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Supplement of

Tectonothermal evolution in the core of an arcuate fold and thrust belt: the south-eastern sector of the Cantabrian Zone (Variscan belt, north-western Spain)

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Supplement 1
CAI data

Locality	Stratigraphic unit	Sample age	CAI (number of specimens)	Mean CAI value	Temperature range (°C)
V-01	Portilla Fm	Middle Givetian	5(2), 5.5(4)	5.3	320-355
V-02	Portilla Fm	Middle Givetian	5(3)	5.0	305-335
V-03	Portilla Fm	Middle Givetian	4.5(1)	4.5	240-280
V-04a	Portilla Fm	Givetian	5.5(42)	5.5	340-375
V-04b	Camporredondo Fm	Givetian-Frasnian	5.5(13), 6(3)	5.6	350-385
V-04c	Alba Fm	Visean	5.5-6(4), 6(2), 7(1)	6.0	380-420
V-05	Portilla Fm	Middle Givetian	5.5(4)	5.5	340-375
V-06	Portilla Fm	Middle Givetian	5(12), 5-5.5(8)	5.2	315-345
V-07	Camporredondo Fm	Famennian	5(30), 5.5(19)	5.2	315-345
V-08	Alba Fm	Visean	5(20), 5-5.5(2), 5.5(22)	5.3	320-355
V-09	Portilla Fm	Middle Givetian	5-5.5(2)	5.3	320-355
V-10a	Santa Lucía Fm	Upper Emsian	5.5(7)	5.5	340-375
V-10b	Alba Fm	Tournaisian	5.5(15), 6(20), 6.5(4)	5.9	380-410
V-11	Alba Fm	Visean	7-8(1)	7.5	550-590
V-12	Alba Fm	Visean	6(5), 7(1)	6.2	400-435
V-13a	Alba Fm	Visean	6(3)	6.0	380-420
V-13b	Barcaliente Fm	Serpukhovian	5.5(3)	5.5	340-375
V-13c	Prioro Gr	Bashkirian	5(2)	5.0	305-335
V-14	Alba Fm	Visean	5.5(24), 6(10)	5.7	350-390
V-15a	Portilla Fm	Middle Givetian	5(5), 5.5(13)	5.4	330-360
V-15b	Prioro Gr	Bashkirian	5.5(14), 6(10)	5.7	350-390
V-16a	Alba Fm	Visean	5(29), 5.5(21), 6(13)	5.4	330-360
V-16b	Prioro Gr	Bashkirian	5(5), 5-5.5(2), 5.5(5)	5.3	320-355
V-17	Barcaliente Fm	Serpukhovian	5-5.5(13)	5.3	320-355
V-18	Alba Fm	Visean	6(3)	6.0	380-420
V-19	Alba Fm	Visean	5-5.5(3)	5.3	320-355
V-22a	Alba Fm	Visean	5-5.5(2), 6(1)	5.5	340-375
V-22b	Barcaliente Fm	Serpukhovian	5-5.5(2), 6(1)	5.5	340-375
V-22c	Prioro Gr	Bashkirian	5.5(2)	5.5	340-375
V-24	Santa Lucía Fm	Upper Emsian	5(1), 5.5(2), 6(2)	5.6	350-385
V-25	Santa Lucía Fm	Eifelian	5-5.5(20)	5.3	320-355
V-27	Portilla Fm	Middle Givetian	5(9), 5.5(2), 6(1)	5.2	315-345
V-29a	Barcaliente Fm	Serpukhovian	5.5(3)	5.5	340-375
V-29b	Prioro Gr	Bashkirian	5.5(10)	5.5	340-375
V-58	Portilla Fm	Middle Givetian	5.5(2), 6(4), 7(3)	6.2	400-435
V-61	Santa Lucía Fm	Upper Emsian	5.5(2), 6(2), 6.5-7(1)	6.0	380-420
V-62	La Vid Gr	Emsian	6.5-7(2)	6.8	470-510

