Introduction

*Elpidia* Théel, 1876 is the type genus of the family Elpidiidae of the order Echinoidea. This genus was distinguished for the other Elpidiidae genera in having four (rarely five) paired tube feet, having papillae present along the entire dorsal radii, having *Elpidia*-type ossicles, and lacking C-shaped ossicles (Hansen 1975; Gebruk 1990; Rogacheva 2007). Twenty-four nominal species and subspecies have been described in this genus (e.g., Belyaev 1971, 1975; Hansen 1975; Rogacheva 2007). *Elpidia* has an essentially cosmopolitan distribution (e.g., Belyaev 1971, 1975; Hansen 1975; Rogacheva 2007), and a wide bathymetrical range, from 70 to 9735 m (Théel 1877; Belyaev 1971).

In the genus *Elpidia*, two morphologically distinct species groups, based upon axis diameter of dorsal *Elpidia*-type ossicles, have been recognized (Belyaev 1971; Hansen 1975). The axis diameter is less than 40 µm in the so-called slender axis group and more than 40 µm in the robust axis group. The slender axis group includes six nominal species: *E. adenensis* Belyaev, 1971, *E. antarctica* Belyaev, 1971, *E. chilensis* Belyaev, 1971, *E. gracilis* Belyaev, 1975, *E. minutissima* Belyaev, 1971, and *E. theeli* Hansen, 1956 (Belyaev 1971, 1975; Hansen 1975). Although Hansen (1975) had synonymized *E. antarctica* into *E. theeli*, and *E. antarctica* is treated as a valid species in this study because it is distinguishable from *E. theeli* in having cross ossicles in its both dorsal and ventral body wall (Belyaev 1971). In the robust axis group, 17 nominal species and subspecies has been reported: *E. belyaevi* Rogacheva, 2007, *E. kermadecensis* Hansen, 1956, *E. ataka-ma* Belyaev, 1971, *E. birsteini* Belyaev, 1971, *E. decapoda* Belyaev, 1975, *E. glacialis* Théel, 1876, *E. hansenii hansenii* Belyaev, 1971, *E. hansenii idzubonensis* Belyaev, 1971, *E. heckeri* Baranova, 1989, *E. javanica* Belyaev, 1971, *E. kurilensis* Baranova and Belyaev in Belyaev, 1971, *E. lata* Belyaev, 1975, *E. longicirrata* Belyaev, 1971, *E. ninae* Belyaev, 1975, *E. solomonensis* Belyaev, 1971, *E. sundensis* Hansen, 1956, and *E. uschakovi* Belyaev, 1971 (Théel 1877; Belyaev 1971, 1975; Hansen 1976; Rogacheva 2007). *Elpidia echinata* (Perrier, 1896) has not been allocated to either group because Perrier (1896) did not describe its external or ossicle morphology in details. These two groups have different bathymetrical distributions with the exception of the Arctic and Antarctic species: the slender axis group occurs in abyssal depths, 2710–5740 m, and the robust axis group is found in hadal depths of 6156–9735 m (Hansen 1956; Belyaev 1971, 1975).

From Japanese waters, six species and subspecies of *Elpidia* have been reported from the Izu-Ogasawara, Japan, and Kurile-Kamchatka Trenches: *E. birsteini*, *E. hansenii hansenii*, *E. hansenii idzubonensis*, *E. kurilensis*, *E. longicirrata*, and *E. minutissima* (Belyaev 1971, 1975; Mironov et al. 2019). The former five species and subspecies belong to the robust axis group, and only *E. minutissima* belongs to the slender axis group.

In this study, we describe one undescribed *Elpidia* spe-
cies based on specimens collected from the Japan Trench area and determine its partial mitochondrial cytochrome c oxidase subunit I (COI) gene sequences for future DNA barcoding and phylogenetic studies.

**Materials and Methods**

Five individuals were collected from the Japan Trench area, east of Iwate Prefecture, northern Japan (39°4.914’N to 39°10.312’N, 143°39.570’E to 143°42.027’E; St. Iwate 4200 Kago) from 3570–4145 m, on 10–11 July, 2018 using a baited trap during the third cruise in 2018 of the R/V Soyo-maru (Japan Fisheries Research and Education Agency: FRA). Specimens were photographed onboard with a digital camera (Nikon D5300); tentacles were subsampled from live animals on board, placed in 95% ethanol, and stored at −20°C; the remaining bodies were fixed and preserved in 99% ethanol. These specimens were deposited in the National Museum of Nature and Science (NSMT), Tsukuba, Japan.

