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Oskarshamn site investigation

Laboratory data from the site investigation programme for the transport properties of the rock

Data delivery for data freeze Laxemar 2.1

Susanne Börjesson, Eva Gustavsson
Geosigma AB

September 2005

Svensk Kärnbränslehantering AB
Swedish Nuclear Fuel
and Waste Management Co
Box 5864
SE-102 40 Stockholm Sweden
Tel 08-459 84 00
+46 8 459 84 00
Fax 08-661 57 19
+46 8 661 57 19

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Keywords: Transport properties, Porosity, Diffusivity, AP PS 400-03-041, AP PS 400-03-093.

Abstract

This report presents data gained from laboratory investigations of diffusivity and sorption characteristics at the time for data freeze Laxemar 2.1. The laboratory investigations are part of the discipline-specific programme "Transport Properties of the Rock" within the SKB site investigations.

Since diffusivity and sorption measurements are time-consuming and still in progress, only matrix porosity data from the boreholes KSH01A, KSH02, KLX02, KLX03, KLX04 and KLX06 that has been retrieved hitherto together with the completed diffusivity measurements data are presented. Discussions and interpretations of the results are not included in the report.

Sammanfattning

Föreliggande rapport redovisar de resultat som erhållits från laboratoriemätningar av diffusions- och sorptionsegenskaper vid tidpunkten för datafrys Laxemar 2.1. Laboratorie-mätningarna ingår i programmet för ”Bergets transportegenskaper” inom SKB:s platsundersökningar.

Då mätningar av genomdiffusion och batchsorption är tidskrävande och ännu pågår, redovisas endast porositetsresultat från KSH01, KSH02, KLX02, KLX03, KLX04 och KLX06 samt data från avslutade diffusionsmätningar. Rapporten redovisar inga diskussioner eller tolkningar av resultat.

Contents

1 Introduction

The report data presents data gained by the laboratory investigations of diffusivity and sorption characteristics within the discipline-specific programme "Transport Properties of the Rock". The laboratory investigations are part of the activities performed within the site investigation at Oskarshamn. The laboratory work was carried out during the period of November 2003 to June 2005, in accordance with activity plan AP PS 400-03-41 and AP PS 400-03-93. In Table 1-1 controlling documents for performing this activity are listed. Both activity plan and method descriptions are SKB's internal controlling documents.

The rock samples for the laboratory measurements were taken from totally eight cored boreholes in the Simpevarp and the Laxemar area by Johan Byegård, Eva Gustavsson and Henrik Widestrand, Geosigma AB. Data from six of these boreholes are presented in this report. The rock samples represent the heterogeneity of bedrock in the Laxemar and the Simpevarp area, which mainly consists of Ävrögranite, quartzmonzo-diorite and fine-grained dioritoid.

The data have been stored in SICADA according to AP PS 400-03-041 and AP PS 400-03-093.

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

Activity plan	Number	Version
Provtagning och analyser av borrkärna från KSH01 och KSH02 för bestämning av bergets transportegenskaper	AP PS 400-03-41	1.0
Provtagning och analyser av borrkärna från KLX01–KLX04 för bestämning av bergets transportegenskaper	AP PS-400-03-93	1.0
Method descriptions	**Number**	**Version**
Metodbeskrivning för geomdiffusionsmätning	SKB MD 540.001	1.0
Metodbeskrivning för batchsorptionsmätning	SKB MD 540.002	2.0

