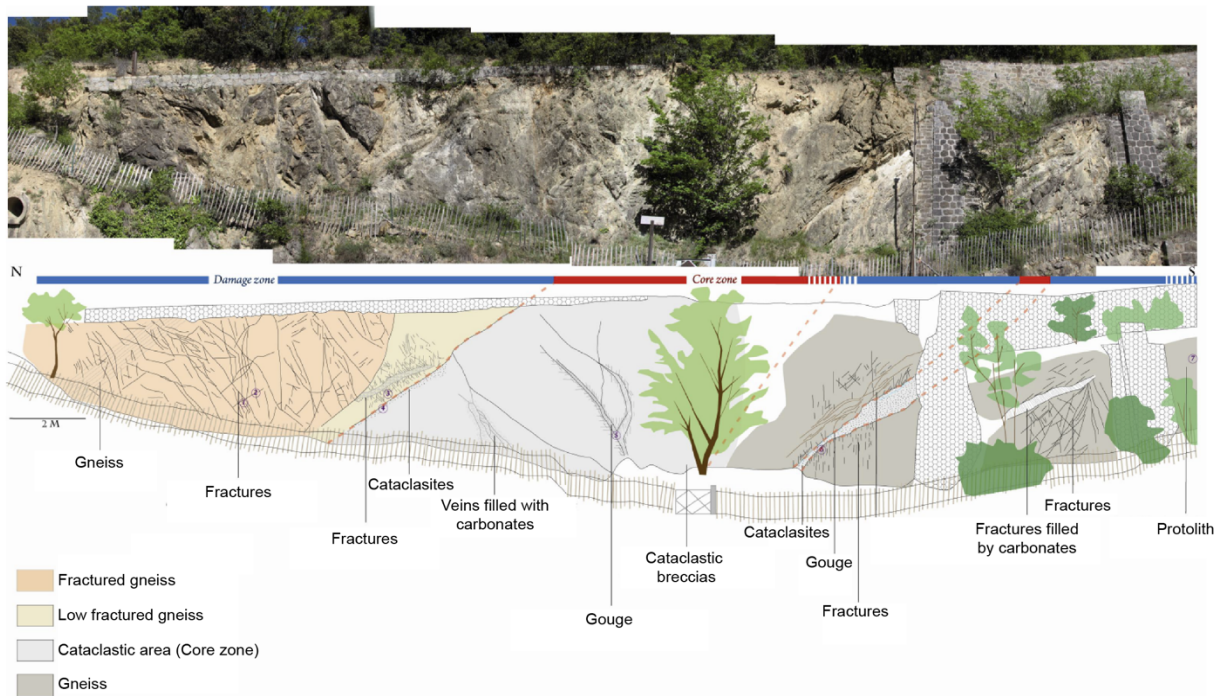


# Supplement Section

## Supplement Section S.1 Fault outcrop



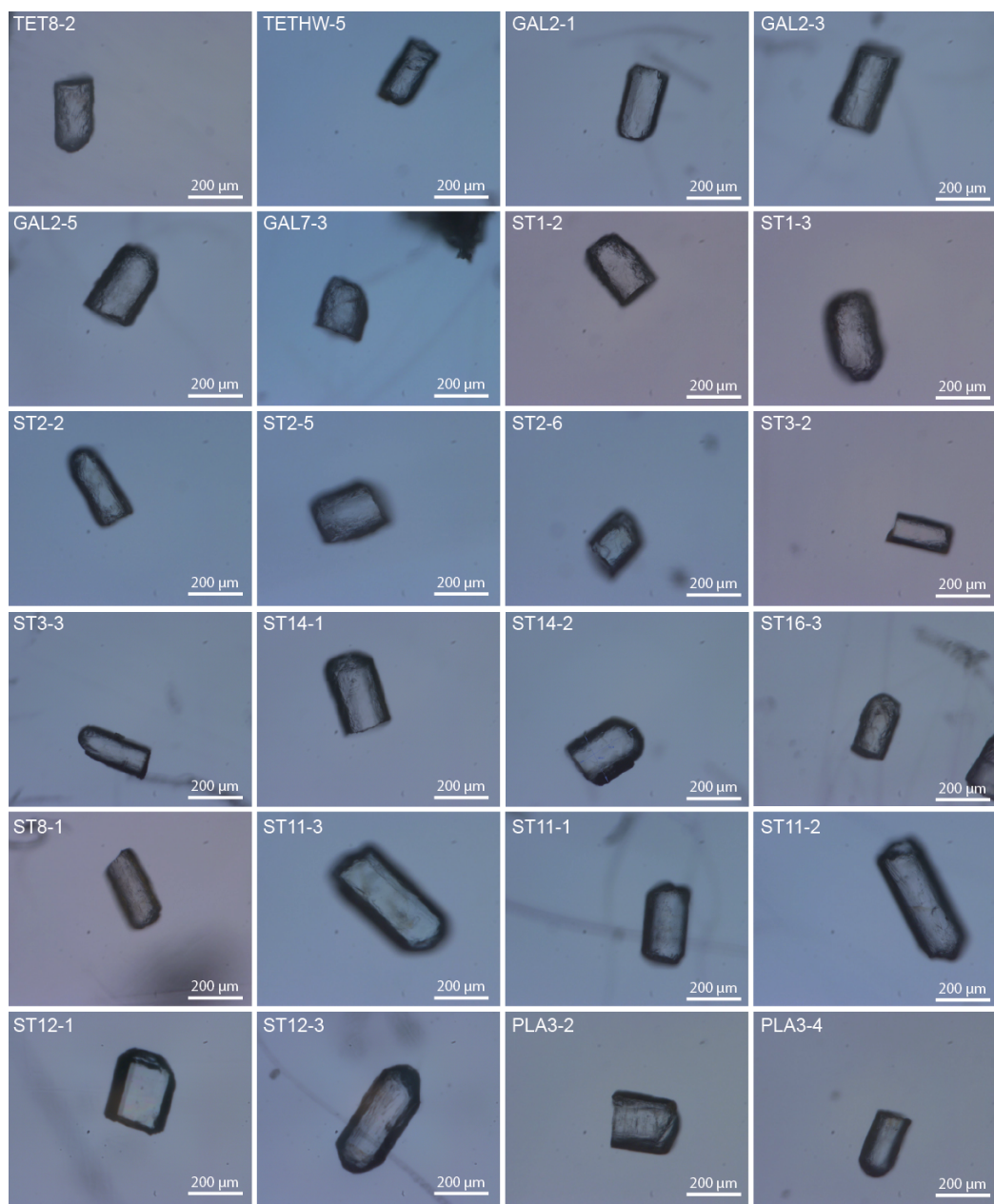
5 **Figure 1. Photo of the Têt fault at Thuès-les-Bains station with interpretation of the fault zone below where Core Zone and Damage zone are distinguished (modified from Martin, 2014). We can see lenses of gneiss preserved near the fault contact and in the damage zone close to the fault.**

