National Science Foundation
Ice Core Facility

Your community resource

Ice Core Working Group Meeting

May 11, 2023
Seattle, Washington
https://icecores.org

NSF ICE CORE FACILITY

National Science Foundation

OPERATED BY U.S. GEOLOGICAL SURVEY

Our Mission

The NSF-ICF, managed by USGS, is dedicated to serving the needs of the ice core community for processing, archiving, and sample provisioning services for meteoric ice cores recovered from the glaciated regions of the world.

We strive to provide subject matter expertise to the ice core science and polar logistics community plus provide community engagement and outreach opportunities.

OUR PEOPLE

National Science Foundation, NSF

- Michael Jackson, Antarctic Science Section (ANT)
- Paul Cutler, ANT Glaciology Program Director

NSF-Ice Core Facility- USGS

- Lindsay Powers, Technical Director
- *Curt La Bombard, Curator
- *Richard Nunn, Assistant Curator
- *Theo Carr, Science technician

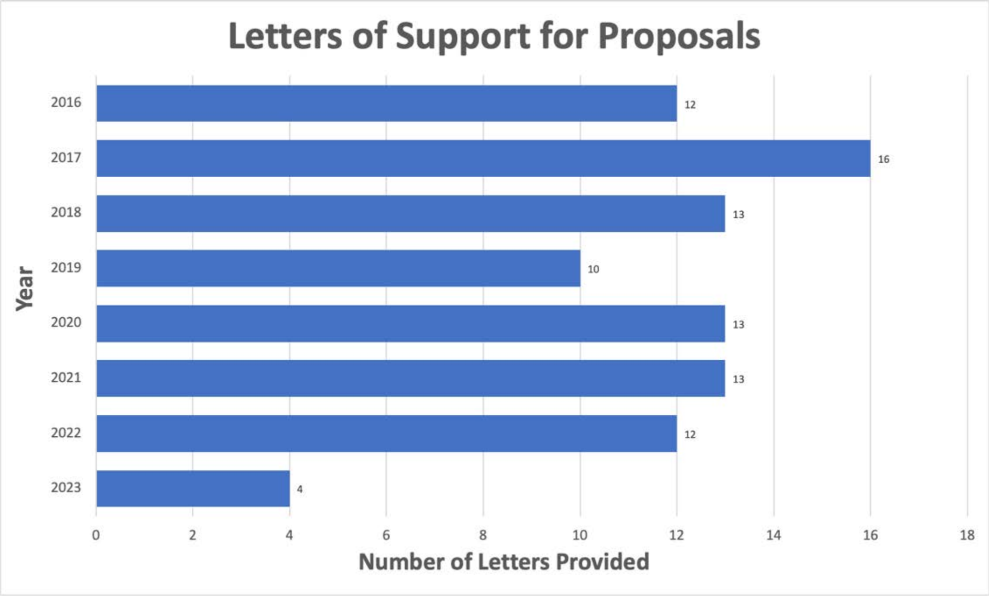
Science Management Office, UNH

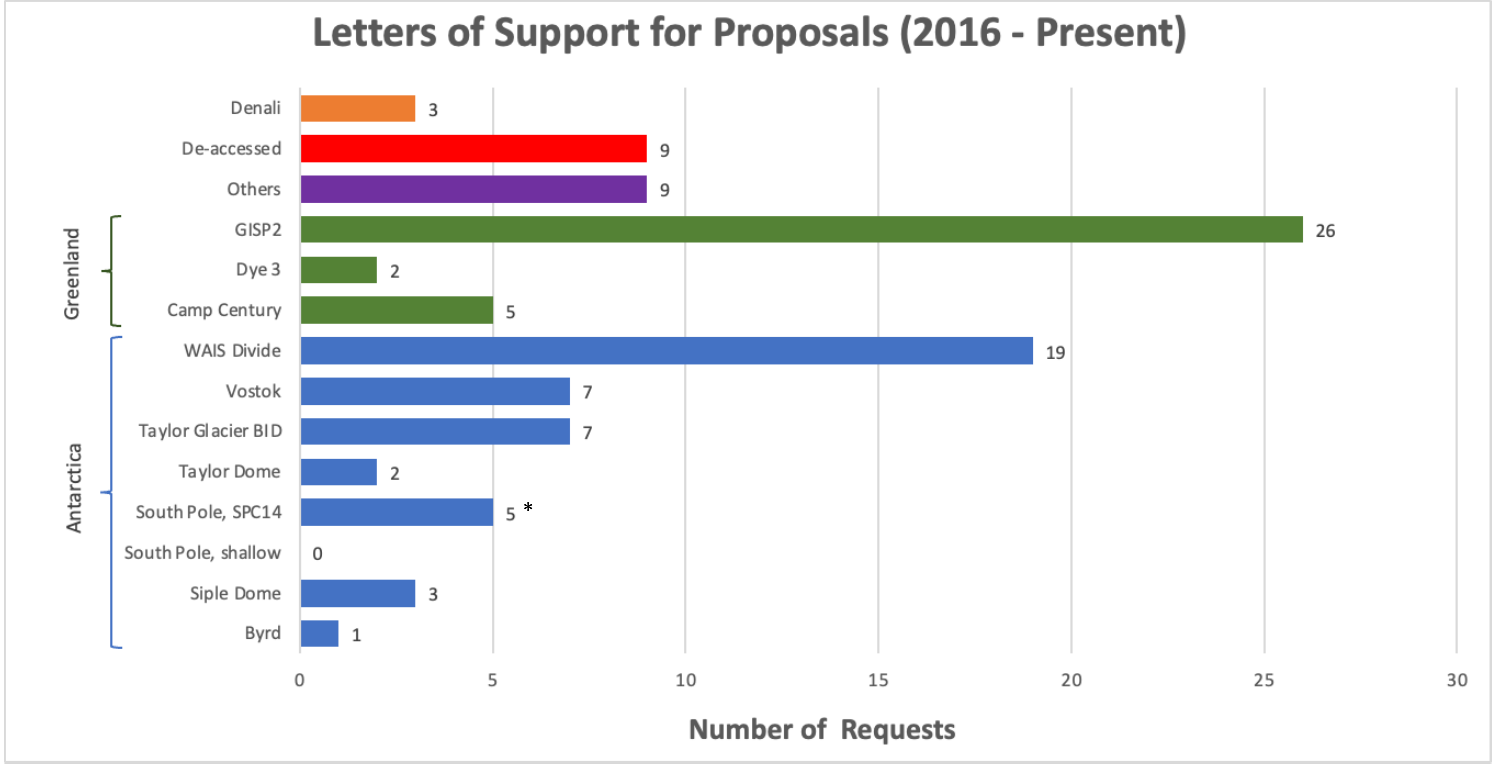
- Joe Souney, SMO Director
- Mark Twickler, hourly employee