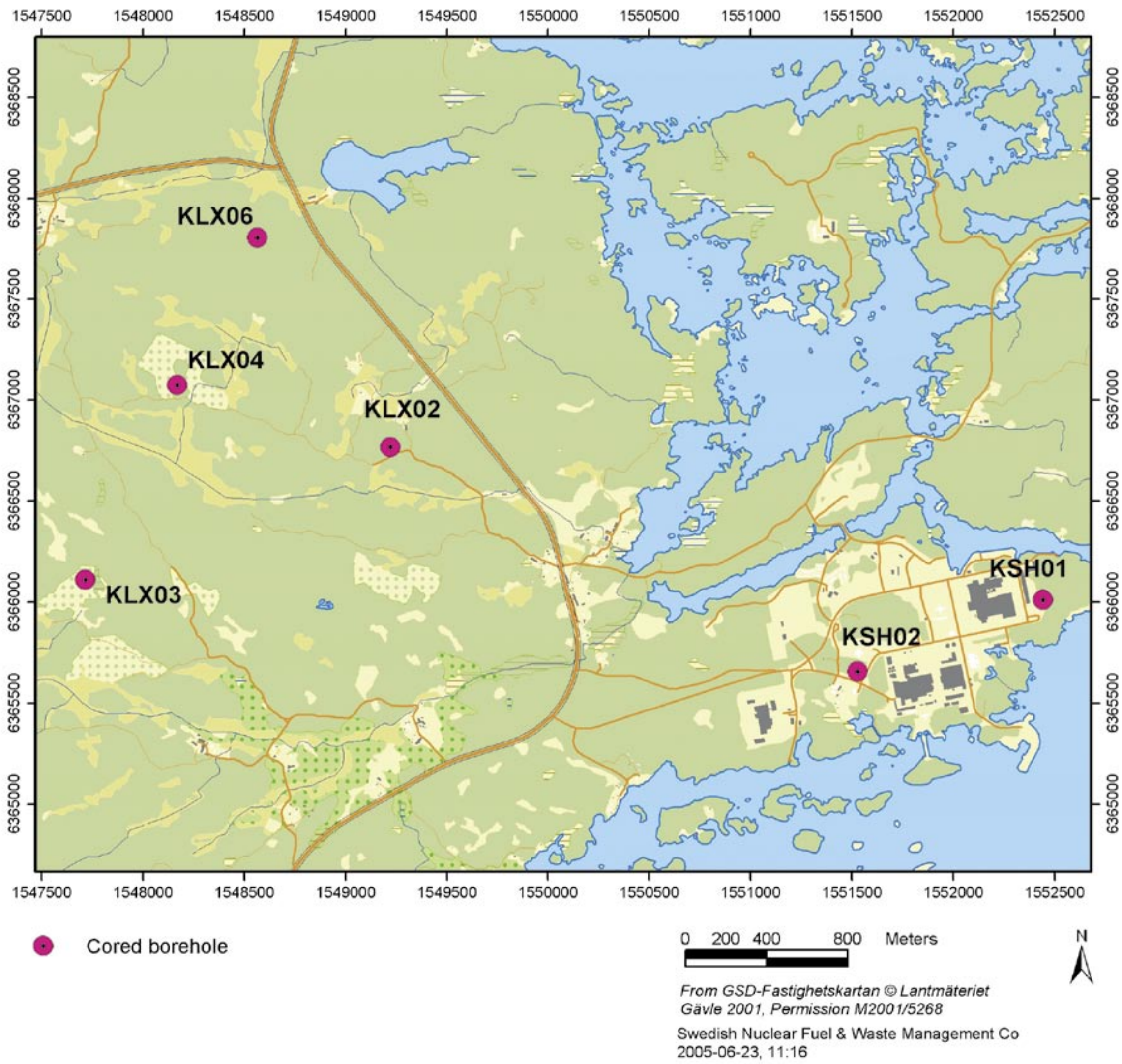

Figure 1-1. *Map showing the locations of the six boreholes included in this report; KSH01, KSH02, KLX02, KLX03A, KLX04 and KLX06 in Laxemar and Simpevarp.*

2 Objective and scope

The main aim with the laboratory investigations performed is to determine the sorption and diffusion properties for the rock materials found in the candidate areas in Laxemar and Simpevarp.

Laboratory measurements on rock samples and drill cores provide direct information on the retardation properties of the rock matrix and the fracture materials. The parameters that are determined are:

- matrix porosity (defined as open porosity in SS-EN 12670),
- porosity distribution,
- diffusivity of the rock materials,
- sorption coefficients for a number of combinations of rock materials, radio nuclides and groundwater compositions.

The measurements are performed on rock cores or crushed rock from several different parts of the candidate rock volume. Major and minor rock types, different fracture types and fracture zones from the Laxemar and Simpevarp area are represented in the total sample collection.

About 350 rock samples from the Simpevarp/Laxemar area are included in the laboratory investigations, but as sorption and diffusivity measurements are time-consuming and still on-going experiments, there are only matrix porosity data and a small number of diffusivity data that can be reported in this document. Electrical resistivity data, for calculating the formation factor and the effective diffusivity, are presented in three separate reports /Löfgren and Neretnieks, 2004; Thunehed, 2005a,b/. Laboratory measurements of ^{14}C- PMMA (porosity distribution) are still in progress.

Brief descriptions of the laboratory methods, relevant for the data presentation in this report, are given in Chapter 3. Strategy for the use of laboratory methods can be found in a separate report, /Byegård et al. 2003/. Matrix porosity data tables and data from through-diffusion measurements are presented in Appendices 1 and 2.

As much of the laboratory works still are in progress, there are no discussions or interpretations of the results included in this report.

3 Equipment and procedures

3.1 General

Sample preparation and water porosity measurements were done at the Swedish National Testing and Research Institute (SP). Through-diffusion measurements are performed at Chalmers University of Technology (CTH).

3.2 Matrix porosity

Information of the porosity is produced in the laboratory measurements as supporting data in the diffusion experiments. The porosity of the rock matrix can be determined in several different ways by means of laboratory measurements on slices of drill cores. The most common method and the method used in this investigation, is the water saturation technique which is determined according to standard methods /SS-EN, 1936; ISRM, 1979/.

