

Radiolarian research by the Geological Survey of Japan, AIST, with bibliographic lists from 1950 to 2019

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Abstract: The Geological Survey of Japan (GSJ), established in 1882, marked its 135th anniversary in 2017 and has issued numerous publications, such as geologic maps, research articles and newsletters, during its history. This article compiles previous GSJ publications related to radiolarian research for future reference. In the GSJ publications from 1950 to 2019, the term of RADIOLARIA in Japanese appears in 252 Geological Maps of the Quadrangle Series (1:50,000), in 21 Geological Maps of the Quadrangle Series (1:200,000), in 75 articles of the Bulletin of the Geological Survey of Japan, in 14 items in Chishitsu News, in 21 items in GSJ Chishitsu News and in seven articles in the Cruise Report. The GSJ publications related to radiolarian research increased during the 1980s, which is consistent with the commonly called Radiolarian Revolution.

Keywords: radiolaria, bibliography, compilation, Paleozoic, Mesozoic, Cenozoic, Japan

1. Introduction

The Geological Survey of Japan (GSJ), a Japanese public organization for geological survey, was established in 1882 under the Ministry of Agriculture and Commerce. In 2001, the National Institute of Advanced Industrial Science and Technology (AIST) was extensively restructured as an independent administrative agency to integrate 15 research institutes, including GSJ.

Since its establishment, GSJ has aimed to make geological maps of Japan and has published many geological maps on several scales (Fig. 1) (Kato *et al.*, 2011). In 1890, GSJ published a geological map of the Japanese Islands (1:3,000,000) for the first time (Fig. 2A). Geologic maps of the Japanese Islands have been often renewed. The most recently published geological map of the Japanese Islands (1:1,000,000) was published in 1992 as the 3rd Edition (Fig. 2B). Twenty quadrangular areas (1:500,000) cover the Japanese Islands (Fig. 3).

GSJ began publishing Geological Maps of the Quadrangle Series (1:50,000) in the 1950s and continued the publication thereafter (e.g. Saito, 2009; Miyazaki, 2018). Radiolarians are important index fossils used to make the geologic maps of the series, some of which contain descriptions of radiolarians. In addition to the

geological maps, GSJ has issued various publications, such as the Bulletin of the Geological Survey of Japan and GSJ Chishitsu News. Some of these publications also contain radiolarian information.

GSJ has also conducted marine surveys since the 1970s (e.g. Arai *et al.*, 2013). Some of their survey results have been presented via GSJ publications, such as in the Cruise Report. Description of radiolarians are included in many of these publications because they are marine protozoa that are generally included in ocean deposits around the Japanese Islands.

Geological Maps of the Quadrangle Series (1:50,000), the Bulletin of the Geological Survey of Japan, GSJ Chishitsu News and Chishitsu News can be downloaded as portable document format (PDF) files from the website of GSJ (Appendix). All documents are OCRed; thus, we searched the documents for the term RADIOLARIA in Japanese (=“放散虫”). The Cruise Report was also downloaded as a PDF file from the website; however, the files are not OCRed.

Here, we present a brief history of radiolarian research by GSJ via the compilation of previous publications. This paper aims to provide bibliographic lists related to radiolarians for future reference.

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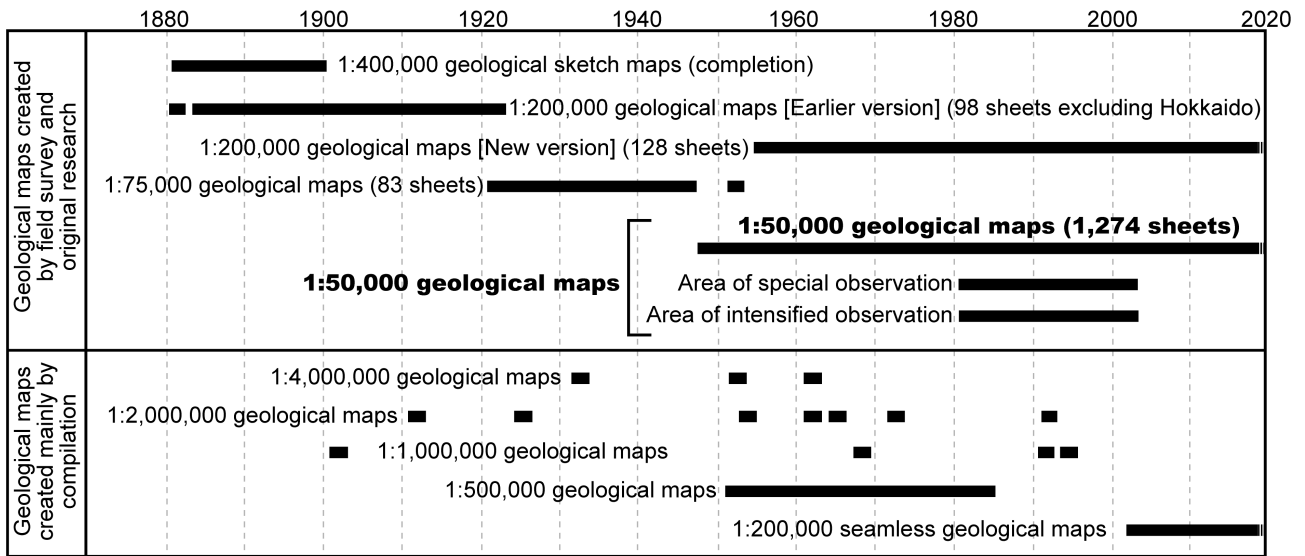


Fig. 1 History of the creation of geological maps by GSI (modified from Kato *et al.*, 2011).

