Schaft Creek Project -

ML-ARD Assessment of Surficial Samples from the Proposed Access Road

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P.Geo. and A.Sc.T. Notice

This study is based on detailed technical information interpreted through standard and advanced chemical and geoscientific techniques available at this time. As with all geoscientific investigations, the findings are based on data collected at discrete points in time and location. In portions of this report, it has been necessary to infer information between and beyond the measured data points using established techniques and scientific judgement. In our opinion, this report contains the appropriate level of geoscientific information to reach the conclusions stated herein.

This study has been conducted in accordance with British Columbia provincial legislation as stated in the Engineers and Geoscientists Act and in the Applied Science Technologists and Technicians Act.

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TABLE OF CONTENTS

List of Tables

List of Figures

Executive Summary

For the Schaft Creek Project, a proposed access road reaches from km 0 in the south, at the Galore Creek access road, to km 39.5 at the proposed plantsite and minesite. Most of the surficial geological material along the proposed road alignment is sediment and alluvium, but rock is exposed in places.

Based on direct and indirect information, the potential for metal leaching (ML) and acid rock drainage (ARD) was ranked for the surficial geological materials along the alignment. These rankings were as follows.

1. Negligible to Minor (green)
2. Moderate, or Unknown, or Beyond Current Analytical Capability suggesting caution (yellow)
3. High to Severe (red)

The results are compiled in Table ES-1.

Recommendations were offered in Chapter 6 for more detailed ML-ARD characterization of sediment and rock, including deeper material that may be disturbed during construction and quarrying. These recommendations should be carried out before, during, and after road construction.

Table ES-1. ML-ARD Rankings for Surficial Sediments and Surficial Rock along the Proposed Alignment of the Schaft Creek Access Road

Road Section (km)	Surficial Sediment Ranking [1]		Surficial Rock Ranking [1,3]	
	ARD[2]	ML	ARD	ML
0-2	1	3	1	1
2-3	1	3	2	2
3-5	1	3	1	3
5-10	1	3	1	1
10-15	1	3	3	3
15-25	1	3	2	2
25-28	1	3	2	3
28-34	1	1	1	3
34-36	1	3	1	1
36-39.5	1	3	2	2

[1] Ranking 1 = Negligible to Minor (green); Ranking 2 = Moderate, or Unknown, or Beyond Current Analytical Capability suggesting caution (yellow); Ranking 3 = High to Severe (red); elevated solid-phase levels are used as surrogates for the ML rankings, although aqueous metal leaching is not necessarily dependent on solid-phase levels.

[2] ARD potential for surficial sediments is based on only four samples, and is thus not reliable over the entire alignment; ML potential was based on many more samples, from other studies.

[3] The number of surficial rock samples (8) does not provide thorough coverage of surficial rock along the road alignment. However, much of the alignment lies on sediments and alluvium, not rock. Mineral potential and iron staining are used for rankings at km 5-24 and at km 34-39.5.

Report Summary

Metal leaching (ML) and acid rock drainage (ARD) are often water-chemistry issues for many minesites. As a result, the accurate prediction and control of ML-ARD at minesites in British Columbia are high priorities of the provincial government. This is explained in British Columbia's formal Policy, Guidelines, and draft Prediction Manual.

In addition to minesites, ML-ARD issues have also arisen at roads and highways, because they can also disturb rock and unconsolidated sediments during construction. Thus, British Columbia's ML-ARD documents can also be generally applied to them. Recent ML-ARD precedents established in Canada for roads and highways include the following.

1) Successful criminal prosecution under the *Fisheries Act* for ML-ARD from a road cut a few meters high and a few hundred meters long.
2) Visual examination of every horizontal meter of rock cut along dozens of kilometers of road alignment, with sampling and analysis as appropriate.
3) Major re-alignment of a highway to avoid disturbance of potentially acid-generating rock.
4) Special environmental controls and remediation for reactive rock removed from rock cuts and quarries and for broken rock used in the road bed.
5) Failure of geologic maps, preconstruction environmental and geologic surveys, and surficial sampling of exposures to identify all geochemically reactive rock reliably.

As part of the Schaft Creek Project, an access road has been proposed. It extends from km 0, at the Galore Creek Access Road, generally northward to km 39.5 near the proposed plantsite and minesite. Some rock quarries and sand-gravel pits may be needed.

This report assessed the ML-ARD potential of the surficial geological materials along the proposed alignment. This assessment was based on pre-existing "indirect" information from various sources, like the provincial Minfile website and air photos, and on "direct" information, like ML-ARD sampling by the authors.

Indirect ML-ARD Information

Indirect ML-ARD information started at the Ministry of Energy, Mines and Petroleum Resources' Minfile and MapPlace website, which provided details of watersheds, surficial geology, bedrock geology, Regional Geochemical Studies (RGS), and nearby mineral deposits and showings. Another source of indirect ML-ARD for this study was air photographs of the road alignment and nearby areas.

The proposed access road passes through two primary watersheds. Most of the road alignment is in the Mess Creek watershed, which drains to the north. A small section, approximately 1.5 km long at the southern end, lies in the More Creek watershed that drains east and south to the Iskut River.

Maps and air photos showed that much of the proposed road alignment lies on the unconsolidated alluvium in the Mess Creek valley. Most of the alignment was covered by trees and other vegetation, and was thus not readily visible. If unconsolidated sediments were composed of locally weathered bedrock, their geochemistry may reflect weathered aspects of the bedrock. If the sediments were transported large distances by water and/or glaciers, then their geochemistry may bear little resemblance to the underlying bedrock. Thus, unconsolidated alluvium was not automatically assumed to have a similar ML-ARD potential as the underlying or nearby bedrock. However, if local rock had a high potential and the potential of local sediment could not be determined, then the sediments were assumed in this report to have the same potential as rock.

Bedrock geology, mostly hidden below the unconsolidated sediments in the Mess Creek valley, is complex. Zones of volcanic, intrusive, sedimentary, and metamorphic rock are mixed, sometimes on a relatively small scale. If ML-ARD potential is related to rock types, then the potential can be highly variable over short distances along the proposed road.

The potential for enriched metals and other minerals can sometimes serve as a proxy for ML-ARD potential. Metallic-mineral potential along the proposed access-road alignment, from the provincial MapPlace website, showed that areas near the road ranged from the lowest mineral potential to the highest. The highest-potential zone coincided with a band of sedimentary rock from ~km 10 to ~km 15. Also, two zones of second-highest potential were at ~km 15-26 and ~km 36-39.5.

Another general indicator of ML-ARD potential can be mineral claims, prospects, and showings. The provincial Minfile site showed two developed mineral prospects and four mineral showings near the proposed road or in tributaries of Mess Creek. All six contained potentially acid-generating sulphide-borne metals like iron, copper, cadmium, arsenic, and/or molybdenum. All six also contained some carbonate minerals, but it was not clear if the carbonate was sufficient to prevent ARD. RGS (Regional Geochemical Survey) water pH values (see below) showed that, just to the north and east of one mineral showing, values as low as 4.5 were measured. Even without ARD, near-neutral metal leaching would remain a concern in these areas. Therefore, along the nearby proposed road alignment, ~km 4-17 and ~km 21-26 were given high, indirect ML-ARD potentials.

The RGS data from the provincial government provided aqueous pH measurements and solid-phase analyses of sediment near the proposed road alignment. Based on aqueous measurements, most pH values upstream of and near the road alignment were around 6.9 to 8.1. The lowest value of 4.5 was found in a tributary to the north and east of one mineral showing, suggesting ARD was actively produced in that tributary.

Solid-phase levels of metals and other elements do not necessarily produce accelerated leaching rates into water. In fact, some solid-phase levels might be high due to slow leaching, but laboratory kinetic tests and detailed RGS water analyses were not available to resolve this. In any case, the RGS surveys provided selected solid-phase elements in alluvium sediments near the proposed road alignment and in tributaries to Mess Creek. Based on solid-phase antimony, arsenic, copper, mercury, nickel, and zinc, the portions of the road alignment with relatively elevated levels included the aforementioned ~km 4-17 and ~km 21-26. Some elements like copper were less variable along the length of the alignment. Also, one sample, only with elevated copper and zinc, was found at the north end of the alignment, around km 34.

The final indirect source of ML-ARD potential came from air photographs, which provided targets for "direct" ML-ARD sampling and analyses (see below). Surficial rusty-coloured iron staining can sometimes signal accelerated metal leaching and/or sulphide oxidation. Such staining appeared to be present in the air photos around km 10.0-14.8 and km 22.0-23.0, which coincided with the aforementioned sections of high, indirect ML-ARD potential. Iron staining was also apparent around: km 0.0, which may be from natural organic processes in the local wetlands; km 18.5-19.5, in a zone of second-highest mineral potential; and km 28-32, anomalously in a zone of lowest mineral potential. These areas of apparent iron staining could not be reached during the field visit, but could be signs of ML-ARD.

Direct ML-ARD Information

The authors of this report flew by helicopter along the proposed road alignment, collecting photographs, notes, and surficial solid-phase samples. This field study confirmed most of the alignment was covered by trees and other vegetation, and thus was not readily accessible for sampling of geological materials.

Rusty-coloured iron staining, sometimes a sign of surficial ML-ARD, was seen along some portions of the alignment. These areas could not be safely reached without additional equipment, so their ML-ARD status is unknown. However, the colouring and staining appeared consistent with locally significant ML-ARD.

Eight samples of surficial rock and four samples of surficial sediments were collected near the proposed access-road alignment. Acid base accounting (U.S. EPA 600 compliant Sobek ABA) of these samples showed that all had near-neutral paste pH at the time of analysis. Total sulphur ranged from <0.01%S in one rock sample to 0.39%S in another rock sample. Most of that total sulphur was potentially acid-generating sulphide, so the more easily measured total sulphur can be used for convenience. However, sulphur values below 0.05%S were relatively inaccurate. Three of the four highest sulphide values were found in the sediment samples, which are typically thought of as weathered and oxidized. Thus, the ARD potential of the sediments cannot be ignored.

Neutralization Potential (NP) ranged from 9 to 387 kg $CaCO_3$ equivalent/tonne, with four of the five highest NP values in sediments. Thus, the sediments contained sufficient NP to offset any internal acid generation by sulphur. In many samples, the Sobek NP was apparently mostly comprised of calcite ($CaCO_3$), which could be measured by the simpler analytical techniques for total carbon or inorganic carbonate.

Net balances of acid-generating and acid-neutralizing capacities were based on the Total-Sulphur-Based Net Potential Ratio (TNPR), with and without adjustments for unavailable NP. This showed eleven samples were net neutralizing indefinitely, plus one sample of rock that was "uncertain" without additional testing. When various amounts of unavailable NP were considered, a second sample of rock showed large changes in TNPR, suggesting the ARD status of this sample was also uncertain without additional testing.

Total-element contents of the 12 access-road samples of surficial rock and sediments were measured by ICP-MS analysis after strong four-acid digestion, and by x-ray-fluorescence (XRF) whole-rock analysis. This showed that most of the 12 access-road samples consisted predominantly of silica and alumina, with substantial and sometimes dominant amounts of iron, calcium, magnesium, sodium, potassium, and Loss on Ignition (LOI). LOI often reflects the weight loss from the samples of some or all sulphur, carbon, and tightly bound or crystalline water. Also, the 12 samples often contained elevated levels of bismuth and selenium, with fewer to rare elevated levels of silver, cadmium, chromium, phosphorus, lead, antimony, and zinc.

Solid-phase correlations of total elements can sometimes reveal mineralogical associations. For example, elements correlating with sulphide may occur predominantly within the sulphide minerals. The elements showing at least some minor correlation with sulphide included arsenic, copper, mercury, and nickel. The elements showing at least some minor correlation with Neutralization Potential, which can dissolve and release metals even without sulphide oxidation, included calcium and manganese.

The preceding information on total elements was combined with "indirect" RGS data and Rescan data along the proposed road alignment. This allowed a spatial interpretation of the data, to highlight sections of the proposed roads with higher ML potential. However, these other sources did not include ABA, so ARD potential was available only for our 12 MDAG samples. For total sulphur, the highest and lowest values were in surficial rock, between km 26 and 31. Nevertheless, some surficial sediments carried significant levels of total sulphur, which were well distributed along the road alignment. For ARD potential, the lowest, "uncertain" values were found near km 26 around Nahta Creek also near the southern end around km 2. The latter sample had low, relatively inaccurate sulphur analyses, so its ARD status was considered "uncertain".

In areas where both surficial rock and sediment analyses were available, sediments sometimes had notably higher levels of some elements. This suggested sediments were not necessarily genetically related to local rock.

Based on selected solid-phase criteria that do not necessarily characterize ML-ARD potential accurately, the seven elements of greatest ML-ARD potential in surficial sediments were antimony, arsenic, barium, cadmium, chromium, copper, and nickel. However, these elements were only elevated along specific sections of the proposed road, and not all seven were elevated at the same location.

Similarly for surficial rock, there were 12 elements of greatest potential ML concern, plus at least an "uncertain" potential for ARD along specific sections of the proposed road. Notably, at km 32-34, eight of the 12 elements of greatest concern were elevated. The lack of rock samples from roughly km 5 to km 24, and from km 34 to km 39.5, precluded assessments there. This incorrectly implied no ML-ARD concern, because zero elements were elevated in these sections. However, indirect information from Chapter 3 was used to supplement the less abundant direct information for rock.

ML-ARD Rankings

The preceding indirect and direct ML-ARD information showed that some surficial rock had an uncertain capacity to release ARD, and more extensive areas of surficial rock and sediments might leach metals at elevated levels even at neutral pH. This was expressed spatially as ML-ARD rankings along sections of the proposed road. Separate rankings were developed for ARD and for ML, because ML can arise even without ARD. Not included here were water-quality parameters potentially created by construction activities, like suspended solids, nitrogen species from any blasting, organic compounds like fuel, and any mined rock from the proposed minesite.

The Rankings used here were based on three levels.

1. Negligible to Minor (green)
2. Moderate, or Unknown, or Beyond Current Analytical Capability suggesting caution (yellow)
3. High to Severe (red)

It is important to note that Rankings should reflect the local receiving environment, but such environmental assessments are beyond the scope of this study. For example, pre-existing high background aqueous concentrations of dissolved copper might show no additional environmental effects in the future after road construction, despite a Ranking of 2 or 3 for a road section or quarry. Thus, the Rankings here assume a pristine environment. This is not consistently the case as shown by some elevated pre-existing metal levels and sulphide in sediments and rock.

The results produced Rankings for ARD and ML that spanned the range from 1 to 3 (Table RS-1). There was no consistent spatial trend of increasing or decreasing Ranking with distance along the road. Overall, the ML Ranking along nearly the entire proposed alignment was high for surficial sediment, and was mostly moderate to high for surficial rock.

As a result, some accelerated metal leaching should be expected from the road during and after disturbance of surficial sediments and rock. However, the ML-ARD potentials of deeper sediments and rock remain unknown at this time. To clarify and improve the ML-ARD assessment of the proposed road alignment, both surficial and deeper, recommendations were offered in Chapter 6 before, during, and after road construction.

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1. INTRODUCTION

Metal leaching (ML) and acid rock drainage (ARD) are often water-chemistry issues for many minesites (e.g., Morin and Hutt, 1997 and 2001). As a result, the accurate prediction and control of ML-ARD at minesites in British Columbia are high priorities of the provincial government. This is explained in British Columbia's formal Policy, Guidelines, and draft Prediction Manual (Price and Errington, 1998; Price, 1998; Price et al., 1997).

In addition to minesites, ML-ARD issues have also arisen at roads and highways, because they can also disturb rock and unconsolidated sediments during construction (Morin et al., 2003; Morin and Hutt, 2005 and 2007a). Thus, British Columbia's ML-ARD documents can also be generally applied to them. Recent ML-ARD precedents established in Canada for roads and highways include the following.

1) Successful criminal prosecution under the *Fisheries Act* for ML-ARD from a road cut a few meters high and a few hundred meters long.
2) Visual examination of every horizontal meter of rock cut along dozens of kilometers of road alignment, with sampling and analysis as appropriate.
3) Major re-alignment of a highway to avoid disturbance of potentially acid-generating rock.
4) Special environmental controls and remediation for reactive rock removed from rock cuts and quarries and for broken rock used in the road bed.
5) Failure of geologic maps, preconstruction environmental and geologic surveys, and surficial sampling of exposures to identify all geochemically reactive rock reliably.

In addition to ML-ARD, road construction can also affect local water quality and downstream environments through effects like suspended solids, any blasting residues (nitrate, ammonia, etc.), and organic compounds (fuel, lubricating oil, etc.). These potential additional effects are not addressed here in this ML-ARD study.

As part of the Schaft Creek Project, ML-ARD has been characterized and predicted in detail for the ore zones (Morin and Hutt, 2007b and 2008). This information is of limited value to the proposed access road, which lies mostly at substantial distances from the ore zones.

Chapter 2 of this report discusses the layout and alignment of the proposed access road for the Schaft Creek Project. "Indirect" ML-ARD information, obtained from various existing sources, is discussed in Chapter 3. Chapter 4 presents "direct" information, based on the field study by the authors of this report. All information is combined into ML-ARD predictions for surficial materials along the road alignment in Chapter 5. Finally, recommendations are made for environmental protection against ML-ARD before, during, and after road construction in Chapter 6. All relevant data are compiled in the appendices.

2. ALIGNMENT OF THE PROPOSED ACCESS ROAD FOR THE SCHAFT CREEK PROJECT

Rescan provided UTM coordinates in NAD 83 datum and a general map of the proposed road alignment (Figure 2-1 and Appendix A). The proposed road reaches from km 0.0 km at the Galore Creek access road to km 39.5 near the proposed millsite. It follows Mess Creek, which flows northward, along most of its length. Quarries and granular-fill areas will be needed for road construction, but their locations were not provided in the time for this study.

For simplicity in this report, the linear km distance (0.0 to 39.5) is used to discuss and depict information, rather than two-dimensional UTM coordinates. However, Appendix A can be used to convert from km distance to UTM if needed.

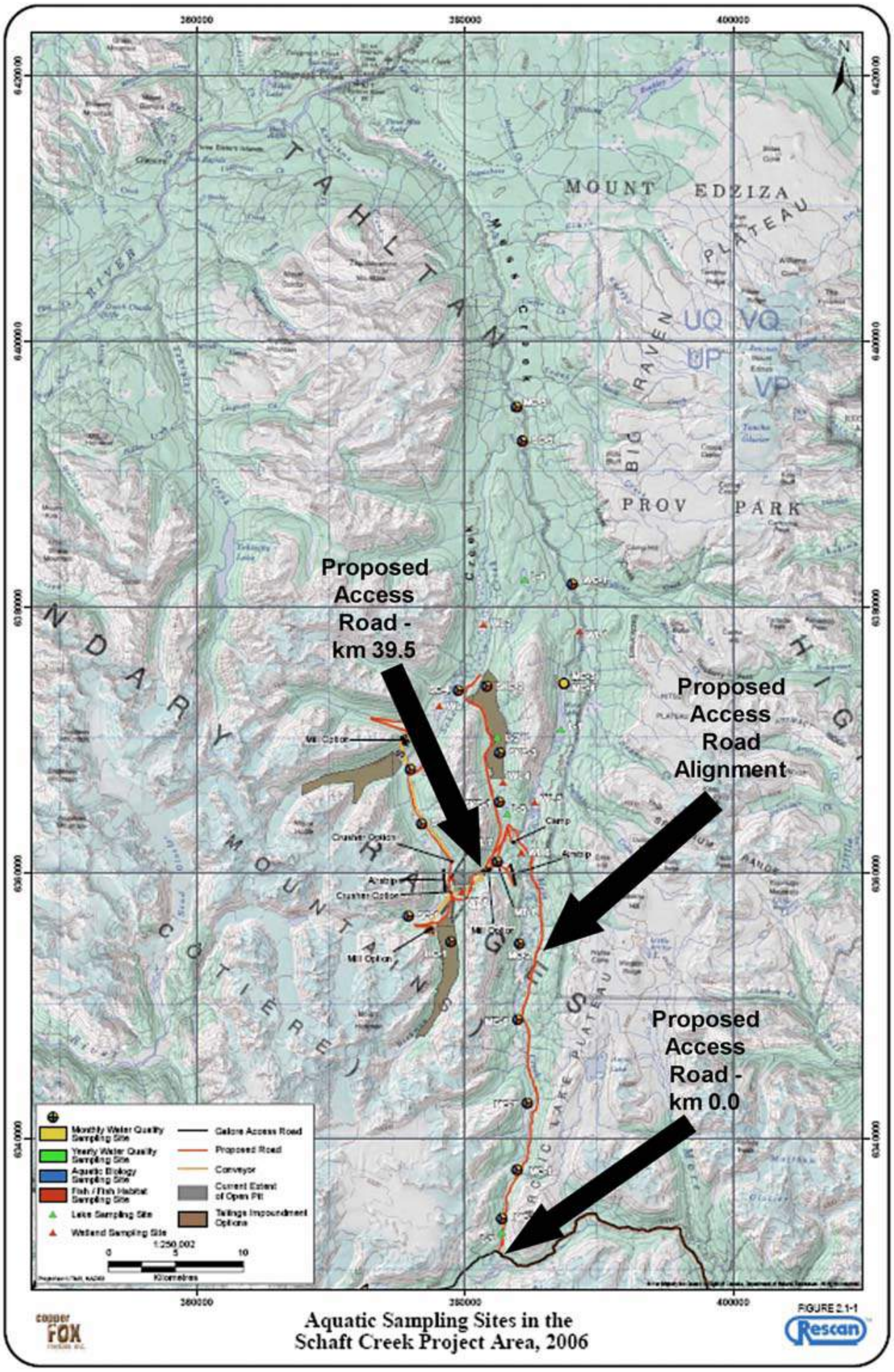

Figure 2-1. Map of the Schaft Creek Site and Proposed Access Road (adapted from Rescan, 2007).

3. EXISTING "INDIRECT" ML-ARD INFORMATION

3.1 Sources of Indirect ML-ARD Information for the Proposed Access Road

The proposed access road for the Schaft Creek Project covers a length of approximately 39.5 km (Chapter 2 and Appendix A). This probably would include potential rock quarries and sand-gravel pits that would be located some lateral distances from the road. As a result, detailed ML-ARD sampling of the entire potential disturbed area would be intensive, and still not provide all information like kinetic testing (Chapter 4). Therefore, existing, external "indirect" sources of ML-ARD information are used in this report. These sources are critical. For example, certain factors like near-neutral metal leaching can sometimes be estimated from local water quality or solid-phase analyses.

The Government of British Columbia offers excellent sources of indirect ML-ARD information. This starts at the Ministry of Energy, Mines and Petroleum Resources' Minfile website (www.em.gov.bc.ca/Mining/Geolsurv/minfile/). Minfile provides details of nearby mineral deposits and minesites. Minfile also provides valuable links to other provincial data sources. These include Regional Geochemical Studies (RGS), which contain solid-phase and aqueous analyses, and MapPlace, which displays maps of features such as local geology, roads, RGS results, and Minfile sites.

Minfile and its links were searched for geochemical and indirect ML-ARD information along the proposed access road. The Mess Creek valley and the Schaft Creek Minfile location provided geographic identification points in this search.

Another important source of indirect ML-ARD for this study was air photographs of the road alignment. This is also discussed later in this chapter (Section 3.6).

3.2 Watersheds Along the Road Alignment

Based on the provincial MapPlace (Section 3.1), the proposed access road passes through two watersheds. The first, short portion from km 0.0 to approximately km 1.5 lies in the Iskut River watershed, with water draining to the east and then south (Figures 3-1 and 3-2). The remaining, major portion of the proposed road, from approximately km 1.5 to km 39.5, lies in the Mess Creek watershed, which drains to the north.

3.3 General Geology Along the Road Alignment

Minfile maps showed that most of the proposed road lies on Quaternary unconsolidated alluvium (Figure 3-3), often sand and/or gravel on the Mess Creek floodplain. However, on this scale of mapping, rock outcrops may not be readily apparent or stored in MapPlace. Additional clarification on this was provided by other indirect information in the following subsections and by a site visit (Chapter 4).

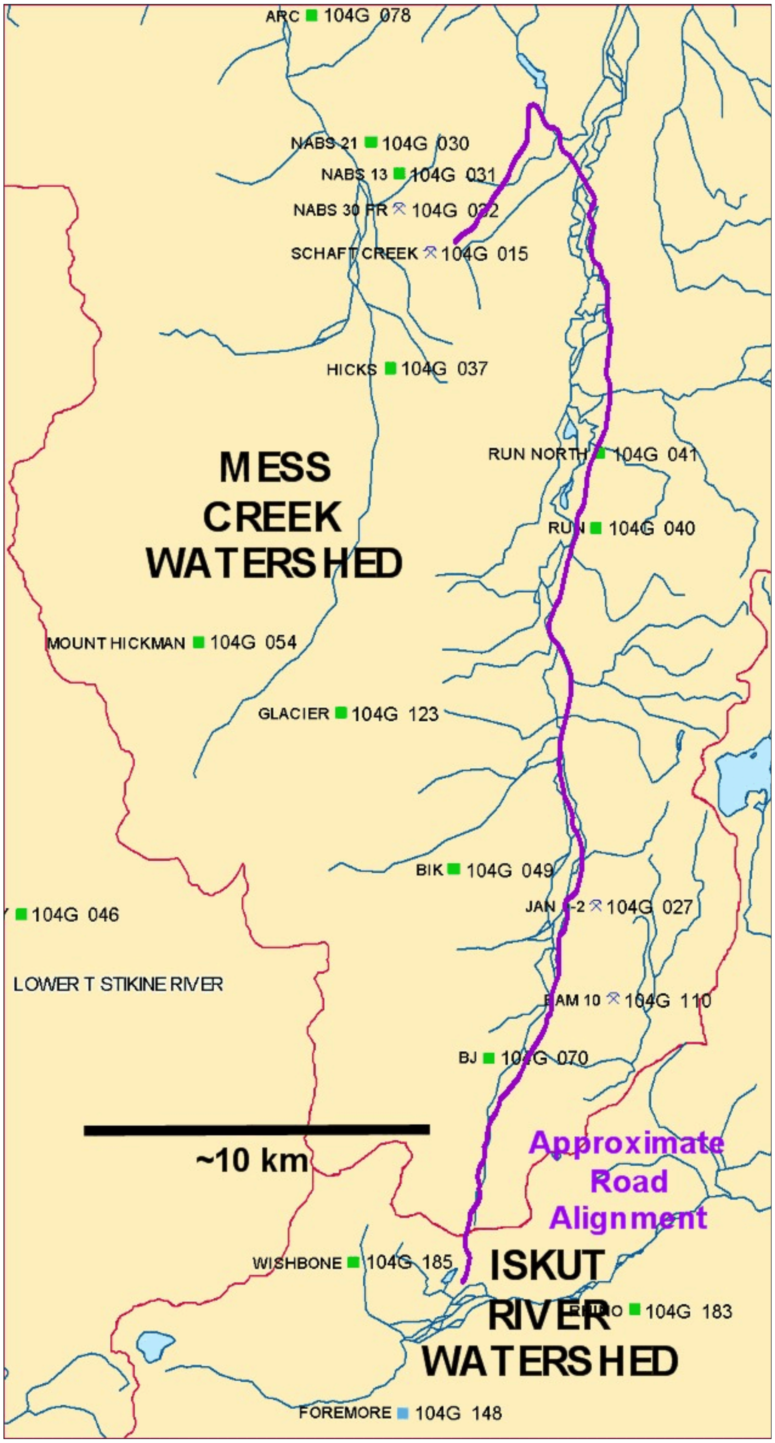

Figure 3-1. Major Watersheds along the Proposed Road Alignment (red lines mark watershed boundaries; taken from the British Columbia MapPlace website).

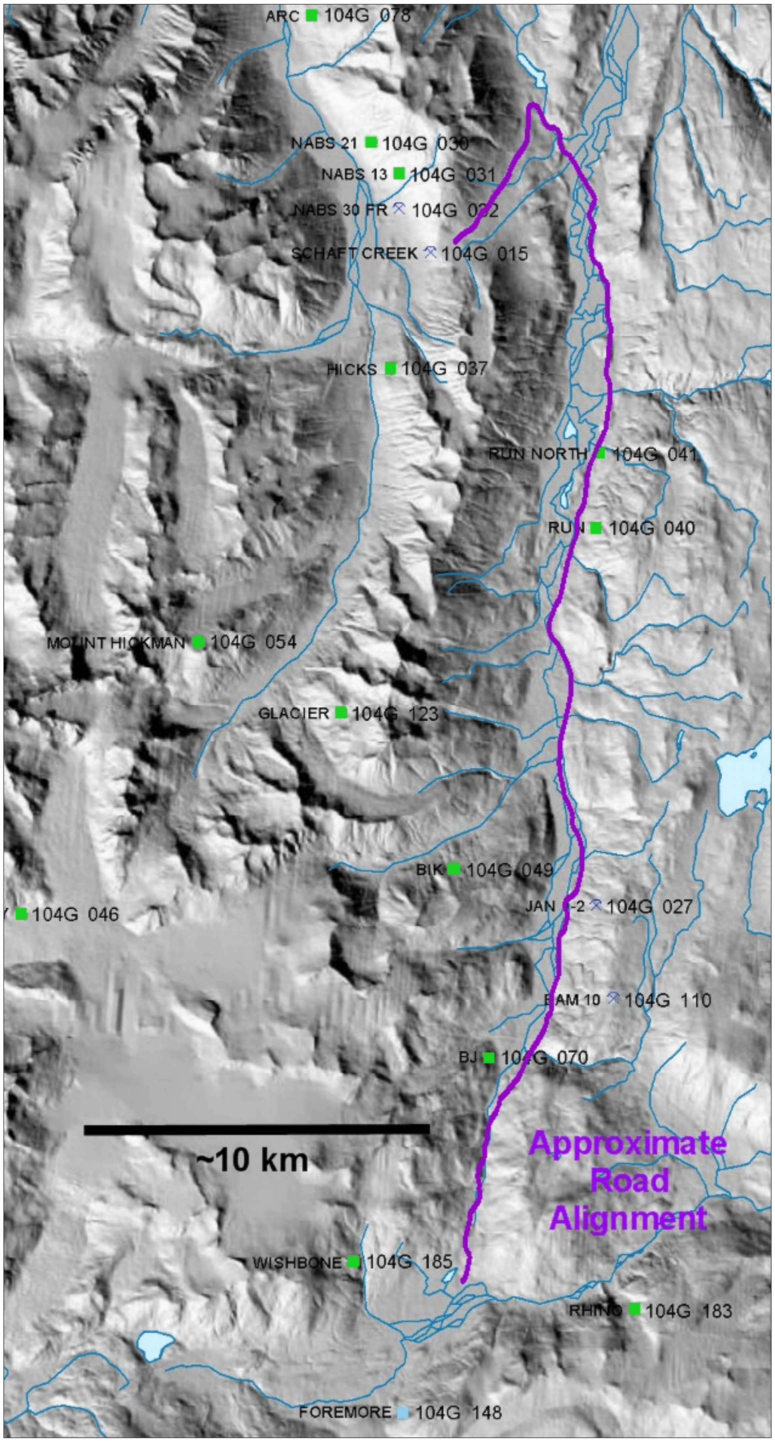

Figure 3-2. Shaded Relief Map of the Schaft Creek Area and the Proposed Access Road (taken from the British Columbia MapPlace website).

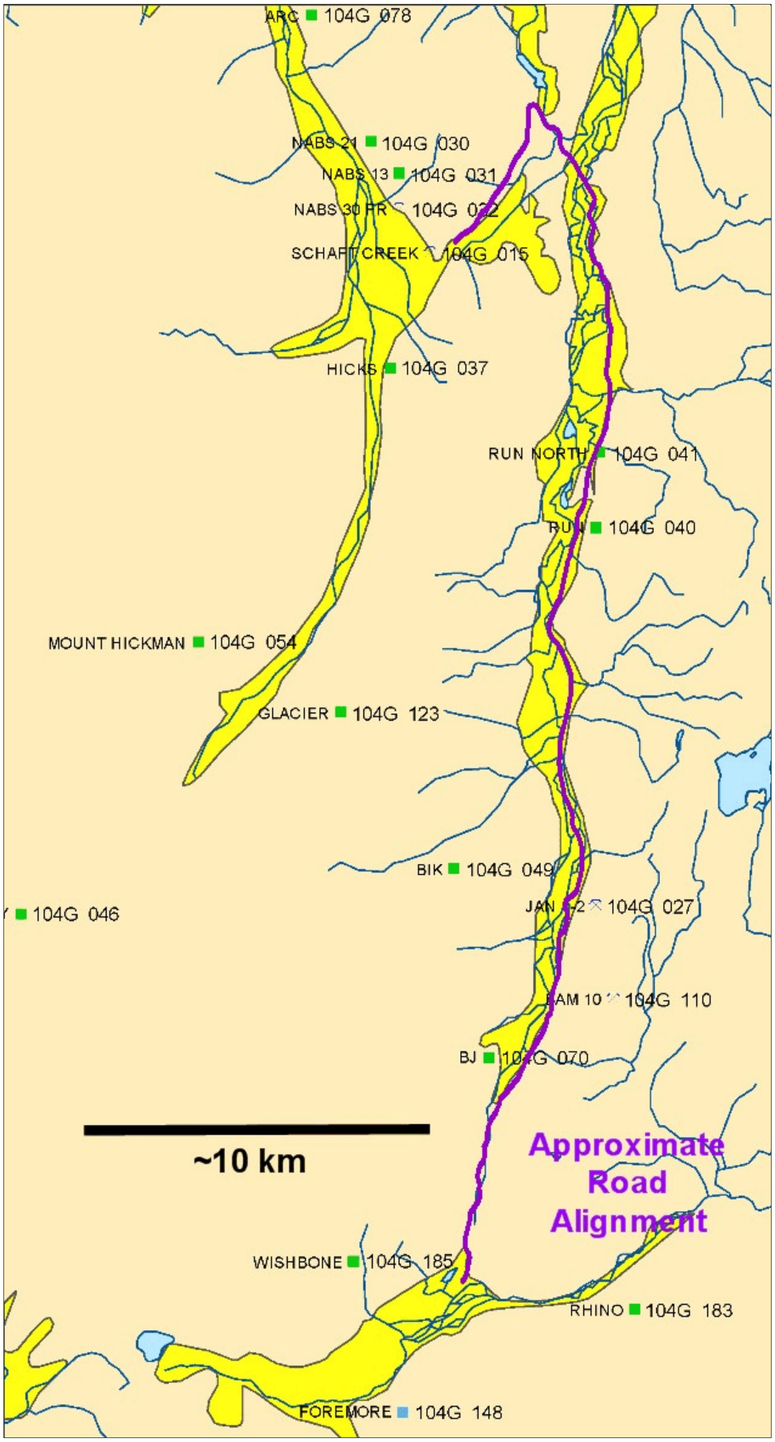

Figure 3-3. Alluvium Covering Most of the Proposed Road Alignment (alluvium shown in yellow) (taken from the British Columbia MapPlace website).

Bedrock geology, mostly hidden below the unconsolidated sediments, is complex (Figure 3-4). Rock of volcanic, intrusive, sedimentary, and metamorphic origins forms a “patchwork” around the road alignment and Mess Creek, sometimes on a relatively small scale. In some cases, ML-ARD potential can be related to rock types. If this applies to the Schaft Creek road, then the ML-ARD potential can be highly variable over short distances along the proposed road.

If unconsolidated sediments were composed of locally weathered bedrock, their geochemistry may reflect weathered aspects of the bedrock. If the sediments were transported large distances by water and/or glaciers, then their geochemistry may bear little resemblance to the underlying bedrock. Thus, unconsolidated sediments are not automatically assumed to have a similar ML-ARD potential as the underlying or nearby bedrock. However, if local rock has a high potential and the potential of local sediment cannot be determined, then the sediments are assumed in this report to have the same potential as rock. This is discussed further below, and in the direct ML-ARD analyses of Chapter 4.

3.4 Mineral Potential and Mineral Occurrences Near the Road Alignment

The local potential for metals and other minerals can serve as a proxy for ML-ARD potential. For example, occurrences of elevated levels of sulphide minerals can suggest a higher ARD potential than surrounding areas.

The provincial Minfile and MapPlace website provided a map of metallic-mineral potential along the existing access-road alignment (Figure 3-5 and Table 3-1). This showed that the southernmost, and part of the northernmost, sections lay in an area of lowest potential, while the remainder is at least second-highest potential.

The zone of highest mineral potential (Figure 3-5) coincides with a band of SSW-trending sedimentary rock (Figure 3-4). A smaller band of volcanic rock with lowest potential is embedded in this sedimentary rock, but for safety is still ranked as highest potential here (Table 3-1).

Another general indicator of ML-ARD potential can be mineral claims. The provincial Minfile website provides valuable details on certain claims, specifically mineral anomalies, showings, prospects, developed prospects, producers (operating minesites), and past producers (Figures 3-1 to 3-5). Each location is given a Minfile number and name, which leads to additional information such as geology, mineralogy, and mineral commodities. For the proposed road alignment, two developed mineral prospects (Jan 1-2 and Bam 10) and four lesser mineral showings (BJ, Bik, Run, and Run North) are relevant.

Jan 1-2 in sedimentary rock (Minfile 104G 027) and Bam 10 in intrusive rock (Minfile 104G 110) are the two developed prospects near the proposed road. The Schaft Creek deposit itself, while a developed prospect, is not included here. This is because it drains to a different valley and thus does not potentially affect ML-ARD of the road, unless mined rock is placed on the road.

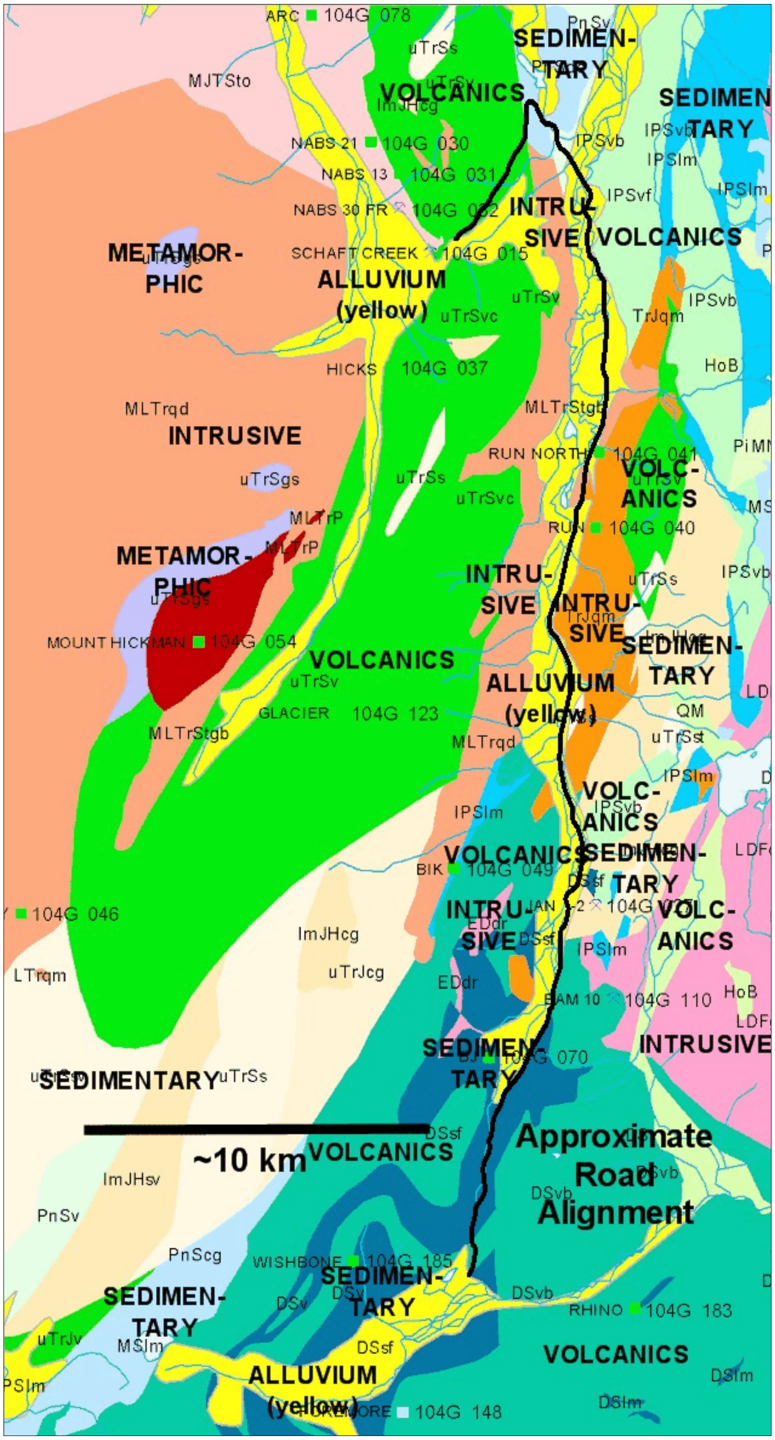

Figure 3-4. Bedrock Geology around the Proposed Road Alignment (taken from the British Columbia MapPlace website).

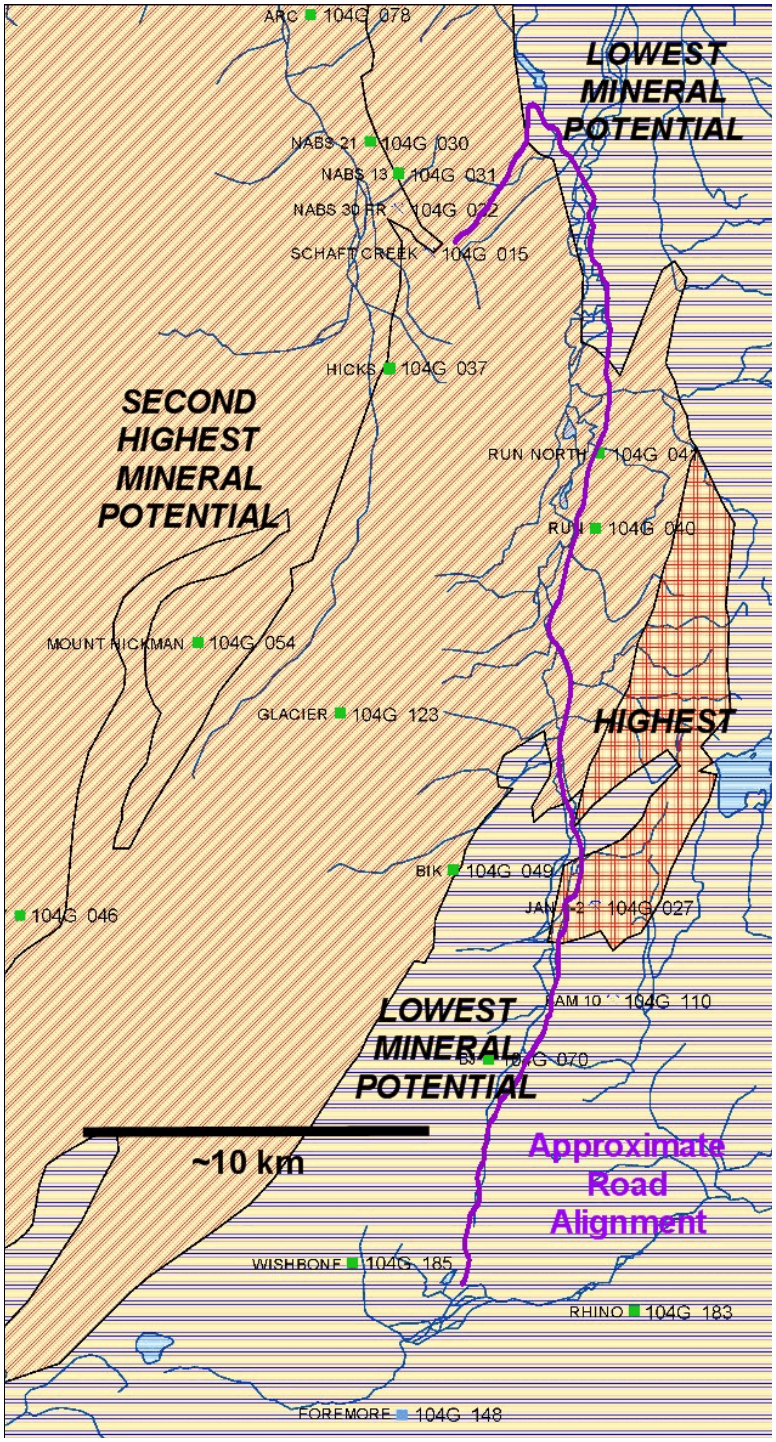

Figure 3-5. Metallic-Mineral Potential around the Proposed Road Alignment (taken from the British Columbia MapPlace website).

Table 3-1. Metallic-Mineral Potential by Distance Along the Proposed Access Road (data from British Columbia Minfile Website; see also Figure 3-4)

Distance	Metallic-Mineral Potential
0 to ~km 10	Lowest
~km 10 to ~km 15 [1]	Highest [1]
~km 15 to ~km 26	Second Highest
~km 26 to ~km 36	Lowest
~km 36 to ~km 39.5	Second Highest

[1] This Highest zone also contains some smaller segments of "Lowest" potential (Figure 3-4), but to be safe they are included here as "Highest".

Jan 1-2 and Bam 10 are pyritic sulphide deposits, with commodity elements of copper, silver, arsenic, cadmium, zinc, antimony, gold, bismuth, and barium. Thus, they mark areas of significant potential for ML-ARD from rock. The reported dark-orange limonite and iron staining at these sites suggest the sulphides have partially oxidized, but the reported limestone and dolomite may maintain near-neutral conditions. This is consistent with RGS near-neutral water-pH measurements in the area (Section 3.5). Nevertheless, near-neutral metal leaching from nearby rock, sediment, and/or drainages, including possibly some ARD, remains a potential concern for the section of the proposed road near these two sites (~km 7 to ~km 13).

The location of Jan 1-2 is within the zone of highest mineral potential (Figure 3-5), but Bam 10 in an area of lowest potential. As a result, mineral potential may not precisely coincide with ML-ARD potential.

For the two mineral showings near the southern portion of the road, BJ (Minfile 104G 070, Figures 3-1 to 3-5) and Bik (Minfile 104G 049), both contain the commodity elements of copper, silver, zinc, lead, and gold in/as sulphide minerals. The pyritic BJ showing is primarily hosted in metamorphic rock with some carbonate minerals present at least locally. Bik is hosted in limestone with some metamorphic and intrusive rock. The distance between these two showings along the proposed alignment includes Jan 1-2 and Bam 10. Thus, they extend the section of the road, with potential ML-ARD concerns in nearby rock, sediments, and drainages, from ~km 4 to ~km 17.

At Run and Run North copper-molybdenum showings (Minfile 104G 040 and 104G 041), pyrite is reported at 1-3% and as high as 10%, with some carbonate minerals present at least locally. This abundance of pyrite may explain the acidic aqueous pH values down to 4.5 reported to the north and east of Run North (Nahta Creek, Section 3.5), and thus these showings represent a significant ML-ARD potential. Consequently, the section of the proposed road encompassed by Run and Run North, and their ML-ARD significance, is from ~km 21 to ~km 24. However, acidic pH values to the north require an extension of the ML-ARD potential to the north, by roughly 2 km to ~km 26 (Section 3.5).

3.5 Regional Geochemical Surveys

The provincial government has conducted Regional Geochemical Surveys (RGS) across the province for decades (e.g., British Columbia Ministry of Energy, Mines and Petroleum Resources, 2006). The RGS program was designed primarily for exploration and geology, but can provide valuable information for environmental purposes. The RGS database contains mostly solid-phase analyses of fine-grained stream sediment, but some locations include aqueous parameters and solid-phase analyses of till, moss, and lake sediment.

The provincial Minfile and MapPlace website provided maps of the local RGS data near the proposed-access-road alignment. Water analyses focussed on pH (Figure 3-6). Aqueous pH was consistently near neutral around 6.9 to 8.1 near the road alignment and in tributaries to Mess Creek. The exception was the tributary (Nahta Creek) to the north and east of the Run North mineral showing (Section 3.5), at ~km 25.3, which produced pH values as low as 4.5. Thus, the rock and perhaps sediments in this section of the proposed road may have sufficient capacity to generate ARD, which was supported by a rock sample from the base of this valley (Chapter 4). This produces a zone of higher ML-ARD potential from close to the Run showing up to this tributary, approximately km 21 to km 26.

Elevated solid-phase levels of metals and other elements do not necessarily produce accelerated leaching rates into water. In fact, some solid-phase levels might be high due to slow leaching, but laboratory kinetic tests and detailed RGS water analyses are not available to resolve this (discussed further in Chapter 4). In any case, the RGS surveys provided solid-phase elements in alluvium sediments near the proposed road alignment and in tributaries to Mess Creek.

The RGS sediment analyses included elements like antimony, arsenic, copper, mercury, nickel, and zinc (Figures 3-7 to 3-12). In these figures, circle size was generally proportional to solid-phase concentration, but the MapPlace did not size all circles accurately. This information is used quantitatively, in more detail, in Section 4.3 of this report, combined with additional analyses from Rescan (2007). Thus, only a cursory review of the data is provided here.

The previous subsections showed that the sections of the proposed road with the highest indirect rating for ML-ARD potential were ~km 4-17 and ~km 21-26. Based on larger circles representing a greater risk for aqueous metal leaching in Figures 3-7 to 3-12, the larger circles were often found in these same sections of the proposed road. Copper (Figure 3-9), nickel (Figure 3-11), and zinc (Figure 3-12) generally showed less variability along the proposed road than the other three elements. Additionally, one sample with elevated copper and zinc was found on the north end of the road around ~km 34, but this sample was not elevated in the other elements.

Of note, the northern end of the road, running southwest towards the Schaft Creek site (km 35-39.5), did not have any samples. Therefore, although it lies in a zone of second-highest mineral potential (Figure 3-5), this could not be confirmed by solid-phase analyses.

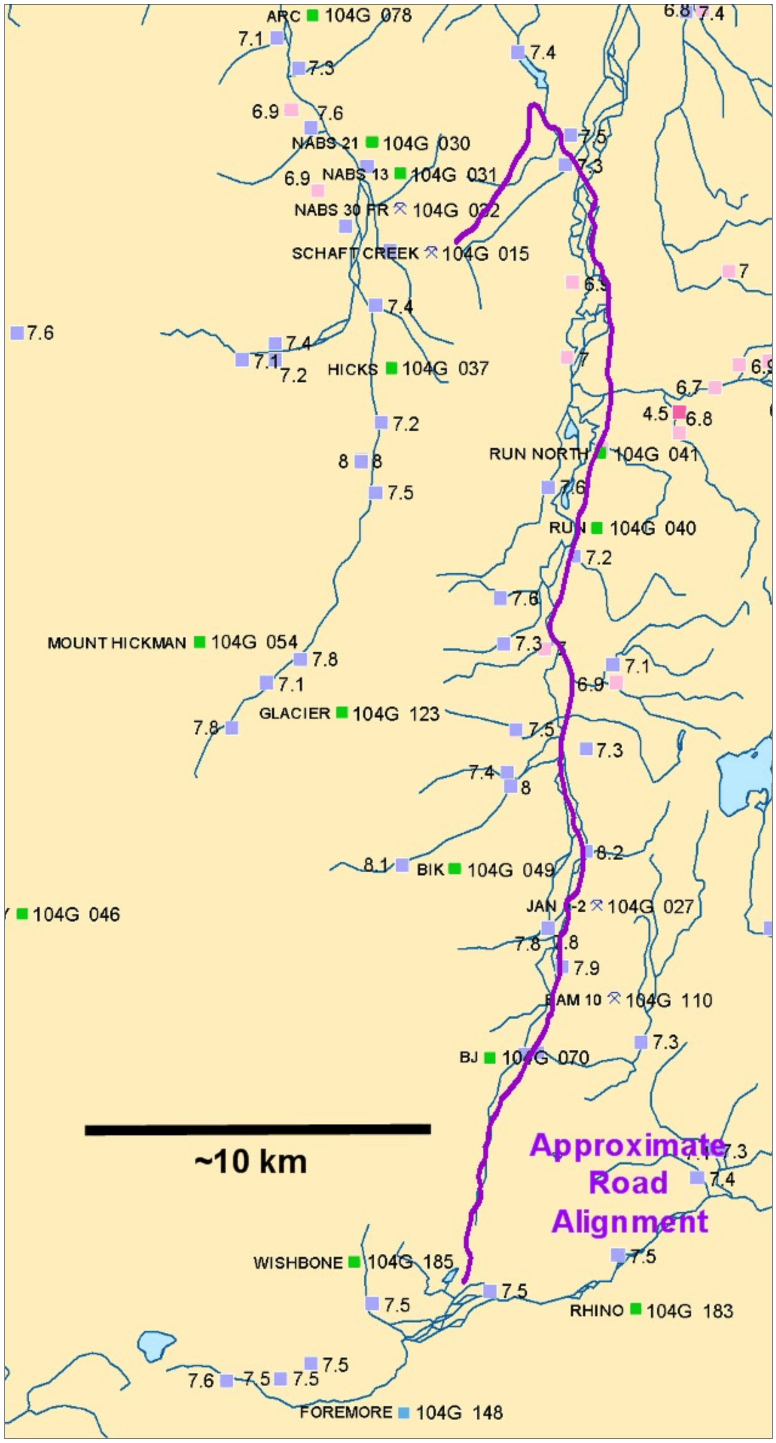

Figure 3-6. Aqueous pH from Provincial Regional Geochemical Surveys around the Proposed Road Alignment (taken from the British Columbia MapPlace website).

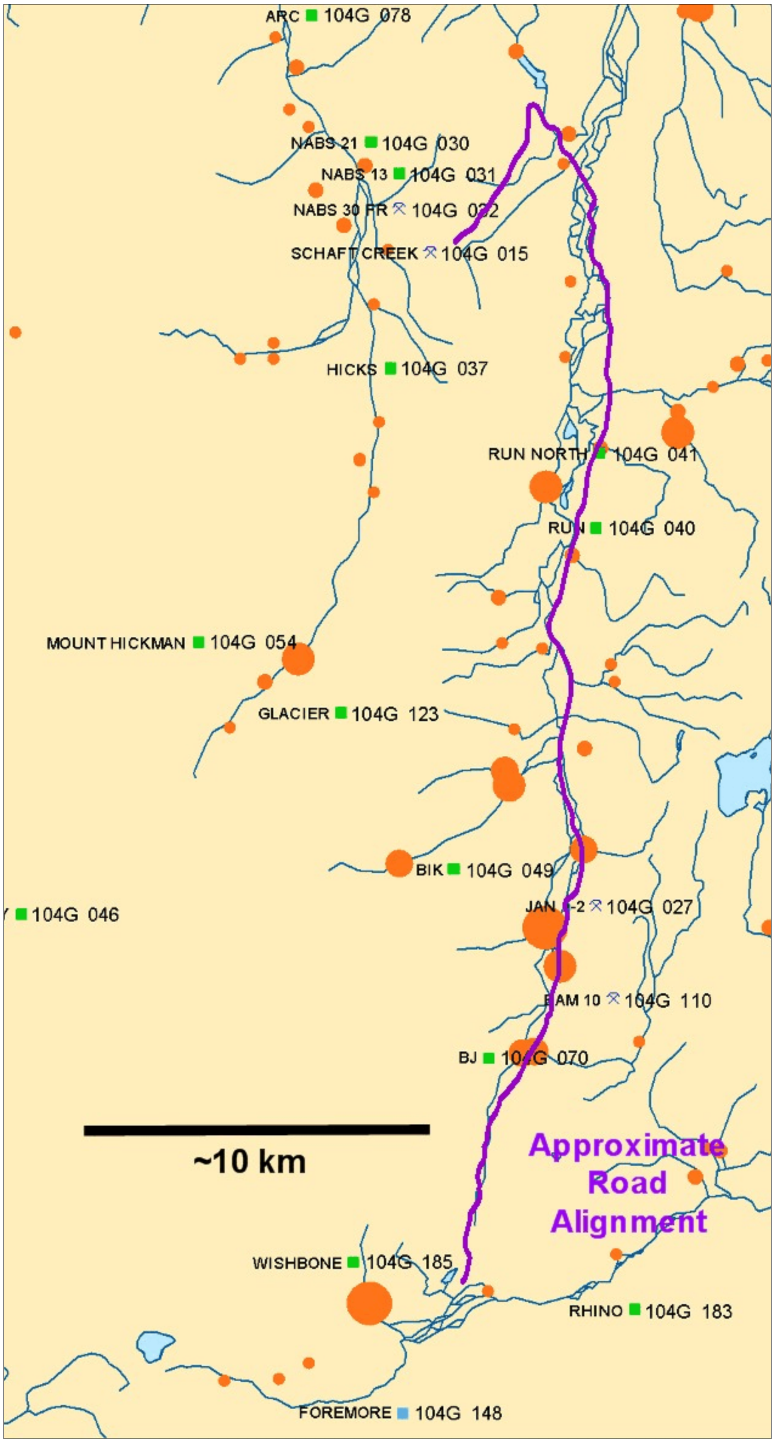

Figure 3-7. Solid-Phase Antimony from Provincial Regional Geochemical Surveys around the Proposed Road Alignment (taken from the British Columbia MapPlace website).

