

VIDEO ANALYSIS AND ANNOTATION OF ICE LOAD RECORDS

Brian Wright
B. Wright & Associates Ltd.
212 Carey Avenue
Canmore, Alberta
T1W 2R6

Table of Contents

1.	Time Lapse Video Cameras.....	1
2.	Analysis of Video Records	3
1.1.1	General.....	3
1.1.2	Time Markers.....	3
1.1.2.1	March 7, 1986.....	4
1.1.2.2	May 22, 1986.....	4
1.1.3	Ice Failure Modes.....	5
3.	Annotation of Ice Load Records.....	8
3.1.	April 12, 1986.....	8
3.2.	May 22, 1986.....	11
3.3.	Annotated plots of remaining events.....	13
4.	Summary table of Key Results.....	23

List of Figures

Figure 1	Schematic illustration of the primary and secondary locations of the three time lapse video cameras that were placed on the Molikpaq.....	1
Figure 2	A view of a first year ridge interaction on the west side of the caisson, taken from the derrick top camera on March 3, 1986. The ice deflector is in the foreground.....	1
Figure 3	A joint view of the east (left) and north (right) faces of the caisson taken from the two cameras mounted on the NE flare boom. The ice was crushing against the caisson's north face, with remnant debris sliding along its east face at the time.....	2
Figure 4	A similar view of the north and east faces of the caisson during darkness hours. In this case, the ice was failing against the east face in mixed modes, with broken ice debris sliding westwards along the caisson's north face.....	2
Figure 5	An example of the correspondence in time markers seen on the video records and on north face ice load group plots, in this case, on March 7, 1986.....	4
Figure 6	An example of the correspondence in time markers seen on the video records and on the ice load group plots, in this case, on May 22, 1986.....	5
Figure 7	Annotated ice load time series for panel groups on the caisson's east face on April 12, 1986, with illustrative video frames (Event 0412C).....	10
Figure 8	Annotated ice load time series for panel groups on the caisson's north face on May 22, 1986, with illustrative video frames (Event 0522B).....	12
Figure 9	March 7 (Event 0307A).....	14
Figure 10	March 7 (Event 0307B).....	15
Figure 11	April 12 (Event 0412B).....	16
Figure 12	April 12 (Event 0412D).....	17
Figure 13	April 12 (Event 0412E).....	18
Figure 14	May 12 (Event 0512A).....	19
Figure 15	May 22 (Event 0522A).....	20
Figure 16	June 2 (Event 0602A).....	21
Figure 17	June 2 (Event 0602B).....	22

List of Tables

Table 1	Summary of annotation results for the ice events under consideration.....	24
---------	---	----

1. TIME LAPSE VIDEO CAMERAS

Three time lapse video camera systems were installed on the Molikpaq to document the ice conditions that it encountered and the types of ice failure modes that occurred. One of these cameras was placed on top of the drilling derrick and had pan and tilt features. This camera was sometimes used to “look out” at the oncoming ice cover. The other two cameras were usually mounted at the outer end of one of the rig’s flare booms, which was located about 20m above the waterline off the NE corner of the caisson. These two video cameras were oriented in fixed directions, with one looking along the east long face of the caisson and the other looking along its north long face.

Figure 1 is a schematic illustration of the three camera locations and the approximate fields of view of the two cameras that were mounted on the flare boom. When the NE flare boom was in use, the two fixed cameras were relocated as shown. Figures 2 to 4 provide representative examples of individual frames taken from the time lapse video records.

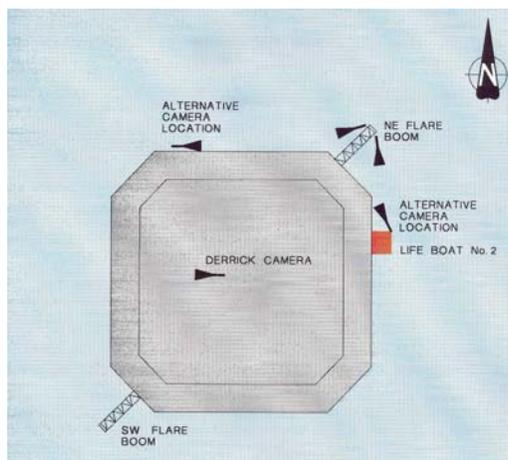


Figure 1 Schematic illustration of the primary and secondary locations of the three time lapse video cameras that were placed on the Molikpaq.



Figure 2 A view of a first year ridge interaction on the west side of the caisson, taken from the derrick top camera on March 3, 1986. The ice deflector is in the foreground.



Figure 3 A joint view of the east (left) and north (right) faces of the caisson taken from the two cameras mounted on the NE flare boom. The ice was crushing against the caisson's north face, with remnant debris sliding along its east face at the time.

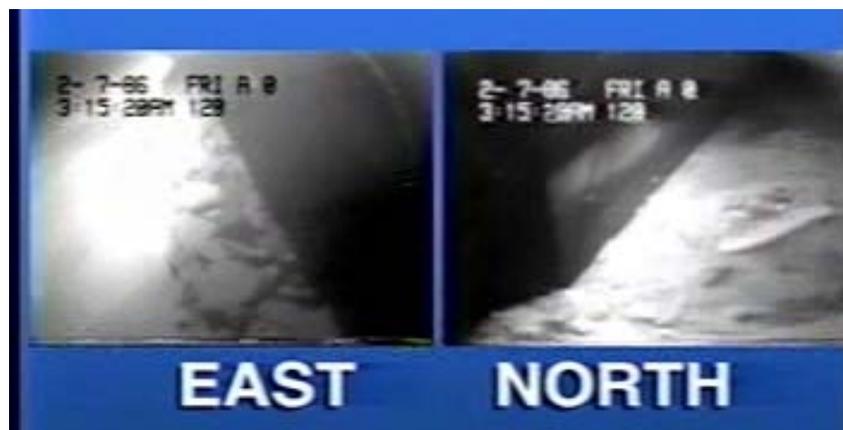


Figure 4 A similar view of the north and east faces of the caisson during darkness hours. In this case, the ice was failing against the east face in mixed modes, with broken ice debris sliding westwards along the caisson's north face.

Several points that should be noted about the video camera system onboard the Molikpaq are highlighted as follows.

- All of the cameras had a low light level capability, so that time lapse video records could be obtained throughout both the day-time and night-time hours
- The time lapse recorders were set to capture picture frames roughly once a second, which is a more than ample frequency to resolve all of the necessary ice interaction details
- The video cameras were hard wired to dedicated recorders and monitors that were located onboard the Molikpaq, in the DAS, and were periodically observed from there
- Since it was not practical to attend the time lapse camera on the derrick top (in terms of continuously changing its field of view to see the oncoming ice cover), a second monitor with pan

and tilt controls was set up in the radio room. It was then primarily used as a tool for observing certain operations (helicopter landings, cranes activities, cargo transfer from vessels, etc.), and not to document ice structure interactions.

- Hence, the two video cameras on the NE flare boom provided the best video records, but only along the N and E caisson faces, with no coverage obtained along the S or W faces during ice interactions associated with ice movements from the south or west
- The east face viewing camera looked straight along the east face, generally providing a profile view of the ice failure at the north end of the east face, while the north face viewing camera had a more oblique view, making it easier to determine ice loading lengths and separate out loading events on the N1, N2 and N3 MEDOF panel groups.
- Repositioning of the two video cameras on NE flare boom was also required several times throughout the winter of 1985/86 (because the flare boom was used and would have “torched them”), so the fields of view of the N and E faces are not exactly the same over the entire ice covered period
- Although the video records are very good, they do not always “see” the complete E and N faces, nor can the precise locations of the N1, N2, N3 and E1, E2, E3 MEDOF panel groups be identified (with exactness) on them
- As a result, practical and experienced judgments must be made when interpreting the ice interaction behaviours seen on the video records, in relation to the load time series derived from the instrument data
- Despite this caveat, the video coverage obtained along the N and E faces is generally of very high quality and in fact, is quite unique.

2. ANALYSIS OF VIDEO RECORDS

1.1.1 General

The information that is presented in the remainder of this section shows direct relationships between “cause and effect”, on the basis of the Molikpaq videos and the recorded ice load instrument data. Firstly, the steps that were taken to analyze the time lapse videos in relation to different ice interaction events are outlined. The results of the analysis, which specify time periods of varying ice failure behaviours over certain widths of the caisson, are then given for a number of key events. This information should be recognized as fundamentally important, since it is used in subsequent sections of the report to assess global ice load levels on the caisson as a function of failure mode, and correlations in load levels across different widths of the caisson, for like ice failure behaviours, for probabilistic averaging applications.

