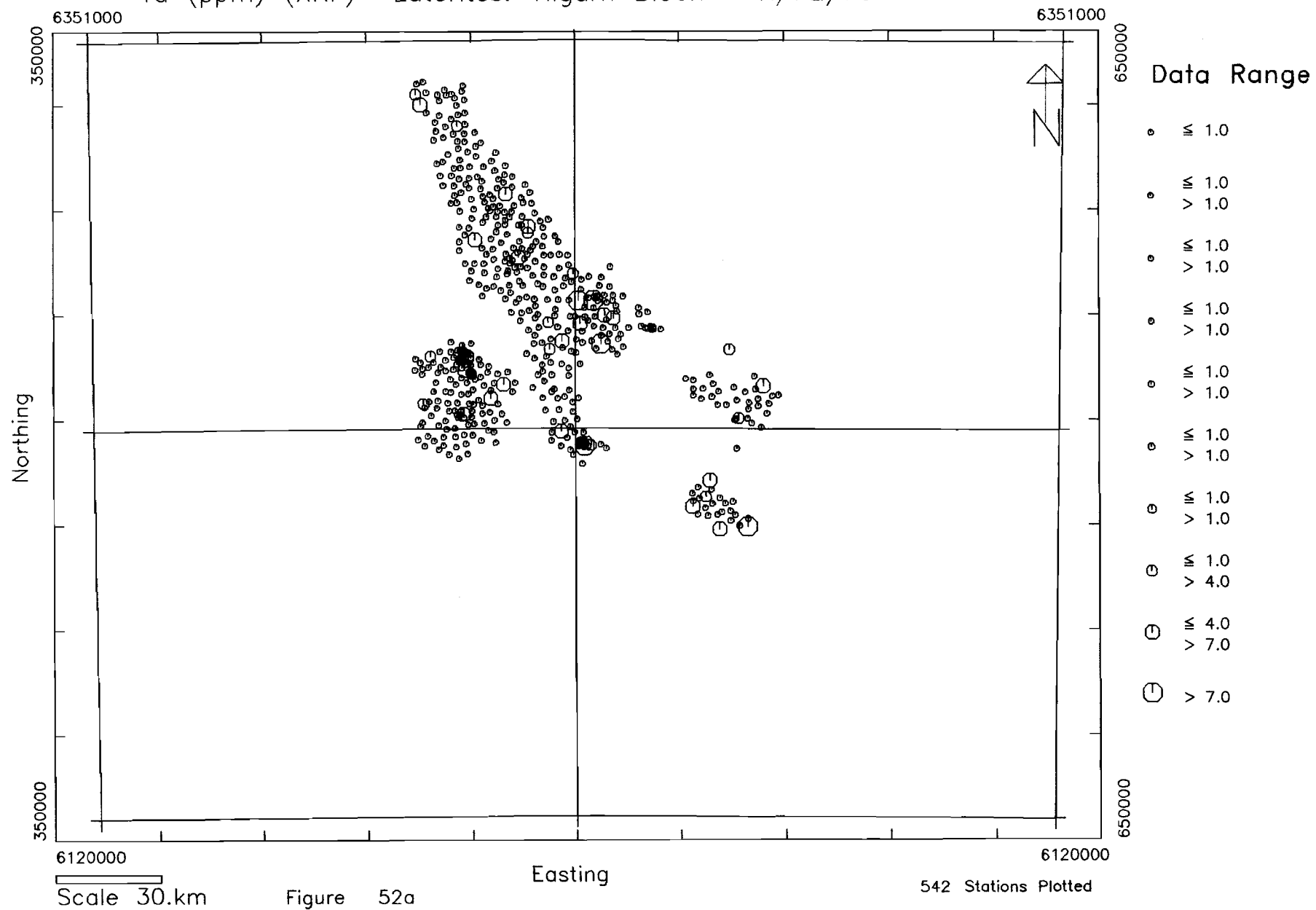




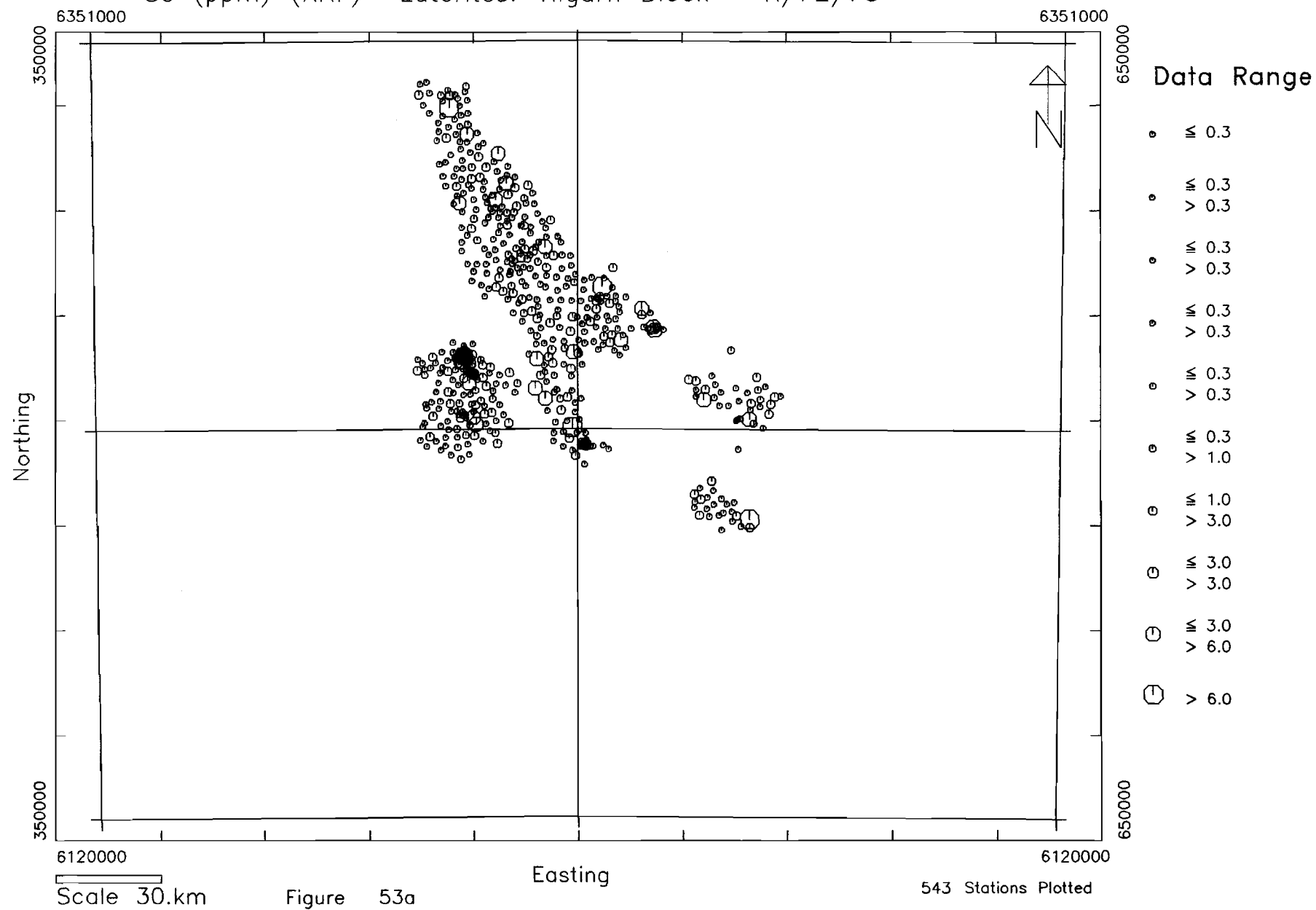


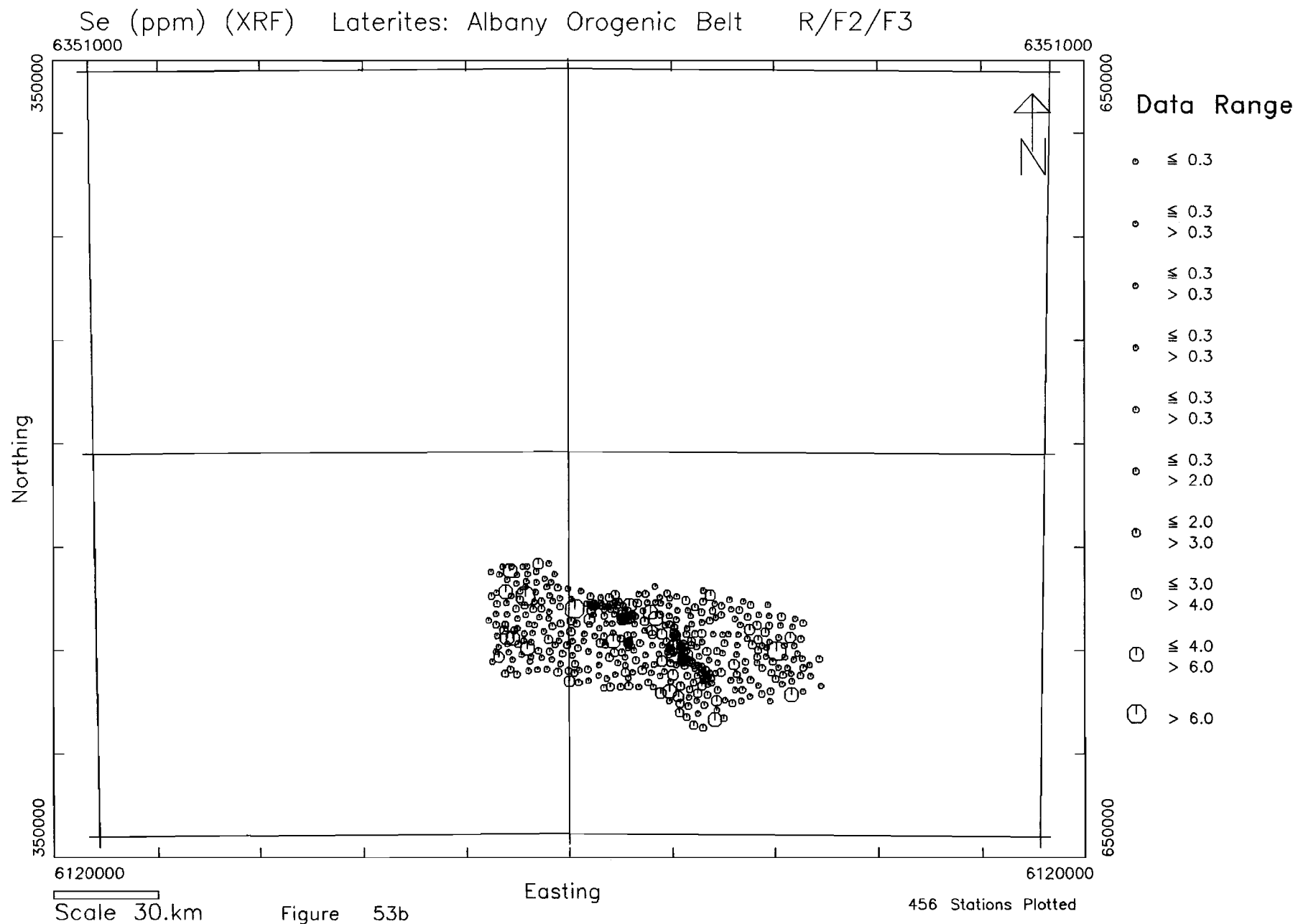


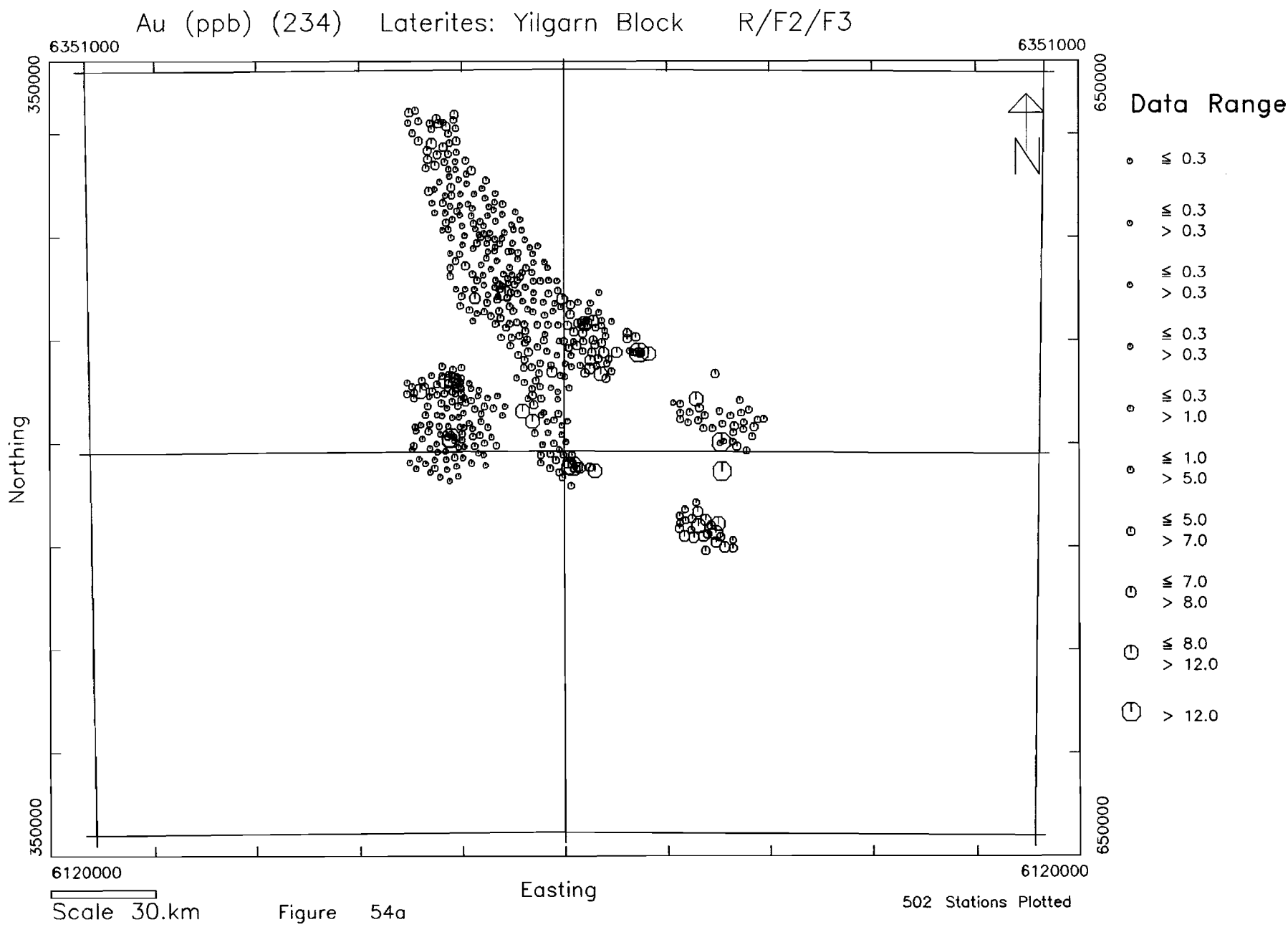
Ta (ppm) (XRF) Laterites: Yilgarn Block R/F2/F3

