

Caron et al. – Stanley Glacier - List of supplementary materials:

Sup. Mat. 1. Figure DR1. Detailed locality information.	02
Sup. Mat. 2. Figure DR2. Claystone lithofacies.	03
Sup. Mat. 3. Table DR1. Specimens counts and relative abundance chart.	04
Sup. Mat. 4. Figure DR3. Small shelly fossils from carbonate beds.	06
Sup. Mat. 5. Item DR5. Description of <i>Stanleycaris hirpex</i> .	08
Sup. Mat. 6. Figure DR4. Additional fossils from the claystone layers.	11
Sup. Mat. 7. Figure DR5. Taphonomy section.	14
Sup. Mat. 8. Figure DR6. Ichnofossils.	16

Figure DR1. Occurrences of BST fossils near Stanley Glacier. Fossils were observed or collected from talus material at multiple outcrops (stars). The circled star represents the area excavated within cycle 5.

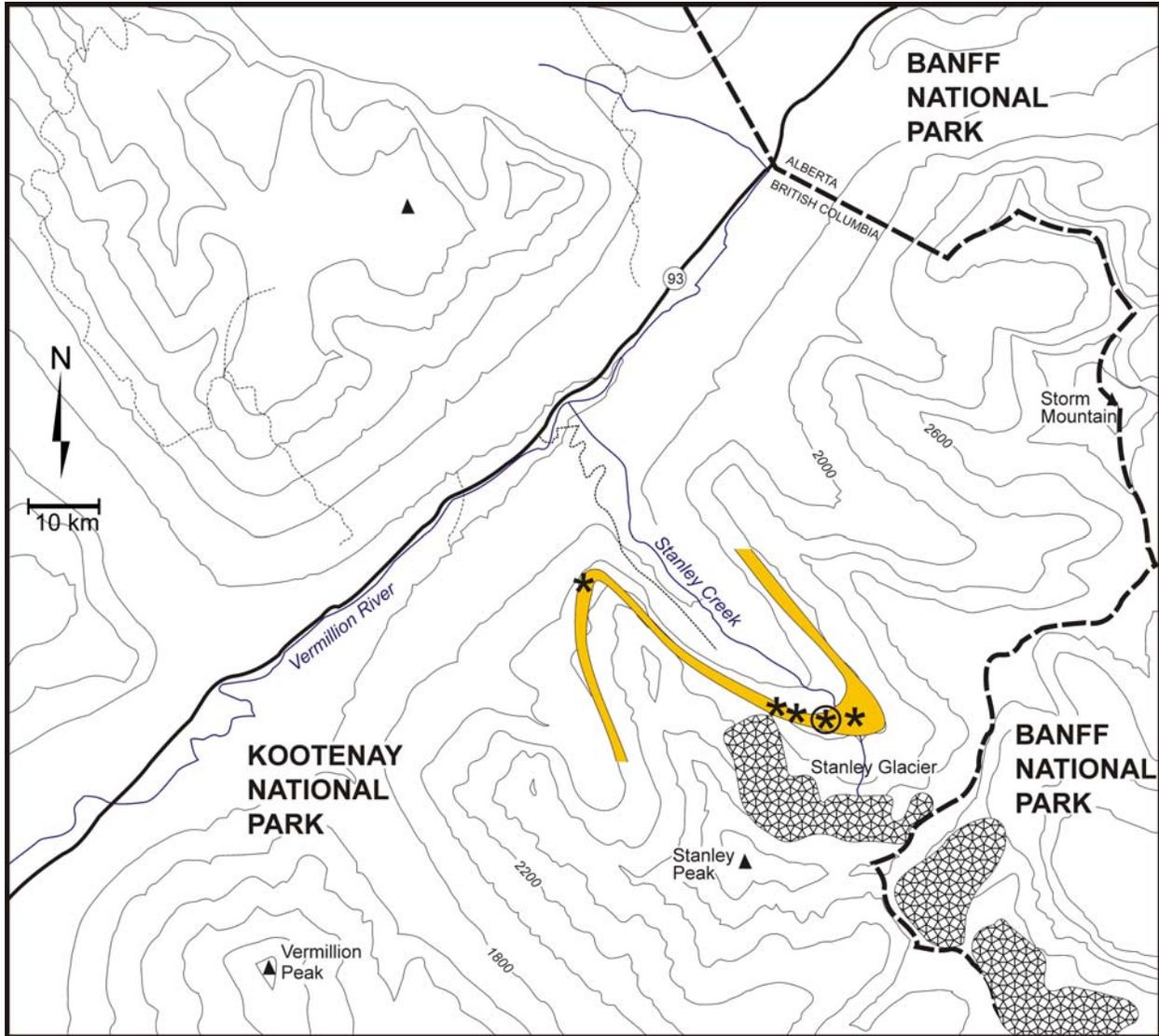


Figure DR2. A. Polished slab of laminated calcareous claystone lithofacies from 27.72 m above the base of the Stephen Formation, in the interval of cycle 5 excavated (circled star in Sup. Mat. 2). Scale bar equals 1 cm. B. SEM micrograph showing randomly oriented clay microfabric typical of the calcareous claystone lithofacies, sample from 27.78 m above the base of the Stephen Formation, also from within cycle 5. Scale bar = 20 μm . Both samples come from ROM 59951.

