



H2020 – Coordination and Support Action



BE-OI

BEYOND EPICA – OLDEST ICE

Grant Agreement No : 730258

Deliverable No 1.3 – Update 22nd March 2017

Mini-traverse to Little Dome C

Submission of Deliverable

Work Package	WP1 Logistic support and coordination		
Deliverable No	D1.3		
Deliverable title	Mini-traverse to Little Dome C		
Version	2 – Update on 22 nd March 2017		
Status	Final		
Dissemination level	PU - Public		
Lead Beneficiary	3 - ENEA		
Contributors	<input type="checkbox"/> 1 – AWI	<input checked="" type="checkbox"/> 2 – IPEV	<input checked="" type="checkbox"/> 3 - ENEA
	<input type="checkbox"/> 4 – CNRS	<input checked="" type="checkbox"/> 5 – NERC-BAS	<input type="checkbox"/> 6 – UU-IMAU
	<input type="checkbox"/> 7 – NPI	<input type="checkbox"/> 8 – SU	<input type="checkbox"/> 9 - UBERN
	<input type="checkbox"/> 10 – UNIBO	<input type="checkbox"/> 11 – UCAM	<input type="checkbox"/> 12 - UCPH
	<input type="checkbox"/> 13 – ULB	<input type="checkbox"/> 14 – ULUND	
Due Date	31 January 2017		
Delivery Date	22 March 2017		

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EXECUTIVE SUMMARY

This report describes the logistic efforts to transfer material within Antarctica to the Little Dome C survey site during the Antarctic season 2016/17. It provides a schedule of performed actions on site and lists required resources.

1. Introduction

The work described further below was carried out in the frame of:

Subtask 1.1.1 Mini-traverse to "Little Dome C" 2016-2017 (IPEV/ENEA, M2-M4)

To enable fieldwork at Little Dome C, in 2016-2017 a Talos Dome to Dome C traverse is planned (M2-M3, D1.3). Once at Concordia Station, the vehicles will allow about 20 days of fieldwork (M3-M4). After providing the infrastructure for a test of geophysical and rapid access equipment at DC, a mini-traverse to Little Dome C will allow the ground-based survey (see Task (T) 2.1.2 and T3.1) in the area we will have chosen on the base of the analysis of the airborne radar surveys from T2.1.1 (D2.1). The traverse is an important Milestone MS2. The retrograde traverse to Concordia Station will take place in M5.

2. Execution

As a part of CSA BE-OI project, between October 28 and December 12, 2016, ENEA/PNRA personnel in strait collaboration with Institut Polaire Francais Paul Emile Victor (IPEV) and British Antarctic Survey (BAS) realized a traverse through northern Victoria Lands, George V and Adelie lands to transfer the ITASE traverse equipment (vehicles, modules, tanks and sledges) from Mario Zucchelli Station/Talos Dome to Concordia Station. After tests of geophysical and rapid access drill equipment at Dome C, ITASE traverse equipment was transferred to "Little Dome C" allowing our research team to conduct 26 days of fieldwork consisting in the ground-based survey (WP2, ***Subtask 2.1.2***) and rapid access drill RAID (WP3, ***Subtask 3.1.1***). At completion of 2016-2017 fieldwork the ITASE traverse equipment returned to Concordia Station, underwent maintenance and was prepared for wintering in 20 days.

Transfer of ITASE traverse equipment from Mario Zucchelli Station/Talos Dome to Little DC

The ITASE traverse system is composed by vehicles, modules and tanks mounted on sledges (fig.1):



Fig. 1 ITASE traverse vehicles and modules during the traverse between Talos Dome and Concordia Station.

In particular the following vehicles and equipment were deployed:

- four vehicles: two Kassbohrer Pisten Bully 330D and two Caterpillar Challenger 65C
- one module for living accommodation, kitchen, dining room and two sleeping rooms (8 beds).
- one module with toilet and shower, diesel-electric generator, workshop, and snow-melter.
- one storage module (spare parts and food)
- 3 fuel sledges (16,000 litres each).
- one scientific module for the drilling activity equipped with a second diesel-electric generator for emergency.

An enclosed passage way connects the first two groups during the stop. Various electric and service connections link the three groups of module (living, toilet/generator and drill).

