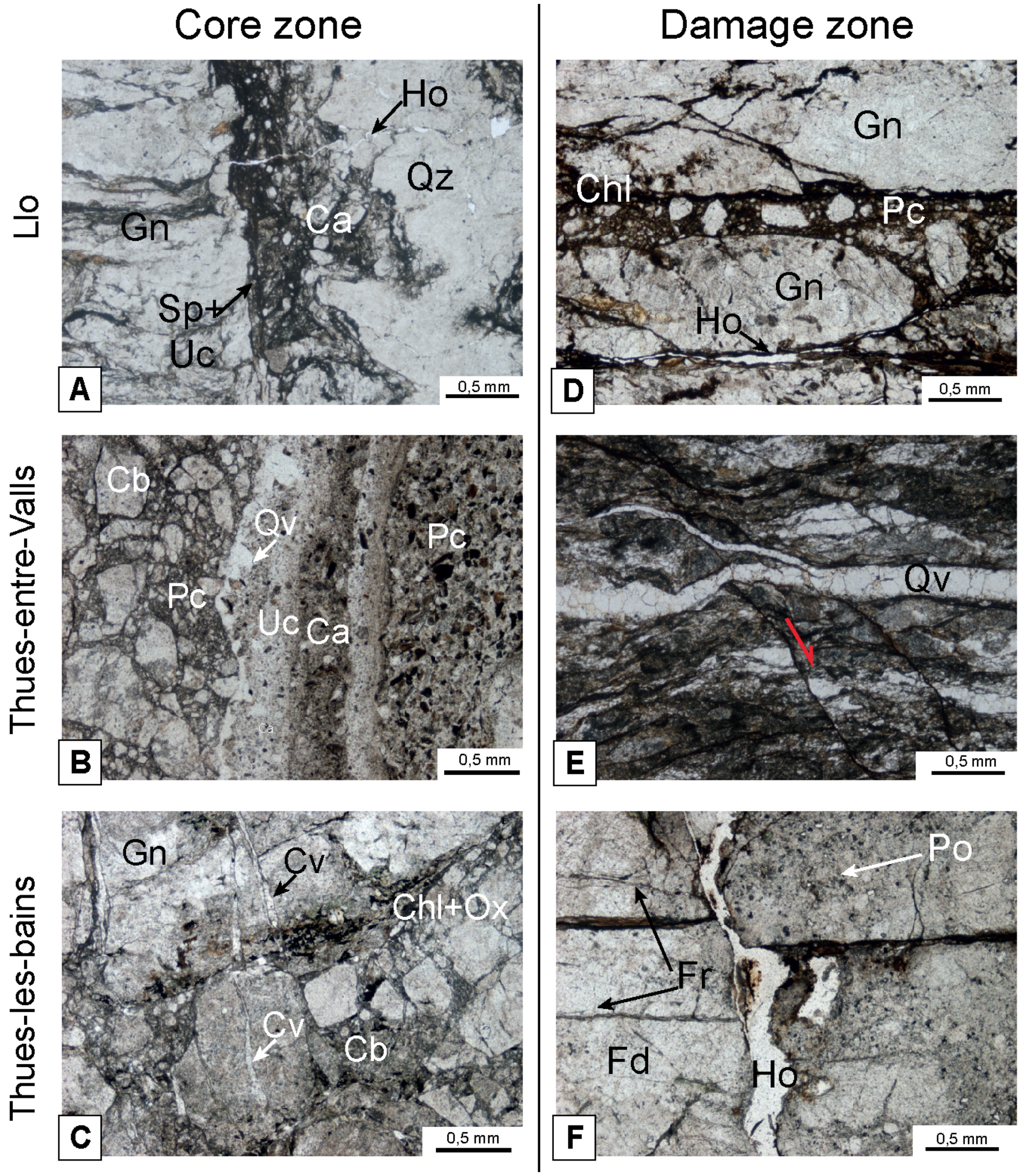
Appendix 1: brittle fault thin sections



Appendix 1: Thin section of brittle fault rocks areas. (A) Llo core zone sample. Cataclastic (Ca) to ultra-cataclastic (Uc) material along a shear plan (Sp) between a gneiss (Gn) and a deformed quartz (Qz). A hole (Ho) crosscuts all the structures (B) Thues-entre-Valls core zone sample. Cataclastic breccia (Cb) to proto-cataclasite (Pc) surrounding cataclasite in a fracture bordered by a quartz vein (Qv). (C) Thues-les-bains core zone sample. Cataclastic breccia with feldspars clasts creeps along a gneissic clast (Gn). A carbonate vein (Cv) crosscuts all the structures, and impregnates the matrix, which include areas of associated chlorite and oxides (Chl+Ox) (D) Llo footwall damage zone sample. Proto-cataclastic (Pc) fills a fracture parallel to the gneissic foliation. A hole (Ho) and chlorite (Chl) run along the foliation. (E) Thues-entre-Valls footwall damage zone sample. Fractured and folded mylonites. A quartz vein (Qv) crosscuts brittle normal fault (F)

Thues-les-bains hanging wall damage zone sample. A hole (Ho) in feldspar crosscuts fractures (Fr). Some porosity (Po) is visible in the feldspars.

Appendix 1 shows microscopic views of 3 sampling sites (Llo, Thues-entre-Valls, Thues-les-bains) along the Têt Fault. The core zone samples are presented in the left part, and the damage zone samples in the right part.

Core zone samples always show localized cataclasites in much less deformed rocks. The Llo core zone sample Llo2 (Appendix 1a), is fractured and faulted gneiss in which the foliation is still visible. Cataclastic matrix separates underformed gneiss from a deformed grain of