*Full time employees

National Science Foundation
OPERATED BY U.S. GEOLOGICAL SURVEY

NSF-ICF Science Management Office (SMO)

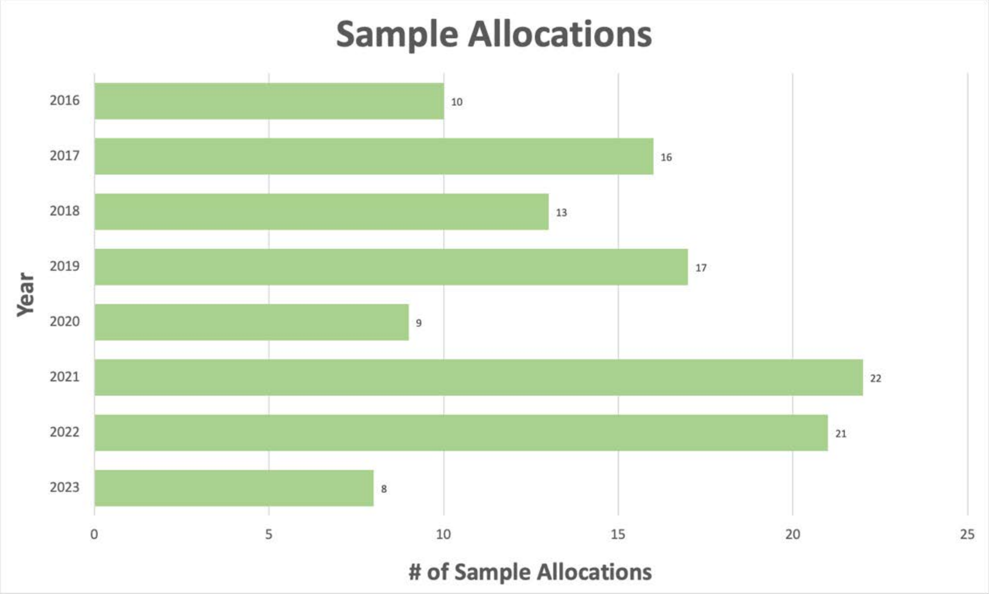


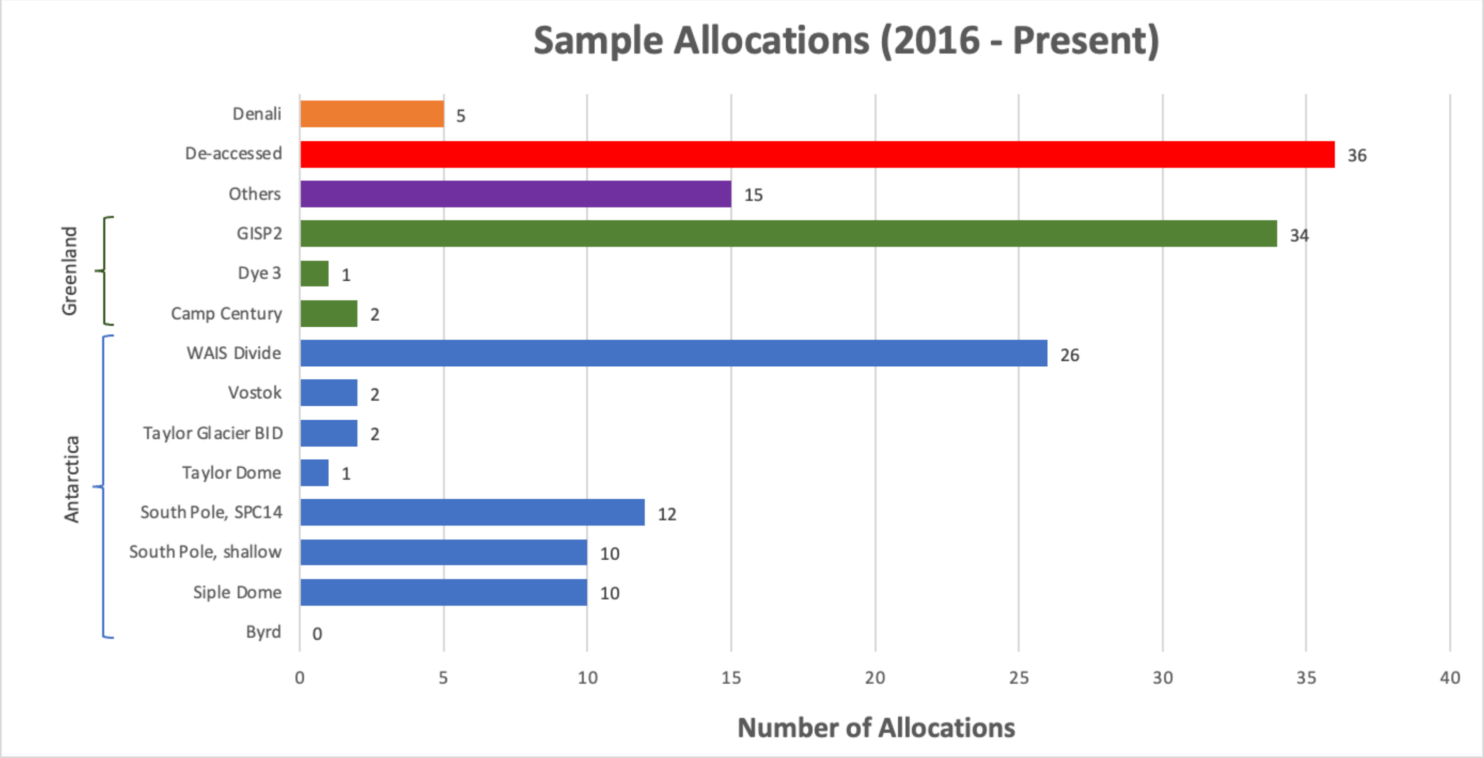


*SPC14: sample requests transferred from the SPICEcore SCO to the NSF-ICF SMO in Nov 2019. Therefore, SPC14 requests are from 11/2019 to present.

NSF ICE CORE FACILITY
National Science Foundation
OPERATED BY U.S. GEOLOGICAL SURVEY

NSF-ICF Science Management Office (SMO)





Deaccession of Cores from the Archive

As U.S. Ice Core Lab Reaches Capacity, Scientists Plan Future Storage Efforts

PAGES 229, 232

Joan Fitzpatrick, technical director of the U.S. National Ice Core Laboratory (NICL), says that most visitors to the curatorial research facility at the Denver Federal Center in Colorado first notice the temperature: -34 °C in the main storage area, and -24 °C in the lab. Afterwards, they may note that the approximately 5000 sq. m repository is packed full with cores, primarily from Antarctica and Greenland.

NICL, which is jointly operated by the National Science Foundation (NSF) and U.S. Geological Survey (USGS), and jointly funded at $380,000 per year, currently holds about 15,838 m of ice cores in 14,069 canisters of aluminized cardboard. The facility, which houses cores collected through NSF's Office of Polar Programs and USGS' Geologic Division, probably is the most comprehensive collection of ice cores in the world, according to Fitzpatrick.

And at a storage cost of $24 per m each year, she and others say the price is a bargain, given the scientific advances the cores have yielded. Cores in good condition "are the only known faithful recorder of ancient atmosphere," Fitzgerald says.

But with the lab now reaching 97% storage capacity, the ice core community faces some hard choices.

To free up space for thousands of new meters of cores expected at the facility over the next few years, the U.S. Ice Core Working Group (ICWG)—an ad hoc advisory committee of scientists—has recommended the "deaccessing," or removal, of about 10% of the ice from the lab. The ice to be removed is in poor condition and of less scientific value than other ice stored there, according to ICWG.

"We've never thrown away a core before," says Mark Twickler, executive director of the NICL science management office that is housed at the Climate Change Research Center at the University of New Hampshire, Durham. "It's not what we want to do, but something that needs to be done."

As part of the deaccessing process, NICL is offering scientists the opportunity to obtain some of the ice for research purposes for the cost of preparing and shipping them.

"We'd rather have scientists get some good science out of [the cores] than have them melt in the parking lot," says Julie Palais, Antarctic glaciology program manager for NSF's Office of Polar Programs.

