

APPENDIX 5: PFF logging observations from Laxemar Borehole KLX01

LAXEMAR
BOREHOLE
KLX01

Depth along core (m)	PFF & TYPE	Minerals	Wallrock Alteration	Calcite morphology	Other data	Fracture Type	Aperture (mm)	Host Lithology	Comment	Sampled	Fracture inclination
1.05 W							?	Granite			sub-horizontal
2.01 W		clay					?	Granite	remnant clay coating		gentle
2.05 W		clay					?	Granite	remnant clay coating		sub-horizontal
7.2 E		chl, cal, il	Reddened to 5 cm on both sides	scaley film, E	O isotope	Reactivated	?	Granite	Mainly scaley calcite film. Some euhedral faces at film edges appear to be rare equant overgrowths		gentle
8.3 W							?	Granite			sub-horizontal
8.85 W							?	Granite			gentle
9.95 W							?	Granite			sub-horizontal
10.15 E		cal, chlo	Feldspar weakly reddened to 2-3 mm on both sides			Reactivated	?	Granite	Clear calcite. Colourless calcite, Thin calcite film on hydrothermal chlorite coating. Calcite crystal morphology unclear		gentle
10.3 W		clay					?	Granite			gentle
10.45 W		clay					?	Granite			sub-horizontal
10.95 E		cal		scaley film			?	Granite	Clear calcite. Colourless calcite. Thin calcite film with occasional euhedral faces. Calcite crystal morphology unclear. Fresh pyrite in host rock	KLX01 10.95, E-L Tullborg for isotopes KLX01 11.20 E-L Tullborg for isotopes and BGS for SEM	sub-horizontal
11.2 E		cal, clay, sulphide		scaley film			?	Amphibolite	Calcite crystal morphology unclear Late calcite film developed on earlier 1 mm scale complex vein. Comprises early hydrothermal feldspar or laumontite with later chlorite, followed by late calcite		gentle
11.8 E		cal, feld or laum, chlo		scaley film		Reactivated	?	Amphibolite		KLX01 11.80, BGS for SEM	moderate
12.95 E		cal, sulphide		scaly, patchy film				Amphibolite		KLX01 13.1 E. L Tullborg for isotopes, BGS for SEM, CL, includes feature 13.20-13.50 ('13.35')	
13.1 E		cal, sulphide		extensive scaly film				Amphibolite	several closely-spaced thin features, some essentially sealed, others are PFFs		moderate

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13.35 E, Feox		cal, Feox, ?sulp		scaly film				volcanite	steep, curved fracture largely coated in scaly calcite, with localised development of Feox on surfaces	Y	steep
13.95 E, D		cal, ?laum, chl		scaley film, ?E		Reactivated		volcanite	Mouldic cavities after laumontite dissolution, with possible equant clear calcite crystals	KLX01 13.95 BGS for SEM	gentle
14.05 E		cal, chlo		scaley film		Reactivated		volcanite			
14.13 W		cal, Feox (trace)		scaly				Amphibolite	calcite slightly weathered		gentle
17.08 E		cal		euohedral calcite crsytals				Amphibolite	possible equant crystals	KLX01 17.08 E-L Tullborg for isotopes, BGS for SEM	gentle
22.1 E cal & py		cal, py	slight pale discolouration	equant	Isotopes indicating bacterial activity (-80 per mil), ICP	Reactivated	>0.5	Amphibolite-Granite	Reactivated old calcite vein. Almost completely encrusted with equant calcite and pyrite euhedra. Pyrite very fresh	KLX01 22.10 E-L Tullborg for isotopes, BGS for SEM, CL etc	
22.97 E cal & py		cal, py, chl, hem	slight discolouration	equant		reactivated	>0.5	volcanite	calcite much damaged; most py possibly nucleated on tiny sulphide crystals in wallrock	KLX01 22.97 E-L Tullborg for isotopes, BGS for SEM	sub-horizontal
35.7 E?		cal		scaly film & crystal aggregates				amphibolite	steep, irregular, possible PFF, not well developed		steep
37.35 E		cal, trace py		equant	isotopes	reactivated	>0.5	amphibolite	crust of well-developed equant calcite and rare fresh pyrite grows over a reactivated older calcite vein; new calcite probably developed along cm-scale channel asperities on reactivated fracture surface	KLX01 37.35 E-L Tullborg for isotopes, BGS for SEM, CL, FI	steep
42.73 E		cal		equant to markedly elongate				amphibolite	steep, curved feature with a near-complete veneer of pale greenish calcite; microscope inspection reveals tiny euhedra lining forming patches and lining vugs, with forms ranging from equant to needles top of feature terminates against gently inclined sealed fracture.		steep
42.9 E		cal, chl		equant		reactivated		amphibolite	late calcite as scaley film and equant euhedra on reactivated early chlorite-calcite vein surfaces	KLX01 42.90 E-L Tullborg for isotopes, BGS for SEM	steep