quartz. The closest right part of the shear plane, antithetic to the Têt Fault, shows cataclasite or even ultracataclasite, composed of more than 60% of matrix. Really fine grains of quartz, opaque minerals (oxydes), and phyllosilicates compose the matrix. Rounded clasts are quartz in a large part, with some feldspar. A hole with irregular borders crosscuts catacastic areas, deformed quartz and the underformed gneiss.

The Thues-entre-Valls core zone sample (Appendix 1b) is a stacking of several stages of cataclasite. A thin ultracataclasite band localizes at the core of the cataclastic zone, surrounded by catalasite with a zonation of various amount of matrix. A quartz vein delineates this area of highly deformed fault rocks with an area of protocataclasite to cataclastic breccia with coarser clasts, on the left of the picture. This vein also crosscuts the central part of the cataclastic zone, outside this picture. Quartz and small minerals with a high birefringence (phylosilicates or epidote) compose the ultracataclasite matrix. Small clasts are principally composed of carbonates and quartz, opaque minerals (oxydes), biotite, muscovite, and more rarely, feldspars. The surrounding cataclasite is composed of quartz-carbonate matrix, with clasts of quartz, feldspars, muscovite and carbonates. Finally, the cataclastic breccia matrix (or in some places protocataclasite) is composed of quartz and high birefringence minerals (phylosilicates or epidote). Clasts are composed of gneiss and quartz in the left part, and mylonites and opaque minerals in the right part. They are more rounded in the central part, and quite angular in the surrounding areas Quartz and oxide veins crosscut them.

