

# Ice Core Working Group Virtual Meeting Data Archiving

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# Summary

With a relatively minor reorganization of data sharing workflow, the US ice core community could greatly contribute to a number of open research data initiatives: e.g.,

Open Data (**ELSEVIER**)

<https://open.nasa.gov/open-data/> (Open Data NASA)

[https://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=nsf15052](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf15052)

FAIR Principles

DataONE

PaCTS and LiPD standards



# Ice core sites

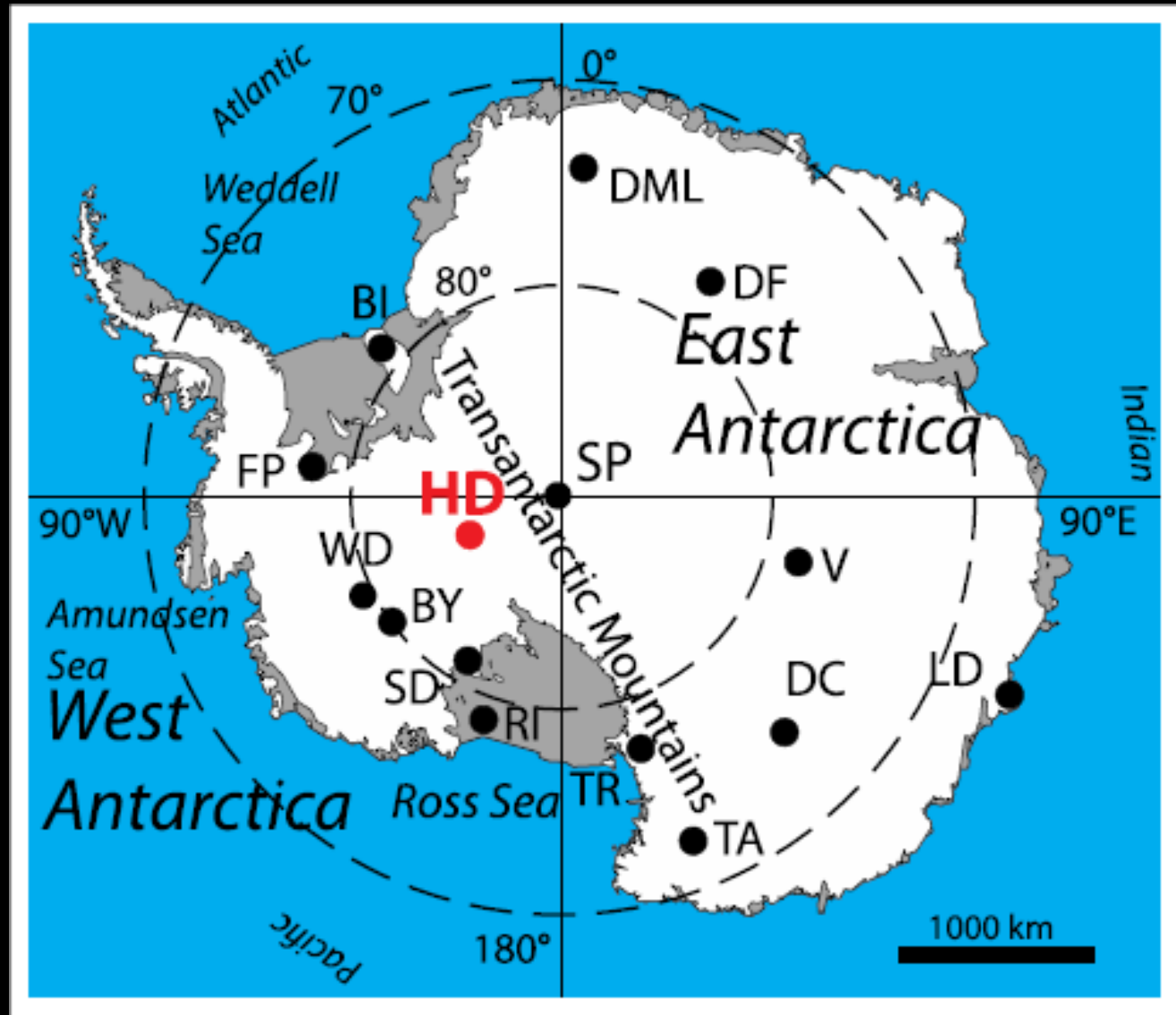




Map of Antarctica with deep ice-core locations labeled: South Pole (SP, to be drilled), Berkner Island (BI), Byrd (BY), EPICA