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43.85 E		cal		?					moderate to steep fracture with an irregular surface and a near-complete veneer of calcite with a pale greenish tinge; microscope observation reveals isolated occurrences of clusters of calcite euhedra, and occasional water-clear euhedral overgrowths		moderate to steep
45.75 E		cal, sulphide		scaley film & equant		reactivated		amphibolite	Steep, irregular to curved fracture, reactivated thin old white calcite-pyrite vein with scaley late calcite overgrowths and asperities with occasional equant calcite crystals		steep
51.2 E		cal, py, ep, hem		equant to scaley	isotopes	reactivated		amphibolite vein by granite	Steep fracture with fine clear scaley calcite and rare equant calcite crystals, largely developed as overgrowths on reactivated and sheared old calcite-hematite-epidote vein		steep
51.3 E		cal, hem		equant and overgrowths	isotopes	reactivated	>1 mm	volcanite	Coarse calcite euhedra on reactivated hemaite-calcite vein surfaces.	KLX01 51.3, includes 51.2. E-L Tullborg for isotopes, BGS for SEM, CL, FI	sub-horizontal
52 E		cal, sulphide, chl, laum	reddened to 3 cm on both sides	equant, stubby-c-axis elongate to c-axis elongated	isotopes	reactivated	>0.5	Granite	Steep, planar fracture. Reactivated older chlorite-calcite-laumontite vein. Thin section petrography (E-L Tullborg) shows calcites to be zoned.	KLX01 52 E-L Tullborg for isotopes, BGS for SEM, CL, ?FI	steep
55 E		cal, chlo, py		equant		Reactivated	>0.5	Granite	Steep irregular fracture, partially sealed fracture, with late calcite as euhedral overgrowths and doubly-terminated crystals, and very fine late pyrite, resting on old calcite-chlorite surfaces.	KLX01 55 E-L Tullborg for isotopes, BGS for SEM, CL	steep
56.6 E		cal, chl, clay, sulphide, hematite, adularia	reddened for 1-2 cm	equant and scaley film		Reactivated		Granite	Multiply reactivated hydrothermal vein: adularia, chlorite-hematite-calcite, with late calcite overgrowths and scaley films.		steep
56.8 ?		cal, chl	weak reddening	scaley film		Reactivated		Granite	Traces of fine, very fresh late sulphide		moderate
57.2		cal, chl	weak reddening	scaley film		Reactivated		Granite	Possibly open, but only very narrow feature, now largely sealed		moderate
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60 E		cal, ep, preh, chl?, lau?	pink feldspars for a distance of several cm's	not determined		reactivated		Granite	steep planar fracture has old hydrothermal green fill to 4 mm wide of chlorite and/or epidote, reactivated and resealed by a calcite vein of around 2 mm wide; the fracture has reactivated again and now has rare development of isolated patches of late calcite	KLX01 60 E-L Tullborg for isotopes, BGS for SEM, CL, FI	steep
69.24 E		cal,chl,lau?		scalenohedra		reactivated		pink fine granite	small, scalenohedral (c. 2 to 3 :1) crystals, some doubly-terminated, clear with a greenish tinge, sit in clusters of cm-scale on a sub-horizontal surface.	KLX01 69.24 E-L Tullborg for isotopes, BGS for SEM, ?CL	sub-horizontal
79.9 D, W		cal, chl, sulp, ?Feox		scaley film		dissolution		Granite	Steep, irregular fracture with weathered surfaces and fissure porosity with moulds after a radiating fibrous phase (possibly after prehnite or laumontite, highlighted by drilling mud invasion along fracture	KLX01 79.9 E-L Tullborg for isotopes, BGS for SEM, CL.	Steep irregular fracture
81.84 ?		cal, chl, sulp		scaley calcite, with some coalesced fine crystals which have been flattened by limited growth space. Possibly largely sealed by older calcite	ELT sampled for mineralogy	?reactivated		Volcanite	series of close-spaced (1-2 cm) irregular fractures. Possibly largely sealed by discontinuous film-like fill of old calcite and trace pyrite, reactivating earlier chlorite vein. The fracture may have some late calcite film formed by coalescing fine crystals which have had very limited growth space.		Sub-vertical
81.94 ?		cal, chl, sulp		scaley calcite, with some coalesced fine crystals which have been flattened by limited growth space. Possibly largely sealed by older calcite	ELT sampled for mineralogy	?reactivated		Volcanite	series of close-spaced (1-2 cm) irregular fractures. Possibly largely sealed by discontinuous film-like fill of old calcite and trace pyrite, reactivating earlier chlorite vein. The fracture may have some late calcite film formed by coalescing fine crystals which have had very limited growth space. Very small, white, doubly-terminated calcite euhedra in lee of asperities of very thin re-fractured calcite-chlorite vein. Late calcite developed at intersection with following PFF fracture		Sub-vertical
83.69 E		cal, chl		stubby c-axis elongated		reactivated	>0.2	volcanite			sub-horizontal