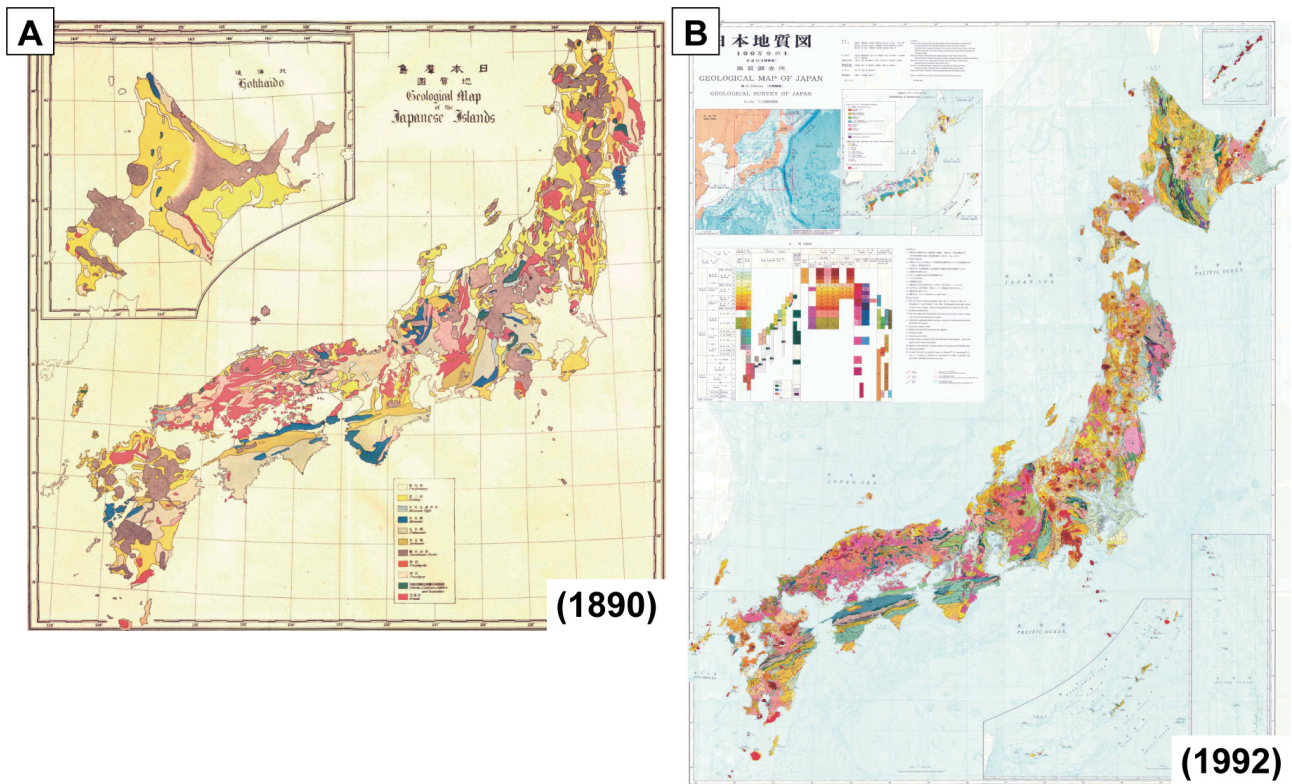


Fig. 2 Geological maps of GSI. A: First published geological map of the Japanese Islands (1:3,000,000) by GSI in 1890, as drawn by T. Harada (reprints from Kato *et al.*, 2011); B: Most recently published geological map of the Japanese Islands (1:1,000,000, 3rd Edition) by GSI in 1992.

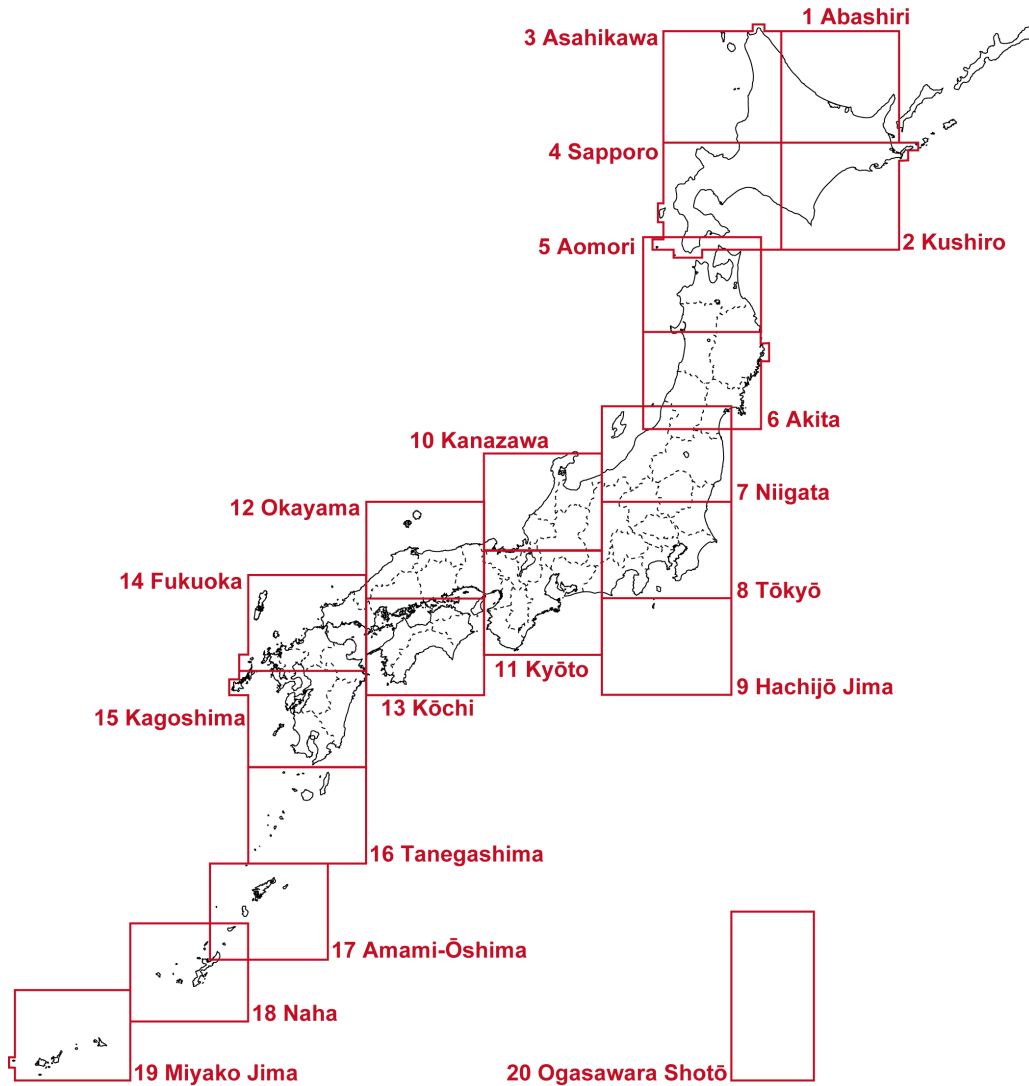


Fig. 3 Japanese Islands with quadrangular areas of 1:500,000.

2. Notable descriptions of radiolarian research in GSJ publications

2.1 Geological Maps of the Quadrangle Series (1:50,000)

The Geological Maps of the Quadrangle Series (1:50,000) have been published since the 1950s (Fig. 1). Between 1951 and 2019, over 700 geological maps in the series have been published. Among them, 252 geological maps contain descriptions of radiolaria (Table 1).

Until the early 1970s, radiolaria were not an important index fossil because they could not be extracted from hard rocks. Pessagno and Newport (1972) discovered a radiolarian extraction method by using hydrofluoric acid (HF). Since their discovery, radiolarian studies have rapidly progressed (e.g. Ichikawa, 1982; Yao *et al.*, 2001; O'Dogherty *et al.*, 2009; Danelian *et al.*, 2017). High-resolution biochronology based on microfossils (radiolaria and conodont) prompted the overturn of

previously believed scenarios for geologic history of the Japanese Islands (e.g. Sakai *et al.*, 1982; Nakaseko *et al.*, 1983; Ichikawa *et al.*, 1985; Ichikawa, 1990; Isozaki and Maruyama, 1991; Yao and Mizutani, 1993; Isozaki *et al.*, 2010; Agematsu-Watanabe and Kamata, 2018). This research progress and the revision of the geologic history are commonly referred to as the Radiolarian Revolution (e.g. Ishigaki and Yao, 1982; Nakaseko, 1984; Sato, 1989; Suzuki and Aita, 2011; Matsuoka and Ito, 2017). Likewise, the GSJ Publications related to radiolarian research also increased in the early 1980s (Fig. 4). Among the geological maps from 1981 to 2019 that include radiolarian descriptions, approximately half present an occurrence list and/or an image of radiolarians in addition to the text.

Meanwhile, even before the 1970s, radiolarian had been described in some geologic maps. In the 1950s, S. Igi had shown an occurrence species list of radiolarians (identified by K. Ichikawa) from chert of the Hidaka Group in the

Table 1 Bibliographic list from the Geological Maps of the Quadrangle Series (1:50,000) that include radiolarian descriptions.
 +: Appearance from its district. -: Appearance from adjacent district(s).

