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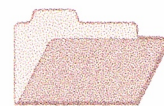
THE MINERALOGICAL AND GEOCHEMICAL EFFECTS OF WEATHERING IN MAFIC AND ULTRAMAFIC PROFILES, MT MAGNET, WESTERN AUSTRALIA

K.M. Scott and A. Martinez

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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.

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SUMMARY

Material from five drill holes located up to 300m west of the Parkinson Pit have provided a suite of mafic volcanic rocks with which the effects of proximity to mineralization and alteration in the weathered zone can be determined. Fresh barren rocks consist of assemblages of calcite + dolomite + albite + chlorite ± minor mica and more proximal rocks, dolomite + chlorite + paragonite ± muscovite whereas altered and mineralized assemblages consist of siderite + dolomite + chlorite + muscovite. With weathering, the carbonates, chlorite and albite break down to Fe oxides, kaolinite ± smectites but micas remain essentially unaffected. Thus within weathered profiles increasing proximity to mineralization is reflected by the progression minor mica → abundant paragonite ± muscovite → abundant muscovite i.e. increasing K contents. The relatively low abundances of other Au pathfinders (As, B, Mo, Sb and W) at Mt Magnet suggests that high muscovite (or K) contents are probably the best guide to mineralization in this area.

The absence of talc high in a weathered ultramafic profile suggests, by comparison with ultramafic profiles from the Eastern Goldfields, the presence of alteration. This is confirmed by the presence of some K-rich zones within the profile and elevated abundances of the Au pathfinders, As, Mo, Sb and Sn, in the surficial calcrete zone of the profile.

1. INTRODUCTION

Previous reports on weathering at Magnet have concentrated on detailing mineralogical and geochemical features within mineralized and barren mafic and felsic rocks from the Parkinson Pit area (Scott, 1989a and b). However, because these "barren" profiles are generally close to mineralization, some difficulty can occur in trying to assess which features are characteristic of mineralization. Therefore this study considers mafic and ultramafic volcanics from profiles up to 300m west of the pit where lenses of mineralization are not so abundant. The use of mica compositions as a guide to mineralization (Scott, 1990b) is also further evaluated.

2. SAMPLES AND METHODS

The reverse circulation drill holes PKN 039, PKN 049, PKN 111 and PKN 203 (see Fig. 1 for location) have been studied in detail by determining the mineralogy down each hole, by X-ray diffractometry (XRD) as described by Scott (1989a), using one metre composite samples. Selected samples, representing each significant mineralogical zone within a particular hole, were then analysed chemically by ICP, XRF and optical emission spectrography (Scott, 1989a). Gold values were determined by Metana Minerals N.L.

In addition one metre composites from the holes SUG 6 and SUG 7, located within 30m of PKN 111, were used to provide additional mineralogical (XRD) data because of the presence of some Au in that area.

3. RESULTS

3.1 PKN 039 (5361E 3780N)

This hole passes through ultramafic rocks as indicated by the abundance of Cr, Mg and Ni throughout its length (Table 1) (see also Section 4.1) and consists of assemblages of quartz, Fe oxides (especially Al-rich goethite), rutile, muscovite, kaolinite and smectitic clays. Carbonates, chlorite/vermiculite

and talc are also present in some samples (Fig 2). Four distinct zones are recognized on the basis of specific mineralogical associations along the hole's 40m length.

The surficial calcrete zone is pink-brown and white in colour and characterized by the presence of calcite and relatively low goethite content. This zone has high Ca, As, B, Mo, Sn and Sr contents.

The underlying kaolinite/goethite zone (3-27m) is buff to brown in colour with an intense red-brown interval between 12 and 15m. Goethite is more abundant in this zone than above and mica is abundant in the upper portion of this zone (Fig 2). Chemically the zone is characterized by high K, Ti and Ba contents and low Mg contents (Table 2).

Brown to buff-grey rocks of the goethite/talc/kaolinite zone (27-35m) contain dolomite, chlorite/vermiculite and talc but no mica (Fig 2). Mn, Co, Cr, Ni, Sn and Zn are elevated in this zone but K and Zr are low (Table 2).

Rocks of the basal 5m (goethite/chlorite zone) are brown to grey in colour and have abundant chlorite but the dolomite and talc of the overlying zone are not present. Fe, Mn, Ba, Sc, V are abundant but Zr contents are low (Table 2).

General features of this hole are the high to very high Fe contents and the slightly anomalous Au contents below 15m (Table 1).

3.2 PKN 049 (5320E 3740N)

Although this hole is only 50m from PKN 039 (Fig 1) the rocks from this hole are mafic volcanics, reflected by the generally much lower Cr contents (Table 3). Thus talc is not present within this profile and smectitic clay less abundant. A major feature of this profile is the proximity of residual albite to the surface (Fig 3). Other features of the whole profile are the high Fe and Ti contents, Au contents > 0.15 ppm and consistently low K contents (Table 3). B, Ba and Cr contents systematically

decrease down the profile (Tables 3 and 4). Specific characteristics of four zones within the profile are considered below.

The surficial calcrete zone (0-3m) is pink-brown in colour and is defined by the presence of calcite, dolomite and gypsum (Fig 3). Ca, Mg, Mo and Sr are high in this zone and Al, Mn, Co, Sb, Sc and V low (Table 4).

Buff to red-brown rocks of the goethite/kaolinite zone (3-14m) have greater goethite and kaolinite contents than the overlying calcrete zone. Cu, Ni and V are elevated in this zone but Mg contents are quite low.

Between 14 and 34m (goethite/albite/vermiculite zone) the rocks are brown in colour reflecting the abundant goethite. Moderate amounts of albite and significant vermiculite are present. Mg, Ga, Mo and Zn are elevated in this zone and the highest Au grades are also present in this zone (Table 4).

The basal albite/chlorite zone (34-40m) is brown to brown-grey in colour. It contains abundant chlorite and albite, reflected by its high Mg and Na contents, but generally lower goethite and kaolinite than the overlying zones (Fig 3). B, Ba, Cr and Ga contents are low.

3.3 PKN 111 (5685E 3938N)

This hole, located just west of the Parkinson Pit (Fig 1), passes through mafic volcanics with relatively fresh (sulfide-bearing) samples being encountered at its base. The minerals present within the most weathered portion of this profile are quartz, Fe oxides, rutile, dolomite and calcite, muscovite, paragonite chlorite, kaolinite and smectitic clays. Pyrite and albite occur in fresher samples deeper in the profile (Fig 4). Si, Ti, Ga, Ge and Zr contents tend to decrease down this hole (Tables 5 and 6). Specific features of six distinct zones within the profile are considered below.

The top 4m consists of a thin red-brown soil above a white to
pink-brown calcrete horizon which is characterized by the
presence of calcite and gypsum and by a relatively low goethite
content (Fig 4). Its Ca, S, Ba and Sr contents are high but Fe,
Mn, As and Cu are low. Au is significant in this zone (Table 6).

Between 4 and 25m (goethite/muscovite zone) the rocks are yellow-
brown to brown in colour. Calcite is not present in this zone
but dolomite is present in the basal portion. Muscovite (and
subsidiary paragonite) and kaolinite are strongly developed and
both goethite and hematite are present (Fig 4). Al, K, Ba, Cr,
Mo contents are high, Au contents are significant in the upper
portion and Mn contents are low (Tables 5 and 6).

The goethite/kaolinite zone (25-53m) is brown to red-brown in
colour, reflecting its abundant Fe oxide content but muscovite is
less abundant than above (Fig 4). Al, Fe, Mn, Co, Cu, Ni, Sc and
Zn contents are high and Mg, Ca and Na contents low (Table 6).
However the elevated Co, Ni and Zn contents of this zone are
largely due to the high Mn sample, 108414 (Table 5).

Material from the goethite/chlorite/muscovite zone (53-76m) is
only partially weathered with rock fragments varying in colour
between brown and grey. Hematite is not present in this zone,
muscovite is more abundant than above and chlorite strongly
developed. Kaolinite is only present above 61m (Fig 4). K, As,
B, Co, Cr, Mo, Sc and Zn are enriched in this zone, with high-
grade Au at the base of the zone (Tables 5 and 6).

The chlorite/dolomite zone (76-119m) is grey to brown-grey in
colour and is characterized by substantial chlorite and dolomite
contents (sometimes accompanied by calcite). Goethite contents
are low and kaolinite completely absent. Muscovite is only a
minor component in this zone but paragonite is quite abundant
(Fig 4). Pyrite may also be present in trace amounts. Mg, Ca,
S, Ag and As are significant in this zone but Si and Ba contents
are low. K contents are also quite low, especially when
considered relative to Na contents (Table 6).

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Fresh green-grey rocks of the calcite/chlorite/albite zone (119-
136m) are relatively similar to rocks from the zone above except
for the carbonate changing to calcite and lower paragonite
contents as albite becomes the major Na host (Fig 4). Mg and Ca
contents are high but Si, Al, Na, K, B, Sb and Sc contents low
(Table 6).

3.4 SUG 6 and SUG 7

These two holes adjacent to PKN 111 help in assessing the
significance of the zones identified in PKN 111 because despite
their proximity they show slightly different mineralogical
associations.

In SUG 6 the top 3m represents the surficial calcrete zone and is
characterized by the presence of calcite ± dolomite ± bassanite
i.e. $CaSO_4.0.5H_2O$ - a partially dehydrated analogue of gypsum
which forms under arid conditions (Akpokodje, 1985). Muscovite
is more abundant in this interval than in PKN 111 (Fig 5).
Between 3 and 34 (goethite/muscovite zone) the rock contains
abundant muscovite and goethite and appreciable kaolinite and
smectitic clay. Dolomite is present between 21 and 34m (Fig 5).
The goethite/kaolinite zone (34-44m) tends to have somewhat
higher abundances of these two minerals but much less muscovite
than above. No carbonates are present in this zone. The basal
goethite/chlorite/mica zone (44-60m) has similar goethite levels
to the overlying zone but its kaolinite content is very much
reduced. Mica is abundant in this zone but paragonite rather
than muscovite is often the dominant variety (Fig 5).

In SUG 7 the calcrete zone extends from 0 to 5m and is
characterized by the presence of calcite and/or bassanite (Fig
6). The muscovite content of this interval is more similar to
that in PKN 111 than that of SUG 7. Between 5 and 28m in the
goethite/mica zone, kaolinite and hematite are more abundant but
muscovite is less abundant than in SUG 6. In fact paragonite is
often the dominant mica in this zone (Fig 6). The underlying
muscovite zone (28-42m) contains more muscovite than the zone
above, lower kaolinite, goethite and hematite contents and
significant dolomite ± calcite development. In the

goethite/chlorite/muscovite zone (42-58m) goethite and kaolinite are still abundant but chlorite is also consistently present. No carbonates are present (Fig 6). The basal chlorite/paragonite zone (58-80m) contains much less goethite than above but kaolinite is completely absent and chlorite very abundant. Paragonite is the dominant mica. Dolomite and calcite are also major components in the deepest sample (Fig 6).

3.5 PKN 203 (5578E 4150N)

This most northerly of the drill holes passes through mafic volcanics well to the west of the Parkinson Pit (Fig 1). It displays systematic increases in K, As, B, Co and Zn and decreases in Ga down its length (Tables 7 and 8). Mineralogically it consists of assemblages of quartz, kaolinite, muscovite, paragonite, goethite, rutile and smectitic clays, with calcite also present in the top few metres and chlorite/vermiculite at the base of the hole. Four distinct zones are present along the length of the drill hole (Fig 7).

The surficial calcrete zone (0-4m) is buff-white in colour and contains calcite. It bears the highest Mg, Ca, S and Sr contents. Au and Ba contents are also high but Fe and Si are low relative to other zones (Table 8).

Buff to red-brown rocks of the goethite/kaolinite zone (4-14m) have more goethite, kaolinite and mica than the calcrete zone. Frequently paragonite is the dominant mica (Fig 7). Al and Mo contents are quite high in this zone and Sr contents relatively low. However the anomalous Mo is entirely due to sample 108604 (Table 7).

The goethite/paragonite zone (14-26m) is brown in colour but kaolinite is not as abundant in this zone as in that above (Fig 7). This zone is characterized by high Fe, Na and Cu contents (Table 8).

