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COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES

GEOLOGY AND GEOPHYSICS.

RECORDS.

RECORDS 1958/4.

HELICOPTER OPERATIONS, CALVERT HILLS-ROBINSON RIVER 4 MILE SHEET AREAS, N.T., SEPTEMBER-OCTOBER 1957

by

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Geological mapping was carried out in the Calvert Hills-Robinson River 4-mile sheet areas with the aid of a Hiller 12C helicopter, under charter from Trans Australia Airlines, from 18th September to 4th October 1957. Some check work was also done on the Westmoreland and Lawn Hill sheet areas, in Queensland.

The air crew consisted of:-

Acting Captain Duncan MacLachlan
Flight engineer George Pozivil.

Geologists engaged on the operation were:-

E.K. Carter, Senior geologist
J.B. Firman, Geologist, Grade III, Party leader.
M.C. Johnstone, Geologist, Grade I.

Specifications of Helicopter

The Hiller 12C helicopter used is a light machine, powered by a 200 h.p. motor, and propelled and controlled by a two-bladed over head rotor, with "paddles" and a small tail rotor. It has seating room for two passengers and can carry freight on platforms mounted on either side of the cabin, above the landing skids. Other details are:-

Maximum pay load (with auxiliary tanks) 450 lb
" range " " " (not with maximum load) 250 miles. (In tropical conditions, and having regard for operational and safety factors, these performance figures cannot be attained.)

Cruising speed about 50 knots.
Ceiling 6,000 ft.; may be as low as 2-3,000 ft. under tropical conditions.
Fuel - 100 octane aviation spirit.

Under operational conditions it is capable of a straight vertical lift of only a few feet from the ground. It takes off by lifting 1-4 feet from the ground and then moving forward until sufficient horizontal speed has been attained to climb. With full load and warm, dry air it may require a clearing in excess of 600 feet.

As it is not capable of hovering with load,, no ladder or winch is carried. It lands on metal skids and cannot therefore run along the ground.

The auxiliary petrol tanks are not connected to the fuel system. The machine must therefore be set down to replenish the main tank, as required.

For practical purposes landings may be made and the engine cut as often as desired but frequent stops are undesirable because generator and starter wear becomes excessive.

Organization of Operation

The programme was planned by J.B. Firman. Seven bases and sub-bases were used. They are shown in the accompanying map. Petrol was positioned at each base by Landrover. Each base was on, or adjacent to, a vehicle track; three were on airstrips. Owing to delay in obtaining petrol and the early arrival of the helicopter, petrol had to be positioned during the operations.

In practically all cases a ground party was at each base when the helicopter arrived at that base.

The programme was as follows:-

September 16th Helicopter arrived Calvert Hills base.
" 18-23rd. Operations from Calvert Hills base.
No flying 20-22nd September on account of lack of petrol. September 24th. Flew to Hopplestrap base, operated from there during day then flew to Robinson River base. 25-27th Operations from Robinson River base. Returned to Calvert Hills base late afternoon 27th. 28th No flying. Aircraft maintenance. 29th Flew to Caralina base; operated from there, then proceeded to Pandanus base. September 30th and October 1st Operations from Pandanus base, using Gorge Creek dump as a sub-base for refuelling. October 2-4th Flew to Tinhole base, morning 2nd. Operations from Tinhole. 4th Returned to Calvert Hills base. 5th No flying. Aircraft maintenance. 6th Helicopter departed for Borroloola; to continue to Katherine on 7th. End of charter.

Under the charter the Bureau was responsible for rescue and salvage. The helicopter carried no radio; the Bureau field party carried one serviceable Traeger transceiver. It was generally kept at the base from which the helicopter was operating. A geologist at the base was informed of the route to be flown by the helicopter before any traverse was commenced. Movements of the helicopter were not reported to the Department of Civil Aviation's radio station at Tennant Creek.

Nature of Terrain and Availability of Landing Sites

The country covered has a total vertical topographic range of about 1000 feet, but local relief does not exceed 400 feet. It has numerous scarps and breakaways. The major streams are deeply incised, particularly in the west, where cliff sections up to 300 feet high are exposed. The surface is commonly rough but level surfaces are abundant.

Vegetation consists of small to medium-sized trees (up to about 40 feet high and 4 feet in girth near the base), with the intervening space generally occupied by light scrub 3-8 feet high. These provide a light but fairly continuous cover in the area and preclude landing over wide areas. Tall trees commonly flank the main water courses but open spaces are also common adjacent to the main channels.