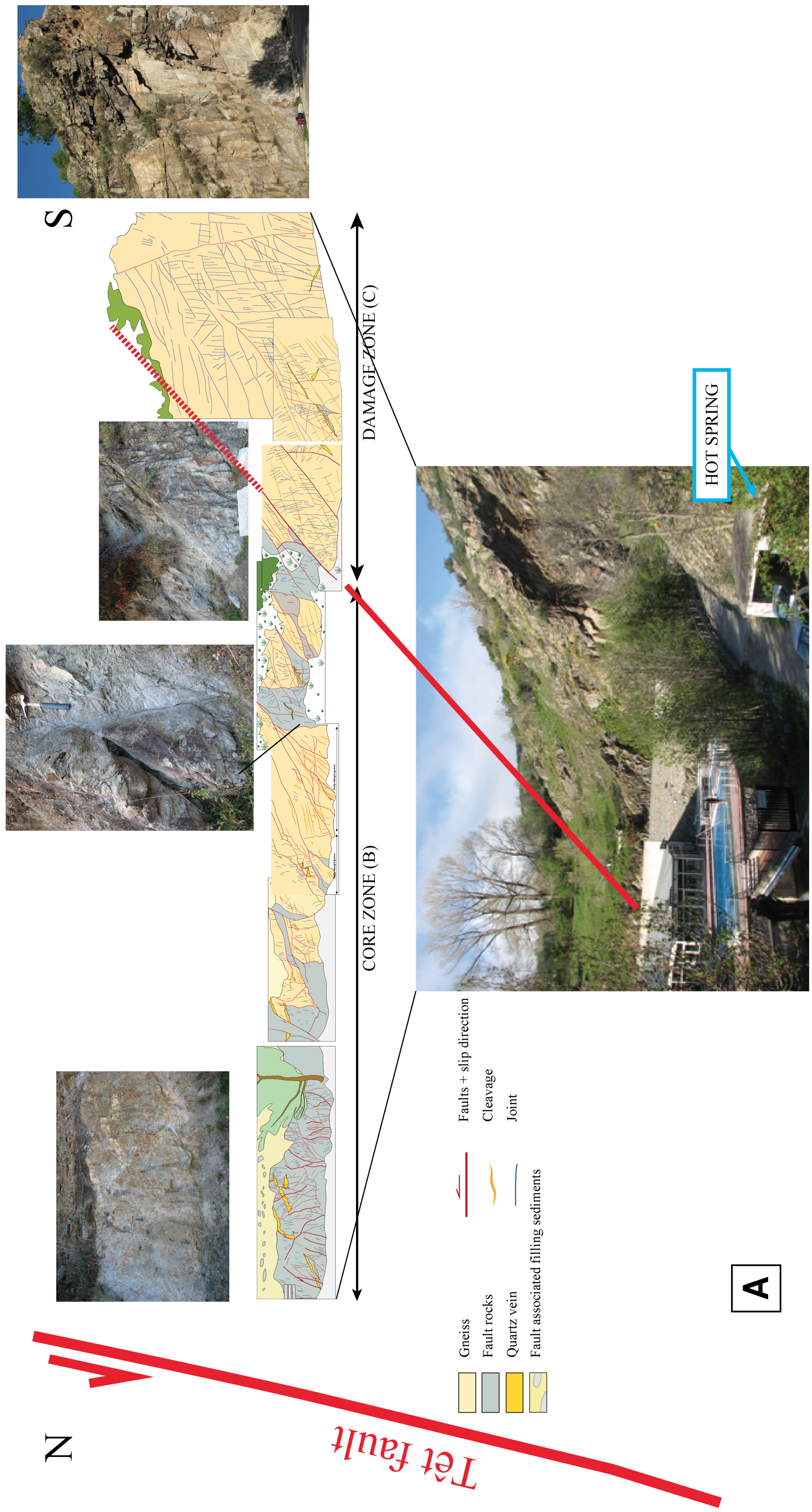
The sample at Thues-les-Bains (Appendix 1c), comes from the core zone near principal fault plane separating the hanging-wall damage zone with the core zone. Clasts of gneiss are surrounded by cataclastic carbonates-quartz rich matrix. Locally, the matrix contains essentially chlorite associated with opaque minerals, probably oxides. Clasts are mainly composed of quartz, calcite, feldspars, gneiss, and clasts of gneiss impregnated with carbonates. Small grains of calcite impregnate every element in the fault rock. Two generations of veins crosscut both matrix and clasts: the calcite-veins, themselves being crosscut by quartz-veins.