V-73	Portilla Fm	Middle Givetian	5.5(2), 6(2)	5.8	355-395
V-75	Brezo Limestone	Serpukhovian	5.5(2)	5.5	340-375
V-76	Brezo Limestone	Serpukhovian	5.5(1)	5.5	340-375
V-77	Portilla Fm	Middle Givetian	5(10), 5.5-6(21)	5.5	340-375
V-148a	Vidrieros Fm	Famennian	3(20), 4 (6)	3.2	130-165
V-148b	Alba Fm	Visean	3-3.5(10), 4(10),4.5(1)	3.7	165-200
V-195	Brezo Limestone	Serpukhovian	5(1)	5.0	305-335
V-198	Brezo Limestone	Serpukhovian	5.5(1)	5.5	340-375
V-601	Portilla Fm	Middle Givetian	5.5(3)	5.5	340-375
V-602	Portilla Fm	Middle Givetian Serpukhovian-	5.5(2)	5.5	340-375
V-717	Barcaliente Fm	Bashkirian	4-4.5(1)	4.3	215-250
V-718	Portilla Fm	Middle Givetian	5(10), 5.5-6(21)	5.5	340-375
P-1a	Gustalapedra Fm	Eifelian	2(2), 2.5(7), 3(43)	2.9	110-145
P-1b	Cardaño Fm	Givetian	3(10), 3.5(10)	3.0	115-155
P-2	Polentinos Fm	Emsian/Eifelian	2.5-3(6), 3(31),3-3.5(20), 3.5(9)	3.3	140-175
P-3	Polentinos Fm	Emsian	3(1), 3.5(22), 4(1)	3.5	150-185
P-6	Abadía Fm	Upper Emsian	4(14), 4-4.5(3), 4.5(16)	4.3	215-250
P-7	Polentinos Fm	Emsian/Eifelian	3(3), 4(17), 4.5(4)	4.0	190-225
P-11	Polentinos Fm	Emsian	4(3), 4.5(5)	4.3	215-250
P-12	Cardaño Fm	Upper Givetian	4.5(21), 5(11)	4.7	265-300
P-13	Polentinos Fm	Emsian/Eifelian	4(21), 4-4.5(5)	4.0	190-225
P-14	Cardaño Fm	Upper Givetian	4.5(2), 5(3), 5.5(3)	5.1	310-340
P-15	Polentinos Fm	Emsian/Eifelian	3.5(6), 4(31), 4.5(5)	4.0	190-225
P-16	Cardaño Fm	Givetian	4.5(27), 5(2), 5.5(2)	4.6	255-290
P-17	Polentinos Fm	Upper Emsian	4.5(2)	4.5	240-280
P-18	Polentinos Fm	Upper Emsian	4.5(2)	4.5	240-280
P-19	Polentinos Fm	Upper Emsian	4.5(2)	4.5	240-280
P-20	Cardaño Fm	Frasnian	4.5(16), 5(2)	4.6	255-290
P-21	Cardaño Fm	Upper Givetian	4.5(18)	4.5	240-280
P-22a	Cardaño Fm	Givetian/Frasnian	4(11), 4.5(15), 5(2), 5.5(4)	4.5	245-280
P-22b	Gustalapedra Fm	Eifelian	4(1), 5(16)	4.9	290-320
P-23	Polentinos Fm	Emsian	4.5(3), 5.5(15), 6(1)	5.4	330-360
P-27a	Polentinos Fm	Eifelian	4.5(3)	4.5	240-280
P-27b	Cardaño Fm	Frasnian	4.5(45), 5(61), 5.5(2)	4.8	280-315
P-28	Cardaño Fm	Frasnian	4.5(17), 5(27), 5.5(17), 6(6)	5.1	310-340
P-30	Cardaño Fm	Upper Givetian	4.5(22), 4.5-5(6), 5(26), 5.5(5)	4.8	280-315
P-31	Cardaño Fm	Upper Givetian	5(10)	5.0	305-335
P-32	Polentinos Fm	Emsian/Eifelian	2(5), 2.5(22), 2.5-3(19), 3(13)	2.6	90-125
P-34a	Polentinos Fm	Emsian/Eifelian	5(4), 6.5(2)	5.5	340-375
P-34b	Cardaño Fm	Frasnian	5(4), 5.5(2)	5.2	315-345
P-35	Polentinos Fm	Upper Emsian	5.5-6(2)	5.8	355-410
P-36	Cardaño Fm	Givetian	6-6.5(1)	6.3	420-450
P-37	Abadía Fm	Emsian	2(3), 2.5(23), 3(13)	2.6	90-125
P-39	Gustalapedra Fm	Eifelian	3-3.5(1), 3.5-4(1)	3.5	150-185
P-40	Polentinos Fm	Eifelian	2.5(15), 3(6), 3-3.5(1)	2.7	100-130
P-41	Polentinos Fm	Eifelian	3(1), 4(13),4.5(6)	4.1	195-235

P-42	Cardaño Fm	Upper Givetian	4.5(12), 5(12), 5.5(12)	5.0	305-335
P-44	Abadía Fm	Pragian	5(4)	5.0	305-335
P-46	Abadía Fm	Emsian	4(12), 4.5(6), 4.5-5(3)	4.3	215-250
P-47	Lebanza Fm	Pragian	4.5-5(1), 5(27), 5.5(2)	5.0	305-335
P-48	Lebanza Fm	Pragian	4(11), 4-4.5(17), 4.5(16)	4.5	240-280
P-49	Abadía Fm	Emsian	4(4), 4.5(81), 5(13), 5.5(7)	4.6	255-290
P-50	Abadía Fm	Emsian	1.5(5), 2(7), 2.5(11)	2.1	55-90
P-51	Carazo Fm	Upper Pridoli	4(6), 4.5(29), 5(8)	4.5	240-280
P-52	Lebanza Fm	Lochkovian/Pragian	3.5(15), 4(59), 4.5(134)	4.3	215-250
P-53	Abadía Fm	Emsian	1.5(2), 2(3), 2.5(7)	2.2	60-95
P-54	Abadía Fm	Emsian	4-4.5(1)	4.3	215-250
P-55	Carazo Fm	Upper Pridoli	4.5(4), 4.5-5(4), 5(16), 5.5(18)	5.1	310-340
P-56	Lebanza Fm	Pragian	4.5(100), 4-4.5(3), 5(6), 5.5(8)	4.6	225-290
P-59	Vidrieros Fm	Famennian	6(4), 6.5(21)	6.4	430-460
P-60	?	Devonian	6(2)	6	380-420
P-67	Cardaño Fm	Frasnian	4.5(2), 5(2)	4.8	280-315
P-78	Carazo Fm	Lochkovian	4(18)	4	190-225
P-79	Villabellaco Fm	Tournaisian	2(36)	2	52-80
P-80	Vidrieros Fm	Famennian	4(44)	4	190-225
P-81	Muda Fm	Bashkirian	3(9)	3	115-155
P-82	Villabellaco Fm	Tournaisian	2(8)	2	52-80
P-83	Brañosera Fm	Kasimovian	1.5(3)	1.5	<40-60
P-84a	Gustalapedra Fm	Eifelian	4.5-5(3), 5(13), 5.5(11)	5.1	310-340
P-84b	Cardaño Fm	Frasnian	4.5(8), 5(14)	4.8	280-320
P-85	Vidrieros Fm	Famennian	4.5(11), 5(2)	4.6	255-290
P-86	Alba Fm	Visean	5-5.5(6)	5.3	320-355
P-87	Vidrieros Fm	Famennian	4.5(13)-5.5(45)	5.3	320-355
P-88a	Vidrieros Fm	Famennian	5(15), 5.5(16)	5.3	320-355
P-88b	Alba Fm	Visean	5(10), 5.5(30), 6(5)	5.4	330-360
P-89	Alba Fm	Tournaisian	5.5(27), 6(48)	5.8	355-395
P-90	Vidrieros Fm	Tournaisian	5.5(10), 6(40)	5.9	375-410
P-91	Olistolith	Givetian	4(6)	4	190-225
P-92	Prioro Gr	Moscovian	5-5.5(3), 6(4)	5.7	350-390
P-93a	Olistolith	Tournaisian	6-7(2)	6.5	440-470
P-93b	Olistolith	Visean	5(29), 5.5(28), 5.5-6(11), 6(37)	5.6	355-385
P-94a	Cardaño Fm	Givetian	4-4.5(2)	4.3	215-250
P-94b	Vidrieros Fm	Famennian	4(10), 4.5(10), 5.5(7), 6(6)		
P-94c	Alba Fm	Tournaisian	4-4.5(4)	4.3	215-250
P-95	Prioro Gr	Bashkirian	1.5(11)	1.5	<40-60
P-96	Alba Fm	Visean	4.5(10)	4.5	240-280
P-97a	Cardaño Fm	Upper Givetian	4(5), 4.5(32)	4.4	230-265
P-97b	Vidrieros Fm	Famennian	4(2), 4.5(2)	4.3	215-250
P-98a	?	Lower Devonian	5.5(1)	5.5	340-375
P-98b	Vidrieros Fm	Famennian	5(80), 5.5(33)	5.1	310-340
P-99	Olistolith	Famennian	5-5.5(11), 6(1)	5.3	320-355
P-100	?	Carboniferous	6(1)	6	380-420