Supplement Section S.2 Hot spring water analyses

10 Table 1. Anion et cation composition of hydrothermal hot springs (ST and PB: Saint-Thomas les bains hot spring cluster, TB and CA: Thuès hot spring cluster, VB: Vernet-les-bains,). In bold, data for water potentially mixed with meteoric water from the St-Louis hot spring in Thuès-les-bains hot spring cluster (from Taillefer, 2017).

Cluster	Llo	Llo	ST		PB	TB			VB		Ca.
			Gd Source	Bar.1	Aig.1	St-Louis	Casc. Amont	Casc. Bas	Du Parc	Vap.	Gr. A - Riv.
Ca	mg/l	2.3	1.5	1.4	1.5	<b>10.1</b>	1.7	1.5	1.5	3	1.4
Mg	mg/l	<0.5	<0.5	<0.5	<0.5	<b>0.7</b>	<0.5	<0.5	<0.5	<0.5	<0.5
Na	mg/l	65.4	55.3	56.4	57	45.8	60.3	60.5	57.2	55.2	60.9
K	mg/l	1.8	1.4	1.3	1.5	1.8	2.4	2.3	1.8	1.9	2.3
NH <sub>4</sub>	mg/l	0.25	0.29	0.32	0.33	<b>&lt;0.05</b>	0.3	0.29	0.2	0.12	0.29
CO <sub>3</sub>	mg/l	21	30	30	33	<b>&lt;10</b>	29	30	25	20	33
HCO <sub>3</sub>	mg/l	29	27	31	29	<b>91</b>	34	32	39	45	31
Cl	mg/l	6.8	8.9	9.2	9.3	8.7	10	9.9	8.4	8.1	7.9
NO <sub>3</sub>	mg/l	<0.5	<0.5	<0.5	<0.5	<b>0.5</b>	<0.5	<0.5	<0.5	<0.5	<0.5
SO <sub>4</sub>	mg/l	51	25.8	25.7	25.7	36.1	28.7	28.3	27.4	37.2	29.5
PO <sub>4</sub>	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
NO <sub>2</sub>	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
F	mg/l	17.5	7.4	7.7	7.8	5.3	7.9	7.9	6.9	6.7	7
Ag	µg l <sup>-1</sup>	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Al	µg l <sup>-1</sup>	6.53	23.5	18.2	24.3	6.15	39.5	60.2	21.3	14.1	31.4
As	µg l <sup>-1</sup>	0.07	6.41	5.77	6.6	5.83	3.42	3.67	0.34	1.66	5.78
B	µg l <sup>-1</sup>	96.3	109	107	124	221	272	293	301	305	157
Ba	µg l <sup>-1</sup>	21.4	12.6	22.3	86.6	6.05	40.2	109	67.5	153	143
Be	µg l <sup>-1</sup>	0.01	0.01	<0.01	<0.01	0.04	0.1	<0.01	<0.01	<0.01	<0.01
Cd	µg l <sup>-1</sup>	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cr	µg l <sup>-1</sup>	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cu	µg l <sup>-1</sup>	<0.1	<0.1	<0.1	<0.1	0.7	<0.1	<0.1	<0.1	<0.1	<0.1
Fe	µg l <sup>-1</sup>	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Li	µg l <sup>-1</sup>	95.3	78	80.1	81.3	71.1	87.7	87.7	69.5	75	93.9
Mn	µg l <sup>-1</sup>	0.15	0.11	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ni	µg l <sup>-1</sup>	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pb	µg l <sup>-1</sup>	<0.05	<0.05	<0.05	<0.05	0.2	<0.05	<0.05	<0.05	<0.05	<0.05
SiO <sub>2</sub>	µg l <sup>-1</sup>	55.6	75.3	72.3	79.1	71.8	92.2	92.7	72.7	70.2	91.2
Sr	µg l <sup>-1</sup>	67	21.9	25.8	20.5	57.8	29.8	28.8	43	75.9	31.9
Zn	µg l <sup>-1</sup>	0.87	1.91	1.32	3.53	3.19	1.5	2.65	1.51	2.98	2.86