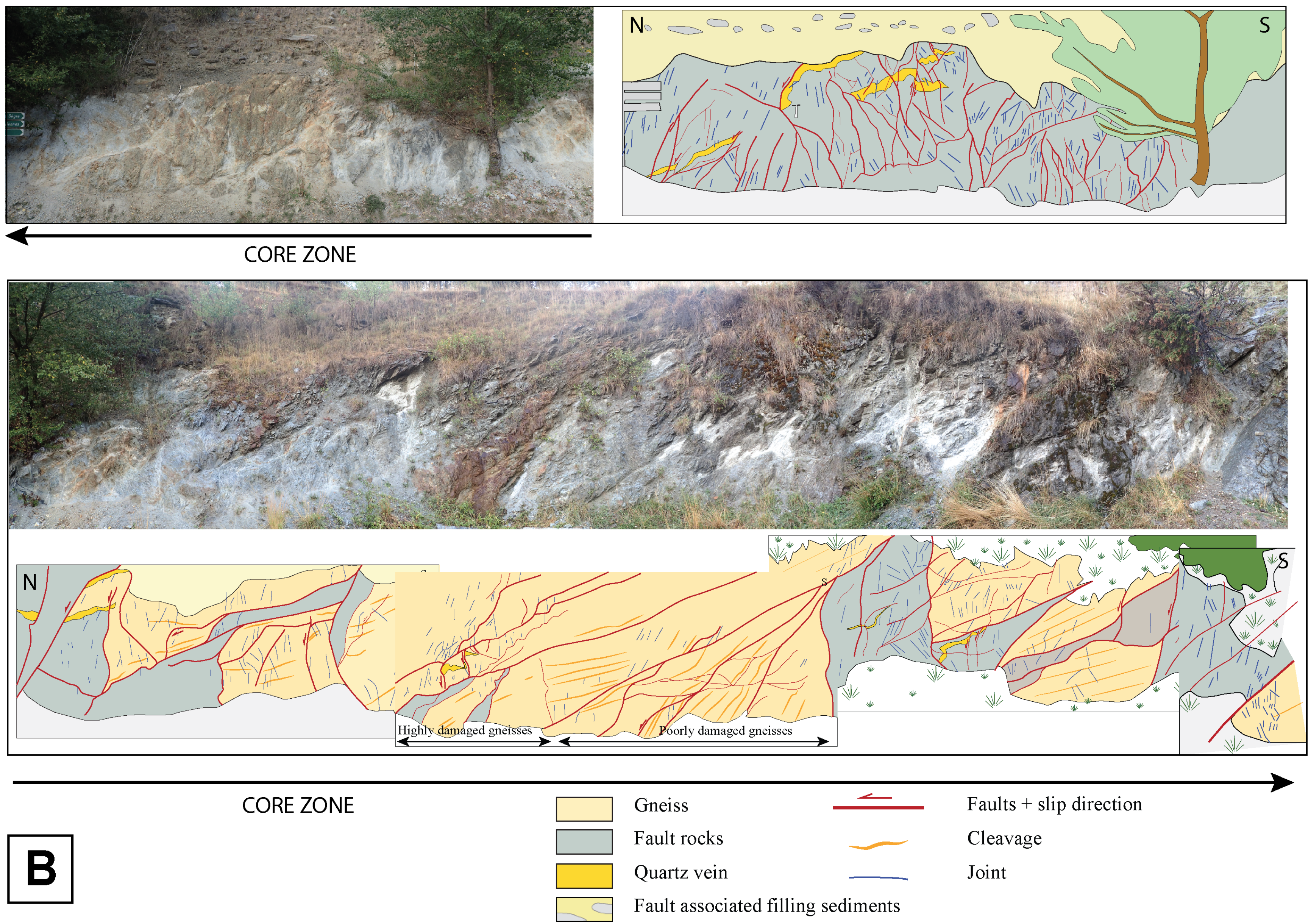
Bedrocks in the damage zone are highly fractured and also show evidence of silicated fluid circulations. The Llo damage zone sample (Appendix 1d) is a fractured gneiss, with some chlorite along the foliation. Proto-cataclastic to cataclastic matrix is observed into fractures parallel to the foliation. The cataclastic matrix is composed of quartz, feldspar, and biotite, then the protolith is probably a local gneiss from the footwall. The matrix contains high quantities of opaque minerals (oxides). Appendix 1d also shows a hole, probably corresponding to an uncemendted crack, bounding a fractured gneiss grain. In another place in the thin section, gneiss is randomly fractured and brecciated suggesting hydraulic brecciation rather than shear related cataclasite.