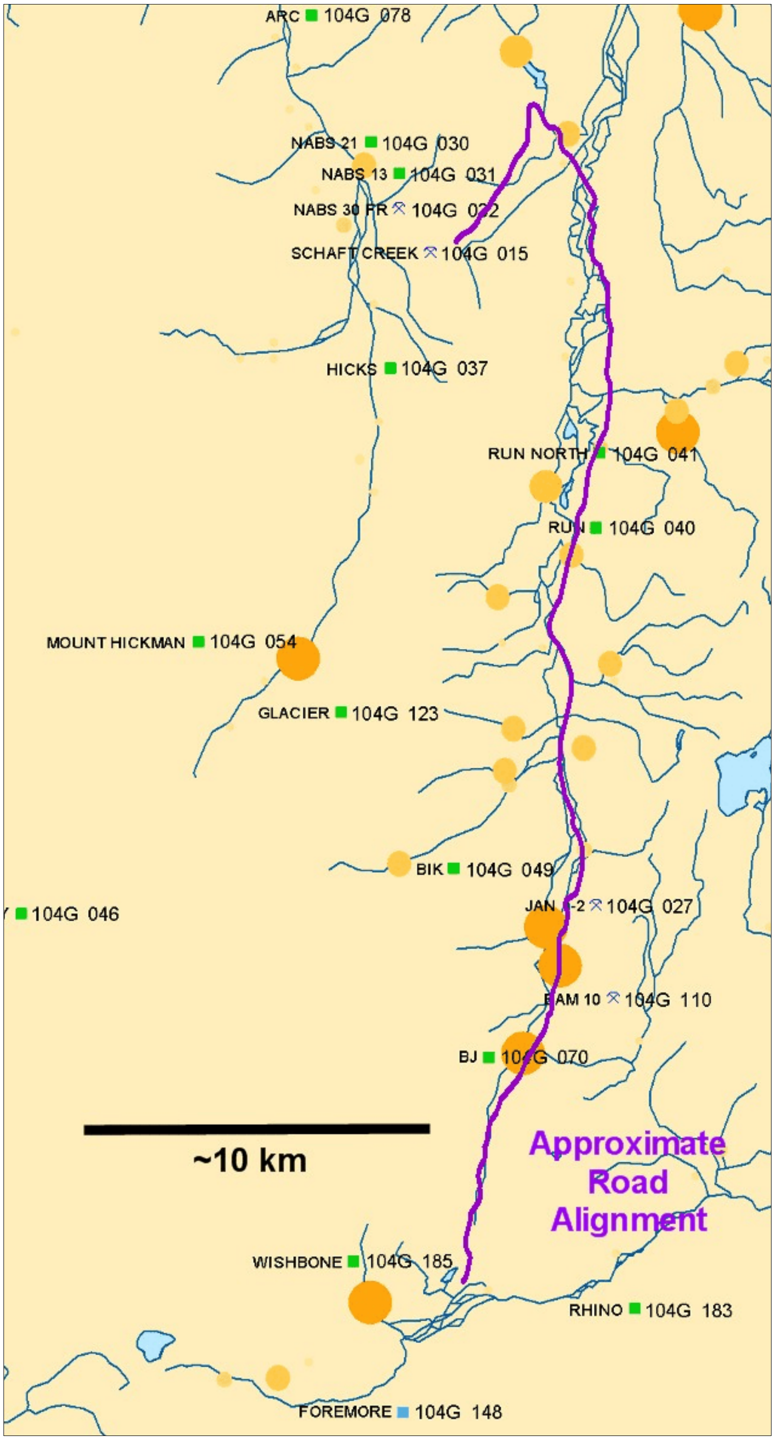

Figure 3-8. Solid-Phase Arsenic from Provincial Regional Geochemical Surveys around the Proposed Road Alignment (taken from the British Columbia MapPlace website).

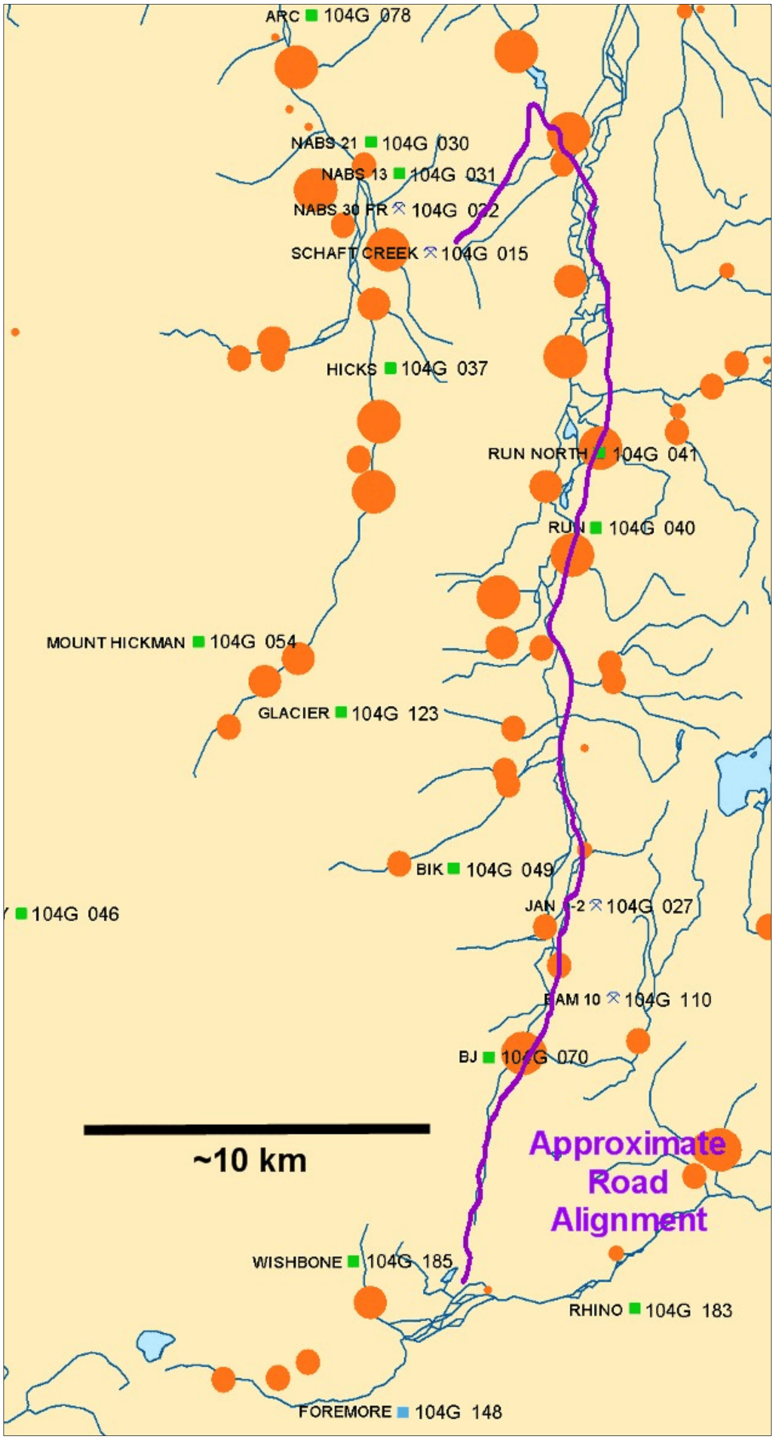

Figure 3-9. Solid-Phase Copper from Provincial Regional Geochemical Surveys around the Proposed Road Alignment (taken from the British Columbia MapPlace website).

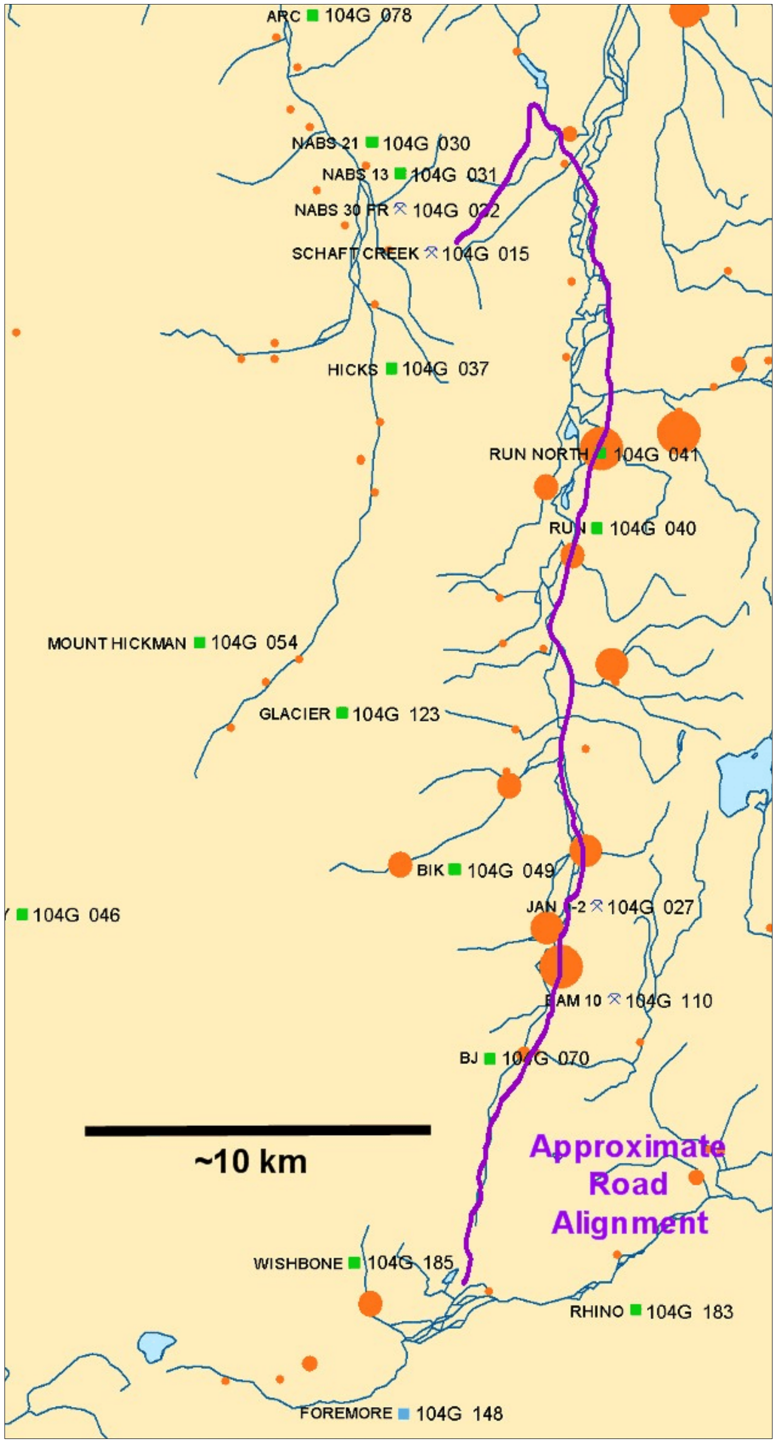

Figure 3-10. Solid-Phase Mercury from Provincial Regional Geochemical Surveys around the Proposed Road Alignment (taken from the British Columbia MapPlace website).

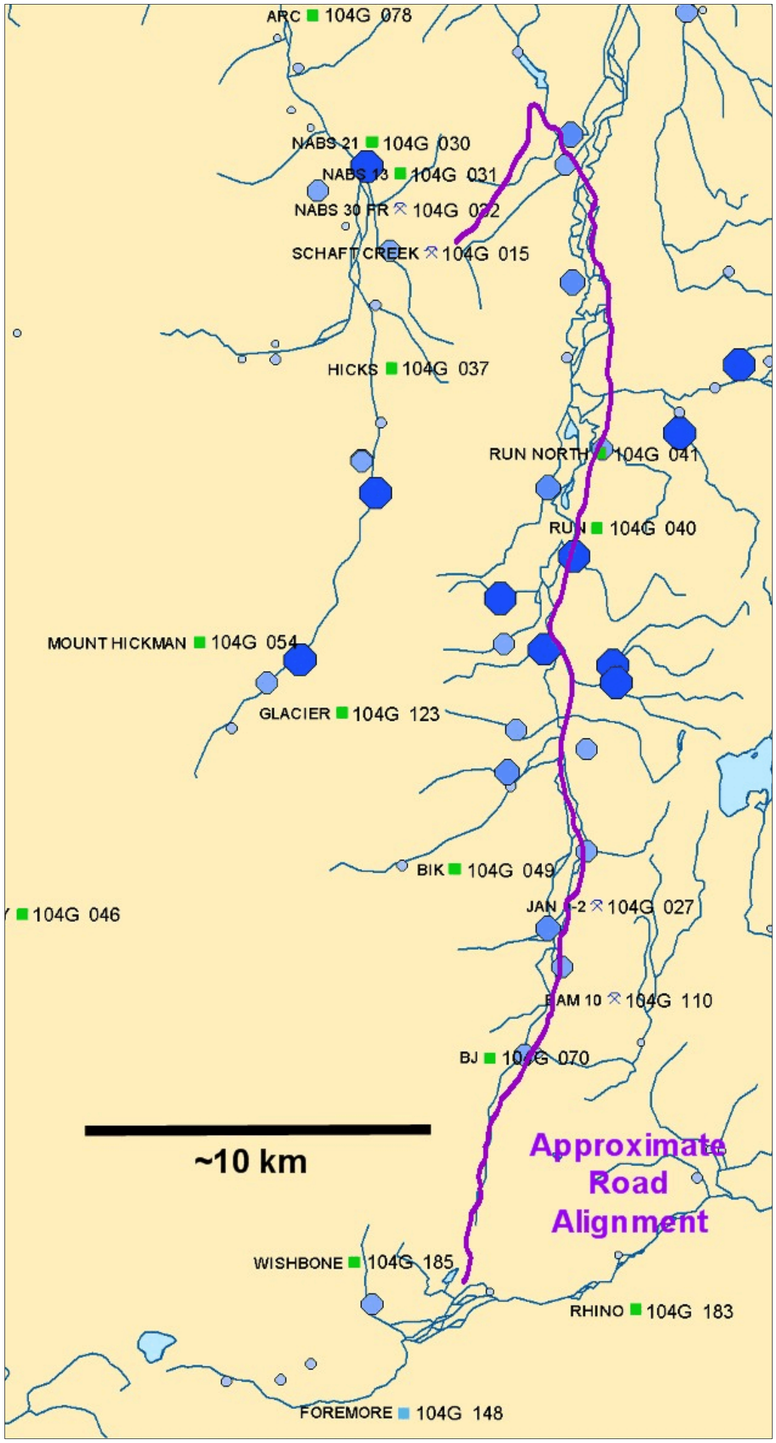

Figure 3-11. Solid-Phase Nickel from Provincial Regional Geochemical Surveys around the Proposed Road Alignment (taken from the British Columbia MapPlace website).

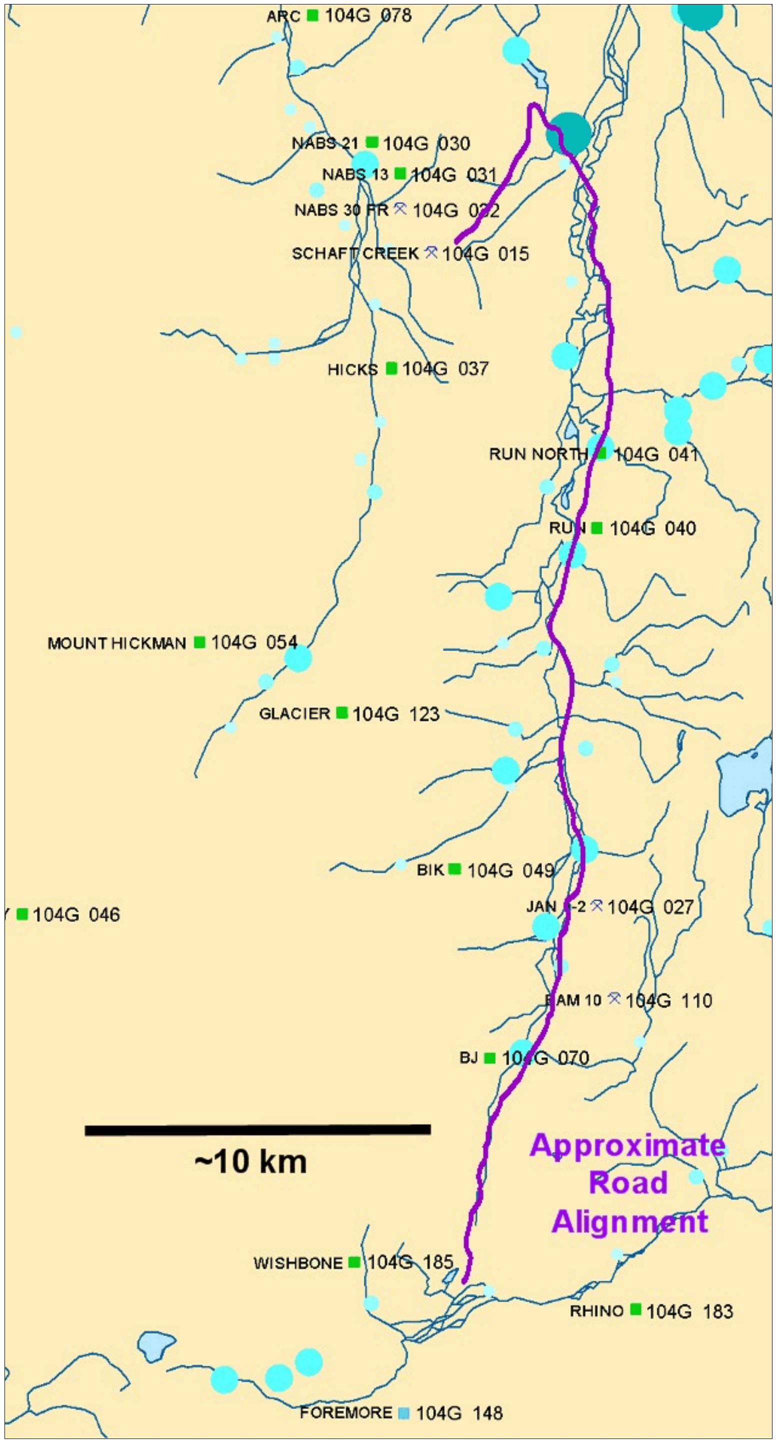

Figure 3-12. Solid-Phase Zinc from Provincial Regional Geochemical Surveys around the Proposed Road Alignment (taken from the British Columbia MapPlace website).

3.6 Air Photographs

The final indirect source of ML-ARD potential comes from air photographs. The air photographs showed that most of the proposed road alignment was covered by trees and other vegetation. Nevertheless, the air photographs also provided targets for "direct" ML-ARD examination (Chapter 4). In particular, surficial rusty-coloured iron staining can sometimes signal accelerated metal leaching and/or sulphide oxidation. Such staining was seen in the air photos around:

~km 0.0: possible iron staining in nearby wetlands

~km 10.5: orange-brown iron staining on west side of Mess Creek valley; possible minor staining on east side (between the Jan 1-2 and Bam 10 developed mineral prospects, Section 3.4)

~km 12.5: possible minor staining on east side of valley (near Jan 1-2 and the Bik mineral showing)

~km 13.0: possible minor staining in center of valley (near Jan 1-2 and the Bik mineral showing)

~km 14.8: possible minor staining on east and west sides

~km 18.5: possible minor staining on west side of valley and center

~km 19.5: possible minor staining on east, center, and west sides of valley

~km 22.0: iron-stained rock at top of mountain to the east (near the Run and Run North mineral showings)

~km 23.0: some iron staining in creek channel, and minor sporadic iron staining on the west slope (near the Run and Run North mineral showings)

~km 28-32: iron stained ponds in valley where the proposed road crosses Mess Creek (the site visit discussed in Chapter 4 identified some rock outcrops near the center of the valley in this area)

The apparent iron staining at ~km 0 in wetlands may be naturally organic in nature. However, the apparent iron staining at ~km 10.5 to 14.8 and at ~km 22.0 to 23.0 would be consistent with the elevated ML-ARD potential obtained from indirect information earlier in this chapter. Iron staining at ~km 18.5-19.5 would be consistent with the second-highest mineral potential in this section. Finally, apparent iron staining at ~km 28-32, in a zone of lowest mineral potential, is anomalous. These areas were inaccessible for direct monitoring (Chapter 4), but could be signs of ML-ARD.

3.7 Summary of Indirect ML-ARD Information for the Proposed Access Road

The proposed access road for the Schaft Creek Project covers a length of approximately 39.5 km, plus potential rock quarries and sand-gravel pits. Existing, external "indirect" sources of ML-ARD information have been used here. This started at the Ministry of Energy, Mines and Petroleum Resources' Minfile and MapPlace website, which provided details of watersheds, surficial geology, bedrock geology, Regional Geochemical Studies (RGS), and nearby mineral deposits and showings. Another source of indirect ML-ARD for this study was air photographs of the road alignment and nearby areas.

The proposed access road passes through two primary watersheds. Most of the road alignment is in the Mess Creek watershed, which drains to the north. A small section, approximately 1.5 km long at the southern end, lies in the More Creek watershed that drains east and south to the Iskut River.

Maps and air photos showed that much of the proposed road alignment lies on the unconsolidated alluvium in the Mess Creek valley. Most of the alignment was covered by trees and other vegetation, and was thus not readily visible. If unconsolidated sediments were composed of locally weathered bedrock, their geochemistry may reflect weathered aspects of the bedrock. If the sediments were transported large distances by water and/or glaciers, then their geochemistry may bear little resemblance to the underlying bedrock. Thus, unconsolidated alluvium was not automatically assumed to have a similar ML-ARD potential as the underlying or nearby bedrock. However, if local rock had a high potential and the potential of local sediment could not be determined, then the sediments were assumed in this report to have the same potential as rock.

Bedrock geology, mostly hidden below the unconsolidated sediments in the Mess Creek valley, is complex. Zones of volcanic, intrusive, sedimentary, and metamorphic rock are mixed, sometimes on a relatively small scale. If ML-ARD potential is related to rock types, then the potential can be highly variable over short distances along the proposed road.

The potential for metals and other minerals can sometimes serve as a proxy for ML-ARD potential. Metallic-mineral potential along the proposed access-road alignment, from the provincial MapPlace website, showed that areas near the road ranged from the lowest mineral potential to the highest. The highest-potential zone coincided with a band of sedimentary rock from ~km 10 to ~km 15. Also, two zones of second-highest potential were at ~km 15-26 and ~km 36-39.5.

Another general indicator of ML-ARD potential can be mineral claims, prospects, and showings. The provincial Minfile site showed two developed mineral prospects and four mineral showings near the proposed road or in tributaries of Mess Creek. All six contained potentially acid-generating sulphide-borne metals like iron, copper, cadmium, arsenic, and/or molybdenum. All six also contained some carbonate minerals, but it was not clear if the carbonate was sufficient to prevent ARD. RGS water pH values (see below) showed that, just to the north and east of one mineral showing, values as low as 4.5 were measured. Even without ARD, near-neutral metal leaching would remain a concern in these areas. Therefore, along the nearby proposed road alignment, ~km 4-17 and ~km 21-26 were given high, indirect ML-ARD potentials.

The Regional Geochemical Survey (RGS) data from the provincial government provided aqueous pH measurements and solid-phase analyses of sediment near the proposed road alignment. Based on aqueous measurements, most pH values upstream of and near the road alignment were around 6.9 to 8.1. The lowest value of 4.5 was found in a tributary to the north and east of one mineral showing, suggesting ARD was actively produced in that tributary.

Solid-phase levels of metals and other elements do not necessarily produce accelerated leaching rates into water. In fact, some solid-phase levels might be high due to slow leaching, but laboratory kinetic tests and detailed RGS water analyses were not available to resolve this. In any case, the RGS surveys provided selected solid-phase elements in alluvium sediments near the proposed road alignment and in tributaries to Mess Creek. Based on solid-phase antimony, arsenic, copper, mercury, nickel, and zinc, the portions of the road alignment with relatively elevated levels included the aforementioned ~km 4-17 and ~km 21-26. Some elements like copper were less variable along the length of the alignment. Also, one sample, only with elevated copper and zinc, was found at the north end of the alignment, around km 34.

The final indirect source of ML-ARD potential came from air photographs, which provided targets for "direct" ML-ARD sampling and analyses in Chapter 4. Surficial rusty-coloured iron staining can sometimes signal accelerated metal leaching and/or sulphide oxidation. Such staining appeared to be present in the air photos around km 10.0-14.8 and km 22.0-23.0, which coincided with the aforementioned sections of high, indirect ML-ARD potential. Iron staining was also apparent around km 0.0, which may be from natural organic processes in the local wetlands; km 18.5-19.5 is in a zone of second-highest mineral potential; and km 28-32 anomalously is in a zone of lowest mineral potential. These areas of apparent iron staining could not be reached during the field visit (Chapter 4), but could be signs of ML-ARD.

4. "DIRECT" ML-ARD INFORMATION

The proposed access road for the Schaft Creek Project covers a length of approximately 39.5 km (Chapter 2 and Appendix A), plus potential rock quarries and sand-gravel pits that would be located some lateral distances from the road. As a result, detailed ML-ARD sampling of the entire potential disturbed area would be intensive, and still not provide all information like kinetic testing. Therefore, this ML-ARD assessment of surficial access-road samples is based on (a) existing, external "indirect" sources of ML-ARD information discussed in Chapter 3 and (b) "direct" information based on sampling and observations by the authors discussed in this chapter.

4.1 Visual Observations and Surficial Solid-Phase Samples Along the Road Alignment

In October 2007, the authors of this report flew by helicopter along the proposed road alignment (Appendix A), collecting photographs, notes, aqueous pH and electrical-conductivity measurements, and surficial solid-phase samples (Appendix B). For example, local water had a slightly acidic pH and an elevated electrical conductivity near ~km 11.8, so this probably represented local ML and perhaps neutralized ARD.

As explained in Chapter 3, most of the alignment of the proposed access road lies in areas of trees and other vegetation over unconsolidated sediment and alluvium. This ground cover was confirmed by direct observations and many areas were relatively inaccessible (Appendix B). Thus, most of the alignment was not directly sampled for ML-ARD potential. This was not a problem here, because this was expected as explained above and was offset by indirect information in Chapter 3.

An important indirect observation from Chapter 3 was apparently rusty-coloured iron staining near sections of the proposed road alignment (Section 3.6). This was considered a possible sign of surficial ML-ARD. The staining in a wetland around km 0.0 appeared related to natural wetland processes and not ML-ARD. Farther along the road alignment, several areas of iron staining visually appeared to be related to ML-ARD, but these areas could not be reached safely in October 2007. Therefore, the road sections listed in Section 3.6, except km 0.0, are taken as areas of elevated ML-ARD potential. All listed sections, except km 0.0 and km 28-32, coincided with elevated potential based on other indirect lines of evidence.

Based on indirect information (Chapter 3) and from visual observations from the air (above and Appendix B), the helicopter was landed, where safe and accessible. As a result, 12 small-scale "hand" samples of surficial rock and surficial unconsolidated sediments were collected (Appendices B and C). Eight of the 12 samples were of surficial rock, whereas the remaining four were of unconsolidated cobbles, gravel, sand, and/or finer material. As explained above, the extensive cover of trees and vegetation precluded the collection of surficial geological materials in most locations.

These solid samples were subjected to the ML-ARD analyses listed in Section 4.2, to estimate ML-ARD potentials of larger volumes that might be disturbed by road construction (Chapters 5 and 6). More reliable upscaling of small-scale ML-ARD predictions typically requires additional kinetic testing (Morin and Hutt, 2007c), which was not done as part of this study.

4.2 ML-ARD Analyses of the Rock and Unconsolidated Sediments

All 12 samples from Section 4.1 were sent to ALS Chemex in North Vancouver for:

1) Chemex Package ABA-PKG05A plus C-IR07, which is standard-Sobek (U.S. EPA 600 compliant, Sobek et al., 1978) expanded acid-base accounting (ABA) including:
   - paste pH in a mixture of deionized water and pulverized rock,
   - total sulphur,
   - leachable sulphate (both HCl and carbonate leach techniques),
   - measured sulphide,
   - calculated sulphide by subtracting sulphate from total sulphur,
   - barium-bound sulphate calculated from barium analyses,
   - calculation of acid potentials based on sulphide levels plus any unaccounted-for sulphur(Sulphide Acid Potential, SAP),
   - standard-Sobek neutralization potential (NP) by acid bath and base titration,
   - inorganic carbonate for mathematical conversion to Carbonate NP (Inorg CaNP),
   - total carbon for mathematical conversion to Carbonate-equivalent NP (Total CaNP),
   - CaNP calculated from calcium (Ca CaNP),
   - CaNP calculated from Ca + Mg (Ca+Mg CaNP),
   - various Net Neutralization Potential (NNP) balances of acid neutralizing capacities minus various acid generating capacities, and
   - various Net Potential Ratio (NPR) balances of acid neutralizing capacities divided by various acid generating capacities.
2) total-metal contents by:
   - Chemex Package ME-MS61m: 49-element analysis after strong 4-acid digestion, and
   - Chemex Package ME-XRF-06: XRF (x-ray-fluorescence) whole rock for 14 elements and parameters.

Analyses are compiled in Appendix C of this report and discussed in the following subsections. No kinetic testing for upscaling (Morin and Hutt, 2007c) or prediction of metal leaching (Section 4.3.2) was performed as part of this study.

4.3 Results of ML-ARD Analyses

4.3.1 Acid Base Accounting

As part of the ABA Package (Section 4.2), paste pH showed that none of the 12 samples was generating net acidity at that time (Figure 4-1 and Appendix C). All samples had pH 6.9 to 9.5, compared to pH 6.2 of the deionized water added to them.

Total sulphur ranged from <0.01%S in one rock sample to 0.39%S in another rock sample (<0.01%S is shown as one-half detection, or 0.005%S, in Figure 4-1). Analyses close to the detection limit typically have higher analytical inaccuracy, and this is an important issue for the proposed access road as explained below.

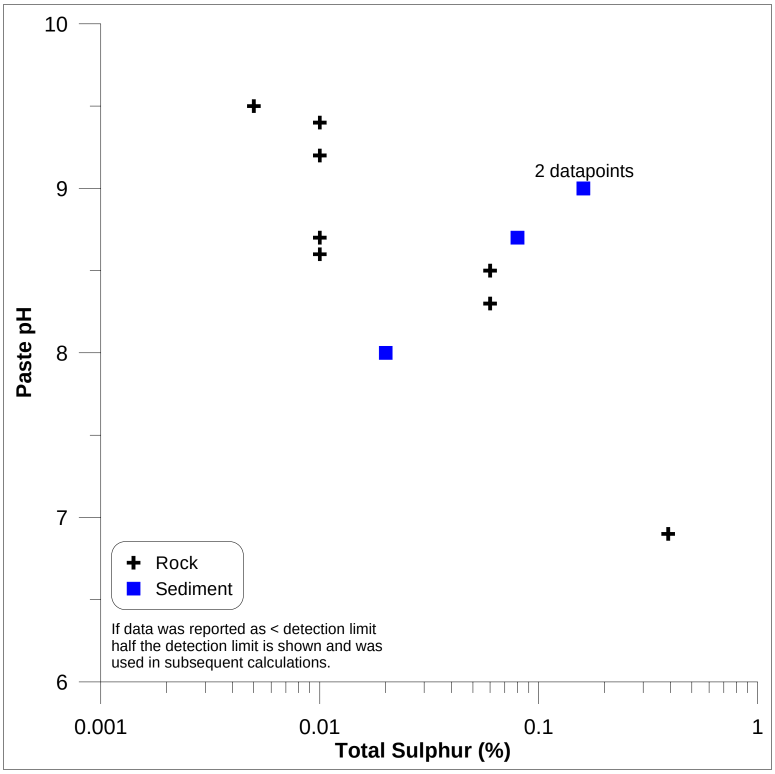

Figure 4-1. Paste pH vs. Total Sulphur in the 12 ML-ARD Proposed-Access-Road Samples.

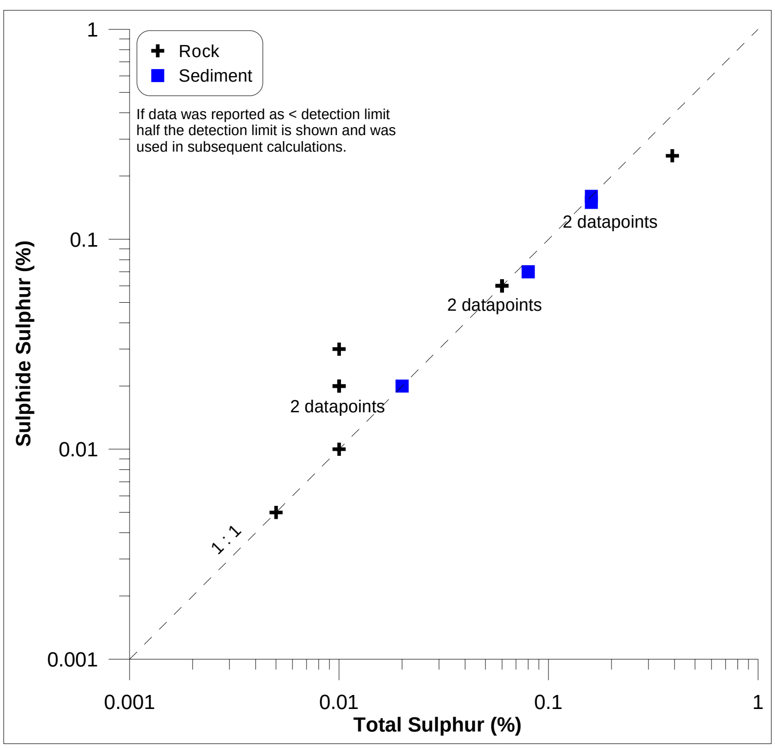

Figure 4-2. Sulphide vs. Total Sulphur in the 12 ML-ARD Proposed-Access-Road Samples.

It is important to understand that detection limits are technological limitations and not environmental criteria. In other words, a value close to, or below, detection does not automatically imply no environmental effects, or in this case no acid generation from sulphide oxidation. In fact, Morin and Hutt (2006) found that sulphur values at least as low as 0.02%S could still generate acidity, and no lower bound could be identified.

A scatterplot of total sulphur and potentially acid-generating sulphide showed that most sulphur was sulphide in most samples (Figure 4-2). Of note, three of the four highest sulphide values were found in the sediment samples, which are typically thought of as weathered and oxidized.

At sulphur levels generally around 0.05%S and below, analytical inaccuracy and numerical round-off can create major discrepancies. For example, in Figure 4-2, two rock samples contained twice as much sulphide (0.02%S) as total sulphur (0.01%S). Also, one rock sample had three times more sulphide (0.03%S) than total sulphur (0.01%S), which is theoretically not possible. Thus, analytical inaccuracy below 0.05%S is an important issue for interpreting the acid-generating potential of the low-sulphur proposed-road samples.

This raises a difficult issue: how to estimate acid potentials of the low-sulphur access-road samples when current analytical technology is not providing accurate information. Again, this technological limitation is not synonymous with environmental protection, since low levels of sulphide can still generate acidity. The safest and prudent way to proceed here is by considering measured total sulphur as 100% acid-generating sulphide, and calculating acid potentials accordingly. In the end, this makes little difference, because Neutralization Potential (NP, below) was the primary determination of ARD status, and using sulphide or total sulphur led to nearly the same predictions.

Sobek Neutralization Potential (NP) ranged from 9 to 387 kg $CaCO_3$ equivalent/tonne (Figure 4-3). Four of the five highest NP values were sediments, so the rock was often relatively depleted in NP.

NP typically reflects to some degree a sample's inorganic carbonate content. This can be seen for the 12 samples of rock and sediment (Figure 4-4, with inorganic carbonate mathematically converted to the same units as NP). However, there was a bias towards higher NP values compared with carbonate, possibly reflecting some non-carbonate neutralization. A better 1:1 correlation with NP was seen for total carbon (Figure 4-5) than inorganic carbonate alone. This suggested simpler total-carbon analyses or adjusted inorganic-carbonate analyses could be substituted for the more intensive NP analysis.

The correlation of NP with calcium was good (Figure 4-6, with calcium mathematically converted to the same units as NP), except for three rock samples. This implies the inorganic carbonate occurs primarily as calcite ($CaCO_3$). The three exceptions then contained additional calcium-bearing non-carbonate minerals.

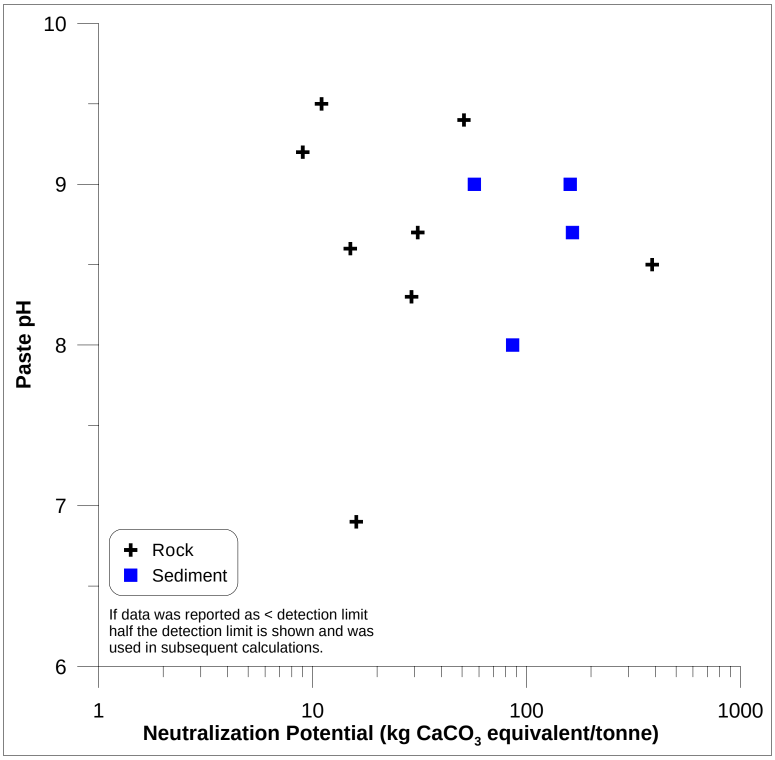

Figure 4-3. Paste pH vs. Sobek (U.S. EPA 600) Neutralization Potential in the 12 ML-ARD Proposed-Access-Road Samples.

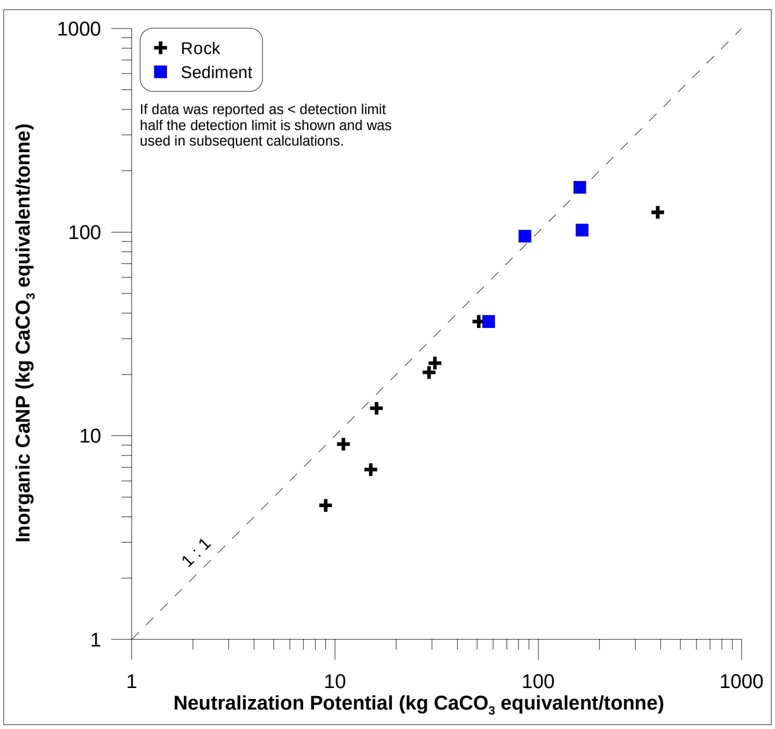

Figure 4-4. Inorganic-Carbonate-Based Neutralization Potential vs. Sobek Neutralization Potential in the 12 ML-ARD Proposed-Access-Road Samples.

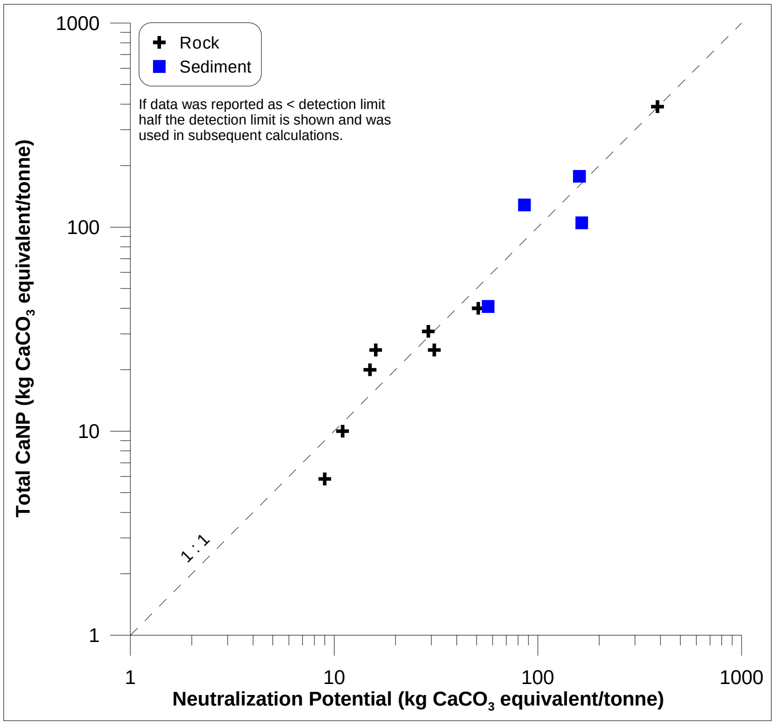

Figure 4-5. Total-Carbon-Based Neutralization Potential vs. Sobek Neutralization Potential in the 12 ML-ARD Proposed-Access-Road Samples.

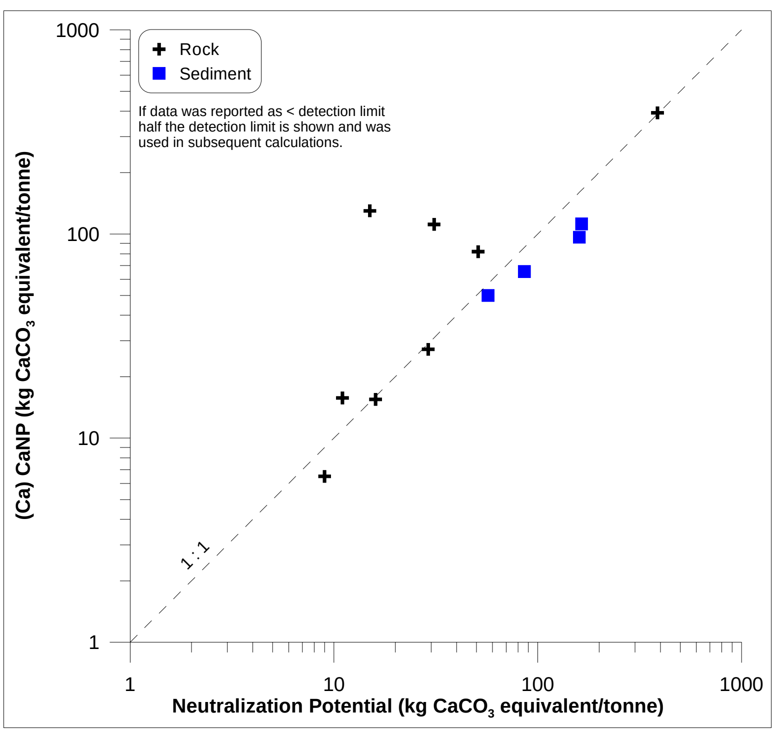

Figure 4-6. Calcium-Based Neutralization Potential vs. Sobek Neutralization Potential in the 12 ML-ARD Proposed-Access-Road Samples.

Interestingly, Sample SCR-05 with the highest NP had equivalent amounts of Total-Carbon-Based CaNP and Calcium-Based CaNP, but Inorganic-Carbonate-Based CaNP was about one-third. This suggests the inorganic-carbonate analyses may have been anonymously low, explaining the bias towards higher NP in Figure 4-4.

Typically, some amount of the measured NP is unavailable for neutralization, with paste pH falling to acidic values as NP decreases. Unavailable NP is typically between 5 and 15 kg/t, but values as low as zero and above 60 kg/t have been reported (Morin and Hutt, 1997 and 2001). Acidic paste pH was not detected in these proposed-access-road samples of rock and sediment (Figure 4-3), so Unavailable NP was not apparent. However, a value of 10 kg/t will be used here to illustrate the effect on net balances.

Net balances of acid-generating and acid-neutralizing capacities can be calculated from sulphur species and NP as discussed above. Based on its net balance, a sample could then be predicted to be net acid generating, perhaps after a long near-neutral “lag time”, “uncertain” without additional testing, or net acid neutralizing indefinitely.

Net balances can be calculated using division (Total-Sulphur-Based Net Potential Ratio, TNPR = NP /TAP) or subtraction (Total-Sulphur-Based Net Neutralization Potential, TNNP = NP - TAP). TNPR is used in this report, and is the preferred approach in British Columbia. Sulphide-based SNPR will also be discussed, to show that total sulphur provided the same predictions as sulphide.

“Adjusted” TNPR values were obtained by first subtracting the currently undefined unavailable NP, such as 10 kg/t, from measured NP:

Adj TNPR = [NP - 10] / [%S(total) * 31.25]

Non-site-specific ABA screening criteria are: TNPR $\leq$ 1 is net acid generating, perhaps after some lag time, 1<TNPR<2 is uncertain until further testing, and TNPR$\geq$2 is net acid neutralizing. While site-specific criteria can be developed with additional testwork, like humidity cells, this years-long testing has not been conducted for the proposed access road. Furthermore, site-specific criteria might be too difficult considering the number and types of rock units near the alignment (Section 3.3).

Based on TNPR with no adjustment for Unavailable NP, only one (SCR-08A, rock) of the 12 access-road samples had a value below 2.0 (Figure 4-7 and Appendix C). Its TNPR value was 1.31, and it also had the highest level of total sulphur and sulphide (0.39%S and 0.25%S) and lowest paste pH (6.9). A value of 1.31 is considered “uncertain” without further testing. However, if sulphide were used in the calculation (SNPR), rather than total sulphur (TNPR), the SNPR value of 2.01 just extends into the net-neutralizing category. At this point, it is prudent to consider the ARD potential of SCR-08A as uncertain.

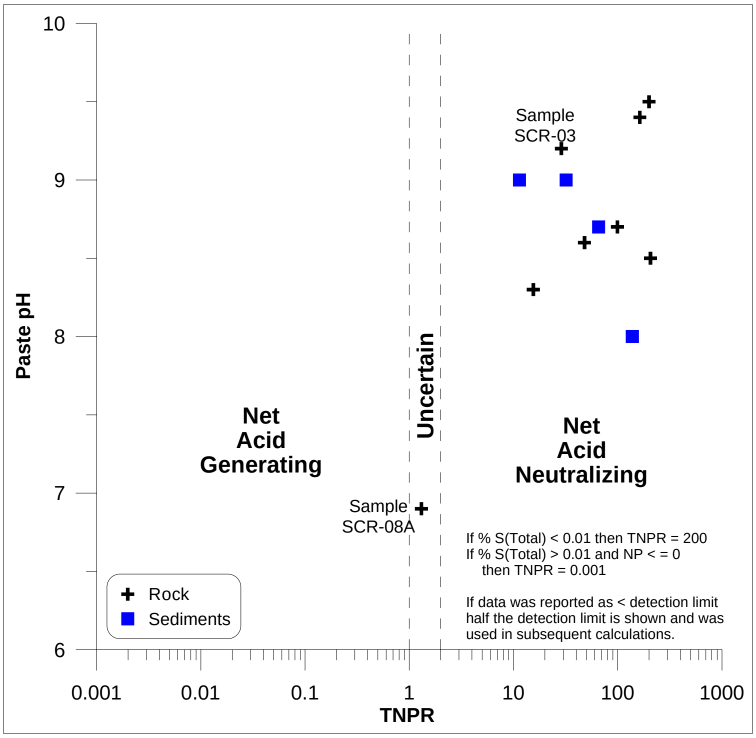

Figure 4-7. Paste pH vs. (Unadjusted) Total-Sulphur-Based Net Potential Ratio (TNPR) in the 12 ML-ARD Proposed-Access-Road Samples.

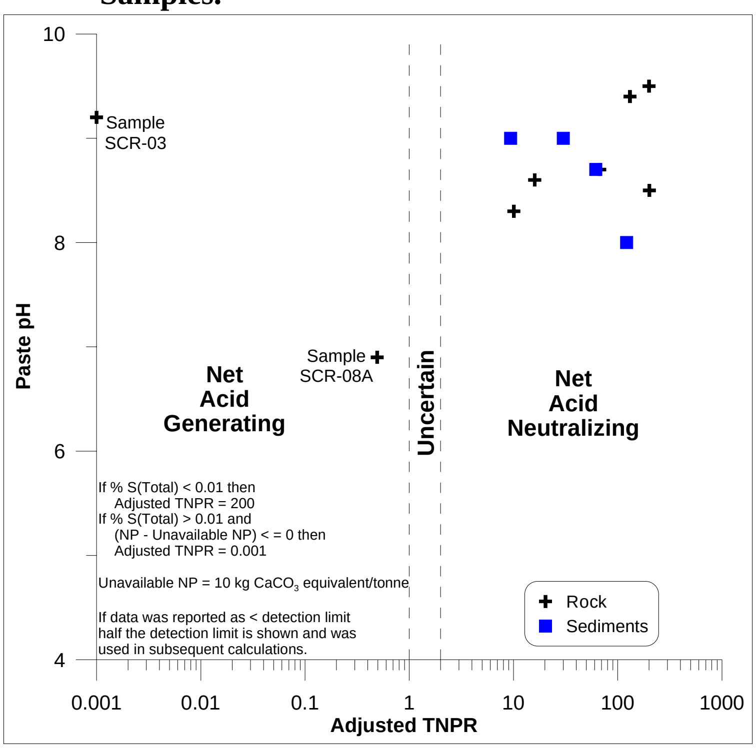

Figure 4-8. Paste pH vs. Adjusted Total-Sulphur-Based Net Potential Ratio (Adj TNPR) in the 12 ML-ARD Proposed-Access-Road Samples.

Based on TNPR with adjustments for Unavailable NP, two primary effects arise. First, preceding Sample SCR-08A, which was “uncertain” based on no unavailable NP, became net acid generating, (a) based on Adjusted TNPR < 1 with unavailable NP at 4 kg/t and higher, and (b) based on Adjusted SNPR < 1 with unavailable NP at 9 kg/t and higher (Figure 4-8). Again, at this point, it is prudent to consider the ARD potential of SCR-08A as uncertain, recognizing it could be net neutralizing or net acid generating.

Second, Sample SCR-03 (rock) with a high Unadjusted TNPR of 28.8 (Figure 4-7) became net acid generating, with a default Adjusted TNPR of 0.001 (Figure 4-8), at any level of unavailable NP at and above 9 kg/t. This is simply because its original, measured NP was 9 kg/t, so the simple declaration of all 9 kg/t as unavailable changed it to net acid generating. Even if unavailable NP were 8 kg/t instead of 9 kg/t, SCR-03 would still be predicted to be net neutralizing based on Adjusted TNPR. Interestingly, sulphide (0.02%S) in this sample was twice as high as total sulphur (0.01%S), which is not possible but reflected analytical inaccuracy as discussed above. Nevertheless, its Unadjusted SNPR was still high at 14.4, but its Adjusted SNPR became net acid generating at unavailable NP levels of 7 kg/t and higher. Therefore, due to major variations in its net balances depending on factors like unavailable NP, the ARD potential of SCR-03 as uncertain, recognizing it could be net neutralizing or net acid generating.

In summary, acid-base accounting (ABA) of the 12 samples of rock and sediments collected near the proposed access-road alignment showed that all had near-neutral paste pH at the time of analysis. Total sulphur ranged from <0.01%S in one rock sample to 0.39%S in another rock sample. Most of that total sulphur was potentially acid-generating sulphide, so the more easily measured total sulphur can be used for convenience. However, sulphur values below 0.05%S were relatively inaccurate. Three of the four highest sulphide values were found in the sediment samples, which are typically thought of as weathered and oxidized. Sobek (U.S. EPA 600) Neutralization Potential (NP) ranged from 9 to 387 kg $CaCO_3$ equivalent/tonne, with four of the five highest NP values in sediments. In many samples, the Sobek NP was apparently mostly comprised of calcite ($CaCO_3$), which could be measured by the simpler analytical techniques for total carbon or inorganic carbonate. Net balances of acid-generating and acid-neutralizing capacities were based on the Total-Sulphur-Based Net Potential Ratio (TNPR), with and without adjustments for unavailable NP. This showed eleven samples were net neutralizing indefinitely, plus one sample of rock that was “uncertain” without additional testing. When various amounts of unavailable NP were considered, a second sample of rock showed large changes in TNPR, suggesting the ARD status of this sample was also uncertain without additional testing.

4.3.2 Total Elements

Total-element contents of the 12 access-road samples of rock and sediments (Section 4.1) were measured by ICP-MS analysis after strong four-acid digestion, and by x-ray-fluorescence (XRF) whole-rock analysis (Section 4.2). The results are compiled in Appendix C.

XRF whole-rock data showed that most of the 12 access-road samples consisted predominantly of silica and alumina, with substantial and sometimes dominant amounts of iron, calcium, magnesium, sodium, potassium, and Loss on Ignition (LOI). LOI often reflects the weight loss from the samples of some or all sulphur, carbon, and tightly bound or crystalline water. Sample SCR-05 was apparently about 40% calcite ($CaCO_3$) and thus was mostly calcium and LOI.

ICP elemental analyses were compared to three times the maximum average crustal abundances from Price (1998), to highlight elements relatively enriched in the access-road samples (see element analyses surrounded by boxes in Appendix C). The 12 samples often contained elevated levels of bismuth and selenium, with fewer to rare elevated levels of silver (two samples of rock), cadmium (one sample of rock also with the highest silver), phosphorus (one sample of rock), lead (one sample of rock also with the highest silver and cadmium), antimony (two rock and one sediment sample), and zinc (one rock sample also with the highest silver, cadmium, lead, and antimony).

A comparison with XRF whole-rock chromium showed ICP-MS levels of chromium averaged 38% lower due to incomplete digestion, so total chromium levels were higher than the boxed levels in Appendix C. As a result, one sample of sediment (SCR-08B) contained elevated chromium.

Elevated solid-phase levels of elements do not necessarily mean they will leach at faster rates into water, because they may be elevated due to a low leaching rate. Only additional long-term kinetic tests or detailed on-site monitoring (Chapter 6) can better characterize leaching.

Solid-phase correlations of elements can sometimes reveal mineralogical associations. For example, elements correlating with sulphide (Section 4.3.1) may occur predominantly within the sulphide minerals. Correlations with Sobek Neutralization Potential may indicate those elements are concentrated in carbonate minerals, which can dissolve even without sulphide oxidation. The elements showing at least some minor correlation with sulphide included arsenic, copper, mercury, and nickel (e.g., Figure 4-9). The elements showing at least some minor correlation with NP included calcium (Figure 4-6) and manganese (Figure 4-10).

In summary, total-element contents of the 12 access-road samples of rock and sediments were measured by ICP-MS analysis after strong four-acid digestion, and by x-ray-fluorescence (XRF) whole-rock analysis. This showed that most of the 12 access-road samples consisted predominantly of silica and alumina, with substantial and sometimes dominant amounts of iron, calcium, magnesium, sodium, potassium, and Loss on Ignition (LOI). LOI often reflects the weight loss from the samples of some or all sulphur, carbon, and tightly bound or crystalline water. Also, the 12 samples often contained elevated levels of bismuth and selenium, with fewer to rare elevated levels of silver (two samples of rock), cadmium (one sample of rock), chromium (one sample of sediment), phosphorus (one sample of rock), lead (one sample of rock), antimony (two rock and one sediment sample), and zinc (one rock sample also with the highest silver, cadmium, lead, and antimony). Solid-phase correlations of elements can sometimes reveal mineralogical associations. For example, elements correlating with sulphide may occur predominantly within the sulphide minerals. The elements showing at least some minor correlation with sulphide included arsenic, copper, mercury, and nickel. The elements showing at least some minor correlation with Neutralization Potential, which can dissolve and release metals even without sulphide oxidation, included calcium and manganese.

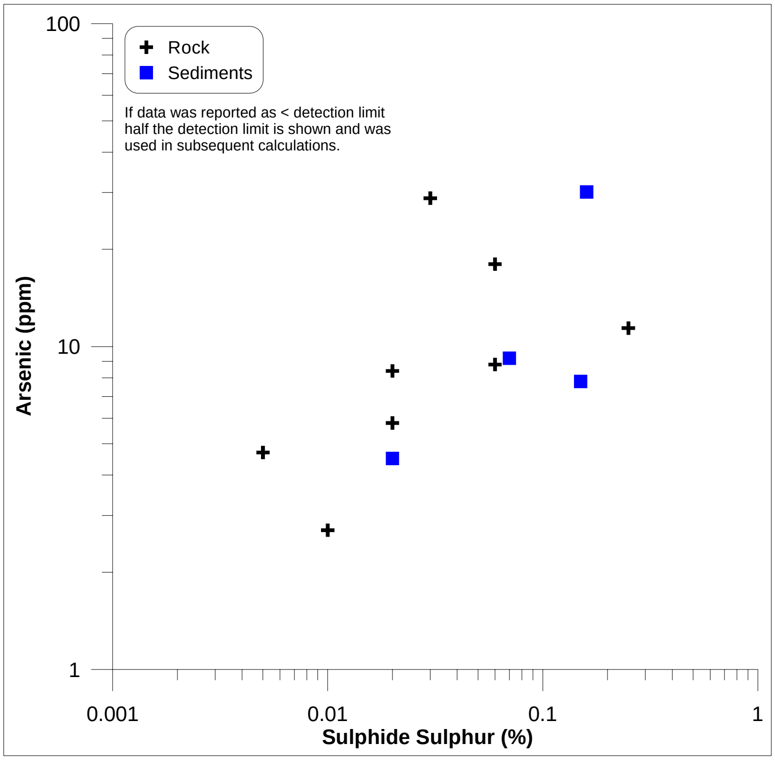

Figure 4-9. Solid-Phase Arsenic vs. Sulphide in the 12 ML-ARD Proposed-Access-Road Samples.