The basal goethite/muscovite zone (26-40m) is brown to brown-grey in colour and dominated by abundant muscovite and goethite. Smectitic clays are consistently present in this zone and

kaolinite contents less than above, chlorite/vermiculite is present in trace amounts below 30m (Fig 7). This zone has the highest K, Mn, Ag, As, Ba, W and Zn contents. Cu and Au contents are also high (Table 8). The anomalous W in this zone is due to percentage amounts of W in goethite veins in sample 108630 (Scott, 1990b).

4. DISCUSSION

4.1 Weathering of ultramafics at Mt Magnet

Drill hole PKN 039 provides an example of an ultramafic profile at Mt Magnet and hence is worthy of comparison with other ultramafic profiles in the Eastern Goldfields.

The ultramafic nature of the profile is confirmed by Ti/Zr >60 and Cr contents >700 ppm (cf. Hallberg, 1984) as well as the maintenance of high Mg, Cr and Ni contents in the profile despite weathering (Scott, 1990a). However these rocks do seem to contain higher TiO_2 contents (~0.8%) than present in the ultramafics at Panglo in the Eastern Goldfields (~0.4%; Scott, 1990a). The formation of greenstones in platform-phase basins in the Murchison Goldfields and rift-phase basins in the Eastern Goldfields involve contamination by crustal rocks and direct eruption respectively (Groves and Phillips, 1987) and could account for the differences in the natures of ultramafics from the two regions. However, recently Barnes and Often (1990) have suggested higher Ti contents in komatiites reflect a lower degree of partial melting than generally associated with komatiites. In either case, there may be a fundamental difference in the nature of the ultramafic rocks of the two regions.

Talc in the barren ultramafic profiles at Panglo may persist to the surface but where alteration and mineralization are developed, it is not found until deeper in the weathered profile (Scott, 1990a). Thus with talc only present below 23m (true depth) in this profile alteration/mineralization would be suspected. Mica contents in ultramafic profiles at Panglo are generally low even where ultramafic rocks are mineralized (Scott 1990a). However in PKN 039 some very low grade Au occurs with K-

rich alteration in the kaolinite/goethite zone (3-27m).
Furthermore the overlying calcrete zone contains the highest
abundances of Au pathfinders (i.e. As, Mo, Sb and Sn) of that
profile even though Au contents are quite low in the calcrete
zone itself (Table 2). These features suggest that minor Au
mineralization and associated alteration occurred within the
profile and with weathering the Au pathfinders have been
concentrated into the calcrete zone.

Using the data from this hole and allowing for the effects of
slight alteration in the kaolinite/goethite zone, an idealized
profile through barren ultramafic rocks at Mt Magnet can be
constructed (Table 8). The effect of alteration would be to
raise muscovite abundances (and hence K contents) and to decrease
the abundances of and level to which chlorite/vermiculite and
talc occur within the profile.

4.2   Characteristics of mafic profiles at Mt Magnet

As drill hole PKN 049 is located about 300m west of major
mineralization at Mt Magnet (Fig 1), it provies a good profile
for barren mafic volcanics (despite the occurrence of Au grades
~0.2 g/t down its length, Tables 3 and 4). Features of the
profile are the surficial calcrete zone above a goethite- and
kaolinite-rich zone which progressively gives way to more albite-
and vermiculite/chlorite-rich assemblages (Fig 3). The low K
contents throughout the hole confirm its generally unaltered
nature (Tables 3 and 4). Thus the major effect of weathering of
distal mafic volcanics at Mt Magnet appear to be the breakdown of
albite and chlorite to kaolinite.

The profile from PKN 203, which has generally lower Au contents
than PKN 049 (cf. Tables 4 and 8), is similar over the initial
14m except for the greater abundance of muscovite and paragonite
and lesser goethite development in PKN 203 (cf. Figs 3 and 7).
However below that level, paragonite and muscovite become even
more abundant than in PKN 049 and albite is not present at all
(Fig 7). Vermiculite/chlorite is poorly developed at the base of
PKN 203 but by comparison with the barren profile from NMS D5
(Scott, 1989a) it may be expected to become more abundant with

greater depth in the PKN 203 area. Thus the major effect of weathering barren mafic volcanics ~150m from the Parkinson Pit (i.e. mineralization) is the breakdown of chlorite to kaolinite with micas remaining stable.

Comparison of these two profiles indicates that whereas fresh mafic volcanics remote from mineralization contain albite and chlorite with only minor mica development, equivalent rocks closer to mineralization contain abundant paragonite and muscovite. Mineralized mafic volcanics profiles also bear abundant micas but such mica is invariably only muscovite (Scott 1989a, 1990b). In weathered profiles, because albite and chlorite are unstable, the progression from distal → proximal → mineralized mafic volcanics is reflected by minor mica content → abundance paragonite ± muscovite → abundant muscovite. The characteristics of these three types of mafic volcanic profiles at Mt Magnet are summarized in Figs 9-11. These figures also reveal that the mineralized profiles tend to have deeper weathering and lesser Fe within the leached saprolite horizon. Carbonates also change from calcite + dolomite to dolomite to siderite + dolomite as mineralization is approached - consistent with Fe enrichment in the carbonates associated with alteration/mineralization (cf. Phillips, 1986; Scott, 1990a).

The As, B, Mo, Sb and W contents of these barren profiles are also consistently lower than in the mineralized profile, NMS D5 (Scott, 1989a). However, because of the relatively low abundances of these pathfinders (generally <200 ppm) even in mineralized profiles, lithogeochemical features like low Na and high K (reflecting the mica compositions) should be regarded as good guides to mineralization in weathered mafic volcanics.

The calcrete zones in both PKN 049 and PKN 203 contain >0.1 ppm Au (Tables 4 and 8) - an amount considered anomalous for calcrete at Panglo in the Eastern Goldfields (Scott 1990a). Thus these drill holes might be expected to be mineralized at depth, although the absence of associated Au pathfinders (e.g. As) does diminish the significance of the elevated Au contents. Nevertheless the presence of abundant muscovite and elevated As, Au and W contents toward the base of PKN 203 (goethite/muscovite

zone; Table 8) does suggest some potential for mineralization below the base of that hole. However the PKN 049 area is unlikely to be highly mineralized on the basis of mineralogical/geochemical characteristics (Fig 3, Table 4).

4.3 Application of mafic profile features to the PKN 111 area

With the mineralogical data from PKN 111, supplemented by that from SUG 6 and SUG 7, the distribution of various minerals relative to a thin steeply dipping lens of mineralization can be observed (Fig 12). The most obvious feature is that the mineralization is enclosed in an envelope of intense muscovite development and strong paragonite development is always displaced from such mineralization. This feature confirms the inverse relationship between mineralization and Na content of the micas reported previously at Mt Magnet (Scott, 1990b). It also indicates that, although on the basis of the proximity of this location to the Parkinson Pit (Fig 1), the profile might be expected to be paragonite-rich (Section 4.2), small scale mineralization has associated alteration which locally overprints the broad alteration pattern. Thus mineralized intervals outside the main zone of mineralization should still be associated with local intense alteration which may extend for up to 10m from that mineralization, thereby increasing the target size during exploration.

Another feature of these three holes is the consistent vertical zonation from calcite (calcrete) → goethite → dolomite → goethite → chlorite → dolomite ± calcite at depth (Fig 12). This sequence suggests that chlorite is more stable to weathering than dolomite and calcite. When chlorite and the carbonates weather they form mainly Fe oxides (especially goethite), kaolinite and some smectitic clays which persist to the surface (e.g. Fig 4). However carbonates reoccur in the profile as surficial calcrete up to 4m thick and as a dolomite zone ~10m thick within the interval 11 to 36m in the PKN 111 area (Fig 12). Calcrete, often with associated gypsum and/or bassanite, is found above mafic volcanics within the Parkinson Pit area where it is related to post-Miocene aridity. Such a calcrete zone is often enriched in Au (Lintern, 1989). Although Au is >0.1 ppm in this

zone, the lack of associated pathfinder elements with the Au may imply that significant Au mineralization is unlikely to occur vertically below the calcrete of PKN 111 (cf. Section 4.2).

Dolomite was not found in the previously studied weathered mafic volcanic profiles from the Parkinson Pit area (Scott, 1989a). However mineralogical studies of profiles from the northern wall of the pit in the Parkinson Zone (i.e. ~4150N) have revealed the existence of the dolomite zone within 25m of the original surface (Fig. 13). From its level and relatively flat-lying position in the weathered profile it would appear to be secondary. Its composition - $Ca_{51.3} Mg_{48.5} Fe_{0.20} Mn_{0.04} Sr_{0.03} Zn_{0.13} (CO_3)_{100}$ reveals that it has much lower Fe and Mn contents than the primary ferroan dolomites from the Parkinson Pit area (Scott, 1990b). Its substantial Zn content ($\equiv$900 ppm) also distinguishes it from primary dolomite which contains <100 ppm Zn. Thus the secondary dolomite is locally important as a host for Zn (and Sr) within the weathered profile.

Although the dolomite horizon appears to come within 5m of the surface in the 4150N area i.e. much higher in the profile than in the PKN 111 area, whether it does dip to the south and the extent of the zone are not currently known. (Along Section 4150 N, it is certainly not present at 5578 E i.e. PKN 203 (Fig. 7)). Under low pH conditions in soil profiles both dolomite and calcite are dissolved but whereas Ca is reprecipitated as calcite, Mg is dispersed or precipitated as dolomite lower in the profile (Wetherby and Oades, 1975). If this phenomenon also occurs in saprolitic rocks, it is possible that dolomite may only be precipitated well away from highly mineralized areas i.e. areas of high acidity. Therefore definition of the extent of secondary dolomite formation should be determined because of its potential application as a guide to mineralization.

5. CONCLUSIONS

The mineralogical assemblages in unweathered mafic volcanics at Mt Magnet change from calcite + dolomite + chlorite + albite ± minor mica content to dolomite + chlorite + paragonite ± muscovite to siderite + dolomite + chlorite + muscovite as

mineralization is approached. In weathered profiles, because the carbonates, chlorite and albite break down to give kaolinite and Fe oxides, only the micas are retained and increasing proximity to mineralization is reflected by the progression minor mica → abundant paragonite ± muscovite → abundant muscovite. Thus mineralized weathered profiles have the highest K contents and lowest Na/K ratios. As, B, Mo, Sb and W are also enriched in mineralized profiles but the relatively low levels (e.g. As ~200 ppm) associated with mineralization at Mt Magnet suggests that K (i.e. muscovite) contents may be a better guide to mineralization. In fact the elevated muscovite (and hence K) in the PKN 111 area (adjacent to the Parkinson Pit) even successfully defines the minor mineralization in that area (Fig 12).

Ultramafic rocks at Mt Magnet are recognized by their high (≥1000 ppm) Cr contents. The absence of talc in near surface samples suggests that the PKN 039 profile is altered and mineralized (by comparison to ultramafic profiles in the Eastern Goldfields). Furthermore, the Au pathfinders, As, Mo, Sb and Sn, are present in elevated amounts in the surficial calcrete zone and low grade Au is in fact found within this profile. Unlike in the mafic profiles, strong muscovite development does not occur with such mineralization in this ultramafic profile.

As well as the surficial calcrete zone which is often present in profiles at Mt Magnet, especially over the northern portion of the Parkinson Pit, a secondary dolomite horizon is present to the north-east of the pit.

6. RECOMMENDATIONS FOR FURTHER STUDY

The use of K contents as a guide to muscovite-rich alteration and hence mineralization within mafic volcanic profiles should be evaluated using a large number of profiles/sections.

The areal extent of the dolomite zone at Mt Magnet should be determined to ascertain whether that dolomite zone has exploration potential.

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Wetherby, K.G. and Oades, J.M., 1975. Classification of carbonate layers in highland soils of the Northern Murray Mallee, S.A., and their use in stratigraphic and land use studies. Aust. J. Soil Res. 13 : 119-132.