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83.72 E		cal, chl, py		? Scaley film and possibly some rare stubby c-axis elongated crystals		reactivated		volcanite	Irregular fracture, with largely coalesced thin platy crystals that grew in restricted film-like pore-space, rarely sealed by scaley film-like calcite and calcite overgrowths on reactivated old calcite-chlorite vein. Traces of late euhedral pyrite. Possibly largely sealed.		Steep
86 W		cal, sulp, chl						Granite	Steep sub-planar fracture with rough or irregular surface coated by thin discontinuous film of old calcite-chlorite mineralisation. The surface of fracture appears 'weathered'		Steep
86.7 E		cal		Scaley film and agglomeration of subhedral late calcite crystals		?reactivated		Altered Granite	Fracture surface with discontinuous scaley calcite coating on old calcite coating. Section of core containing several steep curved fractures with irregular surfaces, all with similar mineralisation	KLX01 86.7 E- L Tullborg for isotopes, BGS for SEM	Steep
86.7 ?		cal		Scaley film		?reactivated		Altered Granite	Fracture surface with discontinuous scaley calcite coating on old calcite coating, similar to adjacent feature, but not clearly open fracture		Steep
87.2 E		cal, chl, ep, he	Strongly reddened and epidotised mylonitic shear band for 2-3 cm in footwall	scaley film and flat hexagonal confined-space crystals small, scattered agglomerations of very small subhedral to euhedral stubby c-axis elongated crystals; most calcite on surface is sample, a discontinuous scaly coating, possibly older	ELT calcite on surface is sample, scraped for isotopes	Reactivated		Altered Granite	Hairline fissure reactivating the hanging wall margin of mylonitic (epidote-chlorite-hematite) band 2-3 cm wide. Clear hexagonal euhedral calcite crystals developed as film on rock surface and as overgrowths on old calcite coating. Late calcite growth restricted by limited pore-space.	KLX01 87.2 E- L Tullborg for isotopes, BGS for SEM, CL	Steep
88.95 E		cal, chl, ep?, sulp	weak reddening			reactivated		Granite	sub-vertical, sub-planar fracture with a dullish surface of patchy chlorite-epidote-scaly calcite; late calcite forms rare patches of agglomerated crystals, with poor form; sulphide is in the wallrock.	KLX01 88.95 BGS for SEM, ?CL	sub-vertical

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89.94	E?, D?	cal, chl	weak reddening	rare euhedra, possibly slightly elongate (stubby)		reactivated		Granite	rare, very small, water-clear, probably stubby scalenohedral calcite crystals line rare slot-moulds (unknown precursor) and sit in a discontinuous cruddy-looking layer of feldspar, quartz and chlorite, sitting partly on weakly weathered wallrock and partly on a reactivated mm-scale calcite vein. Euhedral pyrite overgrowths into fracture, nucleated on pyrite in wallrock. Pyrite crystals display markedly striated crystal faces.		sub-horizontal
111.45	?E	pyr, chl				reactivated		Quartz monzonite			moderate
115.88	?E	cal, py		rare euhedral terminations		?reactivated		volcanite	a dark (weakly chloritised?) fracture surface has a discontinuous coating of scaly calcite with occasional development of euhedral faces on overgrowths developed towards unfilled space; pyrite is in the wallrock.		gentle
121.37	?E	cal, py		very fine restricted flat crystals to scaley film				volcanite	Very fine calcite crystals, flattened due to restricted growth. Uncertain development of good crystal faces, tentatively identified as a PFF. Pyrite exposed in wallrock + possibly traces of euhedral prite overgrowth on wallrock pyrite.		Steep
121									General comment: below around 121 many generally moderately inclined fracture surfaces are polished and have strong-ish dip-oblique (around 20-30 degrees off dip-parallel) striae (possibly related to faultrock developed at around 159.7); scaly calcite coatings always sit on (post-date) the striae.		
123.92	E	cal, ?clay (tr)		flat hexagons, possibly nailhead				volcanite	patches of small crystals and crystal agglomerations with frequent euhedral terminations; some are milky white, others translucent; the best formed crystals have hexagonal outlines and may not have been restricted in z-direction, i.e. they may be nailhead morphology.	KLX01 123.92 E-L Tullborg BGS for SEM, CL	sub-vertical, markedly irregular surface
124.4	E?	cal		possibly elongate; not unequivocal				pink fine granite	patches of calcite on an irregular surface; morphology difficult to discern - possibly markedly elongate locally, but slot-shaped mouldic pores may give a similar impression		steep
136.9	?W							Quartz monzonite	Possibly 'aged' or altered fracture surface with ochreous stain		gentle

