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Supplement of

The Imbert Formation of northern Hispaniola: a tectono-sedimentary record of arc-continent collision and ophiolite emplacement in the northern Caribbean subduction-accretionary prism

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Description of facies associations in the Imbert Formation

<i>Code</i>	<i>Dominant facies types</i>	<i>Features (grain size, grading/fabric/clast orientation)</i>	<i>Flow type</i>	<i>Interpretation of depositional environment</i>
Os	Lensoidal serpentinite blocks in a heterogeneous and mostly deformed matrix composed of shale, mudstone and sandstone	Blocks randomly distributed in a polymictic brecciated matrix. Blocks of mainly peridotite/serpentinite nature (exotic) but also intra-basinal (not-exotic). Block of few centimeters to several meters in size (rarely tens of meters). Blocks and clasts are angular and of similar nature than in Gm (RSJC). Abundant serpentinite particles of sand size. Structureless sills and muds.	Gravity-driven mass-transport processes (debris flows, debris avalanches, slumps, block slides, etc.) and hyper-concentrated flows. Bands of normal brittle shearing	Slope facies to foreland facies. Mass transport deposits at the wedge front
Gm	Massive breccia and matrix-supported, muddy-sandy (polymictic) conglomerate	Desorganized internal structure, pebble to cobble size, ungraded, often erosive base, random clast orientation. Clasts of (mainly) serpentinite, red/green volcanic rocks, laminated sandstone, feldspar grains, (rare) white limestone and red and green mudstones (rip-up clasts). In the RSJC clasts of ferruginized volcanic rocks, red microbreccia, porphyritic lavas, isotropic gabbros and dolerites also occur. Often lenticular beds with erosive base, deformed by syn-sedimentary extensional faulting	Non-cohesive debris flow	Larger channel deposits within submarine fan systems, relatively stable in position, probably served as major sediment conduits to basin. Slumping processes
Gp	Clast-supported, sandy (polymictic) breccia and conglomerate	Inverse-to-normally graded internal structure, clast-supported fabric, angular clasts of sand to pebble grain-size, random clast orientation. Massive internal structure also occur. Often lenticular beds with erosive base, deformed by syn-sedimentary extensional faulting. Interbedded pebbly conglomerate and coarse-grained sandstone	Non-cohesive debris flow transitional to cohesive debris flows?, postdepositional fluidization effects	Channel deposits within submarine fans, possibly less stable in position than Gm. Rare associated overbank/levee deposits. Slumping processes
Sc	Medium-to-thick bedded coarse-grained sandstone and microconglomerates	Parallel-stratified sandstones. Organized internal structure (Bouma-sequences Ta or Tb) or massive. Sand (coarse-to-granule) grain size. Internal normally graded. Often horizontal-lamination, rare argillite pebbles at base. Intercalations of Gn facies conglomerates and microconglomerates	High-concentration turbidity currents. Post-depositional liquefaction	Undifferentiated lobe or channel fill facies. Slumping
Sm	Thin-bedded, medium-to-fine-grained sandstone	Parallel-stratified sandstones. Organized internal structure (Bouma-sequences Tb or Tc) or massive. Silt-sand grain size. Sandstone/mudstone ratios of 40-75% sandstone	Turbidity currents	More proximal lobe-fringe or levee/overbank facies. Slumping
Sf	Fine-grained sandstone, siltstone and laminated mudstone	Alternating fine-grained sandstone-mudstone sequence. Sand-mud couplets and muddy sands, 20-80% sand grade, <80% mud grade. Often organized internal structures. Silt-sand grain size. Graded-stratified silt. Thin regular silt and mud laminae.	Turbidity currents	Distal lobe facies. Slumping in upper stratigraphic levels
Ms (RSJC)	Massive variocolored mudstone-mudslate with clasts and blocks (of Gm)	>80% mud, <30% silt, 0-20% sand of serpentinitic composition. Disorganized internal structures. Caotically disposed <60% cobble to boulder angular to subrounded blocks of serpentinite, beig sandstone, green mudstone. Structureless or banded red, green and grey muds		
Tv	Fine-grained tuff with alternating fine-grained tuffaceous sandstone-mudstone	White, cream and turquoise coloured tuff. Rare laminated internal structure in tuff. Fine-grained size in sands. Structureless silts and muds. Alternating thin-bedded, fine-grained tuffaceous sandstone-mudstone sequence	Dilute turbidity currents and volcanic particle fall	Very distal lobe and basin plain facies.
Lc (RSJC)	White coarse-grained calcarenites	White shelfal-derived calcarenites and bio-calcarenites (intra-basinal) and green serpentinite clasts (extra-basinal elements). Medium to coarse-grained size	Turbidity currents	