3.3 Through-diffusion measurements

Matrix diffusivity measurements are carried out by measuring how quickly an added substance diffuses through a piece of a drill core, so-called through-diffusion measurements /Ohlsson and Neretnieks, 1995; Byegård et al. 1998/. The measurement is normally performed on a 1–5 cm thick sawn-out slice of a drill core placed in a measurement cell. One side of the core piece is in contact with a synthetic groundwater and the other is in contact with a synthetic groundwater tagged with the radionuclide to be studied (in this case tritiated water, HTO). Samples are then taken on the un-tagged side, and the effective diffusion coefficient, De, for the rock matrix can be calculated based on the concentration increase on the un-tagged side.

A more detailed description of through-diffusion experiments can be found in SKB MD 540.001 (SKB internal document).

4 Execution

4.1 General

The obtained results are stored in SICADA, according to AP PS 400-03-41 and AP PS 400-03-93. Discussions of the results and evaluation of the methods are left for the future when the final results will be reported.

4.2 Matrix porosity

Data gained from the laboratory measurements are presented in Appendix 1.

The uncertainty of a single reported porosity value is 0.09%, given with a coverage factor of 2.

4.3 Through-diffusion measurements

The obtained effective diffusivities data are presented in Appendix 2.

The data are presented as a scaled accumulated amount of tracer in the target cell C_r as a function of time. The effective diffusivity D_e and the rock capacity factor α were fitted to the experimental data using Equation 1:

$$C_r = \frac{D_e t}{l^2} - \frac{\alpha}{6} - \frac{2\alpha}{\pi^2}\sum_{n=1}^{\infty}\frac{(-1)^n}{n^2}\exp\left\{-\frac{D_e n^2 \pi^2 t}{l^2 \alpha}\right\}, \quad (1)$$

where t is the experimental time after injection of tracer and l is the length of the rock sample.

The latter part of the experimental data is also fitted to a simplified linear form of Equation 1, i.e.

$$C_r = \frac{D_e t}{l^2} - \frac{\alpha}{6}. \quad (2)$$

In Figure 4-1 an example of experimental through diffusion data is presented together with the result from successful model calculations using Equation 1.

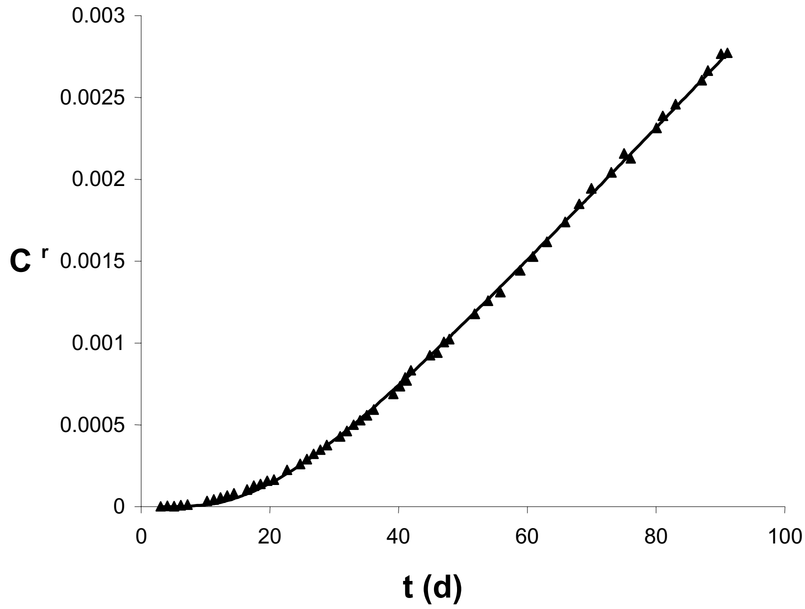

Figure 4-1. *Data of measured C_r values (▲) as a function of time from a HTO through diffusion experiment on a 1.0 cm thick sample from KSH02 (KSH02-474.47–474.48). The solid line represents calculated C_r values using Equation 1 with D_e and α optimized for a fit to the experimental data.*

References

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Appendix 1

Matrix porosity

Table A1-1. Results from the porosity measurements of rock samples from KSH01A according to /SS-EN, 1936/.