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152 E		cal, py, chl		scaley calcite formed by coalescing growth-restricted flay crystals. Possibly some 'nailhead' forms		reactivated		Quartz monzonite	Slickensided chlorite-coated fracture surface, with impersistent coating of scaley thin calcite resting on the slickensided surfaces. The calcite is milky white and has flat euhedral crystal form. The slicken striae are steeply dipping (dip acute).		steep
152.5 E		cal, py, chl		scaley calcite formed by coalescing growth-restricted flay crystals		reactivated		Quartz monzonite	Slickensided chlorite-coated fracture surface, with impersistent coating of scaley thin calcite resting on the slickensided surfaces. The calcite is milky white and has flat euhedral crystal form. The slicken striae are steeply dipping (dip acute).		steep
152.9 E		cal		c-axis elongate crystals, 2-3:1 c:a		fresh	>0.5 mm	Quartz monzonite	clear, well-developed c-axis elongated, doubly terminated calcite crystals resting on fresg quartz monzonite wallrock surfaces. Forms part of a set of parallel features		moderate
153.4 E		cal		c-axis elongate crystals, 2-3:1 c:a		fresh	>0.5 mm	Quartz monzonite	clear, well-developed c-axis elongated, doubly terminated calcite crystals resting on fresg quartz monzonite wallrock surfaces. Forms part of a set of parallel features	KLX01 13.50 (includes 153.62 m) E-L Tullborg for isotopes, BGS for SEM, CL, FI	moderate
153.5 E		cal		c-axis elongate crystals, 2-3:1 c:a		fresh	>0.5 mm	Quartz monzonite	clear, well-developed c-axis elongated, doubly terminated calcite crystals resting on fresg quartz monzonite wallrock surfaces. Forms part of a set of parallel features		moderate
153.62 E		cal		c-axis elongate crystals, 2-3:1 c:a scaley calcite film with euhedral faces at margins of coalesced crystal masses		fresh	>0.5 mm	Quartz monzonite	clear, well-developed c-axis elongated, doubly terminated calcite crystals resting on fresg quartz monzonite wallrock surfaces. Forms part of a set of parallel features formed in hanging wall to a fault rock about 6 m below this point.		moderate
154.5 E		cal, chl		scaley calcite film with euhedral faces at margins of coalesced crystal masses		reactivated		Quartz monzonite	Thin scaley calcite film resting on reactivated chlorite surface. Euhedral faces seen in growth-restricted calcite		steep
156.53 E		cal, chl		scaley calcite film with euhedral faces at margins of coalesced crystal masses		reactivated		Quartz monzonite	Thin scaley calcite film resting on reactivated chlorite surface. Euhedral faces seen in growth-restricted calcite		steep

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157.58 E		cal, chl, clay, hem		scaley film with some euhedral faces		reactivated		Altered and chloritised quartz monzodiorite			moderate
157.89 E		cal, chl		scaley film with some euhedral faces		reactivated		Altered and chloritised quartz monzodiorite	Scaley late calcite film developed on reactivated surface of older calcite vein. Dispersed flattened (restricted growth) clear calcite crystals.		gentle
158 ?		cal, chl		scaley calcite		reactivated		Altered and chloritised quartz monzodiorite	Irregular surface		moderate
158.15 ?		cal, chl		scaley calcite		reactivated		Altered and chloritised quartz monzodiorite			steep
159.32 E		cal, clay, chl		equant		reactivated	>0.5 mm	Cataclastic and alterite quartz monzodiorite	Fine euhedral equant doubly-terminated crystals of clear calcite lining vuggy cavities up to 5 mm wide, in channels on reactivated chlorite vein surface. Dark inclusions contained within the calcite. Top of fault zone: several small reddened, cataclastic, calcite-veined fault rocks; main focus of deformation, and reactivation with later gouge, is at 159.75 m.	KLX01 159.32 E-L Tullborg for isotopes, BGS for SEM, CL, ?FI	moderate
157.03	comment								Patches of carbonate mineralisation with euhedral calcite up tp 2 mm in vugs		
159.75 E		cal, clay, hem	Gouge	equant		Fault rock		Fault rock			
163									Base of fault zone of several small reddened and mylonitic and cataclastic, and calcite-veined fault rocks		moderate
160.62 E		chl, ep, cal, hem		confined growth, scaley film		reactivated		Cataclastic and alterite quartz monzodiorite	Confined growth of clear fine crystals but morphology difficult to determine. Possibly a weak PFF		moderate
160.72 E		chl, ep, cal, hem		confined growth, scaley film		reactivated		Cataclastic and alterite quartz monzodiorite	Confined growth of clear fine crystals but morphology difficult to determine. Possibly a weak PFF		steep
160.9 E		chl, ep, cal, hem		confined growth, scaley film		reactivated		Cataclastic and alterite quartz monzodiorite	Confined growth of clear fine crystals but morphology difficult to determine	KLX01 160.9 E-L Tullborg for isotopes	gentle
160.93 ?E		chl, ep, cal, hem		confined growth, scaley film		reactivated		Cataclastic and alterite quartz monzodiorite	Confined growth of clear fine crystals but morphology difficult to determine. Possibly a weak PFF		gentle