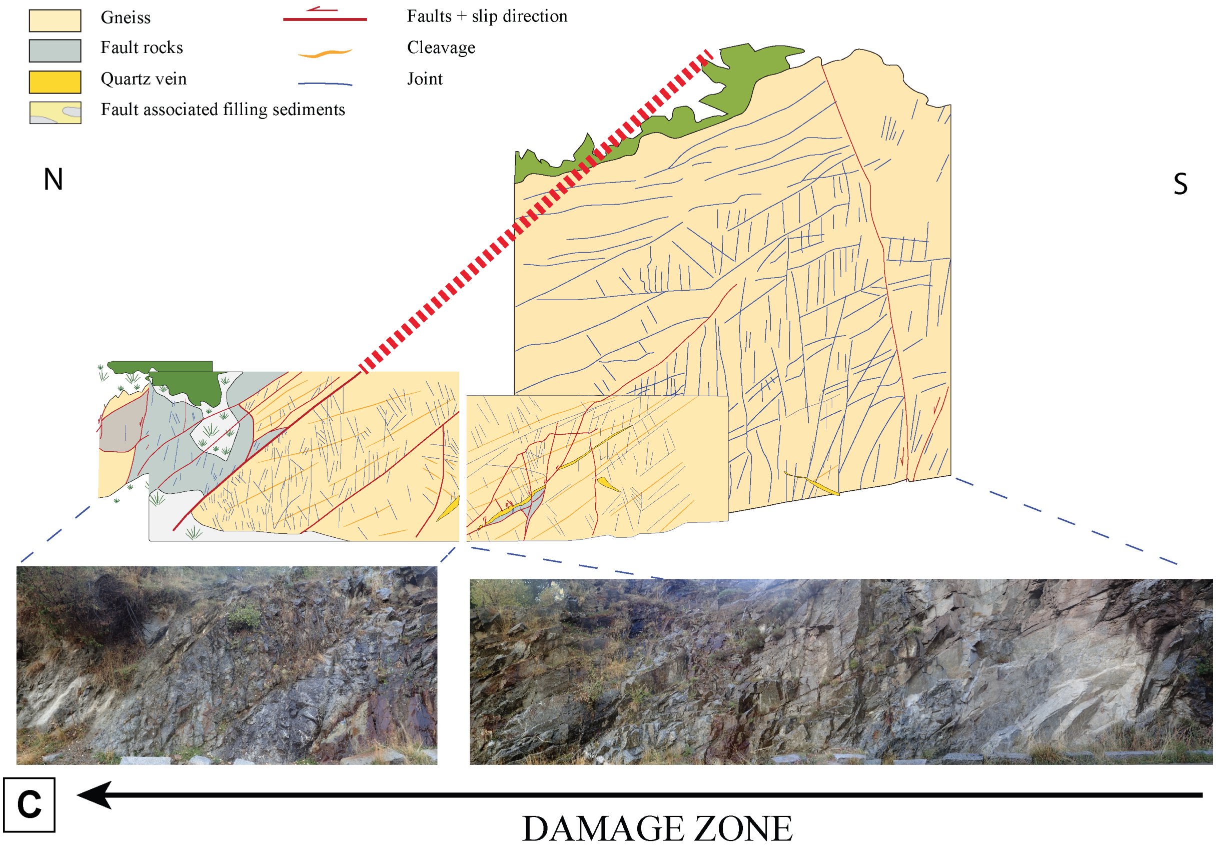
The Thues-entre-Valls damage zone sample (Appendix 1e) is a fractured and folded mylonite, with some bands of ultra-mylonites (also see Appendix 4d), crosscut by brittle normal faults synthetic or antithetic to the Têt Fault. Where the fault network is dense, incipient breccia is observed. Opaque mineral (oxides) and sometimes quartz localize along these fault planes. A quartz vein sub-parallel to the mylonitic foliation crosscuts and so post-dates the brittle deformation.

