International Science Council

ISSN 1998-0337

SCARreport

No 43
November 2022

Seismic Data Library System (SDLS) – new structure and guidelines –

Published by the

SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH

at the

Scott Polar Research Institute, Cambridge, United Kingdom

Seismic Data Library System (SDLS) – new structure and guidelines –

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April 2022

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Table of Contents

Table of Contents

Summary

The Antarctic Seismic Data Library System for Cooperative Research (SDLS) was established and endorsed by the Scientific Committee on Antarctic Research (SCAR) in 1991 and has become the primary host of marine multi-channel seismic (MCS) data around Antarctica. Since then, it has become an almost complete library of MCS data. This cooperative library model of the SDLS has generated many successful collaborations and the exchange of data between scientists of all SCAR countries and beyond.

Technological progress over the last 30 years has changed the way scientific data, including multi-channel seismic, are provided and accessed by the scientific community. This report describes updates to the SDLS organizational structure, guidelines and procedures to keep SDLS in line with these changes and ensure it remains functional in the future.

The key elements of the updated guidelines are:

The overall cooperative model and structure of the SDLS has been successful in the past and is kept in place. The SDLS will continue to operate under the SCAR INStabilities & Thresholds in ANTarctica (INSTANT) programme. The SDLS will continue to be overseen by a three-member Executive Committee which will consist of a representative of the primary operational / technical group (currently OGS), an elected Secretary General / Chair, and a Co-Chair representing the library branches to ensure broader engagement from the library branches.

The timetable for submissions to the SDLS includes the submission of navigation and survey metadata to the SDLS Data Centre as soon as possible after the survey. Stacked or migrated section of the seismic data should be submitted to the Data Centre in SEG-Y format two years after acquisition. After eight years or earlier, the seismic data will be made publicly available through the web portal.

The cost structure has been updated from the previous CD / DVD model to a submission-based structure that consists of a base fee ($1000) plus number of shots ($7.5 per 100 shots) for fully processed, compliant data. This new cost structure and the amounts are necessary to sustain the SDLS Data Centre.

Detailed guidance on submission metadata for surveys, seismic lines, and navigation, as well as for SEG-Y format and headers of the actual data is provided in the appendices.

1. Motivation

The Antarctic Seismic Data Library System for Cooperative Research (SDLS) was established and endorsed by SCAR in 1991 and has become the primary host of marine multi-channel seismic (MCS) data around Antarctica. It has become an almost complete library of MCS data. This cooperative library model has sparked many successful collaborations and the exchange of data between scientists of all SCAR countries and beyond.

The way the SDLS operated has been adapted over the years to accommodate technological progress and to respond to changes in the way the scientific community operates and uses seismic data. It started as a system that distributed data on CD-ROM with customized MS-DOS software and changed to DVD distribution as those became more common and data volumes increased.

Submission, distribution and cost guidelines had been adjusted to reflect these changes. The last of these updates happened in 2006 (SCAR Report 28).

Since this last official update, technology and workflows in the user community have continued to change. Data exchange over the internet has become the standard for data distribution. Following these community trends and preferences, the SDLS has built a successful web portal that is well accepted by the community.

In addition to this technological change, the general scientific community is moving towards better, open data access, improved citations of data in publications as documented, e.g. in the FAIR (Findable, Accessible, Interoperable, and Reusable) principles of data sharing (Wilkinson et al, 2016).

The official SDLS guidelines, submission, and distribution procedures do not reflect these changes. At various meetings of the SDLS community over the last few years, the need for updated guidelines for the SDLS become clear and have been discussed broadly.

This report summarizes the community discussions and presents new, updated guidelines for the SDLS.

2. Background

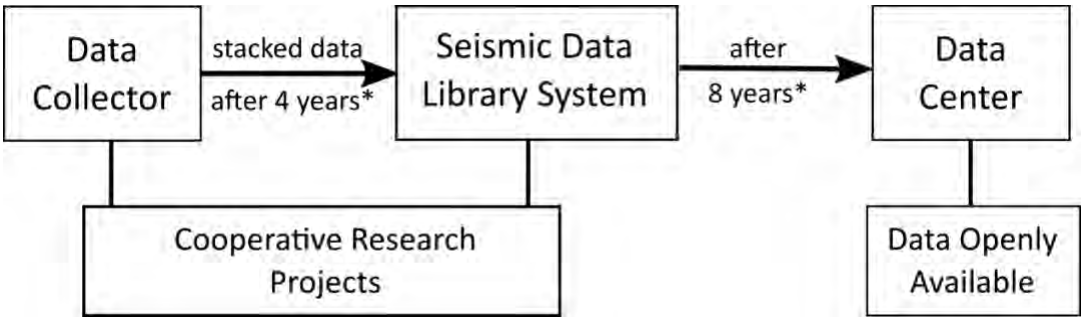
The SCAR Antarctic Seismic Data Library System for Cooperative Research (SDLS) was created in 1991 during a workshop in Oslo, Norway. It originated from the ANTOSTRAT community, a group that brought together scientists from different countries with the goal to improve the understanding of the structure and stratigraphy of the continental margin around Antarctica (e.g., Cooper and Webb, 1991; Webb, 1998). While working together, it became clear that this community would benefit greatly from an organized structure that allowed better and more open data sharing and communicating what data existed where.

The guidelines for the SDLS operations, as developed by community consensus during the workshop in 1991 (see Appendix 3), were presented in SCAR Report 9 (Cooper et al, 1992). These guidelines and the establishment of the SDLS was then formalized in 1991 through recommendations presented to the Antarctic Treaty, and ATCM Recommendation XVI-12 authorizes implementation of these guidelines (Antarctic Treaty System, 1991).

The overarching goal was to implement SDLS as a research tool for earth scientists. The guiding principles of the SDLS as outlined in SCAR Report 28 are:

- to foster, promote and facilitate earth science research;
- to facilitate coordination of Antarctic MCS field and laboratory operations;
- to assist in promoting Antarctic research drilling operations;
- to eliminate the perception by some that MCS data were being used for commercial exploration purposes, and to thereby protect the rights of research scientists to conduct MCS operations in Antarctica; and
- to provide the MCS research community with updated guidelines for their MCS data submission and distribution.

The core of the original structure of the SDLS are national library branches distributed in different countries at Antarctic research institutions that have contributed MCS data to the SDLS. The SDLS library branches host copies of the data and oversee the access to the data (Figure 1). It is widely acknowledged that acquisition and processing of MCS data is expensive and can take several years before the originator can publish results. Therefore, data originators were given four years to work with the data before they had to provide the data to the SDLS library branches. For another four years the data would be held at the branches for read-only access. Interested researchers are able to see what data are available where and can contact the original data collector, if they are interested in collaboration and working with these data. After eight years the data become freely accessible, although collaborating with the original data collector is still encouraged.



**years after original data collection has been finished.*

Figure 1: *Original structure and data flow with original timeline for data submission after data collection.*

In the beginning, the data were distributed via CDs. This changed later to DVDs as those became more commonly used and the data became larger. As technology changed, the SDLS guidelines were updated to facilitate technological and use changes. Faster internet allowed transfer of seismic data and a web service hosted by OGS, Trieste, Italy, was established that allowed access to navigation and seismic data and downloading of data.

The guidelines were updated in 2006 as described in an addendum to SCAR Report 9 and SCAR Report 28 to adjust to these changes in data distribution, data processing workflows, and to accommodate trends in funder data policies (Wardell et al., 2007).

In 2016, at the SDLS meeting in Kuala Lumpur, it was agreed that contributors are required to submit their data now after two years, which is more in line with overall SCAR data policy and many national guidelines. The navigation data and metadata with information about acquisition parameters are submitted immediately after the

cruise to make other groups aware of existing data, which can enhance collaboration and avoids duplication in data collection. The seismic stack data are not openly available for the public until after eight years. While the MCS data are in the SDLS (i.e. two to eight years from collection), researchers can collaborate with the PI on research studies using the data, following SDLS collaboration guidelines (i.e. SCAR Report 9).

Since its establishment, the SDLS community has been meeting every one to two years, mainly during other major Antarctic science conferences including the SCAR Open Science Conferences, ISAES, as part of ANTOSTRAT, ACE, and PAIS, and similar community meetings. During these meetings the community is updated on the status and changes of the SDLS operations, exchanges information about recent and future seismic acquisition plans, and discusses and recommends changes to the SDLS structure and operations. SDLS meetings usually consist of 20-30 people from various countries and include senior and early-career scientists.

Examples of SDLS success stories

Over the decades of its existence, SDLS has led to and contributed to many successful, collaborative research projects that resulted in a significant increase in the understanding of Antarctic tectonic and climate processes and history.

The existence and structure of SDLS allowed the reuse of existing data to be maximised and new data to be strategically collected where necessary, often coordinating data collection between countries. This not only reduces costs and the logistical effort of data collection, but also minimizes unnecessary exposure of possible environmental impacts through seismic data acquisition.