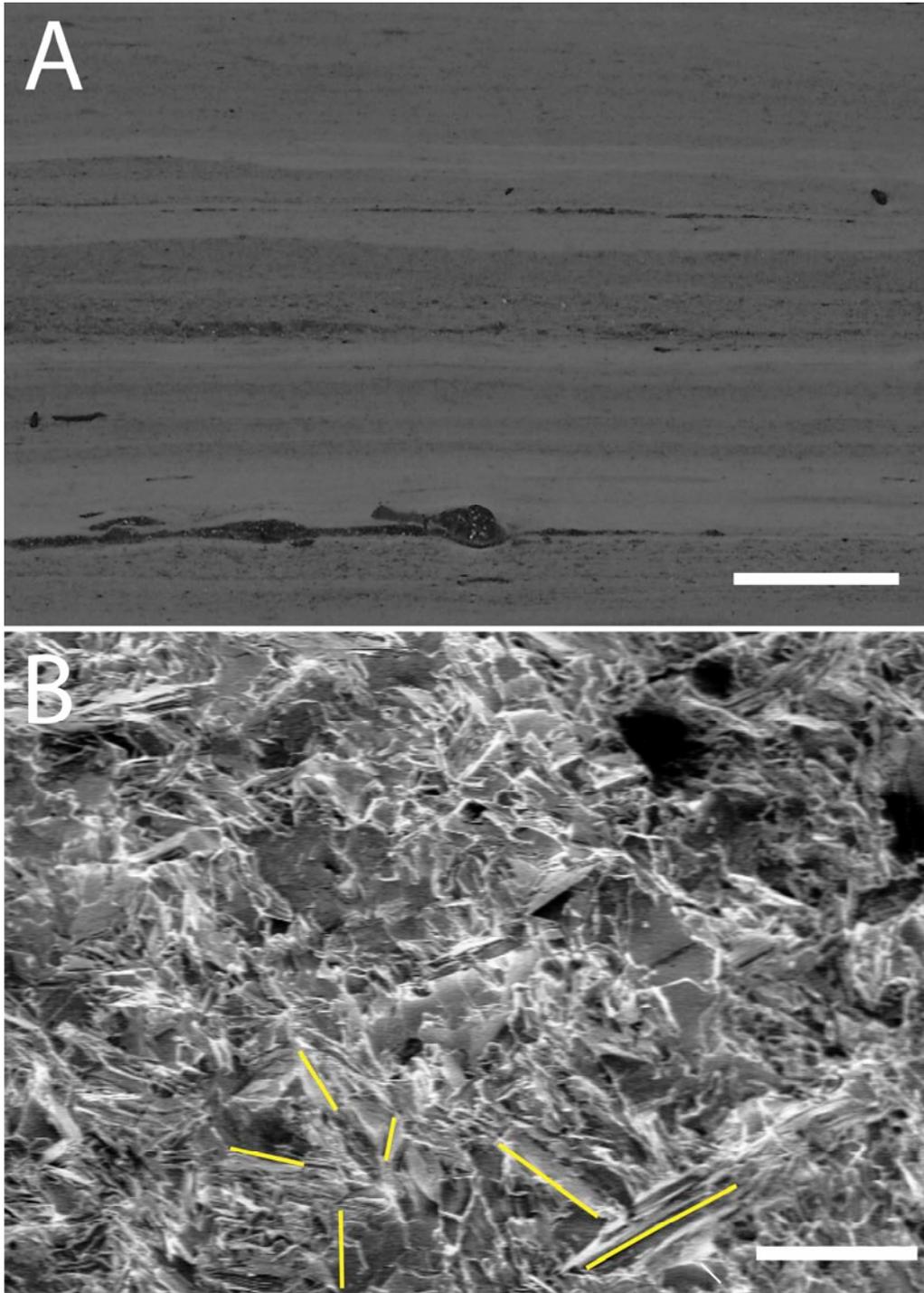
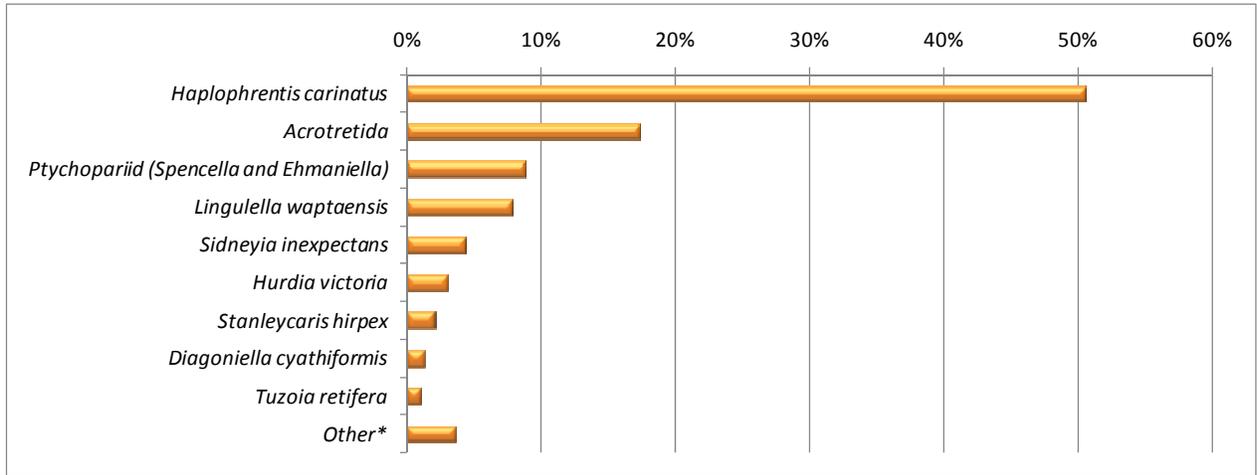


Table DR1; Composition of the fossil assemblages collected or observed from Stanley Glacier. A. Relative abundance of taxa collected or counted *in-situ* through quarrying over an area approximately two square meters in size (see details in B) and from talus material with a summary chart of the proportion of the main taxa. Note, the rank orders of the main taxa from talus slopes (N=687) and collected or observed *in-situ* (N=1098) are almost identical, suggesting the talus material was likely derived from cycle 5. B. Detailed counts of specimens per stratigraphic intervals. Specimens were collected from two rock blocks A and B of similar surface area. NB = the number of specimens of *Stanleycaris* and *Hurdia* were estimated to minimize counting multiple times the same specimen based on individual parts, as follow: *Stanleycaris* = number of assemblages + (number of appendages/2). *Hurdia* = and number of assemblages + (number of appendages/2) + (number of *Hurdia* carapaces-*Proboscicaris* carapaces). Isolated appendages or segments of unidentified arthropods were not counted.