No.	District		Author(s)	Year	Text	Occurrence list	Illustrations			Radiolarian age									
	English	Japanese					SEM	Etched surface	Thin section	Silurian	Devonian	Carboniferous	Permian	Triassic	Jurassic	Cretaceous	Paleogene	Neogene	Quaternary
1 Abashiri																			
9	Kamiokoppe	上興部	Hasegawa K. <i>et al.</i>	1969	+														
10	Okoppe	興部	Hasegawa K. and Uozumi	1975	+														
14	Takinoue	滝上	Matsunami	2002	+									+					
15	Kamishokotsu	上渚滑	Matsunami <i>et al.</i>	2002	-									-					
23	Maruseppu-Hokubu	丸瀬布北部	Yahata <i>et al.</i>	1988	+									+					
24	Engaru	遠軽	Tajika and Yahata	1991	+					+				+					
26, 27	Abashiri	網走	Kawakami G. <i>et al.</i>	2018	-									+					
47	Kitami	北見	Ishida and Sawamura	1968	+									-					
58	Honki	本岐	Yamaguchi and Sawamura	1965	+														
2 Kushiro																			
釧路																			
2	Tokachigawajoryū	十勝川上流	Sakō and Hasegawa	1957	+														
5	Rikubetsu	陸別	Mitani <i>et al.</i>	1960	+														
19	Ashorobuto	足寄太	Mitani <i>et al.</i>	1958	+														
32	Honbetsu	本別	Mitani <i>et al.</i>	1959	+														
33	Kamicharo	上茶路	Sato S. <i>et al.</i>	1961	+														
53	Nukanai	糠内	Yamaguchi and Satoh	1989	+														
56	Idonnappudake	イドンナツブ岳	Suzuki M. <i>et al.</i>	1961a	+														
59	Chūru	忠類	Yamaguchi <i>et al.</i>	2003	+														
65	Mitsuishi	三石	Wada <i>et al.</i>	1992	-									-					
66	Nishicha	西舎	Sakai and Kanie	1986	+									+					
69	Urakawa	浦河	Kanie and Sakai	2002	+									+					
72	Erimo-Misaki	襟裳岬	Igi and Kakimi	1956	+														
3 Asahikawa																			
旭川																			
16	Kamisamifutsu	上猿払	Tanaka K.	1960	+														
20	Pimneshiri	敏音知	Igi	1959	+														
25	Hatsuura	初浦	Hata	1961	+														

Table 1 Continued.

No.	District		Author(s)	Year	Text	Occurrence list	Illustrations			Radiolarian age							
	English	Japanese					SEM	Etched surface	Thin section	Silurian	Devonian	Carboniferous	Permian	Triassic	Jurassic	Cretaceous	Paleogene
35	Soeushinai	添牛内	Hashimoto <i>et al.</i>	1965	+												
39	Horokanai	幌加内	Igi <i>et al.</i>	1958	+	+											
40	Kenbuchi	剣淵	Matsushita <i>et al.</i>	1977	+												
41	Rumoi	留萌	Tsushima and Yamaguchi	1954	+												
42	Ebshima	恵比島	Watanabe and Yaoshida	1995	+												
44	Pippu	比布	Suzuki J.	1957	+												
48	Fukagawa	深川	Suzuki J.	1953	+												
49	Asahikawa	旭川	Suzuki J.	1955	+												
54	Biei	美瑛	Suzuki M. <i>et al.</i>	1961b	+												
4	Sapporo		札幌														
7	Shimofurano	下富良野	Hashimoto	1955	+												
15	Ikushumbetsu-Dake	幾春別岳	Yoshida T. and Kambe	1955	+												
16	Yamabe	山部	Hashimoto	1953	+												
23	Yūbari	夕張	Sasa <i>et al.</i>	1964	+												
24	Ōyubari	大夕張	Nagao <i>et al.</i>	1954	+												
25	Ishikarikanayama	石狩金山	Osanaï <i>et al.</i>	1958	+												
32	Ōiwake	追分	Matsuno and Hata	1960	+												
33	Momijiyama	紅葉山	Takahashi Koh. <i>et al.</i>	2002	+									+			
34	Hidaka	日高	Takahashi Koh. and Suzuki	1986	+												
35, 46	Harauta and Karibayama	原歌及ひ狩場山	Yamagishi and Kurosawa	1987	-									-			
41	Tarumaizan	樽前山	Doi	1957	+												
45	Iwachishi	岩知志	Takahashi Koh. and Suzuki	1978	+												
47	Ohbirayama	大平山	Kurosawa <i>et al.</i>	1993	+	+								+			
52	Shiraoi	白老	Doi	1953	+												
55	Tomikawa	富川	Imai and Sumi	1957	+												
56	Biu	比宇	Yoshida T. <i>et al.</i>	1959	+												

