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Oskarshamn site investigation

Kinematic analysis of ductile and brittle/ductile shear zones in Simpevarp and Laxemar subarea

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December 2006

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Keywords: Ductile and brittle/ductile shear zones.

Abstract

This document reports the data gained by kinematic analysis of ductile and brittle/ductile shear zones in the Simpevarp and Laxemar subareas close to Oskarshamn, southeastern Sweden. The study includes field work as well as microscopy of thin-section from samples collected during field work. The study aims to determine the kinematics of shear zones of the area and to determine the stress field that ruled when the shear zones were active.

The shear zones developed under upper greenschist facies metamorphic conditions. Three main shear zones striking north-south to north-east display sinistral sense of shear. The most prominent is the Äspö shear zone. The principal strain-axis Z (minimum strain) is more or less horizontal and trend towards north-northwest (approximately 330°).

Along the Äspö shear zone the principal strain-axis X (maximum strain) is sub-horizontal and trends west (approximately 250°). In the Simpevarp subarea the shear zones are almost perpendicular to the Z-axis, steep stretching lineations occur and the X-axis is vertical. Shear zones with normal or reverse sense of shear as well as sinistral and dextral shear zones occur.

If the rock is considered to be fairly isotropic and the deformation did not include or subsequently was affected by rigid body rotation, then the strain-axis can be transferred to stress direction. The principal maximum stress σ_1 (corresponding to the Z-axis) would then be almost horizontal trending 330°.

Sammanfattning

Denna rapport presenterar data som insamlats vid undersökningar av plastiska och sprödplastiska skjuvzoner i delområdena Simpevarp och Laxemar. Undersökningarna inkluderar fältarbete såväl som mikroskopiering av tunnslip från bergartsprover insamlade under fältarbetet. Uppgiften var att reda ut kinematiken i skjuvzonerna i området, samt att bestämma det stressfält som rådde då skjuvzonerna bildades.

Skjuvzonerna har bildats under övre grönskifferfaciesförhållanden. Tre större skjuvzoner, varav en är den dominerande Äspöskjuvzonen, är sinistrala. Den maximala förkortningsriktningen (Z-axeln) är ungefär horisontell och riktad mot nordnordväst (ca 330°).

Längs Äspöskjuvzonen är den maximala sträckningsriktningen (X-axeln) flack och riktad mot väster (ca 250°). I delområde Simpevarp ligger skjuvzonerna nästan vinkelrätt mot Z-axeln. Branta lineationer förekommer och X-axeln är vertikal. Både skjuvzoner med vertikal rörelse-riktning (normal eller revers) såväl som sinistrala och dextrala skjuvzoner förekommer.

Om berget är isotropt och ingen rotation av block skett under eller efter deformationen, så kan strain-axlarna översättas till stress-axlar. Huvudstressriktningen σ_1 (motsvarande Z-axeln) blir i så fall flack och riktad mot ca 330°.

Contents

1 Introduction

This document reports the data gained by kinematic analysis of ductile and brittle/ductile shear zones in the Simpevarp and Laxemar subareas, Oskarshamn, southeastern Sweden. The study is included in the site investigation at Oskarshamn. The work was carried out in accordance with activity plan AP PS 400-05-062 (SKB internal controlling document).

The study included field work between the 22nd of August 2005 and the 1st of September 2005, where field measurements were gathered and rock samples for thin-section study were collected. Between January 2006 and June 2006 the thin-sections were analysed and the data was compiled together with the field data.

The original results have been sent to SKB and are stored in the primary database SICADA and can be traced by the activity plan number (AP PS 400-05-062).

2 Geological setting

2.1 Background

Sweden is a part of the Fennoscandian Shield which extends from the southern parts of Sweden to northern Norway and the Kola Peninsula and further to Russian Karelia in the east. The oldest parts of the Shield are located in the northeast and the rocks are then successively younger towards southwest. The rocks in the Oskarshamn region belong to the southern part of the Transscandinavian Igneous Belt (TIB). The TIB consists of large massifs of igneous rocks with ages ranging between 1.85 and 1.67 Ga /Högdahl et al. 2004/. TIB extends from Blekinge on the southern coast of Sweden to the Norwegian coast near Tromsø although it is partly covered by the Scandinavian Caledonides. The southern and southwestern parts of TIB are referred to as the Småland-Värmland Belt (SVB). It is made up by gabbroic/noritic to granitic rocks. The ages of the SVB ranges from 1.86 to 1.65 Ga and the distribution is complex, but most of the SVB rocks belong to the "TIB-1" /Larson and Berglund 1992/ and ranges from 1.81 to 1.76 Ga in age /Högdahl et al. 2004/. The Oskarshamn-Jönköping Belt (OJB), extending from Oskarshamn in the east to Jönköping in the west, consists of supracrustal and intrusive rocks of low metamorphic grade (greenschist facies). The OJB has been interpreted as a terrane accreted to the Svecofennian margin which was later reworked and intruded by continental margin TIB-1 magmatism /Åhäll and Larson 2000, Åhäll et al. 2002/.

Shear zones have been studied in a 21 km^2 large area extending 1.5 km north and south, and 7 km west of the Oskarshamn nuclear power plant. The rocks and the structures in the area and the nearby Äspö Island have been described by previous workers /e.g. Talbot and Munier 1989, Munier 1993, 1995, Wahlgren et al. 2004, 2005, Nilsson et al. 2004/.

2.2 Previous work and local geology

The rocks in the area have been described by /Wahlgren et al. 2004, 2005, Nilsson et al. 2004. The main rock types are (Figure 2-1):

- Fine-grained dioritoid.
- Ävrö granite.
- Quartz monzodiorite.

In addition to these rocks the following rocks also occur:

- Diorite/gabbro.
- Fine-grained diorite/gabbro.
- Fine-grained granite.
- Medium- to coarse-grained granite.

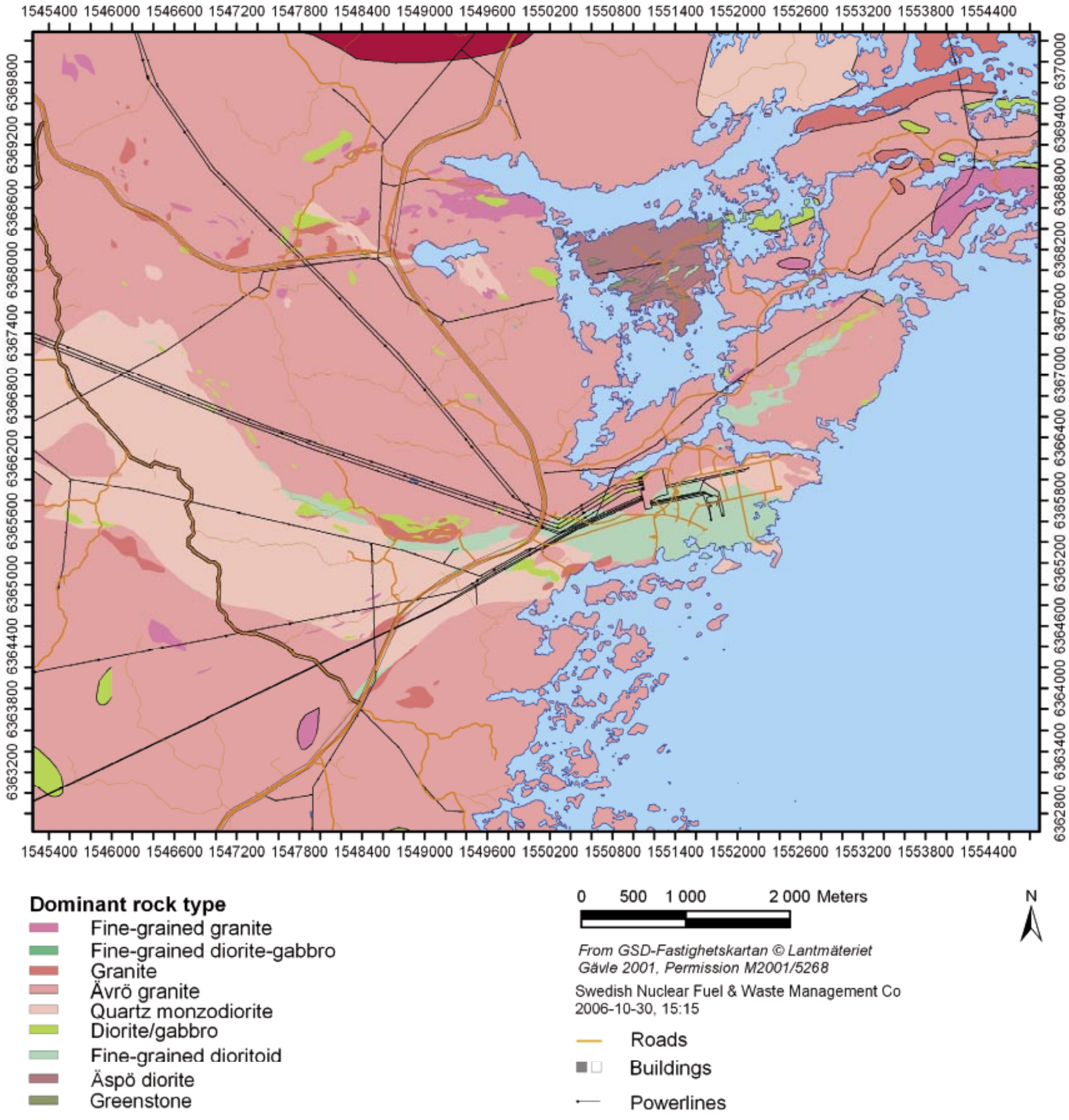

Figure 2-1. *Bedrock map of the area.*

The previous record of magma mixing and mingling and diffuse contacts between the dominant rock types have led to the conclusion that the rocks was formed more or less synchronously. A chronostratigraphy based on field observations was established by /Wahlgren et al. 2004/.

- Fine- grained granite and pegmatite. Youngest
- Fine-grained diorite/gabbro.
- Granite.
- Ävrö granite.
- Quartz monzodiorite.
- Diorite to gabbro.
- Fine-grained dioritoid. Oldest

Brittle and ductile deformation has been studied on the Äspö Island by /Munier 1993, 1995/. In these studies the earliest fabric found on Äspö was a penetrative planar foliation S_1 marked by the orientation of biotite flakes. Subsequent deformation localized and formed gneiss zones in amphibolite facies where grain size remained constant across the gneiss zones. The gneiss zones later narrowed to mylonites that formed under greenschist facies conditions. The S_1 foliation reorientated, intensified and diminished in grain size. Conjugate sets of sinistral and dextral mylonites were found and a model with a Z-axis (the minimum principal strain axis) plunging 5° towards 330° was proposed.

The bedrock in the Simpevarp and Laxemar subarea has been described as more or less isotropic with a sometimes weak foliation developing locally /Nilsson et al. 2004, Wahlgren et al. 2004, 2005/.

During the site investigation a number of deformation zones of varying thickness have been recognized. The most prominent zone is the Äspö shear zone. The Äspö shear zone is an area with high frequency of ductile shear zones. It has been suggested that the area east of the Äspö shear zone is possibly a part of a low grade ductile shear belt and that the area west of the Äspö shear zone could be considered as a tectonic lens /SKB 2006/.

3 Objective and scope

The main goal of the study was to define the kinematics of the shear zones, i.e. the sense of shear. If coeval shear zones in different orientations show different kinematics, then the prevailing stress field can be determined. This was also a goal of the study.

The study is an important complement to the study of the kinematics in brittle deformation zones, initiated in accordance with the activity plan AP PS 400-05-036 (SKB internal document) and is also a detailed complement to the observed structures from the bedrock mapping 2003 of the Simpevarp subarea /Wahlgren et al. 2004/ and the bedrock mapping 2004 of the Laxemar subarea and the regional model area /Nilsson et al. 2004/.

The study was divided into two parts. The first part was a field study, in which measurements were recorded, complemented by field notes, sketches and photos. Rock samples were also collected, for microstudies in thin-sections.

The second part of the study aimed at determining the kinematics from the thin-sections and to compile the data from the field together with the thin-section data. The combined evaluation of the field and thin-section data was then used to determine the kinematics and the presumed stress field.

4 Equipment

4.1 Description of equipment/interpretation tools

The following equipment was used during field work and post processing:

- Bedrock geological map, Simpevarp-Laxemar subareas at the scale 1:10,000 with added outcrops displaying ductile shear zones and/or mylonitic texture /Nilsson et al. 2004, Wahlgren et al. 2005/.
- Magnetic anomaly maps.
- Garmin GPS.
- Hammer.
- Silva compass with clinometer.
- Digital camera.
- Magnifying lens.
- Field notebook.
- Hired car for transportation.
- Microscope for thin-section study.
- Microscope with digital camera equipment.

5 Execution

5.1 General

The study included field investigations of ductile shear zones in the Simpevarp and Laxemar subareas, as well as microscopy study of thin-section from rock samples, collected during field work. The outcrops were selected in consultation with Carl-Henric Wahlgren, Katarina Persson Nilsson and Torbjörn Bergman, SGU. No nonconformities with respect to the activity plan have been noted.

5.2 Execution of field work

Outcrops, displaying ductile deformation and/or mylonitic texture, observed during the bedrock mapping /Wahlgren et al. 2004, Nilsson et al. 2004/, were marked on a bedrock map at the scale of 1:10,000. The coordinates of the observation points were put together in a table, and the most interesting outcrops were marked. A GPS was used for easy localization of the outcrops. 22 of the known observation points and 36 new observation points were visited. Some of the new observations were made on large outcrops with many observation points in the same outcrop. Coordinates were recorded for all points. Most of the totally 58 observation points were localized on the Simpevarp peninsula and along the Äspö shear zone. The GPS instrument was not calibrated. The accuracy of the coordinates of the observation points is therefore unknown. In each observation point, as many as possible, or necessary, of the following measurements/observations were recorded:

- Strike and dip of foliations.
- Trend and plunge of lineations (stretching lineation, intersection lineation or unknown lineation were separated).
- Strike and dip of shear zones.
- Strike and dip of shear bands.
- Strike and dip of dykes.

These measurements together with field notes, sketches and photos made up the macroscopic data collected during field work. 27 rock samples were also collected, for thin-section preparation. Most of the samples were orientated, which is necessary for transferring the kinematics in thin-section to a map-view.

5.3 Thin-section analysis and post processing

The thin-sections were described with respect to mineral composition, texture and kinematics. The kinematics could not be seen in all samples. Some of the samples were not orientated and some of the samples came from undeformed rocks (Figure 5-1). Photos of the microstructures were also taken. Descriptions of the thin-sections were made in free text.

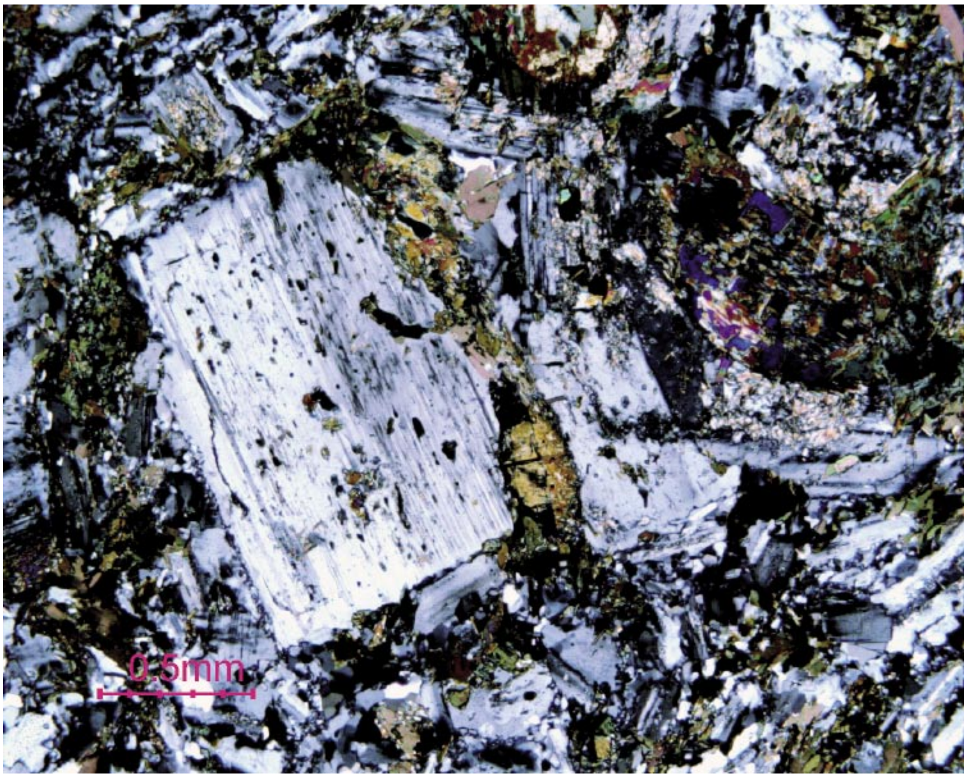

Figure 5-1. *Microphoto of undeformed fine-grained dioritoid in the Simpevarp subarea (crossed nicols). Plagioclase phenocrysts in a fine grained matrix.*

Field data was grouped into five tectonically homogeneous areas. The areas were based on the different deformation zones visible on the magnetic anomaly map and referred to as Area 1, 2, 3, 4 and 5 (Figure 5-2). Note that Area 5 includes the Hålö and Ävrö islands and that the area consists of an array of shear zones.

Mineralogy, texture and eventual kinematic indicators were recorded in all thin-sections. Kinematic data were then compared and integrated with field observations. Also unoriented thin sections from undeformed rocks were analyzed to define the mineralogy and texture of the protolith. Descriptions of the thin sections were documented in free text and the microstructures by optical microphotography.

5.4 Interpretations

Standard techniques were used to determine the direction of movement and the sense of shear, both in the field and under the microscope. These techniques and a thorough description of different shear sense indicators are presented in /Passchier and Trouw 2005/. Stereograms were made using Stereonet for Windows v. 1.2 by Richard W. Allmendinger 2002–2003. Strain-axis were determined based on the geometry of shear zones described in /Passchier and Trouw 2005/.