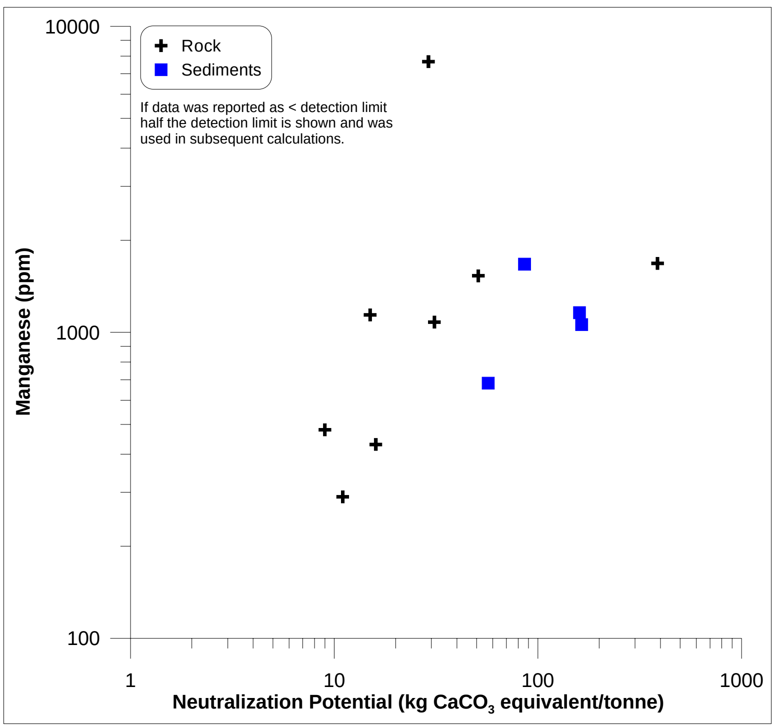

Figure 4-10. Solid-Phase Manganese vs. Sobek Neutralization Potential in the 12 ML-ARD Proposed-Access-Road Samples.

4.4 Spatial Trends in Acid Base Accounting and Total-Element Data

The preceding information on acid base accounting (Section 4.3.1) and total elements (Section 4.3.2) can be combined with "indirect" RGS data (Section 3.5) and Rescan (2007) data along the proposed road alignment (Figure 4-11 and Appendix D). This allows a spatial interpretation of the data, to highlight sections of the proposed roads with higher ML-ARD potential. It is important to note that these different sources of data (1) did not include all elements analyzed for Section 4.3.2, (2) did not use the same, aggressive four-acid digestion for the samples in this study, (3) had analytical methods with differing detection limits, and (4) did not include acid base accounting (Section 4.3.1).

RGS samples were partially digested by the weaker two-acid aqua regia. Rescan (2007) samples were digested with a weaker, non-aqua-regia two-acid digestion. Therefore, any higher solid-phase levels in the 12 ML-ARD samples of this study may be at least partially attributed to the more thorough digestion of the samples.

As shown in Figure 4-11, most sampling locations were of sediments (left side). Only this ML-ARD study provided rock samples (right side). All total-element maps are compiled in Appendix D, with selected ones discussed in this section.

As discussed in Section 4.3.1, total sulphur varied from <0.01%S (numerically set at 0.005%S) to 0.39%S. As seen in Figure 4-12, the highest and lowest values were in rock, between km 26 and 31. Nevertheless, some sediments carried significant levels of total sulphur, which were well distributed along the road alignment.

The map of net balances of acid-generating and acid-neutralizing (TNPR, Section 4.3.1) showed that the lowest, "uncertain" value of 1.31 was found near km 26 around Nahta Creek (Figure 4-13 and Appendix D). The remaining samples of rock and sediments were net neutralizing. Adjusted TNPR, allowing for an unavailable NP of 10 kg/t, showed that the lowest values were again around km 26 and also near the southern end around km 2 (Figure 4-14). This latter sample had low, relatively inaccurate sulphur analyses, so its ARD status was considered "uncertain".

For some solid-phase elements, only samples from this MDAG study were available, such as selenium (Figure 4-15 and Appendix D). As a result, spatial distributions for these elements, based on these relatively few samples, could not be estimated. Other elements included up to three data sets for sediments (MDAG, Rescan, and RGS), such as nickel (Figure 4-16 and Appendix D). Thus, spatial distributions for these elements in sediments were better defined.

For all analyzed elements, the spatial distributions in rock remain poorly defined, reflecting the eight available samples (Appendix C), which in turn reflects the dominant exposure of alluvium near most of the road alignment (Section 3.3). In areas where both rock and sediment analyses were available, sediments sometimes had notably higher levels of some elements, suggesting sediments were not necessarily genetically related to local rock.

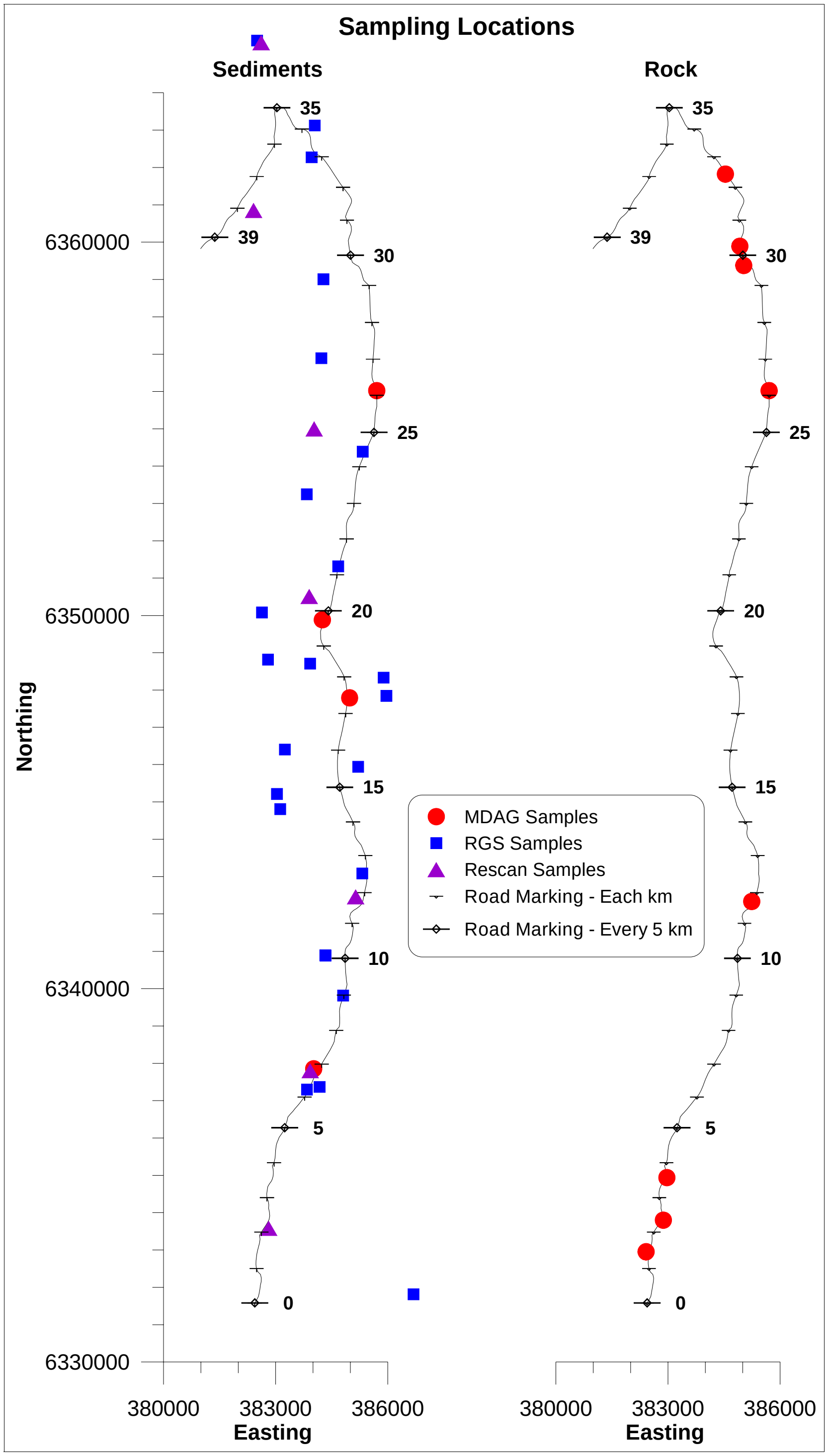

Figure 4-11. Map of Solid-Phase Sampling Locations near the Proposed Road Alignment and in Mess Creek Valley, (from three separate studies).

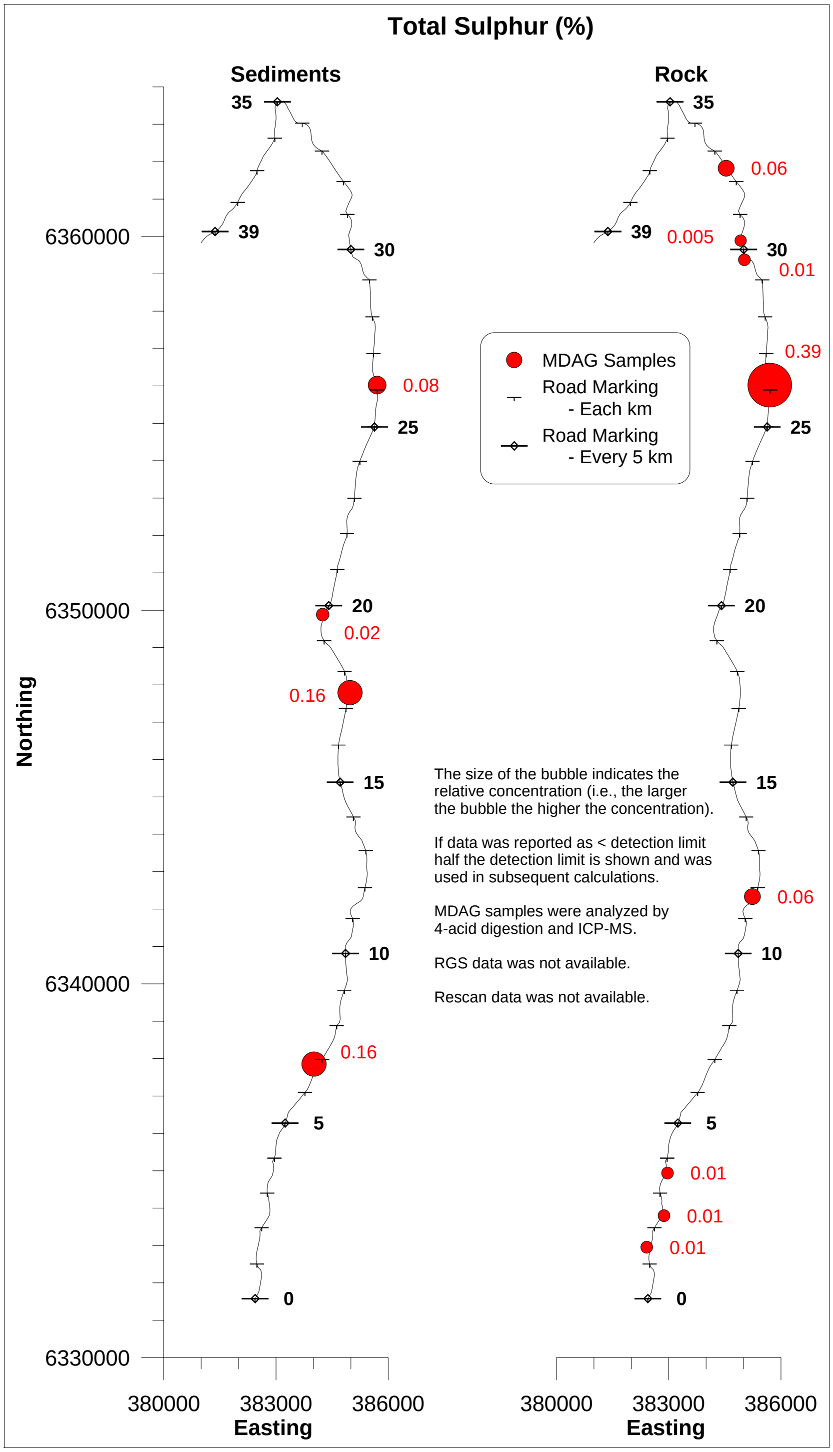

Figure 4-12. Map of Solid-Phase Total Sulphur near the Proposed Road Alignment and in Mess Creek Valley.

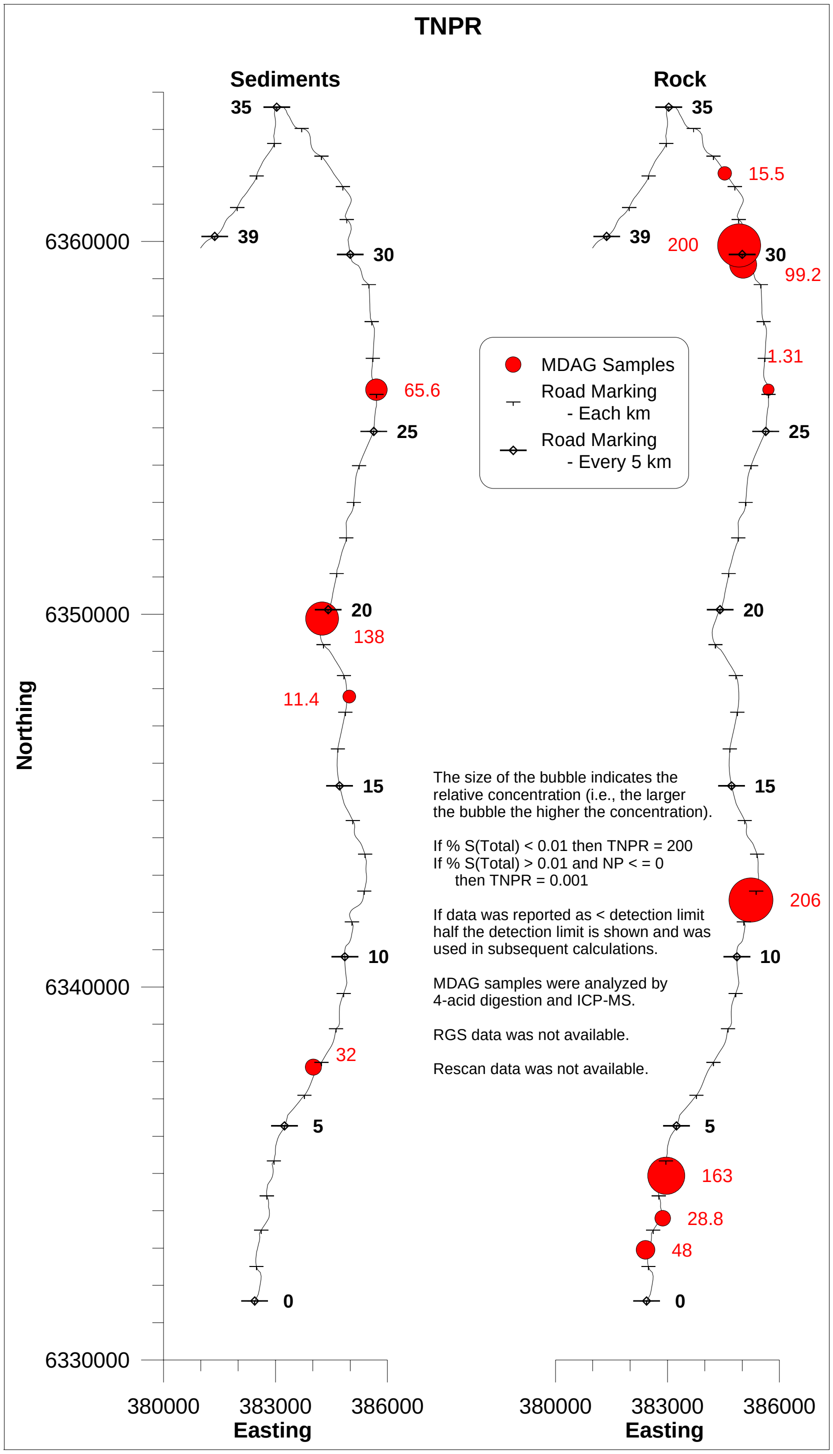

Figure 4-13. Map of (Unadjusted) Total-Sulphur-Based Net Potential Ratio (TNPR) near the Proposed Road Alignment and in Mess Creek Valley.

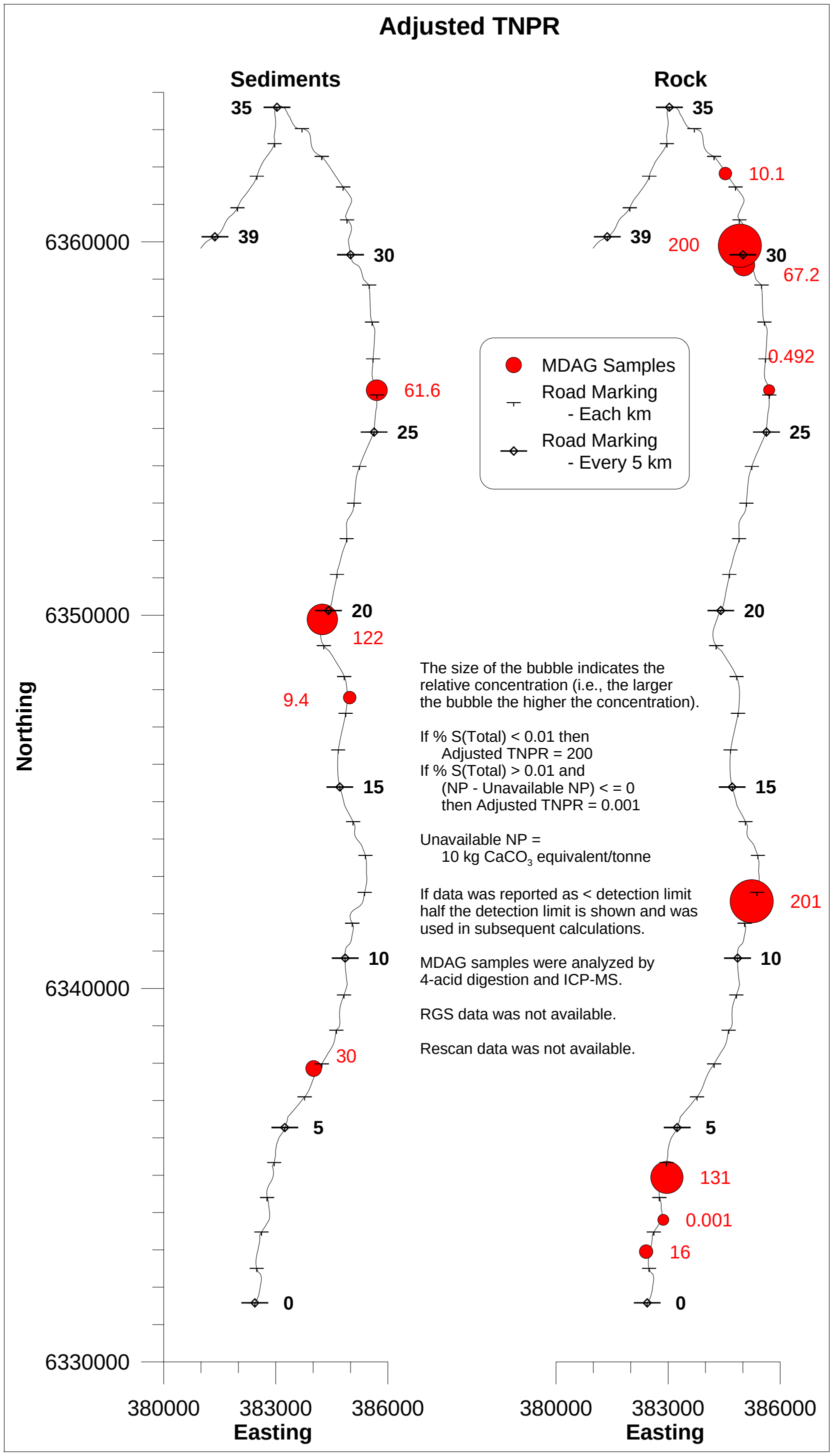

Figure 4-14. Map of Adjusted Total-Sulphur-Based Net Potential Ratio (Adj TNPR) near the Proposed Road Alignment and in Mess Creek Valley.

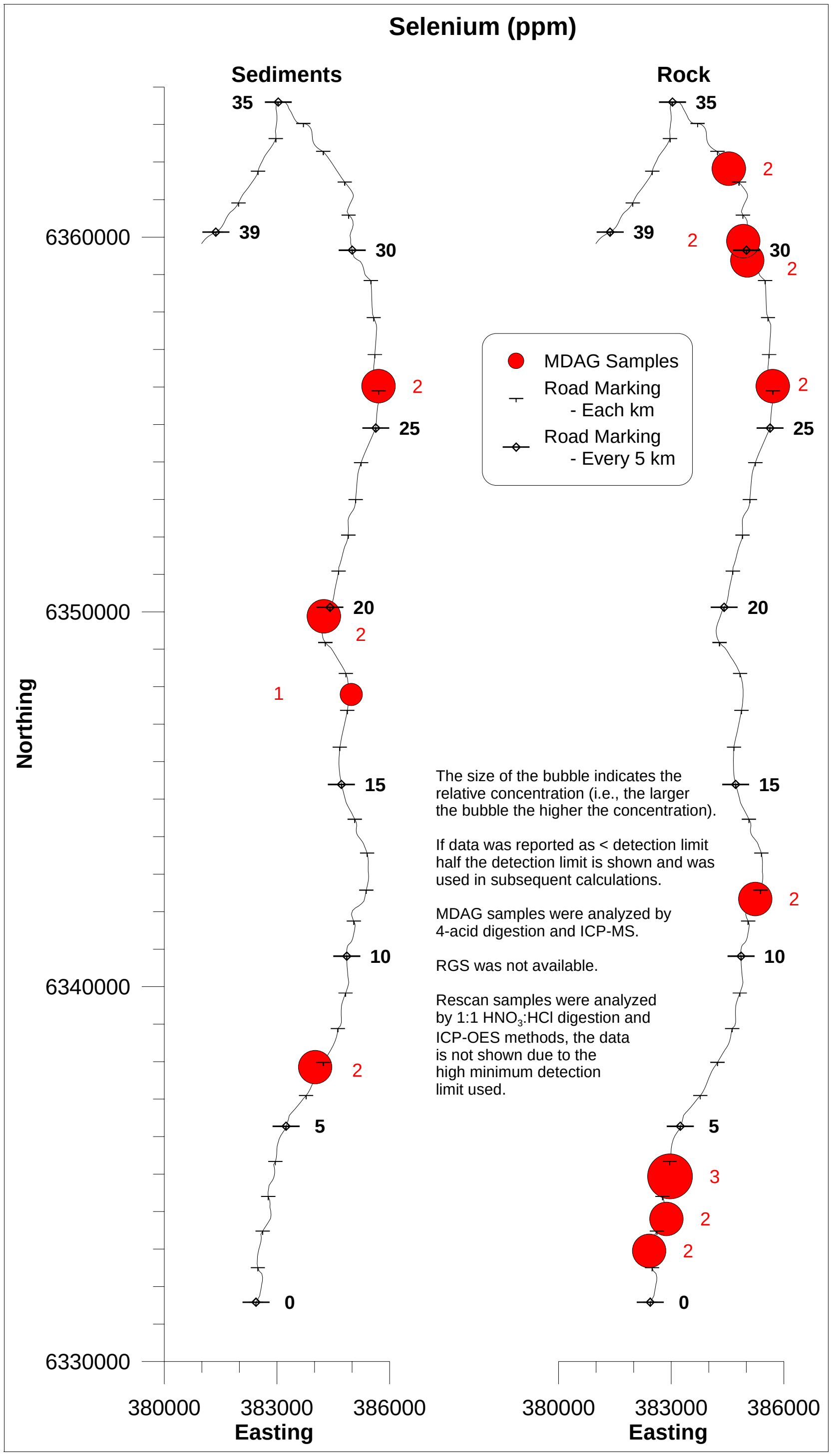

Figure 4-15. Map of Solid-Phase Selenium near the Proposed Road Alignment and in Mess Creek Valley.

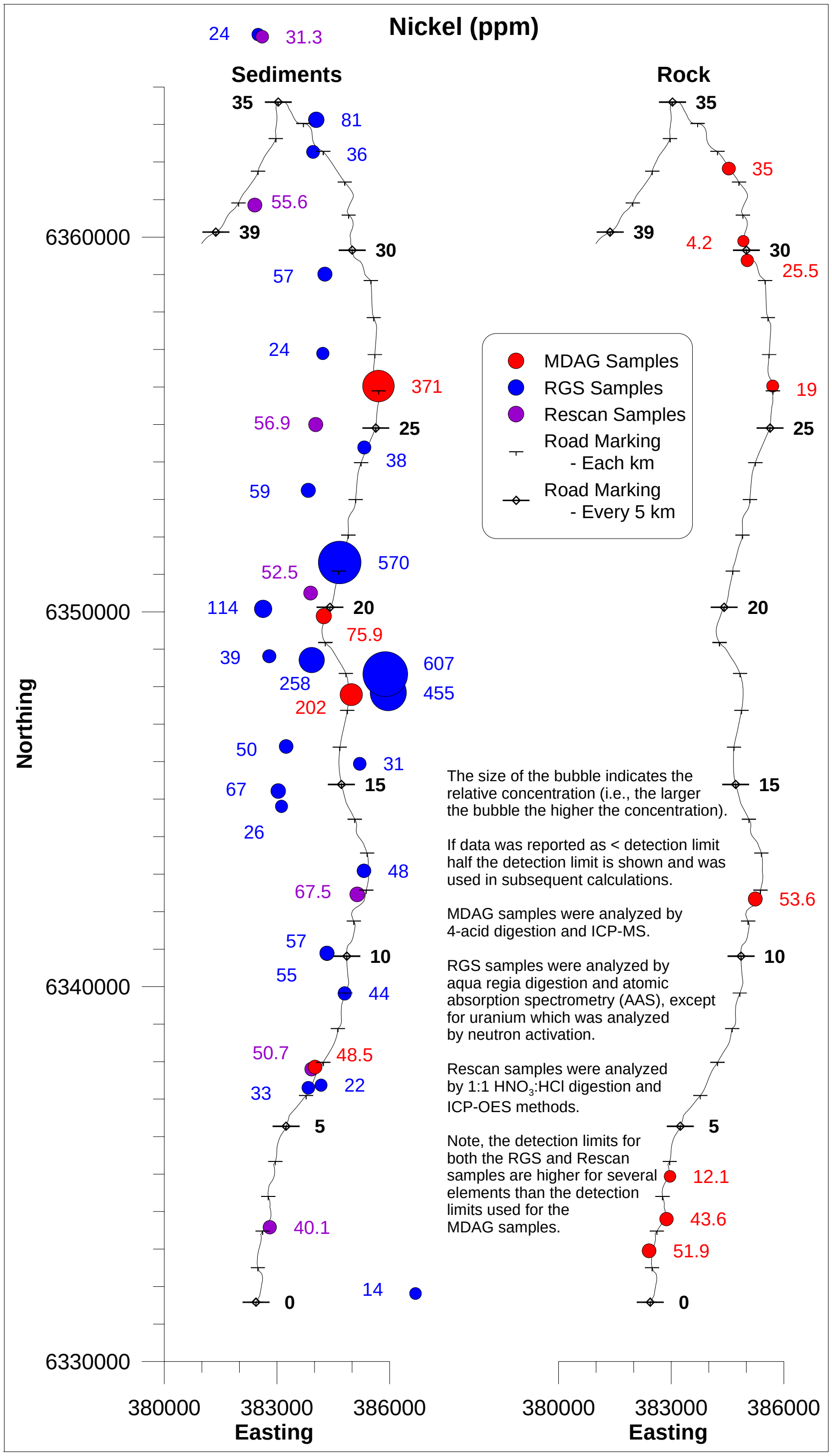

Figure 4-16. Map of Solid-Phase Nickel near the Proposed Road Alignment and in Mess Creek Valley.

The solid-phase elements of greatest potential ML concern were based on three criteria. The first was their variability along the road alignment. In other words, if levels were consistently high or consistently low, there were no “hot spots” of potential concern for that element. Second, if the highest values were close to or above general crustal abundances (listed in Appendix C), then potential concern was high. Again, the solid-phase level of an element does not imply it will leach quickly into water (Section 4.3.2), but it could affect total (unfiltered) concentrations in water if suspended solids are high. Third, the element is commonly known as a water-quality concern, such as copper rather than potassium.

Based on these three criteria, the seven elements of greatest potential ML-ARD concern in sediments were antimony, arsenic, barium, cadmium, chromium, copper, and nickel. Sections of the proposed road alignment with elevated levels of concern are graphically depicted in Figure 4-17, as vertical lines along sections of proposed road. The total number of these elements, elevated along specific sections of the proposed road, showed that all seven were not elevated at the same location (Figure 4-18), but up to four were.

Similarly for rock, there were 12 elements of greatest potential concern based on the three preceding criteria, plus at least an “uncertain” potential for ARD (Figure 4-19). Notably, at km 32-34, eight of the 12 elements of greatest concern were elevated. The lack of rock samples from roughly km 5 to km 24, and from km 34 to km 39.5, precluded an assessment there. This incorrectly implied no ML-ARD concern, because zero elements were elevated in these sections (Figure 4-20). However, indirect information from Chapter 3 can be used to supplement the less abundant direct information for rock.

4.5 Summary of Direct ML-ARD Information for the Proposed Access Road

In summary, the authors of this report flew by helicopter along the proposed road alignment, collecting photographs, notes, and surficial solid-phase samples. As explained in Chapter 3, most of the alignment lies over sediments and alluvium. This field study confirmed most of the alignment was covered by trees and other vegetation, and thus was not readily accessible for sampling of geological materials.

Rusty-coloured iron staining, sometimes a sign of surficial ML-ARD, was seen along some portions of the alignment. These areas could not be safely reached without additional equipment, so their ML-ARD status is unknown. However, the colouring and staining appeared consistent with locally significant ML-ARD.

Acid base accounting (U.S. EPA 600 compliant Sobek ABA) of the eight samples of surficial rock and four samples of surficial sediments, collected near the proposed access-road alignment, showed that all had near-neutral paste pH at the time of analysis. Total sulphur ranged from <0.01%S in one rock sample to 0.39%S in another rock sample. Most of that total sulphur was potentially acid-generating sulphide, so the more easily measured total sulphur can be used for convenience. However, sulphur values below 0.05%S were relatively inaccurate. Three of the four highest sulphide values were found in the sediment samples, which are typically thought of as weathered and oxidized. Thus, the ARD potential of the sediments cannot be ignored.

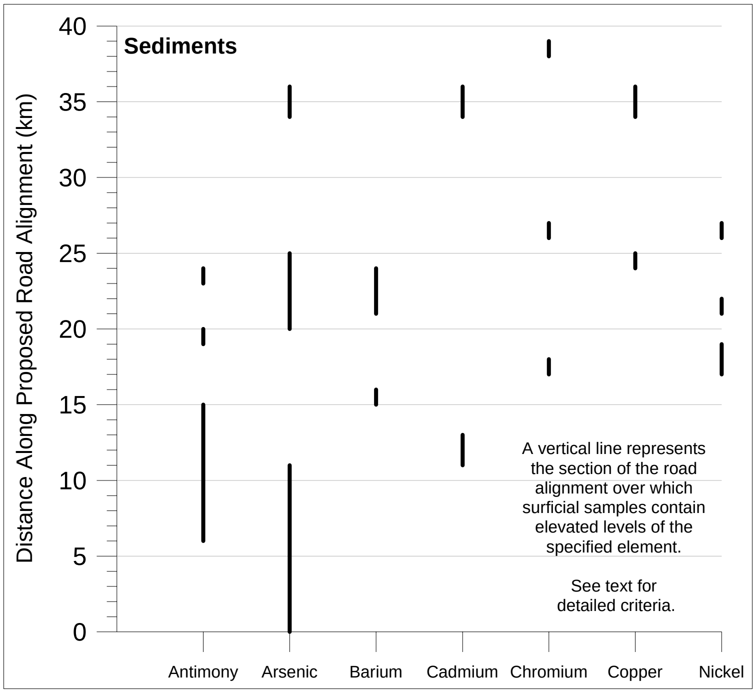

Figure 4-17. Sections of the Proposed Road with Elevated Solid-Phase Levels in Surficial Sediments for Seven Elements of Potential ML-ARD Concern.

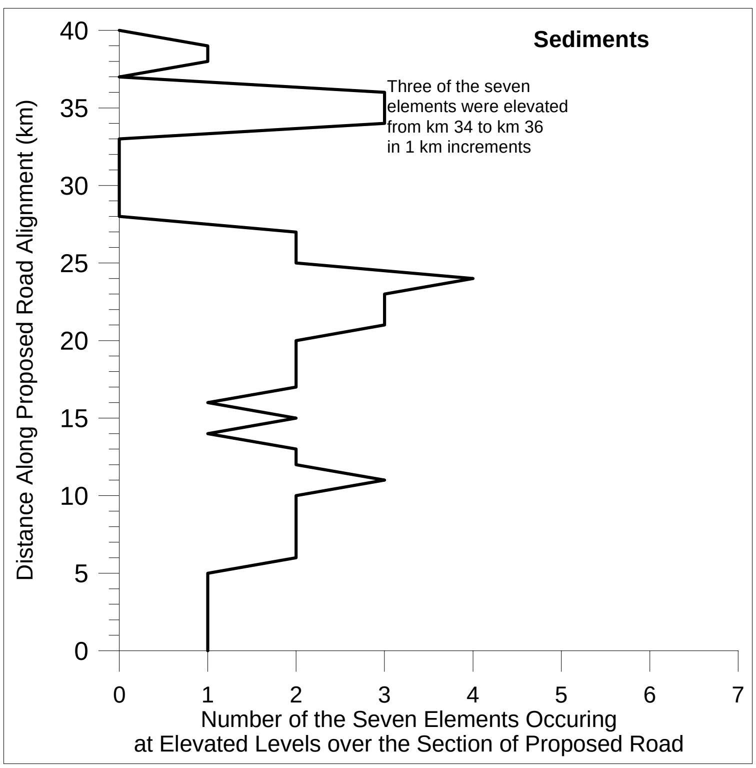

Figure 4-18. Sums of Elements in Surficial Sediments of Potential ML-ARD Concern along Sections of the Proposed Road.

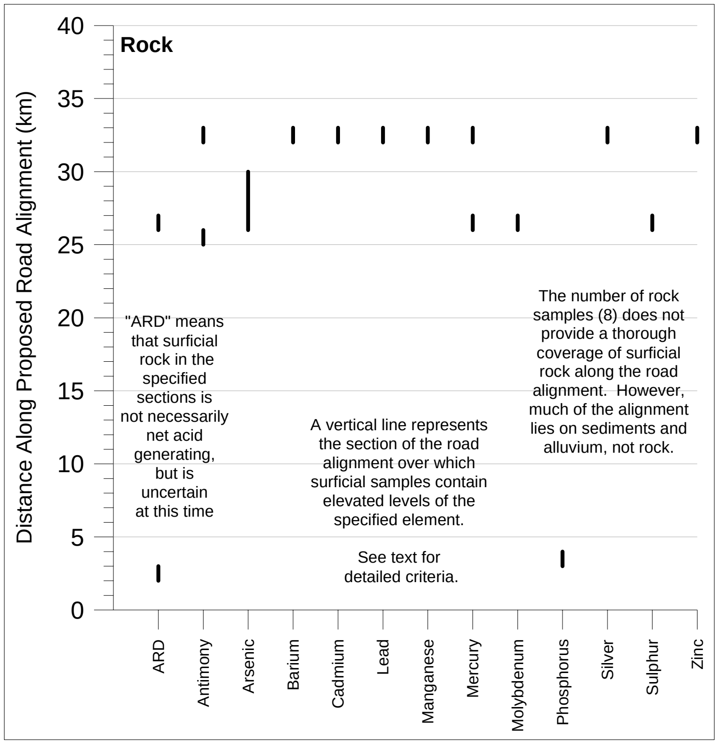

Figure 4-19. Sections of the Proposed Road with Elevated Solid-Phase Levels in Surficial Rock for Twelve Elements of Potential ML-ARD Concern.

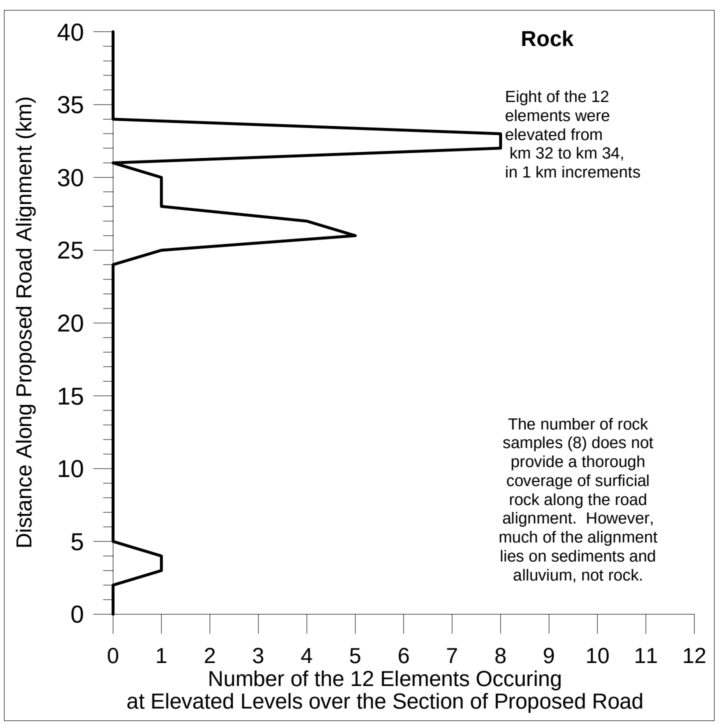

Figure 4-20. Sums of Elements in Surficial Rock of Potential ML-ARD Concern along Sections of the Proposed Road.

Neutralization Potential (NP) ranged from 9 to 387 kg $CaCO_3$ equivalent/tonne, with four of the five highest NP values in sediments. Thus, the sediments contained sufficient NP to offset any internal acid generation by sulphur. In many samples, the Sobek NP was apparently mostly comprised of calcite ($CaCO_3$), which could be measured by the simpler analytical techniques for total carbon or inorganic carbonate. Net balances of acid-generating and acid-neutralizing capacities were based on the Total-Sulphur-Based Net Potential Ratio (TNPR), with and without adjustments for unavailable NP. This showed eleven samples were net neutralizing indefinitely, plus one sample of rock that was "uncertain" without additional testing. When various amounts of unavailable NP were considered, a second sample of rock showed large changes in TNPR, suggesting the ARD status of this sample was also uncertain without additional testing.

Total-element contents of the 12 access-road samples of surficial rock and sediments were measured by ICP-MS analysis after strong four-acid digestion, and by x-ray-fluorescence (XRF) whole-rock analysis. This showed that most of the 12 access-road samples consisted predominantly of silica and alumina, with substantial and sometimes dominant amounts of iron, calcium, magnesium, sodium, potassium, and Loss on Ignition (LOI). LOI often reflects the weight loss from the samples of some or all sulphur, carbon, and tightly bound or crystalline water. Also, the 12 samples often contained elevated levels of bismuth and selenium, with fewer to rare elevated levels of silver (two samples of rock), cadmium (one sample of rock), chromium (one sample of sediment), phosphorus (one sample of rock), lead (one sample of rock), antimony (two rock and one sediment sample), and zinc (one rock sample also with the highest silver, cadmium, lead, and antimony).

Solid-phase correlations of total elements can sometimes reveal mineralogical associations. For example, elements correlating with sulphide may occur predominantly within the sulphide minerals. The elements showing at least some minor correlation with sulphide included arsenic, copper, mercury, and nickel. The elements showing at least some minor correlation with Neutralization Potential, which can dissolve and release metals even without sulphide oxidation, included calcium and manganese.

The preceding information on total elements was combined with "indirect" RGS data and Rescan data along the proposed road alignment. This allowed a spatial interpretation of the data, to highlight sections of the proposed roads with higher ML potential. However, these other sources did not include ABA, so ARD potential was available only for our MDAG samples. For total sulphur, the highest and lowest values were in surficial rock, between km 26 and 31. Nevertheless, some surficial sediments carried significant levels of total sulphur, which were well distributed along the road alignment. For ARD potential, the lowest, "uncertain" values were found near km 26 around Nahta Creek also near the southern end around km 2. The latter sample had low, relatively inaccurate sulphur analyses, so its ARD status was considered "uncertain".

In areas where both surficial rock and sediment analyses were available, sediments sometimes had notably higher levels of some elements. This suggested sediments were not necessarily genetically related to local rock.

Based on selected solid-phase criteria that do not necessarily characterize ML-ARD potential accurately, the seven elements of greatest ML-ARD potential in surficial sediments were antimony, arsenic, barium, cadmium, chromium, copper, and nickel. However, these elements were only elevated along specific sections of the proposed road, and not all seven were elevated at the same location.

Similarly for surficial rock, there were 12 elements of greatest potential ML concern, plus at least an “uncertain” potential for ARD along specific sections of the proposed road. Notably, at km 32-34, eight of the 12 elements of greatest concern were elevated. The lack of rock samples from roughly km 5 to km 24, and from km 34 to km 39.5, precluded an assessment there. This incorrectly implied no ML-ARD concern, because zero elements were elevated in these sections. However, indirect information from Chapter 3 can be used to supplement the less abundant direct information for rock.

5. ML-ARD RANKINGS FOR THE PROPOSED ACCESS ROAD

Indirect information on ML-ARD potential for rock and unconsolidated sediments along the proposed access road was discussed in Chapter 3. Direct information of surficial rock and sediments was discussed in Chapter 4. These chapters showed that some surficial rock had an uncertain capacity to release ARD, and more extensive areas of surficial rock and sediments might leach metals at elevated levels even at neutral pH. This chapter brings together all the direct and indirect information to create ML-ARD rankings for sections of the proposed alignment.

There are two sets of Categories for ranking in this report.

ARD: acidic drainage due to sulphide-mineral oxidation and associated metal hydrolysis and/or precipitation

ML: metal leaching; ARD nearly always includes accelerated ML, but accelerated ML can also occur without ARD.

Not included here: water-quality parameters potentially created by construction activities, like suspended solids, nitrogen species from any blasting, organic compounds like from fuel, and any mined rock from the proposed minesite.

The Rankings used here are based on three levels.

1. Negligible to Minor (green)
2. Moderate, or Unknown, or Beyond Current Analytical Capability suggesting caution (yellow)
3. High to Severe (red)

It is important to note that Rankings should reflect the local receiving environment, but such environmental assessments are beyond the scope of this study. For example, pre-existing high background aqueous concentrations of dissolved copper might show no additional environmental effects in the future after road construction, despite a Ranking of 2 or 3 for a road section or quarry. Thus, the Rankings here assume a pristine environment. This is not consistently the case as shown in Chapters 3 and 4, by some elevated pre-existing metal levels and sulphide in sediments and rock.

The ML-ARD Rankings for each section of road were based on indirect information, like metallic-mineral potential and Regional Geochemical Surveys (Chapter 3), and direct information, like acid base accounts (ABA) and total-element contents (Chapter 4). Because surficial samples of sediments and rock were point-source samples, some judgment was needed in choosing the sections of road applying to them.

For ML Rankings of surficial sediments, the additional samples from the RGS and Rescan (2007) datasets assisted greatly for some elements (Section 4.4). Thus, the ML Rankings for surficial sediments, assuming a relationship with solid-phase levels, were relatively strong for many but not all elements. The ARD Rankings for surficial sediments were weak, due to only four samples over 39.5 km of proposed road.

For surficial rock, direct ML and ARD rankings were weak due to only eight samples. However, most of the proposed alignment is on sediment, so this is not a major issue. Nevertheless, for the road sections from ~km 5 to km 24, and from ~km 34 to km 39.5, no surficial rock was available. Thus, indirect information on metallic-mineral potential and local iron staining was used as surrogates to create ML and ARD Rankings in these sections.

The results produced Rankings for ARD and ML that spanned the range from 1 to 3 (Figure 5-1 and Table 5-1). There was no consistent spatial trend of increasing or decreasing Ranking with distance along the road. Overall, the ML Ranking along nearly the entire proposed alignment was high for surficial sediment, and was mostly moderate to high for surficial rock.

As a result, some accelerated metal leaching should be expected from the road during and after disturbance of surficial sediments and rock. However, the ML-ARD potentials of deeper sediments and rock remain unknown at this time. To clarify and improve the ML-ARD assessment of the proposed road alignment, both surficial and deeper, recommendations are offered in Chapter 6 before, during, and after road construction.

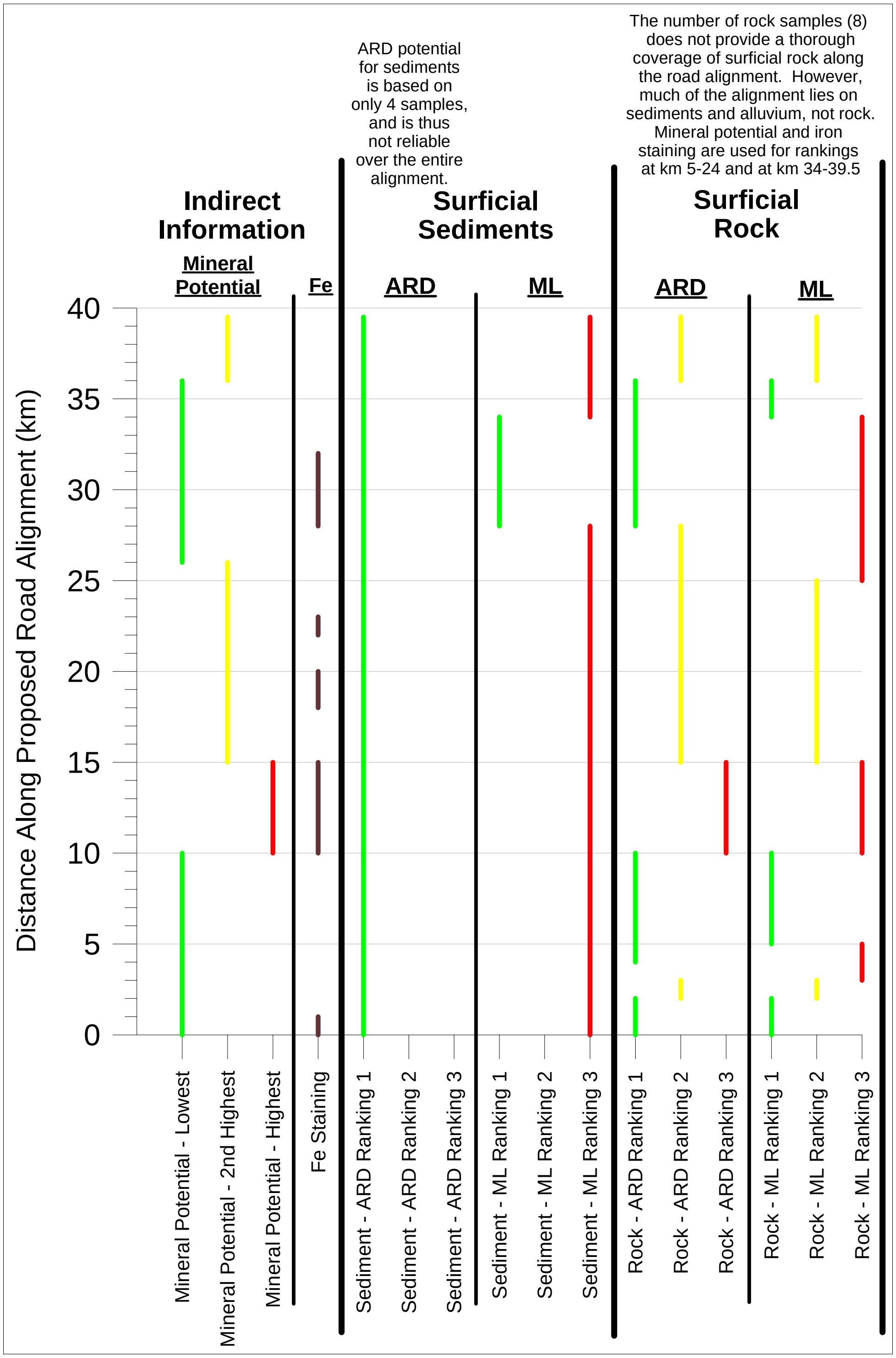

Figure 5-1. ARD and ML Rankings for Surficial Sediments and Surficial Rock along the Proposed Alignment for the Schaft Creek Access Road.

Table 5-1. ML-ARD Rankings for Surficial Sediments and Surficial Rock along the Proposed Alignment of the Schaft Creek Access Road

Road Section (km)	Surficial Sediment Ranking [1]		Surficial Rock Ranking [1,3]	
	ARD[2]	ML	ARD	ML
0-2	1	3	1	1
2-3	1	3	2	2
3-5	1	3	1	3
5-10	1	3	1	1
10-15	1	3	3	3
15-25	1	3	2	2
25-28	1	3	2	3
28-34	1	1	1	3
34-36	1	3	1	1
36-39.5	1	3	2	2

[1] Ranking 1 = Negligible to Minor (green); Ranking 2 = Moderate, or Unknown, or Beyond Current Analytical Capability suggesting caution (yellow); Ranking 3 = High to Severe (red); elevated solid-phase levels are used as surrogates for the ML rankings, although aqueous metal leaching is not necessarily dependent on solid-phase levels.

[2] ARD potential for surficial sediments is based on only 4 samples, and is thus not reliable over the entire alignment; ML potential was based on many more samples, from other studies.

[3] The number of surficial rock samples (8) does not provide thorough coverage of surficial rock along the road alignment. However, much of the alignment lies on sediments and alluvium, not rock. Mineral potential and iron staining are used for rankings at km 5-24 and at km 34-39.5.

6. ML-ARD RECOMMENDATIONS BEFORE, DURING, AND AFTER ROAD CONSTRUCTION

For this proposed access road, the pre-construction studies of Chapter 3 to 5 have shown some potential for ML-ARD, from surficial samples of both rock and unconsolidated sediments. Construction activities and any blasting may add suspended solids, other water-quality species (like nitrate, nitrite, and ammonia), and organic compounds (like fuel or oils) to drainage waters. However, only ML-ARD is addressed here.

Recent ML-ARD precedents established in Canada for roads include the following (e.g., Morin et al., 2003; Morin and Hutt, 2005 and 2007a).

1) Successful criminal prosecution under the *Fisheries Act* for ML-ARD from a road cut a few meters high and a few hundred meters long.

2) Visual examination of every horizontal meter of rock cut along dozens of kilometers of road alignment, with sampling and analysis as appropriate.

3) Major re-alignment of a highway to avoid disturbance of potentially acid-generating rock.

4) Special environmental controls and remediation for reactive rock removed from rock cuts and quarries and for broken rock used in the road bed.

5) Failure of geologic maps, preconstruction environmental and geologic surveys, and surficial sampling to identify all geochemically reactive rock reliably.

Therefore, the following recommendations are offered to reduce the risk of ML-ARD from the access road.

6.1 Preconstruction ML-ARD Testing of Rock and Unconsolidated Sediments

During construction, rock might be disturbed, such as in a road cut, road fill, or rock quarry. The ML-ARD potential of this deeper material may not match that of surficial material examined in this report. Before any substantial disturbance of rock, continuous core should be drilled to one meter vertically below the proposed bottom of the disturbance. Drill holes should be spaced 50 m apart along proposed rock disturbances that extend continuously more than 500 m; otherwise, drill holes should be spaced 20 m apart. Every one-meter-long interval from each hole should be analyzed.

During road construction, unconsolidated material like sand, gravel, alluvium, and soil may be disturbed, such as by road cuts, road fills, and granular borrow pits. Before any substantial disturbance of unconsolidated materials, auger holes or drill holes or hand-dug holes should be excavated to one meter vertically below the proposed bottom of the disturbance. Holes for unconsolidated materials should be spaced 100 m apart along proposed rock disturbances that extend continuously more than 500 m; otherwise, drill holes should be spaced 40 m apart. Every one-meter-long interval from each hole should be analyzed.

Every one-meter-long interval (one-meter composites) from each hole should be analyzed for the inorganic parameters in Table 6-1. Any analyses indicating a potential problem with future drainage chemistry should lead to:

(1) relocation of proposed construction to another location, or
(2) design of remediation procedures such as long-term water treatment, which should be started immediately upon disturbance unless a delay can be justified by the analyses.

Before construction, local waters should be analyzed for baseline water quality (Table 6-2). In this way, any pre-existing water-quality problems would not be attributed later to road construction, and any later construction impacts would be reliably defined.

6.2 Construction ML-ARD Testing of Rock and Unconsolidated Sediments

Past ML-ARD work in Canada has shown that the spacing of drill holes or auger holes during the preconstruction phase will not necessarily be sufficient to identify all reactive material in advance reliably. Therefore, additional work is required during construction.

As any substantial amounts of rock or unconsolidated material is disturbed, a geologist or engineer experienced in environmental drainage chemistry and ML-ARD should visually examine the disturbed material and the remaining walls. This visual examination should look for evidence of reactive material, such as that listed in Table 6-3.

Any rock showing significant evidence of past, current, or future geochemical reactivity or ML-ARD (e.g., Table 6-3) should be collected and submitted for the analyses in Table 6-1. Any analysis indicating a potential problem with future drainage chemistry requires immediate design of remediation procedures such as long-term water treatment. These procedures should be started immediately, unless a delay is justified by the analyses.

Before disturbance, local waters should be analyzed for baseline ML-ARD water quality (Table 6-2). Then, during construction, local water should be periodically analyzed for the following reasons.

1) Changes from baseline conditions might indicate some reactive material had not been detected, and
2) The success of any implemented remediation efforts would be characterized.

Frequent, inexpensive field measurements of pH and electrical conductivity in local waters, like puddles and seeps, would provide advance warning of any major changes of dominant ions in baseline water chemistry.

Table 6-1. Recommended Solid-Phase Analyses for Estimating Effects on Drainage Chemistry

Analytical Package	Included Measurements
U.S. EPA 600-compliant Acid-Base Accounting ("Sobek ABA")[1]	paste pH
	total sulphur
	sulphide
	leachable sulphate
	Sobek neutralization potential
	inorganic carbonate
	total carbon
ICP-based Total Elements	several dozens of metals and other elements
Whole-rock Total Elements	approximately a dozen elements often representing most of the sample's mass

[1] ABA includes many calculated parameters based on the results of all analytical packages.

Table 6-2. Parameters Included in Water-Quality Analyses[1]

Immediate field measurements of pH and electrical conductivity, plus immediate in-field filtering and/or preservation of laboratory samples
General parameters, including laboratory pH, electrical conductivity, alkalinity, acidity, suspended solids, and dissolved solids
Anions, including sulphate, chloride, and fluoride
Nutrients, including nitrate, nitrite, ammonia, and phosphorus
Dozens of cations, total metals, and dissolved metals, including but not limited to calcium, magnesium, sodium, potassium, aluminum, arsenic, antimony, manganese, molybdenum, selenium, zinc, etc.

[1] Detection limits should be at or below applicable water-quality objectives and guidelines

Table 6-3. Some Visible Evidence of Past, Current, or Future Reactive Material[1]
Sulphide minerals like pyrite that might react quickly when exposed to air and moisture
Rusty secondary iron staining that might signify already-reactive rock
Other secondary-mineral staining that might represent already-active metal leaching, such as green staining often reflecting copper leaching
Carbonate minerals like calcite that can dissolve quickly in rainwater and thus release any impurities such heavy metals and other elements into drainage waters
[1] Requires solid-phase analyses of Table 6-1, and experience and knowledge, for confirmation.

6.3 Post-Construction ML-ARD Monitoring

ML-ARD monitoring of local waters (Table 6-2) should continue periodically after construction. This will show:
1) any delayed effects from road construction,
2) any effects from road usage, and
3) the ongoing success of any implemented remediation efforts.

