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INVESTIGATION REPORT

Accident to the Schempp Hirth "Ventus-2CxT" glider[1] registered **G-TABB** on 14 July 2017 at Val des Prés (Hautes-Alpes), "Crête de Peyrolle"[2]

Time	Around 16:55 [3]
Operator	Private
Type of flight	General aviation
Persons on board	Pilot
Consequences and damage	Pilot fatally injured, aircraft destroyed

Loss of control in flight, collision with the terrain, slope soaring flight

1 - HISTORY OF THE FLIGHT

Note: the following information comes from a witness statement and the data recorded by the glider onboard system.

The pilot, the owner of the glider, performed a towed take-off around 12:10 from the Serres La Bâtie-Montsaléon aerodrome in the Hautes-Alpes. Another pilot took off shortly afterwards onboard a second powered glider. Together, they headed north-east to fly a circuit while keeping radio contact.

Around 16:10, the second pilot saw the G-TABB for the last time at an altitude of 3,200 m looking for thermal updrafts.

At 16:27, owing to the cloud layer present north of the Mont-Cenis lake (in the Savoie), the second pilot advised by radio that he was heading back to the Serres La Bâtie-Montsaléon aerodrome. The pilot of the G-TABB replied that he was doing the same. This was their last exchange by radio.

The second pilot landed at 17:35 at the Serres La Bâtie-Montsaléon aerodrome. Around 19:00, friends of the G-TABB pilot were worried that they had had no news from him. The emergency services were contacted around 21:30, 30 minutes after sunset.

The search operations took place throughout the night and the next day. The wreckage of the glider was located at an altitude of 2,470 m on the north-east slope of the Crête de Peyrolle, 130 m below the ridge.

[1]The Ventus-2CxT is a glider with a built-in sustainer system composed of a combustion engine on a retractable pylon installed in the upper part of the fuselage.

[2]Altitude 2,470 m.

[3]Except where otherwise indicated, times in this report are local.

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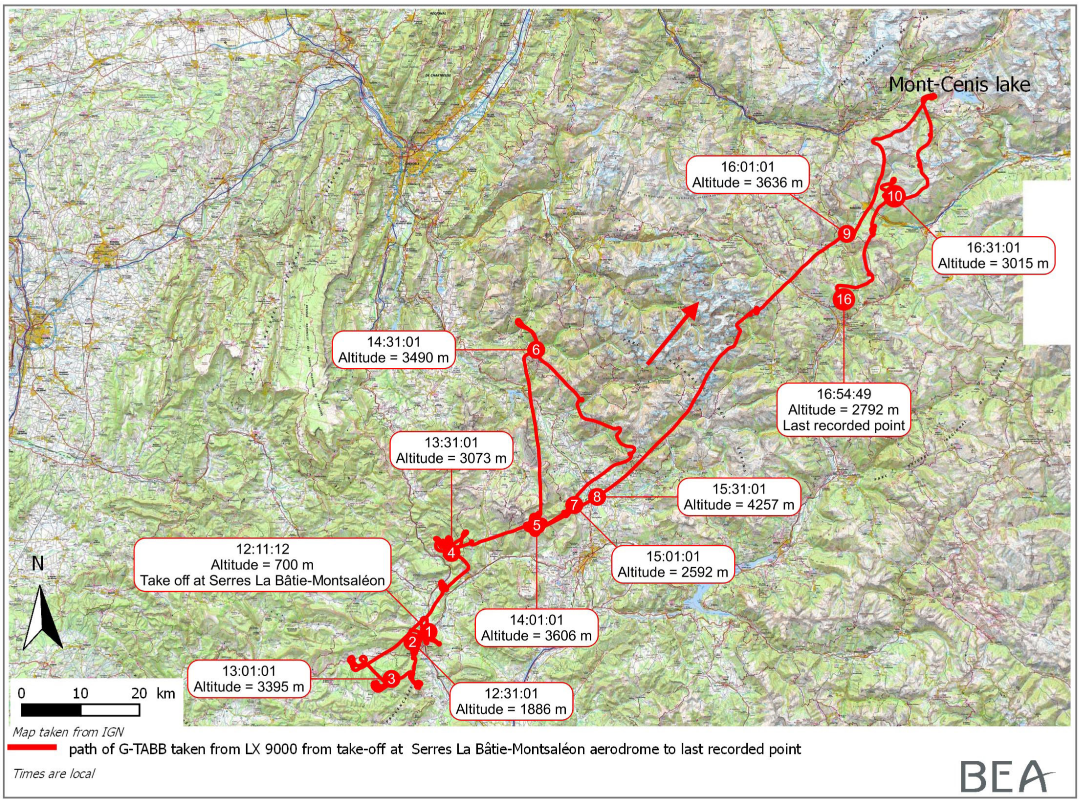


