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**Supplement 1**

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## **Oskarshamn site investigation**

### **Revision of borehole deviation measurements in Oskarshamn**

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## Description

In connection with a major quality revision (autumn 2006 to early spring 2007) regarding orientation of geological objects (fractures, rock contacts etc) a reassessment of the reliability of deviation measurements was made. Some problems with low repeatability and some problems with correct length measurements when using the standard method for deviation measurements caused a decision to introduce a new strategy. This new strategy implies the possibility to combine several deviation measurements.

A new borehole KLX27A was according to a project decision drilled after the revision. Due to that reason a complement of the deviation measurements for KLX27A is made. Tables 5-1 as well as part of Appendix A are updated with data from KLX27A. Table 5-1 present an overview of the resulting uncertainties for inclination and bearing, together with the radius uncertainty at the bottom of each borehole. Also the elevation uncertainty is calculated and presented. The elevation uncertainty is not calculated in Sicada, but it can be calculated according to equation (4-2) in the main report.

A detailed description of the construction of the revised deviation data for KLX27A is shown in Appendix A (core-drilled borehole). A specification of the involved deviation measurements is given, and the resulting deviation file together with the estimated uncertainties is presented.

**Table 5-1. Overview of the deviation uncertainties in all core-drilled boreholes. The inclination I is given at TOC, whereas the elevation, the radius uncertainty  $\Delta r$  and the elevation uncertainty  $\Delta Z$  are given at the bottom of each borehole. The column "Change" displays the change in position at the bottom of each borehole due to the revision. Because the boreholes KLX15A, KLX16A and KLX27A were drilled after the revision, no changes in position are calculated for these boreholes.**

Borehole ID	Bh L [m]	Elev [m]	I [°]	$\Delta I$ [°]	$\Delta B$ [°]	$\Delta r$ [m]	$\Delta Z$ [m]	Change [m]
KLX01	1,077.99	-1,059.35	-85.30	3.0	6.0	56.42	3.29	2.47
KLX02	1,700.50	-1,669.83	-85.00	3.0	6.0	89.00	10.55	5.63
KLX03	1,000.42	-952.21	-74.93	1.8	4.9	31.42	7.60	87.24*
KLX04	993.49	-964.00	-84.76	1.8	4.9	31.21	3.23	0.16
KLX05	1,000.16	-883.26	-65.22	0.55	3.545	26.86	4.17	18.42
KLX06	994.94	-787.99	-65.20	1.019	1.389	17.79	10.06	214.07*
KLX07A	884.73	-631.27	-60.04	1.005	0.575	14.82	9.43	4.75
KLX07B	200.13	-180.99	-85.15	0.145	0.86	0.51	0.04	0.39
KLX08	1,000.41	-832.82	-60.51	0.645	1.67	15.03	5.81	5.69
KLX09	880.38	-850.62	-84.94	0.99	1.76	15.21	1.81	11.59
KLX09B	100.22	-76.60	-89.83	0.178	133.447	0.34	0.001	0.13
KLX09C	120.05	-78.26	-59.52	0.085	0.820	0.91	0.09	5.44*
KLX09D	121.02	-80.57	-60.25	0.035	1.374	1.50	0.04	0.26
KLX09E	120.0	-81.06	-59.96	0.075	0.777	0.83	0.08	0.07
KLX09F	152.30	-109.96	-59.74	0.030	0.650	0.91	0.04	0.02
KLX09G	100.10	-66.90	-61.08	0.020	1.169	1.03	0.02	0.06
KLX10	1,001.20	-975.79	-85.19	0.913	6.103	15.95	1.90	12.62
KLX10B	50.25	-25.05	-59.97	0.066	1.638	0.73	0.03	0.19
KLX10C	146.25	-108.25	-60.03	0.046	0.734	0.97	0.06	6.49*
KLX11A	992.29	-910.99	-76.77	0.825	1.25	14.29	4.64	93.26*
KLX11B	100.2	-79.92	-89.93	0.095	15.017	0.24	0.001	0.75

