GSA Data Repository 2017005

SUPPLEMENTARY INFORMATION AND METHODS

Provenance and stratigraphic position of the studied brachiopods

Stratigraphic logs of the Julfa and AliBashi formations (northwestern Iran) along, the Ali Bashi sections 1 and 3 and the Zal section (Fig. DR1a); stratigraphic logs of the Dalong Formation (South China) along the Shangsi sections 1 and 2 (Figs DR1b), and of the Changhsing Formation (South China) along the Beifengjing and Zhongliang hill section (Fig. DR1c). Note the following correlation of the fossiliferous beds along the Main Valley section (see Ghaderi et al., 2014): JU106=G134; JU112=G138, JU114=G142, JU115=G142B, JU117=G143, JU120=G144, JU121=G145B, JU129=G154, JU131=G154B, JU132=G156, JU133=G157, JU136=G187, JU141=G273; JU140 and JU139 are 30 and 60 cm below the Boundary Clay respectively. The logs of the other investigated sections have already been in the following papers: Main Valley section in Ghaderi et al. (2014); Gyanyima section in Shen et al. (2010) and Garbelli et al. (2016); Elikah, Mangol and Bear Gully sections in Angiolini and Carabelli (2010); Selong Xishan section in Shen et al. (2006) .

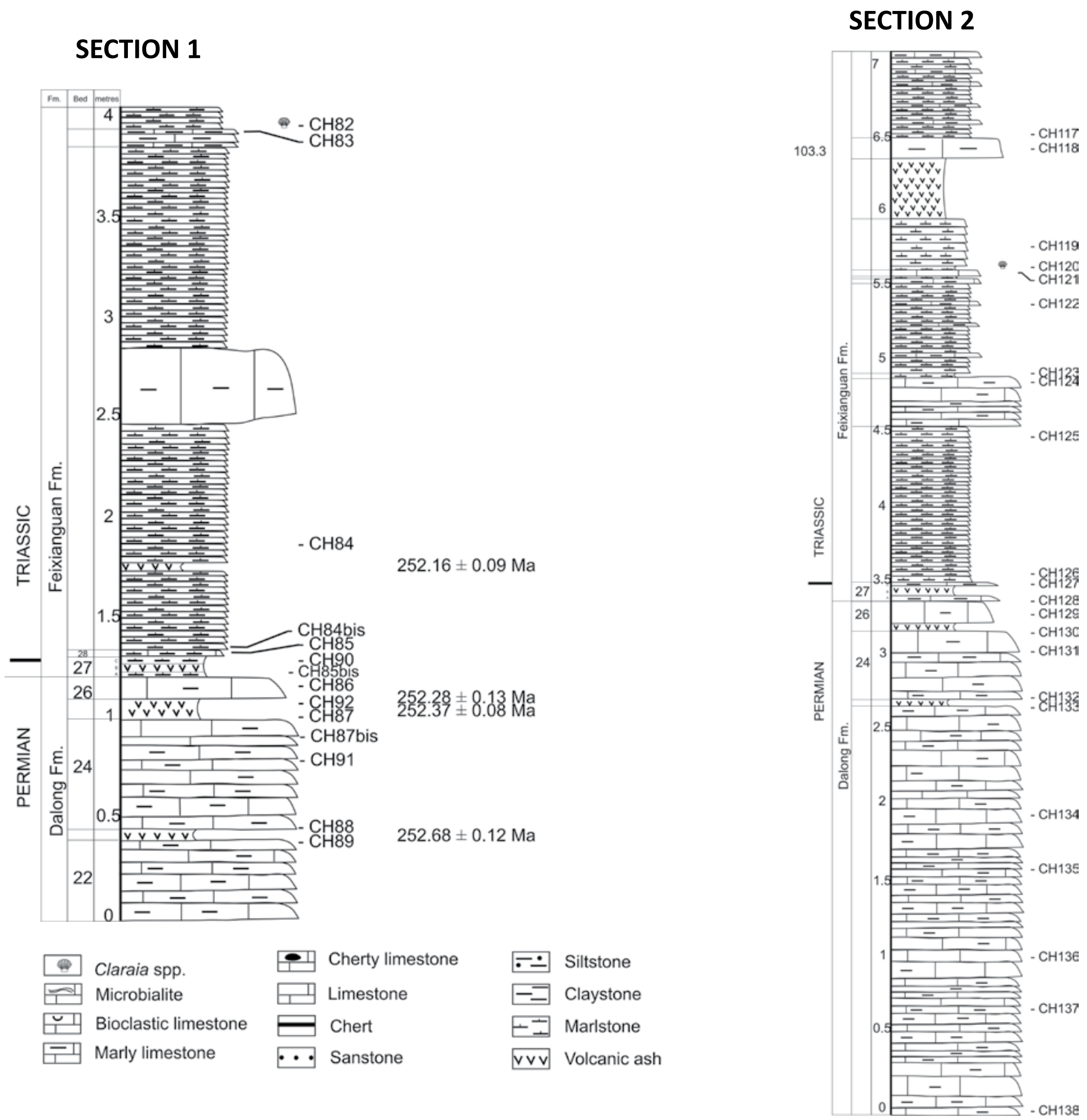

Figure DR1a - Shangsi section 1, 32° 19’ 09.9’’N 105° 27’ 17.3’’EShangsi secti; on 2, 32° 19’ 09.9’’N 105° 27’ 17.3’’E

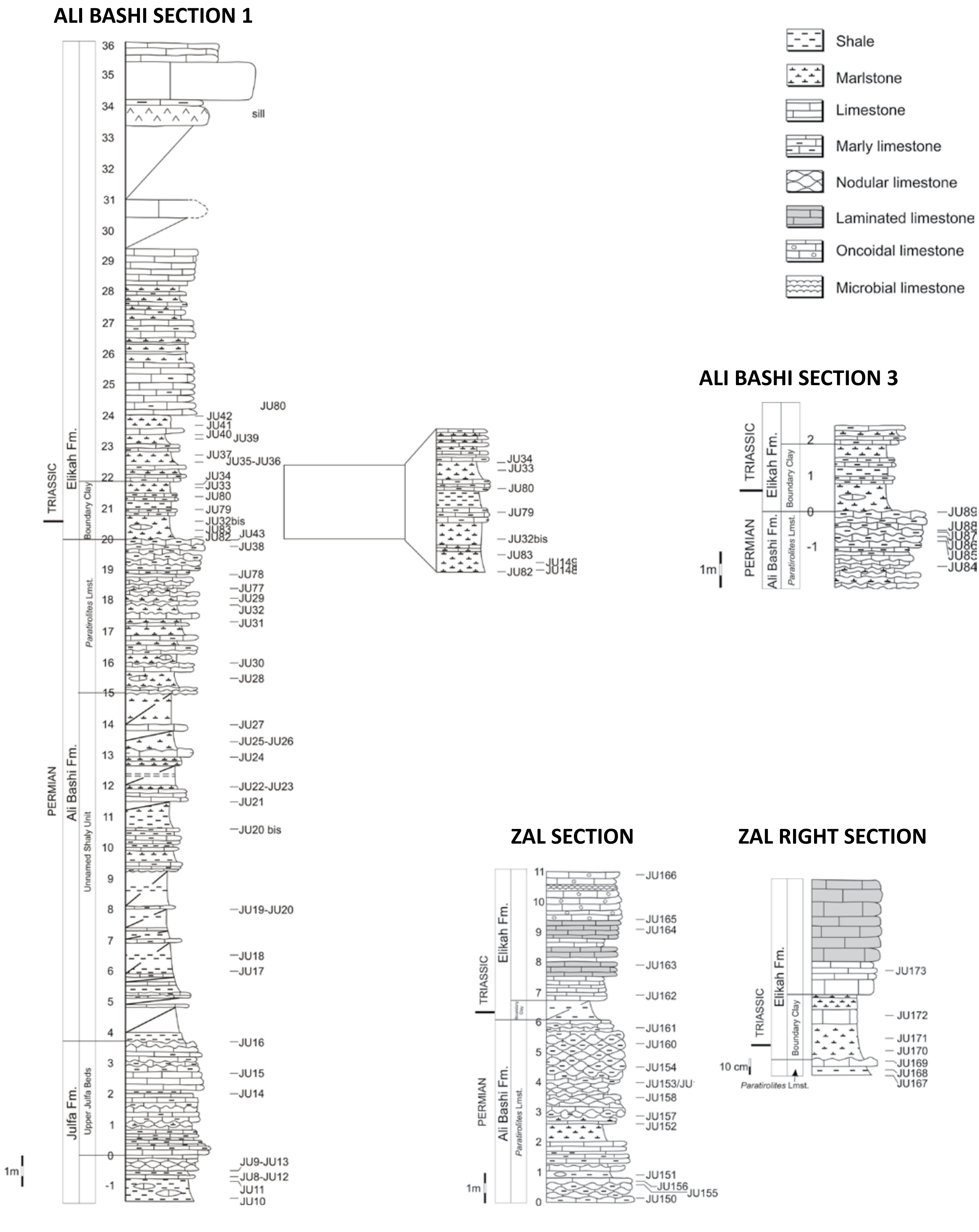

Figure DR1b - Ali Bashi section 1, 38° 56’ 22.5’’N 45° 31’ 13.0’’E; Ali Bashi section 3, 38° 56’ 22.5’’N 45° 31’ 13.0’’E; Zal and Zal right sections, 38° 43’ 55.3’’N 45° 34’ 54.7’’E