P-104	Perapertú Fm	Moscovian	4(10), 4.5(10)	4.3	215-250
P-108	Cea Fm	Moscovian/Kasimovian	5-5.5(2)	5.3	320-355
P-109	Castellería Lms	Upper Moscovian	6(3)	6	380-420
P-113	?	Carboniferous	4(1)	4	190-225
P-125	?	Devonian	7(3)	7	500-535
P-126	Brañosera Fm	Kasimovian	1.5(1), 2(1)	1.8	45-70
P-129	Verdegosa Fm	Moscovian	4(3)	4	190-225
P-130	Ojosa Fm	Moscovian	4(1), 4-4.5(4), 5(2)	4.4	230-265
P-133	Villabellaco Fm	Visean	3.5(5), 4(5)	3.8	175-215
P-134	Lebanza Fm	Lochkovian/Pragian	4.5(6), 5(2)	4.6	255-290
P-135	Abadía Fm	Lower Emsian	4-4.5(10), 5-5.5(10)	4.8	280-315
P-136	Abadía Fm	Lower Emsian	4(4)	4	190-225
P-137	Cardaño Fm	Frasnian	5(39), 5.5(17), 6(1)	5.2	315-345
P-138	Lebanza Fm	Pragian	3.5(7), 4(17), 4.5(10)	4	190-225
P-139	Abadía Fm	Emsian	4(8), 4.5(8)	4.8	280-315
P-140	Abadía Fm	Emsian	4(8), 4-4.5(3), 4.5(3)	4.2	210-240
P-141	Lebanza Fm	Lochkovian/Pragian	4(3), 4.5(1)	4.1	195-235
P-142	Abadía Fm	Emsian	4(7)	4	190-225
P-143	Gustalapedra Fm	Eifelian	5(3), 5.5(2)	5.2	315-345
P-144	Cardaño Fm	Givetian	5(4), 5.5(3)	5.2	315-345
P-145	Vidrieros Fm	Famennian	5(5), 5.5(2), 6(2), 7(1)		
P-146	Abadía Fm	Emsian	5.5(5), 6(2)	5.6	345-385
P-147	Alba Fm	Visean	5-5.5(3), 6(2), 7(2)		
P-148	Vidrieros Fm	Famennian	4.5(18), 5(10)	4.7	265-300
P-149a	Vidrieros Fm	Famennian	5(20), 5.5(10)	5.2	315-345
P-149b	Alba Fm	Visean	5(22), 5.5(31), 6(36)	5.7	350-390
P-150	Barcaliente Fm	Serpukhovian	4.5-5(20), 5(20)	4.9	290-320
P-151a	Cardaño Fm	Frasnian	5(40), 5.5(20), 6(8), 7(6)		
P-151b	Vidrieros Fm	Famennian	5(3), 5-5.5(9)	5.2	315-345
P-152	Alba Fm	Visean	5-5.5(8), 6(2)	5.4	330-360
P-153	Barcaliente Fm	Serpukhovian	5-5.5(6), 6.5(4)	5.8	355-395
P-154	Vidrieros Fm	Famennian	5(30), 5-5.5(6), 5.5 (30)	5.3	320-355
P-155	Alba Fm	Visean	5(10), 5-5.5(12)	5.1	310-340
P-156	Barcaliente Fm	Serpukhovian	5(3), 5.5(10)	5.4	330-360
P-157	Alba Fm	Visean	4(3), 4.5-5(3)	4.4	230-265
P-158	Pando Group	Upper Moscovian	5(3), 5.5(6), 6(2)	5.5	340-375
P-159	Olistolith	Emsian	4(2)	4	190-225
P-161a	Vidrieros Fm	Famennian	5(60)	5	305-335
P-161b	Alba Fm	Visean	5.5-6(40)	5.8	355-395
P-162a	Pebbles in Pando Gr	Pragian	5(20)	5	305-335
P-162b	Pebbles in Pando Gr	Givetian	5(20), 5.5(10)	5.2	315-345
Po-172	Ermita Fm	Famennian	5(2)	5	305-335
Po-173	Alba Fm	Visean	4.5(1), 5(1), 6(1), 7(2)		
P-174	Pando Gr	Moscovian	6-6.5(2)	6.3	420-450
P-178a	Cardaño Fm	Frasnian	5(2), 5.5(3)	5.3	320-355