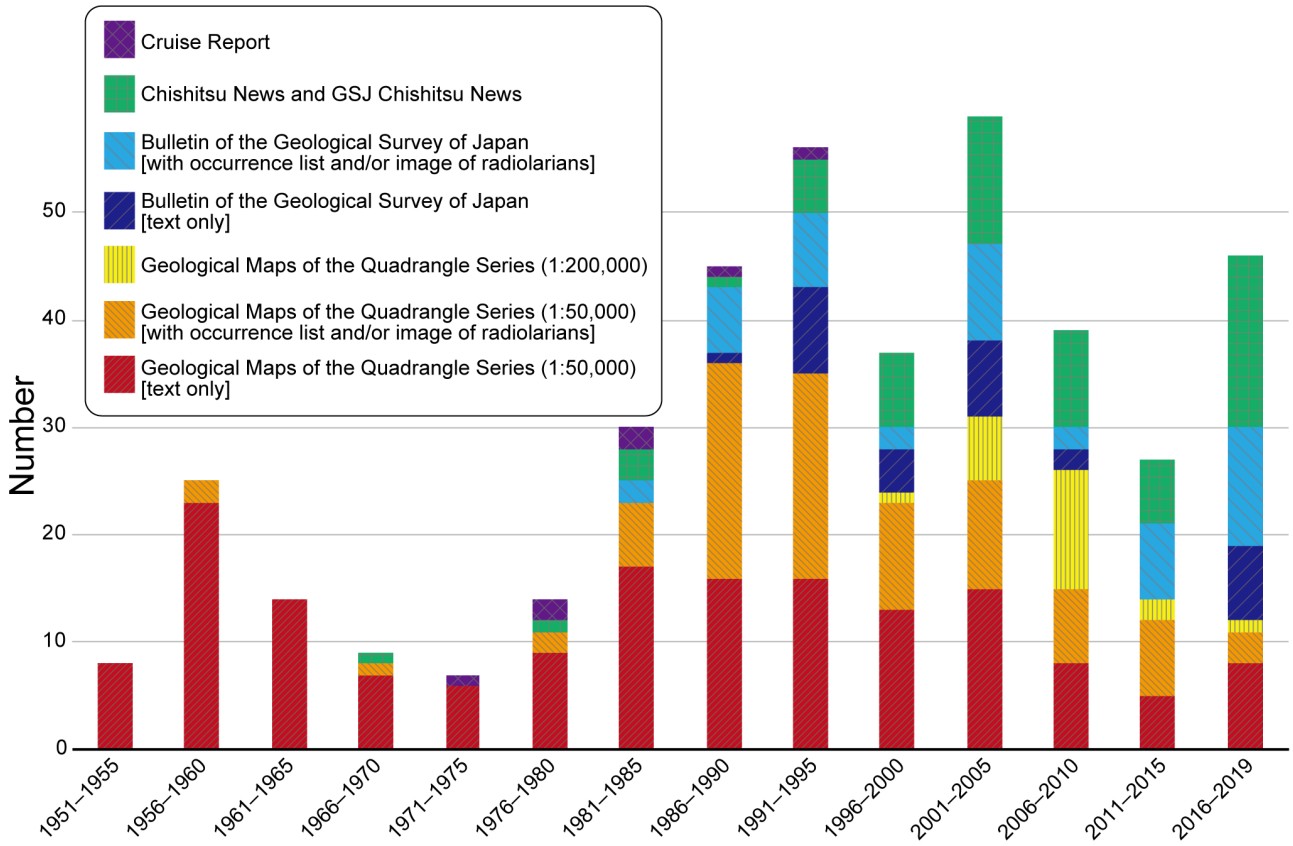


Fig. 4 Quinquennial number of GSJ publications that contain the term RADIOLARIA in Japanese (=“放散虫”).

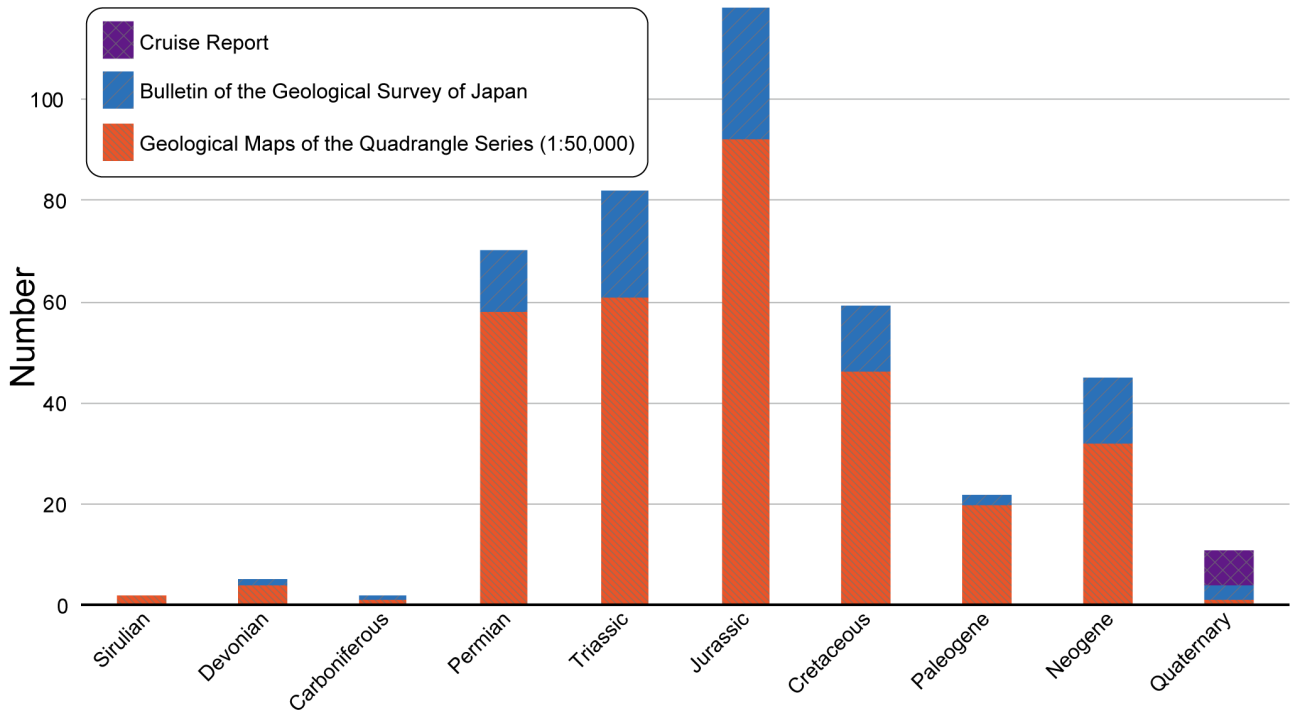


Fig. 5 Age distribution of radiolarian descriptions in GSJ publications.