Sup. Mat. 3A	In Situ		Talus		Total	
	Counts	%	Counts	%	Counts	%
<i>Haplophrentis carinatus</i>	639	58.2%	264	38.4%	903	50.6%
Acrotretida	178	16.2%	131	19.1%	309	17.3%
Ptychopariid (<i>Spencella</i> and <i>Ehmaniella</i>)	113	10.3%	44	6.4%	157	8.8%
<i>Lingulella waptaensis</i>	93	8.5%	48	7.0%	141	7.9%
<i>Sidneyia inexpectans</i>	32	2.9%	46	6.7%	78	4.4%
<i>Hurdia victoria</i>	15	1.4%	39	5.7%	54	3.0%
<i>Stanleycaris hirpex</i>	10	0.9%	27	3.9%	37	2.1%
<i>Diagoniella cyathiformis</i>	4	0.4%	19	2.8%	23	1.3%
<i>Tuzoia retifera</i>	4	0.4%	15	2.2%	19	1.1%
Other*	10	0.9%	54	7.9%	64	3.6%
Tot	1098		687		1785	

*Other =

<i>Herpetogaster collinsi</i>	0	0.0%	14	2.0%	14	0.8%
<i>Isoxys acutangulus</i>	3	0.3%	10	1.5%	13	0.7%
<i>Margaretia dorus</i>	3	0.3%	7	1.0%	10	0.6%
Indet hemichordate?	0	0.0%	6	0.9%	6	0.3%
Indet sipunculan A	2	0.2%	3	0.4%	5	0.3%
Indet anomalocaridid	1	0.1%	2	0.3%	3	0.2%
<i>Anomalocaris canadensis</i>	1	0.1%	1	0.1%	2	0.1%
Indet mollisonid A	0	0.0%	2	0.3%	2	0.1%
<i>Hintzespongia bilamina</i>	0	0.0%	2	0.3%	2	0.1%
Indet great appendage arthropod A	0	0.0%	2	0.3%	2	0.1%
Indet stalked animal	0	0.0%	2	0.3%	2	0.1%
<i>Allonnia</i> sp.	0	0.0%	1	0.1%	1	0.1%
Indet segmented worm	0	0.0%	1	0.1%	1	0.1%
Indet paterinid	0	0.0%	1	0.1%	1	0.1%