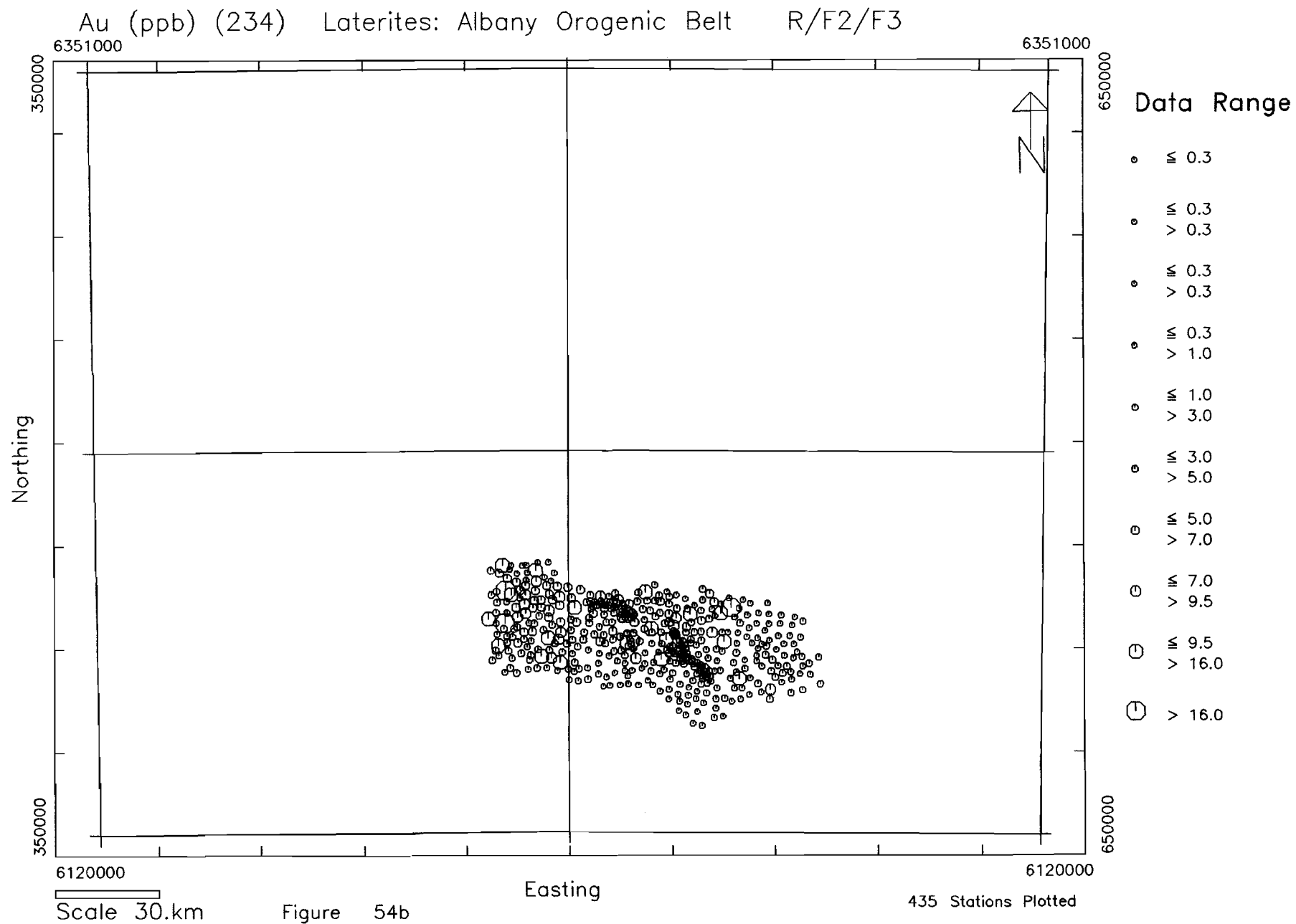


Se (ppm) (XRF) Laterites: Yilgarn Block R/F2/F3









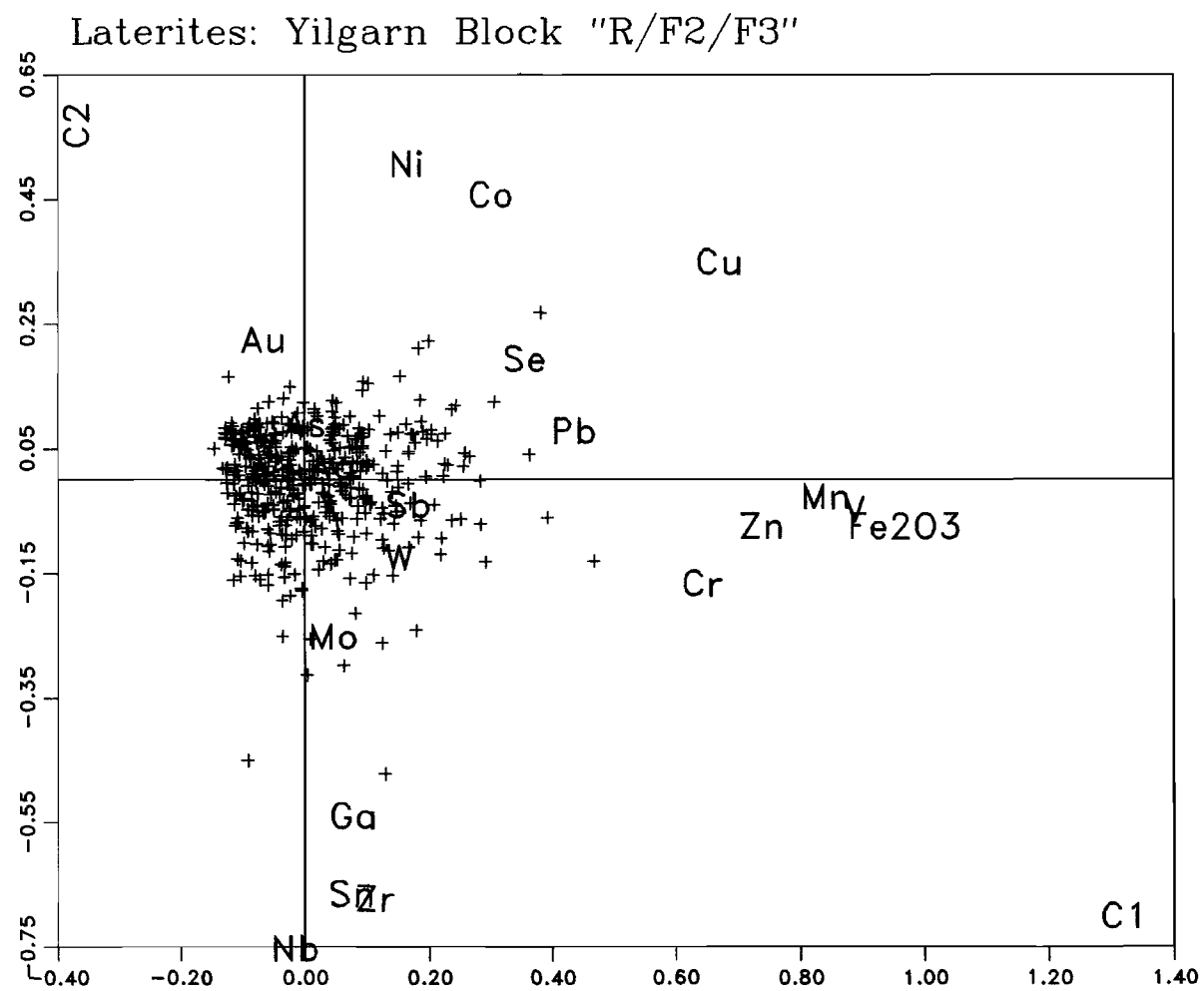
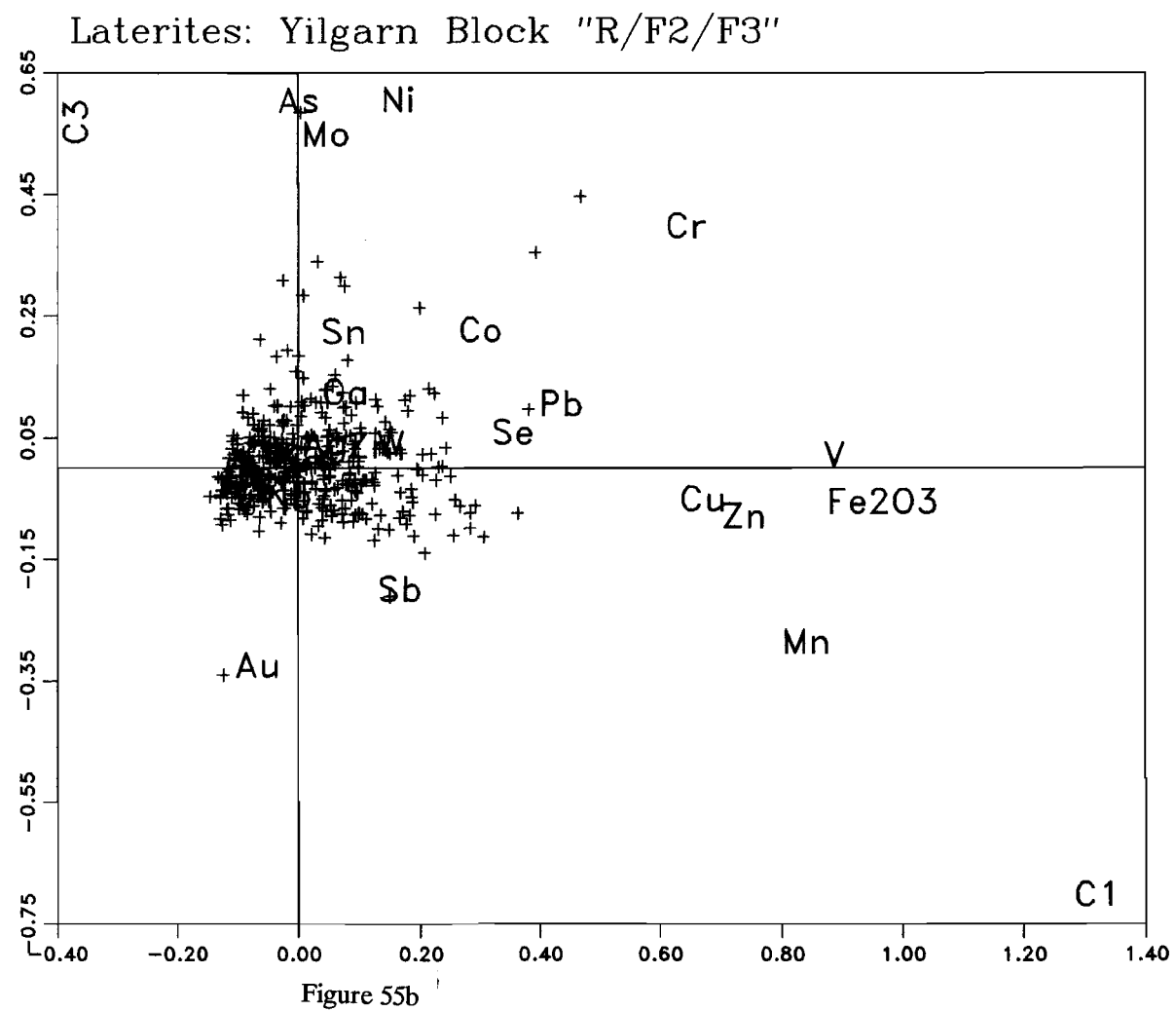