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162.15 ?E		cal, chl, py		confined growth, scaley film		reactivated		Cataclastic and alterite quartz monzodiorite	Confined growth of clear fine crystals but morphology difficult to determine. Irregular surface. Possibly a weak PFF		moderate
162.5 E		cal, chl		confined growth, scaley film, some equant crystals		reactivated		Cataclastic and alterite quartz monzodiorite	Confined growth of clear fine crystals but morphology difficult to determine. Irregular surface. Possibly a weak PFF		steep
162.7 E		cal, chl		confined growth, scaley film, some equant crystals		reactivated		Cataclastic and alterite quartz monzodiorite	Within highly brecciated zone of cataclased monzodiorite		moderate
162.71 E		cal, chl		confined growth, scaley film, some equant crystals		reactivated		Cataclastic and alterite quartz monzodiorite	Within highly brecciated zone of cataclased monzodiorite		moderate
163 E		cal, chl		confined growth, scaley film, some equant crystals		reactivated		Cataclastic and alterite quartz monzodiorite	Within highly brecciated zone of cataclased monzodiorite		moderate
164.3 E		cal, chl		equant		reactivated	<0.5 mm	Chloritised monzodiorite			steep
166.33 E		cal, chl		equant		reactivated	<0.5	Chloritised monzodiorite			moderate
167.03 E		cal		difficult to discern, mainly flattish overgrowths; one reasonably well-developed crystal is scalenohedral, c. 2:1				Quartz monzonite	sparse, relatively large crystals of calcite, possibly mainly overgrowths	KLX01 167.03 E-L Tullborg for isotopes, BGS for SEM	gentle
167.3 comment									approximate base of fractures with notably polished/striated surfaces developed around fault at 159.		
171.1 ?		cal		not determined				Quartz monzonite	sparse agglomerations of very small calcite crystals scattered on fracture surface; calcite morphology not discernible; possibly a weak PFF.	KLX01 172.25 E-L Tullborg for isotopes, BGS for SEM, CL	moderate
172.25 E		cal		equant		reactivated		Quartz monzonite	small sugary water-clear crystals of equant calcite locally coat reactivated fracture surface; patches of older thin calcite vein also on the surface		
173.25 E		cal		equant		?reactivated		Quartz monzonite	small sugary water-clear crystals of equant calcite locally coat reactivated fracture surface; patches of older thin calcite vein also on the surface		steep
175.6 E		cal, ?clay/drilling mud		equant		reactivated		Quartz monzonite	a discontinuous crust of very small water-clear equant crystals may be largely hidden beneath a coating of greenish drilling mud; probably formed along a reactivated thin calcite vein	KLX01 175.6 E-L Tullborg for isotopes, BGS for SEM	sub-vertical

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180.26	?E	cal, chl		scaley film with possible equant crystals		reactivated		Chloritised granodiorite	Mainly scaley calcite film, with traces of euhedral equant calcite. May be a weak PFF		moderate
182.6	E	cal, chl		c-axis elongated 2-5:1 c:a		reactivated	>0.5 mm	Chloritised granodiorite	Well developed, water-clear c-axis elongated and doubly-terminated crystals of calcite in vuggy channels in reactivated old vein calcite surface. Well developed, water-clear c-axis elongated and equant, and doubly-terminated crystals of calcite in vuggy channels in reactivated old vein calcite surface. The equant crystals are fine and line the vuggy walls of channels. C-axis elongated crystals of calcite are present both as fine crystals and coarser crystals. Minute crystals of pyrite rest on the surfaces of the late calcite.	KLX01 182.6 E-L Tullborg for isotopes, BGS for SEM	moderate
186.25	E	cal, chl, py		c-axis elongated and equant crystals 1-5:1 c:a		reactivated	>1 mm	Reddened and altered granodiorite	Traces of needles of clear euhedral calcite on fresh, irregular, rock surface	KLX01 186.25 E-L Tullborg for isotopes BGS for SEM	moderate
186.45	E	cal		c-axis elongated c:a = 5:1 scaley film with some confined growth of possible c-axis elongated crystals but morphology not entirely clear		fresh fracture		Reddened and altered granodiorite	Late clear calcite nucleated on fractured old calcite surface, where fresh fracture cuts through an old calcite vein		moderate
186.84	E	cal		Confined growth form, scaley film and some slightly c-axis elongated stubby crystals		fresh fracture		Weakly reddened and altered granodiorite			moderate
187.24	E	cal		Scaley film and possibly stubby c-axis elongated c-axis elongated, c:a = 2:1 to 6:1, some rare stubby c-axis elongated to sub-equant calcite crystals		fresh fracture		Weakly reddened and altered granodiorite			moderate
187.29	E	cal		Scaley film, morphology uncertain		fresh fracture		Reddened and altered granodiorite	Water clear, well developed euhedral calcite crystals up to 2 mm long in cm-scale cavities and channels	KLX01 187.36 E-L Tullborg for isotopes, BGS for sEM	moderate
187.36	E	cal				fresh fracture	>1 mm	Reddened and altered granodiorite			moderate
187.42	E	cal				fresh fracture		Reddened and altered granodiorite			moderate