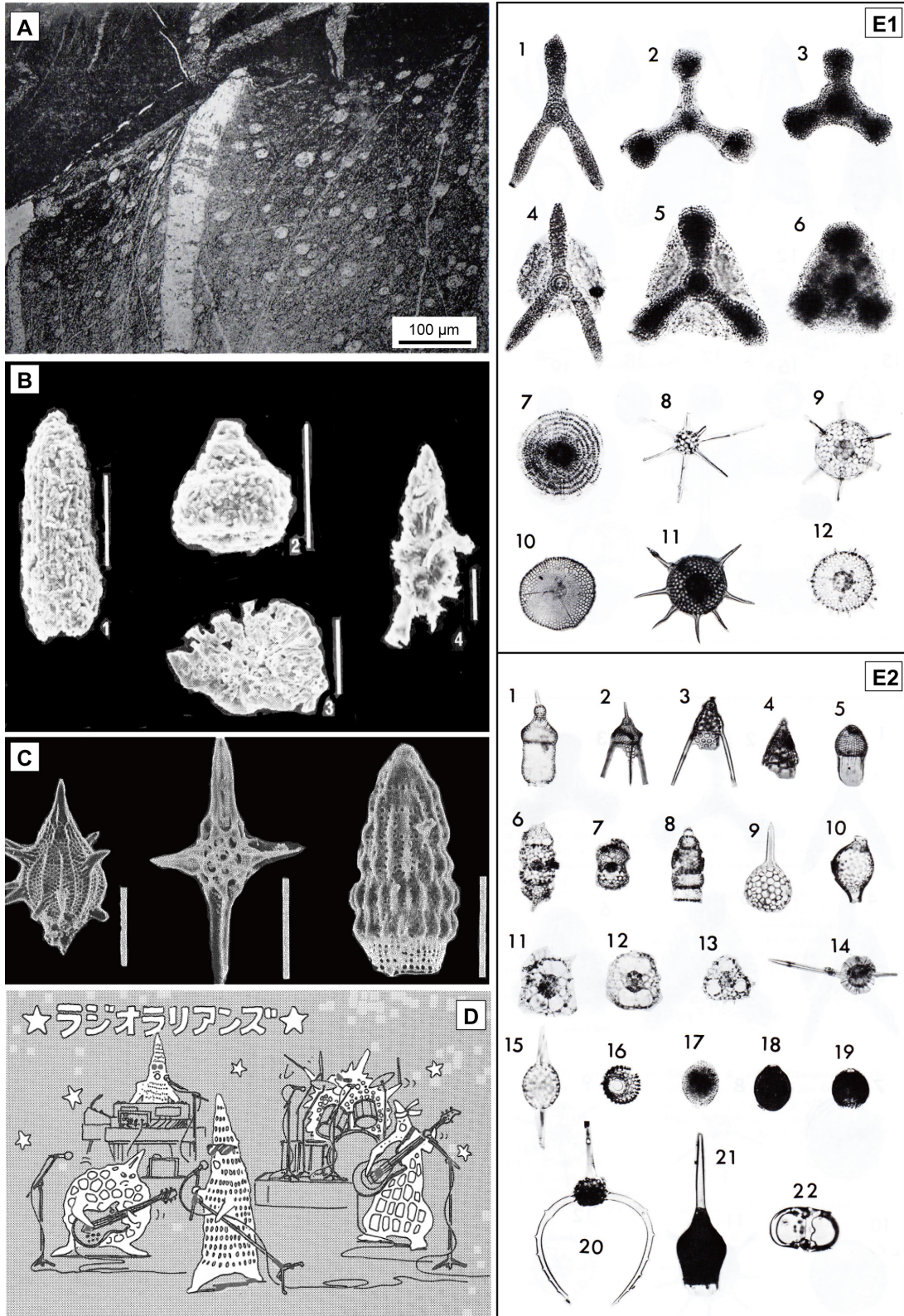


Fig. 6 Notable figures of radiolarian research by GSI. A: First photograph of radiolarians within phyllite (thin section) in the Geological Maps of the Quadrangle Series (1:50,000) (reprints from Yamada, 1966). B: First SEM images of radiolarians in Geological Maps of the Quadrangle Series (1:50,000) (reprints from Sakamoto *et al.*, 1984). C: First SEM images of radiolarians in GSI publications (Chishitsu News) (reprints from Sakai *et al.*, 1982). D: Illustrations of cartoon radiolarians shown in Chishitsu News (reprints from Wakita and Kawamura, 1985). E: Possible first images of radiolarian individuals in GSI publications (Cruise Report) (reprints from Arita and Mizuno, 1977).

Table 2 Bibliographic list from the Geological Maps of the Quadrangle Series (1:200,000) that include radiolarian descriptions.

District		Author(s)	Year
English	Japanese		
Ichinoseki	一関	Takeuchi K. <i>et al.</i>	2005
Ise	伊勢	Nishioka <i>et al.</i>	2010
Ishigaki Jima	石垣島	Nakae <i>et al.</i>	2009
Kaimon Dake and a part of Kuro Shima	開聞岳及び黒島の一部	Kawanabe <i>et al.</i>	2004
Kōfu	甲府	Ozaki <i>et al.</i>	2002
Kubokawa	窪川	Hara <i>et al.</i>	2006
Mito (2nd Edition)	水戸(第2版)	Yoshioka <i>et al.</i>	2001
Nakatsu	中津	Ishizuka <i>et al.</i>	2009
Niigata (2nd Edition)	新潟(第2版)	Takahashi Yut. <i>et al.</i>	2010
Ōita (2nd Edition)	大分(第2版)	Hoshizumi <i>et al.</i>	2015
Okayama and Marugame	岡山及丸亀	Matsuura <i>et al.</i>	2002
Shirakawa	白河	Kubo <i>et al.</i>	2007
Shizuoka and Omae Zaki (2nd Edition)	静岡及び御前崎(第2版)	Sugiyama <i>et al.</i>	2010
Toyohashi and Irigo Misaki	豊橋及び伊良湖岬	Makimoto <i>et al.</i>	2004
Urakawa	浦河	Sakai <i>et al.</i>	2000
Wajima (2nd Edition)	輪島(第2版)	Ozaki <i>et al.</i>	2019
Yaku Shima	屋久島	Saito <i>et al.</i>	2007b
Yamaguchi and Mishima	山口及び見島	Matsuura <i>et al.</i>	2007
Yatsushiro and a part of Nomo Zaki	八代及び野母崎の一部	Saito <i>et al.</i>	2010
Yokosuka (2nd Edition)	横須賀(第2版)	Takeuchi K. <i>et al.</i>	2015
Yoron Jima and Naha	与論島及び那覇	Nakae <i>et al.</i>	2010

2.4 Chishitsu News and GSJ Chishitsu News

Chishitsu News and GSJ Chishitsu News are monthly newsletters published by GSJ. Chishitsu News was published from 1953 to 2011. From 2011 and onward, GSJ Chishitsu News has been published as a successor to Chishitsu News.

In total, 14 and 21 articles containing radiolarian descriptions were published in Chishitsu News and GSJ Chishitsu News, respectively (Tables 4, 5). Fukuda and Natori (1977) showed a transmitted photomicrograph of Neogene radiolaria reprinted from Nakaseko and Sugano (1973). This was possibly the first isolated radiolarian images presented in the GSJ publications. Sakai *et al.* (1982) introduced a micropaleontological study on conodont and radiolaria and described their significance in Chishitsu News at the dawn of the Radiolarian Revolution. They also showed SEM images (Fig. 6C), which were the first SEM images published in the GSJ publications. Wakita and Kawamura (1985) wrote an essay about radiolarians, which included some SEM images, thin section and cartoons (Fig. 6D).

Since 1997, the Geological Museum owned by GSJ has displayed radiolarian exhibits, such as panels and models (Toshimitsu and Saito, 1997). The Geological Museum also made a poster showing radiolarians with

reconstructed oceanic plate stratigraphy in Jurassic accretionary complexes (Fig. 7). Special exhibitions related to radiolarians have often been displayed in the museum (e.g. Shibahara *et al.*, 2012; Ito *et al.*, 2017).

2.5 Cruise Report

GSJ had published the Cruise Report from 1972 to 1997. Twenty-four issues of the Cruise Report were published during this time period. Among them, seven articles contain descriptions of radiolarians (Table 6).

Arita and Mizuno (1977) showed photomicrographs of living radiolarians from the central–eastern part of the Central Pacific Basin (Fig. 6E). These were possibly one of the first isolated radiolarian images in the GSJ publications like Fukuda and Natori (1977).

Acknowledgments: Dr. UCHINO Takayuki (Geological Survey of Japan, AIST) has carefully reviewed the manuscript and has provided constructive comments. Dr. Toshimitsu Seiichi (Geological Survey of Japan, AIST) provided a reprinted poster of “Reconstructed Oceanic Plate Stratigraphy in Jurassic accretionary complexes and radiolarian fossils in Japan” made by the Geological Museum of GSJ.

Table 3 Bibliographic list from the Bulletin of the Geological Survey of Japan that include radiolarian descriptions.