Table 1. Chemical composition of samples, PKN 039
(Major components, wt%; minors, ppm)

Sample No.	108520	108521	108523	108525	108530	108535	108545	108547	108554	108555	108559
Depth (m)	0-1	1-2	3-4	5-6	10-11	15-16	25-26	27-28	34-35	35-36	39-40
SiO_2	57.5	53.7	50.6	59.2	64.8	50.8	74.0	54.7	53.5	62.0	33.4
Al_2O_3	12.1	13.0	13.1	16.9	16.7	16.6	8.97	13.0	11.3	12.0	10.8
Fe_2O_3	11.3	22.4	26.9	13.2	8.69	22.2	10.9	20.1	21.8	16.6	45.8
MgO	3.60	0.73	0.32	0.47	0.38	0.50	0.19	1.94	3.76	1.13	1.86
CaO	3.97	0.21	0.04	0.06	<0.04	0.41	<0.04	<0.04	<0.04	<0.04	0.14
Na_2O	0.19	0.07	0.06	0.15	0.18	0.08	0.04	0.08	0.15	0.07	0.07
K_2O	0.35	0.06	0.44	1.42	2.29	0.22	<0.04	<0.04	0.10	<0.04	0.12
TiO_2	0.84	0.89	0.82	1.49	1.24	1.09	0.71	0.89	0.71	0.90	0.71
MnO	<0.04	<0.04	0.04	<0.04	<0.04	<0.04	<0.05	0.06	0.17	0.16	0.13
Ag	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	0.1	0.1	–	0.1
As	60	100	100	88	39	59	36	46	57	23	46
Au	0.02	<0.01	<0.01	<0.01	<0.01	0.25	0.08	0.09	0.04	0.03	0.03
B	150	160	100	100	80	50	20	15	30	–	40
Ba	220	140	290	360	560	120	9	10	50	40	410
Co	10	10	36	13	12	20	42	110	180	120	78
Cr	870	2400	1400	920	400	1100	1200	3700	2800	2500	2000
Cu	76	130	180	110	70	140	59	130	130	120	130
Ga	15	30	20	20	15	15	10	10	15	–	20
Ge	1.5	3	5	1	1	3	1	0.3	1	–	2
Mo	4	1	0.8	0.8	0.6	0.8	0.5	0.3	0.8	–	0.5
Ni	140	160	230	77	110	240	500	1100	970	590	480
Pb	<50	<50	<50	<50	<50	<50	83	82	77	<50	100
Sb	30	50	50	30	20	20	40	20	40	–	30
Sc	12	41	44	35	41	44	18	28	41	40	44
Sn	4	5	2	2	0.5	1	6	4	8	–	2
Sr	130	23	25	15	12	15	<5	6	11	7	49
V	220	660	470	400	360	450	260	360	360	300	800
Y	10	8	7	13	12	20	13	18	10	5	13
Zn	22	19	41	15	22	31	74	200	140	85	74
Zr	110	59	49	100	77	71	41	48	41	50	48
Ti/Zr	45	92	100	90	96	92	110	110	110	110	90

Note: P_2O_5 < 0.1%, SO_3 < 0.1%; W < 10 ppm

Table 2. Average compositions for zones within PKN 039
(major components, wt%; minors, ppm)

Zone	Calcrete	Kaol/goe	Goe/talc/kaol	Goe/chl
Depth (m)	0-3	3-27	27-35	35-40
No. of Samples	2	5	2	2
SiO_2	55.6	59.8	54.1	47.7
Al_2O_3	12.6	14.5	12.2	11.4
Fe_2O_3	16.9	16.4	21.0	31.2
MgO	2.17	0.37	2.85	1.00
CaO	2.09	0.11	<0.04	0.08
Na_2O	0.13	0.10	0.12	0.07
K_2O	0.21	0.88	0.06	0.07
TiO_2	0.87	1.07	0.80	0.81
MnO	<0.04	<0.04	0.12	0.15
Ag	<0.1	<0.1	0.1	0.1
As	80	64	52	35
Au	0.01(0.01)	0.07(0.07)	0.07(0.06)	0.03(0.04)
B	160	70	23	40
Ba	180	270	30	230
Co	10	25	150	100
Cr	1600	1000	3300	2200
Cu	100	110	130	130
Ga	23	16	13	20
Ge	2	2	0.7	2
Mo	3	0.7	0.6	0.5
Ni	150	230	1000	540
Pb	<50	<50	80	100
Sb	40	42	30	30
Sc	27	36	35	42
Sn	5	2	6	2
Sr	77	14	9	28
V	440	380	360	550
Y	9	13	14	9
Zn	20	37	170	80
Zr	85	68	45	49

Note: P_2O_5 < 0.1%, SO_3 <0.1%; W <10 ppm
Au values in parentheses – average for interval determined from data of Metana Minerals N.L.

Table 3. Chemical composition of samples, PKN 049
(major components, wt%; minors, ppm)

Sample No.	108560	108561	108563	108570	108575	108585	108590	108595	108599
Depth (m)	0-1	1-2	3-4	10-11	15-16	25-26	30-31	35-36	39-40
SiO_2	51.2	55.0	57.3	55.1	58.0	56.8	50.4	56.6	55.1
Al_2O_3	11.0	11.1	14.6	16.1	15.0	14.2	13.4	12.5	13.9
Fe_2O_3	11.7	20.9	18.4	18.1	16.8	17.2	23.6	15.7	15.3
MgO	1.67	0.67	0.36	0.29	0.44	1.83	3.36	5.68	6.65
CaO	8.49	1.96	0.11	0.10	0.28	0.12	0.07	0.16	0.18
Na_2O	0.24	0.15	0.16	0.12	0.13	0.32	0.84	1.36	2.20
K_2O	0.57	0.41	0.20	0.24	0.40	0.31	0.53	0.23	0.17
TiO_2	0.71	0.92	1.35	1.51	1.34	1.43	1.41	1.25	1.40
MnO	0.04	0.05	0.08	0.24	0.09	0.17	0.23	0.12	0.25
As	31	27	26	22	35	28	38	19	<5
Au	0.22	0.10	0.20	0.16	0.13	0.32	0.37	0.31	0.18
B	80	80	80	60	80	60	30	15	–
Ba	430	220	190	240	180	100	120	60	40
Co	20	31	54	47	34	93	52	53	54
Cr	410	790	450	420	350	330	390	250	190
Cu	120	150	230	180	110	180	150	150	160
Ga	15	20	20	20	20	20	30	15	–
Ge	0.8	1.5	1	1.5	1	2	3	1	–
Mo	2	1	0.6	0.8	2	3	1	0.8	–
Ni	110	170	210	300	140	280	150	150	120
Sb	10	20	30	30	30	40	30	20	–
Sc	<5	15	21	45	18	19	25	21	38
Sn	1	2	2	1	2	1	0.8	0.8	–
Sr	160	73	23	20	26	20	29	23	36
V	200	320	400	360	260	320	430	290	310
Y	9	12	13	18	12	19	16	12	7
Zn	52	˙66	92	89	70	220	89	90	90
Zr	100	100	96	110	160	100	110	100	110
Ti/Zr	43	55	84	83	50	85	77	75	80

Note: $P_2O_5 < 0.1\%$, except in 108561 where $P_2O_5 = 0.83\%$, $SO_3 < 0.1\%$;
$Ag \leq 0.1$, $Pb < 50$, $W < 10$ ppm

Table 4. Average compositions for zones within PKN 049
(major components, wt%; minors, ppm)

Zone	Calcrete	Goe/kaol	Goe/ab/verm	albite/chl
Depth (m)	0-3	3-14	14-34	34-40
No of samples	2	2	3	2
SiO_2	53.2	56.2	55.1	55.9
Al_2O_3	11.1	15.4	14.2	13.2
Fe_2O_3	16.3	18.3	19.2	15.5
MgO	1.17	0.33	1.51	6.17
CaO	5.23	0.11	0.16	0.17
Na_2O	0.21	0.14	0.43	1.78
K_2O	0.49	0.22	0.41	0.20
TiO_2	0.82	1.43	1.39	1.32
MnO	0.05	0.16	0.13	0.19
Ag	<0.1	<0.1	0.1	<0.1
As	29	24	34	12
Au	0.16(0.17)	0.18(0.15)	0.27(0.24)	0.20(0.20)
B	80	70	57	15
Ba	330	220	130	52
Co	26	51	60	54
Cr	600	440	360	220
Cu	140	210	150	160
Ga	18	20	23	15
Ge	1	1	2	1
Mo	2	0.7	2	0.8
Ni	140	260	190	140
Sb	15	30	33	20
Sc	9	33	21	30
Sn	2	2	1	0.8
Sr	120	22	25	30
V	260	380	340	300
Y	11	16	16	10
Zn	59	91	130	90
Zr	100	100	120	100

Note: P_2O_5 < 0.1% except in calcrete zone where it equals 0.42%
SO_3 < 0.1%; Pb <50, W <10 ppm.
Au, values in parentheses – average for interval determined from data of
Metana Minerals N.L.

Table 5. Chemical composition of samples, PKN 111 (major components, wt%; minors, ppm)

Sample No.	108385	108387	108388	108395	108400	108407	108414	108424	108434	108442	108447
Depth (m)	1-2	3-4	4-5	11-12	16-17	23-24	30-31	40-41	50-51	58-59	63-64
SiO_2	53.7	65.0	63.6	66.4	56.5	56.7	58.4	57.4	55.1	57.6	59.0
Al_2O_3	12.9	17.3	19.6	18.3	17.0	16.9	17.6	18.3	16.5	16.4	17.7
Fe_2O_3	3.48	1.10	5.44	3.71	6.27	8.63	12.1	13.1	17.1	11.9	10.6
MgO	2.71	0.84	0.38	0.22	2.23	1.72	0.32	0.23	0.49	3.24	1.52
CaO	9.01	2.87	0.35	<0.04	3.01	2.41	0.11	<0.04	<0.04	<0.04	0.06
Na_2O	0.96	0.73	1.02	1.60	1.02	1.00	0.78	0.55	0.67	0.88	1.05
K_2O	1.35	2.21	2.89	2.40	2.25	0.89	0.71	1.21	0.47	0.84	2.62
TiO_2	0.59	0.83	0.95	0.85	0.81	0.79	0.86	0.82	0.79	0.77	0.84
MnO	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.62	0.05	0.15	0.06	0.12
SO_3	0.57	0.67	<0.1	0.17	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ag	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
As	18	19	47	35	40	24	37	30	27	41	53
Au	0.11	0.14	0.22	0.04	0.10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
B	60	60	100	60	70	100	80	60	60	80	90
Ba	300	230	260	230	220	110	120	160	50	60	190
Co	11	6	23	9	43	24	110	63	59	60	77
Cr	260	330	450	300	360	290	160	380	310	340	370
Cu	44	16	190	50	150	74	160	270	180	100	150
Ga	10	15	15	10	12	15	10	15	15	20	10
Ge	1	1	1	1	1	1	1	1	0.8	1	0.3
Mo	1.5	3	15	1.5	10	8	3	4	1	15	2
Ni	100	89	140	44	140	150	380	260	140	180	140
Sb	20	15	30	20	15	20	30	20	30	30	20
Sc	39	48	51	61	75	62	77	83	52	69	59
Sn	1	2	1	1	1	1	0.5	1	1	1	0.3
Sr	180	120	90	100	100	95	84	55	78	98	110
V	160	230	320	270	270	260	290	300	290	240	270
W	10	10	15	<10	15	<10	<10	<10	<10	<10	<10
Y	11	10	15	10	16	17	17	15	20	18	15
Zn	22	12	52	32	130	170	180	160	120	170	210
Zr	78	66	77	62	61	58	66	60	61	51	60
Ti/Zr	45	76	74	82	80	83	77	82	79	90	83

Note: P_2O_5 < 0.1%; Pb < 50 ppm

Table 5. (Cont'd)