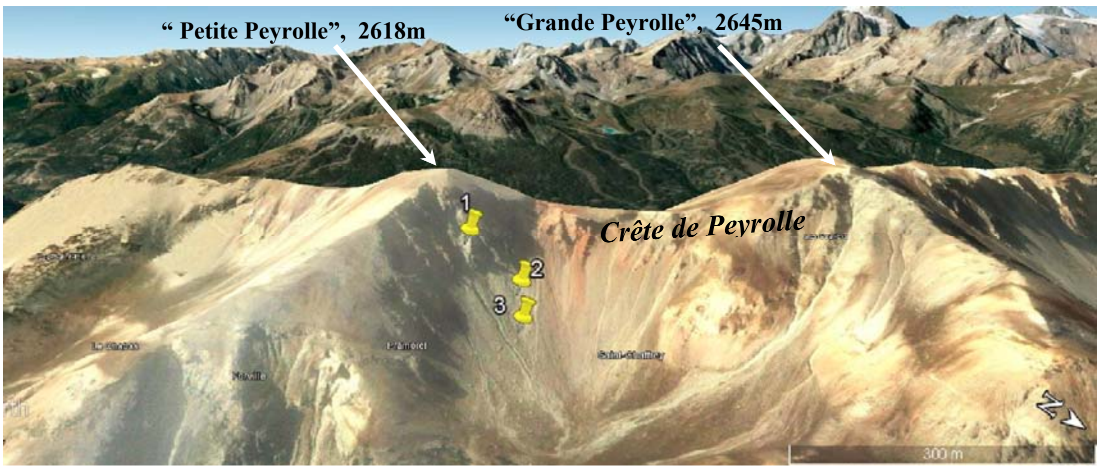
2 - ADDITIONAL INFORMATION

2.1 Examination of site and wreckage

The site was located in a cirque, on the east slope of the Crête de Peyrolle.

It was on steep ground and difficult to access.

The examination carried out two days after the accident showed that the major part of the wreckage was situated at the initial impact point, at an altitude of approximately 2,470 metres, in a small combe (point 1 below). No impact marks with the terrain were observed at an altitude higher than the place where the wreckage was found. Fragments of the left wing were found further down (points 2 and 3 below), in an adjacent combe.



Source Google Earth

Overall view of accident site

The examination of the site and the wreckage showed that the fuselage front section and right wing tip of the glider had struck the mountain slope at a considerable horizontal speed. At the time of the impact, the glider heading was between 300° and 330° with a steep bank angle to the right, greater than 45°.

On the parts of the airframe which it had been possible to reconstruct, it was observed that:

- there was no impact mark with a bird or with any other object on the outer surface of the aircraft;
- the engine was not deployed;
- there was continuity of the rudder control on impact with the ground;
- the right wing air brake was retracted.

(4)Gendarmerie Mountain Rescue Unit.

Access to the wreckage was supervised by the PGHM(4). Given the dangerous conditions at the site, it was not possible to examine all the nooks and crannies.

Consequently, as certain parts of the wreckage could not be recovered, it was not possible to more widely document the condition of the glider and its systems. In particular, it was not possible to determine the position of the left wing air brake or that of the flaps at the time of the accident.

It was not possible to determine whether the pilot was wearing oxygen cannulas.

The oxygen bottle which equipped the glider, with a total capacity of 2 litres, was found empty with the valve partially open, the normal position for using oxygen in flight. The pressure gauge and the electronic oxygen delivery device were broken on impact.

The continuity of the oxygen system could not be checked as numerous lines had been torn away on the impact with the terrain.

(5)Mountain High EDS O2D1.

An electronic oxygen delivery device(5) installed on the oxygen system, is designed to supply a measured dose of oxygen according to the altitude, each time the pilot inhales. This device has a control on its front face to select the operating mode. This control was found in the OFF position. It seems highly unlikely that its position could have been modified on the collision with the ground. Consequently, the device was not supplying oxygen at the time of the impact. Furthermore, when this device is switched on, it emits an audio and visual warning if the oxygen pressure in the bottle is low, if the batteries are low or if there is a break in the oxygen flow. The warnings were disinhibited at the time of the impact.