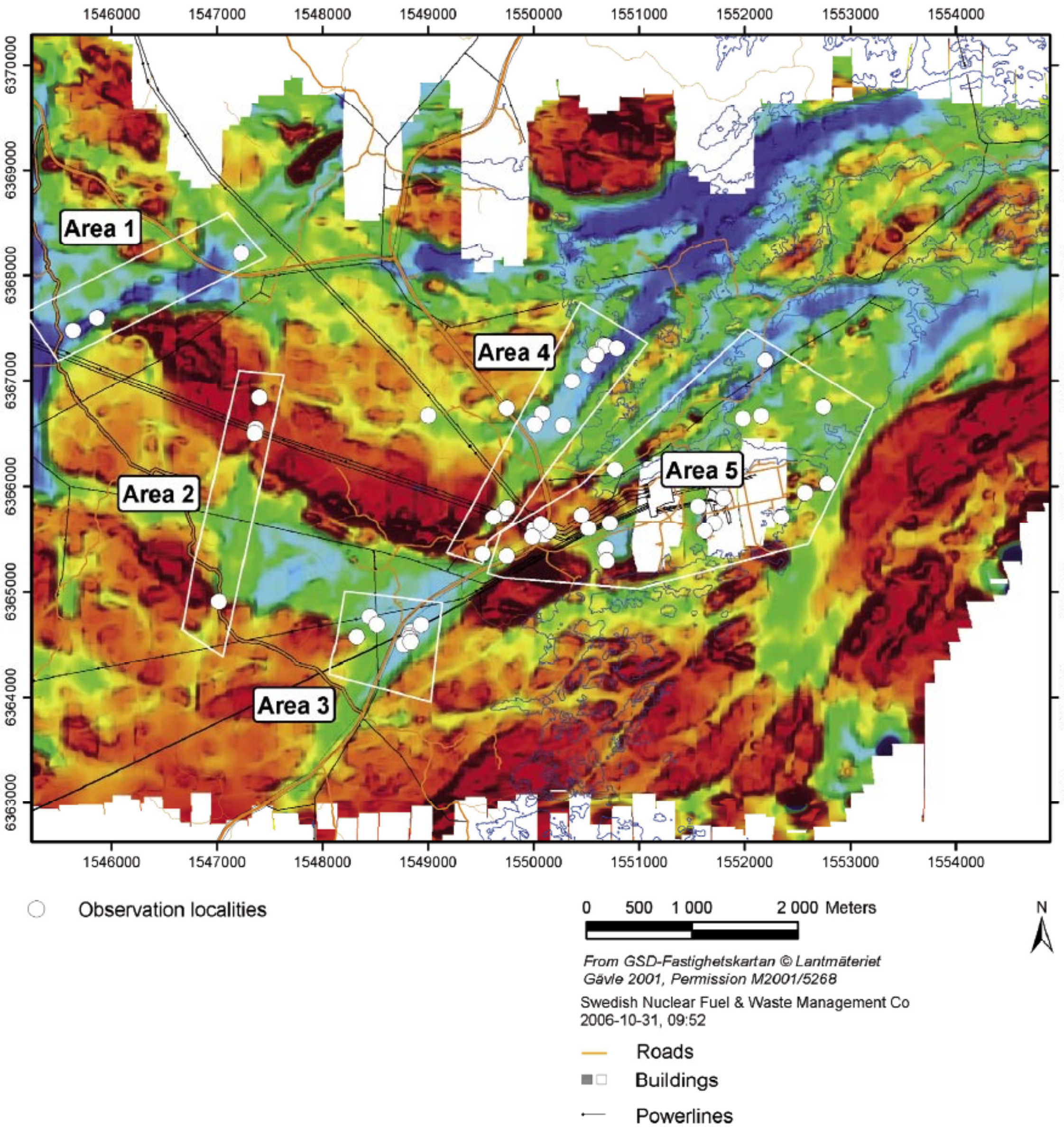

Figure 5-2. *Magnetic anomaly with the tectonically homogeneous areas marked.*

6 Results

6.1 Field observations

The five tectonically homogeneous areas are treated separately. All field data are presented in Appendices A and B. Most observations are located along the Äspö shear zone corresponding to Areas 3 and 4 and on the Simpevarp peninsula including Hålö and Ävrö corresponding to Area 5.

Area 1

Area 1 is situated in the northwest most part of the Laxemar subarea. It includes only three observation points, one of which is a likely breccia zone. The other two are from pervasive banded shear zones, one metre to a few metres wide. Around one of the zones, tens of metres of surrounding rocks are affected by deformation and a strong east-west foliation with unspecified dip occurs. All shear zones plot in the same part of the stereogram (Figure 6-2) and the main shear zone strikes approximately 60°. Two shear zones display sinistral sense of shear.

Figure 6-1. *Banded shear zone on a vertical surface facing northeast in Area 1.*

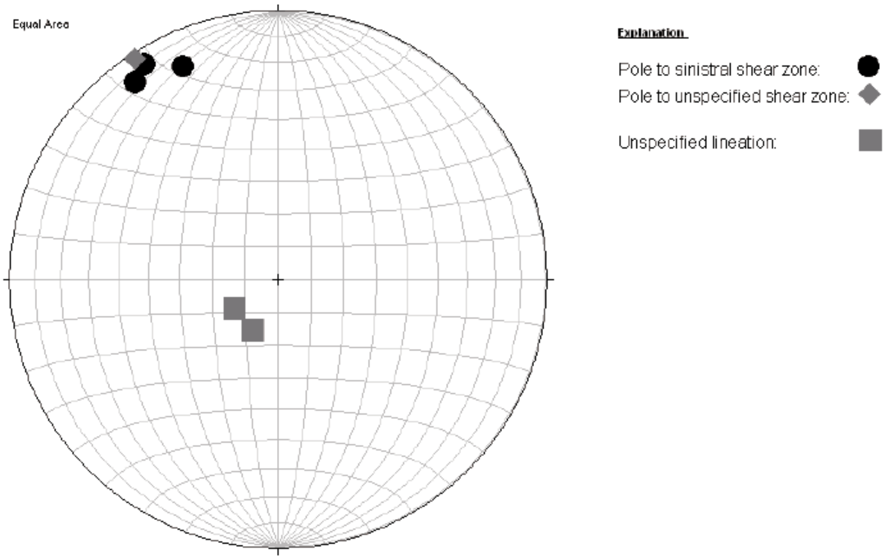

Figure 6-2. Distribution of shear zones and lineations in Area 1. Lower hemisphere of Schmidt equal area, stereographic plot.

Area 2

Area 2 is situated in the central part of the Laxemar subarea (Figure 5-2). It only includes four observations but the data is quite uniform. The main zone strikes approximately 10° and the zone is not very distinct on the magnetic anomaly map. The dominating rock types are Ävrö granite and quartz monzodiorite. The shear zones are thin and rich in epidote or wider and fractured.

The shear zones are sinistral or with unspecified sense of shear and poles to all shear zones plot in the same part of the stereogram. One observation of two uncertain lineations has been made. The stretching lineation is probably gently dipping and the intersection is probably steep (Figure 6-3). If so this would indicate horizontal movement.

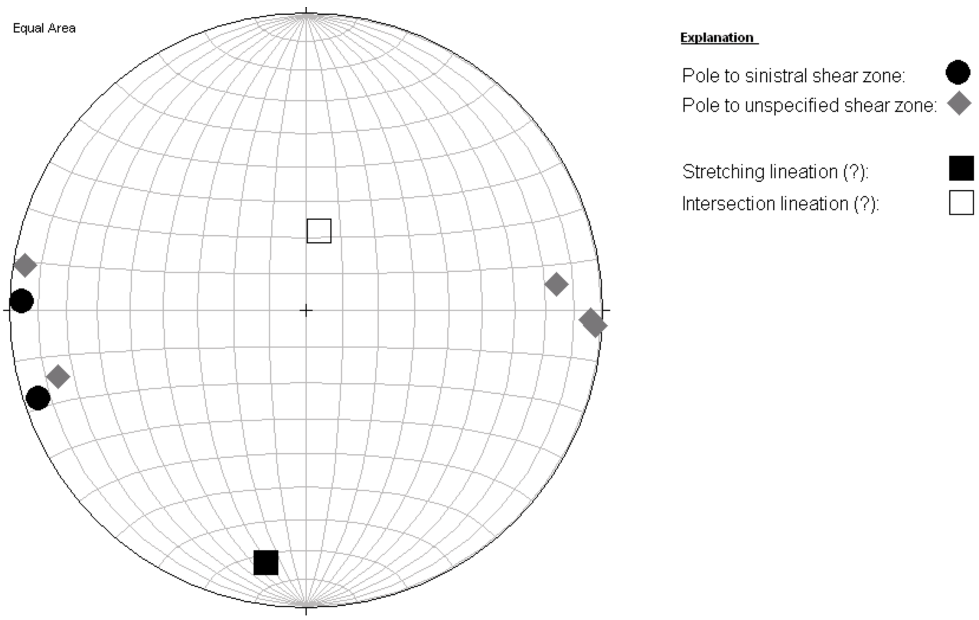

***Figure 6-3**. Distribution of shear zones and lineations in Area 2. Lower hemisphere of Schmidt equal area, stereographic plot.*

Area 3

Shear zones in the southern part of the Äspö shear zone often displays distinct kinematic indicators. Large parts of the surrounding quartz monzodiorite are affected by the deformation and a strong foliation that formed close to the shear zones reveal the sense of shear based on the rotation and orientation of the newly formed foliation (S) compared to the shear zone (C) (Figure 6-4). Also shear bands have formed locally and can be used to determine the sense of shear.

Sinistral and dextral shear zones are well separated in the stereogram and the poles to all unspecified shear zones plot among the sinistral group (Figure 6-6). The main zone on the magnetic anomaly map strikes approximately 35° and also plot among the poles to the sinistral shear zones in the stereogram.

Fine-grained granite dykes cut by shear zones and also boudinaged dykes exist in the area. Boudinage appears to be more frequent and more mature in a horizontal section than in a vertical section. Stretching lineations are shallow plunging and intersection lineations plunges steeply as well as intersections between sinistral and dextral shear zones and intersections between sinistral and dextral shear bands (Figure 6-7). This condition indicates that mainly horizontal movement has occurred and also that the development of boudinage and stretching lineation was coeval. The axis of rotation of S (if formed due to the shear) will be perpendicular to the stretching lineation, i.e. parallel to the intersection lineation (Figure 6-4).

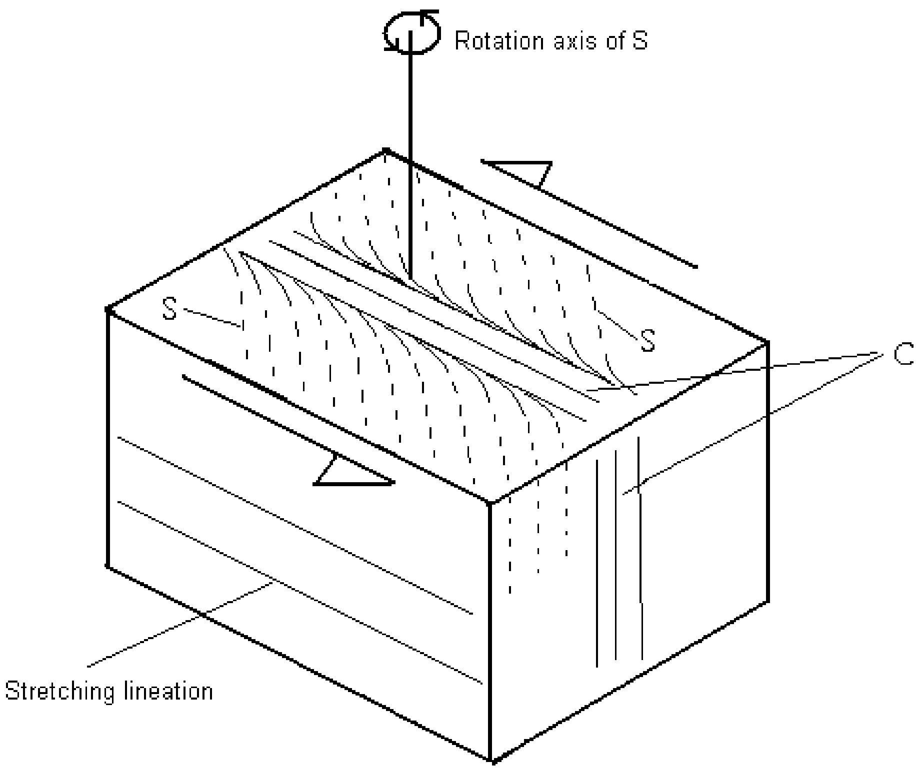

Figure 6-4. *Sketch showing rotation of foliation (S) compared to a mylonite surface (C).*

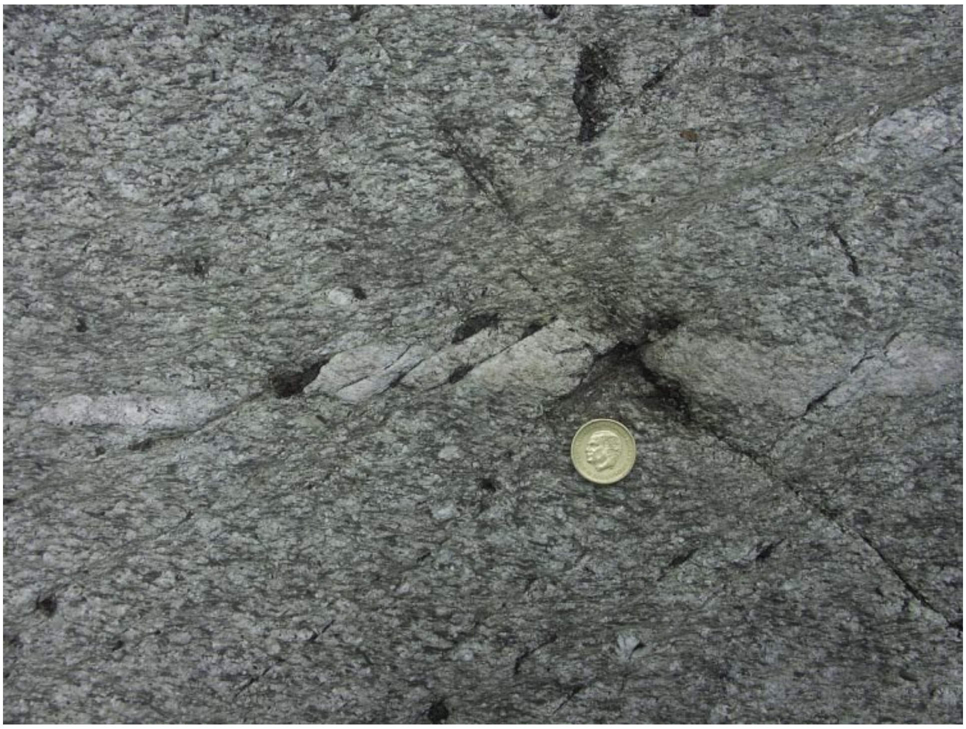

Figure 6-5*. Sinistral shear zone (upper right-lower left) with shear bands in quartz monzodiorite in Area 3. A fine-grained granite dyke is displaced by the shear zone. North is down in picture on a horizontal surface.*

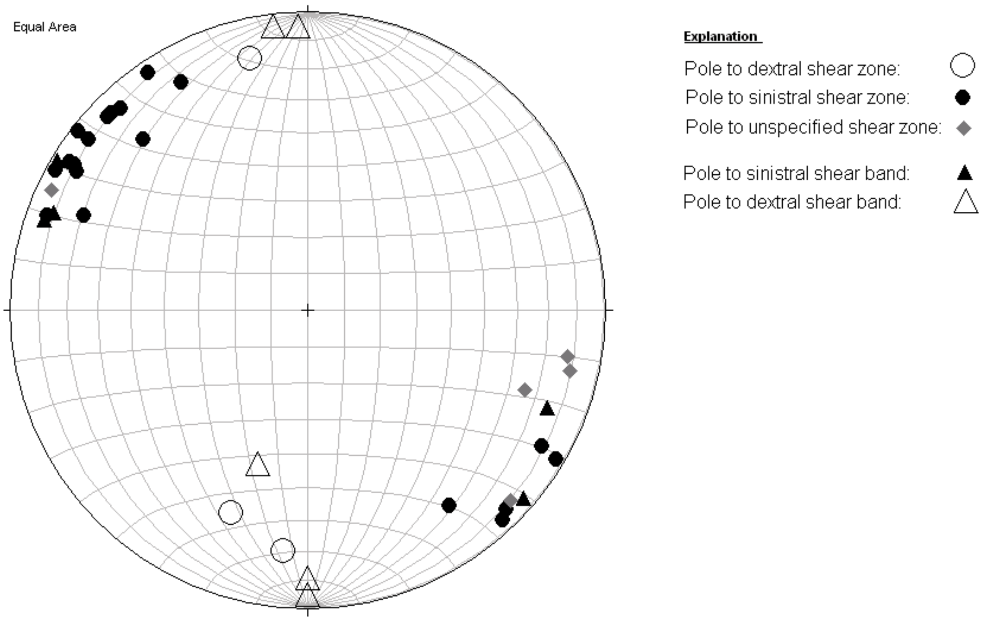

Figure 6-6. *Poles to shear zones and shear bands in Area 3. Lower hemisphere of Schmidt equal area, stereographic plot.*

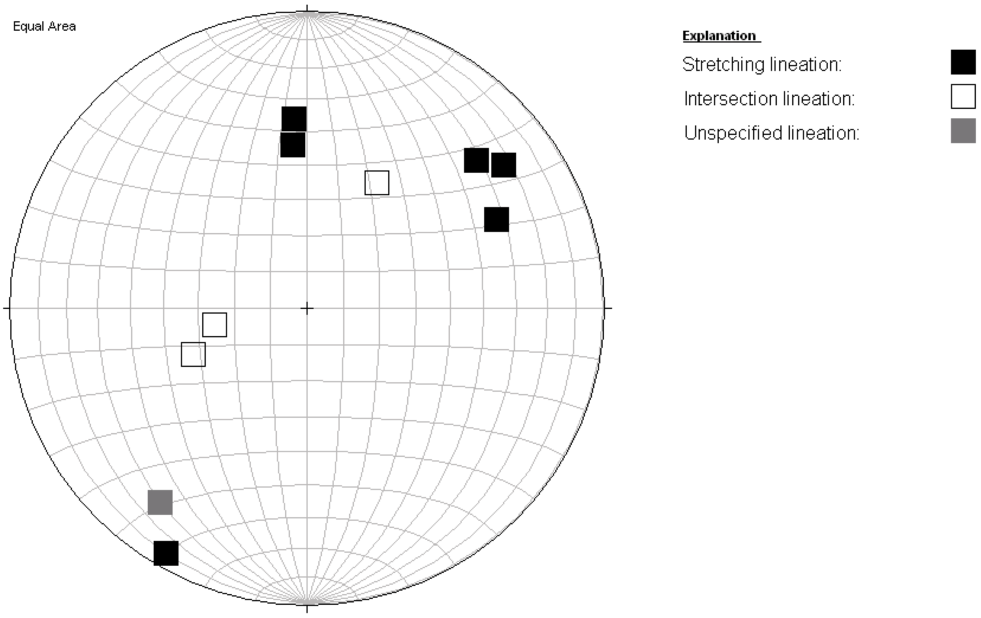

Figure 6-7. *Lineations in Area 3. Lower hemisphere of Schmidt equal area, stereographic plot.*

Area 4

The shear zones in the northern part of the Äspö shear zone are often thin, less than a meter wide, and considerably fractured due to reactivation. Strain is very much localized and the surrounding rock (most often Ävrö granite) is not much affected. Sheared fine-grained granite dykes are also common. It can be difficult to see with the naked eye, whether the dykes are sheared or not due to the low content of dark minerals and their originally small grain size. Most of the measured zones are sinistral but one dextral conjugate shear zone has also been found.