Dome C (DC), Dome Fuji (DF), Dronning Maud Land (DML), Fletcher Promontory (FP), Law Dome (LD), Roosevelt Island (RI), Siple Dome A (SD), Talos Dome (TA), Taylor Dome (TR), Vostok (V), WAIS Divide (WD).

Casey, K., Fudge, T., Neumann, T., Steig, E., Cavitte, M., & Blankenship, D. (2014). The 1500 m South Pole ice core: Recovering a 40 ka environmental record. *Annals of Glaciology*, 55(68), 137-146. doi: 10.3189/2014AoG68A016



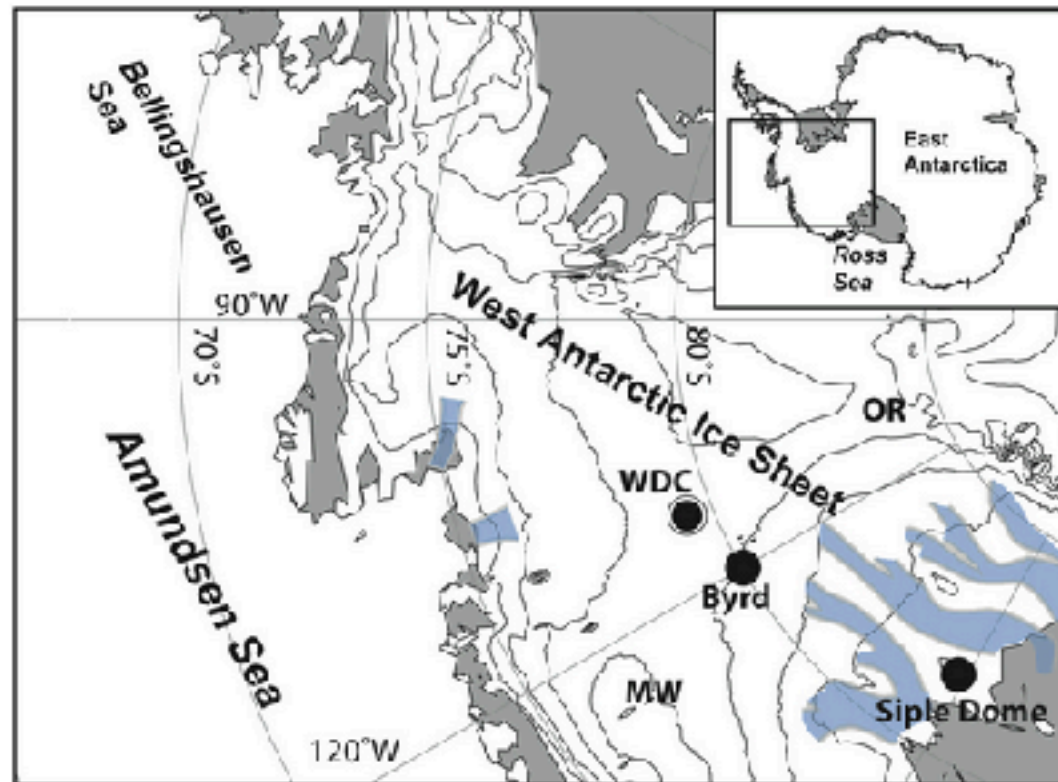


The new ice core will be drilled at Hercules Dome at 86 degrees South, about 400 kilometers (250 miles) from the South Pole and 1,000 km (650 miles) from today's coastline. This map shows the sites of previously drilled Antarctic ice cores. University of Washington