The ballast tanks in the wings and fin were found empty due to the damage. It was not possible to determine if they held water at the time of the impact.

2.2 Glider information

The empty weight of the glider is 366.2 kg (including the water in the fin ballast tank) and the maximum authorized weight is 600 kg.

The total capacity of the wing ballast tanks is 202 litres and the fin ballast tank is 7.8 litres. The maximum quantity of water authorized in order not to exceed the maximum weight during the accident flight was 143 litres, i.e. 143 kg.

The presence of water in the wing ballast tanks increases the weight of the glider and as a result the stalling speed.

In straight and level flight with the engine and air brakes retracted, the manufacturer's Flight Manual indicates the stalling speeds[6] according to the configuration of the flaps, the weight of the glider and the position of the centre of gravity.

[6]The speeds given in the Flight Manual are the Indicated AirSpeeds (IAS).

If the wing ballast tanks are empty, the data in the Flight Manual indicates that the stalling speed (indicated airspeed) is 58 km/h (+/- 5 km/h) with the flaps in position +2 and 59 km/h (+/- 5 km/h) with the flaps in position 0, in straight and level flight.

If there is 40 l of water in each wing ballast tank, the stalling speed (indicated airspeed) is then 63 km/h (+/- 5 km/h) with the flaps in position +2, and 64 km/h (+/- 5 km/h) with the flaps in position 0, in straight and level flight.

In a turn, the increase in the load factor increases these stalling speeds as follows:

Centre of gravity at 380 mm	All up mass 456.2 kg (wing ballast tanks empty)		All up mass 536.2 kg (40l in each wing ballast tank)	
Flap position	(Flaps +2)	(Flaps 0)	(Flaps +2)	(Flaps 0)
Turn with a 30° bank	67 km/h (+/- 5 km/h)	68 km/h (+/- 5 km/h)	73 km/h (+/- 5 km/h)	74 km/h (+/- 5 km/h)
Turn with a 45° bank	82 km/h (+/- 5 km/h)	84 km/h (+/- 5 km/h)	89 km/h (+/- 5 km/h)	90 km/h (+/- 5 km/h)

According to the Flight Manual:

- for smooth thermals flap setting ''+2'' is recommended;
- in turbulent thermals, which require a quick aileron response, flap setting ''+1'' is advantageous;
- the recommended speed range with the flaps in position +1 for low speed flying (straight and level) and at the maximum weight of 600 kg, is between 93 and 100 km/h;
- the loss of height from the beginning of the stall in a 45° bank turn is up to 70 m if the pilot immediately performs the actions for a recovery.

2.3 Influence of wing loading on performances

The wing loading is the ratio between the weight of the glider and the wing surface. It thus varies according to the weight of the pilot(s) and also according to the additional onboard loads. For the same angle of attack, a glider with a heavy load will have a higher speed than a glider of the same type with a lighter load.

The advantage of a high wing loading is to procure a lower rate of sink at high speeds. This is why some pilots choose to fill the wing ballast tanks in order to have higher transition speeds and lose minimum altitude between updrafts.

In contrast, a loaded glider stalls at a higher speed, has a greater rate of sink at low speed and its radius of turn increases for a constant bank angle. It climbs with greater difficulty in thermal updrafts.

When the updrafts are good, the time available for a loaded glider to fly a circuit is decreased by 10% to 20%. When the conditions are less favourable or the updrafts are not good, the pilot always has the possibility of dumping the water of the ballast tanks in flight.

On this glider, dumping the water in the wing ballast tanks when they are completely full requires around 3 min 45 s and in the fin ballast tank, 1 min 30 s.

Ballasting increases the stall speed. The pilot must progressively and regularly practise flying with a high wing loading. The radius of turn is increased, inertia is greater, anticipation must be greater too.

2.4 Pilot information

The pilot, aged 68 years, held a glider pilot's license. He had logged 3,350 flight hours of which 2,843 on gliders and 510 on type of which 58 in the last three months.

He had logged 827 flight hours in mountain gliding, of which 620 hours gliding from the Serres La Bâtie-Montsaléon aerodrome in the southern French Alps, and 207 hours from the Rieti aerodrome in Italy. He had experience in flying above 3,000 m.