Results of these collaborations include the Ross Sea Stratigraphic Atlas, where combining the data and collaborating on the interpretation provided a more detailed understanding of the complex tectonic and sedimentary history of the West Antarctic rift system and the Ross Sea basin development (Brancolini et al., 1995). Other examples of regional works using all existing data available via the SDLS include Bartek et al. (1991), De Santis et al. (1999), Bart et al. (1999), Luyendyk et al. (2001), Chow and Bart (2003), De Santis et al. (2003), Kuvaas et al. (2005), Donda et al., (2008), Sorlien et al. (2007), Cooper et al. (2008), Grikurov and Leitchenkov (2012), Close et al. (2010), Bohm et al. (2009), Granot et al (2010), Pekar et al. (2013), Huang et al. (2014), Sauli et al. (2014), Leitchenkov et al. (2015), Lindeque et al. (2016), Kim et al. (2018), Anderson et al. (2018), Colleoni et al. (2018), Sauermilch et al. (2019), Huang et al. (2020), Perez et al. (2021), Donda et al. (2020).

A recent example of collaborative research is the generation of a grid series of circum-Antarctic Southern Ocean paleo-bathymetry from the Eocene-Oligocene Boundary to Pliocene, for which seismic data of the entire SDLS was compiled (Hochmuth et al., 2020). Further reference can be found in the book published by Elsevier "*Antarctic Climate Evolution*" in 2009 (Florindo and Siegert, 2009) and in 2022 (Florindo, Siegert, De Santis and Naish, 2022). Seismic data from the SDLS have been a key part in proposing, planning and successfully conducting scientific drilling operations around Antarctica. These include the CIROS-1, CRP, ANDRILL, SHALDRILL and MeBo projects, and many ODP and IODP legs (Figure 2 and Tables 1 and 2) that used seismic data from the SDLS for proposal preparation, site selection, and for interpreting and tying the results together (see a summary and references in Escutia et al., 2019).

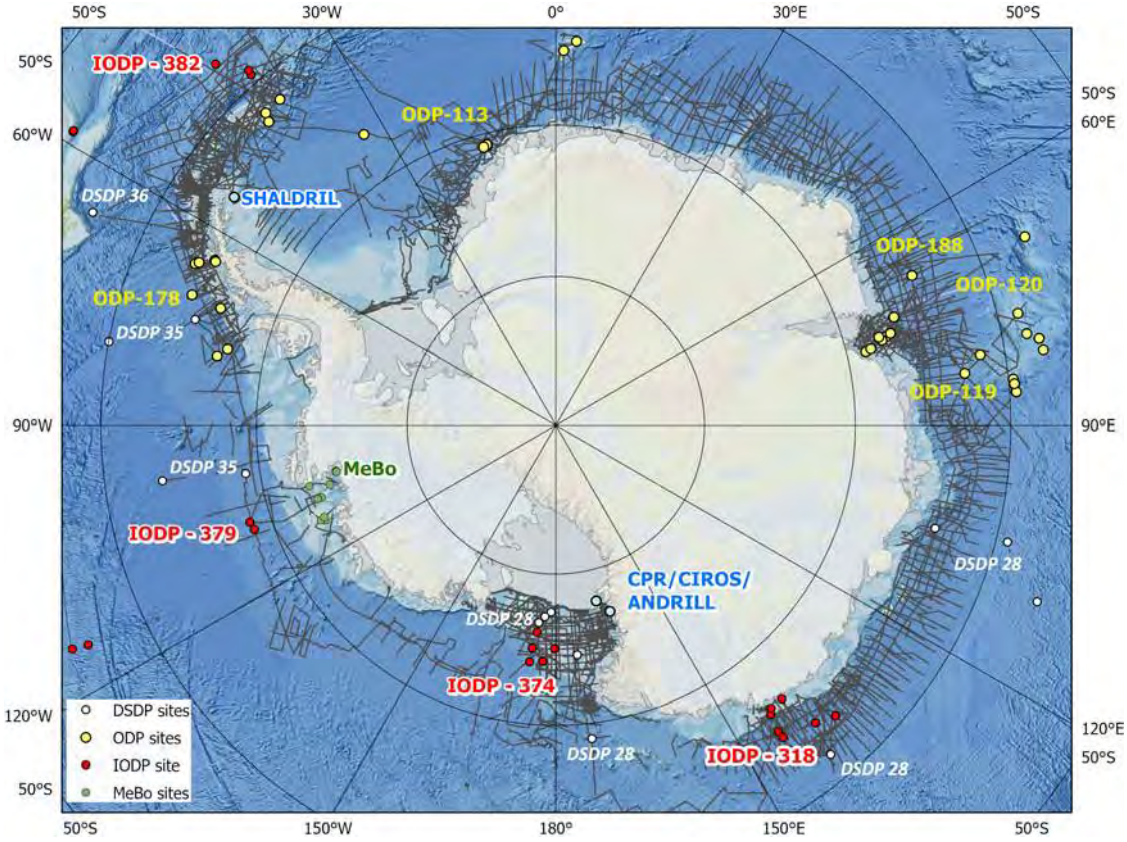


Figure 2: *Map of existing SDLS tracks and drill site locations of major Antarctic scientific drilling projects. These include older DSDP sites (white circles), ODP sites (yellow) and more recent IODP sites (red). Also indicated are the locations of expeditions by other scientific drilling programs (blue dots): the international Cenozoic history of the Ross Sea (CIROS) Project, Cape Roberts Project (CRP), and ANDRILL Programs, all in the Ross Sea; the US SHALDRIL program around the Antarctic Peninsula (blue dots); and the German MeBo drilling in the Amundsen Sea (green dots).*

Recent integration of available data from around the entire Antarctic continental margin has led to the reconstruction of paleobathymetry of Antarctica over the last 34 Ma and the amount of sediment delivered from the continent. This allowed reconstruction of the paleo landscape of Antarctica for a more realistic ice sheet model of earlier glaciations (Hochmuth et al. 2020).

Table 1: *List of (a) past drilling projects on the Antarctic continental margin (excluding expeditions to the north of the Antarctic polar front).*

Drilling project	Region	Sites	Year(s) drilled	Age Range of primary targets	Initial results reference
Dry Valley Drilling Project (DVDP)	Ross Sea	DVDP 1-15	1972-1975	Late Miocene-Quaternary	McGinnis, (1981)
DSDP Leg 28	Ross Sea/ Wilkes Land	DSDP 264-274	1973	Oligocene-Quaternary	Hayes et al., (1975)
DSDP Leg 35	Bellinghausen/ Amundsen Sea	DSDP 322-325	1974	Late Oligocene-Quaternary (thin Cretaceous)	Hollister et al., (1976)
MSSTS	Ross Sea	MSSTS-1	1979	Late Oligocene To Early Miocene	Barrett (1986)
CIROS	Ross Sea	CIROS-1,2	1984-1986	Eocene to Quaternary	Barrett (1989)
ODP 113	Weddell Sea	ODP 689-697	1987	Cretaceous to Quaternary	Barker and Kennett, (1988)
ODP119	Prydz Bay	ODP 736 - 746	1987-1988	Cretaceous to Quaternary	Barron and Larsen., (1989)
Cape Roberts Project	Ross Sea	CRP-1, CRP-2/2A, CRP-3	1997-1999	Eocene to Miocene, (thin Quaternary)	Barrett et al., (1998,2000), Fielding et al., (1999)
ODP 178	Bellingshausen Sea/ Antarctic Peninsula	1095-1103	1998	Late Miocene-Quaternary (including high-res. Holocene)	Barker et al., (1999)
ODP 188	Prydz Bay	ODP 1165-1167	2000	Late Eocene-Quaternary (snapshot Cretaceous)	O'Brien et al., (2001)
ANDRILL	Ross Sea	AND-1, AND-2	2006-2007	Early Miocene to Quaternary	Naish et al., (2007); Florindo et al. (2008)
SHALDRIL	Weddell Sea, Antarctic Peninsula	NBP0602A-01 to NBP0602A-12	2005-2006	Late Eocene to Holocene (including high-res. Holocene)	Anderson et al., (2006)
IODP Expedition 318	Wilkes Land	IODP U1355-U1361	2010	Middle Eocene to Holocene (including high-res. Holocene)	Escutia et al., (2011)
PS104/MeBo	Amundsen Sea	PS104-006,-009,-020,-021,-024, -038, -040,-041,-042	2017	Cretaceous to Holocene	Gohl et al. (2017)
IODP Expedition 374	Ross Sea	IODP U1521- U1525	2018	Early Miocene-Quaternary	Mckay et al., (2019)
IODP Expedition 379	Amundsen Sea	IODP U1532-U1533	2019	Late Miocene-Quaternary	Gohl et al. (2021)
IODP Expedition 382	Scotia Sea	IODP U1534-U1538	2019	Late Miocene-Quaternary	Weber et al., (2019)

Table 2: *proposed expeditions discussed by the SCAR Geoscience action group PRAMSO (Paleoclimate Records from the Antarctic Margin and Southern Ocean) under various stages of development (from McKay et al, 2022).*