The ITASE traverse equipment is at Talos Dome since 2002. To allow activities ENEA/PNRA decided to substitute one of Pisten Bully 330D with a new Kassbohrer Pisten Bully 300 polar equipped with crane, transported by ship at Mario Zucchelli Station (Mzs) during January 2016. This was necessary considering the time lapse that is required for transportation of heavy equipment in Antarctica. This new vehicle had to be transported from Mzs to Talos Dome to join the ITASE traverse. The required material and fuel for the supply of the ITASE traverse was transported to Antarctica from New Zealand by sea (ITALICA cargo vessel, 10-12 days travel time) or by airplane (Lockheed Hercules L-100/30, 8-9 h travel time) then unloaded at Mzs, then transported by airplane (1.5 h travel time).

The distance from Mario Zucchelli Station to Talos Dome by air is 275 km, whereas the distance to cover by land is about 410 km. The first 150 km from Mzs to the plateau are a very dangerous area due the heavy presence of crevasses. Therefore this operation is performed rarely and only if unavoidable by other means, like it was in this case because of the need to bring to Talos Dome an heavy vehicle. For safety reasons, all transportation of personnel and materials to Talos Dome is performed by air (Twin Otter DHC-6, Basler BT-67, Helicopter – Squirrel AS350) from the Mzs at Terra Nova Bay.



Fig. 2 British Antarctic Survey FFB Twin Otter DHC-6, landing at Talos Dome

The traverse route from MZS to Concordia Station can be divided in three sections. These differentiate mainly by the trip difficulties caused by snow surface conditions and crevasses occurrence (Fig.3):