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APPENDIX A. UTM Coordinates in NAD 83 Datum of the Proposed Access Road for the Schaft Creek Project

Schaft Creek Project						
UTM Coordinates for the Proposed Access Road Every 100 m						
Road km	Easting	Northing		Road km	Easting	Northing
0.0	382441	6331581		4.0	382958	6335339
0.1	382492	6331667		4.1	382975	6335437
0.2	382537	6331756		4.2	382993	6335535
0.3	382559	6331853		4.3	382994	6335635
0.4	382578	6331951		4.4	383005	6335735
0.5	382593	6332050		4.5	383026	6335832
0.6	382611	6332149		4.6	383059	6335927
0.7	382616	6332248		4.7	383094	6336020
0.8	382594	6332343		4.8	383151	6336102
0.9	382527	6332413		4.9	383207	6336184
1.0	382490	6332506		5.0	383242	6336277
1.1	382471	6332603		5.1	383280	6336370
1.2	382474	6332703		5.2	383305	6336466
1.3	382481	6332803		5.3	383327	6336563
1.4	382496	6332902		5.4	383391	6336638
1.5	382521	6332998		5.5	383458	6336712
1.6	382544	6333096		5.6	383523	6336788
1.7	382567	6333193		5.7	383586	6336866
1.8	382579	6333292		5.8	383650	6336942
1.9	382572	6333391		5.9	383710	6337022
2.0	382617	6333479		6.0	383774	6337099
2.1	382673	6333561		6.1	383838	6337176
2.2	382726	6333646		6.2	383882	6337265
2.3	382778	6333731		6.3	383919	6337358
2.4	382826	6333819		6.4	383956	6337451
2.5	382840	6333916		6.5	383993	6337544
2.6	382836	6334016		6.6	384030	6337637
2.7	382815	6334114		6.7	384070	6337728
2.8	382817	6334213		6.8	384123	6337813
2.9	382801	6334309		6.9	384177	6337897
3.0	382767	6334403		7.0	384231	6337981
3.1	382764	6334503		7.1	384283	6338066
3.2	382773	6334602		7.2	384333	6338153
3.3	382792	6334699		7.3	384384	6338239
3.4	382844	6334784		7.4	384437	6338324
3.5	382897	6334869		7.5	384490	6338409
3.6	382926	6334964		7.6	384532	6338499
3.7	382939	6335063		7.7	384570	6338592
3.8	382932	6335161		7.8	384588	6338690
3.9	382908	6335254		7.9	384601	6338789

Road km	Easting	Northing		Road km	Easting	Northing
8.0	384621	6338885		12.0	385378	6342575
8.1	384691	6338956		12.1	385400	6342672
8.2	384717	6339049		12.2	385422	6342770
8.3	384714	6339149		12.3	385435	6342869
8.4	384710	6339249		12.4	385438	6342969
8.5	384710	6339348		12.5	385428	6343068
8.6	384716	6339448		12.6	385425	6343168
8.7	384727	6339547		12.7	385429	6343268
8.8	384760	6339642		12.8	385432	6343368
8.9	384793	6339736		12.9	385415	6343466
9.0	384826	6339830		13.0	385400	6343565
9.1	384860	6339925		13.1	385365	6343659
9.2	384893	6340019		13.2	385329	6343752
9.3	384911	6340116		13.3	385291	6343845
9.4	384898	6340215		13.4	385232	6343924
9.5	384886	6340315		13.5	385169	6344000
9.6	384877	6340414		13.6	385123	6344089
9.7	384866	6340514		13.7	385110	6344187
9.8	384863	6340614		13.8	385123	6344286
9.9	384861	6340714		13.9	385116	6344379
10.0	384859	6340814		14.0	385070	6344468
10.1	384858	6340914		14.1	385026	6344557
10.2	384861	6341014		14.2	384981	6344647
10.3	384892	6341107		14.3	384933	6344734
10.4	384961	6341180		14.4	384884	6344822
10.5	385012	6341263		14.5	384843	6344913
10.6	385035	6341361		14.6	384818	6345009
10.7	385052	6341459		14.7	384795	6345107
10.8	385070	6341558		14.8	384770	6345203
10.9	385080	6341657		14.9	384743	6345300
11.0	385048	6341751		15.0	384716	6345396
11.1	385005	6341841		15.1	384694	6345494
11.2	384982	6341938		15.2	384678	6345592
11.3	385012	6342030		15.3	384666	6345691
11.4	385083	6342099		15.4	384659	6345791
11.5	385169	6342149		15.5	384658	6345891
11.6	385247	6342209		15.6	384657	6345991
11.7	385315	6342283		15.7	384657	6346091
11.8	385340	6342379		15.8	384659	6346191
11.9	385358	6342477		15.9	384665	6346291

Road km	Easting	Northing		Road km	Easting	Northing
16.0	384671	6346391		20.0	384410	6350122
16.1	384683	6346490		20.1	384463	6350207
16.2	384707	6346587		20.2	384489	6350303
16.3	384731	6346684		20.3	384510	6350401
16.4	384753	6346781		20.4	384528	6350499
16.5	384773	6346879		20.5	384546	6350598
16.6	384793	6346977		20.6	384565	6350696
16.7	384812	6347075		20.7	384585	6350794
16.8	384832	6347173		20.8	384606	6350892
16.9	384850	6347272		20.9	384627	6350989
17.0	384870	6347370		21.0	384640	6351089
17.1	384891	6347467		21.1	384648	6351188
17.2	384902	6347566		21.2	384681	6351282
17.3	384908	6347666		21.3	384709	6351378
17.4	384913	6347766		21.4	384733	6351475
17.5	384914	6347866		21.5	384758	6351572
17.6	384906	6347966		21.6	384783	6351669
17.7	384898	6348065		21.7	384815	6351764
17.8	384888	6348165		21.8	384847	6351859
17.9	384868	6348262		21.9	384886	6351951
18.0	384833	6348356		22.0	384898	6352048
18.1	384790	6348446		22.1	384899	6352148
18.2	384743	6348534		22.2	384898	6352248
18.3	384692	6348620		22.3	384895	6352348
18.4	384640	6348705		22.4	384893	6352448
18.5	384588	6348791		22.5	384920	6352542
18.6	384537	6348877		22.6	384970	6352629
18.7	384485	6348962		22.7	385025	6352712
18.8	384427	6349042		22.8	385067	6352802
18.9	384351	6349107		22.9	385084	6352900
19.0	384286	6349182		23.0	385095	6353000
19.1	384235	6349268		23.1	385102	6353099
19.2	384209	6349364		23.2	385109	6353199
19.3	384202	6349464		23.3	385118	6353299
19.4	384200	6349564		23.4	385127	6353398
19.5	384228	6349659		23.5	385136	6353498
19.6	384261	6349753		23.6	385144	6353598
19.7	384294	6349848		23.7	385156	6353697
19.8	384326	6349942		23.8	385178	6353794
19.9	384358	6350037		23.9	385205	6353890

Road km	Easting	Northing		Road km	Easting	Northing
24.0	385239	6353984		28.0	385577	6357848
24.1	385279	6354076		28.1	385543	6357942
24.2	385316	6354169		28.2	385537	6358042
24.3	385352	6354262		28.3	385533	6358141
24.4	385388	6354355		28.4	385529	6358241
24.5	385424	6354449		28.5	385526	6358341
24.6	385469	6354538		28.6	385522	6358441
24.7	385511	6354629		28.7	385518	6358541
24.8	385550	6354721		28.8	385515	6358641
24.9	385593	6354811		28.9	385511	6358741
25.0	385632	6354902		29.0	385500	6358840
25.1	385638	6355002		29.1	385427	6358905
25.2	385646	6355102		29.2	385358	6358977
25.3	385654	6355201		29.3	385326	6359071
25.4	385662	6355301		29.4	385300	6359168
25.5	385670	6355401		29.5	385273	6359264
25.6	385684	6355499		29.6	385220	6359348
25.7	385706	6355596		29.7	385134	6359398
25.8	385706	6355696		29.8	385056	6359458
25.9	385707	6355796		29.9	385023	6359552
26.0	385707	6355896		30.0	385003	6359649
26.1	385707	6355996		30.1	384983	6359748
26.2	385707	6356096		30.2	384961	6359845
26.3	385664	6356185		30.3	384963	6359944
26.4	385611	6356270		30.4	384944	6360042
26.5	385583	6356365		30.5	384971	6360137
26.6	385575	6356465		30.6	385008	6360230
26.7	385583	6356564		30.7	385029	6360327
26.8	385590	6356664		30.8	385021	6360426
26.9	385598	6356764		30.9	384977	6360515
27.0	385606	6356863		31.0	384908	6360587
27.1	385614	6356963		31.1	384865	6360674
27.2	385621	6357063		31.2	384896	6360768
27.3	385628	6357163		31.3	384934	6360861
27.4	385634	6357262		31.4	384978	6360951
27.5	385641	6357362		31.5	385021	6361041
27.6	385647	6357462		31.6	385026	6361139
27.7	385653	6357562		31.7	384988	6361231
27.8	385648	6357661		31.8	384926	6361309
27.9	385614	6357755		31.9	384862	6361386

Road km	Easting	Northing		Road km	Easting	Northing
32.0	384804	6361468		36.0	382969	6362626
32.1	384750	6361552		36.1	382928	6362535
32.2	384691	6361632		36.2	382878	6362449
32.3	384631	6361712		36.3	382822	6362366
32.4	384573	6361794		36.4	382766	6362283
32.5	384520	6361879		36.5	382699	6362209
32.6	384467	6361963		36.6	382652	6362121
32.7	384413	6362047		36.7	382609	6362031
32.8	384355	6362129		36.8	382564	6361942
32.9	384296	6362209		36.9	382522	6361851
33.0	384231	6362286		37.0	382494	6361755
33.1	384144	6362334		37.1	382465	6361660
33.2	384060	6362386		37.2	382414	6361574
33.3	383998	6362464		37.3	382358	6361492
33.4	383957	6362555		37.4	382301	6361409
33.5	383945	6362655		37.5	382242	6361329
33.6	383934	6362754		37.6	382183	6361248
33.7	383922	6362853		37.7	382117	6361172
33.8	383874	6362939		37.8	382065	6361088
33.9	383795	6363000		37.9	382015	6361001
34.0	383702	6363029		38.0	381975	6360909
34.1	383602	6363025		38.1	381923	6360824
34.2	383519	6363073		38.2	381857	6360750
34.3	383463	6363156		38.3	381783	6360682
34.4	383418	6363245		38.4	381712	6360612
34.5	383372	6363334		38.5	381656	6360530
34.6	383322	6363420		38.6	381622	6360436
34.7	383281	6363512		38.7	381576	6360347
34.8	383221	6363589		38.8	381520	6360264
34.9	383128	6363623		38.9	381452	6360191
35.0	383034	6363600		39.0	381372	6360132
35.1	382979	6363518		39.1	381284	6360084
35.2	382974	6363419		39.2	381197	6360034
35.3	382990	6363320		39.3	381118	6359974
35.4	383001	6363221		39.4	381052	6359899
35.5	382999	6363121		39.5	380989	6359821
35.6	382984	6363022				
35.7	382973	6362923				
35.8	382956	6362825				
35.9	382966	6362725				

APPENDIX B. MDAG Trip Report, October 17-21, 2007

This trip was to collect samples related to metal leaching and acid rock drainage (ML-ARD) at the Schaft Creek Project. This was done according to the British Columbia Policy, Guidelines, and Prediction Manual for ML-ARD.

There were two primary objectives for this trip:
1) the proposed road alignment, and
2) decades-old drill core that has been weathering in core boxes.

October 17, 2007

We (Nora Hutt and Kevin Morin) travelled from Vancouver to Smithers. We then joined Shane Uren flying to Bob Quinn airstrip and then on the Schaft Creek camp. The flight along Mess Creek to camp showed us that there would be relatively few sites with exposed rock or sand-gravel close to the road alignment. Most of the alignment was covered by trees, other vegetation, soil, and lichens.

No quarries or sand-gravel pits have yet been proposed along the road, and it is not yet clear if this is an issue. Also, deeper rock and other geological materials can have very different ML-ARD characteristics than the surficial samples collected during current ML-ARD road assessments. However, this can only be assessed with pre-construction drilling, or during construction with resulting delays for geochemical analyses and any necessary remediation or ongoing control.

Discussions with Nils on the geology of Schaft Creek and the road alignment were very helpful. We learned that there was old core at site dating back decades, although some had been lost. Because such old core can be an analogue for old mine rock, decades after mining, sample collection became an objective of this trip. We were particularly interested in obtaining old samples of the "high pyrite" zones, containing up to 10% pyrite, which were probably not caught in the Phase 1 or Phase 2 sampling.

October 18, 2007

We flew to the headwaters of Little Mess Creek, and began sampling rock and sand-gravel close to the road alignment (see sample list below). Samples were collected only when a safe landing area was nearby, and when the road alignment could be safely reached from the landing area without boats or hip-waders. Snow cover was a problem in a few areas for seeing rock.

We continued sampling until roughly noon. We then returned to camp. Due to helicopter schedules, shuttling to/from Burrage, and maintenance, we could not collect any more samples that day.

October 19, 2007

We had near-continuous helicopter support through the morning. This allowed us to collect samples quickly as the helicopter remained power up.

Around noon, we visually inspected the final part of the road (~km 33 to 37.5) and the airstrip. No rock outcrops or significant areas of sand-gravel were seen along this section, so no samples were taken.

In the afternoon, we reviewed drillhole maps for the old Hecla (H series) and Teck (T series) drillholes, relative to our existing ML-ARD samples. Also, Nils and Walter pointed out some old holes that might have elevated pyrite contents. We then visually inspected the old core, looking for intervals at least 0.3 m long with both elevated visual sulphides (see sample list below) and substantial ferric-iron staining (except T112 171-172'). This led to the collection of eight samples from the T series from 1980-1981.

October 20, 2007

In the morning, we flew from camp to Burrage airstrip. We then drove to Smithers, arriving in mid afternoon. This provided sufficient time to ship the samples of old core and from the road alignment to ALS Chemex in North Vancouver by Greyhound Courier. The samples should arrive at Chemex on Monday, October 22.

A chain-of-custody and analytical-request form was shipped with the samples. However, Shane needs to clarify the invoicing procedure.

October 21, 2007

We returned home to Surrey.

ML-ARD Samples Along the Proposed Road Alignment (SCR = Schaft Creek Road)

SCR-01 (~km 1.5)
09V 0382413 6332952
Near road alignment below talus slope and in broken-rock field. Snow cover precludes identification of broken rock as talus or in-situ subcrop. Visible rock is light grey silicified volcanics, but may be sedimentary.

SCR-02 (~km 6.9)
09V 0384018 6337854
Floodplain sediments (alluvium). Sediments are orange-brown to light grey gravelly silty sand. Sample SCR-02 contained mostly sand and finer material.

SCR-03 (~km 2.5)
09V 0382875 6333799
High rock outcrop along creek, with road alignment above in the outcrop. Sample SCR-03 was collected at the base of the outcrop, and contained mostly green to black mafic rock (gabbro and peridotite?) and some silicic volcanics.

SCR-04 (~km 3.7)
09V 0382970 6334938
In Little Mess Valley. Black to green-black basalt with thin quartz veining, ands some medium grey volcanics

SCR-05 (~km 11.8)
09V 0385240 6342335
Water in channel against east slope: pH = 6.56, conductivity = 830 µS/cm
Road alignment ~40 m up slope. Ground covered with vegetation and soil. One angular boulder ~1 m long near road alignment was matrix-supported conglomerate. Sample SCR-05 was small angular pieces of medium-grey volcanics near the conglomerate boulder.

SCR-06 (~km 17.4)
09V 0384980 6347790
Floodplain of Alexander Creek ~100 m wide; cobbles, gravel, and sand; Sample SCR-06 was brown to medium-grey to buff gravel. Alexander Creek pH = 8.00, conductivity = 260 µS/cm.

SCR-07 (~km 19.8)
09V 0384250 6349882
Brown sand exposure with some cobbles along east side of Mess Creek. Sample SCR-07 was half sand and half cobbles.

SCR-08 (~km 26.2)
09v 0385705 6356021
Road crossing at Nahta Creek. Nahta Creek pH = 7.89, conductivity = 140 µS/cm. Sample SCR-08A: rock outcrop on south side of creek: heavily weathered greywacke with heavy iron staining on rock surfaces. Sample SCR-08B: Nahta Creek alluvium: grey sand and gravel

SCR-09 (~km 29.8)
09V 0385028 6359373
Small outcrop ~10 m from easternmost channel; black small-block ("chunky") mudstone with some blue and green grains

SCR-10 (~km 30.3)
09V 0384923 6359889
Road alignment is ~half way up a high, steep outcrop. Sample SCR-10 was collected from boulders at the base of the outcrop; dark brown to medium grey, small-block ("chunky") silicified mudstone or volcanic.

SCR-11 (~km 32.5)
09V 0384536 6361822
Rock outcrop in the middle of Mess Creek floodplain, adjacent to road alignment. Sample SCRF-11 was dark brown to black small-block ("chunky") silicified mudstone or volcanic.

APPENDIX C. ML-ARD Analyses of Surficial Proposed-Access-Road Samples

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **Sample Information**
Comments: Sampled by MDAG Oct '07.

Sample Id.	Zone (Top of Drillholes UTM NAD 27)	Easting (Top of Drillholes UTM NAD 27)	Northing (Top of Drillholes UTM NAD 27)	Elevation (m)	Approx. km Along Road	Material Type	Description	Adjacent Water pH (pH units)	Adjacent Water Conductivity (uS/cm)
Method									
MDL									
Crustal Abundance: From									
Crustal Abundance: To									
SCR-01	09V	382413	6332952	1133.3	1.5	Rock	Near road alignment below talus slope and in broken-rock field. Snow cover precludes identification of broken rock as talus or in-situ subcrop Visible rock is light grey silicified volcanics, but may be sedimentary.		
SCR-02	09V	384018	6337854	843.0	6.9	Sediment	Floodplain sediments (alluvium). Sediments are ornage-brown to light grey gravelly silty sand. Sample SCR-02 contained mostly sand and finer material.		
SCR-03	09V	382875	6333799	1035.9	2.5	Rock	High rock outcrop along creek, with road alignment above in the outcrop. Sample SCR-03 was collected at the base of the outcrop, and contained mostly green to black mafic rock (gabbro and peridotite?) and some silicic volcanics.		
SCR-04	09V	382970	6334938	1021.3	3.7	Rock	In Little Mess Valley. Black to green-black basalt with thin quartz veining, ands some medium grey volcanics		
SCR-05	09V	385240	6342335	812.7	11.8	Rock	Road alignment ~40 m up slope. Ground covered with vegetation and soil. One angular boulder ~1 m long near road alignment was matrix-supported conglomerate. Sample SCR-05 was small angular pieces of medium-grey volcanics near the conglomerate boulder. Collected water in channel against east slope.	6.56	830
SCR-06	09V	384980	6347790	793.7	17.4	Gravel	Floodplain of Alexander Creek ~100 m wide; cobbles, gravel, and sand; Sample SCR-06 was brown to medium-grey to buff gravel.	8	260
SCR-07	09V	384250	6349882	751.9	19.8	Sediment	Brown sand exposure with some cobbles along east side of Mess Creek. Sample SCR-07 was half sand and half cobbles.		
SCR-08A	09V	385705	6356021	756.0	26.2	Rock	Road crossing at Nahta Creek. Sample SCR-08A: rock outcrop on south side of creek: heavily weathered greywacke with heavy iron staining on rock surfaces.	7.89	140
SCR-08B	09V	385705	6356021	756.0	26.2	Sediment	Road crossing at Nahta Creek. Sample SCR-08B: Nahta Creek alluvium: grey sand and gravel		
SCR-09	09V	385028	6359373	718.5	29.8	Rock	Small outcrop ~10 m from easternmost channel; black small-block (“chunky”) mudstone with some blue and green grains		
SCR-10	09V	384923	6359889	721.6	30.3	Rock	Road alignment is ~half way up a high, steep outcrop. Sample SCR-10 was collected from boulders at the base of the outcrop; dark brown to medium grey, small-block (“chunky”) silicified mudstone or volcanic.		
SCR-11	09V	384536	6361822	724.5	32.5	Rock	Rock outcrop in the middle of Mess Creek floodplain, adjacent to road alignment. Sample SCRF-11 was dark brown to black small-block (“chunky”) silicified mudstone or volcanic.		

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **ABA Data**
Comments: Sampled by MDAG Oct '07.
pH of DI water used for paste pH read 6.2

Sample Id.	Paste pH	S (Total)	S (Sulphide)	S (Sulphide)	Carbonate Leach S (Sulphate)	HCl Leachable S (Sulphate)	$S(BaSO_4)$	$S(del_{actual})$	S(del)	TAP	SAP	PAP	NP	Available NP	Total C	Inorganic C	Inorganic CO_2	Excess C
	Unity	(% Leco)	(% Leco)	(% Calc)	(%)	(%)	(%)	(%)	(%)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(% Leco)	(%)	(%)	(%)
Method	OA-ELE07	S-IR08	S-IR07	S-CAL06	S-GRA06	S-GRA06a	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	OA-VOL08	Calculated	C-IR07	C-GAS05	C-GAS05	Calculated
MDL	0.1	0.01	0.01	0.01	0.01	0.01							1		0.01	0.05	0.2	
SCR-01	8.6	0.01	0.02	-0.01	*0.005*	0.02	0.002	-0.032	0.000	0.3	0.6	0.2	15	5	0.24	0.07	0.3	0.17
SCR-02	9	0.16	0.16	0.15	0.01	0.01	0.015	-0.025	0.000	5.0	5.0	4.6	160	150	2.13	1.99	7.3	0.14
SCR-03	9.2	0.01	0.02	0	*0.005*	0.01	0.025	-0.045	0.000	0.3	0.6	0.3	9	-1	0.07	*0.025*	0.2	0.045
SCR-04	9.4	0.01	0.01	-0.01	*0.005*	0.02	0.019	-0.039	0.000	0.3	0.3	0.2	51	41	0.48	0.44	1.6	0.04
SCR-05	8.5	0.06	0.06	0.05	0.01	0.01	0.017	-0.027	0.000	1.9	1.9	1.6	387	377	4.67	1.5	5.5	3.17
SCR-06	9	0.16	0.15	0.14	0.01	0.02	0.036	-0.046	0.000	5.0	4.7	4.2	57	47	0.49	0.44	1.6	0.05
SCR-07	8	0.02	0.02	0.01	*0.005*	0.01	0.006	-0.016	0.000	0.6	0.6	0.3	86	76	1.54	1.14	4.2	0.4
SCR-08A	6.9	0.39	0.25	0.28	0.09	0.11	0.025	0.005	0.005	12.2	8.0	7.6	16	6	0.3	0.17	0.6	0.13
SCR-08B	8.7	0.08	0.07	0.07	0.01	0.01	0.013	-0.013	0.000	2.5	2.2	1.3	164	154	1.26	1.21	4.5	0.05
SCR-09	8.7	0.01	0.03	0	*0.005*	0.01	0.021	-0.051	0.000	0.3	0.9	0.6	31	21	0.3	0.27	1	0.03
SCR-10	9.5	*0.005*	*0.005*	-0.015	*0.005*	0.02	0.031	-0.051	0.000	0.2	0.2	0.2	11	1	0.12	0.11	0.4	0.01
SCR-11	8.3	0.06	0.06	0.055	0.04	*0.005*	0.088	-0.093	0.000	1.9	1.9	0.2	29	19	0.37	0.24	0.9	0.13
Maximum	9.5	0.39	0.25	0.28	0.09	0.11	0.088	0.0049	0.0049	12.2	7.97	7.58	387	377	4.67	1.99	7.3	3.17
Minimum	6.9	0.005	0.005	-0.015	0.005	0.005	0.0021	-0.093	0	0.16	0.16	0.16	9	-1	0.07	0.025	0.2	0.01
Mean	8.65	0.081	0.071	0.06	0.017	0.021	0.025	-0.036	0.00041	2.54	2.24	1.77	84.7	74.7	1	0.63	2.34	0.36
Standard Deviation	0.71	0.11	0.076	0.09	0.025	0.028	0.022	0.025	0.0014	3.51	2.42	2.41	110	110	1.32	0.65	2.4	0.89
10 Percentile	8.03	0.01	0.011	-0.01	0.005	0.01	0.0069	-0.051	0	0.31	0.34	0.16	11.4	1.4	0.13	0.074	0.31	0.031
25 Percentile	8.45	0.01	0.02	-0.0025	0.005	0.01	0.014	-0.047	0	0.31	0.62	0.2	15.8	5.75	0.28	0.16	0.55	0.044
Median	8.7	0.04	0.045	0.03	0.0075	0.01	0.02	-0.035	0	1.25	1.41	0.47	41	31	0.42	0.36	1.3	0.09
75 Percentile	9.05	0.1	0.09	0.088	0.01	0.02	0.027	-0.023	0	3.12	2.81	2.25	104	94.5	1.33	1.16	4.28	0.15
90 Percentile	9.38	0.16	0.16	0.15	0.037	0.02	0.035	-0.013	0	5	4.97	4.59	164	154	2.07	1.47	5.4	0.38
Interquartile Range (IQR) [1]	0.6	0.09	0.07	0.09	0.005	0.01	0.013	0.024	0	2.81	2.19	2.05	88.8	88.8	1.05	1	3.73	0.1
Variance	0.5	0.013	0.0058	0.008	0.00063	0.00081	0.00049	0.00061	0.000002	12.3	5.84	5.79	11998	11998	1.75	0.43	5.75	0.79
Skewness	-1.37	2.18	1.45	1.55	2.74	3.25	2.34	-0.73	3.46	2.18	1.49	1.64	2.21	2.21	2.27	1.05	1.05	3.38
Coefficient of Variation (CoV) [2]	0.082	1.38	1.07	1.49	1.5	1.34	0.89	-0.69	3.46	1.38	1.08	1.36	1.29	1.47	1.33	1.03	1.02	2.45
Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12

Total
NPR < 1.0 or NPR = 1.0
1.0 < NPR < 2.0
NPR > 2.0 or NPR =2.0

% NPR < 1.0 or NPR = 1.0 of Total
% 1.0 < NPR < 2.0 of Total
% NPR > 2.0 or NPR =2.0 of Total

[1] Interquartile Range (IQR) = 75th percentile minus 25th percentile
[2] Coefficient of Variation (CoV) = standard deviation divided by mean
NOTE: If data was reported as < detection limit half the detection limit is shown in italics and was used in subsequent calculations.

% S (Sulphide) (calc) = % S (Total) - % S (Sulphate) Carbonate Leach
%$S(BaSO_4)$ = Ba (ppm) * 0.0001 * 32.06 / 137.37
% S (del $_{actual}$) = %S(Total) - %S(Sulphide) Leco - %S(Sulphate) Carbonate Leach - %$S(BaSO_4)$
% S (del) = % S (del $_{actual}$) unless < 0, then 0
TAP = % S (Total) * 31.25
SAP = % S (Sulphide + del) * 31.25

PAP = % Pyrite(Calculated) * 31.25
Note: If Calculated Pyrite is < 0.005 then calculated pyrite assumed to be 0.005
Unavailable NP (UNP) = 10
Available NP = NP - Unavailable NP

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **ABA Data**
Comments: Sampled by MDAG Oct '07.

Sample Id.	Total CaNP	Inorganic CaNP	(Ca) CaNP	(Ca+Mg) CaNP	TNNP	Adjusted TNNP	SNNP	Adjusted SNNP	PNNP	Adjusted PNNP	TNPR	Adjusted TNPR	SNPR	Adjusted SNPR	PNPR	Adjusted PNPR	Fizz Rating	Comparison of Fizz Rating & NP
	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)							Unity	
Method	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	OA-VOL08	
MDL																		
SCR-01	20.0	6.8	129.9	272.7	14.7	4.7	14.4	4.4	14.8	4.8	48	16	24	8	68.2	22.7	1	Agree
SCR-02	177.5	166.0	96.4	201.0	155.0	145.0	155.0	145.0	155.4	145.4	32	30	32	30	34.5	32.4	3	Agree
SCR-03	5.8	4.5	6.5	90.5	8.7	-1.3	8.4	-1.6	8.7	-1.3	28.8	0.001	14.4	0.001	26.3	0.001	1	Agree
SCR-04	40.0	36.4	81.9	160.1	50.7	40.7	50.7	40.7	50.8	40.8	163	131	163	131	200	200	2	Agree
SCR-05	389.2	125.1	392.1	454.7	385.1	375.1	385.1	375.1	385.4	375.4	206	201	206	201	240	234	3	Agree
SCR-06	40.8	36.4	49.9	173.5	52.0	42.0	52.3	42.3	52.8	42.8	11.4	9.4	12.2	10	13.7	11.3	2	Agree
SCR-07	128.3	95.5	65.4	123.9	85.4	75.4	85.4	75.4	85.7	75.7	138	122	138	122	258	228	2	Agree
SCR-08A	25.0	13.6	15.5	21.7	3.8	-6.2	8.0	-2.0	8.4	-1.6	1.31	0.492	2.01	0.753	2.11	0.791	2	Disagree
SCR-08B	105.0	102.3	112.1	365.3	161.5	151.5	161.8	151.8	162.7	152.7	65.6	61.6	75	70.4	128	120	3	Agree
SCR-09	25.0	22.7	111.4	165.3	30.7	20.7	30.1	20.1	30.4	20.4	99.2	67.2	33.1	22.4	51.5	34.9	2	Disagree
SCR-10	10.0	9.1	15.7	21.1	10.8	0.8	10.8	0.8	10.8	0.8	200	200	200	200	200	200	2	Disagree
SCR-11	30.8	20.5	27.2	65.9	27.1	17.1	27.1	17.1	28.8	18.8	15.5	10.1	15.5	10.1	200	200	2	Disagree
Maximum	389	166	392	455	385	375	385	375	385	375	206	201	206	201	258	234		
Minimum	5.83	4.55	6.49	21.1	3.81	-6.19	8.03	-1.97	8.42	-1.58	1.31	0.001	2.01	0.001	2.11	0.001		
Mean	83.1	53.3	92	176	82.1	72.1	82.4	72.4	82.9	72.9	84.1	70.7	76.3	67.1	119	107		
Standard Deviation	110	54.5	104	133	110	110	109	109	109	109	75	75.1	78.1	76.9	96	98.5		
10 Percentile	11	7.05	15.5	26.1	8.9	-1.1	8.62	-1.38	8.88	-1.12	11.8	1.38	12.4	1.48	15	1.84		
25 Percentile	23.8	12.5	24.3	84.3	13.7	3.73	13.5	3.49	13.8	3.8	25.5	9.93	15.2	9.5	32.4	19.8		
Median	35.4	29.6	73.7	163	40.7	30.7	40.4	30.4	40.6	30.6	56.8	45.8	32.6	26.2	98.1	77.4		
75 Percentile	111	97.2	112	219	103	92.8	103	92.8	103	93.1	144	124	144	124	200	200		
90 Percentile	173	123	128	356	161	151	161	151	162	152	196	193	196	193	236	225		
Interquartile Range (IQR) [1]	87.1	84.7	87.2	135	89.1	89.1	89.3	89.3	89.3	89.3	119	114	129	115	168	180		
Variance	12141	2972	10730	17619	12014	12014	11972	11972	11966	11966	5629	5642	6106	5907	9213	9695		
Skewness	2.27	1.05	2.47	0.92	2.22	2.22	2.23	2.23	2.22	2.22	0.62	0.86	0.81	0.93	0.2	0.18		
Coefficient of Variation (CoV) [2]	1.33	1.02	1.13	0.75	1.33	1.52	1.33	1.51	1.32	1.5	0.89	1.06	1.02	1.14	0.81	0.92		
Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12		
Total																		
NPR < 1.0 or NPR = 1.0											0	2	0	2	0	2		
1.0 < NPR < 2.0											1	0	0	0	0	0		
NPR > 2.0 or NPR =2.0											11	10	12	10	12	10		
% NPR < 1.0 or NPR = 1.0 of Total											0.00	16.67	0.00	16.67	0.00	16.67		
% 1.0 < NPR < 2.0 of Total											8.33	0.00	0.00	0.00	0.00	0.00		
% NPR > 2.0 or NPR =2.0 of Total											91.67	83.33	100.00	83.33	100.00	83.33		

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **ABA Data**
Comments: Sampled by MDAG Oct '07.

Sample Id.	Total CaNP	Inorganic CaNP	(Ca) CaNP	(Ca+Mg) CaNP	TNNP	Adjusted TNNP	SNNP	Adjusted SNNP	PNNP	Adjusted PNNP	TNPR	Adjusted TNPR	SNPR	Adjusted SNPR	PNPR	Adjusted PNPR	Fizz Rating	Comparison of Fizz Rating & NP
	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)	(kg $CaCO_3$/t)							Unity	
Method	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	Calculated	OA-VOL08	
MDL																		

[1] Interquartile Range (IQR) = 75th percentile minus 25th percentile
[2] Coefficient of Variation (CoV) = standard deviation divided by mean
NOTE: If data was reported as < detection limit half the detection limit is shown in italics and was used in subsequent calculations.

Total CaNP = % C * 10 * 100.09 / 12.01
Inorganic CaNP = % CO_2 * 10 * 100.09 / 44.01
(Ca) CaNP = (Ca(ppm) * 100.09 / 40.08) / 1000
(Ca+Mg) CaNP = ((Ca(ppm) * 100.09 / 40.08) + (Mg(ppm) * 100.09 / 24.31)) / 1000
TNNP = NP - TAP
Adjusted TNNP = Available NP - TAP
SNNP = NP - SAP
Adjusted SNNP = Available NP - SAP
PNNP = NP - PAP
Adjusted PNNP = Available NP - PAP

TNPR = NP / TAP
Note: If % S(Total) < 0.01 then TNPR = 200
Note: If % S(Total) > 0.01 and NP < = 0 then TNPR = 0.001
Adjusted TNPR = UNP / TAP
Note: If % S(Total) < 0.01 then Adjusted TNPR = 200
Note: If % S(Total) > 0.01 and UNP < = 0 then Adjusted TNPR = 0.001
SNPR = NP / SAP
Note: If % S(Sulphide + del) < 0.01 then SNPR = 200
Note: If % S(Sulphide + del) > 0.01 and NP < = 0 then SNPR = 0.001
Adjusted SNPR = UNP / SAP
Note: If % S(Sulphide + del) < 0.01 then Adjusted SNPR = 200
Note: If % S(Sulphide + del) > 0.01 and UNP < = 0 then Adjusted SNPR = 0.001
PNPR = NP / PAP
Note: If % S(Pyrite, calc) < 0.01 then PNPR = 200
Note: If % S(Pyrite, calc) > 0.01 and NP < = 0 then PNPR = 0.001
Adjusted PNPR = UNP / TAP
Note: If % S(Pyrite, calc) < 0.005 then Adjusted PNPR = 200
Note: If % S(Pyrite, calc) > 0.005 and UNP < = 0 then Adjusted PNPR = 0.001

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **Calculated Mineralogy**
Comments: Sampled by MDAG Oct '07.

Sample Id.	Calculated S (Pyrite) FeS_2 (%)	Calculated S (Chalcopyrite) $CuFeS_2 + CuS_2$ (%)	Calculated S (Arsenopyrite) FeAsS + AsS (%)	Calculated S (Galena) PbS (%)	Calculated S (Cinnibar) HgS (%)	Calculated S (Molybdenite) MoS_2 (%)	Calculated S (Pentlandite) ~NiS (%)	Calculated S (Sphalerite) ZnS (%)
SCR-01	0.007	0.006	0.00036	0.00005	0.00000008	0.0000	0.00288	0.0039
SCR-02	0.148	0.005	0.00129	0.00008	0.00000080	0.0000	0.00269	0.0030
SCR-03	0.011	0.002	0.00025	0.00012	0.00000008	0.0000	0.00242	0.0041
SCR-04	0.003	0.001	0.00012	0.00006	0.00000008	0.0001	0.00067	0.0051
SCR-05	0.052	0.002	0.00077	0.00007	0.00000016	0.0000	0.00298	0.0026
SCR-06	0.133	0.002	0.00033	0.00008	0.00000048	0.0000	0.01122	0.0026
SCR-07	0.011	0.002	0.00019	0.00009	0.00000064	0.0002	0.00422	0.0027
SCR-08A	0.243	0.007	0.00049	0.00018	0.00001216	0.0020	0.00106	0.0016
SCR-08B	0.041	0.004	0.00039	0.00009	0.00000048	0.0001	0.02061	0.0043
SCR-09	0.019	0.004	0.00124	0.00008	0.00000016	0.0001	0.00142	0.0038
SCR-10	0.000	0.000	0.00020	0.00014	0.00000008	0.0001	0.00023	0.0039
SCR-11	-0.012	0.013	0.00038	0.00433	0.00000720	0.0001	0.00194	0.0525
Maximum	0.24	0.013	0.0013	0.0043	0.000012	0.002	0.021	0.052
Minimum	-0.012	0.00044	0.00012	0.000053	0.00000008	0.000021	0.00023	0.0016
Mean	0.055	0.004	0.0005	0.00045	0.0000019	0.00023	0.0044	0.0075
Standard Deviation	0.079	0.0033	0.00039	0.0012	0.0000038	0.00056	0.0059	0.014
10 Percentile	0.00031	0.0012	0.00019	0.000062	0.00000008	0.000021	0.00071	0.0026
25 Percentile	0.006	0.002	0.00024	0.000076	0.00000008	0.000037	0.0013	0.0026
Median	0.015	0.003	0.00037	0.000084	0.00000032	0.000063	0.0026	0.0038
75 Percentile	0.072	0.0048	0.00056	0.00012	0.00000068	0.000089	0.0033	0.0041
90 Percentile	0.15	0.0069	0.0012	0.00017	0.0000066	0.00017	0.011	0.005
Interquartile Range (IQR) [1]	0.066	0.0028	0.00032	0.000049	0.0000006	0.000052	0.002	0.0015
Variance	0.0062	0.000011	0.00000016	0.0000015	1.4E-11	0.00000031	0.000034	0.0002
Skewness	1.58	1.71	1.37	3.46	2.37	3.43	2.38	3.44
Coefficient of Variation (CoV) [2]	1.44	0.84	0.79	2.74	2.04	2.46	1.34	1.9
Count	12	12	12	12	12	12	12	12

Calculated S (Pyrite) (%) =
% S (Sulphide) + S (del) - S (Chalcopyrite) - S (Arsenopyrite) - S (Galena) - S (Cinnibar) - S (Molybdenite) - S (Sphalerite)
Calculated S (Chalcopyrite) CuFeS2 + CuS2 (%) = (1 / 0.99) * Copper (ppm) / 10000
Calculated S (Arsenopyrite) FeAsS + AsS (%) = (1 / 2.33) * Iron (%) / 10000
Calculated S (Galena) PbS (%) = (1 / 6.45) * Iron (ppm) / 10000
Calculated S (Cinnibar) HgS (%) = (1 / 6.25) * Gallium (ppm) / 10000
Calculated S (Molybdenite) MoS2 (%) = (1 / 1.5) * Germanium (ppm) / 10000
Calculated S (Sphalerite) ZnS (%) = (1 / 2) * Hafnium (ppm) / 10000

1

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **ICP Metals Data**
Comments: Sampled by MDAG Oct '07.
Rare earth elements may not be totally soluble in MS61 method.
ME-MS61:Interference: Ca>10% on ICP-MS As ICP-AES results shown.

Sample	Silver	Aluminum	Arsenic	Barium	Beryllium	Bismuth	Calcium	Cadmium	Cerium	Cobalt	Chromium	Cesium	Copper	Iron	Gallium	Germanium
Id.	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge
	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
Method	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61
MDL	0.01	100	0.2	10	0.05	0.01	100	0.02	0.01	0.1	1	0.05	0.2	100	0.05	0.05
Crustal Abundance: From	0.037	4200	1	0.4	1	0.007	5100	0.035	11.5	0.1	2	0.4	4	3800	4	0.2
Crustal Abundance: To	0.11	88000	13	2300	3	0.01	312400	0.42	345	74	170	6	250	86500	30	8
SCR-01	0.05	94000	8.4	10	1.75	0.02	52000	0.15	25.5	27	117	*0.025*	56.9	62200	21.4	0.17
SCR-02	0.16	55900	30.1	590	0.93	$\boxed{0.05}$	38600	0.17	24.8	21.9	62	1.22	44.7	51400	13.2	0.17
SCR-03	0.08	77100	5.8	1100	1.27	$\boxed{0.04}$	2600	0.26	29.1	18.5	59	0.59	21.6	27600	17.3	0.15
SCR-04	0.12	89300	2.7	770	3.06	0.01	32800	0.13	124.5	18.7	8	0.39	10.7	81600	25.6	0.3
SCR-05	0.09	68200	18	720	0.86	0.02	157000	0.18	24.4	12.4	60	0.7	18.9	24200	14.45	0.12
SCR-06	0.07	82800	7.8	1460	1.51	$\boxed{0.03}$	20000	0.04	26.5	19.4	208	1.69	22.8	32300	19.95	0.16
SCR-07	0.09	48900	4.5	290	1.17	$\boxed{0.06}$	26200	0.13	27.3	17	97	0.62	20.1	49300	11.55	0.15
SCR-08A	$\boxed{0.8}$	64200	11.4	1050	0.78	$\boxed{0.07}$	6200	0.12	19.1	8.8	9	1.1	69.2	32100	17	0.11
SCR-08B	0.11	63500	9.2	500	1.03	$\boxed{0.04}$	44900	0.17	23.8	38	436	1.29	36.5	51000	14.75	0.15
SCR-09	0.04	97100	28.8	790	1.74	$\boxed{0.04}$	44600	0.19	34.7	23.4	38	1.78	41.4	62000	20.8	0.18
SCR-10	0.04	75900	4.7	1320	2.88	$\boxed{0.03}$	6300	0.03	48.5	3.2	21	0.84	4.4	18600	18.05	0.14
SCR-11	$\boxed{1.7}$	87900	8.8	3590	1.96	0.02	10900	$\boxed{2.84}$	39	22.6	56	1.72	124.5	45100	19.9	0.16
Maximum	1.7	97100	30.1	3590	3.06	0.07	157000	2.84	124	38	436	1.78	124	81600	25.6	0.3
Minimum	0.04	48900	2.7	10	0.78	0.01	2600	0.03	19.1	3.2	8	0.025	4.4	18600	11.6	0.11
Mean	0.28	75400	11.7	1016	1.58	0.036	36842	0.37	37.3	19.2	97.6	1	39.3	44783	17.8	0.16
Standard Deviation	0.49	15450	9.19	910	0.75	0.018	41480	0.78	28.6	8.88	120	0.56	32.9	18536	3.97	0.048
10 Percentile	0.041	56660	4.52	311	0.87	0.02	6210	0.048	23.9	9.16	10.2	0.41	11.5	24540	13.3	0.12
25 Percentile	0.065	64025	5.52	568	1.01	0.02	9750	0.13	24.7	15.8	33.8	0.61	19.8	30975	14.7	0.15
Median	0.09	76500	8.6	780	1.39	0.035	29500	0.16	26.9	19	59.5	0.97	29.6	47200	17.7	0.16
75 Percentile	0.13	88250	13	1155	1.8	0.042	44675	0.18	35.8	22.8	102	1.39	47.8	54050	20.2	0.17
90 Percentile	0.74	93530	27.7	1446	2.79	0.059	51290	0.25	47.6	26.6	199	1.72	68	62180	21.3	0.18
Interquartile Range (IQR) [1]	0.065	24225	7.52	588	0.8	0.023	34925	0.055	11.1	6.95	68.2	0.78	28	23075	5.49	0.023
Variance	0.24	238690909	84.4	828117	0.57	0.00032	1720582652	0.61	818	78.8	14389	0.32	1083	343577879	15.8	0.0023
Skewness	2.66	-0.23	1.37	2.24	1.05	0.53	2.47	3.42	3.02	0.25	2.39	-0.04	1.71	0.43	0.25	2.34
Coefficient of Variation (CoV) [2]	1.77	0.2	0.79	0.9	0.48	0.5	1.13	2.13	0.77	0.46	1.23	0.57	0.84	0.41	0.22	0.29
Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12

$\boxed{1.7}$ NOTE: if data is boxed, then data is 3 times the maximum crustal abundance.

[1] Interquartile Range (IQR) = 75th percentile minus 25th percentile
[2] Coefficient of Variation (CoV) = standard deviation divided by mean

NOTE: If data was reported as < detection limit half the detection limit is shown in italics and was used in subsequent calculations.

NOTE: If data was reported as > detection limit the detection limit is shown in bold and was used in subsequent calculations.

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **ICP Metals Data**
Comments: Sampled by MDAG Oct '07.
Rare earth elements may not be totally soluble in MS61 method.
ICP-MS: Interference: Samples with Molybdenum >100ppm will cause a low bias on Cadmium-MS61<1ppm
Interference: Mo>400ppm on ICP-MS Cd,ICP-AES results shown.
Tailings: Detection limits on samples requiring dilutions for Hg-CV41 due to inteferences or high concentration levels have been increased according to the dilution factor.

Sample	Hafnium	Mercury	Indium	Potassium	Lanthanum	Lithium	Magnesium	Manganese	Molybdenum	Sodium	Niobium	Nickel	Phosphorus	Lead	Rubidium	Rhenium
Id.	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re
	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
Method	ME-MS61	Hg-CV41	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61
MDL	0.1	0.01	0.005	100	0.5	0.2	100	5	0.05	100	0.1	0.2	10	0.5	0.1	0.002
Crustal Abundance: From	0.3	0.03	0.01	40	10	5	1600	390	0.2	400	0.3	2	170	1	0.2	NA
Crustal Abundance: To	11	0.4	0.26	48000	115	66	47000	6700	27	40400	35	225	1500	80	170	NA
SCR-01	1.1	*0.005*	0.067	300	11	18.4	34700	1140	0.31	29300	7.5	51.9	1580	3.4	0.5	*0.001*
SCR-02	1	0.05	0.054	10400	11.6	27.2	25400	1160	0.7	13700	8.5	48.5	980	5.3	23	*0.001*
SCR-03	3.8	*0.005*	0.067	13600	12	23.5	20400	480	0.32	29100	6.8	43.6	610	7.8	30.1	*0.001*
SCR-04	3.5	*0.005*	0.088	19100	61.2	21.8	19000	1530	0.95	31000	80.6	12.1	5240	4	31.2	*0.001*
SCR-05	1.3	0.01	0.031	13900	13.8	24.6	15200	1680	0.34	19400	8.3	53.6	1120	4.2	36.4	*0.001*
SCR-06	2	0.03	0.026	20200	13.4	14.7	30000	682	0.63	36000	11.9	202	1260	5.2	57.5	*0.001*
SCR-07	1.4	0.04	0.048	10100	12.7	29.5	14200	1670	2.65	12000	13.2	75.9	690	5.5	29.2	*0.001*
SCR-08A	1.3	0.76	0.051	21400	9.9	28.5	1500	430	29.8	18100	4.6	19	840	11.5	54	0.021
SCR-08B	2.3	0.03	0.046	10500	11.2	17.5	61500	1060	0.95	16900	7.9	371	860	5.6	28.5	*0.001*
SCR-09	2.5	0.01	0.059	14100	15.7	20.2	13100	1080	1.14	28100	8	25.5	1830	5.1	34.2	*0.001*
SCR-10	6	*0.005*	0.026	32600	25.3	3.8	1300	290	1.67	30600	15.4	4.2	400	8.8	103	*0.001*
SCR-11	3.4	0.45	0.056	38700	19	12.5	9400	7670	1.22	5200	9	35	1460	279	91.5	*0.001*
Maximum	6	0.76	0.088	38700	61.2	29.5	61500	7670	29.8	36000	80.6	371	5240	279	103	0.021
Minimum	1	0.005	0.026	300	9.9	3.8	1300	290	0.31	5200	4.6	4.2	400	3.4	0.5	0.001
Mean	2.47	0.12	0.052	17075	18.1	20.2	20475	1573	3.39	22450	15.1	78.5	1406	28.8	43.3	0.0027
Standard Deviation	1.49	0.24	0.018	10401	14.2	7.42	16444	1977	8.34	9480	20.8	105	1278	78.8	29.1	0.0058
10 Percentile	1.12	0.005	0.026	10130	11	12.7	2290	435	0.32	12170	6.87	12.8	618	4.02	23.6	0.001
25 Percentile	1.3	0.005	0.042	10475	11.5	16.8	12175	632	0.56	16100	7.8	23.9	802	4.88	29	0.001
Median	2.15	0.02	0.052	14000	13	21	17100	1110	0.95	23750	8.4	46	1050	5.4	32.7	0.001
75 Percentile	3.42	0.042	0.061	20500	16.5	25.2	26550	1565	1.33	29625	12.2	59.2	1490	8.05	54.9	0.001
90 Percentile	3.77	0.41	0.067	31480	24.7	28.4	34230	1679	2.55	30960	15.2	189	1805	11.2	88.1	0.001
Interquartile Range (IQR) [1]	2.12	0.038	0.019	10025	5.02	8.45	14375	934	0.78	13525	4.42	35.3	688	3.18	25.8	0
Variance	2.21	0.057	0.00033	108189318	203	55.1	270412955	3909224	69.6	89868182	434	11130	1633990	6214	847	0.000033
Skewness	1.27	2.37	0.25	0.8	2.97	-0.85	1.4	3.11	3.43	-0.36	3.34	2.38	2.83	3.46	1.03	3.46
Coefficient of Variation (CoV) [2]	0.6	2.04	0.35	0.61	0.79	0.37	0.8	1.26	2.46	0.42	1.38	1.34	0.91	2.74	0.67	2.17
Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12

1.7 NOTE: if data is boxed, then data is 3 times the maximum crustal abundance.

[1] Interquartile Range (IQR) = 75^{th} percentile minus 25^{th} percentile
[2] Coefficient of Variation (CoV) = standard deviation divided by mean

NOTE: If data was reported as < detection limit half the detection limit is shown in italics and was used in subsequent calculations.

NOTE: If data was reported as > detection limit the detection limit is shown in bold and was used in subsequent calculations.

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **ICP Metals Data**
Comments: Sampled by MDAG Oct '07.
Rare earth elements may not be totally soluble in MS61 method.

Sample	Sulphur	Antimony	Scandium	Selenium	Tin	Strontium	Tantalum	Tellurium	Thorium	Titanium	Thallium	Uranium	Vanadium	Tungsten	Yttrium	Zinc	Zirconium
Id.	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
Method	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61	ME-MS61
MDL	100	0.05	1	1	0.2	0.2	0.05	0.05	0.2	50	0.02	0.1	1	0.1	0.1	2	0.5
Crustal Abundance: From	240	0.1	NA	0.05	0.5	1	0.8	NA	0.004	300	0.16	0.45	20	0.6	20	16	19
Crustal Abundance: To	2400	1.5	NA	0.6	6	2000	4.2	NA	17	13800	2.3	3.7	250	2.2	90	165	500
SCR-01	*50*	1.82	46.1	2	1.1	758	0.46	*0.025*	0.9	8020	*0.01*	0.4	278	0.3	26	78	30.6
SCR-02	2000	6.29	22.9	2	1	214	0.5	*0.025*	1.5	5320	0.12	0.6	154	2	13.2	60	36.9
SCR-03	100	0.23	20.6	2	1.7	56.4	0.39	*0.025*	3.1	2920	0.13	3.4	81	0.4	25	81	135
SCR-04	100	0.41	12.2	3	2.7	319	4.66	*0.025*	4.5	13100	0.08	1.6	128	0.6	27.7	102	150
SCR-05	600	0.3	11.5	2	0.8	1180	0.46	*0.025*	1.5	2650	0.12	1	103	0.3	15.2	52	44.2
SCR-06	1500	0.8	10.3	1	0.9	709	0.56	0.05	1.7	3410	0.33	0.8	93	1.8	9.5	51	70.7
SCR-07	200	3.84	9.1	2	1	102.5	0.73	0.1	1.5	2860	0.12	0.7	115	0.8	11.9	53	53.2
SCR-08A	4300	18.1	5.9	2	3	126.5	0.15	0.08	2.1	4700	0.66	3.2	181	1.9	6.2	31	40.9
SCR-08B	1200	0.99	20.1	2	1.2	295	0.48	*0.025*	1.4	4080	0.15	0.7	136	0.6	19	85	85.7
SCR-09	*50*	0.22	30	2	1.4	701	0.44	*0.025*	1.4	7270	0.17	0.8	287	0.2	25.4	75	91.6
SCR-10	*50*	1.07	5.4	2	2.6	197.5	1.1	*0.025*	8.4	2190	0.35	3.3	25	0.7	28.2	77	238
SCR-11	600	19.05	25.8	2	2	148.5	0.52	*0.025*	2.5	5220	1.22	1.1	179	1	22.8	1050	139
Maximum	4300	19	46.1	3	3	1180	4.66	0.1	8.4	13100	1.22	3.4	287	2	28.2	1050	238
Minimum	50	0.22	5.4	1	0.8	56.4	0.15	0.025	0.9	2190	0.01	0.4	25	0.2	6.2	31	30.6
Mean	896	4.43	18.3	2	1.62	401	0.87	0.038	2.54	5145	0.29	1.47	147	0.88	19.2	150	93
Standard Deviation	1255	6.85	11.9	0.43	0.78	352	1.21	0.026	2.09	3098	0.34	1.15	76.6	0.65	7.7	284	62.1
10 Percentile	50	0.24	6.22	2	0.91	105	0.4	0.025	1.4	2671	0.084	0.61	82.2	0.3	9.74	51.1	37.3
25 Percentile	87.5	0.38	10	2	1	143	0.46	0.025	1.48	2905	0.12	0.7	100	0.38	12.9	52.8	43.4
Median	400	1.03	16.2	2	1.3	254	0.49	0.025	1.6	4390	0.14	0.9	132	0.65	20.9	76	78.2
75 Percentile	1275	4.45	23.6	2	2.15	703	0.6	0.031	2.65	5808	0.34	2	180	1.2	25.5	82	136
90 Percentile	1950	16.9	29.6	2	2.69	753	1.06	0.077	4.36	7945	0.63	3.29	268	1.89	27.5	100	149
Interquartile Range (IQR) [1]	1188	4.07	13.6	0	1.15	560	0.15	0.0062	1.17	2902	0.22	1.3	79	0.82	12.7	29.2	92.6
Variance	1576117	46.9	141	0.18	0.6	123677	1.47	0.00066	4.36	9597355	0.12	1.31	5872	0.43	59.4	80773	3857
Skewness	2.09	1.79	1.15	0	0.77	1.14	3.26	1.9	2.37	1.71	2.23	1.1	0.66	0.91	-0.38	3.44	1.21
Coefficient of Variation (CoV) [2]	1.4	1.55	0.65	0.21	0.48	0.88	1.39	0.68	0.82	0.6	1.18	0.78	0.52	0.74	0.4	1.9	0.67
Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12

$\boxed{1.7}$ NOTE: if data is boxed, then data is 3 times the maximum crustal abundance.

[1] Interquartile Range (IQR) = 75th percentile minus 25th percentile
[2] Coefficient of Variation (CoV) = standard deviation divided by mean

NOTE: If data was reported as < detection limit half the detection limit is shown in italics and was used in subsequent calculations.

NOTE: If data was reported as > detection limit the detection limit is shown in bold and was used in subsequent calculations.

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **Whole Rock by XRF**
Comments: Sampled by MDAG Oct '07.

Sample Id.	Al_2O_3	BaO	CaO	Cr_2O_3	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	SrO	TiO_2	LOI	Total
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Method	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06	ME-XRF06
MDL	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
SCR-01	18.32	0.01	7.64	0.03	9.62	0.03	6.14	0.16	4.08	0.33	48.36	0.08	1.5	3.55	99.85
SCR-02	10.3	0.07	5.33	0.01	7.38	1.2	4.32	0.15	1.86	0.194	58.25	0.02	1.02	8.96	99.06
SCR-03	15.15	0.12	0.35	0.01	3.95	1.69	3.57	0.06	4.14	0.123	67.5	0.01	0.59	2.63	99.89
SCR-04	16.79	0.09	4.67	*0.005*	12.17	2.28	3.32	0.2	4.25	1.058	48.28	0.03	2.42	4.22	99.78
SCR-05	11.75	0.08	21.24	0.02	3.37	1.53	2.48	0.21	2.41	0.221	36.87	0.1	0.42	17.9	98.60
SCR-06	15.55	0.17	2.8	0.04	4.77	2.39	5.11	0.09	4.99	0.263	58.42	0.08	0.59	4.57	99.83
SCR-07	8.86	0.03	3.48	0.02	6.78	1.16	2.43	0.2	1.57	0.131	66.44	0.01	0.49	7.07	98.67
SCR-08A	12.37	0.12	0.84	*0.005*	4.56	2.63	0.31	0.05	2.62	0.174	72.18	0.02	0.8	3.13	99.81
SCR-08B	11.65	0.06	6.35	0.09	7.54	1.21	10.31	0.14	2.28	0.171	50.9	0.03	0.69	8.2	99.62
SCR-09	19.29	0.1	6.42	0.01	9.53	1.74	2.4	0.15	3.95	0.386	51.15	0.07	1.33	3.41	99.94
SCR-10	15.26	0.15	0.86	*0.005*	2.71	4.12	0.24	0.04	4.51	0.088	70.43	0.03	0.4	0.99	99.83
SCR-11	17.71	0.42	1.52	0.01	6.92	8.75	1.87	1.06	0.85	0.311	55.8	0.02	0.98	3.44	99.66
Maximum	19.3	0.42	21.2	0.09	12.2	8.75	10.3	1.06	4.99	1.06	72.2	0.1	2.42	17.9	
Minimum	8.86	0.01	0.35	0.005	2.71	0.03	0.24	0.04	0.85	0.088	36.9	0.01	0.4	0.99	
Mean	14.4	0.12	5.12	0.021	6.61	2.39	3.54	0.21	3.13	0.29	57	0.042	0.94	5.67	
Standard Deviation	3.37	0.11	5.64	0.024	2.87	2.24	2.75	0.27	1.35	0.26	10.6	0.032	0.58	4.52	
10 Percentile	10.4	0.033	0.84	0.005	3.43	1.16	0.47	0.051	1.6	0.12	48.3	0.011	0.43	2.68	
25 Percentile	11.7	0.068	1.36	0.0088	4.41	1.21	2.27	0.082	2.17	0.16	50.3	0.02	0.56	3.34	
Median	15.2	0.095	4.08	0.01	6.85	1.72	2.9	0.15	3.28	0.21	57	0.03	0.74	3.88	
75 Percentile	17	0.13	6.37	0.022	8.04	2.45	4.52	0.2	4.17	0.32	66.7	0.073	1.1	7.35	
90 Percentile	18.3	0.17	7.52	0.039	9.61	3.97	6.04	0.21	4.48	0.38	70.1	0.08	1.48	8.88	
Interquartile Range (IQR) [1]	5.3	0.06	5.01	0.014	3.63	1.24	2.25	0.12	1.99	0.15	16.4	0.053	0.53	4.01	
Variance	11.3	0.011	31.8	0.00059	8.22	5.01	7.59	0.075	1.81	0.067	113	0.001	0.34	20.4	
Skewness	-0.18	2.34	2.36	2.41	0.46	2.36	1.32	3.17	-0.25	2.75	-0.2	0.81	1.66	2.01	
Coefficient of Variation (CoV) [2]	0.23	0.89	1.1	1.14	0.43	0.93	0.78	1.31	0.43	0.9	0.19	0.76	0.62	0.8	
Count	12	12	12	12	12	12	12	12	12	12	12	12	12	12	

[1] Interquartile Range (IQR) = 75th percentile minus 25th percentile
[2] Coefficient of Variation (CoV) = standard deviation divided by mean
NOTE: If data was reported as < detection limit half the detection limit is shown in italics and was used in subsequent calculations.