Sample No.	108454	108459	108462	108469	108479	108489	108494	108502	108509	108519
Depth (m)	70-71	75-76	78-79	85-86	95-96	105-106	110-111	118-119	125-126	135-136
SiO_2	59.8	61.5	50.3	48.2	47.1	47.8	53.3	45.5	45.3	41.8
Al_2O_3	17.0	17.9	14.6	14.0	14.7	12.7	15.7	13.5	13.0	12.0
Fe_2O_3	12.7	10.3	9.35	9.99	10.1	9.48	11.4	9.64	8.23	8.29
MgO	2.26	1.01	5.22	5.42	5.18	5.28	6.75	5.44	4.34	4.77
CaO	0.07	0.09	5.36	6.51	6.44	7.44	2.45	10.0	12.7	15.3
Na_2O	1.11	1.12	0.74	1.01	1.24	1.32	1.00	1.32	0.81	0.51
K_2O	1.97	2.90	1.70	0.91	0.95	0.50	0.17	0.16	0.56	0.48
TiO_2	0.80	0.83	0.68	0.64	0.69	0.56	0.67	0.58	0.58	0.53
MnO	0.09	0.08	0.12	0.15	0.20	0.20	0.11	0.13	0.15	0.14
SO_3	<0.1	<0.1	<0.1	<0.1	0.44	0.86	<0.1	<0.1	<0.1	<0.1
Ag	<0.1	0.1	0.2	0.1	0.5	2	<0.1	<0.1	<0.1	<0.1
As	56	69	36	42	68	120	27	29	33	33
Au	0.07	1.61	<0.01	<0.01	0.01	0.03	0.03	0.02	0.05	0.03
B	100	100	60	40	150	120	50	15	30	30
Ba	120	210	150	80	130	90	40	60	190	100
Co	49	89	32	30	36	37	48	40	33	31
Cr	360	400	310	280	310	290	350	300	300	270
Cu	150	150	120	82	130	100	100	98	98	96
Ga	15	15	12	10	12	12	12	10	10	10
Ge	1	1	1	0.3	0.5	1	0.3	0.5	0.3	0.3
Mo	10	3	3	2	8	3	2	3	6	2
Ni	150	160	100	140	130	120	140	130	88	92
Sb	40	30	30	40	30	40	30	20	<10	<10
Sc	81	69	44	50	24	32	27	20	38	14
Sn	1	1	1	0.5	1	1	0.3	0.3	0.6	0.5
Sr	100	110	61	74	86	92	84	76	66	45
V	260	280	230	210	220	180	220	200	190	170
W	10	10	<10	<10	10	15	<10	<10	<10	<10
Y	13	13	14	12	16	13	14	13	15	10
Zn	110	140	78	85	84	73	86	67	68	67
Zr	58	62	48	48	49	40	50	44	39	42
Ti/Zr	83	81	85	81	84	85	80	80	90	76

Table 6. Average compositions for zones within PKN 111
(major components, wt%; minors, ppm)

Zone	Calcrete	Goe/musc	Goe/kaol	Goe/kaol/ musc	Chl/dol	Calc/chl/ ab
Depth (m)	0-4	4-25	25-53	53-76	76-119	119-136
No. of samples	2	4	3	4	6	2
SiO_2	59.4	60.8	57.0	59.0	48.7	43.6
Al_2O_3	15.1	18.0	17.5	17.3	14.2	12.5
Fe_2O_3	2.29	6.01	14.1	11.4	10.0	8.26
MgO	1.78	1.14	0.35	2.01	5.55	4.56
CaO	5.94	1.45	0.04	0.06	6.52	14.0
Na_2O	0.85	1.16	0.67	1.04	1.11	0.66
K_2O	1.78	2.11	0.80	2.08	0.73	0.52
TiO_2	0.71	0.85	0.82	0.81	0.64	0.56
MnO	<0.04	<0.04	0.27	0.09	0.14	0.15
SO_3	0.62	<0.1	<0.1	<0.1	0.25	<0.1
Ag	<0.1	<0.1	<0.1	<0.1	0.5	<0.1
As	19	37	31	52	54	33
Au	0.13	0.09	<0.01	0.42	0.02	0.04
(Au)	(0.11)	(0.06)	(0.02)	(0.13)	(0.04)	(0.04)
B	60	83	67	93	73	30
Ba	270	210	110	150	92	150
Co	9	25	77	69	37	32
Cr	300	350	280	370	310	290
Cu	30	120	200	140	110	97
Ga	13	13	13	15	11	10
Ge	1	1	1	0.8	0.6	0.3
Mo	2	9	3	8	4	4
Ni	95	94	260	160	130	90
Sb	18	21	26	30	32	<10
Sc	44	62	71	70	33	26
Sn	2	1	0.8	0.8	0.7	0.6
Sr	150	96	72	100	79	56
V	200	280	270	260	210	180
W	10	10	<10	<10	<10	<10
Y	11	15	17	15	14	13
Zn	17	96	150	160	79	68
Zr	78	65	62	58	47	41

Note: P_2O_5 < 0.1%; Pb < 50 ppm
Au, values in parentheses - average for interval determined from data of Metana Minerals N.L.

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Table 7. Chemical composition of samples PKN 203
(major components, wt%; minors, ppm)

Sample No.	108600	108603	108604	108610	108615	108623	108630	108639
Depth (m)	0-1	3-4	4-5	10-11	15-16	23-24	30-31	39-40
SiO_2	43.8	56.1	65.7	62.0	53.1	62.1	60.7	60.9
Al_2O_3	12.3	19.7	22.7	17.7	16.0	17.0	15.2	17.3
Fe_2O_3	2.85	1.77	0.61	11.2	21.2	10.9	14.9	11.5
MgO	1.49	0.75	0.15	<0.1	<0.1	<0.1	0.16	0.12
CaO	17.7	6.82	0.28	<0.04	<0.04	<0.04	<0.04	<0.04
Na_2O	0.61	0.94	1.11	1.66	1.55	1.54	0.92	0.90
K_2O	0.26	0.39	0.48	0.70	0.71	1.74	2.77	2.94
TiO_2	0.54	0.88	0.99	0.76	0.68	0.73	0.62	0.72
MnO	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.04	0.14
SO_3	0.16	0.28	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ag	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1
As	21	19	15	45	57	36	67	72
Au	0.36	0.04	<0.01	0.04	<0.01	<0.01	0.25	0.15
B	60	60	70	80	100	60	160	100
Ba	320	170	140	150	130	210	300	550
Co	10	7	6	14	42	15	32	130
Cr	300	510	560	300	410	450	350	400
Cu	38	21	20	140	400	160	230	190
Ga	15	20	20	15	15	15	10	10
Ge	0.3	2	2	1.5	1	1	1	1.5
Mo	0.6	0.8	20	3	5	2	5	5
Ni	69	53	59	120	120	79	79	100
Sb	<10	20	30	30	30	30	20	30
Sc	<5	17	31	43	40	38	20	44
Sn	0.6	0.8	3	1	1	1	0.5	1
Sr	240	150	85	120	120	140	110	160
V	120	240	230	410	320	250	240	250
W	20	15	10	15	40	20	350	<10
Y	9	12	16	16	16	17	19	17
Zn	24	9	7	26	62	40	94	93
Zr	72	82	75	67	54	54	57	61
Ti/Zr	46	65	79	67	76	81	65	70

Note: P_2O_5 < 0.1%; Pb <50 ppm

Table 8. Average compositions for zones within PKN 203
(major components wt%; minors, ppm)

Zone	Calcrete	Goe/Kaol	Goe/parag	Goe/musc
Depth (m)	0-4	4-14	14-26	26-40
No. of samples	2	2	2	2
SiO_2	50.0	63.9	57.6	60.8
Al_2O_3	16.0	20.2	16.5	16.3
Fe_2O_3	2.31	5.90	16.1	13.2
MgO	1.12	0.10	<0.1	0.14
CaO	12.3	0.15	<0.04	<0.04
Na_2O	0.78	1.39	1.55	0.91
K_2O	0.33	0.59	1.23	2.86
TiO_2	0.71	0.88	0.71	0.67
MnO	<0.04	<0.04	<0.04	0.09
SO_3	0.22	<0.1	<0.1	<0.1
Ag	<0.1	<0.1	<0.1	0.2
As	20	30	47	70
Au	0.20 (0.18)	0.02 (0.01)	<0.01 (0.04)	0.20 (0.10)
B	60	75	80	130
Ba	250	150	170	430
Co	9	10	29	81
Cr	410	430	430	380
Cu	30	80	280	210
Ga	18	18	15	10
Ge	1	2	1	1
Mo	0.7	12*	4	5
Ni	61	90	100	90
Sb	13	30	30	25
Sc	10	37	39	30
Sn	0.7	2	1	0.8
Sr	200	100	130	140
V	180	320	290	250
W	18	13	30	180*
Y	11	16	17	18
Zn	17	17	51	94
Zr	77	71	54	59

Note P_2O_5 < 0.1 %; Pb < 50 ppm
Au values in parentheses - average for interval determined from data of
Metana Minerals N.L.
*Average affected by one anomalously high value (see Table 7)
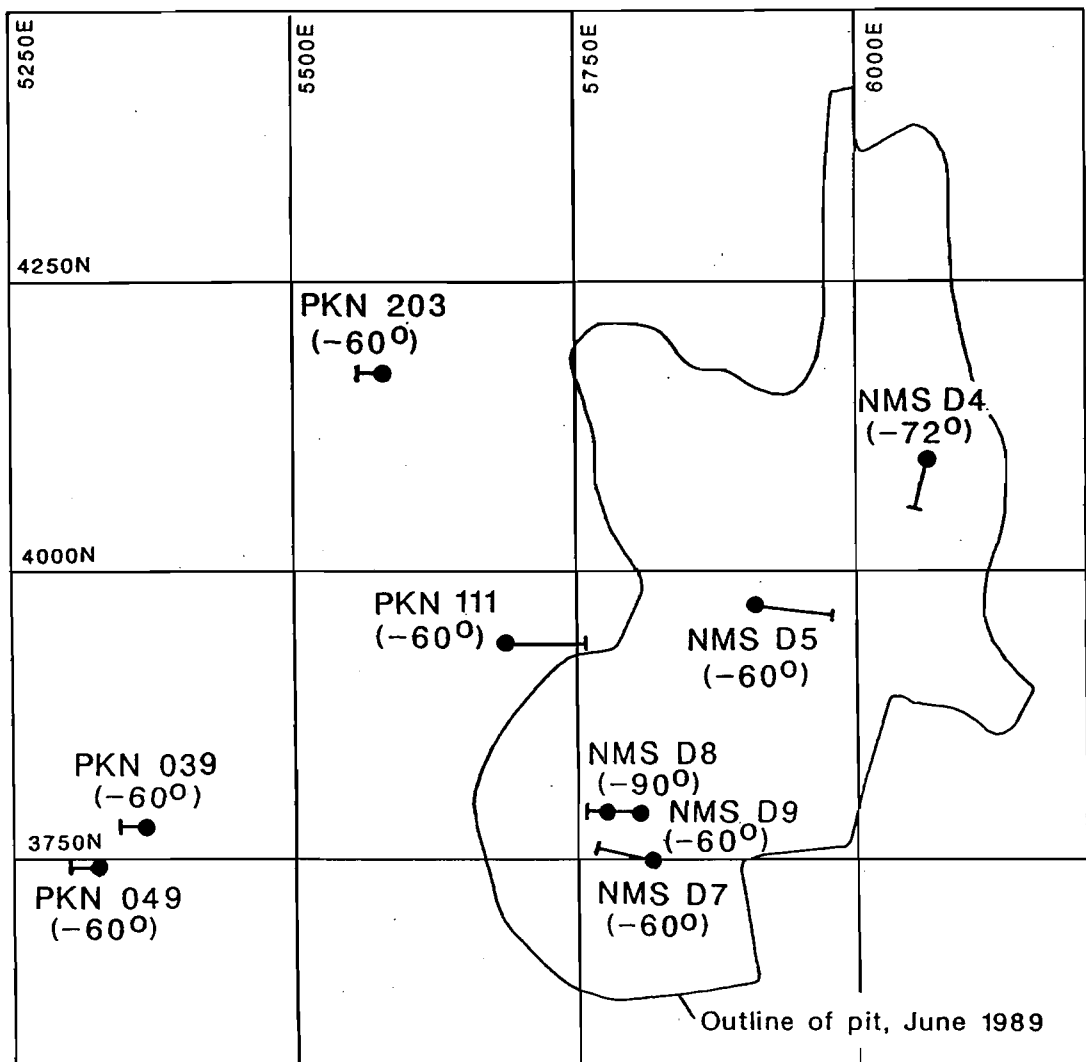
Figure 1   Location of studied drill holes, Parkinson Pit and environs, Mt Magnet.