Borehole ID	Bh L [m]	Elev [m]	I [°]	$\Delta I$ [°]	$\Delta B$ [°]	$\Delta r$ [m]	$\Delta Z$ [m]	Change [m]
KLX11C	120.15	-77.13	-60.73	0.030	0.620	0.65	0.03	3.27
KLX11D	120.35	-75.29	-59.00	0.030	0.882	1.01	0.03	5.92*
KLX11E	121.30	-82.05	-60.92	0.090	0.609	0.65	0.10	5.14*
KLX11F	120.05	-79.39	-61.14	0.035	0.616	0.65	0.04	0.06
KLX12A	602.29	-561.39	-75.31	0.075	1.405	4.04	0.22	12.30
KLX13A	595.85	-567.07	-82.24	0.993	2.694	10.33	1.28	7.75
KLX14A	176.27	-113.36	-49.96	0.037	0.511	1.06	0.08	8.38*
KLX15A	1,000.43	-739.99	-54.42	0.160	0.591	6.77	1.83	N/A
KLX16A	433.55	-371.44	-64.98	0.265	2.113	6.96	0.87	N/A
KLX17A	701.08	-572.47	-61.34	1.8	4.9	30.92	11.37	41.69*
KLX18A	611.28	-581.60	-82.11	0.415	0.734	4.43	0.74	3.18
KLX19A	800.07	-652.63	-57.55	0.995	0.595	13.89	7.61	9.24
KLX20A	457.92	-311.34	-50.03	0.72	0.605	5.75	3.87	3.70
KLX21A	75.00	-47.54	-50.72	0.06	1.425	1.18	0.05	1.25
KLX21B	858.78	-789.36	-70.86	0.135	3.350	18.24	0.74	32.40*
KLX22A	100.45	-64.44	-60.34	0.151	0.666	0.60	0.14	0.14
KLX22B	100.25	-65.35	-61.25	0.101	1.37	1.20	0.09	0.18
KLX23A	100.15	-64.46	-61.36	0.080	0.482	0.42	0.07	0.04
KLX23B	50.27	-21.28	-60.85	0.130	0.552	0.24	0.06	0.02
KLX24A	100.17	-63.68	-59.15	0.071	0.829	0.77	0.07	0.08
KLX25A	50.24	-20.19	-59.46	0.066	0.544	0.25	0.03	0.01
KLX26A	101.14	-71.80	-60.45	0.050	0.907	0.81	0.04	0.86
KLX26B	50.37	-27.76	-60.01	0.035	0.608	0.27	0.02	0.01
KLX27A	650.56	-566.94	-65.37	0.205	0.545	2.73	1.03	N/A
KLX28A	80.23	-58.84	-60.06	0.040	1.516	1.09	0.03	0.48
KLX29A	60.25	-38.64	-60.91	0.080	0.865	0.45	0.04	1.39

\* Calculated as a straight borehole with the starting values of inclination and bearing on 2006-12-17.

### Details of the core-drilled borehole KLX27A

#### Borehole description – KLX27A

Technical description of borehole KLX27A is given in Figure A-1.

#### Deviation measurement in KLX27A

In total four deviation measurements were conducted in KLX27A. The deviation logging activities are tabulated in Sicada Activity Log, see Table A-1.

The Maxibor measurement was executed with the instrument mounted inside a barrel which was joined to the lower end of the drill string.

The starting values for the Maxibor measurements in KLX27A were measured with the Total station aiming on a prism, above and lined up with the TOC. A later calculation gave the values at borehole length 3.00 m which was used as start values (bearing and inclination) for the Maxibor measurements. When the calculation of the Maxibor measurement was done, the values for borehole length 0.00 m was added.

The two Maxibor measurements (ID 13177335, 13177336) were executed down and up the borehole length.

The two Mag/acc measurements (ID 13177474, 13177475) were executed down and up the borehole length, with the Flexit instrument. Corrections of measured data were documented in the File References (Sicada) for the measurements. No geomagnetic disturbances exceeding 0.5 degrees were observed on the date of the Mag/acc measurement, see Figure A-2.

