P-07-191

Oskarshamn site investigation

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Keywords: Laxemar, KLX15A, KLX16A, KLX19A, KLX20A, KLX21B, Modal analyses, Geochemical analyses, Classification of rock types, $^{40}Ar/^{39}Ar$ dating, Dolerite.

Abstract

This report comprises results of modal and geochemical analyses performed during 2007. Drill core samples have been analysed from the cored boreholes KLX15A, KLX16A, KLX19A, KLX20A and KLX21B. Five modal and geochemical analyses are reported from KLX15A, four modal and geochemical analyses from KLX16A, one modal and geochemical analysis from KLX19A, one geochemical analysis from KLX20A and one modal and geochemical analysis from KLX21B.

In order to classify and characterise the sampled rock types, the modal analyses have been recalculated and plotted in the QAP classification diagram of /Streckeisen 1976/. The results of the geochemical analyses have been plotted in the TAS classification diagram of /Middlemost 1994/ and the classification diagram of /Debon and Le Fort 1983/. The classification diagrams are presented separately for each cored borehole.

An age determination of a dolerite dyke that has been documented in the cored borehole KLX20A has yielded a $^{40}Ar/^{39}Ar$ whole rock age of c. 900 Ma.

Sammanfattning

Denna rapport redovisar resultaten av modalanalyser och geokemiska analyser utförda under 2007. Borrkärneprover har analyserats från kärnborrhålen KLX15A, KLX16A, KLX19A, KLX20A och KLX21B. Fem modala och geokemiska analyser är rapporterade från KLX15A, fyra modala och geokemiska analyser från KLX16A, en modal och geokemisk analys från KLX19A, en geokemisk analys från KLX20A och en modal och geokemisk analys från KLX21B.

I syfte att klassificera och karakterisera de provtagna bergarterna har modalanalyserna omräknats och plottats i QAP-diagram enligt /Streckeisen 1976/. Resultaten av de geokemiska analyserna har plottats i klassificeringsdiagrammen enligt /Middlemost 1994/ och /Debon och Le Fort 1983/. Diagrammen presenteras separat för varje borrhål.

En åldersbestämning av en diabasgång som dokumenterats i kärnborrhålet KLX20A har givit en $^{40}Ar/^{39}Ar$-ålder på ca 900 miljoner år.

Contents

1 Introduction

This document reports the data and results gained by modal and geochemical analyses that are carried out during 2007 of drill core samples from the cored boreholes KLX15A, KLX16A, KLX19A and KLX21B, and one geochemical analysis from KLX20A in the Laxemar subarea (Figure 1-1), which is one of the activities performed within the site investigation at Oskarshamn. Furthermore, a $^{40}Ar/^{39}Ar$ dating of a dolerite dyke from KLX20A has been carried out. The work was carried out in accordance with activity plans AP PS 400-06-015 ($^{40}Ar/^{39}Ar$ dating) and AP PS 400-07-02. In Table 1-1, controlling documents for performing this activity are listed. Both activity plans and method descriptions are SKB's internal controlling documents.

Samples for the modal and geochemical analyses were taken in order to characterise the rock types at depth. The results of the analyses are complementary to data from the geophysical loggings in the cored boreholes. These geological and geophysical data sets are of utmost importance for the characterisation of the bedrock. The sample of the dolerite dyke was analysed with the $^{40}Ar/^{39}Ar$ method in order to determine the intrusion age.

The results of the $^{40}Ar/^{39}Ar$ dating and modal and geochemical analyses are stored in the primary database SICADA and are traceable by the activity plan numbers AP PS 400-06-015 and AP PS 400-07-02, respectively.

The number of modal and geochemical analyses performed from each cored borehole is displayed in Table 1-2.

Table 1-1. Controlling documents for the performance of the activity.

Activity plan	Number	Version
Provtagning och analys av ytprover och borrkärna, 2006	AP PS 400-06-015	1.0
Provtagning och analys av ytprover och borrkärna, 2007	AP PS 400-07-02	1.0
Method descriptions	**Number**	**Version**
Metodbeskrivning för bergartsanalyser	SKB MD 160.001	1.0
Metodbeskrivning för åldersdatering av mineral och bergarter	SKB MD 132.002	1.0
Instruktion: Regler för bergarters benämningar vid platsundersökningen I Oskarshamn	SKB MD 132.004	2.0

Table 1-2. Number of analyses carried out in each borehole during 2007.

Cored borehole	Modal analyses	Geochemical analyses
KLX15A	5	5
KLX16A	4	4
KLX19A	1	1
KLX20A		1
KLX21B	1	1
Total	11	12

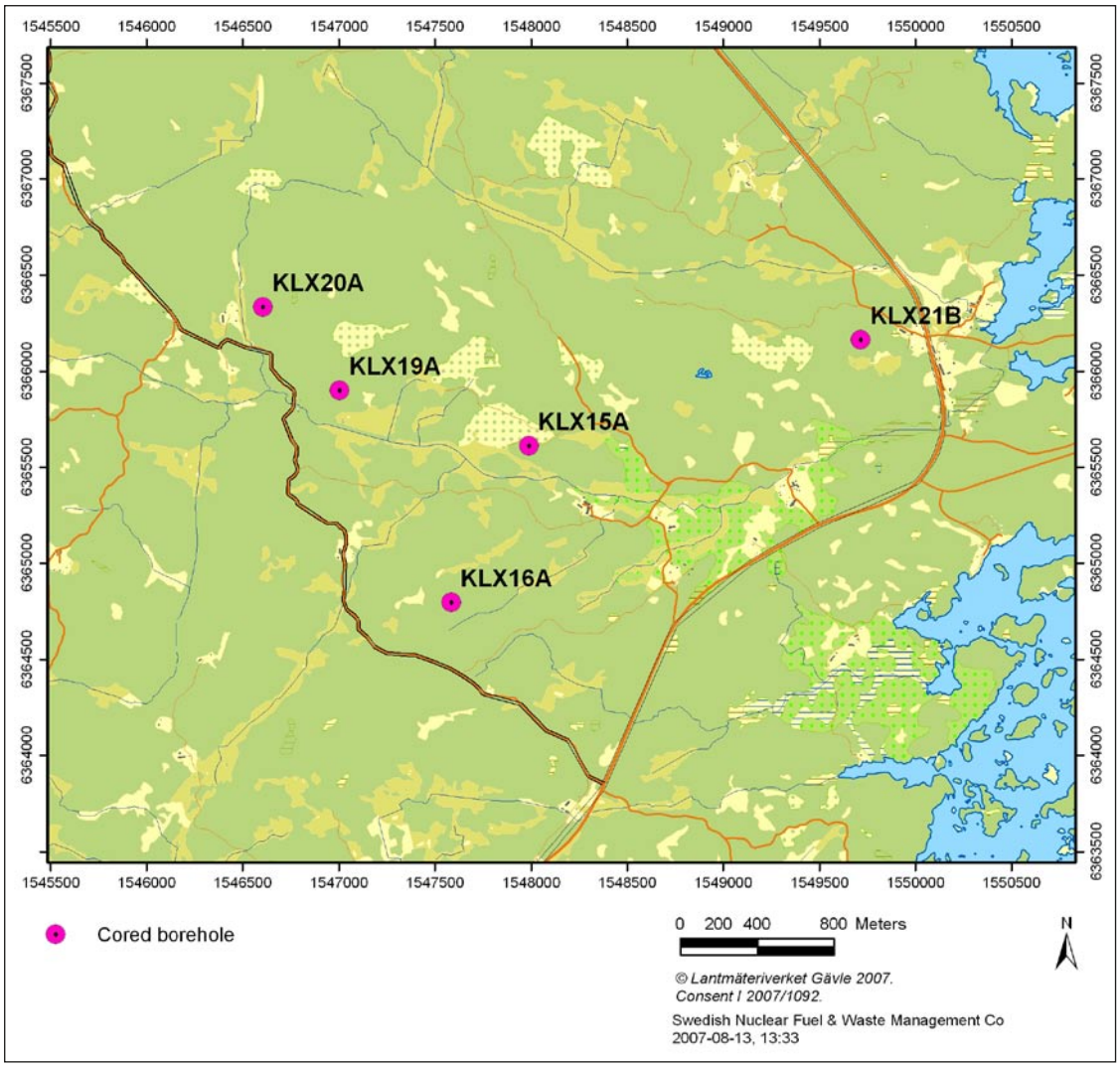

Figure 1-1. *Location of cored boreholes from which samples have been analysed (KLX15A, KLX16A, KLX19A, KLX20A and KLX21B).*

2 Objective and scope

The reported analytical work is focused on the mineralogical and geochemical character of particularly the quartz monzodiorite which is an important and dominant rock type both at the surface and at depth in the focused area in southern part of the Laxemar subarea. In addition, focus has been on the age determination and mineralogical and geochemical character of dolerite dykes that have been documented in the Laxemar subarea.