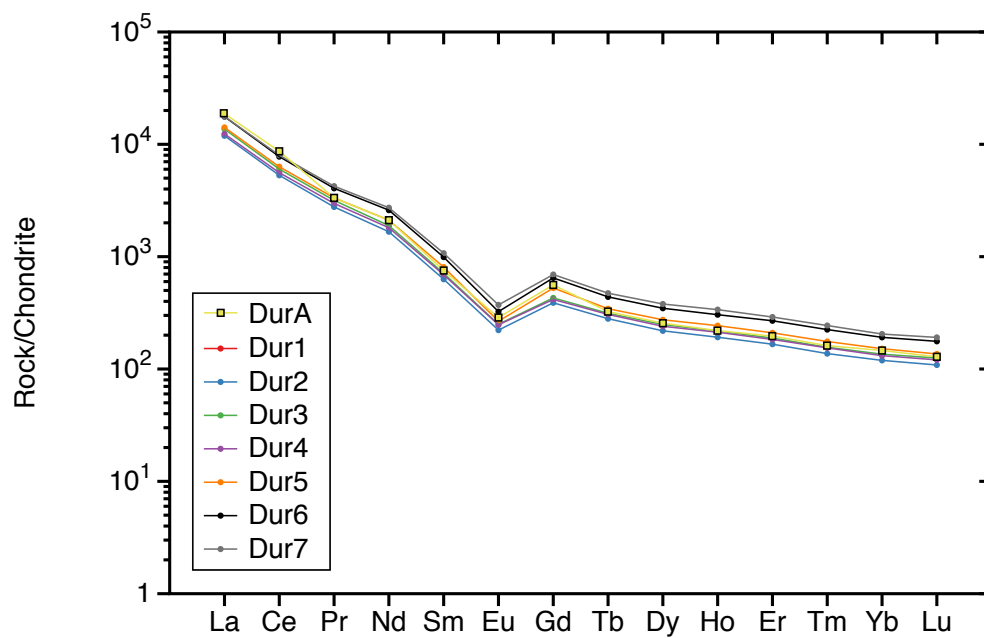
### Supplement Section S.3 Apatite grains



15

**Figure 2. Photographs of apatite grains selected for (U-Th)/He analyses taken under binocular. Sample name is indicated on the upper left corner. Note that apatites are basically well preserved in the damage zone and outside damage zone.**