#### Borehole deviation multiple measurements

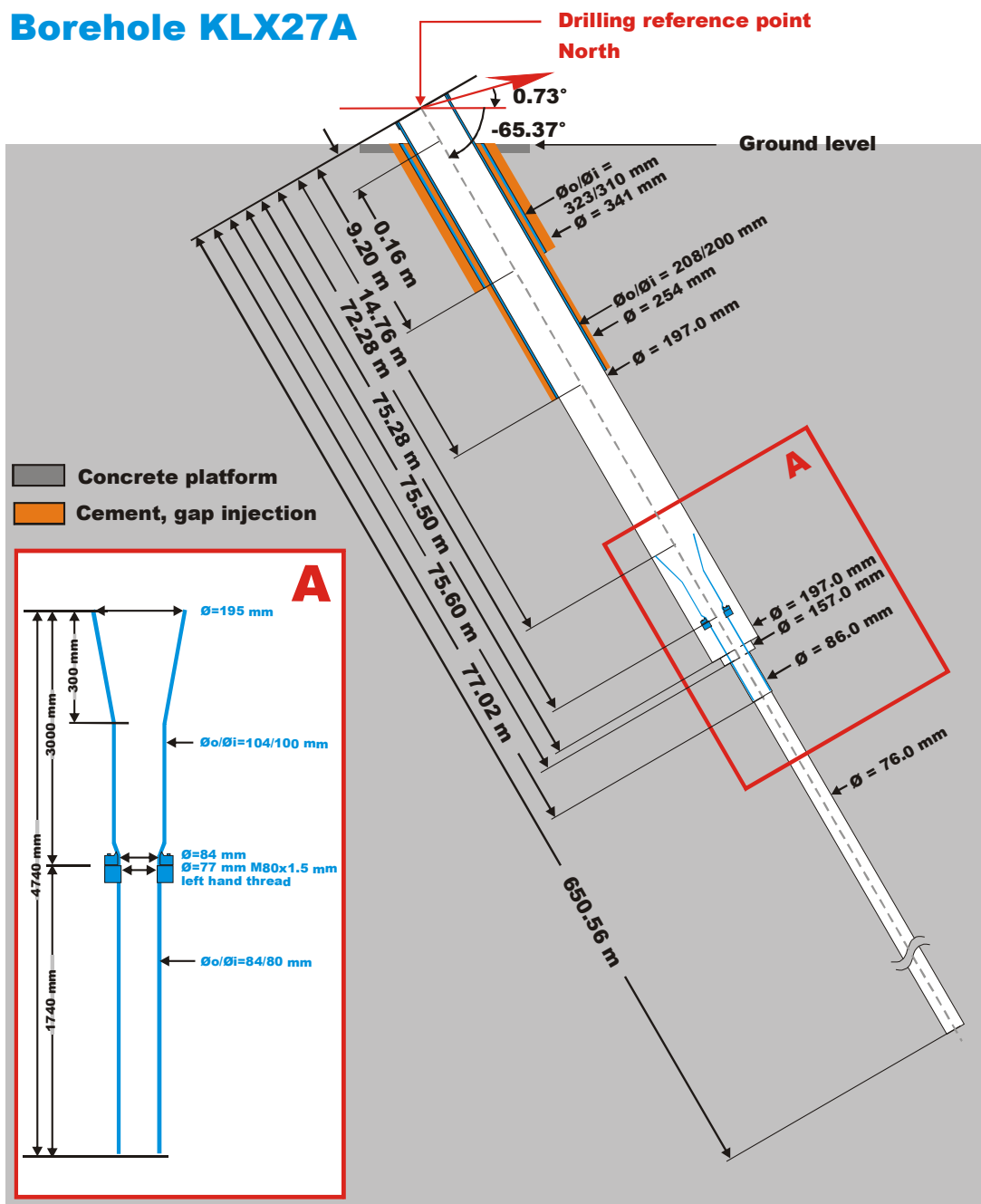
For the calculation of *Borehole deviation multiple measurements* (ID 13177762) the two Maxibor measurements (ID 13177335, 13177336) and the two Mag/acc measurements (ID 13177474, 13177475) was used. Inclination from Maxibor was not used as it gives a strange oscillation of c 0.5 degrees with a wavelength of 15 m. Table A-2 shows all deviation data for the calculation.

A subset of the resulting deviation file for every approximately 100 m elevation (from Object\_location) is shown in Table A-3. The inclination and bearing uncertainties were calculated automatically, and based on these values the “Radius uncertainty” was calculated for every measuring level.

Figure A-3 and A-4 shows the resulting deviation data listed in Table A-1.