P-178b	Vidrieros Fm	Tournaisian	5(3), 5.5(10)	5.4	330-360
P-178c	Alba Fm	Visean	5(8), 5.5(10), 6(5)	5.4	330-360
P-179	Olistolith	Famennian	5.5(15), 6(20), 6.5(4)	5.9	375-410
P-180	Pando Gr	Moscovian	4(2), 4.5(1), 5(2)	4.5	240-280
P-181	Olistolith	Famennian-Visean	4.5(2)	4.5	240-280
P-182	Olistolith	Lower Devonian	4(3)	4	190-225
P-183	Olistolith	Middle Devonian	4(2)	4	190-225
P-184	Olistolith	Famennian-Visean	4(1)	4	190-225
P-185	Olistolith	Famennian-Visean	5.5(2)	5.5	340-375
P-186	Olistolith	Famennian-Visean	5.5(1)	5.5	340-375
Po-187	Alba Fm	Visean	5-5.5(1), 5.5(1)	5.4	330-360
Po-188	Alba Fm	Visean	4(7), 4.5(5), 5-5.5(1), 6(2)		
Po-189	Alba Fm	Serpukhovian	2(4), 3(2)	2.3	79-105
P-190	Remoña Gr	Gzhelian	4.5(2)	4.5	240-280
P-191	Olistolith	Kasimovian-Gzhelian	4.5(2), 5(3), 5.5(2)	5	305-335
Pe-192	Alba Fm	Visean	4(22), 4-4.5(18), 4.5(10)	4.2	210-240
Pe-193	Alba Fm	Visean	4.5(1)	4.5	240-280
Pe-194	?	Kasimovian	2.5(1), 3(2)	2.8	105-140
Pe-195	Barcaliente Fm	Serpukhovian	4(1)	4	190-225
Pe-196	Barcaliente Fm	Serpukhovian	3.5(4), 4(2)	3.7	165-200
Pe-197	Picos de Europa	Moscovian	4(2)	4	190-225
Pe-198	Picos de Europa	Moscovian	3(10), 3.5(31), 4(58), 4-4.5(18)	3.8	175-215
Pe-199	Baleas Fm	Tournaisian	4(3)	4	190-225
Pe-200	Barcaliente Fm	Serpukhovian	3.5(1), 4(2)	3.8	175-215
Pe-201	Picos de Europa	Moscovian	3(6), 3.5(5)	3.2	130-165
Pe-202	Picos de Europa	Kasimovian	3(3)	3	115-155
P-217a	Cardaño Fm	Givetian	5(7), 5.5-6(2)	5.2	315-345
P-217b	Villabellaco Fm	Tournaisian	4.5(4), 5(21), 5.5(10), 6(2)	5.1	310-340
P-217c	Prioro Gr	Bashkirian	5(1), 5.5(1)	5.3	320-355
P-232	Prioro Gr	Bashkirian	7(1)	7	500-535
P-239a	Abadía Fm	Emsian	5(25), 5.5(3)	5.1	310-340
P-239b	Gustalapedra Fm	Givetian	5(10), 5.5(2)	5.1	310-340
P-239c	Cardaño Fm	Frasnian	5(10), 5.5(12), 6(2)	5.3	320-355
P-239d	Alba Fm	Visean	4-4.5(3), 5(3)	4.6	255-290
P-240a	Cardaño Fm	Frasnian	5(40), 5.5(30)	5.2	315-345
P-240b	Vidrieros Fm	Famennian	5(3)	5	305-335
P-240c	Alba Fm	Tournaisian	5-5.5(40)	5.3	320-355
P-300a	Vidrieros Fm	Famennian	5(16), 5.5(15)	5.2	315-345
P-300b	Alba Fm	Visean	5(7), 5.5(3)	5.2	315-345

Supplement 2 Liébana

Formation	Area Code	SAMPLE	KI AD (°20) AD standard	KI EG (°20) EG standard	AI (°20)	Cld	Pri	Pg	I/S	Kln	Chl	C/V	Stp
Campollo Remoña Group	1	PI 243	0.404	0.379		Cld		Pg				C/V	
Campollo Remoña Group	1	PI 244	0.283	0.277	0.195			Pg			Chl	C/V	
Campollo Remoña Group	1	PI 245	0.425	0.397	0.309			Pg			Chl	C/V	
Campollo Remoña Group	1	PI 246	0.415	0.392	0.220			Pg			Chl	C/V	
Campollo Remoña Group	1	PI 247	0.462	0.415	0.288			Pg			Chl	C/V	
Campollo Remoña Group	1	PI 251	0.443	0.403			Pri	Pg					
Campollo Remoña Group	1	PI 259	0.393	0.372				Pg					
Campollo Remoña Group	1	PI 260	0.442	0.412	0.275		Pri	Pg			Chl	C/V	
Campollo Remoña Group	1	PI C	0.352	0.305	0.196				I/S		Chl		
Viorna Group	1	PI 156	0.436	0.637			PRL	Pg	I/S		Chl		
Viorna Group	1	PI 157	0.517	0.449			Pri	Pg	I/S		Chl		
Viorna Group	1	PI 158	0.344	0.332	0.244			Pg			Chl		
Pando Group	1	PI 238	0.353	0.391			PRL						
Pando Group	1	PI 258	0.415	0.423	0.231			Pg			Chl		
Pando Group	1	PI 303	0.738	0.584	0.277				I/S		Chl		
Pando Group	1	PI 304	0.519	0.500	0.251	Cld			I/S		Chl		
Pando Group	1	PI 305	0.422	0.395			PRL						
Pando Group	1	PI 306	0.393	0.357	0.205			Pg			Chl		
Pando Group	1	PI 310	0.490	0.492			Pri		I/S				
Pando Group	1	PI 311	0.581	0.526					I/S				
Pando Group	1	PI 312	0.644	0.518					I/S				
Pando Group	1	PI 313	0.542	0.455				Pg	I/S		Chl		
Pando Group	1	PI 314	0.508	0.420		Cld		Pg	I/S		Chl		
Pando Group	1	PI D	0.324	0.294					I/S		Chl		
Prioro Group	1	PI 152	0.458	0.407	0.283			Pg	I/S		Chl		
Prioro Group	1	PI 153	0.416	0.366					I/S				
Prioro Group	1	PI 154	0.576	0.371				Pg	I/S		Chl		
Prioro Group	1	PI 155	0.424	0.370	0.230			Pg	I/S		Chl		
Prioro Group	1	PI 234	0.327	0.346				Pg					
Prioro Group	1	PI 235	0.346	0.351	0.340	Cld		Pg			Chl		
Prioro Group	1	PI 237	0.302	0.306	0.190			Pg			Chl		
Prioro Group	1	PI 248	0.461	0.460	0.221			Pg			Chl		
Prioro Group	1	PI 249	0.472	0.493	0.195			Pg			Chl		
Prioro Group	1	PI 250	0.470	0.428	0.217			Pg			Chl		
Prioro Group	1	PI 256	0.444	0.425			Pri						
Prioro Group	1	PI 257	0.700	0.545			Pri		I/S				
Prioro Group	1	PI 261	0.524	0.447	0.232			Pg	I/S		Chl		
Prioro Group	1	PI 262	0.517	0.410			Pri	Pg	I/S				
Prioro Group	1	PI 263	0.480	0.418			Pri	Pg	I/S			C/V	
Prioro Group	1	PI 264	0.498	0.439	0.222		Pri	Pg	I/S		Chl		
Prioro Group	1	PI 300	0.640	0.545	0.185				I/S		Chl		
Prioro Group	1	PI 301	0.518	0.439	0.189			Pg	I/S		Chl		
Prioro Group	1	PI 302	0.646	0.560	0.241			Pg	I/S		Chl		
Prioro Group	1	PI 307	0.510	0.443				Pg	I/S				
Prioro Group	1	PI 309	0.429	0.411	0.253		Pri		I/S		Chl		
Prioro Group	1	PI 315	0.326	0.324	0.164	Cld		Pg			Chl		

