Report of Activities 2003

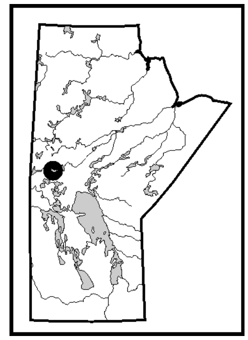
Published by:
Manitoba Industry, Economic Development and Mines
Manitoba Geological Survey, 2003.

ERRATA:

The publisher/department name in the bibliographic reference cited immediately below the title of each GS report should read **Manitoba Industry, Economic Development and Mines** instead of **Manitoba Industry, Trade and Mines**.

GS-4 Geochemical studies of dwarf birch twigs, peat, bog iron and clay at Reed Lake, Manitoba (NTS 63K10)[1]

by G.H. Gale



Gale, G.H. 2003: Geochemical studies of dwarf birch twigs, peat, bog iron and clay at Reed Lake, Manitoba (NTS 63K10); *in* Report of Activities 2003, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 29–36.

Summary

Analyses of dwarf birch twigs collected over an electromagnetic conductor beneath a peat bog at Reed Lake did not provide a geochemical signature over the electromagnetic conductor. ‘Bog-iron’ samples from the base of the peat are anomalous in a number of metals, including Eu, relative to both the overlying peat and the underlying clay. Enzyme Leach[SM] analyses of pale brown (oxidized?) clay shows it is strongly depleted in most metals, including Eu, relative to the underlying grey clay. Anomalously high Mo, associated with the pale brown clay, suggests the presence of an active electrochemical cell associated with a portion of the electromagnetic conductor.

Introduction

Investigations of geochemical signatures of vegetation, peat and inorganic materials in the vicinity of an electromagnetic conductor beneath a bog (Fig. GS-4-1) were initiated in 2002 (Gale, 2002). These investigations were supplemented with an additional 35 twig samples collected in 2003 along three profiles over the peat bog. In addition,

[1] MGS Data Repository item 2003001 containing the data or other information sources used to compile this report is available on request from minesinfo@gov.mb.ca, or, Mineral Resources Library, Manitoba Industry, Trade and Mines, 360-1395 Ellice Avenue, Winnipeg, MB, R3G 3P2, Canada.