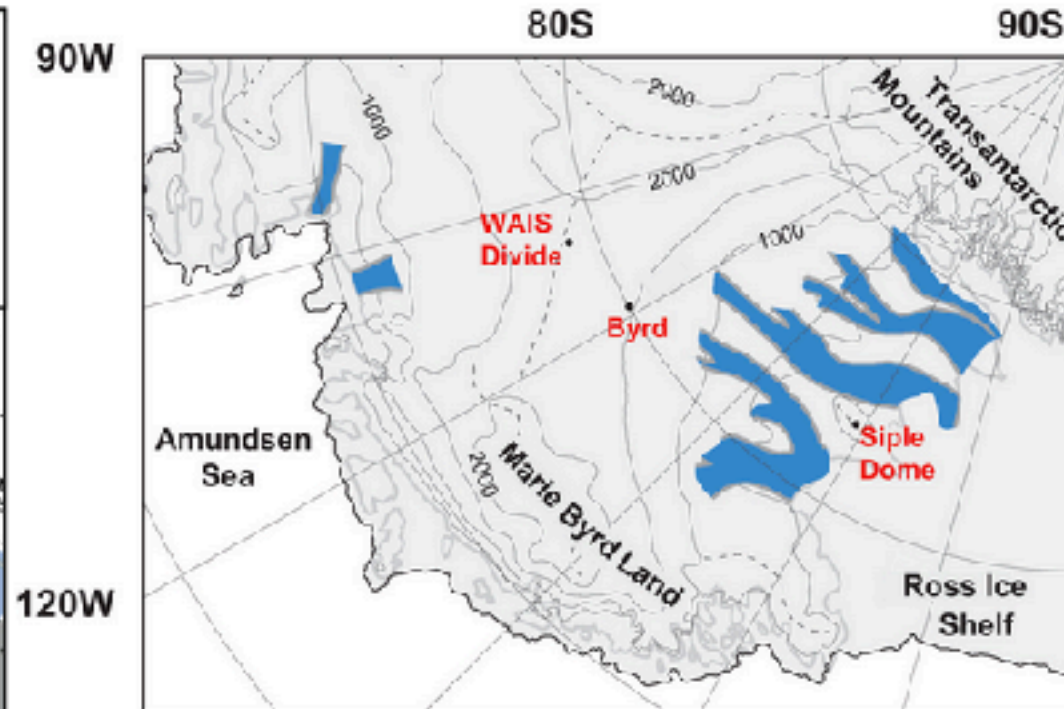
<https://www.washington.edu/news/2020/12/08/hercules-dome-ice-core/>



## MAPS & DRAWINGS



Map of West Antarctica. Locations of the WAIS Divide (WDC), Byrd, and Siple Dome ice cores and the Ohio Range (OR) and Mt. Waesche (MW) are shown. Ice shelves are shown in gray. Siple Coast and Amundsen Sea ice streams are shown by blue shading. Contour interval is 500 meters. Credit: T.J. Fudge [DOWNLOAD FILE](#)



Map of West Antarctica. Locations of the WAIS Divide, Byrd, and Siple Dome ice cores are shown. Siple Coast and Amundsen Sea ice streams are shown by blue shading. Contour interval is 500 meters. Credit: Howard Conway [DOWNLOAD FILE](#)

<https://waisdivide.unh.edu/documentation/#mapsdrawings>









# Ice core info on the www

- <https://www.ncdc.noaa.gov/data-access/paleoclimatology-data/datasets/ice-core>
- <https://www.usap-dc.org>
- <https://arcticdata.io>
- <https://qgreenland.org/>
- <https://www.npolar.no/en/quantarctica/>
- <http://icereader.org>
- [https://en.wikipedia.org/wiki/List\\_of\\_ice\\_cores](https://en.wikipedia.org/wiki/List_of_ice_cores)



