

AVIATION OCCURRENCE REPORT

CONTROLLED FLIGHT INTO TERRAIN

**LES TRANSPORTS AÉRO 2000 INC.
PIPER PA-31 NAVAJO C-GRPM
NOUVEAU-QUÉBEC CRATER, QUEBEC
30 MAY 1996**

REPORT NUMBER A96Q0076

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The Piper Navajo PA-31 (serial number 318012021), belonging to Les transports Aéro 2000 Inc., with three passengers and one pilot on board, was on a charter visual flight rules (VFR) flight from Kangiqsujuaq, Quebec, to Kuujuuaq, Quebec. At 1056 eastern daylight saving time (EDT), the pilot contacted the Kuujuuaq flight service station (FSS) by radio and reported that he had taken off eight minutes earlier and planned to overfly the Nouveau-Québec crater. That was the last message received from the pilot. When the aircraft failed to arrive at destination at the expected time, a search was initiated. The next day, a ground search team found the aircraft. The Navajo struck the eastern slope of the Nouveau-Québec crater while in straight and level flight. The four occupants of the aircraft were fatally injured in the accident.

Ce rapport est également disponible en français.

Other Factual Information

The pilot was certified and qualified for the flight in accordance with existing regulations. He received his airline transport pilot licence (aeroplane) on 31 January 1989. He passed a pilot proficiency check (PPC) on 15 June 1995. His licence validation certificate was current; he was required to wear prescription lenses while flying. The pilot was very familiar with the area he was overflying.

The twin-engine aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures. The last flight entered in the aircraft journey log-book was made the day before the accident. No deficiencies were reported or logged in the aircraft log-book. The aircraft had been declared airworthy 15 days earlier following a 150-hour inspection. The pilot was strict regarding the maintenance of his aircraft and did not hesitate to report deficiencies to the head of maintenance during his journeys. He had not reported any particular problems since departing Quebec City. The aircraft had the instrumentation required for instrument flight. C-GRPM was not equipped with a radio altimeter or ground proximity warning system (GPWS), nor was the aircraft required to be equipped with these instruments. The aircraft was equipped with a global positioning system (GPS).

The aircraft departed Quebec City on 27 May 1996 for a charter flight lasting several days. On 29 May 1996, the aircraft landed at Kangiqsujaq as planned for a one-night layover. On the morning of 30 May, prior to the flight, the pilot telephoned the Kuujuaq FSS for current weather conditions and the destination forecast. He obtained the regular weather observation for 1000 hours and the terminal forecast. The observations indicated favourable conditions for VFR flight. The pilot then filed a VFR flight notification with the FSS specialist. The pilot neither requested nor received the area forecast (FA) for the planned route. However, the area forecast summarized conditions in the crater area as favourable for visual flight.

The flight was to be made in two legs. The aircraft was first to follow a heading of 250 degrees true at a cruising speed of 170 knots for 52 nautical miles (nm) and overfly the Nouveau-Québec crater to allow the passengers to photograph the area, then proceed southeast for 250 nm to Kuujuaq. The planned route led the aircraft over a vast expanse of snow-covered, treeless tundra that was scattered with rocks and largely uninhabited. The terrain at this location slopes upward and consists of hills with elevations of 1,600 to 2,000 feet above sea level.

There is no FSS at the Nouveau-Québec crater. The closest FSS is at Kuujuaq, located about 250 nm southeast. A weather analysis was done by the Weather and Environmental Services Office of Environment Canada in Quebec City. According to the study, the extreme northern region of Quebec was under the influence of a trough, located over Hudson Bay, which caused mixed precipitation during the afternoon and evening of 30 May. At the time of take-off, the ceiling at Kangiqsujaq was approximately 1,100 feet above ground level and visibility was at least 10 miles. Inland, the clouds were broken to overcast from 1,500 to 2,000 feet above sea level. Surface winds were from the south to southwest at 15 to 25 knots, and from the west at 20 to 25 knots 2,000 feet above sea level. Moderate mechanical turbulence was associated with winds at this velocity. In addition, satellite photographs revealed mountain wave turbulence. Again according to the study, visibility at the different observation stations was over six miles. However, in the area of the crater,

visibility was severely reduced or near zero in drizzle and fog on high terrain and slopes exposed to the south and southwest winds. Light to moderate rime or clear ice and freezing drizzle could be encountered in flight if the temperature was near freezing.

At the accident site, the altimeter setting was estimated at 29.72 in. Hg. The aircraft was equipped with two aneroid altimeters that indicated the same altitude. The pilot's altimeter, on the left, was set at 29.76 in. Hg, and the right-hand altimeter showed 29.72 in. Hg.