Prioro Group	1	PI 600	0.406	0.415		PRL				
Prioro Group	1	PI 601	0.821	0.646	0.242			I/S	Chl	
Prioro Group	1	PI 602	0.698	0.663		Pri		I/S		
Prioro Group	1	PI 603	0.578	0.559	0.288	Cld	Pri	I/S		C/V
Prioro Group	1	PI 606	0.678	0.679	0.308			I/S		C/V
Prioro Group	1	PI 607	0.652	0.586		PRL		I/S	Kln	
Prioro Group	1	PI 608	<i>0.538</i>	<i>0.568</i>	0.357	Pri		I/S		C/V
Prioro Group	1	PI 609	0.744	0.723	0.472	Pri		I/S		C/V
Prioro Group	1	PI 610	<i>0.397</i>	<i>0.415</i>	0.206	Cld	Pg		Chl	
Prioro Group	1	PI 612	0.580	0.594	0.315	Cld	Pri	I/S	Chl	C/V
Devonian	1	PI 240	0.291	0.295		PRL				
Devonian	1	PI 316	0.670	0.563		Cld		I/S	Chl	

**Supplement 2
Valdeón**

Formation	Area Code	SAMPLE	KI AD (°2θ) AD standard	KI EG (°2θ) EG standard	AI (°2θ)	Cld	Prl	Pg	I/S	Kln	Chl	C/V	Stp
Viorna Group	2	PI 160	0.528	0.423	0.189		Prl		I/S		Chl		
Viorna Group	2	PI 161	0.307	0.296	0.197	Cld			I/S		Chl		
Viorna Group	2	PI 163	0.310	0.299	0.188				I/S		Chl		
Viorna Group	2	PI 164	0.349	0.290	0.161				I/S		Chl		
Viorna Group	2	PI 165	0.427	0.369		Cld		Pg	I/S				STP
Viorna Group	2	PI 215	0.470	0.415	0.205	Cld		Pg	I/S		Chl		
Viorna Group	2	PI 216	0.411	0.302				Pg	I/S				
Viorna Group	2	PI 217	0.441	0.401	0.199			Pg	I/S		Chl		
Viorna Group	2	PI 218	0.457	0.374	0.221	Cld			I/S		Chl		
Viorna Group	2	PI 219	0.630	0.476				Pg	I/S				
Pando Group	2	PI 220	0.357	0.362	0.207			Pg			Chl		
Pando Group	2	PI 222	0.486	0.432	0.280			Pg	I/S		Chl		
Pando Group	2	PI 223	0.354	0.321	0.203			Pg			Chl		
Pando Group	2	PI 224	0.409	0.346				Pg			Chl		
Pando Group	2	PI A	0.399	0.351					I/S		Chl		

**Supplement 2
Yuso-Carrión**

Formation	Area Code	SAMPLE	KI AD (°20) AD standard	KI EG (°20) EG standard	AI (°20)	Cld	Pri	Pg	I/S	Kln	Chl	C/V	Stp
Devonian	3E	PI 27	0.614	0.448	0.235		PRL	Pg	I/S		Chl		
Devonian	3E	PI 28	0.577	0.442	0.290		PRL	Pg	I/S		Chl		
Devonian	3E	PI 149	0.773	0.651			Pri		I/S		Chl	C/V	
Devonian	3E	PI 319	0.726	0.654					I/S	Kln			
Devonian	3E	PI 320	0.926	0.899					I/S	Kln			
Devonian	3E	PI 321	0.802	0.890					I/S	Kln		C/V	
Devonian	3E	PI 322	0.840	0.956			Pri		I/S	Kln	Chl		
Devonian	3E	PI 324	0.729	0.826			Pri		I/S	Kln	Chl		Stp
Devonian	3E	PI 325	0.855	0.854	0.364		Pri		I/S		Chl		
Devonian	3E	PI 326	0.618	0.591	0.326				I/S		Chl		
Devonian	3E	PI 331	0.582	0.608			Pri			Kln	Chl	C/V	
Devonian	3E	PI 332	0.882	1.157	0.319				I/S		Chl		
Devonian	3E	PI 333	0.829	0.835			PRL						Stp
Devonian	3E	PI 353	0.796	0.807				Pg		Kln			Stp
Silurian	3E	PI 150	0.673	0.713					I/S			C/V	
Silurian	3E	PI 327	0.786	0.661	0.291		Pri		I/S		Chl		
Silurian	3E	PI 328	0.695	0.835			Pri		I/S	Kln	Chl		
Silurian	3E	PI 352	0.698	0.555	0.317		PRL		I/S		Chl		Stp
Silurian	3E	PI 354	0.661	0.584	0.274		Pri	Pg	I/S			C/V	
Pando Group	3W	PI 166	0.265	0.271	0.155	Cld		Pg			Chl		
Pando Group	3W	PI 167	0.300	0.284	0.190			Pg			Chl		
Pando Group	3W	PI 169	0.387	0.381	0.201			Pg			Chl		
Pando Group	3W	PI 171	0.316		0.157	Cld		Pg			Chl		
Prioro Group	3W	PI 208	0.238	0.255	0.130			Pg			Chl		
Pando Group	3W	PI 209	0.316	0.335	0.135	CLD		Pg			Chl		
Pando Group	3W	PI 210	0.218	0.225	0.137						Chl		
Pando Group	3W	PI 211	0.201	0.203	0.134						Chl		
Pando Group	3W	PI 212	0.221	0.233							Chl		
Pando Group	3W	PI 213	0.244	0.250	0.128						Chl		
Pando Group	3W	PI 400	0.283	0.294	0.173						Chl		
Pando Group	3W	PI 401	0.267	0.240	0.159	Cld					Chl		
Pando Group	3W	PI 402	0.245	0.217	0.143	Cld					Chl		
Pando Group	3W	PI 403	0.226	0.229	0.157	Cld					Chl		
Pando Group	3W	PI 404	0.279	0.267	0.171	Cld					Chl		
Pando Group	3W	PI 618	0.381	0.394	0.227	Cld		Pg			Chl		
Pando Group	3W	PI 621	0.400	0.409	0.215	Cld		Pg			Chl		
Pando Group	3W	PI 622	0.380	0.389		Cld		Pg			Chl		
Pando Group	3W	PI 623	0.329	0.326	0.188	Cld					Chl		
Pando Group	3W	PI 624	0.273	0.265	0.189	Cld					Chl		
Devonian	3W	PI 619	0.272	0.271		Cld					Chl		
Devonian	3W	PI 620	0.265	0.275	0.187	Cld					Chl		