Supplement Section S.4 REE analyses



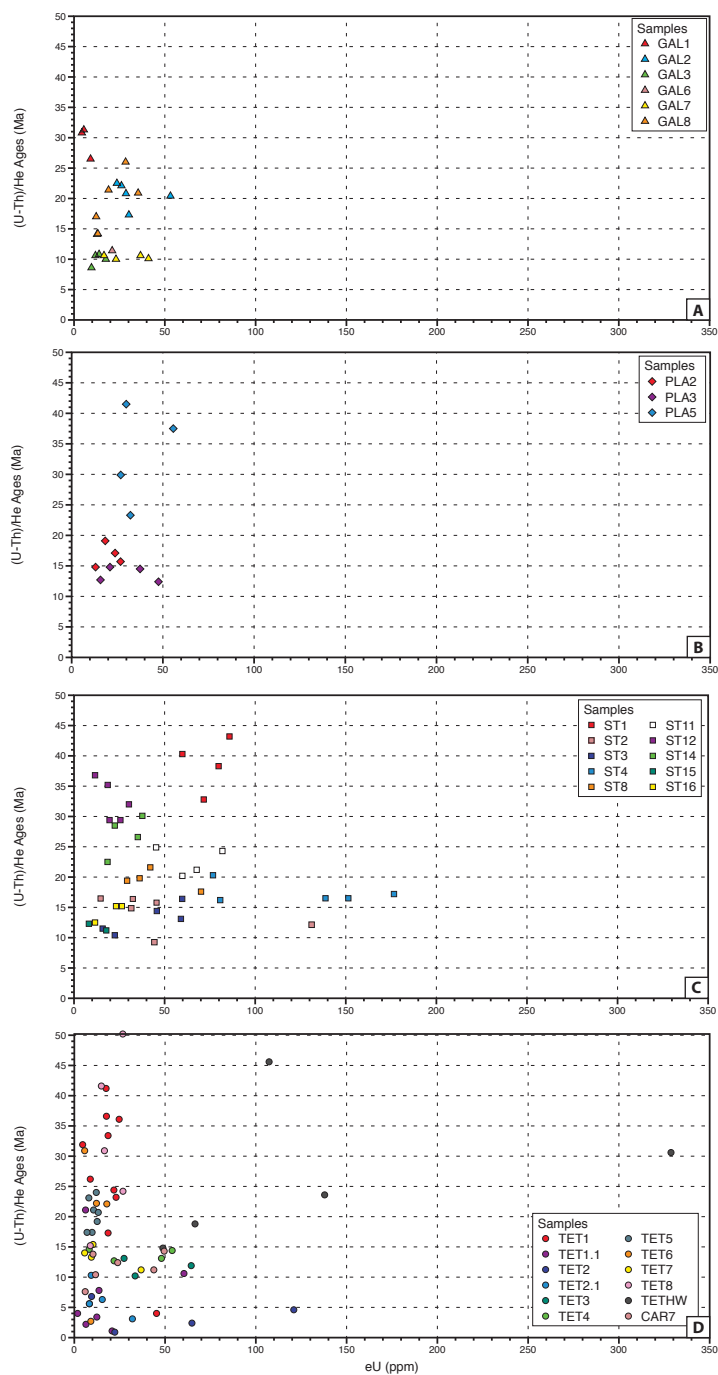
20

Figure 3. REE patterns for Durango apatite standards, consistent with DurA analysis of Chew et al. (2016).