The crater is located in an area of uncontrolled airspace. It is perfectly circular in shape, 3.4 km in diameter, and is surrounded by a mountainous ridge rising 2,156 feet above sea level. The immediate perimeter of the crater consists of rolling terrain with an average elevation of 1,700 feet above sea level. The eastern slope of the crater has a gradient of 15 degrees. Regulations require that, for flights in uncontrolled airspace, visibility in flight must be at least one mile, and aircraft must be outside the clouds when flying less than 700 vertical feet above land or water.

It was determined that the aircraft was in a slight nose-up attitude (about 5 degrees) on a heading of 277 degrees true when it struck the eastern slope of the crater about 1,920 feet above sea level, on a snow-covered uphill slope, with an impact trajectory of 251 degrees true. The aircraft bounced and continued its course in the air for 247 feet, rolling left on its longitudinal axis until the left wing struck the ground. The aircraft continued its course and continued rolling until it came to rest on its back 650 feet west of the initial point of impact. C-GRPM was found 2,100 feet above sea level and 200 feet south of the summit.

The aircraft started to break up on the initial ground impact; pieces of the aircraft were distributed on both sides of the main wreckage trail. The forward upper section of the fuselage and the cockpit sustained substantial damage when the aircraft fell back to the ground on its back. The flaps and landing gear were retracted at the time of ground impact. Examination of the wreckage revealed no evidence of any airframe failure, flight control problems, electrical problems, power loss, or fire during the flight or on the ground. There was fuel in the tanks, and some fuel spilled out on the ground. Weight and balance were within limits. The marks made by the propellers on initial impact indicate that the engines were running at the same rpm, and the ground speed of the aircraft was about 154 knots.

Examination of the faces of the airspeed indicators and the turn and bank indicator provided no reliable information. Examination of the instrument panel revealed the following: the master switch was at ON after the impact; all circuit breakers were at ON; the horizontal situation indicator (HSI) indicated 285 degrees; the weather radar was on "Standby"; and the emergency avionics switch was at OFF.

A fixed automatic emergency locator transmitter (ELT) was installed at the base of the aircraft vertical stabilizer. It was installed five months before the accident. The ELT was serviceable but did not activate on impact. On installation, the selector switch was selected OFF and subsequently was not set back on ARM.

The GPS was recovered and sent to the manufacturer for examination to determine the readings it provided during the flight. The GPS electronic memory contained the names and geographic coordinates of several

waypoints, including some on the final approach courses of runways for which no instrument approach is published. The crater was identified as WPT CRTER at latitude 61° 16'406"N, longitude 073° 42'823"W. The exact position of the Nouveau-Québec crater is in fact 2.5 nm east of the coordinates entered in the GPS. It was determined that, after take-off, the pilot pressed twice on the push-button "D" (direct route) to go to WPT CRTER.

One passenger was sitting in the co-pilot's seat and was wearing a seat-belt; one passenger was sitting, without a seat-belt, in the right-hand seat of the first row facing the rear of the cabin. The third passenger was sitting in the left-hand seat of the second row and was wearing a seat-belt. As a result of the impact forces, the second-row seat separated from the floor, projecting its occupant toward the front of the cabin.

The deaths of the three passengers were attributed to severe multiple trauma sustained in the impact. An autopsy was performed on the body of the pilot. Toxicological test results were negative. The autopsy revealed that the pilot suffered from coronary arteriosclerosis with 60% to 70% stenosis of each coronary artery. The pilot's death was nonetheless attributed to severe multiple trauma sustained in the accident, although the relatively serious coronary arteriosclerosis may have contributed to his death. The pilot's last medical examination, in February 1996, and his last electrocardiogram, in June 1995, did not detect the pilot's cardiovascular condition. The pilot told the civil aviation medical examiner he had never had a cardiovascular disorder and had never been treated for this type of problem or any other health problems. There was no evidence that incapacitation or physiological factors affected the pilot's performance.

A CFIT (controlled flight into terrain) accident is an accident in which an aircraft inadvertently strikes the terrain, water or an obstruction without the crew being aware of the impending mishap. According to TSB statistics, two-thirds of the aircraft involved in accidents in sparsely populated regions of Canada were piloted by one pilot. In many CFIT accidents, pilots tried to see the ground to fly visual, even where the flight was conducted in cloud, at night, in whiteout conditions, or in other conditions that precluded visual flight. Over half of these CFIT accidents occurred during VFR flight. In February 1996, the pilot had attended a Transport Canada presentation on CFIT accidents. The presentation included an analysis of the conditions conducive to this type of accident and suggested strategies to avoid them.