Fig. 1. Fresh specimen of *Elpidia soyoae* sp. nov. (NSMT E-12635: paratype). A, dorsal view; B, ventral view.
Specimens were observed and dissected under a microscope (Leica MZ 8). Body length (BL), body width (BW) and papillae length were measured under the microscope. For SEM study, calcareous ring and ossicles from the dorsal and ventral body walls and the tentacles were extracted. They were coated with gold-palladium alloy and observed under a SEM (JEOL JSM-6380LV) in the NSMT with the acceleration voltage of 10 or 15 kV. The arm length of pieces from the calcareous ring was measured from SEM images. Likewise, we measured the ossicle axis length (DOL), the axis diameter and the height of apophyses (DAH) of Elpidia-type ossicles from dorsal body wall, the ossicle di-

Fig. 2. Papillae arrangements of Elpidia soyoae sp. nov. A, left side view; B, right side view; C–F, dorsal side. A–B, holotype; C, NSMT E-12635: paratype; D, NSMT E-12636: paratype; E, NSMT E-12637: paratype; F, NSMT E-12639: paratype. Abbreviations: lp, paired papillae on dorsal left radius; lu, unpaired papillae on dorsal left radius; rp, paired papillae on dorsal right radius; ru, unpaired papillae on dorsal right radius.
ameter, and the diameter of central connecting portion of wheel ossicles from dorsal body wall, the ossicle axis length (VOL), the axis diameter, and the height of apophyses (VAH) of Elpidia-type ossicles from ventral body wall, and the ossicle length (TOL), the axis diameter, and the height of apophyses (TAH) of Elpidia-type ossicles from the tentacles.

Total genomic DNA was extracted from the subsampled tentacles using the DNeasy Blood and Tissue Kit (Qiagen). Gene fragments of the partial region of mitochondrial COI gene were sequenced by using primers, COIceF and COIceR (Hoareau and Boissin 2010). PCR reactions were performed using the reagent mix: 0.2 µl Tks Gflex DNA polymerase, 5 µl Gflex PCR Buffer (Takara Bio, Inc.), 0.2 µl of each primer, 1.0 µl template DNA, and 3.4 µl H2O and following the profile: preheating at 94°C for 1 min and 30 cycles of denaturation at 98°C for 10 s, annealing at 55°C for 10 s, and extension at 68°C for 30 s. The PCR product was purified (4.0 µl ExoSAP-IT PCR Product Clean-up with ExoSAP-IT thermocycler protocol). The purified products were sequenced using BigDye Terminator v3.1 Cycle Sequencing Kit (Thermo Fisher Scientific, Inc.) on Applied Biosystems 3500xL Genetic analyzer (Life Technologies, Inc.). Sequence data were edited with GeneStudio Professional Edition version 2.2.0.0 (GeneStudio, Inc.) and deposited with the International Nucleotide Sequence Database (INSD) through the DNA Data Bank of Japan. The partial COI sequences obtained from the five specimens were compared with the available sequences in GenBank using BLAST (https://blast.ncbi.nlm.nih.gov/BLAST/). In addition, genetic distances in the five specimens and congeneric sequences obtained from GenBank were calculated using the Kimura 2-parameter model (K2P; Kimura 1980) by the software MEGA7 (Kumar et al. 2016).

Results and Discussion
Order Elasipodida Théel, 1882
Family Elpidiidae Théel, 1882
Genus Elpidia Théel, 1876
[New Japanese name: Kuma-namako-zoku]

Elpidia Théel, 1876: 1–7; Théel 1877: 1–30; Belyaev 1971: 329–330; Hansen 1975: 172–173; Rogacheva 2007: 368–372.
Tutela Perrier, 1896: 901.

Diagnosis [modified from Hansen (1975) and Rogacheva (2007)]. Tentacles 10, having discs with long and slender, retractile processes. Tube feet 4 pairs (5 pairs for E. decapoda), cylindrical, prominent, well spaced and equal in size. Papillae conical, separate, present along the entire dorsal radii, sometimes divided into an anterior and posterior groups. Elpidia-type ossicles (=rods with two paired horizontal arms and one paired vertical apophyses; Gebruk 1990) present; wheels occasionally present; C-shape ossicles absent. Calcareous ring strong and continuous, each piece with four pairs of arms.