The two important considerations in landing are:
1. freedom of obstructions higher than 1 or 2 feet at the point of landing, on which the tail rotor may be damaged.
2. a take-off clearing, free of obstructions higher than 1-2 feet, up to 300 feet long and 50 feet wide. If the terrain is suitable and vegetation light a take-off clearing can be made after landing.

The pilot preferred not to cut his motor unless alongside water or within short walking distance of known water as the generator and starter motor of the helicopter were regarded as somewhat (i.e. by comparison with the engine) unreliable.

Landing sites could generally be found within reasonable distances of points of interest along watercourses (except in some of the gorges) but elsewhere there were wide areas where landing was impracticable, generally because of the low vegetation cover. River alluvial flats, sand bars and rock shelves made excellent landing areas.

Methods of Use

For the most part only one geologist operated in the helicopter as experience early showed that the craft was overloaded for operational purposes with two passengers. When moving from base to base three persons, including pilot and flight engineer, were commonly carried.

The helicopter was used in the following ways:-

1. Preliminary aerial inspection of geology, prior to ground traverses in the region (restricted to Robinson River 4-mile sheet area).

2. Set down for foot traverse, in course of mapping.

3. Aerial inspection with some set down to establish lithology, in course of mapping.

4. Aerial inspection by Senior Geologist and Party Leader.

5. Examination of vertical sections in flat-lying sediments.

6. Determination of spot heights, using helicopter's altimeter.

Comments on Operation

Excellent co-operation existed between air-crew and geologists. Pressure to increase the number of hours flown per day, and thereby reduce the length of the operation, had to be resisted on occasions.

From the viewpoint of efficiency of operation both of the machine and of the geologists more profitable use could have been made of the helicopter during the earlier months (see next section). It is recognised, however, that the helicopter is most useful for check work at the close of a season.

A copy of the charter contract was not held by either of the representatives in the field of the contracting parties. This could have resulted in misunderstandings, delays or failure to fulfil the charter correctly. For example, of the total charter time of 35 hours 05 minutes, between 4 and 5 hours were spent on the ground during engine warm up. I accepted Captain MacLachlan's assurance that it was always provided in charters that warm up time should count as flying time.

General Comments and Conclusions

Helicopter operations require very detailed planning of flight schedules in advance of and during the helicopter operations. In some cases ground servicing operations limit the amount of flying to be done, particularly when the helicopter does not carry radio. Experience shows that the Hiller 12C helicopter is under-powered for the conditions under which it was required to operate in the Calvert Hills-Robinson River area. The performance of the machine is very severely affected by rise in air temperature. I estimate that pay load at 7 a.m. during recent operations was at least 100 lbs greater than at 3 p.m. on the warmer days. As a result it proved unsafe to position two geologists in the morning for pick up in the mid-afternoon (it was too hot for full day traverses) without duplicate flights.

The low angle of ascent at take-off and the low clearance of the tail rotor severely limited the choice of set-down areas. As the machine could not hover and does not possess a ladder or winch it was not possible to set down or pick up passengers without landing.

With full load the helicopter could not reduce horizontal speed below about 15 knots for aerial inspection of inaccessible exposures. However, visibility from the helicopter is much better than from conventional aircraft. The short range required the positioning of many bases with petrol dumps. But for the recent construction of tracks by North Australian Uranium Corporation one, at least, of these bases would have required considerable effort to position.

On the other hand the helicopter enabled a large area to be, in part, adequately mapped and, in part, appraised in a few days. The same area would require many weeks of work by any other method and would probably have required the use of horses in some places. In particular, it was possible to set down near excellent vertical sections which would be practically inaccessible by other means. In areas with gently dipping or flat-lying strata the helicopter results in a very considerable economy of effort as ground traversing requires so much unproductive work. However the examination of isolated sections, with aerial inspection between, restricts the opportunity for location of mineralization, fossils and other detail necessary for a sound knowledge of an area. For this reason I consider that a helicopter can, in general, be more profitably used to position geologists for foot traverses than for point inspections. This is particularly the case in strongly folded strata.

There can be no doubt that aerial inspection by helicopter is a valuable tool but the value is determined by several factors, including experience and skill of the observer, his knowledge of the units being mapped (i.e. amount of ground control by prior mapping), distinctiveness of the units and complexity of the geology. For general reconnaissance without set-down it is doubtful whether the cost of a helicopter justifies its use. One problem in aerial inspection is the difficulty in recording any but the briefest data during flight. The use of a tape recorder might be a help in this respect.