He had logged around 53 flight hours in 11 flights on this glider since his arrival at the Serres La Bâtie-Montsaléon aerodrome on 12 June 2017. It was his 17th stay at the Serres La Bâtie-Montsaléon aerodrome. His first stay was in 2003.

2.5 Medical information

The pilot held a class 2 medical certificate issued 15 February 2017 and valid until 15 February 2018. Since March 2017, the pilot had been taking medication to reduce his blood pressure.

There was no autopsy nor toxicological investigation.

Regulatory requirements are that any flight of more than 30 minutes above an altitude of 3,800 metres is prohibited without oxygen equipment. However, it is considered that the altitude at which outward signs of hypoxia can appear is around 1,500 metres. Hypoxia warning signs are: headache, fatigue, drowsiness, weariness, sleepiness, tingling, oppression, euphoria, feeling of general discomfort, perspiration, breathlessness, reduced attention, difficulties in mental calculation, reading maps, etc. The pilot must therefore avoid staying above an altitude of 3,000 metres without the use of oxygen. On the appearance of one of the hypoxia warning signs, the pilot must start descending and keep the oxygen supply during the descent for a sufficient period of time.

2.6 Meteorological information

The meteorological conditions estimated by Météo-France (French weather centre) for the accident site were the following:

- wind from north-west to north-east at approximately 20 kt, visibility greater than 10 km, clear to partly cloudy sky with cumulus formations based around 3,100 to 3,500 m, moderate turbulence and a temperature of 10.5°C.

The situation described at the safety briefing on the day of the accident was the following:

- aloft wind from north with possibility of turbulence and presence of thermals in lower layers between 3,000 and 4,000 m.

2.7 Onboard computers

The glider was equipped with a LX9000 computer which records the GNSS data every 4 seconds on an internal microSD card. There is a 60-second data buffer and the data is saved every minute. When the recording suddenly stops, up to 60 flight seconds are lost.

The data was analysed and showed that:

At 16:53:29, the pilot reached the Crête de Peyrolle situated near Briançon (Hautes-Alpes), he then followed its west slope at an altitude of approximately 2,770 m. Thirty seconds before the end of the recording, the glider climbed just before changing the direction of its path to the left. The glider crossed the ridge between the Grande Peyrolle peak and the Petite Peyrolle peak to reach the east slope and then turned to the right. It then flew around the Petite Peyrolle peak (altitude 2,618 m) via the south in descent and returned to the west slope of the ridge.