Figure 6-8. *Thin shear zone in an otherwise almost unaffected Ävrö granite. North is to the bottom left corner on a horizontal surface.*

Sinistral and dextral shear zones are well separated and the poles to all shear zones with unknown kinematics plot among the sinistral group in the stereogram (Figure 6-10). This is also the case for the main zone on the magnetic anomaly map striking approximately 30°.

Lineations are poorly developed but at least two stretching lineations have been found. The stretching lineations are plunging gently towards southeast and an intersection lineation is steep indicating dominantly horizontal movement in the shear zone (Figure 6-3). This assumption is based on the general condition that shear bands (C') ideally intersect the shear surface (C) approximately perpendicular to the shear direction (stretching lineation) (Figure 6-9).

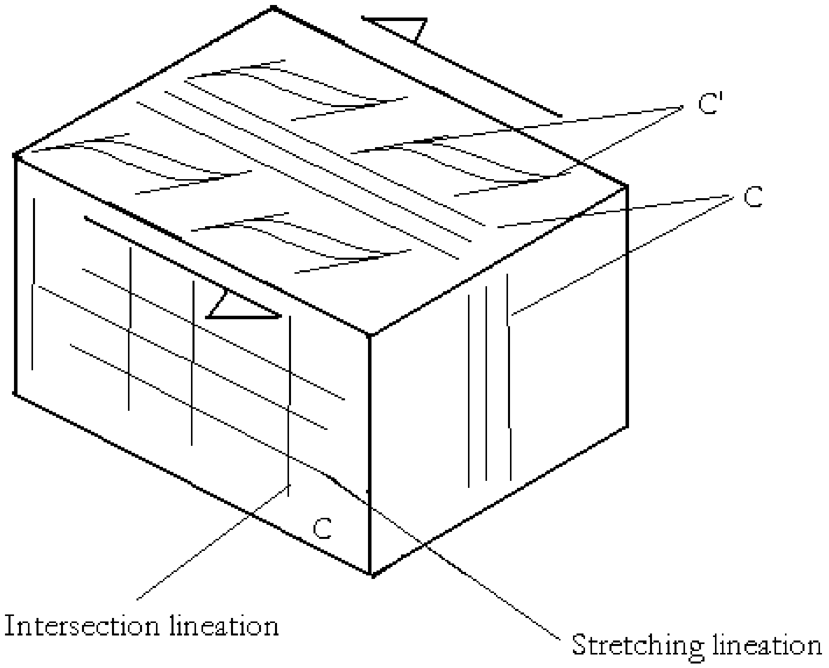

Figure 6-9. *Sketch showing the principal relationship between mylonite surface C, shear bands C' and stretching and intersection lineation.*

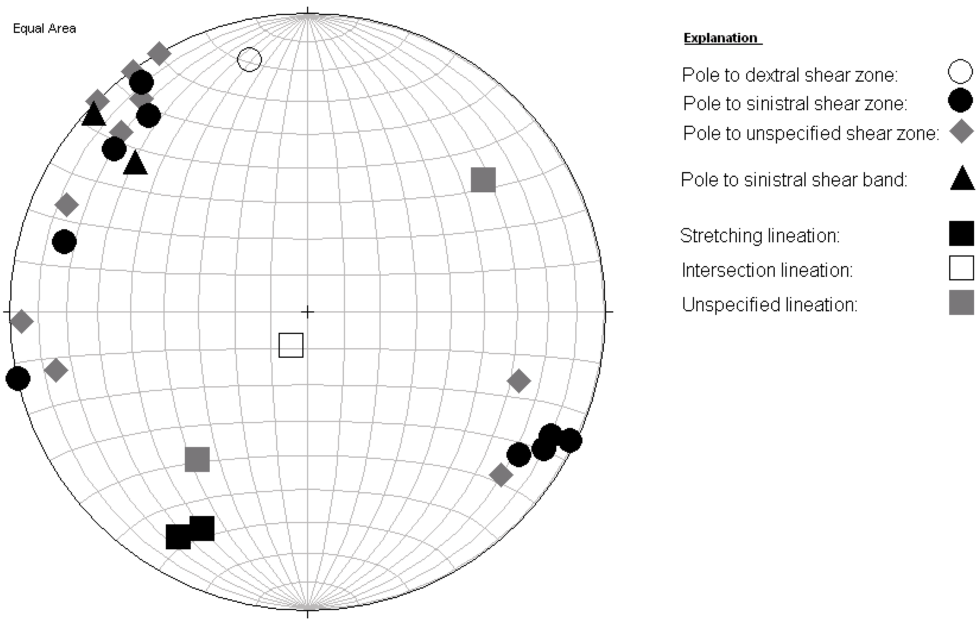

Figure 6-10. *Distribution of shear zones, shear bands and lineations in Area 4. Lower hemisphere of Schmidt equal area, stereographic plot.*

Area 5

Area 5 comprise the Simpevarp peninsula, Hålö and Ävrö islands. It exhibits a spectrum of shear zones rather than a main zone. Strikes range from 40° to 80° and the kinematic picture is more complex than in the other areas. The bedrock in Area 5 is dominated by fine-grained dioritoid or Ävrö granite. Many different types of shear zones occur. Some zones are thin and rich in epidote and other are wider with platy quartz and feldspar porfyroclasts. It is often difficult to see the sense of shear. Some shear zones occur in the contact between dioritoid and fine-grained granite dykes. These shear zones follow the direction of the dyke and can be sinistral or dextral. As they appear to have formed when the dykes rotated during deformation, the kinematic is dependent on the sense of rotation of the dyke.

Sinistral, dextral and shear zones with unknown kinematics plot within the same broad area in a stereogram (Figure 6-12). Some steep lineations have been found, but intersection lineations and unspecified lineations occur within a rather wide range (Figure 6-13). The steep stretching lineations indicate that vertical movements have occurred. On the other hand a few shear bands have been found and the dextral and sinistral shear bands are well separated in a stereogram (Figure 6-12). The constructed intersection between the sinistral and dextral shear bands is steep and this indicates horizontal movement. Clearly both shear zones with normal and reverse as well as sinistral and dextral sense of shear exists within Area 5.

Figure 6-11. *Thin shear zone with epidote. North is to the bottom right corner. Horizontal surface.*

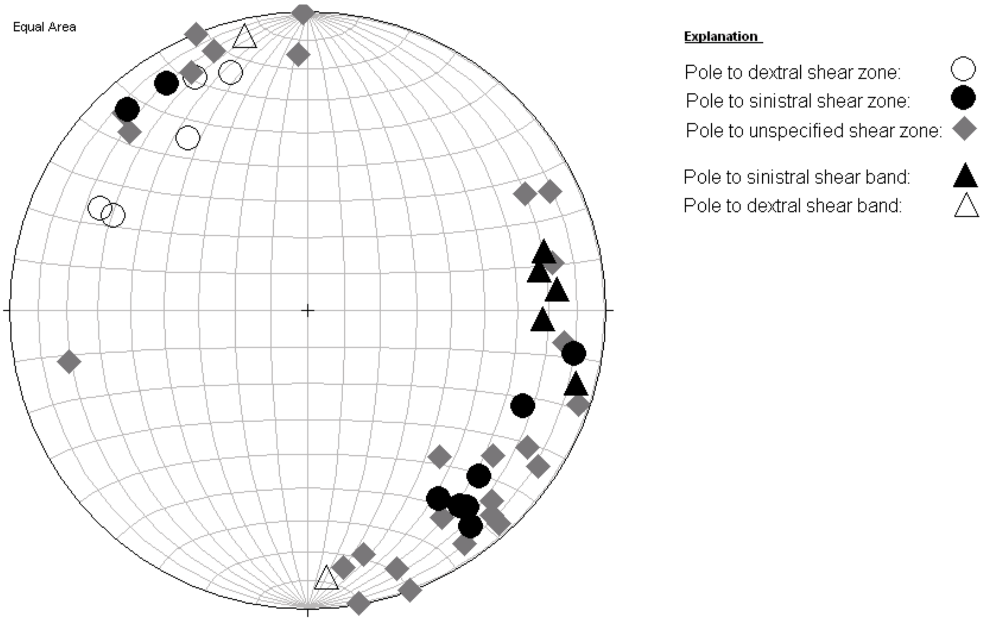

Figure 6-12*. Poles to shear zones and shear bands in Area 5. Dextral shear bands from PSM005771 and sinistral shear bands from PSM007756. Lower hemisphere of Schmidt equal area, stereographic plot.*

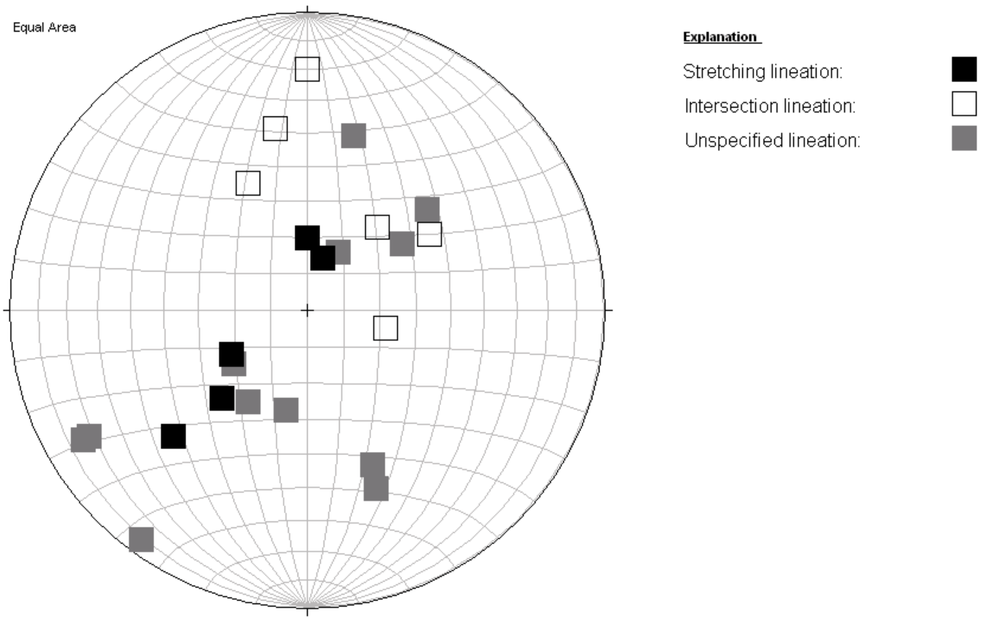

Figure 6-13. *Lineations in Area 5. Lower hemisphere of Schmidt equal area, stereographic plot.*

Foliations

The foliations are measured close to the shear zones and probably formed at the same time as these. If there was an earlier foliation in the bedrock, that foliation was probably faint and has been rotated and overprinted by the new strong foliation visible close to some of the shear zones. The foliation formed orthogonal to the direction of shortening and the poles to the foliation will therefore be a good estimate of the direction of shortening (Figure 6-14). The spreading of poles along the great circle reflects the rotation of the foliation by the shearing.

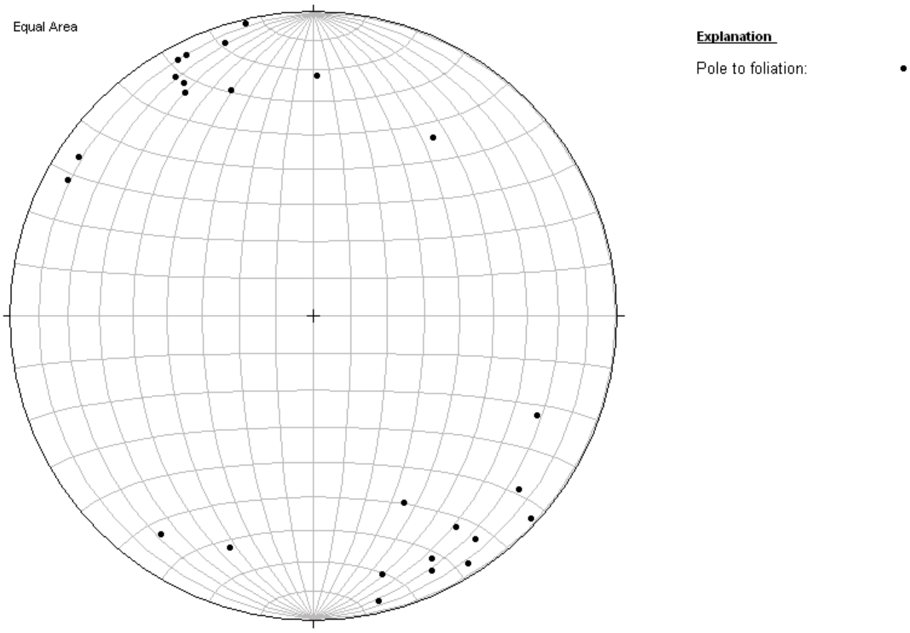

Figure 6-14. *Poles to foliations from Areas 1 to 5. Lower hemisphere of Schmidt equal area, stereographic plot.*

6.2 Fine-grained granite dykes

The orientations of fine-grained granite dykes are shown in Figure 6-17. Some of the dykes appear to have rotated during deformation, especially dykes in Area 5. Dykes in Area 4 have been affected by ductile deformation and the dykes in Area 3 are sometimes cut by shear zones and sometimes boudinaged (Figure 6-15 and 6-16). Locally in Area 3 unfoliated granite intrudes within a shear zone in quartz monzodiorite and also truncates the shear fabric. Thus granitic dykes have formed both before and after shearing. Most likely there is a close relationship between shearing and dyke emplacement.

Figure 6-15. *Fine-grained granite dyke cut by sinistral shear zone. North is to the bottom left corner. Horizontal surface. Area 3.*

Figure 6-16. *Fine-grained granite dykes boudinaged in a shear zone. North is to the bottom left corner. Horizontal surface. Area 3.*

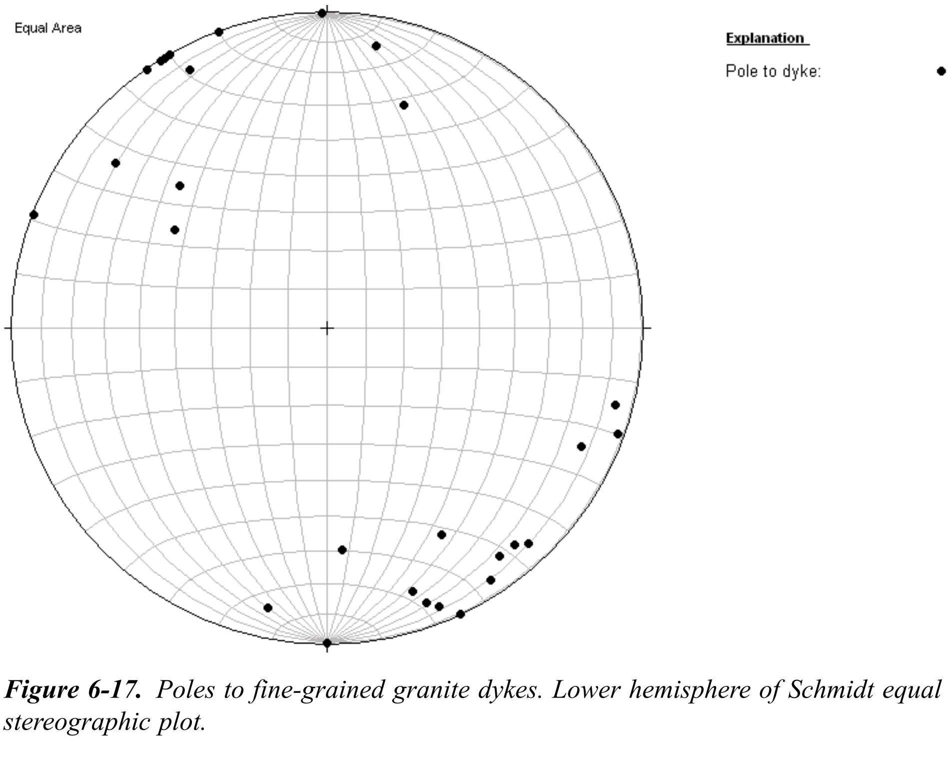

Figure 6-17. *Poles to fine-grained granite dykes. Lower hemisphere of Schmidt equal area, stereographic plot.*

6.3 Thin-section analysis

Mineralogy

The sheared samples are dominated by the following minerals: Quartz, feldspar, mica, chlorite, epidote and calcite. Other minerals found in small amounts or as accessory minerals are: Amphibole, perthitic feldspar, titanite, apatite, garnet, zircon and opaque phases.

Undulouse extinction and subgrains form in quartz crystals and also bulging recrystallisation occurs. Subgrain rotation recrystallisation is the dominating recrystallisation mechanism and this indicates low to medium grade conditions 400–500°C /Passchier and Trouw 2005/. Ribbon quartz, which indicates medium to high metamorphic conditions (400–600°), occurs in some samples from the Södra Laxemar and the Nordvästra domain. Feldspars deform mainly by brittle fracturing, which indicates temperatures below 400° /Passchier and Trouw 2005/. Grain scale faults, bent or kinked cleavage planes or twins are common and indicates temperatures from 400° to 500° /Passchier and Trouw 2005/. In some samples core-and-mantle structures are visible. The latter develops in the temperature range 450–600° /Passchier and Trouw 2005/.

Micas, chlorite and epidote form during deformation and often define a foliation together with elongated quartz aggregates. Chlorite and epidote occur also as later fracture filling. Calcite occurs as fracture filling but is also common as small aggregates in the matrix. Crystals of titanite with a fine grained rim of new small crystals were found in some samples. These new titanite crystals could be dated with U-Pb dating and used to determine the age of the shear zone.

Alterations

Feldspar is often altered to sericite or saussuritized. This alteration occurs both in deformed and undeformed rock samples. Other alterations are chloritization of amphibole and of biotite. Red staining alteration has been observed in the field and is visible on some rock samples, but has not been studied under the microscope.

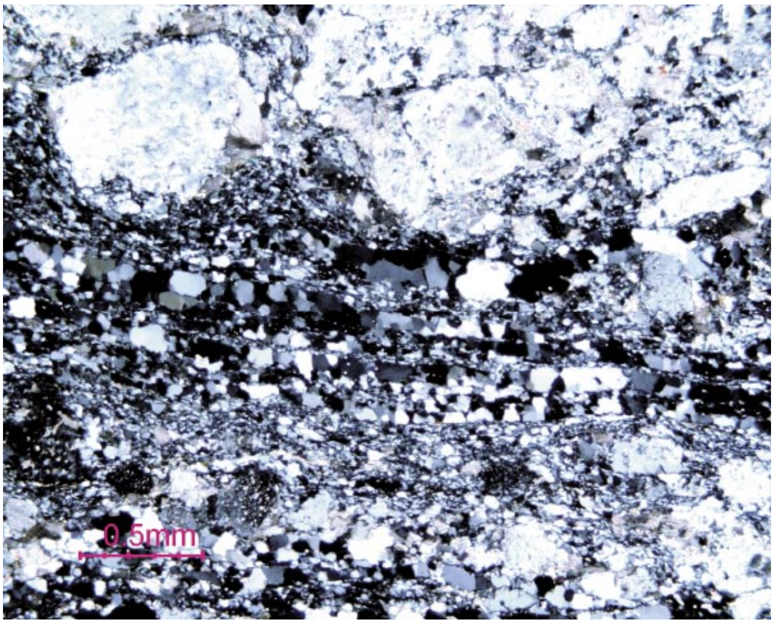

Figure 6-18. *Recrystallised quartz ribbons in the centre. In the top right there is a fractured feldspar porfyroclast and in the top left there is a core-and-mantle feldspar porfyroclast. Thin-section photo from Area 3 (crossed nicols).*

Kinematic analysis

In Table 6-1 the results from the kinematic analysis of thin-sections is presented. The results are also presented in stereogram (Figure 6-19).