Figure 55a



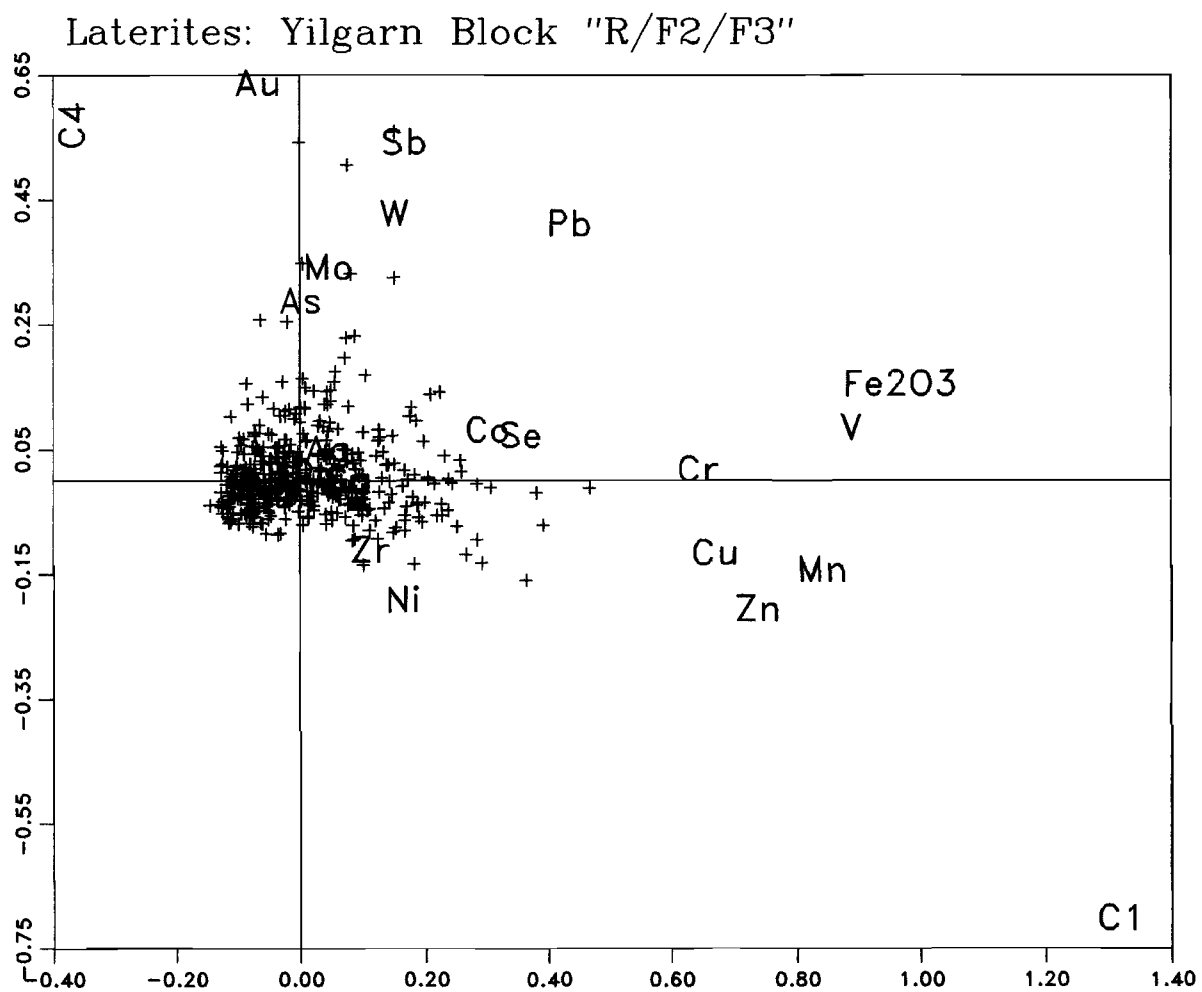


Figure 55c

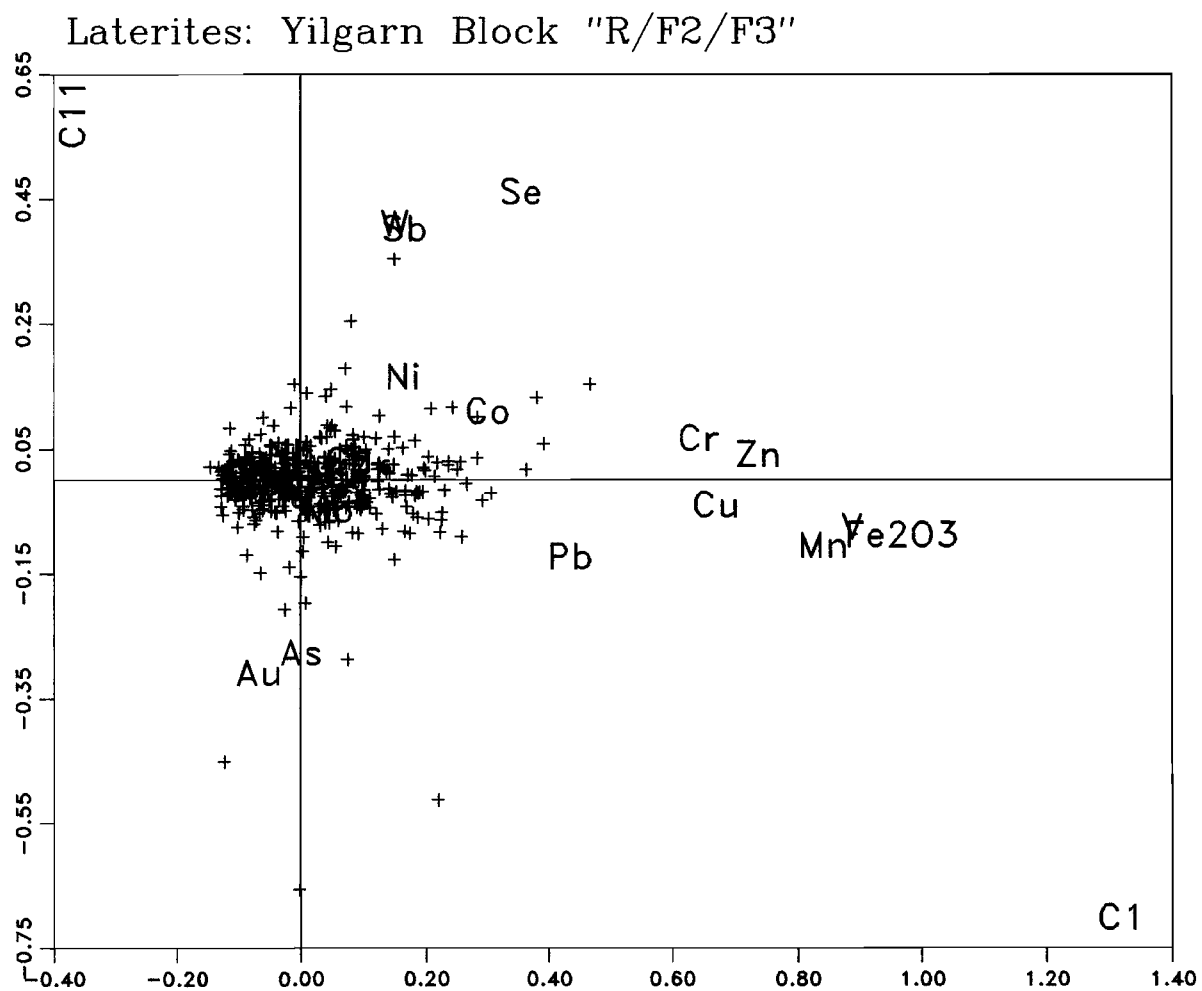


Figure 55d

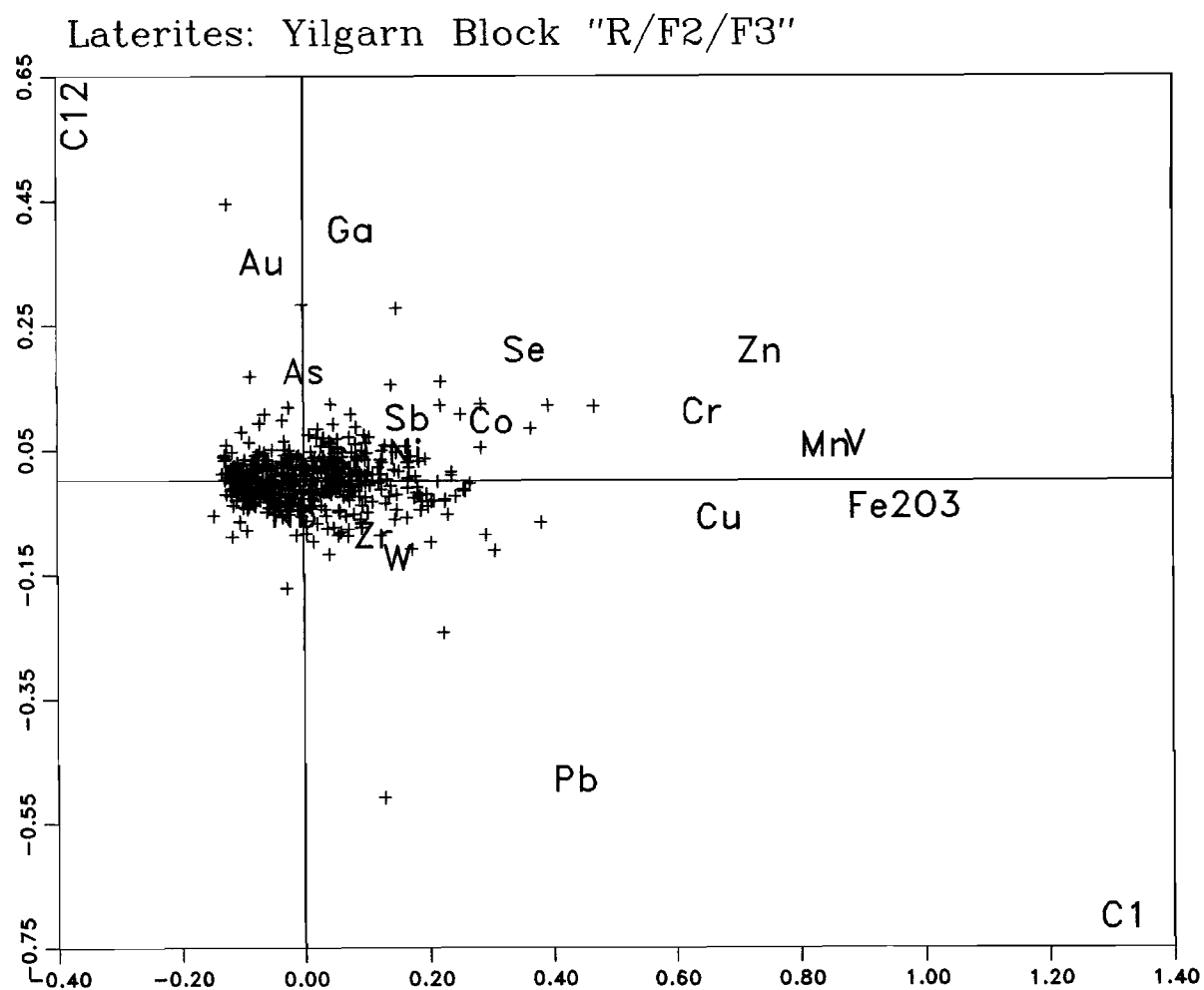
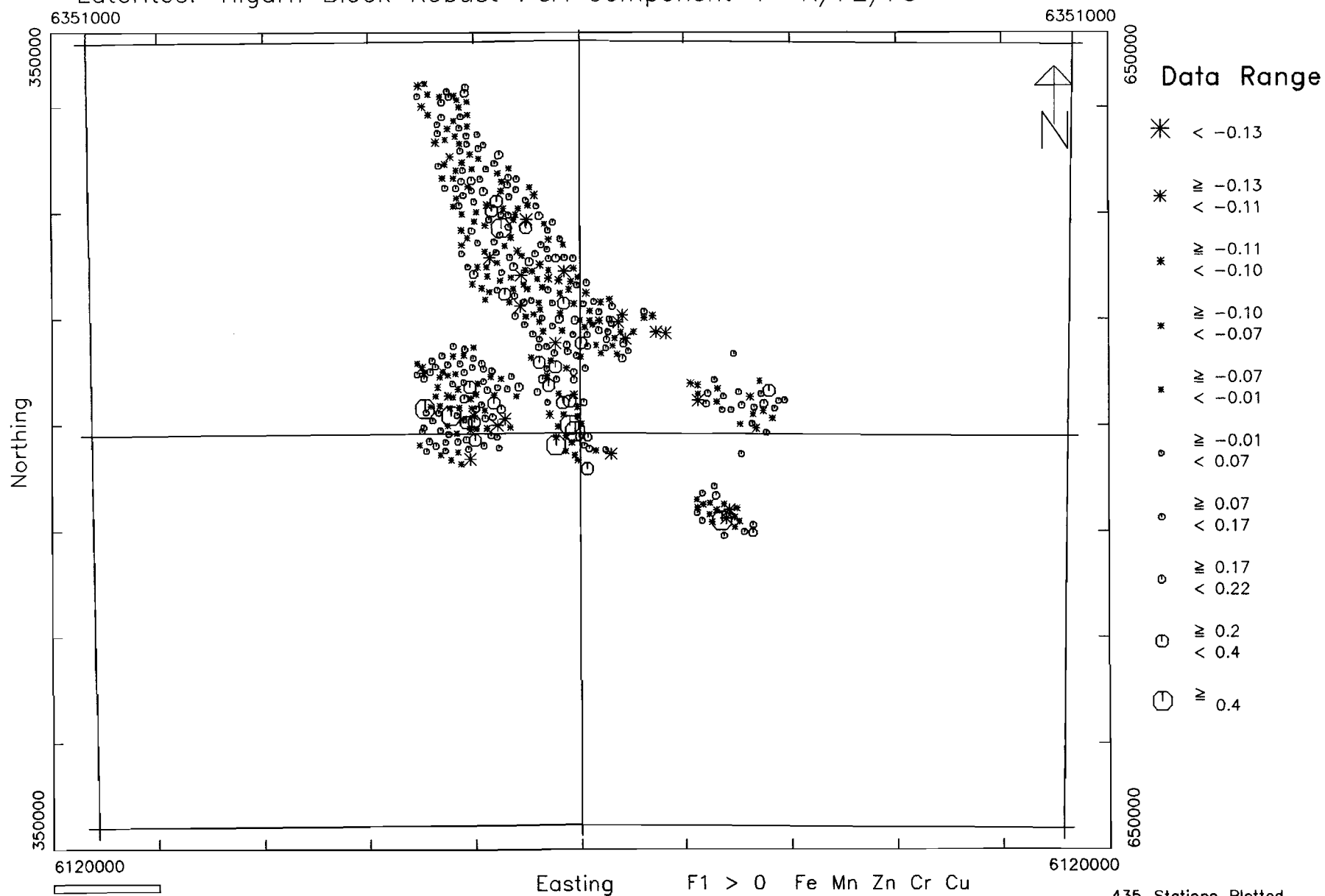
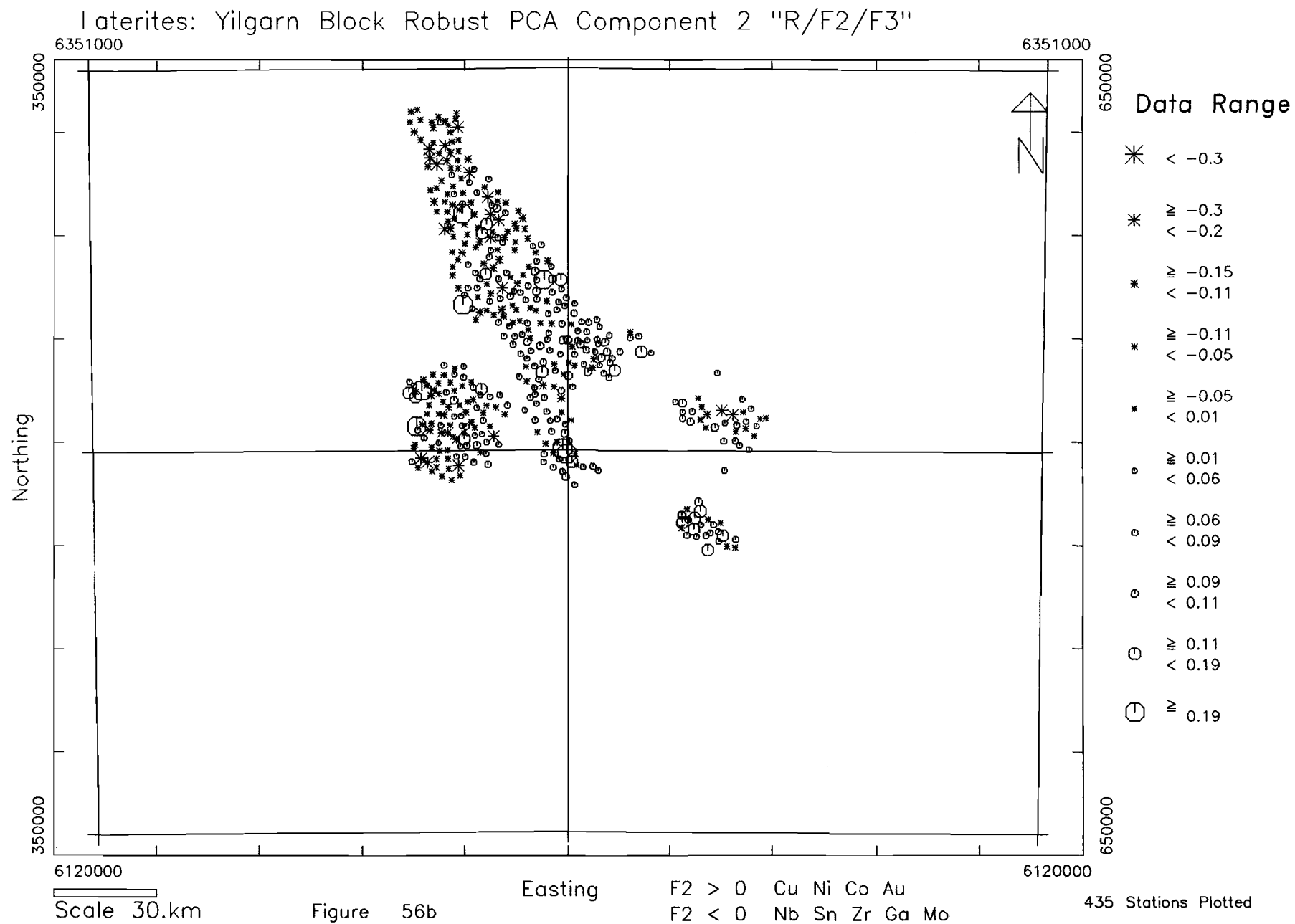


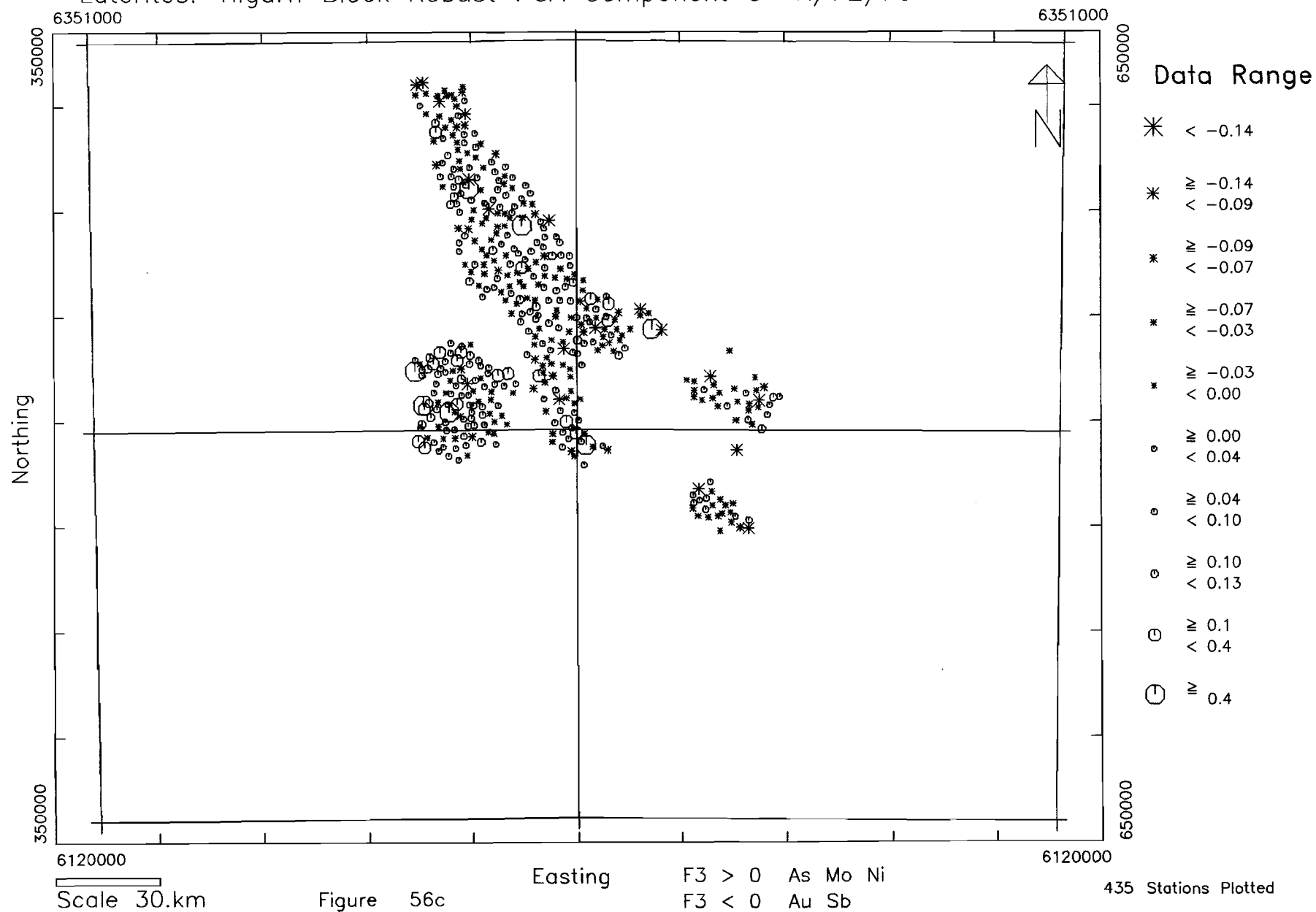
Figure 55e

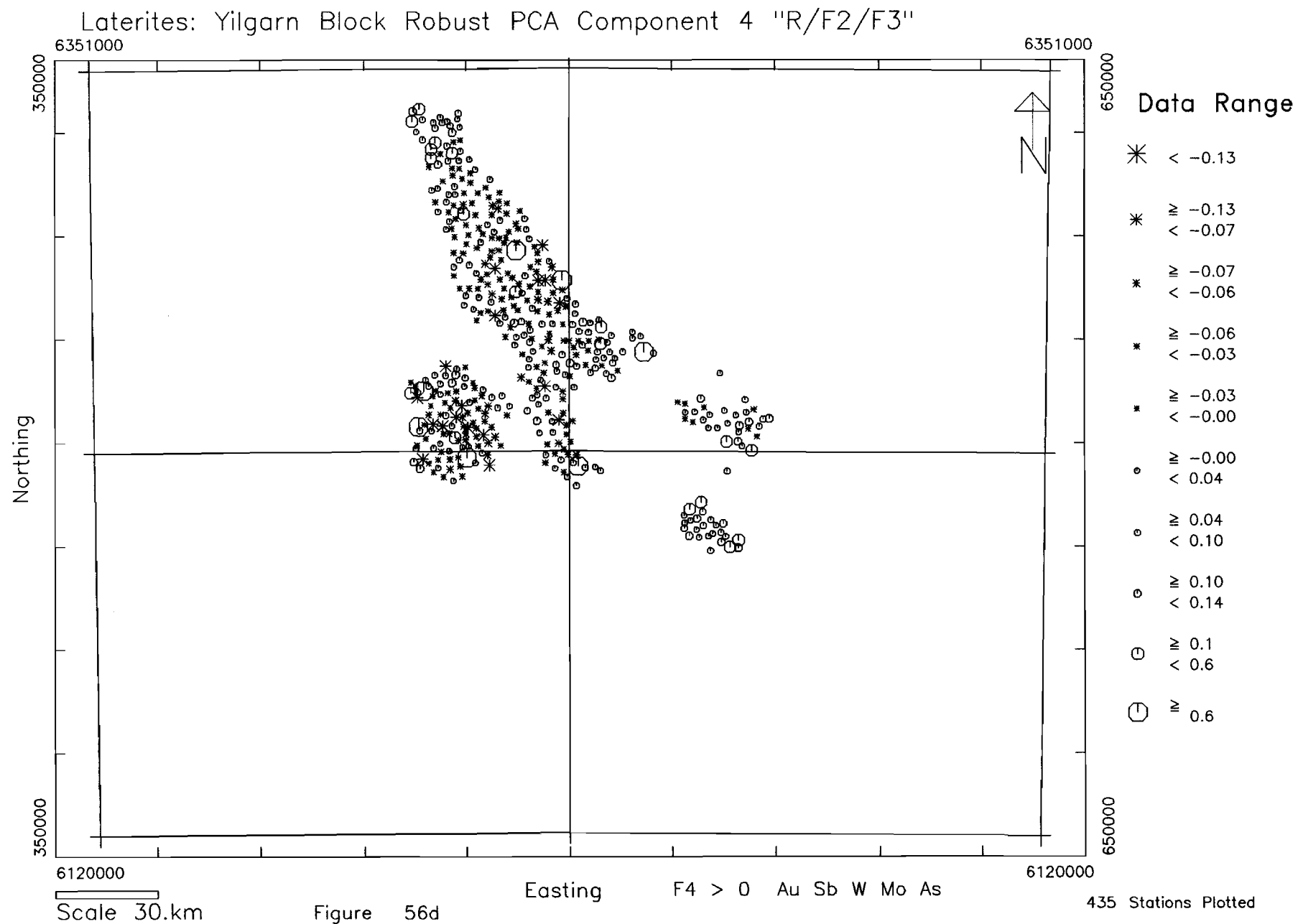
Laterites: Yilgarn Block Robust PCA Component 1 "R/F2/F3"



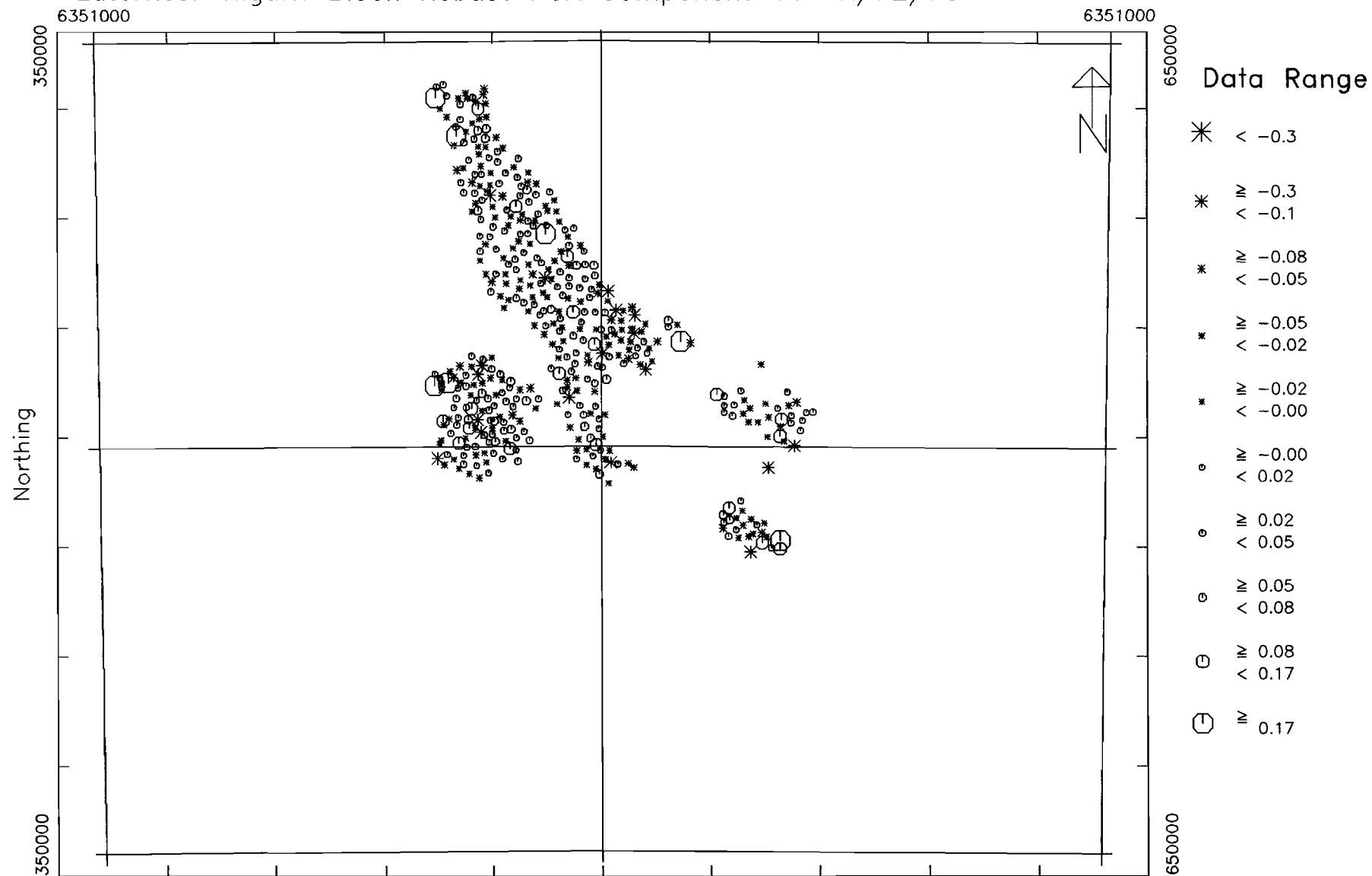


Laterites: Yilgarn Block Robust PCA Component 3 "R/F2/F3"