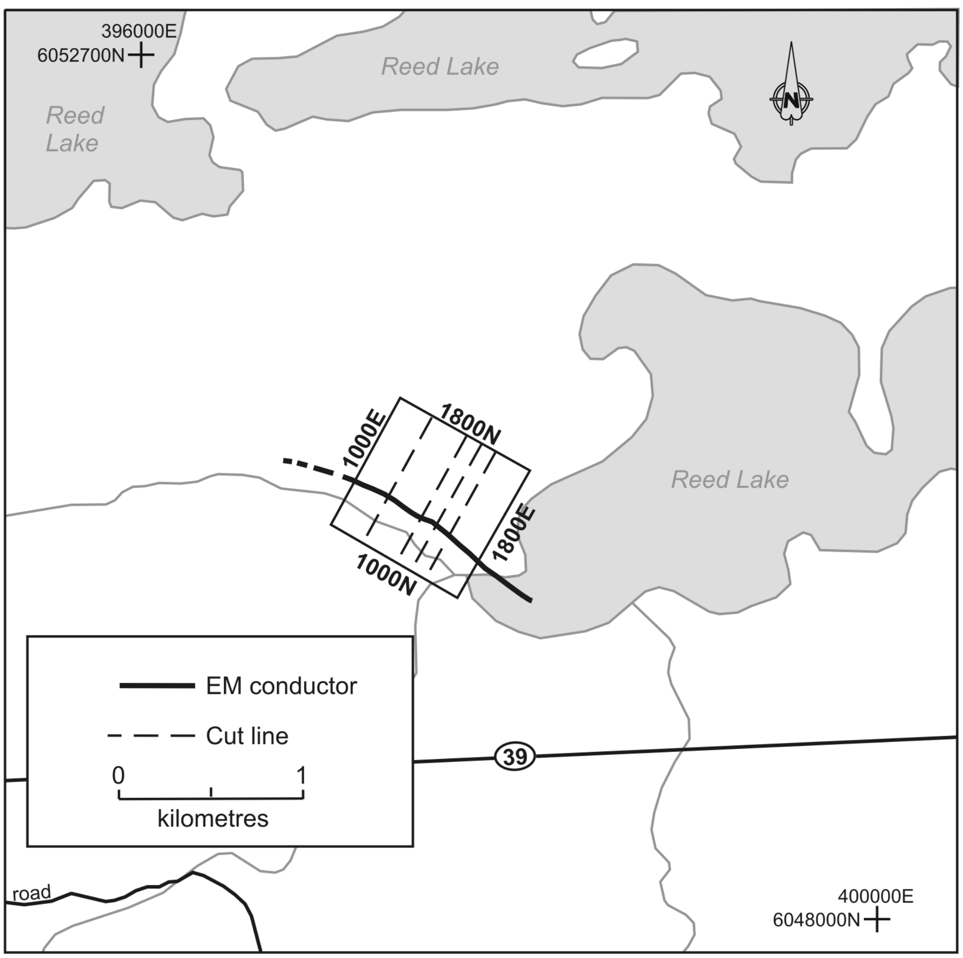


Figure GS-4-1: Location of the Reed property at Reed Lake.