The sense of shear in thin sections was determined based on different shear sense indicators. An S/C-fabric of mica or chlorite was common and sometimes an S/C-fabric occurred formed by subgrains in quartz elongated oblique to the mylonite foliation. In Area 5 the mylonite foliation sometimes formed an array and in some thin sections there were both north up and south up zones in vertical sections.

Table 6-1. Results of kinematic analysis of thin-sections.

Area	Sample	Kinematics in thin section	Kinematics on map-view	Strike and dip of shearzone (RHR)
Area 2	EL0515 (PSM007769)	Sinistral	Sinistral	9/86
Area 4	3855 (PSM003855)	Dextral	Sinistral	44/76
Area 4	4133 (PSM004133)	Sinistral	Dextral	~70/90
Area 4	4137A (PSM004137)	Dextral	Sinistral	60/90
Area 4	4137B (PSM004137)	Dextral	Sinistral	60/90
Area 4	4137C (PSM004137)	Not enough deformation		
Area 1	4153 (PSM004153)	Not enough deformation		
Area 1	6088A (PSM006088)	Dextral	Sinistral	58/84
Area 1	6088B (PSM006088)	Undeformed sample		
Area 5	3314 (PSM003314)	Sinistral	Dextral	212/76
Area 5	3787 (PSM003787)	Sinistral/dextral	East up/west up	214/83
Area 5	5081 (PSM005081)	Sinistral	Sinistral	47/80
Area 5	5776 (PSM005776)	Dextral	Sinistral	60/80
Area 5	5806 (PSM005806)	Not orientated		
Area 5	5821 (PSM005821)	Sinistral/dextral	North up/south up	257/73
Area 5	5843 (PSM005843)	Undeformed sample		
Area 5	5864 (PSM005864)	Sinistral	South up	100/60
Area 5	5768A (PSM005768)	Sinistral/(dextral)	South up/(north up)	245/76
Area 5	5768B (PSM005768)	Not enough deformation		
Area 5	EL0518 (PSM007772)	Undeformed sample		
Area 3	4085A (PSM004085)	Sinistral	Sinistral	200/67
Area 3	4085B (PSM004085)	Sinistral	Sinistral	217/62
Area 3	EL0505A (PSM007759)	Sinistral	Sinistral	50/85
Area 3	EL0505B (PSM007759)	Not enough deformation		
Area 3	EL0506 (PSM007760)	Sinistral	Sinistral	42/86
Area 3	EL0507 (PSM007761)	Sinistral	Sinistral	29/87
Area 3	EL0519 (PSM007773)	Undeformed sample		

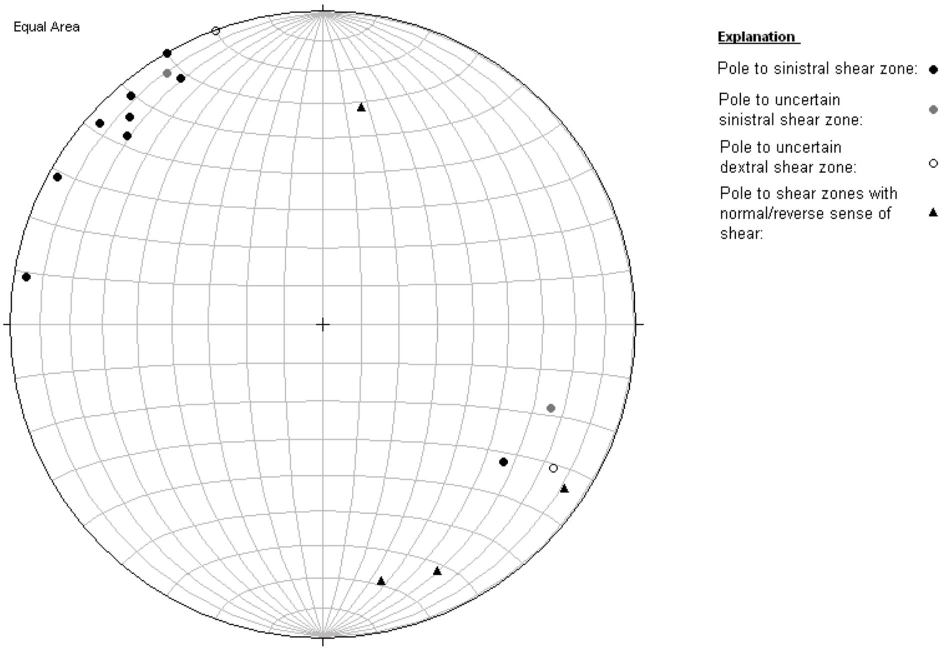

Figure 6-19. *Poles to shear zones analysed in thin-section regarding sense of shear. Lower hemisphere of Schmidt equal area, stereographic plot.*

Figure 6-20. *Mylonite foliation (upper left-lower right) truncated by subhorizontal shear zones resulting in a sinistral S/C-fabric. Thin section photo from Area 5 (parallel nicols). Vertical section.*

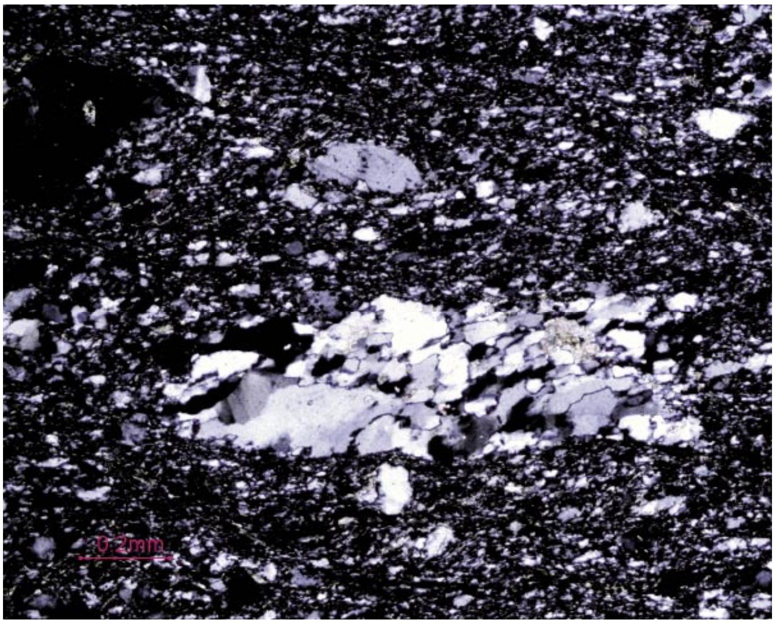

Figure 6-21. *Subgrains in quartz showing a preferred shape orientation oblique to the mylonite foliation (left to right) resulting in a dextral S/C-fabric. Thin-section photo from Area 4 (crossed nicols).*

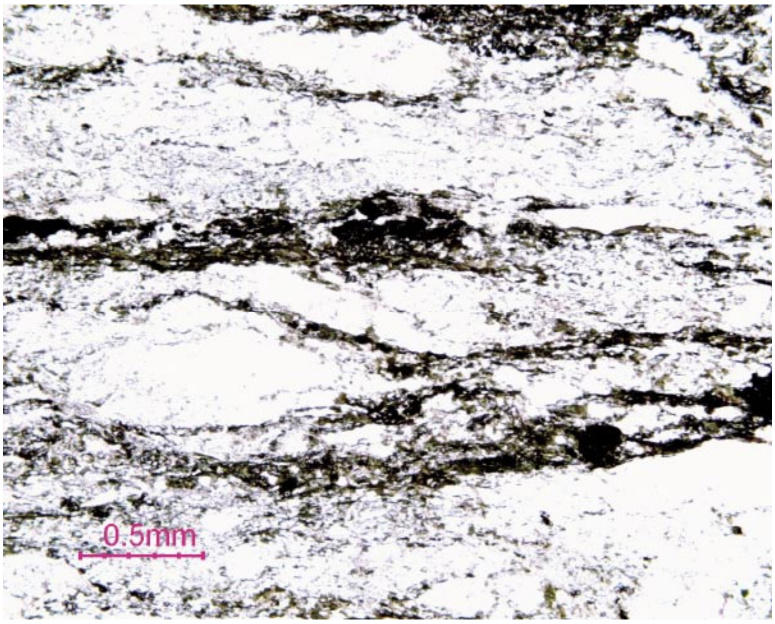

Figure 6-22. *Sinistral shear pod in the central part of a thin-section from Area 3 (parallel nicols).*

6.4 Strain-axis orientation

The principal strain-axes X, Y and Z (X corresponding to maximum strain and Z to minimum strain) were determined for the three observation points where both sinistral and dextral shear zones were recorded. Strain-axes were also determined for the three domains where both sinistral and dextral shear zones occurred. The strain-axes are presented in Table 6-2 and also in a stereogram (Figure 6-23). The Z-axis is very consistent in all areas. The average minimum strain direction plunges 3° towards 327°. The X-axis varies but is generally more or less horizontal along the Äspö shear zone (Areas 3 and 4) and steep in Area 5.

Table 6-2. Results of strain-axis orientation.

Area	X	Y	Z
Area 4	53/18	209/71	320/8
Area 3	248/22	59/68	157/3
Area 5	0*/90	229/0	319/0
Area 3 (PSM007760)	255/28	58/60	160/8
Area 3 (PSM007761)	57/9	184/75	325/11
Area 4 (PSM007765)	52/11	186/75	320/10

* Any trend possible since the plunge is 90°.

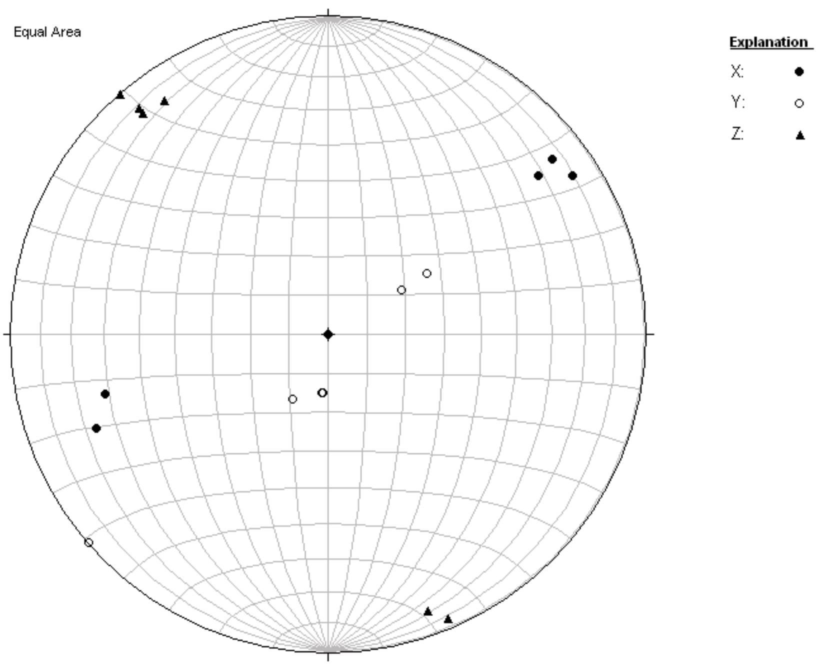

Figure 6-23. *Strain-axes orientations. Lower hemisphere of Schmidt equal area, stereographic plot.*

7 Summary and discussion

Mineralogy

A mineral assemblage of quartz, feldspar, chlorite, epidote, mica and calcite is common in most samples from shear zones. Subgrain rotation recrystallisation is the dominating deformation mechanism in quartz. The mineral assemblage and the deformation mechanism suggest that deformation took place under upper greenschist facies conditions. The conditions appear to be similar in all studied samples.

Strain-axis orientation and kinematics

The principal strain-axis Z (shortening) is more or less horizontal and trends north-northwest (approximately 330°). The orientation of Z is supported both by individual locations, larger domains and the overall foliation developed close to shear zones. Previous work in Äspö has also suggested a north-north westerly direction of minimum strain /Munier 1993, 1995/.

The Äspö shear zone, corresponding to Area 3 and 4, is sinistral as recorded both in field and in thin sections from rock samples. Shallow plunging stretching lineations and steep, constructed and observed, intersections as well as the shear related foliation rotating around a steep axis suggests that dominantly horizontal movements have occurred.

In Area 5 (including Simpevarp, Hålö and Ävrö) the main shear zones strikes between 40° and 80° and the angle between the shear zones and the Z-axis is high, between 70° and 110°. This high angle, around 90°, results in a substantial component of shortening across the shear zones. The steep stretching lineations in this area indicate that this shortening was accommodated by reverse or normal kinematics. This is supported by thin-sections showing both normal and reverse movements. In the field both sinistral and dextral as well as normal or reverse shear zones were found. The varying kinematics in Area 5 indicates a more complex evolution in this area. As there is not evidence of reactivation of shear zones or that younger zones truncate older zones, the complexity is most likely due to different conditions in shear zones with different orientations with respect to the principal strain axes of the area. Depending on orientation, strain may theoretically vary from simple shear (non-coaxial strain) to pure shear (coaxial strain) with a range of general shear in between. The orientation of the stretching lineation will vary depending on the proportion of pure shear and simple shear in the general shear.

In Area 2 the main shear zone strikes north-south. Field observations and thin section analysis suggest sinistral sense of shear and probably mostly horizontal movement. Although there is sparse data from this zone, the data is uniform and fit well into the overall picture.

The main shear zone in Area 1 strikes approximately 60°. The angle between the Z-axis and the shear zone is therefore approximately 90°. This would suggest mostly vertical displacement. Field observations and thin section analysis suggest a sinistral sense of shear. Close to the shear zone there is a strong east-west foliation which might indicate a slightly more north-south direction of minimum strain (shortening) in this area.

The shear zones are presented in rose diagrams, with the Z-axis added, on the magnetic anomaly map (Figure 7-1). Arrows indicating sense of shear are also shown, except for Area 5 where vertical movement is dominating.

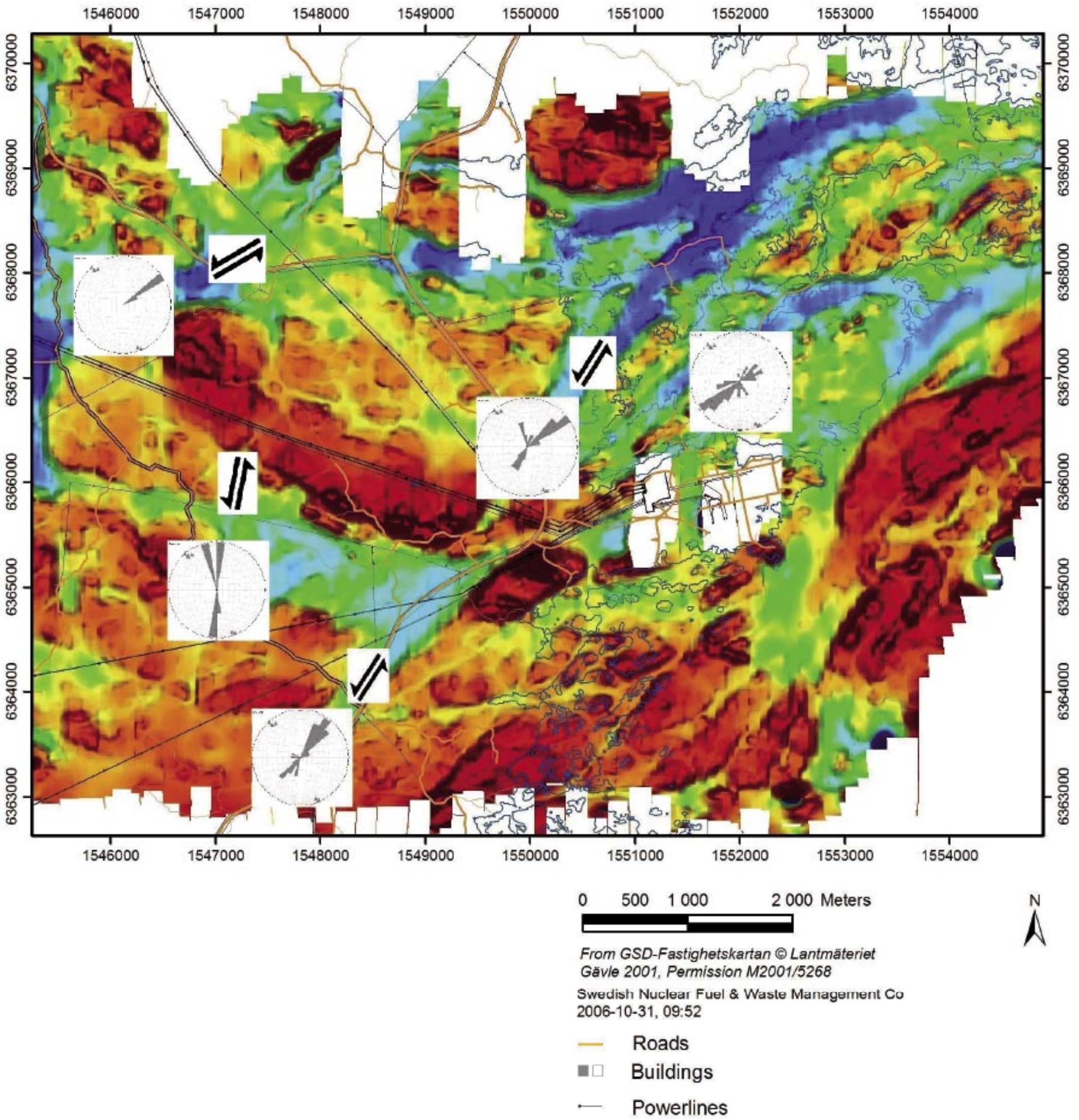

__Figure 7-1.__ Rose Diagram displays shear zone orientations and arrows indicate sense of shear. A stereonet projection of the Z-axis is added to the Rose Diagram.

Stress field

The paleostress cannot be directly observed in any rock of considerable age as the stress is not preserved. However the effects of stress states recorded as strain is possible to decipher and can be converted to orientation of principal stress axes assuming that no rigid body rotation affected the part of the crust studied and that the rock is homogenous. In the study area, conditions to define the strain axes (and to derive the paleostress orientation) are very favourable. The rock compositions are fairly homogenous in particular the granites and the quartz monzodiorites, and the rocks have not been affected by multiple, pervasive deformations. The Z-axis is therefore assumed to correspond to σ_1 (approximately plunging 3° towards 327°), the X-axis to correspond to σ_3 (approximately plunging 2° towards 61°) and the Y-axis to σ_2 (approximately plunging 70° towards 211°). In Area 5 (Simpevarp subarea) σ_3 plunges 90° (any trend possible) and σ_2 plunges 0° towards 229°.