The mineralogical and geochemical analytical data reported here are important complementary information to analytical data of surface samples from the Laxemar and Simpevarp subareas /Wahlgren et al. 2004, 2005/, and also to earlier reported data from cored boreholes in the Laxemar subarea /Wahlgren et al. 2005, 2006ab/. In particular, the analytical data are of utmost importance for the definition and property assignment of rock domains in the site descriptive geological modelling.

3 Equipment

3.1 Description of equipment/interpretation tools

The results of the modal analyses have been recalculated and plotted in the QAP classification diagram of /Streckeisen 1976/.

The results of the geochemical analyses have been plotted in the TAS classification diagram of /Middlemost 1994/ and the classification diagram of /Debon and Le Fort 1983/.

According to the International Union of Geological Sciences /LeMaitre 2002/, the classification of igneous rocks should be based on the modal composition. Thus, the geochemical diagrams should not be used strictly for classification purposes, but merely as an indication of the compositional variation of the different rock types.

The $^{40}Ar/^{39}Ar$ dating of the dolerite dyke was carried out at Department of Geology, Lund University (for analytical procedure, /see Page et al. 2007/).

4 Execution

4.1 General

Half of a 20 cm long section of the drill core was selected for the mineralogical and geochemical analyses. Approximately 5 cm of the drill core was cut off for modal analyses and the remaining part was used for geochemical analysis. A reference sample of the drill core was kept from the making of the thin-sections. The analyses were carried out in accordance with the method description "Metodbeskrivning för bergartsanalyser" (SKB MD 160.001, SKB internal document).

For the age dating of the dolerite, a c. 1 m long section of the whole drill core was sampled. The analysis was carried out in accordance with the method description "Metodbeskrivning för åldersdatering av mineral och bergarter" (SKB MD 132.002, SKB internal document).

4.2 Execution of analyses

The modal analyses have been carried out by Ekström Mineral AB by mineral identification and point counting of 500 points in each thin-section. The geochemical analyses have been performed at Analytica AB by the ICP-QMS and ICP-AES analytical technique. The $^{40}Ar/^{39}Ar$ dating of the dolerite dyke was carried out at Department of Geology, Lund University (for analytical procedure, /see Page et al. 2007/).

4.3 Analyses and interpretations

The modal and geochemical analyses have been performed in order to classify and characterise the different rock types. The modal analyses have been recalculated and plotted in the QAP classification diagram of /Streckeisen 1976/. The geochemical analyses have been utilised for classification and characterisation of the rock types according to /Middlemost 1994/ and /Debon and Le Fort 1983/.

The age of the dolerite is determined by use of the $^{40}Ar/^{39}Ar$ step-heating spectra of whole-rock samples.

4.4 Nonconformities

No nonconformities are reported.

5 Results

5.1 Modal analyses

The results of the modal analyses are stored in the SICADA database and are traceable by the activity plan number AP PS 400-07-02. The analytical results are presented in Appendix 1, but the data stored in the SICADA database shall be used in further interpretation work. In Figures 5-1 to 5-4, the QAP values, recalculated from the modal analyses, are plotted in the classification diagram of /Streckeisen 1976/ separately for each cored borehole. As is evident from the classification diagrams, the quartz monzodiorite displays the same compositional variation as has been obtained earlier from surface and drill core samples /Wahlgren et al. 2004, 2005, 2006ab/.

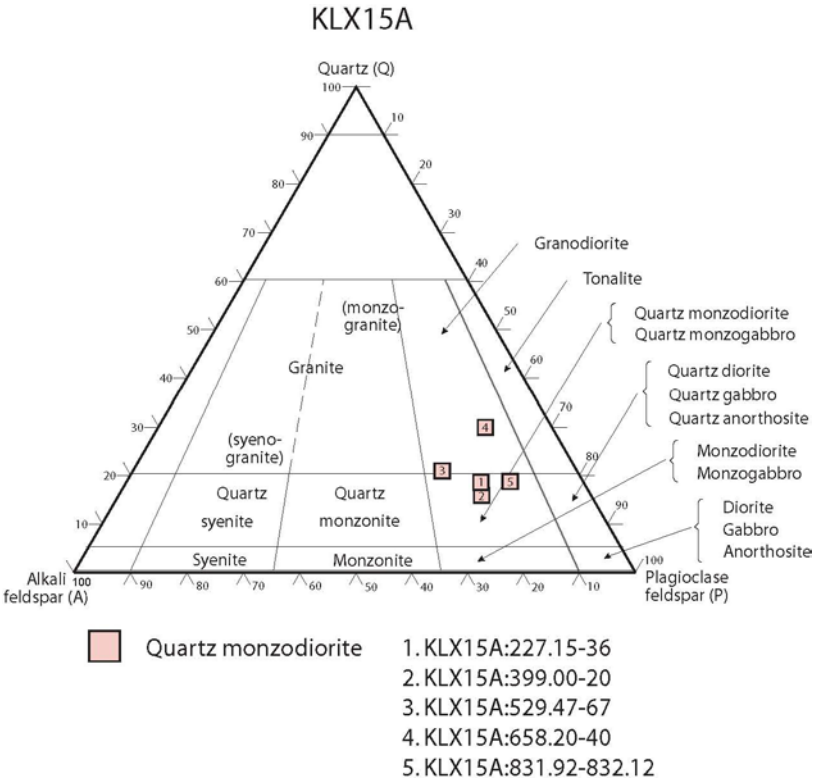

Figure 5-1. *QAP classification of quartz monzodiorite from KLX15A according to /Streckeisen 1976/. The numbers given are the sampled section in borehole length.*

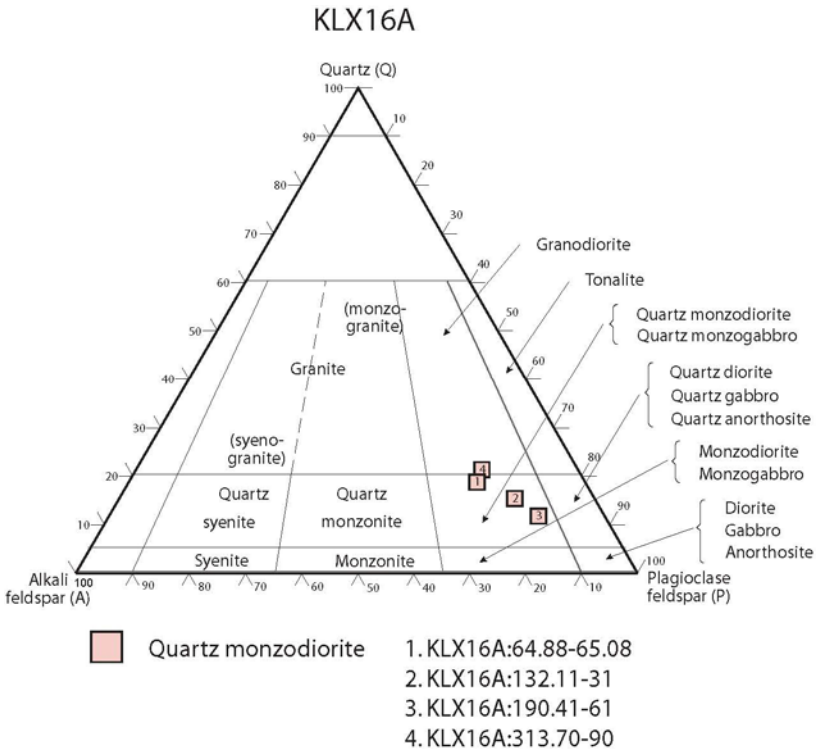

Figure 5-2. *QAP classification of quartz monzodiorite from KLX16A according to /Streckeisen 1976/. The numbers given are the sampled section in borehole length.*