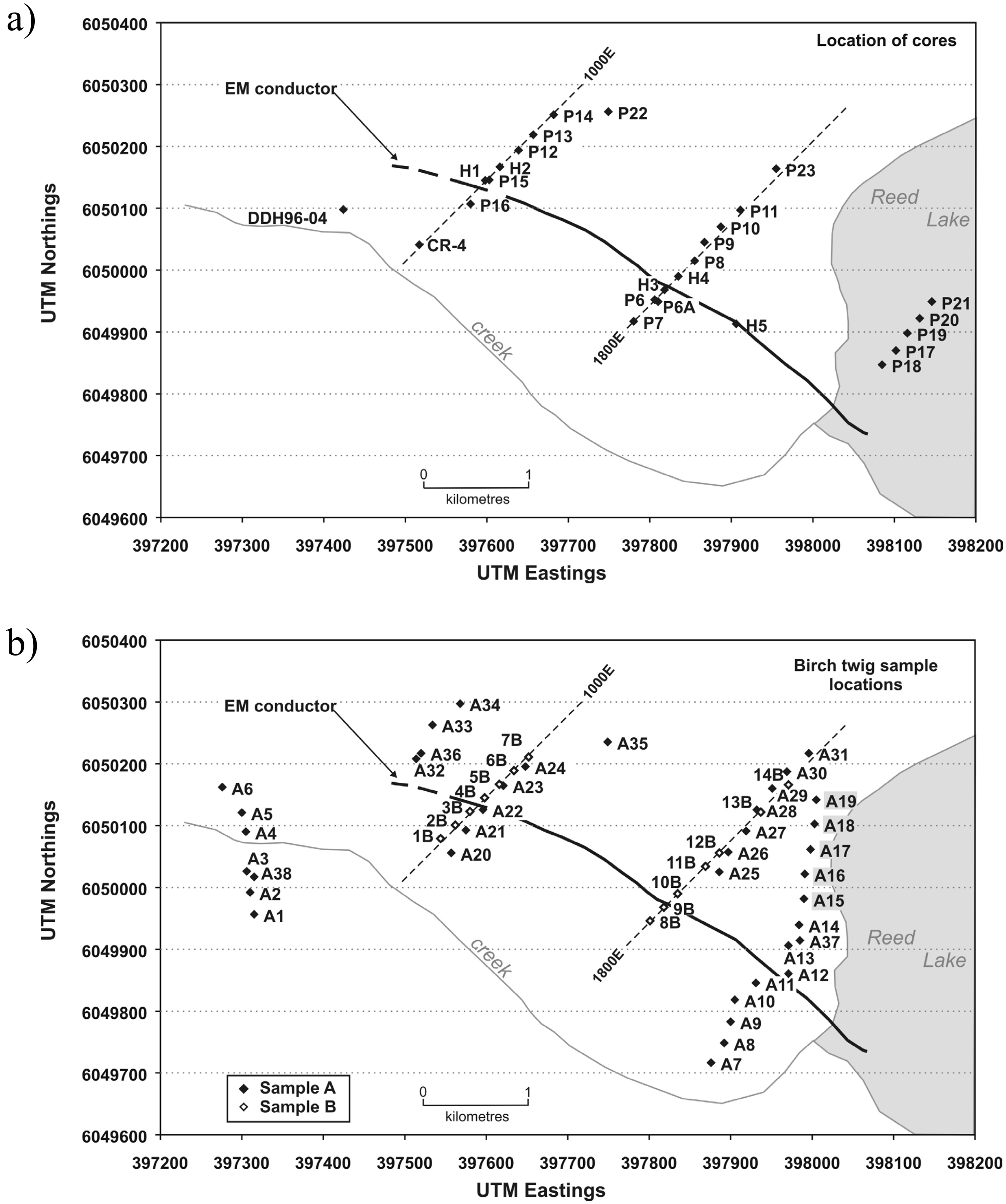


Figure GS-4-2: Location of airborne electromagnetic conductor and sample sites at Reed Lake, Manitoba: a) cores from 2002 are indicated as H1 to H5 whereas cores collected in 2003 are indicated as P6 to P23; b) the locations of dwarf birch twig samples collected in 2002 are shown as 1B to 14B and 2003 twig sample locations are shown as A1 to A35.

18 cores of organic material and clay were collected along two lines in the peat bog and from one line beneath the lake. The profiles were designed to straddle the known electromagnetic conductor at approximately 300 m intervals. The line of cores beneath the lake did not extend beyond the surface expression of the conductor (Fig. GS-4-2). Analyses of ashed twigs and selected peat samples have been completed and the data are summarized here. Samples of clay collected beneath the peat bog and from the lake bottom were analyzed by the Enzyme Leach[SM] selective leach method. The analytical data discussed in this report is available upon request from the Manitoba Geological Survey[1].

This project is designed to determine if anomalous Eu and other elements present in exhalite in the bedrock are detectable in the overlying undisturbed organic and inorganic materials in bog-, floating-bog– and lake-bottom–environments that are generally hostile to exploration methodologies.

Dwarf birch twigs[1]

A trial batch of 13 twig samples from the property indicated the presence of a europium anomaly over the surface projection of the conductor and at one other site (Gale, 2002). Samples of dwarf birch, collected in early April 2003 (at approximately the same time of year as in 2002), provide four partial profiles across the projected surface expression of the known conductor. Samples were ashed, leached with aqua regia and analyzed at Activation Laboratories Ltd. (Ancaster, Ontario).

The 2002 sample data (B series) suggested anomalous Eu, Au, Re and Ba values adjacent to the surface projection of the conductor along one of the profiles sampled. In addition, anomalous Mo and Sb occurring within 100 m of the conductor suggested the presence of 'shoulder' or 'rabbit ear' anomalies. The analytical data for the 2003 samples differs considerably in absolute values from the 2002 data despite collection of the same species under approximately the same conditions. Rare earth element (REE) data obtained for the dwarf birch twigs show several small positive europium anomalies that are within analytical error and therefore are not considered anomalous. Preliminary data indicate that anomalous Au and Pd are present in an untested area south of the conductor (samples A1 to A6).

Sphagnum analyses[1]

Adjacent to the 2002 core sites, five samples of live sphagnum and vegetation were collected from the top layer of frozen material with a shovel. This material includes sphagnum, grass and other organic material, but grass, twigs and roots were extracted during sieving of the samples. In addition, samples of frozen peat were collected with an axe below the sphagnum at core sites H1 to H4; these represent the upper 0 to 7 cm of the peat profile (samples could not be repeated in 2003 because of milder weather conditions).

Mn, Zn, Cu, Pb and Re contents are preferentially concentrated in the uppermost samples at the core sites. The small sample set does not permit the derivation of any firm conclusions about metal distribution in this medium. The variations observed between samples, especially the high Zn and Au values in these samples relative to the underlying peat, indicate that further studies of the uppermost portion of this bog profile are warranted.

Peat samples[1]

The frozen uppermost portion of the peat bog was sampled with an ice auger in the 1 to 1.5 m interval and therefore an undisturbed continuous core could not be obtained during either the 2002 or 2003 sampling programs. Samples of disturbed material were collected in the 0 to 1.5 m interval from cores H3, H4 and H5. Below the 1.5 m interval a continuous undisturbed sample of peat was obtained by using the coring tube in both the 2002 and 2003 sampling programs as described earlier (Gale, 2002). These peat samples were dried, sieved, ashed, leached with aqua regia and analyzed by inductively coupled plasma mass spectrometry (ICP/MS) at Activation Laboratories Ltd.

'Bog iron' was identified in several of the cores during sieving of the peat samples in 2002; subsequent to drying, these samples required minor crushing to permit the sample to pass through a –60 mesh screen. Portions of these samples were analyzed by the same aqua regia leach method as used for the peat samples; a second portion of the 'bog-iron' sample was analyzed by Enzyme Leach[SM] methods (see below). None of the 2003 peat samples have yet been analyzed by the aqua regia digestion method, but the lowermost three samples of peat and 'bog iron' will be analyzed by the Enzyme Leach[SM] method and reported at a later date.