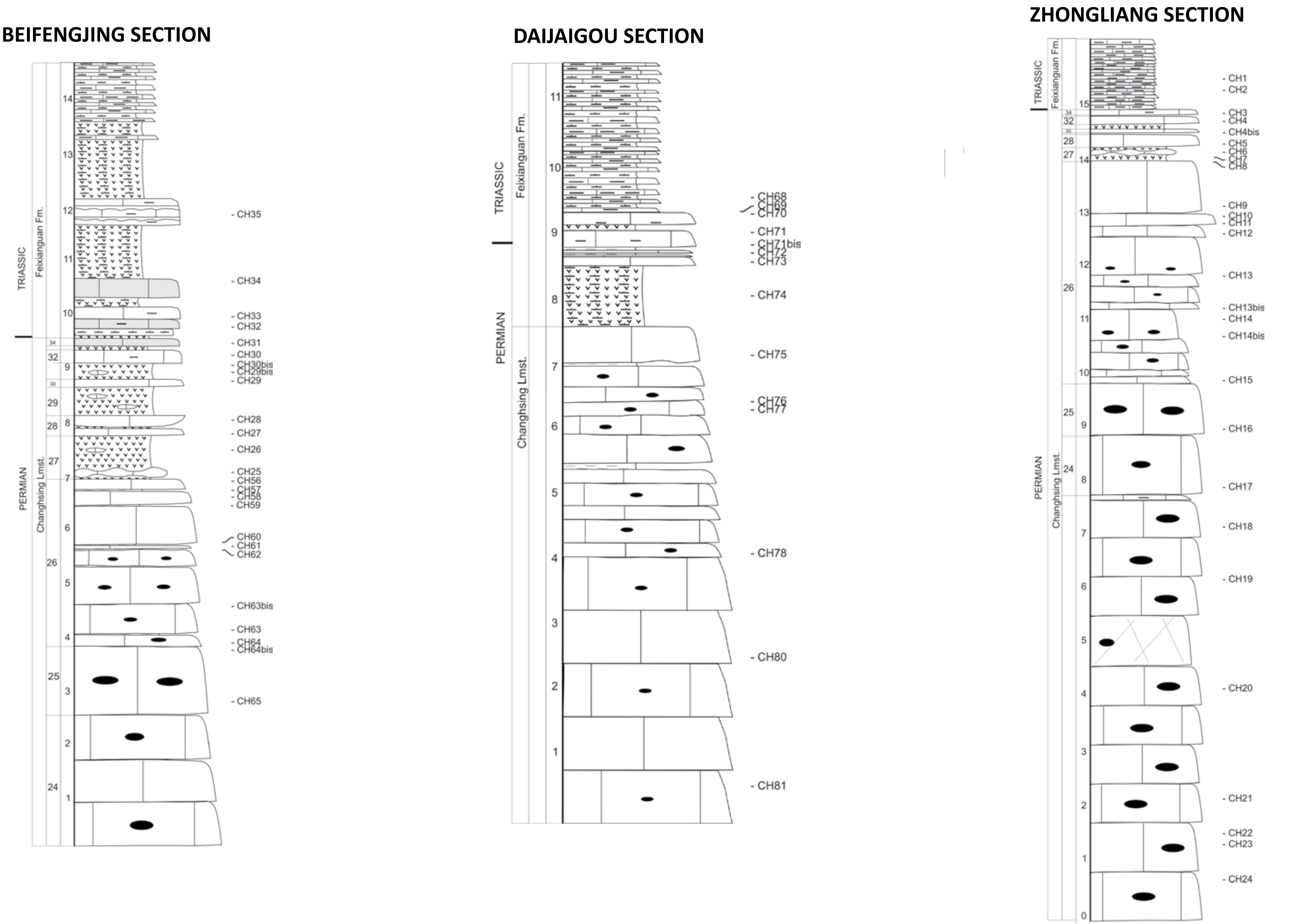

Figure DR1c - Beifengjing section, 29° 30’ 16.1’’N 106° 24’ 15.2’’E; Daijaigou section, 29° 54’ 29.5’’N 106° 31’ 14.6’’E; Zhongliang hill section, 29° 30’ 20.2’’N 106° 24’ 12.1’’E

Table DR1. List of the specimens investigated using SEM. Since the identification is made difficult by the state of preservation of the fossil specimens which may preclude the observation of the characters on which the specific identification is based, the taxonomic determination of species is left open in some cases. However, genera are considered to be the most reliable taxonomic units when dealing with Paleozoic brachiopods (e.g. Crippa et al., 2014) and paleontological studies in general (Allmon 1992). This database contains only mature specimens deemed to be adult based on several features (i.e. muscle scars, cardinalia, gonadal markings, growth lines, population analyses); juvenile shells were excluded to avoid any ontogenetic control on the size of the structural units.
PR= recrystallized primary layer, L=laminar, F=fibrous, P=prismatic, NP=not present; sedimentation: CA = Carbonate, SI= siliciclastic, MIX= mixed carbonatic-siliciclastic; hydrodynamic energy: AFWB = Above fair-weather base, BFWB = Below fair-weather base; paleolatitude: EQ = Equatorial (0°-15° lat), MID= mid latitudes (35°-45° lat);stratigraphc position: C= Changhsingian, W = Wuchiapingian, EI = Extinction Interval, NA=not available

Section	Taxon	Specimen number	Pimary layer	Secondary layer	Columnar tertiary layer	Type	stratigraphic position	hydrodynamic energy	sedimentation	paleolatitude
Abredan	*Haydenella sp.*	IR-1054-11	NP	L	NP	Type-2	?C	BFWB	CA	EQ
Abredan	*Haydenella sp.*	IR-1054-13	NP	L	NP	Type-2	?C	BFWB	CA	EQ
Abredan	*Squamularia formilla*	IR-1055-19	NP	F	NP	Type-2	?C	BFWB	CA	EQ
Abredan	*Squamularia formilla*	IR-1055-29	NP	F	NP	Type-2	?C	BFWB	CA	EQ
Abredan	*Uncinunellina jabiensis*	IR-1055-42	NP	F	NP	Type-2	?C	BFWB	CA	EQ
Abredan	*Uncinunellina jabiensis*	IR-1055-45	NP	F	NP	Type-2	?C	BFWB	CA	EQ
Abredan	*Squamularia formilla*	IR-1056-5	NP	F	NP	Type-2	?C	BFWB	CA	EQ
Abredan	*Meekella sp.*	IR-1036-14	NP	L	NP	Type-2	W	AFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU10-1	NP	F	P	Type-1	W	BFWB	MIX	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU10-2	NP	F	P	Type-1	W	BFWB	MIX	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU10-3	NP	F	P	Type-1	W	BFWB	MIX	EQ
Ali Bashi 1	*Transcaqucasathyris araxensis*	JU10-4	NP	F	P	Type-1	W	BFWB	MIX	EQ
Ali Bashi 1	*Paracrurithyris pygmaea*	JU148-2	NP	F	NP	Type-2	EI	BFWB	SI	EQ
Ali Bashi 1	*Paracrurithyris pygmaea*	JU148-5	NP	F	NP	Type-2	EI	BFWB	SI	EQ
Ali Bashi 1	*Paracrurithyris pygmaea*	JU148-8	NP	F	NP	Type-2	EI	BFWB	SI	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU25-1	NP	F	P	Type-1	C	BFWB	MIX	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU25-2	NP	F	P	Type-1	C	BFWB	MIX	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU30-1	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU30-2	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU30-3	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU32-1	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Paracrurithyris pygmaea*	JU75	NP	F	NP	Type-2	C	BFWB	CA	EQ
Ali Bashi 1	*Paracrurithyris pygmaea*	JU75	NP	F	NP	Type-2	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU75	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU75	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU75	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Acosarina minuta*	JU75-1	R	F	NP	Type-2	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU75-2	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU75-3	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU75-4	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris*	JU76	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU76-1	NP	F	P	Type-1	C	BFWB	CA	EQ

Ali Bashi 1	*Acosarina sp.*	JU76-2	R	F	NP	Type-2	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU77-1	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris*	JU77-2	R	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU77-3	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU77-4	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU78-1	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Transcaucasathyris sp.*	JU78-2	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 1	*Paracrurithyris pygmaea*	JU83-2	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Ali Bashi 1	*Spinomarginifera sp.*	JU85-7	NP	L	NP	Type-2	C	BFWB	CA	EQ
Ali Bashi 1	*Spinomarginifera sp.*	JU86	NP	L	NP	Type-2	C	BFWB	CA	EQ
Ali Bashi 3	*Transcaucasathyris sp.*	JU85-3	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 3	*Transcaucasathyris sp.*	JU85-4	NP	F	P	Type-1	C	BFWB	CA	EQ
Ali Bashi 3	*Transcaucasathyris araxensis*	JU89-1	NP	F	P	Type-1	C	BFWB	CA	EQ
Bear Gully	*?Spinomarginifera sp.*	IR-862-11	NP	L	NP	Type-2	W	BFWB	CA	EQ
Bear Gully	*Araxathyris bruntoni*	IR-862-23b	NP	F	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Orthothetina persica*	IR-864-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Orthothetina persica*	IR-864-2	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Orthothetina persica*	IR-864-7	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Linoproductus*	IR-865-3	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta sp.*	IR-866-2	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta yangtzeensis*	IR-866-3	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta yangtzeensis*	IR-867-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta yangtzeensis*	IR-867-2	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta yangtzeensis*	IR-867-4	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Spinomarginifera spinosocostata*	IR-869-1a	NP	L	NP	Type-2	W	BFWB	CA	EQ
Bear Gully	*Spinomarginifera spinosocostata*	IR-869-1b	NP	L	NP	Type-2	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta yangtzeensis*	IR-870-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta yangtzeensis*	IR-870-2	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta yangtzeensis*	IR-870-3	NP	NP	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Spinomarginifera sulcata*	IR-871-13	NP	L	NP	Type-2	W	BFWB	CA	EQ
Bear Gully	*Araxathyris felina*	IR-871-2	NP	F	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta yangtzeensis*	IR-871-7	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta yangtzeensis*	IR-875-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Spinomarginifera helica*	IR-875-12	NP	L	NP	Type-2	W	BFWB	CA	EQ
Bear Gully	*Araxilevis intermedius*	IR-875-5	NP	F	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta persica*	IR-877-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta persica*	IR-878-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta persica*	IR-878-2	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta persica*	IR-878-3	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta persica*	IR-879-12	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Orthothetina persica*	IR-879-3	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Tyloplecta persica*	IR-879-8	NP	L	P	Type-1	W	BFWB	CA	EQ
Bear Gully	*Spinomarginifera sp.*	IR-883bis-3a	NP	L	NP	Type-2	C	AFWB	CA	EQ
Bear Gully	*Permophricodothyris iranica*	IR-883bis-3b	NP	F	P?	NA	C	AFWB	CA	EQ
Bear Gully	*Permophricodothyris iranica*	IR-883bis-3c	NP	F	P	Type-1	C	AFWB	CA	EQ
Bear Gully	*Spinomarginifera iranica*	IR-885-1	NP	L	NP	Type-2	C	AFWB	CA	EQ
Bear Gully	*Spinomarginifera iranica*	IR-885-6	NP	L	NP	Type-2	C	AFWB	CA	EQ
Bear Gully	*Enteletes sp.*	IR-887-1a	NP	F	P?	NA	C	AFWB	CA	EQ
Bear Gully	*Enteletes sp.*	IR-887-1b	NP	F	P?	NA	C	AFWB	CA	EQ
Bear Gully	*Spinomarginifera spinosocostata*	IR-887-2	NP	L	NP	Type-2	C	AFWB	CA	EQ
Bear Gully	*Spinomarginifera ciliata*	IR-888bis-1	NP	L	NP	Type-2	C	BFWB	CA	EQ
Bear Gully	*Araxathyris bruntoni*	IR-888bis-4	NP	F	P?	NA	C	BFWB	CA	EQ
Bear Gully	*Araxathyris bruntoni*	IR-889-1	NP	F	P	Type-1	C	BFWB	CA	EQ