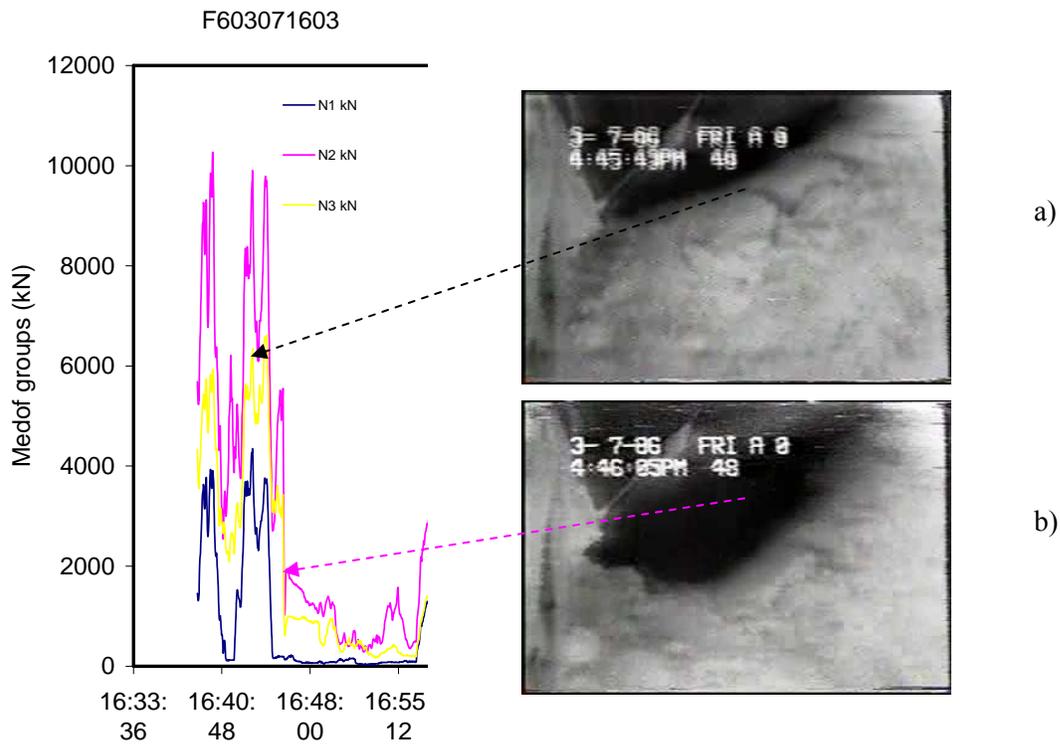
1.1.2 Time Markers

The first step in the analysis procedure was to review the video records in relation to the instrument data time series that had been acquired. A good portion of this work was carried out jointly, at a project meeting January, 2008 in St. John’s, with personnel from NRC-CHC, C-CORE and B. Wright & Associates being involved. At the outset, so-called time markers were found in the videos for all of the events under consideration, to ensure that the measured ice load time series and associated video records had common time stamps. Two representative examples of the type of time markers that were identified

are highlighted as follows, for ice events on the north face of the caisson, on March 7 and May 22, 1986, respectively.

1.1.2.1 March 7, 1986

Figure 5 shows a “slice” of the ice load time series that was recorded by the instrumentation system on the Molikpaq for the March 7 event, starting at about 16:38. Here, the individual ice load traces are given for MEDOF panel groups N1, N2 and N3. Two video frames of the north face are also included, at specific times, to illustrate the type of ice action the caisson was experiencing. Comparisons between the ice load time series and video data indicated a very good time correspondence between both records as signified by the ice slump, to within a few seconds.



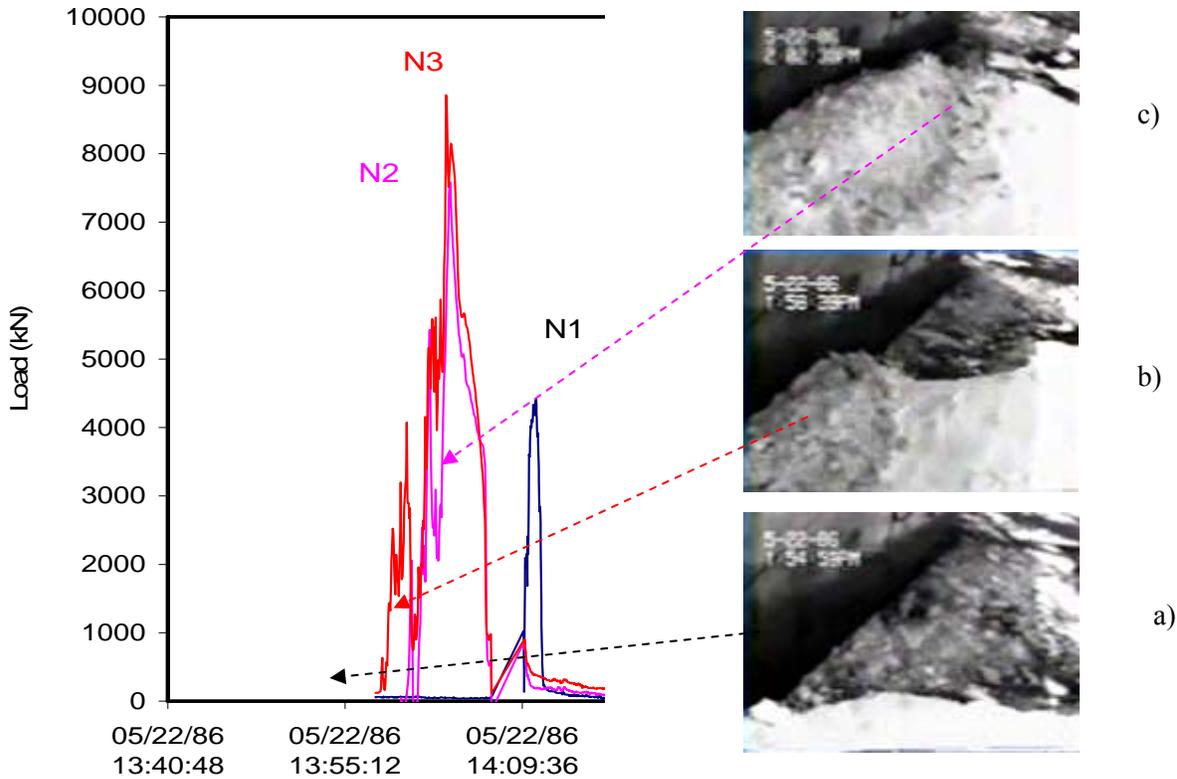
- a) ice crushing on the north caisson face at the N3 (closest) and N2 (middle) panel groups
- b) a slump of the crushed ice debris at N3 and N2, with an immediately reduction in loads

Figure 5 An example of the correspondence in time markers seen on the video records and north face ice load group plots, in this case, on March 7, 1986.

1.1.2.2 May 22, 1986

Figure 6 shows a “slice” of the ice load time series that was recorded by the instrumentation system for the May 22 PM event. Here, individual ice load traces are given for MEDOF panel groups N1, N2 and N3. Several time lapse video frames are also included for specific times, to illustrate the type of ice action that the caisson was experiencing along its north face. This comparison also indicated a very good time

correspondence between the details of the ice failures observed on the video records and the ice loads seen on the panel group plots, again to within a few seconds.



- a) no ice action on the N face just prior to the event
- b) crushing begins at the E end of the N face and spreads west to cover N3
- c) crushing continues to spread west and reaches the N2 panel group (but not N1)

Figure 6 An example of the correspondence in time markers seen on the video records and on the ice load group plots, in this case, on May 22, 1986.

This type of time marker check between the ice load time series and time lapse video records was carried out for all of the events that are under consideration in this study. In most cases, the level of timing correspondence was very good, to within a few seconds. However, there were cases where there was a more substantial time difference between the two data sources. For example, on April 12, 1986, the ice load time series data lagged the time stamps on the video records by about four minutes.

1.1.3 Ice Failure Modes

The video records clearly showed that a wide range of ice failure behaviours across the loaded face (or faces) of the Molikpaq occurred over the course of each different ice event (fast file). These failure modes were highly variable in both space and time. When reviewing the video data, it quickly became apparent that the ice interaction processes observed did not represent “stationary and random crushing” over the

duration of any particular fast file record, as had been assumed in the probabilistic averaging methods used to date (Jordaan, 2006).

For the purposes of this work, a decision was made to subdivide the ice interaction behaviours that were observed on the video records into a number of basic categories. These categories are highlighted as follows, and a few illustrations given to describe each one.

Continuous Ice Crushing

- evidenced by the ongoing creation of small ice pieces along the ice interaction front
- “paste-like extrusions” are commonly seen in thicker ice (e.g.: multi-year floes), but are not observed during most of the thinner first year ice interactions
- ice clearance along the unloaded face(s) may appear to indicate crushing, but actually involves broken ice debris flowing around the caisson

ice crushing on the caisson’s E face
in thick second year ice



note that the NE corner is not loaded but
crushed ice debris is flowing around it

view of crushed ice debris taken
from the caisson’s ice deflector



large crushed ice extrusion clearing around
the NE face of the caisson



view of a “crushed ice extrusion
remnant in the caisson’s wake

Cyclical Ice Crushing

- this ice interaction behaviour involves ice crushing, then a build-up of rubble debris, followed by a flexural failure in the oncoming level ice cover due to the weight of the rubble debris
- the cycle tends to repeat itself a number of times, until the ice cover fractures or more general rubble building or mixed modal ice failures take over
- this type of cyclical ice crushing is quite evident in thinner first year ice, but is more difficult to discern in thicker first year and old ice conditions
- it is important to note that this definition of cyclical crushing should not be confused with that of simultaneous ice crushing discussed by others (Jefferies & Wright, 1987)

crushing on the E caisson face in medium first year ice (roughly 80 cm in thickness)



a flexural failure is seen in the oncoming ice behind the crushed ice rubble debris



ice crushing resumes as the oncoming ice cover penetrates the rubble accumulation



a flexural failure again occurs and the process then repeats itself



Mixed Modal Ice Failures

- mixed modal ice interaction behaviours involve a combination of failure modes across a caisson face, including out-of-plane bending failures, rubble building, fracture and at times, ice crushing across varying widths
- mixed modal ice failures are the type of ice interaction behaviour most commonly seen in first year ice, and also during significant proportions of the time that thicker old ice floes failed against the Molikpaq
- ice load data that involves both mixed modal and the preceding ice crushing failure modes has been incorporated into some of the recent probabilistic ice load averaging work (Jordaan et al, 2006), perhaps tending to mix “apples with oranges” and producing some less than conservative global ice load prediction results



bending and splitting failures along the east face of the caisson



spatially varying bending and crushing failures against the north caisson face

Ice Sliding and Clearance

- a large number of the time lapse video records show ice sliding along the (largely) unloaded faces of the caisson (see Figures 3 and 4)
- this is a natural part of the ice clearance process and should not be misinterpreted as ice failure against an unloaded caisson face
- when the ice attack angle is more than 50 degrees, it has been empirically estimated that the ice will begin to easily slide at low ice load levels (Neth & Spencer, 1990)

Slow Ice Loading

- various interaction events have been recorded where there is a very limited amount of ice movement (cm to tens of cm) over time frames of a few hours to a day or more, and also where the ice cover appears to stop moving (substantially) over periods of a few minutes
- these events have been classified as “slow ice pushes”, which likely involve loading across the ductile range
- no illustrations are provided here, since nothing appears to change in the time lapse video records of these types of ice interactions

3. ANNOTATION OF ICE LOAD RECORDS

The next step in the analysis procedure was to review the video data in combination with the ice load time series records, for each ice event, and annotate them according to the ice failure modes that were observed across the time frame of each fast file. The width over which “like failure modes” were seen (i.e.: whether one, two or three panel groups were experiencing the same type of ice action) was also an important part of this effort. In this regard, there were many cases where only certain portions of the caisson’s loaded face would see ice crushing, with other types of ice interactions occurring along the remainder of its width. Representative examples of this annotation process are given below.

