

SUPPLEMENTARY MATERIAL 1— Original data matrix with the numbers of specimens per BA (columns) and per species (rows) observed in the GPB based on the Royal Ontario Museum Burgess Shale collection.

SUPPLEMENTARY MATERIAL 2— Numbers of specimens of 15 species in 2 different categories of preservation in 26 bedding assemblages from the GPB with more than 300 specimens: (1) complete, (2) dissociated or disarticulated.

SUPPLEMENTARY MATERIAL 3— Original Data matrix used for the Canonical Correspondence Analysis. (See text for details)

SUPPLEMENTARY MATERIAL 4— Partially dissociated and disarticulated specimens of the trilobite *Olenoides serratus*. Single white arrows indicate the presence of appendages; double opposite arrows represent disarticulations). Specimens typically show slight *in-situ* disarticulations of sclerites, i.e. slightly displaced relative to each other on the same bedding plane. Scale bars: (A-E, I) = 10 mm; (F) = 30 mm; (H) = 20 mm. (A-B) (ROM 56633, BA -150): (A) Overall view; (B) Details of one appendage. (C) Detached hypostome (ROM 56635, BA -150). (D) Detached free cheek (ROM 56636, BA -150). (E) Detached free cheeks (ROM 56634, BA -245). (F-I) Specimen with complete dissociation of both limbs and exoskeleton. The exoskeleton is fully articulated with the hypostome in place; there is no trace of the gut and the limbs, including the antennae, seem to have retained their original serial relationship (ROM 56637, BA -210); (F) Overall slab; (G) Sketches of (F); (H) Close-up of the limbs (a=antennae); (I) Close-up of the exoskeleton showing the hypostome in place.

SUPPLEMENTARY MATERIAL 5—Multispecies assemblages and examples of specimens in Category 2 of preservation in various species from the GPB. Scale bars: (A, N)

= 40 mm; (B, D-G, I, J, M) = 10 mm; (C, K, L) = 5 mm; (H) = 2 mm. (A) Slab with articulated and disarticulated specimens of the arthropod *Canadaspis perfecta* representing a possible mass death/moulting event (ROM 56954, BA -350). (B) Dissociated specimen of *Canadaspis perfecta* (ROM 56955, BA -320). (C) Disarticulated moult (?) of *Elrathina cordillerae* (ROM 56956, BA -245). (D) Dissociated specimens of the arthropod *Marrella splendens* (ROM 56957, BA -245). (E) Slab with anterior half of the arthropod *Sidneyia inexpectans*, the anterior part of the small arthropod *Perspicularis dictynna* (below *Sidneyia*), the trilobite *Kootenia burgessensis*, and an indeterminate brachiopod with its flexible pedicle possibly attached to one antennae of *Sidneyia* (black arrow) (ROM 56958, BA -150). (F) Slab with numerous dissociated remains of the arthropod *Waptia fieldensis*, and isolated sclerites of the arthropod *Sidneyia inexpectans* (ROM 56959, BA -150). (G-H) Specimens of the bradorid arthropod *Liangshanella burgessensis*: (G) cluster of dozens of isolated carapaces (ROM 56960, BA -250); (H) Detail of one isolated carapace (ROM 56961, BA -400). (I-J) Specimen of the sponge *Eiffelia globosa* (ROM 56962, BA -210); (I) with high angle light; (J) with polarizing filters on camera and light-source. (K) Specimen of the hyolithid *Haplophrentis carinatus* with operculum slightly dissociated from shell (ROM 56963, BA -210). (L) Specimen of the brachiopod *Micromitra burgessensis* preserved with setae, but with valves slightly dissociated (ROM 56964, BA -245). (M) Dissociated sclerites of the putative polychaete *Wiwaxia corrugata* (ROM 56965, BA -210). (N) Slab with numerous empty tubes of the priapulid worm *Selkirkia columbia* (ROM 56966, BA -250).

SUPPLEMENTARY MATERIAL 6— Presence-absence data of different organisms in the GPB suggesting preservation within habitat (molt, ichnofossils and articulated+disarticulated specimens) and limited taxonomic control on post-burial preservation. The relative

abundance of the cyanobacterium *Morania* is added to recognize that it may have played a role in the preservation of non-biomineralized animals. (See text for details)