# Technical data

## Borehole KLX27A



### Drilling reference point

**Northing:** 6365608.29 (m), RT90 2,5 gon V 0:-15

**Easting:** 1546742.63 (m), RT90 2,5 gon V 0:-15

**Elevation:** 16.98 (m), RHB 70

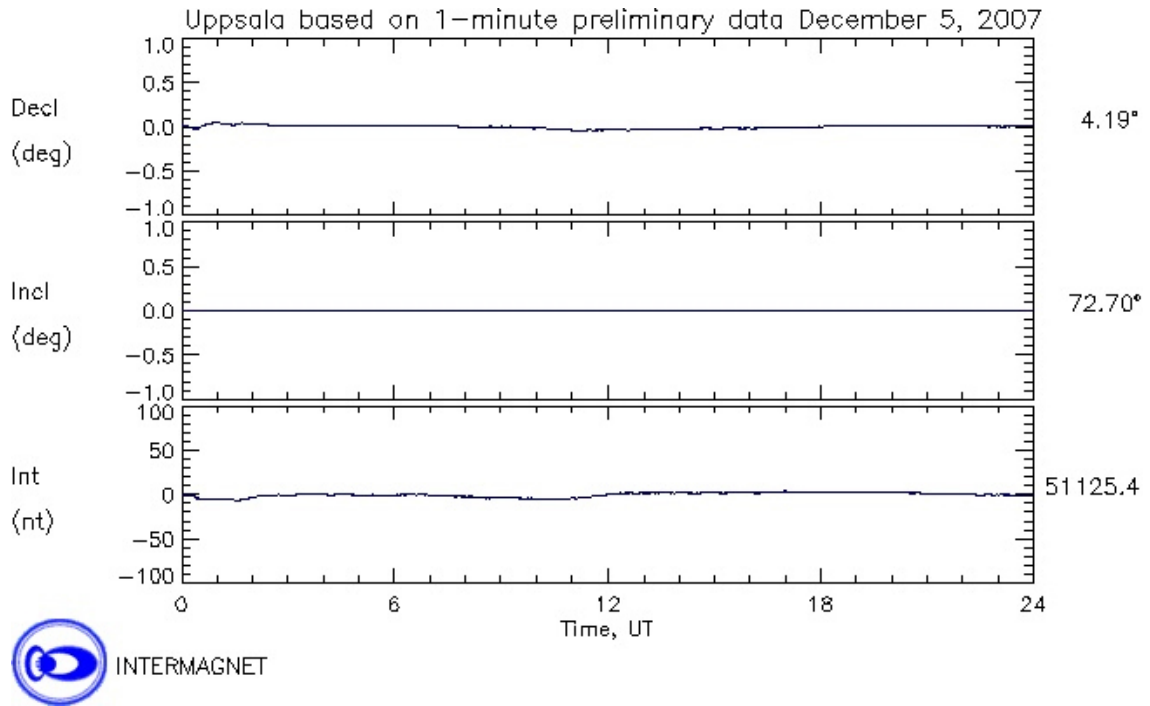
### Drilling period

**2007-08-15 – 2007-08-27, 0.16–75.60 m**

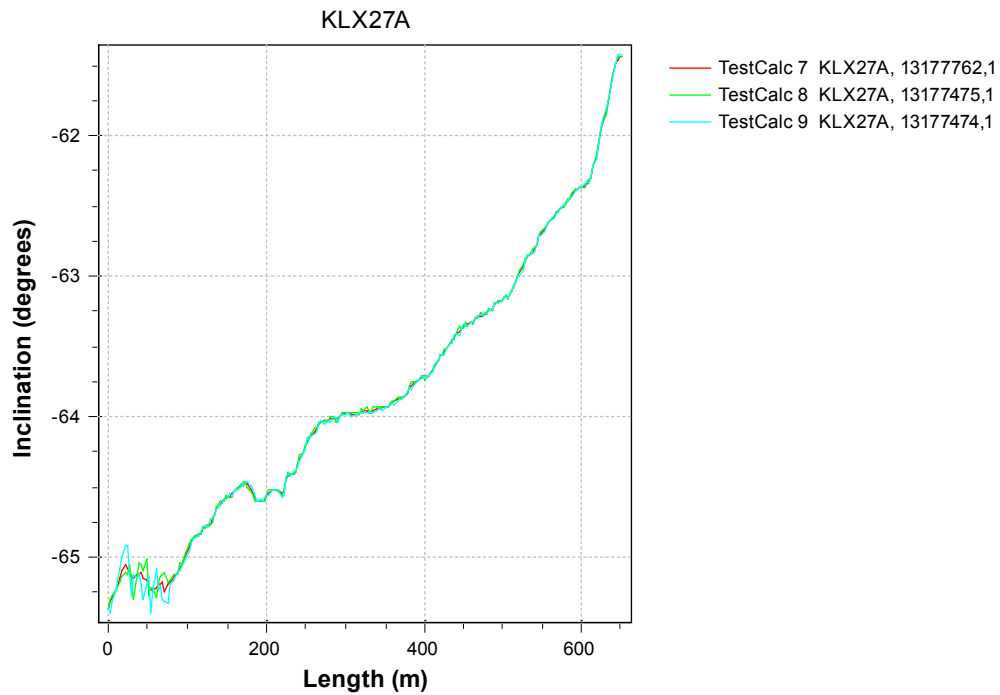
**2007-10-08 – 2007-11-21, 75.60–650.56 m**