While the deaccessed cores may have limited value for paleoclimatologists, some researchers could find them useful for studying cosmic particles, volcanic dust, and other variables.

Palais says the decision to deaccess was reached after nearly 3 years of discussion. "We don't take this kind of deaccession lightly."

Palais, along with Twickler and Fitzgerald, says that of the 1200 m of cores slated for removal, many have deteriorated over time, through evaporation, sublimation, or contamination. Much of the ice lacks robust age-depth relationships, with researchers no longer even knowing which ends of some core sections face the top or bottom—which invalidates that ice for many types of research. Other core samples are duplicates or easily replaceable if ever needed again. No deep cores (those drilled from depths beyond 200-300 m) are slated for removal.

"People don't want to spend a lot of time on samples they can't trust," says Palais. "Most people want newer cores."

Twickler says that ice cores are a "snapshot of time" that record dozens of variables such as the gas composition (including greenhouse gases) of the atmosphere, temperature history, volcanic eruptions, net annual accumulation, ocean surface productivity, and solar activity.

"You get little bubbles of ancient atmosphere" in the ice, Twickler says. "It's a direct link to what was in the atmosphere and the atmospheric circulation patterns, and a proxy to understanding climatic events in the past." He says that unlike other records, such as ocean cores or tree rings, ice cores have a direct link with the atmosphere.

Research into ice cores has yielded a number of important discoveries, including a correlation between historical shifts in the levels of greenhouse gases in the atmosphere and the temperature, and the finding of abrupt and dramatic changes in climate.

Richard Alley, professor of geoscience at Pennsylvania State University, says that ice core data indicates that about 20 abrupt jumps in climate took place during the last 100,000 years, where major changes had occurred over several years or decades rather than during smoother, hundred or thousand year transitions. He says that sometimes climate changes "stumble drunkenly" into and out of glacial and interglacial periods.

Fitzpatrick says "you can count [shifts] right in front of your eyeball, looking at the core." Because no intrinsic property of ice yields its age, researchers manually count off

Fig. 1. Checking cores at the National Ice Core Laboratory. Photo by Ken Abbott

Eos, Vol. 79, No. 19, May 12, 1998

different years in a core by noting seasonal variations in the ice. For instance, on average more dust and sulfate is present in the summer, while more nitrate is present during winter.

Fitzgerald says that NICL's long-range plan for ice core storage includes first removing cores of lesser scientific importance, based on a ranking by ICWG. That strategy could continue for a few more years before the facility receives newer cores that squeeze the amount of available storage space again.

The next step would be for NICL to install a different racking system to double the capacity for storing cores. The consolidation of some cores also is possible, though that could complicate access to them.

Fitzgerald says that once the doubling capacity is reached, the remaining options would be to enlarge the present facility and reduce the amount of accepted for storage there.

Palais says the long-term solution is "more money so we can build a bigger facility."

In addition to the U.S. facility, Japan and Denmark also maintain major ice core repositories, and a number of institutions store cores in smaller freezers. According to Twickler, the facility in Denmark is running out of storage space for cores, and facing a dilemma similar to NICL's of how to store an increasing number of cores.

(One country that has been deeply involved with ice core drilling recently closed a major operation. Russia earlier this year shut down drilling at Lake Vostok in East Antarctica, where the country had been active for the past several decades. Researchers there had successfully drilled the world's deepest ice core, 3623 m, before reaching ice close to the subsurface Lake Vostok. Bottom ice in the Russian core dates back about 450,000 years.)

Twickler says that a number of researchers already have approached NICL to request some ice cores. He says that while the lab currently has no set schedule for removing the cores, he would like to hear from researchers interested in them within a month. For further information, contact Mark Twickler at +1-603-862-1991 and view the NICL Web site: http://www.nicl-smo.sr.unh.edu/NICL/deaccess.html.—*Randy Showstack*

History:

In 1997, the ICWG decided to place cores of limited scientific value on a "deaccession" list. These cores would be easier to allocate to projects that needed ice for method development, large quantity of material, outreach activities, etc., and help reduce storage capacity issues at NICL.

Outcome:

At the time, more than 400 meters of cores were listed for deaccession.

Deaccession of Cores from the Archive

Selection Criteria Developed by the 1998 ICWG
Each Criteria is assigned a number between 1(lowest) and 5 (highest)

Age	Older the core, lower the rating (5 >1995, 4 >1990, 3 >1985….)
Continuity/Volume	How continuous and how much remaining
Dating	How well is the core dated
Published Information	What information is available from previous work
Request	How much interest has there been on the core
Core Quality	Physical condition of core
Duplication	Multiple cores from the same site
Drilling Method	Dry, Thermal, Fluid type
Specific Property Value	Does the core have a specific value for measurements
Uniqueness	Location, replaceable, historical value

Current Deaccession Status

- https://icecores.org/inventory/deaccessed
- 60 cores on the deaccession list; ~1700 meters of core.
- These cores are still in the ICF freezer.
- Disposal of some of these cores will be necessary in the very near future.
- The SMO has provided the ICF with a suggested core ranking for the order of disposal (e.g., which cores do we dispose of first).