[1] MGS Data Repository item 2003001 containing the data or other information sources used to compile this report is available on request from minesinfo@gov.mb.ca, or, Mineral Resources Library, Manitoba Industry, Trade and Mines, 360-1395 Ellice Avenue, Winnipeg, MB, R3G 3P2, Canada.

The 2002 peat samples analyzed by the aqua regia leach method exhibit a number of distinctive features. In general, most metals exhibit little variation within the central, peat portion of the cores (e.g., Cd, Co, Ge, Sn, Sb, Cs, Pb and Bi). Iron contents range from <1% in the upper peat portion of the cores to >7% in the 'bog-iron' portion near the contact with the underlying clay. In cores H2 and H4, collected over the conductor, Mn contents also increase downwards. Ni contents are slightly higher in the 'bog-iron' samples than in the peat, but not necessarily higher than in the samples collected at and near the surface. At three sites, Zn and Pb are much higher in the uppermost part of the peat profile than in the central portions. Cu, Zn, In and Ba are also enriched in the manganese- and iron-rich portions of the peat cores near the contact with the underlying clay. Samples from core H4 exhibit higher Mo contents towards the base within the 'bog-iron' portion of the core. U and Re contents are markedly higher in the lower portion of the peat section ('bog iron') in cores H2 and H4. In contrast, Au contents are highest in the upper parts of the peat profile in cores H3 and H4. Platinum contents are highest in the 'bog-iron' samples but Pd levels are below detection in most of the samples. The rare earth elements (REE) consistently exhibit a negative Eu anomaly in all of the peat samples.

These data illustrate that a number of elements are anomalous in the cores taken adjacent to or directly over the conductor. The presence of anomalous elements varies not only with site locations but also with depth sampled. In general, anomalous Mn, Cu, Zn, Pb and Au are detectable in the uppermost 30 cm of the profile, but the sample set is too small to determine if this is a result of metal transfer from the conductor or residue from the Flin Flon smelter. The range and magnitude of anomalous elements is clearly much greater in the lowermost portion of the peat profile, within 30 cm of the contact with the underlying clay, than it is within the central portions of the peat column. The increased metal values in the lowermost portion of the peat column is considered to represent the transfer of metals from the metal-enriched conductor as a result of an active electrochemical cell (Hamilton, 1998) and its capture by the 'bog iron' rather than an increase due to compaction of peat at the base of the peat column. In addition, the downward percolation of clay, organic material and metals cannot be ruled out at this time.

'Bog iron' Enzyme Leach^{SM} analyses[1]

A small number of samples of 'bog iron' and 'peat' immediately above the contact zone in the 2002 cores were analyzed[1] by Enzyme Leach^{SM}. The objective was to provide a comparison with analyses of the underlying clay and determine its suitability as an exploration sampling medium. Small samples of the 'bog iron' within 3 cm of the 'bog iron'-clay contact in cores H2, H4 and H5 were analyzed together with four samples at 10, 30, 50 and 70 cm above the contact in core H5. The samples of material from the contact zone represent material immediately above the contact in cores H2 and H4 and material that includes both 'bog iron' and clay from the interval immediately below the contact. In core H5, samples containing 'bog iron' and clay analyzed from the interval immediately above and immediately below the diffuse contact with the clay (samples H5-11 and H5-12) show little variations from each other and have element concentrations that are similar to those of the clay rather than the 'bog iron'. Rare earth element data plots give Eu anomalies that are weakly positive in the 'bog-iron' samples from cores H2, H3 and H4, but distinctly negative or near zero for samples from core H5.

Although of limited value because of the small sample population size, the 'bog iron' information obtained from the 2002 samples illustrates that the 'bog-iron' samples taken above the conductor in cores H2 and H4 have elevated values in Zn, Ba and Mo in contrast to samples from cores H3 and H5 located off of the conductor axis.

REE element plots of preliminary data for the 2003 'bog-iron' samples show positive Eu anomalies for most of the samples including those that are situated above clay samples that have negative Eu anomalies. This suggests that metals leached from the underlying clay are deposited in the 'peat'/'bog iron' immediately above the clay-'peat' interface.