Author(s)	Bibliography				Text	Occurrence list	Images			Radiolarian age							
	Year	Vol.	No.	Pages			SEM	Transmitted	Thin section	Devonian	Carboniferous	Permian	Triassic	Jurassic	Cretaceous	Paleogene	Neogene
Hara and Hara	2019	70	1/2	117–123	+		+							+			
Hara <i>et al.</i>	2012	63	11/12	301–308	+		+		+					+			
Hattori	1993	44	7	455–469	+												
Hori N.	2004a	55	9/10	271–285	+						+	+	+				
	2004b	55	9/10	287–301	+	+	+				+						
	2004c	55	9/10	303–334	+	+	+					+					
	2004d	55	9/10	335–388	+	+	+						+				
	2005	56	1/2	37–83	+	+	+				+	+	+				
Hori N. <i>et al.</i>	2002	53	9/10	689–724	+	+	+						+				
Hori R. S.	1993	44	9	555–570	+		+						+				
Imoto and Saijyo	1993	44	9	547–554	+						+	+					
Ishiga and Yamakita	1993	44	7	419–423	+												
Ishiga <i>et al.</i>	1993	44	12	721–726	+												
Ito	2019a	70	1/2	225–247	+	+	+	+	+			+	+	+			
Kakuwa	1993	44	9	533–546	+												
Kametaka <i>et al.</i>	2005	56	7/8	237–243	+		+		+			+					
Kamikuri	2019a	70	1/2	137–161	+	+		+									+
	2019b	70	1/2	163–194	+	+		+									+
Kashiwagi and Kurimoto	2003	54	7/8	279–293	+	+	+					+	+				
Kimura	1997	48	6	313–337	+												
Kimura and Nakae	1993	44	12	727–743	+	+	+		+				+				
Kojima <i>et al.</i>	1994	45	2	63–97	+	+	+					+	+	+			
Kojima and Saito	2000	51	4	143–165	+		+					+	+				
Kurimoto	1987	38	2	69–80	+	+	+					+	+				
	1989	40	2	55–63	+	+	+						+				
	1994a	45	5	235–255	+	+	+	+						+			
Kurimoto and Kuwahara	1991	42	2	69–73	+	+	+					+	+				
Kurimoto <i>et al.</i>	2015	66	3/4	41–79	+	+	+							+			
Matsuzaki and Itaki	2019	70	1/2	195–209	+	+		+									+
Mizutani	2019	70	1/2	261–265	+												
Motoyama	2019	70	1/2	125–136	+												+
Motoyama and Itaki	2019	70	1/2	1–4	+												+
Motoyama and Maruyama	2019	46	7	333–374	+	+	+	+									+
Motoyama <i>et al.</i>	2010	61	3/4	87–103	+	+		+							+	+	+
Musashino	1993	44	12	699–705	+												
Muto <i>et al.</i>	2019	70	1/2	43–89	+							+					
Nakae	1993	44	7	471–481	+												
	2000	51	4	113–128	+	+	+		+				+				
	2001	52	6/7	245–252	+	+	+				+						
	2002	53	1	51–59	+	+	+					+	+				
	2006	57	1/2	29–50	+				+								
	2011	62	11/12	441–453	+	+	+				+						
	2012	63	9/10	269–281	+	+					+						
	2013a	64	3/4	85–112	+	+	+					+	+				
	2013b	64	5/6	151–190	+	+	+					+	+				
2016	67	3	81–100	+	+	+		+				+					

Table 3 Continued.

Author(s)	Bibliography				Text	Occurrence list	Images			Radiolarian age							
	Year	Vol.	No.	Pages			SEM	Transmitted	Thin section	Devonian	Carboniferous	Permian	Triassic	Jurassic	Cretaceous	Paleogene	Neogene
Nakae and Kurihara	2017	68	2	57–86	+	+	+	+						+			
Nakato <i>et al.</i>	2005	56	5/6	225–236	+												+
Noda and Kurihara	2016	67	4	119–131	+	+	+							+			
Saito	1993	44	9	571–596	+	+	+				+	+	+				
Suto <i>et al.</i>	2005	56	11/12	375–409	+												+
Sugiyama K. and Saito	1994	45	7	383–404	+	+	+	+								+	
Takahashi M. <i>et al.</i>	1999	50	3	225–243	+												+
Takemura	2019	70	1/2	267–272	+												
Takeuchi M. and Takizawa	1991	42	9	439–472	+												
Teraoka and Kurimoto	1986	37	8	417–453	+	+	+	+						+			
Tominaga <i>et al.</i>	2019	70	3	299–314	+						+		+	+			
Tuzino	2010	61	3/4	125–136	+												
Uchino	2010	61	9/10	365–381	+												
	2017a	68	2	23–24	+												
Uchino and Hori	2011	62	3/4	191–196	+		+		+			+					
Uchino and Ishida	2017	68	2	25–39	+	+	+						+				
Uchino and Kurihara	2019	70	1/2	109–115	+		+		+	+							
Wakita	1983	34	7	329–342	+	+	+					+	+	+			
	1988a	39	6	367–421	+	+	+		+			+	+	+			
	1988b	39	11	675–757	+							+	+	+			
Wakita and Isomi	1986	37	6	325–333	+		+					+	+				
Wakita and Okamura	1982	33	4	161–185	+		+					+	+	+			
Yanagisawa	1999	50	3	167–213	+												+
	2003a	54	1/2	1–13	+												+
Yanagisawa <i>et al.</i>	1989	40	8	405–467	+	+		+									+
	2003a	54	1/2	29–47	+												+
	2003b	54	11/12	351–364	+												+
Yao	2019	70	1/2	246–260	+												
Yoshii <i>et al.</i>	1997	48	10	567–584	+												

Table 4 Bibliographic list from Chishitsu News that include radiolarian descriptions.

Author(s)	Bibliography			Contents	Images	Age
	Year	No.	Pages			
Endo and Sarashina	2007	632	41–45	Structure and function of proteins		
Fukuda and Natori	1977	273	32–43	Report on international congress about the Neogene in the Pacific	Transmitted photomicrograph	Neogene
Hara <i>et al.</i>	2005	611	49–59	Geology of Lao		
Kanie	2007	633	22–30	Cenozoic stratigraphy of the Ryukyu Arc		
Kanie	1998	532	59–61	Mollusks research in museum		
Kano K. <i>et al.</i>	2003	584	48–49	Outline of the Geological map of Japan (1:2,000,000)		
Kashiwagi <i>et al.</i>	2004	604	15–22	Geology of Mongolia	SEM images	Devonian?
	2005	605	55–60	Geology of Mongolia		
Katada <i>et al.</i>	1970	186	48–51	Thin section of limestone and chert	Thin section	
Kishimoto	1991	437	41–55	Mineral resources in China		
Kurimoto	1994b	482	21–30	Radiolarian biostratigraphy and the Geological maps of Quadrangle Series, 1:50,000	Sketches; SEM images	Mainly Permian to Jurassic
Matsuura <i>et al.</i>	1996	498	22–24	Outline of the Geological map of the Hirone district (Quadrangle Series, 1:50,000)		
Nakajima	1986	387	6–15	Geology around Himalayan		
Nakano <i>et al.</i>	2005	612	53–57	Outline of the Geological map of the Minakuchi district (Quadrangle Series, 1:50,000)		
Nohara <i>et al.</i>	1983	343	9–21	Research on deep sea mineral resource	Transmitted photomicrograph	Quaternary
Saito	1997	514	14–22	Research progress of the Jurassic accretionary complex of Japan		
Saito and Nishioka	1995	487	63–66	Outreach with using geological maps		
Saito and Ozaki	2000	548	59–61	Outreach with using geological maps		
Saito <i>et al.</i>	1997	514	7–13	Exhibition of the Geological Museum		
	2006	619	56–60	Outline of the Geological map of the Tomochi district (Quadrangle Series, 1:50,000)		
	2008	647	52–60	Outline of the Geological map of the Yakushima (1:200,000)	SEM images	Jurassic
Sakai <i>et al.</i>	1982	337	166–167	Research progress of radiolaria and conodont	SEM images	Jurassic
Sato T.	1991a	438	13–25	Research progress of Paleozoic–Mesozoic in Japan		
	1991b	440	19–33	Research progress of Paleozoic–Mesozoic in Japan		
Shinbo	2006	624	42–47	Observation of foraminifera in beach sands		
Takechi	2010	666	48–52	Fossil in Okayama Prefecture	Thin section	

Table 4 Continued.