The Thues-les-bains damage zone sample (Appendix 1f) has been sampled in the hanging-wall of the Têt Fault for question of thin section quality. However, description of hanging wall structures at Thues-les-bains is relevant, since it is the only place where there is hot springs in the hanging wall. The host rock is gneiss with chloritized phyllites (probably muscovite) associated with opaque minerals. Some fractures filled with opaque minerals or quartz are crosscut by a hole (probably an uncemented irregular fracture).

Appendix 2: The Têt Fault outcrop at Llo




N
S
CORE ZONE
N
S
Highly damaged gneisses
Poorly damaged gneisses
CORE ZONE
B
Gneiss
Fault rocks
Quartz vein
Fault associated filling sediments
Faults + slip direction
Cleavage
Joint



Appendix 2 : Têt Fault outcrop at Llo. (A) Distant view of the including the hot spring location, the core zone, the damage zone, and limit between them, and macroscopic pictures of cataclastic textures. (B) Core zone images with associated precise interpretation. The upper image is northern than the lower one (tree for marker). Note the alternation of cataclastic lenses with gneissic lenses. (C) Damage zone image sourthern of (B) with precise interpretation. Numerous fractures crosscut each other, some of them are fault planes.

Appendix 3: XRD analysis

XRD compositions for 6 white mineralization samples in the Têt Valley. Cab : carbonate, Qz : quartz, San : sanidine, Mcl : microcline, Alb : Albite, Mu/Ph : Muscovite/Phengite, Cchl : Clinochlore, Pre : Prehnite, Zeo : zeolite (harmotome). +++ : major minerals; + : present but non-major minerals; <5% : trace minerals. Quartz is often the major mineral, except the sample V3 only composed of harmotome.

	Cab	Qz	San	Mcl	Alb	Mu/ Ph	Cchl	Pre	Zeo
ATAI0114_1		+++	<5%		<5%				
ATAI0194_1		+++	+			+	+	+	
CA2	+++	+		+	<5%				
THU1	<5%	+++				+			
T7		+++			<5%	+			
V3									+++