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187.63 E		cal		Scaley film, morphology uncertain		fresh fracture		Reddened and altered granodiorite			moderate
187.8 E		chl, cal		Scaley film, morphology uncertain		reactivated		Mafic xenolith/granodiorite interface			moderate
188.74 E		chl, cal		scaley film, confined crystal growth, morphology uncertain		reactivated		Reddened and altered granodiorite			steep
189.9 E		cal, chl, il, ad		c-axis elongated crystals, to sub-equant crystals c:a = 1:1 to 1.5:1		reactivated		Reddened and altered granodiorite		KLX01 189.9 E-L Tullborg for isotopes, BGS for SEM	sub-vertical
191.15 E		cal, epi, chl		c-axis elongated crystals, to sub-equant crystals c:a = 1:1 to 1.5:1	EL Tullborg isotopes	reactivated		Cataclastic and alterite granodiorite	Steep, sinuous fracture surface developed along old hydrothermal calcite-epidote vein. Late calcite overgrowths on old calcite surfaces, some rare stubby c-axis elongated crystals.		Steep
192.68 E		cal, chl		c-axis elongated, c:a = 2:1		reactivated	>0.5 mm	Reddened and altered granodiorite			sub-horizontal
193 E		cal		c-axis longated, c:a = 3:1 to 5:1		reactivated	>0.2 mm	Reddened and altered granodiorite	Late calcite on reactivated surfaces of old hydrothermal calcite vein	KLX01 193.0 E-L Tullborg for isotopes	sub-horizontal
194.14 ?		chl, cal, ep		Scaley film, morphology uncertain		reactivated		Fine grained aplitic granite	Largely sealed veins filled by scaley calcite films of coalesced restricted growth crystals but with some crystal faces. Possibly very weak PFFs		Steep
194.19 ?		chl, cal, ep		Scaley film, morphology uncertain		reactivated		Fine grained aplitic granite	Largely sealed veins filled by scaley calcite films of coalesced restricted growth crystals but with some crystal faces. Possibly very weak PFFs		Steep
194.3 ?		chl, cal, ep		Scaley film, morphology uncertain		reactivated		Fine grained aplitic granite	Largely sealed veins filled by scaley calcite films of coalesced restricted growth crystals but with some crystal faces. Possibly very weak PFFs		Steep
196.2 ?		cal, ad, chl, ?ep		Scaley film, morphology uncertain		reactivated		Slightly reddened granodiorite	Largely sealed veins filled by scaley calcite films of coalesced restricted growth crystals but with some crystal faces. Possibly very weak PFFs		gentle
204.1 E		cal, chl		equant to slightly c-axis elongated crystals	E-L T sample	reactivated		Reddened and altered granodiorite			Steep

APPENDIX 5: PFF logging observations from Laxemar Borehole KLX01

Depth along core (m)	PFF & TYPE	Minerals	Wallrock Alteration	Calcite morphology	Other data	Fracture Type	Aperture (mm)	Host Lithology	Comment	Sampled	Fracture inclination
204.2 E		cal, chl		Equant to c-axis elongated, c:a =1:1 to 2:1	E-L T sample	reactivated		Reddened and altered granodiorite	Very fine scaley calcite with some equant to c-axis elongated crystals		gentle
204.5 E		cal, chl, py		Scaley film, morphology uncertain		reactivated		Sheared granodirite	Some euhedral fraces to growth-restricted calcite cystals. Calcite associated with fine euhedrfal late pyrite crystals		gentle
212.45 E		cal	Weak bleaching	Equant to flattened hexagonal crystals				Granodirite		KLX01 212.45, E-L Tullborg for isotopes, BGS for SEM (includes 212.5)	steep
212.5 E		cal	Weak bleaching	Equant to flattened hexagonal crystals				Granodirite			steep
213.6 E		cal, py	Weak reddening	Flat hexagonal	ELT	reactivated		Quartz monzodiorite	Late calcite growing on substrate of old hydrothermal calcite vein		steep
213.75 E		py	Reddened					Quartz monzodiorite	Rough fracture surface, with fine euhedral pyrite crystals		gentle
214.36 ?		cal, chl, py		Possibly very fine crusted overgrowths, morphology undetermined		reactivated		Quartz monzodiorite			gentle
218.5 E		cal, flu		Flat hexagons				Quartz monzodiorite	Sub-translucent calcite hexagonal crystals forming coalescing film on fracture surface. One of three close-spaced parallel fractures.		gentle
218.53 E		cal, flu		Flat hexagons				Quartz monzodiorite	Sub-translucent calcite hexagonal crystals forming coalescing film on fracture surface. One of three close-spaced parallel fractures.		gentle
218.54 E		cal, flu		Flat hexagons equant to slightly c-axis elongated crystals, c:a = </=				Quartz monzodiorite	Sub-translucent calcite hexagonal crystals forming coalescing film on fracture surface. One of three close-spaced parallel fractures.		gentle
220.44 E		hem, cal, chl, py		1.5:1		Reactivated		Aplitic granite	Late fine pyrite crystals		gentle