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KSH01B	19.96	19.99	Quartz monzodiorite	501036	0.47
KSH01B	39.59	39.62	Quartz monzodiorite	501036	0.10
KSH01B	59.12	59.15	Quartz monzodiorite	501036	0.08
KSH01B	76.65	76.68	Quartz monzodiorite	501036	0.12
KSH01B	99.71	99.74	Quartz monzodiorite	501036	0.08
KSH01A	121.41	121.44	Quartz monzodiorite	501036	0.08
KSH01A	140.68	140.71	Quartz monzodiorite	501036	0.34
KSH01A	160.72	160.75	Quartz monzodiorite	501036	0.10
KSH01A	181.47	181.50	Quartz monzodiorite	501036	0.13
KSH01A	200.11	200.14	Quartz monzodiorite	501036	0.08
KSH01A	219.36	219.39	Fine-grained dioritoid	501030	0.08
KSH01A	222.72	222.73	Fine-grained dioritoid	501030	0.15
KSH01A	222.73	222.76	Fine-grained dioritoid	501030	0.08
KSH01A	239.96	239.99	Fine-grained dioritoid	501030	0.19
KSH01A	261.08	261.11	Quartz monzodiorite	501036	1.59
KSH01A	280.23	280.26	Quartz monzodiorite	501036	0.45
KSH01A	295.41	295.44	Quartz monzodiorite	501036	0.13
KSH01A	317.78	317.81	Quartz monzodiorite	501036	0.08
KSH01A	340.88	340.91	Quartz monzodiorite	501036	0.08
KSH01A	362.55	362.58	Fine-grained granite	511058	0.12
KSH01A	378.98	379.01	Fine-grained dioritoid	501030	0.08
KSH01A	398.75	398.78	Fine-grained dioritoid	501030	0.13
KSH01A	420.78	420.81	Fine-grained dioritoid	501030	0.41
KSH01A	440.23	440.26	Fine-grained dioritoid	501030	0.75
KSH01A	460.01	460.04	Fine-grained dioritoid	501030	0.20
KSH01A	478.21	478.24	Fine-grained dioritoid	501030	0.07
KSH01A	500.31	500.34	Fine-grained dioritoid	501030	0.24
KSH01A	520.76	520.79	Fine-grained dioritoid	501030	0.15
KSH01A	539.01	539.04	Fine-grained dioritoid	501030	0.10
KSH01A	559.91	559.94	Fine-grained dioritoid	501030	0.07
KSH01A	580.88	580.91	Fine-grained dioritoid	501030	0.13
KSH01A	598.66	598.69	Fine-grained dioritoid	501030	0.13
KSH01A	620.23	620.26	Fine-grained dioritoid	501030	0.41
KSH01A	640.56	640.59	Ävrö granite	501044	0.17
KSH01A	661.07	661.10	Ävrö granite	501044	0.12
KSH01A	680.21	680.24	Fine-grained granite	511058	0.05
KSH01A	699.01	699.04	Pegmatite	501061	0.02
KSH01A	720.25	720.28	Fine-grained granite	511058	0.20
KSH01A	760.76	760.79	Quartz monzodiorite	501036	0.12
KSH01A	779.20	779.23	Quartz monzodiorite	501036	0.19
KSH01A	800.41	800.44	Ävrö granite	501044	0.58
KSH01A	820.09	820.12	Ävrö granite	501044	0.47
KSH01A	840.71	840.74	Ävrö granite	501044	0.35

KSH01A	859.16	859.19	Fine-grained granite	511058	0.30
KSH01A	880.51	880.54	Ävrö granite	501044	0.39
KSH01A	891.66	891.67	Ävrö granite	501044	0.58
KSH01A	891.67	891.68	Ävrö granite	501044	0.54
KSH01A	891.69	891.72	Ävrö granite	501044	0.45
KSH01A	891.72	891.77	Ävrö granite	501044	0.43
KSH01A	891.77	891.78	Ävrö granite	501044	0.48
KSH01A	891.78	891.79	Ävrö granite	501044	0.60
KSH01A	891.80	891.83	Ävrö granite	501044	0.44
KSH01A	891.83	891.88	Ävrö granite	501044	0.42
KSH01A	891.88	891.89	Ävrö granite	501044	0.48
KSH01A	891.89	891.90	Ävrö granite	501044	0.44
KSH01A	891.91	891.94	Ävrö granite	501044	0.46
KSH01A	898.61	898.64	Ävrö granite	501044	0.35
KSH01A	919.66	919.69	Ävrö granite	501044	0.24
KSH01A	940.81	940.84	Ävrö granite	501044	0.32
KSH01A	960.78	960.81	Quartz monzodiorite	501036	0.35
KSH01A	980.41	980.44	Quartz monzodiorite	501036	0.25
KSH01A	981.43	981.46	Quartz monzodiorite	501036	0.29
KSH01A	981.46	981.49	Quartz monzodiorite	501036	0.29
KSH01A	981.50	981.53	Quartz monzodiorite	501036	0.27
KSH01A	999.46	999.49	Quartz monzodiorite	501036	0.22

Table A1-2. Results from the porosity measurements of rock samples from KSH02 according to /SS-EN, 1936/.