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **QA/QC Data - Comparison on ICP Metals and Whole Rock Analyses**
Comments: Sampled by MDAG Oct '07.

Sample Id.	Whole Rock Al * (ppm)	ICP Al (ppm)	Difference (%) [3]	Whole Rock Ba * (ppm)	ICP Ba (ppm)	Difference (%) [3]	Whole Rock Ca * (ppm)	ICP Ca (ppm)	Difference (%) [3]	Whole Rock Cr * (ppm)	ICP Cr (ppm)	Difference (%) [3]	Whole Rock Fe * (ppm)	ICP Fe (ppm)	Difference (%) [3]
SCR-01	96954	94000	-3.05	90	10	-88.84	54603	52000	-4.77	205	117	-43.00	67286	62200	-7.56
SCR-02	54510	55900	2.55	627	590	-5.90	38093	38600	1.33	68	62	-9.38	51618	51400	-0.42
SCR-03	80178	77100	-3.84	1075	1100	2.35	2501	2600	3.94	68	59	-13.77	27628	27600	-0.10
SCR-04	88857	89300	0.50	806	770	-4.48	33376	32800	-1.73	34	8	-76.62	85121	81600	-4.14
SCR-05	62184	68200	9.67	717	720	0.48	151801	157000	3.42	137	60	-56.15	23571	24200	2.67
SCR-06	82295	82800	0.61	1523	1460	-4.11	20011	20000	-0.06	274	208	-24.00	33363	32300	-3.19
SCR-07	46890	48900	4.29	269	290	7.93	24871	26200	5.34	137	97	-29.12	47422	49300	3.96
SCR-08A	65465	64200	-1.93	1075	1050	-2.31	6003	6200	3.27	34	9	-73.69	31894	32100	0.64
SCR-08B	61655	63500	2.99	537	500	-6.96	45383	44900	-1.06	616	436	-29.20	52738	51000	-3.29
SCR-09	102088	97100	-4.89	896	790	-11.80	45883	44600	-2.80	68	38	-44.46	66656	62000	-6.99
SCR-10	80760	75900	-6.02	1343	1320	-1.75	6146	6300	2.50	34	21	-38.62	18955	18600	-1.87
SCR-11	93726	87900	-6.22	3762	3590	-4.57	10863	10900	0.34	68	56	-18.15	48401	45100	-6.82
Maximum			9.67			7.93			5.34			-9.38			3.96
Minimum			-6.22			-88.8			-4.77			-76.6			-7.56
Mean			-0.44			-9.99			0.81			-38			-2.26
Standard Deviation			4.79			25.3			3.04			22			3.77
10 Percentile			-5.9			-11.3			-2.69			-71.9			-6.97
25 Percentile			-4.1			-6.16			-1.23			-47.4			-4.81
Median			-0.72			-4.29			0.83			-33.9			-2.53
75 Percentile			2.66			-1.19			3.31			-22.5			0.086
90 Percentile			4.16			2.16			3.89			-14.2			2.47
Interquartile Range (IQR) [1]			6.76			4.97			4.54			24.8			4.89
Variance			22.9			641			9.22			483			14.2
Skewness			0.69			-3.22			-0.32			-0.61			0.088
Coefficient of Variation (CoV) [2]			-10.8			-2.53			3.74			-0.58			-1.67
Count			12			12			12			12			12

[1] Interquartile Range (IQR) = 75th percentile minus 25th percentile
[2] Coefficient of Variation (CoV) = standard deviation divided by mean
[3] Difference (%) = (ICP - Whole Rock) * 100 / Whole Rock
* Element calculated from Whole Rock XRF analysis

Al (Whole Rock) = $(Al_2O_3*2*10000*26.98)/(2*26.98+3*16)$
Ba (Whole Rock) = $(BaO*10000*137.34)/(137.34+16)$
Ca (Whole Rock) = $(CaO*10000*40.08)/(40.08+16)$
Cr (Whole Rock) = $(Cr_2O_3*2*10000*52.00)/(2*52.00+3*16)$
Fe (Whole Rock) = $(Fe_2O_3*2*10000*55.85)/(2*55.85+3*16)$

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **QA/QC Data - Comparison on ICP Metals and Whole Rock Analyses**
Comments: Sampled by MDAG Oct '07.

Sample Id.	Whole Rock K * (ppm)	ICP K (ppm)	Difference (%) [3]	Whole Rock Mg * (ppm)	ICP Mg (ppm)	Difference (%) [3]	Whole Rock Mn * (ppm)	ICP Mn (ppm)	Difference (%) [3]	Whole Rock Na * (ppm)	ICP Na (ppm)	Difference (%) [3]	Whole Rock P * (ppm)	ICP P (ppm)	Difference (%) [3]
SCR-01	249	300	20.47	37029	34700	-6.29	1239	1140	-8.00	30268	29300	-3.20	1440	1580	9.72
SCR-02	9961	10400	4.40	26053	25400	-2.51	1162	1160	-0.15	13798	13700	-0.71	847	980	15.76
SCR-03	14029	13600	-3.06	21530	20400	-5.25	465	480	3.30	30713	29100	-5.25	537	610	13.65
SCR-04	18927	19100	0.92	20022	19000	-5.10	1549	1530	-1.22	31529	31000	-1.68	4617	5240	13.50
SCR-05	12701	13900	9.44	14956	15200	1.63	1626	1680	3.30	17879	19400	8.51	964	1120	16.13
SCR-06	19840	20200	1.82	30817	30000	-2.65	697	682	-2.15	37018	36000	-2.75	1148	1260	9.79
SCR-07	9629	10100	4.89	14655	14200	-3.10	1549	1670	7.82	11647	12000	3.03	572	690	20.70
SCR-08A	21832	21400	-1.98	1870	1500	-19.77	387	430	11.05	19437	18100	-6.88	759	840	10.63
SCR-08B	10044	10500	4.54	62177	61500	-1.09	1084	1060	-2.24	16914	16900	-0.08	746	860	15.25
SCR-09	14444	14100	-2.38	14474	13100	-9.49	1162	1080	-7.03	29303	28100	-4.11	1684	1830	8.64
SCR-10	34201	32600	-4.68	1447	1300	-10.18	310	290	-6.39	33458	30600	-8.54	384	400	4.16
SCR-11	72635	38700	-46.72	11278	9400	-16.65	8209	7670	-6.57	6306	5200	-17.54	1357	1460	7.58
Maximum			20.5			1.63			11			8.51			20.7
Minimum			-46.7			-19.8			-8			-17.5			4.16
Mean			-1.03			-6.7			-0.69			-3.27			12.1
Standard Deviation			15.9			6.34			6.09			6.37			4.54
10 Percentile			-4.52			-16			-6.99			-8.37			7.68
25 Percentile			-2.55			-9.66			-6.43			-5.66			9.45
Median			1.37			-5.18			-1.69			-2.97			12.1
75 Percentile			4.62			-2.62			3.3			-0.56			15.4
90 Percentile			8.99			-1.23			7.37			2.72			16.1
Interquartile Range (IQR) [1]			7.17			7.05			9.73			5.1			5.93
Variance			253			40.2			37.1			40.6			20.6
Skewness			-2.27			-1			0.64			-0.49			0.13
Coefficient of Variation (CoV) [2]			-15.5			-0.95			-8.82			-1.95			0.37
Count			12			12			12			12			12

[1] Interquartile Range (IQR) = 75th percentile minus 25th percentile
[2] Coefficient of Variation (CoV) = standard deviation divided by mean
[3] Difference (%) = (ICP - Whole Rock) * 100 / Whole Rock
* Element calculated from Whole Rock XRF analysis

K (Whole Rock) = (K_2O*2*10000*39.09)/(39.09*2+16)
Mg (Whole Rock) = (MgO*10000*24.31)/(24.31+16)
Mn (Whole Rock) = (MnO*10000*54.94)/(54.94+16)
Na (Whole Rock) = (Na_2O*2*10000*22.99)/(22.99*2+16)
P (Whole Rock) = (P_2O5*2*10000*30.97)/(2*30.97+5*16)

Project: **Schaft Creek**
Client: Copper Fox Metals Inc.
Data: **QA/QC Data - Comparison on ICP Metals and Whole Rock Analyses**
Comments: Sampled by MDAG Oct '07.

Sample Id.	Whole Rock Si * (ppm)	ICP Si (ppm)	Difference (%) [3]	Whole Rock Sr * (ppm)	ICP Sr (ppm)	Difference (%) [3]	Leco S (Total)** (ppm)	ICP S (ppm)	Difference (%) [3]	Whole Rock Ti * (ppm)	ICP Ti (ppm)	Difference (%) [3]
SCR-01	226066			676	758	12.05	100	50	-50.00	8992	8020	-10.81
SCR-02	272299			169	214	26.54	1600	2000	25.00	6115	5320	-13.00
SCR-03	315539			85	56	-33.30	100	100	0.00	3537	2920	-17.45
SCR-04	225692			254	319	25.75	100	100	0.00	14508	13100	-9.70
SCR-05	172355			846	1180	39.55	600	600	0.00	2518	2650	5.25
SCR-06	273093			676	709	4.81	1600	1500	-6.25	3537	3410	-3.59
SCR-07	310584			85	103	21.22	200	200	0.00	2938	2860	-2.64
SCR-08A	337417			169	127	-25.20	3900	4300	10.26	4796	4700	-2.00
SCR-08B	237940			254	295	16.29	800	1200	50.00	4137	4080	-1.37
SCR-09	239109			592	701	18.43	100	50	-50.00	7973	7270	-8.82
SCR-10	329236			254	198	-22.15	50	50	0.00	2398	2190	-8.67
SCR-11	260846			169	149	-12.19	600	600	0.00	5875	5220	-11.15
Maximum			NA			39.5			50			5.25
Minimum			NA			-33.3			-50			-17.4
Mean			NA			5.98			-1.75			-7
Standard Deviation			NA			23.6			27.4			6.23
10 Percentile			NA			-24.9			-45.6			-12.8
25 Percentile			NA			-14.7			-1.56			-10.9
Median			NA			14.2			0			-8.75
75 Percentile			NA			22.4			2.56			-2.48
90 Percentile			NA			26.5			23.5			-1.43
Interquartile Range (IQR) [1]			NA			37			4.13			8.42
Variance			NA			555			748			38.9
Skewness			NA			-0.49			-0.35			0.34
Coefficient of Variation (CoV) [2]			NA			3.94			-15.6			-0.89
Count			0			12			12			12

[1] Interquartile Range (IQR) = 75th percentile minus 25th percentile
[2] Coefficient of Variation (CoV) = standard deviation divided by mean
[3] Difference (%) = (ICP - Whole Rock) * 100 / Whole Rock
* Element calculated from Whole Rock XRF analysis

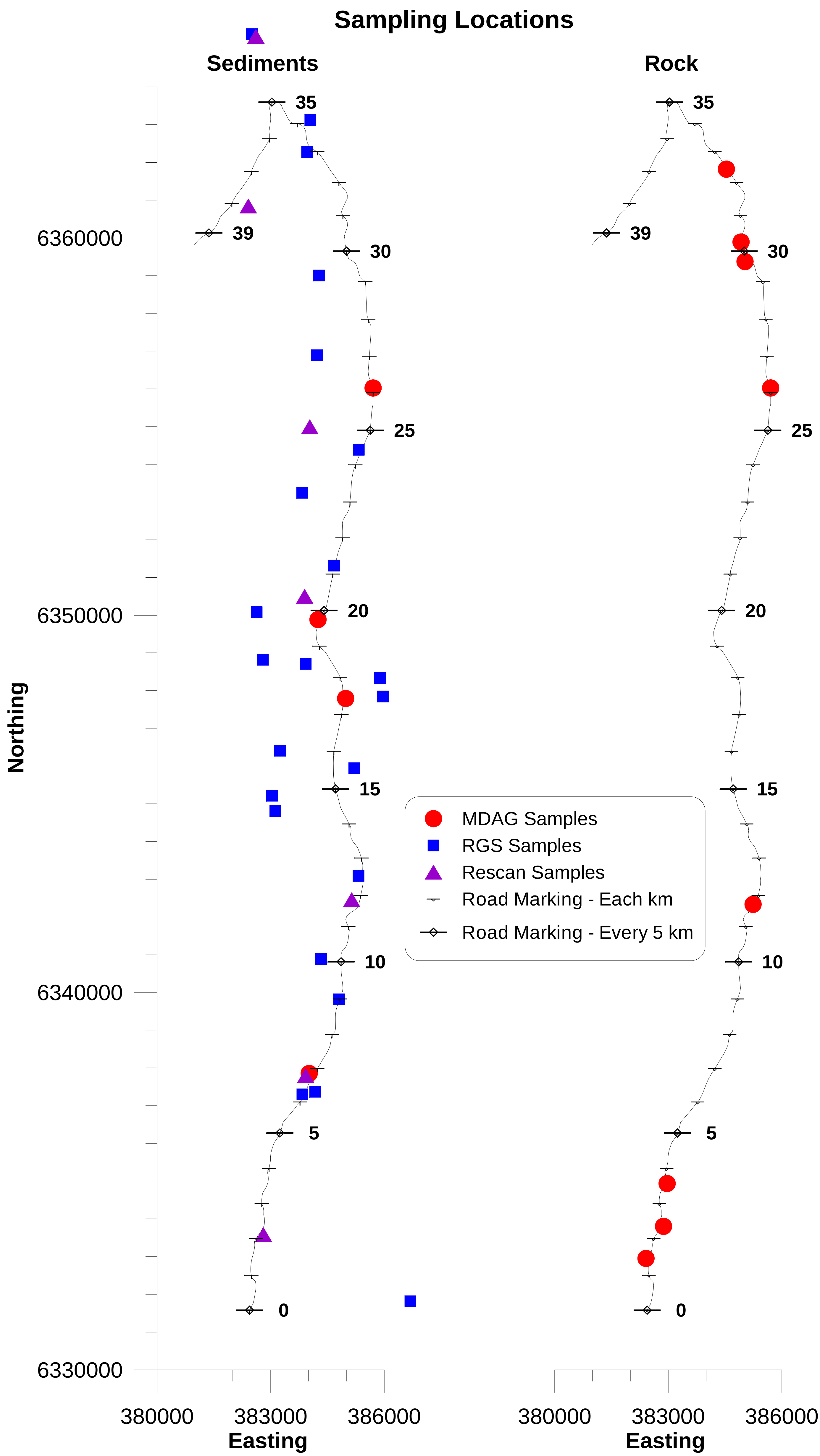
Si (Whole Rock) = (SiO_2*10000*28.09)/(28.09+2*16)

Sr (Whole Rock) = (SrO*10000*87.62)/(87.62+16)

Ti (Whole Rock) = (TiO_2*10000*47.9)/(47.9+2*16)

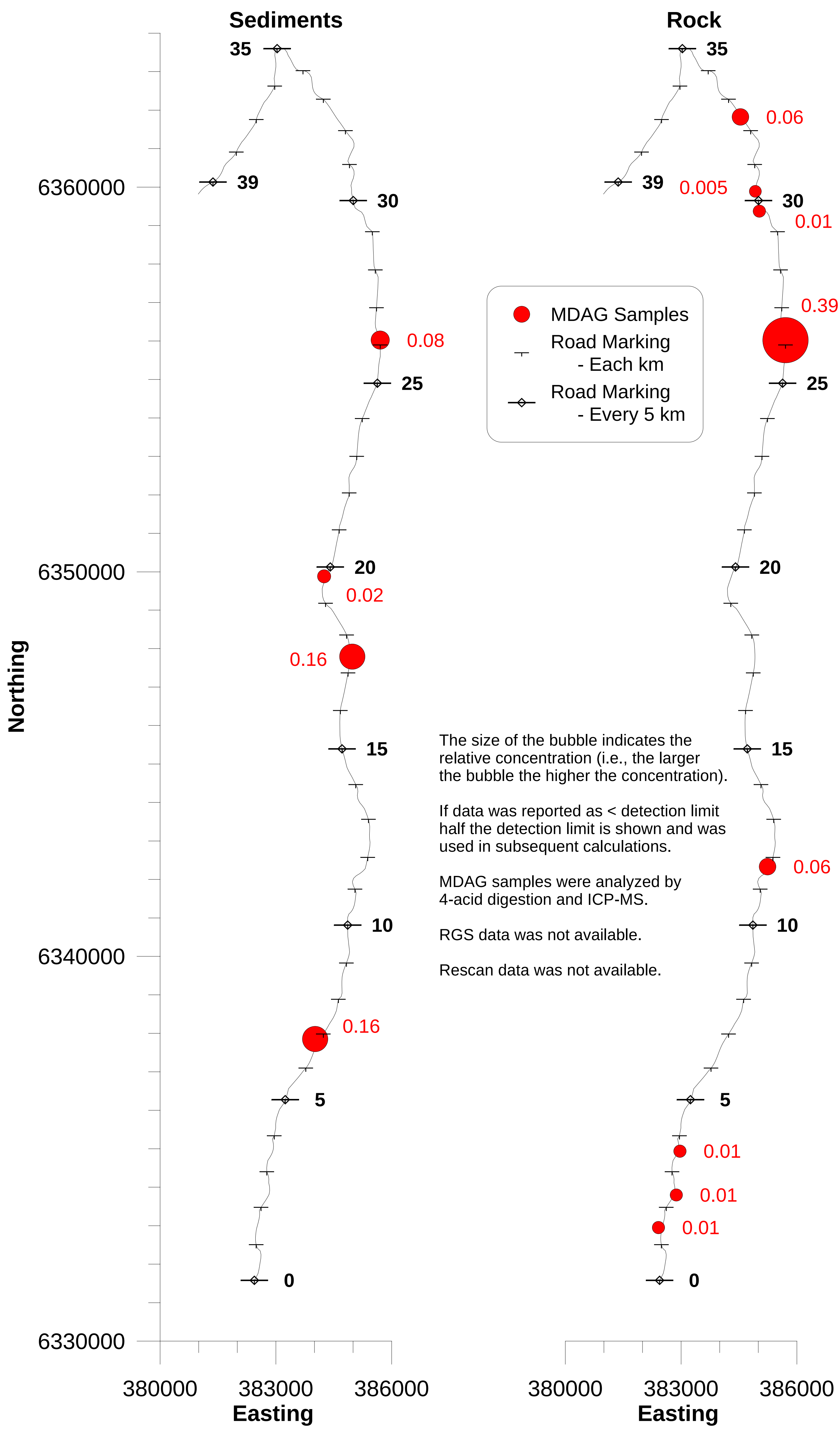
**S (Total) = S (Leco %) * 10000

APPENDIX D. Maps of Solid-Phase Element Levels Near the Proposed Road Alignment (from Appendix C of this study, from Rescan, 2007, and from provincial RGS Regional Geochemical Surveys)



Sampling Locations
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
0
5
10
15
20
25
30
35
39
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km

Total Sulphur (%)



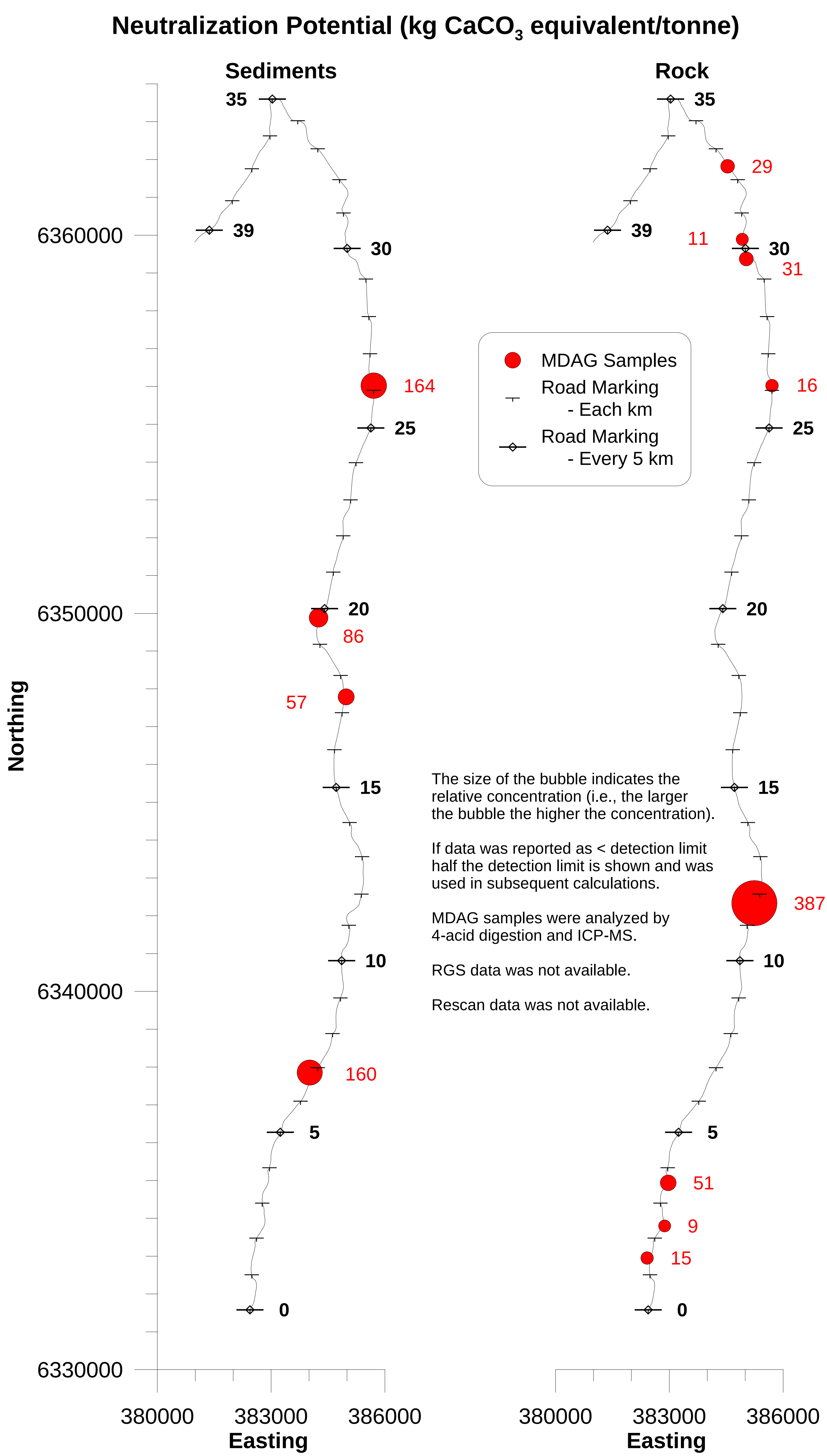
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).

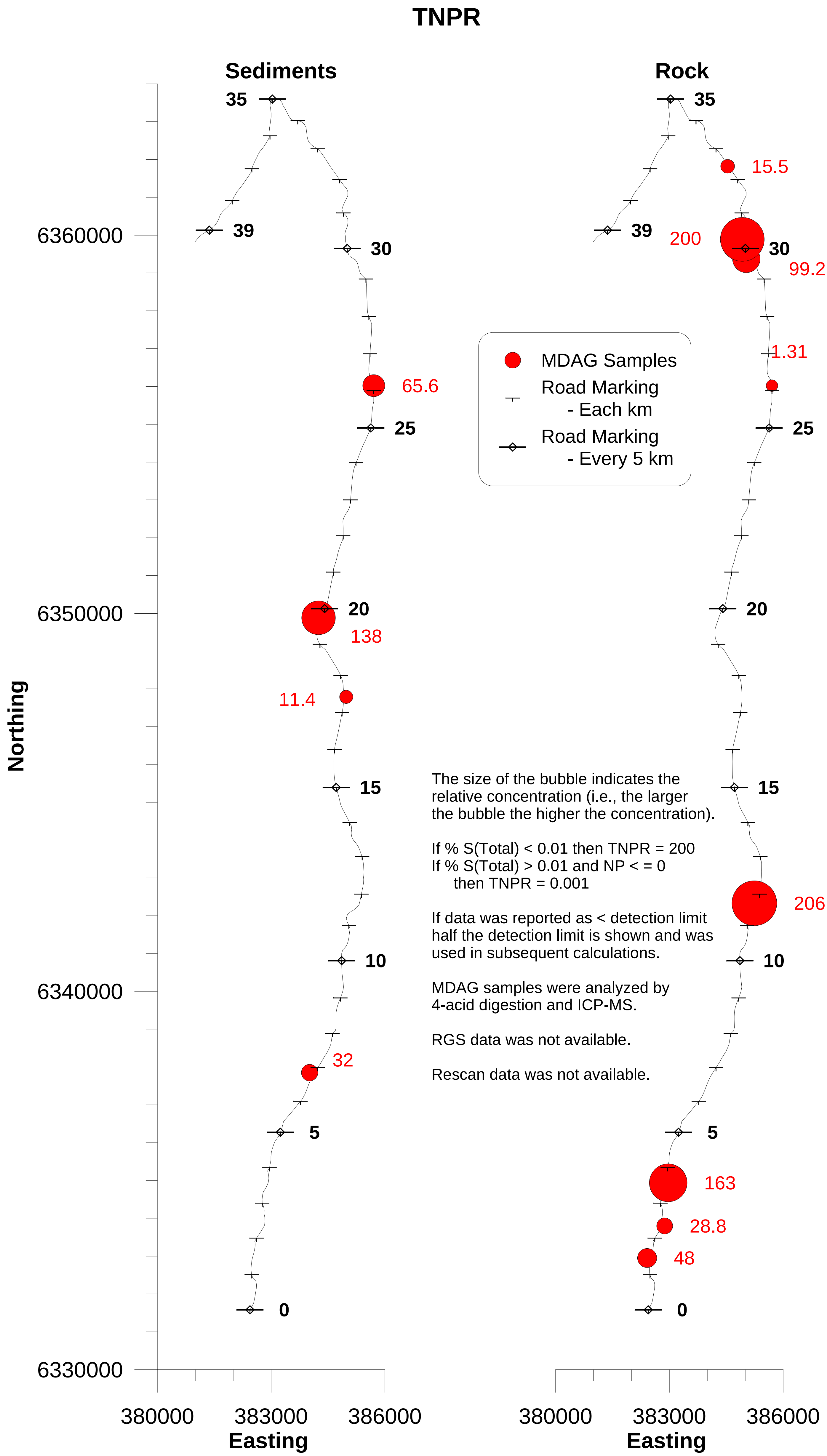
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.

MDAG samples were analyzed by 4-acid digestion and ICP-MS.

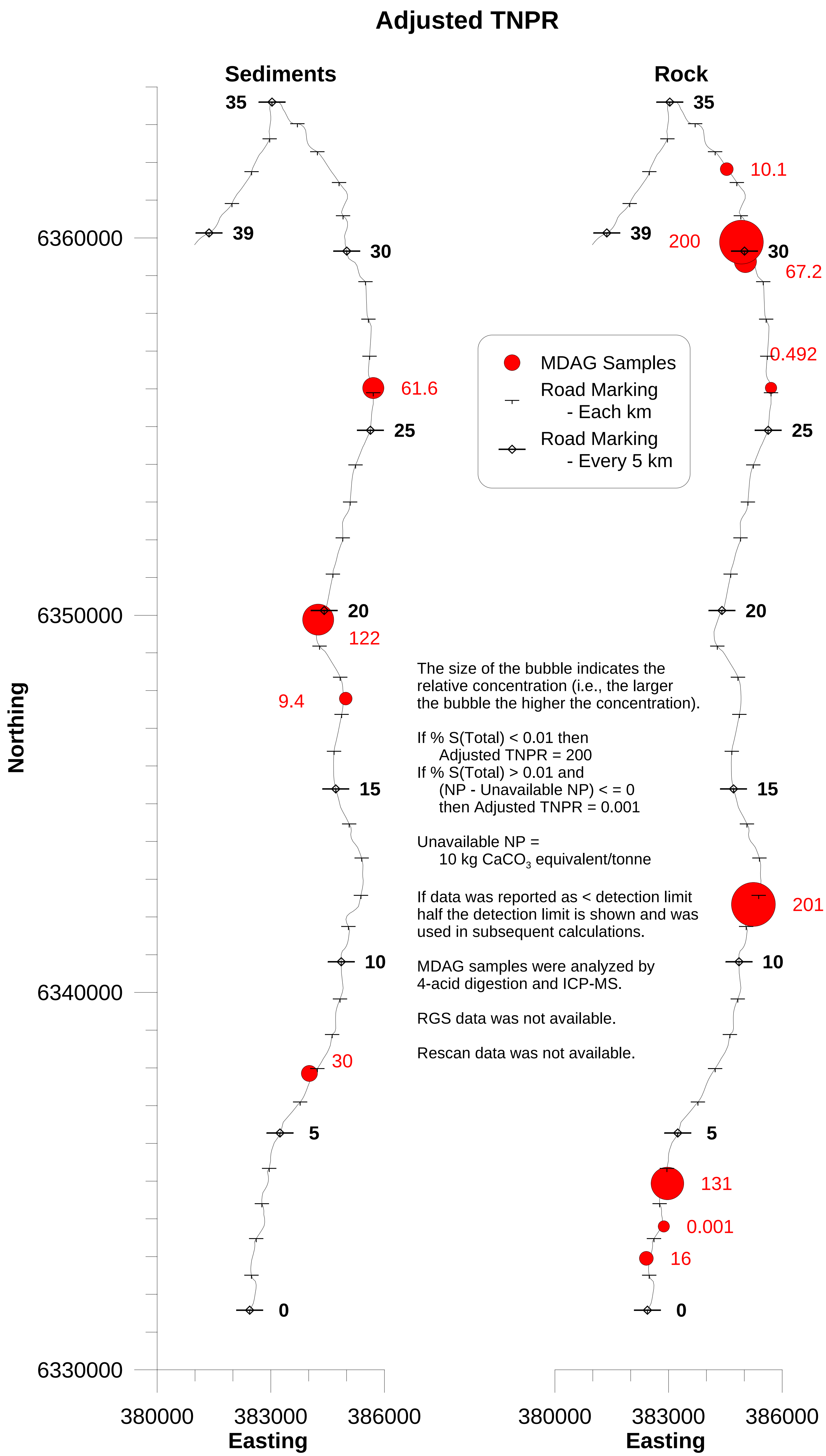
RGS data was not available.

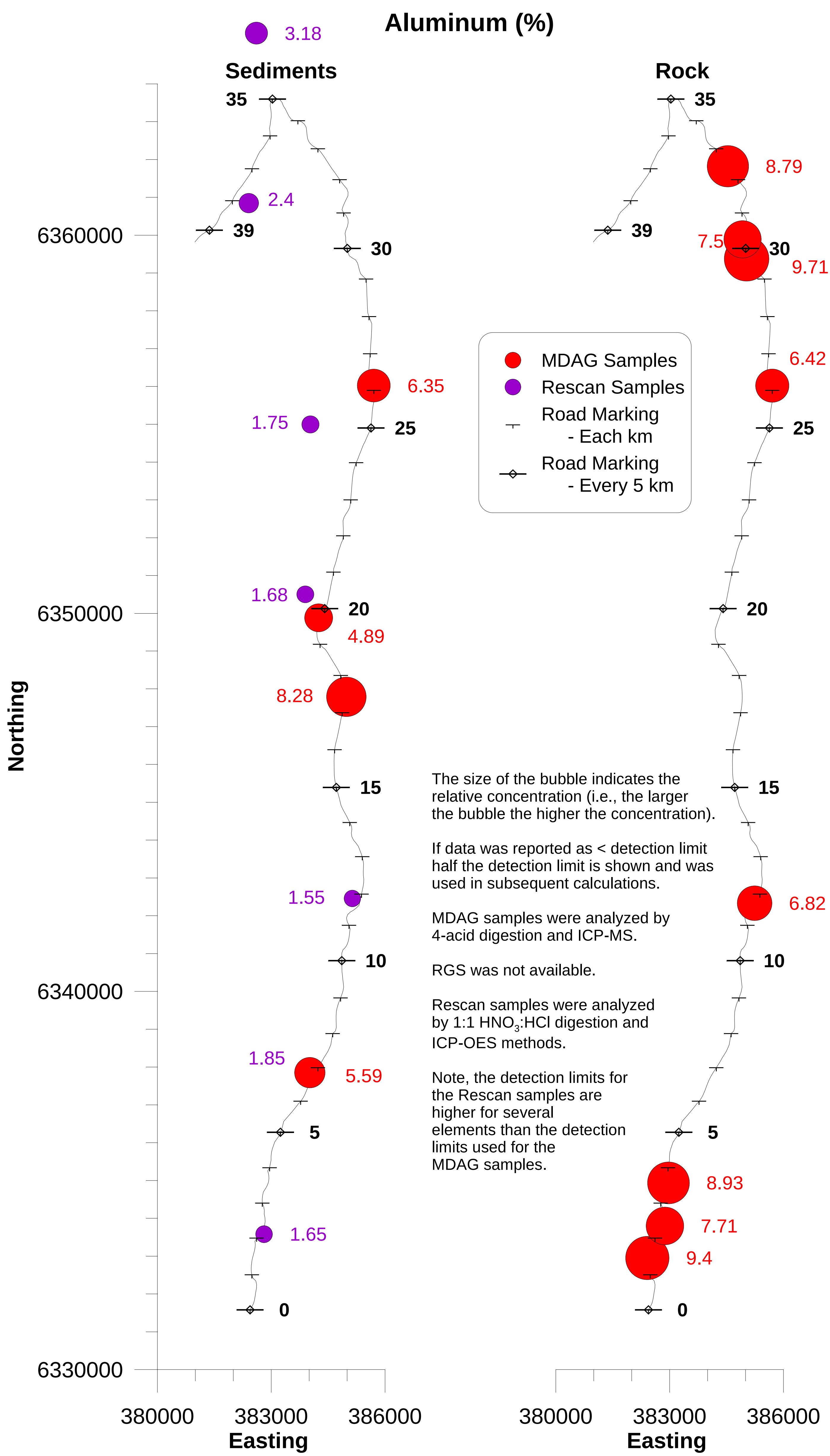
Rescan data was not available.


Neutralization Potential (kg $CaCO_3$ equivalent/tonne)
Sediments
Rock
Northing
Easting
380000
383000
386000
6330000
6340000
6350000
6360000
35
39
30
25
20
15
10
5
0
164
86
57
160
29
11
31
16
387
51
9
15
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.

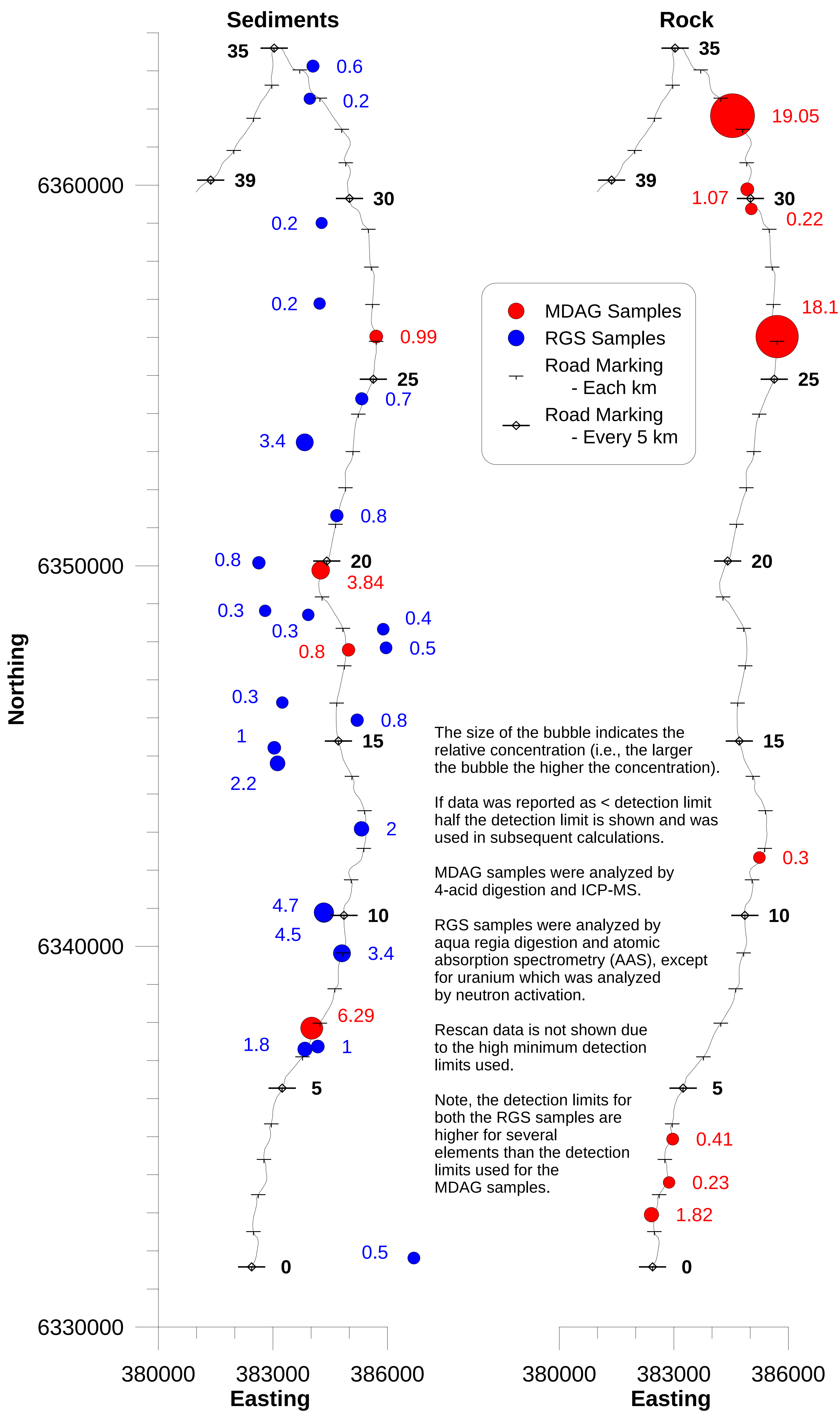


TNPR
Sediments
Rock
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
35
39
30
25
20
15
10
5
0
65.6
138
11.4
32
15.5
200
99.2
1.31
206
163
28.8
48
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If % S(Total) < 0.01 then TNPR = 200
If % S(Total) > 0.01 and NP < = 0
then TNPR = 0.001
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.


Adjusted TNPR
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
61.6
122
9.4
30
10.1
200
67.2
0.492
201
131
0.001
16
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If % S(Total) < 0.01 then Adjusted TNPR = 200
If % S(Total) > 0.01 and (NP - Unavailable NP) < = 0 then Adjusted TNPR = 0.001
Unavailable NP = 10 kg CaCO3 equivalent/tonne
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.


Aluminum (%)
Sediments
Rock
3.18
35
2.4
39
30
6.35
1.75
25
1.68
20
4.89
8.28
15
1.55
10
1.85
5.59
5
1.65
0
8.79
7.5
9.71
6.42
6.82
8.93
7.71
9.4
6360000
6350000
6340000
6330000
Northing
380000
383000
386000
Easting
MDAG Samples
Rescan Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.

Antimony (ppm)



The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).

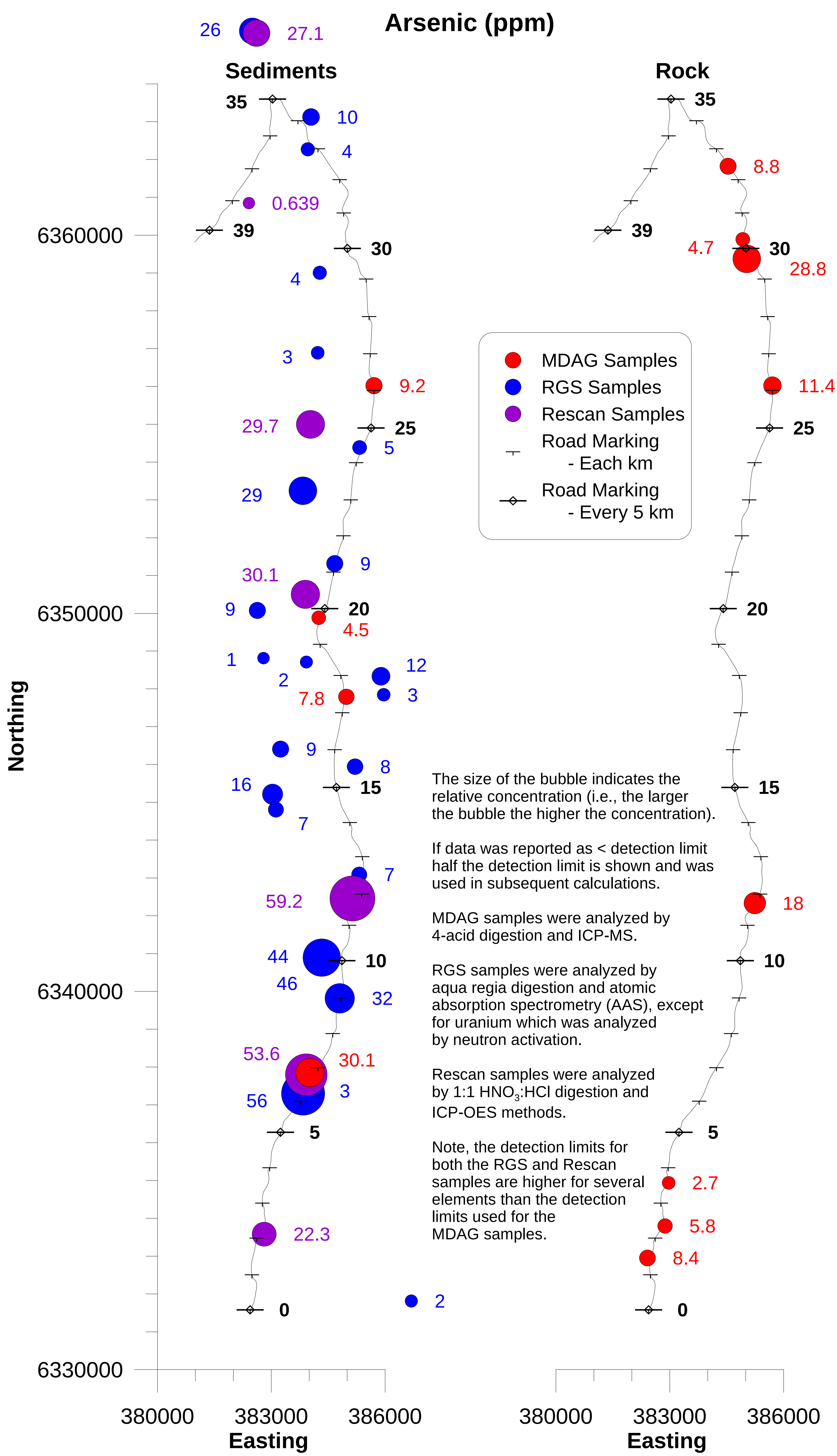
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.

MDAG samples were analyzed by 4-acid digestion and ICP-MS.

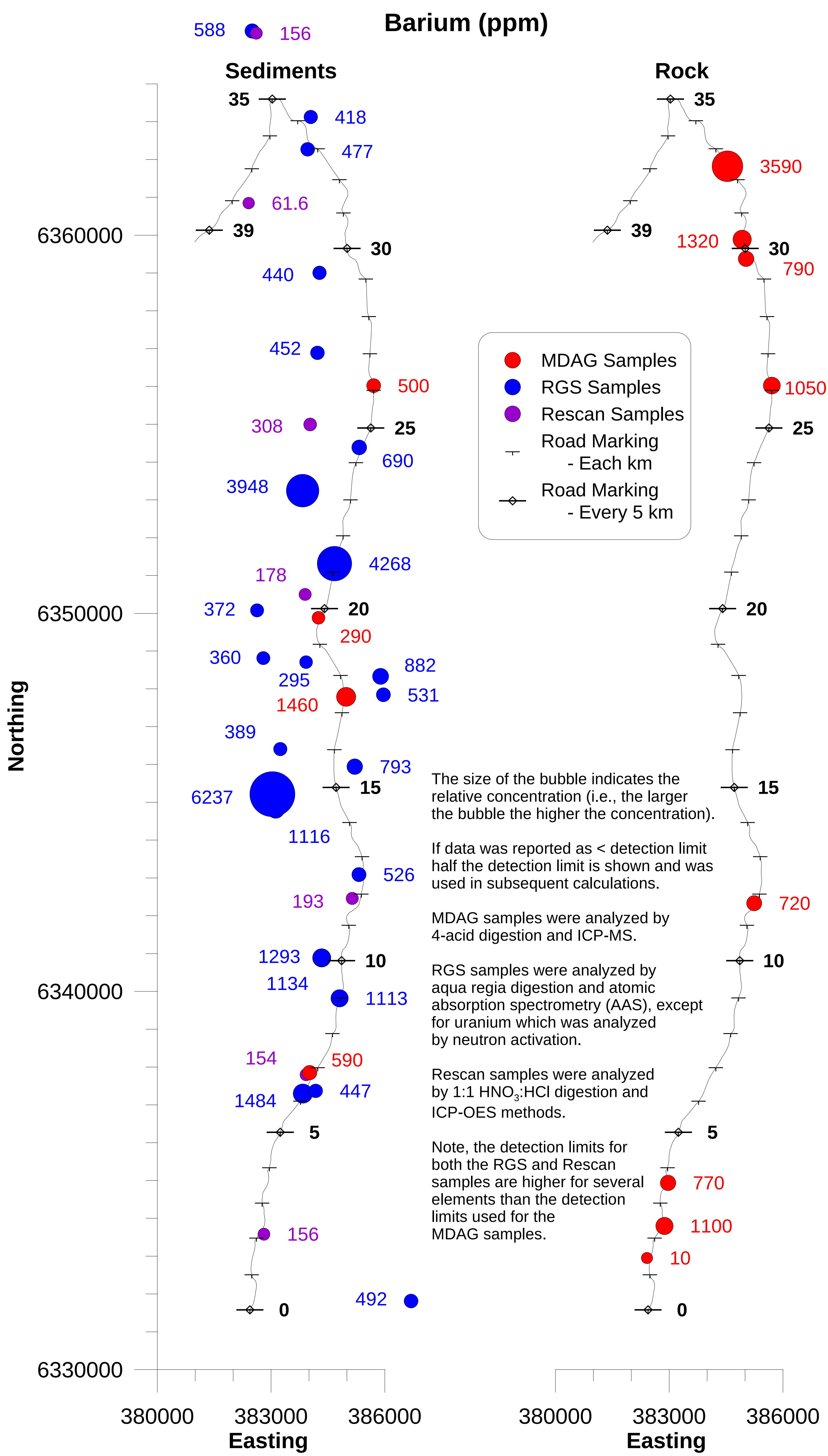
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.

Rescan data is not shown due to the high minimum detection limits used.

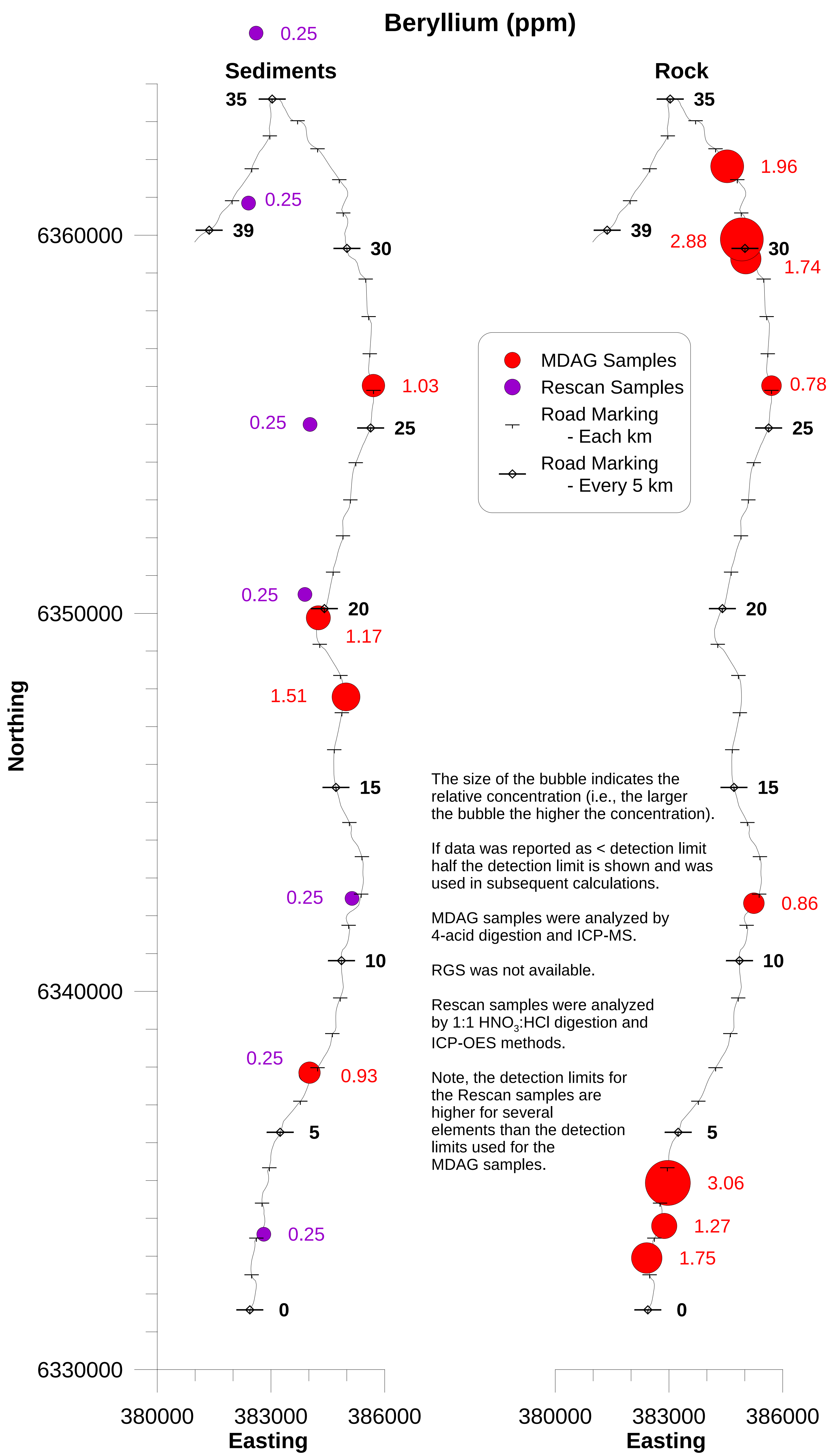
Note, the detection limits for both the RGS samples are higher for several elements than the detection limits used for the MDAG samples.