Beifengjing	*Paracrurithyris pygmaea*	CH30-11	NP	F	NP	Type-2	EI	AFWB	CA	EQ
Beifengjing	*Paracrurithyris pygmaea*	CH30-11	NP	F	NP	Type-2	EI	AFWB	CA	EQ
Beifengjing	*Paracrurithyris pygmaea*	CH30-11	NP	F	NP	Type-2	EI	AFWB	CA	EQ
Beifengjing	*Hustedia sp.*	CH30-15	R	F	NP	Type-2	EI	AFWB	CA	EQ
Beifengjing	*Acosarina minuta*	CH30-3	NP	F	NP	Type-2	EI	AFWB	CA	EQ
Beifengjing	*Transcaucasathyris*	CH30-4	NP	F	P	Type-1	EI	AFWB	CA	EQ
Beifengjing	*Hustedia sp.*	CH60-15	R	F	NP	Type-2	C	AFWB	CA	EQ
Beifengjing	*Peltichia sp.*	CH60-8	NP	F	NP	Type-2	C	AFWB	CA	EQ
Beifengjing	*Peltichia sp.*	CH60-9	NP	F	NP	Type-2	C	AFWB	CA	EQ
Bulla	*Comelicania sp.*	PK56-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Bulla	*Comelicania sp.*	VB9A-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Bulla	*Comelicania sp.*	VB9B-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Bulla	*Comelicania sp.*	VB9B-2	NP	F	P	Type-1	C	AFWB	CA	EQ
Daijaigou	*Acosarina sp.*	CH71-14	R	F	NP	Type-2	EI	AFWB	CA	EQ
Daijaigou	*Spinomarginifera sp.*	CH71-17	NP	L	NP	Type-2	EI	AFWB	CA	EQ
Daijaigou	*Spinomarginifera sp.*	CH71-3	NP	L	NP	Type-2	EI	AFWB	CA	EQ
Daijaigou	*Cathaysia sp.*	CH71-4	NP	L	NP	Type-2	EI	AFWB	CA	EQ
Daijaigou	*Cathaysia sp.?*	CH71-8	NP	L	NP	Type-2	EI	AFWB	CA	EQ
Daijaigou	*Strophomenata*	CH72-10	NP	L	NP	Type-2	EI	AFWB	MIX	EQ
Daijaigou	*Acosarina minuta*	CH72-11	R	L	NP	Type-2	EI	AFWB	MIX	EQ
Daijaigou	*Cathaysia sp.*	CH72-13	NP	L	NP	Type-2	EI	AFWB	MIX	EQ
Daijaigou	*Paryphella sp.*	CH72-4	NP	L	NP	Type-2	EI	AFWB	MIX	EQ
Daijaigou	*Paracrurithyris pygmaea*	CH72-5	NP	F	NP	Type-2	EI	AFWB	MIX	EQ
Daijaigou	*Rhynchonellata sp.*	CH72-6	NP	F	NP	Type-2	EI	AFWB	MIX	EQ
Elikah river	*Permophricodothyris iranica*	IR158-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris iranica*	IR159-2	NP	NP	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris ovata*	IR159-3	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris iranica*	IR159-4-	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris iranica*	IR161-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris iranica*	IR161-2	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris iranica*	IR161-4	NP	NP	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris iranica*	IR162-2	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris ovata*	IR162-5	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris ovata*	IR162-6	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris ovata*	IR163-10-	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris ovata*	IR163-4	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris ovata*	IR163-8	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris iranica*	IR164-3	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris iranica*	IR164-5	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Permophricodothyris iranica*	IR164-8-	NP	F	P	Type-1	C	AFWB	CA	EQ
Elikah river	*Spinomarginifera helica*	IR167-1	NP	L	NP	Type-2	C	AFWB	CA	EQ
Elikah river	*Orthothetina persica*	IR168-4	NP	L	P?	NA	C	BFWB	CA	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ15-15	NP	L	P	Type-1	C	BFWB	CA	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ65_31	NP	L	P	Type-1	C	BFWB	CA	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ65_32	NP	L	NP	Type-2	C	BFWB	CA	EQ
Gomaniibrik	*Alatorthotetina sp.*	EBHZ65-12	NP	L	NP	Type-2	C	BFWB	CA	EQ
Gomaniibrik	*Spinomarginifera sulcata*	EBHZ65-27	NP	L	NP	Type-2	C	BFWB	CA	EQ
Gomaniibrik	*Spinomarginifera spinosocostata*	EBHZ65-33	NP	L	NP	Type-2	C	BFWB	CA	EQ
Gomaniibrik	*Alatorthotetina sp.*	EBHZ65-9	NP	L	NP	Type-2	C	BFWB	CA	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ68-1	NP	L	P	Type-1	C	BFWB	MIX	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ68-2	NP	L	P	Type-1	C	BFWB	MIX	EQ
Gomaniibrik	*Spinomarginifera spinosocostata*	EBHZ69-1	NP	L	P	Type-1	C	BFWB	MIX	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ69-2	NP	L	P	Type-1	C	BFWB	MIX	EQ

Gomaniibrik	*Spinomarginifera helica*	EBHZ69-4	NP	L	NP	Type-2	C	BFWB	MIX	EQ
Gomaniibrik	*Alatorthotetina sp.*	EBHZ69-6	NP	L	NP	Type-2	C	BFWB	MIX	EQ
Gomaniibrik	*Alatorthotetina sp.*	EBHZ70-6	NP	L	NP	Type-2	C	AFWB	MIX	EQ
Gomaniibrik	*Alatorthotetina sp.*	EBHZ70-8	NP	L	NP	Type-2	C	AFWB	MIX	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ71-10	NP	L	P	Type-1	C	AFWB	MIX	EQ
Gomaniibrik	*Alatorthotetina sp.*	EBHZ71-2	NP	L	NP	Type-2	C	AFWB	MIX	EQ
Gomaniibrik	*Alatorthotetina sp.*	EBHZ71-6	NP	L	NP	Type-2	C	AFWB	MIX	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ71-9	NP	L	P	Type-1	C	AFWB	MIX	EQ
Gomaniibrik	*Alatorthotetina sp.*	EBHZ80-16	NP	L	NP	Type-2	C	BFWB	MIX	EQ
Gomaniibrik	*Alatorthotetina sp.*	EBHZ80-5	NP	L	NP	Type-2	C	BFWB	MIX	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ90-2	NP	L	NP	Type-2	C	AFWB	MIX	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ90-3	NP	L	P	Type-1	C	AFWB	MIX	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ91-3	NP	L	NP	Type-2	C	AFWB	MIX	EQ
Gomaniibrik	*Spinomarginifera helica*	EBHZ91-4	NP	L	NP	Type-2	C	AFWB	MIX	EQ
Gyanyima	*Acosarina minuta*	GY1(1-1)	NP	F	na	Type-2	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY10(6-15)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Martinia sp.*	GY11(7-5)	NP	NP	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Alphaneospirifer anshunensis*	GY12(7-5)	NP	F	P?	NA	C	BFWB	CA	MID
Gyanyima	*Costiferina spiralis*	GY13(7-5)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Costiferina spiralis*	GY14(8-2)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Costiferina spiralis*	GY15(8-2)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Costiferina spiralis*	GY16(8-2)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Stenoscisma sp.*	GY17(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Stenoscisma sp.*	GY18(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY19(9-23)	PR	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Neospirifer sp.*	GY2(6-1)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Hemiptychina sp.*	GY20(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Araxathyris sp.*	GY21(9-23)	PR	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Costiferina sp.?*	GY22(9-24)	NP	L	NP	Type-2	C	AFWB	CA	MID
Gyanyima	*Costiferina sp.*	GY23(9-24)	NP	L	NP	Type-2	C	AFWB	CA	MID
Gyanyima	*Costiferina sp.*	GY24(9-24)	NP	L	NP	Type-2	C	AFWB	CA	MID
Gyanyima	*Terebratudlida sp.*	GY25(6-12)	PR	F	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Transennatia gratiosa*	GY26(6-14)	NP	L	P?	NA	C	BFWB	CA	MID
Gyanyima	*Marginalosia sp.?*	GY27(9-17)	PR	L	na	NA	C	AFWB	CA	MID
Gyanyima	*Marginalosia sp.?*	GY28(9-17)	NP	L	na	NA	C	AFWB	CA	MID
Gyanyima	*Costatumulus sp*	GY29(9-17)	NP	L	NP	Type-2	C	AFWB	CA	MID
Gyanyima	*Acosarina minuta*	GY3(6-1)	NP	F	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY30(6-12)	NP	NP	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY31(6-12)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY32(6-12)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY33(7-1)	NP	no	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY34(7-1)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY35(7-1)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY36(9-23)	NP	NP	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY37(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY38(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Notothyris sp.*	GY39(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Stenoscisma gigantea*	GY4(6-1)	NP	NP	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Costiferina sp.*	GY40(6-12)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Acosarina sp.*	GY41(6-12)	NP	F	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Notothyris sp.*	GY42(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY43(7-4)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY44(7-4)	NP	F	P	Type-1	C	AFWB	CA	MID

Gyanyima	*Permophricodothyris sp.*	GY46(7-2)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Notothyris sp*	GY47(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Stenoscisma sp*	GY48(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Alphaneospirifer sp.*	GY49(9-23)	NP	F	NP	Type-2	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY5(6-12)	PR	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Martinia sp.*	GY50(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Hemiptychina sp.*	GY51(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Richthofenia lawrenciana*	GY52(6-12)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Notothyris sp.*	GY53(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY54(7-4)	NP	NP	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY55(6-1)	NP	NP	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Dielasma sp.*	GY56(7-3)	NP	F	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY57(7-3)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Notothyris sp.*	GY58(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Martinia sp.*	GY59(6-12)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Enteletes sp.*	GY6(6-12)	PR	F	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Stenoscisma sp.*	GY60(7-1)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Richthofenia lawrenciana*	GY61(6-12)	NP	F	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Neospirifer sp.*	GY62(6-1)	PR	F	P?	NA	C	BFWB	CA	MID
Gyanyima	*Costiferina subcostatus*	GY63(6-12)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY64(6-12)	NP	NP	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY65(6-12)	NP	NP	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY66(6-12)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Neospirifer sp.*	GY67(6-12)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Dielasma sp.*	GY7(6-12)	NP	F	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY70(6-15)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Neospirifer sp.*	GY73(7-4)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Costiferina indica*	GY74(7-16)	NP	L	NP	Type-2	C	AFWB	CA	MID
Gyanyima	*Costiferina indica*	GY75(8-2)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Costiferina indica*	GY76(8-2)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Costiferina indica*	GY77(8-13)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Costiferina indica*	GY78(8-14)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Costiferina indica*	GY79(8-14)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Neospirifer sp.*	GY8(6-15)	NP	F	P	Type-1	C	BFWB	CA	MID
Gyanyima	*Neospirifer sp.*	GY80(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Neospirifer sp.*	GY81(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY83(9-23)	NP	F	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY84(9-24)	NP	NP	P	Type-1	C	AFWB	CA	MID
Gyanyima	*Costiferina indica*	GY85(9-24)	NP	L	NP	Type-2	C	AFWB	CA	MID
Gyanyima	*Costiferina subcostatus*	GY86(9-27)	NP	L	NP	Type-2	C	BFWB	CA	MID
Gyanyima	*Permophricodothyris sp.*	GY9(6-15)	NP	F	P	Type-1	C	BFWB	CA	MID
Main valley	*Araxathyris protea*	G142-3	NP	F	P	Type-1	W	BFWB	CA	EQ
Main valley	*Araxathyris abichi*	G142-4	NP	F	P	Type-1	W	BFWB	CA	EQ
Main valley	*Araxathyris abichi*	G148-4	NP	F	P	Type-1	W	BFWB	CA	EQ
Main valley	*Araxathyris protea*	G155-1	NP	F	P	Type-1	W	BFWB	CA	EQ
MainValley	*Spinomarginifera sp.*	Ju106-1	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Spinomarginifera sp.*	Ju106-2	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Spinomarginifera sp.*	Ju106-3	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Spinomarginifera sp.*	JU107-1	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Spinomarginifera sp.*	JU112-1	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Spinomarginifera sp.*	JU114-1	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Spinomarginifera sp.*	Ju115-1	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Spinomarginifera sp.*	JU117-1	NP	L	P	Type-1	W	BFWB	MIX	EQ