PROPOSED EXPEDITIONS	Region	Sites	Proposal status	Age Range	Lead proponents
IODP Proposal 732 Full	Bellinghausen Sea / Antarctic Peninsula	8 primary piston core sites (PEN1-5,BEL1-3)	Approved by IODP - awaiting scheduling	Miocene-Pleistocene	James Channell, Rob Larter
IODP 813 Full (Expedition 373)	Wilkes Land	16 sites (seabed drill) to 80 m penetration	Approved by IODP - awaiting scheduling	Eocene to Pliocene	Trevor Williams, Carlota Escutia
IODP 931-Pre (EAIS evolution)	Sabrina Coast	6 sites (mission specific platform) to 80 m penetration	Assessed by IODP Science Evaluation Panel - invited to submit full proposal	Paleocene to Quaternary	Amelia Shevenell, Sean Gulick
IODP 982-Pre (Totten Glacier Climate Vulnerability)	Sabrina Coast		Submitted to IODP -	Miocene-Pleistocene	Bradley Opdyke
IODP Proposal 953-Pre	Australian-Antarctic Rift Drift	4 sites using standard ship-based	Assessed by IODP Science Evaluation Panel - invited to submit full proposal	Cretaceous to Quaternary	Peter Bijl, Isabel Sauermilch
IODP P998-pre (Ross Sea)	Ross Sea	4 sites using standard ship-based	Submitted to IODP	Cretaceous to Early Miocene	Robert Mckay, Laura De Santis
SWAIS-2C	Ross Sea (Siple Coast)	2(+) Sites using custom-designed sub-ice shelf drill	Approved – to be drilled 2021/22	Pliocene to Quaternary	Richard Levy, TBC
Ekström Ice Shelf	Dronning Maud Land / Weddell Sea	3(+) sites using custom-designed sub-ice shelf drill	Proposal in development	Cretaceous to Early Miocene	Gerhard Kuhn, TBC

3. Current status of SDLS

3.1 SDLS structure

In its core, the SDLS has maintained operations as originally devised. Figure 3 shows the current organizational structure. While the official framework under the Antarctic Treaty has not changed, the SDLS has been operating under and in collaboration with the ANTOSTRAT, ACE and PAIS SCAR research programmes / initiatives for the last 30 years.

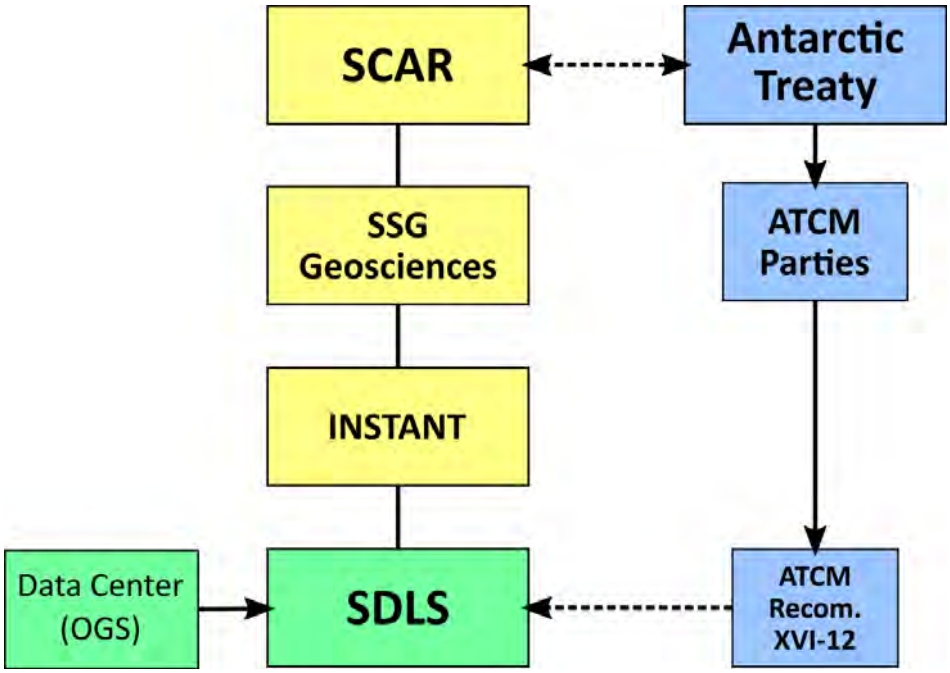


Figure 3: *Current organizational structure of SDLS as part of the SCAR framework.*

In the past, the SDLS was overseen by an Executive Committee with a Chair, and two representatives from the principal operational groups (i.e. USGS and OGS), with advice from all principal data collectors (and SDLS branch leaders) and their National Antarctic Programme funding managers. Going forward, a similar concept is envisioned with a three-member Executive Committee with advice from the same groups as previously in the Antarctic Science community (see section 4.2 for details). The Executive Committee will be elected at the next full SDLS meeting.

The SDLS will continue to operate under the SCAR INSTANT programme, like it had operated under the previous PAIS programme.

The data flow has remained the same as described in Figure 1 above, with slightly updated timelines for data submission as shown in Figure 4. The central Data Centre is currently hosted by OGS in Trieste and there are currently 14 official library branches (Figure 5).

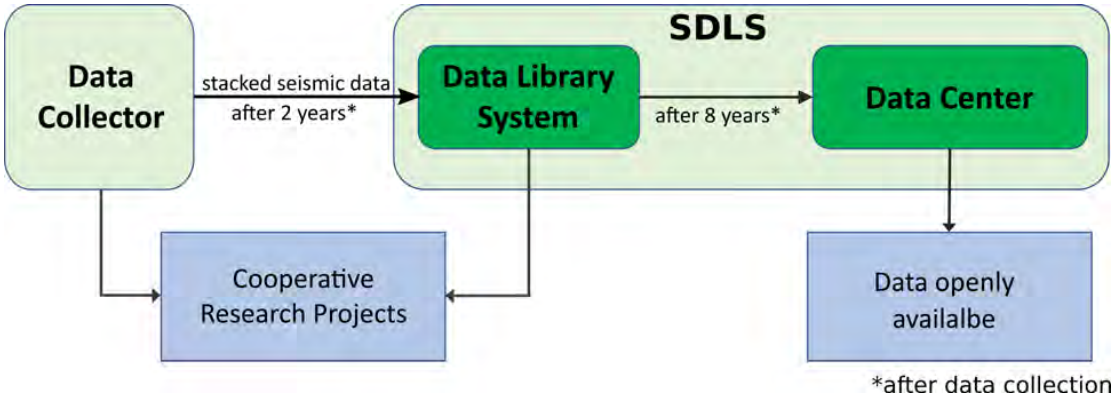


Figure 4: *Data flow after 2016 with updated timelines.*

Figure 5: *Current Library locations (red) and potential new library locations (green).*

3.2 Current data holdings

The amount of data held by SDLS has continued to grow. There are currently data from 153 surveys with over 336,000 km on seismic lines from 16 countries included in the SDLS (Figure 6). This represents around 87% of the known seismic data collected in Antarctica (see Table 3).

Table 3: *SDLS data holding as of 2021 (data received by SDLS).*

Country	MCS total [km]	MCS in SDLS [km]	MCS not in SDLS [km]	% in SDLS
Australia	30479	30479	0	100%
Brazil	5578	5578	0	100%
China	2128	0	2128	0%
France	7706	4900	2806	64%
Germany	56320	42892	13428	76%
Italy	35933	35581	352	99%
Japan	48980	48980	0	100%
Korea	10272	10272	0	100%
New Zealand	3400	0	3400	0%
Norway	12771	12771	0	100%
Russia	98888	60457	38431	61%
Spain	17690	11712	5978	66%
UK	10857	5034	5823	46%
USA	27074	25154	1920	93%
USSR	22543	9003	13540	40%
Total	**390619**	**298032**	**90459**	**76%**

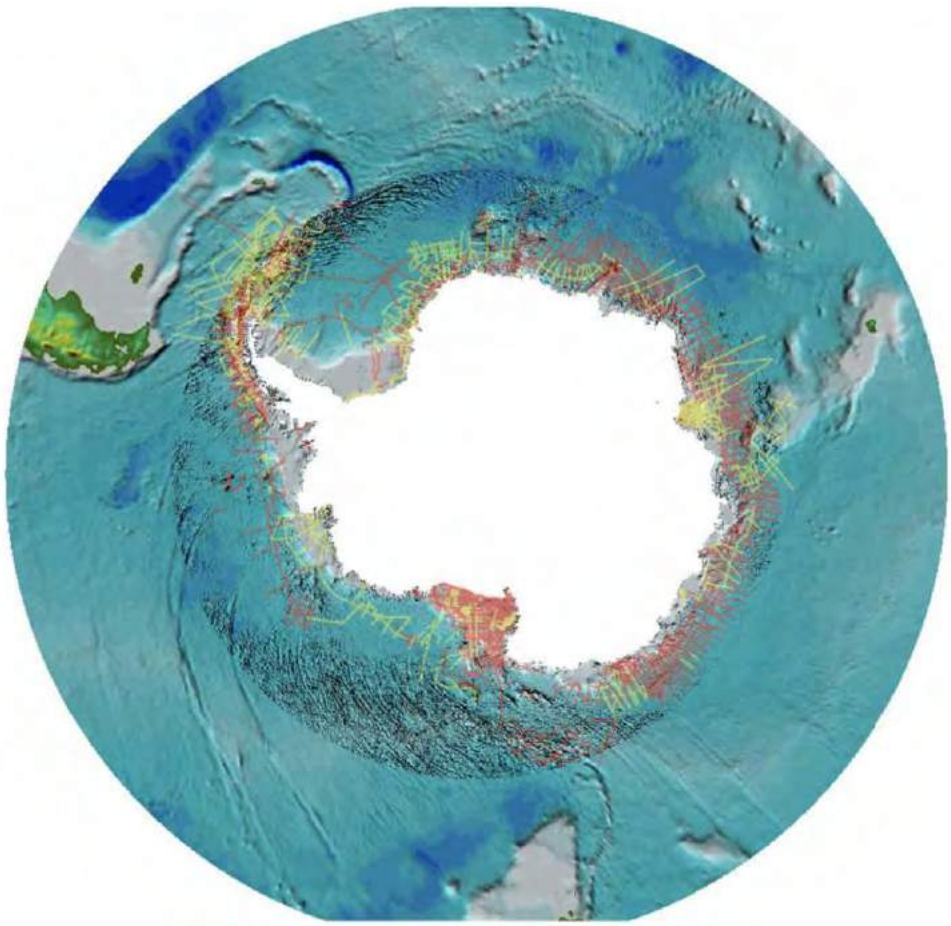


Figure 6: *Map of seismic data available through the SDLS (Red tracks link to seismic lines where both SEG-Y and navigation files are available. Yellow traces link to seismic lines where only navigation and metadata is available).*

This represents around 87% of the known marine MCS data collected in Antarctica. Some of the data not submitted to the SDLS, however, are older data from surveys in the 1970s and 1980s that are likely lost.