Deaccession of Cores from the Archive

1267 tubes

Location	Fieldsite	Core Name	Core ID	Years Drilled	Lat/Long	Core Top (m)	Core Bottom (m)	Diameter (cm)	# Tubes in Inventory (6-28-2022)	Sub-Rank	Rank	Notes
Antarctica	Bentley Shot Holes	BENTLEY SHOT HOLE 3	BEN3	1995	-81.78, -111.325	0	50.24	10	41	1	1	
Antarctica	J9	J-9	J-9	1978	-82.3833333, -168.6333333	35.05	416.07	7.6	267	1	1	
Antarctica	RIDS	RIDSBETA	RIDSBETA	1995	-77.7333333, -116.3333333	0	19	10	13	1	1	
Antarctica	South Pole	South Pole 01 hole 1	SP01-1	2001	-90, 0	0.57	122.91	8	49	1	1	
Antarctica	South Pole	South Pole 01 hole 2	SP01-2	2001	-90, 0	0.47	121.78	8	103	1	1	
Antarctica	South Pole	South Pole 04 hole 1	SP04-C1	2004	-89.95778, -17.83611	0	39.94	10.2	14	1	1	
Antarctica	South Pole	South Pole 04 hole 2	SP04-C2	2004	-89.95778, -17.80028	0	40.78	10.2	21	1	1	
Antarctica	South Pole	South Pole 04 hole 3	SP04-C3	6/26/05	-89.95, -17.53333	0	39.84	10.2	35	1	1	
Antarctica	South Pole	South Pole 04 hole 4	SP04-C4	6/26/05	-89.95778, -17.66722	0	39.84	10.2	27	1	1	
Antarctica	South Pole	South Pole 04 hole 5	SP04-C5	6/26/05	-89.95749, -17.6	0	181.59	10.2	27	1	1	Keep any good ice and log for outreach/pilot projects
Antarctica	South Pole	South Pole 04 hole 6	SP04-C6	2004	-89.95, -17.533329	0	101.55	10.2	101	1	1	
Antarctica	Upstream C	UPC 96	SDMUPC	35383	-82.45, -135.9833333	0	134.59	10	41	1	1	Keep any good ice and log for outreach/pilot projects
Antarctica	Windless Bight	WINDLESS BIGHT-1	WB1	1996	-77.8321667, 167.1472667	0	43.18	10	36	1	1	
Antarctica	Windless Bight	WINDLESS BIGHT-2	WB2	1996	-77.732, 167.1476667	0	80.9	10	71	1	1	
Greenland	Crete	CRETE	CRETE74	1974	71.1166667, -37.3166667	0.32	404.64	12.7	82	1	1	Keep any good ice and log for outreach/pilot projects
Greenland	Humboldt	HUMBOLDT B	HumB	1995	78.5269444, -56.8322222	0	20	10.16	8	1	1	
Greenland	Humboldt	HUMBOLDT EAST	HumE	1995	78.5258333, -55.6986111	0	20.4	10.16	11	1	1	
Greenland	Humboldt	HUMBOLDT SOUTH	HumS	1995	78.3030556, -56.8258333	0	20.8	10.16	11	1	1	
Greenland	Humboldt	HUMBOLDT WEST	HumW	1995	78.5244444, -57.9572222	0	20.7	10.16	11	1	1	
Greenland	Milcent	MILCENT	MILCENT	5/26/05	70.3, -44.5833333	6.81	399.62	12.7	199	1	1	Keep any good ice and log for outreach/pilot projects
Greenland	Site A	SITE A, CORE 2 1985	SITE A2	1985	70.75, -35.9583333	0	109.6	10	51	1	1	
Greenland	Tunu	TUNU E50	T-E50	1996	78.0166667, -33.9930556	0	14.99	10.16	8	1	1	
Greenland	Tunu	TUNU N25	TN25	1996	78.0166667, -33.9930556	0	15.01	10.16	8	1	1	
Greenland	Tunu	TUNU N50	TN50	1996	78.0166667, -33.9930556	0	14.93	10.16	8	1	1	
Greenland	Tunu	TUNU South	T-South	1996	78.0166667, -33.9930556	0	14.98	10.16	8	1	1	
Greenland	Tunu	TUNU W25	TW25	1996	78.0166667, -33.9930556	0	14.98	10.16	8	1	1	
Greenland	Tunu	TUNU W50	TW50	1996	78.0166667, -33.9930556	0	15.04	10.16	8	1	1	
Antarctica	Byrd	BYRD STATION '71	BYRD 71	1971	-80.0167, -119.5167	15.55	380.06	11.4	164	2	1	Keep any good ice and log for outreach/pilot projects
Antarctica	Dominion Range	DOMINION RANGE	DOMINION	1984	-85.25, 166.16667	0	159.66	10	63	2	1	
Antarctica	Siple Dome	SIPLE DOME G	SDMG	35443	-81.5708333, -148.5975	0	30.63	10	31	2	1	
Antarctica	Siple Dome	SIPLE DOME H	SDMH	35445	-81.7395, -148.9768333	0	30.75	10	31	2	1	
Antarctica	Siple Dome	SIPLE DOME I	SDMI	35446	-81.6375, -148.7658333	0	30.06	10	4	3	1	
Antarctica	South Pole	SOUTH POLE 2	SP 2	1994	-90, 0	0	123.4	10	109	3	1	
Antarctica	Bentley Shot Holes	BENTLEY SHOT HOLE 4	BEN4	1994	-81.3730556, -107.2730556	0	50.56	10	49	4	1	
Antarctica	RIDS	RIDS95B	RIDS95B	1995	-79.4608333, -118.0444444	0	60	10	41	4	1	