MainValley	*Spinomarginifera iranica*	JU1-2	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Spinomarginifera sp.*	JU120-1	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Spinomarginifera spinosocostata*	JU121-1	NP	L	P	Type-1	W	BFWB	CA	EQ
MainValley	*Spinomarginifera spinosocostata*	JU121-2	NP	L	P	Type-1	W	BFWB	CA	EQ
MainValley	*Haydenella kiangsiensis*	JU129-1	NP	L	NP	Type-2	W	BFWB	CA	EQ
MainValley	*Transcaucasathyris araxensis*	JU129-1	NP	L	P	Type-1	W	BFWB	CA	EQ
MainValley	*Haydenella kiangsiensis*	JU129-4	NP	L	NP	Type-2	W	BFWB	CA	EQ
MainValley	*Spinomarginifera spinosocostata*	JU1-3	NP	L	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Transcaucasathyris sp.*	JU131-2	NP	F	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Transcaucasathyris sp.*	JU131-4	NP	F	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Transcaucasathyris sp.*	JU132-1	NP	F	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Transcaucasathyris sp.*	JU132-2	NP	F	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Transcaucasathyris sp.*	JU133-2	NP	F	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Transcaucasathyris sp.*	JU133-5	NP	F	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Transcaucasathyris sp.?*	JU133-6	NP	F	P	Type-1	W	BFWB	MIX	EQ
MainValley	*Transcaucasathyris araxensis*	JU136-1	NP	F	P	Type-1	W	BFWB	CA	EQ
MainValley	*Transcaucasathyris sp.*	JU139-3	NP	F	P	Type-1	C	BFWB	CA	EQ
MainValley	*Spinomarginifera iranica*	JU1-4	NP	L	P	Type-1	W	BFWB	CA	EQ
MainValley	*Transcaucasathyris sp.*	JU140-1	NP	F	P	Type-1	C	BFWB	CA	EQ
MainValley	*Transcaucasathyris sp.*	JU140-2	NP	F	P	Type-1	C	BFWB	CA	EQ
MainValley	*Transcaucasathyris sp.*	JU140-3	NP	F	P	Type-1	C	BFWB	CA	EQ
MainValley	*Transcaucasathyris sp.*	JU140-4	NP	F	P	Type-1	C	BFWB	CA	EQ
MainValley	*Transcaucasathyris sp.*	JU140-5	NP	F	P	Type-1	C	BFWB	CA	EQ
MainValley	*Transcaucasathyris sp.*	JU140-6	NP	F	P	Type-1	C	BFWB	CA	EQ
MainValley	*Transcaucasathyris sp.*	JU141-4	NP	F	P	Type-1	C	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-310-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Araxilevis intermedius*	IR-311-4	NP	F	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Araxilevis intermedius*	IR-311-6a	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Araxilevis intermedius*	IR-311-6b	NP	F	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-312-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-312-6	NP	NP	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-312-8	NP	NP	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta persica*	IR-313-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-313-6	NP	NP	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-313-7	NP	NP	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta persica*	IR-314-11	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-314-16	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta persica*	IR-314-bis5	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-315-5	NP	NP	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-315-6	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*?Orthothetina sp.*	IR-315-7	NP	L	P?	NA	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-316-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-317-4	NP	NP	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-317-6	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-317-7b	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-320-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-320-13	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-322-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-322-bis2	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Araxathyris felina*	IR-323-3	NP	F	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta yangtzeensis*	IR-324-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta persica*	IR-326-1	NP	L	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Tyloplecta persica*	IR-326-2	NP	NP	P	Type-1	W	BFWB	CA	EQ

Mangol Quarry	*Tyloplecta persica*	IR-329-1	NP	L	P	Type-1	W	AFWB	CA	EQ
Mangol Quarry	*Tyloplecta persica*	IR-329-2	NP	L	P	Type-1	W	AFWB	CA	EQ
Mangol Quarry	*Tyloplecta persica*	IR-329-5	NP	L	P	Type-1	W	AFWB	CA	EQ
Mangol Quarry	*Haydenella sp.*	IR-330-3	NP	L	NP	Type-2	W	BFWB	CA	EQ
Mangol Quarry	*Spiriferida*	IR-330-5	NP	F	P	Type-1	W	BFWB	CA	EQ
Mangol Quarry	*Haydenella sp.*	IR-330-6	NP	L	NP	Type-2	W	BFWB	CA	EQ
Mangol Quarry	*Enteletes lateroplicatus*	IR-332-1	PR	F	NP	Type-2	W	AFWB	CA	EQ
Mangol Quarry	*Permophricodothyris iranica*	IR-332-5	NP	F	P	Type-1	W	AFWB	CA	EQ
Mangol Quarry	*Permophricodothyris iranica*	IR-341-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Mangol Quarry	*Spinomarginifera iranica*	IR-343-1	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Quarry	*Spinomarginifera spinosocostata*	IR-347-1	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Quarry	*Spinomarginifera iranica*	IR-347-2	NP	L	P	Type-1	C	AFWB	CA	EQ
Mangol Quarry	*Permophricodothyris iranica*	IR-350-bis1	NP	NP	P	Type-1	C	AFWB	CA	EQ
Mangol Quarry	*Spinomarginifera spinosocostata*	IR-353-1	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Quarry	*Spinomarginifera spinosocostata*	IR-353-4	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Quarry	*Spinomarginifera helica*	IR-353-5	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Quarry	*Spinomarginifera ciliata*	IR-354-11	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Quarry	*Spinomarginifera ciliata*	IR-354-7	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Quarry	*Spinomarginifera ciliata*	IR-354-8	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Quarry	*Spinomarginifera ciliata*	IR-356-1	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Quarry	*Enteletes lateroplicatus*	IR-356-4	NP	F	NP	Type-2	C	AFWB	CA	EQ
Mangol Quarry	*Spinomarginifera helica*	IR-357-1	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Quarry	*Spinomarginifera iranica*	IR-357-2	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Quarry	*Spinomarginifera pygmaea*	IR-357-3	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Quarry	*Permophricodothyris ovata*	IR-358-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Mangol Quarry	*Spinomarginifera ciliata*	IR-358-10	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Quarry	*Spinomarginifera spinosocostata*	IR-358-7	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Leptodus nobilis*	IR-337-3	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera spinosocostata*	IR-337-9	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera iranica*	IR-338-1	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Leptodus nobilis*	IR-338-2	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera iranica*	IR-339-1	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera pygmaea*	IR-339-23	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera iranica*	IR-339-29	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Restaurant	*Spiriferida*	IR-340-3a	NP	F	NP	Type-2	C	BFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera iranica*	IR-340-3b	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera iranica*	IR-340-7	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera iranica*	IR-361-2a	NP	L	P	Type-1	C	BFWB	CA	EQ
Mangol Restaurant	*Permophricodothyris iranica*	IR-361-3	NP	F	P	Type-1	C	BFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera iranica*	IR-361-4	NP	L	NP	Type-2	C	BFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera iranica*	IR-362-1a	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Permophricodothyris iranica*	IR-364-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Mangol Restaurant	*Permophricodothyris iranica*	IR-365-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Mangol Restaurant	*Permophricodothyris iranica*	IR-367-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Mangol Restaurant	*Permophricodothyris iranica*	IR-367-2	NP	F	P	Type-1	C	AFWB	CA	EQ
Mangol Restaurant	*Permophricodothyris iranica*	IR-367-3	NP	F	P	Type-1	C	AFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera pygmaea*	IR-372-15	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera iranica*	IR-372-2	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera spinosocostata*	IR-372-9	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera spinosocostata*	IR-374-4	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera helica*	IR-374-6a	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera helica*	IR-374-6b	NP	L	NP	Type-2	C	AFWB	CA	EQ
Mangol Restaurant	*Spinomarginifera helica*	IR-337-7	NP	L	NP	Type-2	C	BFWB	CA	EQ

Mangol Restaurant	*Permophricodothyris iranica*	IR-360-1	NP	F	P	Type-1	C	AFWB	CA	EQ
Mobarakabad	*Spinomarginifera iranica*	IR-1126-8	NP	L	NP	Type-2	?W	BFWB	CA	EQ
Mobarakabad	*Spinomarginifera ciliata*	IR-1126-3	NP	L	NP	Type-2	?W	BFWB	CA	EQ
Selong Xishan	*Neospirifer sp.*	NL-1	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Bullarina sp.*	NL-10	NP	NP	NP	NA	NA	BFWB	MIX	MID
Selong Xishan	*Spiriferella sp.*	NL-11	PR	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Spiriferella sp.*	NL-12	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Neospirifer sp.*	NL-13	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Spiriferella sp.*	NL-14	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Spiriferella sp.*	NL-15	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Spiriferella sp.*	NL-16	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Spiriferella sp.*	NL-17	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Spiriferella sp.*	NL-18	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Spiriferella sp.*	NL-19	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Neospirifer sp.*	NL-20	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Spiriferella sp.*	NL-21	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Neospirifer sp.*	NL-22	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Spiriferella sp.*	NL-23	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Neospirifer sp.*	NL-24	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Spiriferella sp.*	NL-25	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Rhynchonella*	NL-26	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Spiriferella sp.*	NL-2a	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Neospirifer sp.*	NL-2b	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Neospirifer sp.*	NL-2c	NP	L	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Retimarginifera sp.*	NL-3	NP	L	NP	Type-2	NA	BFWB	MIX	MID
Selong Xishan	*Spiriferella sp.*	NL-4	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Retimarginifera sp.*	NL-5	NP	L	NP	Type-2	NA	BFWB	MIX	MID
Selong Xishan	*Neospirifer sp.*	NL-6	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Neospirifer sp.*	NL-7	NP	F	P	Type-1	NA	BFWB	MIX	MID
Selong Xishan	*Spiriferella sp.*	NL-8	NP	F	P	Type-1	NA	BFWB	CA	MID
Selong Xishan	*Neospirifer sp.*	NL-9	NP	F	P	Type-1	NA	BFWB	MIX	MID
Shangsi 1	*Paracrurithyris pygmaea*	CH85bis-10	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH85bis-11	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH85bis-20	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH85bis-4	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH86-1	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-20	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-25	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-27	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87-bis-28	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-3	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-30	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-33	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-38	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-39	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-4	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-40	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-7	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-8	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 1	*Paracrurithyris pygmaea*	CH87bis-9	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 2	*Paracrurithyris pygmaea*	CH128-11	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Shangsi 2	*Paracrurithyris pygmaea*	CH128-14	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Shangsi 2	*Paracrurithyris pygmaea*	CH128-3	NP	F	NP	Type-2	EI	BFWB	MIX	EQ