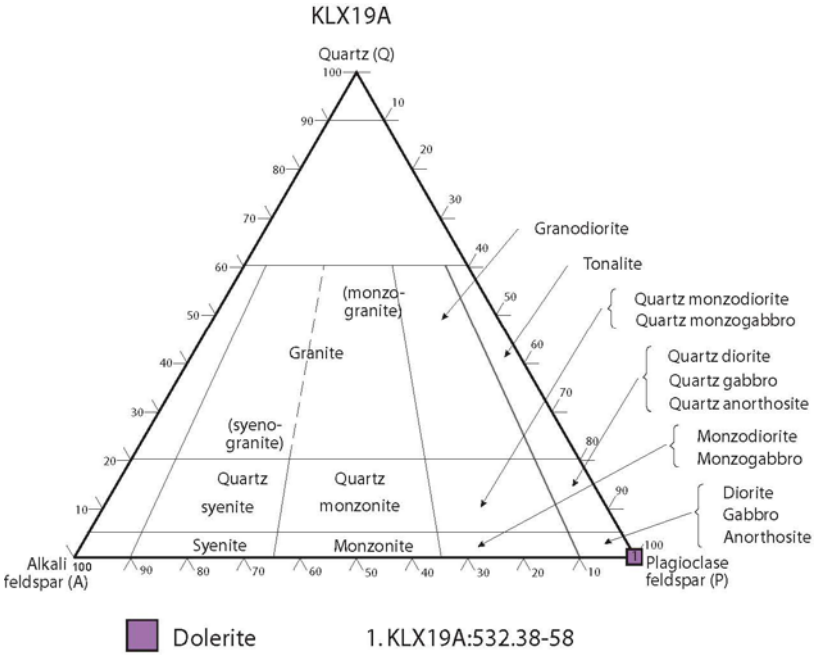

Figure 5-3. *QAP classification of dolerite from KLX19A according to /Streckeisen 1976/. The number given is the sampled section in borehole length.*

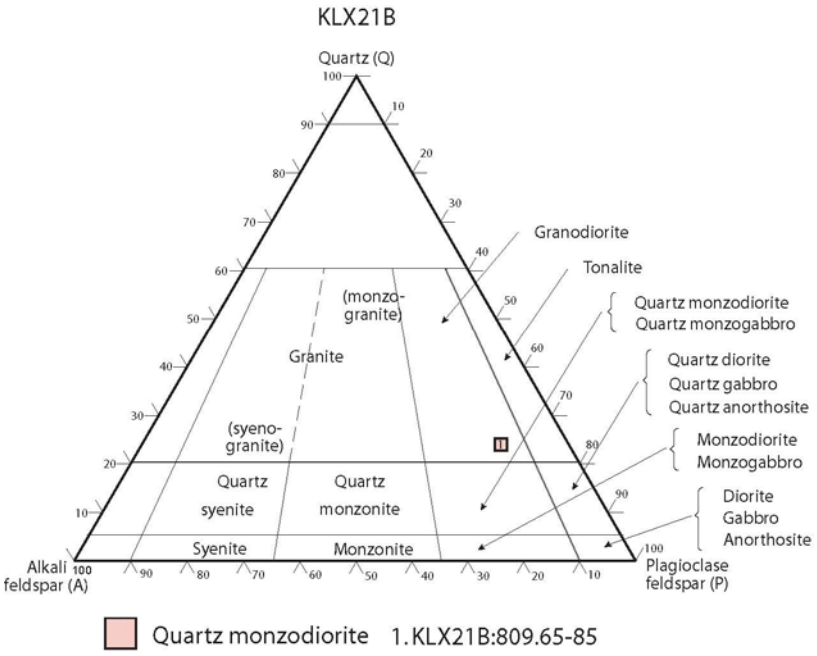

Figure 5-4. *QAP classification of quartz monzodiorite from KLX21B according to /Streckeisen 1976/. The number given is the sampled section in borehole length.*

5.2 Geochemical analyses

The results of the geochemical analyses are stored in the SICADA database and are traceable by the activity plan number AP PS 400-07-02. The analytical results are also presented in Appendix 2, but the data stored in the SICADA database shall be used in further interpretation work.

In Figures 5-5 to 5-14 the geochemical analyses are plotted in the TAS classification diagram of /Middlemost 1994/ and the classification diagram of /Debon and Le Fort 1983/, separately for each cored borehole.

As is evident, the geochemical classification of the quartz monzodiorite is similar to what has been obtained from earlier reported classification of surface and drill core samples /Wahlgren et al. 2004, 2005, 2006ab/.

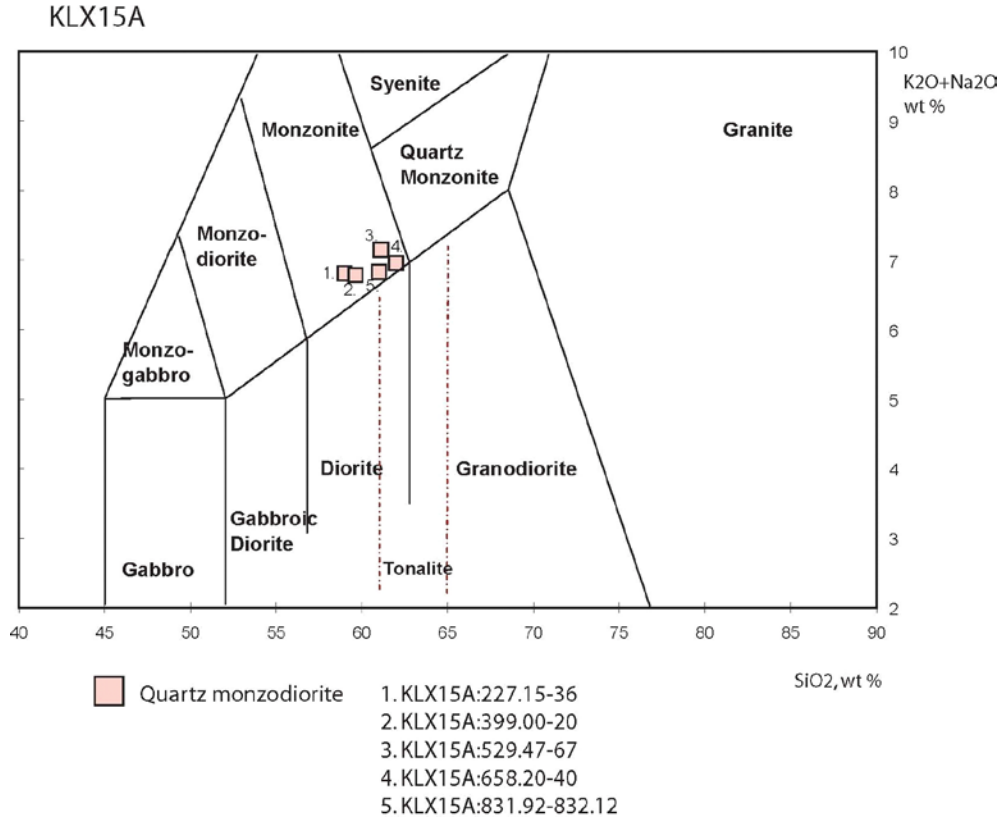

Figure 5-5. *Classification of quartz monzodiorite from KLX15A according to /Middlemost 1994/. The numbers given are the sampled section in borehole length.*

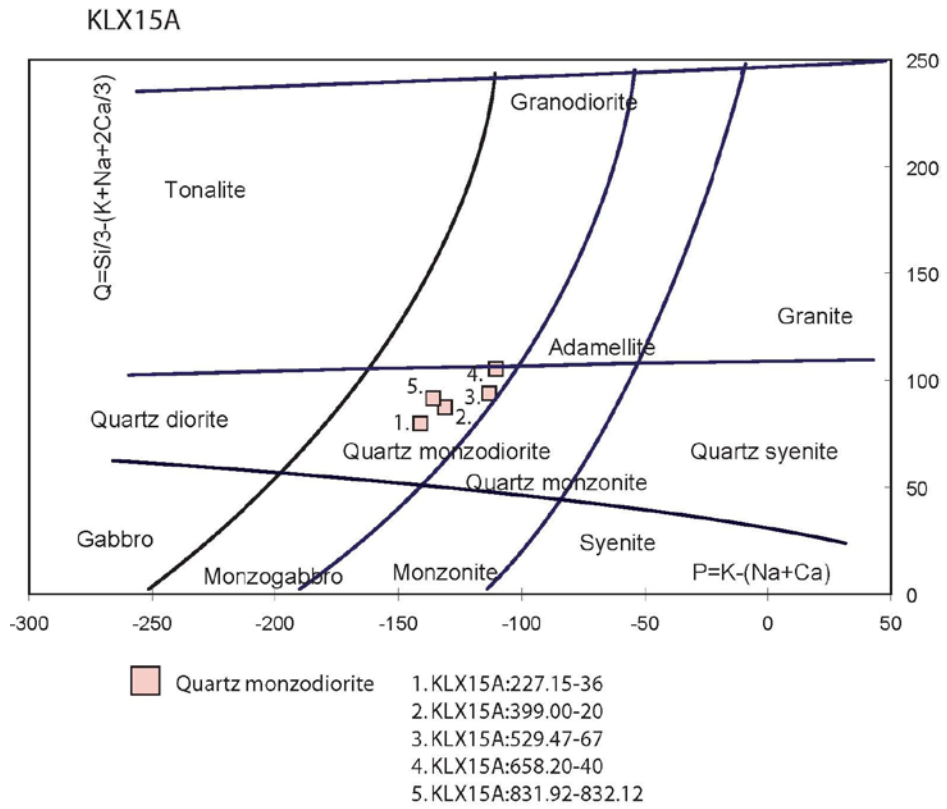

Figure 5-6. *Classification of quartz monzodiorite from KLX15A according to /Debon and Le Fort 1983/. The numbers given are the sampled section in borehole length.*