### GISP drilling operations<sup>[1]</sup>

Year	Location	Coordinates	Type of drill	Core diam. (cm)	Depth (m)	
1971	Dye 3 ←	 65°11'N 43°49'W	Thermal	10.2	372	CARREL th
1972	North Site	 75°45'N 42°27'W	SIPRE	7.6	15	
1972	Crete	 71°07'N 37°19'W	SIPRE	7.6	15	
1973	Milcent	 70°18'N 45°35'W	Thermal	12.4	398	CARREL th
1973	Dye 2	 66°23'N 46°11'W	Shallow	7.6	50	
1974	Crete	 71°07'N 37°19'W	Thermal	12.4	405	CARREL th
1974	Dye 2	 66°23'N 46°11'W	Shallow	10.2	101	
1974	Summit	 71°17'N 37°56'W	Shallow	7.6	31	
1975	Dye 3 ←	 65°11'N 43°49'W	Shallow	7.6	95	
1975	South Dome	 63°33'N 44°36'W	Shallow	7.6	80	
1975	Hans Tausen	 82°30'N 38°20'W	Shallow	7.6	60	
1976	Dye 3 ←	 65°11'N 43°49'W	Wireline	10.0	93	CARREL w
1976	Hans Tausen	 82°30'N 38°20'W	Shallow	7.6	50	
1977	Camp Century	 77°10'N 61°08'W	Shallow	7.6	100	
1977	Dye 2	 66°23'N 46°11'W	Shallow	7.6	84	
1977	North Central	 74°37'N 39°36'W	Shallow	7.6	100	
1977	Camp III	 69°43'N 50°08'W	Shallow	7.6	49	
1978	Dye 3 ←	 65°11'N 43°49'W	Shallow	10.2	90	
1978	Camp III	 69°43'N 50°08'W	Shallow	7.6	80	
1979-1981	Dye 3 ←	 65°11'N 43°49'W	Thermal & electromechanical	10.2	2037	CARREL th

There was a follow-up U.S. GISP2 project, which drilled at a glaciologically better location on the summit of the ice sheet. This

[https://en.wikipedia.org/wiki/Greenland\\_Ice\\_Sheet\\_Project](https://en.wikipedia.org/wiki/Greenland_Ice_Sheet_Project)





# Austin Carter

Developing a comprehensive list of ice cores



# Ice core measurements



## DESCRIPTION:

An 80.4m ice core was recovered in August 1998 from a site at 6500m above sea level from the East Rongbuk (ER) Glacier(27°59'N, 86°55'E), less than 5km northeast of the peak of Mt. Qomolangma (Everest),

## DATA:


Column 1: Depth(cm)  
 Column 2: dating  
 Column 3: (18O (‰)  
 Column 4: NH4+ (ppb)  
 Column 5: Na+ (ppb)  
 Column 6: K+ (ppb)  
 Column 7: Cl- (ppb)  
 Column 8: Mg2+ (ppb)  
 Column 9: Ca2+ (ppb)  
 Column 10: SO42- (ppb)  
 Column 11: NO3- (ppb)

Depth(cm)	dating	d18O	NE4+	Na+	K+	Cl-	Mg2+	Ca2+	SO42-	NO3-
2.50	1997.93	-13.91	175.69	27.11	14.59	49.92	4.55	120.75	96.21	32.18
7.50	1997.86	-18.07	175.69	6.89	3.47	8.03	4.23	198.75	29.65	17.47
12.50	1997.79	-18.78	59.88	5.41	4.83	5.75	2.45	78.32	27.26	21.90
17.50	1997.71	-18.99	60.40	5.48	4.96	5.95	2.53	74.46	27.99	21.98
21.50	1997.64	-19.67	62.26	5.71	4.03	6.14	1.80	55.94	18.04	13.08
25.50	1997.57	-19.23	24.54	2.88	2.11	3.90	0.96	50.08	8.91	6.51
29.50	1997.50	-17.67	33.23	7.80	5.85	7.47	2.75	94.36	20.44	12.98
33.50	1997.43	-17.04	44.46	10.43	11.55	13.26	3.02	81.14	35.66	17.89
37.50	1997.36	-17.17	38.46	8.32	5.59	12.93	2.47	107.46	33.57	15.97
41.50	1997.29	-16.44	42.66	9.60	7.14	18.14	2.40	64.93	35.78	23.46
45.50	1997.21	-16.20	72.61	26.61	16.57	46.16	3.04	93.06	40.88	21.51
49.50	1997.14	-16.44	48.79	6.84	3.68	10.94	2.39	103.08	48.02	21.74
53.50	1997.07	-16.33	95.74	11.82	4.13	14.33	4.79	140.06	57.37	33.94
57.50	1997.00	-15.82	127.15	58.56	30.45	73.65	12.10	110.51	93.21	27.61
61.50	1996.93	-16.26	187.23	36.17	22.75	96.26	13.69	91.04	87.68	22.12
65.50	1996.87	-16.71	55.60	30.56	50.79	58.34	20.77	110.52	3.99	26.72
69.50	1996.80	-18.02	21.79	10.50	5.56	16.49	6.42	176.11	80.69	46.62