Shangsi 2	*Paracrurithyris pygmaea*	CH131-2	NP	F	NP	Type-2	C	BFWB	MIX	EQ
Shangsi 2	*Paracrurithyris pygmaea*	CH134-16	NP	F	NP	Type-2	C	BFWB	CA	EQ
Shangsi 2	*Paracrurithyris pygmaea*	CH134-9	NP	F	NP	Type-2	C	BFWB	CA	EQ
Shangsi 2	*Paryphella sp.*	CH136-2	NP	L	NP	Type-2	C	BFWB	CA	EQ
Shangsi 2	*Paracrurithyris pygmaea*	CH136-4	NP	F	NP	Type-2	C	BFWB	CA	EQ
Shangsi 2	*Paracrurithyris pygmaea*	CH136-5	NP	F	NP	Type-2	C	BFWB	CA	EQ
Shangsi 2	*Paracrurithyris pygmaea*	CH136-5	NP	F	NP	Type-2	C	BFWB	CA	EQ
Zal	*Transcaucasathyris sp.*	JU150-2	NP	F	P	Type-1	C	BFWB	CA	EQ
Zal	*Transcaucasathyris sp.*	JU150-8	NP	F	P	Type-1	C	BFWB	CA	EQ
Zal	*Transcaucasathyris sp.*	JU151-4	NP	F	P	Type-1	C	BFWB	CA	EQ
Zal	*Transcaucasathyris sp.*	JU151-5	NP	F	P	Type-1	C	BFWB	CA	EQ
Zal	*Transcaucasathyris sp.?*	JU152-1	NP	NP	P	Type-1	C	BFWB	CA	EQ
Zal	*Transcaucasathyris sp.*	JU152-2	NP	F	P	Type-1	C	BFWB	CA	EQ
Zal	*Transcaucasathyris sp.*	JU167-1	NP	F	P	Type-1	C	BFWB	CA	EQ
Zal	*Paracrurithyris sp.*	JU172-3	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Zal	*Paracrurithyris pygmaea*	JU172-4	NP	L	NP	Type-2	EI	BFWB	MIX	EQ
Zal	*Paracrurithyris pygmaea*	JU172-5	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Zal	*Paracrurithyris pygmaea*	JU172-6	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Zal	*Paracrurithyris pygmaea*	JU172-7	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Zal	*Paracrurithyris pygmaea*	JU172-8	NP	F	NP	Type-2	EI	BFWB	MIX	EQ
Zhongliang hill	*Paraspiriferina alpha*	CH12-3	R	F	NP	Type-2	C	AFWB	CA	EQ
Zhongliang hill	*Paryphella sulcatifera*	CH4-3	NP	L	NP	Type-2	EI	AFWB	CA	EQ
Zhongliang hill	*Haydenella sp.*	CH4-5	NP	L	NP	Type-2	EI	AFWB	CA	EQ
Zhongliang hill	*Paryphella sulcatifera*	CH4-6	NP	L	NP	Type-2	EI	AFWB	CA	EQ
Zhongliang hill	*Paryphella sulcatifera*	CH4-7	NP	F	NP	Type-2	EI	AFWB	CA	EQ
Zhongliang hill	*Cathaysia sp.*	CH4-8	NP	L	NP	Type-2	EI	AFWB	CA	EQ
Zhongliang hill	*Acosarina sp.*	CH4bis-1	R	F	NP	Type-2	C	AFWB	CA	EQ
Zhongliang hill	*Acosarina sp.*	CH4bis-3	R	F	NP	Type-2	C	AFWB	CA	EQ
Zhongliang hill	*Acosarina minuta*	CH5-7	R	F	NP	Type-2	C	AFWB	CA	EQ
Zhongliang hill	*Paryphella sulcatifera*	CH5-9	NP	L	NP	Type-2	C	AFWB	CA	EQ
Zhongliang hill	*Prelissorhynchia pseudoutah*	CH6-12	NP	F	NP	Type-2	C	AFWB	CA	EQ
Zhongliang hill	*Paryphella sp.*	CH6-5	NP	L	NP	Type-2	C	AFWB	CA	EQ
Zhongliang hill	*Acosarina minuta*	CH6-6	NP	F	NP	Type-2	C	AFWB	CA	EQ
Zhongliang hill	*Spinomarginifera sp.?*	CH6-9	NP	L	NP	Type-2	C	AFWB	CA	EQ

Methods of qualitative and quantitative analysis of the shell fabric using the Scanning Electron Microscopy.

For the microstructural investigations by scanning electron microscopy (SEM), the specimens were cut along their longitudinal and transverse axes, embedded in resin, polished and then etched with 5% HCl for 10 s. The plane of the section was set perpendicular to the local tangent plane to the shell surface to cut. The exposed surfaces were metal coated with Au by the sputtering process and then inspected with the scanning electron microscopy (SEM) Cambridge S-360 featuring a LaB6 source and an acceleration voltage of 20kV.

Type of fabric, structural units investigated and meaning for the shell organic/inorganic content of fossils brachiopods

The two classes belonging to the Rhynchonelliformea, the extinct Strophomenata and the extant Rhynchonellata, differ in the secretory mechanism of their shell (Williams 1997, Williams and Cusack, 2007, Garbelli et al. 2014). Strophomenata brachiopods produced two or three layered shells, with a primary layer of randomized granular calcite, a secondary layer of cross-bladed laminar calcite – in case accessorized with pseudopunctae - and, at times, a tertiary layer of large columnar calcite. In almost all Strophomenata the secondary layer is secreted as a layer of calcite which is segregated into aligned calcitic structural units (the blades, see fig DR2-C) by impersistent protein strands exuded by the cell surfaces; in longitudinal section this results in a succession of laminae (Fig DR2-D).

Contemporaneous, but still extant, Rhynchonellata have shells with two or three layers, but their secondary layer consists of calcite structural units called fibers (fig DR2-A) – in case accessorized with punctae - that are larger and have a characteristic cross section (fig DR2-B). These discrete fibers are each ensheathed by a glyco-proteinaceous membrane. Furthermore, there is less inter- crystalline space in the secondary fibrous layer of the Rhynchonellata than in the laminar one of the Strophomenata, indicating that the latter were more rich in organic substrates when alive (Garbelli et al. 2014a and references therein).

Despite these differences, a common feature is present in the two classes: both groups could, in several species, develop a columnar layer (fig. DR2-E). This layer is produced under a special secretory regime, in which the cells of the mantle cease to migrate and stop to produce the organic matrix that control and frame the secondary layer; it is considered a less organic-rich fabric than the fibrous one (Goetze et al., 2009)

Image analysis

SEM microphotographs were analyzed using ImageJ, a public domain Java image processing program. For further details on the software see http://imagej.nih.gov/ij/. Several measures of the structural units of the brachiopods shell fabric can be acquired using this software. In particular, two types of measurements were taken:

- the thickness of the laminae in the taxa of the Strophomenata
- the width, in cross section, of the taxa of the Rhynchonellata.

To reduce measurement errors, the thickness of packed laminae was measured and divided by the counted number of laminae. For the fibrous fabric it was possible to take measurements of width directly on the transverse section of each single fiber. The measures were acquired in analogous position of the shells (see the example in figure DR 4-B), to avoid to compare ontogenetically different parts of the shell. The procedures used to acquire these measurements is summarized in figure DR3.

Screening test to asses the pristinity of the shells.

Brachiopods were screened for preservation using both SEM and CL because diagenetic alteration could affect fabric and modify the shape and size of the structural units. SEM morphological preservation was evaluated following Samtleben et al. (2001) and Garbelli et al., (2012). To check the degree of preservation vs. alteration of the different morphological types, cathodoluminescence and trace element analyses were performed. Thin sections of selected specimens were analyzed by cathodoluminescence with a cold cathode luminoscope (Nuclide ELM2) operating at 10 kV with a beam current of 5–7 mA. Exposure to the electronic beam (before taking the photo) was on the order of 15–30 s, not to force shell material to luminesce, and it was consistent for all specimens. Photographic exposure time was uniform and set to seconds for consistency with a Nikon Coolpix 4500 operating at 400 ISO. Calcite luminescence is controlled by the molar ratio of Fe/Mn. High Mn content in the calcite lattice is an activator of luminescence, whereas Fe is a quencher of luminescence rather than a source in calcite (Machel et al., 1991; Machel, 2000). Mn is generally low (<200 ppm) in unaltered recent and fossil brachiopod shells (e.g., Brand et al., 2003), where it may be preferentially incorporated during diagenesis (Brand and Veizer, 1980). Fe contents are generally lower than 140 ppm (µm/g) in recent brachiopod shells, although much higher values have also been reported (Brand et al., 2003). Preservation data from most of the analyzed shells have been published in previous papers (Garbelli et al. 2012, 2014, 2016).