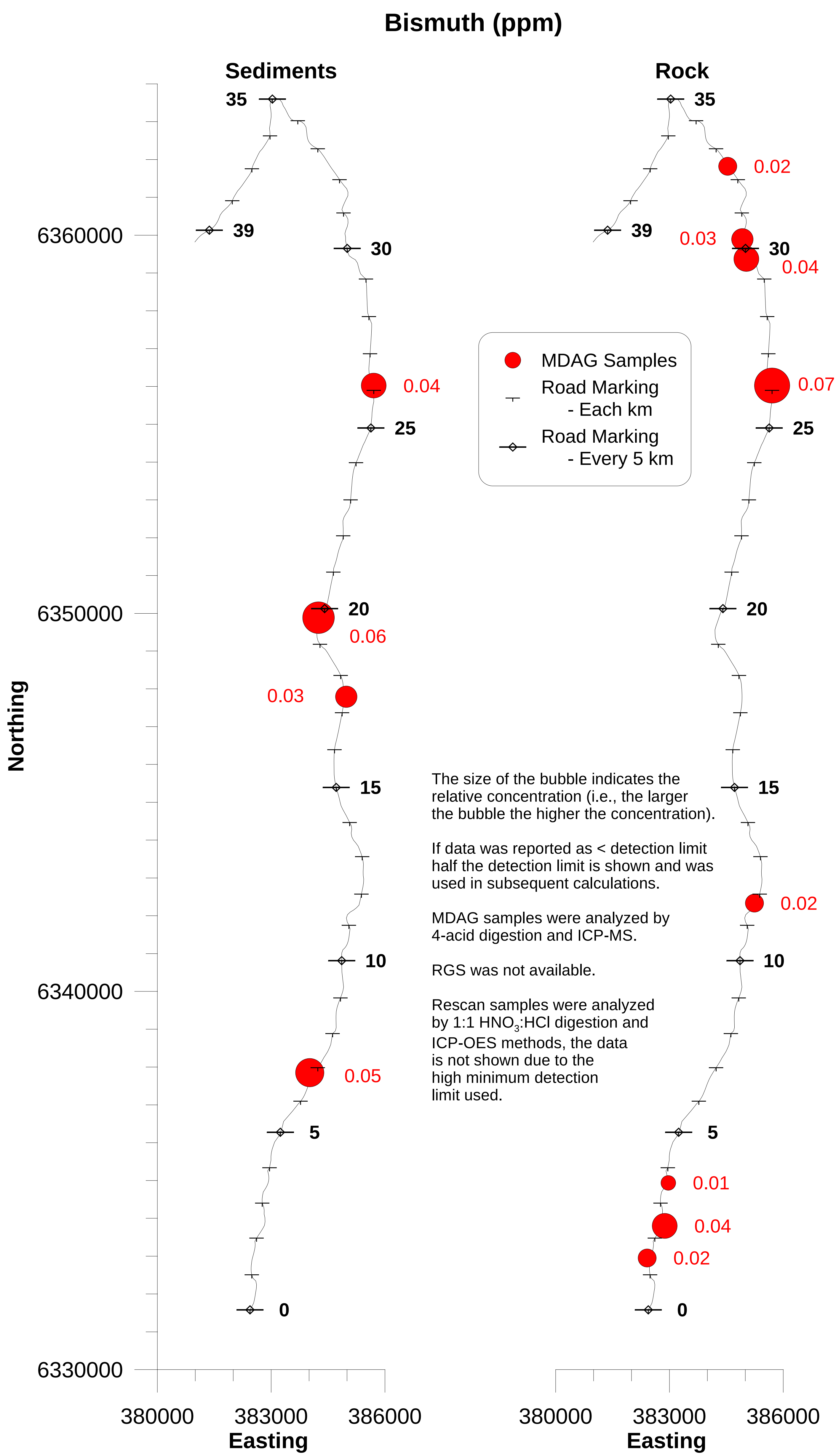
Arsenic (ppm)
Sediments
Rock
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.
Northing
6360000
6350000
6340000
6330000
Easting
380000
383000
386000
26
27.1
10
4
0.639
4
3
9.2
29.7
5
29
9
30.1
9
4.5
1
2
12
3
7.8
9
8
16
7
7
59.2
44
46
32
53.6
30.1
3
56
22.3
2
8.8
4.7
28.8
11.4
18
2.7
5.8
8.4
35
39
30
25
20
15
10
5
0



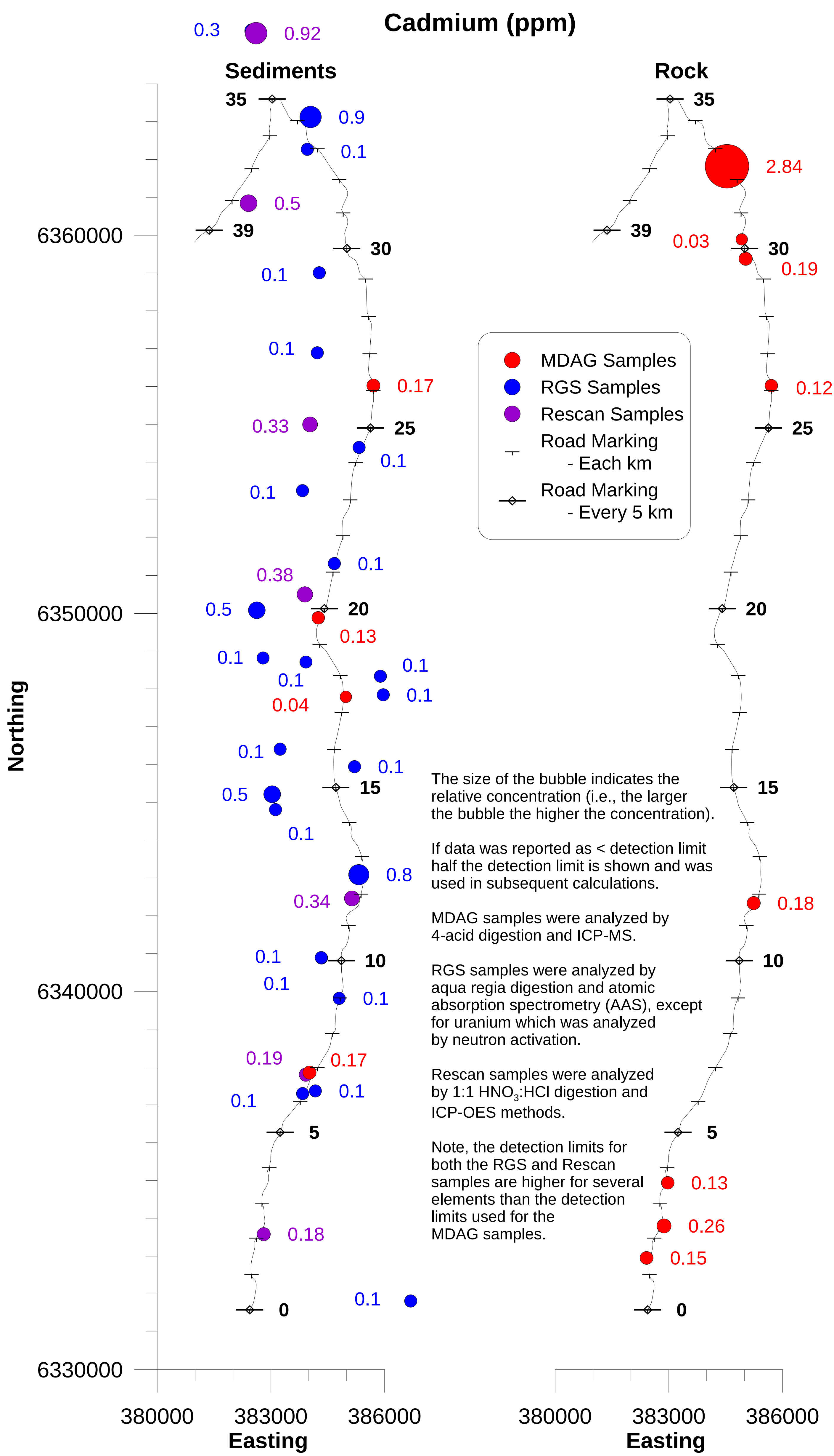
Barium (ppm)
Sediments
Rock
588
156
418
477
61.6
440
452
500
308
690
3948
4268
178
372
290
360
295
882
531
1460
389
793
6237
1116
526
193
1293
1134
1113
154
590
1484
447
156
492
3590
1320
790
1050
720
770
1100
10
35
39
30
25
20
15
10
5
0
6360000
6350000
6340000
6330000
380000
383000
386000
Northing
Easting
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



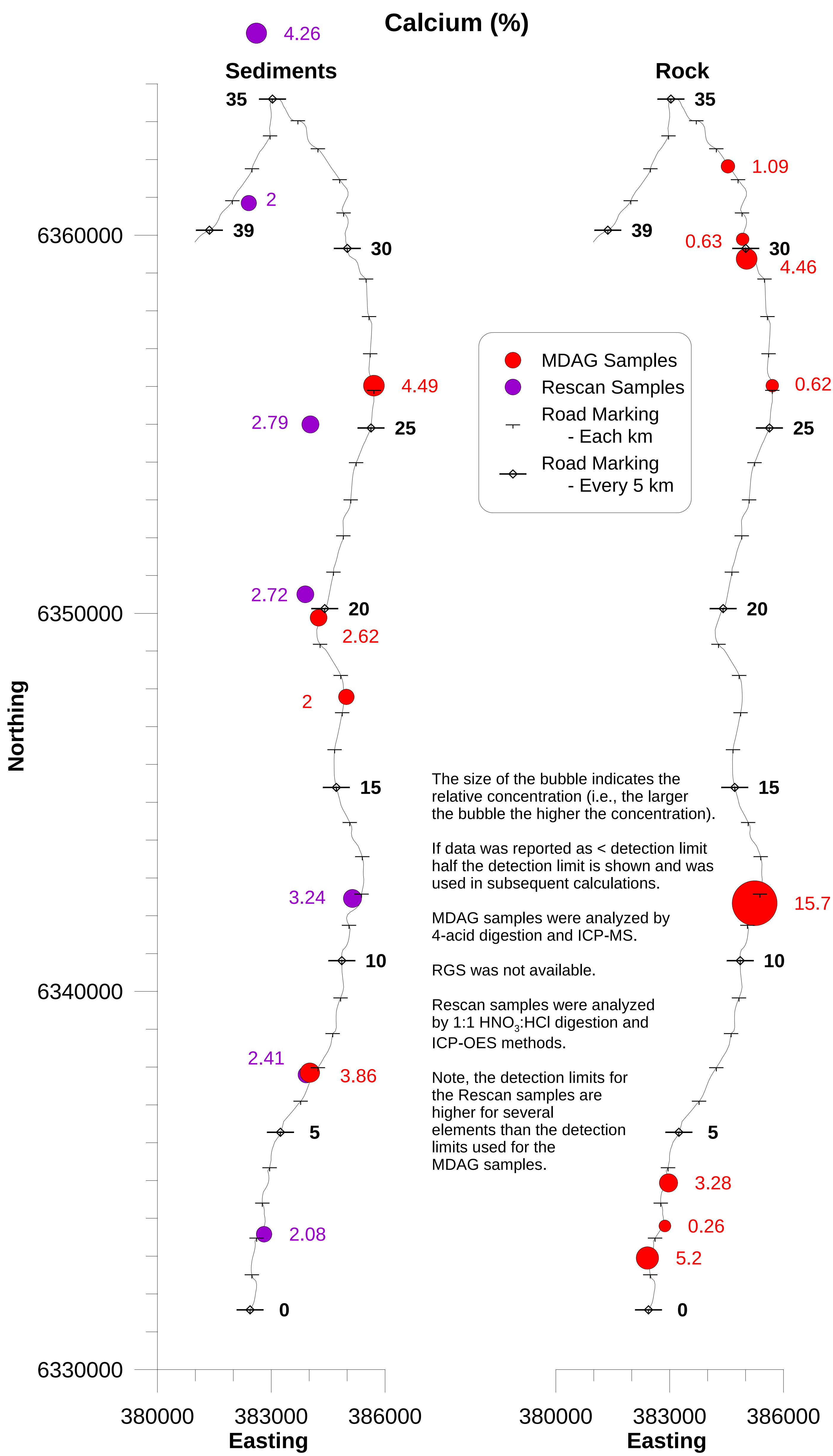
Beryllium (ppm)
Sediments
Rock
Northing
Easting
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
380000
383000
386000
35
39
30
25
20
15
10
5
0
0.25
0.25
1.03
0.25
0.25
1.17
1.51
0.25
0.25
0.93
0.25
1.96
2.88
1.74
0.78
0.86
3.06
1.27
1.75
MDAG Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



Bismuth (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
0.04
0.06
0.03
0.05
0.02
0.03
0.04
0.07
0.02
0.01
0.04
0.02
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods, the data is not shown due to the high minimum detection limit used.

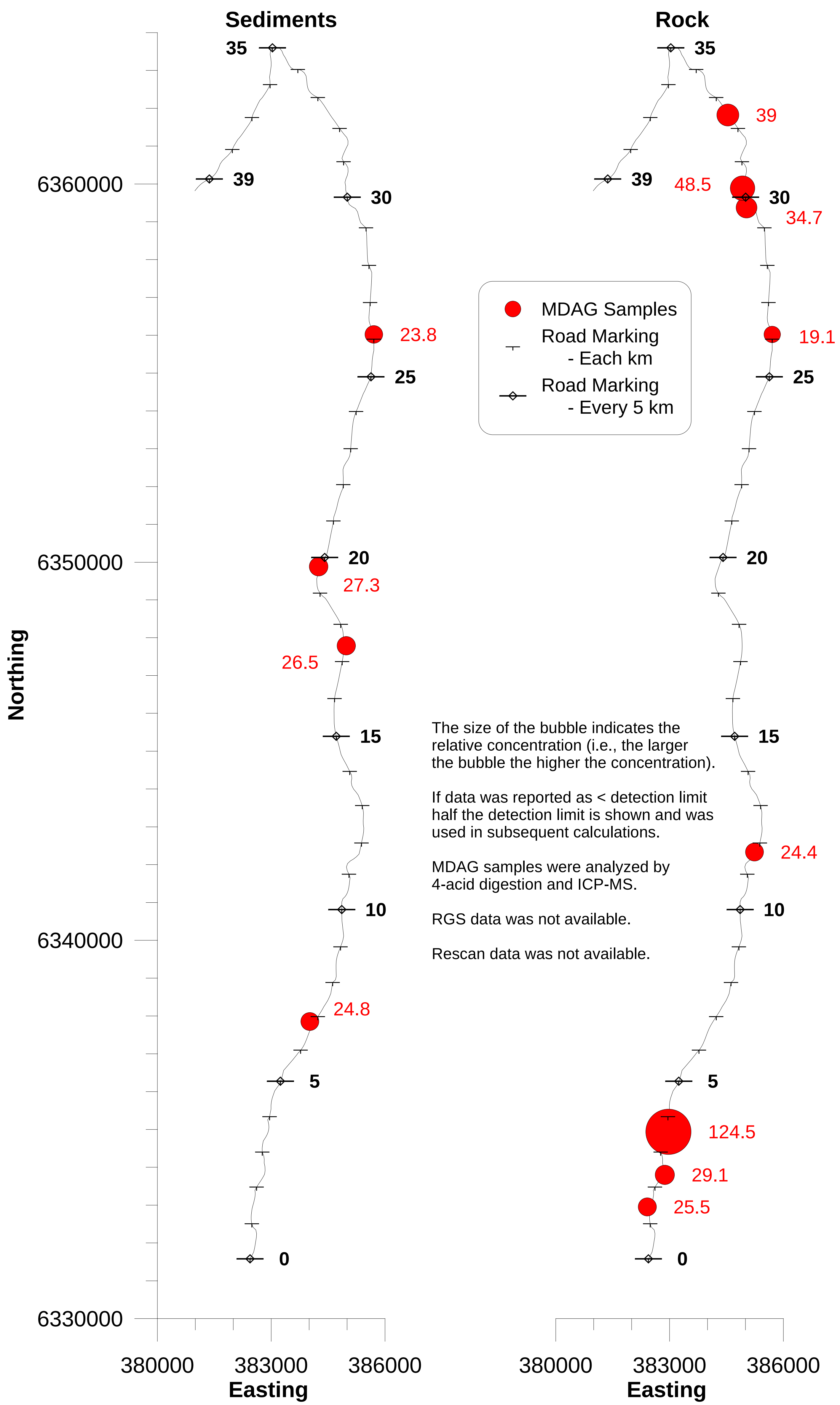


Cadmium (ppm)
Sediments
Rock
0.3
0.92
35
0.9
0.1
0.5
39
30
0.1
0.1
0.17
0.33
25
0.1
0.1
0.1
0.38
0.5
20
0.13
0.1
0.1
0.1
0.04
0.1
0.1
0.1
0.5
15
0.1
0.8
0.34
0.1
10
0.1
0.1
0.19
0.17
0.1
0.1
5
0.18
0.1
0
2.84
0.03
0.19
0.12
0.18
0.13
0.26
0.15
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting

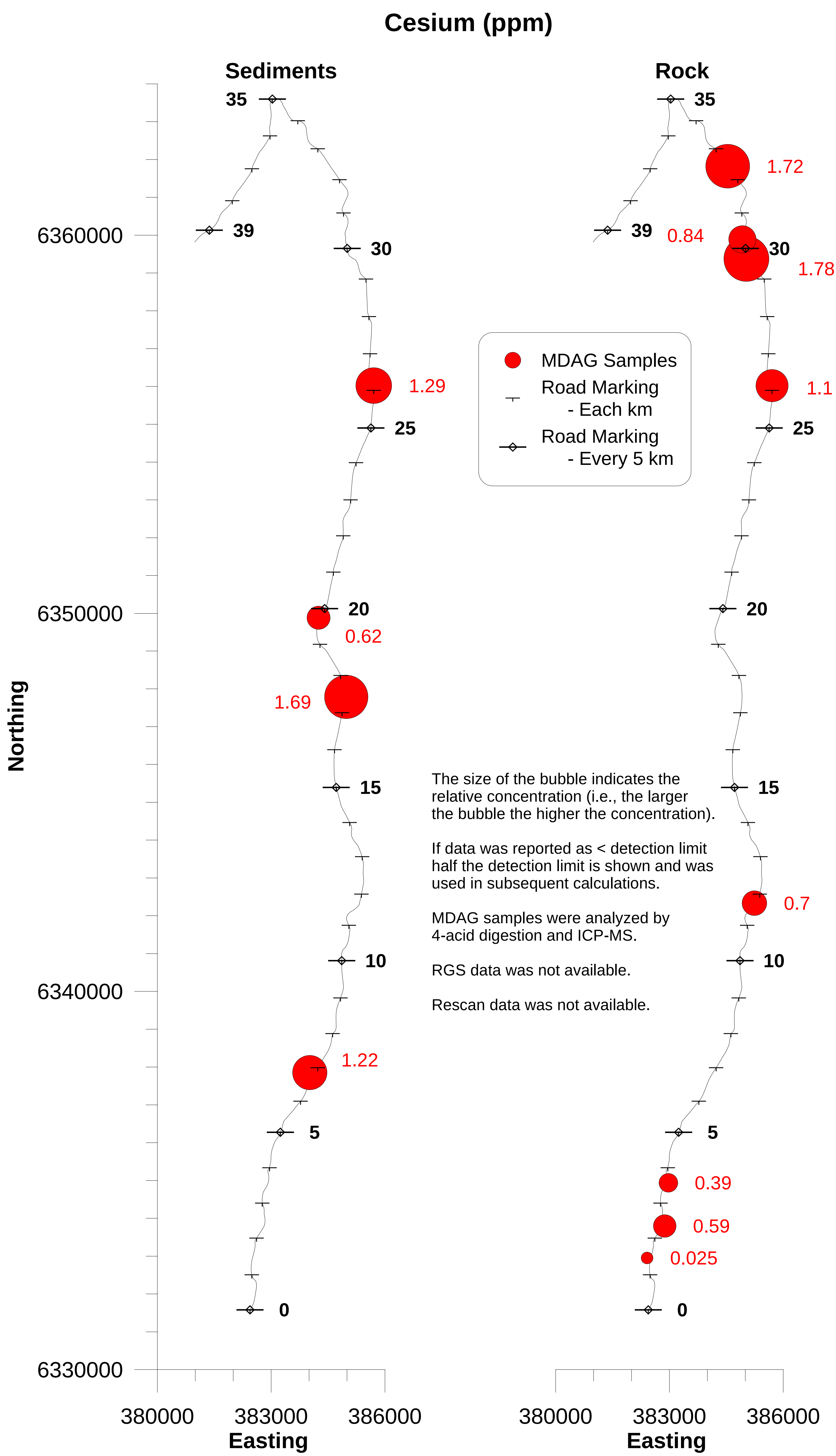


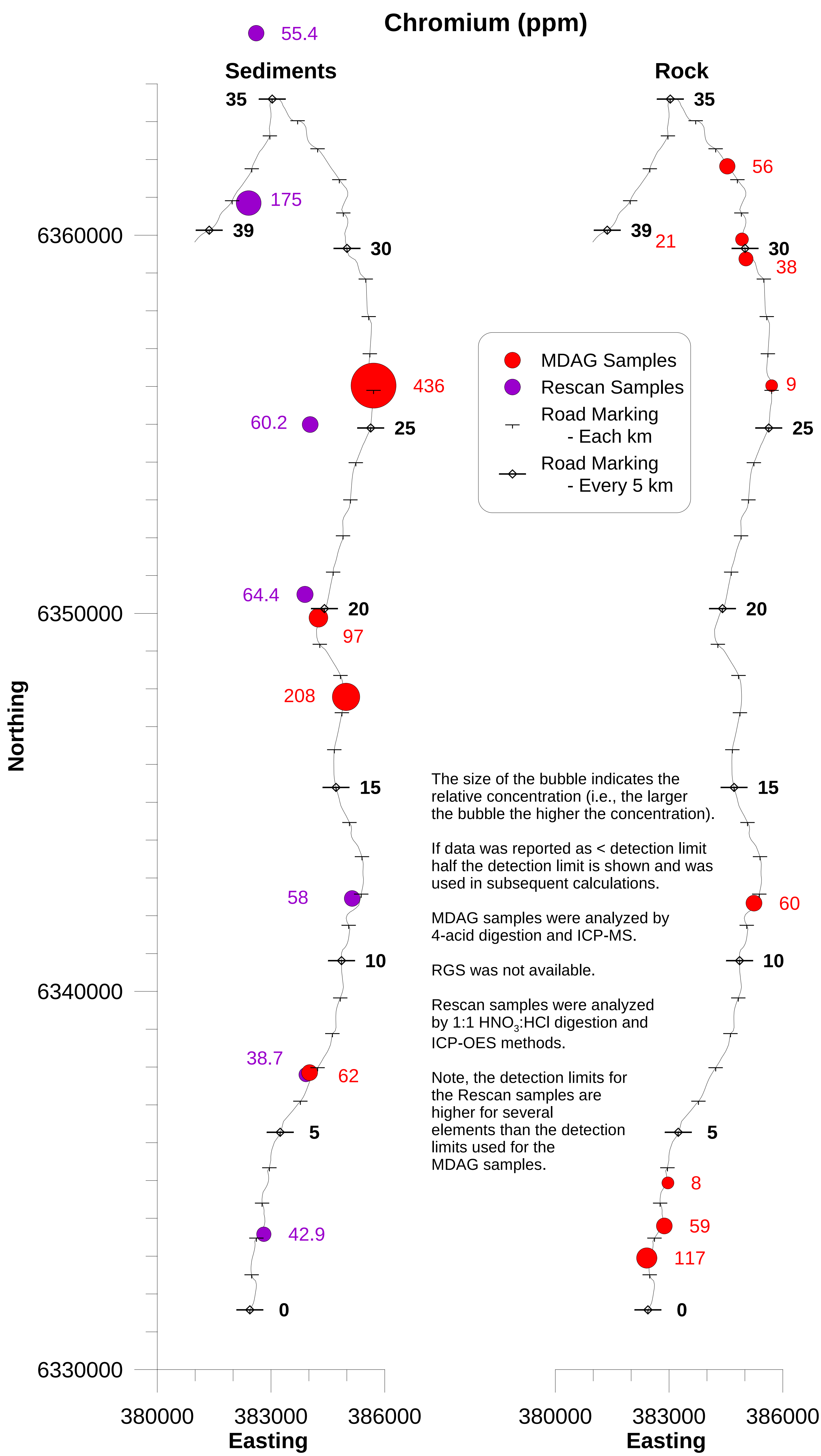
Calcium (%)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
35
39
30
25
20
15
10
5
0
4.26
2
4.49
2.79
2.72
2.62
2
3.24
2.41
3.86
2.08
1.09
0.63
4.46
0.62
15.7
3.28
0.26
5.2
MDAG Samples
Rescan Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.

Cerium (ppm)

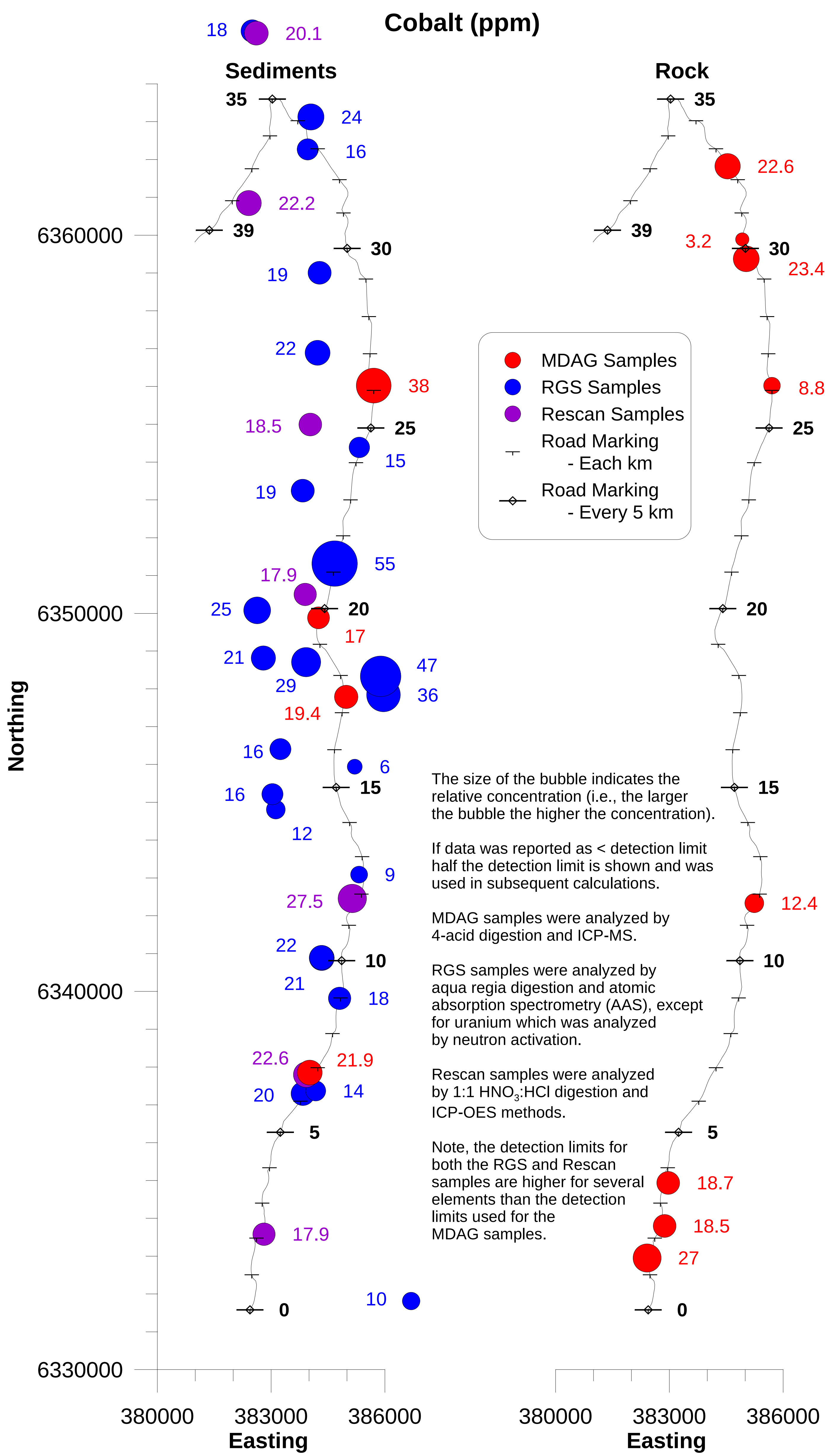


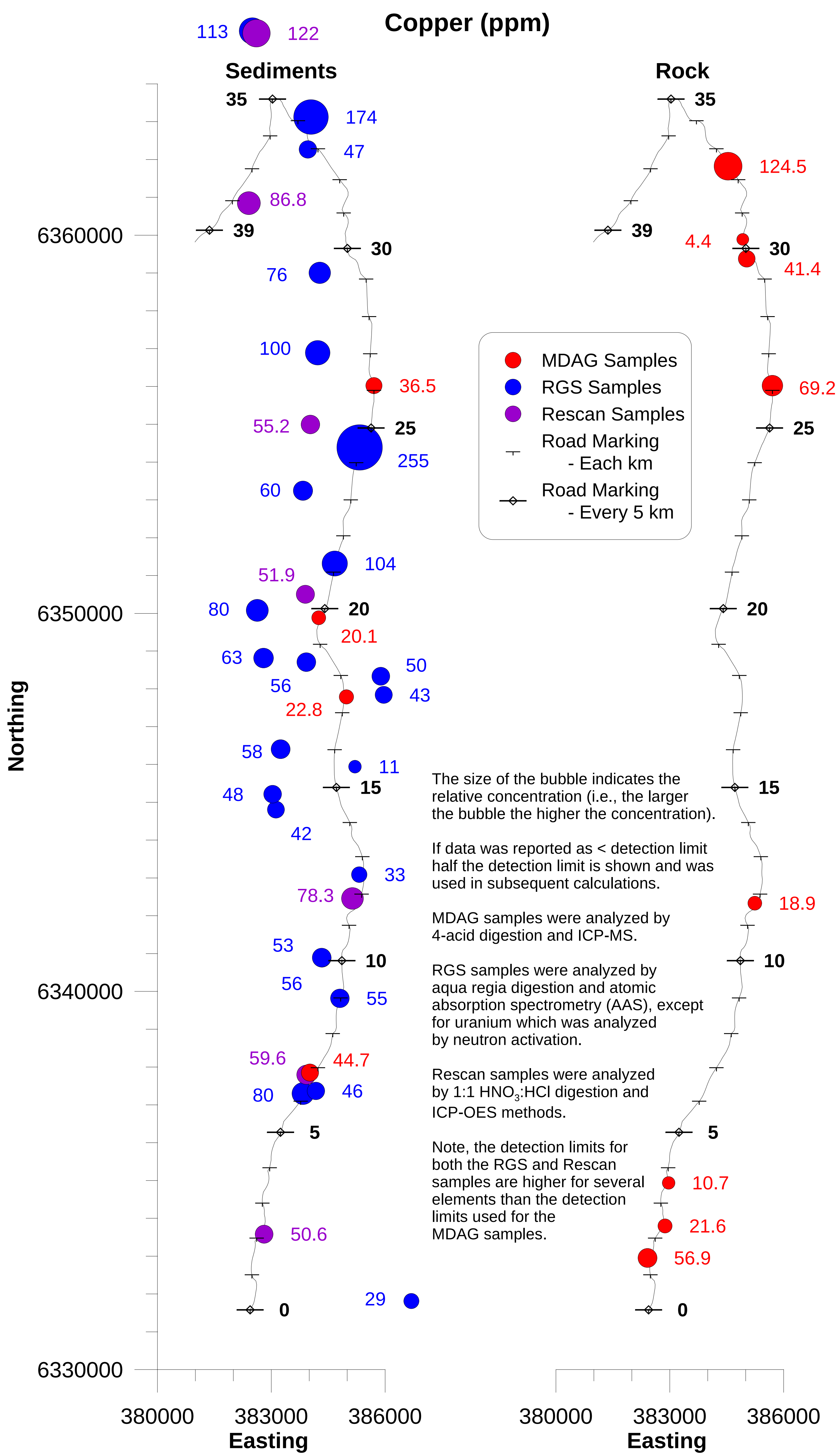
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
23.8
27.3
26.5
24.8
39
48.5
34.7
19.1
24.4
124.5
29.1
25.5
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.


Cesium (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
1.29
0.62
1.69
1.22
1.72
0.84
1.78
1.1
0.7
0.39
0.59
0.025
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.

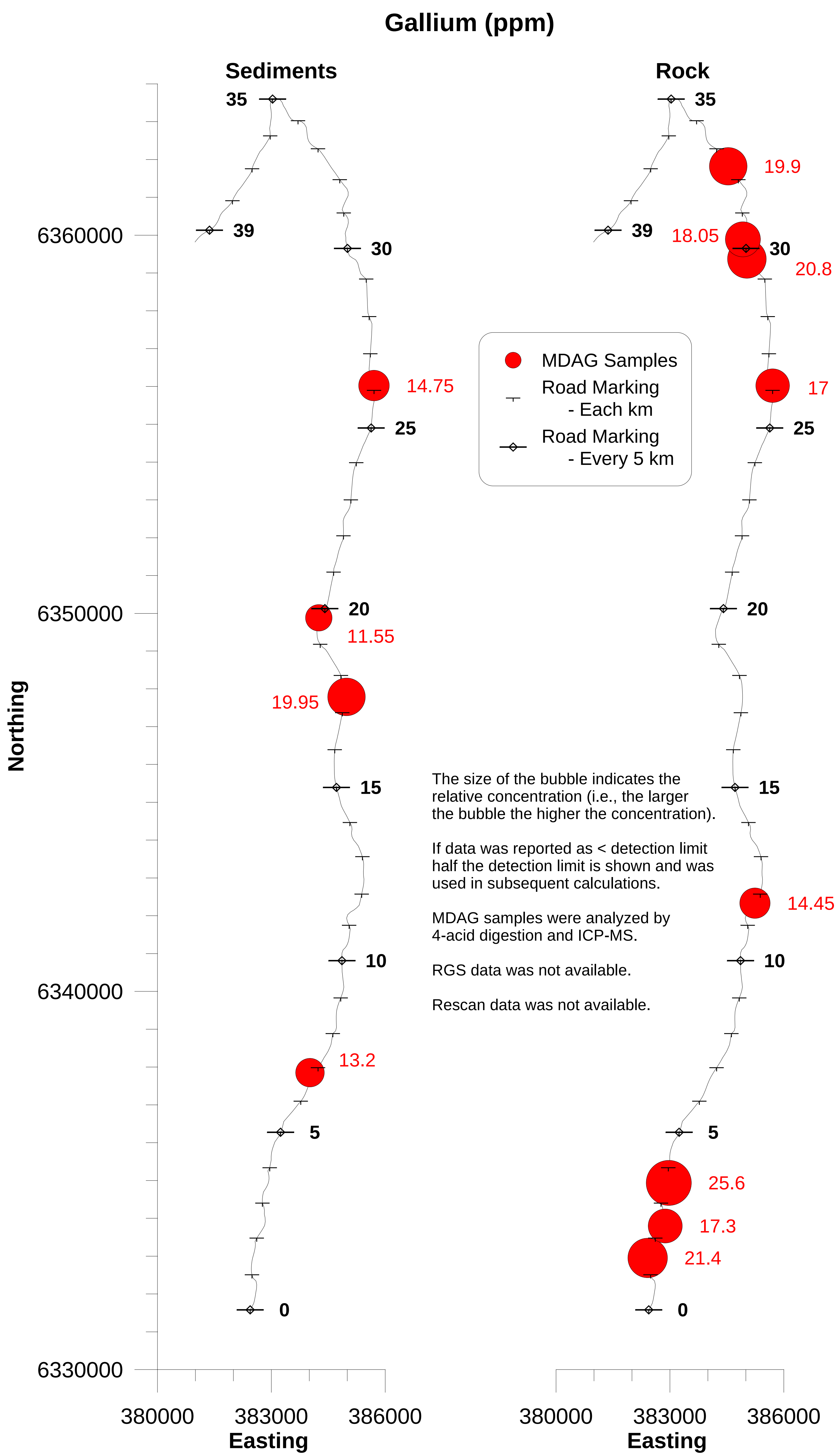


Chromium (ppm)
Sediments
Rock
55.4
175
436
60.2
64.4
97
208
58
38.7
62
42.9
56
21
38
9
60
8
59
117
35
39
30
25
20
15
10
5
0
6360000
6350000
6340000
6330000
Northing
380000
383000
386000
Easting
MDAG Samples
Rescan Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.

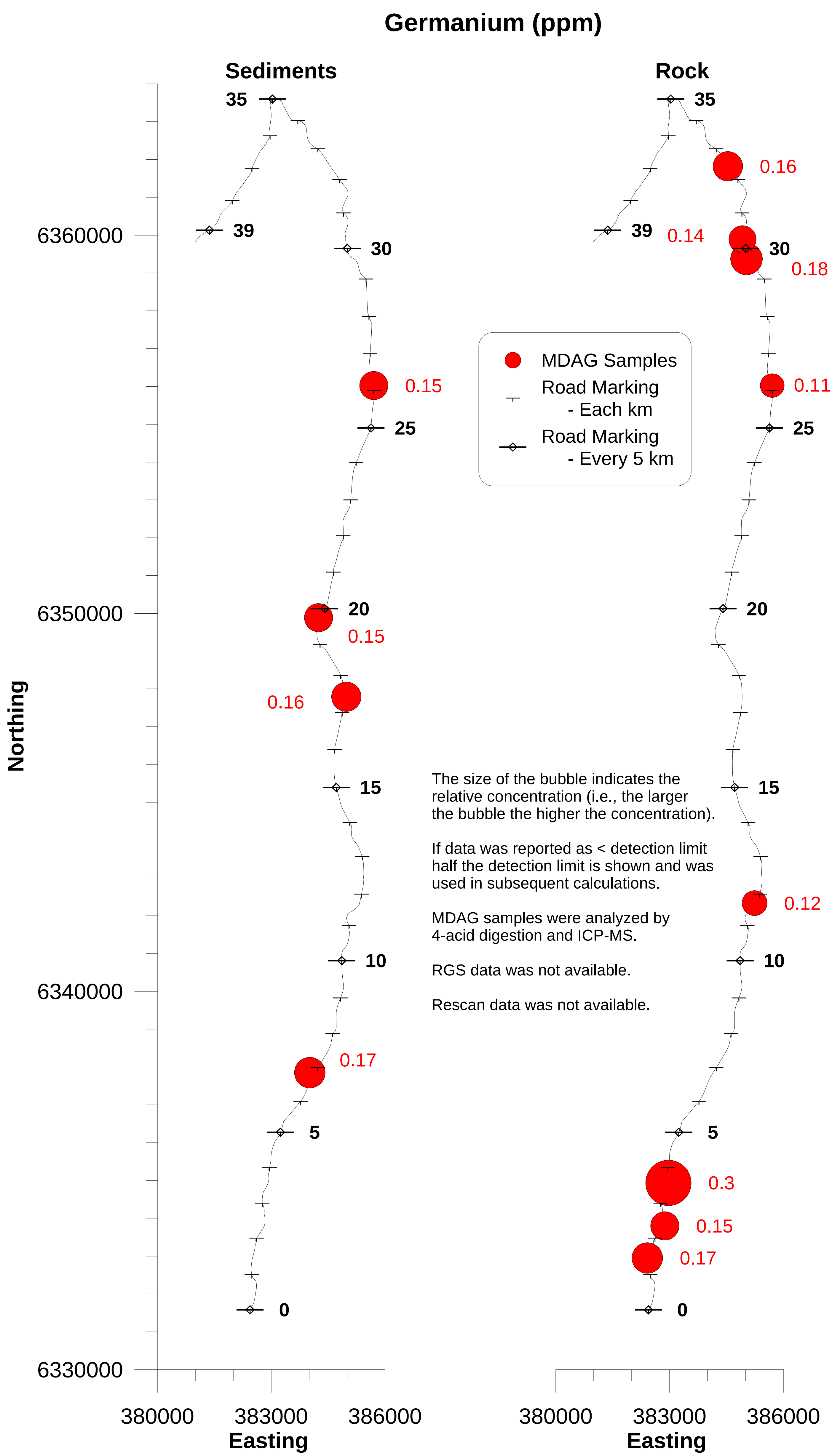

Cobalt (ppm)
Sediments
Rock
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



Copper (ppm)
Sediments
Rock
113
122
174
47
86.8
76
100
36.5
55.2
255
60
104
51.9
80
20.1
63
56
50
43
22.8
58
11
48
42
33
78.3
53
56
55
59.6
44.7
80
46
50.6
29
124.5
4.4
41.4
69.2
18.9
10.7
21.6
56.9
35
39
30
25
20
15
10
5
0
Northing
6360000
6350000
6340000
6330000
Easting
380000
383000
386000
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.

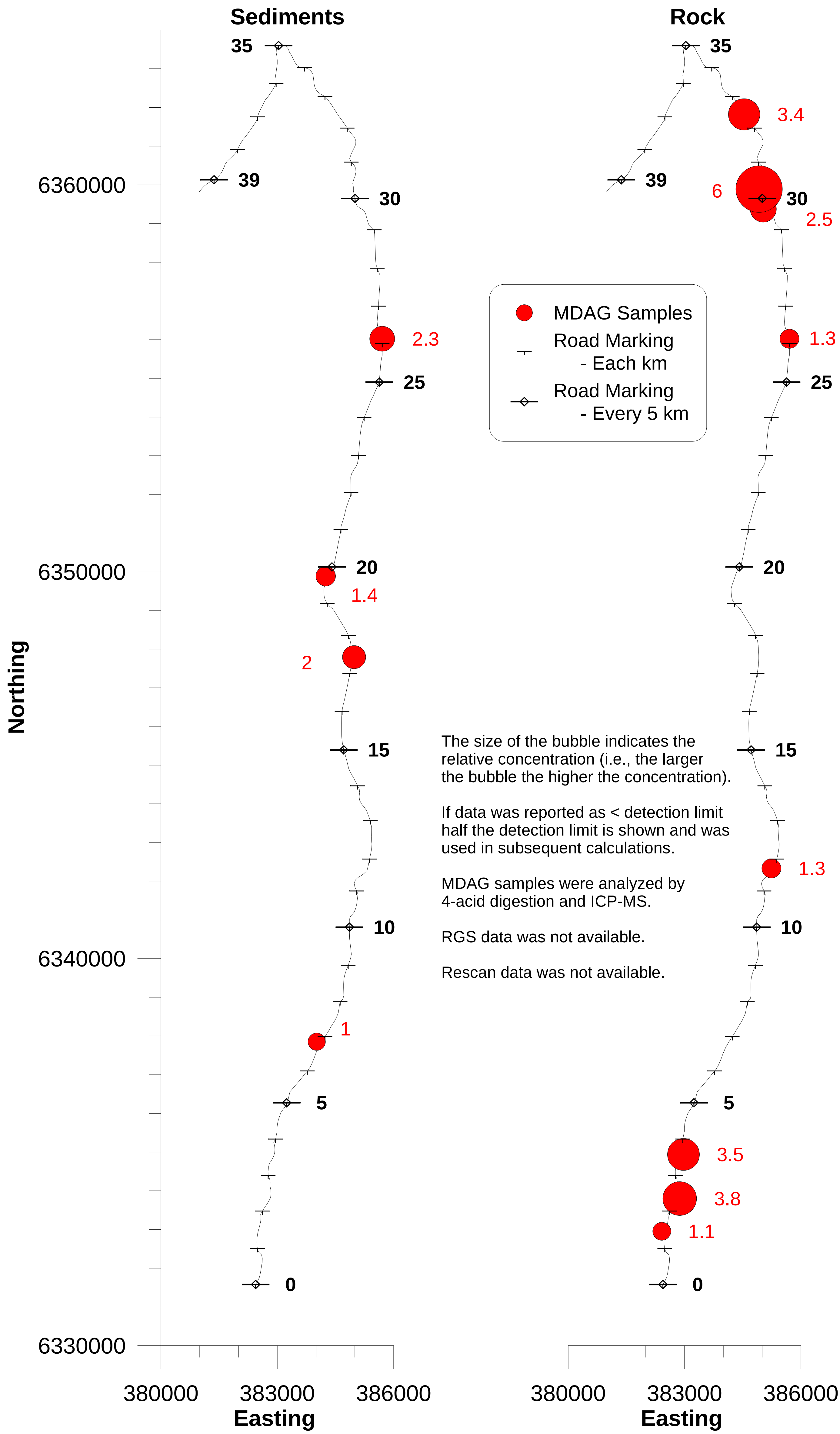


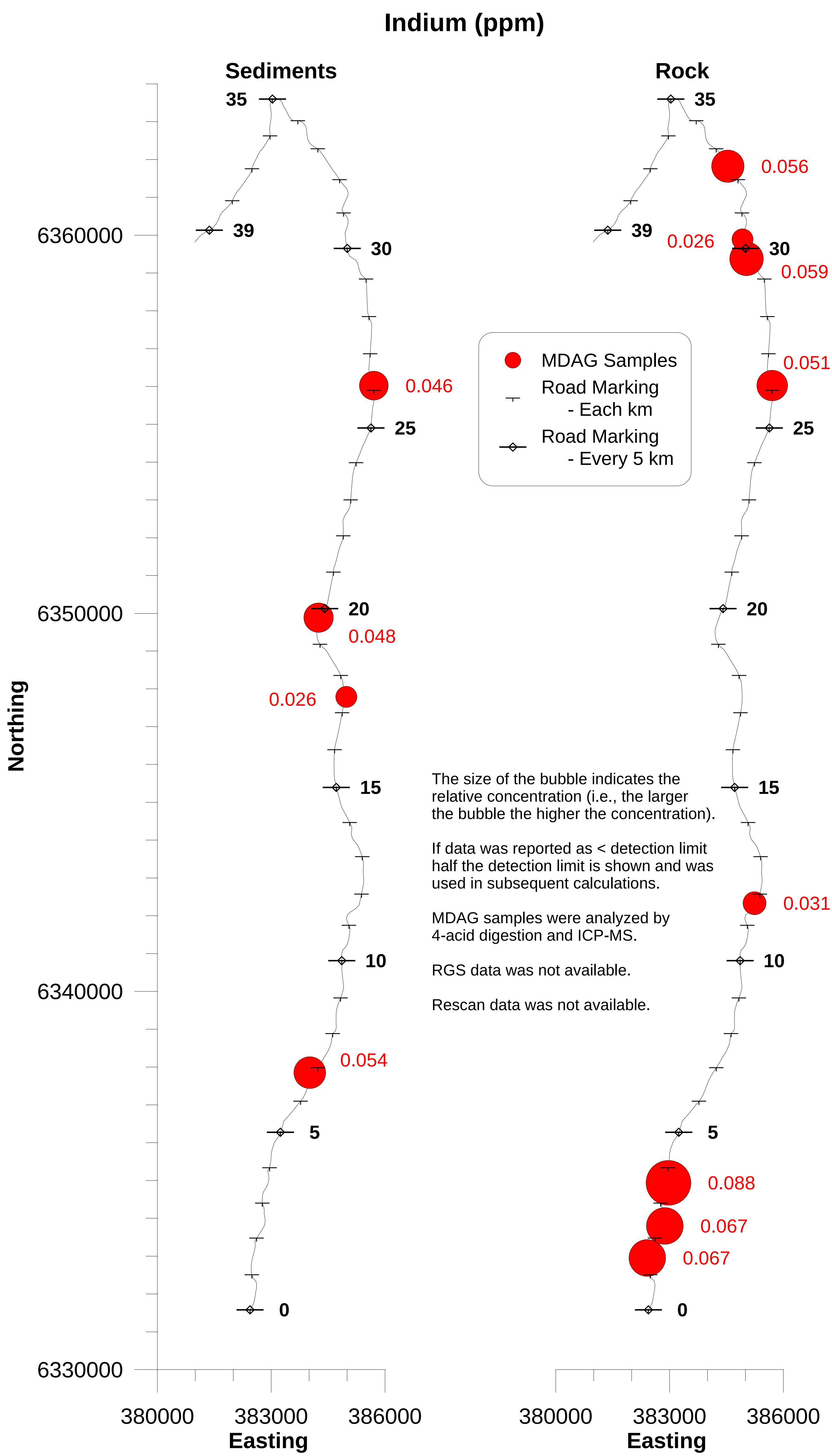
Gallium (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
14.75
11.55
19.95
13.2
19.9
18.05
20.8
17
14.45
25.6
17.3
21.4
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.



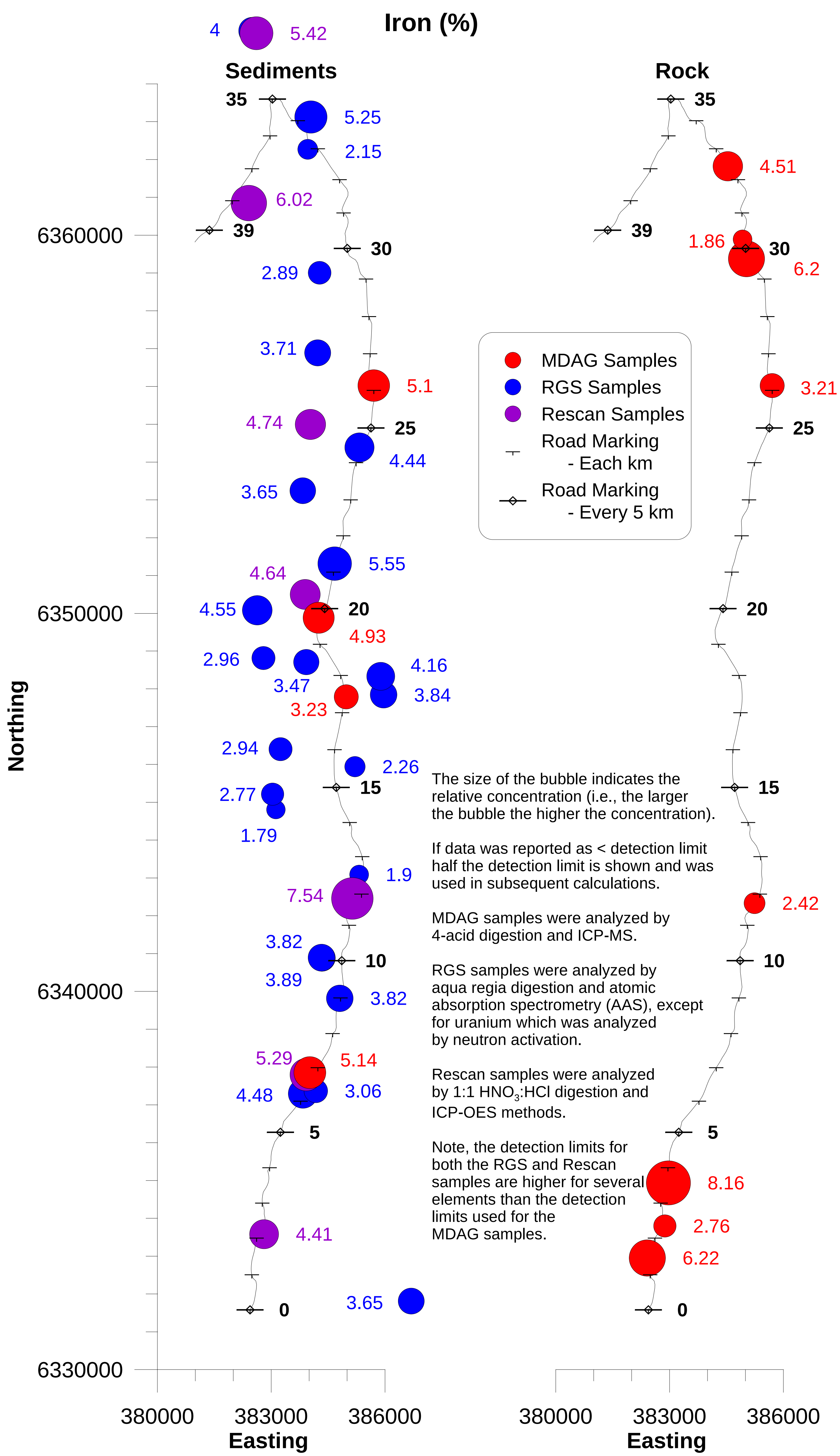
Germanium (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
0.15
0.15
0.16
0.17
0.16
0.14
0.18
0.11
0.12
0.3
0.15
0.17
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.

Hafnium (ppm)

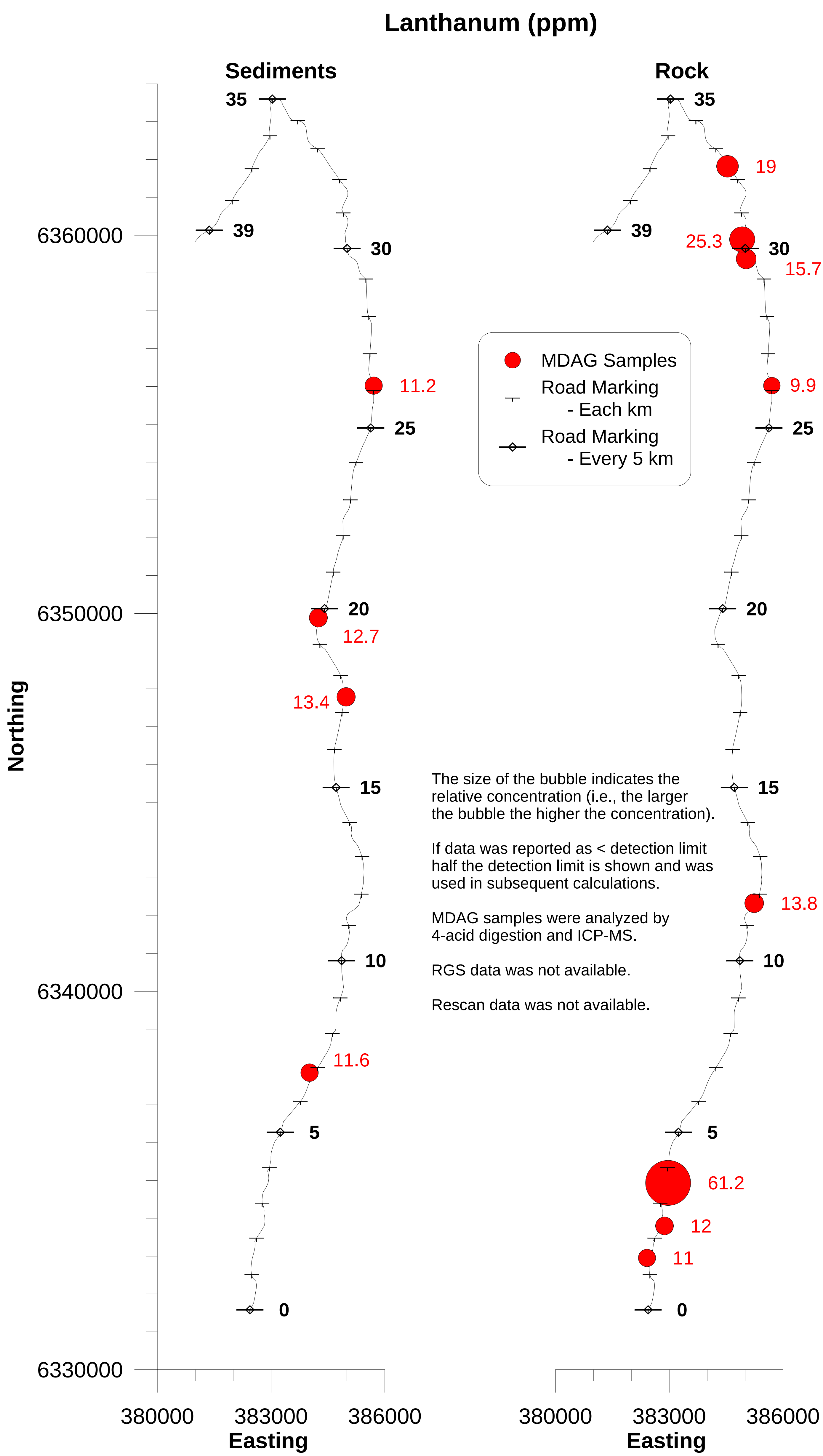

Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
2.3
1.4
2
1
3.4
6
2.5
1.3
1.3
3.5
3.8
1.1
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.



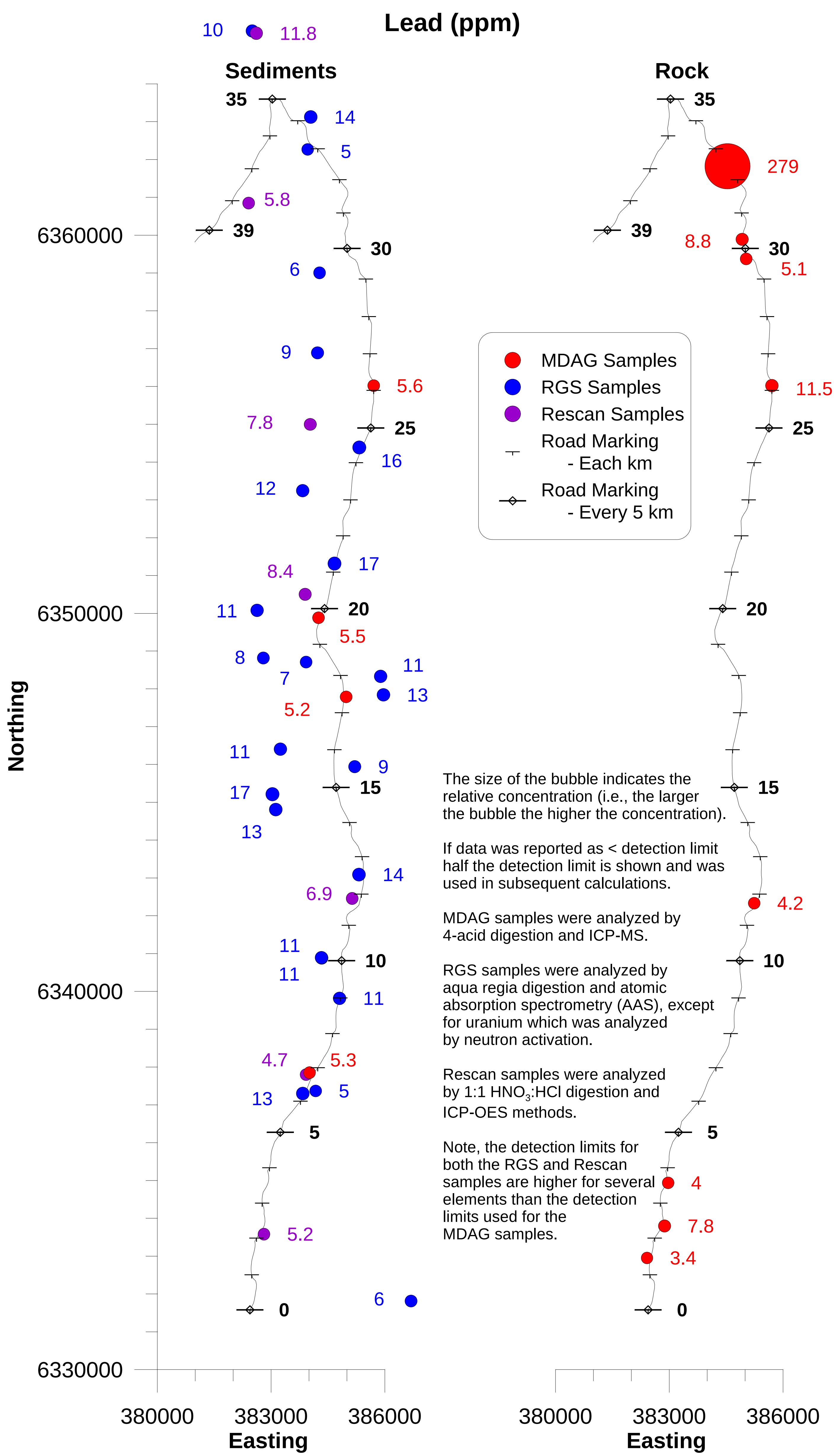
Indium (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
0.046
0.048
0.026
0.054
0.056
0.026
0.059
0.051
0.031
0.088
0.067
0.067
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.

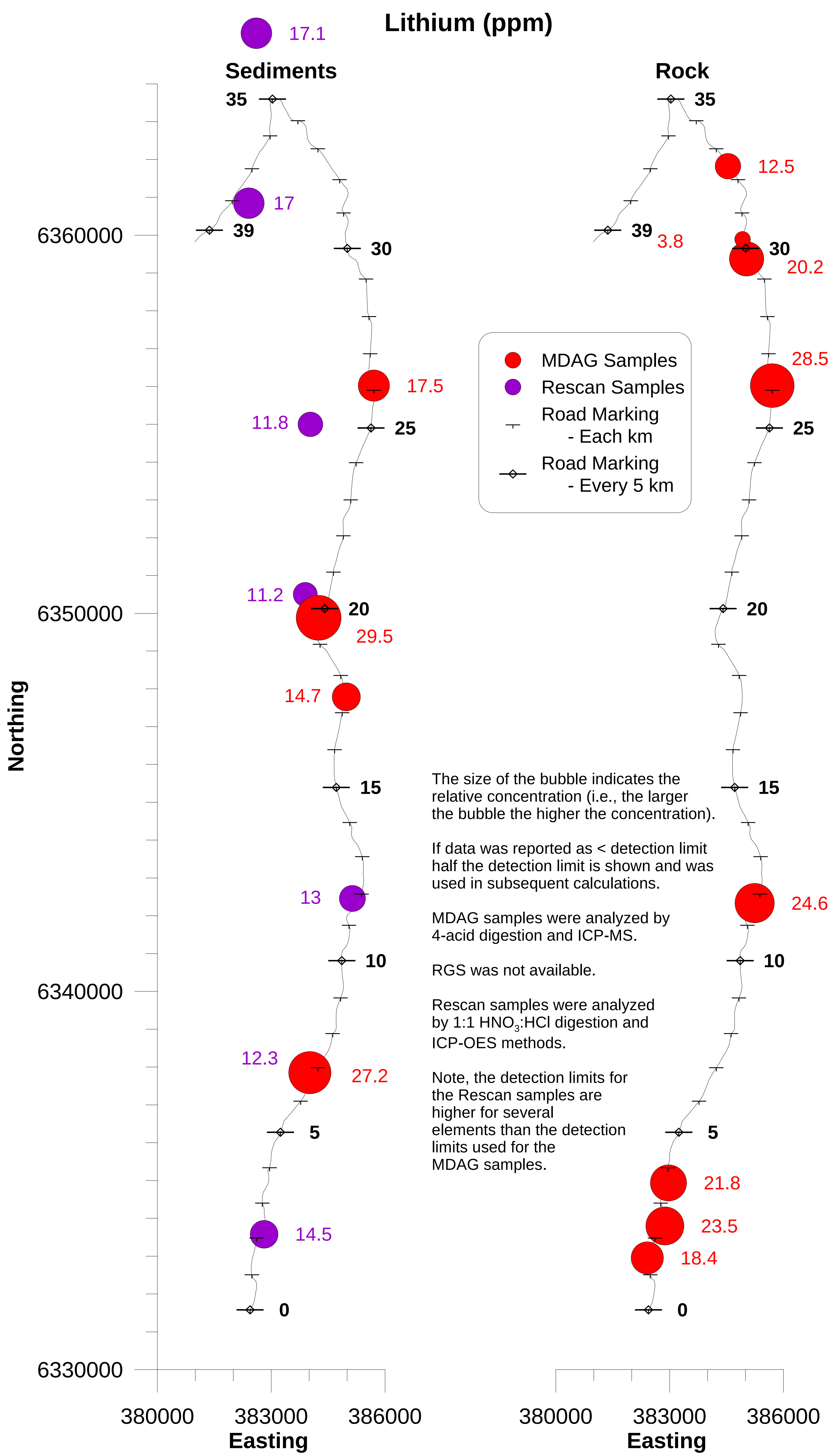


Iron (%)
Sediments
Rock
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
35
39
30
25
20
15
10
5
0
4
5.42
5.25
2.15
6.02
2.89
3.71
5.1
4.74
4.44
3.65
5.55
4.64
4.55
4.93
2.96
3.47
4.16
3.84
3.23
2.94
2.26
2.77
1.79
1.9
7.54
3.82
3.89
3.82
5.29
5.14
4.48
3.06
4.41
3.65
4.51
1.86
6.2
3.21
2.42
8.16
2.76
6.22
MDAG Samples
RGS Samples
Rescan Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.