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KSH02	19.96	19.99	Fine-grained dioritoid	501030	0.05
KSH02	39.96	39.99	Fine-grained dioritoid	501030	0.07
KSH02	60.18	60.21	Fine-grained dioritoid	501030	0.20
KSH02	80.01	80.04	Fine-grained dioritoid	501030	0.12
KSH02	99.91	99.94	Fine-grained dioritoid	501030	0.53
KSH02	119.96	119.99	Fine-grained dioritoid	501030	0.10
KSH02	140.16	140.19	Fine-grained dioritoid	501030	0.08
KSH02	148.09	148.10	Fine-grained dioritoid	501030	0.38
KSH02	148.11	148.12	Fine-grained dioritoid	501030	0.15
KSH02	148.12	148.15	Fine-grained dioritoid	501030	0.07
KSH02	148.16	148.21	Fine-grained dioritoid	501030	0.06
KSH02	148.21	148.22	Fine-grained dioritoid	501030	0.00
KSH02	148.23	148.24	Fine-grained dioritoid	501030	0.05
KSH02	148.24	148.27	Fine-grained dioritoid	501030	0.08
KSH02	148.28	148.33	Fine-grained dioritoid	501030	0.02
KSH02	148.34	148.35	Fine-grained dioritoid	501030	0.05
KSH02	148.36	148.39	Fine-grained dioritoid	501030	0.05
KSH02	148.39	148.44	Fine-grained dioritoid	501030	0.03
KSH02	159.96	159.99	Fine-grained dioritoid	501030	0.20
KSH02	179.96	179.99	Fine-grained dioritoid	501030	0.10
KSH02	219.66	219.69	Fine-grained dioritoid	501030	0.12
KSH02	239.96	239.99	Fine-grained dioritoid	501030	0.07
KSH02	259.83	259.86	Fine-grained dioritoid	501030	0.05
KSH02	280.01	280.04	Fine-grained dioritoid	501030	0.07
KSH02	299.95	299.98	Fine-grained dioritoid	501030	0.34

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KSH02	339.94	339.97	Fine-grained dioritoid	501030	0.10
KSH02	360.06	360.09	Fine-grained dioritoid	501030	0.68
KSH02	397.42	397.45	Fine-grained dioritoid	501030	1.32
KSH02	397.45	397.48	Fine-grained dioritoid	501030	1.41
KSH02	397.58	397.61	Fine-grained dioritoid	501030	3.35
KSH02	397.61	397.64	Fine-grained dioritoid	501030	3.35
KSH02	419.96	419.99	Fine-grained dioritoid	501030	0.84
KSH02	459.69	459.72	Fine-grained dioritoid	501030	0.27
KSH02	474.46	474.47	Fine-grained dioritoid	501030	0.61
KSH02	474.47	474.48	Fine-grained dioritoid	501030	0.40
KSH02	474.56	474.59	Fine-grained dioritoid	501030	0.42
KSH02	474.60	474.65	Fine-grained dioritoid	501030	0.10
KSH02	474.65	474.66	Fine-grained dioritoid	501030	0.30
KSH02	474.66	474.67	Fine-grained dioritoid	501030	0.20
KSH02	474.68	474.71	Fine-grained dioritoid	501030	0.20
KSH02	474.71	474.76	Fine-grained dioritoid	501030	0.31
KSH02	474.77	474.78	Fine-grained dioritoid	501030	0.59
KSH02	474.78	474.79	Fine-grained dioritoid	501030	0.47
KSH02	474.80	474.83	Fine-grained dioritoid	501030	0.18
KSH02	474.86	474.91	Fine-grained dioritoid	501030	0.42
KSH02	480.01	480.04	Fine-grained dioritoid	501030	0.19
KSH02	500.01	500.04	Fine-grained dioritoid	501030	1.33
KSH02	539.86	539.89	Fine-grained dioritoid	501030	0.20
KSH02	560.06	560.09	Fine-grained dioritoid	501030	0.21
KSH02	580.11	580.14	Fine-grained granite	511058	0.07
KSH02	599.35	599.36	Fine-grained granite	511058	0.32
KSH02	599.36	599.37	Fine-grained granite	511058	0.28
KSH02	599.37	599.40	Fine-grained granite	511058	0.19
KSH02	599.41	599.46	Fine-grained granite	511058	0.20
KSH02	599.46	599.47	Fine-grained granite	511058	0.23
KSH02	599.47	599.48	Fine-grained granite	511058	0.26
KSH02	599.48	599.51	Fine-grained granite	511058	0.19
KSH02	599.52	599.57	Fine-grained granite	511058	0.24
KSH02	599.57	599.58	Fine-grained granite	511058	0.40
KSH02	599.58	599.59	Fine-grained granite	511058	0.25
KSH02	599.59	599.62	Fine-grained granite	511058	0.29
KSH02	599.62	599.67	Fine-grained granite	511058	0.24
KSH02	600.01	600.04	Fine-grained granite	511058	0.17
KSH02	639.89	639.92	Fine-grained granite	511058	0.30
KSH02	660.09	660.12	Fine-grained dioritoid	501030	0.09
KSH02	680.16	680.19	Fine-grained dioritoid	501030	0.31
KSH02	685.98	685.99	Fine-grained dioritoid	501030	0.38
KSH02	685.99	686.00	Fine-grained dioritoid	501030	0.25
KSH02	686.00	686.03	Fine-grained dioritoid	501030	0.10
KSH02	686.04	686.09	Fine-grained dioritoid	501030	0.08
KSH02	686.09	686.10	Fine-grained dioritoid	501030	0.19
KSH02	686.10	686.11	Fine-grained dioritoid	501030	0.25
KSH02	686.11	686.14	Fine-grained dioritoid	501030	0.12
KSH02	686.15	686.20	Fine-grained dioritoid	501030	0.04
KSH02	686.20	686.21	Fine-grained dioritoid	501030	0.10
KSH02	686.21	686.22	Fine-grained dioritoid	501030	0.05
KSH02	686.22	686.25	Fine-grained dioritoid	501030	0.05