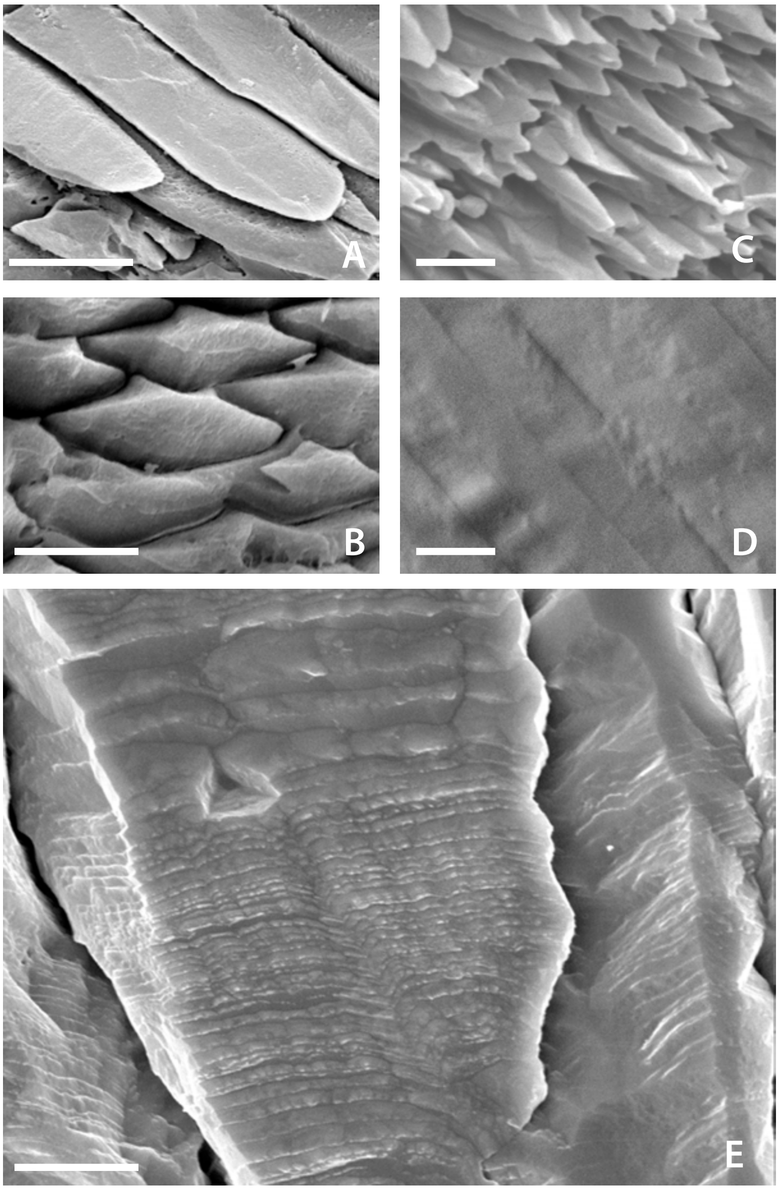

Figure DR2. A-B, details of fibers, whcih are the structural unists in secondary layer of Rhynchonellata, scale bars 10 and 5 µm respectively, transversal and cross section respectively: C-D details of the laminae composed of blades/laths, whcih are the structural units of Strophomenata, scale bars 2 and 0.5 µm respectively, transversal and cross section respectively: strcural units of the columnar/prisamtic tetary layer, whicih is morphologically homologou in the two classe of Rhynchonelliformea, scale bars 10 µm

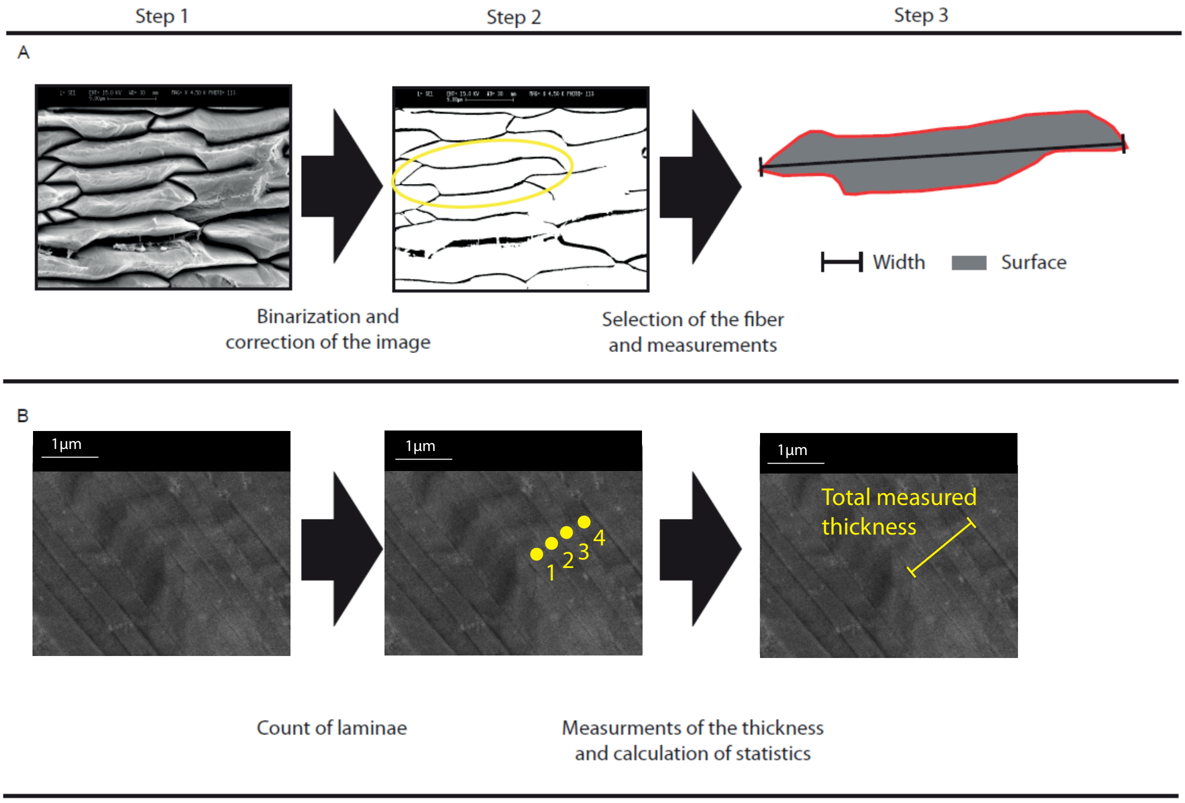

Figure DR3. A). Images showing trasverse sections of the fibers were first selected (step 1) and subsequent-ely binarized or corrected to define manually the outline when the image contrast was not sufficient (step 2). The fiber to be measured was then selected with the ImageJ selection tool and a number of measurements and morphological descriptors were acquired by the software (step 3). B) Images showing the sections of the selected laminae (step 1); the number of laminae were counted (step 2) and subsequently the thickness of the packed laminae was measured to calculate the related statistics (step 3).

Table DR2. Mean, standard deviation (SD) and number of measures (N) for the thickness of laminae of some of the specimens under investigation with SEM. In the "P (m)" column are reported the stratigraphic position in meters for specimens plotted in Figure 3 of the main text

		Thickness of laminae (μm)			
Species	Specimen	Mean	SD	N	P(m)
Spinomarginifera sp.	JU106-1	0.23	0.03	51	50.9
Spinomarginifera sp.	JU106-2	0.22	0.04	23	50.9
Spinomarginifera sp.	JU107-1	0.22	0.03	53	50.7
Spinomarginifera sp.	JU112-1	0.22	0.02	41	49.1
Spinomarginifera sp.	JU114-1	0.22	0.03	14	46.2
Spinomarginifera sp.	JU115-1	0.25	0.04	27	45.7
Spinomarginifera sp.	JU117-1	0.23	0.05	30	44.4
Spinomarginifera spinosocostata	JU121-1	0.25	0.05	13	43.2
Spinomarginifera spinosocostata	JU121-2	0.24	0.04	19	43.2
Spinomarginifera iranica	IR361-4	0.28	0.02	6	30.5
Spinomarginifera ciliata	IR358-10	0.28	0.01	6	
Spinomarginifera iranica	IR357-2	0.24	0.04	11	
Spinomarginifera pygmaea	IR357-3	0.33	0.04	14	
Spinomarginifera helica	IR357-1	0.48	0.04	8	
Spinomarginifera ciliata	IR356-1	0.31	0.06	10	28.5
Spinomarginifera ciliata	IR354-7	0.32	0.03	10	29.9
Spinomarginifera helica	IR353-5	0.35	0.09	7	30.3
Spinomarginifera spinosocostata	IR347-1	0.28	0.04	7	36.2
Spinomarginifera iranica	IR343-1	0.27	0.04	6	39.3
Spinomarginifera iranica	IR875-10	0.34	0.09	13	
Spinomarginifera iranica	IR339-8	0.28	0.07	8	22.8
Spinomarginifera spinosocostata	IR887-2	0.28	0.06	11	
Spinomarginifera iranica	IR885-2	0.33	0.03	5	
Spinomarginifera helica	IR875-12	0.31	0.06	9	
Spinomarginifera sp.	IR862-11	0.28	0.03	10	
Spinomarginifera helica	IR374-6a	0.33	0.02	10	20.2
Spinomarginifera iranica	IR372-2	0.30	0.02	12	22
Spinomarginifera pygmaea	IR372-15	0.39	0.02	10	22
Spinomarginifera pygmaea	IR339-23	0.30	0.04	12	22.8
Spinomarginifera sulcata	EBHZ65-27	0.28	0.04	18	
Spinomarginifera helica	EBHZ65-31	0.26	0.03	4	
Spinomarginifera spinosocostata	EBHZ65-33	0.28	0.07	17	
Spinomarginifera helica	EBHZ68-2	0.33	0.14	10	
Spinomarginifera spinosocostata	EBHZ69-1	0.27	0.04	15	
Spinomarginifera helica	EBHZ69-2	0.31	0.04	7	
Spinomarginifera helica	EBHZ69-4	0.27	0.03	12	
Spinomarginifera helica	EBHZ71-10	0.24	0.05	19	
Spinomarginifera helica	EBHZ90-3	0.24	0.04	14	

Costiferina subcostatus	GY62 (6-12)	0.49	0.10	13	128
Costiferina indica	GY79 (8-14)	0.49	0.07	17	37
Costiferina subcostatus	GY86 (9-27)	0.68	0.12	13	11
Costiferina indica	GY85 (9-24)	0.75	0.13	15	13
Costiferina indica	GY77 (8-13)	0.68	0.09	9	39
Costiferina indica	GY74 (7-16)	0.60	0.11	16	51
Costiferina indica	GY76 (8-2)	0.49	0.09	10	43
Alatorthotetina sp.	EBHZ65-12	0.40	0.13	40	
Alatorthotetina sp.	EBHZ65-9	0.45	0.06	17	
Alatorthotetina sp.	EBHZ69-6	0.41	0.05	31	
Alatorthotetina sp.	EBHZ70-8	0.47	0.09	45	
Alatorthotetina sp.	EBHZ70-6	0.47	0.12	25	
Alatorthotetina sp.	EBHZ71-2	0.53	0.15	68	
Alatorthotetina sp.	EBHZ71-6	0.41	0.07	16	
Alatorthotetina sp.	EBHZ80-16	0.45	0.09	8	
Alatorthotetina sp.	EBHZ80-5	0.42	0.09	23	
T. persica	IR314-11	0.41	0.08	25	
T. yangtzeensis	IR314-16	0.30	0.05	20	
T. persica	IR314-bis5	0.25	0.04	11	
T. persica	IR329-5	0.33	0.05	15	
T. yangtzeensis	IR867-4	0.38	0.08	14	
T. yangtzeensis	IR871-7	0.39	0.10	23	
Paryphella	CH136-2	0.36	0.04	29	
Paryphella	CH4-3	0.37	0.04	36	
Paryphella	CH5-9	0.36	0.04	15	
Spinomariginifera	CH71-17	0.31	0.04	32	
Spinomarginifera	CH71-3	0.31	0.04	34	
Cathaysia	CH71-8	0.24	0.03	15	
Cathaysia	CH72-13	0.31	0.03	16	

Table DR3. Mean, standard deviation (SD) and number of measures (N) for the width of fibers in some of the specimens under investigation with SEM. In the “P (m)” column are reported the stratigraphic position in meters for specimens plotted in Figure 3 of the main text.