The current status of data not yet submitted can be seen in Appendix 2. Some of these surveys are indeed old, while most of them are quite recent but have not been submitted, or need some format revision by the OGS team and / or metadata-information completion by the data collectors.

3.3 SDLS web interface

During the last decades, the SDLS web portal has become the main interface to find and download seismic data. The structure of the web portal of the SDLS is based on the workflow in Figure 7. Users search for seismic survey and lines interactively on a web GIS, both geographically or using text queries. Once data has been identified, metadata can be analysed. For machine-to-machine interoperability metadata, follow ISO 19115, OGC O&M and SensorML standards. In addition, BODC vocabulary server is used to avoid semantic issues. Once the user has analysed the metadata and identified seismic data of interest, the user can preview these data interactively.

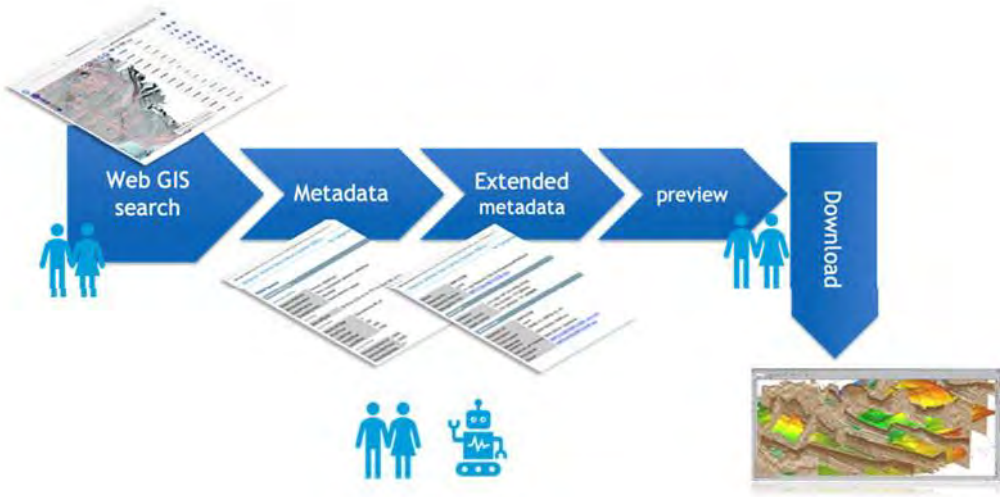


Figure 7: *SDLS web portal workflow*

The preview facility (Figure 8) uses a geographic map to show the actual position of traces on a seismic line, and highlights where seismic lines cross each other.

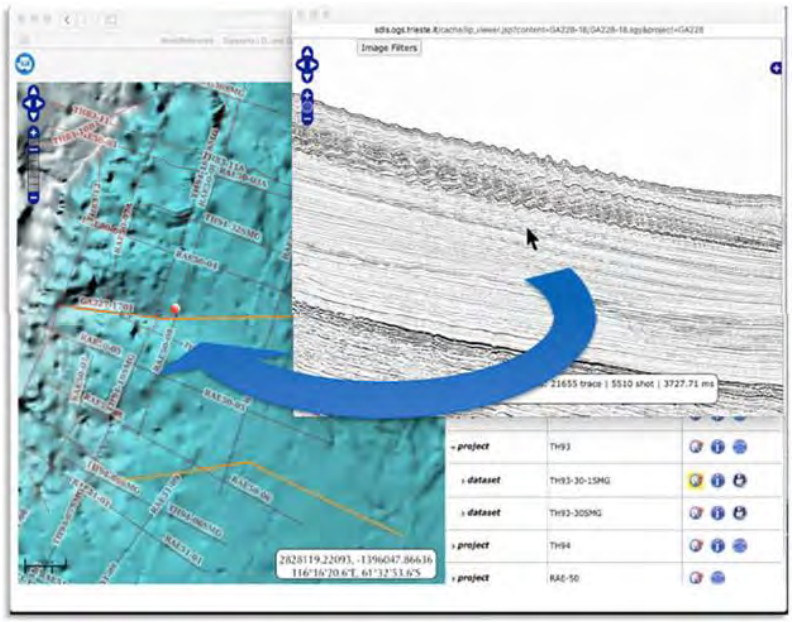


Figure 8: *Seismic data preview facility*

Once data have been previewed, it is possible to download them as SEG-Y format for seismic data and UKOOA format for navigation.

The SDLS web system offers OGC-compliant WMS and WFS web services to allow adding SDLS positioning on any end user's GIS software workstation. The services are reachable using the following web addresses:

WMS: https://sdls.ogs.trieste.it/geoserver/ows?service=wms&version=1.1.1
WFS: https://sdls.ogs.trieste.it/geoserver/ows?service=wfs&version=1.1.0

3.4 Reasons for changed data handling guidelines

The process of having professional DVDs created has been expensive and was a major cost factor including the curation of the data. However, DVDs are no longer widely used. Many computer systems rely on data transfer via the internet and storage on hard drives.

The last DVD that was created is number 102 for data submitted to SDLS in 2009 and there has not been demand for further DVD creation. For many current users, the original data distribution using DVD is out-of-date; and the web interface hosted by OGS has become the dominant distribution method for most users.

The previous funding model for SDLS data curation was tied to DVD and CD creation and the web presence has largely been a side product. With the changed web-based access to data described above, the DVD-based funding system is no longer fit for purpose and a new funding structure is necessary.

In addition, there is a general movement of the science community to increase more Open Data, FAIR principles and citations of data and reproducibility.

A substantial part of the work performed at OGS, besides preparing DVDs for printing, was correcting navigation, reformatting the SEG-Y and navigation files and basic post-stack processing, if needed. Additional work is often necessary for metadata creations including collecting information from often disparate sources. In the new version of the web SDLS, metadata is central not only to inform end users, but also to SDLS internal data management. Therefore, metadata preparation is now vital and has become the most critical time-consuming activity.

4. New structure and submission guidelines

4.1 Overall mission and objective

During SDLS business meetings over the last few years, there have been extended discussions about how to best address the data management issues, including updates to the cost structure and guidelines. The overall agreement is that the basic model of the SDLS has served the community well. It was successful in encouraging data contributions to the SDLS and collaborations between data contributors and users.

Therefore, there has been broad agreement that the key objectives should remain:

- to foster, promote and facilitate earth-science research;
- to facilitate coordination of Antarctic MCS field and laboratory operations;
- to assist in promoting Antarctic research drilling operations;
- to eliminate the perception by some that MCS data were being used for commercial exploration purposes, and to thereby protect the rights of research scientists to conduct MCS operations in Antarctica;

- and to provide the MCS research community with guidelines for, and more direct management of their MCS data distribution.

In addition, the SDLS will work to make the data more FAIR and to broaden the use of the publicly available data.

The SDLS will continue to encourage broad participation from a wider community by reaching out to scientists in countries that are currently less engaged with SDLS and engaging early-career scientists in SDLS activities.

4.2 Updated organizational structure

The basic structure of the SDLS has been very successful in the past and we plan to keep the operational framework under SCAR-Geosciences and the Antarctic Treaty (ATCM) as described in Figure 3. The SDLS will continue to operate under the SCAR INSTANT programme.

The general concept of the distributed library branches will be maintained. The Data Centre as central library will be hosting the website and online access to all submitted MCS data. The library branches will hold copies of navigation and MCS data older than eight years (i.e. publicly available) to assure long-term multinational access. Branches will be asked to promote nationally the SDLS and to solicit and secure the metadata, navigation and stacked SEG-Y data submission in the right time and format to the SDLS central library. They will continue to play a key role in promoting and facilitating collaborative research between data owners and interested users and as national point of contact for SDLS-related questions.

As in the past, the SDLS will continue to be overseen by a three-member Executive Committee which will consists of a representative of the primary operational / technical group (currently OGS), an elected Secretary General / Chair, and a Co-Chair representing the library branches to ensure broader engagement from the library branches. SDLS branch leaders, principal data collectors, and their National Antarctic Programme funding managers will continue to advise the Executive Committee. The Executive Committee will be elected at the next full SDLS meeting. The representative for the library branches should be selected from among the different library branches for two years (could be a rotating position).