KEY FIGURES 2-7

Qz	=	Quartz
Ab	=	Albite/oligoclase
He	=	Hematite
Go	=	Goethite
Ru	=	Rutile
Do	=	Dolomite
Ca	=	Calcite
Mu	=	Muscovite/illite
Pa	=	Paragonite
Ch	=	Chlorite/vermiculite
Ka	=	Kaolinite
Sm	=	Smectitic clay
Ta	=	Talc

very abundant
abundant
moderate
significant
minor
trace
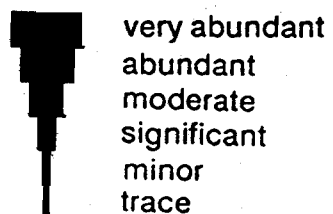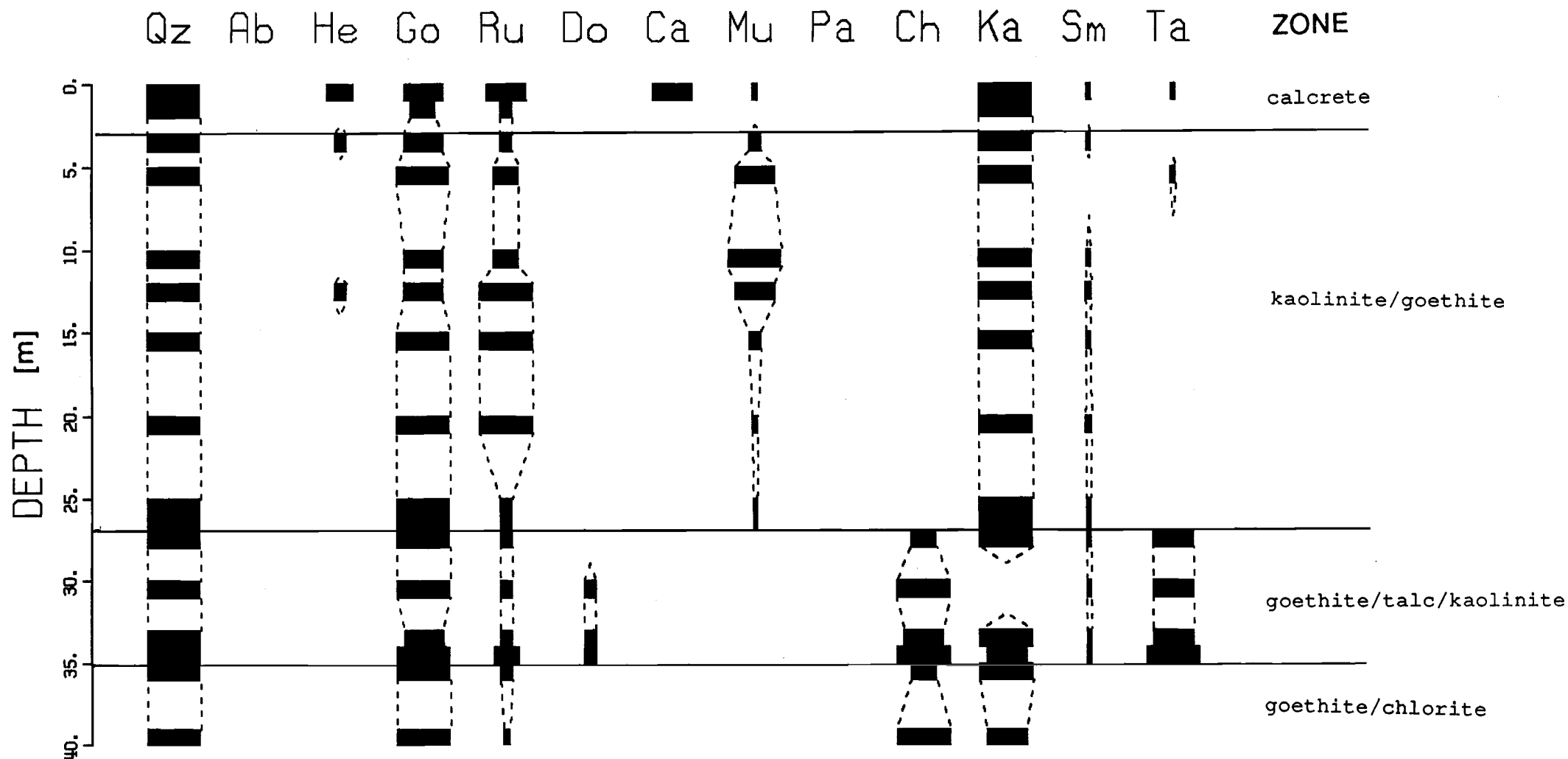
Figure 2. Mineralogical profile through PKN 039