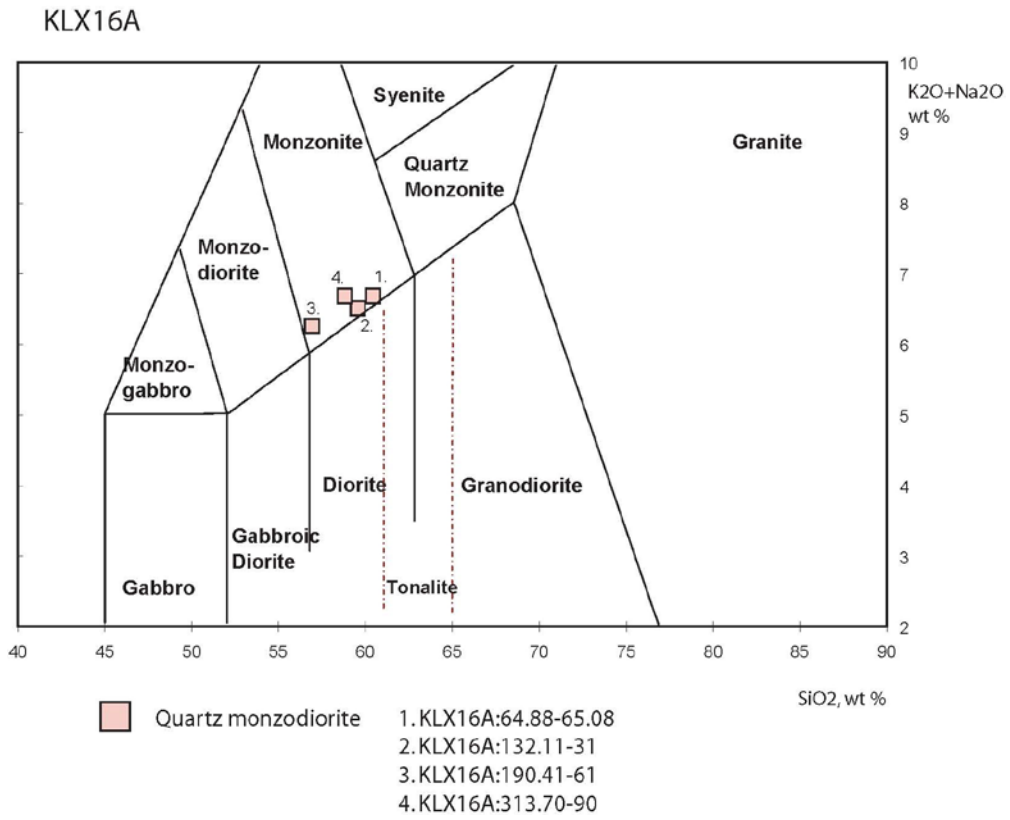

Figure 5-7. *Classification of quartz monzodiorite from KLX16A according to /Middlemost 1994/. The numbers given are the sampled section in borehole length.*

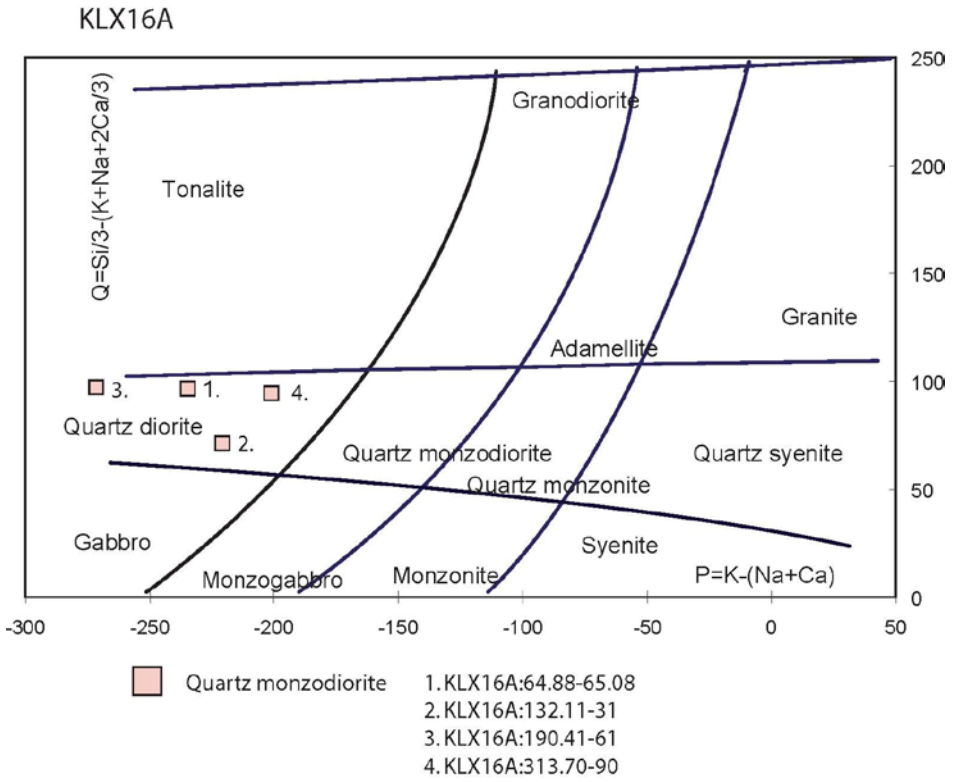

Figure 5-8. *Classification of quartz monzodiorite from KLX16A according to /Debon and Le Fort 1983/. The numbers given are the sampled section in borehole length.*

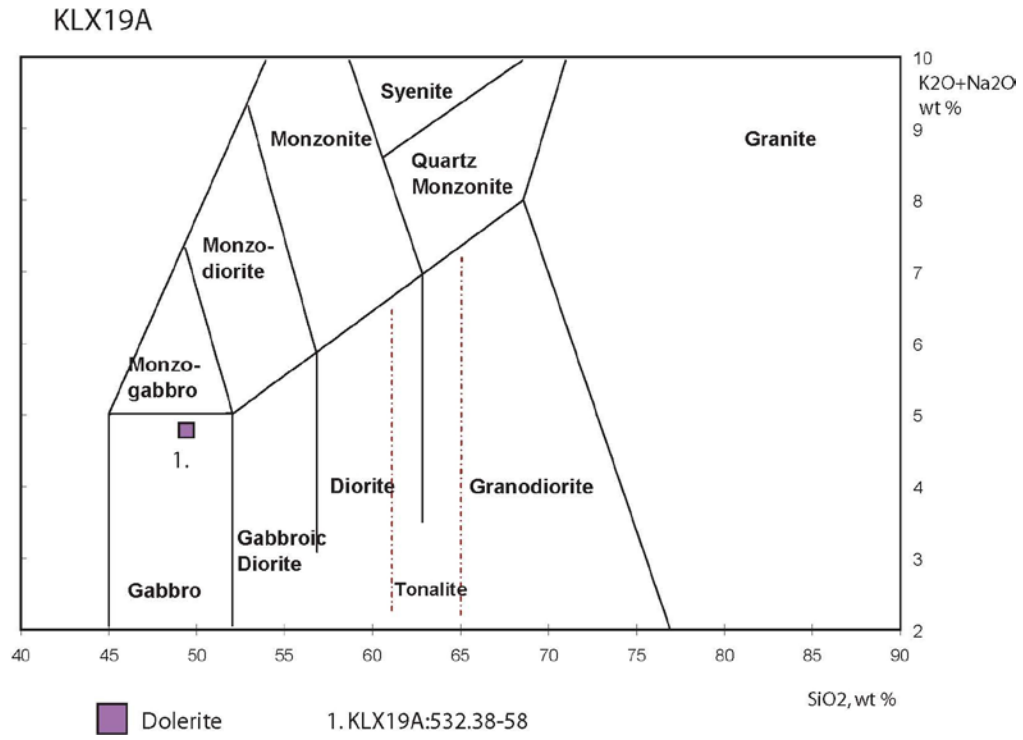

Figure 5-9. *Classification of dolerite from KLX19A according to /Middlemost 1994/. The numbes given is the sampled section in borehole length.*