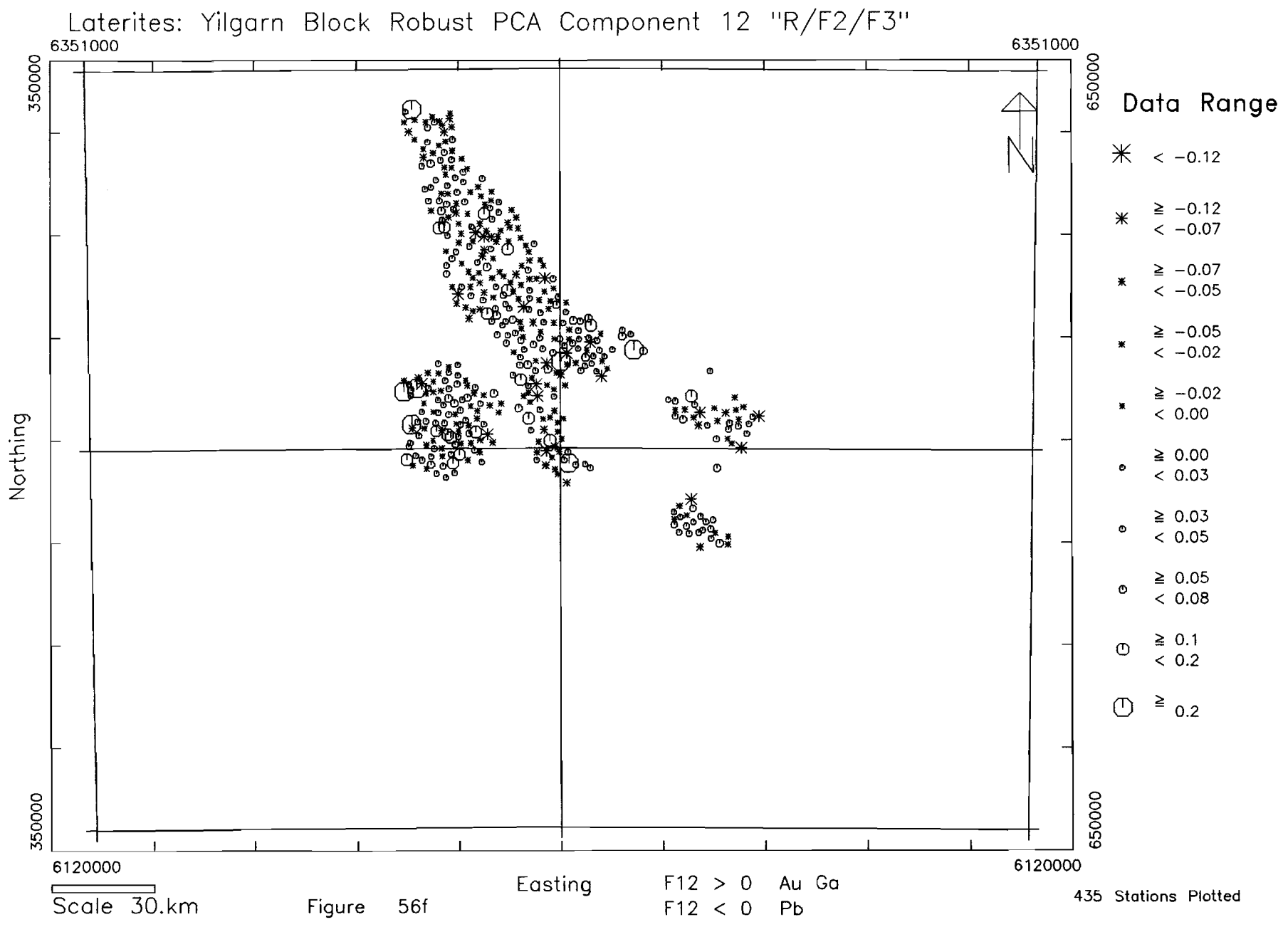




Laterites: Yilgarn Block Robust PCA Component 11 "R/F2/F3"