Clay Enzyme Leach^{SM} data[1]

Four of the five cores obtained in 2002 included variably oxidized clay and grey clay. All of the cores collected in 2003 reached the clay stratum but the depth of penetration into the clay substrate was quite variable. In comparison to samples from core H5, drilled south of the conductor, samples from cores H2 and H4 appear to have apical anomalies in V, Co, Ni, Cu, Zn, Ba, U, Li, Bi and Se. In comparison to samples from cores H2 and H4, samples from cores H3 and H5, located north and south respectively of the conductor, appear to be anomalously high in Mo and Sb; this suggests that Mo and Sb may form 'shoulder' or 'rabbit ear' anomalies to the conductor. Rare earth element plots for

[1] MGS Data Repository item 2003001 containing the data or other information sources used to compile this report is available on request from minesinfo@gov.mb.ca, or, Mineral Resources Library, Manitoba Industry, Trade and Mines, 360-1395 Ellice Avenue, Winnipeg, MB, R3G 3P2, Canada.

the clay samples from these cores exhibit Eu anomalies that are near zero or negative.

The Quaternary material below peat and 'bog iron' retrieved in the 2003 cores consists mostly of pale brown and grey clay; the bottom portion of core P18 is white clay. The pale brown 'oxidized'(?) clay commonly overlies grey clay and silty grey clay, but its thickness varies from nil (e.g., P16) to approximately 100 cm (e.g., P7) in the cores. In general, the pale brown clay is more amenable to coring than the grey clay and longer cores were obtained from this material.

Whereas Ni, Cu, Zn, As, Rb, Th, Mn, Li, V and Pb are commonly depleted in the pale brown clay, with respect to the grey clay, Mo, U, Sb and Re appear to be enriched in the pale brown clay. Although element contents vary markedly from sample to sample in the same core, in general there is an overall increase or decrease in abundance below the contact with the organic material for most elements. Figures GS-4-3a, -3b, and -3c show the distribution of Mo in clay samples. Figure GS-4-3a shows the maximum Mo in the clay samples from each core, however, these cores do not represent the same depths of samples and the size of the Mo values coincide approximately with the distribution of the pale brown clay intersected in the cores. Figures GS-4-3b and -3c show the distribution of Mo in the clay at approximately 0 to 10 cm and 10 to 20 cm, respectively, below the interface with the 'peat'. Figure GS-4-4a shows that the distribution of Sb in the uppermost part of the clay correlates with anomalously high Mo samples. The distribution of As (Fig. GS-4-4b) is similar to that of Cu, however, there are only several anomalously high Zn values in the clay samples–in most of the samples Zn values are below the detection limits of the methods used.

REE chondrite normalized plots for the grey clays commonly show light REE enrichment and heavy REE values that are considerably greater (5 to 10 times) than the pale brown 'oxidized' clay that locally overlies the grey clay (Fig. GS-4-5). All of the grey clay samples have negative Eu anomalies and the Enzyme Leach^{SM} REE contents of the pale brown and brown 'oxidized' clay are not significant because they are commonly near the detection limits of the Enzyme Leach^{SM} methodology (Fig. GS-4-5). The low values obtained for the pale brown 'oxidized' clay is a function of either stripping of the REE from the grey clay during oxidation and leaching or the inability of the Enzyme Leach^{SM} process to strip material from the pale brown 'oxidized' clay.

These data illustrate that there is no preferential accumulation of REE and most other metals at the top of the Quaternary section below the organic material in both the lake bottom and bog environments at the sites sampled.

Conclusions and economic significance

A preliminary investigation of analytical data from twigs, sphagnum, peat-bog material, lake-bottom sediment and underlying clay indicates significant variations in the distribution of metals within several of the media. None of the media appear to define the surface projection of the conductor. The dwarf birch twig analytical data indicate the presence of anomalous gold and palladium in an area south of the conductor that has not been drilled. Preliminary data from the near-surface portion of the peat bog suggest that anomalous metals are associated with near-surface peat, however, cored material from below the 1 m interval is not anomalous except where 'bog iron' is present in the core. Preliminary analysis of 'bog-iron' sample data from above the 'peat'-clay interface indicates that a number of metals, including Eu, are concentrated immediately above the interface. There is no positive Eu anomaly at the contact between the clay and overlying peat. The strong correlation between depletion of some metals and the enhancement of others, notably Mo, in cores with pale brown to brown clay suggest that an electrochemical cell (Hamilton, 1998) may be operating under the lake at the east end of the conductor. This may explain the depletion of some metals in the clays and their enrichment in the immediately overlying 'bog iron'. The absence of strong apical base metal or gold anomalies over this portion of the conductor may be an indication that there are no near-surface concentrations of metals associated with the eastern end of this conductor. Although further analysis of the data is required before final conclusions can be drawn, the available data suggests that both the top and basal portions of the bog material can be used to evaluate electromagnetic conductors prior to undertaking a drill program.