Fostering collaborations, data and science exchange between members of the SDLS community remains the primary goal of the SDLS. Therefore, we will continue to hold annual meetings either as virtual meetings or in person as part of international conferences (e.g. SCAR Open Science Conference, ISAES, or INSTANT Conference). As part of these meetings, representatives of the library branches should meet every year to provide updates on recent or planned cruises, status of data processing and delivery to the SDLS. We will encourage participation of early-career scientists and of representatives from countries that are not actively engaged at this point.

4.3 General flow for submission and distribution of seismic data

The SDLS is primarily a data library for marine multi-channel seismic data and does not currently contain land-based MCS data, but submission of land-based data is encouraged and should follow the same submission guidelines as marine MCS data. According to the resolution ATCM XVI-12 "*requires inter alia that digital data from multichannel seismic reflection surveys be sent to the SDLS*".

Single-channel seismic data can provide important connections and insights where MCS data do not exist. Therefore, we encourage the submission of critical SCS data to the SDLS. The submissions should follow the MCS guidelines and costs.

The inclusion of legacy SCS data into the SDLS will require additional funding and might require updates to the current web portal to handle differences in the underlying metadata.

The updated data flow for submission and access are illustrated in figure 7. The details are described in the following sections.

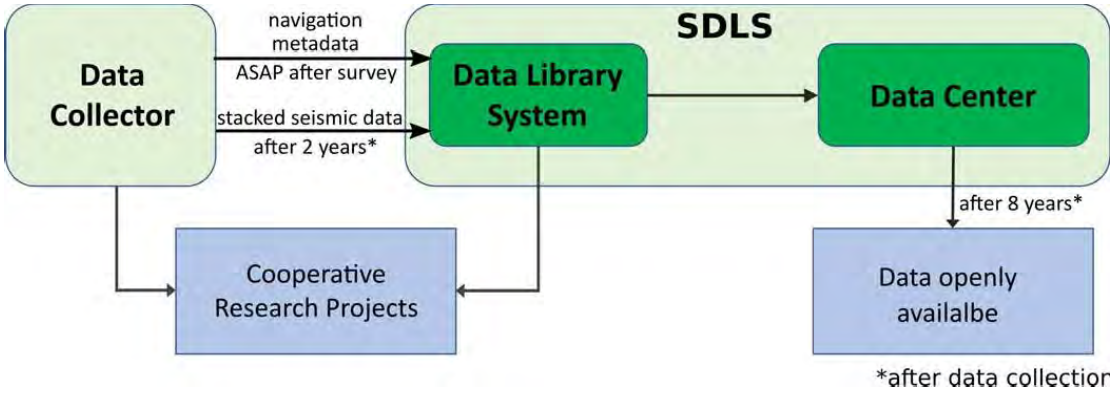


Figure 7: *Updated data flow for submitting and distributing seismic data through SDLS.*

4.4 Updated data submission guidelines

The recommended steps for data submission are the following:

(1) Data contributors or the contact person of the library branches should inform SDLS about new seismic surveys as soon as possible after the surveys are completed. This can be done also as part of the annual meetings.

(2) Right after the cruise, the data contributor should submit shot point / track line navigation files, together with basic survey and acquisition metadata, to the SDLS Data Centre. Sharing this information early will help the community to coordinate surveys, prevent duplication of efforts and provide potential linkage between surveys.

Navigation data should be submitted as ASCII text files or UKOOA format. Data formats will need to follow SEG-Y and UKOOA-P1/90 rules that have been mandatory since 1991. Details of required formats and metadata are listed in Appendix 1.

After data submission, the SDLS Data Centre will perform quality checks and add the navigation data and metadata to the database. The track lines and the survey metadata information will be displayed and can be accessed through the web portal. The navigation data will be viewable and downloadable through the new web portal.

(3) Seismic data should be submitted to the SDLS Data Centre as stacked migrated and non-migrated sections in SEG-Y format two years after acquisition. Original

shot data and velocity models can be archived at national repositories. The detailed metadata and format requirements are described in Appendix 1.

Until they become publicly available, the seismic sections cannot be viewed in the web browser and the use of the seismic data is restricted while in the SDLS. This means that, with the consent of the Principal Investigator (PI), the data can be made available to users as part of a collaboration with the PI.

(4) After eight years or earlier, if the data owner wishes or agrees to release the data before the eight years are over, the seismic data will be made publicly available through the web portal for registered users and the seismic sections can be viewed in the web browser.

Rare exceptions to these dates might be possible, in the case of processing delays or ongoing Ph.D. thesis, but such delays would require documented reasons and proposed updated submission dates being sent to the SDLS Executive Committee for approval. In the rare case of an extended data release beyond 8 years, the track lines will be displayed and can be accessed and downloaded through the web portal, but there will be no download options of the SEG-Y data.

The data will receive a DOI that will allow citation of the datasets. DOIs will be provided when data are fully loaded in the SDLS system in consultation with the submitter (i.e., no DOIs provided for surveys for which only navigation is available). Usually there will be one DOI for a survey. Exceptions, for example when large surveys are broken up into sub-surveys, will need to be discussed when data are submitted. The DOI might not be made public until the data are public or the DOI is required for a publication.

4.5 Updated cost structure for data submission

Under this new data distribution model, which does not include the distribution of DVDs, SDLS cannot charge submission fees based on DVD production. There are, however, costs related to navigation and seismic quality control and clearance, as well as metadata and DOI creation for each submission. Metadata creation in the new web SDLS structure is much more complex than in the previous version. In the new system, metadata not only inform end users but the metadata are also used by the system itself, for example to allow semantic interoperability and linked data with other systems. In addition, maintaining the server and storage infrastructure, and the web service itself, generate ongoing expenses and require investments every three-to-five years, regardless of new data submissions.

Therefore, SDLS will change to a submission / publication fee-based system to support the data storage and web-based distribution process.

(1) **Submission of standard/ fully processed/ clean data**

Much of the work is related to quality control, preparation, and ingestion of new data into the SDLS system. For each submitted survey, the data submitter will be charged a data submission fee that consists of a base fee of $1000 plus $7.5 per 100 shots. This will cover the general quality control and metadata-related activities.

Seismic data and metadata must be complete and fully comply with the format requirements described in Appendix 1 to minimize the effort of the central data repository staff. Data contributors can work with their national library branch to check for data compliance and prepare the data for submission.

Principal investigators should include necessary funds into their project budgets.

(2) **Submissions that require additional work**

For data submissions that do not fully comply with the required formats and require additional work by the data curators in SDLS Data Centre, the Data Centre will charge an additional processing fee to cover the extra effort that is required to prepare the data for ingestion into the SDLS system. The SDLS will only assist enhancing stacked or migrated data. Creating seismic stacks from field data is outside the scope of SDLS.

The additional costs will depend on the amount of work that is necessary and should be negotiated with the SDLS Data Centre curator.

(3) **Special data rescue grants**

In addition to the regular data submission, researchers and library branches can work with their national funding agencies and the SDLS Data Centre to seek funds to bring older, legacy datasets and other seismic data of value into the SDLS for which the regular pathways are not possible. The costs of these submissions should follow the cost structure of (1) and (2) and should be defined in consultation with the SDLS Data Centre.

4.6 Updated data use guidelines

The following guidelines apply to the use of MCS data in the SDLS, as outlined initially in SCAR Report 9 (Attachment 3). These guidelines are recommended to protect the intellectual property rights of Antarctic data collectors and to promote cooperative research projects.

(1) **Within 2 years of data collection:**

Data collectors have exclusive rights to the use of their data.

(2) **From 2 to 8 years following data collection:**

Data in the SDLS are subject to the following restrictions:

a. The data can only be used for research, and not for commerce.
b. Data can be used only in cooperative research studies with the data collector, and the data collector must be offered authorship on research papers based on his or her data.
c. The data collector must be given a copy of all research products based on his or her data, including copies of the reprocessed data.
d. The source of data must be properly cited in all reports.
e. Data at each SDLS branch will be overseen by a senior Antarctic research scientist residing at that branch.
f. Interested users can directly appeal to the data collector to share the SEG-Y data and establish collaborations for surveys that are not publicly available yet.

(3) **After 8 years from data collection:**

Data become publicly available at the SDLS web portal:

a. The web portal requires a login and creation of account for data download to keep track of who downloaded which data.

b. The SDLS encourages collaboration with the original data collectors. The data used must be properly cited. Users are encouraged to cite the data that they are working with using the DOI. Usually, one DOI will be created for each survey. Users of single lines can use the DOI for the whole survey as a citation of the data source.

The above guidelines give the data collectors some "rights" to control the use of their data. These "rights" come with the implicit understanding that access to MCS data for cooperative research projects proposed by other scientists will only be denied when the proposed research directly conflicts with active research projects currently being conducted by the data collector. Such "rights" and restrictions on use of data in the SDLS will encourage timely contributions of data to the SDLS and will promote greater involvement in cooperative Antarctic seismic studies.

If data from the SDLS are used for published research, we recommend mentioning the use of the SDLS in the acknowledgments; for example, by adding:

"This research used data provided by the Scientific Committee on Antarctic Research (SCAR) Seismic Data Library System (SDLS)"

An example citation for a dataset citation would be:

"*OGS (1995). Processed Multi-Channel Seismic data from 1994/95 Antarctic Peninsular OGS Explorer cruise - IT95AP, SDLS, doi: 10.6092/SDLS.269498AE-CBA2-11E8-AD51-52540085A32B*."