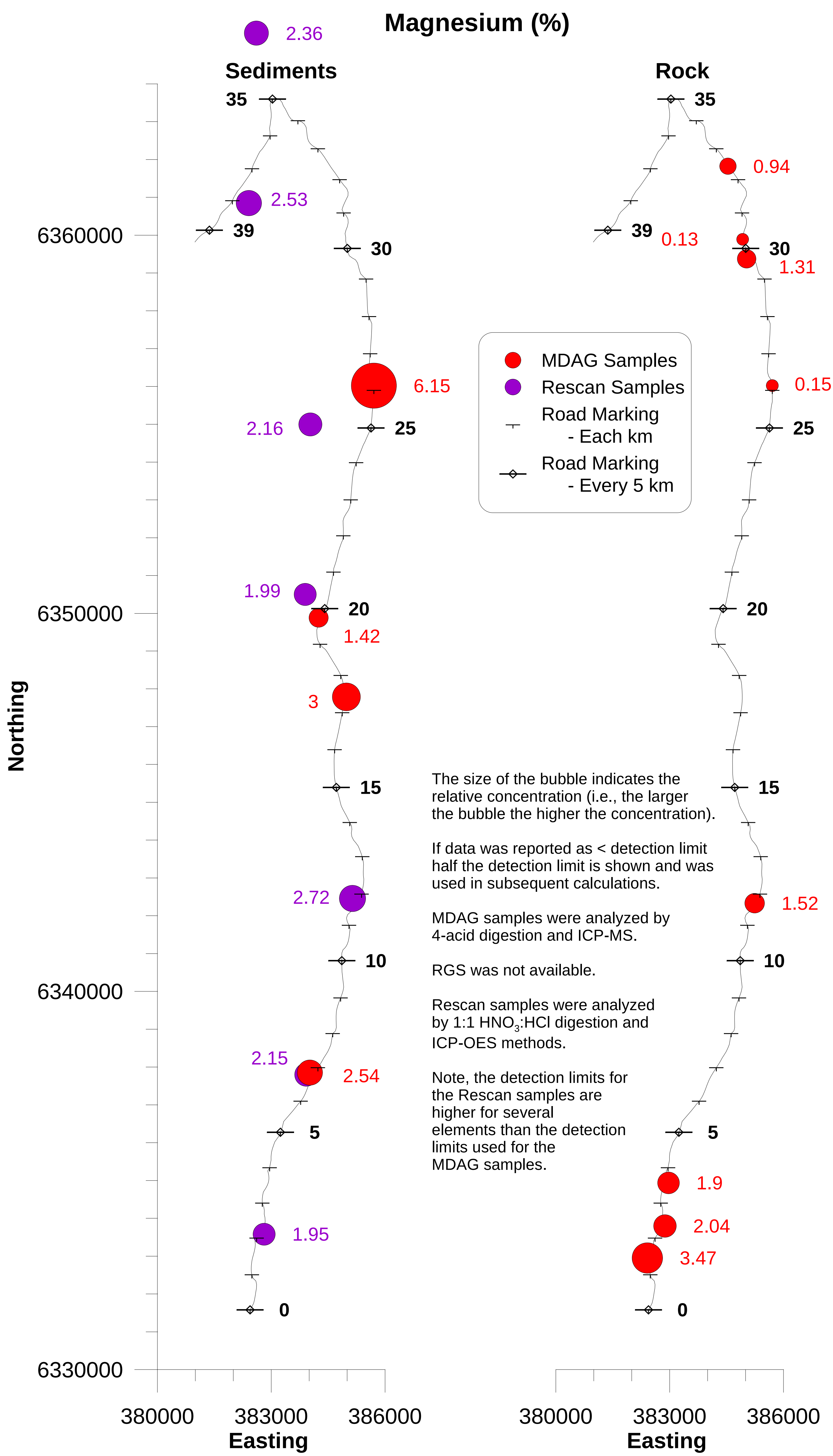


Lanthanum (ppm)
Sediments
Rock
Northing
Easting
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
380000
383000
386000
35
39
30
25
20
15
10
5
0
35
39
30
25
20
15
10
5
0
11.2
12.7
13.4
11.6
19
25.3
15.7
9.9
13.8
61.2
12
11
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.

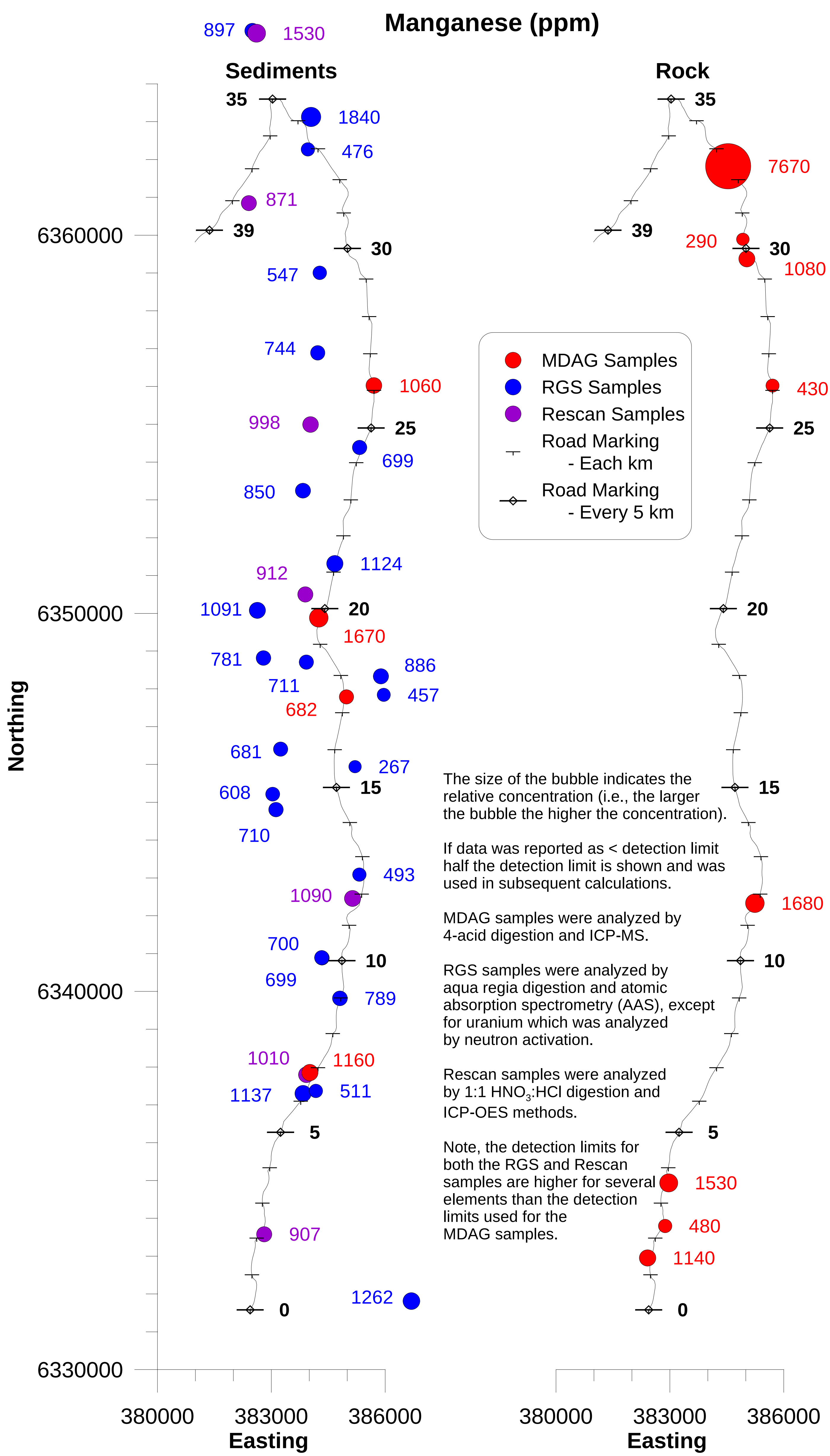

Lead (ppm)
Sediments
Rock
Northing
Easting
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
380000
383000
386000
35
39
30
25
20
15
10
5
0
10
11.8
14
5
5.8
6
9
5.6
7.8
16
12
17
8.4
11
5.5
8
7
11
13
5.2
11
9
17
13
14
6.9
11
11
11
4.7
5.3
13
5
5.2
6
279
8.8
5.1
11.5
4.2
4
7.8
3.4
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



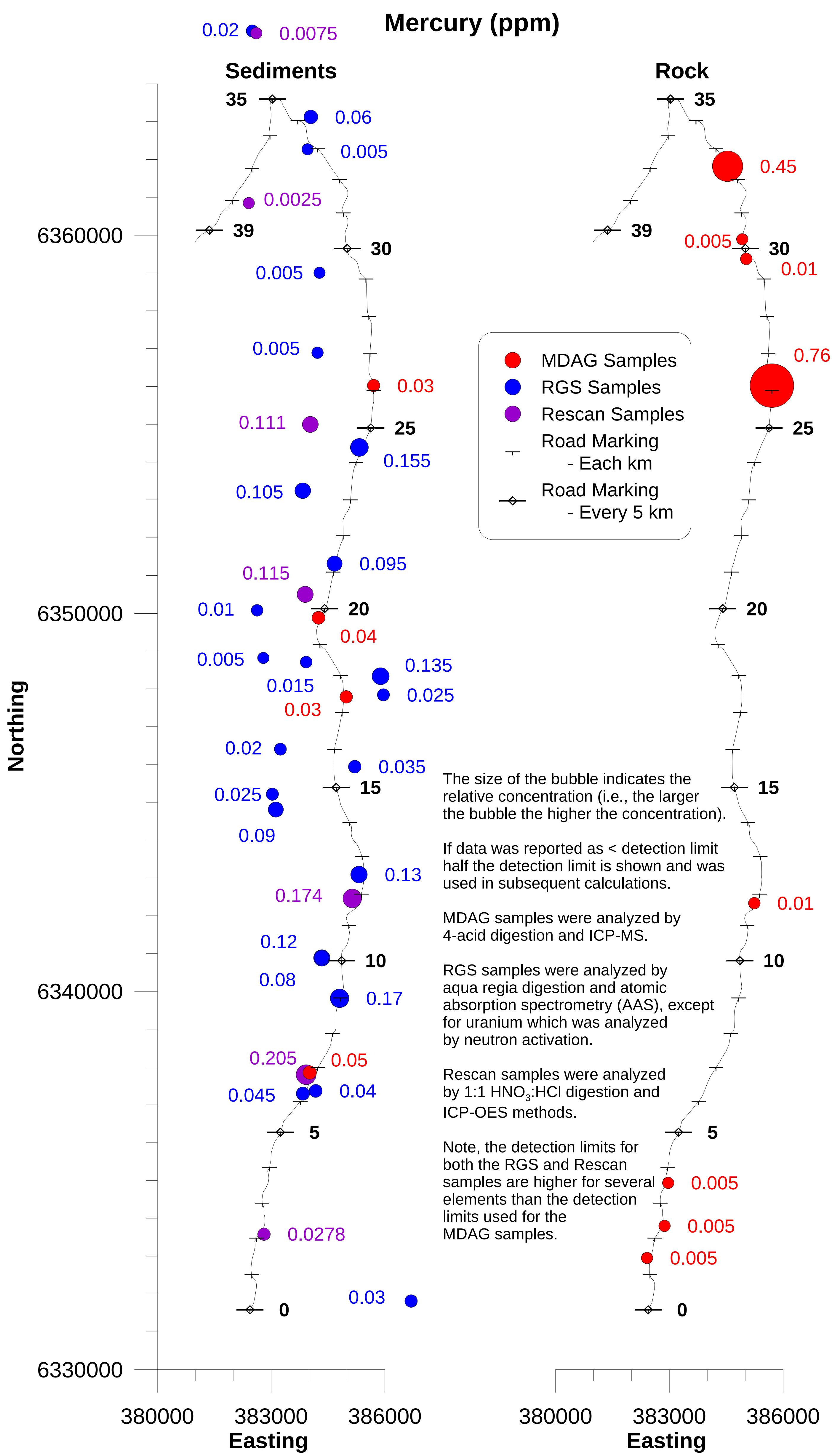
Lithium (ppm)
Sediments
Rock
17.1
17
11.8
17.5
11.2
29.5
14.7
13
12.3
27.2
14.5
12.5
3.8
20.2
28.5
24.6
21.8
23.5
18.4
35
39
30
25
20
15
10
5
0
MDAG Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting



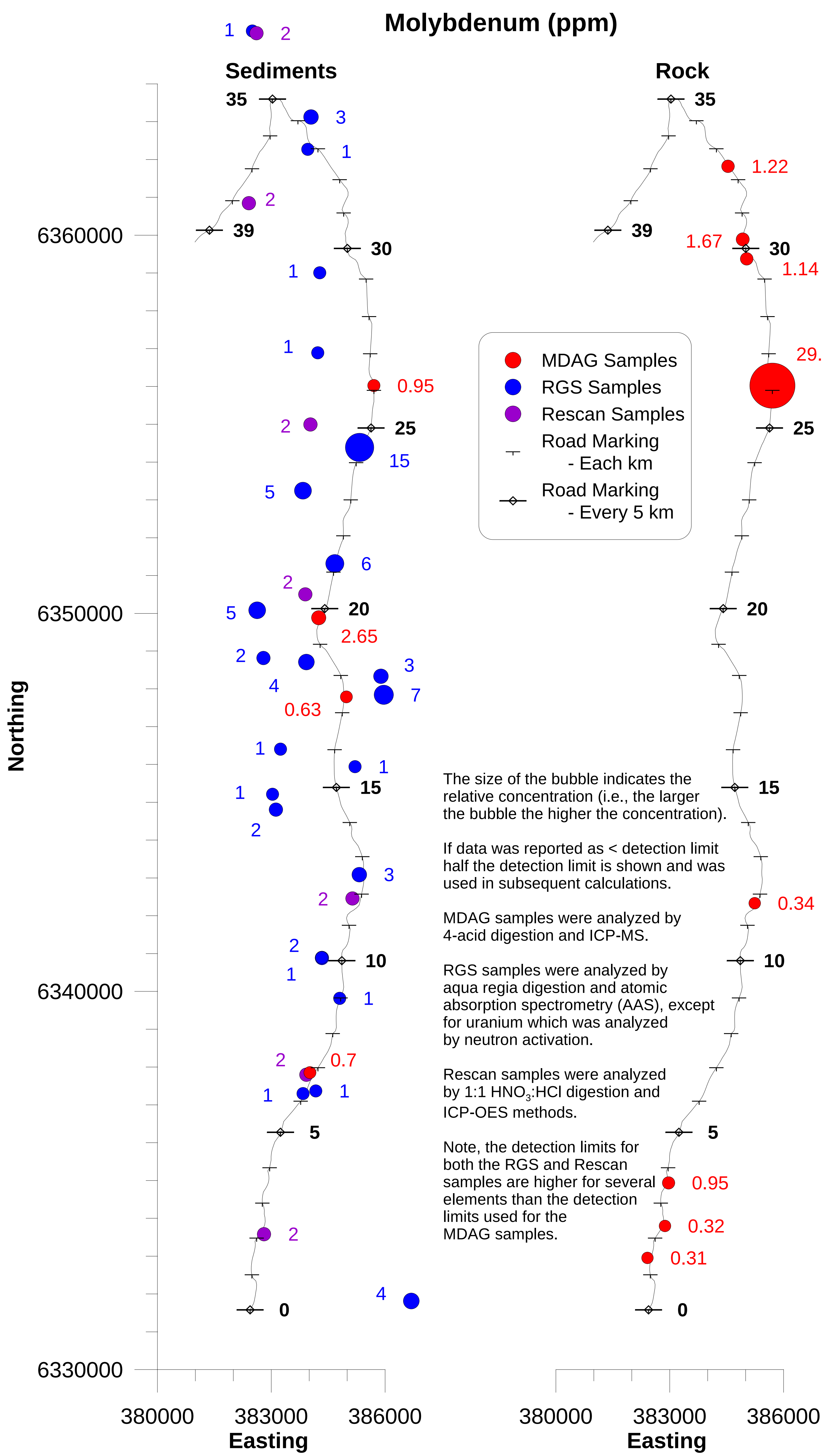
Magnesium (%)
Sediments
Rock
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
35
39
30
25
20
15
10
5
0
2.36
2.53
6.15
2.16
1.99
1.42
3
2.72
2.15
2.54
1.95
0.94
0.13
1.31
0.15
1.52
1.9
2.04
3.47
MDAG Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



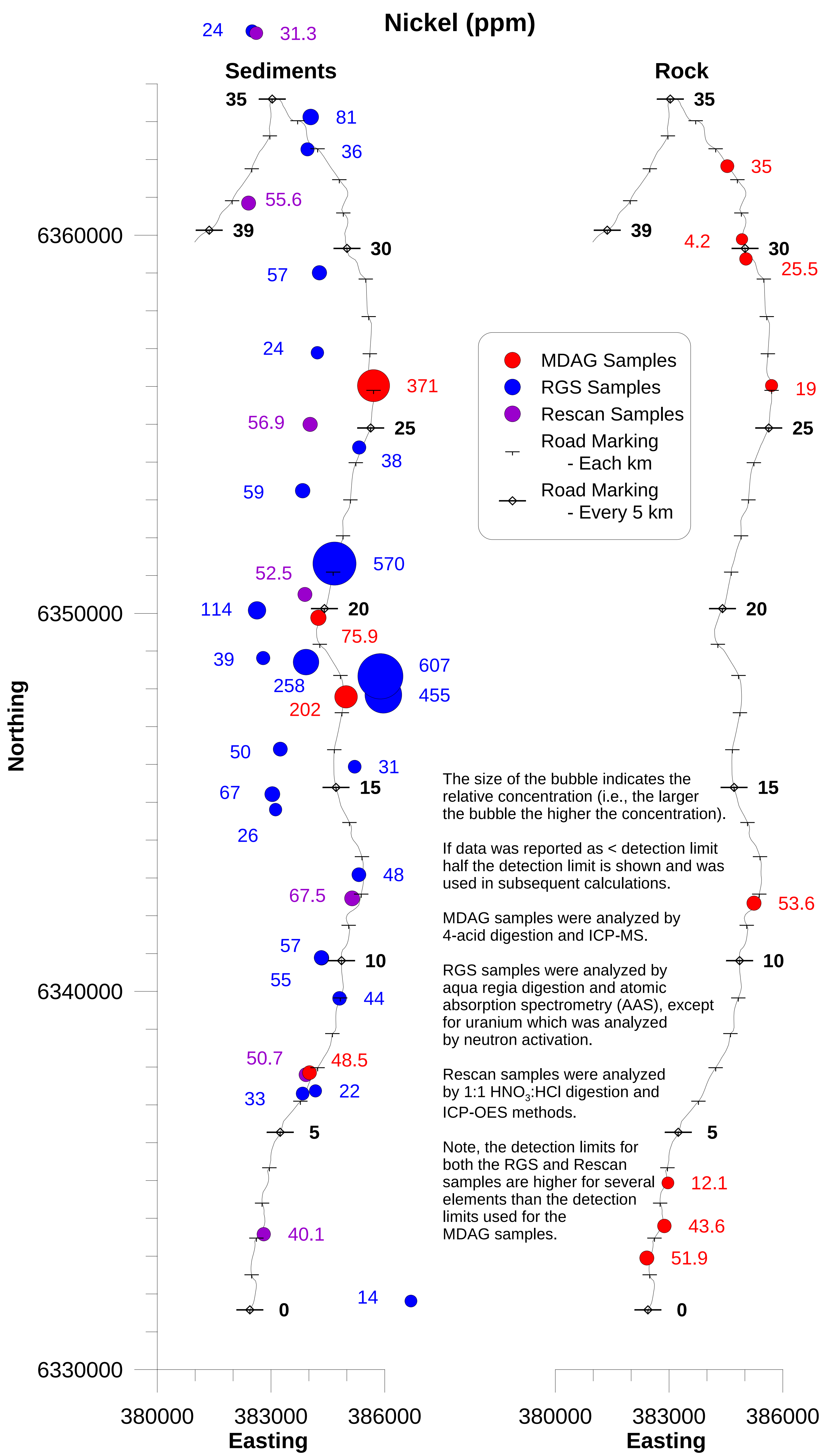
Manganese (ppm)
Sediments
Rock
Northing
Easting
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
380000
383000
386000
897
1530
1840
476
871
547
744
1060
998
699
850
1124
912
1091
1670
781
711
886
457
682
681
267
608
710
493
1090
700
699
789
1010
1160
1137
511
907
1262
7670
290
1080
430
1680
1530
480
1140
0
5
10
15
20
25
30
35
39
MDAG Samples
RGS Samples
Rescan Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.

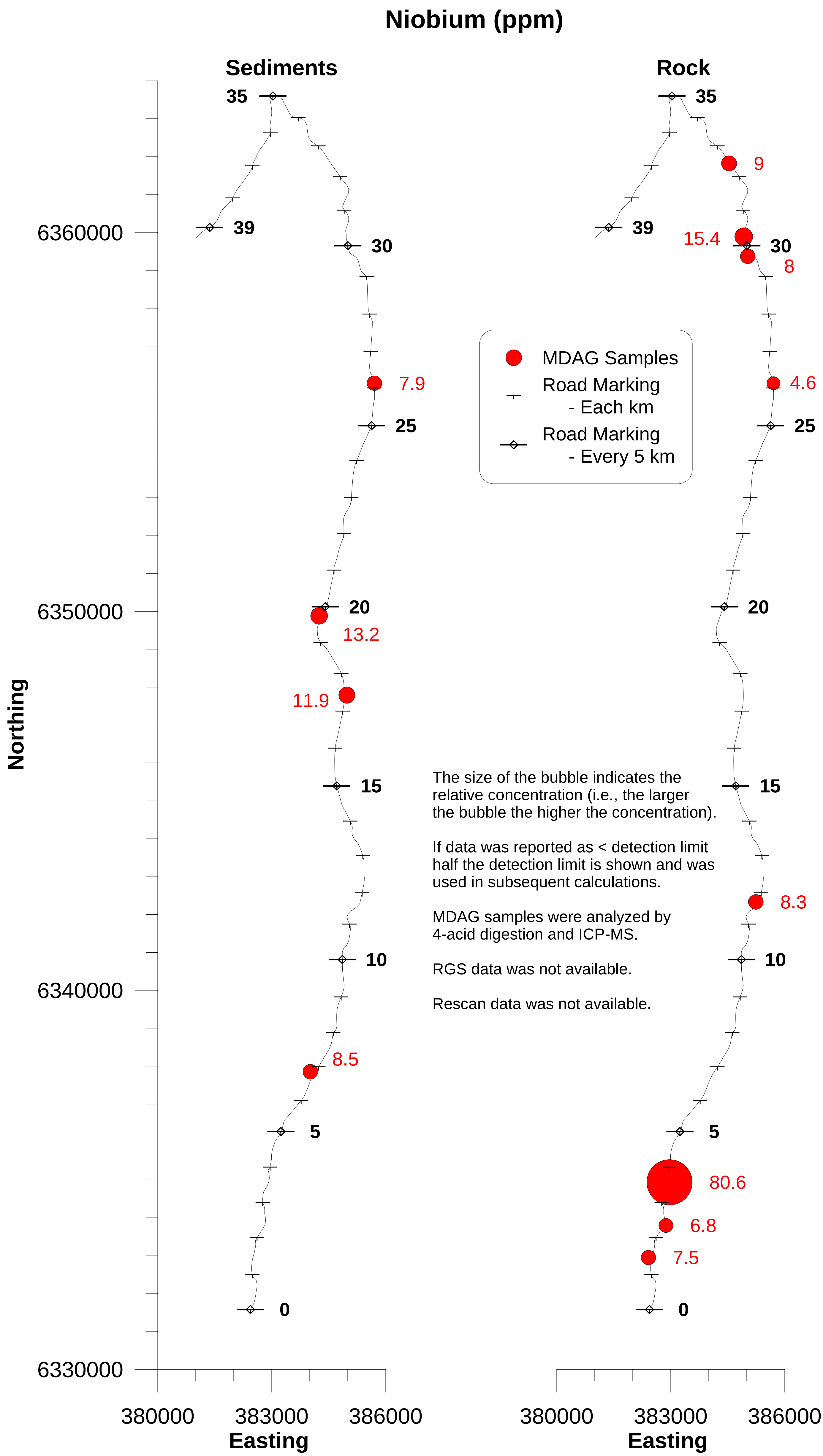


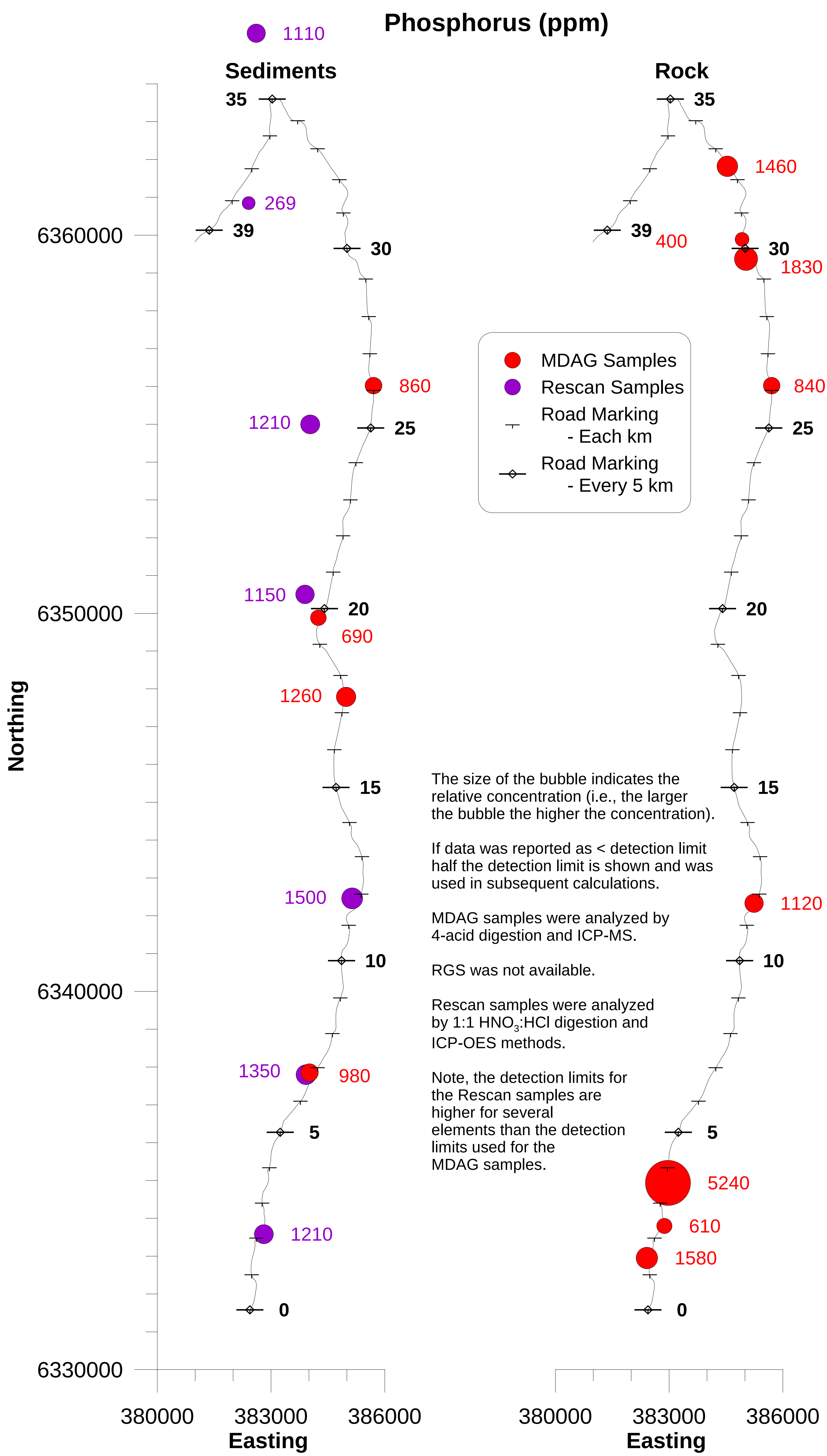
Mercury (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
0.02
0.0075
0.06
0.005
0.0025
0.005
0.005
0.03
0.111
0.155
0.105
0.095
0.115
0.01
0.04
0.005
0.015
0.135
0.025
0.03
0.02
0.035
0.025
0.09
0.13
0.174
0.12
0.08
0.17
0.205
0.05
0.045
0.04
0.0278
0.03
0.45
0.005
0.01
0.76
0.01
0.005
0.005
0.005
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



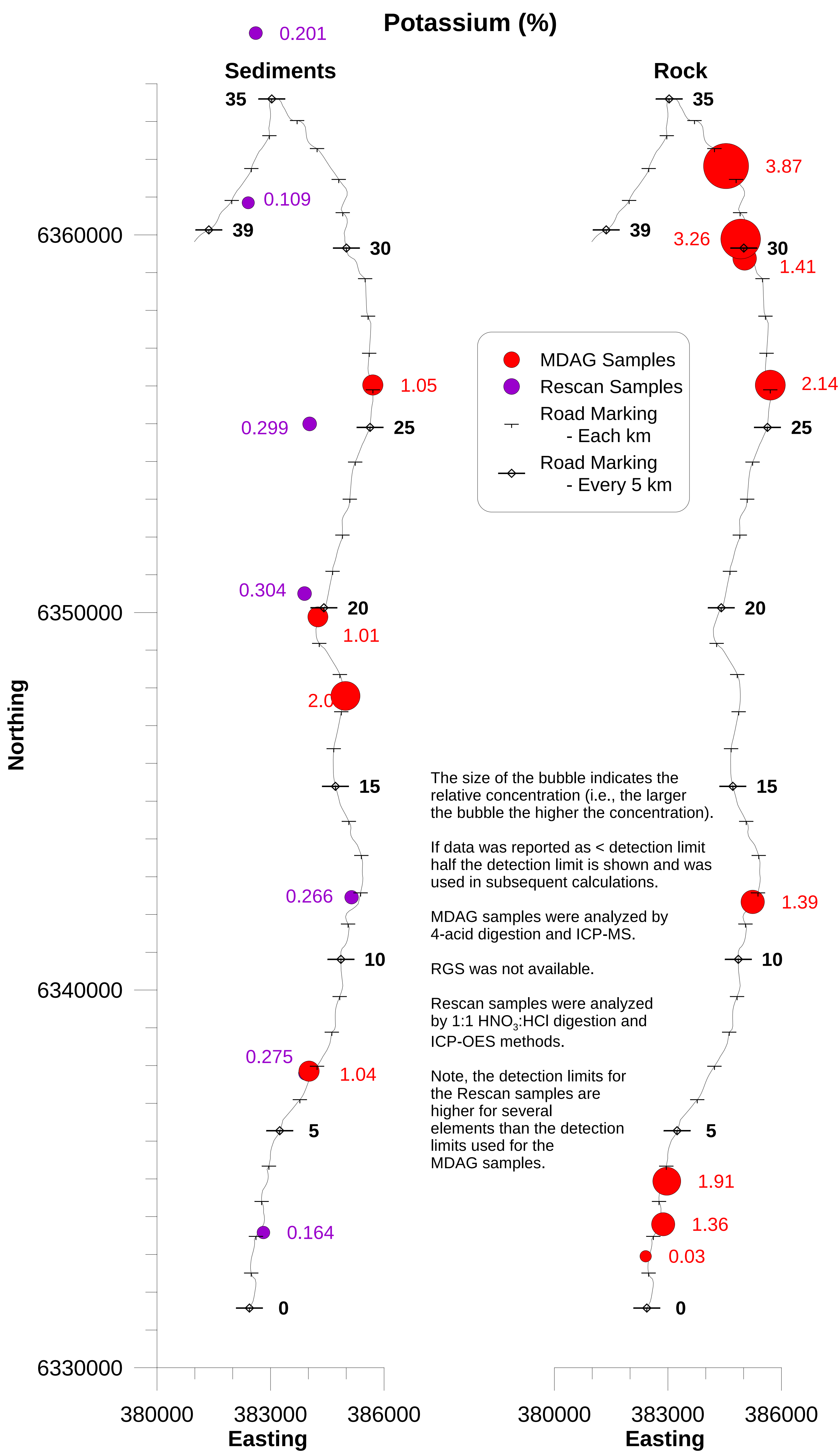
Molybdenum (ppm)
Sediments
Rock
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.
Northing
6360000
6350000
6340000
6330000
Easting
380000
383000
386000
0
5
10
15
20
25
30
35
39
0.95
2.65
0.63
0.7
1.22
1.67
1.14
29.8
0.34
0.32
0.31


Nickel (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.

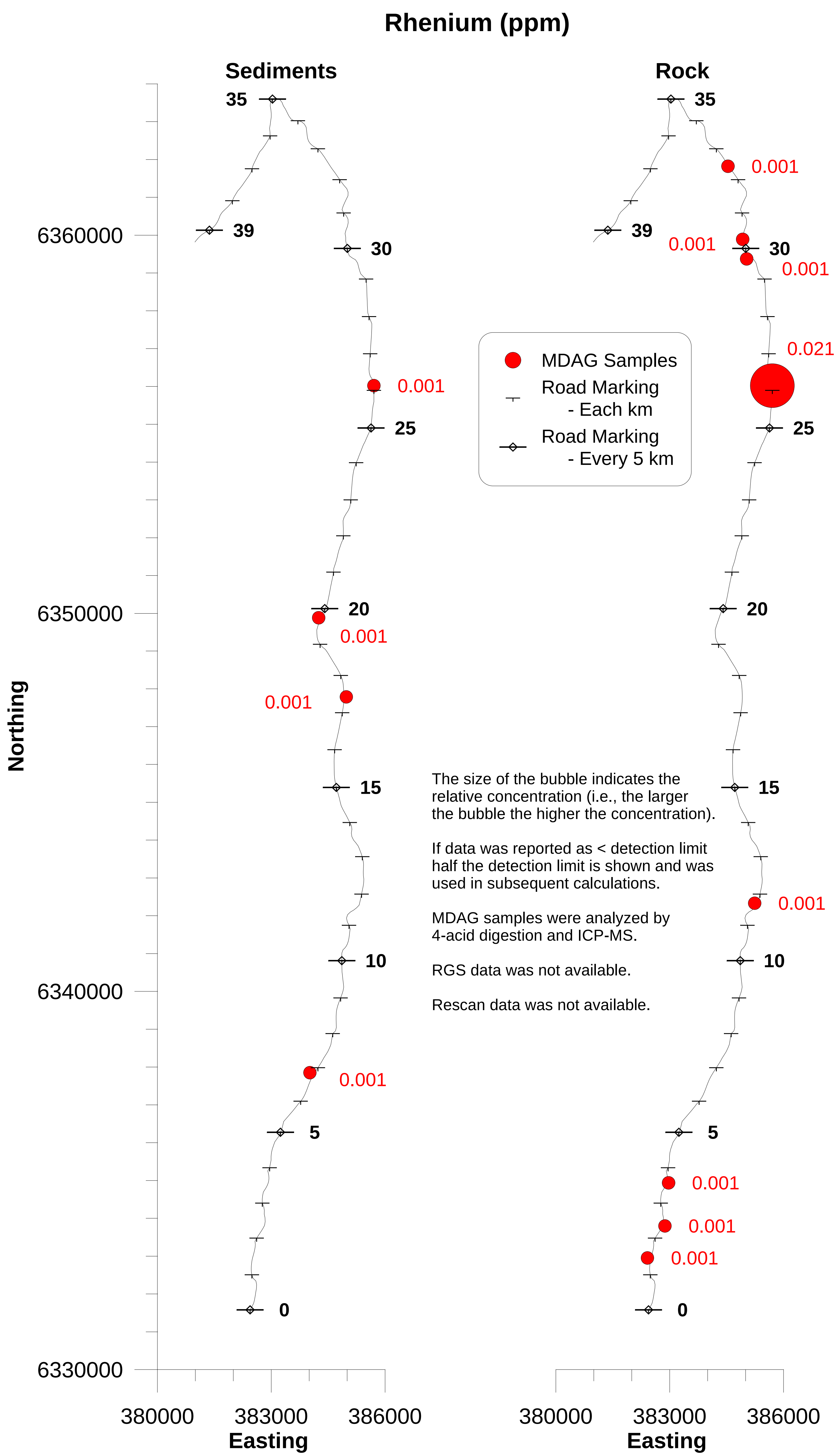

Niobium (ppm)
Sediments
Rock
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
35
39
30
25
20
15
10
5
0
7.9
13.2
11.9
8.5
9
15.4
8
4.6
8.3
80.6
6.8
7.5
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.



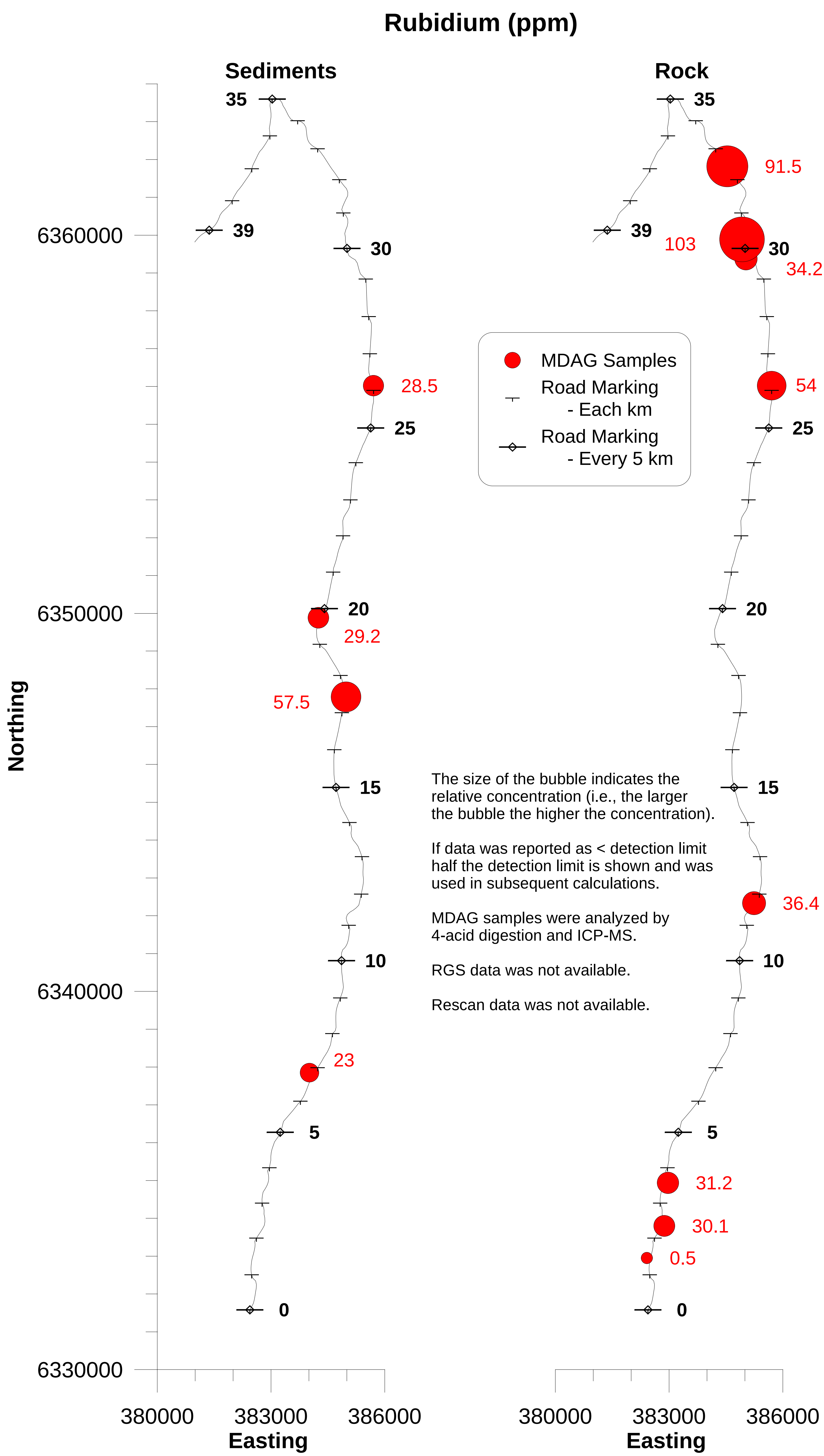
Phosphorus (ppm)
1110
Sediments
Rock
35
39
30
25
20
15
10
5
0
269
860
1210
1150
690
1260
1500
1350
980
1210
1460
400
1830
840
1120
5240
610
1580
MDAG Samples
Rescan Samples
Road Marking
- Each km
Road Marking
- Every 5 km
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



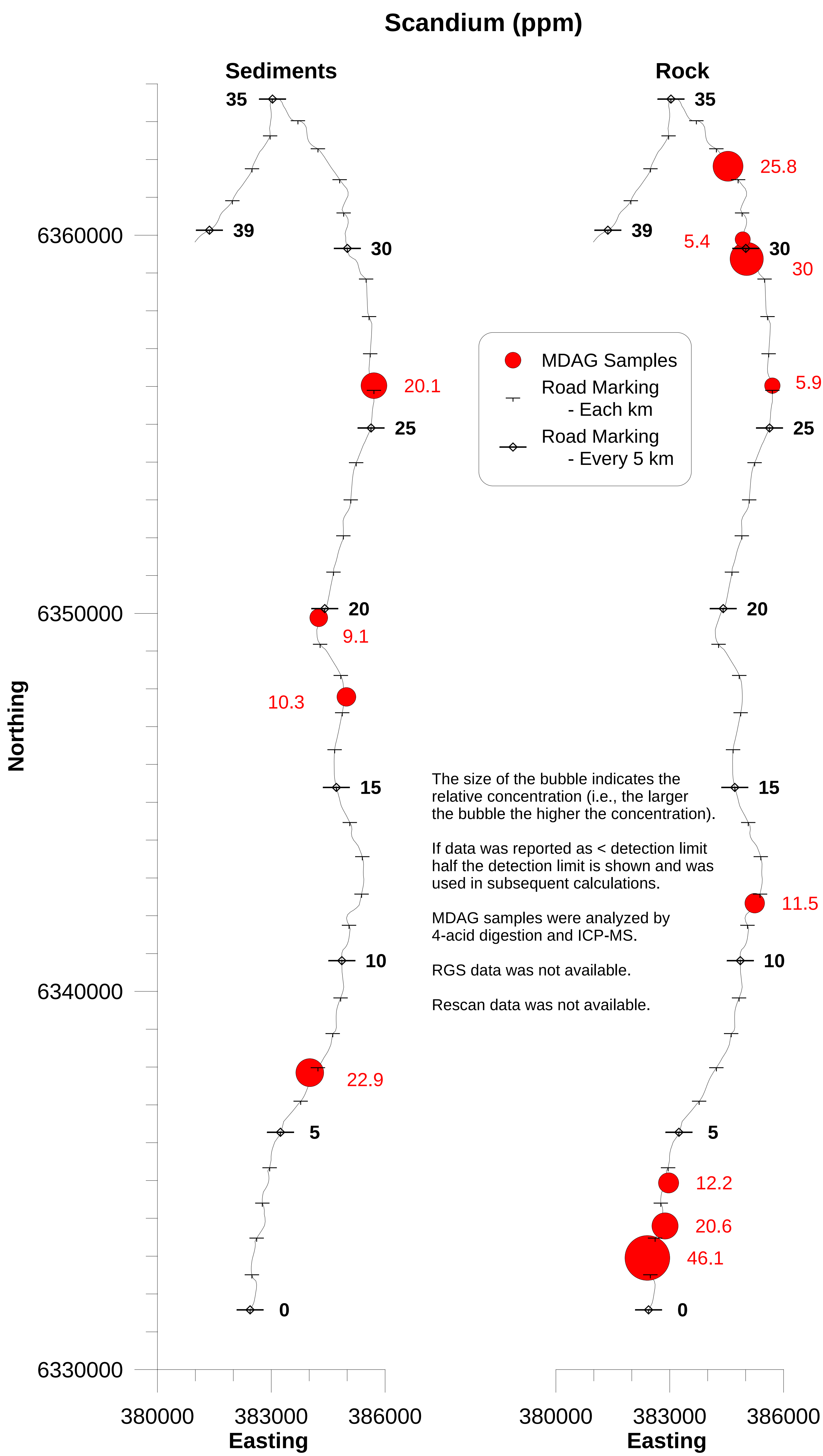
Potassium (%)
Sediments
Rock
MDAG Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
0.201
0.109
1.05
0.299
0.304
1.01
2.0
0.266
0.275
1.04
0.164
3.87
3.26
1.41
2.14
1.39
1.91
1.36
0.03
0
5
10
15
20
25
30
35
39
Northing
6360000
6350000
6340000
6330000
Easting
380000
383000
386000
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.

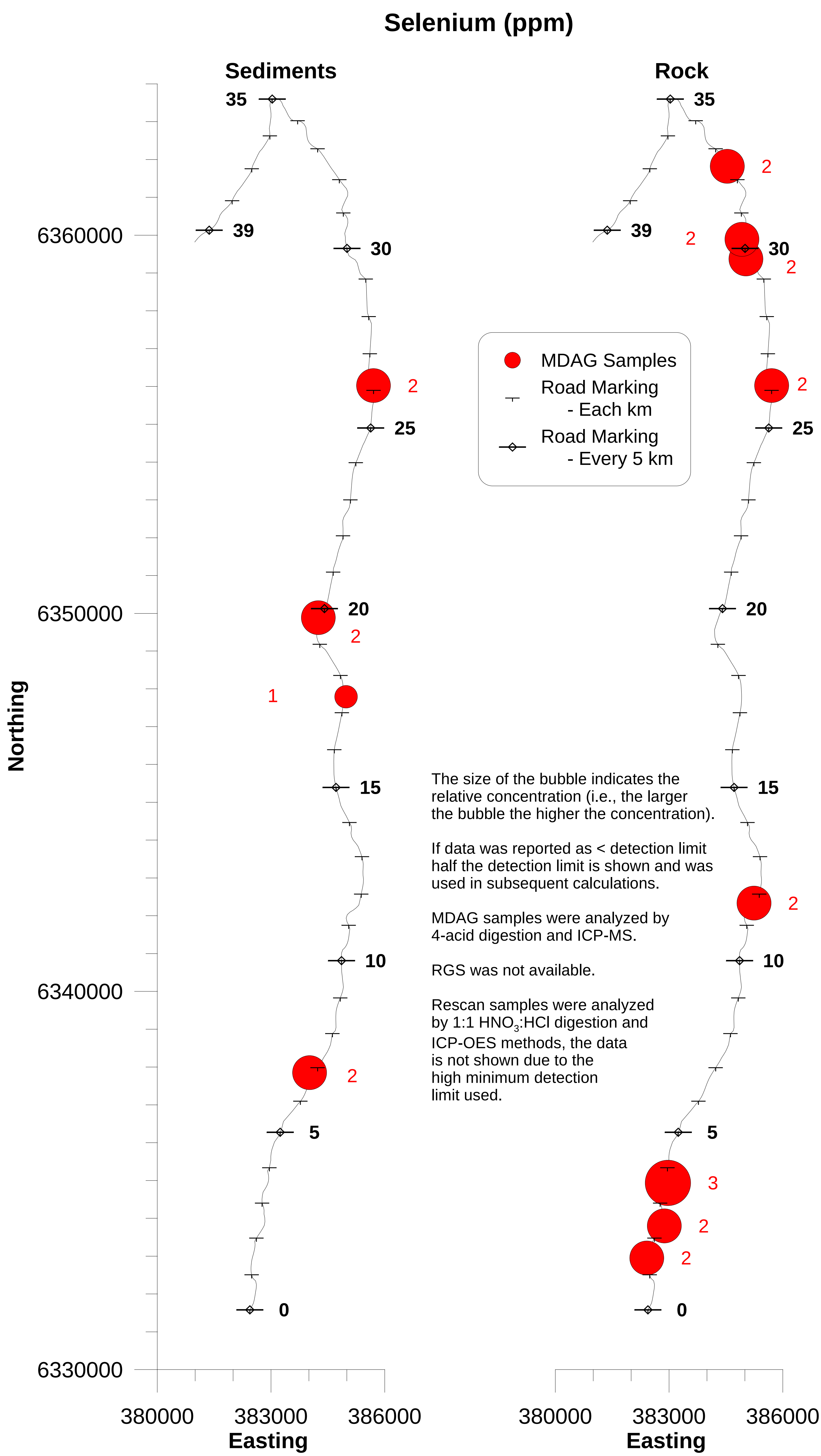


Rhenium (ppm)
Sediments
Rock
Northing
Easting
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
380000
383000
386000
35
39
30
25
20
15
10
5
0
0.001
0.001
0.001
0.001
0.021
0.001
0.001
0.001
0.001
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the
relative concentration (i.e., the larger
the bubble the higher the concentration).
If data was reported as < detection limit
half the detection limit is shown and was
used in subsequent calculations.
MDAG samples were analyzed by
4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.

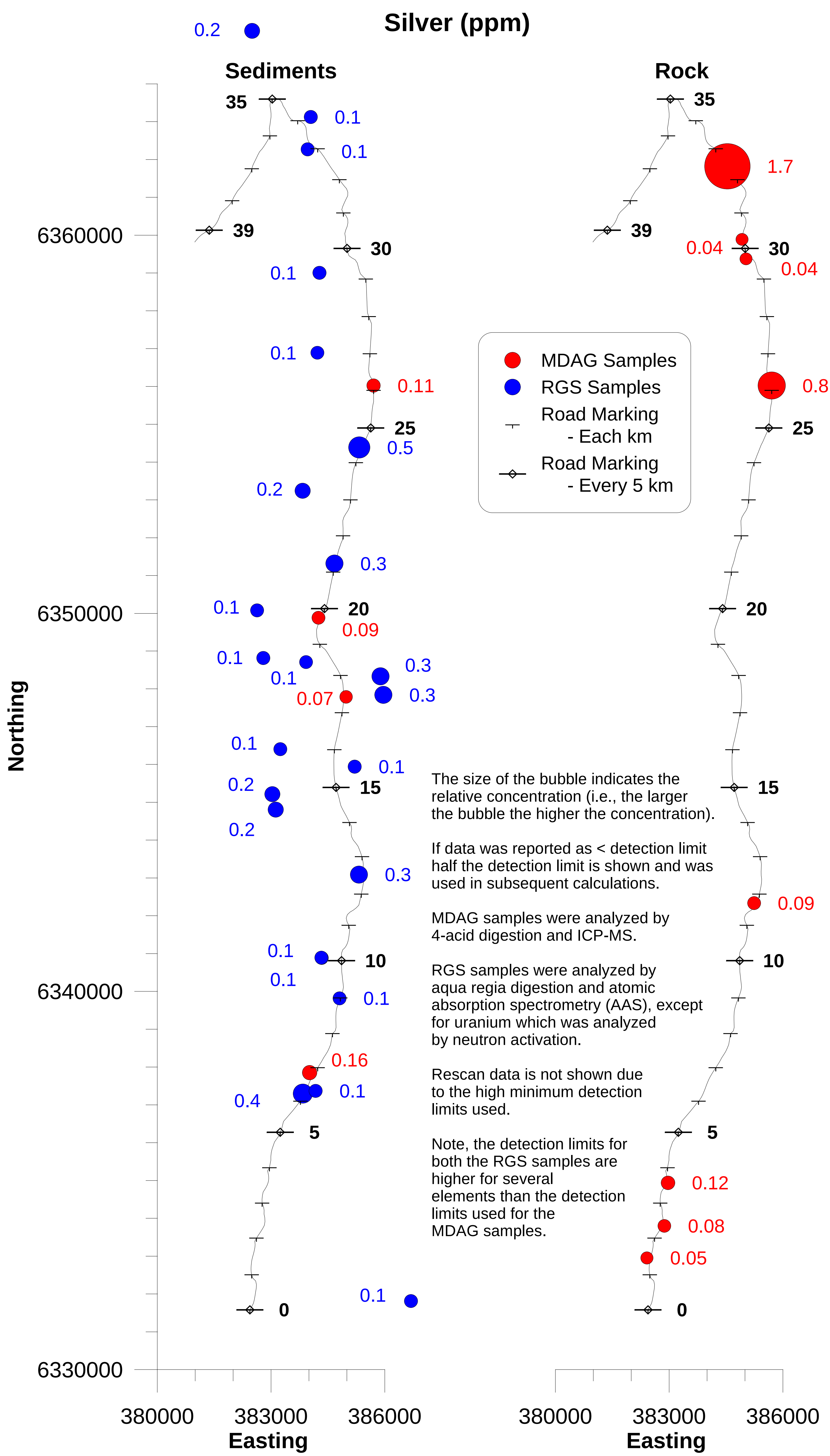


Rubidium (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
28.5
29.2
57.5
23
91.5
103
34.2
54
36.4
31.2
30.1
0.5
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.

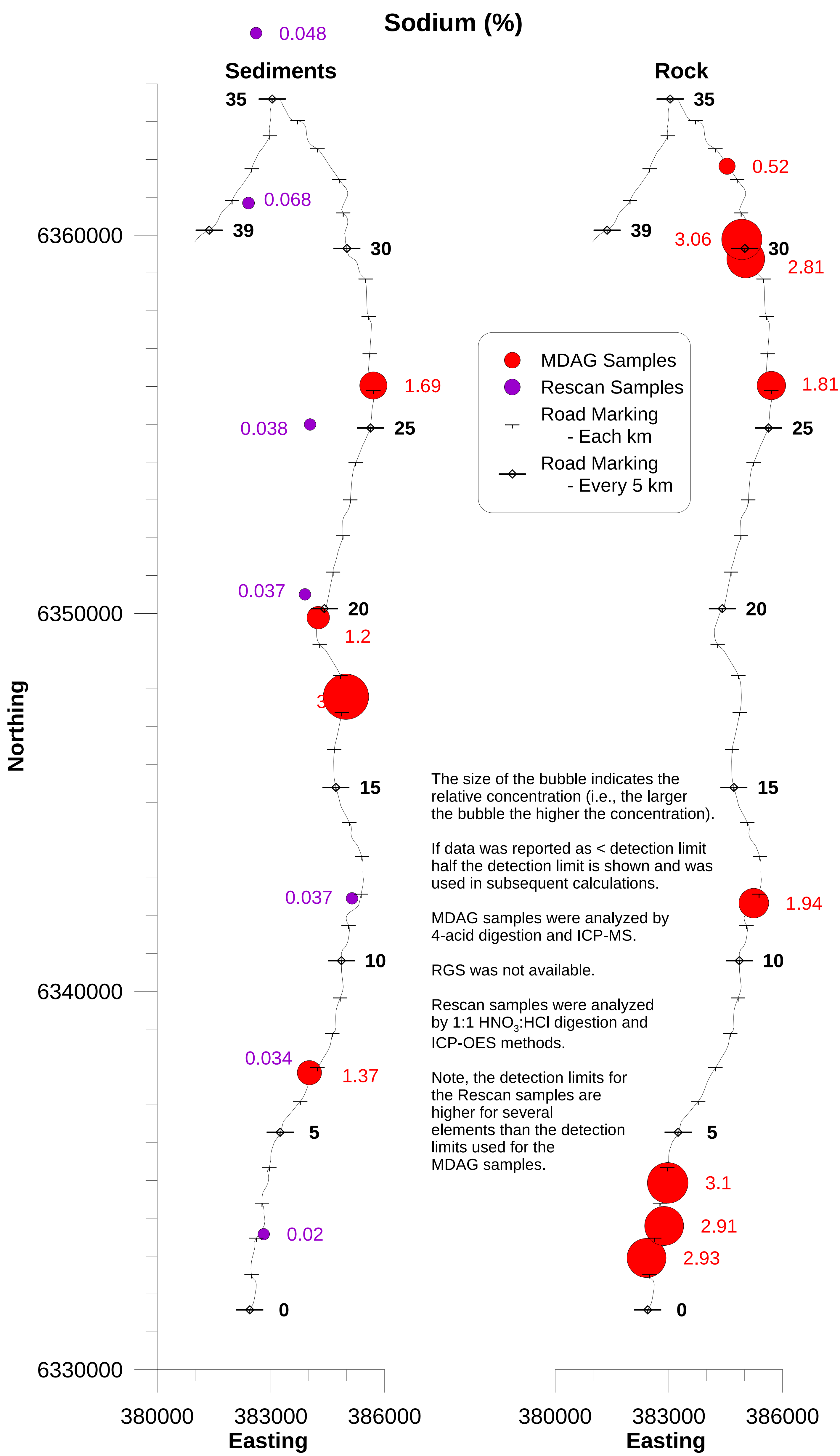

Scandium (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
20.1
9.1
10.3
22.9
25.8
5.4
30
5.9
11.5
12.2
20.6
46.1
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.