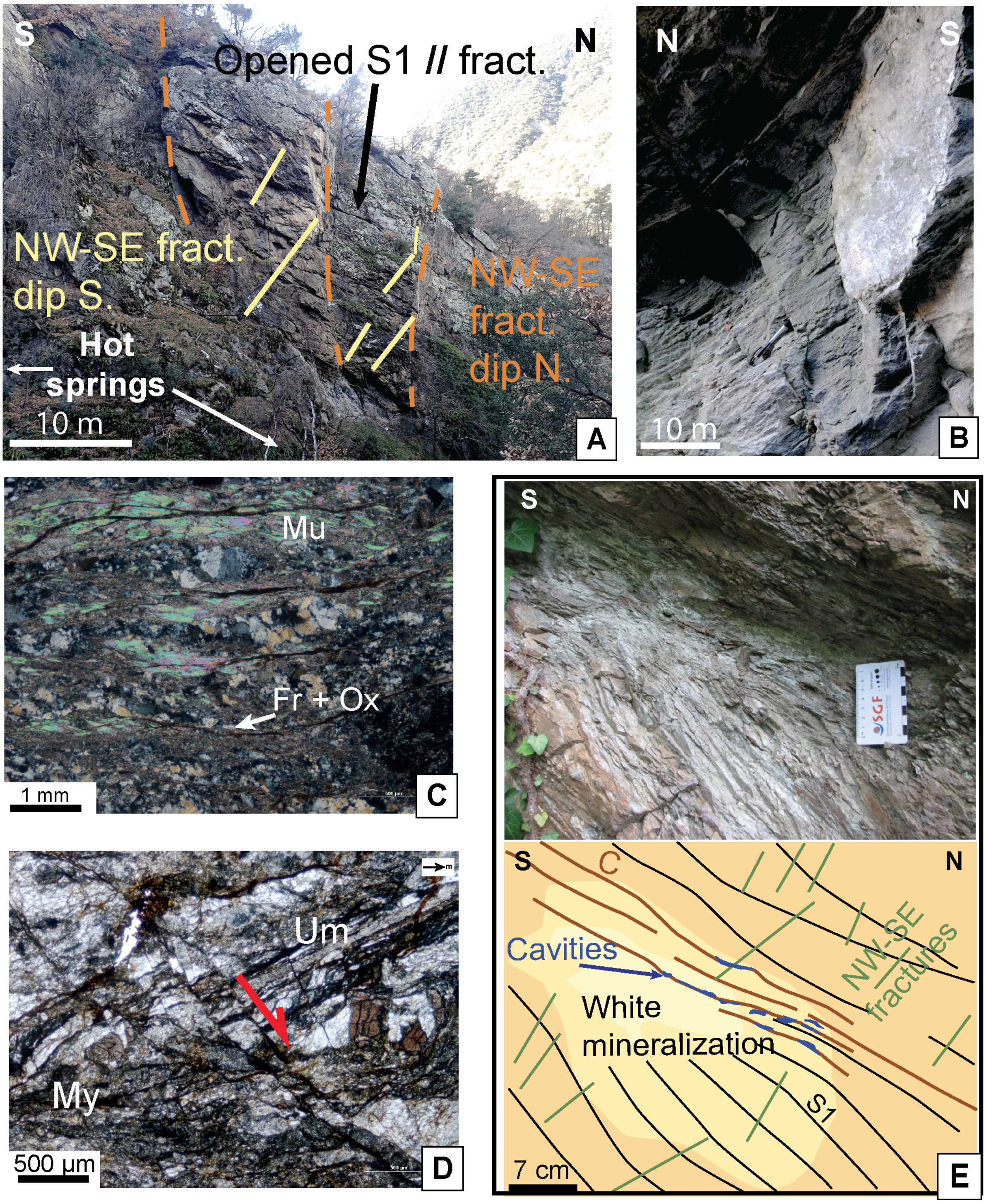
XRD analyses have been performed on white mineralization sampled in six places along the Têt Fault, especially near the hot springs. Appendix 2 presents sample compositions. Samples involve different lithologies and location with respect to the hot springs or the Têt Fault.

ATAI0114_1 was sampled 270 m West of Prats-Balaguer hot springs and 600 m from the Têt Fault. The mineralization covers a N115E 75NE normal fault plane with a left-lateral strike-slip component in a marble layer. ATAI0194_1 fills veins of a hydraulic breccia in meta-sediments located 450 m North-East of the Prat-Balaguer hot springs, 260 m from the Têt Fault, close to a large lineament. CA2 fills multiple joints of 2-3 mm opening in very thinly foliated mylonite at the Carança canyon entrance (Thues-entre-Valls). Two samples come from the Thues-les-bains train station outcrop: THU1, is as a pervasive deposition along a major fault plane separating the cataclastic rocks of the core zone and the gneiss in the damage zone; T7 fills joints which are sub-parallel to the gneissic foliation in the footwall of the Têt Fault damage zone. There is at least 4 hot springs in the first 100 m around these 2 samples. Finally, V3 was sampled at the Vernet-les-bains thermal resort, 1300 m South of the Têt Fault, filling a N020E 10E vein in the ductile fault of the CMNC.