3.1. April 12, 1986

The first involves ice action on the east face of the Molikpaq on the afternoon of April 12, 1986. In this case, the ice cover was moving towards the northwest and loading the caisson’s east face (as well as its southeast and southern faces). Figure 7 shows the ice load time series for the three MEDOF panel groups on the east face, along with a number of video frames of this face at various times throughout the fast file record. As mentioned earlier, time markers that were found in these records showed the video time stamps

were offset from those on the ice load time series, preceding them by about 4 minutes. Some annotation details relating to this April 12 fast file record are highlighted as follows.

- Ice starts to crush against the E3 panel group at the beginning of the record and then spreads northwards along the caisson's east face, reaching the E2 group, followed by the E1 group. The three video frames on the left hand side of the load time series plot show this progression to full ice crushing across the entire east face. Appropriate time frames, ice failure modes and loaded panel groups (widths) for this first segment of the record are:
 - ice crushing begins at the E3 MEDOF panel group at 13:00:07
 - ice crushing spreads north from E3, then across E2 ($\approx 20\text{m}$ spacing) at 13:01:32
 - crushing reaches E1 at 13:03:11, loading the E1, E2 and E3 groups ($\approx 40\text{m}$ spacing) at the same time, and continues until about 13:08:46 when fractures are seen near E1
 - ice crushing continues on the E2 and E3 groups ($\approx 20\text{m}$ spacing) until a large collapse is seen in the oncoming ice cover along the entire east face at 13:10:43
- After this collapse, sliding occurs along the caissons east face towards the north, with periods of:
 - ice crushing seen on the E2 and E3 groups from 13:14:57 to 13:19:25
 - isolated crushing seen on the E2 group from 13:32:05 to 13:34:33
- Crushing then resumes along the east face near the end of the record, with full width loading initially, followed by crushing on E2 and E3, as follows:
 - ice crushing against the E1, E2 and E3 groups from 13:39:30 to 13:42:30
 - ice crushing on the E2 and E3 groups from 13:42:30 to 13:50:15, then a collapse

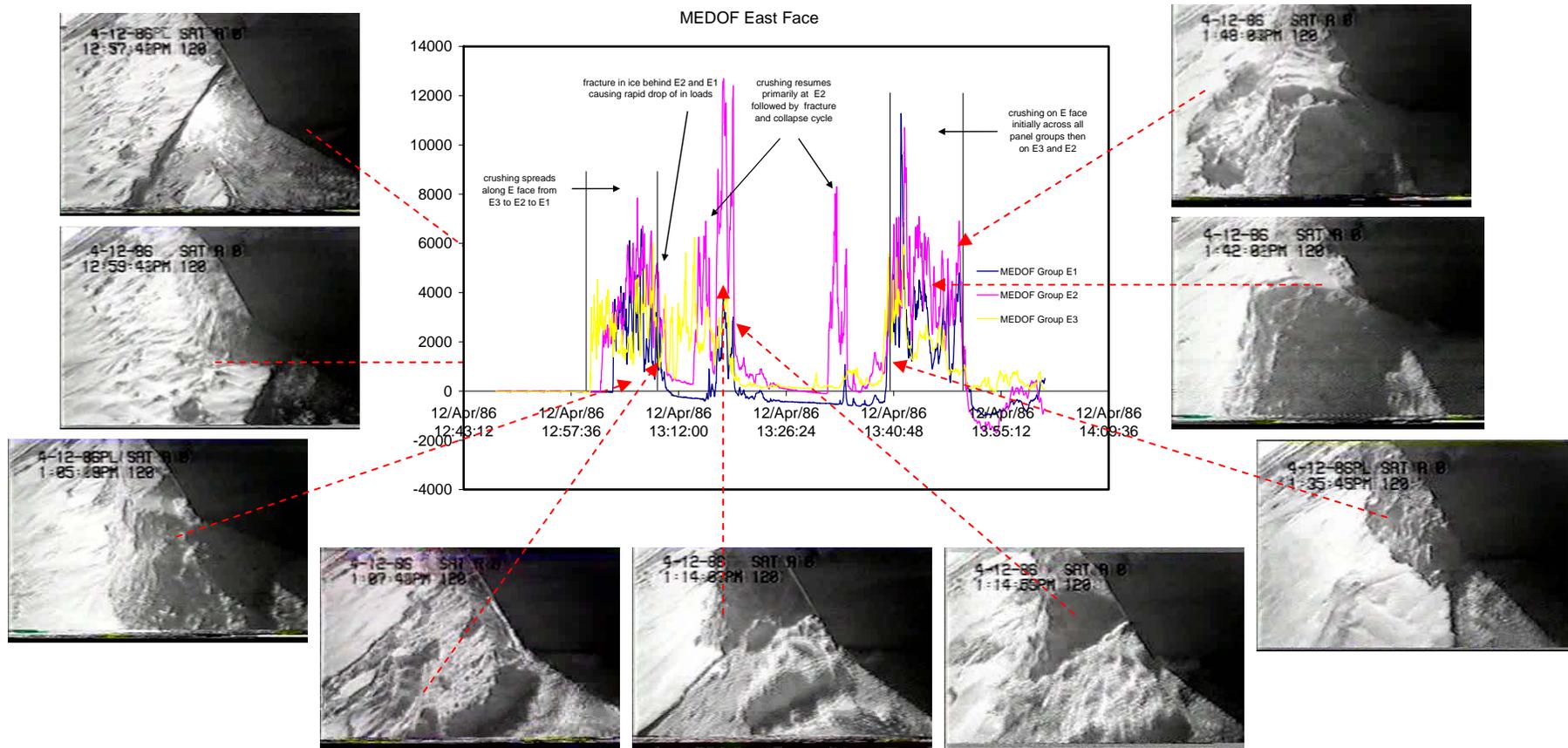


Figure 7 Annotated ice load time series for panel groups on the caisson's east face on April 12, 1986, with illustrative video frames (Event 0412C)

3.2. May 22, 1986

The second example of the annotation procedure involves ice action on the north face of the Molikpaq on the afternoon of May 22, 1986. In this case, the ice cover was moving towards the southwest and loading the caisson's north face (as well as its northeast and east faces). Figure 8 shows the ice load time series for the three MEDOF panel groups on the north face, together with a number of video frames of this face at different times throughout the fast file record. As noted earlier, specific time markers on the May 22 records showed that the video time stamps were within a few seconds of those on the load time series. Annotation details relating to this May 22 fast file record are highlighted as follows.

- Ice starts to crush against the N3 panel group at the beginning of the record and then spreads westwards along the caisson's north face, reaching the N2 group but not the N1 group. The video frames on the left hand side of the load time series plot show this progression of this ice crushing across the north face. Appropriate time frames, ice failure modes and loaded panel groups (widths) for the first segment of this record are:
 - ice crushing begins at the N3 MEDOF panel group at 13:58:07
 - ice crushing spreads west from N3 to N2 ($\approx 20\text{m}$ spacing) at 14:01:04
 - crushing on both the N3 and N2 panel groups continues until about 14:06:43, when a bending failure is seen in the oncoming ice
- After this major collapse, sliding of ice occurs along the caisson's north face towards the west, with periods of:
 - isolated crushing seen on the N1 panel group at 14:10:44
 - ice crushing seen on the N3 and N2 groups from 14:56:55 to 15:01:58
- This is followed by the ice stopping and then slowly pushing on the N3 and N2 panel groups until the end of the ice load time series record.