**Table 2. Chondrite normalised REE content of dated apatite grains according to Sun and McDonough (1989).**

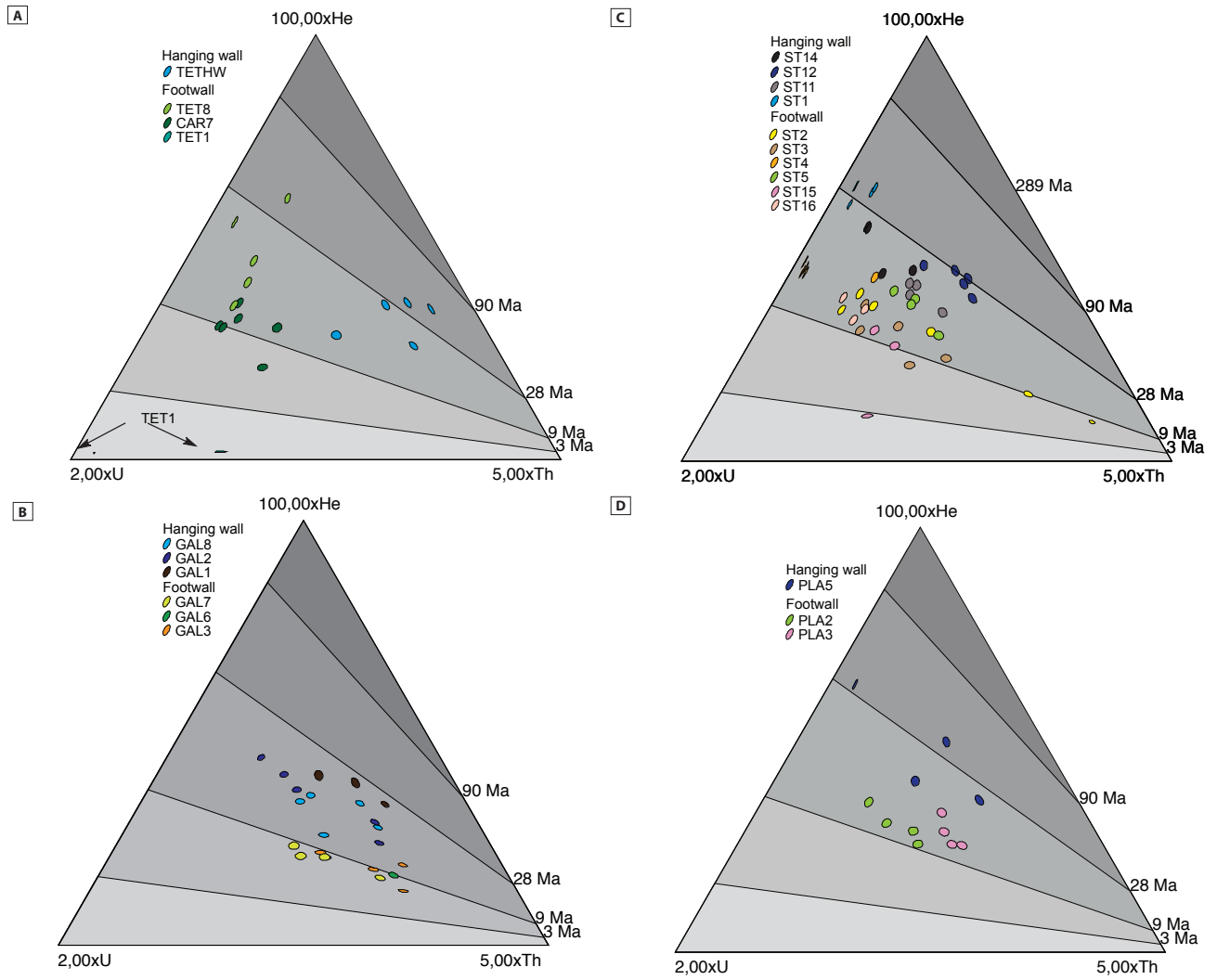
Profil	Name	A/E ages	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	ΣREE
<b>Footwall samples</b>																	
<b>TET Profile</b>	TET1-2	23.2	557.0	756.2	902.2	1048.2	1526.4	132.9	1858.2	1930.7	1744.1	1354.5	1010.9	785.5	585.4	471.0	14663.3
	TET1-3	36.1	744.2	951.5	1106.5	1248.8	1852.8	150.9	2227.8	2287.1	1980.0	1434.9	1030.8	776.8	549.8	444.6	16786.5
	TET1-4	41.2	421.9	571.5	694.8	821.7	1218.2	112.2	1525.8	1543.4	1333.7	986.5	700.1	534.9	387.3	310.5	11162.4
	TET1.1-1	4.0	82.7	110.1	138.3	164.7	249.8	40.7	305.5	306.7	263.7	191.0	137.4	101.2	76.8	61.7	2230.2
	TET1.1-2	2.2	133.9	168.9	206.4	240.8	355.2	58.8	416.4	417.5	359.5	268.5	194.8	150.0	116.6	92.2	3179.3
	TET1.1-4	2.11	284.7	394.7	446.0	499.0	706.1	54.1	819.6	845.0	743.8	549.7	392.3	304.1	238.6	183.0	6460.9
	TET1.1-11	3.4	197.7	262.1	320.7	375.7	555.5	86.1	665.1	656.7	556.2	417.8	316.8	241.6	195.8	155.2	5003.1
	TET1.1-12	1.1	230.9	297.0	361.9	434.0	629.7	93.0	764.9	758.1	672.7	538.5	413.7	318.7	243.3	196.5	5953.0
	TET1.1-13	10.6	537.0	671.7	785.5	885.5	1266.6	206.0	1447.7	1460.7	1279.3	1007.2	769.3	623.9	508.4	403.1	11852.2
	TET2.1-1	10.3	122.1	166.4	215.5	269.4	282.1	84.7	269.2	206.1	175.0	156.7	133.4	108.3	93.0	92.5	2374.3
	TET2.1-2	3.1	63.4	87.6	110.3	134.2	163.0	26.4	176.8	151.7	130.4	107.2	81.3	59.2	43.3	39.2	1374.1
	TET2.1-3	0.3	8.5	5.5	3.4	2.5	1.9	0.7	1.2	1.0	1.0	0.9	0.9	1.0	0.9	0.7	30.2
	TET2.1-4	5.6	111.4	137.0	168.8	208.2	216.5	56.7	208.4	170.0	151.5	137.0	121.4	104.8	91.7	86.5	1969.8
	TET2.1-11	5.6	112.0	136.7	173.7	221.5	255.1	77.1	250.6	202.6	178.3	165.7	152.3	135.4	110.0	109.5	2280.5
	TET2.1-12	6.3	142.0	182.7	233.0	301.1	357.4	91.7	365.0	303.5	279.1	263.2	237.8	211.5	188.8	175.8	3332.6
TET5-2	23.1	386.3	501.6	571.0	632.4	898.7	68.0	1039.7	1057.6	920.0	676.0	486.8	369.9	284.9	222.7	811.5	1715.7
TET5-4	20.7	456.8	590.5	685.9	757.0	1071.9	83.8	1259.4	1319.8	1166.2	870.8	634.2	485.7	377.2	305.0	10064.2	
<b>CAR sample</b>	CAR7-1	11.2	430.4	578.5	696.0	800.6	1130.2	169.8	1323.6	1345.1	1187.9	914.5	686.3	543.6	415.9	339.7	10562.3
	CAR7-2	7.6	131.3	178.7	217.5	264.4	383.7	71.4	463.8	454.1	395.3	298.2	216.4	159.6	116.3	93.6	3444.3
	CAR7-3	10.4	199.4	236.7	272.2	315.1	450.3	66.1	523.0	522.8	461.1	350.8	268.4	215.4	174.3	142.6	4198.1
	CAR7-4	12.4	470.0	605.9	714.5	830.7	1149.5	216.5	1379.8	1380.4	1222.3	951.2	719.1	551.9	427.9	354.2	10973.8
	CAR7-5	13.8	285.1	365.2	431.1	506.1	709.7	113.9	828.5	815.1	705.1	534.7	385.0	275.3	192.6	154.8	6302.2
	CAR7-6	14.3	554.3	740.8	868.3	989.4	1427.5	135.3	1645.1	1678.9	1473.2	1146.6	871.5	702.0	579.8	451.9	13264.7
<b>GAL Profile</b>	GAL7-1	10.6	220.6	251.0	285.5	326.8	271.9	105.1	269.8	192.4	164.4	152.8	133.9	121.5	118.5	142.2	2756.5
	GAL7-2	10.0	1011.8	1103.8	1145.6	1188.2	1975.3	236.3	863.1	669.5	574.4	443.3	381.1	339.9	340.6	9790.9	
	GAL7-3	10.6	764.1	829.9	848.8	884.5	685.2	271.9	598.0	432.9	370.5	348.0	315.0	285.1	278.7	328.3	7240.9
	GAL7-4	10.1	366.4	419.3	483.2	600.1	929.5	158.4	1564.3	1742.2	1881.8	1912.1	1811.4	1711.3	1604.9	1445.4	16630.3
	GAL3-1	14.1	379.6	412.0	461.7	526.7	447.4	158.1	608.2	387.3	312.9	278.5	202.5	177.5	156.9	171.0	4680.4
	GAL3-2	10.8	246.9	266.0	294.4	339.2	290.0	94.8	409.3	249.8	190.6	165.8	114.3	98.1	78.2	87.2	2924.5
GAL3-3	8.6	509.8	503.2	521.3	555.0	436.7	141.5	606.8	360.6	282.3	249.2	181.1	158.5	124.6	143.5	4774.2	