APPENDIX 5: PFF logging observations from Laxemar Borehole KLX01

Depth along core (m)	PFF & TYPE	Minerals	Wallrock Alteration	Calcite morphology	Other data	Fracture Type	Aperture (mm)	Host Lithology	Comment	Sampled	Fracture inclination
220.58 E		hem, cal, chl, py		Flat hexagons		Reactivated		Aplitic granite	Agglomeration of fine flat hexagonal calcite crystals foring thin coating on fracture surface	KLX01 220.58, E-L Tullborg for isotopes, BGS for SEM	gentle
220.78 E		chl, hem, cal		Scaley film, morphology uncertain	ELT	Reactivated		Reddened and altered granodiorite	Very thin crystals forming film coating fracture surface. Crystal growth has been restricted by thin aperture but pronouched cystal elongation		steep
220.98 E		chl, hem, cal		c-axis elongated c:a = 3:1 to 5:1		Reactivated		Reddened and altered granodiorite	Irregular fracture, rough surface		gentle
223.9 E		cal, chl, sulp	Weak bleaching	equant to slightly c-axis elongated, 1:1 to 1.5:1		Reactivated		Granodiorite	Sub-planar fracture with late calcite growth on reactivated old hydrothermal chlorite-calcite vein. Grey calcite. Crystal growth and morphology restrictrcd by fracture aperture	KLX01 223.90 E-L Tullborg for isotopes, BGS for SEM	Steep
226.5 E		cal, py, chl, ep	weak reddening	Flat to slightly c-axis elongated crystals, c:a = 1:1 to 1.5:1		Reactivated		Granodiorite	Traces of fine late pyrite crystals		gentle
239.75 E		cal		Scaley film, morphology uncertain					Scaley film of late calcite, with patches of agglomerate crystals.		Steep
240.34 E		cal, chl		Flat to slightly c-axis elongated crystals, c:a = 1:1 to 1.5:1		Reactivated		Granodiorite with mafic enclaves	Agglomeration of fine calcite crystals, with growth flattened by restriction in fracture, forming thin coating on fracture surface. Some slightly elongated crystals		Steep
241.35 E		cal, chl		Morphology not determined		Reactivated		Granodiorite with mafic enclaves	Patches of flat agglomerate fine calcite crystals		Sub-vertical
323.7 ?E		cal, py, ?il		Scaley film, morphology uncertain		?Reactivated		Granodiorite	Rough , irregular fracture, possibly originally mineralised by green illite. Small euhedral pyrite crystals resting on surfaces. Possibly a weak PFF		gentle
325.23 ?E		cal, chl, py		Scaley film, morphology uncertain		Reactivated		Granodiorite	Small euhedral pyrite crystals resting on calcite surfaces. Possibly a weak PFF		Sub-horizontal
326.7 E		cal, py, chl, ?il		Scaley film and very fine, possibly c-axis elongated crystals		Reactivated		Amphibolite	Fine scaley calcite comprising coalescing patches of fine, slightly elongated white and clear calcite crystals. Rare c-axis elongated overgrowths on old calcite surface. Possibly a weak PFF		Sub-vertical

APPENDIX 5: PFF logging observations from Laxemar Borehole KLX01

Depth along core (m)	PFF & TYPE	Minerals	Wallrock Alteration	Calcite morphology	Other data	Fracture Type	Aperture (mm)	Host Lithology	Comment	Sampled	Fracture inclination
316.77 E		cal, py, pre, chl, flu		scaley overgrowths, morphology unclear scaley film, small patches of aggregated crystals, morphology not discernable		Reactivated		Reddened and altered granodiorite	Late calcite is very limited in development, and grown in very limited pore space.		gentle
321.9 ?E		cal, chl, py				Reactivated		Granodiorite	Scattered pyrite euhedra on surface	KLX01 294.35 BGS for SEM SEND TO E-LT	gentle
294.35 E		cal, py		Flat hexagonal crystals Scaley film, some rare euhedral flattish crystals but morphology not very clear				Granodiorite	Agglomerations of flat euhedral calcite. Calcite is greyish, frosted Mainly partially filled by clay. Small vuggy cavities up to 5 mm wide lined by euhedral pyrite. Rare fragments of flattish or bladed calcite. One of several close-spaced gapped features		Moderate
255 E		cal, il, py		Flat, nailhead or bladed crystals, with 'rounded' crystal outlines, and white or 'frosted' surface		Reactivated	1 mm	Granodiorite			Sub-vertical
255 E		cal, il							Penny-shaped or bladed calcite crystals	KLX01 255, E-L Tullborg for isotopes, BGS for SEM	Sub-vertical
837 E		cal		Generally clear, colourless c-axis flattened or 'nailhead' crystals with c:a = 1:3 to 1:5		fresh fracture		Pink felsitic	Weakly developed calcite, nailhead crystals		Sub-vertical
840 E		cal		Generally clear, colourless c-axis flattened or 'nailhead' crystals with c:a = 1:3 to 1:5		fresh fracture	2 mm	Granodiorite	Very well developed calcite sitting directly on wallrock	KLX01 840, E-L Tullborg for isotopes, BGS for SEM	Sub-vertical
834.85 E		cal		Generally clear, colourless c-axis flattened or 'nailhead' crystals with c:a = 1:3 to 1:5		fresh fracture	<1 mm	Amphibolite	Weakly developed calcite, nailhead crystals		Steep