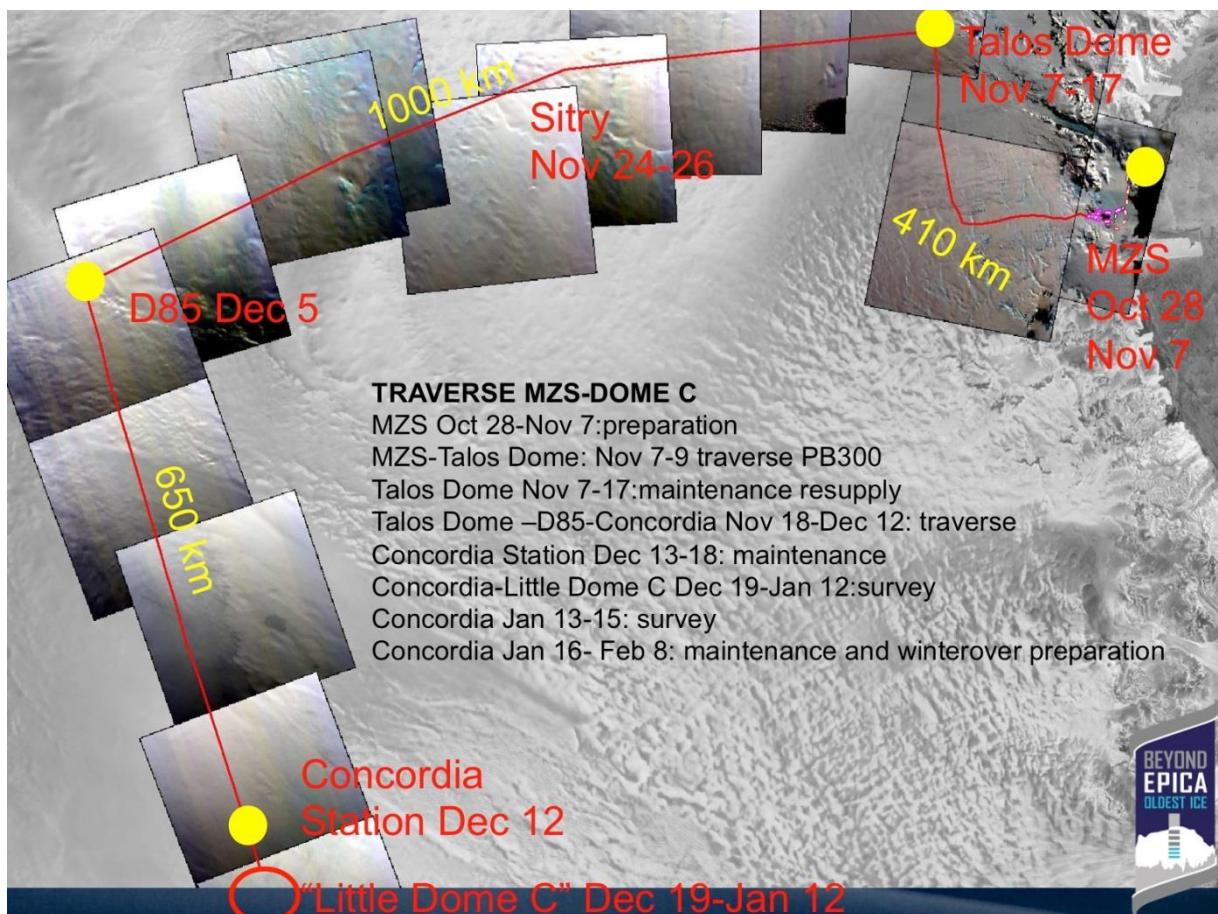


Fig. 3 Map of the traverse from MZS to Concordia Station/Little Dome C, with the distance and the time.

- First part: the traverse from MZS to Talos Dome, 410 km long, the most dangerous part because of the presence of a heavy crevasses area in the first 150 km;
- Second part: from Talos Dome to D85 about 1000 km long, the most difficult part from a logistic point of view, because of the presence of a high roughness surface, sastrugi and dunes respectively higher than a meter and a half and 3 metres.
- Third part: from D85 to Concordia Station about 650 km following the Concordia logistic traverse route from the coastal station of Cape Prud'homme to Concordia Station. As this logistic traverse is performed three times per year for the necessities of supply of Concordia Station, this part of route is made of compressed snow and permits a faster and safer travel of vehicles and modules.

The traverse team was composed of 8 persons that arrived on October 28, 2016 at Mario Zucchelli Station by Hercules L-110/30 from Christchurch (NZ). From October 29 and November 7, the team prepared the material, food, scientific instruments and the new vehicle PB300 polar to the transfer to Talos Dome. During this period the team with the support of MZS staff also performed surveys over the crevassed area by helicopter and land, to identify the safer route to reach the plateau. The most dangerous area, the conjunction of Widowmaker Glacier with Larsen Glacier, was examined using radio-echo sounding to detect the wide of the crevasse and their depth of snow bridge, to establish the less dangerous point to cross with the PistenBully 300.

On November 7, the Basler BT-67 transferred part of the team to Talos Dome, while the other part reached Talos Dome from MZS by land with the new PB300 polar, 3 days were necessary for this trip for a total of 42 h of transfer. To avoid problems caused by the low temperatures, the PB300 was never stopped during the last 32 h of travel. A shift of the crew was done after 20 h with the support of the NERC-British Antarctic Survey TwinOtter FFB. The vehicles velocities were about 10 km/h with a fuel JetA1 consumption of 1250 l (about 3 l per km).

From November 7 to 17, the team at Talos Dome performed pre departure operations: cleaning of the vehicles and modules from the snow, and accurate maintenance of the vehicles for the traverse. During this period the traverse received a resupply of food and fuel by Basler and BAS TwinOtter, with a total received mass of approx. 20t.

The traverse moved from Talos Dome on November 18 and arrived at D85 on December 5, covering about 1000 km. The first 350 km from Talos Dome were very hard for the vehicles and team due the roughness of surface and climatic conditions in a pristine environment never reached by man. The traverse stopped 3 days (November 24-26) at "Sitry" site.

The traverse successfully arrived at Concordia Station on December 12.

Globally 10 days of preparation at MZS, 35 days of travel were needed from MZS and 23 from Talos Dome. The traverse succeeded in arriving at Concordia Station according to the original plans (Fig. 3).

Between December 13 and 18 the team was partially swapped with researchers of WP2 and WP3 and the vehicles were serviced. In parallel, during this period, radar surveys with DELORES unit and GPS strain net measurements were performed in the so called “Patch North” area and a radar survey was also performed between Concordia Station and “Little Dome C” (Fig. 4).

The traverse was then moved to “Little Dome C”.