F11 > 0 W Sb Se
F11 < 0 Au As



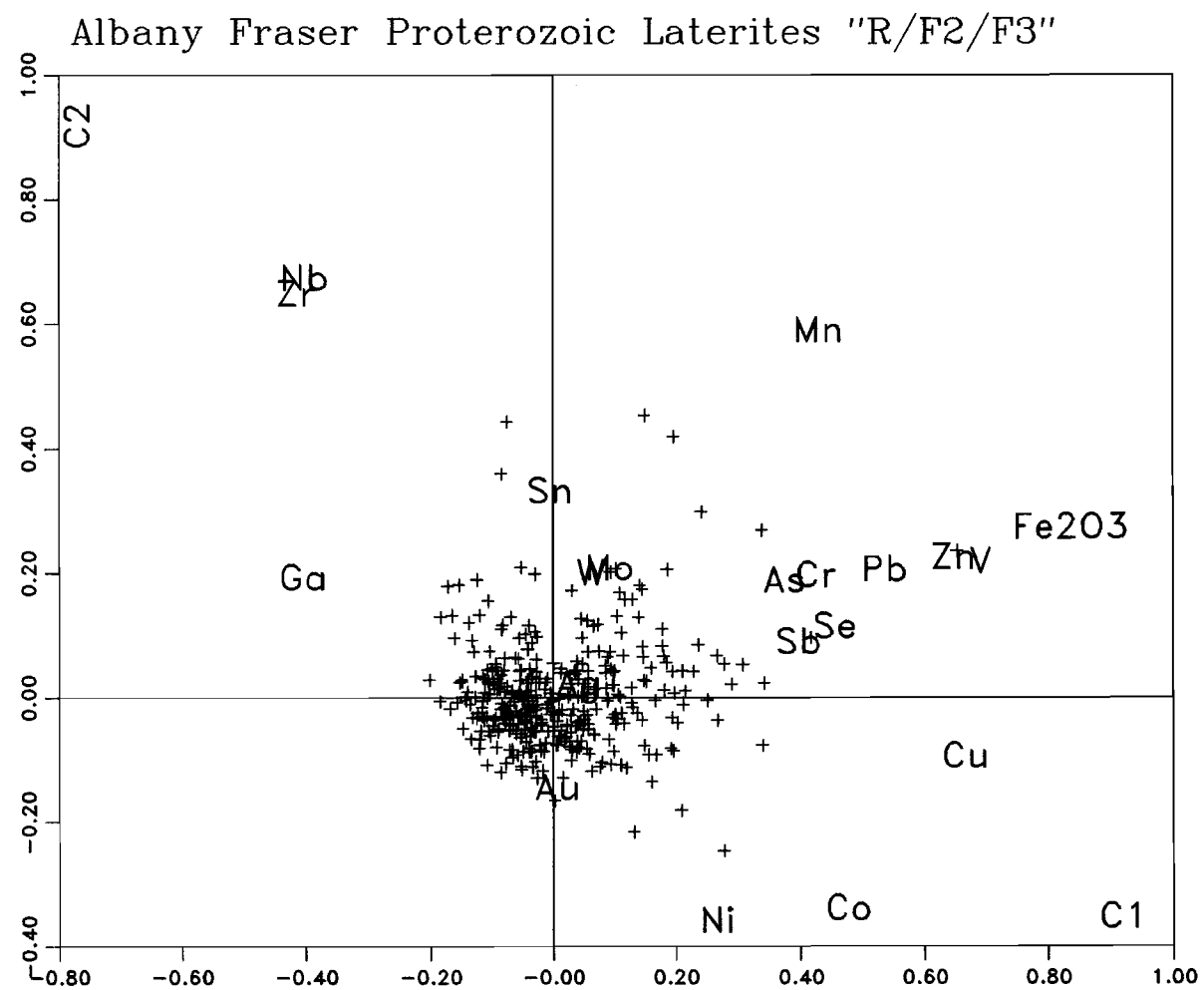


Figure 57a

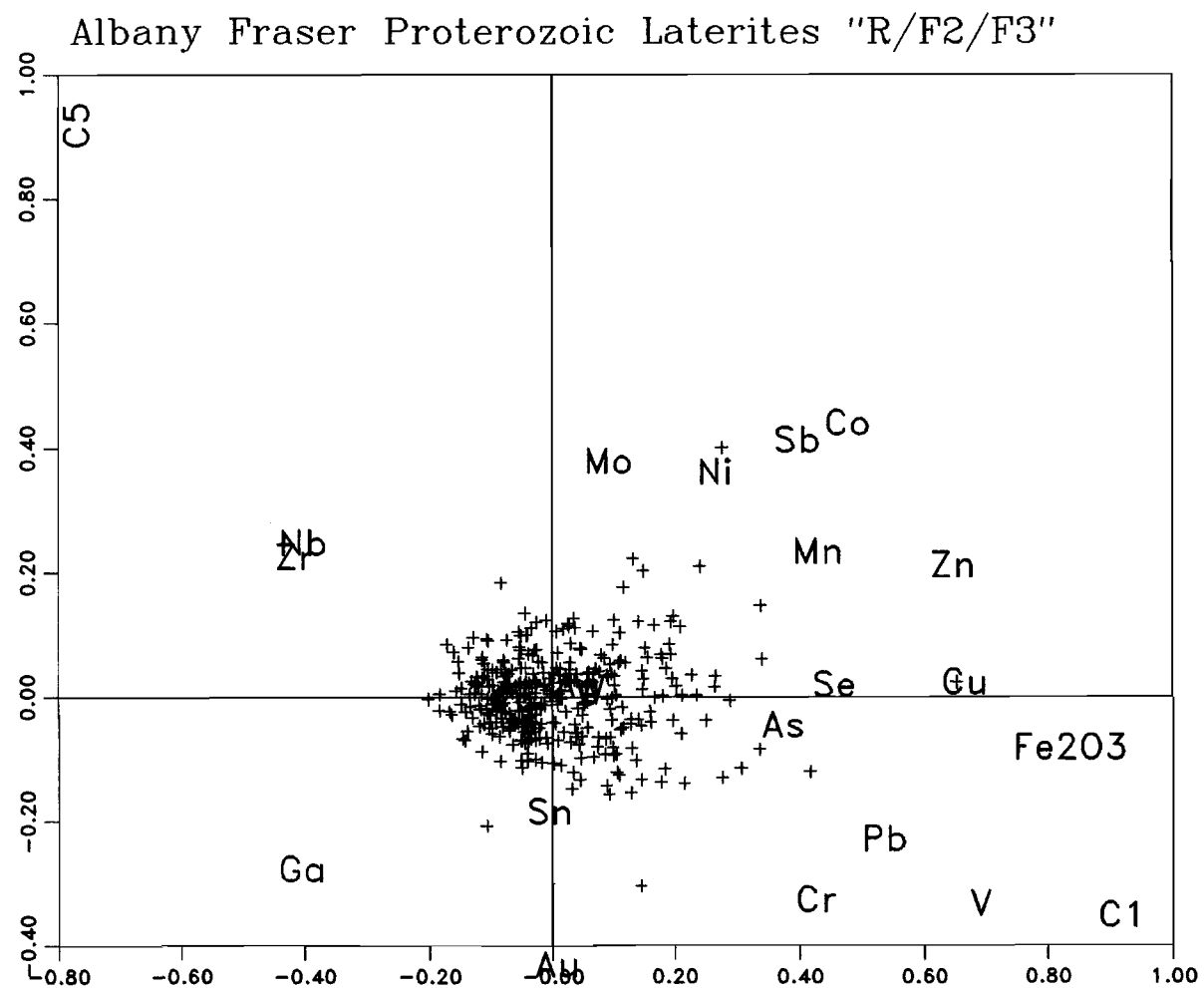


Figure 57b

+

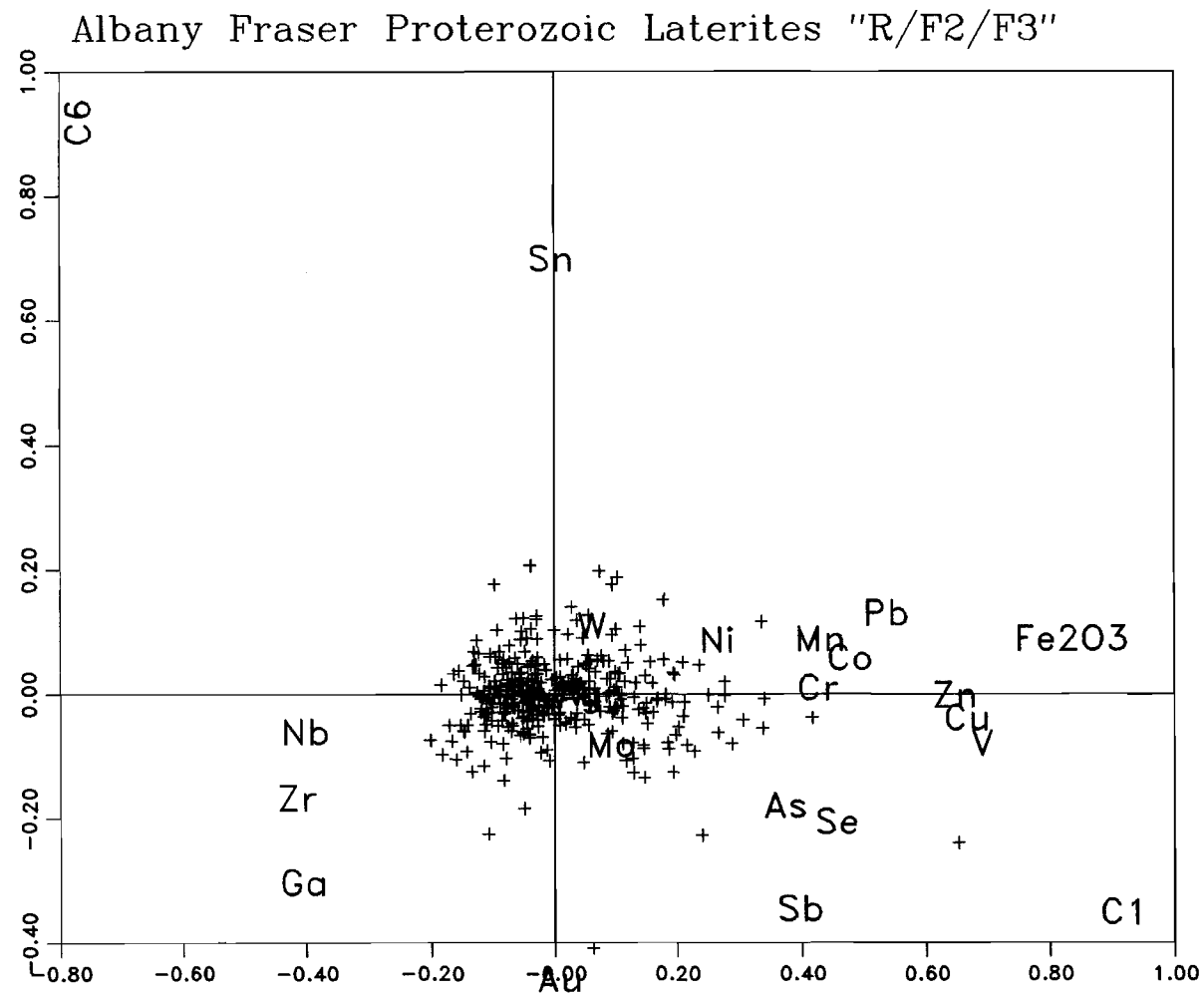


Figure 57c

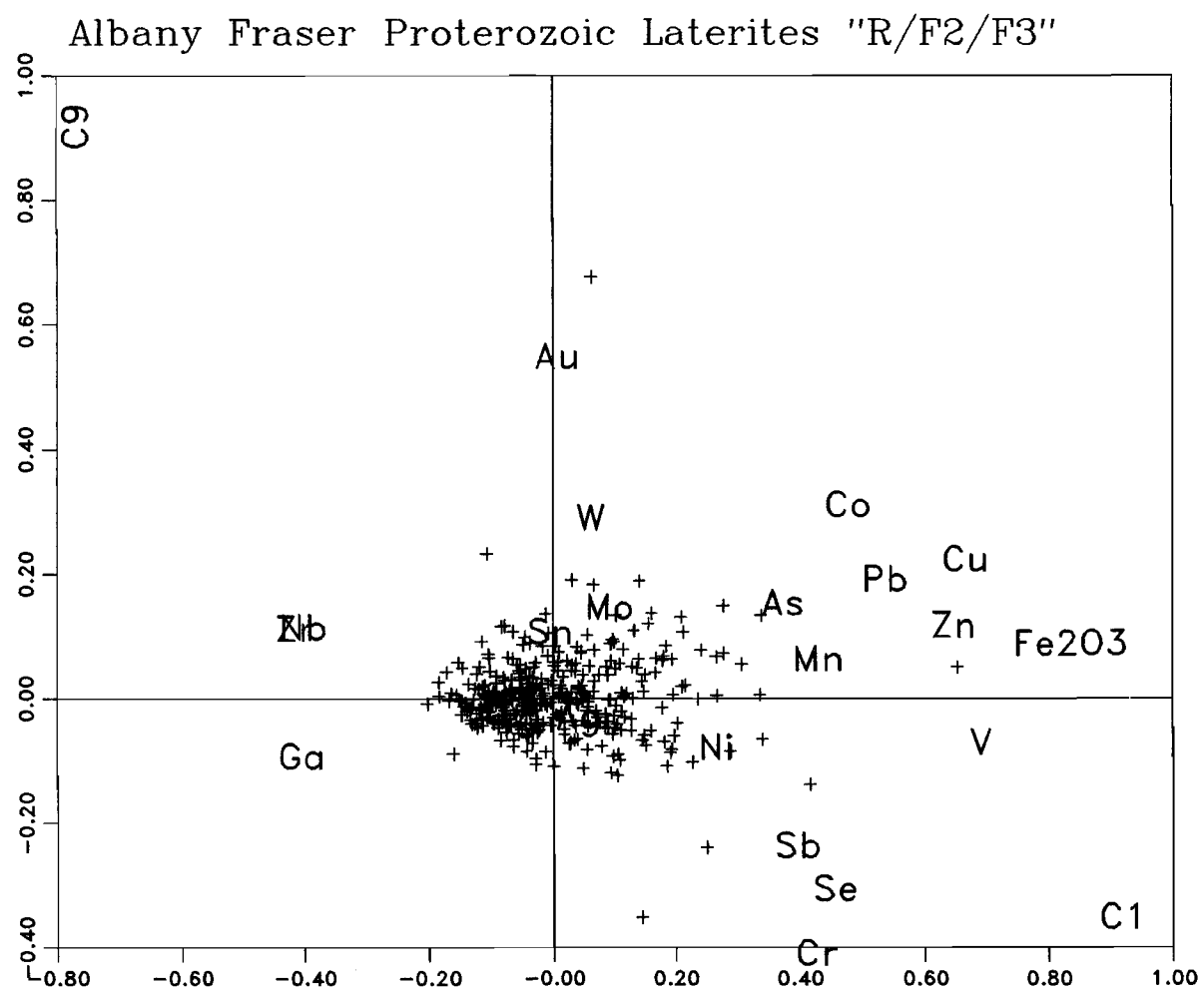


Figure 57d

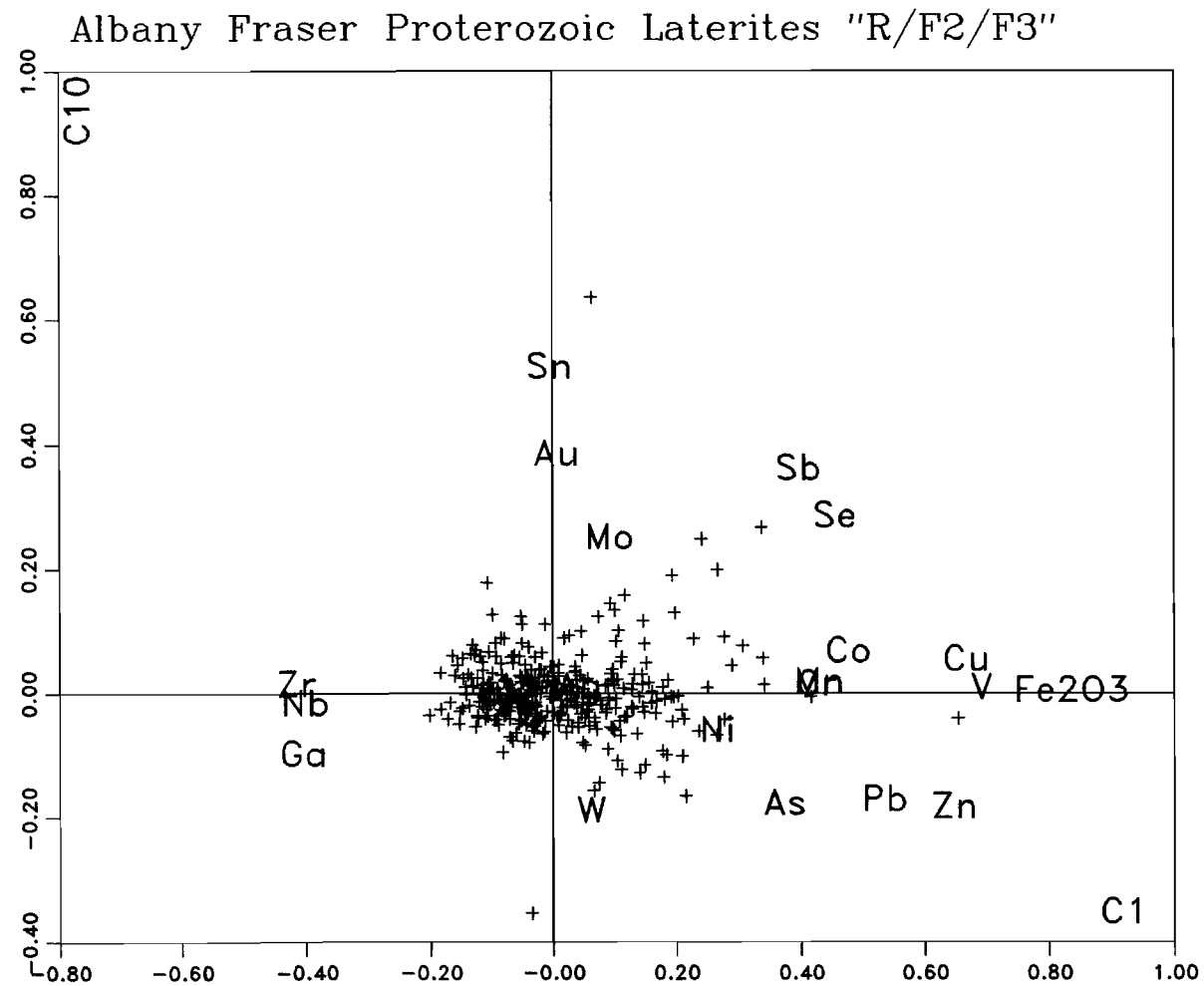
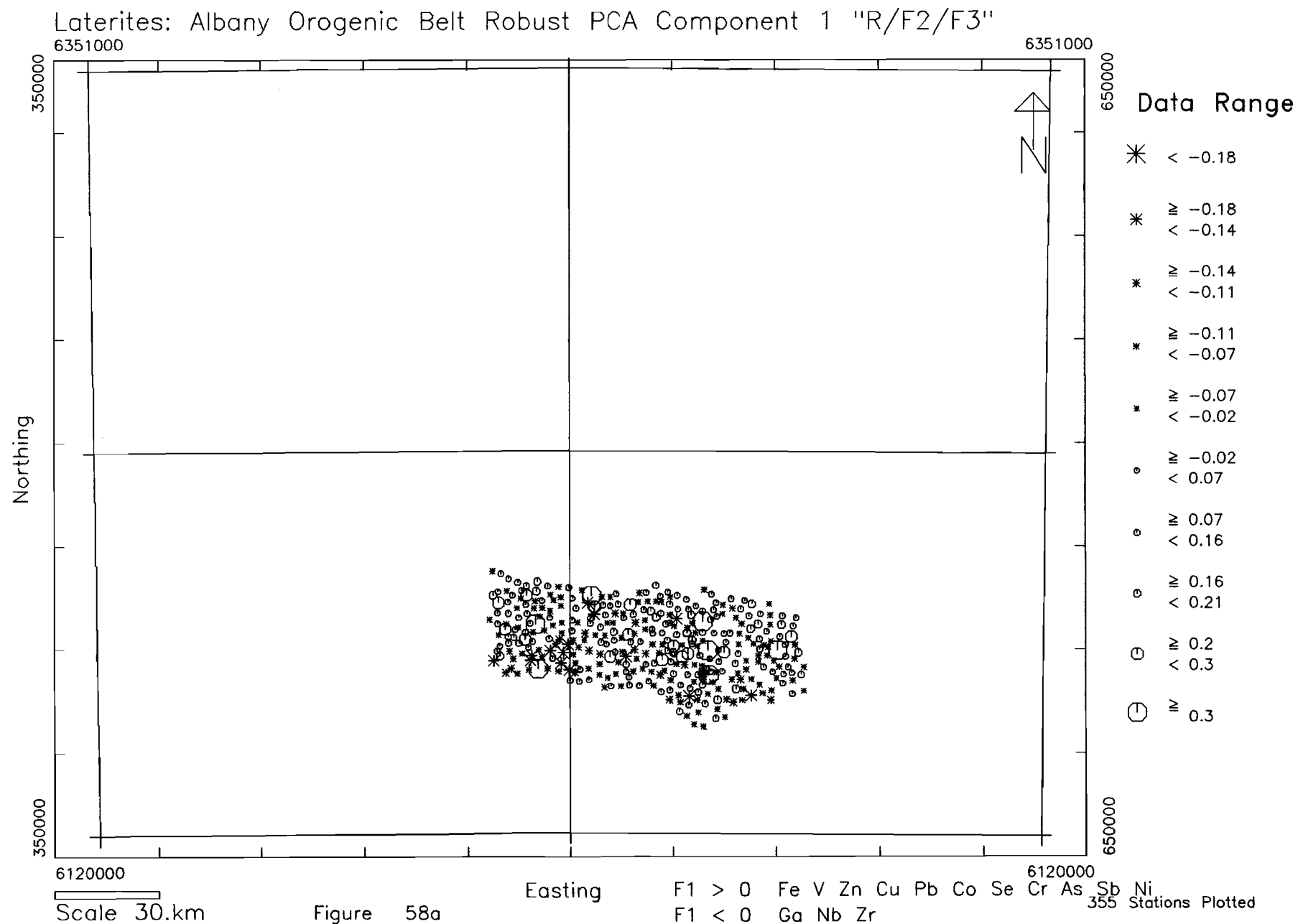
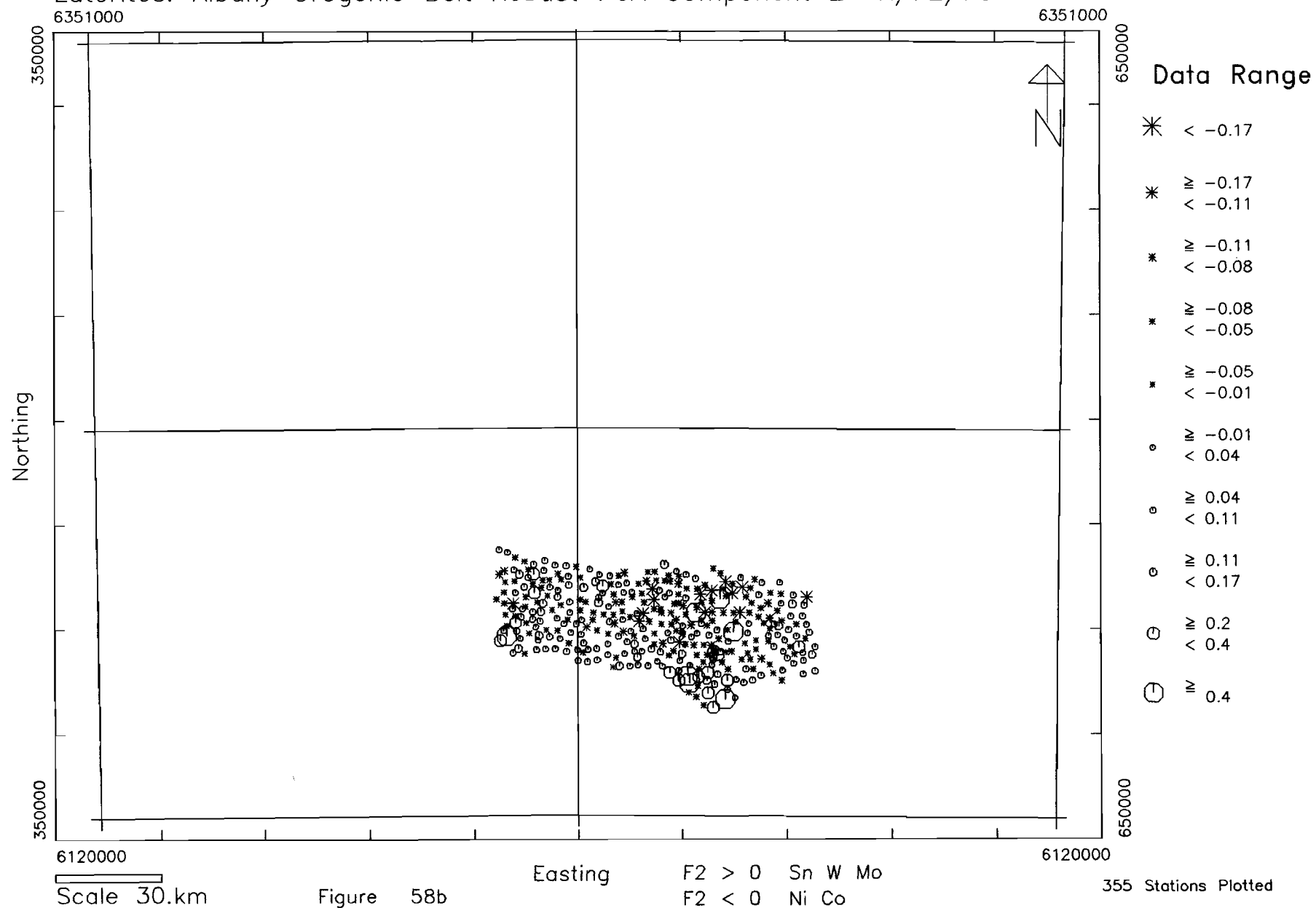
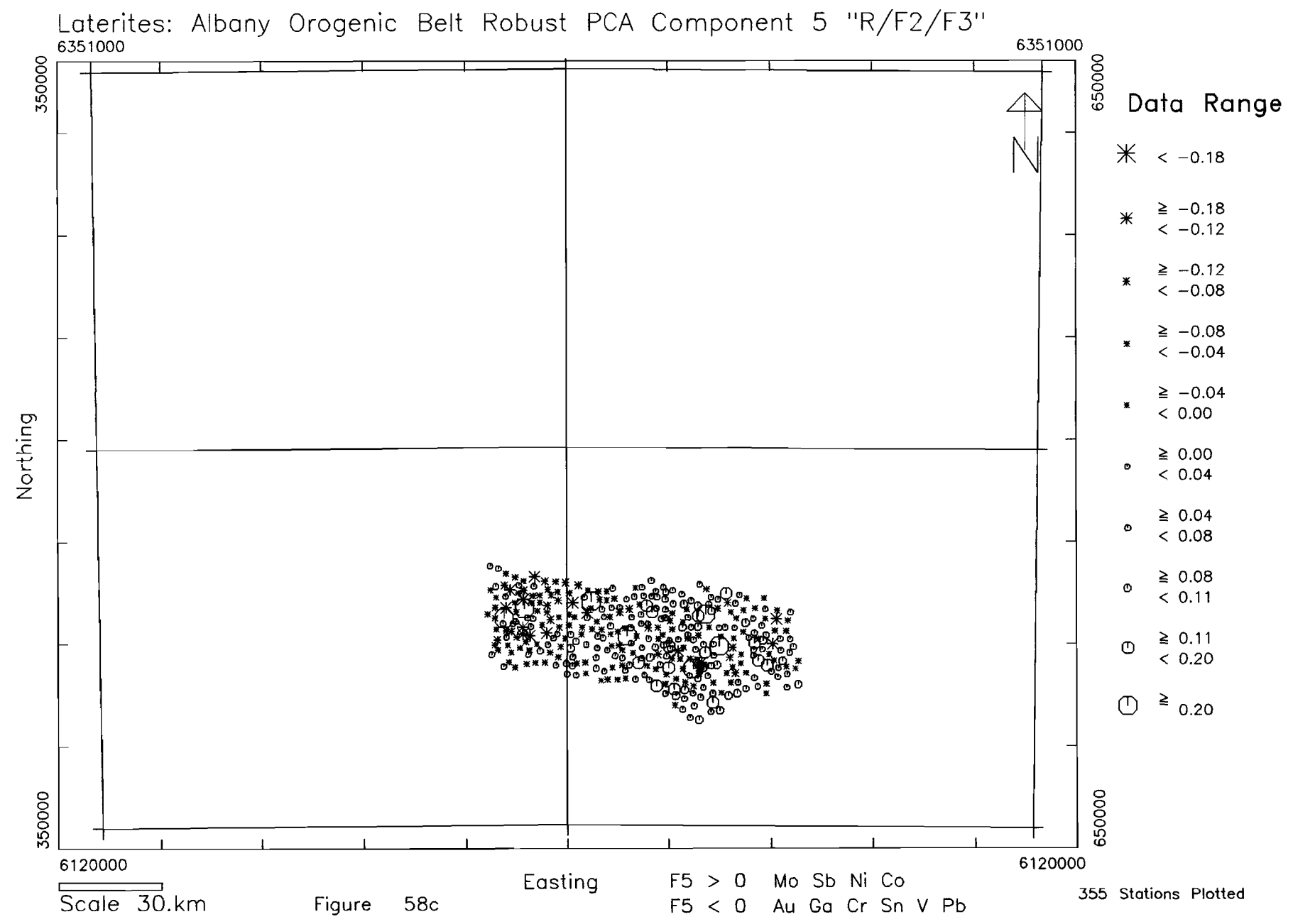


Figure 57e

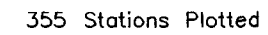


Laterites: Albany Orogenic Belt Robust PCA Component 2 "R/F2/F3"