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Appendix A

Field table

Abbreviations

SIN. SH.B	–	Sinistral shear bands.
SIN. SH.Z	–	Sinistral shear zones.
DEX. SH.B	–	Dextral shear bands.
DEX. SH.Z	–	Dextral shear zones.
OTHER SH.Z	–	Shear zones with unspecified kinematics.
STRETCHING LIN.	–	Stretching lineations.
INTERS. LIN.	–	Intersection lineations.
OTHER LIN.	–	Unspecified lineations.
DYKES	–	Fine-grained granite dykes.

AREA	ID_CODE	NORTHING	EASTING	SAMPLE	PHOTOS	FOLIATIONS	SIN. SH.B	SIN. SH.Z	DEX. SH.B	DEX. SH.Z	OTHER SH.Z	STRETCHING LIN.	INTERS. LIN.	OTHER LIN.	DYKES
AREA 5	PSM003314	6366158	1550770	3314		220/78					212/76	227/38	15/39	216/5	
AREA 5	PSM003787	6365576	1550148	3787	IMGP4363			232/72			214/83	28/72			
AREA 5	PSM003792	6365645	1550071					235/88				235/12			227/83
NOT IN AREAS 1–5	PSM003823	6366736	1549747								345/80				
AREA 4	PSM003826	6366688	1550082				41/66, 43/88	51/74, 54/85, 40/74						53/27, 217/38	
AREA 4	PSM003828	6366582	1550014								198/64				
AREA 4	PSM003855	6366998	1550365	3855							347/76, 358/86, 44/76				
AREA 2	PSM003966	6366498	1547358					342/85			174/74, 345/76				
AREA 3	PSM004063	6364572	1548328			255/77		38/88			193/80				
AREA 3	PSM004067	6364763	1548452			70/68									62/82, 21/90, 58/90
AREA 3	PSM004067	6364763	1548452												200/88, 59/90, 60/90, 55/90
AREA 3	PSM004069	6364687	1548517			245/82		25/85							
AREA 3	PSM004074	6364496	1548770			60/74									
AREA 3	PSM004085	6364526	1548840	4085A, B		204/70					190/78, 200/67	356/36, 355/44			
AREA 4	PSM004133	6367311	1550792	4133							54/~90				
AREA 4	PSM004137	6367245	1550597	4137A, B, C		257/86, 244/78, 62/85		24/78, 52/80			60/90, 45/~90				
AREA 1	PSM004153	6367476	1545638	4153											
AREA 4	PSM004315	6365796	1549751			260/					220/74				
AREA 4	PSM004316	6365707	1549622								65/				
AREA 4	PSM004641	6366573	1550278								253/72				
AREA 2	PSM005030	6364905	1547020					2/86							
AREA 5	PSM005077	6365518	1549989			234/80									
AREA 5	PSM005081	6365333	1549750	5081							64/78, 47/80			240/14	
AREA 5	PSM005085	6365357	1549517					231/74,189/80						240/16	
AREA 5	PSM005768	6365810	1551561	5768A, B	IMGP4359, 4360						236/84, 262/76, 251/81	360/70, 16/75			
AREA 5	PSM005771	6365890	1551803		PICT0176			228/82	266/79, 77/84, 87/77	64/88			103/68, 40/60, 58/50	157/43, 159/36	252/77, 33/48
AREA 5	PSM005776	6365599	1550520	5776		60/80									
AREA 5	PSM005777	6365647	1550726		PICT0178			58/79, 233/80				224/56, 240/66			
AREA 5	PSM005781	6365404	1550685								169/73, 199/86				
AREA 5	PSM005806	6365706	1552349	5806	IMGP4381, 83, 84					228/56, 226/78	187/76				109/64, 237/85, 250/82
AREA 5	PSM005812	6365576	1551623								68/~90				
AREA 5	PSM005821	6365287	1550693	5821		62/85					257/73				
AREA 5	PSM005843	6365725	1550457	5843							250/~90	250/46			
AREA 5	PSM005864	6366750	1552748	5864		124/60, 91/68					88/75			192/62, 234/65, 213/60	
AREA 5	PSM005870	6365940	1552575								218/68, 260/~90				241/64, 248/85, 229/80
AREA 5	PSM005895	6366023	1552782		IMGP4385			235/66			228/86, 89/~90				89/90, 282/80, 233/80
AREA 5	PSM005895	6366023	1552782												270/90, 266/60, 195/84
AREA 5	PSM005920	6367196	1552198								45/74				
AREA 1	PSM006088	6368208	1547229	6088A, B	IMGP4373	89/		66/76, 58/84, 54/80					207/73		
AREA 5	PSM007755	6365590	1550125		IMGP4361, 4362			224/69		154/80, 348/71	152/72				100/80, 245/90
AREA 5	PSM007756	6365388	1550670		IMGP4364		182/68, 195/83, 175/73	204/68					360/20, 350/38		
AREA 5	PSM007756	6365388	1550670		PICT0177		170/68, 166/71						335/51		
AREA 5	PSM007757	6365650	1551715			305/77				26/67, 26/62, 64/76, 55/60, 72/73					70/90
AREA 3	PSM007758	6364616	1548837		IMGP4365, PICT0179, 0180	244/58, 72/84, 77/89, 223/88	19/83, 31/88	210/80		291/62			248/56		
AREA 3	PSM007759	6364576	1548819	EL0505A, B	IMGP4366, PICT0181	64/85		227/86				54/19			
AREA 3	PSM007760	6364505	1548794	EL0506	IMGP4367, 4368	61/77	21/81, 221/86	234/70, 225/84, 31/80, 211/87	83/86, 288/45	276/70		65/30, 49/25	260/64		
AREA 3	PSM007760	6364505	1548794		PICT0182, 0183, 0184, 0185			61/77, 46/69, 45/83	270/79, 88/85, 270/85						
AREA 3	PSM007760	6364505	1548794					56/86, 47/82, 38/83, 20/83							
AREA 3	PSM007761	6364553	1548824	EL0507	IMGP4369, PICT0186, 0187, 0188	236/73	202/76	23/71, 32/82, 32/84, 29/87, 44/83		77/76	223/83	210/5	29/50	217/19	205/78
AREA 4	PSM007762	6367150	1550518			290/70		347/~90							
AREA 4	PSM007763	6367260	1550584			29/82		29/82?							
AREA 4	PSM007764	6367339	1550660		IMGP4370, PICT0189	34/83		206/88, 210/81, 214/75				206/20, 210/14	206/80		
AREA 4	PSM007765	6367333	1550684					16/74, 207/81		77/76	40-60/				
AREA 5	PSM007766	6365589	1550010		IMGP4371, 4372	238/86		48/80							
AREA 4	PSM007767	6365738	1549702												44/55, 38/74
AREA 2	PSM007768	6366544	1547369		IMGP4374										
AREA 2	PSM007769	6366839	1547404	EL0515							182/86, 9/86, 183/88	189/15?	9/68		
AREA 1	PSM007770	6367598	1545867		IMG4375, 4378						57/88	237/74			
AREA 5	PSM007771	6366637	1551986		IMGP4380						70/82				
AREA 5	PSM007772	6366662	1552160	EL0518											
AREA 3	PSM007773	6364689	1548935	EL0519											
NOT IN AREAS 1–5	PSM007774	6366669	1549006								355/~90				
AREA 5	PSM007775	6365534	1550096								237/72				

Appendix B

Field notes

Metadata for field notes

All measurements have been made according the right hand rule (RHR) and are noted *strike/dip.* This means that for example 90/60 is dipping 60 degrees towards south and 180/40 is dipping 40 degrees towards west.

The letters S, D, U is a notification about the kinematics of the measurement seen in the field. S = sinistral, D = dextral and U = unknown.

Lineations are noted trend/plunge. This means that for example 90/60 is a lineation plunging 60 degree's towards east and 180/40 is a line plunging 40 degrees towards south.

The lineation measurement is followed by a letter I, S or U. This means I = intersection lineation, S = stretching lineation or U = unknown lineation.

ID_CODE:	**PSM003314**	
AREA:	AREA 5	
COORDINATES:	N6366158	E1550770
SAMPLES:	3314	
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	220/78	
SHEAR ZONES:	212/76 U	
SHEAR BANDS:		
LINEATIONS:	227/38 S, 15/39 I, 216/5 U	
DYKES:		

FREE TEXT

Approximately 1 m wide shear zone and a total of 5 m wide zone affected by deformation. Stripes of biotite and quartz occur in the zone. 2 cm feldspar with a light (white) core and a red rim, occur in the surrounding rock and there is a transition towards a red mylonite with epidote and platy quartz. The zone appears to have been exposed to a brittle reactivation.

The sample is taken at GPS 6366144 N 1550759 E.

ID_CODE: **PSM003787**

AREA: AREA 5

COORDINATES: N6365576 E1550148

SAMPLES: 3787

PHOTOS: IMGP4363

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES: 232/72 S, 214/83 U

SHEAR BANDS:

LINEATIONS: 28/72 S

DYKES:

FREE TEXT

(214/83) is an approximately 1 m wide mylonite zone with several metres of surrounding rock affected by deformation. The foliation is wrapping around lenses.

Red fine-grained granite dykes in the area have a grain shape fabric consisting of quartz and biotite. Perhaps they deformed at a higher temperature. Distinct parallel fractures occur in the granite dykes.

(232/72) is a thin shear zone with epidote and a sinistral sense of shear on a horizontal surface. Quartz ribbons and feldspar augen along the margins.

ID_CODE: **PSM003792**

AREA: AREA 5

COORDINATES: N6365645 E1550071

SAMPLES:

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES: 235/88 S

SHEAR BANDS:

LINEATIONS: 235/12 S

DYKES: 227/83

FREE TEXT

A 3 m wide zoned, pegmatite have been sheared along the contact. There is a sinistral shear component on a horizontal surface. There is also a boudinaged granite dyke. Epidote occurs in brittle ductile shear zones. (235/88 S) is a red fine grained zone with epidote and thinly banded mylonite.

ID_CODE:	**PSM003823**
AREA:	NOT IN AREAS 1–5
COORDINATES:	N6366736 E1549747
SAMPLES:	
PHOTOS:	
SKETCHES:	

MEASUREMENTS

FOLIATIONS:	
SHEAR ZONES:	345/80 U
SHEAR BANDS:	
LINEATIONS:	
DYKES:	

FREE TEXT

A thin shear zone, less than 1 cm wide, with epidote and red staining.

ID_CODE:	**PSM003826**
AREA:	AREA 4
COORDINATES:	N6366688 E1549747
SAMPLES:	
PHOTOS:	
SKETCHES:	

MEASUREMENTS

FOLIATIONS:	
SHEAR ZONES:	51/74 S, 54/85 S, 40/74 S
SHEAR BANDS:	41/66 S, 43/88 S
LINEATIONS:	53/27 U, 217/38 U
DYKES:	

FREE TEXT

Fractured foliated zone with epidote. Quartz forms lenses. Sinistral kinematics is clearly visible with magnifying lens. (53/27) should be intersection lineation but looks like a stretching lineation. The rock looks prolate.

50 m towards north-northwest, is a 1 dm wide shear zone (54/85) with what appears to be sinistral shear bands on a horizontal surface.

ID_CODE:	**PSM003828**	
AREA:	AREA 4	
COORDINATES:	N6366582	E1550014
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:	198/64 U	
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

A fine-grained granite mylonite approximately 1 m wide with quartz lenses. Looks like an aplite. The zone is fractured.

ID_CODE:	**PSM003855**	
AREA:	AREA 4	
COORDINATES:	N6366998	E1550365
SAMPLES:	3855	
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:	347/76 U, 358/86 U, 44/76 U	
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

(347/76) and (358/86) are thin shear zones with epidote. (44/76) is a very fine-grained, fractured mylonite, which appears to be the same as the one at PSM004137.

ID_CODE:	**PSM003966**	
AREA:	AREA 2	
COORDINATES:	N6366498	E1547358
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:	342/85 S, 174/74 U, 345/76 U	
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

All shear zones are thin zones with epidote in Ävrö granite.

ID_CODE:	**PSM004063**	
AREA:	AREA 3	
COORDINATES:	N6364572	E1548328
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	255/77	
SHEAR ZONES:	38/88 S, 193/80 U	
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

(38/88) is a fine-grained granite mylonite. Oblique foliation aligns with the zone in a sinistral pattern.

(193/80) mylonite with epidote and quartz lenses. Small pieces of granite rock also appears in the shear zone.

ID_CODE:	**PSM004067**	
AREA:	AREA 3	
COORDINATES:	N6364763	E1548452
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	70/68	
SHEAR ZONES:		
SHEAR BANDS:		
LINEATIONS:		
DYKES:	62/82, 21/~90, 58/~90, 200/88, 59/~90, 60/~90, 55/~90	

FREE TEXT

Plane-parallell granite dykes in foliated quartz monzodiorite.

ID_CODE:	**PSM004069**	
AREA:	AREA 3	
COORDINATES:	N6364687	E1548517
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	245/82	
SHEAR ZONES:	25/85 S	
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

An oblique foliation aligns in a sinistral pattern with a shear zone. The shear zone is diffuse and might be a protomylonitic zone.

ID_CODE:	**PSM004074**	
AREA:	AREA 3	
COORDINATES:	N6364496	E1548770
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	60/74	
SHEAR ZONES:		
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

(60/74) is a foliation in quartz monzodiorite, in contact with a granite dyke. The dyke is striking approximately east-west. The dyke has mostly light-coloured minerals in the middle and is fine-grained on one side and coarser on the other side.

ID_CODE:	**PSM004085**	
AREA:	AREA 3	
COORDINATES:	N6364526	E1548840
SAMPLES:	4085A, 4085B	
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	204/70	
SHEAR ZONES:	190/78 U, 200/67 U	
SHEAR BANDS:		
LINEATIONS:	356/36 S, 355/44 S	
DYKES:		

FREE TEXT

The stretching lineations are straight, strong lineations.

Granite dykes in the area are less deformed on a vertical surface than on a horizontal surface. The dykes are more pinched on a horizontal surface, but the difference in competence between the dykes and the surrounding rock is rather small.

ID_CODE:	**PSM004133**	
AREA:	AREA 4	
COORDINATES:	N6367311	E1550792
SAMPLES:	4133	
PHOTOS:		
SKETCHES:		

MEASUREMENTS

FOLIATIONS:	
SHEAR ZONES:	54/~90 U
SHEAR BANDS:	
LINEATIONS:	
DYKES:	

FREE TEXT

Fine-grained ultramylonite. Looks similar to the one at PSM004137.

ID_CODE:	**PSM004137**	
AREA:	AREA 4	
COORDINATES:	N6367245	E1550597
SAMPLES:	4137A, 4137B, 4137C	
PHOTOS:		
SKETCHES:		

MEASUREMENTS

FOLIATIONS:	257/86, 244/78, 62/85
SHEAR ZONES:	24/78 S, 52/80 S, 60/90 U, 45/~90 U
SHEAR BANDS:	
LINEATIONS:	
DYKES:	

FREE TEXT

Large outcrop with many observations.

(257/86), (258/83) are foliations in Ävrö granite.

ID_CODE: **PSM004153**

AREA: AREA 1

COORDINATES: N6367476 E1545638

SAMPLES: 4153

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES:

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

A zone with large amount of light-coloured minerals. Some surfaces show elongated minerals, but no consistent direction. Fractures occur in all directions. There are many large boulders in the area.

ID_CODE: **PSM004315**

AREA: AREA 4

COORDINATES: N6365796 E1549751

SAMPLES:

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS: 260/

SHEAR ZONES: 220/74 U

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

A zone with a faint east-west foliation. Feldspars with red rim and bright core are approximately 1 cm in diameter. Nearby is a small shear zone (220/74).

ID_CODE: **PSM004316**

AREA: AREA 4

COORDINATES: N6365707 E1549622

SAMPLES:

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES: 65/U

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

A brittle/ductile zone with epidote.

ID_CODE: **PSM004641**

AREA: AREA 4

COORDINATES: N6366573 E1550278

SAMPLES:

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES: 235/72 U

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

A red fine-grained granite mylonite with quartz lenses and many fractures.

ID_CODE: **PSM005030**

AREA: AREA 2

COORDINATES: N6364905 E1547020

SAMPLES:

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES: 2/86 S

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

A brittle/ductile zone with epidote. Not so many fractures. Kinematics appears to be sinistral on a horizontal surface.

ID_CODE: **PSM005077**

AREA: AREA 5

COORDINATES: N6365518 E1549989

SAMPLES:

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS: 234/80

SHEAR ZONES:

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

A red fractured zone, similar to PSM007766. Strong foliation.

ID_CODE:	**PSM005081**	
AREA:	AREA 5	
COORDINATES:	N6365333	E1549750
SAMPLES:	5081	
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:	64/78 U, 47/80 U	
SHEAR BANDS:		
LINEATIONS:	240/14 U	
DYKES:		

FREE TEXT

Two red fine-grained granite mylonites.

ID_CODE:	**PSM005085**	
AREA:	AREA 5	
COORDINATES:	N6365357	E1549517
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:	231/74 S, 189/80 S	
SHEAR BANDS:		
LINEATIONS:	240/16 U	
DYKES:		

FREE TEXT

Less than 1 cm wide shear zones with epidote. Sinistral kinematics on a horizontal surface.

ID_CODE:	**PSM005768**
AREA:	AREA 5
COORDINATES:	N6365810 E1551561
SAMPLES:	5768A, 5768B
PHOTOS:	IMGP4359, IMGP4360
SKETCHES:	
MEASUREMENTS	
FOLIATIONS:	
SHEAR ZONES:	236/84 U, 262/76 U, 251/81 U
SHEAR BANDS:	
LINEATIONS:	360/70 S, 16/75 S
DYKES:	

FREE TEXT

An approximately 1.5 m wide zone is affected by deformation. A red granite dyke is less affected than the surrounding fine-grained dioritoid. There is possibly a sinistral sense of shear on a horizontal surface and north up on a vertical surface.

ID_CODE:	**PSM005771**
AREA:	AREA 5
COORDINATES:	N6365890 E1551803
SAMPLES:	
PHOTOS:	PICT0176
SKETCHES:	
MEASUREMENTS	
FOLIATIONS:	
SHEAR ZONES:	228/82 S, 64/88 D
SHEAR BANDS:	266/79 D, 77/84 D, 87/77 D
LINEATIONS:	103/68 I, 40/60 I, 58/50 I, 157/43 U, 159/36 U
DYKES:	252/77, 33/48

FREE TEXT

Contact between quartz monzodiorite and fine-grained dioritoid. (64/88) is a brittle and fractured zone. There is possibly north up sense of shear on an inclined surface. Micas occur in the shear zone. Black streaks occur, possibly of biotite and chlorite. Quartz and feldspar disappear.

(157/43) and (159/36) are lineations on the surface under a sheared dyke (33/48). The dyke is a granite dyke and almost a pegmatite along the margin. Strong shearing has occurred in the contact between the dyke and the surrounding rock.