Bulk rock major and trace element compositions of studied samples from the Imbert Fm

X	-70,812	-70,812	-70,809	-70,829	-70,812	-70,812	-70,812
Y	19,758	19,758	19,753	19,778	19,758	19,758	19,758
Rock	dyke	dyke	sill	sill	basalt	basalt	dolerite
Sample	10JE222	10JE222B	11JE15	13JE27	13JE30A	13JE30B	13JE30C
SiO ₂	52,91	52,87	51,48	49,19	52,05	52,16	43,54
TiO ₂	1,17	1,17	1,26	0,68	1,24	1,22	0,43
Al ₂ O ₃	15,43	15,55	16,24	14,77	15,50	15,31	9,85
Fe ₂ O ₃	11,27	11,17	11,23	8,70	11,55	11,61	4,20
MgO	3,22	3,22	3,67	6,63	3,19	3,09	1,59
CaO	6,48	6,46	8,74	6,81	6,36	6,32	19,31
Na ₂ O	3,43	3,48	3,18	2,32	3,45	3,39	1,77
K ₂ O	1,49	1,49	1,10	0,87	1,29	1,32	1,62
P ₂ O ₅	0,22	0,22	0,18	0,12	0,22	0,22	0,11
MnO	0,20	0,20	0,18	0,13	0,20	0,18	0,36
Cr ₂ O ₃	0,00	0,00	0,00	0,02	0,00	0,00	0,03
LOI	3,90	3,90	2,50	9,60	4,70	5,00	17,00
SUM	99,77	99,77	99,78	99,84	99,77	99,77	99,84
Mg# ^a	36	36	39	60	35	35	43
Cr	3,4	6,8	6,8	116,3	6,8	6,8	225,8
Co	26,20	26,50	27,10	24,60	26,20	24,90	11,70
Ni	5,40		5,80	69,30	5,20	4,90	66,10
V	354	360	385	224	369	359	98
Rb	19,00	18,80	16,60	10,00	13,30	12,30	16,90
Ba	256	262	204	276	236	273	487
Th	2,10	2,20	1,50	1,00	1,80	1,60	1,00
U	0,90	0,90	0,80	0,40	0,70	1,00	0,40
Nb	2,50	2,40	1,70	2,50	2,30	2,30	2,00
Ta	0,40	0,20	0,17	0,21	0,19	0,19	0,17
La	10,40	10,80	8,80	6,70	10,60	11,50	6,50
Ce	27,10	27,20	21,60	14,00	25,30	24,80	11,30
Pb	5,30	4,60	28,70	11,70	3,90	2,70	2,20
Pr	4,12	4,14	3,42	1,91	3,81	3,92	1,70
Sr	253,6	256,6	286,8	192,3	280,1	268,9	362,9
Nd	19,80	20,10	16,80	8,10	19,00	18,90	7,80
Sm	5,25	5,58	4,50	2,08	5,01	4,95	1,86
Zr	148,5	150,1	129,3	58,8	141,9	135,0	61,1
Hf	4,50	4,50	3,60	1,60	4,10	4,10	1,50
Eu	1,43	1,47	1,33	0,68	1,43	1,34	0,59
Gd	5,52	5,63	4,69	2,37	5,39	5,77	2,10
Tb	0,98	1,01	0,76	0,42	0,92	0,97	0,35
Dy	6,12	5,97	4,75	2,42	5,28	5,49	2,07
Y	34,2	33,8	28,5	14,0	31,3	29,9	11,7
Ho	1,25	1,30	0,98	0,55	1,15	1,20	0,43
Er	3,71	3,75	2,97	1,75	3,34	3,38	1,31
Tm	0,58	0,58	0,47	0,25	0,51	0,53	0,21
Yb	3,68	3,67	2,93	1,71	3,39	3,27	1,32
Lu	0,56	0,56	0,45	0,23	0,52	0,49	0,21

Major elements in wt.%; trace elements in ppm.