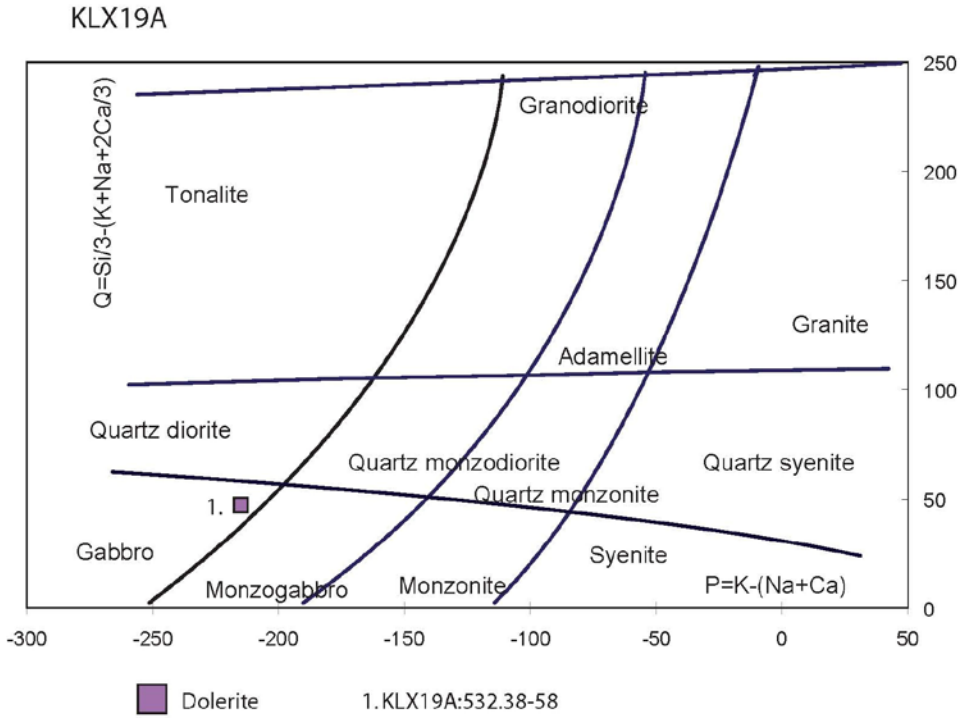

Figure 5-10. *Classification of dolerite from KLX19A according to /Debon and Le Fort 1983/. The number given is the sampled section in borehole length.*

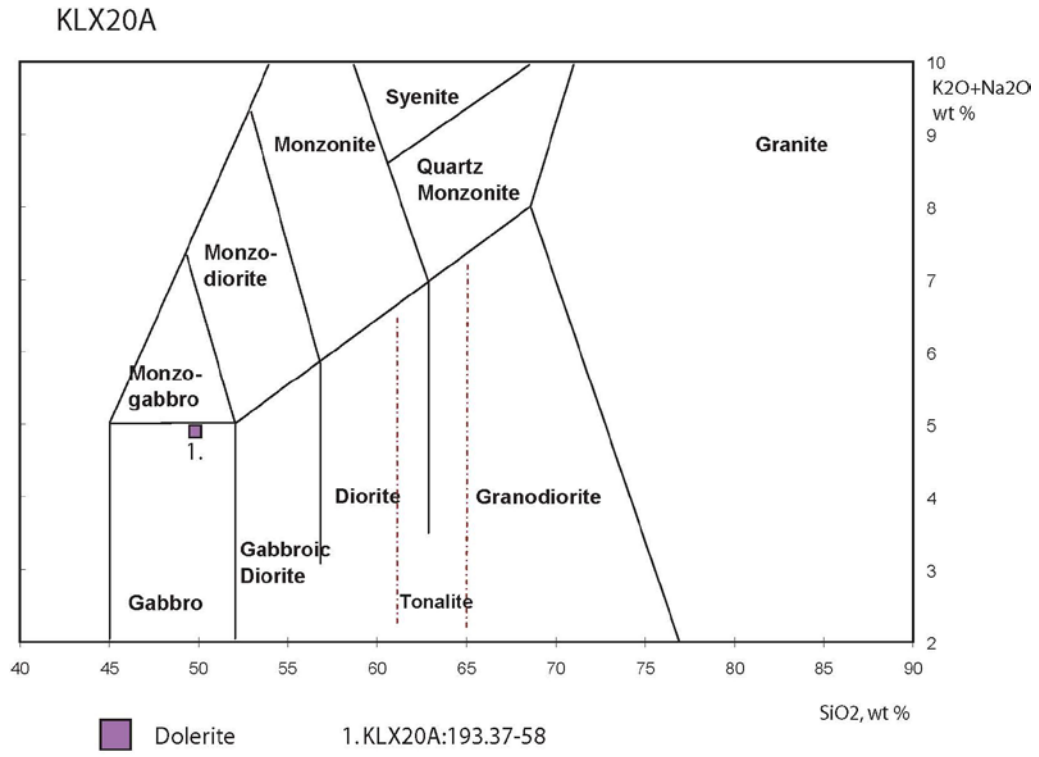

Figure 5-11. *Classification of dolerite from KLX20A according to /Middlemost 1994/. The number given is the sampled section in borehole length.*

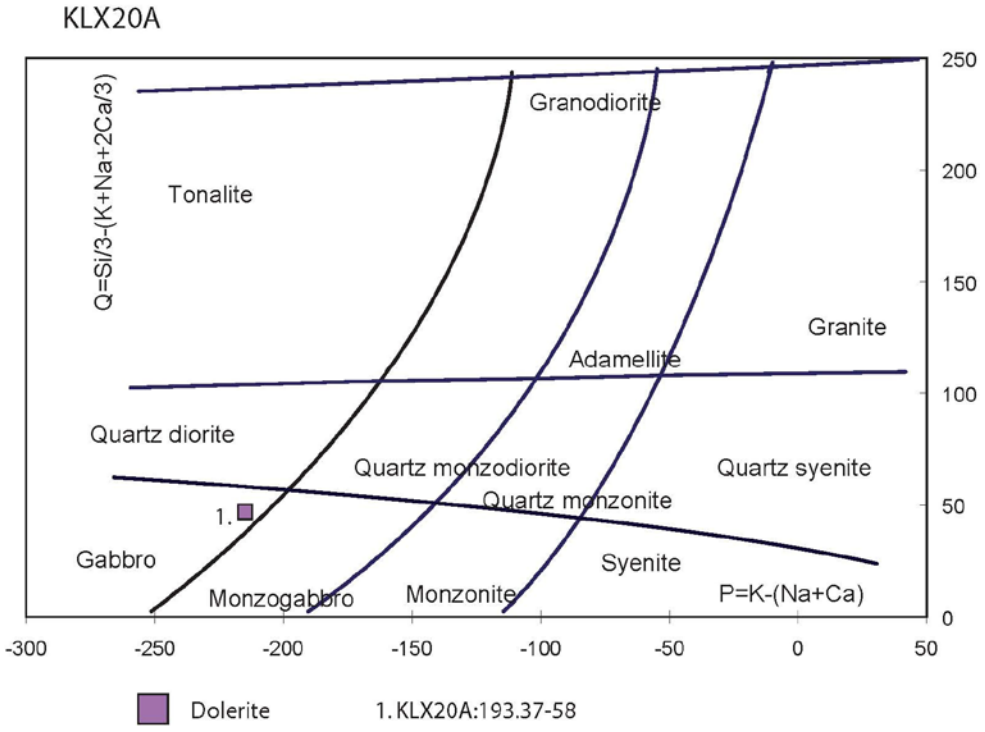

Figure 5-12. *Classification of dolerite from KLX20A according to /Debon and Le Fort 1983/. The number given is the sampled section in borehole length.*