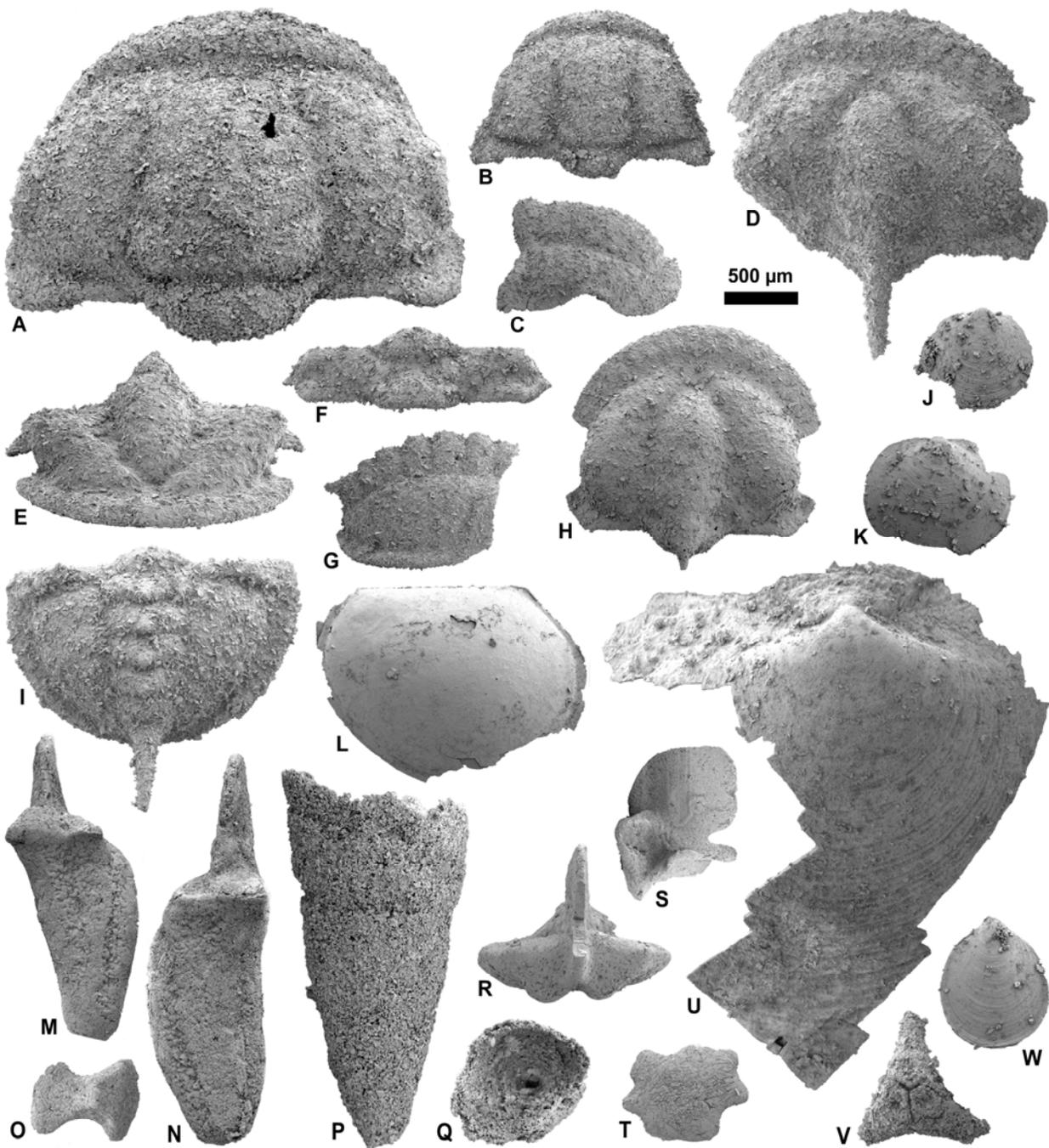


Sup. Mat. 3B	Block A									Block B																Sum	Collected	Non-collected											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25				26										
Intervals in meters	30.02-29.90	29.90-29.80	29.80-29.70	29.70-29.60	29.60-29.50	29.50-29.40	29.40-29.30	29.30-29.22	29.22-29.15	28.59-28.50	28.50-28.37	28.37-28.32	28.32-28.26	28.26-28.19	28.19-28.07	28.07-27.92	27.92-27.85	27.85-27.76	27.76-27.70	27.70-27.60	27.70-27.48	27.48-27.39	27.39-27.30	27.30-27.20	27.20-27.10	27.10-27.00													
Acrotretida							2								5	5	2				1	6	4					1	7	8	1	7	8	0					
<i>Anomalocaris canadensis</i>							1																						1	1	1	0	0	0					
<i>Stanleycaris hirpex</i>						1					1			1	2		1	1						1	1	1			1	1	0	0	0						
<i>Diagoniella cyathiformis</i>											2				1						1								4	4	0	0	0						
<i>Ehmaniella burgessensis</i>																						1						1	1	1	0	0	0						
<i>Haplophrentis carinatus</i> (1)	9	3	4	1	2	3	4	8	3		3	4		1	4	5	2	1	1	2	3	9	4	3	1	9	3	1	9	3	1	5	6	3	2	1	9	4	5
<i>Hurdia victoria</i>					1	2	1				1				3	1	2					2				1	1		1	1	1	0	0	0	0	0	0		
Indet anomalocaridid						1																							1	1	1	0	0	0	0	0	0		
Indet Ptychopariid (2)	1	1													1	0	8	4	2	1	2	2	4	8	3				1	0	3	7	0	9	0	9			
Indet sipunculan												1			1														2	2	0	0	0	0	0	0	0		
<i>Isoxys acutangulus</i> (3)						1	1		1		1		1						1										6	5	1	0	0	0	0	0	0		
<i>Lingulella waptaensis</i>	2	1	2	5	4	2	7	2	1		8		1	9	9	2	7			2	5	1		1	1		1	9	3	1	7	4	9	0	9	0	9		
<i>Margaretia dorus</i>				2											1														3	2	1	0	0	0	0	0	0		
<i>Sidneyia inexpectans</i>				2		2									7	4	5	2			1	1	5		2	1		3	2	1	7	5	0	0	0	0			
<i>Spencella</i> sp.		1													1							1						3	3	0	0	0	0	0	0	0			
<i>Tuzoia retifera</i>									1		1							1							1			4	4	0	0	0	0	0	0	0	0		
Other:																																							
Algae?		1		2	1	7	2	2		1	3				1								1					2	1	5	6	0	0	0	0	0			
Trace fossils	1	1		1	3	1	5	2	1	2	1			1	1	1	1										1	2	3	7	0	0	0	0	0	0			

Notes:

- 1 Operculum only not counted
- 2 Complete or cranidia
- 3 Counts divided by 2

Figure DR3. Examples of fossils recovered from the carbonate beds of the Stephen Formation at Stanley Glacier. A-C. Cranidia of *Spencella* sp. in dorsal (A, ROM 59952; B, ROM 59953) and lateral view (C, ROM 59954). D-I, *Pagetia* spp. D. cranidium with faint scrobicules on anterior border and long cranidial spine, ROM 59955. E. anterior view of cranidium, ROM 59956. F. thoracic segment, ROM 59957. G. lateral view of pygidium with short terminal axial spine, ROM 59958. H. cranidium with faint scrobicules and short cranidial spine, ROM 59959. I. pygidium with long terminal axial spine, ROM 59960. J, K. Ventral and dorsal valve of *Acrothyra* sp. (ROM 59961, 59962). L. Left valve of undetermined bradoriid, ROM 59963. M-O, R-T. Dolomitized echinoderm ossicles; M, N, suboral plates of Ctenocystoidea (ROM 59964, 59965); O, ossicle resembling edrioasteroid ambulacral floor plates (ROM 59966). R, S. frontal and lateral view of two ctenocystoid suroral plates (ROM 59967, 59968). T. gogiid? thecal plate (ROM 59969). P, Q. Laminated internal cones of *Salterella* sp. P. lateral view (ROM 59970). Q. apertural view showing central tube (ROM 59971). U. Ventral valve of paterinid brachiopod (compare with Sup. Mat. 6I), ROM 59972. V. Chancelloriid sclerite, *Allonnia?* sp. (ROM 59973). W. Shell of juvenile *Lingulella* sp. (ROM 59974). Stratigraphic distribution of individual fossils: B, C, E-H, M-O, R-T, parasequence 1; V, W, parasequence 3; K, L, U, parasequence 4; A, D, I, J, P, Q, parasequence 5. All illustrated at the same scale.