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KSH02	686.26	686.31	Fine-grained dioritoid	501030	0.05
KSH02	700.01	700.04	Fine-grained granite	511058	0.20
KSH02	720.01	720.04	Fine-grained dioritoid	501030	0.10
KSH02	740.01	740.04	Fine-grained granite	511058	1.15
KSH02	760.17	760.20	Fine-grained dioritoid	501030	0.14
KSH02	779.82	779.85	Fine-grained dioritoid	501030	0.25
KSH02	819.91	819.94	Fine-grained dioritoid	501030	0.42
KSH02	840.01	840.04	Fine-grained dioritoid	501030	0.02
KSH02	859.96	859.99	Fine-grained dioritoid	501030	0.21
KSH02	880.01	880.04	Fine-grained dioritoid	501030	0.15
KSH02	900.01	900.04	Fine-grained dioritoid	501030	0.17
KSH02	920.01	920.04	Fine-grained dioritoid	501030	0.13
KSH02	940.01	940.04	Fine-grained dioritoid	501030	0.13
KSH02	959.96	959.99	Fine-grained dioritoid	501030	0.12
KSH02	979.96	979.99	Fine-grained diorite-gabbro	505102	0.20

Table A1-3. Results from the porosity measurements of rock samples from KLX02 according to /SS-EN, 1936/.

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KLX02	201.89	201.92	Ävrö granite	501044	0.30
KLX02	216.69	216.70	Ävrö granite	501044	0.35
KLX02	216.70	216.71	Ävrö granite	501044	0.23
KLX02	216.71	216.74	Ävrö granite	501044	0.13
KLX02	216.74	216.79	Ävrö granite	501044	0.15
KLX02	216.79	216.80	Ävrö granite	501044	0.44
KLX02	216.80	216.81	Ävrö granite	501044	0.28
KLX02	216.81	216.84	Ävrö granite	501044	0.19
KLX02	216.84	216.89	Ävrö granite	501044	0.16
KLX02	216.89	216.90	Ävrö granite	501044	0.43
KLX02	216.91	216.92	Ävrö granite	501044	0.33
KLX02	216.92	216.95	Ävrö granite	501044	0.21
KLX02	216.95	217.00	Ävrö granite	501044	0.19
KLX02	220.11	220.14	Ävrö granite	501044	0.36
KLX02	235.02	235.05	Ävrö granite	501044	0.36
KLX02	235.05	235.08	Ävrö granite	501044	0.39
KLX02	235.08	235.11	Ävrö granite	501044	0.39
KLX02	239.88	239.91	Ävrö granite	501044	0.28
KLX02	258.96	258.99	Ävrö granite	501044	0.23
KLX02	280.01	280.04	Ävrö granite	501044	0.19
KLX02	299.79	299.82	Ävrö granite	501044	0.21
KLX02	320.04	320.07	Ävrö granite	501044	0.13
KLX02	339.95	339.98	Ävrö granite	501044	0.17
KLX02	387.78	387.81	Fine-grained diorite-gabbro	505102	0.21
KLX02	420.02	420.05	Ävrö granite	501044	0.25
KLX02	440.21	440.24	Ävrö granite	501044	0.15
KLX02	459.69	459.72	Ävrö granite	501044	0.38
KLX02	480.02	480.05	Ävrö granite	501044	0.40
KLX02	499.95	499.98	Ävrö granite	501044	0.25
KLX02	519.63	519.66	Ävrö granite	501044	0.21