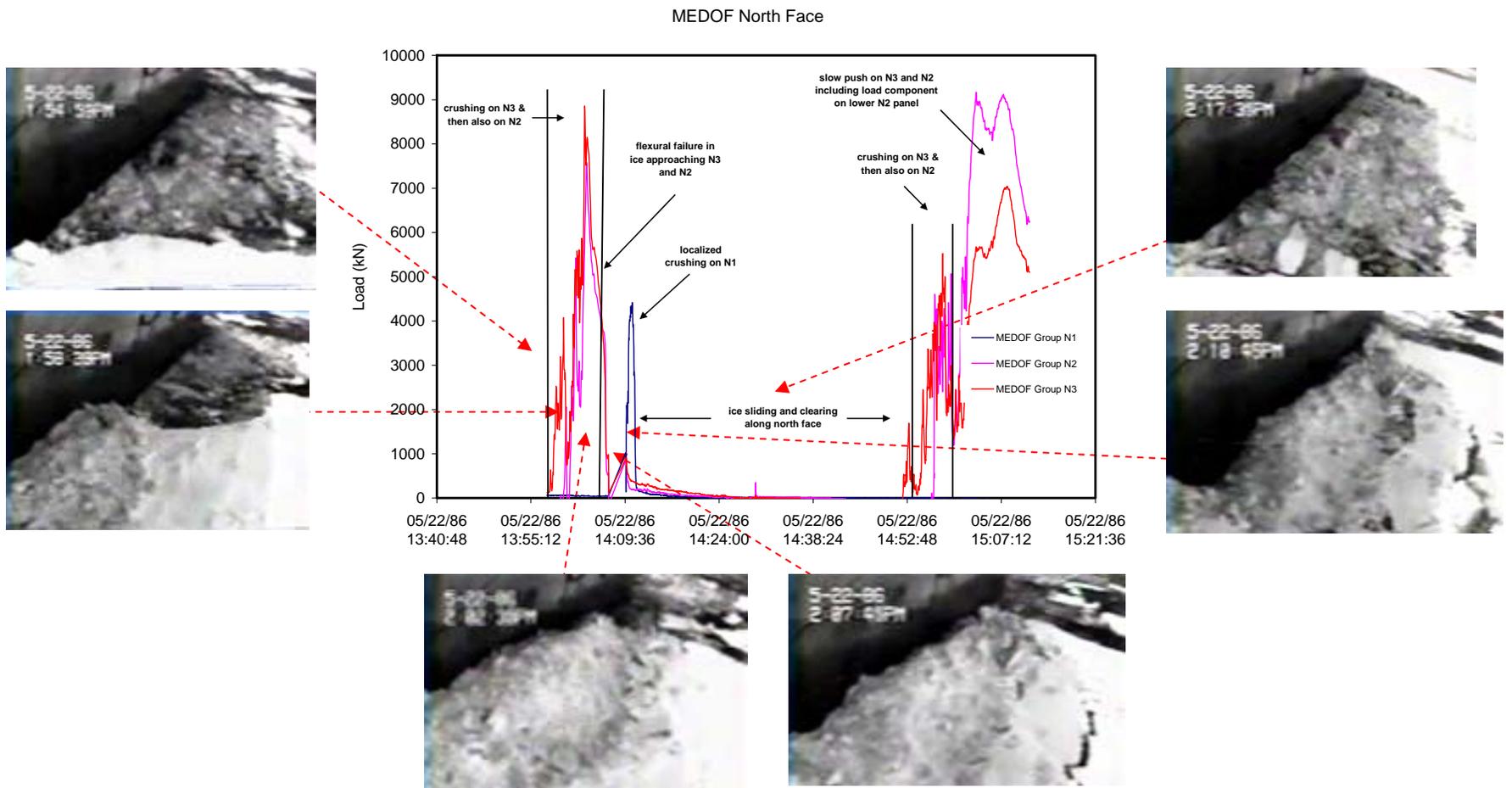


Figure 8 Annotated ice load time series for panel groups on the caisson's north face on May 22, 1986, with illustrative video frames (Event 0522B)

3.3. Annotated plots of remaining events

Similar ice load time series annotations have been developed for all of the other ice events that are under consideration in this work, on the basis of the time lapse video records. These additional annotations are provided in this Section.

At this stage, it is important to note that periods of ice crushing failures are not particularly lengthy, especially across the entire face of the caisson. These relatively short time periods of observed ice crushing, often across limited widths, may not be fully amenable to the type of probabilistic averaging analyses that have been conducted to date. However, they are a true representation of reality, based upon the time lapse video records.

In this regard, one challenge in this work has been to achieve a proper balance between the limitations of probabilistic averaging methods and the length (and spatial width) of the data segments that reflect ice crushing. Because of this, checks have been made to assess whether probabilistic averaging projections capture the appropriate proportion of high global ice load occurrences.

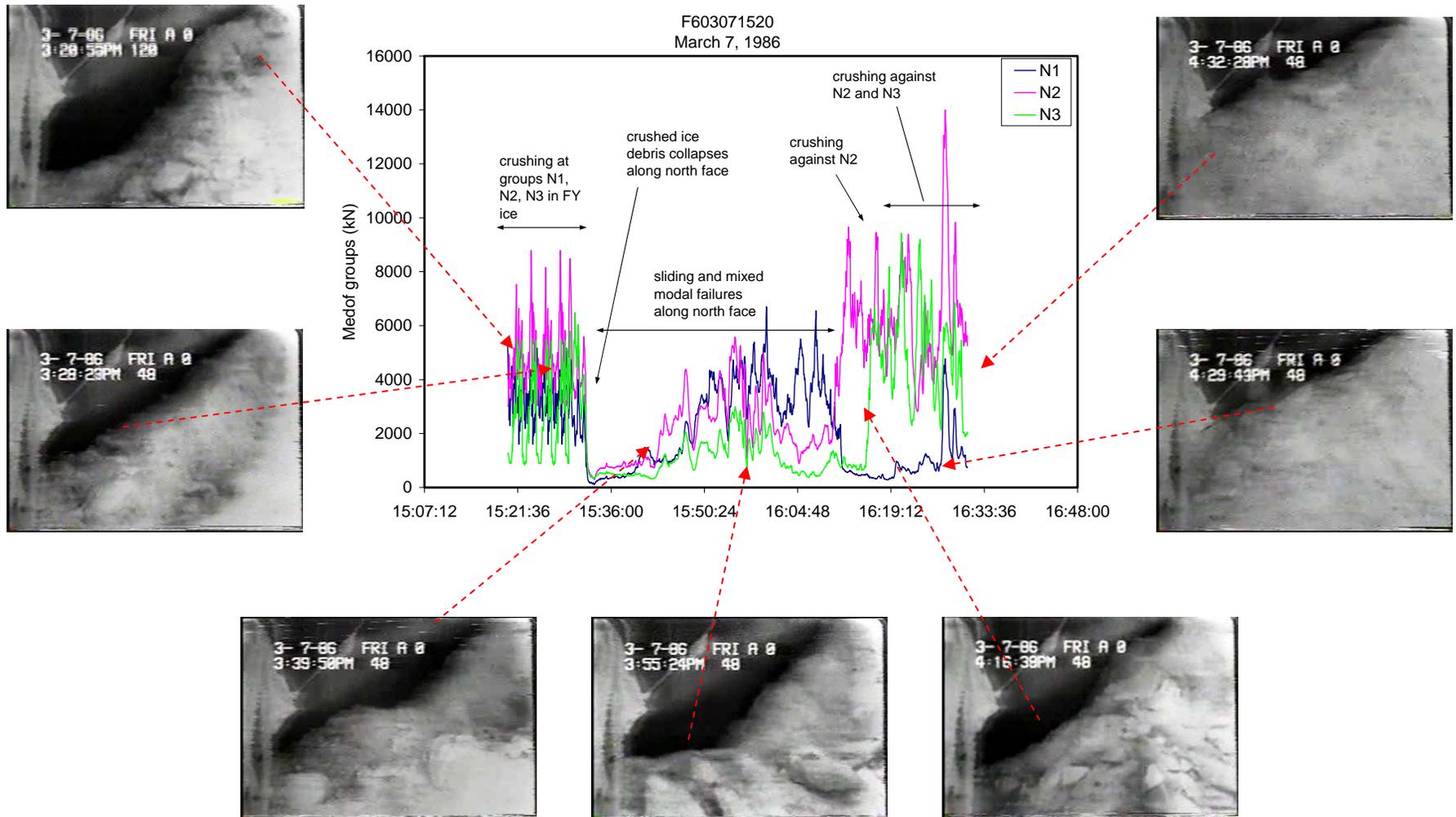


Figure 9 March 7 (Event 0307A)