It was not possible to plot any of the information obtained while the helicopter operations were in progress. This imposes a limit to the time that a helicopter can be profitably used by a party. With a four-geologist party it might be possible to use a helicopter for four weeks or more but more efficient use would be made of it in any sustained operation, in my opinion, by having the helicopter operate alternately between two 3 or 4-geologist parties for a period of not more than a fortnight at a time with each party.

The time per day for which a helicopter can be used varies considerably with the type of operation, the number of geologists being positioned and the complexity of ground operations needed to support the helicopter. The average time of flying per day in the Calvert Hills-Robinson River operation was 2 hours 42 minutes.

Table II presents a schedule and analysis of the helicopter operations.

TABLE I - DISTRIBUTION OF GEOLOGISTS' TIME DURING HELICOPTER OPERATIONS

	E. K. CARTER	J. B. FIRMAN	M. C. JOHNSTONE
Flying time ✱	13 hours	14¾ hours	9½ hours
Ground work associated with flying (i.e. mapping at set-downs; foot traverses, positioned by helicopter).	6½ "	10 "	7 "
Foot or vehicle traverses not associated with helicopter.	3 days	½ day	2½ days
Positioning of fuel, clearing air strips, etc; travel by Landrover to new helicopter base.	3½ "	5 "	4¼ "
Preparations for helicopter work (preparation of air photo flight panels, planning, etc.).	2 "	2 "	2 "
Other duties and stand-down.	1 "	3½ "	2½ "

Note: These figures do not include preliminary preparations, prior to arrival of helicopter, nor the period 20-22nd September, nor the time of field assistants.

✱ Does not include engine warm-up period on ground. Total geologists' flying time exceeds actual flying time because on occasions two geologists travelled in helicopter together.

TABLE II - ANALYSIS OF HELICOPTER OPERATIONS

Date, 1957	A Total Hours Flown.	B Local Positioning of Helicopter at Bases.	C Positioning for Foot Traverses; Picked up at Different Point.	D Aerial Inspection with Short set-down (-2 hours).	E Aerial Inspection and Familiarization.
September 18	1 hr 20 min			1 hr 20 min	(also E)
19	1 " 25 "			1 " 25 "	(" ")
20	-				
21	-				
22	-				
23	1 " 10 "			1 " 10 " ✱	
24	4 " 50 "	3 hr 00 min +	1 hr 05 min		0 hr 45 min
25	2 " 10 "			2 " 10 "	
26	2 " 40 "			2 " 40 "	
27	4 " 00 "	1 " 35 "		2 " 25 "	
28	-				
29	3 " 30 "	2 " 15 "		1 " 15 "	
30	4 " 10 "			4 " 10 "	
October 1	1 " 35 "			1 " 35 "	
2	2 " 45 "			2 " 45 "	
3	2 " 35 "			1 " 50 "	0 " 45 "
4	2 " 55 "	1 " 00 "		1 " 55 "	
5	-				
6	Departed for Borroloola and Katherine.				
Totals	35 hrs 05 mins	7 hrs 50 min	1 hr 05 min	24 hrs 40min	1hr 30 min

Figures above may include up to 15 minutes engine warm up for each flight.

All flights had elements of "E" in them.

✱ J.B.F. engaged primarily on location of reported manganese deposits.

\+ Set down during positioning flight.

HELICOPTER OPERATIONS
CALVERT HILLS
Sept – Oct 1957.

SCALE OF MILES

16 8 0 16

16°S

17°S

18°S

138°E

Gulf of Carpentaria

"Seven Emus"

ROBINSON RIVER
4 MILE SHEET

Focische River

Robinson River

"Robinson River"

"Purgatina"

Calvert R.

Robinson R.

"Hopplestrap"

MAIN BASE

"Culvert Hills"

NORTHERN TERRITORY

QUEENSLAND

Settlement Creek

"Wollogorang"

"Westmoreland"

"Carolina"

CALVERT HILLS
4 MILE SHEET

WESTMORELAND
4 MILE SHEET

"Seigals Creek"

"Pancanus"

Gorge Creek

Tin Hole

"Corinda"

Nicholson River

"Bowthorn"

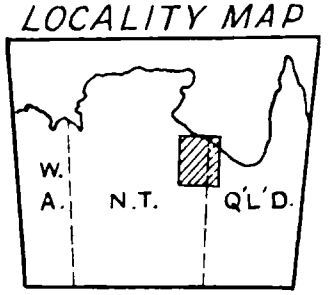
MOUNT DRUMMOND
4 MILE SHEET

LAWN HILL
4 MILE SHEET

Reference

- Homestead or Outstation
- Airstrip
- Base for helicopter operations
- Flight lines (approx)

LOCALITY MAP



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