Author(s)	Bibliography			Contents	Images	Age
	Year	No.	Pages			
Tanaka Y.	2007	634	29–34	Biogenic particles including radiolarian one		
Takahashi Koz.	2002	576	37–43	Diatom and radiolarian (including Phaeodarian)	SEM images	Recent
Takahashi Yut.	1996	506	7–14	Geology of the Iide Mountains		
	2005	607	57–62	Outline of the Geological map of the Suhara district (Quadrangle Series, 1:50,000)		
Teraoka	2004	599	40–48	Geology of Shimanto accretionary complex		
Tokuhashi	2008	645	26–52	Report on excursion of 17th International Sedimentology Congress 2006, Fukuoka		
Toshimitsu and Saito	1997	514	frontispiece	Exhibition of the Geological Museum	Hand-size model	Mainly Mesozoic
Wakita	2001	567	52–66	Geology of Indonesia		
	2002a	574	53–67	Geology of Indonesia		
	2002b	576	44–59	Geology of Indonesia		
Wakita and Kawamura	1985	376	60–66	Research progress of radiolaria	SEM images; Thin section; Cartoon	Devonian–recent
Yamada	2009	660	32–47	Geological map compiled by T. Harada		
	2011	679	8–22	Geological map compiled by T. Kochibe and others		
Yoshida F.	2003	592	61–63	Photographs of Shirasaki coast		

Table 5 Bibliographic list from GSJ Chishitsu News that include radiolarian descriptions.

Author(s)	Bibliography				Contents	Images	Age
	Year	Vol.	No.	Pages			
Hara and Ito	2018	7	11	259–261	International training course in the Kanto Mountains including field excursion and observation on radiolarian fossil	SEM images	Permian
Itaki	2019	8	5	125–127	Artificial intelligence technology for accurate identification and sampling of radiolarians	Transmitted photomicrograph	Quaternary
Ito	2017a	6	5	166–174	Author's radiolarian research in China		
	2017b	6	5	175–178	Chinese signage of words of sedimentology including "radiolarian ooze"		
	2017c	6	11	373–376	Chinese signage of words of paleontology including "radiolarian"		
	2017d	6	11	377–380	Chinese local name based on scientific name with examples of Permian radiolarians		
	2019b	8	7	175–180	Report on the 5th International Palaeontological Congress, with observation of samples of Deflandre (1952)	Transmitted photomicrograph	Carboniferous
Kano K.	2013	2	8	235–238	Outline of the Geological map of the Aniai district, 2nd Edition (Quadrangle Series, 1:50,000)		
Kato	2012	1	10	293–309	Excursion in the Chichibu area including "radiolarian slate" noted by K. Hosaka		
Kawabata	2016	5	8	263–265	Introduction of new staffs of the Geological Survey of Japan in 2016		
Nakashima <i>et al.</i>	2015	4	8	230–234	Lecture of Cenozoic stratigraphy in Japan		
Ozaki	2019	8	2	31–40	Outline of the Geological map of the Minobu district (Quadrangle Series, 1:50,000)		
Takahashi M.	2017	6	5	149–157	Discussion on tectonic boundary between Northeast and Southwest Japan		
Takahashi Yut. <i>et al.</i>	2018	7	11	303–308	International training course in the Abukuma Mountains		
Toshimitsu <i>et al.</i>	2019	8	12	322–335	Chronological timetable of the Geological Museum		
Tuzino <i>et al.</i>	2019	8	10	261–272	Exhibition of rocks (inc. radiolarian chert) in the Geological Museum		
Uchino	2015	4	3	69–74	Origin of "Shiraishi" in the "Shikinen Sengu ceremony" at Ise Jingu		
	2017b	6	9	283–288	Vegetation on chert in the Toba District		
	2018	7	4	91–101	Outline of the Geological map of the Toba district (Quadrangle Series, 1:50,000)		
Uchino and Kawamura	2014	3	11	329–333	Outline of the Geological map of the Hayachine San district (Quadrangle Series, 1:50,000)		
Utsunomiya	2018	7	9	223–226	Report on the 16th International Nannoplankton Association Meeting		

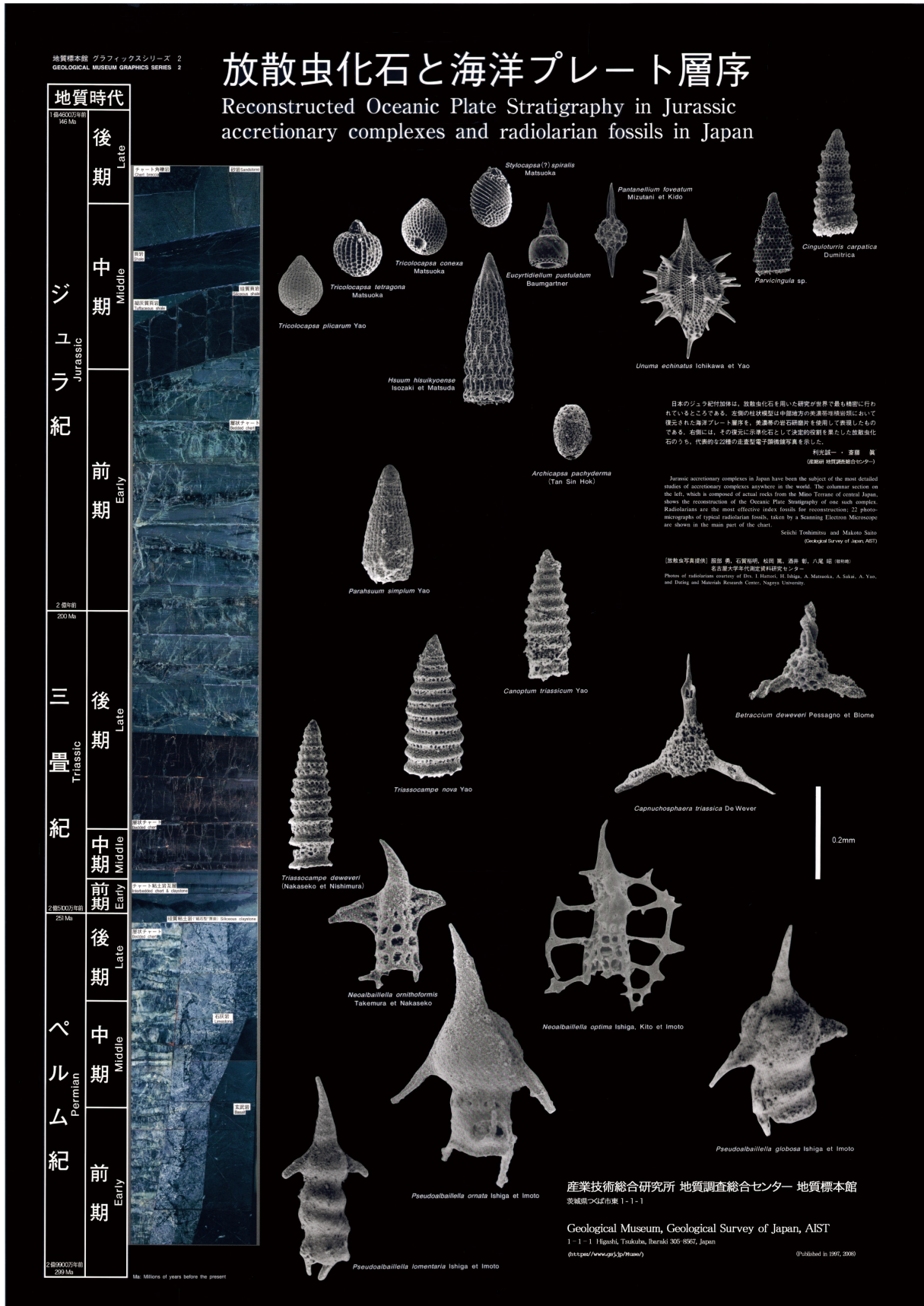


Fig. 7 Reprinted poster of “Reconstructed Oceanic Plate Stratigraphy in Jurassic accretionary complexes and radiolarian fossils in Japan” made by the Geological Museum of GSJ.