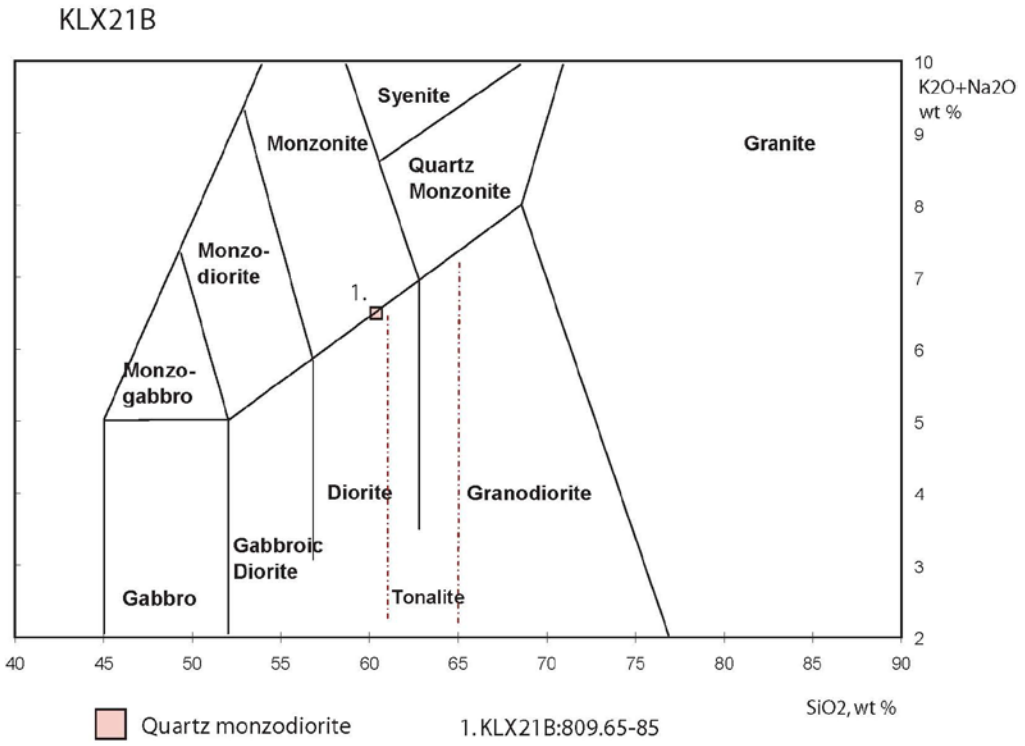

Figure 5-13. *Classification of quartz monzodiorite from KLX21B according to /Middlemost 1994/. The number given is the sampled section in borehole length.*

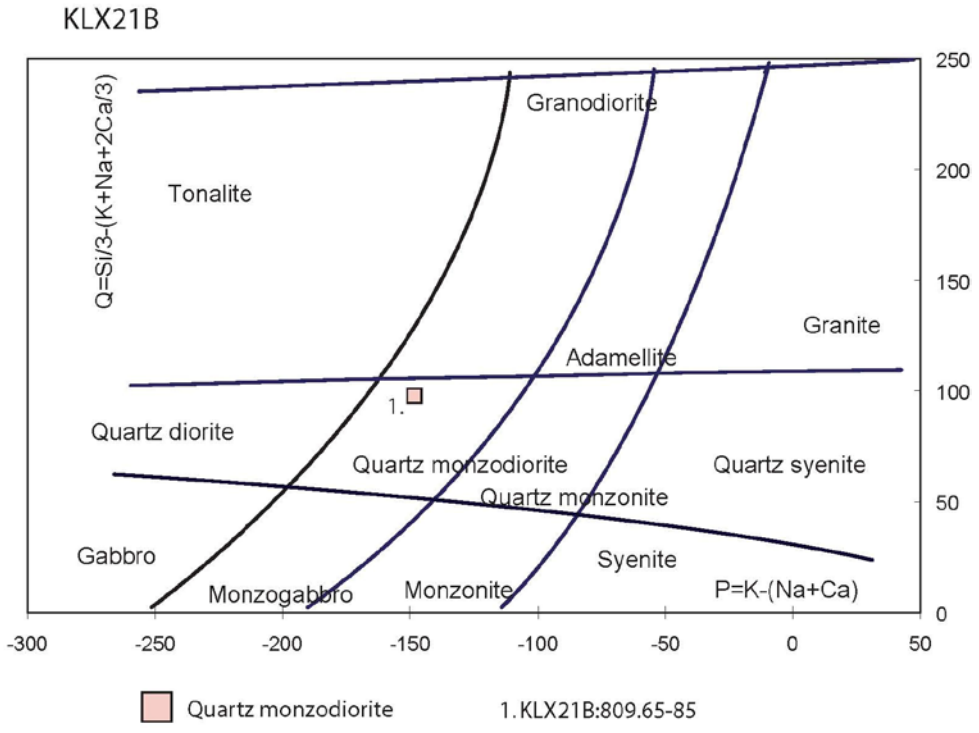

Figure 5-14. *Classification of quartz monzodiorite from KLX21B according to /Debon and Le Fort 1983/. The number given is the sampled section in borehole length.*

5.3 $^{40}Ar/^{39}Ar$ dating

The result of the $^{40}Ar/^{39}Ar$ dating is stored in the SICADA database and is traceable by the activity plan number AP PS 400-06-015. Two splits of the dolerite sample were analysed, yielding ages of 904 ± 3 Ma and 898 ± 3 Ma (Figure 5-15), representing 40% and 70% of the ^{39}Ar gas released, respectively. Consequently, the dolerite dykes in the Laxemar subarea are interpreted to be c. 900 Ma old and related to the waning stages of the Sveconorwegian orogeny that has had a major impact on the bedrock of south-western Sweden.

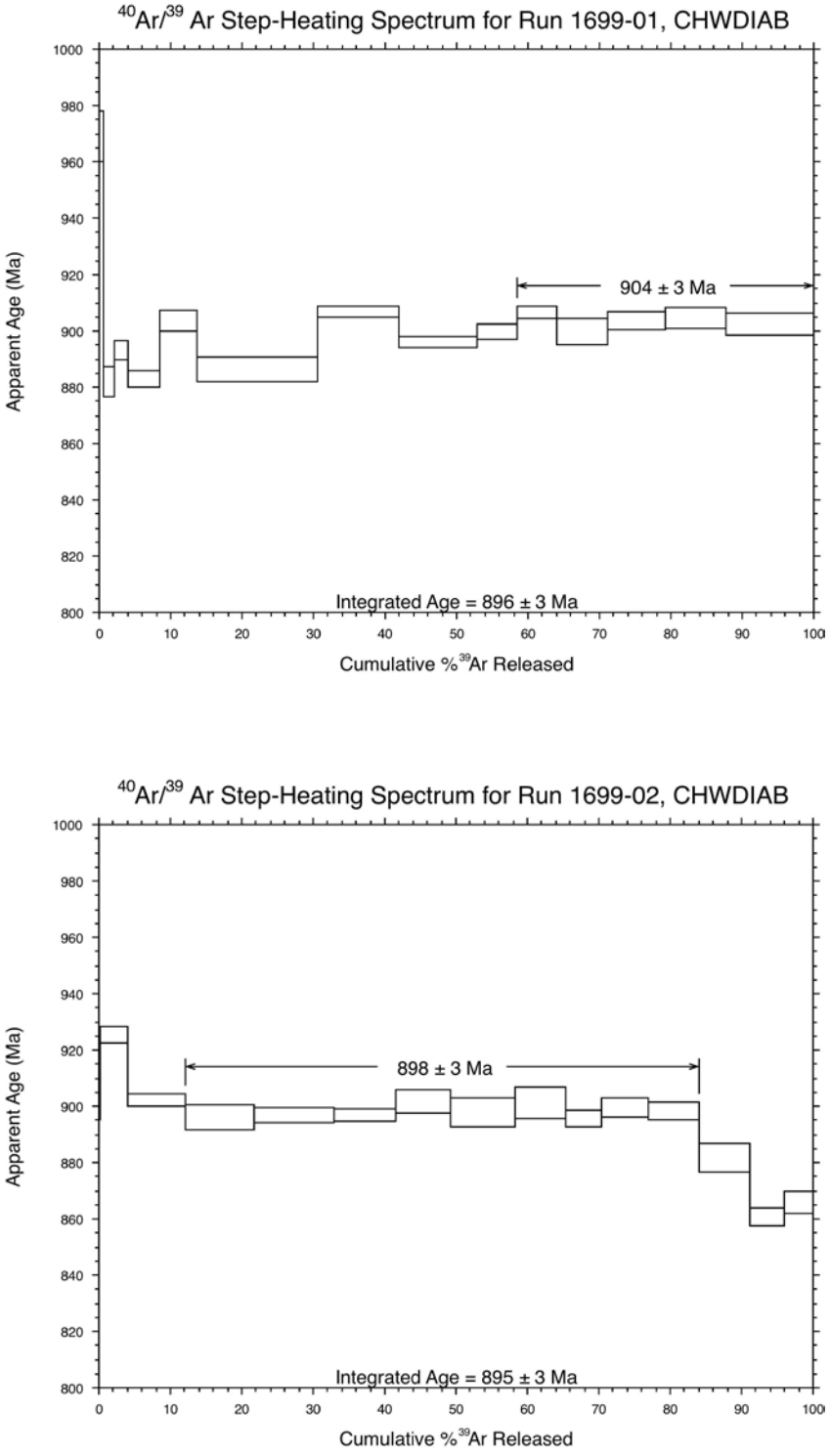

Figure 5-15. *$^{40}Ar/^{39}Ar$ step heating spectra for the dolerite whole-rock sample.*

6 Discussion

As is evident from Figures 5-9 to 5-12 and Appendix 2, the chemical composition of the dolerites in KLX19A and KLX20A are almost identical, which strongly indicates that the dolerites in the area belong to the same late Sveconorwegian, c. 900 Ma old generation.