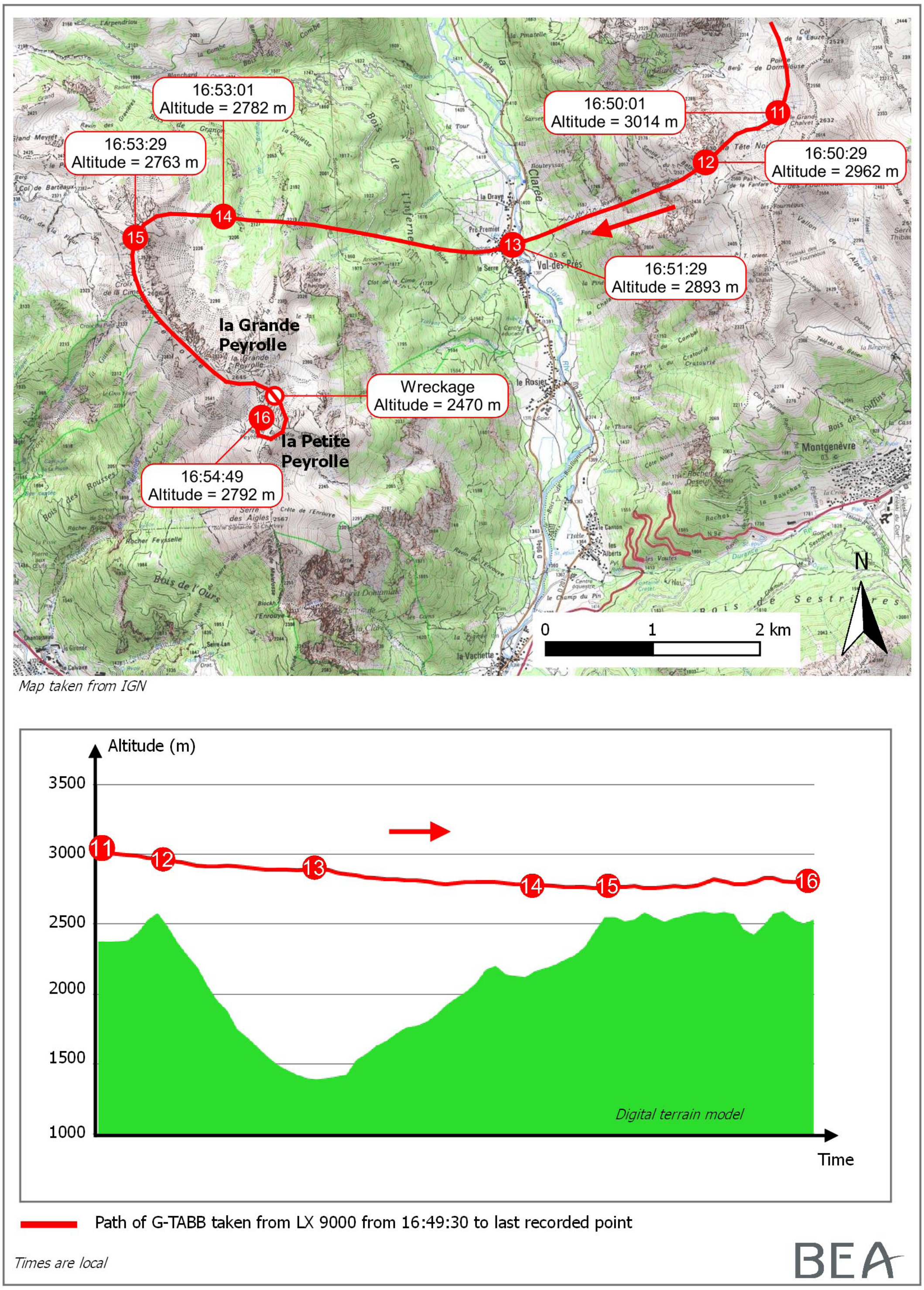
During the very last seconds of the recorded path, the altitude of the glider, in a right turn, was diminishing. The radius of turn decreased and the True Air Speed[7] dropped from 123 km/h to 89 km/h. The last recorded point at 16:54:49 showed the glider at an altitude of 2,792 m between the Grande Peyrolle peak and the Petite Peyrolle peak. The glider was over the west slope of the ridge, with a heading of 066° facing the ridge pass (altitude 2,542) with a TAS of 89 km/h which corresponds after calculation, to an IAS of around 75 km/h[8].

[7]The true airspeed is the horizontal component of the air flow speed around the aircraft. The only speed the LX9000 measures is the true airspeed, using a differential pressure sensor. The LX9000 corrects the measurement according to the air density at a given altitude.

[8]When the altitude increases, the true airspeed becomes greater than the indicated airspeed on the airspeed indicator. To obtain the true airspeed using the indicated airspeed, the IAS must be increased by 1% for every 5 degrees of deviation from the temperature and by 1% for every 600 ft above sea level (1013.25hPa).

The bank angle of the glider during the last turn, calculated from data, varied between 20° and 40°.

The wind direction and strength estimated from the data are the following: direction between 280° and 360°, speed around 30 km/h.



2.8 Witness statements

2.8.1 Tug pilot

The tug pilot stated that he had flown over the accident site a few minutes after the wreckage had been found, the day after the accident. While flying near the ridge, on the lee side of the Grande Peyrolle and over the east slope of the Crête de Peyrolle, he encountered strong downdrafts and said that the indicated rate of descent was at the maximum value on the vertical speed indicator. He explained that there was a strong north-west wind.

2.8.2 Pilot of second glider

The pilot said that he had a discussion with the pilot of the G-TABB about the effect the quantity of water carried had on the glider's performances at high speed and on ease of handling. The pilot of the G-TABB was planning to take part in a glider racing competition on 1 August at Rieti (Italy). During this discussion, the pilot of the G-TABB told him that he wanted to increase his flying speeds during the races. The pilot of the second glider suggested that he increase the quantity of water in each wing from 25 l to 40 l.

He said that they added water to the wing ballast tanks of their respective gliders but that he did not know what quantity the pilot of the G-TABB had added. He added that the pilot of the G-TABB had oxygen supply cannulas in one of his pockets, before getting into his glider. He specified that the pilot was in the habit of checking the oxygen system before his flights.