The authors should also notify the SDLS of manuscript submission and submit complete citation information upon acceptance.

5. Recommendations for future developments

Besides the new SDLS guidelines and structure described above, the SDLS community has identified several directions for future developments, which at least in part are dependent on additional funding. These include:

- improve usability of the web portal;
- open for new developments in technology and data management;
- inclusion of legacy Single Channel Seismic (SCS) data into the SDLS (which would likely follow the cost model described above in section 4.4) and require additional funding since the original project has probably long ended;
- check and update data format to allow direct use for IODP proposals (see IODP current guidelines);
- Another important task for SDLS over the next few years will be improving integration and engagement of a new generation of Antarctic researchers as well as nations that recently resumed seismic work in Antarctica, including China and Japan.

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Appendix 1: Detailed data and metadata submission guidance

A1.1 Procedure:

Navigation and survey metadata should be submitted to the SDLS as soon as possible after the survey. This will make other groups aware of the survey and will help to avoid duplication. Data are to be submitted later once data products fitting requirements for data upload are derived. If possible, data providers are encouraged to start the submission of seismic data before the two-year period of proprietary use has finished.

All information should be submitted to the central library, currently OGS, using email (e.g. sdls@inogs.it). Other means of data transfer should be previously agreed upon with the SDLS management team at OGS that can be reached at the same email address.

Navigation and metadata should list all the information needed otherwise it will not be possible to publish data in the portal. In filling metadata, please use the fields listed in table 1.A and 1.B. In preparing navigation and the actual data, please follow the requirements in section A1.3.

A1.2 Metadata structure:

Metadata are gathered in two classes: Survey metadata and Seismic line metadata (Figure A1).

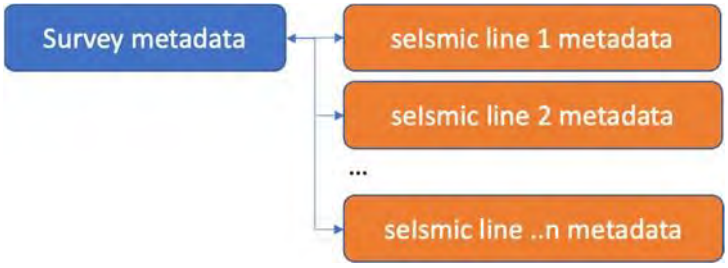

Figure A.1: *Metadata structure*

The reason for this distinction is related to the adoption of international standards but also to legacy practices derived from former SDLS system implementations.

Information related to a survey do not (so far) refer to controlled vocabularies. This is due to compatibility with information entered in previous SDLS versions and has been chosen to ease the first steps of data upload. The required fields are listed in Table A1-1.

Information related to the actual seismic data (line) on the contrary need more efforts to be handled correctly, and in the perspective of interoperability with other systems need the introduction of international standards such as OGC O&M and SensorML. The compilation of such metadata in the proper XML format is left to the SDLS administrator, while the data provider is requested to provide the necessary metadata values using the datatypes and terms listed in table A1-2. These terms refer to internationally standardized controlled vocabularies. To ease data entry, in this version of the portal, they will be formatted correctly by the SDLS OGS team

upon actual upload. It is to be noted that OGC standards require more fields than those listed in Table A2; this problem will be managed directly by the system administrator. In case of doubt, the data provider will be contacted in order to fix possible issues.

A1.3 Survey Metadata:

Survey metadata refers to all generic metadata available regarding an acquisition survey. Fields consist mostly of unstructured string datatypes. The information there contained will be used to create records in the database and XML files to be published in the SDLS portal. The same record for a survey will be linked to all the seismic lines acquired within the same survey. Submissions should contain such information as separate text file or in an email sent to the SDLS team.

Table A1-1: *Required and recommended metadata for survey submission:*

<Survey>		
	SurveyName or CruiseID	[string]
	Description	[string] Please describe original aims of the survey
	Platform/ShipName	[string]
	StartDate	[dd/mm/yyyy]
	End date	[dd/mm/yyyy]
	PortOfDeparture	[string]
	PortOfreturn	[string]
	Number of lines	[integer]
	PI (contact, can be multiple)	Family name [string] Name [string] – Institution [string] – email address [string]
	ResponsibleInstitution (can be multiple)	[string]
	DataProvider	[string] If different from Institution
</Survey>		

A1.4 Seismic line Metadata:

Seismic line metadata refers to detailed information needed to describe the data acquired in discovery and to run the SDLS portal itself. Seismic line metadata are therefore very important and should be entered with great care. Seismic line metadata use BODC controlled vocabularies that are used by many international initiatives allowing the SDLS to be interoperable with them. To ease entering this information, Table A1-2 lists the terms that should preferably be used. Submissions should contain such information as separate text file or in an e-mail sent to the SDLS team.

Table A1-2: *Required and recommended metadata for seismic lines:*

<Characteristics>		
	<Overall infos>	
	Dimensionality	List: • 2D • 3D • 4D
	DataProduct	List: • Field data - Single fold continuous profile • Processed - Single fold continuous profile • Stacked • migrated • Other
	OverallQuality	List: • 0 [unknown (none)] • 1 [good (good)] • 2 [fair (probably_good)] • 3 [poor (probably_bad)] • 4 [bad (bad)]
	</Overall infos>	
	<Source>	
	SourceType	List: • Boomer • Air gun (single) • Air gun (array) • Sparker • Flexichoc • Flexotir • Watergun • GI-gun, • Aquapulse, • Vaporchoc, • Single-bubble airgun • Other [string] please provide description [include volume cu in or litre]
	ShotDistance	[float] [uom=metres] this is the distance between two consecutive shot (it is assumed that this distance is constant)
	</Source>	
	<Receiver Configuration>	
	ReceiverType	[string] please provide description
	FirstChan	[integer]
	LastChan	[integer]

	FirstChanOffset	[float] [uom=metres]
	LastChanOffset	[float] [uom=metres]
	<Acquisitor>	
	SamplingInterval	[float][uom = microsec, BODC voc P61]
	SamplesPerTrace	[integer]
	RecordingDelay	[float] uom = microsec (recommended if exist)
	</Acquisitor>	
	</Acquisitor>	
	</Acquisitor>	
<Capabilities>		
	TopBandwidth	List: • up to 60 HZ • up to 250 HZ • up to 1000 HZ • up to 2000 HZ • higher than 2000 HZ
</Capabilities>		

A1.5 Navigational data:

Before submission, all navigation data should be already transformed, if necessary, to EPSG: 4326 (Geographic Coordinates based on WGS84) before submission. Navigational data should preferably be submitted using the UKOOA P1/90 format, but a comma separated ASCII file with the following fields: Line name, shot point, latitude, longitude, listed in columns for each seismic line can be accepted.

File naming should follow the convention:

Surveyname.uko (if single ukooa file per survey)
Surveyname_linename.uko (if multiple ukooa files per survey)
Surveyname_linename.csv (if not ukooa)

A detailed description of the UKOAA format can be seen
https://seg.org/Portals/0/SEG/News%20and%20Resources/Technical%20Standards/seg_ukooa_ads_meta_format_ver1.pdf

UKOOA Mandatory and Recommended headers:

Since all UKOOA fields accept free text, no automatic validation based on a vocabulary is possible. It is therefore quite easy to introduce errors. This information will be present also in the O&M extension to the CDI where instead validation will be performed. Once the end user receives the data, this can be analysed separately from the CDI and its O&M extension, then it could be of some help to find immediately some critical information. We suggest including in the P1/90 file the following basic information in the header section:

Mandatory ----

H0800 Co-ordinate location Centre of Source

H8000 EPSG Geographic CS NameWGS84 Geographic 2D

H8001 EPSG Geographic CS Code 4326

Recommended---

H0100: Area of the survey

H0102: Vessel detail. In case this header is used, after the name of the vessel (at columns 60) an ID code should be entered for the latter. We suggest of course using the integer "1". The P1/90 format prescribes that the following data record describing shots should report this identification code in column 17.

H0103: Source detail. In this header, it is possible to place the type of source used. In case this header is used after the type of the source (at columns 60), an ID code should be entered for the latter. We suggest of course using the integer "1". The P1/90 format prescribes that the following data record describing shots should report this identification code in column 18.

H0200: Survey date.

A1.6 SEG-Y Data transport format (seismic data):

Seismic data should be submitted to the central library, currently OGS, as stacked or migrated (preferred) sections in SEG-Y format (https://seg.org/Portals/0/SEG/News%20and%20Resources/Technical%20Standards/seg_y_rev2_0-mar2017.pdf).