GAL3-4	10.6	489.5	486.6	515.7	552.7	425.8	157.6	552.8	350.2	277.9	251.0	176.8	154.2	137.8	149.8	4678.5	
<b>ST Profile</b>	ST15-1	11.2	53.1	68.1	102.2	175.3	457.0	72.3	868.0	1004.0	1097.2	1124.3	1023.5	869.4	741.9	633.6	8289.6
	ST15-2	12.3	169.7	227.9	278.2	332.9	475.1	47.3	528.2	501.4	429.4	340.5	267.4	241.8	226.5	186.3	4252.5
	ST16-1	12.5	187.5	256.9	324.3	388.9	606.7	56.6	700.4	699.8	603.8	458.0	339.8	265.8	211.0	169.6	5269.2
	ST16-2	15.2	271.8	386.3	488.9	588.8	915.8	86.0	1033.3	1050.3	923.9	701.9	535.0	431.3	342.0	266.4	8021.8
	ST16-3	15.2	343.7	475.2	593.5	730.1	1051.0	103.5	1170.7	1154.3	1038.1	835.6	668.3	590.9	551.2	457.0	9763.0
	ST2-1	16.4	269.6	348.1	409.8	470.1	642.4	78.3	652.4	647.4	590.9	483.4	400.1	334.0	279.8	218.3	5824.5
	ST2-2	14.8	494.6	665.4	835.2	1329.4	141.1	136.4	1304.8	1203.7	1025.4	850.2	727.8	594.2	467.6	316.7	11962.7
	ST2-3	12.1	10842.3	5392.9	3483.7	2799.5	2537.9	385.6	2622.7	2579.2	2358.0	1995.0	1625.5	1315.9	1024.6	817.3	39780.0
	ST2-4	9.2	5460.6	2576.3	1552.8	1206.6	937.9	157.4	832.0	776.1	705.8	598.4	509.9	441.9	368.6	293.8	16418.1
	ST2-5	15.7	1015.1	1362.1	1645.6	1864.9	2187.0	227.4	2023.3	1959.1	1832.8	1583.7	1381.4	1238.1	1086.6	872.9	20279.8
	ST2-6	16.3	580.1	796.4	979.5	1145.0	1493.5	156.9	1485.7	1429.4	1331.1	1096.1	916.9	798.1	644.9	517.3	13370.9
	ST4-1	16.5	618.8	758.4	862.8	879.4	1342.0	192.0	1541.9	1712.4	1444.7	1026.4	752.7	597.6	461.7	357.9	12548.8
ST4-2	17.2	1033.6	1228.1	1329.9	1336.5	1997.1	267.0	2346.2	2667.7	2272.9	1645.3	1236.2	997.1	802.4	620.1	19770.2	
ST4-3	16.5	766.7	944.8	1043.3	1044.0	1632.3	212.6	1872.2	2122.5	1788.7	1268.8	927.0	743.9	583.1	450.6	15400.4	
ST4-4	16.2	637.2	774.8	851.9	861.1	1330.7	184.1	1545.3	1714.5	1438.3	1004.2	738.1	583.2	450.6	353.4	12467.4	
ST4-5	20.3	456.3	571.6	637.2	650.7	1026.9	143.3	1169.3	1308.4	1080.3	754.8	542.4	433.2	335.1	260.4	9369.9	
ST8-1	21.6	807.9	1023.9	1190.2	1337.3	2001.9	171.5	2367.9	2489.5	2131.9	1574.5	1143.9	887.7	665.7	522.8	18316.7	
ST8-2	19.8	564.1	776.2	953.8	1097.6	1647.1	124.8	1893.8	1982.3	1715.6	1258.2	911.6	697.4	521.1	401.3	14544.8	
ST8-3	19.4	582.1	780.3	938.4	1072.3	1605.4	161.9	1921.1	2021.5	1800.6	1375.7	1010.7	619.9	494.6	315.7	15174.4	
ST8-4	17.6	1098.0	1445.0	1693.8	1822.5	2458.4	225.3	3386.8	3548.8	3104.3	2300.8	1655.5	1245.5	910.1	712.7	26075.0	
<b>PLA Profile</b>	PLA3-1	12.4	352.0	416.8	498.8	602.2	890.7	72.8	1111.4	1151.6	1128.8	998.7	873.3	787.1	692.5	583.6	10160.4
	PLA3-2	12.7	116.2	150.8	196.2	261.5	437.2	34.0	546.3	543.7	519.0	453.7	390.1	347.4	308.0	267.6	4571.9
	PLA3-3	14.8	161.9	202.2	255.3	331.9	531.2	41.2	654.1	660.7	623.8	543.3	462.9	410.4	364.1	313.5	5556.6
	PLA3-4	14.5	299.0	387.3	488.7	626.6	1029.7	78.9	1276.5	1288.5	1231.2	1079.6	921.7	825.6	711.3	622.9	10867.6
	PLA2-1	17.1	727.1	974.0	1180.8	1371.7	2154.7	132.0	2501.2	2523.0	2184.3	1634.0	1202.3	932.2	706.9	569.5	18793.6
	PLA2-2	14.8	443.0	622.2	785.4	958.7	1591.3	112.2	1858.4	1850.5	1562.1	1147.7	835.4	647.3	482.3	384.3	13280.9
PLA2-3	19.1	586.5	775.9	999.0	1169.5	1779.9	128.4	2146.7	2194.6	1921.6	1458.9	1090.8	842.9	653.9	514.1	16272.6	
PLA2-4	15.7	567.1	791.5	968.9	1143.9	1880.6	102.7	2166.8	2172.5	1844.9	1378.1	1017.4	786.0	612.4	485.4	15918.2	
<b>Hanging wall samples</b>																	
<b>TET Profile</b>	TETHW-1	30.6	1205.0	1631.7	1922.1	2114.4	3082.7	289.3	3293.6	3512.7	3181.1	2575.6	2208.5	1933.4	1553.8	1279.5	29783.5
	TETHW-2	23.6	1888.7	2596.6	2880.9	3138.5	4209.5	257.7	4643.5	4916.5	4612.5	3821.7	3130.0	2579.2	1997.7	1640.5	42313.