<https://www.ncei.noaa.gov/pub/data/paleo/icecore/trop/everest/rongbuk.txt>



# Arctic data center



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Melinda Nicewonger, Murat Aydin, and Eric Saltzman. 2019. [Ice core ethane and acetylene measurements, Greenland and Antarctica, 0-1900 CE](#). Arctic Data Center. doi:10.18739/A2J09W45H.

Citations 1

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Assessment report

Files in this dataset: Package: icecore\_ethane\_urn:uuid:b756a396-c1f9-4f0e-9f8f-cba0ff81f44f

Name	File type	Size	Download All
Metadata: ice_core_ethane_and_acetylene_measurements.xml	EML v2.2.0	69 KB 45 views	Download
WDC05A_Ethane.txt	<a href="#">More info</a> plain text (.txt)	671 B 13 downloads	Download
WDC05A_EthaneAcetylene_2ky.txt	<a href="#">More info</a> plain text (.txt)	1 KB 14 downloads	Download
WDC06A_Ethane.txt	<a href="#">More info</a> plain text (.txt)	885 B 12 downloads	Download
WDC06A_EthaneAcetylene_2ky.txt	<a href="#">More info</a> plain text (.txt)	3 KB 9 downloads	Download
SPC14_Ethane.txt	<a href="#">More info</a> plain text (.txt)	485 B 8 downloads	Download
SPC14_EthaneAcetylene_2ky.txt	<a href="#">More info</a> plain text (.txt)	2 KB 13 downloads	Download
GISP2B_Ethane.txt	<a href="#">More info</a> plain text (.txt)	475 B 10 downloads	Download
GISP2B_EthaneAcetylene_2ky.txt	<a href="#">More info</a> plain text (.txt)	4 KB 10 downloads	Download
GISP2B_Ethane.txt	<a href="#">More info</a> plain text (.txt)	303 B 12 downloads	Download
GISP2B_EthaneAcetylene_2ky.txt	<a href="#">More info</a> plain text (.txt)	514 B 13 downloads	Download

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General

Identifier doi:10.18739/A2T727Q2X

Screenshot

<https://arcticdata.io/metacat/d1/mn/v2/object/urn:uuid:b756a396-c1f9-4f0e-9f8f-cba0ff81f44f>



<https://arcticdata.io/metacat/d1/mn/v2/object/urn:uuid:b756a396-c1f9-4f0e-9f8f-cba0ff81f44f>