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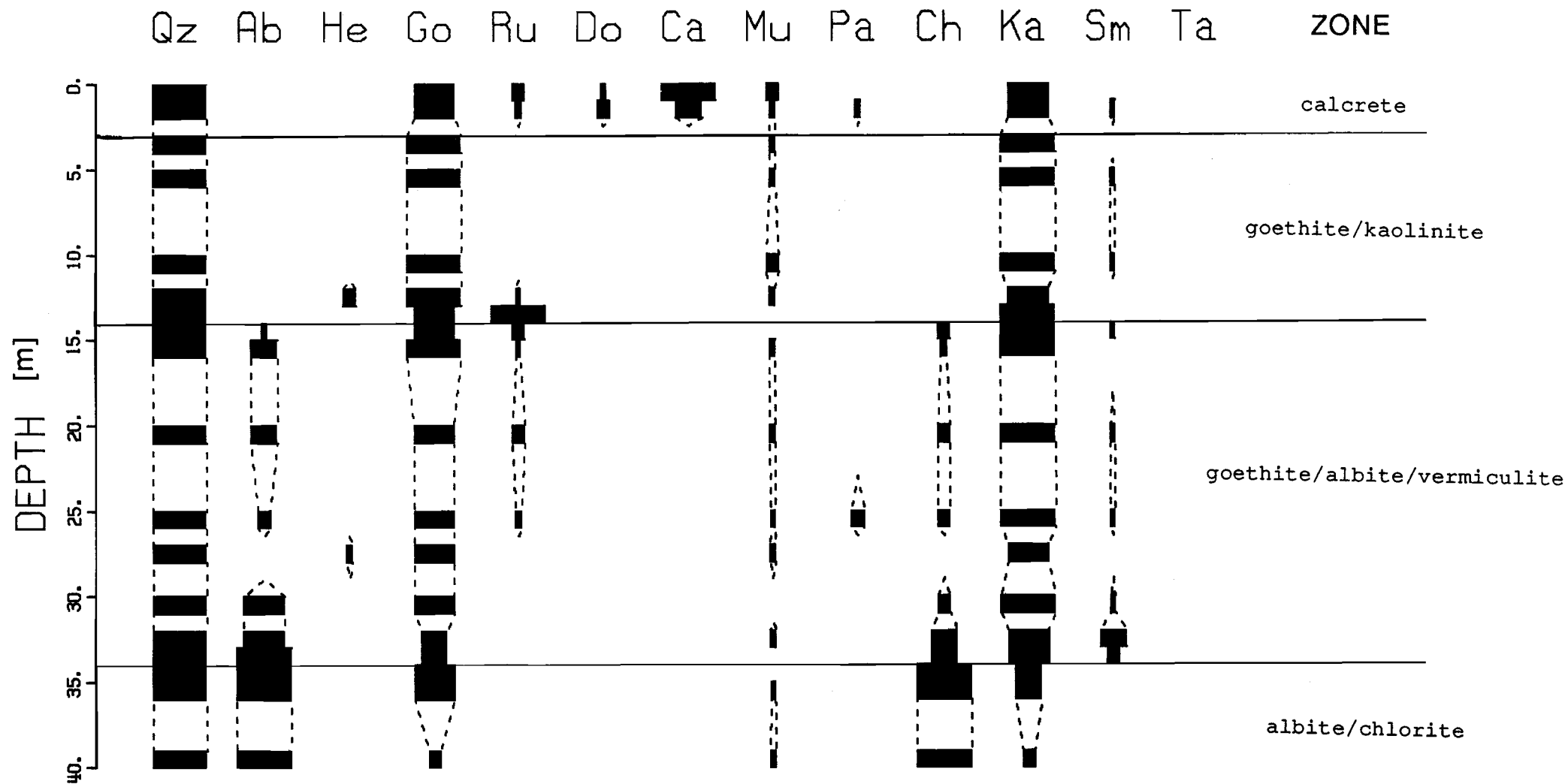
Figure 3.   Mineralogical profile through PKN 049
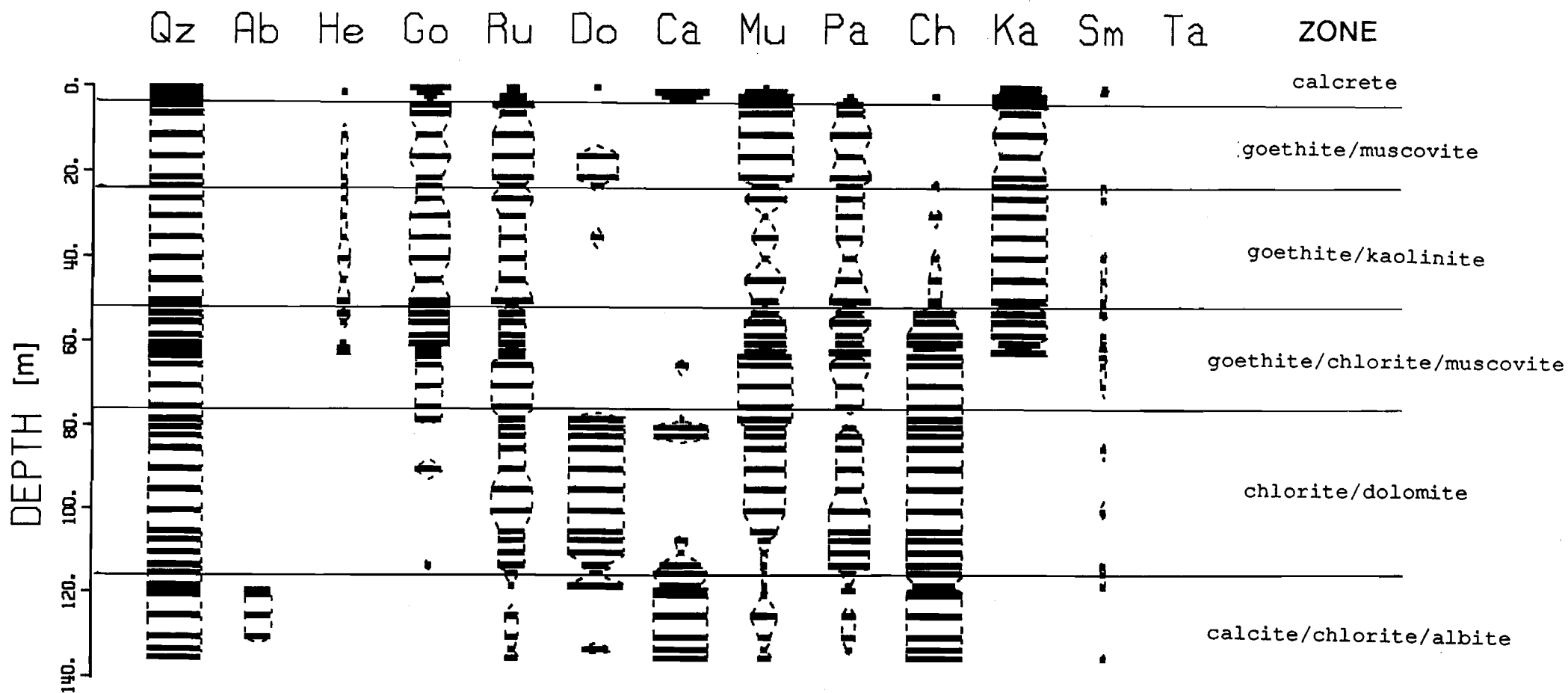
Figure 4.   Mineralogical profile through PKN 111
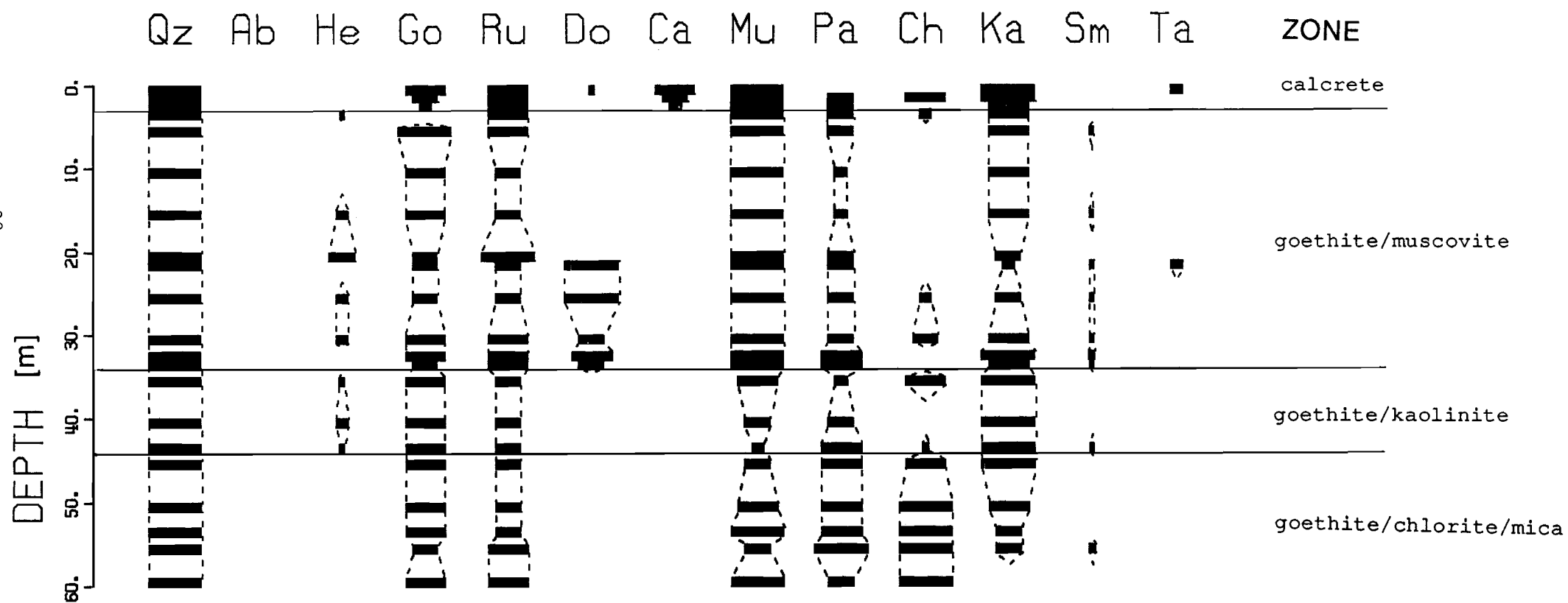
Figure 5.   Mineralogical profile through SUG 6
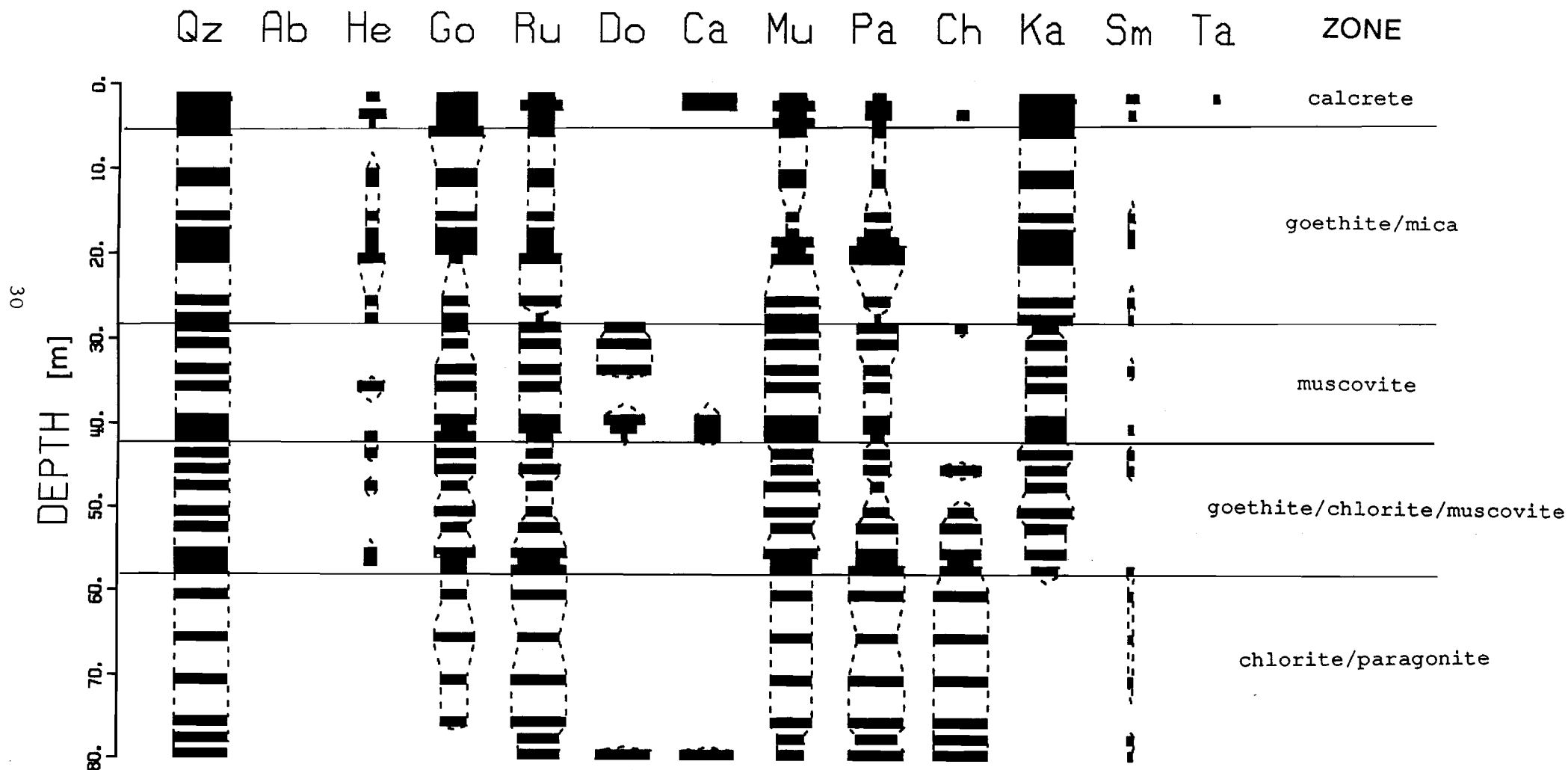
Figure 6.   Mineralogical profile through SUG 7
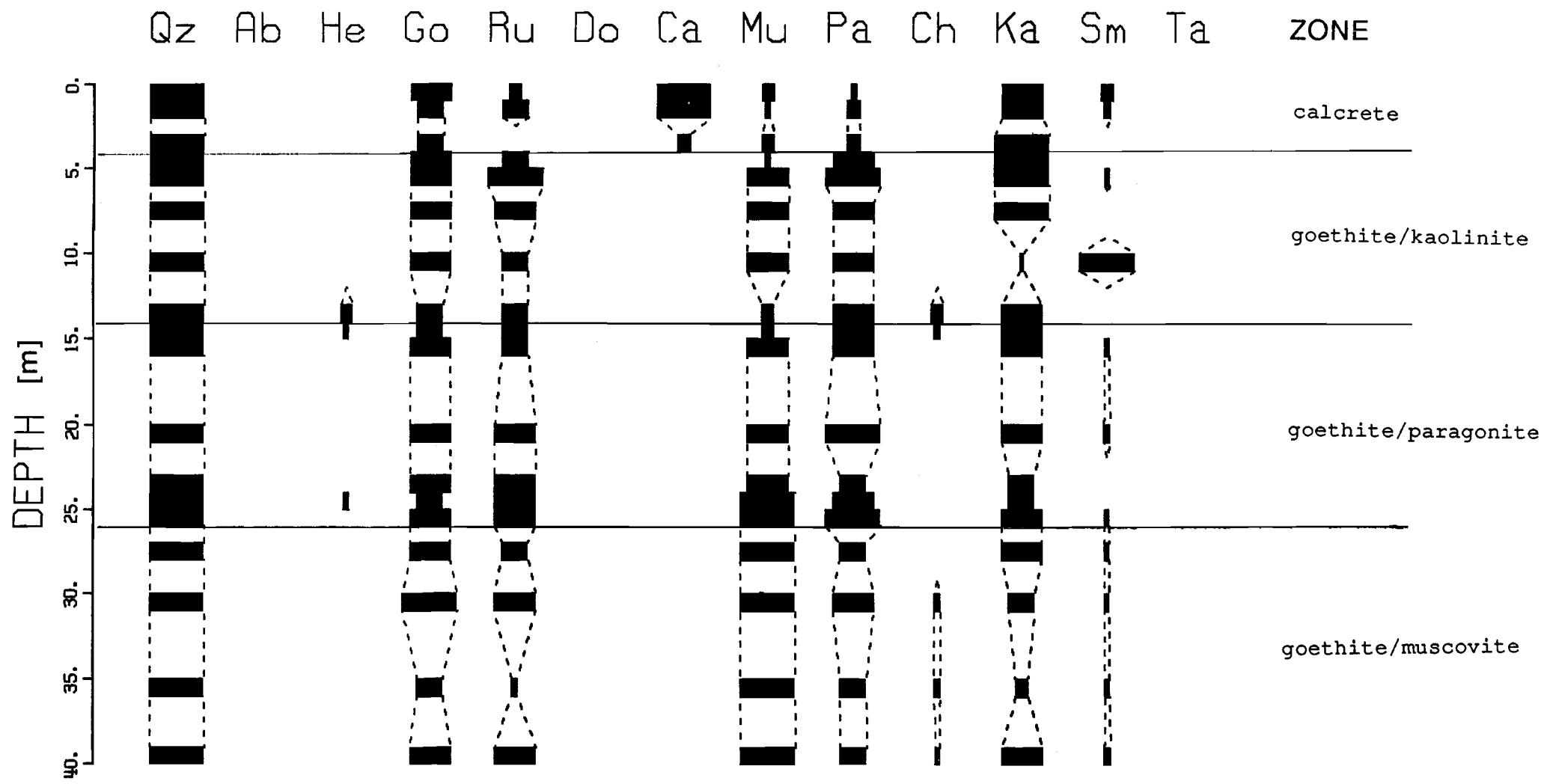
Figure 7.   Mineralogical profile through PKN 203

KEY FIGURES 8-11

Qtz	=	Quartz
Calc	=	Calcite
Dol	=	Dolomite
Hem	=	Hematite
Goe	=	Goethite
Musc	=	Muscovite/illite
Parag	=	Paragonite
Chl/V	=	Chlorite/vermiculite
Talc	=	Talc
Kaol	=	Kaolinite
Smec	=	Smectitic clays
Gyp/Ba	=	Gypsum/bassanite
Pyrite	=	Pyrite