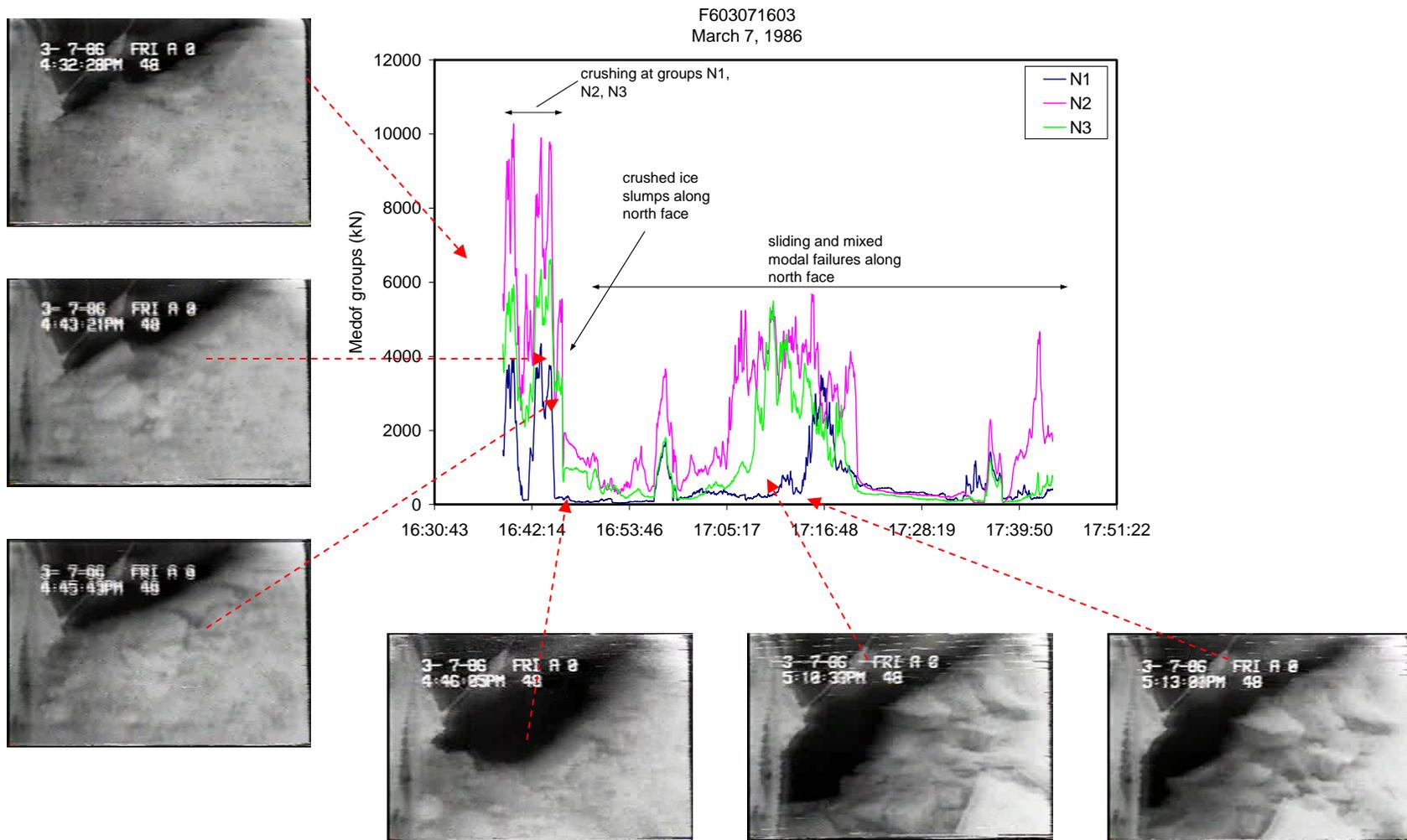


Figure 10 March 7 (Event 0307B)

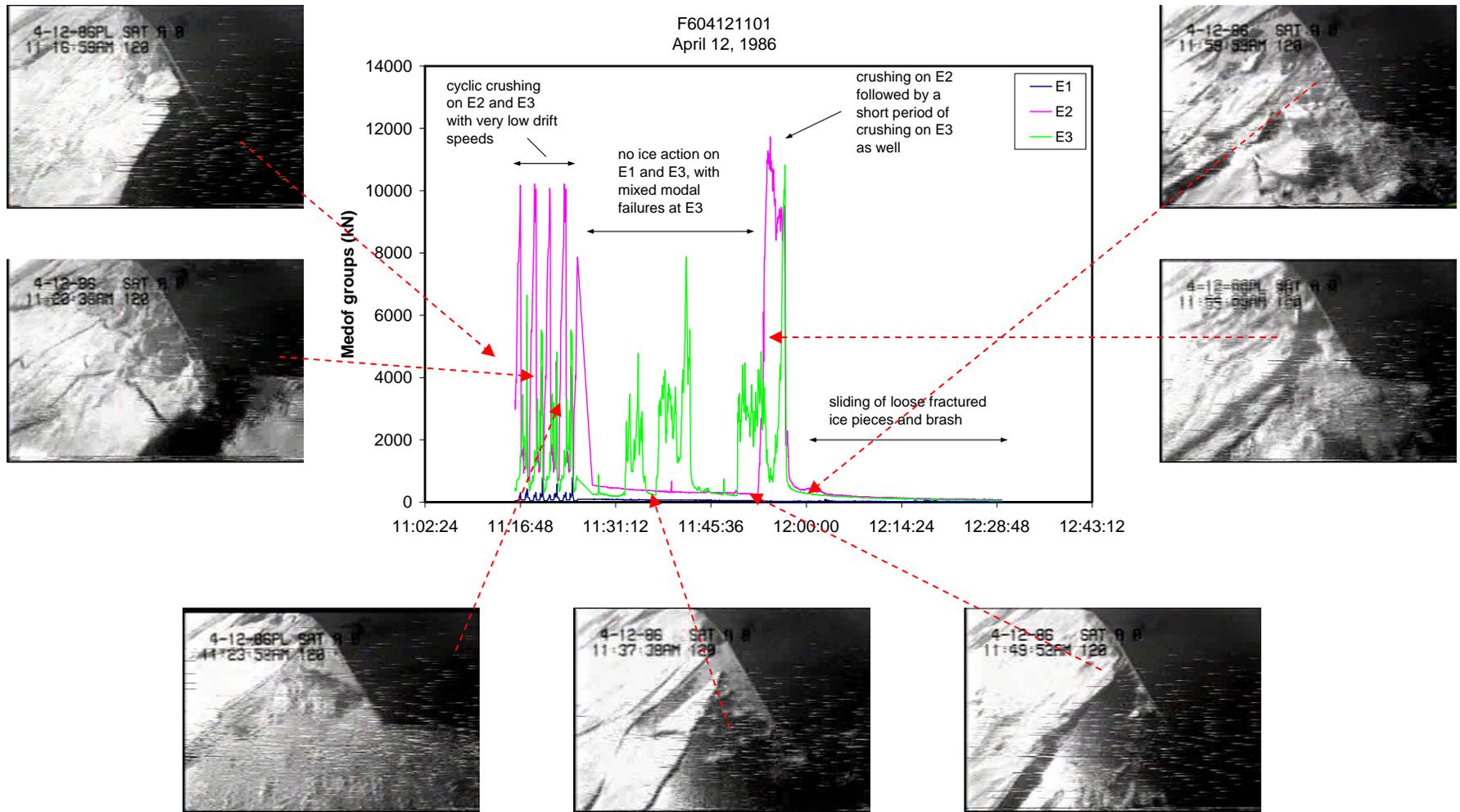


Figure 11 April 12 (Event 0412B)