Type species. Elpidia glacialis Théel, 1876.

Remarks. The remarkable morphological characters of genus Elpidia are four paired tube feet and mainly Elpidia-type ossicles (Gebruk 1990) in dorsal and ventral body...
| Morphological characters                  | NSMT E-12638 | NSMT E-12635 | NSMT E-12636 | NSMT E-12637 | NSMT E-12639 |
|------------------------------------------|--------------|--------------|--------------|--------------|--------------|
| **Body length (BL, mm)**                 | 18           | 25           | 21           | 19           | 12           |
| **Body width (BW, mm)**                  | 11           | 13           | 12           | 12           | 8            |
| **BL/BW ratio**                          | 1.6          | 1.9          | 1.8          | 1.5          | 1.5          |
| **Right papillae number**                | 7            | 6            | 4            | 4            | 4            |
| **Left papillae number**                 | 5            | 6            | 4            | 4            | 5            |
| **Maximum papillae length (mm)**         | 3.4          | 5            | 3.2          | 3.6          | 0.8          |
| **Minimum papillae length (mm)**         | 0.2          | 0.7          | 1.6          | 1.3          | 0.3          |
| **Tube foot pair number**                | 4            | 4            | 4            | 4            | 4            |
| **Rods, *Elpidia*-type ossicles, from dorsal body wall:** |              |              |              |              |              |
| **Length (DOL, µm)**                     | 259–673 (N = 16) | 317–1336 (N = 21) | 256–956 (N = 24) | 265–1065 (N = 29) | 193–952 (N = 14) |
| **Maximum axis diameters (µm)**          | 10–30 (N = 36) | 9.4–29 (N = 34) | 10–26 (N = 44) | 10–33 (N = 42) | 8.1–28 (N = 36) |
| **Axis shape**                           | Straight     | Straight     | Straight     | Straight     | Straight     |
| **Apophyses height (DAH, µm)**           | 25–219 (N = 56) | 32–174 (N = 32) | 17–145 (N = 55) | 44–232 (N = 67) | 28–167 (N = 26) |
| **DAH/DOL ratio**                        | 0.12–0.33 (N = 25) | 0.083–0.34 (N = 24) | 0.051–0.23 (N = 36) | 0.13–0.47 (N = 90) | 0.12–0.27 (N = 15) |
| **Wheel ossicles from dorsal body wall:** |              |              |              |              |              |
| **Diameter (µm)**                        | 33 (N = 1)   | 31 (N = 1)   | NA           | NA           | 30 (N = 1)   |
| **Diameter of central connecting portion (µm)** | 21 (N = 1) | 20 (N = 1) | NA           | NA           | 18 (N = 1)   |
| **Spokes number**                        | 9            | 9            | NA           | NA           | 9            |
| **The number of central rays**           | NA           | NA           | NA           | NA           | 3            |
| **Rods, *Elpidia*-type ossicles, from ventral body wall:** |              |              |              |              |              |
| **Length (VOL, µm)**                     | 150–532 (N = 54) | 91–557 (N = 32) | 73–495 (N = 37) | 161–521 (N = 44) | 178–539 (N = 33) |
| **Maximum axis diameters (µm)**          | 7–24 (N = 35) | 7–19 (N = 54) | 4–18 (N = 63) | 8–18 (N = 52) | 6.7–19 (N = 50) |
| **Axis shape**                           | Straight     | Straight     | Straight     | Straight     | Straight     |
| **Apophyses height (VAH, µm)**           | 22–119 (N = 95) | 27–140 (N = 90) | 10–115 (N = 103) | 27–125 (N = 83) | 36–142 (N = 67) |
| **VAH/VOL ratio**                        | 0.078–0.35 (N = 93) | 0.12–0.70 (N = 53) | 0.071–0.51 (N = 68) | 0.11–0.37 (N = 71) | 0.082–0.36 (N = 47) |
| **Rods, *Elpidia*-type ossicles, from tentacles:** |              |              |              |              |              |
| **Length (TOL, µm)**                     | 160–580 (N = 51) | 234–776 (N = 44) | 211–588 (N = 47) | 151–535 (N = 38) | 77–408 (N = 43) |
| **Maximum axis diameters (µm)**          | 6.3–30 (N = 53) | 4.2–39 (N = 44) | 8.6–31 (N = 50) | 11–35 (N = 47) | 11–25 (N = 49) |
| **Axis shape**                           | Arched       | Arched       | Arched       | Arched       | Arched       |
| **Apophyses height (TAH, µm)**           | 2.4–177 (N = 91) | 9.0–227 (N = 76) | 3.4–162 (N = 73) | 6.9–151 (N = 67) | 47–93 (N = 73) |
| **TAH/TOL ratio**                        | 0.0097–0.57 (N = 91) | 0.012–0.47 (N = 76) | 0.0077–0.45 (N = 73) | 0.020–0.36 (N = 67) | 0.021–0.58 (N = 73) |
walls. Although *E. decapoda* has five paired tube feet as an exception, *E. decapoda* has only *Elpidia*-type ossicles and shares the other diagnostic characters. *Elpidia*-type ossicles were also found in the genera *Penilpidia* Gebruk, 1988 and *Proteipidia* Gebruk, 1983, but *Elpidia* differs from these two genera in the combination with other type ossicles (Rogacheva 2007): *Penilpidia* and *Proteipidia* have C-shape ossicles, while they do not occur in *Elpidia*. Therefore, the diagnosis of genus *Elpidia* was modified and written clearly the exceptional number of tube feet for *E. decapoda*, and the absence of C-shape ossicles.