There are also horizontal dykes in the area.

ID_CODE:	**PSM005776**
AREA:	AREA 5
COORDINATES:	N6365599 E1550520
SAMPLES:	5776
PHOTOS:	
SKETCHES:	
MEASUREMENTS	
FOLIATIONS:	60/80
SHEAR ZONES:	
SHEAR BANDS:	
LINEATIONS:	
DYKES:	

FREE TEXT

Deformed granite dyke. Approximately 3 m wide zone affected. Foliation disappears towards east and there is a transition to massive granite.

ID_CODE:	**PSM005777**
AREA:	AREA 5
COORDINATES:	N6365647 E1550726
SAMPLES:	
PHOTOS:	PICT0178
SKETCHES:	PSM005777S
MEASUREMENTS	
FOLIATIONS:	
SHEAR ZONES:	58/79 S, 233/80 S
SHEAR BANDS:	
LINEATIONS:	224/56 S, 240/66 S
DYKES:	

FREE TEXT

There is a meandering mylonite in the contact between a granite dyke and fine-grained dioritoid. The shearing has probably occurred when the dyke rotated.

ID_CODE:	**PSM005781**
AREA:	AREA 5
COORDINATES:	N6365404 E1550685
SAMPLES:	
PHOTOS:	
SKETCHES:	
MEASUREMENTS	
FOLIATIONS:	
SHEAR ZONES:	169/73 U, 199/86 U
SHEAR BANDS:	
LINEATIONS:	
DYKES:	

FREE TEXT

(199/86) is a winding shear zone on a curved surface.

50 m to the south there is a small, less than 1 cm wide shear zone (169/73).

ID_CODE:	**PSM005806**
AREA:	AREA 5
COORDINATES:	N6365706 E1552349
SAMPLES:	5806
PHOTOS:	IMGP4381, IMGP4383, IMGP4384
SKETCHES:	
MEASUREMENTS	
FOLIATIONS:	
SHEAR ZONES:	226/78 D, 228/56 D, 187/76 U
SHEAR BANDS:	
LINEATIONS:	
DYKES:	109/64, 237/85, 250/82

FREE TEXT

(226/78) is an approximately 7 cm wide shear zone. The shear zone bends and cuts a granite dyke (dextrally). The dyke has a core with higher amount of quartz and is red towards the margin, hence less quartz and more feldspar. Pieces of the dyke are found in the shear zone.

There are lots of dykes in the area. Some dykes are cut by shear zones and other dykes cut the shear zones.

The rock sample is from brittle, fractured and deeply weathered shear zone (187/76), approximately 1–2 dm wide.

(228/56) seems to cut a wide dyke (250/82) dextrally.

ID_CODE: **PSM005812**

AREA: AREA 5

COORDINATES: N6365576 E1551623

SAMPLES:

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES: 68/~90

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

A 0.5 m wide shear zone, fractured and deeply weathered. Brittle or brittle reactivation.

ID_CODE: **PSM005821**

AREA: AREA 5

COORDINATES: N6365287 E1550693

SAMPLES: 5821

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS: 62/85

SHEAR ZONES: 257/73 U

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

Red, fine-grained, fractured rock, with an uneven foliation. There is a 1 dm wide shear zone in the fractured rock (257/73).

ID_CODE:	**PSM005843**	
AREA:	AREA 5	
COORDINATES:	N6365725	E1550457
SAMPLES:	5843	
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:	250/~90 U	
SHEAR BANDS:		
LINEATIONS:	250/46 S	
DYKES:		

FREE TEXT

Shear zone in Ävrö granite, approximately 1.5 m is affected. Lineations looks like a mineral stretching lineation. The sample is from "undeformed" Ävrö granite.

ID_CODE:	**PSM005864**	
AREA:	AREA 5	
COORDINATES:	N6366750	E1552748
SAMPLES:	5864	
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	124/60, 91/68	
SHEAR ZONES:	88/75 U	
SHEAR BANDS:	107/90 U	
LINEATIONS:	192/62 U, 234/65 U, 213/60 U	
DYKES:		

FREE TEXT

Approximately 2 m wide zone affected by deformation. Short shear bands, similar to small fractures, on a vertical surface indicating north-up. Kinematics might switch at GPS N6366745 E1552776.

ID_CODE:	**PSM005870**	
AREA:	AREA 5	
COORDINATES:	N6365940	E1552575
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:	260/~90 U, 218/68 U	
SHEAR BANDS:		
LINEATIONS:		
DYKES:	241/64, 248/85, 229/80	

FREE TEXT

Fractured zones. Perhaps reactivated shear zones. Piece of sinistrally sheared granite dyke is found in (260/~90).

ID_CODE:	**PSM005895**	
AREA:	AREA 5	
COORDINATES:	N6366023	E1552782
SAMPLES:		
PHOTOS:	IMGP4385	
SKETCHES:	PSM005895S	
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:	235/66 S, 228/86 U, 89/~90 U	
SHEAR BANDS:		
LINEATIONS:		
DYKES:	89/~90, 282/80, 233/80, 270/~90, 266/60, 195/84	

FREE TEXT

(235/66) is a brittle zone, which has bent (89/~90) sinistrally. A dyke side by side with the shear zone is undeformed. (228/86) and (22/~90) are brittle zones with a tension gash.

ID_CODE:	**PSM005920**
AREA:	AREA 5
COORDINATES:	N6367196 E1552198
SAMPLES:	
PHOTOS:	
SKETCHES:	
MEASUREMENTS	
FOLIATIONS:	
SHEAR ZONES:	45/74 U
SHEAR BANDS:	
LINEATIONS:	
DYKES:	

FREE TEXT

6 cm wide shear zone. Distinct foliation of elongated minerals. The zone is meandering.

ID_CODE:	**PSM006088**
AREA:	AREA 1
COORDINATES:	N6368208 E1547229
SAMPLES:	6088A, 6088B
PHOTOS:	IMGP4373
SKETCHES:	PSM006088S
MEASUREMENTS	
FOLIATIONS:	89/
SHEAR ZONES:	66/76 S, 58/84 S, 54/80 S
SHEAR BANDS:	
LINEATIONS:	207/73 I
DYKES:	

FREE TEXT

There is a thinly banded mylonite, approximately 3 m wide and sinistral on a horizontal surface. A wide zone in the surrounding rock is affected by deformation. The surrounding rock consists of red medium grained granite with a foliation (89/).

ID_CODE: **PSM007755**

AREA: AREA 5

COORDINATES: N6365590 E1550125

SAMPLES:

PHOTOS: IMGP4361, IMGP4362

SKETCHES: PSM007755S

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES: 224/69 S, 154/80 D, 348/71 D, 152/72 U

SHEAR BANDS:

LINEATIONS:

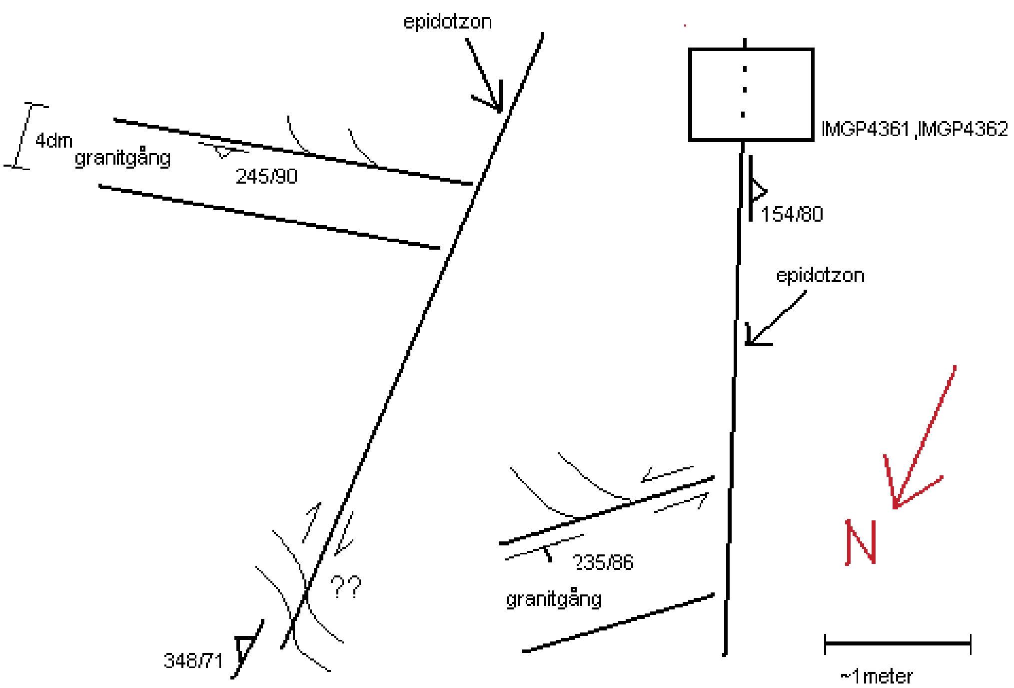
DYKES: 100/80, 245/90

FREE TEXT

Shear zones with epidote, approximately 2–3 cm wide and more than 1,5 m long.

(245/90) is an approximately 4 dm wide granite dyke cut dextrally by (348/71) on a horizontal view (see Sketch).

Further east there is coarser granite with approximately 2 cm K-feldspars. (224/69) is a 3 cm wide mylonite with platy quartz. There is also platy quartz in the protomylonitic surrounding. It appears to be a very abrupt strain increase between mylonite and the surrounding rock. There is a distinct sinistral component on a horizontal surface.



ID_CODE:	**PSM007756**
AREA:	AREA 5
COORDINATES:	N6365388 E1550670
SAMPLES:	
PHOTOS:	IMGP4364, PICT0177
SKETCHES:	

MEASUREMENTS

FOLIATIONS:	
SHEAR ZONES:	204/68 S
SHEAR BANDS:	182/68 S, 195/83 S, 175/73 S, 170/68 S, 166/71 S
LINEATIONS:	360/20 I, 350/38 I, 335/51 I
DYKES:	

FREE TEXT

A retrograde zone approximately 1.5 m wide. The shearing is not penetrative. The zone is fractured and the surface is weathered. The shear zone is sinistral and sinistral shear bands are visible.

ID_CODE:	**PSM007757**
AREA:	AREA 5
COORDINATES:	N6365650 E1551715
SAMPLES:	
PHOTOS:	
SKETCHES:	

MEASUREMENTS

FOLIATIONS:	305/77
SHEAR ZONES:	26/67 D, 26/62 D, 64/76 D, 55/60 D, 72/73 D
SHEAR BANDS:	
LINEATIONS:	
DYKES:	70/90

FREE TEXT

Many granite dykes in an area with fine-grained dioritoid. Shearing has occurred in the contact between the dyke and the fine-grained dioritoid. The dyke appears to have rotated counterclockwise and this has caused dextral shearing in the contact zone. The shear zones are rich in epidote.

ID_CODE: **PSM007758**

AREA: AREA 3

COORDINATES: N6364616 E1548837

SAMPLES:

PHOTOS: IMGP4365, PICT0179, PICT0180

SKETCHES: PSM007758S

MEASUREMENTS

FOLIATIONS: 244/58, 72/84, 77/89, 223/88

SHEAR ZONES: 210/80 S, 291/62 D

SHEAR BANDS: 19/83 S, 31/88 S

LINEATIONS: 248/56 I

DYKES:

FREE TEXT

Approximately 1 dm wide zone shows a distinct sinistral S/C'-fabric on a horizontal surface. The closest surrounding bedrock, quartz monzodiorite, on the south-eastern side is strongly foliated. The foliation bends into and aligns with the shear zone in a sinistral fashion. The surrounding bedrock on the north western side is coarser and less foliated and the foliation turns abruptly into alignment with the shear zone. The zone probably contains biotite and chlorite.

(291/62) is actually a conjugate shear band, but corresponds to a dextral shear zone.

ID_CODE: **PSM007759**

AREA: AREA 3

COORDINATES: N6364576 E1548819

SAMPLES: EL0505A, EL0505B

PHOTOS: IMGP4366, PICT0181

SKETCHES:

MEASUREMENTS

FOLIATIONS: 64/85

SHEAR ZONES: 227/86 S

SHEAR BANDS:

LINEATIONS: 54/19 S

DYKES:

FREE TEXT

Approximately 5 cm wide shear zone with epidote. The foliation in the surrounding quartz monzodiorite rotates abruptly into the shear zone. The kinematics appears to be sinistral on a horizontal surface.

Immediately to the east of the shear zone, there is a fine-grained granite (aplite) in contact with quartz monzodiorite. (64/85) is a strong foliation parallel with the foliation in the quartz monzodiorite. The contact is irregular.

ID_CODE:	**PSM007760**
AREA:	AREA 3
COORDINATES:	N6364505 E1548794
SAMPLES:	EL0506
PHOTOS:	IMGP4367, IMGP4368, PICT0182, PICT0183, PICT0184, PICT0185
SKETCHES:	PSM007760S
MEASUREMENTS	
FOLIATIONS:	61/77
SHEAR ZONES:	234/70 S, 225/84 S, 31/80 S, 211/87 S, 61/77 S, 46/69 S, 45/83 S, 56/86 S, 47/82 S, 38/83 S, 20/83 S, 276/70 D
SHEAR BANDS:	21/81 S, 221/86 S, 83/86 D, 288/45 D, 270/79 D, 88/85 D, 270/85 D
LINEATIONS:	65/30 S, 49/25 S, 260/64 I
DYKES:	

FREE TEXT

Shear zone in gneissic quartz monzodiorite. The shear zone is cutting approximately 2 cm wide granite dykes. The dykes also have brittle fractures.

Rock sample is taken from a sinistral zone (45/83) with a stretching lineation (49/25).

ID_CODE:	**PSM007761**
AREA:	AREA 3
COORDINATES:	N6364553 E1548824
SAMPLES:	EL0507
PHOTOS:	IMGP4369, PICT0186, PICT0187, PICT0188
SKETCHES:	PSM007761-1S, PSM007761-2S, PSM007761-3S
MEASUREMENTS	
FOLIATIONS:	236/73
SHEAR ZONES:	23/71 S, 32/82 S, 32/84 S, 29/87 S, 44/83 S, 77/76 D, 223/83 U
SHEAR BANDS:	202/76 S
LINEATIONS:	210/5 S, 29/50 I, 217/19 U
DYKES:	205/78

FREE TEXT

Large area with dykes and shear zones. The competence contrast between granite and quartz monzodiorite varied during different stages of deformation. At first the granite is less competent than the quartz monzodiorite and a cleavage is produced in that rock. Micas, produced during mylonitization of the quartz monzodiorite, soften the rock and eventually the granite becomes more competent. The granite is then pinched and/or boudinaged.

ID_CODE:	**PSM007762**	
AREA:	AREA 4	
COORDINATES:	N6367150	E1550518
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	290/70	
SHEAR ZONES:	347/~90 S	
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

Approximately 5 cm wide shear zone with epidote. There is an oblique foliation indicating a sinistral movement in the shear zone although the foliation does not bend and aligns with the shear zone. The transition is rather abrupt.

ID_CODE:	**PSM007763**	
AREA:	AREA 4	
COORDINATES:	N6367260	E1550584
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	29/82	
SHEAR ZONES:	29/82 S	
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

Short protomylonitic zone, which shows the beginning of mylonitization. The zone displays grain size reduction, micas and ductile deformation of feldspar and quartz. Foliation close to the shear zone coincides with strike of shear zone.

ID_CODE:	**PSM007764**	
AREA:	AREA 4	
COORDINATES:	N6367339	E1550660
SAMPLES:		
PHOTOS:	IMGP4370, PICT0189	
SKETCHES:	PSM007764S	
MEASUREMENTS		
FOLIATIONS:	34/83	
SHEAR ZONES:	206/88 S, 210/81 S, 241/75 S	
SHEAR BANDS:		
LINEATIONS:	206/20 S, 210/14 S, 206/80 I	
DYKES:		

FREE TEXT

Many approximately 1 cm thick mylonites and at least 5 m long. Very little deformation in surrounding Ävrö granite i.e. abrupt strain increase.

ID_CODE:	**PSM007765**	
AREA:	AREA 4	
COORDINATES:	N6367333	E1550684
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:	16/74 S, 207/81 S, 77/76 D, 40-60/ U	
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

(40-60/) is a fractured, brittle zone. The same zone is also found and was sampled at PSM004137. Some small shear zones occur in the vicinity of the brittle zone.

ID_CODE:	**PSM007766**	
AREA:	AREA 5	
COORDINATES:	N6365589	E1550010
SAMPLES:		
PHOTOS:	IMGP4371, IMGP4372	
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:	238/86	
SHEAR ZONES:	48/80 S	
SHEAR BANDS:		
LINEATIONS:		
DYKES:		

FREE TEXT

Approximately 5 cm wide mylonite in strongly fractured Ävrö granite with fracture cleavage.

ID_CODE:	**PSM007767**	
AREA:	AREA 4	
COORDINATES:	N6365738	E1549702
SAMPLES:		
PHOTOS:		
SKETCHES:		
MEASUREMENTS		
FOLIATIONS:		
SHEAR ZONES:		
SHEAR BANDS:		
LINEATIONS:		
DYKES:	44/55, 38/74	

FREE TEXT

Only fine-grained granite dykes is found at this spot. No major shearing seems to have occurred.

ID_CODE:	**PSM007768**	
AREA:	AREA 2	
COORDINATES:	N6366544	E1547369
SAMPLES:		
PHOTOS:	IMGP4374	
SKETCHES:		

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES:

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

Fine-grained, red, granite dyke, approximately 7 cm wide in Ävrö granite. Thin vein with epidote in the fine grained dyke. Possibly a sinistral shear in the lower contact, which would indicate a west side up in vertical section or a clockwise rotation of the dyke.

ID_CODE:	**PSM007769**	
AREA:	AREA 2	
COORDINATES:	N6366839	E1547404
SAMPLES:	EL0515	
PHOTOS:		
SKETCHES:		

MEASUREMENTS

FOLIATIONS:	
SHEAR ZONES:	182/86 U, 9/86 U, 183/88 U
SHEAR BANDS:	
LINEATIONS:	189/15 S, 9/68 I
DYKES:	

FREE TEXT

Fractured zone with strong foliation.

ID_CODE:	**PSM007770**
AREA:	AREA 1
COORDINATES:	N6367598 E1545867
SAMPLES:	
PHOTOS:	IMGP4375, IMGP4378
SKETCHES:	PSM007770S

MEASUREMENTS

FOLIATIONS:	
SHEAR ZONES:	57/88 U
SHEAR BANDS:	
LINEATIONS:	237/74 S
DYKES:	

FREE TEXT

Thinly banded mylonite with epidote, approximately 1 m wide.

ID_CODE:	**PSM007771**
AREA:	AREA 5
COORDINATES:	N6366637 E1551986
SAMPLES:	
PHOTOS:	IMGP4380
SKETCHES:	PSM007771S

MEASUREMENTS

FOLIATIONS:	
SHEAR ZONES:	70/82 U
SHEAR BANDS:	
LINEATIONS:	
DYKES:	

FREE TEXT

Contact between Ävrö granite (lower part in sketch) and fine.grained dioritoid (upper part in sketch). The fine-grained dioritoid appears to have a lensoid shape indicating sinistral movement on a horizontal surface.