Table 6 Bibliographic list from the Cruise Report that include radiolarian descriptions.

Author(s)	Bibliography			Ocean area	Occurrence list	Images	Age
	Year	No.	Pages				
Arita and Mizuno	1977	8	301–308	Central Pacific		Transmitted photomicrograph	Quaternary
Hasegawa S. <i>et al.</i>	1976	7	80–85	Southern Kurile Trench and Slope			Quaternary
Inoue <i>et al.</i>	1972	1	20–33	Northwest Pacific			Quaternary
Nishimura	1984	20	67–89	Magellan Trough		Smear slide	Quaternary
	1986	21	56–83	Central Pacific		Transmitted photomicrograph; SEM image	Quaternary
Nishimura and Ikehara	1992	22	85–96	Central Pacific	+		Quaternary
Takayangi <i>et al.</i>	1982	18	301–308	Wake-Tahiti Transect in the Central Pacific	+		Quaternary

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Appendix: How to access and download the publications mentioned in this article

A1. Geological Map of the Quadrangle Series (1:50,000 and 1:200,000)

Access the web page (<https://gbank.gsj.jp/datastore/download.php?lang=en>) and do as follows. The numbers correspond to the numbers in the circles in Fig. A1.

- 1: Enter or copy-paste a district name.
- 2: Click the “search” button.
- 3: Select the check box that you need.
- 4: Click the “download” button.

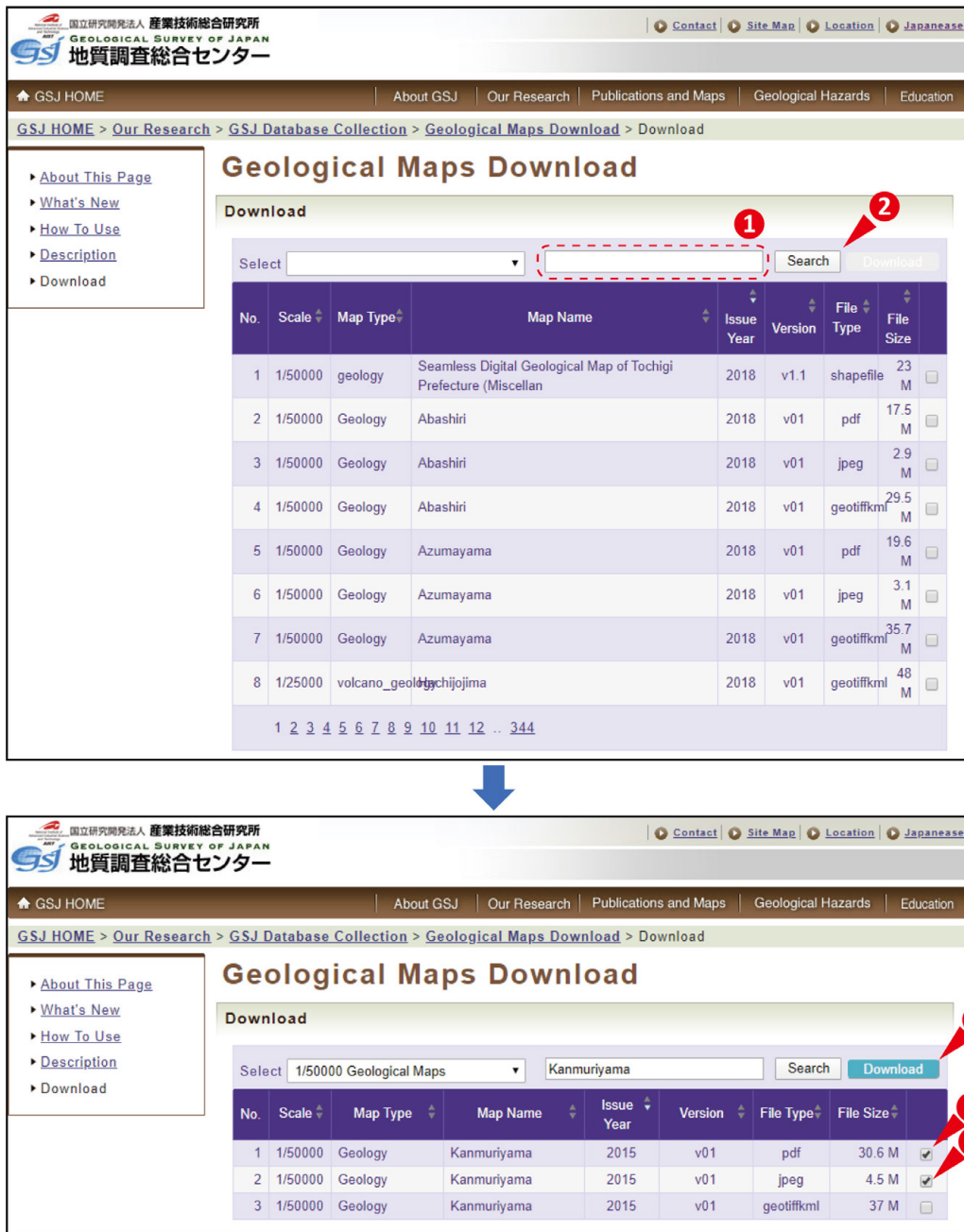


Fig. A1 Image captures of the webpage for search and download of geological maps from GSJ.

A2. Bulletin of the Geological Survey of Japan (1950 to 2011, vol. 52, no. 2/3)

Access the web page (<https://www.gsj.jp/en/publications/bull-gsj/index.html>) and download the article of interest.

A3. Bulletin of the Geological Survey of Japan (2011, vol. 52, no. 4/5 to present)

Access the web page (<https://www.gsj.jp/en/publications/bulletin/index.html>) and download the article of interest.

A4. Chishitsu News [Japanese only]

Access the web page (<https://www.gsj.jp/publications/pub/chishitsunews/news-contents.html>) and download the article of interest.

A5. GSJ Chishitsu News [Japanese only]

Access the web page (<https://www.gsj.jp/publications/gcn/gcn.html>) and download the article of interest.

A6. Cruise Report

Access the web page (<https://www.gsj.jp/en/publications/cruise-rep/index.html>) and download the article of interest.

地質調査総合センターにおける放散虫研究の歴史及び
1950年～2019年(昭和25年～令和元年)の関連出版物目録

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要 旨

1882年(明治15年)に設立された地質調査所(現産業技術総合研究所地質調査総合センター)は、2017年に創立135周年を迎えた。その歴史の中で、地質図、論文、ニュース誌など、数多くの出版物を刊行してきた。本論では、これらの出版物の中で放散虫に関係するものを纏めた。1950年(昭和25年)から2019年(令和元年)の間の出版物の中で、「放散虫」という単語は、5万分の1地質図幅では252編、20万分の1地質図幅では21編、地質調査所月間報告及び地質調査研究報告では75編、地質ニュースでは14編、GSJ地質ニュースでは21編、Cruise Reportでは7編の論文・記事で記述されている。放散虫研究にかかわる出版物の数は1980年代に増加しており、これはいわゆる放散虫革命と同時期である。