*Elpidia soyoae* sp. nov.

[New Japanese name: Soyo-kuma-namako]

(Figs 1–6; Tables 1, 2)

**Material examined.** Holotype: NSMT E-12638 (BL 18 mm; BW 11 mm), INSD accession number LC528684, 610 bps. Paratypes: NSMT E-12635 (BL 25 mm; BW 13 mm), INSD accession number LC528681, 628 bps; NSMT E-12636 (BL 21 mm; BW 12 mm), INSD accession number LC528682, 639 bps; NSMT E-12637 (BL 19 mm; BW 12 mm), INSD accession number LC528683, 636 bps; NSMT E-12639 (BL 12 mm; BW 8 mm), INSD accession number LC528685, 623 bps.

**Diagnosis.** BL up to 25 mm. Dorsal papillae up to five pairs along the entire dorsal radii; second pairs widely separated from third ones. Purple pigmentation spots on dorsal and ventral body walls, tentacles, and tube feet. Ossicles in dorsal body wall mainly rods, *Elpidia* type, with two pairs of horizontal arms and one pair of vertical apophyses, rod axis up to 1336 μm long, 8.1–33 μm in diameter, length of apophyses 5.1–47% of axis length; tentacle rods with arched axis, and short arms and/or apophyses.

**Description.** Body semi-ellipsoidal with flat ventrum, 12–25 mm long (5 individuals), 1.5–1.9 times as long as wide (Fig. 1). Mouth anteroventral. Anus at posterior end of body. Dorsal papillae conical, 0.2–5.0 mm long (N=49 from 5 individuals, Table 1), four or five paired and 0–3 unpaired papillae present on two dorsal radii (four to seven papillae on each radius, Fig. 2). Paired large papillae 0.3–5.0 mm long (N=42 from 5 individuals), anterior two pairs widely separated from third paired ones. Unpaired minute papillae 0.2–2.7 mm long (N=7 from 3 individuals), between

![Fig. 4. SEM images of ossicles from dorsal body wall of Elpidia soyoae sp. nov. (NSMT E-12635: paratype). A, rods with straight axis, well developed horizontal arms, and vertical apophyses; B, wheel from convex side and obliquely lateral side. Abbreviations: ax, axis; bt, brim teeth; ccp, central connecting portion; cr, central rays; ha, horizontal arms; sp, spokes; va, vertical apophyses.](image-url)
second and third paired papillae on holotype and one para-
type (NSMT E-12639), and on the posterior dorsum of ho-
lotype and one paratype (NSMT E-12635). Ventrolateral
radii without conical papillae. Tube feet cylindrical, four on
each ventrolateral radius. Mid-ventral radius without tube
feet. Tentacles ten, with cylindrical stems, and four conical
digits on terminal discs. Papillae, tube feet, and tentacles
nonretractile. Calcareous ring comprising five pieces sur-
rounding pharynx (Fig. 3A), each piece with four pairs of
straight arms (Fig. 3B): inside anterior pair (495–1131 µm
long, N = 10 in holotype), inside posterior pair (266–907 µm
long, N = 8 in holotype), outside anterior pair (1092–
2075 µm long, N = 7 in holotype), and outside posterior pair
(968–1972 µm long, N = 9 in holotype). Tips of inside arm
pairs branched or broadened in holotype (Fig. 3C). Gonad
white unpaired tuft, comprising central genital ducts and
surrounding genital vesicles. Polian vesicle single, fusiform,
transparent, whitish in holotype. Body skin whitish, occa-
sionally with purple pigmentation spots composed of small
purple particles on dorsal and ventral surfaces. Discs of tube
feet and tentacles light yellow, sometimes with purple pig-
mentation spots composed of small purple particles.