Whiteout (also called milky weather) occurs over an unbroken snow cover and beneath a uniformly overcast sky. Sunlight is dispersed and diffused through cloud and reflected back in all directions by the snow cover. The space between the ground and the clouds appears to be engulfed in a uniformly diffused white glow. Depth perception is impossible, as the milky white of the sky blends with the snowy white of the ground, completely obliterating the horizon as a spatial reference line.

Analysis

On departing Kangiqsujaq, the pilot knew that the current weather conditions and the conditions forecast for Kuujuuaq were favourable for VFR flight. But the crater is in a largely uninhabited region, and the pilot was unaware that the weather quickly deteriorated west of Kangiqsujaq and that the weather at the crater was poor.

In fact, visibility in that area was reduced, and the mountainous ridge surrounding the crater was probably

hidden by cloud. Also, the atmospheric conditions at the time and the local topography were conducive to whiteout. The pilot continued flight in adverse weather in which he risked losing the visual references necessary for avoiding obstructions.

The hypothesis of an engine failure or aircraft system malfunction, or both, was eliminated, because the examination of the aircraft revealed no deficiencies and no distress calls were received. Also, if an emergency situation had occurred in flight, all passengers would likely have been found in their seats with their seat-belts fastened. There was no evidence found of any emergency or aircraft malfunction prior to impact.

The aircraft struck the ground on the planned route, 2.5 nm east and one minute's time of flight from the waypoint entered in the GPS. All indications are that the pilot did not know his actual position in relation to the crater. The pilot was evidently using the information provided by the GPS to go directly to the crater; since the coordinates entered in the GPS for the crater were incorrect, the pilot was unaware of the actual position of the aircraft, and evidently arrived at the crater one minute sooner than he expected.

The pilot encountered adverse weather conditions and probably used the GPS to lighten his workload. Two possibilities were examined: either the pilot descended to break out of the clouds and see the crater, or he flew under the clouds so he could see the ground and fly visual. The theory that he tried to descend below the cloud base was considered unlikely, however, as it would have been unusual for the pilot to descend to an altitude below the crater summit and below the safe altitude for the area. Also, if the pilot had attempted such a manoeuvre, it is highly probable that the aircraft would have struck the ground in a nose-down attitude.

Instead, it appears that the pilot, who knew the area well, was trying to fly visual, by using the GPS, to arrive over the crater in visual meteorological conditions (VMC). However, the pilot encountered reduced visibility and whiteout conditions, where there was a considerable risk that he would lose visual contact with the ground due to the prevailing weather conditions.

The slight nose-up attitude and the heading of the aircraft, about 25 degrees greater than that of the route planned and that of the breakup trajectory, suggest that the pilot initiated a climb and an uncoordinated right turn just before colliding with the ground. Therefore, it is reasonable to believe that the pilot evidently did not have the required visual references and did not see the ground in time to avoid it.

The aircraft was not equipped with a radio altimeter or GPWS. These devices could have warned the pilot that the aircraft was dangerously close to the terrain; however, these devices were not mandatory.

Although the autopsy report determined that serious coronary arteriosclerosis may have contributed to the pilot's death, there was no evidence that his performance was affected by physiological factors. In fact, the aircraft attitude and heading on impact indicate that the pilot was not affected by any incapacitation that could have prevented him from controlling the aircraft.

The Nouveau-Québec crater is a unique terrain feature located in an inaccessible region. It could not be determined why the pilot decided to continue the flight in adverse weather. However, it is probable that his

knowledge of the area, the proximity of the crater, and the information provided by the GPS influenced the pilot's decision.

Findings

1. The pilot was certified and qualified for the flight in accordance with existing regulations.
2. There was no evidence found of any airframe failure or system malfunction prior to or during the flight.
3. The pilot was unaware of the current weather conditions in the crater area.
4. While the pilot was en route toward the crater, weather conditions deteriorated; the pilot continued flight and evidently used the GPS.
5. Visibility was reduced, and the atmospheric conditions and local topography were conducive to whiteout at the accident site at the time of impact.
6. In the moments preceding the impact, the pilot evidently did not have the visual references required to avoid obstructions.
7. Because incorrect coordinates were entered in the GPS, the crater's actual position was 2.5 nm east of the position indicated by the GPS, and the pilot evidently arrived at the crater about one minute sooner than he expected.
8. The ELT selector switch was at OFF.
9. The aircraft was not equipped with a GPWS, nor was one required under existing regulations.
10. The pilot suffered from relatively serious coronary arteriosclerosis which was not detected by routine medical examinations.
11. There was no evidence that incapacitation or physiological factors affected the pilot's performance.

Causes and Contributing Factors

The pilot continued flight in adverse weather and may have lost situational awareness due to incorrect information provided by the GPS. The pilot evidently did not have the visual references required to avoid striking the eastern slope of the Nouveau-Québec crater.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 23 April 1997.