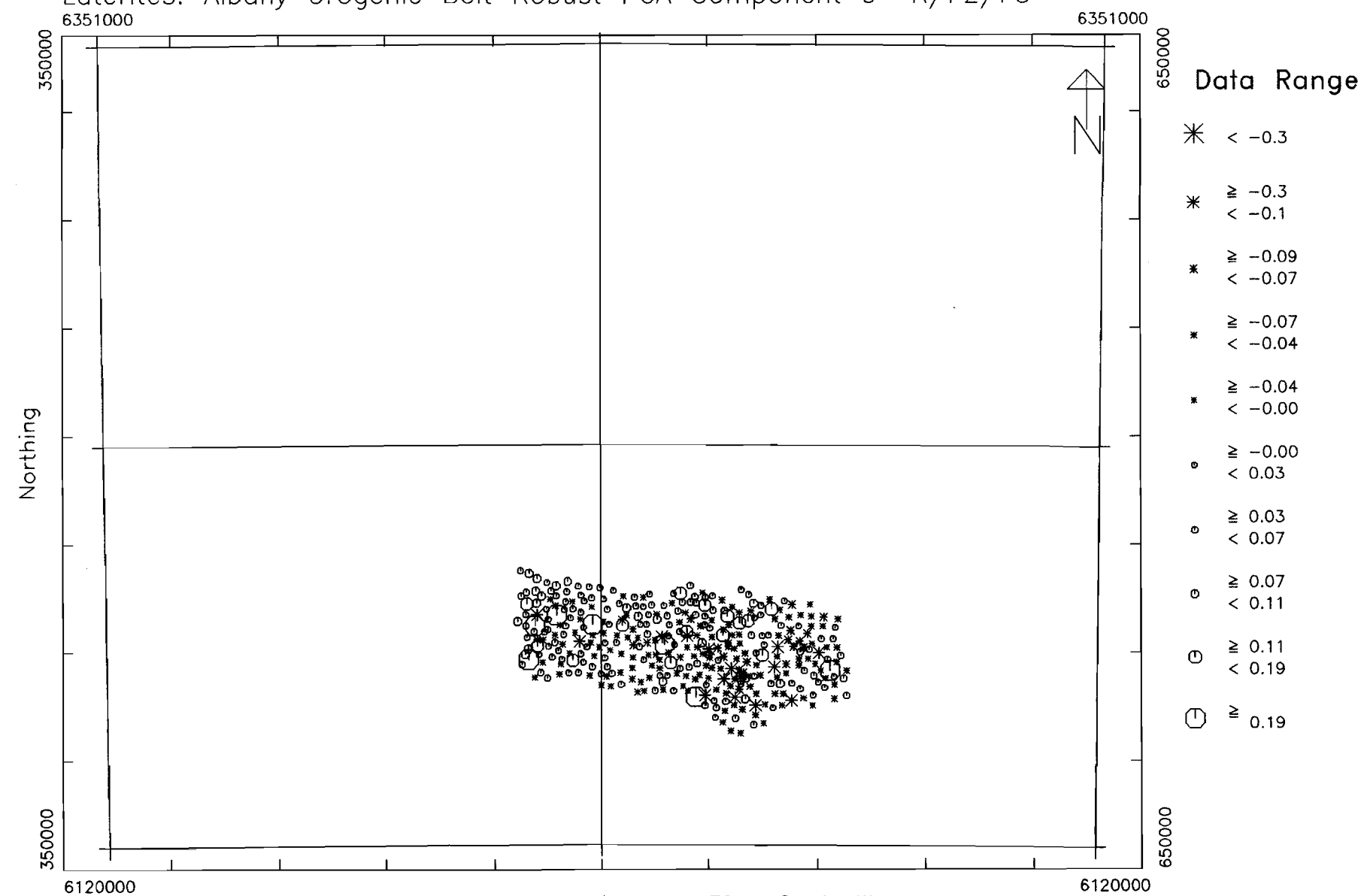




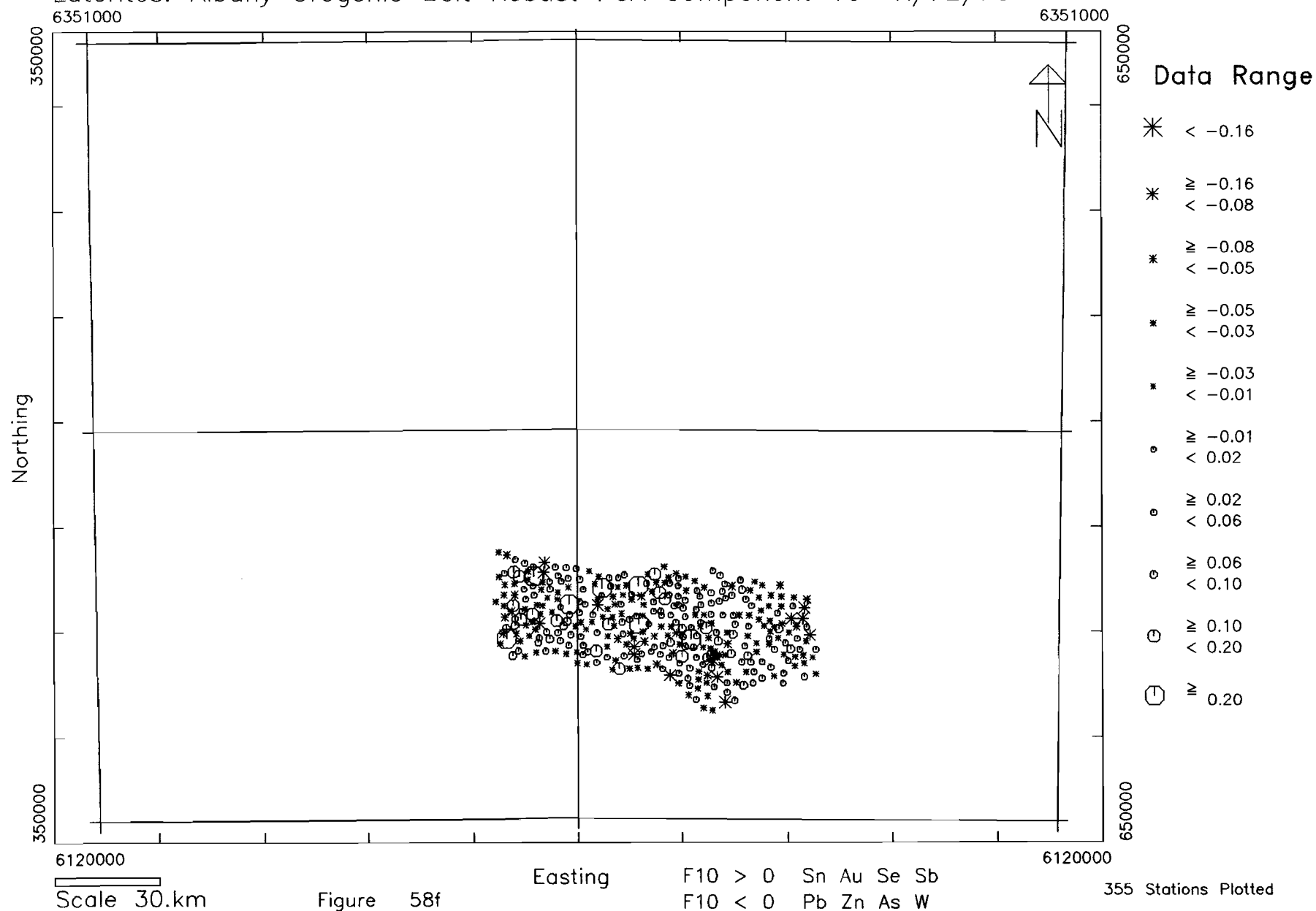
6351000

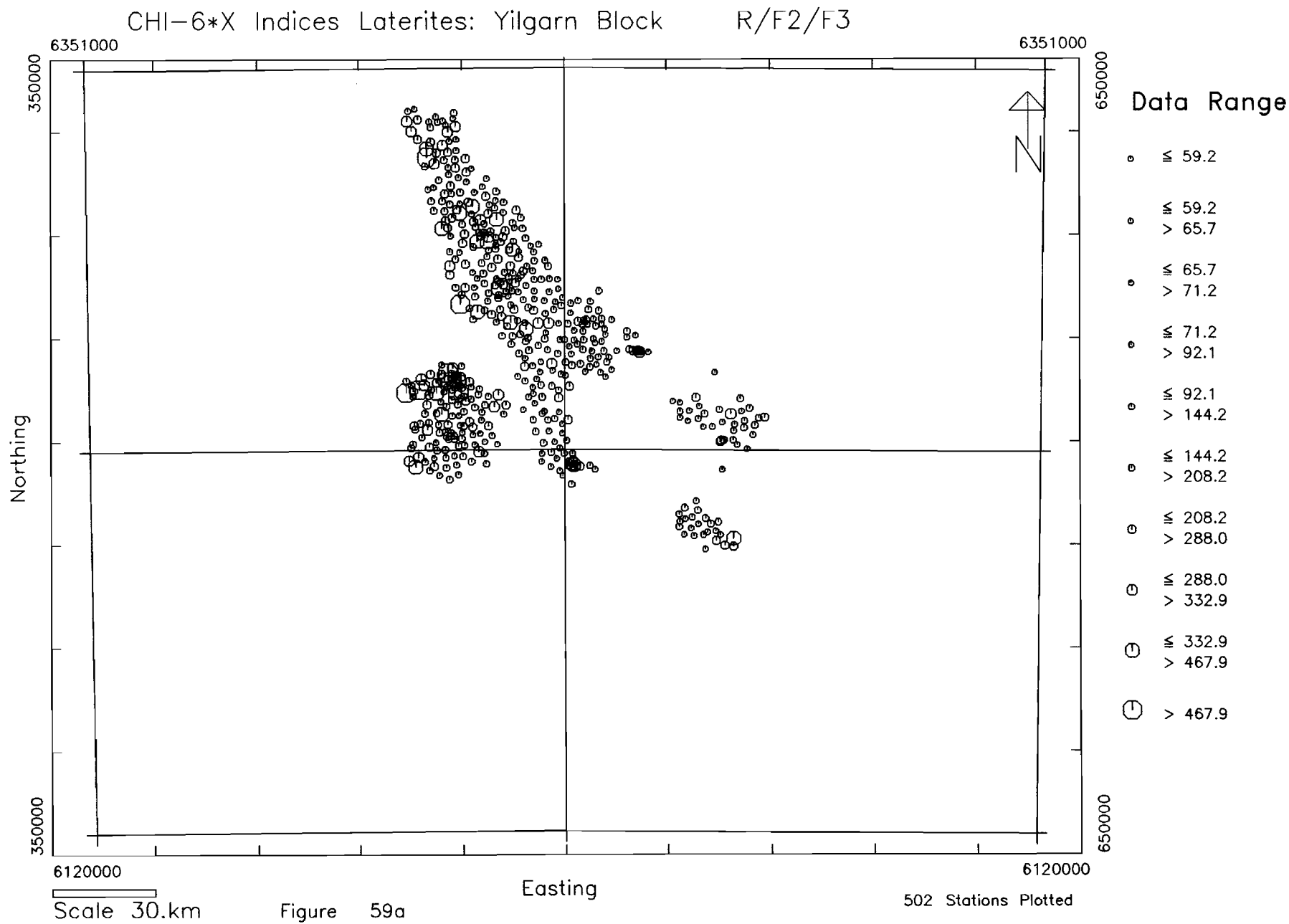


Laterites: Albany Orogenic Belt Robust PCA Component 9 "R/F2/F3"

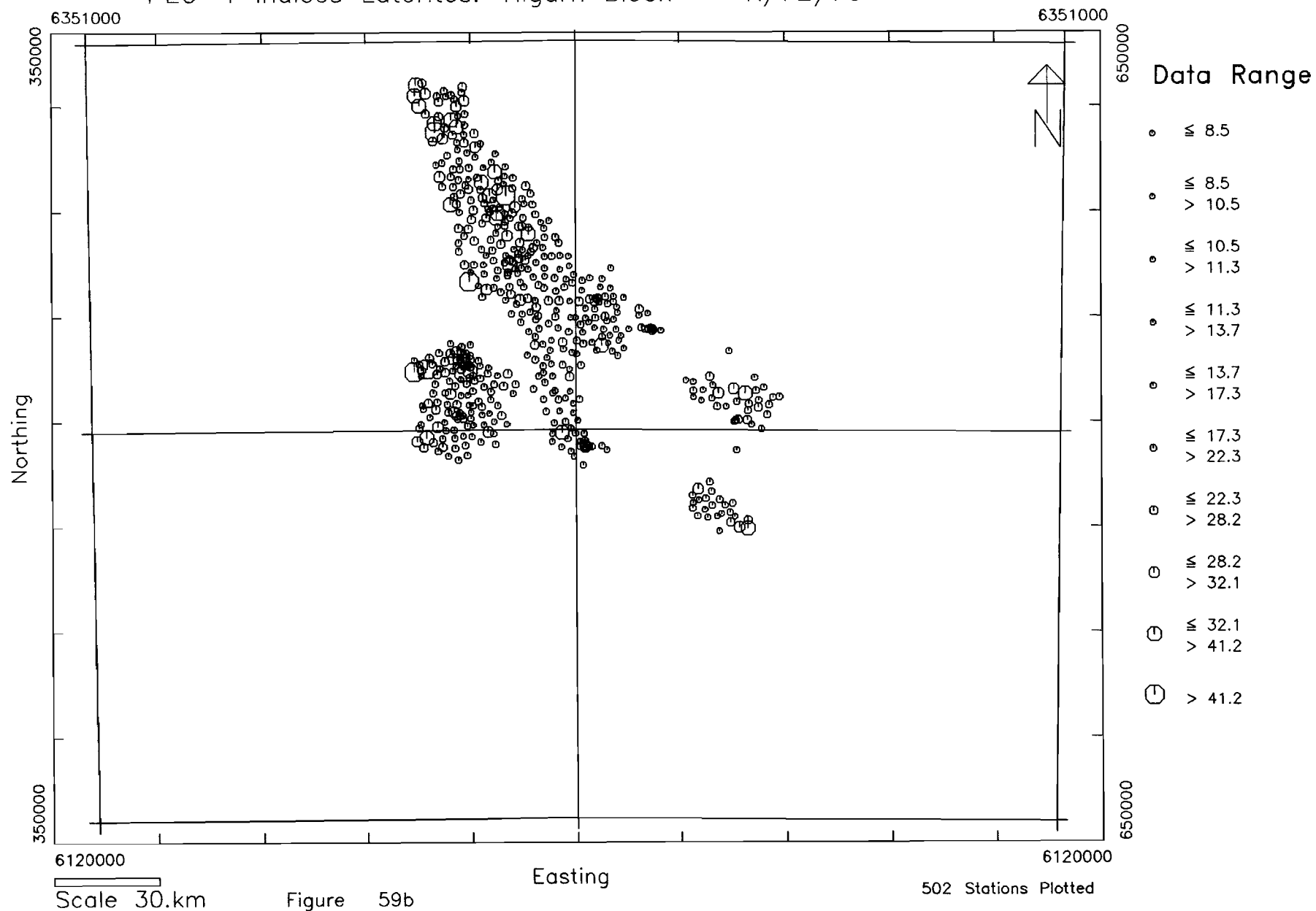


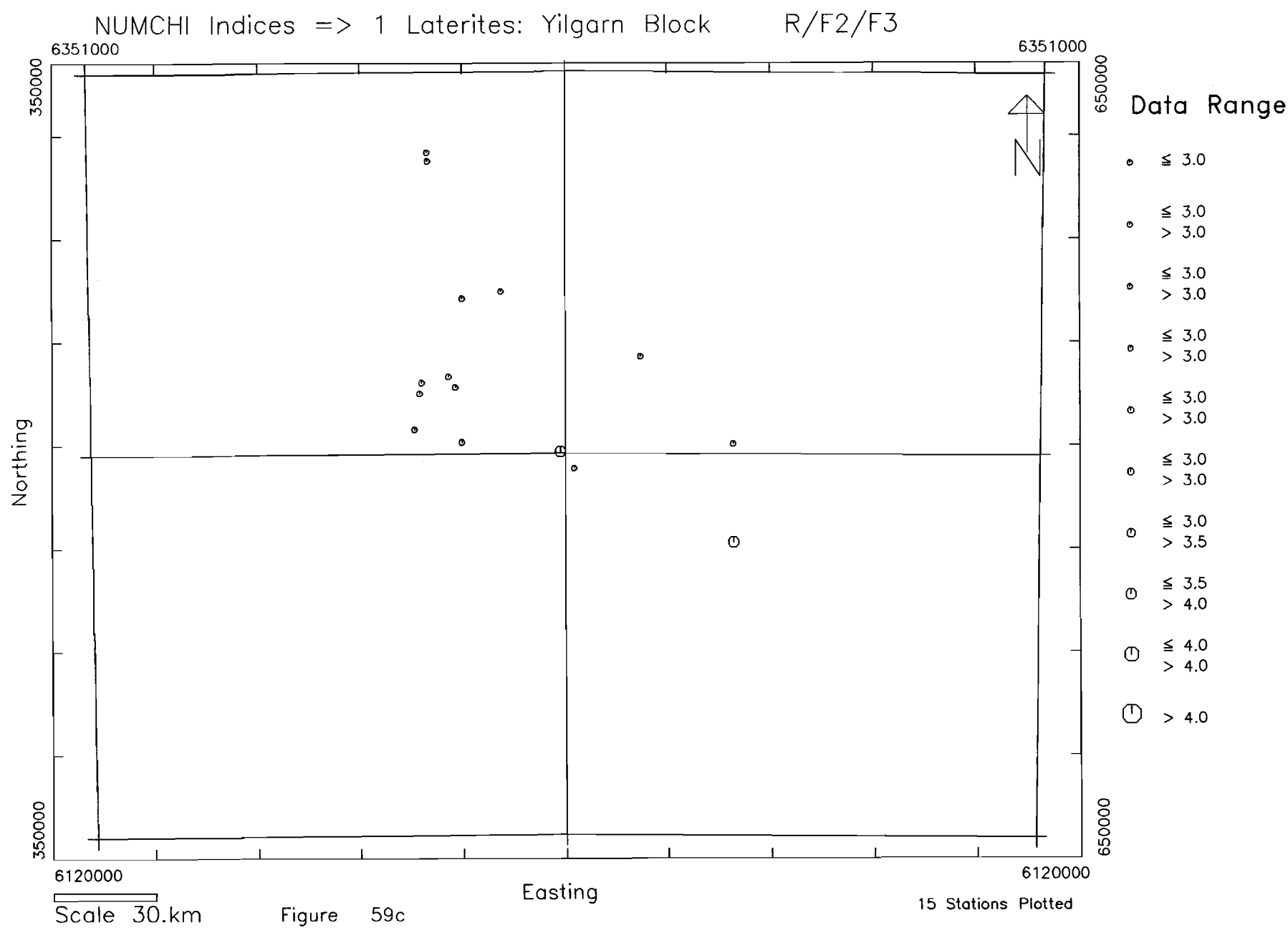
Laterites: Albany Orogenic Belt Robust PCA Component 10 "R/F2/F3"