References

Debon F, Le Fort P, 1983. A chemical-mineralogical classification of common plutonic rocks and associations. Transactions of Royal Society of Edinburgh, Earth Sciences 73, 135–149.

LeMaitre R W (Editor), 2002. A classification of igneous rocks and glossary of terms: Recommendations of the International Union of Geological Sciences, Subcommission on the Systematics of Igneous Rocks, 2nd edition, Blackwell, Oxford.

Middlemost E A K, 1994. Naming materials in the magma/igneous rock system. Earth-Science Reviews 37, 215–224.

Page L, Söderlund P, Wahlgren C-H, 2007. Oskarshamn site investigation. $^{40}Ar/^{39}Ar$ and (U-Th)/He geochronology of samples from the cored boreholes KSH03A, KSH03B, KLX01, KLX02 and the access tunnel to the Äspö Hard Rock Laboratory. SKB P-07-160, Svensk Kärnbränslehantering AB.

Streckeisen A, 1976. To each plutonic rock its proper name. Earth Science Reviews 12, 1–33.

Wahlgren C-H, Ahl M, Sandahl K-A, Berglund J, Petersson J, Ekström M, Persson P-O, 2004. Oskarshamn site investigation. Bedrock mapping 2003 – Simpevarp subarea. Outcrop data, fracture data, modal and geochemical classification of rock types, bedrock map, radiometric dating. SKB P-04-102, Svensk Kärnbränslehantering AB.

Wahlgren C-H, Bergman T, Persson Nilsson K, Eliasson T, Ahl M, Ekström M, 2005. Oskarshamn site investigation. Bedrock map of the Laxemar subarea and surroundings. Description of rock types, modal and geochemical analyses, including the cored boreholes KLX03, KSH03 and KAV01. SKB P-05-180, Svensk Kärnbränslehantering AB.

Wahlgren C-H, Bergman T, Ahl M, Ekström M, 2006a. Oskarshamn site investigation. Modal and geochemical analyses of drill core samples 2005. Classification of rock types in KLX03, KLX04, KLX06, KLX07A, KLX07B, KLX08 and KLX10. SKB P-06-07, Svensk Kärnbränslehantering AB.

Wahlgren C-H, Bergman T, Ahl M, Ekström M, 2006b. Oskarshamn site investigation. Modal and geochemical analyses of drill core samples 2006 and updated bedrock map of the Laxemar subarea. Classification of rock types in KLX08, KLX10, KLX11A, KLX12A, KLX18A and KLX20A. SKB P-06-279, Svensk Kärnbränslehantering AB.

Appendix 1

Modal composition of analysed samples

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX15A: 227,15-36
Datum:	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-08-20	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor: i K-fältspat läkta delvis med glimmer, få mikrosprickor i kvarts och plagioklas
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	13,4	myrmekitbildning
K-fältspat	+	13,8	
Plagioklas	+	47,4	sericitiserad
Biotit	+	11,2	lätt kloritiserad
Muskovit			
Klorit			
Epidot	+	0,2	
Titanit	+	0,4	
Kalcit			
Hornblände	+	10,8	
Opak min.	+	1,2	il, mg, ht, py och spår av cp och sp
Apatit	+	0,4	
Zirkon			
Prehnit			
Klinopyroxen	+	1,2	omvandlad till amfibol
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp= kopparkis
.

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX15A: 399,00-20
Datum: Ny räkning	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-08-21	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor: i amfibol och fältspat
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	10,8	myrmekitbildning
K-fältspat	+	13,4	
Plagioklas	+	44,4	sericitiserad
Biotit	+	10,2	
Muskovit	+	0,6	
Klorit			
Epidot	+		
Titanit	+	0,6	
Kalcit			
Hornblände	+	18,2	
Opak min.	+	1,2	mg, il, py och mindre ht
Apatit	+	0,4	
Zirkon	+		
Klinopyroxen	+	0,2	omvandlad till amfibol
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp= kopparkis
.
En tunn spricka korsar slipet och är läkt med fältspat och lermineral

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX15A: 529,47-67
Datum:	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-08-21	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor: i fältspat delvis läkta med epidot
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	15,2	myrmekitbildning
K-fältspat	+	17,8	
Plagioklas	+	41,0	sericitiserad och saussuritiserad
Biotit	+	15,0	
Muskovit	+	0,2	
Klorit	+		
Epidot	+	1,6	större korn tillsammans med biotit och hornbl.
Titanit	+	0,8	
Kalcit	+		
Hornblände	+	6,8	
Opak min.	+	0,8	il, py, mg och spår av cp
Apatit	+	0,8	
Zirkon	+		
Prehnit			
Klinopyroxen			
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp= kopparkis
.

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX15A: 658,20-40
Datum:	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-08-22	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor: i kvarts och plagioklas läkta med glimmer
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	19,4	myrmekitbildning
K-fältspat	+	8,0	
Plagioklas	+	38,8	sericitiserad och saussuritiserad
Biotit	+	22,2	
Muskovit			
Klorit			
Epidot	+	5,8	större korn tillsammans med biotit
Titanit	+	1,2	
Kalcit	+		
Hornblände	+	3,8	
Opak min.	+	0,6	mg, il och py
Apatit	+	0,2	
Zirkon	+		
Prehnit			
Klinopyroxen			
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp = kopparkis, po = magnetkis
.

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX15A: 831,92-832,12
Datum:	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-08-22	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor:
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	14,2	myrmekitbildning
K-fältspat	+	10,2	
Plagioklas	+	53,2	sericitiserad och lätt saussuritiserad
Biotit	+	8,8	
Muskovit	+		
Klorit			
Epidot	+		
Titanit	+	0,4	
Kalcit			
Hornblände	+	12,4	
Opak min.	+	0,6	mg, il, py och spår av cp
Apatit	+	0,2	
Zirkon	+		
Prehnit			
Klinopyroxen	+		spår av omvandlad pyroxen
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp = kopparkis, po = magnetkis
.

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX16A: 64.88-65.08
Datum:	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-05-10	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor: i kvarts och fältspat läkta med glimmer
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	13,8	myrmekitbildning
K-fältspat	+	14,6	
Plagioklas	+	46,4	lätt sericitiserad, enstaka korn är starkt sericitis.
Biotit	+	9,0	
Muskovit	+		
Klorit			
Epidot	+		
Titanit	+	0,2	
Kalcit	+		
Hornblände	+	14,2	
Opak min.	+	1,2	mg, il, ht, py och cp
Apatit	+		
Zirkon	+		
Prehnit			
Klinopyroxen		0,6	omvandlad till amfibol
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp= kopparkis
.

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX16A: 132.11-31
Datum: Ny räkning	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-05-10	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor: i kvarts läkta med glimmer
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	10,2	
K-fältspat	+	9,8	
Plagioklas	+	47,8	sericitiserad och saussuritiserad
Biotit	+	22,2	
Muskovit			
Klorit	+		
Epidot	+	8,2	större korn tillsammans med biotit
Titanit	+	0,4	
Kalcit			
Hornblände	+	0,2	
Opak min.	+	0,6	il, mg och py
Apatit	+	0,4	
Zirkon	+		
Klinopyroxen	+	0,2	omvandlad till amfibol
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp= kopparkis
.

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX16A: 190.41-61
Datum:	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-05-11	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor: i plagioklas läkta med glimmer och epidot
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	8,2	
K-fältspat	+	8,8	
Plagioklas	+	55,6	lätt sericitiserad
Biotit	+	19,2	
Muskovit			
Klorit	+		
Epidot	+		
Titanit	+	0,2	
Kalcit			
Amfibol	+	1,6	omvandlad efter klinopyroxen
Opak min.	+	1,4	mg, il, py, och spår av cp
Apatit	+	0,2	
Zirkon	+		
Prehnit			
Klinopyroxen	+	4,8	
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp= kopparkis
.

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX16A: 313.70-90
Datum:	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-05-11	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor: i kvarts läkta med glimmer
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	13,2	
K-fältspat	+	11,0	
Plagioklas	+	39,0	sericitiserad och saussuritiserad
Biotit	+	25,0	delvis kloritiserad
Muskovit			
Klorit	+		
Epidot	+	10,2	större korn tillsammans med biotit
Titanit	+	0,6	
Kalcit	+	0,2	
Hornblände	+	0,2	
Opak min.	+	0,2	il, py, cp, ht och spår av po
Apatit	+	0,4	
Zirkon	+		
Prehnit			
Klinopyroxen			
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp = kopparkis, po = magnetkis
.