Sup. Mat. Item DR5. Description of *Stanleycaris hirpex*. A. Systematic palaeontology. B. Plate

Stem group Arthropoda

Class: Dinocarida Collins, 1996

Order: Radiodonta Collins, 1996

Genus: *Stanleycaris* n. gen.

Derivation: From Stanley Glacier near the locality sites in Kootenay National Park and the Latin *caris* meaning crab.

Type and only species: *Stanleycaris hirpex* n. sp. (Sup. Mat. 5B)

Diagnosis: Appendage with 11 tapering podomeres bearing robust, double-pointed spines projecting from the dorsal surface at an oblique angle, as well as five spinous ventral blades that are two to three times the length of the dorsal spines and slightly curved.

Stanleycaris hirpex n. sp.

Derivation: From the Latin *hirpex* meaning “large rake” in relation to the morphology of the dorsal spines.

Holotype: Royal Ontario Museum (ROM) Stanley Glacier ROM 59944. Paratypes: ROM 59975, 59976, 59977. All from talus material.

Other material: A total of 37 specimens, including 29 isolated single appendages (representing a minimum of 15 specimens), 11 pairs of appendages and 11 assemblages (with appendages, mouthparts or body segments in close proximity). All material is stored at the ROM.

Horizons and localities. All material is derived from the “middle Cambrian (Series 3)” Stephen Formation near Stanley Glacier (Kootenay National Park) in British Columbia. About 10 specimens were collected from the claystones of cycle 5 (Sup. Mat. 3B). GPS coordinates = N51,10.781; W116,02.509

Diagnosis: As for genus.

Description: Appendages have lengths (measured along dorsal midline from proximal margin to terminus) ranging continuously between 12.5 mm and 30.3 mm (mean = 20.6 mm, STD = 3.9, N=21), with no evidence for discreet size classes. The most proximal podomere of the appendage is square or rectangular shaped, and the rest of the podomeres tapers in height towards the terminus imparting a convex curve to the dorsal margin of the appendage. The distal end of the appendage is straight in some specimens (Sup. Mat. 5B2) or sharply curved in others (Sup. Mat.

5B1). The appendage terminates in a rounded podomere bearing as many as three curved terminal spines. In some specimens the dorsal spines on the 2nd and 3rd to last podomeres curve forward towards the terminus and have a second set of smaller spines on them (Sup. Mat 5B1-2).

Double-pointed dorsal spines are prominent and project outwards from the dorsal margin of all podomeres except for the first and last at an angle of 45-90°. The largest spine on the most proximal segment can be nearly as long as the width of the podomere, but they decrease in size towards the distal end. The second to sixth podomeres have thin, elongated, lanceolate-shaped projections extending outwards from their ventral surface, reaching a maximum length of 3 times the length of the dorsal spines. These ventral blades are straight or slightly curved, and in some specimens (Sup. Mat. 5B1), the tips curve sharply forwards. As many as five single, straight auxiliary spines project from each ventral blade at an angle of 90°. Some specimens (Sup. Mat. 5B2) have a sixth short, spineless ventral blade projecting from the seventh podomere.

Appendages are often paired, sometimes with two or three pairs in close proximity on the same slab (Sup. Mat. 5B3-4). Appendages are also found in disarticulated assemblages with anomalocaridid mouthparts (“Peytoia”), that consist of a circlet of plates with a square central opening (Sup. Mat 5B3-4). One specimen (Sup. Mat. 5B4) also preserves indistinct carapace material that may be a partial body of the animal, although no details of the body morphology can be determined.

Comments: The appendages described herein are suggested to be the frontal appendages of an anomalocaridid animal because they have an overall similar morphology (segmented with dorsal spines and ventral blades) and preservation to other Burgess Shale anomalocaridid appendages (e.g. Whittington and Briggs, 1985; Daley *et al.* 2009; Daley and Budd, in press), and they are found closely associated with typical anomalocaridid mouthparts in disarticulated assemblages. The relatively short length of the podomeres and the presence of dorsal spines and five ventral blades indicate that the frontal appendage of *Stanleycaris* is more similar to that found in *Laggania* and *Hurdia* (Whittington and Briggs, 1985; Daley *et al.* 2009), as compared to the elongated appendages of *Anomalocaris* or *Caryosyntrips*, where ventral protrusions are short and spiny. The appendage of *Stanleycaris* is distinguished from that of *Laggania* and *Hurdia* by the presence of robust, double-pointed dorsal spines.

Daley, A., and G. Budd, In press, New anomalocaridid appendages from the Burgess Shale, Canada: Palaeontology.

Whittington, H. B., and D. E. G. Briggs, 1985, The largest Cambrian animal, *Anomalocaris*, Burgess Shale, British Columbia: Philosophical Transactions of the Royal Society of London, Series B, v. 309, p. 569-609.

Plate: 1. Holotype, ROM 59944. 2. Paratype, ROM 59975. 3. Paratype, ROM 59977 in close association with Peytoia-type mouthpart. 4. Paratype, ROM 59976, pair of appendages in close association with Peytoia-type mouthpart. Scale bars B1-3 = 1 cm, except B2 = 0.5 cm.