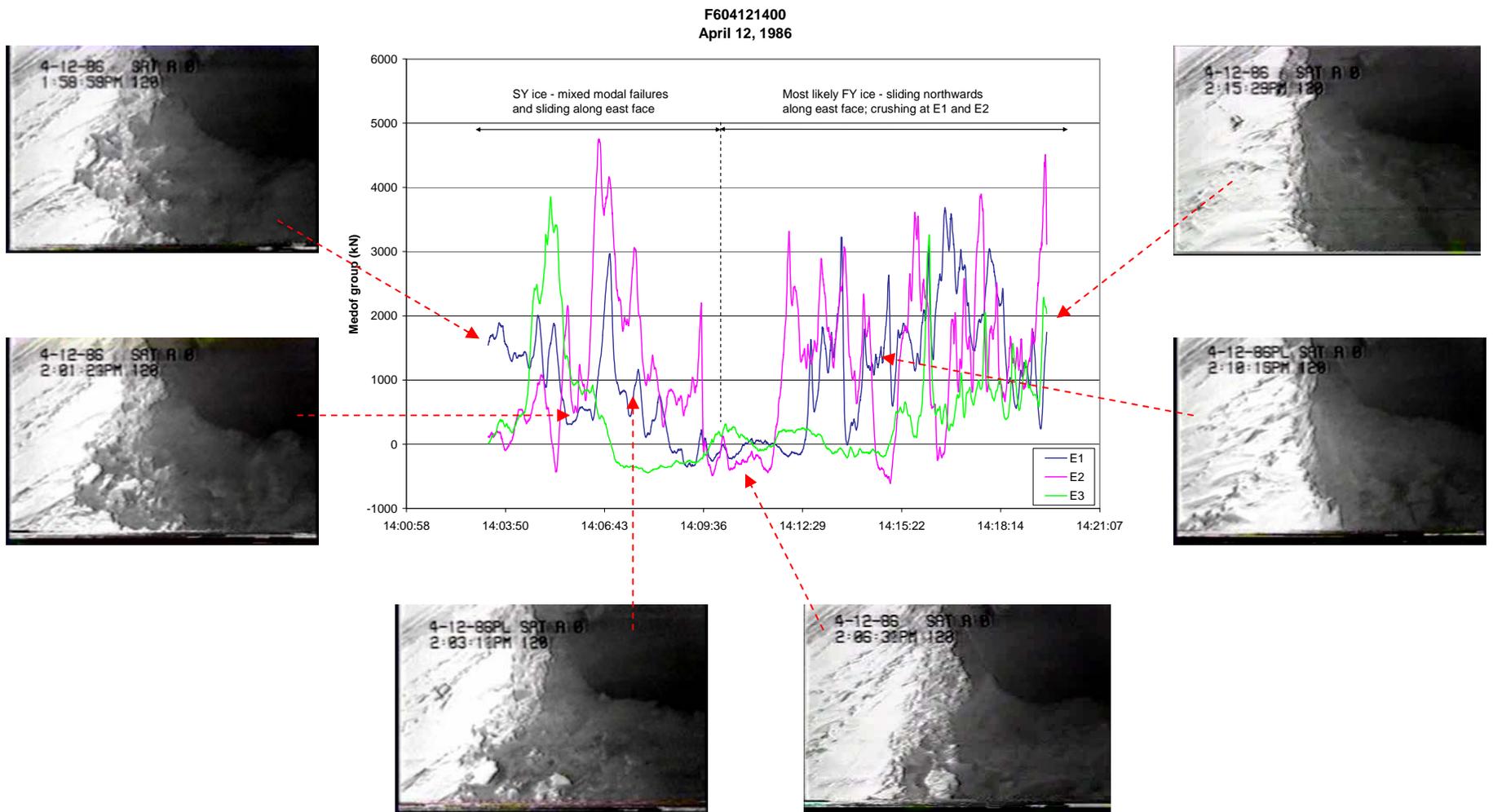


Figure 12 **April 12 (Event 0412D)**

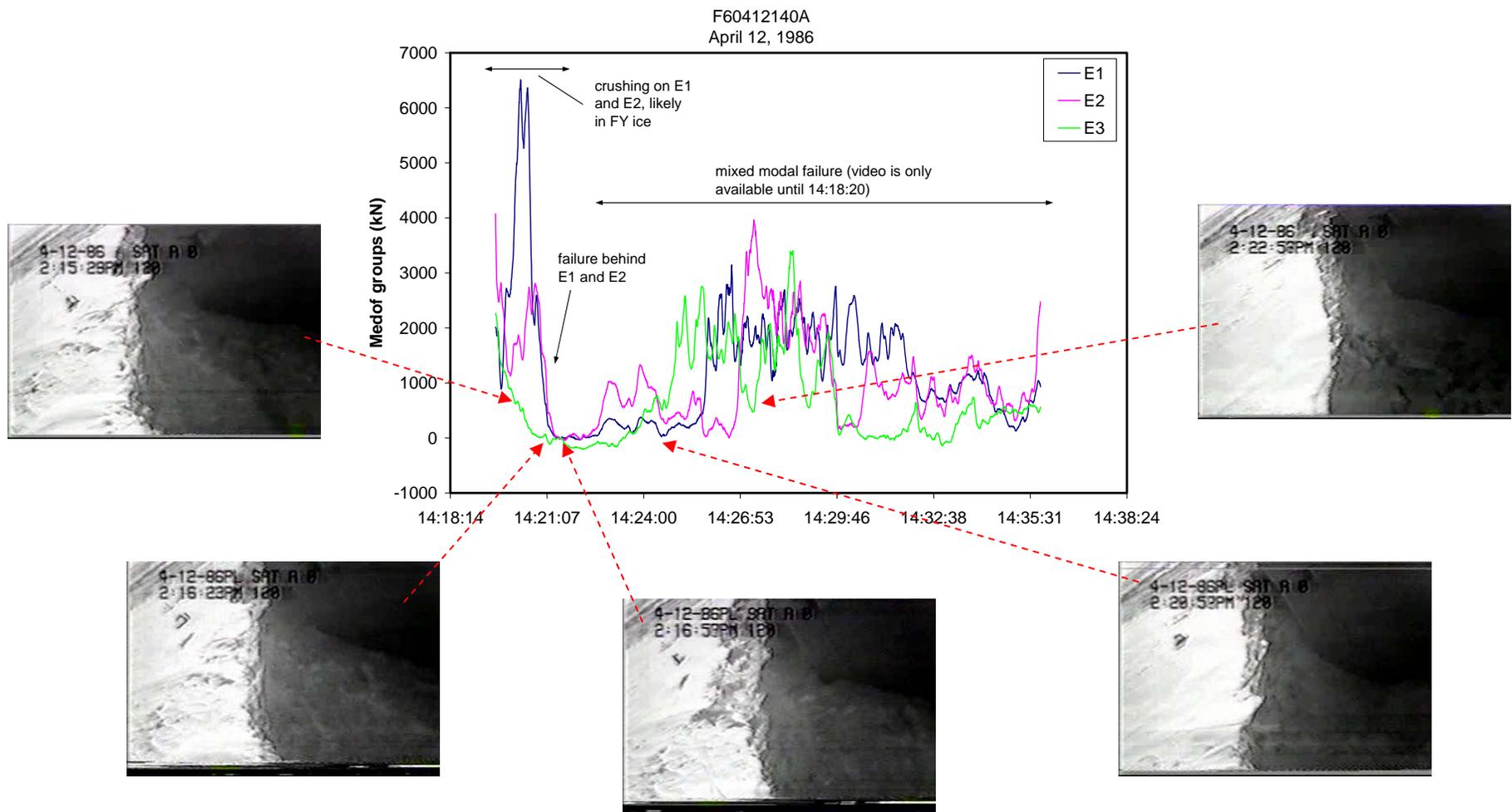


Figure 13 April 12 (Event 0412E)

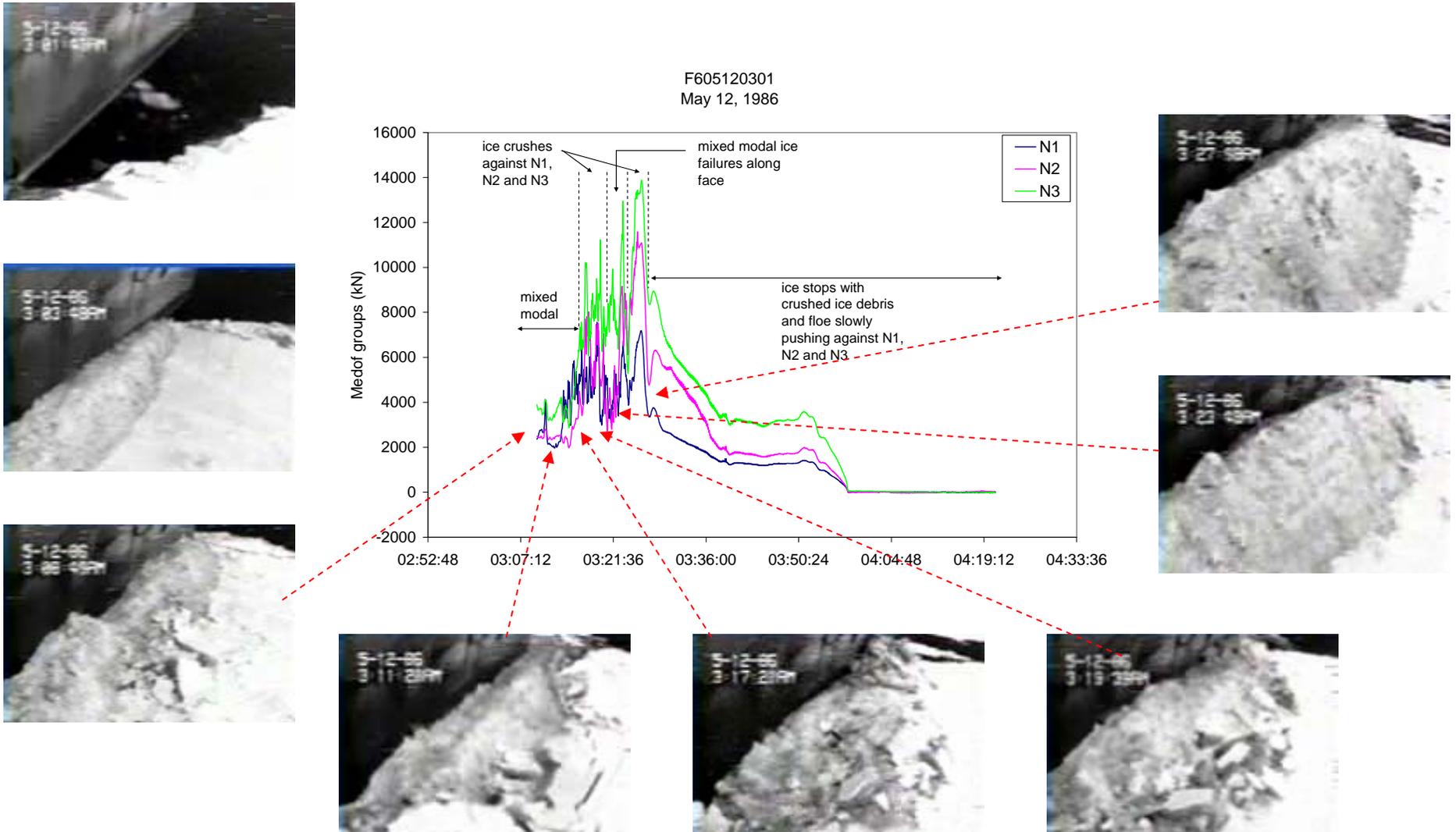


Figure 14 May 12 (Event 0512A)