		Width of fibers (μm)			
Taxon	Specimen	Mean	SD	N	P(m)
Paracrurithyris pygmaea	CH128-11	12.22	0.37	115	0.05
Paracrurithyris pygmaea	CH128-3	14.09	0.92	6	0.05
Paracrurithyris pygmaea	CH131-2	16.81	0.51	12	0.5
Paracrurithyris pygmaea	CH134-16	17.34	1.46	21	1.48
Paracrurithyris pygmaea	CH136-5	17.67	0.56	14	2.6
Paracrurithyris pygmaea	CH85bis-10	11.04	0.27	12	0

Paracrurithyris pygmaea	CH85bis-20	12.61	0.50	10	0
Paracrurithyris pygmaea	CH85bis-4	10.054	0.26	14	0
Paracrurithyris pygmaea	CH86-1	10.27	0.38	8	1
Paracrurithyris pygmaea	CH87bis-20	11.69	0.42	10	0.28
Paracrurithyris pygmaea	CH87bis-25	9.74	0.22	15	0.28
Paracrurithyris pygmaea	CH87bis-27	11.33	0.58	8	0.28
Paracrurithyris pygmaea	CH87bis-28	12.34	0.79	15	0.28
Paracrurithyris pygmaea	CH87bis-3	12.85	0.31	16	0.28
Paracrurithyris pygmaea	CH87bis-33	14.89	0.56	8	0.28
Paracrurithyris pygmaea	CH87bis-38	14.12	0.50	33	0.28
Paracrurithyris pygmaea	CH87bis-39	9.55	0.25	24	0.28
Paracrurithyris pygmaea	CH87bis-4	8.85	0.25	18	0.28
Paracrurithyris pygmaea	CH87bis-40	12.79	0.59	8	0.28
Paracrurithyris pygmaea	CH87bis-7	8.87	0.20	14	0.28
Paracrurithyris pygmaea	CH87bis-8	14.02	0.21	143	0.28
Paracrurithyris pygmaea	CH87bis-9	13.19	0.87	123	0.28
Permopricodothyris sp.	GY10 (6-15)	10,88	1,30	6	126
Permopricodothyris sp.	GY19 (9-23)	5,95	0,59	10	13
Permopricodothyris sp.	GY44 (7-4)	7,77	0,54	6	98
Permopricodothyris sp.	GY46 (7-2)	10,15	1,62	5	117
Permopricodothyris sp.	GY5 (6-12)	9,34	0,83	6	128
Permopricodothyris sp.	GY57 (7-3)	7,40	1,65	13	110
Permopricodothyris sp.	GY83 (9-23)	6,09	0,82	10	13
Permopricodothyris sp.	GY9 (6-15)	8,0	1,6	26	125
Permopricodothyris iranica	IR164-3	16,1	1,7	5	
Permopricodothyris iranica	IR367-2	10,3	1,4	11	

Statistical Analysis of the fabric types occurrences.

To establish the association between factors (stratigraphic position, sedimentation, paleolatitude and Depth/hydrodynamic energy) and the outcome variable (probability of occurrence of Type 1/ Type 2 fabrics), we built a Multiple Logistic Regression Model following the method suggested by Hosmer et al., (2013). First we evaluated the level of association between each factor and the outcome via standard contingency table analysis. We applied a Pearson chi-square test to assess the significance of each factor (table DR4) and we estimated the logodds and its 95% confidence interval for each factor to visualize the amount of association between factors and outcome variable (Fig. DR4). Factors that have a p –value less than 0.25 were included in the multivariate model.

Subsequently, to compare the impact of factors on the outcome variable, we ran a regression logistic model considering the additive effects of all the factors. After fitting the model, we tested the overall effect of each level of the factors applying a Wald test: the p-value was used to estimate the importance of the factors considered. Factors which did not contribute to the statistical significance (p-value > 0.01), were eliminated and a new model was fitted (Table DR5). The new and smaller model was then compared to the previous one using the partial likelihood ratio test to assess if the fit increased significantly (Table DR6). In total, four model have been performed. We also calculated the Δ β (Hosmer et al, 2013), to see how much the excluded factor impact on the adjustment of the effect of the factors that remained in the model. If the Δ β>20%, the excluded factor was considered significant for the impact on the adjustment, and the factor was added back into the model, including interaction in the model. The results of Δ β are summarized in table DR7. For each model, Hosmer-Lemeshow Tests have been apply to assess the absolute Goodness of the Fit (Table DR8).

Note: Siliciiclalstic sedimentation has three samples, characterized by taxa with type-2 fabric only and in the contingency table returns as a zero (frequency) cell. Since the logistic regression could fail to converge and produce a point estimate for the odds ratios of either zero or infinity, and since the number of observations is small, we included these three data in the category of carbonate – siliciclastic sedimentation.

Table DR4. Results of Pearson chi-square test to assess the significance of each factor using contingency tables.

Factors	Chi-squared	df	p-value
paleolatitude	9.9859	1	0.001577
stratigraphic position	84.809	2	< 2.20e-16
sedimentation	5.2672	1	0.02173
hydrodynamic energy	4.7083	1	0.03002

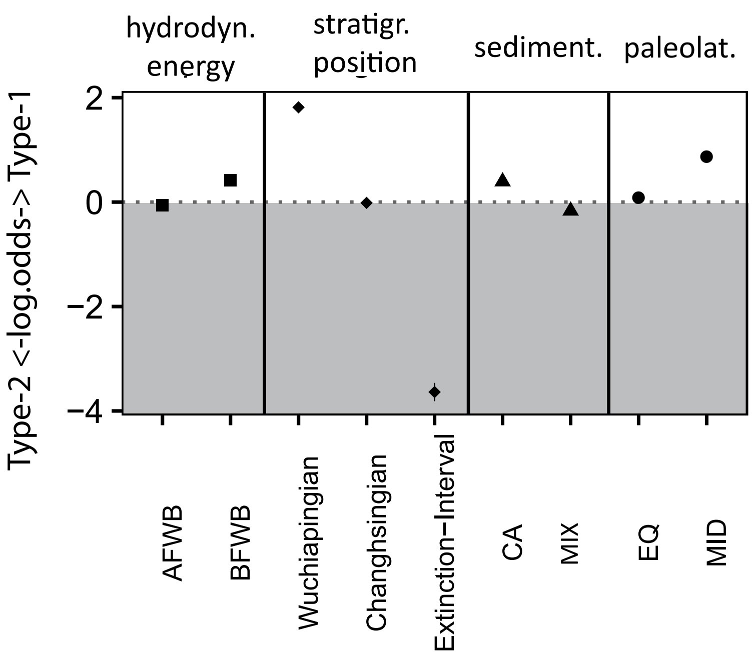

Fig. DR4. Estimated logodds for each factor.

Table DR5. Estimated Logistic Regression Coefficients, Standard Errors, Wald Statistics, p-Values and 95% CIs from four models in which variables were removed on the basis of their statistical significance. Intercept contains stratigraphic position (C), paleolatitude (EQ), sedimentation (CA-SI) and hydrodynamic energy (AFWB), which are the levels including most of the data for their respective factors. In bold p-values close to the statistical significance, in bold red those with highly statistical significance

Model	Factor (level)	Coeff.	Std.Error	z	p-Values	95% CI	
1	Intercept	-0.168	0.201	-0.832	0.4052	-0.565	0.226
	Stratigraphic position (W)	2.268	0.359	6.313	**<<0.001**	1.595	3.012
	Stratigraphic position (EI)	-3.372	1.032	-3.266	**0.0011**	-6.267	-1.783
	Paleolatitude (MID)	0.574	0.291	1.974	**0.0483**	0.009	1.151
	Sedimentation (CA-SI)	-0.550	0.335	-1.642	0.1005	-1.215	0.103
	hydrodynamic energy (AFWB)	0.277	0.256	1.082	0.2794	-0.223	0.782
2	Intercept	-0.041	0.164	-0.252	0.8012	-0.363	0.280
	Stratigraphic position (W)	2.168	0.347	6.253	**<<0.001**	1.522	2.891
	Stratigraphic position (EI)	-3.287	1.029	-3.194	**0.0014**	-6.179	-1.708
	Paleolatitude (MID)	0.559	0.289	1.932	**0.0533**	-0.003	1.134
	Sedimentation (CA-SI)	-0.595	0.332	-1.793	0.0729	-1.254	0.051
3	Intercept	-0.158	0.150	-1.048	0.2945	-0.454	0.136
	Stratigraphic position (W)	2.127	0.343	6.203	**<<0.001**	1.488	2.842
	Stratigraphic position (EI)	-3.480	1.024	-3.398	**<0.001**	-6.367	-1.917
	Paleolatitude (MID)	0.676	0.282	2.394	**0.0170**	0.128	1.237
4	Intercept	0.040	0.126	0.314	0.7533	-0.207	0.287
	Stage (W)	1.930	0.333	5.798	**<<0.001**	1.312	2.627
	Stage (EI)	-3.677	1.021	-3.602	**<0.001**	-6.561	-2.125

Table DR6. Comparison of different models by partial likelihood ratio test.

Contrast	Resid. Df	Res. Dev.	Dev	p-values
Model 1 vs Model 2	6	17.886		
	7	19.061	-1.1755	0.2783
Model 2 vs Model 3	7	19.061		
	8	22.314	-3.2529	0.0713
Model 3 vs Model 4	8	22.314		
	9	28.183	-5.8696	**0.0154**

Table DR7. Values of Δ β%. Note that removing paleolatitude has the same impact on all levels of stratigraphci position. Intercept contains the factor (levels) which are selected as references.