**Supplement 2
Pisuerga**

Formation	Area Code	SAMPLE	KI AD (°2θ) AD standard	KI EG (°2θ) EG standard	AI (°2θ)	Cld	Pri	Pg	I/S	Kln	Chl	C/V	Stp
Viorna Group	4E	PI 114	0.752	0.590					I/S	Kln			
Viorna Group	4E	PI 115	0.602	0.485					I/S	Kln	Chl		Stp
Viorna Group	4E	PI 116	0.434	0.359					I/S	Kln	Chl		
Viorna Group	4E	PI 117	0.544	0.417					I/S	Kln		C/V	
Viorna Group	4E	PI 120	0.490	0.377					I/S		Chl		
Viorna Group	4E	PI 121	0.684	0.449		Cld			I/S	Kln			
Viorna Group	4E	PI 122	0.403	0.347		Cld			I/S	Kln	Chl	C/V	STP
Viorna Group	4E	PI 123	0.701	0.445		Cld			I/S	Kln	Chl	C/V	Stp
Viorna Group	4E	PI 128	0.705	0.524					I/S	Kln	Chl	C/V	
Viorna Group	4E	PI 129	0.553	0.366					I/S	Kln	Chl	C/V	
Viorna Group	4E	PI 131	0.361	0.348	0.267						Chl		
Viorna Group	4E	PI 132	0.476	0.420				Pg			Chl		
Viorna Group	4E	PI 134	0.670	0.565					I/S	Kln			STP
Viorna Group	4E	PI 135	0.431	0.376		Cld	Pri		I/S	Kln			STP
Viorna Group	4E	PI 137	0.395	0.359							Chl		
Viorna Group	4E	PI 146	0.408	0.342	0.250	Cld	Pri	Pg			Chl		
Viorna Group	4E	PI 147	0.394	0.341		Cld	Pri	Pg			Chl		
Viorna Group	4E	PI 148	0.356	0.317	0.256	Cld		Pg			Chl	C/V	
Viorna Group	4E	PI 151	0.293	0.286	0.196						Chl		
Viorna Group	4E	PI 317	0.344	0.317	0.165	Cld					Chl		
Pando Group	4E	PI 105	0.446	0.372		Cld			I/S	Kln	Chl		
Pando Group	4E	PI 106	0.493	0.394					I/S	Kln	Chl		
Pando Group	4E	PI 118	0.688	0.484					I/S	Kln		C/V	
Pando Group	4E	PI 125	0.539	0.373					I/S	Kln		C/V	
Pando Group	4E	PI 126	0.359	0.336		Cld			I/S	Kln	Chl		
Pando Group	4E	PI 127	0.432	0.359		Cld			I/S	Kln			
Pando Group	4E	PI 130	0.568	0.383					I/S	Kln	Chl	C/V	
Pando Group	4E	PI 133	0.344	0.319	0.242			Pg			Chl		
Pando Group	4E	PI 136	0.582	0.482		Cld			I/S	Kln			Stp
Pando Group	4E	PI 139	0.447	0.382	0.419	Cld		Pg	I/S		Chl		
Pando Group	4E	PI 140	0.343	0.344	0.248			Pg	I/S		Chl		
Pando Group	4E	PI 141	0.443	0.408	0.306	Cld		Pg	I/S		Chl		Stp
Pando Group	4E	PI 142	0.466	0.410	0.244	Cld		Pg	I/S		Chl		
Pando Group	4E	PI 143	0.727	0.697		Cld	Pri		I/S			C/V	
Pando Group	4E	PI 144	0.532	0.418		Cld			I/S		Chl		
Pando Group	4E	PI 329	0.488	0.451		Cld			I/S			C/V	
Pando Group	4E	PI 330	0.345	0.375	0.187						Chl		
Pando Group	4E	PI 359	0.721	0.719			Pri		I/S	Kln		C/V	
Prioro Group	4E	PI 100	0.475	0.366					I/S				
Prioro Group	4E	PI 101	0.475	0.318	0.224				I/S		Chl		
Prioro Group	4E	PI 102	0.413	0.306		Cld			I/S			C/V	
Prioro Group	4E	PI 103	0.415	0.296	0.142				I/S	Kln			
Prioro Group	4E	PI 104	0.356	0.306					I/S	Kln	Chl	C/V	
Prioro Group	4E	PI 107	0.491	0.404					I/S	Kln		C/V	
Prioro Group	4E	PI 108	0.427	0.348					I/S	Kln	Chl	C/V	
Prioro Group	4E	PI 109	0.468	0.366					I/S	Kln		C/V	
Prioro Group	4E	PI 119	0.473	0.358					I/S			C/V	
Prioro Group	4E	PI 124	0.503	0.348					I/S	Kln		C/V	
Prioro Group	4E	PI 145	0.505	0.458	0.321	Cld		Pg	I/S		Chl		
Prioro Group	4E	PI 241	0.457	0.467	0.242			Pg			Chl		
Prioro Group	4E	PI 242	0.382	0.384				Pg					
Prioro Group	4E	PI 253	0.470	0.464				Pg		Kln			
Prioro Group	4E	PI 255	0.360	0.348	0.184			Pg			Chl		
Prioro Group	4E	PI 349	0.657	0.656			Pri		I/S	Kln			