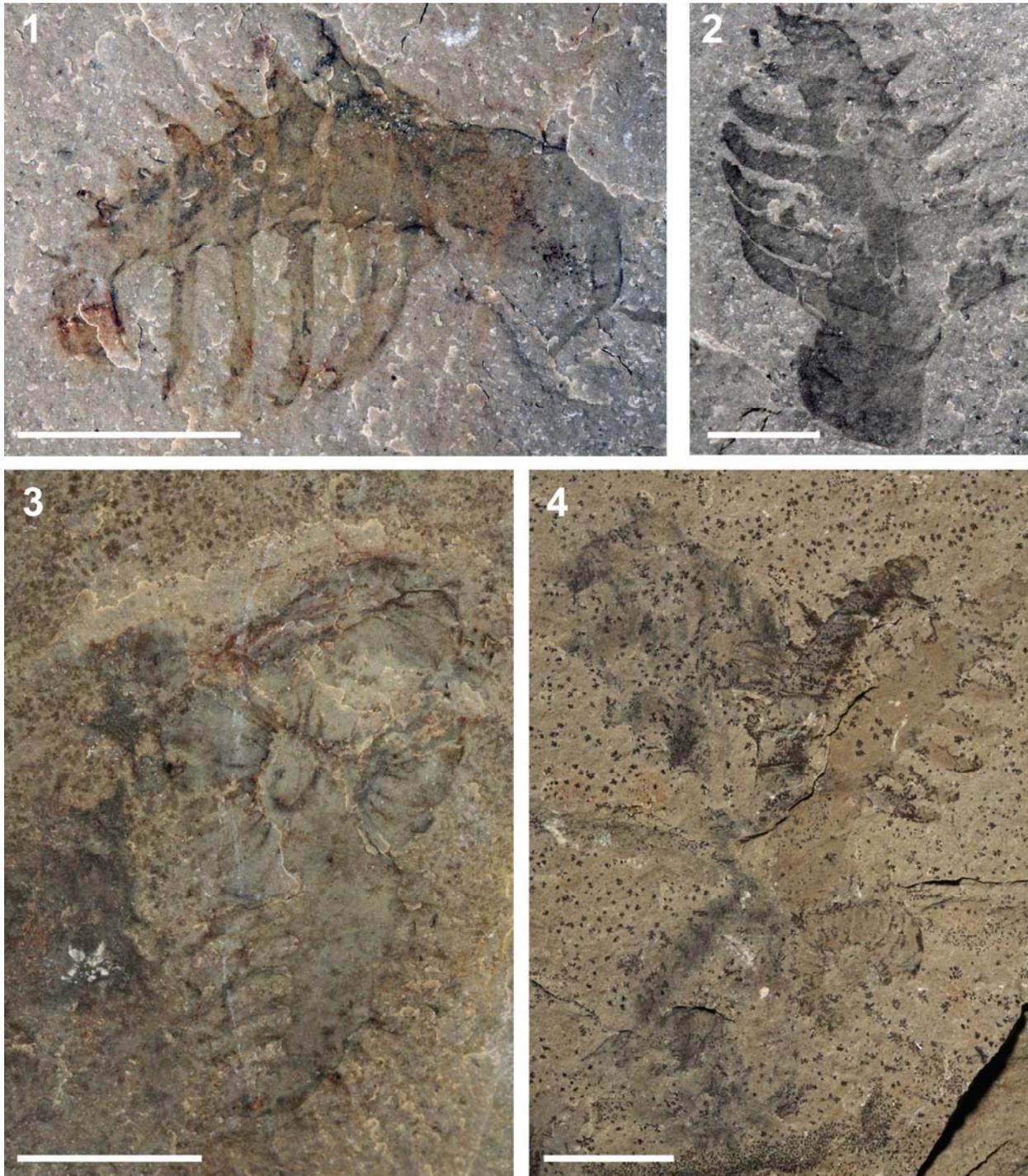
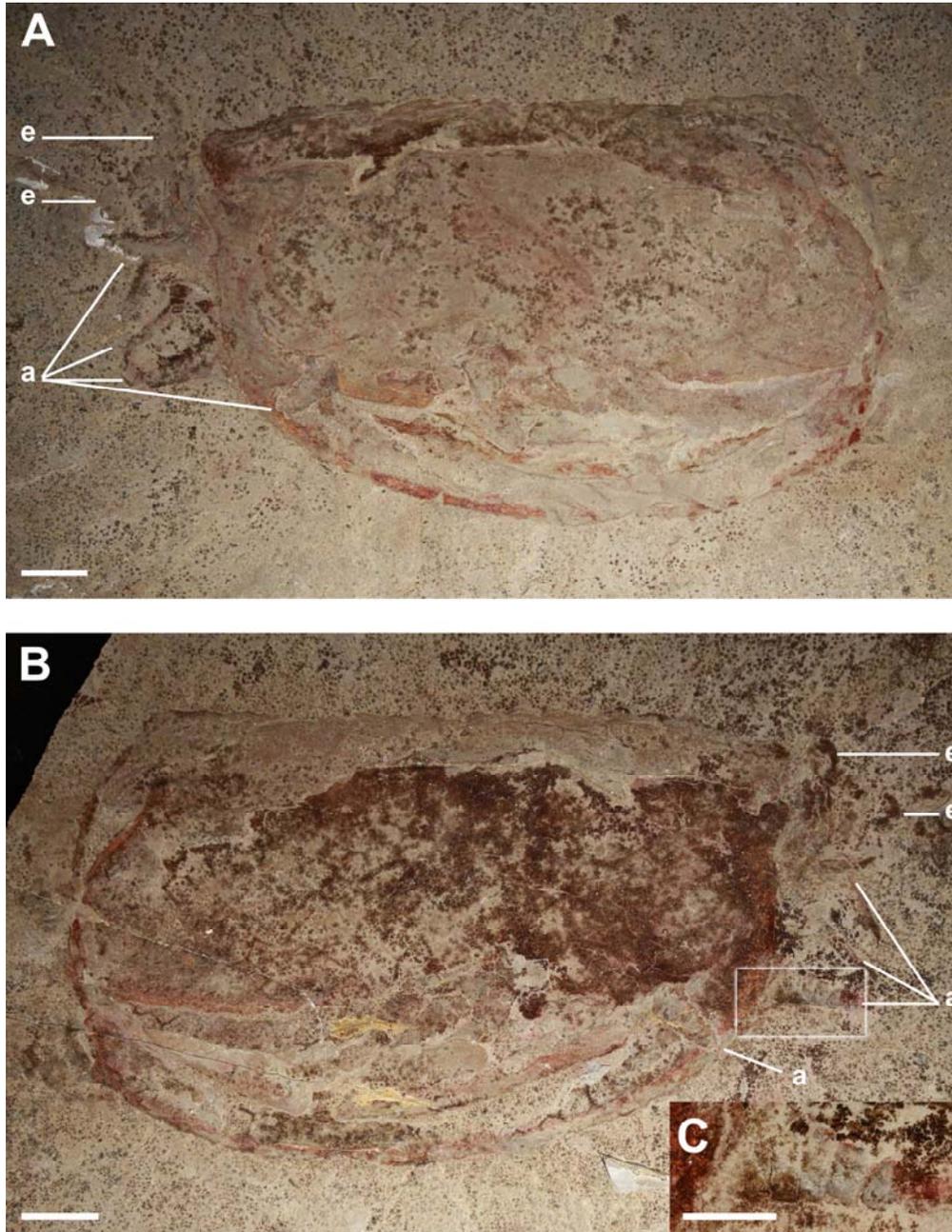