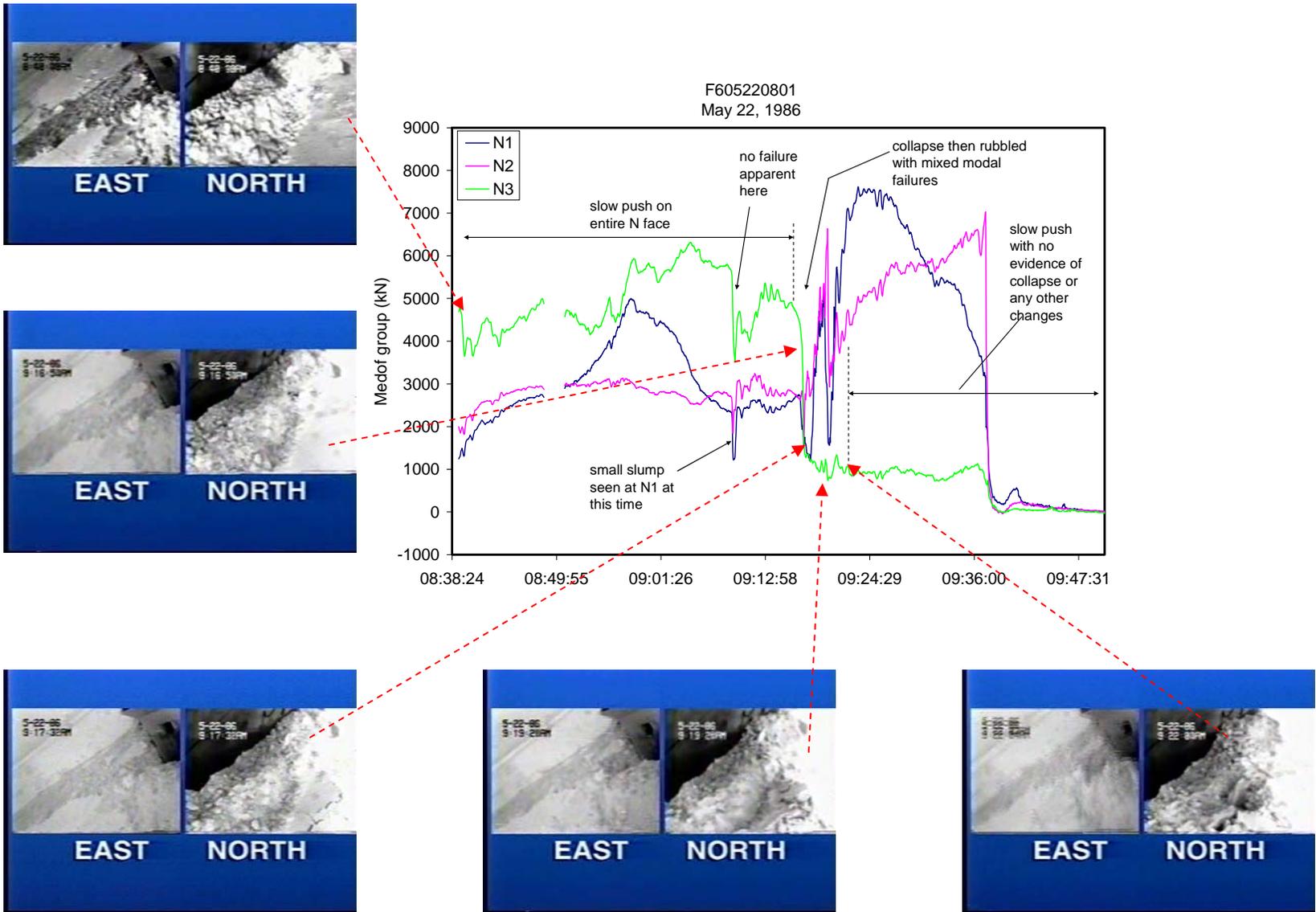


Figure 15 May 22 (Event 0522A)

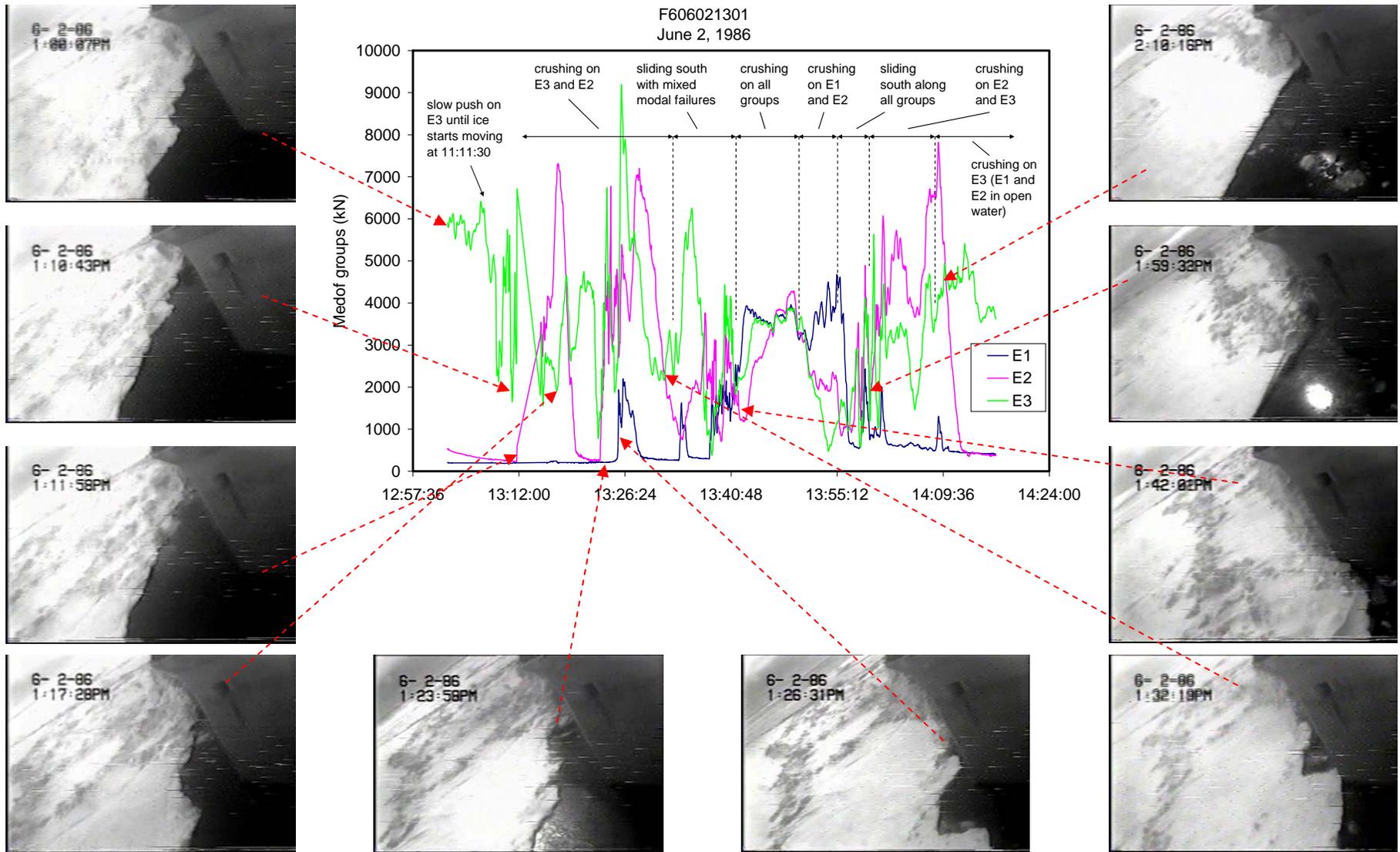


Figure 16 June 2 (Event 0602A)

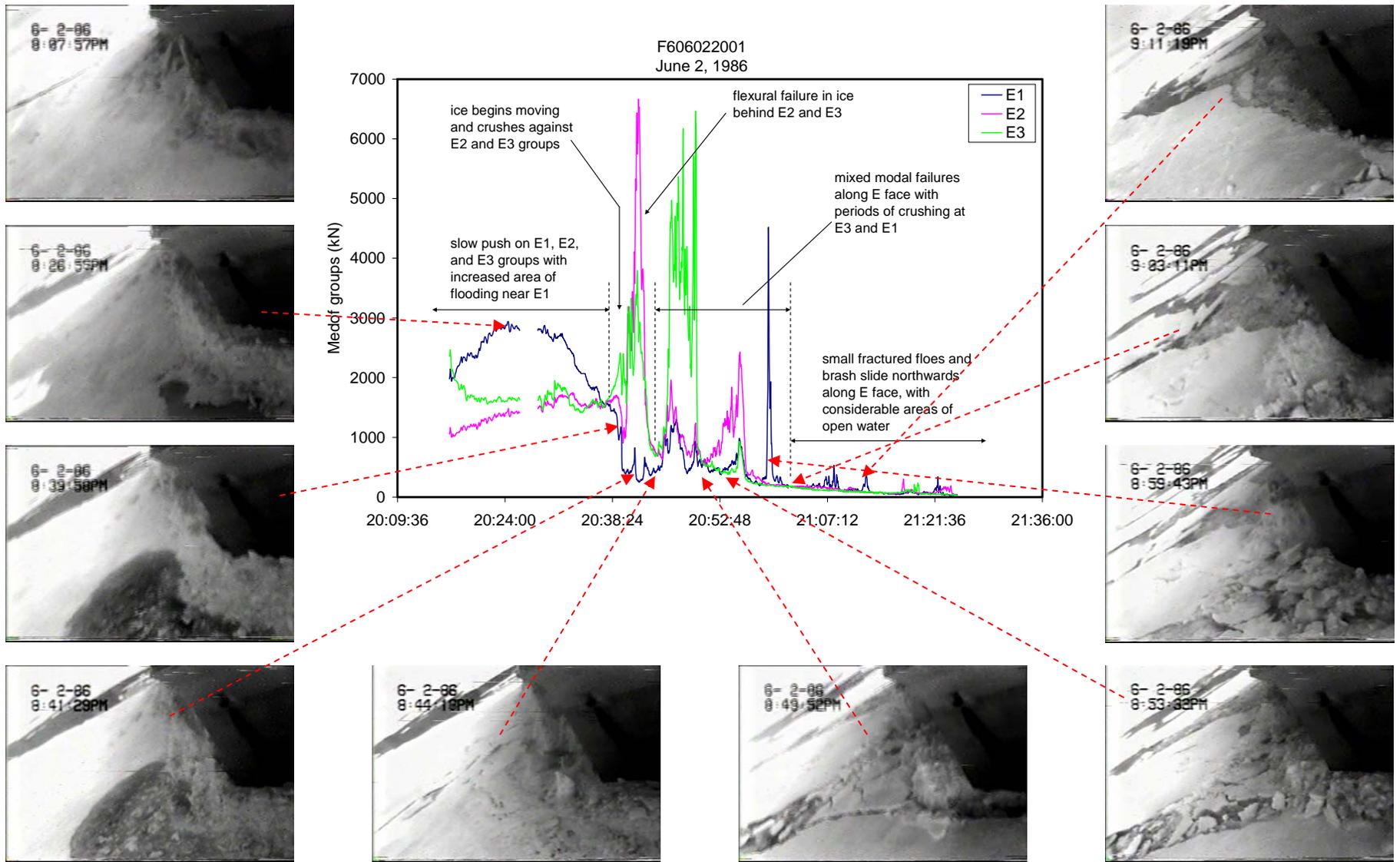


Figure 17 June 2 (Event 0602B)

4. SUMMARY TABLE OF KEY RESULTS

The key results of this time lapse video annotation work are summarized in Table 1, for all of the ice interaction events that are under consideration in this work for which time lapse video coverage is available. Most of the data entries in this table are self-explanatory. However, a couple of related notes are given as follows.