Core_ID	Top_depth		Bottom_Depth		Gas_age		Gas_Age_calendar_year			Etha
WDC05A	297.900	298.055	956	994	79.8	20.1	37.3	42.9	9.8	
WDC05A	255.850	255.990	775	1175	87.7	11.6	28.6	32.9	9.9	
WDC05A	236.160	236.340	694	1256	106.3	8.4	34.2	39.3	7.1	
WDC05A	199.555	199.705	532	1418	97.9	16.5	38.1	43.8	8.1	
WDC05A	191.010	191.160	495	1455	118.5	7.9	25.5	29.3	6.6	
WDC05A	190.860	191.010	494	1456	110.4	6.4	27.0	31.1	5.3	
WDC05A	179.235	179.360	441	1509	87.2	16.7	31.3	36.0	8.1	
WDC05A	167.535	167.685	389	1561	75.1	21.1	36.2	41.6	10.2	
WDC05A	139.425	139.575	266	1684	81.9	6.5	15.2	17.5	5.4	
WDC05A	116.450	116.600	168	1782	94.2	6.8	16.6	19.1	5.6	
WDC05A	107.890	108.040	130	1820	63.8	14.2	-999.0	-999.0	-999.0	
WDC05A	98.715	98.865	91	1859	68.9	16.8	15.2	17.5	7.7	
WDC05A	98.715	98.865	91	1859	69.3	14.6	13.1	15.0	6.7	
WDC05A	95.530	95.680	79	1871	50.2	16.0	18.8	21.6	7.6	
WDC05A	95.530	95.680	79	1871	61.4	17.2	15.0	17.2	7.9	
WDC05A	91.925	92.075	63	1887	67.3	16.9	11.8	13.6	7.5	
WDC05A	91.775	91.925	63	1887	85.7	14.7	-999.0	-999.0	-999.0	
WDC05A	91.090	91.210	59	1891	105.7	20.8	17.6	20.2	9.5	
WDC05A	84.790	84.880	31	1919	85.6	23.3	15.6	17.9	10.3	
WDC05A	83.280	83.430	25	1925	97.8	19.2	21.1	24.2	9.0	
WDC05A	83.130	83.280	24	1926	105.8	17.7	13.8	15.9	8.0	



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# U.S. ANTARCTIC PROGRAM DATA CENTER

A	B	C	D	E	F	G	H	I	J	K	L
SPICEcore (South Pole Ice Core 2014)											
Tube Number	Sample Number	Top Depth (m)	Bottom Depth (m)	Sample Length (m)	Cl- (ppb)	NO3- (ppb)	SO42- (ppb)	Na+ (ppb)	K+ (ppb)	Mg2+ (ppb)	Ca2+ (ppb)
400	1	399.945	399.966	0.0212	28.0	81.9	63.8	9.8	1.3	1.9	6.4
400	2	399.966	399.987	0.0212	27.5	82.1	56.7	10.3	1.3	2.0	5.4
400	3	399.987	400.009	0.0212	31.1	87.7	43.7	11.6	1.5	2.3	5.1
400	4	400.009	400.030	0.0212	30.1	93.5	60.5	16.1	1.2	3.0	4.9
400	5	400.030	400.051	0.0212	23.9	87.8	45.4	3.8	0.8	1.6	4.3
400	6	400.051	400.072	0.0212	27.5	82.1	56.7	10.3	1.3	2.0	5.4
400	7	400.072	400.093	0.0212	31.1	87.7	43.7	11.6	1.5	2.3	5.1
400	8	400.093	400.114	0.0212	30.1	93.5	60.5	16.1	1.2	3.0	4.9
400	9	400.114	400.136	0.0212	23.9	87.8	45.4	3.8	0.8	1.6	4.3
400	10	400.136	400.157	0.0212	27.5	82.1	56.7	10.3	1.3	2.0	5.4
400	11	400.157	400.178	0.0212	31.1	87.7	43.7	11.6	1.5	2.3	5.1
400	12	400.178	400.199	0.0212	30.1	93.5	60.5	16.1	1.2	3.0	4.9
400	13	400.199	400.220	0.0212	23.9	87.8	45.4	3.8	0.8	1.6	4.3
400	14	400.220	400.241	0.0212	27.5	82.1	56.7	10.3	1.3	2.0	5.4
400	15	400.241	400.263	0.0212	31.1	87.7	43.7	11.6	1.5	2.3	5.1
400	16	400.263	400.284	0.0212	30.1	93.5	60.5	16.1	1.2	3.0	4.9
400	17	400.284	400.319	0.0212	23.9	87.8	45.4	3.8	0.8	1.6	4.3
400	18	400.319	400.340	0.0212	27.5	82.1	56.7	10.3	1.3	2.0	5.4
400	19	400.340	400.361	0.0212	31.1	87.7	43.7	11.6	1.5	2.3	5.1
400	20	400.361	400.382	0.0212	30.1	93.5	60.5	16.1	1.2	3.0	4.9
400	21	400.382	400.404	0.0212	23.9	87.8	45.4	3.8	0.8	1.6	4.3
400	22	400.404	400.425	0.0212	27.5	82.1	56.7	10.3	1.3	2.0	5.4
400	23	400.425	400.446	0.0212	31.1	87.7	43.7	11.6	1.5	2.3	5.1