Ver 2007-12-12

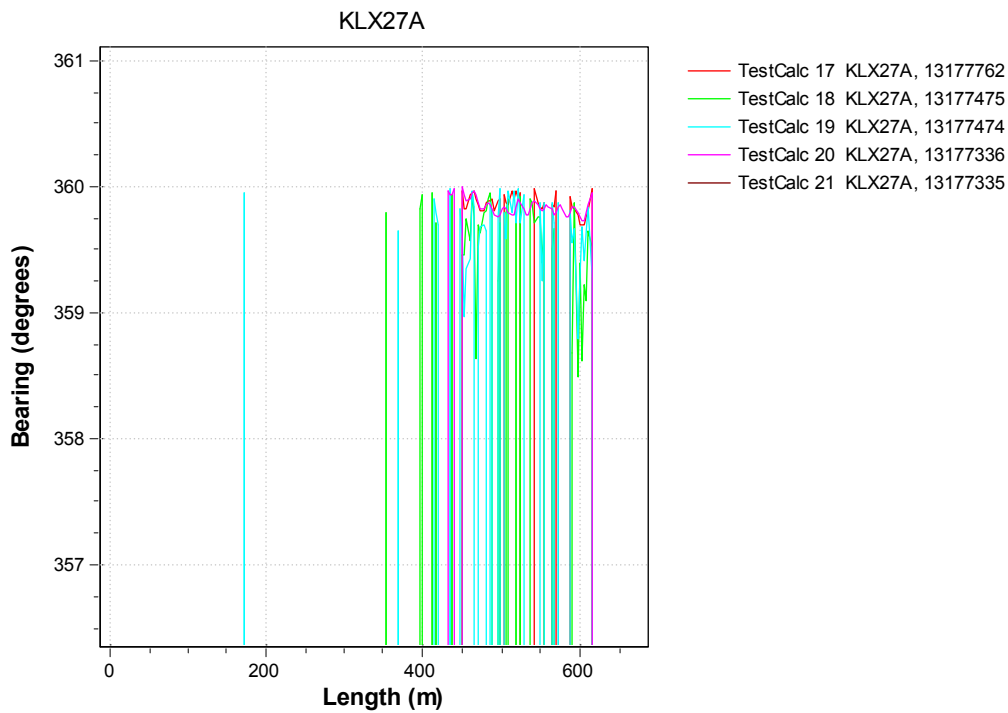
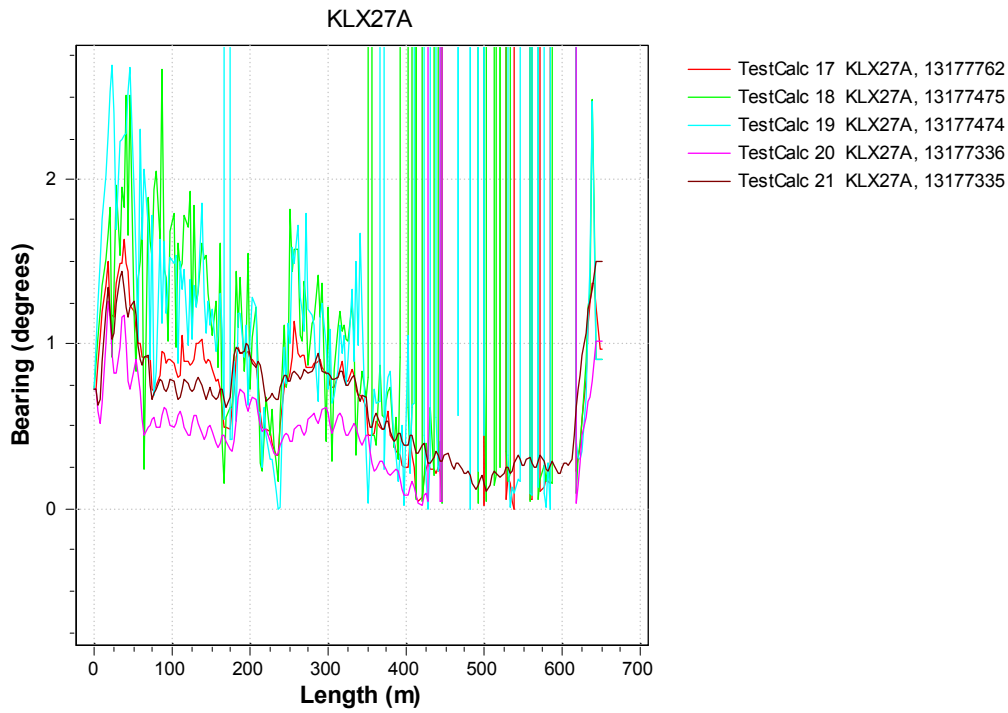
Figure A-1. Technical description of borehole KLX27A.