Figure DR4. A-I. Additional fossils from Stanley Glacier. A-C. *Tuzoia* with eyes (e) and appendages (a), part (A) and counterpart (B); C, details of one segmented appendage, ROM 59978. D. “Great appendage arthropod A”, counterpart (see part Fig. 3F), ROM 59948. E. *Spencella* sp., ROM 59979. F. *Ehmaniella burgessensis*, ROM 59980. G-H. part (G) and counterpart (H), new “sipunculan A” worm (w) at the end of a tube (t) possibly lined with mucus, ROM 59950. I. Paterinid brachiopod with setae (s), ROM 59981. Scale bars, A,B,D,F,I = 1 cm; C,E,G,H = 0.5 cm



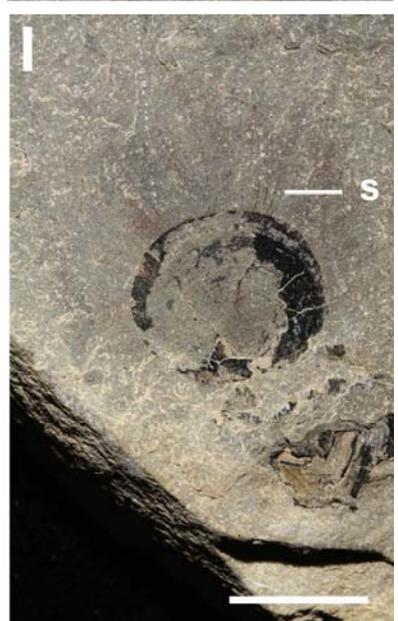
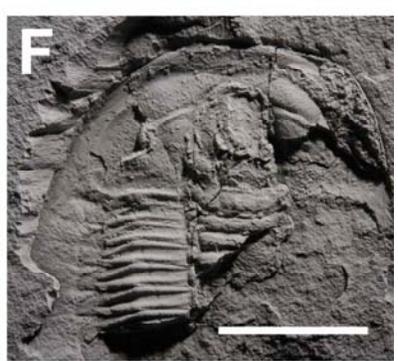
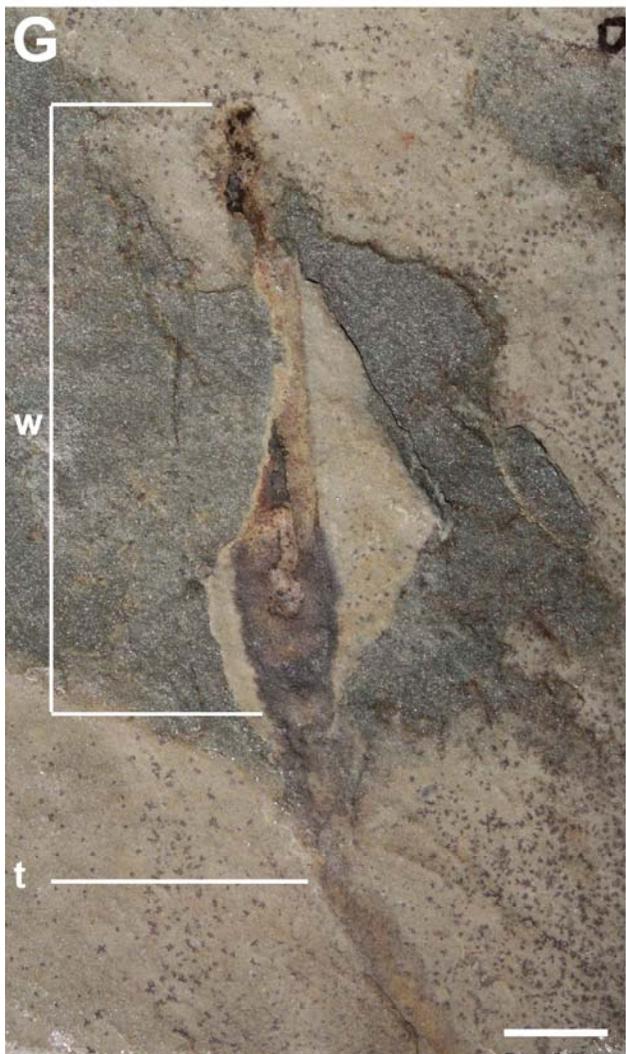