Acknowledgements

D. Berk and V. Varga are thanked for obtaining the core samples for this study.

References

Gale, G.H. 2002: Geochemistry of drillcore samples, alders, peat, bog iron and till at Reed Lake, Manitoba (NTS 63K/9); *in* Report of Activities 2002, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 75–82.

Hamilton, S.M. 1998: Electrochemical mass-transport in overburden: a new model to account for the formation of selective leach geochemical anomalies in glacial terrain; Journal of Geochemical Exploration, v. 63, p. 155–172.

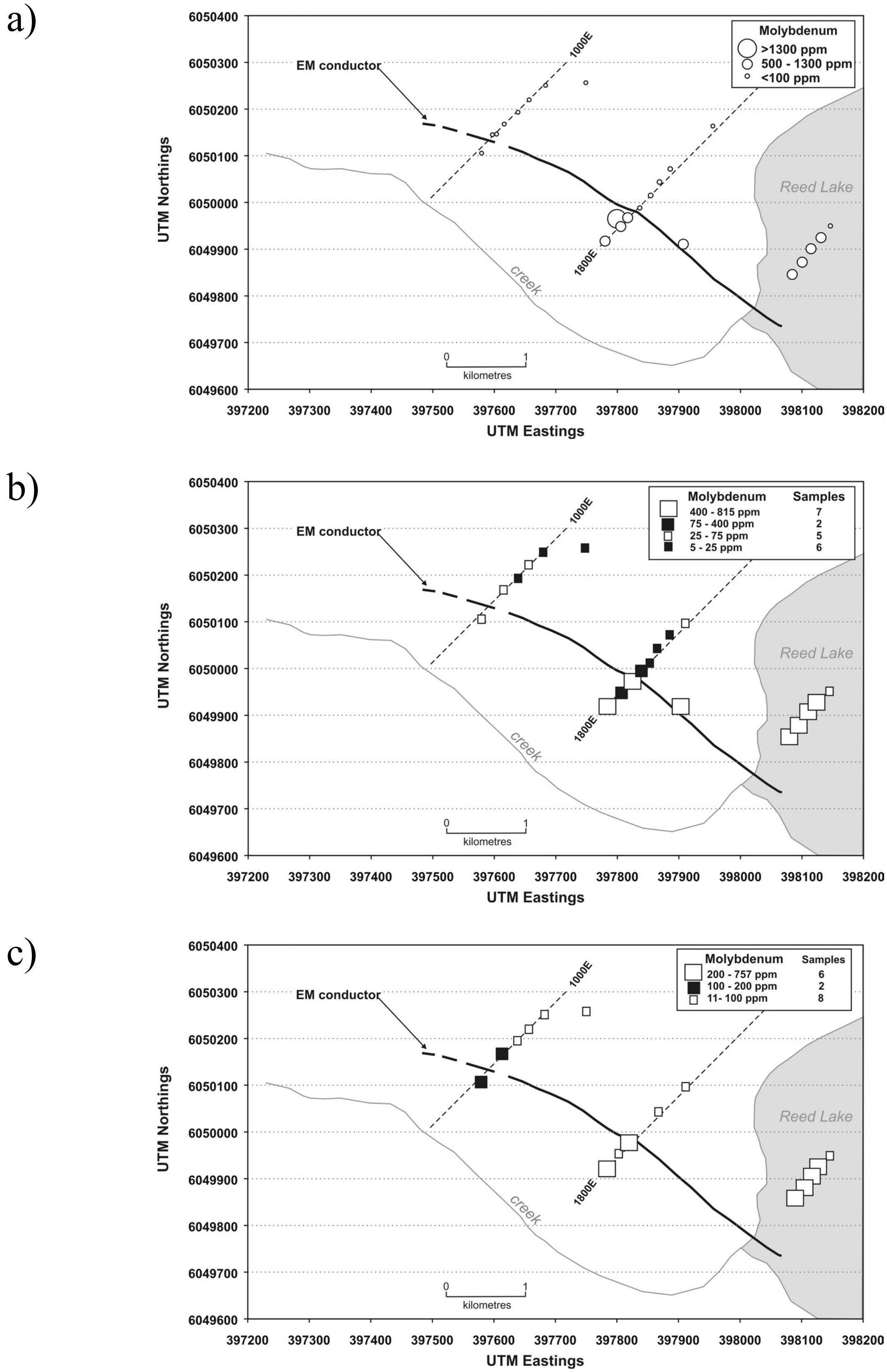
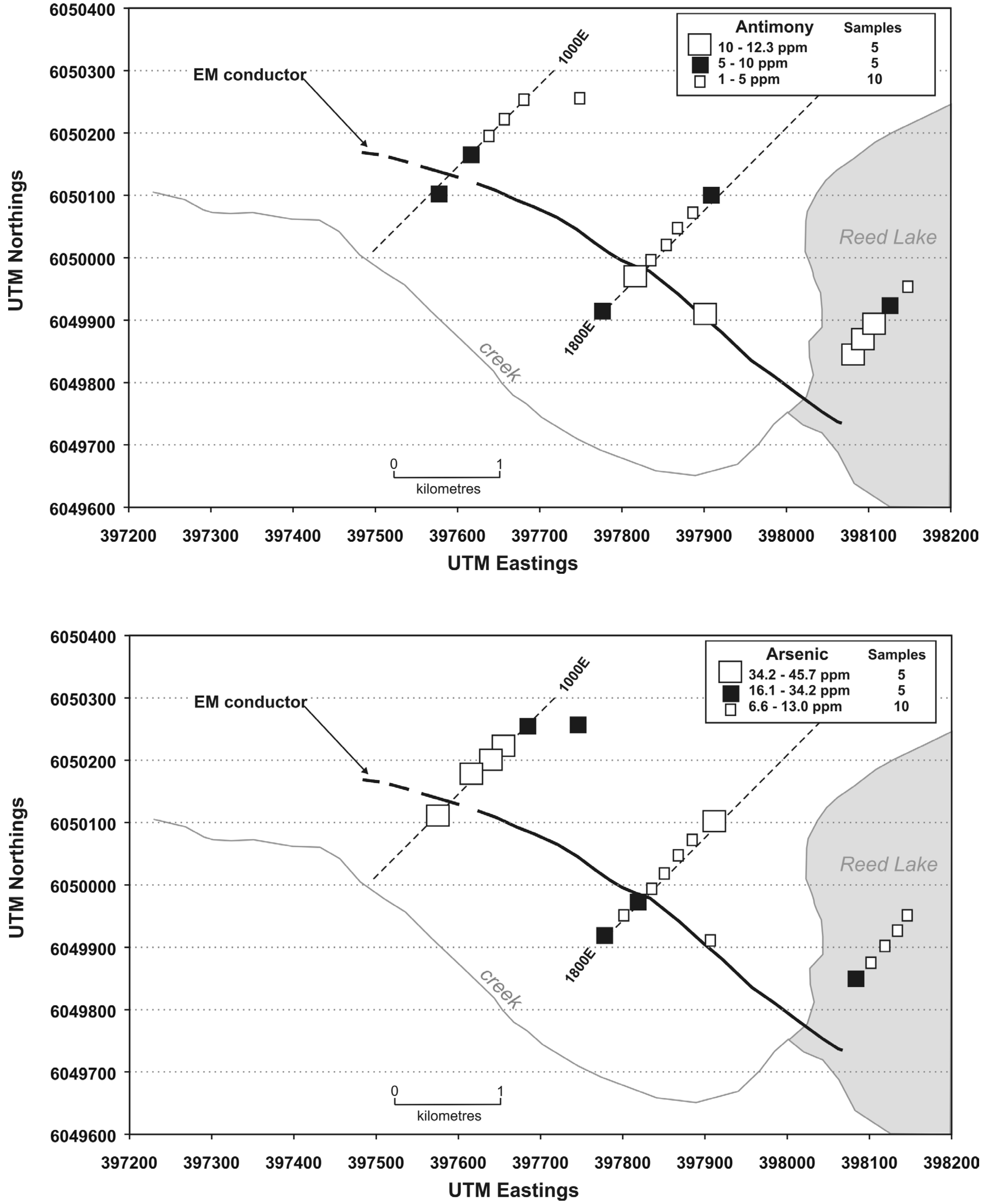


Figure GS-4-3: Distribution of Mo determined by Enzyme Leach^{SM} in clay samples: a) maximum Mo contents in all samples at each core site; b) Mo contents in clay samples 0 to 10 cm below peat-clay interface; c) Mo contents in clay samples collected 10 to 20 cm below peat-clay interface.