Deaccession of Cores from the Archive

Location	Fieldsite	Core Name	Core ID	Years Drilled	Lat/Long	Core Top (m)	Core Bottom (m)	Diameter (cm)	# Tubes in Inventory (6-28-2022)	Sub-Rank	Rank	Notes
Antarctica	Newall Glacier	NEWALL GLACIER	NEWALL	1988	-77.61667, 162.5	0	175	10	102		2	
Antarctica	RIDS	RIDS-95A	RIDS95A	1995	-77.7333333, -116.3333333	0	150	10	117		2	
Antarctica	RIDS	RIDS-95C	RIDS-95C	1995	-79.9988889, -79.9988889	0	60	10	46		2	
Antarctica	Taylor Dome	TAYLOR DOME MIC2	MIC2	12/91-1/92	-77.6666667, 158	0	98.81	10.2	91		2	
Greenland	Camp Century	CAMP CENTURY 1961	CC 61	1961	77.1666667, -61.1333333	11.89	185.98	12.4	93		2	
Greenland	Camp Century	CAMP CENTURY 1962	CC 62	1962	77.1666667, -61.1333333	10.53	237.95	12.4	142		2	
Greenland	GISP2	GISP-2 E	GISP2E	1990	72.5833333, -38.466667	0	83	10.2	85		2	
Greenland	GISP2	GISP-2 F	GISP2F	1991		0	124	10.2	17		2	
Greenland	GISP2	GISP-2 G1	GISP2G1	1990	72.5833333, -38.466667	0	103	10.2	102		2	
Greenland	GISP2	GISP-2 G2	GISP2G2	1991	72.5833333, -38.466667	0	152.09	10.2	131		2	
Greenland	GISP2	GISP2H	GISP2H	1992	72.5833333, -38.466667	0	127.01	10.2	133		2	
Antarctica	Siple Dome	SIPLE DOME C	SDMC	12/15/96	-81.655, -148.7943333	0	91.95	10	71		2.5	
Antarctica	Siple Dome	SIPLE DOME E	SDME	12/27/96	-81.3023333, -148.3023333	0	99.99	10	83		2.5	
Antarctica	Bentley Shot Holes	BENTLEY SHOT HOLE 2	BEN2	1995	-82.3669444, -119.2830556	0	93.55	10	88		3	
Antarctica	Bentley Shot Holes	BENTLEY SHOT HOLE 5	BEN5	1994	-82.0938889, -115.2280556	0	90.12	10	80		3	
Antarctica	Siple Dome	SIPLE DOME F	SDMF	1/5/97	-81.9085, -149.337	0	100.77	10	67		3	
Antarctica	Siple Dome	SIPLE DOME J	SDMJ	97/98	-81.6588333, -148.812	0	118.61	10	105		3	
Greenland	GISP2	GISP-2 B	GISP2B	1989	72.5833333, -38.466667	0	200	10.2	197		3	
Greenland	GISP2	GISP-2 C	GISP2C	1989	72.5833333, -38.466667	0	91.86	10.2	73		3	
Greenland	GISP2	GISP-2 I	GISP2I	1992	72.5833333, -38.466667	0	84.08	10.2	84		3	
Antarctica	Taylor Dome	TAYLOR DOME MIC3	MIC3	12/91-1/92	-77.6666667, 158	0	127.34	10.2	120		4	
Antarctica	Vostok	VOSTOK BH-5	VOSTBH-5	1991/1992	-78.4666667, 106.8	3	179	12	136		4	

NSF ICE CORE FACILITY National Science Foundation OPERATED BY U.S. GEOLOGICAL SURVEY