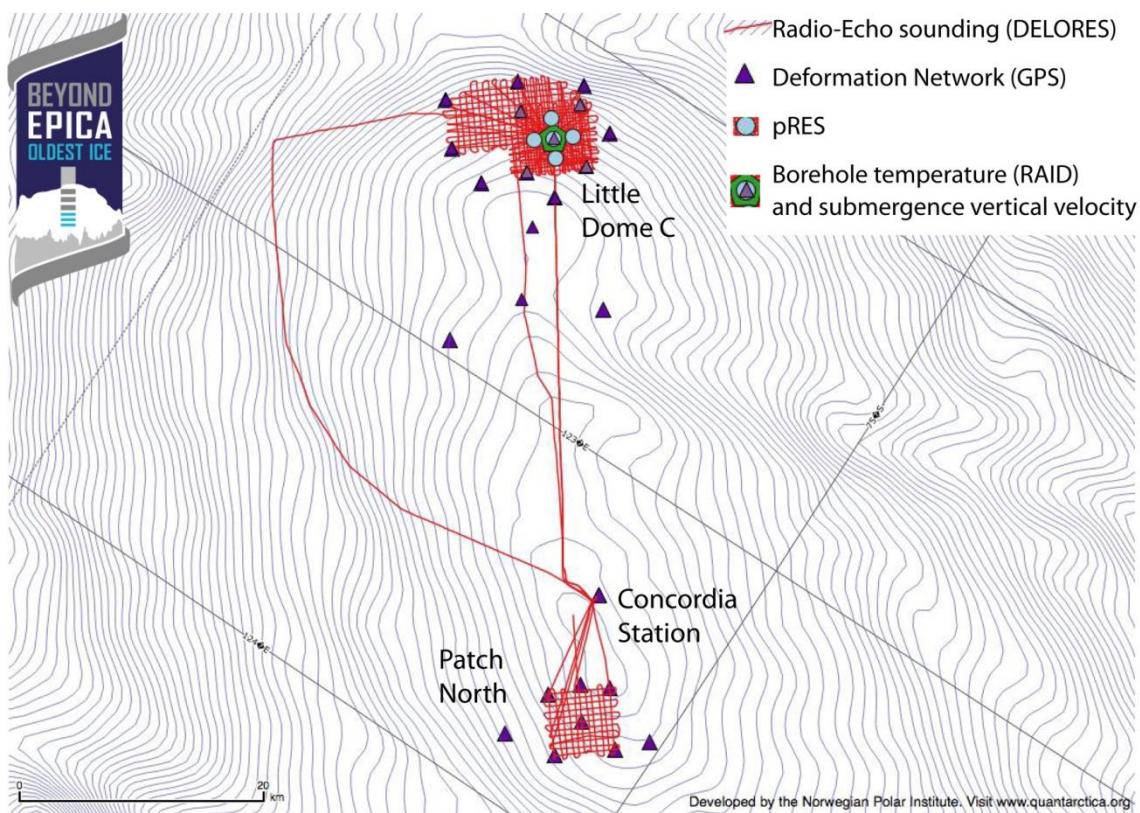


Fig. 4 Map (contour line every 0.5 m) of the Dome C area and activities conducted during the field season, DELORES and pRES profiles.

Fieldwork at “Little DC” closure of the 2016-2017 field season

The deployment of ITASE traverse equipment to “Little DC” allowed over 25 days of fieldwork. The fieldwork team was composed of five people and worked there from December 19, 2016 to January 12, 2017. WP2 and WP3 related activities were performed at “Little Dome C” and at “Patch North” as originally planned for more than 20 days (Fig. 4 and 5).

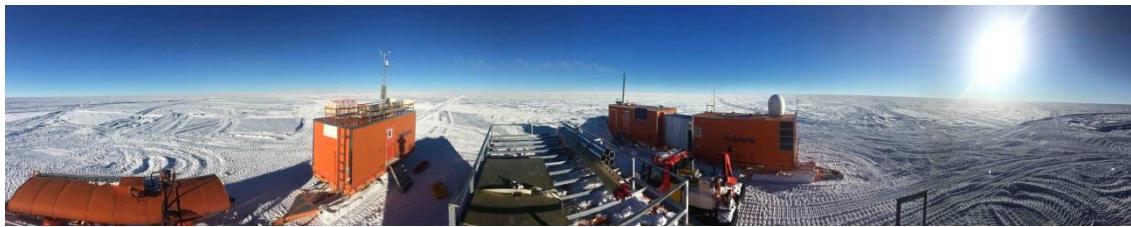


Fig. 5 The “Little Dome C” camp.