Most of the white mineralizations contain quartz as major mineral, expect two exceptions (see Table 2): harmotome (zeolite) for V3, and calcite for CA2 also containing quartz and albite, as several other sites. For the different sites, the trace minerals are always different. Two categories of secondary minerals may be differentiated: feldspars (sanidine and microcline) in the Eastern part of the whole sampling area, and minerals typical of hydrothermal alteration of crystalline continental crust (albite, prehnite, or clinochlore).

Minerals composing this white mineralization are similar from those observed in thin sections, whether in veins for quartz and carbonate, or in cataclastic matrix and fractures infilling for secondary minerals. General compositions are similar for all the sites, except at Vernet-les-bains.

Appendix 4 : Ductile fault outcrops



Appendix 4: Ductile fault outcrop and thin sections. (A) Thues-les-bains outcrop picture and interpretation including (E). Two fractures sets intersect the opened foliation-parallel fractures near two hot springs. (B) Siliceous-carbonated cement filling fractures in the Têt Fault footwall damage zone at Thues-entre-Valls (see XRD, appendix 3). (C) Thin section of thinly foliated muscovite-rich (Mu) gneiss at Vernet-les-bains. Foliation-parallel fractures (Fr) are filled with oxides (Ox). (D) Thues-entre-valls mylonite (My) to ultra-mylonite (Um) thin section crosscut by brittle normal faults. (E)Thues-les-bains ductile fault outcrop picture and

interpretation. Dissolution cavities align along the shear zone (C) in the fractured mylonites. Sinter covers the outcrop.

Ductile fault zones also show evidence of fluid circulations.

At Thues-les-bains (Appendix 4a), mylonites of the CMNC dip 50° to the North, a few hundred meters to the South of the Têt Fault. N120E fractures dipping to the South crosscut the mylonites (green in Appendix 3e). They are less than 10m-long, spaced by 50 cm to 1 m intervals, open and unsealed. Their orientation is consistent with the principal fracture orientation of the Têt Fault damage zone at Thues-les-bains. NW-SE fractures dipping to the North (orange lines in Appendix 4a) are more than 10-meter long, open, and spaced of a few meters. Other fractures, parallel to the foliation (Blue lines in Appendix 4a), have centimeter-wide opening and multi-meter length.

At Thues-entre-Valls (Appendix 4b), numerous fractures of the Têt Fault damage zone in mylonites are filled by white pervasive mineralization principally constituted) of silicate and carbonates (see XRD, appendix 3).

At Vernet-les-bains, Appendix 4c presents a thin section of this ductile fault. This sample shows muscovite-rich gneiss highly foliated. Brittle-ductile shear planes concentrate opaque minerals, oxides and chlorite. Fractures parallel to the foliation are filled with oxides. Quartz veins crosscut and so post-date the foliation.

At Thues-entre-Valls, Appendix 4d shows the mylonite in the damage zone, close to the transition with the core zone. Bands of ultra-mylonites with highly reduced grain size are displaced by brittle normal faults. Oxydes and quartz localize along these brittle fault planes and late quartz veins run along the mylonitic foliation.

As in Vernet-les-bains, millimeter-size elongated cavities are also observed (Appendix 4e) at Thues-les-bains, between 2 hot springs separated from about hundred meters (Cascade Bas and Lukas). They are not cemented and they align along shear surfaces

(C planes in Appendix 4e), close to which the foliation is very thin. Halos of white mineralization surround the cavities. Numerous South-dipping N120E fractures crosscut the foliation. Appendix 3e outcrop locates at the bottom of the cliff shown in Appendix 4a, where these fractures are visible at a larger outcrop scale.