## Supplement Section S.5 Chemical analyses of apatite



25

Figure 4. (U-Th)/He ages vs. eU (U+0.235\*Th) for the 4 different profiles: A) Thuès B) Galinàs C) St-Thomas D) Planès.



30 **Figure 5.** U-Th-He ternary diagrams using Helioplot (Vermeesch, 2010) for the 4 profiles where samples from the Têt fault footwall and hanging wall are distinguished A) Thuès B) Gallinàs C) St-Thomas D) Planès.

## Supplement Section S.6 Numerical modelling under QTQt

Table 3. QTQt models parameters for the Têt fault footwall and hanging wall.

### QTQt model for the Têt fault footwall

#### Samples and data used in simulations

##### AHe data

TET3  
TET4  
TET5  
TET7  
GAL3  
GAL6  
GAL7

AFT data (Maurel et al., 2008)  
ZHe data (Maurel et al., 2008)

#### Data treatment, uncertainties, and other relevant constraints

##### AHe data

**Treatment:** Each of the 4 samples was used as a separate constraint in QTQt. Uncorrected  
**He ages (Ma):** Uncorrected He age of each apatite grain  
**Error (Ma) applied in modelling:** the  $1\sigma$  sample standard deviation  
**r ( $\mu\text{m}$ ):** equivalent radius of each apatite grain  
**eU (ppm):** eU of each apatite grain  
**eU zonation:** none

#### Additional geologic information

##### Assumption

At surface temperature of  $15 \pm 10^\circ\text{C}$  by 0 Ma  
Motion of Canigou and Carança massif

#### System and model specific parameters

**He kinetic model:** Gautheron et al. (2009)  
**Modelling code:** QTQt v.5.7.0  
Number of MCMC chain 100000

### QTQt model for the Têt fault hanging wall

#### Samples and data used in simulations

##### AHe data

ML1  
ST14  
ST12  
GAL2  
GAL1

AFT data (Maurel et al., 2008)  
ZHe data (Maurel et al., 2008)