Contact the library (e.g. pdiviacco@inogs.it) to arrange the data transfer. Suggested SEG-Y file-naming format:

InstitutionAcronym _Year_(survey name or acronym)-lineNumber

e.g.: IT88A-06 (or OGS1988_IT88A-06)

Referring to the schema in figure A.1, the SEG-Y trace header should be populated as follows:

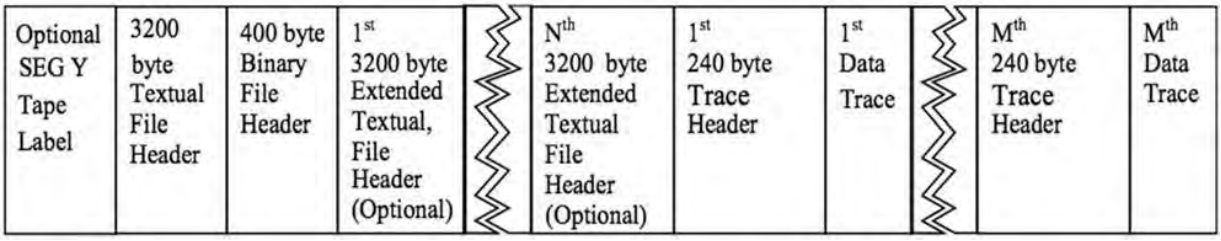

Figure A.2: *Required SEG-Y data structure.*

The first 3200-bytes, textual file header record contains 40 lines of 80 columns textual information. These provide a human-readable description of the seismic data in the file. This information is in free form, although SEG provide a suggested layout for the first 20 lines.

In order to ease the work of data managers, we suggest reporting here, in a free-text format, only the following information:

- The owner or provider of the data
- The platform / ship
- Survey ID, line number, year

Binary File Header

The Binary File Header contains binary values that affect all the seismic line.

Also here, to ease the work of data managers, we list the mandatory fields. Other header fields are optional and it is up to the submitter to fill them.

Table A1-3: *List of required and suggested binary file header values.*

Bytes loc.	description	mandatory
3217-3218	Sample interval **(microseconds)**	yes
3221-3222	n samples per data trace	yes
3225-3226	Data sample format code	yes
	1= 4-byte IBM floating point (recommended) (*) 2= 4-byte, two's complement integer 3= 2-byte two's complement integer 4= 4-byte fixed point with gain (obsolete) 5= 4-byte IEEE floating point 6= not used 7= not used 8= 1-byte, two's complement integer	
3227-3228	CDP fold	if available
3229-3230	trace sorting -1=Other (should be explained in text header) 0=Unknown 1= as recorded (no sorting) 2= CDP ensemble 3= single fold continuous profile 4= Horizontally stacked 5= common source 6= common receiver 7= common offset 8= common mid-point 9= common conversion point	yes
3251-3252	Gain recovery 1= yes 2= no	If Vintage data
3253-3254	Gain recovery method 1= none 2= spherical divergence 3=AGC 4=Other	If Vintage data

Trace header

The trace header contains trace attributes, which are defined as two-byte or four-byte two's complement integers. The values in byte 1-180 were defined in the 1975 standard and these entries remain unchanged in the revision 1. Bytes 181-240 were for optional information originally and this has been the main area where dialects were developed.

There have always been ambiguities regarding where to put the shot-point number. Byte 9-12 is reserved for original filed record number. Byte 17-20 can be used when more than one record occurs at the same effective surface locations, then SEG-Y revision1 recommends moving the Shot point number field to byte 197-202, but at the same time SEG acknowledge that this works only in the case of 2D post-stack data. Many interpretive and processing software do not seek automatically shot point values at byte 197-202, rather at byte 17-20 or even 9-12. Then we suggest copying the shot point value in all three locations.

Table A1-4: *List of required and suggested SEG-Y trace header values.*

bytes	description	mandatory
1-4	Trace sequence number within line – numbers continue to increase if the same line continues across multiple SEG-Y files	yes
9-12	original FFID (*)	yes
13-16	Trace number within the original field record	If pre-stack
17-20	Energy Source point (*)	yes
21-24	CDP (assumes geometry is installed)	if available
25-28	trace within CDP (assumes geometry is installed)	if available
29-30	Trace ID should be 1 (possibly dead/dummy).	yes
37-40	offset (assumes geometry was already installed + pre-stack)	If available
41-44	Receiver elevation (see 45-48)	
45-48	to be discussed: delays should be applied or only reported see also byte 109 If used, bytes 69-70, scaler be applied to all elevations and depths specified in bytes 41-68	
69-70	Scalar for elevations	
109-110	Delay recording time See 45-48	
115-116	n samples	yes
117-118	sample interval in microsec	Yes
197-202	Shot-point number (*)	2D post-stack

(*) the same value is stored at byte 9-14, 17-20, 197-202

Appendix 2: Detailed list of surveys without SEG-Y data submission

This appendix provides more detailed information on the datasets that SDLS is aware of, but has not yet received the actual seismic data. These are surveys where only navigation data have been submitted so far while no SEG-Y data has been yet made available by the data owner. Surveys that acquired data over eight years ago, and for which the data are therefore overdue, are highlighted in red. These include some older surveys (1990s and earlier) for which the data might be lost, while most of them are more recent but data have not been submitted yet.

Table A2-1: *List of surveys where only navigation is available while no SEG-Y data has been submitted yet. Surveys in red have been collected more than eight years ago.*

Cruise	Area	Season	Group	Country	MCS (km)
SAE-26	WS	1980/1981	PMGRE	USSR	750
SAE-27	WS	1981/1982	PMGRE	USSR	820
SAE-31	PB	1985/1986	PMGRE	USSR	930
SAE-32PB	RS	1986/1987	PMGRE	USSR	4320
MD47	PB	1986	EOST	France	1612
ANT-VI-2	AP	1987/1988	AWI/IG Kiel	Germany	1400
D172	AP	1987/1988	BAS	UK	3640
SAE-33	PB	1987/1988	PMGRE	USSR	3710
SAE-35	AP	1989/1990	SMG/MAGE	USSR	3010
MD67	PB	1991	EOST	France	1194
ANT-XIII-3	WS	1995/1996	AWI	Germany	500
SCAN-97	AP	1996/1997	IACT/CSIC/UGR	Spain	3778
SCAN2001	AP	2000/2001	IACT/CSIC/UGR	Spain	2576
ANT-XVIII-5A	AP/MBL	2000/2001	AWI/VI	Germany, Russia	572
ANT-XIX-2	AP	2001/2002	AWI/ING	Germany Italy	2930
COHIMAR	AP	2001/2002	UB/ICM-CSIC/OGS	Spain/Italy	1260
KSL02	AP	2002/2003	KORDI	Korea	570
KSL03	AP	2003/2004	KORDI	Korea	640
KSL04	AP	2004/2005	KOPRI	Korea	740
SCAN2004	WS	2004/2005	IACT/CSIC/UGR	Spain	2791
ANT-XXIII-4	MBL	2005/2006	AWI/BAS/VI	Germany, UK, Russia	2227
WISE	RS	2005/2006	OGS	Italy	1358
TAN0602	RS	2005/2006	LINZ	New Zealand	3400
DRAKE2008	WS	2008	IACT/CSIC/UGR	Spain	600
SCAN2008	WS	2008	IACT/CSIC/UGR	Spain	1600
RAE-54	PB	2008/2009	PMGRE	Russia	3000
ANT-XXVI-3	MBL	2009/2010	AWI	Germany	5000
RAE-55	WL	2009/2010	PMGRE	Russia	4200
RAE-56	QML	2010/2011	PMGRE	Russia	3235

Cruise	Area	Season	Group	Country	MCS (km)
RAE-57	PB	2011/2012	PMGRE	Russia	2671
RAE-58	QML	2012/2013	PMGRE	Russia	3255
CHINARE30	RS	2013/2014	SIO	China	325
NBP1402	WL	2014	NSF	USA	1066
RAE-59	WL	2014	PMGRE	Russia	4480
BAS-145	AP	2015	BAS	UK	2183
CHINARE31	RS	2014/2015	SIO	China	515
NBP1502B	RS	2015	NSF	USA	854
RAE-60	CS	2015	PMGRE	Russia	3150
CHINARE32	RS	2015/2016	SIO	China	752
RAE-61	QML	2016	PMGRE	Russia	3000
CHINARE33	RS	2016/2017	SIO	China	536
PS104 -3	AS	2016/2017	AWI	Germany	799
RAE-62	PB	2017	PMGRE	Russia	3215
TYTAN	WL	2017	OGS	Italy	352
RAE-63	WL	2018	PMGRE	Russia	2650
RAE-64	RS	2019	PMGRE	Russia	2000
RAE-65	RLS	2020	PMGRE	Russia	3575

Note:
AS Amundsen Sea
AP Antarctic Peninsula
CS Cosmonauts Sea
MBL Mary Byrd Land
PB Prydz Bay
QML Queen Maud Land
RLS Riiser-Larsen Sea
RS Ross Sea
WL Wilkes Land
WS Weddell Sea

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Appendix 3: SDLS Founding documents (1991) for reference

SCAR Report #9 (partial) and ATCM XVI-12 (complete)

SCAR Report # 9 – August 1992

A SCAR Seismic Data Library System for Cooperative Research:
Summary Report of the International Workshop on Antarctic Seismic Data
Oslo, Norway, 11-15 April 1991.

Page 6:

"A new data system [i.e. the SDLS] must have low operational costs and management requirements, and must compliment existing local, regional, and world-wide data management systems.

Also, a new system must

a. be implemented quickly,
b. be based on modern technology available to all countries,
c. be easily accessible to all Antarctic researchers,
d. be operated and overseen by those within the geoscience community (i.e. SCAR),
e. be paid for by all seismic-data contributors and users of the system (not by SCAR), and
f. be coordinated with the World Data Centers."