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KLX02	540.03	540.06	Ävrö granite	501044	0.29
KLX02	560.72	560.75	Ävrö granite	501044	0.43
KLX02	579.77	579.80	Ävrö granite	501044	0.30
KLX02	600.19	600.22	Ävrö granite	501044	0.27
KLX02	620.79	620.82	Ävrö granite	501044	0.34
KLX02	639.93	639.96	Ävrö granite	501044	0.42
KLX02	680.83	680.86	Ävrö granite	501044	0.27
KLX02	682.34	682.37	Fine-grained dioritoid	501030	0.06
KLX02	682.37	682.40	Fine-grained dioritoid	501030	0.06
KLX02	682.40	682.43	Fine-grained dioritoid	501030	0.12
KLX02	700.15	700.18	Fine-grained dioritoid	501030	1.49
KLX02	839.39	839.42	Fine-grained diorite-gabbro	505102	0.15
KLX02	859.70	859.73	Ävrö granite	501044	0.42
KLX02	880.95	880.98	Ävrö granite	501044	1.12
KLX02	898.04	898.07	Fine-grained dioritoid	501030	0.04
KLX02	921.15	921.18	Fine-grained dioritoid	501030	0.07
KLX02	938.42	938.45	Ävrö granite	501044	0.39
KLX02	959.56	959.59	Ävrö granite	501044	0.32
KLX02	979.92	979.95	Ävrö granite	501044	0.41
KLX02	998.20	998.23	Ävrö granite	501044	0.25

Table A1-4. Results from the porosity measurements of rock samples from KLX03 according to /SS-EN, 1936/.

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KLX03	662.10	662.13	Quartz monzodiorite	501036	0.78
KLX03	662.13	662.16	Quartz monzodiorite	501036	0.76
KLX03	662.16	662.19	Quartz monzodiorite	501036	1.03

Table A1-5. Results from the porosity measurements of rock samples from KLX04 according to /SS-EN, 1936/.

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KLX04	110.40	110.43	Ävrö granite	501044	0.24
KLX04	130.55	130.58	Ävrö granite	501044	0.46
KLX04	149.56	149.59	Ävrö granite	501044	0.27
KLX04	169.66	169.69	Granite	501058	0.38
KLX04	190.62	190.65	Ävrö granite	501044	0.39
KLX04	209.72	209.75	Ävrö granite	501044	0.36
KLX04	236.78	236.81	Ävrö granite	501044	0.99
KLX04	256.72	256.75	Ävrö granite	501044	0.43
KLX04	277.66	277.69	Fine-grained dioritoid	501030	0.39
KLX04	297.06	297.09	Ävrö granite	501044	0.89
KLX04	317.19	317.22	Ävrö granite	501044	0.36
KLX04	337.55	337.58	Ävrö granite	501044	0.22
KLX04	357.06	357.09	Ävrö granite	501044	0.36
KLX04	380.78	380.81	Ävrö granite	501044	0.63
KLX04	400.72	400.75	Quartz monzodiorite	501036	0.19
KLX04	419.95	419.98	Granite	501058	0.84
KLX04	460.09	460.12	Quartz monzodiorite	501036	0.12

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KLX04	479.82	479.85	Quartz monzodiorite	501036	0.21
KLX04	489.48	489.49	Quartz monzodiorite	501036	0.32
KLX04	489.49	489.50	Quartz monzodiorite	501036	0.21
KLX04	489.50	489.53	Quartz monzodiorite	501036	0.09
KLX04	489.53	489.58	Quartz monzodiorite	501036	0.19
KLX04	489.60	489.61	Quartz monzodiorite	501036	0.21
KLX04	489.61	489.62	Quartz monzodiorite	501036	0.16
KLX04	489.62	489.65	Quartz monzodiorite	501036	0.15
KLX04	489.65	489.70	Quartz monzodiorite	501036	0.05
KLX04	489.73	489.74	Quartz monzodiorite	501036	0.22
KLX04	489.74	489.75	Quartz monzodiorite	501036	0.31
KLX04	489.75	489.78	Quartz monzodiorite	501036	0.10
KLX04	489.78	489.83	Quartz monzodiorite	501036	0.10
KLX04	499.70	499.73	Quartz monzodiorite	501036	0.10
KLX04	519.84	519.87	Fine-grained granite	511058	0.28
KLX04	539.68	539.71	Quartz monzodiorite	501036	0.12
KLX04	559.69	559.72	Ävrö granite	501044	0.33
KLX04	579.73	579.76	Ävrö granite	501044	0.43
KLX04	600.37	600.40	Ävrö granite	501044	0.27
KLX04	620.02	620.05	Ävrö granite	501044	0.39
KLX04	640.02	640.05	Ävrö granite	501044	0.29
KLX04	659.81	659.84	Ävrö granite	501044	0.33
KLX04	680.77	680.80	Quartz monzodiorite	501036	0.09
KLX04	700.20	700.23	Quartz monzodiorite	501036	0.26
KLX04	718.21	718.24	Fine-grained granite	511058	0.22
KLX04	718.24	718.27	Fine-grained granite	511058	0.22
KLX04	718.27	718.30	Fine-grained granite	511058	0.22
KLX04	719.37	719.40	Fine-grained granite	511058	0.26
KLX04	740.40	740.43	Ävrö granite	501044	0.25
KLX04	759.83	759.86	Ävrö granite	501044	0.22
KLX04	780.73	780.76	Ävrö granite	501044	0.20
KLX04	800.02	800.05	Ävrö granite	501044	0.15
KLX04	820.90	820.93	Ävrö granite	501044	0.23
KLX04	840.17	840.20	Ävrö granite	501044	0.22
KLX04	860.28	860.31	Fine-grained diorite-gabbro	505102	0.16
KLX04	880.25	880.28	Ävrö granite	501044	1.45
KLX04	899.89	899.92	Ävrö granite	501044	0.41
KLX04	920.40	920.43	Ävrö granite	501044	0.80
KLX04	939.77	939.80	Ävrö granite	501044	0.79
KLX04	978.72	978.75	Ävrö granite	501044	0.33