^aMg# = 100 * mol MgO/ mol (FeO + MgO); for Fe₂O₃/FeO = 0.2. Total Fe as Fe₂O₃.

Results of the paleostress analysis in the Imbert Formation

Outcrop ^a	Lithology	Number	σ_1^b	Eigenvalue	σ_2	Eigenvalue	σ_3	Eigenvalue	R
11JE11	IM2 unit, PPC	36	14,1;12,5	0,325	237,1;73,2	0,305	106,6;11,1	0,019	0,94
11JE15	IM2 unit, PPC	20	107,9;72,4	0,212	319,8;15,1	0,161	227,4; 08,9	0,050	0,69
10JE224	IM2 unit, PPC	22	20,5; 08,5	0,274	191,5; 81,4	0,187	290,3; 01,3	0,087	0,54
10JE224B	IM2 unit, PPC	12	98,1; 70,7	0,345	341,3; 08,9	0,338	248,6; 16,9	0,007	0,98
10JE225	IM2 unit, PPC	25	108,4; 76,7	0,262	207,9;02,2	0,220	298,5;13,1	0,043	0,81
10JE225B	IM2 unit, PPC	12	112,5; 67,9	0,354	208,9; 02,6	0,318	300,0;21,9	0,036	0,89
11JE51	IM3 unit, RSJC	20	322,4;82,1	0,322	126,8;8,6	0,294	212,6;14,8	0,094	0,88
10JE252	IM3 unit, RSJC	32	73,4; 34,9	0,343	215,4; 48,5	0,237	329,1; 19,6	0,107	0,55
10JE252B	IM3 unit, RSJC	12	29,8; 82,4	0,328	231,3;07,1	0,222	141,0;02,8	0,102	0,53

^aAll data rotated by unfold the average bedding plane

^bThe values of sigma correspond to two angles (in degrees), the first one being the trend of stress axis and the second one being its plunge.

Trends and plunges of axes of paleostress tensors deduced from the inversion of orientation and striae of faults using FaultKin software (Marret and Almendinger, 1990)

R , axial ratio, $(\sigma_2 - \sigma_3) / (\sigma_1 - \sigma_3)$

Summary of ⁴⁰Ar-³⁹Ar incremental heating experiments of mineral separates

10JE54 Plagioclase (sample/mineral)											
Laser	Isotope Ratios										
Power(%)	40Ar/39Ar	2s	36Ar/40Ar	2s	r.i.	Ca/K	%40Ar atm	f 39Ar	40Ar*/39A Age	2s	
2,3	125,508	4,635	0,331	0,015	0,013	0,802	91,033	6,296	11,257	57,529	33,025
3,2	29,374	0,543	0,065	0,003	0,093	8,360	74,259	32,249	7,585	38,965	9,131
3,5	18,838	0,400	0,027	0,002	0,105	3,374	49,093	17,636	9,602	49,185	7,508
3,9	19,268	0,165	0,033	0,002	0,054	2,489	58,027	10,302	8,095	41,554	6,719
4,5	23,247	0,427	0,046	0,003	0,025	2,643	68,229	13,626	7,393	37,988	8,756
5,5	24,884	0,481	0,046	0,002	0,067	4,822	63,239	11,807	9,165	46,973	5,453
7	24,154	0,753	0,047	0,003	0,037	7,312	65,324	8,083	8,399	43,096	11,428

J = 0.00287150 ± 0.00000574 Volume 39A 0,021062 x E-13 cm3 NPT
 Integrated Date = 44,041456 3,0551387 Ma
 Plateau age = 44.0 ± 3.1 Ma (2s, including J-error of MSWD = 1.2, probability=0.28 Includes 100% of the 39A steps 1 through 7
 Inverse isochron (correlation age) results, plateau steps: Model 1 Solution (±95%-conf.) on 7 points
 Age = 42.8 ± 5.3 Ma Initial 40Ar/36Ar = 350 ± 20 MSWD = 1.5 Probability = 0.15