- The ice failure modes that were observed during each given fast file segment have been summarized in accordance with the following abbreviations:
 - CR: continuous ice crushing
 - CC cyclic ice crushing
 - MM mixed modal failures
 - SLD ice sliding along a face
 - SLW a creep or indiscernibly slow ice push
- Entries related to the spacing of MEDOF panel groups have been explicitly included to identify the width scale over which correlations should be assessed with probabilistic averaging methods.

As noted earlier, additional ice load time series records and illustrative video frames that are associated with the annotations given in Table 1 are presented in Appendix D of this report.

Table 1 Summary of annotation results for the ice events under consideration.

<i>Event ID</i>	<i>Date</i>	<i>Fast File</i>	<i>Segment</i>	<i>Time Period</i>	<i>Failure Mode</i>	<i>Panel Groups</i>	<i>Spacing of Groups</i>	<i>Comments</i>
0307A	March 7	F603071520	full file	15:20:41 – 16:31:01	CR, SLD & MM	all groups	≈ 40m	
0307A-1			1	15:20:41 – 15:32:21	CR	N1, N2 & N3	≈ 40m	- interaction involves first year ice
0307A-2			2	15:32:22 – 15:44:32	SLD	N1, N2 & N3	≈ 40m	
0307A-3			3	15:44:33 – 16:10:25	MM	N1, N2 & N3	≈ 40m	- interactions involves old ice - 3 cracks formed off NE side around 16:02
0307A-4			4	16:10:26 – 16:16:01	CR	N2	< 20m	
0307A-5			5	16:16:02 – 16:31:01	CR	N2 & N3	≈ 20m	
0307B	March 7	F603071603	full file	16:38:54 – 17:43:47	CR, MM & SLD	all groups	≈ 40m	
0307B-1			1	16:38:54 – 16:45:05	CR	N1, N2 & N3	≈ 40m	
0307B-2			2	16:45:06 – 17:43:47	SLD & MM	N1, N2 & N3	≈ 40m	
0308A	March 8	F603081603						- no time lapse video coverage available
0308B	March 8	F603081731						- no time lapse video coverage available
0325A	March 25	F603250801	full file	08:30:39 – 09:44:13	SLW	N1, N2 & N3	≈ 40m	- creep loading across entire north face - 20 cm displacement from N to S during the day
0412B	April 12	F604121101	full file	11:16:02 – 12:29:31	CC, CR, MM & SLW	N1, N2 & N3	≈ 40m	
0412B -1			1	11:16:02 – 11:24:51	CC	E2 & E3	≈ 20m	
0412B -2			2	11:24:52 – 11:52:48	SLW & MM	E3	< 20m	- sliding along E face with little loading on E1 & E2
0412B -3			3	11:52:49 – 11:57:12	CR	E2	< 20m	- crushing also on E1 from 11:55:03 to 11:57:08
0412B -4			4	11:57:13 – 12:29:31	SLD	E1, E2 & E3	≈ 40m	- loose brash and small fractured floes in open water

Table 1 (cont'd): Summary of annotation results for the ice events under consideration.

<i>Event ID</i>	<i>Date</i>	<i>Fast File</i>	<i>Segment</i>	<i>Time Period</i>	<i>Failure Mode</i>	<i>Panel Groups</i>	<i>Spacing of Groups</i>	<i>Comments</i>
0412C	April 12	F604121201	full file	13:00:07 – 14:01:04	CR, M & SLD	E1, E2 & E3	≈ 40m	
0412C -1			1	13:00:07 – 13:01:32	CR	E3	< 20m	
0412C -2			2	13:01:33 – 13:03:11	CR	E2 & E3	≈ 20m	
0412C -3			3	13:03:12 – 13:08:46	CR	E1, E2 & E3	≈ 40m	
0412C -4			4	13:08:47 – 13:10:43	CR	E2 & E3	≈ 20m	
0412C -5			5	13:10:44 – 13:14:57	CR	E3	< 20m	- sliding along remainder of east face
0412C -6			6	13:14:58 – 13:19:25	CR	E2 & E3	≈ 20m	
0412C -7			7	13:19:26 – 13:42:30	SLD	E1, E2 & E3	≈ 40m	- isolated crushing on E2 from 13:32:05 – 13:34:33
0412C -8			8	13:42:31 – 13:50:15	CR	E2 & E3	≈ 20m	
0412C -9			9	13:50:16 – 14:01:04	SLD & MM	E1, E2 & E3	≈ 40m	
0412E	April 12	F60412140A	full file	14:19:35 – 14:35:31	CR & MM	E1, E2 & E3	≈ 40m	
0412E-1			1	14:19:35 – 14:20:56	CR	E1 & E2	≈ 20m	
0412E-2			2	14:20:57 – 14:35:31	MM	E1, E2 & E3	≈ 40m	
0512A	May 12	F605120301	Full file	03:10:16 – 03:58:24	CR, MM & SLW	N1, N2 & N3	≈ 40m	
0512A-1			1	03:10:16 – 03:16:28	MM	N1, N2 & N3	≈ 40m	
0512A-2			2	03:16:29 – 03:19:28	CR	N1, N2 & N3	≈ 40m	
0512A-3			3	03:19:29 – 03:22:23	MM	N1, N2 & N3	≈ 40m	
0512A-4			4	03:22:24 – 03:27:33	CR	N1, N2 & N3	≈ 40m	
0512A-5			5	03:27:34 – 03:58:24	SLW	N1, N2 & N3	≈ 40m	

Table 1 (cont'd): Summary of annotation results for the ice events under consideration.

<i>Event ID</i>	<i>Date</i>	<i>Fast File</i>	<i>Segment</i>	<i>Time Period</i>	<i>Failure Mode</i>	<i>Panel Groups</i>	<i>Spacing of Groups</i>	<i>Comments</i>
0522A	May 22	F605220801	full file	08:39:23 – 09:50:27	SLW & MM	N1, N2 & N3	≈ 40m	
0522A -1			1	08:39:23 – 09:16:56	SLW	N1, N2 & N3	≈ 40m	- second year ice loading - no evidence of large collapse at 09:09:20 other than small slump at N1
0522A -2			2	09:16:57 – 09:21:25	MM	N1, N2 & N3	≈ 40m	
0522A -3			3	09:21:26 – 09:29:50	SLW	N1, N2 & N3	≈ 40m	- video coverage ends at 09:29:50
0522B	May 22	F605221301	full file	13:58:07 – 15:11:32	CR, SLD & SLW	N1, N2 & N3	≈ 40m	
0522B -1			1	13:58:07 – 14:01:04	CR	N3	< 20m	
0522B -2			2	14:01:05 – 14:06:43	CR	N2 & N3	≈ 20m	
0522B -3			3	14:06:44 – 14:54:50	SLD	N1, N2 & N3	≈ 40m	- isolated crushing on N1 at around 14:10:44
0522B -4			4	14:54:51 – 14:56:54	CR	N3	< 20m	
0522B -5			5	14:56:55 – 15:01:58	CR	N2 & N3	≈ 20m	
0522B -6			6	15:01:59 – 15:11:32	SLW	N2 & N3	≈ 20m	
0602A	June 2	F606021301	full file	13:02:26 – 14:16:45	CR, MM, SLW & SLD	E1, E2 & E3	≈ 40m	
0602A -1			1	13:02:26 – 13:11:30	SLW	E3	< 20m	
0602A -2			2	13:11:31 – 13:32:05	CR	E2 & E3	≈ 20m	- no load on E1 until MM failure around 13:26:31
0602A -3			3	13:32:06 – 13:41:08	SLD & MM	E1, E2 & E3	≈ 40m	
0602A -4			4	13:41:09 – 13:51:53	CR	E1, E2 & E3	≈ 40m	
0602A -5			5	13:51:54 – 13:55:09	CR	E1 & E2	≈ 20m	
0602A -6			6	13:55:10 – 13:58:04	SLD	E1, E2 & E3	≈ 40m	
0602A -7			7	13:58:05 – 14:10:16	CR	E2 & E3	≈ 20m	
0602A -8			8	14:10:17 – 14:16:45	CR	E3	< 20m	- ice fragments flow south with OW at E1 and E2

Table 1 (cont'd): Summary of annotation results for the ice events under consideration.

<i>Event ID</i>	<i>Date</i>	<i>Fast File</i>	<i>Segment</i>	<i>Time Period</i>	<i>Failure Mode</i>	<i>Panel Groups</i>	<i>Spacing of Groups</i>	<i>Comments</i>
0602B	June 2	F606022201	Full file	20:16:55 – 21:24:33	SLW, CR & MM	E1, E2 & E3	≈ 40m	
0602B -1			1	20:16:55 – 20:40:19	SLW	E1, E2 & E3	≈ 40m	- increasing flooding near E1 panel group
0602B -2			2	20:40:20 – 20:43:53	CR	E2 & E3	≈ 20m	
0602B -3			3	20:43:54 – 21:00:50	MM	E1, E2 & E3	≈ 40m	- crushing on E3 from 20:46 to 20:49:30 - a short crushing event on E1 around 20:59
0602B -4			4	21:00:51 – 21:24:33	SLD	E1, E2 & E3	≈ 40m	- considerable open water along east face