*Figure A-2. The geomagnetic field was observed at the Observatory in Uppsala on 2007-12-05.*



*Figure A-3. The Borehole deviation multiple measurements data (red line) together with the other, deviation activities specified in Table A-1. The inclination is shown except for the inclination of Maxibor which shows an unrealistic oscillation.*



*Figure A-4. The Borehole deviation multiple measurements data (red line) together with the other deviation activities specified in Table A-1. The upper diagram shows the bearing greater than 0° and the lower diagram shows the bearing below 360°.*

**Table A-1. The deviation logging activities in Sicada.**

<b>Id code</b>	<b>Activity Id</b>	<b>Activity type code</b>	<b>Activity</b>	<b>Start date</b>	<b>Secup (m)</b>	<b>Seclow (m)</b>	<b>Flags</b>
KLX27A	13177335	EG156	Maxibor measurement	2007-11-25 06:00	0.00	645.00	CF
KLX27A	13177336	EG156	Maxibor measurement	2007-11-25 10:00	0.00	645.00	CF
KLX27A	13177474	EG157	Magnetic - accelerometer measurement	2007-12-05 17:30	0.00	645.00	CF
KLX27A	13177475	EG157	Magnetic - accelerometer measurement	2007-12-05 20:00	0.00	645.00	CF
KLX27A	13177762	EG154	Borehole deviation multiple measurements	2007-12-14 15:30	0.00	645.00	I CF

**Table A-2. Content of the EG154-file.**

<b>Id code</b>	<b>Deviation activity Id</b>	<b>Deviation angle type</b>	<b>Approved secup (m)</b>	<b>Approved seclow (m)</b>	<b>Man estim angle uncert (degrees)</b>
KLX27A	13177335	Bearing	21.00		
KLX27A	13177336	Bearing	21.00		
KLX27A	13177474	Bearing	21.00		
KLX27A	13177474	Inclination	3.00		
KLX27A	13177475	Bearing	21.00		
KLX27A	13177475	Inclination	3.00		



**Table A-3. Subset (for every approx. 100 m elevation) of the resulting “Object\_location” in Sicada.**

<b>Id code</b>	<b>Northing (m)</b>	<b>Easting (m)</b>	<b>Elevation (m)</b>	<b>Length (m)</b>	<b>Elevation_uncert (m)</b>	<b>Inclination (degrees)</b>	<b>Bearing (degrees)</b>	<b>Inclination_uncert (degrees)</b>	<b>Bearing_uncert (degrees)</b>	<b>Radius_uncert (m)</b>
KLX27A	6365608.29	1546742.63	16.98	0.00	0.00	-65.37	0.73	0.205	0.545	0.00
KLX27A	6365615.83	1546742.77	0.63	18.00	16.35	-65.09	1.51	0.205	0.545	0.07
KLX27A	6365662.61	1546743.62	-100.02	129.00	117.00	-64.77	0.91	0.205	0.545	0.52
KLX27A	6365710.32	1546744.22	-200.24	240.00	217.22	-64.35	0.51	0.205	0.545	0.97
KLX27A	6365758.91	1546744.92	-300.04	351.00	317.02	-63.94	0.44	0.205	0.545	1.43
KLX27A	6365809.52	1546745.14	-402.19	465.00	419.17	-63.30	359.97	0.205	0.545	1.91
KLX27A	6365859.99	1546745.09	-501.05	576.00	518.03	-62.50	0.13	0.205	0.545	2.39
KLX27A	6365894.88	1546745.30	-566.94	650.56	583.92	-61.44	0.97	0.205	0.545	2.73