Ossicles (Table 1). Ossicles in dorsal body wall mostly
rods, Elpidia-type, and rarely wheels (Fig. 4). Rod axis
193–1336 µm in length (DOL, N = 104 from 5 individuals),
straight, with two paired horizontal arms, and one pair of
vertical apophyses. Axis 8.1–33 µm in diameter (N = 192
from 5 individuals), with conical tips at both ends. The
height of apophyses 17–232 µm (DAH, N = 236 from 5 in-
dividuals). DAH/DOL ratio between 0.051–0.47 (N = 150
from 5 individuals). Wheels rare, 30–33 µm in diam-
eter (N = 3 from 3 individuals), central connecting portion
18–21 µm in diameter (N = 3 from 3 individuals), with nine
spokes (N = 3 from 3 individuals), three central rays (N = 2
from 2 individuals), and triangular brim teeth (N = 3 from
3 individuals) (Fig. 4B). Ossicles in ventral body wall only
rods, Elpidia-type ossicles (Fig. 5). Rod axis 73–557 µm in
length (VOL, N = 200 from 5 individuals), straight, with two
paired horizontal arms, and one pair of vertical apophyses,
sometimes shortened. Axis in diameter 4–24 µm (N = 274

Fig. 5. SEM images of ossicles from ventral body wall of Elpidia soyoae sp. nov. (holotype). Rods with straight axis, well developed
horizontal arms, and vertical apophyses. Abbreviations: ax, axis; ha, horizontal arms; va, vertical apophyses.
from 5 individuals). The height of apophyses 10–142 µm (VAH, N=438 from 5 individuals), VAH/VOL ratio between 0.071–0.70 (N=332 from 5 individuals). Ossicles in tentacles only rods, Elpidia-type ossicles (Fig. 6). Rods 77–776 µm in length (TOL, N=223 from 5 individuals), with one arched axis, shortened arms and/or shortened apophyses sometimes completely lacking arms and apophyses. Axis in diameter 4.2–39 µm (N=243 from 5 individuals). The height of apophyses 2.7–227 µm (TAH, N=380 from 5 individuals), TAH/TOL ratio between 0.0077–0.58 (N=380 from 5 individuals).

**Distribution.** Known only from the type locality: Japan Trench area, depth 3570–4145 m.

**Etymology.** The species is named after the R/V Soyo-maru which collected these specimens.

**Remarks.** Morphological features of examined specimens were well coincident with five diagnostic characters of the genus *Elpidia* (see the Diagnosis section for the genus above). The dorsal rods of the examined specimens ranged from 8.1 to 33 µm in axis diameter, indicating *Elpidia soyoae* sp. nov. belong to the slender axis group. A morphological comparison of *E. soyoae* sp. nov. with six species of the slender axis group is provided in Table 2. *Elpidia soyoae* sp. nov. is distinguished from other species by the following four features: i) dorsal papillae on two dorsal radii, four or five paired papillae and unpaired papillae present along the entire dorsal radii (four to seven papillae on each radius), with wide separation between second and third paired papillae, ii) maximum length of dorsal rods exceeds 1000 µm, iii) tentacle rods with arched axis and shortened or occasionally completely reduced arms and apophyses, and iv) purple pigmentation spots composed of small purple particles on dorsal and ventral body walls. In addition, this species is easily distinguished from non-grouped species, *E. echinata*, which has 3 papillae on each dorsal radius (Perrier 1896).