He added that on this particular day, in wave flight, the air was calm but that outside of this, there was strong turbulence close to the terrain. He explained that he had encountered strong downdrafts on his return to Serres La Bâtie-Montsaléon and that he had observed a rate of descent of -4.5 m/s associated with a substantial reduction in speed. The orientation of the terrain at this spot was similar to the orientation of the terrain where the accident occurred. He dumped the water in the wing ballast tanks at 10 minutes from his arrival at Serres-la-Bâtie.

He said that they had been warned by the chief pilot of the risk of strong turbulence close to the terrain during the safety briefing.

2.8.3 Other witness statements

A glider instructor from the Mont-Dauphin Saint-Crépin aerodrome (Hautes Alpes)[9] said that the Crête de Peyrolle is often used by gliders. When there is a westerly wind there are numerous updrafts and pilots fly at an altitude of more than 2,700 m to use them. When there is a northerly wind, the east slope of the ridge must be used as the air is very turbulent on the lee side of the terrain and there are strong downdrafts near the terrain which can cause rates of descent of around -6 to -7 m/s. According to him, "*the day of the accident was not ideal for performing a thermal flight.*"

[9] Situated in the valley at 27 km to the south

Furthermore, several witnesses said that the conditions were turbulent that day close to the terrain. In particular, the Crête de Peyrolle was subject to possible downdrafts on the lee side of the terrain, made worse by the specific features of the site, that is the junction of several ridge lines and a steep slope at the Grande-Peyrolle.

The manager of the glider club at the Serres La Bâtie-Montsaléon aerodrome said that during the pilot's stay at the aerodrome, no oxygen replenishment had been recorded in his name in the book provided for this.

3 - LESSONS LEARNED AND CONCLUSION

When in proximity to the Mont-Dauphin Saint-Crépin aerodrome, on his return to the departure aerodrome, the pilot tracked along the west slope of the Crête de Peyrolle. As this may have been upwind and still sunny at the end of the day, he had probably wanted to use the uplifts. The break in the ridge at the Grande Peyrolle peak could have surprised him and caused him to cross the Peyrolle ridge and find himself over its east slope, on the lee side of the Grande Peyrolle peak.

The recorded flight parameters were analysed. These did not include the last seconds (up to 60 seconds) which were not recovered as they were in the data buffer. The analysis of the parameters showed that the last calculated indicated airspeed was around 75 km/h in the turn, thus below the recommended minimum flying speed of 1.45 Vs, whatever the flap configuration that had been chosen according to the quantity of water actually present in the wing ballast tanks at that time.

Under the effect of turbulence, downdraft or wind shear, the glider stall speed may have been suddenly reached while the glider was circling at low speed, causing a stall or autorotation. The height available to the pilot at this precise moment did not give him sufficient time to recover control of the aircraft.

The investigation was unable to determine with certainty the exact cause of the accident. Nevertheless, the following causes are possible:

- The inappropriate decision of the pilot to perform manoeuvres at an insufficient speed, despite his knowledge of the various parameters affecting flight in mountainous terrain and at an altitude, could be the cause of the loss of control in flight.

- The flight conditions, more than five hours, of which more than two-thirds were above FL 100, could have generated the start of hypoxia symptoms. In these conditions, it is possible that demands were made on the pilot's cardiovascular system while the regulation of this system may have been affected by his health and its treatment for high blood pressure. Although the analysis of the path seems to exclude a major problem of hypoxia, the pilot's cardiovascular pathology and its treatment may, nevertheless, have diminished his adaptation to this real prolonged exertion. This could have constituted a contributing factor by depriving him of the physical and mental resources required to maintain the glider's path or to analyse the situation in a critical phase in turbulent air. Lastly, the final bank angle of the glider estimated using the data from the LX 9000 computer suggested a turn with a load factor likely to increase the deficit in oxygenation of the brain. The investigation was not able to determine if the pilot had used oxygen. However, the end of the flight was carried out without oxygen, the electronic oxygen delivery device being switched off.

Considering all these uncertainties, the hypothesis of the pilot feeling faint or dizzy can be envisaged.

- The absence of certain components of the flight controls meant that it was not possible to draw any conclusions regarding the prior condition of the associated systems.

A document giving additional technical information "*Sécurité du vol en montagne*" (Safety in mountain flying)[10] (Edition 2.0 dated 20/01/12) published by the CNVV[11], describes the risks and threats inherent in mountain flying and draws attention to technical issues and human factors.

[10] http://www.calameo.com/read/0047216103c00bbb2ba7f

[11] Centre National de Vol à Voile (French national gliding centre)