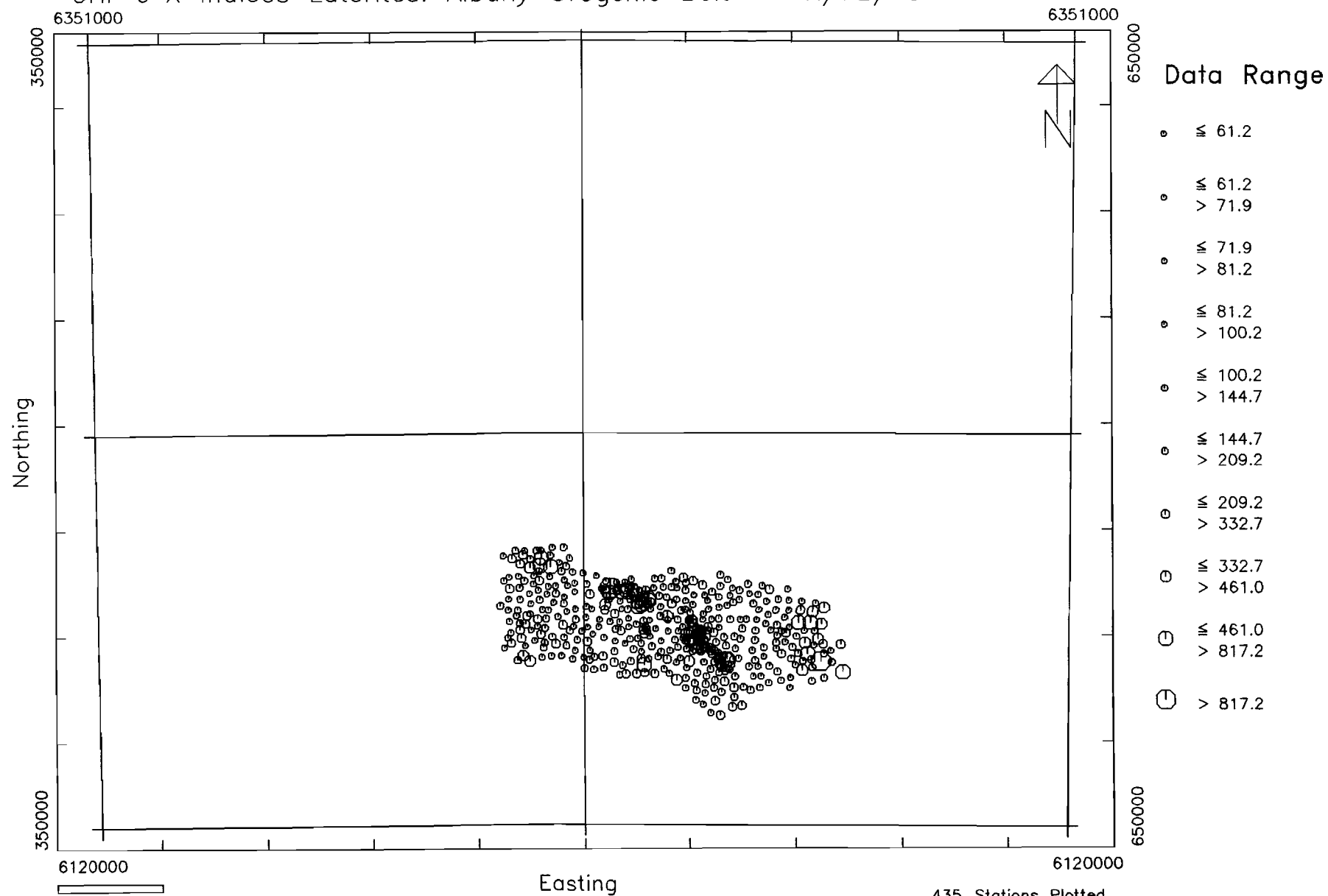
PEG-4 Indices Laterites: Yilgarn Block R/F2/F3