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX19A: 538,38-58
Datum: Ny räkning	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-01-31	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor:
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts			
K-fältspat			
Plagioklas	+	59,0	lätt omvandlad till lermineral
Biotit			
Muskovit			
Klorit	+		
Epidot			
Titanit			
Kalcit			
Amfibol			
Opak min.	+	6,0	il dominerande och spår av py
Apatit	+		
Zirkon			
Brun pyroxen	+	11,8	
Olivin	+	2,2	
Iddingsit/serpentin	+	16,2	omvandling från olivin
Pyroxen, apatit och strålig amfib.?	+	4,8	finkorniga, delvis stråliga mineral som sitter mellan plagioklaslister
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp= kopparkis
.

EKSTRÖM MINERAL AB **MIKROSKOPERINGSFORMULÄR**

ALLMÄN INFORMATION	SGU
Mikroskopering utförd av:	Provnummer: KLX21B: 809,65-85
Datum:	Annan märkning
Punkträkning utförd av: Mary Ekström	Diarienummer:
Antal punkter: 500	Uppgift:
Datum: 2007-01-30	Bergart:
Topoblad: Ekonomblad:	Lokal:
Koordinater:	BGDATA-id:

Bergartsbeskrivning
Kornstorlek:
Kornfogar:
Mikrosprickor: i K-fältspat och kvarts
Omvandling:
Struktur:
Textur:

MINERAL	OBSERVERAD	%	KOMMENTAR
Kvarts	+	18,0	myrmekitbildning
K-fältspat	+	10,2	
Plagioklas	+	49,8	delvis sericitiserad
Biotit	+	16,6	
Muskovit			
Klorit			
Epidot	+	1,2	
Titanit	+	2,2	
Kalcit	+		
Hornblände	+		
Opak min.	+	2,0	mg, il, py och spår av cp och ht
Apatit	+		
Zirkon	+		
Prehnit			
Klinopyroxen			
Summa		100,0	

Övrigt:
mg = magnetit, py = pyrit, il = ilmenit, ht = hematit, cp= kopparkis
.

Appendix 2

Chemical composition of analysed samples

	KLX15A: 227.15–227. 36	KLX15A: 399.00–399. 20	KLX15A: 529.47–529. 67	KLX15A: 658.20–658. 40	KLX15A: 831.92–832.12	KLX16A: 64.88–65.08	KLX16A: 132.11–132. 31	KLX16A: 190.41–190. 61	KLX16A: 313.70–313. 90	KLX19A: 532.38–532. 58	KLX20A: 193.37–193. 58	KLX21B: 809.65–809. 85
	%	%	%	%	%	%	%	%	%	%	%	%
SiO2	59.3	59.8	61.0	61.7	60.9	60.1	59.4	57.3	58.8	49.4	49.8	60.4
Al2O3	16.3	16.2	16.1	15.8	16.4	16.1	16	16.9	15.7	16.4	16.5	16.3
CaO	5.26	5.12	4.75	4.63	5.23	5.28	5.08	5.98	4.97	7.31	7.26	4.92
Fe2O3	7.46	7.41	6.66	6.70	7.08	7.19	7.18	7.84	7.03	12.8	12.9	7.91
K2O	3.30	3.39	3.71	3.62	3.38	3.26	3.15	2.75	3.78	1.3	1.36	2.79
MgO	2.80	2.68	2.46	2.42	2.64	2.74	2.45	2.7	2.86	5.26	5.44	2.22
MnO	0.118	0.119	0.107	0.109	0.113	0.111	0.118	0.127	0.117	0.149	0.15	0.106
Na2O	3.54	3.43	3.40	3.34	3.48	3.38	3.35	3.55	2.86	3.48	3.54	3.71
P2O5	0.344	0.320	0.304	0.287	0.33	0.318	0.342	0.353	0.316	0.634	0.653	0.394
TiO2	1.00	0.949	0.915	0.878	0.971	0.945	1.02	1.05	0.894	2.92	2.89	1.12
Summa	99.4	99.4	99.4	99.5	100.5	99.4	98.1	98.6	97.3	99.7	100.5	99.9
LOI	0.5	0.5	0.7	0.8	0.7	0.4	0.9	0.8	1.4	0.5	0.1	0.5
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Ba	1,150	1,060	1,070	970	1,020	1,020	893	943	1,040	393	415	773
Be	2.31	2.33	2.42	2.40	2.42	2.22	2.48	2.28	2.23	1.44	1.4	2.61
Co	11.6	14.4	14.2	9.91	9.97	13.7	12.7	15.9	13.3	41.2	40.9	15.5
Cr	35.9	50.4	40.1	38.3	39.4	50.5	30.9	30.9	51.5	59.5	61	19.7
Cu	25.7	25.9	22.5	19.2	23.7	13.3	6.32	6.54	29.7	25	31.3	21.6
Ga	17.9	18.1	17.9	16.2	16.4	19.4	18.6	21.7	19.3	19	18.8	20.3
Hf	5.54	5.80	5.42	9.44	6.10	8.10	8.78	6.91	6.42	5.61	5.38	4.65
Mo	3.25	3.66	3.15	3.60	3.42	<2	<2	<2	<2	2.42	2.6	2.46
Nb	10.8	16.0	17.0	12.5	13.3	16.6	18.4	15.9	16	18.1	17.8	20.7
Ni	18.6	21.1	16.7	20.2	21.1	20.9	13	14.6	21.2	69.6	71.6	<10
Rb	104	104	116	117	102	110	122	87.8	149	29.6	29.2	94.9
Sc	17.2	17.3	16.2	15.6	17.3	16.9	18	18.2	16.3	17.7	17.9	14
Sn	3.60	4.12	3.92	4.11	3.56	5.26	4.2	4.06	3.54	3.76	3.77	4.41
Sr	655	645	606	588	640	599	590	650	644	528	543	562
Ta	0.896	0.976	0.938	1	0.944	1.17	1.3	1.12	1.14	0.912	0.883	0.821
Th	6.26	7.31	7.69	9.37	7.46	8.91	7.55	6.57	9.57	1.45	1.4	9.07
U	2.71	3.02	3.34	3.47	3.04	2.83	2.39	2.27	3.69	0.534	0.608	1.89
V	109	111	97	94.8	104	105	102	131	111	213	212	106
W	1.90	2.04	1.79	1.52	1.74	1.86	1.72	1.42	1.54	0.646	0.584	0.672
Y	34.0	33.3	32.3	34.7	33.9	31.5	34.7	37.9	30.2	32.3	32.4	35.6
Zn	91.3	89.4	84.2	83.2	84.9	110	96.3	97.5	88.9	124	125	111
Zr	183	206	186	339	226	282	320	246	231	229	231	194
La	44.7	45.9	44.5	52.9	46.5	46.6	49	45.5	48.8	24.2	24.1	75.1
Ce	104	105	103	117	105	116	111	103	111	57	56.4	157
Pr	10.7	10.5	10.1	11.4	10.5	10.7	11.6	10.5	11.5	7.65	7.56	18.5
Nd	40.4	40.5	38.6	43.3	39.9	40.6	44.5	40.3	43.1	33.6	33.3	68.4
Sm	7.66	7.55	7.3	7.84	7.57	7.62	8.45	7.54	7.89	7.49	7.52	11.3
Eu	1.81	1.8	1.72	1.72	1.89	1.83	1.93	2.08	1.79	2.29	2.34	1.99
Gd	6.48	6.85	6.3	6.6	6.24	6.75	7.34	6.55	6.74	7.34	7.19	8.95
Tb	0.937	0.947	0.899	0.935	0.955	0.971	1.05	0.987	0.949	1.08	1.05	1.24
Dy	5.79	5.71	5.45	5.68	5.83	5.81	6.39	5.96	5.72	6.25	6.45	7.1
Ho	1.16	1.13	1.12	1.17	1.17	1.16	1.3	1.2	1.14	1.21	1.21	1.34
Er	3.34	3.38	3.15	3.35	3.32	3.38	3.73	3.36	3.26	3.31	3.25	3.56
Tm	0.457	0.457	0.463	0.485	0.484	0.488	0.538	0.466	0.463	0.454	0.436	0.486
Yb	3.14	3.06	2.94	3.09	3.03	3.05	3.46	3.14	3.1	2.83	2.84	3.04
Lu	0.454	0.485	0.455	0.492	0.478	0.464	0.508	0.465	0.438	0.41	0.398	0.441