Deaccession Discussion

Blue Ice Drill (BID) core overview

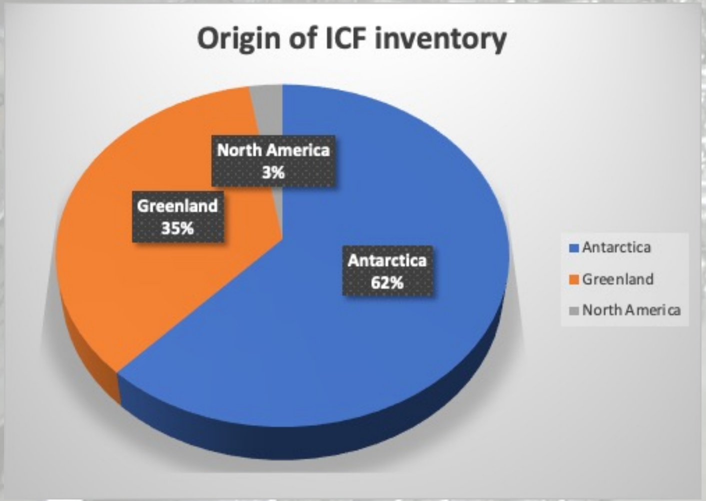
- ICF has the tools and some experience cutting and archiving AH 2019 BID cores
- Smaller pieces have a variety of shapes which can alter the cut profile, sample size, produce off cuts which are challenging to archive and overall require more grantee involvement to reconcile the piece in hand vs the cut plan.
- Large pieces are heavy, need two people to handle but cut great on the new BID saw.
- Boxed 9.5” diameter BID Cores take up a significant amount of space (~4:1 as compared to 4”core), we’ve settled on utilizing corrugated plastic 3 and 4 mm banker style boxes for small and large sized BID cores
- Plan accordingly for sampling and CPL’s when BID core is involved.

ICE CORE BOX UPDATE

- NSF-ICF received 480 new “Skufa” boxes in November 2022
- 150 placed in the USAP cargo stream for the 2024 vessel, ICF planning to send an additional 150 for the 2024 vessel
- 78 have been sent to PFS
- 40 being used by Peter Neff this summer
- Based on current estimates for Herc Dome and COLDEX we anticipate continued use of ISC boxes given the lengthy lag and lead times for staging and shipping
- We estimate ~800 usable ISC boxes held by ASC and ICF
- Skufa boxes only for field shipments
- NSF owns the mold – minimum order is 50 boxes

IGSN Update

- Test IGSN's have been assigned to a couple of cores in the ICF collection through DataCite, mapping the core metadata to the fields in DataCite, and soon we will assign proper IGSN's to all cores in the ICF collection
- The next step will be to assign IGSN's to core sections for the major cores in the collection
- Once this procedure has been established, all future samples will be assigned IGSN's by the ICF staff
- Ideally, boreholes would get their own IGSN assigned to them, separate from the Core IGSN