ID_CODE: **PSM007772**

AREA: AREA 5

COORDINATES: N6366662 E1552160

SAMPLES: EL0518

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES:

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

Sample site for fine-grained dioritoid.

ID_CODE: **PSM007773**

AREA: AREA 3

COORDINATES: N6364689 E1548935

SAMPLES: EL0519

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES:

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

Sample site for quartz monzodiorite.

ID_CODE: **PSM007774**

AREA: NOT IN AREAS 1–5

COORDINATES: N6366669 E1549006

SAMPLES:

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES: 355/~90 U

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

Approximately 2 cm wide shear zone, which looks brittle. It is not fractured.

ID_CODE: **PSM007775**

AREA: AREA 5

COORDINATES: N6365534 E1550096

SAMPLES:

PHOTOS:

SKETCHES:

MEASUREMENTS

FOLIATIONS:

SHEAR ZONES: 237/72 U

SHEAR BANDS:

LINEATIONS:

DYKES:

FREE TEXT

Probably bedrock (but might be a boulder). Very fine-grained, red rock with strong foliation (looks like an aplite). Probably containing recrystallized quartz.

Appendix C

Thin-section notes

ID_CODE: PSM003314 **THIN-SECTION:** 3314

PHOTOS: 3314_pnic_01, 03; 3314_xnic_02

ROCK: Ävrö granite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: Dextral (212/76)

MACROSCOPIC DESCRIPTION:

The rock is red and fine-grained with streaks forming a foliation. Only some larger quartz aggregates, up to 1 mm across, are visible for the naked eye. Some areas are rich in epidote.

MICROSCOPIC TEXTURE:

The foliation is formed by elongated quartz aggregates or lenses and streaks of mica and chlorite. Feldspars show evidence of brittle deformation. A few feldspar porfyroclasts can be found and also some large quartz aggregates, but most of the sample consist of fine-grained matrix.

MINERALS:

Quartz occur both in aggregates, where larger grains show undulouse extinction and bulging between grains, and as fine grains in matrix.

Feldspar, both plagioclase and microcline, occur as porfyroclasts. The porfyroclasts show evidence of brittle deformation, but some have a weak core and mantle structure.

Mica, both biotite and muscovite, forms streaks, together with chlorite.

Chlorite occurs in streaks with mica.

Epidote is very common and especially localized in one area.

Titanite might be present.

KINEMATIC INDICATORS:

Oblique foliation forming an S/C-fabric, visible in low magnification.

Sinistral shear pods.

ID_CODE: PSM003787 **THIN-SECTION:** 3787

PHOTOS: 3787_pnic_02, 03; 3787_xnic_01

ROCK: Ävrö granite

KINEMATICS IN THIN-SECTION: Sinistral/Dextral

KINEMATICS ON MAP-VIEW: South-east or north-west up (214/83).

MACROSCOPIC DESCRIPTION:

The rock is fine-grained with visible quartz lenses. There is a strong foliation and several fractures oblique to the foliation. Some dark streaks follow the foliation.

MICROSCOPIC TEXTURE:

The rock is very fine-grained. The fractures are filled with quartz or calcite. Bands of mica and some chlorite form the foliation and matrix together with fine grained quartz. Some small, less than 1 mm across, feldspar porfyroclasts are present. The porfyroclast are sometimes slightly altered to sericite.

MINERALS:

Quartz occurs as fine grains in the matrix and also in quartz lenses elongated along the foliation.

Plagioclase is the dominating feldspar. Porfyroclasts are small, less than 1 mm across and just some alteration has occurred. Some core and mantle structures are also found.

Muscovite is common and form bands with chlorite.

Chlorite occurs in matrix.

Calcite occurs both in matrix and as fracture fill.

KINEMATIC INDICATORS:

The fractures follow sinistral kinks or dextral C'.

Both sinistral and dextral zones.

ID_CODE: PSM003855 **THIN-SECTION:** 3855

PHOTOS: 3855_pnic_01, 02, 03; 3855_xnic_04

ROCK: Ävrö granite

KINEMATICS IN THIN-SECTION: Dextral

KINEMATICS ON MAP-VIEW: Sinistral (44/76)

MACROSCOPIC DESCRIPTION:

The rock is fine-grained with a foliation of dark streaks. Some feldspar porfyroclasts and some quartz aggregates are visible for the naked eye. There seems to be some zones with higher strain within the sheared rock.

MICROSCOPIC TEXTURE:

The rock consists of a very fine-grained matrix of quartz, feldspar and muscovite, with occasional porfyroclasts of feldspar. Quartz grains form aggregates or elongated lenses or bands stretched along the foliation. The individual quartz grains are elongated oblique to the foliation forming a dextral S/C-fabric. There are also fractures or seams along the foliation filled with opaque phases.

MINERALS:

Quartz occurs in fine grains in matrix or in aggregates stretched along the foliation, with individual subgrains elongated oblique to the foliation forming a dextral S/C-fabric.

Plagioclase is the dominating feldspar. Most of the grains are very fine grains in matrix, but some small porfyroclasts less than 1 mm across also occurs. The porfyroclasts show evidence for brittle deformation and some are slightly altered to sericite.

Muscovite occur both in matrix, sometimes as large, up to 0.25 mm across, crystals, but also as very fine grained sericite.

Calcite occurs in up to more than 1·1 mm large aggregates

Chlorite occurs along fractures or streaks along the foliation.

Opaque phases occur along fractures or streaks along the foliation.

An unknown red/orange fine-grained mineral occur along fracture or streaks along the foliation.

KINEMATIC INDICATORS:

Quartz crystals in aggregates elongated oblique to the foliation forming a dextral S/C-fabric. Tips on the rim of quartz grains dipping to the right indicating dextral movement.

ID_CODE: PSM004085 **THIN-SECTION:** 4085A

PHOTOS: 4085A_pnic_01; 4085A_xnic_02

ROCK: Quartz monzodiorite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: Sinistral (200/67)

MACROSCOPIC DESCRIPTION:

The rock is banded with quartz rich bands separated by thin bands. Some of the thin bands are red or terracotta coloured. Feldspar porfyroclast are also visible.

MICROSCOPIC TEXTURE:

The thin bands consist mostly of quartz and separate bands of quartz and feldspar. The feldspar show evidence of brittle deformation and some are also altered. Quartz form bands or quartz ribbons. Triple points between grains are evidence for annealing due to static recrystallisation.

MINERALS:

Quartz occurs mostly in annealed quartz ribbons, but some grains show undulouse extinction and subgrains.

Feldspar, both plagioclase and microcline, show evidence of brittle deformation. Twinning induced by deformation is present and some core and mantle structures can be found. Pertite also exists.

Muscovite occurs in thin bands but also as fine grained sericite in lumps or in altered feldspar.

Biotite occur

Chlorite occurs as alteration from biotite.

Calcite is present.

Titanite might occur.

A red or terracotta coloured fine grained mineral is also present.

KINEMATIC INDICATORS:

Weak sinistral shear pods.

ID_CODE: PSM004085 **THIN-SECTION:** 4085B

PHOTOS: 4085B_pnic_01, 04, 06, 08; 4085B_ xnic_02, 03, 05, 07

ROCK: Quartz monzodiorite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: Sinistral (217/62)

MACROSCOPIC DESCRIPTION:

The rock is dark and fine-grained. A red fine-grained streak approximately 1 cm wide goes straight through. The edges of the red streak are in some places very straight black and look like pseudotachylytes. The largest visible “pseudotachylyte” is 27 mm · 0.5 mm. The red streak is rich in quartz and has a strong foliation. In the dark rock, feldspar porfyroclasts up to 1 mm across can be found and also lumps with a golden metallic lustre, which might be pyrite.

MICROSCOPIC TEXTURE:

The dark rock is fine-grained with bands of biotite and epidote. A sinistral S/C-fabric is present. Grains of quartz and feldspars are mostly fine, but some feldspar porfyroclast occur.

The red rock has larger feldspar porfyroclasts and also quartz aggregates or ribbons. Fine grains of quartz and feldspar also exists.

The red rock and the dark rock are separated by a dark very fine-grained material perhaps including titanite and epidote.

MINERALS:

Quartz occurs in fine grains but also as ribbon quartz in the red rock.

Plagioclase is the dominating feldspar. Porfyroclast of plagioclase are larger in the red rock than in the dark rock. Some porfyroclasts are altered to sericite.

Biotite occurs in the dark rock.

Muscovite occurs as sericite in altered quartz.

Epidote occurs in the dark rock.

Calcite occurs in both the red and the dark rock.

Titanite with opaque inclusion exists.

KINEMATIC INDICATORS:

Sinistral S/C-fabric and sinistral stair-stepping in IMGP4986 and 4987.

ID_CODE: PSM004133 **THIN-SECTION:** 4133

PHOTOS: 4133_pnic_01, 03; 4133_xnic_02

ROCK: Ävrö granite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: Dextral (70/90)

MACROSCOPIC DESCRIPTION:

The rock is red and fine-grained. The foliation consists of dark streaks and elongated lenses of quartz. There are fractures both along the foliation and across.

MICROSCOPIC TEXTURE:

Extremely fine-grained material makes up a matrix. A foliation is made up of thin bands of quartz and muscovite. Fragments of the mylonite have rotated, but have the same mineral assemblage and grain size as the surrounding.

MINERALS:

Quartz occurs in lenses and thin bands with muscovite.

Microcline crystals are visible as small porfyroclasts but *plagioclase* might also be a present in the very fine grained matrix.

Muscovite occurs in the matrix and together with quartz. Occasional larger crystals are also present.

Chlorite has formed during deformation and is present in the matrix and together with quartz.

Garnet of magmatic origin is also found.

Titanite and *calcite* might also occur.

KINEMATIC INDICATORS:

Rotated mylonite fragments.

ID_CODE: PSM004137 **THIN-SECTION:** 4137A

PHOTOS: 4137A_pnic_01, 04, 05; 4137A_xnic_02, 03

ROCK: Ävrö granite

KINEMATICS IN THIN-SECTION: Dextral

KINEMATICS ON MAP-VIEW: Sinistral (60/90)

MACROSCOPIC DESCRIPTION:

The rock is red and very fine-grained. No crystals are visible for the naked eye. There is a strong foliation of dark streaks.

MICROSCOPIC TEXTURE:

Quartz, feldspar and muscovite make up a fine-grained matrix. Muscovite and quartz lenses form a foliation. Feldspar occurs in all sizes up to 1·1 mm.

MINERALS:

Quartz occurs in aggregates where larger crystals show undulouse extinction. Small grains of quartz also exist as a part of the matrix.

Feldspar, both plagioclase and microcline, occur in all sizes up to 1·1 mm. Some feldspars are altered to sericite and some show evidence of brittle deformation.

Muscovite occurs in fine discontinuous bands and also as fine-grained sericite in lumps.

Calcite occurs in fractures but also in the matrix.

Chlorite occurs in some fracture.

Titanite might be present.

Opaque phases occur in streaks.

A red or terracotta coloured fine-grained mineral occur in fractures and also in streaks along the foliation.

KINEMATIC INDICATORS:

Dextral antithetic microfaults of feldspar porfyroclast.

A weak dextral S/C-fabric in low magnification.

A dextral S/C-fabric of muscovite visible in high magnification.

Quartz aggregates with subgrains elongated oblique to the foliation forming a dextral S/C-fabric.

ID_CODE: PSM004137 **THIN-SECTION:** 4137B

PHOTOS: 4137B_pnic_01, 02; 4137B_xnic_03

ROCK: Ävrö granite

KINEMATICS IN THIN-SECTION: Dextral

KINEMATICS ON MAP-VIEW: Sinistral (60/90)

MACROSCOPIC DESCRIPTION:

The rock is red and very fine-grained. No crystals are visible for the naked eye. A strong foliation of dark streaks is visible.

MICROSCOPIC TEXTURE:

The sample constitutes mostly of fine-grained matrix. Feldspars exist in all sizes up to 1·1 mm. Porfyroclasts are affected by brittle deformation. Elongated quartz aggregates and muscovite make up a foliation.

MINERALS:

Quartz occurs in aggregates where larger crystals show undulouse extinction and subgrain formation.

Feldspars, both plagioclase and microcline, occur in all sizes up to 1·1 mm. The porfyroclasts show evidence of brittle deformation. There is a tendency to core and mantle structures in some porfyroclasts.

Muscovite occurs in matrix but also as fine-grained sericite in small lumps.

Chlorite occurs in fractures.

Calcite occurs in fractures.

A red or terracotta coloured fine-grained mineral occur in streaks.

KINEMATIC INDICATORS:

Dextral S/C-fabric in low magnification.

Dextral stair-stepping.

Dextral S/C-fabric in high magnification.

ID_CODE: PSM004137 **THIN-SECTION:** 4137C

PHOTOS: 4137C_pnic_01; 4137C_xnic_02

ROCK: Ävrö granite

MACROSCOPIC DESCRIPTION:

The rock is red/orange/terracotta coloured and unequigranular. Also quartz is reddish. Grain sizes vary up to approximately 8 mm in diameter. In between the larger grains there is a dark matrix. The rock is fractured, with a light green fracture fill, probably epidote. There seems to be a weak east-west foliation in one cut.

MICROSCOPIC TEXTURE:

Large porfyroclasts of plagioclase and microcline are extensively altered by saussuritization. Sericite and albite is formed. Epidote is common also in dark zones with opaque phases. There is no clear foliation.

MINERALS:

Quartz occurs in aggregates where larger grains show undulouse extinction. Bulging occur between grains.

Plagioclase is the dominating feldspar, but *microcline* also occurs. Feldspars are extensively altered by saussuritization, where sericite and albite is formed.

Muscovite occurs in the sample and also as fine grained sericite in altered feldspars.

Albite is formed during saussuritization.

Epidote is common and also occurs in fine grains together with opaque phases.

Chlorite and *calcite* is also present.

Titanite and *apatite* occur as accessory minerals.

Opaque phases occur and based on crystal shape pyrite seems to be one possibility.

KINEMATIC INDICATORS:

Not enough deformation.

ID_CODE: PSM4153 **THIN-SECTION:** 4153

PHOTOS: 4153_pnic_02; 4153_xnic_01

ROCK: Ävrö granite breccia

MACROSCOPIC DESCRIPTION:

The rock is reddish with lots of quartz. Both fine-grained quartz and larger aggregates occur. Many fractures in all directions filled with quartz. Some fractures are filled with a dark material and some are filled with a rusty-red material.

MICROSCOPIC TEXTURE:

The rock is fine-grained. Some grains are up to 2 mm in diameter. There are many fractures with opaque phases and epidote.

MINERALS:

Quartz shows undulouse extinction.

Plagioclase and *microcline* are altered and show evidence of brittle deformation. An alteration to perhaps albite is common and secondary microcline in plagioclase also occurs.

Pertite also occurs.

Epidote occurs in occasional clusters and in fractures.

A rusty-red fine-grained mineral occur in fractures.

KINEMATIC INDICATORS:

Not enough deformation.

ID_CODE: PSM005081 **THIN-SECTION:** 5081

PHOTOS: 5081_pnic_02; 5081_xnic_01

ROCK: Fine-grained dioritoid or quartz monzodiorite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: Sinistral (47/80)

MACROSCOPIC DESCRIPTION:

The rock is reddish with some 1 mm in diameter large grains and quartz aggregates visible for the naked eye.

MICROSCOPIC TEXTURE:

Quartz and feldspar is dominating. There is a discontinuous foliation of mica and chlorite. Some alteration of feldspar occurs. Protomylonitic fabric.

MINERALS:

Quartz shows undulouse extinction and bulging between grains and occurs both in aggregates and in fine-grained streaks.

Plagioclase and *microcline* occur both as porfyroclasts and as very fine grains. The larger grains are slightly altered to sericite.

Biotite and *muscovite* occur. Fine grained muscovite, sericite, also occurs in altered feldspar.

Chlorite and *Epidote* occur.

Magmatic *titanite,* with a cluster of very fine-grained titanite that probably formed during deformation, also occurs.

KINEMATIC INDICATORS:

Protomylonitic fabric.

A weak sinistral S/C-fabric.

ID_CODE: PSM005768 **THIN-SECTION:** 5768A

PHOTOS: 5768A_pnic_02, 04; 5768A_xnic_01, 03

ROCK: Fine-grained dioritoid

KINEMATICS IN THIN-SECTION: Sinistral/(dextral)

KINEMATICS ON MAP-VIEW: South side up/ (north side up) (245/76)

MACROSCOPIC DESCRIPTION:

The rock is dark and fine-grained with red granite streaks along the foliation. No grains visible for the naked eye in the dark rock. Some quartz lenses and grains are visible for the naked eye in the red rock.

MICROSCOPIC TEXTURE:

The dark rock is fine-grained and there is less feldspar porfyroclasts and less quartz lenses. Streaks with very fine-grained or opaque mineral occur. In the red rock there are quartz lenses with subgrains elongated oblique to the foliation forming a sinistral S/C-fabric, and feldspar porfyroclast and calcite forming bands. These bands are separated by bands with very fine-grains of quartz feldspar and mica. In some places there is lots of epidote.

MINERALS:

Quartz occurs in lenses where subgrains are elongated oblique to the foliation forming an S/C-fabric. Larger quartz grains show undulouse extinction. Bulging between grains also occur.

Plagioclase and *microcline* are often altered to sericite and calcite and show evidence of brittle deformation.

Biotite occurs mostly in the dark rock in matrix.

Muscovite occurs in matrix and in altered feldspars as fine-grained sericite.

Epidote occurs in occasional clusters.

Calcite occurs in the red rock and in altered feldspars.

KINEMATIC INDICATORS:

Subgrains, in quartz lenses, elongated oblique to the foliation forming a sinistral S/C-fabric.

Dominating sinistral zones, but dextral conjugate occurs.

ID_CODE: PSM005768 **THIN-SECTION:** 5768B

PHOTOS: 5768B_pnic_02; 5768B_xnic_01

ROCK: Red fine grained granite in area with fine-grained dioritoid.

MACROSCOPIC DESCRIPTION:

The rock sample is medium-grained and pegmatite like in one end, but the cut is very fine-grained with no grains visible for the naked eye. There is a strongly fractured foliation.

MICROSCOPIC TEXTURE:

Grain sizes vary from very fine-grained up to small porfyroclasts. Feldspar porfyroclast show evidence of brittle deformation and incipient alteration to sericite and perhaps albite. Quartz occurs in small aggregates.

MINERALS:

Quartz occurs in small aggregates. Larger grains show undulouse extinction. Bulging between grains is also visible.

Plagioclase and *microcline* are altered to sericite and perhaps albite. Lamellae formed by deformation are visible. *Pertite* also occurs.

Muscovite occurs both in matrix and as very fine-grained sericite in small lumps in matrix and in altered feldspars.

Calcite and *Titanite* occur as well.

Chlorite occurs in fractures.

KINEMATIC INDICATORS:

Not enough deformation for a reliable kinematic analysis.