JM9112 Plagioclase (sample/mineral)												
Laser	Isotope Ratios											
Power(%)	40Ar/39Ar	1σ	37Ar/39Ar	1σ	36Ar/39Ar	1σ	Ca/K	%40Ar atm	f 39Ar	40Ar*/39ArK	Age	2σ
2,00 W	621,48	32,76	46,61	2,96	2,114	0,124	88,26	99,92	0,16	0,519	5,20	± 357,01
2,20 W	114,42	1,91	14,70	0,38	0,391	0,011	27,20	99,92	4,27	0,093	0,94	± 52,71
2,40 W	98,52	1,04	18,69	0,36	0,329	0,008	34,70	97,03	7,86	2,964	29,51	± 43,73
2,70 W	71,43	0,70	79,08	1,44	0,247	0,006	153,39	93,09	13,55	5,225	51,71	± 32,66
3,00 W	21,64	0,25	77,74	1,43	0,083	0,002	150,65	83,76	7,06	3,720	36,96	± 15,25
3,40 W	15,34	0,21	36,62	0,75	0,052	0,002	68,86	80,82	8,06	3,022	30,08	± 12,10
4,00 W	9,75	0,08	14,80	0,26	0,028	0,001	27,39	71,15	38,66	2,841	28,30	± 5,00
4,80 W	23,44	0,27	43,13	0,81	0,077	0,002	81,47	81,46	11,40	4,482	44,45	± 11,82
5,80 W	24,38	0,20	51,25	0,92	0,077	0,002	97,39	76,43	5,23	5,962	58,89	± 11,28
6,80 W	32,21	0,34	64,29	1,21	0,109	0,004	123,34	84,01	3,76	5,394	53,36	± 21,18

J = 0.0055517 ± 0.0000278 Volume 39Ar: 0,095 Integrated Dat 35,54 ± 6,76 Ma
 Plateau Age = 29.5 ± 4.3 Ma (2s, including J-error of .3 MSWD = 0.71, probability=0.64 79.6% of the 39Ar, steps 1 through 7
 Inverse isochron (correlation age) results, plateau steps: Model 1 Solution (±95%-conf.) on 10 poi Age = 34 ± 13 Ma
 40/36 intercept: 300 ± 18, MSWD = 3.8, Probability = 0.002 (at J=.0055517±.3% 2s)

HH9124 Hornblende (sample/mineral)	
Laser	Isotope Ratios

Power(%)	40Ar/39Ar	1σ	37Ar/39Ar	1σ	36Ar/39Ar	1σ	Ca/K	%40Ar atm	f 39Ar	40Ar*/39ArK	Age	2 σ
2,00 W	5886,02	3452,78	281,78	165,84	19,940	11,710	644,24	99,50	0,03	37,045	337,97	± 3459,40
2,80 W	526,06	25,45	13,28	0,68	1,810	0,096	24,55	99,66	3,19	1,787	17,83	± 243,56
3,30 W	258,22	16,39	61,53	4,17	0,887	0,064	117,81	98,16	2,06	4,973	49,21	± 200,04
4,00 W	87,11	1,78	14,67	0,50	0,290	0,014	27,14	96,16	3,46	3,379	33,58	± 73,07
5,00 W	25,46	0,32	1,69	0,04	0,068	0,002	3,10	78,12	35,96	5,576	55,09	± 11,65
6,00 W	19,57	0,28	3,67	0,09	0,048	0,002	6,73	71,61	25,23	5,571	55,04	± 11,08
7,00 W	21,67	0,35	4,44	0,13	0,044	0,002	8,16	58,63	30,06	8,994	88,05	± 8,74

J = 0.0055474 ± 0.0000277 Volume 39Ar: 0,018 Integrated Dat 63,11837 ± 10,70 Ma
 Plateau Age = 55 ± 8 Ma (2s, including J-error of .3 MSWD = 0.093, probability=0.993 69.9% of the 39Ar, steps 1 through 6
 Inverse isochron (correlation age) results, plateau steps: Model 1 Solution (±95%-conf.) on 6 poin Age = 55.5 ± 9.6 Ma
 40/36 intercept: 294.1 ± 9.2 MSWD = 0.09, Probability = 0 (at J=0.005547±.3% 2s)