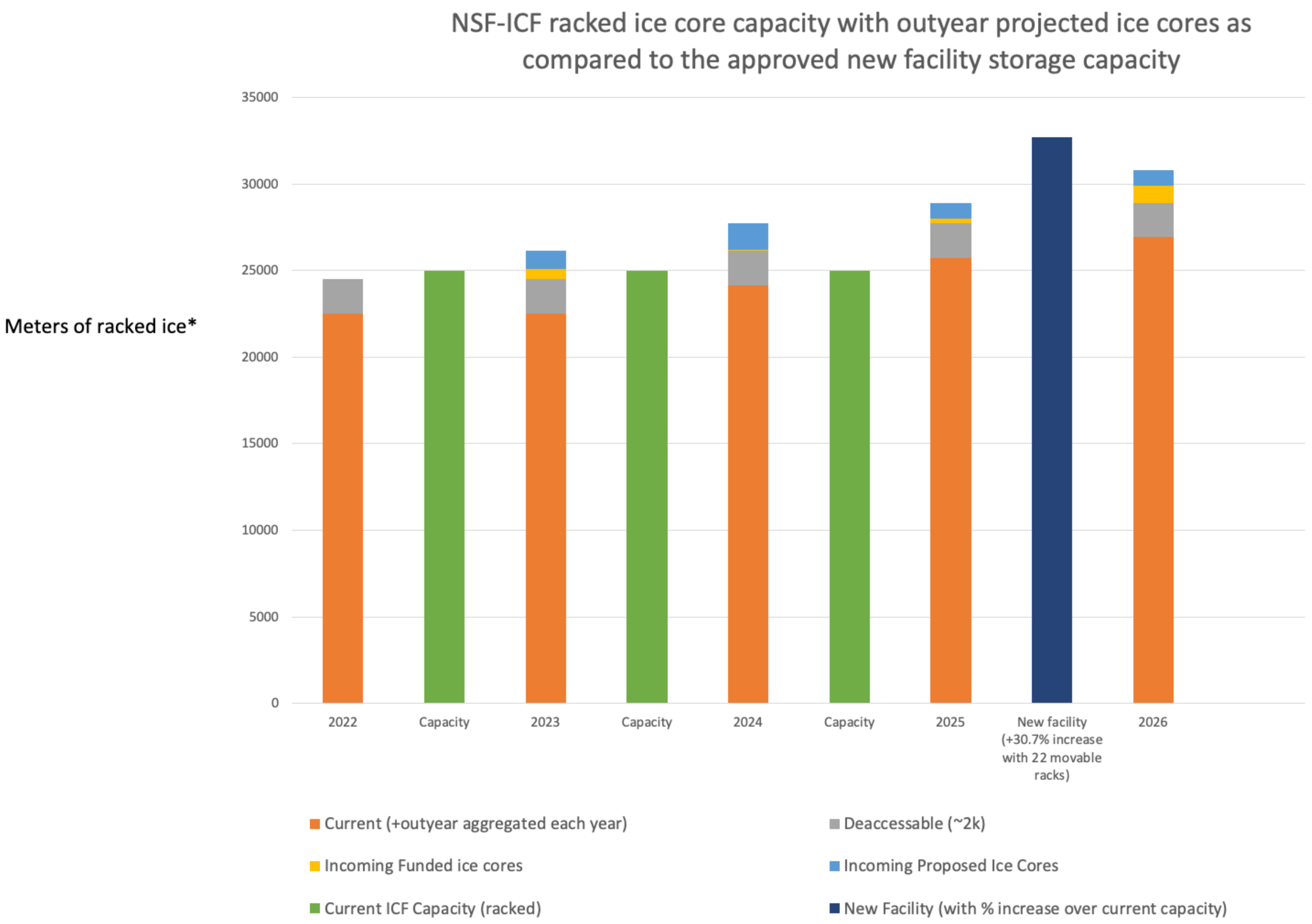
Database Update

- Work is underway to update the online database to a more user friendly PostgreSQL format.
- The in-house database will continue to use Filemaker Pro while the full transition from Filemaker to PostgreSQL happens
- ICF updating computers (trailer and exam room)

Related Update

- Ice Cores drilled under COLDEX will be integrated into the public database inventory, requests for this material will go through COLDEX sample allocation committee.

Shelving storage capacity reached



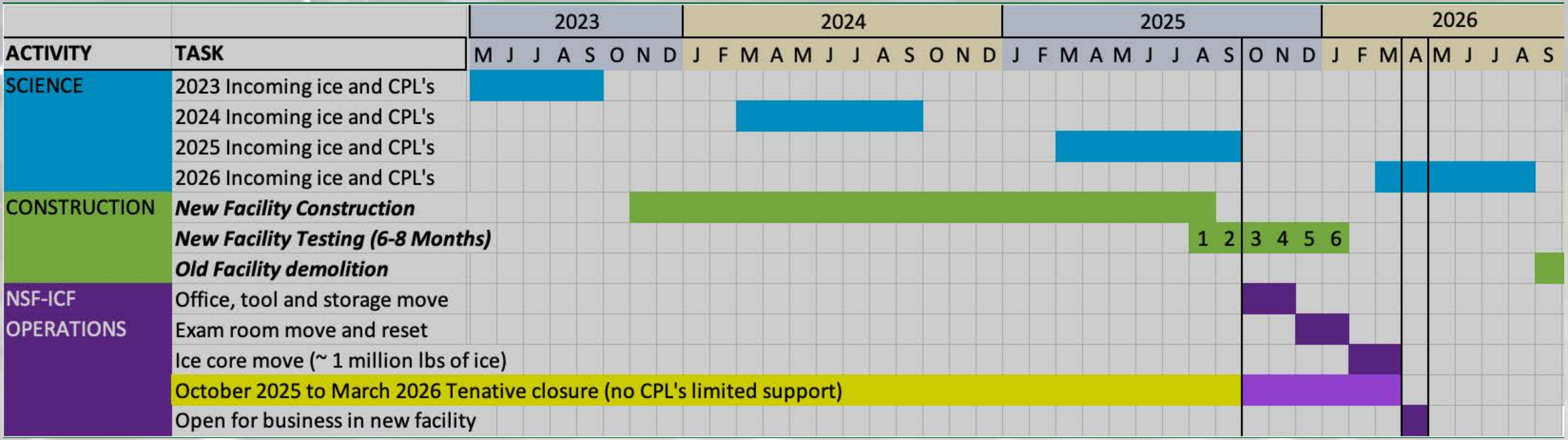
New facility layout

- Main storage 800 sq ft larger
- 22 Movable racks for denser storage capacity
- ~30% additional storage over current facility.
- Dedicated collaboration and meeting space plus configurable changing room
- Facility at grade to eliminate stairs and ramp and maximize space

Main storage- new facility
106’ L x 58’ W x tbd H
6,148 sq ft (5,280 sq ft old)

NEW footprint 150’ x 60’ 8,700 sq ft
OLD footprint 138’ x 57’ 7,866 sq ft

NSF-ICF
New Facility, Science and Move Schedule
DRAFT, May 2023



ICF collections not in inventory or on racks…

ICF has ~ 25,000 meters worth of racking space but we also store ~120 ISC (or 12+ pallets) of sample returns, aliquots, ice cores and associated materials under our evaporators.

This material needs archival and inventory or disposal prior to our facility move since we do not have the same floor space in the new facility.

The new facility staging area floor space is the same but will not accommodate the volume.

Actions to help us get there prior to the move:

Sample return policy

Continued action on guidelines for deaccession and disposal

PI-re-allocation and proprietary cores

SMO site visit to remove material that can be disposed

NSF ICE CORE FACILITY National Science Foundation
OPERATED BY U.S. GEOLOGICAL SURVEY

QUESTIONS