ID_CODE: PSM005776 **THIN-SECTION:** 5776

PHOTOS: 5776_pnic_02; 5776_xnic_01

ROCK: Medium-grained granite in area with fine-grained dioritoid.

KINEMATICS IN THIN-SECTION: Dextral

KINEMATICS ON MAP-VIEW: Sinistral (60/80)

MACROSCOPIC DESCRIPTION:

The rock is fine-grained with some quartz grains visible for the naked eye. Dark streaks form a clear foliation. A weak (sinistral on map) S/C-fabric can be seen.

MICROSCOPIC TEXTURE:

Feldspar occurs in all sizes up to 1.5 mm in diameter. Feldspar has been altered to sericite and albite. Some porfyroclasts have kinked lamellae. Thin bands of muscovite, chlorite and a rusty-red mineral form a foliation. There are also dark thin bands of fine-grained opaque minerals and/or epidote and/or titanite.

MINERALS:

Quartz shows undulouse extinction and bulging between grains.

Plagioclase and *microcline* are often altered to sericite and albite. Lamellae are often kinked. All sizes up to 1.5 mm in diameter occur.

Muscovite occurs as fine grained sericite in small lumps or in streaks and also in altered feldspar.

Epidote occurs in large occasional grains and perhaps as very fine grains in streaks.

Chlorite occurs in fractures

Titanite occurs as occasional crystals and perhaps as very fine grains in streaks.

KINEMATIC INDICATORS:

Elongated quartz forming dextral S/C-fabric with mica.

Weak dextral S/C-fabric in low magnification.

ID_CODE: PSM005806 **THIN-SECTION:** 5806

PHOTOS: 5806_pnic_01; 5806_xnic_02

ROCK: Fine-grained dioritoid (sample not orientated)

MACROSCOPIC DESCRIPTION:

The rock is dark and fine-grained. Occasional porfyroclasts are visible for the naked eye. Wavy dark streaks are also visible.

MICROSCOPIC TEXTURE:

The rock constitutes of bands of fine-grained quartz and feldspar separated by bands of biotite and chlorite. Occasional feldspar porfyroclasts, less than 1 mm in diameter, occur.
The porfyroclasts are often slightly altered to sericite.

MINERALS:

Quartz occurs in aggregates where some larger aggregates have been subjected to brittle deformation and are fractured. Large quartz grains show undulouse extinction. Some triple junctions between quartz grains can also be found and is evidence of static recrystallisation.

Plagioclase is the dominating feldspar and occurs as small porfyroclast up to 1 mm in diameter and also in smaller grain sizes. Kinked lamellae are common and sometimes the porfyroclasts are slightly altered to sericite.

Biotite occurs in streaks with chlorite.

Chlorite occurs in streaks with biotite.

Muscovite occurs as very fine-grained sericite in altered feldspar.

Epidote occurs sometimes as fine grains in the biotite and chlorite streaks, but also as larger occasional grains.

ID_CODE: PSM005821 **THIN-SECTION:** 5821

PHOTOS: 5821_pnic_02, 03; 5821_xnic_01

ROCK: Fine-grained dioritoid

KINEMATICS IN THIN-SECTION: Dextral/Sinistral

KINEMATICS ON MAP-VIEW: Sinistral north side up or dextral south side up (257/73).

MACROSCOPIC DESCRIPTION:

The rock is dark and fine-grained. Dark streaks form a dextral S/C-fabric.

MICROSCOPIC TEXTURE:

Feldspar shows a strong alteration to sericite, albite and perhaps epidote. A large calcite fragment is deformed and statically recrystallized. Opaque phases and titanite is formed during deformation.

MINERALS:

Quartz displaying undulouse extinction and subgrain formation occurs, but triple junctions can also be found indicating static recrystallization.

Plagioclase and *microcline* are heavily altered by saussuritization. Sericite and albite and perhaps epidote are formed.

Muscovite occurs as fine-grained sericite in altered feldspar.

Chlorite occurs as alteration from an amphibole.

Amphibole occurs but is extensively altered to chlorite.

Titanite seems to be formed during deformation.

Calcite is growing during deformation but is also statically recrystallized.

KINEMATIC INDICATORS:

Two systems; both dextral and sinistral occur.

ID_CODE: PSM005843 **THIN-SECTION:** 5843

PHOTOS: 5843_pnic_01; 5843_xnic_02

ROCK: Ävrö granite (undeformed rock sample).

MACROSCOPIC DESCRIPTION:

The rock is equigranular, with grain size between 1 and 3 mm. Quartz feldspar and mica occur and some lumps with metallic lustre. An area with red staining is found in the sample but is not covered by the thin section.

MICROSCOPIC TEXTURE:

Quartz and feldspar show a nice magmatic texture, but some quartz show undulouse extinction and subgrain formation. Feldspar is slightly altered to sericite. Amphibole occurs and is altered to biotite. Biotite has lost titanium during deformation. Titanite with opaque inclusions, perhaps illmenite, has formed during deformation.

MINERALS:

Quartz occurs as nice magmatic crystals but is sometimes undulouse with beginning of subgrain formation.

Feldspar, both plagioclase and microcline, has nice magmatic texture but is sometimes slightly altered to sericite. Secondary microcline seems to form in plagioclase.

Biotite is formed from amphibol, but is also broken down and an opaque phase is dissolved. Kinked biotite occurs.

Amphibole occurs but is altered to biotite.

Epidote occurs and is formed between plagioclase and amphibole.

Titanite occurs, and sometimes with an opaque inclusion, perhaps consisting of illmenite.

ID_CODE: PSM005864 **THIN-SECTION:** 5864

PHOTOS: 5864_pnic_01, 02; 5864_xnic_03

ROCK: Ävrö granite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: South side up (100/60)

MACROSCOPIC DESCRIPTION:

The rock is dark and fine-grained. Porfyroclasts up to 2 mm in diameter are visible. A sinistral S/C-fabric is formed by red streaks.

MICROSCOPIC TEXTURE:

Occasional feldspar porfyroclasts, up to 2 mm in diameter, lie in a fine-grained matrix. Foliation is made up by thin continuous streaks of biotite and epidote. Feldspar porfyroclasts are often extensively altered to albite.

MINERALS:

Quartz occurs in fine grains in matrix.

Plagioclase and *microcline* occur as fine grains in matrix and as occasional porfyroclast up to 2 mm in diameter. The porfyroclasts are often extensively altered to *albite*.

Biotite and *epidote* occur in thin continuous streaks that form the foliation.

Muscovite occurs in matrix.

Titanite with opaque inclusions also occurs.

KINEMATIC INDICATORS:

Short sinistral C' shear bands visible in low magnification.

Sinistral S/C-fabric.

Sinistral shear pods.

ID_CODE: PSM6088 **THIN-SECTION:** 6088A

PHOTOS: 6088A_pnic_02, 04; 6088A_xnic_01, 03

ROCK: Medium-grained granite.

KINEMATICS IN THIN-SECTION: Dextral

KINEMATICS ON MAP-VIEW: Sinistral (58/84)

MACROSCOPIC DESCRIPTION:

The rock has a distinct foliation of bands with quartz lenses and feldspar porfyroclast separated by dark and green streaks. The dark and green streaks are fine-grained with no grains visible for the naked eye.

MICROSCOPIC TEXTURE:

The rock constitutes of alternating bands of fine-grained quartz and very fine-grained quartz. Some quartz grains shows undulouse extinction but triple junctions in ribbon quartz is also visible. The quartz has been statically recrystallized. Feldspar porfyroclasts up to 2 mm in diameter occurs. The feldspar has been altered to sericite and calcite. In plagioclase alteration to secondary microcline might have occurred.

MINERALS:

Quartz occurs as ribbon quartz which has been annealed due to static recrystallization. Quartz with undulouse extinction is also present.

Plagioclase and *microcline* have kinked lamellae and are often altered to sericite and calcite. In plagioclase alteration to secondary microcline might have occurred. Feldspar occurs as porfyroclasts up to 2 mm in diameter.

Muscovite occurs as fine-grained sericite in altered feldspar.

Calcite occurs.

Chlorite is also present.

Titanite and *epidote* might occur.

KINEMATIC INDICATORS:

Dextral zones.

A weak dextral S/C-fabric.

ID_CODE: PSM6088 **THIN-SECTION:** 6088B

PHOTOS: 6088B_pnic_02; 6088B_xnic_01

ROCK: Medium- to coarse-grained granite (undeformed rock sample).

MACROSCOPIC DESCRIPTION:

The rock is equigranular with grain sizes from 1 to 5 mm. Feldspar, quartz, mica is present. A red-staining is covered by the thin section.

MICROSCOPIC TEXTURE:

Quartz shows undulouse extinction and bulging between grains. Feldspar show evidence of brittle deformation and are also often altered to sericite. Chlorite and biotite occur and fractures are filled with chlorite and epidote. There are also fractures filled with a rusty-red mineral.

MINERALS:

Quartz shows undulouse extinction and bulging between grains.

Plagioclase is the dominating feldspar. Plagioclases are often altered to sericite and perhaps to secondary microcline. Crystals are large, more than 2.5 mm in diameter.

Muscovite occurs as fine-grained sericite in altered plagioclase.

Biotite, chlorite and *calcite* occur.

Epidote and *chlorite* occurs in fractures.

Opaque phases also occurs.

A rusty-red mineral occurs in fractures.

ID_CODE: PSM007759 **THIN-SECTION:** EL0505A

PHOTOS: EL0505A_pnic_01, 03; EL0505A_xnic_02

ROCK: Quartz monzodiorite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: Sinistral (50/85)

MACROSCOPIC DESCRIPTION:

The rock sample is dark and fine-grained. Feldspar porfyroclasts are visible for the naked eye. The distinct foliation consists of elongated feldspars and dark/greenish seams. Lumps with gold/yellow metallic lustre are visible.

MICROSCOPIC TEXTURE:

Lensoid quartz aggregates and seams with chlorite, biotite and opaque phases exist in a fine-grained matrix of mostly white mica. Larger porfyroclasts of altered and fractured feldspars also exists.

MINERALS:

Quartz, occurs mostly in lenses. Some grains show undulouse extinction. Bulging between the grains is also common.

Feldspar, occurs in up to 1.5–2 mm large porfyroclasts. The dominating feldspar is plagioclase. The feldspars exhibit saussuritization. Sericite and calcite can be found in altered feldspars. The feldspars also show evidence of brittle deformation.

Mica, occurs as small grains in matrix. Biotite together with chlorite and opaque phases form seams along the foliation. White mica is the dominating mineral in the matrix, but also occurs in altered feldspars as fine-grained sericite.

Chlorite, form seams along the foliation together with biotite and opaque phases.

Epidote, is common in the sample.

Titanite, occur in small amounts and are probably magmatic.

Calcite, occurs both in matrix and in altered feldspars.

Apatite, occur as accessory mineral.

Opaque phases, occur in seams and/or fractures.

KINEMATIC INDICATORS:

A sinistral S/C’-fabric is visible with low magnification.

Sinistral shear pods.

ID_CODE: PSM007759 **THIN-SECTION:** EL0505B

PHOTOS: EL0505B_pnic_02; EL0505B_xnic_01

ROCK: Quartz monzodiorite (lower part of sample) and fine-grained granite dyke (upper part of sample).

MACROSCOPIC DESCRIPTION:

The upper part consists of fine-grained granite. Some crystals are visible for the naked eye, but they are still smaller than 1 mm across. No foliation is visible.

The lower part is dark and fine-grained. Some feldspar porfyroclasts and some quartz aggregates are visible for the naked eye. A vague foliation is visible in form of dark stripes or seams. The foliation is cut by the granitoid.

MICROSCOPIC TEXTURE:

(Upper part): Some feldspars are sericitisized but they are also affected by cataclasis. Larger quartz crystals show undulouse extinction.

(Lower part): Seams or stripes with brown biotite and chlorite forms a foliation. Some epidote occurs as well and perhaps a few titanites. Feldspars are more altered. Quartz aggregates sometimes show a vague elongation along the foliation. Larger quartz crystals show undulouse extinction.

MINERALS:

Quartz, show undulouse extinction and smaller crystals forms aggregates with a sometimes vague elongation along the foliation.

Feldspars are fractured and/or altered to sericite. Alteration is more extensive in the lower part (quartz monzodiorite). Both plagioclase and microcline occurs.

Biotites are brown and forms stripes or seams with mainly chlorite.

Muscovite occurs as small aggregates or as fine-grained sericite in altered feldspars.

Chlorite occurs in stripes or seams together with mainly biotite.

Epidote occurs in the lower part (quartz monzodiorite).

Titanite might occur in the lower part.

KINEMATIC INDICATORS:

Not enough deformation.

ID_CODE: PSM007760 **THIN-SECTION:** EL0506

PHOTOS: EL0506_pnic_01, 03; EL0506_xnic_02

ROCK: Quartz monzodiorite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: Sinistral (42/86)

MACROSCOPIC DESCRIPTION:

The rock is dark and fine-grained. No crystals in the matrix are visible for the naked eye. Some feldspar porfyroclasts are visible. Short dark stripes or lenses are also visible and probably consists of quartz. Small lumps with a golden metallic lustre also occur and probably consist of pyrite. There is a strong foliation throughout the sample.

MICROSCOPIC TEXTURE:

Lenses and bands of quartz and feldspar in a fine-grained matrix of mica. Biotite is the dominating mineral in the matrix, but muscovite also occurs. There are also some fractures containing opaque minerals.

MINERALS:

Quartz form lenses where subgrains are elongated oblique to the elongation of the lens itself. This makes up a sinistral S/C-fabric. Bulging between the crystals also occur.

Plagioclase is the dominating feldspar. The feldspars are sometimes very fine-grained. Larger crystals are often altered by saussuritization.

Biotite is fine-grained and dominates the matrix.

Muscovite is present in the matrix and is also present as very fine-grained sericite in altered feldspars.

Titanite with inclusion of an opaque mineral is present.

Epidote and calcite also occurs in the sample.

KINEMATIC INDICATORS:

Quartz lenses with oblique foliation make up a sinistral S/C-fabric.

ID_CODE: PSM007761 **THIN-SECTION:** EL0507

PHOTOS: EL0507_pnic_01, 02, 04; EL0507_xnic_03, 05

ROCK: Quartz monzodiorite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: Sinistral (29/87)

MACROSCOPIC DESCRIPTION:

The rock is dark and fine-grained. Quartz aggregates less than 1 mm across are visible for the naked eye. Stripes with a distinct green colour are visible and most likely consist of epidote.

MICROSCOPIC TEXTURE:

Continous stripes or seams with biotite and epidote make up a foliation. Porfyroclast of feldspar and quartz aggregates is also present.

MINERALS:

Quartz shows undulouse extinction and formation of subgrain due to dynamic recrystallisation. Triple junctions, which is evidence for static recrystallization, can also be found.

Plagioclase is the dominating feldspar. Feldspars show evidence for brittle deformation. Some feldspars are also strongly altered to mainly sericite.

Biotite forms a foliation.

Muscovite occurs as fine-grained sericite in altered feldspars.

Epidote is common.

Titanites with opaque core are present and are probably not magmatic.

Calcite can also be found.

KINEMATIC INDICATORS:

Sinistral shear bands of biotite.

Oblique foliation along the (L) mark edge of the sample.

ID_CODE: PSM007769 **THIN-SECTION:** EL0515

PHOTOS: EL0515_pnic_03; EL0515_xnic_01, 02, 04

ROCK: Ävrö granite

KINEMATICS IN THIN-SECTION: Sinistral

KINEMATICS ON MAP-VIEW: Sinistral (9/86)

MACROSCOPIC DESCRIPTION:

The rock is dark and fine-grained. Feldspar porfyroclasts are visible for the naked eye. Thin dark stripes or seams are present. A sinistral S/C-fabric is visible and a tension gash formed due to sinistral pull-apart is also visible. Fractures probably filled with epidote also occur.

MICROSCOPIC TEXTURE:

There are continuous streaks with muscovite and some chlorite. Larger porfyroclasts of feldspar show evidence of brittle deformation. Feldspar also occurs as fine grains in matrix. Quartz forms larger aggregates, but also occurs as fine grains in matrix. A weak sinistral S/C-fabric can be seen at low magnification.

MINERALS:

Quartz, occur in fine grains in matrix and in aggregates. Larger grains show undulouse extinction and there is also bulging between crystals.

Plagioclase is the dominating feldspar. Feldspars are fractured due to brittle deformation and alteration to sericite is also common. Some feldspars show weak core-and-mantle structure.

Muscovite occurs in continuous streaks but also as very fine-grained sericite in altered feldspars.

Chlorite occurs in streaks and in pressure shadows around porfyroclasts.

Epidote is mostly present in fractures.

Titanite might be present in very fine grains forming streaks. Identification is difficult due to the very fine grain size.

KINEMATIC INDICATORS:

A weak sinistral S/C-fabric visible in low magnification.

A sinistral S/C-fabric visible in rock sample

ID_CODE: PSM007772 **THIN-SECTION:** EL0518

PHOTOS: EL0518_pnic_03; EL0518_xnic_01, 02

ROCK: Fine-grained dioritoid (undeformed rock sample)

MACROSCOPIC DESCRIPTION:

The rock is dark and fine-grained. Almost no grains are visible for the naked eye. Some lumps with a golden metallic lustre probably consisting of pyrite are present.

MICROSCOPIC TEXTURE:

Most grains are less than 0.5 mm across, but some plagioclases are up to 1.5·2.5 mm and also some biotites are larger than 1 mm across. Some biotites seem to be alterations from amfiboles, perhaps hornblende. Plagioclase is often altered to sericite.

MINERALS:

Quartz, only occur in fine grains.

Feldspars, both plagioclase and microcline occur, but plagioclase is by far the most common. Alteration to sericite is common.

Biotites occur sometimes as larger euhedral grains. Some biotite seems to be alterations from an amphibole.

Muscovite occurs as very fine-grained sericite in altered feldspar.

Amphibole occurs, but is altered to biotite. The original amphibole is probably a hornblende.

ID_CODE: PSM007773 **THIN-SECTION:** EL0519

PHOTOS: EL0519_pnic_01; EL0519_xnic_02, 03

ROCK: Quartz monzodiorite (undeformed rock sample)

MACROSCOPIC DESCRIPTION:

Large, up to 5 mm across, feldspars are visible and also some spots of quartz. In between the feldspars there is a dark matrix with micas.

MICROSCOPIC TEXTURE:

Quartz occurs in small aggregates, less than 2 mm across. Some biotites are up to 2 mm across. There is a lot of epidote in the sample. The feldspars are altered by saussuritization, forming mainly muscovite, but also epidote chlorite and calcite.

MINERALS:

Quartz occurs in small aggregates. Larger crystals show undulouse extinction and there is also bulging in between grains.

Feldspar occurs both as plagioclase and as microcline and plagioclase is most common. The feldspars are often altered by saussuritization forming muscovite, epidote, chlorite, calcite and also secondary plagioclase.

Mica both biotite and muscovite is present in the sample. Muscovite also occurs as very fine-grained sericite in altered feldspar.

Epidote is common in the sample.

Calcite occurs both free in the sample and also in altered feldspars.

Chlorite is also present.