"The SDLS described below was recommended to the SCAR Executive Committee, and was formally endorsed by them as a SCAR initiative in early June 1991.

As structured, the SDLS will be a new and separate entity that will not alter or supercede

a. existing national data policies,
b. data ownership (i.e. by data collectors) and its implied rights, or
c. World Data Center policies and procedures."

Page 7:

"Once fully implemented, the SDLS will have library branches located worldwide at research institutions that have collected Antarctic MCS data, that have given these data to the SDLS, and that wish to host a library branch.

Every library branch will have copies of all MCS data that have been given to the SDLS ~~based on the time-guidelines outlined below~~. Seismic data will be available in digital format ~~on CD-ROMs (Compact Disc - Read Only Memory)~~ at all branches ~~and on paper rolls at branches with adequate facilities~~. Library branches will be open to all researchers who wished to view or study the seismic data, but restrictions will apply for a specific period regarding the use and copying of the data as outlined below."

“Time Guidelines

The following will apply to newly collected and existing data:

1. For a period of up to ~~four~~ 2 years after data collection, the data will remain in the data collector's archives. This period will allow time for processing, interpretation, and first publication by the data collectors and their chosen colleagues, if any.
2. To the greatest extent feasible and practicable, data will go into the SDLS ~~four~~ 2 years after data collection (or earlier, if possible). Data will remain in the SDLS ~~for 4 years, or~~ until 8 years from the time of data collection, before being sent to the World Data Centers or other data bank for general release. While in the SDLS, data will be subject to the data-use guidelines listed below.
3. Existing data will be subject to the same time-guidelines as future data sets. ~~In practice, some time will be needed to edit and format data for the CD-ROMs, which will be used to send data to the SDLS branch libraries and World Data Center (or alternative).”~~

Pages 7 and 8:

“Data-use Guidelines

The following guidelines will apply to the use of MCS data. These guidelines are recommended to protect the intellectual property rights of Antarctic data collectors and to promote cooperative research projects.

1. Data collectors will have exclusive rights to the use of their data ~~until the data are sent to the SDLS~~ within ~~four~~ 2 years from the time of data collection.
2. Data that are in the SDLS (i.e. during the period of up to 8 years following data collection) will be subject to the following restrictions:
   a. The data can only be used for research, and not for commerce.
   b. Copies of the collector's data can only be ~~made and~~ removed from the SDLS branches with the consent of the data collector. ~~Branches will not generally be equipped to make large volumes of data copies or large-size copies on-site. Large~~ requests for data copies must be directed to the data collector.
   c. Data can be used only in cooperative research studies with the data collector, and the data collector must be offered authorship on research papers based on his or her data.
   d. The data collector must be given a copy of all research products based on his or her data, including copies of the reprocessed data.
   e. The source of data must be properly cited in all reports.
   f. Data at each SDLS branch will be overseen by ~~a librarian and~~ a senior Antarctic research scientist residing at that branch.”

“The above guidelines give the data collectors some "rights" to control the use of their data. These "rights" come with the implicit understanding that access to MCS data for cooperative research projects proposed by other scientists will only be denied when the proposed research directly conflicts with active research projects currently being conducted by the data collector. Such "rights" and restrictions on use of data in the SDLS will encourage timely contributions of data to the SDLS and will promote greater involvement in cooperative Antarctic seismic studies.”

Note: Other parts of SCAR Report #9 are excluded from Appendix 3 because they are no longer relevant due to technology upgrades of the SDLS since 1991.

ATCM Recommendation XVI-12

From the final report of the XVI Antarctic Treaty System meeting
1991, Bonn, Germany
https://documents.ats.aq/ATCM16/fr/ATCM16_fr001_e.pdf, p.129

XVI - 12

ACCESSIBILITY OF ANTARCTIC GEOPHYSICAL DATA

The Representatives,

Recalling that Article 3 of the Antarctic Treaty requires that scientific data be exchanged and made freely available;

Noting that Article 7 of the Protocol on Environmental Protection to the Antarctic Treaty signed in Madrid on 4 October, 1991 prohibits any activity relating to mineral resources other than scientific research;

Aware that solid earth science disciplines have made major contributions to the understanding of our planet, and that such work has long been recognised as having global significance as applied inter alia to studies of plate tectonics and Antarctic glacial history including its effects on world climate;

Reiterating the importance of pursuing geological and geophysical research and their commitment to the disclosure, availability and timely publication of scientific results;

Recommend to their governments that the Seismic Data Library System (SDLS) approved by the SCAR Executive in 1991 and described in the report "A SCAR Seismic Data Library System for Co-operative Research" of the SCAR Group of Specialists on the Evolution of Cenozoic Paleoenvironments of the Southern High Latitudes (GSC) - Antarctic Offshore Acoustic Stratigraphy Project (ANTOSTRAT) be implemented. The SDLS requires inter alia that digital data from multichannel seismic reflection surveys be sent to the SDLS within four years of collection and eight years after collection to the World Data Centres or other archives for general dissemination.

Appendix 4: List of SDLS branches with contacts

Country	SDLS Branch and Address	Senior Antarctic Researcher
Australia	Canberra Branch: Geoscience Australia	Dr. Jodie Smith Email: jodie.smith@ga.gov.au
Brazil	Rio De Janeiro Branch: Universidade Federal Fluminense Laboratorio De Geologia Marinna - Lagemar	Dr. Luiz A. P. Gamboa Email: gamboa@petrobras.com.br
France	Strasbourg Branch: Ecole et Observatoire des Sciences de la Terre CNRS - Université de Strasbourg	Dr. Marc Schaming Email: Marc.Schaming@unistra.fr
Germany	Bremerhaven Branch: Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung	Dr. Karsten Gohl Email: karsten.gohl@awi.de
Germany	Hannover Branch: Bundesanstalt fur Geowissenschaften und Rohstoffe	Dr. Axel Ehrhardt Email: Axel.Ehrhardt@bgr.de
Italy	Trieste Branch: Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS)	Dr. Paolo Diviacco Email: pdiviacco@ogs.trieste.it
Japan	Tsukuba Branch: Geo-Resources & Environment Geological Survey of Japan	Dr. Manabu Tanahashi Email: tanahashi-m@aist.go.jp
Korea	Incheon Branch: Korea Polar Research Institute	Dr. Jongkuk Hong Email: jkhong@kopri.re.kr
Norway	Bergen Branch: Seismological Observatory University of Bergen	Dr. Yngve Kristoffersen Email: Yngve.Kristoffersen@geo.uib.no
Russia	St.Petersburg Branch: VNIIOkeangeologia	Dr.German Leitchenkov Email: german_l@mail.ru
Spain	Madrid Branch: Instituto Geologico y Minero de Espana (IGME)	Dr. Fernando Bohoyo Email: f.boyoho@igme.es
United Kingdom	Cambridge Branch: British Antarctic Survey	Dr. R.D. Larter Email: r.larter@bas.ac.uk
USA	LDEO Branch: Lamont-Doherty Earth Observatory of Columbia University	Dr. Frank O. Nitsche Email: fnitsche@ldeo.columbia.edu
USA (former)	Menlo Park Branch: U.S. Geological Survey	Dr. Alan Cooper Email: akcooper@pacbell.net
China (in review)	Hangzhou Branch: Second Institute of Oceanography, MNR	Dr. Jinyao GAO Email: gaojy@sio.org.cn
New Zealand (in review)	Wellington Branch: GNS - CRI	Stuart Henrys Email: S.Henrys@gns.cri.nz

Appendix 5: List of Acronyms

ACE	Antarctic Climate Evolution
ANDRILL	Antarctic Geological Drilling
ANTOSTRAT	Antarctic Offshore Stratigraphy project
ASCII	American Standard Code for Information Interchange
BODC	British Oceanographic Data Centre
CD	Compact Disc
CD-ROM	Compact Disc Read-Only Memory
CIROS-1	Cenozoic Investigations in the western Ross Sea
CRP	Cape Roberts Project
DVD	Digital Versatile Disc
FAIR	Data principles of Findable, Accessible, Interoperable, and Reusable
GIS	Geographic Information System
INOGS	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Italy
INSTANT	INStabilities & Thresholds in ANTarctica
IODP	International Ocean Discovery Program (formerly Integrated Ocean Drilling Program)
ISAES	International Symposium on Antarctic Earth Sciences
ISO	International Organization for Standardization
Ma	million years (Geological age)
MCS	marine multi-channel seismic (data)
MeBo	Meeresboden-Bohrgerät drill rig
MS-DOS	Microsoft Disk Operating System
ODP	Ocean Drilling Program
OGC O&M	Open Geospatial Consortium Observations and Measurements
OGS	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Italy
PAIS	Past Antarctic Ice Sheet dynamics
PI	Principal Investigator
PRAMSO	Paleoclimate Records from the Antarctic Margin and Southern Ocean
SCS	Single Channel Seismic data
SDLS	Antarctic Seismic Data Library System for Cooperative Research
SEG-Y	File format developed by the Society of Exploration Geophysicists
SensorML	Sensor Model Language, an Open Geospatial Consortium (OGS) standard
SHALDRIL	Shallow Drilling on the Antarctic Continental Margin
UKOOA	United Kingdom Offshore Operators Association
USGS	United States Geological Survey
WFS	Web Feature Services
WMS	Web Map Services