APPENDIX 5: PFF logging observations from Laxemar Borehole KLX01

Depth along core (m)	PFF & TYPE	Minerals	Wallrock Alteration	Calcite morphology	Other data	Fracture Type	Aperture (mm)	Host Lithology	Comment	Sampled	Fracture inclination
835.55 E		cal		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		fresh fracture	<1 mm	Red aplitic granodiorite	Moderately well-developed late calcite mineralisation, crystal sit directly on wallrock Largely sealed veins filled by scaley calcite films of coalesced restricted growth crystals but with some crystal faces. Possibly very weak PFFs		Sub-vertical
830.5 E		cal, chl		Probably nailhead		Reactivated		Amphibolite			Sub-vertical
940.8 E		cal, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Red granodiorite	Weak to moderate development of late calcite with sub-mm scalev crystals		Sub-vertical
941.7 E		cal, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Cataclased granodiorite	Weak developed calcite crystals sitting on chlorite surface		Sub-vertical
944.7 E		cal, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Pink granodiorite	Weak to moderate development of late calcite with sub-mm scalev crystals. Resting on chlorite		Steep
945.34 E		cal, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5 Scaley film comprised coalesced nailhead crystals		Reactivated		Cataclased granodiorite	Moderate development of late calcite on reactivated calcite-chlorite vdein surfaces	KLX01 945.34 E-L Tullborg for isotopes, BGS for SEM	Steep
934.75		cal, chl				Reactivated		Granodiorite	Very weakly developed calcite coating. Possibly weak PFF		Steep
936.3 E		cal		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		fresh fracture		Granodiorite	Moderately developed late calcite sits directly on rock surface	KLX01 936.3 E-L Tullborg for isotopes, BGS for SEM	Steep to subvertical

APPENDIX 5: PFF logging observations from Laxemar Borehole KLX01

Depth along core (m)	PFF & TYPE	Minerals	Wallrock Alteration	Calcite morphology	Other data	Fracture Type	Aperture (mm)	Host Lithology	Comment	Sampled	Fracture inclination
936.8 E		cal, py		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		fresh fracture		Granodiorite	mm-scale well-developed clear calcite euhedra on subvertical to steep curved fracture	KLX01 936.8 E-L Tullborg for isotopes BGS for SEM, CL, FI	Sub-vertical to Steep, curved
937.67 E		cal		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		fresh fracture		Granodiorite	Weakly developed calcite, nailhead crystals		moderate
937.69 E		cal		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		fresh fracture		Granodiorite			moderate
939 E		cal, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated			Reactivated old calcite-chlorite vein. Old calcite surface with very well-developed PFF and almost completely encrusted with nailhead calcite.	KLX01 939 E-L Tullborg for isotopes BGS for SEM	Sub-vertical
940.65 E		cal, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Pink granodiorite	Reactivated chlorite surface. Weakly-developed late calcite		Steep
924.37 E		cal, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Granodiorite	Embryonic nailhead calcite crystals on reactivated chlorite surface		Steep
927.26 E		cal, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Granodiorite	Weak developed calcite crystals sitting on chlorite surface		Steep
909 E		cal, chl, py		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Granodiorite	Reactivated calcite-chlorite vein. Moderately developed coating of late calcite		Steep

APPENDIX 5: PFF logging observations from Laxemar Borehole KLX01

Depth along core (m)	PFF & TYPE	Minerals	Wallrock Alteration	Calcite morphology	Other data	Fracture Type	Aperture (mm)	Host Lithology	Comment	Sampled	Fracture inclination
910.2 E		cal, chl, py		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Granodiorite	Reactivated calcite-chlorite vein. Moderately developed coating of late calcite	KLX01 910.2 E-L Tullborg for isotopes, BGS for SEM	Steep
913.85 E		cal		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		?fresh fracture		Dark red aplite	Very weakly developed calcite coating. Possibly weak PFF		Steep
905.31		cal, il, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Granodiorite	Very weakly developed calcite coating. Possibly weak PFF		Steep
907.6		cal, chl, hem		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Granodiorite	Very weakly developed calcite coating. Possibly weak PFF		Steep
907.85		cal, chl, hem		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Granodiorite	Very weakly developed calcite coating. Possibly weak PFF		Steep
908.1		cal, chl		Generally clear, colourless c-axis flattened or 'nailhead crystals with c:a = 1:3 to 1:5		Reactivated		Granodiorite	Reactivated calcite-chlorite vein. Very weakly developed coating of euhedral late calcite		Steep