**Molecular data comparison.** In BLAST searches, the closest hits for the five obtained partial COI gene sequences were those of *Elpidia glacialis* (INSD accession number HM196413 or HM196420, with 90.1% and 90.8% similarity in 98% to 100% coverage). K2P genetic distances were calculated in terms of 603 bps COI partial sequences in the five obtained sequences and 17 *E. glacialis* sequences in GenBank (INSD accession numbers HM196413–196429): the interspecific K2P distance was 0.101–0.120 between *Elpidia soyoae* sp. nov. and *E. glacialis*, and the intra-specific distance was 0.005–0.017 and 0–0.019 in *E. soyoae* sp. nov. and *E. glacialis*, respectively. The results confirmed that five specimens belong to the genus *Elpidia*, and supported that *E. soyoae* sp. nov. and *E. glacialis* are genetically independent and distinct species.

![Fig. 6. SEM images of rods from tentacles of Elpidia soyoae sp. nov. (NSMT E-12635: paratype). Rods with arched axis, especially shortened horizontal arms, and vertical apophyses. Abbreviations: ax, axis; ha, horizontal arms; va, vertical apophyses.](image-url)
Table 2. Morphological comparison of *Elpidia soyoae* sp. nov. with *Elpidia* species in the slender axis group. DAH and DOL indicate apophyses height and ossicle length of rods in dorsal body wall, respectively.

| Morphological characteristics | *E. soyoae* sp. nov. | *E. theeli* Hansen, 1956 | *E. minutissima* Belyaev, 1971 | *E. antarctica* Belyaev, 1971 | *E. adenensis* Belyaev, 1971 | *E. chilensis* Belyaev, 1971 | *E. gracilis* Belyaev, 1975 |
|------------------------------|----------------------|--------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Maximum body length (mm)     | 25                   | 12                       | 13                      | 33                      | 11                      | 22                      | 23                      |
| Number of papillae along each dorsal radius | 4–7                  | 5–7                      | 3                       | 4–6                     | 4                       | 2                       | 3                       |
| Papillae distribution        | Entirely from anterior to posterior; large four or five paired papillae and 0–3 unpaired papillae; 2nd and 3rd pairs widely separated | Entirely from anterior to posterior, regular intervals | Anterior to 3rd tube feet | 1st and 2nd pairs widely separated | Anterior to 3rd tube feet | Anterior half | Anterior to 2nd tube feet |
| Skin pigmentation            | Purple spots composed of small particles | Purple particles | Scattered purple particles | Unknown | Without pigmentation | Unknown | Unknown |
| Rods, *Elpidia*-type ossicles, of dorsal body wall | Maximum length (µm) | 1336 | 700 | 850 | 570 | 1200 | 1250 | 1200 |
| DAH/DOL ratio                | 0.12–0.33            | ca. 0.40                 | 0.25–0.35               | 0.20–0.50               | 0.07–0.15               | 0.10–0.14               | 0.20–0.70               |
| Axis diameters (µm)          | 9–30                 | 35                       | <40                     | <20                     | 35                      | 35                      | 20–30                   |
| Additional ossicles in dorsal body wall | Wheels | Wheels | Unknown | Cruciform ossicles | Unknown | Unknown | Unknown |
| Rods, *Elpidia*-type ossicles, of tentacles | Axis shape | Arched | Arched | Arched | Arched | Arched | Arched |
| Arms                         | Shortened, sometimes completely reduced | Unknown | Shortened, sometimes completely reduced | Shortened, sometimes completely reduced | Shortened, sometimes completely reduced | Shortened, sometimes completely reduced | Unknown |
| Apophyses                    | Shortened, sometimes completely reduced | Unknown | Shortened, sometimes completely reduced | Shortened, sometimes completely reduced | Shortened, sometimes completely reduced | Shortened, sometimes completely reduced | Unknown |
| Distribution                 | Japan Trench area, depth 3570–4145 m | Tasman Sea, depth 4510 m | Aleutian Trench, depth 5740 m; Bering Sea, depth 4382 m; Japan Trench area, depth 4100 m | Ross Sea, depth 650–700 m | Gulf of Aden, depth 3070 m | Peru-Chile Trench area, depth 2710–4600 m | Scotia Sea, depth 5450–5480 m |
| References                   | This study           | Hansen (1956, 1967, 1975); Belyaev (1971, 1975) | Belyaev (1971) | Belyaev (1971) | Belyaev (1971) | Belyaev (1971) | Belyaev (1975); Rogacheva (2007) |
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