**Supplement 2
Pisuerga**

Prioro Group	4E	PI 350	0.576	0.611		Pri	I/S	Kln	C/N
Prioro Group	4E	PI 358	0.488	0.523			I/S		
Prioro Group	4E	PI 360	0.430	0.427	0.416		Pg		Chl
Devonian	4E	PI 110	0.561	0.400			I/S		C/N
Devonian	4E	PI 111	0.863	0.445			I/S	Kln	C/N
Devonian	4E	PI 112	0.407	0.327					
Devonian	4E	PI 113	0.917	0.513			I/S	Kln	Chl
Silurian	4E	PI 356	0.478	0.519		Pri	I/S		C/N
Pando Group	4W	PI 226	0.410	0.348			Pg		Chl
Pando Group	4W	PI 227	0.281	0.265	0.127	Cld	Pg		Chl
Pando Group	4W	PI 228	0.224	0.226					
Pando Group	4W	PI 339	0.422	0.428	0.263		Pg		Chl
Pando Group	4W	PI 340	0.326	0.338	0.202	Cld			Chl
Pando Group	4W	PI 351	0.367	0.355	0.166	Cld			Chl
Pando Group	4W	PI 357	0.338	0.312			Pg		Chl
Prioro Group	4W	PI 229	0.368	0.326	0.193		Pg		Chl
Prioro Group	4W	PI 230	0.444	0.396	0.176	Cld	Pg		Chl
Prioro Group	4W	PI 231	0.506	0.470	0.204	Cld	Pg		Chl
Prioro Group	4W	PI 233	0.471	0.416	0.236		Pg		Chl
Prioro Group	4W	PI 236	0.254	0.248	0.156		Pg		Chl
Prioro Group	4W	PI 341	0.577	0.563	0.277		Pg		Chl
Prioro Group	4W	PI 342	0.533	0.512	0.241		Pg		Chl
Prioro Group	4W	PI 343	0.383	0.371					Chl
Prioro Group	4W	PI 344	0.435	0.482	0.260		Pg		Chl
Prioro Group	4W	PI 345	0.470	0.499			Pg		Chl
Prioro Group	4W	PI 346	0.434	0.439			Pg		
Prioro Group	4W	PI 347	0.504	0.502	0.306				Chl
Prioro Group	4W	PI 348	0.486	0.473			Pg		C/N
Silurian	4W	PI 355	0.555	0.595		Pri	Pg		Chl

Supplement 2
Riaño-Cervera

Formation	Area Code	SAMPLE	KI AD (°20) AD standard	KI EG (°20) EG standard	AI (°20)	Cld	Pri	Pg	I/S	Kln	Chl	C/V	Stp
Pando Group	5E	PI 2	0.413	0.347	0.227		Pri	Pg			Chl		
Pando Group	5E	PI 3	0.527	0.498	0.242			Pg			Chl	C/V	
Pando Group	5E	PI 33	0.330	0.330	0.246	Cld	Pri	Pg			Chl		
Pando Group	5E	PI 36	0.330	0.338				Pg					
Pando Group	5E	PI 37	0.293	0.306	0.257			Pg			Chl		
Pando Group	5E	PI 38	0.542	0.719	0.168	Cld	PRL	Pg			Chl		Stp
Pando Group	5E	PI 42	0.219	0.216		Cld		Pg			Chl		
Pando Group	5E	PI 56	0.356	0.336		Cld		Pg			Chl		
Prioro Group	5E	PI 1	0.345	0.323	0.220			Pg			Chl		
Prioro Group	5E	PI 7	0.485	0.480		Cld	Pri	Pg			Chl	C/V	
Prioro Group	5E	PI 8	0.397	0.394	0.259	Cld		Pg			Chl	C/V	
Prioro Group	5E	PI 9	0.464	0.446	0.280		Pri	Pg			Chl		
Prioro Group	5E	PI 10	0.367	0.352	0.264	Cld		Pg			Chl	C/V	
Prioro Group	5E	PI 11	0.368	0.368	0.207	Cld		Pg			Chl	C/V	
Prioro Group	5E	PI 12	0.353	0.343				Pg			Chl	C/V	
Prioro Group	5E	PI 13	0.330	0.321	0.194	Cld		Pg			Chl		
Prioro Group	5E	PI 14	0.331	0.326	0.207	Cld		Pg			Chl		
Prioro Group	5E	PI 16	0.350	0.348		Cld		Pg			Chl		
Prioro Group	5E	PI 17	0.300	0.304				Pg					
Prioro Group	5E	PI 18	0.358	0.314	0.226			Pg			Chl		
Prioro Group	5E	PI 19	0.422	0.349	0.218			Pg			Chl		
Prioro Group	5E	PI 20	0.360	0.345	0.228			Pg			Chl		
Prioro Group	5E	PI 21	0.401	0.413	0.247	Cld		Pg			Chl		
Prioro Group	5E	PI 22	0.430	0.402				Pg			Chl		
Prioro Group	5E	PI 23	0.324	0.323	0.189			Pg			Chl		
Prioro Group	5E	PI 24	0.338	0.327	0.202	Cld		Pg			Chl		
Prioro Group	5E	PI 30	0.503	0.373					I/S	Kln			
Prioro Group	5E	PI 34	0.372	0.364	0.231			Pg			Chl		
Prioro Group	5E	PI 40	0.290	0.290	0.197			Pg			Chl		
Prioro Group	5E	PI 41	0.285	0.293		Cld		Pg			Chl		
Prioro Group	5E	PI 43	0.315	0.303	0.143			Pg			Chl		
Prioro Group	5E	PI 49	0.227	0.230	0.152			Pg			Chl		
Prioro Group	5E	PI 50	0.285	0.278	0.183	Cld		Pg			Chl		
Tour-Vis	5E	PI 4	0.393	0.366	0.245			Pg			Chl	C/V	
Tour-Vis	5E	PI 6	0.521	0.440	0.228		Pri	Pg	I/S		Chl		
Tour-Vis	5E	PI 15	0.336	0.341	0.254	Cld	Pri	Pg			Chl		
Tour-Vis	5E	PI 35	0.266	0.262	0.183			Pg			Chl		
Tour-Vis	5E	PI 44	0.229	0.219	0.170						Chl		
Devonian	5E	PI 5	0.376	0.343			Pri	Pg			Chl		
Devonian	5E	PI 25	0.253	0.227		Cld					Chl		
Devonian	5E	PI 31	0.330	0.311	0.205		PRL	Pg			Chl		
Devonian	5E	PI 32	0.366	0.384				Pg			Chl		
Devonian	5E	PI 39	0.441	0.468				Pg					
Devonian	5E	PI 51	0.340	0.340	0.245	Cld		Pg			Chl		
Viorna Group	5W	PI 175	0.445	0.359	0.190			Pg	I/S		Chl		
Viorna Group	5W	PI 180	0.340	0.312	0.186	Cld		Pg			Chl		