Figure DR5. . Taphonomy section. A. Articulated specimen of *Sidneyia*, possibly representing a molt assemblage based on the absence of a gut and partially missing front and back portions of the body, ROM 59982. B. *Hurdia* assemblage with one pair of appendages and the mouthpart in close association, ROM 59983. C. Clusters of articulated *Haplophrentis* specimens with individuals of various sizes preserved together. Note the presence of opercula and pairs of helens, ROM 59984. Scale bars = 1 cm

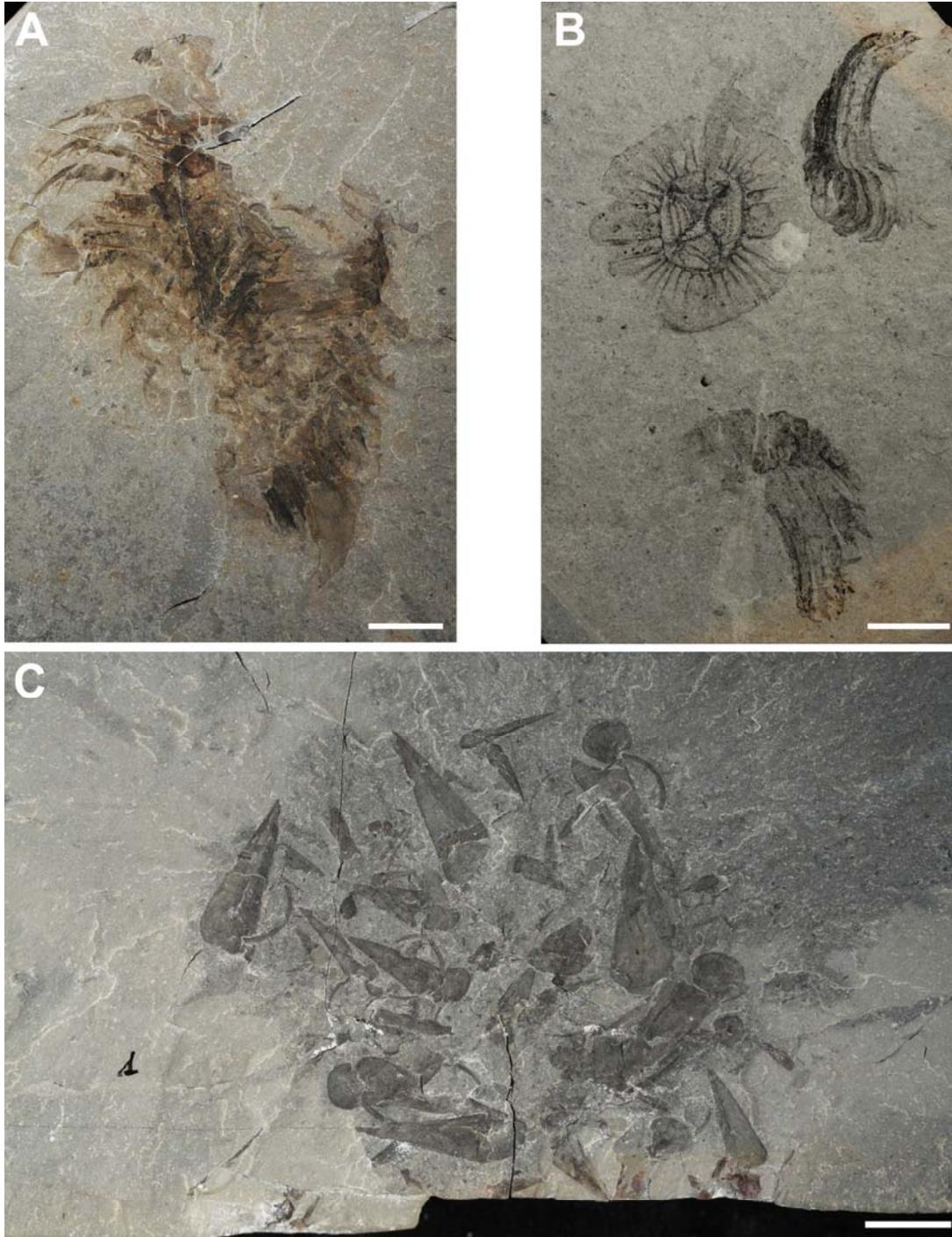


Figure DR6. Selected trace fossils from Stanley Glacier. A. basal bedding-plane view of an oriented slab showing rosary structures, *Hormosiroidea*-like (Ro), *Diplopodichnus* (Di), *Gordia* (Go), and *Helminthoidichnites* (He), ROM 59985. B. Linear rosary structures (*Hormosiroidea*-like - Ro) and radial structure (Ra), ROM 59986. C. Arthropod trackway, *Diplichnites*. Notice the undulating path suggestive of a relatively long body, ROM 60186. D. Tiny pelleted burrow within a carapace, *Alcynidiopsis*, ROM 59988. E. Small specimens of *Cruziana problematica* ROM 59989. F. *Hurdia* carapace with associated *Helminthoidichnites*, ROM 59987. Scale bars = 2 cm (A,C,E); 1 cm (B,F); 2 mm (D).