During this period five pRES stations were installed as planned. The very precise GPS positioning was successfully executed both at “Little Dome C” and “Patch North” with 26 stations including one permanent station and two firn compaction/vertical strain stations. A considerable ground based radar profiling was achieved with the DELORES radar, resulting in more than 1000 line km of new high-resolution profiles of internal echoes and of the bedrock. In addition at “Little Dome C”, a second search patch located slightly North from Concordia Station was documented with the DELORES radar. Intermediate ice core were drilled at a depth of 105.25 m with RAID system (WP3) for borehole temperature profile and ‘coffee-can’ firn compaction/vertical strain cable was anchored to the bottom of the borehole.

At the end of the fieldwork the ITASE traverse equipment was returned to Concordia Station and between 15/1/2017 and 8/2/2017. The vehicles and modules were maintained and prepared for the winter-over at Concordia Station where the temperature can fall below -80°C.

3. Other significant information

Both the deliverables (D1.1 and D1.3) and the Milestone (MS2) have been achieved with 100% of success and as originally planned.

The total fuel consumption of the traverse from MZS to Concordia Station was 41,650 litres:

- MZS – Talos Dome: 410 km, 1250 litres, about 3 l/km (only PB300 polar);
- Talos Dome – D85: 1000 km, 25,000 litres, about 24.5 l/km (entire traverse plus power generator);
- D85-Concordia: 650 km, 15,400 litres 23.5 l/km ((entire traverse plus power generator)).

The total consumption of the traverse (PB300, PB330 and Caterpillar 65C) and for GPS and radar survey (1400 km) at “Little Dome C” was about 6000 litres.

At D85 and at 250 km from Concordia the RAID logistic traverse provided 15,400 litres (Fig. 6) of diesel fuel (SAAB). Additional 5700 litres were provided at Concordia Station for the activity at “Patch North” and at “Little Dome C”.



Fig. 6 Refuelling of the ITASE traverse from RAID logistic traverse at 250 km from Concordia Station

Moreover, the traverse ITASE transported 14,000 litres of JetA1 at Concordia Station. This fuel will be used at the beginning of next season (2017-18) when the temperature will be lower than -50°C.

The total air support for the traverse was:

- HDB and HNR helicopters Squirrel AS350: 12.15 h
- FFB NERC-BAS, Twin Otter DHC-6: 45.4 h
- KBO Twin Otter DHC-6: 5.4 h
- VKB Basler BT-67: 14.6

The maintenance of vehicles at Talos Dome and during the transfer from Talos Dome to D85 were marked by breakdown and following necessity of reparation of: PB330: high pressure tube two times; PB300: coupling high-pressure tube two times, wipers motor, the oil pressure system of the tracks, fan control of hydraulic oil, various electronic fault;

Caterpillar 65C: elastic coupling between the engine and transmission, voltage regulator; sledge of drill module. Due to these inconveniences, the convoy was stopped for a total of 3 days. The spare parts were provided by MZS and Cape Prud'Homme stations.

The traverse and “Little Dome C” activity was performed with climatic conditions very severe due to katabatic winds that has reached over 70 nodes in coastal area (MZS-Talos) and with temperatures dropped below -45 °C with wind-chill frequently below -50°C.

The team that prepared and conducted the traverse from MZS to Concordia Station was composed from 7 person (^) plus the contribution for the survey and maintenance of vehicles mainly by others 5 person (*), whereas the team of “Little Dome C” were composed by 5 person (*) for a total of 643 man/day:

^Bianchi Fasani Gianluca (28/10/2016 -13/12/2016)

^Brunetti Simone (7-11/11/2016)

^Bussani Massimo (9-10/11/2016)

^Calligaro Luigi (29/11-13/12/2016)

^De Leonardis Antonio (10-17/11/2016)

^De Podestà Davide (30/10/2016-13/12/2016)

^*Frascati Fabrizio (28/10/2016 -21/1/2017)

^*Frezzotti Massimo (28/10/2016 -21/1/2017)

^Panichi Saverio (28/10/2016 -15/12/2016)

*Mulvaney Robert (20/11/2016-21/1/2017)

^*Quintavalla Mario (28/10/2016 -8/2/2017)

^Scalet Michele (8/11/2016-13/12/2016)

^Urbini Stefano (28/10/2016-21/11/2016)

*Vittuari Luca (20/11/2016-21/1/2017)

The crew of NERC-BAS FFB Twin Otter DHC-6 have supported the traverse from November 1 and 25, 2016:

Steven King - Aircraft Captain

David Benner - Aircraft Engineer