Variables removed from the model	Variable remaining in the model				
	stratigraphic position			Paleolatitude	Sedimentation
	Intercept	W	EI	MID	CA-SI
hydrodynamic energy	12.6	9.9	8.5	1.4	4.5
sedimentation	11.6	4.1	19.3	11.6	--
paleolatitude	19.7	19.7	19.7	--	--

Tabl DR8. Results of Hosmer-Lemeshow Tests

Model	Chi-squared	df	p-values
1	0.563	10	1
2	0.348	9	1
3	0.075	4	0.999
4	0.030	1	0.863

Interpretation. Our analysis suggests that the distribution of type of fabrics in our database is poorly correlated with the environmental variables considered; instead, the probability to find one of the two types in different stratigraphic positions (stages) is dramatically different. This does not necessarily mean that others factors do not have effect at all, but simply that the probability to find one of the two types is more depending on the stratigraphic position than on the environmental variables here considered. In particular, through the Late Permian, the probability to find shells with type-2 fabric increases up to the extinction Interval.
The absolute Goodness of the Fit indicated that all four models are suitable to generate the data we observed (Table DR8), however the partial likelihood ratio test show that the fit is increased significantly only for the Model 4 (Table DR6), which includes only stratigraphic positions. This discrepancy could be reconciled by the fact that the numbers of bins, used to calculate quantiles in the Hosmer-Lemeshow Tests, are higher in the complex models (i.e. those including more factors), giving the impression that models 1, 2 and 3 are slightly better than the simplest one (model 4). Instead the values of Δ β% highlights that the removal of less significant factors does not strongly affect (<20%) the estimated regression coefficients in simpler models.

Statistical analysis of measures of structural units.

Table DR9. A Welch t-test with non-pooled standard deviation has been applied in order to compare the mean of the measures of the structural units between different stratigraphic horizons. A p-values correction has been applied, using the method of Hommel (1988). The comparison is performed only between beds belonging to the same stratigraphic section. This statistical method protects the significance from error of type I level and it is more efficient when sample sizes are unequal because it protects against possible heterogeneity of variance, simply performing a separate-variances test unconditionally (Zimmerman 2004, Zimmerman and Zumbo, 2009). In the following tables the p-values are reported; the significant values of contiguous startigraphic horizon are in red.

Table DR9

Julfa Formation, Main Valley section - *Spinomarginifera*						
	JU106	JU107	JU112	JU114	JU115	JU117
JU107	1.000	-	-	-	-	-
JU112	0.487	1.000	-	-	-	-
JU114	1.000	1.000	1.000	-	-	-
JU115	0.656	0.039	0.016	0.738	-	-
JU117	1.000	1.000	1.000	1.000	1.000	-
JU121	1.000	0.116	0.057	1.000	1.000	1.000

Nesen Formation, Mangol section -*Spinomarginifera*								
	IR339	IR343	IR347	IR353	IR354	IR356	IR361	IR372
IR343	1.000	-	-	-	-	-	-	-
IR347	1.000	1.000	-	-	-	-	-	-
IR353	1.000	1.000	1.000	-	-	-	-	-
IR354	1.000	0.710	0.750	1.000	-	-	-	-
IR356	1.000	1.000	1.000	1.000	1.000	-	-	-
IR361	1.000	1.000	1.000	1.000	1.000	1.000	-	-
IR372	0.850	0.260	0.320	1.000	1.000	1.000	1.000	-
IR374	1.000	0.750	1.000	1.000	1.000	1.000	1.000	1.000

Gyanyima section- *Costiferna*						
	GY6-12	GY7-16	GY8-13	GY8-14	GY8-2	GY9-23/24
GY7-16	0.0763	-	-	-	-	-
GY8-13	0.0026	0.5275	-	-	-	-
GY8-14	1.0000	0.0222	0.0014	-	-	-
GY8-2	1.0000	0.0763	0.0029	1.0000	-	-
GY9-23/24	3.7e-05	0.0186	0.7002	1.0e-05	5.7e-05	-
GY9-27	0.0034	0.7002	1.0000	0.0014	0.0036	0.7002

Gyanyima section - *Permophricodothyris*					
	GY6-12	GY6-15	GY7-2	GY7-3	GY7-4
GY6-15	0.36761	-	-	-	-
GY7-2	0.70841	0.36761	-	-	-
GY7-3	0.04097	0.33366	0.11471	-	-
GY7-4	0.04324	0.33366	0.19480	0.70841	-
GY9-23/24	0.00052	4.5e-07	0.04324	0.11471	0.00069

Dalong Formation, Shangsi section - *Paracrurithyris*						
	CH128	CH131	CH134	CH136	CH85bis	CH86
CH131	0.00018	-	-	-	-	-
CH134	0.04660	1.00000	-	-	-	-
CH136	0.00099	1.00000	1.00000	-	-	-
CH85bis	0.02113	7.8e-06	0.00734	0.00043	-	-
CH86	0.00526	3.0e-06	0.00340	0.00011	0.81856	-
CH87bis	0.04114	5.1e-05	0.00949	0.00159	1.00000	0.27591

Gomaniibrik Formation - *Spinomarginifera*				
	EBHZ65	EBHZ68	EBHZ69	EBHZ71
EBHZ68	1.0000	-	-	-
EBHZ69	1.0000	1.0000	-	-
EBHZ71	0.0610	0.4260	0.0900	-
EBHZ90	0.1000	0.4260	0.1460	1.0000

Gomaniibrik Formation - *Alatorthotetina*				
	EBHZ65	EBHZ69	EBHZ70	EBHZ71
EBHZ69	1.00000	-	-	-
EBHZ70	0.03062	0.00167	-	-
EBHZ71	0.00063	1.6e-05	0.32791	-
EBHZ80	1.00000	1.00000	0.17440	0.00556

Nesen Formation, Bear Gully section - *Spinomarginifera*			
	IR862	IR875	IR885
IR875	0.0560	-	-
IR885	0.0840	1.0000	-
IR887	1.0000	0.2300	0.2300

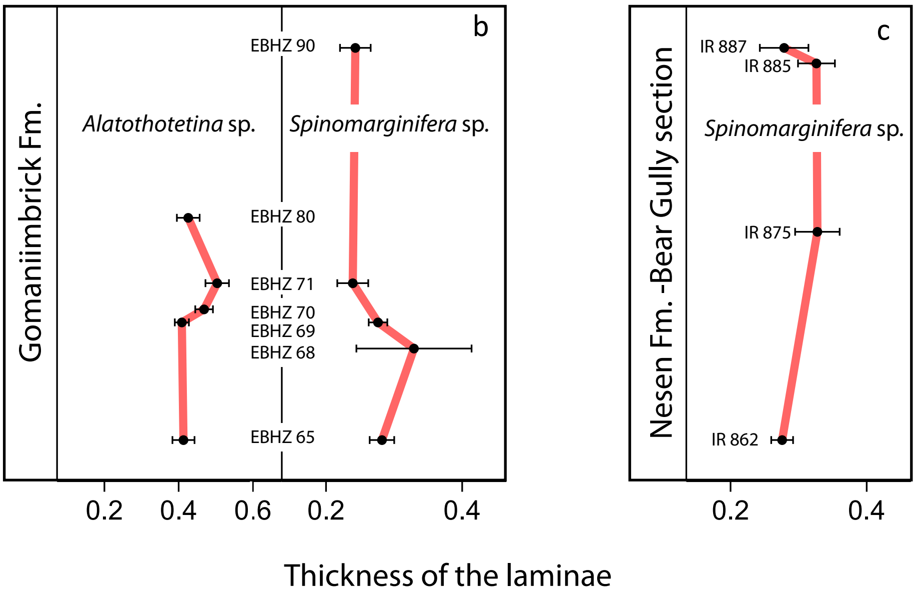

Figure DR5. Plots of mean and 95% confidence interval of the thickness of the laminae in species of *Alatorthotetina* (a) and *Spinomarginifera* (b) from the Lopingian Gomaniibrik Formation, Turkey, and in *Spinomarginifera* (c) species from the Lopingian Nesen Fomation, northern Iran, in the Bear Gully section; see Angiolini and Carabelli (2010), fig.4.

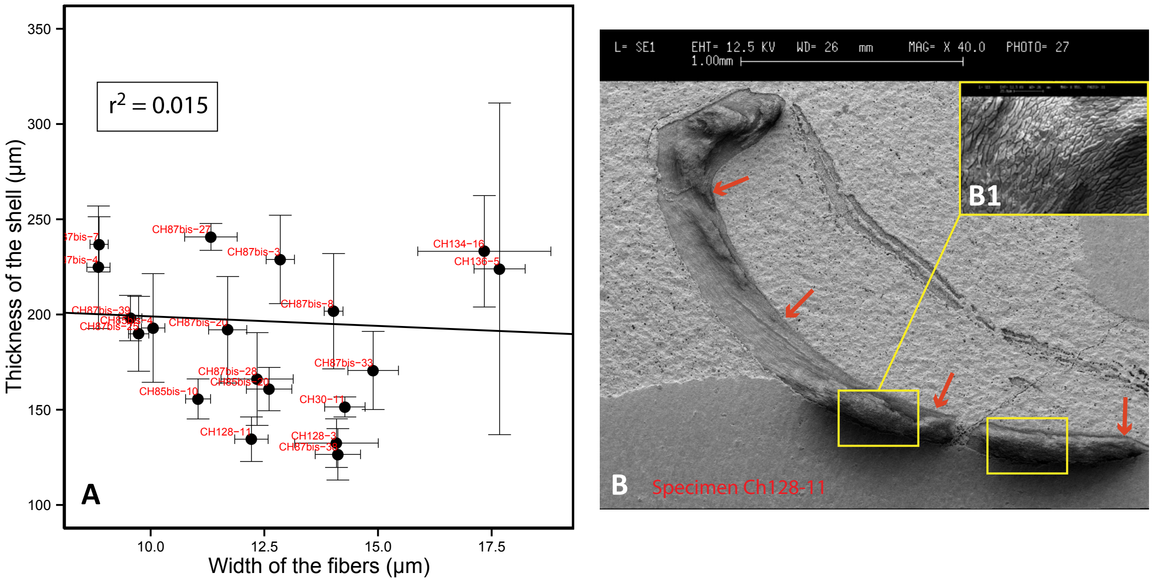

Figure DR6. A- Cross plot of width of the fibers vs thickness of the shell in Paracrurithyris sp. at Shangsi; for the thickness, the vertical bars represent the standard error of four measures taken along the transversal section of the shell; for the width of the fibers, the horizontal bars represent the standard error of measures taken in the selected analogous position of the shell, as summarized in table DR3; the regression is computed using ordinary least square regression since the two variables are random and the error on y (shell thickness) is one to two order of magnitude larger than x (fibers width). Excluding the two apparent outliers (CH134-16 and CH136-5), the R2 results higher (0.33). This opens interesting possibilities of trade offs between thickness of shell and fibers size. Since it is a negative correlation (the thicker is the shell, the smaller are the fibers), it is in favour of our hypothesis that there is a general tendency to increase the organic content of the shell: when the organism made a larger shell (thicker), it did so by adding proportionally more organic membranes than inorganic calcite. This observation may give more support to our hypothesis, but it requires further investigation in the next future. B - Longitudinal section of the ventral valve in Paracrurithyris sp. which shows where the measures of shell thickness and fibers width were acquired; the red arrow indicates the positions where the shell thickness has been measured; the fields outlined in yellow indicate the analogous regions where the width of the cross section of the fibers was measured; B1 is an enlargement.

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