Thickness (m)	Unit	Qtz	Calc	Dol	Hem	Goe	Musc	Chl/V	Talc	Kaol	Smec	Colour	Cr ppm	Ni ppm	K_2O %	MgO %	Fe_2O_3 %
approx 3.0	Soil / Transported laterite	●	●		●	●	●		●	●	●	Pink-brown to white	1600	150	0.2	2.0	17.0
20	Leached saprolite	●			●	●	●	●	●	●	●	Buff to brown	1000	230	0.2	0.4	16.0
>20	Saprolite	●		●	●			●	●	●	●	Brown to grey-buff	3300	1000	0.1	3.0	21.0
		●				●		●	●	●		Brown to grey	2000	480	0.1	2.0	21.0
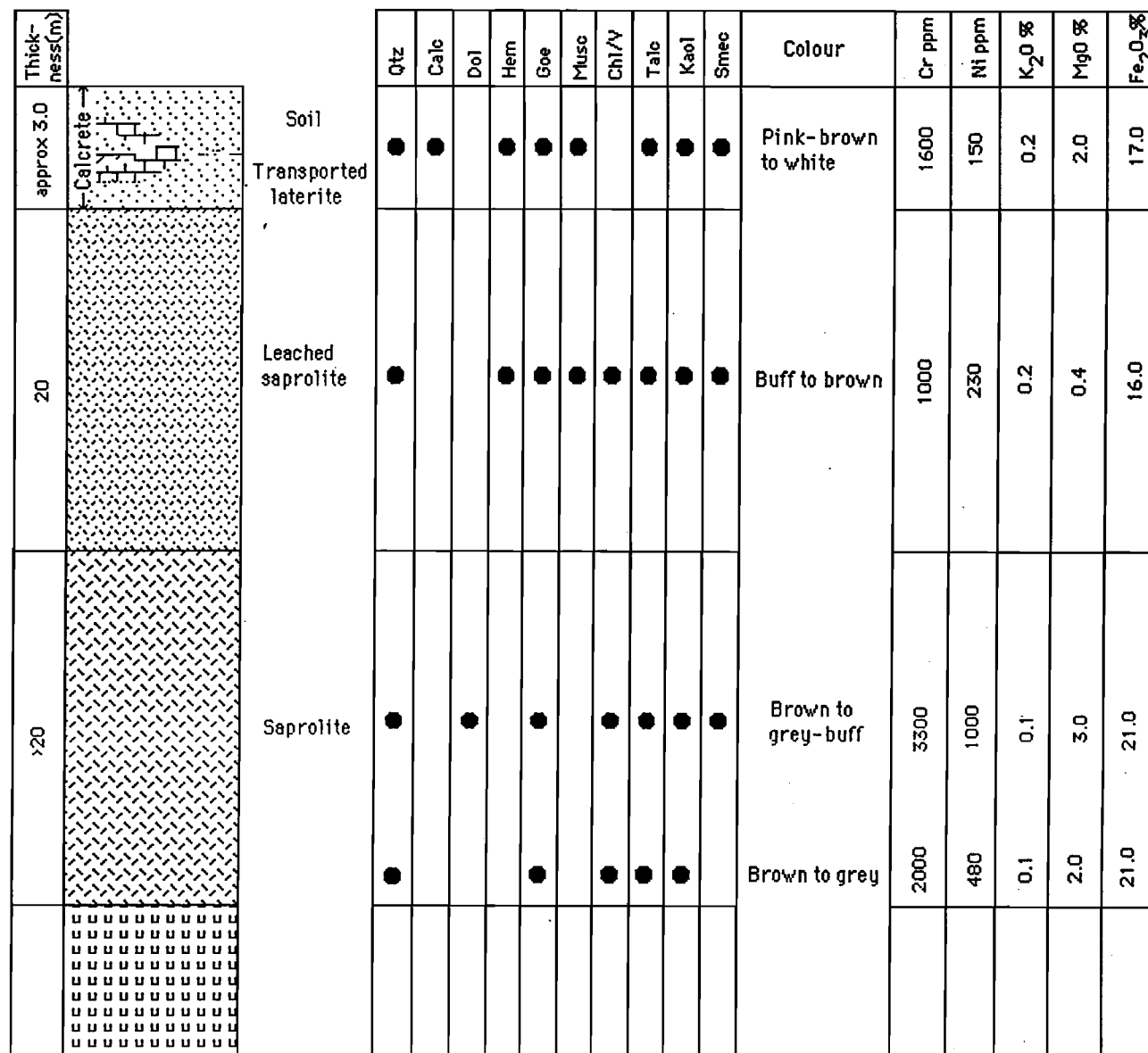
Figure 8.   Idealized profile through barren ultramafic rocks, Mt   Magnet

Thickness (m)	Zone	Qtz	Plag	Calc	Dol	Hem	Goe	Musc	Parag	Chl/V	Kaol	Smec	Gyp/Ba	Pyrite	Colour	Cr ppm	Au ppm	K₂O %	MgO %	Fe₂O₃ %
approx 3.0	Soil and calcrete	●		●	●	●	●	●			●	●	●		Pink-brown	600	<0.01	0.5	1.0	16.0
10	Leached saprolite	●				●	●	●			●	●			Buff to red-brown	450	<0.01	0.2	0.3	18.0
25	Saprolite	●	●				●	●		●	●	●			Brown	350	<0.01	0.4	1.5	19.0
		●	●				●	●		●	●				Brown to brown-grey	250	<0.01	0.2	6.0	16.0
	Fresh Rock	●	●	●	●		●			●				●	Grey	300	<0.01	0.5	5.0	10.0
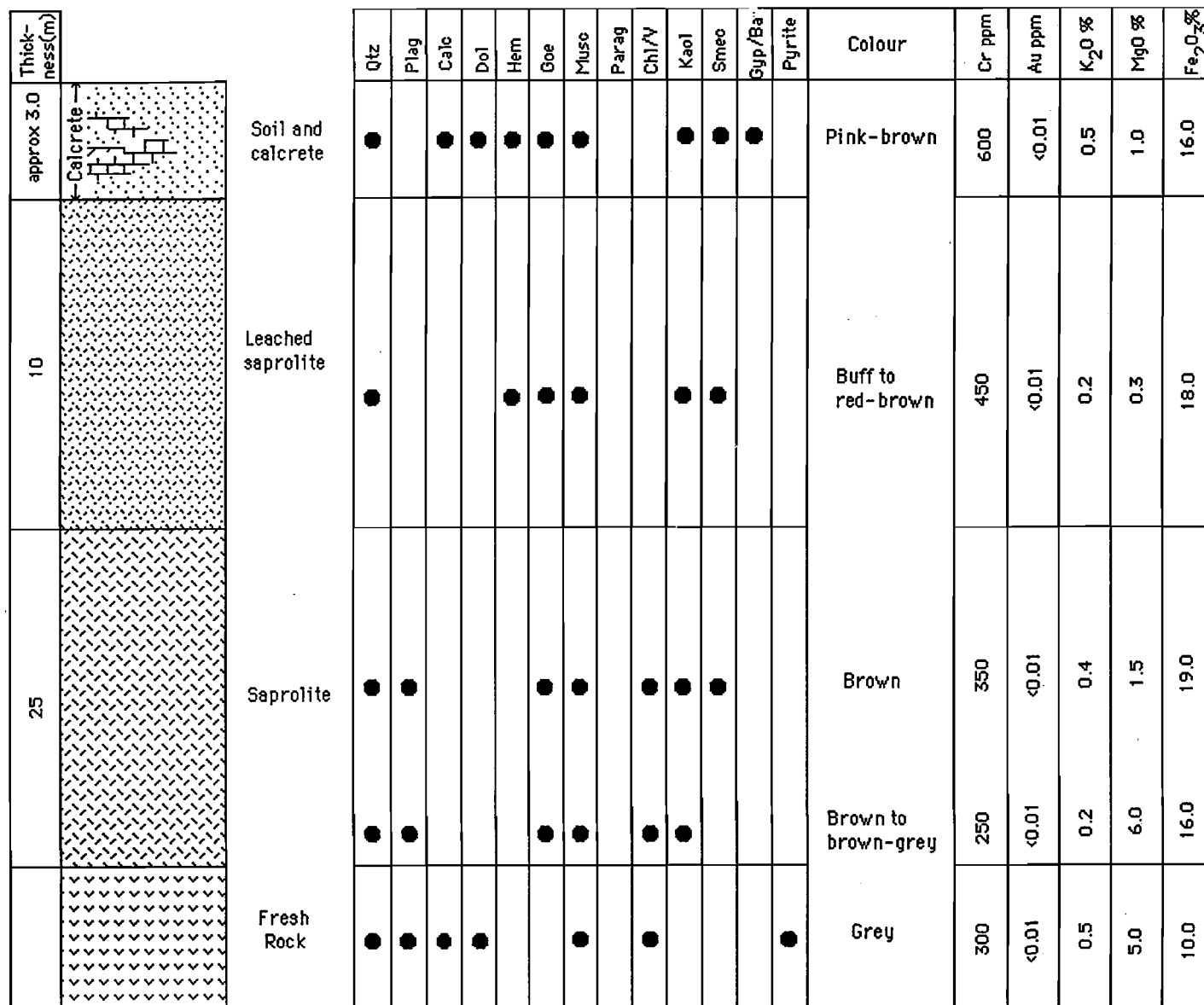
Figure 9. Idealized profile through distal mafic volcanics, Mt Magnet

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Thickness (m)	Zone	Qtz	Plag	Calc	Dol	Hem	Goe	Musc	Parag	Chl/V	Kaol	Smec	Gyp/Ba	Pyrite	Colour	Cr ppm	Au ppm	K_2O %	MgO %	Fe_2O_3 %
approx 3.0 (Calcrete)	Soil and calcrete	•		•			•	•	•		•	•			Buff to white	410	0.20	0.3	1.0	2.0
10	Leached saprolite	•					•	•	•		•	•			Buff to red-brown	430	0.01	0.6	0.1	6.0
>25	Saprolite	•					•	•	•		•	•			Brown	430	0.04	1.2	<0.1	16.0
		•					•	•	•	•	•	•			Brown to brown-grey	380	0.1	2.8	0.1	13.0
	Fresh Rock	•			•		•	•	•	•				•	Grey	360	0.05	2.5	3.0	10.0
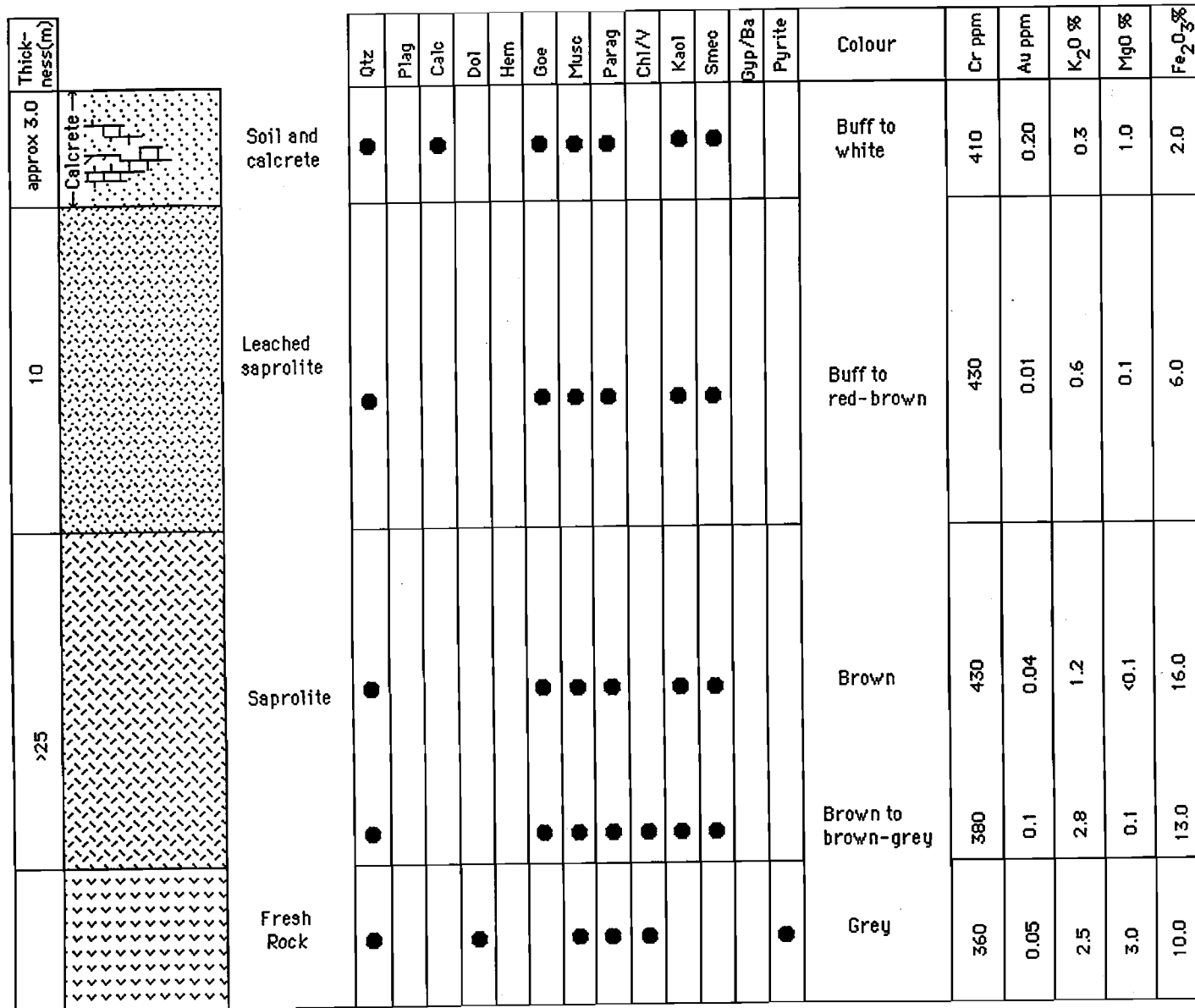
Figure 10. Idealized profile through proximal mafic volcanics, Mt Magnet