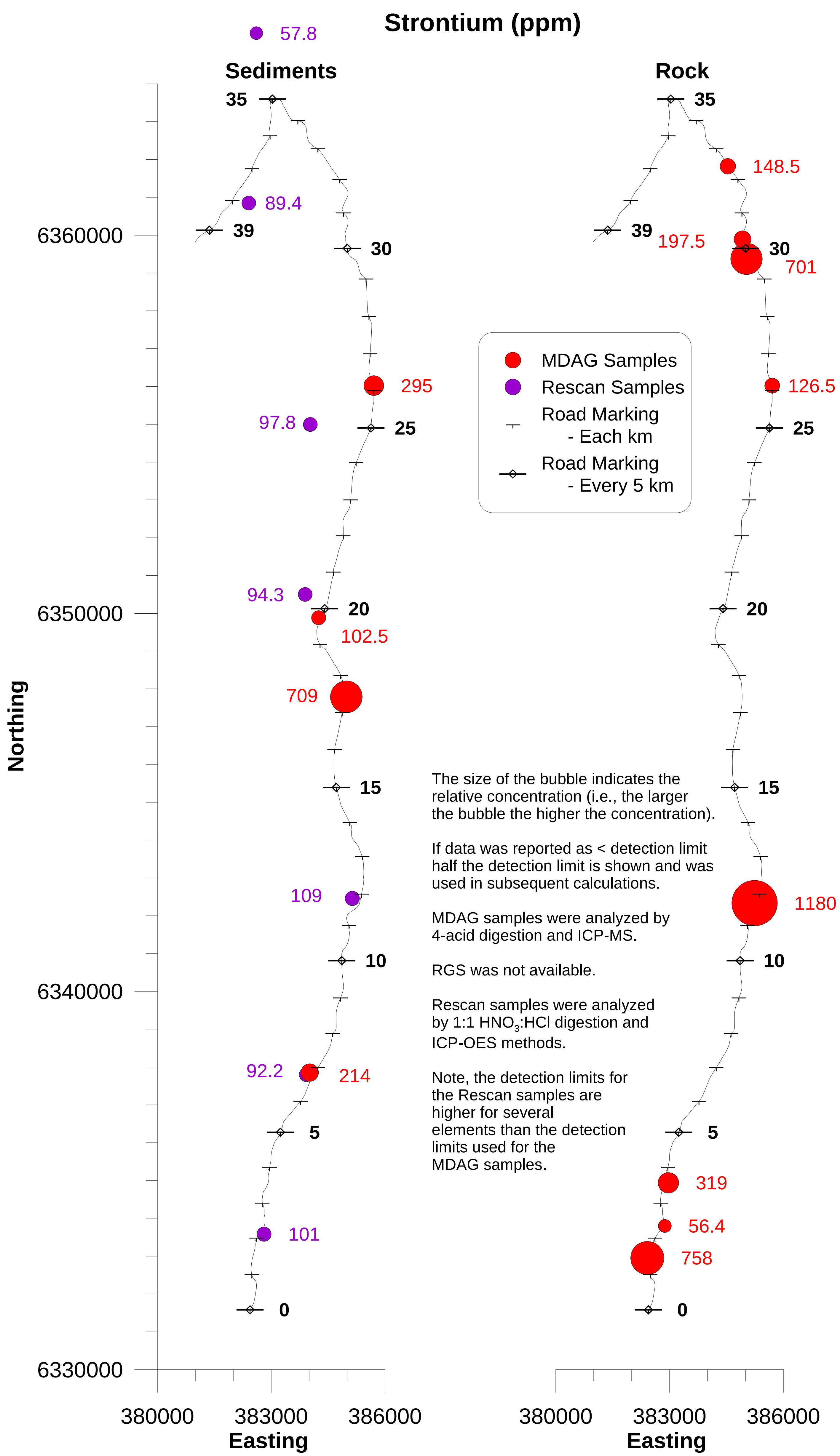


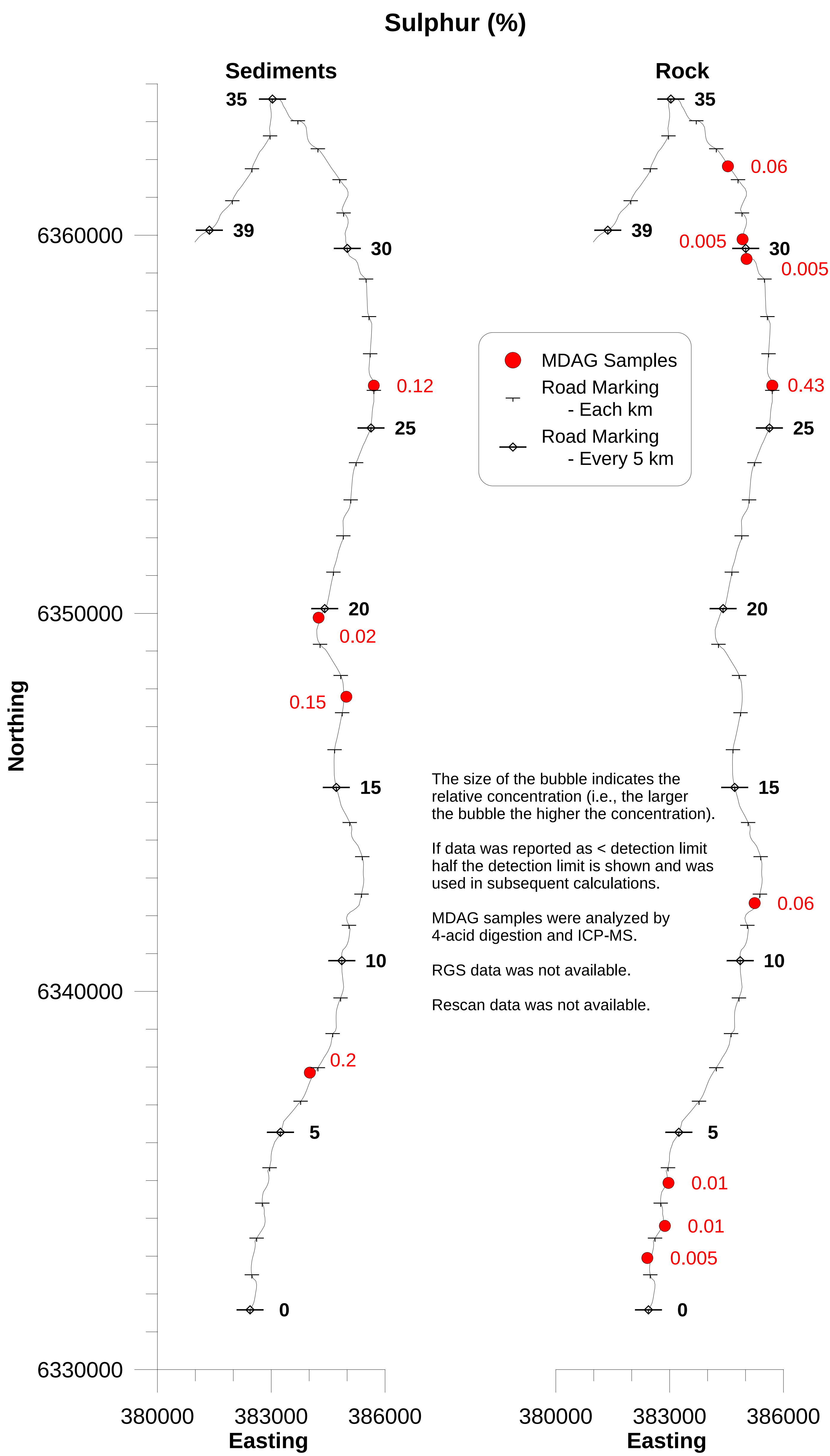
Selenium (ppm)
Sediments
Rock
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
35
39
30
25
20
15
10
5
0
1
2
3
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods, the data is not shown due to the high minimum detection limit used.



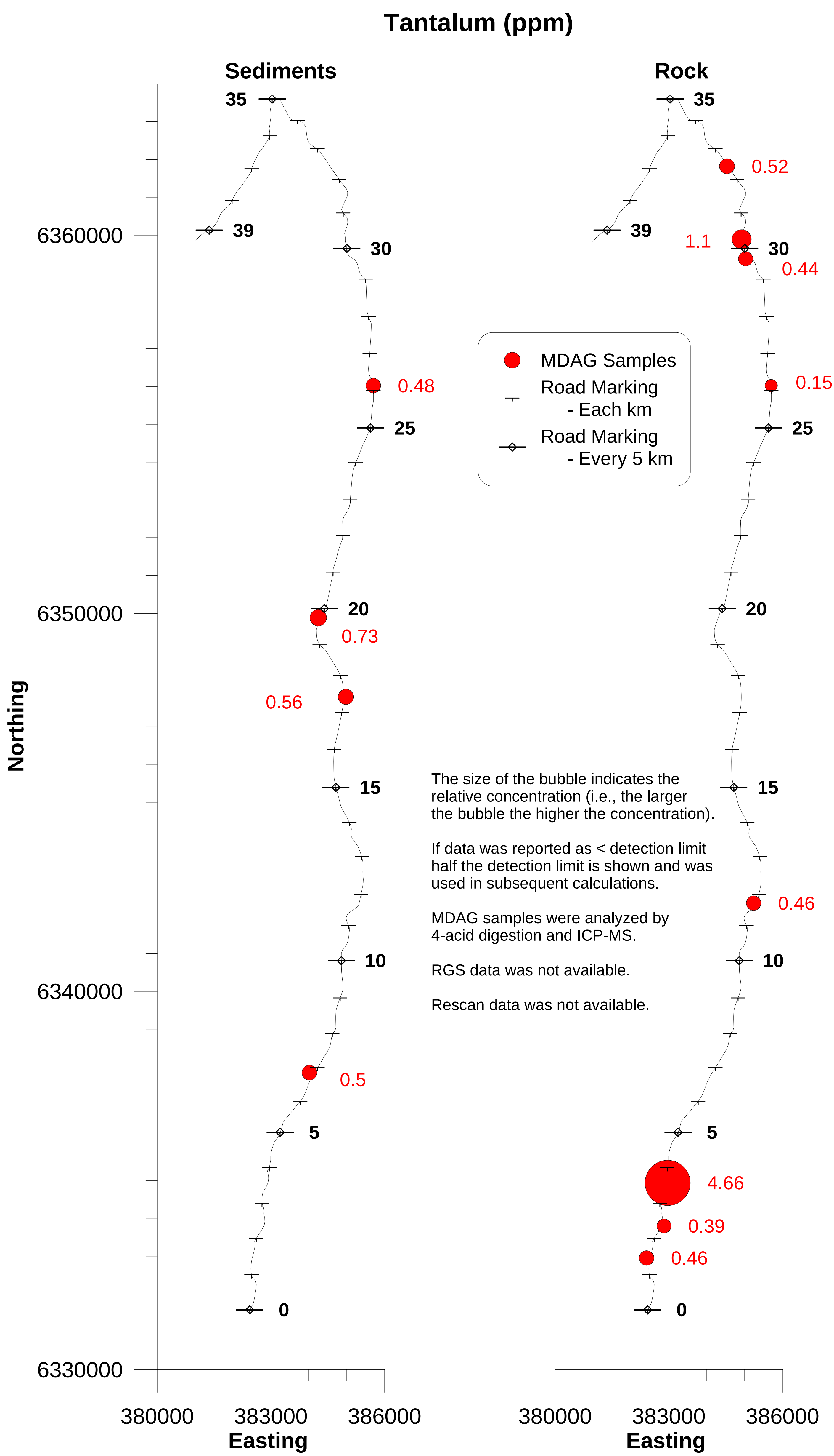
Silver (ppm)
Sediments
Rock
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
35
39
30
25
20
15
10
5
0
0.2
0.1
0.11
0.5
0.3
0.09
0.07
0.4
0.16
1.7
0.04
0.8
0.12
0.08
0.05
MDAG Samples
RGS Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan data is not shown due to the high minimum detection limits used.
Note, the detection limits for both the RGS samples are higher for several elements than the detection limits used for the MDAG samples.


Sodium (%)
Sediments
Rock
0.048
0.068
0.038
0.037
0.037
0.034
0.02
1.69
1.2
1.37
0.52
3.06
2.81
1.81
1.94
3.1
2.91
2.93
MDAG Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.
Northing
6360000
6350000
6340000
6330000
Easting
380000
383000
386000
0
5
10
15
20
25
30
35
39

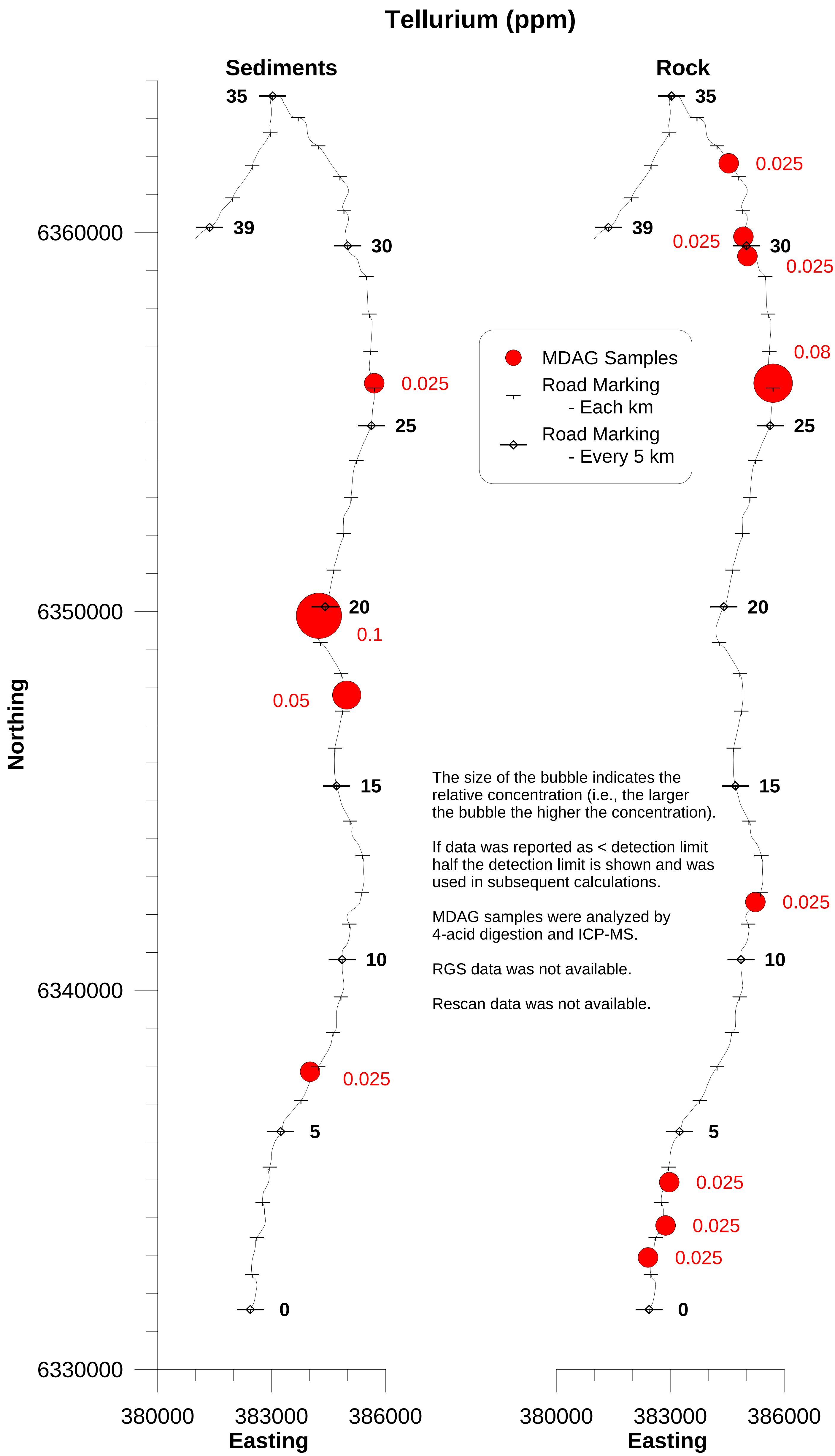

Strontium (ppm)
Sediments
Rock
MDAG Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
57.8
89.4
97.8
94.3
109
92.2
101
295
102.5
709
214
148.5
197.5
701
126.5
1180
319
56.4
758
0
5
10
15
20
25
30
35
39
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



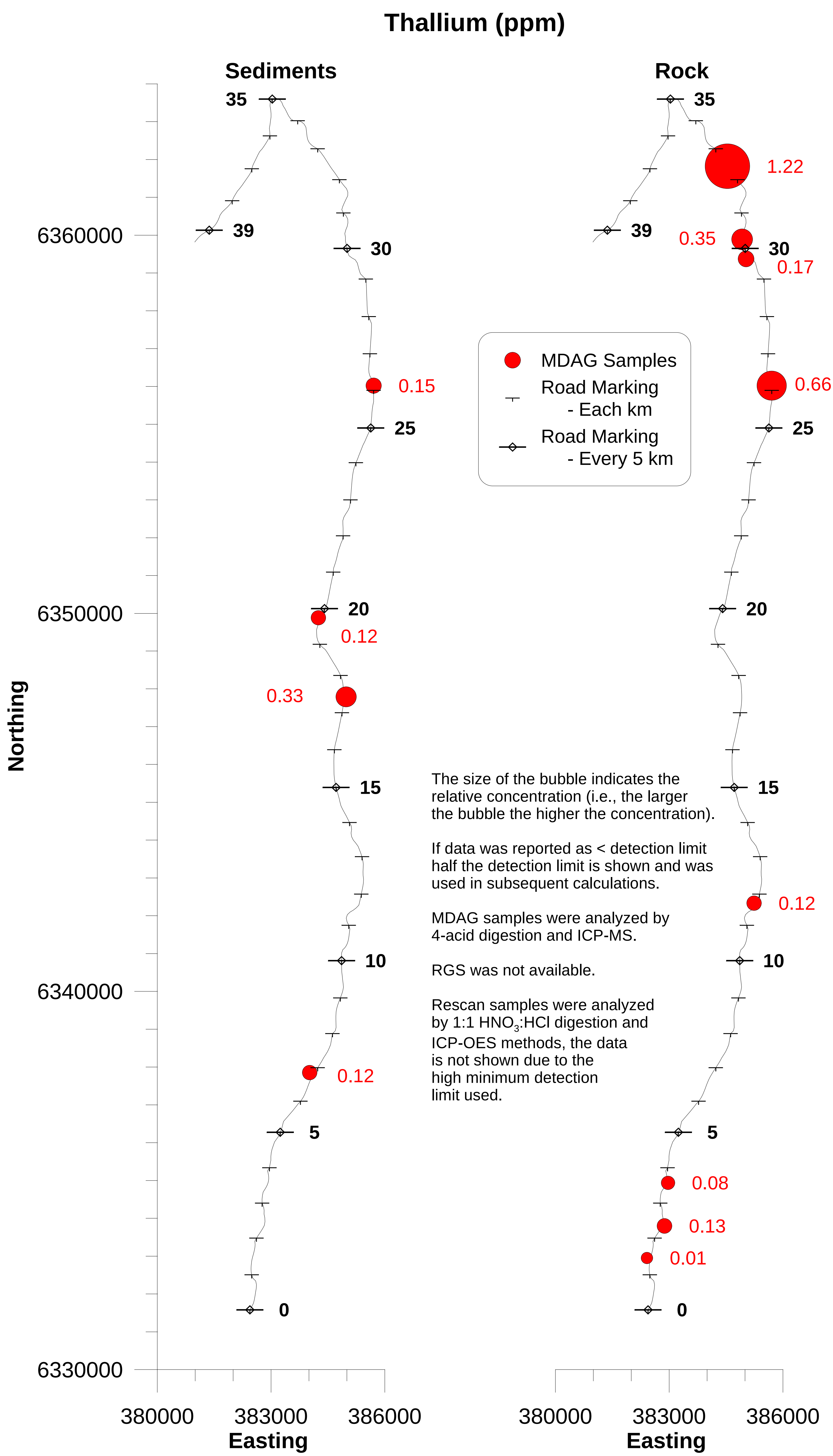
Sulphur (%)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
0.12
0.02
0.15
0.2
0.06
0.005
0.005
0.43
0.06
0.01
0.01
0.005
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.



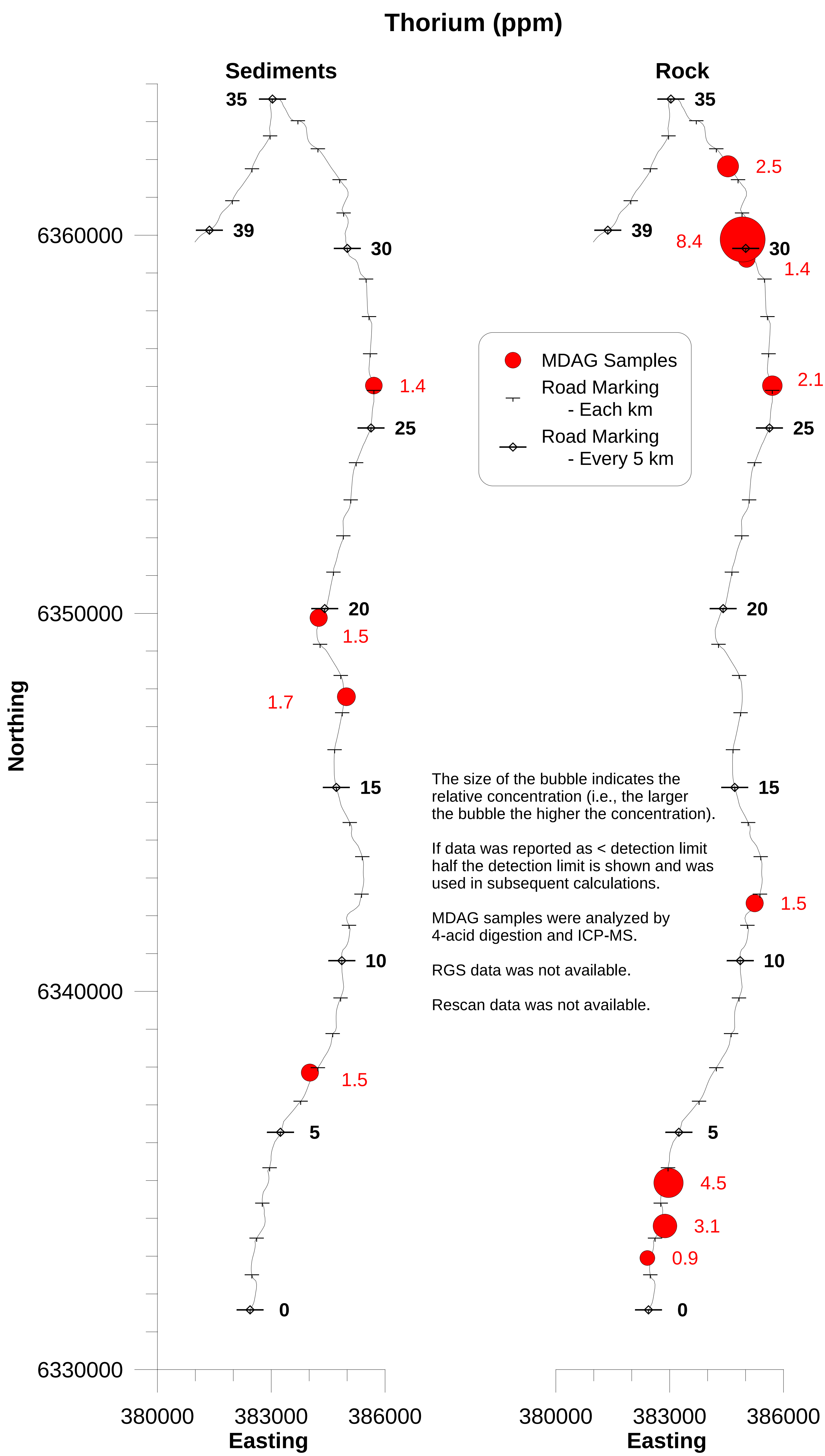
Tantalum (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
0.48
0.73
0.56
0.5
0.52
1.1
0.44
0.15
0.46
4.66
0.39
0.46
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.



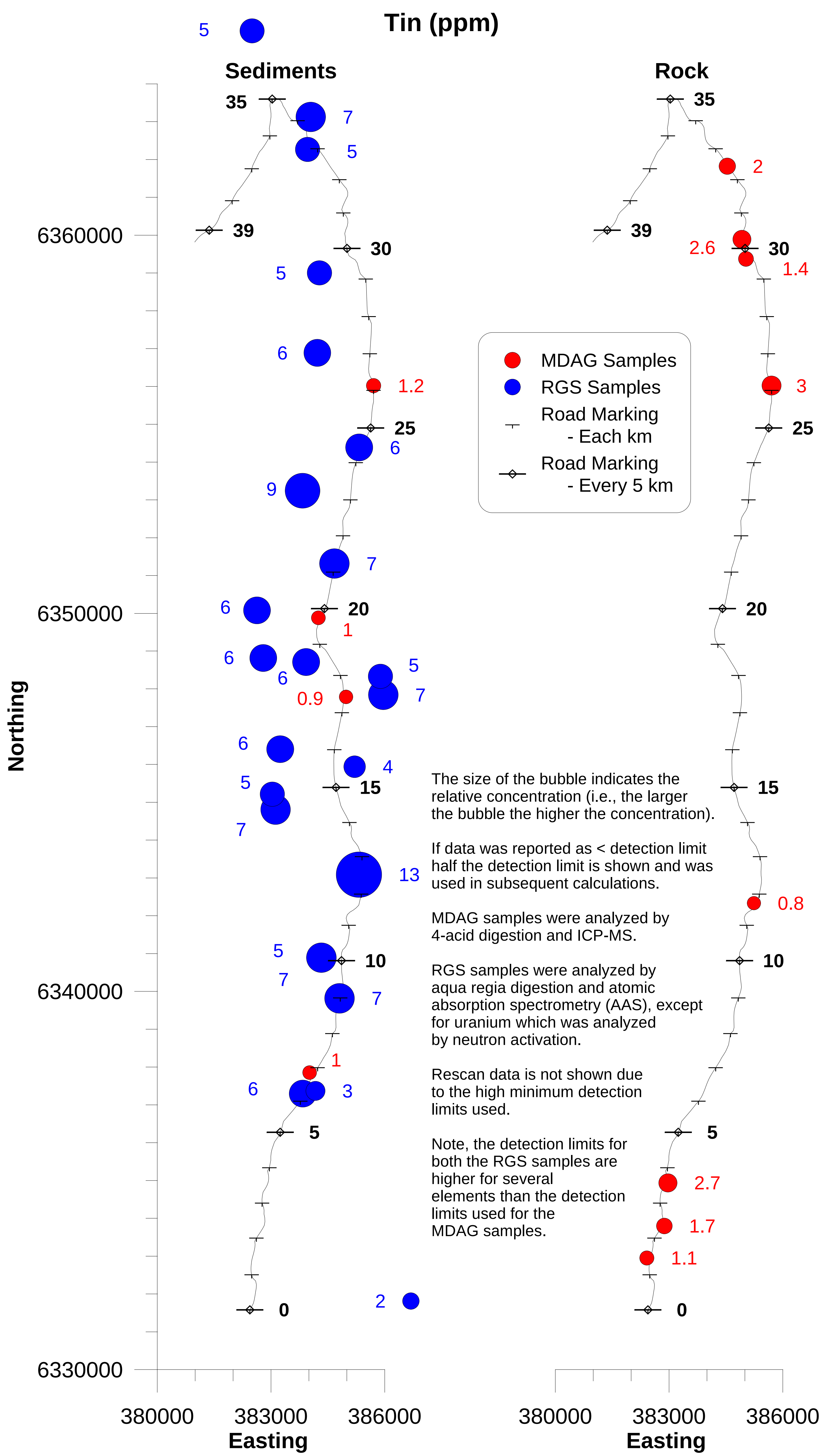
Tellurium (ppm)
Sediments
Rock
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
35
39
30
25
20
15
10
5
0
0.025
0.1
0.05
0.08
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.



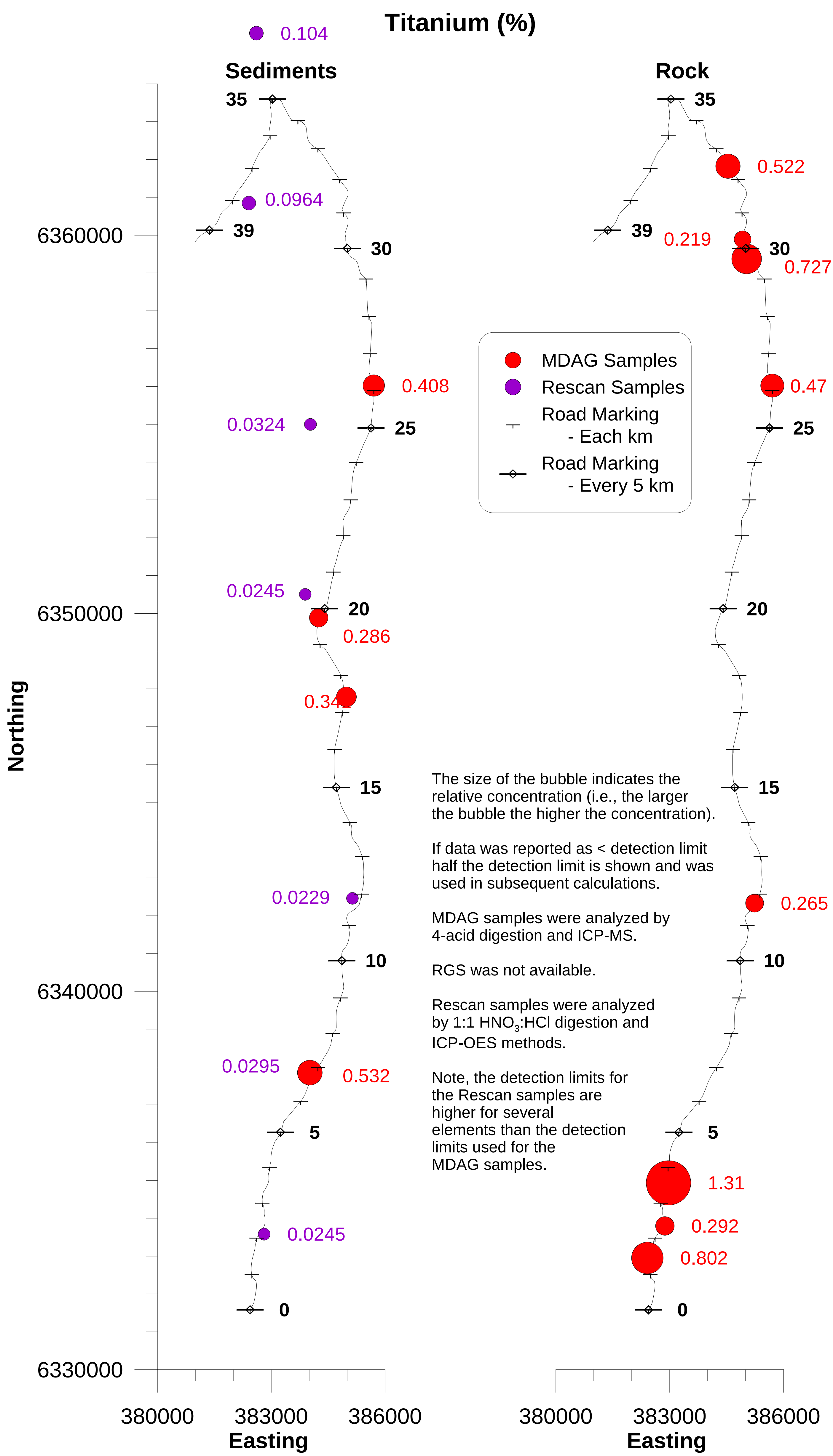
Thallium (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
0.15
0.12
0.33
0.12
1.22
0.35
0.17
0.66
0.12
0.08
0.13
0.01
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods, the data is not shown due to the high minimum detection limit used.



Thorium (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
1.4
1.5
1.7
1.5
2.5
8.4
1.4
2.1
1.5
4.5
3.1
0.9
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.

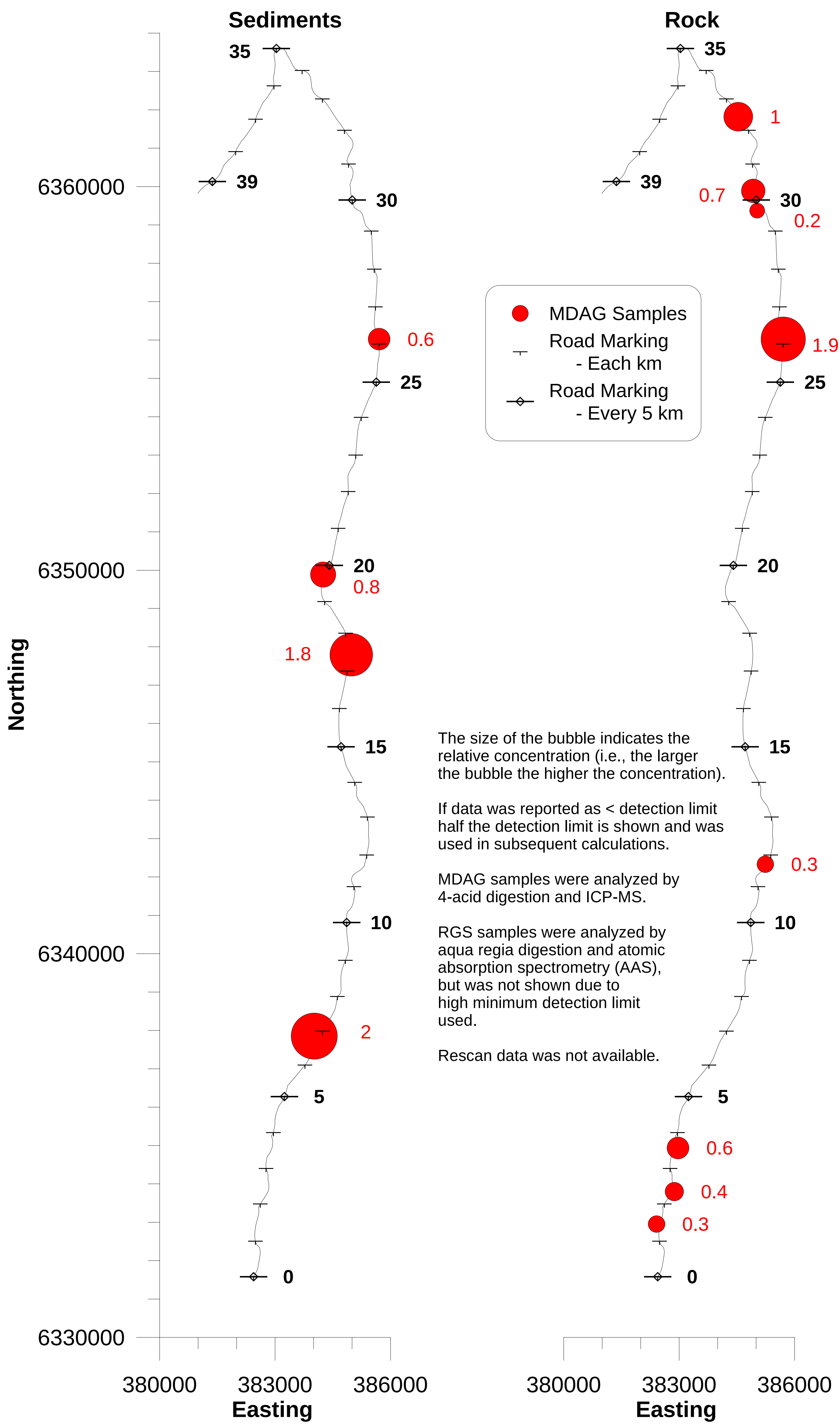


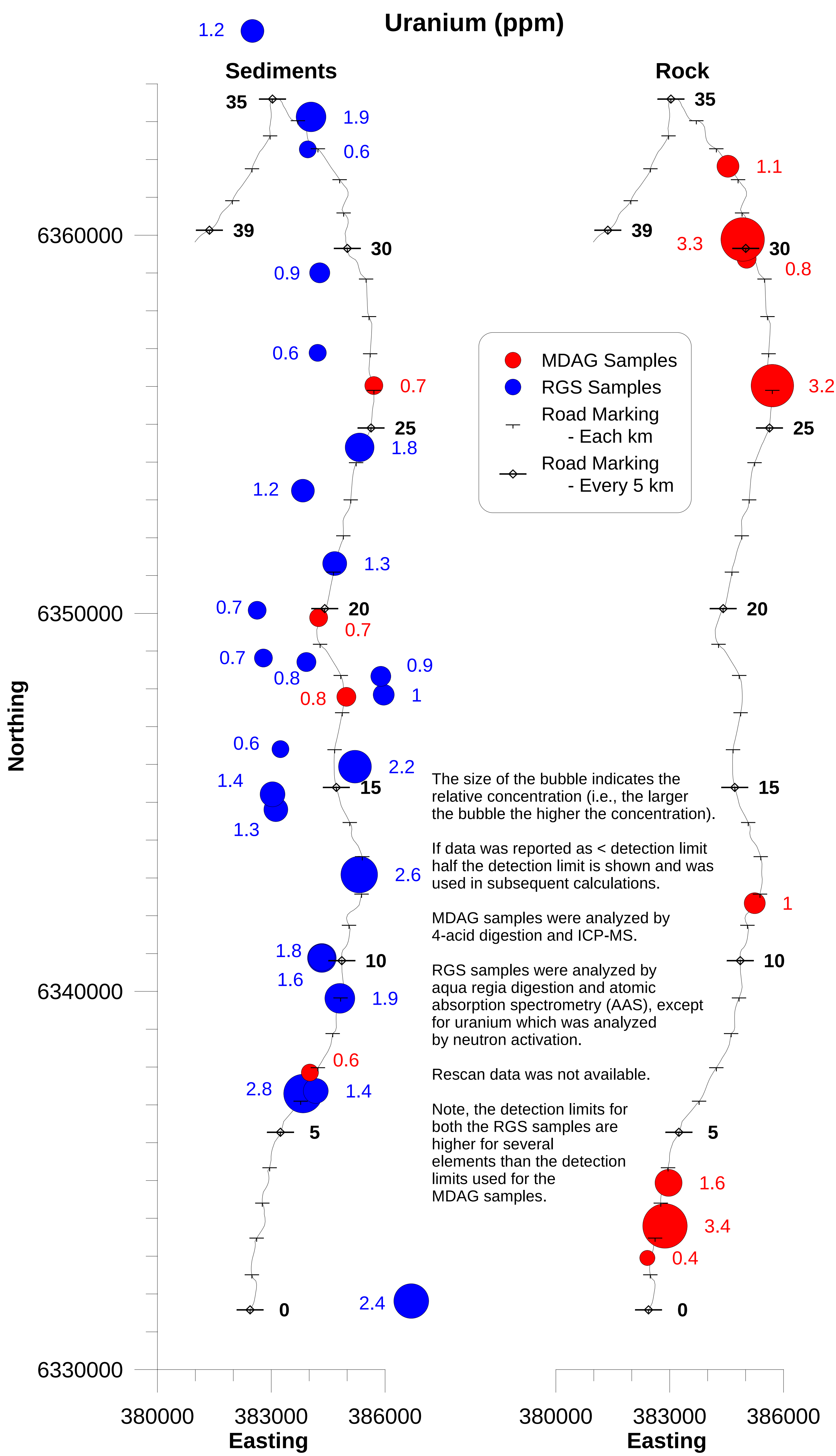
Tin (ppm)
Sediments
Rock
MDAG Samples
RGS Samples
Road Marking
- Each km
Road Marking
- Every 5 km
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan data is not shown due to the high minimum detection limits used.
Note, the detection limits for both the RGS samples are higher for several elements than the detection limits used for the MDAG samples.

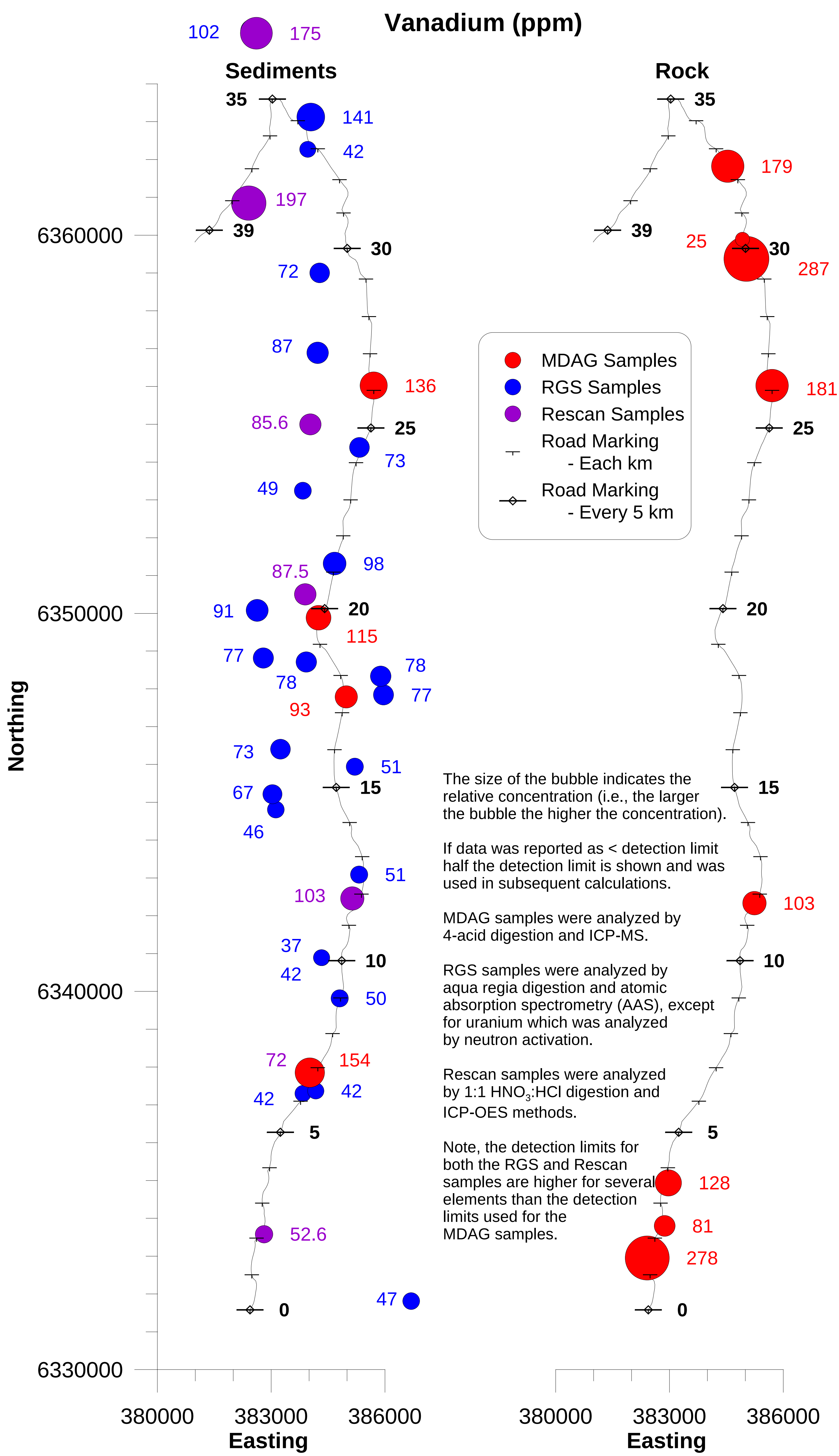


Titanium (%)
Sediments
Rock
Northing
Easting
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
380000
383000
386000
35
39
30
25
20
15
10
5
0
0.104
0.0964
0.408
0.0324
0.0245
0.286
0.34
0.0229
0.0295
0.532
0.0245
0.522
0.219
0.727
0.47
0.265
1.31
0.292
0.802
MDAG Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS was not available.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for the Rescan samples are higher for several elements than the detection limits used for the MDAG samples.

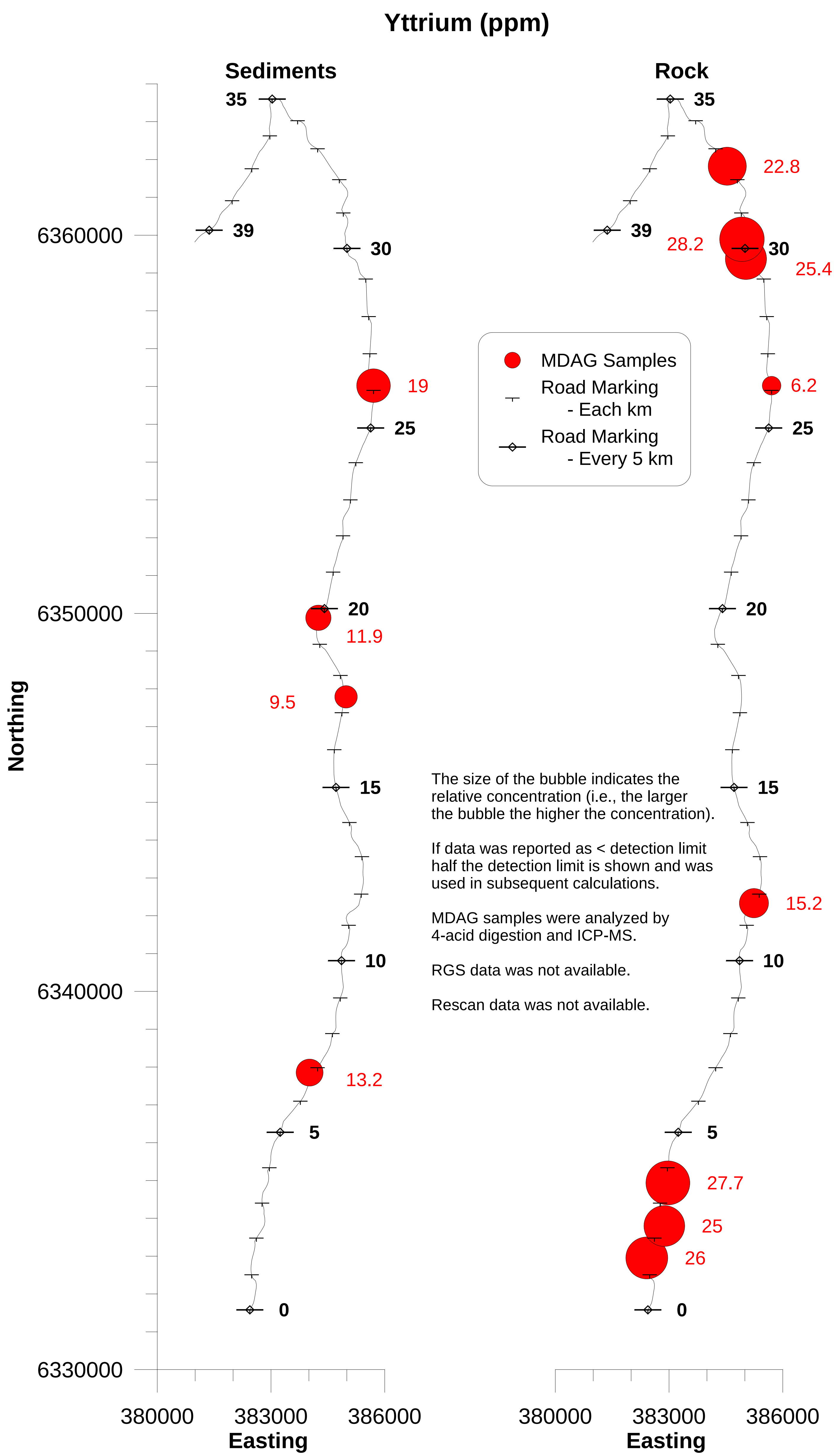
Tungsten (ppm)



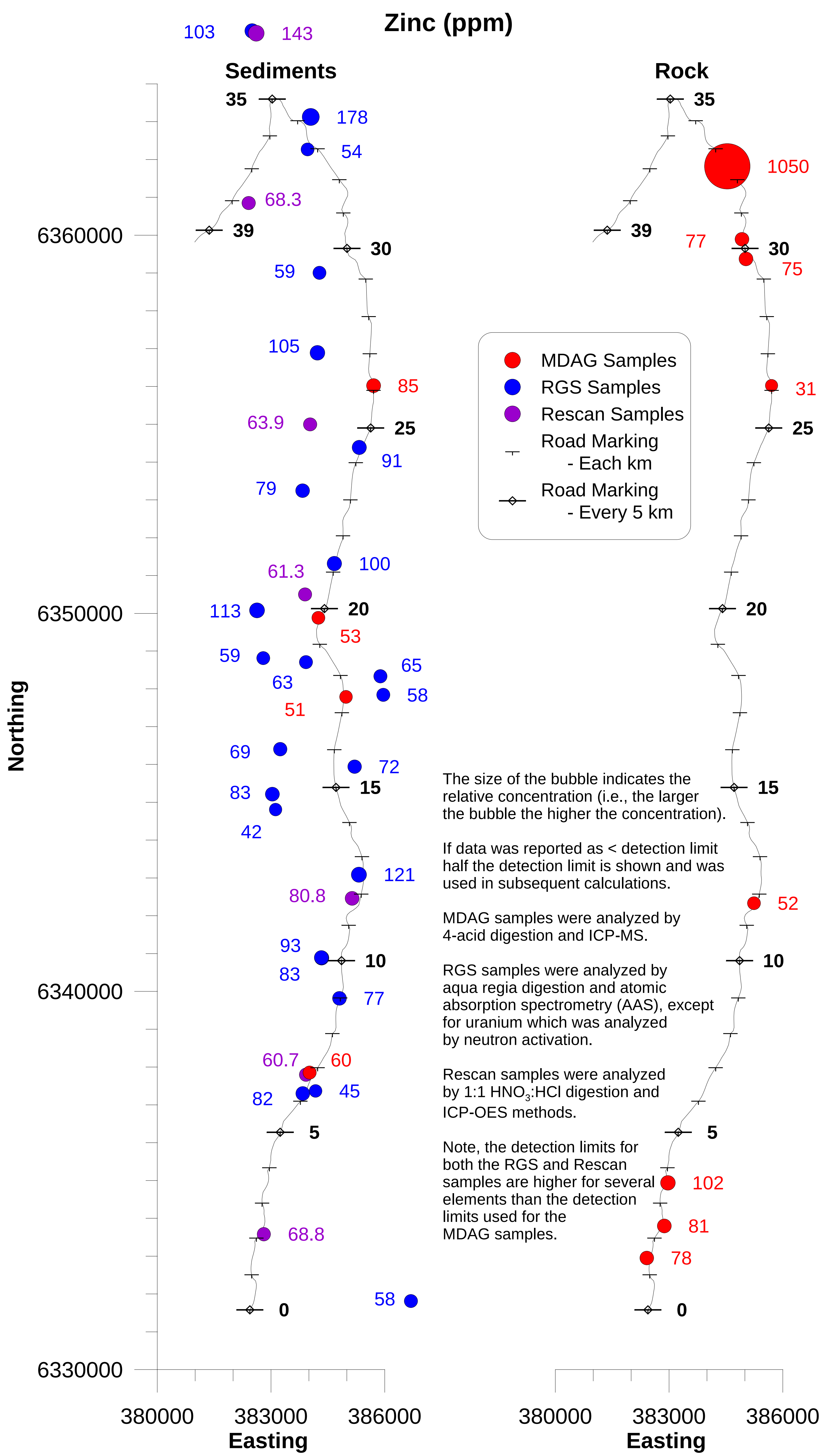

Uranium (ppm)
Sediments
Rock
Northing
Easting
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
380000
383000
386000
MDAG Samples
RGS Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan data was not available.
Note, the detection limits for both the RGS samples are higher for several elements than the detection limits used for the MDAG samples.



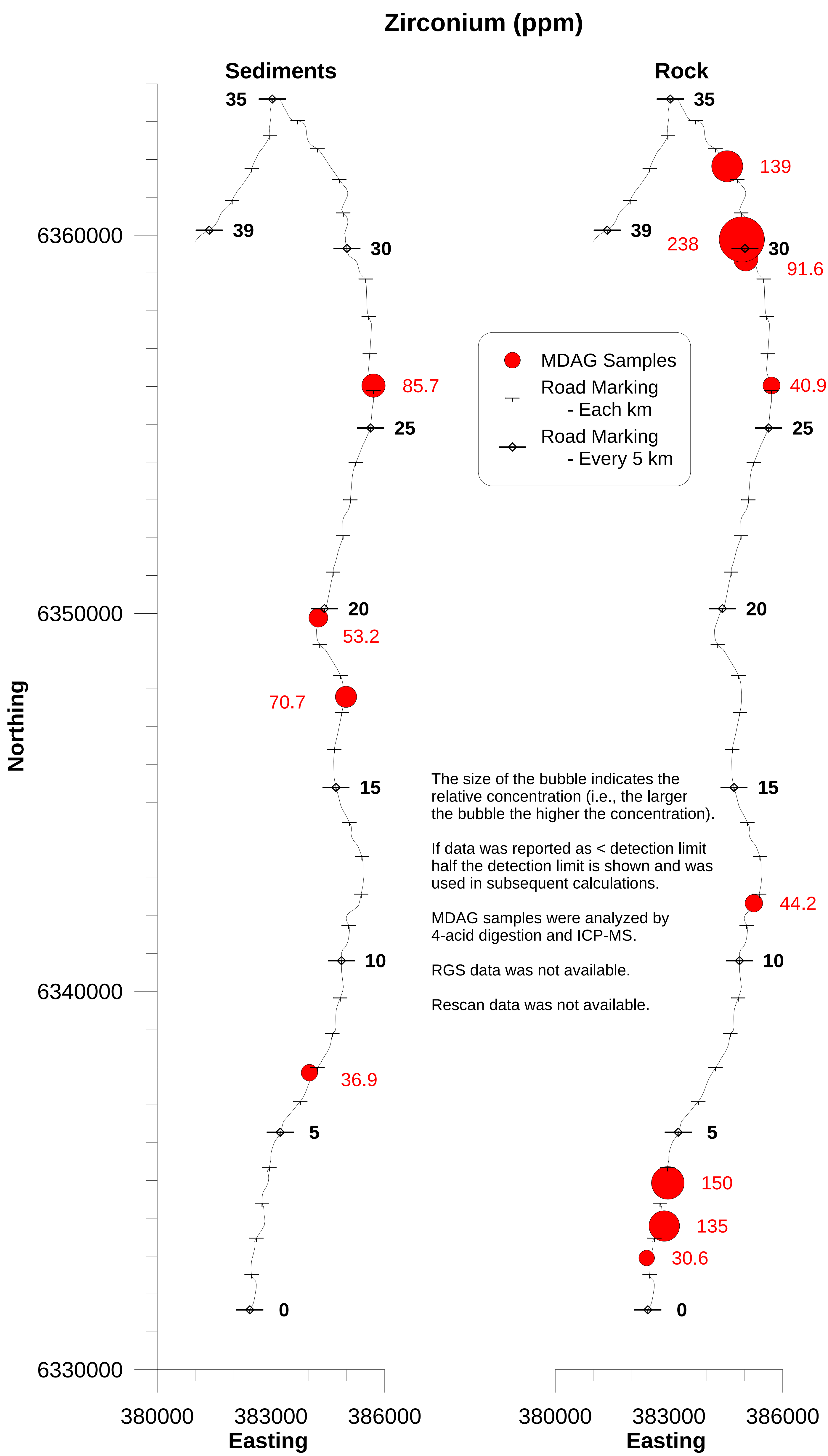
Vanadium (ppm)
Sediments
Rock
102
175
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
141
42
197
72
87
136
85.6
73
49
98
87.5
91
115
77
78
78
77
93
73
51
67
46
51
103
37
42
50
72
154
42
42
52.6
47
179
25
287
181
103
128
81
278
MDAG Samples
RGS Samples
Rescan Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



Yttrium (ppm)
Sediments
Rock
Northing
6360000
6350000
6340000
6330000
380000
383000
386000
Easting
35
39
30
25
20
15
10
5
0
19
11.9
9.5
13.2
22.8
28.2
25.4
6.2
15.2
27.7
25
26
MDAG Samples
Road Marking
- Each km
Road Marking
- Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.



Zinc (ppm)
Sediments
Rock
Northing
Easting
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
380000
383000
386000
35
39
30
25
20
15
10
5
0
35
39
30
25
20
15
10
5
0
103
143
178
54
68.3
59
105
85
63.9
91
79
100
61.3
113
53
59
63
65
58
51
69
72
83
42
121
80.8
93
83
77
60.7
60
82
45
68.8
58
1050
77
75
31
52
102
81
78
MDAG Samples
RGS Samples
Rescan Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS samples were analyzed by aqua regia digestion and atomic absorption spectrometry (AAS), except for uranium which was analyzed by neutron activation.
Rescan samples were analyzed by 1:1 HNO_3:HCl digestion and ICP-OES methods.
Note, the detection limits for both the RGS and Rescan samples are higher for several elements than the detection limits used for the MDAG samples.



Zirconium (ppm)
Sediments
Rock
Northing
Easting
6360000
6350000
6340000
6330000
380000
383000
386000
35
39
30
25
20
15
10
5
0
85.7
53.2
70.7
36.9
139
238
91.6
40.9
44.2
150
135
30.6
MDAG Samples
Road Marking - Each km
Road Marking - Every 5 km
The size of the bubble indicates the relative concentration (i.e., the larger the bubble the higher the concentration).
If data was reported as < detection limit half the detection limit is shown and was used in subsequent calculations.
MDAG samples were analyzed by 4-acid digestion and ICP-MS.
RGS data was not available.
Rescan data was not available.