#### Data treatment, uncertainties, and other relevant constraints

##### AHe data

**Treatment:** Each of the 4 samples was used as a separate constraint in QTQt. Uncorrected  
**He ages (Ma):** Uncorrected He age of each apatite grain  
**Error (Ma) applied in modelling:** the  $1\sigma$  sample standard deviation  
**r ( $\mu\text{m}$ ):** equivalent radius of each apatite grain  
**eU (ppm):** eU of each apatite grain  
**eU zonation:** none

#### Additional geologic information

##### Assumption

At surface temperature of  $15 \pm 10^\circ\text{C}$  by 0 Ma  
Motion of Mont Louis massif

#### System and model specific parameters

**He kinetic model:** Gautheron et al. (2009)  
**Modelling code:** QTQt v.5.7.0  
Number of MCMC chain 100000



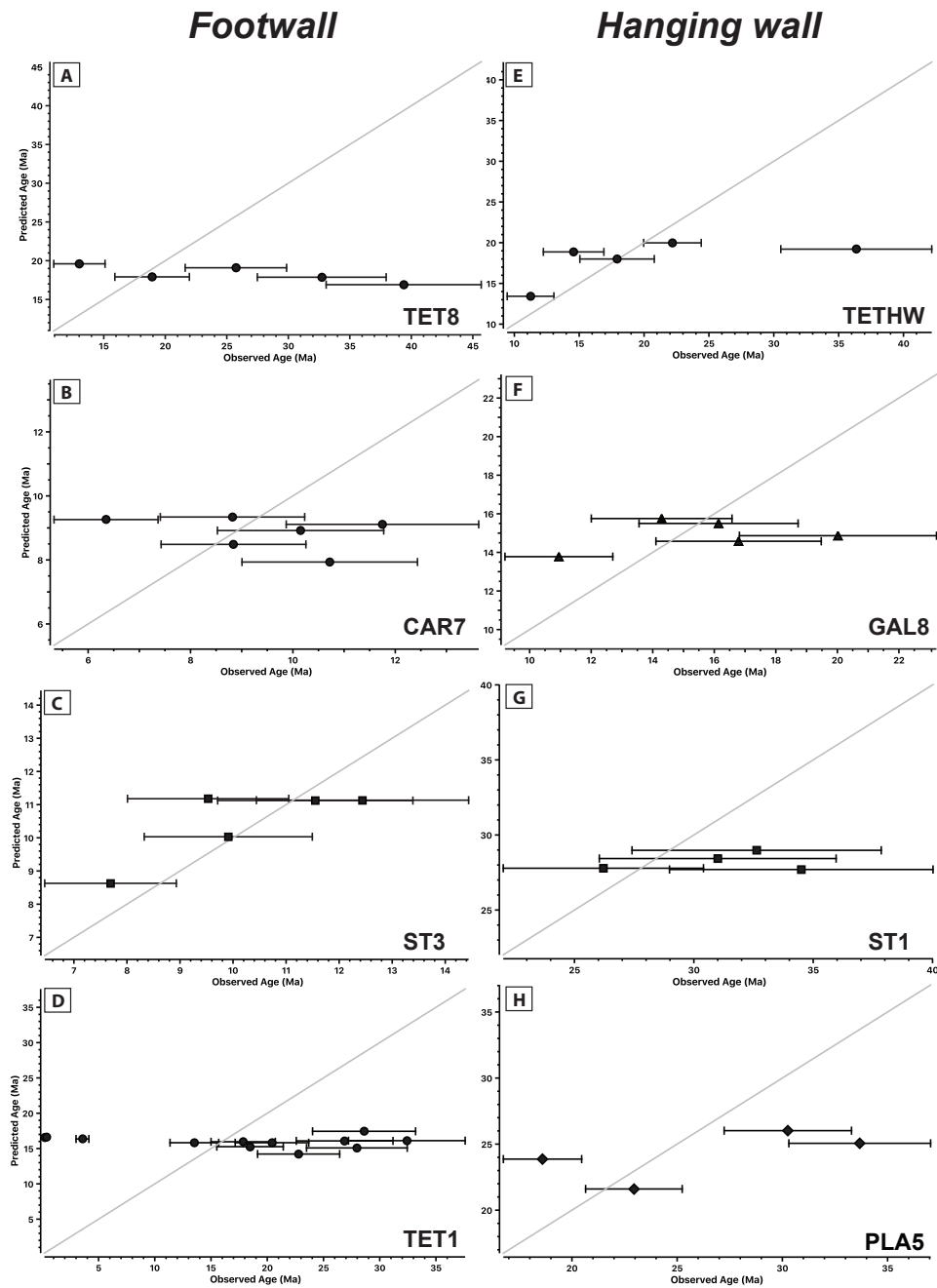


Figure 6. Predicted age vs Observed age graph using QTQt (Gallagher, 2012) for samples from the damage zone footwall (A,B,C and D) and hanging wall (E,F,G and H), computed with Gautheron et al. (2009) diffusion model. Modelling parameters are those of Table 3 with AFT and ZHe data from Maurel et al. (2008). For all samples, the weak or the lack of correspondence between observed and predicted ages indicates that no regional cooling history can reasonably explain the AHe age dispersion.

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