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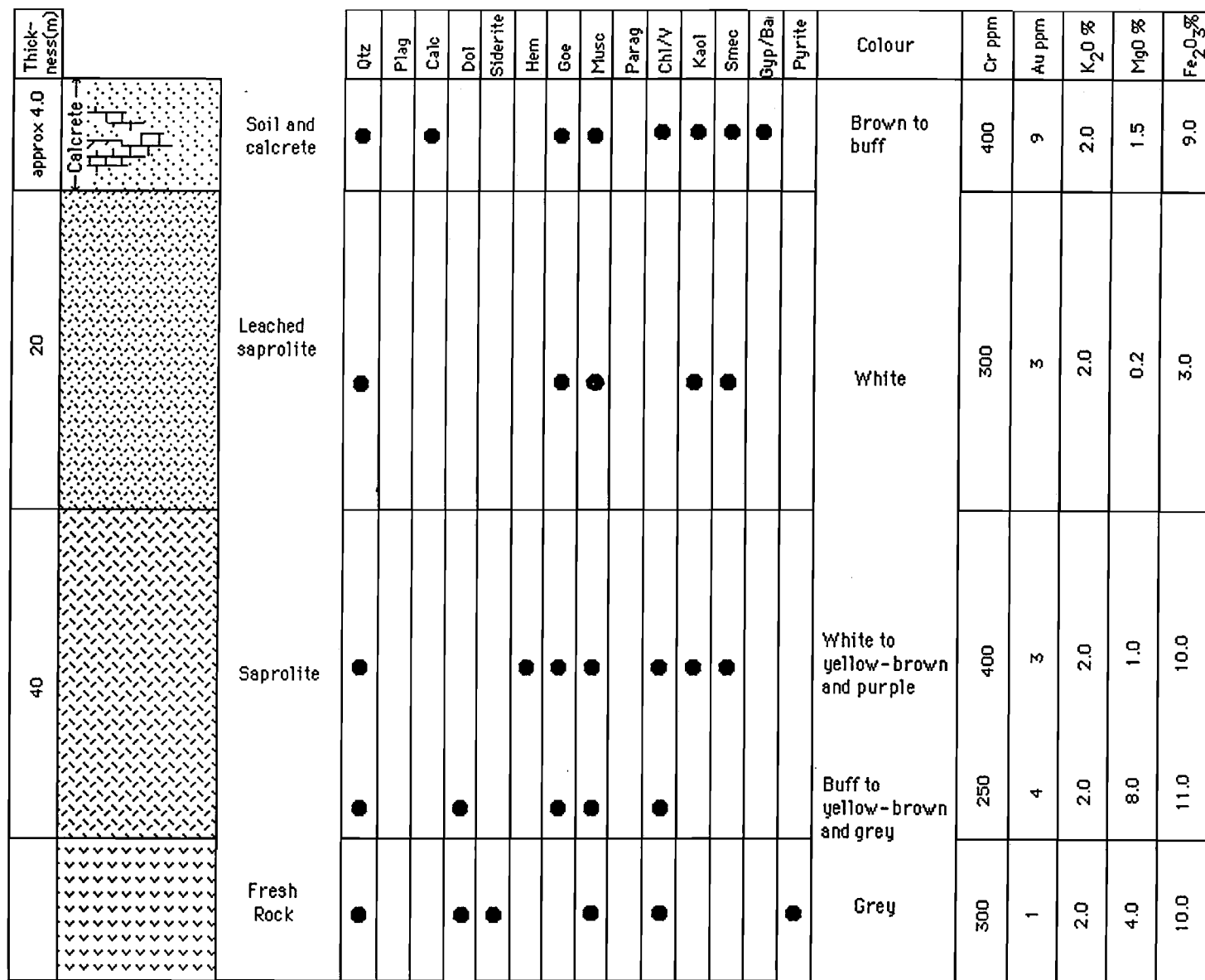| Thickness (m)		Qtz	Plag	Calc	Dol	Siderite	Hem	Goe	Musc	Parag	Chl/V	Kaol	Smec	Gyp/Ba	Pyrite	Colour	Cr ppm	Au ppm	K₂O %	MgO %	Fe₂O₃ %
approx 4.0 (Calcrete)	Soil and calcrete	●		●				●	●		●	●	●	●		Brown to buff	400	9	2.0	1.5	9.0
20	Leached saprolite	●						●	●			●	●			White	300	3	2.0	0.2	3.0
40	Saprolite	●					●	●	●		●	●	●			White to yellow-brown and purple	400	3	2.0	1.0	10.0
	Saprolite	●			●			●	●		●					Buff to yellow-brown and grey	250	4	2.0	8.0	11.0
	Fresh Rock	●			●	●		●			●				●	Grey	300	1	2.0	4.0	10.0

Figure 11. Idealized profile through mineralized mafic volcanics, Mt Magnet
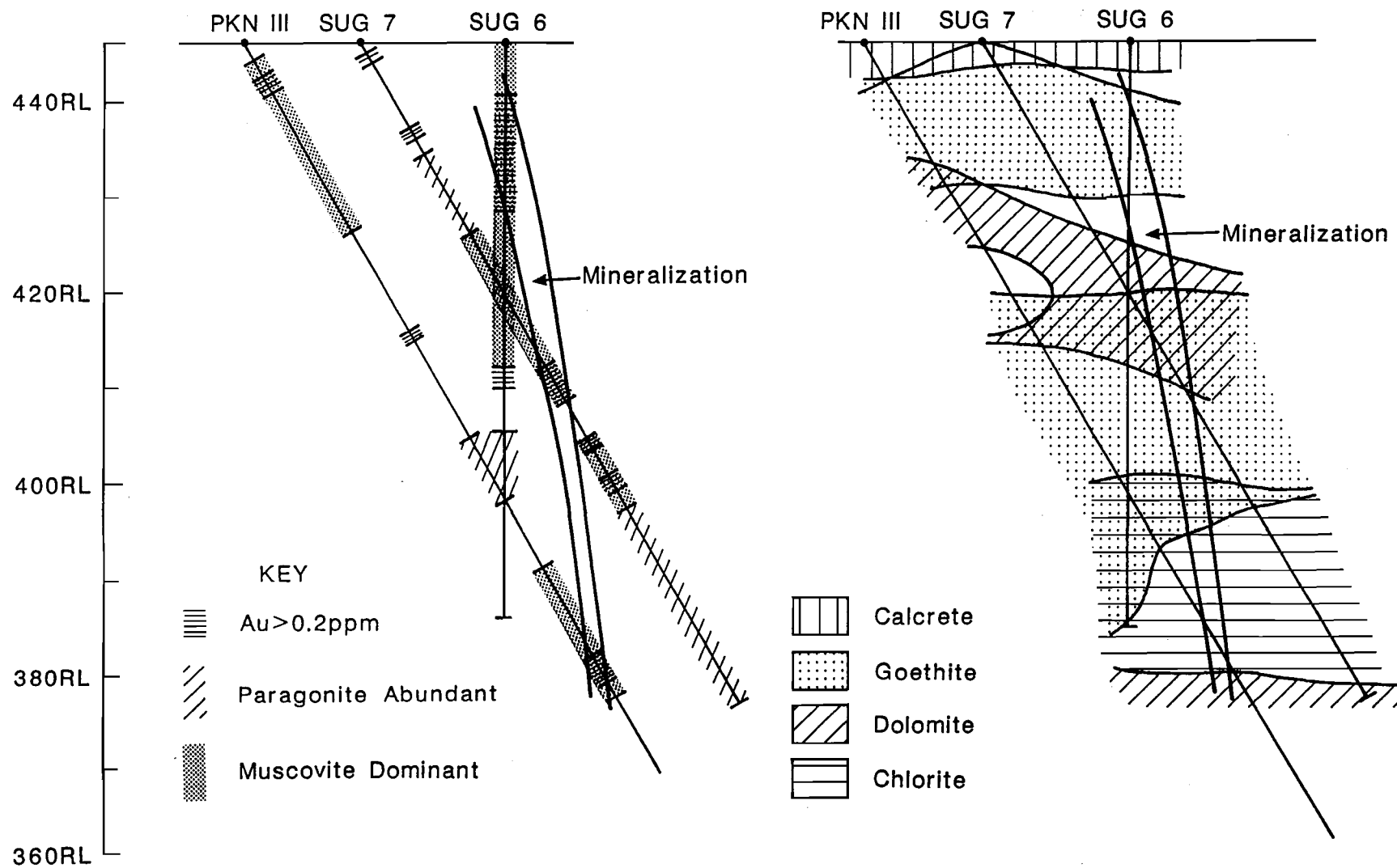
Figure 12. Mineralogical zonation in the PKN 111 area - Section 3938N

KEY

≡ Au>0.2ppm

⫽ Paragonite Abundant
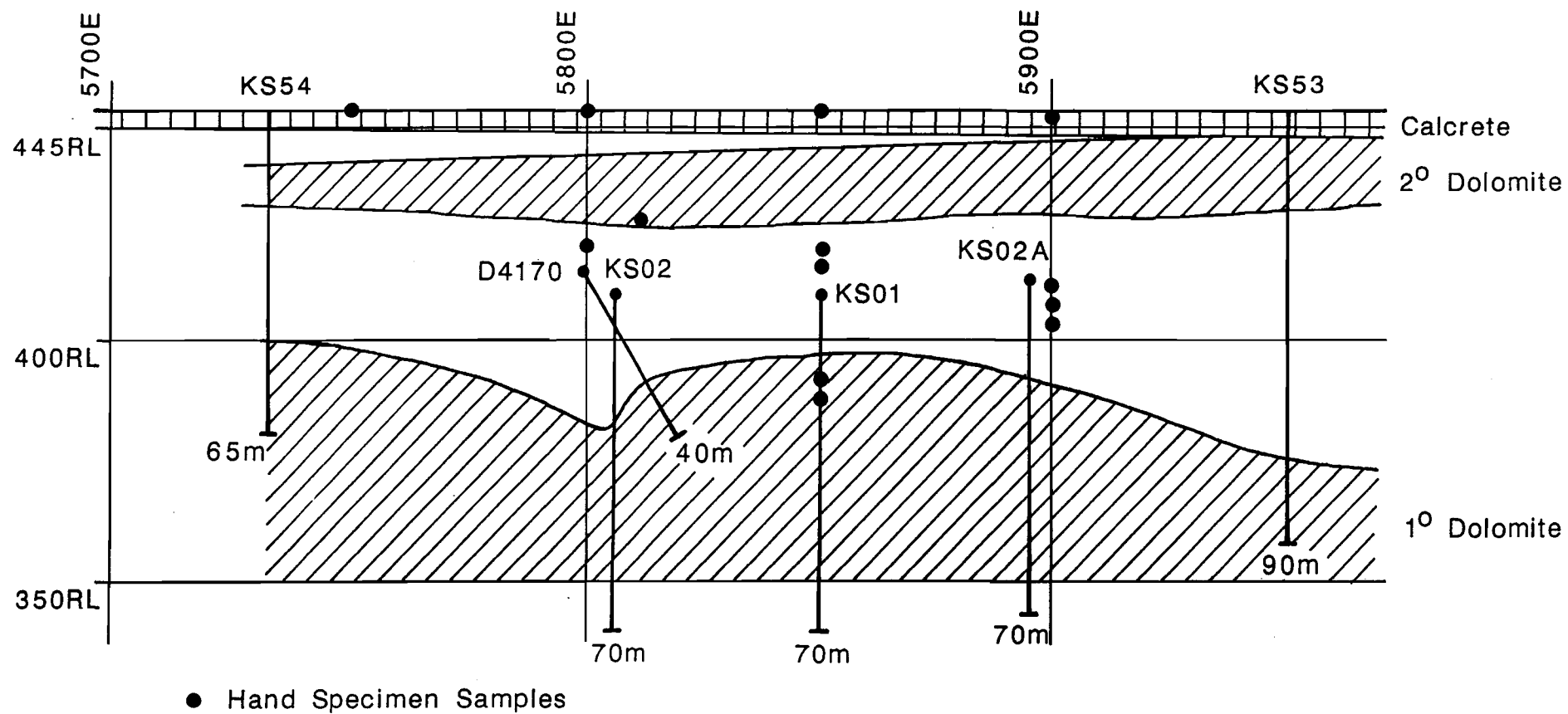
▓ Muscovite Dominant

|||| Calcrete

⋮⋮ Goethite

⫻ Dolomite

≡ Chlorite

Figure 13. Distribution of carbonates along Section 4150N