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## Dataset Information

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### SPICEcore 400-480 m Major Ions SDSU

**Data DOI:** <https://doi.org/10.15784/601430>

#### Cite as

Cole - Dai, J. et al. (2021) "SPICEcore 400-480 m Major Ions SDSU" U.S. Antarctic Program (USAP) Data Center. doi: <https://doi.org/10.15784/601430>.

#### Abstract

Major ion concentrations in SPICEcore samples from the section of 400-480 m were measured with ion chromatography. The ions are chloride, nitrate, sulfate, sodium, potassium, magnesium, and calcium. This section was analyzed to replicate the measurement of the same section at Dartmouth College.

**Creator(s):** Cole-Dai, Jihong; Larrick, Carleigh

**Date Created:** 2021-01-30

**Repository:** USAP-DC (current)



<https://www.usap-dc.org/view/dataset/601430>



# Proposed set of actions

- Develop crowdsourced ice core sites list
- Store the list on the GitLab to track all changes
- Adapt IGSN ice core sample numbers for measurements
- Develop common standards and best practices for reporting ice core measurements
- Make methodology publicly available (DOI, publications +Zenodo)
- Coordinate ice core measurement standards implementation with data centers
- “Soft enforce” community standards with certificates



# Ice core point or location

Based on the template developed for the WAIS Divide Ice Core project

- [1] see WAIS Divide Borehole Locations table.
- In this step, ice core project leaders will register an International Geo Sample Number **IGSN** for the following data. If all required fields are available, the data set automatically becomes compliant with the **ice core site** certificate.
- The registered number will be used as a **Parent IGSN** number for all ice core samples from this location.

Proposed data fields for the ice core point or location certificate

Field	Required	Example
Certificate name	No	Ice core site-1.0
Certificate id	No	ICS-1.0
Certificate Date	No	May 21, 2020
dataTypeId	Yes	ICE CORES
Site	Yes	WAIS
Project	No	West Antarctic Ice Sheet Divide deep ice core
Project web site	No	<a href="http://www.waisdivide.unh.edu">http://www.waisdivide.unh.edu</a>
Borehole ID	Yes	WDC-06A
Geolocation	Yes	coordinates
Longitude	Yes	112.085° W
Latitude	Yes	79.467° S
Surface elevation	No	1,788 m
Drilling start date	Yes	December 9, 2006
Drilling end date	No	December 1, 2011
Depth	No	3405 meters
Drilling system	No	DISC drill
Drill diameter	No	122 millimeter
Drilling fluid	Yes	Isopar K
Drilled by	No	Ice Drilling Design and Operations (IDDO)
Funding information	No	NSF-Grant ID

[https://wiki.icecoredata.org/mediawiki/index.php/Ice\\_core\\_point\\_or\\_location](https://wiki.icecoredata.org/mediawiki/index.php/Ice_core_point_or_location)



# GeoCSV files compressed into a single bzip2/zip file

timeScale.csv  
info.csv  
data.csv

Similar to LiPD zipped folder that contains the data in csv format and the metadata in JSON-LD



- Julien Emile-Geay
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- Deborah Khider



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- Erich Osterberg
- Lindsay Powers
- Mark Royer
- Jessica Scheick
- Joseph Souney
- Valerie Stanley
- Mark Twickler



# Arctic Ice Core Data Workshop, May 14-16, 2019 participants

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- Erin McConnell
- Paolo Gabrielli
- Jacob Morgan
- Karl Kreutz
- Katherine Anderson
- Kristen Rasmussen
- Nels Iverson
- T.J. Fudge
- Trey Stafford