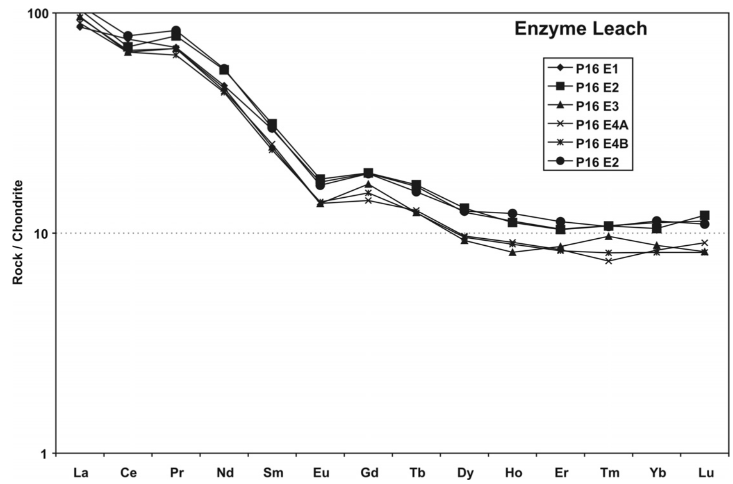
a)



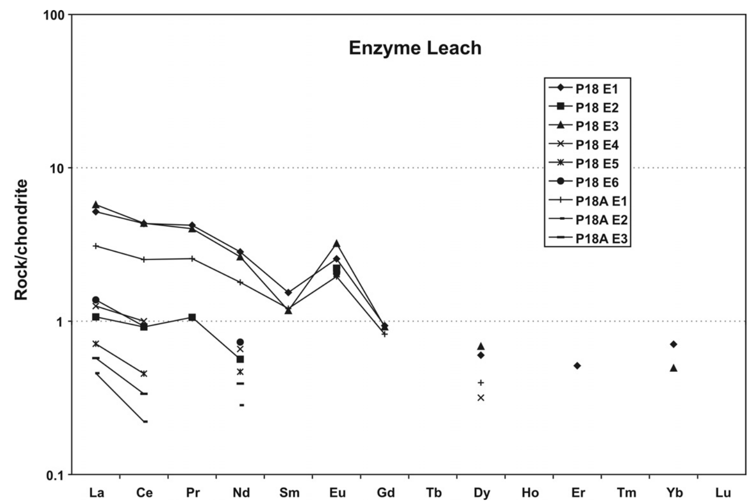
b)

Figure GS-4-4: Distribution of a) Sb and b) As in clay samples 0 to 10 cm below peat-clay interface.

a)



b)



c)

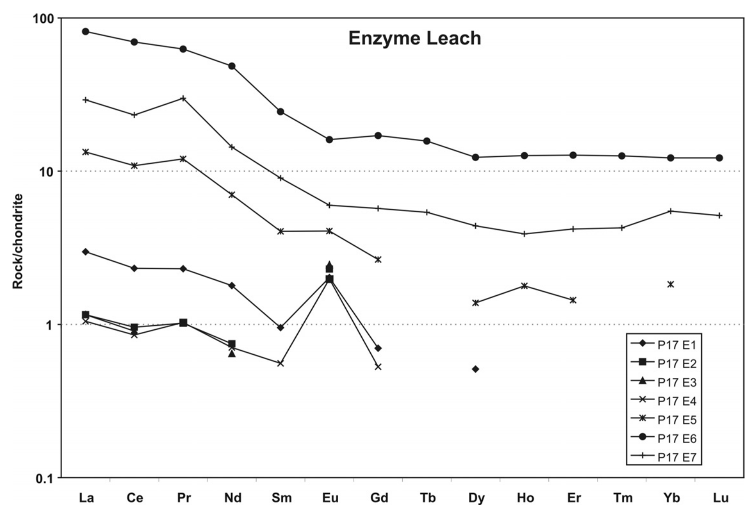


Figure GS-4-5: Chondrite normalized profiles for Enzyme Leach^{SM} REE data for selected clay samples: a) samples of grey clay from core P16 (samples P16 E2 were hidden duplicates and samples P16 E4A and P16 E4B are two portions of the same clay interval); b) samples of pale brown 'oxidized' clays from core P18; c) samples of brown and pale brown clay and grey clay (P17 E5, E6, E7) in core 17. Note that the apparent Eu positive anomalies in plots b and c appear to be analytical artifacts because the values are near the detection limits for Eu.