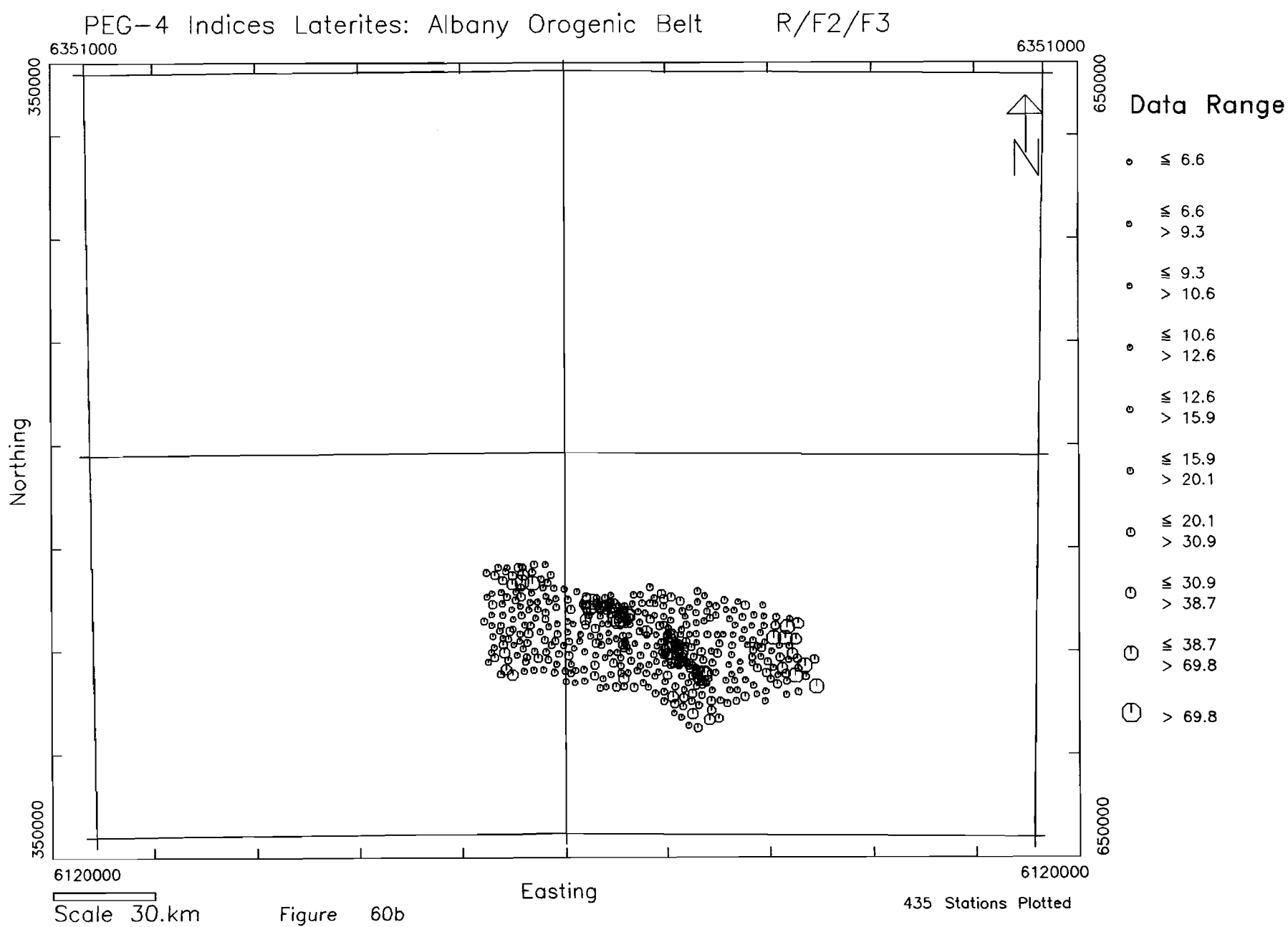




CHI-6*X Indices Laterites: Albany Orogenic Belt

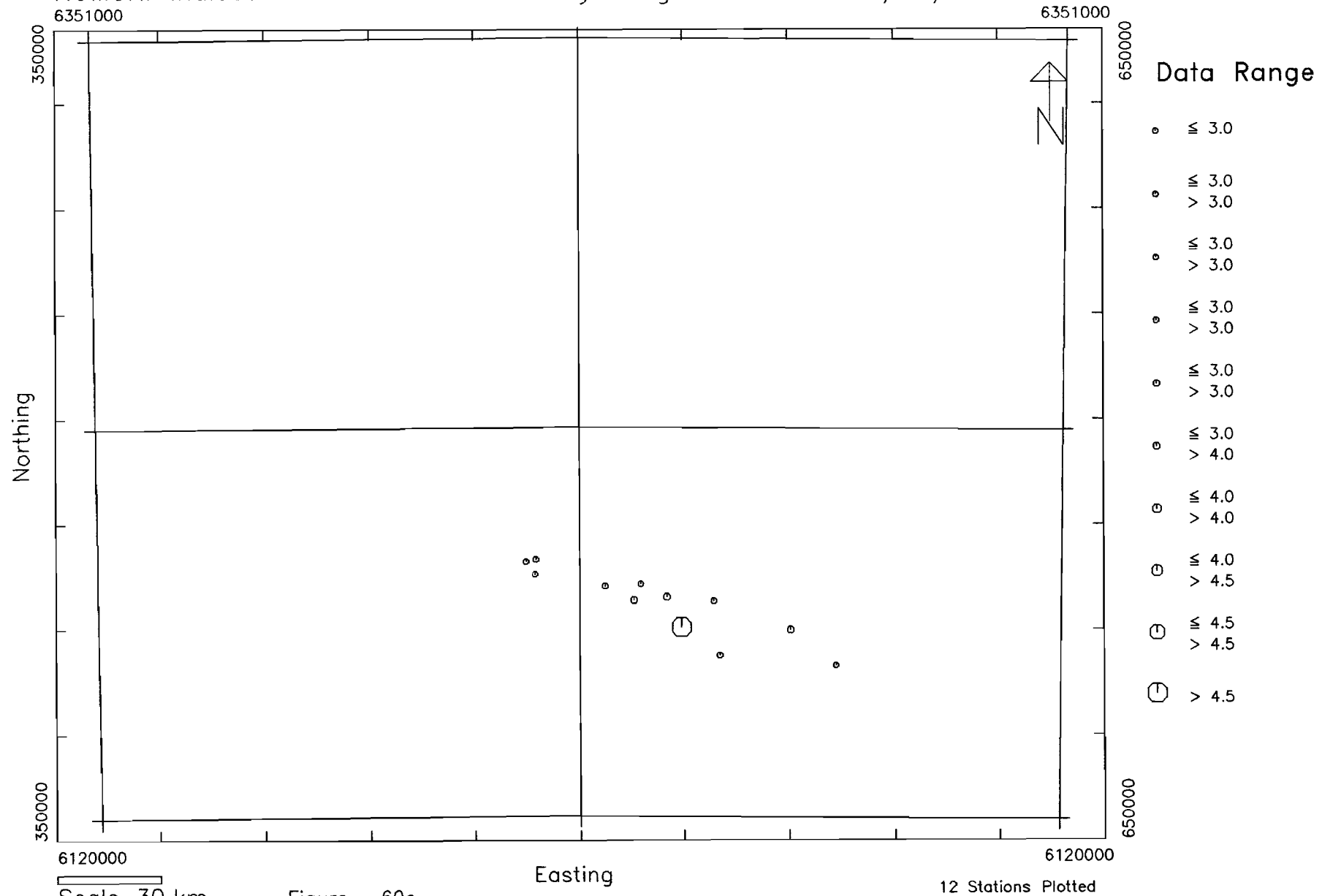
R/F2/F3





NUMCHI Indices => 1 Laterites: Albany Orogenic Belt

R/F2/F3



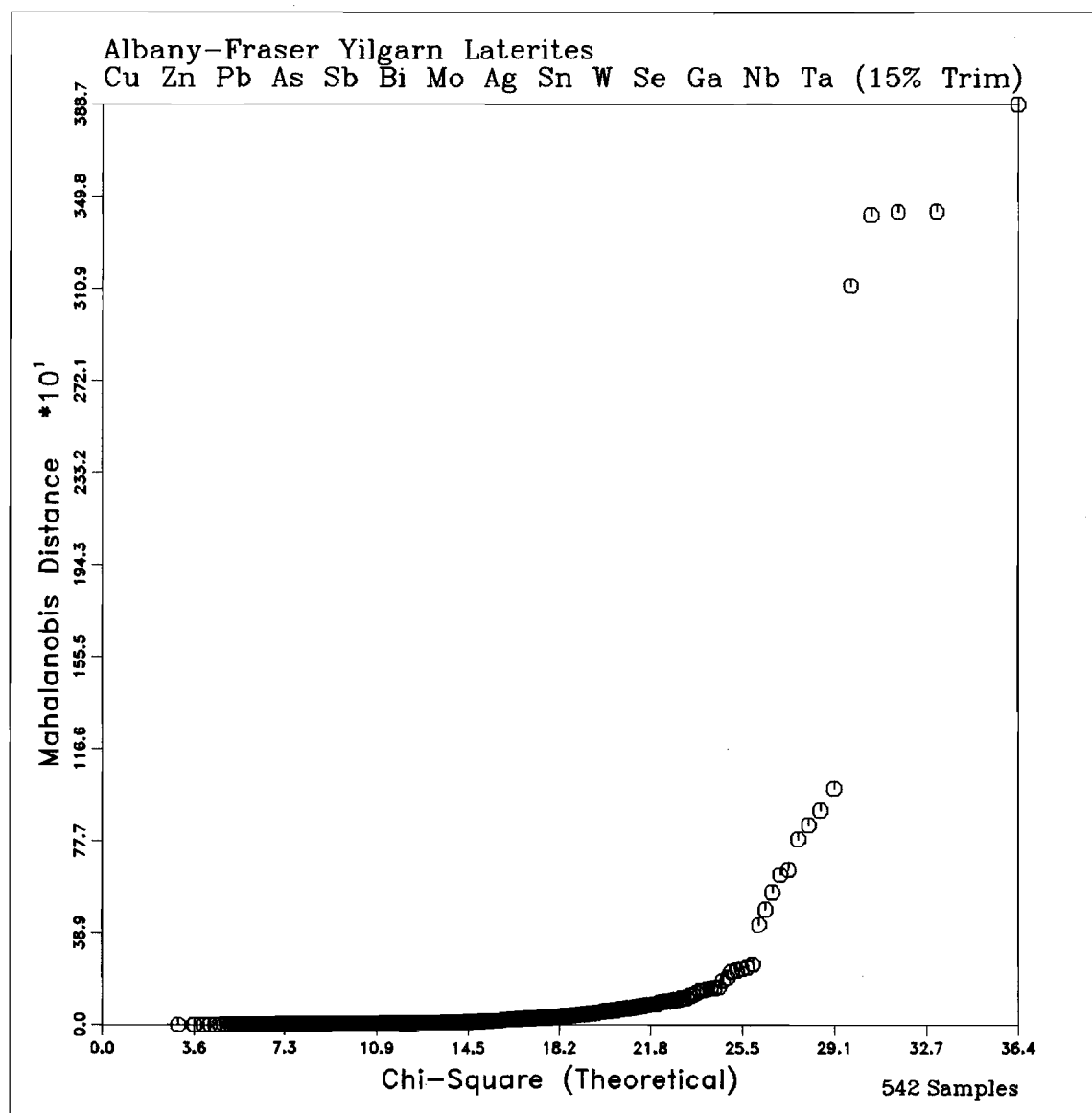


Figure: 61a

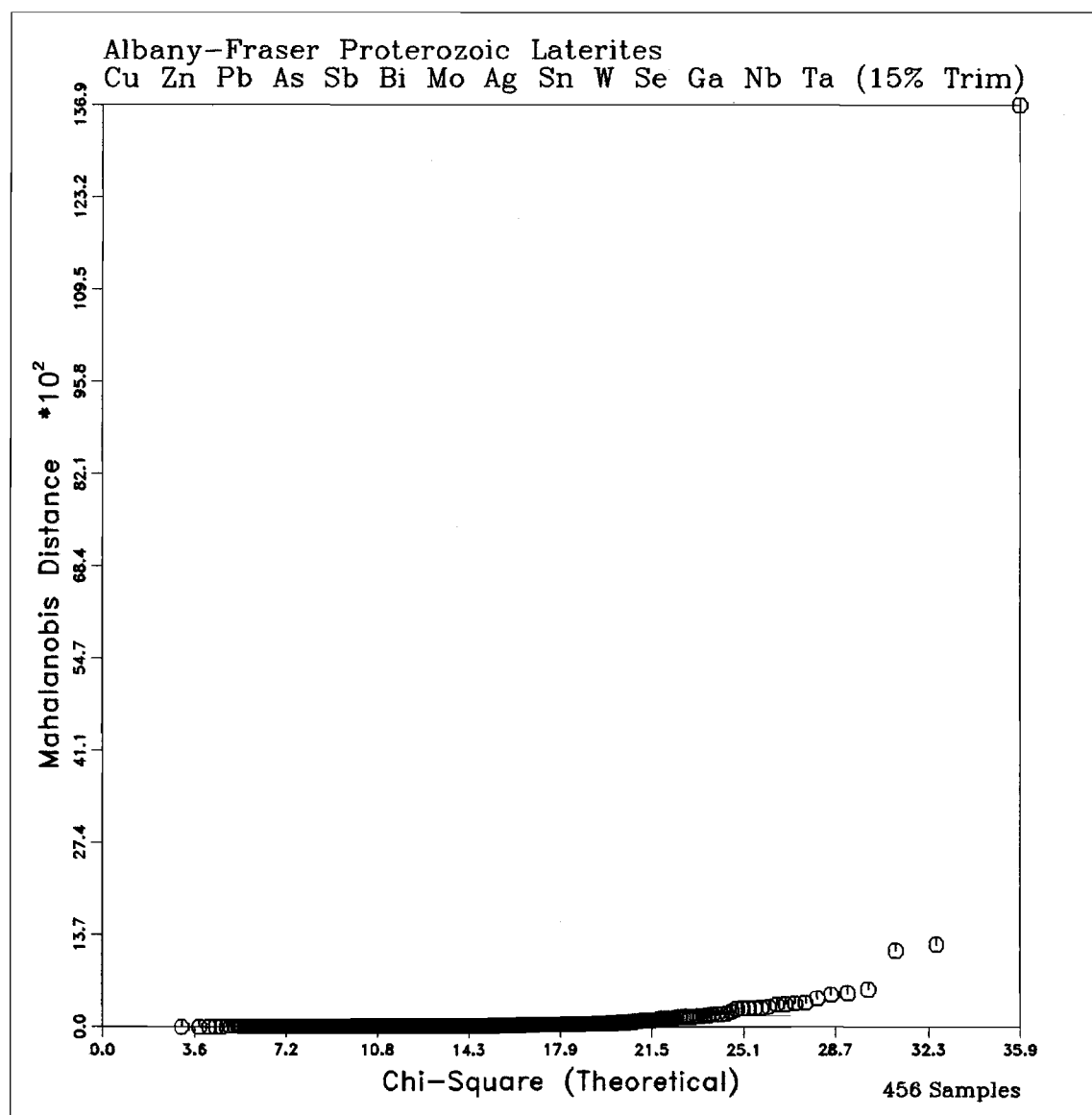


Figure: 61b

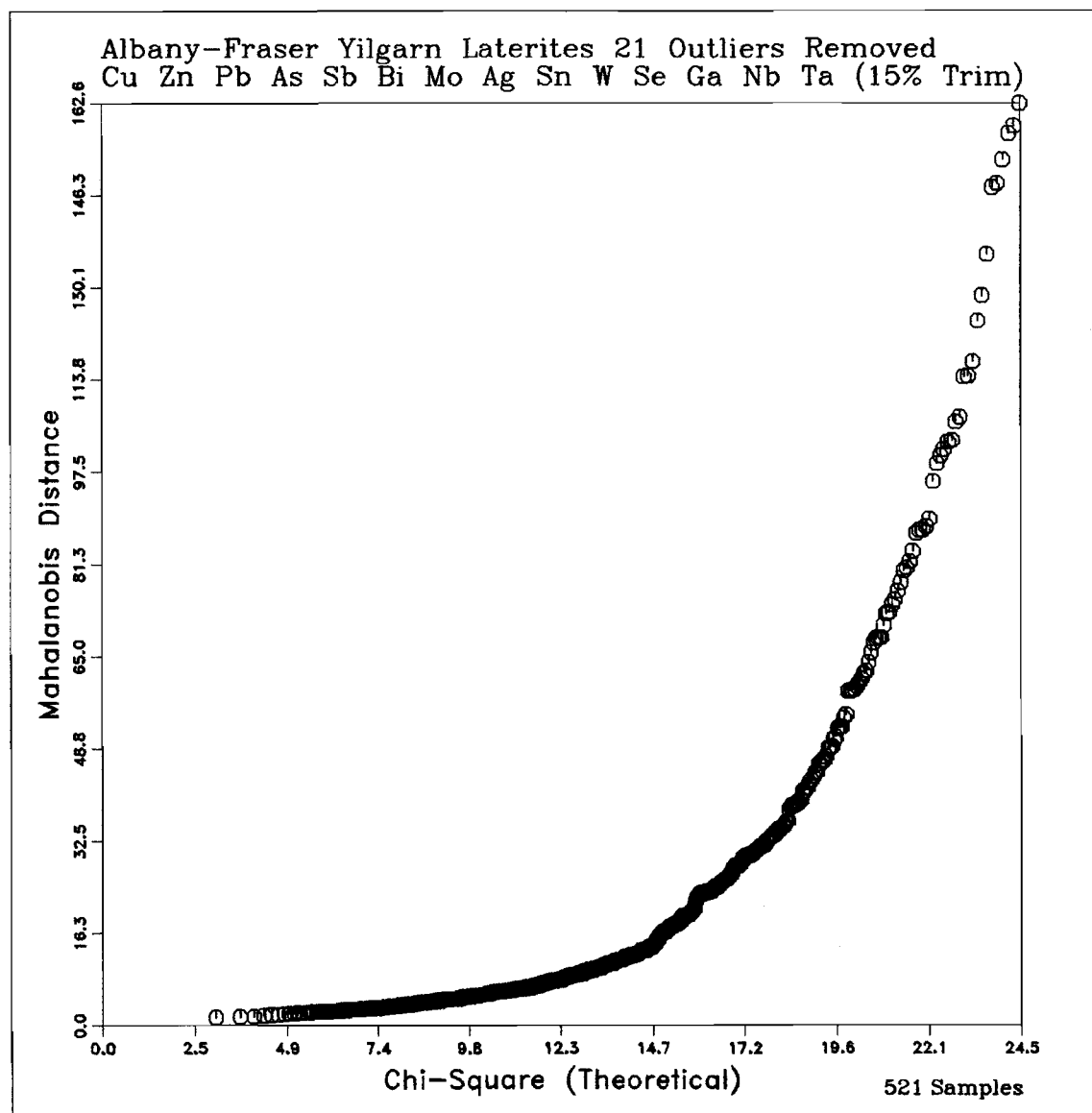


Figure: 62a

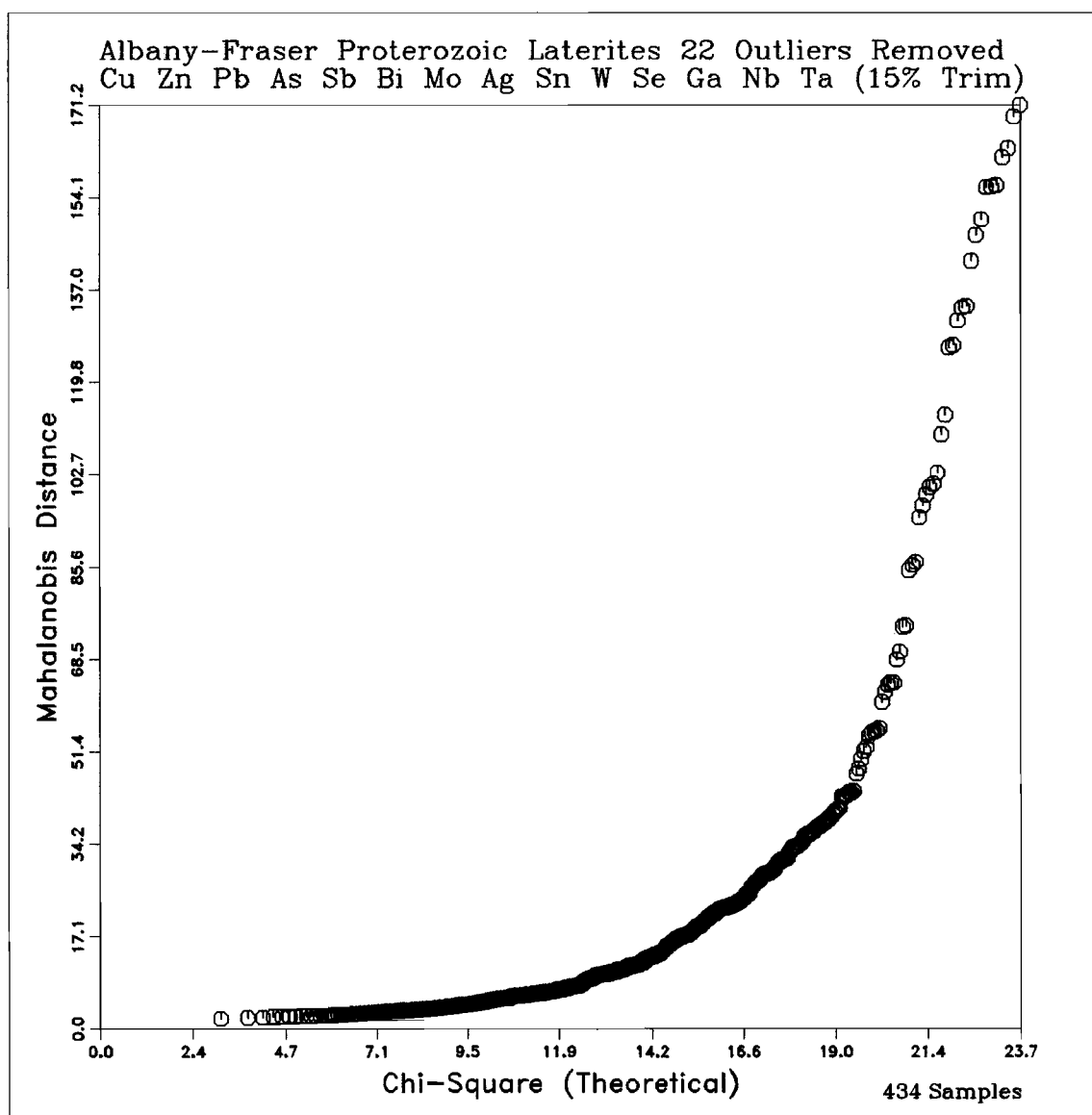
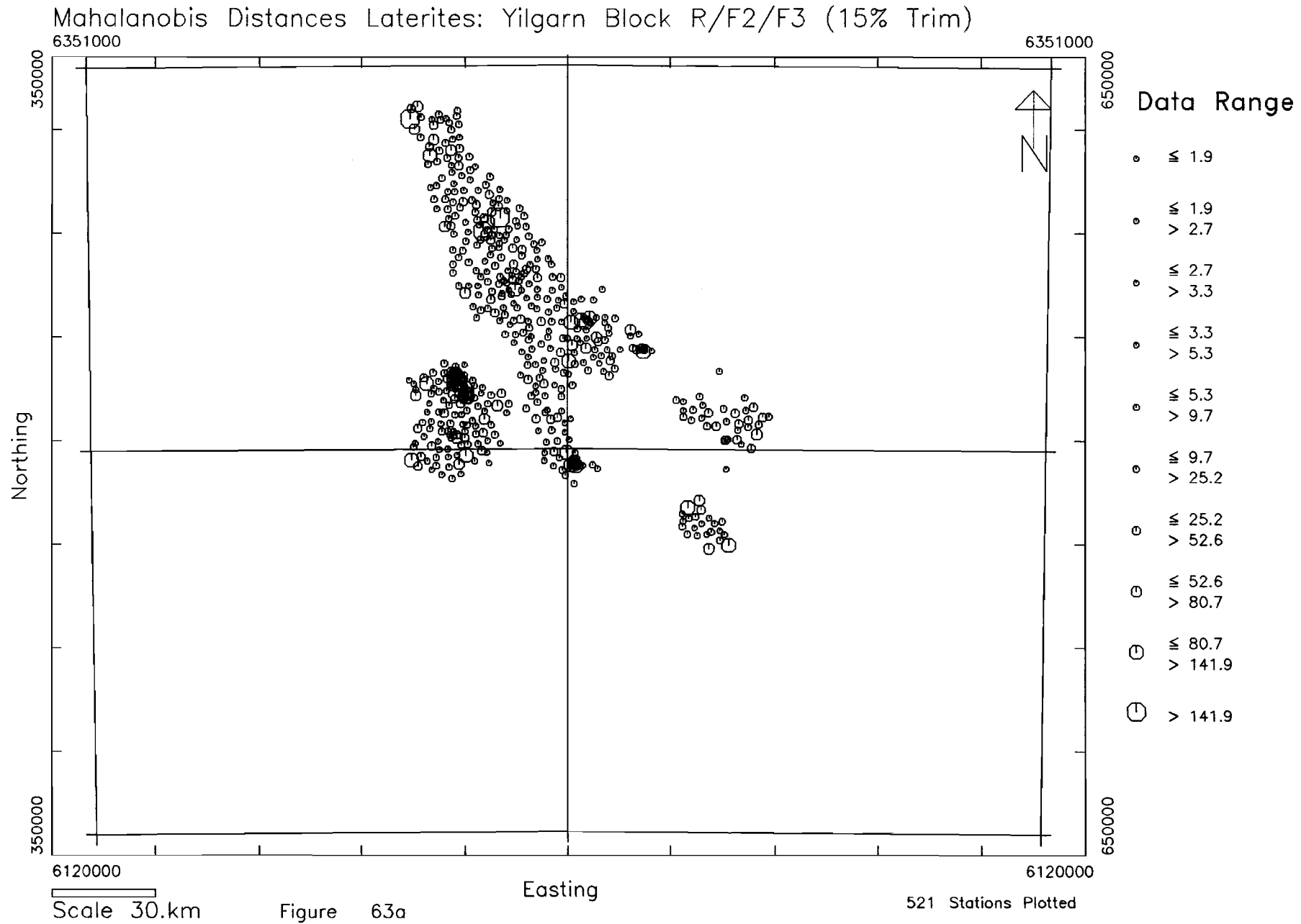
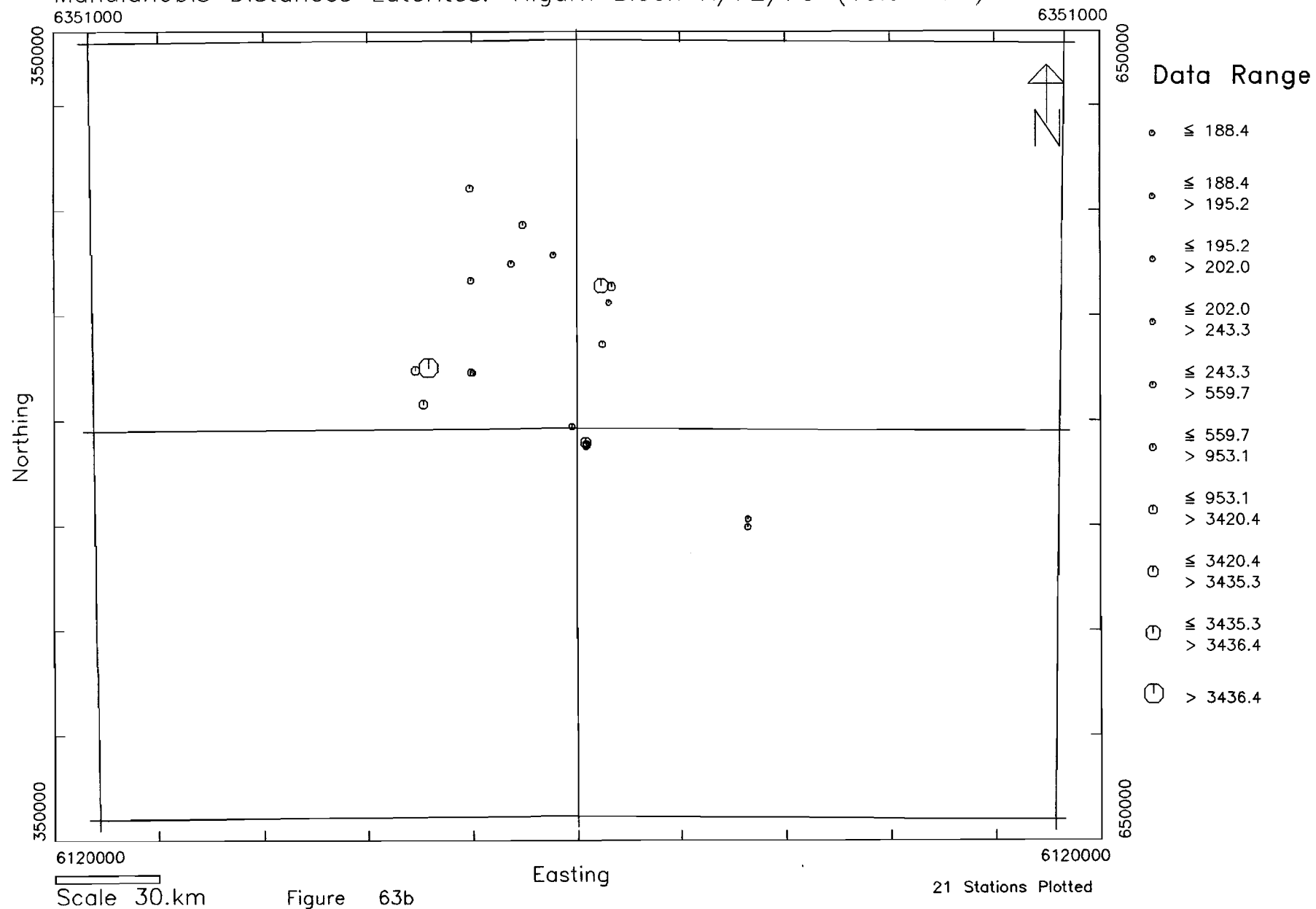
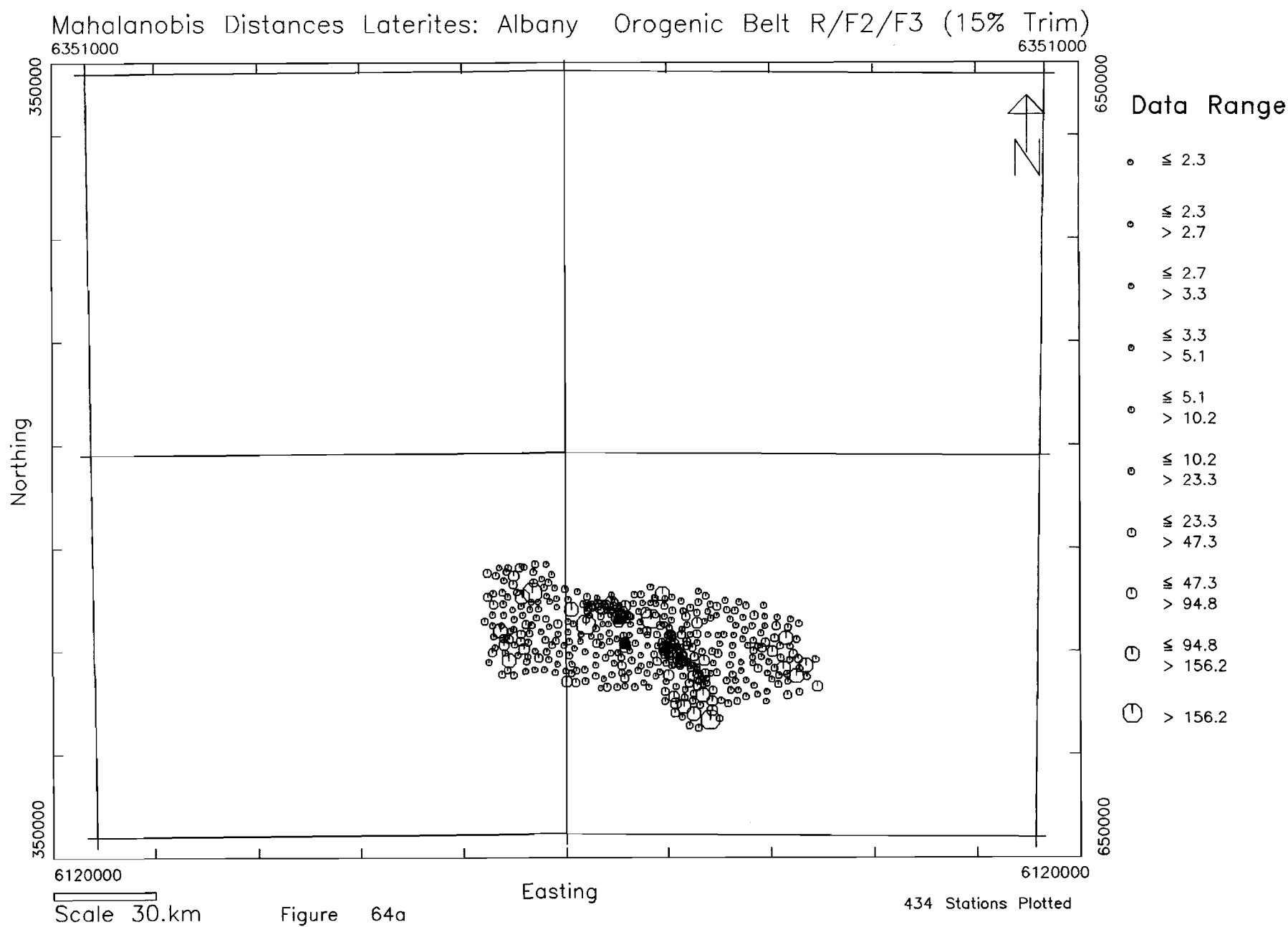


Figure: 62b



Mahalanobis Distances Laterites: Yilgarn Block R/F2/F3 (15% Trim)





Mahalanobis Distances Laterites: Albany Orogenic Belt R/F2/F3 (15% Trim)