Table A1-6. Results from the porosity measurements of rock samples from KLX06 according to /SS-EN, 1936/.

idcode	secup	seclow	rock_type	rock_code	matrix_porosity
KLX06	402.41	402.44	Granite	501058	4.19

Appendix 2

Effective diffusivity and rock capacity factor

Table A2-1. Results from trough diffusion experiments of rock samples from KSH01A and KSH02. De, the effective diffusivity and α, the rock capacity factor were obtained from least square fits of experimental data to Equation 1 and Equation 2 (the linear form).

SKB ID	Sample thickness (mm)	D_e from Eq 1 (m^2/s)	D_e from Eq 2 (m^2/s)	α from Eq 1	α from Eq 2
KSH01A 891.66–891.67	5	1.3E–12	1.3E–12	1.3E–02	1.5E–02
KSH01A 891.67–891.68	10	1.0E–12	1.0E–12	4.6E–03	4.9E–03
KSH01A 891.69–891.72	30	9.2E–13	9.3E–13	1.3E–02	1.4E–02
KSH01A 891.72–891.77	50	9.0E–13	9.2E–13	3.0E–03	4.1E–03
KSH01A 891.77–891.78	5	1.0E–12	1.0E–12	1.5E–02	1.8E–02
KSH01A 891.78–891.79	10	1.1E–12	1.2E–12	ne	ne
KSH01A 891.80–891.83	30	9.8E–13	9.9E–13	1.3E–02	1.5E–02
KSH01A 891.83–891.88	50	8.8E–13	8.6E–13	1.0E–02	9.8E–03
KSH01A 891.88–891.89	5	1.1E–12	1.1E–12	1.0E–02	1.1E–02
KSH01A 891.91–891.94	30	1.1E–12	1.1E–12	1.2E–02	1.2E–02
KSH01A 940.80–940.85	30	4.4E–13	4.4E–13	9.5E–03	9.7E–03
KSH01A 981.43–981.46	30	4.8E–13	4.9E–13	8.8E–03	9.7E–03
KSH01A 981.46–981.49	30	4.2E–13	4.2E–13	1.1E–02	1.2E–02
KSH01A 981.50–981.53	30	3.7E–13	3.8E–13	7.4E–03	8.4E–03
KSH02 474.46–474.47	5	1.0E–13	1.0E–13	1.7E–02	1.8E–02
KSH02 474.47–474.48	10	5.1E–14	5.2E–14	6.6E–03	7.0E–03
KSH02 474.49–474.56	30	1.4E–13	1.4E–13	3.8E–03	4.2E–03
KSH02 474.65–474.66	5	8.7E–14	8.8E–14	9.9E–03	1.3E–02
KSH02 474.66–474.67	10	9.5E–14	9.6E–14	1.2E–02	1.2E–02
KSH02 474.68–474.71	30	6.6E–14	6.6E–14	2.5E–03	2.6E–03
KSH02 474.71–474.76	50	5.1E–13	5.2E–13	3.7E–03	4.2E–03
KSH02 474.77–474.78	5	4.8E–13	4.8E–13	1.9E–02	2.0E–02
KSH02 474.78–474.79	10	8.5E–13	8.5E–13	1.7E–02	1.5E–02
KSH02 474.80–474.83	30	7.1E–14	7.2E–14	2.0E–03	2.1E–03
KSH02 600.00–600.05	30	8.4E–14	8.5E–14	3.1E–03	3.2E–03

Table A2-2. Results from trough diffusion experiments of rock samples from KLX02. D_e, the effective diffusivity and α, the rock capacity factor were obtained from least square fits of experimental data to Equation 1 and Equation 2 (the linear form).

SKB ID	Sample thickness (mm)	D_e from Eq 1 (m^2/s)	D_e from Eq 2 (m^2/s)	α from Eq 1	α from Eq 2	Comments
KLX02 216.70– 216.71	10	1.1E–13	1.1E–13	ne (not evaluated)	ne	Capacity factor not evaluated, fixed from water saturation measurement (0.23%)
KLX02 216.80– 216.81	10	1.3E–13	1.3E–13	ne	ne	Capacity factor not evaluated, fixed from water saturation measurement (0.28%)
KLX02 216.91– 216.92	10	1.6E–13	1.8E–13	2.2E–3	6.0E–3	