Supplement 2
Riaño-Cervera

Pando Group	5W	PI 173	0.499	0.395			Pg	I/S	
Pando Group	5W	PI 176	0.443	0.356	0.202		Pg	I/S	Chl
Pando Group	5W	PI 178	0.408	0.369			Pg	I/S	
Pando Group	5W	PI 179	0.426	0.370		Pri	Pg	I/S	
Pando Group	5W	PI 181	0.345	0.301	0.134		Pg		Chl
Pando Group	5W	PI 182	0.359	0.282	0.195		Pg		Chl
Pando Group	5W	PI 183	0.286	0.289	0.198		Pg		Chl
Pando Group	5W	PI 184	0.328	0.318	0.178		Pg		Chl
Pando Group	5W	PI 186	0.322	0.311	0.149		Pg		Chl
Pando Group	5W	PI 190	0.301	0.300	0.206				Chl
Pando Group	5W	PI 207	0.318	0.312	0.144		Pg		Chl
Prioro Group	5W	PI 185	0.353	0.349	0.178		Pg		Chl
Prioro Group	5W	PI 202	0.428	0.421	0.181	Cld	Pg		Chl
Prioro Group	5W	PI 613	<i>0.423</i>	<i>0.435</i>	0.231	Cld	Pg		Chl
Prioro Group	5W	PI 614	0.417	0.401	0.270	Cld	Pg		Chl
Prioro Group	5W	PI 616	0.400	0.382	0.209	Cld	Pg		Chl

Supplement 2
Riaño-Cervera

Pando Group	5W	PI 173	0.499	0.395			Pg	I/S	
Pando Group	5W	PI 176	0.443	0.356	0.202		Pg	I/S	Chl
Pando Group	5W	PI 178	0.408	0.369			Pg	I/S	
Pando Group	5W	PI 179	0.426	0.370		Pri	Pg	I/S	
Pando Group	5W	PI 181	0.345	0.301	0.134		Pg		Chl
Pando Group	5W	PI 182	0.359	0.282	0.195		Pg		Chl
Pando Group	5W	PI 183	0.286	0.289	0.198		Pg		Chl
Pando Group	5W	PI 184	0.328	0.318	0.178		Pg		Chl
Pando Group	5W	PI 186	0.322	0.311	0.149		Pg		Chl
Pando Group	5W	PI 190	0.301	0.300	0.206				Chl
Pando Group	5W	PI 207	0.318	0.312	0.144		Pg		Chl
Prioro Group	5W	PI 185	0.353	0.349	0.178		Pg		Chl
Prioro Group	5W	PI 202	0.428	0.421	0.181	Cld	Pg		Chl
Prioro Group	5W	PI 613	<i>0.423</i>	<i>0.435</i>	0.231	Cld	Pg		Chl
Prioro Group	5W	PI 614	0.417	0.401	0.270	Cld	Pg		Chl
Prioro Group	5W	PI 616	0.400	0.382	0.209	Cld	Pg		Chl

**Supplement 2
Valsurbio**

Formation	Area Code	SAMPLE	KI AD (°2θ) AD standard	KI EG (°2θ) EG standard	AI (°2θ)	Cld	Prl	Pg	I/S	Kln	Chl	C/V	Stp
Viorna Group	6	PI 337	0.385	0.375	0.202		Prl	Pg			Chl		
Viorna Group	6	PI 338	0.647	0.445	0.206		Prl	Pg	I/S		Chl		
Pando Group	6	PI 187	0.419	0.354	0.178			Pg			Chl		
Pando Group	6	PI 188	0.286	0.275	0.169	Cld		Pg			Chl		
Pando Group	6	PI 189	0.377	0.351	0.180			Pg			Chl		
Pando Group	6	PI 192	0.390	0.345	0.229						Chl		
Pando Group	6	PI 193	0.376	0.313	0.205						Chl		
Pando Group	6	PI 194	0.347	0.320	0.153			Pg			Chl		
Pando Group	6	PI 201	0.253	0.265	0.141						Chl		
Pando Group	6	PI 203	0.417	0.392		Cld	Prl	Pg					
Pando Group	6	PI 206	0.405	0.387	0.262	Cld		Pg			Chl		
Prioro Group	6	PI 204	0.459	0.399				Pg			Chl		
Prioro Group	6	PI 205	0.307	0.298	0.166			Pg			Chl		
Prioro Group	6	PI 615	0.531	0.528					I/S				
Tour-Vis	6	PI 199	0.412	0.375	0.196		Prl				Chl		
Tour-Vis	6	PI 335	0.343	0.341	0.202			Pg			Chl		
Devonian	6	PI 52	0.202	0.209	0.196	Cld					Chl	C/V	
Devonian	6	PI 53	0.195	0.194	0.147						Chl		
Devonian	6	PI 54	0.271	0.262	0.190	Cld		Pg			Chl		
Devonian	6	PI 59	0.333	0.312		CLD		Pg			Chl		
Devonian	6	PI 60	0.233	0.239	0.15	Cld		Pg			Chl		
Devonian	6	PI 61	0.286	0.276		CLD		Pg			Chl		
Devonian	6	PI 62	0.255	0.257		CLD					Chl		
Devonian	6	PI 64	0.236	0.247		CLD					Chl		
Devonian	6	PI 66	0.202	0.208	0.158	Cld					Chl		
Devonian	6	PI 67	0.206	0.203	0.141						Chl		
Devonian	6	PI 68	0.348	0.365	0.207	CLD		Pg			Chl		
Devonian	6	PI 69	0.248	0.248	0.152	Cld		Pg			Chl		
Devonian	6	PI 71	0.287	0.298	0.152	CLD		Pg			Chl		
Devonian	6	PI 72	0.266	0.270	0.166	CLD		Pg			Chl		
Devonian	6	PI 336	0.351	0.328		Cld	Prl						
Devonian	6	PI 617	0.274	0.264	0.208	Cld					Chl		